

APPENDIX (3)

QUESTIONNAIRES SHEET OF WATER SUPPLY SURVEY

DATA SHEET FOR PRELIMINARY FIELD SURVEY

(OCT/NOV/DEC 1990. BY)

(I) VILLAGE/COMMUNITY DATA

1. Name: _____ Tentative No.
2. Region _____, Accessibility: _____
3. Approx. Area: _____ Km² or _____ M × _____ M
4. Population Data:

_____ (1980) _____ (1990) _____ ()

Annual Growth Rate _____ % (),

No. of Houses _____ Family Structure _____ persons
5. Distribution of Houses, dispersed /concentrated
6. Public Facilities, School, Market, Church, Others
7. Village Organization or Community Structure:

8. Landownership: private / state own
9. Agriculture and Cattle Breeding: _____

10. Problems in Public Health : serious _____
11. Water Consumption : _____ L / Day/Family,

Total _____ M³/day (Safe Water _____ M³/day)
12. Traditional Use of Water :drinking _____

cooking _____, washing _____
13. Existing Regional Development & Water Supply Plan: _____

14. Existing Power Supply: _____
15. Fuel Oil Supply : _____
16. Other Characteristics : _____

(II) PROPOSED WATER SOURCES & SUPPLY FACILITIES

1. Type of Sources : Dug Well, Deep Well

Protected Spring, River, Pond

Lake Others Water Vendor

2. Population/Houses to be Served:

3. Public Institutions to be Served:

4. Livestock To Be Served:

5. Total Potential Water Demand:

6. Service Level and Facilities

(1) Protected Spring

(2) Tube Well with Handpump

(3) Tube Well with Submerged Motor Pump

(Elect. or Diesel Driven)

(4) Distribution System

(a) Storage Tank :

(b) Distribution Main :

(c) Public Faucets :

(d) House Connection :

(5) Bath Room, Wash Tank, Pump House, Hand Pump Platform, Cistern for Livestock.

(6) Drainage Around Well.

(7) Leveling, Access way, Fence

7. Others:

| (III) <u>The Principal Components for Evaluation</u> | SCORE |
|--|----------------------|
| 1. <u>Availability of Ground Water or Alternative</u> | <input type="text"/> |
| 2. <u>Community Needs</u> | <input type="text"/> |
| (1) Inadequacy of Existing Water Supply System | <input type="text"/> |
| (a) Insufficient Quality, _____ M ³ /day | |
| (b) Difficult Access to the Source, avg. _____ km | |
| (c) Seasonal Variation | |
| (d) Poor Water Quality (Seriousness of Health Problem) | |
| (2) Others Urgency | <input type="text"/> |
| 3. <u>Community Commitment and Capacity</u> | <input type="text"/> |
| (1) Financial Commitment by Villagers | <input type="text"/> |
| (a) Willingness in Sharing Capital Cost | |
| (b) Willingness in Sharing O/M Cost | |
| (2) Local Organization for O/M | <input type="text"/> |
| (3) Possibility of Collection of Service Fee | <input type="text"/> |
| (4) Others | <input type="text"/> |
| 4. <u>Community Potential</u> | <input type="text"/> |
| (1) Financial Capacity (Village, Family Income) | <input type="text"/> |
| (2) Technical Capacity or Level | <input type="text"/> |
| (3) Social - Administrative Structure | <input type="text"/> |
| (4) Possibility of Productive Enterprise | <input type="text"/> |
| (5) Potential for Future Economic Development | <input type="text"/> |
| (6) Availability of Support Service (Such as personal hygiene training) | <input type="text"/> |
| (7) Others | <input type="text"/> |
| 5. <u>Capital & Operating Cost</u> | <input type="text"/> |
| 6. <u>Strategic Importance of the Region in National Development Program</u> | <input type="text"/> |
| OVERALL SCORE | <input type="text"/> |

SUPPLEMENTAL DATA SHEET FOR DETAIL SURVEY

(AUG / OCT / NOV 1990. BY)

1. Trends of Village Population

Natural : _____

Social : _____

2. Water Troubles, if any

Quantity : _____ Quality : _____

Labor : _____ Water Charge : _____

Others : _____

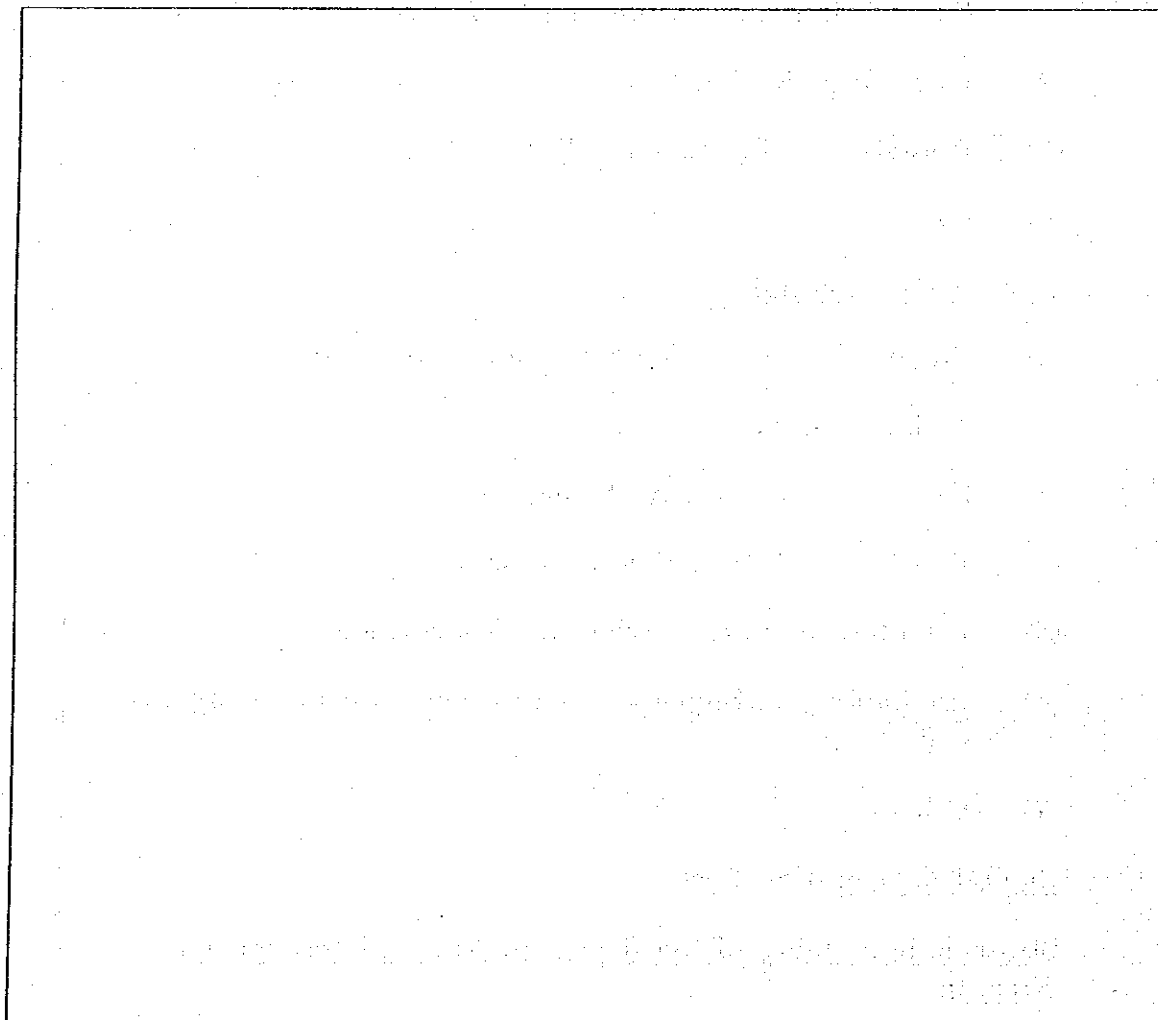
3. Any Information useful to O/M plan

Human Resource : _____

Social Unit : _____

Others : _____

4. Village Layout



APPENDIX (4)

QUESTIONNAIRES SHEET OF WILLINGNESS TO PAY SURVEY

WILLINGNESS TO PAY SURVEY

- I. Village name: Date:
Household number: Household size:
Water consumption per day (No. container/day)
(Note container size):
Water source and distance:
Number of trips to get water per day per family member:
How would you rate the quality of water you use ?
Do all children go to school every day ?
Have you completed compulsory education ?
For water buyers only:
Who controls the money in the family ?
Who pays for water ?

- II. Type of house: roof
wall
floor
Number of rooms:
Appliances (radio, etc.):
Dwelling only or cum business ?
Do family members look healthy ?

III. Willingness to pay

- (a) Do you think your household would be willing to pay 500 FMG each month to use a public standpost (or a hand pump well or a motorized pump well) located in your neighborhood ?

| | |
|--------------|-----------|
| Yes | Go to (b) |
| No | Go to (c) |
| I don't know | Go to (f) |

- (b) We do not know the amount of money the village water committee will require each household to pay for using the new water source. If the decision of the village water committee is to require each household to pay 1,000 FMG each month, would your household be willing to pay this amount ?

| | |
|--------------|-----------|
| Yes | Go to (f) |
| No | Go to (d) |
| I don't know | Go to (f) |

- (c) We do not know the amount of money the village water committee will require each household to pay for using the new water source. If the decision of the village water committee is to require each household to pay 50 FMG each month, would your household be willing to pay this amount ?

| | |
|--------------|-----------|
| Yes | Go to (e) |
| No | Go to (f) |
| I don't know | Go to (f) |

- (d) Would your household be willing to pay 700 FMG each month to use a public standpost (or a hand pump well or a motorized pump well) located in your neighborhood ?

| | |
|--------------|-----------|
| Yes | Go to (f) |
| No | Go to (f) |
| I don't know | Go to (f) |

- (e) Would your household be willing to pay 200 FMG each month to use a public standpost (or a hand pump well or a motorized pump well) located in your neighborhood ?

| | |
|--------------|-----------|
| Yes | Go to (f) |
| No | Go to (f) |
| I don't know | Go to (f) |

- (f) Think for a moment about the largest amount of money your household would be willing to pay each month to use a public standpost (or a hand pump well or a motorized pump well). If the cost to your household is more than this amount, your household could not afford to pay and would not be able to use the new water source.

| | |
|-----------------|----------|
| Amount of money |FMG |
| I don't know | |

APPENDIX (5)

SPECIFICATIONS OF TEST DRILLING

Specifications and Tentative Sites of Test Drilling Works

1 Specifications of test drilling works

(1) Target drilling

The depth of drilling shall vary from place to place ranging from 40 to 220 meters with estimated average depths of 200m in the intramountain (high plateau) area and 50m in the coastal (low plateau) plain. The target depth for each site shall be determined based on the results of the hydrogeological investigations.

(2) Drilling diameter

The drilling diameter shall be 7 5/8" for shallow boreholes with an average depth of 50m and 8 1/2" for deep boreholes with an average depth of 200m. The diameters of casing and screen to be installed shall be 4" for shallow boreholes and 6" for deep boreholes.

(3) Logging

In order to determine the number and location of the screens, three (3) types of geophysical logging shall be conducted prior to casing installation, which are

- a. Spontaneous potential logging
- b. Electrical resistivity logging
- c. Gamma-gamma logging

Measurement shall be continuously done near the ground surface down to the bottom of the borehole.

Logging data shall be attached to the drilling record.

(4) Casing and screen installations

A sand trap, screens and blind casings shall be lowered into the drilled hole with centralizer after the determination of screen settings. The location of the screens shall

be determined after conducting the abovementioned logging.

(5) Gravel packing

Immediately after the installation of casings and screens, the sieved gravel and coarse sand shall be packed in the annular space between the screen or casing and the drilled hole. This packing shall be done very carefully to ensure full packing of the annular space. The volume of the gravel packing used in each drilled hole shall be checked by the drilling supervisor.

The gravel pack shall cover the entire screen length and shall rise to a minimum of 3m above the top of the uppermost screen.

(6) Well development

The well development shall continue until water from the well turns apparently clean. Any well development method like bailing, air lifting or surging, or motor pumping can be utilized.

(7) Pumping test

Three (3) types of pumping test shall be carried out at each test well, which shall be directed by the JICA (Study Team) Expert.

- a. Step drawdown test: Five (5) steps, with a pumping duration of three (3) hours or more per step.
- b. Continuous drawdown test: This test shall be accompanied by (a). The last step of (a) shall be continued for at least 24 hours.
- c. Recovery test: After the continuous pumping (b), the recovery of water level shall be measured.

(8) Well completion

The well completion procedure shall comprise the following items:

- a. Back filling of the annular space between casing and drilled hole with drill cuttings to within 5m of the ground surface.
- b. Cement grouting of the 5m section below the ground surface.
- c. Construction of concrete base, with a dimension of 40cm for both length and width and 30cm for depth, to firmly fix the well casing.

Fig. 5.5 shows the drilling and casing programs in Phase II of the Study.

5.4.2 Tentative site for test drilling

Based on the results of the Study in Phase I, the target sites for test drilling were tentatively selected as shown in Fig. 5.6. The criteria for selecting the site were derived considering the following points:

- (1) To investigate the groundwater level and hydraulic aquifer characteristics and evaluate the overall potential of groundwater resources in the Study Area (i.e., in both areas estimated to be high potential and low to moderate potential).
- (2) To examine the groundwater for suitability as drinking water and to clarify the groundwater flow mechanism by comparing the chemical components of the groundwater in different regions and in different aquifers.
- (3) To select the priority area and to formulate a groundwater development plan for the selected priority areas.

However, these target sites for test drilling shall be finally selected from the results of the detailed site survey in Phase II of the Study.

6" Borehole (AV./Depth 200m)

4" Borehole (AV./Depth 50m)

