Case 2

Table IV.D.1 Results of Hydraulic Calculation (1)

Station No.	Distance	EL	DL	Discharge	Dia-meter	Velocity	Hydralic Gradient	Head Loss	Dynamic water pressure	Hydras-static pressure	Remark
	m	m		m^3/S	mm	m/s	0/00	m	m	m	m	
1											
3		10.5							47.53	47.53	0.00	
4	649	10.5		2.76	1,500	1.56	0.910	0.59	46.94	36.44	0.59	
5	1,900	10.5		1.89	1,350	1.32	0.758	1.44	45.50	35.00	2.03	
6	2,400	14.5		1.39	1,000	1.77	1.854	4.45	41.05	26.55	6.48	
7	2,800	19.0		0.60	700	1.50	2.248	6.29	34.76	15.76	12.77	
8	2,300	22.0		0.14	500	0.71	0.765	1.76	23.00	11.00	14.53	
9	650	22.0		-0.58	800	-1.15	1.073	-0.70	33.70	11.70	13.83	
13	2,400	16.0		-1.42	900	-2.23	3.200	-7.68	41.38	25.38	6.15	
2	2,400	10.0		-2.13	1,100	-2.24	2.564	-6.15	47.53	37.53	0.00	
3	1	10.5		-4.42	1,500	-2.50	2.179	-0.00	47.53	37.03	0.00	
2												
2		10.0							47.53	47.53	0.00	
3	2,400	16.0		2.13	1,100	2.24	2.564	6.15	41.38	25.38	6.15	
9	2,400	22.0		1.42	900	2.23	3.200	7.68	33.70	11.70	13.83	
10	1	22.0		0.84	900	1.32	1.220	0.00	33.70	11.70	13.83	
11	2,899	20.5		-0.12	600	-0.44	0.253	-0.73	34.43	13.93	13.10	
12	2,000	15.5		-0.78	700	-2.02	3.577	-7.16	41.56	26.06	5.94	
1	2,400	15.0		-1.51	1,100	-1.59	1.352	-3.25	44.84	29.84	2.69	
2	2,500	10.0		-2.29	1,350	-1.60	1.081	-2.70	47.53	37.53	0.01	

Results of Hydraulic Calculation (2)

Case 3

Station No.	Distance	EL	DL	Discharge	Dia-meter	Velocity	Hydralic Head Gradient	Loss	Dynamic water pressure	Hydras-static pressure	Remark
	m	m		m^3/S	mm	m/s	0/00	m	m	m		
1		15.0							41.44	26.44	0.00	
2	1	15.0		3.86	1,800	1.52	0.700	0.00	41.44	26.44	0.00	
3	3,149	10.5		3.08	1,800	1.21	0.460	1.45	39.99	29.49	1.45	
4	1	10.5		2.37	1,100	2.49	3.108	0.00	39.99	29.49	1.45	
5	1,899	10.5		1.50	1,100	1.58	1.341	2.55	37.44	26.94	4.00	
6	1,600	14.5		1.00	900	1.58	1.685	2.70	34.74	20.24	6.70	
7	2,800	19.0		0.21	500	1.09	1.694	4.74	20.00	11.00	11.44	
8	2,300	22.0		-0.25	500	-1.28	2.282	-5.25	35.25	13.25	6.19	
9	650	22.0		-0.97	900	-1.52	1.576	-1.02	26.27	14.27	5.17	
10	2,900	20.0		-1.93	1,350	-1.35	0.788	-2.28	38.55	18.55	2.89	
11	2,000	15.5		-2.58	1,500	-1.46	0.808	-1.62	40.17	24.67	1.27	
1	2,400	15.0		-3.32	1,800	-1.30	0.528	-1.27	41.44	26.44	0.00	

