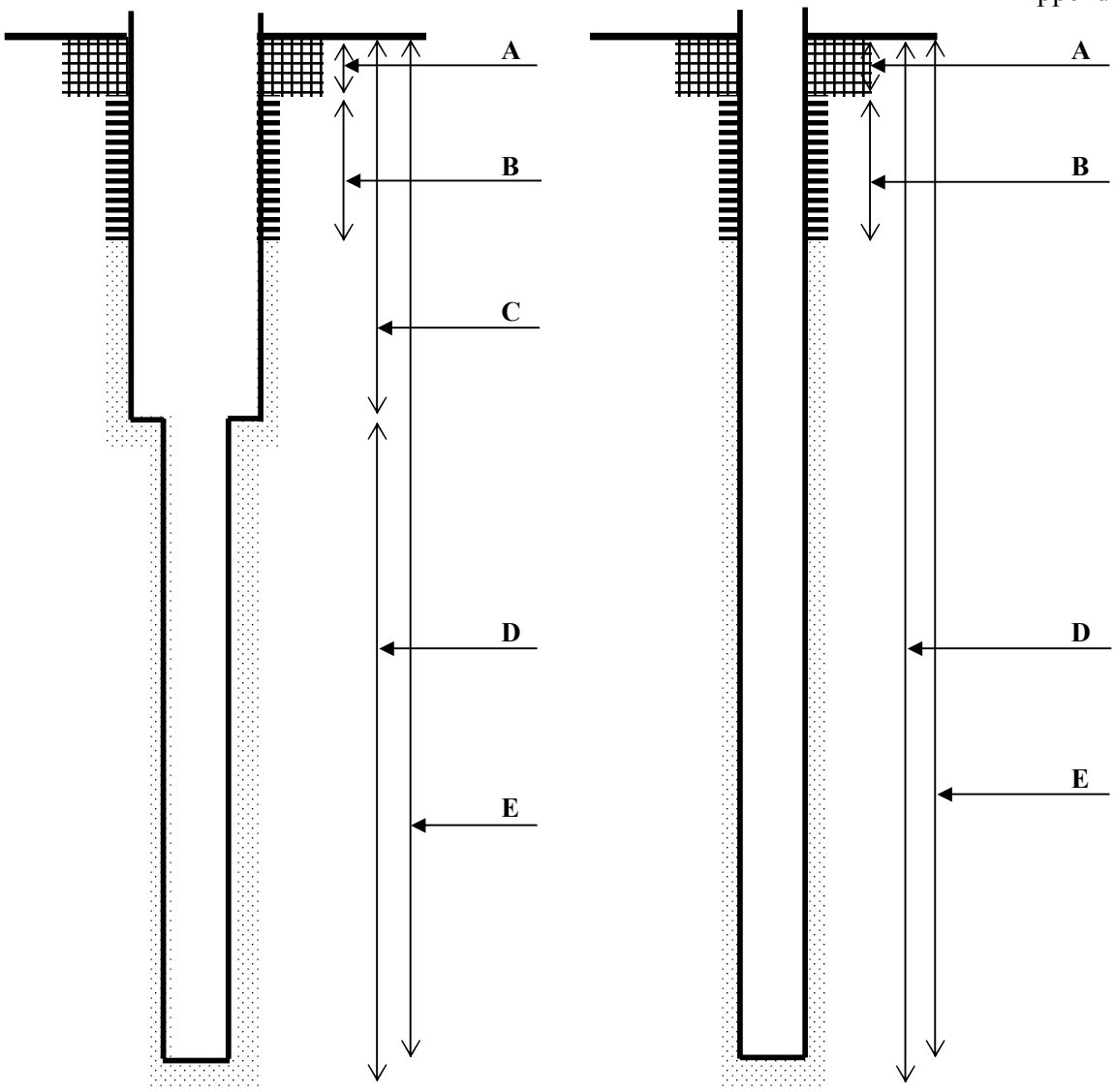
Appendix 1

Standard Well Design (type-1 and type-2)



Type-1 **Type-2**

(Solar pump + Generator pump system) **(Public power pump system only)**

Example of Wells	Well Dimension				
	A: concrete base (size)	**B: Clay packing (m)**	**C: Installation depth of 12" pipes for pump chamber of 2 pumps**	**D: Installation depth of 6" casing/screen pipes**	**E: Drilling depth (m)**
K1-1	L x W x D = 1.5 x 1.5 x 1.0	Average depth: around 10m in general. Below the clay packing, gravel pack will be done	42	120	125
K2-3			32	120	125
G-3			67	150	155
D4-1			58	150	155
D4-2			58	150	155
Others			40 - 60	50 - 150	55 - 155

Note: 1 Exploratory wells of 17 of the first investigation shall be used for production wells of stage-1 implementation

2 Remaining casing/screnn pipes in the first investigation stage will be used

Standard Well Design (type-1 and type-2)

Appendix 2

Spread Sheet on Plan and Design for Rural Water Supply

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**				
1	**Province**		:	Dak Lak	
2	**Name of Commune/Town**		:	Krong Nan (I, II, III, IV, V, VI, VII, VIII, VIIII)	
3	**System Number**		:	D-1	
4	**Water Resource**		:	Deep Well	(present number of wells 1)

II	**WATER SUPPLY PLAN**							
A	**Plan Parameter (1)**							
1	**Water resource**			Deep well				
1)	**Altitude of JICA deep well**	El m	:	714				
2)	**Latitude**	N	:	1432676	Longitude	E 213371		
3)	**Permissible yield /well**	m3/day (l/sec)	:	346	(4) (see note)			
4)	**Static water surface level (S.W.L)**	m	:	12				
5)	**Dynamic water level (D.W.L)**	m	:	28				
6)	**Well diameter**	mm	:	150/110				
2	**Water demand**			2001	2010	2020		
1)	**Number of household**	Numbers	:	1998				
2)	**Population**	Numbers	:	10989	12903	15423		
3)	**Per capita consumption**	l/s/d	:	30	60	60		
4)	**Maximum daily water demand**	m3/day	:	129	1027	1444		
5)	**Maximum hourly water demand**	m3/hour		11	86	120		
3	**Required number of well**	no.	:	1	2	2	Total	5
B	**Plan Parameter (2)**							
1	**Water intake**		:	Deep Well				
2	**Raw water transmission**		:	GI Pipes				
3	**Reservoir**		:	Ground Reservoir and elevated tower				
4	**Water treatment**		:	Chlorination,				
5	**Water distribution**		:	PVC, PE, Public taps, house connection				
6	**Power supply**		:	Public Net				

III	**WATER SUPPLY FACILITY DESIGN**									
A	**Source**	**Deep Wells**								
		Numbers needed in addition to existing Jica well								
		2002-2010	2							
		2010-2020	2							
B	**Pump**	**Submersible pump**					**Booster pumps**			
		Yield:	4.0 l/s		Lift 55 m			Yield		Lift
		2002-2010	3	nos			2002-2010	86	m3/hr	15 m
		2010-2020	2	nos			2010-2020	34	m3/hr	15 m
C	**Power**	**Public net**								
D	**Reservoir**	**Ground reservoir**					**Elevated Tower**			
		2002-2010	300	m3			2002-2010	43	m3	
		2010-2020	122	m3			2010-2020	17	m3	
		Total	422	m3			Total	60	m3	
E	**Treatment**	**Chlorination**							:	
		Chlorination via concrete mixing tank								
F	**Pipeline, raw water**									
		Diameter	100	mm						
		2002-2010	4.5	km						
		2010-2020	3	km						
G	**Distribution pipes**									
		Diameter		2002-2010		2010-2020				:
		25-65	mm	21	km	1.9	km			
		75-125	mm	12.5	km	1.1	km			
		150-200	mm	3.5	km		km			
I	**Public taps**	Type	: 1		Numbers :	10				

IV Notes

A well yield of 346 m3/day is used for planning

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**				
	1	**Province**		:	Dak Lak
	2	**Name of Commune/Town**		:	Ea Leo (K1, K2, K3, K4, K5, K6, K7, K8, K9, K10, K11, Blech, Le Da)
	3	**System Number**		:	D-2
	4	**Water Resource**		:	Deep Well (present number of wells 1

II	**WATER SUPPLY PLAN**										
	A	**Plan Parameter (1)**									
	1	**Water resource**			Deep well						
	1)	**Altitude of JICA deep well**	El m	:	644						
	2)	**Latitude**	N	:	1461593			Longitude	E	196617	
	3)	**Permissible yield /well**	m3/day (l/sec)	:	225	(	2.6	) (See note)			
	4)	**Static water surface level (S.W.L)**	m	:	24						
	5)	**Dynamic water level (D.W.L)**	m	:	46						
	6)	**Well diameter**	mm	:	150/110						
	2	**Water demand**			2001		2010		2020		
	1)	**Number of household**	Numbers	:	2631						
	2)	**Population**	Numbers	:	15180		18464		22953		
	3)	**Per capita consumption**	l/s/d	:	30		60		60		
	4)	**Maximum daily water demand**	m3/day	:	178		1469		2148		
	5)	**Maximum hourly water demand**	m3/hour		15		123		179		
	3	**Required number of well**	no.	:	1		6		3	Total	10
	B	**Plan Parameter (2)**									
	1	**Water intake**		:	Deep Well						
	2	**Raw water transmission**		:	GI Pipes						
	3	**Reservoir**		:	Ground Reservoir						
	4	**Water treatment**		:	Chlorination,						
	5	**Water distribution**		:	PVC, PE, Public taps, house connection						
	6	**Power supply**		:	Public Net						

III	**WATER SUPPLY FACILITY DESIGN**									
	A	**Source**	**Deep Wells**							
			Numbers needed in addition to existing Jica well							
			2002-2010	6						
			2010-2020	3						
	B	**Pump**	**Submersible pump**							
			Yield:	2.6	l/s		Lift	80	m	
			2002-2010	7	nos					
			2010-2020	3	nos					
	C	**Power**	**Public net**							
	D	**Reservoir**	**Ground reservoir**							
			2002-2010	490	m3					
			2010-2020	227	m3					
			Total	717	m3					
	E	**Treatment**	**Chlorination**							
										:
			Chlorination via concrete mixing tank							
	F	**Pipeline, raw water**								
			Diameter	100	mm					
			2002-2010	10.5	km					
			2010-2020	4.5	km					
	G	**Distribution pipes**								
			Diameter			2002-2010		2010-2020		:
			25-65	mm		21.5	km	8.5	km	
			75-125	mm		12	km	3.5	km	
			150-200	mm		3.5	km	0.5	km	
	I	**Public taps**	Type	:	1		Numbers :	16		

IV Notes
The well drilled by the study team only yielded 0,5 l/s. For calculation purposes a yield of 216 m3/day has been used for future wells

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**						
	1	**Province**		:	Dak Lak		
	2	**Name of Commune/Town**		:	Krung Puk (Nos. 4, 9, MB, Cho, Krung Buk, Krai A, Kla)		
	3	**System Number**		:	D 3-1		
	4	**Water Resource**		:	Deep Well	(present number of wells	1

II	**WATER SUPPLY PLAN**										
A	**Plan Parameter (1)**										
1	**Water resource**			Deep well							
1)	**Altitude of JICA deep well**	El m	:	484							
2)	**Latitude**	N	:	1412609			Longitude	E	217070		
3)	**Permissible yield /well**	m3/day (l/sec)	:	415	(4.8)						
4)	**Static water surface level (S.W.L)**	m	:	9							
5)	**Dynamic water level (D.W.L)**	m	:	30							
6)	**Well diameter**	mm	:	150/110							
2	**Water demand**			2001		2010			2020		
1)	**Number of household**	Numbers	:	1192							
2)	**Population**	Numbers	:	6791		8556			11060		
3)	**Per capita consumption**	l/s/d	:	30		60			60		
4)	**Maximum daily water demand**	m3/day	:	79		681			1035		
5)	**Maximum hourly water demand**	m3/hour		7		57			86		
3	**Required number of well**	no.	:	1		1			1	Total	3
B	**Plan Parameter (2)**										
1	**Water intake**		:	Deep Well							
2	**Raw water transmission**		:	GI Pipes							
3	**Reservoir**		:	Ground Reservoir with elevated tower.							
4	**Water treatment**		:	Chlorination,							
5	**Water distribution**		:	PVC, PE, Public taps, house connection							
6	**Power supply**		:	Public Net							

III	**WATER SUPPLY FACILITY DESIGN**									
A	**Source**	**Deep Wells**								
		Numbers needed in addition to existing Jica well								
		2002-2010	1							
		2010-2020	1							
B	**Pump**	**Submersible pump**				**Booster pumps**				
		Yield: 4.8	l/s	Lift	55 m		Yield		Lift	
		2002-2010	2	nos		2002-2010	57	m3/hr	15	m
		2010-2020	1	nos		2010-2020	29	m3/hr	15	m
C	**Power**	**Public net**								
D	**Reservoir**	**Ground reservoir**				**Elevated Tower**				
		2002-2010	199	m3		2002-2010	28	m3		
		2010-2020	103	m3		2010-2020	15	m3		
		Total	302	m3		Total	43	m3		
E	**Treatment**	**Chlorination**						:		
		Chlorination via concrete mixing tank								
F	**Pipeline, raw water**									
		Diameter	100	mm						
		2002-2010	3	km						
		2010-2020	1.5	km						
G	**Distribution pipes**									
		Diameter		2002-2010		2010-2020			:	
		25-65	mm	10	km	1.5	km			
		75-125	mm	3.5	km	0.5	km			
		150-200	mm	1	km		km			
I	**Public taps**	Type :	1	Numbers :	9					

IV Notes

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**				
1	**Province**		**:**	Dak Lak	
2	**Name of Commune/Town**		**:**	Krung Puk (Nos. 8, 10,11, 12, 17)	
3	**System Number**		**:**	D-3-2	
4	**Water Resource**		**:**	Deep Well (present number of wells	0)

II	**WATER SUPPLY PLAN**								
A	**Plan Parameter (1)**								
1	**Water resource**			Deep well					
1)	**Altitude of JICA deep well**	El m	:						
2)	**Latitude**	N	:			Longitude	E		
3)	**Permissible yield /well**	m3/day (l/sec)	:	415	(4.8)				
4)	**Static water surface level (S.W.L)**	m	:						
5)	**Dynamic water level (D.W.L)**	m	:						
6)	**Well diameter**	mm	:						
2	**Water demand**			2001		2010		2020	
1)	**Number of household**	Numbers	:	640					
2)	**Population**	Numbers	:	3543		4463		5770	
3)	**Per capita consumption**	l/s/d	:	30		60		60	
4)	**Maximum daily water demand**	m3/day	:	41		355		540	
5)	**Maximum hourly water demand**	m3/hour		4		30		45	
3	**Required number of well**	no.	:	1		0		1	Total 2
B	**Plan Parameter (2)**								
1	**Water intake**		:	Deep Well					
2	**Raw water transmission**		:	GI Pipes					
3	**Reservoir**		:	Ground Reservoir and elevated tower					
4	**Water treatment**		:	Chlorination,					
5	**Water distribution**		:	PVC, PE, Public taps, house connection					
6	**Power supply**		:	Public Net and/or generator					

III	**WATER SUPPLY FACILITY DESIGN**										
A	**Source**	**Deep Wells**									
		Numbers needed in addition to existing Jica well									
		2002-2010	1								
		2010-2020	1								
B	**Pump**	**Submersible pump**					**Booster pumps**				
		Yield:	4.8 l/s	Lift	70 m			Yield		Lift	
		2002-2010	1	nos			2002-2010	30	m3/hr	15	m
		2010-2020	1	nos			2010-2020	15	m3/hr	15	m
C	**Power**	**Public net, alternatively**									
		Diesel generator									
D	**Reservoir**	**Ground reservoir**					**Elevated Tower**				
		2002-2010	104	m3			2002-2010	15	m3		
		2010-2020	54	m3			2010-2020	8	m3		
		Total	158	m3			Total	23	m3		
E	**Treatment**	**Chlorination**							:		
		Chlorination via concrete mixing tank									
F	**Pipeline, raw water**										
		Diameter	100	mm							
		2002-2010	1.5	km							
		2010-2020	1.5	km							
G	**Distribution pipes**										
		Diameter		2002-2010		2010-2020				:	
		25-65	mm	15	km	5	km				
		75-125	mm	5	km	2	km				
		150-200	mm	2	km		km				
I	**Public taps**	Type	: 1		Numbers :	7					

IV Notes
No well was constructed in the area during the first phase of the study.

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**			
1	**Province**		:	Dak Lak
2	**Name of Commune/Town**		:	Ea Drong (T1, T2, T3, T4, T5, T6, E-Joh)
3	**System Number**		:	D 4-1
4	**Water Resource**		:	Deep Well (present number of wells 1

II	**WATER SUPPLY PLAN**								
A	**Plan Parameter (1)**								
1	**Water resource**			Deep well					
1)	**Altitude of JICA deep well**	El m	:	615					
2)	**Latitude**	N	:	1427255		Longitude	E	209295	
3)	**Permissible yield /well**	m3/day (l/sec)	:	268	(3.1)				
4)	**Static water surface level (S.W.L)**	m	:	16					
5)	**Dynamic water level (D.W.L)**	m	:	42					
6)	**Well diameter**	mm	:	150					
2	**Water demand**			2001	2010			2020	
1)	**Number of household**	Numbers	:	1245					
2)	**Population**	Numbers	:	6984	7775			8760	
3)	**Per capita consumption**	l/s/d	:	30	60			60	
4)	**Maximum daily water demand**	m3/day	:	82	619			820	
5)	**Maximum hourly water demand**	m3/hour		7	52			68	
3	**Required number of well**	no.	:	1	2			1	Total 4
B	**Plan Parameter (2)**								
1	**Water intake**		:	Deep Well					
2	**Raw water transmission**		:	GI Pipes					
3	**Reservoir**		:	Ground Reservoir with elevated tower					
4	**Water treatment**		:	Aeration and Slow filtration. Chlorination,					
5	**Water distribution**		:	PVC, PE, Public taps, house connection					
6	**Power supply**		:	Public Net and/or generator/solar systems					

III	**WATER SUPPLY FACILITY DESIGN**									
A	**Source**	**Deep Wells**								
		Numbers needed in addition to existing Jica well								
		2002-2010	2							
		2010-2020	1							
B	**Pump**	**Submersible pump**					**Booster pumps**			
		Yield:	3.1 l/s	Lift	80 m			Yield		Lift
		2002-2010	3 nos				2002-2010	52	m3/hr	15 m
		2010-2020	1 nos				2010-2020	16	m3/hr	15 m
C	**Power**	**Public net**								
		Diesel generator								
		Solar system								
D	**Reservoir**	**Ground reservoir**					**Elevated Tower**			
		2002-2010	181 m3				2002-2010	26 m3		
		2010-2020	59 m3				2010-2020	9 m3		
		Total	240 m3				Total	35 m3		
E	**Treatment**	**Aeration, Slow sand filtration and chlorination.**								
		Aeration area:		**Reaction tank, volume:**			**Filter area**	:		
		2002-2010	5 m2	2002-2010	26 m3		2002-2010	:	11 m2	
		2010-2020	2 m2	2010-2020	9 m3		2010-2020	:	3 m2	
		Total	7 m2	Total	35 m3		Total		14 m2	
		Chlorination via concrete mixing tank								
F	**Pipeline, raw water**									
		Diameter	100 mm							
		2002-2010	4.5 km							
		2010-2020	1.5 km							
G	**Distribution pipes**									
		Diameter		2002-2010	2010-2020			:		
		25-65 mm		17 km	2 km					
		75-125 mm		6.5 km	1 km					
		150-200 mm		3 km	km					
I	**Public taps**	Type	: 1	Numbers :	9					

IV Notes

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**			
1	**Province**		:	Dak Lak
2	**Name of Commune/Town**		:	Ea Drong (7, 8, 9, 10, Ea Kng)
3	**System Number**		:	D 4-2
4	**Water Resource**		:	Deep Well (present number of wells 0

