

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (1 / 7)

Name of Block (Danusha D)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
D-1	I	Naktajhij, Puswarpur	4,206	460	Paddy, Wheat, Vegetables, Tobacco, Mustard, Maize	Good	The block lays along E/W Highway and the access from the highway is about 1km.	Less than 100/sec	The block lays in the east and west directions and is divided by the Aurhi and the Jaladh rivers flowing north to south.	C
D-2	I	Naktajhij, Hariharpur, Digambarpur	5,203	578	Sugarcane, Wheat, Vegetables, Paddy, Maize	Good	The block is located south of Block D-1, and the access from the E/W Highway is about 2km in the maximum.	Less than 100/sec	The block is divided by the Aurhi and the Jaladh rivers as same as Block D-1.	C
D-3	I	Tejnagar, Makhamba, Darushgovindapur	5,080	2,490	Paddy, wheat, Vegetables, Oilseed.	Good	It is possible to access from the maintenance roads along the Kamala Western Main Canal. The block is located about 6km far from the E/W Highway.	Less than 300/sec	The most part of the block is located in the STWP area.	C
D-4	II	Mithaleswar, Nikosh, Kasera, Ramaul	4,708	523	Paddy, wheat, Vegetables, Oilseed.	Good	The block is located about 16km south of the E/W Highway and the access road constructed under KR-2 grant aid can be used for the access to the block.	100/sec~350/sec	The half of the block is located in the STWP area.	C
D-5	III	Kachnri Thera,	6,962	773	Paddy, Wheat, Vegetables, Oilseed.	Good	The block is located south of D-4 Block. The access road constructed under KR-2 grant aid can be used for the access to the block. The access from Janakpur is not in good condition.	400/sec		C

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (2/7)

Name of Block (Danusha D.)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
D-6	II	Karakpatti, Paudeswar, Mahuwa, Kapaleswar	8,912	990	Paddy, Wheat, Vegetables	Good	The block is located east of Janakpur and the access to the block is good.	500/sec	It is possible to transport heavy equipment on the road between Janakpur and Belauni after some improvement of road surface.	A
D-7	I	Basahiya, Binhi, Kua Rampur	9,772	1,089	Paddy, Wheat, Vegetables	Good	The block is located about 4km south of Janakpur adjacent to the airport, and the paved approach road to the airport can be used for the access.	500/sec	The farmers' willingness for the project is good and the access to the block is also good.	A
D-8	III	Gholgas, Deopra	7,798	865	Paddy, Wheat, Vegetables	Good	The block is located south of D-7 Block and the access is good. There is no bridge at the crossing of the Jaladh river.	500/sec	The block is divided by the Jaladh river diagonally crossing the block.	A
D-9	III	Fulgama, Lagmagadaguchi Nagarain	13,994	1,550	Paddy, Wheat, Vegetables	Good	It is necessary to cross the Jaladh river for approaching the block, and heavy equipment traffic is impossible due to narrow farm roads in the block.	250/sec~440/sec	The drainage is not so good during the rainy season.	C
D-10	I	Dubarkot, Baiba, Sagahra, Sirgyahimaran, Bisarbhora	16,852	1,870	Paddy, Wheat, Vegetables	Good	The access condition is not good though there are 2 ways; one from Siraha of the Sagarmatha zone crossing the Kamala river and the other from the Kamala Western Main Canal.	400/sec	Although the access is not so good, it is judged to be necessary to develop this block because the block was excluded from the Kamala Irrigation Project area.	B

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (3/7)

Name of Block (Darusha D.)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
D-11	I	Bateswar, Laximitbas, Bhuchakrpur	19,510	2,160	Sugarcane, Wheat, Tobacco, Paddy, Vegetables	Good	The block is located southeast of Dhalkebar, and there are 2 accesses; one from the E/W Highway and the other from the highway between Jeleswar and Dhalkebar. The access from the E/W Highway is better.	10ℓ/sec~24ℓ/sec	The block is divided by the small rivers flowing north to south.	C
D-12	I	Laximitbas	9,035	1,002	Sugarcane, Wheat, Tobacco, Vegetables	Good	The block is located north of D-11 Block, and the access from the E/W Highway seems to be good.	10ℓ/sec~24ℓ/sec	The block is divided by the small rivers flowing north to south as same as D-11 Block.	C

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMQN (4/7)

Name of Block (Mahottari D.)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
M-1	III	Hatilet, Bigarpwa, Bargadawar (Danusha)	8,000	888	Paddy, Oilseed, Sugarcane, Mungbean, Tobacco, Vegetables, Maize	Good	The access to the block is good, and the block is located 5km south of the E/W Highway.	10ℓ/sec~34ℓ/sec	The block lays east to south slenderly and is divided by the small rivers flowing in the block.	C
M-2	I	Laximiniya, Bharatpur	6,190	683	Paddy, Sugarcane, Maize, Tobacco, Oilseed	Good	The block is located adjacent to the forest area as extending northern part of the Terai plain, and the forest roads can be used for the access.	30ℓ/sec	The block is topographically flat gently sloped southward.	C
M-3	I	Bampagar	8,978	995	Paddy, Tobacco, Maize, Oilseed, Mustard.	Good	The road between the E/W Highway and Goshala can be used for the access to the block.	25ℓ/sec~44ℓ/sec	The block is divided by the Jargha river flowing across the block, and the confluence of this river is also in the block.	C
M-4	I	Bigalpura, Hatilet, Parkauli, Banarghula	6,900	766	Paddy, wheat, Mungbean, Vegetables, Tobacco, Sugarcane	Good	The blocks is accessible through the village road extending south from the E/W Highway (about 6km).	25ℓ/sec~44ℓ/sec	The blocks is divided by the tributaries of the Ratu river, etc.	A
M-5	II	Samnauli, Harinmari, Itaharwa	6,161	650	Paddy, Wheat, Vegetables	Good	Although the road between Jaleswar and Goshala can be used for the access to the block, it is necessary to cross the Ratu river flowing 3km north of Jaleswar.	25ℓ/sec~44ℓ/sec	The block is located about 18km north of Jaleswar. The access to the block is not so good.	C
M-6	II	Padaul, Balwa, Badiyabanchauri	6,470	718	Paddy, Wheat, Vegetables	Good	There exist 2 accesses from Janakpur and Jaleswar, but the both accesses are not so good due to the crossing of the Ratu river.	35ℓ/sec~54ℓ/sec	The block is located about 1.3km north of Jaleswar and about 15km west of Janakpur.	C

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (5/7)

Name of Block (Mahottari D.)	Priority	Fanchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
M-7	II	Ratauli, Khuttiparadi, Basbiti	9,150	1,010	Paddy, Wheat, Vegetables	Good	The road extending westward from Janakpur can be used for the access to the block. Culverts and bridges are installed and their condition is also good.	50¢/sec	The block is judged to be the most suitable in the blocks located in southern part of the Mahottari district in view of the access.	A
M-8	II	Sanda, Gonarpura, Dhamhi Madari, Badiya Banchauli	8,036	880	Paddy, Wheat, Vegetables	Good	The village road extending northward from Jaleswar can be used for the access to the block.	25¢/sec~44¢/sec	The block is divided by the Ratu and the Akwiji rivers.	C
M-9	III	Ratauli, Ehamarpura	7,700	855	Paddy, Wheat, Vegetables	Good	It seems to be better to access the block from Janakpur due to crossing of the Katumsari river, though the access from Pipra is the shortest.	50¢/sec	The block is located about 4km north of the Janakpur-Jaleswar Highway.	C
M-10	III	Bathanaha, Bathatauliya, Kikuswa, Bagiya	11,200	1,240	Paddy, Wheat, Vegetables	Good	The access from Jaleswar is possible, but it is necessary to cross the Ratu river.	10¢/sec~34¢/sec	The block is located about 7km north of Jaleswar.	C
M-11	III	Dhirapur, Pigaura, Ekriya, Maghaura	21,600	2,405	Paddy, Wheat, Vegetables	Good	The village road extending southward from the Jaleswar-Janakpur Highway.	25¢/sec~44¢/sec	The block is located about 3km south of the Janakpur-Jaleswar Highway and the drainage in the block is not so good.	C

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (6/7)

Name of Block (Salrahi D.)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
S-1	I	Karmaiya, Dhungra Khola, Hariwan	17,227	1,914	Sugarcane, Wheat, Tobacco, Mustard, Vegetables	Good	Since the block is located near the E/W Highway, the access from the highway is good.	40¢/sec	The northern part of the block is hilly area and may have different geological condition, it is better to select the irrigation areas in southern part.	A
S-2	II	Sasapur, Patharkot	3,798	442	Paddy, Wheat, Vegetables, Sugarcane	Good	The access from the E/W Highway is good as same as S-1 Block.	25¢/sec~44¢/sec	The access is good, but there is a little farm land in the block.	B
S-3	II	Lalbandi, Ranigangi, Parwanipur	5,736	636	Paddy, Wheat, Vegetables, Mustard	Good	The access from the E/W Highway is good as same as S-1 and S-2 Blocks.	10¢/sec~24¢/sec	The access to the block is good, but most of the block is covered by forest.	C
S-4	I	Netraganj	4,286	476	Wheat, Mustard, Maize, Vegetables	Good	The access from the Nawalpur - Malanguwa road is good.	40¢/sec	The block consists of mainly the northern part of horticultural center and the southern part of migration area recently developed.	A
S-5	I	Raniganj	3,440	382	Wheat, Tobacco, Sugarcane, Vegetables, Mustard	Good	The access to the block is good, since the block is located near the E/W Highway.	10¢/sec~34¢/sec	The block is divided by the Kalina and the Phalpa rivers.	C
S-6	I	Kabilasi, Salimpur, Gamariya, Bishnupur, Belhi	8,957	995	Paddy, Wheat, Maize	Good	The block is accessible from Malanguwa, but some river crossing with the Jhim and the other small rivers is necessary on the way to the block.	40¢/sec		C

Table 4.1 Results of Inventory Survey on Development Blocks Requested by HMGN (7 / 7)

Name of Block (Salrahi D.)	Priority	Panchayat in Block	Population	Number of Houses	Major Crop	Willingness	Access	Expected Potential	Remarks	Category
S-7	I	Belhi, Triruwannagar, Mohampur, Brahmanpuri, Chandranagar	9,987	1,109	Paddy, Wheat Oilseed, Vegetables	Good	The block is accessible from Malanguwa with the river crossing with the Jhim river.	500/sec	The block is located about 6km north of Malanguwa.	A

Note: - Category A indicates the blocks that seem to have good potential for development in view of groundwater potential, access and farmers' willingness for development, and that seem to have less objection against development.

- Category B indicates the blocks that seem to have difficulty for development, though much necessity of development is recognized, in view of condition of access, etc.

- Category C indicates the blocks of which locations are proposed to be changed due to less groundwaters potential and poor access conditions, etc.

Table 4.2 Summary of 1st Priority 8 Development Blocks

Development Block and Irrigation Area *	Design Discharge (l/sec)	Irrigable Area (ha)	Access Roads (km)	Topography			Crops		Forest, Orchard	Ponds	Remarks
				Flat	Sloped	Undulating	Paddy	Upland			
D-8 (Ghorgas)											
① No. 3+1 (80)	50	50	6.3	○			○		○	○	Villages along road, many forest and orchards, 5 small ponds. Villages along road, forest and orchard, 3 small ponds. Flat paddy field, no pond, village road running across the area, enough area for irrigation. Sloped toward the eastern boundary (river)
② No. 1+2 (90)	50	50	6.3	○			○		○	○	
③ No. 5 (130)	50	50	7.0	○			○				
④ No. 5 (130)	50	50	7.0	○			○				
⑤ No. 4A+B (80)	50	50	7.3	○			○				
D-6 (Benga Shibapur)											
① No. 3A+B (180)	50	50	1.0	○			○			○	Flat land sloped southward, no obstacles such as forest and pond, farm road running north to south. Rectangular slender land, brick factory at south-western end. Slender land laying southward, flat land sloped southward. Flat land, no obstruction such as forest, pond and village.
② No. 3A+B (180)	50	50	1.0	○			○				
③ No. 6B+7B (110)	50	50	0.5			○	○				
④ No. 7A (90)	50	50	0.5	○			○			○	
⑤ No. 1B (120)	50	50	1.5	○			○				
M-7 (Rautauligohi)											
① No. 4+6 (170)	50	50	3.2	○			○				Road along southern side of No.4, small forest scattered, road across No.6 brick factory. Slender land laying east to west, many forests. Slender land laying east to west, some villages, 3 ponds. Many small forests, village road along western and eastern sides.
② No. 4+6 (170)	50	50	3.2	○			○				
③ No. 1 (90)	50	50	3.2	○			○		○		
④ No. 2A+B (140)	50	50	4.1	○			○		○	○	
⑤ No. 7 (110)	50	50	3.9	○			○		○		
S-1 (Hariwan)											
① No. 3D+C (110)	40	40	0			○				○	Located along E/W Highway, sloped toward the Chapini river. Flat land, sugar factory, many sugarcane and wheat. Divided by E/W Highway, villages along roads. E/W Highway along northern side, sloped near river. E/W Highway along northern side, 2 jeepable village road.
② No. 1B (140)	40	40	0	○					○	○	
③ No. 6A (90)	40	40	0			○			○	○	
④ No. 7A (140)	40	40	0			○			○	○	
⑤ No. 6B (110)	40	40	0	○					○	○	
S-4 (Netraganj)											
① No. 1+2 (460)	40	40	0			○				○	Lalbandi Re-settlement Project area, total area: 460 ha, irrigable area: 330 ha, sloped upland field with some undulation, project office at the center, small river running southern part, cultivated area per 1 holder: 1.3 ha.
② No. 1+2 (460)	40	40	0			○				○	
③ No. 1+2 (460)	40	40	0	○					○	○	
④ No. 1+2 (460)	40	40	0	○					○	○	
⑤ No. 1+2 (460)	40	40	0	○					○	○	
D-7 (Basahiya)											
① No. 1 (90)	50	50	3.6	○			○		○	○	Villages sharing half of the area, flat, 5 ponds. Sloped southward, orchard in northern part, 4 ponds. Sloped southward, large pond in northern part. Same undulation, 2 ponds, elevated land at the center. Same undulation, orchard, elevated land at the center.
② No. 2+3 (90)	50	50	4.3	○			○		○	○	
③ No. 5+3 (100)	50	50	4.1	○			○		○	○	
④ No. 8A (60)	50	50	3.6			○	○		○	○	
⑤ No. 8B+4B (70)	50	50	3.2			○	○		○	○	
M-4 (Kisanagar)											
① No. 2A+B (80)	25	25	3.5		○					○	Villages at south end, rather steep slope. Rivers flowing both sides of two area, road at the center. Some undulation, sloped southward, no pond and forest, etc. Some undulation, no village, road at the center. Villages along the road across the area, sloped southward.
② No. 3A (70)	25	25	4.5		○					○	
③ No. 3A+B+C (60)	25	25	4.5		○	○				○	
④ No. 3B+C (60)	25	25	5.6		○	○				○	
⑤ No. 4A+B (110)	25	25	6.8		○					○	
S-7 (Uramhapuri)											
① No. 7 (60)	40	40	5.0	○			○			○	Flat land, less forest, pond and villages area. Sloped southward, some villages, ponds and forests. Flat land. Flat land with some undulation, low land at the center. Gently sloped south-eastward, some villages.
② No. 7+2A (60)	40	40	5.0	○			○		○	○	
③ No. 9A (80)	40	40	4.7				○			○	
④ No. 9B+C (120)	40	40	4.2	○			○		○	○	
⑤ No. 1A (90)	40	40	4.2	○			○		○	○	

Note: Irrigation area is indicated with the ward No., and the figures in parentheses shown the entire area of irrigation area in ha.

Table 4.3 Comparative Summary of Requested 30 Blocks and Proposed 23 Blocks

District	Requested 30 Development Blocks	Change	Proposed 23 Development Blocks	Panchayat in the Proposed Blocks	Expected Discharge (l/sec)	1st. Priority & Blocks
Sarlahi	S-1	--	S-1	Hariwan	40	○
	S-2	--	S-2	Sasapur	40	
	S-3	Canceled				
	S-4	--	S-4	Netraganji	40	○
	S-5	Canceled				
	S-6	Canceled				
	S-7	--	S-7	Bramhapuri	40	○
		Proposed	S-8	Raniganj, Iswarpur	30	
		Proposed	S-9	Bhaktipur	30	
		Proposed	S-10	Kabilashi	55	
		Proposed	S-11	Gamharla	55	
Sub-total			8 blocks			
Mahottari	M-1	Canceled				
	M-2	Canceled				
	M-3	Canceled				
	M-4	--	M-4	Kisannagar	25	○
	M-5	Canceled				
	M-6	Canceled				
	M-7	--	M-7	Ratauligohi	50	○
	M-8	Canceled				
	M-9	Canceled				
	M-10	Canceled				
	M-11	Canceled				
		Proposed	M-12	Bharatpur	40	
	Proposed	M-13	Ramnagar	40		
Sub-total			4 blocks			
Dhanusha	D-1	Canceled				
	D-2	Canceled				
	D-3	Canceled				
	D-4	Canceled				
	D-5	Canceled				
	D-6	--	D-6	Bengashibapur	50	○
	D-7	--	D-7	Basahiya, Deopra	50	○
	D-8	--	D-8	Chorgas	50	○
	D-9	Canceled				
	D-10	--	D-10	Dubprkot	40	
	D-11	Canceled				
	D-12	Canceled				
		Proposed	D-13	Sitapur	30	
		Proposed	D-14	Chandrapur	30	
		Proposed	D-15	Naktajhij	30	
		Proposed	D-16	Bharatpur	30	
		Proposed	D-17	Tallogodar	30	
		Proposed	D-18	Kanakpatti, Mansinputti	50	
		Proposed	D-19	Lohana, Kuarampur	50	
Sub-total			11 blocks			
Total of Proposed Blocks			23 blocks			

Note: Names of Canceled Panchayats are shown in Table 4.1

Table 4.4 Standard Deep Tubewells (1/2)

Description	Type of Tubewell			
	I	II	III	IV
- Depth	(m) 89	159	205	205
- Diameter	7½"	7½"	7½"	7½"
- Length of Casing	(m) 84	154	200	200
- Length of 14"-casing Pipe	(m) 36 (6 nos.)	60 (10 nos.)	36 (6 nos.)	48 (8 nos.)
- Length of 8"-casing Pipe	(m) 18 (3 nos.)	54 (9 nos.)	114 (19 nos.)	102 (17 nos.)
- Length of 8"-screen Pipe	(m) 30	40	50	50
- Volume of Gravel (diameter: 2~9mm)	(m³) 8.7	15.7	22.9	22.1
- Design Discharge	(ℓ/sec) 40	25~30	40~50	40
- Static Water Level	(m) 15~20	20~30	0~5	0~5
- Dinamic Water Level	(m) 25	50	25	35
- Installed Depth of Pump	(m) 30	55	30	40
- Installed Pump	Okamoto Turbine 30m head 45ℓ/sec	Ebara Turbine 55m head 40ℓ/sec Okamoto Turbine 55m head 25ℓ/sec	Ebara Turbine 30m head 60ℓ/sec	Ebara Turbine 40m head 65ℓ/sec
- Installed Engine	Isuzu Diesel (45 HP) Isuzu Diesel (45 HP)	Fiat Diesel (72 HP)	Fiat Diesel (72 HP)	Fiat Diesel (72 HP)

Table 4.4 Standard Deep Tubewells (2/2)

Description	Type of Tubewell			
	I	II	III	IV
- Remarks	--	Since the length of rod for 1 set of pump is 30m, the rods and discharge pipes for 2 sets will be used for this type.	--	As same as Type-II, the pipes and rods for 4 sets will be used for 3 sets.

