BASIC DESIGN REPORT
ON
WATER SUPPLY PROJECT
FOR AFGHAN REFUGEES IN PAKISTAN

OCTOBER 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

It is with great pleasure that I present this Basic Design Report on Water Supply Project for Afghan Refugees in Pakistan to the Government of the Islamic Republic of Pakistan.

This report embodies the result of a Basic Design survey which was carried out in Saranan area in Baluchistan Province from 7th November 1980 to 15th June 1981 by a Japanese survey team commissioned by the Japan International Cooperation Agency following the request of the Government of Pakistan to the Government of Japan.

The survey team, headed by Mr. M. Yamada, had a series of discussions with the officials concerned of the Government of Pakistan and conducted a wide scope of field survey and data analyses.

I hope that this report will be useful as a basic reference for development of the project.

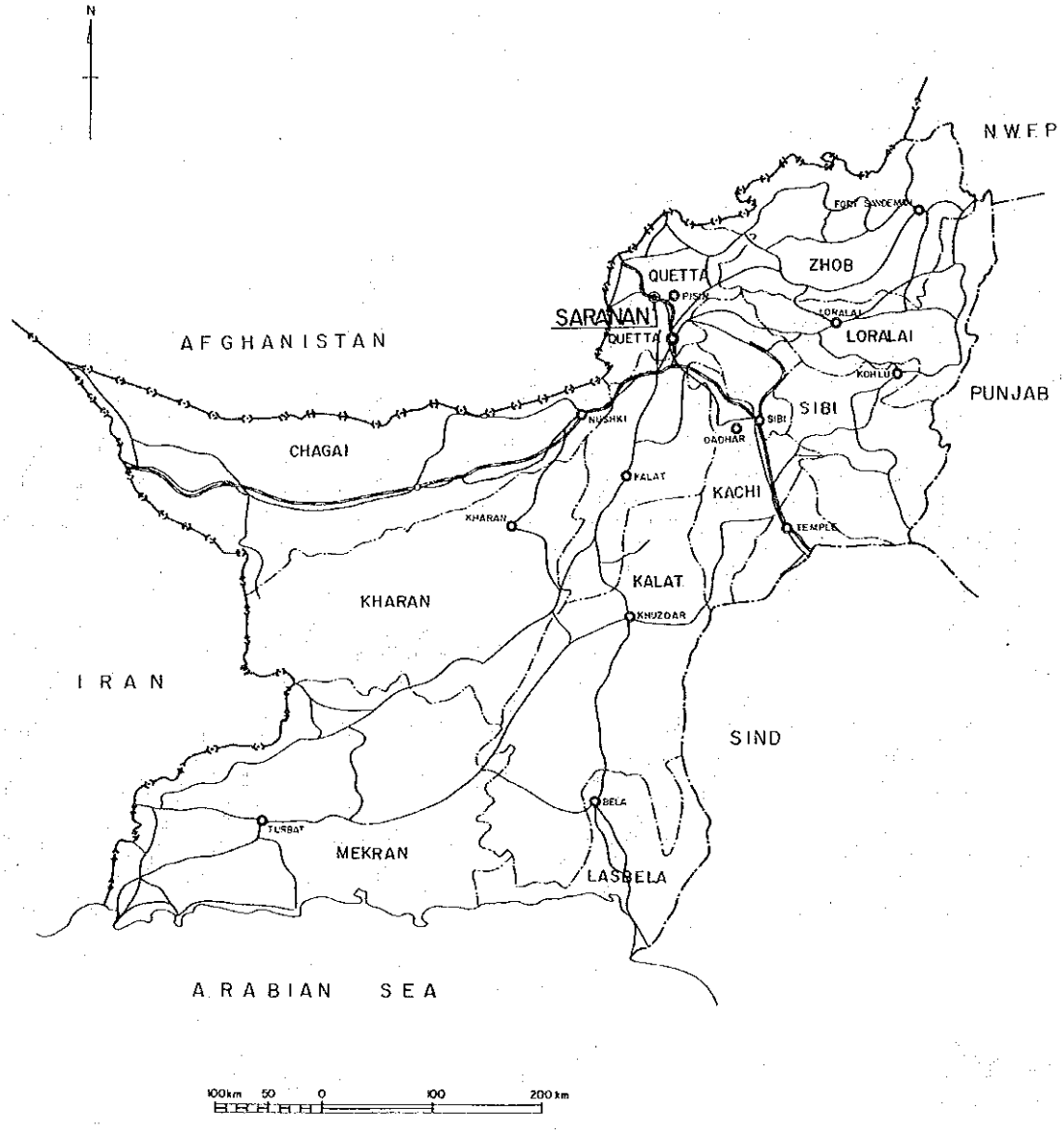
I wish to express my deep appreciation to the officials concerned of the Government of Pakistan for their close cooperation extended to the survey team.

Keisuke Arita

October 1981

KEISUKE ARITA
President
Japan International Cooperation Agency

BALUCHISTAN PROVINCE



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A N N E X E S

SUMMARY

In response to the request by the Government of the Islamic Republic of Pakistan, the Government of Japan has extended the technical cooperation in the basic design study on water supply project for Afghan refugee camp in the Saranan area, Baluchistan province.

The study performed was divided into two phases; namely, Phase I and Phase II. The Phase I Study, conducted in November 1980 through January 1981, covered the field inspection and prospecting of productive aquifers for determining drilling sites. While the Phase II, carried out in April 1981 through July 1981, covered two test drillings and the basic design for the required water supply system.

In the Phase I, field investigation and review of the existing data and available information of the topography and geology on the survey area have found that some productive aquifers are expected to run through Saranan area in the direction of NNE. And hence, the geo-electric prospecting has been performed on the selected 54 survey points, most of which were arranged along this strip.

The geo-electric prospecting has concluded that the area lies on the ancient river channel running through Saranan to Haikalzai, may be promising in groundwater development. Therefore, the test drilling should be carried out in this area in the Phase II Study.

In the initial stage of the Phase II, No. 1 Well (92.5 m deep) was drilled in the Haikalzai area, and penetrated excellent aquifers. The No. 2 Well (132.8 m deep) was drilled in the Saranan area and confirmed more desirable aquifers therein.

The basic design for the water supply system has been made based upon an idea that water would be supplied at the rate of 15 litres per day per person for population totalling 22,000 persons. So far as facilities are concerned, a 15-m elevated steel tank (55 m^3 capacity) is provided at the No. 2 Well site, from which PVC pipe lines (ø75 - 125 mm) are laid out about 6.5 km for water distribution.

The fund required for the execution of the project is estimated at 300 million yen which will be procured from the Japan's Grant-Aid Program.

I. INTRODUCTION

In response to the request of the Government of the Islamic Republic of Pakistan, the Government of Japan has made a decision to provide the basic design study on water supply project in accordance with laws and regulations in force in Japan.

The Japan International Cooperation Agency (JICA), an official agency responsible for implementation of technical cooperation programs of the Government of Japan, has carried out this study in close cooperation with the Government of the Islamic Republic of Pakistan and authorities concerned.

The general objectives of the study are:

a) To conduct the basic design study on Water Supply Project for Afghan Refugee Camp at Saranan area in Baluchistan Province; and,

b) To transfer technical knowledge to the Government staff concerned.

The general contents of the study are as follows:

a) Phase I (November 1980 - January 1981)

i) Collection of data and information

- Topographic map, meteorological data, design criteria, construction materials, construction machine, costs, tariff rate, etc.

ii) Field investigation

- Geological survey
- Hydrogeological survey
- Confirmation of the condition of existing facilities

iii) Electrical resistivity test and selection of boring sites

b) Phase II (April 1981 - July 1981)

i) Trial boring on the selected sites

- Drilling the wells
- Aquifer tests by utilizing the trial well
- Water quality tests
- Determination of the location of well site

ii) Field investigation

- Reconnaissance of pipeline route
- Reconnaissance of locations on elevated tank, communal water points, etc.

iii) Basic design

- Basic design of the pipeline and facilities
- Estimation of construction, operation and maintenance costs
- Preparation of construction program

The Pakistan Government provided the team with the following government officers as the counterpart personnel:

a) Phase I

Major Khawaja Mohammad	Coordinator, Afghan Refugee Commissioner Office
Mr. Mohammad Siddiqui	Water Works Engineer, Irrigation and Power Department
Mr. Syed Ahasan Haider Naqvi	Hydrogeologist, Baluchistan Development Authority

b) Phase II

Mr. Shirin Khan	Coordinator, Irrigation and Power Department
Mr. Mir Hazar Khan	Water Works Engineer, Irrigation and Power Department
Mr. Ali Murad Khoso	Drilling Engineer, Irrigation and Power Department

II. TOPOGRAPHIC CONDITIONS

Topography of the survey area can be specified into four - (i) mountain highland, (ii) hill, (iii) alluvial fan, (iv) alluvial plain, as shown in Fig. 1.

(i) Mountain highland

The mountain highlands surround the Pishin region and the Pishin Lora basin with alluvial plain opening southward. These highlands elevate in a range from EL 5,000 ft (1,500 m) to EL 8,000 ft (2,500 m) with steep topography in matured stage, and provide a mountain range extending NNE to SSW and a large dale running NNE to SSW as well.

The mountain highlands, which are a major recharging source of the water resources in the survey area, have the catchment area by about 380 sq. mile (970 sq. km) in the eastern part, about 15 sq. mile (40 sq. km) in the western part and about 500 sq. mile (1,300 sq. km) in the northern part.

(ii) Hill

The hill extending from Khushdil Khan to Yaru, divides the survey area into two - the Pishin region and the Pishin Lora basin, and has an elevation ranging from EL 5,000 ft (1,500 m) to EL 5,300 ft (1,600 m). The range of this hill runs NE to SW almost in parallel with the mountain ranges.

(iii) Alluvial fan

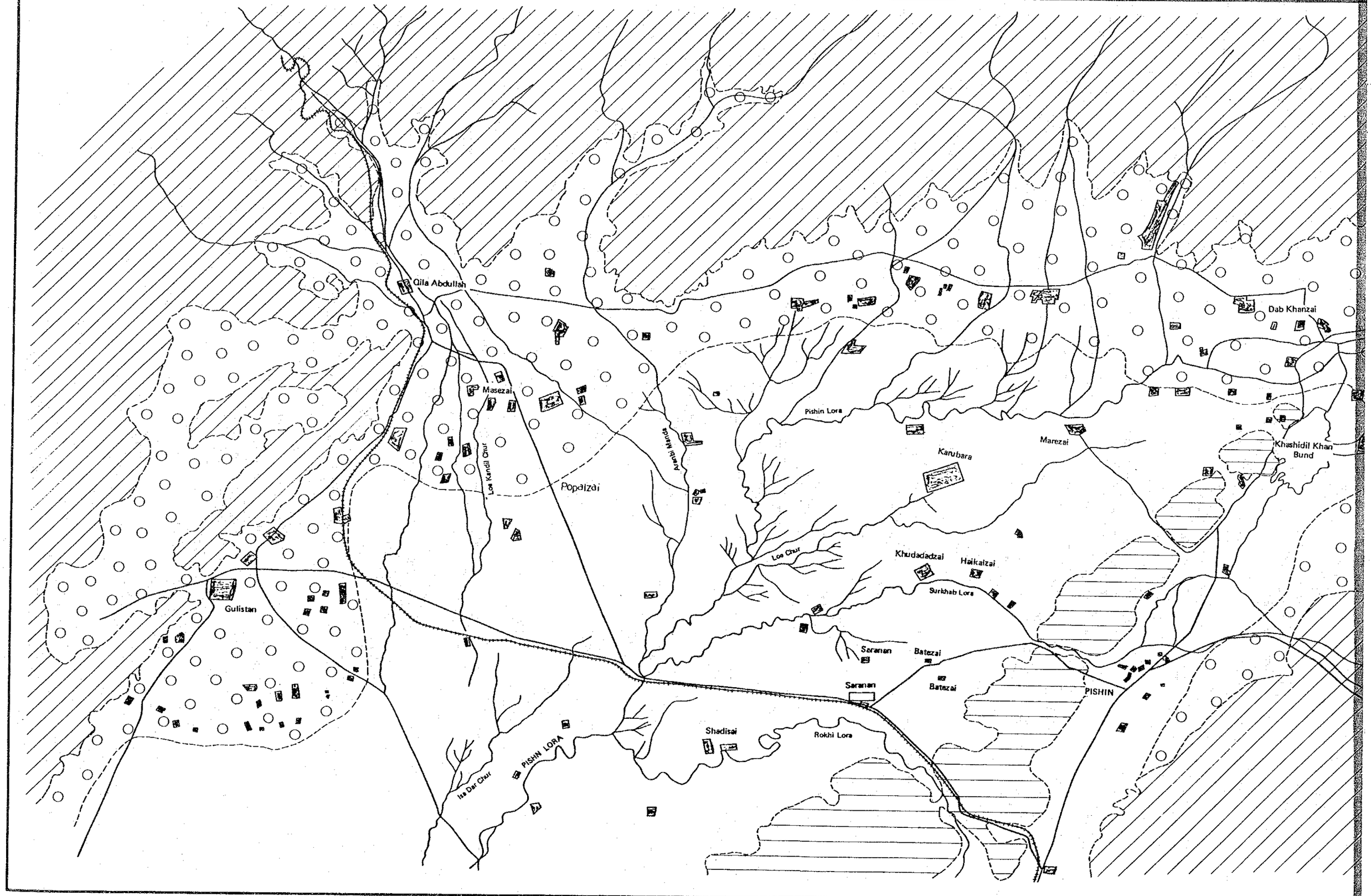
The alluvial fan extends in the piedmont of the mountain highlands with remarkable development in the north and the northwest of the Pishin Lora basin and around Gulistan region. The gently sloping alluvial fan has developed dales in a radial manner.

(iv) Alluvial plain

The alluvial plains, developing continuously in the alluvial fan, form a flat plain as the Pishin Lora basin. The alluvial plains are adjacent to the alluvial fan in the northern and eastern sides, while to the hill in the western side. On the other hand, the southern side continuously extends in the flat area dissected by Pishin river.

(v) Rivers

The rivers flowing through the Pishin Lora are the Pishin river and its tributaries of the Loe river, Surkhab river, Rokhi river, Aranbi Manda river, Loe Kandil river, and Isa Dar river. The Pishin river, originating in the mountain highland in the northeast of the survey area, flows down westward first and runs straight after turning its course to southwest almost in the center of the Pishin Lora basin. The Surkhab river and the Rokhi river, originating in the mountain highland, west of Pishin, flow down toward the west through the Pishin region and then join the Pishin river after dissecting the hill. The rivers running in the northern and western parts of the Pishin river flow down southwestward to join the Pishin river. Besides the above major rivers, small rivers have developed in a radial manner in the alluvial fan.


Qila Abdullah
Masezai
Loe Kandi Chur
Popalzai
Arambi Nala
Pishin Lora
Karubara
Marezai
Dab Khanzai
Khashidil Khan Bund
Loe Chur
Khudadadzai
Haikalzai
Surkhab Lora
Gulistan
Saranan
Batezai
Saranan
Batezai
PISHIN
Shadisai
Rokhi Lora
Isa Dar Chur
PISHIN LORA

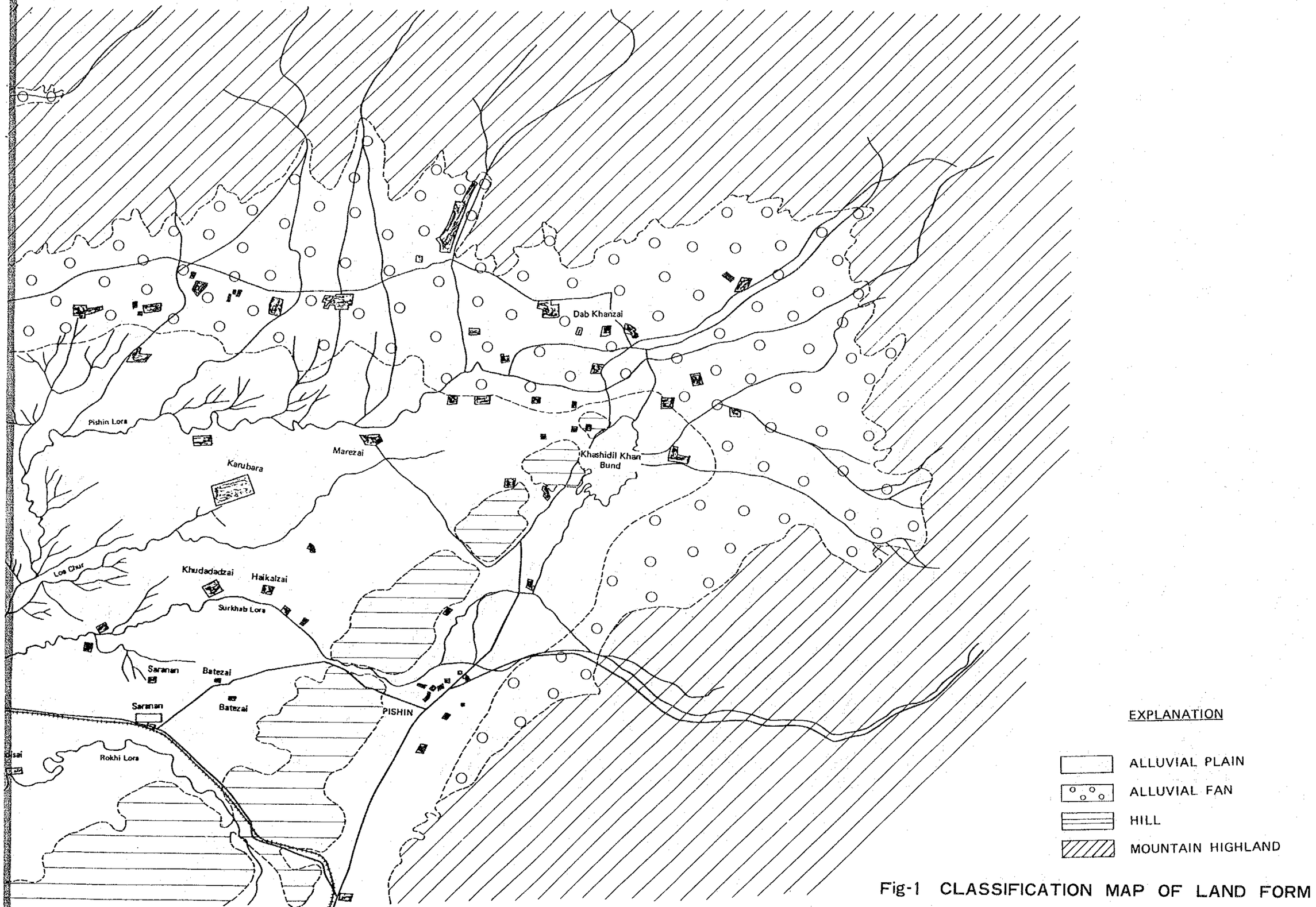


Fig-1 CLASSIFICATION MAP OF LAND FORM

III. GEOLOGICAL CONDITIONS

The survey area consists of (i) bed rocks, (ii) Bostan Formation, (iii) fan deposits, (iv) alluvial deposits, and (v) recent river deposits as shown in Fig. 2.

(i) Bed rocks

The bed rocks, forming the mountain highlands, consist mainly of sedimentary rocks developed in a period from the Triassic to the Miocene with igneous rock intrusion in some parts. In the eastern parts, the basement rocks consist mainly of sandstones, shales and limestone of the Triassic to Miocene, and igneous rocks are mainly gabbroes and other ultrabasic rocks of the Cretaceous to Paleocene. The northern part consists of sandstones, shales, limestones and conglomerates of the Oligocene to Miocene. In the western part sandstones, shales, limestones and conglomerates of the Oligocene to Miocene spread out. All of these rocks are generally hard.

(ii) Bostan Formation

The Bostan Formation, forming the hill, is composed of Pleistocene sedimentary rocks. This formation consists of poorly consolidated clay and silt with a few sand layers. This formation includes the Dada Formation which is composed of poorly consolidated conglomerate.

(iii) Fan deposits

The fan deposits, forming the alluvial fan, consist of the older alluvial sediments by almost coarse materials such as unconsolidated sand and gravel. The alluvial fan provides favorable aquifer.

(iv) Alluvial deposits

The alluvial deposits, forming the alluvial plain, consist of the older alluvium sediments. This is generally composed of unconsolidated clay and silt with a few sand layers, whereas coarse materials of sands and gravels are deposited in the place where the

Pishin river and the Surkhab river flow into the alluvial plain. Judging from the present topographic conditions, the river courses flowing into the Pishin Lora basin would remain unchanged from the time these sediments had been deposited.