II	**WATER SUPPLY PLAN**								
A	**Plan Parameter (1)**								
1	**Water resource**			Deep well					
1)	**Altitude of JICA deep well**	El m	:						
2)	**Latitude**	N	:			Longitude E			
3)	**Permissible yield /well**	m3/day (l/sec)	:	268	(3.1)	(estimate)			
4)	**Static water surface level (S.W.L)**	m	:						
5)	**Dynamic water level (D.W.L)**	m	:						
6)	**Well diameter**	mm	:	150					
2	**Water demand**			2001		2010		2020	
1)	**Number of household**	Numbers	:	431					
2)	**Population**	Numbers	:	1827		2034		2291	
3)	**Per capita consumption**	l/s/d	:	30		60		60	
4)	**Maximum daily water demand**	m3/day	:	21		162		214	
5)	**Maximum hourly water demand**	m3/hour		2		14		18	
3	**Required number of well**	no.	:	1		0		0	Total 1
B	**Plan Parameter (2)**								
1	**Water intake**		:	Deep Well					
2	**Raw water transmission**		:	GI Pipes					
3	**Reservoir**		:	Ground Reservoir with elevated tower					
4	**Water treatment**		:	Aeration and Slow filtration. Chlorination,					
5	**Water distribution**		:	PVC, PE, Public taps, house connection					
6	**Power supply**		:	Public Net and/or generator/solar system					

III	**WATER SUPPLY FACILITY DESIGN**										
A	**Source**	**Deep Wells**									
		Numbers needed in addition to existing Jica well									
		2002-2010	1								
		2010-2020	0								
B	**Pump**	**Submersible pump**					**Booster pumps**				
		Yield:	3.1 l/s	Lift	80 m			Yield		Lift	
		2002-2010	1	nos			2002-2010	14	m3/hr	15	m
		2010-2020	0	nos			2010-2020	4	m3/hr	15	m
C	**Power**	**Public net, alternatively**									
		Diesel generator									
		Solar systems									
D	**Reservoir**	**Ground reservoir**					**Elevated Tower**				
		2002-2010	48	m3			2002-2010	7	m3		
		2010-2020	15	m3			2010-2020	2	m3		
		Total	63	m3			Total	9	m3		
E	**Treatment**	**Aeration, Slow sand filtration and chlorination**									
		Aeration area:			**Reaction tank, volume:**			**Filter area** :			
		2002-2010	1	m2	2002-2010	7	m3	2002-2010 :	2	m2	
		2010-2020	1	m2	2010-2020	2	m3	2010-2020 :	2	m2	
		Total	2	m2	Total	9	m3	Total	4	m2	
		Chlorination via concrete mixing tank									
F	**Pipeline, raw water**										
		Diameter	100	mm							
		2002-2010	1.5	km							
		2010-2020	0	km							
G	**Distribution pipes**										
		Diameter		2002-2010		2010-2020			:		
		25-65	mm	10	km	3	km				
		75-125	mm	5	km	0.5	km				
		150-200	mm		km		km				
I	**Public taps**	Type	: 1	Numbers	: 6						

IV Notes
No deep well was constructed in phase 1

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	**GENERAL INFORMATION**			
1	**Province**		:	Dak Lak
2	**Name of Commune/Town**		:	Ea Wer (Nos. 3, 4, 5, 6, 7, 8, A, B, Ha Bac, Center District)
3	**System Number**		:	D 5-1
4	**Water Resource**		:	Deep Well (present number of wells 1

II	**WATER SUPPLY PLAN**										
A	**Plan Parameter (1)**										
1	**Water resource**			Deep well							
1)	**Altitude of JICA deep well**	El m	:	255							
2)	**Latitude**	N	:	1418900			Longitude	E	813607		
3)	**Permissible yield /well**	m3/day (l/sec)	:	320	(3.7)						
4)	**Static water surface level (S.W.L)**	m	:	2							
5)	**Dynamic water level (D.W.L)**	m	:	24							
6)	**Well diameter**	mm	:	150							
2	**Water demand**			2001		2010			2020		
1)	**Number of household**	Numbers	:	963							
2)	**Population**	Numbers	:	5491		8920			10981		
3)	**Per capita consumption**	l/s/d	:	30		60			60		
4)	**Maximum daily water demand**	m3/day	:	64		710			1028		
5)	**Maximum hourly water demand**	m3/hour		5		59			86		
3	**Required number of well**	no.	:	1		2			1	Total	4
B	**Plan Parameter (2)**										
1	**Water intake**		:	Deep Well							
2	**Raw water transmission**		:	GI Pipes							
3	**Reservoir**		:	Ground Reservoir with elevated tower							
4	**Water treatment**		:	Aeration and Slow filtration. Chlorination,							
5	**Water distribution**		:	PVC, PE, Public taps, house connection							
6	**Power supply**		:	Public Net							

III	**WATER SUPPLY FACILITY DESIGN**										
A	**Source**	**Deep Wells**									
		Numbers needed in addition to existing Jica well									
		2002-2010	2								
		2010-2020	1								
B	**Pump**	**Submersible pump**					**Booster pumps**				
		Yield: 3.7	l/s	Lift	40	m		Yield		Lift	
		2002-2010	3	nos			2002-2010	59	m3/hr	15	m
		2010-2020	1	nos			2010-2020	27	m3/hr	15	m
C	**Power**	**Public net**									
D	**Reservoir**	**Ground reservoir**					**Elevated Tower**				
		2002-2010	207	m3			2002-2010	30	m3		
		2010-2020	93	m3			2010-2020	13	m3		
		Total	300	m3			Total	43	m3		
E	**Treatment**	**Aeration, Slow sand filtration and chlorination**									
		Aeration area:			**Reaction tank, volume:**			**Filter area**	:		
		2002-2010	6	m2	2002-2010	30	m3	2002-2010	:	11	m2
		2010-2020	3	m2	2010-2020	13	m3	2010-2020	:	7	m2
		Total	9	m2	Total	43	m3	Total		18	m2
		Chlorination via concrete mixing tank									
F	**Pipeline, raw water**										
		Diameter	100	mm							
		2002-2010	4.5	km							
		2010-2020	1.5	km							
G	**Distribution pipes**										
		Diameter		2002-2010		2010-2020			:		
		25-65	mm	15.5	km	2.8	km				
		75-125	mm	5	km	2.6	km				
		150-200	mm	4.5	km		km				
I	**Public taps**	Type	: 1		Numbers	: 11					

IV Notes

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I	GENERAL INFORMATION			
1	Province		:	Dak Lak
2	Name of Commune/Town		:	Kien Duc (Communities Nos.1, 2, 3, 4, 5, 6, 7, 8)
3	System Number		:	D 6-1
4	Water Resource		:	Deep Well (present number of wells 1

II	WATER SUPPLY PLAN								
A	Plan Parameter (1)								
1	Water resource			Deep well					
1)	Altitude of JICA deep well	El m	:	691					
2)	Latitude	N	:	1325577		Longitude	E 772292		
3)	Permissible yield /well	m3/day (l/sec)	:	259	(3)	(See note)			
4)	Static water surface level (S.W.L)	m	:	32					
5)	Dynamic water level (D.W.L)	m	:	54					
6)	Well diameter	mm	:	150					
2	Water demand			2001		2010		2020	
1)	Number of household	Numbers	:	1492					
2)	Population	Numbers	:	8807		10619		13071	
3)	Per capita consumption	l/s/d	:	30		60		60	
4)	Maximum daily water demand	m3/day	:	103		845		1223	
5)	Maximum hourly water demand	m3/hour		9		71		102	
3	Required number of well	no.	:	1		3		1	Total 5
B	Plan Parameter (2)								
1	Water intake		:	Deep Well					
2	Raw water transmission		:	Gi Pipes					
3	Reservoir		:	Ground Reservoir					
4	Water treatment		:	Chlorination,					
5	Water distribution		:	PVC, PE, Public taps, house connection					
6	Power supply		:	Public Net					

III	WATER SUPPLY FACILITY DESIGN									
A	Source	Deep Wells								
		Numbers needed in addition to existing Jica well								
		2002-2010	3							
		2010-2020	1							
B	Pump	Submersible pump								
		Yield: 3.0 l/s			Lift 120 m					
		2002-2010	4	nos						
		2010-2020	1	nos						
C	Power	Public net								
D	Reservoir	Ground reservoir								
		2002-2010	282	m3						
		2010-2020	126	m3						
		Total	408	m3						
E	Treatment	Aeration, Slow sand filtration and chlorination.								
		Aeration area:			Reaction tank, volume:			Filter area :		
		2002-2010	7	m2	2002-2010	35	m3	2002-2010 :	14	m2
		2010-2020	3	m2	2010-2020	16	m3	2010-2020 :	7	m2
		Total	10	m2	Total	51	m3	Total	21	m2
		Chlorination via concrete mixing tank								
F	Pipeline, raw water									
		Diameter	100	mm						
		2002-2010	6	km						
		2010-2020	1.5	km						
G	Distribution pipes									
		Diameter		2002-2010		2010-2020		:		
		25-65 mm		15.5 km		8.5 km				
		75-125 mm		8.5 km		1.5 km				
		150-200 mm		0.5 km		km				
I	Public taps	Type :	1		Numbers :	10				

IV Notes
The well constucted during the first phase of the study only yielded 0,4 l/s, however a higher yield has been used for design purposes
Two existing wells will be included in the system. These reportedly give a yield of more than 3 l/s each

SPREAD SHEET ON PLAN AND DESIGN FOR RURAL WATER SUPPLY

I		**GENERAL INFORMATION**		
	1	**Province**	:	Dak Lak
	2	**Name of Commune/Town**	:	Krong Mar (Communities Nos.K1, K 2, K 3, K 4, K 5, K 6, K 7, K 8)
	3	**System Number**	:	D 7-1
	4	**Water Resource**	:	Deep Well (present number of wells 1

II		**WATER SUPPLY PLAN**							
	A	**Plan Parameter (1)**							
	1	**Water resource**			Deep well				
	1)	**Altitude of JICA deep well**	El m	:	436				
	2)	**Latitude**	N	:	1384752		Longitude E	210996	
	3)	**Permissible yield /well**	m3/day (l/sec)	:	553	(6.4)			
	4)	**Static water surface level (S.W.L)**	m	:	4				
	5)	**Dynamic water level (D.W.L)**	m	:	11				
	6)	**Well diameter**	mm	:	150				
	2	**Water demand**			2001	2010		2020	
	1)	**Number of household**	Numbers	:	1169				
	2)	**Population**	Numbers	:	5930	7484		9123	
	3)	**Per capita consumption**	l/s/d	:	30	60		60	
	4)	**Maximum daily water demand**	m3/day	:	69	595		854	
	5)	**Maximum hourly water demand**	m3/hour		6	50		71	
	3	**Required number of well**	no.	:	1	1		0	Total 2
	B	**Plan Parameter (2)**							
	1	**Water intake**		:	Deep Well				
	2	**Raw water transmission**		:	GI Pipes				
	3	**Reservoir**		:	Ground Reservoir				
	4	**Water treatment**		:	Chlorination,				
	5	**Water distribution**		:	PVC, PE, Public taps, house connection				
	6	**Power supply**		:	Public Net				

III	**WATER SUPPLY FACILITY DESIGN**											
A	**Source**	**Deep Wells**										
		Numbers needed in addition to existing Jica well										
		2002-2010	1									
		2010-2020	0									
B	**Pump**	**Submersible pump**						**Booster pumps**				
		Yield: 6.4	l/s	Lift	45	m			Yield		Lift	
		2002-2010	2	nos				2002-2010	50	m3/hr	60	m
		2010-2020	0	nos				2010-2020	21	m3/hr	60	m
C	**Power**	**Public net**										
D	**Reservoir**	**Ground reservoir**										
		2002-2010	199	m3								
		2010-2020	86	m3								
		Total	285	m3								
E	**Treatment**	**Aeration, Slow sand filtration and chlorination.**										
		Aeration area:			**Reaction tank, volume:**			**Filter area** :				
		2002-2010	5	m2	2002-2010	25	m3	2002-2010 :	9	m2		
		2010-2020	3	m2	2010-2020	11	m3	2010-2020 :	6	m2		
		Total	7	m2	Total	36	m3	Total	15	m2		
		Chlorination via concrete mixing tank										
F	**Pipeline, raw water**											
		Diameter	100	mm								
		2002-2010	1.5	km								
		2010-2020	0	km								
G	**Distribution pipes**											
		Diameter		2002-2010		2010-2020		:				
		25-65 mm		13 km		5 km						
		75-125 mm		5 km		3 km						
		150-200 mm		1 km		km						
I	Public taps	Type :	1	Numbers :	10							

IV Notes

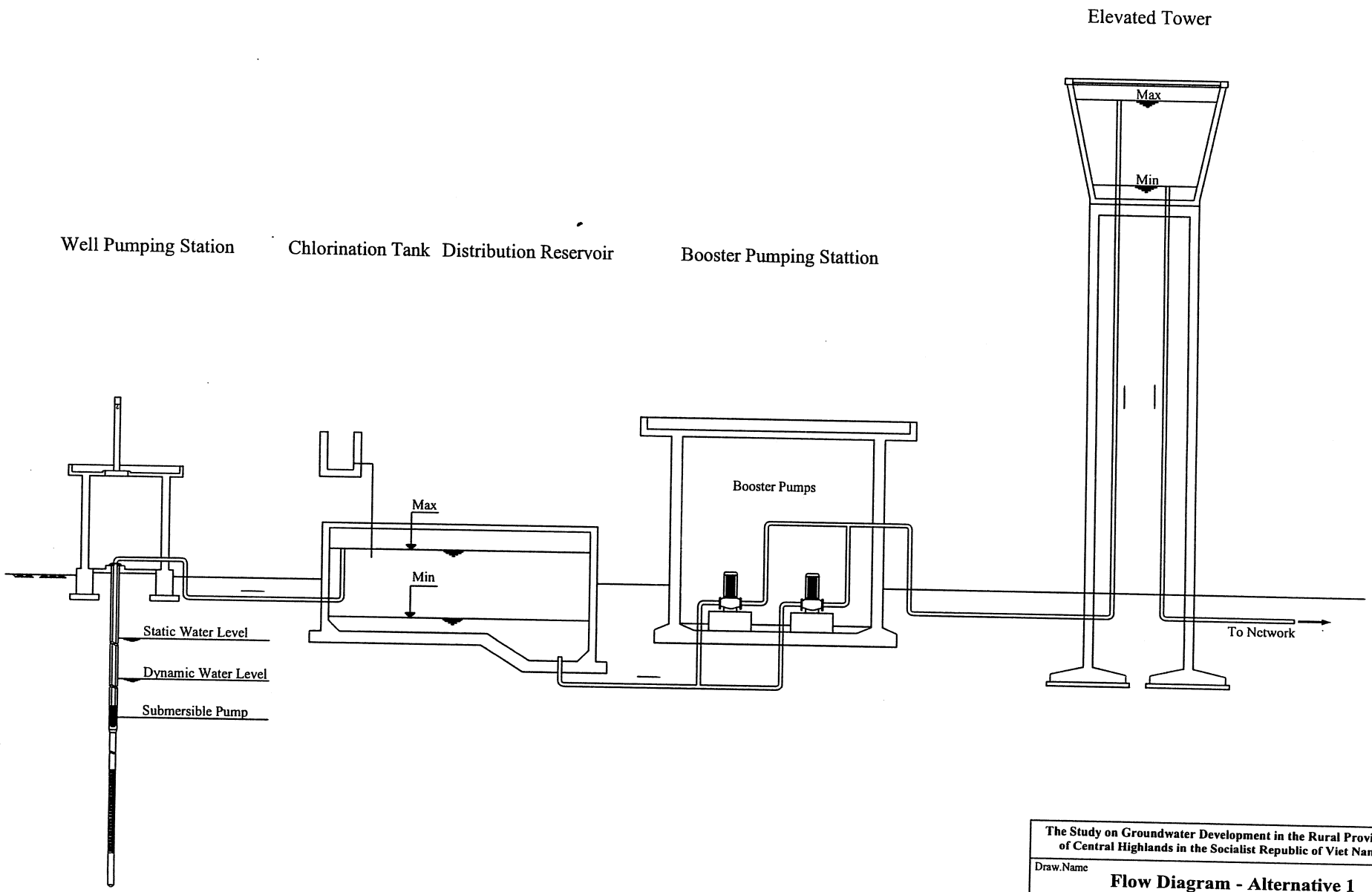
One existing well will be included in the system

Existing network will be included in the system

Appendix 3

Standard Designs of Water Supply Facilities

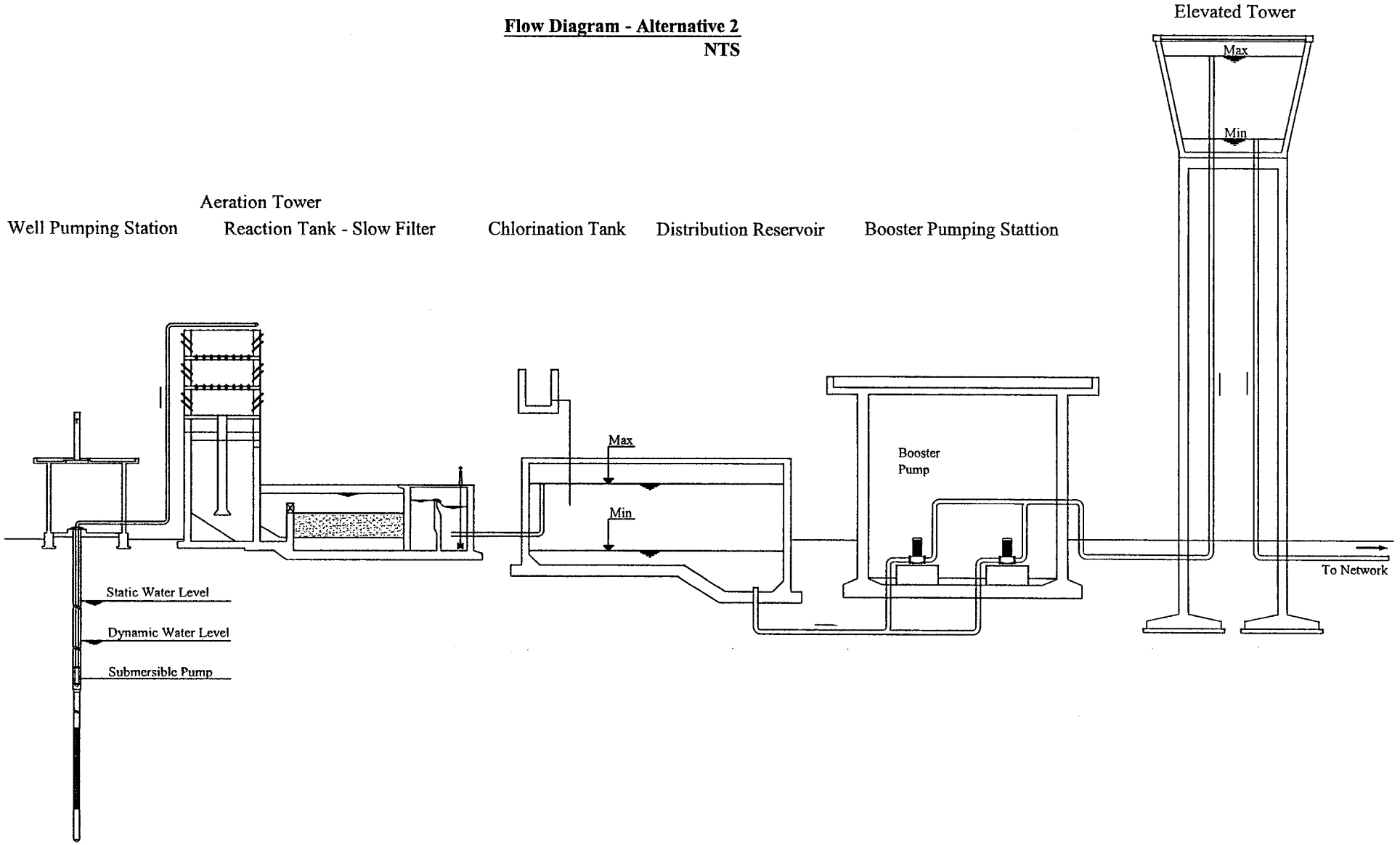
Flow Diagram - Alternative 1
NTS



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name	Flow Diagram - Alternative 1		
Date. Nov. 2001	Scale. NTS		Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

Flow Diagram - Alternative 2

NTS



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name	Flow Diagram - Alternative 2		
Date. Nov. 2001	Scale. NTS		Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