Note : The profiles of the above type of tubewell are shown on Fig. 4.2.

Table 4.5 Major materials and Equipment
for Drilling 115 Production Tubewells (1/4)

Items	Requirement		
	Provided by HMGN	Additional Requirement	Total
(1) Drilling and Development Materials and Equipment			
- Drilling Rig (including mud pump) (TRD-500: 4 nos. YRD-501R: 3 nos.) (necessary to send spare parts)	6 nos.	--	6 nos.
- Bits			
Tricone bit 17½"	--	130 nos.	130 nos.
Tricone bit 14¾"	--	130 nos.	130 nos.
Hole opener 14¾" - 17½"	--	70 nos.	70 nos.
- Materials and Equipment for Development			
Air compressor (75Kg/cm ² , 10.5 m ³ /min.)	6 nos.	--	6 nos.
High pressure air compressor (20 Kg/cm ² , 20m ³ /min.)	--	1 no.	1 no.
6"-suction pipe (screwed, L=5.5m) (for pump-up test)	731.5m	--	731.5m
4"-suction pipe (screwed, L=5.5m)	363m (192.5m)	198m	561m
1"-air pipe (screwed, L=5.5m)	363m (308m)	198m	561m
- Materials and Equipment for Pump-up Test			
Submersible motor pump for 14"-pipe	8 nos.	--	8 nos.
Submersible motor pump for 8"-pipe (Large capacity by low head type)	3 nos. (1 no.)	--	3 nos.
Submersible motor pump for 8"-pipe (Small capacity by high head type)	1 no. (1 no.)	--	1 no.
Generator for submersible pump	(1 no.)	11 nos.	-- 11 nos.
Flanged 8"-suction pipe	93.5m	--	93.5m
Screwed 5"-suction pipe	159.5m (159.5m)	--	159.5m

Table 4.5 Major materials and Equipment
for Drilling 115 Production Tubewells (2/4)

Items	Requirement		
	Provided by HMGN	Additional Requirement	Total
Notch tank for measuring lifted discharge (2.5m ³) (to be manufactured at site)	3 nos. (2 nos.)	3 nos.	6 nos.
- DC Engine Welder (3.6 kVA)	2 nos. (1 no.)	4 nos.	6 nos.
- Pipes and Screens			
20"-conductor pipe (L= 3m)	84m	1,368m	1,452m
14"-casing pipe (L= 6m)	4,932m	612m	5,544m
8"-casing pipe (L= 6m)	9,324m	--	9,324m
8"-Johnson screen (L= 5.25m) (without reinforcement)	105m	--	105m
8"-reinforced Johnson screen	2,572.5m	reinforcement materials	2,572.5m
8"-ring based wire-wrapped screen (L= 5.5m)	--	1,996.5m	1,996.5m
Centerizer for 8"-casing pipe	--	594 nos.	594 nos.
Reducer (14"→8")	120 nos.	--	120 nos.
- Pumps for Production Tubewells			
Ebara vertical turbine pump (60ℓ/sec, 45m)			
Pump body and engine	68 nos.	--	68 nos.
Pipes and shafts (30m/unit)	85 nos.	8 nos.	93 nos.
Okamoto vertical turbine pump (45ℓ/sec, 40m)			
Pump body and engine	47 nos.	--	47 nos.
Pipes and shafts (30m/unit)	72 nos.	7 nos.	79 nos.
8"-delivery pipe (L= 1.2m, with elbow)	--	68 nos.	68 nos.
6"-delivery pipe (L= 1.2m, with elbow)	--	47 nos.	47 nos.
- Other Materials and Equipment			
Volute pump for water supply	7 nos.	--	7 nos.
Portable water tank (3m ³ , water proof cloth)	6 nos. (6 nos.)	18 nos.	24 nos.
Portable diesel tank (2m ² , steel plate)	2 nos.	4 nos.	6 nos.
Gas welder	4 nos. (3 nos.)	2 nos.	6 nos.

Table 4.5 Major materials and Equipment
for Drilling 115 Production Tubewells (3/4)

Items	Requirement		
	Provided by HMGN	Additional Requirement	Total
Wireless (host: 1 no., branch: 6 nos.)	--	1 set	1 set
Electric sounding apparatus (1 no.)	1 no.	--	1 no.
Electric geologer (Geologer-300)	4 nos.	--	4 nos.
Current meter	2 nos. (2 nos.)	1 no.	3 nos.
Groundwater gauge 115 nos.	--	115 nos.	
Gradation analysis apparatus (1 no.)	1 no.	--	1 no.
Automatic water level gauge	--	10 nos.	10 nos.
- Consumerbles			
Cement	--	58 ton	58 ton
Bentonite	--	460 ton	460 ton
Barite	--	29 ton	29 ton
CMC	--	18 ton	18 ton
Mud cleaner	--	15 ton	15 ton
Gravel for packing	--	2,127m ³	2,127m ³
Fuel	--	1,135kℓ	1,135kℓ
(2) Transportation Vehicles			
4t-cargo truck with 3t- crane (HINO FT 173)	5 nos.	1 no.	6 nos.
4t-cargo truck (HINO FT 173)	4 nos.	--	4 nos.
Fuel tank lorry (4,000ℓ) (HINO FT 173)	2 nos.	1 no.	3 nos.
Water tank lorry (4,000ℓ) (HINO FT 173)	5 nos.	1 no.	6 nos.
20t-trailer truck	3 nos.	--	3 nos.
1 t-pick-up truck	--	6 nos.	6 nos.
4t-fork lift	1 no.	1 no.	2 nos.

**Table 4.5 Major materials and Equipment
for Drilling 115 Production Tubewells (4/4)**

Items	Requirement		
	Provided by HMGN	Additional Requirement	Total
(3) Construction Equipment			
6t-bulldozer	1 no.	—	1 no.
11t-bulldozer	13 nos.	—	13 nos.
0.8m ³ -wheel loader	5 nos.	—	5 nos.
1.2m ³ -wheel loader	6 nos.	—	6 nos.
2.8m-motor grader	1 no.	1 no.	2 nos.
3.1m-motor grader	5 nos.	—	5 nos.
4t-vibro road roller	5 nos.	1 no.	6 nos.
Tractor + 2t-trailer	3 nos.	—	3 nos.
3.5t-dump truck (HINO FT 173)	10 nos.	2 nos.	12 nos.
0.5m ³ -concrete mixer	4 nos.	2 nos.	6 nos.
(4) Operation and Maintenance Vehicles			
Wagon type jeep	3 nos.	3 nos.	6 nos.
Jeep	—	12 nos.	12 nos.
(5) Materials and Equipment for Workshop	1 set	—	1set

Note: - Figures in parentheses show the requirement which will be necessary for the Basic Design Study Phase II and be provided by the Government of Japan.

- Spare parts necessary for drilling production tubewells are shown in Table 4.6.

Table 4.6 Spare Parts for Construction of 115 Production Tubewells (1/2)

Items	Required Quantity		
	Quantity Supplied by HMGN	Additional Requirement	Total
e. <u>Spare Parts for Pump-up Test Equipment</u>	All of the stock	As required	—
f. <u>Pumps for Production Tubewells</u>			
f-1. Necessary parts for Ebara vertical turbine pump			
Key for upper rod including spare	38 nos.	34 nos.	72 nos.
Cuppling for center rod including spare	1,114 nos.	188 nos.	1,302 nos.
Outside column including spare	1,211 nos.	91 nos.	1,302 nos.
Battery including spare	53 nos.	19 nos.	72 nos.
f-2. Necessary parts for Okamoto vertical turbine pump			
Cuppling for center rod including spare	792 nos.	77nos.	869 nos.
f-3. Spare parts including diesel engine	All of the stock	—	—
g. <u>Other Spare Parts and Consumables</u>			
Recording paper for electric logging	—	230 rolls	230 rolls
Other spare parts	All of the stock	As required	—
h. <u>Spare Parts for Transportation Vehicles</u>			
Spare parts for transportation vehicles	All of the stock	As required	—
Spare tire for 31 trucks including HINO FT173 type truck (31 nos./2×6 nos. × 4 years)(special size not available at site)	—	372 nos.	372 nos.
Spare tire for the other vehicles	—	As required	—
i. <u>Construction Equipment</u>			
Spare parts and spare tire	All of the stock	As required	—
j. <u>Operation and Maintenance Vehicles</u>			
Spare parts and spare tire	All of the stock	As required	—
k. <u>Workshop</u>			
Spare parts and consumables	All of the stock	As required	—

Table 4.6 Spare Parts for Construction of 115 Production Tubewells (2/2)

Items	Required Quantity		
	Quantity Supplied by HMGN	Additional Requirement	Total
a. Spare Parts for Drilling Rig			
Water Swivel	3 nos. (3 nos.)	4 nos.	7 nos.
Suction hose and foot valve	-	40 sets	40 sets
Main hoisting wire (for replacement)	-	7 nos.	7 nos.
Sub-hoisting wire (for replacement)	-	4 nos.	4 nos.
High pressure hose for swivel, $\varnothing 75$ mm	2 nos.	5 nos.	7 nos.
High pressure connecting hose, $\varnothing 75$ mm	3 nos.	4 nos.	7 nos.
High pressure mixing hose, $\varnothing 75$ mm	2 nos.	5 nos.	7 nos.
14 $\frac{3}{4}$ "-bit stabilizer (TRD) (including spare)	3 nos.	5 nos.	8 nos.
14 $\frac{3}{4}$ "-bit stabilizer (YRD) (including spare)	6 nos.	2 nos.	8 nos.
Sub-socket 6, 7 5/8" \times 6 5/8" (for replacement)	-	14 nos.	14 nos.
Cross saver sub. (for YRD, replacement)	-	3 nos.	3 nos.
14 $\frac{1}{2}$ "-bit sub. (for YRD, replacement)	-	2 nos.	2 nos.
17 $\frac{1}{2}$ "-bit sub. (for YRD, replacement)	3 nos.	3 nos.	6 nos.
Must cylinder (YRD) for replacement	-	1 set	1 set
Compound case (YRD) for replacemnt	-	1 set	1 set
b. Spare Parts for Equipment of Drilling Rig			
Bevel gear for rotary table	-	2 nos.	2 nos.
Plate lock for water swivel	3 nos. (3 nos.)	3 nos.	6 nos.
Oil filter for truck engine	-	42 nos.	42 nos.
Other spare parts	All of the stock	As required	-
c. Consumables for Mud Pump (NAS-7 type)			
Piston liner $\varnothing 7\frac{1}{2}$ "	-	58 sets	58 sets
Piston rubber $\varnothing 7\frac{1}{2}$ "	-	58 sets	58 sets
V-packing	-	58 sets	58 sets
Piston rod with nut	-	58 sets	58 sets
Sheet, conical valve	-	58 sets	58 sets
Conical valve assembly	-	58 sets	58 sets
Piston spring	-	58 sets	58 sets
Sheet rubber	-	58 sets	58 sets
Guide valve	-	58 sets	58 sets
O-ring, P-160	-	232 sets	232 sets
O-ring, P-165	-	116 sets	116 sets
O-ring, P-235	-	116 sets	116 sets
d. Spare Parts for Development Equipment			
	All of the stock	As required	-

Table 4.7 Comparison of Request and Plan (1/12)

Request	Plan	Reason
1. Basic Concept		
1.1 Objective of the project		① It is necessary to introduce the advanced technology for promoting deep tubewell irrigation development systems such as 1) study of groundwater potential, 2) hydrogeological investigation for the selection of deep well location, 3) deep well drilling and development and 4) pumping test, water management, etc.
(1) Expansion of irrigated area.	The same as the requested components.	
(2) Stabilized increase of the agricultural products.		
(3) Increase of farmers' income and improvement of living standard.		
(4) Promotion of the farmers' social welfare.	In addition to the above (1)-(4), following (5) and (6) are added.	② Since the discharges on the surface water projects such as Bagmati, Kamala, Manusmala and Hardinath are overvalued in the planning stage of those projects, the irrigable areas cannot be expanded by these projects only. Therefore, groundwater will become the most reliable source for expanding irrigated area.
(5)	Establishment of the method for deep tubewell irrigation development.	
(6)	Deep well irrigation development model in the Terai plain.	
1.2 Project area	The Terai plain covering the Dhanusha, Mahottari and Sarlahi Districts in the Janakpur Zone. But, the following areas shall be excepted.	The results of the preliminary study and this basic design study, and the discussion with HMGCN clarified the objective area.
The Terai plain in the Janakpur Zone.		
	- Existing irrigation area in each District, - The shallow tubewell irrigation projects area of TIA/TSP, and - The ground water project areas under DIHM.	
1.3 Components of the project		
(1) Utilization of the drilling and construction materials and equipment for deep tubewells provided under the KR-2 grant aid.	The same as the request	The intention of HMGCN was confirmed in this basic design study.
(2) Irrigation of 3,000 ha by the construction of 150 deep tubewells and irrigation facilities	The possible number of deep tubewells is 115 and the irrigable area is 4,625 ha.	The possible number of deep tubewells was determined to be 115 from the results of the following study and survey : - The hydrogeological study - The inventory survey of the KR-2 drilling and construction equipment and materials for deep tubewells (refer to 4.2.3).

Table 4.7 Comparison of Request and Plan (2/12)

Request	Plan	Reason																																																									
<p>2. Development Blocks</p> <p>2.1 Development blocks and priority ranking. 30 development blocks (Each block : 8 km² = 800 ha) are proposed in the project area. 30 develop development blocks requested by HMGN and the ir priority are as follows :</p> <table border="1" data-bbox="678 1456 909 2049"> <thead> <tr> <th>District</th> <th>Priority</th> <th>First</th> <th>Second</th> <th>Third</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Dhanusha</td> <td></td> <td>7</td> <td>2</td> <td>3</td> <td>12</td> </tr> <tr> <td>Mahottari</td> <td></td> <td>3</td> <td>3</td> <td>5</td> <td>11</td> </tr> <tr> <td>Sarlahi</td> <td></td> <td>5</td> <td>-</td> <td>2</td> <td>7</td> </tr> <tr> <td>Total</td> <td></td> <td>15</td> <td>5</td> <td>10</td> <td>30</td> </tr> </tbody> </table>	District	Priority	First	Second	Third	Total	Dhanusha		7	2	3	12	Mahottari		3	3	5	11	Sarlahi		5	-	2	7	Total		15	5	10	30	<p>(1) The 8 blocks out of the requested 30 blocks are to be implemented prior to the other blocks. The numbers of the first priority of 8 blocks and the names of district and panchayat are as follows :</p> <table border="1" data-bbox="582 873 917 1444"> <thead> <tr> <th>Number</th> <th>District</th> <th>Panchayat</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Sarlahi</td> <td>Hariwan</td> </tr> <tr> <td>2</td> <td>Sarlahi</td> <td>Bramhapuri</td> </tr> <tr> <td>3</td> <td>Mahottari</td> <td>Kisannagar</td> </tr> <tr> <td>4</td> <td>Mahottari</td> <td>Ratauligohi</td> </tr> <tr> <td>5</td> <td>Dhanusha</td> <td>Bengashibapur</td> </tr> <tr> <td>6</td> <td>Dhanusha</td> <td>Basahiya</td> </tr> <tr> <td>7</td> <td>Dhanusha</td> <td>Chorgas</td> </tr> <tr> <td>8</td> <td>Dhanusha</td> <td>Naktajhij</td> </tr> </tbody> </table>	Number	District	Panchayat	1	Sarlahi	Hariwan	2	Sarlahi	Bramhapuri	3	Mahottari	Kisannagar	4	Mahottari	Ratauligohi	5	Dhanusha	Bengashibapur	6	Dhanusha	Basahiya	7	Dhanusha	Chorgas	8	Dhanusha	Naktajhij	<p>The irrigable area was estimated to be 4,625 ha based on the application of the unit water requirement of 1 l/sec/ha (refer to 4.2.4).</p> <p>The requested 30 development blocks have such difficulties as lack of groundwater potential and poor access, etc. Therefore, attractive 8 blocks were picked up as the first priority blocks. Though 2 blocks out of the rest 22 blocks are considered to be effective for development, it seems difficult to implement in view of access, etc. The 20 blocks are recommended to relocate to avoid the undergoing other project area.</p>
District	Priority	First	Second	Third	Total																																																						
Dhanusha		7	2	3	12																																																						
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7	Dhanusha	Chorgas																																																									
8	Dhanusha	Naktajhij																																																									
<p>(2) Possible number of development block : 23 blocks Possible number of deep tubewells : 115 wells</p> <p>(3) 23 development blocks (including 8 development blocks) are as follows :</p> <table border="1" data-bbox="1101 873 1332 1601"> <thead> <tr> <th>District</th> <th>Priority ranking</th> <th>First priority</th> <th>2-nd,3-rd priorities</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Dhanusha</td> <td></td> <td>4</td> <td>7</td> <td>11</td> </tr> <tr> <td>Mahottari</td> <td></td> <td>2</td> <td>2</td> <td>4</td> </tr> <tr> <td>Sarlahi</td> <td></td> <td>2</td> <td>6</td> <td>8</td> </tr> <tr> <td>Total</td> <td></td> <td>8</td> <td>15</td> <td>23</td> </tr> </tbody> </table>	District	Priority ranking	First priority	2-nd,3-rd priorities	Total	Dhanusha		4	7	11	Mahottari		2	2	4	Sarlahi		2	6	8	Total		8	15	23	<p>Refer to the Section 1.3.(2).</p> <p>① From Section 2.1.(1), the twenty (20) blocks out of thirty (30) blocks requested by HMGN are recommended to be relocated.</p> <p>② From Section 2.1. (2), the deep tubewells of 115 nos. are possible to dug and construct. The 23 blocks and the 115 wells are possible for development.</p> <p>③ Based on the above ① and ②, 15 blocks were newly selected and the locations of 23 development blocks were decided.</p> <p>④ In the selection of the new blocks of 15 nos, the following items were considered.</p>																																	
District	Priority ranking	First priority	2-nd,3-rd priorities	Total																																																							
Dhanusha		4	7	11																																																							
Mahottari		2	2	4																																																							
Sarlahi		2	6	8																																																							
Total		8	15	23																																																							

