Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (1/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingness of Farmers	Population	Numbers of Household	Main Crops	Development Priority
S-1 ※2	Hariwan	The block is located in the northwestern part of Salrahi district. It extends north of Guorkauli village (0.5 km), near from E-W highway. Roads in the block are good.	The eastern boundary is to be Chapini river, north and west Hariwan river. The area slightly undulates but has no problem of irrigation. Sugarcane is main crop. Available groundwater is estimated to be 10 - 15 l/sec based on the result of the pumping test in Phase II.	15 l/s	Strong Strongly requested by HMGN	17,227	1,914	Sugarcane, wheat, oil seeds	II
S-2	Sasapur, Nawalpur	The block is located in the north of Salrahi district. It extends north of intersection between E-W highway and Nawalpur-Malangwa road (1 km). Roads in the block are to be improved.	Land is gentle. Nawalpur has to be included in the block since Sasapur has only 150 ha of farm land.	less than 24 l/s	Good	Sasapur 4,839 Nawalpur is statistically included in Netraganji. 5,385	854 847	Rice, maize, wheat, potato, oilseeds, pulses, vegetables, sugarcane	IV
S-4	Netraganji	The block is located in the north of Salrahi district. Both E-W highway and Nawalpur-Malangwa are to be used for an access. Roads in the block are to be improved.	The block almost corresponds to the area of Lal Bandi Resettlement Project. The south end of the block is to be main canal of Bagmati Irrigation Project. Topography in the northern part is flat but slightly undulates in the southern part.	25 - 34 l/s	Good	5,385	847	Rice, maize, wheat, potato, oilseeds, pulses, vegetables, sugarcane	II

※1: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
※2: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (2/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes o f Farmers	Population	Numbers o f Household	Main Crops	Develop-ment Priority
S-7 /2	Bramhapuri	The block is located in the south of Sarlahi district. It extends east of Malangwa. A road branching from E-W highway along the Phuljor river gives good access.	Land slope is gentle. It undulates slightly in the south. Drilling work in the Phase-II revealed aquifer lies more than 260 m below ground surface so that the deep tubewell development is not economical.	-	Strong	9,987	1,109	Rice, wheat, oilseed, vegetables	Be ex-cluded from the develop-ment.
S-8	Raniganji	The block is located in the north of Sarlahi district. It lies south of Raniganji village along E-W highway (1.5 km). Roads in the block are to be improved.	Land slope is gentle. The southern part of the block has to be mainly developed because the northern part has little potential of groundwarer.	25 - 34 l/s 5	Good	3,561	631	Rice, maize, oilseeds, millet, tobacco, potato, wheat, vegetables	III
S-9	Bhaktipur	The block is located in the south of Salrahi district. A forest road branching from E-W highway gives good access (10 km). Roads in the block are to be improved.	Land slopes gently but undulates slightly in the south. The potential of groundwater is high and farm land is also extend in the south. So, the southern part is mainly to be developed.	15 - 44 l/s Deep tubewell 5	Good	13,623	2,035	Rice, wheat, maize, tobacco, potato, vegetables, pulses, oilseeds	II

/1 : One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2 : One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (3/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
S-10	Kabilashi	The block is located in the south of Sarlahi district. It extends on the both sides of the Nawalpur-Malangwa road. Access roads is to be constructed in the block.	Land slope is gentle. The both sides of Nawalpur-Malangwa road could be developed. Bagmati Irrigation Project has a plan to irrigate this area.	35 - 44 l/s	Good	6,634	1,133	Rice, wheat, vegetables, pulses, oil seeds, sugarcane	Be excluded from the develop-ment
S-11	Gamharia	The block is located in the south of Sarlahi district. It extends north of Malangwa town. Nawalpur-Malangwa road is used for access. Access roads are to be constructed in the block.	Land slope is gentle. Irrigation water is taken from Jhim river in the rainy season. River discharge is unstable. Intake structure is destroyed every year by the flood of the river. Bagmati Irrigation Projedct has a plan to irrigate this area.	35 - 44 l/s	Good	3,511	501	Rice, wheat, vegetables, pulses, oilseeds, sugarcane	Be excluded from the develop-ment
S-12/2	Gaurishankar	The block is located in the east of Sarlahi district. A forest road branching from E-W Highway gives good access (4.5 km). Roads in the blocks are also suitable for transportation.	Land slope is gentle. The northern part has little potential of groundwater. In the western part, irrigation water is taken from the Goga river in the rainy season. The middle, southern and eastern parts are suitable for development.	15 - 24 l/s	Good	8,018	1,333	Rice, wheat, tobacco, vegetables, pulses, oilseeds, maize	IV

/1 : One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2 : One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (4/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
M-4 /1	Kisannagar Meghutath, Banarjhula	The block is located in the northeast of Mahottari district. Ramnagar village is near. A village road branching from E-W highway would be used for access, if it is improved (5 km).	The block extends from north to south but is limited in the direction of east to west. The land slope is slightly steep from north to south. The area has slightly steep slope from center to east and to west. A test well was drilled and a pumping test was made in the Phase II. It is recommended to shift southward the area proposed in the Phase I.	20 l/s	Strong	6,900	766	Rice, maize wheat, vegetables, tobacco, sugarcane	II
M-7 /1	Ratauligoh	The block is located in the southeast of Mahottari district. It extends west of Janakpur (2.5 km), good access from Janakpur. The roads in the block are to be improved.	Land slope is very gentle. Farm land and forest are scattered in the block. The longer irrigation canals will be required to irrigate farm land than those in other blocks.	35 - 44 l/s	Strong	9,150	1,010	Rice, wheat, vegetables	II
M-12	Ramnagar	The block is located in the northwest of Mahottari district. A forest road branching from E-W highway gives good access (8 km). Roads in the block are good.	Land slope is gentle. The northern part has less potential of groundwater. The middle and southern parts are suitable for development.	15 - 24 l/s	Strong	4,760	836	Rice, maize, wheat, oil seeds, potato, pulses	IV

/1: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (5/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
M-13	Laximiniya Bharatpur Khor	The block is located in the north of Mahottari district. A forest road branching from E-W highway gives good access (9 km). Roads in the block are good.	Land slope is gentle. Many shallow tubewell are developed in the southern part of B. Khor P. The middle and northern part will be developed by deep tubewell. Since these have not enough farm land, the southern part of Laximinya P. located north side of the B. Khor P. will be included in the area to be developed.	15 - 24 l/s	Good	Laximiny 7,161 B. Khor 6,234	1,213 994	Rice, wheat, maize, oil seeds, pulses, potato, vegetables	IV
M-14 /2	Parkauli Mahottari	The block is located in the south of Mahottari district. It extends along with Janakpur-Jaleswar road. Roads are to be improved.	Land slope is gentle. Parkauli P. has not enough farm land. Farm land in Mahottari located at the north side of Parkauli will be included in the area to be developed.	15 - 34 l/s	Good	Parkauli 3,873 Mahottari 7,388	481 941	Rice, wheat, oilseeds, pulses, potato, vegetables	III
M-15 /2	Dahmi	The block is located in the south of Mahottari district. The Jaleswar-Gaushara road gives good access. It is 3.5 km distance from Jaleswar. The roads in the block are to be improved.	Land slope is gentle. The block is subdivided into several plots by streams.	15 - 34 l/s	Good	7,534	1,085	Rice, wheat, oilseeds, potato, vegetables	III

/1 : One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2 : One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (6/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
M-16 /2	Paraul	The block is located in the south of Mahottari district. The Jaleswar-Gaushara road gives good access. It is 9 km distance from Jaleswar. The roads in the block are to be improved.	Land slope is gentle. The block is subdivided into several plots by streams. Paraul may have not enough farm land for development. There is some possibility of shallow tubewell development.	15 - 34 l/s	Good	4,380	628	Rice, wheat, tobacco, oilseeds, potato, pulses	III
M-17 /2	Katti, Manra	The block is located in the south of Mahottari district. The Jaleswar-Malangwa road gives good access. It is 10 km distance from Jaleswar.	Land slope is gentle. Since Katti P. has not enough farm land, Manra P. will be included. The potential of groundwater is estimated to be less in this block.	less than 14 l/s	Good	6,522	774	Rice, wheat, oilseeds, potato, pulses, vegetables	Be ex-cluded from the develop-ment.
D-6 /1	Benga Shibapur	The block is located in the northeast of Danusha district. It extends north of Janakapur town. The Janakapur-Belauni road gives good access. Roads in the block are to be improved.	Land slope is gentle. Farm lands mainly extend in the northern and southern parts.	35 - 44 l/s	Strong	8,912	990	Rice, wheat, vegetables	III

/1: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (7/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
D-7 /1	Basahiya	The block is located in the south of Danusha district. It extends south of Janakpur town (2.5 km). Access is good. Roads in the block are to be improved.	Land slope is gentle. The land is undulated locally in south. A test tubewell was drilled and the probable pumping discharge was estimated at 40 l/sec after pumping test in the Phase II.	40 l/s	Strong	9,772	1,089	Rice, wheat, vegetables	I
D-8 /1	Ghorgas	The block is located in the south of Danusha district. It extends south of Janakpur town (5 km). Go down south along with Janakpur-Airport road. The access road and roads in the block are to be improved.	Land slope is gentle. The middle and southern parts have farm land expanded though wide forest in the north.	35 - 44 l/s	Strong	7,798	865	Rice, wheat, vegetables	III

/1: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (8/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
D-10	Simyahimarang, Dubrikot	The block is located in the southeast of Danusha district. There are 2 ways for access:	Land slope is gentle but undulated. The western part is in the area of Kamla Irrigation Project and the northern area is in the shallow tube well irrigation area. The remaining area is also be developed be either project.			Simyahi-marang 6,951 Dubrikot 5,065	1,008 739	Rice, wheat, maize, tobacco, pulses, oilseeds, potato, vegetables, sugarcane	Be ex-cluded from the develop-ment.
		(1) Operation road of Kamla West Main Canal is used for access (20 km). The surface and shoulder of road is seriously damaged by bull cart. The road must be repaired and it results in high cost. However, the improvement work is not made arbitrarily by the Terai Project, because it belongs to the property of the Kamla Irrigation Project. (2) The another access is from Siraha of Sagarmatha zone crossing the Kamla river. The flow in Kamla river varies year by year and season by seeason. It is not ensured to cross the river at any time.							
D-13	Bhuchakrapur	The block is located in the northwest of Danusha district. A village road branched from E-W highway gives a good acfess (7.5 km). Roads in the block are to be improved.	Land slope is gentle. Ground water potential is low in the north but high from middle to south.	15 - 34 l/s	Good	3,895	659	Wheat, rice, maize, tobacco, potato, vegetables, sugarcane, pulses	III

/1: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (9/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
D-14	Bateswar	The block is located in the northwest of Danusha district. A village road branched from E-W highway gives a good access (5.5 km). Roads in the block are to be improved.	Land slope is gentle. Ground water potential is high in the middle and south.	15 - 34 l/s	Good	4,836	817	Rice, wheat, tobacco, potato, sugarcane, vegetables, oilseeds	III
D-15 [1]	Naktajhij, Hariharpur	The block is located in the northwest of Danusha district. The Dalkewar-Janakpur road gives a good access (3.5 km). The road in the block is to be improved.	Land slope is gentle. The middle and south are developed by shallow tube well. The northern part is developed by this project. Since the northern part has not enough area for development, Harikarpur panchayat is included. A probable pumping discharge is estimated at 40 l/s after pumping test in Phase II.	40 l/s	Strong			Rice, wheat sugarcane, vegetables	I
D-16	Bharatpur	The block is located in the northeast of Danusha district. North side and south side of E-W highway. Access is good.	Land slope is gentle but undulated. 5 deep tubewell were developed in this block. No further development is required.	15 - 24 l/s	Good	10,245	1,782	Rice, wheat, sugrcane, vegetables, potato, oilseeds, pulses	Be excluded from the development.

[1]: One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
[2]: One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-1 Results of Inventory Survey on Development Blocks Proposed by HMGN (10/10)

Name of Block	Panchayat in the Block	Location and Access	General Condition	Expected Ground-water Potential	Willingnes of Farmers	Population	Numbers of Household	Main Crops	Develop-ment Priority
D-17	Tallogodar, Lovetoli	The block is located in the northeast of Danusha district. North side and south side of E-W highway. Access is good.	Land slope is gentle but undulated. The northern part of Tallogador has been developed, the southern part is to be developed. Farm land is not enough, Lovetoli panchayat is included.	15 - 24 l/s	Good	Tallogodar 6,690 Lovetoli 2,042	1,226 357	Rice, wheat, sugarcane, vegetables, potato, oilseeds, pulses	IV
D-18	Kanakpati, Mansinpati	The block is located in the south of Danusha district. Janakpur-Belauni road gives a good access.	Land slope is gentle. Kanakpati has not enough land, Mansinpati is included.	25 - 44 l/s	Good	Kanakpati 3,880 Mansinpati 2,861	589 425	Rice, wheat, potato, oilseeds, pulses	IV
D-19	Lohana, Kuarampur	The block is located in the south of Danusha district, southeast of Janakpur (2 km). Janakpur-Airport road is used for access.	Land slope is gentle but slightly undulated. Lohana has not enough land, Kuarampur is included.	35 - 44 l/s	Good	Lohana 4,367 Kuarampur is statistically included in Janakpur Maegu 40,561	579 5,839	Rice, wheat, oilseeds, pulses, potato, vegetables	III
D-20 /2	Muzelia, Laxminia Bazar	The block is located in the south of Danusha district, north of Janakpur (2km).	Land slope is gentle. Land extends westside of Janakpur-Dalkewar road. Farm land is not enough, two panchayats are to be joined.	35 - 44 l/s	Good	Muzelia is statistically included in Janakpur Maegu. 40,561 L. Bazar is statistically included in Lamnipur Bagewa. 5,074	5,839 768	Rice, wheat, oilseeds, pulses, potato, vegetables	II

/1 : One of the first priority development blocks selected in the Phase-I Study (18 blocks in total)
/2 : One of the blocks presented by the HMGN in the Phase-II Study (6 blocks in total)

Table 3-2 List of the Existing Tubewells Tested

Well No.	Location	Pump Installed	Present Condition
D-7(4)	North in D-7 Block	Newly drilled, not installed	Drilled by JICA team in the Phase-II
M-4(A)	South of original M-4 Block	ditto	ditto
N-15	Eastern end of D-7 Block	Not installed	Drilled in Mar. 1986, canal & pump house were completed. Artesian (about 6 l/s)
N-33	North in D-15 Block	ditto	Drilled in Mar. 1987, under construction of canal & pump house in 1988.
N-35	Southern end of D-15 Block	ditto	Drilled in Apr. 1987, under construction of canal & pump house in 1988.
N-37	In S-9 Block	ditto	ditto
N-39	Northern end in S-1 Block	ditto	ditto
Fishery Centre	Janakpur	ditto	No drill log data (drilled by Indian contractor). Screen is collapsed.
J-22	1km north from S-4 Block	OKAMOTO PUMP	Drilled in Aug. 1979, only pump house was built. No canal.
S1 S5	3km south from S-10 Block 0.5km south from S-10 Block	JOHNSTONE PUMP (INDIA)	Drilled by Indian contractor about 18 years ago. Canal & pump house were built. Insufficient capacity of engine & pump. No hole for observation of G/W.
T3-9 T3-11 T7-13 T7-14 T8-15 T8-16	About 10km east from the line between Janakpur and Hardinath farm	EBARA PUMP under KR-2 grant aid	During 1986 to 1987 all the facilities such as canals and pump houses were built and pump were installed by TONE. Those seem not to be used.

Table 3-3 Results of Pumping Tests

The figures in the brackets are those supplied by HMGN.

Well No. (Block)	Organization	Location (District)	Installation Date	Depth (m)	Casing & Screen	Total Screen (m)	Artesian Discharge (l/s)	S.W.L.	P.W.L.	Yield (l/s)	Specific Capacity (l/s/m)	Transmissibity m3/day/m		Permeability (cm/sec)	Storage Coeff.	Tested Hours
												By JACOB	By THIEM			
D-7 (A) (D-7)	JICA PHASE-II TEAM	Basahiya (Danusha)	1988.Feb. Drilled	205	14": 70m 8": 200m	45	19.6	+6.00	8.02m: 45.1 l/s	41.2	3.7	-	412	1.1×10^{-2}	-	72.0
M-4 (A) (M-4)	JICA PHASE-II TEAM	Kisannagar (Mahottari)	1988.Mar. Drilled	186	14": 85 8": 165	44	-	35.86	40.00: 25.1 l/s	14.6	6.9	-	757	2.0×10^{-2}	-	91.0
N-15 (D-7)	JADP	Sonapora (Danusha)	1986.Mar. Drilled	180	14": 53.5 8": 176	35	3 ~ 5 (6)	+	44.5 (-)	36.6 (50)	0.8 (-)	-	93	3.08×10^{-3}	-	5.7 (-)
N-33 (D-15)	TIATSP	Naktajhij (Danusha)	1987.Mar. Drilled	113.5	14": 77 8": 113.5	24	-	42.05 (40)	45.05 (61)	19 (30)	6.3 (1.4)	-	638 (169)	3.08×10^{-2} (8.15×10^{-3})	-	7.5 (-)
N-35 (D-15)	TIATSP	Mahendranagar (Danusha)	1987.Apr. Drilled	118	14": 48 8": 113	27.5	-	12.09 (15)	20.5 (30)	47 (50)	5.6 (3.3)	-	642 (399)	2.70×10^{-2} (1.68×10^{-2})	-	9.0 (-)
N-37 (S-9)	TIATSP	Bhaktipur (Sarlahi)	1987.Apr. Drilled	115	14": 54 8": 112.5	32	5 (-)	+ (1.5)	21.84 (29)	57.6< (60)	2.6 (2.2)	-	274 (268)	9.94×10^{-3} (9.72×10^{-3})	-	8.0 (-)
N-39 (S-1)	TIATSP	Hariyon (Sarlahi)	1987.Mar. Drilled	136	14": 78 8": 132	29.5	-	47.9 (51)	66.2 (59)	5 (25)	0.3 (3.1)	-	95 (344)	3.71×10^{-3} (1.35×10^{-2})	-	8.0 (-)
Fishery Development Centre	FISHERY DEVELOPMENT CENTRE	Janakpur (Danusha)	No Information	No Information	14": 25		-	+0.52 Screen damaged	20.65 (=8.3 l/s)	3.3	0.2	-	-	-	-	5.0 (-)
J-22 (S-4)	JADP	Nawalpur (Sarlahi)	1979.June pump(1988?)	72.5	14": 40 8": 72.5	18	-	19.8 (21.3)	24.58 (29.5)	25 (40)	5.2 (4.9)	-	555 (554)	3.57×10^{-2} (3.56×10^{-2})	-	7.5 (-)
S 2 (S-10)	MINOR IRRIGATION PROJECT	Birnagar (Sarlahi)	1970s	77	10"	-	-	No hole to measure (6.4)	(9.75)	27 (66.6)	Pump capacity small (19.9)		(2285)	(1.47×10^{-1})	-	9.0 (-)
S 5 (S-10)	MINOR IRRIGATION PROJECT	Chainpur (Sarlahi)	1970s	99	10"	-	-	No hole to measure (9.14)	(14.02)	29 (52.9)	Pump capacity small (10.8)		(1257)	(4.85×10^{-2})	-	4.0 (-)
T3-9	TONE TEAM	Mangalpur (Danusha)	1986.1.7	170	14": 50 8": 170	50	-	20.15 (23.73)	42.6 (34.17)	10 (50)	0.4 (4.8)	-	51 (560)	1.19×10^{-3} (1.29×10^{-2})	-	8.0 (-)
T3-11	TONE TEAM	Ghira (Danusha)	1986.2.24	155	14": 50 8": 155	35	-	21.42 (29.4)	32.3 (37.06)	10.3 (40)	0.9 (5.2)	-	103 (590)	3.40×10^{-3} (1.95×10^{-2})	-	8.0 (-)
T7-13	TONE TEAM	Kajara Ramoul (Danusha)	1986.2.11	170	14": 50 8": 170	40	-	9.21 (9.31)	45.74 (51.38)	5.6 (10)	0.1 (0.2)	-	17 (27)	4.89×10^{-4} (7.94×10^{-4})	-	7.0 (-)
T7-14	TONE TEAM	Laliya (Danusha)	1986.3.15	166.5	14": 50 8": 166.5	75	-	4.87 (4.6)	14.39 (16.4)	25 (30)	2.6 (2.5)	-	292 (290)	4.51×10^{-3} (4.48×10^{-3})	-	7.5 (-)
T8-15	TONE TEAM	Hanspur Karapulla (Danusha)	1986.2.27	186	14": 50 8": 175	50	Weak	0 (+)	25.96 (45.85)	4.4 (10)	0.1 (0.2)	-	18 (25)	4.15×10^{-4} (5.86×10^{-4})	-	6.0 (-)
T8-16	TONE TEAM	Jhatiyahi (Danusha)	1986.3.2	161	14": 50 8": 160	60	-	2.0 (2.28)	25.18 (35.95)	16.7 (20)	0.7 (0.6)	-	82 (70)	1.59×10^{-3} (1.36×10^{-3})	-	8.0 (-)

Table 3-4 Result of the Inventory Survey on KR-2 Equipment and Materials (1/5)

Category	Name of Equip. & Materials	Q'ty Granted	Present Q'ty	Available Quantity			Present Condition	Stored Place
				Usable	To be repaired	Total		
I. Deep Tubewell Construction	1. Drilling rigs (YRD-501R: 3 units and TRD-500: 4 units)	7 units	7 units	6 units	1 unit	7 units	A mud pump of TRD-500 is to be repaired. Clutch disk plate of 7 rigs are to be replaced with new ones to be purchased.	Outdoors in TIATSP quarters
	2. Tricone bit 17-1/2"	28 pcs.	0	0	0	0	Totally consumed.	-
	3. Tricone bit 14-3/4"	15 pcs.	0	0	0	0	Totally consumed.	-
	4. Tricone bit 12-1/4"	81 pcs.	54 pcs.	54 pcs.	0	54 pcs.	Usable.	Godown in TIATSP quarters
	5. Air compressor (7 kg/cm2, 10.5 m3/min)	7 units	7 units	7 units	0	7 units	A draw bar for one unit is to be purchased.	Outdoors in TIATSP quarters
	6. 6" discharge pipe (L = 5.5m)	962.5 m	696 m	330 m	0	330 m	Rust and corrosion of pipes, particularly their screw portions are to be scraped off.	Ditto
	7. 2" air pipe (L = 5.5m)	962.5 m	646.5 m	401.5 m	0	401.5 m	Rust and corrosion of pipes, particularly their screw portions are to be scraped off.	Ditto
	8. 8" delivery pipe (L = 4m)	476 m	476 m	476 m	0	476 m	Usable without trouble.	Outdoors in Nawalpur farm
	9. 5" submersible motor pump (45 l/sec. 75m lift)	2 sets	2 sets	1 set	0	1 set	One is not repairable because of damage in suction casing and captired cable.	Outdoors in TIATSP quarters
	10. 6" submersible motor pump (45 l/sec. 35m lift)	2 sets	2 sets	2 sets	0	2 sets	One has been rented to the paper factory, the other requires to procure a flange with thread.	Ditto
	11. 8" submersible motor pump (60 l/sec. 40m lift)	2 sets	2 sets	2 sets	0	2 sets	One requires a flange with thread.	Ditto
	12. 8" submersible motor pump (90 l/sec. 45m lift)	4 sets	4 sets	4 sets	0	4 sets	One requires a strainer and flange with thread.	Ditto