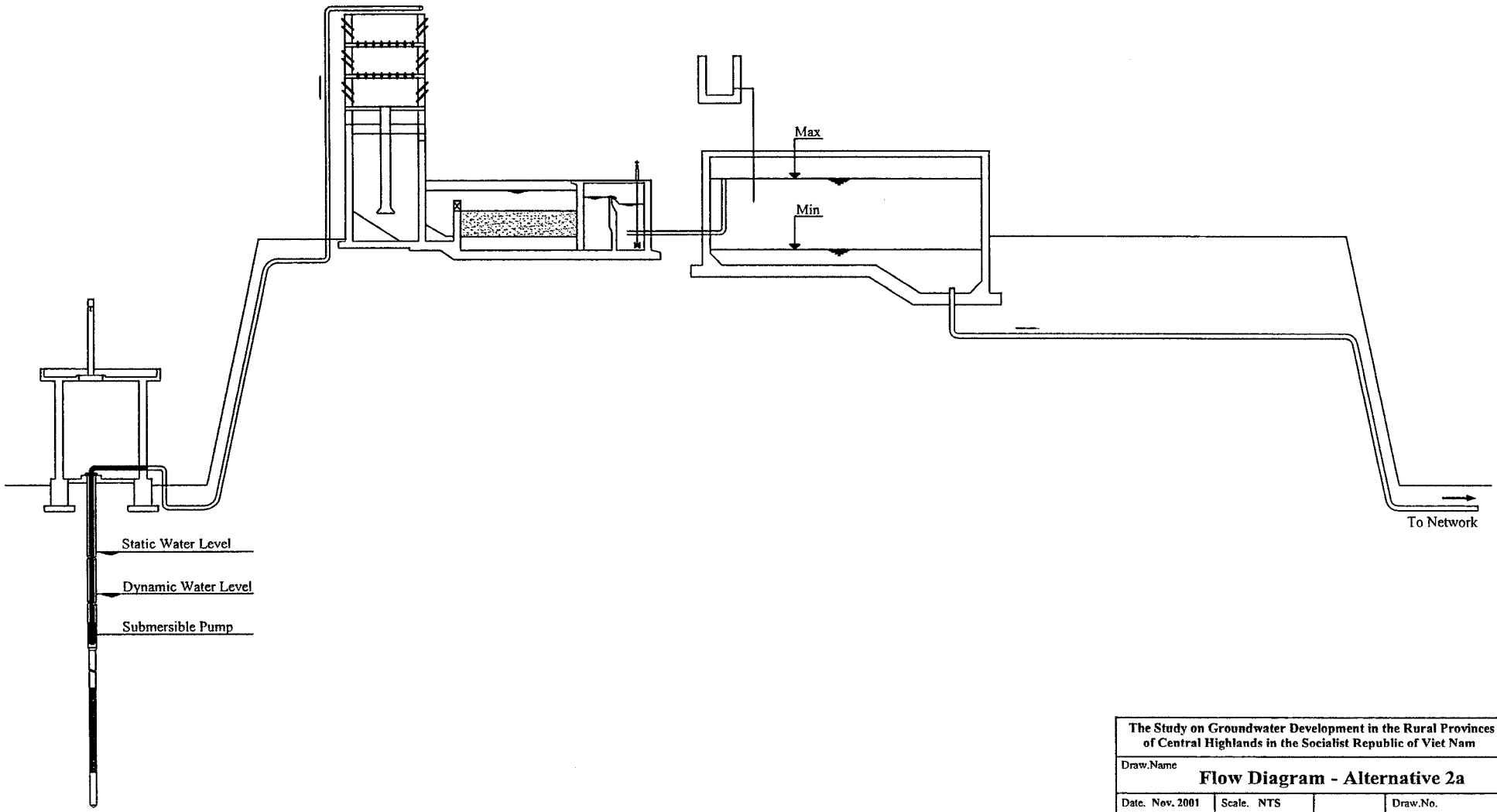
Format A3

Flow Diagram - Alternative 2a

NTS

Aeration Tower

Well Pumping Station | Reaction Tank - Slow Filter | Chlorination Tank | Distribution Reservoir | Booster Pumping Stattion



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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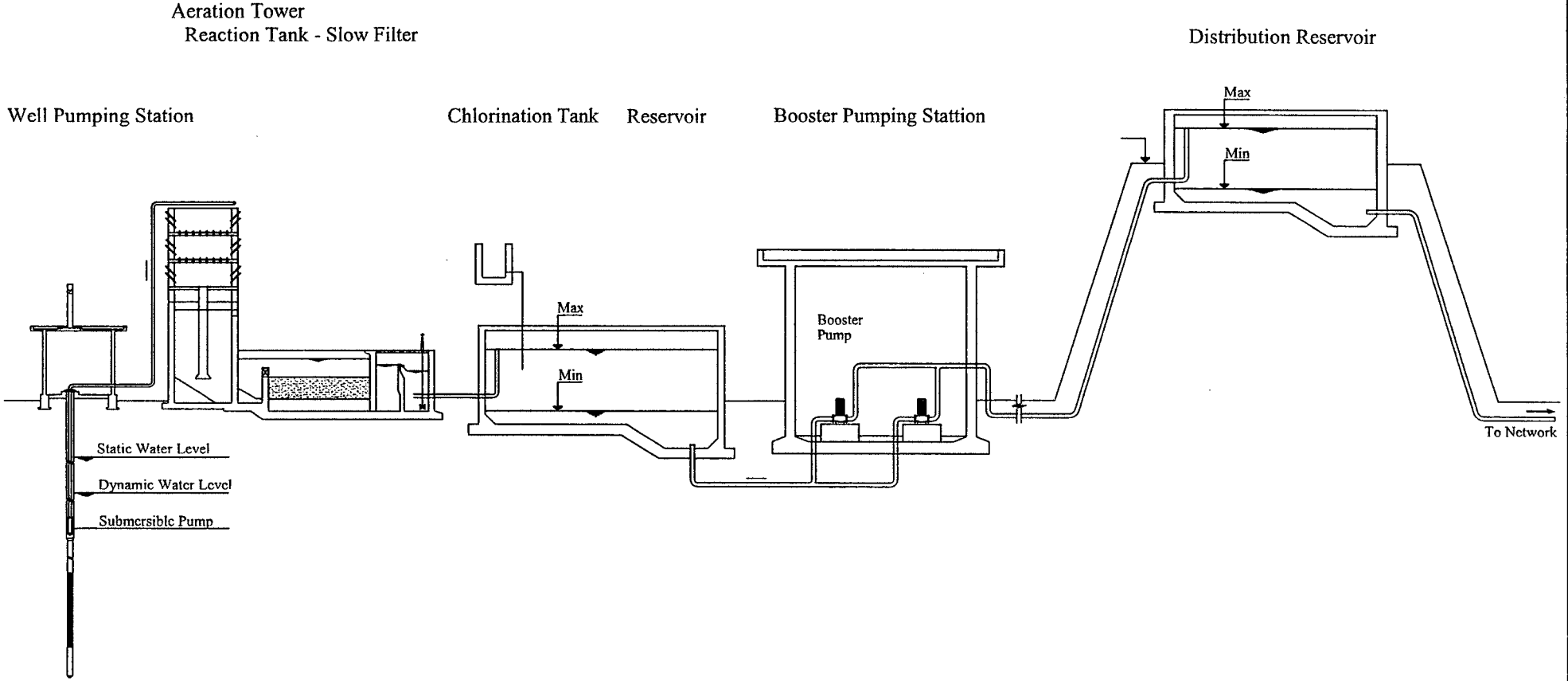
Date. Nov. 2001	Scale. NTS		Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

Format A3

Flow Diagram - Alternative 2b
NTS



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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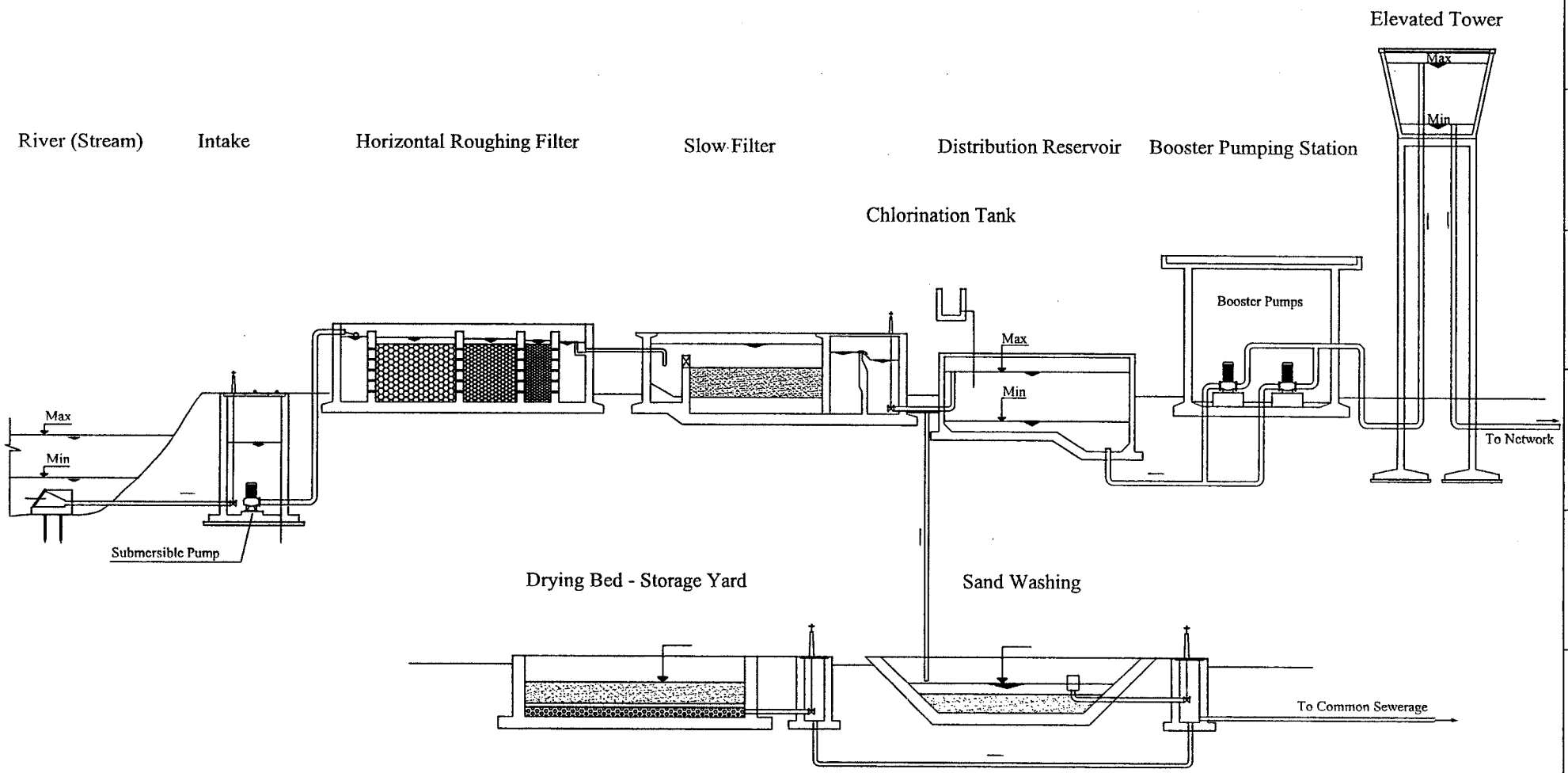
Date. Nov. 2001	Scale. NTS		Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

Format A3

Flow Diagram - Alternative 3

NTS

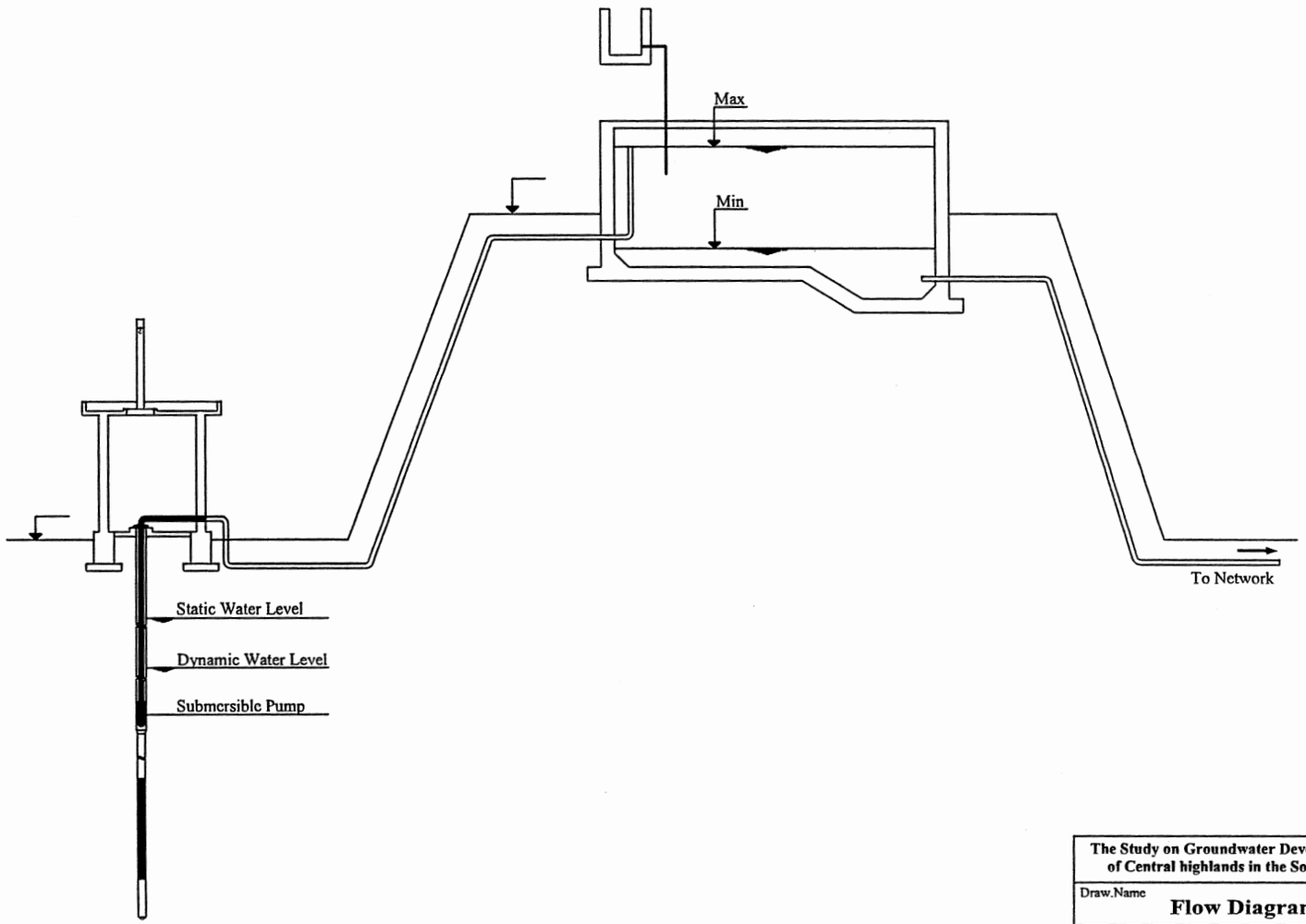


The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name: Flow Diagram - Alternative 3			
Date. Nov. 2001	Scale. NTS		Draw.No. A
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

Flow Diagram - Aternative 4

NTS

Well Pumping Station Chlorination Tank Distribution Reservoir



The Study on Groundwater Development in the Rural Provinces of Central highlands in the Socialist Republic of Viet Nam			
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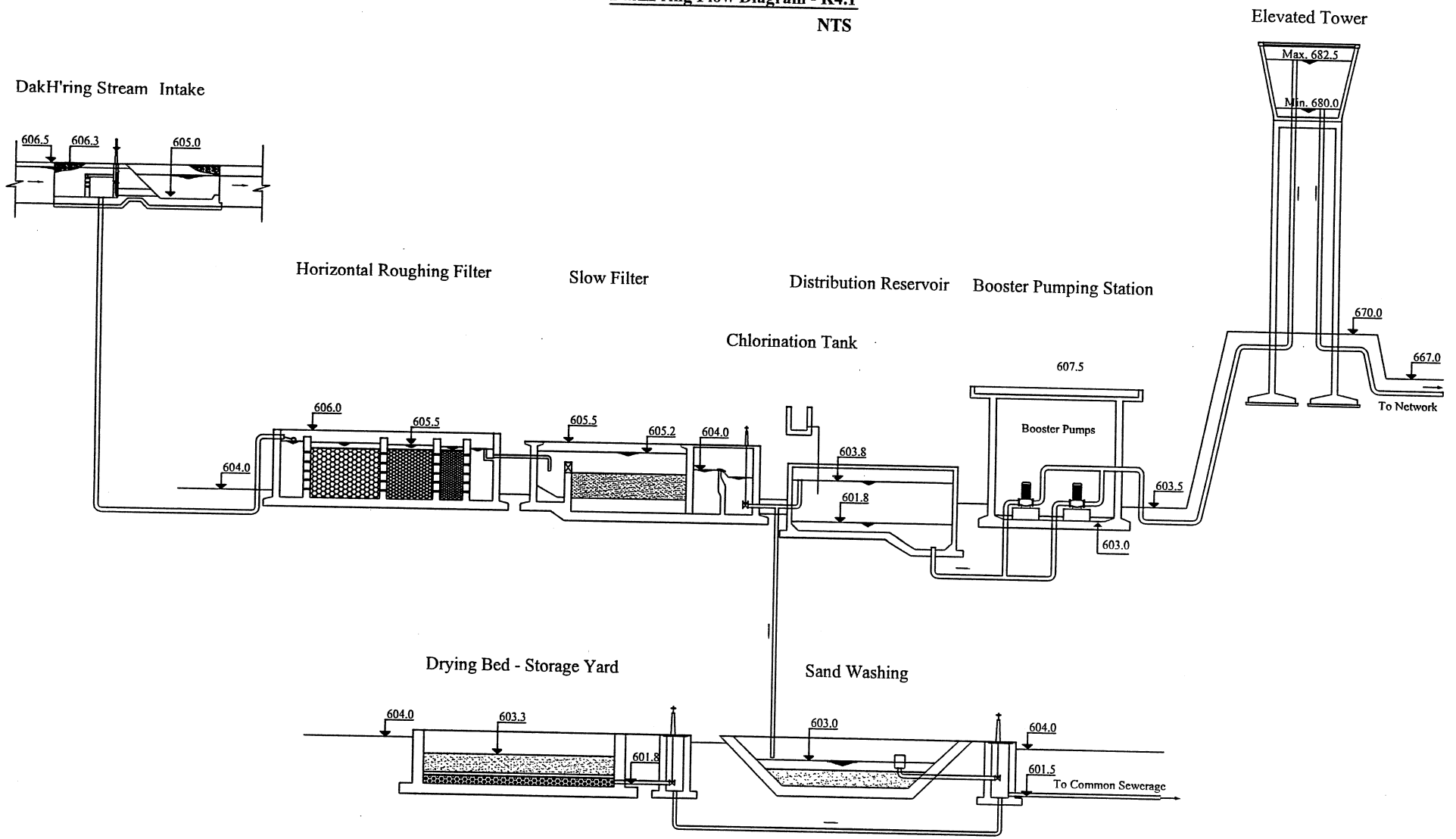
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

DakH'ring Flow Diagram - K4.1

NTS



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name: DakH'ring Flow Diagram - K4.1			
Date. Nov. 2001	Scale. NTS		Draw.No. A
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

CAD File : Layout_Alter1.dwg

Format A3

Typical Layout Plan - Alternative 1

S = 1/250

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam	
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Date. Nov. 2001	Scale. 1 : 250
For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

Format A3

CAD File : Layout_Alter2.dwg

Typical Layout Plan - Alternative 2

S = 1/250

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam	
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Date. Nov. 2001	Scale. 1 : 250
For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

H G F E D C B A

11 10 9 8 7 6 5 4 3 2 1

CAD File : Layout_Alter3.dwg

Format A3

Typical Layout Plan - Alternative 3

S = 1/250

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam	
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Date. Nov. 2001	Scale. 1 : 250
For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

CAD File : Layout_Alter4.dwg

Format A3

Typical Layout Plan - Alternative 4

S = 1/250

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam	
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For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

