4-3 Project Outline

4-3-1 Project Implementation Plan

The Project implementation plan has the following aspects.

(1) The Project Area is some 1,730km^2 and encompasses T.A./S.T.A. Mlonyeni, Mavwere, Zulu, Mduwa, Mkanda and Dambe in Mchinji District of the Central Region.

(2) As the water supply facilities must ensure a stable and adequate supply of clean drinking water, boreholes which meet this criteria will be constructed.

(3) The target water supply conditions are a supply rate of 27*l*/person/day and a service population of 250/borehole.

(4) The water source is good quality groundwater contained in a large volume in weathered and/or cracked bedrock layers.

(5) Strainers will be installed in aquifers which do not dry up throughout the year.

(6) Easy-to-maintain and economical handpumps will be installed in view of the small service population per borehole.

(7) Ancillary facilities will consist of an apron, drainage channel and washing slab, etc. by the placing of concrete around the borehole mouth in view of the sanitary and functional aspects.

(8) Local inhabitants will be provided with health education to prevent artificial secondary pollution.

(9) The number of boreholes to be constructed is 300 which will be located in accordance with the Project Area's population distribution and existing borehole distribution.

(10) The water service ratio using boreholes will be improved from 17% (1987) to approximately 50% by the time of the Project's completion with a target service population of some 100,000.

(11) The target number of boreholes to be constructed in each year is 80 in the first year, 110 in the second year and 110 in the third year.

(12) Construction work will commence in the southern part of the Mchinji District (Zone 1) where the service ratio is lowest and will then move towards the north (Zone 2 and Zone 3).

The machines, equipment and materials required for the successful completion of the above plan, taking the borehole drilling machines and equipment currently owned by the Department of Water into consideration, are listed in Table 4-3-1.

4-3-2 Borehole Site Plan

The selection of the borehole site locations is based on the following basic conditions.

(1) Borehole construction work will be conducted in Zone 1 first, followed by Zone 2 and then Zone 3.

(2) The number of boreholes in each zone as well as in each T.A. is determined based on the estimated population in 1996 and the number of existing boreholes in each zone (or T.A.).

Formula to calculate number of required boreholes in each T.A./S.T.A. in each zone:

$$\text{Number of new boreholes in T.A./S.T.A.} = \left\{ \left(\underset{\text{New Boreholes}}{300} + \underset{\text{Existing Borehoels}}{95} \right) \times \frac{\text{T.A./S.T.A. population}}{\underset{\text{Total Population}}{203.130}} \right\} - \underset{\text{in T.A./S.T.A.}}{\text{Number of Existing Boreholes}}$$

(3) Village population is an important criterion. Borehole construction priority is given to villages with a population of 200 or more. The minimum service population of 400-500/borehole is employed for those villages requiring two or more boreholes due to a large population size.

(4) The location of boreholes in areas where small villages are scattered is decided based on geographical considerations (in view of using these boreholes as substitute water sources in the dry season).

(5) Careful consideration is given to the hydrogeological conditions of the candidate sites.

Table 4-3-1 List of Machines, Equipment and Materials Required for the Project

Item	To be Newly Provided	To be Provided by Malawi	Total Qty. Required for the Project
Truck-Mounted Drilling Rig (Rotary/Air-Hammer Type	1	1	2
Compressor	1	1	2
Truck-Mounted Test Pumping Equipment	1	1	2
Electric Prospecting Equipment	1 set	1 set	2 sets
Borehole Logging Equipment	1 set	1 set	2 sets
Other Testing Equipment			
Groundwater Level Measuring Apparatus	1 set	1 set	2 sets
Electric Conductivity Meter (with Thermometer)	1 set	1 set	2 sets
PH Meter	1 set	1 set	2 sets
Vehicles			
4WD Station Wagon	2	–	2
4WD Pick-Up Truck	2	–	2
Cargo Truck with 5 ton Crane	2	–	2
Cargo Truck with 3 ton Crane	1	1	2
Motorcycle	3	–	3
Water Tank ($4m^3$)	1	–	1
Communication Equipment	1 set	–	1 set
Casing with Screen (PVC)	300 sets	–	300 sets
Pump (Afridev Handpump)	330	–	330
Repair Equipment	1 set	–	1 set
Muddy Water Agent and Blowing Agent	300 sets	–	300 sets
Materials for Civil Work	1 set	1 set	2 sets
Local Base Facilities	1 set	–	1 set
Spare Parts for Newly Provided Machines and Equipment	1 set	–	1 set
Spare Parts for Previously Provided Machines and Equipment (Tools for Drilling Rig and Others)	1 set	–	1 set

(6) Areas where the water quality is poor are omitted from the candidate locations.

(7) Villages where the conditions of access roads are poor are omitted from the candidate locations.

(8) Priority is given to villages where such public facilities as schools, clinics and public markets are located.

The number of boreholes to be constructed and their locations which have been determined based on the above conditions are shown in Table 4-3-2 and Fig. 4-3-1 respectively. Villages where new boreholes will be located are listed in the Appendix.

Table 4-3-2 Number of Boreholes to be Constructed in Each T.A./S.T.A.

Zone	T.A./S.T.A.	Estimated Population (1996)	No. of Boreholes			Phase		
			Total	New	Existing	Phase 1	Phase 2	Phase 3
1	Mlonyeni	18,700	37	9	28	28	—	—
	Mavwere	67,470	131	19	112	52	60	—
	Zulu	22,310	43	9	34	—	34	—
	Sub—Total	108,480	211	37	174	80	94	—
2	Zulu	15,640	31	2	29	—	16	13
	Mduwa	20,180	39	12	27	—	—	27
	Dambe	21,070	41	15	26	—	—	26
	Sub-Total	56,890	111	29	82	—	16	66
3	Mkanda	21,790	42	18	24	—	—	24
	Dambe	15,970	31	11	20	—	—	20
	Sub-Total	37,760	73	29	44	—	—	44
Total		203,130	395	95	300	80	110	110