Table 3-4 Result of the Inventory Survey on KR-2 Equipment and Materials (2/5)

Category	Name of Equip. & Materials	Q'ty Granted	Present Q'ty	Available Quantity			Present Condition	Stored Place
				Usable	To be repaired	Total		
I. Deep Tubewell Construction (Cont'd)	13. Diesel engine generator for Item No. 9 - No. 12	10 sets	10 sets	7 sets	0	7 sets	Three sets have been used in power stations.	Outdoors in TIATSP quarters
	14. Notch tank (2.5 m3)	1 pc.	1 pc.	1 pc.	0	1 pc.	Usable without trouble.	Ditto
	15. DC engine welder	7 sets	7 sets	0	0	0	One is usable, but will be exhausted in the near future. The rest is not repairable.	Godown in TIATSP quarters
	16. 20" conductor pipe (L=5.5m)	22 m	22 m	22 m	0	22 m	Usable, but will be consumed by TIATSP in the near future.	Outdoors in TIATSP quarters
	17. 24" conductor pipe (L=5.5m)	63 m	24 m	24 m	0	24 m	Usable, but will be consumed by TIATSP in the near future.	Ditto
	18. 14" casing pipe (L=6m)	8400 m	4998 m	4980 m	0	4980 m	Screw portion of several pipes are damaged.	Outdoors in TIATSP quarters and Nawalpur farm
	19. 8" casing pipe (L=6m)	15996 m	13026 m	12936 m	0	12936 m	Coupling portion of several pipes are damaged.	Ditto
	20. 8" Johnson screen (L=5.25, 3.25m)	7500 m	4863 m	4863.75 m	0	4863.75 m	Reinforcement is essential.	Ditto
	21. 8" pipe for submersible pump L=5.5	148.5 m	148.5 m	148.5 m	0	148.5 m	Usable without trouble.	Outdoors in TIATSP quarters
	22. 6" pipe for submersible pump L=5.5	110.0 m	110.0 m	110.0 m	0	110 m	Ditto	Ditto
	23. 5" pipe for submersible pump L=5.5	71.5 m	71.5 m	71.5 m	0	71.5 m	Ditto	Ditto
	24. 14"-8" reducer	216 pcs.	161 pcs.	161 pcs.	0	161 pcs.	Ditto	Ditto

Table 3-4 Result of the Inventory Survey on KR-2 Equipment and Materials (3/5)

Category	Name of Equip. & Materials	Q'ty Granted	Present Q'ty	Available Quantity			Present Condition	Stored Place
				Usable	To be repaired	Total		
II. Pump for Production Tubewell	1. Vertical type turbine pump (60 l/sec. 45m lift)	109 sets	98 sets	98 sets	0	98 sets	Usable without trouble.	Indoors in TIATSP quarters
	2. Diesel engine for the above-1	109 sets	97 sets	97 sets	0	97 sets	Batteries are missing by 47 pcs.	Ditto
	3. Pipe and shaft for the above-1	For 109 sets	For 87 sets	For 87 sets	0	For 87 sets	Majority of pipes and shafts are rusted or corroded at screw portion. But most of them can be reconditioned.	Outdoors in TIATSP quarters and Nawalpur farm
	4. Vertical type turbine pump (45 l/sec. 40m lift)	88 sets	77 sets	77 sets	0	77 sets	Usable without trouble	Outdoors in TIATSP quarters
	5. Diesel engine for the above-4	88 sets	77 sets	77 sets	0	77 sets	Batteries are missing by 11 pcs.	Indoors in TIATSP quarters
	6. Pipe and shaft for the above-4	For 88 sets	For 76 sets	For 76 sets	0	For 76 sets	Majority of pipes and shafts are rusted or corroded at screw portion, but most of them can be reconditioned.	Outdoors in TIATSP quarters and Nawalpur farm
	7. Centrifugal pump	8 sets	8 sets	2 sets	0	2 sets	The 6 sets are not repairable.	Indoors in TIATSP
III. Transportation Equipment	1. 4ton cargo truck with 3ton crane	5 units	5 units	5 units	0	5 units	Several spare parts are required for maintenance.	Outdoors in TIATSP quarters
	2. 4ton cargo truck	4 units	4 units	4 units	0	4 units	Ditto	Ditto
	3. Fuel tank lorry (4 kl)	2 units	2 units	1 unit	1 unit	2 units	Battery and hose are missing.	Ditto
	4. Water tank lorry (4 kl)	5 units	5 units	4 units	1 unit	5 units	One is out of order. Water pump of 5 units are to be replaced with new one.	Ditto
	5. 20ton trailer truck	3 units	3 units	3 units	0	3 units	Usable without trouble.	Ditto

Table 3-4 Result of the Inventory Survey on KR-2 Equipment and Materials (4/5)

Category	Name of Equip. & Materials	Q'ty Granted	Present Q'ty	Available Quantity			Present Condition	Stored Place
				Usable	To be repaired	Total		
III. Transportation Equipment (Cont'd)	6. 1ton, 4WD pick-up truck	7 units	7 units	0	0	0	Two are not repairable, the rest will be exhaused in the near future. No spare tire is available.	Outdoors in TIATSP quarters
	7. Folklift	1 unit	1 unit	1 unit	0	1 unit	Battery is missing.	Ditto
IV. Construction Equipment	1. 6ton bulldozer	1 unit	1 unit	1 unit	0	1 unit	Usable without trouble.	Ditto
	2. 11ton bulldozer	11 units	11 units	7 units	4 units	11 units	Four are to be repaired.	Ditto
	3. 0.8 m3 wheel roader	5 units	5 units	1 unit	4 units	5 units	Hydraulic and drive systems are to be repaired.	Ditto
	4. 1.2 m3 wheel roader	7 units	7 units	6 units	1 unit	7 units	A break system is to be repaired.	Ditto
	5. 2.8m motorgrader	1 unit	1 unit	0	1 unit	1 unit	A fuel system is to be repaired.	Ditto
	6. 3.1m motorgrader	5 units	5 units	4 units	1 unit	5 units	A blade turning pin is to be set.	Ditto
	7. 4ton vibro-road roller	5 units	5 units	1 unit	4 units	5 units	Four require to repair the fuel system.	Ditto
	8. Tractor and 2ton trailer	3 sets	3 sets	3 sets	0	3 sets	Two trailers exist in TIATSP quarters, but three tractors and one trailer are under using at site.	Ditto
	9. 3.5ton dump truck	10 units	10 units	4 units	6 units	10 units	Six require to repair fuel system and drive system.	Ditto
	10. 0.5 m3 concrete mixer	4 units	4 units	3 units	1 unit	4 units	One requires to remove a set concrete in tank. Four require 4 handles for starting engines.	Ditto

Table 3-4 Result of the Inventory Survey on KR-2 Equipment and Materials (5/5)

Category	Name of Equip. & Materials	Q'ty Granted	Present Q'ty	Available Quantity			Present Condition	Stored Place
				Usable	To be repaired	Total		
V. Vehicles	1. Wagon type jeep	5 units	5 units	3 units	0	3 units	Three are usable, the rest has been used in Kathmandu. No spare tire is available.	Ditto
VI. Generator	1. 2kW portable engine generator	3 units	3 units	0	0	0	Not repairable.	Indoors in TIATSP quarters

Table 3-5 Expenditure of JADP/TIATSP

(Unit: Rs.1,000)

Item No.	Description	1983/84	1984/85	1985/86	1986/87	1987/88
1	Salary of project staff	821	1,335	1,417	1,200	1,833
2.	Allowance of the above	414	14	19	15	15
3.	Travelling & daily allowance	82	125	125	125	125
4.1	Postage, registry & telephone expenses	33	25	20	20	24
4.2	Printing & advertisement	20	7	7	7	-
5.	House & store rent	35	24	11	20	8
6.	Repair & maintenance of house, quarters, vehicles, canals, etc.	217	140	762	775	774
7.1	Stationeries for office	34	27	25	25	25
7.2	Books & journals	4	4	104	5	4
7.3.1	Fuel for vehicles	369	238	300	400	398
7.3.2	Fuel for generators, pump sets and machinery	705	150	231	250	341
7.4.1	Clothes for drilling & workshop	12	10	10	10	10
7.5.1	Other expendable goods	55	45	45	45	52
8.	Extension, training and drilling expenditure	1,531	2,072	5,209	4,803	4,803
9.	Public relation expenditure	16	9	8	8	7
10.1	Furnitures	73	18	0	0	0
10.2	Vehicles	0	0	0	0	0
10.3	Machinery	630	147	190	1,321	109
11.1	Land acquisition	0	300	0	0	0
12.1	Building construction	1,289	938	2,398	1,500	1,290
12.2	Other construction (canals, land development, etc.)	1,935	3,756	2,675	3,300	3,198
	Total	8,275	9,384	13,656	13,829	13,016

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (1/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
1. Basic Concept		
1.1 Object of the project (1) Extension of irrigation area (2) Increase and stable of agricultural production (3) Increase of farmers income and level up of living standard (4) Increase of social welfare of the farmer (5) Establishment of the deep well irrigation development technique (6) Establishment of the model of deep well irrigation development in the Terai Plain	Those items are studied again and were accepted except for (4) and (6). (4) Being concrete, irrigation canal can be used for domestic water supply. (6) The existing bore-hole engine-drive pump is not economical and not well advanced. The deep tube wells in this project are not always suitable for a model in the Terai Plain.	The items from (1) to (5) are accepted but (6) is to be excluded. (4) is to be changed to "ensure domestic water supply".
1.2 Project area Project area is Janakpur zone in the Terai, which includes Dhanusha, Mahottari and Sarlahi district except the surface water irrigation area such as Bagmati, Kamala, Manusmara & Hardinath, and shallow well irrigation area by TIATSP and by Department of Irrigation.	1.2 No need to be changed.	1.2 Same as those considered in Phase I.
1.3 Components of the project (1) To use materials and equipment granted by KR-2. (2) 115 production wells can be constructed by supplying additional materials and equipment, and the area of 4,625 ha can be irrigated.	(1) The existing materials and equipment were re-evaluated. (2) Based on the results of test well drilling, it is concluded that test wells are to be drilled and pumping test are to be made in the all blocks to determine the overall development plan.	1.3 (1) In principle, the existing materials and equipment granted by KR-2 are utilized. Additional materials and equipment are to be supplied. (2) 1) The overall development plan considered in Phase-I is cancelled. 2) Implementation of D-7 and D-15 blocks can be done.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (2/20)

Basic Plan in Phase-I

2. Project Area

2.1 Development Blocks

(1) Out of 30 blocks proposed by HMGN, 23 blocks were selected.

Priority / District	First priority	Lower than second priority	Total
Danusha	4	7	11
Mahottari	2	2	4
Sarlahi	2	6	8
Total	8	15	23

Study

(1) 1) The 23 blocks were investigated again and the following blocks were abandoned.

D-10: Access is very difficult. Suitable for shallow tube well irrigation due to hydrogeological condition and poor accessibility.

D-16: Five production wells have been already constructed. No more development is necessary.

S-7: As a result of test well drilling, good aquifer is underlain lower than 260 m below.

S-10: This block will be irrigated by Bagmati Irrigation Project.

S-11: Same condition of S-10.

2) Six blocks newly proposed by HMGN are also investigated. Of them, five blocks are taken up:

D-20, M-14, M-15, M-16, S-12

3) 23 blocks were classified into 4 categories according to the ground water potential, HMGN's intention, etc.

Standard of classification is as follows:

Basic Plan in Phase-II

(1) The potential development block is of 23 and is classified as follows:

District	Priority I	Priority II	Priority III	Priority IV	Total
Danusha	2 <1	1 <2	5 <3	2 <4	10
Mahottari	0	2 <5	3 <6	2 <7	7
Sarlahi	0	3 <8	1 <9	2 <10	6
Total	2	7	9	6	23

Suitability for developing will be finally determined after test well drilling and pumping test.

<1: Name of block D-7, D-15
<2: Name of block D-20
<3: Name of block D-6, D-8, D-13, D-14, D-19
<4: Name of block D-17, D-18
<5: Name of block M-4, M-7
<6: Name of block M-14, M-15, M-16
<7: Name of block M-12, M-13
<8: Name of block S-1, S-4, S-9
<9: Name of block S-8
<10: Name of block S-2, S-12

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (3/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
(2) Eight blocks were selected for first priority development.	Priority-I: A more than 25 l/sec probable pumping discharge has been confirmed by pumping test. A basic design has been made. Good access and good willingness of farmers are expected. Priority-II: Nearly same situation with priority-I, but pumping discharge has not been tested yet and/or basic design has not been made. Priority-III: Urgent development is not required from the viewpoint of farmer's intention. Access is not so good as I and II. Priority-IV: Less groundwater potential, area can be irrigated by shallow tube well or other means.	
	(2) 1) Test tube wells were drilled in D-7, M-4 and S-7 blocks respectively. Results of pumping tests show: - Aquifer is underlain too deep to develop in S-7. - 40 l/s of pumping discharge was tested in D-7. - Only 20 l/s of pumping discharge was tested in M-4. 2) Pumping test was carried out in D-15 and S-1 at well drilled by TIATSP. Results are: - 19 ~ 40 l/sec in D-15 - 5 ~ 6 l/sec in S-1 3) Pumping discharge is not known in D-6, D-8 and M-7 because not test wells were drilled.	(2) D-7 and D-15 can be developed in the first year. 1) Irrigable area will be of 200 ha in D-7. 2) Irrigable area will be of 200 ha in D-15. 3) Irrigable area is to be shifted to southward in M-4. 4) A test tube well will be drilled in the next basic design study in the south of S-1. 5) S-7 is abandoned.

	Name of block	District	Panchayat
1	S-1	Sarlahi	HARIWAN
2	S-7	Sarlahi	BRAMHAPURI
3	M-4	Mahottari	KISANNAGAR
4	M-7	Mahottari	RATAULOGOHI
5	D-6	Danusha	BENGASHIBAPUR
6	D-7	Danusha	BASAHIYA
7	D-8	Danusha	GHORGAS
8	D-15	Danusha	NAKTAJHIJ

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (4/20)

Basic Plan in Phase-I

2.2 Selection of Irrigable Area

(1) Irrigable area in the 8 blocks were planned as follows:

Name of block	Panchayat	Irrigable area (Ward No.)
D-7	BASAHIYA	1, 2, 3, 5, 8A, 8B
D-8	GHORGAS	1, 2, 3, 4A, 4B, 5
D-6	BENGASHIBAPUR	1B, 3A, 3B, 6B, 7A, 7B
D-15	NAKTAJHIJ	Not planned
M-4	KISANNAGAR	2A, B, 3A, 3B, 3C, 4A, 4B
M-7	RATAULOGOHI	1, 2A, 2B, 4, 6, 7
S-1	HARIWAN	1B, 3C, 3D, 6A, 6B, 7A
S-7	BRAMHAPURI	1A, 2A, 7, 9A, 9B, 9C

Study

2.2 1) Irrigable area was selected through field investigation and discussion with HMGN. The cadastral map was used to identify the area.

2) Standard of selection are:

- To construct five production wells in one block including a test tube well.
- To have high groundwater potential.
- To have enough farm land for gravity irrigation.
- To have good access for drilling rig.
- To have strong intention for irrigation farming.
- To select irrigable area according to Ward boundary.
- To keep apart production wells more than 600 m each other.
- To exclude existing shallow and deep tube well irrigation areas.

3) Results of pumping test and other investigations made in Phase-II are reflected to the selection.

Basic Plan in Phase-II

2.2

(1) The following eight blocks are selected for first and second priority of development.

Name of block	Panchayat	Irrigable area (Ward No.)
D-7	BASAHIYA	1, 2, 3, 5, 6, 7, 8A, 8B
D-15	NAKTAJHIJ, HARIHARPUR	3, 4, 6A, 6B, 6C, 7B 2A, 2B, 2C
D-20	MUZELIA LAXMINIA BAZAR	Not yet fixed
M-4	MEGHNATH BANARJHULA	Not yet fixed
M-7	RATAULIGOHI	Not yet fixed
S-1	HARIWAN	Not yet fixed
S-4	NETRAGANJI	Not yet fixed
S-9	BHAKTIPUR	Not yet fixed

1) Irrigable area in D-20, M-7, S-1 and S-4 will be selected based on the results of pumping test and topographic survey in future.

2) Irrigable area in S-9 will be selected through topographic survey, since the pumping discharge has been already confirmed.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (5/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
		3) Irrigable area in M-4 will be selected through topographic survey, and be located in the south of test well drilled in Phase-II.
(2) Three representative blocks were selected for making development plan of 23 blocks.	(2) Because the project area is very wide and has different hydrogeological condition from place to place, results of the Phase-II study, i.e. test well drilling in D-7, M-4 and S-7, pumping test in D-7, M-4, S-7, D-15 and S-1, and electric resistivity survey in these five blocks, are not enough for discussing overall development plan. Test well drilling and pumping test in every block are indispensable for judging suitability of development. A topographic survey was made in and around the irrigable area and a topographic map with a scale of 1 to 1,000 was made for every block. A cadastral map prepared by HMGN with a scale of 1 to 2,400 was referred.	(2) Implementation of D-7 and D-15 can be done in the first year. S-7 block is cancelled. Every block has five production wells. Irrigable area is estimated according to the pumping discharge. Unit irrigation requirement is to be of 1.0 l/sec.

Name of block	Pumping discharge (l/s)	Irrigable area (ha)
D-7	50/well	50/unit Total 250 ha
M-4	25/well	25/unit Total 125 ha
S-7	40/well	40/unit Total 200 ha

Name of block	Pumping discharge (l/s)	Irrigable area (ha)
D-7	40/well	40/unit Total 200 ha
D-15	40/well	40/unit Total 200 ha

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (6/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
3. Groundwater Development Plan		
- Construction of 115 production tubewells in the proposed 23 development blocks	- In due consideration of the results of the phase-II study, it was judged that the deep tubewell irrigation development in each block should be subject to the result of a test tubewell to be drilled in each block. The development should be limited to the blocks that the test tubewell discharged more than 25 l/sec in pumping test, because an economical use of the vertical turbine pumps already granted under a KR-2 aid can be realized by the construction of the production tubewells with a yield of more than 25 l/sec.	- The overall development plan, constructing 115 production tubewells in 23 development blocks during 4 implementation years, proposed in the phase-I study, is abandoned. - Only D-7 and D-15 blocks are developed in the implementation year. That is, ten production tubewells, including two wells to be graded up from the test tubewell, and the respective irrigation facilities are constructed.
- Utilization of KR-2 equipment & materials and procurement of an additional equipment & materials	- In order to utilize the existing KR-2 equipment & materials effectively, the following countermeasures are required as clarified by the inventory survey for the KR-2 equipment and materials: o procurement of considerable quantities of spare parts of the rigs and mud pumps, and repair and maintenance of the rigs and mud pumps o procurement of tricone bits and drilling materials such as bentonite, CMC, barite, etc. o procurement of conductor pipes, jetting nozzles, mud cleaner, etc. o repair and maintenance of the existing vehicles and construction equipment o procurement of spare parts of the existing vehicles and construction equipment o procurement of transport equipment and vehicles	- Repair and maintenance of the KR-2 equipment are carried out using spare parts to be newly purchased as clarified by the inventory survey for the KR-2 equipment and materials, and additional equipment and materials as clarified in the Phase-II study are newly procured.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (7/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
3.1 Groundwater Potential (1) Hydrogeologic survey	- The groundwater potential map was checked up referring to the discharge data of the existing deep tubewells confirmed by the Phase-II study team (13 nos in the Phase-I and 17 nos in the Phase-II), because the existing well data collected by the Phase-I study team were not necessary reliable and accurate and thereby the groundwater potential map prepared in the Phase-I study based on such data is not useful for the planning and implementation of the deep tubewell irrigation development.	- The groundwater potential map prepared in the Phase-I is revised. - Prior to the construction of production tubewells, probable pumping discharge in the development block is confirmed by a pumping test to a test tubewell drilled in the same block. Also, a core drilling cum groundwater table observation well is drilled in a small diameter in each development block for the purpose of core sampling, observation of groundwater levels while pumping both test and production tubewells and long term groundwater table.
	- Analysis of groundwater balance Simulation analysis of groundwater balance by computer programed in the Phase-II study was cancelled from the following reasons: because the overall development, constructing 115 production tubewells in 23 blocks, was abandoned, the necessary data for the analysis, i.e., location of blocks, location and discharge of production tubewells, annual implementation plan, etc. are not available at present.	- In the Phase-II study, 3 sets of longterm groundwater table monitor were installed one each of Paukauli, Naktajhij and Kisannagar. It is expected the records will be able to be available as one of the fundamentals data necessary for groundwater balance study to be carried out in early or middle implementation stage.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (8/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
(2) Drilling of test tubewell A test tubewell in each development block of D-7, M-4 and S-7 shall be drilled to confirm probable pumping discharge in the respective blocks and safety of the reinforced Johnson screen, etc.	(2) Three nos of test tubewell, one each of D-7, M-4 and S-7 blocks, were drilled in the Phase-II study and the results were as follows: - D-7(A) well: the discharge of 40 l/s was confirmed through a continuous pump test of 72 hours. M-4(A) well: the discharge of 15 l/sec was confirmed by a pumping test of 91 hours, and probable pumping discharge in this block is assured to be 20 l/sec, though the planned tubewell sites have to be shifted south-west ward for obtaining shallower groundwater table. - S-7 well: no attractive aquifer was found out by the test drilling, and this block was therefore abandoned. - The safety and usability of the reinforced Johnson screen were confirmed. - A practical method of tubewell developing and cleaning, which uses both jetting nozzles and mud cleaner, was established for the construction of production tubewells.	- D-7 and D-15 blocks can be developed in the first implementation year. - The test tubewell of D-7(A) shall be completed as one of five production tubewells. - The existing tubewell (N-33) and its irrigation facilities is included in the development plan. - The necessary equipment & materials for the drilling of the test tubewells will be granted by GOJ.
(3) Drilling of long term groundwater table observation wells (including core sampling) It was proposed to drill the observation wells one each of development blocks, using the existing rigs, equipment and materials.	(3) Construction of the observation wells by using the existing rigs, equipment and materials has the following difficulties: o The existing 7 rigs are wholly employed for drilling test tubewells and production tubewells annually.	(3) Four construction of the observation wells, the following equipment and materials are to be additionally granted: 1) a wire-line type core boring machine in a capacity of drilling 250 m in HQ size

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (9/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
	o Core sampling by the existing rigs is hardly possible, because they are non-core type. o The driller can not examine geological situation while drilling by using the existing rigs because of high noises in their compound case. o The casing pipes and screens of 4" dia. planned for the observation wells have to be additionally granted, because the existing pipes and screens were granted for the shallow tubewell construction and have been used by Nepal side for the same purpose.	2) required quantity of 4" casing pipes and screens 3) required numbers of groundwater table monitoring recorder, etc.
(4) Electric sounding The electric soundings shall be executed in D-7, D-15, M-4, S-1 and S-7 blocks at the rate of 20 points per block to obtain the basic data for the siting of the production tubewells.	(4) - The basic data required for the siting of the production tubewells were obtained by the electric sounding of 20 points per each block on an average. - The soundings in S-7 block, where the existing tubewell data were not available, had to be conducted in parallel with the drilling of the test tubewell in order to obtain the basic data necessary for siting the production tubewells.	(4) - The soundings were carried out by using the latest model of MACOHM, but in order to improve an accuracy of the soundings, the power booster and battery recently developed for salling shall be procured and set. - The sounding will be employed to site production tubewells in the development blocks to be constructed.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (10/20)

Basic Plan in Phase-I

3.2 Specifications of standard tubewells

- Referring to the existing tubewells data obtained in the Phase-I study, the following 4 types of standard deep tubewell were planned to be applied for the production tubewells to be constructed in the planned 23 development blocks.

