BASIC DESIGN STUDY REPORT

ON

GROUNDWATER DEVELOPMENT AND SANITATION IMPROVEMENT PROJECT IN THE NORTHERN PROVINCE OF THE REPUBLIC OF ZAMBIA

FINAL REPORT

AUGUST 2003

JAPAN INTERNATIONAL COOPERATION AGENCY
J A P A N T E C H N O C O . , L T D .

PREFACE

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a basic design study on the Groundwater Development and Sanitation Improvement Project in the Northern Province and entrusted the study to the Japan International Cooperation Agency (JICA).

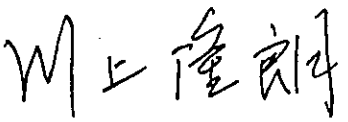
JICA sent to Zambia a study team from 6 March 2003 to 16 April 2003.

The team held discussions with the officials concerned of the Government of the Republic of Zambia, 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 Zambia in order to discuss a draft basic design, from 19 July 2003 to 28 July 2003, 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 Zambia for their close cooperation extended to the teams.

August 2003



Takao Kawakami
President
Japan International Cooperation Agency

August 2003

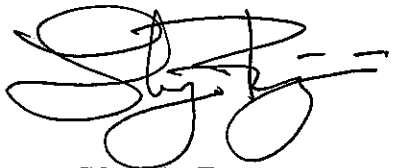
LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Groundwater Development and Sanitation Improvement Project in the Northern Province in the Republic of Zambia.

This study was conducted by Japan Techno Co., Ltd, under a contract to JICA, during the period from March 2003 to August 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Zambia 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.

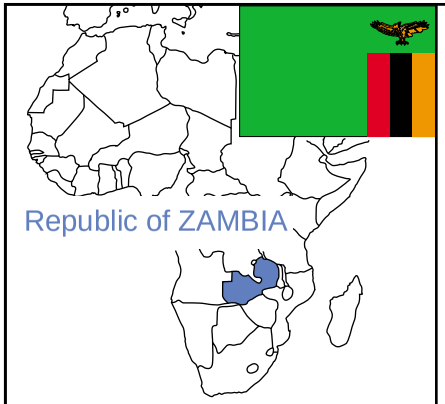
Very truly yours,

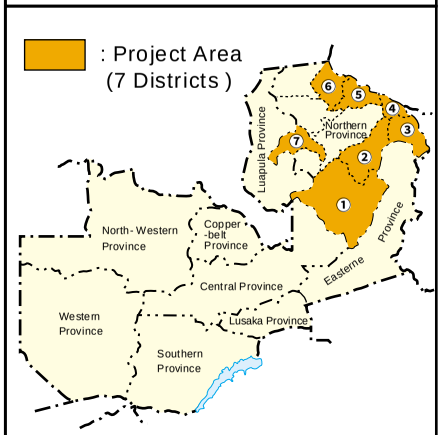


Shoji Fujii
Project Manager
Basic Design Study Team
The Groundwater Development
and Sanitation Improvement
Project in the Northern Province
The Republic of Zambia
Japan Techno Co., Ltd.

GROUNDWATER DEVELOPMENT AND SANITATION IMPROVEMENT PROJECT IN THE NORTHERN PROVINCE OF THE REPUBLIC OF ZAMBIA

LOCATION MAP OF PROJECT AREA





Project Area	Number of Survey Sites
① Mpika Dist.	45
② Chinsali Dist.	36
③ Isoka Dist.	43
④ Nakonde Dist.	36
⑤ Mbala Dist.	53
⑥ Mpulungu Dist.	43
⑦ Luwingu Dist.	44
Total of Survey Sites	300

Groundwater Development and Sanitation Improvement Project in the Northern Province in the Republic of Zambia

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LIST OF ABBREVIATIONS

AfDB	African Development Bank
A/P	Authorization to Pay
APM	Area Pump Mender
B/A	Banking Arrangement
BHN	Basic Human Needs
DANIDA	Danish International Development Assistance
DFID	Department for International Development
DISS	Department of Infrastructure and Support Services
DTH	Down-the-Hole
DWA	Department of Water Affairs
D-WASHE	District Water, Sanitation and Health Education (Committee)
E/N	Exchange of Notes
GTZ	Deutsche Gesellschaft fur Technische Zumsammenarbeit
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immuno-Deficiency Syndrome
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt fur Wierderaufbau
MEWD	Ministry of Energy and Water Development
MLGH	Ministry of Local Government and Housing
NGO	Non-governmental Organization
NORAD	Norwegian Agency for Development Cooperation
OJT	On-the-Job Training
PDM	Project Design Matrix
PRA	Participatory Rapid (Rural) Appraisal
P-WASHE	Provincial Water, Sanitation and Health Education (Committee)
RWSS	Rural Water Supply and Sanitation
TOT	Training of Trainers
Sub-WASHE	Sub-District Water, Sanitation and Health Education (Committee)
UNICEF	United Nations (International) Children's (Emergency) Fund
VIP	Ventilated Improved Pit (Latrine)
V-WASHE	Village Water, Sanitation and Health Education (Committee)
WASHE	Water, Sanitation and Health Education (Committee)
WHO	World Health Organization

SUMMARY

SUMMARY

For the Republic of Zambia, in order to raise the low coverage in water supply, which is currently about 30% in rural areas of the country, the Japanese government implemented the "Study on National Water Resources Master Plan" during 1993-95. Then in 1994, the "National Water Policy" was formulated in line with this master plan. Included in this national water policy was the rural water supply and sanitation (RWSS) plan which became the principle foundation for sustainable water supply in the rural areas. On the other hand, apart from the master plan, the Japanese government implemented grant aid projects in Southern Province, Lusaka Province, Central Province, Western Province and Copperbelt Province in the groundwater development and water supply sector. The five-year rural water supply and sanitation programme for the Northern Province formulated in 1998 set objectives to increase the coverage of safe and adequate water supply from 17% to 50%; increase the sanitation coverage from 11% to 55%; and promulgate improved sanitation practices to 50% of the residents. In July 2001, to meet these objectives, the Government of Zambia presented its request to the Government of Japan for grant aid assistance for the Groundwater Development and Sanitation Improvement Project in the Northern Province of Zambia (hereafter called the "Project") to improve the delay in water coverage in this area.

The Project area is the rural area of the Northern Province in the 7 Districts of Mpika, Chinsali, Isoka, Nakonde, Mbala, Mpulungu and Luwingu. The beneficiary group is the residents of the target area. The overall goal related to this project is the improvement of the sanitary environment of the target residents. The objective of the project is the sustainable supply of safe water through the construction of borehole facilities equipped with handpumps using the procured equipment and materials.

Presently, in the Northern Province, due to the lack of sanitary water sources, the residents are compelled to drink unsanitary water that can increase chances of water-borne diseases. Also, women and children are subjected to time consuming hard labor of fetching water. Therefore, if water supply facilities fitted with handpumps are constructed at the project sites, the population served with safe water can increase and the sanitary environment will be upgraded.

The executing agency for this project is the Department of Water Affairs (DWA) under the Ministry of Energy and Water Development (MEWD). On the other hand, the responsibility for operation and maintenance of water supply facilities will be transferred to the Department of Infrastructure and Support Services (DISS) under the

Ministry of Local Government and Housing (MLGH).

The contents of the request for this Project by Zambia government are summarized below.

a. Construction of three hundred (300) water supply facilities fitted with handpump
b. Procurement of drilling equipment and materials
c. Technology transfer on drilling techniques, and TOT for management and supervision of the construction for borehole
d. Capacity building and institutional strengthening on management, and operation and maintenance of the constructed water supply facilities, through the software-component programme

After examination on the contents of the request, the basic policies of the Project are as follows:

1. In the numerous Japanese grant projects previously implemented in Zambia, technology was transferred to the Zambian side. Therefore, the present project should consider procurement of equipment with construction being done by the Zambian side as much as possible. However, the training was not sufficient for complete independent drilling by the Zambian side, as well as transfer of acquired skills to other staff members. As a result, in this project, in order for the Zambian side to continue the drilling works on their own, equipment will be procured for this purpose, and, not only technology transfer on drilling skills, but a training of trainers on management and supervision of drilling works through collaborative efforts will also be included.

2. The drilling equipment and support vehicles that were already procured by the previous Japanese grant projects will be used in order to take effective benefits of the fund.

3. The water source will basically be confined groundwater pumped from boreholes. However, since the success rate for confined aquifers is predicted to be low, if the confined aquifer is judged to be unsuccessful, then unconfined aquifers will be exploited. The total success rate of 75% will be applied for this project.

As for selection of the site, the following criteria were used to select sites feasible for development by District Water, Sanitation and Health Education (D-WASHE). This screening process revealed that out of the 300 surveyed sites, 268 have feasibility.

a. The target population is 100 or more persons.
b. Construction vehicles are accessible into the site.

c. The site is not receiving a safe and sufficient supply of water.
d. The target residents are willing to maintain the constructed water supply facilities.
e. Other water supply projects are not in duplication in the site.

However, in order to reduce the number of construction works by the Japanese side so that the Zambian side will be able to increase their possibilities for independent drilling, the following criterion was added to narrow down the sites, and as a result 175 sites were selected out of 268 sites for implementation in this Project.

f. The site has already voluntarily formed a water or health related organization

Equipment and materials to be procured under this Project are listed below.

No.	Item	Design Concept
1.	DRILLING EQUIPMENT	
1)	Truck-mounted rig, Top-head drive type	1 unit
2)	Standard tools and accessories	1 set
3)	Truck-mounted compressor	1 unit
4)	Logging equipment	1 unit
5)	Pumping test equipment	1 set
6)	Workshop equipment and tools	1 set
2.	SUPPORTING VEHICLES FOR DRILLING WORKS	
1)	Cargo truck with 3t crane for transport containers and pipes	1 unit
2)	Cargo truck with 3t crane for transport pumping test equipment	1 unit
3)	Water tanker, 4 m^3	1 unit
4)	Fuel tanker, 4 m^3	1 unit
5)	Pickup truck, 4WD, double cabin	3 units
3.	GEOLOGICAL SURVEY EQUIPMENT	1 set
4.	SPARE PARTS	1 lot
5.	CONSTRUCTION MATERIALS	
1)	Consumable drilling tools	Included in construction (175 sets)
2)	Consumable drilling materials	
3)	Casing and screen	
4)	Handpump with spare parts kit	
6.	SUPPORTING EQUIPMENT FOR WASHE ACTIVITIES	
1)	Station wagon, 4WD	-
2)	Pickup truck, 4WD	2 units
3)	Motorbike	21 units
4)	Data processing equipment	1 set
5)	Water quality analysis kit	7 sets

If the Project is approved for implementation under Japan's grant aid assistance, the provisional cost estimate is JY 809 million (about 32.5 billion Kwacha) as Japan's assistance and Zambia's responsibility is estimated at ZK 1.19 billion.

The Project will be implemented under the guidelines for Grant Aid stipulated by the Japanese government. The prime contractor will be a Japanese firm selected on a lump-sum basis through tendering procedures in Japan. A Japanese consultant will be recommended for detail designing and tendering support, as well as supervision of procurement and construction works. The Project will be implemented in 2 phases as follows.

Phase	Implementation Item	Training	Target Districts
Phase 1	Procurement of equipment Construction of water supply facilities at 60 sites	Drilling technique	Luwingu, Mpulugu, Part of Mbala
Phase 2	Construction of water supply facilities at 115 sites	Drilling technique Management and supervision	Part of Mbala, Nakonde, Isoka, Chinsali, Mpika

As a result of the implementation of the project, the following benefits can be expected.

1. The target sites will receive safe and stable water throughout the year from the completed water supply facilities.
2. Operation and maintenance system of water supply facilities with communities' initiative will be established.
3. Skills and capacities of drilling engineers and trainers of DWA are strengthened in terms of construction of boreholes and management of construction works.

This project has effects as explained above and will contribute to improvement of the bassic human needs of the population. Therefore, implementation of this project through the Japanese grant assistance will have great significance. However, if strengthening and capacity building of each level WASHE committees are properly conducted and appropriately coordinated, this project can be effectively implemented and the water supply system will become sustainable.

CONTENTS

CHAPTER 1
BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

For the Republic of Zambia, in order to raise the low coverage in water supply, which is currently about 30% in rural areas of the country, the Japanese government implemented the "Study on National Water Resources Master Plan" during 1993-95. Then in 1994, the "National Water Policy" was formulated in line with this master plan. Included in this national water policy was the rural water supply and sanitation (RWSS) plan which became the principle foundation for sustainable water supply in the rural areas. On the other hand, apart from the master plan, the Japanese government implemented grant aid projects in Southern Province, Lusaka Province, Central Province, Western Province and Copperbelt Province in the groundwater development and water supply sector. The five-year rural water supply and sanitation programme for the Northern Province formulated in 1998 set objectives to increase the coverage of safe and adequate water supply from 17% to 50%; increase the sanitation coverage from 11% to 55%; and promulgate improved sanitation practices to 50% of the residents. In July 2001, to meet these objectives, the Government of Zambia presented its request to the Government of Japan for grant aid assistance for the Groundwater Development and Sanitation Improvement Project in the Northern Province of Zambia (hereafter called the "Project") to improve the delay in water coverage in this area.

The target area for this project is the Northern Province, having an area of 147,826 km^2 and bordering Tanzania to the North. Of the total population of the Northern Province numbering 1,407,088 persons (2000 census), the estimated 70% rural population fall in the low income and vulnerable group. The poverty level of rural communities of the Northern Province has declined with ineffective water resources management and inadequate access to safe supply of water and proper sanitation facilities, giving rise to water-borne and related infectious diseases. The lack of adequate health facilities and medicines among the rural population further complicates the already worse situation.

The Northern Province, located in a heavy rainfall area, with an average annual rainfall ranging from 1,000 mm to 1,400 mm, boasts an abundance of water resources. The main water supply sources in this province include protected wells, springs, traditional sources, rivers, streams, dambos and lakes. Unlike water from protected sources, the quality of water from other sources is questionable and its safety cannot be guaranteed. Therefore, this project has objectives to improve the safe drinking water coverage rate in the project area and reduce the incidences of water borne diseases.

CHAPTER 2
CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Objectives

The Project area is the rural area of the Northern Province in the 7 Districts of Mpika, Chinsali, Isoka, Nakonde, Mbala, Mpulungu and Luwingu. The beneficiary group is the residents of the target area. The overall goal related to this project is the improvement of the sanitary environment of the target residents. The indicators to verify these goals are, the decrease in incidences of waterborne diseases in the target area, and improvement in habits of residents concerning sanitary management of water sources, water storage methods, water use patterns, hand washing behaviours, and use of sanitary facilities.

The objective of the project is the sustainable supply of safe water through the construction of borehole facilities equipped with handpumps using the procured equipment and materials. The verifying indicators towards this objective are the following:

- ✧ The target residents are supplied with the design rate of water from the constructed water supply facilities.
- ✧ The water quality of the water supply facilities conforms with the design criteria throughout the year.
- ✧ The time lapse from the moment of damage to repair of the facilities is reduced as compared to the present situation in the target area.
- ✧ The residents periodically set aside an agreed amount to cover the operation and maintenance cost of the handpump facilities.

Presently, in the Northern Province, due to the lack of sanitary water sources, the residents are compelled to drink unsanitary water that can increase chances of water-borne diseases. Also, women and children are subjected to time consuming hard labor of fetching water. Therefore, if water supply facilities fitted with handpumps are constructed at the project sites, the population served with safe water can increase and the sanitary environment will be upgraded.

2-1-2 Project Brief

The request from the Zambian government is summarized in the following table.

Table 2-1 Summary of Request

Administrative Division		District Pop. (2000 Census)	Requested No. of Sites
Northern Province (7 Districts out of Total 12 Districts)	Mpika District	145,315	45
	Chinsali District	129,406	36
	Isoka District	100,990	43
	Nakonde District	153,548	36
	Mbala District	161,533	53
	Mpulungu District	66,332	43
	Luwingu District	83,369	44
Total	7 Districts	842,493	300

Description of Request	
1. Requested Components	1) Facilities Construction Construction of 300 boreholes fitted with handpumps
	2) Procurement of Equipment and Materials ・Drilling equipment 2 sets ・Supporting vehicles 2 sets ・Geological survey equipment 1 set ・Spare parts 1 lot ・Construction materials 300 sets ・Supporting equipment for WASHE activities
	3) Water, Sanitation and Health Education
2. Input from Recipient Country	Staff and budget for operation and maintenance of completed facilities and procured equipment

In the Project area, 300 sites are targeted as greatly needing intervention to increase the coverage rate in order to satisfy the national goal. The requested 300 sites were confirmed in the Minutes of Discussions, but during the field survey in the target districts, the following points were further confirmed.

- Since the number of requested sites may need to be reduced, each district D-WASHE submitted a list of priority ranking for the district-wise requested sites.
- Some sites had sufficient existing water supply facilities, while the beneficiary of some other sites were too small, and other problems were encountered during the field survey. These matters were discussed with the relevant districts, and resulted in lowering the priority rankings of these sites or canceling the site from the list.

- Since the field survey was conducted during the rainy season, routes to a number of the sites were inaccessible as to prevent direct access, in which case alternative farther routes had to be taken, or if access by vehicle was impossible, the site was accessed on foot. Further, some of the bridges leading into the villages were damaged or had collapsed, making these sites completely inaccessible, and consequently these sites could not be surveyed.

Moreover, as a result of analysis of the field survey data, the following conclusions can be made.

- ✧ The hydrogeological survey results showed necessity to reflect drilling success rates upon low potential and poor water quality (due to high iron contents) of confined groundwater in some areas.
- ✧ Safe and perennially stable confined aquifers are given priority for development, but if these aquifers have any problems with yield or quality, then unconfined aquifers may be considered.
- ✧ The socio-economic survey results revealed necessity to narrow down the site number and revise the priority ranking as follows.

a. Narrowing Down of Sites

The following criteria were used to screen out sites not feasible for implementation in this project. As a result, 268 sites were selected as having development potential through the project.

1) The target population is 100 or more persons.
2) Construction vehicles are accessible into the site.
3) The site is not receiving a safe and sufficient supply of water.
4) The target residents are willing to maintain the constructed water supply facilities.
5) Other water supply projects are not in duplication in the site.

b. Revision of Priority Ranking

In order to increase possibilities for the Zambian side to carry out construction works by themselves, the number of sites for project implementation needed to be decided. Therefore, from the 268 feasible sites selected above, the priority ranking had to be revised. For this revision, based on the priorities given by the D-WASHEs through existence

of sufficient water supply facilities, accessibility, population and other factors, a new criterion as follows was added.

6) The site has already voluntarily formed a water or health related organization

In effect, the 268 feasible sites can be grouped into those with and those without the existence of such organizations. The group having organizations will be the prioritized candidate sites, while those not having such organizations will be reserved as alternative sites. The priorities within each group will be in accordance with the ranking given by the D-WASHEs. Although activities of the existing water or health related organizations may need strengthening, these sites are judged to have higher awareness of the importance and willingness to contribute to improvement of the water and sanitary environment, and more knowledge and experience in organizational activities than other sites. If this criterion is applied, then 175 sites remain as the project candidate sites.

Table 2-2 Number of Project Sites

District	No. of Requested Sites	No. of Feasible Sites	No. of Project Candidate Sites
Mpika	45	37	21
Chinsali	36	35	27
Isoka	43	35	16
Nakonde	36	32	24
Mbala	53	51	31
Mpulungu	43	36	23
Luwingu	44	42	33
Total	300	268	**175**

The requested sites and results of project candidate sites are listed in the next page. The map indicating locations of the requested sites is shown in the following page.

