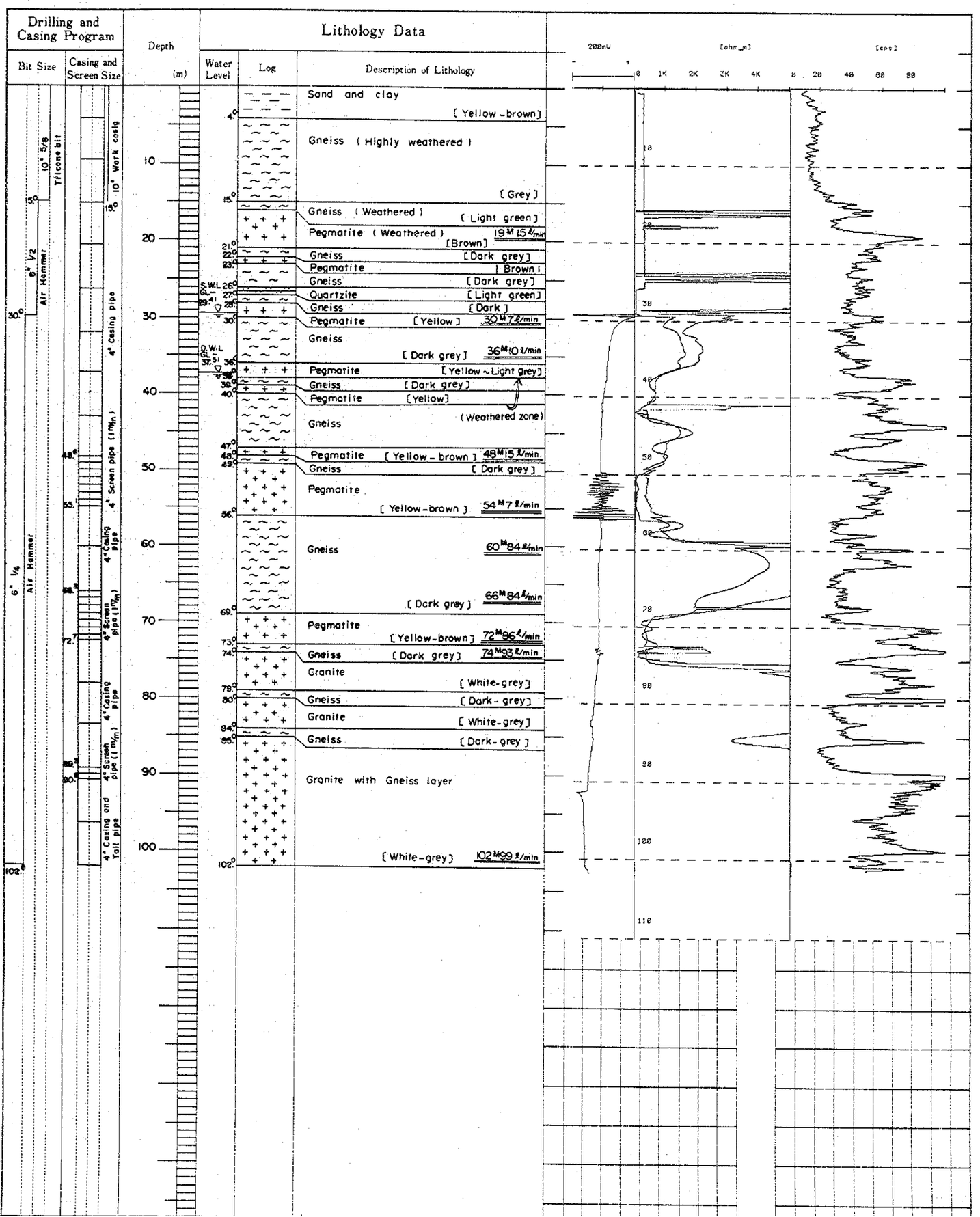
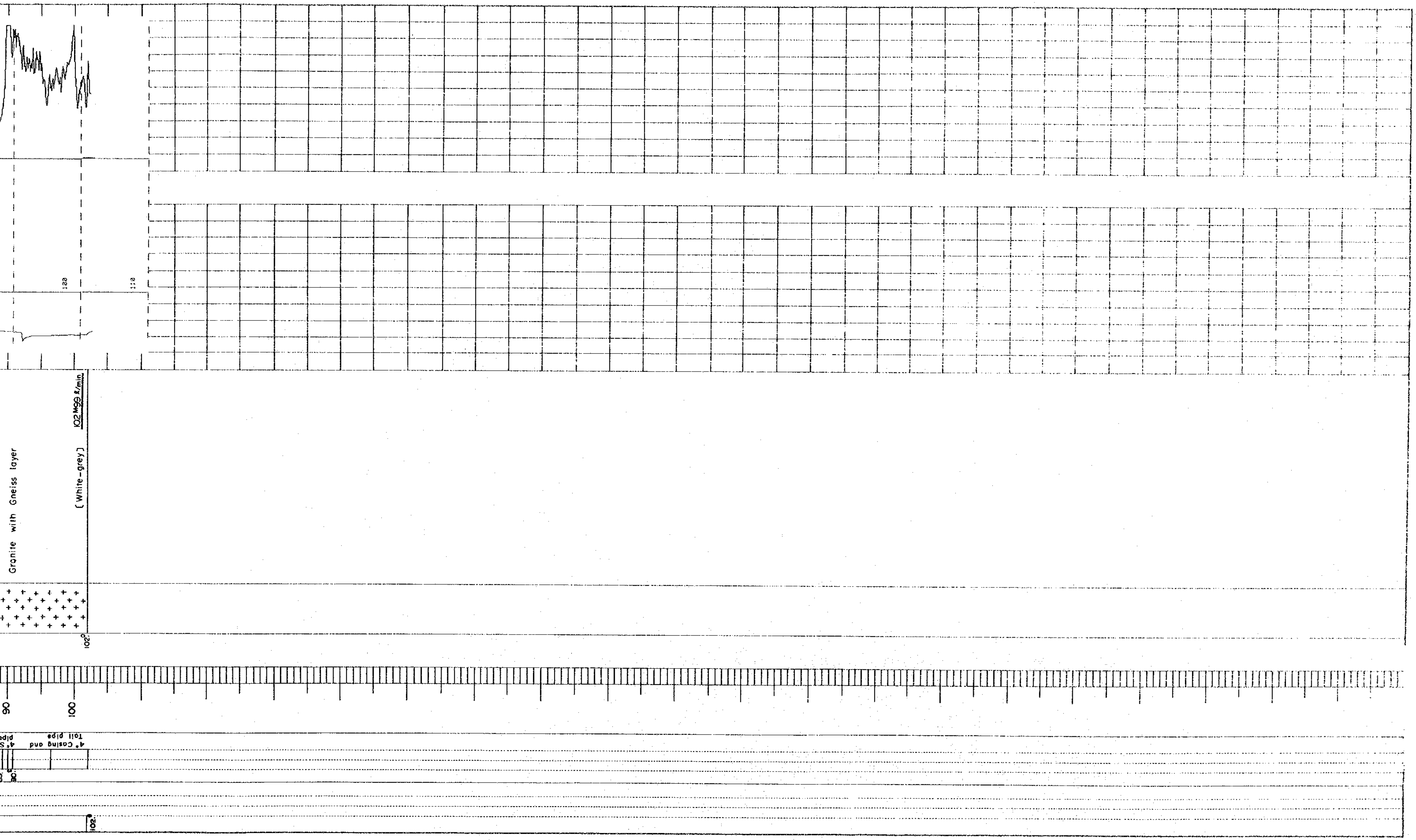
WELL LOG

Data No. _____

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	YAMBUKI	NO. 8 - 1 (Test Well)	
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	102.0 m	DRILLING RIG	Top - 750
DRILLING STARTED	12th. JAN. 1989	DRILLED BY	Y. Tanabe
WELL COMPLETED	16th. JAN. 1989	LOGGED BY	N. Kawabata

STATIC WATER LEVEL	GL - 29.41 m	WATER TEMPERATURE	29.9 ℃
DYNAMIC WATER LEVEL	GL 37.51 m	CONDUCTIVITY	520 μ℧/cm
PUMPING RATE	69 ℓ/min (99.36 m³/d)	pH	6.77
SPECIFIC CAPACITY	12.27 m³/d/m	TOTAL HARDNESS	




Granite with Gneiss layer
(White-grey)
90
100

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - YAMBUKI

SITE NO.: - 8

(TEST DRILL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test drill borehole (Yambuki No. 8) was drilled during the time from 16th January to 22nd January 1989 at Yambuki village in Kaura Namoda Local Government.

The well was drilled using a Tone Boring top -750 B rig.

From ground level (G.L.) to 5.0m below ground level (G.L.-), it was drilled using a 10"5/8 tricone bit with air.

From G.L.-5.0m to the total depth of 90.0m, it was drilled using an 8"1/2 air hammer. (From G.L.-5.0m to G.L.-24.0m, it was drilled using a 6"1/4 air hammer before reamed by an 8"1/2 air hammer.)

The drilling fluid for air hammer was air/foam.

After the drilling, electric log had been carried out and then the borehole was cased with 4" blind steel pipe from G.L.+1.0m to G.L.-36.1m and from G.L.-40.9m to G.L.-52.0m and from G.L.-56.9m to G.L.-67m and from G.L.-72.8m to G.L.-80.0m.

Total length of 4.8m and 4.9m and 4.9m of Johnson's screen 4"I.D.(slot size 1.0mm) were inserted from G.L.-36.1m to G.L.-40.9m and from G.L.-52.0m to G.L.-56.9m and from G.L.-67.9m to G.L.-72.8m.

The lithology encountered consists of granite and crystalline schist. These are pre-Cambrian to upper-Cambrian basement complex.

The probable water bearing portion is weathered zone along fractures.

After development of the borehole the static water level was measured at G.L.-28.80m.

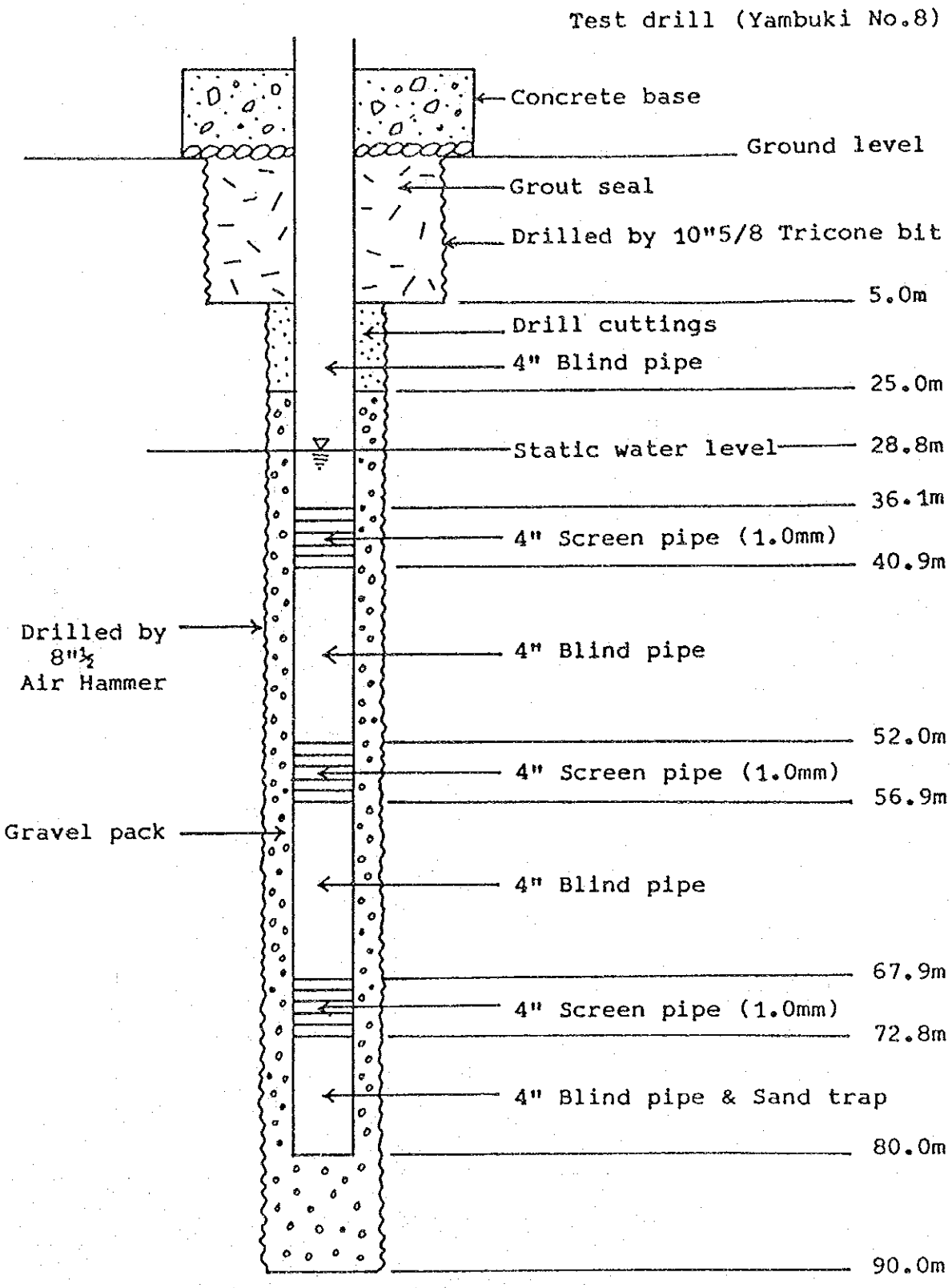
During the air lifting, the maximum average yield was 60 ℓ/min.

WELL SUMMARY

Test drill (Yambuki No. 8)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Yambuki village in Kaura Namoda Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	16th January, 1989
Date well Completed	22nd January, 1989
Total Depth	90 m
Screen Position	G.L.36.1m~40.9m, G.L.-52.0m~56.9m G.L.67.9m~72.8m (1.0mm)
Drilling Method	Air Hammer drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	Y. Tanabe
Logged By	N. Kawabata
Static Water Level	G.L.-28.80m
Yield By Air Lifting	60 ℓ/min, 3.6m^3/h, 86.4m^3/d
Pumping Rate	-
Dynamic Water Level	-
Specific Capacity	-
Critical Capacity	-
Transmissivity	-
Permeability	-
Water Temperature	-
Conductivity	-
pH	-

WELL SKETCH



Not to Scale

WELL LITHOLOGIC LOG

Test drill (Yambuki No.8)

Depth (m)	Log	Lithology			Geological Division
1.0		Sand and Clay,	Yellowish brown		
18.0		Granite,	-do-	W.Z	Basement Complex (Upper-Cambrian) ⟆ (Pre-Cambrian)
20.0		Gneiss,	Black		
21.0		Granite,	Yellowish brown		
22.0		Gneiss,	Grey		
23.0		Granite,	Yellowish brown		
24.0		Gneiss,	Black		
26.0		Granite,	Yellowish brown		
30.0		Gneiss,	Grey		
33.0		Gneiss,	Black	P W.Z	
35.0		Granite,	Yellowish brown		
41.0		Gneiss,	Black		
43.0		Granite,	Yellowish brown		
49.0		Gneiss,	Black		
50.0		Granite,	Yellowish brown		
62.0		Gneiss,	Black		
63.0		Granite,	Yellowish brown		
78.0		Gneiss,	Black		
83.0		Granite,	Dark pink		
90.0		Gneiss,	Black		