Type	Area	Drilling Depth	S.W.L	Aquifer (Average)	Location of Aquifers	Probable Discharge
I	North of Sarlahi	89 m	50-20m	* (10m) G1 (5m) G2 (25m)	10-20m 30-35m 45-70m	40 l/sec (average)
II	North of Mahottari North of Danusha	159 m	30-40m	* (10m) G3-1(10m) G5 (10m)	35-45m 90-110m 125-140m	25-30 l/sec (average)
III	South of Sarlahi South of Mahottari Center of Danusha	205 m	+2-6m	G2(10-20m) G3-1(20m) G5 (10m) G6 (15m)	70-80m 130-140m 160-170m 175-190m	50 l/sec (average)
IV	North to middle of Mahottari North to middle of Danusha	205 m	20-35m	G2 (10m) G3 (20m) G5 (20m)	70-80m 100-130m 140-160m	40 l/sec (average)

Study

3.2

- Four types of standard deep tubewell planned for 23 development blocks in the Phase-I study were cancelled since the overall development plan for 23 blocks was abandoned in the Phase-II study.
- Specifications of standard deep tubewells were examined for only 2 blocks: D-7, D-15 to be dealt with in the Phase-II study.

Basic Plan in Phase-II

- Specifications of standard deep tubewells for D-7 and D-15 blocks are set as follows.

Specifications of Standard Deep Tubewells

Development block	D-7	D-15	
Drilling depth (m)	210	150	150
Diameter of well	17-1/2"	17-1/2" 14-3/4"	17-1/2" 14-3/4"
Drilling program (m)	210	80/70	70/80
14" Casing pipe (m)	30	60	42
8" Casing pipe (m)	120	42	66
8" Screen (m)	48.75	37.0	37.0
Volume of gravel packing (m3)	15	11	12
Design discharge(l/s)	40	40	40
S.W.L. (m)	*	42	12
P.W.L. (m)	6	48	20
Pump depth (m)	25	57	35
Pump to be installed	Existing vertical turbine pump		

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (11/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
- Influence area of well Influence radius of each deep tubewell was examined in the following cases.	- Influence area of the standard deep tubewells for 4 development blocks mentioned above is reexamined based on the result of the field survey in the Phase-II study.	- The interval among deep tubewells is determined to be 600 m, same as planned in the Phase-I study.

Permeability	$1x10^{-2}$ cm/s	$1x10^{-3}$ cm/s	$1x10^{-4}$ cm/s
Thickness of aquifer	50 - 30 m		
Discharge	50 l/s	40 l/s	30 l/s
Recovery time (for 0.001 m)	3 days = 259,200 sec.		
Volume porosity	0.28 (inferred)		
Radius of Influ (R) $R = 2G\sqrt{Tt/S}$	300 m	140 m	100 m
$R = 3000 \cdot Sw \cdot K^{1/2}$	150 m	100 m	60 m

Max. radius of influence (R) of the deep tubewell was calculated at 300 m as shown in the above table, so that the interval among deep tubewells was determined to be 600 m or more.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (12/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
3.3 KR-2 existing equipment & materials and additional ones required From the available quantities of the KR-2 existing equipment & materials, specifications of 4 types of standard tubewell and number and location of the proposed development block, an overall utilization plan of the KR-2 equipment & materials was determined as summarized in the following table. The overall plan clarified that about 115 nos of production tubewell would be able to be constructed, provided that a considerable quantities of additional equipment, parts and materials would be procured for the construction.	3.3 The equipment and materials plan was studied in detail for only 4 development blocks (D-7, D-15, M-4 and S-1), which were subject to prepare the development plan in the Phase-II study, based on the result of the inventory survey on the KR-2 equipment and materials performed in the Phase-II study, since the overall development plan of the Project covering 23 development blocks was annulled in the Phase-II study. The main points clarified in the study are as follows: 1) Additional supply of parts of rigs and their mud pump is vitally required. 2) Procurement of the drilling materials such as tricone bits, hole openers is inevitable. 3) Procurement of conductor pipes and strengthened rod based screens (collapse strength of 28 kg/cm2 and slit interval of 1.0 mm) is essential. 4) Drilling mud such as bentonite, CMC, barite, etc. and mud cleaner shall be sent from Japan. 5) DC engine welders and their accessories shall be purchased, because the existing ones are severely deteriorated.	3.3 - To construct 10 nos of production tubewell including 2 nos drilled as test tubewell and the respective irrigation facilities in the 2 development blocks in a year, the additional equipment and materials as described in Chapter 5.4 of the main report are required to be newly procured. - The following major equipment and materials are required to be newly purchased: A. Tubewell Construction - Spare parts and tools of rigs and parts of mud pumps - Various kinds of tricone bid and hole opener - Drilling mud such as bentonite, CMC, barite, etc. and mud cleaner - Conductor pipes and strengthened rod based screens - DC engine welders and accessories - Jetting nozzles and bailers necessary for cleaning tubewells - High head-small discharge type submersible pump necessary for pumping test

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (13/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II

Quantity	Confirmed	Available Q'ty	Consumption per well	Consumption Total	Remaining Q'ty
14" Casing pipe	5,592m	4,932m	48.2m	5,544m	-612m
8" Casing pipe	13,392m	12,732m	98.4m	9,324m	3,408m
8" Screen	5,076m	4,110m 20.957 in?	24.0m	2,572.5m	1,537.5m
Pump 60 l/sec type	98 sets	90 sets	-	68 sets	22 sets
Rising pump	98 sets	90 sets	-	88 sets	2 sets
Pump 45 l/sec type	79 sets	79 sets	-	47 sets	32 sets
Rising pump	79 sets	79 sets	-	74 sets	5 sets

Note) 1) Available quantity means the quantities of pipes, screens and pumps left after construction of 18 nos of deep tubewell by TIATSP in 1987/88.

2) The 8" screens are used after reinforcing the existing Johnson type screens granted under a KR-2 aid in 1982.

3) Rod base screens of 1996.5m are required to be newly purchased.

6) Ebara vertical turbine pumps having a capacity of 60 l/sec, granted under a KR-2 aid, are not usefull for the Project because of excess capacity against probable pumping discharge in the proposed development blocks.

7) A considerable quantity of both shaft and column pipe of the existing vertical turbine pumps is required to be reconditioned and/or replaced with new ones, since they are left in an open air condition and majority of them is thereby corroded.

8) It is vital to procure ample quantity of spare parts and tires for the existing transportation equipment and construction equipment and also to purchase the required nos of transportation equipment and vehicles.

B. Transportation

- 1 ton 4x4 pick-up truck
- 4x4 wagon type jeeps
- 4x4 ordinary jeeps
- Spare parts for the existing transportation equipment
- Spare parts for the existing construction equipment

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (14/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
4. Irrigation and Drainage Plan: 4.1 Concept of Planning (1) Irrigation area The planned irrigation area based on the water requirement of 1 l/sec/ha and each deep well discharge (25 l/sec, 30 l/sec, 40 l/sec, 50 l/sec & 55 l/sec) is estimated at 4,625 ha. (2) Irrigation facilities 1) [Per one planned irrigation area] Pump house and operator house 1 no each Main canal length 1.6 km Turnout 7 Nos.- 9 area 14 Nos. - 6 areas Drop 3 nos. Crossdrain 2 nos. Road across structure 9 nos. Division box 1 no. Corner box 4 nos. Precast check plate 10 nos. Cattle pass 4 nos. Pool for domestic utilization 0.2 nos. Access road length 120 m (from existing road to pump station)	(1) Refer to item No. 2.2 (2) in this table. (2) 1) Basic concept - Detailed design will be made based on the topographic map of 1:1,000 scale. - Linked well system will be planned in case that its system is recommendable in view of topographic conditions and the relation of neighboring irrigation area, and probable in phisically. - Wells interval is at least 600m taking into account a well's influence area. - Well location will be decided in an attractive place having good hydrogeologic conditions based on electric soundings. - Point of a pump station will be selected at terrace in the irrigable area in order to avoid a reverse slope and taking into account of well's influence area, hydrogeologic conditions. - Irrigation water will be pumped up from deep well and be distributed to irrigation areas through open canals. - Rotation irrigation method will be employed and irrigation interval will be seven days (one week). - Irrigation area will be divided into 7 (or 14) location units. - Irrigation water for each location unit will be distributed through branch canal from turnout on main canal. - Branch canal will be planned and constructed by farmers themselves.	(1) The pumping discharge and irrigation area of D-7 and D-15 are mentioned in the former chapter 2.2(2) in this table. The overall implementation schedule is not intended in this study. (2) The numbers of irrigation facilities in D-7 and D-15 blocks are shown in the section 5.3.3

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (15/20)

<table>
<tr>
<th>Basic Plan in Phase-I</th>
<th>Study</th>
<th>Basic Plan in Phase-II</th>
</tr>
<tr>
<td>
2)
- Pump house of one story is made of brick, mortar and plaster. The size is 13.50 m2 (=5.0m x 2.7m) x 2.7m.
- Baffle tank is made by brick, mortar structure and attached "V" notch.
- Bathing pool is made one no. in each development block by brick, mortar structure.
- Water supply pipe system is not made.
- Operator house is made by brick, mortar structure of one story. The space is 9.72 m2 (3.6m x 2.7m) x 2.7m.
3)
- Main canal is brick-made structure of one layer.
- Longitudinal slope of the canal is less than 1/200.
- Standard canal section size (inside) on each discharge is as follows:
<table>
<tr><th>Type</th><th>I</th><th>II</th></tr>
<tr><td>Inside size (widthxheight) (cm)</td><td>35x42</td><td>35x35</td></tr>
<tr><td>Design discharge (l/sec)</td><td>50~55</td><td>40</td></tr>
<tr><td>Design velocity (m/sec)</td><td>0.56</td><td>0.50</td></tr>
<tr><td>Max. discharge (l/sec)</td><td>80</td><td>65</td></tr>
<tr><td>Max. velocity</td><td>0.80</td><td>0.77</td></tr>
</table>
</td>
<td>
2) Pump house and operator hut
- Store room is not necessary because it is unused at present, which was equipped in pump house made under KR-2 programme. The size of a pump house is sufficient in that of JADP.
- Baffle tank in the delivery of pump. "V"-notch for a measuring in its outlet are needed.
- His majesty's government of Nepal recommends that baffle tank and canal is enough to use for a domestic (drinking, bathing and washing).
- Water supply piping system will not be made because it has a problem in an effective use compared the construction costs. (The period of pumping irrigation will be limited to 8~10 months annually.)
- Two storied operator house constructed under KR-2 and by JADP were not used for a living space. The space of operator house is enough in such a space of taking a rest because the operation hours are twelve (12) only in day time.
3) Main canal and related structures
- Canal section will be designed in the suitable size for a discharge. And the section is the same size throughout all the canal route in area for an application of the rotation irrigation system which is easy water management.
</td>
<td>
2)
- Pump house of one story is made of brick, mortar and plaster. The size is 13.50 m2 (=5.0m x 2.7m) x 2.7m.
- Baffle tank is made by brick, mortar structure and attached "V" notch.
- Bathing pool is not made.
- Water supply pipe system is not made.
- Operator house is made by brick, mortar structure of one story. The space is 9.72 m2 (3.6m x 2.7m) x 2.7m.
3)
- Main canal is brick-made structure of one layer.
- Standard canal section size (inside) on each discharge is as follows:
<table>
<tr><th>Type</th><th>I</th><th>II</th></tr>
<tr><td>Inside size (widthxheight) (cm)</td><td>35x42</td><td>35x35</td></tr>
<tr><td>Design discharge (l/sec)</td><td>more than 45</td><td>45-30</td></tr>
</table>
</td>
</tr>
</table>

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (16/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
	- Brick structure is cheaper than concrete flume structure and maintenance by a farmer in future is easy. Therefore, flume canal will be made by brick structure. - Longitudinal slope will be decided by the velocity within the range of 0.4 - 1.0 m/sec to prevent the bruck-made canal. Free board of a canal is 1/3 of inside height of a canal to prevent the overflow caused by the backwater in the operation of the check plate.	
- Siphon is not planned. In case of crossing a farm road, the culvert system covered on a canal by pre-cast concrete slab will be used. The approach will have a gentle slope to the slab.	- Siphon in a small size canal is feared to be stopped up by a sand and mud. The cleanings of the materials are impossible. Drainage culvert along a road is needed to construct at crossing point in order to drain the water stagnated on road in a rainy season.	- Siphon is not planned. In case of crossing a farm road, the culvert system covered on a canal by pre-cast concrete slab will be used. The approach will have a gentle slope to the slab. Drainage culvert will be constructed in the lower part of canal embankment along an agriculture road.
- Aqueduct is not needed.	- From the field investigation results, any bridge were not needed in each irrigation area of development block.	- Aqueduct is not needed.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (17/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
- The pipe made by pre-cast concrete for drainage culvert will be installed in the lower part of canal embankment. The inlet part of the pipe will be protected by the guide-wall constructed by brick.	- Drainage culvert will be constructed at the crossing point of the canal and drainage ways and at the depression. It will be made by pipe structure of large diameter to remove a silting mud and sand.	- The pipe made by pre-cast concrete for drainage culvert will be installed in the lower part of canal embankment. The inlet part of the pipe will be protected by the guide-wall constructed by brick. Drainage culvert will be constructed at 400~500m intervals of canal length.
- The drop made of brick masonry is provided at the necessary point.	- Longitudinal slope will be required to avoid the steeps slope exceeding 1/200 in view of the maximum allowable velocity (1.0 m/sec).	- The drop made of brick masonry is provided at the necessary point.
- Turn-out will be made in order to divert the irrigation water from main canal to branch canal.	- Turn-outs of 7 or 14 nos. are needed to install since a rotation irrigation system of one week cycle will be taken in view of the maintenance and water supply.	- The number of turn-out of main canal is 7 or 14 nos. turnout will be made by brick.
- Division box will be installed in division point of canal and corner box will be installed at the corner of canal.	- Division box is needed to install in the division point of canal in order to make a smoothing flow and get a stabilized flow. In the necessitated place in topographic viewpoint, the box will acts same as drop structure.	- Division box will be made by brick in division point of canal and corner box will be made by brick at the corner of canal.
	- Corner box is needed to install at the corner of canal in order to have the same functions as division box.	

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (18/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
- Cattle pass is needed.	- Cattle pass is needed to construct for the passing over the canal of a cow, buffalo, goat, etc. A flume canal is covered by precast concrete slab.	- Cattle pass will be constructed at about 500 m intervals of canal.
- Farm road and maintenance road are not needed.	- Canal inspection can be made by walking along the embankment tops (width=0.5m) of the both canal dikes. Farm road for a transportation of agricultural inputs and products are available.	- Maintenance road along a canal is not needed to construct. Farm road is not needed to be newly construct.
5. Implementation and Management System		
5.1 Responsible Office Ministry of Agriculture Dept. of Agriculture	Deep well irrigation project is one of the projects in TIATSP. The in-charge of this project is, therefore, TIATSP on the administration and management.	TIATSP is required to consolidate the following section. <u>Section</u>
5.2 Organization of Operation and Management Tubewell Irrigation Agriculture Training and Services Project (TIATSP)	Considering the scale of this project, improvement of TIATSP organization and increase of the staff are needed in the stages of implementation, and operation and maintenance.	Workshop : One technician Agriculture : One overseer Extension & training Operation & maintenance : One assist. engr One overseer

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (19/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
		- Operation, maintenance and administration after the construction of the facilities will be done by TIATSP. The operation costs will be collected from the beneficial farmers as the water charge. o Personnel expenditure of the operator o Fuel cost for pump engine o Maintenance and operation costs of the facilities The subsidy by HMGN will be needed at the following order. - First years: All the costs will be subsidized by HMGN. - Second years: Seventy (70) parcents of costs will be subsidized by HMGN. - Third years: Thirty (30) percents of costs will be subsidized by HMGN. Within the above three (3) years, TIATSP shall organize water users' groups. All the water charge is to burden on the water users' groups in and after four (4) years.
	- Management of equipment and materials This project will be carried out by using the equipment and materials granted to HMGN by GOJ under the KR-2 grant aid. These equipment and materials are maintaining by HMGN and it is fearred that the formalities of use by contractor are complicated and the progress of construction is hindered. Therefore, it is desirable that the required equipment and materials for construction will be handed to the contractor at the beginning of construction and the contractor will maintain on their own responsibility.	- Management of equipment and materials It is desirable that the required equipment and materials for construction will be handed to the contractor and the contractor will maintain on their own responsibility.

Table 4-1 Comparison on the Project Components in Phase-I and in Phase-II (20/20)

Basic Plan in Phase-I	Study	Basic Plan in Phase-II
6. Allocation of the Project Costs		6. The same as the results of Phase-I Study.
6.1 Wells and Related Buildings (Pump house, operator house)	6.1	
(1) Construction cost: By Japan	(1) It is not problem to allocate the construction cost to the Government of Japan according to the grant aid system.	
(2) Land acquisition and compensation: By HMGN	(2) According to the grant-aid sytem in Japan, the said costs are allocated to HMGN.	
6.2 Main Canal and Related Structures (turnout, drop, culvert, etc.)	6.2	
(1) Construction cost: By Japan	(1) The same as Section 6.1 (1).	
(2) Site purchase and compensation: By HMGN	(2) The same as Section 6.1 (2).	
6.3 Lateral canal (earth canal after turnout): By Farmers	6.3 In the irrigation project by HMGN, the farmers are to construct the tertiary or lateral canal (branch canal in this project).	
6.4 Temporary roads for the construction (new road construction and existing road repair)	6.4	
(1) Construction cost: By Japan	(1) It is judged to be impossible to construct by HMGN in view of a finance and capability.	
(2) Land acquisition and compensation: By HMGN		

Table 5-1 Principal Features of Irrigation Facilities

Irrigation facilities	Block D-7						Block D-15				
	Irrigation Unit					Total	Irrigation Unit				Total
	1	2	3	4	5		1	2	3	4	
1. Canal (m)	2,184	1,616	1,294	1,266	2,246	8,606	1,847	1,430	2,580	1,050	6,907
2. Pump house	1	1	1	1	1	5	1	1	1	1	4
3. Operator hut	1	1	1	1	1	5	1	1	1	1	4
4. Baffle tank	1	1	1	1	1	5	1	1	1	1	4
5. Cattle pass	3	1	3	3	4	14	3	3	3	3	12
6. Road crossing (L)	0	1	0	0	0	1	2	1	0	0	3
7. Road crossing (S)	10	8	6	8	10	42	6	5	7	5	23
8. Turnout	14	14	14	14	14	70	14	14	14	14	56
9. Cross drain	5	6	4	4	4	23	4	1	4	2	11
10. Cross drain (L)	0	0	0	0	1	1	0	0	0	0	0
11. Corner box	8	11	5	2	6	32	1	5	8	1	15
12. Division box	1	1	0	1		5	2	1	2	2	7
13. Drop	0	0	0	2	0	2	1	1	1	3	6
14. Check plate	12	12	14	11	11	60	12	14	10	11	47

Table 5-2 Principal Features of Main Canals

Name of block	Name of canal	Type of canal	Length (m)	Discharge (l/s)	Gradient	Velocity (m/sec)	Water depth (m)
D-7	BSY 1-1	II	738	40	1/1,000~1/500	0.49~0.64	0.23~0.18
	BSY 1-2	II	778	40	1/1,000~1/350	0.49~0.73	0.23~0.16
	BSY 1-3	II	668	40	1/1,000	0.49	0.23
	BSY 2-1	I	922	40	1/1,600~1/350	0.40~0.73	0.28~0.16
	BSY 2-2	I	694	40	1/1,600~1/800	0.40~0.53	0.28~0.21
	BSY 3-1	II	671	40	1/1,000~1/400	0.49~0.69	0.23~0.17
	BSY 3-2	II	623	40	1/500~1/300	0.64~0.77	0.18~0.15
	BSY 4-1	II	881	40	1/1,600~1/500	0.40~0.46	0.28~0.18
	BSY 4-2	II	385	40	1/1,000	0.49	0.23
	BSY 5-1	II	1,711	40	1/1,600~1/500	0.40~0.64	0.28~0.18
	BSY 5-2	II	390	40	1/500	0.64	0.18
	BSY 5-3	II	145	40	1/300	0.77	0.15
D-15	HHP 1-1	II	418	40	1/1,000	0.49	0.23
	HHP 1-2	II	590	40	1/1,000~1/150	0.49~0.09	0.23~0.12
	HHP 1-3	II	715	40	1/210~1/150	0.88~0.99	0.13~0.12
	HHP 1-4	II	124	40	1/1,000	0.49	0.23
	HHP 2-1	II	740	40	1/1,000~1/150	0.49~0.99	0.23~0.12
	HHP 2-2	II	690	40	1/290~1/150	0.78~0.99	0.15~0.12
	NTJ 1-1	II	1,575	40	1/900~1/150	0.51~0.99	0.22~0.12
	NTJ 1-2	II	420	40	1/1,000~1/150	0.49~0.99	0.23~0.12
	NTJ 1-3	II	585	40	1/1,000~1/200	0.49~0.90	0.23~0.13
	NTJ 2-1	II	770	40	1/150~1/625	0.99~0.59	0.12~0.20
	NTJ 2-2	II	100	40	1/1,000	0.49	0.23
	NTJ 2-3	II	180	40	1/800	0.53	0.21