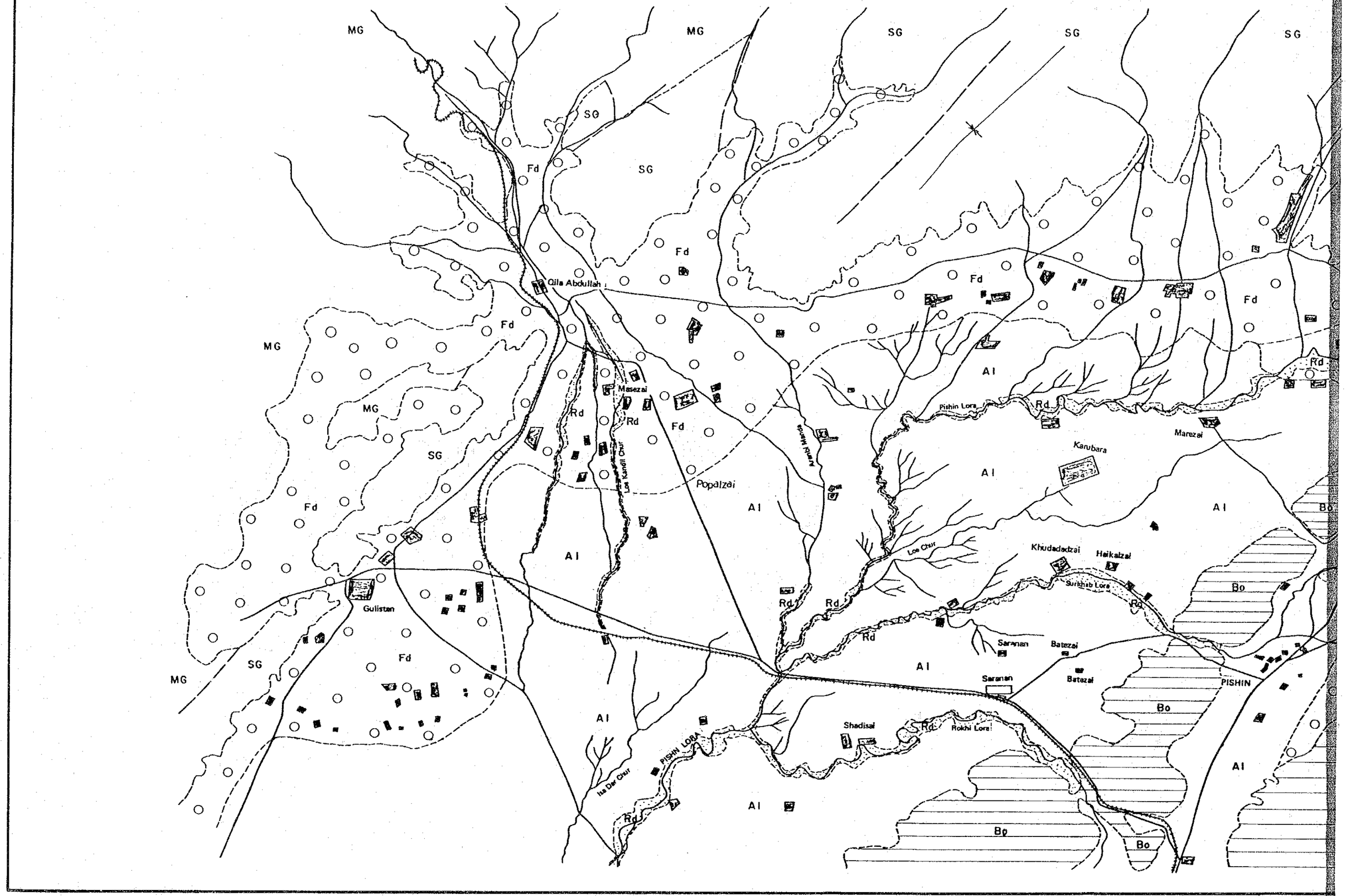
The cross laminated gravel beds and sand beds are observed from the outcrops in the aforesaid inflow points of the rivers to the basin. The river flow directions in the old time are assumed to be the same as the present directions according to the cross laminar conditions observed therearound. The observation made on the outcrops found the distribution of these coarse materials between the hill and the point about two miles therefrom. The layers of coarse materials in these deposits provide favorable aquifers.

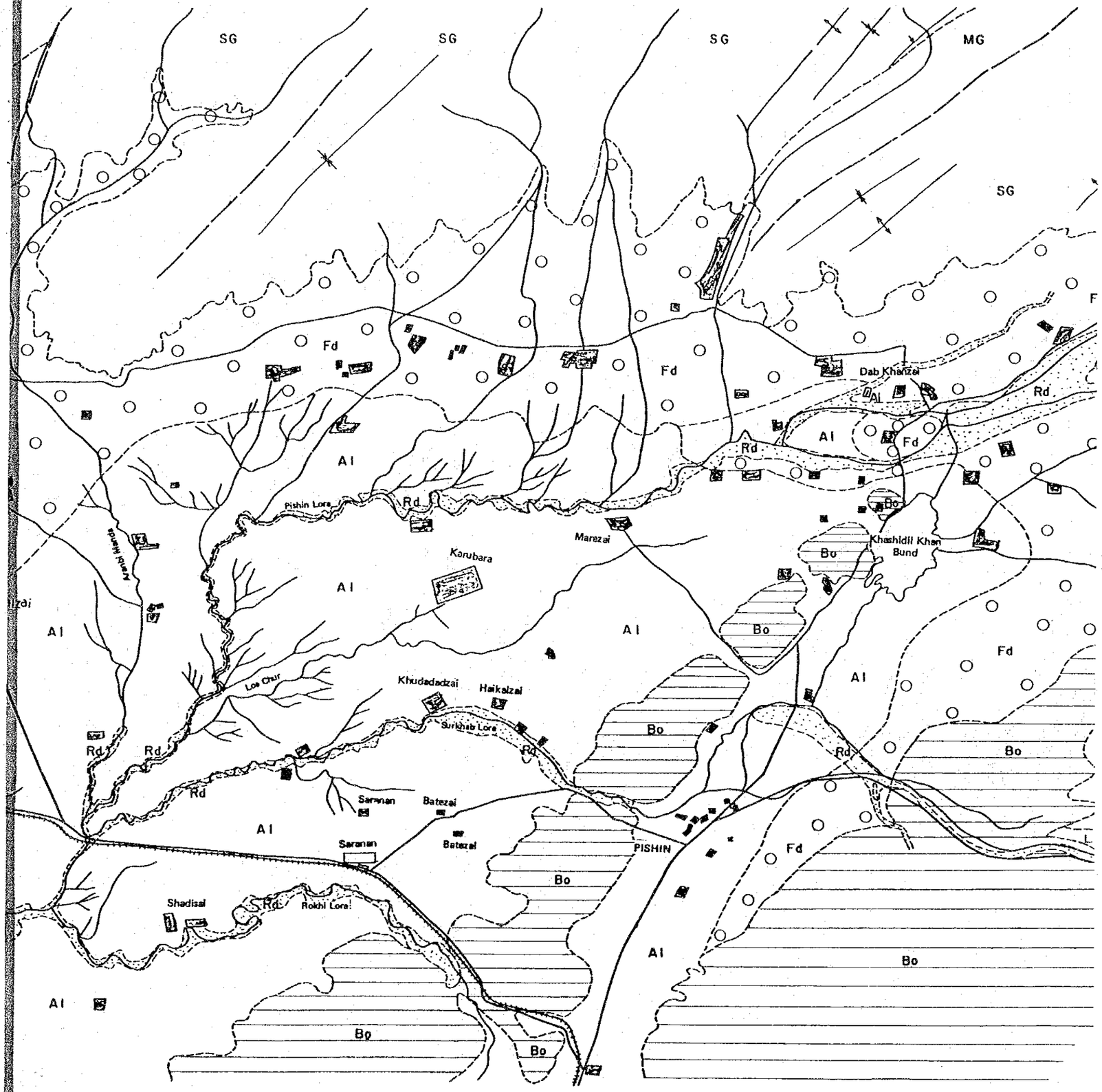
(v) Recent river deposits

The recent river deposits are distributed in the present river beds. These deposits are composed mainly of sand and gravel around the mountain highland, while of clay and silt, partly with sand, almost all parts in the center of the basin and southern part. Gravels are found in the place between the inflow point of the Pishin river to the basin and the place five miles downstream therefrom, while found four miles downstream from the inflow point of the Surkhab river.

Table 1. Geological Stratigraphy

Age	Formation		Rock Facies and Distribution
Holocene	**Recent river deposits**		**Mainly clay and silt, partly sand, gravel. River bed.**
	Alluvial deposits		Mainly clay and silt, partly sand, gravel. Whole alluvial plain area.
	Fan deposits		Mainly gravel, partly sand, clay. Whole area in alluvial fan.
Pleistocene	Bostan Formation (included Dada Formation)		Mainly clay and silt, partly sand stone and conglomerate, Dada Formation is mainly conglomerate. Whole area in Hill.
Miocene	Bed rocks	Shagalu sandstone	Mainly sandstone and shale, limestone, conglomerate. Whole area in mountain highland.
Oligocene		Murgha faqirzai shale	Mainly sandstone and shale, shaly-limestone slate, schist and quartzite. Western part and some area in northern part.
Eocene		Spintangi limestone	Mainly limestone, shale. Some area in eastern part.
Paleocene		Mulslimbagh intrusion	Gabblo, other ultrabasic rocks, and volcanic material. Some area in eastern part.
Cretaceous		Parh group	Mainly limestone, shale, volcanic material. Some area in eastern part.
Jurassic		Chiltan limestone	Limestone. Some area in eastern part.
Triassic		Shirinab formation	Mainly limestone, shale. Some area in eastern part.


MG
SG
Fd
Al
Rd
Bo
Qila Abdullah
Masezai
Popalzai
Gulistan
Pishin Lora
Karubara
Marezai
Khudadadzai
Haikalzai
Surkhab Lora
Saranan
Batezai
PISHIN
Shadisal
Rokhi Lora
PISHIN LORA
Lora Kandil Chur
Lora Mahi Kanda
Loe Chur
Isa Dar Chur



EXPLANATION

Age		Formation	Sign	Rock Facies
Recent		Recent river deposits	Rd	Mainly clay and silt, partly sand, gravel
		Alluvial deposits	Al	Mainly clay and silt, partly sand, gravel
		Fan deposits	Fd	Mainly gravel, partly sand, clay
Pliotocene		Bostan formation (included Data formation)	Bo	Mainly clay and silt, partly sand stone and conglomerate, Data formation is mainly conglomerate
Miocene	Bed rocks	Shagalu Sandstone	Sg	Mainly sandstone and shale, limestone, conglomerate
Oligocene		Murgha faqirzai shale	Mg	Mainly sandstone and shale, shaly-limestone slate, schist and quartzite
Eocene		Spintangi limestone	Sp	Mainly limestone, shale

Foult

Anticlinal axis

Synclinal axis

Boundary line

Fig-2 GEOLOGICAL MAP

IV. HYDROGEOLOGICAL CONDITIONS

Groundwater is a dependable source of water supply in the survey area. The main aquifers are composed of unconsolidated sand and gravel. These aquifers spread out in the fan deposits and some part of the alluvial deposits.

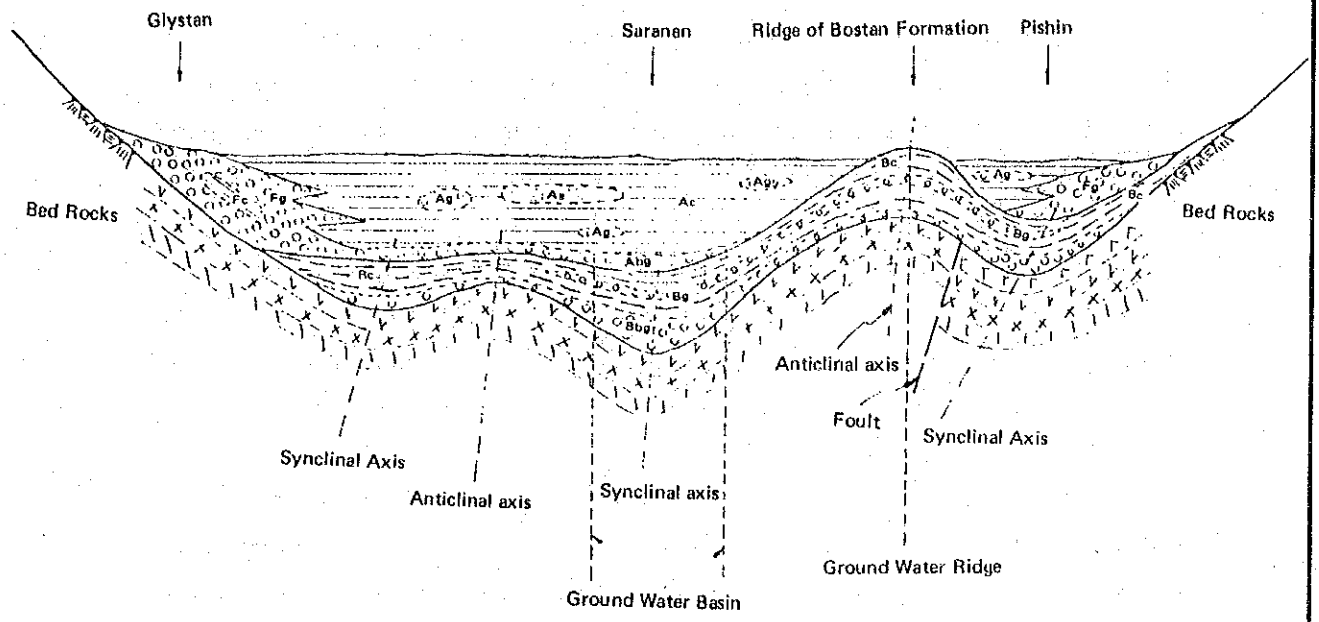
The fan deposits, as shown in Fig. 1, form a belt zone in the piedmont area of the mountain highlands. The villages, being dotted along this belt zone, use the water obtained from underflows of the alluvial fan through the shallow dug wells and tube wells.

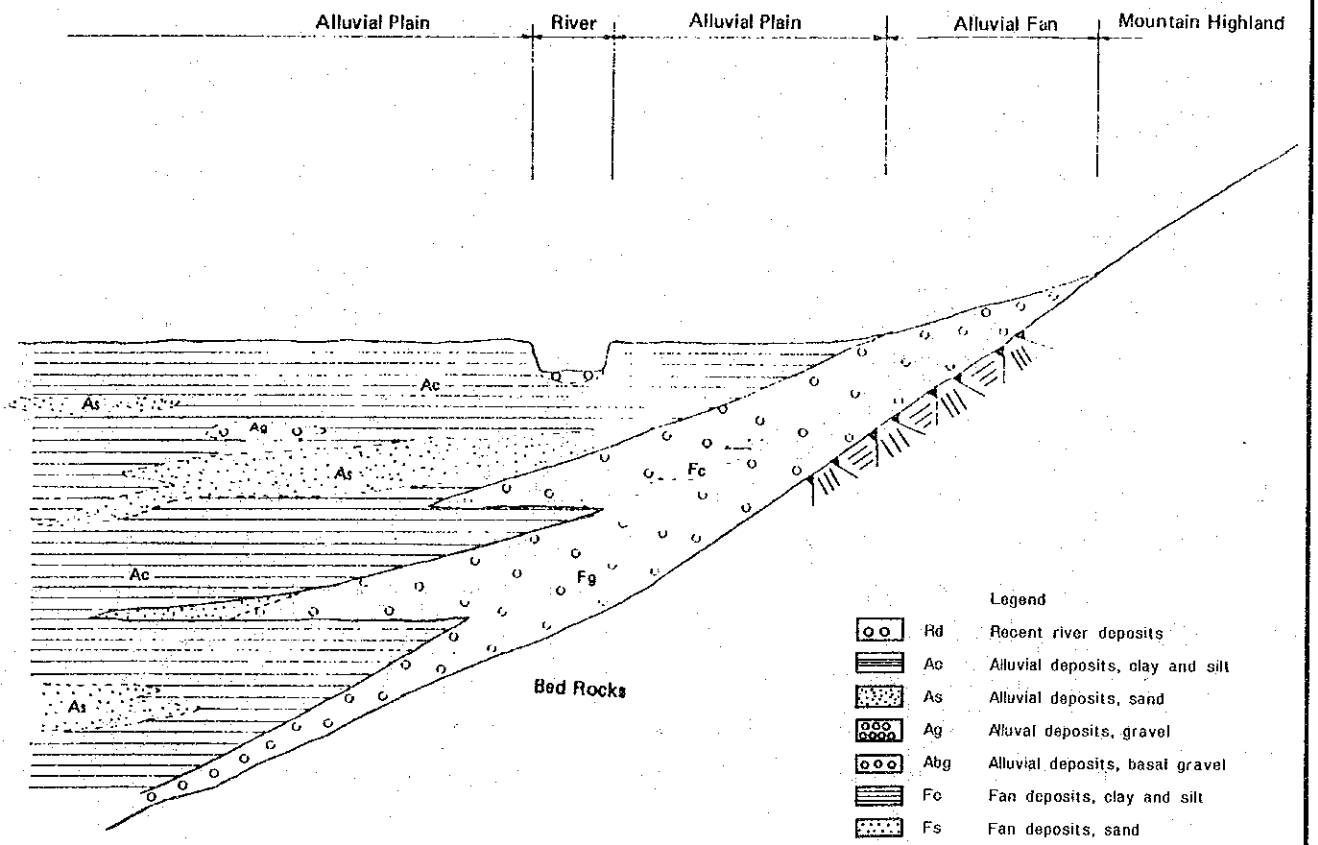
The aquifers in the alluvial deposits are found around the inflow points of the ancient channels to the area. The topographic conditions of the hill suggests that these aquifers are distributed around the present river courses.

In addition to the above, the existence of some aquifers will be expected in the basal gravel of the alluvium, and gravel & sand layers and basal gravel in the Bostan Formation. It will be considered that these aquifers will be formed in the gravel & sand layers on the synclinal axis running NNE through Saranan, because the topographical conditions and the geological conditions of this area indicate that Saranan is on the synclinal axis and the ridge of Bostan Formation is on the anticlinal axis. (See Fig. 3).

In view of the above, the electric prospecting sites were arranged along the line running NNE through Saranan, from which the survey was started. Then, an intensive survey was carried out to look into the hydrological system of the area which would be considered promising through the above survey. On the other hand, apart from the survey along the said line, the survey point was conducted in such areas, where the existing wells have produced effective groundwater in quantity, as Gulistan, Masezai and Dab Khanzai.

Fig-3 SCHEMATIC SECTION





Legend

Rd	Recent river deposits
Ac	Alluvial deposits, clay and silt
As	Alluvial deposits, sand
Ag	Alluval deposits, gravel
Abg	Alluvial deposits, basal gravel
Fc	Fan deposits, clay and silt
Fs	Fan deposits, sand
Fg	Fan deposits, gravel
Bc	Bostan Formation, clay and silt
Bg	Bostan Formation, gravel
Bdg	Bostan Formation, basal gravel

V. ELECTRIC PROSPECTING

(i) Equipment and method to be employed

Equipment: ES-GI Electric Prospecting Equipment, OYO Corporation

Method: Resistivity sounding, four-electrode method

(ii) Number of sites and depth for prospecting

Number of sites: 54 sites (see Fig. 4)

Prospecting depth: 34 sites up to 400 m from the surface
6 sites up to 200 m from the surface
14 sites up to 100 m from the surface

(iii) Results of electric prospecting

The specific resistivity profiles for each area are shown in Fig. 5.

From the results of electric prospecting, the most promising sites for groundwater development near Saranan, are on the ancient channel running through Saranan and Haikalzai (see Fig. 5, Saranan District).

In view of the above, the trial boring sites were selected in Saranan and Haikalzai.

Fig-4-1 LOCATION MAP OF MEASURING POINTS

Saranan, Batezai, Haikarzai, Karbala

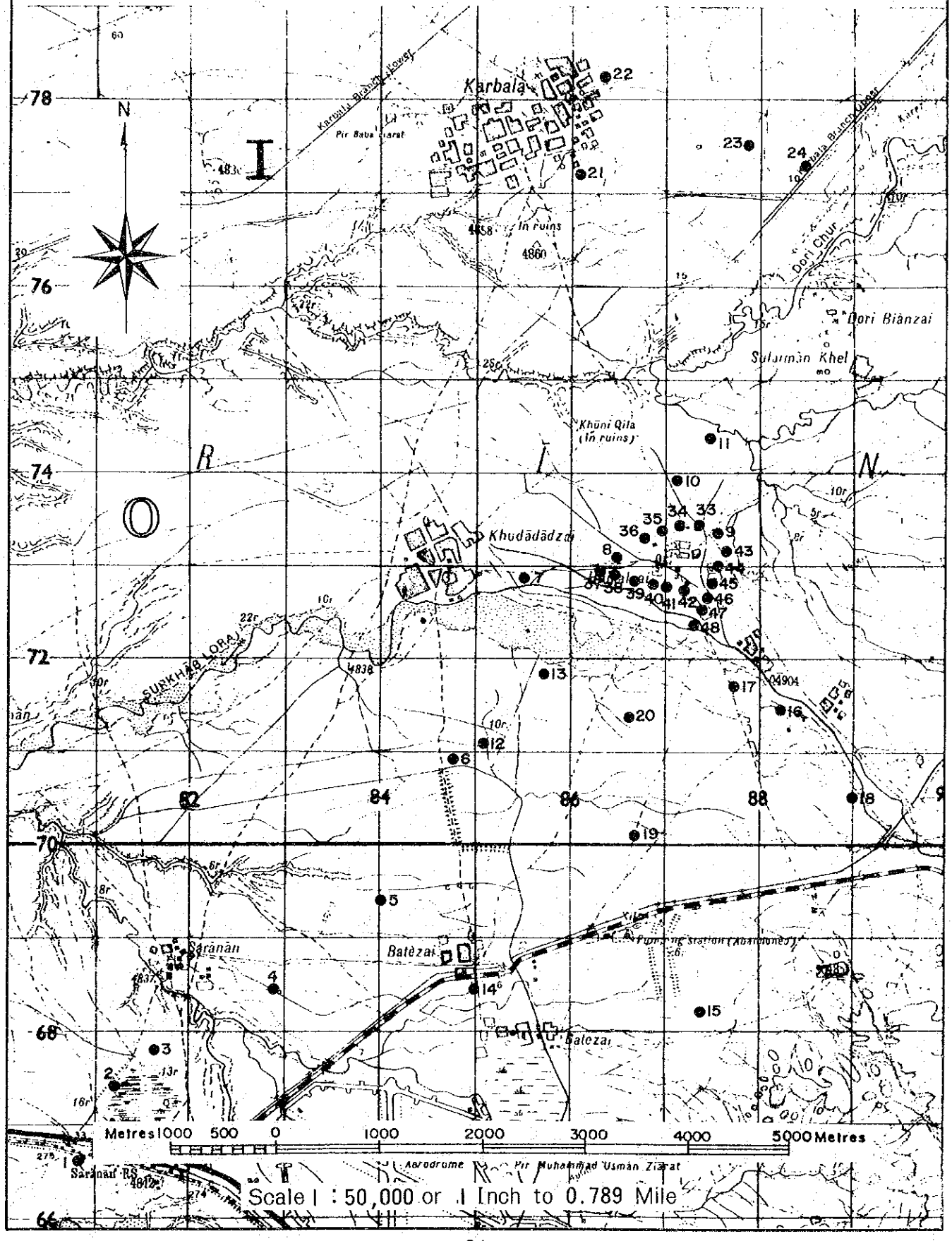
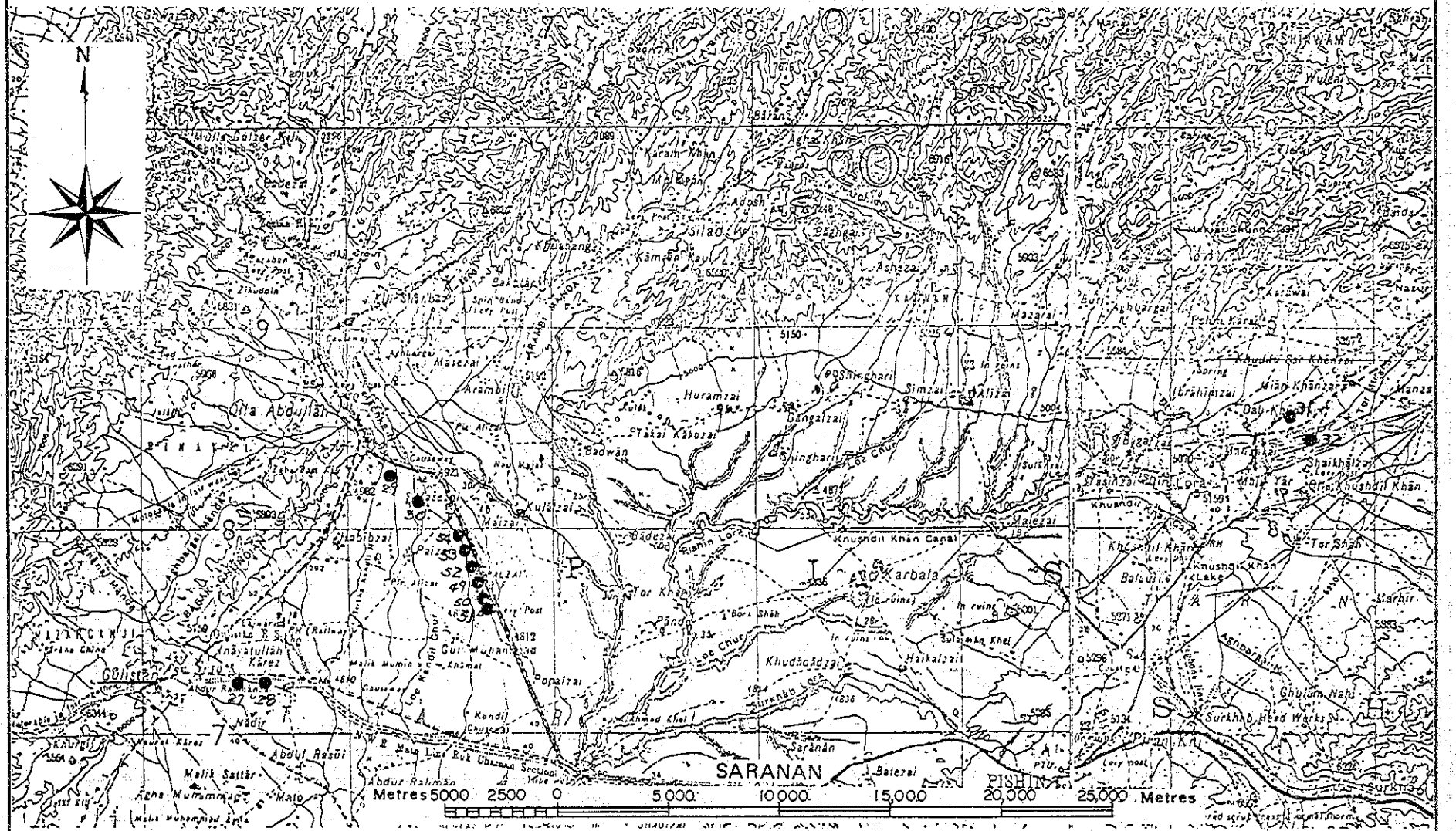