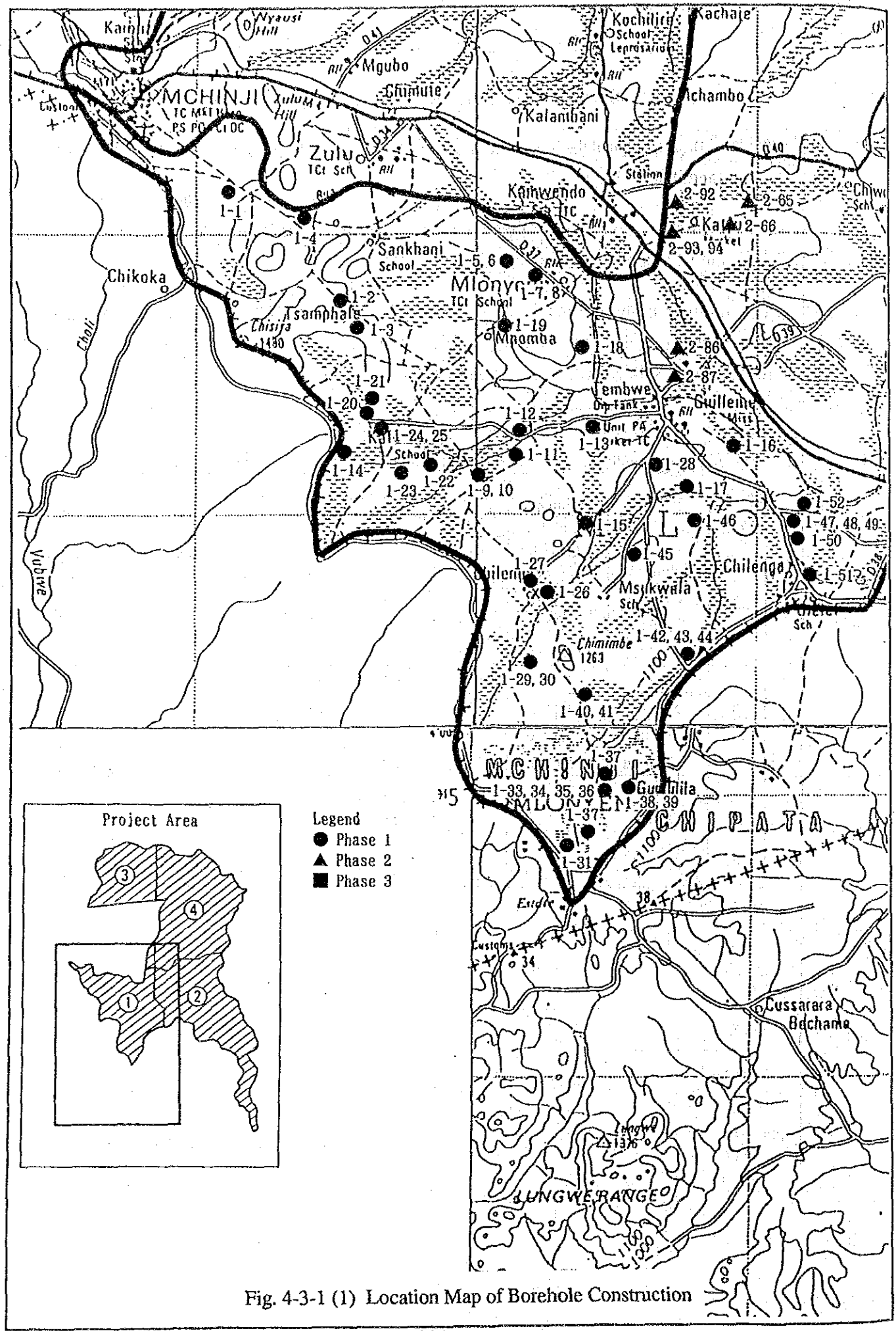


Fig. 4-3-1 (1) Location Map of Borehole Construction

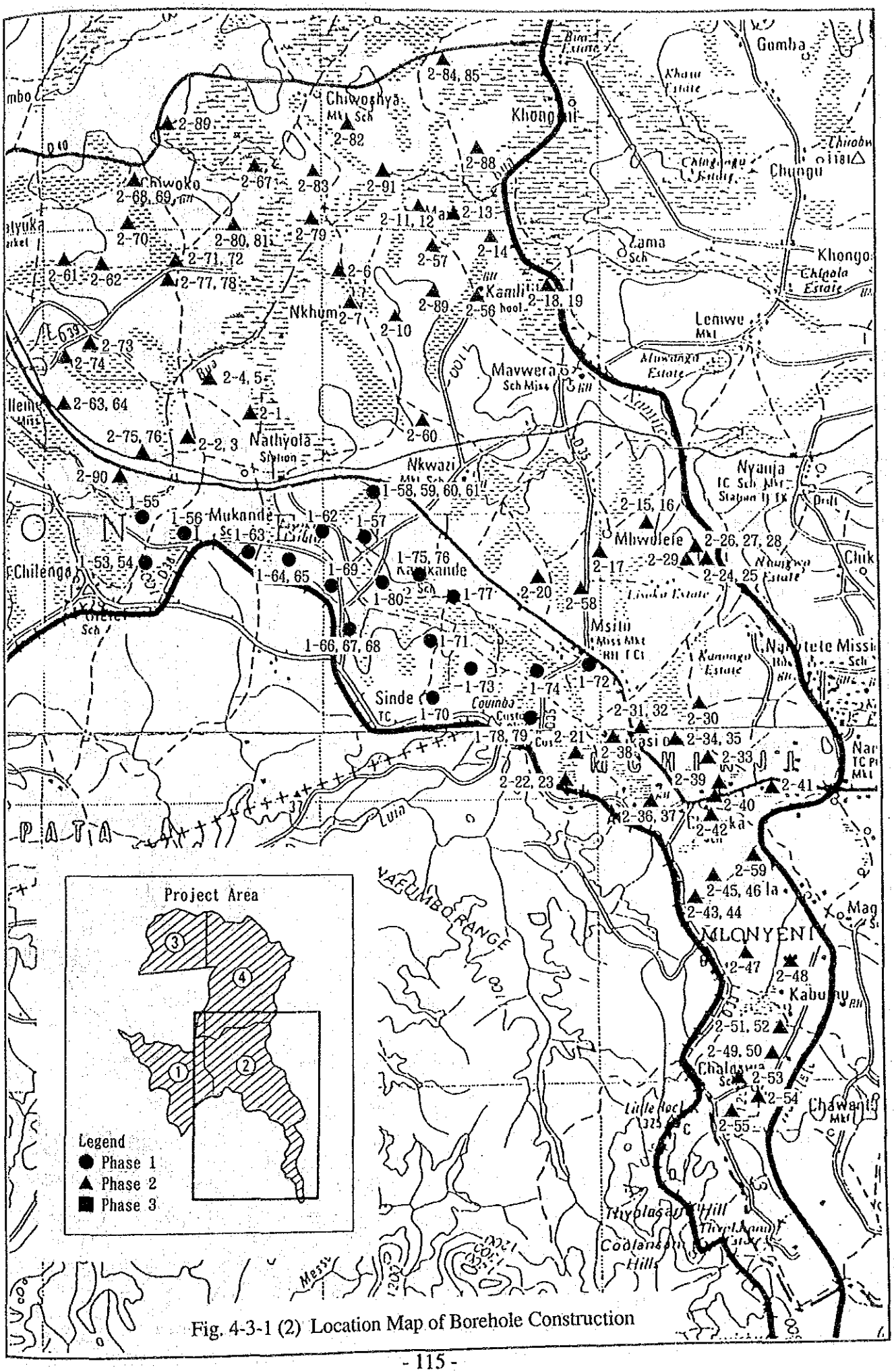


Fig. 4-3-1 (2) Location Map of Borehole Construction

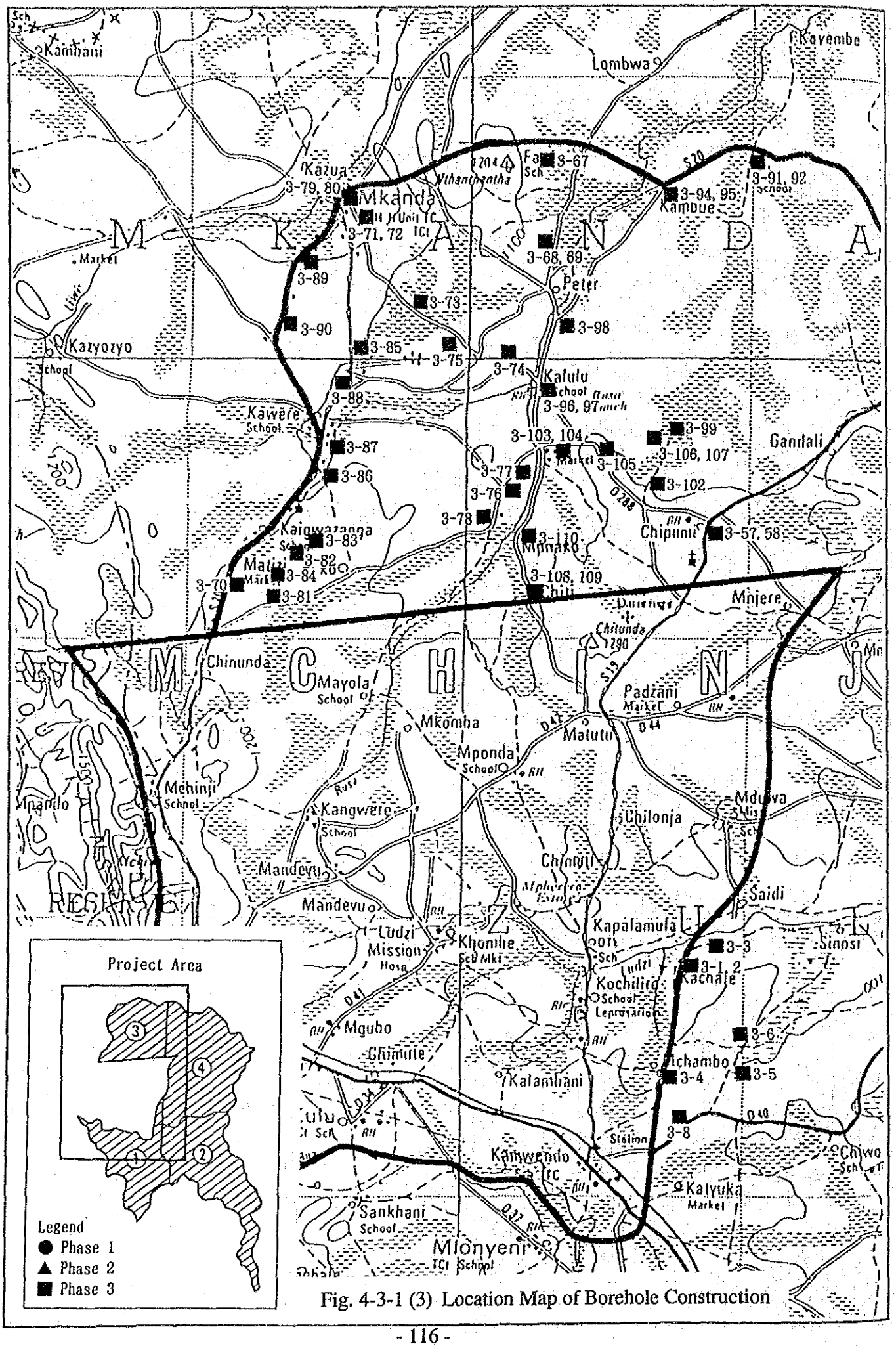


Fig. 4-3-1 (3) Location Map of Borehole Construction

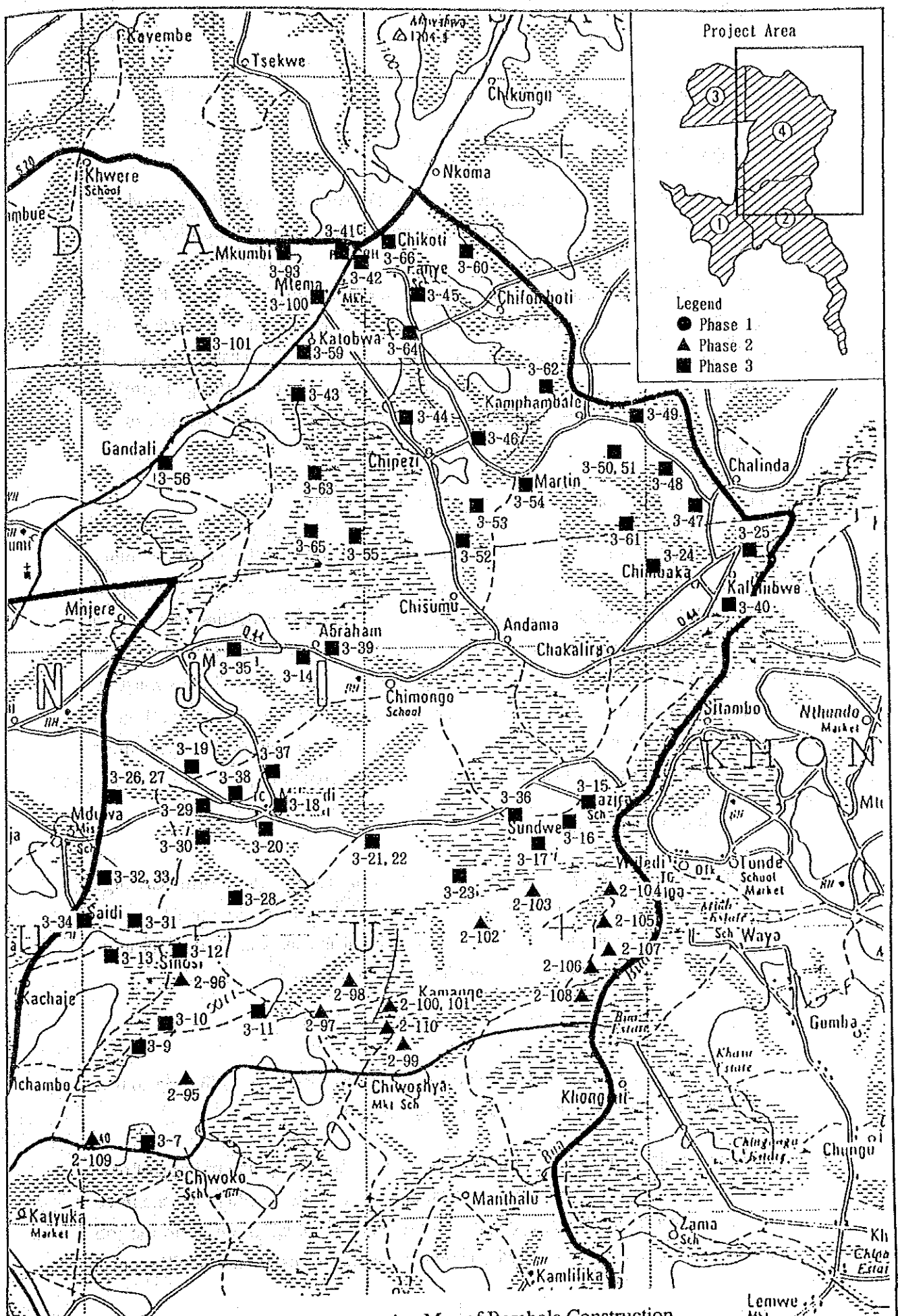


Fig. 4-3-1 (4) Location Map of Borehole Construction

4-3-3 Technical Cooperation

(1) Drilling Technology

Two drilling rigs were provided by Japan for the North Kawinga Project and two drillers from the Department of Water underwent technical training on the operation of these rigs while working for the project. They are currently an essential part of the workforce in the Southern Region where an UNHCR project to assist refugees from Mozambique and an urgent disaster project in Phalombe are underway and also in the Central Region where an IFAD-assisted project is in progress by the Ministry of Agriculture. However, there is strong desire for further training as inadequate experience and technical strength are felt in the following fields.

1) Drilling Technology Vis-a-Vis Diverse Geological Conditions

Although drilling experience has been accumulated with the use of air-rotary rigs and air-percussion rigs, inadequate drilling experience with the help of muddy water has resulted in the adoption of inappropriate drilling methods, in turn causing an extra burden on the machines and equipment and drilling accidents. For the efficient use of the drilling rigs, these problems must be solved by arming drillers with drilling expertise vis-a-vis diverse geological conditions. In addition, drillers must be capable of selecting the most appropriate drilling method for given geological conditions.

2) Dealing with Drilling Accidents

Hardly any drilling accidents occurred in the case of the North Kawinga Project. However, there is always the possibility of accidents due to rig conditions, geological conditions, operational mistakes and other reasons. Drillers must, therefore, be taught how to deal with such accidents.

3) Rig Maintenance

It is necessary for drillers to understand the mechanism of a drilling rig so that they can repair simple failures using repair tools.

Since the Project anticipates the provision of a new drilling rig, the training of new drillers is essential in addition to the retraining of the present drillers. Of the three problems described above, problem 1) may well be solved through on-the-job training during the Project period. In comparison, problems 2) and 3) will require

the training of drillers in Japan in accordance with well established training curricula as the drillers will be unable to experience all the relevant situations through the implementation of the Project. In view of this, the Government of Malawi strongly demands the following technical cooperation for the training of drillers.

Training Method	Subject Personnel	Period
On-the-job training	A × 2	Throughout Project implementation period
- do -	B × 1 or more	- do -
Training in Japan	A × 2	Short-term

Note) A: Retraining of present drillers
B: Training of new drillers

(2) Groundwater Development

The Groundwater Section which is responsible for groundwater development currently has 12 hydrogeologists who are engaged in general administrative work at present. Although they have a good academic knowledge of hydrogeology, they have little site supervision experience because of their organizational position. These hydrogeologists must acquire practical knowledge and experience of concrete hydrogeological conditions for self-reliant groundwater development in Malawi in the future using the newly provided machines and equipment. In this context, the Government of Malawi demands the following training for hydrogeologists.

Training Method	Subject Personnel	Period
Training in Japan	A × 1	Long-term
	B × 1	Short-term

Note) A: Hydrogeologist whose service at the Department of Water is less than 5 years
B: Hydrogeologist whose service at the Department of Water is 5 years or more

CHAPTER 5

BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Basic Selection Criteria for Machines, Equipment and Materials

As stated in 4-2-4, the following description is based on the assumption that the construction of 300 new boreholes will be conducted using two drilling rigs, one to be newly provided by Japan for the Project and one currently allocated to the Central Regional Office of the two rotary/air-hammer type borehole drilling rigs owned by the Department of Water.

The selection of the types of machines, equipment and materials and their respective quantities should be based on the following conditions.

(1) Selection should take into consideration the natural and socioeconomic conditions and infrastructure, etc. of the Project Area.

(2) Selection should take into consideration the organization, staffing strength, technical level, past performance and machines and equipment owned by the Department of Water.

(3) Selection should stress machines and equipment with good mobility so that a large number of boreholes can be constructed in an efficient manner in the vast Project Area.

(4) The division of labour between the drilling teams and pumping test teams should be established in view of the efficient construction of the boreholes.

(5) The selected drilling rig should be versatile vis-a-vis working with diverse geological conditions, from sediments to hard rocks.

(6) Selection should take into consideration applicability, operationability, durability, easy maintenance and price, etc.

(7) Two drilling teams and two pumping test teams should be introduced and the necessary, materials and spare parts for three years' requirements should be provided.

(8) In principle, on-the-job training should be conducted in addition to the provision of the drilling rig, other machines, equipment and materials to ensure the transfer of related technologies.

5-2 Selection of Main Machines, Equipment and Materials

(1) Drilling Rig and Other Equipment

The drilling rig and other equipment to be provided should be selected in view of the smooth implementation of the Project while noting the following requirements.

1) All equipment and materials required for the drilling and construction of the boreholes must be included.

2) A work period of three years should be assumed in the determination of quantities.

3) The actual performance of the drilling rigs and other equipment provided by Japan in 1989 for the North Kawinga Project should be carefully examined.

4) There will be two drilling teams (of which one team will use the new drilling rig and other rig to be provided by Japan for the Project).

5) The natural conditions, socioeconomic conditions and infrastructure, etc. in the Project Area should be taken into consideration.

6) The operationability, durability and applicability of the drilling rig should be taken into consideration.

7) The original contents of the request made by the Government of Malawi and existing groundwater development projects should be taken into consideration.

8) The organization, staffing strength, technical level and past performance of the Department of Water should be taken into consideration.

The main machines for the Project is a drilling rig and Table 5-2-1 lists the characteristics of different types of drilling rigs while Table 5-2-2 gives their evaluation results. The following conditions deriving from the geological conditions of the Project Area must be satisfied in the evaluation of these rigs.

1) The geological structure of the Project Area consists of a relatively loose surface layer of unconsolidated sediments and highly weathered rocks with a lower layer of hard rock, mainly gneiss of the Pre-Cambrian. As the groundwater is generally expected to exist in a the fissure zone between the

highly weathered rock layer and the upper hard rock layer, the new drilling rig must be capable of dealing with diverse geological conditions.

2) The new drilling rig must have a better work performance than the percussion type drilling rigs currently owned by the Department of Water.

3) The new drilling rig must be capable of drilling a relatively large diameter hole throughout the different layers, ranging from fragile layers to hard bedrock, using the forward mud circulation method.

4) The new drilling rig must be capable of drilling through hard rock layers with high efficiency using an air-hammer.

5) The new drilling rig must be mounted on a truck to ensure superior mobility to cover the vast Project Area and must be equipped with a mud pump, injection pump (for form drilling) and a hydraulic collapsible boring tower.

Based on the above conditions, the rationals for the best drilling rig for the Project are explained below.

① Drilling rigs are largely classified into the percussion type, rotary type with normal mud circulation and rotary type with reverse mud circulation. Although the percussion type is easy to operate and maintain because of its simple structure, the drilling speed is slow. In addition, its inability to drill through hard rock disqualifies it from use in the Project because of the geological conditions of the Project Area and the planned schedule for the Project.

The rotary type rig with reverse mud circulation is normally used for the drilling of a large diameter hole (more than 450mm) and is unsuitable for the Project.

The remaining type, i.e. rotary type with normal mud circulation, is capable of dealing with various geological conditions and work environments. Its additional use for air-percussion drilling or air-rotary drilling is also feasible.

② As examined in ① above, the rotary type drilling rig with normal mud circulation appears to be the most suitable for the Project. In fact, this type is further divided into three models, i.e. spindle, table and top drive models. The spindle model requires much work during drilling operation because of the relatively little movement of the spindle and is, therefore, inefficient and

most suitable for small jobs, such as test boring. Since the table type is suitable for the drilling of a borehole of more than several 100m in depth, the top drive model appears to be the most suitable for the Project.

③ When a drilling rig which has air-rotary as well as air-percussion drilling functions is compared to any of the above 3 rotary type drilling rig models, it is found that there is little difference in the price and operation cost, etc. for a similar performance level (expressed in horse power). Consequently, the final selection of the rig should be based on the expected work efficiency.

The drilling rig to be selected is, therefore, the hydraulic top drive power swivel type which is the same as those provided by Japan for the North Kawinga Project. Given the planned maximum drilling depth of some 75m, the actual rig must have sufficient capability to drill a final borehole diameter of 170mm and a maximum drilling depth of more than 100m with ease. Moreover, as well as high efficiency and safety, the lightweight and good workability requested by the Department of Water must be guaranteed.

Since there will be two drilling teams, two drilling rigs are required, one of which will be the rotary rig owned by the Department of Water and which will be supplied with spare parts to maintain good working order. The compressor and drilling tools for the new rig to be provided will be selected to match the performance of the rig.