Table 5-3 Total quantity of equipment and materials required for construction of production tubewells and irrigation facilities (1/2)

Name of equipment and materials/Block	D-7	D-15	Total	Procurement Method: Use of existing RR-2 materials	Procurement Method: Newly granted by GOJ
(I) Drilling equipment and materials					
1. Drilling rig (including mud pump)	3 units		3 units	3 units	0
2. Spare parts for the drilling rig	The necessary quantity (Table 5-4)			0	as Table 5-4
3. Spare parts for the mud pump	The necessary quantity (Table 5-5)			0	as Table 5-5
4. Drilling tools	The necessary quantity (Table 5-6)			0	as Table 5-6
5. Tricone bit 17-1/2" R	0	3 pcs.	3 pcs.	0	3 pcs.
6. Tricone bit 17-1/2" MR	4 pcs.	1 pc.	5 pcs.	0	5 pcs.
7. Tricone bit 14-3/4" R	0	3 pcs.	3 pcs.	0	3 pcs.
8. Tricone bit 14-3/4" MR	4 pcs.	1 pc.	5 pcs.	0	5 pcs.
9. 22"-conductor pipe (L = 3m)	24 m	48 m	72 m	0	72 m
10. 14"-casing pipe (L = 6m)	144 m	246 m	390 m	390 m	0
11. 8"-casing pipe (L = 6m)	528 m	252 m	780 m	780 m	0
12. 8"-reinforced Johnson screen (L = 5.25m)	63 m	126 m	189 m	189 m	0
13. 8"-strengthened rod-base screen (L = 5.5m)	132 m	22 m	154 m	0	154 m
14. 14"-8" reducer	4 pcs.	4 pcs.	8 pcs.	0	8 pcs.
15. 8"-bottom plug	4 pcs.	4 pcs.	8 pcs.	0	8 pcs.
16. Centralizer 17-1/2"	18 pcs.	0	18 pcs.	0	18 pcs.
17. Centralizer 14-3/4"	0	16 pcs.	16 pcs.	0	16 pcs.
18. Hole opener (17-1/2" -> 24", blade type)	3 pcs.		3 pcs.	1 pc.	2 pcs.
19. Hole opener (14-3/4" -> 17-1/2", roller cutter type)	4 pcs.		4 pcs.	0	4 pcs.
20. Submersible motor pump	3 sets		3 sets	2 sets	1 set
21. Diesel engine generator	3 sets		3 sets	2 sets	1 set
22. DC engine welder (3.6 kVA)	3 sets	(one set per one site)	3 sets	0	3 sets
23. Centrifugal pump	3 sets	(one set per one site)	3 sets	2 sets	1 set
24. Square-angle notch tank (2.5 m^3)	3 pcs.	(one pc. per one site)	3 pcs.	3 pcs.	0
25. Portable fuel tank (steel plate made 2 m^3)	3 pcs.	(one pc. per one site)	3 pcs.	3 pcs.	0
26. Portable water tank (water-proof cloth made 3 m^3)	12 pcs.	(two pcs. per one site)	12 pcs.	6 pcs.	6 pcs.
27. Jetting nozzle	3 pcs.	(one pc. per one site)	3 pcs.	0	3 pcs.
28. Bailer	3 pcs.	(one pc. per one site)	3 pcs.	0	3 pcs.
29. Mud balance, viscosimeter	3 sets	(one for each site)	3 sets	0	3 sets
30. 6" delivery pipe (L = 1.2 m)			10 pcs.	0	10 pcs.
31. 3-ton crane truck	3 units	(one for each site)	3 units	3 units	0
32. Fuel tank lorry	2 units	(two units shall be used for 3 sites.)	2 units	2 units	0
33. Water tank lorry	3 units	(one for each site)	3 units	3 units	0
34. 3.5-ton dump truck	2 units	(two units shall be used for 3 sites.)	2 units	2 units	0
35. 1-ton pick-up truck (4WD)	3 units	(one for each site)	3 units	0	3 units
36. 6-ton crane truck	1 unit	(one shall be used for the sites.)	1 unit	0	1 unit
37. 20-ton trailer	1 unit	(for the transportation of bulldozer & pipes)	1 unit	1 unit	0
38. 11-ton bulldozer	1 unit	(for repairing of access roads)	1 unit	1 unit	0

Table 5-3 Total quantity of equipment and materials required for construction of production tubewells and irrigation facilities (2/2)

Name of equipment and materials/Block	D-7	D-15	Total	Procurement Method: Use of existing KR-2 materials	Procurement Method: Newly granted by GOJ
(II) Pump for production tubewell (including engine)					
1. OKAMOTO pump (45 l/sec, 46 m)	5 sets	5 sets	10 sets	10 sets	0
2. Column pipe and pump shaft for OKAMOTO pump	5 sets	5 sets	10 sets	6 sets	4 sets
(III) Construction equipment of irrigation facility					
1. 11-ton bulldozer	6 units	(2 units for each site)	6 units	6 units	0
2. 3.1M motor grader	3 units	(one unit for each site)	3 units	3 units	0
3. 1.2m^3 wheel loader	3 units	(one unit for each site)	3 units	3 units	0
4. 4-ton vibro road roller	9 units	(3 units for each site)	9 units	5 units	4 (rent)
5. 3.5-ton dump truck	6 units	(2 for each site)	6 units	6 units	0
6. 4-ton cargo truck	3 units	(one unit for each site)	3 units	3 units	0
7. 0.5m^3 concrete mixer	3 units	(one unit for each site)	3 units	3 units	0
(IV) Vehicles for operation and supervision					
1. 4WD wagon type jeep	4 units	(one for consultant, one for drilling constructor, one for civil constructor and one for surveying)	4 units	3 units	1 unit
2. 4WD jeep	4 units	(one for consultant, one for mechanics and two for construction supervisors)	4 units	0	4 units

Table 5-4 Spare parts for 3 drilling rigs (YRD-501R)

Number of drilling rigs to be used		3 units	Remarks
	Name of parts\Block	Total	
1.	Control panel with change lever assembly	9 sets	
2.	Tacometer and sensor	1 set	
3.	Wire for engine control	1 set	
4.	Propeller shaft and universal joint	1 set	
5.	Pressure gauge DU100ø x 35 kg/m^2	3 pcs.	
6.	Pressure gauge DU100ø x 350 kg/m^2	6 pcs.	
7.	Suction hose with band 6" x 6m	6 sets	
8.	Foot valve 150 mm	6 pcs.	
9.	Cylinder for break-out	1 pc.	
10.	Rotary tong (for drill collar)		
	Extra jaws for tong slip	16 sets	
11.	Rotally tong (for drill pipe)		
	Extra jaws for tong slip	16 sets	
12.	Kelly saver sub	3 pcs.	
13.	3" ball valve (mud line)	6 pcs.	
14.	Brake band	3 pcs.	
15.	Clutch disk plate	3 pcs.	
16.	Clutch cover	3 pcs.	
17.	Oil pump A7V	1 pc.	
18.	Oil motor ME600	1 pc.	
19.	Oil motor ME300	1 pc.	
20.	Hydraulic hose 1/4" x 5.9m (High pressure type)	6 pcs.	
21.	Grease EP-2 (10 kg)	5 cans	
22.	Bearing for turn table	2 pcs.	
23.	Kelly drive bushing with bolt	3 sets	
24.	Seekens valve DZ5DP2-10315	3 pcs.	
25.	Check valve CA-12A-A330	3 pcs.	
26.	Tension spring (compound case)	3 pcs.	
27.	O-ring JIS 1516 No. 9	6 pcs.	
28.	O-ring P-29.5	12 pcs.	
29.	O-ring G-55	12 pcs.	
30.	O-ring G-120	10 pcs.	
31.	O-ring G-185	4 pcs.	
32.	High pressure hose 30Kx75øx1.25m	3 pcs.	
33.	High pressure hose 30Kx75øx3.5m	3 pcs.	
34.	High pressure hose 30Kx75øx8.0m	3 pcs.	
35.	Oil pump TOP-13A	3 pcs.	
36.	Push pull cable	3 units	
37.	Oil seal (rotally table)	3 pcs.	
38.	Rubber for gauge protecting (mud line)	5 pcs.	
39.	Wire for draw works	3 pcs.	
40.	Water swivel with reducer	3 sets	
41.	Chain (HV-CHAIN)	3 sets	
42.	Hydraulic oil	1,250 lit.	
43.	Gear oil	450 lit.	
44.	Line element for hydraulic system	7 pcs.	
55.	Suction strainer for hydraulic oil	3 pcs.	
46.	Engineering tools	3 sets	
47.	Mission (gear, shaft, bearing and tools etc.)	1 set	

Table 5-5 Spare parts of 3 mud pumps (NAS-7)

Name of parts/Blocks		for 8 Wells Total	Remarks
Valve block			
Bolt	E0326-639	2 pcs.	
Ground packing	E1150-251	8 pcs.	
Ground packing	E1150-252	8 pcs.	
Keeper	E1835-013	2 pcs.	
Cap	D1836-246	2 pcs.	
Nut	E2160-574	2 pcs.	
Nut	E2160-578	2 pcs.	
Liner (6-3/4")	D2705-207	12 pcs.	
Piston rod with nuts	D2841-151	9 pcs.	
Seat valve	D2915-025	32 pcs.	
Conical valve	D0187-029	32 pcs.	
Guide valve	D1081-025	32 pcs.	
Sheet rubber	D2917-026	48 pcs.	
Rubber packing	E2702-172	6 pcs.	
Washer	E3420-570	24 pcs.	
Bolt	M16X40	24 pcs.	
Piston body (6-3/4")	D0337-040	6 pcs.	
Nut	E2160-579	12 pcs.	
Washer (6-3/4")	E3420-569	12 pcs.	
Piston rubber 6-3/4" OH		32 pcs.	
Spring		32 pcs.	
V packing	55.80.4.2	128 pcs.	
O-ring	JIS B2401 P-60	6 pcs.	
O-ring	JIS B2401 P-90	6 pcs.	
O-ring	JIS B2401 P-120	4 pcs.	
O-ring	JIS B2401 P-160	24 pcs.	
O-ring	JIS B2401 P-235	6 pcs.	
Clunk case			
Stuffing box	E0334-056	2 pcs.	
Collar	E1841-665	4 pcs.	
Nut	E2160-574	2 pcs.	
Key	7X7X28	2 pcs.	
Oil seal	SB9512013	4 pcs.	
Ground packing		18 pcs.	
Bearing	SL 01-4852	2 pcs.	
Bearing	22315	2 pcs.	
Bearing	22320	2 pcs.	
O-ring	JIS B2401 G-220	8 pcs.	
O-ring	JIS B2401 G-250	8 pcs.	
Bushing	E0251-604	2 pcs.	
Lubricating system			
Oiler	E4587-003	2 pcs.	
Delivery line			
Diaframo	E0540-002	4 pcs.	
Prossure gauge		4 pcs.	

Table 5-6 List of necessary drilling tools for 3 rigs (for 8 production wells)

Name of equipment and materials	Specification	Total
Drilling rig		3 units
Water swivel	3 inch	3 pcs.
Swivel sub PxB	Reverse 4-1/2"REG	3 pcs.
Kelly rod 3-1/2"	Reverse 4-1/2"REG	3 pcs.
Kelly drive bushing	3-1/2"	3 pcs.
Kelly sub PxB	3-1/2" IF	3 pcs.
Drill stringth		
Drill pipe	API-IF	102 pcs.
		612 m
Cross saver sub (collar sub)	3-1/2" IF PxB	3 pcs.
Drill collar		9 pcs.
(9-1/2" x 3m, PxB)	6-5/8" REG	27 m
Blade stabilizer	17-1/2" hole	6 pcs.
Blade stabilizer	14-3/4" hole	2 pcs.
Bit sub 6-5/8"B x 6-5/8"B	6-5/8" REG	3 pcs.
Bit sub 6-5/8"B x 6-5/8"B 3	6-5/8" REG	3 pcs.
Fishing tools		
Hoisting elevator	2 pullies	3 pcs.
Hoisting wire rope	ø18 mm	3 pcs.
		300 m
Centre clutch elevator	3-1/2" drill pipe	6 pcs.
Casing elevator	8" x 30 ton	6 pcs.
Casing slip	8" (spider)	3 sets
Casing elevator	14" x 30 ton	6 pcs.
Drill collar and band	9-1/2"	6 sets
Drill collar.slip	9-1/2"	3 pcs.
Drill collar.lifting.plug	9-1/2", 6-5/8" REG	6 pcs.
Drill pipe and band	3-1/2"	6 pcs.
Hoisting swivel	1"	3 pcs.
Rod breaker		
Rotally tong	3-1/2" drill pipe	3 sets
Rotally tong	9-1/2" drill collar and jaws	3 sets
Engineering tools		3 sets