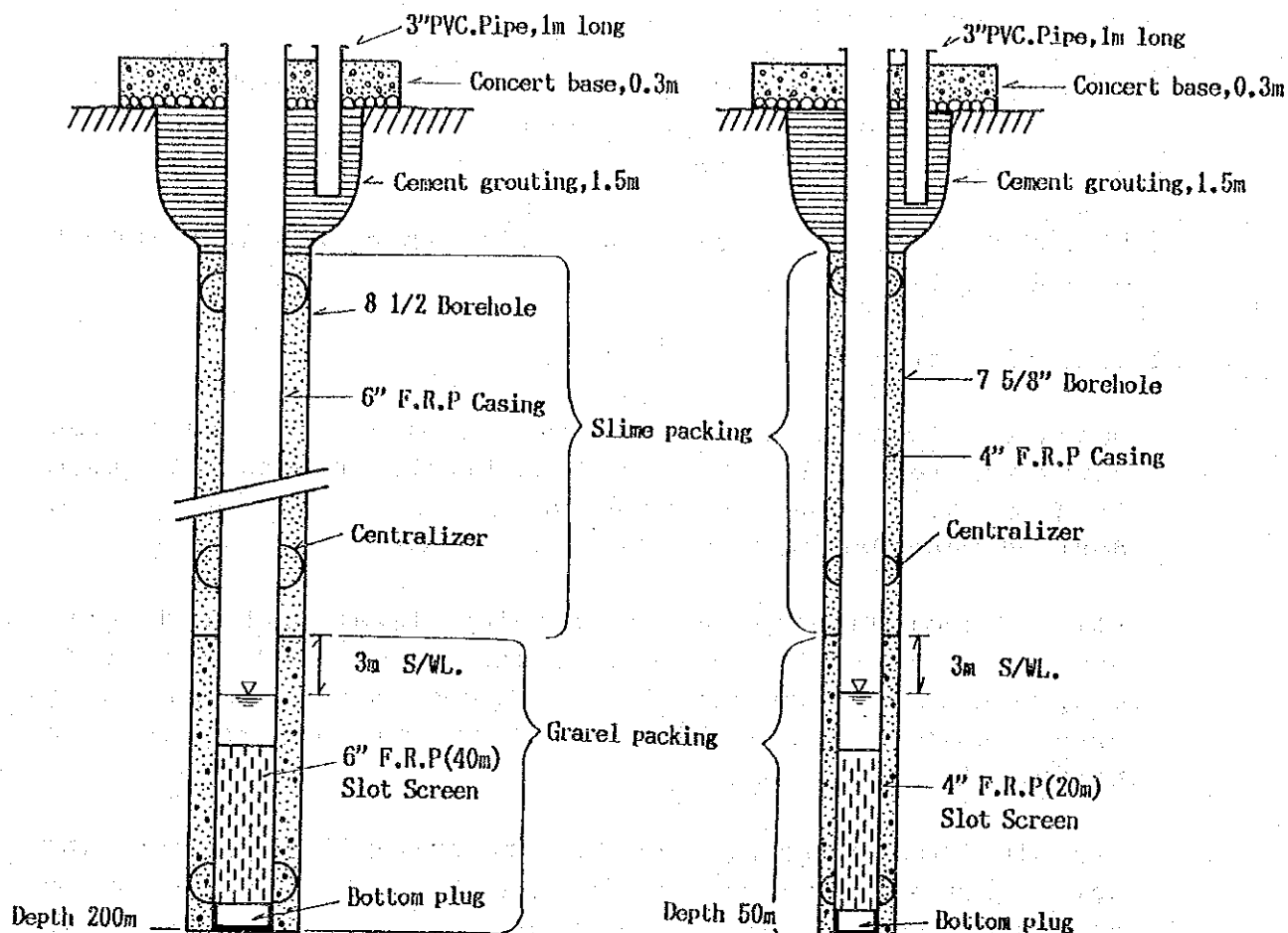
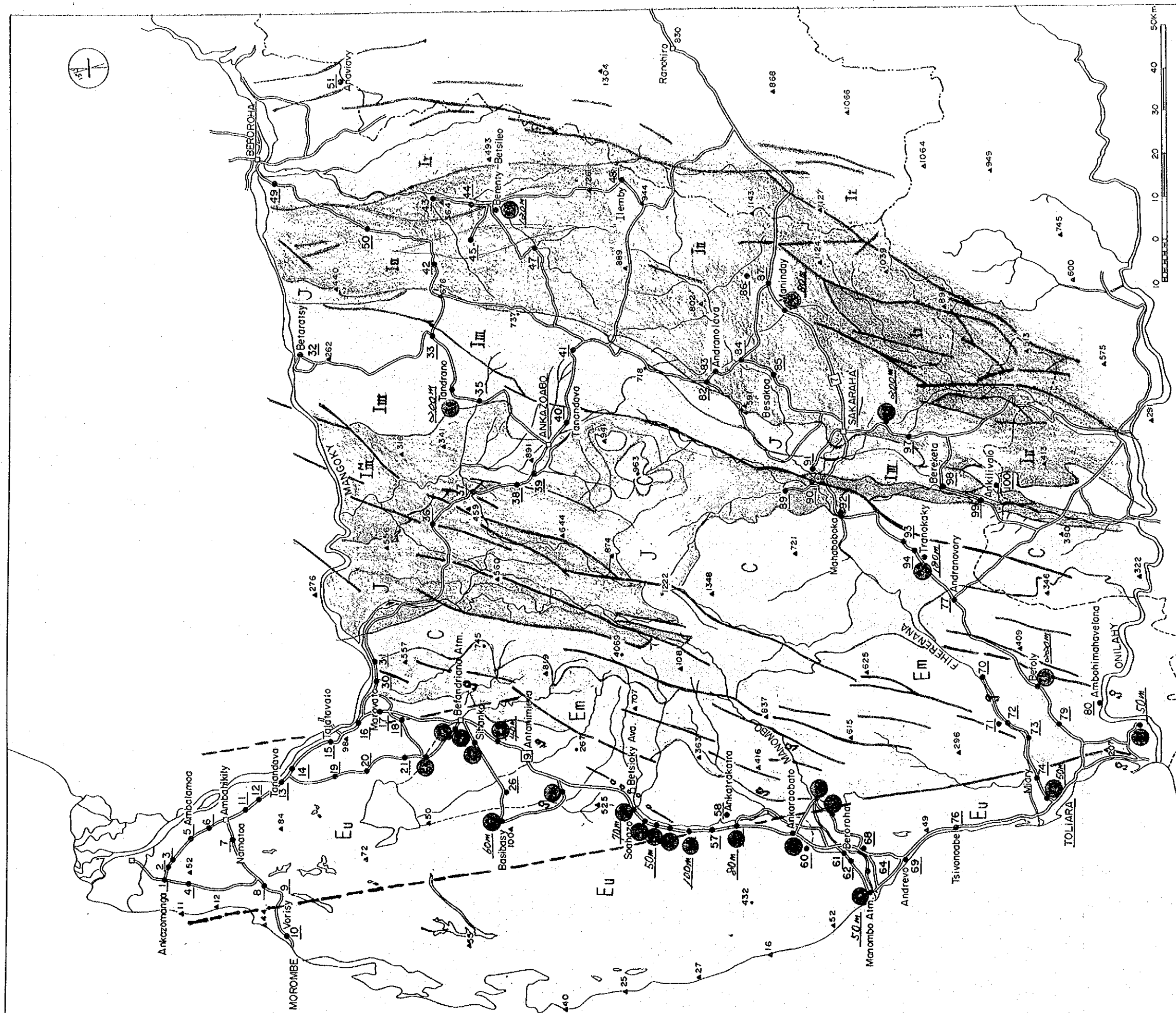


Fig. 5.5 Drilling and casing program



Location Map of tentative site for test drilling

- : 4" wells will be drilled by SM-200 & New Drilling Machine (1,000m, 18 boreholes)
- : 6" wells will be drilled by TOP-200 (1,000m, 6 boreholes)

APPENDIX (6)

SPECIFICATIONS OF PILOT FACILITIES

TECHNICAL SPECIFICATION

FOR

THE MODEL WATER SUPPLY

SYSTEM CONSTRUCTION

[Type A]

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GENERAL

This specification has been prepared by the JICA Study Team for the construction of "the model water supply system", which are contained within "The Groundwater Development Study in South - Western Region of Madagascar", undertaken by the joint Study Team of "the Ministry of Industry, Energy and Mine (MIEM)" and "the Japan International Cooperation Agency (JICA)".

Among four (4) types of model/trial construction proposed, following three (3) types of the groundwater sourced water supply system are proposed for the models of rural water supply in this Study Area; The forth type (D) is the works of rehabilitation of the existing water supply system.

1) Type A system:

A semi - urban style water supply system for the middle to large - scale villages, and equipped with:

- Diesel engine generated submersible motor pump
- Generator house
- Elevated reservoir tank
- Branch type distribution pipeline, and
- Communal faucets with concrete base.

2) Type system:

One of the point source type supply system equipped with one or two communal faucet near reservoir tank, and submersible motor pump with solar generating units sand solar monitoring units.

3) Type C system:

Point source with hand pump.



Construction of the Type A System is proposed in the village of Tranokaky about 60 km north - east of Toliara. A deep well with a depth of 200 m has been constructed in this village.

The trial construction of a solar energized facility is proposed in the village of Soahazo with a population of more than 2,000.

However, since this facility is to be constructed just for the study of effectiveness of solar energy by the long - term observation, the population to be served by the facility is limited to more or less 500, and this facility is accompanied with the monitoring system for illumination power, solar generated electricity and pumpage capacity.

The hand pumps accompanied with pump platforms are to be installed to the 16 test wells which will be drilled during the study period.

All of the above mentioned construction works is to be done by the Contractor under the supervision of the Joint Study Team.

The major materials and equipment for the water supply system like submersible motor pumps, generator, hand pumps and solar generating facilities are provided by the JICA, and all of other materials and equipment are to be prepared by the Contractors.

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SCOPE OF THE WORK

Construction of a gravity distribution system (Type A System)

1) Major aspects of the work in Tranokaky

(Map of Tranokaky is shown in Fig. 1 - 1, scale : 1/2,000)

- a. Construction of an elevated reservoir tank
- b. Pipe work for distribution and service pipe lines
- c. Faucet base construction and faucet installation
- d. Housing work for the generator operation and material storage
- e. Installation of a submersible motor pump in the drilled tube well, of a diesel generator in a generator house and of a water meter to the main distribution pipe
- f. Test run of all the systems

2) Materials and equipment supplied by JICA

- a. Submersible motor pump with riser pipes and other accessories Type 50NPL - 25 - 110A, 50 - 150 liter/min at a head of 200 - 70m
- b. Diesel engine generator with L.S. of spare parts
TYPE Denyo DCA - 451, 37kVa 400V/50Hz

3) Materials and equipment to be procured by the Contractor

- a. Reservoir tank and tank foundation materials
- b. Distribution pipes, fitting, valves and valve boxes
- c. Water meter to be attached to the main pipe
- d. Faucets and materials for faucet bases
- e. Materials for generator house and storage house

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4) Details of each facility materials and construction work

a. Construction of elevated reservoir tank: (Fig. A -2)

a - 1 Tank materials:

Reinforced concrete or stainless steel with painting

a - 2 Shape of the tank:

Box type or cylindrical

a - 3 Tank volume: about seventeen (17) cubic meters

- Cylindrical: 3m in diameter, 2.5m in height (17.66 m³)

- Box type: 2.6m × 2.6 × 2.6m (17.58m³)

a - 4 Height of the tank bottom:

2.5 m above ground surface

a - 5 Material for tank foundation:

Reinforced concrete, 2.3 ~ 2.5 m high above ground surface
and 0.5 ~ 1.0 m below ground surface depending on type of
foundation

b. Piping works: (Fig. A - 3)

b - 1 Pipe material:

Galvanized iron pipes and fittings

b - 2 Dimension/length of distribution/service pipes:

ø 50mm: Total length 365m

ø 30mm: Total length 30m

Total length 395m

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b - 3 Excavation, pipe laying and valve box construction:

Excavation: 30 cm wide and 40 cm deep, with total length of 395m

Valve box: 3 places close to public faucets

c. Construction of public facets and drainages: (Fig. A - 4)

c - 1 Faucet base material, number:

Reinforced concrete, three (3) places

c - 2 Type of faucet base:

1) Equipped with two (2) taps to No. 1 and No.2 base, and four (4) to No. 3

2) Washing place for every faucet base

3) No exposure of stand pipes

c - 3 Drainage channel:

More than ten (10) meters long from faucet base, with a concrete facing

d. Housing work: (Fig. A - 5)

d - 1 Materials for generator house and storage house:

The house of generator operation and fuel storage shall be built combined or independent each other near to reservoir tank by use of brick or concrete block with mortar coating, and with zinc roofing or fiber - cement roofing.

d - 2 Area of houses:

Generator house: 12 square meters (4m × 3m)

Fuel/spare parts storage house: 6 square meters (2m × 3m)

e. Pump/generator installation and others: (Fig. A - 6)

- e - 1 Pump installation in the drilled borehole (lowering down to 80 m), and proper connection with generator
- e - 2 Generator installation in the generator house, and test operation of the pump
- e - 3 Installation of water meter to the main pipe close to the reservoir tank (Fig. A - 2)
- e - 4 Test run of all the system, and repair or rearrangement if something wrong being found

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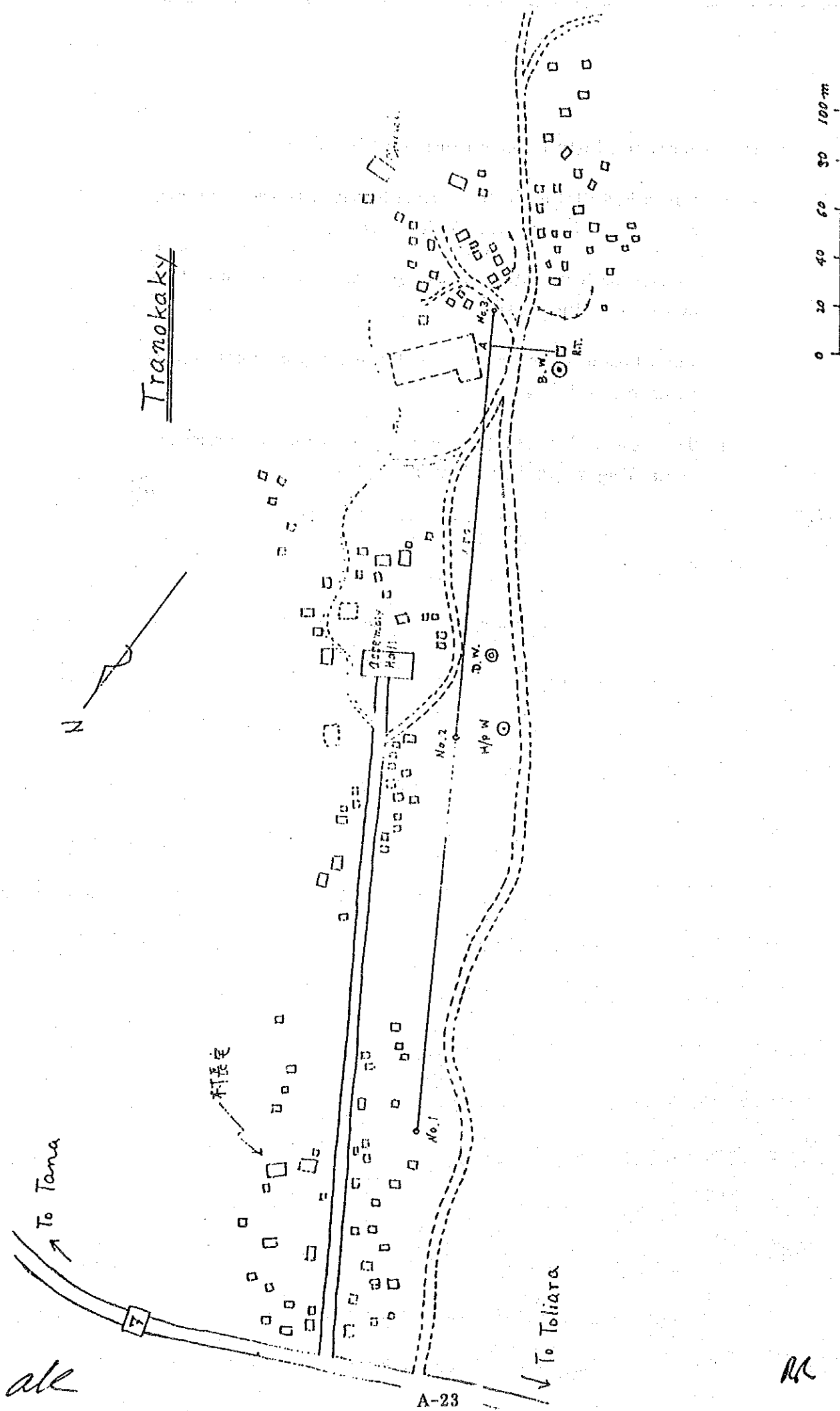
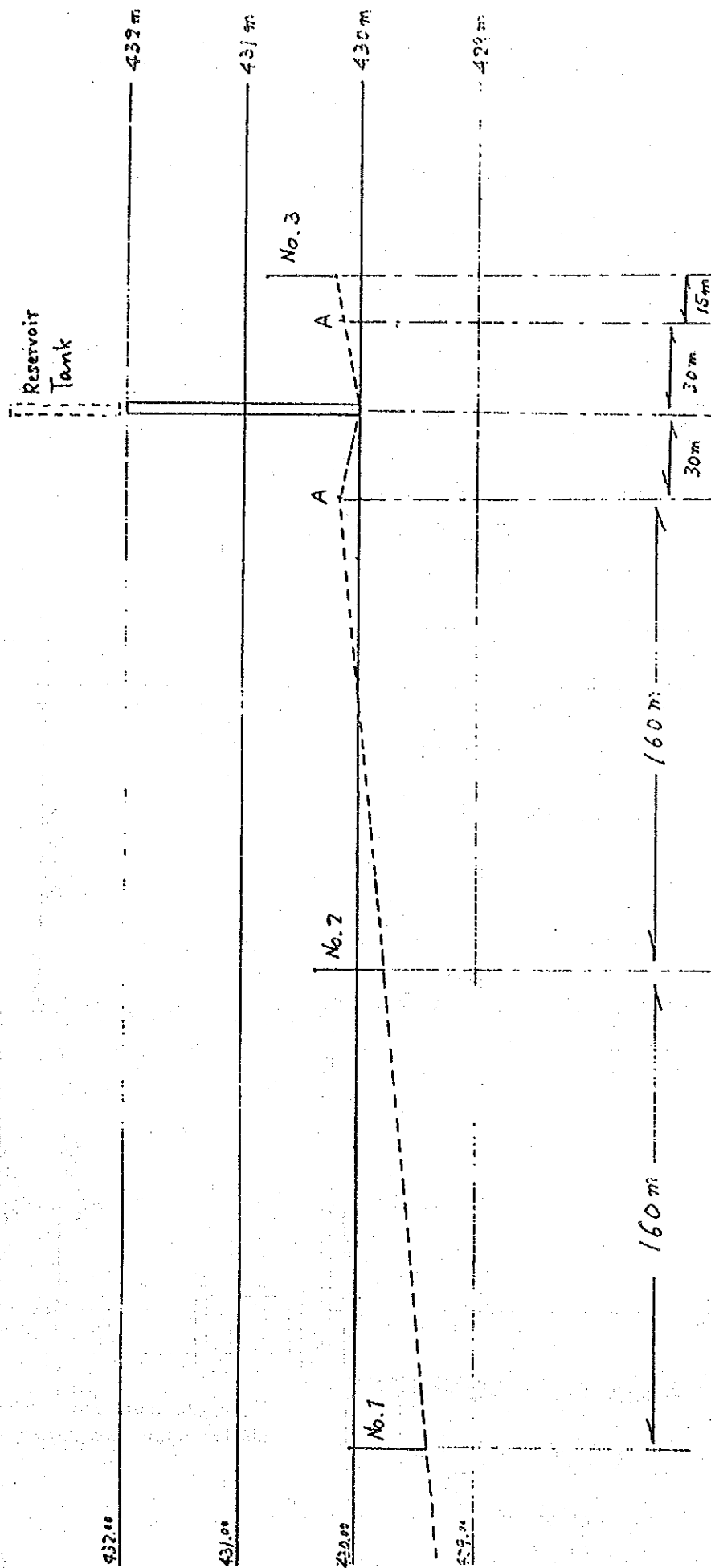


