

DIRECTORATE OF WATER DEVELOPMENT  
MINISTRY OF NATURAL RESOURCES  
THE REPUBLIC OF UGANDA

**BASIC DESIGN STUDY REPORT  
ON  
THE RURAL WATER SUPPLY PROJECT  
IN MPIGI, MUBENDE AND KIBOGA DISTRICTS  
IN  
THE REPUBLIC OF UGANDA**

OCTOBER 1997

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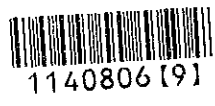


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SANYU CONSULTANTS INC.**



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## PREFACE

In response to a request from the Government of the Republic of Uganda the Government of Japan decided to conduct a basic design study on the Rural Water Supply Project in Mupigi, Mubende and Kiboga Districts in the Republic of Uganda and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Uganda a study team from April 1 to May 26, 1997.

The team held discussions with the officials concerned of the Government of Uganda, 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 Uganda in order to discuss a draft basic design, 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 Uganda for their close cooperation extended to the teams.

October, 1997



Kimio FUJITA

President

Japan International Cooperation Agency



October, 1997

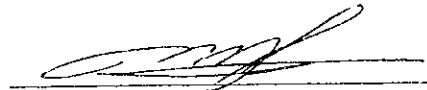
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Rural Water Supply Project in Mpigi, Mubende and Kiboga Districts in the Republic of Uganda.

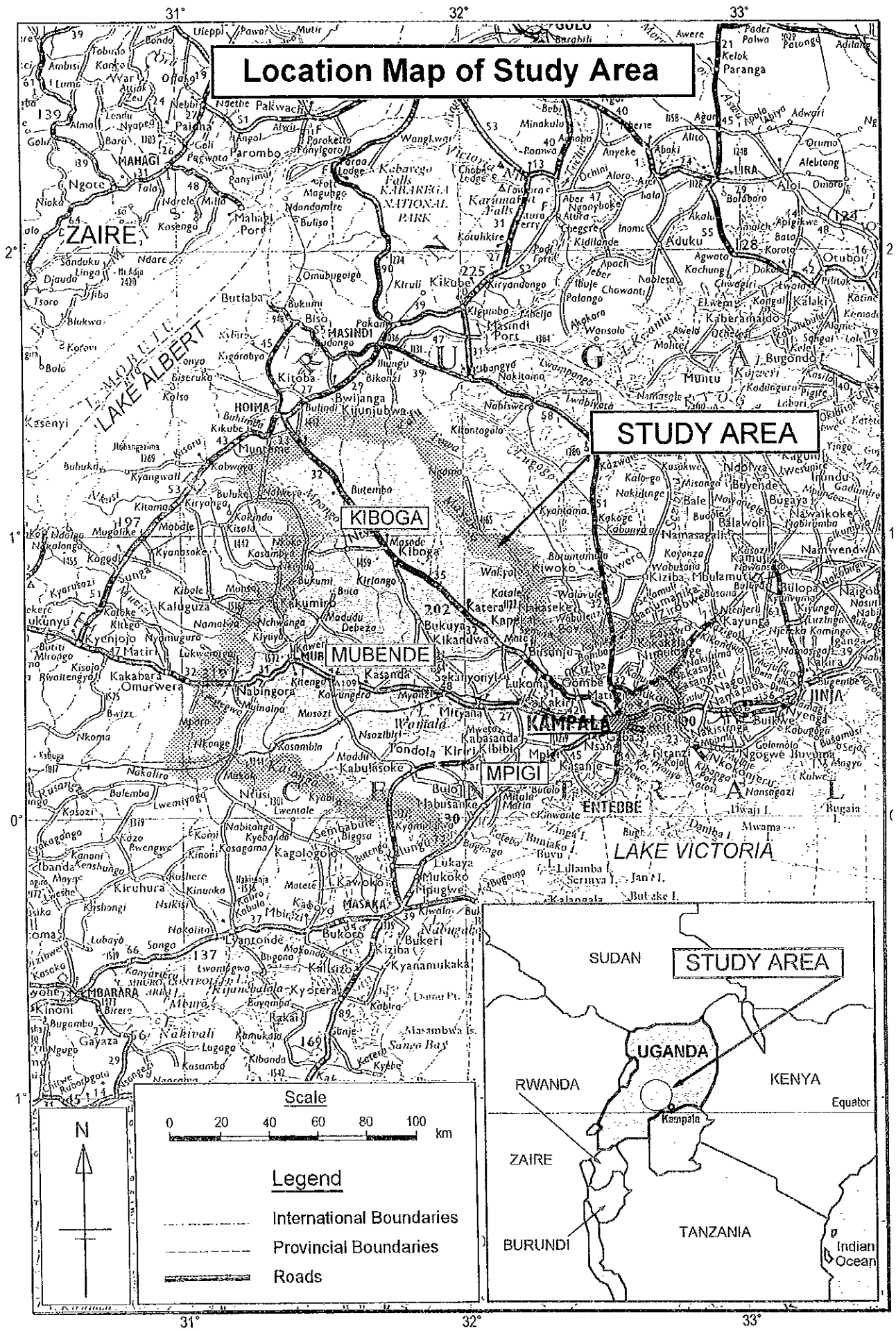
This study was conducted by Sanyu Consultants Inc., under a contract to JICA, during the period from March 19, 1997 to November 25, 1997. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Uganda and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

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

Very truly yours,



Yasuo TERAMURA  
Project Manager,  
Basic Design Study Team on  
The Rural Water Supply Project  
in Mpigi, Mubende and Kiboga Districts  
Sanyu Consultants Inc.



# Location Map of Study Area

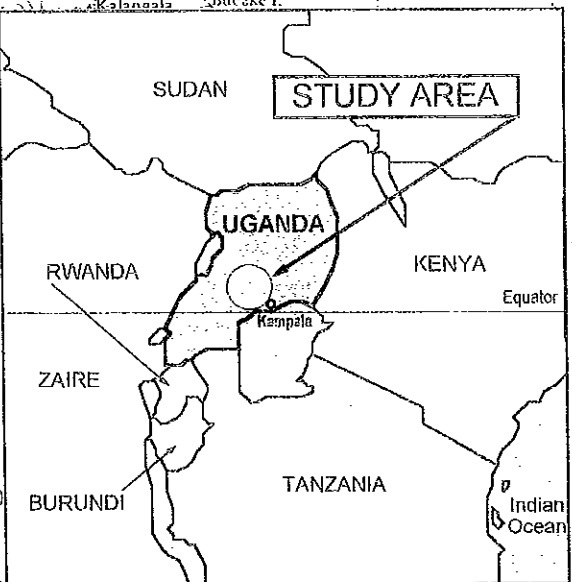
## STUDY AREA

## STUDY AREA

**Scale**  
0 20 40 60 80 100 km

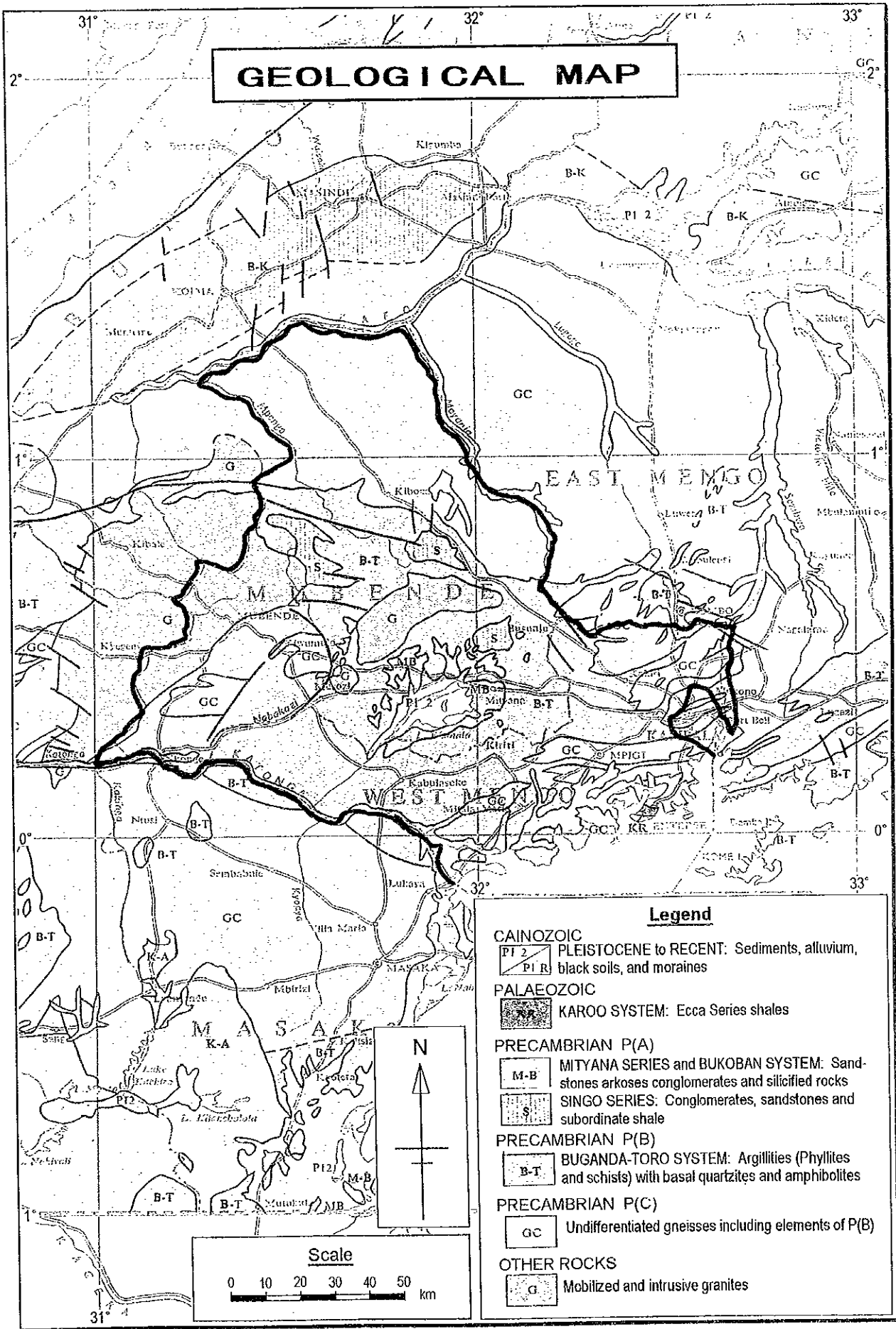
**Legend**

- International Boundaries
- Provincial Boundaries
- Roads





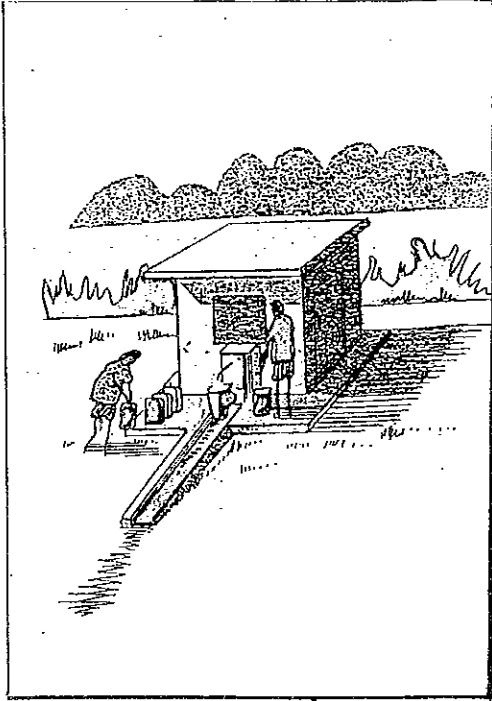
# GEOLOGICAL MAP



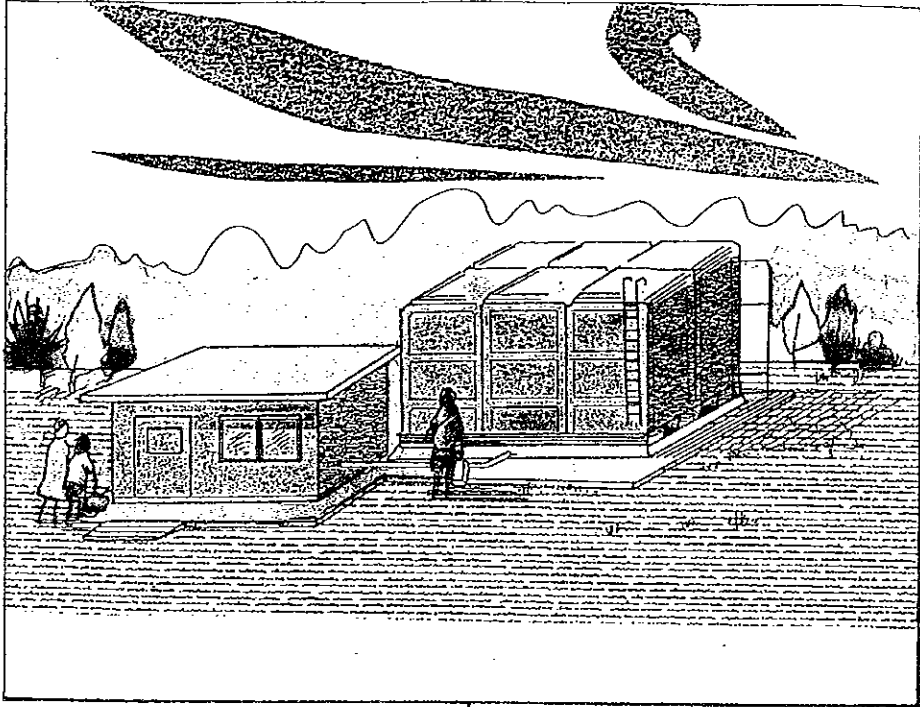
### Legend

- CAINOZOIC**
- PI 2 PLEISTOCENE to RECENT: Sediments, alluvium, black soils, and moraines
  - PI R
- PALAEOZOIC**
- KAROO KAROO SYSTEM: Ecca Series shales
- PRECAMBRIAN P(A)**
- M-B MITYANA SERIES and BUKOBAN SYSTEM: Sandstones arkoses conglomerates and silicified rocks
  - S SINGO SERIES: Conglomerates, sandstones and subordinate shale
- PRECAMBRIAN P(B)**
- B-T BUGANDA-TORO SYSTEM: Argillities (Phyllites and schists) with basal quartzites and amphibolites
- PRECAMBRIAN P(C)**
- GC Undifferentiated gneisses including elements of P(B)
- OTHER ROCKS**
- G Mobilized and intrusive granites

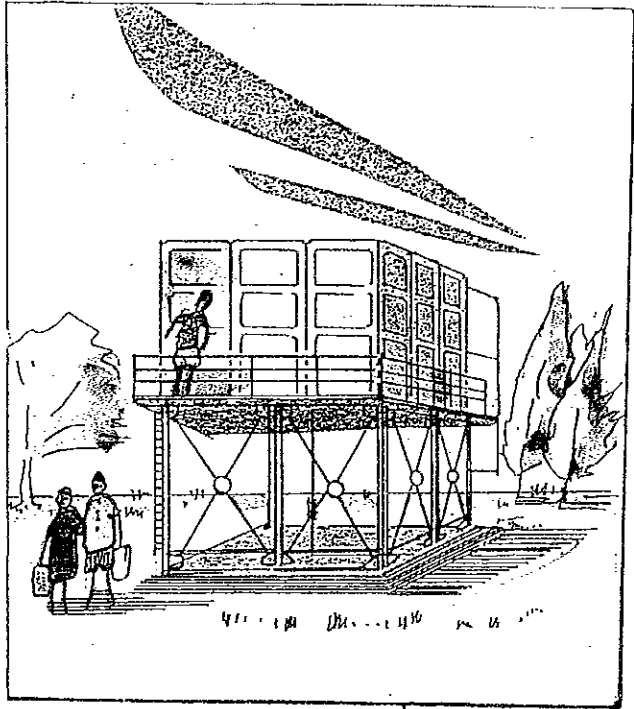
IDEAL FIGURE OF KIBOGA LEVEL II SYSTEM.



