MINISTRY OF PUBLIC WORKS AND HOUSING
THE REPUBLIC OF MOZAMBIQUE

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE DEVELOPMENT OF RURAL DRINKING WATER SUPPLY
IN
GAZA PROVINCE
IN
THE REPUBLIC OF MOZAMBIQUE

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PACIFIC CONSULTANTS INTERNATIONAL
MITSUI MINERAL DEVELOPMENT ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Republic of Mozambique the Government of Japan decided to conduct a basic design study on the Project for the Development of Rural Drinking Water Supply in Gaza Province in the Republic of Mozambique and entrusted the study to the Japan International Cooperation Agency (JICA).

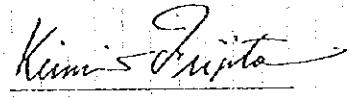
JICA sent to Mozambique a study team from 12th of December, 1995 to 25th of January, 1996.

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

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

March 1996



Kimio Fujita
President
Japan International Cooperation Agency

March, 1996

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Development of Rural Drinking Water Supply in Gaza Province in the Republic of Mozambique.

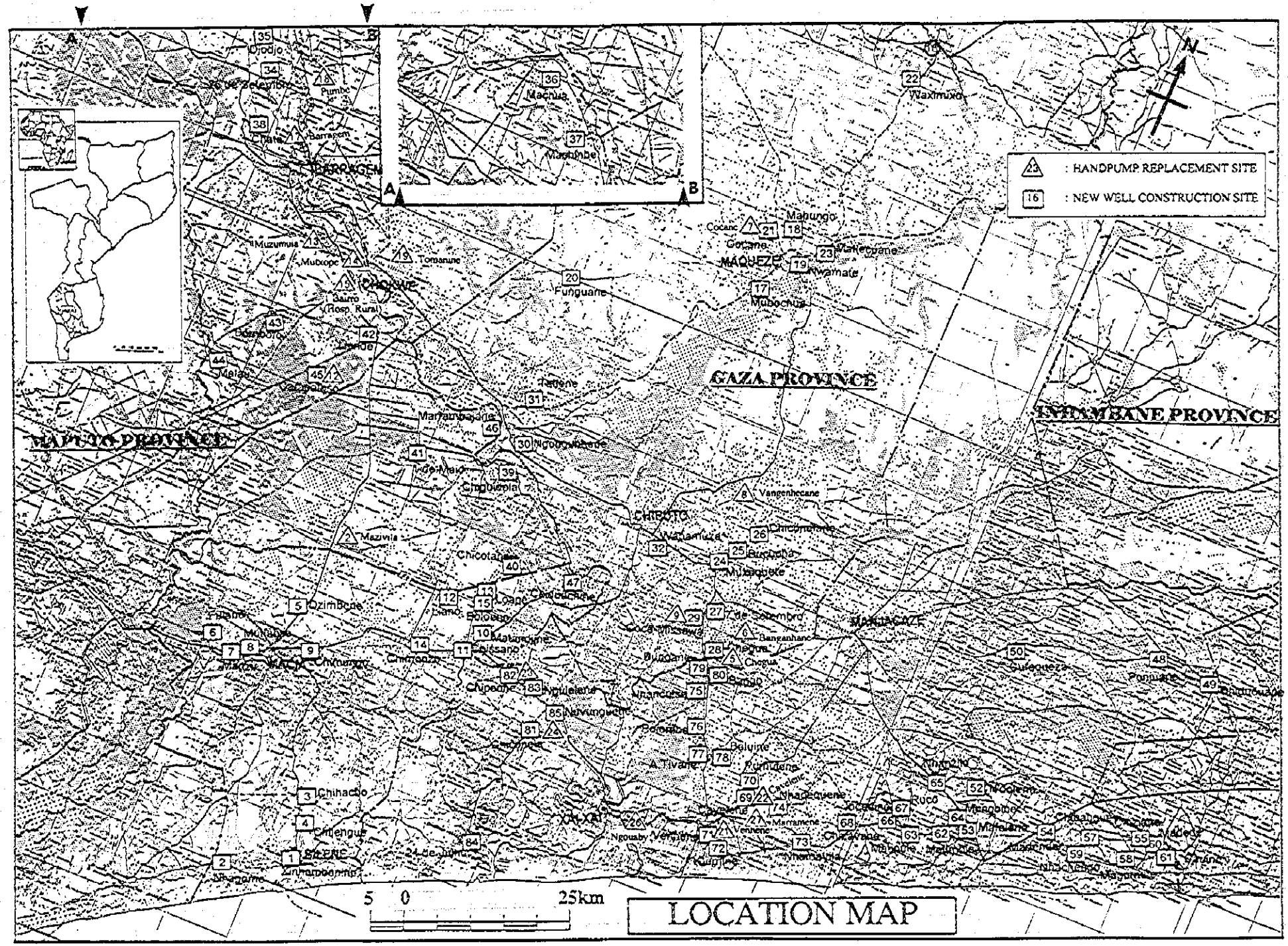
This study was conducted by Pacific Consultants International incorporated with Mitsui Mineral Development Engineering Co., Ltd., under a contract to JICA, during the period from December 8th., 1995 to March 29th., 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Mozambique and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

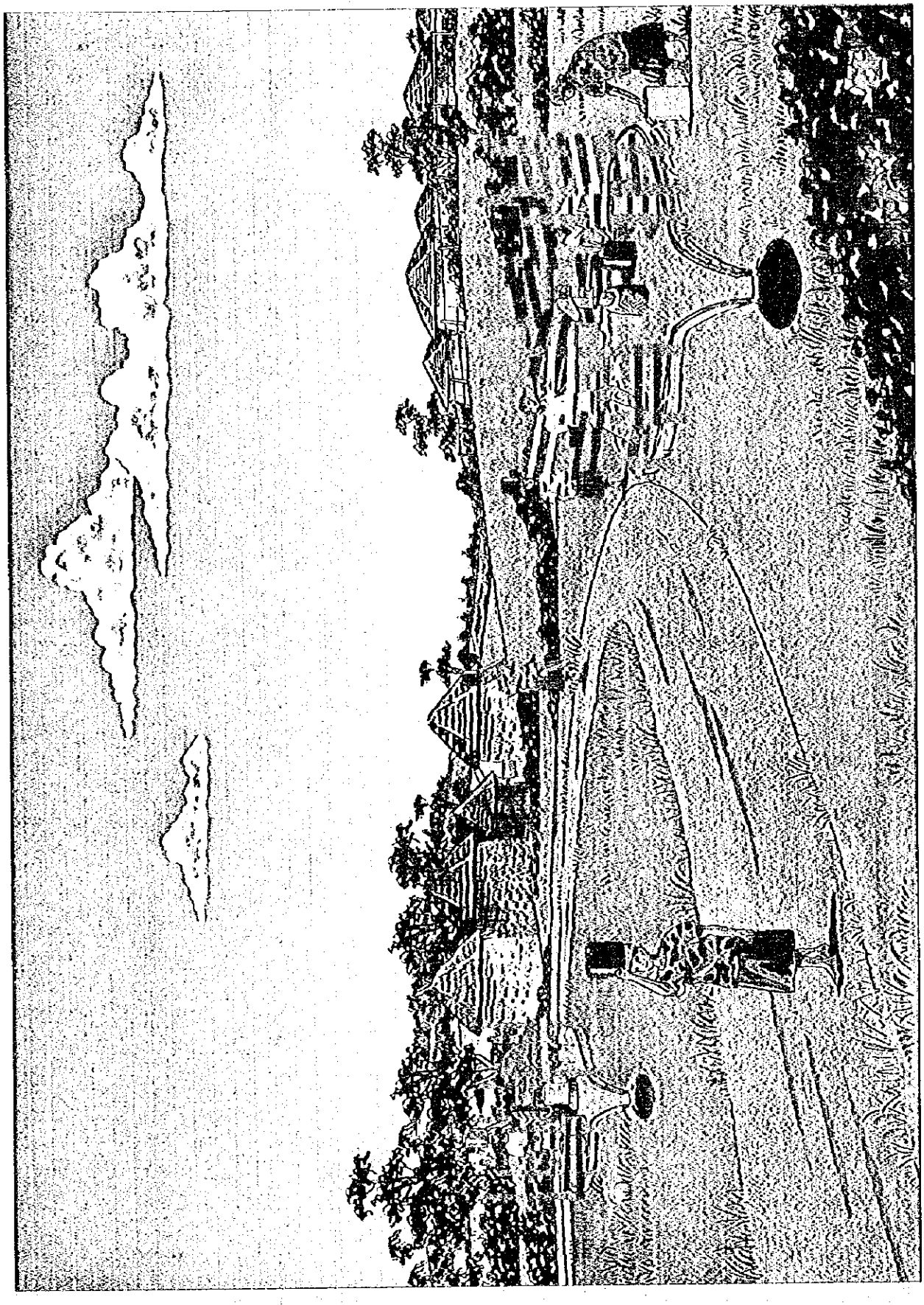
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Norifumi Yamamoto
Project manager,
Basic design study team on
the Project for the Development of Rural Drinking Water Supply in Gaza Province in the Republic of Mozambique.

Pacific consultants International
incorporated with
Mitsui Mineral Development Engineering Co., Ltd.


A
B
N
: HANDPUMP REPLACEMENT SITE
: NEW WELL CONSTRUCTION SITE
MAPUTO PROVINCE
GAZA PROVINCE
INHAMBANE PROVINCE
MANHIÇA
MARRACUENE
MACHAVA
CHIBUTO
MAQUEZE
CHOKWE
BARRAGEM
5 0 25km
LOCATION MAP



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Abbreviations

MPOH	: Ministry of Public Works and Housing
DNA	: National Directorate of Water
DRH	: Water Resources Department
PRONAR	: Office for the National Program of Rural Water
EPAR	: Provincial Workshop for Rural Water
DPOPH	: Provincial Directorate for Public Works and Housing
PEC	: Community Education and Participation
VLOM	: Village Level Operation and Maintenance
DTH	: Down the Hole
ISO	: International Organization for Standardization
JIS	: Japan Industrial Standard
SABS	: South African Bureau Standard
OJT	: On the Job Training
PVC	: Polyvinyl Chloride
RSA	: Republic of South Africa
HDPE	: High Density Polyethelene

CHAPTER 1

BACKGROUND OF THE PROJECT

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Mozambican government formed A National Five-year Plan (1995～2000) in the end of 1995. It intends the improvement of the rural water supply system that the ratio of population served would be 46% from approximately 30% at present until 2000 and 100% until 2017.

Although about twelve hundred boreholes have completed in Gaza province under the assistance by foreign countries, international agencies and NGO, only two third of them are working now. On the assumption that a water well can supply water for 500 persons, the ratio of population served is estimated 30.8% in Gaza province. In order to improve this condition based on the national plan, the government plans to start from the 6 districts (Guija, Chibuto, Chokwe, Manjacaze, Xai-Xai, Bilene) in the southern part of the province where the total population of them is approximately 78% of the province. Eighty villages (150 water wells) in them where it is necessary to develop rural water supply system particularly are given higher priority.

The government must construct more than 1800 water wells in Gaza province to hit the target. However, EPAR-Gaza has only two simple percussion rigs that its drilling capacity is limited to 50m depth and it is unsuitable to drill hard rocks in the northern part of Gaza province.

Therefore the Mozambican government requested the government of Japan grant aid assistance for construction of water wells in rural area and provision of equipment and materials necessary for implementation of the Project to reinforce DNA which is the executing agency of the Project.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objectives of the Project

Since the independence in 1975,the Mozambican people have experienced years of civil war and severe drought, which causes various difficulties such as destruction of infrastructure, depression in economic activities and agricultural production, etc. Especially in the Gaza province where the Renamo sect expanded its activities widely, lot of public infrastructures were destroyed and many farmers ran away from their home villages as refugees, resulting in severe shortage of drinking water in the rural areas. The Government of Mozambique is taking various efforts in providing the rural water supply system in order to achieve 100% of service ratio by 2017.

In Gaza province, about 1,210 of wells have been constructed by the efforts of various donors like NGO for the population of 1,308,800. It is, however, considered that only 807 wells equivalent to about two-third (2/3) of these wells are in functional condition. The service ratio of water supply is calculated to be about 30.8% only on assumption that one (1) well could supply drinking water for 500 people.

In order to raise this low service ratio, the government determined to provide more wells putting emphasis on six (6) districts (Guija, Chibuto, Chokwe, Manjacaze, Xai-Xai and Bilene districts) whose total population shares 78% of the province. 81 villages were selected as those requiring well construction urgently because of low service ratio comparing with the other ones, and 150 wells are proposed to be constructed in these villages. The service ratio of the selected 80 villages, six districts and the whole of Gaza province are raid form 20.8% to 57.9%, from 27.6% to 36.0% and from 30.8% to 37.4%, respectively due to the implementation of the well construction.

To achieve 100% of service ratio in the province as scheduled in the national program, 1,488 in the southern part of Gaza and 323 wells in the northern part of there have to be constructed by 2017, and it is necessary to construct 82 new wells every year to realize the plan. The EPAR-Gaza which is in charge of drilling wells in the province has only two British-made simple percussion-type drilling rigs of which maximum drilling depth

is considered as small as 50 m. In order to enable the EPAR-Gaza to drill 82 well every year expanding its drilling area toward the northern area where the hard rock is prevailing, it is necessary to introduce stronger effective rig machine as soon as possible and to utilize competent local drilling contractors available in the country.

The objectives of the project are to construct 150 new wells for providing drinking water to the selected 80 rural villages, and to provide the EPAR-Gaza with the drilling rig and appurtenant equipment to enhance its capacity to drill boreholes.

2.2 Basic Concept of the Project

The Project aims to improve the water supply condition in 80 villages through the construction of tubewells. The request was examined from this point of view through discussions with relevant personnel of the Mozambican government, and the contents of the Request was confirmed and justified based on the results of field surveys, studies and analyses as stated below.

2.2.1 Confirmation of the Request

The contents of the latest Request dated September 28, 1995 are itemized as stated below.

① The construction of 150 tubewells in the Gaza province, and replacement of pump units in 50 existing wells.
② Provision of construction materials and handpump units for 300 wells.
③ Provision of geophysical survey equipment, drilling rigs and appurtenant equipment necessary for drilling works.

Based on the Request, a series of discussions was held and the contents of the Request were found to be modified as stated below.

1) Considering difficulties in accessing sites and so forth, the study area for this stage is modified and reduced from whole of the Gaza province to six districts of Guija,

Chibuto, Chokwe, Manjacaze, Xai-Xai and Bilene which are located in the southern part of the province.

2) The number of materials for constructing wells is reduced from 300 to 150 to set the same value as that for construction of new wells.

3) The number of handpump units for replacement is changed from requested 50 to 41 to set same value as that requested for replacement works.

4) The numbers, items, and specifications of the drilling rigs and appurtenant equipment are modified as listed below.

Process of Discussion on Requested Equipment

M/M on Sep. 28th. 1995	M/M on Dec. 22nd. 1995	Basic Design Study
Truck Mounted Drilling Rig (2units)	Considering present human resources of EPAR -Gaza, 1set is suitable.	No Change
High Pressure Air Compressor (2units)	Tailored Type High Pressure Air Compressor. According to the rig number, one compressor is suitable.	No Change. According to the procured rig type, it may be mounted on the drilling rig directory.
Pumping Test & Appurtenance(2sets)	According to the rig number, one set is suitable.	No Change
Cargo Truck -6x4 with 6ton Crane (2units) -6x4 10ton load Capacity (2units)	According to the rig number and so forth, Cargo Truck -4x4 with 6ton Crane (1unit) -4x410ton load Capacity (1unit)	Considering diversion of an existing cargo truck, one unit is available. -4x410ton load Capacity with 3 ton Crane (1unit)
Water Tank (No request)	-5,000 l Water Tank Trailer (1 unit)	Considering mobility and safety, it should be not trailer but vehicle. -5,000 l Water Tank Lorry (1 unit)
Fuel Tank (No request)	-5,000 l Fuel Tank Trailer (1 unit) -500 l Fuel Tank (2 units)	Same reason as above -3,000 l Fuel Tank Lorry (1 unit) -Fuel Tanks aren't necessary.
Pick up, 4 WD (total 4 units) -Drilling teams (2 units) -Handpump installation teams (2 units)	Pick up, 4 WD (total 4 units) -Drilling Team -Handpump Installation team -Pumping test team -Administration of DNA -Gaza	Considering diversion of an existing pick up vehicles, Pick up, single cabin 4 WD (total 2 units) -Handpump installation team -Pumping test team
Station Wagon, 4 WD - PEC (2 units)	Station Wagon, 4 WD -PEC (1 unit)	Considering the number of staffs in PEC-Gaza, one unit of single cabin 4WD pick up is available.
Motorcycle (14units)	Motorcycle - 7 units for Animadors	Considering the number of Animadora & exiting M/C, 7 units are available.
Geoelectric & Geophysical Survey Equipment (2 sets)	-Resistivity Survey Equipment (1 set) -Electromagnetic Survey Equipment (1 set) -GPS (2 sets)	-Resistivity Survey Equipment (1 set) -Electromagnetic Survey Equipment (1 set) -GPS (1 sets) for siting by DPOPH
Water Analysis Kit (2 sets)	Water Analysis Kit (5 sets) for five regional office of EPAR-Gaza	No Change.
Tailored Type Mobile Workshop (2 units)	According to the rig number, one unit is suitable.	No Change.
Camping Set (4 sets)	12 sets for every 2 person	Mozambican sides can procure.
Radio System -Base Station (1 set) -Mobile Station (9 sets)	According to the number of requested motor vehicles, -Base Station (1 set) -Mobile Station (6 sets)	Radio System is not necessary this time. Since mobile workshop is procured, most ordinary troubles could be dealt with.