Fig. A-1-1 Plane map of Tranokaky

Scale 1:2000

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A-24

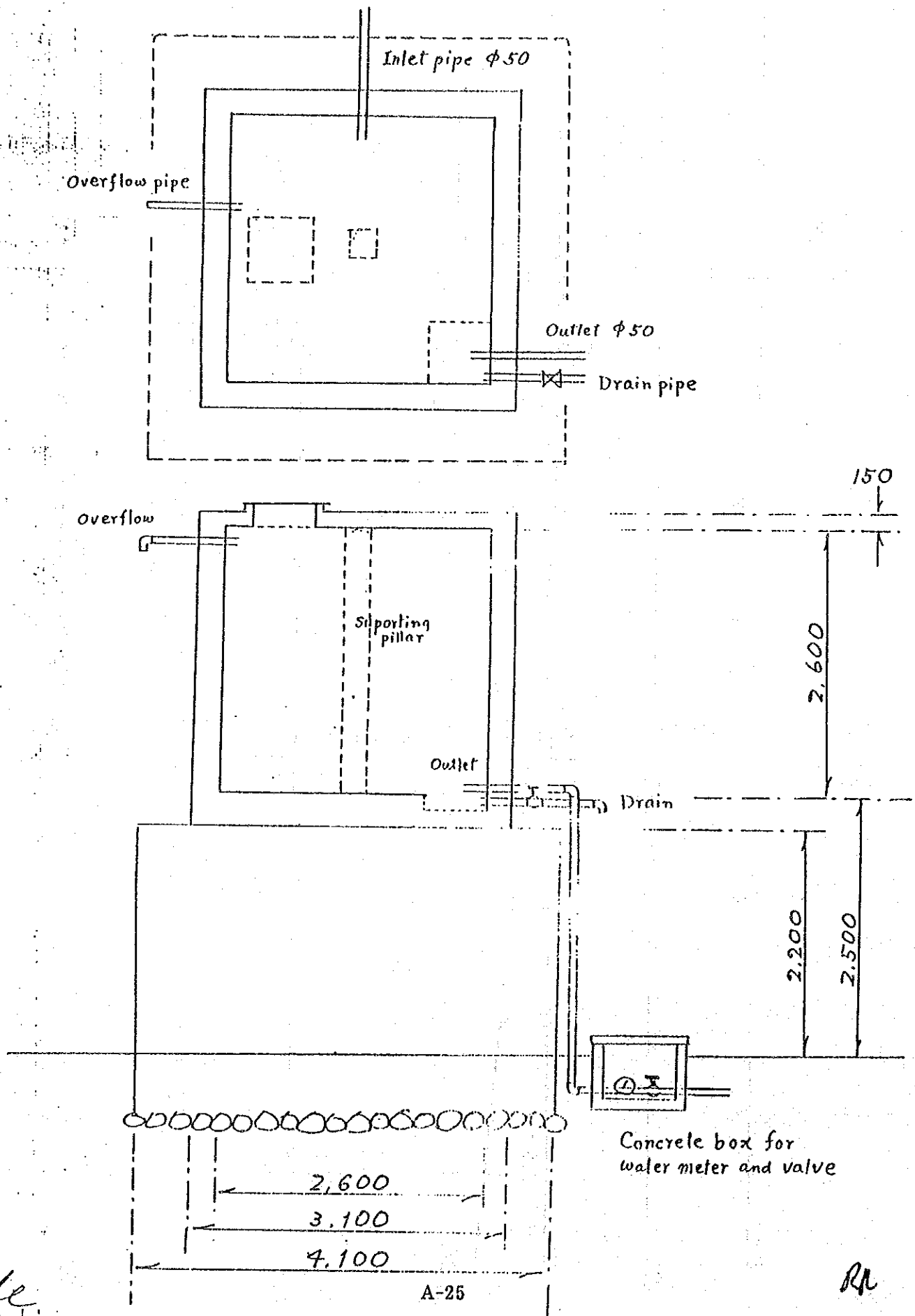
$\phi 2''$ pipe (160 + 160 + 15 + 30) Total length 365 m

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Fig. A-1-2 Cross Section along Distribution Pipeline

Box type concrete reservoir tank

Fig. A-2-1



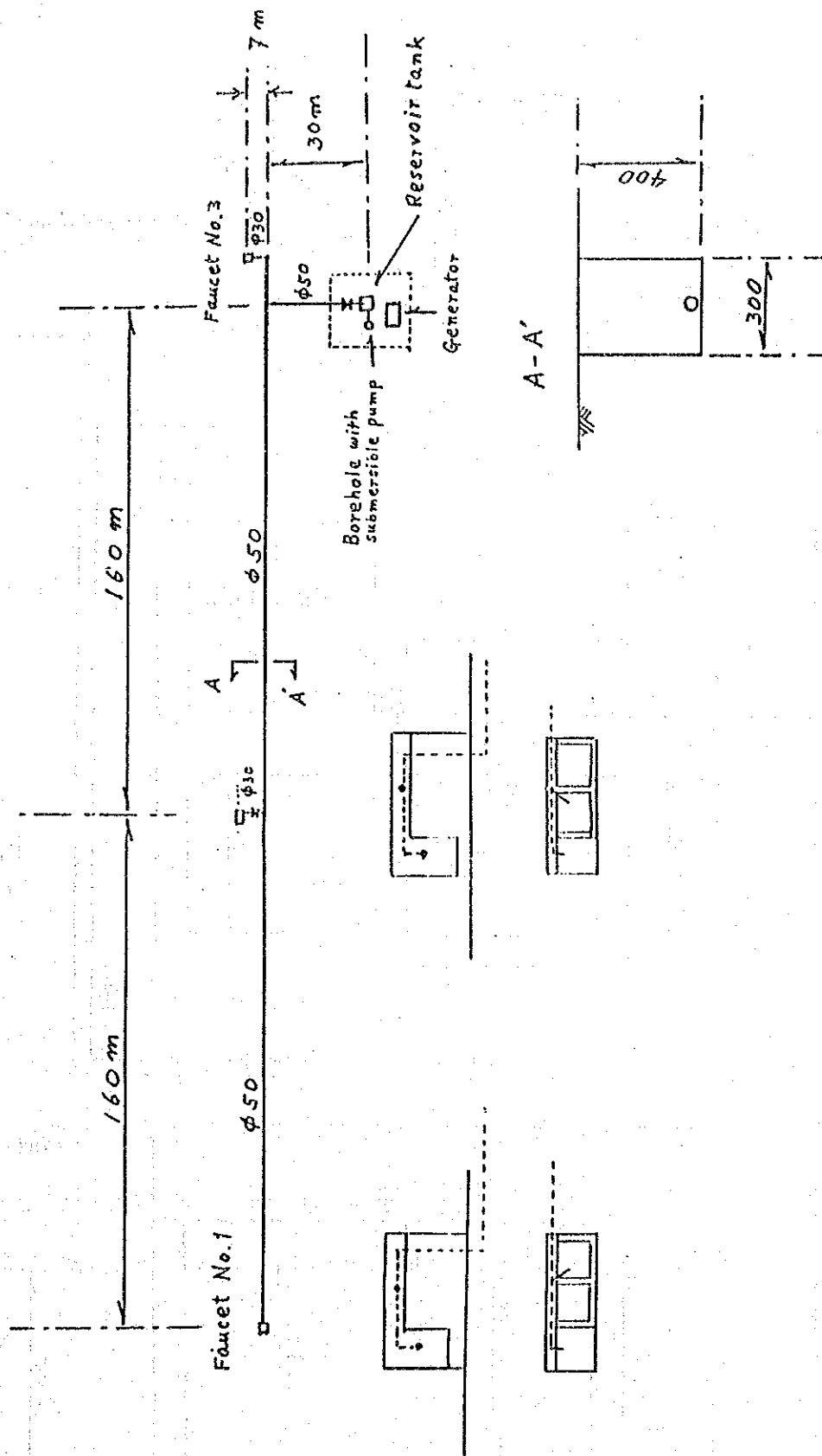
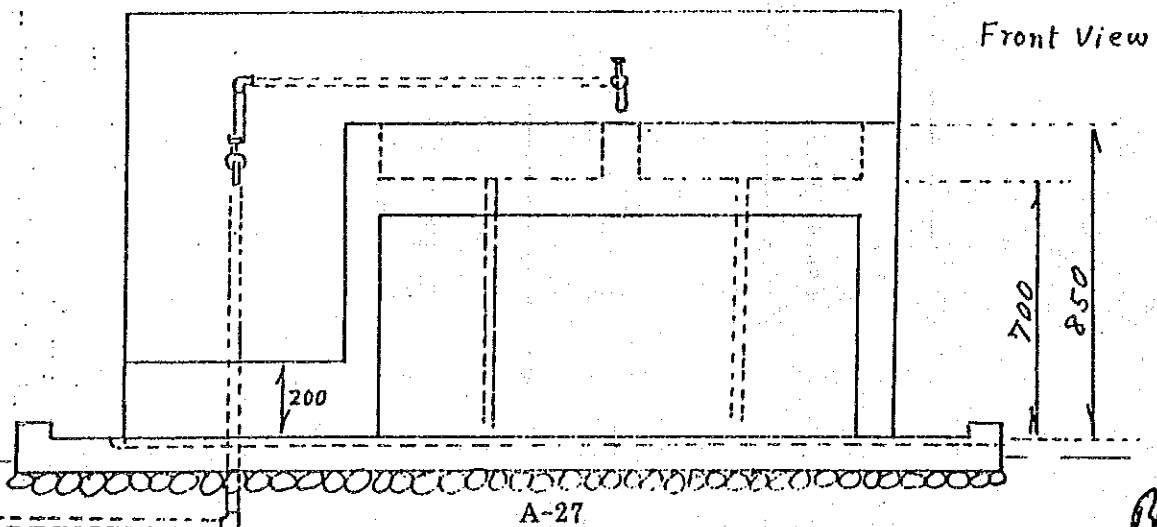
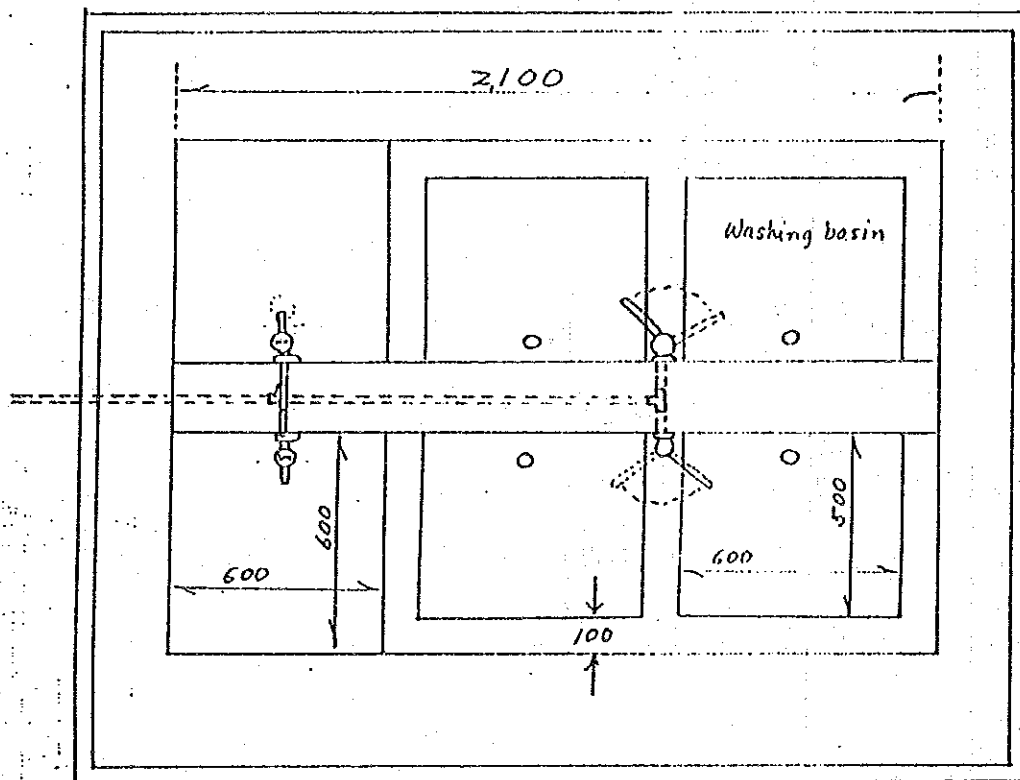
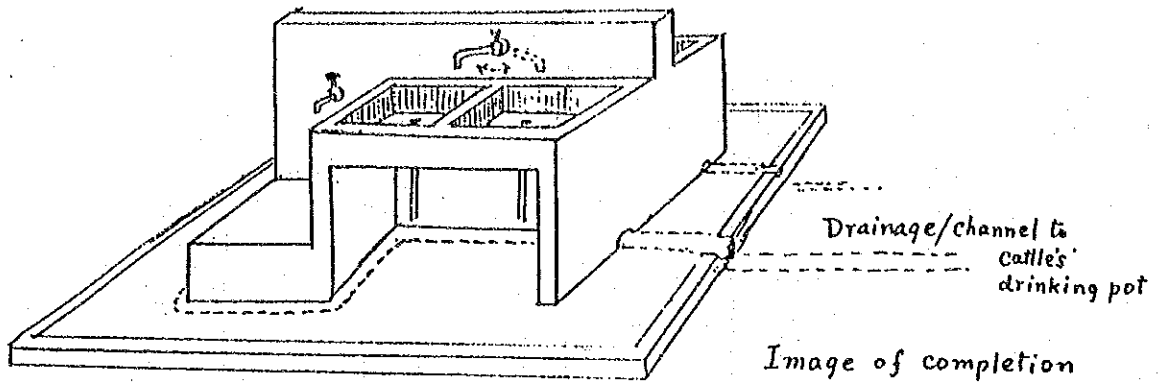
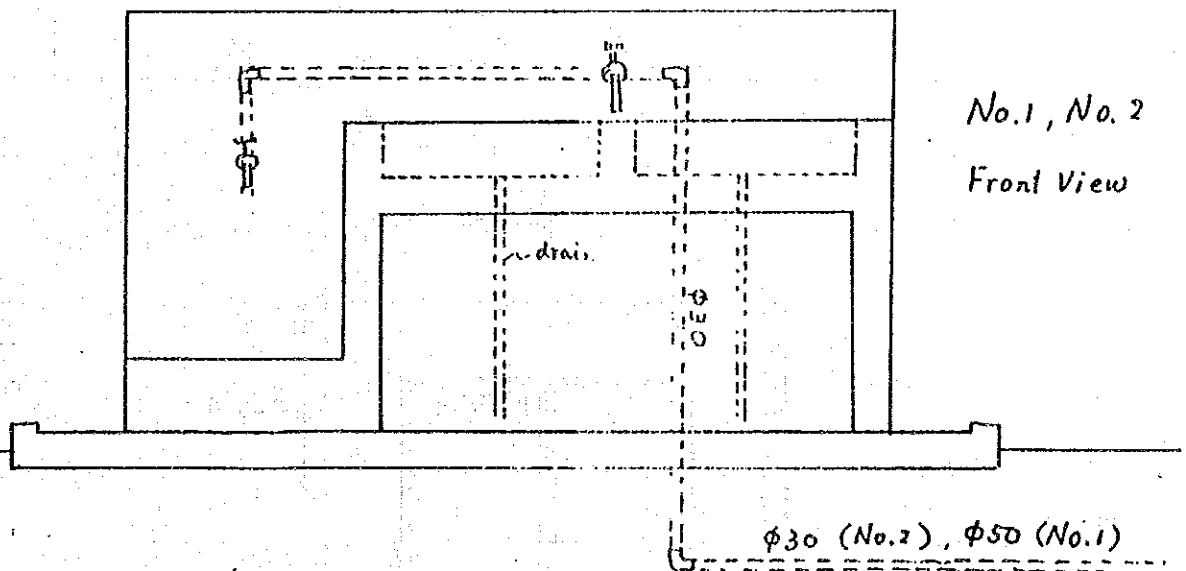
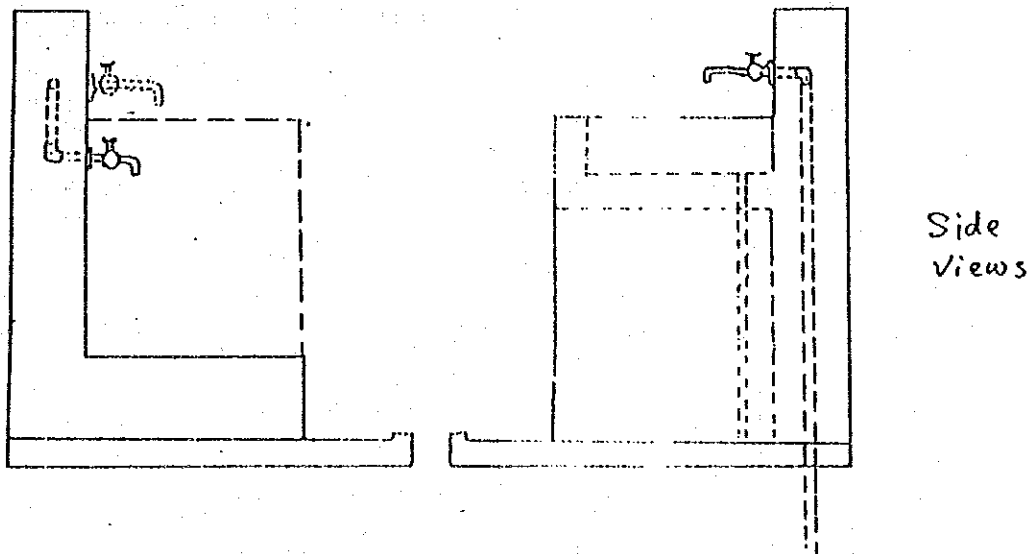
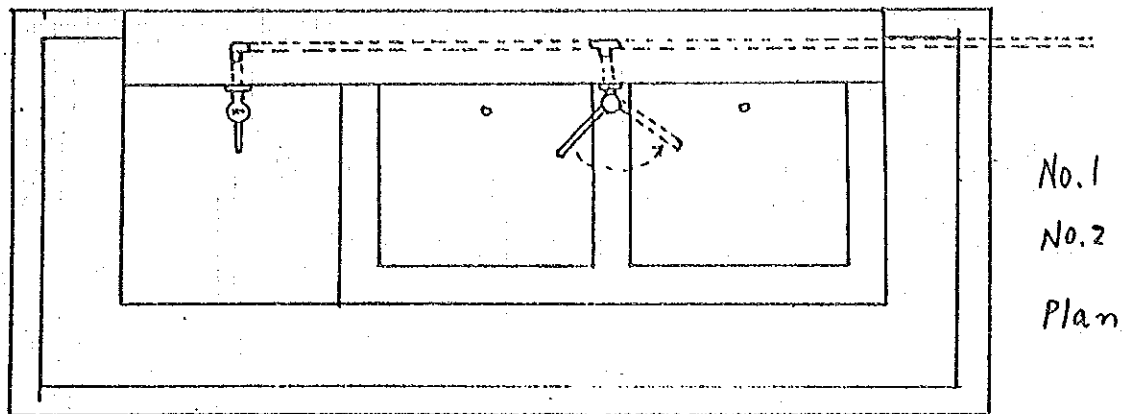