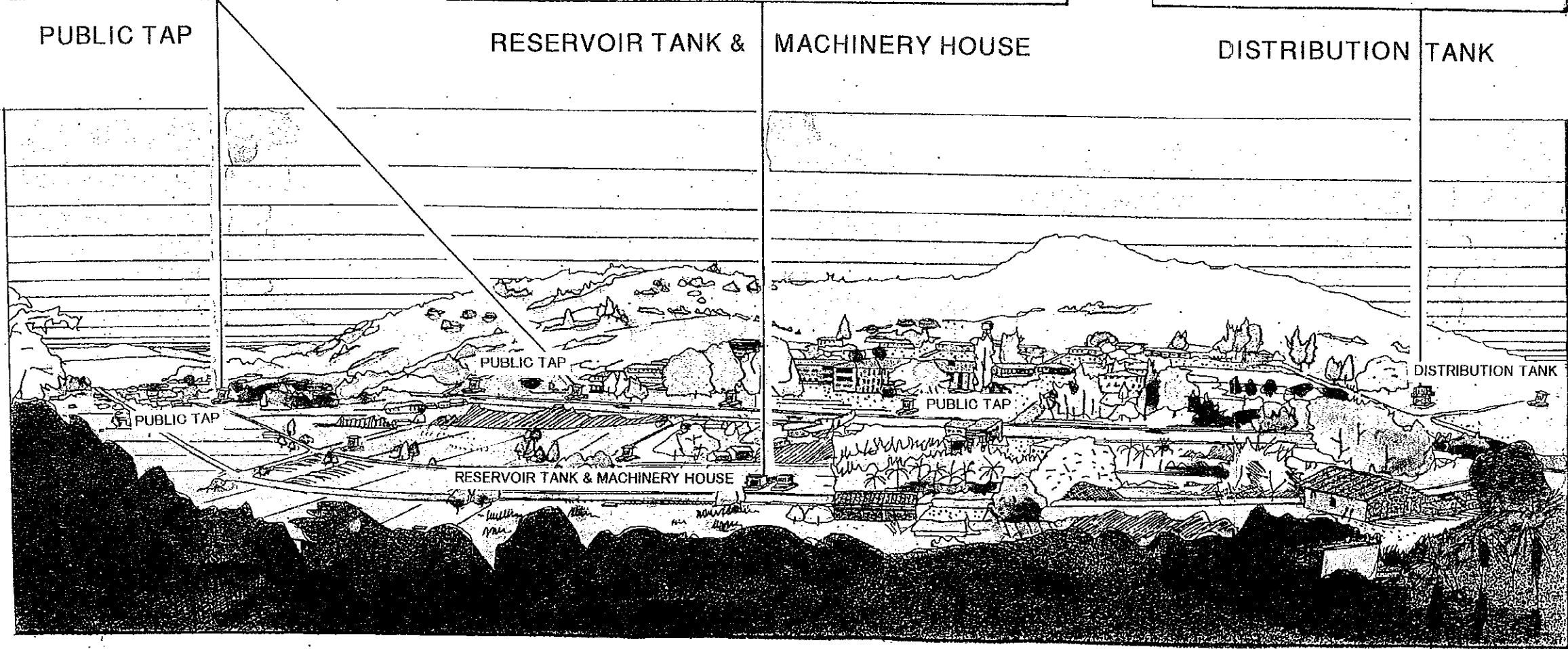
PUBLIC TAP



RESERVOIR TANK & MACHINERY HOUSE



DISTRIBUTION TANK

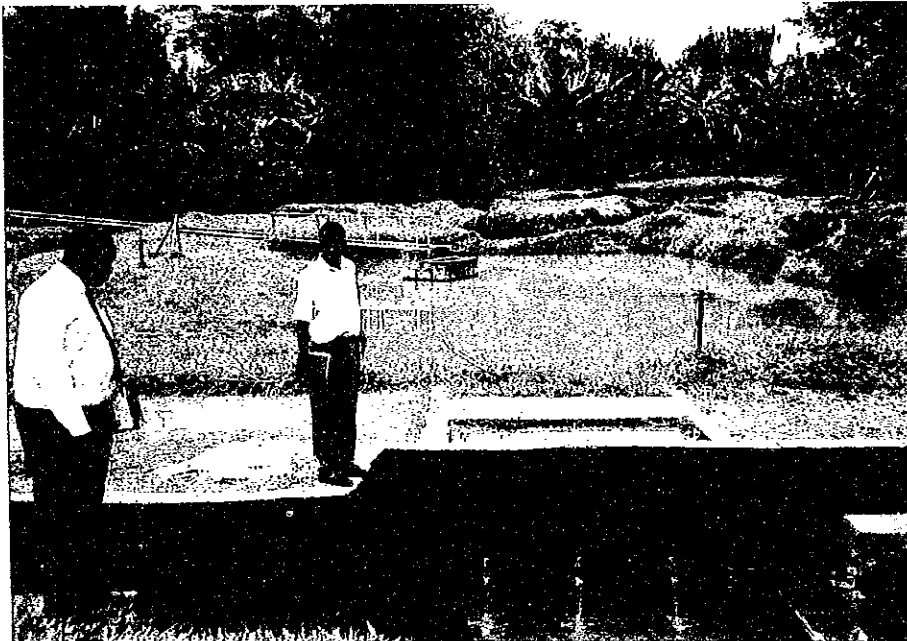


VIEW OF KIBOGA TOWN



#### PROTECTED SPRING

Springs are protected in order to prevent direct intrusion of surface water. Production of springs are 30l/min. more or less.



#### VALLEY DAM

Valley dams are constructed at streams or springs and protected around the outlet pipes. Outflow is clean compared with pond water but no difference of bacteria content.



#### BOREHOLE

Many boreholes are seen to become dry in the few years after construction due to mechanical trouble of pump or miss-siting.



#### PUBLIC TAP OF LEVEL-II SYSTEM

Level-II system seems very convenient for inhabitant. However O&M activity is not enough and valves, etc. are left in damaged. Mobilization is strictly expected.



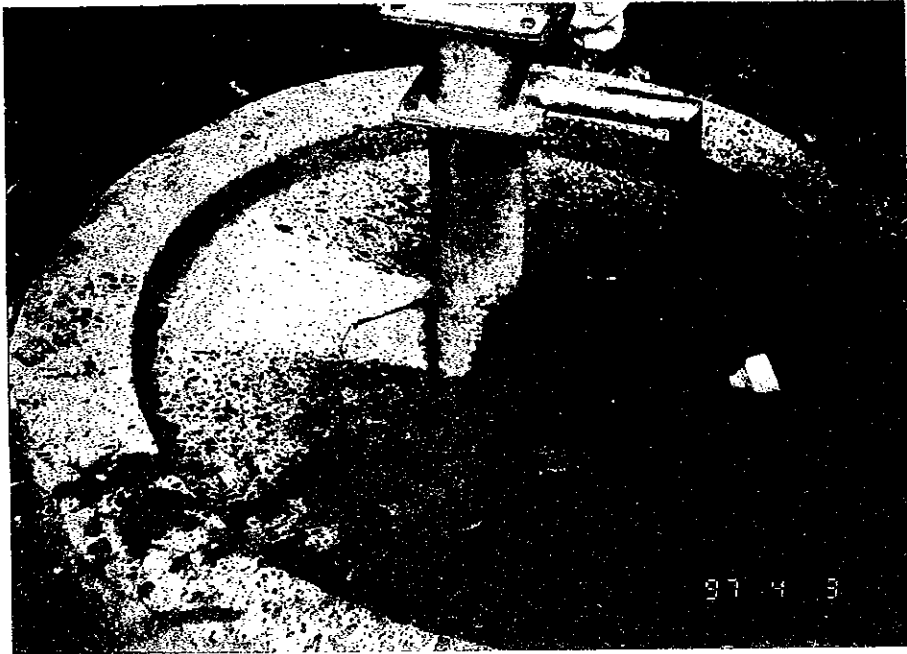
#### BOREHOLE IN VILLAGE

Many people are waiting for their turn at the borehole when time come.



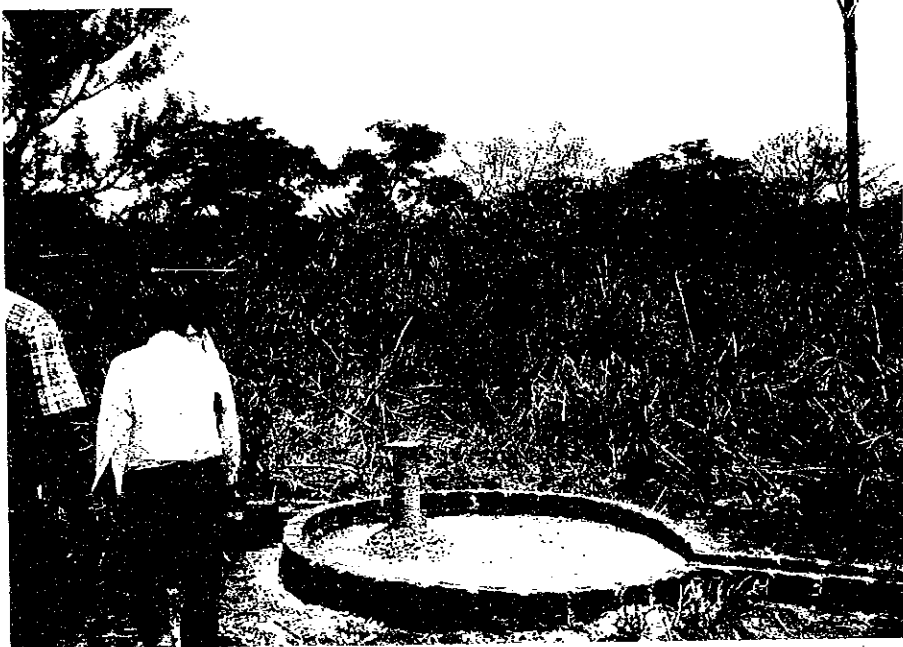
#### WASHING BESIDE WATER RESOURCES

Washing women gather beside water.



HEAD WORK

Dirty water is intruding through crack of head work.



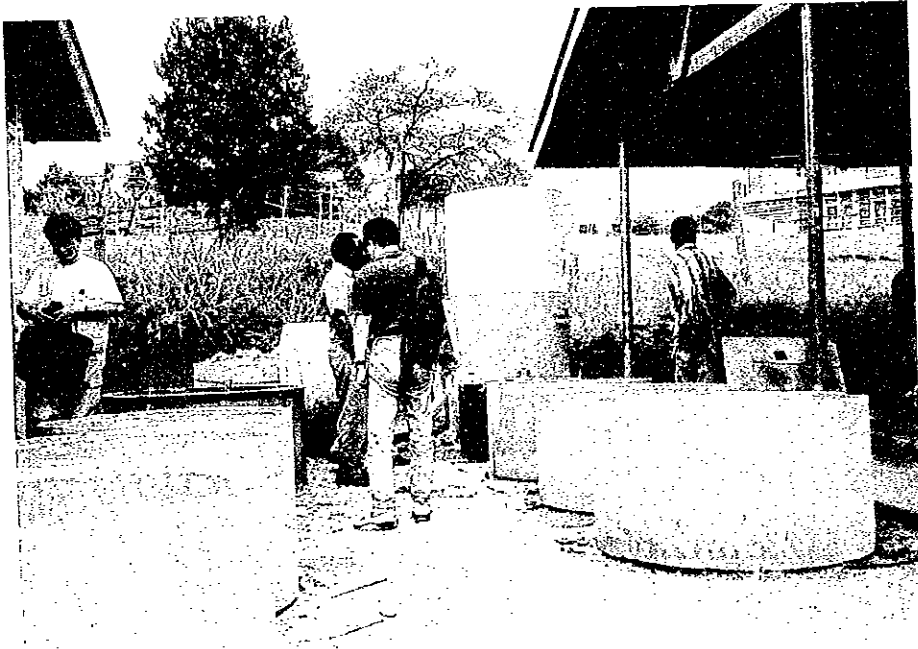
SHALLOW WELL

A shallow well which is under construction by UNICEF.



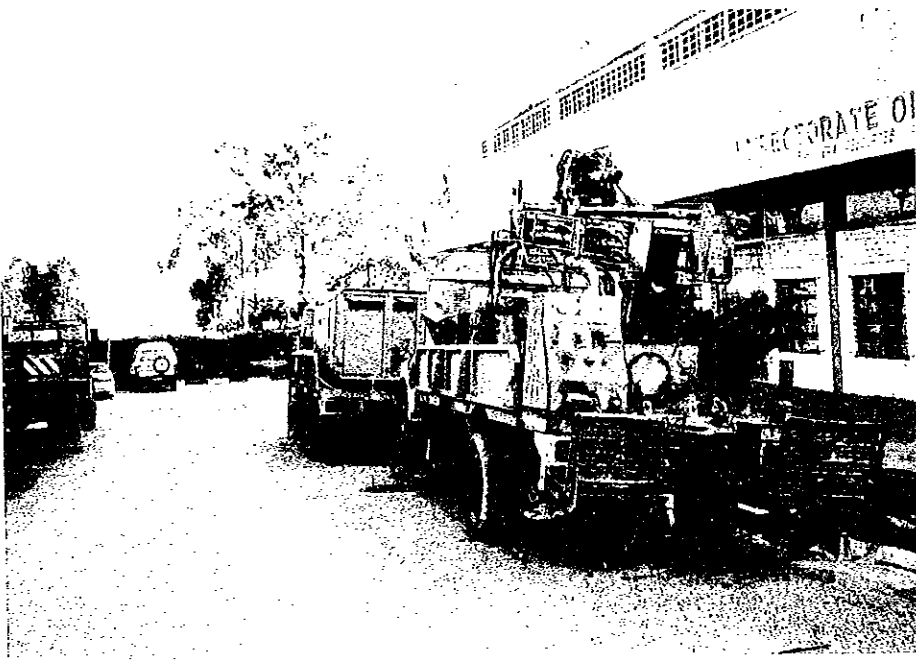
#### COLLECTING TANK

Collecting tank of rainfall is one of water source but water is contaminated with impurities. So the countermeasure to educate them to boil the water is expected.



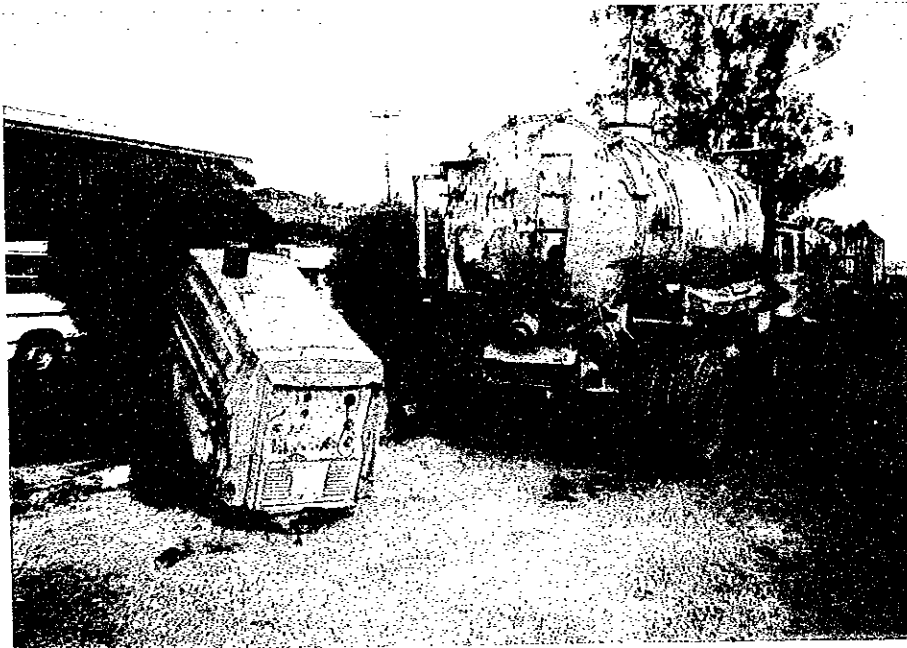
#### PREFABRICATION OF COLLECTING TANK

Prefabricated block of rainfall water collecting tank.



#### DRILLING RIG OF DWD

It is said there are 22 units of drilling rigs in DWD. However, even the newest one is 7 years old and many mechanical trouble disturb their workability.



#### WATER TANKLORRY AND COMPRESSOR

Many supporting vehicles such as a water tank-lorry, compressor are more than ten years old and almost of them are unusable.