Table 4.7 Comparison of Request and Plan (3/12)

Request	Plan	Reason																											
2.2 Selection of five (5) irrigation areas in a development area. Not described.	<p>(1) The following table shows each five (5) irrigation areas planned for eight (8) development blocks of the first priority.</p> <table border="1"> <thead> <tr> <th>Development Block</th> <th>Panchayat</th> <th>Planned Irrigation Area (Ward No.)</th> </tr> </thead> <tbody> <tr> <td>D-7</td> <td>BASAIHIYA</td> <td>1,2,3,5,8A,8B</td> </tr> <tr> <td>D-8</td> <td>CHORGAS</td> <td>1,2,3,4A,4B,5</td> </tr> <tr> <td>D-6</td> <td>BENGASHIBAPUR</td> <td>1B,3A,3B,6B,7A,7B</td> </tr> <tr> <td>D-15</td> <td>NAKTAJIHJ</td> <td>not selected yet</td> </tr> <tr> <td>M-4</td> <td>KISANNAGAR</td> <td>2A,3,3A,3B,3C,4A,4B</td> </tr> <tr> <td>M-7</td> <td>PATAULICOHJI</td> <td>1,2A,2B,4,6,7</td> </tr> <tr> <td>S-1</td> <td>HARIWAN</td> <td>1B,3C,3D,6A,6B,7A</td> </tr> <tr> <td>S-7</td> <td>BRAMHAPURI</td> <td>1A,2A,7,9A,9B,9C</td> </tr> </tbody> </table>	Development Block	Panchayat	Planned Irrigation Area (Ward No.)	D-7	BASAIHIYA	1,2,3,5,8A,8B	D-8	CHORGAS	1,2,3,4A,4B,5	D-6	BENGASHIBAPUR	1B,3A,3B,6B,7A,7B	D-15	NAKTAJIHJ	not selected yet	M-4	KISANNAGAR	2A,3,3A,3B,3C,4A,4B	M-7	PATAULICOHJI	1,2A,2B,4,6,7	S-1	HARIWAN	1B,3C,3D,6A,6B,7A	S-7	BRAMHAPURI	1A,2A,7,9A,9B,9C	<ul style="list-style-type: none"> - The areas of the possible discharge more than 25 l/sec. - Requests from HIMGN, accessibility - Exclusion of the areas of the other irrigation projects underway and/or scheduled in future. <p>In the selection of irrigation blocks, it is needed to confirm (by the field survey) the locations of access road, topographic conditions, cropping pattern, location of forest, pond and villages, etc. These results are shown on the map (1/1,000 scale).</p> <p>For the eight (8) development blocks of the first priority, five (5) irrigation areas were selected in each block, since 8 blocks are intended to be constructed in an early stage. The selections were done based on the field investigation using the topographic maps of 1/50,000 scale, land use maps of the same scale and cadastral map of 1/2,400 scale.</p>
Development Block	Panchayat	Planned Irrigation Area (Ward No.)																											
D-7	BASAIHIYA	1,2,3,5,8A,8B																											
D-8	CHORGAS	1,2,3,4A,4B,5																											
D-6	BENGASHIBAPUR	1B,3A,3B,6B,7A,7B																											
D-15	NAKTAJIHJ	not selected yet																											
M-4	KISANNAGAR	2A,3,3A,3B,3C,4A,4B																											
M-7	PATAULICOHJI	1,2A,2B,4,6,7																											
S-1	HARIWAN	1B,3C,3D,6A,6B,7A																											
S-7	BRAMHAPURI	1A,2A,7,9A,9B,9C																											
	<p>(2) Three (3) blocks are selected as the representatives of twenty three (23) blocks.</p> <p>(3) The following is the selected three (3) blocks for which the topographic maps of 1/1,000 scale were made based on the field survey works.</p>	<p>In order to estimate the whole construction quantities and project costs in the limited period, typical three (3) blocks, representatives of the rest twenty (20) blocks, were selected and carried out the following studies.</p> <ul style="list-style-type: none"> - Survey and preliminary design of three (3) blocks. - Calculations of the work quantities of three (3) blocks. - Cost estimations for all the twenty three (23) blocks based on the results of the above three (3) blocks. 																											
	<table border="1"> <thead> <tr> <th>Name of Block</th> <th>D-7</th> <th>M-4</th> <th>S-7</th> </tr> </thead> <tbody> <tr> <td>Name of District</td> <td>Dhanusha</td> <td>Mahottari</td> <td>Sarlahi</td> </tr> <tr> <td>Name of Panchyat</td> <td>Basahiya</td> <td>Kisannagar</td> <td>Bramhapuri</td> </tr> <tr> <td>Expected Discharge</td> <td>50 l/sec X 5 nos. 50 ha X 5 sites (250 ha)</td> <td>25 l/sec X 5 nos. 25 ha X 5 sites (125 ha)</td> <td>40 l/sec X 5 nos. 40 ha X 5 sites (200 ha)</td> </tr> <tr> <td>Irrigable Area</td> <td>1 2+3 3 4 5</td> <td>2A+2B 3A 3A+3B+3C 3B+3C 4A+4B</td> <td>7 7+2A 9A 9B+9C 1A</td> </tr> </tbody> </table>	Name of Block	D-7	M-4	S-7	Name of District	Dhanusha	Mahottari	Sarlahi	Name of Panchyat	Basahiya	Kisannagar	Bramhapuri	Expected Discharge	50 l/sec X 5 nos. 50 ha X 5 sites (250 ha)	25 l/sec X 5 nos. 25 ha X 5 sites (125 ha)	40 l/sec X 5 nos. 40 ha X 5 sites (200 ha)	Irrigable Area	1 2+3 3 4 5	2A+2B 3A 3A+3B+3C 3B+3C 4A+4B	7 7+2A 9A 9B+9C 1A								
Name of Block	D-7	M-4	S-7																										
Name of District	Dhanusha	Mahottari	Sarlahi																										
Name of Panchyat	Basahiya	Kisannagar	Bramhapuri																										
Expected Discharge	50 l/sec X 5 nos. 50 ha X 5 sites (250 ha)	25 l/sec X 5 nos. 25 ha X 5 sites (125 ha)	40 l/sec X 5 nos. 40 ha X 5 sites (200 ha)																										
Irrigable Area	1 2+3 3 4 5	2A+2B 3A 3A+3B+3C 3B+3C 4A+4B	7 7+2A 9A 9B+9C 1A																										

Table 4.7 Comparison of Request and Plan (4/12)

Request	Plan	Reason
3. Groundwater Development Plan		
3.1 Deep tubewell plan		
(1) Number of drilling wells 150 wells are constructed in the development blocks of 30 nos.	(1) 115 wells are constructed in the development blocks of 23 nos. which were decided through the discussion with HMCN.	(1) The development plan including the following items was discussed in the meeting with HMCN. 1) The shallow well irrigation area clarified by the hydrogeologic results. 2) The potential area having the possible discharge of 25 c/sec or more. 3) The effective use of the existing KR-2 materials and equipment clarified by the inventory survey results. 4) Avoidance of the overlap of the area with the other groundwater projects.
(2) Wells interval, standard wells and countermeasures of land subsidence Not described.	(2) Wells interval is at least 600 m or more. Standard wells are four (4) types. Main aquifer in the southern area feared from a land subsidence is at the depth of 170 m or below. In the southern area a clay layer is inferred to be thickly distributed from hydrogeological viewpoint.	(2) Well interval, standard wells and countermeasures for land subsidence are determined considering the results of four(4) test drilling and hydrogeological study of the existing data, etc.
(3) Test well drilling Not described.	(3) Before the construction of production wells, one test well is drilled in each development block (five production wells) based on the following conditions. ① Specifications of the test well is the same with that of the standard tubewell to be adopted in each development block. ② The following materials and equipment are necessary for test well drilling.	(3) According to the hydrogeological results, the aquifers in the project area are varied locally in N-S and E-W directions. It is, therefore, needed to confirm the discharge and the details of fine sand layer in the southern part prior to the production wells drilling. The advantages of the test wells are as follows : - Detailed discharge and the distributions of aquifer can be clarified.

Table 4.7 Comparison of Request and Plan (5/12)

Request	Plan	Reason
<p>Rig and mud pump1 set (in case of the construction of production wells in started in 1987)</p> <p>Rigs and mud pumps3 set (in case of the construction is not started in 1987)</p> <p>Drilling bits17 1/2" and 14 3/4" tricone bit</p> <p>Casing & screen</p> <p>14" and 8" casing pipes and 8" reinforced Johnson screen, 8" ring base screen, etc.</p>	<p>Rig and mud pump1 set (in case of the construction of production wells in started in 1987)</p> <p>Rigs and mud pumps3 set (in case of the construction is not started in 1987)</p> <p>Drilling bits17 1/2" and 14 3/4" tricone bit</p> <p>Casing & screen</p> <p>14" and 8" casing pipes and 8" reinforced Johnson screen, 8" ring base screen, etc.</p>	<ul style="list-style-type: none"> - It can reduce to drill a dry well or low discharge production well less than 25 €/sec. - It can be possible to grasp the drilling schedule of production well and its capability before the construction. - Groundwater table and aquifer conditions can be clarified. Production well structure and detail specification can be decided. - The type and specification of production well pump can be decided.
<p>3.2 Materials & equipment plan for the project. The followings are possible to be provided by HMCN from the KR-2 materials and equipment.</p>	<p>⊙ The pumping tests in test wells shall be conducted in order to obtain the basic data for production well.</p>	<p>As for the deep well drilling, it is a principle plan to use in maximum the existing KR-2 materials and equipment. But it is necessary to newly supply some additional materials and equipment from the following reasons.</p>
<p>A) Materials & equipment for the deep well construction.</p>	<p>Based on the due consideration of the hydrogeological results in each block, the following materials and equipment will be additionally supplied (main parts only) in order to construct the production wells of 115 nos. including 23 nos. of test well (one well per block) in the development blocks of 23 nos. and the irrigation facilities.</p>	<p>As for the deep well drilling, it is a principle plan to use in maximum the existing KR-2 materials and equipment. But it is necessary to newly supply some additional materials and equipment from the following reasons.</p>
<p>(1) Drilling rigs (including mud pump, etc.)</p>	<p>(1) Addition of the parts</p> <p>i) Spare parts of mud pump (cylinder liner, piston rubber, bearing, etc.). As required</p>	<p>Main parts for mud pumps are no stored. One mud pump is now unusable because the bearings are out of order and no store.</p>
<p>7 nos.</p>	<p>ii) Rotary tongue of YRD-500 1 no.</p> <p>iii) Water swivel 7 nos.</p> <p>iv) Wire cable 7 nos.</p> <p>v) 14 3/4" stabilizer 3 nos.</p> <p>vi) Overhaul of the YRD - 501R mast 1 no.</p> <p>vii) Gear box for the YRD - 501R 1 no.</p>	<p>ii) The tongue is out of order, no spare parts to repair.</p> <p>iii) The thread is out of order.</p> <p>iv) Wire were seriously abraded.</p> <p>v) No store is found.</p> <p>vi) The mast cannot stand up due to trouble in the hydraulic system.</p> <p>vii) The abnormal noises sound in the box during the operation.</p>

Table 4.7 Comparison of Request and Plan (6/12)

Request	Plan	Reason
(2) EBARA vertical turbine pumps (60 l/sec 90 nos.)	(2) Addition of the parts i) Batteries for the pump engine 13 nos. ii) Lifting column pipe 226 m (113 nos.) iii) Shaft coupling 183 nos. iv) Key for the upper shaft 34 nos.	The following shortage and 5% spare are included. i) Nine (9) batteries are insufficient for the planned wells. ii) The pipes of 90 m long are insufficient. iii) Couplings of 129 nos. are insufficient. iv) Key of 29 nos. are insufficient.
(3) OKAMOTO vertical turbine pump 79 nos.	(3) Addition of the parts Couplings for the line shaft 77 nos.	(3) Coupling of 77 nos. are insufficient and 5% spare is included
(4) 20" conductor pipe 84 m	(4) The same	(4) The installed conductor pipes are not removed.
(5) 14" casing pipe 4,932 m	(5) The same	(5) In this year, TIATSP will use the pipes of 660 m for their wells out of the existing 5,592 m. The pipes of 5,230 m will be consumed in the 115 production wells of this project. (including 5% spare, 264 m.)
(6) 8" casing pipe 12,732 m	(6) The pipes of 9,324 m will be used for this project. No additional supply may be needed.	(6) TIATSP will use the pipes of 660 m for their program in this year. The pipes of 9,324 m are estimated for the project including 5% spare. (9,324 m --- 115 production wells)
(7) 8" Johnson type screen 5,076m	(7) Utilization of the present screen 105m (7') Utilization of the reinforced Johnson screen 2,572.5m (7'') Utilization of the newly supplied ring base wire - wrapped screen 1,996.5m	(7) The reinforced Johnson screen will be installed in the depth of 50 ~ 150m. The newly supplied ring base screen will be installed below the depth of 150m.
(8) Centerlizer for 8" pipe No store	(8) The same (one piece per three pipes) 594 nos.	(8) Centerlizer is needed to install the pipes in the hole center which will be drilled at 17½" diameter through all the depth.

Table 4.7 Comparison of Request and Plan (7/12)

Request	Plan	Reason
(9) 17½" tricone bit	(9) The same (for the production well drilling of 115 nos.) 130 nos. Hard type bits are needed in the northern part of the project area.	(9) The bits of 7 nos only are stored. The bit life will be 70m drilling/bit in the northern part and 90m drilling/bit in the southern part. (Total 130 nos. are including 10% spare).
(10) 14½" tricone bit	(10) The same as the above.	(10) No store is found. The bit life will be 60m drilling (northern part) and 100m drilling (southern part) per one bit respectively (10% spare is included in total quantity).
(11) Hole opener	(11) The same	(11) The hole openers of 70 nos are needed to use for the reaming (14½" → 17½").
(12) 6" large capacity of discharge and low head type submersible motor pump	(12) The same (available for use in 8" well)	(12) The pump is needed for the pumping test of the test wells in the central to southern area.
(13) High pressure type air compressor	(13) The capacity required is of approx. 20kg/cm², 20m³/min	(13) The pressure of the existing air compressors granted under KR - 2 is 7kg/cm² in TRD rig and 10.5kg/cm² in YRD rig respectively. The capacity in the pressure of these existing air compressors is small for the developing works on the deep portion screens of the planned wells (mainly 200m class).
(14) Spare parts	(14) The following spare parts for the vehicles and construction equipment are additionally supplied. - For the necessary spare parts for the jeeps, trucks and construction equipment granted before 1982. - For the necessary spare parts of the filters for the jeeps and trucks granted in 1982.	(14) They are no stock or very small quantity. - Their stock is consumed day by day.
B) Vehicles for the transportation		
(1) 4t - cargo truck with 3t crane	(1) The same.	(1) One truck in each drilling and main canal construction site is needed (six sites at the same time).
(2) 4t - cargo truck	(2) The same. No additional supply is necessary.	(2) It is possible to rent in Nepal.
(3) Fuel tank lorry (4,000ℓ)	(3) The same.	(3) One lorry in two drilling sites is needed.

Table 4.7 Comparison of Request and Plan (8/12)

Request	Plan	Reason
(4) Water tank lorry (4,000ℓ)	5 nos.	(4) One lorry in each drilling site is needed.
(5) 20t - trailer truck	3 nos.	(5) One truck in two drilling sites is sufficient.
(6) 1t - pick-up truck	7 nos.	(6) One truck in each drilling site is needed. The existing seven (7) trucks are used for the shallow well project.
(7) 5t - fork lift	1 no.	(7) Pipes are keeping in the two stores separately. Therefore, additional supply of one lift for loading on the trailer trucks is required.
C) Construction equipments		
(1) 6t - bulldozer	1 no.	(1) The quantity of the existing bulldozers is sufficient.
(2) 11t - bulldozer	13 nos.	(2) The quantity of the existing bulldozers is sufficient.
(3) 0.8m ³ - wheel loader	5 nos.	(3) The quantity of the existing bulldozers is sufficient.
(4) 1.2m ³ - wheel loader	6 nos.	(4) The quantity of the existing bulldozers is sufficient.
(5) 2.8m - motor grader	5 nos.	(5) For the temporary road, one additional grader is needed.
(6) 3.1m - motor grader	5 nos.	(6) The quantity of the existing graders is sufficient.
(7) 4t - vibro road roller	5 nos.	(7) One roller for each main canal construction site (six sites at the same time) is needed.
(8) Tractor + 2t - trailer	6 nos.	(8) The equipment is possible to rent at the site.
(9) 3.5t - dump truck	10 nos.	(9) Two trucks are needed at each main canal construction site.
(10) 0.5m ³ - concrete mixer	4 nos.	(10) One mixer is needed at each main canal construction site.
D) Vehicles for an administration		
(1) Wagon type jeep	3 nos.	(1) Three (3) jeeps are needed for the topographic survey works. In addition, each one jeep is needed for the management and maintenance of the offices of the consultant, drilling constructor and civil engineering constructor.
(2) Jeep	No stored	(2) For the administration and supervision of the construction, it is needed to use one (1) jeep for consultant, four (4) jeeps for drilling contractor and seven (7) jeeps for civil engineering contractor.