W.Z .... Weathered zone

P .... Partially weathered zone

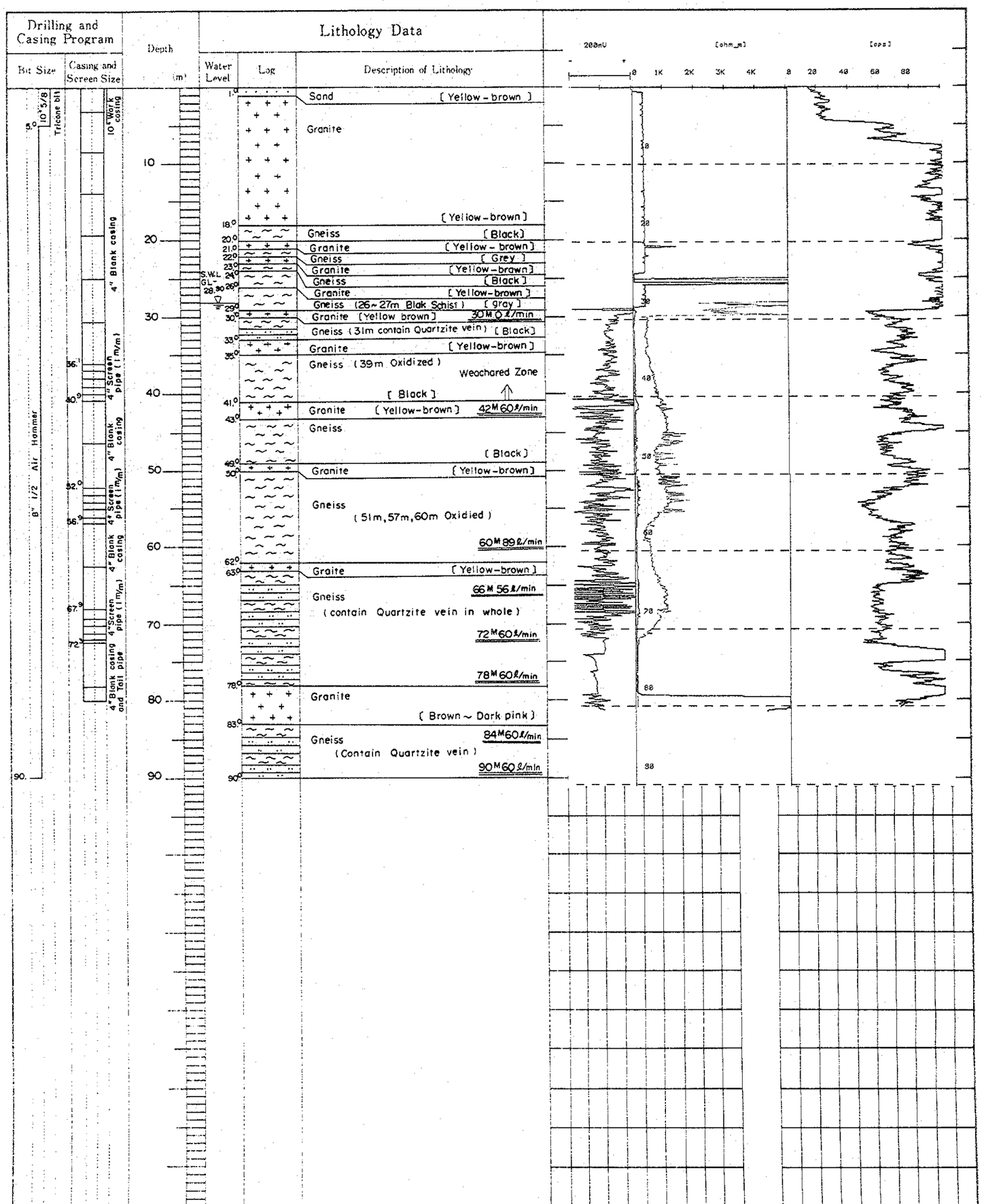
W.Z

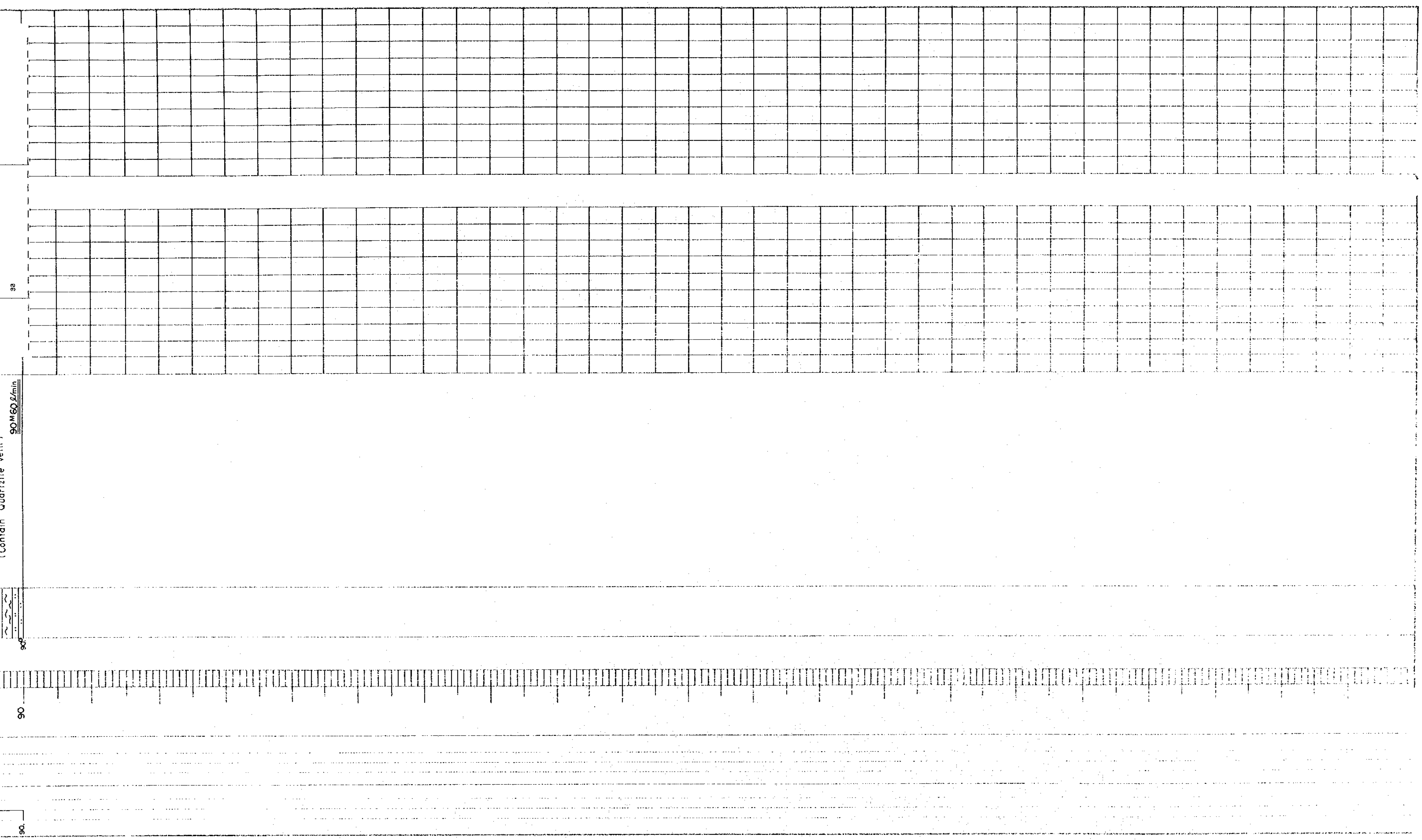
Data No. _____

WELL LOG

PROJECT NAME	The Study for Groundwater Develoment in Sokoto State		WELL NO.
AREA AND LOCATION	YAMBUKI NO. 8-2 (Test drilling)		
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	90.0 m	DRILLING RIG	Top - 750
DRILLING STARTED	17 th. JAN. 1989	DRILLED BY	Y. Tanabe
WELL COMPLETED	22 nd. JAN 1989	LOGGED BY	N. Kawabata

STATIC WATER LEVEL	GL-28.80 m	WATER TEMPERATURE	— ℃
DYNAMIC WATER LEVEL	— m	CONDUCTIVITY	— μ℧/cm
PUMPING RATE	— //min (— m^3/d)	pH	—
SPECIFIC CAPACITY	— m^3/d/m	TOTAL HARDNESS	




90
90
90

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - MAGA

SITE NO.: - 10

(TEST WELL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test well borehole (Maga No. 34) was drilled during the time from 9th December to 16th December 1988 at Maga village in Zuru Local Government

Test well borehole was 45m apart from test drill borehole. The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 18.0m below ground level (G.L.-), it was drilled using a 10"5/8 tricone bit with mud rotaly drilling method.

From G.L.-18.0m to G.L.-50.0m, it was drilled using a 6"1/4 air hammer with air/foam. But from G.L.-50.0m to downward, it was hardly drilled using an air hammer for caving between G.L.-40.0m and G.L.-45.0m. So, the borehole was reamed using a 10"5/8 tricone bit, and cased with 7" work casing till G.L.-45.0m.

Then, from G.L.-50.0m to the total depth of 138.0m, it was drilled using a 6"1/4 air hammer with air/foam.

After the drilling electric log had been carried out and then the borehole was cased with 4" blind steel pipe from G.L.+1.0m to G.L.-42.0m and from G.L.-45.0m to G.L.-123.0m and from G.L.-129.0m to -138.0m.

Total length of 3.0m and 6.0m of Johnson's screen 4" I.D. (slot size 0.5mm) were inserted from G.L.-42.0m to G.L.-45.0m and from G.L.123.0m to G.L.-129.0m.

The lithology encountered consists of crystalline schist and quartzite vein. These are pre-Cambrain to upper Cambrian basement complex.

The probable water bearing portions are wethered zone along fractures and fissures near quartzite vein.

After development of the borehole the static water level was measured at G.L.-7.79m.

During the air lifting the maximum average yield was 120 ℓ/min.

Pumping test was carried out during the time from 8th January to 12th January 1989.

By the five steps drawdown test, the critical discharge of this well was determined about 80 ℓ/min.

Continuous drawdown test was done for 48 hours with a pumping rate of 100 ℓ/min, and a drawdown of 57.83m was observed. (Dynamic water level was masured at G.L.-65.62m.)

On the other hand, a drawdown of 2.68m was observed at the test drill borehole that was 45m apart from test well borehole.

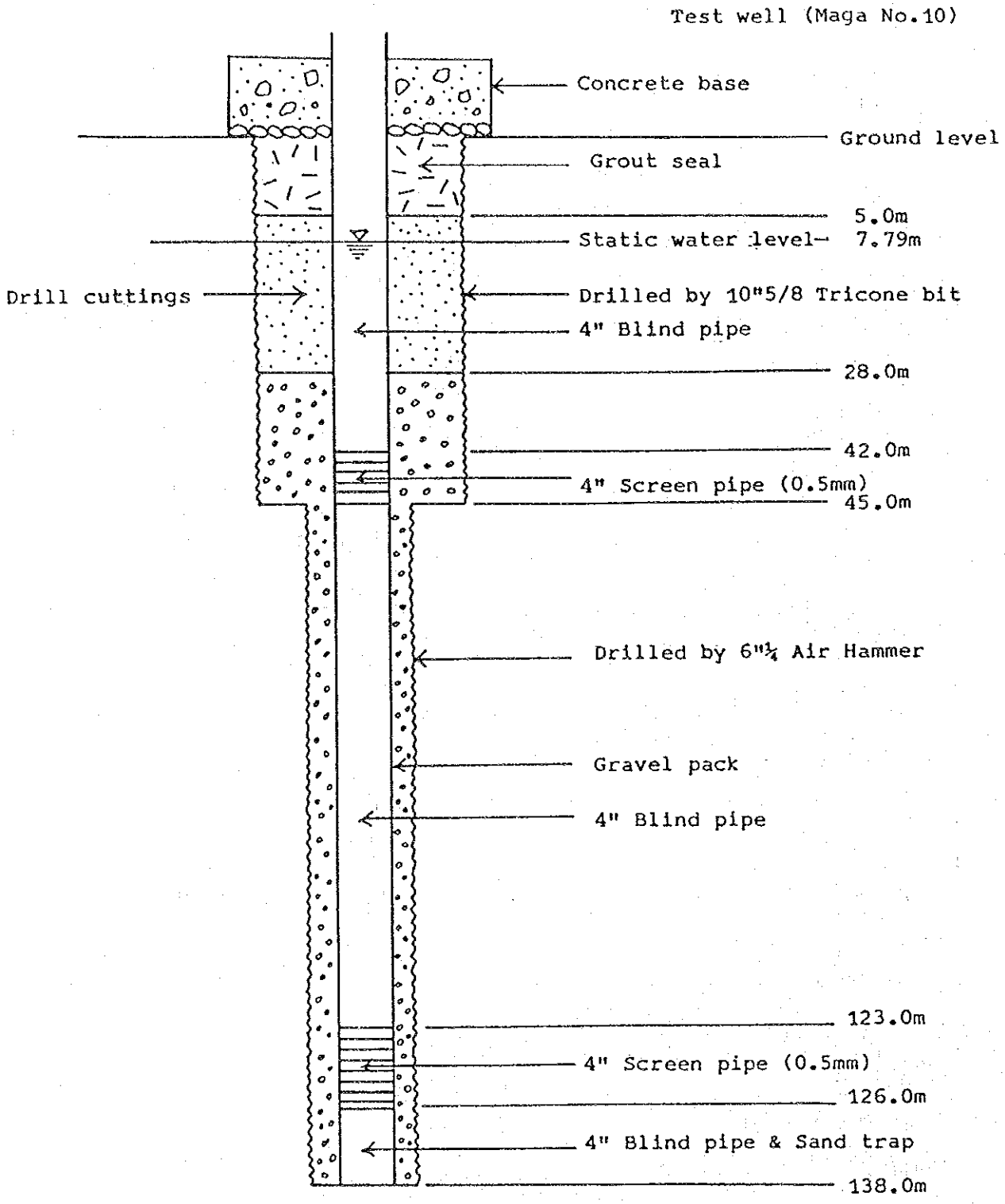
Then recovery of water level was measured for 15 hours.

WELL SUMMARY

Test Well (Soro No. 10)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Maga village in Zuru Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	9th December, 1988
Date well Completed	16th December, 1988
Total Depth	138 m
Screen Position	G.L.-42.0m~45.0m, G.L.-123.0m~129.0m (0.5mm)
Drilling Method	Mud rotaly drilling and Air Hammer drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	G. Kuragane
Logged By	N. Kawabata
Static Water Level	G.L.-7.79m
Yield By Air Lifting	120 ℓ/min, 7.2m^3/h, 172.8m^3/d
Pumping Rate	100 ℓ/min, 144m^3/d
Dynamic Water Level	G.L.-65.62m (Drawdown 57.83m)
Specific Capacity	1.73ℓ/min/m, 2.49m^3/d/m
Critical Capacity	80 ℓ/min
Transmissivity	1.65×10^{-3} m^2/min
Permeability	3.32×10^{-4} cm/sec
Water Temperature	31 °C
Conductivity	280 μu/cm
pH	6.24

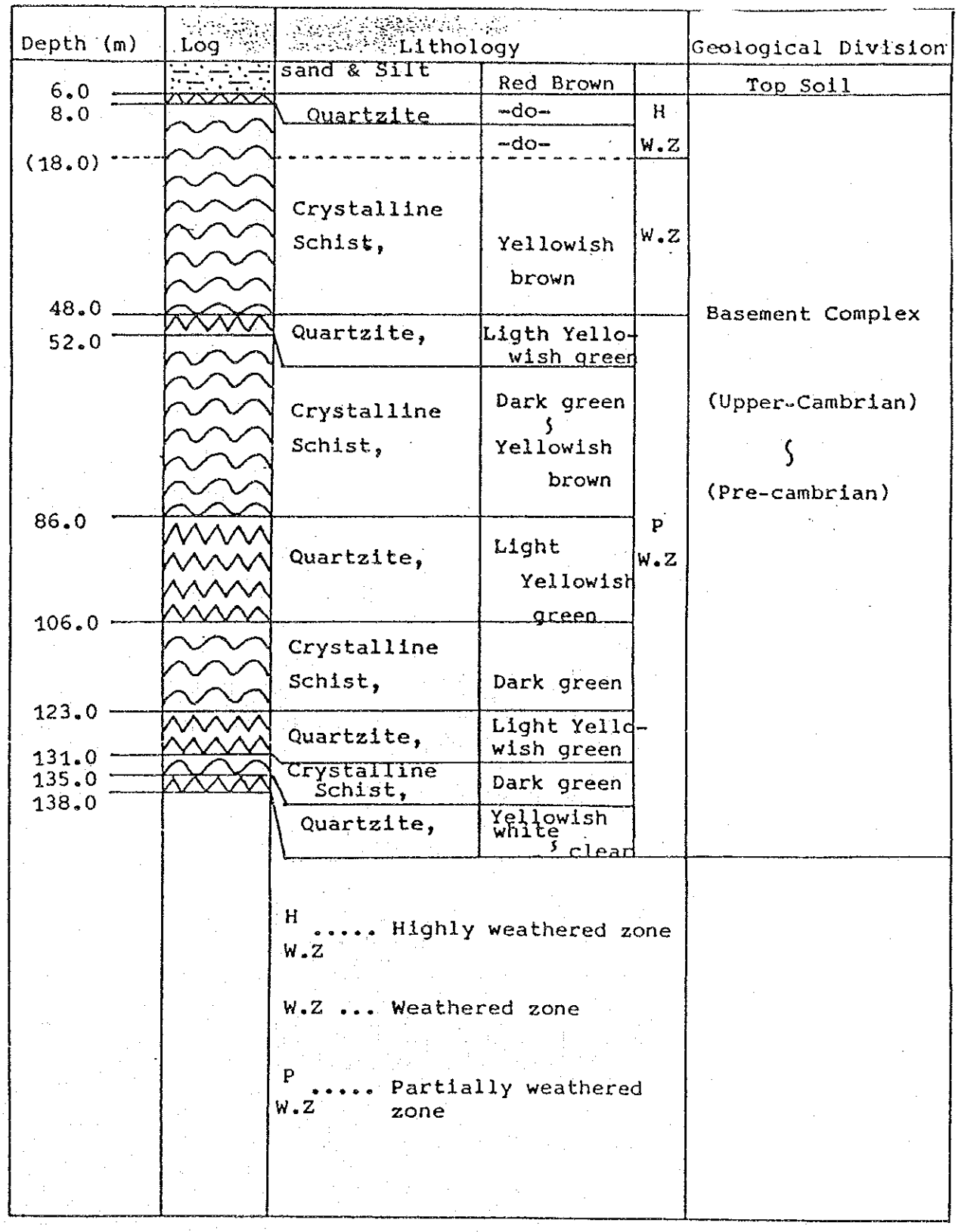
WELL SKETCH



Not to Scale

WELL LITHOLOGIC LOG

Test well (Maga No.10)

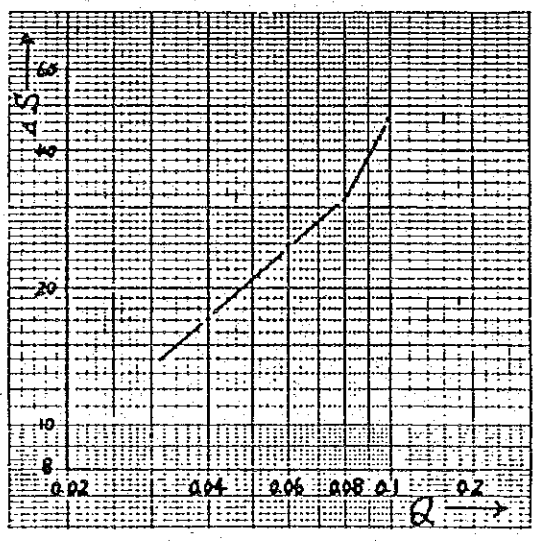


PUMPING TEST

Test well (Soro No. 10)

Step drawdown test

Step	Pumping rate Q (m^3/min)	Drawdown ΔS (m)	Specific Capacity (m^3/min/m)
1	0.03	9.57	0.003
2	0.04	17.06	0.002
3	0.06	24.84	0.002
4	0.08	31.08	0.003
5	0.10	46.89	0.002



Critical discharge 0.08m^3/min

PUMPING TEST

Test well (Soro No.10)

Continuos drawdown test and Recovery test

	Test well hole (product well)	Test drill hole (Observation well)
Static water level	G.L. -7.79m	G.L. -7.73m
Pumping rate	100 l/min	-
Dynamic water level	G.L. -65.62m	G.L. -10.41m
Drawdown	57.83m	2.68m
Specific Capacity	1.73 l/min/m	-
Elapsed time	48 hours	

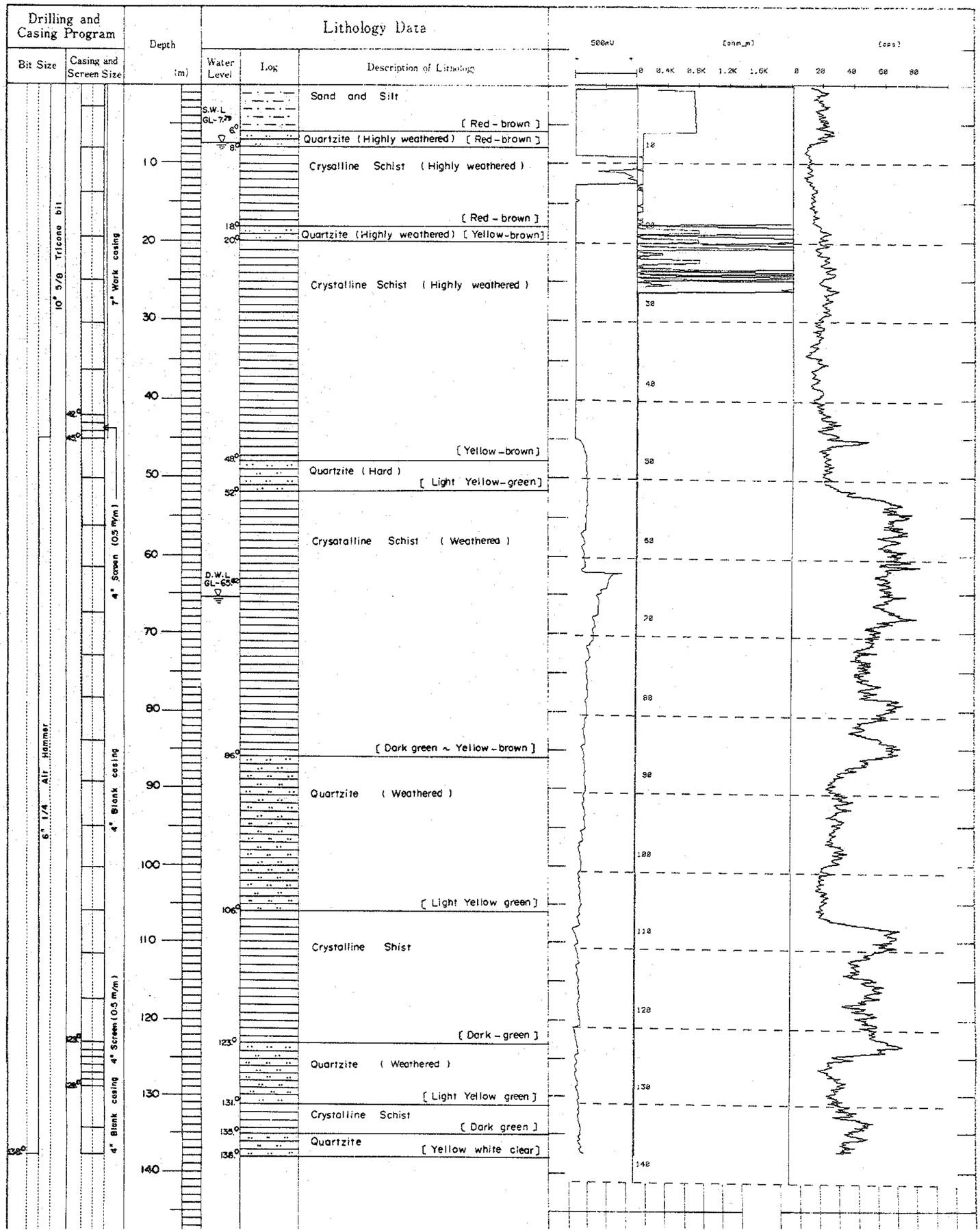
	Transimissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	1.46×10^{-3}	1.26×10^{-3}	2.70×10^{-4}	2.33×10^{-4}
Recovery	3.82×10^{-3}	6.31×10^{-4}	7.07×10^{-4}	1.17×10^{-4}
Average	1.65×10^{-3}		3.32×10^{-4}	