## TABLE OF CONTENTS

Preface		
Letter of Transmittal		
Location Map/Photograph		
Abbreviations		
Chapter 1	Background of the Project.....	1-1
Chapter 2	Contents of the Project .....	2-1
2-1	Objectives of the Project.....	2-1
2-2	Basic Concept of the Project .....	2-2
2-2-1	Water Supply Facility.....	2-2
2-2-2	Procurement of Equipment and Materials .....	2-6
2-2-3	Education and Campaign Activity .....	2-8
2-3	Basic Design .....	2-9
2-3-1	Design Concept.....	2-9
2-3-2	Basic Design .....	2-15
2-4	Implementation Setup of the Project.....	2-27
2-4-1	Organization.....	2-27
2-4-2	Budget .....	2-31
2-4-3	Personnel and Technical Level.....	2-32
Chapter 3	Implementation Plan.....	3-1
3-1	Implementation Plan.....	3-1
3-1-1	Implementation Concept.....	3-1
3-1-2	Implementation Conditions .....	3-2
3-1-3	Scope of Works .....	3-3
3-1-4	Consultant Supervision.....	3-3
3-1-5	Procurement Plan .....	3-4
3-1-6	Implementation Schedule .....	3-5
3-1-7	Obligations of Recipient Country .....	3-7
3-2	Operation and Maintenance Plan .....	3-7
Chapter 4	Project Evaluation and Recommendation.....	4-1
4-1	Project Effect .....	4-1

4-2 Recommendation .....	4-2
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Appendices

1. Member List of the Survey Team .....	D-1
2. Survey Schedule.....	D-2
3. List of Party Concerned in the Recipient Country .....	D-4
4. Minutes of Discussion .....	D-6
5. Cost Estimation Borne by the Recipient Country .....	D-6
6. Reference Data.....	D-6
Attachment-1 Minutes of Discussion for Basic Design Study .....	D-8
Attachment-2 Minutes of Discussion for Draft Report Explanation.....	D-19
Attachment-3 Cost Estimation Borne by the Recipient Country .....	D-27
5.1 Annual Budget for Project Office .....	D-27
5.2 Import Taxes .....	D-29
5.3 List of Construction Equipment.....	D-31
5.4 Temporary Work Tools and Materials .....	D-32

## TABLES

Table 2-1	Requested Water Supply Facilities.....	2-2
Table 2-2	Revision of Facilities.....	2-4
Table 2-3	Proposed Water Supply Facilities.....	2-4
Table 2-4	Details of Water Supply Facilities .....	2-5
Table 2-5	Requested Equipment and Materials.....	2-6
Table 2-6	Recommendable Equipment and Materials .....	2-7
Table 2-7	Borehole Plan.....	2-9
Table 2-8	Success Rate and Total Numbers of Drillings.....	2-10
Table 2-9	DWD Water Quality Guideline.....	2-11
Table 2-10	Equipment and Materials .....	2-26
Table 2-11	Annual Budget - Ministry of Natural Resources .....	2-31
Table 2-12	Annual Budget of DWD.....	2-31

## FIGURES

Figure 2-1	Typical Borehole Section.....	2-16
Figure 2-2	Standard Head Works.....	2-18
Figure 2-3	Plan of Kiboga T/C Level-II System.....	2-20
Figure 2-4	Illustrate of Kiboga Level-II System.....	2-21
Figure 2-5	Reservoir Tank .....	2-22
Figure 2-6	Machinery House.....	2-23
Figure 2-7	Distribution Tank .....	2-24
Figure 2-8	Water Kiosk.....	2-25
Figure 2-9	Organization of the Government and the Ministry of Natural Resources.....	2-28
Figure 2-10	Structure of Directorate of Water Development .....	2-29
Figure 2-11	Proposed Organization for Project Implementation .....	2-30
Figure 3-1	Implementation Schedule .....	3-6
Figure 3-2	Plan of Operation and Maintenance.....	3-9
Figure 3-3	Schedule of Mobilization for Rural Water supply Project in Mpigi, Mubende and Kiboga District.....	3-10

## ANNEX TABLES AND FIGURES

Table-1	Result of Water Quality Test at Pilot Borehole(B/D 1997).....	A-1
Table-2	Result of Water Quality Test at Pilot Borehole(F/S 1997) .....	A-2
Table-3	Result of Field Water Quality Test.....	A-3
Table-4	Result of Site Investigation in Mpigi District(1/2).....	A-4
Table-5	Result of Site Investigation in Mpigi District(2/2).....	A-5
Table-6	Result of Site Investigation in Mubende District(1/2) .....	A-6
Table-7	Result of Site Investigation in Mubende District(2/2) .....	A-7
Table-8	Result of Site Investigation in Kiboga District(1/2) .....	A-8
Table-9	Result of Site Investigation in Kiboga District(2/2) .....	A-9
Table-10	Plan of Borehole Depth by Geo-electrical Survey(Mpigi District : 37 points) .....	A-10
Table-11	Plan of Borehole Depth by Geo-electrical Survey(Mubende District : 35 points) .....	A-11
Table-12	Plan of Borehole Depth by Geo-electrical Survey(Kiboga District : 36 points) .....	A-12
Figure-1	Location Map of Target Communities(Mpigi).....	A-13
Figure-2	Location Map of Target Communities(Mubende) .....	A-14
Figure-3	Location Map of Target Communities(Kiboga) .....	A-15
Figure-4	Resistivity Sounding $\rho$ -a Curve(Mpigi District).....	A-16
Figure-5	Resistivity Sounding $\rho$ -a Curve(Mubende District).....	A-27
Figure-6	Resistivity Sounding $\rho$ -a Curve(Kiboga District).....	A-37
Figure-7	Resistivity Sounding $\rho$ -a Curve(Kiboga Town) .....	A-45

## ABBREVIATION

BH	Borehole
BMS	Borehole Maintenance Supervisor
BMU	Borehole Maintenance Unit
DANIDA	Danish International Development Agency
DCDO	District Community Development Officer
DHI	District Health Inspector
DMO	District Medical Officer
DWD	Directorate of Water Development, Ministry of Natural Resources
DWO	District Water Officer
GDP	Gross Domestic Product
GNP	Gross National Product
GOJ	Government of Japan
GOU	Government of the Republic of Uganda
HP	Handpump
HPM	Handpump Mechanic
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
LC	Local Council(former RC)
LLDC	Least among Less-Developed Country
MFEP	Ministry of Finance and Economic Planning
MNR	Ministry of Natural Resources
MOH	Ministry of health
MOLG	Ministry of Local Government
NGO	Non-Governmental Organization
NRM	National Resistance Movement
O&M	Operation and Maintenance
RUWASA	Rural Water and Sanitation, Eastern Uganda Project by DANIDA
RWP	National Rural Water Supply Programme
S/C	Sub-County

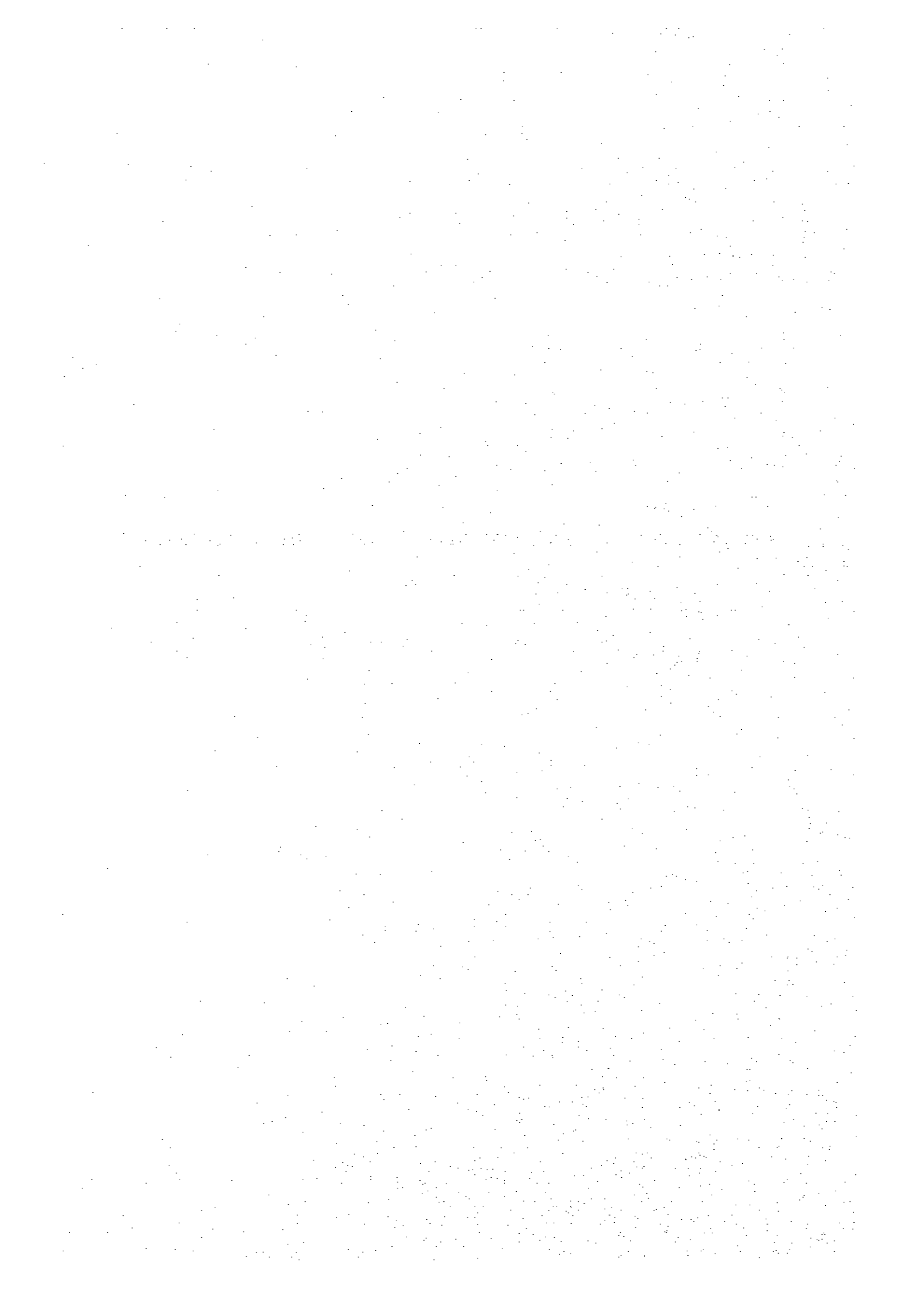
SIDA	Swedish International Development Authority
UNICEF	United Nations Children's Emergency Fund
US\$	U.S. Dollars
Ush	Uganda Shillings
WAP	Water Action Plan for Water Resources Development and Management
WES	Water and Environmental Sanitation , UNICEF
WES	Water Supply and Environmental Sanitation
WID	Wommen in Development
WUC	Water User's Committee

### UNITS OF MEASUREMENT

mm	: millimeter
cm	: centimeter
m	: meter
km	: kilometer
mm <sup>2</sup>	: square millimeter
cm <sup>2</sup>	: square centimeter
m <sup>2</sup>	: square meter
km <sup>2</sup>	: square kilometer
l	: liter
l/c/d	: liter/capita/day
mm <sup>3</sup>	: cubic millimeter
cm <sup>3</sup>	: cubic centimeter
m <sup>3</sup>	: cubic meter
m <sup>3</sup> /hr	: cubic meter per hour
m <sup>3</sup> /hr/BH	: cubic meter per hour per borehole
KW	: kilowatt
V	: volt
KV	: kilovolt
KVA	: kilovolt ampere
Hz	: hertz
HP	: horsepower
US\$	: US dollar
Ush	: Uganda Shilling

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





## **Chapter 1 Background of the Project**

The Republic of Uganda lies astride the equator in the heart of the African Continent. It covers an estimated area of approximately 236,000 km<sup>2</sup> of which about 42,000 km<sup>2</sup> (17%) are occupied by the Lake Victoria, Edward, Albert and rivers or swamps. The population is estimated at about 19.1 million people in 1994. The country lies on the great African plateau at the average altitude of 1,220m above the sea level. The average annual temperature is 25°C to 27°C and the temperature variations are minimal due to the location of proximity to the equator. The average annual rainfall is 1,000mm in most parts of the country although it is ranging from 1,200mm to 1,500mm in the surrounding of the Lake Victoria and from 600mm to 1,000mm in the northern parts.

Agriculture of which main crop of coffee occupying 50% of Gross Domestic Product(GDP) is the key industry in Uganda and contribute to the country's foreign exchange revenues. However, income from agriculture is fluctuated because of the unstable weather or prices of agricultural product on the world market, so the balance of the trade have been undergoing at a deficit condition. Thus the country received considerable financial support from both multilateral and bilateral donors through grant and loans. The country's Gross National Product(GNP) per capita is low as 190 U.S dollar and the country is classified as Least among Less-Developed Country (LLDC).

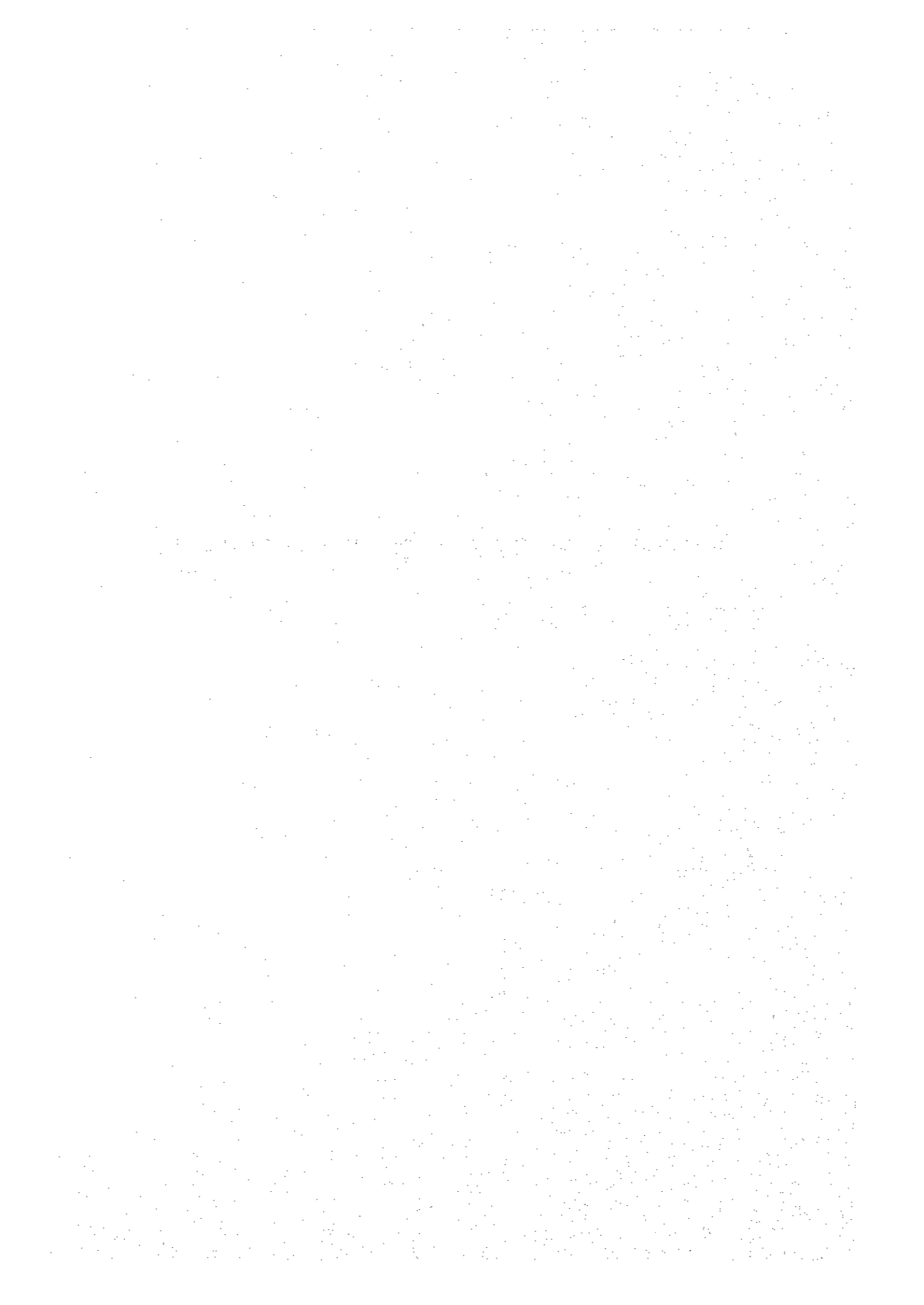
The coverage of water supply in the Republic of Uganda as of 1994 is very low at 50% in the urban area and 31% in the rural area. The situation results into high morbidity and mortality particularly for infants, of water and fecal related diseases such as diarrhea, malaria, intestinal worms, nutritional deficiency and so forth. Lack of proper water supply facilities forces a heavy workload mainly on women, particularly housewives, and children to collect water. The workload of water collection results into lack of opportunity for education, childcare and other productive activities.

Under the said circumstances, the Government of Uganda formulated the National Rural Water Supply Program in 1991. The program aims to achieve the supply of safe water of 20 liter per capita per day to 75% of rural population. Basing on the program, the Government of Uganda has been implementing the Water and Environmental Sanitation(WES) Project with the assistance of United Nations

International Children's Emergency Fund(UNICEF) in 35 districts out of 45 districts of hole the country. The components of the project are mobilization of sanitation, construction of water supply facilities and spreading of latrines. And in other 10 districts, the Rural Water Supply (RUWASA) Project is on going in the assistance of Danish International Development Agency(DANIDA) on the same manner.

In the three districts of Mpigi, Mubende and Kiboga where are located in the middle western part of Uganda with a difficult geological condition for developing of boreholes, the covering ratio of water supply facilities is extremely low with the ratio of 10%, 26% and 18% respectively. Therefore the said projects will not be a complete solution. Under these circumstances, in response to the request of Uganda, the Japan International Cooperation Agency (JICA) which is official agency of the Government of Japan implemented the Feasibility Study in the said three districts in 1995. Thus , JICA formulated a rural water supply development plan basing on the target of the year of 2005. According to the plan, the Government of Uganda requested to the Government of Japan to extend the Grant Aid Cooperation for the project composed of the construction of 446 boreholes and etc. at 276 communities in the three districts.

## **CHAPTER 2 CONTENTS OF THE PROJECT**



## Chapter 2 Contents of the Project

### 2-1 Objectives of the Project

The coverage of water supply in the Republic of Uganda as of 1994 is very low at 50% in the urban area and 31% in the rural area. Out of 45 districts in Uganda, three districts of Mpigi, Mubende and Kiboga are in the poor zone and under the lowest water supply coverage of 16% with individual coverage between 10% to 26%. Under the said circumstances, the Government of Uganda set forth the Project to improve the water supply coverage in those districts. The objectives of the Project are the construction of 435 boreholes in 231 communities and the construction of a Level-II System in Kiboga T/C. The population of benefit from the Project is around 143,000. The coverage will be improved from 16% to 24%. At the same time, the Project aims to improve sanitation, to spread environmental sanitation facilities, to relieve women and children from heavy workload in order to collect water and to decrease water-related diseases.

The Direct Objectives are as follows:

#### (1) Short-term Objectives

- to secure access to safe and stable water sources and proper sanitation environment for the rural population in the project area,
- to improve awareness and habits on hygiene and environmental sanitation of the rural population, and
- to mobilize the rural population in the community based maintenance system(CBMS).