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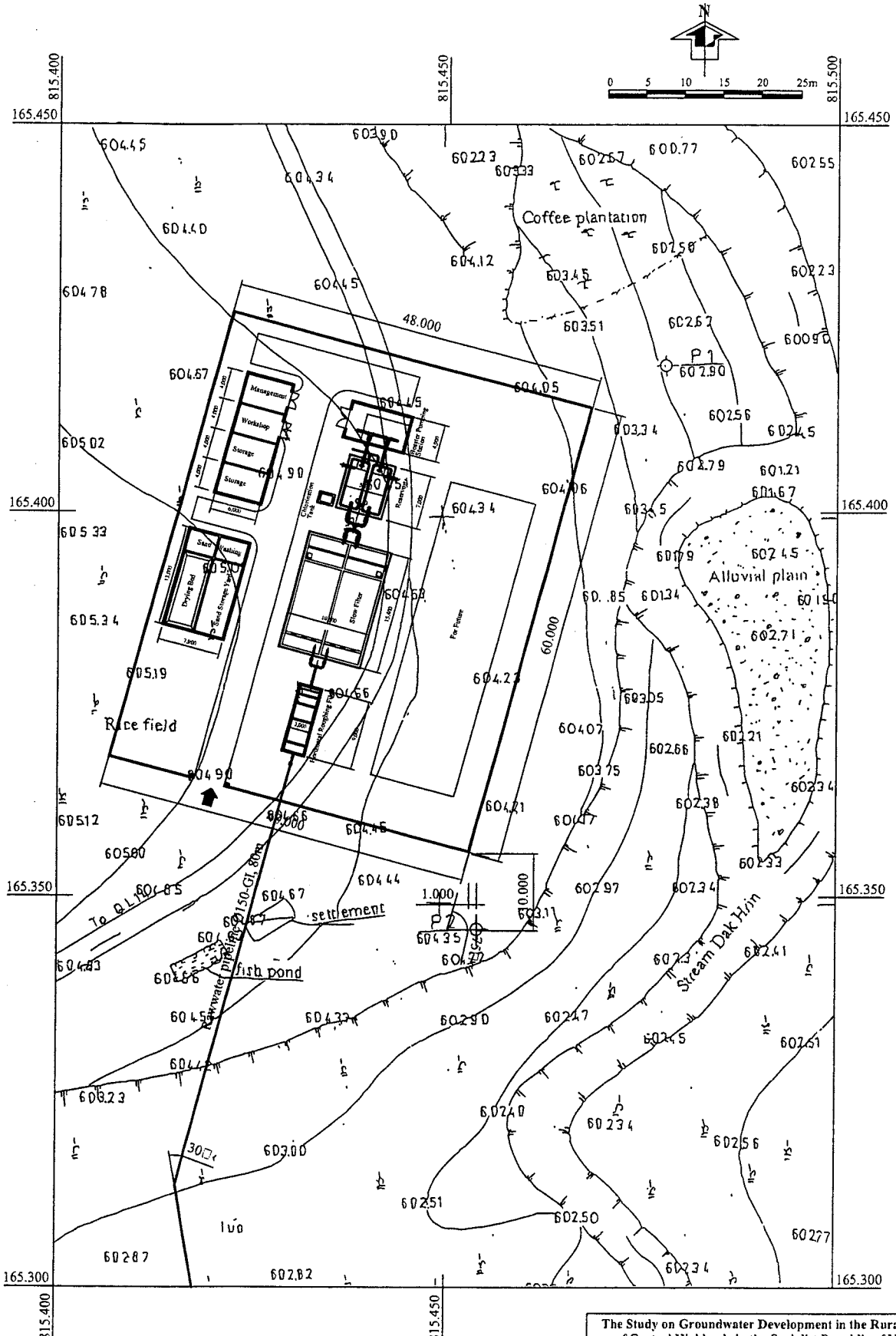

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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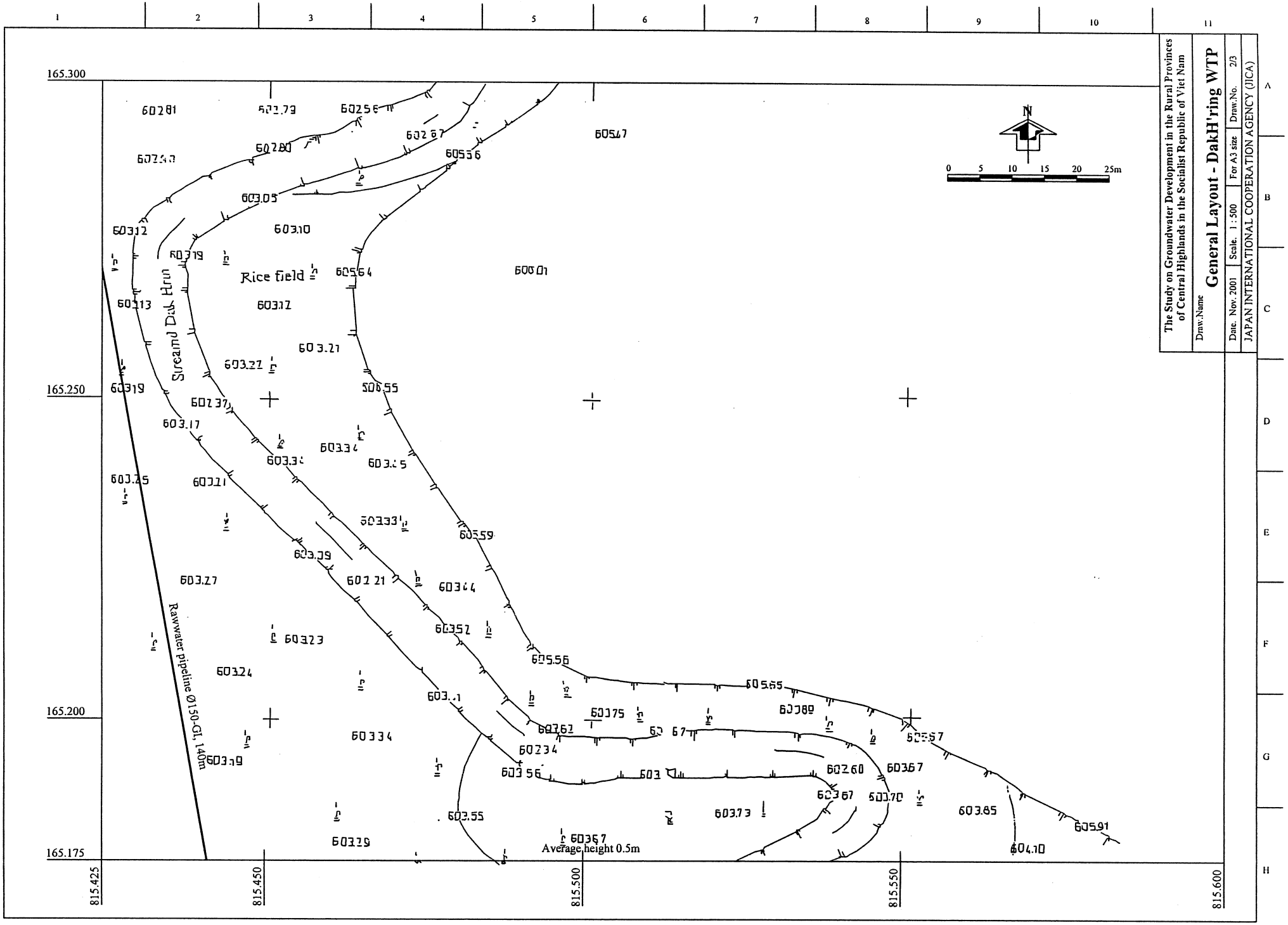
Date. Nov. 2001	Scale. 1 : 500	For A3 size	Draw.No. 1/3
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw:Name

General Layout - DakH'ring WTP

Date: Nov. 2001	Scale: 1 : 500	For A3 size	Draw:No. 2/3

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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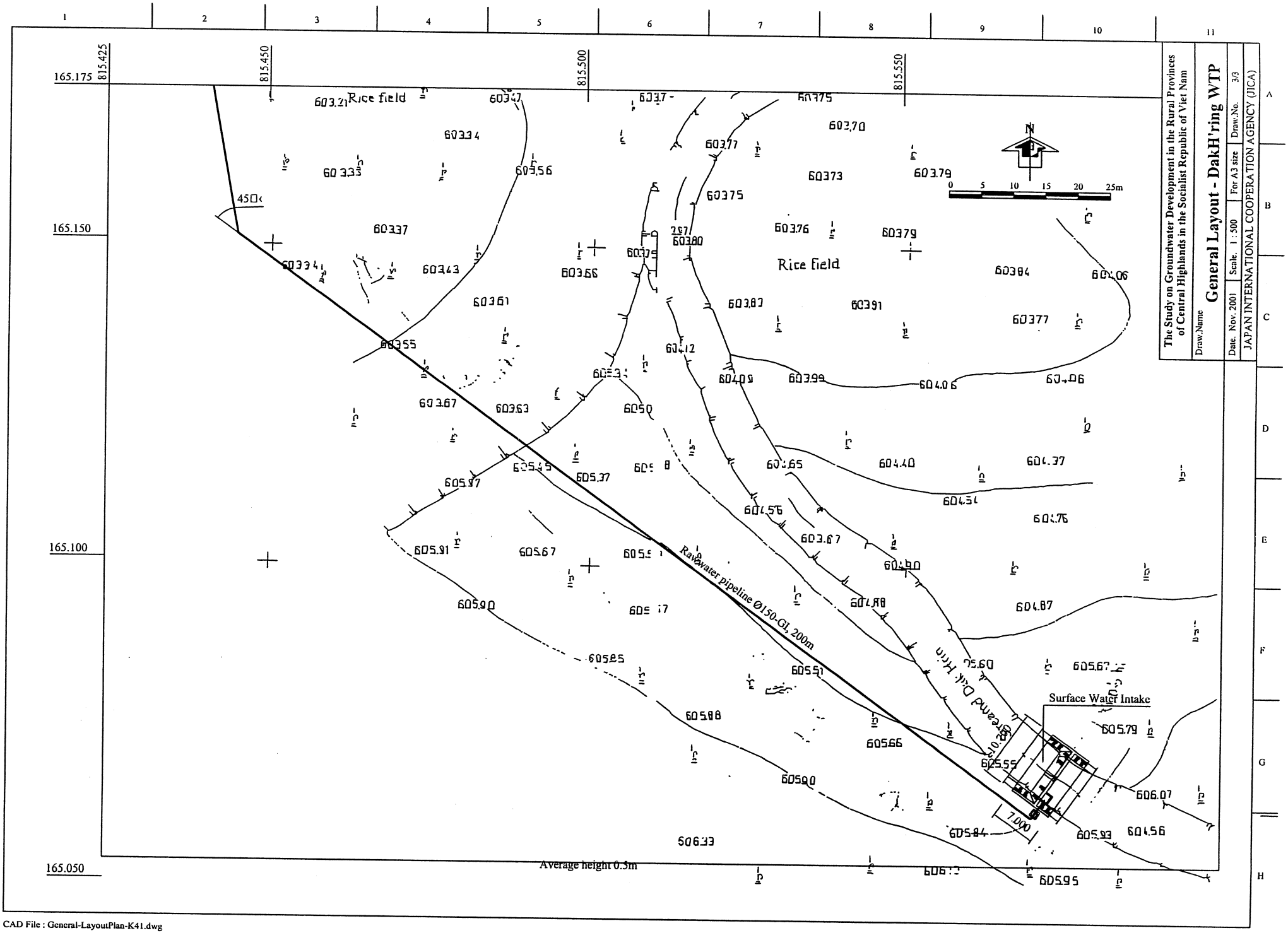


CAD File : General-LayoutPlan-K41.dwg

CAD File : LayoutPlan-K41.dwg

Format A3

DakH'ring Water Treatment Plant Layout - K4.1

S = 1/250

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name

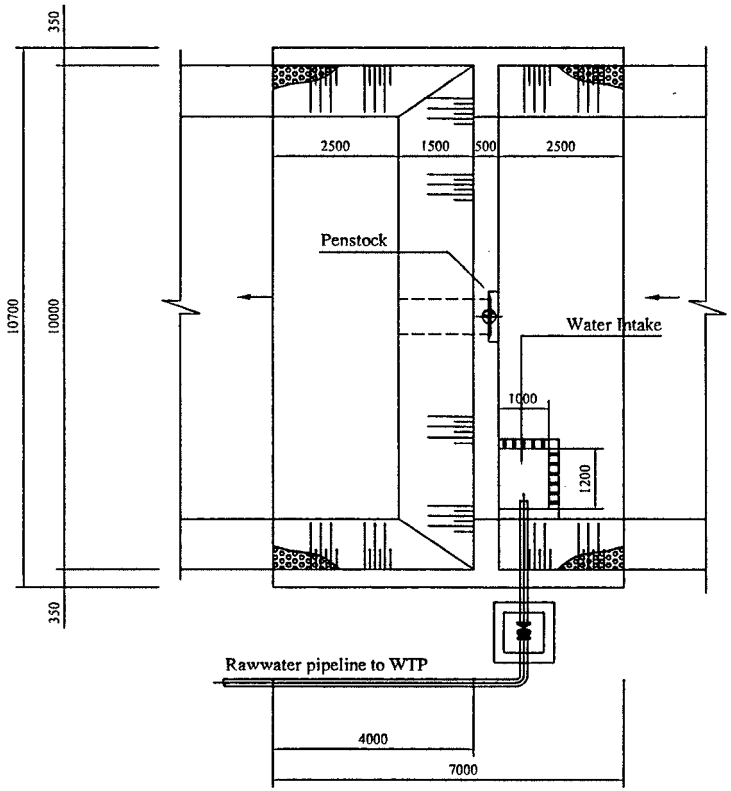
DakH'ring Water Treatment Layout - K4.1

Date: Nov. 2001	Scale: 1 : 250	For A3 size	Draw.No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

# Surface Water Intake
S = 1/100

Plan



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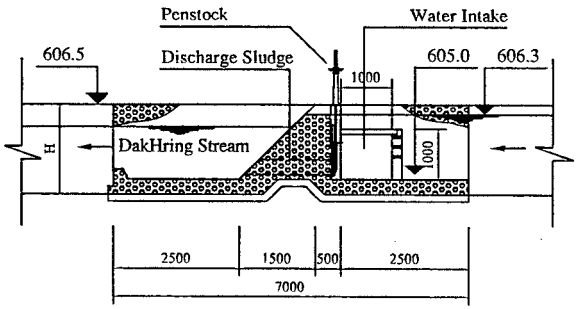
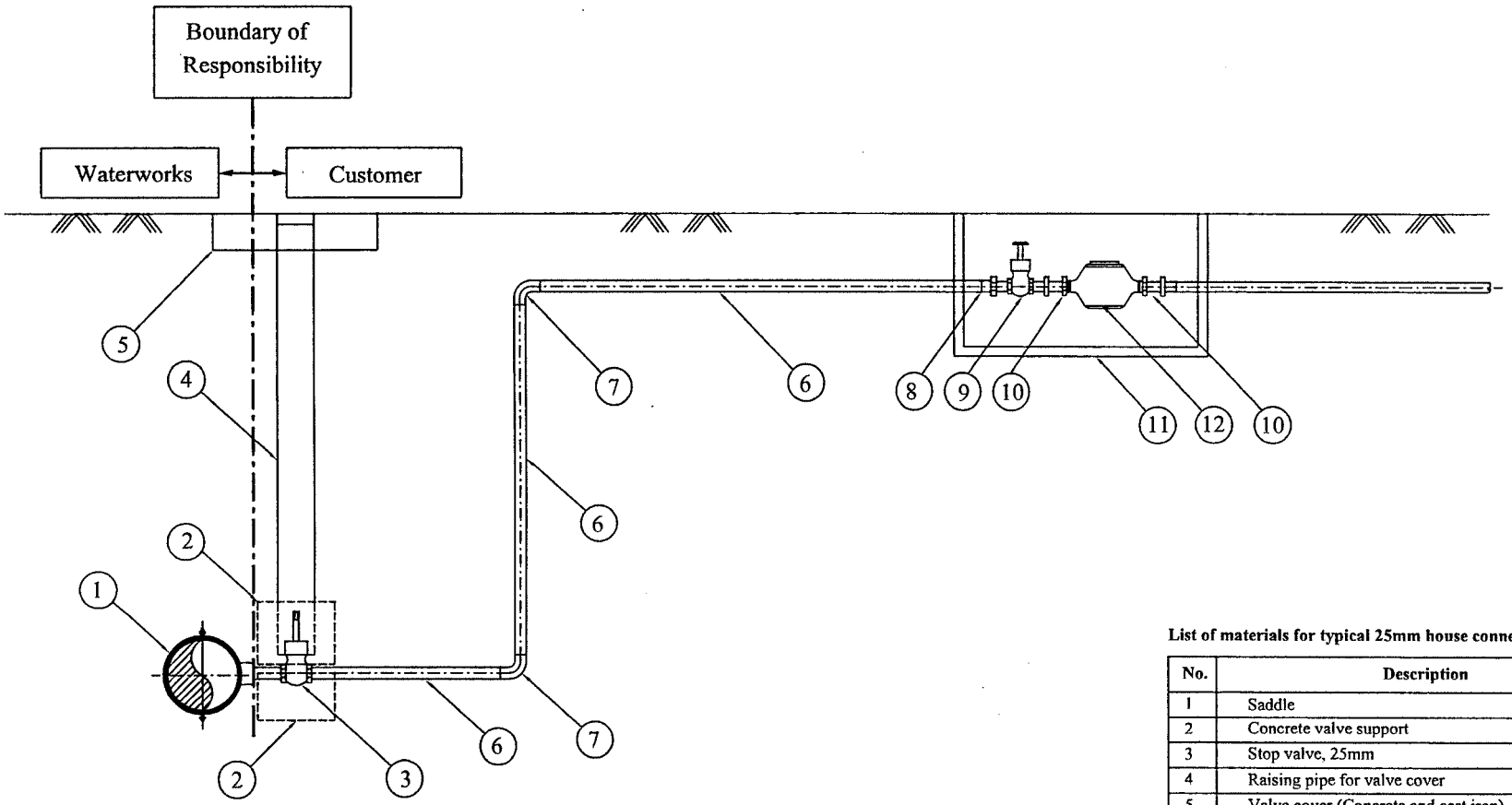


The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name: Surface Water Intake			
Date. Nov. 2001	Scale. 1 : 100	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

CAD File : Surface Water Intake.dwg

Format A3

Typical House Connection
NTS



List of materials for typical 25mm house connection

No.	Description
1	Saddle
2	Concrete valve support
3	Stop valve, 25mm
4	Raising pipe for valve cover
5	Valve cover (Concrete and cast iron)
6	PVC Straight Pipe, 25mm
7	Elbow, 25mm
8	Socket, 25mm
9	Stop valve, 25mm
10	Union Coupling, 25mm x 15mm
11	Concrete made meter box with steel cover
12	Water meter, 15mm

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name **Typical House Connection**