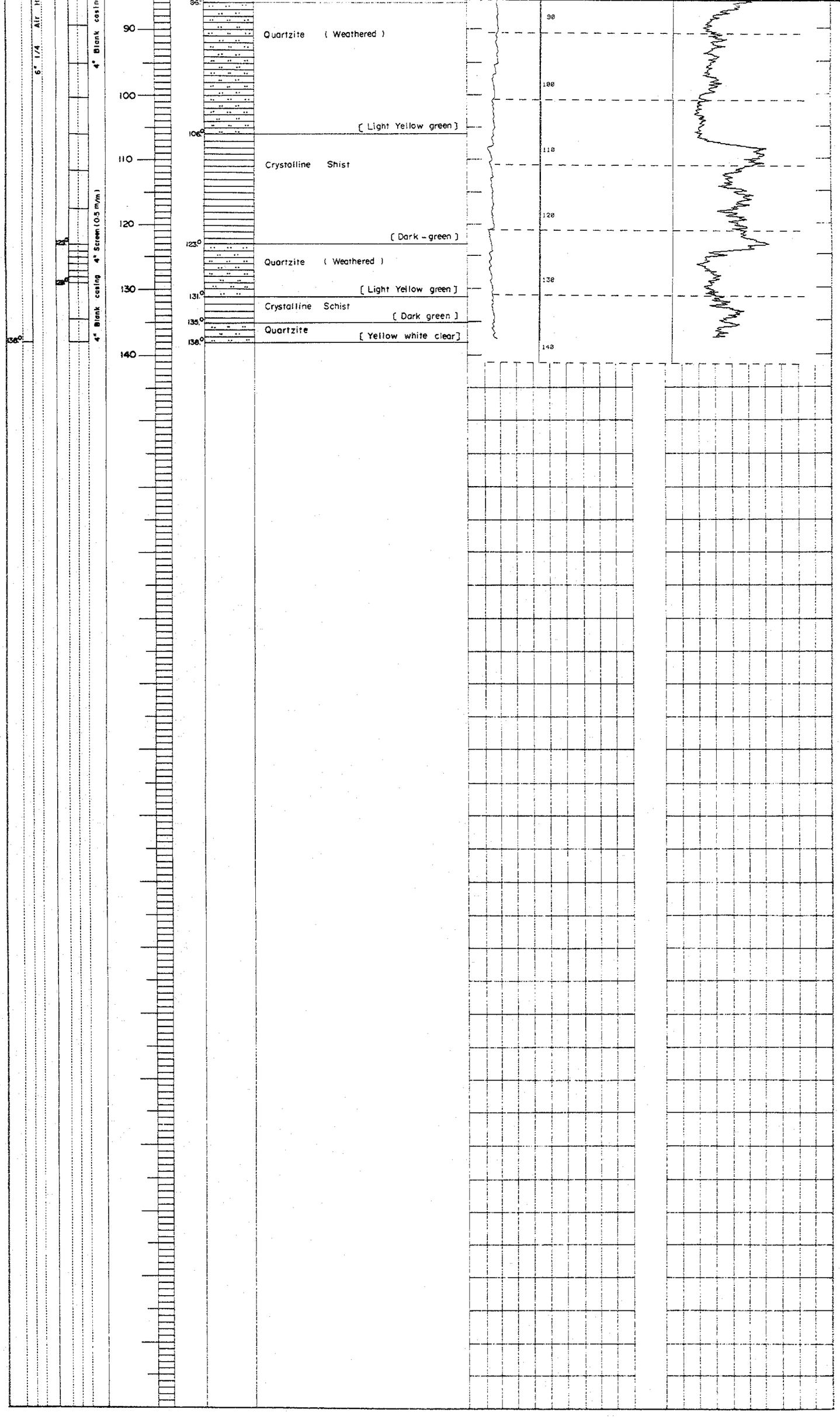
WELL LOG

Data No.

PROJECT NAME	The Study for Groundwater Development in Sokoto State	WELL NO.	
AREA AND LOCATION	MAGA No. IO - I (Test well)		
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	138.0 m	DRILLING RIG	Top - 750
DRILLING STARTED	7th. Dec. 1988	DRILLED BY	G. Kuragane
WELL COMPLETED	13 th. Dec. 1988	LOGGED BY	N. Kawabata

STATIC WATER LEVEL	GL - 7.79 m	WATER TEMPERATURE	31.0 ℃
DYNAMIC WATER LEVEL	GL 65.62 m	CONDUCTIVITY	280 μ℧/cm
PUMPING RATE	100 ℓ/min (144 m³/d)	pH	6.24
SPECIFIC CAPACITY	2.49 m³/d/m	TOTAL HARDNESS	




6" 1/4 Air H
4" Blank casing
4" Screen (0.5 m/m)
4" Blank casing
90
100
110
120
130
140
136.0
96.0
Quartzite (Weathered)
[Light Yellow green]
106.0
Crystalline Shist
[Dark - green]
123.0
Quartzite (Weathered)
[Light Yellow green]
131.0
Crystalline Schist
[Dark green]
135.0
Quartzite
[Yellow white clear]
138.0
90
100
110
120
130
140

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - MAGA

SITE NO.: - 10

(TEST DRILL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test drill borehole (Maga No. 10) was drilled during the time from 16th December to 19th December 1988 at Maga village in Zuru Local Government.

The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 30.0m below ground level(G.L.-), it was drilled using a 12"1/4 tricone bit with mud rotaly drilling method.

From G.L.-30.0m to G.L.-42.0m, it was drilled using an 8"1/2 air hammer and from G.L.-42.0m to the total depth of 84.0m using a 6"1/4 air hammer. Then, the borehole was reamed from G.L.-42.0m to G.L.-84.0m by 8"1/2 air hammer. The drilling fluid for air hammer was air/foam.

After the drilling electric log had been carried out and then the borehole was cased with 4"P.V.C. pipe from G.L.+1.0m to G.L.-71.0m and from G.L.-75.0m to G.L.-84.0m.

Total length of 4.0m of P.V.C. screen 4" (slot size 1.0mm) was inserted from G.L.-71.0m to G.L.-75.0m.

The lithology encountered consists of crystalline schist and quartzite vein. These are pre-Cambian to upper Cambrian basement complex.

The probable water bearing portion is fissures near quartzite vein. After development of the borehole the static water level was measured at G.L.-7.73m.

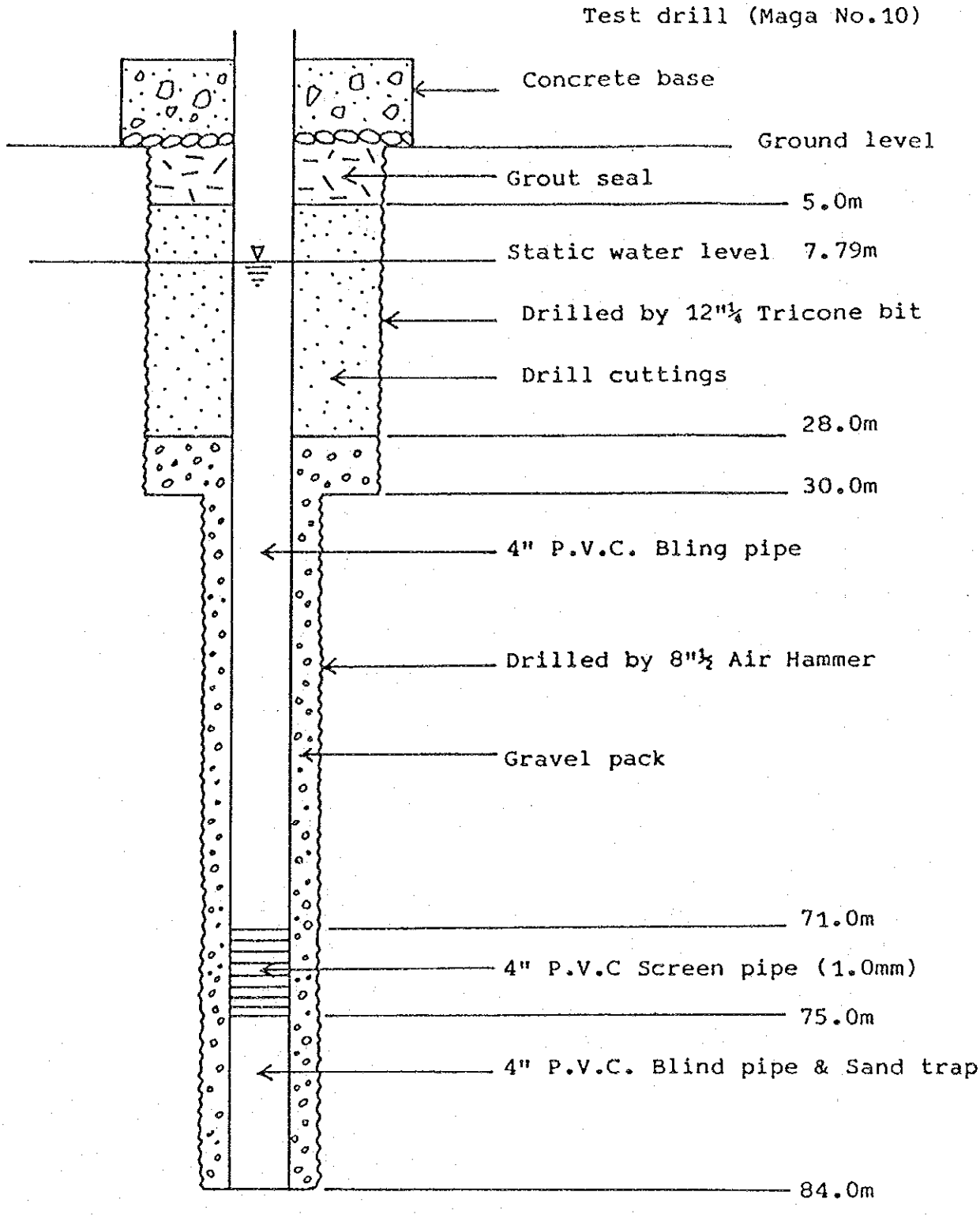
During the air lifting the maximum average yield was 4 ℓ/min.

WELL SUMMARY

Test Drill (Maga No. 10)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Maga village in Zuru Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	16th December 1988
Date well Completed	19th December 1988
Total Depth	84 m
Screen Position	G.L.-71.0m~75.0m (1.0mm)
Drilling Method	Mud rotaly drilling and Air Hammer drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	G. Kuragane
Logged By	N. Kawabata
Static Water Level	G.L.-7.79m
Yield By Air Lifting	4 ℓ/min, 0.24m^3/h, 5.76m^3/d
Pumping Rate	-
Dynamic Water Level	-
Specific Capacity	-
Critical Capacity	-
Transmissivity	-
Permeability	-
Water Temperature	-
Conductivity	-
pH	-

WELL SKETCH



Not to Scale

WELL LITHOLOGIC LOG

Test drill(Maga No.10)

Depth (m)	Log	Lithology			Geological Division
		Sand and Silt,	Reddish brown		Top Soil
15.0		Quartzite,	Yellowish brown		Basement Complex (Upper-Cambrian) ⟩ (Pre-Cambrian)
23.0		Crystalline Schist,	-do-		
30.0		Crystalline Schist,	-do-	W.Z	
33.0		Crystalline Schist,	Dark green	P W.Z	
70.0		Quartzite,	Light Yellowish green		
75.0		Crystalline Schist,	Dark green		
84.0					

W.Z ..... Weathered Zone

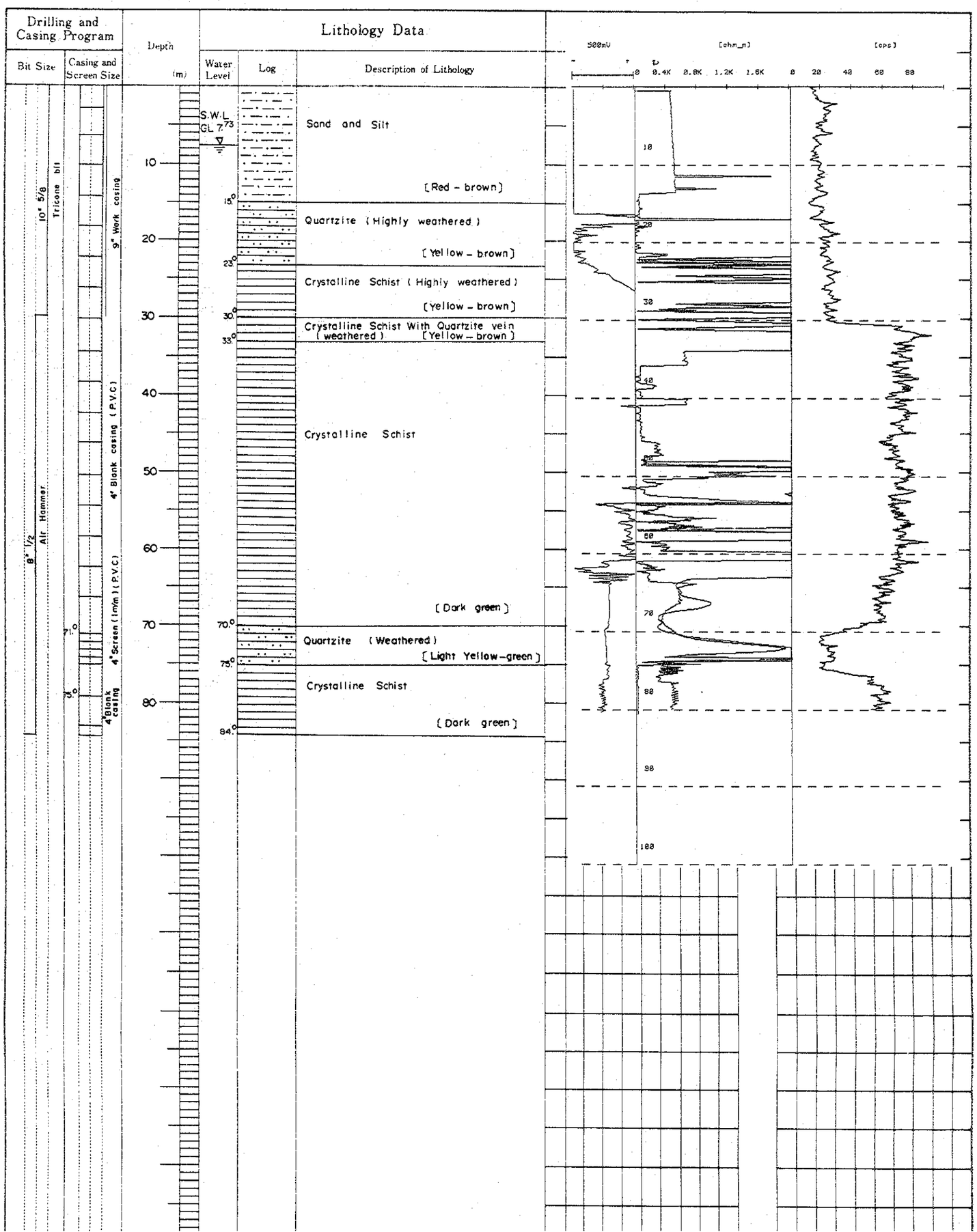
P W.Z ..... Partially weathered Zone

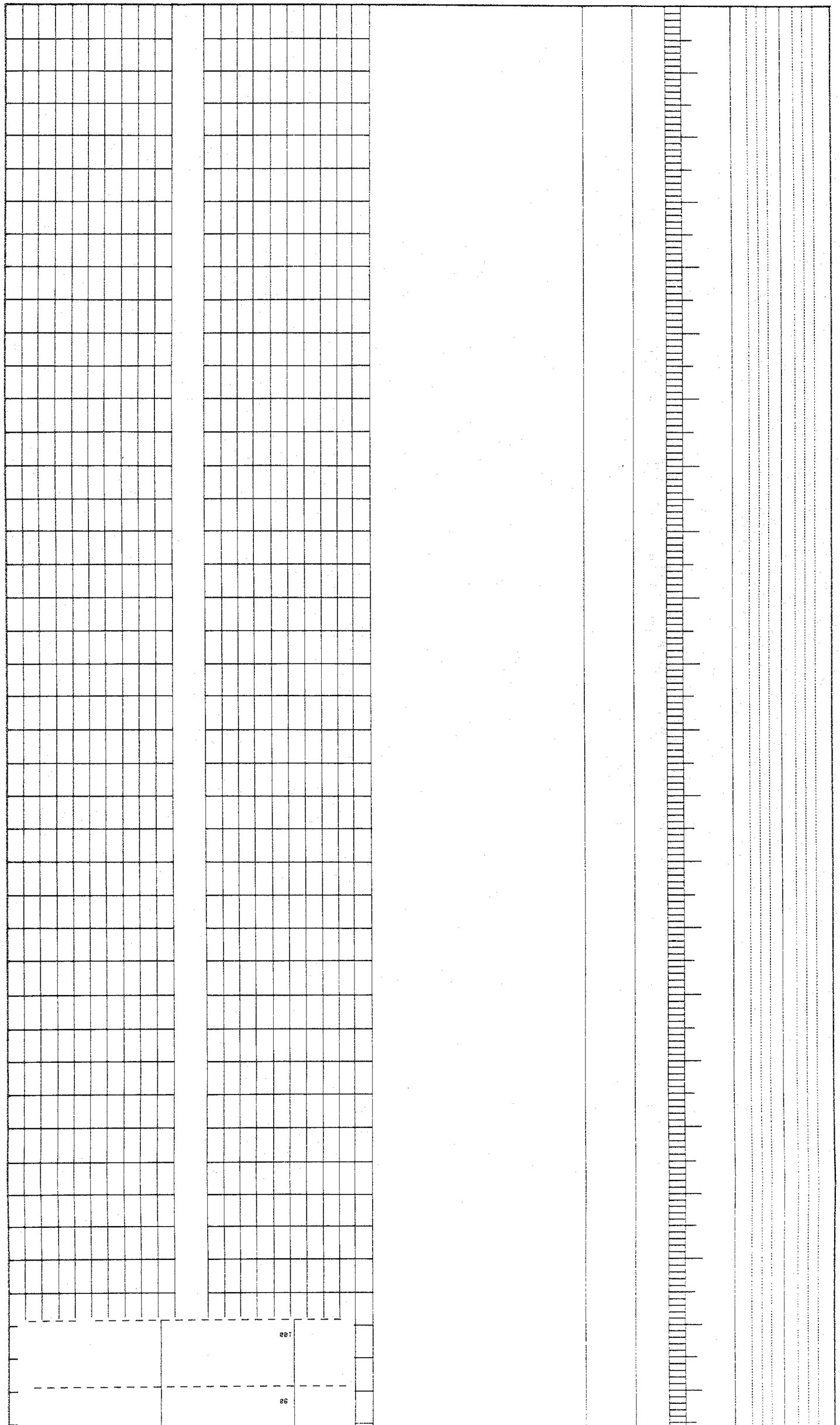
WELL LOG

Data No. _____

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	MAGA NO.10 - 2	(Test drilling)	
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	84.0 m	DRILLING RIG	Top - 750
DRILLING STARTED	13th. Dec. 1988	DRILLED BY	G. Kuragane
WELL COMPLETED	16th. Dec. 1988	LOGGED BY	N. Kawabata

STATIC WATER LEVEL	GL - 7.73 m	WATER TEMPERATURE	— °C
DYNAMIC WATER LEVEL	— m	CONDUCTIVITY	— μ℧/cm
PUMPING RATE	ℓ/min (— m³/d)	pH	—
SPECIFIC CAPACITY	— m³/d/m	TOTAL HARDNESS	




100
90

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - HORO BIRNI

SITE NO.: - 23

(TEST WELL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test well borehole (Horo Birni No. 23) was drilled during the time from 26th November to 30th November 1988 at Horo Birni village in Yabo Local Government.

Test well borehole is 5m apart from test drill borehole.

The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 5.7m below ground level(G.L.-), it was drilled using a 12"1/4 tricone bit, and from G.L.-5.7m to the total depth of 110.0m using a 10"5/8 tricone bit.

Mud rotaly drilling was the method used.

After the drilling electric log had been carried out and then the borehole was cased with 6" blind steel pipe from G.L.+1.0m to G.L.-72.0m and from G.L.-80.5m to G.L.-110.0m.

A total length of 8.5m of Johnson's screen 6"I.D. (slot size 0.25mm) was inserted from G.L.-72.0m to G.L. -80.5m.

The lithology encountered consists of mainly marly shale, sand (coarse & fine), sandy shale. These formations are divided into Taloka formation and Sokoto group in ascending order, and the boundary is at G.L. -33.0m.