Fig-4-2 LOCATION MAP OF MEASURING POINTS

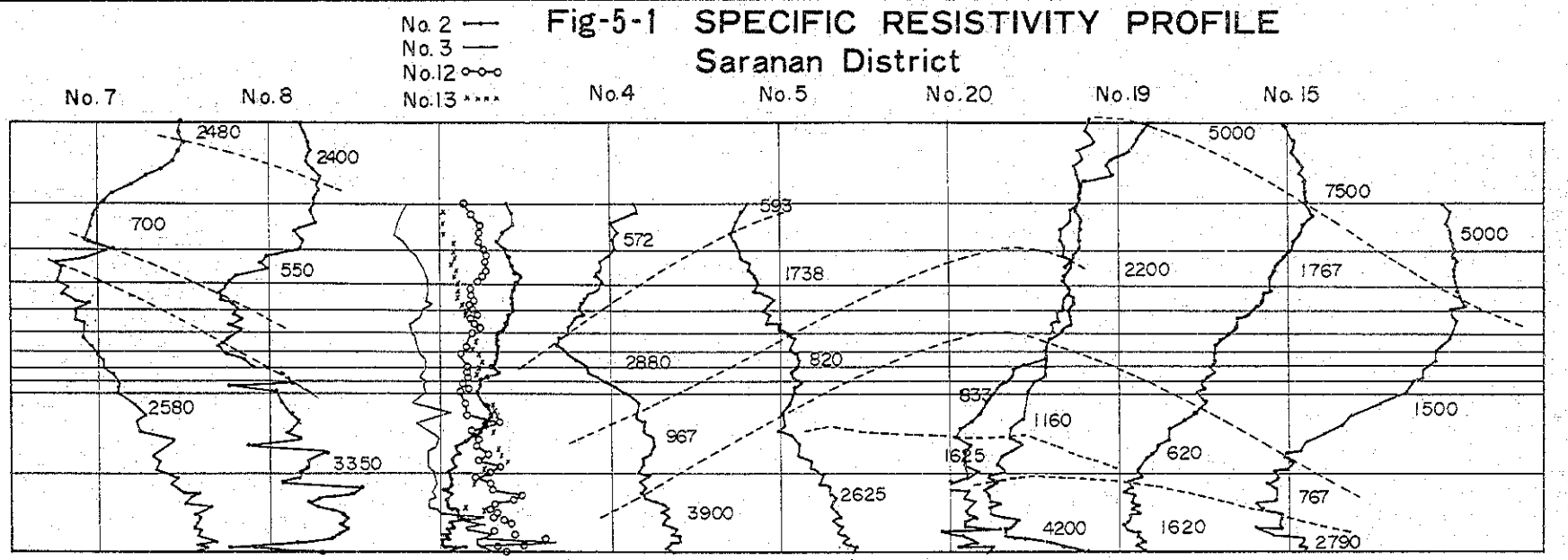
Popalzai



Scale 1 Inch to 4 Miles or 1 : 253,440

Fig-5-1 SPECIFIC RESISTIVITY PROFILE

Saranan District



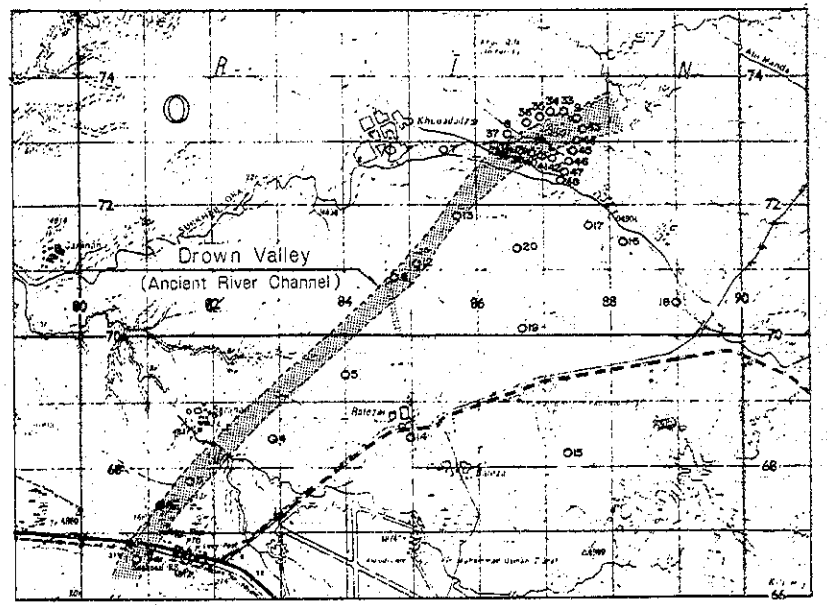
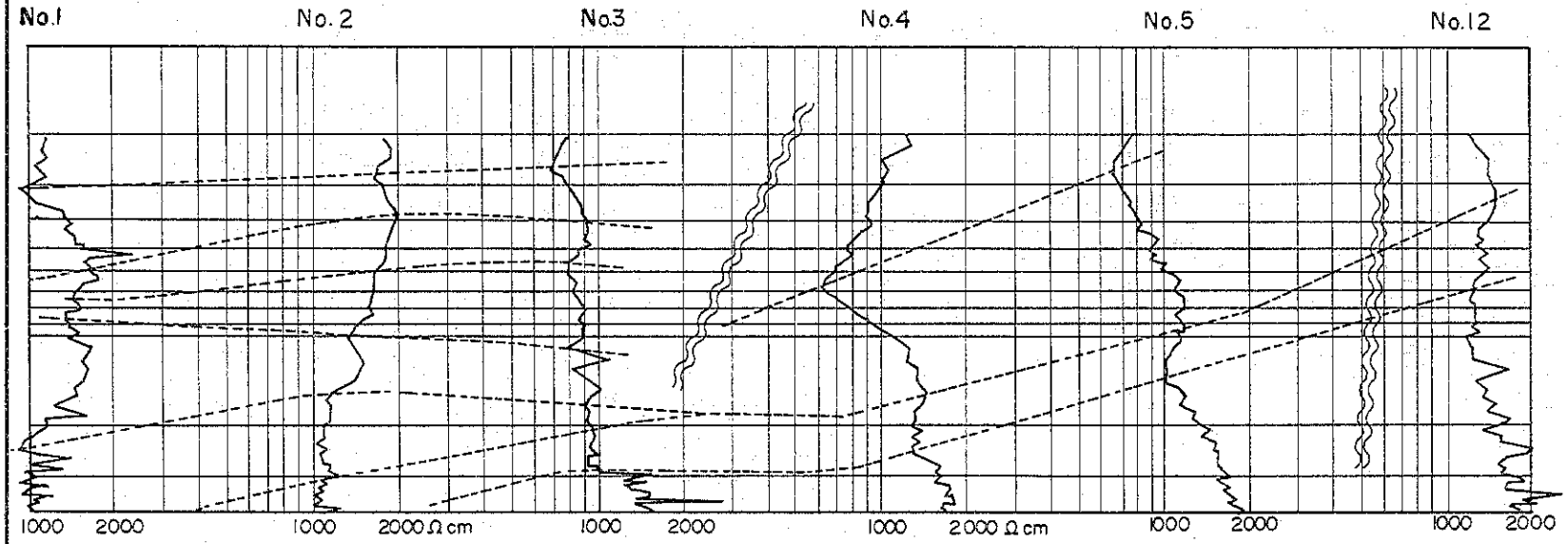


Fig-5-2 SPECIFIC RESISTIVITY PROFILE

Batezai District



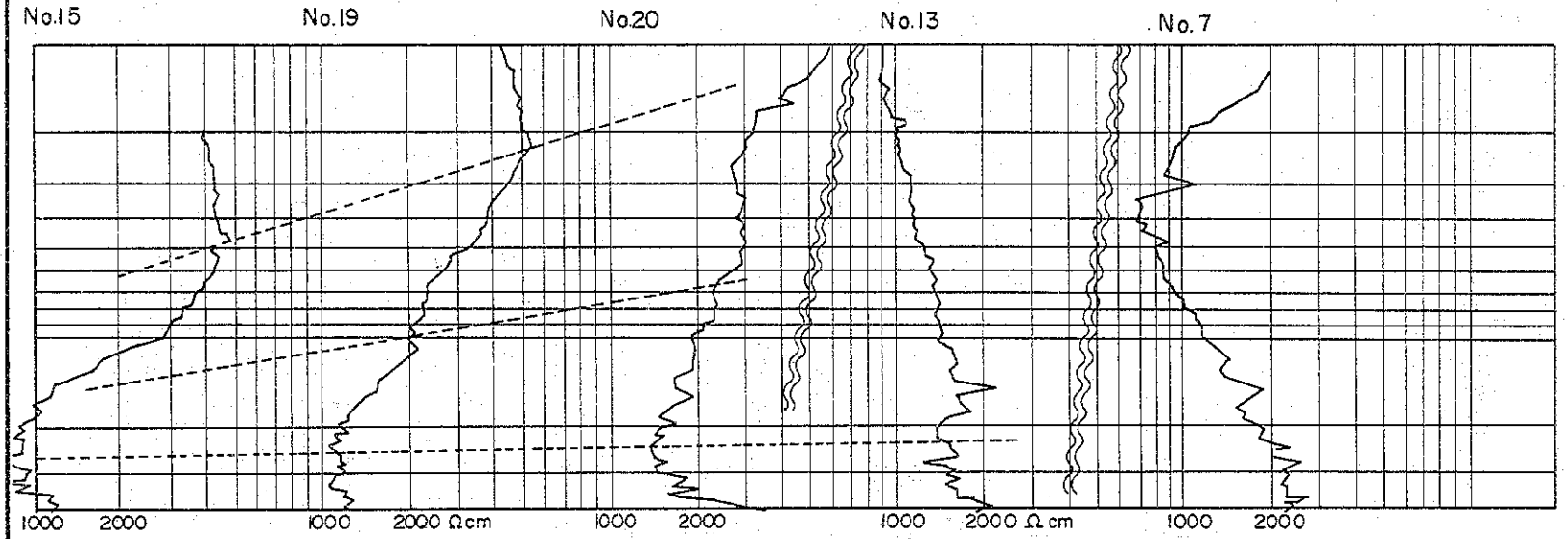


Fig-5-3 SPECIFIC RESISTIVITY PROFILE

Haikarzai District A

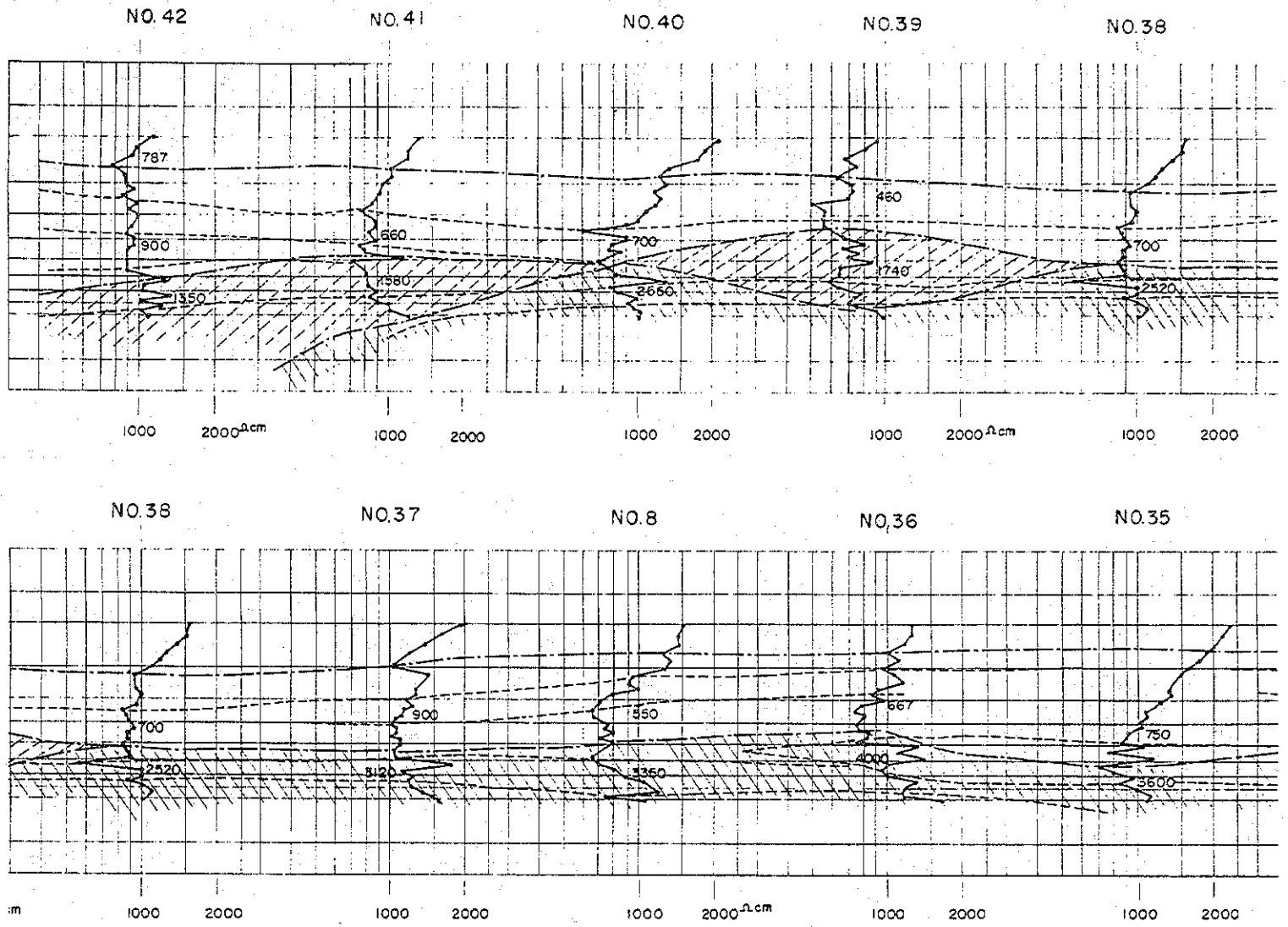
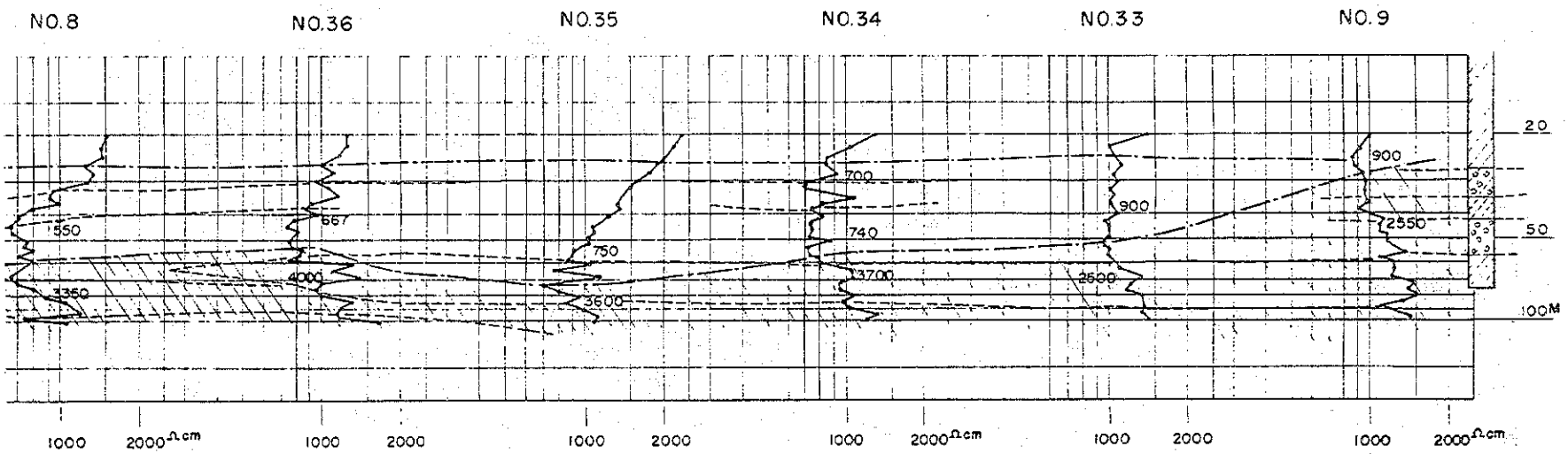