5) Other than the above-listed equipment, the following equipment and machine which

are considered necessary for the Project implementation are requested to be provided additionally.

Additionally Requested Equipment

Additional Requested Items	Reasons
Well Logging Equipment (1 set)	To detect high saliferous layers and determine the depth of screening pipes
Copier (1 set)	To distribute leaflets, pamphlets and others to villagers in the PEC activity.
Personal Computer (1 set)	To arrange well ledger and analyze well data for O&M of wells.

The contents of the Request are confirmed based on the above discussions made on December 22, 1995 as stated bellow.

Confirmation of the Request

<Well Facility>

Name	Items	Contents	
Construction New Wells	Quantity (Well + Handpump)	150 Wells	Xai-Xai, Bilene, Chokwe, Chibuto, Manjacaze
		Handpump	AFRIDEV TYPE (Total Head :60m)
Rehabilitation Wells	Quantity (Handpump)	41 Wells	Xai-Xai, Bilene, Chokwe, Chibuto, Guija
		Handpump	AFRIDEV TYPE (Total Head :60m)

<Equipment and Materials>

List of Drilling Well Equipment and Geophysical Survey Equipment

No.	Equipment	Specifications	Quantity
1	Truck Mounted Drilling Rig	Drilling Rig -Drilling Capacity: Max. 200m -Diameter : -Correspond to DTH and Rotary Method Truck -Diesel Engine -Wheel Drive: 4x4, 6x4 or 6x6	1 Unit
2	Drilling Accessories	-Standard Accessories -Drilling Tools -Casing and Tools -Fishing -Tools -Attachment and Tools	1 Lot
3	Tailored Type High Pressure Air Compressor	Compressor -Air Supply : 20bar	1 Unit
4	Pumping Test & Appurtenance	(1) High Capacity Submersible Pump	1 Set
		(2) Low Capacity Submersible Pump	1 Set
		(3) Generator	1 Set
		(4) Others -Notch Tank, Lifting Pipe, Water Level Meter, Tools, etc.	1 Lot
5	Geophysical Survey Equipment	(1) Resistivity Survey Equipment	1 Set
		(2) Electromagnetic Survey Equipment	1 Set
		(3) Well Logging Equipment	1 Set
		(4) GPS	2 Set
6	Motor Vehicles	(1) Cargo Truck	
		- 4x4 with 6 ton Crane	1 Unit
		- 4x4 10 ton load capacity	1 Unit
		(2) Water Tank Trailer -Tank Capacity: 5,000 liters	1 Unit
		(3) Fuel Tank Trailer -Tank Capacity: 5,000 liters	1 Unit

No.	Equipment	Specifications	Quantity
6	Motor Vehicles	(4) Pickup type, 4WD Vehicle -Drilling team -Handpump installation team -Pumping test team -DPOPH	4 Units
		(5) Station Wagon 4WD for PEC (6) Motorcycles -Displacement: ≦125 cc	1 Unit 7 Units

Water Quality Analysis Equipment

No.	Name of Equipment	Main Specification	Quantity
1	Portable Kits for Water Quality Analysis	-Handy Type, Dry Battery or Rechargeable Battery -Analysis Items: Color, Hardness, HCO_3, Cl, NO_3, NO_2, SO_4, F, Ca, Mg, Na, K, Mn, Fe, Conductivity, PH.	5 Sets

Equipment and Materials for Water Well Construction

No.	Equipment	Specifications	Quantity
1	Handpump	-Afridev Type Handpump -Max. Pumping Capacity: 0.2 liters/sec -Total Head: 60m	191Sets
2	Casing / Screening Pipe	-Quality: PVC, Length: 3m -Caliber: I.D.103mm, O.D. 113mm -Perforation Ratio: >3%	1 Lot

Equipment and Materials for Operation and Maintenance

No.	Equipment	Specifications	Quantity
1	Trailer Type of Mobile Workshop	-Welder, Generator, Tools, etc.	1 Lot
2	Spare Parts	-Spare Parts for Procured Equipment in This Project -for Drilling Rig -for Geophysical Equipment -Hand Pump	1 Lot
3	Personal Computer & Copier	-IBM or Its Compatible PC, Printer, Software	1 Set

Other Equipment

No.	Name of Equipment	Main Specification	Quantity
1	Fuel Tank	500 l	1 Unit
2	Camping Set	For PEC and drilling team	1 Set
3	Radio Communication System	Consisting of 1 base and 6 mobile stations	1 Set

2.2.2 Selection of Villages for the Project

1) Candidate Villages

The presented list of the candidate villages for constructing wells consists of 164 wells covering 81 villages. However, since it contains repetition of village names, unbalance between village population and requested well number, abandoned

villages, etc., the list was examined and updated based on the results of field survey as presented in Table 2.1. The updated number of candidate sites are kept in 164 as same as that presented in the original list based on the discussions held with the officials in DPOPH-Gaza.

2) Selection of Villages of Well Construction

Based on the results of the field survey, 150 sites were selected from the candidate 164 sites considering access to sites, availability of present water sources, potential of ground-water development, etc. The selection criteria is presented in the table.

Selection Criteria for Drilling Sites

I. ACCESS TO SITES A: Accessible by ordinary car B: Accessible by 4WD Vehicles C: Inaccessible by 4WD Vehicles	IV EXPECTED GROUNDWATER DEPTH A: D < 50 m B: D > 50 m
II. AVAILABLE WATER SOURCE A: ONLY SURFACE WATER AVAILABLE B: GROUNDWATER AVAILABLE IN ADJUCENT VILLAGE C: GROUNDWATER AVAILABLE IN OWN VILLAGE	V WATER QUALITY(EC) A: EC < 1,500 B: 1,500 < EC < 5,000 C: EC > 5,000
III. EXPECTED YIELD A: Q > 0.2 l/sec B: Q < 0.2 l/sec	VI INTENSION TO PAY WATER CHARGE A: Yes B: No

The results of the evaluation are shown in Table 2.2. In the evaluation, the following items are considered.

- Distribution of the new wells to be constructed should be fair among the villages.
- Usable water should be expected in both quality and quantity.
- Groundwater levels should be expected in the depth with which the water is able to be lifted by a handpump.

The selected 150 sites covers 80 villages in the area, and their locations are indicated in Location Map.

As for the replacement of the existing handpump units, all the requested 43 wells were examined at site on their possibilities to function after replacement, and it is

concluded that only 23 wells listed in Table 2.3 are considered to become functional by replacement of handpump units.

2.2.3 Construction of Wells

1) Geology, Hydrogeology and Geophysical Prospecting

The study area extends over a part of Alto Changane Plains, Limpopo-Incomati Interfluvial Plains, Dune Belt, and Alluvial Valleys, according to the Hydrogeological Map of Mozambique (1987 DNA). A large part of the area is covered by Quaternary deposits underlain by Tertiary sandstone. Aquifers occurring in the sediments will be developed in this project.

The groundwater in the area will be exploited with construction wells equipped hand-pumps. Hydrogeological condition of the area should be considered for the development, especially two hydrogeological issues, saline water and depth to ground water level.

Electrical resistivity survey, field survey and analysis of existing well data were conducted after examinations of maps of topography, geology and hydrogeology. The electrical resistivity survey was carried out at the survey points selected hydrogeologically. Generally two survey points were selected in villages requesting more than one water well and one point was selected in others. The survey points were 134 in total.

- Surveyed villages and points : 80 villages, 134 points
- Measurement method : Schulumberger method
- Maximum interval of electrodes : 250 m

Groundwater elevations and water qualities were examined analyzing the results of such resistivity surveys, and it was found that the yields of groundwater is expected to be enough to provide the necessary amount of drinking water, though in some villages, it is recommended to provide some countermeasures against less water high TDS and low groundwater level in finishing wells. It is, therefore, proposed to

reduce the number of wells to be drilled in the villages requesting the well construction more than two (2). As a result, 150 numbers of sites were selected for drilling wells.

The depth of aquifer is expected to be 20 - 100 m for the confined aquifers, and the electric conductivity varies from 300 to 3,000 *μ/cm* in the surveyed areas.

2) Water Quality

It is known that water quality of some areas are saline and not acceptable for drinking. In general the government recommends the conductivity of less than 1,500 micro-S/cm. However ground-water of the conductivity of 1,500 to 5,000 micro-S/cm is used practically. If water quality of a constructed well in a village has a slightly high conductivity, the village can decide whether they use the well or not.

The result of the field study suggests that the northern part of the study area is a higher conductivity groundwater area. However, the result also shows that there is a difference in a conductivity even in same village. The electrical resistivity survey indicated that an aquifer having lower conductivity may occur in a deeper layer underlying a shallow aquifer with high conductivity. Therefore the locations and depth of drilling wells should be decided carefully and hydrogeologically.

The result of the field study and the electrical resistivity survey shows that groundwater in the following villages may be salinity water.

Nwamate(No.19), Cocane (No.21), Waximixo (No.22), Chate (No.38), Chigidela (No.39), Lionde (No.42), Bombofo (No.43), Malau (No.44), Carapatoso (No.45), Malanbajane (No.46), Chiduachine (No.47)

In the villages requesting more than one water well, the number of wells to be drilled has to be reduced with one (1) or two (2) sites in order to ensure the yield.

3) Groundwater Level

In the eastern part of the study area, there are villages at high altitude relatively 80 to 100 m above sea level. The depth to groundwater levels in these villages may exceed the capacity of hand-pumps planning to install. According to the well inventory, a confined aquifer with the less deep potentiometric level may be found in a deeper layer in some part of the area, not all. The selection and decision of locations and depth of drilling wells require adequate consideration.

In the following villages groundwater levels are expected to be comparatively deep.

Madender (No.54), Chiziane (No.55), Chinbangue (No.57), Magumete (No.58), Nachengo (No.59), Madede (No.60), Cauine (No.61), Nhamavila (No.73), Nhapequene (No.74), Nhancutse (No.75), Poiombo (No.76), A.Tivane (No.77), Baluine (No.78), Bungane (No.79), Bango (No.80)

In the villages requesting more than one water well among the above, the number of drilling wells has to be reduced in order to ensure the water quality.

4) Selection of Villages for Drilling Wells

Hydrogeological analysis was conducted on the villages for the well construction based on the result of field study and electrical resistivity survey. As a result of the analysis, 150 wells were selected for the construction of the project. Table 2.2 shows the result of analysis on each village.

5) Success Rate of Borehole Drilling

Although the number of drilling wells are narrowed down as mentioned above, it may be difficult to succeed in well drilling at all the sites. Consequently, a certain number of extra wells should be included in the plan to account for the failure in well drilling. Success rate of well drilling is estimated at about 90% considering the records of 89% marked last year covering whole of the areas including saline areas.

2.2.4 Provision of Equipment

The field survey was conducted in Mozambique and South Africa interviewing PRONAR, DPOPH and private companies in order to examine the possibility of purchasing the equipment for the Project in these countries. The results are summarized below.

1) Geophysical Survey Equipment

No geophysical survey equipment is manufactured or assembled in South Africa. There are agents of manufacturers of the equipment. However, orders for spare parts are placed from the manufactures by DNA instead of through the agents because it makes the cost higher and takes long time if spare parts are purchased through such agents.

2) Drilling Rig

(1) Manufacturer

There are two (2) manufacturers of drilling rig in RSA; Super Rock Drills and Smith Capital Equipment.

The Super Rock Drills supplies drilling rigs and related materials. Drilling rigs are made up by assembling the parts manufactured by other makers and its own manufactured drilling mast and hydraulic units. Product quality of the rig is not considered well, and the reliability of the date of its delivery is low.

Smith Capital Equipment supplies drilling rigs. The finishing of rigs are of satisfactory. However, the rigs are not equipped with draw works which are normally equipped on the drilling rigs made in Japan and in other major countries.

(2) Agents and Assembler

The survey was made on the following three (3) major agents of drilling rigs.

- Atlas Copco
- Ingersoll-Rand
- Schramm

Atlas Copco is one of the major makers of the mining equipment in Sweden. It has a branch office in RSA. Rigs are assembled in a factory near Johannesburg. While common spare parts are stocked always, the other spare parts are not stocked and are supplied from the headquarters in response to the order from users.

Ingersoll-Rand is one of the major American makers of the mining equipment. Drilling rigs are imported from USA and are mounted on the carriers in its own factory near Johannesburg. Spare parts are supplied from the headquarters similar to Atlas Copco.

Schramm is one of the major American makers of drilling rigs, and it has a branch office in RSA. The imported drilling rigs and the mast manufactured locally are mounted in the factory near Johannesburg. The situation of supplying spare parts are similar to Ingersoll-Rand.

(3) Equipment and Materials for Well Construction

i) Handpump Unit

There exists only one (1) manufacturer in Mozambique; STENAKS, and it manufactures and sells AFRIDEV-type handpump. The pumping head of AFRIDEV type handpump is 60 m in maximum, and considered durable. Therefore, it becomes quite popular type of handpump in the projects implemented under PRONAR.

There are makers manufacturing MONO Pump and Orbit also in RSA, and former is considered the largest pump maker in RSA manufacturing and selling high-head pump as well as manufacturing submersible pumps. The

latter is the maker manufacturing and selling small handpumps with high head. The mechanism of pump is considered same as MONO Pump.

ii) Pipes and Others

Most of pipes and reference materials for the construction of wells and aprons are manufactured in RSA, and considered to be procured in RSA.

2.3 Basic Design

2.3.1 Design Policy

The basic design for the Project is made on the basis of the following policies.

1) Natural Conditions

- The climate of Mozambique is characterized by rainy and dry seasons. The rainy season from October to March is hot and has much rainfall. It becomes difficult to access the site during the rainy season because of muddy road condition. Therefore, it is necessary to considered this situation in determining the implementation plan.
- Since the aquifer in the project area is considered of the sandy layers, it is necessary to considered this geological situation in determining drilling schedules and structure of well.
- In some areas the groundwater is expected to contain high saline water. When the groundwater does not satisfy the Mozambican standard, such are should be excluded. The geological logging is indispensable to confirm the existence of the aquifers containing high salinity.

2) Social Conditions

- The government of Mozambique requested to include whole Gaza province, and it was decided that only the southern districts are considered as a first step of the Project. According to the rural water supply plan till 2017, about 1,800 handpump well are required to satisfy the water demand in the six (6) districts in the southern part of Gaza province. 164 candidate sites covering 85 villages

were selected these six (6) districts for the Project, and these villages desire well construction urgently.

- The fence to be provided around the well site should be constructed by the beneficial villagers in order to facilitate villager's participation and to enlighten the villagers moral in rural sanitation and hygiene.

3) Local Situation on Construction, Contractors and Materials

- Local contractors should be utilized as much as possible.
- To facilitate the operation and maintenance works after the completion of wells, the materials for construction of wells should be compatible to DIN standards, which has been applied for the wells constructed so far.
- Drilling rigs and mobile vehicles should be procured as the brands of which agents are available in Mozambique or in RSA

4) Operation and Maintenance Capacity

- The operation and maintenance of the constructed wells are to be made by EPAR and the maintenance group of village as same as other wells having been constructed so far.
- In Gaza province the PEC proceeds with enlightenment and education to the villagers to facilitate operation and maintenance after the well construction. They make the villagers be aware that the constructed well is their own property and technical knowledge is important to maintain the provided well. It is, therefore, important to assist such PEC activities in the Project also.
- PEC is expected to provide same level of extension services as those to the villagers having received wells so far on rural hygiene and maintenance of well to the villagers who will also receive new wells under the Project.
- The technical transfer through the On-the-Job Training will be performed under the Project for geological survey equipment and drilling rigs. The former needs the training on electric and electro-magnetic survey, while the latter requires rotary and DTH types of drilling methods.