Table 4.7 Comparison of Request and Plan (9/12)

Request	Plan	Reason																					
4. Irrigation and Drainage Plan																							
4.1 Irrigable area																							
Average 20ha/well	<p>Planned irrigable area is estimated at 4,625ha, based on the unit water requirement of 1ℓ/sec/ha and possible pumping discharge of each deep tubewell (25ℓ/sec, 30ℓ/sec, 40ℓ/sec, 50ℓ/sec, 55ℓ/sec). Irrigable area by possible pumping discharge of each deep tubewell is as follows :</p>	<p>Since ground water potential is different area by area, this plan has to be made on the basis of the expected possible pumping discharge of each deep tubewell in the area.</p>																					
	<table border="1"> <thead> <tr> <th>Possible Pumping Discharge</th> <th>Number of Tubewell</th> <th>Irrigable Area (ha)</th> </tr> </thead> <tbody> <tr> <td>25ℓ/sec</td> <td>5 (5)</td> <td>125 (125)</td> </tr> <tr> <td>30ℓ/sec</td> <td>35 (5)</td> <td>1,050 (150)</td> </tr> <tr> <td>40ℓ/sec</td> <td>35 (10)</td> <td>1,400 (400)</td> </tr> <tr> <td>50ℓ/sec</td> <td>30 (20)</td> <td>1,500 (1,000)</td> </tr> <tr> <td>55ℓ/sec</td> <td>10 (0)</td> <td>550 (0)</td> </tr> <tr> <td></td> <td>115 (40)</td> <td>4,625 (1,675)</td> </tr> </tbody> </table>	Possible Pumping Discharge	Number of Tubewell	Irrigable Area (ha)	25ℓ/sec	5 (5)	125 (125)	30ℓ/sec	35 (5)	1,050 (150)	40ℓ/sec	35 (10)	1,400 (400)	50ℓ/sec	30 (20)	1,500 (1,000)	55ℓ/sec	10 (0)	550 (0)		115 (40)	4,625 (1,675)	
Possible Pumping Discharge	Number of Tubewell	Irrigable Area (ha)																					
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55ℓ/sec	10 (0)	550 (0)																					
	115 (40)	4,625 (1,675)																					
	<p>Note : The figures in parentheses are number of tubewell and irrigable area with first priority.</p>																						

Table 4.7 Comparison of Request and Plan (10/12)

Request	Plan	Reason																								
4.2 Irrigation facilities																										
(1) Pumping station																										
- Pump house (one - story, concrete made, 17.64m ² , 1no.)	- One - story pump house of brick masonry. 1 no. (13.50m ²)	- The brick masonry is the most suitable for pump house because of cheap cost and easy construction. The floor area of 13.50m ² is sufficient.																								
- Baffle tank : no description.	- The baffle tank with a V - notch will be provided.	- The baffle tank for stilling and the V - notch for measuring discharge are necessary.																								
- Bathing pool for domestic use : no description.	- It will be attached to one of the pumping stations in each development block.	- The strong request of farmers and the results of the preliminary survey were considered.																								
- Water supply system (PVC pipe 8", 6", 500m long)	- The water supply system will not be provided.	- Only the above bathing pool will be provided because such supply system will not be used effectively comparing with the necessary construction cost.																								
- Operator house (concrete made, one - story, 17.28m ² , 1no.)	- One story operator house of brick masonry. 1 no. (9.72 m ²)	- Since the operator works only for 12ha in day time, only the space for rest is considered.																								
(2) Main irrigation canals and related facilities																										
- Main irrigation canal (concrete made, canal section : 0.525m X 0.6m, length : 500m)	- One layer brick canal - Canal gradient : less than 1/200. - The typical sections are as follows.	- The strong request of FIMGN, maintenance and repair and cost of construction are considered. The canal gradient is so determined that the velocity is within the range from 0.5 to 0.8m/sec. To save the construction cost as much as possible, the section of canal is determined so as to meet the lifted discharge.																								
	<table border="1"> <thead> <tr> <th>Description</th> <th>Type-I</th> <th>Type-II</th> <th>Type-III</th> </tr> </thead> <tbody> <tr> <td>Inside dimension (width X height) (cm X cm)</td> <td>35 X 42</td> <td>35 X 35</td> <td>28 X 28</td> </tr> <tr> <td>Discharge (ℓ/sec)</td> <td>50~55</td> <td>40</td> <td>30</td> </tr> <tr> <td>Velocity (m/sec)</td> <td>0.56</td> <td>0.50</td> <td>0.73</td> </tr> <tr> <td>Max. discharge (ℓ/sec)</td> <td>80</td> <td>65</td> <td>40</td> </tr> <tr> <td>Max. velocity (m/sec)</td> <td>0.80</td> <td>0.77</td> <td>0.79</td> </tr> </tbody> </table>	Description	Type-I	Type-II	Type-III	Inside dimension (width X height) (cm X cm)	35 X 42	35 X 35	28 X 28	Discharge (ℓ/sec)	50~55	40	30	Velocity (m/sec)	0.56	0.50	0.73	Max. discharge (ℓ/sec)	80	65	40	Max. velocity (m/sec)	0.80	0.77	0.79	
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- Siphon (concrete made, 2nos.)	- The road crossing will be the culvert type of precast concrete slab on irrigation canal instead of the siphon.	- The siphon on the small canal is apt to be clogged by sediments, and such sediments can not be removed easily.																								
- Aqueduct (concrete made, 1no.)	- Aqueduct is not provided.	- There is no place requiring the aqueduct.																								

Table 4.7 Comparison of Request and Plan (11/12)

Request	Plan	Reason
- Crossdrain : no description.	- The crossdrain will be provided at the crossing between canal and natural drainage. It will be of precast concrete pipe.	- The crossdrain is necessary for preventing the farm land from the water stagnation by canal embankment. The precast concrete pipe will be gotten easily at site.
- Drop (concrete made, 2nos.)	- Drop will be of brick masonry.	- It will be provided for controlling flow velocity in canal within the design allowable velocity.
- Turnout (concrete made, 20nos.)	- The number of turnout in main canal will be 7 or 14.	- The rotation irrigation of 7 days is considered.
- Division and corner boxes : no description	- The division and corner boxes are made of brick masonry, and provided where necessary.	- These boxes are provided to assure the smooth flow of canal water.
- Cattle pass : no description	- The precast concrete slab will be provided on the main canal where necessary.	- This structure is provided for preventing the canal from the damages by pass of such cattle as cows, sheep and goats, etc.
- Farm road/maintenance road : no description	- Neither farm road nor maintenance road will be provided.	- It is judged to be unnecessary in view of land compensation and its cost.
(3) Commencement of the construction of irrigation facilities : no description.	The construction of the deep tubewells and the irrigation facilities will be made in a same year but after confirming the actual discharge at site.	It is necessary to provide the irrigation facilities matching the actual discharge.
5. Administration and Management System		
(1) The Ministry of Agriculture has the sole responsibility for the implementation of the project.	(1) The same.	
(2) TIATSP is an executive organization of the project.	(2) The same. TIATSP shall strengthen the following divisions : Construction division : An increase of the competent staff. Drilling division : The same as the above. Irrigation division : The same as the above. Extension/Training of agriculture division : The same as the above. O & M division : To be newly established.	(2) Judging from the total number of the present staff in TIATSP, the execution of this project and the management/maintenance for the irrigation facilities are impossible. - The staff are needed to advise farmers in order to organize the users' groups. TIATSP is required to do trainings of the extension officers in an early stage. The water management organization is established under the guidance by the Agriculture Extension and Training division. - The newly established Maintenance and Administration division collects the water charge (pump fuel costs + maintenance cost for the irrigation facilities). Also the management of pump and irrigation facilities and the maintenance/ administration are done by the above division.

Table 4.7 Comparison of Request and Plan (12/12)

Request	Plan	Reason
<p>(3)</p> <p>The water charge includes pump fuel cost, operator cost and maintenance/administration costs for the irrigation facilities. Operator cost, pump fuel cost and maintenance/administration costs for the facilities are collected by TIATSP as the water charge. The details are as follows:</p> <ul style="list-style-type: none"> - Subsidy by HMG/N for all the costs in the first year. - Subsidy by HMG/N for the half costs in the following two years. - Within the above three years, the water management organization shall be made by the beneficial farmers. - All the costs shall be collected from the beneficial farmers in and after four (4) years. <p>6. Cost Allocation</p> <p>(1) Allocation to Japan</p> <ul style="list-style-type: none"> - Construction of the wells and the related facilities of pump station. - Construction of the irrigation facilities (minor canal and related structures). <p>(2) Allocation to Nepal</p> <ul style="list-style-type: none"> - Construction of the lateral canals by the beneficial farmers. 	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>
<p>(3)</p> <ul style="list-style-type: none"> - The same. - The same. - Construction of temporary roads to pump station, canal and repair of the existing roads. 	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>
<p>(3)</p> <ul style="list-style-type: none"> - The same. - Land compensation for the above facilities. 	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>	<p>(3) It is reasonable that the operation and maintenance shall be done by TIATSP for the pump and the irrigation facilities and the water charge shall be collected by TIATSP from the beneficial farmers. In addition, it is reasonable to provide the subsidy of HMG/N to the beneficial farmers in the first three years.</p>

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (1/19)

Components		Pre-study Results	Study	Basic Plan																		
1. Basic Concept																						
1.1 Object of the project																						
(1)	Expansion of the irrigation area		The object of the ground water development is the same as the proposal by HMGN and pre-study results. In order that HMGN establish the deep well irrigation development technique, it needs to introduce the technique from the developed countries.	In addition to (1), (2), (3) and (4), (5) Establishment of the deep well irrigation development technique.. (5) The model of deep well irrigation development in the Terai plain.																		
(2)	Stable increase of agricultural production	The same																				
(3)	Increase of farmers income and level up of living standard.																					
(4)	Increase of social welfare in the farmer.																					
1.2 Project area																						
Janakpur Zone in Terai.																						
(1)	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, Manumara & Hardinath and shallow well irrigation area.		(1) Discharge of the rivers, such as Bagmati, Kamala, Manumara and Hardinath irrigation project by surface water, are over-estimated. The area in these projects will be estimated to be decrease. The increase of irrigation area on the above projects is hardly expected. The expansion of irrigation area shall be subjected by the groundwater.	The project area is the same as shown in pre-study results. In addition, the groundwater project area under DIHM in Mahottari will be avoided from the block selection.																		
(2)			(2) Judging from the distribution of shallow aquifer, the expansion of shallow well irrigation area is impossible.																			
(3)			(3) Groundwater project by DIHM is under way at Mahottari district. The selection of the block was requested from HMGN to avoid the other groundwater project area.																			
1.3 Components of the project																						
(1) Use of deep well construction materials & equipments provided by KR-2 grant.																						
		The same For the groundwater development in the northern area and deep aquifer development in the southern area, some additional supply from Japan will be needed on construction materials & equipments such as screen and pipe, etc.	As the basic concept, the existing KR-2 materials & equipments only shall be used for this project. But, according to the inventory results on the above items, it is needed to newly supply from Japan the considerably many additional materials & equipments. Based on the hydrogeologic study results, standard deep well (= 4 types) were decided and 115 production wells in total were estimated to be possible in case of the use of existing KR-2 materials & equipments and some additional supply.	Judging from the hydrogeologic study results (groundwater potential map, hydrogeologic profiles, electric soundings results) and the existing KR-2 materials & equipments, 115 production wells are possible to construct. Well nos. of each standard type are as follows: (Details is shown in Section 3.2)																		
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Standard type</th> <th>Depth(m)</th> <th>Well No.</th> </tr> </thead> <tbody> <tr> <td>I</td> <td>33</td> <td>20</td> </tr> <tr> <td>II</td> <td>159</td> <td>45</td> </tr> <tr> <td>III</td> <td>205</td> <td>45</td> </tr> <tr> <td>IV</td> <td>205</td> <td>5</td> </tr> <tr> <td>Total</td> <td></td> <td>115</td> </tr> </tbody> </table>					Standard type	Depth(m)	Well No.	I	33	20	II	159	45	III	205	45	IV	205	5	Total		115
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I	33	20																				
II	159	45																				
III	205	45																				
IV	205	5																				
Total		115																				

Table 4.8 Study on the Project Components Requested by HMG and Basic Plan (2/19)

Components		Pre-study Results		Study		Basic Plan								
(2) Irrigation area of 3,000ha by 160 deep wells and irrigation facilities construction.		The same.		The same.		Total irrigation area is 4,626ha. Possible discharge and the irrigation area in each deep well type are as follows.								
Discharge quantity per one deep well is more than 25ℓ/sec.		115 deep wells are possible to construct as described in (1). HMG recognized also them. (refer 2.1).		Irrigation area plans as 1ℓ/sec/ha (day time) and the probable discharge in each well (25ℓ/sec, 30ℓ/sec, 50ℓ/sec, 55ℓ/sec).		Type of possible discharge								
				According to the confirmation to HMG, object of the deep wells of this project is mainly for the irrigation. The wells for domestic use are not constructed as the basic concept.		No. of wells								
		Water charge by the wells will be paid by the farmer as the principle of HMG. Well construction will be desirable to select in a high groundwater potential area in order to lowering water charge.				Irrigation areas, ha								
		The existing vertical type turbine pumps are available for the discharge of 25ℓ/sec or more.				25ℓ/sec (125)								
						30ℓ/sec (150)								
						40ℓ/sec (400)								
						50ℓ/sec (1,000)								
						55ℓ/sec (0)								
						Total 115 (40) 4,625 (1,675)								
						(Note) (Well and area of the high priority)								
						(Nos. of wells and irrigation area are shown in Section 2.1 with each district, priority ranking)								
(2) Development Blocks and priority ranking		Nos. of development block, Nos. of well and irrigation area for each district and priority ranking are as follows (The location of 30 development blocks requested by HMG is shown on Fig-1).		Field investigation was carried out for 30 blocks requested from HMG. 30 blocks were categorized into A, B and C based on the results of hydrogeologic study, interview study and requests by HMG. Standard of category and its block are as follows.		8 blocks were decided as the highest priority development blocks. Nos. of their (3) blocks, name of district and Panchayat are as follows (the location of each block is shown on Fig. 1).								
(1) 30 development blocks (every 8km ² = 800ha) in the project area.														
District	No. of block	No. of wells	Irrigation area(ha)	Category	Description	Block No.	Development Block No.	District	Panchayat					
1st. Priority	Danusha	7	860	A	<ul style="list-style-type: none"> • High effectiveness by the development <ul style="list-style-type: none"> - high groundwater potential - good access - good willingness for the payment of the water charge, etc. • Very low link, low obstacle and problem on the above potentiality, access and willingness. 	D-6, D-7	S-1	Sarlahi	HARIWAN					
	Mahottari	3	300			D-8, M-4	S-7	Sarlahi	BRAMHAPURI					
	Serlahi	5	760			M-7, S-1	M-4	Mahottari	KISANNAGAR					
2nd. Priority	Sub total	16	1,920			B	It seems that the blocks have some difficulties for development in view of access condition etc. But good effectiveness for development is recognized.	S-4, S-7	M-7	Mahottari	RATAULGOHI			
		Danusha	2					260	D-10	D-6	Dhanusha	BENGASHIBAPUR		
		Mahottari	3					300	S-2	D-7	Dhanusha	BASAHIYA		
3rd. Priority	Sub total	5	460					It seems that the blocks have less G/W potential, poor access and low attractiveness in view of the develop-		D-1, D-2	D-8	Dhanusha	GHORGAS	
		Danusha	3							300	D-1, D-2	D-15	Dhanusha	NAKTAJHIJ
		Mahottari	2							160	D-3, D-4			
Total	30	366	3,000									D-5, D-9		

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (3/19)

Components	Pre-study Results	Study	Basic Plan
		ment effects. The location of blocks of which are proposed to change due to the above reasons and the avoidance from the under-going G/W project area.	D-11, D-12,M-1, M-2,M-3, M-5,M-6 M-8,M-9 M-10 M-11 S-3,S-6-S- 6
		Field investigation results of 30 blocks are as shown on Table-2. 8 blocks categorized into "A" were decided as the development blocks in the highest priority decided by the discussion with HMGN.	
(2) Nos. of possible development block: Not described	Not described.	As described in Sectopn 1.3, deep wells of 115 (23 Blocks) are possible to construct by the use of existing KR-2 materials & equipments. HMGN approved the above.	Nos. of possible development block: 23 Blocks Nos. of possible drilling well: 115 wells
(3) Locations of 23 blocks and their selection: Not described	Not described.	For the rest 15 blocks after a re-confirmation of the highest priority of 8 development blocks, the selection of 15 blocks was done with taking into account of the request from HMGN and based on the G/W potential map. The selection of them were discussed with HMGN. The study of selection for 23 blocks was carefully carried out to avoid the other under-going irrigation projects areas as described in Section 4.2.1.	30 development blocks requested from HMGN and re-located 23 development blocks after the study are as shown on Fig. 1 and Table 3. From the above study (1), (2) and (3), each district located the former blocks, nos. of the former development blocks in each priority rank. Nos. of deep wells and the irrigation area are changed as follows:

District	Development blocks of the first priority		Development blocks of 2-nd & 3-rd priorities		Total	
	Nos. of block	Irrigation area(ha)	Nos. of block	Irrigation area(ha)	Nos. of block	Irrigation area(ha)
Dhanusha	4	900	7	1,300	11	2,200
Mahottari	2	375	2	400	4	775
Sarlahi	2	400	6	1,250	8	1,650
Total	8	1,675	15	2,950	23	4,625

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (4/19)

Components	Pre-study Results	Study	Basic Plan
<p>2-2 Selection of 5 irrigation sites in each development block. The decision will be made in the D/D stage.</p>	<p>Typical 3 blocks will be selected from 30 development blocks in the D/D study. The decision of well location and preliminary design of irrigation facilities will be made in the basic design stage.</p>	<p>The first priority blocks (8 nos.) were selected based on the detailed field investigation works (access, topographic condition, cropping pattern, forest, pond, canal, village, etc.) with a reference of cadastral map (1/2, 400) and direction with HMGN because 8 blocks or some of which will be constructed and designed at the implementation stage of the first year.</p>	<p>(1) and (2) The summary of field investigation results for the first priority blocks (8 blocks) and the selected irrigation areas are shown on Table-4.</p>
-	<p>The standard of type classification will be done by means of well lay-out (independent well and linked wells)</p>	<p>(2) 5 irrigation areas in each block were decided taking into account of the following items.</p> <ul style="list-style-type: none"> - Irrigation area is based on Ward unit because the operation and maintenance after completion of the irrigation facilities are advisable to be carried out by the unit of the smallest administration (Ward). - In order to apply the irrigation system of linked group wells (2 wells or more) recommended from pre-study report, neighboring Wards will be selected for the area. - In order to improve the development effects, 5 irrigation areas in each block will be selected for a surrounded village in the center of the areas. - The area scared a river flood will be cancelled. - Wells interval will be at least 600m or more to prevent the influence. - The area of which existing farm road (access road) is good will be selected. 	
-			<p>(3) 3 development blocks (15 irrigation areas) conducted the topographic survey are as described below.</p>
<p>(3) 3 development blocks were selected from 23 blocks described in Section 2.1, taking into account of the following items. After the approval from HMGN, the survey of total 15 irrigation areas, 5 areas in each block, were conducted.</p>			

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (5/18)

Components	Pre-study Results	Study	Basic Plan				
			Development block	D-7	M-4	S-7	
		<p>(Principles of the selection of 3 blocks)</p> <ul style="list-style-type: none"> The block will be selected from 8 development blocks which the blocks will be constructed in the highest priority. The blocks will be selected in view of the representing type of the rest 20 blocks. The blocks will be selected for the potential area of 50 l/sec, 40 l/sec and 30 l/sec. The blocks will be selected one block from each district (Dhanusha, Mahottari and Sarlahi). The blocks will be selected each one block in view of geological & topographic conditions from the northern, middle and southern parts. 	District	Dhanusha	Mahottari	Sarlahi	
			Panchayat Design discharge(l/s)	BASAHYA 50	KIRANNAGAR 25	ERAMHAFRI 40	
			Irrigation area	50ha/area	25ha/area	40ha/area	Total 200ha
			Ward	Total 260ha	Total 125ha	Total 200ha	
			Ward No.	1	2A + 2B	7	
				2 + 3	3A	7 + 2A	
				5 + 5	3A + 3B + 3C	9A	
				3A	3B + 3C	9B + 9C	
				8B + 4B	4A + 4B	1A	

Surveyed 15 irrigation areas were decided the well locations and designed. Also, preliminary out of main canal was carried out (refer 4-1 (2)).