Table 5-2-1 Drilling Methods

Type	Characteristics and Summary	Drilling Method	Rotary Drilling 	Straight Drilling 	Muddy Water Normal Circulation 
Percussion Boring	Drilling is conducted by the impact of the free fall bid from a certain height. Has the longest application history of all deep drilling methods. While the rig is cheap, this type of rilling is unsuitable for a consolidated layer.	Percussion	–	Wire	Mud Collector
Spindle Type Rotary Boring	Drilling is conducted by the rotary and straight movements of the spindle with a fixed drill pipe. Compact and suitable for a care drilling.	Rotary	Spindle	Spindle	Muddy Water Normal Circulation
Table Type Rotary Boring	Drilling is conducted by rotary movement using the rotary table and straight movement using the suspension wire. Although a large rotation force is possible, the rig tends to be large.	Rotary	Turn Table	Wire	Muddy Water Normal Circulation
Top Drive Type (Power Head Type) Rotary Boring	Drilling is conducted by rotary movement using the hydraulic motor at the top of the drill pipe and straight movement using the hydraulic jack. The rig is relatively small and light and has high efficiency, including good operationability of the drill pipe.	Rotary	Hydraulic Motor	Hydraulic Jack	Muddy Water Normal Circulation
Reverse Rotary Boring	The flow direction of the muddy water is the reverse of normal rotary boring methods. Need to use much muddy water and suitable for a relatively large hole.	Rotary	Spindle Turn Table Hydraulic Motor	Spindle Turn Table Hydraulic Motor	Muddy Water Reverse Circulation
Air Rotary Boring	Compressed air is used to discharge the mud to replace the muddy water in the rotary boring methods. Efficient but incapable of deep drilling.	Rotary	Spindle Turn Table Hydraulic Motor	Spindle Turn Table Hydraulic Jack	Compressed Air, Blowing Agent, Normal Circulation
Air Percussion Boring	Drilling is conducted by the impact of the rotating hammer at the end of the air rotary drill pipe. Highly efficient but incapable of deep drilling.	Rotary & Impact	Spindle Turn Table Hydraulic Motor	Spindle Wire Hydraulic Jack	Compressed Air, Blowing Agent, Normal Circulation

Table 5-2-2 Drilling Rig Ratings

Machine Type and Drilling Method	Drilling Capacity		Applicable Geological Layer			Applicability Below Groundwater Level	Applicability to (f) and (g)	Availability of Spare Parts	Operationability	Durability	Maintenance	Work Speed	Operation Cost	Price*	Suitability to Request	Comprehensive Appraisal
	Depth (m)	Hole Diameter (mm)	Upper Layer	Sedimentary Rock	Bedrock											
a) Percussion (Cable Tool)	100-200	100-600	o	Δ	x	Δ	x	o	o	◎	o	x	o	1.00	x	x
b) Direct Rotary, Spindle Type	500-	46-1,500	o	o	Δ	o	o	o	o	o	o	Δ	o	0.90	x	x
c) Direct Rotary, Table Type	500-	46-1,500	o	o	Δ	o	o	Δ	Δ	o	Δ	Δ	o	1.25	x	x
d) Direct Rotary, Top Drive, Power Head Type	500	46-1,500	o	◎	Δ	o	◎	Δ	Δ	o	Δ	Δ	o	1.10	Δ	x
e) Reverse Rotary	100	450-1,500	o	Δ	Δ	o	x	x	Δ	o	Δ	Δ	-	1.55	x	x
f) Air Rotary	100	100-200	◎	o	x	Δ	-	Δ	Δ	o	Δ	-	-	-	Δ	x
g) Air Percussion	100	100-200	x	Δ	◎	Δ	-	Δ	Δ	o	Δ	-	-	-	Δ	x
b) + f) + g) Spindle Type, Air Rotary, Air Percussion	500-	46-1,500	◎	o	◎	o	-	Δ	Δ	o	Δ	o	o	1.55	Δ	o
c) + f) + g) Table Type, Air Rotary, Air Percussion	500-	46-1,500	◎	o	◎	o	-	Δ	Δ	o	Δ	o	o	1.95	Δ	o
d) + f) + g) Top Drive Type, Air Rotary, Air Percussion	500	46-1,500	◎	◎	◎	o	-	Δ	Δ	o	Δ	◎	o	1.75	◎	◎

Notes ◎ : Very Good
o : Good
Δ : Slightly Bad
x : Bad

* : Ratios assuming that the price of a) is 1.00.

(2) Pumping Test Equipment

The pumping test teams will be assigned the following work.

1) Cleaning of boreholes dug by the drilling teams.

2) Determination of possible pump discharge by conducting pumping tests.

3) Installation of handpumps.

4) Determination of water quality by conducting quality tests.

Given the above list of assigned work, the provision of the equipment described in 1) and 2) below is deemed necessary for each pumping test team. However, it is judged that one team can be equipped with the existing pumping test equipment and tools provided for the North Kawinga Project and, therefore, only one set of pumping test equipment and tools will be newly provided.

1) Track-mounted pumping test equipment is selected in view of mobility, including a tower and a winch to lift up and down the compressor and tools for air lifting and air jettisoning. The tower and winch can also be used for pump installation.

2) Other equipment includes a submersible pump, generator and groundwater level measuring apparatus, etc. for pumping tests and an electric conductivity meter (with thermometer) and PH meter, etc. for water quality tests.

(3) Physical Prospecting Equipment

Electric prospecting equipment which is appropriate for groundwater survey use to determine the borehole locations is required for physical prospecting. Since one set of this equipment can be provided from the previously provided equipment, only one set of electric prospecting equipment need be newly provided.

(4) Logging Equipment

Electric logging equipment is required to determine the favourable casing and screen combination following the initial drilling of a borehole. Since one set of this equipment can be provided from the previously provided equipment, only one set of electric logging equipment need be newly provided.

(5) Vehicles

Because of the local road conditions, all vehicles except motorcycles should be right-hand drive vehicles with a four wheel drive mechanism. The results of the examination on the optimal vehicle combination to perform the work referred to in (1) and (2) above are described below.

1) Cargo Trucks with Crane

Two trucks mounted with a 5 ton crane and a 3 ton crane respectively are required to transport the drilling equipment and materials, including drilling tools, drilling water, gravel, borehole casings and screens, etc. These vehicles will also be used to transport the materials for ancillary facilities, including cement, sand, gravel, bricks, laterite, petrol and light oil (in drums), etc. As the previously provided truck with a 5 ton crane is beyond repair, the provision of another truck as a replacement is required to make a truck fleet of three.

2) Station Wagons

This type of vehicle is essential to ensure the swift transfer of construction workers and the maintenance of the boreholes as the subject boreholes are scattered over a wide area. two station wagons are required for the two drilling teams. Although the use of the existing station wagon was considered, this idea was abandoned as the mileage of the vehicle in question is likely to exceed 150,000km at the time of the Project's commencement (present mileage is some 100,000km). The severe conditions of the unpaved earth roads which would pose a further problem for an old vehicle also contributed to this decision. As a result, the provision of two new station wagons is now planned.

3) Pick-Up Trucks

These trucks are essential for various purposes, including the transportation of repair equipment (generator and welding equipment, etc.) and measuring instruments, communications and work assistance. As in the case of the station wagon, the mileage of the existing pick-up truck will exceed 150,000km at the time of the Project's commencement and will require replacing. Consequently, the provision of two new pick-up trucks is now planned.

4) Motorcycles

These will be used to patrol the boreholes for maintenance purposes. Each operator of the Maintenance Offices in Malawi is responsible for the maintenance of 100 boreholes. Since 300 new boreholes are to be constructed in three years, the provision of three motorcycles is planned. Given the local road conditions, the most suitable type of motorcycle is the off-road type with an engine capacity of 100-125cc.

(6) Water Tank

A water tank (capacity: $4m^3$) is required to transport the drilling water. Instead of a fixed tank, a removable tank using a crane will be employed to ensure efficient vehicle use.

(7) Communication Equipment

Mchinji Boma where all machines, equipment and materials are stored is expected to act as the local base (for project management, site supervision and storage purposes) throughout the Project implementation period. Communication between this base and the Department of Water can be secured by telephone. However, communication between the base and actual construction sites (mobile stations) is also necessary and the provision of the following radio equipment is planned in this regard.

At local base:	FM communication equipment (1)
Sites (mobile stations):	FM communication equipment (5)

(8) Pumps

The planned pump is the Afridev handpump which is requested by the Government of Malawi as an essential component of the envisaged VLOM borehole maintenance system. This decision is also based on the Afridev handpump's maintainability, durability and ease of securing spare parts in the future as described in 2-2-2.

(9) Casings and Screens

FRP casings were used in the North Kawinga Project. In the case of the present Project, the use of PVC casings is planned because of the newly established PVC pipe local production system, allowing orders in small quantities and fast delivery. Although the PVC pipe is more vulnerable to heat than the FRP pipe, a minimum

inventory level of PVC pipes on site should ensure the use of new pipes which have not been subject to deformation or deterioration due to heat.

(10) Miscellaneous

The quantities of miscellaneous items, including spare parts, should be determined based on their consumption in the three years required to construct the 300 new boreholes. An additional set of spare parts for overhaul purposes should be provided to rejuvenate the drilling rig and other machines and equipment provided in 1989 for its efficient use.

(11) Facilities for Local Base

The use of two containers (some $36m^3$ with windows) and other equipment is planned as the Project management office and workshop to ensure the efficient operation of the local base which is required for the storage and maintenance of the planned machines, equipment and materials and also for borehole construction administration work.

5-3 Basic Design

5-3-1 Borehole Construction Method and Ancillary Facilities

The borehole construction process using the provided machines, equipment and materials is outlined below.

(1) The drilling diameter at the borehole mouth will be 10 5/8". Muddy water drilling will be conducted to a depth of 6m and a conductor pipe with an internal diameter of 10" will be inserted.

(2) In the case of the sediment and/or highly weathered rock layer (10-20m below the ground surface) below the depth given in (1) above, further muddy water drilling will be conducted with a drilling diameter of 8 1/2" and a guide pipe with an internal diameter of 7 1/2" will be inserted. Electric logging will be conducted where deemed necessary to confirm the existence of an aquifer before the insertion of the guide pipe.

(3) In the case of the hard rock layer below (2) above, air-hammer drilling will be conducted with a drilling diameter of 6 3/4".

(4) When the predetermined drilling depth has been reached, the existence of an aquifer will be confirmed by electric logging and a screen and casing, both with an internal diameter of 4", will be installed.

(5) Gravel of a predetermined size and clay will be firmly packed around the screen and casing respectively.

(6) The borehole will be cleaned using the air lift equipment until clean water is obtained.

(7) Pumping and water quality tests will be conducted to determine the usability of the borehole. In the case of the pumping test, the phased pumping test and/or recovery test will be conducted where deemed necessary.

(8) When the borehole is judged to be usable based on both the pumping and water test results, a pump will be installed and the work relating to such ancillary facilities as the apron, drainage channel and washing slab etc. will be implemented to complete the borehole construction process.

The above ancillary facilities will be designed based on the following conditions.

(1) Measures will be introduced to keep the environment around the borehole clean and the facility layout will ensure the convenience of users.

(2) All the facilities will be of a durable structure.

(3) The apron will have an area of some $4m^2$ which should not disturb water drawing and will be provided with a bucket stand so that users can easily place the buckets on their heads.

(4) The drainage channel will have a total length of 7.6m to prevent the area around the mouth of the borehole from becoming muddy.

(5) Two washing basins will be provided in the washing slab.

(6) In view of the prospective use of the Afridev handpump, standing area with the same structure as the apron will be constructed at the back of the handpump.

(7) In view of the fact that animals are attracted to standing water which occurs in places where the drainage conditions around a borehole are poor, causing groundwater pollution by dung and encouraging the propagation of mosquitoes, a catch basin will be constructed near the borehole and a wooden fence to prevent animals approaching the catch basin will be constructed by local inhabitants.

Figs. 5-3-1 - 5.3.3 show the structures of the borehole, ancillary facilities and catch basin respectively.