Fig. A-3 Distribution Pipeline $S = 1/2,000$

Faucet Base with Washing Basin No. 3 Faucet Fig. A-4-1



Faucet Base with Washing Basin No.1 and 2 Faucet Fig. A-4-2.



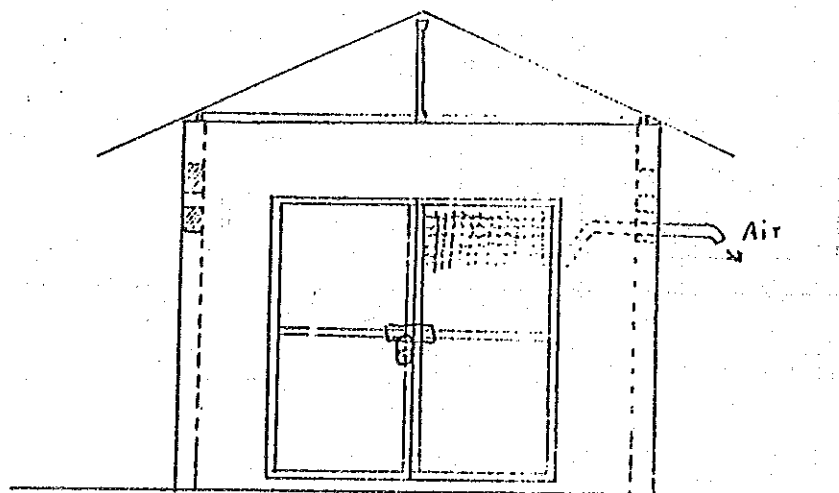
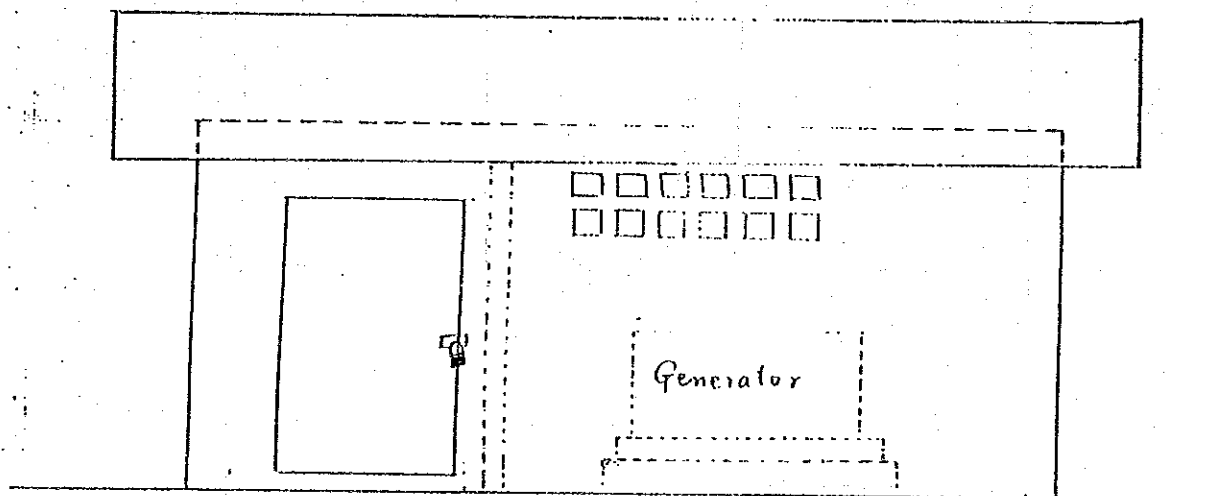
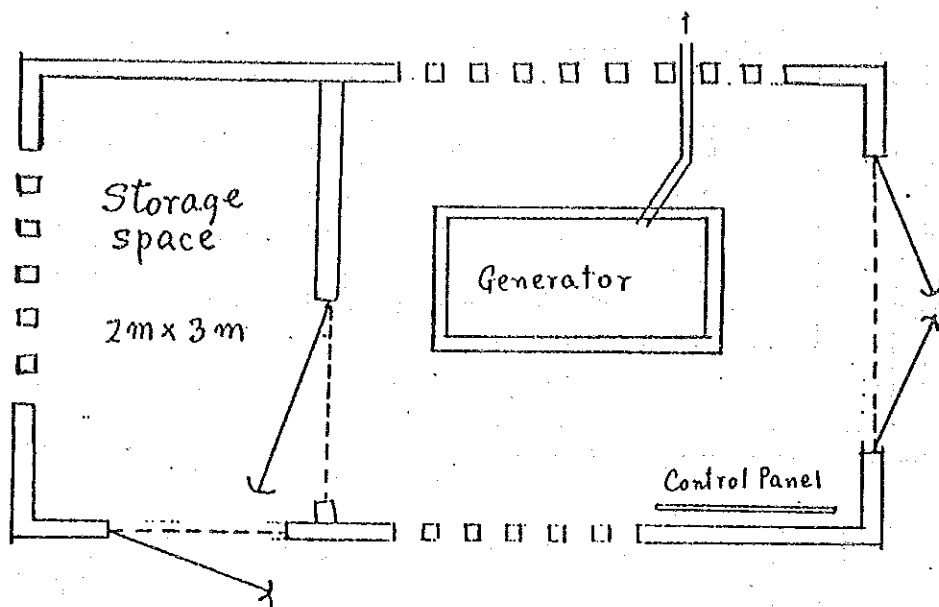
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Generator house, Storage house

Fig. A-5

$S = 1/50$

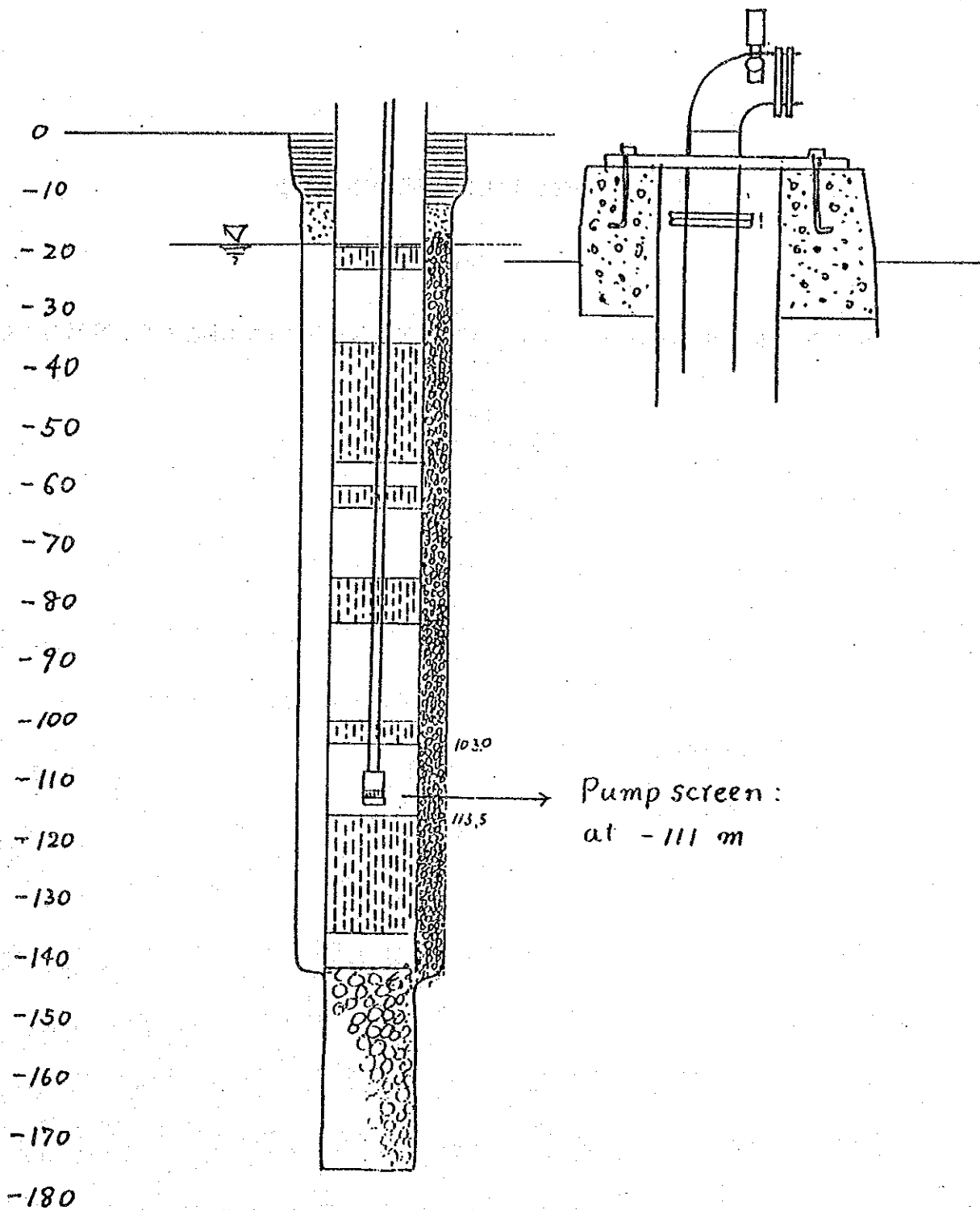


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Pump Installation (Tranokaky)


Fig. A-6



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TECHNICAL SPECIFICATION
FOR
SOLAR PUMP SYSTEM CONSTRUCTION AND REHABILITATION WORK
[Type B&D]

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GENERAL

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1) Type A system:

A semi - urban style water supply system for the middle to large - scale villages, and equipped with:

- Diesel engine generated submersible motor pump
- Generator house
- Elevated reservoir tank
- Branch type distribution pipeline, and
- Communal faucets with concrete base.

2) Type system:

One of the point source type supply system equipped with one or two communal faucet near reservoir tank, and submersible motor pump with solar generating units sand solar monitoring units.

3) Type C system:

Point source with hand pump.



Construction of the Type A System is proposed in the village of Tranokaky about 60 km north - east of Toliara. A deep well with a depth of 200 m has been constructed in this village.


The trial construction of a solar energized facility is proposed in the village of Soahazo with a population of more than 2,000.

However, since this facility is to be constructed just for the study of effectiveness of solar energy by the long - term observation, the population to be served by the facility is limited to more or less 500, and this facility is accompanied with the monitoring system for illumination power, solar generated electricity and pumpage capacity.

The hand pumps accompanied with pump platforms are to be installed to the 16 test wells which will be drilled during the study period.

All of the above mentioned construction works is to be done by the Contractor under the supervision of the Joint Study Team.

The major materials and equipment for the water supply system like submersible motor pumps, generator, hand pumps and solar generating facilities are provided by the JICA, and all of other materials and equipment are to be prepared by the Contractors.