3. Ground water development plan
- Nos. of drilling wells: 150 (Average depth 150m)
 - Use of KR-2 materials & equipments and to be supplied the additional materials & equipments.

The same

- Additional overhaul of KR-2 equipments.

As a result of 23 blocks selection based on the hydro-geological results and the use of KR-2 existing equipments, total nos. of production wells is 115. Also the shortage and overhaul for the equipments are clarified as follows:

- Shortage of mud pump spare parts
- Overhaul on the drill rigs
- Shortage of tricone-bits and pipes
- Weak strength for collapse in screen pipes

Considerably large quantities of materials & equipments shall be additionally supplied for 115 wells construction.

- Reinforcement for the existing Johnson type screen
- supply of perforated pipe base wire-wrapped screen
- Overhaul on the drilling rigs

- 3.1 Groundwater potential (1) Hydrogeological study: Not described.

Confirmation of the shallow wells irrigation area.

Shallow wells irrigation area was clarified by the existing data and study.

Settlement of north limited line for shallow wells zone (G/W depth of 7m from the surface):

- It was confirmed that unavailable irrigation area by shallow wells where G/W depth is 7m or more and centrifugal pump for shallow well cannot be applied.
- Settlement of south limited line for shallow wells zone (by the check of distribution for a available shallow aquifer in 30-40 deep):
- The south limited line was checked from the dis-

Unavailable area by the shallow well irrigation was selected for the this project based on the deliberation from HMGN.

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (8/19)

Components	Pre-study Results	Study	Basic Plan
		<p>tribution of the shallow aquifer in the 7 profiles of N-S direction made by the existing deep well geologic data.</p>	
◆	<p>Analysis of hydrogeologic structure. 5 N-S profiles were interpreted based on the existing deep well data.</p>	<p>By analyzing of the total 7 N-S profiles, each aquifer (distribution, characteristics, etc.) was confirmed.</p>	<p>The development plan for the available aquifers is clarified from the G1-G6 aquifers. The details are shown in Section 3.2 (standard well specification).</p>
-	<p>Uncontinuous and unhomogenous geologic structure were indicated in E-W direction.</p>	<p>By analyzing of the total 3 E-W profiles, the continuity of east-west direction was studied.</p>	
-	<p>Distribution of G1-G5 aquifers was confirmed and the aquifer below 200m which belongs to upper Siwalik formation was suggested.</p>	<p>From the above study and the three drilled results TW1~TW3, G6 aquifer below G5 was confirmed.</p>	
◆	<p>G/W potential and development blocks The area along E-W highway was indicated to be the poor potential from the hydrogeologic viewpoints</p>	<p>The investigation work of discharge quantity on the existing deep wells was carried out (Table-1). In the northern area along E-W highway, it is indicated that potential area more than 25 l/sec discharge will be restricted in the part near Bagmati river and the Kamala river.</p>	<p>Low potential blocks of discharge less than 25 l/sec out of 30 blocks are re-located through the discussion with HMGN.</p>
-	<p>G/W potential map was made based on the existing data. 30 development blocks were judged to be possible as a whole.</p>	<p>In order to examine the feasibility on 30 development blocks, the investigation work of discharge quantity on the existing wells was carried out. G/W potential map was made based on this data and hydrogeological structures.</p>	
(2) Drilling of test wells	<p>Drillings of 3 test wells were recommended. Drilling points of which were in north, middle and south area represented each hydrogeology.</p>	<p>4 test wells were dugged at north area (Jammibas), middle area (two wells of Mujeria & Rani Bezar) and south area (Palkauli). Drilling results are as follows:</p>	
◆	<p>Not described</p>	<p>Drilling by hard type tricone bit was necessary in the north area because of many gravel and boulders. (drilling depth, 150m). Small quantity of 3-6l/s discharge was clarified, the area in and around this site and the area along EW highway show low G/W potential and low probability for deep tubewell irrigation.</p>	
-	<p>Recommendation of the confirmation of geology to reach 240m depth and deep aquifers below 200m.</p>	<p>Drilling depth of dugged two wells in the middle area was 212m and 230m deep respectively. Upper part of two drilled points is developed with clay layer. Aquifer consists of middle sand or gravel (φ5mm). Drilling efficiency was moderately good.</p>	
-	<p>Land subsidence occurring G/W abstraction was scarce in the south area where thick clay layer is expanded. Therefore, it was recommended to develop the G6 aquifer below 190m.</p>		

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (7/19)

Components	Pre-study Results	Study	Basic Plan												
		<ul style="list-style-type: none"> - The thick clay layers are predominantly developed to 170m deep in the south area. Main aquifer is composed of fine sand in the depth of 170m or more. (Drilling depth: 240m), which requires a countermeasure of land subsidence. - 8" Johnson screen of KR-2 used for the above 4 wells collapsed or damaged seriously, it was judged the screen had a weak collapse strength. 	<ul style="list-style-type: none"> - Drilling of test wells are as follows: <ul style="list-style-type: none"> - Use of one drilling rig & mud pump. - Use of 17 1/2" and 14 1/2" tri-cone bits. - One test well drilling per one development block. - Specification of test well is the same with that of production wells in each block. - 14" and 8" casing pipe and screen will be used for the test wells. 												
<ul style="list-style-type: none"> ⊕ Propose of testwell drilling Not described 	Not described	<p>Results of hydrogeological analysis and drilled test wells show that the characteristic of aquifer in the area is variable place by place.</p> <p>It needs to confirm and check for the G/W potential in north area and the details of fine sand layer in south area prior to well construction stage. Before starting of the production well construction, the drilling of test wells is recommended. Its advantages are;</p> <ul style="list-style-type: none"> - Hydrogeological and G/W potential conditions can be checked. - Risk on a dry well drilling or low discharge well less than 25 l/sec will be avoidable. - Progress and drilling capability for production wells can be grasped. - Specification and structure for production wells can be decided in detail from the test well results. 													
<ul style="list-style-type: none"> (3) Electric soundings Selection for deep well drilling points 10 blocks per one year 45 Soundings per one block Total 450 soundings 	<ul style="list-style-type: none"> - 10 blocks for the first year implementation - 10-20 soundings per one block - Propose of total 150 soundings 	<ul style="list-style-type: none"> ⊕ Electric soundings were carried out on 13 blocks out of 30 blocks requested from HMGN. Name of block and quantity carried out were as follows. <table border="1" data-bbox="1027 734 1187 1218"> <tr> <td>Dhanusha: D-6, D-7, D-8, D-12, (part of D-11)</td> <td>subtotal</td> <td>59</td> </tr> <tr> <td>Mahottari: M-1, M-2, M-3, M-4, M-7</td> <td>"</td> <td>44</td> </tr> <tr> <td>Sarlahi: S-1, S-2, S-4, S-7 (Part of S-6)</td> <td>"</td> <td>32</td> </tr> <tr> <td>total</td> <td></td> <td>135</td> </tr> </table> 	Dhanusha: D-6, D-7, D-8, D-12, (part of D-11)	subtotal	59	Mahottari: M-1, M-2, M-3, M-4, M-7	"	44	Sarlahi: S-1, S-2, S-4, S-7 (Part of S-6)	"	32	total		135	
Dhanusha: D-6, D-7, D-8, D-12, (part of D-11)	subtotal	59													
Mahottari: M-1, M-2, M-3, M-4, M-7	"	44													
Sarlahi: S-1, S-2, S-4, S-7 (Part of S-6)	"	32													
total		135													
		<p>From the above investigation results, the structure of resistivity distribution was obtained as follows:</p> <ul style="list-style-type: none"> - 3 aquifers were clarified in the artesian zone. 													

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (S/19)

Components	Study			Basic Plan
	Pre-study Results	Depth(m)	Thickness(m)	
		30-50	20-50	100-300
		100-110	40-70	150-1550
		150~	40-100	100-900
	<p>All the layer of 1,2 and 3 are confined because they are covered by clay layer with low resistivity. Above layer of 1 and 2 are sporadically distributed in lenticular form (like block form) with several kilometers spaces.</p> <p>Permeable layer and/or completely dried layer having high resistivity of 500-7,500Ω.m are developed near the surface at the top of fan. Its thickness ranges 20m to 50m and 80m in D-12 block. In area located this layer, the probability of confining layer and confined aquifer distribution is hardly expected.</p>			
	<p>② Selection of the deep well drilling points: Electric soundings were made for the selection of drilling points on the each block of the first priority of 8 blocks.</p>			
	<p>D-6 block: Good aquifer having the resistivity of 250-1700Ω.m is widely expanded below the depth of 110m.</p>			
	<p>D-7 block: Main aquifers are developed in the center parts below the depth of 120m where the resistivity is 180Ω.m or more. east and western parts of the block have a poor aquifer having low resistivity value to reach 250m in depth.</p>			
	<p>D-8 block: High resistivity layer exceeding 700Ω.m is judged to have a good G/W potential in the depth of 100 to 150m or below that. But, this high resistivity layer is lost in the eastern part of the block.</p>			
	<p>M-4 block: The results indicate no confined water exists since the high resistivity layer develops in the depth of 20-40m. Below the average depth of 40m, resistivity layer of 150-350Ω.m appears and it can be expected to distribute the river-bed water of the Ratu river.</p>			
	<p>2-nd and 3-rd aquifers have an excellent potential of G/W. These aquifers can be aimed for deep well construction. But it is impossible to clarify the sand grain size and the ratio of sand & gravel included from the resistivity value.</p>			
	<p>The distribution of confined water is hardly expected in the top of fan. Mainly phreatic water can be taken from the infiltration of the river-bed water. Therefore, except the area along the Ratu river, it is recommendable to decide the development blocks on the downstream area which confined aquifers exist.</p>			
	<p>D-6 block: It is judged to be able to obtain the sufficient discharge from this aquifer. Any place can be selected for deep well judging from electric soundings results. The depth of wells is recommendable to reach 205m.</p>			
	<p>D-7 block: Location of wells is recommendable to select as possible as the center part of the block. The recommendable depth of wells is 205m.</p>			
	<p>D-8 block: It is recommendable to select the well sites as possible as in the western part of the block. Well depth is 205m. But further soundings work needs in the implementation stage.</p>			
	<p>M-4 block: ground water level will exist below 40m from the surface. The drilling depth is recommendable to reach 155m. Un-confined water may be expected in this block.</p>			

Table 4.8 Study on the Project Components Requested by HMCN and Basic Plan (3/18)

Components	Pre-study Results	Study	Basic Plan
		<p>M-7 block: Though a high potential aquifer is widely distributed, which is underlaid below the depth of 130-150m and has the resistivity value of 250-460Ω.m, the aquifer has a poor continuity in N-S direction. In the western part, the another high potential layer demonstrating the resistivity value of 1,700Ω.m is locally distributed over that aquifer.</p>	<p>M-7 block: Well location is good in the western part. Recommendable well depth is 205m, further soundings are needed in the implementation stage.</p>
		<p>S-1 block: It is a tendency to have a low resistivity of 20-70Ω.m to reach in the depth of 100m. Geological log of the existing wells shows the alternation of gravel and clay layers are commonly expanded. Discharge quantity from the existing wells is considerably good. Resistivity layer in the depth of approx 30m has a high resistivity in the western part.</p>	<p>S-1 block: Shallow ground water is available. The aquifer is not clarified whether a phreatic or confined because thin clay layer only exists. In the western part of the block, wells need rather deeper depth than 89m of eastern part.</p>
		<p>S-4 block: The aquifer is underlaid in the depth of 30m to 100m (partly 150m) with a thin clay layer on that.</p>	<p>S-4 block: As same as S-1 block, shallow G/W is available. the recommendable depth of well is 89m.</p>
		<p>S-7 block: The aquifer having high G/W potential is underlaid below the depth of 100m or 140m which the resistivity ranges 100-1,020Ω.m. It has a tendency of lowering the resistivity and deepening in the downstream part.</p>	<p>S-7 block: It is recommendable to select the wells in the upstream part. The well depth is 205m.</p>
<p>3.2 Specification of a standard well: Not described.</p>	<p>Propose of the standard well type setting.</p>	<p>(1) Taking into account the hydrogeological results and the distribution of G/W potential, standard well type for each area was studied as follows.</p>	<p>4 standard well types were designed based on the hydrogeological characteristics. But the standard wells may be changed for the details based on the future test well results in the implementation stage.</p>

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (10/18)

Components		Pre-study Results					Study		Basic Plan	
Well type	Area	Drilling depth	C/W depth	Name of aquifer (Thickness)	Average depth of aquifer	Possible discharge	* A shallow aquifer will be only selected in the area of uninfluence condition for a shallow wells			
I	North Serahi	89m	80-20m	(10m) ² O1(8m) O2(25m)	10-20m 30-35m 65-70m	Average 400/sec				
II	North Mahotari North Dhanusa	159m	30-40m	(10m) ² O5-11(10m) O5(10m)	35-45m 80-110m 135-140m	25-300/sec				
III	South Serahi South Mahotari Central Dhanusa	205m	+2-6m	O2(18-25m) O3-13(20m) O3(10m) O4(15m)	70-80m 120-140m 160-170m 175-180m	Average 300/sec				
IV	North-Middle Mahotari & North-Middle Dhanusa	205m	20-35m	O4(10m) O3(20m) O5(20m)	70-80m 100-130m 140-160m	Average 400/sec				

(2) Influence area of well

Permeability coefficient and discharge of aquifers vary from a reason of their ununiformity. Supposing of the following various cases, the influence area (R) of wells was calculated as shown below.

Influence of one well is judged to be 300m. Therefore, wells interval needs at least 600m or more.

Permeability (cm/sec)	1x10 ⁻²	1x10 ⁻³	1x10 ⁻⁴
Thickness of aquifers	50	30 - 30m	30
Discharge (l/sec)	50	40	30
Recovery time (error of 0.001m)		30 days - 25200sec	
Porosity		0.28 (interval)	
Influence area (R)	300m	140m	100m
R = 25√TDS			

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (11/19)

Components		Pre-study Results			Study			Basic Plan			
3.3 Existing KR-2 Materials & equipments		- For the construction of 115 wells, pre-study team requested to HMNG to offer all the existing materials & equipments of KR-2. - HMNG approved the above. - The following quantity shows the results inventoried by pre-study team.			- The same as pre-study results - The following quantity shows the inventory results by the team.			Plan of consumption of the deep well drilling materials & equipments was decided as follows, based on the block locations, available quantity of the existing KR-2 materials & equipments and the specification of the deep well standard.			
Main materials & equipment	Q'ty	Quantity	Conditions	Quantity	Present conditions	Item	Qty	Available Qty	Qty of ac. consump.	Expected Consump.	remains
Drilling rig	7	7 nos.	Some trouble exists	7 nos.	One rig is unavailable due to out of order of mud pump	14" casing	5,882m	4,892m	48.2m/well	5,544m	412m
Air-compressor (10.5m ³ /min)	7	4 nos.	Good	4 nos.	Shortage of pressure 7kg/cm ² on the developing of deep portion	8" casing	13,392m	12,792m	38.4m/well	9,274m	3,400m
Submersible motor pump	10	5 nos.	"	5 nos.	2 nos. : 45/sec head 76m, 4 nos. : 90/sec. head 46m etc.	8" screen	5,076m	4,110m	34m/well	2,572.5m	1,587.5m
DC engine welder	7	4 nos.	(7 nos. was supplied)	4 nos.	Not easy to use.	Pump(90/2/s)	98 nos.	98 nos.	-	63 nos.	33 nos.
4t-cargo truck with 3t-crane	7	5 nos.	"	5 nos.	Good (repaired)	Lifting pipe*	88 nos.	90 nos.	-	35 nos.	2 nos.
Water tank lorry (4,000ℓ)	5	5 nos.	"	5 nos.	Good (one lorry is under repairing)	Pump(45/2/s)	79 nos.	79 nos.	-	47 nos.	32 nos.
3.5t-dump truck	5	10 nos.	2 nos. are out of order	10 nos.	Two trucks are under repairing	Lifting pipe*	79 nos.	79 nos.	-	74 nos.	5 nos.
12t-bulldozer	5	* Not described	"	5 nos.	Good (Ten bul-dozers are new one)						
4t-vibro road roller	3	7 nos.	"	12 nos.	Four trucks have no spare parts. Mainly used for shallow well works.						
1t-pick-up truck	7	7 nos.	"	5,592m	Available						
14" casing pipe	1,500m	5,310m	Equivalent of 80 wells(66m/well)	13,392m	Available qty is 107 wells X 46m/well after this year drillings						
8" casing pipe	10,000m	12,150m	Equivalent of 110 wells(110m/well)	5,076m	Available qty is 155 wells X 63m/well after this year drillings.						
8" Johnson screen	7,000m	5,010m	Equivalent of 167 wells(30m/well)	160 nos	Collapses strength is weak. Reinforcement & replacement are needed.						
Reducer (14" → 8")	160	160 nos	Not described	7 nos.	Good						
Tricone bit(17"1/2)	60	-	"	0	All the bits will be used out in this year.						
" (14"3/4)	105	-	"	79 nos.	12"1/4 bit (54 nos.) is remained.						
Vertical turbine pump (45ℓ/sec)	76	8 nos. + 79 nos	8 nos.(EBARA), 72 supplied 79 nos.(OKAMOTO), 83 "	98 nos	Eight pumps were used. Shortage of some parts.						
Vertical turbine pump (60ℓ/sec)	75	8 nos. + 95 nos	Serious trouble exists	98 nos	No problem is found.						