Fig. 5-3-1 Structure of Borehole

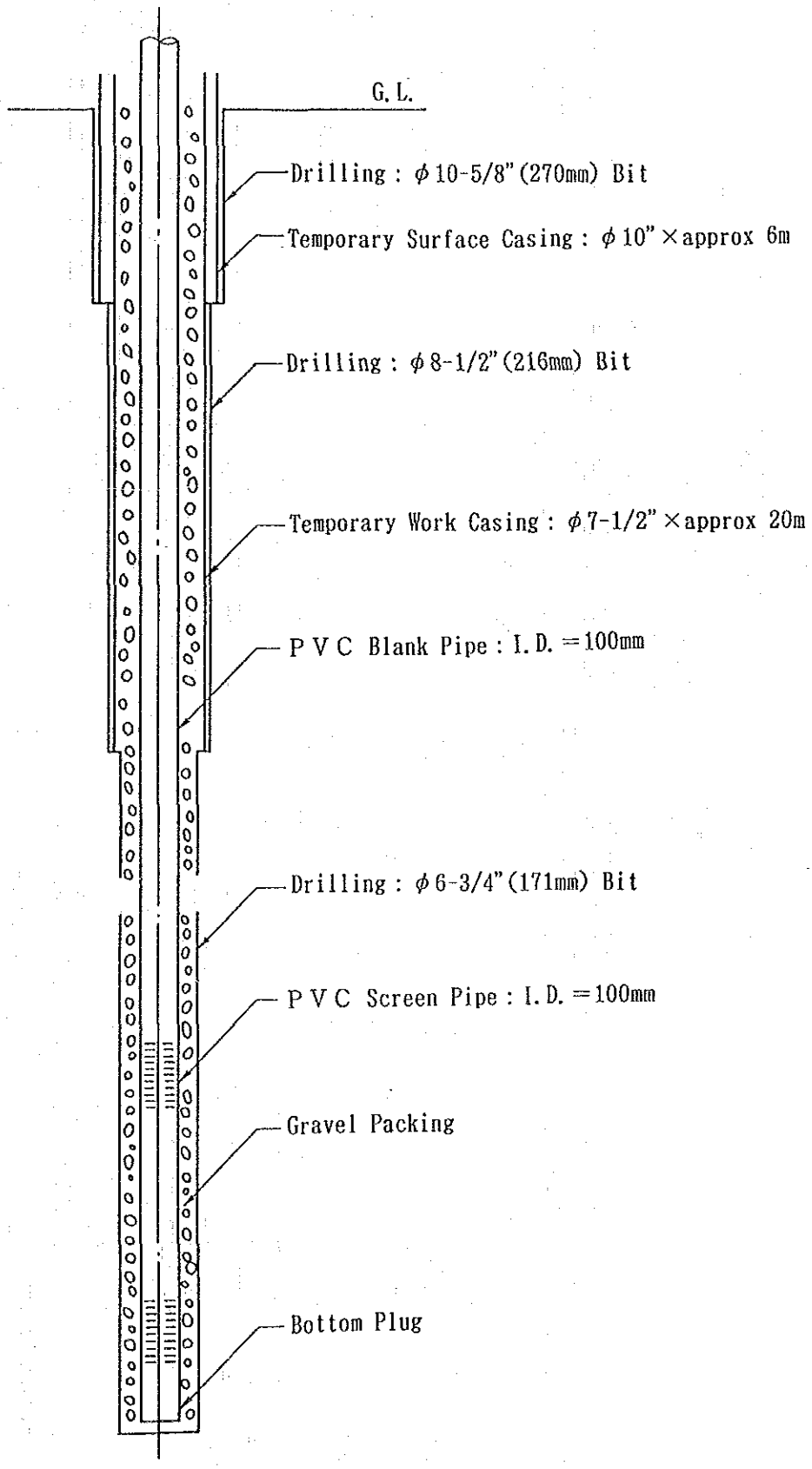


Fig. 5-3-2 Plan and Section of Ancillary Facilities

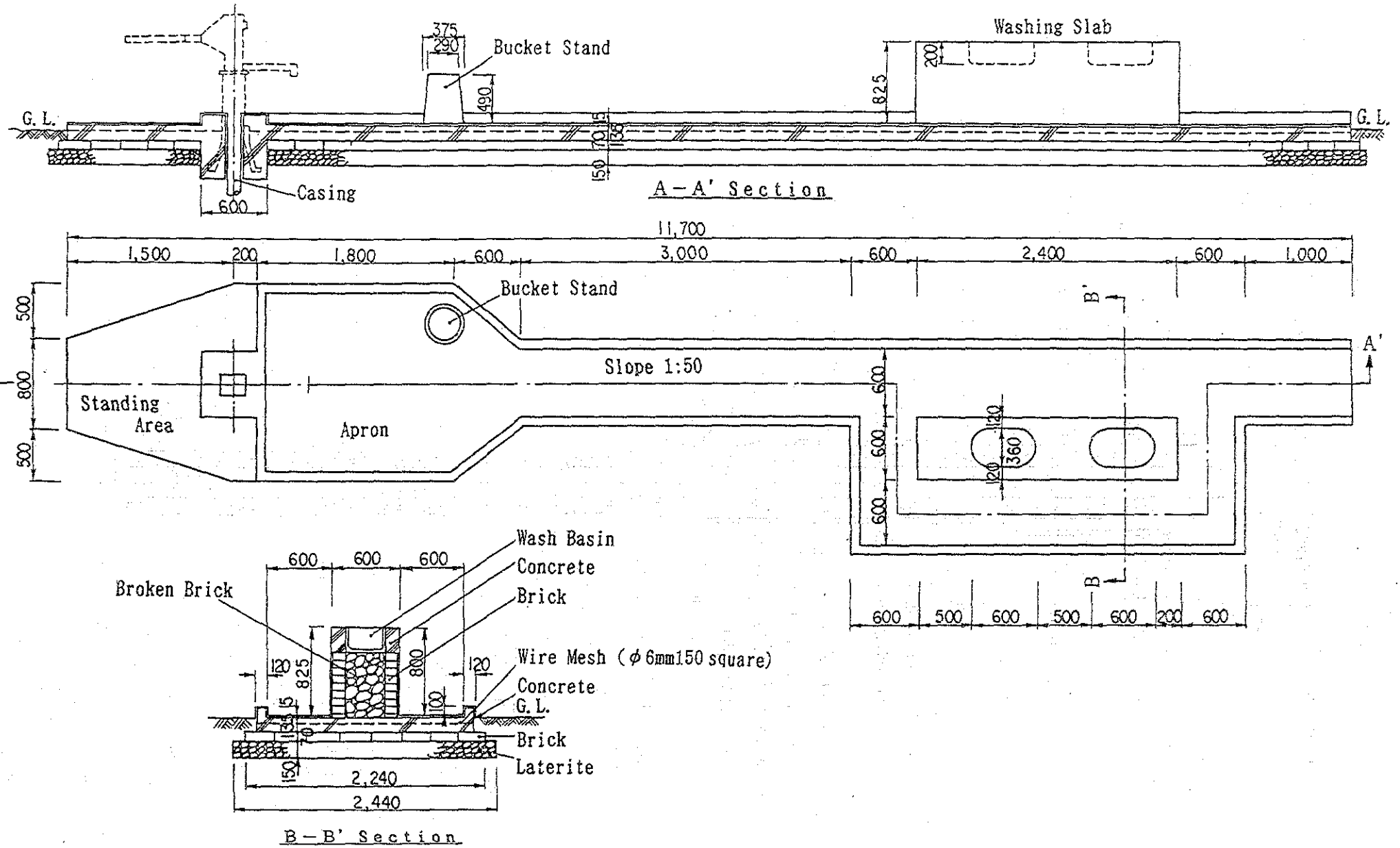
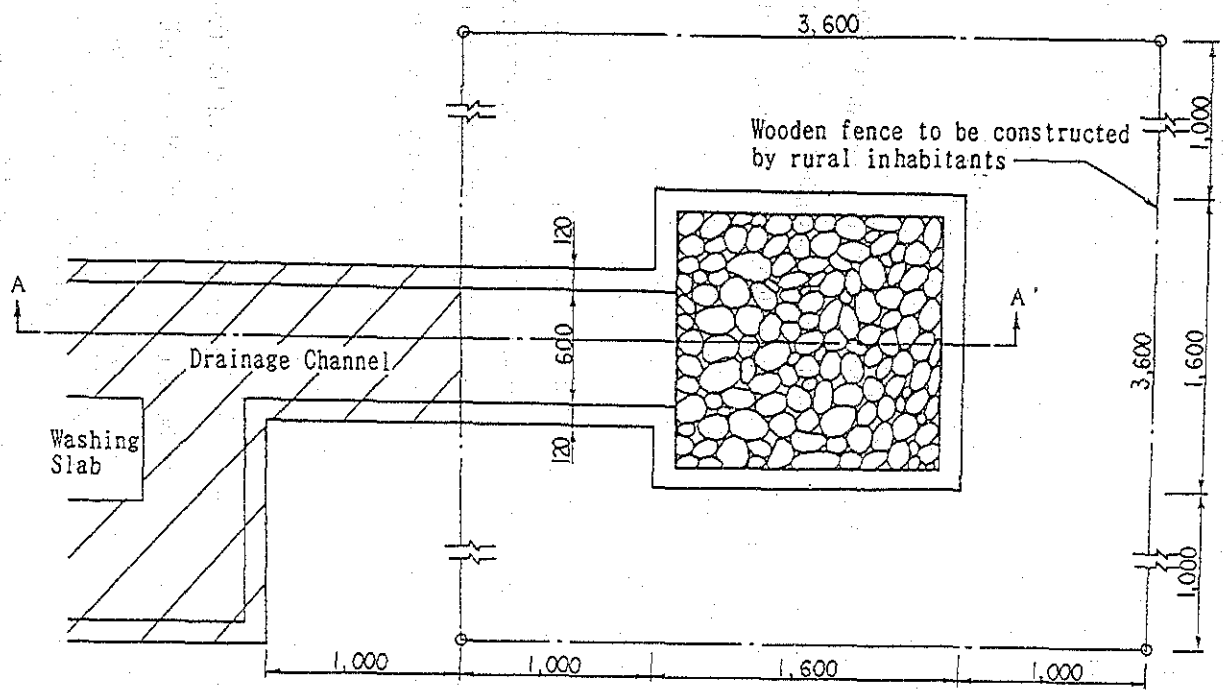
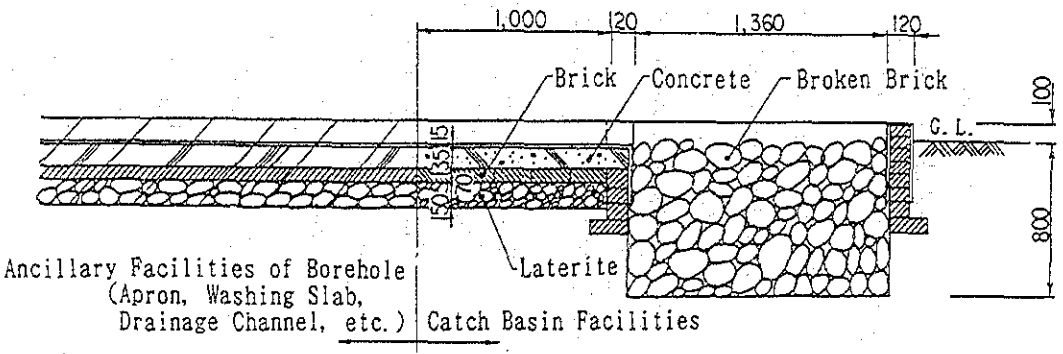


Fig. 5-3-3 Plan and Section of Catch Basin



Plan



A—A' Section

Above processes from (1) through (5) will be conducted by the drilling teams of which the standard composition of machines and equipment will be as follows.

- Truck-mounted drilling rig
- Air compressor
- Station wagon
- Cargo truck with crane

Processes (6) and (7) will be conducted by the pumping test teams of which the standard composition of machines and equipment will be as follows.

- Truck-mounted pumping test equipment
- Pick-up truck
- Cargo truck with crane

It is essential that the Government of Malawi completely repair (or construct) access roads to the prospective sites with the cooperation of local inhabitants to provide smooth passage for vehicles if the construction of 80-110 boreholes/year is to be successfully completed by the two drilling teams and two pumping test teams.

5-3-2 Machines, Equipment and Materials Plan

The machines, equipment and materials required for the implementation of the Project will be provided to the Government of Malawi as grant aid of the Government of Japan. The specifications and quantities of the items to be provided are decided based on the respective examination results and the basic policy for the Project and are described below.

(1) Truck-Mounted Drilling Rig

The Project Area is generally covered by a surface layer of sediments of 10-20m in thickness or highly weathered rocks above the hard bedrock. The selected drilling rig, i.e. rotary-cum-air hammer type, is one which can deal with such diverse geological conditions with great drilling efficiency.

Given the estimated maximum depth of the fissure zone of 75m, the expected drilling performance of the drilling rig is a bottom hole diameter of 170mm and a drilling depth of more than 100m using the air-hammer method.

(2) Air Compressor

The air compressor is expected to assist the drilling rig by discharging the drilled sediments and rocks through the operation of the air-hammer and air circulation. The air compressor is very important as its capacity determines the drilling speed against hard rock. In order to perform satisfactorily vis-a-vis the geological structure of the Project Area, the planned air compressor is the truck-mounted type with an air pressure of 17.5kg/cm^2 and an air volume of more than 20m^3/min.

(3) Truck-Mounted Pumping Test Equipment

The pumping test equipment consists of equipment used to clean the drilled boreholes, to confirm the water quality and quantity by means of pumping and water quality tests, to install the handpumps and to rehabilitate the existing boreholes. It includes a tower and a winch to lift tools up and down.

The air lift will be used for borehole cleaning and the minimum capacity of the compressor to be mounted on the truck for cleaning work is an air pressure of 7.0kg/cm^2 and a blowing volume of 3.5m^3/min or more. The submersible pump used for the pumping tests will have a head of 50m and a discharge volume of 100l/min or more. A generator will also be provided for operation of the pump. Additional instruments include groundwater level measuring apparatus for the pumping tests and an electric conductivity meter (with thermometer) and a PH meter for the water quality tests.

(4) Other Equipment

Electric prospecting equipment will be provided to identify the hydrogeological conditions below the ground and to select the borehole locations. The prospecting capacity is designed to be upto 200m given the geological conditions of the Project Area.

Electric logging equipment will also be provided to confirm the existence of aquifers and will be capable of measuring resistivity and natural potential upto a depth of 100m.

(5) Vehicles

While roads other than trunk roads in the Project Area are covered with laterite, there are sections where no subgrade work has been conducted or where the gradient is very steep. Moreover, the drilling and pumping test teams will need to

pass through places indicated on the map as being unsuitable for vehicles. All vehicles will, therefore, have a four wheel drive mechanism.

Each drilling team will have one truck mounted with a drilling rig, one station wagon and upto two transport trucks while each pumping test team will have one truck mounted with pumping test equipment, one pick-up truck and possibly one transport truck.

The designed use of the trucks is not confined to the transportation of the water tank and/or repair equipment and includes the transportation of a wide range of items, including fuel, cement, sand and casings.

Of the vehicles belonging to the Central Regional Office and to be used for the Project, the truck with a 5 ton crane is now beyond repair due to an accident. Moreover, the mileage of the station wagon and pick-up truck at the time of the Project's commencement will be more than 150,000km. These vehicles will, therefore, be unable to be used for the Project. These three types of vehicles are now included in the list of vehicles to be newly provided in view of the above.

The provision of three motorcycles for borehole maintenance purposes is designed to cover the 300 boreholes to be constructed in three years.

(6) Communication Equipment

The radio communication equipment will be used to maintain contact between the base (at Mchinji Boma) and the sites (mobile stations) and is designed to be capable of communicating over a distance of some 100km in view of the topography of the Project Area. A total of six units will be provided, i.e. one for the base, one for each drilling team and pumping test team and one for the vehicle to be used at random.

(7) Pumps

The Afridev handpump is selected to assist the spread of the VLOM system. In addition to 300 handpumps for the planned 300 boreholes, 30 additional handpumps will be provided as spares.

(8) Casings and Screens

Locally manufactured PVC pipes will be used for the casings and screens. The pore ratio of the screen is 5% with a standard slit of 1.0mm. The total length of the pipes is 16,500m assuming a 10% loss.

Screen: $300 \times 15m \times 1.1 = 4,950m$

Casing: $300 \times (50 - 15)m \times 1.1 = 11,550m$

(9) Repair Equipment

The machines, equipment and tools to be provided for repair purposes include an engine welder, drilling machine, grinder, pipe cutter, measuring tools, gas cutter and many other tools.

(10) Materials and Spare Parts

The material and spare part quantities are decided based on their estimated consumption for the construction of 300 boreholes in three years.

With regard to spare parts, two years' supply will be provided in the first year and one year's supply will be provided in the third year.

List of Machines, Equipment and Materials Specifications and Quantities

Items and Specifications	First Year	Second Year	Third Year
1. Drilling Rig			
1.1 Drilling Rig	1		
Truck-Mounted Rotary/Air-Hammer Type Drilling Rig			
Truck Specifications: water-cooled diesel engine, right-hand drive, 4 × 4			
Drilling Rig Capacity: bottom hole diameter 6 3/4" (170mm), maximum drilling depth: approx. 100m (by air-hammer method)			
Mud Pump Capacity: discharge volume 600l/min, pressure 20kg/cm^2 or more			
1.2 Standard Accessories for Drilling Rig	1 set		
1.3 Tools for Drilling Rig	1 set	1 set	1 set
a) Drilling Tools (muddy water drilling tools and down-the-hole hammer drilling tools, etc.)			
b) Casing Tools (surface casing, casing holder and pipe vent, etc.)			
c) Fishing Tools (jack and inside-outside tap, etc.			
2. Truck-Mounted Air Compressor	1		
Capacity: 17.5kg/cm^2 x 20m^3/min or more with standard accessories			
3. Pumping Test Equipment	1 set		
3.1 Truck-Mounted Borehole Development Unit (with tower and winch)			
Truck Specifications: water-cooled diesel engine, right-hand drive, 4 × 4			
3.2 Air Lift Tools			
Compressor: 7kg/cm^2 x 3.5m^3/min or more, discharge pipe 2" / air pipe 3/4" } total 75m			
3.3 Generator: 50Hz, 220V, 20KVA			
3.4 Submersible Pump: lift 50m, discharge volume 100l/min or more, lifting pipe 1 1/2"			
3.5 Groundwater Level Measuring Apparatus upto a depth of 100m			
3.6 PH Meter			
3.7 Electric Conductivity Meter (with Thermometer)			
4. Electric Prospecting Equipment	1 set		
maximum prospecting depth of 200m or more			
5. Electric Logging Equipment	1 set		
Type: automatic recording with 100m long code			
Logging Items: natural potential and resistivity (micro, with log)			
Accessories: battery and recording paper, etc.			
6. Vehicles			
6.1 Cargo Trucks with Crane			
Specifications: water-cooled diesel engine, right-hand drive, 4 × 4			
Crane Capacity: 5 ton crane GVW 16 tons	2		
3 ton crane GVW 16 tons	1		
6.2 Station Wagons	2		
Specifications: water-cooled diesel engine, right-hand drive, 4 × 4, long body			
6.3 Pick-Up Trucks	2		
Specifications: water-cooled diesel engine, right-hand drive, 4 × 4, 500kg			
6.4 Motorcycles	3		
100-125cc, off-road type			
7. Water Tank	1		
Specifications: 4m^3 (truck mountable) with water pump			
8. Communication Equipment	1 set		
Specifications: output 50W, with fixed antenna for the base (1 unit) for vehicles (mobile stations: 5 units)			