The aquifer section consists of sand (fine & medium), Taloka formation.

After development of the borehole the static water level was measured at G.L.-45.73m.

During the air lift the maximum average yield was 350 ℓ/min.

Pumping test was carried out during the time from 13rd December to 16th December 1988.

By the five steps drawdown test, the critical discharge of this well was determined more than 300 ℓ/min that was the maximum capacity of the submercible pump used.

Continuos drawdown test was done for 48 hours with a pumping rate of 300 ℓ/min, and a drawdown of 8.26m was observed. (Dynamic water level was measured at G.L.-53.99m.)

On the other hand, a drawdown of 0.55m was observed at the test drill borehole that was 5m apart from test well borehole.

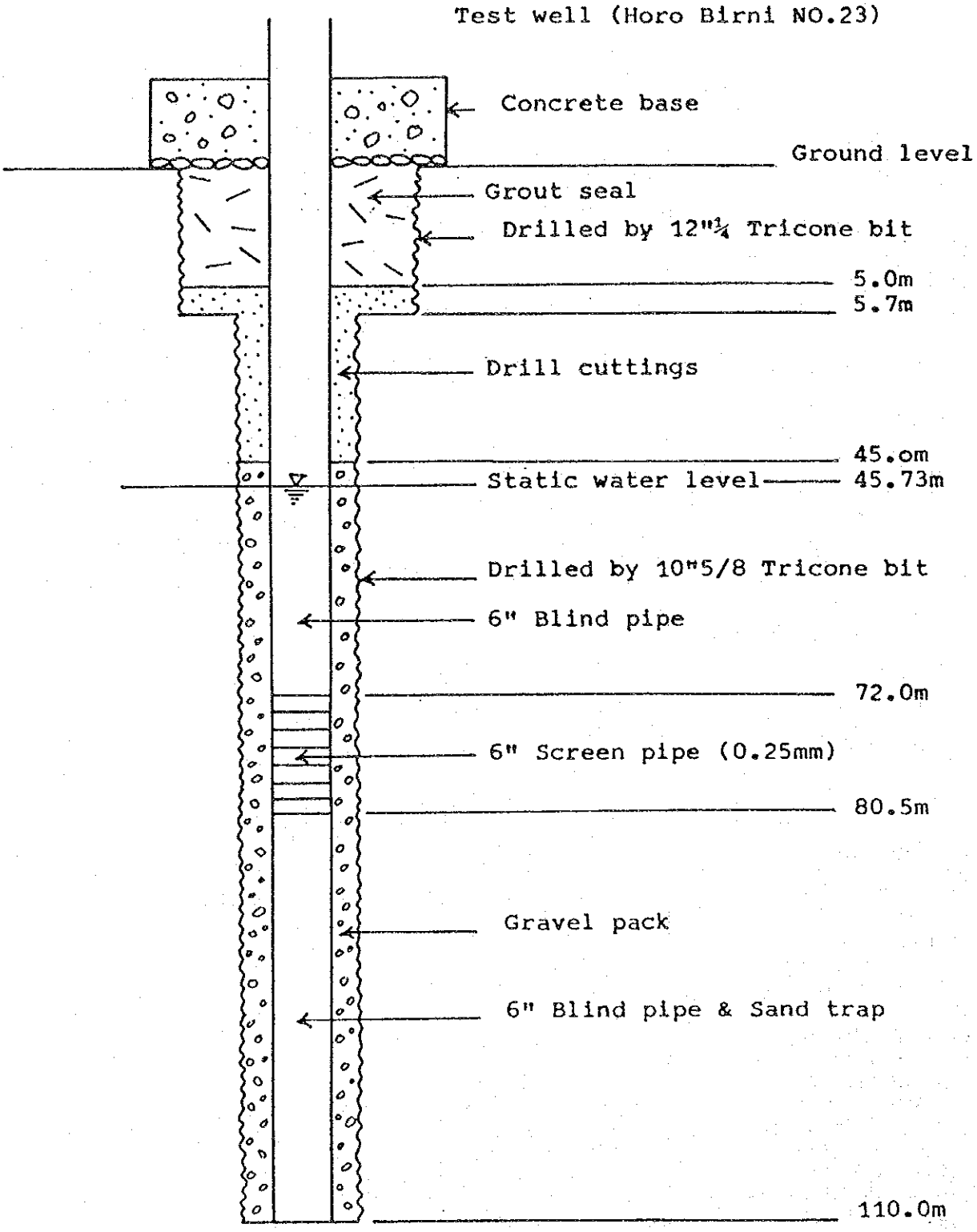
Then recovery of water level was measured for 4.5 hours.

WELL SUMMARY

Test Well (Horo Birni No. 23)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Horo Birni village in Yabo Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	26th November 1988
Date well Completed	30th November 1988
Total Depth	110.0 m
Screen Position	G.L.-72.0m~80.5m slot (0.25mm)
Drilling Method	Mud rotaly drilling
Drilling Rig	Tone Boring Top-750B
Drilled by	G. Kuragane
Logged By	K. Yoshida
Static Water Level	G.L.-45.73m
Yield By Air Lifting	350 ℓ/min, 21m^3/h, 504m^3/d
Pumping Rate	300ℓ/min, 432m^3/d
Dynamic Water Level	G.L.-53.99m Drawdown (8.26m)
Specific Capacity	36.3ℓ/min/m, 57.3m^3/d/m
Critical Capacity	Over 300ℓ/min
Transmissivity	0.265m^2/min
Permeability	5.17×10^{-2}cm/sec
Water Temperature	31.7 ℃
Conductivity	140 μυ/cm
pH	6.38

WELL SKETCH



Not to scale

WELL LITHOLOGIC LOG

Tese well (Horo Birni NO.23)

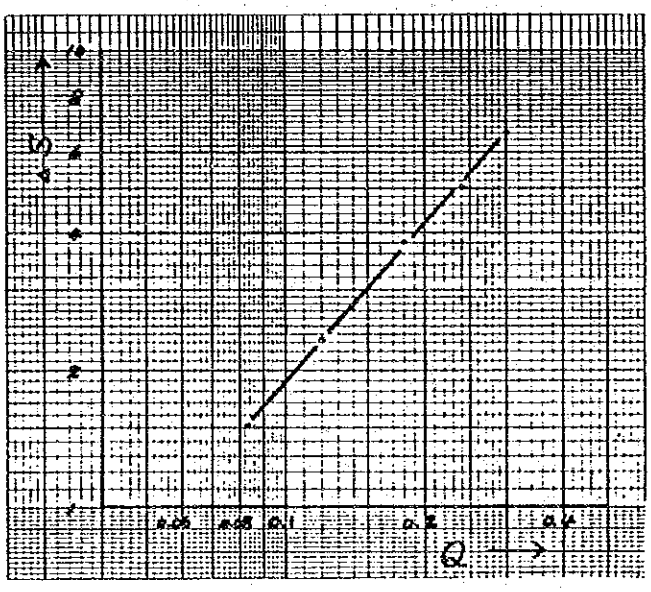
Depth (m)	Log	Lithology		Geological Division
3.0		Laterite,	Red	Sokoto group (Tertiary)
		Marly shale,	Whitish grey	
20.5				
24.0		Sand, medium&coarse	-do-	
		Marly shale,	Grey	
33.0		Sand, coarse	whitish yellow	
40.0		Alternation of sand & clay,	whitish yellow & Light pink	Taloka formation (Upper cretaceous)
68.0		Sand, fine & medium	-do-	
89.0				
95.0		Alternation of Sand & clay,	whitish yellow	
102.0		Sandy shale,	Black	
110.0		Alternation of sand & shale	Grey	

Pumping Test

Test well (Horo Birni NO.23)

Step drawdown test

Step	Pumping rate Q (m^3/min)	Drawdown ΔS (m)	Specific Capacity (m^3/min/m)
1	0.083	1.52	0.055
2	0.120	2.34	0.051
3	0.180	3.81	0.047
4	0.240	5.07	0.047
5	0.300	6.61	0.045



Critical discharge $>$ 0.3m^3/min

Pumping Test.

Test well (Horo Birni NO.23)

Continuos drawdown test and Recovery test

	Test well hole (product well)	Test drill hole (Observation well)
Static water level	G.L. -45.73m	G.L. -45.21m
Pumping rate	3001/min	-
Dynamic water level	G.L. -53.99m	G.L. -45.76m
Drawdown	8.26m	0.55m
Specific capacity	36.31/min/m	-
Elapsed time	48 hours.	

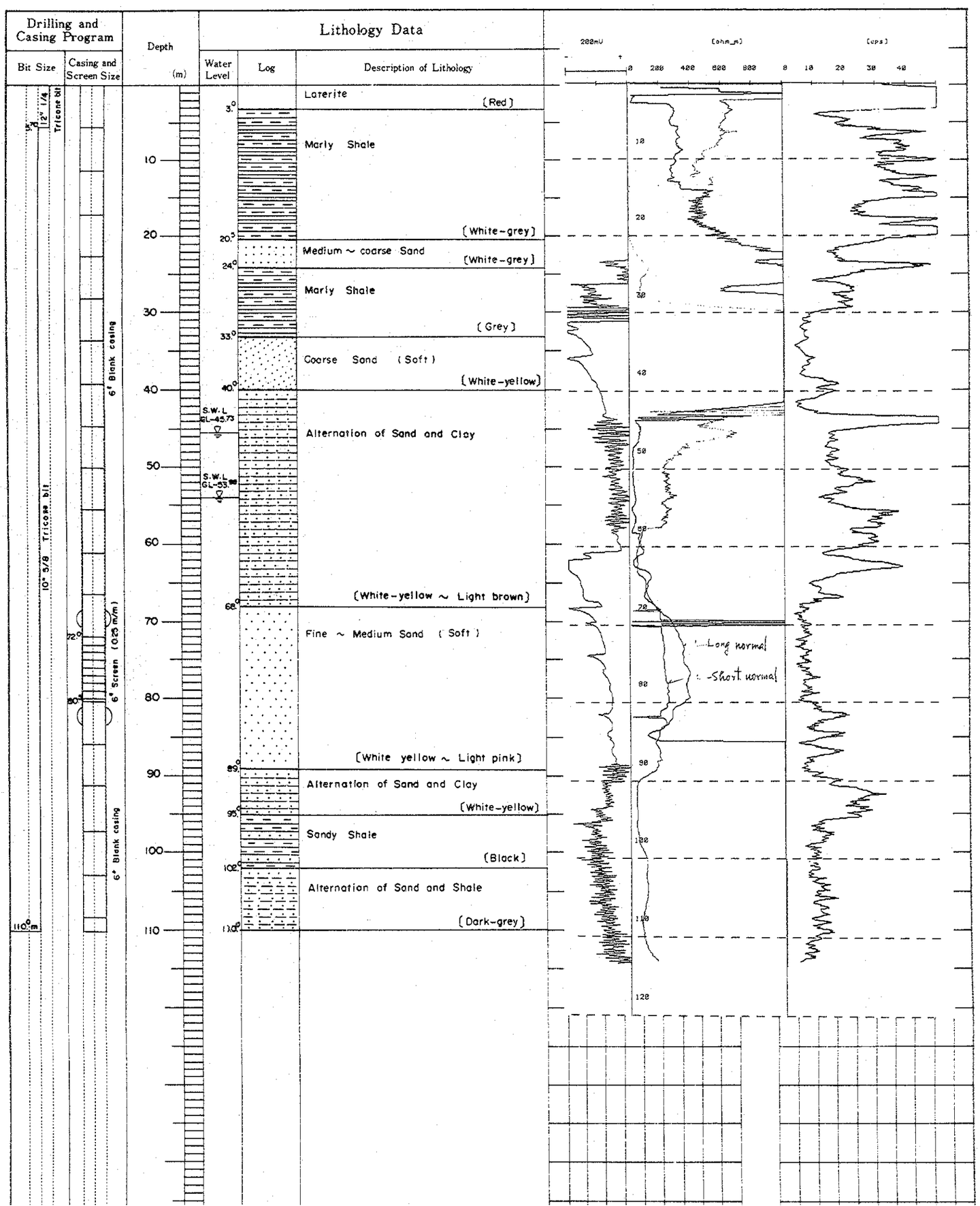
	Transimissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	0.054	0.458	1.00×10^{-2}	9.00×10^{-2}
Recovery test	0.044	0.504	8.33×10^{-3}	9.88×10^{-2}
Average	0.265		5.17×10^{-2}	

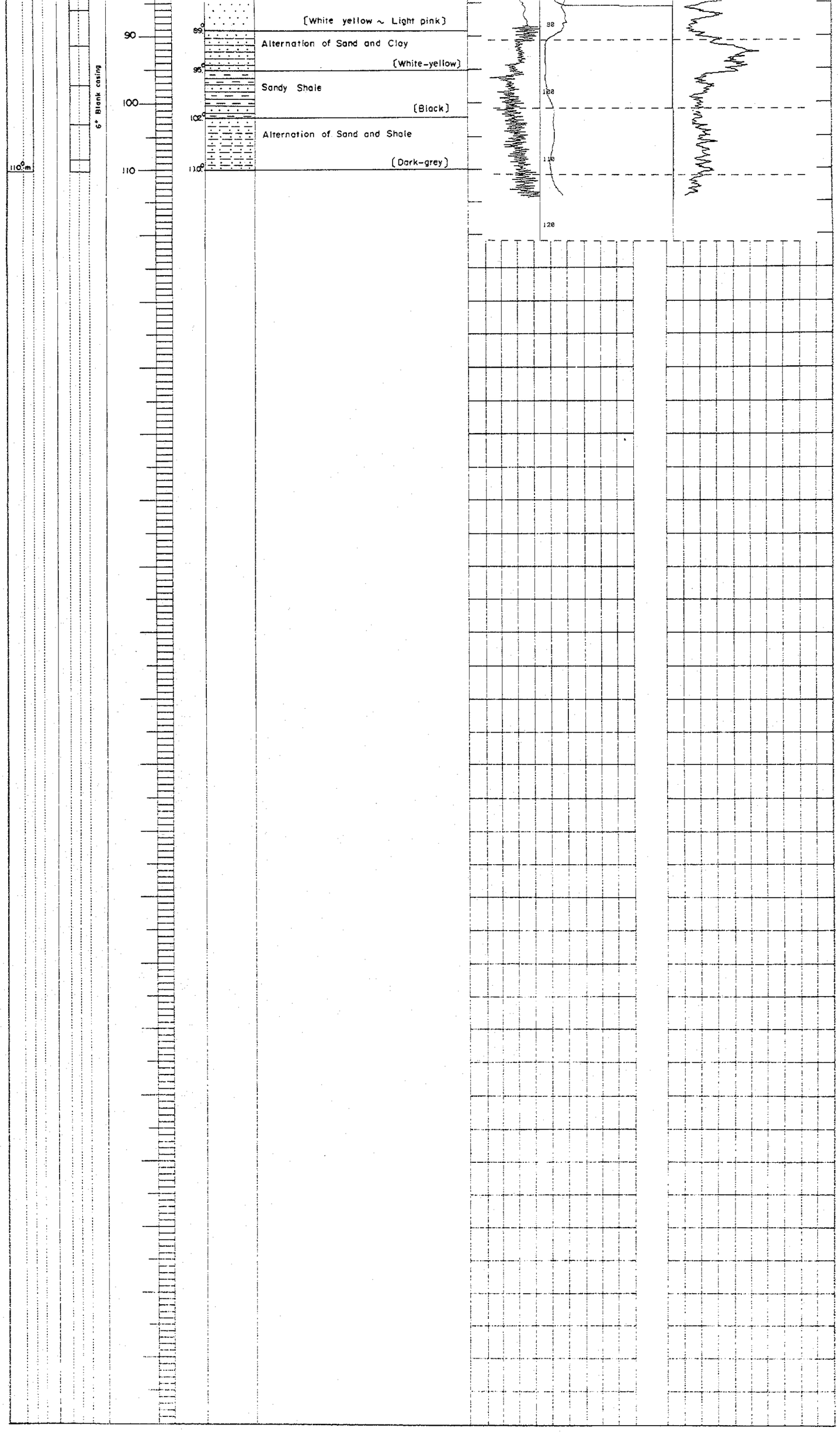
Data No. _____

WELL LOG

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	HORO BIRNI	NO. 23-2 (Test well)	
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	110 m	DRILLING RIG	Top - 750
DRILLING STARTED	22nd. Nov. 1988	DRILLED BY	G. Kuragane
WELL COMPLETED	27th. Nov. 1988	LOGGED BY	K. Yoshida

STATIC WATER LEVEL	GL - 45.73 m	WATER TEMPERATURE	31.7 ℃
DYNAMIC WATER LEVEL	GL - 53.99 m	CONDUCTIVITY	140 μℭ/cm
PUMPING RATE	300 ℓ/min (432 m³/d)	pH	6.38
SPECIFIC CAPACITY	64.8 m³/d/m	TOTAL HARDNESS	




6" Blank casing
110.0m
90
100
110
99.0
95.0
100.0
110.0
[White yellow ~ Light pink]
Alternation of Sand and Clay
[White-yellow]
Sandy Shale
[Black]
Alternation of Sand and Shale
[Dark-grey]
98
108
118
120

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - HORO BIRNI

SITE NO.: - 23

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test drill borehole (Horo Birni No. 23) was drilled during the time from 18th November to 23rd November, 1988 at Horo Birni village in Yabo Local Government.

The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 5.7m below ground level (G.L. -), it was drilled using a 12"1/4 tricone bit, and from G.L.-5.7m to the total depth of 150.0m using a 8"1/2 tricone bit.

Mud rotaly drilling was the method used.

After the drilling electric log had been carried out and then the borehole was cased with 4" blind steel pipe from G.L.+1.0m to G.L.-70.0m and from G.L.-80.5m to G.L.-150.0m.

A total length of 10.5m of Johnson's screen 4" I.D. (slot size 0.25 m/m) was inserted from G.L.-70.0m to G.L.-80.5m.

The lithology encountered consists of mainly marly shale, sand (fine & medium), sandy shale. These formation are divided into Taloka formation and Sokoto group in ascending order, and the boundary is at G.L.-30.0m.

The aquifer section consists of sand (fine & medium), Taloka formation.

After development of the borehole the static water level was measured at G.L.-45.2m.