Table 2-3a List of Project Sites

Site Code	Site Name	Pop.	D-WASHE Priority	Project Priority	Shortlist
	Mpika District				
MK 22	Malambwa Village	1,326	2	1	Project
MK 20	Ifunda Village	510	5	2	Project
MK 19	Kaluba Village	2,500	6	3	Project
MK 7	Katongo Kapala	600	7	4	Project
MK 8	Mwateshi	130	8	5	Project
MK 26	Kaole Village	1,812	12	6	Project
MK 32	Mukungule Palace	243	13	7	Project
MK 17	Chobela Village	105	15	8	Project
MK 15	Chobela School	250	16	9	Project
MK 16	Chishala Village	156	17	10	Project
MK 14	Chishala School	226	18	11	Project
MK 11	Lufila Village	185	19	12	Project
MK 6	Ngwai	205	23	13	Project
MK 29	Luchembe Village	1,200	24	14	Project
MK 31	Chakopo Village	3,000	29	15	Project
MK 24	Chambeshi Village	2,214	33	16	Project
MK 21	Mufubushi Village	100	34	17	Project
MK 1	Kapoko	800	35	18	Project
MK 4	Mpumba Village	600	37	19	Project
MK 5	Lukulu Village	360	38	20	Project
MK 33	Chikole Village	455	44	21	Project
MK 40	New Kamwanya	8,500	1	22	Alternative
MK 34	Chikwanda Village	800	3	23	Alternative
MK 18	Mwamfushi Village	2,000	4	24	Alternative
MK 35	Mundemwa School	728	11	25	Alternative
MK 10	Mukungule Village	200	14	26	Alternative
MK 44	Kashaita Village	800	21	27	Alternative
MK 45	Kashila Village	1,000	22	28	Alternative
MK 28	Aluni Village	1,300	25	29	Alternative
MK 27	Ndakala Village	300	26	30	Alternative
MK 38	Kopa School	573	27	31	Alternative
MK 37	Kopa Village	1,200	28	32	Alternative
MK 36	Chikakala Village	265	30	33	Alternative
MK 25	Kamulamwiko Village	1,000	31	34	Alternative
MK 23	Mpepo Village	2,000	32	35	Alternative
MK 3	Mpumba School	546	36	36	Alternative
MK 30	Chisengo	516	43	37	Alternative
MK 41	Chiundaponde Village		39		Inaccessible
MK 42	Chiundaponde School		40		Inaccessible
MK 43	Chiundaponde RHC		41		Inaccessible
MK 39	Mpandafishala Community		45		Only 1 household
MK 12	Kakoko Village	95	20		Population too small
MK 2	Chilonga	465	9		Existing water facility suffice
MK 9	Chisongo Village	1,000	10		Existing water facility suffice
MK 13	Chifinshi Village	1,715	42		Inaccessible
	Chinsali District				
CH 4	Kalela Village 1	1,000	1	1	Project
CH 21	Kantimba School	272	2	2	Project
CH 30	Kalisha School	510	6	3	Project
CH 24	Musonko School	272	8	4	Project
CH 22	Vitondo School	229	9	5	Project
CH 6	Nambuluma Village	575	10	6	Project
CH 27	Kapashi Village	574	12	7	Project
CH 31	Shimwalule School	300	13	8	Project
CH 33	Chipunga School	238	14	9	Project
CH 10	Kalela Village 2	1,000	15	10	Project
CH 34	Mupeka School	200	16	11	Project
CH 16	Mungulube School	315	17	12	Project
CH 14	Sele School	211	18	13	Project
CH 13	Chinkalanga School	287	19	14	Project
CH 9	Chabala Village	400	21	15	Project
CH 7	Mulanga Village	776	22	16	Project
CH 11	Chibesakunda School	600	23	17	Project
CH 12	Kabangama School	327	24	18	Project
CH 19	Mwalala School	500	25	19	Project
CH 18	Chibesa School	348	26	20	Project
CH 26	Mukwikile Palace	125	28	21	Project
CH 29	Kapisha School	231	29	22	Project
CH 32	Cheswa School	270	30	23	Project
CH 1	Mubanga Village	568	31	24	Project
CH 3	Musanya School	267	32	25	Project
CH 15	Lubwa Village	800	33	26	Project
CH 2	Mpyanavwalya Village	700	34	27	Project
CH 36	Chilunda School	370	3	28	Alternative
CH 5	Lubu Scheme	216	5	29	Alternative
CH 28	Mukungwa School	230	7	30	Alternative
CH 17	Poya School	237	11	31	Alternative
CH 8	Musapa Village	310	20	32	Alternative
CH 23	Matumbo Village	2,150	27	33	Alternative
CH 25	Choshi Village	3,000	35	34	Alternative
CH 20	Chandamali Village	2,000	36	35	Alternative
CH 35	Bwinambo School		4		Inaccessible

Site Code	Site Name	Pop.	D-WASHE Priority	Project Priority	Shortlist
	Isoka District				
IS 17	Katanga Village	1,803	1	1	Project
IS 28	Muyombe Village A	1,209	3	2	Project
IS 27	Thendere Basic School	900	6	3	Project
IS 26	Thendere RHC	200	7	4	Project
IS 43	Mulekatembo	200	11	5	Project
IS 39	Itontela Village	1,000	12	6	Project
IS 41	Nachisitu Village	500	14	7	Project
IS 5	Mulamba	260	17	8	Project
IS 2	Kafwimbi C	1,000	24	9	Project
IS 21	Mutukumbi	2,000	26	10	Project
IS 11	Namisuku (Kalungu)	1,676	27	11	Project
IS 31	Sansamwenje Village	230	28	12	Project
IS 38	Mulungwizi Village	674	30	13	Project
IS 34	Kawenga	1,000	34	14	Project
IS 32	Kantensha (Yazaza)	130	38	15	Project
IS 12	Mwaiseni Village A	200	39	16	Project
IS 42	Chimungoto Village	600	2	17	Alternative
IS 1	Wenela	784	4	18	Alternative
IS 16	Tubale	200	5	19	Alternative
IS 33	Sichinga (Choma) Village	112	8	20	Alternative
IS 3	Kapembe	157	9	21	Alternative
IS 13	Chanama	350	10	22	Alternative
IS 9	Mweni Mpangala	2,500	13	23	Alternative
IS 7	Mupapa	215	16	24	Alternative
IS 20	Lualizi	900	20	25	Alternative
IS 6	Chitete Village	560	21	26	Alternative
IS 24	Nyengo Village	177	22	27	Alternative
IS 4	Ntumbi	105	23	28	Alternative
IS 18	Chuwi	900	32	29	Alternative
IS 14	Chiwanda Village	600	33	30	Alternative
IS 22	Noa's Village	180	35	31	Alternative
IS 23	Kosamu Village	402	36	32	Alternative
IS 29	Chinyansi Village	1,008	37	33	Alternative
IS 40	Mwaiseni Village C	200	40	34	Alternative
IS 15	Kapililonga	375	41	35	Alternative
IS 19	Mwembe	116	31		Existing water facility suffice
IS 36	Zebedia Village	169	43		Existing water facility suffice
IS 37	Namyala	355	42		Existing water facility suffice
IS 8	Mweniwisi		15		Inaccessible
IS 10	Mweniwisi School		18		Inaccessible
IS 30	Chipokoso Village		25		Inaccessible
IS 25	Sichitambule Village	80	19		Population too small
IS 35	Kalimwitengo	124	29		Inaccessible
	Nakonde District				
NA 35	Chapanya School	300	1	1	Project
NA 36	Mwanga School	219	2	2	Project
NA 9	Mipulya School	320	3	3	Project
NA 2	Kawele School	232	4	4	Project
NA 14	Nankungulu School	175	6	5	Project
NA 15	Chisambwe School	150	7	6	Project
NA 27	Chitambi Village	300	9	7	Project
NA 19	Shemu RHC	108	10	8	Project
NA 12	Uzinji School	243	11	9	Project
NA 21	Lukumba Village	400	13	10	Project
NA 23	Mutachi Village	647	16	11	Project
NA 25	Lyuchi Village	465	17	12	Project
NA 28	Musesengoma Village	107	18	13	Project
NA 29	Mwanga Village	431	19	14	Project
NA 33	Chozi	950	20	15	Project
NA 1	Nakakola Village (A)	1,000	21	16	Project
NA 3	Kandalala Village	192	22	17	Project
NA 4	Kawele Village	800	23	18	Project
NA 6	Nega (A)	324	25	19	Project
NA 11	Isasa Village	170	28	20	Project
NA 8	Mayembe Village	309	29	21	Project
NA 30	Izuwa Village (B)	700	32	22	Project
NA 32	Nkasichila Village	1,876	33	23	Project
NA 34	Muli Village	560	34	24	Project
NA 13	Chiwale school	135	5	25	Alternative
NA 17	Yolo Community School	240	12	26	Alternative
NA 22	Ilenga Village	105	14	27	Alternative
NA 24	Kazembe Village	425	15	28	Alternative
NA 5	Burton Village	1,115	24	29	Alternative
NA 7	Kasakalabwe Village	207	26	30	Alternative
NA 26	Musanka Village	100	31	31	Alternative
NA 31	Chinsambwe Village	170	35	32	Alternative
NA 16	Kazembe School		8		Inaccessible
NA 20	Kalanda	65	30		Population too small
NA 18	Musesengoma School	360	36		Existing water facility suffice
NA 10	Nachipeta A	260	27		Existing water facility suffice

Table 2-3b List of Project Sites

Site Code	Site Name	Pop.	D-WASHE Priority	Project Priority	Shortlist
	Mbala District				
MB 7	Musipazi Village	400	1	1	Project
MB 6	Musipazi School	168	2	2	Project
MB 8	Mpunga Village	894	3	3	Project
MB 45	Makala Village	431	4	4	Project
MB 48	Kakonde Village	500	5	5	Project
MB 52	Kavumbo School	564	7	6	Project
MB 28	Vimbuli Village	720	8	7	Project
MB 31	John Chivuta School	176	9	8	Project
MB 25	Kamyanga Village	600	10	9	Project
MB 24	Namukale Village	436	11	10	Project
MB 39	Moses School	285	13	11	Project
MB 42	Kalala Village	400	16	12	Project
MB 12	Mulowezi Village	355	17	13	Project
MB 40	Moses Village	2,400	19	14	Project
MB 2	Njelesani Village	800	24	15	Project
MB 46	Kati Village	630	25	16	Project
MB 37	Mfwambo School	256	27	17	Project
MB 36	David Chikoti Village	400	28	18	Project
MB 16	Songolo Village	426	29	19	Project
MB 29	Mambwe School	603	30	20	Project
MB 14	Rueben School	280	31	21	Project
MB 26	Chimula Village	900	33	22	Project
MB 4	Zombe School	324	37	23	Project
MB 5	Chupa Village	210	38	24	Project
MB 43	Isanya Village	2,200	43	25	Project
MB 47	Londe Village	300	46	26	Project
MB 3	Mulunda Village	202	48	27	Project
MB 53	Chileshya School	306	49	28	Project
MB 30	Nshindano School	150	50	29	Project
MB 33	Kalekwa Village	1,160	52	30	Project
MB 32	Mwila Village	400	53	31	Project
MB 51	Mindolo Village	340	6	32	Alternative
MB 13	Kaziwe School	108	12	33	Alternative
MB 20	Muwambezi Chilino Village	665	14	34	Alternative
MB 22	Chinenke Village	700	15	35	Alternative
MB 41	Sume Village	402	18	36	Alternative
MB 50	Chasha Village	315	20	37	Alternative
MB 23	Kedricks Katipa Village	250	21	38	Alternative
MB 1	Chiyanga School	415	23	39	Alternative
MB 44	Kanyika Village	324	26	40	Alternative
MB 27	Chimula School	224	34	41	Alternative
MB 18	Chipanda Village	250	35	42	Alternative
MB 19	Kaponda Village	112	36	43	Alternative
MB 34	Elon Village	238	39	44	Alternative
MB 11	Lukwesa Village	304	40	45	Alternative
MB 17	Nakaponda Village	135	41	46	Alternative
MB 35	Lobo Village	210	42	47	Alternative
MB 10	Musekelele Village	192	44	48	Alternative
MB 9	Masamba Village	345	45	49	Alternative
MB 49	Muntonga Village	700	47	50	Alternative
MB 38	Mwamba School	302	51	51	Alternative
MB 21	Mwambezi Kawama Village	376	22		Existing water facility suffice
MB 15	Mwenyi School	175	32		Inaccessible

Site Code	Site Name	Pop.	D-WASHE Priority	Project Priority	Shortlist
	Mpulungu District				
ML 20	Muswilo	530	1	1	Project
ML 25	Katula	192	2	2	Project
ML 30	Makola	284	3	3	Project
ML 40	Mwanakatwe	266	4	4	Project
ML 29	Isoko	320	5	5	Project
ML 43	Kasakalawe	4,800	7	6	Project
ML 38	Mupata	6,400	9	7	Project
ML 42	Musende	750	11	8	Project
ML 24	Patrick	380	13	9	Project
ML 23	Chitinta	370	14	10	Project
ML 41	Kapoko	680	15	11	Project
ML 17	Chilwa	2,400	16	12	Project
ML 15	Jecap	2,220	21	13	Project
ML 12	Kabamba	500	23	14	Project
ML 13	Kopeka	4,815	25	15	Project
ML 6	Chitimbwa RHC	1,380	27	16	Project
ML 8	Chikonde	150	29	17	Project
ML 5	Mutemfuma	270	35	18	Project
ML 26	Mukaka	150	36	19	Project
ML 35	Kasansala	514	39	20	Project
ML 27	Mululwe	1,000	41	21	Project
ML 31	Chinakila	3,000	42	22	Project
ML 33	Mulilanondo	425	43	23	Project
ML 37	Kasasa	1,200	8	24	Alternative
ML 39	Posa	504	10	25	Alternative
ML 11	Shimwalota	170	22	26	Alternative
ML 10	Ntema	116	24	27	Alternative
ML 21	Kalongola	170	26	28	Alternative
ML 18	Chaulu	370	28	29	Alternative
ML 2	Kambole	150	30	30	Alternative
ML 7	Kasita	630	32	31	Alternative
ML 4	Lemba 1	200	33	32	Alternative
ML 3	Kakolo	357	34	33	Alternative
ML 19	Mengo	360	37	34	Alternative
ML 9	Kasusu	250	38	35	Alternative
ML 36	Kaunda	115	40	36	Alternative
ML 1	Kamba	170	31		Existing water facility suffice
ML 14	Simoche	531	6		Inaccessible
ML 28	Kaizya	585	12		Inaccessible
ML 16	Kasasi	333	20		Inaccessible
ML 22	Chibote	240	17		Inaccessible
ML 32	Vyamba	500	19		Inaccessible
ML 34	Mungula	6,400	18		Inaccessible

	Luwingu District				
LU 40	Kabombo School	191	1	1	Project
LU 25	Chabula School	274	2	2	Project
LU 32	Katuta RHC	360	3	3	Project
LU 28	Lundu School	520	4	4	Project
LU 9	Mpasa School	223	5	5	Project
LU 12	Chifwile School	250	6	6	Project
LU 16	Luena Clinic	200	8	7	Project
LU 36	Malekani School	236	9	8	Project
LU 7	Chitwa School	126	12	9	Project
LU 8	Mucheleka School	361	13	10	Project
LU 10	Chibiliti Community School	348	14	11	Project
LU 30	Mwando HP	150	15	12	Project
LU 21	Kabangala School	221	16	13	Project
LU 2	Saili	405	17	14	Project
LU 19	Washeni School	216	18	15	Project
LU 14	Misambula School	188	19	16	Project
LU 44	Sande Village	731	20	17	Project
LU 42	Kapoma Village	240	21	18	Project
LU 33	Bulambo School	211	22	19	Project
LU 15	Kandata School	234	23	20	Project
LU 18	Nsolo School	106	24	21	Project
LU 29	Nsombo Village	931	25	22	Project
LU 26	Mwando School	200	26	23	Project
LU 41	Kaputu Village	350	27	24	Project
LU 37	Chimpama School	231	29	25	Project
LU 39	Kansasa School	292	30	26	Project
LU 3	Paundi	200	32	27	Project
LU 11	Katuta Village	400	34	28	Project
LU 24	Mumba Village	394	35	29	Project
LU 31	Chepeshi Village	123	37	30	Project
LU 27	Shindaila Village	275	38	31	Project
LU 6	Mulala School	286	42	32	Project
LU 34	Chambo School	226	43	33	Project
LU 17	Mfungwe School	368	7	34	Alternative
LU 43	Lwenge School	336	10	35	Alternative
LU 20	Chibofwe	455	11	36	Alternative
LU 5	Kapisha	1,124	31	37	Alternative
LU 38	Tolopa Village	360	33	38	Alternative
LU 22	Chakaba Village	360	39	39	Alternative
LU 23	Malaya Village	210	40	40	Alternative
LU 1	Chanda Chipalo	432	41	41	Alternative
LU 35	Ndalama Village	280	44	42	Alternative
LU 4	Isandulula	900	36		Duplicate with other project
LU 13	Mukanga School	234	28		Existing water facility suffice

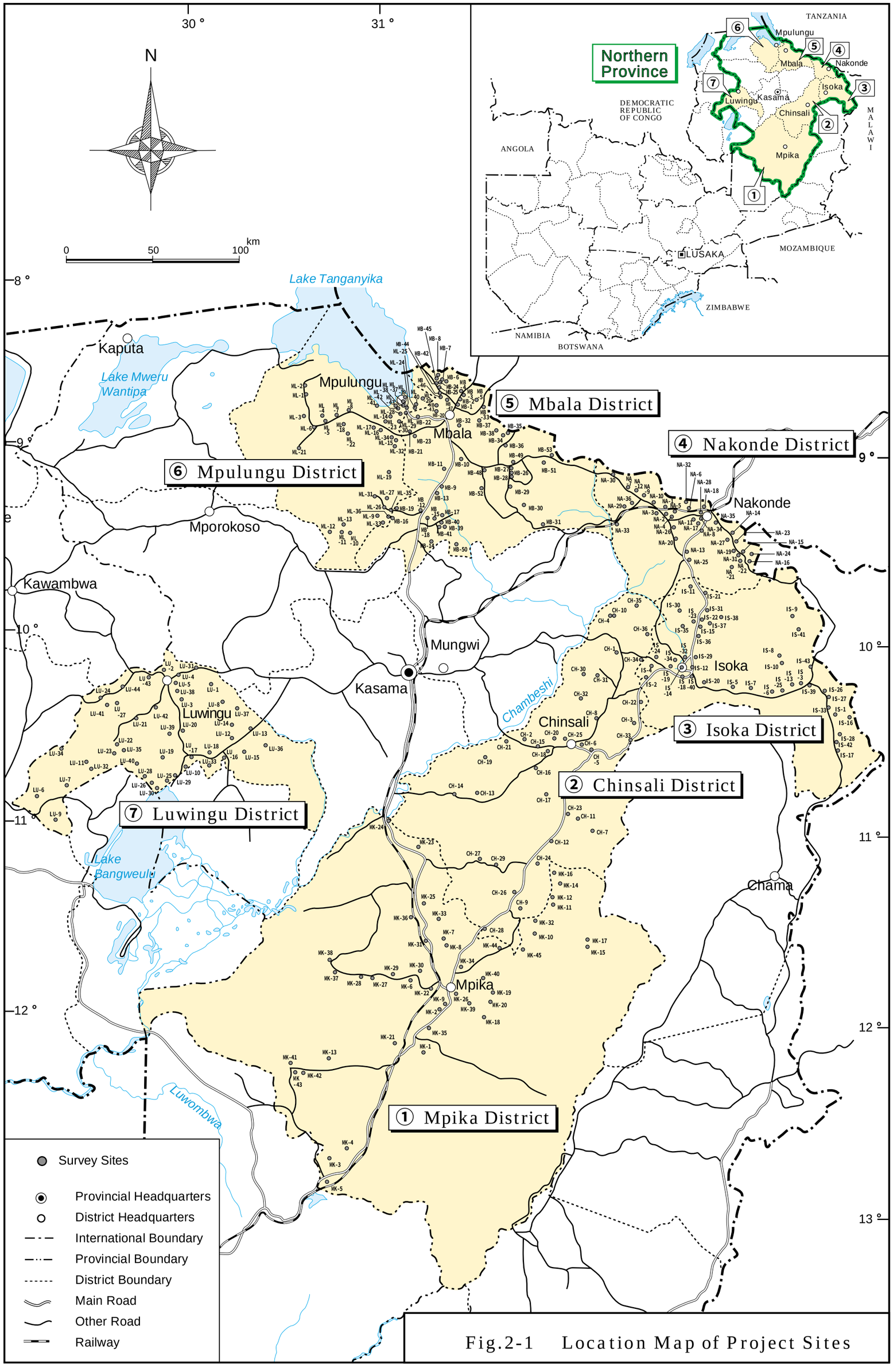


Fig.2-1 Location Map of Project Sites

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

The Logical Framework or Project Design Matrix (PDM) for this Project is shown in the next page. The PDM describes the objectives and outputs of the project reflecting upon the results of discussions with the executing agency, P-WASHE and each target D-WASHE.

2-2-1-1 Basic Policy

Although 300 sites were requested, to make effective use of the decreasing budget of the Japanese government, the following policy will be considered.

a. The Zambian government requested the construction of 300 handpump fitted water supply facilities in order to attain the objective of raising the water coverage rate from 17% to 50% as set in the Five-Year plan on water supply and sanitation for the Northern Province of 1998. However, in order to reduce the number of construction works by the Japanese side so that the Zambian side will be able to increase their possibilities for independent drilling, the requested sites were narrowed down to 175 sites.
b. Equipment presently owned by DWA, which were procured in previous Japanese Projects, will be basically used to drill the project boreholes and drilling operations will be focused on the crew of DWA. However, local drilling subcontractors will also be used to cover any shortages.
c. The water source will basically be confined groundwater pumped from boreholes. However, since the success rate for confined aquifers is predicted to be low, if the confined aquifer is judged to be unsuccessful, then unconfined aquifers will be exploited at the same point. The total success rate of 75% will be applied for this project.
d. Since technology was transferred to the Zambian side in the numerous Japanese grant projects previously implemented in Zambia, the present project should consider procurement of equipment with construction being done by the Zambian side as much as possible. However, since only a handful of staff who received training remain posted, this creates a weak structure with low technical capacity for borehole construction works and no ability for transfer of acquired skills to other staff members. As a result, in this project, in order for the Zambian side to continue the drilling works on their own, equipment will be procured for this purpose, and, rather than a mere transfer of drilling technology, a training of trainers on drilling management and supervision through collaborative activities will be conducted.