Fig. IV.D.4 Water Transportation System Chart

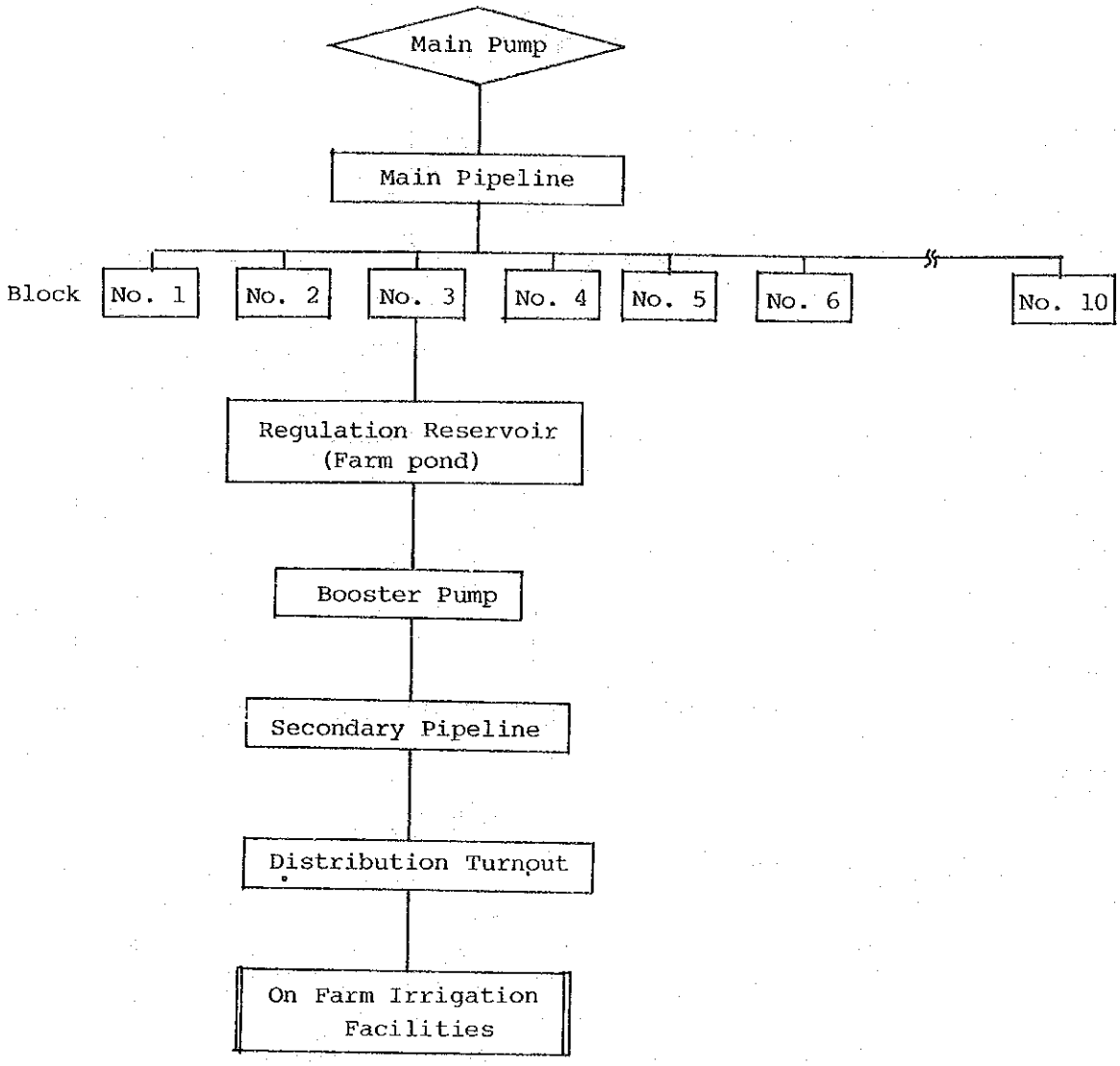


Fig. IV.D.5 Pipeline Network

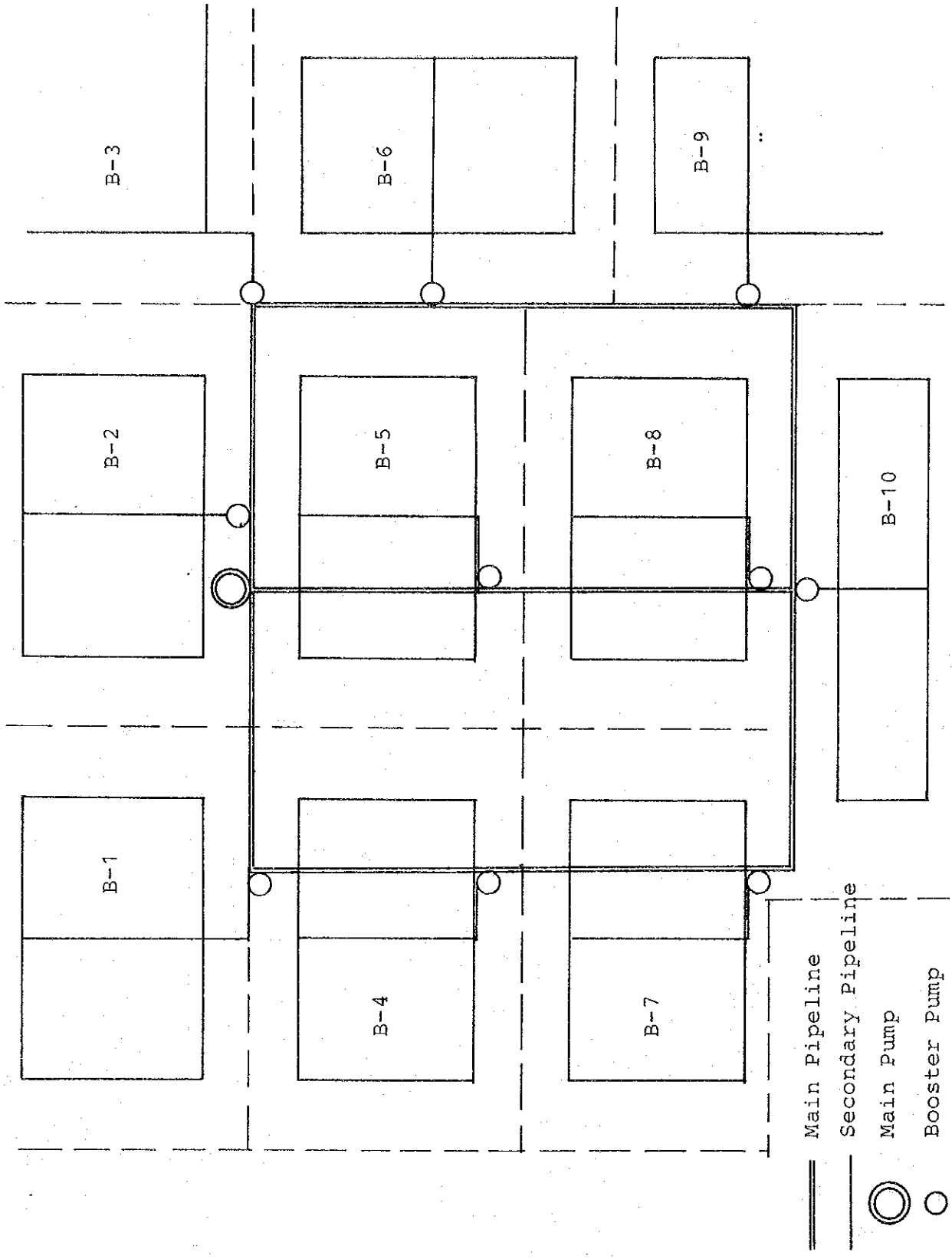


Table IV.D.2 Quality of Pipe Material

Item	FRPM	VP	DCIP	SP	AP	PCP
Corrosion Resistance	No corrosion under ground laying pipe	No corrosion except from organic solution soil	No risk of corrosion from general soils	Prevention work is needed	Inferior corrosion - resistance. painting is needed.	No prpoblem by thickness
Wear Resistance	Good	Good	Interior pipe surface may show wear after a long period.	Corrosion resistance - poor	Corrosion resistance - poor	Corrosion resistance - poor
Shock Resistance	Not affected by impact from small stones.	Not affected by impact from small stones	Poor resistance to large shocks.	Taking care of painting is needed.	Minute cracks occur easily.	Minute cracks occur easily.
Flexibility Efficiency	The most elastic material	Use of Flexible joint required.	Use of flexible joints required.	No flexibility	Pipes may become detached.	Pipes may become detached.

Table IV.D.3 Workability of Pipes

	Laying	Base	Processing at site
FRPMP	. light weight . easy to connect . short time	. sand base is sufficient . care necessary when refilling	. light and easy to cut . good
VP	. high . easy to connect	. same as above	. same as above
DCIP	. heavy . difficult to connect	. base is not specified . refilling is not specified.	. heavy and difficult to cut . poor
SP	. painting is required . takes the longest time and is most expensive	. refilling with sand is	. same as above
AP	. heavy . takes much time	. sufficient care required	. heavy and difficult to cut . poor
PCP	. the heaviest . very expensive	. same as above	. not possible

	Material Cost	Construction Cost	Maintenance
FRPMP	. cheaper than steel pipes, more expensive than concrete pipes	. cheaper than steel pipes . total cost is equal to concrete pipes	. resistant to corrosion and friction . easy to repair
VP	. same as above	. same as above	. same as above
DCIP	. the most expensive among the pipe material	. base is simple, total cost is the most expensive	. strength adequate for high pressure pipeline.
SP	. welding cost is high compared with material cost.	. high, since welding and the painting costs are high.	. poor quality painting creates problems.