Date. Nov. 2001	Scale. NTS		Draw.No. D

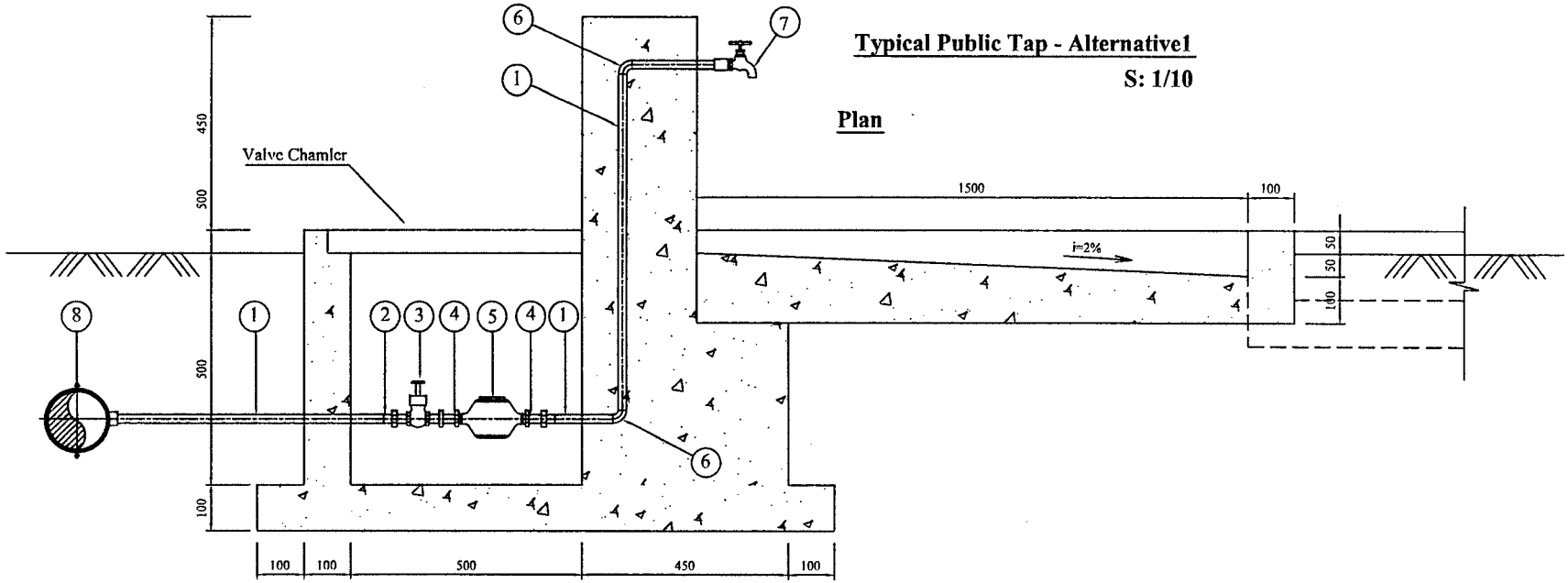
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Format A3

Typical Public Tap - Alternative1

S: 1/10

Plan



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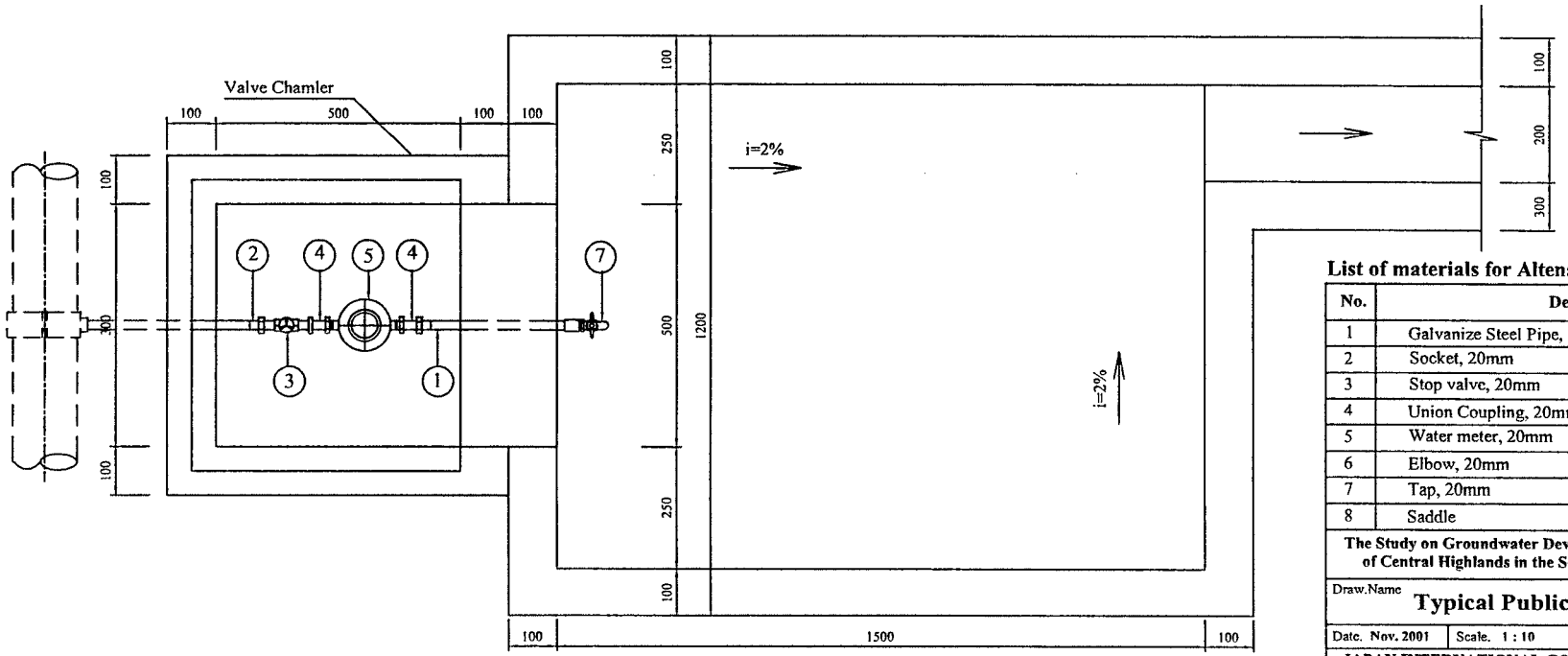


List of materials for Altenative 1

No.	Description
1	Galvanize Steel Pipe, 20mm
2	Socket, 20mm
3	Stop valve, 20mm
4	Union Coupling, 20mm x 15mm
5	Water meter, 20mm
6	Elbow, 20mm
7	Tap, 20mm
8	Saddle

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name: **Typical Public Tap - Alternative1**

Date. Nov. 2001	Scale. 1 : 10	For A3 size	Draw.No.

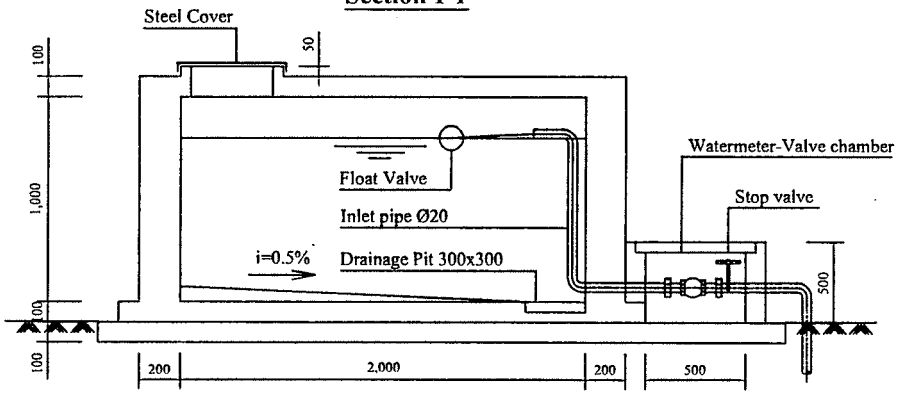
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Format A3

Typical Public Tap - Alternative 2

S: 1/25

Section 1-1



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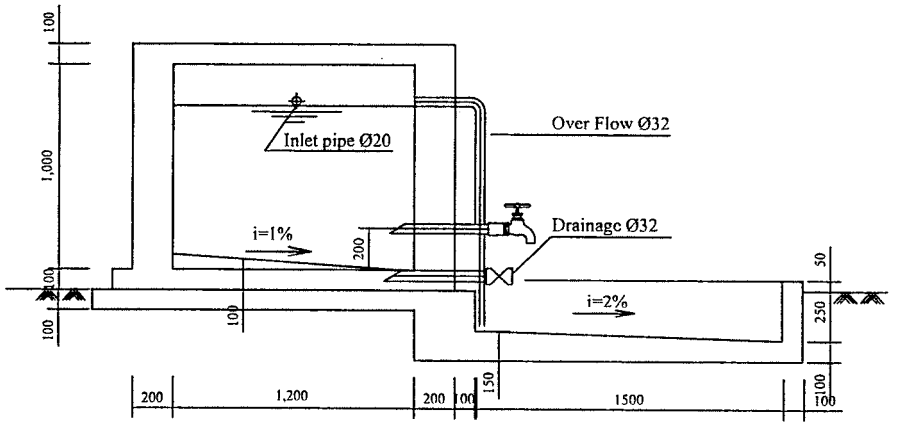
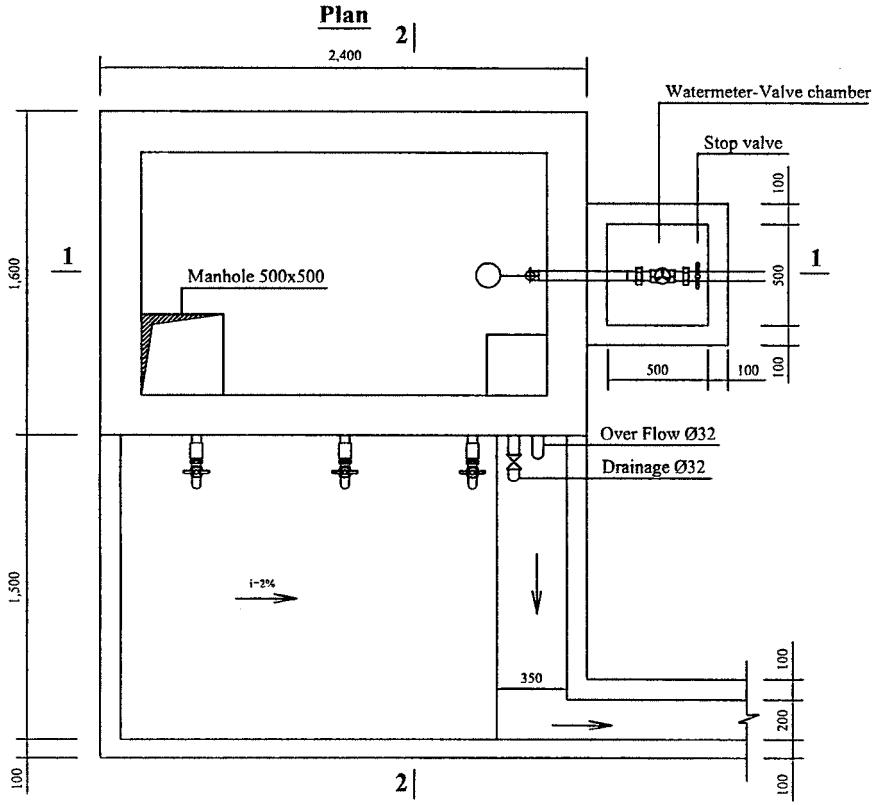


Plan



List of materials

No.	Description
	Galvanize Steel Pipe, 20mm
	Socket, 20mm
	Stop valve, 20mm
	Union Coupling, 20mm x 15mm
	Water meter, 20mm
	Elbow, 20mm
	Tap, 20mm
	Float Valve
	Saddle

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name: Typica Public Tap - Alternative 2

Date. Nov. 2001	Scale. 1 : 25	For A3 size	Draw.No. 4

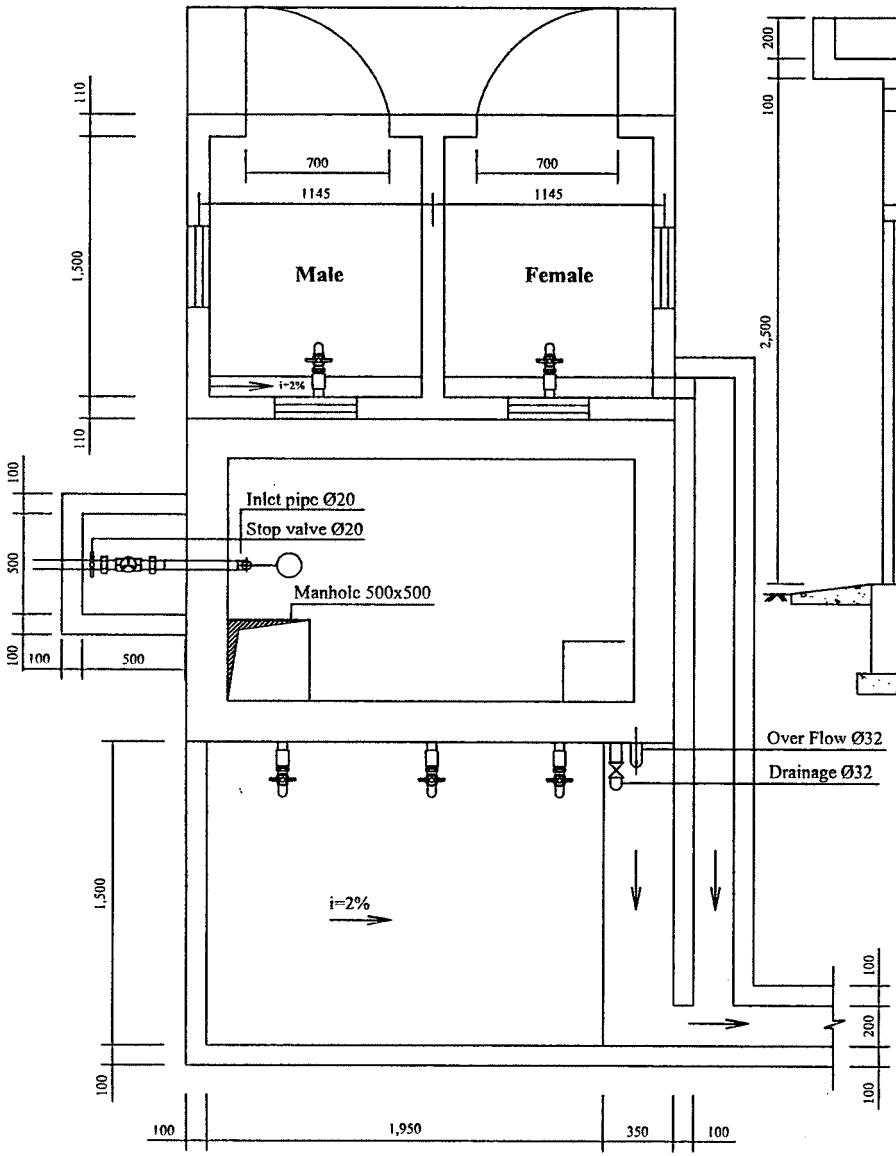
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Format A3

Typical Public Tap - Alternative 3

S: 1/25

Plan



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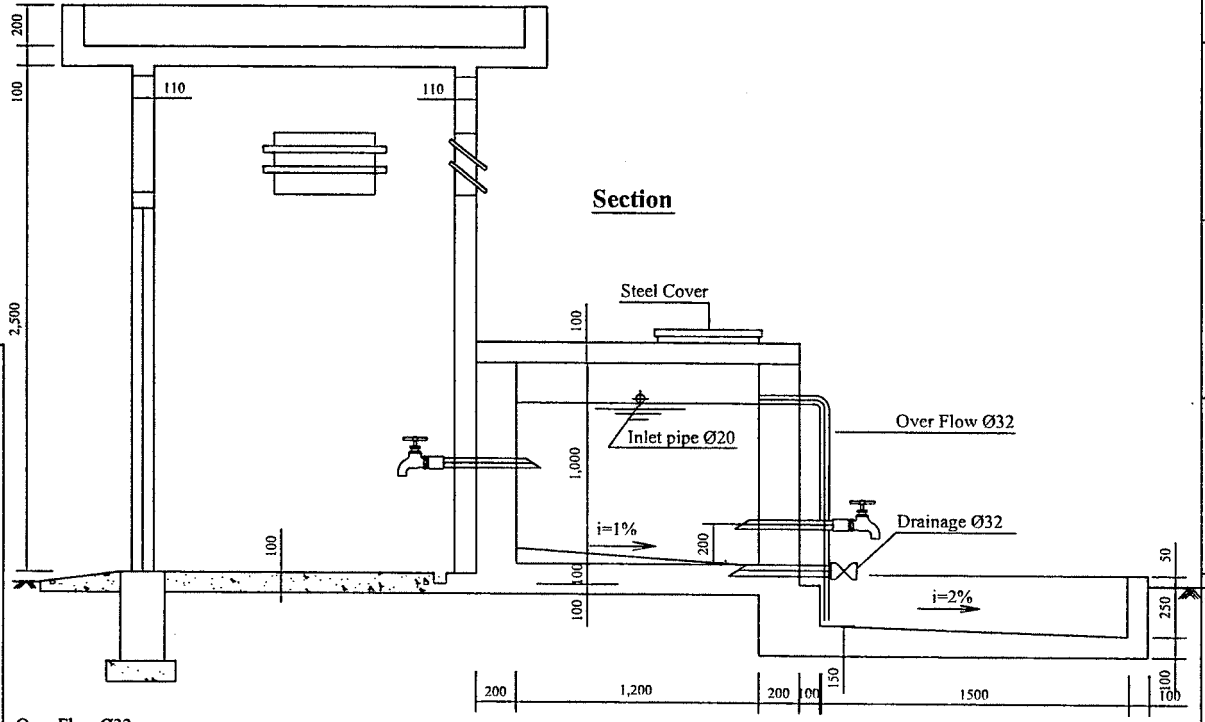


List of materials

No.	Description
	Galvanize Steel Pipe, 20mm
	Float Valve
	Socket, 20mm
	Stop valve, 20mm
	Union Coupling, 20mm x 15mm
	Water meter, 20mm
	Elbow, 20mm
	Tap, 20mm
	Saddle

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name: **Typical Public Tap - Alternative 3**

Date. Nov. 2001	Scale. 1 : 25	For A3 size	Draw.No. 5

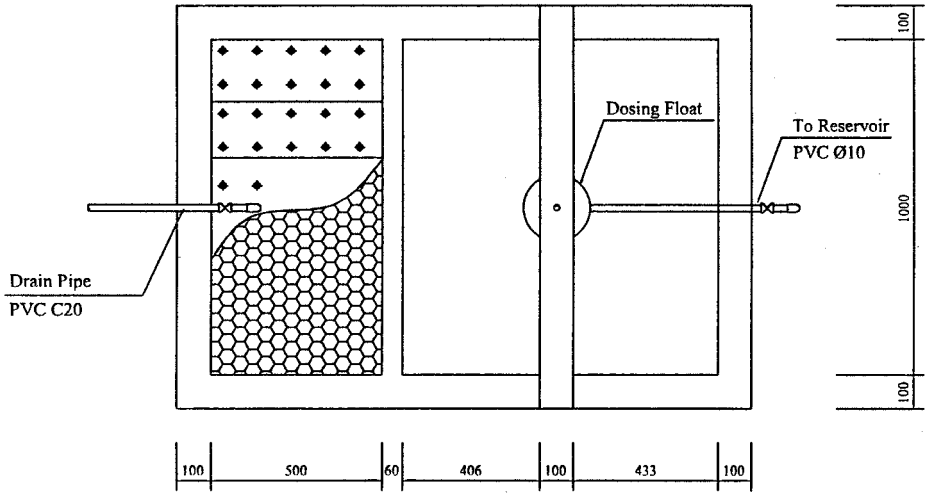
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Format A3

Chlorinator

S = 1/15

Plan



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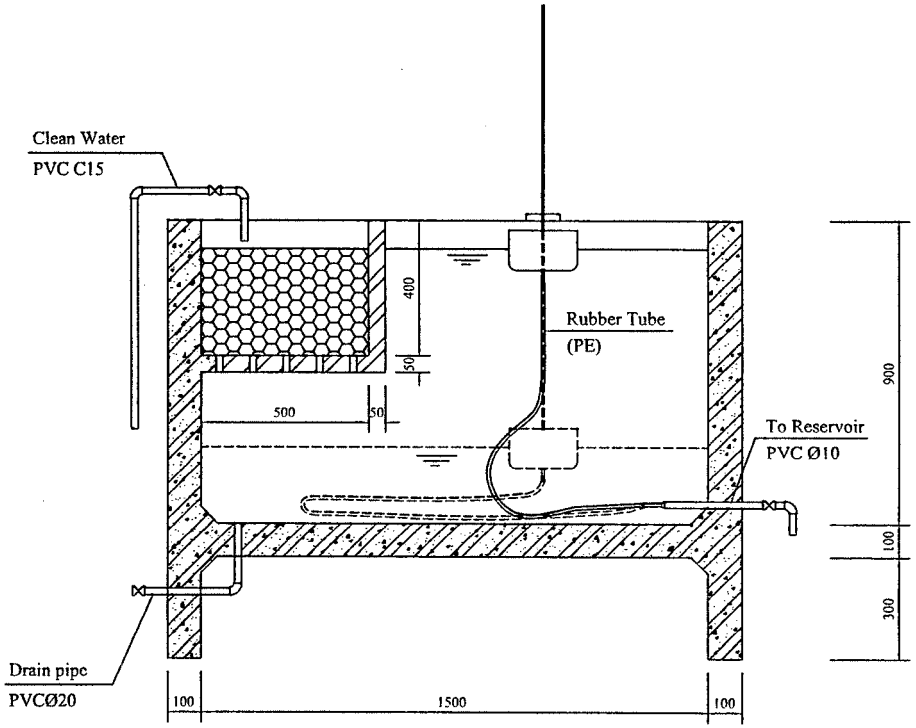