Table 2-4 LOGICAL FRAMEWORK OF THE PROJECT (Project Design Matrix: PDM)

Project Title: Groundwater Development and Sanitation Improvement Project in the Northern Province
Target Area: Mpika, Chinsali, Isoka, Nakonde, Mbala, Mpulungu, Luwingu Districts
Ver. 4.0 (Developed on 2nd July 2003)
Target Group: Residents of the target communities
Project Period: 2004 - 2007

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal ☐ Health and hygiene conditions of the target group are improved.	☐ Incidences of water borne diseases have decreased in the target villages. ☐ Practices of the target group have improved in terms of hygienic management of water points, water storage methods, water use pattern, hand washing, and use of sanitary facilities.	Interview, PRA, Monitoring Report	
Project Objective Safe water is provided to the target group in sustainable manner from the borehole facilities with handpumps to be constructed in the project using the procured equipment and materials.	☐ The target group are supplied with the design rage of water from the constructed water supply facilities throughout the year. ☐ The water quality of the facility conforms with the design criteria throughout the year. ☐ The time lapse from the moment of damage to repair of the facilities is reduced as compared to the present situation in the target area. ☐ The residents periodically set aside an agreed amount to cover the operation and maintenance cost of the handpump facilities with an agreed schedule.	☐ Interview, PRA, monitoring report ☐ Monitoring report ☐ Interview, monitoring report ☐ Account book of V-WASHE	☐ Provision of the primary health care services in the target area will be improved. ☐ Impact of HIV/AIDS will be mitigated in the target area. ☐ Zambian side will continue health and hygiene education as well as interventions for improvement of sanitary conditions in the target area.
Outputs 1 Borehole facilities with handpumps are constructed to provide safe and sustainable water supply in the target area where the residents have no access to the protected safe water sources. 2 Skills and capacities of drilling engineers and trainers of DWA are strengthened in terms of construction of borehole and management of construction works, respectively, through involving them in the construction works of the project. Output to be realised through the "Software Component Programme" 3 Skills and capacities of human resources at the district and catchment area are improved for facilitation of capacity building and hygiene education in improvement of water supply and operation and maintenance system with the communities' initiative. 4 Skills and capacities of D-WASHE and Sub-WASHE are strengthened concerning monitoring and evaluation of the impact of interventions in water supply and sanitation.	1-1 Number of communities using unprotected water source for drinking decreases in the target area compared with the present situation. 1-2 The water quality of the constructed facilities meets the design criteria. 1-3 Served quantity of water from the constructed facilities meets the design criteria. 2-1 The drilling engineers and trainers complete planned training programme in the project. 2-2 Construction of boreholes by the drilling teams of DWA is streamlined after completion of the cooperation by the Japanese side. 2-3 Drilling engineers are trained by the trainers of DWA when necessary after completion of the cooperation by the Japanese side. 3-1 Trainers, Extension Staff and Area Mechanic are equipped with skills required to provide support services for the communities in terms of operation and maintenance of water facilities. 3-2 V-WASHE is established in every target community through facilitation by the D-WASHE and Sub-WASHE (Extension Staff). 3-3 V-WASHE in every target community is equipped with skills for operation and maintenance of water facilities through training by the Sub-WASHE (Extension Staff) and Area Mechanic. 4-1 Results of monitoring of activities for improvement of water supply and sanitation are recorded and kept at D-WASHE. 4-2. The Action Plan is compiled by D-WASHE and Sub-WASHE annually based on the review and evaluation of the results of monitoring.	1-1 Monitoring report, interview 1-2 Results of water quality analysis 1-3 Completion report 2-1 Completion report 2-2 Report of DWA 2-3 Report of DWA 3-1 Progress report, O&M manual, Guideline for facilitation of O&M 3-2 Progress report, member list of V-WASHE 3-3 Progress report, V-WASHE Action Plan 4-1 Progress report, monitoring report 4-2 D-WASHE Action Plan	☐ Hydrological conditions of the target area will not get worse. ☐ Water quality from the sources in the target area will not get worse. ☐ Socio-economic conditions will not deteriorate further in the target area. ☐ Trainers at the district level and Sub-WASHE members continue to serve for the target area.
Activities [Procurement of Equipment and Construction of Water Facilities] 1-1 To procure equipment and materials necessary for construction works and facilitation of operation and maintenance activities. 1-2 To construct 175 borehole water supply facilities with handpumps. 2-1 To train the drilling engineers of DWA in construction of borehole water supply facilities through actual construction works in collaboration with the Japanese contractor. 2-2 To train trainers of DWA in skills for building capacities of drilling engineers through construction works in collaboration with the Japanese contractor 2-3 To train trainers of DWA in supervising drilling works by the private contractors as well as planning and management of construction works by DWA. [Capacity Building for Establishment of Operation and Maintenance System] 3-1 To facilitate agreement with D-WASHE and Sub-WASHE on O&M system of handpump water supply facility in the districts and interventions necessary to establish and strengthen the system. 3-2 To train D-WASHE trainers, Sub-WASHE and Area Mechanic in skills required to pursue their roles and responsibilities related to operation, maintenance and repair of handpump water facilities. 3-3 To train Sub-WASHE in facilitation of community mobilisation, participatory planning and monitoring, management of water facilities and participatory hygiene education. 3-4 To verify levels of understanding and acquisition of skills of Sub-WASHE and Area Mechanic through implementation of the actual exercises at the target communities for establishment of O&M system. 3-5 To train D-WASHE and Sub-WASHE in formulation and implementation of monitoring and evaluation plan including verification of the process of activities, achievement of output, and impact of the interventions..	**Inputs** 【Japanese Side】 Human resources: Basic Design Study Team, Detailed Design Study Team, Consultant team for supervision of the project implementation, contractor for construction works and procurement of equipment Equipment and materials for construction works and O&M activities Fund: Grant aid for procurement of equipment, construction of water facilities, support for establishment of O&M system and supervision of the project implementation 【Zambian Side】 Human resources: Counterpart personnel, drilling teams, trainers of drilling engineers, P-WASHE, D-WASHE, Sub-WASHE Equipment for construction works owned by the implementing agency Fund: counterpart fund for personnel involved from Zambian side	☐ Development of groundwater will be successful in the project sites. **Precondition** ☐ Import and custom clearance of the procured equipment and materials will not delayed seriously.

2-2-1-2 Policy towards Natural Conditions

a. Geology

Geological surveys were conducted at 10 sites in each of the target districts. According to the results of the survey and comparative work with existing geological maps, the distribution of geological formations for drilling in this project are shown below.

Table 2-5 Distribution of Geological Formation of Target Area

District	Geological Distribution	
	Main	Secondary
Mpika	Granite	Basalt
Chinsali	Granite	Basalt, Quartzite
Isoka	Granite, Quartzite	Sandstone
Nakonde	Granite	Basalt, Migmatite, Diorite
Mbala	Granite	Quartzite
Mpulungu	Quartzite	Basalt, Chart, Slate, Sandstone
Luwingu	Granite	Basalt

With the exception of Mpulungu district, the target area is widely distributed by granite formations (including gneiss and migmatite). These formations possess fissure water in the granite basement and stratum water in the weathered cracks of granite which are potential water sources for extracting from boreholes. Cracks are generally developed in the granite observed on the surface showing potential for existence of fissure water. Also, the existing boreholes constructed in the granite-distributed areas are blessed with a year round supply of stable water. However, if fissure water is used as the water source, the following problems need to be considered.

(1) Since a weathered layer covers the surface, the basement condition cannot be confirmed.
(2) The aquifer is sometimes found very deep.
(3) The yield might not be sufficient.

For selection of drilling points, electrical prospecting will be carried out at each site, the basement condition and aquifer depth will be determined, and the appropriate drilling method will be selected, and then the necessary

drilling equipment will be prepared. In the Northern Province, if boreholes are to yield fissure water in granite formations, the iron concentration in the groundwater may be above the guideline value, in which case, the countermeasure will be discussed later.

Most shallow groundwater is found in weathered formations, and groundwater in sedimentary layers of flood plains and highland alluviums is rarely extracted. This is due to the fact that most of the villages in the Northern Province are located on mountain ridges and hills. In general, weathering progresses going north, the weathered layer is widely distributed and the layer tends to be thick. Therefore, in Mbala and Luwingu districts, many boreholes will most likely extract water from shallow aquifers. When targeting the shallow groundwater in weathered formations, the following problems are conceivable.

(1) If the water table is shallow, the water may be or has potential to be contaminated through living activities and livestock faeces.
(2) The yield fluctuates due to climatic conditions. Especially, the groundwater level can lower drastically during the dry season.
(3) If the weathering is highly progressed, the weathered layer can contain clayey soil to greatly reduce the permeability. Especially, the electrical prospecting results for Mbala and Luwingu districts revealed existence of areas of thick clay layers.

For selection of drilling points of shallow aquifers, the aquifer depths and permeability of the basement are predicted through the results of electrical prospecting and the appropriate drilling method and drilling diameter are selected. In Mpulungu district, almost all of the sites will target fissure water found in cracks of rock basements. Sedimentary layers, excluding quartzite and quartz-schist, have developed fissures showing anticipation for a sufficient supply of groundwater, while quartzite and quartz-schist formations have almost no cracks or often the cracks are sealed. However, the survey results showed that developed fissures are found in localized areas and small-scale intrusions of basalt can be confirmed. Therefore, selection of drilling points requires sufficient areal prospecting to narrow down the candidate points.

b. Water Quality

As a result of the field survey, the content of iron in the groundwater found in the granite basement of the target area is often higher than the Zambian guideline value of 1 mg/lit. In some districts, over half of the boreholes might give concentrations which does not meet the guideline value. In this respect, upon discussions with the executing agency, a value of 2 mg/lit, which is reported as not presenting a hazard to health, will be adopted for this project. If the groundwater in rock formations does not meet the guideline value, then as an alternative, pumping from unconfined aquifers in weathered layers will be considered.

2-2-1-3 Policy towards Socio-Economic Conditions

At the village level, the activities related to improvement of water and sanitation, and especially the roles taken in the community for promoting participation are centered on women. Since women must allocate a main portion of their daily time to fetching water as a household chore, water must be sought from sources located at a distance or resort to contaminated water from hand-dug wells due to shortages of safe and stable water supply facilities in the village. Under this inferior water supply environment, women are the most directly influenced, and therefore, they are encouraged to participate initiatively and to make comments and decisions on formation, capacity building and training of WASHE in the village, as well as understand the operation and maintenance skills of water supply facilities. However, as revealed in the social survey results, since women also spend a major part of the day on household chores other than water fetching, special attention is necessary to sufficiently confirm the participation possibility and willingness of each individual when requesting their participation.

In the Northern Province, the WASHE program is adopted for construction of water and sanitation facilities. In this program, protected shallow wells and VIP latrines are constructed with materials such as sand, gravel and burnt bricks supplied by the villagers and laborers provided by the village. In the case of handpump-fitted boreholes, since skilled personnel are not available in the district, the contractor constructs the appurtenant facilities. However, the

residents are asked to contribute construction materials such as sand, gravel and bricks, and save up fees for operation and maintenance. In this project, the participation of the residents will be promoted before the construction stage to foster sense of ownership and responsibility.

2-2-1-4 Policy on Construction

This project will construct facilities principally in line with WASHE activities. However, the construction plan will sufficiently consider the present low capacity in human resources.

The construction materials will be procured locally as much as possible in consideration of effectiveness in handling and minimizing costs. The main material needed for this project such as cement, concrete blocks and wood are available in the Northern Province, and handpumps can be procured domestically in Zambia. Local procurement will be considered to the utmost for other materials and equipment.

2-2-1-5 Policy on Use of Local Contractors

The construction of borehole facilities will be centered on the crew of DWA. Further, if the DWA crew is insufficient, local drilling contractors will be considered. Three to four drilling contractors have experience in the Northern Province, but they need to be strictly supervised under specific terms of reference.

2-2-1-6 Policy on Capacity of Executing Agency for Operation and Maintenance

The executing agency for this project is the Department of Water Affairs (DWA) under the Ministry of Energy and Water Development (MEWD). DWA has its headquarters in the capital city of Lusaka and has responsibilities for water resources development and management. On the other hand, the responsibility for operation and maintenance of water supply facilities will be transferred to the Department of Infrastructure and Support Services (DISS) under the Ministry of Local Government and Housing (MLGH). This allocation

of responsibilities is stated in the official papers of the Zambian government, which confirms that MEWD is responsible for water resources development and management, and MLGH is in charge of provision of water supply and sanitation services as well as the operation and maintenance of completed facilities. Moreover, the Minutes of Discussions, agreed during the basic design field study, clarified that the role of MLGH in the Project implementation is as follows:

a. At national level through DISS, to participate in site inspections and attend meetings as scheduled by the Project.
b. Ensure the full participation of the council through D-WASHE activities.
c. Ensure that there is no duplication of D-WASHE on development of the sites.
d. Respective District Council should avail staff for training on handpump maintenance and other issues.

The organization charts of DWA (headquarters and Provincial) and DISS are indicated in the following page. The numbers of staff of DWA are listed below.

DWA Headquarters (Lusaka): Total 98 persons

Permanent Staff	25 persons
Ancillary Staff	73 persons

DWA Northern Province Office: Total 40 persons

Permanent Staff	26 persons
Non-Civil Servants	14 persons

Out of the 7 target districts, 4 districts (Mpika, Chinsali, Isoka and Nakonde) have DWA District offices where in each district, a District Water Engineer and an Engineering Assistant are stationed.

The operation and maintenance responsibilities of rural water supply facilities will be eventually transferred to the local governments and village bodies. The actual operation and maintenance will be handled by the V-WASHE to be formed in the village.

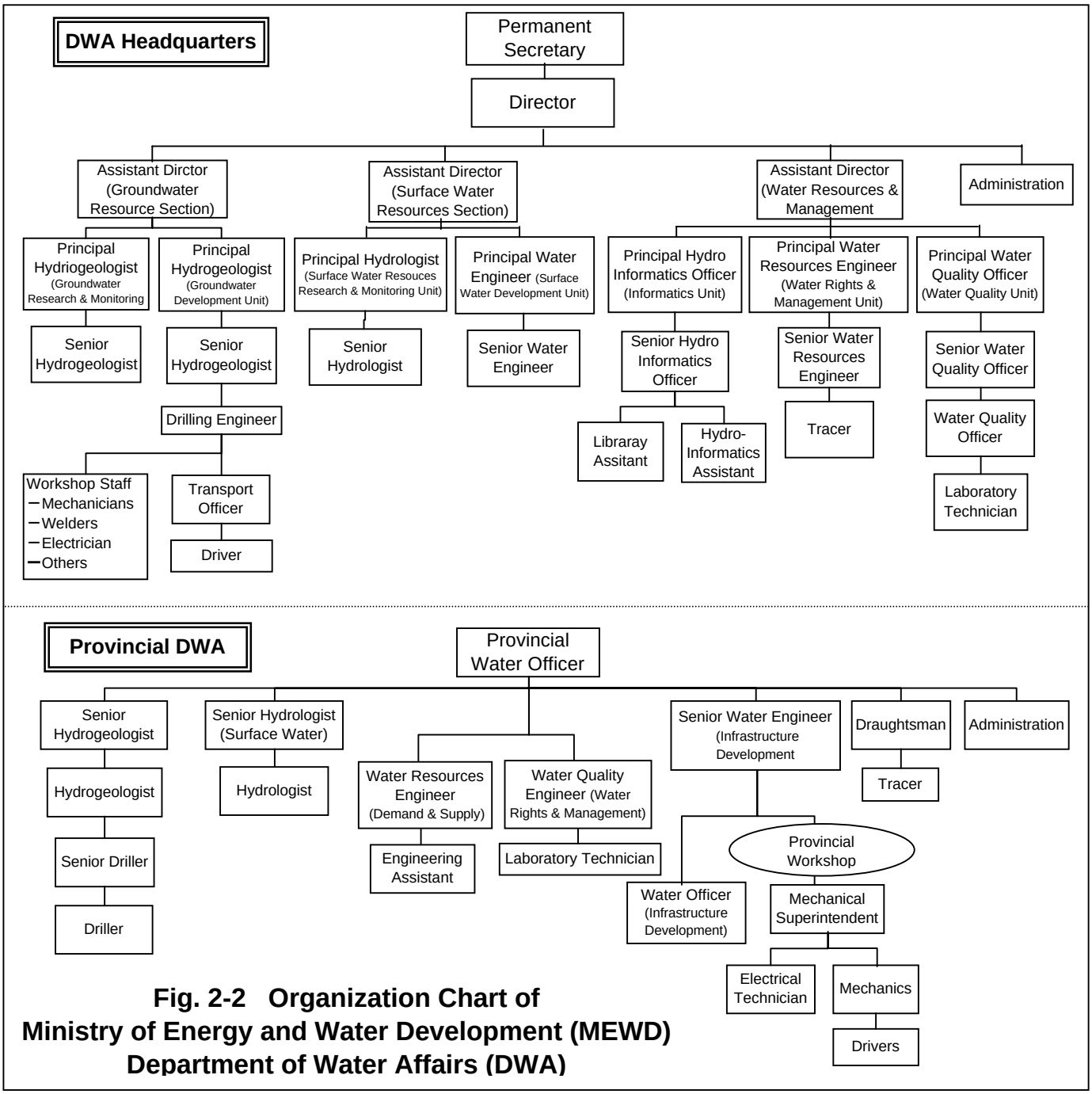


Fig. 2-2 Organization Chart of Ministry of Energy and Water Development (MEWD) Department of Water Affairs (DWA)

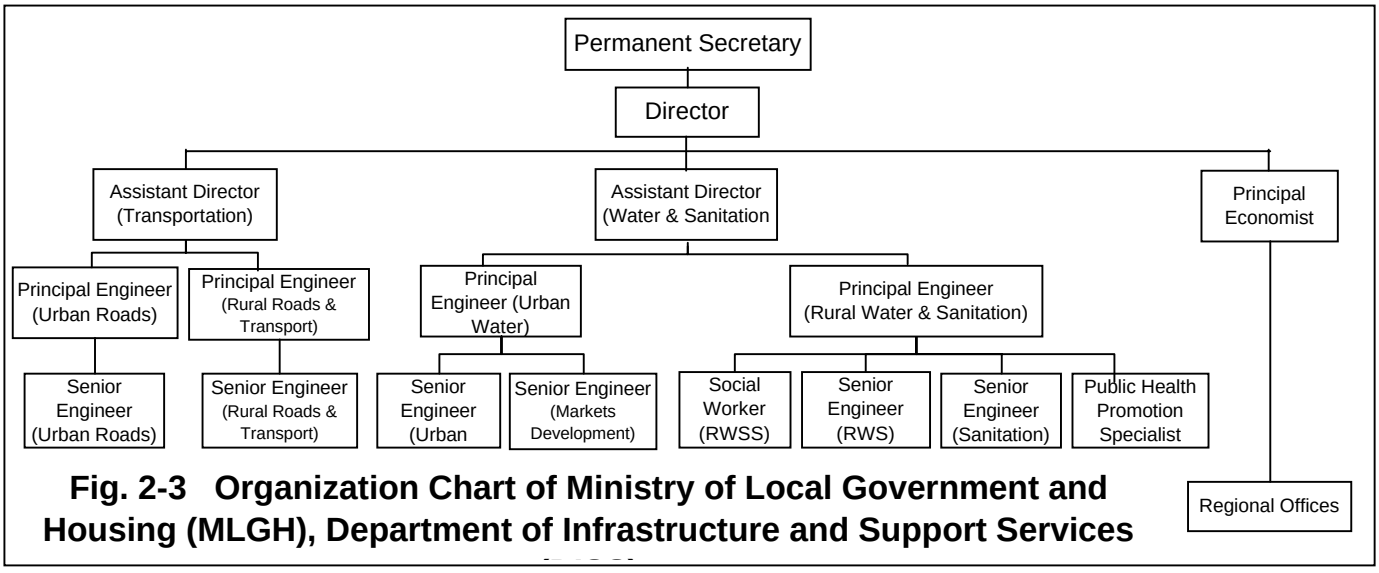


Fig. 2-3 Organization Chart of Ministry of Local Government and Housing (MLGH), Department of Infrastructure and Support Services

2-2-1-7 Policy on Quality of Facilities

The project water supply facilities as public infrastructure will be designed to be durable, easy to operate and maintain, and matched to the daily lifestyle of the target villages. Facilities design and specifications of equipment and materials will be in conformity with Zambian standards.

2-2-1-8 Policy on Procurement/Construction Schedule

The conditions for preparing the construction schedule are: the daily working hours is the Zambian labor standard of 8 hours, and annual days off are Saturdays, Sundays and National Holidays totaling 11 days. Also, during the rainy season from November to April, the months from January to April form a very difficult period for transporting heavy equipment to the construction sites. Therefore, the annual working days total about 165 days.

The schedule for this project will be based on such factors as, the time requirements for manufacturing/shipping/customs clearance of procured equipment, the number of facilities to be constructed and areal distribution of the sites, to assure proper procurement supervision, site management and construction work supervision. The construction schedule will be prepared so that the works can be completed within the allotted timeframe without any hindrance in procurement and construction. Implementation of this project in two phases is determined to be most feasible in consideration of the lowering of work efficiency in the rainy season, the number of project sites, availability of equipment and crew, and technology transfer.

2-2-2 Basic Plan

2-2-2-1 Construction of Water Supply Facilities

1) Design Criteria for Water Supply Facilities

Design criteria of water supply facilities to be used for this project will as follows.