AP	. cheaper than steel pipes and nearly equal to plastic pipes	. cheaper than steel pipes	. breakdown very rare. . difficult to repair on site
PCP	. cheaper than steel pipes and plastic pipes	. generally cheaper than steel pipes. . total cost is equal to plastic pipes	. friction on inside wall main cause of breakdown . difficult to

Table IV.D.5 Selection of Pipe Material

Item	Pipe Material
Main Pipeline	FRPMP (Fiberglass-Reinforced Plstic Mortar Pipe) or DCIP (Ductile Iron Pipe)
Secondary Pipeline	PVC (Vinyl Chloride Pipe) or FRPMP (Fiberglass-Reinforced Plastic Mortar Pipe)

Table IV.D.6 Final Selection of Pipes

Item	Diameter	Piep Material Selected
Main Pipeline	ø1800 ~ ø500	FRPMP (Fiberglass-Reinforced Plastic Mortar Pipe)
Secondary Pipeline	ø800 ~ ø350	FRPMP
	ø300 ~ ø100	PVC (Vinyl Chloride Pipe)

Table IV.D.7 Comparison of Lining Materials

	Concrete lining	Rubber sheet lining
Materials supply	Available locally	Difficulty in importing materials
Construct-ability	Care required in laying and curing	Labor saving
Maintenance Work	Machinery available	Necessary to excavate by hand in order to prevent damage to sheets
Durability	Fine durability	Elastic, antishock, anti disparity sinking, poor heat-resistance
Economic	Economical	High percentage of import materials costly

Farm Pond Spillway Design

1. Designing discharge: Q

Designing discharge can be obtained from the total discharge conveyed from the main pipelines to the farm pond.

Standard design discharge is 0.879 m^3/sec for block B-8.

2. Cross section

Spillway is set at the edge of the farm pond. The weir is designed with a wide cross section. The flow formula of a wide cross section weir is as follows:

$Q = C.B.H^{3/2}$

Q: discharge of flow (m^3/sec)
C: Coefficient of flow
B: Overflow width (m)
H: Overflow depth (m)

$$C = 1.60 \frac{1+2a\left(\frac{H}{Hd}\right)}{1+a\left(\frac{H}{Hd}\right)}$$

H: Overflow head (m)
Hd: Design head (m)
a: Constant
D: Cross section depth (m)

$$Cd = 2.200 - 0.0416\ (Hd/D)^{0.9900}$$

Conditions $Q = 0.879\ m^3/sec$
$D = 2.60\ m$
$Hd = 0.20\ m$

Therefore, $Cd = 2.200 - 0.0416\ (0.20/2.60)^{0.9900}$

$= 2.197$

$$2.197 = 1.60\ \frac{1 + 2a}{1 + a}$$

$$2.197\ (1 + a) = 1.60\ (1 + 2a)$$

$$a = 0.595$$

$$C = 1.60 \times \frac{1 + 2 \times 0.595\left(\frac{0.13}{0.20}\right)}{1 + 0.595\left(\frac{0.13}{0.20}\right)}$$