Fig-5-4 SPECIFIC RESISTIVITY PROFILE

Haikarzai District B



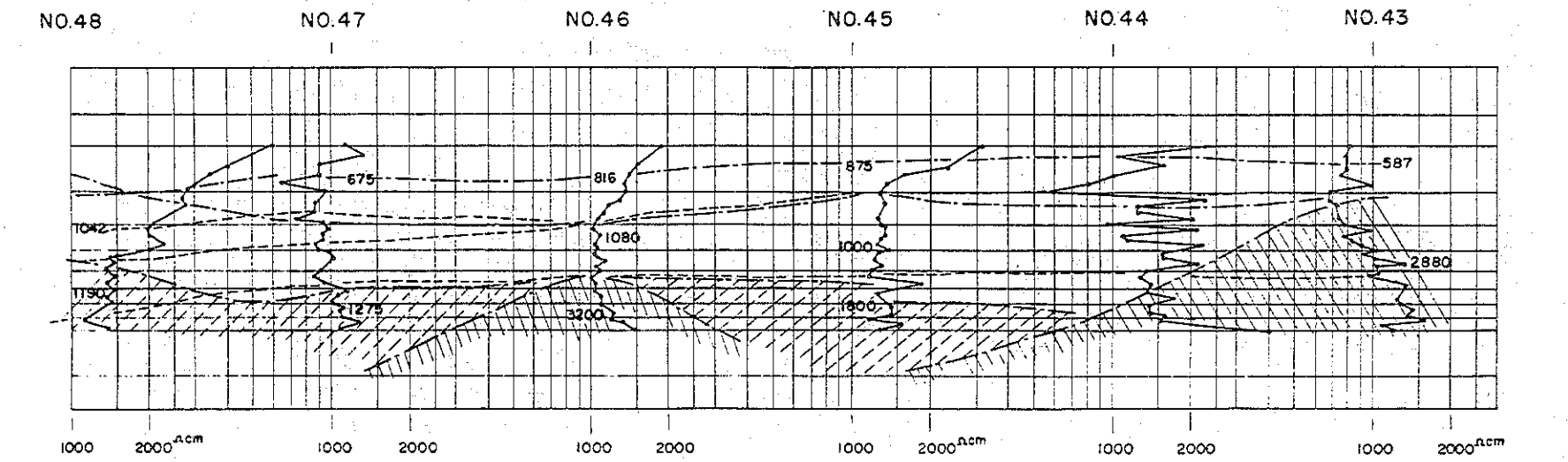
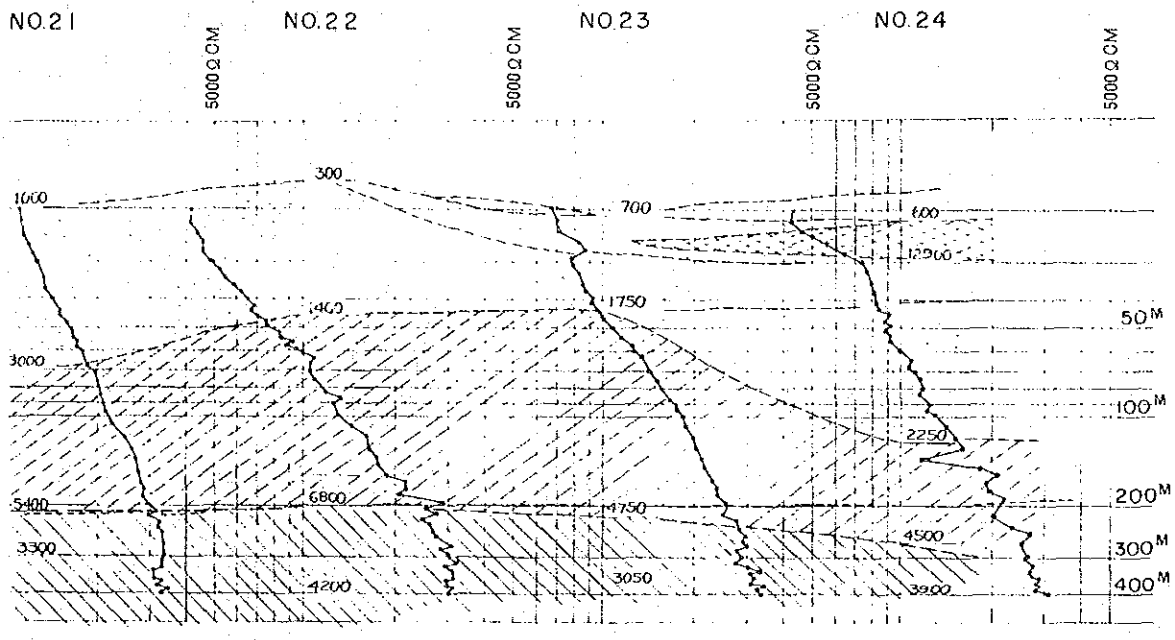
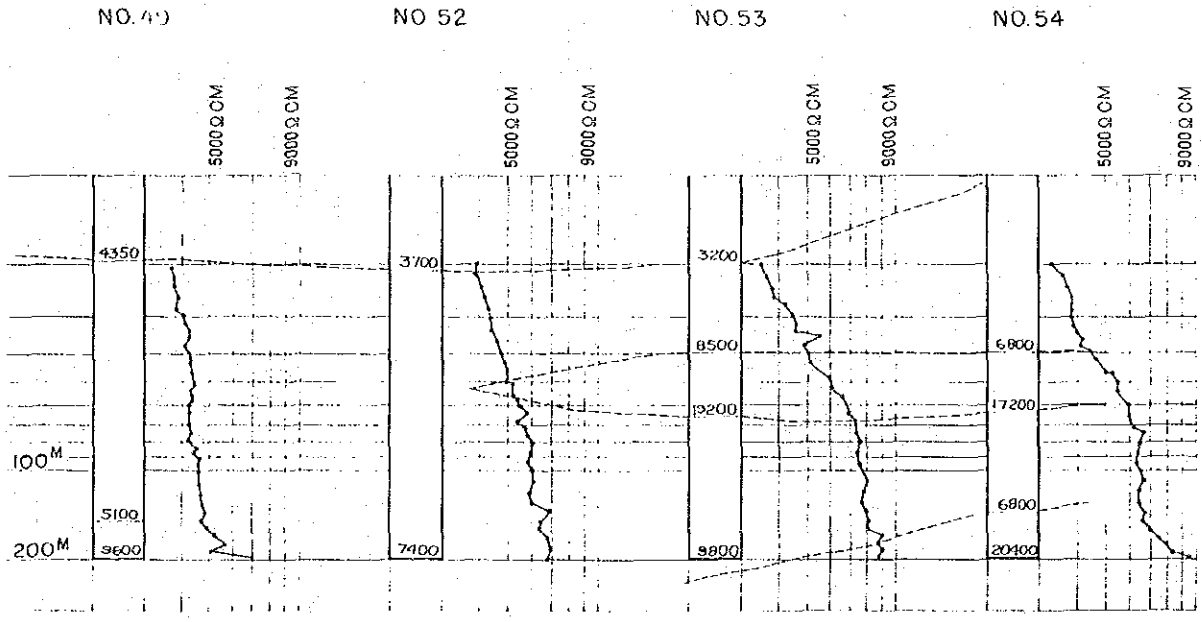


Fig-5-5 SPECIFIC RESISTIVITY PROFILE

Karbala District



Popalzai District



VI. TRIAL BORING

The trial boring has been carried out at two sites, as marked on Fig. 6, resulting from the electrical resistivity test.

The contents of trial boring are drilling, aquifer test and water quality test.

Its results are summarized in Table 2, and the details are given in Fig. 7 to Fig. 12, and Table 3. The correlation of electric prospecting and trial boring are illustrated on Fig. 13 and Fig. 14.

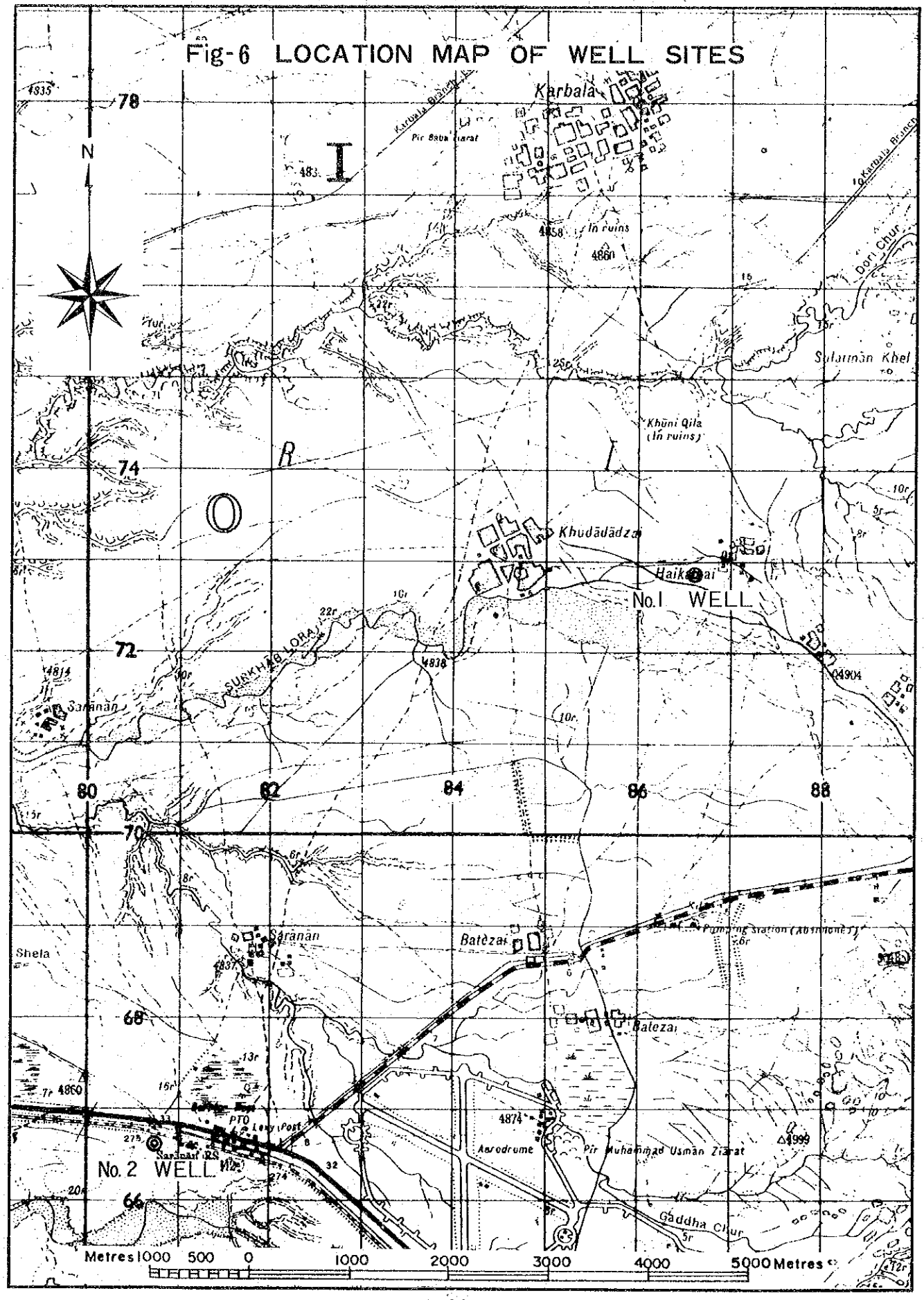


Fig-6 LOCATION MAP OF WELL SITES
N
Karbala
Pir Baba Ziarat
Karbala Branch
In ruins
Dori Chur
Sulaimān Khel
Khūni Qila
(In ruins)
Khudādādzai
Haikalai
No.1 WELL
SURKHĀB LORAI
Sāranān
Shela
Batèzai
Pumping Station (Abstracted)
Bateza
Aerodrome
Pir Muhammad Usmān Ziārat
Gāddha Chur
No. 2 WELL
Metres 1000 500 0 1000 2000 3000 4000 5000 Metres

Table 2. Summary of Well Characteristics

1.	Well No.	No. 1	No. 2
2.	Site	Haikalzai	Saranan
3.	Date of Drilling Commenced	29 Apr '81	10 May '81
4.	Date of Well Completed	12 May '81	28 May '81
5.	Total Depth (m)	92.50	132.80
6.	Static Water Level (GL, m)	-14.87	-18.26
7.	Drawdown (m)	13.10	3.66
8.	Withdrawal (ℓ/min)	277.0	310.0
9.	Specific Capacity (ℓ/min/m-drawdown)	21.15	84.70
10.	Transmissivity (m^2/sec)	3.4×10^{-4}	2.89×10^{-3}

Fig-7-1 TEST WELL LOG (No. 1 WELL)

Well No.	No. 1	Total Depth	92.50M
Coordinates		Static Water Level	GL −14.87M
Site	Haikalzai	Drawdown Water level	GL −27.97M
Location		Withdrawal	277L/min
Elevation		Specific Capacity	21.15L/min/m
Drilling Started	29. 4. 81	Water Temperature	
Well Completed	12. 5. 81	Water Quality	

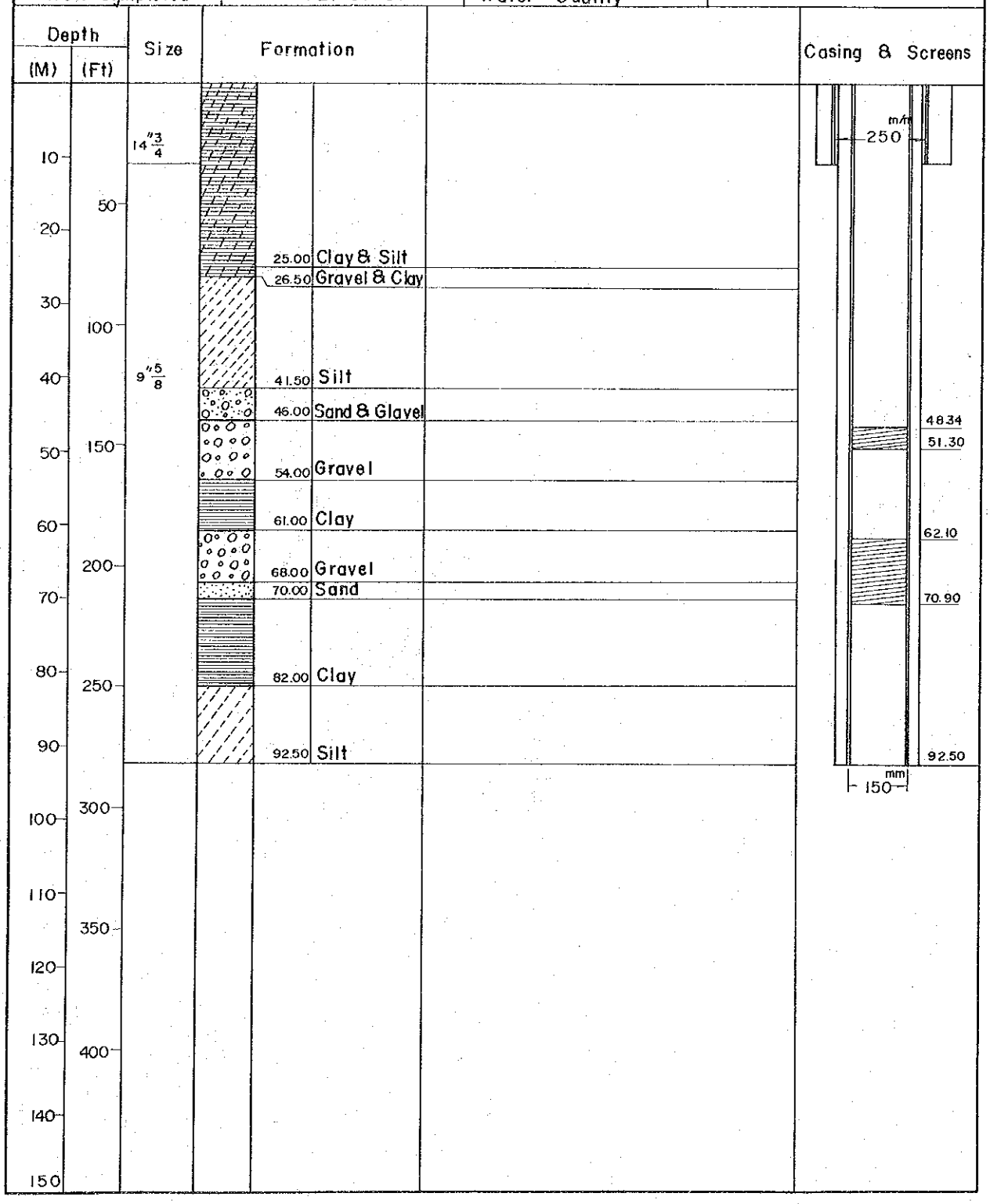


Fig-7-2 TEST WELL LOG (No. 2 WELL)

Well No.	No.2	Total Depth	132.80 m
Coordinates		Static Water Level	GL- 18.261m
Site	Saranan	Drawdown Water level	GL- 21.917m
Location		Withdrawal	310 L/min
Elevation		Specific Capacity	84.79 L/m /min
Drilling Started	10.5 . 81	Water Temperature	
Well Completed	28.5 . 81	Water Quality	

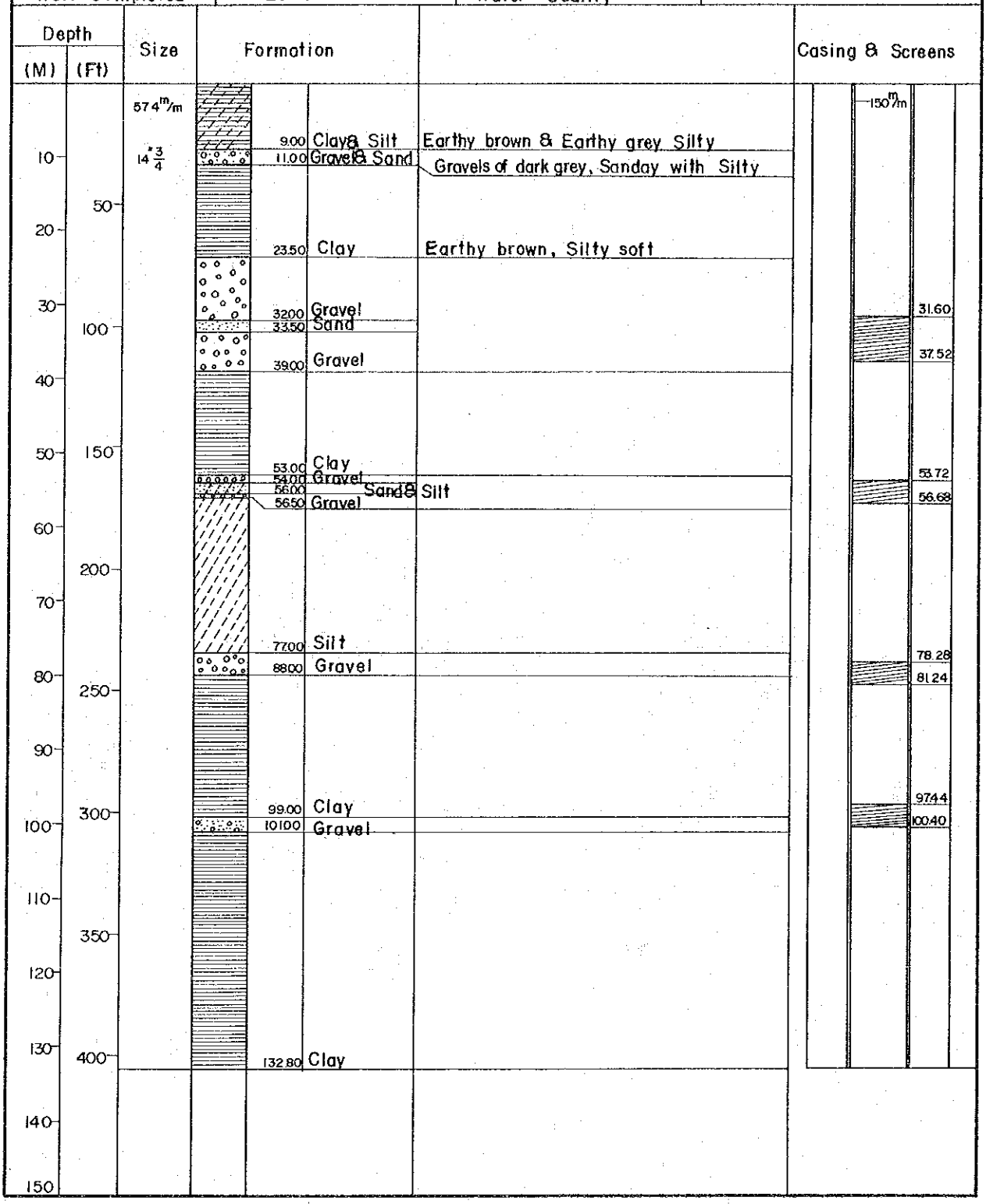


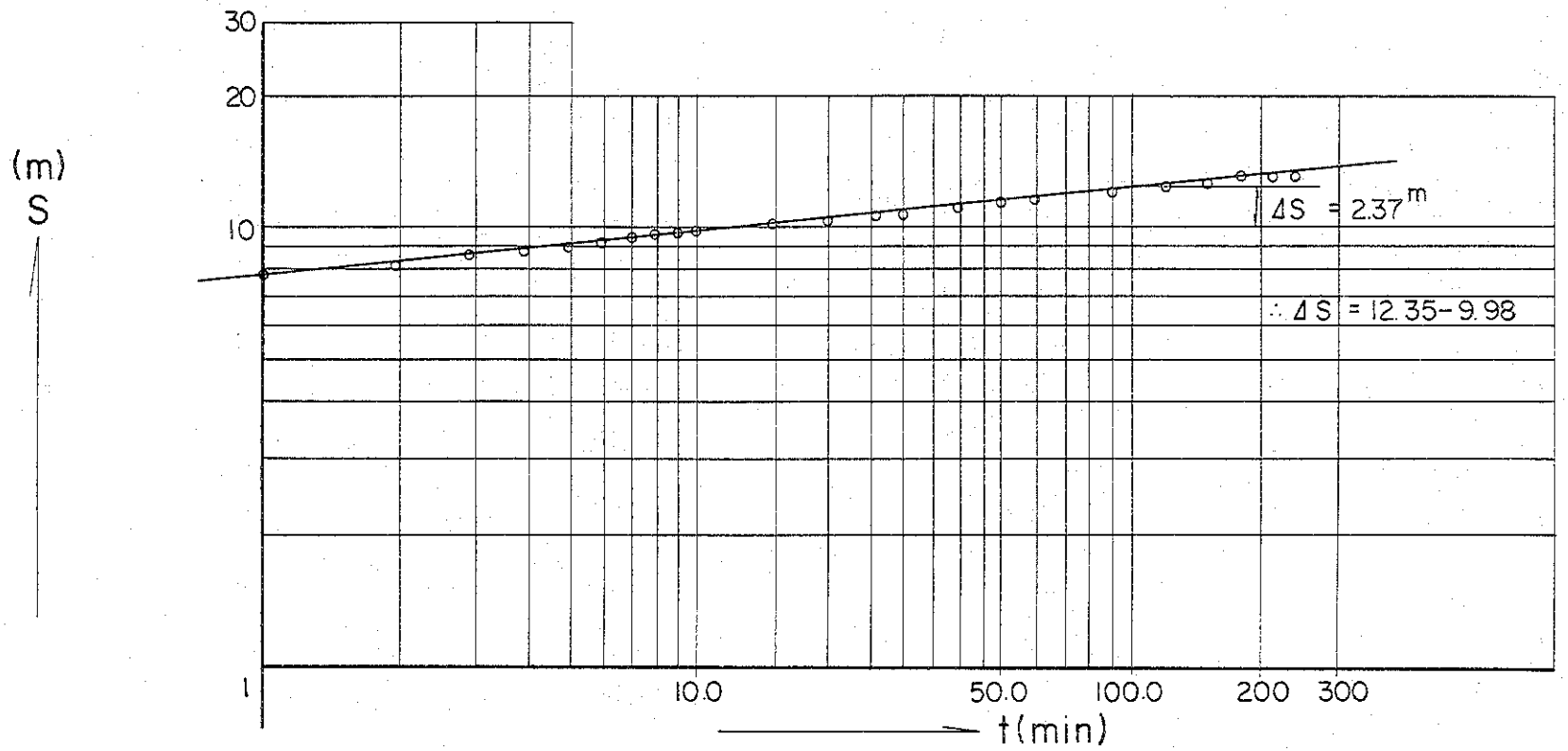
Table 3-1. Pumping Test Record
No.1 Well