#### (2) Medium and Long-term Objectives

- to decrease morbidity and mortality, particularly for infants, of water and faecal related diseases,
- to reduce the burden for medical expenditure,
- to improve nourishment particularly of children,
- to relieve women and children from heavy workload to collect water,
- to create opportunity for primary and adult education,
- to create opportunity for improvement of income, and
- to promote welfare of women and children.

## 2-2 Basic Concept of the Project

### 2-2-1 Water Supply Facility

The request for the construction of water supply facilities from the Government of Uganda are the construction of water supply facilities as shown in Table 2-1 for 276 communities in three districts of Mpigi, Mubende and Kiboga. Those facilities were selected basing on the following conditions:

- 1) the borehole equipped with handpump to those communities where only deep groundwater is available,
- 2) the shallow dug well equipped with handpump to those communities where shallow groundwater is available,
- 3) the protected spring system to those communities where natural springs are available,
- 4) the Level-II System to those communities which are densely populated and,
- 5) the valley dam to those communities where neither deep nor shallow ground water nor springs are available.

Any type of facilities to cover all population in the communities, projected to the year 2005, under the national target of basic rate of water supply is 20 litres per capita per day and the maximum distance of 1.5km. The contents and quantity of those facilities are summarized as Table 2-1.

**Table 2-1 Requested Water Supply Facilities**

District	Community (LC1)	Borehole	Shallow Well	Protected Spring	Level-II System	Valley Dam
Mpigi	93	162	37	57	0	5
Mubende	95	164	20	65	0	8
Kiboga	88	120	4	65	1	0
Total	276	446	61	187	1	13

The concept of the Project is to supply safe drinking water steadily. Basing on this concept shallow wells, protected springs and valley dams are excluded from the Project contents due to the following reasons:

- ① The source of shallow wells, protected springs and valley dams are easily contaminated,
- ② The source of those facilities can not supply drinking water steadily due to drought during dry season.

The drinking water from the facilities constructed by the Japanese Grant Aid Project shall be safe and supplied steadily, accordingly only boreholes will be constructed by the Project. However, the Level-II System for Kiboga T/C is included in the Project.

As data collected at the Feasibility Study is different from the data of the Basic Study in the following reasons;

- big change in population,
- some villages are overlapped,
- water supply facilities are already existing,
- deep groundwater development is difficult,

the contents of the project facilities is revised as shown in Table 2-2. Although the difficult point to construct a borehole in Kassanda T/C, numbers of facilities were reduced to available numbers to be constructed. The numbers of boreholes at Kirasi community in Mpigi are reduced to meet actual population of which data collected at the Basic Design Study because of the big difference of population between Feasibility Study and Basic Design Study. It becomes clear that the village of Lugaaga is the same as the village of Nkokonjeru and Kasangati T/C is the same as Kazinga. The number of boreholes are adjusted as its population. Nkokonjeru is excluded from the target communities because the village is supplied from the Level-II System of Lwamata in Kiboga district. The contents are arranged in Table 2-2.



**Table 2-2 Revision of Facilities**

District (LC5)	Sub-County (LC3)	Community (LC1)	Facilities		Reason
			Request	Change	
Mpigi	Maddu	Kirasi	B/H 11	B/H 6	Population reduced from 3,500 to 1,500, Benefited population in 2005 will be 2,000.
	Kabulasoke	Luzira	B/H 5	B/H 4	Benefited population in 2005 will be 1,700. $1,700 - 430 = 4B/H$
	Kabulasoke	Lugaaga	B/H 2	B/H 4	Lugaaga and Nkonjeru are the same village. Benefited population in 2005 will be 1,390
	Kabulasoke	Nkonjeru	B/H 2	B/H 0	Lugaaga and Nkonjeru are the same village
	Nangabo	Kasangati T/C	B/H 1	B/H 1	Kasangati T/C and Kazinga are the same village. Benefited population in 2005 will be 330.
	Nangabo	Kazinga	B/H 1	B/H 0	Kazinga is a part of Kasangati T/C.
Mubende	Kassanda	Kassanda T/C	B/H 6	B/H 5	6 Boreholes are difficult to construct in this village.
Kiboga	Lwamata	Nkokonjeru	B/H 3	B/H 0	Nkokonjeru is supplied by the Level-II System of Lwamata.

As shown in Table 2-3, it is provided that 435 Boreholes for 231 communities in the said three districts will be projected and a Level-II System in Kiboga T/C will be constructed by the proposed Japanese Grant Aid Project. A valley dam which is proposed instead of a deep well is excluded from the Project. Table 2-4 is the details of Table 2-3.

**Table 2-3 Proposed Water Supply Facilities**

	Mpigi		Mubende		Kiboga		Total	
	Facilities	LC1	Facilities	LC1	Facilities	LC1	Facilities	LC1
Borehole	158	78	159	81	118	73	435	231
Level-II	0	0	0	0	1	1	1	1
Total	158	78	159	81	119	74	436	232

**Table 2-4 Details of Water Supply Facilities**

District	Sub-County	LC1 (No.)	Beneficiary (2005)	Proposed Facilities				Total
				Bore- holes	Protected Spring	Shallow well	Level- II	
Mupigi	Maddu	13	11,047	26				26
	Kabulasoke	12	7,752	26				26
	Mpenja	9	6,020	20				20
	Kyambogo	12	9,027	27				27
	Nangabo	4	2030	4				4
	Ngando	8	5,034	16				16
	Kiziba	4	1,874	6				6
	Namayumba	11	6,975	21				21
	Wakiso	3	2,807	8				8
	Kituntu	1	678	2				2
	Kikomazi	1	844	2				2
	Total	78	54,088	158	0	0	0	158
Mubende	Kitenga	4	2,163	8				8
	Bageza	8	5,087	17				17
	Kasambya	2	1,672	5				5
	Madudu	2	867	4				4
	Kiyuni	1	459	2				2
	Kassanda	7	4,939	14				14
	Myanzi	10	7,111	21				21
	Bukuya	4	1,054	4				4
	Busimbi	7	4,032	14				14
	Bulera	3	2,147	6				6
	Sekanyonyi	6	4,121	13				13
	Kikandwa	2	944	3				3
	Maanyi	7	3,506	12				12
	Butayunja	6	3,500	12				12
	Kakindu	8	4,708	17				17
	Malagala	4	2,528	7				7
Total	81	48,838	159	0	0	0	159	
Kiboga	Bukomero	11	6,146	21				21
	Ntwetwe	11	6,169	19				19
	Kiboga	11	4,129	16				16
	Kiboga T/C	1	3,603				1	1
	Lwamata	5	2,211	6				6
	Butemba	8	3,552	12				12
	Muwanga	2	892	3				3
	Nsambya	8	3,761	13				13
	Masodde	7	3,564	11				11
	Gayaza	9	5,758	17				17
	Total	73	39,785	118	0	0	1	119
Grand Total	232	142,711	435	0	0	1	436	

## 2-2-2 Procurement of Equipment and Materials

The request for the procurement of equipment and materials from the Government of Uganda are listed as shown in Table 2-5. Those equipment and materials are necessary for the strengthening of functions of BMU in DWD and activity of WES related staff in district level. The requested equipment and materials are listed in Table 2-5 below.

**Table 2-5 Requested Equipment and Materials**

Item	Specification	Quantity
1. Drilling Rig	Track mounted typical type(Drilling capacity 300m)	2 Units
2. Supporting Equipment		
1) Drilling Tools		2 Units
2) Air Compressor	High-pressure	2 Units
3) Cargo Truck	with 3-ton crane	2 Units
4) Water lorry	5,000 liters	2 Units
3. Pickup Truck	4WD, for DWD 2 Units, for Districts 3 Units	5 Units
4. Station Wagon	4WD, for DWD 1 Unit, for BMU 1 Unit	2 Units
5. Workshop Equipment and Tools	for BMU	1 Set
6. Servicing Rig	4WDwith mast, winch, air-compressor and tools for BMU	1 Unit
7. Water Analysis Kit	for District Laboratories	3 Lots

### 1) Drilling Rig

Although 2 units of Drilling Rig were requested from the Government of Uganda, the Rigs will not be included in the Project judging from the situation of the policy of Uganda such as privatization. Regarding the construction of boreholes in the Project, the Contractor shall provide drilling rigs as his own responsibility. The drilling rigs shall be prepared with specifications of drilling methods of mud circulation and percussion.

### 2) Supporting Vehicles

An Air Compressor, a Cargo-truck, a Water Lorry and Drilling Tools which are necessary for construction of boreholes shall be purchased by the Contractor as his own responsibility. Pickup Trucks are procured for the Operation and Maintenance for BMU and Mobilization for WES activity of target districts. Station wagons are excluded from the procurement judging them unnecessary for the Project.

### 3) Work Shop Equipment and Tools

Work Shop Equipment and Tools are composed of a welding equipment, a diesel generator, tools of maintenance for vehicles procured by the Project. They are distributed at the Mpigi BMU as the use of operation and maintenance after construction of the requested facilities.

### 4) Service Rig

The Service Rig is to be used for maintenance of boreholes constructed by the Project. It mounts a winch, crane, a compressor and tools, and is distributed at the Mpigi BMU.

### 5) Water Analysis Kits

Water Analysis Kits are procured and distributed at the laboratories of target districts and Kiboga T/C in order to use for periodical monitoring of water quality.

Table 2-6 shows the recommendable equipment and materials as the Japanese Grant Aid Project.

**Table 2-6 Recommendable Equipment and Materials**

Item	Description(Specification)	Quantity
Pickup Track	4WD Double cabin type, for Operation and Maintenance and Education campaign for WES personnel in district basis.	4 Units
Servicing Rig(4WD)	Winch capacity 1.5~2t to be distributed at BMU in Mpigi for the rehabilitation of borehole in the Project area. It mounts following equipment : Air-Compressor(5m <sup>3</sup> /min) 1 Unit Welder with engine(10KVA) 1 Unit Tools 1 Set	1 Unit
Workshop Equipment and Tools	for BMU in Mpigi for maintenance of supplied equipment. Welder, Generator, Tools for maintenance of vehicles and other equipment.	1 Set
Water Analysis Kit	Distributed for three districts and Kiboga T/C for monitoring of water quality. Simple Water Analysis Kit(18 item), Handy pH meter Handy EC meter	4 Sets
Spareparts	for 2 year	1 Lot

### **2-2-3 Education and Campaign Activity**

For the obtaining of safe water, the construction of water supply systems are necessary. On the other hand, introduction of knowledge of sanitation to users, popularization of latrines and other hygienic facilities, proper operation and maintenance by users themselves are necessary conditions. In Uganda, users of water supply systems shall organize water users' committee(WUC) according to the Law. Those facilities are maintained by the WUCs, however it is important to educate users to have accurate knowledge for using those facilities and for construction of them. Accordingly, the following facts will be included in the Project.

- ① Seminar for trainers introducing sanitary education and maintenance of water supply facilities.
- ② Guidance for establishment of WUC.
- ③ Support for Pump Mechanics to train to repair handpumps.

## 2-3 Basic Design

### 2-3-1 Design Concept

#### (1) Design Concept for Boreholes

##### ① Selection of Borehole Site

Boreholes' sites are selected according to the analysis of electrical prospecting.

##### ② Depth of Boreholes and Length of Casing

Depth of boreholes are summarized according to hydrogeological conditions as shown in Table 2- 7.

Table 2-7 Borehole Plan

District	Hydrogeological Unit	Average Depth (m)	Max. Depth (m)	Soft Format'n (m)	Hard Format'n (m)	Ave. Yield (m <sup>3</sup> /hr)	No. of Wells
Mpigi	Buganda-Toro System	95	150	55	40	1.3	121
	Gneiss Complex	70	150	25	45	2.5	37
Mubende	Mityana Series	90	130	30	60	2.0	21
	Buganda-Toro System	100	150	50	50	0.8	110
	Gneiss Complex	90	150	30	60	0.8	13
	Granites	70	90	25	45	0.6	15
Kiboga	Mityana Series	95	130	55	40	2.0	6
	Buganda-Toro System	75	150	35	40	0.9	20
	Gneiss Complex	75	150	35	40	1.0	92

##### ③ Success Rate and Numbers of Drilling

The Success Rate is summarized in Table 2-8 according to the result of field survey executed by the Basic Design Study depending on improvement of borehole structure and proper selection of borehole site. Therefore, the success rate of drilling is estimated at 82% in total, numbers of success rate of drilling are 435 boreholes and total numbers of drilling of 529 holes including 94 dry holes.

**Table 2-8 Success Rate and Total Numbers of Drillings**

District	Hydrogeological Unit	Success Rate (a)	Planed No. of Drillings (N)	No. of Dry Holes $n=N(1-a)$	No. of Max. Drillings (N+n)
Mpigi	Buganda-Toro System	80%	121	24	145
	Gneiss Complex	86%	37	5	42
Mubende	Mityana Series	75%	21	5	26
	Buganda-Toro System	75%	110	28	138
	Gneiss Complex	75%	13	3	16
	Granites	70%	15	5	20
Kiboga	Mityana Series	75%	6	2	8
	Buganda-Toro System	80%	20	4	24
	Gneiss Complex	80%	92	18	110
Total		82%	435	94	529

④ Criteria for Boreholes

The following criteria for Yield and Quality of Water are used for boreholes according to the DWD Criteria.

Yield	Shall not be less than the value below
Standard	720 l/hr
Special case	360 l/hr

Quality                      Shall not be the value above Table 2-9

⑤ Construction of Boreholes

The Construction of Boreholes will be executed by the Japanese Contractor. However, the Ugandan drillers will be hired according to the privatization as the Uganda Government policy. And the drilling rigs for the construction shall be the one available in Uganda as many as possible.

**Table 2-9 DWD Water Quality Guideline**

Parameters	Guidelines
1. Appearance	Acceptable
2. Taste	Acceptable
3. Odor	Acceptable
4. Turbidity	10 NTU
5. TDS	1,000 mg/l
6. pH	5.5 - 8.5
7. Hardness(Total)as CaCO <sub>3</sub>	600 mg/l
8. Iron(Total Fe)	1.0 mg/l
9. Manganese(Mn <sup>++</sup> )	1.0 mg/l
10. Chloride(Cl <sup>-</sup> )	250 mg/l
11. Fluoride(F <sup>-</sup> )	2.0 mg/l
12. Sulphate(SO <sub>4</sub> <sup>-</sup> )	250 mg/l
13. Nitrate(NO <sub>3</sub> <sup>-</sup> )	20 mg/l
14. Nitrite(NO <sub>2</sub> <sup>-</sup> )	0.0mg/l

Note: WHO set the standard on colon is less than 10MPN(through the year)

(2) Design Concept for Kiboga Level-II System

① Standard for Supply and System

The design population is 3,603(estimated population in 2005 in Kiboga T/C, see Table 2-4) and design unit demand is 20 l/c/d.

② Numbers of taps

Numbers of public taps are planned at 10 taps including existing one public tap for residence supply from Kiboga hospital.

③ Reservoir Tank

A collecting reservoir tank to collect water from the proposed boreholes and a distribution reservoir tank to supply water to beneficiary are installed. The capacity of those reservoir tanks shall be good for a daily demand.

④ Pump

Submersible pumps for boreholes and booster pumps to lift up from the collecting tank to the distribution tank.



⑤ Source of Power

The public power line will be used as the source of power for pumps.

⑥ Supply for Kiboga Hospital

The source of water of existing Kiboga hospital is taken from a spring with a small dam. The source is not enough during dry season because of drought. The water becomes muddy during rainy season because of inflow of surface water. And in order the location at the lowland of Kiboga T/C, the source may be contaminated in future according to increase of population. Therefore the following improvement shall be undertaken to improve its capacity and water quality:

- a) Residence supply from the hospital facility is included in the Project,
- b) Protection of the spring as water source of hospital supply shall be considered,
- c) A supplementary tap will be considered as the source of the hospital facility.

(3) Concept for Procurement of Equipment and Materials

① Drilling Rigs

The drilling rigs will not be procured due to following reasons:

- (a) Reduction of the drilling sector of DWD and the privatization of drilling sector are progressing. And private drilling companies are growing gradually. The DWD is having a plan to sell drilling rigs, supporting vehicles and equipment, workshops and tools.
- (b) The future plan to use drilling rigs of DWD is not clear.
- (c) The main equipment and tools of DWD's workshops are not existing or are deteriorated. Maintenance of equipment is charged to private companies. Therefore it is difficult to maintain those equipment themselves.
- (d) In order to be having an opportunity to train private drilling company as a skilled driller for borehole construction, there is no reason to keep drilling rigs at DWD for full growth of private companies.
- (e) There is no budget to maintain drilling rigs and supporting equipment.

② Procurement of Vehicles

The DWD sets 10 Borehole Maintenance Units (BMUs) in the hole country to maintain boreholes in each charge. The BMU in charge to the Project is set in Mpigi town. The BMU has no vehicle for its own activities. Therefore a vehicle (pickup truck) is procured and allocated to maintain boreholes to be constructed by the Project.

The Project will support campaigning for introducing of operation and maintenance of boreholes and sanitary education. The campaigning will be implemented according to the construction schedule of the Project in the order of Mpigi, Kiboga and Mubende. The plan will be executed by the district water officer, district community development officer and district health inspector to support water developing activities. However, as there are only few vehicles in the district office, they are not enough for the work. Accordingly, three vehicles out of four to be procured are distributed to each target district.