During the air lifting the miximum average yield was 200 ℓ /min

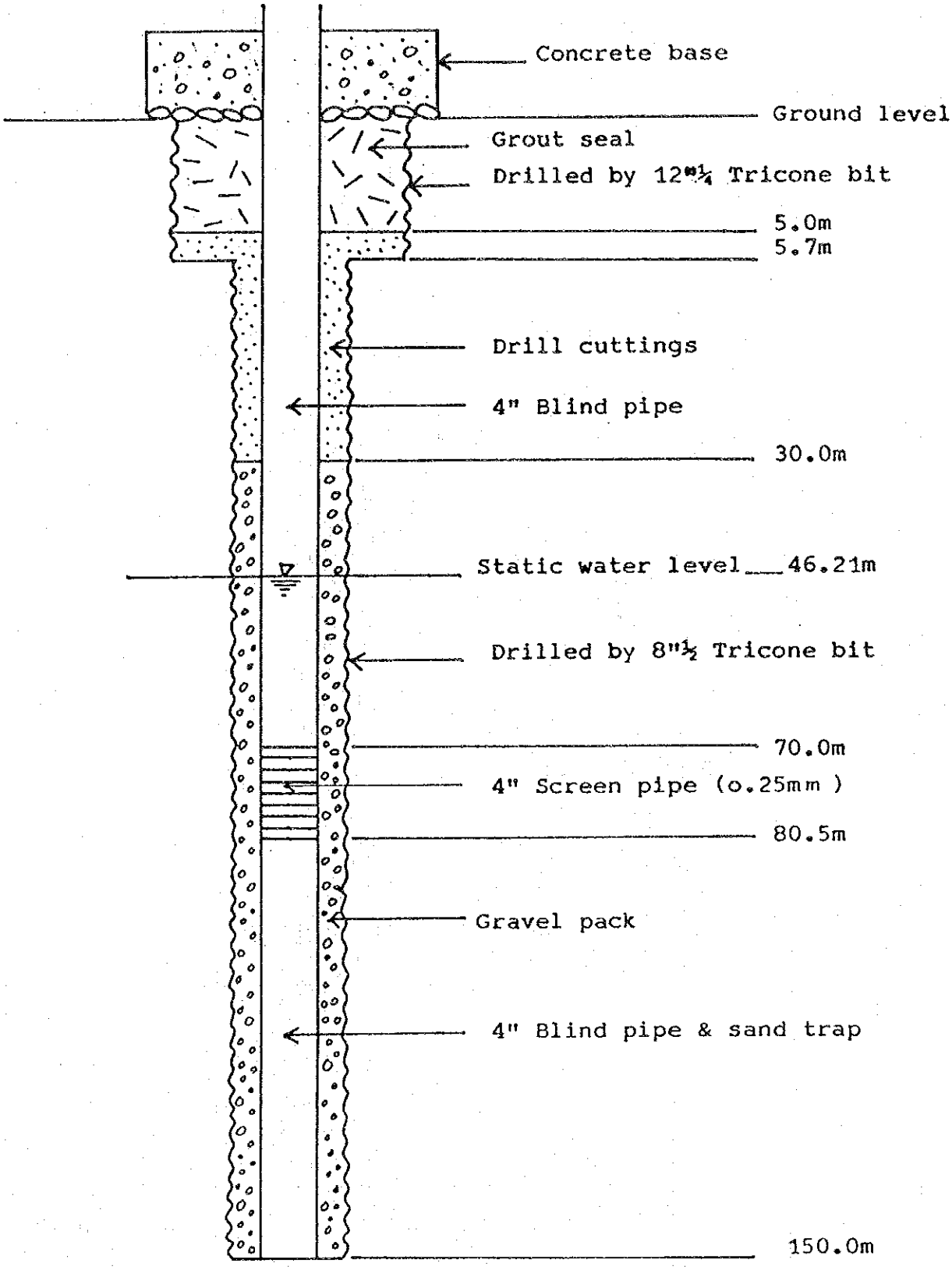
WELL SUMMARY

Test Drill (Horo Birni No. 23)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Horo Birni village in Yabo Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	18th November 1988
Date well Completed	23rd November 1988
Total Depth	150 m
Screen Position	G.L.-70.0m~80.5m slot (0.25mm)
Drilling Method	Mud rotaly drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	G. Kuragane
Logged By	H. Suwa
Static Water Level	G.L.-45.21m
Yield By Air Lifting	200 ℓ/min,12m^3/h, 288m^3/d
Pumping Rate	-
Dynamic Water Level	-
Specific Capacity	-
Critical Capacity	-
Transmissivity	-
Permeability	-
Water Temperature	-
Conductivity	-
pH	-

WELL SKETCH

Test drill (Horo Birni No. 23)



Not to scale

WELL LITHOLOGIC LOG

Test drill (Horo Birni NO.23)

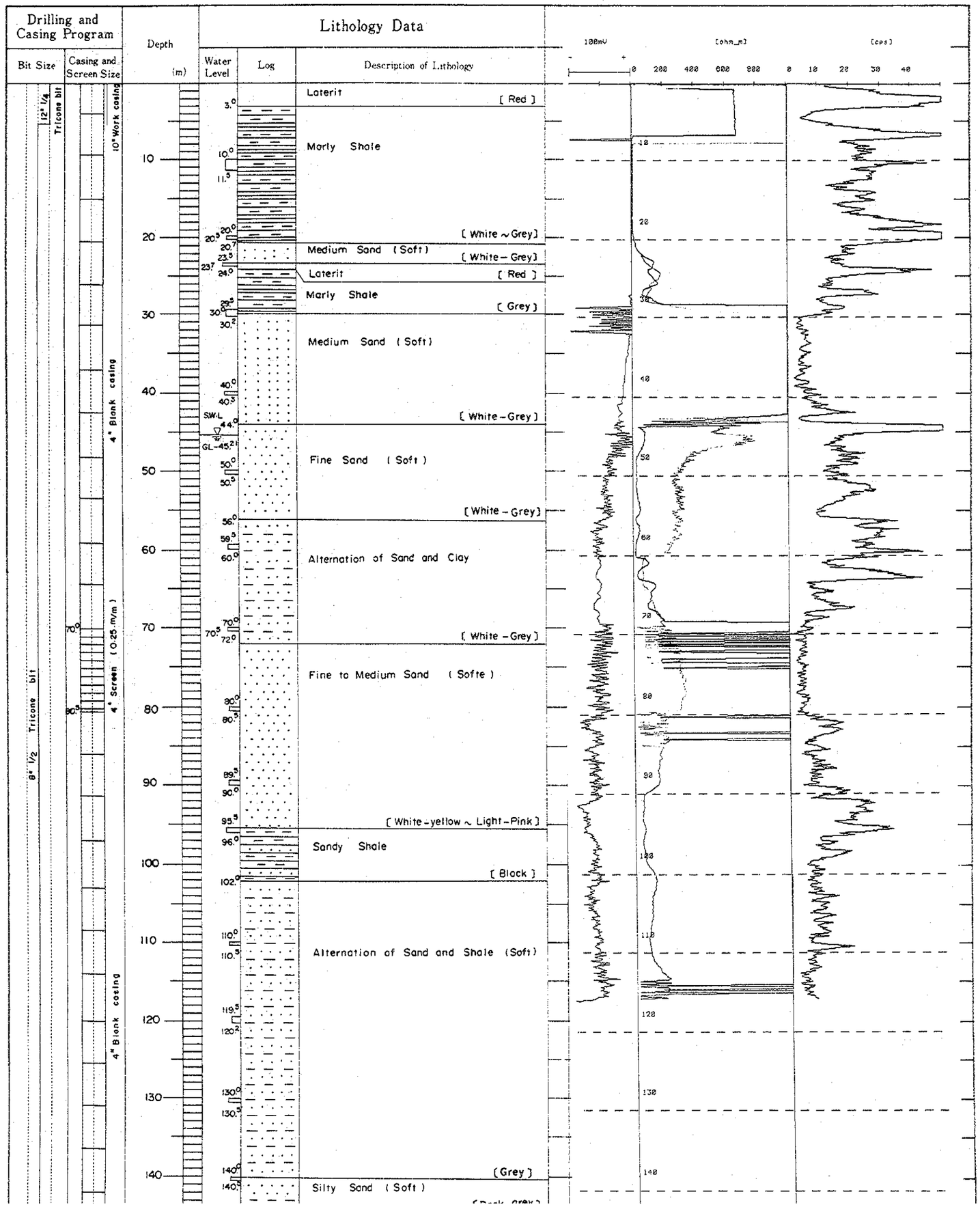
Depth (m)	Log	Lithology		Geological Division
3.0		Laterite	Red	SOkoto group (Tertiaty)
		Marly shale	white Grey	
20.7		sand medium	whitish grey	
		Laterite	Red	
30.0		Marly shale	Grey	
44.0		sand medium	whitish grey	Taloka formation (Upper-Cretaceous)
		sand fine	whitish grey	
56.0		Alternation of sand & clay	whitish grey	
72.0		Sand (fine~ medium)	whitish yellow, light pink	
95.5		Sandy shale	Black	
102.0		Alternation of Sand & shale	Grey	
140.0		Silty sand	Dark grey	
144.0		Sandy shale	Black	
150.0				

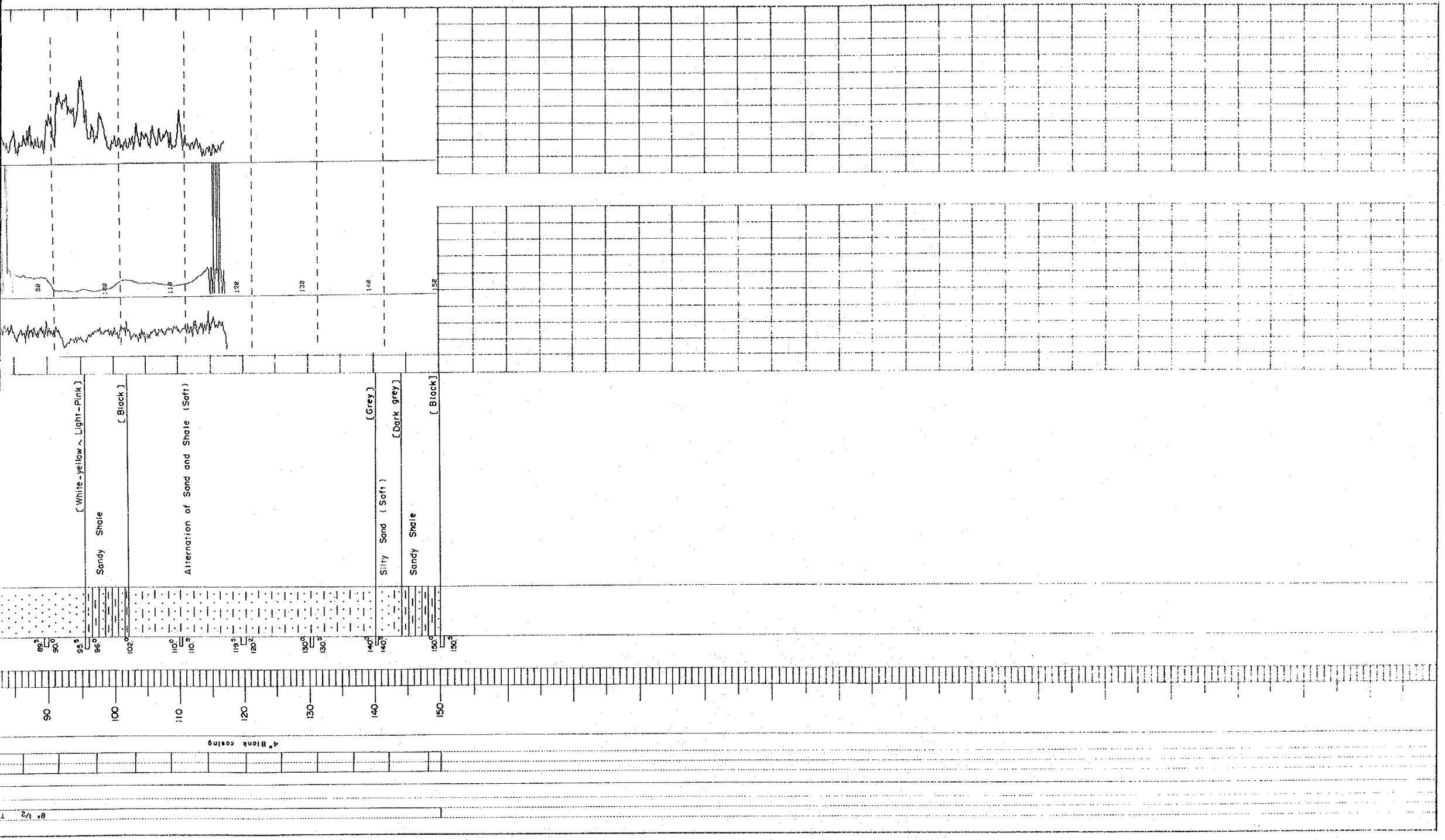
WELL LOG

Data No. _____

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	HORO BIRNI	NO. 23 - 1	(Test Drilling)
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	150 m	DRILLING RIG	Top - 750
DRILLING STARTED	15th. NOV. 1988	DRILLED BY	G. Kuragane
WELL COMPLETED	22nd. NOV. 1988	LOGGED BY	S. Suwa

STATIC WATER LEVEL	GL - 45.21 m	WATER TEMPERATURE	— ℃
DYNAMIC WATER LEVEL	— m	CONDUCTIVITY	— μ℧/cm
PUMPING RATE	— ℓ/min (— m^3/d)	pH	—
SPECIFIC CAPACITY	— m^3/d/m	TOTAL HARDNESS	




[White-yellow ~ Light-Pink]
Sandy Shale
[Black]
Alternation of Sand and Shale (Soft)
[Grey]
Silty Sand (Soft)
[Dark grey]
Sandy Shale
[Black]
4" Blank casing
8" 1/2 T

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - SORO

SITE NO.: - 34

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Borehole (Soro No. 34) was drilled during the time from 1st December to 6th December 1988 at Soro village in Silame Local Government.

The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 5.7m below ground level (G.L.-), it was drilled using a 12"1/4 tricone bit, and from G.L.-5.7m to the total depth of 150.0m using a 10"5/8 tricone bit.

Mud rotaly drilling was the method used.

After the drilling electric log had been carried out and then the borehole was cased with 6" blind steel pipe from G.L.+1.0m to G.L.-64.6m and from G.L.-76.0m to G.L.-150.0m.

A total length of 11.4m of Johnson's screen 6" I.D. (slot size 0.25m) was inserted from G.L.-64.6m to G.L.-76.0m.

The lithology encountered consists of mainly laterite, clay, sand (fine medium), limestone. These formations are divided into Kalambaina formation and Gwandu formation in ascending order, and the boundaly is at G.L.-88.0m.

The aquifer section consists of sand (medium), Gwandu formation.

After development of the borehole the static water level was measured at G.L.-1.71m.

During the air lift the maximum average yield was 900 ℓ/min.

Pumping test was carried out during the time from 3rd. January to 6th January 1989.

Five steps drawdown test was carried out using air compressor.

The critical discharge of this well was regarded as more than 1000 ℓ/min that was maximum quantity of this method.

Continuos drawdown test was done for 48 hours with a pumping rate of 316 ℓ/min, and drawdown of 4.22m was observed. (Dynamic water level was measured at G.L.-5.93m.)

Then recovery of water level was measured for 3 hours.

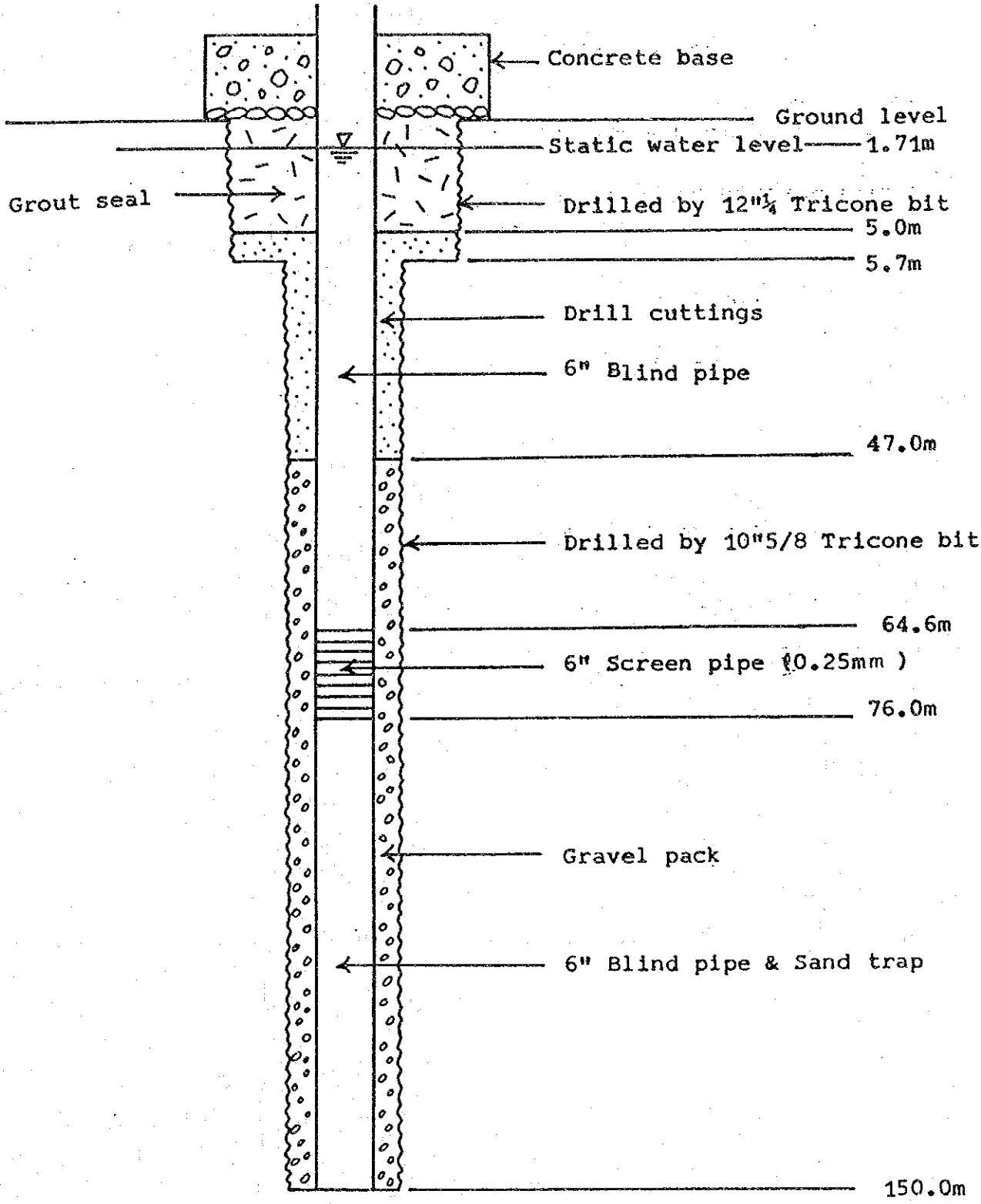
WELL SUMMARY

(Soro No. 34)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Soro village in Silame Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	1st December, 1988
Date well Completed	6th December, 1988
Total Depth	150.0 m
Screen Position	G.L.-64.6m~76.0m slot size (0.25mm)
Drilling Method	Mud rotaly drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	G. Kuragane
Logged By	K. Yoshida
Static Water Level	G.L.-1.71m
Yield By Air Lifting	900 ℓ/min, 54m^3/h, 1296m^3/d
Pumping Rate	316 ℓ/min, 455m^3/d
Dynamic Water Level	G.L.-5.93m (Drawdown 4.22m)
Specific Capacity	74.9 ℓ/min/m, 107.8m^3/d/m
Critical Capacity	Over 1000 ℓ/min.
Transmissivity	0.324 m^2/min
Permeability	4.75×10^{-2} cm/sec
Water Temperature	-
Conductivity	-
pH	-

WELL SKETCH

(Soro No.34)



Not to scale

WELL LITHOLOGIC LOG

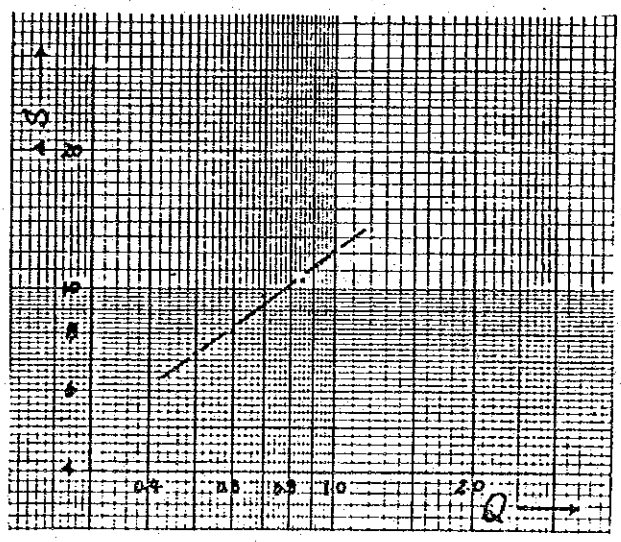
(Soro No.34)

Depth (m)	Log	Lithology		Geological Division
5.0		Sand, fine	Yellow	Gwandu formation (Tertiary)
13.0		Laterite,	Brown	
16.0		Clay,	Yellowish brown	
25.0		Alternation of Laterite & Clay	-do-	
34.5		Clay,	whitish grey	
52.0		Sand, fine	Yellowish grey	
56.0		Clay,	Grey	
82.0		Sand, medium	Yellowish grey	
88.0		Alternation of Sand & Clay,	Yellowish grey	
100.0		Clay,	Dark blue & Grey	Kalambaina formation (Tertiary)
124.0		Alternation of Limestone & Limeclay,	whitish grey	
148.0		Clay,	Dark blue	
150.0		Clay with sand,	-do-	

PUMPING TEST

Step drawdown test (Soro No.34)

Step	Pumping rate Q (m^3/min)	Drawdown ΔS (m)	Specific Capacity (m^3/min/m)
1	0.50	7.24	0.069
2	0.60	8.07	0.074
3	0.70	9.65	0.073
4	0.85	10.34	0.082
5	1.00	12.13	0.082