The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name: Chlorinator			
Date. Nov. 2001	Scale. 1 : 15	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

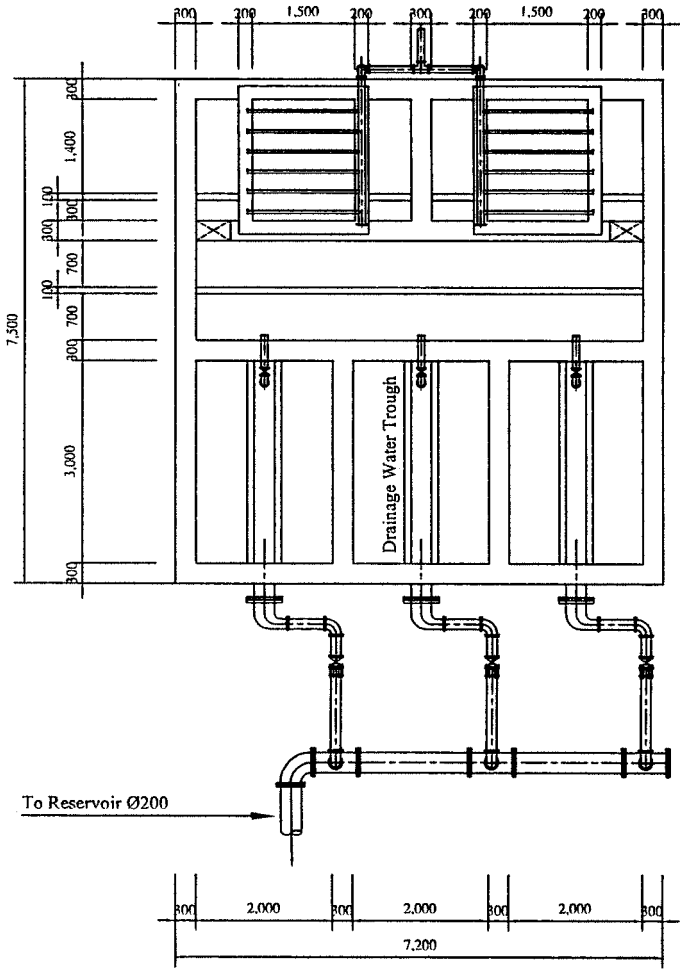
CAD File : Typ_ChemicalTank.dwg

Format A3

Aeration Tower - Reaction Tank - Slow Sand Filter

S = 1/75

Plan



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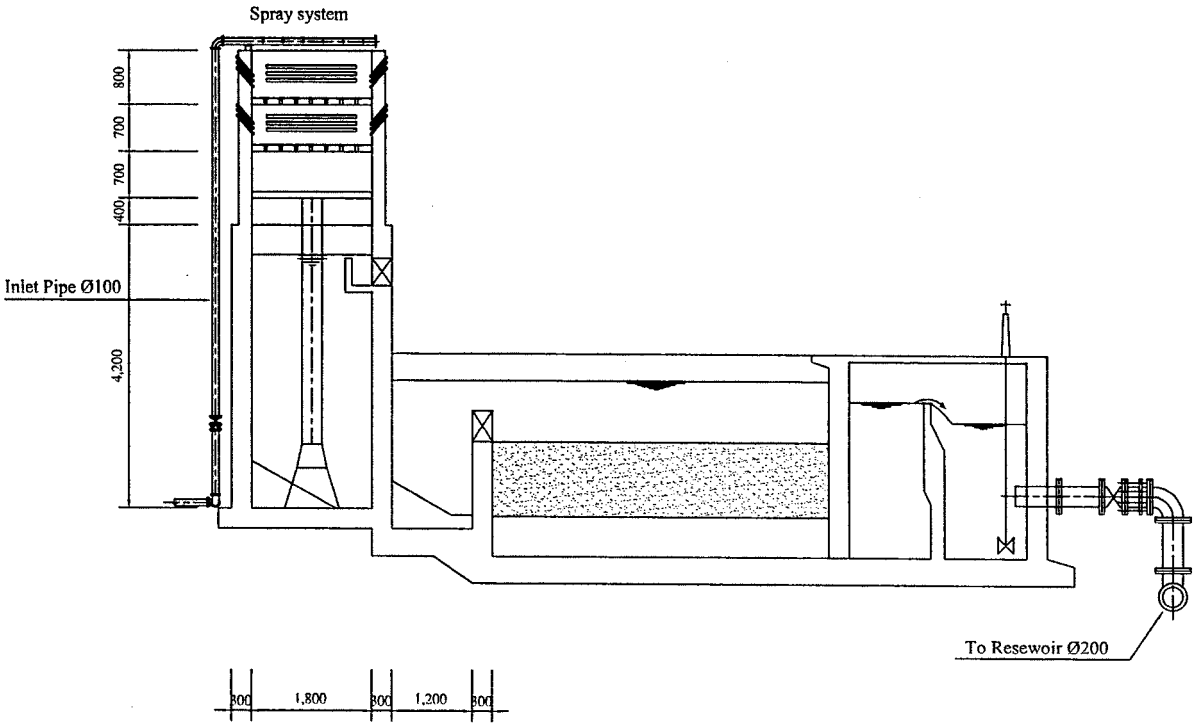

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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Date. Nov. 2001	Scale. 1 : 75	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

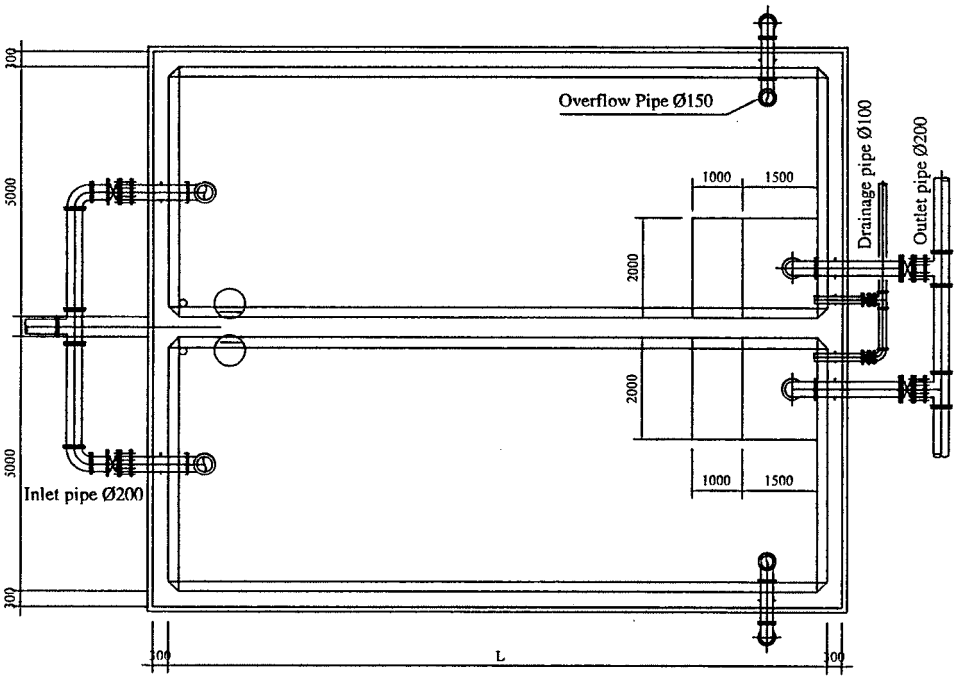
CAD File : Typ_Rapid Filter.dwg

Format A3

Distribution Reservoir

S = 1/100

Plan



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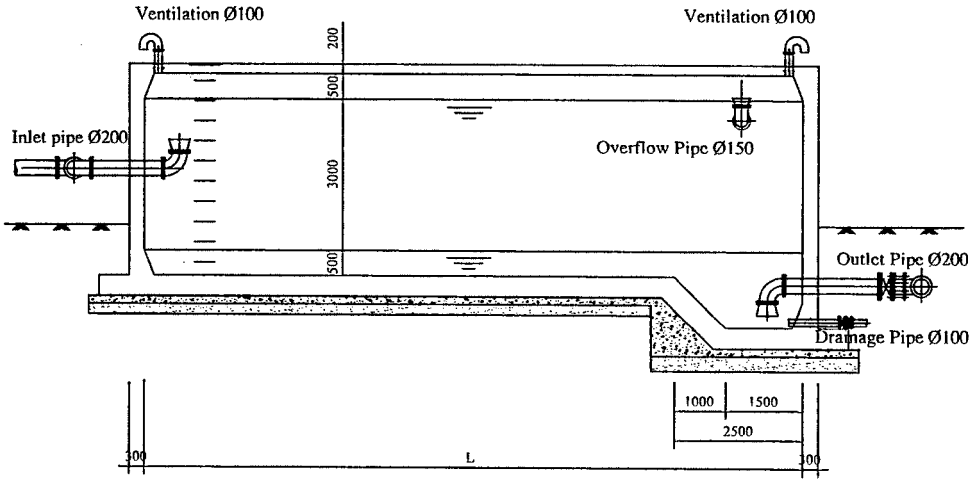

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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Date. Nov. 2001	Scale. 1 : 100	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

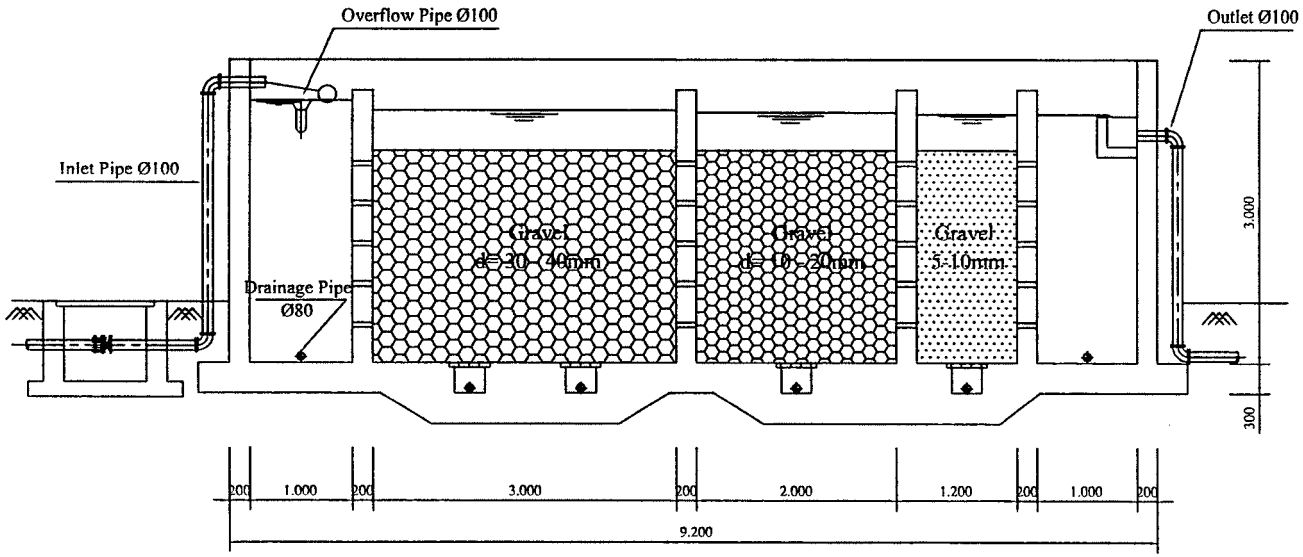
CAD File : Typ_Reservoir.dwg

Format A3

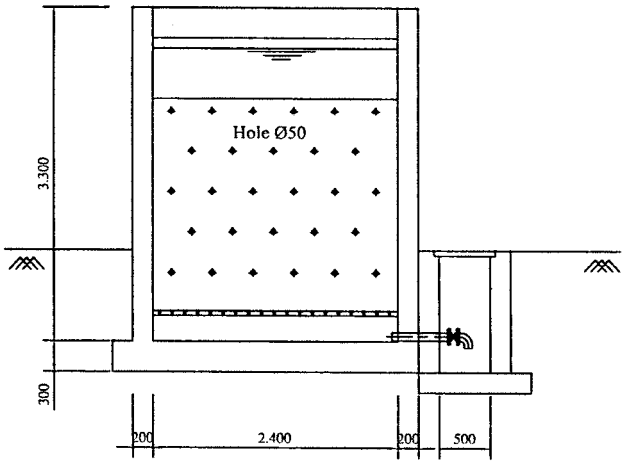
Horizontal Roughing Filter

S = 1/50

Section A - A



Section B - B



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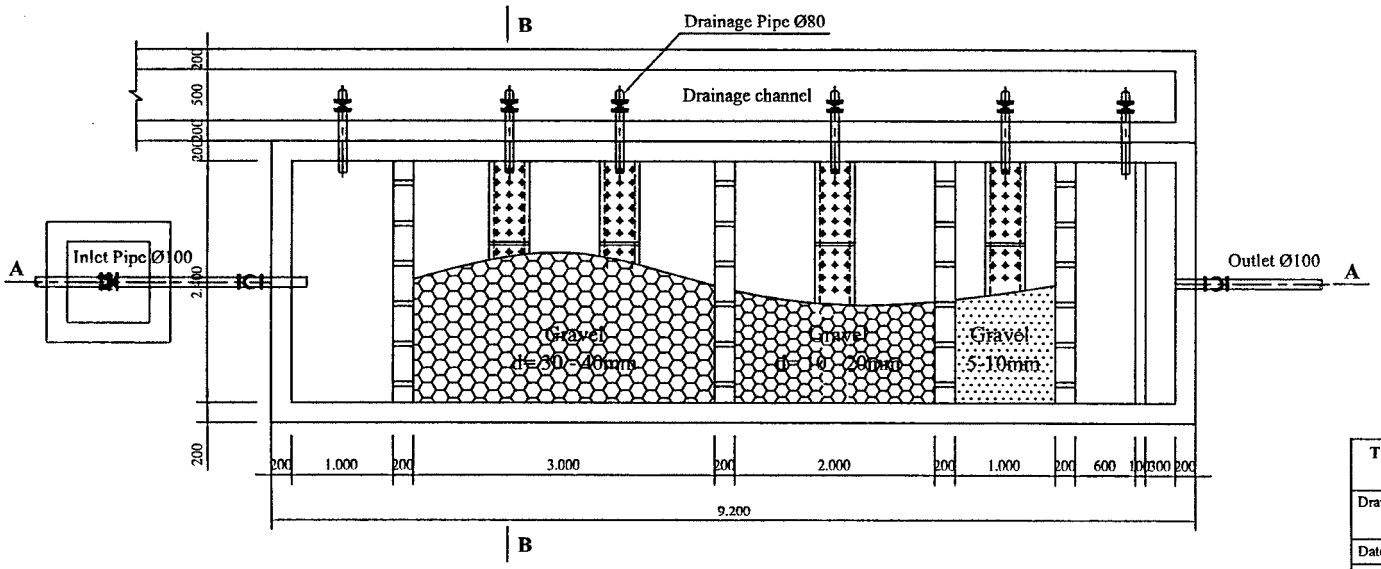

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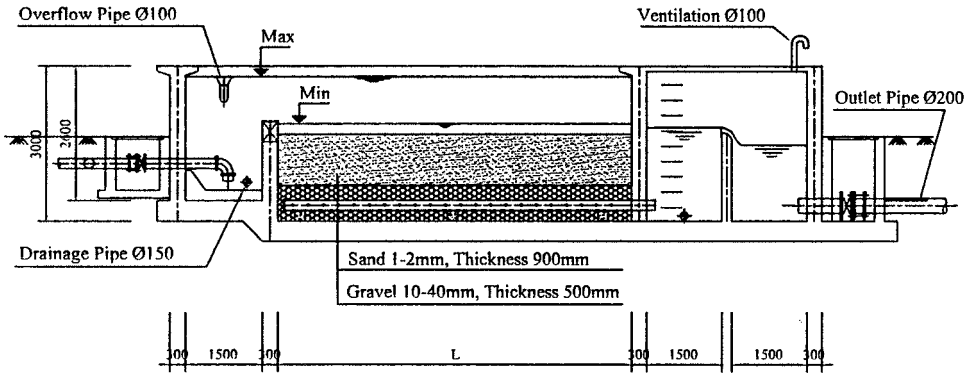
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

CAD File : Typ_RoughingFilter.dwg

Format A3

Slow Filter
S = 1/100

Section A - A



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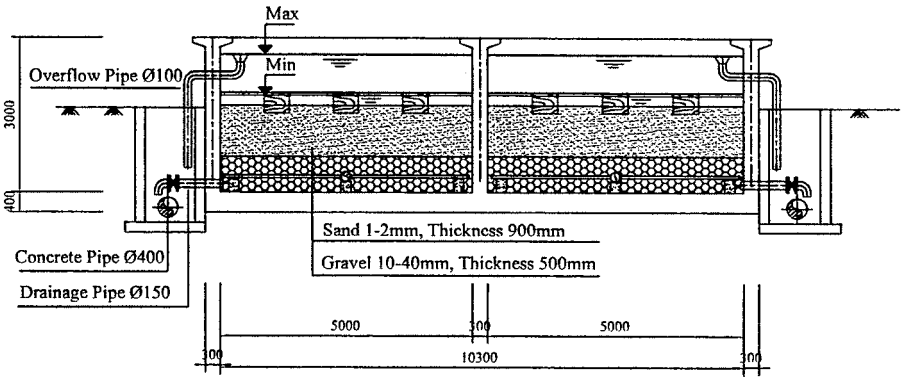

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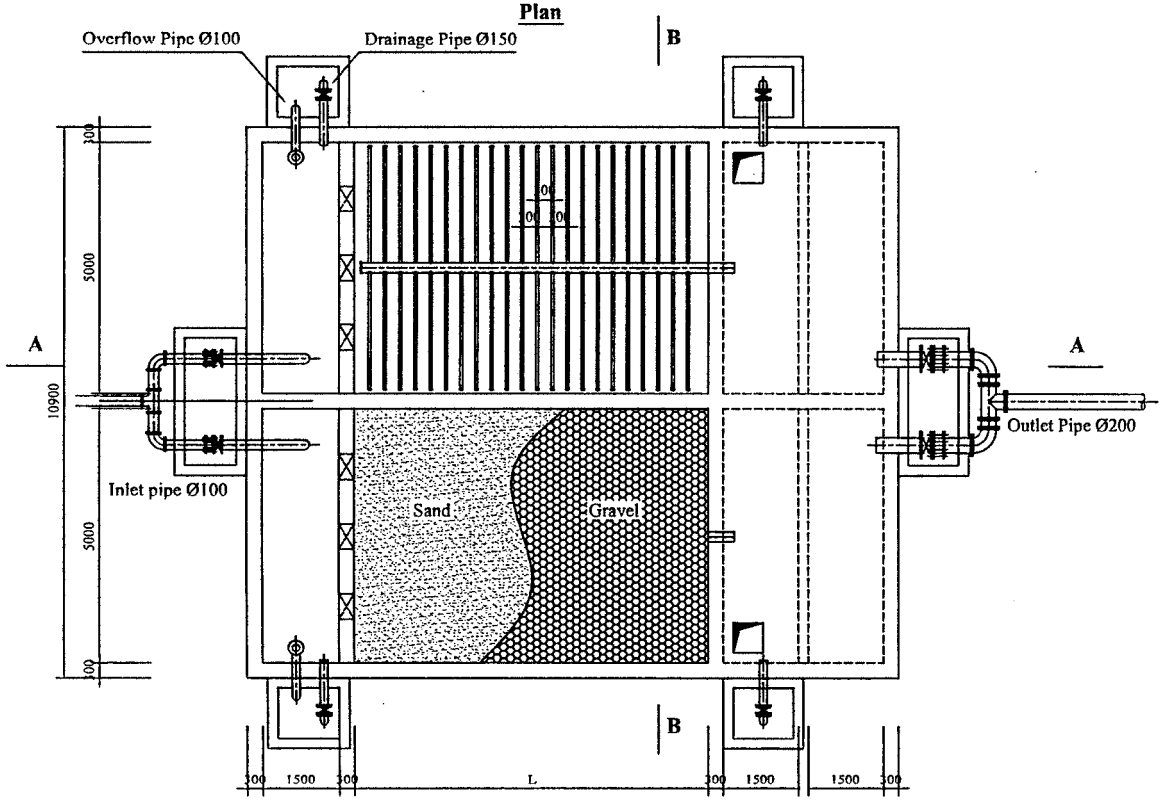