③ Service Rig

Exchange of cylinders for handpumps, rehabilitation of boreholes and etc. which can not be undertaken by a handpump mechanic (HPM) will be executed by BMU at Mpigi. However, Mpigi BMU has no service rig to repair boreholes. Therefore a service rig with a compressor, a winch and a crane is proposed to be procured for DWD.

④ Workshop Equipment and Tools

Workshop Equipment and Tools will be procured and distributed to Mpigi BMU. The Equipment and tools are used as repairing equipment and vehicles which are procured by the Project.

⑤ Water Analysis Kits

Four water analysis kits are procured for the laboratory of each target districts and Kiboga T/C. They are used to monitor the water quality of boreholes which are constructed by the Project and other existing water sources.

⑥ Construction Materials

Handpumps, casing pipes, steel bars, cement, aggregate and etc. are available in Uganda. So those construction materials will be purchased in the country.

(4) Support for Education and Training

A district water officer (DWO), a district community development officer (DCDO) and a district health inspector(DHI) are assigned to each district. They are able to provide proper knowledge and to improve sanitation. The government of Uganda has experience and enough knowledge of improving the environment and sanitation through the WES program in cooperation with UNICEF and NGOs. The target districts are in the area of WES Project, therefore those activities are their duty.

The officers will be working to train trainers in LC3 through seminars once(1) or twice(2) a year. Japanese side will hardly interfere in the activity because the training are to be held in local language. The budget for expenses of these training or remuneration of trainers is lacking. Therefore, WES support will be needed periodically for remuneration of district officers.

As the training program of WES covers environmental sanitation sector, it is adequate that the sector shall be put into WES's responsibility. However, if community member have no proper knowledge of operation and maintenance of water supply facilities, proper O & M is not expected. Accordingly, the training on O & M, supporting for establishment of WUC and training for HPM shall be included in the supporting services of the Project.

## 2-3-2 Basic Design

### (1) Basic Design of Borehole

#### ① Design Criteria

Target Year	:	2005
Demand per capita per day	:	20 l/c/d
Beneficiary per borehole	:	Standard 360, Max. 430
Demand per day per borehole	:	$20 \times 430 = 8,600 \text{ l/d}$ (8.6m <sup>3</sup> /d, 12hr operation)
Demand per hour	:	720l/hr

#### ② Yield of Borehole

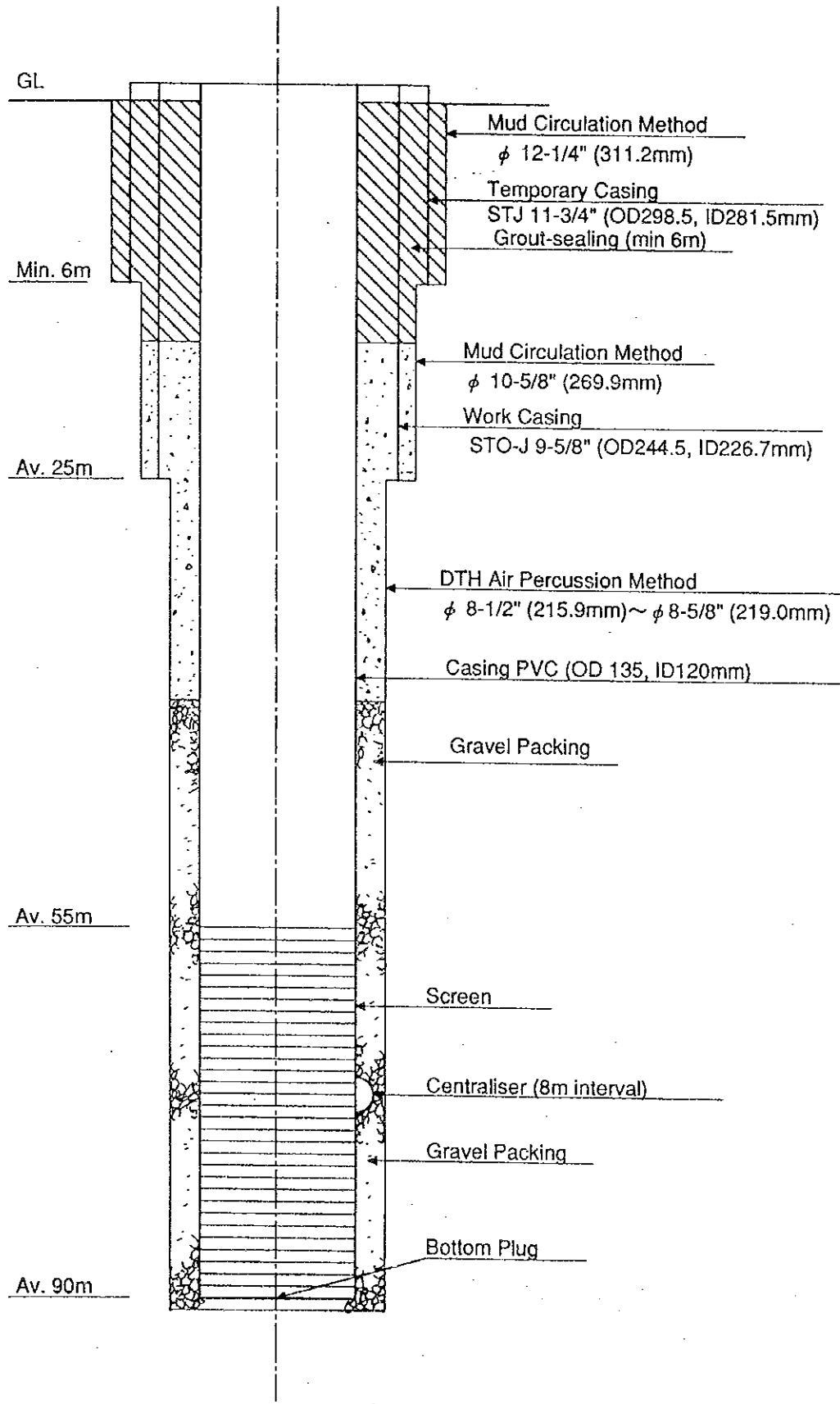
Although the capacity is not constant depending on the hydrogeological unit and site conditions, the yield of borehole is usually 800~2,500l/hr and it is suitable to the design capacity (See Table 2-7). Only the area where the hydrogeological unit is classified as granites, the yield is under 600l/hr. Accordingly in the area, Max. 320 persons of beneficiaries shall be considered or 14 hr of pump operation shall be required.

#### ③ Structure of Borehole

The typical section of borehole structure is illustrated in Figure 2-1 according to DWD standard. Drilling method of borehole shall be the mud-circulating method for soft formation overlaying the bed-rock formation and the percussion method for bed-rock. In order to prolong the life period of the borehole as well as the handpump, the whole portion of the borehole is to be properly cased and packed by gravel.

Diameter of borehole	:	upper portion 311.2mm~269.9mm, lower portion 219.1mm
Diameter of well	:	inner diameter 125mm
Casing Pipe	:	PVC, Screen(opening ratio is more than 8%) shall be 30% of well depth

FIG 2-1 TYPICAL BOREHOLE SECTION



④ Headwork

Concrete slab and drainage are provided to make easy cleaning and maintenance and to prevent intrusion of surface water. The design of headwork is according to DWD standard as shown in Figure 2-2.

⑤ Handpump

The type of handpump to be used is U2 or U3 which is manufactured in Uganda. The materials of handpump shall be stainless steel(AISI 316) and brass materials to prevent corrosion.

(2) Level-II System for Kiboga T/C

① Demand

Daily Demand  $20 \times 3,603 \div 80\% = 90,075$  l/d(8hr operation), 11,260 l/hr

② Outlet Tap

Tap capacity  $90\text{m}^3/\text{d} \div 10 \text{ taps} \div 8\text{hr} = 1.125\text{m}^3/\text{hr}$

③ Numbers of Boreholes

Demand  $1.125\text{m}^3/\text{hr} \times 8\text{hr} \times 10\text{taps} = 90\text{m}^3/\text{d}$

Assuming yield per borehole of  $2.5\text{m}^3/\text{hr}$ , pump operation hour of 10hr

$90\text{m}^3/\text{d} \div 2.5\text{m}^3/\text{hr}/\text{BH} \div 10\text{hr} \doteq 4\text{BHs}$

④ Capacity of Reservoir

Distribution Tank :  $45\text{m}^3$  ( $90\text{m}^3 \div 2 = 45\text{m}^3$ )

Reservoir Tank :  $45\text{m}^3$  ( $90\text{m}^3 \div 2 = 45\text{m}^3$ )

⑤ Pipeline

Conduit pipe  $\phi$  40mm L = 1,600m

Supply pipe  $\phi$  100mm L = 750m

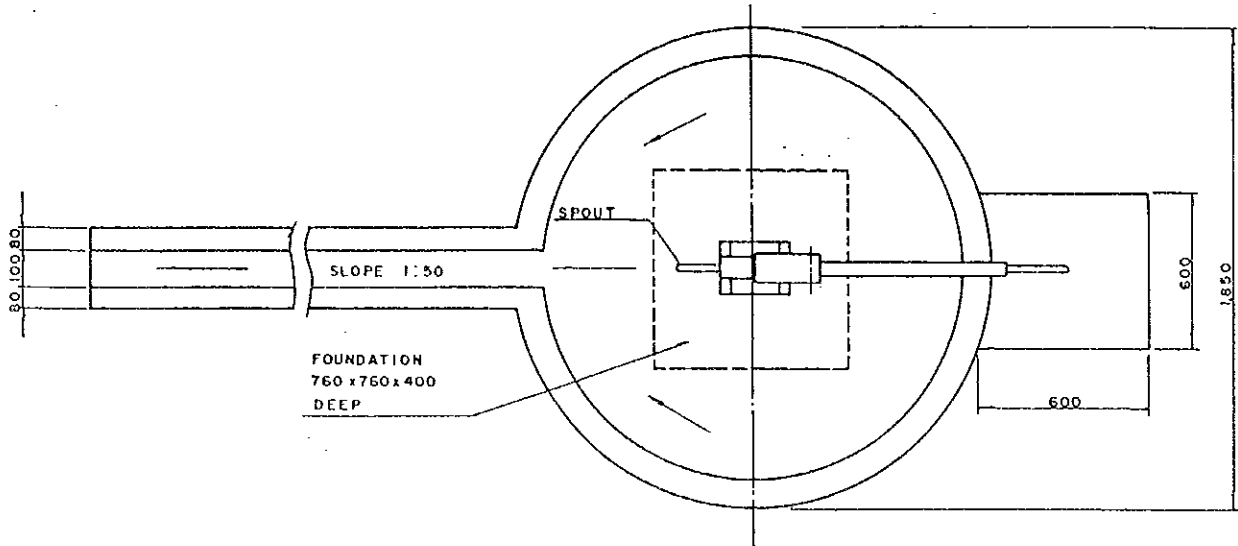
Distribution pipe  $\phi$  80mm L = 4,100m

⑥ Pump

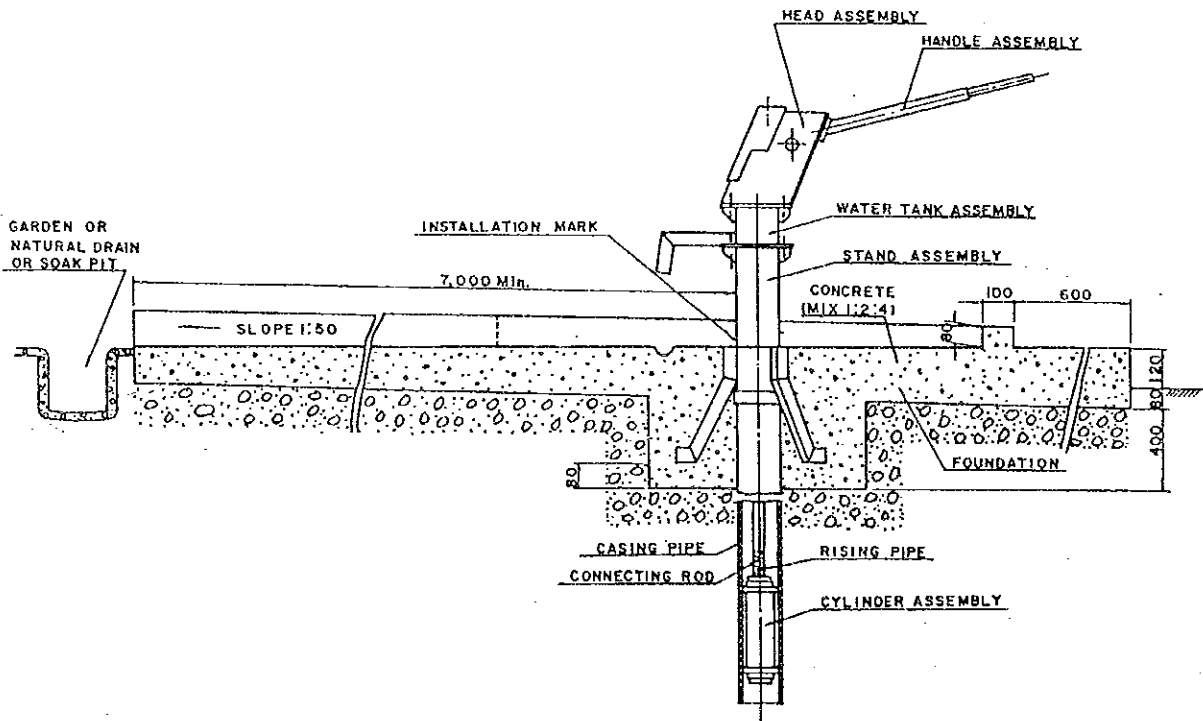
Submersible pump  $\phi$  40mm

Supply pump  $\phi$  100mm

FIG 2-2 STANDARD HEADWORKS



PLAN



SECTION

ALL DIMENSIONS ARE IN MILLIMETER

⑦ Plan and Drawing

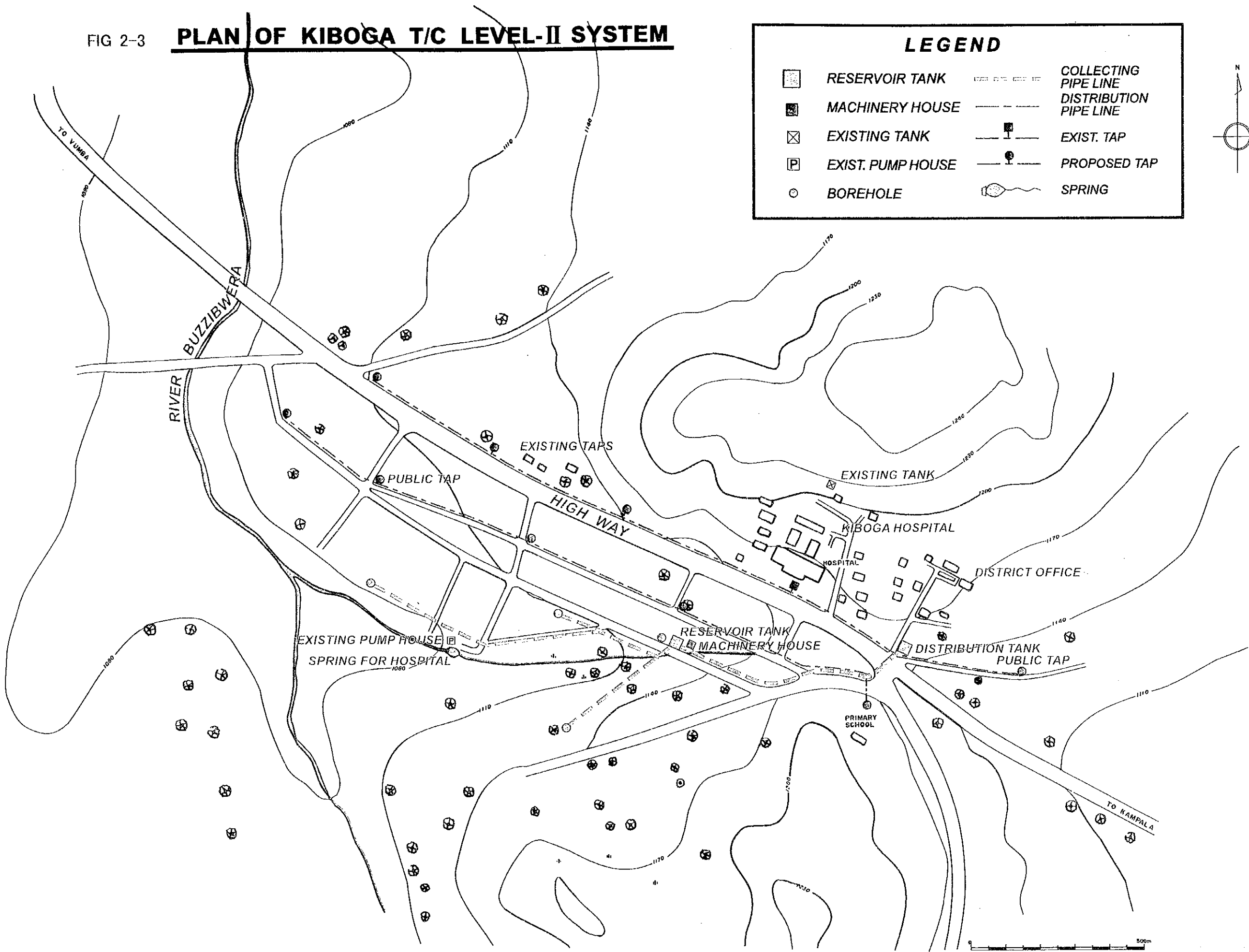
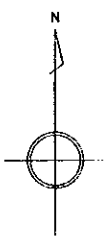
Plan and Drawing of Level-II System at Kiboga T/C are illustrated in Figure 2-3 and Figure 2-10.