$= 2.05$

$$\therefore\ Q = 2.05 \times B \times 0.13^{3/2}$$

$0.096B$

$$B = \frac{0.879}{0.096} = 9.16 \fallingdotseq 10.0\ m$$

Fig. IV.D.6 Relation between Undulation Height and Crest Length

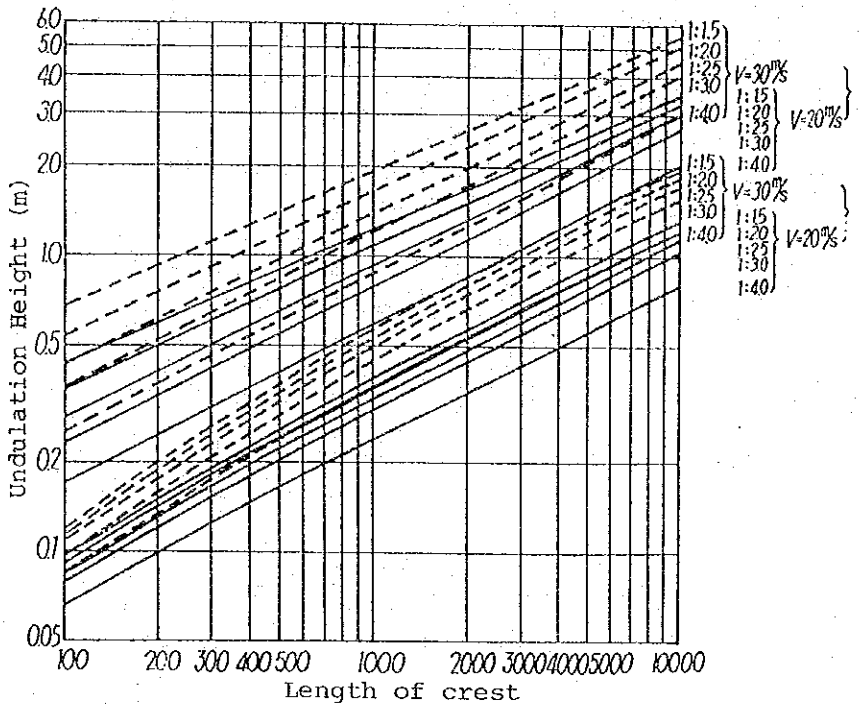
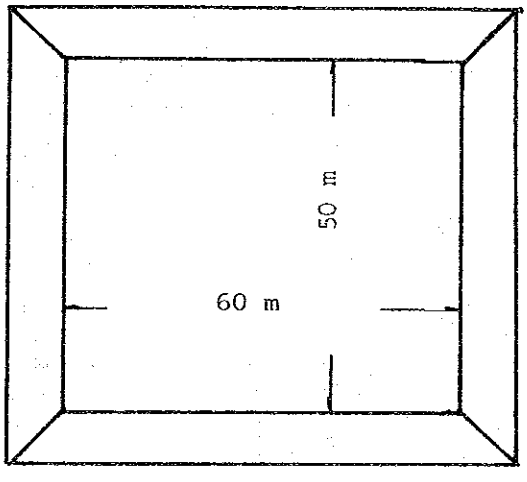
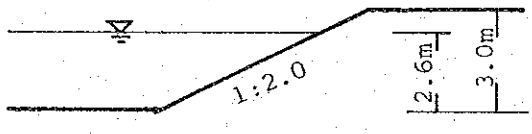