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SCOPE OF THE WORK

(1) Construction of solar energized simple supply system in Soahazo (Type B System)

1) Major aspects of the work in Soahazo

- a. Construction of a reservoir tank near to the drilled borehole
- b. Pipe work of about 25 m from the tank to the faucet
- c. Construction of a communal faucet base
- d. Framing up of the solar generating unit and monitoring system, including fence work surrounding solar system
- e. Construction of a generator house, and installation of a diesel engine generator for spare use. (This generator is to be reserved for the season in which solar generating is not available)
- f. Test run of all the facility including test operation of both types of generating system

2) Materials and equipment supplied by JICA

a. Submersible motor pump:

SP2A - 13, 0.55KW, 200V/50Hz with riser pipes and other accessories 1 set

b. A set of solar generating system which is expected to generate 800 ~ 900 Wp (200V/50Hz), consisting of:

b - 1 18 panels of photovoltaic cells with array frame

b - 2 Inverter

b - 3 Connecting parts and spare parts

c. A set of monitoring system for solar generating, consisting of data logger, flow meter, actinometer, storage battery, charger, solar panel and casing box.

d. Diesel engine generator and control panel



DENYO DCR - 6F SSII, 5.5KVA, 200V/50HZ

3) Materials and equipment to be prepared by the Contractor

- a. Reservoir tank and tank foundation materials
- b. Distribution pipes and fittings
- c. Water meter, valve and the material for meter and valve box
- d. Faucets and materials for faucet base
- e. Materials for foundation of solar panel
- f. Fence materials
- g. Materials for generator house

4) Details of materials and construction works

a. Construction of elevated reservoir Tank: (Fig. B- 2)

a - 1 Tank materials:

Reinforced concrete or stainless steel with painting

a - 2 Shape of the tank:

Box type or cylindrical

a - 3 Tank volume: about 10 cubic meters

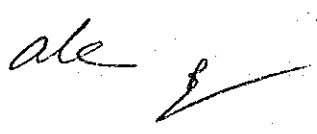
- Box: 2.5m (L) 2.5m (w) × 1.7m (H) (10.6M³)
- Cylindrical: 2.6m (diameter) × 2.0m(H) (10.6M³)

a - 4 Height of the tank bottom:

1.2m above ground surface

a - 5 Material for tank foundation:

Reinforced concrete, 1.1 ~ 1.2 m high above ground surface
and 0.4m below ground surface



b. Piping works (Fig. B -1)

b - 1 Pipe material:

Galvanized iron pipes and fittings

b - 2 Dimension/total length of the pipe:

ø 50 mm: Total length 25 m

B - 3 Excavation, pipe laying and valve/meter installation:

Excavation: 30 cm wide and 40 cm deep, with total length of about 25 m

valve meter installation: The valve and water meter shall be installed in one box close to the foot of the tank

c. Construction of public faucet base: (Fig. B - 3)

One (1) faucet base equipped with two (2) faucets is to be constructed about 25 m apart from the tank

c - 1 Faucet base material, number:

Reinforced concrete, 1 place

c - 2 Type of faucet base:

Equipped with draining/washing faucet floor, and no exposure of stand pipes

c - 3 Drainage channel:

More than ten (10) meters long from faucet base, with a concrete lining

d. Installation of solar generating system: (Fig. B - 4)

d - 1 Foundation work for solar panel frame:

Fifty (50) cm excavation and reinforced concrete footing in two lines, and the pillars (50 cm (H) × 30 cm (W) × 30 cm (L)) with anchor bolt at the interval of about 2.4m



d - 2 Framework of solar panel array and line connection:

In accordance with the special instruction manual, and also by referring to the existing solar panel used for translation base near Befoly or Tranokaky

d - 3 Framework of monitoring system:

In accordance with the special instruction manual

d - 4 Fence work: (Fig. B - 1)

The solar array and the monitoring system shall be surrounded by barbed wire fence with a lock and key entrance
Height of fence: 1, 8m, Interval of poles: 2m Interval of b - wire: 25 cm

e. Housing work: (Fig. B - 5)

A generator house involving the space for fuel storage and for the monitoring unit installation shall be built near the reservoir tank, and the generator for reserved and the control panel shall be installed in it.

e - 1 Materials for housing:

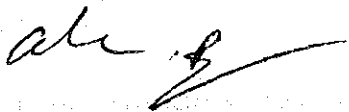
Brick or concrete block with zinc roofing or fiber cement roofing

e - 2 Area of houses:

Fifteen (15) square meters (3m × 5 m)

f. Test run of all the system:

Completion of the works will be certified by the JICA Team after the successful test run of all the facility.



(2) Rehabilitation of existing water supply system in Befandriana (Type D construction)

1) Major aspects of the work in Befandriana

- a. Construction of public faucet base with plural numbers of faucet
- b. Reinstallation of pump and power
- c. Construction of pump house
- d. Pipe works from existing tank to the faucet
- e. Tank cleaning and change of main/drain valve
- f. Test run of all facility

2) Materials and equipment supplied by JICA

a. Submersible motor pump

Nihon PLOIGER 65NPL - 5 - 37A, 3.7KW, 400V/50Hz with
riser pipes and other accessories/spare parts 1 set

b. Diesel engine generator

Denyo DCA - 15PK, 12,5KVA, 400V/50Hz 1 set

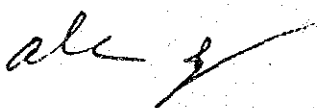
c. Control panel

3) Materials and equipment to be prepared by the Contractor

- a. Distribution pipes, fittings and valves
- b. Faucet base materials and faucets
- c. Materials for generator/storage house
- d. Fuel for test run

4) Details of materials and construction works

- a. Construction of faucet base and piping work from the existing reservoir tank



- One (1) faucet base equipped with four (4) faucets is to be constructed within a distance of 20 m from the tank

a - 1 Faucet base material: Reinforced concrete

a - 2 Type of faucet base: (See Fig. D - 1)

- Equipped with 2 faucets each at front and back
- Different height rack of front and back
- Drainage channel surrounding faucet base

a - 3 Dimension and material of the pipe

2" in diameter, galvanized iron pipe

a - 4 - Pipe laying

- Excavation: 40 cm deep, 30cm wide
- Total length: About 20m

b. Pump house construction

b - 1 Material of the house: Wood or brick

b - 2 Type of the house

In addition to the generator base, the space for fuel storage and the shelf or rack for generator/pump spare parts shall be prepared. The door with lock and key and ventilation window shall be equipped.

b - 3 Area of the house: 12m^2 ($3\text{m} \times 4\text{m}$)

c. The work of tank related

c - 1 Cleaning of the tank

c - 2 Valve installation to the drain pipe, and to the outlet pipe at the foot of the tank

alc 

c - 3 Countermeasure by sealing or welding if leakage is found
(Owner's welding equipment can be used)

d. Pump/Generator installation and test run

d - 1 Installation of the new submersible motor pump: The pump shall be installed at a depth of JICA Team's instruction (Owner's tripod can be used when lowering of the pump)

d - 2 Generator and control panel installation in the pump house

d - 3 Test run of the all the facility

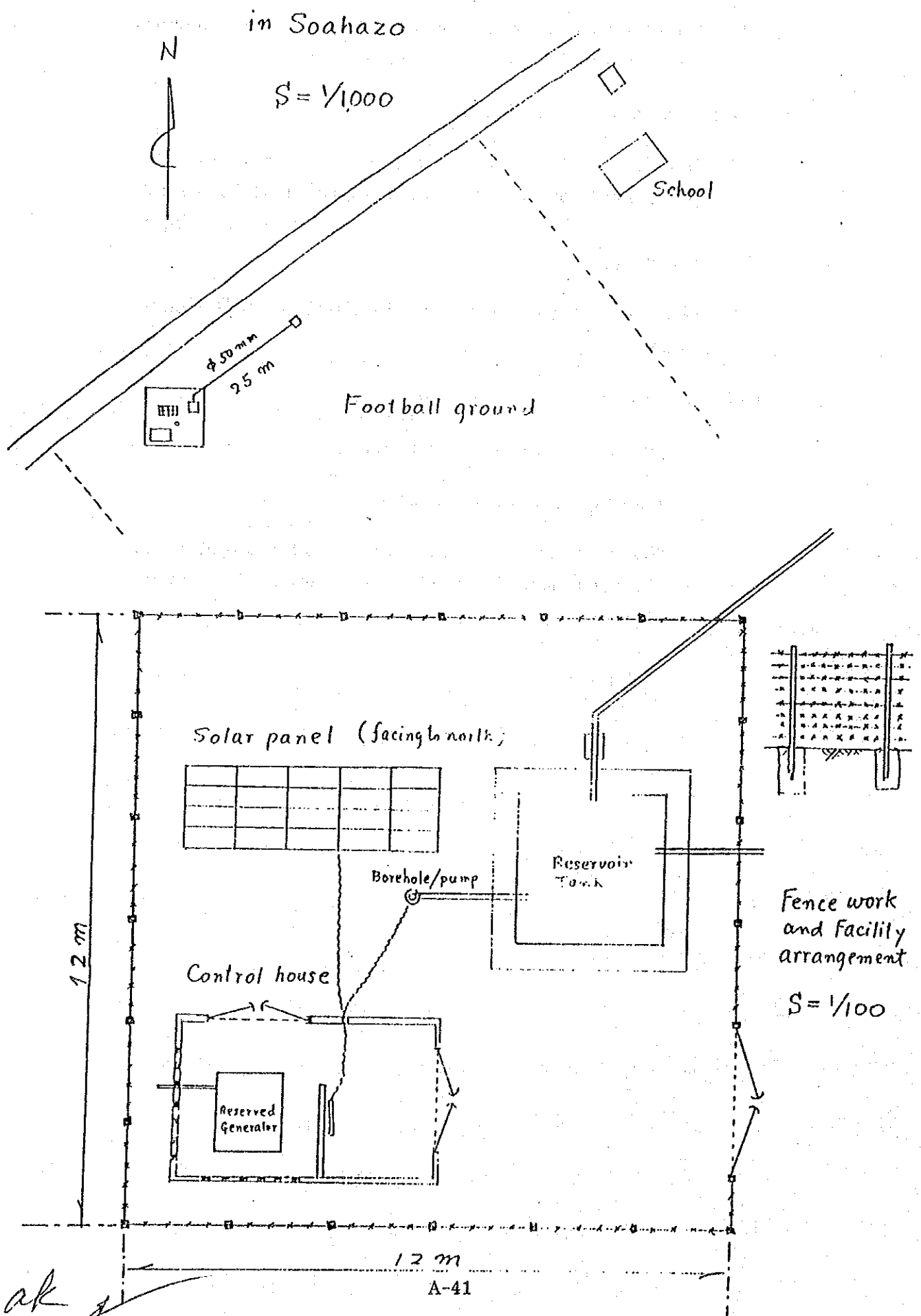
- Duration: More than 6 hours
- Fuel supply by the Contractor:

The 2 (two) full drum cans (about 400 liters) of gas oil shall be procured by the Contractor for the test run and storage

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Plan of the Type B System

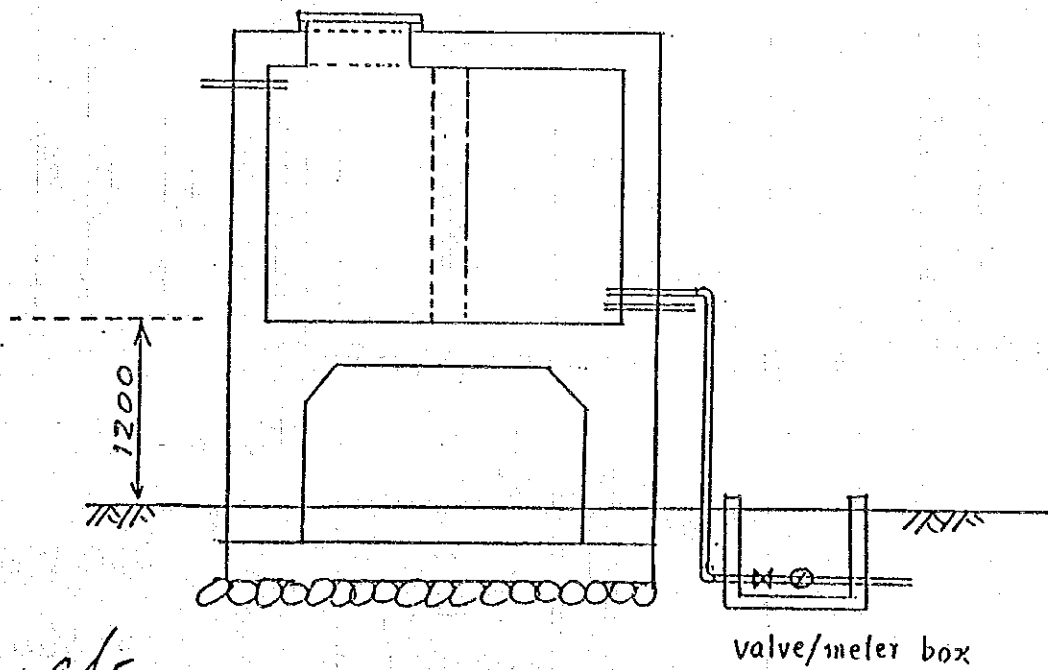
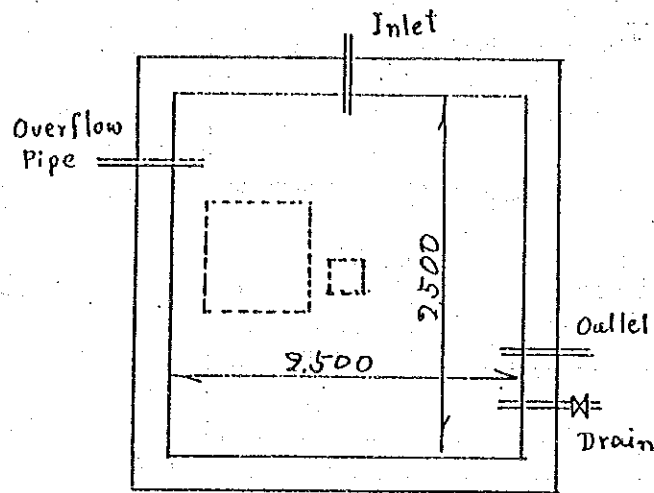
Fig. B-1



Reservoir Tank for Type B System

Fig. B-2

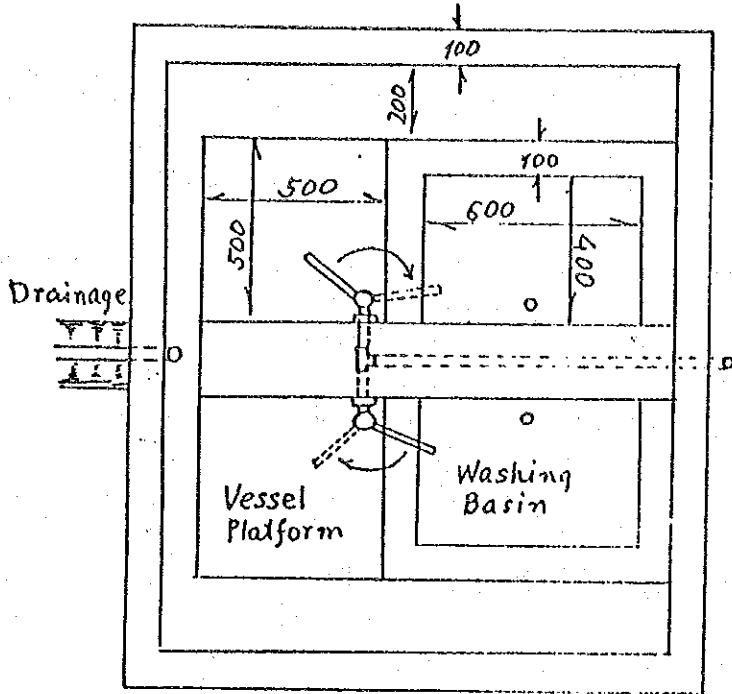
$$S = 1/50$$



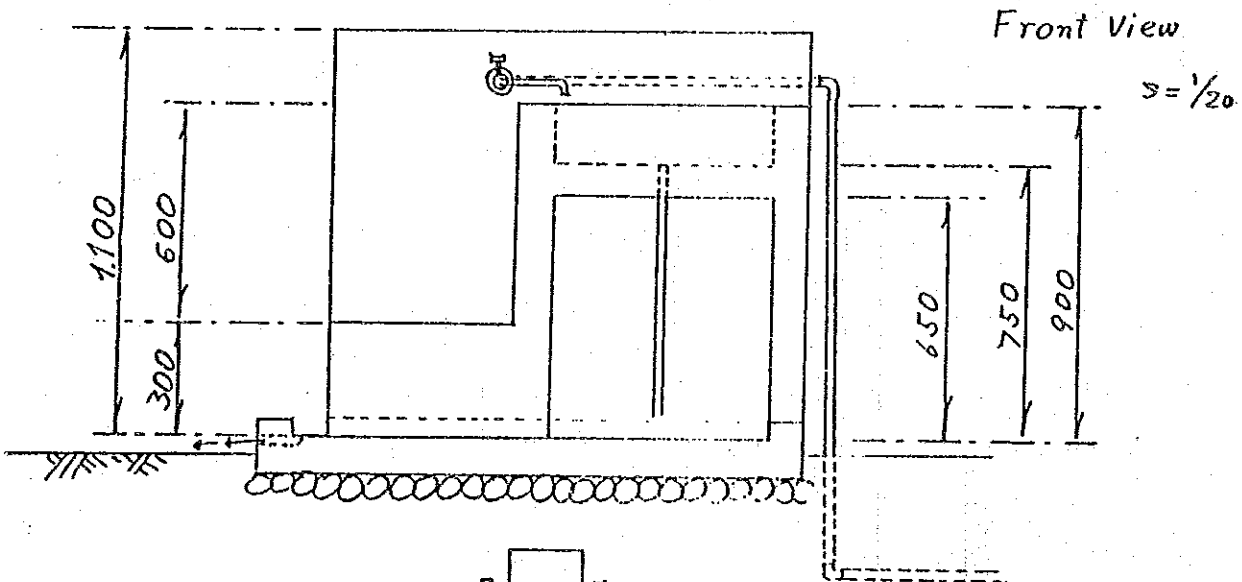
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Faucet Base in Type B System