5) Scope of Project

(1) Well Facilities

- The successful well is defined as that producing the yield over 1.0 m^3/hr (0.28 l/sec) as standardized in Mozambique.
- The success rate is set at 90% considering the record of PRONAR marked in 1994.
- The handpump to be installed is of AFRIDEV type, which is maintained by village users and available in Mozambique.
- Water demand per capita is set at 20 l/day, and a well is constructed to supply the water for 500 people as standardized in Mozambique.
- The arrangement of casing and screen pipes should be determined based on the results of geological logging, and four (4) inch pipes are applied with gravel packing.
- An apron, a drainage pit and fences will be constructed to protect the water source from contamination.

(2) Procurement of Equipment and Materials

- The geophysical survey equipment consists of an electric resistivity and an electro-magnetic survey equipment taking into account that geologically the aquifer expand in the southern area is of alluvium while in the northern part the target water is fissure water in the rock.
- The drilling rig to be procured is of the type possible to operate both drilling methods of rotary and DTH, because both stratum water and fissure water is targeted for development.
- The depth of well is set between 40 and 120 m considering results of geophysical survey and drilling records for the existing wells. The diameters of well and drilling bit are set 4" and 8-5/8", respectively, as shown in Basic Design Drawings.

- The number of vehicles required for each category of work is tableted below,

and some of the vehicles being used in EPAR-Gaza at present have to be utilized when the actual drilling works are commenced at site.

Required Number of Vehicles

Purpose	Truck M. Rig	Trailer Comp-ressor	Truck w/6 t Crane	5 t Cargo Truck	Water T. Lorry	Fuel Tank Lorry	Support. Vehicles	Trailer Work-shop	Motor Bike
Drilling Wells	1	1	1	(1)	1	1			
Pump Test							1		
Pump Inst.							1		
O & M								1	
PEC Activities							1		7+(5)
Total	1	1	1	(1)	1	1	3	1	7+(5)
Procurement	1	1	1	0	1	1	3	1	7

Note The vehicles in ( ) are those borrowed from EPAR-Gaza

6) Implementation Period

- Considering that it takes six (6) months for manufacturing and delivering the drilling rig, and that 150 wells are not able to be constructed within a year, the Project is proposed to be implemented with two (2) phases. In the first phase, the procurement of equipment and construction of wells by local contractors are made, and the wells are constructed substantially in the second phase.
- It is necessary to construct the wells, in dry season, located in the villages of which access condition is considered to be worse in rainy season.

2.3.2 Basic Design

1) Overall Plan

(1) Villages for Drilling Wells

The 150 new wells are planned to be constructed in 80 villages selected in five (5) districts which are located in the southern part of the province as summarized in the Table. In addition, the handpump units of 23 existing wells are replaced as summarized in the table. The location of each village is presented in Location Map.

Target Villages for Well Construction

District	Number of Target Villages	Number of Wells to be Drilled
1. Xai-Xai	17	29
2. Bilene	14	32
3. Chokwe	14	26
4. Chibuto	16	33
5. Manjacaze	19	30
Total	80	150

Target Villages for Replacement of Pump Units

District	Number of Target Villages	Number of Wells to be Drilled
1. Xai-Xai	6	6
2. Bilene	1	1
3. Chokwe	5	5
4. Chibuto	5	8
5. Guija	2	3
Total	19	23

(2) Water Supply Plan

i) Lifting Capacity of Handpump and Water Supply Capacity

The handpump of AFRIDEV type is widely applied in the Project areas. The actual lifting capacity was observed at site during the field survey to confirm the values of 0.21 l/sec of capacity stated in the manufactures specification sheet. The results varies widely from 0.16 l/sec operated by child to 0.35 l/sec by male adult. Considering that such pump operation is traditionally made by children and women in the Project area, 0.21 l/sec is adopted for the average capacity of the pump unit as in accordance with the specification sheet.

Pumping Capacity of AFRIDEV Pump

Case	Capacity (l/sec)
Male Adult	0.35
Tow Children	0.16
Two Female Adults	0.25
Specification	0.21

It is generally understood in Mozambique that a well supplies drinking water of 20 l/day for 500 population. Thus, the pump unit has to be operated for 13.2 hr/day continuously as stated below.

(Operation Hour of Pump Unit (hr/day))

= (Water Demand (l/day)) x (Population) / (Pump Capacity (l/sec)) x 1,000 / 60 / 60

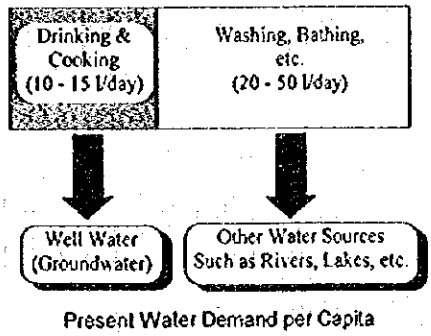
= 0.02 x 500 / 0.21 x 1,000 / 60 / 60

= 13.2 hr/day

The average supply capacity of AFRIDEV pump is considered to be 10 m^3/day in the above calculation.

ii) Water Demand per Capita

According to the results of interview survey conducted during the field survey, the water demand per capita is approximately estimated at 65 l/day in



Present Water Demand per Capita

maximum as illustrated in the figure though it varies widely depending on the distances to the water sources. Out of this value, 20 - 50 l/day is used for washing and bathing, and the rest of 10 - 15 l/day is considered as the water for drinking and cooking. Generally in the Project areas, people goes to the water source every day to get the drinking and cooking water even if the source is located far away from their houses. They get water for bathing and washing in the surface water sources such as rivers and lakes nearby their houses. However, in the areas where the water sources are quite limited, the water consumption is considered less than 10 l/day. Therefore, the water demand of 20 l/day, which is considered as the standard value in Mozambique, is applied for the Project.

(3) Water Sources

i) Natural Recharge

Natural Recharge is defined as the quantity of rainwater that reaches the ground-water table by infiltration. According to the Hydrogeological Map of Mozambique (1987 DNA), most of the sedimentary terrain have the recharge capacity of more than 5% of the annual rainfall. In Gaza the annual mean rainfall is 500 mm and the study area is about 14,000 km^2 , consequently the volume of groundwater recharge of the area is 350 million m^3/year at least.

150 wells, the pumping rate of which is 6.5 m^3/day, will be planned to construct in the area. The total discharge volume from the drilling wells is 975 m^3/day, or about 356 thousand m^3/year, which is 0.1 % of the natural recharge. The recharge is considered to be enough for the project.

ii) Water Quality

In general Water quality of ground-water in the area satisfies the Mozambican water quality guideline which is based on the one of WHO. However it is known that there are aquifers including saline water in some part of the area. Therefore the locations and depth of drilling wells should be decided after careful hydrogeological consideration.

(4) Procurement of Equipment and Materials

i) Geophysical Survey Equipment and Drilling Rig

a) Truck-mounted Drilling Rig

In the southern part of Gaza province drilling target is alluvial layer and such formation which is easily collapsed, while hard basement rock is predominant in the northern part. The drilling rig type should be, therefore, what can adapt both down-the-hole hammer type that makes use of compressed air and rotary type that makes use of drilling fluid. Moreover the drilling rig should be truck-mounted style to mitigate its damage caused by jolting during transit.

The procured drilling rig is expected to drill deeper than 150 m with bit diameter of 8-5/8". As for its accessories, they should to adapt both drilling types naturally.

The drilling system should be chosen and procured from the drilling rig maker in RSA that can provide spare parts and after services.

b) Trailer Type Compressor

Compressor should correspond to a capability of above mentioned rig in order to utilize for the down-the-hole hammer drilling method. The compressor needs to be mounted on a trailer or on a truck where the rig is mounted.

c) Cargo Truck with Crane

This vehicle is used for transportation and cargo work of equipment and materials in relation to the well construction, and required to have 10-ton cargo capacity with 4WD and 3-ton crane should be attached.

d) Mobile Water Tank

As well drilling period is estimated at a week, 5,000 l seems to be suitable for the water tank capacity. The truck that mounts the water tank is to be of 4WD.

e) Mobile Fuel Tank

Judging from the period for drilling of one (1) well, consumption amount is estimated to be approximately 3,000 l for drilling rig, compressor and other vehicles. It is equivalent to the total consumption rate for drilling of one (1) site. The truck that mounts the fuel tank is to be more than 4x4.

f) Pick-up Type Motor Vehicle

Three (3) pick-up trucks will be procured for the pump installation, the pump test and the PEC teams. The truck is of seating capacity of three (3) persons.

g) Pump Test Equipment

As 4-inch caliber casing will be installed, pumping test equipment and its related facilities should match them. Two pump units will be procured for high (100 m) and low (60 m) head of which pump capacity is approximately 0.5 l/min.

h) Geophysical Survey Equipment

A combined use of electric resistivity and electromagnetic prospecting to investigate the project area efficiently seems to be valid since the aquifer type in the area is fissure water or stratum water type predominantly. Consequently, horizontal and vertical prospecting should be adopted as geophysical survey equipment. Furthermore, GPS should be procured to grasp survey points exactly.

It is necessary to confirm the precise section of aquifers for designing a casing program after completion of drilling. For this purpose, a well

logging system is adopted. Items of logging are electrical resistivity, natural electrode, temperature and electric conductivity.

i) Water Quality Analysis Tools

Five (5) sets of portable water quality analysis kits for EPAR-Gaza and four regional offices will be provided. Their analytical items ought to coincide with the water quality guideline of WHO.

ii) Equipment and Materials for Well Construction

a) Handpump

AFRIDEV type handpump (max. pumping head is 60 m) which is used all over the country should be installed.

b) Casing and Screen Pipes

Since the new wells will be constructed by EPAR and Japanese contractor, equipment and materials for them should conform to DIN8061 and DIN4925 which are prevailing in Mozambique.

c) Other Construction Materials

Gravel, cement, bentonite, etc. are available in local market as well as in RSA, and they are of the standards conforming to SABS.

iii) Equipment and Materials for Operation and Maintenance

a) Trailer Type Workshop

A trailer type workshop will be procured to facilitate operation and maintenance of the drilling rig and appurtenant facilities properly. The facilities to be furnished in the workshop will be of the grade to enable routine and ordinary operation and maintenance at site.

b) Motor Bike

Seven (7) two-seater motor bikes of 125 cc will be procured to facilitate the PEC's activities requiring moving under bad access conditions.

c) Spare Parts

Spare parts for the equipment and facilities to be procured under the Project will be provided together with such equipment and facilities. The procured spare parts should be of kinds and numbers enough to maintain such equipment and facilities at least for two (2) years.

d) Computer and Copy Machine

A set of computer and a copy machine will be procured to facilitate operation and maintenance activities of PEC.

2) Facility Plan

(1) Facility Plan

The following facilities will be constructed under the Project.

• Well facility:	Well drilling, installation of casing and screen pipes and finishing of well
• Supply facility:	Installation of handpump, apron, drainage pit and fence
• Replacement of handpump:	Replacement of existing handpump, construction of apron, drainage pit and fence

The fences will have to be constructed by the beneficial villagers to facilitate their participation in maintaining wells.

(2) Design Conditions, Criteria and Standards

The following items will be considered in designing the project facilities.

i) Location of Well and Water Source

• The groundwater source should be utilized after confirming its yield

enough to supply drinking water for 500 population.

- The groundwater source should be applied after examining its water quality. Electric conductivity of water source has to be measured to be less than 1,500 μS/m desirably, it must be less than 5,000 μS/m at least if it exceed the desirable value.
- The location of well construction site should be selected so as to avoid the intrusion of contaminated water.

ii) Well Facilities

- It is necessary to provide some protection works such as sealing by cement to prevent the intrusion of contaminated water form the ground surface.
- Position of casing and screen pipes should be determined after grasping the position of the aquifers containing the saline water by geological logging. Such scheduling of pipes must be made so as to obtain maximum production yield of safe water.
- To prevent collapse of borehole, proper countermeasure such as stove pipes should be taken.

iii) Pump and Related Facilities

- The handpump unit is of AFRIDEV type which is predominantly applied in the country as that to meet the requirement of VLOM (Village Level Operation and Maintenance)
- To prevent the contamination of the water, it is necessary to provide the apron which facilitate the drainage of excess water and contaminated water out of the well site.
- The protection fence should be provided to prevent the well site from invasion of domestic animals.

iv) Standards

The major civil work components of the Project are considered to be pump stand and apron only, and these structures have been constructed in most of the well provided by PRONAR. The PRONAR has its own criteria for these structures, and, therefore, such civil work structures to be constructed under the Project should be designed in conformity with those stipulated by PRONAR.

(3) Facility Design

As presented in the Basic Design Drawings attached hereto, the well facilities consist of drilled well, handpump, pump stand, apron, drainage pit and fence. All of these facilities are constructed under the project except for the fences which is to be constructed by the beneficial villagers. The specification of such facilities to be provided by the Project are summarized in the table.

Specifications of Wells and Pumps to be Provided

Facilities	Item	Description
1. Wells	Number	150
	Ave. Depth	70 m
	Dia. of Casing	113 mm
2. Handpumps	Type	AFRIDEV Type
	Pump Capacity	0.21 l/sec
	Max. Head	60 m
	Related Facility	Epron, Drainage Protection Fence*
3. Replacement of Handpump	Type	AFRIDEV Type (23 Nos.)
	Pump Capacity	0.21 l/sec
	Max. Head	60 m
	Related Facility	Epron, Drainage Protection Fence*

Note * : Constructed by villagers

(4) Procurement Plan for Well Construction Materials

- In order to facilitate the maintenance management, the PRONAR intends to standardize the specification of handpump in Mozambique. AFRIDEV type of handpump should be selected in this point, of which pumps are manufactured in local.
- Almost of casing screens used in Mozambique is imported from Europian countries and considered to be locally available. These materials should be applied in this Project.
- All materials for well digging such as drilling foam for DTH type operation, bentonite CMC for rotary digging and aggregates etc. are available in local.

- Drilling bit is also available in South Africa. It is recommended to procure it from either South Africa or Japan where there will be procured well dig.
- All materials such as cement, iron bars, aggregate materials are available in local.
- The materials for constructing protection fence are available in Mozambique, and the villagers are able to procure them in local market.

(5) Procurement Plan for Geophysical Survey Equipment and Drilling Rig

i) Selection of Equipment and Materials for Well Construction

In the proposed plan, the following major equipment and materials will be required according to the basic design and construction planning.

a) Equipment and Materials for Drilling Wells

- Deep well digging machine and auxiliaries
- Probe equipment and instruments (Well logging equipment, Well soil layer inspection apparatus, Pump test equipment)
- Vehicles for service

b) Materials for Well Construction

- Casing for well drilling, Screen
- Bentonite for well drilling
- Cement, sand, aggregates etc.

c) Water Quality Analysis Tools

d) Tools and Spare Parts for Workshop

- Machine for repairing
- Spare parts for well drilling machine
- Spare parts for pumps

ii) Specifications and Quantities of the Procured Equipment and Materials

The specification and quantity of the equipment and materials to be procured under the Project are tableted below.