Fig. IV.D.7 Farm Pond Plan



Basic Plan



Slope Section

Fig. IV.D.8 Booster Pump Station

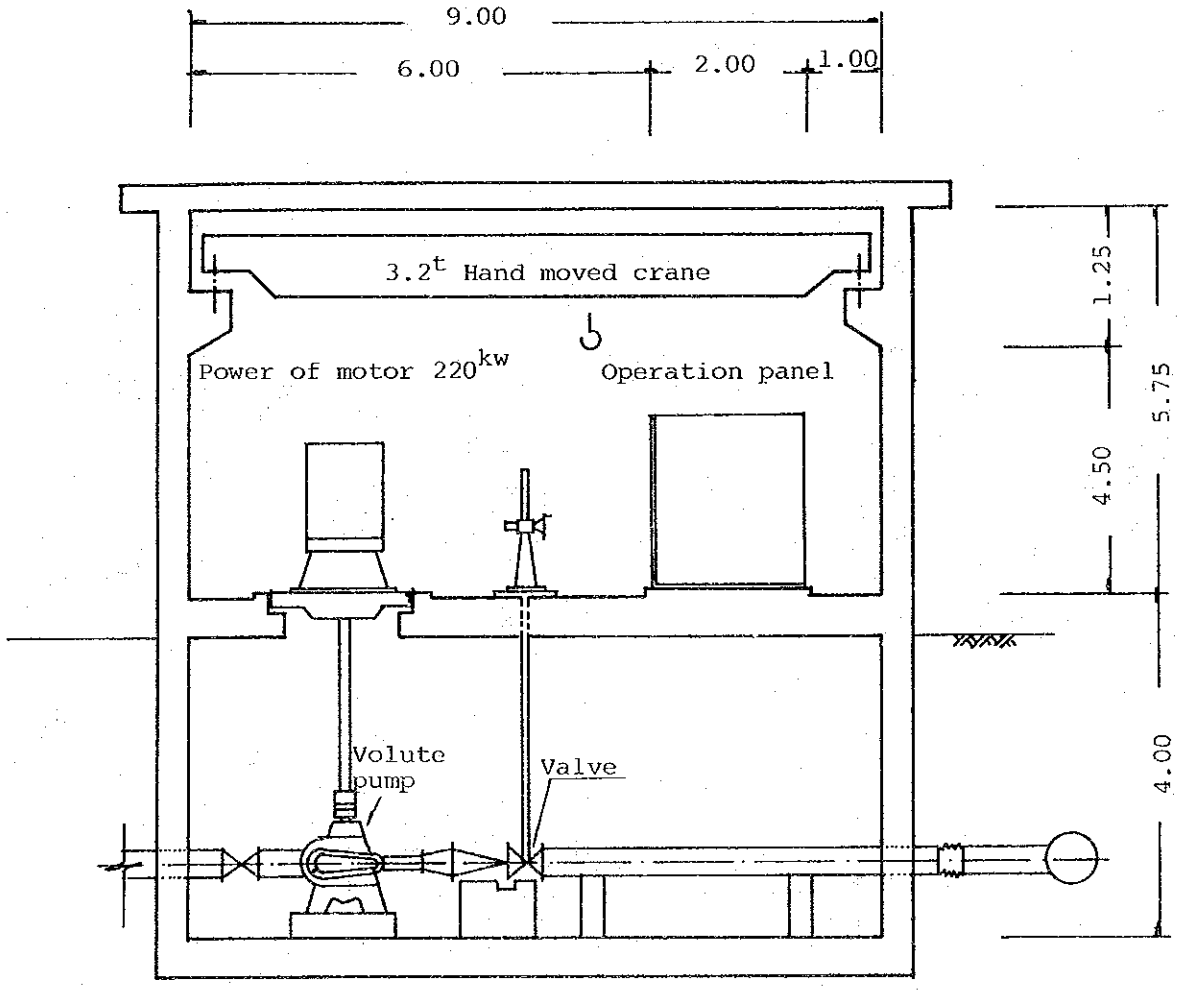


Fig. IV.D.9 Secondary Pipeline Distribution System

Unit: upper: Area (Fedder)

lower: Discharge (m^3/s)