- ✧ Supply Method — Borehole facility fitted with handpump
- ✧ Unit Supply Rate — 30 lit/cap/day, as the unit water supply rate for rural areas used in Zambia
- ✧ Served Population — 250 persons per handpump fitted facility

✧ Design Supply Rate 7.5 m^3/borehole/day, from unit supply rate of 30 lit/cap/day and served population of 250 pers/borehole

The following criteria will be used to determine a successful borehole.

✧ Yield Over 0.75 m^3/hr, assuming 10 hours daily operation with a daily supply rate of 7.5 m^3/borehole

✧ Water Quality In accordance with the guideline for drinking water quality used in Zambia, but 2 mg/lit for iron.

2) Project Water Source

In order to provide a stable supply of safe water, the basic policy of this project is to exploit the confined aquifers where water level does not have seasonal fluctuation and risk of contamination from the surface is low. However, according to the results of the hydrogeological and water quality surveys in the target area, the groundwater potential is low in some areas while high concentration of iron was confirmed in other areas. Consequently, the average success rate for the 7 target districts is estimated at 54%. Since adequate benefits cannot be anticipated with this rate, the main source for this project will be the confined groundwater, but if this aquifer has problems with yield or quality, then the unconfined groundwater will be exploited. If unconfined groundwater is to be used, to minimize the risk of external contamination and water table lowering, water will be pumped from the lower depths, such as 20 m to 35 m. Then the success rate can rise to 75%. The district-wise success rates are listed below.

Table 2-6 District-Wise Drilling Success Rates

District	Success Rate (%)	
	For Confined Aquifer Only	If Complemented with Unconfined Aquifer
Mpika	44	69
Chinsali	77	78
Isoka	53	66
Nakonde	63	92
Mbala	67	90
Mpulungu	42	63
Luwingu	35	73
Average	**54**	**75**

3) Handling of Unsuccessful Boreholes

As previously explained, a success rate of 75% is applied for this project. During the drilling operation, if 2 points are determined as unsuccessful at the same site, then a third drilling will not be conducted, as agreed in the Minutes of Discussions. When a borehole is determined to be unsuccessful because the adopted criteria for a successful hole cannot be met, the following measures will be considered.

- ✧ When the yield of the borehole is determined to be insufficient, and if the residents request to use the source under the condition that they are aware that sufficient water cannot be supplied, and upon consent of the executing agency, the borehole will be handed over for completion and construction of supply facilities by the Zambian side. If the residents wish not to use the well, but if DWA requests to use it as an observation well, then the borehole will be handed over to be completed by the Zambian side.
- ✧ When the iron content of groundwater surpasses 2 mg/lit, the borehole will not be handed over to the residents, even if the residents request using the borehole for purposes other than drinking, because the hole may later be changed over to drinking, and hence health effects and sustainability cannot be assured. In this case, the borehole can be back-filled and abandoned, or if the Zambian side requests using it as an observation well, then the incomplete hole will be handed over upon assurance that appropriate measures are taken to prevent the residents from accessing this source.

Out of the 300 requested sites, 268 were selected as feasible for development. Then the 268 feasible sites were shorted listed to 175 sites for possible implementation. In this process, 93 sites had to be screened out, but these will be kept as alternative sites for drilling. That is, after 2 unsuccessful drillings at one site, the third drilling will be moved to one of the alternative sites. The selection of which alternative site to use will be considered from hydrogeological conditions, population to be served and existing water source, and according to its priority ranking upon discussions with the relevant D-WASHE and DWA. Therefore, 175 water supply facilities can be assured in the final stage.

4) Selection of Handpump

The following 5 types of handpumps are currently standardized in Zambia.

- India Mark-Ⅱ
- Afridev
- Consallen
- Blair
- Bush

Of the above handpumps, the Consallen, Blair and Bush handpumps are not yet widely used.

The India Mark II type handpump is most popular in Zambia. Consequently, the number of area pump menders (APM) who can repair the India Mark II has increased. Also, under the initiative of UNICEF, to improve the procurement status of spare parts for the villagers, WASHE Shops that carry spare parts for handpumps are being promoted in each district. Furthermore, subsidization of partial cost of spare parts to ease the affordability on the villagers is being tested.

In the Northern Province, the India Mark II is also mainly used. However, dealers who can distribute spare parts are not yet available in the Northern Province. Therefore when repairs are needed, the parts must be procured from Lusaka, or specially ordered from the TAZARA workshop[1] in Mpika. Nevertheless, since maintenance factors such as familiarity in repairing at the rural level and availability of spare parts in the country are favorable, the India Mark II will be considered as the model of handpump for this project.

5) Construction of Appurtenant Facilities for Handpump

The appurtenant facilities for the handpump include the concrete apron, drain channel and soakaway. The design of theses facilities will be adopted from those being standardized by WASHE committees.

According to the advice from the Zambian government and other donors, the construction of handpump and appurtenant facilities should be the responsibility of the residents in order for them to become aware of and understand the significance of such facilities. However, in many cases, the residents do not have cash incomes and cannot purchase the required

[1] The TAZARA (Tanzania-Zambia Railway) workshop does not manufacture spare parts for handpumps, but if a part is brought into the workshop, the exact same piece can be duplicated with the machine-tools in the workshop by the technicians working their.

materials such as cement. Therefore, in previous Japanese assisted grant projects, the procurement of construction materials and installation of handpumps were done by the Japanese side, and the residents were asked to contribute labor, and through the guidance of the APM, the residents constructed the appurtenant facilities. However, in this project, the Japanese side will also construct facilities such as the apron and drainage, and community participation will be limited to labor contribution and installation of fencing around the facilities.

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

1) Quantities

The requested equipment and materials are listed below showing the quantities requested, agreed in the Minutes of Discussion, and designed for this project.

Table 2-7 List of Equipment and Materials

No.	Item	Request	Minutes	Design
1.	DRILLING EQUIPMENT			
1)	Truck-mounted rig, Top-head drive type	2 units	1 unit	1 unit
2)	Standard tools and accessories	2 sets	1 set	1 set
3)	Truck-mounted compressor	2 units	1 unit	1 unit
4)	Logging equipment	2 units	1 unit	1 unit
5)	Pumping test equipment	3 sets	1 set	1 set
6)	Workshop equipment and tools	1 set	1 set	1 set
2.	SUPPORTING VEHICLES FOR DRILLING WORKS			
1)	Cargo truck with 3t crane for transport containers and pipes	2 units	1 unit	1 unit
2)	Cargo truck with 3t crane for transport pumping test equipment	2 units	1 unit	1 unit
3)	Water tanker, 4 m^3	2 units	1 unit	1 unit
4)	Fuel tanker, 4 m^3	2 units	1 unit	1 unit
5)	Pickup truck, 4WD, double cabin	6 units	3 units	3 units
3.	GEOLOGICAL SURVEY EQUIPMENT	1 set	1 set	1 set
4.	SPARE PARTS	1 lot	1 lot	1 lot
5.	CONSTRUCTION MATERIALS			
1)	Consumable drilling tools	1 lot	Included in construction	Included in construction (175 sets)
2)	Consumable drilling materials	1 lot		
3)	Casing and screen	300 sets		
4)	Handpump with spare parts kit	300 sets		
6.	SUPPORTING EQUIPMENT FOR WASHE ACTIVITIES			
1)	Station wagon, 4WD	2 units	-	-
2)	Pickup truck, 4WD	8 units	3 units	2 units
3)	Motorbike	24 units	21 units	21 units
4)	Data processing equipment	2 sets	2 sets	1 set
5)	Water quality analysis kit	8 sets	7 sets	7 sets

1. Drilling Equipment

The Zambia government has set objectives for improving the national water supply coverage to 50% by 2005 and 75% by 2015. Although many drilling equipment were procured in past Japanese projects, most of them have become deteriorated through continuous use extending over 10 years, and the present number of drilling equipment is insufficient to meet these objectives. Therefore, the procurement of another set of drilling equipment is significant to contribute to meeting the planned goals.

2. Supporting Vehicles for Drilling Works

Vehicles and tools to support the above drilling equipment is necessary for proper drilling works achieve the goals of the Zambian government.

3. Geological Survey Equipment

In line with the objectives mentioned above, geological survey equipment is needed to support the drilling activities.

4. Spare Parts

Spare parts needed for drilling related equipment procured in the previous Japanese grant projects of “Groundwater Development and Sanitation Improvement Project in Drought Prone Rural Areas” and “Rural Water Supply Development Project in Southern Province” will be procured in this project. However, a portion of the parts will be included in the construction cost to minimize the changes in requirements due to time lapse.

5. Construction Materials

The construction materials will be budgeted in the cost for construction, as agreed in the Minutes.

6. Supporting Equipment for WASHE Activities

1) Station Wagon

As a result of survey on the use of existing nehicles and upon discussions, both sides agreed that the station wagons would not be included in this project.

2) Pickup Truck

The requested number of pickup trucks was reduced from 8 to 3 during the discussions due to similar reasons as the station wagon. However, since the Northern Province is divided into the eastern and western parts due to the configuration of the main road system, two trucks are needed to cover the activities of the two divided areas. In consideration of efficiency and maintenance, these pickup trucks shall be stationed at the Provincial DWA office in Kasama, to be used for project management and monitoring activities by the P-WASHE.

3) Motorbike

The Minutes agreed that 21 motorbikes should be distributed to the 7 target districts. The motorbikes will be used for Sub-WASHE activities in the catchment areas. The possession and maintenance of the procured motorbikes shall be the responsibility of each D-WASHE.

4) Data Processing Equipment

Two sets of data processing equipment were requested. However, in consideration of P-WASHE capacity and centralization of activities, one set is essential to coordinate and manage the water supply and sanitation improvement activities of P-WASHE for the entire Northern Province. The installation of this equipment, whether at the Provincial DWA office or the P-WASHE chairman's room in the Provincial MLGH office, should be decided upon discussion within P-WASHE.

5) Water Quality Analysis Kit

In order to easily analyze the water quality of water sources during routine patrols, 7 portable water quality analysis kits are needed for each of the 7 target districts.

2) Specifications of Equipment and Materials to be Procured

The main design specifications for the equipment and materials listed in the previous table are shown below.

Table 2-8 Specifications of Equipment and Materials to be Procured

Main Item	Main Specifications	Reasons
Truck Mounted Drilling Rig	Type: DTH, mud drilling Capacity: 100 m Diam.: 150-300 mm Vehicle: 4×4 drive, approx. 140 kW	DTH needed to drill into main geological formations of granite and quartzite, and mud needed for unconsolidated layers. 100 m capacity required to drill down to about 60 m depths. Drilling diameters are 6"(150mm)and 12" (300mm).
Truck Mounted Compressor	Supply rate: 20 m^3/min Air Pressure: 2 Mpa Capacity: approx. 230 kW Vehicle: 4×4 drive, approx. 140 kW	Required capacity for DTH operation and well cleaning.
Cargo Truck for Drilling Accessories	4×4 drive, with 3 t crane, Max. Output: Approx. 170 kW	Required capacity to transport, load and unload standard accessories and tools, casing pipes, handpumps, etc. having total weight about 5.5 t.
Cargo Truck for Pumping Test Equipment	4×4 drive, with 3 t crane, Max. Output: Approx. 140 kW	Required capacity to transport, load and unload submersible pump, generator, pipes, etc. having total weight about 2.8 t.
Water Tanker	4×4 drive, with 3 t crane, 6 t class, Max. Output: approx. 140 kW, Tank: 4m^3, 2m^3, 1m^3 interchangeable	Required to transport water for mud drilling (about 4m^3 for each preparation) and water for drilling crew.
Fuel Tanker	4×4 drive, with 3 t crane Tank: 4m^3 fixed type	Required to transport fuel for drilling, pumping test and vehicles (1 site consumes about 4m^3 of fuel)
Supervision Vehicle	4×4 drive pick-up truck, double cabin Max. Output: 61 kW	Needed to transport workers and supervisors for drilling, pumping test and appurtenant works
Geological Survey Equipment	Electrical prospecting equipment: measurement depth to 100 m	Needed to measure earth resistivities down to about 60 m to determine hydrogeological properties.
Spare Parts	For drilling rig, Koken FSW-7T-L42 For support vehicle, Hino NZ227K and Hino ZC141B	Required parts to operate drilling rig and support vehicles previously procured in "Drought Prone Project" and "Southern Province Project"
Vehicle for WASHE Activities	4×4 drive pick-up truck , single cabin Max. Output: 61 kW	Based in Kasama, required for coordination and management of WASHE activities held in the 7 target districts divided into eastern and western sections.

1. Selection of Drilling Equipment and Compressor

1) Determination by Load

Assuming a maximum depth of 100m and drilling diameter of 6-1/4", the weight of the drilling tools (drilling bit, drill pipe, stabilizer, hammer body, hammer bit, etc.) will total about 4.4 t. In addition to lowering and raising these tools, if the wall collapses and the bit and other tools get stuck, then enough strength is needed to pull up the tools stuck inside the loosened soil. Therefore, since a 20% increase in strength is necessary, a total pulling capacity of 5.3 t is required.

2) Determination by Lengths of Drill Pipes and Mast Size

From the reasons listed below, the drilling equipment should have a mast length applicable to drill pipes of 6 m length.

- Efficiency in drill pipe connections

  Drill pipes of 3m and 6 m lengths are widely available. Either type will not affect the quality of the drilling. However, if the 3 m drill pipe is used, twice as much connections is required than using the 6 m pipe, and therefore the drilling operation time is increased.
- Compatibility with existing equipment

  The existing equipment of DWA uses 6 m drill pipes. The newly procured equipment should be compatible with the existing equipment to ensure continuity and improve efficiency even after completion of the project.

3) Determination of Mud Pump

In general, a mud velocity of 0.25 to 0.49 m/s is required inside the borehole. If a mud velocity of 0.25 m/s is assumed, then the rate of mud passing through the space between the drilled borehole diameter of 12-5/8" (320 mm) and drill pipe of 4-3/4" (120 mm) is calculated as 1,038 lit/min. Therefore, mud pump capacity is theoretically 1,038 lit/min. However, since the mud drilling for this project is down to 10 m in average and 20 m maximum, and for the below reasons, only 60% of the mud velocity is required.

- The problem associated with insufficient mud velocity would be loss of drilling speed due to slime accumulation in the bit head. However, at depths of 20 m, the mud is actively circulating and slime accumulation is very rare.
- Even if a large mass of slime is encountered, the bit will break the slime into small pieces to facilitate the flow.

Due to the above reasons, a mud pump having a pumping rate of 600 lit/min, which is 60% of the theoretical value, is selected for this project.

4) Determination of Compressor

For a drilling diameter of 6-1/4" and maximum depth of 100m, the DTH hammer of silver drill SD-6 class is applicable. The required capacity of the compressor for SD-6 is determined from the following factors.

- Circulation Air Velocity

  The required circulation air velocity to effectively discharge the slime from the borehole is generally 15 to 35 m/s (Ingersoll-Rand), and minimum 20.5 m/s (Sandvik).

- Consumed Air Rate

  The rate of consumed air for DTH drilling of diameter 6-1/4" (159 mm) with drill pipe of 4-3/4" (120 mm) is calculated to be 13.2 m^3/min.

- Compressed Air Pressure

  The air pressure necessary to supply compressed air from the compressor is 1.03 MPa.

- Head Pressure

  When groundwater flows into the borehole, the pressure on the well floor is about 0.01 MPa per m of water depth. Since the maximum groundwater depth in a borehole of 100 m depth is 100 m, the pressure required to discharge all the water with compressed air is 1 MPa.

  Therefore, the minimum requirement for the compressor would be 2.03 MPa and the equipment must be capable of varying the compressed air pressure range from 1.03 to 2.03 MPa.

2. Selection of Vehicles

1) Vehicle for Transporting Drilling Equipment

This vehicle will transport standard accessories and tools for drilling rig, as well as screens, casing pipes, and site camping equipment. The total weight of equipment to be transported at one time for one trip is about 5.5 t, and therefore the load capacity of the vehicle must be 5.5 t minimum.

Furthermore, since the drill pipes, casing pipes and screens are 6 m long, the loading length must be at least 5.5 m. Moreover, since the vehicles will travel long distances on bad road conditions to the sites, the vehicles must be of 4WD.

2) Vehicle for Transporting Pumping Test Equipment

The main equipment to be transported are generator, submersible pump and site camping equipment needed to conduct pumping tests. Also, to carry materials for handpump facilities construction, the vehicle will function as a cargo truck with 3t crane. The total weight of equipment to be transported at one time for one trip is about 2.8 t. Furthermore, long distance travel on bad road conditions is expected, and so a 4WD vehicle is necessary.

3) Water Tanker

The vehicle is required to transport water for mud drilling as well as water to be

used at the camping site. The vehicle will also function as a cargo truck with 3t crane to carry materials for handpump facilities construction. In consideration of road conditions, a 4WD is essential.

The capacity of the water tank 4 m^3, in consideration of requirements for mud circulation in the borehole for 12-5/8" hole of 20 m depth, in addition to water kept in the mud pit on the surface and surplus amount for losses.

4) Fuel Tanker

The vehicle will transport diesel oil from Kasama to the site offices, stock yards and site camping areas. A 4WD vehicle is required to cope with the bad road conditions.

The tank capacity takes into consideration that from Kasama to the farthest site is about 300 km, and with an average velocity of 20 km/hr, about 4 days is required for one round trip. The maximum fuel consumption rate for one drilling site is about 4 m^3 in operation for about 6 days. In addition, fuel is needed for the pumping test crew and handpump facilities construction crew. Therefore, a fuel tank capacity of 4 m^3 is feasible.

3. Selection of Other Equipment

1) Workshop Equipment

Presently, the workshop at DWA Northern Province office has a shortage of appropriate equipment for maintenance of drilling rigs, compressors and vehicles. Therefore, equipment such as welder, grinder, lathe, work bench, mechanical tools and electrical tools installed in a container type workshop will be procured to improve the maintenance capacity of DWA.

2) Borehole Logging Equipment

This equipment is needed to select the proper screen installation depth. The measuring depth shall be 100 m.

3) Pumping Test Equipment

A pumping test is required after installing the screen and casing pipes to determine the borehole capacity. UNICEF has set a successful borehole as 60 lit/min. Therefore, a pump having specifications of 80 lit/min with 60 m total head is selected. This would give a standard 1.5 to 2.2 kw type pump. The

equipment will include pump, generator, power panel, riser pipes, cable, valves and weir.

4) Geological Survey Equipment

For borehole siting, geological survey equipment is needed. The availability of groundwater is confirmed through resistivities in the geology. The measuring depth shall be 100 m.

4. Procurement of Spare Parts

The spare parts to be procured are those required at the beginning of the project for drilling equipment and supporting vehicles will be procured. These include, among others, fuel pumps, motors, valves, 0-rings, seals, piston rods, nipples, brakes shoes, shock absorbers, springs and electrical parts.

3) Specifications of Construction Materials

The specifications and their decision factors for the construction materials are shown below.

Table 2-9 Specifications and Decision Factors for Construction Materials

No.	Item	Specifications and Decision Factor
1.	Handpump	The type will be selected in consideration of groundwater level, water quality, product quality, cost and availability of spare parts. These factors give favor to India Mark II.
2.	Casing and Screen	The decision factors are water quality, local availability, product quality and cost, among others. In this respect, PVC is given top priority.
3.	Gravel Pack	The policy of D-WASHE is that the residents should prepare gravel for packing, but this can greatly affect the life of the borehole. Therefore, gravel procured by the Contractor and sieved will be used for this project.
4.	Materials for Appurtenant Facilities	The required materials are cement, sand and gravel, but other than cement, these materials can be contributed by residents of the target sites along with labor contribution.
6.	Materials for Drilling	Drilling materials such as foam and bentonite will be procured from third countries.

2-2-2-3 Technology Transfer and TOT on Drilling Supervision

1) Plan for Technology Transfer

For the past 20 some years, Japan has continuously assisted Zambia in the rural water supply sector. Although assistance to the Northern Province is the first time for Japan, the Zambian government has apprehension of Japanese grant aid in this sector and has received several trainings on borehole construction. From this viewpoint, the project should be procurement of equipment with construction works done by the recipient side. However, only a few of the trained staff are still remaining. The problem is that not only has the Zambian side not been transferring the technology onto other technicians, but also the Japanese side has transferred only technology without any training to trainers.

Consequently, in this project, to enable the Zambian side to construct boreholes by themselves in the future, equipment will be procured and in addition, rather than only the usual technology transfer through collaborative drilling, emphasis will be placed on training of trainers. Therefore, the plan proposed for this project will include training of technicians as previously conducted to strengthen the technical staff of DWA, followed by technology transfer on planning, supervision and management to foster trainers for the future. The proposed technology transfer is composed of the following.

1. Guidance and training on drilling techniques to drilling engineers and drillers to strengthen their capacity.
2. Training on drilling management and private drillers' supervision to foster trainers.

2) Guidance on Drilling Techniques

The Northern Province presently has one drilling crew and is planning to create a 2-crew structure. The project will transfer technology to structure the 2-crew formation. In the Northern Province, the main drilling method will be DTH with application of the mud circulation method as a supplementary method. The basic programme is shown below.