List of Equipment and Materials to be Procured under the Project

<Equipment List for Geophysical Survey, Drilling Well and Related Things>

No.	Name of Equipment	Specification	Q'ty	Purpose of Use
1	Truck Mounted Drilling Rig	Drilling Rig -Drilling Capacity: >150m -Max. Lifting Weight: >6,000Kg -Rotary Torque: >500Kgf-m -Top Drive -Top-Drive System with Power Take-off Method or Individual Power Drive Method -Correspond to DTH and Rotary Method Truck -Water-cooled Diesel Engine, >230HP -Wheel Drive: 4x4, 6x4 or 6x6	1 Set	Deep Well Drilling
2	Standard Accessories and Tools for Rig	-Standard Accessories -Drilling Tools -Casing and Tools -Fishing -Tools -Attachment and Tools	1 Lot	Well Drilling
3	Trailer Mounted High Pressure Compressor	Compressor -Air Supply >21m³/min. x Pressure 17.5kg/cm² Trailer -Off-load type -Possible to be set on the rig carrier	1 Set	DTH Drilling Method
4	Pumping Test & Appurtenance	(1) High Capacity Submersible Pump Pumping Capacity: 1.5Kw x 100m Head	1 Set	Evaluation of Well Capacity after Drilling
		(2) Low Capacity Submersible Pump Pumping Capacity: 0.75Kw x 50m Head	1 Set	
		(3) Generator: 10Kw		
		(4) Related Equipment and Materials Notch Tank, Lifting Pipe, Water Level Meter, Tools , others	1 Lot	
5	Geophysical Survey Equipment	(1) Electric Resistivity Survey Equipment - Measuring Item: Apparent resistivity - Range: > ± 25-2500mv,Auto range - Accuracy: >1 μ v -Transmitter: Max.200mA,200V - Power: 12 V DC	1 Set	Grasp of aquifer between sediment types with difference of resistivity rate for siting wells.
		(2) Electromagnetic Survey Equipment - Survey Depth: >200m - Measurement Range: 40,000 to 50,000nT - Power Source: Batteries - Measurement Items: Apparent Resistivity or In-Phase and Quadrate Component - Transmitter - Receiver system: Untouched Loop Method - Frequency of Transmitter - Receiver - Range: 0.1 to 100kHz (>8 Frequencies) - Synchronization: Reference Cable	1 Set	Grasp of fissure and geological structure by electromagnetic wave for. siting wells
		(3) Well Logging Equipment - Measurement Depth: Max. 300m Armored Cable <Measurement Items> - Resistivity: Electrodes Interval 25, 100cm or 16, 64 inch - Measurement Range: 100 to 10,000 ohm-m - Natural Electrical Potential: Range±2,000mV - Fluid Conductivity: Range 50 to 50,000 μ s - Temperature: 0 to 100degrees C.	1 Set	Decision of casing depth and its length range

No.	Name of Equipment	Specification	Q'ty	Purpose of Use
	Geophysical Survey Equipment	(4) Others - GPS	1 Set	Site positioning
6	Motor Vehicles	(1) Crane Mounted Cargo Truck -Wheel Drive: 4x4 -Load capacity: 10 tons -Crane Capacity: 3 Beams x 3tons	1 Set	Transportation of equipment and materials for drilling.
		(2) Water Tank Lorry -Wheel Drive: 4x4 -Tank Capacity: 5,000 liters	1 Set	Transportation of mixing water for drilling.
		(3) Fuel Tank Lorry -Wheel Drive: 4x4 -Tank Capacity: 3000 liters	1 Set	Transportation of fuel for drilling machine and vehicles.
		(4) Pickup type Vehicle(single cabin) -Wheel Drive: 4x4 -Seating Capacity: 3 Persons	3 Sets	-PEC -Pumping test team. -Pump installation team.
		(5) Motorcycles -Displacement: <125 cc -Seating Capacity: 2 Persons	7 Sets	for Animadors in PEC

<Equipment and Materials for Water Well Construction>

No.	Name of Equipment	Specification	Q'ty	Purpose of Use
1	Handpump	-Afridev Type Handpump -Lifting Pipe Caliber: <4 inches -Max. Pumping Capacity: 0.2 liters/sec -Total Head: 60m	173 Sets	For well construction and rehabilitation.
2	Casing / Screening Pipe	-Quality: PVC, Length: 3m -Caliber: I.D.103mm, O.D. 113mm -Connection: BS879 Standard Thread -Perforation Ratio: >3%	1 Lot	For well construction

<Water Quality Analysis Equipment>

No.	Name of Equipment	Specification	Q'ty	Purpose of Use
1	Portable Kits for Water Quality Analysis	-Handy Type, Dry Battery or Rechargeable Battery -Analysis Items: Color, Hardness, HCO_3, Cl, NO_3, NO_2, SO_4, F, Ca, Mg, Na, K, Mn, Fe, Conductivity, PH.	5 Sets	Ordinary water quality monitoring and new well. (for EPAR's 5 regional offices)

<Equipment and Materials for Operation and Maintenance>

No.	Name of Equipment	Specification	Q'ty	Purpose of Use
1	Trailer Type of Mobile Workshop	-Welder, Generator, Tools, etc.	1 Lot	O & M for drilling rig
2	Spare Parts	-Spare Parts for Procured Equipment in This Project -for Drilling Rig -for Geophysical Equipment -Handpump	1 Lot	O & M for procured equipment.
3	Personal Computer & Copy Machine	-IBM or Its Compatible PC, Printer, Software	1 Set	O & M of wells and enlightenment of villagers by PEC

iii) Equipment and Materials to be Procured in Mozambique and South Africa

The following table shows the equipment and materials to be procured in Mozambique and RSA.

Equipment and Materials to be Procured in Mozambique or RSA

Equipment	Place of Procurement	Reason
1) Truck Mounted Drilling Rig	Japan or RSA	Drilling rig is not manufactured in local. Some rigs are produced /assembled in RSA. It is possible to supply spare parts through agents.
2) Standard Accessories		
3) Truck Mounted Air Compressor		
4) Pumping Test Appurtenance	RSA	ditto
5) Water Tank Lorry	Japan or RSA	The equipment are manufactured or supplied through agents.
6) Fuel Tank Lorry		
7) Pick Up Type 4 WD Vehicle		
8) Motorcycle		
9) Handpumps	Mozambique	Afridev type pumps shall be adopted
10) Casing/Screen Pipes	Mozambique or RSA	DIN standard shall be adopted. It is available in RSA and Mozambique
11) Bentonite	Mozambique	It is sold in local.
12) Drilling Bit	RSA	Same reason as drilling rig
13) Water Quality Analysis Equipment/Kit	Japan or RSA	it is possible to procure in inland or RSA.
14) Maintenance Workshop	Japan	It is assembled in Japan.

Table 2.1 Confirmed Number of Requested Wells

District	No	Area/Village	Surveyed Population	Required Well No. (Original)	Existing Well No.	Working Well No.	Replacement of Pump Unit	Additionally Required Well No.	Requested Well No.
Bilene	1	Xinhambanine	758	2	0	0		2	2
	2	Nhagome	240	1	0	0		1	1
	3	Chihacho	759	2	1	1		1	1
	4	Chilengue	1,257	3	3	2		1	1
	5	Dzimbene	9,463	19	2	1		18	3
	6	Fulano	6,872	14	1	1		13	3
	7	Manzir	3,379	7	6	3		4	3
	8	Mutlabse	5,357	11	6	5		6	2
	9	Chimungo	1,580	3	1	1		2	2
	10	Matandjine	993	2	0	0		2	2
	11	Chissano	3,256	7	2	2		5	5
	12	Liano	757	2	1	1		1	1
	13	Loane	4,563	9	6	3		6	3
	14	Chimonzo	2,788	6	1	1		5	5
	15	Boloene	1,260	3	0	0		3	1
Chibuto	16	-	-	1	-	-	-	-	-
	17	Mubochua	1,902	4	0	0		4	2
	18	Mahungo	3,035	6	0	0		6	2
	19	Nwamate	560	1	0	0		1	1
	20	Funguane	362	1	0	0		1	1
	21	Cocane	2,169	4	1	0	1	3	2
	22	Waximixo	108	1	0	0		1	1
	23	Matlecuane	2,060	4	1	1		3	2
	24	Muxuquete	2,076	4	3	1		3	2
	25	Bucucha	1,267	3	1	1		2	2
	26	Chiconelane	2,998	6	3	3		3	1
	27	7 de Setembro	4,662	9	5	1		8	4
	28	Chegua	2,788	6	6	2	3	1	1
	29	Coca-Missawa	2,250	5	7	2	1	2	2
	30	Ngungunhane	9,420	19	3	1		18	5
	31	Tatlene	1,379	3	0	0		3	3
	32	Wahamuza	3,856	8	2	2		6	2
	33	-	-	-	-	-	-	-	-
Chokwe	34	25 de Setembro	2,202	4	5	1		3	2
	35	Djodjo	1,201	2	0	0		2	1
	36	Machua	2,351	5	0	0		5	2
	37	Machinhe	2,453	5	3	3		2	2
	38	Chate	1,779	4	0	0		4	2
	39	Chiguidela	5,447	11	3	3		8	2
	40	Chicotane	1,917	4	4	2		2	2
	41	1 de Maio	16,135	32	3	3		29	2
	42	Gionde	10,352	21	5	5		16	4
	43	Bombofo	1,672	3	1	1		2	1
	44	Malau	1,550	3	1	0		3	2
	45	Carapatoso	374	1	0	0		1	1
	46	Marrarobajane	400	1	0	0		1	1
	47	Chiduachine	6,012	12	1	1		11	2
Manjacaze	48	Ponjuane	385	1	0	0		1	1
	49	Chiducuane	1,761	4	1	1		3	3
	50	Cufaqueza	446	1	0	0		1	1
	51	-	-	-	-	-	-	-	-
	52	Ndofene	1,756	4	2	1		3	2
	53	Mafelene	860	2	1	1		1	1
	54	Madender	1,758	4	0	0		4	4
	55	Chiziane	1,125	2	0	0		2	2
	56	-	-	-	-	-	-	-	-
	57	Chibangue	665	1	0	0		1	1
	58	Magumete	800	2	1	0		2	2
	59	Nhachengo	1,726	3	2	2		1	1
	60	Madede	786	2	0	0		2	1
	61	Cauine	927	2	0	0		2	2
	62	Matimbine	922	2	1	0		2	2
	63	Matinule	2,249	4	1	1		3	2
	64	Mungoine	1,000	2	0	0		2	2
	65	Nhanzilo	893	2	0	0		2	1
	66	Incadine	794	2	1	0		2	2
	67	Ruco	536	1	1	0		1	1
	68	Chizavane	4,383	9	3	2		7	5
Xai-Xai	69	Cavelene	1,500	3	2	0	1	2	2
	70	Pumulene	1,255	3	1	1		2	2
	71	Venhene	800	2	1	0	1	1	1
	72	Cumine	2,164	4	1	1		3	2
	73	Nhamavila	2,525	5	2	1		4	1
	74	Nhapequene	6,830	14	1	0		14	2
	75	Nhancutse	10,175	20	12	9		11	4
	76	Polombo	4,099	8	7	5		3	2
	77	A.Tivane	3,580	7	4	4		3	3
	78	Baluine	1,085	2	0	0		2	2
	79	Bungane	9,880	20	2	0		20	2
	80	Bango	2,922	6	3	1		5	2
	81	Chiconela	3,378	7	2	1	1	5	3
	82	Chipenhe	3,457	7	4	3	1	3	2
	83	Nguelene	2,722	5	3	3		2	2
	84	24 de Julho	6,738	13	2	2		11	1
	85	Nuvunguene	8,214	16	4	4		12	2
Total		81	233,130	476	153	97	9	369	163

Note: The required well number is calculated on the condition that a well would supply the life water for the population of 500 - 750.

Table 2.2 Overall Evalutation of Villages for Well Construction (1/2)

District	No.	Area/Village	Surveyed Population	Requested Well No.	I. Access to Sites	II. Present Water Sources	III. Expected Yeild	IV. Expected Depth to Water Surface	V. Water Quality	VI. Intension to Pay Water Charge	VII. Overall Judgement (No. of Drilled Well)
Bilene	1	Xinhambanine	758	2	A	A	A	A	A	A	2
	2	Nhagome	240	1	C	A	A	A	A	A	0
	3	Chiñacho	759	1	A	C	A	A	A	A	1
	4	Chilengue	1,257	1	A	C	A	A	A	A	1
	5	Dzimbene	9,463	3	A	C	A	A	A	A	3
	6	Fulano	6,872	1	A	C	A	A	A	B	1
	7	Manzir	3,379	3	A	C	A	A	A	A	3
	8	Mutlabse	5,357	2	A	C	A	A	A	A	2
	9	Chimungo	1,580	2	A	C	A	A	A	A	2
	10	Matandjine	993	2	A	A	A	A	A	A	2
	11	Chissano	3,256	5	A	C	A	A	A	A	5
	12	Liano	757	1	A	C	A	A	A	A	1
	13	Loane	4,563	3	A	C	A	A	A	A	3
	14	Chimonzo	2,788	5	A	C	A	A	A	A	5
	15	Boloene	1,260	1	A	A	A	A	A	A	1
Chibuto	16	-	-	-	-	-	-	-	-	-	-
	17	Mubochua	1,902	2	B	A	A	A	B	A	2
	18	Mahungo	3,035	2	B	A	A	A	B	B	2
	19	Nwamate	560	1	B	A	A	A	B	B	1
	20	Funguane	362	1	B	A	A	A	B	A	1
	21	Cocane	2,169	2	B	A	A	A	B	A	2
	22	Waximixo	108	1	B	A	A	A	B	B	1
	23	Matlecuane	2,060	2	B	C	A	A	B	A	2
	24	Muxuquete	2,076	2	A	C	A	A	A	A	2
	25	Bucucha	1,267	2	A	C	A	A	A	A	2
	26	Chiconelane	2,998	1	A	C	A	A	A	B	1
	27	7 de Setembro	4,662	4	A	C	A	A	A	A	4
	28	Chegua	2,788	1	A	C	A	A	A	A	1
	29	Coca-Missawa	2,250	2	A	C	A	A	A	A	2
	30	Ngungunhane	9,420	5	A	C	A	A	B	B	5
	31	Tatlene	1,379	3	A	A	A	A	B	A	3
	32	Wahamuza	3,856	2	A	C	A	A	A	A	2
	33	-	-	-	-	-	-	-	-	-	-
Chokwe	34	25 de Setembro	2,202	2	B	C	A	A	B	A	2
	35	Djodjo	1,201	1	B	A	A	A	B	A	1
	36	Machua	2,351	2	B	A	A	A	B	B	2
	37	Machinhe	2,453	2	B	C	A	A	B	A	2
	38	Chate	1,779	2	A	A	A	A	B	A	2
	39	Chiguidela	5,447	2	A	C	A	A	B	A	2
	40	Chicotane	1,917	2	B	C	A	A	B	B	2
	41	1 de Maio	16,135	2	A	C	A	A	B	A	2
	42	Lionde	10,362	4	A	C	A	A	B	A	4
	43	Bombofo	1,672	1	A	C	A	A	B	A	1
	44	Malau	1,550	2	A	A	A	A	B	B	2
	45	Carapatoso	374	1	A	A	A	A	B	A	1
	46	Marrambajane	400	1	A	A	A	A	B	B	1
	47	Chiduachine	6,012	2	A	C	A	A	B	A	2

Table 2.2 Overall Evalutation of Villages for Well Construction (2/2)

District	No.	Area/Village	Surveyed Population	Requested Well No.	I. Access to Sites	II. Present Water Sources	III. Expected Yeild	IV. Expected Depth to Water Surface	V. Water Quality	VI. Intension to Pay Water Charge	VII. Overall Judgement (No. of Drilled Well)
Manjacaze	48	Ponjuane	385	1	B	A	A	A	A	A	1
	49	Chiducuane	1,761	3	B	C	A	A	A	A	3
	50	Cufaqueza	446	1	B	A	A	A	A	A	1
	51	-	-	-	-	-	-	-	-	-	-
	52	N'dolene	1,756	2	A	C	A	A	A	B	2
	53	Mafelene	860	1	A	C	A	A	A	B	1
	54	Madender	1,758	4	A	A	A	B	A	B	2
	55	Chiziane	1,125	2	A	A	A	B	A	B	1
	56	-	-	-	-	-	-	-	-	-	-
	57	Chibangue	665	1	A	A	A	B	A	B	1
	58	Magumete	800	2	A	A	A	B	A	B	1
	59	Nhachengo	1,726	1	A	C	A	B	A	B	1
	60	Madede	786	1	A	A	A	B	A	B	1
	61	Cavine	927	2	A	A	A	B	A	B	1
	62	Matimbine	922	2	A	A	A	A	A	B	2
	63	Matinule	2,249	2	A	C	A	A	A	A	2
	64	Mungoine	1,000	2	A	B	A	A	A	B	2
	65	Nhanzilo	893	1	A	A	A	A	A	A	1
	66	Incadine	794	2	A	B	A	B	A	B	1
	67	Ruco	536	1	A	A	A	A	A	A	1
	68	Chizavane	4,383	5	A	C	A	A	A	B	5
Xai-Xai	69	Cavelene	1,500	2	A	A	A	A	A	A	2
	70	Pumulene	1,255	2	A	C	A	A	A	A	2
	71	Venhene	800	1	A	B	A	A	A	A	1
	72	Cumine	2,164	2	A	A	A	A	A	A	2
	73	Nhamavila	2,525	1	A	C	A	A	A	A	1
	74	Nhapequene	6,830	2	A	A	A	B	A	A	1
	75	Nhancutse	10,175	4	A	C	A	B	A	A	3
	76	Polombo	4,099	2	A	C	A	B	A	A	1
	77	A.Tivane	3,580	3	A	C	A	B	A	A	1
	78	Baluine	1,085	2	A	B	A	B	A	A	1
	79	Bungane	9,880	2	A	A	A	A	A	A	2
	80	Bango	2,927	2	A	C	A	A	A	A	2
	81	Chiconela	3,378	3	A	C	A	A	A	A	3
	82	Chipenhe	3,457	2	A	C	A	A	A	A	2
	83	Ngulelene	2,722	2	A	C	A	A	A	A	2
	84	24 de Julho	6,738	1	A	C	A	A	A	A	1
	85	Nuvunguene	8,214	2	A	C	A	A	A	A	2

Note: Selection criteria of drilling sites are shown below.