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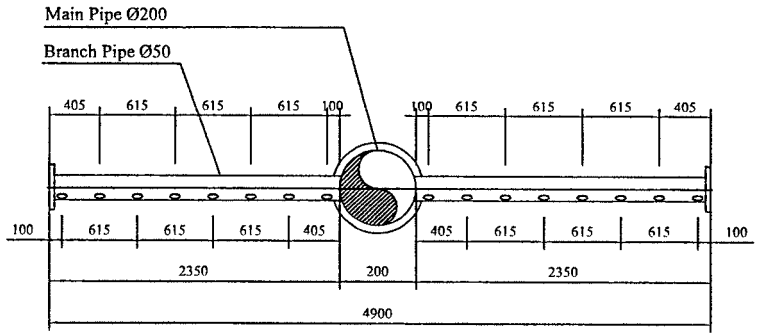

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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Date. Nov. 2001	Scale. 1 : 100	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

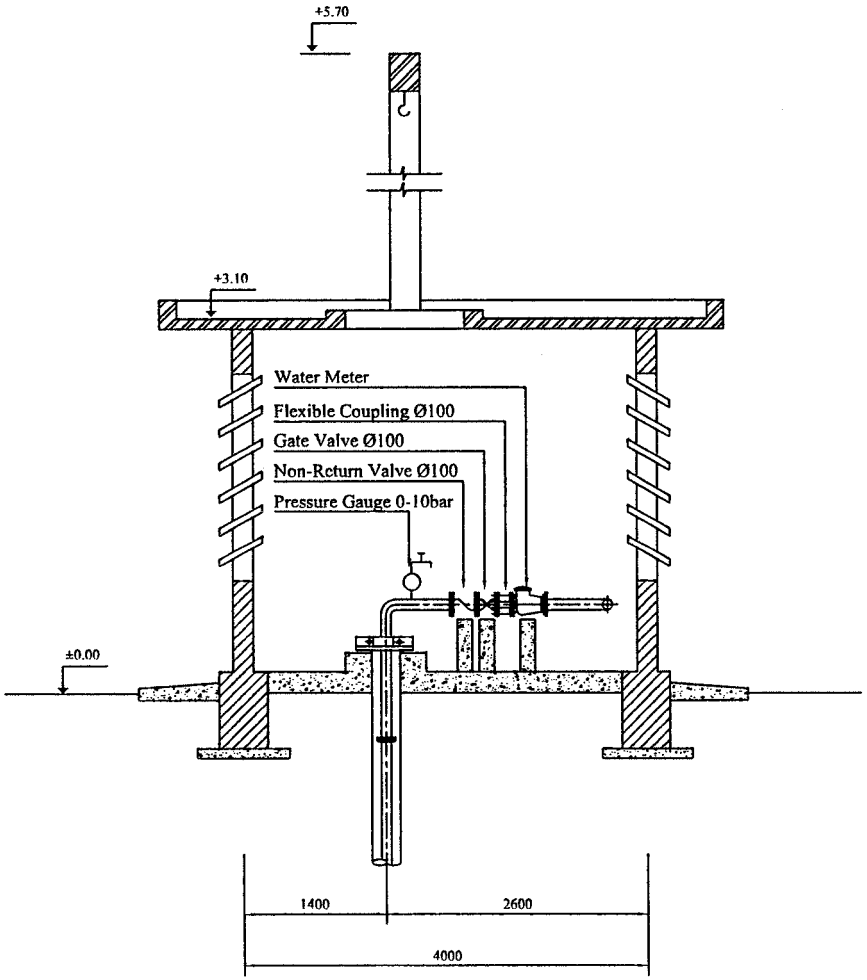
CAD File : Typ_SlowFilter.dwg

Format A3

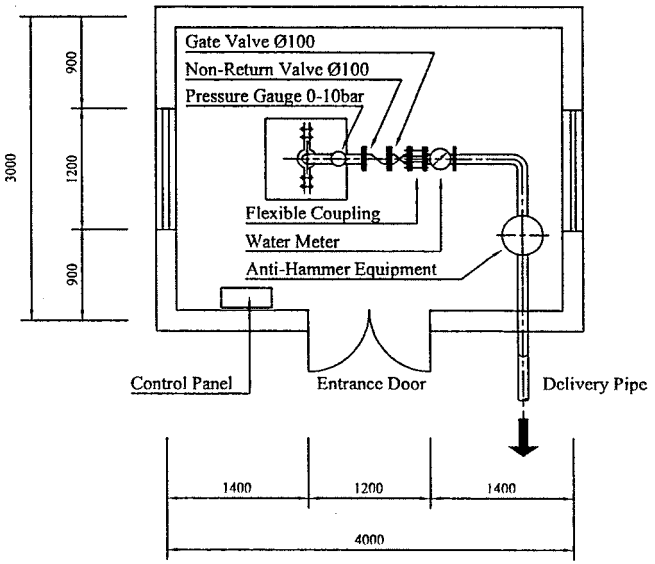
Well Pumping Station

S: 1/50

Section



Plan

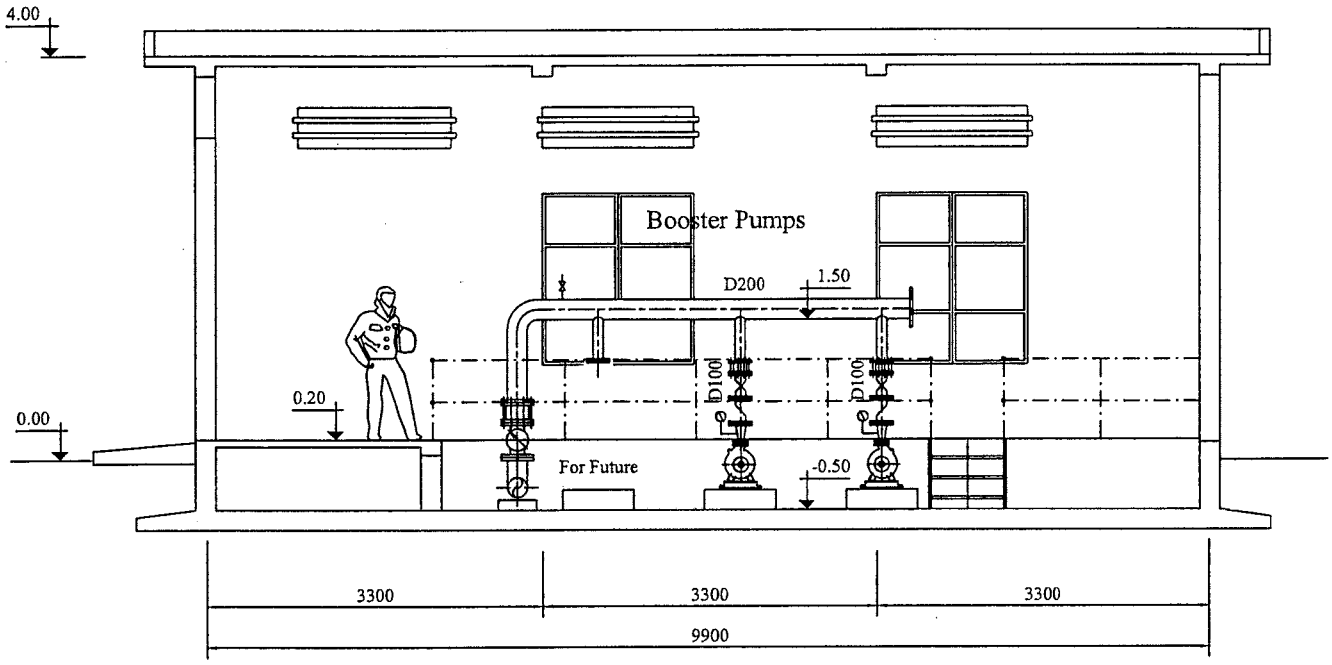


The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name: Well Pumping Station			
Date. Nov. 2001	Scale. 1 : 50	For A3 size	Draw.No. 3
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

CAD File : Typ_WellPS.dwg

CAD File : Typ_BoosterPump.dwg

Section



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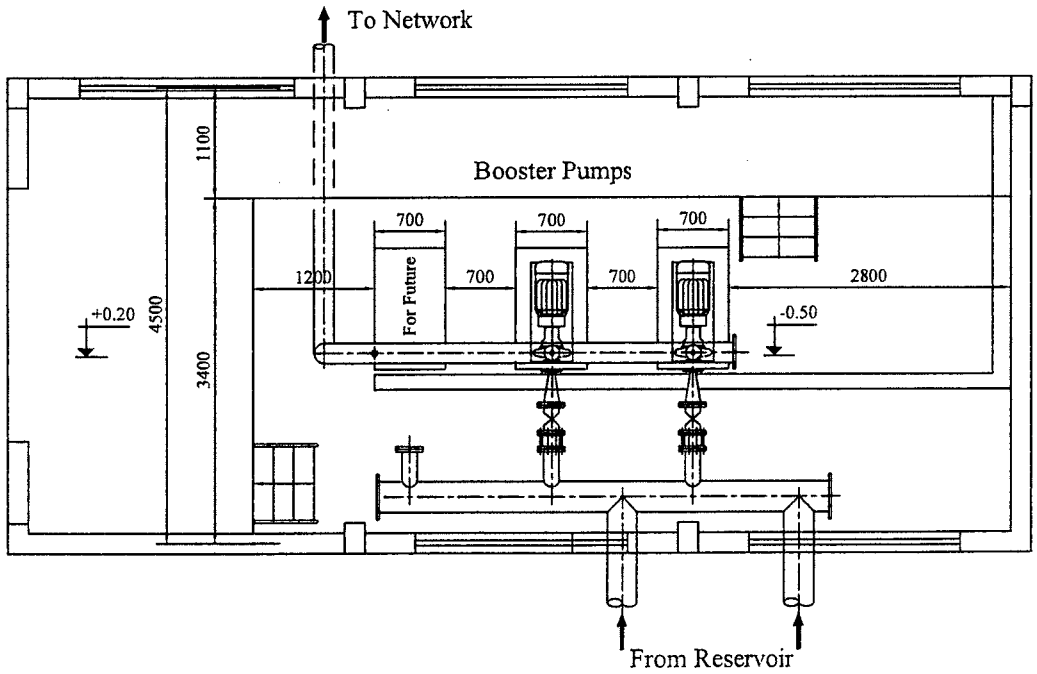
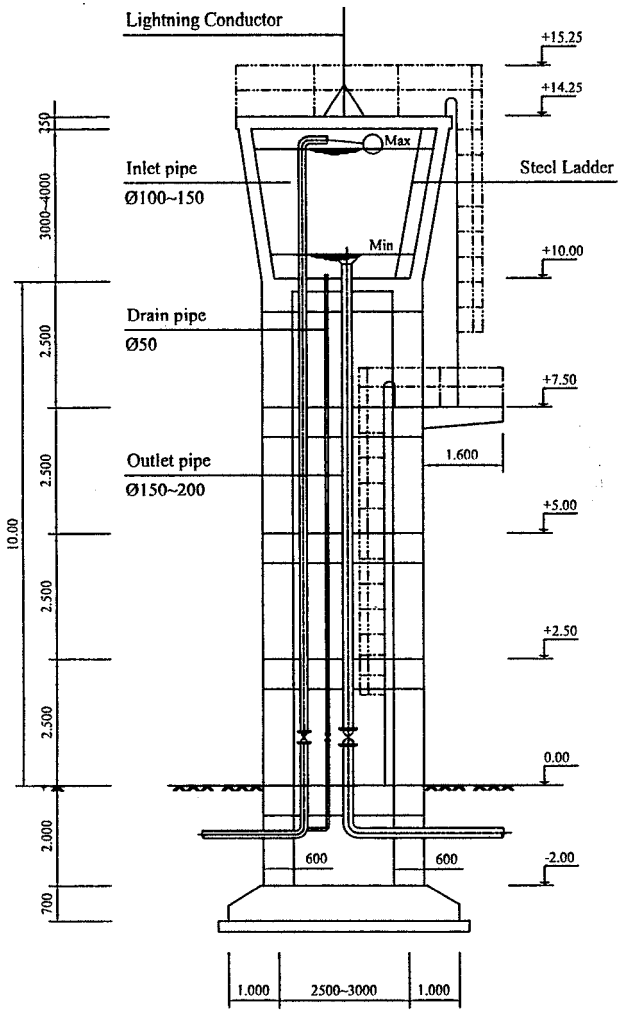


The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
Draw.Name	**Booster Pumping Station**		
Date. Nov. 2001	Scale. 1 : 50	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

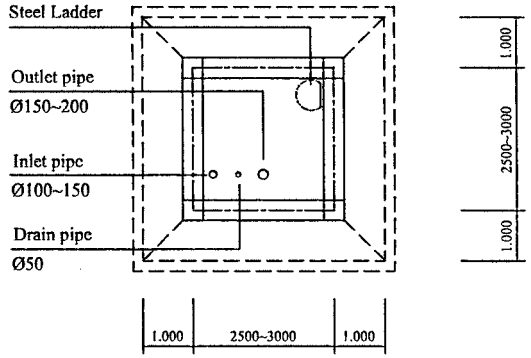
Typical Elevated Tower

S : 1/100

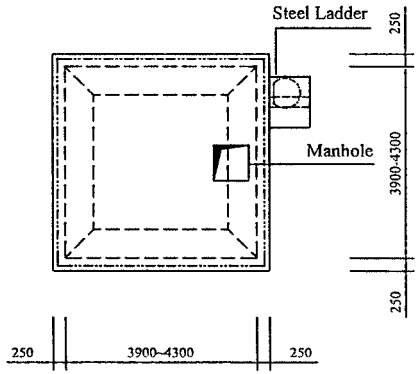
Section



Plan at El. +2.50



Plan at El. +15.30



The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam			
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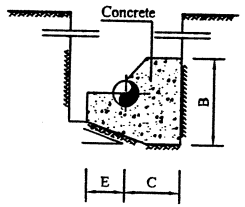
Date. Nov. 2001	Scale. 1 : 100	For A3 size	Draw.No.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			

CAD File : ElevatedTower.dwg

Format A3

CAD File : Typ_Thrustblock.dwg

Section 1



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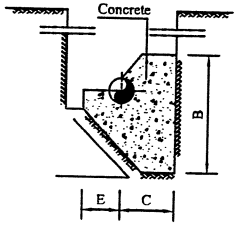

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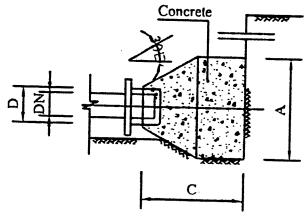
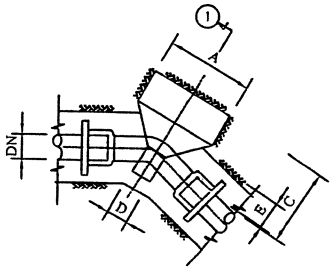
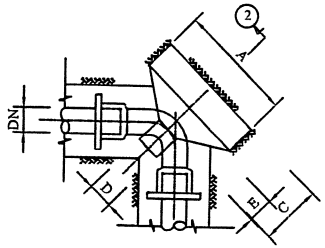


Plan of Bend < 90°



Plan of Bend 90°



Plan of Deal end

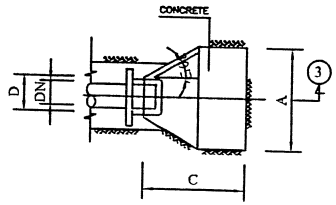


Table of Dimensions for Bends < 90°

DN (mm)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	VOLUME m^3
65	250	250	200	150	100	
80	250	250	200	150	100	
100	300	350	400	200	100	0.04
150	500	500	600	200	150	0.08
200	700	700	600	200	200	0.16
250	850	850	600	200	250	0.20

Table of Dimensions for Bends 90°

DN (mm)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	VOLUME m^3
65	250	250	200	150	100	
80	250	250	200	150	100	
100	500	500	400	250	100	0.10
150	700	700	600	250	150	0.20
200	950	950	600	250	200	0.40
250	1150	1150	600	250	250	0.60

Table of Dimensions for Dead end

DN (mm)	A (mm)	B (mm)	C (mm)	D (mm)	VOLUME m^3
65	250	250	350	150	
80	250	250	350	150	
100	400	400	400	200	0.05
150	600	600	600	250	0.17
200	800	800	800	300	0.41
250	1000	1000	1000	350	0.76

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name

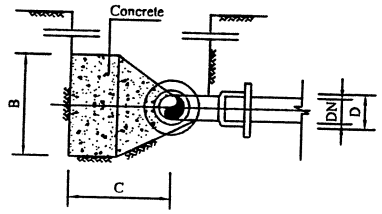
Thrust Blocks 1/2

Date. Nov. 2001 | Scale. NTS | For A3 size | Draw.No.

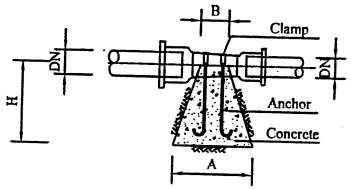
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CAD File : Typ_Thrustblock.dwg

Section 4



Section2



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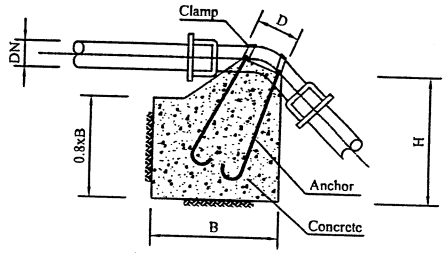
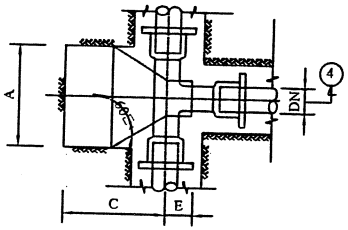
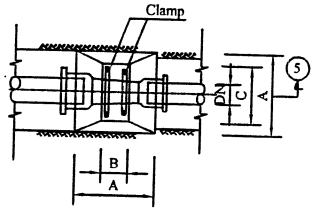


Plan of Tee



Plan of Reducer



Plan of Vertical Bend

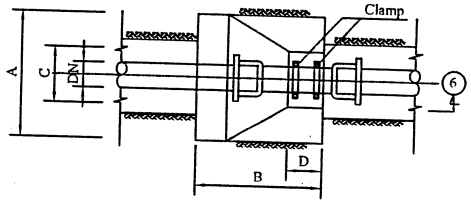


Table of Dimensions for Tees

DN (mm)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	VOLUME m^3
65	300	300	300	150	100	
80	300	300	300	150	100	
100	400	400	400	200	100	0.06
150	600	600	600	250	150	0.18
200	800	800	800	300	200	0.45
250	1000	1000	1000	350	250	0.90

Table of Dimensions for Reducer

DN1xND2 (mmxmm)	A (mm)	B (mm)	C (mm)	H (mm)	VOLUME m^3
80x65	250	150	150	300	
100x80	250	150	150	300	
150x100	500	250	350	500	0.08
200x150	700	260	450	700	0.2
250x200	800	270	550	800	0.3

Table of Dimensions for Vertical Bend

DN (mm)	A (mm)	B (mm)	C (mm)	D (mm)	H (mm)	VOL (m^3)
65	300	300	150	150	300	
80	300	300	150	150	300	
100	700	700	300	200	700	0.33
150	900	900	400	250	900	0.71
200	1100	1100	450	260	1100	1.25
250	1250	1250	550	330	1250	1.90

The Study on Groundwater Development in the Rural Provinces of Central Highlands in the Socialist Republic of Viet Nam

Draw.Name

Thrust Blocks 2/2

Date. Nov. 2001 | Scale. NTS | For A3 size | Draw.No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Appendix 4

Technical Specifications

Appendix 4

TECHNICAL SPECIFICATIONS

1. Introduction

This appendix includes detailed specification for delivery and installation of all relevant items of implementation of a piped network. The specifications include delivery and laying of Pipes (GI, PVC, PE, valves, airvalves, checkvalves and water meters).