Items and Specifications	First Year	Second Year	Third Year
9. Pumps Afridev Handpumps	90	120	120
10. Repair Equipment 10.1 Welder and Accessories 10.2 Electric Drill and Accessories 10.3 Grinder and Accessories 10.4 Pipe Cutter and Accessories 10.5 Screw Cutter and Accessories 10.6 Sander and Accessories 10.7 Pipe Vice 10.8 Bench Vice 10.9 Measuring Tools 10.10 Gas Cutter 10.11 Hydraulic Jack 10.12 Grease Supplier 10.13 Flexible Speed Cutter and Accessories 10.14 Miscellaneous	1 set		
11. Muddy Water Agent and Blowing Agent 11.1 Muddy Water Agent (chemical product) 11.2 Blowing Agent	0.4 tons 2 tons	0.5 tons 3 tons	0.5 tons 3 tons
12. Civil Work Equipment 12.1 Rammer 12.2 Belt Conveyor	1 1 set		
13. Local Base Facilities 13.1 Container Workshop (some 36m^3 with windows and tables for installation of repair equipment) 13.2 Simple Toilet 13.3 Generator (20KVA) for Repair Equipment 13.4 Water Tank (4m^3) 13.5 Fuel Tank (6m^3) 13.6 Mobile Tank (2m^3)	2 1 set 1 set 1 set 1 set 3 sets		
14. Spare Parts for Machines and Equipment to be Newly Provided 1.1 Generator 2. Compressor 3.1 Borehole Development Unit 3.3 Generator 3.4 Submersible Pump 3.5 Groundwater Level Measuring Apparatus 3.6 PH Meter 3.9 Electric Conductivity Meter 4. Electric Prospecting Equipment 5. Electric Logging Equipment 6. Vehicles 8. Communication Equipment 9. Pumps 10.1 Welder 12.1 Rammer 12.2 Belt Conveyor 13.3 Generator	1 set		1 set
15. Spare Parts and Tools for Machines and Equipment Previously Provided 15.1 Spare Parts a) Drilling Rig (FSW-7T, NZ227) b) Compressor (PDSH750, NZ227) c) Borehole Development Unit (DWT-60C, PDS125, DCA-27PI) d) Truck with 3 ton Crane (NZ227) e) Submersible Motor Pump (40BHS 13-52.2) f) Electric Prospecting Equipment (MCOHM)	1 set		1 set

Items and Specifications	First Year	Second Year	Third Year
g) Electric Logging Equipment (Geologer-3030)			
h) Groundwater Level Measuring Apparatus (ST type)			
i) Electric Conductivity Meter (SC51)			
j) PH Meter (PH81)			
k) Rammer (VRA-85)			
l) Belt Conveyor (KET 35-5)			
15.2 Drilling Tools drill pipe, drill collar, stabilizer, down-the-hole hammer, shock absorber, casing tool (7 1/2"), miscellaneous tools	1 set		
15.3 Air Lifting Tools discharge pipe (2"), air pipe (3/4"), 75m	1 set		
15.4 Other Tools	1 set		
16. Casings and Screens (to be locally procured)			
16.1 PVC Casing (4" x 3m)	1,050	1,400	1,400
16.2 PVC Screen (4" x 3m)	450	600	600
16.3 PVC Bottom Plug (4")	90	120	120
16.4 Solvent Cement	70 cans	98 cans	98 cans
16.5 Drills and Rivets	1 set	1 set	1 set

5-4 Project Implementation

5-4-1 Implementation Guidelines

The guidelines for the implementation of the Project are explained below.

(1) The Project will be implemented in accordance with the established system for the Japanese grant aid with the Department of Water of Malawi's Ministry of Works acting as the implementation body.

(2) Work relating to the detailed design, tender process, supervision of the procurement of borehole construction machines, equipment and materials and supervision of the borehole construction work will be conducted by a Japanese consultant pursuant to Japanese grant aid system.

(3) The procurement and delivery of the borehole construction machines, equipment and materials and the borehole construction work (including on-the-job training) will be conducted by a Japanese contractor.

(4) The Department of Water will make two teams of capable local staff, who will participate in on-the-job training to be provided by the contractor, available prior to the commencement of the construction work.

(5) The Department of Water will provide the necessary manpower to implement the Project throughout the Project period.

(6) Tax exemption and other necessary measures vis-a-vis machines, equipment and materials imported for Project purposes will be put into effect with the cooperation of Malawi's Ministry of Finance.

(7) The Department of Water will make all necessary arrangements vis-a-vis locally procured materials so that the supply of these items is given priority to follow the Project implementation schedule.

5-4-2 Implementation System

(1) Project Implementation Body

The implementation body for the Project will be the Department of Water of the Ministry of Works which is responsible for water supply administration nationwide. The Department of Water will use the borehole construction machines, equipment and materials to be newly provided as grant aid of the

Government of Japan and also similar machines and equipment already in possession to conduct the construction of the boreholes by means of appointing and supervizing a Japanese contractor. The Department of Water will also be responsible for the future maintenance of the completed boreholes and for the provision of a local base site.

In view of the smooth implementation of the Project, the Department of Water plans to secure the services of 58 administrative and technical staff, mainly from the Groundwater Section of the Headquarters and the Administrative Section, the Construction Unit and the Maintenance Unit of the Central Regional Office throughout the Project period as shown in Table 2-2-2. Managers of the relevant technical sections should, therefore, be briefed on the objectives of the Project and the implementation guidelines so that they can prepare the assignment of appropriate personnel.

(2) Consultant

The Japanese side will be responsible for the procurement of the machines, equipment and materials, preparation of the detailed design and supervision of the borehole construction work. This work will be conducted by a Japanese consultant. Immediately following the signing of the Exchange of Notes (E/N) on the Japanese grant aid, the Malawi side will conclude an agreement with a Japanese consultant on the following work.

1) Preparation of the detailed design and tender documents relating to the procurement of the machines, equipment and materials and also to the construction of the boreholes.

2) Execution of the tender process on behalf of the Government of Malawi and analysis and evaluation of tenders.

3) Provision of advice vis-a-vis negotiation of the contract between the Government of Malawi and the successful Japanese tenderer.

4) Witnessing of the inspection of the machines, equipment and materials during the manufacturing process and at the time of delivery.

5) Supervision of the borehole construction work.

(3) Contractor

Delivery of the machines, equipment and materials and the construction of the boreholes will be executed by a Japanese contractor. The Government of Malawi will conduct the tender process with the assistance of the consultant described in (2) above and will conclude a construction contract with the selected contractor. The contractor will be responsible for the following work.

1) Delivery of Machines, Equipment and Materials

The contractor will deliver the machines, equipment and materials listed in the contract to the Department of Water by the specified delivery date(s). The contractor will also provide explanations and guidance on the assembly, installation, operation, maintenance and daily inspection, etc. of the machines, equipment and materials.

2) Borehole Construction Work

The borehole construction work will be conducted by a Japanese contractor to be contracted by the Government of Malawi (same as 1) above) in accordance with the grant aid system of the Government of Japan. The contractor will complete the construction of the specified number of boreholes within the specified period in the contract and will also conduct the transfer of the borehole drilling technologies to Malawi engineers/technicians.

5-4-3 Implementation Plan

Implementation of the Project is planned on the basis of the provision of grant aid by the Government of Japan. With the signing of the E/N which approves the implementation of the Project, a consultant responsible for supervising the implementation of the Project and a contractor responsible for the procurement of machines, equipment and materials as well as the borehole construction work will be selected. The implementation of the Project will then follow the schedule shown in Table 5-4-1.

It is essential, however, that the Malawi side completes the following work prior to the delivery of the borehole construction machines, equipment and materials.

(1) Determination of the 300 borehole locations through discussions with local inhabitants and taking the hydrogeological data obtained by the electric prospecting conducted by the consultant into consideration.

(2) Construction or repair of access roads to the borehole locations using local inhabitants (for road work as well as ground preparation at the prospective borehole sites) and materials (sand and laterite, etc.) furnished by them as soon as such locations are determined.

(3) Securing of a 2,000m^2 site in Mchinji Boma prior to the commencement of the construction work to serve as a local base (office and workshops) and preparation of the ground with laterite.

(4) Arrangement of an machinery and equipment repair service at the Blantyre Workshop of the Plant and Vehicle Hire Organization (PVHO), Ministry of Works in the case of large-scale repair work being required although mechanical problems during the borehole construction work should be solved on site using the tools and spare parts to be provided for maintenance and repair purposes under the Project.

(5) Securing of capable and experienced local staff (in sufficient number to organize tow teams) to participate in on-the-job training.

(6) Obtaining of permission from the competent government authorities for the use of the design frequency associated with the communication equipment to be provided.

(7) Implementation of a publicity campaign to enlighten the inhabitants of the Project Area on the significance of the Project, health and borehole maintenance (VLOM system).

The commencement of the borehole construction work will be 1.5 months after the arrival of the machines, equipment and materials at the unloading port of Dar es Salaam based on the assumption that 1 month will be required for customs clearance purposes and to transport the goods to Mchinji Boma and another 2 weeks will be required for delivery and acceptance.

The Japanese contractor will organize two drilling teams to construct the 300 boreholes in three years using the machines, equipment and materials to be provided.

5-4-4 Work Supervision Plan

With the signing of the consultancy agreement following the signing of the Exchange of Notes, the consultant will prepare the detailed design, prepare the tender documents and conduct the tender process on behalf of the Malawi side. Following the selection of the

contractor, the consultant will supervise the procurement of the borehole construction machines, equipment and materials and also supervise the borehole construction work.

(1) Preparation of Detailed Design and Tender Documents

Based on the results of the electric prospecting and water quality tests conducted at the time of the basic study and also on data on existing boreholes, the consultant will prepare the detailed design documents as well as tender documents to be discussed with and approved by the Government of Malawi. At the time of approval of these tender documents, only the list of villages and average borehole drilling depth will be indicated in relation to the locations and depth of the boreholes. The final borehole locations and the drilling depth for each borehole will be decided prior to the commencement of the drilling work based on the detailed results of the electric prospecting to be conducted parallel to the tender work.

(2) Execution of Tender Work on Behalf of the Government of Malawi

On behalf of the Government of Malawi, the consultant will conduct the public announcement of tender, acceptance of tender application forms, meeting to explain the tender procedure, distribution of tender documents, acceptance of tenders and analysis and evaluation of tenders. In addition, the consultant will provide advice in regard to the negotiation of the construction contract between the Government of Malawi and the successful tenderer to assist the completion of an appropriate contract.

(3) Supervision of Procurement and Construction Work

Following the signing of a blanket contract relating to the procurement of machines, equipment and materials and borehole construction work, the consultant will be responsible for the supervision of the procurement and construction work.

In Japan, the consultant will inspect and approve the documents to be submitted by the contractor, inspect and approve the specifications of the items to be procured in Japan and witness the inspection of these items at the respective factories.

In Malawi, the consultant will conduct the final inspection of the delivered equipment and materials, confirm the final locations of the 300 boreholes (80 for Phase 1 and 110 each for Phases 2 and 3) and conduct work supervision, quality control and material control, etc.

(4) Personnel Plan

The consultant will appoint hydrogeologist (A) and hydrogeologist (B) for electric prospecting and an engineer specializing in the design of borehole construction machines, equipment, materials and borehole facilities in addition to a general manager for the detailed design. The consultant will dispatch the same hydrogeologist (A), general manager and engineer for on the spot supervision during the work supervision phase.

5-4-5 Procurement Plan

The local market survey in Malawi found some of the borehole construction materials, notably cement, gravel, sand, laterite, filtering materials, bricks, reinforcing bars, casings and screens, to be locally available. However, other materials must be imported.

The following procurement decisions have been made based on a study of the financial situation of the Government of Malawi and the economy as well as on the quality of the products.

(1) Items to be Procured Locally

1) Cement, Gravel and Others

Cement will be supplied by a cement plant at Changalume which is located halfway between Blantyre and Zomba. Gravel, sand and laterite are readily available on site. An adequate amount of good quality filtering materials will be provided by the collecting site owned by the Department of Water on the shore of Lake Malawi.

2) Bricks

Bricks are the most typical construction materials in Malawi and are readily available from Malawi's many brickworks. There are two types of bricks depending on the use of wooden or steel moulds.

3) Reinforcing Bars

Reinforcing bars are constantly imported from South Africa and are readily available.

4) Petrol and Gas Oil

Both petrol and gas oil are imported from South Africa and there is no sign of a shortage.

5) Casings and Screens

Both casings and screens will be supplied from a local manufacturer's plant in Lilongwe. The production quantity and quality are both good and the plant is capable of meeting a small quantity order within a short delivery time to prevent the deterioration of the products during storage at the site.

(2) Items to be Imported

1) Muddy Water Agent

Bentonite is generally used as a muddy water agent. As bentonite is unavailable in Malawi, however, a substitute, which is a chemical product capable of the same performance as bentonite with a smaller quantity and which is much cheaper than bentonite (approximately 11-15% of the cost of bentonite, inclusive of transportation cost), will be imported from Japan.

2) Borehole Drilling Machines and Equipment

Much of the machines and equipment relating to borehole drilling has a compatibility problem. Since many pieces of machines and equipment are involved, the appropriate machines and equipment will be procured in Japan taking into consideration the functions, quality, future prospect, ready availability of spare parts, after-service and price.

3) Afridev Handpumps

Afridev handpumps are not manufactured in Japan and local production is not yet operational. Therefore, the Afridev handpumps will be imported from India which has a good Afridev handpump supply performance from both the quantity and quality aspects.

4) Survey Equipment

The survey equipment will be imported from Japan as this equipment is good.

5) Vehicles

As the drilling rig, its auxiliary equipment, the compressor and radio equipment, etc. must be assembled and mounted on the respective vehicles in Japan, Japanese vehicles will be procured and exported to Malawi.

(3) Labour

Several drilling companies operate in Malawi, all of which use percussion rigs. Given their working capacity, however, they are generally overloaded with work. The recruitment of operators for the rotary/air-hammer drilling rig to be used for the Project, therefore, appears difficult even though there are operators in Malawi who are conversant with drilling work. Given these conditions, while workers will in principle be recruited locally, engineers to perform the key roles in the fields of technical control, work control and repair/maintenance of the provided machines and equipment will be dispatched from Japan because of the following reasons.

1) The borehole construction work, which is at the centre of the Project-related construction work, must be efficiently conducted in order to complete the planned number of boreholes within a limited period using the provided rotary/air-hammer drilling rig. It would be difficult for operators who are unfamiliar with this type of rig to satisfy these conditions.

2) The transfer of technology in a wide range of fields, including operation of the new rig, to operators/engineers of the Department of Water (some with experience of the rotary rig and others without) is necessary during the construction period.

3) One of the drilling teams will use the existing rig, other machines and equipment, including vehicles, of the Department of Water which were provided by Japan in 1989. The repair and maintenance (mainly of the drilling rig and vehicles) is essential in view of the smooth commencement of the construction work. Moreover, it is crucial that the machines and equipment be constantly checked to keep it in working order for the successful completion of the Project.

5-4-6 Scope of Work

The Malawi and Japanese sides are assigned the following scopes of work to be undertaken by the the implementation of the Project.

(1) Scope of Work to be Undertaken by the Government of Malawi

1) To provide data and information necessary for implementation of the Project.

2) To secure the land for drilling and construction of boreholes.

3) To ensure prompt unloading, tax exemption, customs clearance of the goods for the Project at the point of disembarkation in Malawi and prompt internal transportation therein of the products purchased under the Japan grant aid.

4) To exempt Japanese nationals engaged in the project form customs duties, internal taxes and other fiscal levies which may be imposed in Malawi with respect to the supply of the products and services under the verified contracts.