FIG 2-3

# PLAN OF KIBOGA T/C LEVEL-II SYSTEM

LEGEND			
	RESERVOIR TANK		COLLECTING PIPE LINE
	MACHINERY HOUSE		DISTRIBUTION PIPE LINE
	EXISTING TANK		EXIST. TAP
	EXIST. PUMP HOUSE		PROPOSED TAP
	BOREHOLE		SPRING



SCALE 1:5,000

FIG 2-4 Illustrate of Kiboga Level-II System

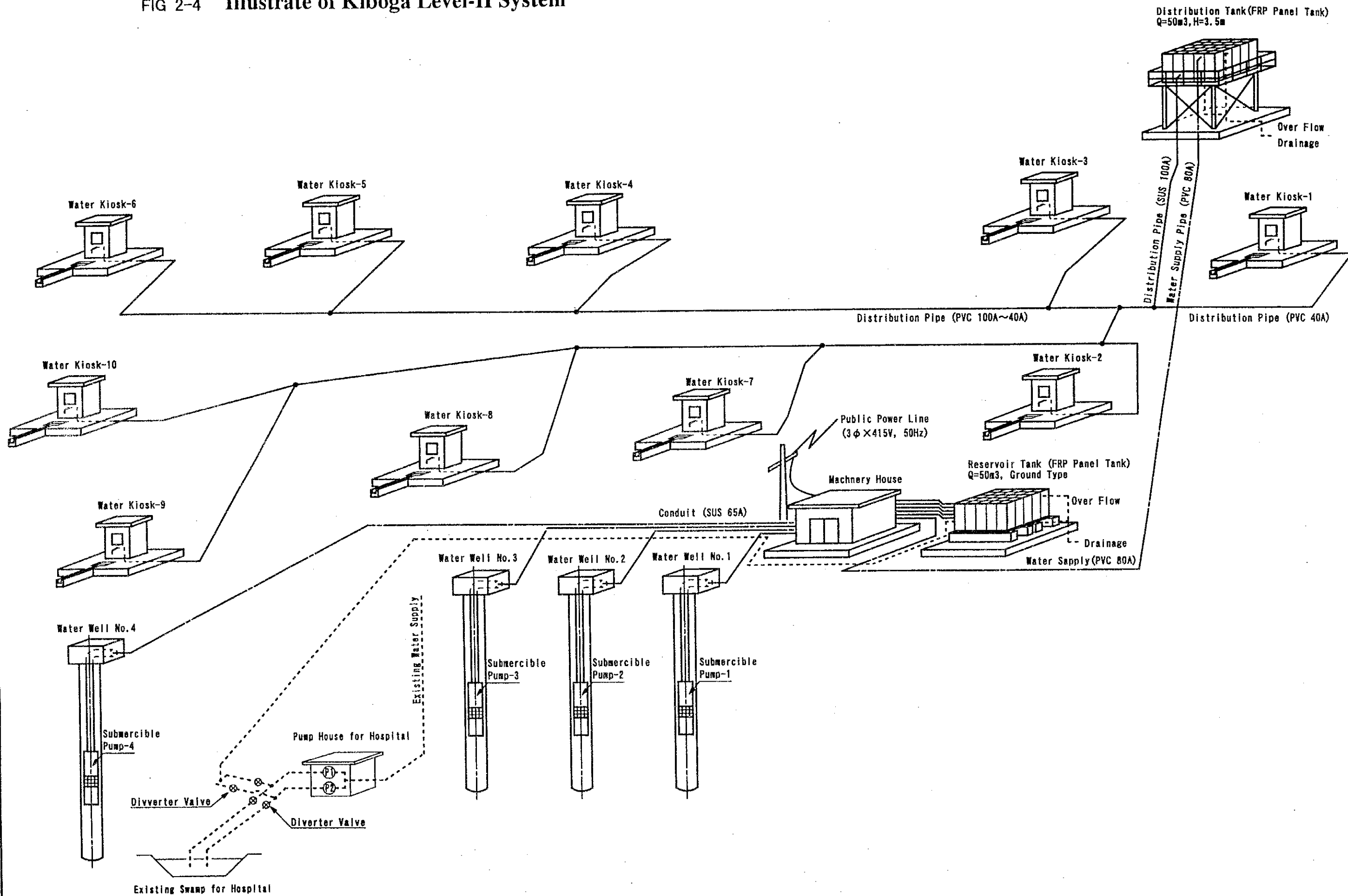


FIG 2-5 RESERVOIR TANK

SCALE 500 1,000 1,500 2,000

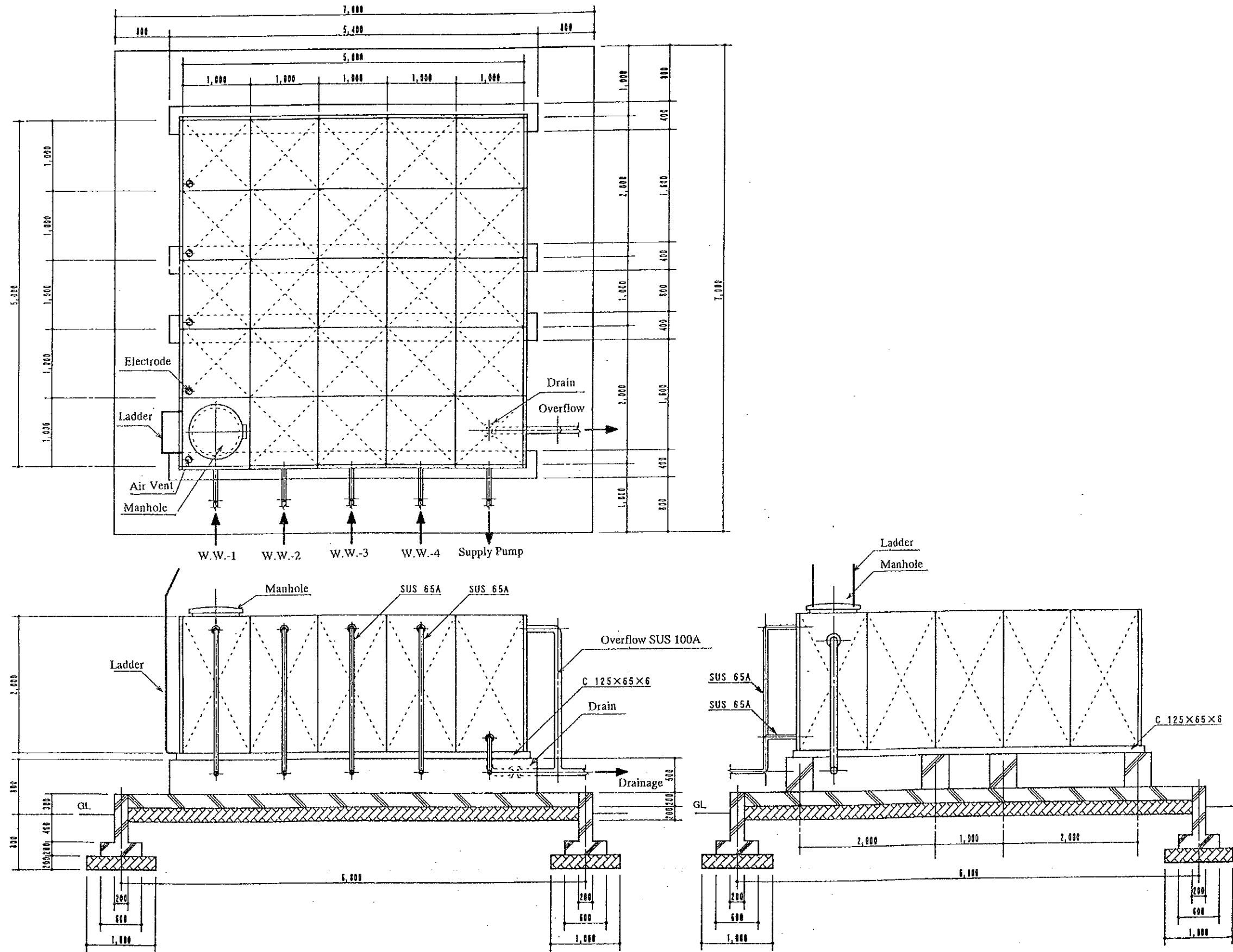


FIG 2-6 MACHINERY HOUSE

SCALE 0 500 1,000 1,500 2,000 mm

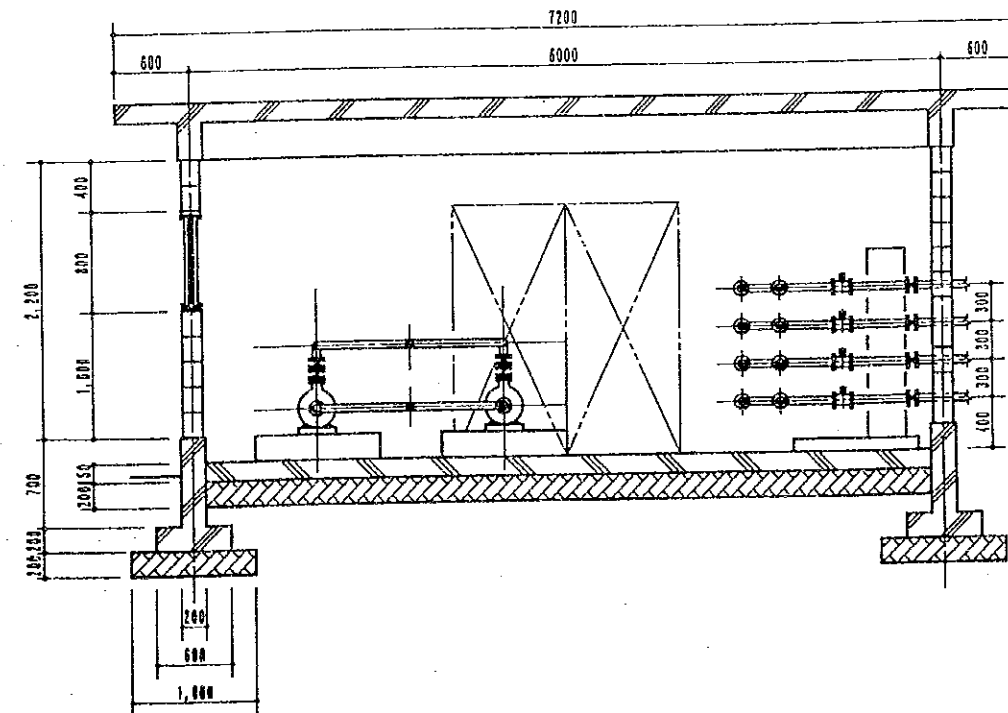
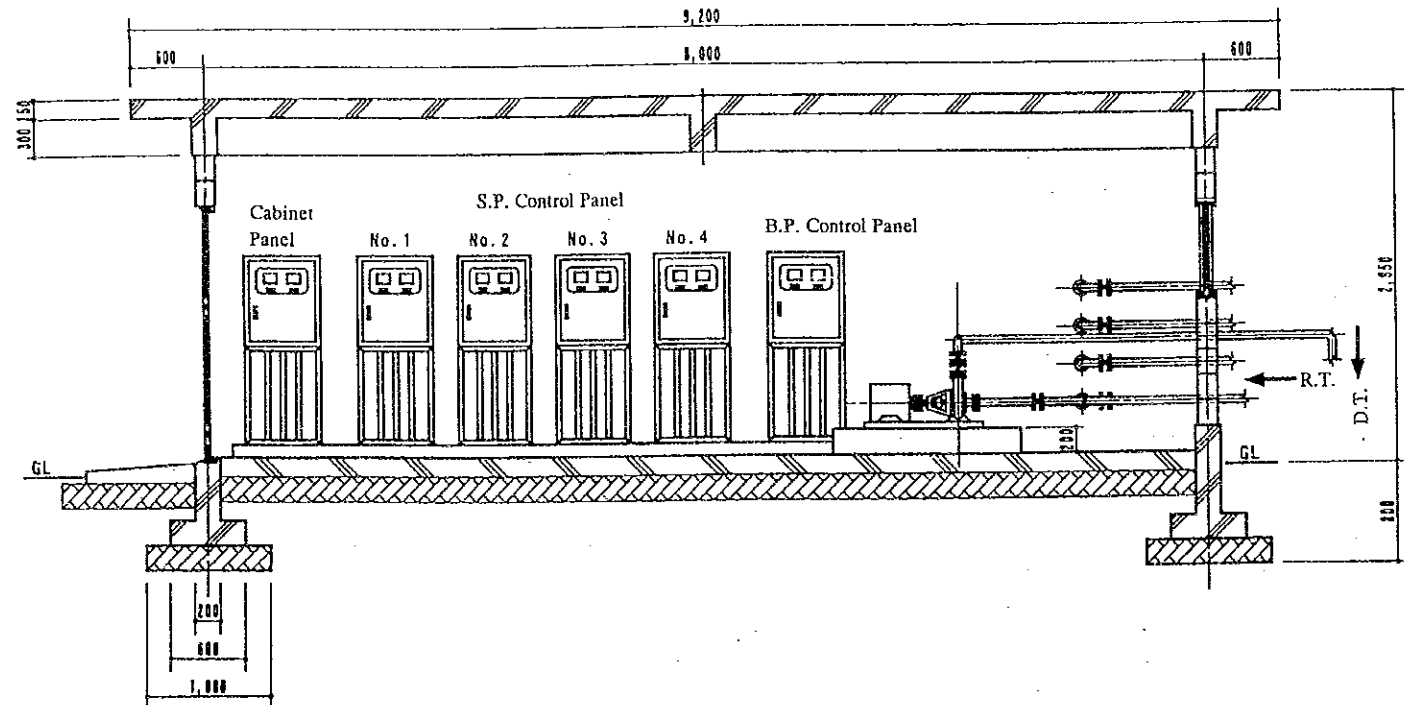
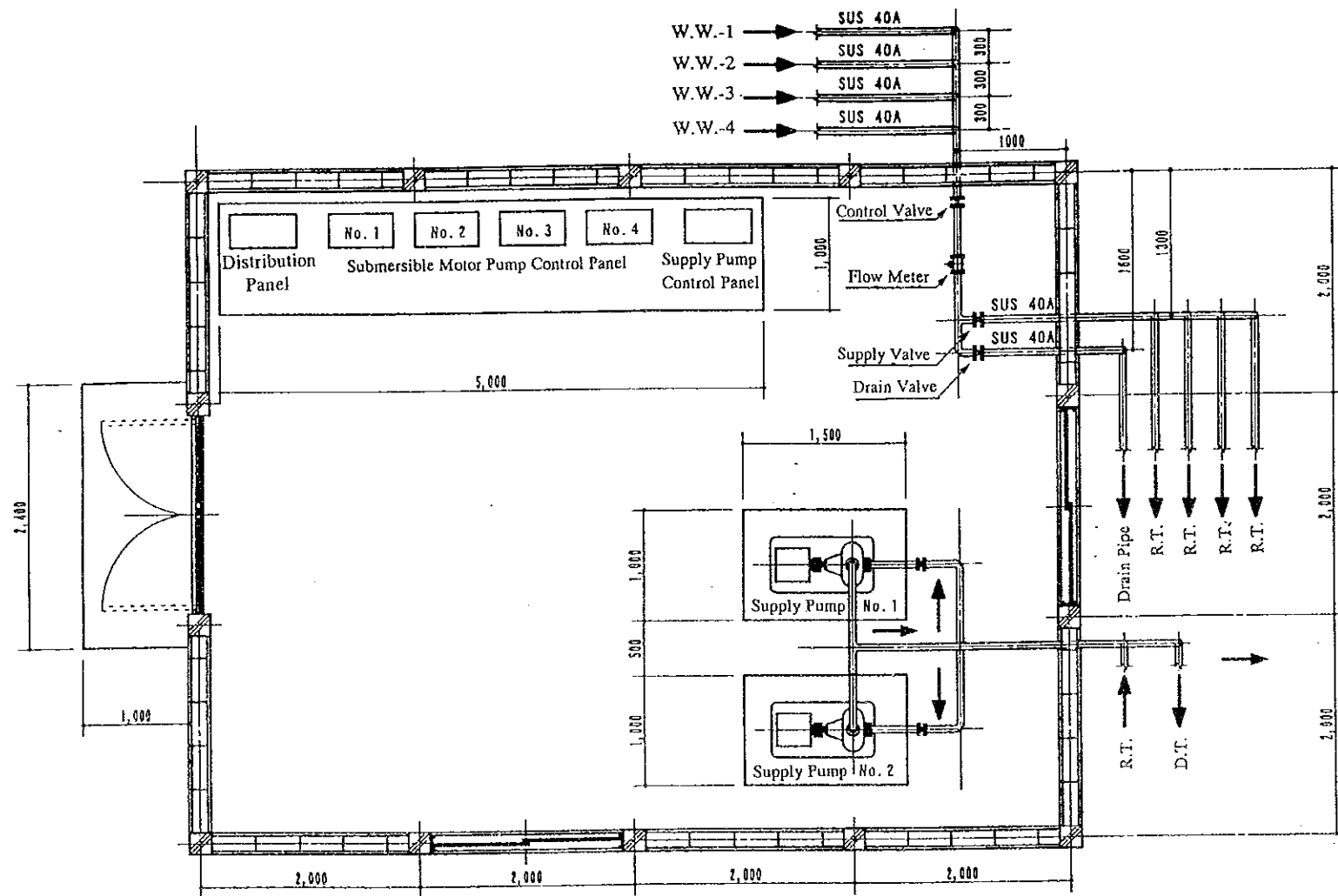