FIGURES

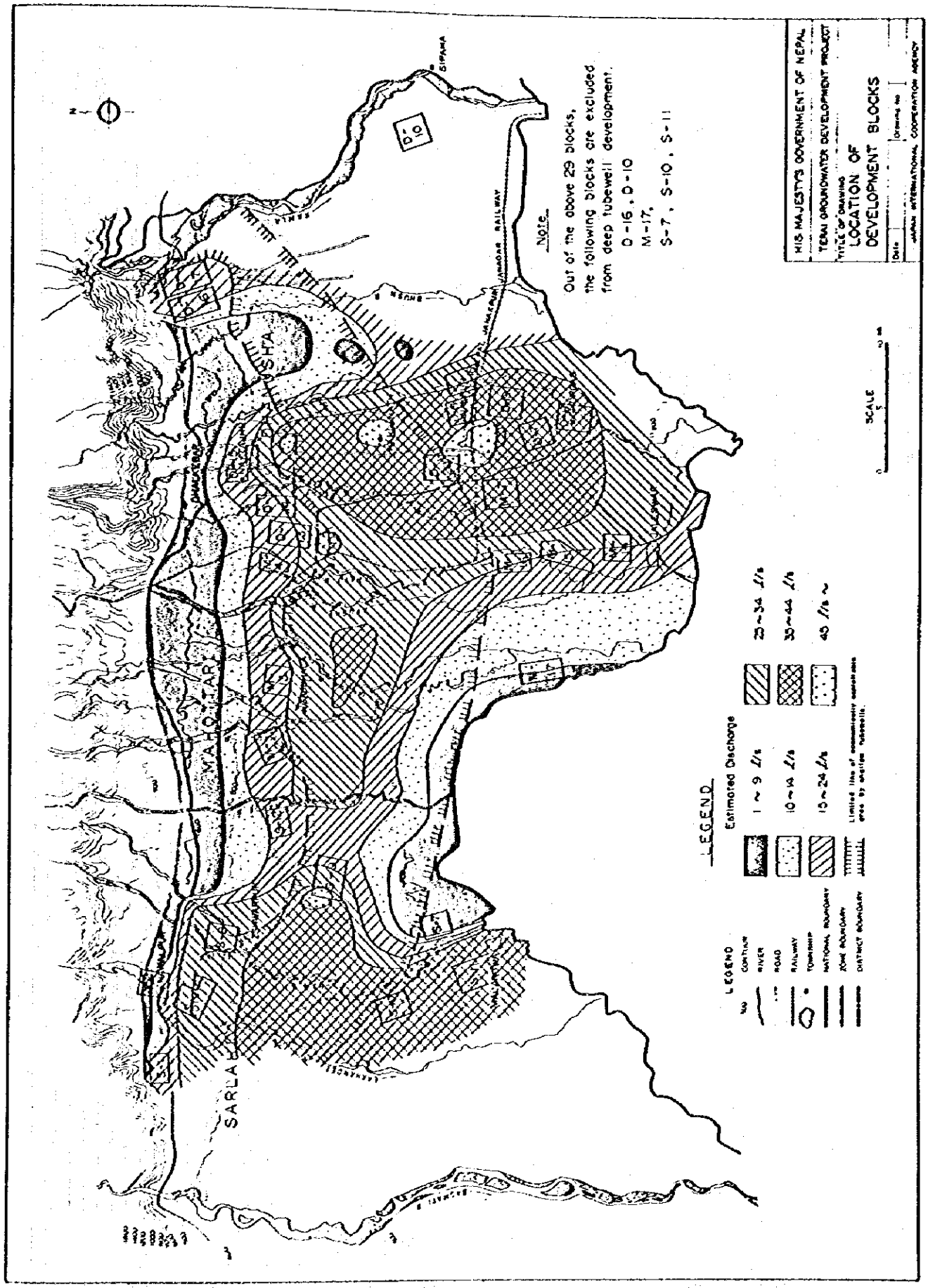


Figure 3-1 Distribution of Groundwater Potential and Development Blocks

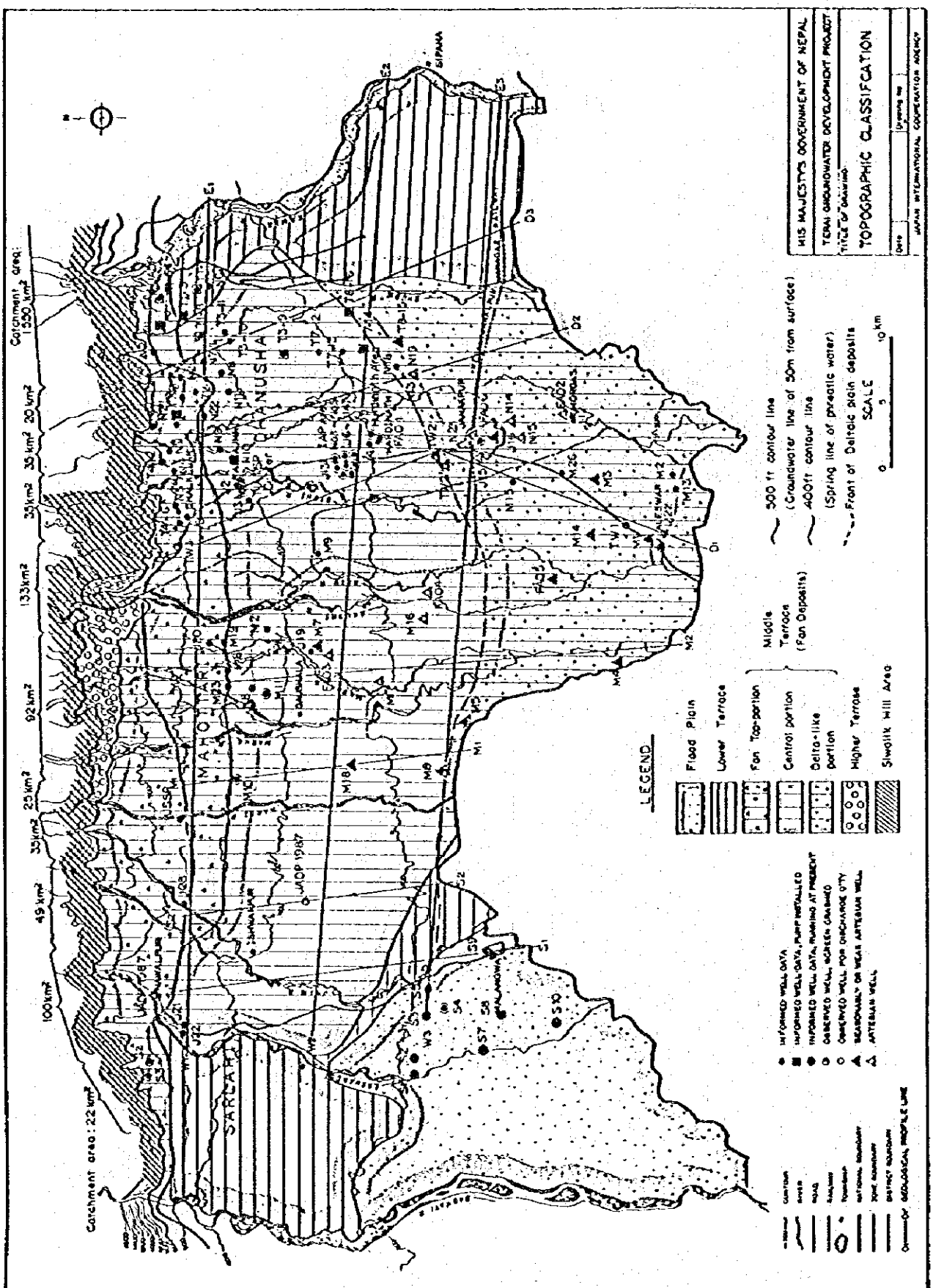


Figure 3-2 Topographic Classification

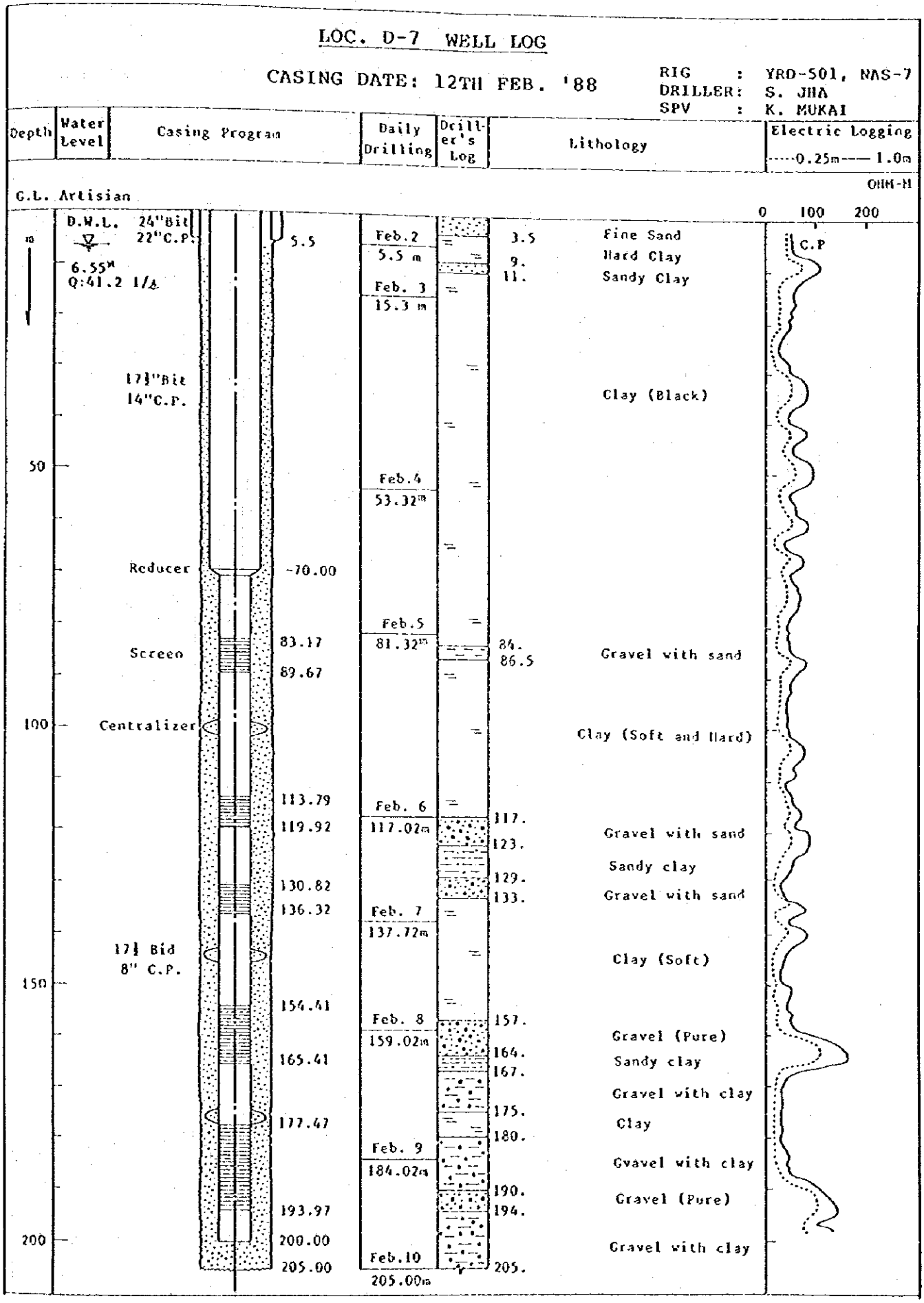


Figure 3-3 Well Log at D-7 Test Well

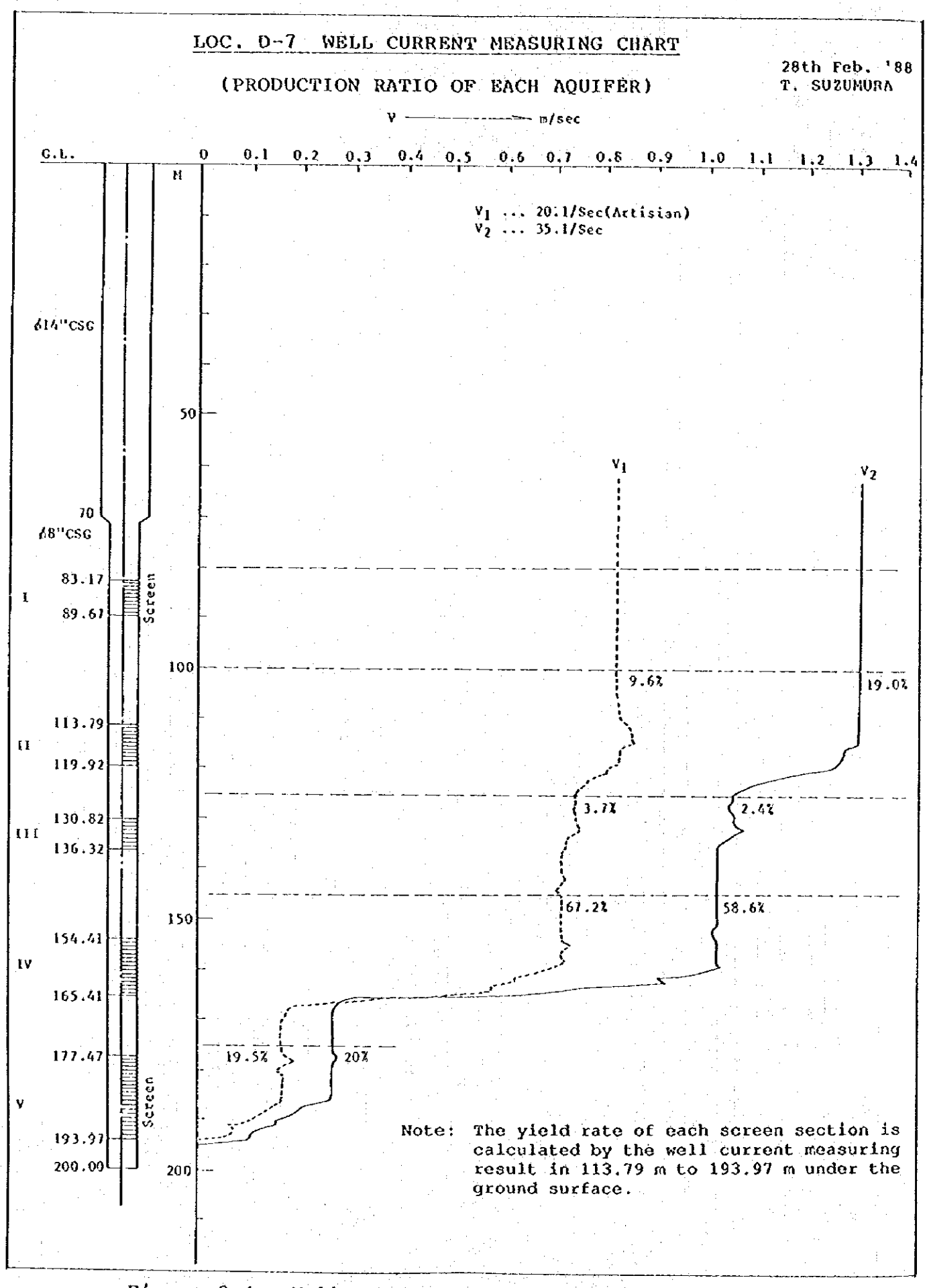


Figure 3-4 Well Current Measuring Chart at D-7 Test Well

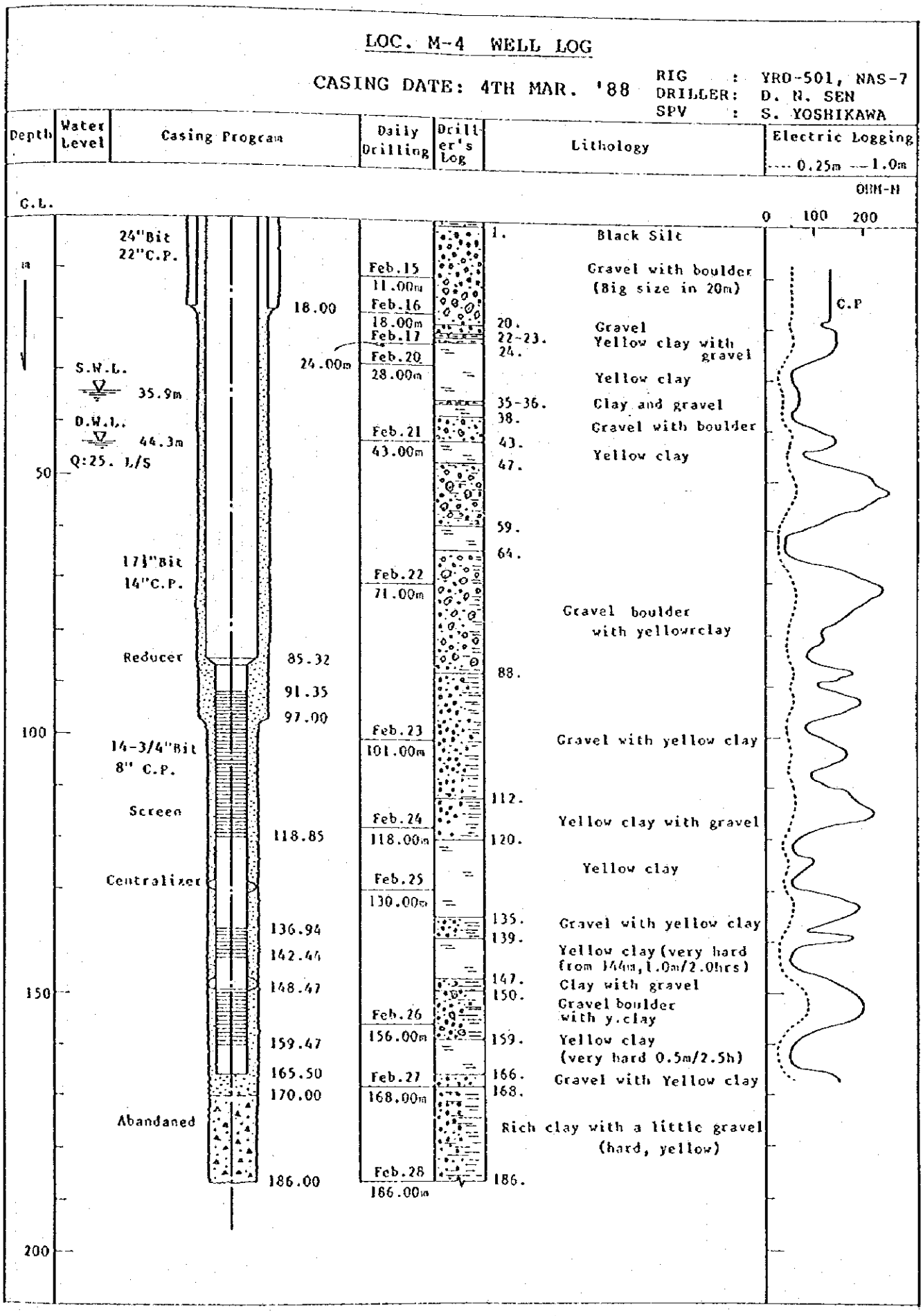


Figure 3-5 Well Log at M-4 Test Well

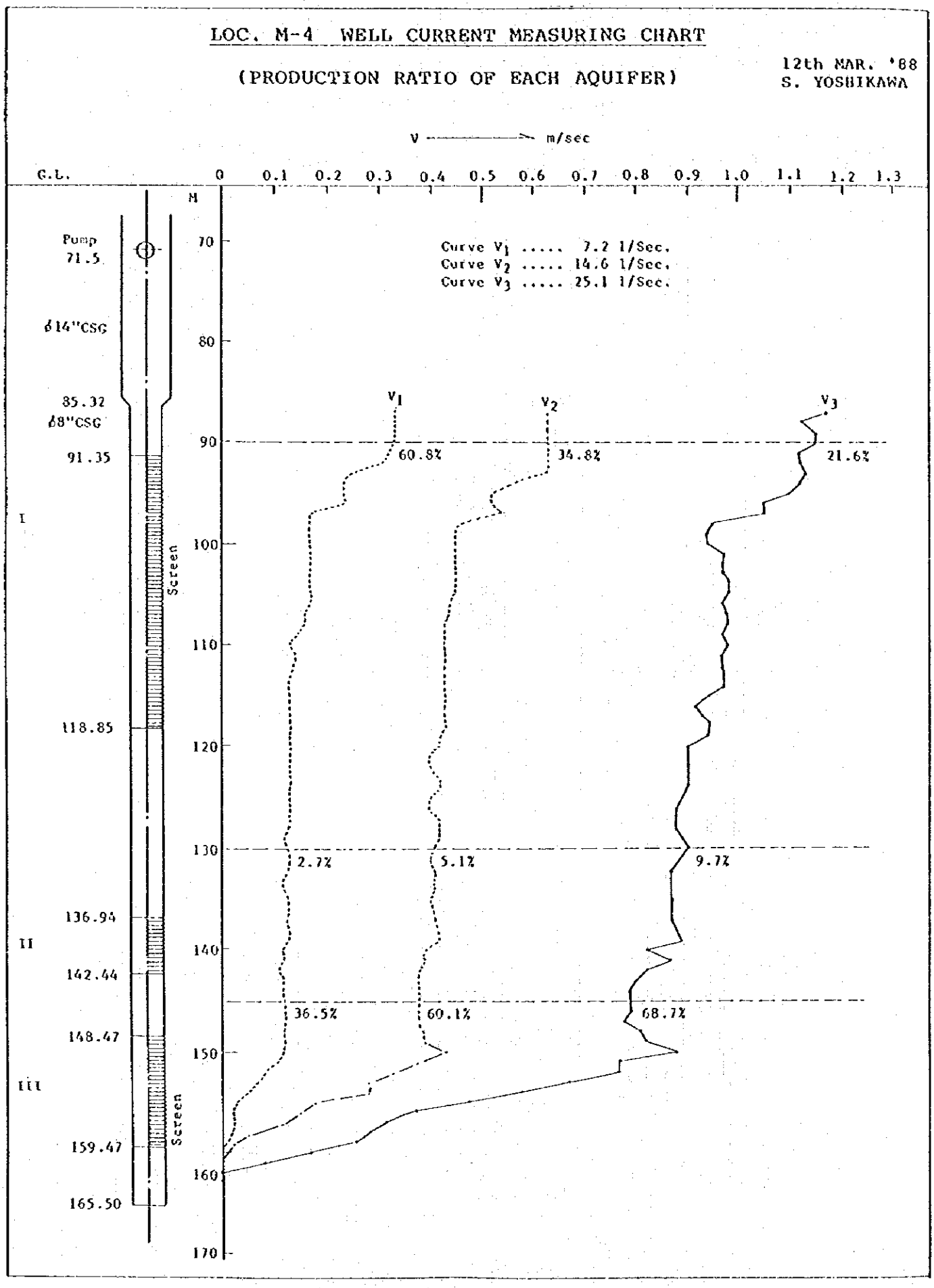


Figure 3-6 Well Current Measuring Chat at M-4 Test Well

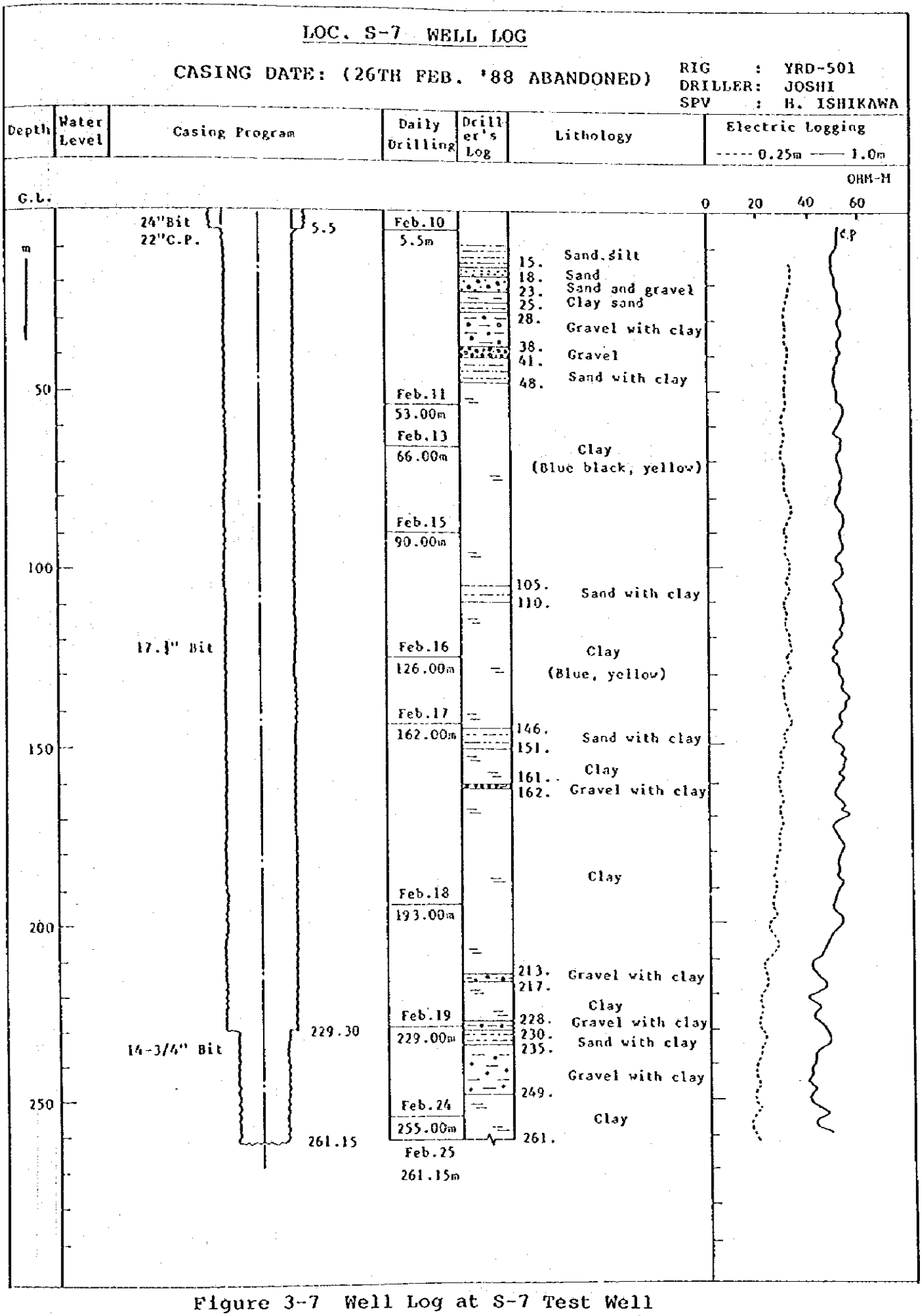


Figure 3-7 Well Log at S-7 Test Well

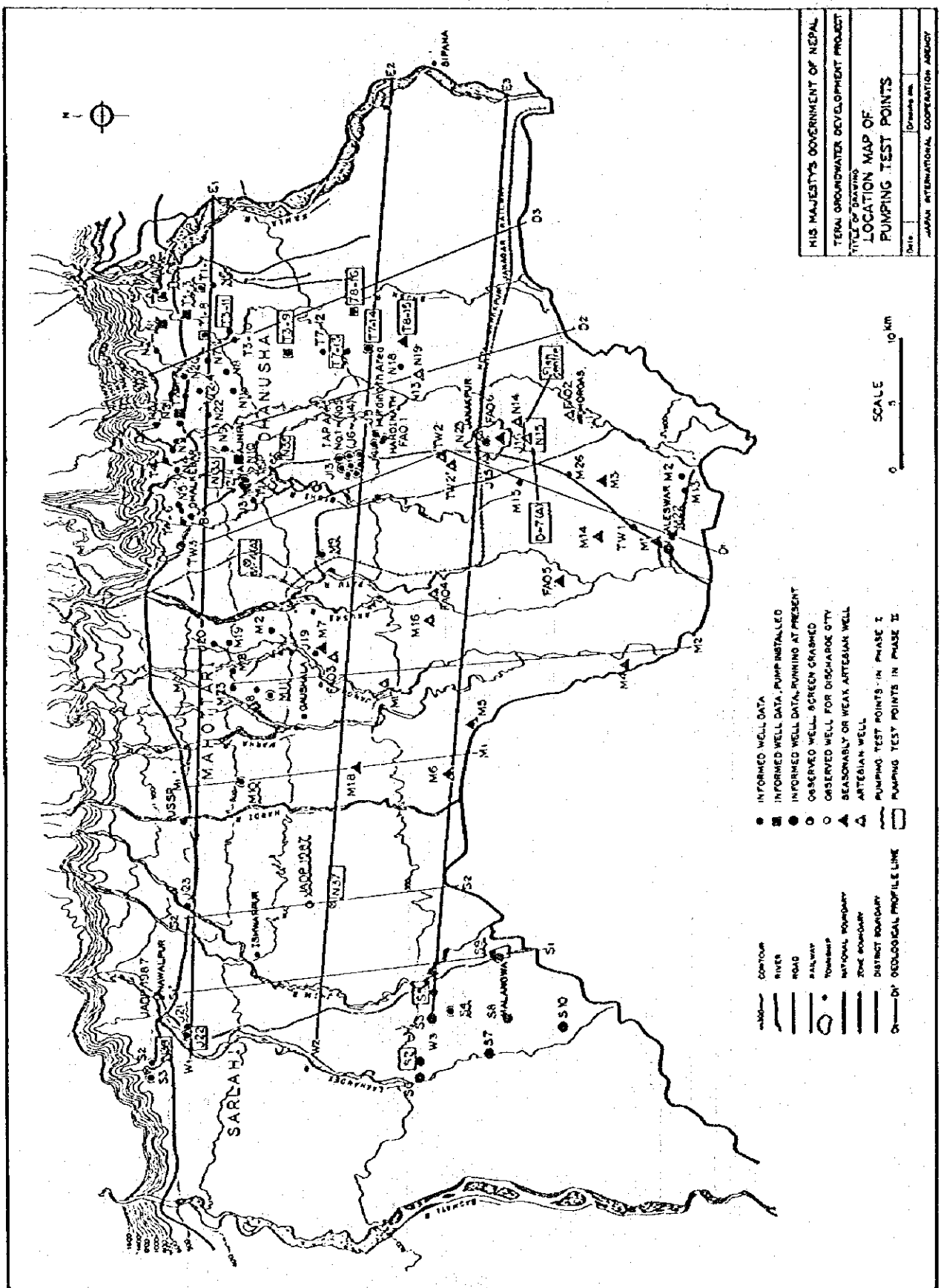


Figure 3-8 Location Map of Pumping Test Points

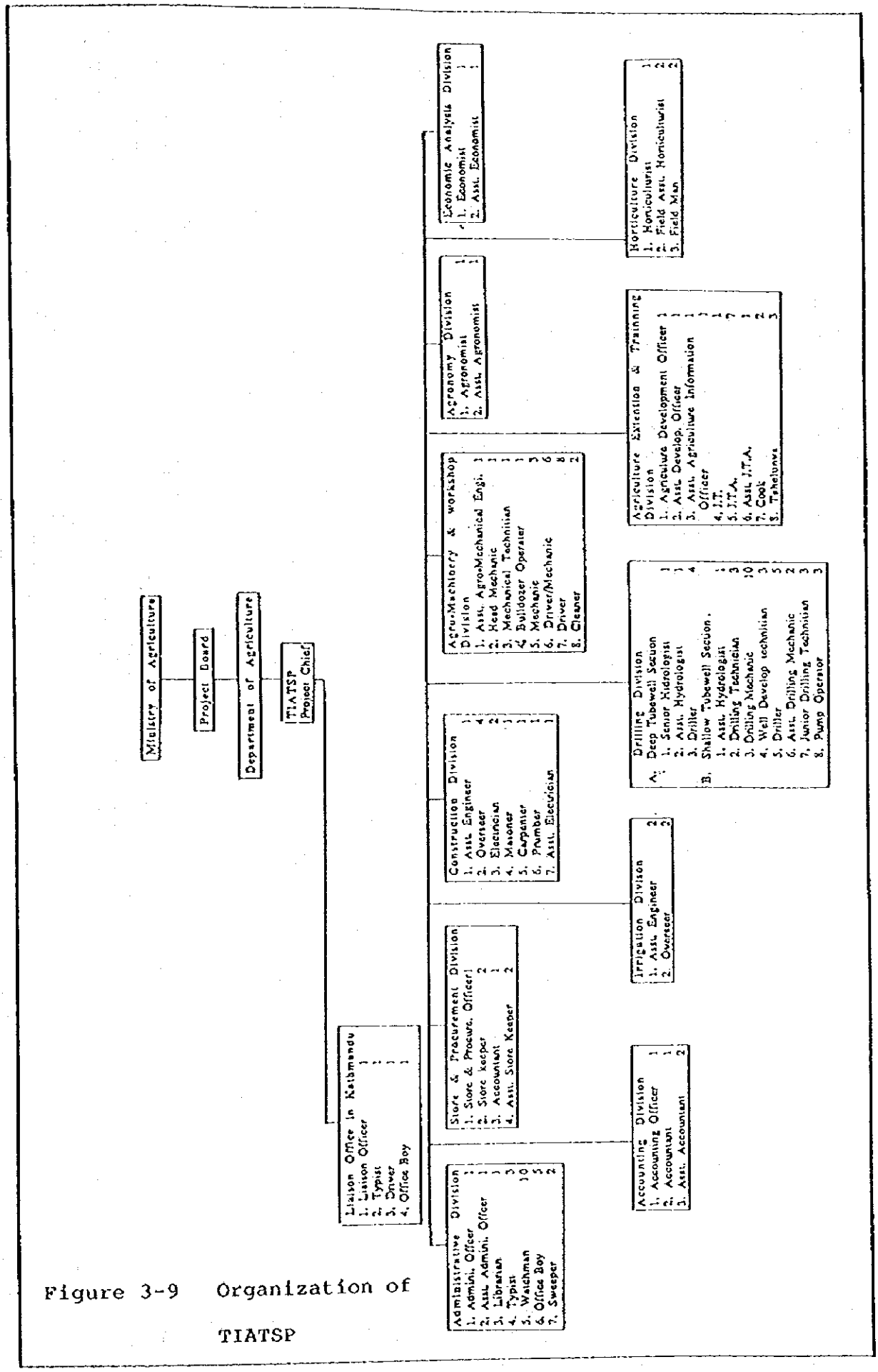


Figure 3-9 Organization of TIATSP

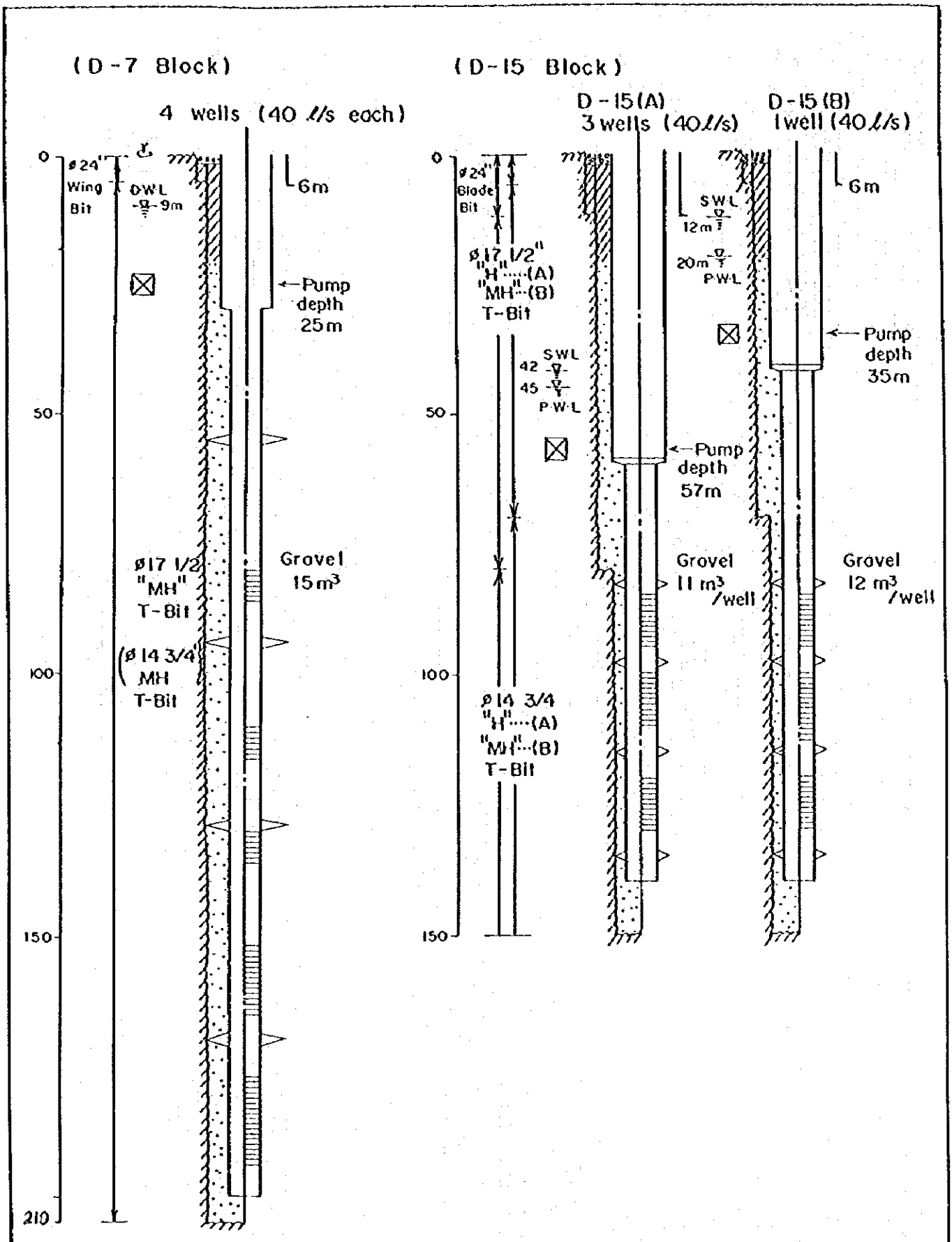
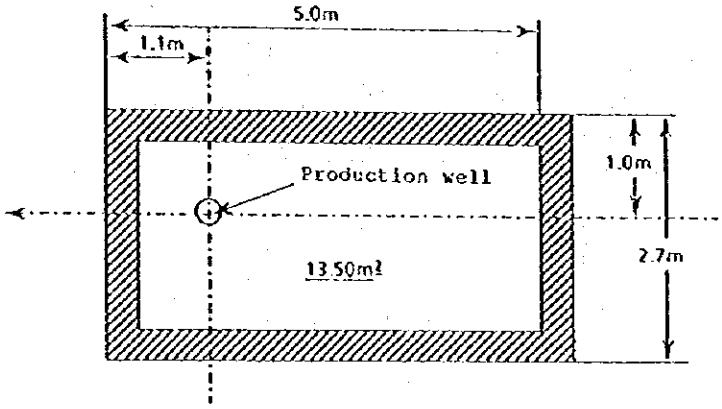


Figure 5-1 Typical Profile of Deep Tubewell

Plan of Pump House



Plan of Operator Hut

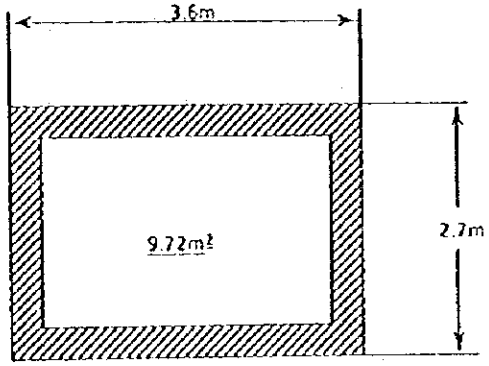
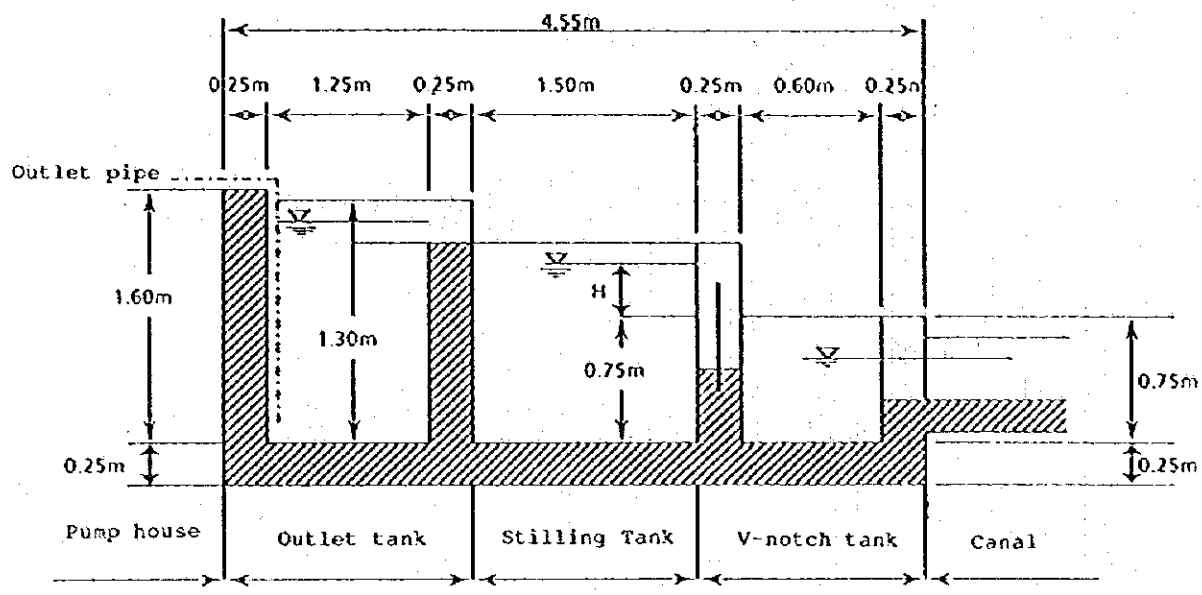