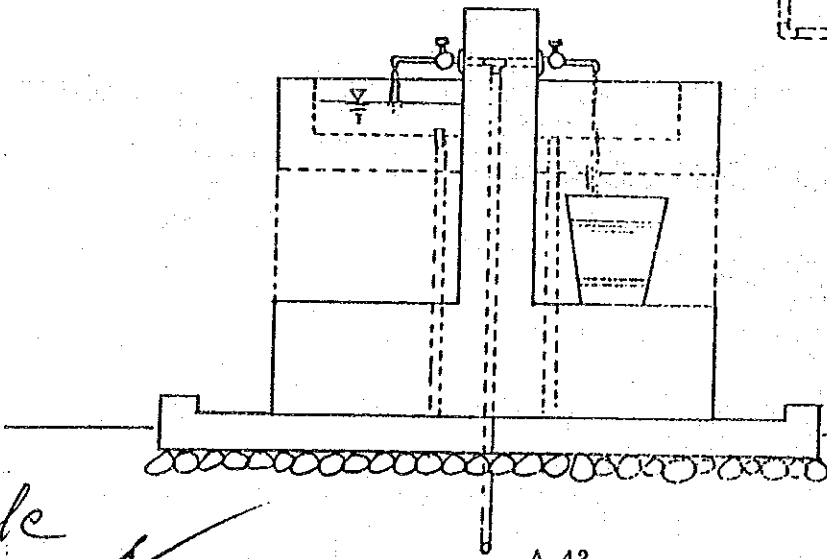
Fig. B-3



Plan

$$S = 1/20$$


Front View

$$s = \frac{1}{20}$$


Side View

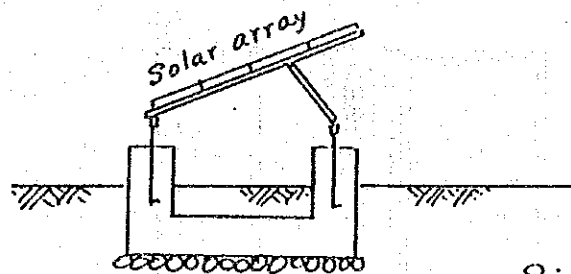
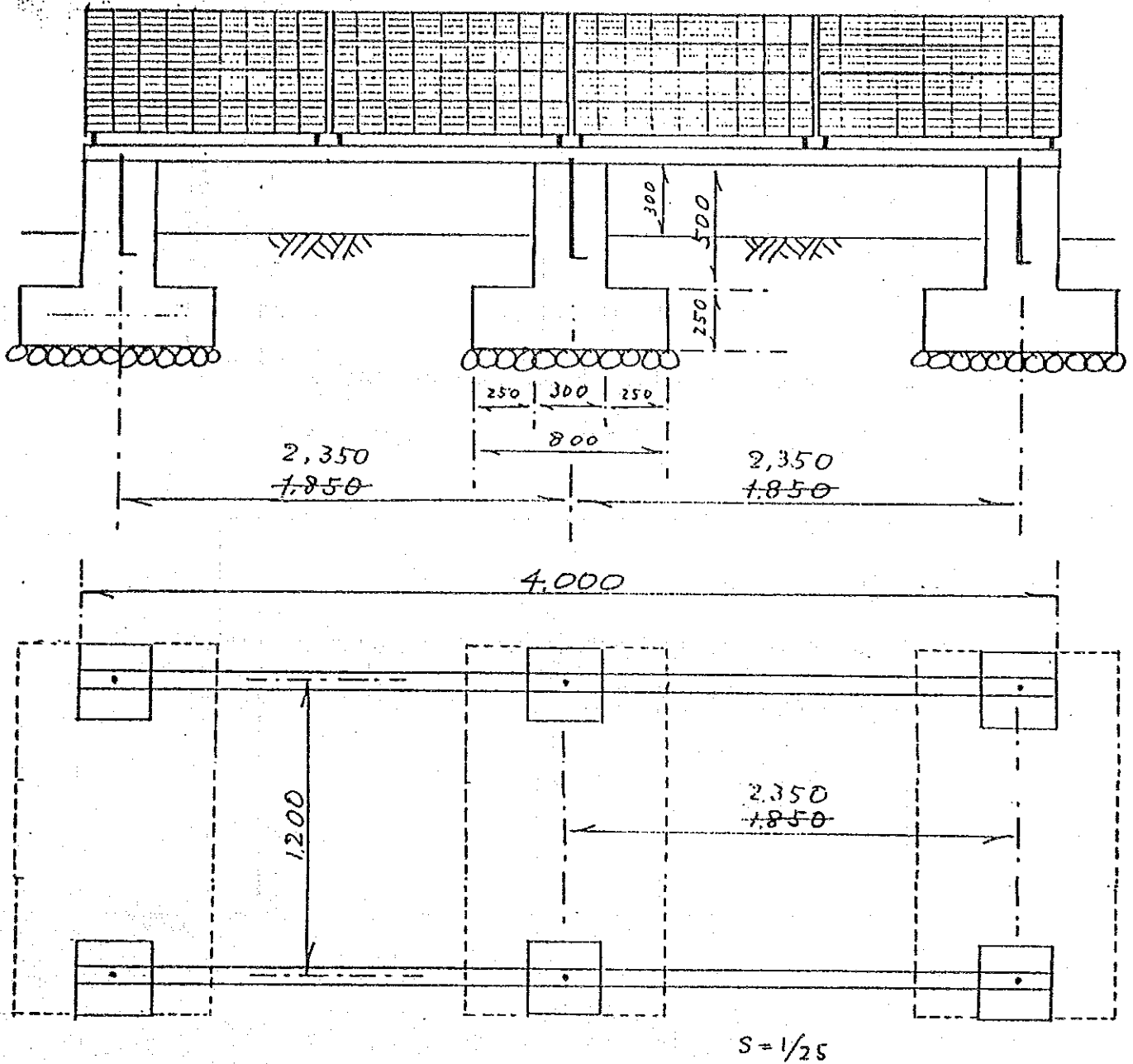
$$S = 1/20$$

A-43

Installation of solar generating system Fig. B-4

Foundation for solar array frame

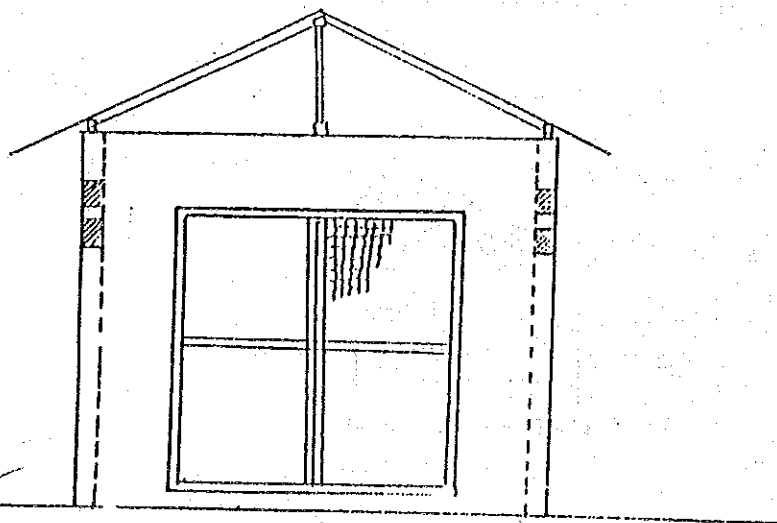
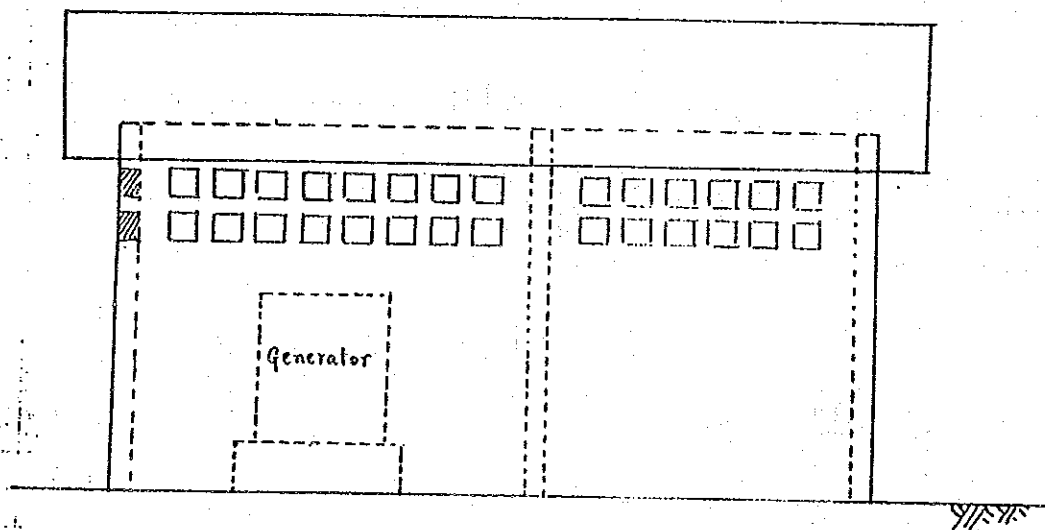
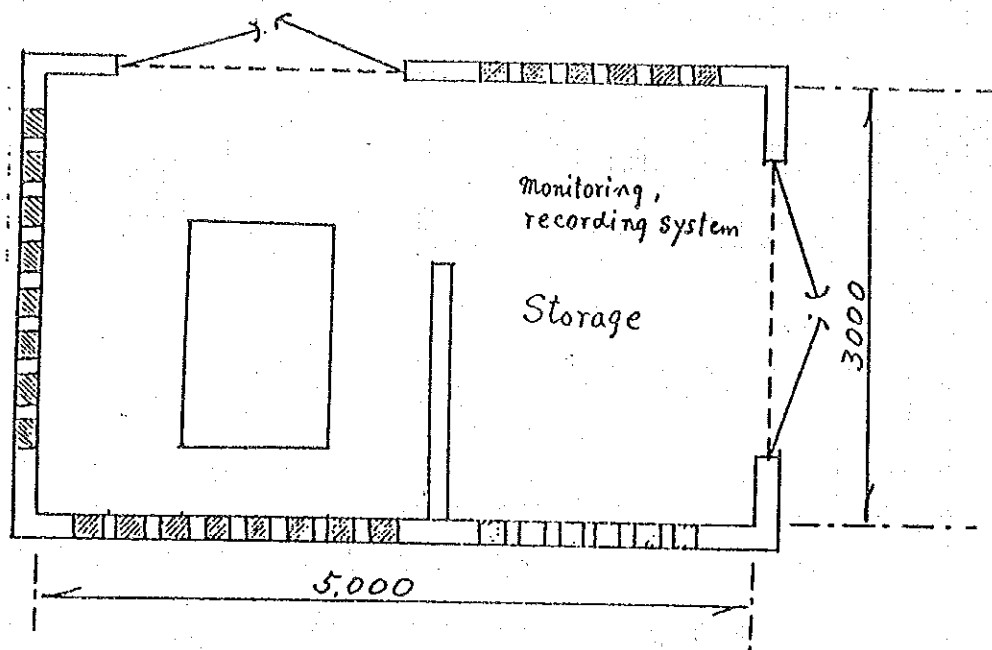
$$S = 1/25$$



Side view $S = 1/50$

Generator/Storage House

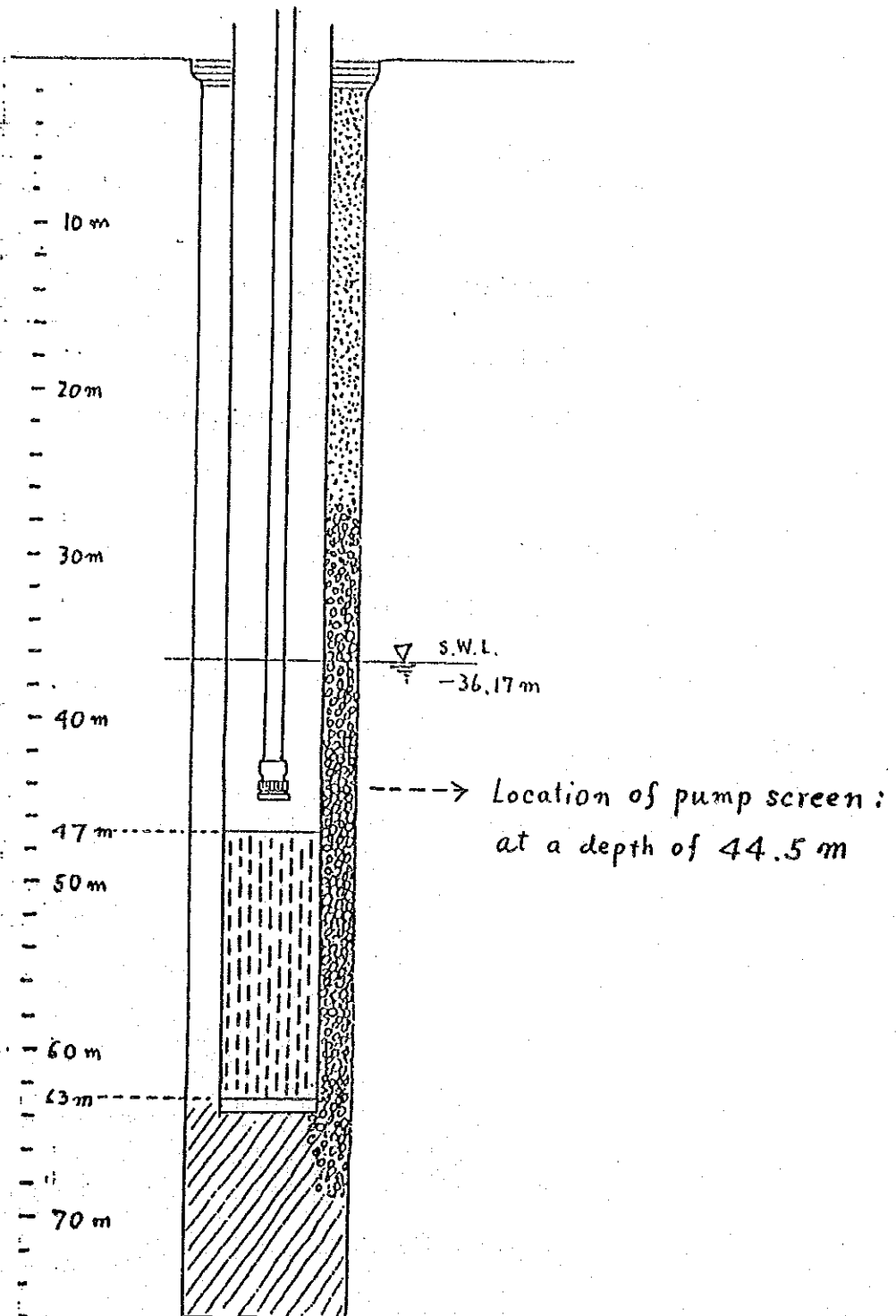
Fig. B-5



A-45

Pump Installation (Soahazo)

Fig. B-6



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**TECHNICAL SPECIFICATION
FOR
PUMP BASE CONSTRUCTION AND
HAND PUMP INSTALLATION
TO THE DRILLED TEST WELLS**

[Type C]

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GENERAL

This specification has been prepared by the JICA Study Team for the construction of "the model water supply system", which are contained within "The Groundwater Development Study in South - Western Region of Madagascar", undertaken by the joint Study Team of "the Ministry of Industry, Energy and Mine (MIEM)" and "the Japan International Cooperation Agency (JICA)".