FIG 2-7 DISTRIBUTION TANK

SCALE 0 500 1,000 1,500 2,000 mm

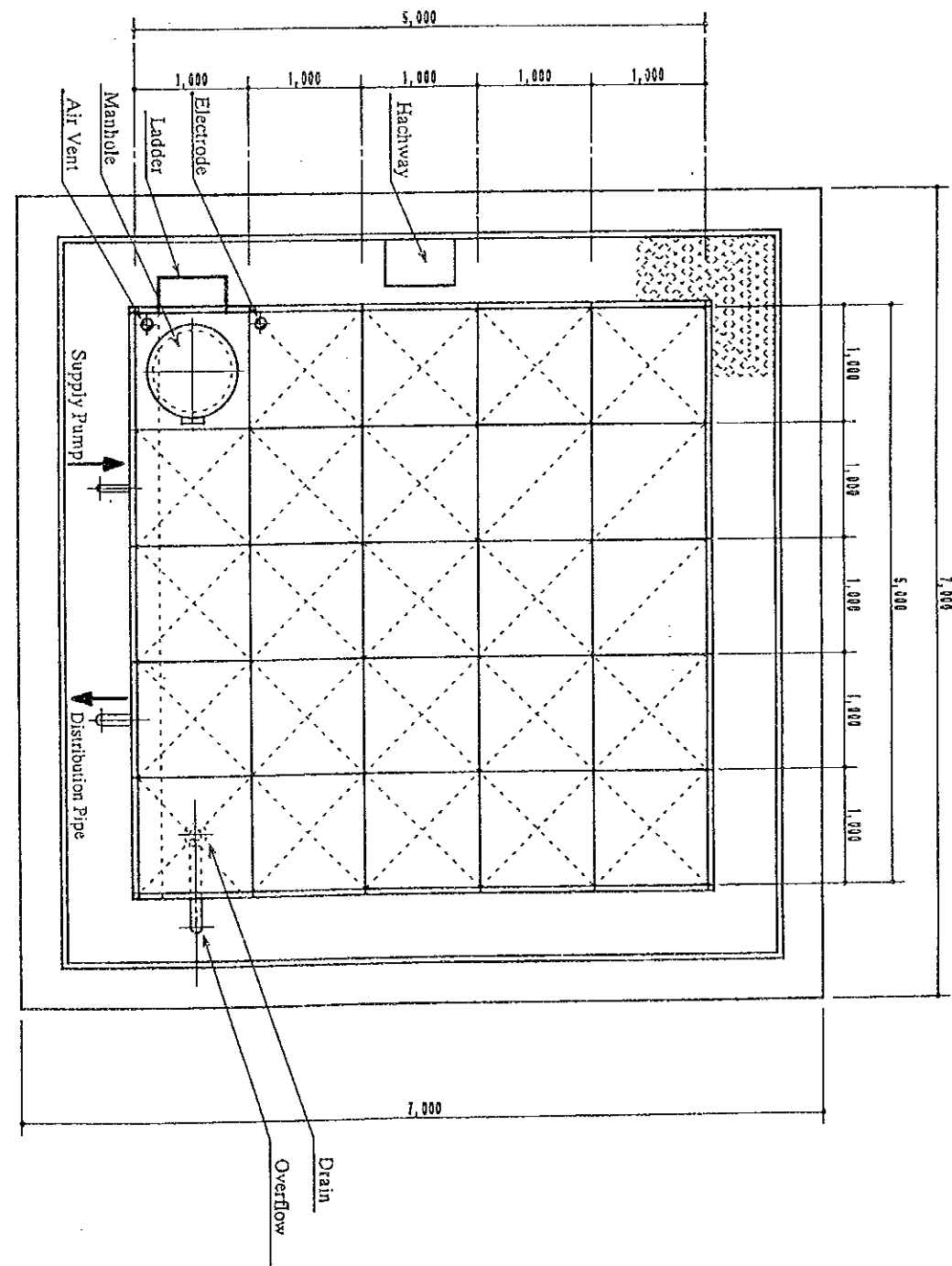
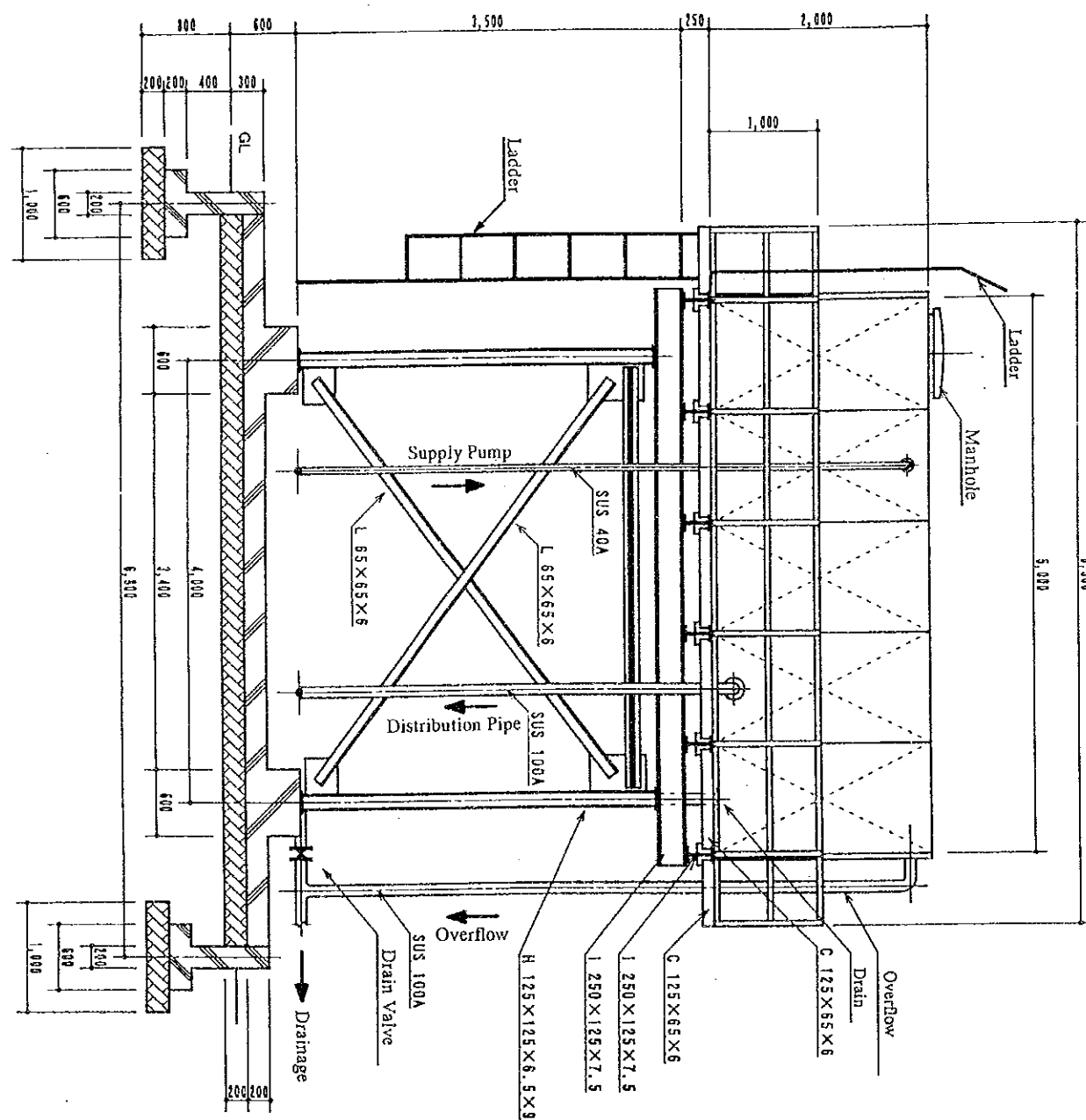
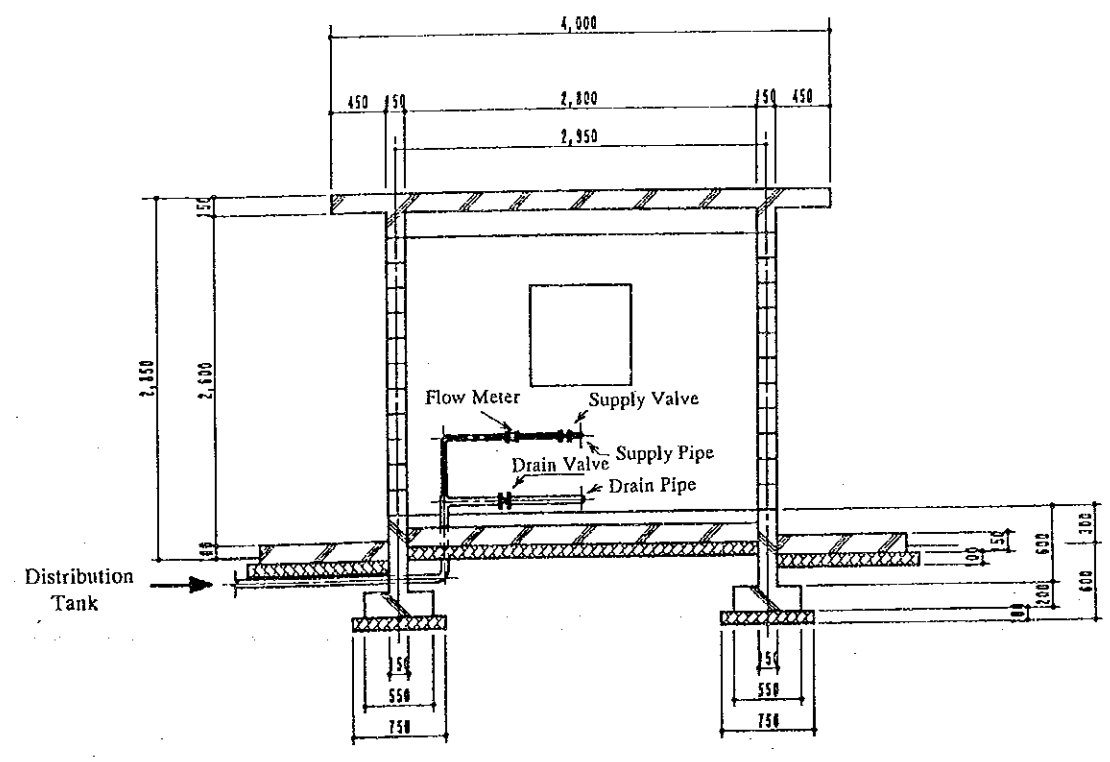
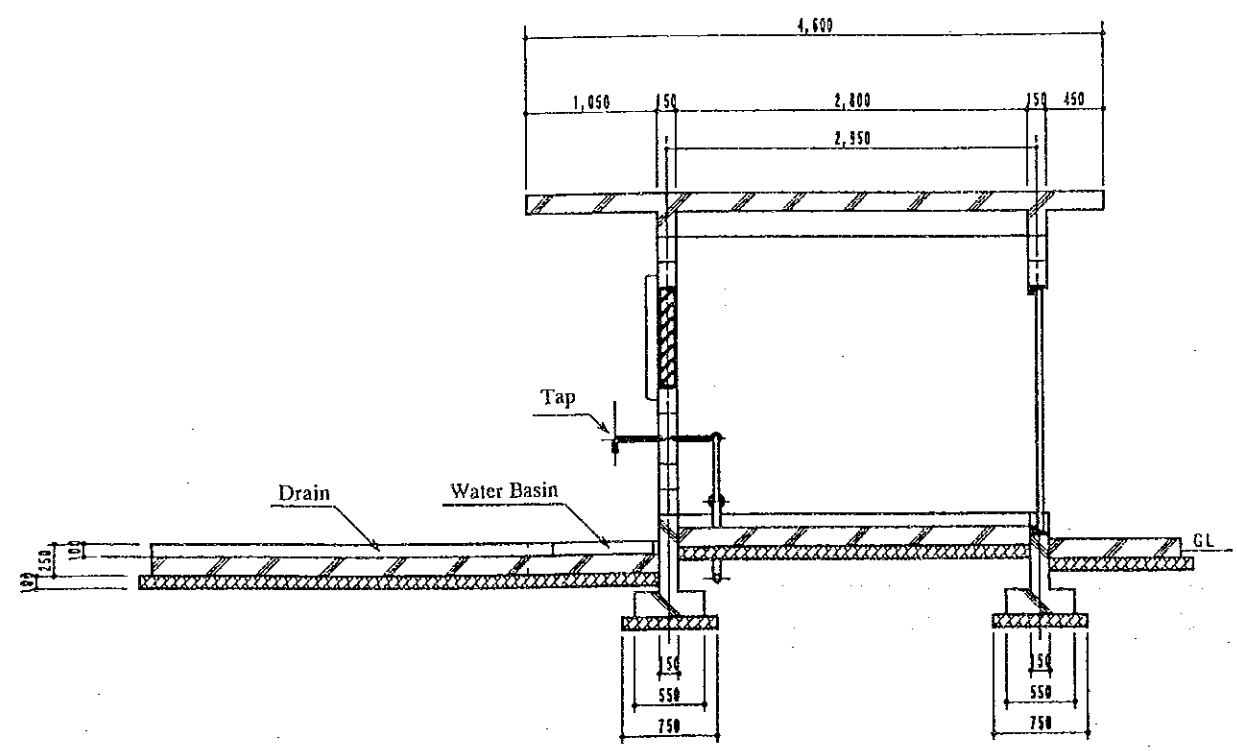
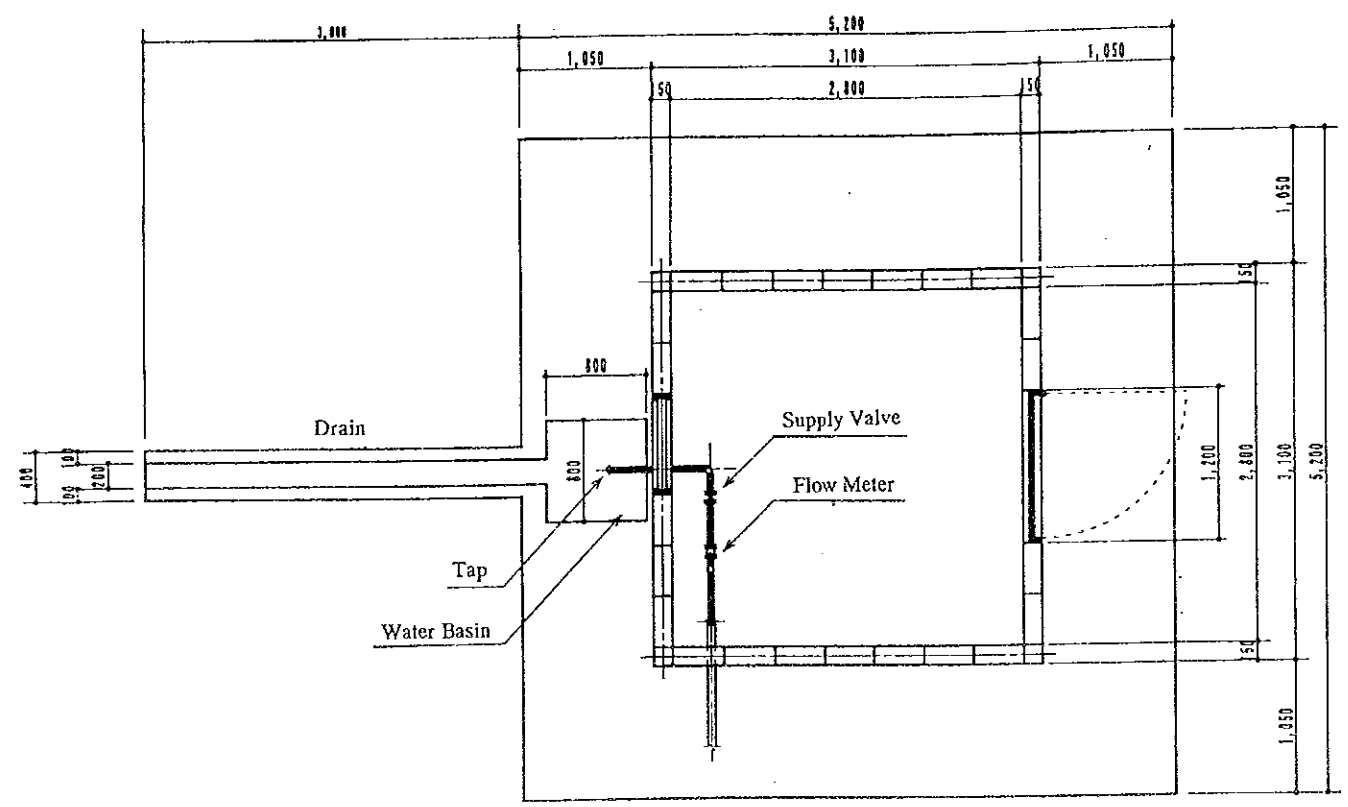


FIG 2-8 WATER KIOSK

SCALE 0 500 1,000 1,500 2,000 mm





(3) Equipment and Materials

Equipment and materials which are procured by the Project are four(4) pickup trucks, a service rig, one set of workshop equipment and four(4) sets of water analysis kits as mentioned in paragraph 2-2-2. The specifications and purposes are shown in Table 2-10 below.