5) To accord Japanese nationals whose services may be required in connection with the Project under the verified contracts such facilities as may be necessary for their entry into Malawi and stay therein for the duration of their work stay.

6) To provide necessary permissions, licenses and other authorization for carrying out the Project.

7) To bear two kinds of commissions to the Japanese foreign exchange bank for the banking services, based upon the "Banking Arrangement", namely, the advising commission of the "Authorization to Pay" and payment commission.

8) To bear all the expenses, other than those to be borne by the Japanese grant aid.

9) To ensure the necessary budget and personnel for the proper and effective implementation of the Project, including operation and maintenance of the equipment provided under the Japanese grant aid.

(2) Scope of Work to be Undertaken by the Government of Japan

1) To provide the machines and equipment for one team of borehole construction and the spareparts and tools for existing machines and equipment (provided in

1989) for one team and materials required for the construction of 300 boreholes.

2) To construct 300 boreholes (including on-the-job training) in three phases.

3) To transport the machines, equipment and materials from Japan to the port of unloading by sea and to obtain of customs clearance.

4) To transport the above goods from the port of unloading to Mchinji Boma by land and to deliver them to the Malawi side after inspection.

5) To provide consultancy services for the detailed design and tender process.

6) To supervise the borehole construction work.

5-4-7 Implementation Schedule

The Project will commence with the signing of the Exchange of Notes (E/N) by the two governments, followed by the signing of the consultancy agreement between the Department of Water and a Japanese consultant. The consultant will then prepare the tender documents, including the specifications and will conduct the tender process to select a Japanese contractor responsible for the delivery of the machines, equipment and materials and also for the construction of the boreholes upon receipt of approval of the above documents by both governments. The consultant will also be present at the signing of the construction contract between the Government of Malawi and the successful tenderer (contractor). It is estimated that it will take 3.5 months from the signing of the E/N to the signing of the construction contract.

Manufacture and delivery of the machines, equipment and materials will be in two stages, i.e. ① delivery of spare parts and tools for the existing machines and equipment and ② delivery of the machines, equipment and materials to be newly provide.

The former will require 2.5 months for the manufacture and procurement of spare parts and tools, 1.5 months for marine transportation, 1 month for customs clearance and land transportation and 0.5 months for inspection and final delivery while the latter will require 5 months for the manufacture of the drilling rig, vehicles and others and thereafter a similar period of time as the former.

In short, it will take 9 months from the signing of the E/N to the delivery of the spare parts and tools for the existing machines and equipment. A further 2 months will be required for work preparation (repair and adjustment of existing machines and equipment) before the actual commencement of the drilling work.

The Project implementation period will be divided into three phases, in turn consisting of three stages, i.e. preparation of the detailed design by the consultant, manufacture and procurement of machines/equipment and materials by the contractor and construction of the boreholes by the contractor.

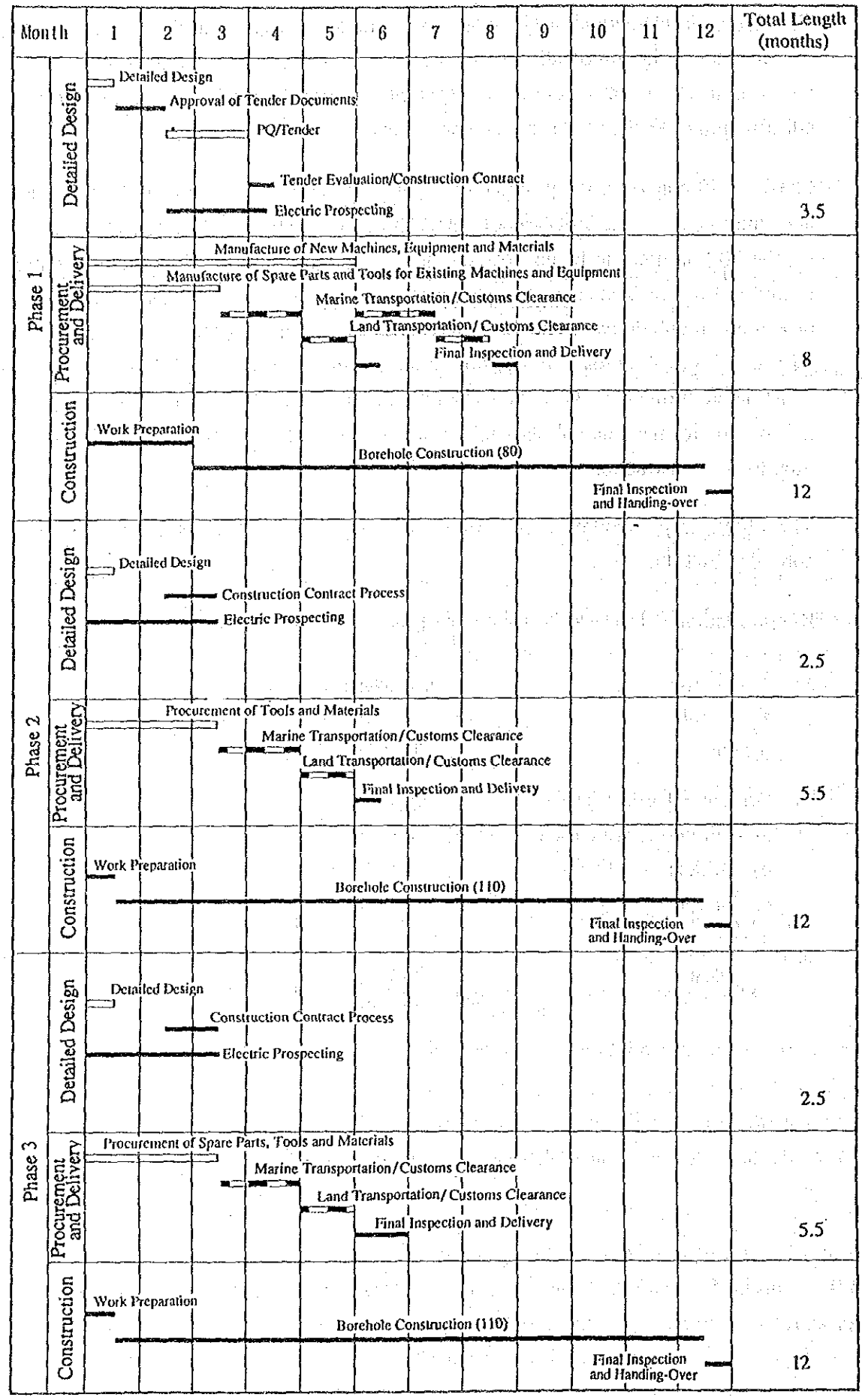
Phase 1 will consist of the provision of spare parts and tools for the existing machines and equipment and the provision of the machines and equipment as well as the materials for the 80 boreholes to be constructed during the work period. The estimated lengths required for the 3 stages are 3.5 months for the detailed design, 8 months for procurement and delivery and 12.0 months for construction. Both Phase 2 and Phase 3 will consist of the provision of equipment and materials for the 110 boreholes to be constructed during the respective work period. The estimated lengths of the 3 stages are 2.5 months for the detailed design, 5.5 months for procurement and delivery and 12.0 months for construction.

The above implementation schedule consisting of different phases and stages is compiled in Table 5-4-1.

5-4-8 Rough Estimate of the Project Cost to be Borne by Malawi Side

1)	Fuel Cost	K 130,000
	a) Petrol	K 108,000
	b) Oil	K 22,000
2)	Personnel Cost	K 190,000
	a) Administrative Officer	K 16,000
	b) Drillers	K 141,000
	c) Driver	K 33,000
	Total	K 320,000
		(Approx. ¥15,000,000)

Table 5-4-1 Project Implementation Schedule



CHAPTER 6

MAINTENANCE PLAN

CHAPTER 6 MAINTENANCE PLAN

The maintenance plan for the Project mainly consists of two components, i.e. boreholes as water supply facilities and borehole construction machines and equipment. As the maintenance system must be operational immediately following the completion of the Project, it is a determining factor in the Project's success.

(1) Water Supply Facility Maintenance System

The Department of Water has been trying to achieve the wide adoption of the VLOM (Village Level Operation and Maintenance) system by selecting the easy-to-maintain Afridev handpump and plans to adopt the VLOM system for the boreholes to be constructed under the Project (see Fig. 6-1). The VLOM system has two operational components, i.e. dealing with daily maintenance at a village level and dealing with organizational activities to establish the system and also finding solutions to social, economic and technical problems, as described below.

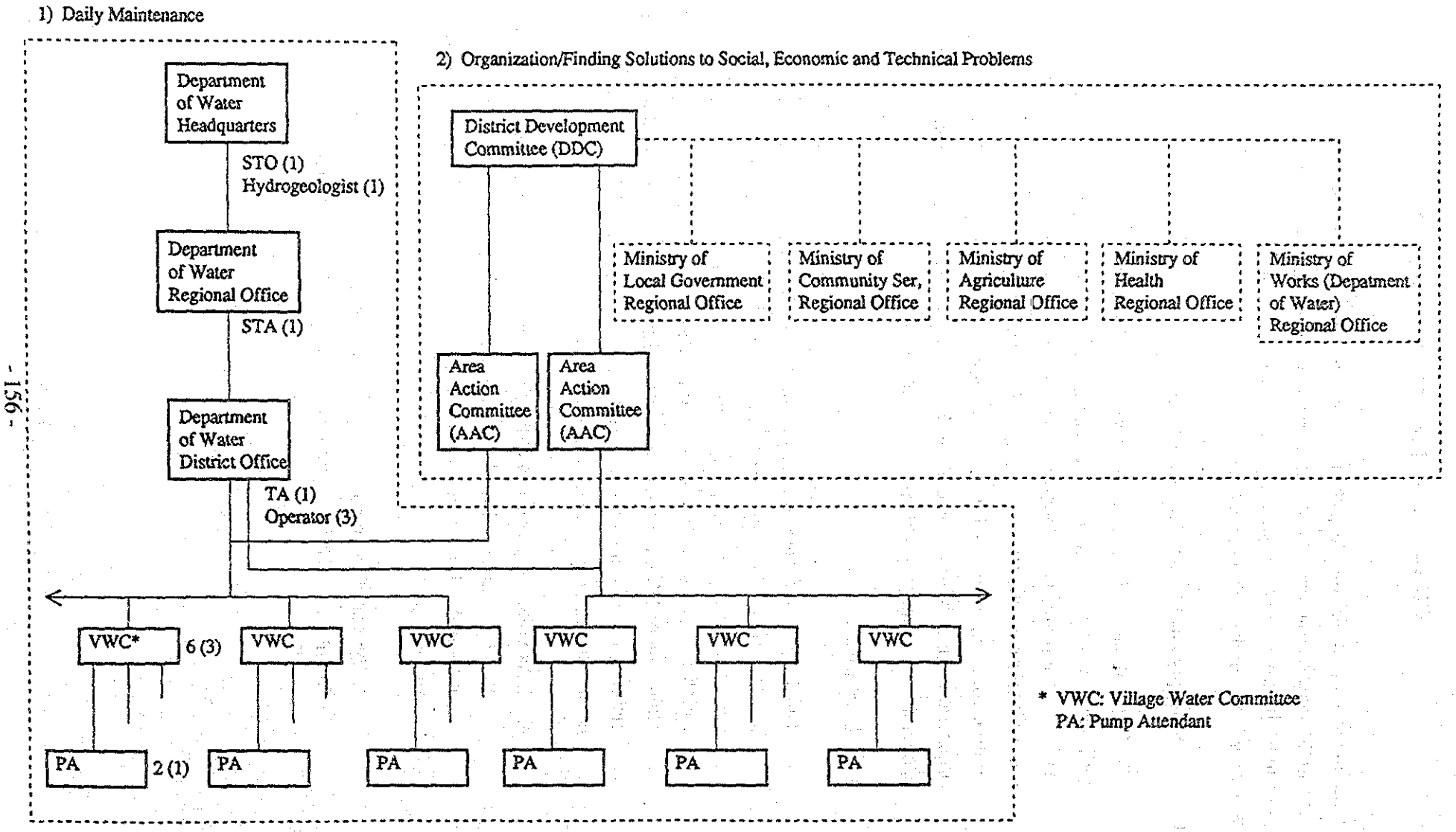
1) Daily Maintenance

The daily maintenance of each borehole is conducted by two pump attendants (PA: at least one of which must be a woman) who have been trained on borehole/pump maintenance and sanitary requirements. The Village Water Committee (VWC) which is established for every 5-10 boreholes and the technical assistant of the Maintenance Office of the Groundwater Section are also responsible for the daily maintenance of boreholes. The services of the PAs and VWC are of a voluntary nature and the people involved are not paid.

a) PAs voluntarily conduct daily checks and simple repairs in accordance with the items specified in the maintenance book (daily log book) and are also responsible for the cleaning of areas around the boreholes and other hygienic measures.

b) If the necessary repair is beyond the ability of the PAs, an operator of the Maintenance Office (appointed for every 100 boreholes) is called in.

Fig. 6-1 VLOM System



2) Organization of Activities and Solving of Social, Economic and Technical Problems

The Area Action Committee (AAC), controlled by the District Development Committee (DDC) composed of the District Governor, representatives of government ministries and chiefs of TAs, is responsible for organizing the operation and maintenance system at the VWC and PA levels. Any social, economic or technical problem occurring in the course of borehole operation and management is reported to the DDC to be solved with the advice of related government ministries and agencies.

The successful outcome of the Project will depend on the introduction of an appropriate maintenance system. In this context, it is essential that villagers participate in the decision on borehole locations, construction work and pump maintenance following the completion of the construction work so that they see the boreholes and pumps as being their own.

3) Running Cost

The annual running cost of the boreholes will consist of the following personnel cost and maintenance cost.

a) Personnel Cost

As described in (1) above, one operator is appointed for every 100 boreholes, necessitating the appointment of three operators to cover the 300 boreholes. The resulting annual personnel cost will be K10,800 as calculated below.

3 operators × (K1,200 for basic wages + K2,400 for allowances) = 10,800

b) Maintenance Cost

Vehicle Maintenance	K 6,100/year
Pump Spare Parts and Others	K45,000/year
Total	K51,100/year

As described in 4-2-2, the Department of Water plans to appropriate K160,000, which more than sufficiently covers the above costs (K61,900), for the maintenance of the boreholes to be constructed under the Project.

(2) Machine and Equipment Maintenance

The two sets of borehole construction machines and equipment, including drilling rigs, which were provided by Japan in 1989 are currently allocated to the Central and Southern Regional Offices. The new set of similar equipment to be provided under the Project will, therefore, be allocated to the Northern Regional Office following the completion of the Project.

The Northern Regional Office has 34 staff members working for the Construction Unit of the Groundwater Section which will be responsible for the maintenance of the above machines and equipment. It is planned that drillers of the Construction Unit will undergo on-the-job training on not only drilling technologies but also on maintenance work. As the Northern Regional Office has its own workshop, it is capable of conducting simple machines and equipment repairs. In the case of a necessary repair being beyond the capability of the Regional Office staff, it will be conducted at the Blantyre Workshop of the Plant and Vehicle Hire Organization (PVHO) of the Ministry of Works.,

CHAPTER 7

EFFECTS OF PROJECT IMPLEMENTATION AND CONCLUSION

CHAPTER 7 EFFECTS OF PROJECT IMPLEMENTATION AND CONCLUSION

7-1 Effects of the Project

The domestic water supply in Malawi is generally inadequate except in urban centres. Mchinji District, the subject area of the Project, is one of the areas where the provision of water supply facilities is lagging behind other areas despite national priority being given to the district in terms of agricultural output and other aspects.