* Lifting pipe length is 30m/pump.
 Note: Available quantity means the number after used for 18 wells by TIATSP in this year.
 : 8" screen will be used after the reinforcement
 : 8" ring base wire-wrapped screen (1,996.6m) will be additionally supplied and be used.

Table 4.8 Study on the Project Components Requested by HMG and Basic Plan (12/19)

Components	Pre-study Results	Study	Basic Plan
(2) Problems on the materials & equipments for drilling and additional materials & equipment:	<ul style="list-style-type: none"> ◆ Spare parts of mud pump: The followings were no stored. <ul style="list-style-type: none"> - Piston rod packing - Ground packing A and B - Bushing ◆ All the drilling rigs were out of order. The over-haul will be completed until Jan'87. 	<p>The followings are no stored.</p> <ul style="list-style-type: none"> - Cylinder liner - Piston rubber - Bearings <p>6 drilling rigs are now usable, one rig is out of order in the bearing of mud pump.</p> <p>i) TRD-500 : Rotary-tongue of one rig is out of order. (It needs replacement) : 4 water-swivels and wire cables must be replaced. : lack of 3 stabilizers (14 3/4")</p> <p>ii) YRD-501R : bearing of one mud pump is out of order. : Mast of one rig cannot stand up, the gear box is occurred the noise & vibrations. : 3 water-swivels and wire-cables must be replaced.</p>	<p>The following additional materials are required to be supplied for the implementation of project.</p> <ul style="list-style-type: none"> - Spare parts of mud pumps. - (mud pump is one of the hardest using equipments). - The other necessary spare parts and parts are required to replace.
◆ Many troubles were occurred on the granted vertical turbine pumps of 95 nos (for 6 nos out of installed 8 nos).		<p>The troubles were occurred in the granted pumps of 8 nos. in '82 (the troubles were solved by the pump maker). The another granted pumps of 95 nos (101 nos. in actual) have no problem as the test running results.</p>	Solved.
◆ 14" casing pipe: Not described.		<p>14" casing pipes of 612m long included 5% spare will be shortaged for 23 blocks, 115 production deep wells.</p>	<p>The additional 14" casing pipes of 612m (102 nos.) are required, but minor change of the quantity will occur.</p>
◆ 8" casing pipe: Not described.		<p>8" casing pipes of the total 9,324m long (1,554 nos) will be used by the construction of 115 production wells.</p>	<p>No additional 8" casing pipe is required.</p>
◆ Reinforcement of 8" screen: Not described.		<p>In the depth from 80m to 150m, the reinforcement measure as described in [3.1(2)] will be taken on the granted Johnson screen. Below the depth of 150m, the ring base wire-wrapped screen will be used (the reinforced screen have a shortage in the collapse strength).</p>	<p>Existing 8" Johnson screen shall be reinforced. The necessary quantity to be reinforced is 2,572.5m. 8" ring base wire-wrapped screen of 1,996.5m is to be supplied additionally.</p>
◆ 20" conductor pipe: Not described.		<p>All the conductor pipes to be installed are not removed. Existing quantity is 84m only. The consumption quantity is follows: {(av. 12m X 115 Nos) X 1.05 - 84m} X 1.05 including 5% spare. Total 3m X 484 nos.</p>	<p>Quantity to be supplied is 1,368m (3m X 456 nos.)</p>

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (13/13)

Components	Pre-study Results	Study	Basic Plan
◆	Centerlizer for 8" pipe: Not described.	Drilling diameter of the production well is 17"1/2 throughout all the depth. For the installation of 8" pipes, the centerlizer are needed.	Quantity to be supplied is 835 nos. on the 8" casing pipe (hole dia = 17"1/2).
◆	Parts of vertical turbine pump: Not described.	<p>The following parts were recognized to be shortage. (It is recommended to involve 5% spare on i), ii) & iii)</p> <ul style="list-style-type: none"> i) Shortage of lifting (column) pipes, 90m for the turbine pump of 60ℓ/sec. ii) Shortage of shaft couplings, 120 nos. for the turbine pump of 60ℓ/sec. Shortage of 29 nos. key. iii) Shortage of engine batteries of 9 nos. (Existing batteries are 59 nos. only). iv) Shortage of line shaft couplings of 77 nos for the turbine pump of 45ℓ/sec. 	<p>These parts (i~iv) for vertical turbine pump are needed to supply in the 3rd or 2nd implementation stage.</p> <ul style="list-style-type: none"> i) Additional supply of the lifting pipes 225m (= 113 nos.) ii) Additional supply of the shaft couplings of 188 (for 60 ℓ/sec. pump) and the keys of 34 nos. iii) Additional supply of engine batteries of 13 nos for 60ℓ/sec pump. iv) Additional supply of line-shaft couplings of 77 nos for 45ℓ/s pump.
◆	Supply of the pump for pumping test (small capacity by high head on a discharge): Not described.	<p>In the northern part, the well have the possibility that a pumping water level may be drawdown to the depth of 50m or more and a discharge may be 10ℓ/sec or less. The submersible motor pumps granted under KR-2 have big capacity of pumping up head, 75m and discharge of 45ℓ/sec (too large capacity for a pumping test).</p>	<p>Additional submersible motor pump for a pumping test is required to supply. The required pump is of high head and small discharge. The granted engine generator under KR-2 will be used for the above pump.</p>
◆	Drilling bit: Not described.	<p>All the bits for the drillings of 115 wells are required to supply from Japan.</p> <ul style="list-style-type: none"> i) 17 1/2" tricone bit will be consumed one hard type bit per 70m drillings in northern parts and one medium to hard type bit per 90m drillings in southern area. ii) 14 3/4" tricone bit will be consumed one hard type bit per 60m drillings in northern parts and one medium to hard type bit on 100m drillings in southern area. 	<p>The followings i~iv are included 10% spare in each quantity.</p> <ul style="list-style-type: none"> i) Additional supply of 17 1/2" tricone bits of 130 nos. for 4 years. ii) Additional supply of 14 3/4" tricone bits of 130 nos. for 4 years. iii) Additional supply of hole opener (14 3/4" → 17 1/2") of 70 nos. for 4 years.
◆	Other spare parts etc: To be supplied.	<p>The spare parts of the following vehicles and construction equipments are shortage.</p> <ul style="list-style-type: none"> i) Spare parts of the jeeps, trucks and construction equipments granted before 1982. ii) The Jeeps and trucks granted under KR-2 in 1983. (Various kinds of filters) 	<p>The necessary spare parts shall be added.</p>

Table 4.8 Study on the Project Components Requested by HMCN and Basic Plan (14/19)

Components	Pre-study Results	Study	Basic Plan
(3) Granted drilling materials & equipments: Not described.	<ul style="list-style-type: none"> ◇ Submersible motor pump for pumping tests (low head and large discharge capacity): Not described. ◇ High pressure type air compressor and others: Not described. 	<ul style="list-style-type: none"> ◇ There are no available pumps (submersible motor pump of the capacity of low head and large discharge) for 8" well in the existing KR-2 materials & equipments. ◇ Existing air compressors for air lifting have the capacity of 7 kg/cm² in TRD and 10.5 kg/cm² in YRD respectively. The above capacity shows not to be sufficient for the developing of deep portion screens, wells of which are planned in the maximum depth of 200m. 	<ul style="list-style-type: none"> ◇ It is needed to newly supply a submersible motor pump which is available for 8" well and has a capacity of low head and large discharge. ◇ Air compressor of approx. capacity of 20 kg/cm², 20m³/min and air pipes of 200m are needed to newly supply.
(4) Transportation vehicles:			
◇ 4t - cargo trucks with 3t - crane of 5 nos. will be supplied from HMCN.	◇ The same, four (5) trucks are usable.	◇ Five (5) trucks are usable, total six (6) trucks are needed for the well and main canal construction in six (6) sites at the same time (one truck per one site).	◇ One truck is needed to newly supply.
◇ 4t - cargo trucks. Not described.	◇ The same, four (4) trucks are usable.	◇ It is possible to rent cars in Nepal for the shortages.	◇ Not necessary to additionally supply.
◇ Fuel tank lorry (4,000ℳ)	◇ The same, two (2) lorries are usable.	◇ Even if two lorries were supplied, one lorry per two drilling sites is needed.	◇ One lorry is needed to additionally supply.
◇ Water tank lorries (4,000ℳ)	◇ The same, four (4) lorries are usable.	◇ Even if five lorries were supplied, one lorry per each drilling site is needed.	◇ One lorry is needed to additionally supply.
◇ 20t - trailer truck Not described.	◇ The same, Not described.	◇ Three trucks are existing. One truck per two drilling sites will be sufficient.	◇ Not necessary to additionally supply.
◇ 1t - pick up trucks of 7 nos. will be supplied.	◇ The same, seven (7) trucks are usable.	◇ All the existing trucks are used in the shallow well project. The spare parts are consuming. Therefore, it is recommendable to additionally supply one truck per one drilling site.	◇ Six trucks are needed to additionally supply.
◇ 5t-fork lift: Not described.	◇ The same. Not described.	◇ One lift only exists. For the loadings of the drilling pipes on trailer truck, one additional lift is needed to supply due to the pipes are separately keeping in two stores.	◇ One lift is needed to additionally supply.
(6) Construction equipment:			
◇ 6t - bull dozer Not described.	◇ The same.	◇ One bull dozer only exists.	◇ Not necessary to additionally supply.
◇ 11t - bull dozer	◇ The same. Not described.	◇ Thirteen (13) bull dozers exist. The quantity is sufficient for the construction.	◇ Ditto
◇ Five (5) bull dozers will be supplied.	◇ The same. Not described.	◇ Five (5) loaders exist. Same as the above.	◇ Ditto
◇ 0.8m ³ - wheel loader Not described.	◇ The same. Not described.	◇ Six (6) loaders exist. Same as the above.	◇ Ditto
◇ 1.2m ³ - wheel loader Not described.	◇ Five (5) loaders. The same. Not described.	◇ One grader only exists. One additional grader is needed to construct a temporary road.	◇ One grader is needed to additionally supply.

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (15/19)

Components	Pre-study Results	Study	Basic Plan
<ul style="list-style-type: none"> ◆ 3.1m - motor graders of 2 nos. will be supplied. ◆ 4t - vibro road rollers of 3 nos. will be supplied. ◆ One pair of tractor and 2t-trailer will be supplied. ◆ 3.5t - dump trucks of 5 nos. will be supplied. ◆ 0.5m³ - concrete mixers of 4 nos. will be supplied. 	<ul style="list-style-type: none"> ◆ The same. ◆ Not described. ◆ The same. ◆ Not described. ◆ The same. ◆ Three nos. ◆ The same. ◆ Eight (8) nos. ◆ The same. ◆ Four (4) nos. 	<ul style="list-style-type: none"> ◆ Five (5) graders exist. The quantity is sufficient for the construction. ◆ Five (5) rollers exist. One roller per each site of a main canal construction is needed (six sites at the same time). ◆ Six (6) tractors exist (including for the shallow well project). It is possible to rent tractors at the site for the shortages. ◆ Ten (10) trucks including one truck under repair are usable. Two (2) trucks per each site of a main canal construction are needed. ◆ Four (4) mixers exist. One mixer per one site of a main canal construction is needed. 	<ul style="list-style-type: none"> ◆ Not necessary to additionally supply. ◆ One roller is needed to additionally supply. ◆ Not necessary to additionally supply. ◆ Two (2) trucks are needed to additionally supply. ◆ Two (2) mixers are needed to additionally supply.
(6) Vehicles for operation and maintenance:			
<ul style="list-style-type: none"> ◆ Wagon type jeeps of 3 nos. will be supplied. ◆ Jeep ◆ Not described. 	<ul style="list-style-type: none"> ◆ Three (3) jeeps are usable. Topo-survey works need three jeeps. In addition, each one jeep is needed for the management and operation of the respective offices for a consultant, drilling contractor and civil contractor. ◆ All the existing jeeps were used up. Seven (7) jeeps are needed through the construction works for a consultant (one jeep), drilling contractor (4 jeeps) and civil contractor (7 jeeps). 	<ul style="list-style-type: none"> ◆ Three (3) jeeps are needed to additionally supply. ◆ Twelve (12) jeeps are needed to additionally supply. 	
4. Irrigation and Drainage Plan:			
4.1 Concept of planning:			
(1) Planned irrigable area average 20 ha/well.	Water requirement: 10/sec/ha.	The same	As described in Section 1.3.(2), the planned irrigation area bases on each deep well discharge (250/sec, 300/sec, 400/sec, 500/sec & 550/sec) and the water requirement of 10/sec/ha.
(2) Layout of wells and design of main canal will be decided in the D/D stage.	<ul style="list-style-type: none"> - The same as Section 2.2. The followings will be studied at the preliminary design: - Recommendation of linked wells system more than two wells. - Investigation and confirmation of a good hydrogeology by electric soundings. - Avoidance of reverse slope and steep slope. - Utilization of domestic water. 	<ul style="list-style-type: none"> - Preliminary and detailed design will be 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 physically. - 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. 	<ul style="list-style-type: none"> - Number of main irrigation facilities in the studied 15 areas are as follows: - {Per one planned irrigation area} <ul style="list-style-type: none"> Pump house and operator house 1 nos. each Main canal length 1.6 km Turn out 7 nos. - 9 areas Drop 14 nos. - 6 areas Cross-drain 3 nos. Road across structure 2 nos. Division box 9 nos. - 1 no.

Table 4.8 Study on the Project Components Requested by HMCN and Basic Plan (16/16)

Components	Pre-study Results	Study	Basic Plan
		<ul style="list-style-type: none"> - Point of a pump station will be selected a terrace in the irrigable area in order to avoid a reverse slope and taking into account of well's influence area, hydrogeologic conditions. - Utilization for domestic water will be taken into consideration on the pump station neighboring a village. <p>Toposurvey was done with a consideration on the above.</p> <p>Based on the topo-map, the selection of well point, preliminary lay-out of main canal and related structures were decided on 15 irrigation areas of 3 blocks.</p>	<ul style="list-style-type: none"> Corner box 4 nos. Pre-cast check plate 10 nos. Cattle pass 4 nos. Pool for domestic utilization 0.2 nos. Access road length 120 m <p>(From existing road to pump station)</p>
4.2 Irrigation facilities:	Main irrigation facilities consist of a main canal, pump house and operation room etc. Preliminary design will be done in the b	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.	Pump house of one story is made of brick, mortar and plaster. The size is 13.50m ² (= 5.0m X 2.7m) X 2.7m.
◆ Pump station: Pump house (1 no.) made by concrete one story. 17.64m ² (4.2m X 4.2m X 2.7m)			
◆ Baffle tank (1 nos.): Not specified.		Baffle tank in the delivery of pump. "V" - notch for a measuring in its out-let are needed.	Baffle tank is made by brick, mortar structure and attached "V" notch.
◆ Bathing pool: Not specified.		The pump station neighbouring a large scale village shall be constructed the bathing pool which is able to use for a domestic (drinking, bathing and washing).	Bathing pool is made one no. in each development block by brick, mortar structure.
◆ Water supply pipe: (total 500m) PVC 8", 6"		Bathing pool will be made for the utilization of farmer's domestic use. But water supply system will not be made because it has a problem in a effective use compared the construction costs.	Water supply pipe system is not made.
◆ Operator house (1 nos.): concrete made, one story 17.28m ² (4.8m X 3.6m X 2.4m)		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.	Operator house is made by brick, mortar structure of one story. The space is 9.72m ² (3.6m X 2.7m) X 2.7m.
(2) Main canal and related structure	Concrete-made canal was recommended. The section suited in discharge was recommended. asic design stage.	Canal embankment of 50cm high from the ground will be designed in order to prevent the water stagnation in a rainy season. Canal section will be designed in the suitable size for a discharge. And the section is the same size	<ul style="list-style-type: none"> - 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:
◆ Main canal (total 500m) Concrete made Canal section 0.315m ² (0.525m X 0.6m)			

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (17/18)

Components	Pre-study Results	Study	Basic Plan		
			Type	I	II
		<p>throughout all the canal route in area for an application of the rotation irrigation system which is easy water management.</p> <ul style="list-style-type: none"> - Brick-made canal structure was strongly recommended from HMGN though pre-cast concrete flume was intended. Brick structure has some advantages such as 1) both construction costs in the structures are nearly same (one layer brick structure is rather cheaper than pre-cast concrete structure) 2) maintenance by a farmer in future is easy etc. <p>- Canal section and longitudinal slope</p> <p>Longitudinal slope will be decided by the velocity within the range of 0.8 - 0.8 m/sec to prevent the brick-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.</p>	<p>Inside size (width X height) (cm)</p> <p>35 X 42</p> <p>35 X 35</p> <p>28 X 28</p>		
◆ Siphon (2nos.) Concrete-made.	Not described	<p>Siphon in a small size canal is feared to suspend a sand and mud. The cleanings of the suspended materials are impossible.</p>	<p>Design discharge (l/sec)</p> <p>50-55</p> <p>40</p> <p>30</p> <p>Design velocity (m/sec)</p> <p>0.55</p> <p>0.50</p> <p>0.73</p> <p>Max. discharge (l/sec)</p> <p>80</p> <p>65</p> <p>40</p> <p>Max. velocity</p> <p>0.80</p> <p>0.77</p> <p>0.79</p>		
◆ Aqueduct (1no.) Concrete-made	The same as the above	<p>From the field investigation results, any bridge were not needed in each irrigation area of development block.</p>			
◆ Drainage culvert Not described.	Ditto.	<p>Drainage culvert will be constructed at the crossing point of the canal and drainage ways. It will be made by pipe structure of large diameter to remove a sitting mud and sand.</p>			
◆ Drop (2nos.) Concrete-made.	Ditto	<p>Longitudinal slope will be required to avoid the steep slope exceeding 1/200 in view of the velocity.</p>			
◆ Turn-out (20nos.) Concrete	The same as the above	<p>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 in even quantity.</p>			
◆ Division box - A type - B type Not described.	Ditto.	<p>- A type (to be installed in the division point of canal) Division box (A) is needed to install in the division point of canal in order to make a smoothening flow and get a stabilized flow. In the necessitated place in topographic viewpoint, the box will acts same as drop structure.</p>			
		<p>Siphon is not planned. In case of crossing a agriculture road, the culvert system covered on a canal by pre-cast concrete slab will be used. The approach having gentle slope will be made by the reclamation to reach the slab.</p> <p>Aqueduct is not needed.</p> <p>The pipe made by pre-cast concrete will be installed in the lower part of canal embankment. The in-let part of the pipe will be prevented by the guide-wall constructed by brick.</p> <p>The drop of brick masonry is provided at the necessary point.</p> <p>The number of turn-out of main canal is 7 or 14 nos. Turn-out will be made by brick, the box to decelerate water in turn-out will be installed at the out-let.</p> <p>Both (A) and (B) are made with brick in the necessary points.</p>			

Table 4.3 Study on the Project Components Requested by HMGN and Basic Plan (18/19)

Components	Pre-study Results	Study	Basic Plan
		<ul style="list-style-type: none"> - B type (to be installed in the canal corner) Division box (B) is needed to install at the corner of canal in order to have the same functions as (B). 	
④ Cattle pass Not described.	Ditto.	Cattle pass is needed to construct for the passing over the canal of a cow, buffalo, goat, etc.	In the necessary place of canal, pre-cast concrete slab will be placed on the canal.
④ Agricultural road/administrating road Not described.	The same	<ul style="list-style-type: none"> - Land compensation problem will be defensed within the allowably minimum limit. - Canal administrator can walk along the embankment tops of the both canal dikes. - Cart roads for a transportation of agricultural tools and products are already constructed. 	<ul style="list-style-type: none"> - Administrative road is not needed to construct. - Agricultural road is not needed to newly construct.
5. Administration and Management System			
5.1 Responsible office Ministry of Agriculture Dept. of Agriculture	The same	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.	The same
5.2 Organization of operation and management TIATSP	The same	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 maintenances.	<p>The same TIATSP is required to consolidate the following section</p> <ul style="list-style-type: none"> Construction : Increase of a capable staff Drilling : Same as the above Irrigation : Ditto Workshop : Ditto Agriculture : Ditto Extension & training Operation & maintenance : Newly established <ul style="list-style-type: none"> - 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. - Personnel expenditure of the operator - Fuel cost for pump engine - Maintenance and operation costs of the facilities <p>The subsidy by HMGN will be needed at the following order.</p> <ul style="list-style-type: none"> - First years : All the costs will be subsidized by HMGN.