Table 2-10 Training for Drilling Techniques

Training Items for each crew	Main Executing Body
1. Basic Training on Drilling Techniques (3 months) Training on analysis of drilling samples, data recording, basic operation of drilling rig, drilling techniques, routine maintenance of vehicles and compressor and other drilling related subjects.	Japan
2. Drilling by DTH Method (2 months) Training on drilling using the DTH method for various geological formations.	Japan-Zambia Collaboration
3. Drilling by Mud Circulation + DTH (3 months) Training on drilling using the mud circulation method for consolidated formations, and changeover to the DTH method in unconsolidated formations.	
4. Independent Drilling by DWA and Evaluation (8 months) The DWA crews will demonstrate the technology acquired through the previous stage of the training by carrying out drillings by themselves through supervision by the Japanese side. The results will be evaluated through a collaborative effort.	Zambia, with Japanese Supervision

The above training programme has the objective of developing three-years' experience drilling technicians. Although an ideal training programme should extend for 3 years, but this programme will finalized in 2 years within the project timeframe. As shown in the above programme, the first year will focus on guidance and training, while the second year will let the crews work independently and a Japan-Zambia collaboration unit will evaluate the outcomes.

The prime contractor to conduct this training will be a Japanese enterprise in accordance with the guidelines for Japanese grant aid.

3) Training on Drilling Management and Subcontractor Supervision

Training on management and supervision of drilling works has the objective of fostering senior level staff through TOT (training of trainers). In this project, as requested by DWA, one senior hydrogeologist, one hydrogeologist and three engineering assistants from the target area of Northern Province, and 2 senior hydrogeologists and one engineering assistant from DWA headquarters in Lusaka, which has responsibility for the whole country, for a

total of 8 trainees are scheduled to be trained. This training will target the 2 drilling crews of DWA who are receiving training on drilling techniques, as well as the subcontracted private drilling company. Siting of the drilling points will be conducted as an OJT during the second phase detailed design stage by the hydrogeologist and geophysicist of the consultant team. The other programme items will be handled by the prime contractor. The consultant will supervise the progress of the training and monitoring activities. The description of the training is explained below.

DESCRIPTION OF TRAINING

Siting of Drilling Points

[Execution Period]

During detailed design stage

[Objective]

- Training on geological survey methods from a hydrogeological viewpoint to determine the drilling points
- Training on geophysical survey methods to select drilling points with higher precision
- Training on sociological approach to acquire knowledge on how to make the optimum selection in consideration of points requested by the residents.

[Method]

a. Geological Survey

Training on geological survey methods will be conducted at the sites by the hyudrogeologist. Topological and geological characteristics of the sites will be used to determine points having high potential for locating aquifers.

b. Geophysical Survey

Again at the sites, the geophysicist will carry out training on electrical prospecting and other geophysical survey methods at the points selected in the above training a. to improve the accuracy of the selection.

c. Sociological Consideration

In addition to hydrogeological considerations, the opinions of the residents will also need to be considered. Discussions will be made with the residents to finally decide on the most appropriate drilling points.

[Duration]

Classroom lectures will be given for about one week. Then the 8 trainees will be divided into 3 groups to receive training at the sites. Each group will cover 10 sites. The geological and geophysical survey trainings can be carried out at 2 sites per day, which would mean 5 days is needed for each group. Therefore, about one month is required for this training.

Formulation of Drilling Programme

[Execution Period]

At the beginning of the project

[Objective]

The formulation of the programme is an important work of a project supervisor. If the drilling programme is poorly prepared, serious delays can occur, in which case, rushing to meet the schedule deadlines can hamper quality management. Therefore, the trainees will be given the opportunity to prepare the actual programme together with the project implementers.

[Method]

First, classroom lectures will be conducted, followed be the programmes listed below.

a. Construction Schedule

   The target villages will be plotted on a map to acquire information on distances, access routes to be taken and other scheduling items. Then the drilling schedule is prepared in consideration of crew formation (drilling crew, pumping test team and appurtenant facilities construction team) as well as treatment of unsuccessful boreholes.

b. Vehicle Management

   For this project, 8 vehicles are needed for each crew. Also, since some of the vehicles will be shared between the teams for drilling, pumping test and appurtenant facilities construction, the vehicle scheduling must be carefully planned in line with the above construction schedule to avoid unnecessary delays.

c. Manning Schedule

   The DWA drilling crews will work under the supervision of the prime contractor to drill boreholes, carry out pumping tests and construct appurtenant facilities. Therefore, the manning schedule needs to be prepared in consideration of the

position and capability of the crew members.

d. Budget Planning

Planning the budget for the project will be practiced. However, this will be used for training purposes only and the budget is not necessary the actual budget of the project.

e. Coordination of WASHE Activities with Districts and Ministries

The schedules prepared above will be explained to the relevant authorities and any adjustments will be made, if necessary. The trainees will acquire knowledge on improving their coordination ability.

f. Meetings with DWA Drilling Crews and Private Drilling Subcontractors

Procedures similar to programme e. above will be taken to coordinate and confirm the activities to be taken by the drilling crews.

[Duration]

The preliminary lectures, preparation of the programmes, discussions and meetings with relevant bodies will require about 2 weeks of training.

Supervision of Drilling Works

[Execution Period]

During project implementation

[Objective]

Since the trainees for this programme are not drillers, detailed drilling techniques are not needed to be transferred. As supervisors, they need to learn how to manage and supervise drilling works, and when necessary, give advice on proper techniques and important precautions. Also, they must know how to determine a borehole as being successful or unsuccessful.

[Method]

The actual drilling works will be observed, and the drillers and Japanese engineers will explain and comment on the drilling procedures.

[Duration]

For this training, the trainees will be divided into 2 groups. The DWA drilling crews and private drilling crews each requires 5 sites for a total of 10 sites for the on-site supervision training. Training at the 10 sites will need about 3 months.

Quality Control

[Execution Period]

During project implementation

[Objective]

If quality is not controlled during the construction stage, then problems such as dry boreholes and sand inclusion can occur after completion of the works, where the borehole will not be used. Poor quality control can also affect operation and maintenance in terms of costs and maneuverability. Therefore, training on quality control is necessary for sustained use of the water supply facilities.

[Method]

Training will be held at the borehole drilling sites. Not only the drilling works need inspection, but also pumping tests and construction of appurtenant facilities need quality control.

a. Confirmation of Proper Drilling

   After completion of the drilling, confirmation on interior wall collapse, drilled depth, straightness and other conditions for proper drilling need to be inspected.

b. Casing Programme

   The casing programme is basically made during the drilling stage by determining the aquifer availability and drilling progress along with electric logging results to decide on the appropriate placing of screens.

c. Installation of Casing Pipes and Screens, and Gravel Packing

   Casing pipes and screens are installed following the casing programme. The proper installation methods and management of gravel packing will be transferred.

d. Borehole Cleaning and Development, and Cementation

   Borehole cleaning is carried out after gravel packing. Training on proper cleaning time, air pressures and other development practices as well as cementation techniques will be conducted.

e. Pumping Tests and Water Quality Analyses

   Pumping tests can confirm the possibility of enough yield for handpumps. Furthermore, water samples will be taken during this stage for quality analyses.

f. Installation of Handpumps

   Proper installation of handpumps is important in terms of operation and maintenance. Correct depths of foot valves, connection methods of riser pipes and quality of pump foundation are important factors for this training.

g. Construction of Appurtenant Facilities

Since the appurtenant facilities for this project is reinforced concrete, the training items will include proper reinforcement layout, molding placement, cement-water ratio, mixing, concrete placing, curing and other techniques requiring supervision and quality control.

h. Handing Over to Residents

After completion of the facilities, they will be handed over to the residents. However, when handing over the facilities, the proper use of the handpumps, operation and maintenance methods, measures to be taken in case of emergencies and other precautious explanations are needed.

[Duration]

Basically, this training will be held in parallel to the drilling supervision programme. Therefore, if the pumping tests and construction of appurtenant facilities is included, this programme will last 3.5 months.

Schedule Management

[Execution Period]

During project implementation

[Objective]

Delays in schedule can cause important delays in the project. Therefore, progress of the original schedule must be confirmed. If any delay occurs, adjustments must be made by considering such measures as increasing crews or working overtime. Also, for sites to be constructed thereafter, adjustments need to be made with WASHEs and districts.

[Method]

During the training, the trainees are in the field, but the progress of the total drilling schedule must be confirmed periodically. Furthermore, the trainees must go to the headquarters in Kasama on a routine basis to have discussions on the progress of the schedule with relevant bodies.

[Duration]

During the same period as the quality control training, which will be 3.5 months.

Procurement Management and Inspection of Equipment and Materials

[Execution Period]

During project implementation

[Objective]

If inappropriate equipment and materials are selected or if improper inspection of them is carried out, poor quality materials can be ordered or shortages can occur to lower the quality of the works and also to cause delays in the schedule. The training includes methods for inspection of quality and quantity of materials such as casing pipes, screens, handpumps and cement. Also, stock confirmation and procurement of fuel and other miscellaneous materials will be explained to prevent any delays.

[Method]

This training is basically conducted at Kasama in line with the construction schedule. The equipment and materials necessary for the required works must be confirmed. Since the required equipment and materials is numerous, a systematic management is necessary.

[Duration]

During the same period as the quality control training, which will be 3.5 months.

Report Preparation

[Execution Period]

After completion of the training in the field

[Objective]

A report must be prepared for operation and maintenance purposes and as a record of hydrogeological and other data. Without a report, a new project might be duplicated because there is no record of a borehole. Moreover, when a borehole yields no water, the report can be helpful to determine the reason so that the problem can be quickly and properly remedied.

[Method]

After completion of the field training, the trainees will prepare the report. The significant points in writing the report will be explained. Upon receiving consensus between the trainees, the report will be finalized. Then, the prepared report will be used to evaluate the training.

[Duration]

The preparation of the report and evaluation will require 2 weeks.

Monitoring

The above TOT covers one cycle of training items under the supervision of Japanese

engineers. Subsequently, the trainees must continue to practice their acquired skills to strengthen their capacities. They will need to conduct, 1) Preparation of drilling programme, 2) Supervision of drilling works, 3) Quality control, 4) Schedule management, 5) Procurement management and inspection of equipment and materials, at the field on their own. Then, they will prepare the report. These activities need to be monitored to evaluate their outcomes.

The monitoring activities will be the responsibility of the prime contractor through supervision of the consultant.

4) Schedule

Training on drilling techniques and supervision is scheduled to last 2 years. The schedule to conduct this training programme is shown in the next page.

Table 2-11 Schedule for Technology Transfer

Training Item		Detailed Design Stage	First Year									Second Year									
			1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10
Drilling Techniques																					
Basic Operation of Drilling Equipment	DWA Crew 1																				
	DWA Crew 2																				
DTH Drilling	DWA Crew 1																				
	DWA Crew 2																				
Mud+DTH Drilling	DWA Crew 1																				
	DWA Crew 2																				
Independent Drilling and Evaluation	DWA Crew 1																				
	DWA Crew 2																				
Drilling Management/Supervision																					
Drilling Point Siting																					
Drilling Programme Preparation																					
Supervision of Drilling																					
Quality Control																					
Schedule Management																					
Procurement/Inspection of Equipment & Materials																					
Report Preparation & Evaluation																					
Subcontracting to Private Driller																					

2-2-3 Basic Design Drawings

Fig. 2-4 Standard Borehole Structure (For Confined Groundwater)

Fig. 2-5 Standard Borehole Structure (For Unconfined Groundwater)

Fig. 2-6 Appurtenant Facilities for Handpump Facilities

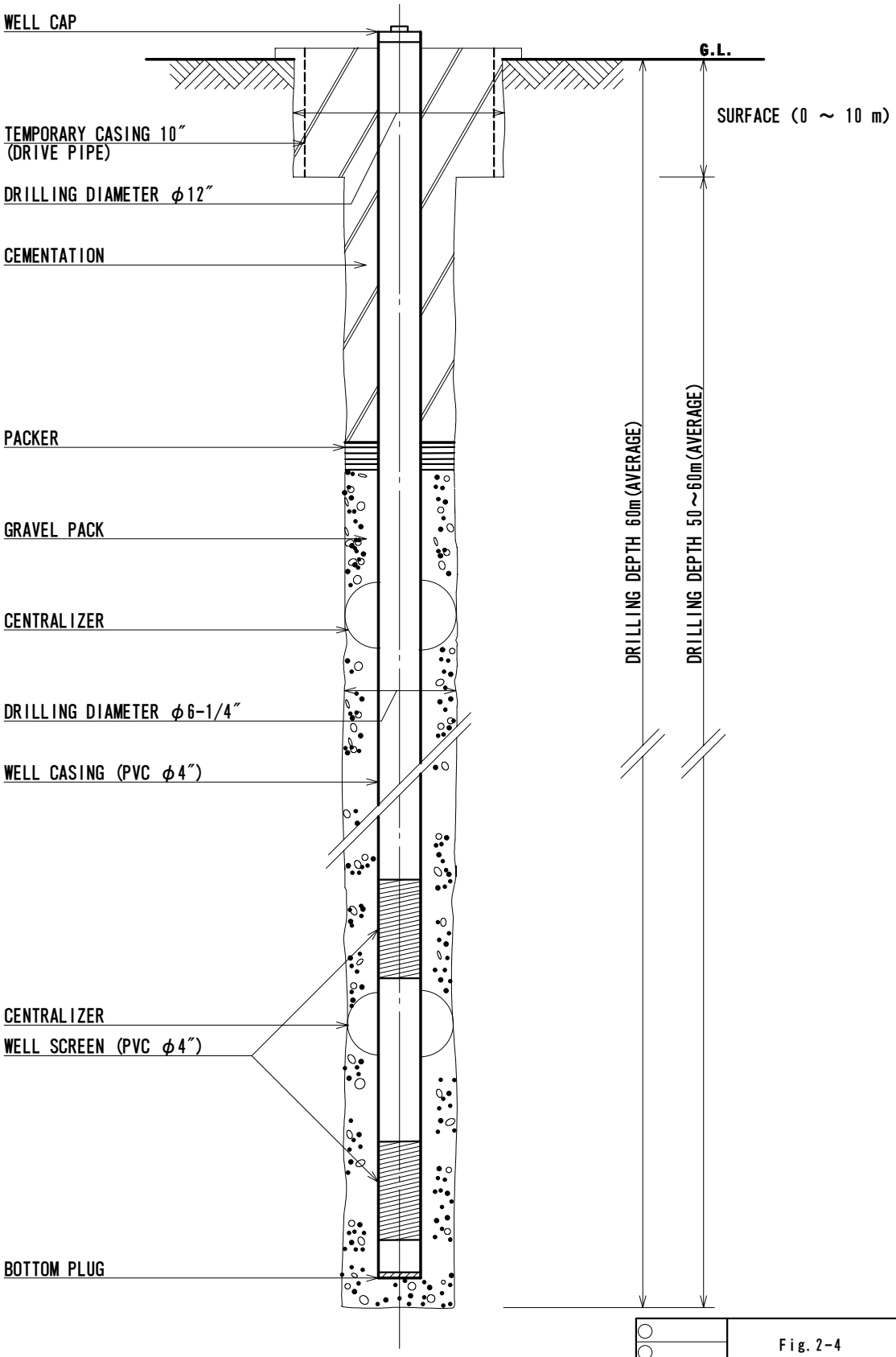


Fig. 2-4

STANDARD BOREHOLE STRUCTURE
(For Confined Groundwater)

JAPAN TECHNO

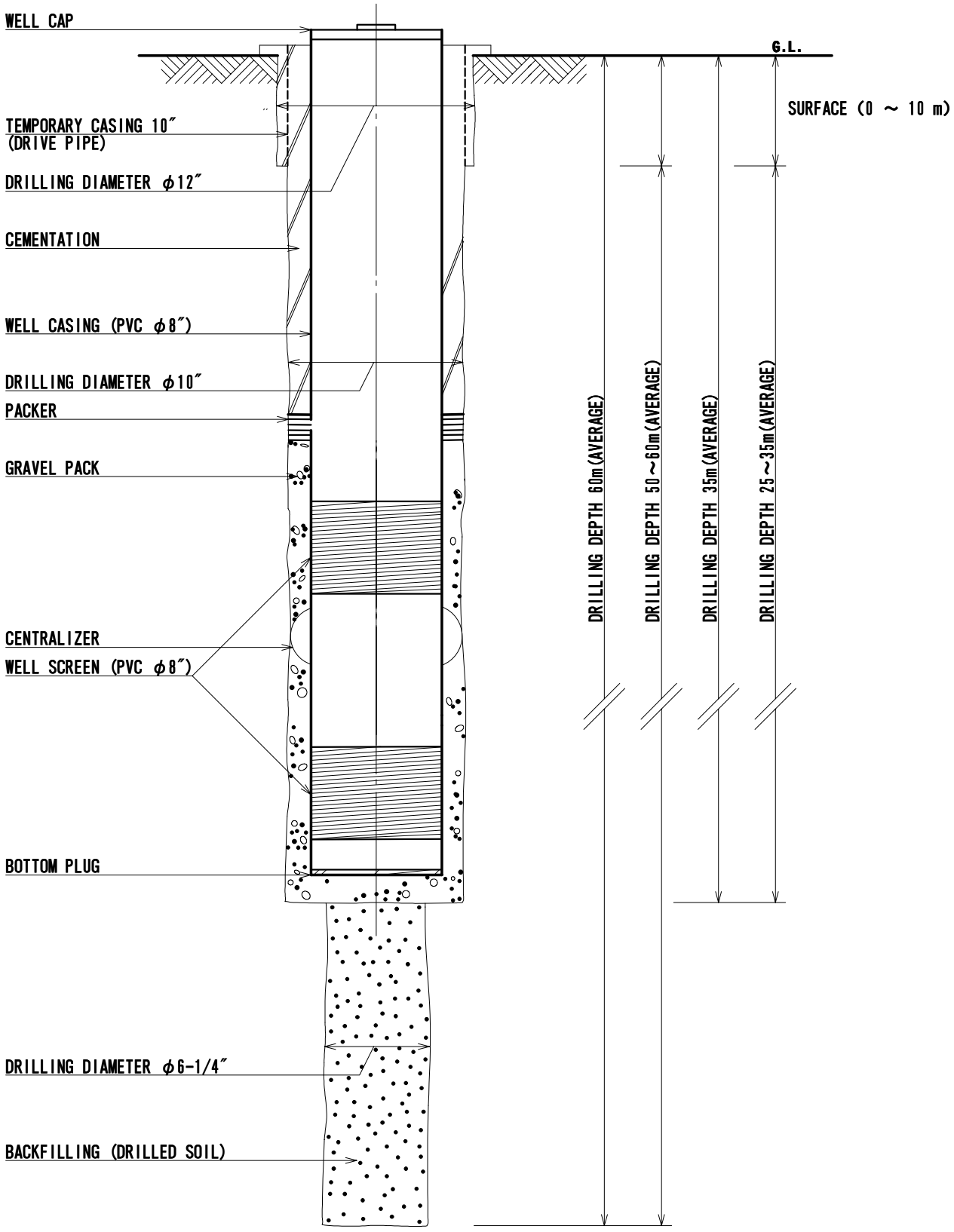
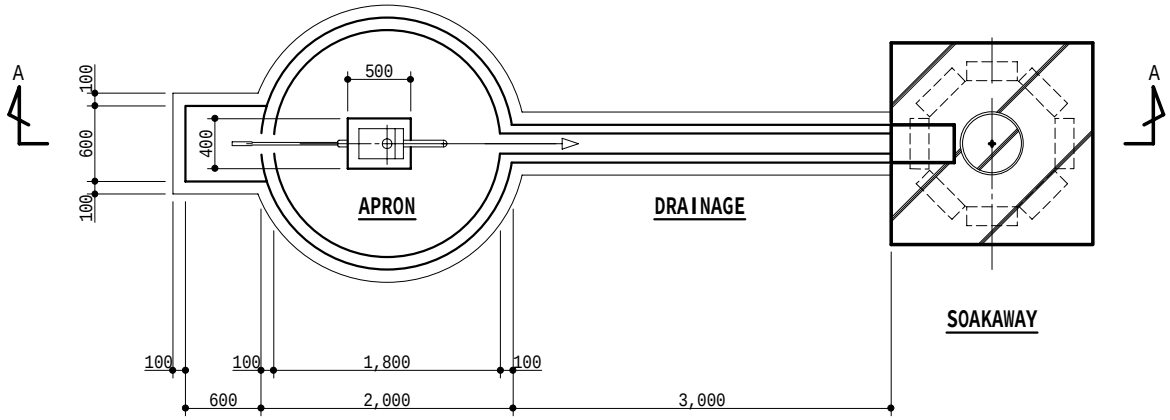


Fig. 2-5

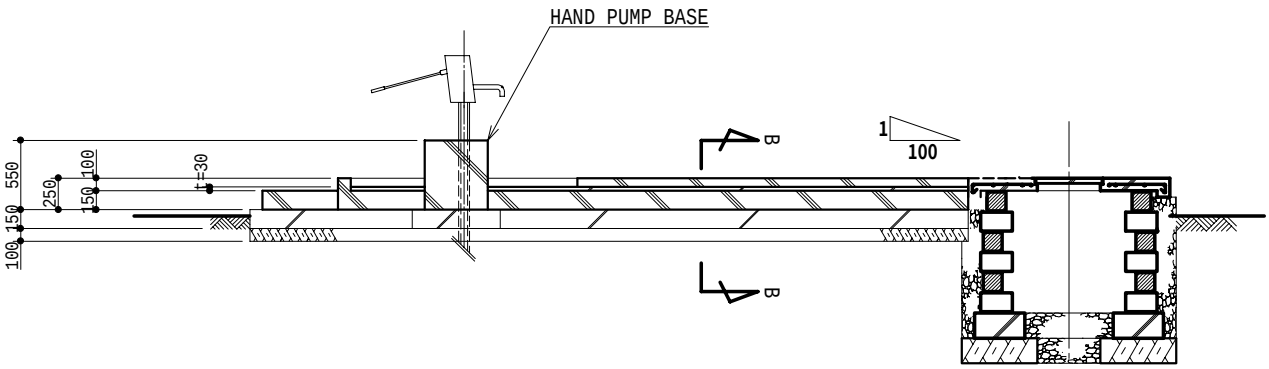
STANDARD BOREHOLE STRUCTURE
(For Unconfined Groundwater)

JAPAN TECHNO

PLAN



A - A



B - B

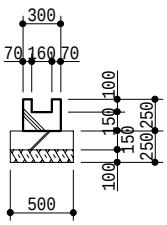


Fig.2-6

APPURTENANT FACILITIES
FOR HANDPUMP FACILITIES

JAPAN TECHNO

2-2-4 Implementation Plan

The prime contractor will be a Japanese firm under the Japanese Grant Aid scheme. The construction works should be practically undertaken by DWA and local sub-contractors under the supervision of the prime contractor. For proper implementation and procurement, the Project is to be executed in close collaboration with the Provincial and District DWA offices, Northern Province P-WASHE, as well as D-WASHEs and Sub-WASHEs of each of the 7 target districts.