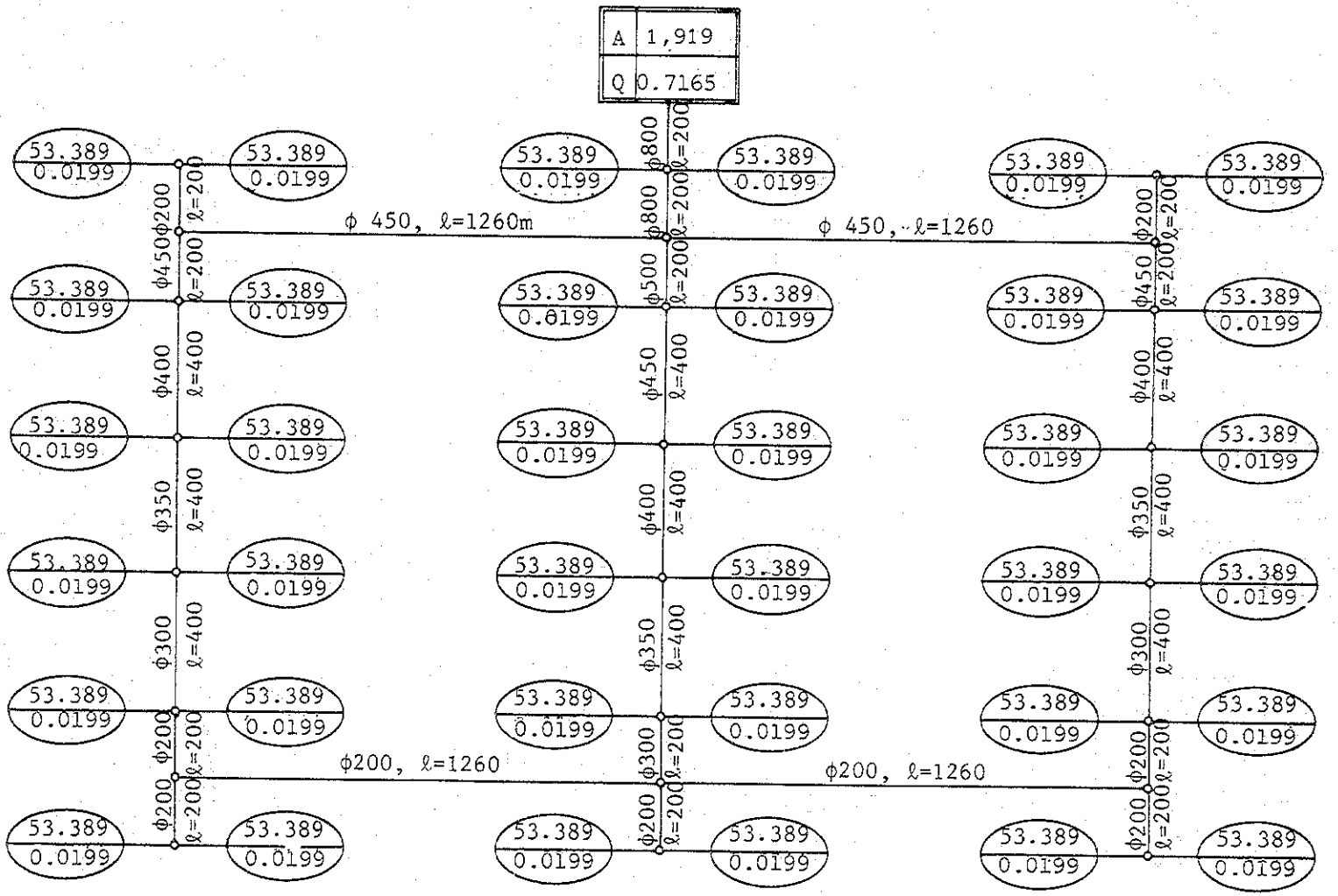


Table IV.D.1 Results of Hydraulic Calculation (1)

Secondary Pipeline

Station No.	Distance	EL	DL	Discharge	Dia-meter	Velocity	Hydraulic Gradient	Head Loss		Dynamic water pressure	Hydras-static pressure	Remark
1	m	m		m^3/S	mm	m/s	0/00	m	m	m		
1		15.0								42.10	0.00	
2	1260.0	"		0.22	450	1.38	2.967	0.43		41.67	0.43	
3	200.0	"		0.18	450	1.13	2.044	1.01		40.66	1.44	
4	400.0	"		0.14	400	1.11	2.275	1.19		39.47	2.63	
5	400.0	"		0.10	350	1.03	2.331	1.35		38.12	3.98	
6	400.0	"		0.06	300	0.84	1.905	0.68		37.44	4.66	
7	200.0	"		0.02	200	0.62	1.729	2.44		35.00	7.10	30.0+2.0+3.0
8	1260.0	"		-0.02	200	-0.66	-1.939	-0.35		35.35	6.75	
9	200.0	"		-0.08	300	-1.15	-3.402	-0.76		36.11	5.99	
10	400.0	"		-0.12	350	-1.26	-3.368	-0.93		37.04	5.06	
11	400.0	"		-0.16	400	-1.28	-2.979	-0.91		37.95	4.15	
12	400.0	"		-0.20	450	-1.27	-2.529	-0.41		38.36	3.74	
1	200.0	"		-0.24	500	-1.23	-2.117	-3.74		42.10	0.00	
2												
1	200.0	15.0									0.00	
12	400.0	"		0.24	500	1.23	2.117	3.74			3.74	
11	400.0	"		0.20	450	1.27	2.529	0.41			4.15	
10	400.0	"		0.16	400	1.28	2.979	0.91			5.06	
9	200.0	"		0.12	250	1.26	3.368	0.93			5.99	
8	1260.0	"		0.08	300	1.15	3.402	0.76			6.95	
13	200.0	"		0.02	200	0.66	1.936	0.35			7.10	
14	400.0	"		-0.02	200	-0.62	-1.729	-2.44			4.66	
15	300.0	"		-0.06	300	-0.84	-1.905	-0.68			3.98	
16	350.0	"		-0.10	350	-1.03	-2.331	-1.35			2.63	

Results of Hydraulic Calculation (2)

Secondary Pipeline

Station No.	Distance		EL	DL	Discharge	Diameter	Velocity	Hydraulic Gradient	Head Loss		Dynamic water pressure	Hydrastatic pressure	Remark
1	m		m		m^3/S	mm	m/s	0/00	m	m	m		
17	400.0		15.0		-0.14	400	-1.11	-2.275	-1.19			1.44	
18	450.0		"		-0.18	450	-1.13	-2.044	-1.01			0.43	
1	450.0		"		-0.22	450	-1.38	-2.967	-0.42			0.01	

Table IV.D.9 Specification of Well Construction

Item	Remarks
1) Number of Wells	30
2) Drilling method	Percussion method
3) Drilling mud	Clay
4) Conductor pipe	equivalent to JISG 3452 with sleeve ϕ508.0 mm
5) Casing pipe	equivalent to JISG 3452 with sleeve ϕ318.5 mm
6) Screen pipe	Pipe base wire wrapped type pipe: equivalent to JISG 3452 with sleeve ϕ318.5 mm wire: equivalent to JISG 3505-SWRM 3-4 (galvanized)
7) Centralizer	Setting every 15 m, 10 plates with hinge
8) Sampling	drilling slime of each layer
9) Geophysical logging	Spontaneous potential Electric resistivity
10) Gravel packing	Gravel size: 2 - 4 mm (to be well rounded)
11) Development	Water circulation, bailing and swabbing
12) Pumping test	Step drawdown test: 10 steps (1 step: 2 hours) Continuous discharge test: 72 hours Recovery test = 12 hours