Critical discharge > 1.0m^3/min

PUMPING TEST

(Soro No. 34)

Continous drawdown test and Recovery test

Static water level	G.L. -1.71m
Pumping rate	316 l/min
Dynamic water level	G.L. -5.93m
Drawdown	4.22m
Specific Capacity	74.9 l/min/m
Elapsed time	48 hours

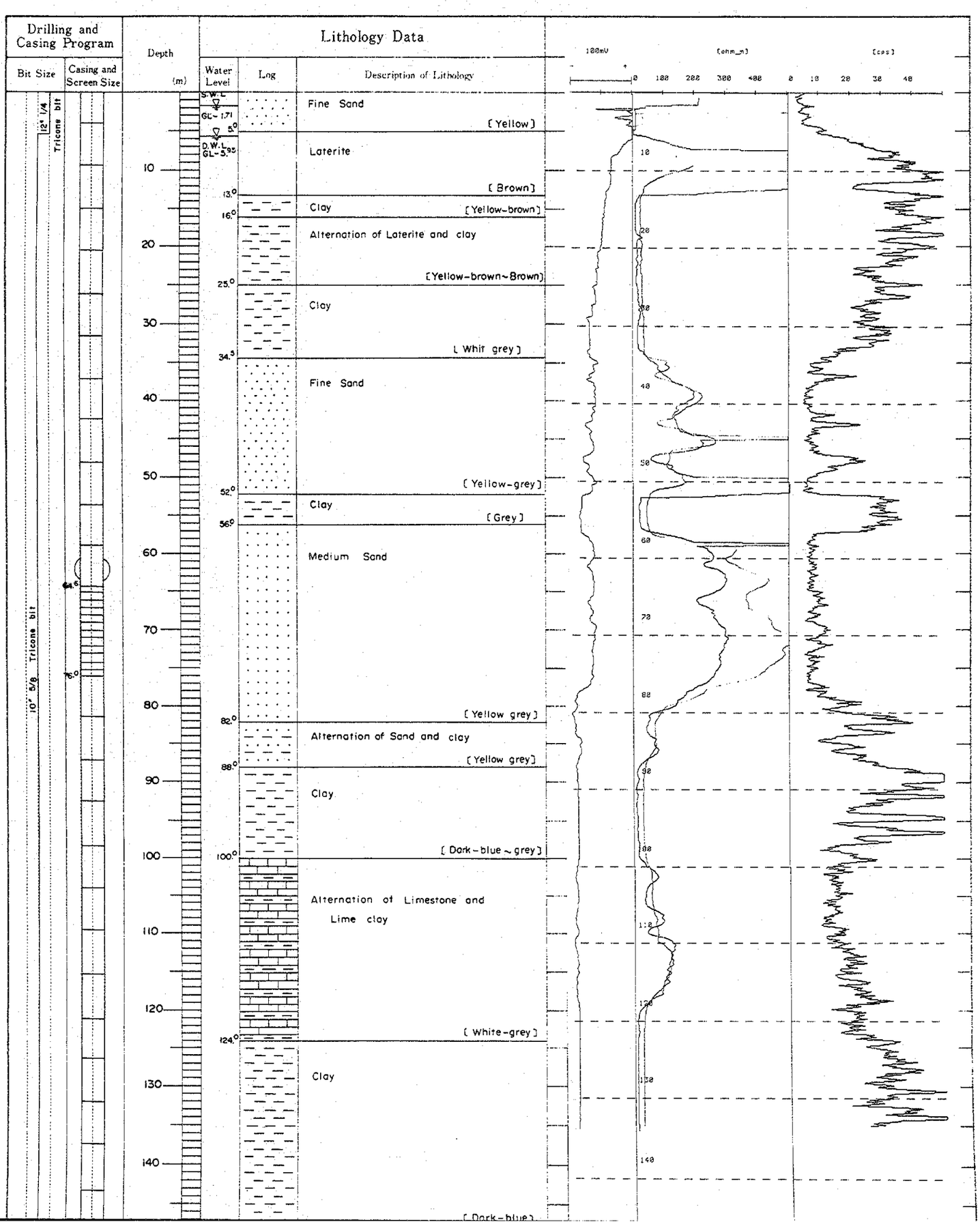
	Transimissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	0.0975	0.297	1.43×10^{-2}	4.35×10^{-2}
Recovery test	0.0762	0.826	1.11×10^{-2}	1.21×10^{-1}
Average	0.324		4.75×10^{-2}	

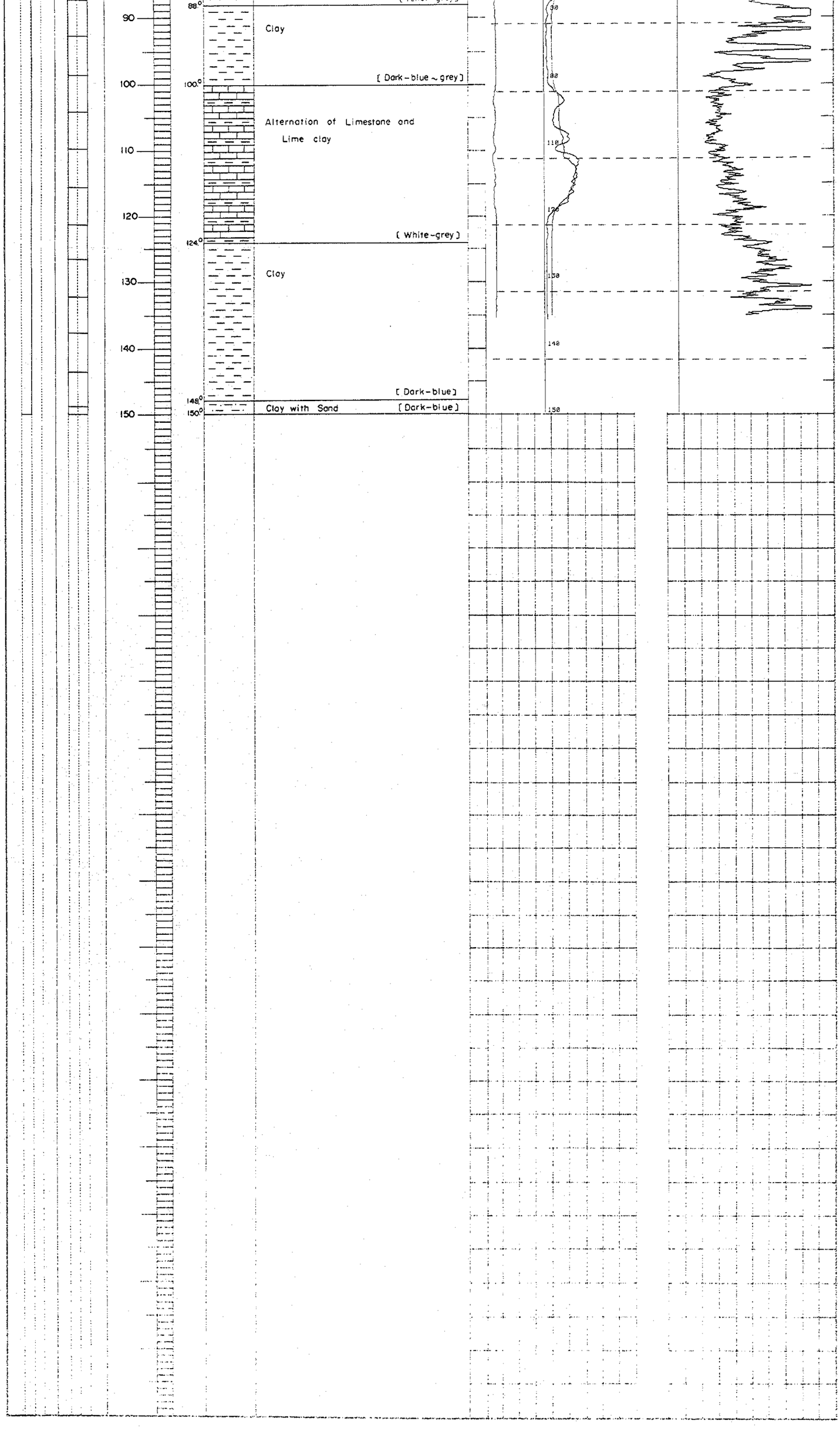
WELL LOG

Data No. _____

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	SORO NO. 34		
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	150 m	DRILLING RIG	Top - 750
DRILLING STARTED	28 th. NOV. 1988	DRILLED BY	G. Kuragane
WELL COMPLETED	3 rd. DEC. 1988	LOGGED BY	K. Yoshida

STATIC WATER LEVEL	GL - 1.71 m	WATER TEMPERATURE	—— ℃
DYNAMIC WATER LEVEL	GL - 5.93 m	CONDUCTIVITY	—— μ℧/cm
PUMPING RATE	316 ℓ/min (455 m³/d)	pH	——
SPECIFIC CAPACITY	107 m³/d/m	TOTAL HARDNESS	




88°
90
100°
100
Clay
[Dark-blue ~ grey]
Alternation of Limestone and
Lime clay
110
120
124°
[White-grey]
Clay
130
140
[Dark-blue]
148°
Clay with Sand
[Dark-blue]
150°
150
30
80
110
120
130
140
150

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - KUKA KOGO

SITE NO.: - 44

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Borehole (Kuka Kogo No. 44) was drilled during the time from 30th January to 3rd February, 1989 at Kuka Kogo village in Jega Local Government.

The well was drilled using a Tone Boring Top -750 B rig.

From ground level (G.L.) to 5.0m below ground level (G.L.-), it was drilled using a 12"1/4 tricone bit.

From G.L.-5.0m to the total depth of 113.0m, it was drilled using a 10"5/8 tricone bit. Mud rotally drilling was the method used.

After the drilling, electric log had been carried out and then the borehole was cased with 4" blind steel pipe from G.L.+1.0m to G.L.-51.0m and from G.L.-60.0m to G.L.-113.0m.

A total length of 9.0m of Johnson's screen 6" I.D. (slot size 0.5mm) was inserted from G.L.-51.0m to G.L.-60.0m.

The lithology encountered consists of alternation layers of sand, sand and gravel, clay of Illo formation.

The aquifer section consists of sand and gravel , whitish yellow~brown.

After development of the borehole, the static water level was measured at G.L.-14.60m.

During the air lifting, the maximum average yield was 840 ℓ/min.

Pumping test was carried out during the time from 7th February to 12th February, 1989.

Step drawdown test was carried out using air compressor.

The critical discharge of this well was regarded as more than 500 ℓ/min that was maximum quantity of this time method.

Continuos drawdown test was done for 48 hours with a pumping rate of 316 ℓ/min, and a drawdown of 10.16m was observed. (Dynamic water level was measured at G.L.-24.76m.)

Then, the recovery of water level was measured for 24 hours.

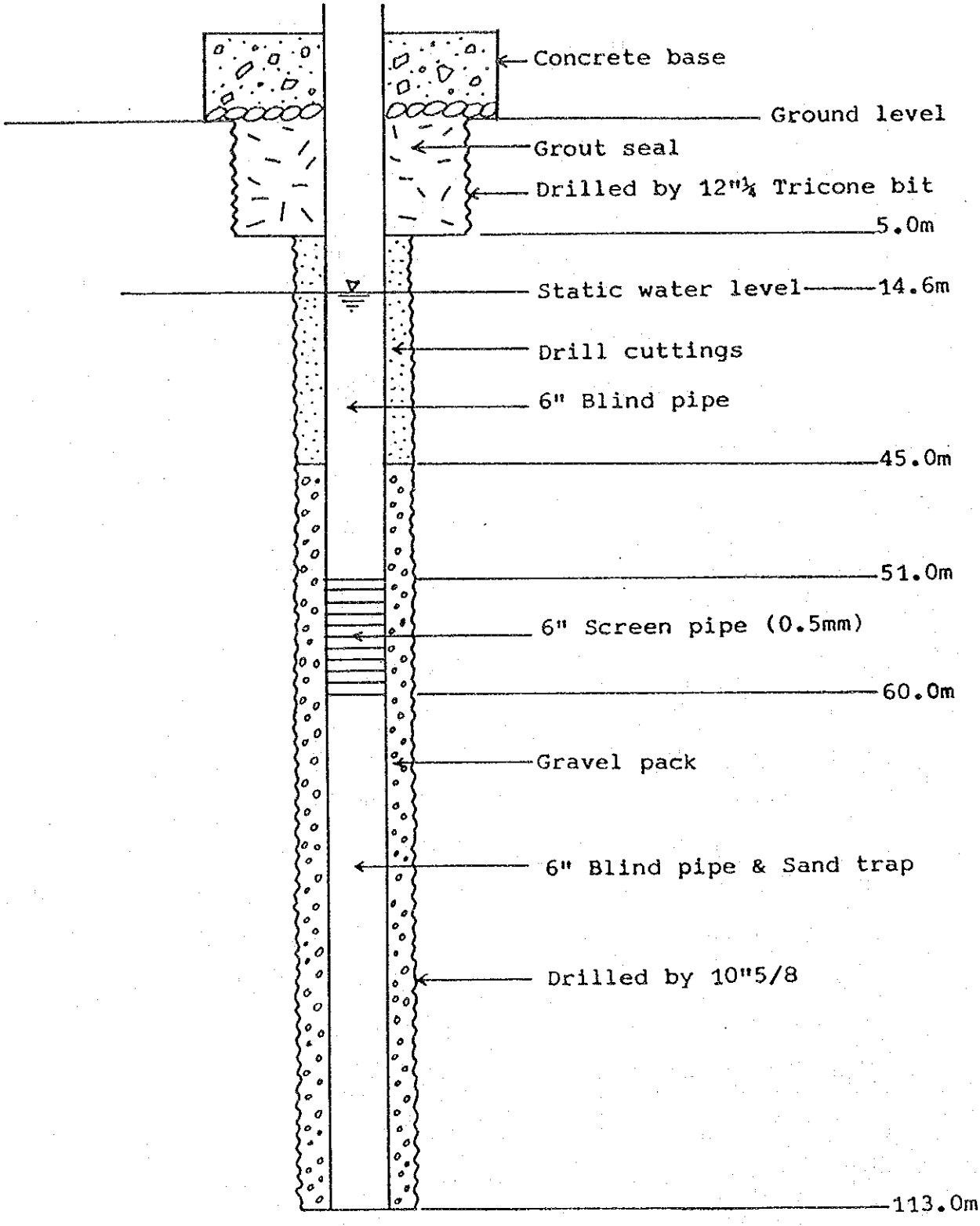
WELL SUMMARY

(Kuka Kogo No. 44)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Kuka Kogo village in Jega Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	30th January, 1989
Date well Completed	3rd February, 1989
Total Depth	113 m
Screen Position	G.L.-51.0m~60.0m (0.5)
Drilling Method	Mud potally drilling
Drilling Rig	Tone Boring Top -750B
Drilled by	Y. Tanabe
Logged By	N. Kawabata
Static Water Level	G.L.-14.60m
Yield By Air Lifting	840 ℓ/min, 50.4m^3/h, 1209.6m^3/d
Pumping Rate	316 ℓ/min, 455.0m^3/d
Dynamic Water Level	G.L.-24.76m (Drawdown 10.16m)
Specific Capacity	31.1 ℓ/min/m, 44.8m^3/d/m
Critical Capacity	Over 500 1/min
Transmissivity	3.19×10^{-2} m^2/min
Permeability	5.91×10^{-3} cm/sec
Water Temperature	31.4 ℃
Conductivity	600 μυ/cm
pH	6.26

WELL SKETCH

(Kuka Kogo No.44)



Not to scale

WELL LITHOLOGIC LOG

(Kuka Kogo No.44)

Depth (m)	Log	Lithology		Geological Division
3.0		Sand, fine	Reddish brown	ILLO FORMATION (cretaceous)
8.0		Sand & Gravel	-do-	
16.0		-do-	-do-	
19.0		-do-	Yellowish brown	
25.0		-do-	Yellow	
37.0		※	-do-	
41.0		Sand, medium	-do-	
44.0		Clay,	Whitish Yellow	
45.0		Sand, coarse	Yellow	
51.0		Clay,	Whitish Yellow	
53.0		Sand & Gravel	-do-	
54.0		Clay,	Reddish brown	
65.0		Sand & Gravel	Yellow~Whitish Yellow	
67.0		Sand, Clayey	Reddish brown (dark)	
69.0		Clay, Sandy	-do-	
70.0		Sand, coarse	Dark Yellow	
78.0		Clay, Sandy	Reddish brown (dark)	
85.0		Sand, fine	-do-	
96.0		Clay, Sandy	-do-	
98.0		Sand, fine	-do-	
103.0		Clay, Sandy	-do-	
113.0		※	Grey~Dark blue	

※ ... Alternation of Sand and Gravel

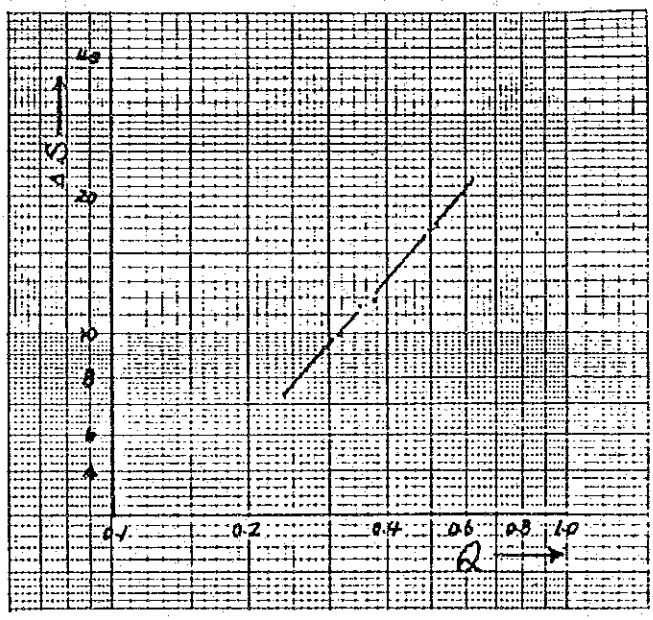
PUMPING TEST

(Kuka Kogo No.44)

Step drawdown test

Step	Pumping rate Q (m^3/min)	Drawdown ΔS (m)	Specific Capacity (m^3/min/m)
1	0.500	16.92	0.030
2	0.353	11.65	0.030
3	0.375	11.87	0.032
(4)	0.316	9.89	0.032

(4): Result of Continuos drawdown test, elapsed time is 180 min.