	Drawdown			Residual drawdown		Step drawdown test	
Time (min)	Rate (ℓ/min)	Water level (m)	Difference (m)	Water level (m)	Difference (m)	Rate (ℓ/min)	Water level (m)
Start		GL-14.87				14.87	
1		22.68	7.81				
2		23.09	8.22				
3	277	23.62	8.75				
4		24.03	9.16				
5		24.19	9.32				
6		24.50	9.63				
7		24.61	9.74				
8		24.69	9.82			277	27.97
9		24.77	9.90				
10		24.85	9.98				
15		25.24	10.37				
20		25.44	10.57				
25		25.62	10.75	15.29	0.420		
30		25.81	10.94				
40		26.07	11.20				
50		26.41	11.54				
60		26.72	11.85	15.045	0.175		
90		27.20	12.33	15.041	0.171		
120		27.46	12.59				
150		27.69	12.82	15.034	0.164		
180		27.97	13.10	15.022	0.152		
210		27.98	13.11	15.016	0.146		
240		27.98	13.11	15.013	0.143		
1440	277	27.96					
2880		27.97					

Table 3-2. Pumping Test Record
No.2 Well

	Drawdown			Residual drawdown		Step drawdown test	
Time (min)	Rate (ℓ/min)	Water level (m)	Difference (m)	Water level (m)	Drifference (m)	Rate (ℓ/min)	Water level (m)
Start	310	18.261					
1		21.284	3.023				
2		21.312	3.051			74	20.223
3		21.353	3.092				(1.962)
4		21.371	3.110				
5		21.390	3.129			108	20.565
6		21.447	3.186				(2.304)
7		21.466	3.205				
8		21.470	3.209			189	21.228
9		21.473	3.212				(2.967)
10		21.550	3.289				
15		21.615	3.354			310	21.917
20		21.698	3.437				(3.656)
25		21.725	3.464	18.293	0.032		
30		21.740	3.479				
40		21.785	3.524				
50		21.797	3.536				
60		21.810	3.549	18.285	0.024		
90		21.850	3.589	18.284	0.023		
120		21.875	3.614				
150		21.917	3.656	18.283	0.022		
180		21.917	3.656	18.279	0.018		
210		"	"	18.279	0.018		
240		"	"	18.278	0.017		
1440							
2880							

Fig-8 PUMP TEST ANALYSIS (JACOB'S METHOD, DRAWDOWN)
No. 1 WELL



T (Transmissibilty coeffcient) = 3.57×10^{-4} m²/sec K (Permeability coeffcient) = 1.79×10^{-5} m/sec S (Storage coeffcient) = 1.08×10^{-6} sec

$T = \frac{2.30}{4\pi\Delta S} = \frac{2.3 \times 0.277}{4 \times 3.14 \times 2.37}$ $\therefore T = 0.0214\ m^2/min \fallingdotseq 3.57 \times 10^{-4}\ m^2/sec$ $S = \frac{2.25Tto}{r^2} = \frac{2.25 \times 76 \times 10^{-6} \times 2.14 \times 10^{-2}}{0.005625} \fallingdotseq 6.5 \times 10^{-5}$ min

$Q = 0.277\ m^3/min$

$\Delta S = 2.37$ m

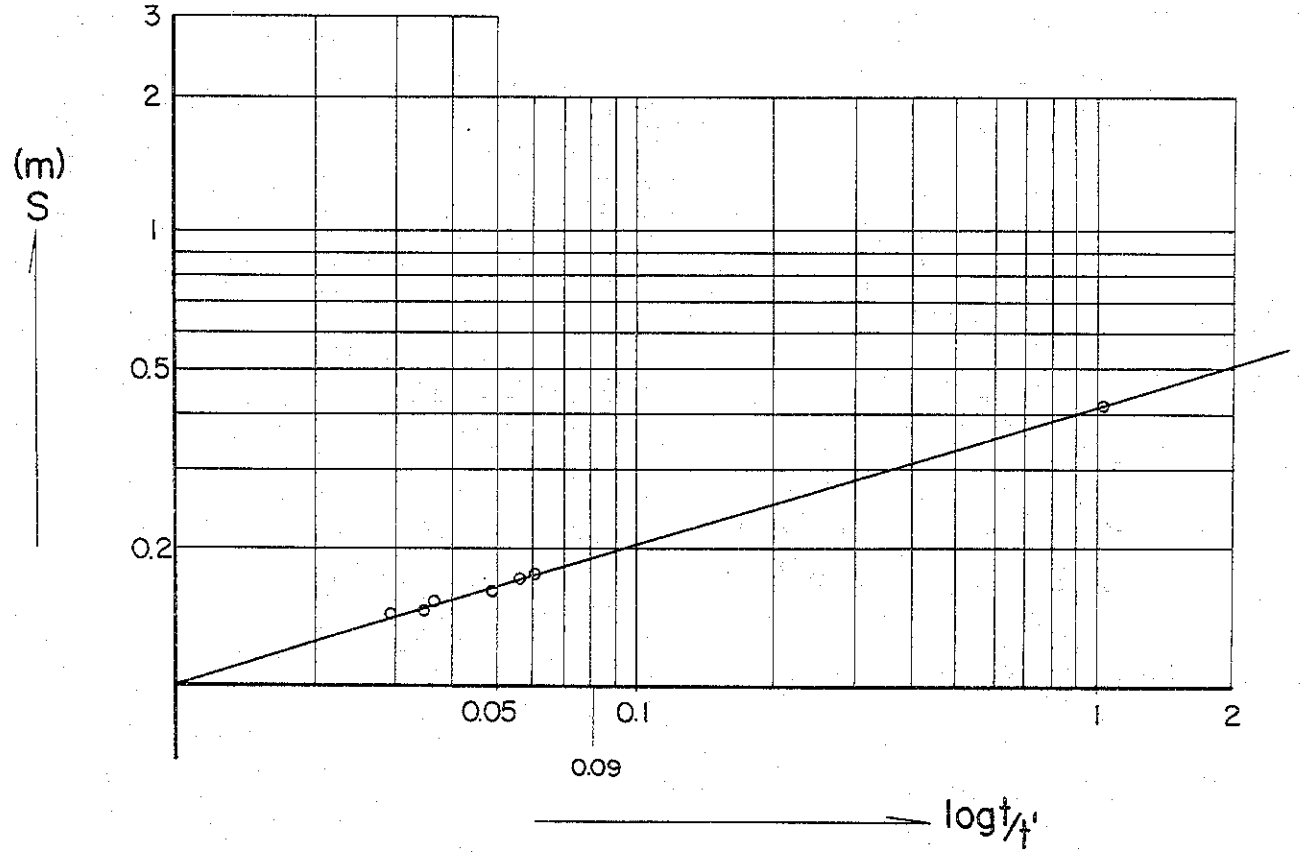
$\therefore K = \frac{T}{M} \fallingdotseq \frac{3.57 \times 10^{-4}}{20} = 1.79 \times 10^{-5}$ m/s

to = 7.6×10^{-6} min

r = 0.075 m

1.08×10^{-6} sec

Fig-9 PUMP TEST ANALYSIS (JACOB'S METHOD, RECOVERY)
No. 1 WELL

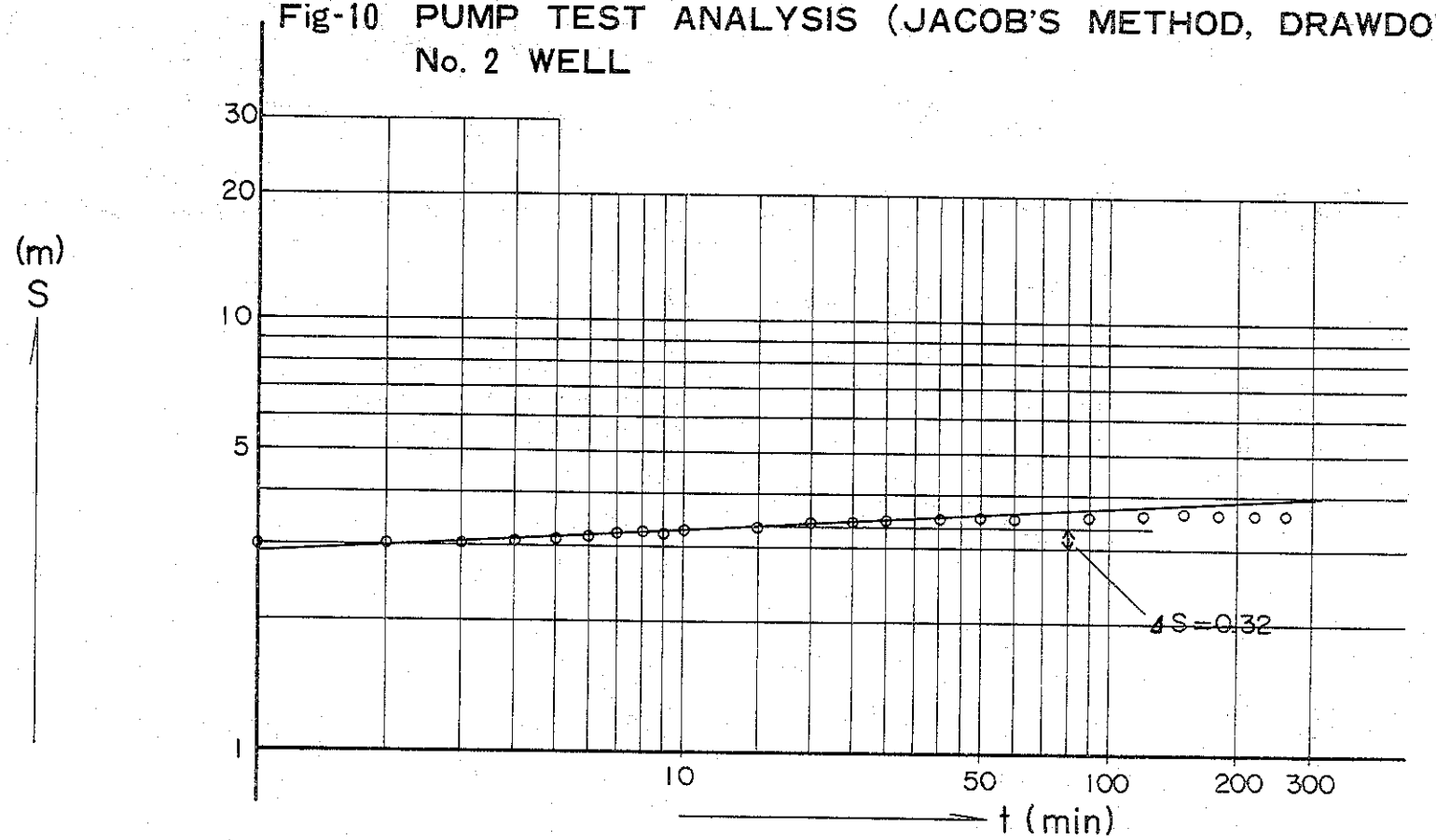


T (Transmissibility coeffcient) = 3.231×10^{-4} m²/sec K (Permeability coeffcient) = 1.62×10^{-5} m/sec

$$T = \frac{0.183Q}{S} \log t/t' = \frac{0.183 \times 0.277 \times 0.09}{0.20} = 0.0187 \text{ m}^2/\text{min} = 3.231 \times 10^{-4} \text{ m}^2/\text{sec}$$

$$K = \frac{T}{M} = \frac{3.231 \times 10^{-4}}{20} = 1.62 \times 10^{-5} \text{ m/sec}$$

Fig-10 PUMP TEST ANALYSIS (JACOB'S METHOD, DRAWDOWN)
No. 2 WELL



T (Transmissibility coeffcient) = 2.95×10^{-3} m²/sec K (Permeability coeffcient) = 1.34×10^{-4} m/sec S (Storage coeffcient) = 1.35×10^{-6} sec

$T = \frac{2.3Q}{4\pi\Delta s} = \frac{2.3\times0.31}{4\times3.14\times0.32}$ ∴ $T = 0.177\ m^2/min = 2.95\times10^{-3}\ m/sec$

$S = \frac{2.25Tto}{r^2} = \frac{2.25\times1.77\times1.15\times10^{-8}}{0.005625} \fallingdotseq 8.14\times10^{-5}\ min \fallingdotseq 1.35\times10^{-6}\ sec$

$Q = 0.31\ m^3/min$

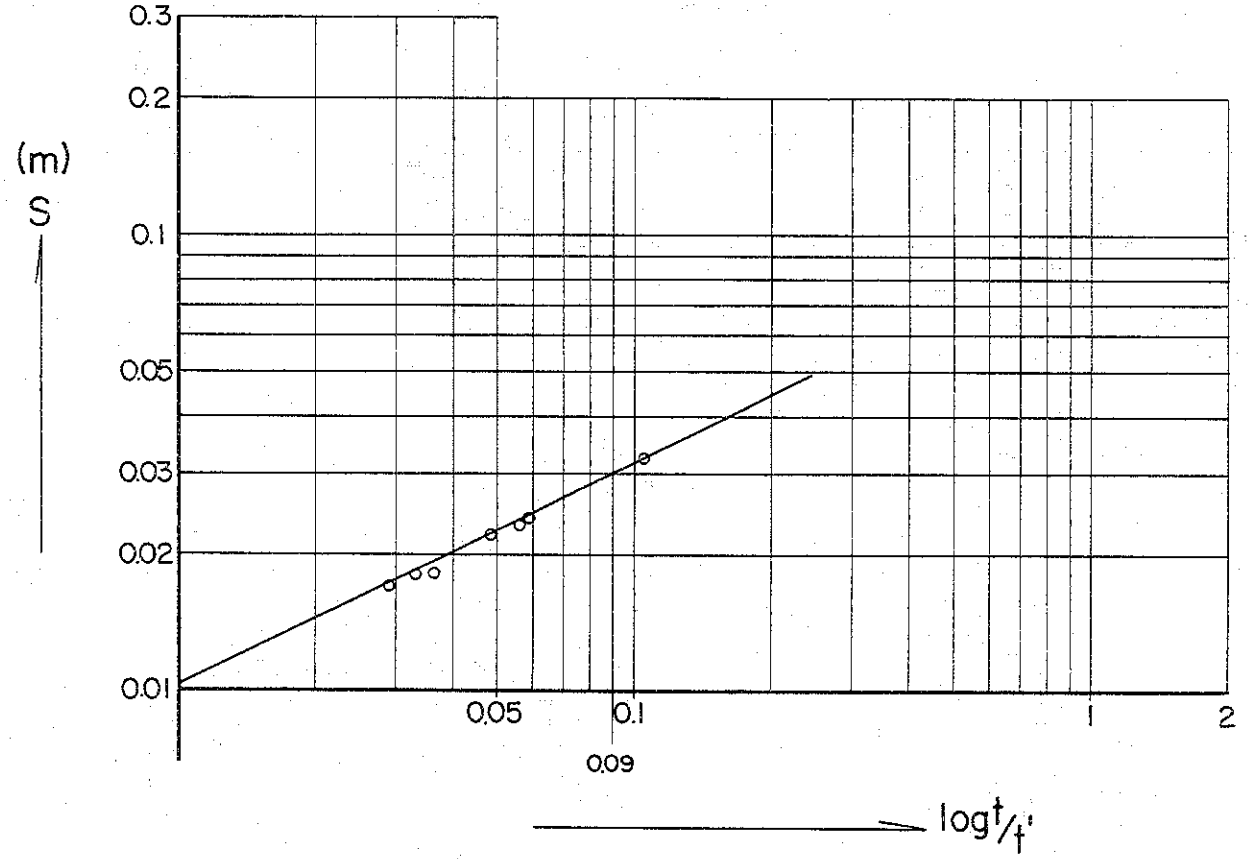
$\Delta s = 0.32m$

∴ $K = \frac{T}{M} \fallingdotseq \frac{2.95\times10^{-3}}{22} = 1.34\times10^{-4}\ m/sec$

$to = 1.15\times10^{-7}\ min$

$r = 0.075m$

Fig-11 PUMP TEST ANALYSIS (JACOB'S METHOD, RECOVERY)
No. 2 WELL



T (Transmissibility coeffcient) = 2.83×10^{-3} m^2/min

K (Permeability coeffcient) = 1.29×10^{-5} m/sec

$$T = \frac{0.183Q}{S} \log t/t' = \frac{0.183 \times 0.31 \times 0.09}{0.03} = 0.17 \ m^2/min = 2.83 \times 10^{-3} m^2/sec$$