Fig. IV.D.10 Water Well Design

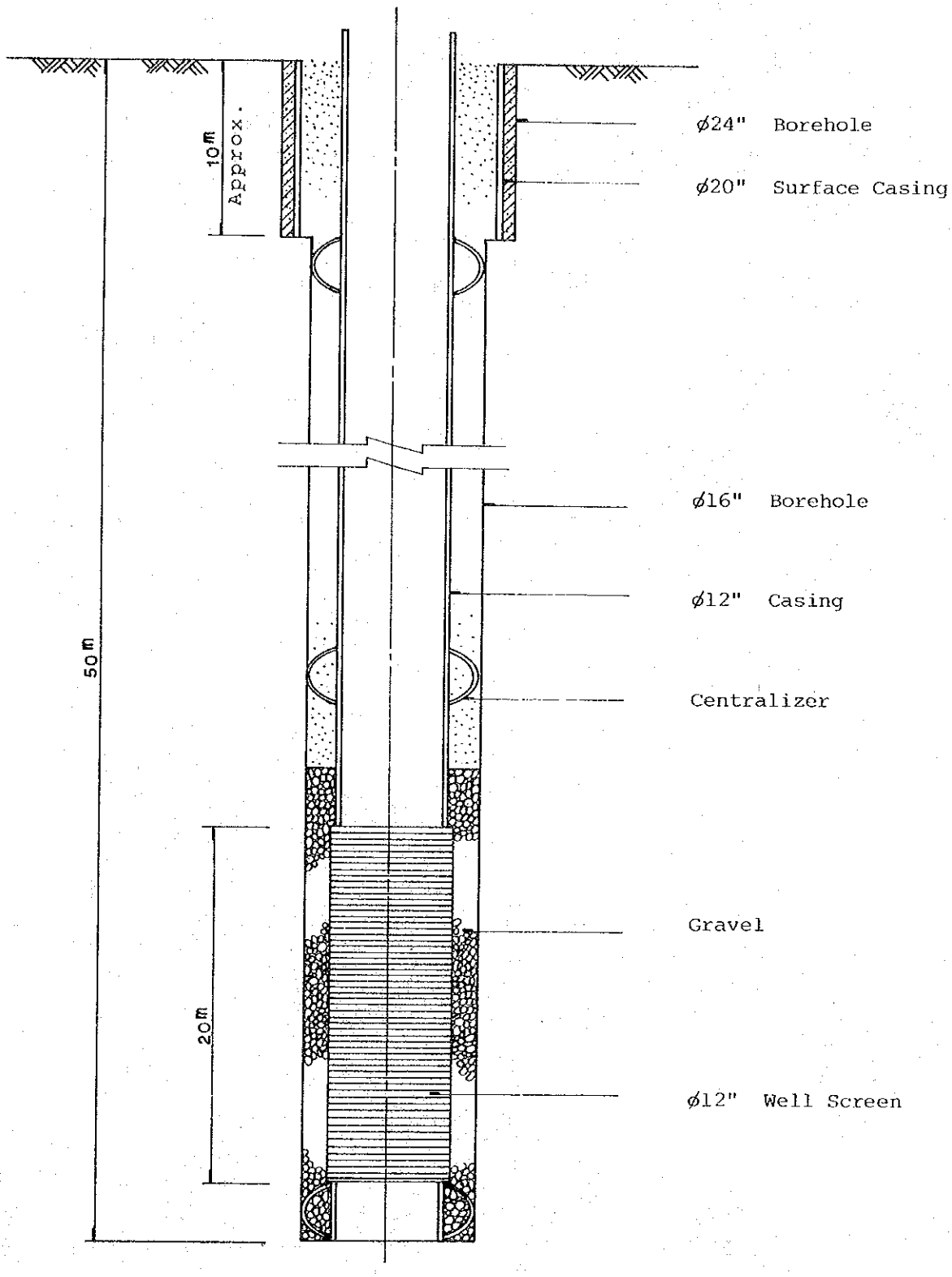


Fig. IV.D.1 Intakerate Test Point Map

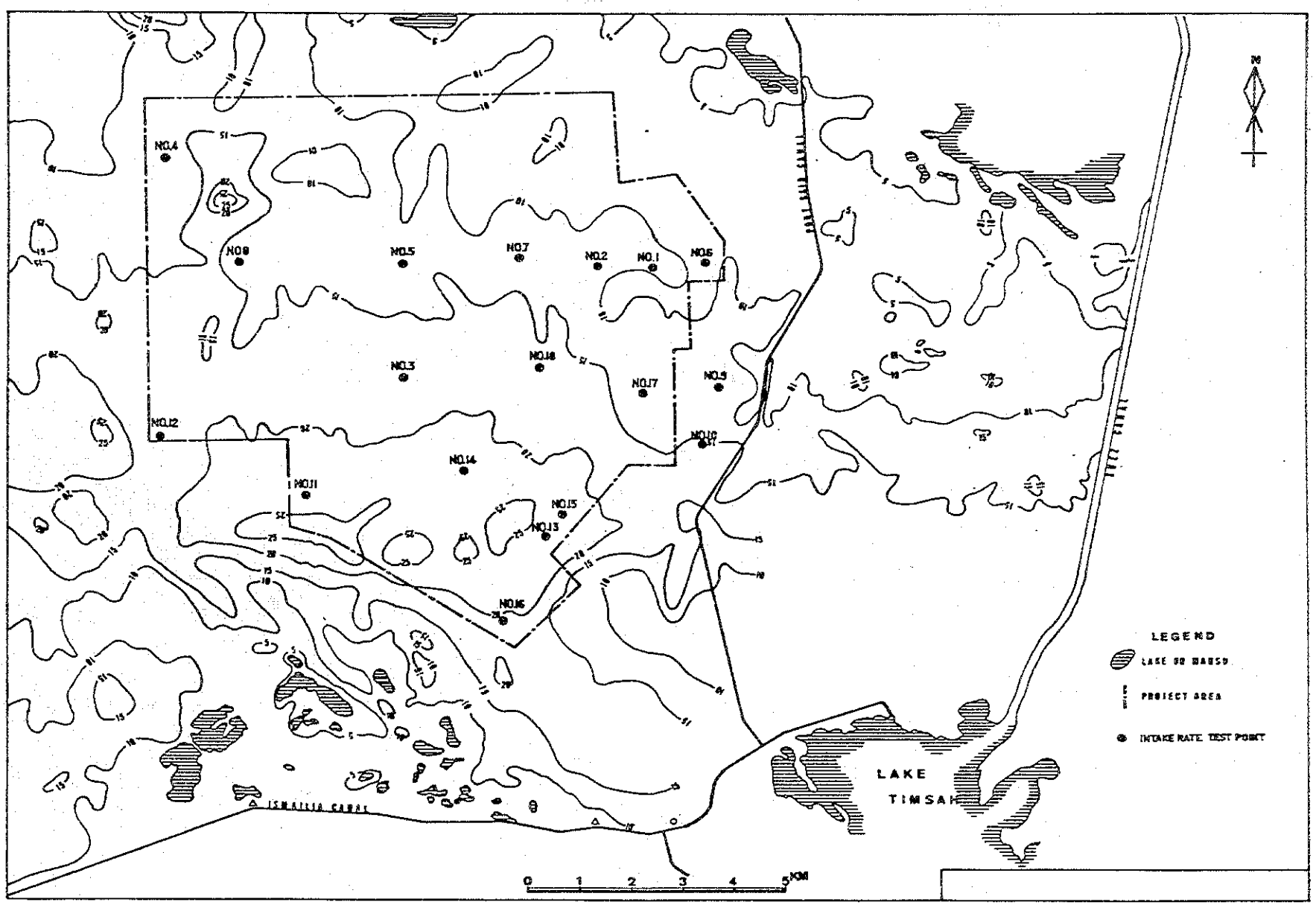


Table IV.D.10 Physical Characterisity of Soil Concerning Area

Experimental Points	Depth cm	Soil Texture	(1) R.S.G.	(2) A.S.G.	Porosity %	(3) Three phase of Soil Solid Phase %	Vapor Phase %	Liquid Phase %	Hardness	Reference
No. 1	0 ~ 5	CoS	(2.65)	1.66	37.3	62.7	32.0	5.3		
	10	"		1.67	37.0	63.0	31.5	5.5		
	20	"		1.64	38.1	61.9	33.5	4.6		
	30	"		1.78	32.8	67.2	27.9	4.8		
	50	"		1.65	37.7	62.3	33.2	4.5		
	85	"		1.78	32.7	67.3	29.6	3.1		
2	0 ~ 5	CoS	(2.65)	1.72	35.3	64.7	31.4	3.9		
	10	"		1.72	35.0	65.0	31.0	4.0		
	20	"		1.76	34.3	65.7	28.0	4.3		
	30	"		1.70	36.0	64.0	30.2	5.8		
	50	"		1.74	34.4	65.6	27.4	7.0		
	85	"		1.73	34.6	65.4	25.6	9.0		
3	10	CoS	(2.65)	1.74	34.2	65.8	26.4	7.8		
	20	"		1.69	36.2	63.8	30.2	6.0		
	50	"		1.71	35.4	64.6	29.0	6.4		
	85	"		1.74	34.4	65.6	28.8	5.6		
4	10	CoS	(2.65)	1.71	35.6	64.4	29.9	5.7		
	20	"		1.74	34.2	65.8	28.0	6.2		
	50	"		1.82	31.5	68.5	24.2	7.3		