I. ACCESS TO SITES A: Accessible by ordinary car B: Accessible by 4WD Vehicles C: Unaccessible by 4WD Vehicles	IV EXPECTED GROUNDWATER DEPTH A: D < 50 m B: D > 50 m
II. AVAILABLE WATER SOURCE A: ONLY SURFACE WATER AVAILABLE B: GROUNDWATER AVAILABLE IN ADJUCENT VILLAGE C: GROUNDWATER AVAILABLE IN OWN VILLAGE	V WATER QUALITY(EC) A: EC < 1,500 B: 1,500 < EC < 1,500 C: EC > 5,000
III. EXPECTED YIELD A: Q > 0.2 l/sec B: Q < 0.2 l/sec	VI INTENSION TO PAY WATER CHARGE A: Yes B: No

Table 2.3 Overall Evaluation of Villages for Replacement of Handpumps

District	No.	Area/Village		Diameter (mm)	Water Quality	Access Road*	Present Pump**	Present Condition	Necessity	Proposed Pump**
Bilene	1	Incoluane	(1)	1,200	Drinkable	B	IM	Dry up well	X	
	2	Mazivila	(1)	1,200	Drinkable	A	(AF)	No pump	O	AF
	3	Mao Tee Tung	(1)	150	Drinkable	C	AF	Normally operated	X	
			(2)	1,200	Drinkable	C	(ICM)	Dry up well	X	
			(3)	1,200	Drinkable	A	(ICM)	Dry up well	X	
			(4)	150	Drinkable	A	AF	Normally operated	X	
	4	Luis Carlos Prestes	(1)	1,400	Drinkable	B	IM	Dry up well	X	
			(2)	150	Drinkable	B	AF	Dry up well	X	
			(3)	1,400	Drinkable	C	IM	Dry up well	X	
			(4)	1,200	Drinkable	C	ICM	Dry up well	X	
			(5)	1,400	Drinkable	C	IM	Dry up well	X	
			(6)	1,200	Drinkable	C	ICM	Dry up well	X	
Chibuto	5	Chegua	(1)	150	Drinkable	B	AF	Damaged	O	AF
			(2)	150	Drinkable	B	IM	Damaged	O	AF
			(3)	150	Drinkable	B	IM	Damaged	O	AF
	6	Banganhane	(1)	150	Drinkable	B	AF	Damaged	O	AF
			(2)	150	Drinkable	B	IM	Damaged	O	AF
	7	Cocane	(1)	150	Drinkable	C	AF	Damaged	O	AF
	8	Vangenhecane	(1)		Drinkable	C	AF	No pump	O	AF
	9	Coca Missawa	(1)	150	Drinkable	A	IM	Damaged	O	AF
Chokwe	10	25 de Setembro	(1)	150	High Saline	A	AF	Unused by high saline	X	
	11	Malau	(1)	200	High Saline	C	-	Damaged	X	
	12	Carrapatoso	(1)	75	Drinkable	A	-	Damaged	O	AF
	13	Muzumuia	(1)	150	Drinkable	A	IM	Damaged	O	AF
			(2)	150	Drinkable	A	AF	Normally operated	X	
	14	Mutxope	(1)	150	Drinkable	B	AF	Damaged	O	AF
	15	1 Bairro (Hosp. Rural)	(1)	100	Drinkable	A	Chain Type	Damaged	O	AF
	16	Massavasse	(1)	100	High Saline	A	Chain Type	Unused by high saline	X	
	17	Barragem	(1)	100	Drinkable	A	Chain Type	Damaged	O	AF
Guija	18	Pumbe	(1)	75	Drinkable	B	VO	Damaged	O	VO
			(2)	75	Drinkable	B	VO	Normally operated	X	
			(3)	75	Drinkable	B	VO	Normally operated	X	
	19	Tomanine	(1)		Drinkable	B	VO (Old)	Damaged	O	VO
			(2)		Drinkable	B	VO (Old)	Damaged	O	VO
	20	Javanhane	(1)		High Saline	B	-	Abandoned	X	
Xai-Xai	21	Venhene	(1)		Drinkable	A	AF	Damaged	O	AF
	22	Cavelene	(1)		Drinkable	A	AF	Damaged	O	AF
	23	Chipenhe	(1)	75	Drinkable	A	AF	Damaged	O	AF
	24	Chiconela	(1)		Drinkable	A	IM	Damaged	O	AF
	25	Fidel Castro	(1)		Drinkable	B	AF	Normally operated	X	
	26	Ngouaby	1		Drinkable	A	IM	Damaged	O	AF
			2		Drinkable	B	IM	Reclamation	X	
	27	Marramene	1		Drinkable	A	VO	Damaged	O	AF

Note: *: A: Good, B: Bad, C: Extreamly Bad
**: AF: AFRIDEV, IM: Indian Mark II, VO: Volanta

CHAPTER 3
PROJECT PLAN

CHAPTER 3 PROJECT PLAN

3.1 Implementation Plan

3.1.1 Basic Policies for Project Implementation

1) Organizational Scheme of the Project Implementation

DNA, Department of Water Resources of Ministry of Public Works and Housing, will be the responsible agency for the execution of the Project and will execute the Project in accordance with conditions described in the Exchange of Note (E/N) between the Governments of Mozambique and Japan. DNA will entrust the construction management of the Project to PRONAR and DPOPH.

DNA will hire a Japanese consulting company for engineering services such as preparation of detailed design and tender documents, assistance to tendering and construction supervision. DNA will assign Japanese firm(s) as contractor(s) for the Project implementation through a tender in accordance with the Guidelines for the Japan's Grant Aid. There are several local companies that are considered to be capable to conduct construction works with similar scale and component to those of the proposed Project. Those local contractors will be involved in the Project as sub-contractors of the Japanese contractors.

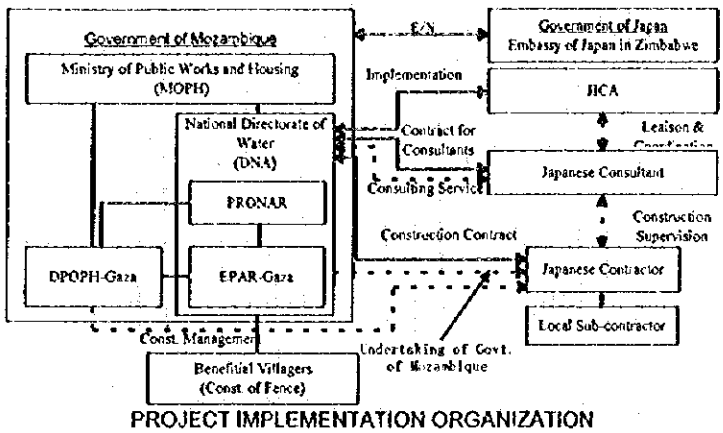
The selected Japanese contractor will complete the construction works on his responsibility in the following manners.

- Execute the construction of wells sub-contracting the available local contractors
- Execute the construction of wells borrowing free of charge the technical staff, equipment and materials which will be procured and provided to the Government of Mozambique under the Project. OJT on operation and maintenance of such equipment and materials in the course of

construction works.

The construction works above-mentioned does not include the fence to be constructed by the beneficial villagers.

Related organizations and their inter-relations are shown in the figure.



PROJECT IMPLEMENTATION ORGANIZATION

2) Type of Tendering and Contract

The Project comprises of the following two (2) major portions.

(1) Construction of 150 wells with AFRIDEV type pump and replacement of handpumps in 23 existing wells

(2) Procurement of equipment/materials that are used in the construction works in the Project

Construction of wells and procurement of equipment and materials are executed by Japanese contractor(s), and the local contractors will be involved in construction as subcontractors as much as possible.

3) Undertakings of Mozambique

To ensure smooth and effective implementation of the Project, the Mozambique side will fulfill the scope of works for which they are responsible. The scope for which the Mozambican side is responsible is described in the later section of this report.

The Mozambican government is required to provide his technical staff and the procured equipment and materials necessary for implementation. The necessary costs borne by DNA for this is estimated in Sub-section 3.1.7. The timing and quantity of such equipment and staff to be provided by Mozambican side are determined through the discussions among the Mozambican government and Japanese consultants and contractors.

4) Utilization of Local Resources

Several companies that are capable to conduct construction works with similar scale and contents to those of the Project are available in the Mozambique. Most construction materials, local made or the South African made, are available in the local market. Thus, these locally available resources should be utilized in the implementation of the Project as far as they are competitive in cost- and quality-wise to those originated in foreign countries.

3.1.2 Matters to be Considered in the Project Implementation

The following matters are necessary to be considered for the smooth and effective implementation of the Project.

- The climate of the Project area is characterized by the significant dry and rainy seasons, and the access conditions become worse during the rainy season due to rainfall. Since in this Project, it is necessary to conduct the drilling works for 150 wells, such access condition is considered to affect the progress to a substantial extent. It is, therefore, important to duly consider these conditions in planning construction schedules.
- The sandy layer is predominant in the project area, and it may cause the collapse of drilled bore resulting in incomplete finishing of well as well as short durability of well. Special attention should be paid, therefore, to this aspect so as to avoid such collapses by applying stove pipes.

- In some areas high saline water may found especially in the areas along the right bank of the Limpopo river. It is, therefore, necessary to grasp the position of aquifers containing saline water as exactly as possible by geological logging, and to adopt such structures of well that is able to prevent the intrusion of saline water into well.

3.1.3 Division of Scope between Two Governments

1) Well Construction

The table shows the scope which will be fulfilled by both governments of Japan and Mozambique. The construction works will be conducted by the selected Japanese contractor on his responsibility. As mentioned in Subsection 3.1.1, The contractor will construct 150 wells by sub-contracting with the local contractors, and 25 wells using the equipment, materials and staff of Mozambican side. As for such 25 wells that will be constructed using the materials, equipment and staff, the Mozambican government has to provide the contractor with its own

Scope Divided between Mozambican and Japanese Governments

Description	Japanese Side	Mozambican Side
- Land Acquisition		○
- Construction of Access Roads to the Well Sites		○
- Land Preparation for Well Construction		○
- Drilling and Development of Wells	○	
- Installation of New Handpumps	○	
- Construction of Protection Fence		○
- Construction of Drainage Pits	○	
- Replacement of Handpumps Including Construction of Aprons	○	

Propposed Construction PHases of Target Villages

District	No	Area/Village	Well No	Category
Bilene	1	Xinhambanine	2	C2
	2	Nhagome	0	-
	3	Chihacho	1	C2
	4	Chilengue	1	C2
	5	Dzimboe	3	C2
	6	Fulano	1	C2
	7	Manzir	3	C2
	8	Matabse	2	C2
	9	Chimango	2	C2
	10	Matandjine	2	C1
	11	Chissano	5	C1
	12	Liano	1	C1
	13	Loane	3	C1
	14	Chimonzo	5	C1
	15	Boloene	1	C1
Chibuto	16	-	-	-
	17	Mubochua	2	C1
	18	Mabongo	2	C2
	19	Nwamate	1	C2
	20	Fungone	1	C2
	21	Cocane	2	C2
	22	Wasimiva	1	C2
	23	Matecuane	2	C2
	24	Muxuguete	2	C2
	25	Rumicha	2	C2
	26	Chiconclane	1	C2
	27	7 de Setembro	4	C2
	28	Chegua	1	C2
	29	Coca-Missawa	2	C2
	30	Ngunguhane	5	C2
	31	Taclene	3	C2
	32	Wahamona	2	C2
	33	-	-	-
Chokwe	34	25 de Setembro	2	C2
	35	Djodjo	1	C2
	36	Machua	2	C2
	37	Machinhe	2	C2
	38	Chate	2	C2
	39	Chigo-lela	2	C2
	40	Chicotane	2	C1
	41	1 de Maio	2	C2
	42	Lionde	4	C2
	43	Bombofo	1	C2
	44	Malua	2	C2
	45	Canapatoso	1	C2
	46	Mamambajane	1	C2
	47	Chidzachine	2	C1
Manjacaze	48	Panjaene	1	C2
	49	Chidecuane	3	C2
	50	Cufaqueza	1	C2
	51	-	-	-
	52	Ndelene	2	D
	53	Mafelene	1	D
	54	Madender	2	C2
	55	Chiziane	1	C2
	56	-	-	-
	57	Chibangue	1	C2
	58	Magumete	1	C2
	59	Machengo	1	D
	60	Madede	1	C2
	61	Cauine	1	C2
	62	Matimbine	2	D
	63	Matinde	2	D
	64	Muingone	2	D
	65	Nhanzilo	1	C2
	66	Incadine	1	D
	67	Ruco	1	D
	68	Chizavane	5	D
Xai-Xai	69	Cavelene	2	D
	70	Pamalene	2	D
	71	Venhene	1	D
	72	Cumine	2	D
	73	Shamavila	1	C2
	74	Shapequene	1	C2
	75	Shancuene	3	C2
	76	Polombo	1	C2
	77	A.Tivane	1	D
	78	Bahine	1	C2
	79	Bungone	2	C2
	80	Bango	2	C2
	81	Chiconcla	3	C1
	82	Chipenhe	2	C1
	83	Ngalelene	2	C1
	84	24 de Julho	1	C1
	85	Nwanguene	2	C1

Note: C1: Constructed by local sub-contractors in first year
C2: Constructed by local sub-contractors in second year
D: Constructed by Japanese contractor with the provided equipment

truck for the smooth progress of works, and the operation costs of truck should be shouldered by the Mozambican side.

The table in the previous page present the list of villages of which the wells will be constructed by local sub-contractors under supervision of the Japanese contractor and by the Japanese contractor with the procured equipment and materials.

2) Technology Transfer

The Japanese side will conduct technical transfer to Mozambican side on geophysical survey and well drilling. Contents and methods of technology transfer are as stated below.

(1) Geophysical Prospecting

In case the Project is implemented, the detailed design study will be executed to decide exact locations of the wells to be constructed under the Project by the consultant hired by DNA. Technology of geophysical prospecting will be done during the detailed design study or in the supervision stage as OJT by the consultant.

(2) Well Drilling

i) Contents

- Basic operation skills of equipment
- Daily inspection of equipment
- Selection of drilling methods suitable for actual geological conditions
- Survey methods
- Safety
- Trouble shooting

- Maintenance and repairing of equipment

ii) Method of Transfer

The engineers for drilling and operation and maintenance will be sent to the site to construct the wells and the necessary transfer of technology will be made by them through OJT.

3.1.4 Construction Supervision Plan

The Project is implemented under the Japanese Grant Aid scheme. DNA will hire the Japanese consultant recommended by JICA. The consultant will conduct the detailed design study and the construction supervision necessary for the implementation of the Project.

1) Detailed Design

In the detailed design phase for the Project, the detailed design, drawings, tender documents and other documents necessary for the execution of the Project are to be prepared. These documents and drawings shall be submitted to DNA for his approval.

2) Tendering

The consultant will assist DNA in tendering procedures for the Project. The contract between the successful tenderer and DNA will go into effect after the verification by the Japanese government.

3) Construction Supervision

The consultant will assist DNA to complete the Project by the scheduled completion date described in the Exchange of Note (E/N) in the meeting with contractors prior to the commencement of the Project construction works, witness the shipment of the Project use materials and equipment going to the Project sites, and provide the contractors with instructions related to the

construction works, equipment installation, test operations and post installation inspections.

3.1.5 Materials/Equipment Procurement Plan

In principal, most materials/equipment required for the Project are to be procured in the Mozambique or in the South Africa. Equipment for geophysical survey, however, is to be procured in Japan, since it is neither manufactured nor assembled in South Africa.

There are several manufactures of drilling rigs and related materials/equipment in South Africa. The drilling rig and related materials/equipment are to be procured in South Africa or Japan considering conditions of supply of spare parts and after-services. They have to have their agents or branch offices in Mozambique or South Africa to assure smooth supply of spare parts and to provide services after delivery. The other materials are in principle procured in South Africa as much as possible if such materials are available in South Africa.

In case of the procurement in Japan the procured equipment and materials are transported by sea to Maputo, and transported by land to Xai-Xai where the office of EPAR-Gaza. As for the equipment/materials procured in RSA they are transported by land to Xai-Xai. There exist two (2) land routes available from RSA to Xai-Xai. The final destination for delivery is the workshop of EPAR in Xai-Xai.

3.1.6 Implementation Program

1) Construction Period

(1) Workable Days

Annual workable days are set at 253 days considering five working days a week, 8 national holidays and the rainy season between August and February when working efficiency is assumed to decrease by 50% of that

in the dry season. It becomes 305 day a year including Saturdays.