2-2-4-1 Implementation Policy

Principally, local contractors and equipment and materials on the local market will be employed as much as the circumstances allow with sufficient consideration of the capacity of firms and the qualities of equipment and materials. Nevertheless, Japanese engineers will be dispatched for supervision requirements as well as to support the local capacity. Furthermore, the equipment and materials that are either not available or of improper quality in Zambia will be imported from Japan or a third country. Products from third countries are only those procurable in Zambia.

2-2-4-2 Implementation Conditions

The following are conditions concerning implementation and procurement.

- ✧ Since the project sites are scattered, the one consultant assigned for supervision must work efficiently to maintain the standard of the construction works.
- ✧ An appropriate transportation system will be planned out upon confirming the conditions of access roads to the target sites.
- ✧ The construction works will be proceeded upon sufficient discussions with representatives of the target villages.
- ✧ To promote capacity building, WASHE members will be trained to enable them to train the local laborers from the target villages.
- ✧ The quality and availability of local materials and equipment will be surveyed, and multiple supply routes will be investigated to create fair competition, reduce costs and ensure a stable supply.

2-2-4-3 Scope of Works

The scope of works of the Zambian side concerning borehole construction consists of the following:

a. Preparation of the access roads
b. Clearing and leveling of the land for the construction works
c. Rental of DWA owned drilling related equipment without charge to this Project
d. Assurance of DWA drilling staff and their expenses for drilling works
e. Securing storage places for materials

Moreover, the scope of works of the Zambian side for procurement of equipment is as follows:

a. Securing of parking space for vehicles
b. Securing of storage area for equipment and materials
c. Allocation of workshop equipment and materials, and preparation of installation points
d. Proper allocation of support equipment for WASHE activities

Other responsibilities of the Zambian side are listed in Section 2-3.

2-2-4-4 Consultant Supervision

A full-time supervisor for the construction works stationed at the sites will mainly supervise the entire process. The project manager will be in charge of planning and discussions with the counterparts and contractors. The assigned tasks of the Japanese consultant are summarized below.

Table 2-12 Assignment for Detailed Design and Supervision

Function	Assignment
Project Manager	Management of the entire Project. Detailed design, Preparation of tender documents and drawings
Hydrogeologist	Detailed design, Preparation of tender documents and drawings for drillings and borehole construction. Selection of drilling points
Geophysist	Detailed design, Preparation of tender documents and drawings for drillings and borehole construction. Geophysical prospecting.
Cost Estimation / Procurement Supervisor	Detailed design, Preparation of tender documents and drawings. Supervision of procured equipment and materials
Operation and Maintenance Support Planner	Detailed design, Preparation of tender documents and program for O&M strengthening and health & hygiene education
Full-Time Supervisor	Overall supervision of the construction works at project sites and procurement of equipment and materials

2-2-4-5 Quality Control Plan

1) Equipment and Materials

Almost all equipment and materials can be procured in Zambia. Firstly, a procurement officer of the prime contractor checks the quality before making any orders. After the equipment and materials arrive at the sites, engineers will check the delivered quality. Then, the supervisor from the consultant will check them before they can be used for the construction works.

2) Borehole Drilling

- ✧ Sampling of the soil is carried out at 2 m intervals and at points where stratums change in order to gauge the hydrogeological conditions.
- ✧ After electric logging, the screen position will be selected by the Japanese drilling engineer.
- ✧ Casing pipes and screens will be installed, and gravel will be packed.
- ✧ Pumping tests will be conducted under the supervision of the engineer with confirmation by the consultant.
- ✧ Water samples are taken whenever an aquifer is hit and before the end of the pumping test to analyze the water quality.

2-2-4-6 Procurement Plan

1) Equipment

Equipment to be newly procured include drilling rig, air compressor, supporting vehicles, geological survey equipment, as well as equipment for D-WASHE activities such as vehicles, motorbikes, data processing equipment and water quality analysis kits. Dealers for the small vehicles such as pickups and motorbikes, and data processing equipment are found locally and therefore, these can be procured in the local market. For the other equipment, factors such as maneuverability, availability of spare parts, cost and compatibility with existing equipment will be considered in planning for their procurement.

2) Spare Parts

The presently implemented Japanese grant aid project, the “Groundwater Development and Sanitation Project in Drought Prone Rural Areas (2001-2004)”, is using drilling rigs, support vehicles and compressors procured in the said project as well as previous projects, the “Project for the Rural Water Supply Development Phase-III (1991-1992)” and the “Rural Water Supply Development Project in Southern Province (197-1998)”, to construct the boreholes. The use of these equipment and vehicles in the present project is also being considered. However, the equipment procured in the “Project for the Rural Water Supply Development Phase-III (1991-1992)” have been in use for over ten years, and repairs are frequently needed during their use in the “Drought Prone Area Project”. As a consequence, support vehicles procured in the “Southern Province Project” and drilling equipment procured in the “Drought Prone Area Project” will be basically considered for use in this project. Therefore, the supply of required spare parts for these equipment and vehicles will be designed.

3) Construction Materials

The India Mark II as well as other types of handpumps are currently not available in the Northern Province, but the India Mark II can be procured from dealers in Lusaka. Cement, sand, gravel and other materials for appurtenant facilities can be procured in the Northern Province.

2-2-4-7 Implementation Schedule

The Project will be divided into two phases. Each phase will commence upon concluding the Exchange of Notes (E/N) for Japan’s Grant Aid scheme between the Zambia and Japanese governments. The actual duration of construction works for each phase is restricted and Japanese Grant assistance stipulates that each phased out Project must be completed within one Japanese fiscal year.

Upon conclusion of an E/N, the executing agency, the Department of Water Affairs (DWA) will sign a contract with a Japanese consulting firm. After the

government of Japan verifies the contract, the consultant will make a detailed design of the facilities and equipment, prepare the tender drawings, and acquire the approval from the governments of both Japan and Zambia. In addition, the consultant shall support DWA concerning the tender for the construction and procurement, or actually conduct it on behalf of DWA, and also assist in the negotiation with the lowest tenderer. Then, the consultant will supervise all of the works including construction works and procurement of the equipment and materials until they are handed over to the government of Zambia.

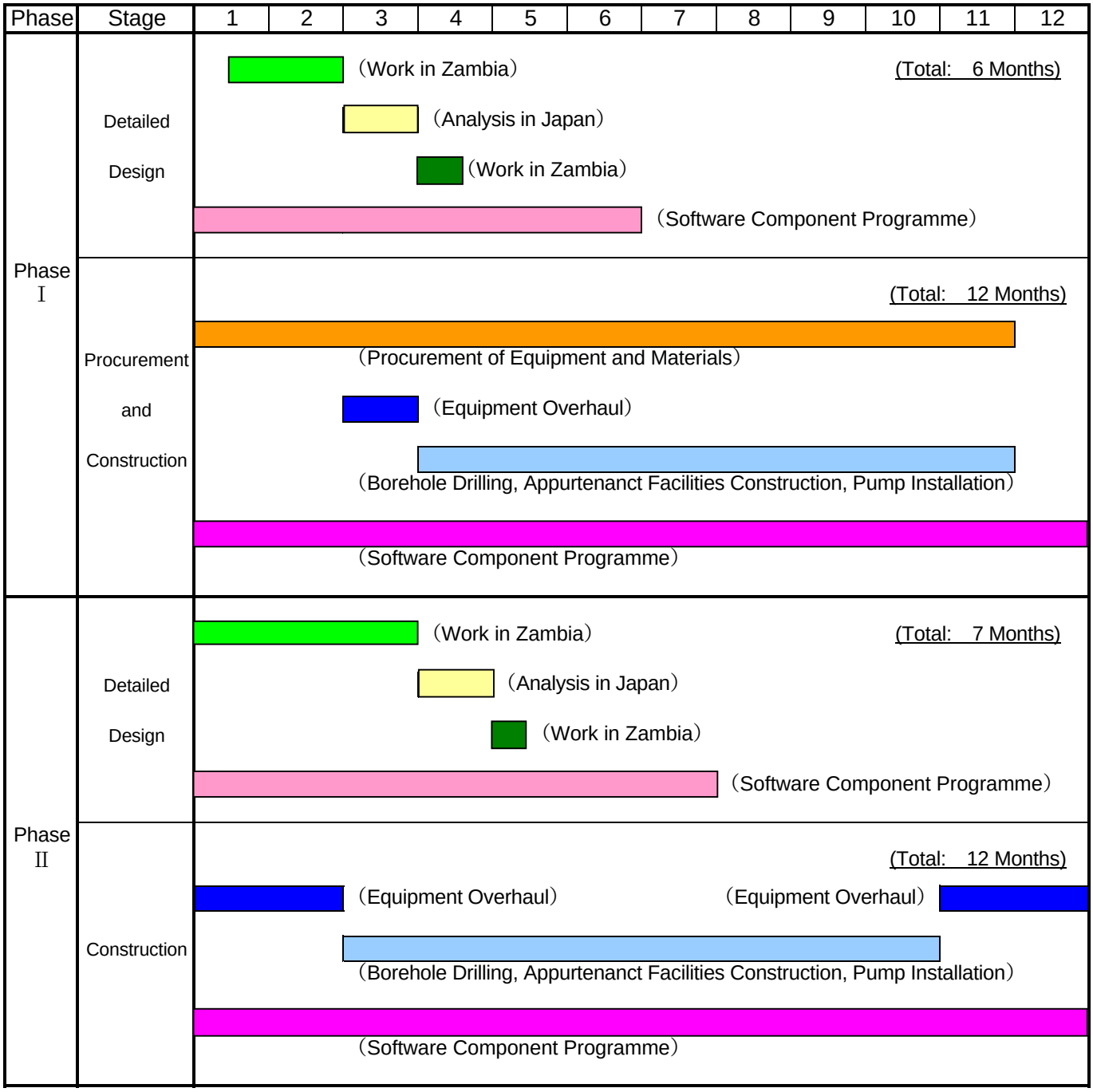
On the other hand, the software component program activities will start before commencement of the construction works and procurement of equipment. By starting the activities before the construction and procurement, the beneficiary residents can become more prepared for acceptance of the facilities and contribute to decisions on the implementation.

As explained above, the Project will be implemented in 2 phases. The description of each phase is listed below. The implementation schedule is shown in the next page.

Table 2-13 Description of Phase-Wise Implementation

Phase	Implementation Item	Training	Target Districts
Phase 1	Procurement of equipment Construction of water supply facilities at 60 sites	Drilling technique	Luwingu, Mpulugu, Mbala
Phase 2	Construction of water supply facilities at 115 sites	Drilling technique Management/supervision of drilling works	Mbala, Nakonde, Isoka, Chinsali, Mpika

Table 2-14 PROJECT IMPLEMENTATION SCHEDULE



2-3 Obligations of Recipient Country

If the project is approved for implementation, in order for the project to proceed in a smooth manner, both sides need to carry out required obligations. The Zambian Government must confirm undertaking the following responsibilities.

- To secure land necessary to construct the water supply facilities, and to clear, level and reclaim the land prior to commencement of the construction.
- To prepare access routes to the construction site and provide necessary incidental facilities in and around the project sites.
- To secure buildings prior to the procurement in case of installation of the equipment.
- To ensure all expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products under the Grant Aid, in case products are imported.
- To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.
- To accord Japanese nationals, whose services may be required in connection with the supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.
- To operate and maintain the facilities constructed and equipment procured under the Grant Aid properly and effectively, and to appoint necessary staff for this operation and maintenance.
- To bear the advising commission for an Authorization to Pay (A/P) and the payment commissions to the Japanese foreign exchange bank for the banking services based upon on the banking arrangement (B/A).
- To bear all the expenses other than those covered by the Grant Aid.

2-4 Project Operation and Maintenance Plan

The management, and operation and maintenance of rural water supply facilities in the Northern Province are initiatively conducted on a level-wise basis: i.e., province by P-WASHE, district by D-WASHE, sub-district or catchment area by Sub-WASHE, and village level by V-WASHE. Presently, P-WASHE is focusing on the establishment of a Three-Tier System involving D-WASHE, Sub-WASHE and V-WASHE. In this collaborative management system, the strengthening of the planning and implementation functions of the catchment areas and villages is especially emphasized.

The operation and maintenance approach for this project will be based on Zambia's rural water and sanitation sector development strategy using the WASHE concept as well as the Three-Tier System promoted in the Northern Province. The basic policies of this system are as follows.

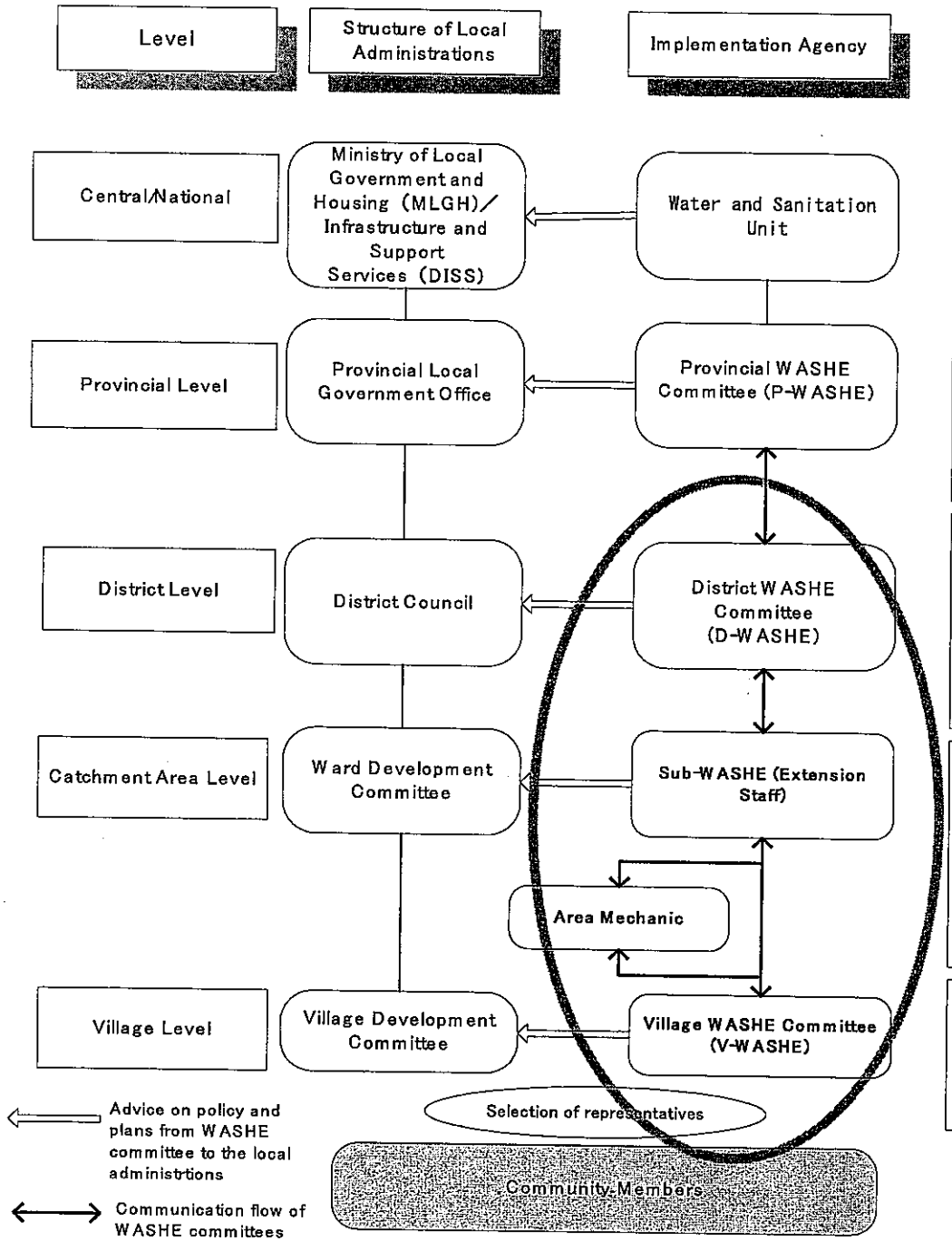
1. Framework for Operation and Maintenance

The responsible body related to management, and operation and maintenance of water supply facilities for this Project is the Ministry of Local Government and Housing (MLGH). This ministry is in charge of policy-making, technical support and budget allocation for rural water and sanitation improvement of Provincial and district governments through the Department of Infrastructure and Support Services.

The functions and responsibilities of district, catchment area and village level WASHE committees, which are the main bodies in the overall structure for management, and operation and maintenance, are shown in the next page.

2. Operation and Maintenance of Water Supply Facilities through Ownership and Responsibility of the Beneficiary Residents

The operation and maintenance of completed water supply facilities will be the responsibility of the V-WASHE committee. The main roles of this committee are the realization of needs for water and sanitation improvement in the village, preparation of action plan for these and promotion of its implementation; routine maintenance and simple repair of water supply facilities; collection and management of operation and maintenance fees; and liaison with Sub-WASHE and D-WASHE.



Members	Roles
Coordinator (Person in charge of the Unit) Facilitator	❑ to establish and train P-WASHE ❑ to train D-WASHE for institutional strengthening ❑ to develop and manage National Water Inventory ❑ to make national water and sanitation policy and develop mannual
❑ Provincial Staff of Ministry of Energy and Water Development, Ministry of Local Government and Housing, Ministry of Education, Ministry of Health, Ministry of Community Development and Social Welfare, Ministry of Agriculture and Cooperatives, CSO ❑ Ireland Aid	❑ to make water and sanitation policy and plans at Provincial Level ❑ to distribute resources to districts ❑ to monitor D-WASHE activities ❑ to provide technical and financial support to D-WASHE ❑ to manage information and data regarding water and sanitation in the province
❑ District Staff ❑ District Staff of DWA, Ministry of Education, Ministry of Community Development and Social Welfare, Ministry of Agriculture and Cooperatives ❑ NGO	❑ to plan, implement, and monitor district WASHE Action Plan ❑ to manage information and data regarding water and sanitation in the district ❑ to coordinate the projects by donors and NGOs in the district ❑ to train and supervise human resources at catchment area ❑ to review the activities at village level and reflect the findings on the planning
Sub-WASHE (Extension Staff) ❑ Environmental Health Technician (EHT), Community Development Officer, Agriculture Officer, Teacher Area Mechanic ❑ Community Members	Extension Staff ❑ to develop capacity of V-WASHE in community management ❑ to provide hygiene education and facilitate involvement of communities into operation and maintenance activities ❑ to monitor the village level activities, report to D-WASHE, and support application of the WASHE concept in communities Area Mechanic ❑ to provide communities with services of repair works of handpump with charge
Community Members V-WASHE : Chairperson, Vice-Chair Person, Secretary, Treasurer, Care Taker	V-WASHE ❑ to plan, implement, and monitor the action plans for improvement of water and sanitation ❑ to collect and manage the O&M fund ❑ to maintain the facilities and clean the surroundings

Fig. 2-7 Operation and Maintenance System of the Project

The members of V-WASHE are basically composed of a committee president, vice president, secretary, accountant, borehole attendant and other members. The members are selected by the village residents, with emphasis on gender balance and participatory promotion so that female representation is honored in the decision making.

3. Catchment Area (Sub-WASHE) Level Village Support Structure

The Sub-WASHE organized for each catchment area is responsible for village resident activities such as awareness campaigns, health and hygiene education and formation of V-WASHEs. Also, the Sub-WASHE must prepare members who can respond quickly to requests made by the villagers in case the villages cannot make their own repairs. Further, since some catchment areas are too large for one Sub-WASHE to take the responsibilities, difficulties arise in handling the required repairs with the present members. As a consequence, an Area Pump Mender (APM) selected from the area needs to be trained to support the Sub-WASHE.