$$K = \frac{T}{M} = \frac{2.83 \times 10^{-3}}{22} = 1.29 \times 10^{-5}$$

Fig-12 STEP DRAWDOWN TEST ANALYSIS
No. 2 WELL

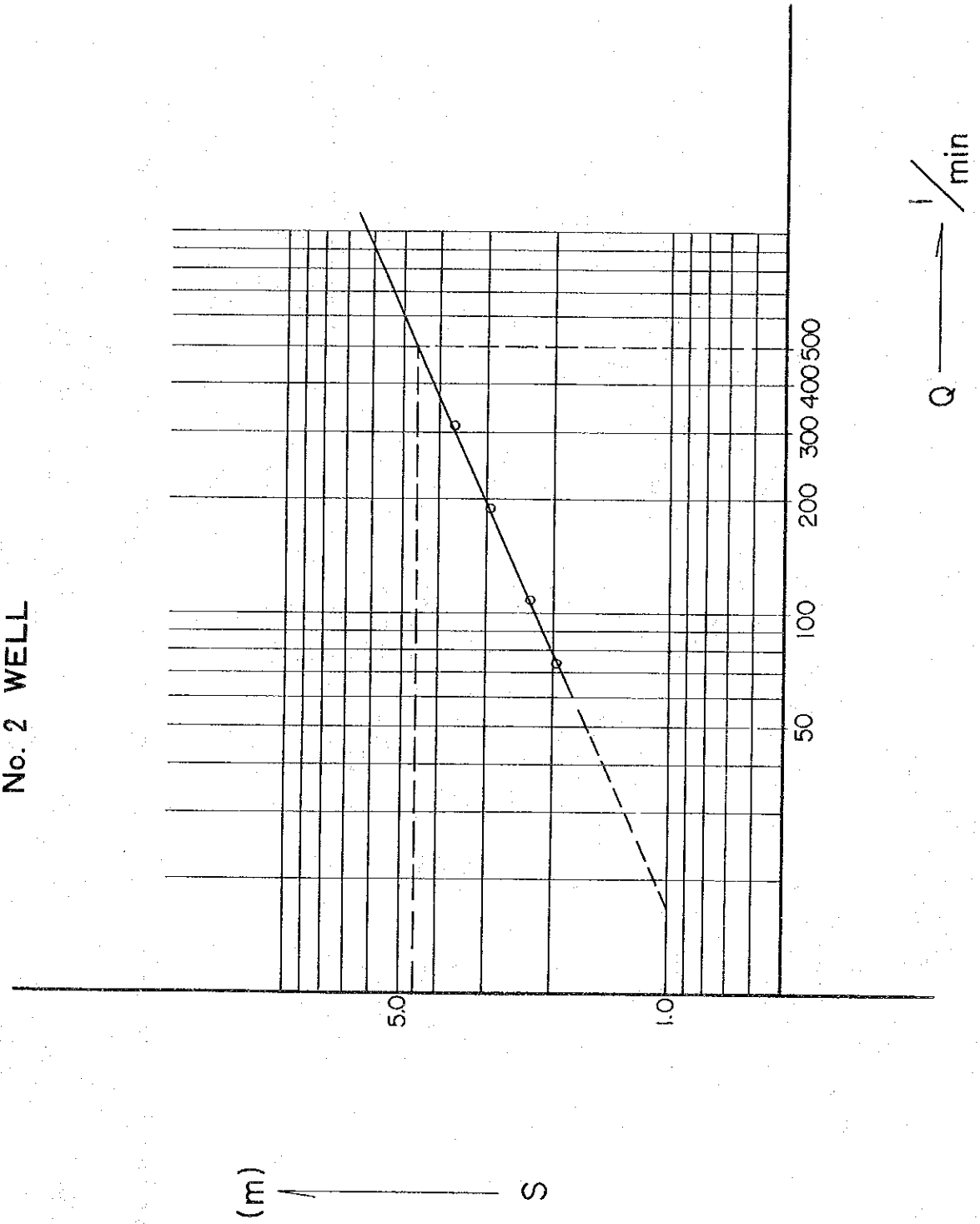


Fig-13-1 GEOLOGICAL PROFILE (No. 1 WELL)
WELL AND RESISTIVITY LOG

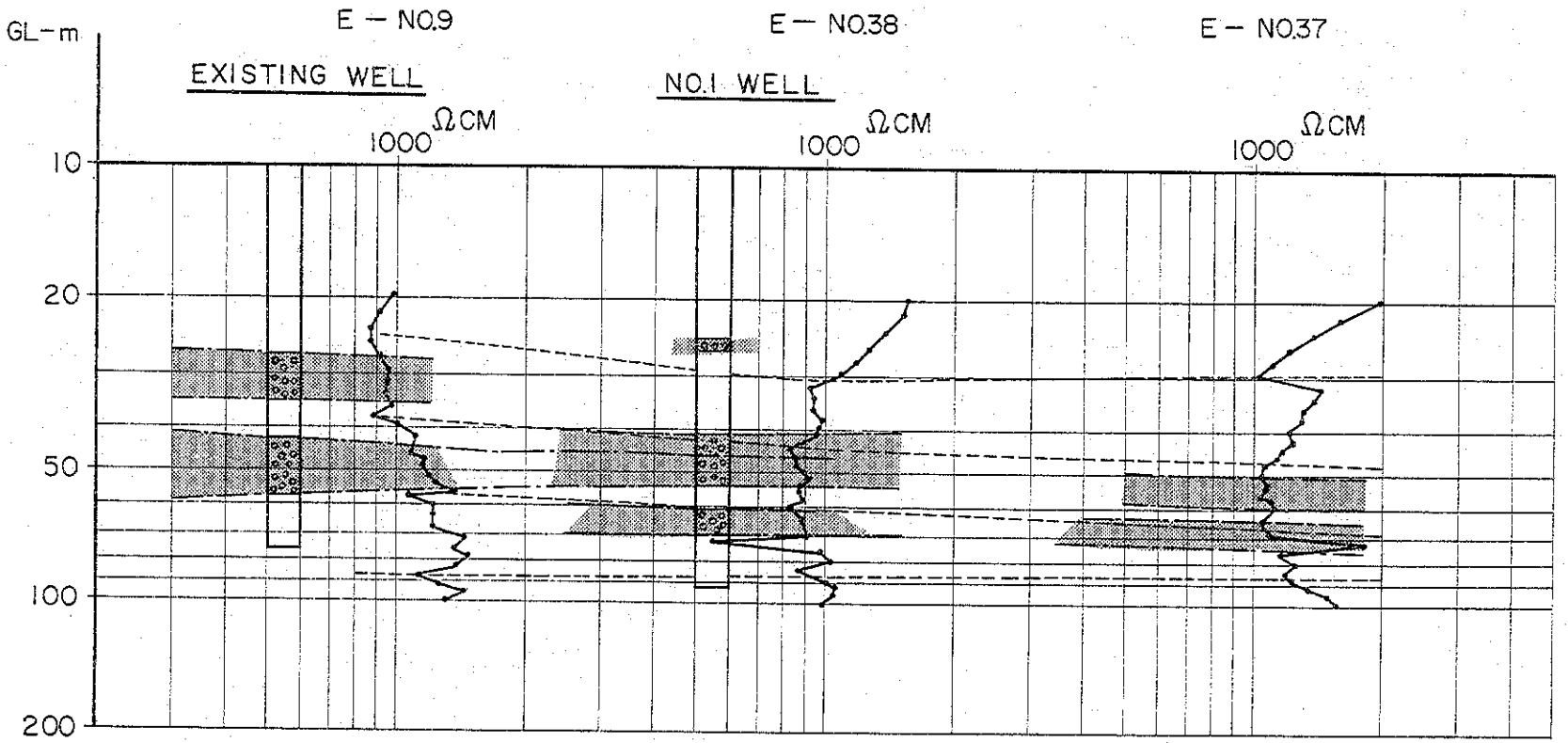


Fig-13-2 GEOLOGICAL PROFILE (No. 2 WELL)
WELL AND RESISTIVITY LOG

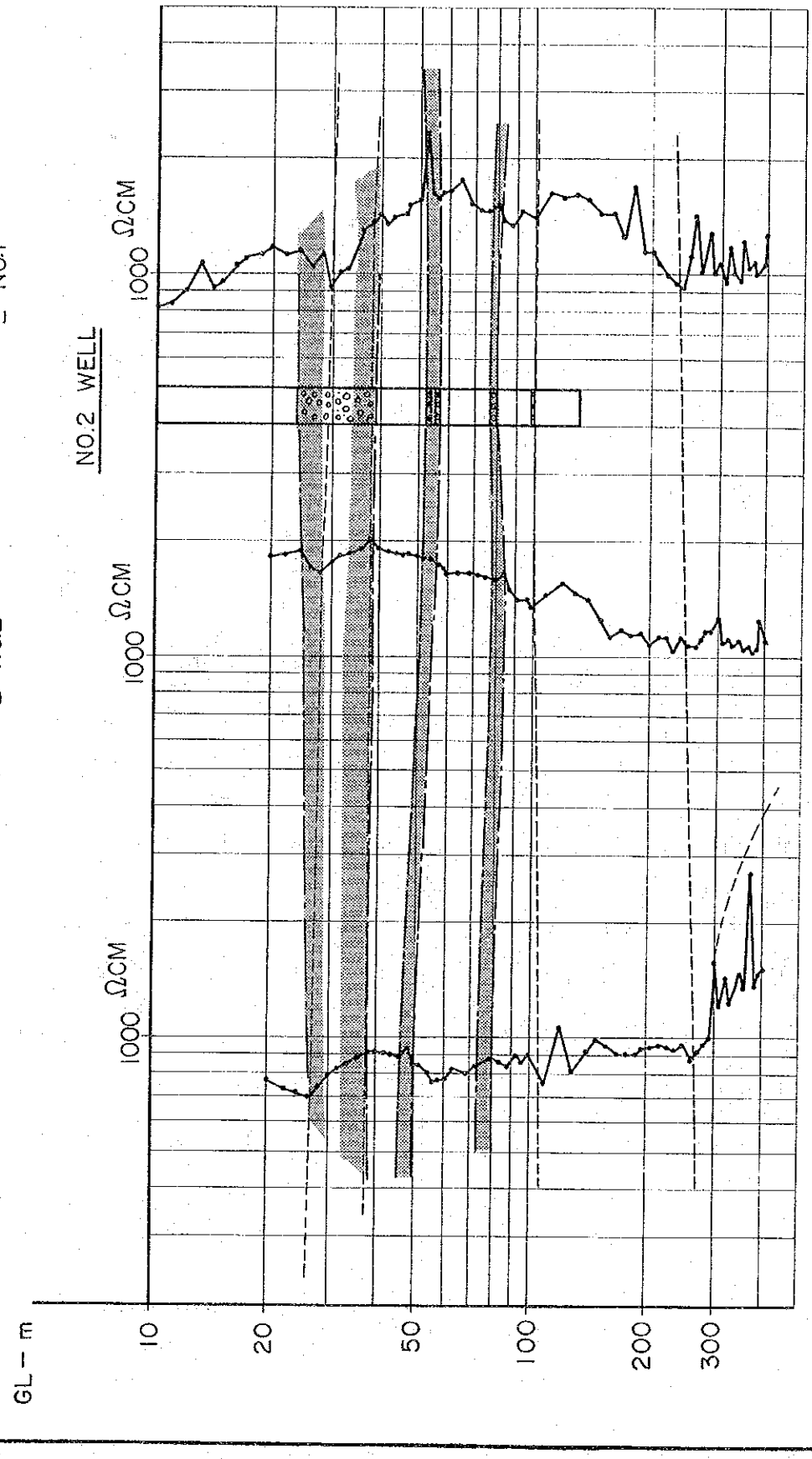
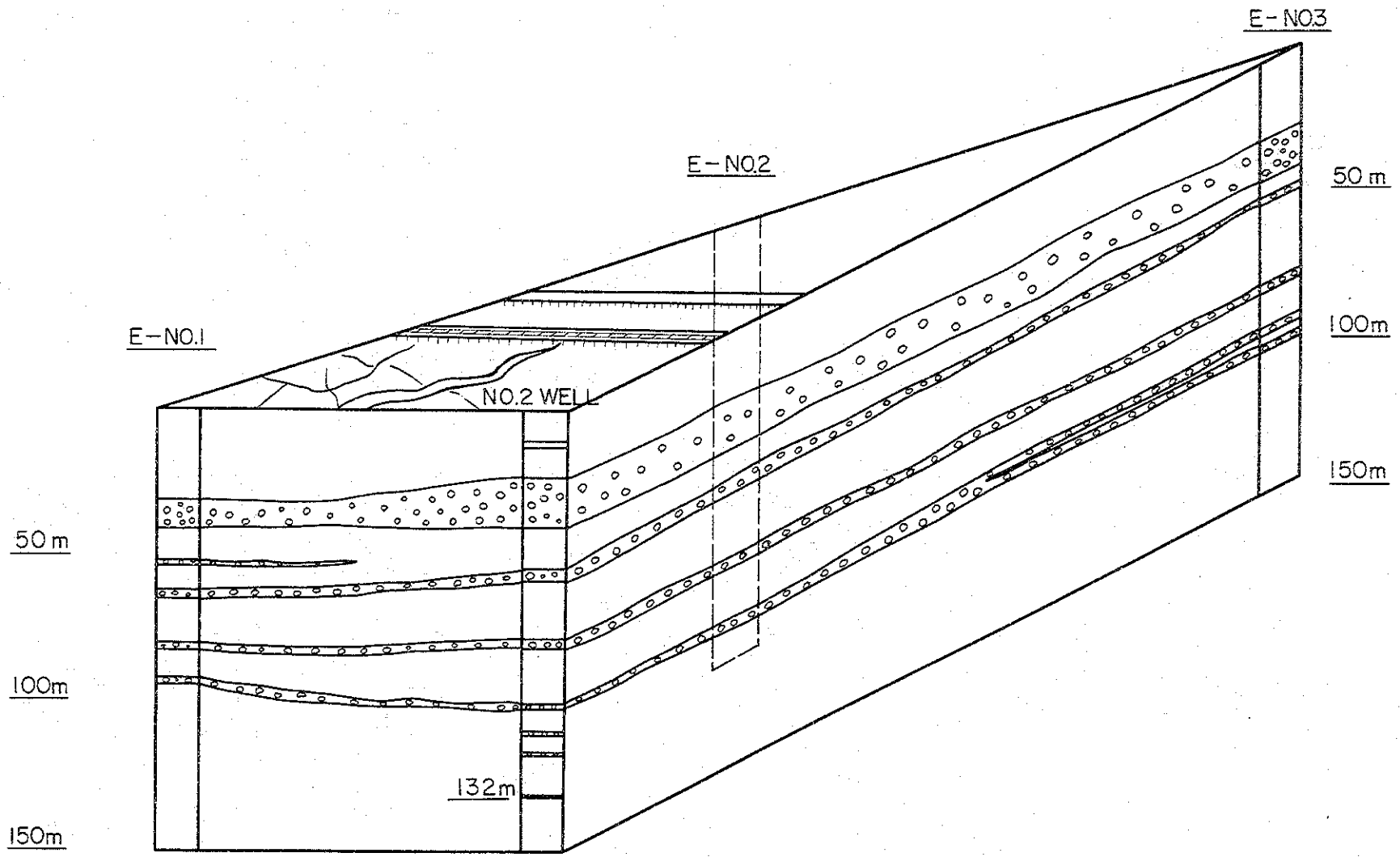


Fig-14 GEOLOGICAL BLOCK DIAGRAM
No. 2 WELL



VII. BASIC DESIGN

(i) General

Water supply would be provided to Afghan Refugees Camp at Saranan with population totalling 22,000 persons. The designs are planned to provide 15 litres per day per person. Ground water from No. 2 Well at Saranan will be used as water source of the project.

Water supply installation would consist of tube well, pump, elevated tank, pipes, communal water points and operator's house. The water will be pumped up from tube well to the elevated tank which will be built above the tube well from where water will be conveyed by gravity to the communal water points in camp.

(ii) Water Supply Facilities

The pump will be submersible motor pump with high-head capacity and will be operated for 12 hours daily. The electricity will be supplied by two ways: i.e., power transmission line of WAPDA and diesel generator. The elevated tank will be made of steel and the capacity has been designed to meet the hourly changes of consumption. As far as pipes are concerned, hard vinyl chloride pipes will be used.

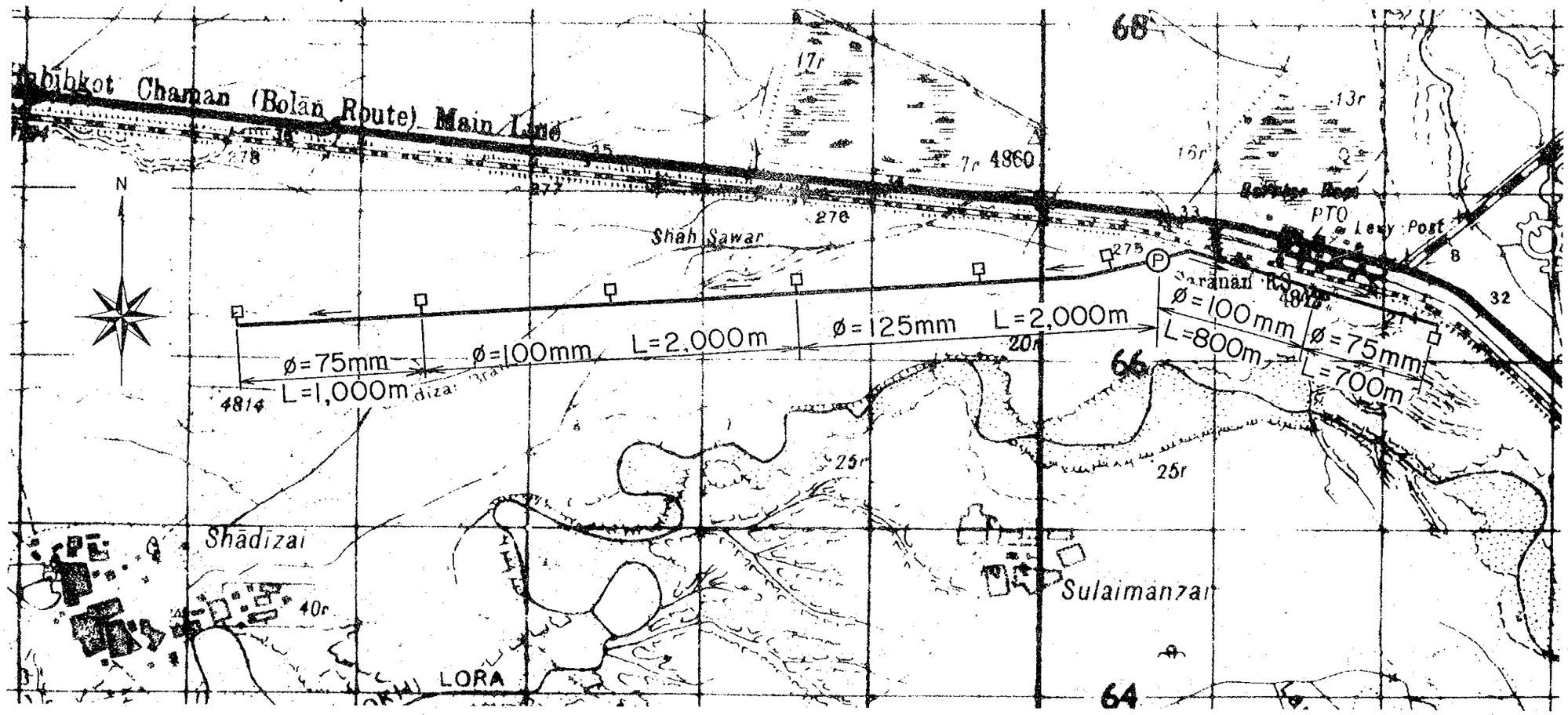
The general plans are shown in Fig. 15 to Fig. 21.

(iii) Project Cost Estimate and Maintenance

The costs required for execution of the project are estimated as shown in Table 4. The total project costs will be Yen 300 million and some expenditure from the Government of Pakistan for land recognition of well pump station.

As far as the operation and maintenance are concerned, the staffs such as pump driver, helper, valve man and chowkidar are required. For operating the pump, diesel oil and electric power are needed.

Scale 1 : 25,000



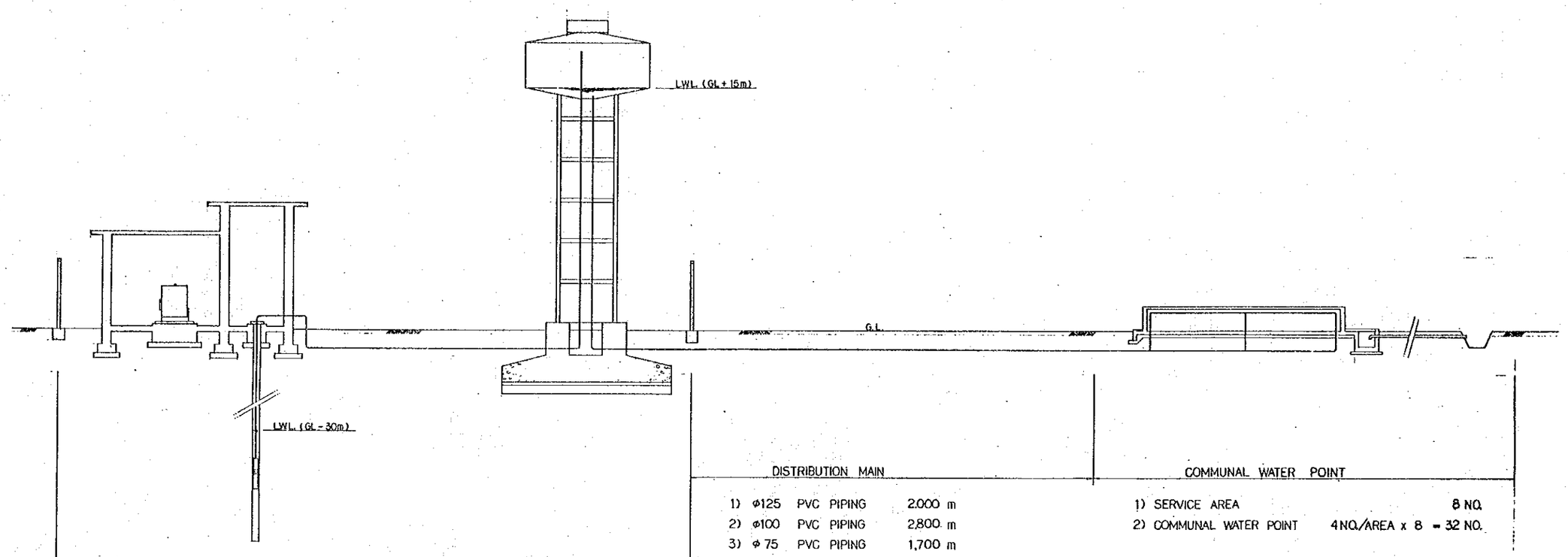
LEGEND

——— PIPE LINE

Ⓟ WELL PUMP STATION

COMMUNAL WATER POINT

Fig-15 LOCATION PLAN



WELL PUMP STATION 63 m x 63 m = 3,969 m²

1) WELL PUMP HOUSE 6.3 m x 8.1 m = 51 m² 1 NO.
   - WELL PUMP 460 l/min x 56 m , φ80 1 NO.
   - DIESEL GENERATOR 30 KVA 1 NO.
   - TRANSFORMER 30 KVA 1 NO.

2) OPERATOR'S HOUSE 8.1 m x 14.7 m = 119 m² 1 NO.

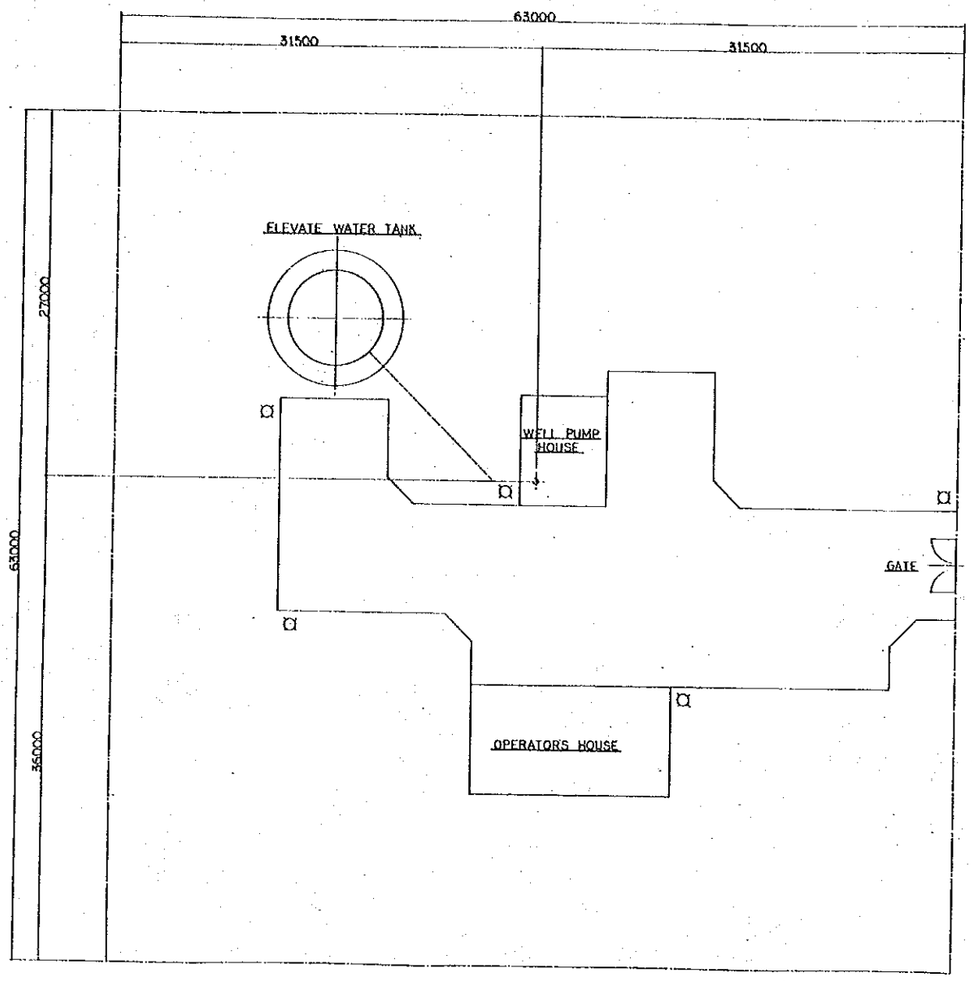
3) ELEVATED WATER TANK 55 m³ 1 NO.