The structure can be directly used for preparation of specifications in detailed design. British Standard has been used as basis everywhere.

2. Galvanised Steel Pipes

Standards

Except where otherwise stated, steel pipes and fittings shall be in accordance with BS 534: Specification for Steel Pipes and Specials for Water and Sewage, BS 3601: Carbon Steel Pipes and Tubes with specified Room Temperature Properties for Pressure Purposes and BS 1387: Screwed and Socketed Steel Tubes and Tubulars and for Plain End Steel Tubes suitable for Welding or for Screwing to BS 21 Pipe Threads.

Joints

Mild steel pipes and fittings shall be supplied with either flanged ends or with screwed ends as specified in the Bill of Quantities.

Flange joints shall have flanges in accordance with BS 4504: Section 3.1. Where pipes supplied with flanges welded on, the welding shall be carried out in accordance with BS 2633 or BS 2971.

Bolts and nuts, unless otherwise specified shall be of mild steel and the dimensions and finish shall comply with BS 3692. Where washers are used they shall be of appropriate material and the dimensions shall comply with BS 4320.

Where screwed ends are specified each pipe shall be supplied complete with one screwed socket to complete the joint.

Gaskets for flange joints shall be of the inside-bolt-circle type. The dimensions of gaskets shall comply with BS 4865:Part 1. Gaskets shall be manufactured from material complying with the provisions of BS 2494 for type W rings.

Tests

Before dispatch all mild steel straight pipes shall be hydraulically tested by the manufacturer in accordance with BS 3601.

The hydraulic test pressure to be applied to each straight pipe shall be the greater of:

- either the pressure given in the relevant clause of Section 2 of BS 3601, or
- twice the specified working pressure.

Hydraulic testing of mild steel fittings and specials shall be carried out in accordance with the recommendations given in Clause 4.3 of BS 534.

Galvanising

After being tested the mild steel pipes and fittings shall be galvanised in accordance with BS 729.

3. Screwed Stainless Steel Pipes

Screwed stainless steel pipes shall comply with BS 6362: Specification for Stainless Steel Tubes suitable for Screwing in accordance with BS 21 Pipe Threads for Tubes and Fittings where pressure tight Joints are made on the Threads.

Welded Stainless Steel Tubes

Welded stainless steel tubes shall comply with BS 6323, Part 8: Specific Requirements for longitudinally welded Stainless Steel Tubes. Welded pipe joints shall be welded in compliance with the procedures laid down in BS 4870 and welders shall be approval tested in accordance with BS 4871 and BS 4872.

4. Unplasticized Polyvinyl Chloride (PVC) Pipes

PVC Pipes for Pressure Applications

PVC pipes for pressure applications shall comply with BS 3505. Joints and fittings to be used therewith shall comply with BS 4346. The pressure classification shall be PN 6 or PN 10.

All buried pipes shall, unless otherwise indicated, be of the socket and spigot type made water tight in the joints by the compression of rubber gaskets with two thick lips.

Common Requirements

PVC pipes shall be capable of withstanding ultraviolet degradation. A rodent inhibitor shall be incorporated in the material of the pipe.

The Contractor shall advise the manufacturer of the climatic and conditions at the site of the Works and shall seek his advice on the storage of PVC materials on site. Subject to the Engineer's approval this advice shall be followed at all times.

Except in the case of flanged joints and where otherwise specified or approved by the Engineer pipe joints shall be flexible and sealed with a rubber gasket to the approval of the Engineer and shall withstand the various tests specified in the applicable standards. For pipes with a nominal bore of 100 to 230 mm the joints shall be capable of withstanding a deflection of not less than 3.0 degrees in any direction and for pipes with a nominal bore of 250 to 330 mm a deflection of 2.0 degrees and from 350 to 600 mm 0.5 degrees in any direction. All pipes shall be capable of

withstanding a "draw" of 13 mm over and above the initial jointing allowance. The initial jointing allowance is the gap measured parallel to the centre line of the pipeline and shall not be less than 6 mm or more than 13 mm or as otherwise recommended by the pipe manufacturer and approved by the Engineer. Pipes and fittings shall be indelibly marked prior to laying to indicate the correct initial jointing allowance.

Gaskets

The gasket consists of a substantial body, which is extended into two thick lips directed towards the bottom of the socket. The outer edge of the body is formed into an annular shoulder, which fits into the recess in the socket of the pipe. The side of the shoulder facing the entry to the socket is given a chamfer, which centres the gasket in its recess.

The standard gaskets are moulded components with a generous cross section providing large seating surfaces to ensure fluid tightness and a substantial reserve of elasticity. The maximum continuous working temperature for these gaskeks is 70^{o}C. In natural rubber or an equivalent elastomer the gaskets for ND 60 to 600 are homogenous. It is preferred that the gaskets are factory fitted and factory lubricated with a long lasting silicone lubricant. The pipes must be supplied with end caps protecting the pipes effectively against fouling etc.

The storage conditions for the gaskets are:

. the storage temperature should be between +5^{o}C and +25^{o}C. They should be brought to about 30^{o}C for long enough to give them their original flexibility before being used.
. for vulcanised elastomer based products the following should be avoided:

- storage in a too damp or too dry atmosphere;
- direct sunlight or high ultra-violet artificial light;
- protect them from ambient air and the especially harmful effects of ozone.

Transport and Storage

During transport pipes shall be solidly supported under the lower layer and at the sides to prevent accidental damage. Storage on site shall be on a raised floor with support frames so that the sockets do not touch the ground and shall be head to tail to prevent pipes from resting on the sockets.

Pipes must at all times during storage be protected against ultraviolet light from the sun.

Excavation of Trenches

Trenches shall be excavated to the width and the depth and to the lines shown on the drawings and in conformity with Clause “Earthworks”. The earth cover shall be at least 0.6 metre above the pipeline and must never exceed 3 metres.

Laying PVC Pipes

The Contractor shall submit for the Engineer's approval the pipe manufacturer's complete and detailed recommendations for the handling and installation of pipes and fittings in open trench.

Flexible pipes shall be laid and bedded in approved granular materials except where concrete protection is required. The particle size in the material must not exceed 16 mm and the contents of particles between 8 and 16 mm must not exceed 10 %. Sharp stones or crushed material must not be present in the material. The granular material shall be placed over the full with of the bottom of

the trench and shall extend from a level 150 mm below the underside of the sockets or couplings on the pipeline to 200 mm above the crown of the pipes for the full length of the pipeline. The granular material shall be carefully compacted by hand.

Jointing of PVC Pipes

Before lowering the pipes into the trench the Contractor shall carefully inspect and clean the pipe to ensure that it has been freed for all foreign matter.

The alignment of the pipe in the trench shall be controlled by level instrument or boning rods to ensure correct levels. For water supply the minimum slope shall be 1 mm per metre pipe length. No zero slope will be tolerated.

The Contractor shall keep the interior of pipes clean and free from water, dirt, stones and other foreign matter as laying proceeds, and at the end of the day's work or at other times when installation work is not proceeding the open ends of the pipes shall be sealed off by a suitable stopper or end cap. The Contractor shall take such precautions as are necessary to prevent pipes from floating.

The pipes shall be laid in straight lines both in horizontal and vertical planes. Changes of direction of less than $11\frac{1}{4}^{o}$ shall be obtained by deviating the pipes after jointing at one or more joints. The angle of deviation at each joint depends on the ND and has the maximum values as stated above.

General Jointing Procedure

The general jointing procedure may vary with the type of joint used, but the basic requirements are:

- Overall cleanliness
- Correct positioning of the components
- Correct centring of the spigot in the socket
- Strict observance of the manufacturer's assembling instructions.

The Contractor shall be responsible for providing the necessary copies of these instructions.

The general jointing procedure is as follows:
The spigot end of the pipe P2 to be laid must penetrate into the socket of the waiting pipe P1 fitted with its gasket.

- Check that the spigot end of pipe P2 is correctly chamfered.
- Carefully clean with a rag:
  - the interior of the socket and especially the seat of the gasket of pipe P1, if the gasket is not factory fitted;
  - the spigot of the pipe P2 to be assembled;
  - the gasket, if not.
- Fit the gasket, if not factory fitted, in the socket of pipe P1 with the lips pointing towards the bottom of the socket. Check that it is correctly and uniformly placed in its groove.
- Mark the normal jointing depth on the spigot of pipe P2 on each side of the pipe. These marks should be the depth of the socket less 10 mm away from the end of the pipe.
- Lower the pipe P2 into the trench carefully. Hold the spigot about 400 mm from the socket of the pipe P1.
  Bring the spigot of pipe P2 into the socket of pipe P1 to the level of the gasket.
- Coat with lubricant:
  - the inside of the gasket;

- the spigot of pipe P2 up to about 25 mm from the two socketing depth marks.

. Push in place to the socketing depth marks manually.
If difficult to push the pipe in place a special jointing tackle with looped slings fitted around the two pipes can be used.

Note: It shall not be permitted to use the arm of an excavator to push the pipe P2 into position in the socket of pipe P1.

. If the pipeline lay out indicates a deviation this may now be made.
. The levelling layer must be checked to make sure the pipes are evenly supported.
. The side fill to the pipe must provide adequate support with the approved granular material in order to keep it centred in the socket. Stamping with the foot is recommended.
. The top layer of 200 mm to be equally filled and stamped with the foot.

Polyethylene Pipes

Polyethylene pipes for cold water services shall comply with ISO 161:1988 and ISO 4065:1978 pressure class PN 6 and PN 10. Fittings shall be compression type fittings to BS 864 Part 3.

Nominal diameters are 20, 25, 32, 50, 63 and 80mm.

Polyethylene piping shall be laid in accordance with the pipe manufacturer's recommendations as described under PVC pipes above and to the approval of the Engineer.

5. CHAMBERS

General

Chambers shall be constructed on water supply pipelines in the positions indicated at the drawings and to house valves and flow meters. Generally all chambers shall be constructed in either precast or in-situ concrete made with Portland cement to the standard details shown on the Drawings.

Construction details

Precast concrete chamber sections shall be constructed with slabs aligned correctly. Joints shall be made so that the required jointing material fills the joint cavity. Any surplus jointing material extruded inside the chamber shall be trimmed off and joints shall be pointed on completion.

Bases for chambers shall be constructed to the standard details shown on the Drawings.
Valves and other accessories shall be seated, embedded and anchored to concrete plinths cast in concrete Class 20.

For valves with DN up to 200 mm surfaces boxes will be provided and shall be ductile iron Class A in accordance with BS 5834 and shall have a minimum clear opening of 380 x 230 mm. Surface boxes for other purposes shall be cast iron and shall comply with the relevant provisions of BS 5834 and be heavy duty grade A.

For large bulk flow meter chambers, covers shall be of raised pattern non-slip mild steel solid floor plates to BS 1449 Part 2, in Grade 43 steel and in the dimensions shown on the Drawings. Covers will be installed hinged as shown on the Drawings and shall be holed for and supplied with standard lifting keys. Steel plates for this purpose shall be hot dip galvanised in accordance with the relevant provisions of BS 729 and will be minimum 4,5 mm thick.

Covers and frames with minimum clear openings outside the ranges in BSEN 124 shall comply with the relevant provisions of that standard where applicable. All manhole covers shall have at least two closed keyways per complete cover. Keyways shall be at symmetrical points to enable lifting without tilting or jamming.

Chamber covers and frames shall in general be constructed flush with the final ground level. In cases where existing pipes are laid close to the surface and it is not possible to construct chambers with the top flush with final ground, the Contractor will propose for the Engineer's approval, the construction of the chamber to be partly above ground in order to accommodate the correct installation of valves etc.

The external surface of all chambers including roof slabs shall be protected with bituminous coating.

Chambers shall be substantially watertight, with no identifiable flow of water penetrating the permanent works. If there is any discernible flow of water entering the chamber at a point which can be located by visual inspection, the Contractor shall take such measures as are necessary to stop such infiltration. Plasticized PVC waterstops shall comply with the relevant provisions of WIs No. 4-31-02.

Pipework
All pipes and assembling parts selected under this Contract must be of first quality, truly circular, and of uniform thickness, free from scale, lamination, honeycombs and other defects, and shall be designed and suitable for the stated pressures and temperatures.

6. Gate Valves and accessories

The Contractor shall submit full details of valves with manufacturer's drawings to the Engineer and obtain his approval before manufacture is commenced. All valves shall be individually tested by the manufacturer for both strength and leakage.

Gate (sluice) valves shall comply with BS 5163:1986 unless otherwise stated in the Contract.

i) Valves shall be Type B.

ii) The pressure rating shall be PN10 unless stated otherwise in the Contract.

iii) Gates shall be resilient faced up to 300mm diameter. Gates shall be cast iron to BS 1452 GR220 min or ductile iron to BS 2789 73 min.

For resilient faced gates the gate shall be entirely encapsulated with rubber to BS 2494 Type W. Nitrile/EPDM with a minimum 3mm of rubber in the seating area.

For metal seated gates both the body and the gate rings shall be gunmetal to BS 1400 LG2 and components shall be designed to provide adequate seating performance before and after wear of the seating surfaces.

iv) The body and bonnet shall be cast iron to BS 1452 GR 220 min or Ductile Iron to BS 2789 73 min.

v) Valve stems shall be threaded sufficiently to allow the gate to be raised clear of the nominal bore of the valve. Stem sealing shall be as detailed within the following table:

Diameter (mm)	Actuator or Gearbox Fitted	No Actuator or Gearbox
50 - 150 inc	0 - seal	0 - seal
200 - 300 inc	Packed Gland	0 - seal

[0 - seal = Double toroidal sealing ring to BS 2494 Type W]

Means shall be provided for resealing the stem under working conditions.

vi) Valves shall be designed to pass potable water and raw water.

vii) Valve caps shall be secured by hexagonal headed set screws.

viii) Operating levers will be hand wheels for 100-300 mm valves..

ix) Direction of closure shall be clockwise. The direction of closing shall be indicated by an arrow cast on the upper face of the gland or stem seal housing.

x) Unless indicated otherwise on the Drawings valves will be used in the closed end application.

xi) Valves with nominal diameter greater than 200 mm will be installed with ductile iron anchoring pipes on the upstream side as shown on the Drawings. Anchoring pipes will have 2 flanges and 1 puddle flange.

Gate valves shall be coated in accordance with WIS No 4-52-01 - Class A internally and Class B externally.

Extension spindles, support brackets and centring spiders shall be constructed of mild steel galvanised to BS729. Support brackets of the bolt-fixing type shall be provided to extension spindles at centres not exceeding 2 metres. The top bracket shall be located a maximum 300mm below the spindle cap, handwheel or top of wall as appropriate. Extension spindles in gate valve extension spindle chambers shall be provided with centring spiders at centres not exceeding 2 metres. The top spider shall be located a maximum 300mm below the spindle cap. All exposed universal joints shall be coated with a non-perishable material with an internal grease packing to allow flexible movement.

Check Valves

Check valves shall comply with BS 5153 unless otherwise stated in the Contract and shall be as follows:

i) Nominal pressure shall be 10 bar (PN106) unless otherwise stated in the contract.

ii) Valve to be swing type resilient seated.

iii) Body ends to be flanged to BS 4504 PN10 unless otherwise stated in the contract.

Altitude valves (Level control valves)

Altitude valves shall be used to control the water level in public taps and treatment plants to avoid any overflow events. Altitude valves shall regulate the water flow in a reservoir by means of a float with 2 positions. The valve shall be able to close at a preset high water level, and open at a preset low water level. This function shall be governed by a hydraulic system connected to the float. The altitude valves shall be Danfoss C701 or similar approved.

7. Mechanical flow meters

Mechanical water meters shall comply with the relevant provisions of BS 5728 Class B or ISO 4064 and shall be of the in-line helical rotary type for bulk flows. They shall be designed on the basis of the expected flow rating.

Meter housings shall be of cast iron or other approved material and be double flanged to BS 4504. The meters must be capable of being installed in horizontal, vertical or inclined pipelines without loss of accuracy. The complete measurement mechanism shall be removable from the meter body and a blank cover to replace the working unit shall also be supplied. The design of the meter shall be such that water passes through it with negligible head loss and without restriction or change of direction.

Meters shall have straight reading counters registering total flow in cubic meters (m^3). A centre sweep hand registering in litres (l) shall also be fitted.

Meters shall be suitable to a maximum working pressure of 16 bars and the Contractor shall ensure their suitability for use in the prevailing conditions.

Meter housings shall be coated by dipping or other equivalent means using a cold applied black bitumen material complying with BS 3416 and made from petroleum or asphaltic bitumen but not coal tar bitumen. No coating is to be applied to the casting until its surfaces are clean, dry and free from rust, oil and deleterious material.

The complete working mechanism of the meters shall be manufactured from materials offering maximum resistance to wear and corrosion.

8. Support of Pipework and Valves

All necessary supports including foundations, hangers, saddles, sliding shoes, slings, expansion pieces, fixing bolts, foundation bolts, fixing and anchor points and all other attachments shall be supplied to support the pipework and its associated equipment in an approved manner. Valves, meters, strainers and other devices mounted in the pipework shall be supported independently of the pipes to which they connect.

All brackets or other forms of support which can conveniently be so designed, shall be rigidly built up of steel sections by riveting or welding, in preference to the use of castings.

No point of passage of pipes through floors or walls shall be used as a point of support, except with the approval of the Engineer.
All brackets and fixings shall be hot-dip galvanised in accordance with BS 729.

pumped to the proposed injection point on the pipeline as shown in the Drawings. The chlorinator capacity shall be such that a free chlorine residual of at least 1 mg/l can be attained in the water after a minimum contact time of 20 minutes. This condition must be attainable even when maximum flow rates coincide with anticipated maximum chlorine demands. The equipment shall be of such design that it will operate accurately at both minimum and maximum flow rates without the use of standby equipment.

9. Dosing Pumps

In case dosing pumps are to be used for chlorination they shall fullfil the following conditions.
Dosing pumps shall be of the positive displacement reciprocating variable stroke type suitable for sodium hypochlorite solution dosing and shall be designed to. It shall be possible to regulate the pump output by adjustment of the pump stroke length or the stroke frequency. Pump housing shall be of composite material ensuring mechanical strength and chemical resistance. The pumps shall be able to draw from the solution storage tanks. Sealing materials shall be of Viton and the diaphragms of teflon. The proposed dosing pump will comply at least with the following requirements:

Max. suction lift:	3 m
Max. back pressure:	10 bar
Electrical connection:	230 V, 50 Hz
Max temperature of medium:	35^{o} C

Pump capacity shall range between 3.5 l/h and 25 l/h.

The dosing pump shall be manual start and manual stop with automatic cut-out in the event of the feed tank being emptied.

The delivery lines shall also be provided with an overpressure cut-out to stop the pumps in the event of either the line becoming blocked or an attempt being made to run the pump against closed valve.

Appendix 5

Comparison of Power Cost between Existing Line Use and Generator Driven Pump

Appendix 5

COMPARISON OF POWER COST BETWEEN EXISTING LINE USE AND GENERATOR DRIVEN PUMP

1) Power cost with existing electricity line

The power cost is calculated on the following assumptions;

a) Pumping efficiency of 50%

b) Cost of electricity is 750 VND/kWh, and

The power cost is calculated for following 4 communes (systems);

Commune	Daily kWh	Monthly cost (VND/day)	Discharge rate (m^3/hr)	Cost per m^3 (VND/m^3)
K-1	30	686,250	3.6	318
K-2	54	1,235,250	6.1	338
G-3	220	5,032,500	13	524
D-4	110	2,516,250	13	323

2) Alternative power cost with generator-driven pump

The power cost is calculated on the following conditions;

a) Cost of fuel is 4,000VND/hr

b) Fuel consumption at 100% load is as followings;

Generator	Consumption(l/hr)
30 kVA	7.2
20 kVA	5.8
15 kVA	4.6
10.5kVA	3.3

The power cost is calculated for following 4 communes;

Commune	Required power (kVA)	Fuel cost (VND/hr)	Discharge rate (m^3/hr)	Cost per m^3 (VND/m^3)
K-1	10.5	13,200	7.2	1,833
K-2	15	18,400	11.9	1,546
G-3	30	28,800	13.0	2,215
D-4	20	23,200	10.8	2,148

3) Conclusion

The power cost with using generator is around 6 times higher than with using electric line.