Figure 5-2 Plan of Pump House and Operator Hut

Plan of Baffle Tank



Detail of V-notch

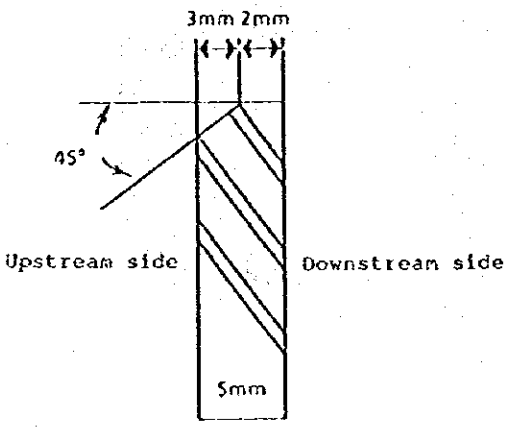
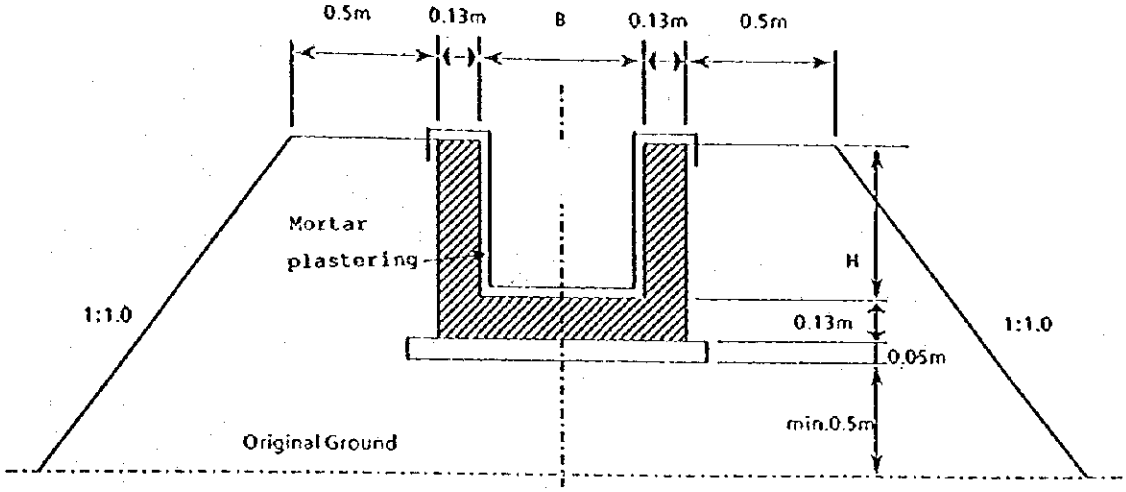
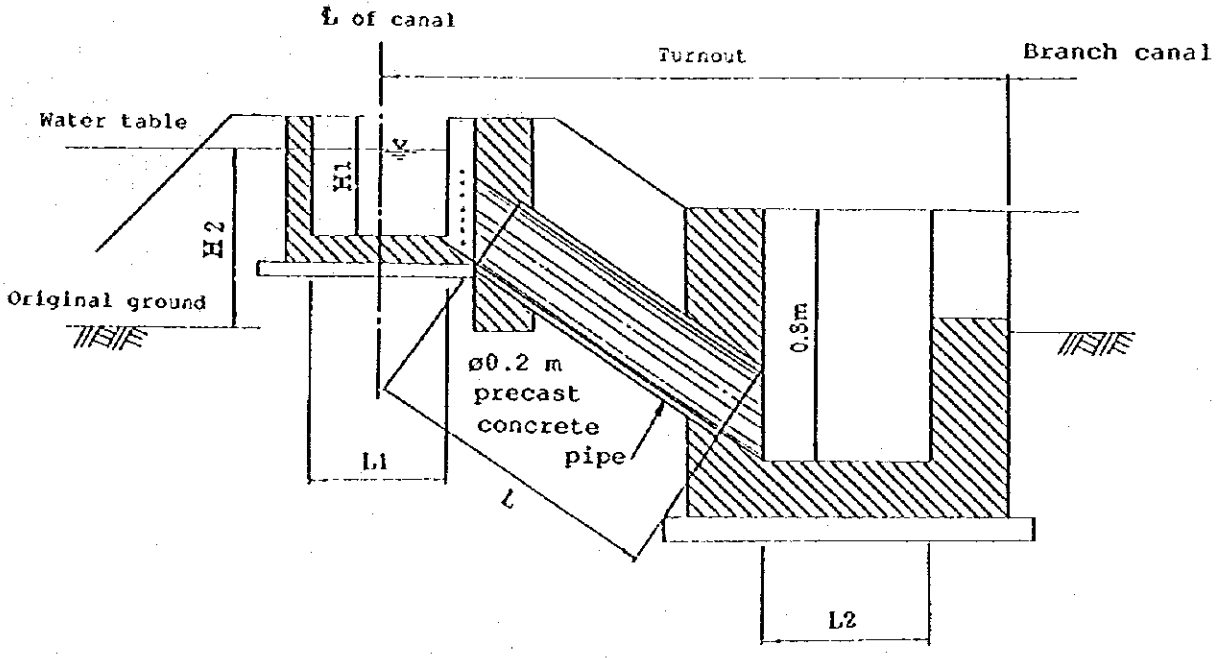


Figure 5-3 Baffle Tank and V-notch

Canal section



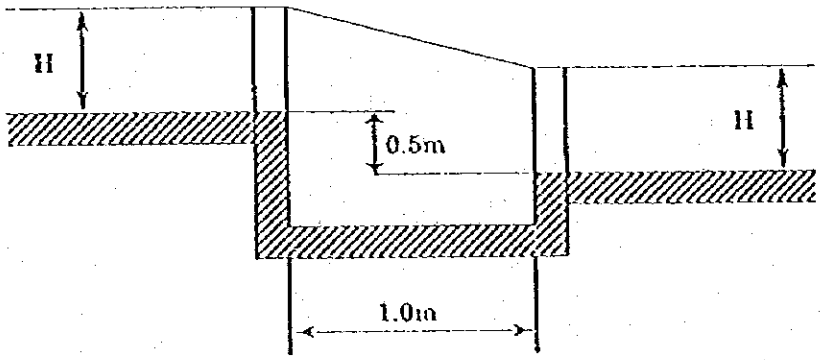
Profile of Turnout



Type	Canal type	L_1	L_2	L	H_1	H_2
I	I	0.35m	1.0m	2.5m	0.42m	<0.86m
II	I	0.35m	1.0m	5.0m	0.42m	≥ 0.86m
III	II	0.35m	0.75m	2.5m	0.35m	<0.86m
IV	II	0.35m	0.75m	5.0m	0.35m	≥ 0.86m

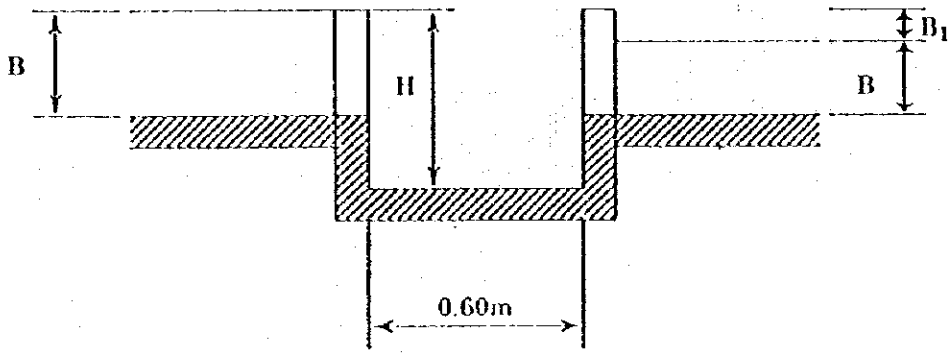
Figure 5-4 Canal Section and Turnout

Profile of Drop



Type	Canal type	H (m)	L (m) (Width)
I	I	0.42	0.35
II	II	0.35	0.35

Profile of Division Box and Corner Box

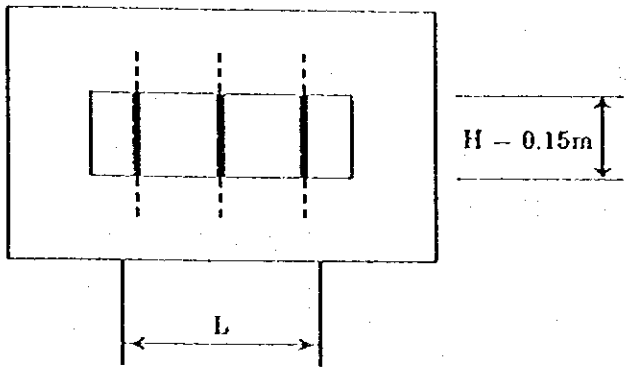


(Unit: m)

Type	Canal type	A	B	B_1	H
I - I	I	0.35m	0.42m	0.00	0.62
I - II	I	0.35m	0.42m	0< B1 ≤0.25	0.62< H ≤0.87
I - III	I	0.35m	0.42m	0.25< B1 ≤0.50	0.87< H ≤1.12
II - I	II	0.35m	0.35m	0.00	0.48
II - II	II	0.35m	0.35m	0< B1 ≤0.25	0.48< H ≤0.73
II - III	II	0.35m	0.35m	0.25< B1 ≤0.50	0.73< H ≤0.98