4. Strengthening of District Level as Coordination Body

In the Three-Tier System, as a result of capacity building in implementation functions of Sub-WASHEs and V-WASHEs, the function of the D-WASHEs can be transferred from that of an implementation body to a coordinator. As a coordinating body, the main responsibilities of the D-WASHE are formulation of district development programmes based on reports from the Sub-WASHEs concerning village needs and implementation progress of water and sanitation improvement activities; monitoring of programme outputs; policy and technical support to the Sub-WASHEs; and information management of water and sanitation improvement in the district. Especially in this project, the selection of parameters, method of information collection, method of evaluation and other monitoring activities need to be confirmed and agreed with the D-WASHEs and Sub-WASHEs.

The management, and operation and maintenance by the community, and the approach taken to improve this structure are determined to be feasible as follows.

a. The feasibility of planning for management and operation and maintenance is assured because of the conformity with the basic policy and strategy being promoted by the Zambian government.
b. In the Northern Province, the Provincial government as well as each district administrative bodies are adopting the WASHE concept for operation and maintenance. Also, since the necessary personnel training at the Province and districts is being advanced through sectoral development plans, and although differences in allocation and capacity of staff are found, human resources are available to an extent for this project.
c. Most of the project sites are scattered in remote rural areas away from the district headquarters. Therefore, in order to maintain the constructed water supply facilities in a sustainable and effective way, the residents must carry out appropriate usage and maintenance methods to prevent malfunctions and breakdowns before their occurrence, and a system capable of responding from nearby the village when a problem arises needs to be established. This structure can be effective for reducing operation and maintenance costs, as well as minimizing non-operating periods of facilities. The realization of this kind of operation and maintenance system that is possible at the community level is a significant factor to assure self-development of the project.

Due to the delayed start in guidance on operation and maintenance of handpumps in the Northern Province, since last year, with the support from Ireland Aid, P-WASHE started preparing an “Operation and Maintenance System, Guiding Document” to improve the present predicaments previously mentioned. According to the guideline, P-WASHE is taking the following approach to structure the operation and maintenance.

a. Sub-WASHE members will be trained to enable repairs of handpumps to be made at the Sub-WASHE level, which becomes nearer to the villages. Also, a person residing in the catchment area will be selected and trained to become an Area Pump Mender (APM) or Area Mechanic in order to form a support for the Sub-WASHE on technical matters of operation and maintenance.
b. A trainer will be allocated in the D-WASHE to train the Sub-WASHE members and APMs.
c. The V-WASHE will be trained on preventive maintenance and simple repairs.
d. Operation and maintenance tools will be allotted to the catchment areas and

villages according to their scope of responsibilities.

e. Spare parts for handpumps will be allocated to each district to create an environment in which the villagers can purchase them whenever necessary.

According to the P-WASHE, the above-mentioned operation and maintenance guideline is scheduled for completion within this year, and its introduction to the districts and training of trainers in the D-WASHEs are anticipated. However, since the introduction of this new guideline will probably start in the latter part of the year, the response will probably be realized next year. Therefore, for realization of a sustainable operation and maintenance structure, the support through a software component in this project is essential.

In the discussions with P-WASHE members and Ireland Aid representatives, mutual agreement was made that the basic policies and approach presently adopted by P-WASHE will be followed in this project for consistency. Moreover, since the introduction of an operation and maintenance approach for handpump facilities focusing on the village level is still a new concept, P-WASHE and Ireland Aid requested the reflection of experiences and lessons learned from the Japanese grant projects implemented in other provinces of Zambia.

2-5 Technical Training for Capacity Building and Institutional Strengthening (Software-Component Programme)

2-5-1 Background

The Zambian government has requested, in addition to construction of facilities which will enable safe and stable supply of water, the support for capacity building and institutional strengthening in order to create a structure in which the beneficiary communities can operate and maintain the completed water supply facilities by themselves. Problems were analyzed, through the Basic Design Study, in relation with the beneficiary communities of improvement of water and sanitation conditions and local authorities which role as policy-maker and facilitator of interventions related to water and sanitation. Upon confirmation of the problems confronting these stakeholders of the target area during the field survey, the results revealed the necessity for strengthening the management, and operation and maintenance system of water supply facilities, for early realization of the expected outcomes through the effective use of the facilities constructed by the project, based upon establishment of proper hygiene behaviours, and awareness on ownership by the communities.

As described in the previous Section 2-4, Project Operation and Maintenance Plan, the community-based operation and maintenance system is primarily managed by the community members with support services from the local authorities in Zambia. This project will also introduce this operation and maintenance system in the target area. Due to decentralization in rural water supply and sanitation sector in Zambia, the local authorities through the District Councils are mandated to govern the operation and maintenance of interventions related to rural water supply and sanitation. They are also responsible for building capacities of human resources involved in planning, implementation, and maintenance of water supply and sanitation in the districts, facilitation of community participation, and support from policy-making, technical and financial aspects. Therefore, it is indispensable for each target district to allocate human resources with enough skills and knowledge to implement and facilitate the interventions in order to establish operation and maintenance system in the target area during and after the project. However, the results of the field survey in the Basic Design Study revealed some issues to be solved in relation with these human resources and existing organisations in the target districts.

Therefore, to improve the water and sanitation environment based on the community participation and promote operation and maintenance activities, the "Software Component Programme" aims to give support for capacity building of the personnel of the local authorities and those who are involved in actual support activities to residents at the village level in terms of improvement of water and sanitation. The following paragraphs explain the basic policies related to rural water supply and sanitation of the Zambian government and issues to be solved in the target area of this project, which are basic for deciding policies and contents of the cooperation by the Japanese government through the "Software-Component Programme".

1. Basic Policy on Operation and Maintenance related to Rural Water Supply and Sanitation of Zambia

The Zambian government is facilitating direct involvement of the beneficiaries in the management of interventions on community water supply and sanitation as the basic principle by adopting the National Water Policy (1994) followed by the Community Water Supply and Sanitation Strategy (1999), and Guidelines for Implementation of Community Water Supply and Sanitation Projects (2001). This principle aims to realise the community-based management of water supply and sanitation, which is implemented by the communities' analyzing their problems and needs and deciding allocation of resources as well as measures to improve the present situation. Therefore beneficiary communities are responsible to contribute a part of the investment costs in cash, kind, or form of labour and to bear the operation and maintenance costs as well. For these communities' own initiative, the local authorities are expected to provide technical support for the informed choice by the communities, training of the community leaders, mobilization of communities, and allocation and coordination of resources.

The so-called "Three Tier System" operated by the WASHE committees at district, catchment area and village levels is the mechanism to activate the operation and maintenance based on the collaboration between the communities and local authorities. Refer to Chapter 4 for operation and maintenance with the Three Tier System.

2. Basic Strategy and Approach for Improvement of Management, and Operation and Maintenance Structure

The WASHE concept officially adopted by the Zambian government in 1997 is the basic strategy and approach to plan and implement the community-based rural water supply and sanitation interventions. It centres approaches and methodologies for strengthening their capacities with the participatory methods for problem solving as well as for organizing the stakeholders at both local authorities and communities. Based on the feedback of the lessons learnt from the past experiences in the RWSS projects with assistance from the donor agencies, these methodologies, called the "WASHE activities", have been systematized to some degree. The Zambian government is encouraging to introduce the WASHE activities in all the RWSS projects in the country.

Aiming at realization of sustainable management of water and sanitation, the WASHE activities emphasize to achieve the following conditions through the integrated approach between promoting transformation of attitudes toward appropriate hygiene concept and behaviours, and strengthening of operation and maintenance system of water and sanitation facilities.

1) Creating sense of ownership of the communities towards improvement of their living conditions
2) Improvement of capacities of community members for problem analysis and action planning
3) Strengthening leadership of the community leaders to facilitate the communal activities
4) Enhancement of understanding and action to secure positive impacts produced from correlative relation between prevention of diseases/ improvement of health conditions and safe water and sanitation environment
5) Provision of support services from the local authorities to facilitate improvement of awareness, life skills and behaviours of the community members as mentioned above

In case of interventions on improvement of water supply, series of activities to confirm needs of the communities and to discuss solutions with paying attention to the health and hygiene is, therefore, incorporated into the project with training in skills for operation and maintenance of water facilities.

With regard to the budget allocation for the capacity building, the local authorities are expected to manage it under their responsibility. However, due to their vulnerable financial status, they have difficulties to bear the initial costs required to establish the operation and maintenance system. For this reason, the local authorities seek assistance from donors for these initial costs as part of the investment of the project together with funds for construction of water facilities. While the beneficiary communities and local authorities will be responsible for management and monitoring of the water facilities after completion of this project, the Zambian government is requesting the Japanese side for support to the implementation of these WASHE activities, with proper coordination with the construction works, as part of the initial inputs by the Japanese side.

After the Zambian government adopted the WASHE as the national strategy, it has also been incorporated into the rural water supply projects funded by the Japanese grant aid assistance as the basic policy on operation and maintenance of the projects. Further, activities to support establishment of the operation and maintenance system have been conducted through the Software-Component Programme. As a result of these cooperations, the on-going "Project for Groundwater Development and Sanitation Improvement in Drought Prone Rural Areas" funded by the Japanese government achieved formation of V-WASHEs in all the target villages and the community members are ready to be involved in fund-raising of the maintenance costs as well as management and repair of water facilities under the leadership of the V-WASHEs. This project will also elaborate the action plans on these technical training for capacity building and institutional strengthening with considering special conditions of the target areas such as socio-economic status of the beneficiary communities and present capacities of the local authorities regarding the provision of support services as well as lessons learnt from the on-going Japanese project and similar interventions by other donor agencies/ NGOs.

3. Issues to be Solved

a. Problems at the Village Level

The field appraisal was conducted in the Basic Design Study to assess the present water and sanitation environment for the beneficial communities, feeling of satisfaction of the communities towards the present situation, their needs and willingness, and support activities to facilitate community-based

management of water and sanitation by the local authorities represented by the D-WASHE. Problems summarized hereunder are the results of these exercises for appraisal and to be solved in this project;

1) V-WASHE and community members do not have knowledge and skills necessary for operation and maintenance of borehole water supply facilities

While the construction of borehole water supply facilities with handpumps are currently promoted in the Northern Province, the community members of V-WASHEs are not trained in skills required for preventive maintenance of the facilities in all the target districts. Therefore, the existing handpump facilities are being used by the communities without knowledge to replace the consumables and to check defects on the facilities. Even in case that the facility breaks down, it takes a long period for the District Councils or D-WASHEs to attend the repair works after receiving a report from the community. Among these villages, there is a facility which has been left for more than half a year after breakdown. During the field survey in the target areas, quite a good number of community members answered that they would prefer to have handpumps rather than the cylinder bucket type or protected hand dug wells, as the mechanism of handpumps saves on load to pump up water and protects water quality compared with these two other alternatives. However, at the same time, they pointed disadvantages of the handpump as, they cannot manage the problem on the facility by themselves due to lack of knowledge on daily maintenance of facilities and maintenance tools.

In another case in the villages where they have existing handpump facilities, V-WASHEs cannot set the user fees properly since they do not have information on maintenance costs, items of spare parts and frequency to replace them, and hence difficulties to quickly prepare a fund for repair in case of breakdown.

2) Capacity to perform the roles and responsibilities of V-WASHE is inadequate.

As an entry point of the interventions on water and sanitation, formation of V-WASHEs in the villages are commonly facilitated under the projects by the D-WASHEs in the target districts with assistance from the Ireland Aid. The D-WASHE, through Sub-WASHE in the affected area, firstly promotes

formation of V-WASHE in the village where the community members express their needs to improve water and sanitation. Similarly, in case of health issues, the Ministry of Health facilitates to organise the Neighbourhood Health Committee at the village level.

Therefore, community-based organisations related to health, water, and sanitation such as health committee, V-WASHE, and water management committee are organised with community's initiatives in several villages where they have felt needs to improve water, sanitation or health regardless of existence of water and sanitation facilities in the village. These communities can be regarded to have a certain degree of awareness on importance of improvement of health and water supply conditions as well as implementation of interventions by the community-based organisations. Therefore these existing organisations can be utilized in this project as well to establish the operation and maintenance system at the village level.

At involvement of these existing community-based organisations, capacity building of members on management of the organisation and leadership should be emphasized in the project, with considering the problems that the regulations of the committee and roles and responsibilities of the members are not clearly defined, hence few understanding by other community members towards purpose of the organisation.

3) Fund-raising for operation and maintenance is not yet common in the target area.

Community members in approximately 80% of the survey sites rely on streams, dambos, scoop holes, and unprotected spring and shallow wells for drinking water. As the maintenance fund is not collected for these unprotected water sources, most of the residents in the target sites do not have experiences in raising and managing the maintenance fund for communal water supply facilities.

According to results of the key informant interviews to community leaders such as village heads and head teachers in the target areas, they acknowledged necessity of fund-raising for the maintenance of water facilities in case of construction of new facilities in the project and expressed willingness to pay for it. Meanwhile, some households questioned or ignored costs to be borne for maintenance of the communal facilities in the

village during the sample household survey. Therefore, it is required to enhance awareness of the community members in the project on details of costs to keep the communal water facilities in proper conditions and necessity of cost sharing by the users together with importance of use of safe water. In addition, training of V-WASHEs are also required in simple book keeping and recording on inventory of repair works for proper management of the maintenance fund contributed by the users.

b. Problems at the Catchment Area Level

1) The roles and responsibilities of D-WASHE and Sub-WASHE are not clearly defined.

The Three Tiers System was introduced in operation and maintenance of RWSS in the Northern Province with an expectation to facilitate and support the community-based management of water and sanitation closer to the village level. The Sub-WASHE formed in every catchment area consists of staffs providing the outreach services of local administrations such as rural health centres, schools and agriculture blocks located within the area.

These Extension staffs have communications with the community members on a daily basis as part of their routine work of each organisation as well as with district offices of the ministries through regular reporting. The Sub-WASHEs formed by these extension staffs are supposed to facilitate community mobilization to promote the district development plans related to water and sanitation, formation of V-WASHEs and hygiene education, while utilizing the communication channels between the district and villages. On the other hand, the D-WASHEs are mandated to formulate the development plan for improvement of water supply and sanitation in the districts based on the needs collected from the village and catchment area levels, to provide financial and technical support through Sub-WASHEs to the communities, and to co-ordinate and supervise the interventions.

Considering the present situation of the target area, the demarcations of roles and responsibilities between the D-WASHE and the Sub-WASHE are not clearly defined as the policy-makers of the entire development plan of the project, and the facilitator of actual activities in the village, respectively. Due to duplication of the demarcations of roles and responsibilities, both of them are directly involved in the activities for community mobilization and

capacity building at the village level in some districts. Since this situation implicates duplication of costs for activities and indistinct definition of responsible persons, clear definition of roles and responsibilities of district, catchment area and villages is required to establish the efficient operation and maintenance system.

2) The catchment area does not have personnel with skills to support the community in operation and maintenance and repair of borehole facilities equipped with handpumps

Technical support to the communities is not available at the catchment area in terms of maintenance and repair of handpump facilities due to lack of trained personnel. There is a need to train and appoint the Area Mechanics or Area Pump Menders who can provide the technical services for installation, maintenance and repair of the water facilities while the Extension staff will be trained in skills for formation of V-WASHE, facilitation of participatory activities for improvement of living conditions, and hygiene education.

c. Problems at the District Level

1) Personnel capable of giving training on maintenance and repair of handpump fitted borehole facilities is in shortage.

At present, only personnel at the district offices of DWA have skills and knowledge on maintenance and repair of handpump water facilities. However, the number of these staffs are not enough to directly serve for maintenance activities at the village level due to restructuring of the staff deployment of DWA as a part of the process for reorganisation of the RWSS sector including transferring the responsibilities on operation and maintenance from DWA to the local authorities under the Ministry of Local Government and Housing. In order to shift the implementation set up of the operation and maintenance activities from the direct involvement of DWA to a community-based system, trainers are to be appointed at the district level to provide technical training to the communities and personnel in the catchment areas. For this reason, some of the D-WASHE members will be trained as the trainers on installation and repair of handpump water facilities.

2) Process, achievement and impact of the interventions on water and sanitation are not sufficiently monitored by the district.

The extension staffs, in conjunction with the community members, are supposed to regularly monitor the process of implantation of the V-WASHE action plans, daily maintenance of water supply, handling of the problem on the facilities, and actions to improve the hygiene behaviours at the village level. Nevertheless, these monitoring activities and feedback of those results to the new action plans are not smoothly conducted as the establishment of monitoring and evaluation plan and its methodologies is delayed at the district level. It brings up necessity to set up the methodologies for monitoring and evaluation of the process and achievements of activities related to the capacity building and technical training, performance of the trained personnel, and impact of the interventions. Based on this monitoring and evaluation system, appropriateness of the training methods and contents of the program applied to the interventions will be verified and utilized to increase the value of these WASHE activities in future.

2-5-2 Objectives

With respect to the issues mentioned above, stakeholders at district, catchment area and village levels need to share the common views on the goals and approaches for improvement of water and sanitation in the district and to equip themselves with skills and knowledge necessary for the community-based management of these interventions. This approach will be incorporated into this project as the Software-Component Programme under the cooperation by the Japanese side since it can effectively work to realise the objective of this project and to ensure the sustainability of positive impacts of the project.

The direct target group of capacity building and institutional strengthening under this Sofwaret-Component Programme is the personnel at the district and catchment area while the community members in the target sites will finally enjoy the benefits to be produced from the improvement of these personnel at district and catchment area. Activities at the village level such as community mobilization/ organisation and training in operation and maintenance will be conducted as a series of the programme for capacity building of these personnel in facilitation of the WASHE activities.

Considering the policy of this project on construction works to be implemented with the community participation, the schedules of construction works and the WASHE activities are to be coordinated properly. It is expected that strengthening of the support services of D-WASHE and Sub-WASHE will enable them to continue follow up for the beneficiary communities and to utilize their skills in the similar interventions to be implemented in other areas after completion of this project.

2-5-3 Outputs of the Software-Component Programme (Direct Effects)

The direct effects or outputs anticipated through the realization of the software-component programme are explained below.

1) The skills and knowledge of the human resources at the district and catchment areas are improved for capacity building and facilitation of hygiene education required to improve water supply and create an appropriate operation and maintenance system with communities' initiatives.

The indicators to measure the above output and their means of verification are as follows.

a. D-WASHE trainers, Sub-WASHE members (Extension Staff) and Area Mechanics/ Area Pump Menders who have acquired the skills necessary for proper operation and maintenance of water supply facilities will be allocated in the district.

Through actual training of the Area Mechanics, achievements of the training of two trainers appointed from each D-WASHSE will be verified in terms of installation and repair of handpump water facility, concept of the community-based management of the water and sanitation, roles and responsibilities of each actor, skills to provide trainings to the Area Mechanics. Regarding the personnel at the catchment area level, degree of achievement of training programmes for the extension staff will be verified through provision of training to the communities in participatory planning and monitoring as well as hygiene education. Similarly, the progress of training of the Area Mechanics will be monitored in the process of training of communities, which will be conducted by the Area Mechanics for technology transfers on daily maintenance of water facilities at village level.

b. V-WASHE is formed in every target community through facilitation by the

D-WASHE and Sub-WASHE (Extension Staff).

Prior to the commencement of the construction works, V-WASHEs are to be organised at the 175 target communities with facilitation by the Sub-WASHEs. Attention is to be paid at the verification of achievement of this indicator whether the methodologies to proceed the discussions and time for the community meetings are decided to facilitate women's participation and contribution of their opinions in actual decision making.

c. V-WASHEs at the target villages acquire operation and maintenance skills for water supply facilities through training by Sub-WASHE members (Extension Staff) and Area Mechanics.

Skills to be equipped to the V-WASHEs for operation and maintenance are categorized into the technical issues such as preventive maintenance, replacement of the consumables, and measures to protect environmental sanitation around the water point and the management issues related to action planning for maintenance activities, provision of advices to the users on proper use of water facility, collection and management of the maintenance fund, and access to the support services of the D-WASHE and Sub-WASHE. These issues are to be dealt in the training of V-WASHEs by the Extension Staff and Area Mechanic appropriately, and to be reflected in the V-WASHE action plans. Understanding of the V-WASHEs on maintenance costs as well as utilization of repair services by the Area Mechanics should also be confirmed in the verification of achievements.

2) The skills and capacity of the D-WASHEs and Sub-WASHEs to monitor and evaluate the impact of water and sanitation activities are strengthened.

The indicators to measure the above output and their means of verification are as follows.

a. The results of monitoring on water and sanitation improvement activities at the village and catchment area levels will be recorded and accumulated by D-WASHEs.

At the commencement of the project, goals to be achieved in each activity under the Software-Component Programme as well as the objective and outputs of the project will be shared by the D-WASHEs and Sub-WASHEs. Further, the plans for monitoring and evaluation will be formulated by these parties to measure the implementation process, achievements and impact of

the interventions. The D-WASHEs, Sub-WASHEs and Area Mechanics will conduct the monitoring activities based on these plans by utilizing the monitoring forms to be elaborated by them in the project. Therefore, results of these monitoring activities filled in the forms are to be periodically collected and filed at the district.

b. By reflecting upon the monitoring results from D-WASHEs and Sub-WASHEs, annual action plans are updated yearly.