Among four (4) types of model/trial construction proposed, following three (3) types of the groundwater sourced water supply system are proposed for the models of rural water supply in this Study Area; The forth type (D) is the works of rehabilitation of the existing water supply system.

1) Type A system:

A semi - urban style water supply system for the middle to large - scale villages, and equipped with:

- Diesel engine generated submersible motor pump
- Generator house
- Elevated reservoir tank
- Branch type distribution pipeline, and
- Communal faucets with concrete base.

2) Type system:

One of the point source type supply system equipped with one or two communal faucet near reservoir tank, and submersible motor pump with solar generating units sand solar monitoring units.

3) Type C system:

Point source with hand pump.

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Construction of the Type A System is proposed in the village of Tranokaky about 60 km north - east of Toliara. A deep well with a depth of 200 m has been constructed in this village.

The trial construction of a solar energized facility is proposed in the village of Soahazo with a population of more than 2,000.

However, since this facility is to be constructed just for the study of effectiveness of solar energy by the long - term observation, the population to be served by the facility is limited to more or less 500, and this facility is accompanied with the monitoring system for illumination power, solar generated electricity and pumpage capacity.

The hand pumps accompanied with pump platforms are to be installed to the 16 test wells which will be drilled during the study period.

All of the above mentioned construction works is to be done by the Contractor under the supervision of the Joint Study Team.

The major materials and equipment for the water supply system like submersible motor pumps, generator, hand pumps and solar generating facilities are provided by the JICA, and all of other materials and equipment are to be prepared by the Contractors.

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SCOPE OF THE WORK

Construction of the pump bases and installation of hand pumps at sixteen (16) numbers of drilled test well (Type C System)

During this Groundwater Development Study, 25 numbers of test wells will be drilled in order to identify the geological composition and hydrogeological characteristics of the Study Area at the location shown in attached Survey Area Map.

Among these boreholes, the sixteen numbers are to be selected for installation of had pumps:

Since the number of the wells with higher water level than 40 m BGS is unknown as of now, the initial contract cost will be provisionally fixed for sixteen sites. The final contract cost will vary in accordance with the final number of the site.

1) Major aspects of the work

- a. Arrangement of transportation to the different place in accordance with the drilling schedule
- b. Construction of pump base and installation of hand pump
- c. Drainage construction

2) Materials and equipment supplied by JICA

- a. Two (2) sets of 30 m head hand pump with spare parts
- b. Three (3) sets of 50 m head hand pump with spare parts

3) Materials and equipment to be prepared by the Contractor

- a. Eleven (11) sets of the deep - well hand pumps with an average length of rods of 35m
- b. Reinforcing bars (ϕ 8mm), concrete materials and framing board
- c. Tripod or other instrument for lowering of pump cylinder and rods

4) Details of hand pump construction work

a. Pump base construction: (Fig. C - 1)

a - 1 Removal of temporary protection casing and surface soil, and fixing of pump body by concreting:

a - 2 Concrete platform construction:

Width: 1.5m, Length: 2.0m, reinforced concrete, with 2 to 5cm high edge and drainage hole

a - 3 Lowering of the cylinder and rods to a depth individually specified, and finalize the pump:

b. Construction of drainage channel:

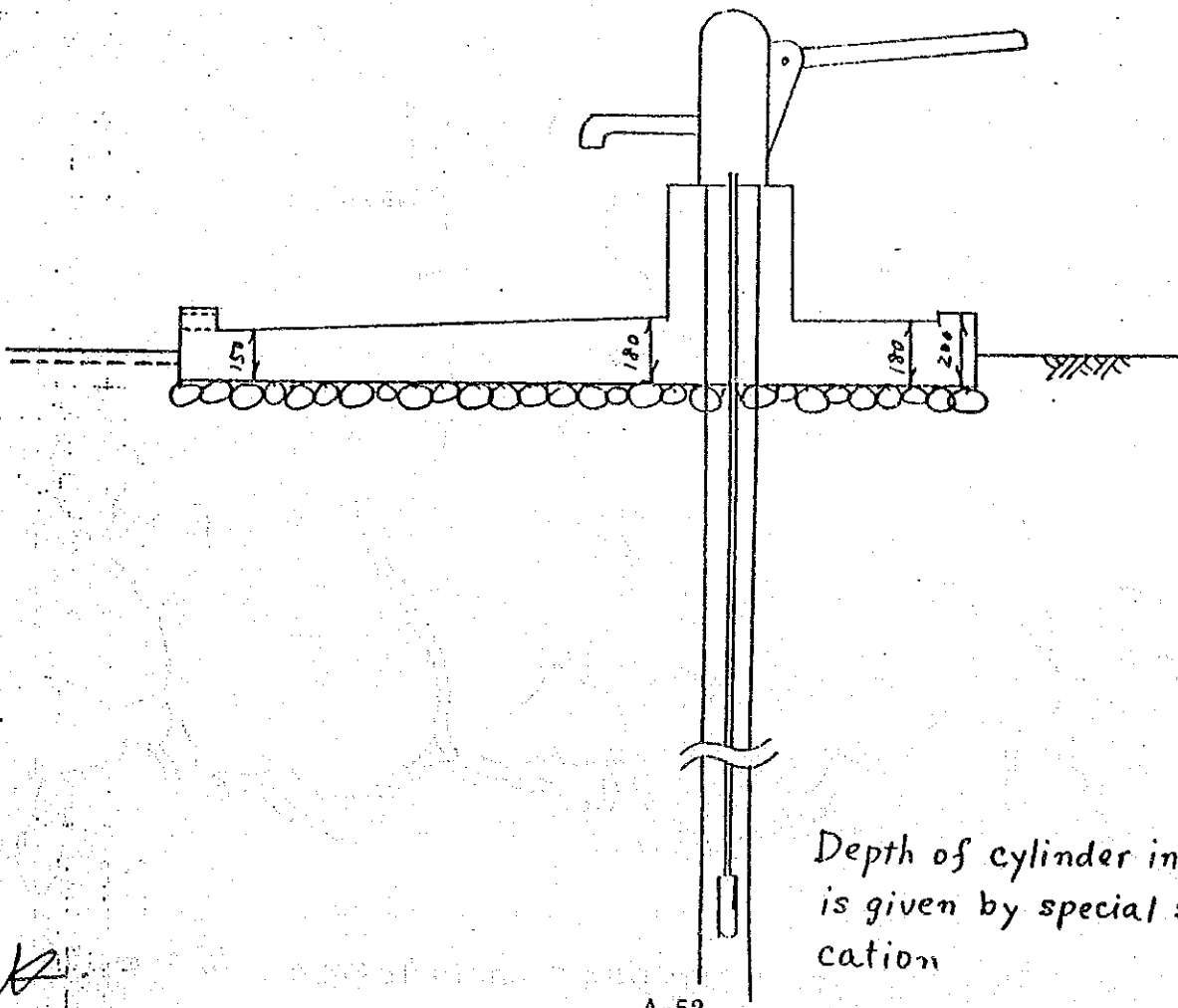
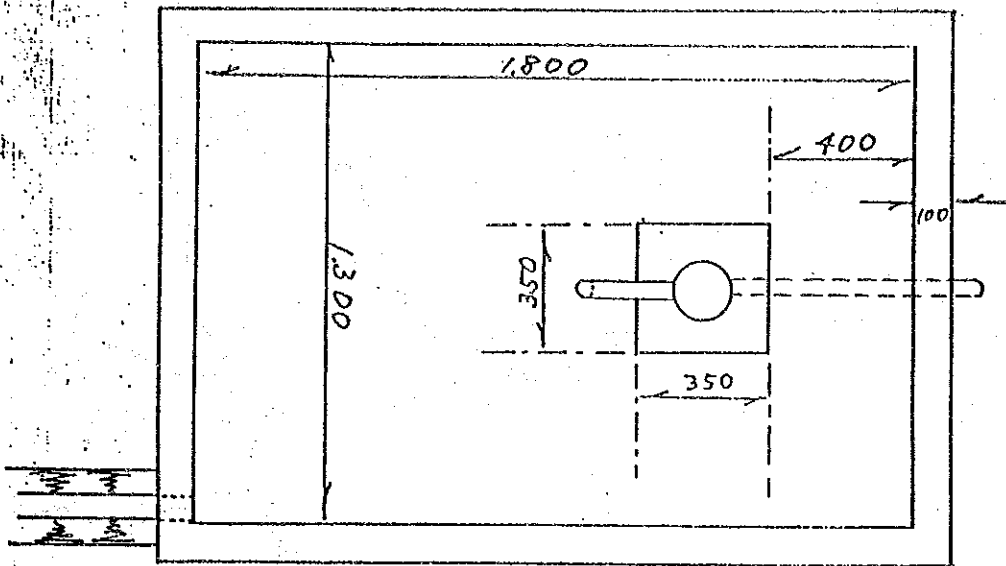
More than 10 m long drainage channel shall be extended to the lower portion with cement coating

ab.

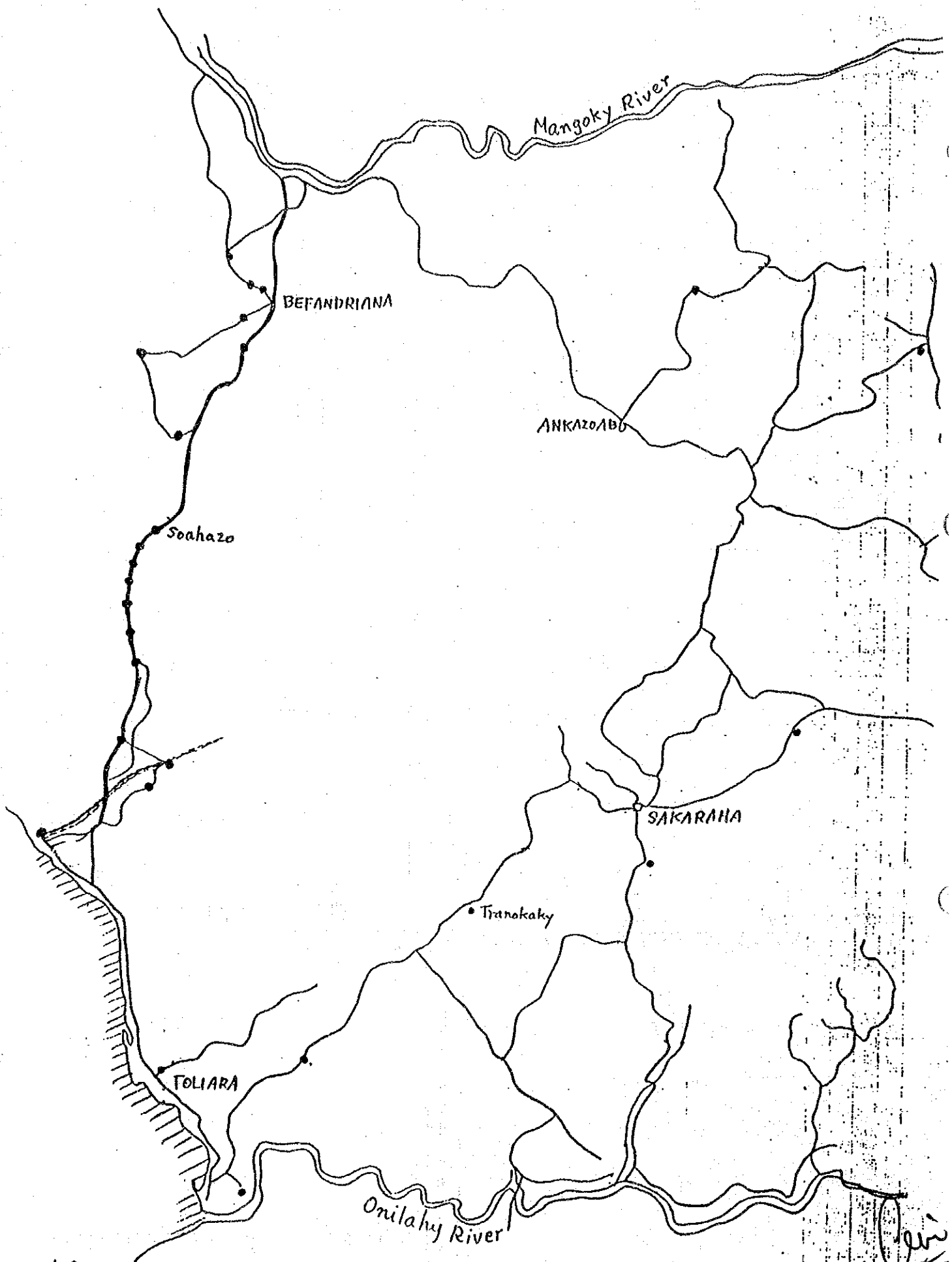
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Hand-pump Installation

Fig. C-1



Depth of cylinder installation
is given by special speci-
fication



Location map for Hand pump installation

16 among 26

A-53

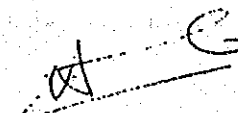
APPENDIX (7)
SCOPE OF WORK

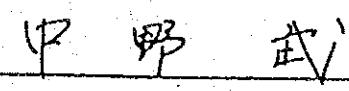
Appendix A

SCOPE OF WORK
FOR
GROUNDWATER DEVELOPMENT STUDY
IN
SOUTH-WESTERN REGION
OF
THE DEMOCRATIC REPUBLIC OF MADAGASCAR

AGREED UPON BETWEEN
THE MINISTRY OF INDUSTRIES, ENERGY AND MINES
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Antananarivo, May 29, 1989


Mr. RAKOTONDRAINIBE Jean Herivelo
Directeur de l'Energie et de l'Eau
pour le Ministre de l'Industrie,
de l'Energie et des Mines (M.I.E.M.)


Mr. Takeshi NAKANO
Leader, Japanese Preliminary
Survey Team, Japan Inter-
national Cooperation Agency
(J.I.C.A.)

I. INTRODUCTION

In response to the official request of the Government of Democratic Republic of Madagascar, the Government of Japan decided to conduct the Groundwater Development Study in the South-Western Region of Madagascar (hereinafter referred to as "the Study" in accordance with the relevant laws and regulations in force in Japan.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the ^{official} agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Democratic Republic of Madagascar.

The Ministry of Industries, Energy and Mines (hereinafter referred to as "MIEM"), shall act as counterpart agency to the Japanese study team and also as a coordinating body in relation with other relevant organizations for the smooth implementation of the Study.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

- (1) to evaluate groundwater potential in Study area.
- (2) to formulate groundwater development plan in priority areas.
- (3) to pursue technology transfer to counterpart personnel in the course of the Study.

III. SCOPE OF THE STUDY

1. Study Area

The Study will cover the area between Mangoky River and Onilahy River of South-Western Region in the Democratic Republic of Madagascar.