Figure 5-5 Profile of Drop, Division Box and Corner Box

Check Plate



Type	Canal type	H (m)	L (m)
I	I	042	0.35
II	II	0.35	0.35

Figure 5-6 Check Plate

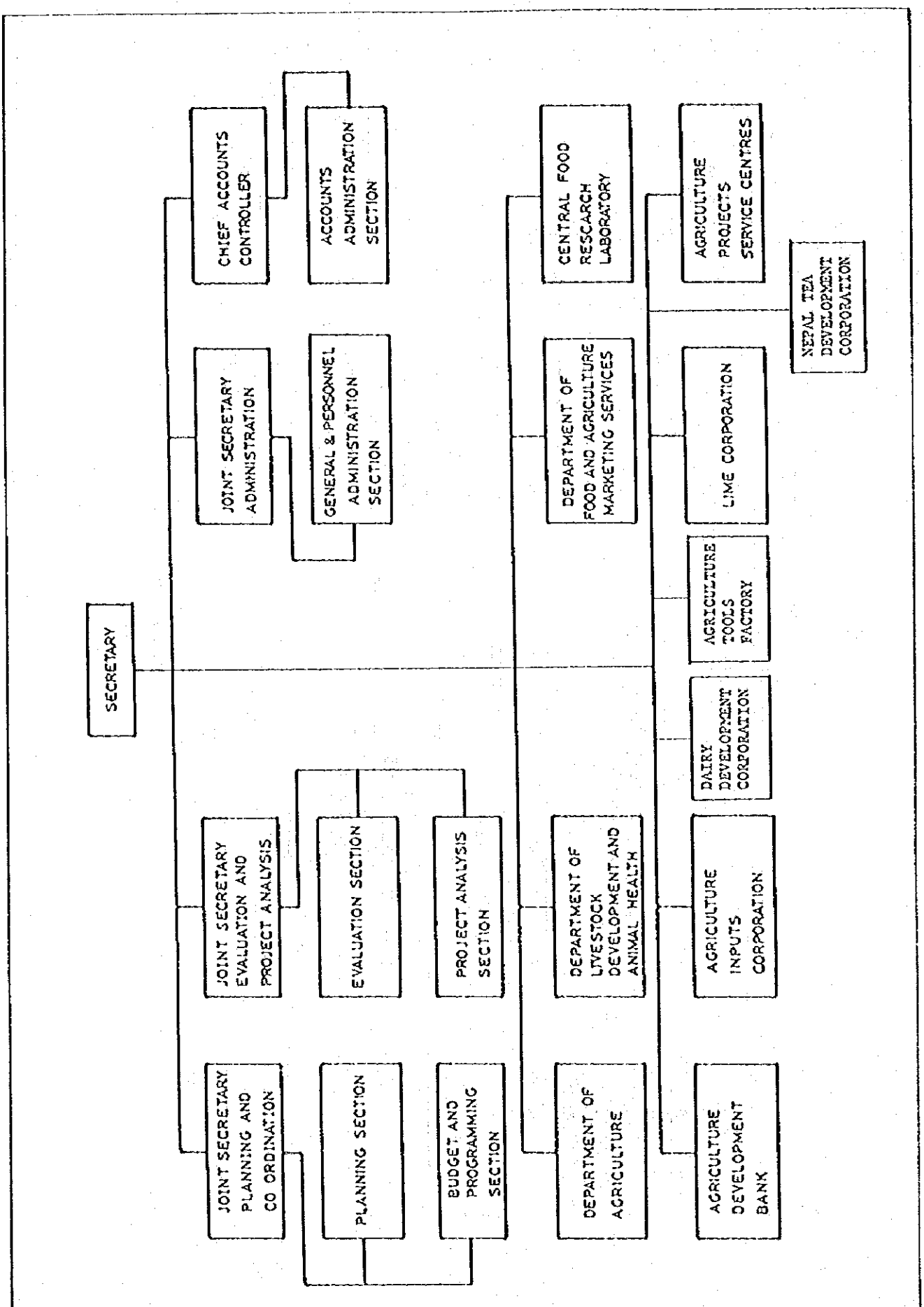


Figure 6-1 Organization of Ministry of Agriculture

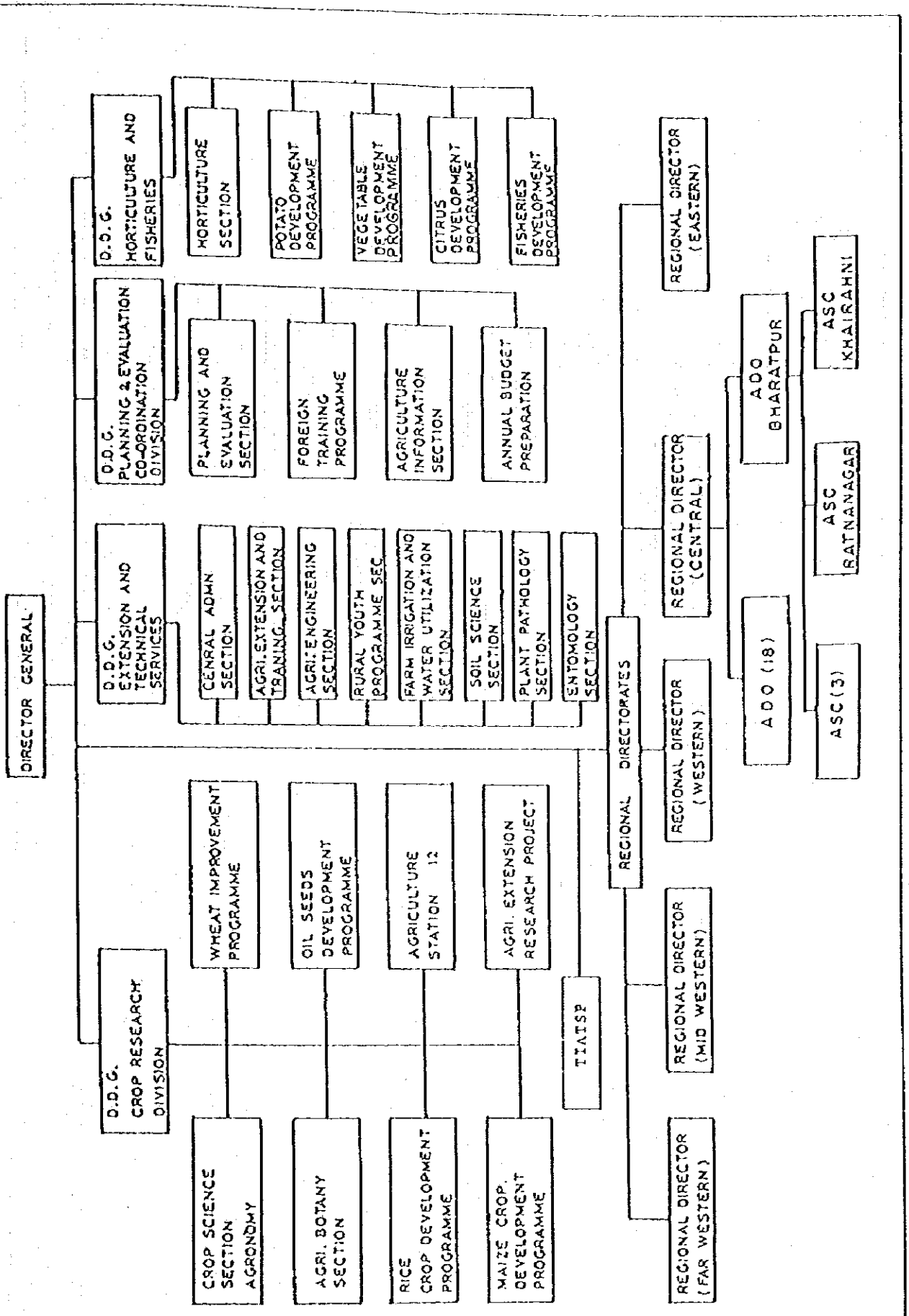


Figure 6-2 Organization of Department of Agriculture

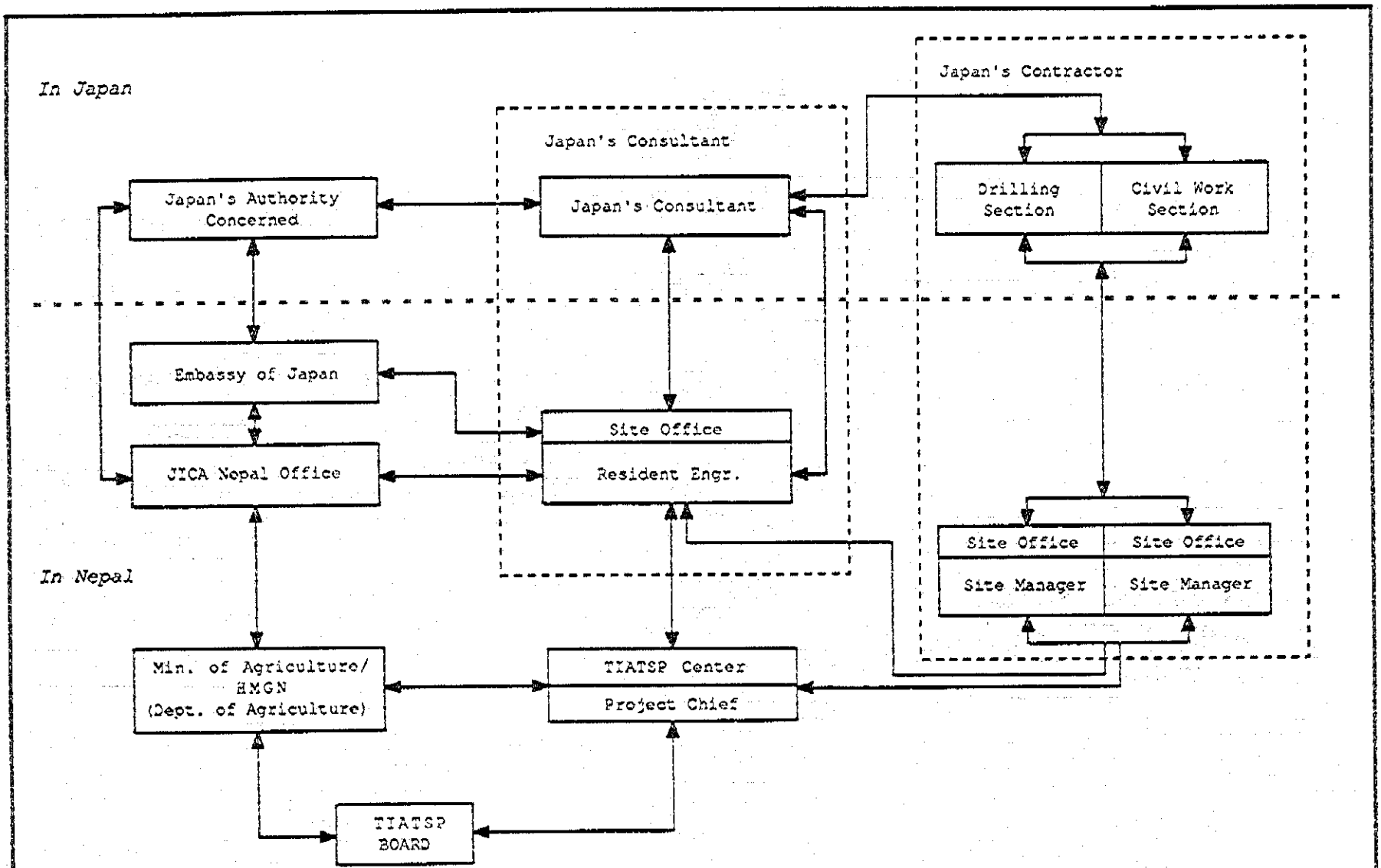
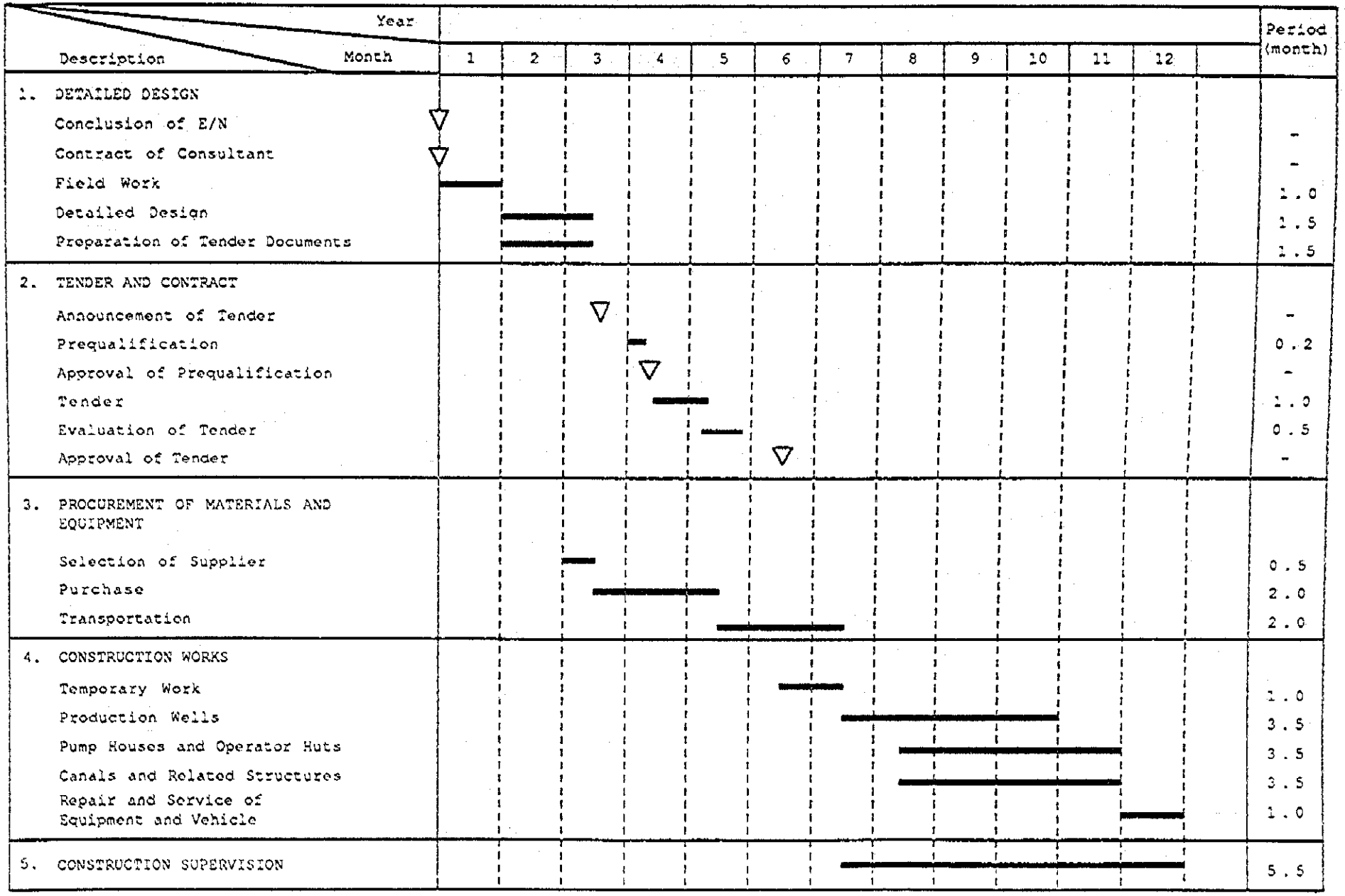


Fig. 6-3 Organization of Construction Implementation

Fig. 6-4 Tentative Implementation Schedule



APPENDICES

MEMBER OF BASIC DESIGN SURVEY TEAM (PHASE-II)

Yoshiki MIYANISHI	Team Leader, Grant Aid Division, Bureau of Economic Cooperation, Ministry of Foreign Affairs
Masayuki WADA	Senior Hydrogeologist, Groundwater Development Plan Professional Officer, Resources Division, Planning Department, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries
Ryuji MATSUNAGA	Coordinator, First Basic Design Study Division, Grant Aid Planning and Survey Department, Japan International Cooperation Agency
Tadanori SUZUKI	Coordinator, First Basic Design Study Division, Grant Aid Planning and Survey Department, Japan International Cooperation Agency
Yoshimitsu MASE	Irrigation and Drainage Engineer, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Tadao SUZUMURA	Hydrogeologist-A, Investigation and Planning Department, Nippon Koei Co., Ltd.
Yukishi TOMIDA	Hydrogeologist-B, Investigation and Planning Department, Nippon Koei Co., Ltd.
Shinichi YOSHIKAWA	Drilling Expert-A, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Mr. MUKAI	Drilling Expert-B, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Hiroshi ISHIKAWA	Drilling Expert-C, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Michio ICHIMARU	Mechanical Engineer, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Masayuki KODAMA	Irrigation and Drainage Design Engineer-A, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Kazuyuki SHIMAZAKI	Irrigation and Drainage Design Engineer-B, Irrigation and Drainage Department, Nippon Koei Co., Ltd.
Yutaka NAKANO	Cost Estimator, Irrigation and Drainage Department, Nippon Koei Co., Ltd.

ITINERARY OF SURVEY TEAM (1/4)

No.	Date	Mr. Wada	Mr. Matsunaga	Mr.Mase	Mr.Suzumura	Mr.Kodama Mr.Shimazaki	Mr.Tomida	Mr.Yoshikawa Mr.Mukai Mr.Ishikawa Mr.Ichimaru
1	Jan.10 (Sun)	Trip from Tokyo to Bangkok						
2	11 (Mon)	Trip from Bangkok to Kathmandu						
3	12 (Tue)	Courtesy call to JICA office, Min. of Agri. & Finance, Explanation of Inception report						
4	13 (Wed)	Courtesy call to Embassy of Japan, Trip to Janakpur						
5	14 (Thu)	Explanation of Inception report to TIATSP, Inspection of D-7 block						
6	15 (Fri)	Inspection of M-4 and S-7 blocks						
7	16 (Sat)	Trip to Kathmandu				Inspect. S-1		
8	17 (Sun)	Report to JICA office and Embassy of Japan				Topo survey		
9	18 (Mon)	Kathmandu to Bangkok		JICA office	Trip	- do. -		
10	19 (Tue)	Bangkok to Tokyo		Trip	Custom clearance	- do. -		
11	20 (Wed)			Study	Trip	- do. -	Tokyo to Bangkok	
12	21 (Thu)			Weekly meeting			Bangkok to Kathmandu	
13	22 (Fri)			Prepara-tory works	Field survey		Kathmandu to Janakpur	
14	23 (Sat)			Insp. of pump	- do. -	- do. -	Field survey	Preparatory works
15	24 (Sun)			- do. -	- do. -	- do. -	- do. -	- do. -
16	25 (Mon)			- do. -	- do. -	- do. -	- do. -	- do. -
17	26 (Tue)			- do. -	- do. -	- do. -	- do. -	- do. -
18	27 (Wed)			- do. -	- do. -	- do. -	- do. -	- do. -
19	28 (Thu)			Weekly meeting				- do. -

ITINERARY OF SURVEY TEAM (2/4)

No.	Date	Mr.Masa	Mr.Suzumura	Mr.Kodama Mr.Shimazaki	Mr.Tomida	Mr.Yoshikawa Mr.Mukai Mr.Ishikawa Mr.Ichimaru
20	29 (Fri)	Field. insp.	Field survey	Topo. survey	Field survey	Preparatory works
21	30 (Sat)	- do. -	- do. -	- do. -	- do. -	- do. -
22	31 (Sun)	- do. -	- do. -	- do. -	- do. -	- do. -
23	Feb.1 (Mon)	- do. -	- do. -	- do. -	- do. -	- do. -
24	2 (Tue)	- do. -	- do. -	- do. -	- do. -	Drilling in D-7
25	3 (Wed)	- do. -	- do. -	- do. -	- do. -	- do. -
26	4 (Thu)	Meeting with TIATSP	- do. -	- do. -	Analysis of the results	- do. -
27	5 (Fri)		- do. -	- do. -	- do. -	Drilling in M-4
28	6 (Sat)	Drilling in D-7	- do. -	- do. -	- do. -	- do. -
29	7 (Sun)	Weekly meeting			- do. -	- do. -
30	8 (Mon)	Pumping test in D-15		- do. -	- do. -	- do. -
31	9 (Tue)	Irrig. plan	Jank. to to KIM	- do. -	Install. water level recorder	- do. -
32	10 (Wed)	- do. -	Data collect.	- do. -	- do. -	Drilling in S-7
33	11 (Thu)	Drilling in M-4	- do. -	- do. -	Field test	- do. -
34	12 (Fri)	Inventory	- do. -	- do. -	- do. -	Casing D-7
35	13 (Sat)	Irrig. plan	- do. -	- do. -	Field inspec.	Cleaning D-7
36	14 (Sun)	Drilling in M-4	- do. -	- do. -	Field test	Redrilling M-4
37	15 (Mon)	Weekly meeting	- do. -	Weekly meeting		- do. -
38	16 (Tue)	Field inspect.	KIM to Jank.	Field inspect.	Field test	- do. -

ITINERARY OF SURVEY TEAM (3/4)

No.	Date	Mr.Mase	Mr.Suzumura	Mr.Kodama Mr.Shimazaki	Mr.Tomida	Mr.Yoshikawa Mr.Mukai Mr.Ishikawa Mr.Ichimaru
39	17 (Wed)	Field inspect.	Field survey	Field inspect.	Field test	Redrilling M-4
40	18 (Thu)	Irrig. plan	- do. -	Irrig. plan	- do. -	- do. -
41	19 (Fri)	Drilling M-4	- do. -	- do. -	- do. -	- do. -
42	20 (Sat)	Prep. materials	- do. -	Jank. to KIM	- do. -	- do. -
43	21 (Sun)	Discuss S-7	- do. -	Data collect.	- do. -	Cleaning S-7
44	22 (Mon)	Prep. interim report	Elect. sound.	KIM to BKG	- do. -	Elect. sound.
45	23 (Tue)	- do. -	Field survey	BKG to TYO	Prep. interim report	Redrilling S-7
46	24 (Wed)	Weekly meeting			Field test	- do. -
47	25 (Thu)	Field inspect.	Elect. sound.		- do. -	Elect. sound.
48	26 (Fri)	Jank. to KIM	Field survey		- do. -	Abandan S-7
49	27 (Sat)	Prep. interim report	- do. -		- do. -	Drilling M-4
50	28 (Sun)	- do. -	- do. -		Analysis	Pump test D-7
51	29 (Mon)	JICA Embassy Japan	Elect. sound.		- do. -	- do. -
52	Mar.1 (Tue)	Data collect.	Field survey		Jank. to KIM	- do. -
53	2 (Wed)	- do. -	- do. -		Data collect.	- do. -
54	3 (Thu)	- do. -	- do. -		KIM to BKG	Casing M-4
55	4 (Fri)	Discuss. JICA, Min. of Agri, etc.	- do. -		BKG to TYO	Cleaning M-4
56	5 (Sat)	KIM to Birg.	- do. -			- do. -

ITINERARY OF SURVEY TEAM (4/4)

No.	Date	Mr.Nakanishi Mr. Wada	Mr. Suzuki	Mr.Mase	Mr.Suzumura	Mr.Yoshikawa Mr.Mukai Mr.Ishikawa Mr.Ichimaru
57	6 (Sun)			Birg. to Jank.	Field survey	Cleaning M-4
58	7 (Mon)			Weekly meeting	- do. -	- do. -
59	8 (Tue)			Data collect.	- do. -	- do. -
60	9 (Wed)			- do. -	- do. -	- do. -
61	10 (Thu)			Pump test M-4	- do. -	Pump test M-4
62	11 (Fri)	Trip from Tokyo to Bangkok		Inventory survey	- do. -	- do. -
63	12 (Sat)	Trip from Bangkok to Kathmandu		Field inspect.	- do. -	- do. -
64	13 (Sun)	Courtesy call to Min. Agri., Discussion		- do. -	- do. -	- do. -
65	14 (Mon)	JICA office		- do. -	- do. -	- do. -
66	15 (Tue)	Trip from Kathmandu to Janakpur		Joint with team leader		Jank. to KTM
67	16 (Wed)	Field inspection of D-15, S-4 and S-9 blocks				Embassy of Japan
68	17 (Thu)	Field inspection		Hand over equip. to TIATSP		KTM to BKG
69	18 (Fri)	Trip to Birganji				BKG to TYO
70	19 (Sat)	Trip to Kathmandu				
71	20 (Sun)	Discussion with Ministry of Agriculture				
72	21 (Mon)	Discussion with TIATSP				
73	22 (Tue)	Discussion with Ministry of Agriculture				
74	23 (Wed)	Report to embassy of Japan, Trip from KTM to Bangkok				
75	24 (Thu)	Trip to Tokyo				

DRAFT APPENDIX-3

MINUTES OF DISCUSSION
ON
THE BASIC DESIGN STUDY PHASE II
FOR
THE TERAI GROUNDWATER DEVELOPMENT PROJECT
IN
THE KINGDOM OF NEPAL

In response to the request of His Majesty's Government of Nepal, the Government of Japan decided to conduct the basic design study Phase II on the Terai Groundwater Development Project (hereinafter referred to as "the Project") in succession to the basic design study Phase I and entrusted the basic design study Phase II to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to Nepal the Study Team headed by Mr. Yoshiki MIYANISHI, an official of Grant Aid Division, Bureau of Economic Cooperation, Ministry of Foreign Affairs, from January 10, 1988 to March 22, 1988.