Critical discharge > 500 l/min

PUMPING TEST

(Kuka Kogo No.44)

Continuos drawdown test and Recovery test

Static water level	G.L.-14.60m
Pumping rate	316 l/min
Dynamic water level	G.L.-24.76m
Drawdown	10.16m
Specific Capacity	31.1 l/min/m
Elapsed time	48 hours

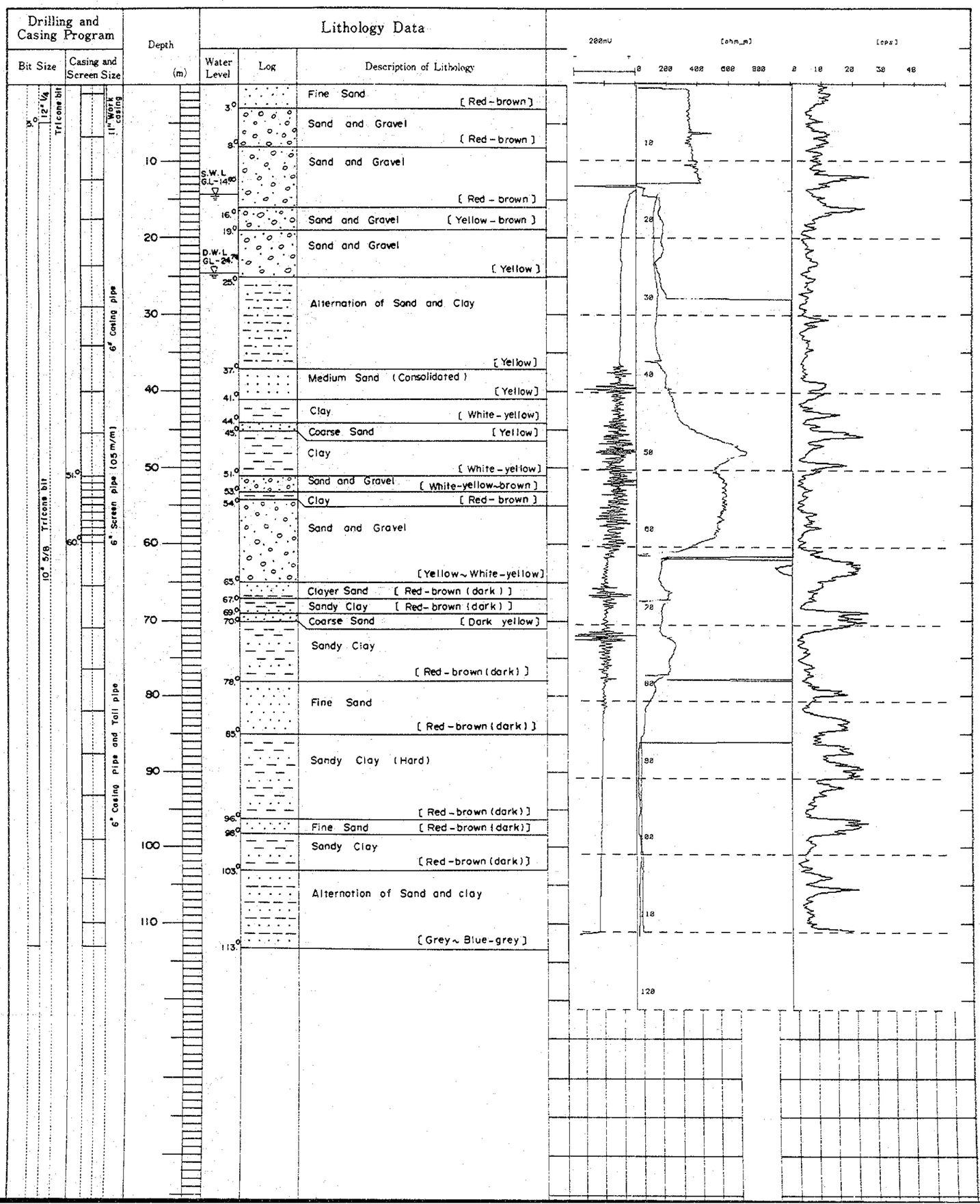
	Transimissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	3.09×10^{-2}	3.30×10^{-2}	5.72×10^{-3}	6.12×10^{-3}
Recovery test	3.11×10^{-2}	3.25×10^{-2}	5.77×10^{-3}	6.02×10^{-3}
Average	3.19×10^{-2}		5.91×10^{-3}	

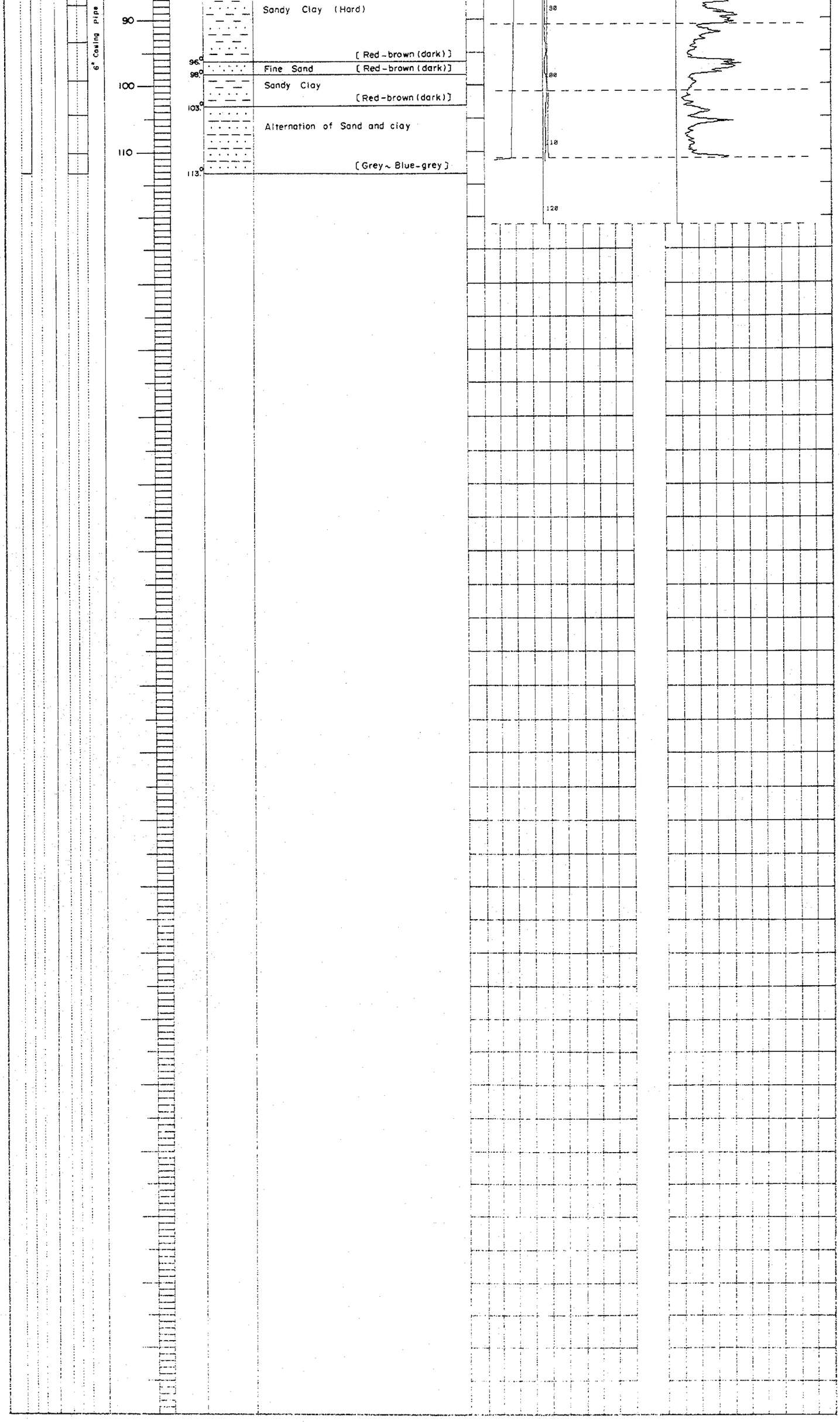
WELL LOG

Data No. _____

PROJECT NAME	The Study for Groundwater Development in Sokoto State		WELL NO.
AREA AND LOCATION	KUKA KOGA	NO. 44	
ELEVATION	m	LATITUDE	LONGITUDE
TOTAL DEPTH	113.0 m	DRILLING RIG	Top - 750
DRILLING STARTED	30th. JAN. 1989	DRILLED BY	Y. Tanabe
WELL COMPLETED	3rd. FEB. 1989	LOGGED BY	N. Kawabata

STATIC WATER LEVEL	GL - 14.60 m	WATER TEMPERATURE	31.4 °C
DYNAMIC WATER LEVEL	GL - 24.76 m	CONDUCTIVITY	600 μ℧/cm
PUMPING RATE	316 ℓ/min (455.04 m³/d)	pH	6.26
SPECIFIC CAPACITY	44.79 m³/d/m	TOTAL HARDNESS	




6" Casing Pipe
90
100
110
Sandy Clay (Hard)
[Red-brown (dark)]
96.0
98.0
Fine Sand
[Red-brown (dark)]
Sandy Clay
[Red-brown (dark)]
103.0
Alternation of Sand and clay
[Grey~ Blue-grey]
113.0
30
80
10
120

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - ZUGU

SITE NO.: - 15-1

(TEST WELL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test well borehole (Zugu No. 15-1) was drilled during the time from 4th July to 5th July, 1989 at Zugu village in Zuru Local Government.

The well was drilled using a Tone Boring Top -200 B drilling rig.

From ground level (G.L.) to 2.0m below ground level (G.L.-), it was drilled using an 8"1/2 tricone bit with mud rotary drilling method. From G.L.-2.0m to G.L.-130.0m, it was drilled using a 6"1/4 air hammer with drilling foam.

After completion of the drilling, electric logging had been carried out and the borehole was cased with 4" blind steel pipe from G.L.+1.0m to G.L.-50.72m, from G.L.-58.77m to G.L.-76.89m, from G.L.-80.11m to G.L.-122.39m and from G.L.--124.00m to G.L.-130.00m.

Total length of 12.88m of 4" I.D. Johnson's screen (slot size 0.5mm) were inserted from G.L.-50.72m to G.L.-58.77m, from G.L.-76.89m to G.L.-80.11m and from G.L.-122.39m to G.L.-124.00m.

The lithology encountered mainly consists of mica schist with quartzite vein and meta quartzite. These are pre-Cambrian to upper-Cambrian basement complex.

The probable water bearing portions are weathered zone along fractures and fissures near quartzite vein.

The static water level was measured at 14.00m after development of the borehole.

During the air lifting the maximum average yield was 30 ℓ/min.

Continuous drawdown test was done for 48 hours with a pumping rate of 28 ℓ/min., and a drawdown of 31.68m was observed. (Dynamic water level was measured at G.L.-45.68m.)

Then recovery of water level was measured for 24 hours.

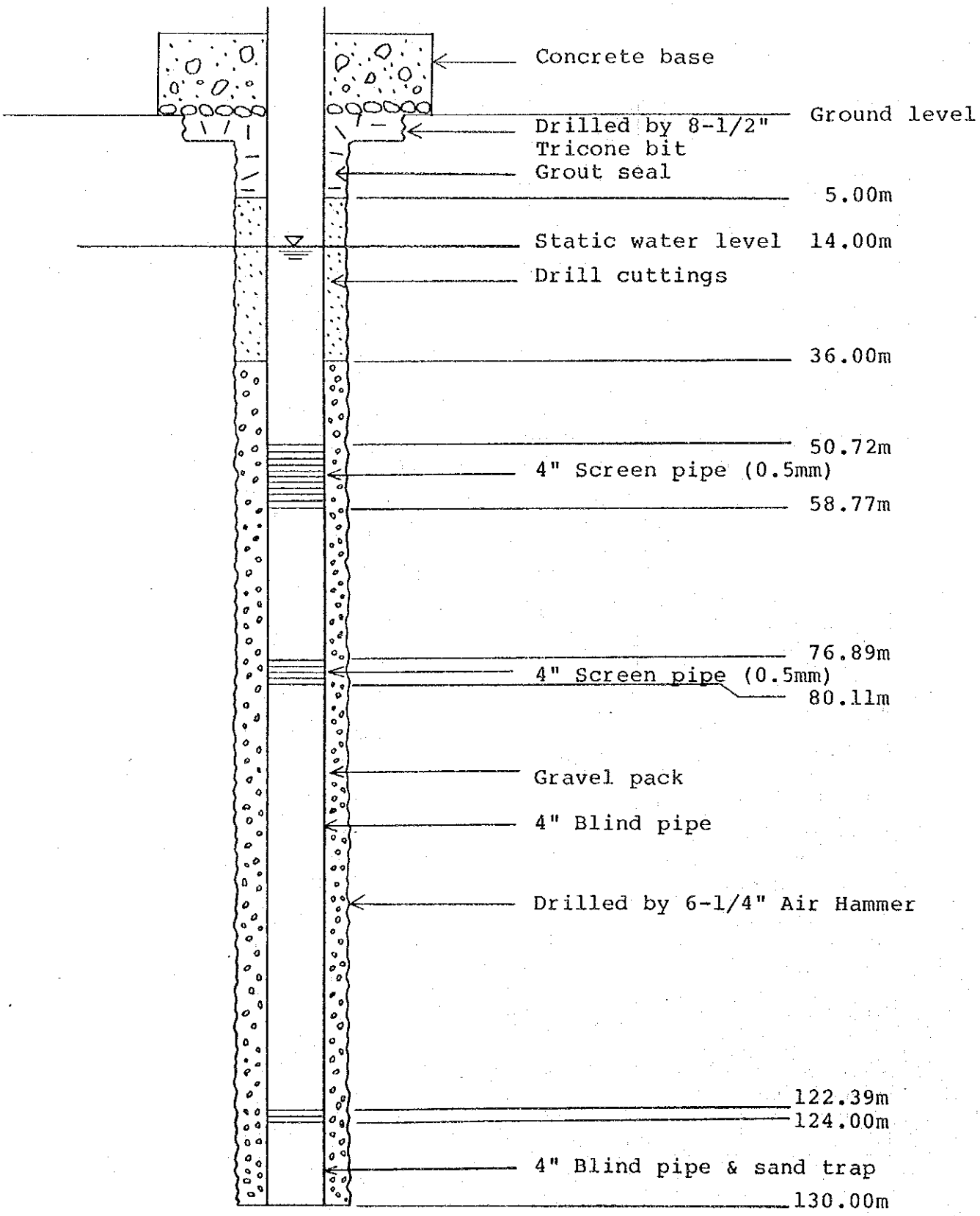
WELL SUMMARY

Test well (Zugu No. 15-1)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Zugu village in Zuru Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	4th July, 1989
Date well Completed	5th July, 1989
Total Depth	130 m
Screen Position	G.L.-50.72m~58.77m, G.L.-76.89m~80.11m G.L.-122.39m~124.00m
Drilling Method	Mud rotary drilling and air hammer drilling
Drilling Rig	Tone Boring Top-200B
Drilled by	G. Kuragane
Logged By	T. Ohtsubo
Static Water Level	G.L.-14.00m
Yield By Air Lifting	30 ℓ/min, 1.8m^3/h, 43.2m^3/d
Pumping Rate	28 ℓ/min, 40.3m^3/d
Dynamic Water Level	G.L.-45.68m (Drawdown 31.68m)
Specific Capacity	0.88 ℓ/min/m, 1.27m^3/d/m
Critical Capacity	-
Transmissivity	4.54×10^{-4} m^2/min
Permeability	6.31×10^{-5} cm/sec
Water Temperature	30 °C
Conductivity	500 μu/cm
pH	6.57

WELL SKETCH

Test well (Zugu No.15-1)



(Not to Scale)

WELL LITHOLOGIC LOG

Test well (Zugu No.15-1)

Depth	Log	Lithology			Geological Division
		Sand & Silt	Red brown		
1.0		Meta Quartzite	Dark brown		Basement Complex (Upper-Cambrian) ⟆ (Pre-Cambrian)
3.0		Mica Schist	- do -	H W.Z	
10.0		Meta Quartzite	Yellow brown		
12.0		Mica Schist	- do -		
26.0		Meta Quartzite with Quartzite vein	Yellowish brown grey	W.Z	
47.0		Mica Schist	Dark grey	PW.Z	
54.0		Meta Quartzite	Grey	W.Z	
60.0		Mica Schist	Dark grey ~ grey	P W.Z	
74.0		Meta Quartzite	Grey		
79.0		Mica Schist with Quartzite vein	Dark grey ~ grey		
97.0		Meta Quartzite with Quartzite vein	Grey ~ dark grey		
121.0		Mica Schist	Dark grey		
128.0					
130.0		Meta Quartzite	Grey		

H W.Z ..... Highly weathered zone

W.Z ..... Weathered zone

P W.Z ..... Partially weathered zone

PUMPING TEST

Test well (Zugu No.15-1)

Continuous drawdown test and recovery test

	Test well hole
Static water level	G.L. -14.00m
Pumping rate	28 l/min
Dynamic water level	G.L. -45.68m
Drawdown	31.68m
Specific capacity	0.88 l/min/m
Elapsed time	48 hours

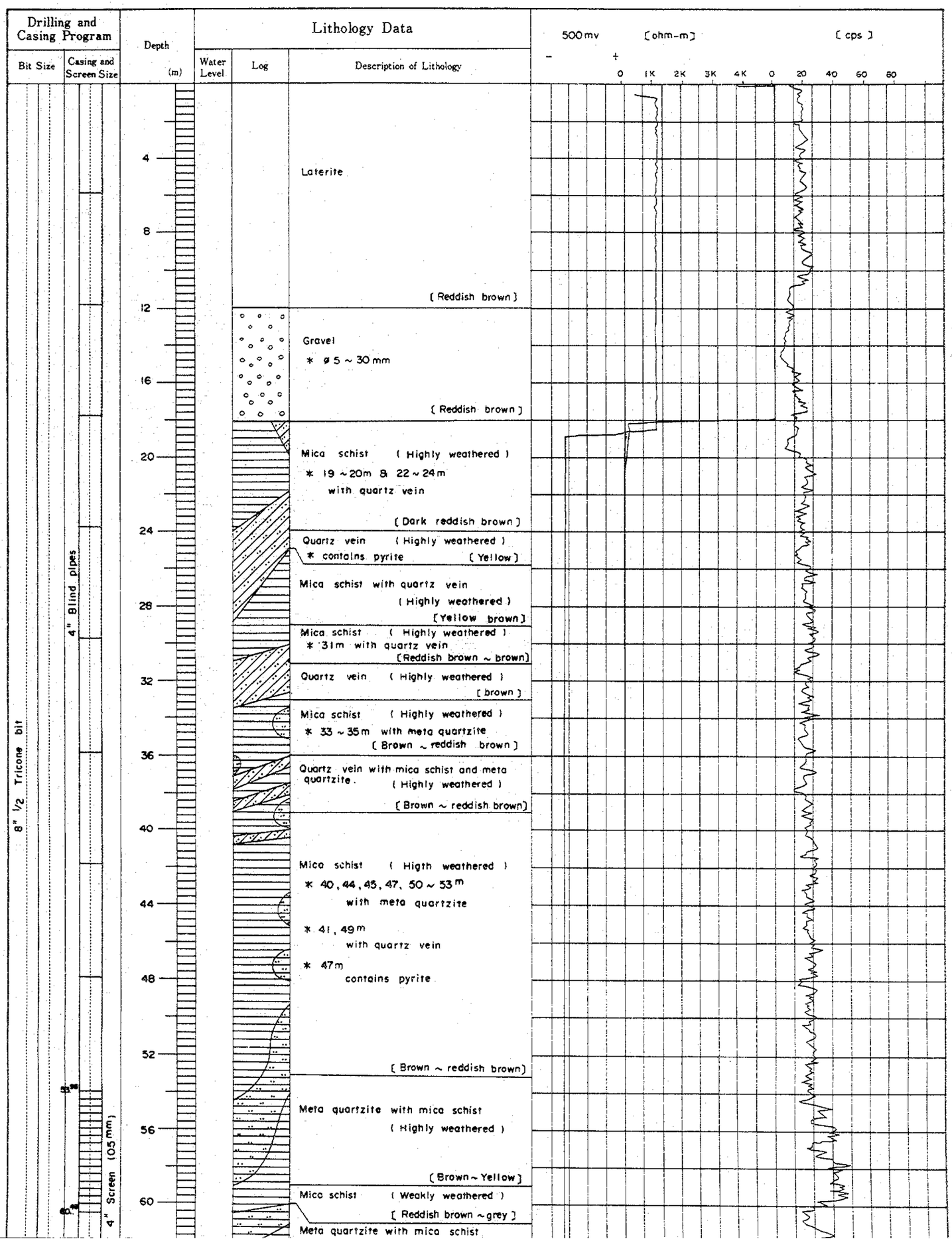
	Transmissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	5.29×10^{-4}	7.06×10^{-4}	7.35×10^{-5}	9.80×10^{-5}
Recovery test	3.09×10^{-4}	2.73×10^{-4}	4.30×10^{-5}	3.80×10^{-5}
Average	4.54×10^{-4}		6.31×10^{-5}	