Table 4.8 Study on the Project Components Requested by HMGN and Basic Plan (19/19)

Components	Pre-study Results	Study	Basic Plan
<p>6. Allocation of the Project Costs</p> <p>6.1 Wells and related buildings (Pump house, operator house)</p> <p>(1) Construction cost : by Japan</p> <p>(2) Land acquisition and compensation : Not described</p>	<p>By Japan.</p> <p>By HMGN.</p>	<p>It is no problem to allocate the construction cost to the Government of Japan according to the grant aid system.</p> <p>According to the grant-aid system in Japan, the said costs are allocated to HMGN.</p>	<p>The following : The half costs will be subsidized by two years HMGN.</p> <p>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.</p> <p>The same as the pre-study results.</p> <p>The same as the above.</p>
<p>6.2 Main canal and related structures (turn out, drop, culvert, etc.)</p> <p>(1) Construction cost : by Japan</p> <p>(2) Site purchase and compensation : Not described.</p>	<p>By Japan.</p> <p>By HMGN.</p>	<p>The same as Section 6.1.(1).</p> <p>The same as Section 6.1.(2).</p>	<p>The same as the pre-study results.</p> <p>The same as the above.</p>
<p>6.3 Lateral canal (earth canal after turn out) : by the beneficial farmers.</p> <p>6.4 Temporary roads for the construction (new road construction and existing road repair).</p> <p>(1) Construction costs : by Japan</p> <p>(2) Land acquisition and compensation : Not described</p>	<p>By HMGN.</p> <p>By HMGN.</p>	<p>In the irrigation project by HMGN, the farmers are to construct the tertiary or lateral canal(it means branch canal in this project).</p> <p>It is judged to be impossible to construct by HMGN in view of a finance and capability.</p>	<p>All the lateral canals shall be constructed by the beneficial farmers.</p> <p>By Japan (Contractor).</p> <p>By HMGN.</p>

Table 5.1 Summary of Irrigation Facilities (1/3)

Irrigation Facilities	Basahiya		Kisannagar		Bramhapuri	
	Area	Required Number	Area	Required Number	Area	Required Number
1. Irrigation Canal	1	2,570m	1	1,480m	1	1,610m
	2	1,820m	2	1,270m	2	1,120m
	3	1,600m	3	1,580m	3	1,380m
	4	1,130m	4	1,480m	4	1,790m
	5	1,840m	5	1,770m	5	1,450m
Total		8,960m		7,580m		7,350m
2. Pump House	1	1	1	1	1	1
	2	1	2	1	2	1
	3	1	3	1	3	1
	4	1	4	1	4	1
	5	1	5	1	5	1
Total		5		5		5
3. Operator Hut	1	1	1	1	1	1
	2	1	2	1	2	1
	3	1	3	1	3	1
	4	1	4	1	4	1
	5	1	5	1	5	1
Total		5		5		5
4. Buffle Tank	1	1	1	1	1	1
	2	1	2	1	2	1
	3	1	3	1	3	1
	4	1	4	1	4	1
	5	1	5	1	5	1
Total		5		5		5
5. Bathing Pool	1	1	1	--	1	--
	2	--	2	1	2	--
	3	--	3	--	3	--
	4	--	4	--	4	--
	5	--	5	--	5	1
Total		1		1		1

Table 5.1 Summary of Irrigation Facilities (2/3)

Irrigation Facilities	Basahiya		Kisannagar		Bramhapuri	
	Area	Required Number	Area	Required Number	Area	Required Number
6. Cattle Pass	1	4	1	2	1	3
	2	3	2	2	2	6
	3	4	3	3	3	3
	4	3	4	3	4	3
	5	5	5	3	5	3
Total		19		13		18
7. Road Crossing (Large)	1	—	1	1	1	—
	2	—	2	1	2	2
	3	—	3	1	3	—
	4	—	4	3	4	—
	5	1	5	3	5	—
Total		1		9		2
8. Road Crossing (Small)	1	11	1	6	1	7
	2	10	2	6	2	6
	3	9	3	6	3	6
	4	9	4	7	4	6
	5	11	5	5	5	5
Total		50		30		30
9. Turnout	1	7	1	7	1	14
	2	14	2	7	2	7
	3	14	3	7	3	14
	4	14	4	7	4	7
	5	14	5	7	5	7
Total		63		35		49
10. Crossdrain	1	2	1	—	1	5
	2	4	2	—	2	2
	3	1	3	—	3	4
	4	3	4	—	4	2
	5	3	5	—	5	2
Total		13		—		15

Table 5.1 Summary of Irrigation Facilities (3/3)

Irrigation Facilities	Basahiya		Kisannagar		Bramhapuri	
	Area	Required Number	Area	Required Number	Area	Required Number
11. Corner Box	1	10	1	1	1	1
	2	8	2	1	2	1
	3	2	3	4	3	4
	4	1	4	—	4	8
	5	8	5	3	5	3
Total		29		9		17
12. Division Box	1	1	1	—	1	1
	2	—	2	1	2	1
	3	—	3	1	3	—
	4	1	4	3	4	—
	5	1	5	2	5	—
Total		3		7		2
13. Drop	1	—	1	10	1	—
	2	—	2	8	2	—
	3	—	3	10	3	—
	4	3	4	5	4	—
	5	1	5	8	5	—
Total		4		41		—
14. Check Plate	1	8	1	7	1	12
	2	14	2	7	2	6
	3	14	3	7	3	10
	4	13	4	9	4	7
	5	15	5	7	5	7
Total		64		37		42

Table 5.2 Preliminary Specification of Additional Materials and Equipment (1/3)

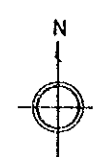
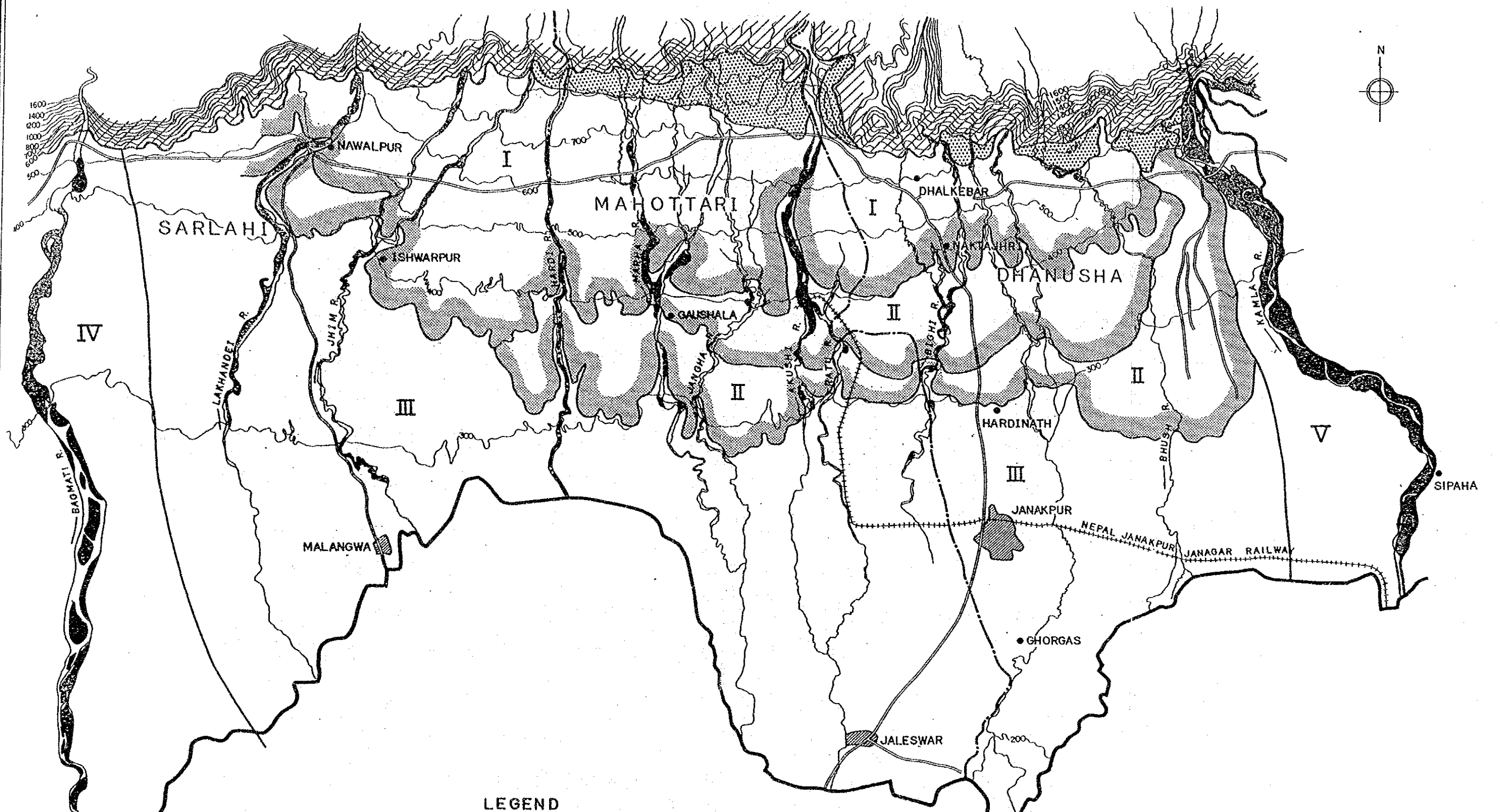
Materials and Equipment	Preliminary Specification
<u>A. Materials and Equipment for Drilling Deep Tubewell</u>	
1. 20"-conductor pipe (Total : 1,368m)	L= 3m, diameter:20", thickness : 10.8mm
2. 14"-casing pipe (Total : 612m)	L= 6m, diameter : 14" thickness : 6.4mm
3. 8"-Johnson type screen (Total : 2,572.5m) reinforcing materials (L= 5.25m and L= 3.25m)	$\phi = 193.7\text{mm}$, ring (thickness : 6.0mm) and flat bar (16mm wide, 6mm thick)
4. Ring base wire-wrapped screen (Total : 1,996.5m)	L= 5.5m, diameter : 8", collapse strength : 28kg/cm ²
5. Centerlizer for 8"- casing pipe (594 nos.)	For 8"-casing pipe
6. 17½"- tricone bit (130 nos.)	API standard (H type and MH type)
7. 14¾"- tricone bit (130 nos.)	API standard (H type and MH type)
8. Hole opener (70 nos.)	API standard (14¾" → 17½")
9. High pressure air compressor (1no.)	20 kg/cm ² , 20m ³ /min.
10. DC engine welder (5nos.)	3.6kVA
11. Water jetting nozzle (7nos.)	Fittable to mud pump (NAS-7 type)
12. Bailer (5nos.)	Diameter is smaller than that of reinforced screen
13. Suction pipe (ϕ 4") (390.5m)	L= 5.5m
14. Air pipe (ϕ 1") (506m)	L= 5.5m
15. 8"-pipe and shaft (8 × 25m) for production tubewells	For Ebara vertical turbine pump, center rod : 2 m, diameter : 35.7mm, outside column : L= 2m, diameter : 8"

Table 5.2 Preliminary Specification of Additional Materials and Equipment (2/3)

Materials and Equipment	Preliminary Specification
16. 8"-pipe and shaft (7×25m) for production tubewells	For OKAMOTO vertical turbine pump, center rod :L=2.75m, diameter : 35mm, outside column : L=2.75m, diameter : 200mm
17. Large capacity low head submersible pump (1 no.) (excluding generator)	For 8"-tubewell, 50ℓ/sec 36m head For 8"-tubewell, 40ℓ/sec 50m head
18. 8"-delivery pipe for EBARA pump (68 sets)	L=1.2m, both flanged, with elbow
19. 6"-delivery pipe for OKAMOTO pump (47 sets)	L=1.2m, both flanged, with elbow
20. Portable water tank (24nos.)	Made of water proof cloth (3m ³)
21. Portable fuel tank (4nos.)	Made of steel plate (2m ³)
22. Triangle notch tank (5nos.)	Made of steel plate (2.5m ³)
23. Gas welder (5 nos.)	Oxgen, Acetylen (100kg) with assembly
24. Wireless(1 set)	70km (host :1 no., branch:6 nos.)
25. Current meter (3 sets)	0.2~1.5 m/sec
26. Mud balance, viscosity meter (1 set)	For measuring mud
27. Spare parts for drilling rig and mud pump	1 lot
28. Recording unit for electric logging aparatus (Geologer 300) (1 set)	-
29. Electiric sounding apparatus (1 set)	Sounding depth = 300 m, 800 V - 300 mA, including electric wire and other accessories

Table 5.2 Preliminary Specification of Additional Materials and Equipment (3/3)

Materials and Equipment	Preliminary Specification
30. Gradation analysis apparatus (1 set)	For measuring fine sand and silt
31. Automatic water level gauge (10 nos.)	For recording continuously one month
32. Tools and tester (1 set)	--
33. Steel wire (65 roles)	No.18
<u>B. Transportation Vehicle</u>	
1. 4t-cargo truck with 3t-crane (1 no.)	Length of loading platform: 4m
2. 4,000ℓ-fuel tank lorry (1 no.)	--
3. 4,000ℓ-water tank lorry (1 no.)	--
4. 1t-pick-up truck (6 nos.)	4WD, station wagon type (5 persons)
5. 4t-fork lift (1 no.)	--
<u>C. Construction Equipment</u>	
1. 2.8m ³ -motor grader (1no.)	--
2. 4t-vibro road roller (1 no.)	--
3. 3.5t-dump truck (2 nos.)	Length of loading platform : 3.5m
4. 0.5t-concrete mixer (2 nos.)	Movable type
<u>D. Vehicle for Operation</u>	
1. Jeep (12nos.)	Short chassis, Land Cruiser type
2. Wagon type jeep (3 nos.)	Long chassis, Land Cruiser type



LEGEND
(GEOLOGY)

- ~ 300 ~ CONTOUR
- RIVER
- ROAD
- ++++ RAILWAY
- TOWNSHIP
- NATIONAL BOUNDARY
- ZONE BOUNDARY
- DISTRICT BOUNDARY

- ALLUVIAL(1) FAN DEPOSITS (3 UNITS) FLOOD AND PRESENT RIVER DEPOSITS
- G1 ALLUVIAL(2) G1 ~ G4; AOUFER LAYERS
- G2
- G5 & G6 TERRACE DEPOSITS
- SIWALIK FORMATION

(TOPOGRAPHIC CLASSIFICATION)

- I : UPPER TERRACE
- II : MIDDLE TERRACE
- III : LOWER TERRACE
- IV : BAGMATI FLOOD AREA
- V : KAMLA FLOOD AREA

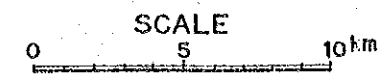


Fig. 3.1 HYDROGEOLOGICAL MAP

HIS MAJESTY'S GOVERNMENT OF NEPAL		
TERAI GROUNDWATER DEVELOPMENT PROJECT		
TITLE OF DRAWING		
Date	Drawing No.	
JAPAN INTERNATIONAL COOPERATION AGENCY		

Fig. 3.2 HYDROGEOLOGICAL PROFILE (1/3)