Based on the review and evaluation of the monitoring results obtained from the activity mentioned above, D-WASHEs are expected to formulate the annual action plan.

The main outputs to verify the above indicators are listed below.

1. Operation and maintenance manuals for water supply facilities fitted with handpumps (for Area Mechanics and V-WASHEs)
2. Guideline for D-WASHE and Sub-WASHE on facilitation of appropriate management, and operation and maintenance system
3. Monitoring records from Sub-WASHEs and D-WASHEs
4. Action plans of V-WASHEs

2-5-4 Intervention Plan

In accordance with the guidelines on the WASHE activities, which has been standardized to a certain degree in Zambia, and based on the assessment of current activities as well as available resources in the target districts, intervention plan for the capacity building and institutional strengthening required for each district are prepared as follows.

1) Japanese Side Intervention

Activity No. 1 Orientation of the project and preparation of plan of operation for establishment of the operation and maintenance system of the project

Objectives

- To explain objectives, contents and implementation plan of the entire project and the Software-Component Programme and request for cooperation of the local authorities.
- To form a task force in the D-WASHE.

- To discuss and develop consensus on the goals, target group, approaches/ methodologies and implementation schedule after defining the roles and responsibilities of each actor in the operation and maintenance system.
- To formulate monitoring and evaluation plan to be executed during and after the project.
- To make consensus on usage and management system of the equipment for the operation and maintenance activities to be procured under the project.

Target Group

All members of D-WASHE of each district and representatives from Sub-WASHE (2 members from each catchment area)

Implementation Period

4 days/workshop × 7 districts

Activity No. 2 Capacity building of D-WASHE Trainers responsible for training the Area Mechanics

Objectives

- To foster understanding on the WASHE concept of the community-based operation and maintenance of water supply facilities.
- To equip skills necessary for installation and repair of handpumps and construction of appurtenant facilities.
- To equip skills necessary for training of the Area Mechanic and planning, operating and managing the training workshop with the participatory approaches.
- To compile the operation and maintenance manuals of handpump water facilities, which will be used for the training of the Area Mechanics and caretakers.

Target Group

Trainers selected from each D-WASHE (2 persons from each district)

Implementation Period

5 days/workshop (target districts will be divided into 3 groups, and so 3 workshops will be held)

Activity No. 3 Improvement of skills necessary for guidance and facilitation of the community-based water and sanitation interventions

Activity 3-1 Confirmation of approaches and methodologies for village level activities

Objectives

- To improve skills required to facilitate community sensitization, hygiene education, pre-siting, participatory planning and evaluation, and management of the water facility in accordance with the plan of operation agreed upon at the Activity No. 1.
- To formulate the work schedule for each Sub-WASHE who will be involved in the community sensitization and training of V-WASHE in the project sites.
- To confirm the communication flow for the operation and maintenance of water facilities in the district.

Target Group

Sub-WASHE members from the catchment areas where the project sites are located (2 Extension Staff/ catchment area)

Implementation Period

5 days/workshop × 7 districts

Activity 3-2 Technical training through facilitation of exercises at the village level

Objectives

- To enhance establishment of skills and capacities of Sub-WASHEs through facilitation of community mobilization, hygiene education, formation of V-WASHEs and their training on operation and maintenance utilizing the skills obtained from the Activity 3-1. The modules of the exercises are as described below.
  (1) Introductory visits: briefing of the project to the community leaders (0.5 day/ site)
  (2) Community meeting for confirmation of the willingness of the community members towards implementation of the project and sensitization for participation in the project (0.5 days/ site)
  (3) Pre-siting of the candidate locations of water facilities based on the problem analysis on existing water and sanitation environment (1 day/ site)

(4) Participatory hygiene education and baseline survey (1 day/ site)
(5) Formation of V-WASHE (1 day/ site)
(6) Training of V-WASHE on their roles and responsibilities and formulation of the V-WASHE action plan (2 days/ site)
(7) Training of the treasurers in financial management for O&M (1day/ catchment area)
(8) Training of caretakers in management of sanitary conditions of the water point (1 day/ site)
(9) Hygiene education to promote appropriate use of the constructed water facility (1 day/ site)

Target Group

Sub-WASHE members who successfully completed the training in Activity 3-1

Implementation Period

9 days in total/ site × 175 sites

Activity 3-3 Monitoring and evaluation by D-WASHEs

Objectives

- To verify the achievements of exercises conducted by the Sub-WASHE as mentioned in Activity 3-2 and give advice for improvement of the skills based on the monitoring by the D-WASHE and local NGO/ consultant.
- To examine necessity to modify the approaches and methods for capacity building as well as hygiene education through monitoring the situation of cooperation from the V-WASHE and community members towards implementation of the projects, their participation in the meetings and trainings, and degree of understanding.

Target Group

Sub-WASHE members trained in Activity 3-1

Implementation Period

Carry out the monitoring at about one third of the project sites for modules (1) through (9), respectively, according to the time required for conducting each module.

Activity No. 4 Training to Area Mechanics on repair and maintenance of borehole facilities fitted with handpumps

Activity 4-1 Orientation

Objectives

- To develop understanding on the concept of the community-based management, operation and maintenance of water facilities.
- To equip skills necessary for installation, maintenance and repair of handpumps and construction of the appurtenant facilities.
- To equip skills necessary for training of the community members as well as V-WASHEs on daily maintenance of the facilities and for planning and implementation of these training exercises at the village level.
- To confirm the communication flow for the operation and maintenance of water facilities in the district.

Target Group

Area Mechanics selected from catchment areas where the project sites are located (2 persons/ catchment area)

Implementation Period

5 days/workshop × 7 districts

Activity 4-2 Technical training through involvement in the actual construction works

Objectives

- To enhance establishment of skills and capacities of the Area Mechanics trained in Activity 4-1 through involving them in the actual construction works of the water facilities and training of caretakers at the village level.

Target Group

Area Mechanic who successfully completed training in Activity 4-1 above

Implementation Period

(1) Monitoring and promotion of labour contribution during installation of handpumps as well as construction of appurtenant facilities by the contractor (2 days/ site × 175 sites)

(2) Training of caretakers on operation and maintenance skills (1 day/site × 175 sites)

Activity 4-3 Monitoring and evaluation by D-WASHEs

Objectives

- To verify the achievements of training of the Area Mechanics based on monitoring by the D-WASHEs on the process of implementation of the exercises mentioned in Activity 4-2 above.
- To examine necessity to modify the approaches and methodologies for training of operation and maintenance skills at the village level through monitoring degree of understanding of the caretakers concerning the preventive maintenance of water facilities.

Target Group

Area Mechanics who successfully completed training in Activity 4-1 above

Implementation Period

Carry out monitoring at about one third of the project sites for modules 1) and 2), respectively, in Activity 4-2.

Activity No. 5 Evaluation on achievements and impact of the interventions

Objectives

- To evaluate the achievements and impact of the Software-Component Programme based on the monitoring records collected during each activity, upon completion of all activities.
- To compile a guideline for D-WASHE and Sub-WASHE on facilitation of the community-based operation and maintenance activities which will be continued after the project.

Target Group

Representatives from each D-WASHE (2 persons/ district)

Implementation Period

5 days/workshop × 2 times (target districts will be divided into 2 groups)

2) Responsibilities of Zambian Side

In this project, the Japanese side will support the above-mentioned interventions before construction of water supply facilities and continue until their completion within the entire implementation period governed by the Exchange of Notes to be signed by the both governments. However, after

completion of the Japanese supported intervention, the following monitoring activities need to be continued by the Zambian side.

a. Monthly Village Monitoring by Sub-WASHE (12 times a year)

[Objective]

Situation on proper usage, yield and quality of water, operating condition of handpumps, improvements in hygiene practices and other parameters need to be confirmed with each V-WASHE. Also, the water and sanitation improvement policies prepared by the D-WASHEs will be promoted at the village level. The monitoring results can be reflected in the D-WASHE action plans of each target district.

b. Hygiene Education by Sub-WASHEs (12 times a year)

[Objective]

After completion of the Japanese cooperation, based on the results of the monthly monitoring mentioned above, hygiene education must be continued to improve hygiene practices. These activities should be conducted in the same period as the monitoring. Sub-WASHE members should transfer skills to the V-WASHEs accordingly so that hygiene education can be given to the residents by them.

2-5-5 Assignment of Personnel

Personnel to be assigned to implement the Software-Component Programme are the following.

1) Japanese Consultant (in charge of operation and maintenance plan and public health)

One Japanese consultant is needed to (1) formulate the Software-Component Programme, supervise the implementation schedule and the progress of the entire programme; (2) report to the Client and Japanese concerns and coordinate the parties concerned in the programme; and (3) coordinate with the construction schedule. Also, technical advices and capacity building will be given to local staff from NGO/consultant who will be involved in facilitation of the activities under the programme. The Japanese consultant shall be sufficiently experienced in the social development field.

2) Counterpart from Executing Agency

One staff member of DWA will participate as counterpart to the Japanese consultant to cooperate in supervisory activities. In the course of the programme implementation, this personnel will also coordinate administrative matter with the Zambian side when necessary.

3) Local NGO or Consultant

To effectively promote the activities under the Programme, personnel from a local NGO or consultant having similar experience in Zambia will be hired. The required personnel are described below, but each staff must be fluent in communication with the languages used in the target area.

a. Programme Coordinator: 1 person

Under the supervision of the Japanese consultant, this person will be responsible to lead the activities, manage the inputs and methodologies, control the outputs, and report the progress to the consultant. The programme coordinator must have full experience as manager of related WASHE activities.

b. Facilitator (in charge of participatory water and sanitation interventions): 2 persons

Under the management of the programme coordinator, the facilitators will conduct supporting work, especially technical training in installation, repair and O&M of handpumps, participatory planning and evaluation, and hygiene education. The facilitators must be fully experienced in capacity building and facilitation of community participation, awareness campaign, formation of community-based organisation and hygiene education.

2-6 Project Cost Estimation

2-6-1 Project Cost Estimation

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

2-6-1-1 Cost Borne by the Japanese Government

Total Project Cost Estimate **Approx. 809 million Yens**

1) Contraction Cost 175 Sites (175 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	386
Detail Design, Construction Supervision, Technical Guidance		97
Software Component Programme Activities		36

Cost Estimate (Total) **Approx. 519 million Yens**

a. Mpika District: 21 Sites (21 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	48
Detail Design, Construction Supervision, Technical Guidance		12
Software Component Programme Activities		5

Cost Estimate (Sub-Total) Approx. 65 million Yens

b. Chinsali District: 27 Sites (27 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	58
Detail Design, Construction Supervision, Technical Guidance		15
Software Component Programme Activities		5

Cost Estimate (Sub-Total) Approx. 78 million Yens

c. Isoka District: 16 Sites (16 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	34
Detail Design, Construction Supervision, Technical Guidance		9
Software Component Programme Activities		3

Cost Estimate (Sub-Total) Approx. 46 million Yens

d. Nakonde District: 24 Sites (24 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	51
Detail Design, Construction Supervision, Technical Guidance		13
Software Component Programme Activities		5

Cost Estimate (Sub-Total) Approx. 69 million Yens

e. Mbala District: 31 Sites (31 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	65
Detail Design, Construction Supervision, Technical Guidance		16
Software Component Programme Activities		6

Cost Estimate (Sub-Total) Approx. 87 million Yens

f. Mpulungu District: 23 Sites (23 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	53
Detail Design, Construction Supervision, Technical Guidance		13
Software Component Programme Activities		5

Cost Estimate (Sub-Total) Approx. 71 million Yens

g. Luwingu District: 33 Sites (33 Boreholes)

Item		Cost Estimate (million Yens)
Construction	Borehole Construction, Pumping Test, Water Analysis, Handpump Installation, Apron Construction	77
Detail Design, Construction Supervision, Technical Guidance		19
Software Component Programme Activities		7

Cost Estimate (Sub-Total) Approx. 103 million Yens

2) Equipment Cost

Executing Agency: Department of Water Affairs,
Ministry of Energy and Water Development

Item		Cost Estimate (million Yens)
Procurement	Drilling Rig, Compressor, Pumping Test Equipment, Crane Truck, Water Tanker, Fuel Tanker, Transport Truck, Geological Survey Equipment, WASHE Support Vehicle, WASHE Motorbike, Computer, Water Analysis Kit	275
Detail Design, Procurement Supervision		15

Cost Estimate (Total) Approx. 290 million Yens

2-6-1-2 Cost Borne by the Zambian Government

Cost Item	Total	Calculation	Comment
Personnel Expense for Drilling Crew	ZK 658,560,000	ZK 140,000/pers/day × 7 pers/crew × 2 crews/phase ×8 months×21 days/mon × 2 phases	
Personnel Expense for Trainees on Management and Supervision	ZK 456,960,000	ZK 160,000/pers/day × 8 persons × 17 months × 21 days/mon	
Personnel Expense for Counterpart from Executing Agency and Members of P-WASHE and D-WASHE for Software-Component Activities	ZK 54,707,000		See breakdown in Appendix Ap 5-5
Advising Commission for Authorisation to Pay (A/P)	ZK 480,000	ZK 160,000×2 phases + ZK 80,000×2 times	¥4,000 for each A/P ¥2,000 for each amendment
Payment Commission to Bank	ZK 16,650,000	ZK 33.3 billion×0.0005	0.05% of each payment
Grand Total	**ZK 1,187,357,000**		

2-6-1-3 Conditions for Estimation

a. Estimation Base — April 2003

b. Exchange Rate — 1 US$ = 121.06 Yen
1 ZK = 0.02489 Yen

c. Period of Construction and Procurement — Implemented in two (2) phases according to schedule shown in previous section.

d. Others — This project is to be implemented in accordance with the guidelines for grant assistance of the Japanese government.

2-6-2 Operation and Maintenance Cost

The cost for operation and maintenance of the completed borehole facilities fitted with handpumps will be as follows.

Table 2-15 Cost Required for Operation and Maintenance

(Unit: Thousand Kwacha/year)

Target Committee	Cost Item		Unit Cost	Q'ty	Amount
P-WASHE	Operation and Maintenance Activities	*1	9,872/Team	2	19,744
D-WASHE (Sub-WASHE)	Operation and Maintenance Monitoring Activities	*2	20,946/Dist	7	146,622
V-WASHE	Operation and Maintenance Activities	*3	380/Site	175	66,500
Total					**232,866**

*1 Cost for P -WASHE O&M Activities

Allowance: ZK 160,000/pers/day×1 per/trip×3 days/trip×4 trips/yr = ZK 1,920,000

Fuel Expense: ZK 4,200/lit×900 km/trip×4 trips/yr×lit/6 km =ZK 2,520,000

Pick-up O&M Cost: As 7% of vehicle cost (ZK 77,600,000)/yr/veh = ZK 5,432,000

Sub-Total: ZK 9,872,000

*2 Cost for D-WASHE (Sub-WASHE) O&M Monitoring Activities

Allowance:	ZK 150,000/per/day×3 per/day×3 days/mon×12 mon ＝ ZK 16,200,000
Fuel Expense:	ZK 4,200/lit×200 km/trip×12 trips/yr×lit/15 km×3 bikes ＝ ZK 2,016,000
Motorbke O&M Cost:	As 7% of motorbike cost（ZK 13,000,000）/yr/bike ×3 bikes = ZK 2,730,000
Sub-Total:	ZK 20,946,000

*3 Cost for V-WASHE O&M Activities

Spare Parts for Handpump:	As 10% of Handpump Cost（ZK 1,900,000）/yr ＝ ZK 190,000
Reserve for Replacement:	ZK 1,900,000 /10 yr = ZK 190,000
Sub-Total:	ZK 380,000

The above figure shows that the annual cost to be reserved by each V-WASHE of the target sites amounts to about ZK 380,000, which is about ZK 1,520/pers/yr in consideration of one borehole to serve 250 persons, or about ZK 760/HH/mon. According to the social survey results, the amount that the residents are willing to pay for operation and maintenance is ZK 500 to ZK 1,000/HH/mon. This amount is similar to what residents are presently paying in villages of other projects. Therefore, the cost required for this Project is determined to be feasibly payable by the residents.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effect

The effects of the Project and anticipated improvements in the present situation are listed below.

Table 3-1 Effects and Improvements due to Project Implementation

Present State and Problems	Measures to be Taken in the Project	Effects and Improvements
1. Due to shortage of drilling related equipment, the goals for groundwater development cannot be achieved.	• Equipment and materials necessary to conduct drilling operations will be procured.	• Groundwater development can be promoted and operation and maintenance structure can be strengthened with the procured equipment and materials. • The supply of safe and stable water to the target area can contribute to meeting the development goals.
2. The target villages are using rivers and springs as water sources, which are unsanitary and have unstable flow throughout the year. Due to this situation, the villagers are having problems with diarrhea and other water-borne diseases.	• Borehole facilities fitted with handpumps will be constructed at the target sites.	• The target sites will receive 30 lit/cap/day of water throughout the year from the completed water supply facilities. • The water quality of water supply facilities will satisfy the quality guidelines throughout the year.
3. Although past Japanese grant projects transferred technology on borehole construction, restructuring and passing away of trained technician has left only a few skilled technicians.	• OJT on drilling techniques and TOT on supervision of drilling works will be given to DWA staff.	• Capacity for borehole drilling of DWA will be improved. • Trained engineers can train new drillers when necessary.
4. Provincial, district, sub-district and village level WASHEs each has separate functions for operation and maintenance of completed water supply facilities, but the structure needs strengthening. Also, proper management, and operation and maintenance cannot be carried out due to lack of vehicles and equipment.	• Guidance on operation and maintenance through the software-component programme will be conducted. • Equipment and materials to support WASHE activities will be procured.	• V-WASHE will be formed in every target site and will receive training on proper operation and maintenance of water supply facilities through facilitation by D-WASHE and Sub-WASHE (Extension Staff) • The residents will periodically set aside an agreed amount (about ZK380,000 /borehole/year) to cover the operation and maintenance cost. • The time lapse from the moment of damage to repair of water facilities will be reduced as compared to the present average of 4 months.

3-2 Recommendations

1) Measures needed for Low Groundwater Potential Areas

Hydrogeologically, groundwater is scarce in many areas of the Northern Province. Especially in Mpulungu and Luwingu districts, many villages are relying on surface waters and springs as their water sources because groundwater is difficult to access. From the results of the field survey, the success rate for these 2 districts is determined to be very low. Therefore, at low potential sites as well as sites not selected for this study, improvement of existing sources such as protection of surface water or springs; survey of alternative sources; and education on safe water use are recommended.

2) Measures against Groundwater Contamination from Surface

During the field survey, at villages located in or around urban centers and where agricultural activities are found near the villages, the use of large quantities of agricultural chemicals was confirmed. The results of water quality analyses showed high nitrate and ammonium concentrations in shallow layer groundwaters which could be caused by agricultural chemicals. Also, high COD values were found in surface waters and springs which are believed to be the result of detergents and domestic wastewater. Of the surveyed villages, some are using the same water point for drinking as well as for washing clothes and other purposes, resulting in the water quality being deteriorated. In other villages, waterweed and aquatic animals are breeding in the source to contribute to contamination. Therefore, water qualities should to be monitored and countermeasures, such as protecting wells or using deeper groundwater, need to be carefully considered.

3) Handling of High Iron Concentration Groundwater

The water quality tests made during the field survey revealed high iron concentrations in many samples from existing boreholes, where some samples showed values higher than 6 mg/lit. These boreholes are presently being used for drinking. Iron in the water produces rusty taste and odor, and stains clothing when washing with this water. However, drinking water quality guidelines explain that concentrations up to 2 mg/lit are not detrimental to the health.

For this Project, if the deeper confined groundwater does not satisfy the water quality guideline, then shallow groundwater will be used. However, for long-term planning, using the deeper groundwater with treatment is recommended. Since Zambia does not have experience with iron removal facilities, and DWA and each level WASHEs do not have knowledge and skills for operation and maintenance of such facilities, the introduction of iron treatment facilities may present problems. However, for the Northern Province, measures against high level of iron in groundwater need to be considered for safe and sustainable water supply. Therefore, a pilot scale facility for iron removal should be demonstrated and after confirming its feasibility, the facility should gradually be introduced.

4) Strengthening of Water Quality Analysis Structure at Kasama

The water quality analysis section at the Provincial DWA office in Kasama, in the Northern Province, is not properly functioning. Therefore, the following recommendations are advised.

- Improvement of present facilities
- Procurement of required analysis equipment and chemicals
- Strengthening of water quality section and capacity building of staff

This strengthening of the water quality analysis structure is essential to contribute to water quality surveys for environmental monitoring as described above.

5) Necessity for Continuous Monitoring on Operation and Maintenance

A software-component programme is included in this Project which aims to strengthen the operation and maintenance structure. After completion of the water supply facilities, in order to confirm the effects and outputs of the project, as well as changes in behaviour and awareness of the residents, periodic monitoring on a long-term continuous basis is essential. The actual demands and necessities of the beneficiaries as well as other results from monitoring and evaluation can be reflected in similar future projects.