DISTRIBUTION MAIN			COMMUNAL WATER POINT	
1) φ125	PVC PIPING	2,000 m	1) SERVICE AREA	8 NO.
2) φ100	PVC PIPING	2,800 m	2) COMMUNAL WATER POINT	4 NO./AREA x 8 = 32 NO.
3) φ 75	PVC PIPING	1,700 m		

Fig-16 FLOW DIAGRAM

GENERAL LAYOUT OF WELL PUMP STATION

Unit ; mm



GATE

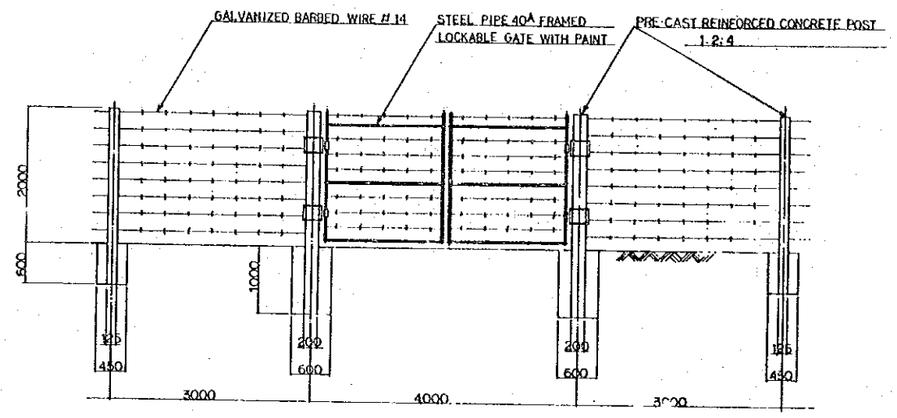
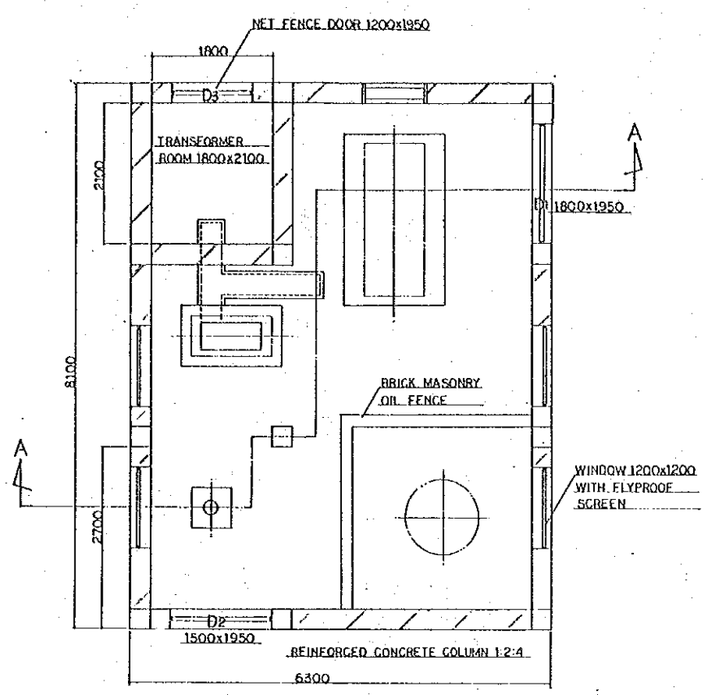
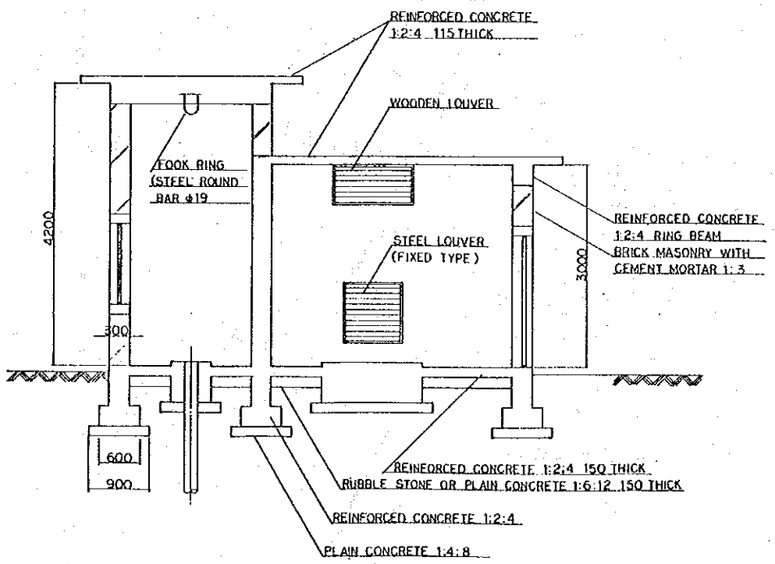


Fig-17 GENERAL LAYOUT OF WELL PUMP STATION

WELL PUMP HOUSE

Unit ;mm

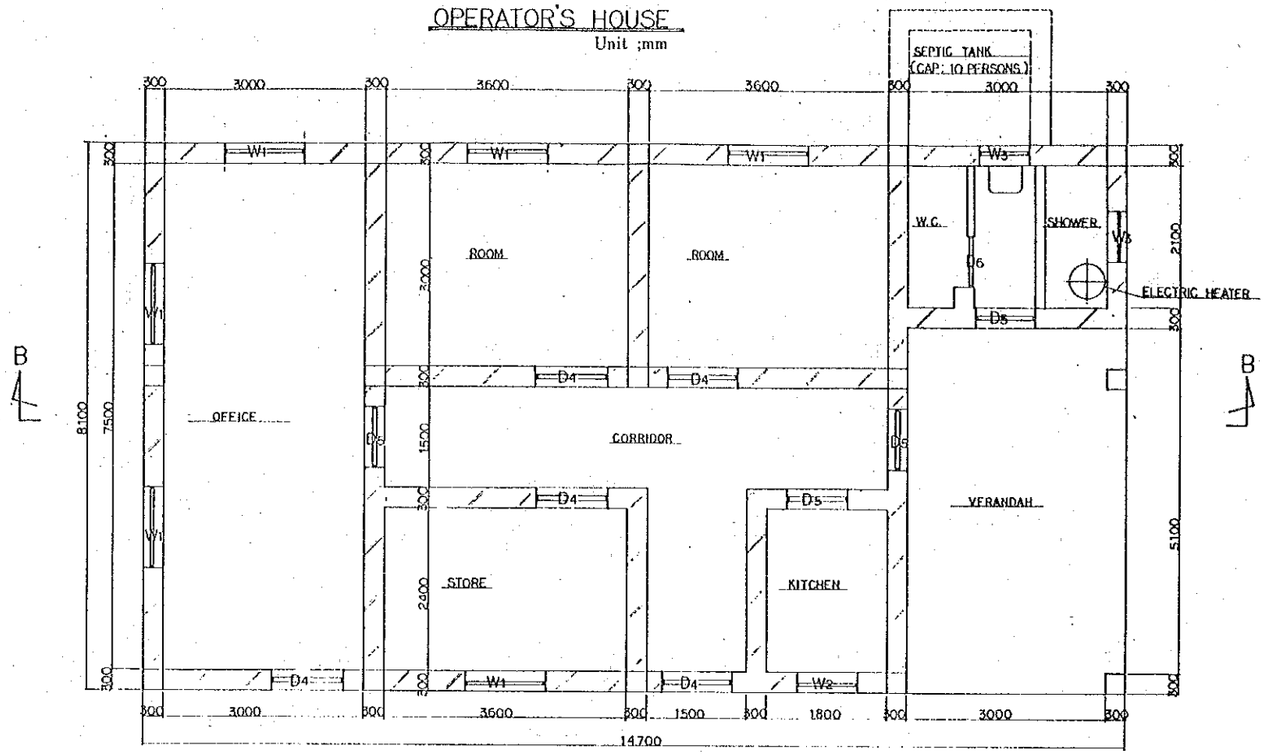


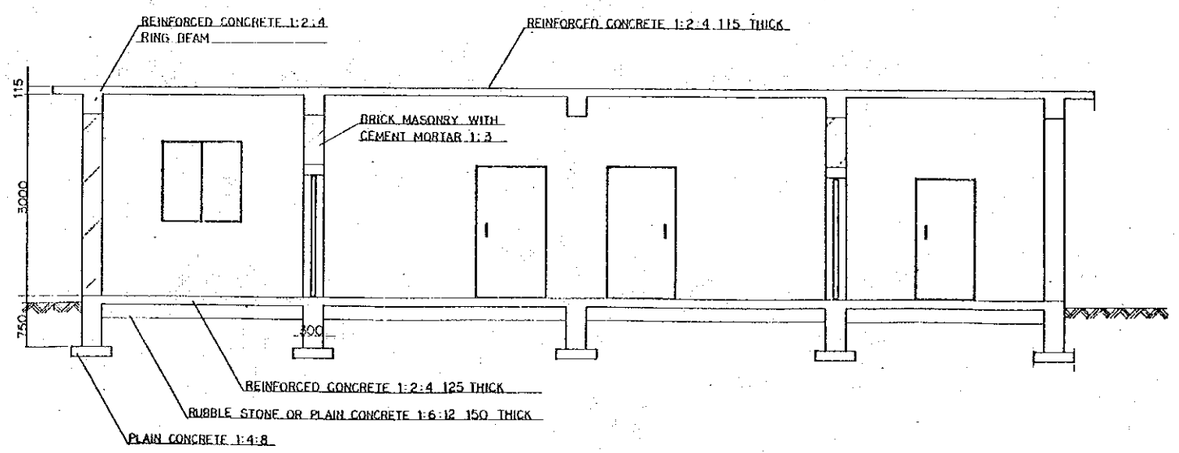


SECTION A-A

OPERATOR'S HOUSE

Unit ;mm





SECTION B-B

NOTE)

1) WALL SURFACES SHALL BE RENDERED BY CEMENT PLASTER 1:3 1/2 THICK AND PAINTED BY COLORED EMULSION PAINT
2) PREFABRICATED HOUSE SHOULD BE ITAKEN INTO CONSIDERATION FOR OPERATOR'S HOUSE ON DETAILD DESIGN STAGE

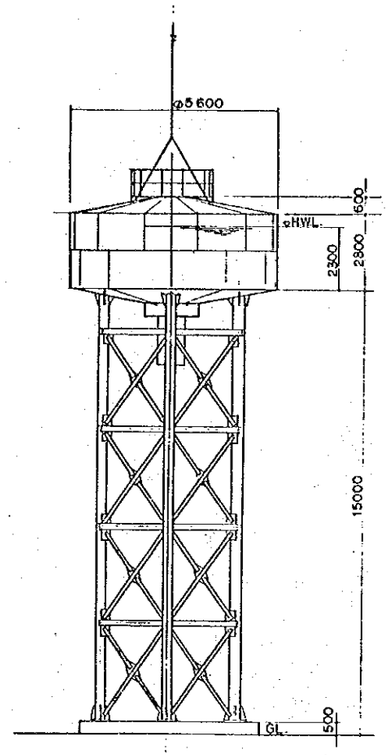
DOORS	D1	1800×1950	D4	1050×19
	D2	1500×1950	D5	900×18
	D3	1200×1950	D6	750×18

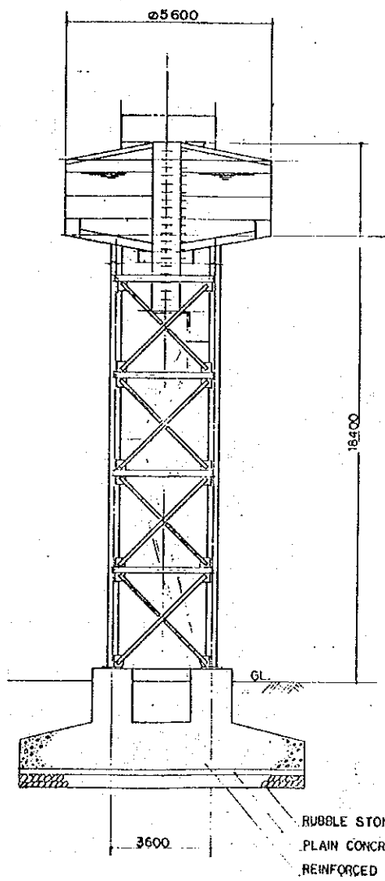
WINDOWS	W1	12 00×1200	WITH FLYPROOF SCRFEN
	W2	9 00×1200	〃
	W3	7 50× 450	

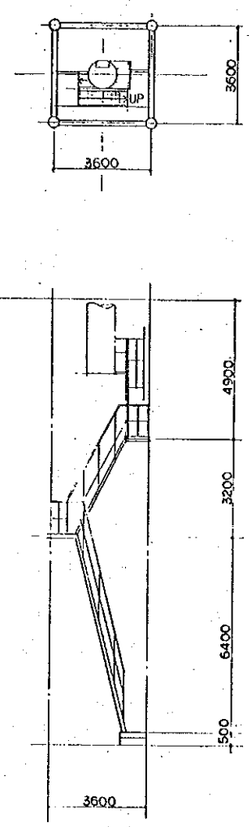
Fig-18 HOUSING

55M³ ELEVATED TANK

Unit ; mm







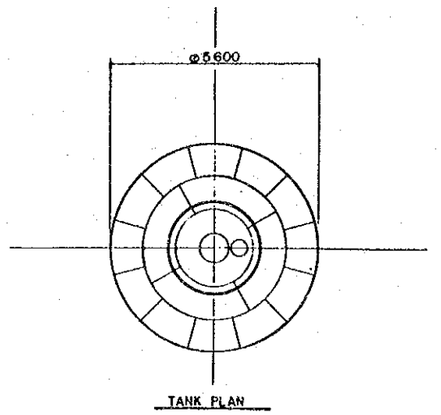
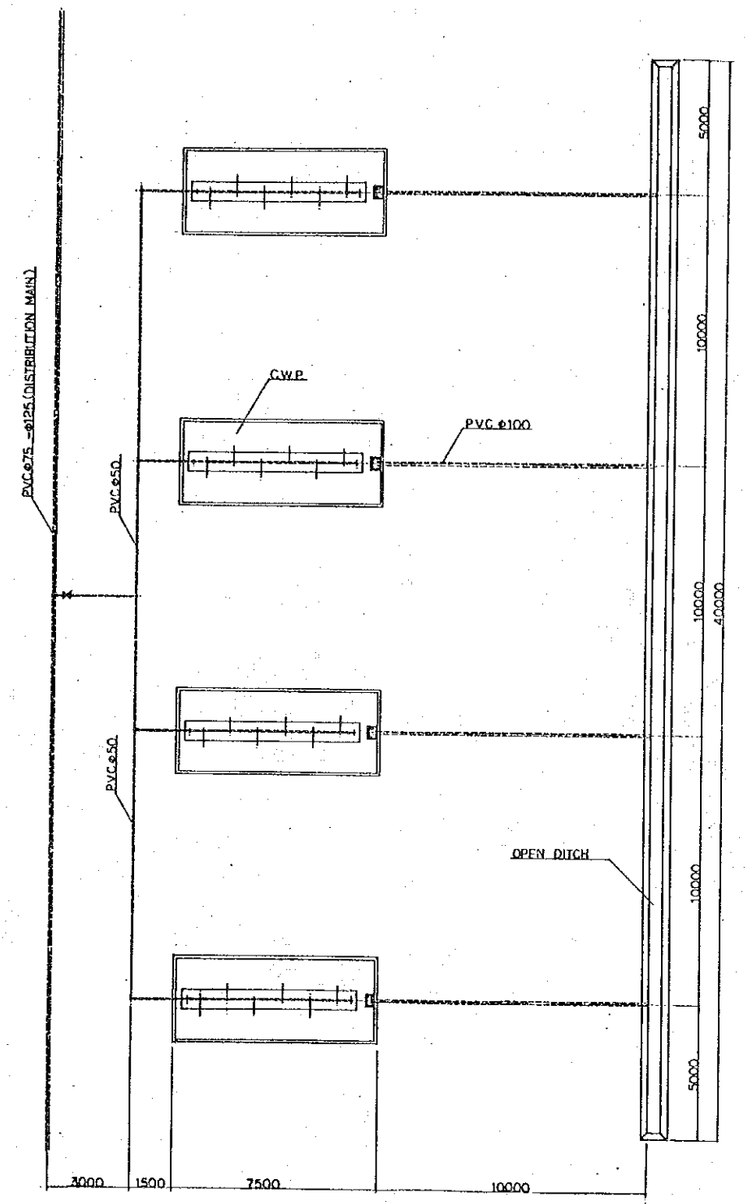


Fig-19 ELEVATED WATER TANK

NOTE) PREFABRICATED STEEL TANK SHOULD BE TAKEN INTO CONSIDERATION ON DETAILD DESIGN STAGE.

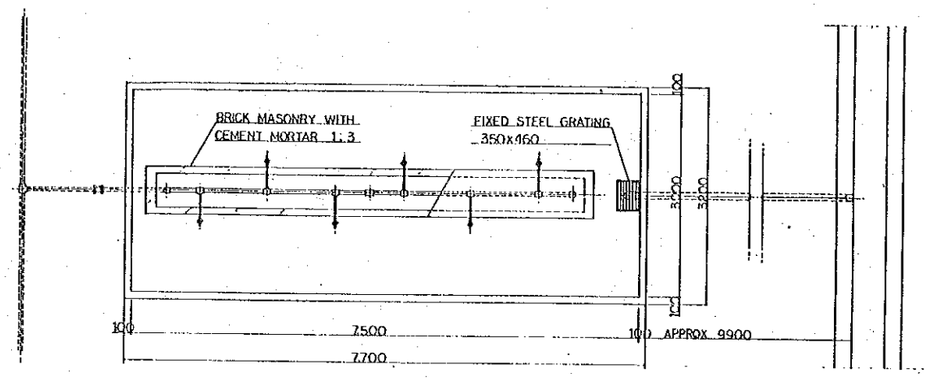
LAYOUT OF SERVICE AREA

Unit ; mm



COMMUNAL WATER POINT

Unit ; mm



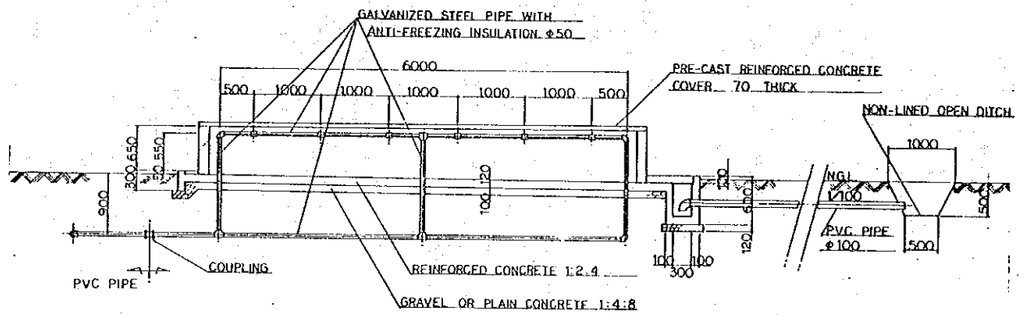
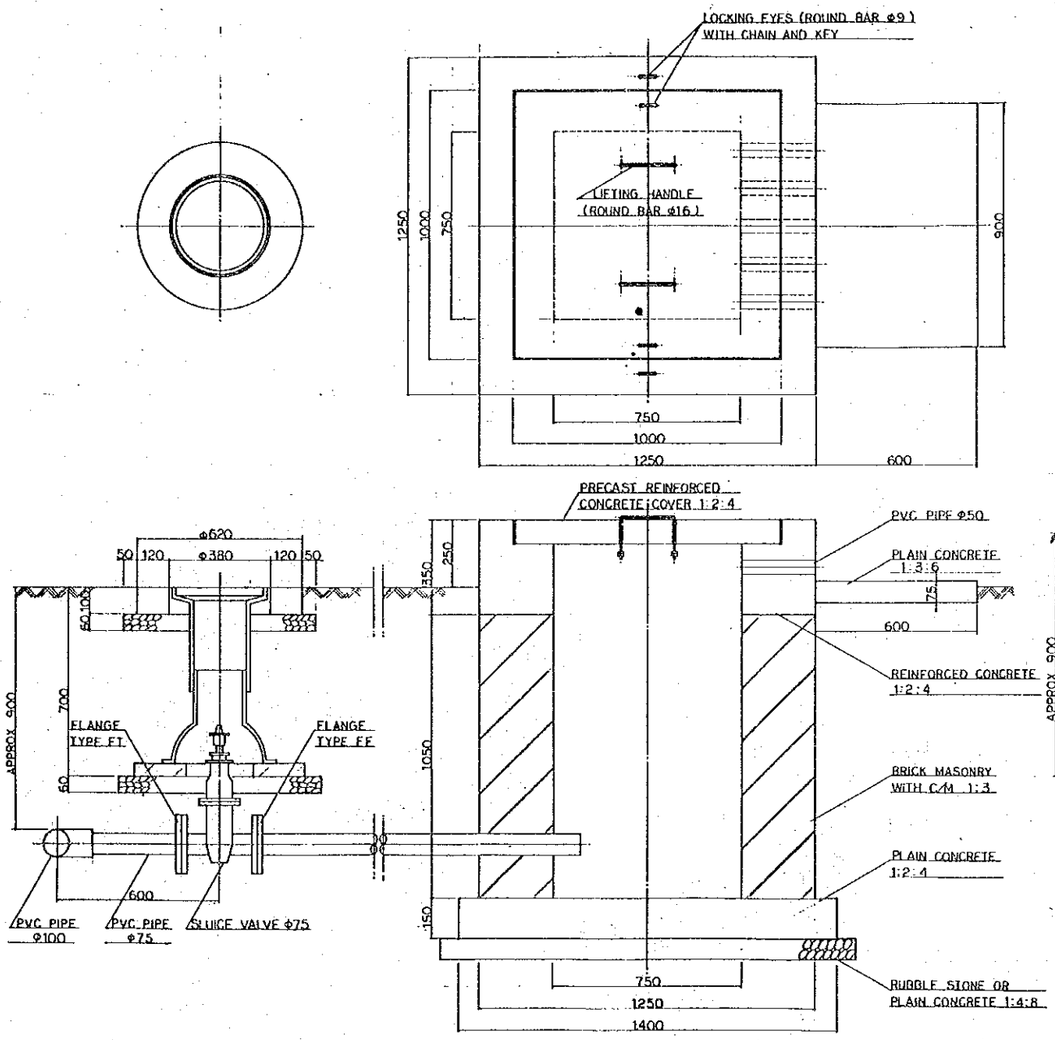


Fig-20 COMMUNAL WATER POINT

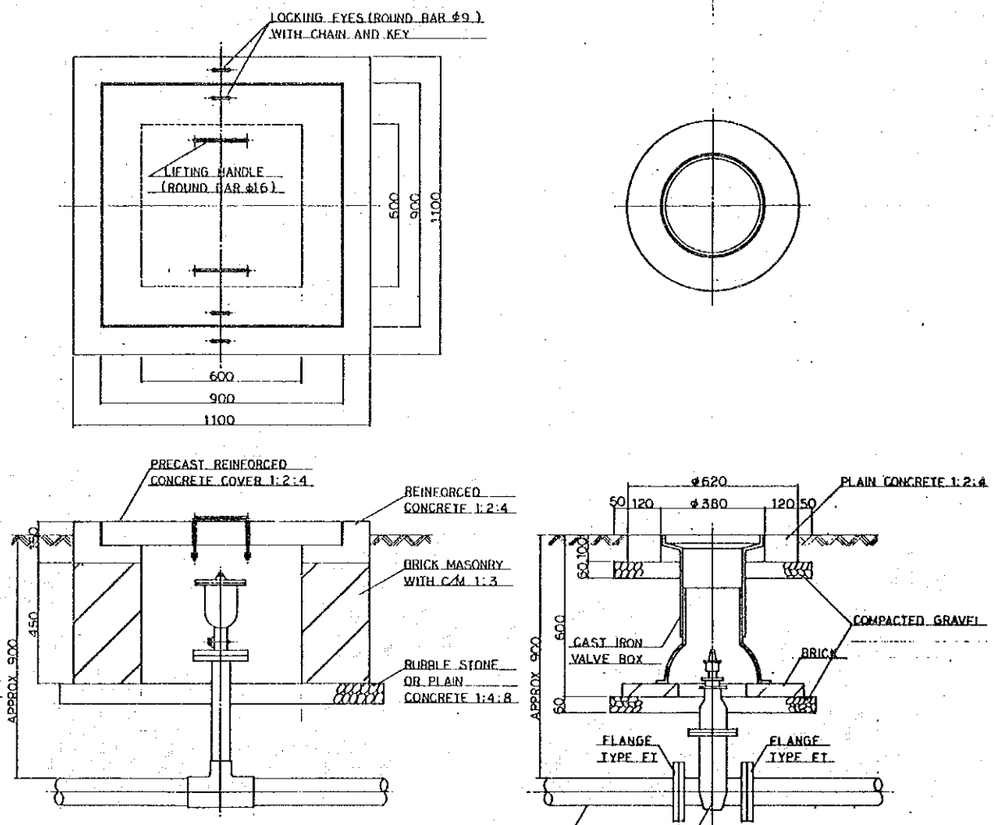
SCOUR VALVE BOX AND CHANBER

Unit ; mm



φ13 AIR VALVE BOX

Unit ; mm



SLUICE VALVE BOX

Unit ; mm

Fig-21 VALVE BOX

Table 4. Project Cost Estimate

Item	Amount (Yen '000)
A. Construction Cost	
1. Well Pump Station:	175,000
Well Pump House, Operator's House and Elevated Water Tank	
2. Pipeline:	57,000
PVC ø75 mm - ø125 mm, L=6.5 km	
3. Communal Water Point:	28,000
8 units	
Sub-total	260,000
B. Consultant's Fee	40,000
TOTAL	300,000

VIII. IMPLEMENTATION SCHEDULE AND SCOPE OF THE PROJECT

(i) Tentative implementation schedule

Assuming that the project is to be implemented under the Japanese grant-aid program, the schedule is tentatively set as shown in Fig. 22.