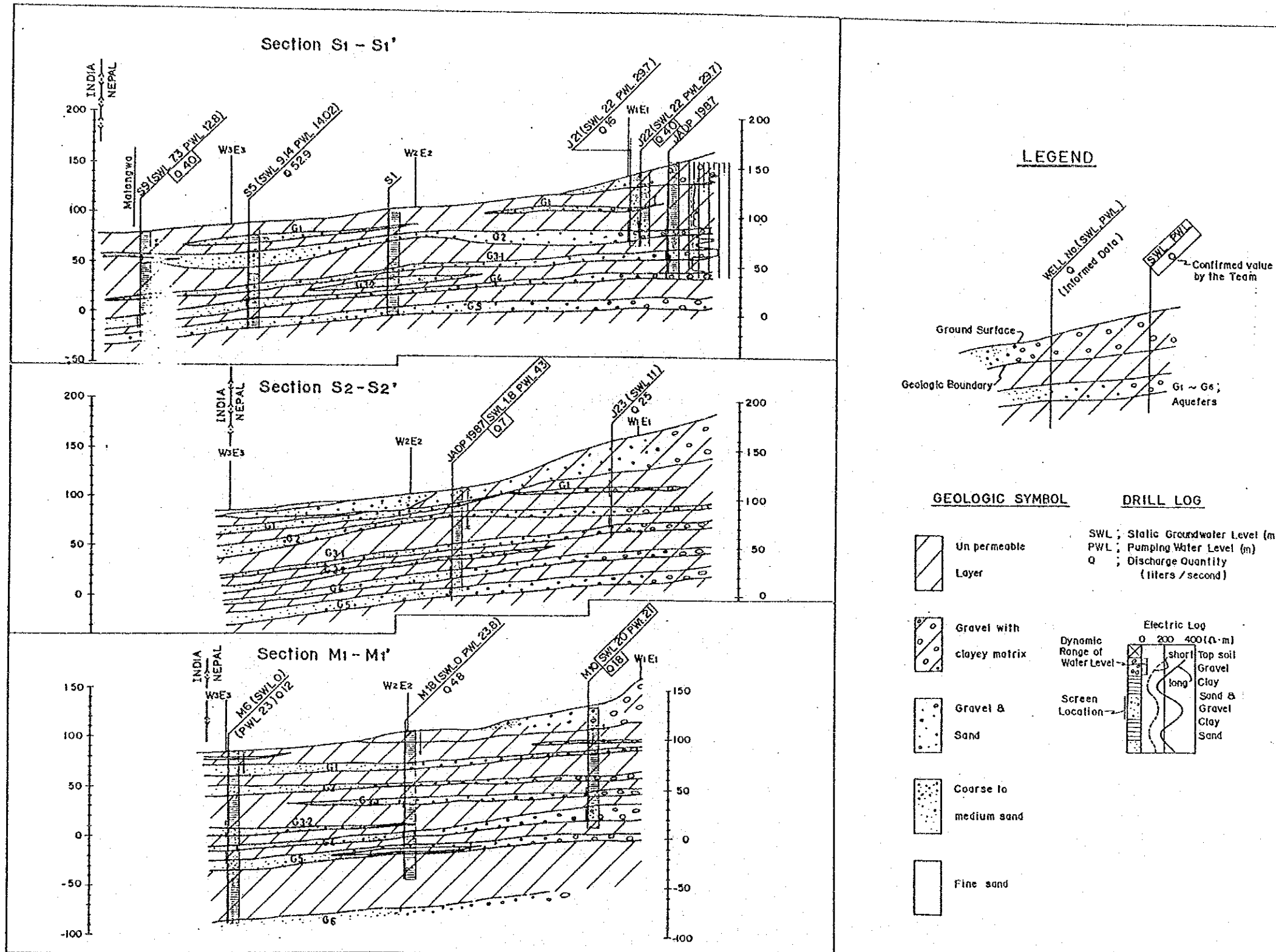


Fig. 3.2 HYDROGEOLOGICAL PROFILE (2/3)

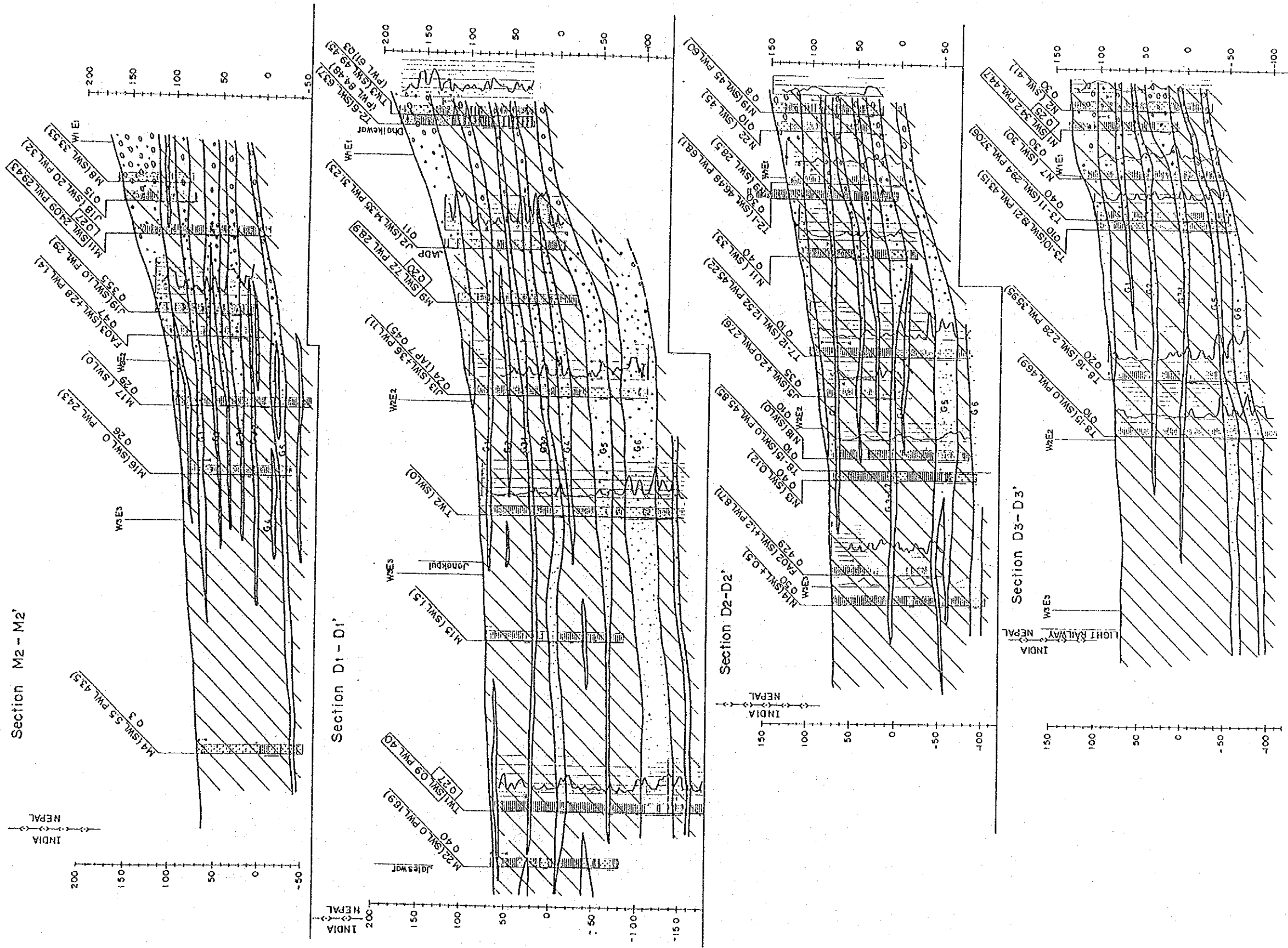
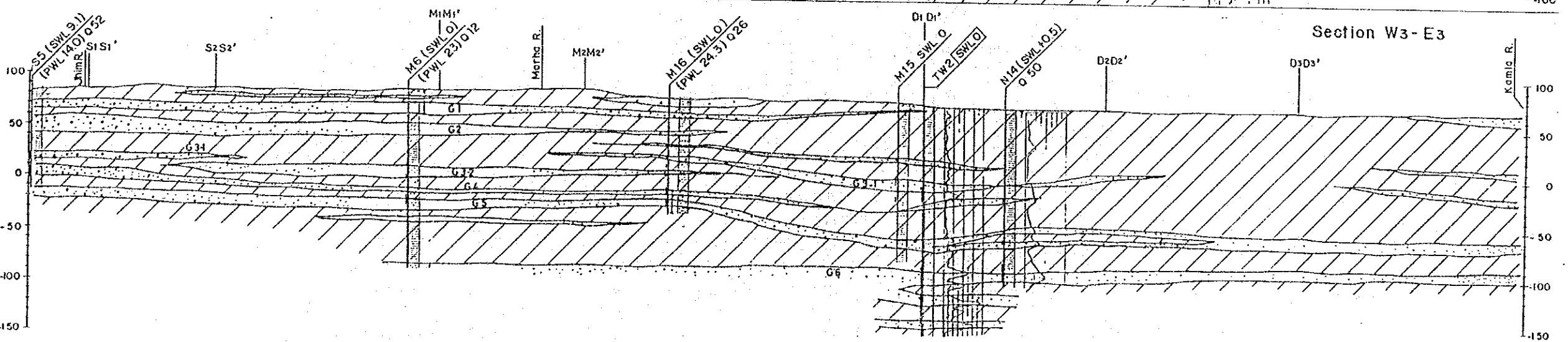
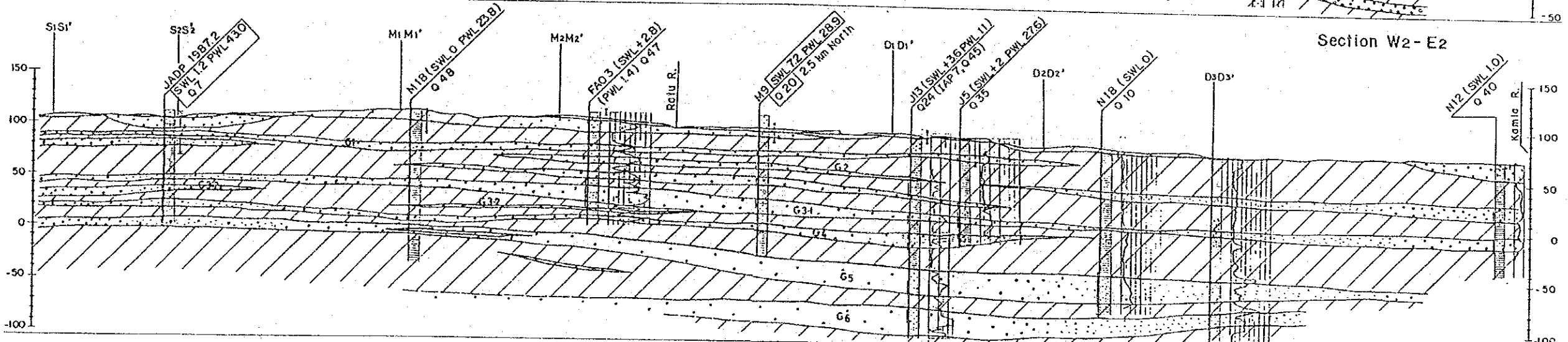
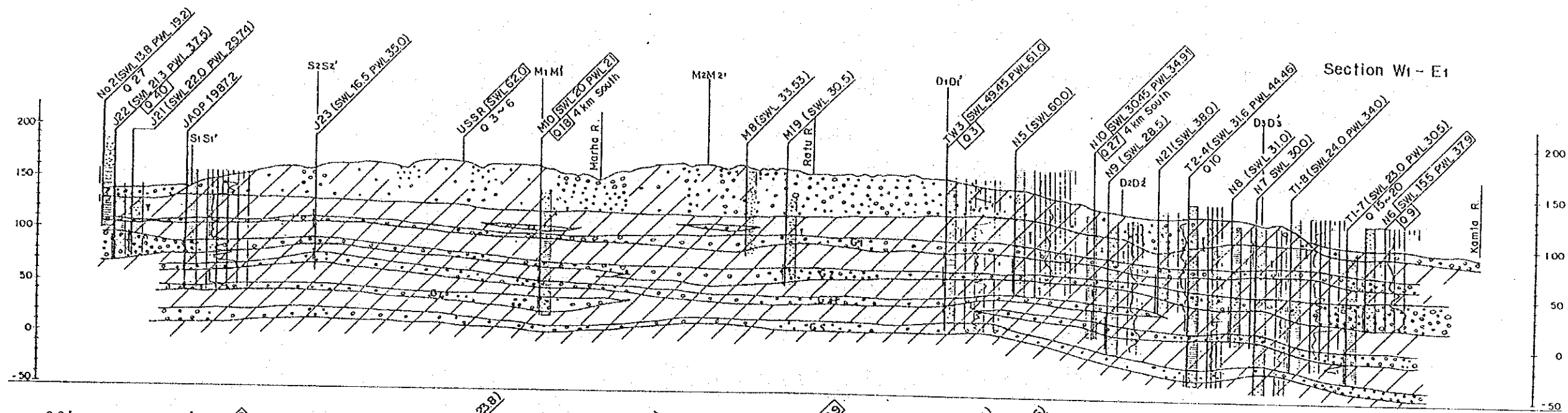


Fig. 3.2 HYDROGEOLOGICAL PROFILE(3/3)

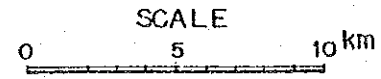




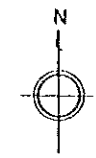
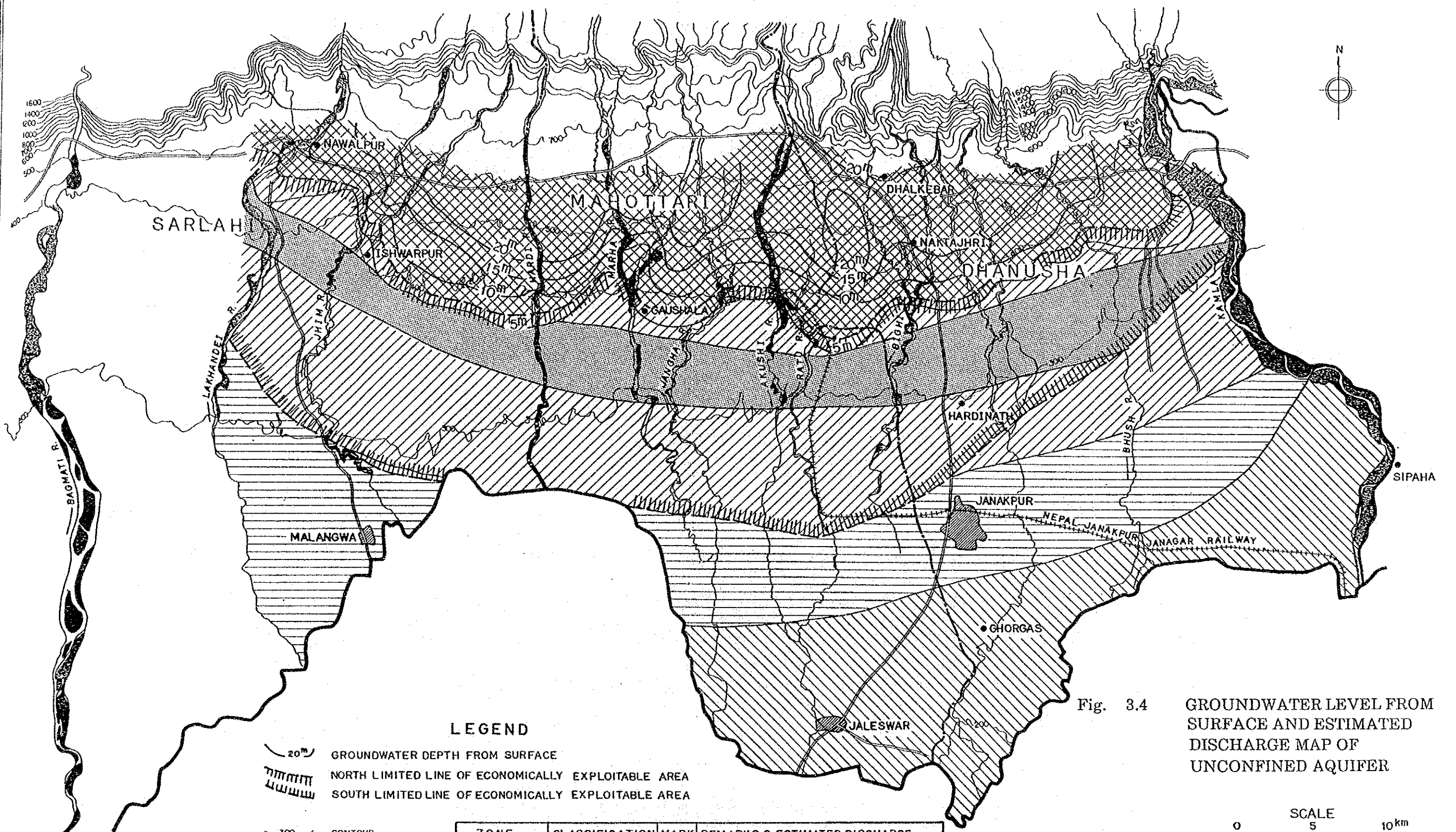
- LEGEND**
- 300- CONTOUR
 - RIVER
 - ROAD
 - RAILWAY
 - TOWNSHIP
 - NATIONAL BOUNDARY
 - ZONE BOUNDARY
 - DISTRICT BOUNDARY
 - D1—D1' GEOLOGICAL PROFILE LINE

- INFORMED WELL DATA
- INFORMED WELL DATA, PUMP INSTALLED
- INFORMED WELL DATA, RUNNING AT PRESENT
- ◐ OBSERVED WELL, SCREEN CRASHED
- OBSERVED WELL FOR DISCHARGE Q'TY
- ▲ SEASONABLY OR WEAK ARTESIAN WELL
- △ ARTESIAN WELL

Fig. 3.3 LOCATION MAP OF EXISTING WELLS



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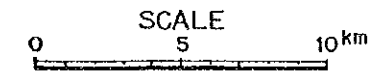
LEGEND

- 20^m GROUNDWATER DEPTH FROM SURFACE
- NORTH LIMITED LINE OF ECONOMICALLY EXPLOITABLE AREA
- SOUTH LIMITED LINE OF ECONOMICALLY EXPLOITABLE AREA
- 300 CONTOUR
- RIVER
- ROAD
- RAILWAY
- TOWNSHIP
- NATIONAL BOUNDARY
- ZONE BOUNDARY
- DISTRICT BOUNDARY

ZONE	CLASSIFICATION	MARK	REMARKS & ESTIMATED DISCHARGE
ZONE 1	NOT AVAILABLE		TOO DEEP HEAD FOR CENTRIFUGAL PUMP
ZONE 2	ZONE 2-A		MORE THAN 10 L/SEC.
	ZONE 2-B		7 TO 10 L/SEC.
ZONE 3	ZONE 3-A		5 TO 7 L/SEC.
	ZONE 3-B		LESS THAN 5 L/SEC.

(AFTER AIBA & YAMOTO REPORT 1983)

Fig. 3.4 GROUNDWATER LEVEL FROM SURFACE AND ESTIMATED DISCHARGE MAP OF UNCONFINED AQUIFER



HIS MAJESTY'S GOVERNMENT OF NEPAL
 TERAI GROUNDWATER DEVELOPMENT PROJECT
 TITLE OF DRAWING

Date	MAY 1987	Drawing No.	3-5
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