(2) Construction Period of Well Construction

i) Delivery Period for Procurement of Construction Materials

Most materials/equipment used in the construction works are to be procured in the RSA, and 1.5 months are estimated at for the period for procurement and delivery including formalities for custom clearance, etc.

ii) Necessary Number of Rigs

The well construction will be conducted applying three (3) drilling rigs consisting of two (2) rigs of the local sub-contractors and one (1) rig procured under the Project. The well construction works will be made with the steps illustrated in the figure.

PROCESS OF WELL CONSTRUCTION

Each work will be conducted by the individual team such as drilling team, pump test team, installation team, etc. except for the construction of fence which is to be made by the beneficial villagers. The period necessary for drilling a well is estimated at 13.91 days, while 6.27 days for unsuccessful well.

The number of well to be drilled is calculated to be 165 considering the success rate of 90% (150 x 1.1 = 165). Out of this, 28 are constructed by the Japanese contractor with the equipment procured under the Project, while the rest of 137 are by the local sub-contractors under the Japanese contractors' supervision. The number

of wells to be constructed with the procured equipment is estimated considering that the ordinary progress may not be expected because it must take time for the government staff to progress as same as the local sub-contractors due to unfamiliarity at the initial stage of works. OJT will be provided through the construction works with the procured equipment.

2) Phasing of Implementation

The actual construction works will be able to commenced after the delivery of the drilling equipment, and it will take six (6) months to procure such equipment including the period necessary for manufacturing. Since the wells to be constructed are scheduled as many as 137 including unsuccessful ones, it is considered difficult to construct all of them in one (1) fiscal year. Many sub-contractors have to be hired and it is difficult to manage and control them. It is, therefore, necessary to adopt phasing of implementation as indicated in the table presented in Sub-section 3.1.3. However, drinking water supply is considered urgent issues in the project areas, and then it is proposed to commence the well construction works hiring local sub-contractors in the first fiscal year. The timing of implementation is indicated in the table shown in item 1) of the sub-section 3.1.3 well by well.

3.1.7 Undertakings of the Government of Mozambique

The scope to be undertaken by the Government of Mozambique are as follows:

1) To provide data and information necessary for the implementation of the Project
2) To secure the sites for the Project.
3) To clear, level and reclaim the sites prior to the commencement of the construction.
4) To construct access roads to the sites prior to the commencement of the

construction.

5) To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement;
   - Advising commission of Authorization to Pay (A/P), and
   - Payment commission.
6) To ensure prompt unloading and custom clearance of the Project goods at the destination of the land transportation from Maputo to sites.
7) To exempt Japanese Nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Mozambique with respect to the supply of the products and services under the verified contracts.
8) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities may be necessary for their entry into the Mozambique and stay therein for the performance of their work
9) To maintain and use properly and effectively the facilities constructed and equipment provided under the Project.
10) To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the execution of the Project.
   - Land acquisition for construction sites
   - Construction of access roads (width: more than 3.5m in the straight section and 5m in the curved section)
   - Land preparation of drilling sites: leveling 10m x (10 to 15)m
   - Construction of protection fences around the apron of pump unit by beneficial villagers

The costs borne by the Mozambican side for the above items are estimat-

Project Costs Shouldered by Mozambican Side

(Unit: ¥1,000,000)

Item	Expenses	Remarks
(1) Land Acquisition	-	Public Lands
(2) Const. of Access Road	-	Managed by villagers.
(3) Const. of Fence	-	Managed by villagers.
(4) Staff Salary	1.63	Drilling Experts
(5) Fuel Charge, etc.	0.09	EPAR's truck is used.
Total	1.72	-

ed as presented in the table.

3.2 Operation and Maintenance Plan

3.2.1 Operation and Maintenance

1) Technology Transfer on Operation and Maintenance

(1) PEC Activities

PRONAR conducts the enlightenment of villagers on necessity of well, operation and maintenance of well and pump unit, etc. through various activities of PEC section in each district and province. The PEC activities were commenced in 1986 under the UNICEF's guidance, its activities cover whole of the country. The objectives of the PEC activity are;

- to motivate the community (and especially the women) to participate in all facets of the well construction process, from choosing the site to taking care of the finished well, and
- to educate the community in the correct utilization of the well and, the proper use and treatment of water (including the transport and storage of water), and the general relationship of water to health.

The animadors who take an important role in the activities, 14 animadors are at present working in Gaza province. Out of 14 animadors, 12 are attached to the respective district offices of EPAR, and are assigned for enlightenment of villagers on operation and maintenance of wells. The rest of two (2) animadors are attached to the main office of EPAR. They are in charge of managing and controlling the activities of other animadors, and take a coordination with the PEC section of PRONAR.

Prior to commencement of the well construction, the animadors have a series of discussion with villagers on necessity team of well, necessary obligation of villagers, establishment of operation and maintenance of well, etc., and an agreement is signed between animador and villagers. After the completion of well construction, OJT will be conducted at site

to transfer technology of operation and maintenance. When the completed well is handed over the villagers, tools and spare parts necessary for operation and maintenance are also handed together, and various training are conducted by the animadors on disassemble, assemble and repair of such wells in order to facilitate the villagers' operation and maintenance system. In addition, they monitor and record the situation of operation and maintenance by villagers in order to collect useful information and data for further improvement of pump structures and operation and maintenance of wells.

The activities of PEC is conducted for extending VLOM (Village Level Operation and Maintenance) based on the decentralization policy of the Mozambican government. The government understand the purposes of these activities well and is expecting its successful results. Villagers understand on necessity of operation and maintenance of wells as well as their own participation in these activities, and satisfy such animadors' activities. Therefore, it is considered that the activities of animadors having been conducted so far would be continued and applied for the wells to be constructed under the Project.

(2) Training by Manufacturers

It is basically necessary for the manufacturers to conduct site training when the facilities are handed over the beneficiaries. Some Dutch manufacturer has made such training service dispatching its specialists to the site previously. However, in case of the handpump like AFRIDEV type, it is widely applied in the country, and the technical staff of EPAR-Gaza have had much experience in operating and managing same type of pump units so far. It is, therefore, considered that such training by the manufacturer is not necessary in this Project.

2) Operation and Maintenance of Well and Handpump

The villagers have to organize a operation and maintenance group consisting of some selected village members before handing over the constructed wells. This group has to be organized for each well. In addition, a staff for collecting and managing the water charge collection should be selected among the member of village. Only simple repair of handpump such as change of valve, etc. will be taken care by such operation and maintenance group. Rather complicated operation or repair like rehabilitation of well will be managed by EPAR, but its costs has to be compensated by villagers. It is considered that such operation and maintenance manners would be applied for the wells to be constructed under the Project. The table shows the items of operation and maintenance of wells to be manag-ed by EPAR and villagers.

Obligation in Operation and Maintenance of Wells

Items	EPAR-Gaza	Villages
Cleaning of Well	O	
Removal of mud in the well	O	
Replacement of spare parts		O
Renewal of Handpumps	O	
Renovation of Well		O
O&M of Related Facility		O

3) Operation and Maintenance of Procured Equipment

The most of the equipment and materials to be procured under the Project shown in the table of Sub-section 2.3.2 will be managed by EPAR-Gaza except for geophysical survey equipment to be managed by Water Resources Section of DNA. EPAR has a workshop of which space is considered enough to maintain such equipment and materials that will be procured.

The Government of Mozambique intends to formulate the staff organization as stated below.

- Geophysical Investigation Team consisting of one (1) Geophysicist and one (1) Assistant geophysicist (Hydrogeological Section of DRH, DNA)
- Drilling Team consisting of one (1) chief driller, two (2) assistant drillers,

two (2) helpers, and one (1) mechanical engineer for operation and maintenance (EPAR-Gaza)

- Pump Test Team consisting of one (1) engineer, one (1) plumbing expert and one (1) helper (EPAR-Gaza)
- Installation Team consisting of one (1) mechanical engineer and two (2) helpers (EPAR-Gaza) The final installation of pump units will be conducted by aminadors for OJT of villagers.

The geophysical survey equipment is composed of electric resistivity survey equipment and electro-magnetic survey equipment, and both needs one (1) geophysicist and one (1) assistant for each survey equipment, but it is considered quite rare to conduct both survey at once. Thus, the planed number of staff is considered enough to operate both survey equipment. As for the other teams, the number of staff for them is assigned choosing proper personnel among those assigned for their rigs at present in operation. Therefore, the above-proposed formation of teams is judged to be possible to operate and maintain such equipment and materials to be procured under the Project.

4) Recommendation on Operation and Maintenance of EPAR

(1) Wells and Handpumps

The wells to be constructed under the Project will actually be operated and maintained by the beneficial villagers themselves. For facilitate such management by villagers, it is recommended to improve and modify the operation and maintenance system of EPAR as stated below.

i) Selection of Operation and Maintenance Group

The results of the field survey shows that there are 153 wells including dug wells in the targeted 81 villages. Out of these number of wells, only 97 wells equivalent to two third (2/3) is considered functional,

and the other one are out of order or unusable because of damage caused by sand clogging. If the maintenance works such as change of spare parts are conducted by villagers properly, AFRIDEV type of handpump must be usable even for 5 - 10 years. Such durability of handpump depends fully on the quality of operation and maintenance services conducted by villagers.

According to the hearing survey conducted during the field survey, there are many villages which have such organization for operation and maintenance headed by the village chief. However, only a few villages conducts daily maintenance services such as periodical replace of spare parts. Therefore, it is necessary to make thorough formation of such operation and maintenance groupie through the animadors' guidance. It is further necessary to monitor the activities conducted by villagers, and such monitored records should be utilized for improving the system of operation and maintenance in future.

ii) Preparation and Utilization of Operation and Maintenance Records

There exist about 1,200 wells in Gaza province at present, and functional wells are estimated two third (2/3) of them. EPAR is take efforts to collect the records on situation of operation and maintenance and of damage through the activities of animadors. However, it seems to be rather difficult to grasp the exact situation by the present collection manner. Therefore, it is recommended to organize such collected data and records into a comprehensive database with the computer in EPAR-Gaza in order to arrange and analyze such records to grasp the actual situation of the existing wells and handpumps exactly. Based on such arranged database, it is possible to find causes, frequency and extent of damages of handpumps and wells, and the results of analyses will be reflected to the further improvement and

modification of pump sets as well as methods and manners of extension and training services.

(2) Equipment and Facilities

It is possible to use the equipment more than 10 years after the completion of the Project if they are properly maintained. The equipment is considered to be usable even after the completion of the intended drilling schedule. Therefore, technical transfer on the O&M is considered necessary. It is recommended that following O&M system be arranged for the long term operation of the equipment.

i) It is desirable to assign the person incharge of operation and maintenance as follows:

- Geophysical survey equipment: Electric engineer
- Drilling rigs: Mechanical engineer

ii) It is possible to maintain long life of the Equipment by periodically maintenance. The contents and results of the maintenance shall be recorded in the maintenance manual and the evaluation table. Degree of the Equipment and accessories shall be observed considering the operation period and the operation under the severe conditions.

iii) It is necessary to establish the communication system between the drilling team and the maintenance crew.

iv) Spare parts are properly stocked and maintained in the warehouse. For the improvement of the stocking and maintenance system, it is better to analyze the frequency of replacement and exhausting of spare parts.

3.2.2 Operation and Maintenance Costs

1) Wells and Handpumps

The operation and maintenance of wells and handpumps will be conducted by the group selected among villagers, and their contribution is free of charge. The tools and instruments are handed over villagers at the time of handing over of wells. Therefore, only the costs for purchasing spare parts should be considered to be shouldered by villagers. As shown in the table, the purchase costs of spare parts of AFRIDEV pump amount to 592,170 Mt/year.

Replacement costs of Handpump Spare Parts

Spare Parts	Frequency of Replacement per Year	Government Price (1,000 Mt)	Annual Costs (1,000 Mt)
"U" Sole	12	31.44	188.64
Rubber Ring	1	1.44	1.44
Valve Bobbin	1	8.22	8.22
Plastic Joint	12	47.52	285.12
Centralize and Steel Rod	1	108.75	108.75
Total	-	-	592.17

The amount of 592.17 Mt/year is considered equivalent to 590 Mt/month/family. The water charge being collected at present in most of villages is in a range between 500 and 1,000 Mt/month/family, and the results of interview survey indicate that in most of the village interviewed reveal their intention to accept 1,000 Mt/month/family of water charge. It is, therefore, judged possible to pay the above-mentioned amount of water charge for villagers.

2) Equipment and Facilities

The operation and maintenance service to be considered for drilling rig, vehicles, geophysical survey equipment covers the following items.

- Daily and periodically maintenance
- Maintenance of tools and spare parts
- Maintenance in the field

- Maintenance and management in the workshop of EPAR

These service will be conducted by the personnel promoted for this Project in the present government organization such and EPAR and DNA, and it will consists of geophysical, drilling, pump test and installation teams. The costs additionally required for the service is only fuel charge. It is, therefore, considered to be payable by the respective government organization. The amount required is estimated in 210,000,000 Mt/year as shown in the table.

Required Stuff for the Procured Equipment

Team		Specialty	Req. No.	Remarks
Geophysical Survey Team		Geophysicist	1	DNA
		Helper	1	
Drilling Team	(Drilling)	Driller	1	
		Asst. Driller	1	
		Helper	2	
	(O&M)	Mech. Eng.	1	
Pump Test Team		Mech. Eng.	1	EPAR-Gaza
		Plumber	1	
		Helper	2	
Pump Installation Team		Mech. Eng.	1	
		Helper	2	

O&M Cost for Equipment

Item	Expense (Mt)
Salary	90,000,000
Fuel Charge	120,000,000
Total	210,000,000

Fig.3.1 IMPLEMENTATION SCHEDULE (TOTAL PERIOD)