The overall schedule is divided into (1) the present basic design study by technical cooperation, and (2) the detailed design, construction works, and supervision. Subsequent to the present basic design study, the detailed design is to be started, comprising preparations of drawings and specifications necessary for construction, preparations of tendering, and construction contract documents.

(ii) The works are to be taken by the Government of Japan (within the scope of Japanese grant program)

1) Consulting service

Detailed design and supervision of construction

2) Construction of the water supply system

Well pump station, pipeline and communal water points

(iii) The works are required to be taken by the Government of Pakistan

1) General

a) to ensure prompt unloading and customs clearance of imported materials and equipment for the proposed project and also to facilitate their internal transportation in Pakistan.

b) To exempt Japanese nationals concerned from customs duties, internal taxes and charges which may be imposed in Pakistan on the occasion

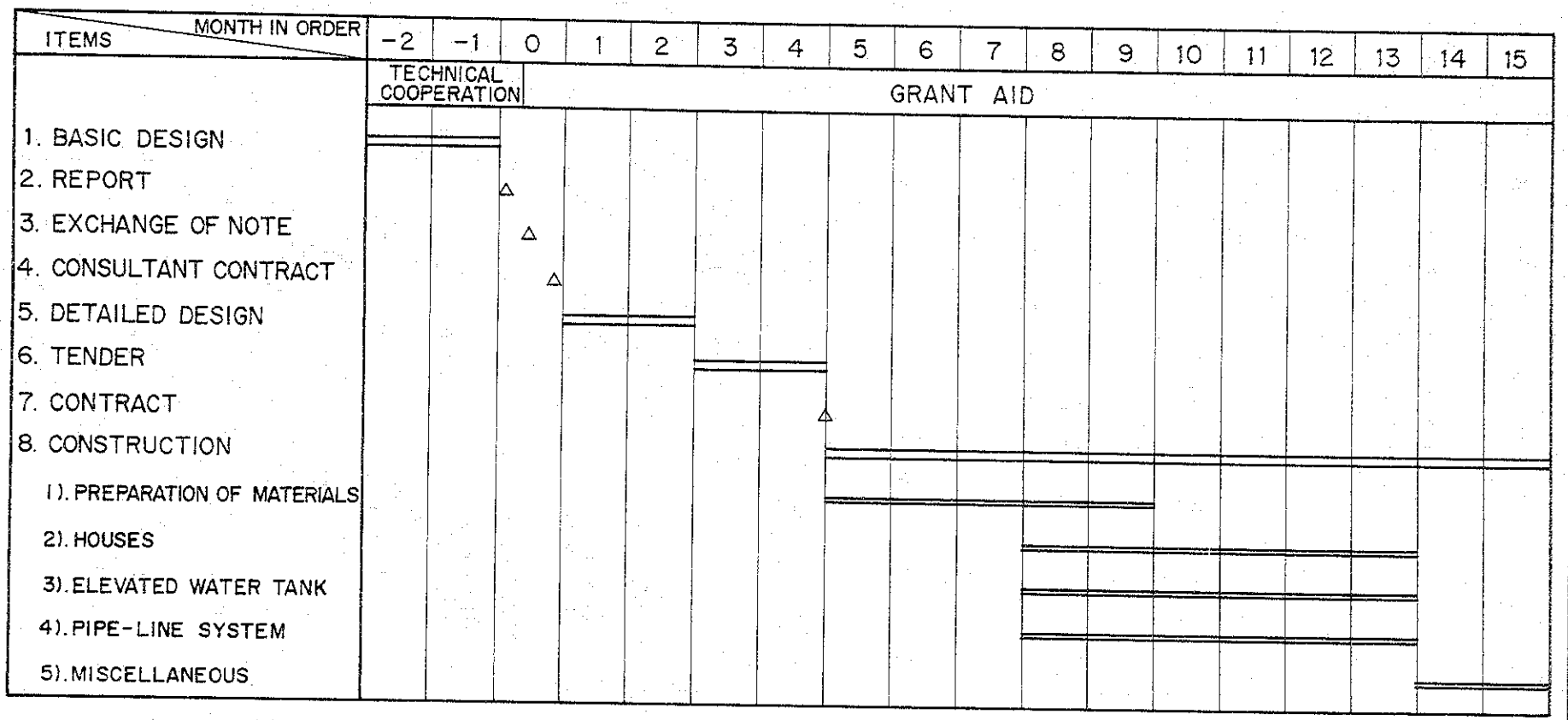
of the supply of goods and services for the construction of the proposed project.

c) To provide and authorize necessary permissions, licenses and other authorizations required for the construction.

2) To secure the land necessary for well pump station

3) Electric power supply to the pump station

Fig-22 IMPLEMENTATION SCHEDULE



A N N E X E S

ANNEX-I. BASIC DESIGN STUDY TEAM

Phase I

Mr. Terumi IIJIMA	Team Leader
Mr. Yuji OKAZAKI	Coordinator
Mr. Mitsutoshi YAMADA	Project Manager
Mr. Takao KUME	Water Works Engineer
Mr. Yasufumi NAGATOMO	Geologist
Mr. Kozo TAKAHASHI	Hydrogeologist
	Electrical Resistivity Expert
Mr. Hidemi SHINODA	Design Engineer
	Electrical Resistivity Expert

Phase II

Mr. Mitsutoshi YAMADA	Project Manager
Mr. Takao KUME	Water Works Engineer
Mr. Kozo TAKAHASHI	Hydrogeologist
Mr. Toshio YUSA	Well Drilling Expert
Mr. Fumio SAITO	Well Drilling Expert

ANNEX-II. ITINERARY

1980

November 7	-	Arriving Islamabad	(Islamabad)
8-9	-	Courtesy call on Joint Secretary (Ministry of States and Frontier Regions) and UNHCR. Preparatory meeting at Ministry of States and Frontier Regions.	
10	-	Arriving Quetta	(Quetta)
11-12	-	Data Collection. Trial Operation of Equipment	
13	-	Preparatory meeting with Project Director, Commissioner Office	
14-17	-	Courtesy call on Commissioner and Deputy Commissioner in Pishin. Field investigation for Saranan Area	
18-25	-	Electrical resistivity test. Data collection. Meeting with Government Officers.	
26	-	Courtesy call on Secretary of Irrigation and Power Department.	
Nov. 27 to Dec. 3	-	Electrical resistivity test	
4	-	Courtesy call on New Commissioner	
5-11	-	Electrical resistivity test	
12-14	-	Data Collection Meeting with Government Officers. Data analysis. Discussion with Government Officers	
15	-	Joint meeting with Commissioner Office, Irrigation Department: Water Supply Dept.: and Baluchistan Development Authority	
16	-	Checking the equipment	
17	-	Leaving Quetta and arriving Islamabad	(Islamabad)
18	-	Meeting with Joint Secretary, Ministry of States and Frontier Regions	
19-20	-	Meeting with UNHCR and Embassy of Japan	
21	-	Leaving Islamabad	
22-31	-	Home Works	(Japan)

1981

Jan. 1-31	-	-ditto-	(-ditto-)

1981

April 17	-	Arriving Islamabad	(Islamabad)
18	-	Courtesy call on Embassy of Japan	
19	-	Courtesy call on Joint Secretary (Ministry of States and Frontier Regions)	
20	-	Arriving Quetta	(Quetta)
21	-	Courtesy call on Commissioner and Secretary of Irrigation and Power	
22-25	-	Checking with survey equipment	
26-28	-	Preparatory work at No. 1 Well site	
May 29-4	-	Drilling the No. 1 Well	
5-9	-	Aquifer test and preparatory work at No. 2 Well site	
10-20	-	Drilling the No. 2 Well	
20-26	-	Aquifer test	
27-31	-	Cleaning away the site and storage	
June 1-2	-	Reconnaissance of pipeline route	
3-9	-	Data analysis and preparation of progress report	
10	-	Meeting with Irrigation and Power Department	
11	-	Joint meeting with Commission and Irrigation and Power Department	
12	-	Leaving Quetta and arriving Islamabad	(Islamabad)
13	-	Meeting with Joint Secretary, Ministry of States and Frontier Regions, and Embassy of Japan	
14	-	Leaving Islamabad and arriving Karachi	(Karachi)
15	-	Leaving Karachi	
16-30	-	Home Works	(Japan)
July 1-15	-	-ditto-	-ditto-
August	-	Submission of Report	(Pakistan)

ANNEX-III. LIST OF REFERENCES

1. Geological Map of Pakistan; Scale 1:2,000,000
2. Topographic Map

   West Pakistan; Scale 1:50,000, Six sheets around Saranan

   Pakistan Afghanistan; Scale 1:253,440 34J, 34N
3. Operational Navigation Chart; Scale 1:1,000,000
4. Pakistan showing political Divisions; Scale 1:3,168,000
5. Road Map of Pakistan; Scale 1:2,000,000
6. World Travel Map; Scale 1:4,000,000
7. Plan Showing Completed, On-going and proposed water supply schemes in Pishin Area; Scale 1:50,000
8. The Ground water of Pishin Lora Basin, Baluchistan, Pakistan
9. Hydrogeology of Pishin Loral Valley Project Area
10. Geodynamics of Pakistan
11. Nisai Area, Zhob River Basin Ground Water Development Project
12. Records of the Geological Survey of Pakistan, Vol. 20, Part 2
13. Estimate for Extension and Improvement of Water Supply Scheme, Shadazai.
14. Standing Rates Committee Publication Series, Schedule of Wage Rates Vol. III, Part-I, 1962
15. List of Completed, On-going and Proposed Water Supply Scheme in Pishin District
16. History of Baluch Race and Baluchistan
17. Search lights on Baluches and Baluchistan
18. Travels and Baluchistan and Sind.
19. Meteorological Data
20. Tube Well Boring Progress and Completion Chart, Gulistan, Karbala, Haikalzai, Khudaedadzai.

ANNEX-IV. GOVERNMENT OFFICERS INTERVIEWED BY THE TEAM

Ministry of States and Frontier Regions:

Lt. Col. A.M. Babar	Joint Secretary
Mr. A.A. Sidiqi	Deputy Secretary

Chief Commissioner Rate Afghan Refugees:

Mr. Col. Razzaq Mirza	Director

UNHCR Islamabad:

Mr. Roman Kahaut	Chief Mission in Islamabad
Mr. Banh Nguyen Tang	Deputy Chief

Afghan Refugee Commissioner Office, Baluchistan:

Mr. Abdul Qayum Khan	Commissioner
Mr. Abbas Hussain Shah	Commissioner
Mr. Col. Rafi	Additional Commissioner
Raja Mohammad Gulzar	Project Director
Major Khawaja Mohammad	Chief Liaison Officer
Mr. Noor-Ul-Haq	Assistant Commissioner and Liaison Officer

UNHCR, Quetta Sub-Office:

Mr. Nanda	Chief, Quetta
Mr. Y. Koike	Education and Medical Officer
Mr. Kasidis Rochanacorn	Programme Officer

Irrigation and Power Department, Government of Baluchistan, Quetta:

Mr. Abdur Raziq	Secretary, Irrigation & Power
Mr. Shirin Khan	Executive Engineer, Water Supply Division
Mr. Munawar Khan	Executive Engineer, Irrigation Division
Mr. Mohammad Siddiqui	S.D.O. Water Supply Division, Quetta
Mr. Nadir Ali	S.D.O. Water Supply Division, Quetta
Mr. Ali Murad Khoso	S.D.O. Water Supply Division, Quetta
Mr. Hazar Khan	S.D.O. Irrigation Division, Pishin

Baluchistan Development Authority, Quetta:

Comd. A.A. Naseem	Chairman
Mr. Ali Tahir Kazmi	General Manager
Mr. Idris Ahmad Khan	Project Director, Bela Plain Project
Mr. Syed Ahsan Haider Naqvi	Senior Hydrogeologist, Bela Plain Project
Mr. Najam-Ul-Sadiq	Geologist, Bela Plain Project

Water and Power Development Authority:

Mr. Rauf Siddiqi	Project Director
Mr. Asim Ali	Senior Hydrogeologist
Mr. Akram Faiz	Senior Geophysicist
Mr. Khalid Saeed	Junior Hydrogeologist
Mr. Sadrul Huda	Technical Officer Power Section

Geological Survey of Pakistan, Quetta:

Mr. Abdul Farah	Chief Geophysicist
Mr. Mohammad Ali Mirza	Director Planning
Mr. Hashim Raza	Director, Geophysicist
Mr. Ghazanfar Abbas	Deputy Director
Mr. Manzur Ahmed	Research Officer
Mr. Ghulam Qadir Soomer	Programme Officer
Mr. Ghulam Mustafa Ghazi	Assistant Publication Officer

Deputy Commissioner, Pishin District:

Major Mohammad Naeem	Deputy Commissioner

Department of Protocol:

Mr. Gul Mohammad Rind	Deputy Chief of Protocol
Mr. Awan	Deputy Chief of Protocol

Survey of Pakistan:

Mr. Akbar	D.D.S.R., Quetta

Union Council Saranan:

Mr. Paradin Tareen	Chairman

ANNEX-V. MINUTES OF THE PRELIMINARY SURVEY ON THE FIELD OF WATER SUPPLY FOR THE AFGHAN REFUGEES IN PAKISTAN

I. Introduction

During Foreign Minister Ito's visit to Pakistan in August 1980, the Foreign Minister made an on-the-spot inspection of the Afghan refugee camp in Pakistan and realized the necessity for further increasing Japan's humanitarian relief assistance for the Afghan refugees.

The Government of Japan despatched then immediately, through the Japan International Cooperation Agency, a Preliminary Survey Team headed by Mr. T. ITO from September 26 to October 7, for the purpose of finding out the most effective way of extending assistance for the refugees. The Preliminary Survey Team, paying special attention to the field of water supply for the Refugees, held a series of consultations with Pakistani Authorities concerned and inspected several refugee camps both in N.W.F.P. and Baluchistan. On the basis of the results of the Preliminary Survey Team, the main survey team for water supply project will be sent to Pakistan in accordance with the following manner:

II. Objective

The prime objective of the Main Survey Team is to determine the exact location of the site(s) for establishing water supply system under the Japanese assistance. For the present, Saranan Area of Pishin District will become the object of the Main Survey.

III. Contents of the Main Survey

(1) The Main Survey Team (Phase I) will be despatched for the period of approximately one month from the end of October 1980 for:

1) Collection of data and information;
2) Electrical resistivity tests and selection of the boring site(s).

(2) The Main Survey Team (Phase II) will be despatched as soon as the necessary equipment to be sent from Japan becomes available at the site in order to perform:

1) Trial boring on the selected site(s);
2) Aquifer tests by utilizing the trial boring;
3) Quality tests of the water;
4) Other necessary tests.

IV. Undertakings by the Government of Japan

The Government of Japan will take the following measures for the execution of the above-mentioned survey:

1) to despatch the team;
2) to prepare the necessary materials and equipment, including the electrical resistivity apparatus and boring rig(s).
3) to employ necessary local labour;
4) to pay entire expenditure connected with the stay and survey operations of the Japanese Team.

V. Undertakings by the Islamic Republic of Pakistan

The Government of the Islamic Republic of Pakistan will take the following measures to facilitate the execution of the Main Survey by the Japanese team:

1) to arrange for the team an office space, accommodation facilities and transportation;

2) to provide the team with necessary data and information;

3) to exempt taxes from and to ensure quick unloading and delivery for the materials and equipment for the Survey;

4) to assign a number of counterparts to cooperate with the team;

5) to assure the security of the team during its survey period.

TETSUO ITO Leader of the Preliminary Survey Team	A. M. BABAR Joint Secretary to the Government of Pakistan, Ministry of States & F.R.

ANNEX-VI. WATER SUPPLY PROJECT IN SARANAN AREA

I. General

This water supply project would be planned for local inhabitants in Saranan area (Saranan Bazar and Shadizai). The population and supply amount are shown in Table A-1.

II. Water Supply Facilities

Water supply facilities would consist of tube well, pump, elevated tank, pipes, communal water points and operator's house. The water will be pumped up from tube well to the elevated tank which will be built above the tube well from where water will be conveyed by gravity to the communal water points in village.

The pump will be submersible motor pump with high-head capacity and will be operated for 18 hours daily. The elevated tank will be made of steel and the capacity has been designed to meet the hourly changes of consumption. As far as pipes are concerned, hard vinyl chloride pipes will be used.

The general plans are shown in Fig. A-1.

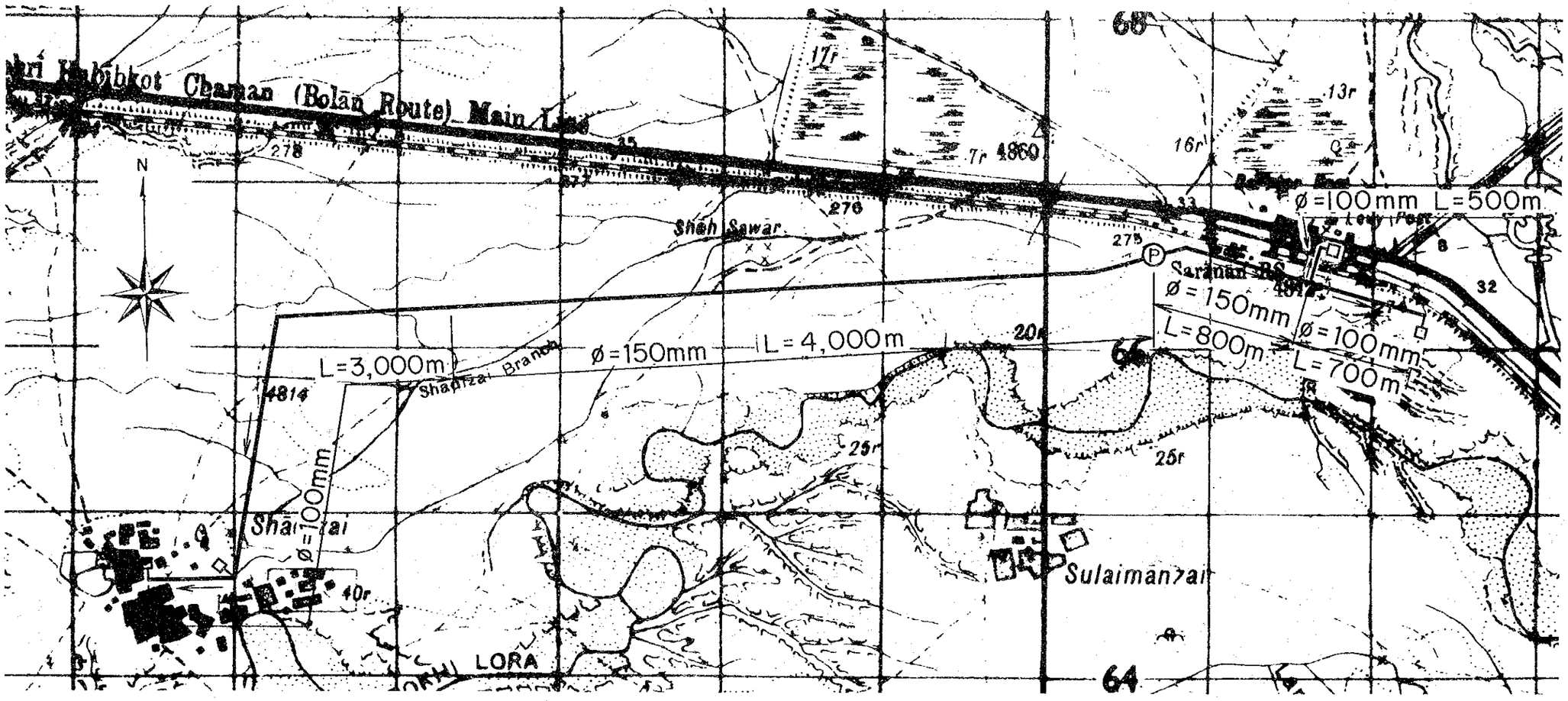
III. Project Cost Estimate

The fund required for the execution of the project is estimated at 350 million yen which will be procured from the Japan's Grant-Aid Program (see Table A-2).

Table A-1. Population and Supply Amount

Name of Village	Planned Service Population (person)	Supply Amount Per Person (ℓ/day/person)	Planned Supply Amount (m^3/day)
Saranan Bazar	3,500	40	140
Shadizai	4,000	40	160
Refugee Camp	18,000	10	180
Total	25,500		480

Scale 1 : 25,000



LEGEND

——— PIPE LINE

Ⓟ WELL PUMP STATION

COMMUNAL WATER POINT

Fig-A-1 LOCATION PLAN

Table A-2. Project Cost Estimate

Item	Amount (Yen '000)
A. Construction Cost	
1. Well Pump Station:	175,000
Well Pump House, Operator's House and Elevated Water Tank	
2. Pipeline:	116,000
PVC ø100 mm - ø150 mm, L=9.0 km	
3. Communal Water Point:	14,000
4 units	
Sub-total	305,000
B. Consultant's Fee	45,000
TOTAL	350,000