The groundwater level in the Project Area is relatively shallow. However, as the area has large swamps, such as Dambo, most of the local inhabitants rely on dug wells and/or Dambo, often contaminated by coliforms and other bacteria, for the supply of drinking water. As a result, the inhabitants run a high risk of contacting waterborne diseases. In addition to its humanitarian purposes, any groundwater development project has public benefits in terms of a stable supply of clean drinking water, promotion of the settlement of rural inhabitants, improvement of the health and sanitation environment, liberalization of inhabitants from the non-productive labour of water transportation, improvement of the living standard and the promotion of agriculture.

The present Project intends the provision of a stable supply of clean groundwater for those people currently using poor quality water for drinking purposes by means of constructing 300 boreholes in villages where there is an acute need for such supply. Moreover, it is hoped that the Project will solve the water supply shortage during the dry season.

The anticipated effects of the Project and degree of improvement following its implementation are explained in Table 7-1-1.

Table 7-1-1 Anticipated Effects and Degree of Improvement with Project Implementation

Present Situation and Problems	Remedial Measures Taken by Project	Effects and Degree of Improvement
1. The present service ratio in the Project Area is only 17%. Most people use poor quality water from dug wells and/or Dambo, resulting in the frequent occurrence of waterborne diseases, particularly harsh water transportation work and water shortage in the dry season, etc. The Government of Malawi is giving priority to the solving of these problems.	Construction of 300 boreholes in villages with relatively large populations in three years based on one borehole/250 inhabitants. The boreholes will be closed by concrete, preventing unwanted contamination. The durable structure will guarantee a clean water supply with the use of handpumps. The planned locations are village centres which will be the most convenient place for water transportation by most villagers.	With the construction of boreholes to suit the population size of each village, the following positive effects can be anticipated. ① A daily supply rate of 27*l*/person will be secured for a service population of 107,440 (inclusive of those benefiting from existing boreholes) and the service ratio will improve to 53%. ② The prospect of preventing waterborne diseases will be much improved with the use of clean groundwater. ③ Women and children will be largely liberated from the daily harsh labour of water transportation (in consideration of WID issues).
2. Most inhabitants using poor quality water are unaware of the fact that the water is often contaminated by coliforms and/or other bacteria and are generally unaware of sanitary requirements.	The VLOM system will be introduced after the construction of the boreholes which is expected to increase the public's awareness of sanitary requirements through health education.	The awareness of inhabitants of health and sanitary requirements will be much improved.
3. The Department of Water which will be responsible for Project implementation is a national organization with staff throughout the country. However, the drilling rigs, other machines and equipment for groundwater development are somewhat deteriorated and the work efficiency is low. Only the two rotary/air-hammer rigs provided by Japan in 1989 are in satisfactory working order at present. The Department of Water hopes to procure more rigs of this type to improve the work efficiency. Training on the operation of the rotary rig was provided by the North Kawinga Project but was both short and insufficient.	The construction of the new boreholes will be conducted by two drilling teams, of which 1 team will be equipped with the drilling rig to be newly provided by Japan. Malawi operators will participate in the construction work to undergo on-the-job training.	The provision of the drilling rig (coupled with the transfer of technology) will greatly enhance the Department of Water's capability to conduct groundwater development, thus facilitating rural water supply projects in the future. The drilling rig is generally expected to have a life of ten years. The provision of funds to operate the rig, other machines and equipment will enable the Department of Water to use them for at least seven more years with an annual construction rate of some 50 new boreholes.

7-2 Conclusion

Implementation of the Project can be expected to result in the many positive effects described in 7-1 and, therefore, the provision of grant aid for the Project is deemed viable. There are no signs of any problems on the Malawi side in regard to the implementation of the Project as the Government of Malawi is capable of providing the necessary manpower and finance.

After completion of the Project, the drilling rig, other machines and equipment provided under the Project will still have a life of some 7 years. The Government of Malawi is required to secure proper budgetary appropriation and to both expand and consolidate the organizational set-up and manpower to further promote groundwater development projects so that the above machines and equipment are fully utilized.

APPENDICES

APPENDIX 1

MEMBER LISTS OF STUDY TEAMS

APPENDIX 1-(1) MEMBER OF STUDY TEAM (BASIC DESIGN STUDY)

Kazuhisa MATSUOKA	Team Leader Director First Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency
Yoshinori TANAKA	Water Supply Planner General Affairs Department Fukuoka Municipal Waterworks Bureau
Hiroyuki KANZAKI	Project Coordinator First Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency
Akinori TAKAKU	Groundwater Development Planner Japan Engineering Consultants Co., Ltd.
Ryoji IMAI	Hydrogeologist Japan Engineering Consultants Co., Ltd.
Sakae NAKAMURA	Machinery Planner Japan Engineering Consultants Co., Ltd.

APPENDIX 1-(2) MEMBER OF STUDY TEAM (DRAFT REPORT EXPLANATION)

Yoshihide NAKAI	Team Leader Resident Representative Malawi Office Japan International Cooperation Agency
Hiroyuki kanzaki	Project Coordinator First Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency
Akinori TAKAKU	Groundwater Development Planner Japan Engineering Consultants Co., Ltd.
Sakae NAKAMURA	Machinery Planner Japan Engineering Consultants Co., Ltd.

APPENDIX 2

STUDY SCHEDULES

APPENDIX 2-(1) STUDY SCHEDULE (BASIC DESIGN STUDY)

No.	Date	Movement	Accommodation	Activities	
1	Oct. 14 (Mon)	TYO→LON→	on broard	Departure of Team Leader, M. Tanaka and Mr. Kanzaki	
2	15 (Tue)	HRE→LUN	LUN		
3	16 (Wed)	LUN→LLW	LLW	Team Leader, Mr. Tanaka and Mr. Kanzaki : Report to Embassy of Japan, Arrival at Lilongwe	
		TYO→PAR→AMS	on broard	Departure of Consultants	
4	17 (Thu)	LLW	LLW	Team Leader, Kr. Tanaka and Mr. Kanzaki : Preparation for Field Study	Meeting with DW
		— do —	— do —	Arrival of Consultants	Meeting with DW
5	18 (Fri)	— do —	— do —	Courtesy Call on MOF, MOW, Discussion with DW	
6	19 (Sat)	— do —	— do —	Site Survey	
7	20 (Sun)	— do —	— do —	Visit to World Bank Borehole Rehabilitation Project in LLW Northeast and UNICEF Project in LLW	
8	21 (Mon)	— do —	— do —	Discussion with DW	
9	22 (Tue)	— do —	— do —	Discussion with DW (Mr. Imai:Survey on Drilling Rig Previously Provided)	
10	23 (Wed)	— do —	— do —	Discussion with DW regading Minutes, Data Collection	
11	24 (Thu)	LLW→(PAR)	on broard	Signing of Minutes.	Departure of Team Leader and Mr. Tanaka
		LLW	LLW		Mr. Kanzaki and Consultants: Data Collection
12	25 (Fri)	— do —	— do —	Discussion with DW	
13	26 (Sat)	— do —	— do —	Preparation for Site Survey, Sorting and Arrangment of Results of Discussions)	
14	27 (Sun)	LLW→NK→LWD	LWD	Survey on North Kawinga Groundwater Development Project (Mr. Imai : Preparation for Site Survey, Data Collection)	
15	28 (Mon)	LWD→Zomba →Blantyre	Blantyre	Survey on Drilling Previouly Provided in Phalombe, Discussion with NSO and GSD, Data Collection (Mr. Imai : Preparation for Site Survey, Data Collection)	
16	29 (Tue)	Blantyre→Zomba →LLW	LLW	Survey on Afridev Handpump Manufacturers, Data Collection	
17	30 (Wed)	LLW ←→ Mchinji	— do —	Discussion with DW, Site Survey	

Notes) TYO : Tokyo
LDN : London
LUN : Lusaka
HRE : Harare
LLW : Lilongwe
LWD : Liwonde
PAR : Paris
AMS : Amsterdam
DW : Department of Water
MOW : Manistry of Works
MOF : Manistry of Finance
NSO : National Statistical Office
GSD : Geological Survey Department

No	Date	Movement	Accommodation	Activities
18	Oct. 31 (Thu)	LLW ←→ Mchinji	LLW	Site Survey, Data Collection
19	Nov. 1 (Fri)	— do —	— do —	— do —
20	2 (Sat)	— do —	— do —	— do —
21	3 (Sun)	— do —	— do —	Site Survey, Data Collection (Mr. Nakamura : LLW→Blantyre)
22	4 (Mon)	— do —	— do —	Site Survey, Data Collection (Mr. Nakamura : Data Collection in Blantyre, Blantyre→LLW)
23	5 (Tue)	— do —	— do —	Site Survey, Data Collection
24	6 (Wed)	— do —	— do —	Site Survey, Data Collection, Discussion with DW
25	7 (Thu)	— do —	— do —	Site Survey, Data Collection, Sorting and Arrangement of Collected Data
26	8 (Fri)	— do —	— do —	Site Survey
27	9 (Sat)	— do —	— do —	Sorting and Arrangement of Collected Data (Mr. Nakamura : Survey on Pump Maintenance of Karonga Project, LLW→Karonga→Mzuzu)
28	10 (Sun)	— do —	— do —	Arrangment of Collected Data (Mr. Nakamura : Mzuzu→LLW)
29	11 (Mon)	— do —	— do —	Arrangment of Collected Data, Discussion with DW
30	12 (Tue)	— do —	— do —	Arrangment of Collected Data, Study and Examination of the Plan
31	13 (Wed)	— do —	— do —	Arrangment of Collected Data, Study and Examination of the Plan, Report to JICA
32	14 (Thu)	— do —	— do —	Wrap-up Meeting with DW
33	15 (Fri)	LLW→LUN→	on broard	Departure of Mr. Kanzaki and Consultants, Report to Embassy of Japan
34	16 (Sat)	→LDN	LDN	
35	17 (Sun)	LDN→	on broard	
36	18 (Mon)	→TYO		Return of Mr. Kanzaki and Consultants to Japan

Notes) TYO : Tokyo
LDN : London
LUN : Lusaka
HRE : Harare
LLW : Lilongwe
LWD : Liwonde
PAR : Paris
AMS : Amsterdam
DW : Department of Water
MOW : Manistry of Works
MOF : Manistry of Finance
NSO : National Statistical Office
GSD : Geological Survey Department

APPENDIX 2-(2) STUDY SCHEDULE
(DRAFT REPORT EXPLANATION)

No.	Date	Movement	Accommodation	Activities
1	Oct. 14 (Sat)	TYO→AMS→	on broard	Departure
2	15 (Sun)	→LLW	LLW	Arrival
3	16 (Mon)	LLW	LLW	Meeting with JICA, Courtesy Call on MOF, MOW, DW, Explanation of Draft Report to DW
4	17 (Tue)	— do —	— do —	Explanation of Draft Report to and Discussion with DW, Discussion with World Bank
5	18 (Wed)	— do —	— do —	Discussion with SCF(UK), Discussion with Mr. Matsumoto(OPC), Site Survey on Gravel
6	19 (Thu)	— do —	— do —	Discussion with DW regarding Minutes and Signing of Minutes
7	20 (Fri)	LLW→LUN	LUN	Departure Report to Embassy of Japan
8	21 (Sat)	LUN→	on broard	
9	22 (Sun)	→NBO→ROM	ROM	
10	23 (Mon)	ROM→	on broard	
11	24 (Tue)	→TYO	——	Return to Japan

Notes) TYO : Tokyo
LUN : Lusaka
LLW : Lilongwe
AMS : Amsterdam
NBO : Nairobi
ROM : Rome
DW : Department of Water
MOW : Ministry of Works
MOF : Ministry of Finance
SCF(UK) : Save the Children Fund (UK)

APPENDIX 3

MEMBER LIST OF OFFICIALS CONCERNED IN MALAWI

APPENDIX 3 MEMBER LIST OF OFFICIALS CONCERNED IN MALAWI

(1) Malawi Side

1) Office of the President and Cabinet(OPC)

Mr. A. Mkangama	Economist, EP & DD
Mr. Chakravarti	Economist, EP & DD
Mr. A. Matsumoto	Economic Advisor, EP & DD

2) Ministry of Works

Mr. B. W. Zingano	Acting Principal Secretary
Mr. D. A. Mtalimanja	Deputy Secretary
Mr. J. Brickle	Quantity Surveyor & Contract Officer
Mr. C. K. Gunchi	Road Supervisor, DRIMP, Roads Department

3) Ministry of Finance

Mr. H. A. Kawonga	Deputy Secretary
Mr. A. H. Mzoma	Administrative Officer

4) Ministry of Agriculture

Mr. K. M. Mtawali	Principal Economist
Mr. E. S. Kabuye	Deputy Chief Agricultural Officer
Mr. Kapida	Senior Land Husbandry Officer, Kasungu A. D. D.
Mr. I. R. Msuku	Land Husbandry Officer, Kasungu A. D. D.
Mr. J. A. Magwede	Senior Land & Husbandry Assistant, Mchinji R. D. P.
Mr. L. P. Mwale	Veterinary Assistant, Mchinji R. D. P.

5) Ministry of Health

Mr. J. F. Lipats	Assistant Statistician

6) Department of Water

〔 Headquarters 〕

Mr. E. Msolomba	Controller of Water Servies
Mr. Laisi	Chief Water Resources Officer
Mr. R. D. Kafundu	Principal Hydrogeologist
Mr. P. P. Mkandawire	Hydrogeologist
Mr. K. Banda	Hydrogeologist

Mr. J. Banda	Hydrogeologist
Miss M. Banda	Hydrogeologist
Mr. K. G. Liyanage	Mechanical Engineer
Mr. H. Koviwa	Chief Driller
Mr. P. Msisika	Water Economist
Mrs. D. Lakudzala	Senior Chemist
Mr. E. C. Beseleni	Senior Executive Officer
Mr. N. L. B. Chaya	Principal Civil Engineer (Rural Piped Water Supply Section)
Mr. J. Farmer	Senior Civil Engineer (Rural Piped Water Supply Section)

(Central Regional Office)

Mr. P. Mtembezeka	Hydrogeologist
Mr. R. Wengawenga	Hydrogeologist

(Southern Regional Office)

Mr. F. Devison	Hydrogeologist
Mr. R. Msisika	Hydrogeologist

(Mchinji Office, Water Supply Branch)

Mr. N. J. Kamtuwanje	Water Plant Operator

7) National Statistical Office

Mr. T. P. Zamaere	Assistant Commissioner for Census and Statistics
Mr. L. M. Magombo	Assistant Statistician

8) Geological Survey Department

Mr. R. S. M. Mshali	Principal Geologist

9) Mchinji District & Mchinji District Development Commitee(DDC)

Mr. A. F. Kalima	District Commissioner & Chairman of DDC

10) National Meteorological Centre

Mr. A. Dambe	Senior Meteorologist

11) Tabacco Control Commission

Mr. K. J. Chikuswe	Assistant Tabacco Sales Supervisor

(2) International Organizations and Others

1) The World Bank

Mr. N. Kulemeka	Economist/Programme Officer

2) UNDP

Mr. M. Roine	UNCDP Field Implementation Officer

3) EEC

Mr. Hugh Johnstone	Delegate of the Commission
Mr. C. J. Cracknell	Engineering Adviser, Delegation of the Commission

4) DANIDA

Mr. B. Jesperson	Project Manager for Karonga Lakeshore Integrated Rural Groundwater Supply Project

5) SCF(UK)

Mr. M. Elliott	Water Engineer

(3) Japanese Side

1) Embassy of Japan in Zambia

Mr. Kazuyuki Eda	Second Secretary
Mr. Kaoru Tsurita	Second Secretary

2) J I C A Malawi Office

Mr. Yoshihide Nakai	Resident Representative
Mr. Narihiro Yaegashi	Assistant Resident Representative
Mr. Hiroto Mitsugi	Assistant Resident Representative
Mr. D. L. Mmanga	Secretary

APPENDIX 4

MINUTES OF DISCUSSIONS

APPENDIX 4-(1) MINUTES OF DISCUSSIONS
(BASIC DESIGN STUDY)

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT FOR
MCHINJI GROUNDWATER DEVELOPMENT IN
THE REPUBLIC OF MALAWI

In response to the request of the Government of the Republic of Malawi (hereinafter referred to as "G.O.M."), the Government of Japan (hereinafter referred to as "G.O.J.") decided to conduct a Basic Design Study on The Project for Mchinji Groundwater Development (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Malawi a study team (hereinafter referred to as "the Team"), which is headed by Mr. Kazuhisa MATSUOKA, Director, First Basic Design Study Division, Grant Aid Study & Design Department, JICA, from October 16 to November 15, 1991. The Team had a series of discussions with the officials concerned of G.O.M. and conducted a field survey in the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The Team will proceed with further works and prepare the Basic Design Study Report.