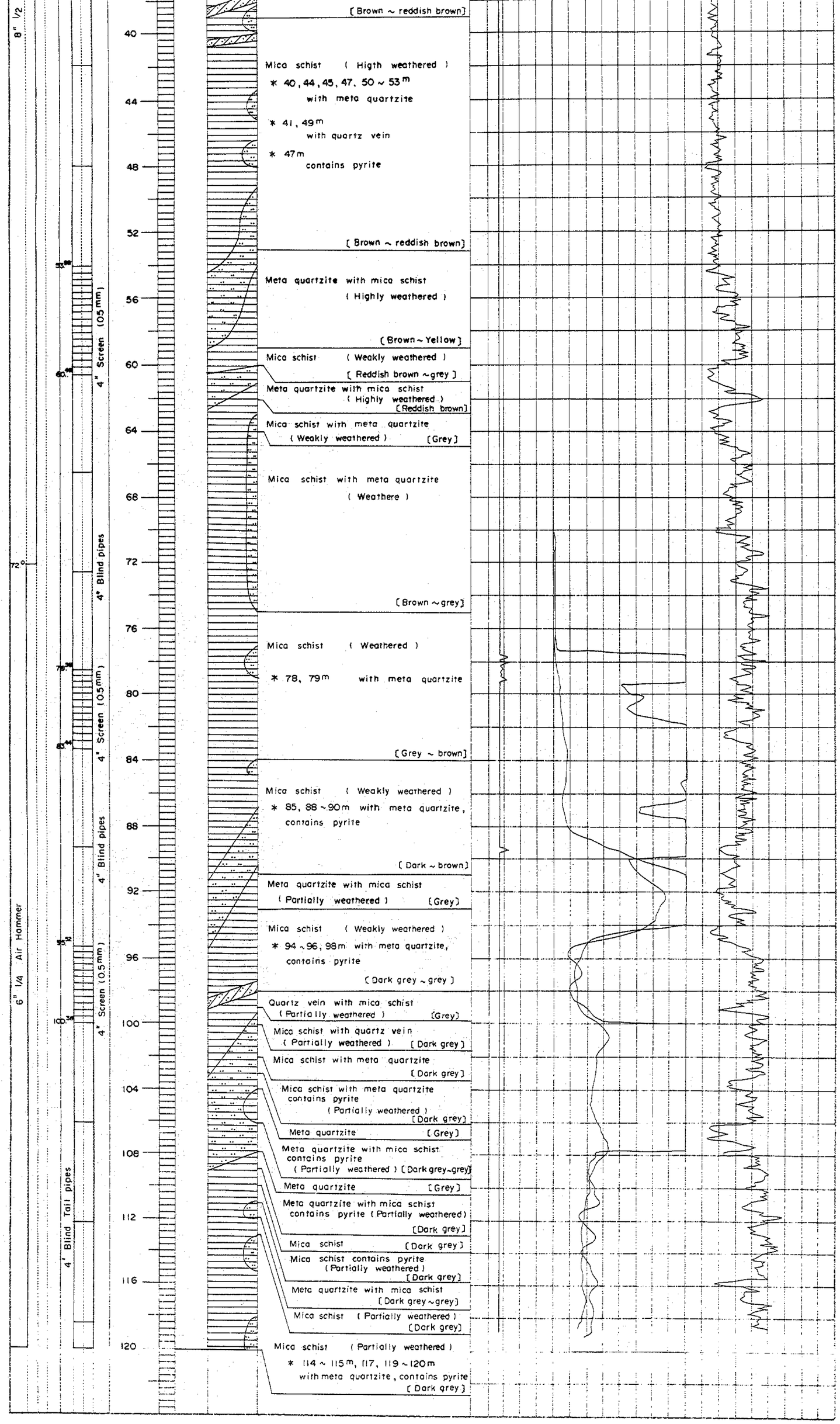
WELL LOG

Data No. _____

PROJECT NAME	The Study for ground water Development in Sokoto State		WELL NO.
AREA AND LOCATION	Zugu NO. 15 - 2 (Test Well)		
ELEVATION	m	LATITUDE N 11°51'	LONGITUDE E 5°20'
TOTAL DEPTH	120.0 m	DRILLING RIG	TOP - 200B
DRILLING STARTED	6th JULY 1989	DRILLED BY	G. KURAGANE
WELL COMPLETED	7th JULY 1989	LOGGED BY	T. OHTSUBO

STATIC WATER LEVEL	10.30 m	WATER TEMPERATURE	28.5 °C
DYNAMIC WATER LEVEL	15.72 m	CONDUCTIVITY	400 μ℧/cm
PUMPING RATE	140 ℓ/min (201.6 m³/d)	pH	6.38
SPECIFIC CAPACITY	37.2 m²/d/m	TOTAL HARDNESS	




8" 1/2
6" 1/4 Air Hammer
4" Screen (105mm)
4" Blind pipes
4" Screen (105mm)
4" Blind pipes
4" Screen (0.5mm)
4' Blind Tail pipes
72°
40
44
48
52
56
60
64
68
72
76
80
84
88
92
96
100
104
108
112
116
120
[Brown ~ reddish brown]
Mica schist (Higth weathered)
* 40, 44, 45, 47, 50 ~ 53m with meta quartzite
* 41, 49m with quartz vein
* 47m contains pyrite
[Brown ~ reddish brown]
Meta quartzite with mica schist (Highly weathered)
[Brown ~ Yellow]
Mica schist (Weakly weathered) [Reddish brown ~ grey]
Meta quartzite with mica schist (Highly weathered) [Reddish brown]
Mica schist with meta quartzite (Weakly weathered) [Grey]
Mica schist with meta quartzite (Weathere)
[Brown ~ grey]
Mica schist (Weathered)
* 78, 79m with meta quartzite
[Grey ~ brown]
Mica schist (Weakly weathered)
* 85, 88 ~ 90m with meta quartzite, contains pyrite
[Dark ~ brown]
Meta quartzite with mica schist (Partially weathered) [Grey]
Mica schist (Weakly weathered)
* 94 ~ 96, 98m with meta quartzite, contains pyrite
[Dark grey ~ grey]
Quartz vein with mica schist (Partially weathered) [Grey]
Mica schist with quartz vein (Partially weathered) [Dark grey]
Mica schist with meta quartzite [Dark grey]
Mica schist with meta quartzite contains pyrite (Partially weathered) [Dark grey]
Meta quartzite [Grey]
Meta quartzite with mica schist contains pyrite (Partially weathered) [Dark grey~grey]
Meta quartzite [Grey]
Meta quartzite with mica schist contains pyrite (Partially weathered) [Dark grey]
Mica schist [Dark grey]
Mica schist contains pyrite (Partially weathered) [Dark grey]
Meta quartzite with mica schist [Dark grey ~ grey]
Mica schist (Partially weathered) [Dark grey]
Mica schist (Partially weathered)
* 114 ~ 115m, 117, 119 ~ 120m with meta quartzite, contains pyrite
[Dark grey]

THE STUDY FOR GROUNDWATER DEVELOPMENT IN SOKOTO STATE.

SUMMARY DRILLING REPORT

SITE NAME: - ZUGU

SITE NO.: - 15-2

(TEST WELL)

JICA (JAPAN INTERNATIONAL CO-OPERATION AGENCY)

WELL DESCRIPTION

Test well borehole (Zugu No. 15-2) was drilled during the time from 6th July to 7th July, 1989 at Zugu village in Zuru Local Government.

The well was drilled using a Tone Boring TOP-200B drilling rig.

From ground level (G.L.) to 2.0m below ground level (G.L.-), it was drilled using an 8"1/2 tricone bit with mud rotary drilling method. From G.L.-2.0m to G.L.-84.0m, it was drilled using a 6"1/4 air hammer with drilling foam. However, from G.L.-24.0m to downward, it was hardly drilled using an air hammer due to the caving. Therefore, the hole was reamed with 8"1/2 tricone bit, and cased with 7" work casing till G.L.-72.0m. Then, from G.L.-72.0m to G.L.-120m, it was drilled using a 6"1/4 air hammer with drilling foam.

After completion of the drilling, electric logging had been carried out and hole was cased with 4" blind steel pipe from G.L.+1.00m to G.L.-53.98m, from G.L.-60.46m to G.L.-78.58m, from G.L.-83.44m to G.L.-95.52m and from G.L.-100.38m to G.L.-120.00m.

Total length of 16.20m of 4" I.D. Johnson's screen (slot size 0.5mm) were inserted from G.L.-53.98m to G.L.-60.46m, from G.L.-78.58m to G.L.-83.44m and from G.L.-95.52m to G.L.-100.38m.

The lithology encountered consists of mica schist with quartzite vein and meta quartzite. These are pre-Cambrian to upper-Cambrian basement complex.

The probable water bearing portions are weathered zone along fractures and fissures near quartzite vein.

The static water level was measured at 10.30m after development of the borehole.

During the air lifting the maximum average yield was 400 ℓ/min.

Pumping test was carried out during the time form to 1989.

By the five steps drawdown test, the critical discharge of this well was regarded as more than 140 ℓ/min that was the maximum capacity of the submersible pump used.

Continuous drawdown test was done for 48 hours with a pumping rate of 140 ℓ/min, and drawdown of 5.42m was observed. (Dynamic water level was measured at G.L.-15.72m.)

Then recovery of water level was measured for 6 hours.

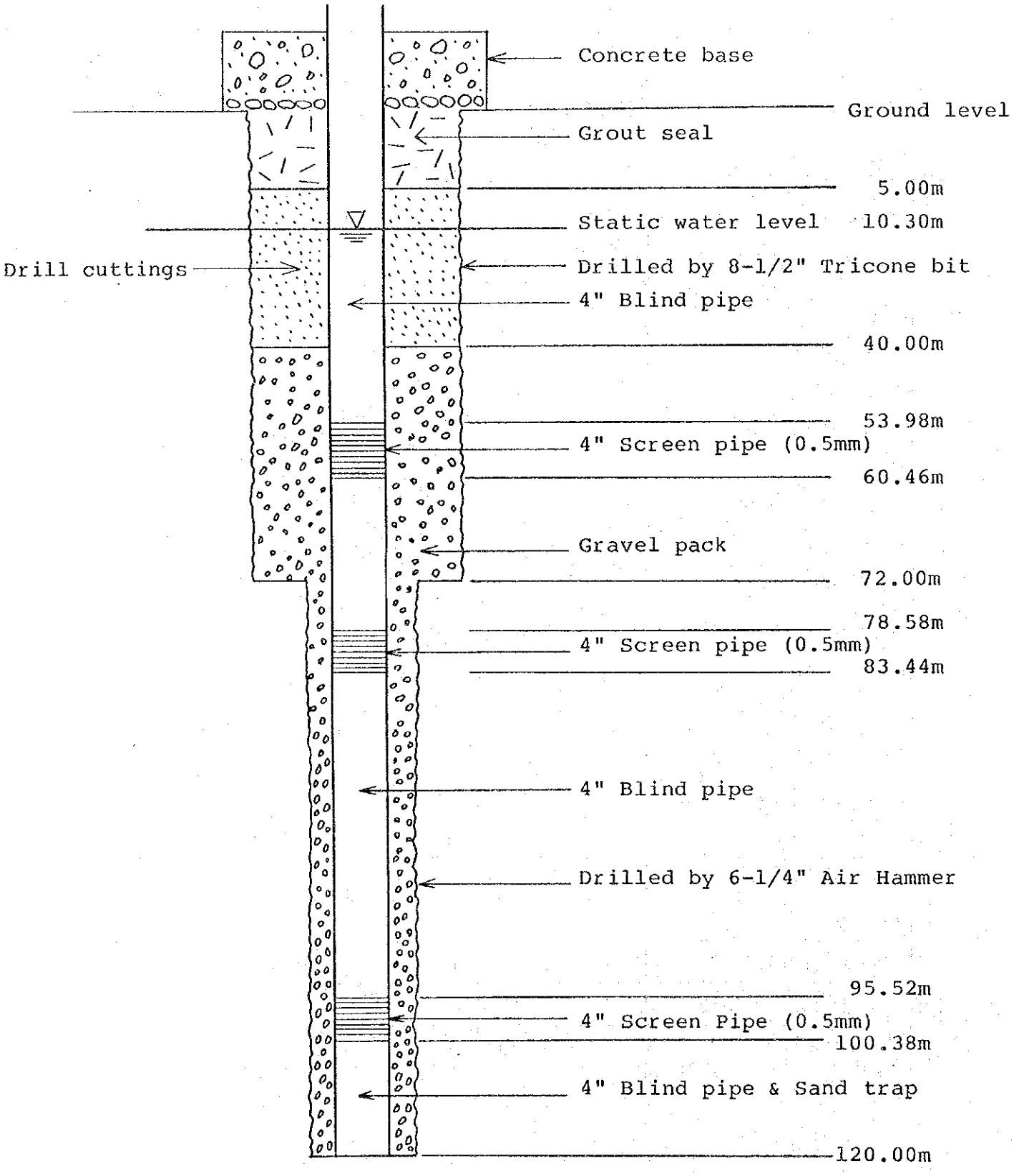
WELL SUMMARY

Test well (Zugu No. 15-2)

Project Name	The study for groundwater development in Sokoto State.
Area and Location	Zuru village in Zuru Local Government
Elevation	m
Coordinates	N E
Date Drilling Started	6th July, 1989
Date well Completed	7th July, 1989
Total Depth	120 m
Screen Position	G.L.-53.9m~60.46m, G.L.-78.58m~83.44m G.L.-95.52m~100.38m (1.0mm)
Drilling Method	Mud rotary drilling and air hammer drilling
Drilling Rig	Tone Boring Top-200B
Drilled by	G. Kuragane
Logged By	T. Ohtsubo
Static Water Level	G.L.-10.30m
Yield By Air Lifting	400 ℓ/min, 24m^3/h, 576m^3/d
Pumping Rate	140 ℓ/min, 201.6m^3/d
Dynamic Water Level	G.L.-15.72m (Drawdown 5.42m)
Specific Capacity	25.83 ℓ/min/m, 37.20m^3/d/m
Critical Capacity	Over 140 ℓ/min
Transmissivity	1.53×10^{-2} m^2/min
Permeability	1.71×10^{-3} cm/sec
Water Temperature	28.5 ℃
Conductivity	400 μυ/cm
pH	6.38

WELL SKETCH

Test well (Zugu No.15-2)



(Not to Scale)

WELL LITHOLOGIC LOG

Test well (Zugu No.15-2)

Depth	Log	Lithology			Geological Division
		Laterite	Reddish brown		
12.0		Gravel	- do -		
18.0		Mica Schist with Quartzite vein	Brown ~ Reddish brown	H W.Z	Basement Complex (Upper-Cambrian) ∫ (Pre-Cambrian)
41.0		Mica Schist	- do -		
48.0		Meta Quartzite with Mica Schist	Brown ~ Yellow		
59.0		Mica Schist with Meta Quartzite	Grey ~ Brown	W.Z	
91.0		Mica Schist with Quartzite vein	Dark grey ~ Grey		
103.0		Mica Schist with Quartzite vein	Dark grey	P W.Z	
110.0		Mica Schist	Dark grey ~ Grey		
120.0					

H W.Z ..... Highly weathered zone

W.Z ..... Weathered zone

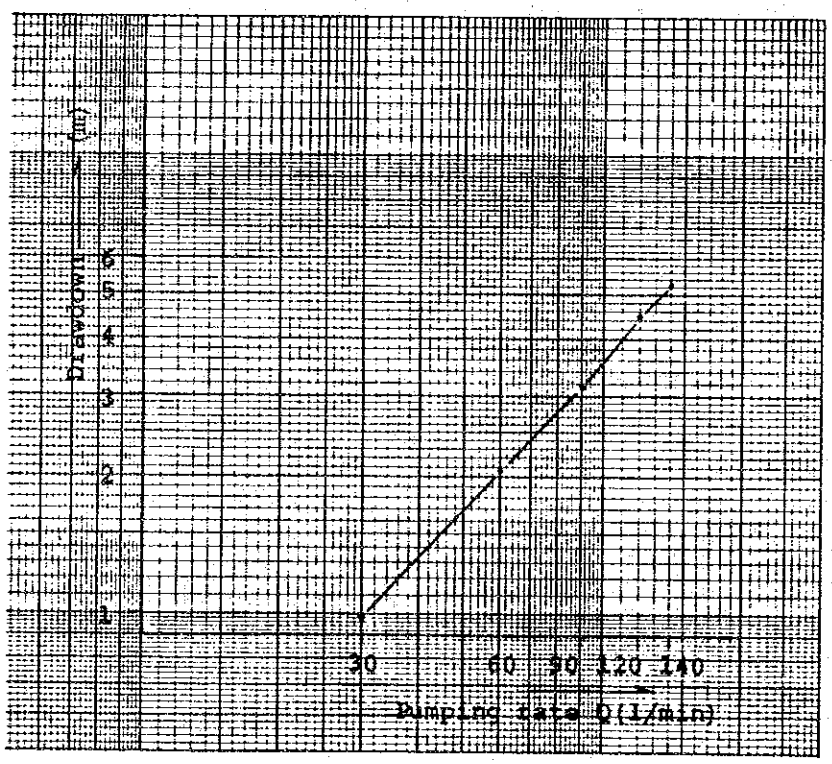
P W.Z. ..... Partially weathered zone

PUMPING TEST

Test well (Zugu No.15-2)

Step drawdown test

Step	Pumping rate Q (m^3/min)	Drawdown S (m)	Specific Capacity (m^3/min/m)
1	0.03	0.98	0.030
2	0.06	2.08	0.028
3	0.09	3.18	0.028
4	0.12	4.43	0.027
5	0.14	5.23	0.026



Critical discharge: over 0.14 m^3/min)

PUMPING TEST

Test well (Zugu No.15-2)

Continuous drawdown test and Recovery test

	Test well hole
Static water level	G.L. -10.30m
Pumping rate	140 l/min
Dynamic water level	G.L. -15.72m
Drawdwon	5.42m
Specific capacity	25.83 l/min
Elapsed time	48 hours

	Transmissivity (m^2/min)		Permeability (cm/sec)	
	Theis's method	Jacob's method	Theis's method	Jacob's method
Drawdown test	1.50×10^{-2}	1.63×10^{-2}	1.67×10^{-3}	1.82×10^{-3}
Recovery test	1.40×10^{-2}	1.60×10^{-2}	1.56×10^{-3}	1.78×10^{-3}
Average	1.53×10^{-2}		1.71×10^{-3}	

Data No. _____

WELL LOG

PROJECT NAME	The Study for groundwater Dev in Sokoto State		WELL NO.
AREA AND LOCATION	Zugu NO. 15 - 1 (Test Well)		
ELEVATION	m	LATITUDE N 11°50′	LONGITUDE E 5°20′
TOTAL DEPTH	130.0 m	DRILLING RIG	TOP - 200B
DRILLING STARTED	4 th JULY 1989	DRILLED BY	G. KURAGANE
WELL COMPLETED	5 th JULY 1989	LOGGED BY	T. OHTSUBO

STATIC WATER LEVEL	14.0 m	WATER TEMPERATURE	30 ℃
DYNAMIC WATER LEVEL	45.68 m	CONDUCTIVITY	500 μ℧/cm
PUMPING RATE	28 ℓ/min (40.3 m^3/d)	pH	6.57
SPECIFIC CAPACITY	1.27 m^3/d/m	TOTAL HARDNESS	

Drilling and Casing Program		Depth	Lithology Data			500mv	(ohm-m)	(cps)
Bit Size	Casing and Screen Size	(m)	Water Level	Log	Description of Lithology	- +	0 1K 2K 3K 4K	0 20 40 60 80
8" 1/2 Tricone bit	4" Blind pipes	4			Soil (Reddish brown)			
					Meta quartzite (Highly weathered) (Dark reddish brown)			
					Mica schist (Highly weathered) (Dark reddish brown)			
		8			Meta quartzite (Highly weathered ~ weathered) (Brown)			
					Mica schist (Highly weathered) (Brown)			
					Meta quartzite (Weathered) (Y·B)			
		12			Mica schist (Highly weathered) * 14m with quartz vein (Brown)			
		16						
		20			Meta quartzite (Weathered) (Yellowish brown)			
		24			Mica schist (Highly weathered) * 24m with quartz vein (Brown)			
					Meta quartzite (Weathered)			
		28			Mica schist (Weathered) (Brown)			
		32			Meta quartzite (Weakly weathered) * 32m, 38m with quartz vein (Yellowish brown)			
		36						
		40			Meta quartzite with mica schist (Partially weathered) (Y·B ~ grey)			
		44			Meta quartzite (Weakly weathered) * 44m with mica schist (Yellowish brown ~ grey)			
		48			Mica schist (Partially weathered) * 51m with meta quartzite (Dark grey)			
	50.7							
		52			Mica schist (Weakly weathered) * 52m with mate quartzite, contains pyrite. * 54m with quartz vein (Dark grey with brown)			
		56			Meta quartzite (Partially weathered) (Grey)			
					Meta quartzite (Weakly weathered) (Grey)			
	58.7				Mica schist with quartz vein (Weakly weathered) (Grey ~ dark grey)			
	4" Screen (0.5 m/m)	60						