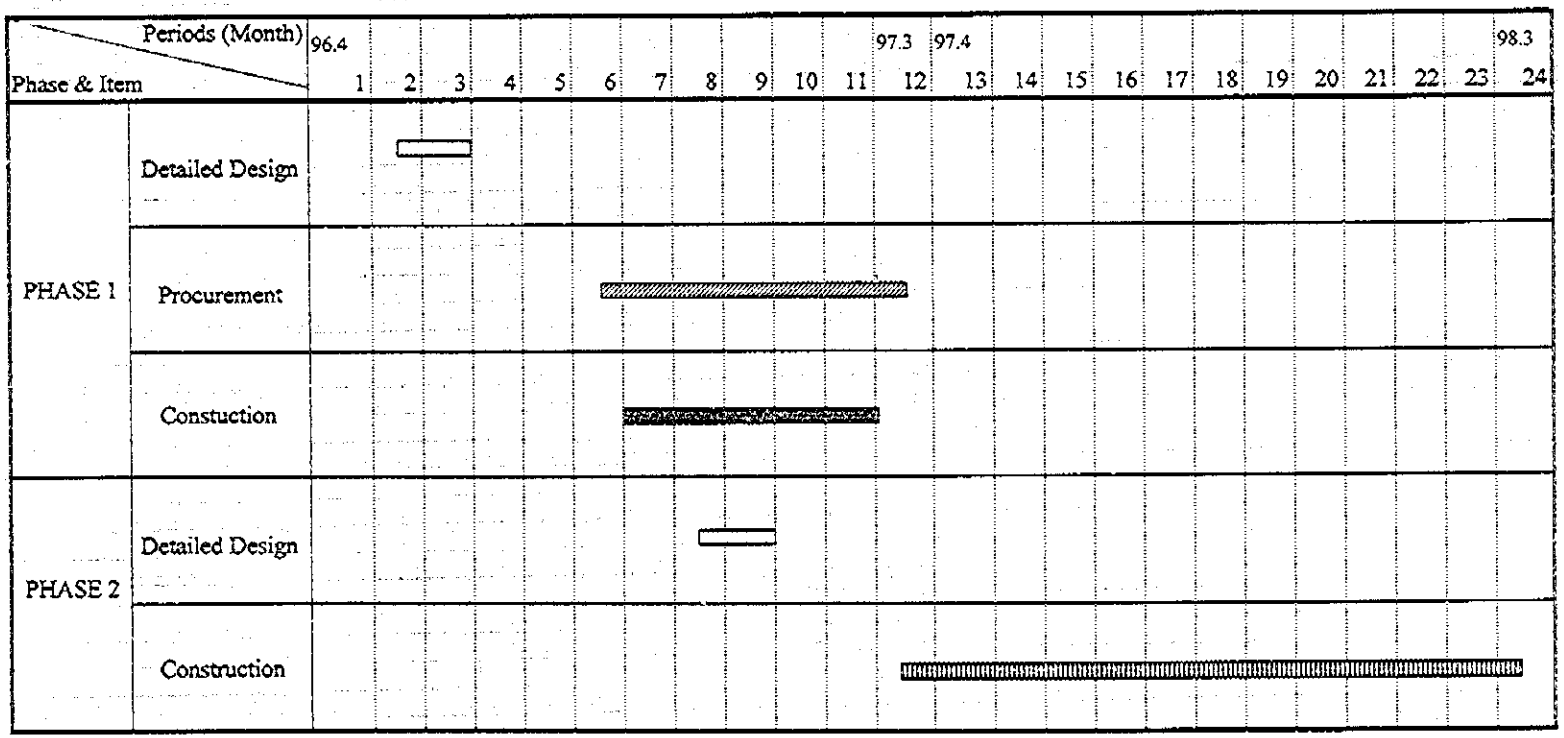
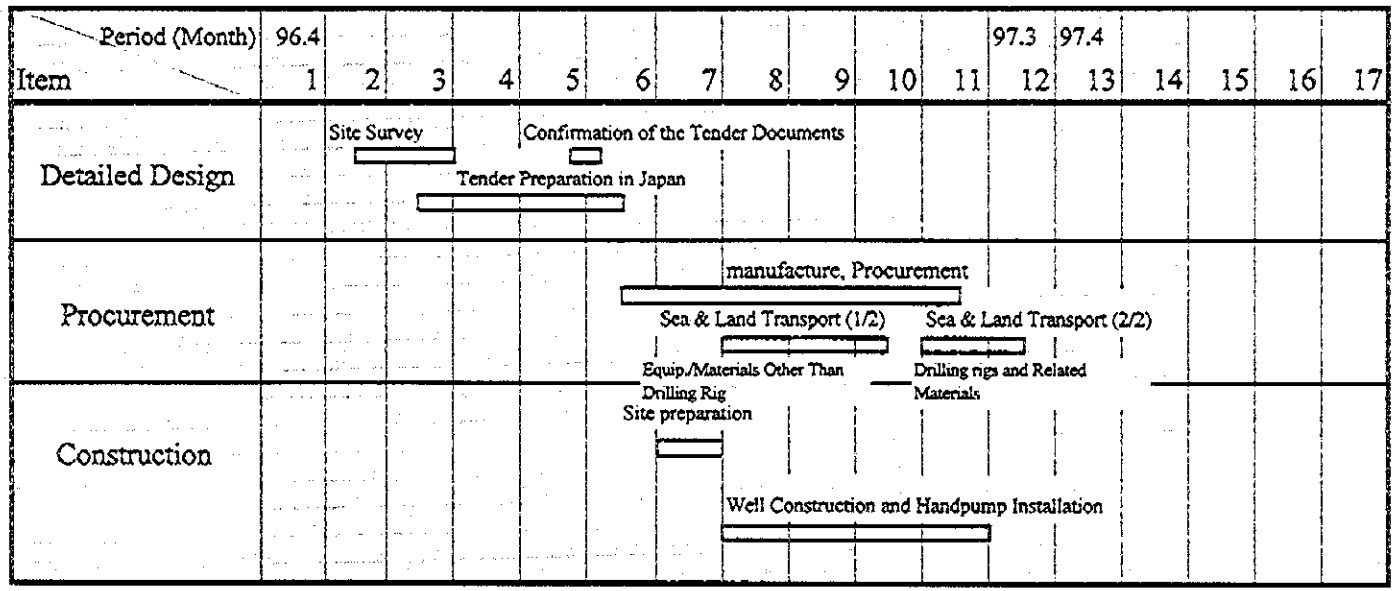


Fig.3.2 IMPLEMENTATION SCHEDULE (PHASE 1)



(Note) The equipment and materials will be delivered at site separately; the equipment to be manufactured will delivered later while the other equipment and materials will be delivered first.

CHAPTER 4
PROJECT EVALUATION AND RECOMMENDATION

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION

4.1 Project Effect

The Mozambican Government has improved its infrastructure under the assistance of foreign countries and international agencies since the end of the civil war. The government has recognized that it's an urgent matter to improve the rural water supply system in Gaza province whose ratio of population served is approximately 30%. Since they are still obliged to use unprotected water sources, this causes the high incidence of infectious water related diseases. Furthermore, it is a severe work for women and children to fetch and carry water from distant water sources. This situation has been much worsen in this province whose precipitation is least in Mozambique because of continuous severe drought since 1992. Therefore, high priority is given to supply safe and inexhaustible water in the rural area of Gaza province.

In case this Project is implemented, recipient population is 75,000 for new water wells and 11,500 for rehabilitated existing wells, totaling 86,500. The ratio of population served increases to approximately 37% in Gaza province and 36% from 28% in six districts of southern part of the province.

At present, it is necessary to drill 1,488 boreholes in six districts according to the national plan which plans to realize 100% ratio of population served in the rural area until 2017. Including the northern part of the province, the number of boreholes becomes 1,800 over. However it is hard that EPAR Gaza which is in charge of water well construction under PRONAR, because EPAR has only two simple percussion rigs whose capacity is limited to 50m depth and unsuitable to drill hard rocks in the northern part.

Considering these circumstances, provision of equipment and materials for well drilling in this project enables EPAR to construct water wells by himself and it much contributes to accelerate the development of rural water supply.

Supply of safe water in the rural area through this Project is agree with the basic human

needs in Mozambique, and it contributes to stabilizing the human welfare and improving the human life in the rural area.

It is evaluated highly beneficial to implement this Project in the rural area where urgent improvement of water supply condition is necessary.

Judging from the effect and nature of the Project mentioned below, it is proper to implement the Project under the Japan's grant aid scheme.

1) The Project will be implemented in the rural area and the recipient population is large, 86,500 person.
2) The Project aims to satisfy the Basic Human Needs (BHN). It has urgency to be implemented because Mozambique has been attacked by severe drought since 1992.
3) Since women in the rural area are obliged to spend much time and energy to fetch and carry water from a distance, they has lost chance to get their education and income. The Project will improve their situation more or less.
4) It is considered to be possible to operate and maintain the Project by the Mozambican side's own fund, personnel and technique.
5) Mozambique intends to accelerate the improving the rural water supply project as one of the basic policy regime. The Project will contribute to attain the national policy of Mozambique.
6) Incomplete rural water supply system caused by the inner war and so force is the one of the main factors that obstructs resettlement of refugees and returned soldiers. The Project will contribute to promote their resettlement.
7) This Project is not high profitable because it aims to improve the environment of living in the rural area.
8) The Project causes no negative affect to the environment because of its purpose to improve the environment.
9) It is considered to be possible to implement the Project without any difficulties under the Japan's grant aid scheme.

4.2 Recommendation

The Project shall be urgently implement in the view point of countermeasure to severe drought since 1992 and satisfaction of the Basic Human Needs (BHN) to improve the environment of living and hygiene in the rural area. Furthermore, it contributes to the improvement of the rural water supply project, one of the national policy regime.

It is much significant to implement the Project under the Japan's grant aid scheme because it will be much effectual and aims to improve the Basic Human Needs (BHN) in the rural area.

The Project will be smoothly and effectively implemented, if following items will be considered in the implementation.

1) It is important to allocate necessary budget, equipment and personnel for proper maintenance of the water supply facilities.
2) Operation and maintenance cost will be mainly borne by the community people. It is necessary to collect the water fund without retardation.
3) Necessary number of personnel should be allocate for the smooth operation of drilling rig, its supporting vehicles and geophysical survey equipment.
4) EPAR will continue to construct water wells using a drilling rig and geophysical survey equipment after the completion of this Project. For this purpose, it is important to keep them in proper condition.
5) Technique of drilling of well and geophysical survey will be transferred through this Project by the OJT method. However, further training is necessary to smoothly implement the project. Therefore, it is recommended to request the Japanese government to accept training of counterparts.
6) The Detailed Design Study should be conducted in consideration of the following items as requested by the Mozanbican side (Minutes of Discussions on 20th. March, 1996).

   - Possibility to purchase the necessary equipment and facilities in the Mozanbican

market.

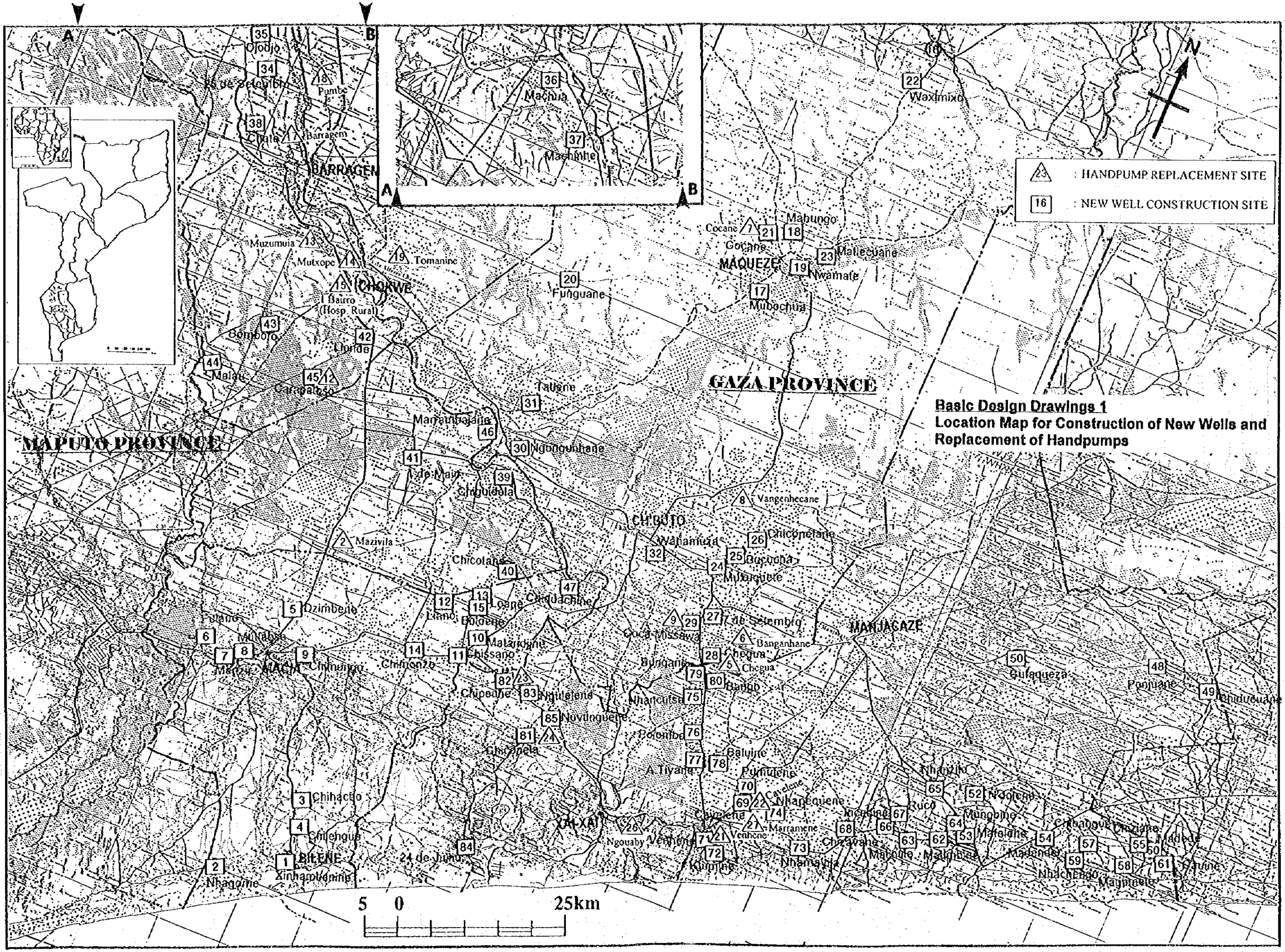
- Grade-up of pickup vehicles from 2,800 cc to 4,000 cc class.
- Modification of specifications and combination of the tracks and vehicles to be purchased as summarized below.

Modification of Specification and Combination of Vehicles to be Purchased

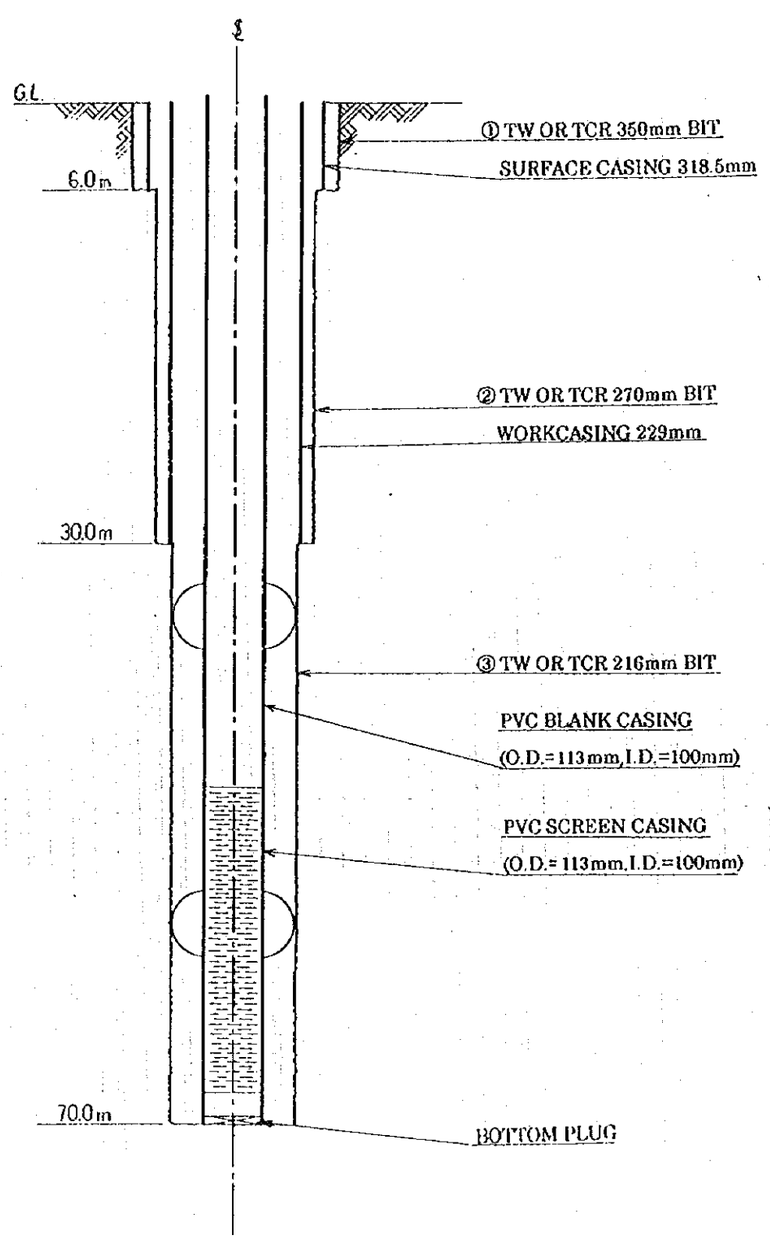
	Proposal of Japanese Side	Propsal of Mozanbican Side	Usage of Vehicles
Vehicles	(1) 10 t track with 3 t crane 1 no.	(1) 10 t truck with 3 t crane 1 no. (2) 5 t truck with 3 to crane 1 no.	General cargo and assistance to drillings rig Trailer, general cargo and loading fuel tanks
	(2) 5,000 l water tank lorry 1 no.	(3) Trailer type water tank 1 no.	Transportation of drilling water
	(3) 3,000 l fuel tank lorry 1 no.	(4) 1,000 l fuel tank mounted on 5 t truck 3 no.	Transportation of fuel for drilling rig and vehicles

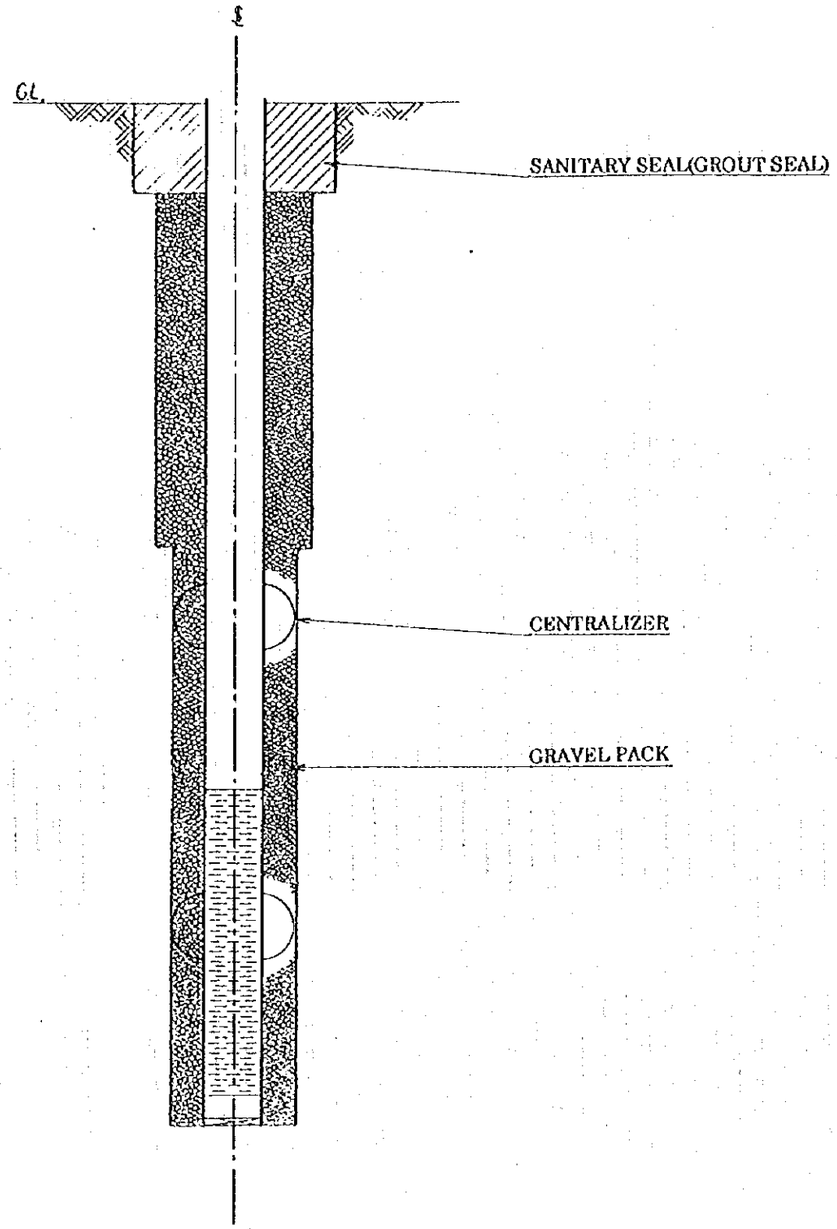
(Reason) To reduce number of drivers and operation and maintenance costs and to use vehicles for multiple purposes.