2. Study Framework

The Study comprises following three (3) phases:

Phase I: Preliminary Analysis and Field Reconnaissance

The Study in this phase shall comprise a review and analysis of existing studies and data, and analysis of satellite image and aerial photos as well as conduct of the first field survey for the Study area

The results of survey and analysis mentioned above shall be lead up to revise hydrogeological map and to identify potential areas for the ground water development

Phase II: Analysis and Evaluation on Groundwater Resource Potential

This phase shall comprise conduct of the second field survey including geological survey, ground water leveling, water quality analysis, geophysical survey, test drilling and pumping test, for the evaluation of groundwater resource potential and selection of priority areas for rural water supply development

Phase III: Formulation of Rural Water Supply Development

This phase shall comprise project formulation of rural water supply in the priority areas from the socio economic, technical and institutional aspects

3. Study Item

3-1 Phase 1: Preliminary Analysis and Field Reconnaissance

3-1-1 Collection of Relevant Data and Information

- (a) Socio economic parameters
- (b) Satellite photos and aerial photos
- (c) Topographical, geological and hydrogeological map
- (d) Data on meteorology, hydrology geology and hydrogeology
- (e) Data on existing well
- (f) Existing reports and studies
- (g) Other related data and information

3-1-2 Review and Assessment of Existing Data and Previous Studies

- (a) Satellite image analysis
- (b) Aerial photo interpretation
- (c) Review and assessment on previous reports and studies
- (d) Compilation of geological, hydrological and hydrogeological map
- (f) Others

3-1-3 Conduct of First Field Survey and Analysis of Obtained Data

- (a) Geological reconnaissance
- (b) Hydrological investigation
- (c) Geophysical survey
- (d) Others

3-1-4 Revision of Hydrogeological Maps

- (a) Geological map
- (b) Hydrological map
- (c) Hydrogeological map
- (d) Others

3-1-5 Identification of Potential Areas for Groundwater Development

- (a) Clarification of field survey area including drilling site and appropriate methodology
- (b) Revision of Study schedule
- (c) Preparation of detailed survey programme including drilling
- (d) Others

3-2 Phase II : Analysis and Evaluation on Groundwater Resource Potential

3-2-1 Conduct of the Second Field Survey and Analysis of Obtained Data

- (a) Geological survey
- (b) Groundwater leveling
- (c) Water quality analysis
- (d) Geophysical survey
- (e) Test drilling and pumping test
- (f) Others

3-2-2 Analysis and Evaluation on Groundwater and other water resources potential

- (a) Topographical and geological analysis
- (b) Hydrological and water balance analysis
- (c) Evaluation on groundwater potential
- (d) Evaluation on surface water potential

3-2-3 Water Demand Projection and Allocation

- (a) Forecasting water demand
- (b) Water Allocation
- (c) Selection of priority area for groundwater development

3-2-4 Preliminary Study on Water Supply System

- (a) Existing water supply facilities
- (b) Operation and maintenance
- (c) Technical and financial condition for project implementation
- (d) Pilot facilities construction

3-3 Phase III . Formulation of Rural Water Supply Development Plan

3-3-1 Technical and economic analysis

- (a) Zoning of water supply districts
- (b) Appropriate water supply system
- (c) Preliminary evaluation
- (d) Identification of feasible plans

3-3-2 Implementation plan

- (a) Implementation program
- (b) Operation and maintenance
- (c) Financial plan

3-3-3 Preparation of feasible water supply scheme

- (a) Project design
- (b) Estimation of project cost
- (c) Social and economic evaluation

IV. SCHEDULE OF THE STUDY

The Study will be carried out in accordance with the tentative schedule as attached herewith. The schedule is tentative and subject to be modified when both parties agree upon any necessity that will arise during the course of the Study.

V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Democratic Republic of Madagascar. The reports will also be prepared in French for reference with the exception of Progress Report, Interim Report and Supporting Annex of Draft Final and Final Reports.

1. Inception Report

Twenty (20) copies at the commencement of the first field survey in the Democratic Republic of Madagascar. This report contains the schedule and methodology of the Study as well as outline of the field survey.

2. Progress Report (1):

Twenty (20) copies at the end of first field survey.

This report will summarize the finding in the first field survey.

3. Interim Report:

Twenty (20) copies at the commencement of the second field survey. This report will contain outline of the analysis and details of the study programme such as the selected areas, methodology and others for the second phase.

4. Progress Report (2)

Twenty (20) copies at the end of second field survey.

This report will summarize the finding in the second field survey.

5. Draft Final Report

Twenty (20) copies

within five (5) months after the end of the second field survey

MIEM shall submit their comments within one (1) month after the receipt of the Draft Final Report

6 Final Report

Fifty (50) copies within one (1) month after the receipt of the comments on the Draft Final Report

VI. UNDERTAKINGS OF THE GOVERNMENT OF THE DEMOCRATIC REPUBLIC OF MADAGASCAR

- 1 To facilitate the smooth conduct of the Study the Government of the Democratic Republic of Madagascar will take necessary measures
 - (1) To secure the safety of the Japanese study team.
 - (2) To permit the members of the Japanese study team to enter, leave and sojourn in the Democratic Republic of Madagascar for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees.
 - (3) To exempt the members of the Japanese study team from taxes, duties, fees and any other charges on equipment, machinery and other materials brought into Madagascar Democratic Republic for the conduct of the Study.
 - (4) To exempt the members of the Japanese study team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the Study.

- (5) To provide necessary facilities to the Japanese study team for the remittance as well as the utilization of funds introduced into ^{the} Democratic Republic of Madagascar from Japan in connection of the implementation of the Study.
- (6) To secure permission for entry into private properties or restricted areas for the conduct of the Study.
- (7) To secure permission for the Japanese study team to take all data, and documents including photographs, after the authorization by responsible organizations concerned, related to the Study out of the Democratic Republic of Madagascar Japan
- (8) To provide medical services in case of necessity, and the fees shall be chargeable to the members of the Japanese study team
2. The Government of Democratic Republic of Madagascar shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the member of the Japanese study team
3. MIEM shall, at its expense, provide the Japanese study team with the followings in cooperation with other relevant organizations.
- (1) Available data and information related to the Study.
 - (2) Additional survey related to the Study, if necessary.
 - (3) Counterpart personnels.
 - (4) Suitable office space with necessary equipments in the Study area.
 - (5) Appropriate number of vehicles with drivers in the Study area.
 - (6) Credentials or identification card

VII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures

1. To dispatch, at its own expense, the study team to the Democratic Republic of Madagascar,
2. To pursue technology transfer to counterparts personnel in the course of the Study

VIII. CONSULTATION

JICA and MEM will consult with each other in respect of any matter that may arise from or in connection with the Study

ANNEX I

TENTATIVE WORK SCHEDULE

| Phase | I | | | | | | | | | | | | II | | | | | | | | | | III | | | | | |
|---------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|--|--|--|--|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | | | | | | |
| Month in Order | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Works in Madagascar | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Works in Japan | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reports | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

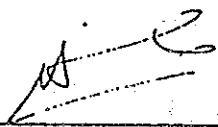
(Remarks)

Ic/R : Inception Report
P/R(I) : Progress Report (I)
It/R : Interim Report
P/R(II) : Progress Report (II)
DF/R : Draft Final Report
F/R : Final Report

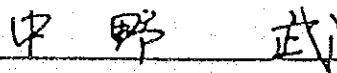
MINUTE OF MEETINGS
ON
SCOPE OF WORK
FOR
GROUNDWATER DEVELOPMENT STUDY
IN
SOUTH-WESTERN REGION
OF
THE DEMOCRATIC REPUBLIC OF MADAGASCAR

CONFIRMED BETWEEN
THE MINISTRY OF INDUSTRIES, ENERGY AND MINES
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

Antananarivo, May 29, 1989



Mr. RAKOTONDRAINIBE Jean Harivelo
Directeur de l'Energie et de l'Eau
pour le Ministre de l'Industrie,
de l'Energie et des Mines (M.I.E.M.)



Mr. Takeshi NAKANO
Leader, Japanese Preliminary
Survey Team, Japan International
Cooperation Agency (J.I.C.A.)

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), at the official request of the Government of the Democratic Republic of Madagascar, dispatched a Preliminary Survey Mission (hereinafter referred to as "the Mission"), headed by Mr. Takeshi NAKANO, from May 19 to June 2, 1989 to determine the Scope of Work for the Groundwater Development Study in the South-western Region of the Democratic Republic of Madagascar (hereinafter referred to as "the Study").

The Mission had a series of discussion with the authorities concerned of the Government of Democratic Republic of Madagascar, in particular with Ministry of Industries, Energy and Mines (hereinafter referred to as "MIEM") and agreed on the Scope of Work for the Study, which is duly signed on May 29, 1989.

This document sets forth the main points confirmed in the discussions.

1. In reference to III (the Scope of the Study) of the agreed Scope of Work (S/W), both sides agreed ;
 - 1) The Study will cover the area of Toliara I (city area), Toliara II, Sakaraha, Morombe, Ankazoabo and a part of Beroroha prefectures
 - 2) In the Study, a special emphasis will be placed on rural area for the groundwater development in the villages with population size of 500-3,000, to meet the demand of 2,000 as a target year.
 - 3) The number of the villages to be covered in Phase I study shall be about 100. Phase II study shall identify the villages to be located in high groundwater potential areas and classify these villages into certain categories from the view-points of social and economic effects. Phase III study shall formulate the water supply scheme for the villages to be selected in Phase II study.
 - 4) It is expected that total length of test drilling will be about 2,000 meters by using two drilling machines provided -- by both sides.
 - 5) The study will also cover the rehabilitation plan for existing borehole water supply systems in 9 villages.

2. In reference to IV (Schedule of the Study) of S/W, Madagascar side stated its hope to complete the Study as quickly as possible to implement the project for coping with the urgent need.
3. In reference V (Report) of S/W, both sides agreed that one hundred (100) copies of revised hydrogeological maps, will be provided as annex of Final Report. Legend for the above maps will be based upon the international legend for African countries which is applied in Madagascar.
4. For the smooth and efficient implementation of the Study, both sides agreed on the followings :
 - 1) In reference to I (Introduction) of S/W, MIEM will secure the full support and participation of the Toliara Provincial Government in the course of the Study, especially for field survey.
 - 2) In reference to VI. 3 (3) (~~undertakings~~ of the Government of Democratic Republic of Madagascar.) of S/W. MIEM will assign the appropriate number of counterpart personnel and supporting staff in such fields as project manager, geologist/hydrogeologist, hydrologist, geophysist, drilling engineer (together with technician and skilled worker) and sanitary engineer to Japanese Study team.
 - 3) In reference to VI. 3 (4), MIEM will provide office spaces in Antananarivo and Toliara with basic furniture, except for office equipment.
 - 4) MIEM will not^{be} able to provide any vehicle for the Study because of the constraint of its availability of own vehicles.
5. In reference to VII (2) (Undertaking of JICA) of S/W, Madagascar side strongly requested that technology transfer to Madagascar counterpart personnel would be realized through technical training in Japan, especially on the satellite image analysis and hydrogeological mapping.

The Mission promised to convey the above request for consideration in JICA HDQ.

6. Regarding the arrangement of the equipment necessary for the Study,
- 1) MIEM shall be able to provide its own equipment as shown in the annex 1 attached.
 - 2) MIEM strongly requested the Mission to provide survey equipment including vehicles and office equipment, as shown in the annex 2 attached. MIEM also requested that these equipment be donated to Madagascar side after the completion of the Study in order for MIEM to conduct further study.
7. MIEM stressed the fact that water supply project in the study area is a deep concern of the Government of Madagascar and the hope that the recommendations and results of the Study could be implemented through the grant aid program to be provided by the Government of Japan.

Annexe 1 : EQUIPMENT TO BE PROVIDED BY MIEM

| | |
|--|---|
| 1. Drilling Machine (SANKYO SM 200) with Accessories | 1 |
| 2. Geoelectric Survey Equipment | 1 |
| 3. Water level Detector | 1 |
| 4. Water Quality Analysis Kit | 1 |
| 5. EC, PH Meters | 1 |
| 6. Electric Water Pump | 1 |
| 7. Water Flow Meter | 1 |

Annexe 2 : EQUIPMENT REQUESTED TO JICA TO PROVIDE

| | |
|---|---|
| 1. Drilling Machine (Middle Size 100 m) with Accessories | 1 |
| 2. Casing, Screen and Materials for Drilling | 1 |
| 3. Geoelectric Survey Equipment | 2 |
| 4. Water Quality Analysis Kit (EC, PH, Digital Type) | 4 |
| 5. Generator | 1 |
| 6. Welder | 1 |
| 7. Photocopy Machine | 2 |
| 8. Drafter | 1 |
| 9. Micro Computer and Software for Hydrogeological Data Base | 1 |
| 10. Typewriter or Word Processor | 2 |
| 11. 4-wheel Driving car (JEEP Type) | 4 |
| 12. Truck (8 ton) with 3 Ton Crane | 2 |
| 13. 4-wheel Driving Truck (Double Cabine) | 2 |
| 14. Water Tank Lorry (4,000 liters) | 2 |
| 15. Camping Equipment and Tent | 4 |
| 16. Walkie Talkie | 6 |
| 17. Spare parts for equipment | 1 |

APPENDIX (8)

SURVEY EQUIPMENT AND MATERIALS BY JICA

9. Equipment
(1) Equipment provided by JICA

Survey Equipment List Provided by JICA (1)

| Item No. | Description of Articles | Quantity | Specification (Type) | Time of Shipment |
|----------|---|----------|---|-----------------------------|
| 1 | Drilling Machine with Accessories and Spare Parts | 1 unit | Middle side 100m drilling, Tractor mounted. Diesel engine generator, Test pumping tools, Borehole logger, Welder, etc. | |
| 2 | Casing, Screen and Materials for Drilling | 1 lot | 4" (1,000m), 6" (1,000m). Bentonite, Foaming powder, etc. | |
| 3 | Well Service Machine (for Rehabilitation Survey) with Accessories and Spare Parts | 1 unit | Diesel truck mounted. Capable of 250m deep work, Jetting, Surging and Brushing. | |
| 4 | Water Tank Lorry with Accessories and Spare Parts | 2 units | MITSUBISHI, 6,000 Liters capacity. | The end of December, 1989 |
| 5 | 8 Ton Cargo Truck with 3 Ton Crane, Accessories and Spare Parts | 2 units | ISUZU FTSZH (MODEL: UR332). | The middle of January, 1990 |
| 6 | 4-wheel Car (JEEP Type) with Accessories and Spare Parts | 4 units | TOYOTA HJ 62LG-KRC. Station wagon type. Diesel engine (about 4,000 cc). | The end of October, 1989 |
| 7 | 4-wheel Truck (Double Cabine) with Accessories and Spare Parts | 2 units | TOYOTA LN 106L-FRMRS (6 seater). Diesel engine (about 2,800 cc). | The end of October, 1989 |
| 8 | Personal Computer with Software and Accessories | 3 units | MODEL J3100 SL021 (TOSHIBA): 2 units, MODEL J3100 GX (TOSHIBA): 1 unit. Printer and Accessories: 3 sets. Software with Word Star (3 units, English and French). | The end of October, 1989 |

Survey Equipment List Provided by JICA (2)

| Item No. | Description of Articles | Quantity | Specification (Type) | Time of Shipment |
|----------|---|----------|---|-------------------------------|
| 9 | Photocopy Machine with Accessories and Spare Parts | 2 units | CANON NP3285, Cassette: A3, B4, A4, A4R, Capable of magnification and reduction. Articles of consumption. | The end of October, 1989 |
| 10 | Drafter with Accessories | 2 sets | UCHIDA AP-2 | The end of October, 1989 |
| 11 | Automatic Precipitation Recorder with Accessories | 3 units | ÔTA KEIKI NO. 113B. A paper roll of 3 monthly. | The end of October, 1989 |
| 12 | Automatic Water Level Recorder (Borehole) with Accessories | 5 units | IKEDA KEIKI ADR-105WP. A paper roll of 3 monthly. | The end of October, 1989 |
| 13 | Water Flow Meter (for Discharge Measurement) with Accessories | 2 units | LP Digital Type, 0.03 to 3m / sec. | The end of October, 1989 |
| 14 | Water Measurement Plate | 6 sets | Steel plate. | The end of October, 1989 |
| 15 | Water Level Detector (Borehole) | 4 units | NP-100 Type (Tape Measure Type, 100m). | The end of October, 1989 |
| 16 | Water Quality Analysis Kit with Accessories | 2 sets | MODEL U-7. PH. EC. TDS. + 27 Components. | The end of October, 1989 |
| 17 | Water Quality Analysis Kit with Accessories | 2 sets | MODEL DREL 2000. | The middle of September, 1989 |

Survey Equipment List Provided by JICA (3)

| Item No. | Description of Articles | Quantity | Specification (Type) | Time of Shipment |
|----------|---|----------|--|-------------------------------|
| 18 | Geoelectric Survey Equipment with Accessories | 2 sets | McOHM 2115. Analysis program in English and French. | The end of October, 1989 |
| 19 | VLF Magneto-Telluric Survey Equipment with Accessories | 1 set | WADI (for prospecting groundwater controlled by fault). | The end of September, 1989 |
| 20 | Walkie Talkie with Accessories | 6 units | FTC-2625 / 2640: 2 units (4WD mounted type). FTC-2006: 4 units. | |
| 21 | Spare Parts for Existing Drilling Equipment in Madagascar | 1 lot | | |
| 22 | Camping Equipment | 1 set | 8 Tents (8 P / T), 4 Generators (HONDA EB550), 2 Table sets, etc. | The middle of September, 1989 |

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