The Team had a series of discussion on the Project with the officials concerned of His Majesty's Government of Nepal headed by Mr. B. B. Shah, Project Manager of the Tubewell Irrigation Agriculture Training & Services Project (hereinafter referred to as "TIATSP"), Ministry of Agriculture, and conducted a field survey including the drilling of three (3) nos. of test deep tubewell, one each of 3 development blocks D-7, M-4 and S-7, topographic survey of two (2) development blocks S-1 and D-15, etc.

As a result of the survey and discussion, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Kathmandu, March , 1988

ATTACHMENT

1. The objectives of the Project are: 1) to extend irrigable area; 2) to stabilize and increase agricultural production; 3) to increase farmers' income; and 4) to improve farmers' living standard and social welfare by the construction of deep tubewells and their respective irrigation facilities in the groundwater potential areas in the Terai plain of Janakpur Zone, which mostly utilize the deep tubewell and civil construction equipment and materials already granted to His Majesty's Government of Nepal under a KR-2 grant aid program of the Japanese Government in 1982 and 1983.

2. The project area extends over the Terai plain in Sarlahi, Mahottari and Dhanusha districts in Janakpur Zone. A commercial center of the project area is Janakpur city, district capital of Dhanusha, located about 150 km (straight distance on map) south-east or about 390 km by National Highway from Kathmandu, the capital of the Kingdom of Nepal. The TIATSP office is located about 19 km north from Janakpur as shown in Annex-1.

3. The major components of the Project will be:

   1) to develop deep aquifer of the project area for irrigation purpose, by employing the blockwise development method proposed by His Majesty's Government of Nepal;

   2) to construct deep tubewells and the respective irrigation facilities such as pump houses, operator house, irrigation canals and their related structures;

   3) to procure essential spare parts for the KR-2 equipment and materials required for construction of deep tubewells and their irrigation facilities;

4) to improve rural roads required for transport of farm inputs and outputs and for operation and maintenance of the completed deep tubewells and irrigation facilities;

5) to establish a proper operation and maintenance system of the completed tubewells and irrigation facilities and water users' groups to distribute pumped water equitably to their farm plots.

6) to provide Nepali engineers and technicians with engineering knowledge and technical skill on planning, design, construction, water management, and operation and maintenance of deep tubewells, pumps and irrigation facilities.

4. The Ministry of Agriculture of His Majesty's Government of Nepal is responsible for the overall administration and execution of the Project that is managed and operated by TIATSP.

5. The Study Team will convey to the Government of Japan the request of His Majesty's Government of Nepal listed in Annex-II, and the request of His Majesty's Government of Nepal should be examined by the Government of Japan.

6. The Government of Japan takes necessary measures to cooperate with His Majesty's Government of Nepal.

7. His Majesty's Government of Nepal has understood Japan's Grant Aid System explained by the study team, which includes a principle of use of a Japanese consulting firm, Japanese Tubewell Contractor and Japanese Civil Contractor for construction.

8. His Majesty's Government of Nepal will take necessary measures listed in Annex-III on condition that the Grant Aid would be extended to the Project.

9. In the first implementation year, five (5) production tubewells, including one (1) to be graded up from test tubewell, and the respective irrigation facilities will be constructed in D-7 development block.

10. For the second implementation year, the survey should be newly made in the planned blockwise sites agreed by both the sides. The new survey shall consist of, according to the necessity, constructing the test tubewell, confirming the discharge of the test tubewell, making topographic survey, and others in each planned blockwise site.

11. The basic design of the irrigation facilities for each block shall be made only after the confirmation of ground water potential in that particular block. In other words after confirming the discharge of the test well then only the canal and other irrigation facilities design should be approved.

12. During the Project period, one observation well will be constructed in each development block to facilitate operation and maintenance of the completed tubewells and to avoid miss operation of the pumps and engines.

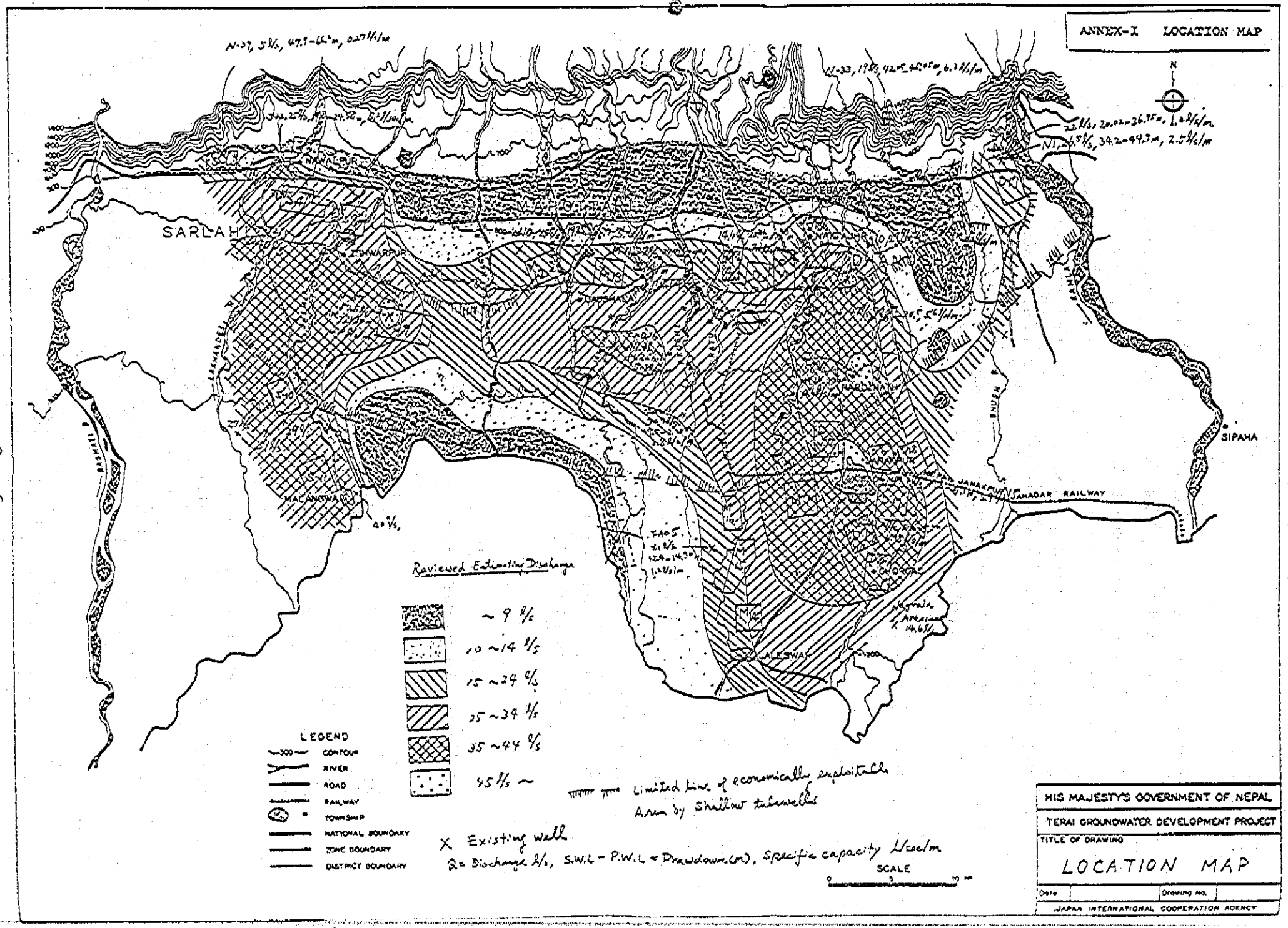
13. During the Project period, the existing equipment, which was provided under the KR-2 grant aid, shall be exclusively utilized for the Project.

14. The Japanese consultant firm, tubewell contractors and civil contractors must have experienced hydrogeologist, engineers for drilling and civil works in all the phases of the project period.

15. Both TIATSP and tubewell contractors will cooperate one another to supervise the drilling, electric logging, installation, and pumping test.

16. Both the sides, TIATSP and the Basic Design Study teams (Phase I & II) feel that the surface investigation, e.g., electric sounding, is sometimes not reliable for the positive indication. The most reliable and suitable test for confirming ground water is the test boring in each block prior to the drilling of production wells.

17. The matters which have not been agreed in the series of discussion between both sides are shown in Annex-IV.


ANNEX-I LOCATION MAP
N
SARLAHI
MALANGWA
LAHAN
DHANUSHA
MAHOTTARI
SIRAHA
SIPAHA
JANAKPUR
JANAKPUR RAILWAY
JALESWAR
Reviewed Estimated Discharge
~ 9 l/s
10 ~ 14 l/s
15 ~ 24 l/s
25 ~ 34 l/s
35 ~ 44 l/s
45 l/s ~
LEGEND
CONTOUR
RIVER
ROAD
RAILWAY
TOWNSHIP
NATIONAL BOUNDARY
ZONE BOUNDARY
DISTRICT BOUNDARY
Limited line of economically exploitable Area by Shallow tubewells
X Existing well
Q= Discharge l/s, S.W.L - P.W.L = Drawdown (m), Specific capacity l/sec/m
SCALE
HIS MAJESTY'S GOVERNMENT OF NEPAL
TERAI GROUNDWATER DEVELOPMENT PROJECT
TITLE OF DRAWING
LOCATION MAP
Date
Drawing No.
JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX-II THE REQUEST OF
HIS MAJESTY'S GOVERNMENT OF NEPAL
FOR GRANT AID OF JAPAN

1. Under the Japanese Grant Aid, about one hundred and fifteen (115) numbers of production deep tubewell and their respective irrigation facilities and twenty three (23) observation tubewells will be constructed in (23) twenty three development blocks as shown in Annex-I.

2. The test tubewells shall be drilled one number in each 23 development blocks prior to the construction of production tubewells. The test tubewell which has a good discharge more than 25 l/sec is defined as a production tubewell otherwise it cannot be classified as the production tubewell. Any tubewell has less than 25 l/sec as decided from the test result then there will be no further drilling in that block, and another block will be selected.

3. Main Works requested by His Majesty's Government of Nepal for the first implementation year are as follows:

1) Construction of Production Tubewells:

a) Drilling, electric logging, installation of pump housing, casting and screen pipes, gravel packing, development and pumping tests of deep tubewells.

b) Installation of vertical turbine pumps and diesel engines.

c) Construction of pump houses with buffle water tank and pump operator's hut.

d) Supplement of spareparts and expendables of the deep tubewell construction equipment and the vehicles to be used for transport of tubewell materials and for construction and its management.

e) Supplement for shortage of necessary deep tubewell construction materials.

f) Purchase of transport equipment such as truck crane, water and fuel tank lorries, jeep type vehicles and motor cycles.

2) Construction of Irrigation Facilities:

a) Construction of main irrigation canals and the related structures such as bifurcation, turnout, drop, syphone, culvert, cattle crossing, cross drain, etc.

b) Supplement for spareparts and expendables of the construction equipment and the vehicles to be used for transport of construction materials and for construction and its management.

3) Construction of Observation Wells:

a) Drilling, electric logging, installation of casing and screen pipes, gravel packing, and development.

b) Installation of long term groundwater monitor for each observation well.

4. The Japanese consulting firm, tubewell contractors and civil contractors shall use TIATSP drivers and operators of rig machines, vehicles, and other equipment engaged in drilling, driving and operating for construction, etc. and pay them on the basis of D.S.A. (Daily Service Allowance) and overtime.

5. The proposed blockwise sites for the survey for the second implementation year are as follows:

S-1, S-2, S-10, M-4, M-12, M-13, D-13, D-14
D-19 (9 blockwise sites)

ANNEX-III ARRANGEMENTS TO BE UNDERTAKEN BY HIS MAJESTY'S GOVERNMENT OF NEPAL

1. To strengthen TIATSP with an increase of capable staffs particularly for construction, drilling, irrigation division and workshop division and to establish an operation and maintenance division.

2. To acquire the land required for construction of pump house, pump operator house, main canals and other structures.

3. To ensure the land or the right of way for construction of the temporary access roads from the existing rural roads to the proposed tubewell sites.

4. To assure a right of way for the vehicles, machine, construction equipment on the national highway and rural roads.

5. To exempt import duties and incidental expenses and to take necessary measures for custom clearance of the materials, equipment and spareparts brought for implementation of the project.

6. To exempt custom duties for personal goods of Japanese nationals who will be engaged in the Project. The personal goods will be specified in details before the Japanese personnel leave Japan.

7. To provide Japanese consulting firm, tubewell contractor and civil contractor, with the deep tubewell and civil construction equipment, transport equipment, vehicles, spareparts and other materials supplied under the KR-2 grant aid program in 1982 and 1983, as requested by them.

8. To construct farm channels branching off from the main canals, just after the main canals are completed under the grant aid.

9. The Government of Nepal will take care of operating and maintaining of the equipment and facilities provided under the grant aid.

10. To establish water users' group after completion of deep tubewells and to collect water charge necessary for operation and maintenance of the completed facilities, from the beneficiaries.

ANNEX-IV THE MATTERS TO BE SETTLED

1. The charge for the existing equipment granted under the KR-2

   Japanese side requested that any charge should not be imposed to the Japanese consulting firm, tubewell contractors and civil contractors.

2. Dry and uneconomical tubewell

   Japanese side requested that the issue on the dry and uneconomical tubewells shall be settled through the continuous discussion by both the Governments.

3. The selection of the blockwise sites for the survey for the second implementation year

   Japanese side replied that the location and number of blockwise sites for this survey shall be agreed by both the sides based on the technical data to be prepared by the team.

OFFICIALS CONTACTED AND COUNTERPART PERSONNEL

1. Officials Contacted

(1) Ministry of Finance

Mr. P. P. Dahal	:	Joint Secretary

(2) Ministry of Agriculture

Mr. A. N. Rana	:	Secretary
Mr. R. B. Singh	:	Joint Secretary
Mr. S. N. Regmi	:	Director General, Department of Agriculture
Mr. Yukio Ohata	:	Japanese Expert to Ministry of Agriculture, HMG/Nepal

(3) Embassy of Japan

Mr. Kazuaki Arichi	:	Ambassador Extraordinary and Plenipotentiary
Mr. Houjun Kikuchi	:	Counsellor
Mr. Takao Nishina	:	First Secretary
Mr. Takashi Muromoto	:	Second Secretary

(4) JICA Nepal Office

Mr. Hideo Ono	:	Resident Representative

2. Counterpart Personnel

Mr. B. B. Shah	:	Project Chief, TIATSP
Mr. S. P. Rajbandari	:	Deputy Chief/Agri. Engineer, TIATSP
Mr. M. Lamichhane	:	Hydrogeologist, TIATSP
Mr. R. P. Singh	:	Irrigation Engineer, TIATSP
Mr. K. C. Jha	:	Agro-economist, TIATSP
Mr. P. Mukhiya	:	Senior Drilling Technician, TIATSP
Mr. S. Sah	:	Surveyor, TIATSP

APPENDIX 5. GROUNDWATER STUDY

5.1 Groundwater Level Fluctuation

No long-term water level measurement of shallow well has been carried out during this study because of its short period, but water level fluctuation of 10 exiting shallow wells was measured by FAO in 1969 ~ 1970, as shown in Fig. 1. The data show that the lowest water level is observed during the period from the end of May to early in June, and water level rapidly rises in the rainy season and reaches the highest level during the period from the end of September to the beginning of October. It is judged that the groundwater level in the study area seasonally varies within 1 ~ 2 m in range.

On the other hand, annual water level fluctuation of deep well has not been observed except for the measuring record by FAO in 1970 ~ 1971, as shown in Fig. 2, at Birganj area, where its topographic and geological conditions are similar to those of the study area. The water level fluctuation patterns of deep wells correspond with those of the shallow wells and the range of fluctuation is within 2 ~ 3 m.

It is estimated from above-mentioned data that the lowest water level, from the end of May to early in June, of both the shallow and deep wells will be about 0.5 m under the groundwater level observed in the Phase-II study, and the lowest water level in the development stage is estimated to be 1 m lower than the observed water level, taking into account a drawdown of the groundwater level in the drought year.

5.2 Pumping Test

5.2.1 Test Well at M-4 Site

a. Step-drawdown test

Screens have been installed on the three sections of the deep test well from 91.35 m to 159.47 m in depth, as shown in Fig. 3. One step of the test was continued for one hour. Difference between initial water level and recovery water level is identified due to incomplete well development. The recovery water level, after step-drawdown test, is considered to indicate actual static water level. Therefore, the drawdown of the step-drawdown test at the discharge rate of 25.1 l/sec is corrected, as shown in Table 1, by the result of yield logging performed at the pumping test.

According to the relationship between discharge rate and drawdown shown in Fig. 4, a pumping discharge of 20 l/sec is considered not to be adequate for that of the production well because the drawdown tends to increase rapidly when the discharge rate exceeds 20 l/sec.

Table 1. Step-drawdown Test Data

Q (l/sec)	S.W.L. (m)	P.W.L. (m)	s(m)	s/Q
0	-35.98		0	
5.2		-36.39	0.41	0.079
8.4		-36.73	0.75	0.089
11.9		-37.06	1.08	0.091
14.6		-37.32	1.34	0.092
20.4		-38.92	2.94	0.144
25.1		(-40.00)*	4.02	0.160

* : ( ) corrected value
Q : discharge rate,
S.W.L. : static water level,
P.W.L. : pumping water level,
s : drawdown

b. Continuous pumping test and recovery test

Continuous pumping test for 72 hours was performed at the discharge rate of 14.6 l/sec decided based on the step-drawdown test result, and the water level recovery was observed for 12 hours after the pumping was stopped. The water level was 35.86 m below the ground surface before pumping test, 37.98 m after 72 hours, and 35.90 m after 12 hours from stop of pumping. Consequently, the drawdown of the pumping test was 2.12 m in depth and the specific capacity is calculated at 6.9 l/sec. Transmissivity, calculated by using the results of continuous pumping test, is as follows:

Adaptation of steady radial flow equation

$$T = (2.3Q/2\pi s) \log (R/r)$$

where, T : transmissivity
Q : constant pumping rate
s : drawdown
R : radius of influence
r : radius of tubewell

If the radius of influence is practically assumed to be 300 m.

$$T = \frac{2.3 \times 0.0146 \times 86400}{2 \times 3.14 \times 2.12} \log (300/0.1) = 757 \text{ m/day}$$

c. Yield logging

Yield logging of three steps was performed in order to examine yield section and yield amount of the test well. The results are shown in Fig. 5 and summarized as follows:

Table-2. Yield Logging Data of M-4 Test Well

Aquifer	Screen section (m)	Yield section (m)	Yield amount (l/sec)		
(1)	91.35 ~ 118.85	93 ~ 98	4.4	5.1	5.4
(2)	136.94 ~ 142.44	139 ~ 143	0.2	0.7	2.4
(3)	148.47 ~ 159.47	150 ~ 159	2.6	8.8	17.3
	Total		7.2	14.6	25.1

It is judged from the data that the good aquifer exists below 150 m from the ground surface.

d. Well loss

Well loss is calculated by Jacob's equation as shown below.

$$S' = BQ + CQ^2$$

where, S' : drawdown in pumping
B and C : constant
Q : discharge rate
BQ : aquifer loss
CQ^2 : well loss

B and C are estimated by the relation curve obtained from the step-drawdown test, as shown in Fig. 6, and the results are as follows:

$B = 0.05,$
$C = (0.16 - 0.05)/25.1 = 0.0044,$ that is,
$S' = 0.05Q + 0.0044Q^2$

5.2.2 Test Well at D-7 Site

a. Step-drawdown test

About 20 l/sec of self flowing from the test well was observed, but its piezometric head was not measured.

Screens have been installed on five sections between 83.17 m and 193.97 m, as shown in Fig. 7. Pumping time was 2 hours for each step and drawdown in response to the pumping is shown in Table 3.

Table 3. Step-drawdown Test Data

Q (l/sec)	S.W.L. (m)	P.W.L. (m)	s(m)	s/Q
0.0	(+6.00)*		0	
20.0		0	6.00	0.30
25.1		-1.46	7.46	0.29
30.2		-3.57	9.57	0.32
35.6		-4.58	10.58	0.30
41.2		-6.90	12.90	0.31
45.1		-8.02	14.02	0.31

* : ( ) estimated value
Q : discharge rate
S.W.L. : static water level
P.W.L. : pumping water level
s : drawdown

Initial water level before commencement of the test is estimated at 6 m in depth by the lineal relationship between discharge rate and drawdown, as shown in Fig. 8. Increase of well loss by rise of pumping rate was not observed in the test.

b. Continuous pumping test

The pumping test was carried out at a discharge rate of 41.2 l/sec for 72 hours, but the recovery water level was not able to be measured because of self flowing immediately after stopping pump.

Water level was down to 6.42 m under the ground surface in depth just after the beginning of the pumping test and then the water level gradually rose up to 5.66 m with opening of well clogging. Therefore, the real drawdown in response to the discharge rate of 21.2 l/sec (41.2 ~ 20) is judged to be 5.66 m, and the specific capacity is calculated to be 3.7 l/sec.m.

While, transmissivity calculated by using the pumping test data is as follows:

Adaptation of steady flow equation

$$T = (2.3/2\pi s)\log(R/r)$$

$$= \frac{2.3 \times 0.0212 \times 86400}{2 \times 3.14 \times 5.66} \log (300/0.1) = 412 \text{ m/day}$$

where, T, Q, s, R and r are same to those in case of M-4 test well.

In this case, unsteady flow equation can not be applied because the drawdown does not respond to the lapse of time under a constant pumping discharge.

c. Yield logging

The yield logging was performed in order to examine yield section and yield amount of test well. The results are shown in Fig. 9 and summarized as follows.