BASIC DESIGN DRAWINGS


Basic Design Drawings 1
Location Map for Construction of New Wells and Replacement of Handpumps
: HANDPUMP REPLACEMENT SITE
: NEW WELL CONSTRUCTION SITE
N
GAZA PROVINCE
MAPUTO PROVINCE
CHOKWE
BARRAGEM
MAQUEZE
CHIBUTO
MANJACAZE
MACIA
BILENE
XAI-XAI
5 0 25km
A
B

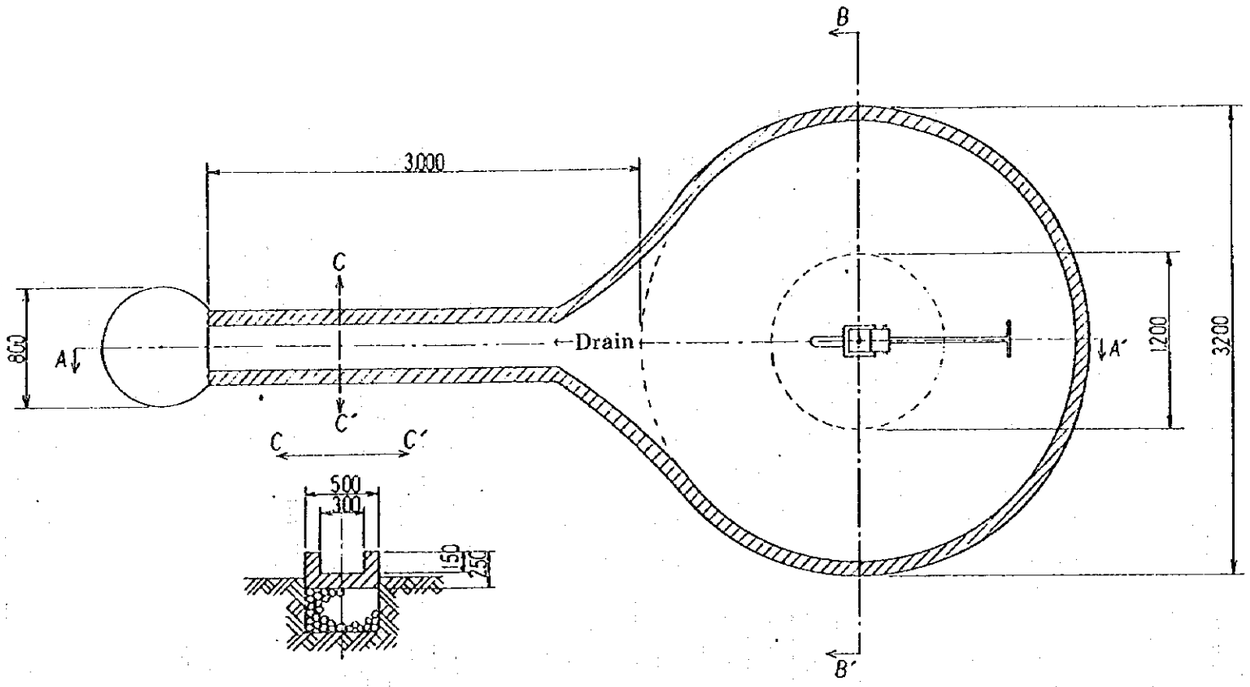
STANDARD DESIGN OF BOREHOLE

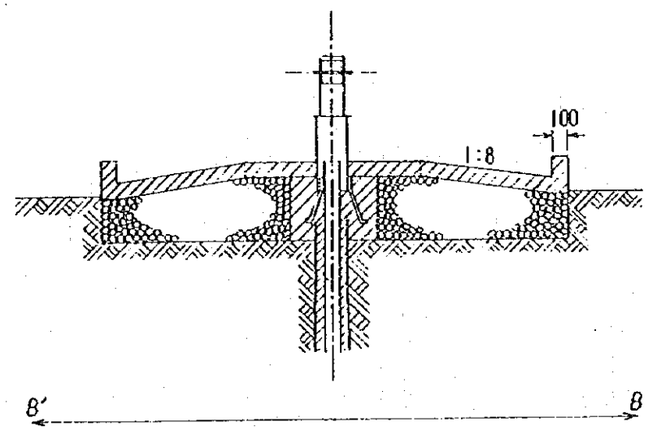


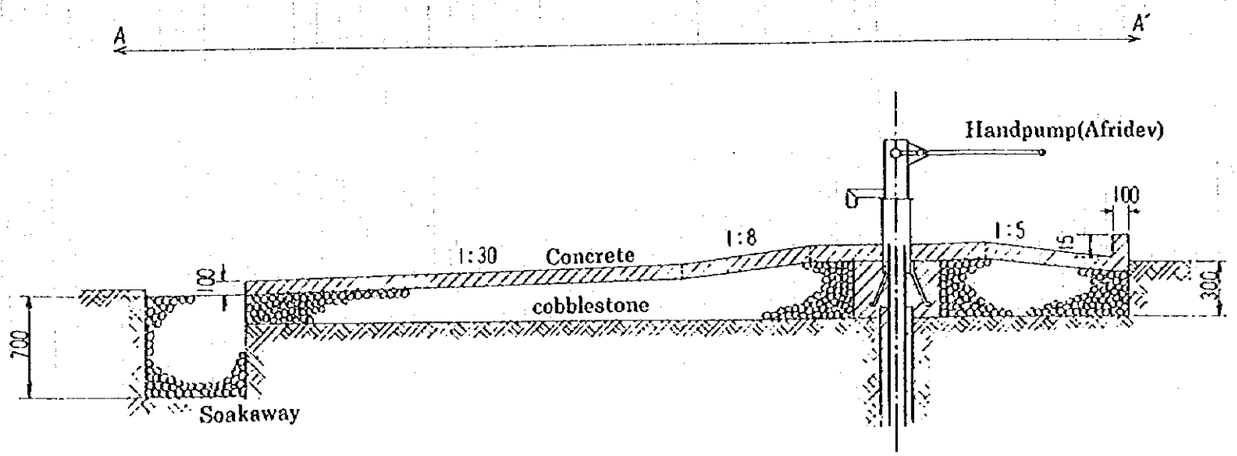


Basic Design Drawinge 2
Standard Well

Standard Construction of Head-Works







Basic Design Drawings 3
Installation of Handpumps and Related Facilities

APPENDICES

ATTACHMENT I. MEMBER LIST OF THE SURVEY TEAM

1.	Dr. Y. MARUO	Team Leader	Senior Development Specialist, JICA
2.	Mr. K. TERAO	Grant Aid Planner	Grant Aid Division, Ministry of Foreign Affair
3.	Mr. S. MASUDA	Coordinator	Grant Aid Study and Design Depr., JICA
4.	Mr. N. YAMAMOTO	Chief Consultant	Pacific Consultants International
5.	Mr. S. YUMOTO	Water Supply/Operation and Maintenance Planner	Pacific Consultants International
6.	Mr. Y. OSHIKA	Hydrogeologist	Pacific Consultants International
7.	Mr. M. KATO	Geophysicist	Bishimetal Exploration Co., Ltd.
8.	Mr. K. SUGAWARA	Geophysicist	Bishimetal Exploration Co., Ltd.
9.	Mr. T. SUZUKI	Cost Estimate/Procurement	Mitsui Mineral Development Engineering Co., Ltd.
10.	Ms. Y FUKUSHIMA	Interpreter	Pacific Consultants International

ATTACHMENT II. SURVEY SCHEDULE

(1) Field Survey for Basic Design

Order	Date		Activities			
	(Member)		(Maruo and Masuda)	(Yamamoto, Yumoto and Fukushima)	(Oshika, Kato and Sugawara)	(Suzuki)
1	Dec. 12, 1995	Tue.	Dept. for Amsterdam			-
2	Dec. 13, 1995	Wed.	Arriving at Harare, Cautesy call to Embassy of Japan			-
3	Dec. 14, 1995	Thu.	Dept. Harare and arriving at Maputo			-
4	Dec. 15, 1995	Fri.	Courtesy call to Ministry of MOPH and UNICEF, and discussions			-
5	Dec. 16, 1995	Sat.	Discussions and explanation of Inception Report			Dept. Tokyo
6	Dec. 17, 1995	Sun.	Site visit and inspection			Dept. London
7	Dec. 18, 1995	Mon.	Site survey and discussion,			Arriving at Maputo
8	Dec. 19, 1995	Tue.	Discussions on Inception Report			
9	Dec. 20, 1995	Wed.	Discussions on Inception Report			
10	Dec. 21, 1995	Thu.	Discussions on Minutes of Meeting			
11	Dec. 22, 1995	Fri.	Signing of Minutes of Meeting			
12	Dec. 23, 1995	Sat.	Data collection			
13	Dec. 24, 1995	Sun.	Leaving for Tokyo	Data collection		
14	Dec. 25, 1995	Mon.	-	Field surveys		
15	Dec. 26, 1995	Tue.	-	- do -		
16	Dec. 27, 1995	Wed.	-	- do -		
17	Dec. 28, 1995	Thu.	-	- do -		
18	Dec. 29, 1995	Fri.	-	- do -		
19	Dec. 30, 1995	Sat.	-	- do -		
20	Dec. 31, 1995	Sun.	-			
21	Jan. 1, 1996	Mon.	-	Field surveys		
22	Jan. 2, 1996	Tue.	-	- do -		
23	Jan. 3, 1996	Wed.	-	- do -		
24	Jan. 4, 1996	Thu.	-	- do -		
25	Jan. 5, 1996	Fri.	-	- do -		
26	Jan. 6, 1996	Sat.	-	- do -		
27	Jan. 7, 1996	Sun.	-			
28	Jan. 8, 1996	Mon.	-	Field surveys		
29	Jan. 9, 1996	Tue.	-	- do -		
30	Jan. 10, 1996	Wed.	-	Field surveys		Dept. for Johannesburg
31	Jan. 11, 1996	Thu.	-	- do -		Material survey in Johannesburg
32	Jan. 12, 1996	Fri.	-	- do -		- do -
33	Jan. 13, 1996	Sat.	-	- do -		- do -
34	Jan. 14, 1996	Sun.	-	- do -		- do -
35	Jan. 15, 1996	Mon.	-	- do -		- do -
36	Jan. 16, 1996	Tue.	-	- do -		- do -
37	Jan. 17, 1996	Wed.	-	- do -		- do -
38	Jan. 18, 1996	Thu.	-	- do -		Dept. Johannesburg
39	Jan. 19, 1996	Fri.	-	- do -		Arr. at Tokyo
40	Jan. 20, 1996	Sat.	-	- do -		-

Order	Date		Activities			
	(Member)		(Maruo and Masuda)	(Yamamoto, Yumoto and Fukushima)	(Oshika, Kato and Sugawara)	(Suzuki)
41	Jan. 21, 1996	Sun.	-	Dept. for Harare	Field Sirveys	-
42	Jan. 22, 1996	Mon.	-	Cautesy call to Embassy of Japan	- do -	-
43	Jan. 23, 1996	Tue.	-	Dept Harare	- do -	-
44	Jan. 24, 1996	Wed.	-	Dept. Frankfurt	Dept. Maputo	-
45	Jan. 25, 1996	Thu.	-	Arr. at Tokyo	Arr. at Tokyo	-

(2) Explanation of Draft Basic Design

Order	Date		Activities		
	(Member)		(Maruo)	(Yamamoto, Yumoto, Suzuki and Fukushima)	(Terao)
1	Mar. 12, 1996	Tue.	Dept. for Johannesburg		
2	Mar. 13, 1996	Wed.	Arr. at Maputo from Johannesburg		
3	Mar. 14, 1996	Thu.	Courtesy Call to MPOH, DNA and PRONAR		
4	Mar. 15, 1996	Fri.	Site Inspection		
5	Mar. 16, 1996	Sat.	Site Inspection		
6	Mar. 17, 1996	Sun.	Internal Meeting		Dept. for Harare
7	Mar. 18, 1996	Mon.	Discussion and Explanation on B/D		Seminar in Zimbabwe
8	Mar. 19, 1996	Tue.	Discussion and Explanation on B/D		Seminar in Zimbabwe
9	Mar. 20, 1996	Wed.	Signing of M/M		Seminar in Zimbabwe
10	Mar. 21, 1996	Thu.	Dept. for Johannesburg		Seminar in Zimbabwe
11	Mar. 22, 1996	Fri.	Meeting in RSA	Arr. at Harare, Cautesy Call to Embassy of Japan	
12	Mar. 23, 1996	Sat.	Meeting in RSA	Dept. for Bangkok	
13	Mar. 24, 1996	Sun.	Meeting in RSA	Arr. at Bangkok and Dept. for Tokyo	
14	Mar. 25, 1996	Mon.	Meeting in RSA	Arr. at Tokyo	

ATTACHMENT III. LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

Ministry of Public Works and Housing

National Water Directorate (DNA)

1. Mr. Luis Elias	National Director

Department of Water Resources

2.. Mr. Justino Bahane	Chief, Groundwater Section
3. Mr. Sigrun Spaans	Advisor, Geohydrology Section
4. Mr. Tomas Belo Elias Mangue	Hydrology Section
5. Harm Albert Zanting	Advisor, Hydrology Section
6. Pedro Gambuka	Chief, Water Quality Section
7. Sergio Benio Sitoe	Geohydrology Section

National Rural Water Supply Programme (PRONAR)

8. Ms. Maria Angelina Francisco	Director
9. Mr. Leo Stalk	Technical Advisor
10. Ms. Felicidade	Chief, PEC Section

Provincial Directorate of Public Works and Housing (DPOPH), Gaza

11. Mr. Arnaldo Artur Guilaziane	Provincial Director
12. Mr. Manuel Antonio de Figueiredo	Chief, Water Department

Provincial Workshop of Rural Water (EPAR), Gaza

13. Mr. Estevao Mucavel	Chief
14. Mr. Baltazar M. Guidanga	Chief, Production Section
15. Ms. Maria da Luz A. Matsimbe	Chief, PEC Section

Ministry of Foreign Affairs and Cooperation

16. Dr. Americo A. Fortuna	National Director
17. Mr. Chico Verniz Mortar	Desk Officer for Japan

United Nations Children's Fund (UNICEF)

18. Christian Hubert	Snr. Project Officer, Water and Environmental Sanitation
19. Mark Henderson	Project Officer, Water and Environmental Sanitation