**Table 2-10 Equipment and Materials**

No.	Item	Specifications	Purposes	Qu'ty
1	Pickup truck	Double cabin type, 4WD, Diesel engine	For O&M and Education & Training program	4 Units
2	Service Rig Truck Mounting Tools ① Compressor ② Welder ③ Tools and Box	4 WD, Crane 2 ton cap.  5 m <sup>3</sup> /min x 7 kg/cm <sup>2</sup> 5.6 kW Standard tools	For cleaning of borehole and Repairing of pump	1 Unit  1 Unit 1 Unit 1 Set
3	Workshop Tools Bowl plate Bench grinder Disk grinder Compressor Engine welder/Generator Welder Chain block/Supporter Electric screw threader Pipe wrench Chain tongue Speed cutter pipe cutter Bench vice Tool and Tool box	1~13mm φ 205mm, with 3 grindstone Grinder 100 pieces motor, 0.4m <sup>3</sup> /min x 7kg/cm <sup>2</sup> 10 kVA Transformer, 300A 3 ton 1/2~2"  Grinder, 30 pieces Manual, 1~3" 150mm Standard tools	for drilling hole for grinding for cutting and grinding for painting for welding and lighting for welding for lifting for threading -do- -do- for cutting for cutting of pipe for fixing	1 unit 1 unit 2 units 1 unit 1 unit 1 unit 1 unit 1 unit 2 sets 2 sets 2 units 2 units 1 unit 1 set
4	Water analysis kits Water analysis kit EC Meter pH Meter	18 items, additional chemicals 100	Judging of drinkable	4 sets
5	Spare parts	For two year's spare parts		1 set



## 2-4 Implementation Setup of the Project

### 2-4-1 Organization

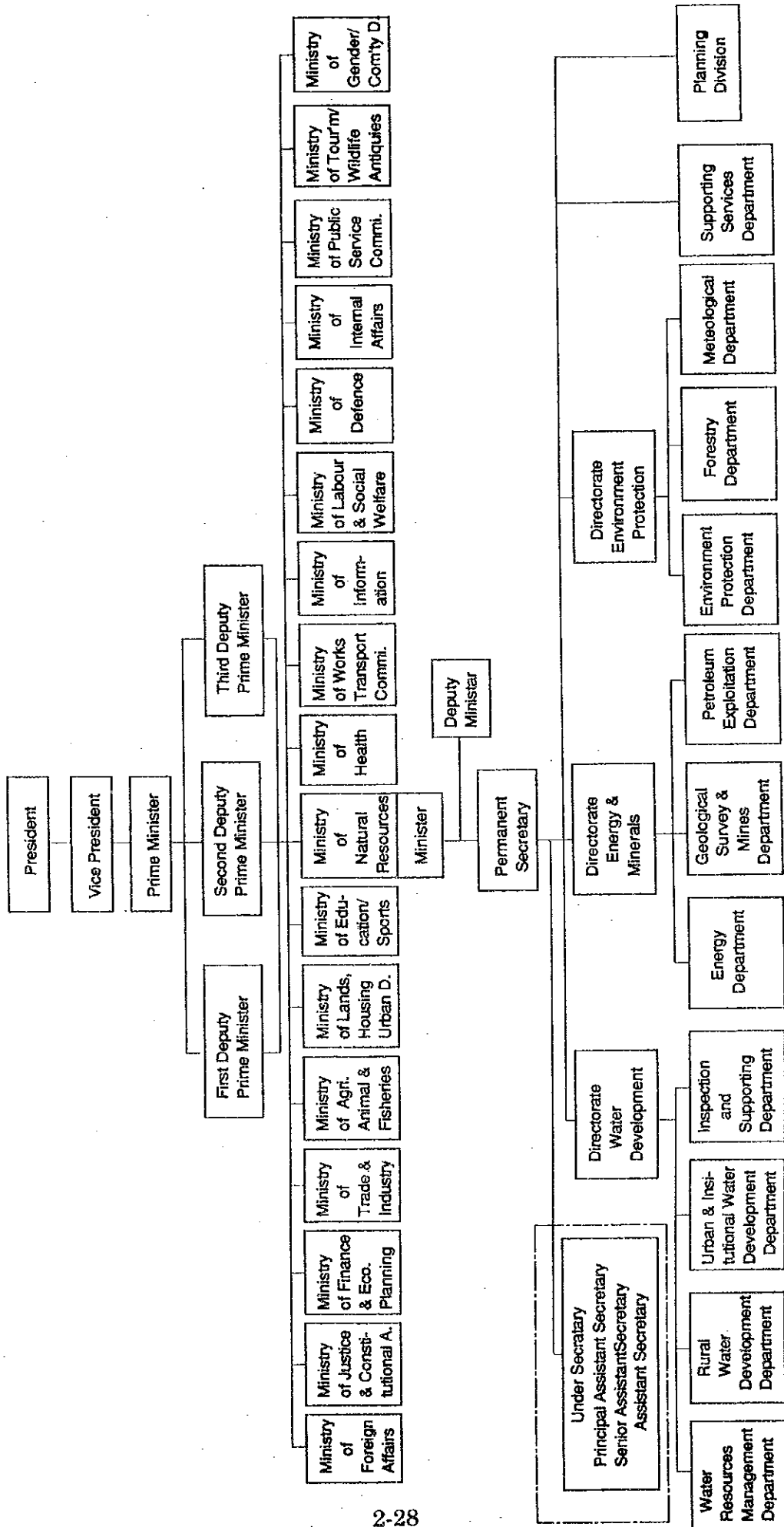
The responsible ministry for the Project is the Ministry of Natural Resources (Refer to Figure 2-9), and the implementing agency is the Directorate of Water Development (DWD). The organization of DWD is composed of four departments under the Director namely Water Resources Management Department, Rural Water Development Department, Urban and Institutional Development Department and Inspection and Support Services Department as shown in Figure 2-10. Out of those four departments, the executing department is the Rural Water Development Department (RWD). The RWD is divided into three divisions namely Planning and Development, Groundwater Development and Surface Water Development Division. The Government Agencies are now under restructuring according to the government policy. The existing number of personnel is as follows:

#### Number of Personnel of DWD

<u>Description</u>	<u>Number</u>
Staff(Administrative)	25
Staff(Technical)	240
Secretary	24
Technician	242
Other Employees	335

As mentioned above, the executing department is RWD. The DWD will set up the Project Office. A manager and several technical staff will be assigned to the Project Office, and they will be in charge of site selection, supervising of construction and construction control in cooperation with the Consultant. On the other hand, they will solve problems on the construction and problems on the land acquisition in cooperation with the personnel of the District Office. The organization chart of the Project Implementation is shown in Figure 2-11.

FIG 2-9 ORGANIZATION OF THE GOVERNMENT AND THE MINISTRY OF NATURAL RESOURCES



Source: Information from DWD and Background to the Budget 1993-1994, Ministry of Finance and Economic Planning June 1993.

FIG 2-10 STRUCTURE OF DIRECTORATE OF WATER DEVELOPMENT

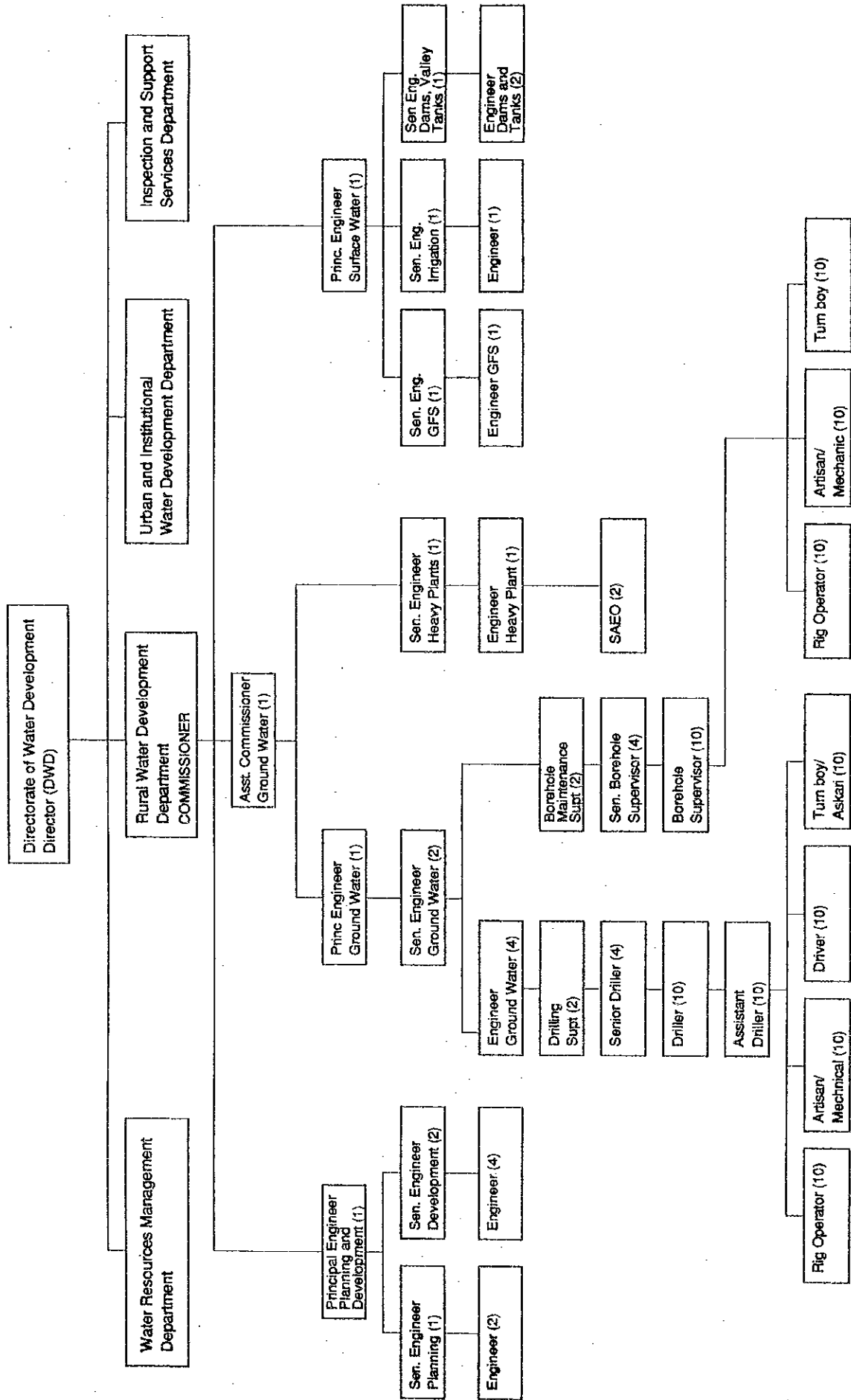
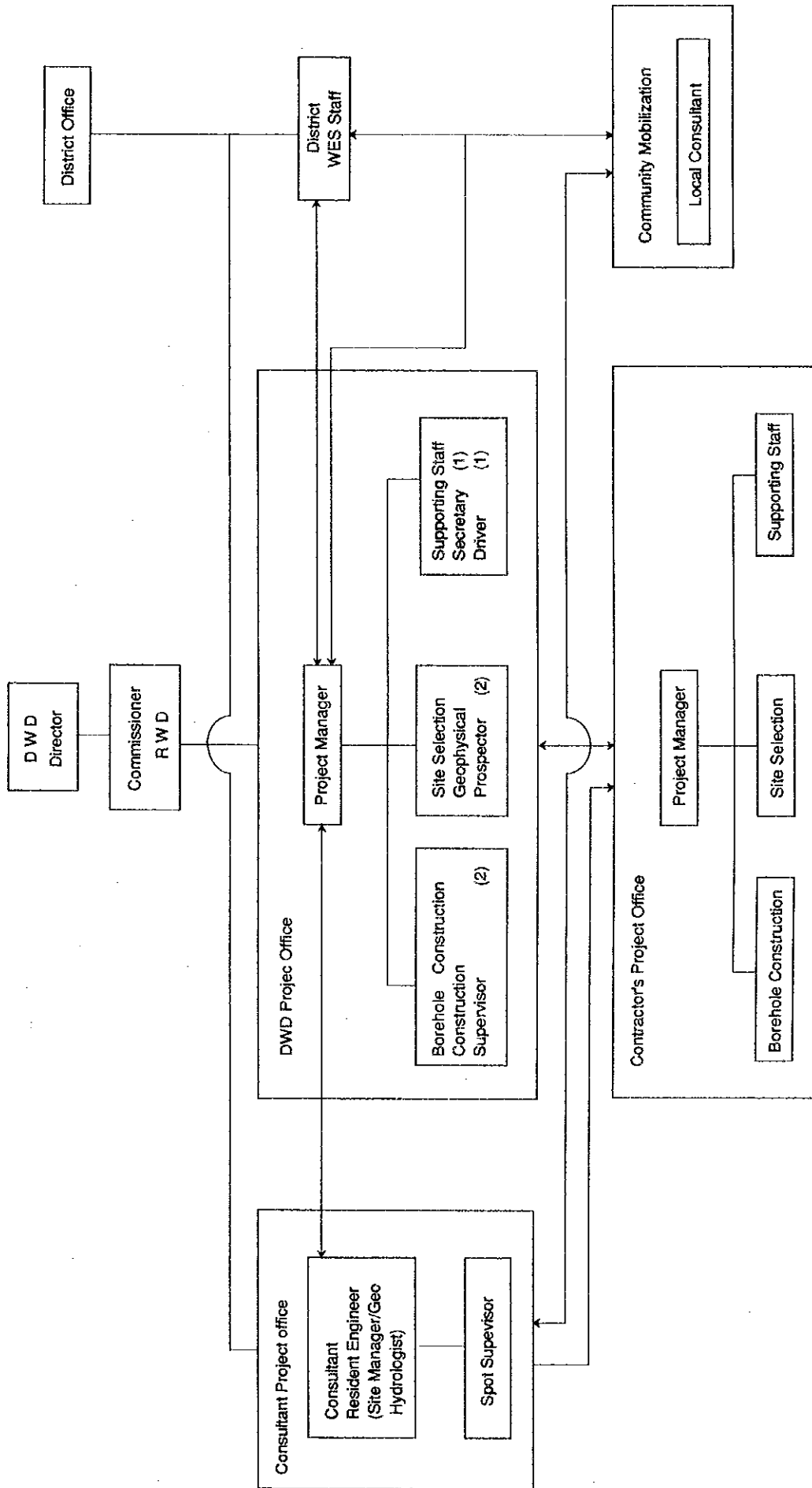


FIG 2-11 PROPOSED ORGANIZATION FOR PROJECT IMPLEMENTATION



## 2-4-2 Budget

The Ministry of Natural Resource (MNR) is composed of three Directorates namely Water Development, Energy & Minerals and Environment Protection. The budget of past three years (until 1995/96) are as shown in Table 2-11 below.

**Table 2 - 11 Annual Budget - Ministry of Natural Resources**

Unit : 10<sup>3</sup>USh

Directorate	1993/94	1994/95	1995/96
Supporting Services	293,000	366,000	403,000
Energy & Minerals	1,814,000	2,267,000	2,494,000
Water Development	3,022,000	3,778,000	4,156,000
Environment Protection	756,000	945,000	1,039,000
Total	5,885,000	7,356,000	8,092,000

The Government Budget in Uganda have increased at a yearly growth rate of 30% in recent years. The budget of 1994/95 is expanded at 20% of the previous financial year's budget which is explained by the salary of government employees increase. The budget of 1995/96 increased by 10% of the previous year's budget. The Budget of DWD in last three years (until 1995/96) is shown in Table 2-12.

**Table 2- 12 Annual Budget of DWD**

Unit : 10<sup>3</sup>USh

Item	1993/94	1994/95	1995/96
General Expenses	290,000	362,000	398,000
Development Cost	2,732,000	3,416,000	3,758,000
Total	3,022,000	3,778,000	4,156,000

The Development Budget is mostly assistance by SIDA, DANIDA and UNICEF. Only 10% of the development budget are local finances of the Ugandan Government.

### **2-4-3 Personnel and Technical Level**

As mentioned in the previous paragraph, the executing agency is the Department of Rural Water Development in the Directorate of Water Development. The Department is composed of three Divisions of Planning & Development, Groundwater Development and Surface Water Development, and has 144 staffs. The main technical staffs are 30 which are five(5) of high grade technical staffs, nine(9) of senior technical staffs and sixteen(16) of junior technical staffs. The other staffs are technicians such as operators of drilling rigs, drivers and mechanics, secretaries and so on. Seven staffs are required to be assigned to the Project Office, and the Department has enough capacity.

The staffs of the Department have sufficient experience for the project implementation and the borehole construction through RUWASA and WES projects. Those projects were mostly implemented by force account method, the Projects will however be implemented by contract method. Therefore, the main works of the Project Office are supervision of borehole construction which will be no problem. The mud circulating method will be introduced in this Project and staffs must obtain the new technic. But it is considered no problem for the staffs to follow the technology.