Lilongwe, October 24, 1991

Mr. Kazuhisa MATSUOKA
Team Leader
Basic Design Study Team
JICA

Mr. B. Zingano
Acting Secretary
Ministry of Works

pp Mr. H. P. Kawonga
Deputy Secretary to the Treasury
Ministry of Finance

ATTACHMENT

1. Background of the Project

Since independence in 1964, G.O.M. has always emphasized the promotion of agriculture as one of its crucial development objectives. One pressing issue to be dealt with in facilitating agricultural development is a stable supply of clean domestic water. This is particularly relevant in rural areas.

In line with the United Nations International Drinking Water Supply and Sanitation Decade (1981-1990), G.O.M. has introduced the target of securing a sufficient supply of domestic water and of decreasing waterborne diseases. The exact target numbers of the water supply ratio and the population served for rural inhabitants have been set as 74 % and 5,860,000 respectively by the end of 1996 which is the final implementation year of the Statement of Development Policy (1987-1996). The two main components of the initiative for rural water supply are the drilling and rehabilitation of boreholes and wells, and the construction and rehabilitation of gravity type piped water supply facilities.

By 1991, 4,893,000 of rural inhabitants had access to water with acceptable quality. In reality, however, to achieve the above target number of population, G.O.M. should develop new water supply facilities to serve for the remaining 967,000 of rural population until 1996. To realize this target, G.O.M. has made a five year implementation plan (1992-1996) of rural water supply program in which 250,000 are planed to be served by the drilling of new boreholes, 78,000 are by wells and 639,000 are by the construction of piped water supply facilities.

Concerning the new borehole development, G.O.M has an intention to drill 1,000 boreholes during coming five years by using the fund from foreign assistance and its own budget. The donor agencies have already committed the development of 521 boreholes comprising 131 boreholes in Salima and Nkhota-kota by EEC, 200 boreholes in Liwonde by KFW, 190 boreholes in Mangochi by KFW. The borehole fund under the dispersed program of G.O.M. is also scheduled to be allocated to the development of 150 boreholes during this term. Accordingly, the development of the remaining 329 boreholes in the rural area of Mchinji District is expected to be financed by other donor agencies.

Mchinji district plays an important role in agricultural development as it is one of the most fertile areas in Malawi and located to the westside of Lilongwe which is the capital and a big food consumption city. It is embraced with a population of 248,161 according to 1987 census, and is administratively divided into Mlonyeni Traditional Authority (T.A.), Mavwere Sub Traditional Authority (S.T.A.), Zulu T.A., Mduwa S.T.A., Mkanda T.A., Dambe S.T.A. and Mchinji Boma (township).

The subject area of the Project covers approximately two third of Mchinji district, excluding the service area of Mchinji Boma gravity type piped water supply facility and estate areas, and had 138,885 of rural inhabitants in 1987. The number of existing boreholes is only 101 comprising 49 public, 20 institutional and 32 private. The public and institutional boreholes are used by the public, serving only 17,250 inhabitants or 12% of the population. Although there are several dug wells in villages, water quality of those wells is unacceptable by the G.O.M. standards.

The population growth rate in the Project area is as high as approximately 4.5% during ten years between 1977 census and 1987's. As it is estimated that the population in 1996 would be 203,640 in the Project area, 186,390 of rural inhabitants (92% of population) will still wait to enjoy clean water supply and improve their social life conditions through the implementation of the Project. As such the Project area is one of the worst area in Malawi in terms of domestic clean water supply shortage.

2. Objective of the Project

The objective of the Project is to improve and stabilize the social conditions of the rural areas by supplying safe and clean water to the rural people in Mchinji District.

3. Project Area

The Project area is located in the southern, eastern, central and northern part of Mchinji District. G.O.M. has divided this area into three zones on the basis of population density. The Project area map and the basic indicators of each zone are shown in Annex-1 and Annex-2 attached herewith respectively.

4. Project Site

Although G.O.M. has put priority for development of boreholes in order from Zone-1 to Zone-3, detailed information is now under preparation. A list of the construction sites of boreholes in which the name of villages with population, the number of necessary boreholes in each village and the priority order for drilling are described, should be prepared by G.O.M and sumitted to the Team before their leaving Malawi.

5. Executing agency

The Ministry of Works through the Water Department is responsible for the administration and execution of the Project. As the contribution of G.O.M. to the Project, the operation and maintenance of boreholes will be carried out by village community through a system of Village Level Operation and Maintenance (VLOM) which is now being introduced all-over the country under the guidance of the Water Department.

6. Request of G.O.M.

(1) Construction of 300 boreholes in the Project area utilizing two drilling machines one of which was provided by G.O.J. in 1988 under its Grant Aid Program.

(2) Provision of one set of drilling machine, equipment, spare parts and materials which will be nessesary for the construction of above mentioned boreholes. It is preferrable to use the Afridev Pump in the Project, because G.O.M has a policy to standardize on this type of pump for the smooth implementation of VLOM.

(3) Provision of on-the-job training (drilling and other techniques) to the Malawian counterpart staff during the borehole construction period.

(4) Provision of training in Japan for drilling techniques and hydrogeology.

7. Japan's Grant Aid system

(1) G.O.M. has understood the system of Japanese Grant Aid explained by the Team.

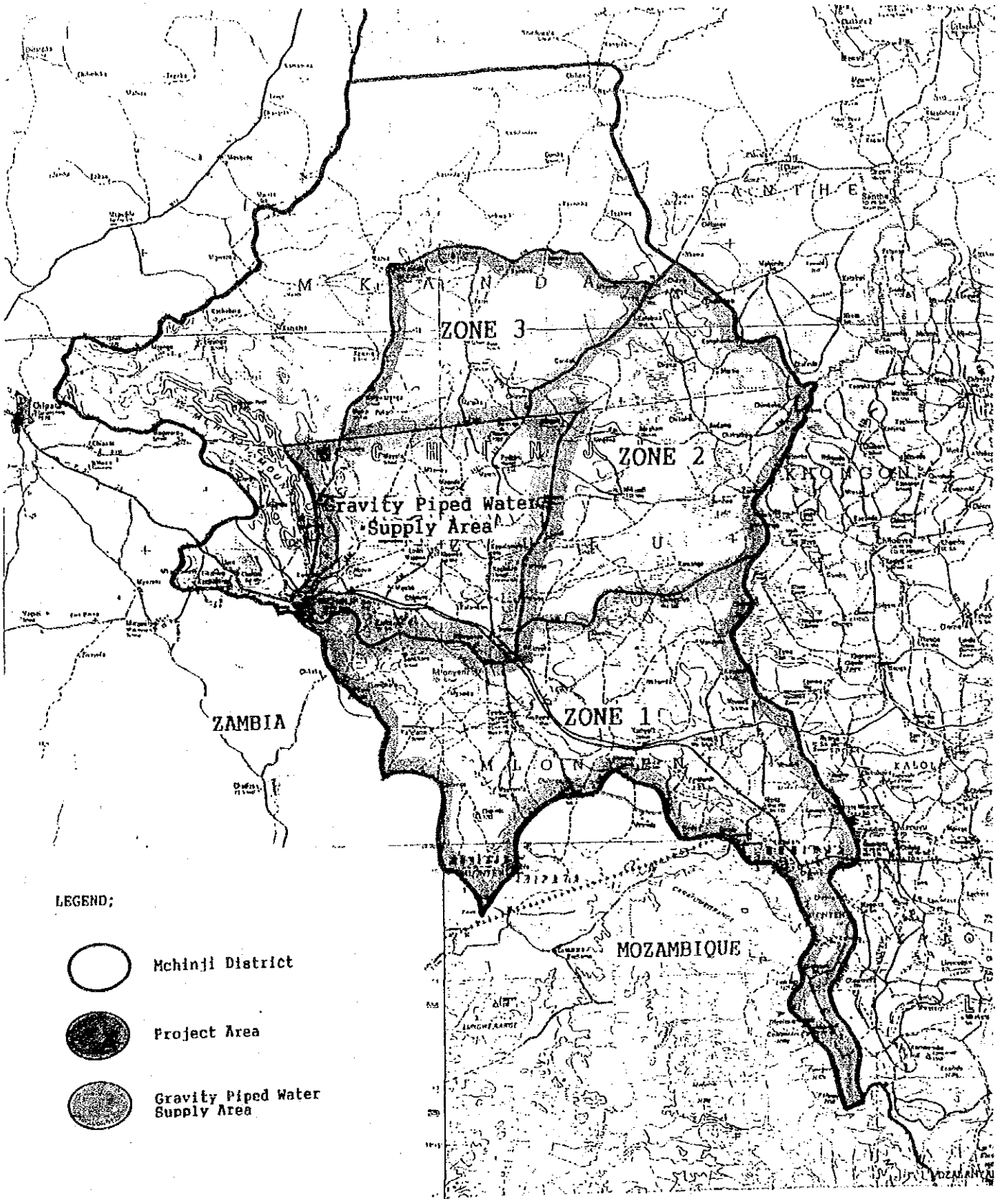
(2) G.O.M. will take necessary measures, described in Annex-3 for smooth implementation of the Project, on condition that the Grant Aid Assistance by G.O.J. is extended to the Project.

8. Schedule of the Study

(1) The Team will proceed with further studies in Malawi until November 15 in 1991.

(2) Based on this Minutes of Discussions and technical examination of the study results, JICA will prepare a draft final report and send a mission for the explanation and consultation on that report by March 1992.

Annex-1: Map of the Project Area



Annex-2 : Basic Indicators of The Project Area

		Zone-1	Zone-2	Zone-3	SubTotal
Mlonyeni T.A.	Population '87	13,500			13,500
	Population '96	18,700			18,700
Mavwere S.T.A.	Population '87	48,565			48,565
	Population '96	67,470			67,470
Zulu T.A.	Population '87	15,632	10,563		26,195
	Population '96	22,310	15,070		37,380
Mduwa S.T.A.	Population '87		13,767		13,767
	Population '96		21,260		21,260
Mkanda T.A.	Population '87			14,514	14,514
	Population '96			21,790	21,790
Dambe S.T.A.	Population '87		12,709	9,632	22,341
	Population '96		21,070	15,970	37,040
Total	Population '87	77,697	37,039	24,146	138,882
	Population '96	108,480	57,400	37,760	203,640
	Ext. boreholes	27	20	22	69

Annex-3 : Necessary measures to be taken by the Government of the Republic of Malawi

1. To provide data and information necessary for implementation of the Project.

2. To secure the land for drilling and construction of boreholes.

3. To ensure prompt unloading, tax exemption, customs clearance of the goods for the Project at the point of disembarkation in Malawi and prompt internal transportation therein of the products purchased under the Grant Aid.

4. To exempt Japanese nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Malawi with respect to the supply of the products and services under the verified contracts.

5. To accord Japanese nationals whose services may be required in connection with the Project under the verified contracts such facilities as may be necessary for their entry into Malawi and stay therein for the duration of their work stay.

6. To provide necessary permissions, licences and other authorization for carrying out the Project.

7. To bear two kinds of commissions to the Japanese foreign exchange bank for the banking services, based upon the "Banking Arrangement", namely, the advising commission of the "Authorization to Pay" and payment commission.

8. To bear all the expenses, other than those to be borne by the Grant Aid.

9. To ensure the necessary budget and personnel for the proper and effective implementation of the Project, including operation and maintenance of the equipment provided under the Grant Aid.

APPENDIX 4-(2) MINUTES OF DISCUSSIONS
(DRAFT REPORT EXPLANATION)

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT FOR
MCHINJI GROUNDWATER DEVELOPMENT IN
THE REPUBLIC OF MALAWI
(CONSULTATION ON DRAFT REPORT)

In October 1991, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team on the Project for Mchinji Groundwater Development (hereinafter referred to as "the Project") to the Republic of Malawi, and through discussions, field survey, and technical examination of the results in Japan, has prepared the draft report of the study.

In order to explain and to consult the Malawi side on the components of the draft report, JICA sent to Malawi a study team, which is headed by Mr.Yoshihide Nakai, Resident Representative, JICA Malawi Office, and is scheduled to stay in the country from March 15 to 20,1992.

As a result of the discussions, both parties confirmed the main items described on the attached sheets.

Lilongwe, March 19 ,1992

Mr. Yoshihide Nakai
Leader
Draft Report Explanation Team
JICA

Mr. B. Zingano
Acting Secretary
Ministry of Works

Mr. H. P. Kawonga
Deputy Secretary to the Treasury
Ministry of Finance

ATTACHMENT

1. Components of draft report

The Government of Malawi has agreed and accepted in principle the components of the draft report proposed by the Team.

2. Japan's Grant Aid System

(1) The Government of Malawi has understood the system of Japanese Grant Aid explained by the Team.

(2) The Government of Malawi will take the necessary measures, described in Annex , for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

3. Further schedule

The Team will make the final report in accordance with the confirmed items, and send it to the Government of Malawi by the end of May 1992.

Annex : Necessary measures to be taken by the Government of the Republic of Malawi in case Japan's Grant Aid is executed

1. To provide data and information necessary for implementation of the Project.

2. To secure the land for drilling and construction of boreholes.

3. To ensure prompt unloading, tax exemption, customs clearance of the goods for the Project at the point of disembarkation in Malawi and prompt internal transportation therein of the products purchased under the Grant Aid.

4. To exempt Japanese nationals engaged in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Malawi with respect to the supply of the products and services under the verified contracts.

5. To accord Japanese nationals whose services may be required in connection with the Project under the verified contracts such facilities as may be necessary for their entry into Malawi and stay therein for the duration of their work stay.

6. To provide necessary permissions, licences and other authorization for carrying out the Project.

7. To bear two kinds of commissions to the Japanese foreign exchange bank for the banking services, based upon the "Banking Arrangement", namely, the advising commission of the "Authorization to Pay" and payment commission.

8. To bear all the expenses, other than those to be borne by the Grant Aid.

9. To ensure the necessary budget and personnel for the proper and effective implementation of the Project, including operation and maintenance of the machines and equipment provided under the Grant Aid.