	85	"		1.77	33.1	66.9	25.0	8.1		

No. 5	10	CoS	(2.65)	1.74	34.4	65.6	25.9	8.5
	20	"		1.63	38.3	61.7	30.9	7.8
	30	"		1.65	37.3	62.3	29.4	8.3
	50	"		1.65	37.6	62.4	28.6	9.0
	85	SL		1.65	37.6	62.4	14.6	23.0
6	10	CoS	(2.65)	1.65	37.6	62.4	32.2	5.4
	20	"		1.68	36.7	63.3	28.0	8.7
	30	"		1.73	34.9	65.1	27.4	7.5
	50	"		1.72	35.0	65.0	25.8	9.2
	85	"		1.66	37.5	62.5	26.7	10.8
7	10	CoS	(2.65)	1.78	33.0	67.0	28.5	4.5
	20	"		1.80	32.1	67.9	24.3	7.8
	30	"		1.79	32.4	67.6	26.4	5.8
	50	"		1.76	34.6	66.4	26.6	7.0
	85	"		1.71	35.3	64.7	29.1	6.2
8	10	CoS	(2.65)	1.89	28.8	71.2	19.2	9.6
	20	"		1.82	31.4	68.6	21.3	10.1
	30	"		1.81	31.8	68.2	25.8	6.0
	50	"						
	85	"						
9	10		(2.65)	1.69	36.2	63.8	33.1	3.1
	20			1.71	35.6	64.4	29.7	5.9
	30			1.73	34.8	65.2	27.9	6.9
	50			1.77	33.8	66.2	23.3	10.5

No. 10	10		(2.65)	1.73	34.6	65.4	25.0	9.6
	20			1.78	32.8	67.2	22.3	10.5
	30			1.71	35.4	64;6	25.5	9.9
	50			1.64	38.2	61.8	26.8	11.4
	85			1.61	39.2	60.8	27.2	12.0
11	10		(2.65)	1.75	33.8	66.2	25.1	8.7
	20			1.67	37.0	63.0	28.2	8.8
	30			1.71	35.3	64.7	25.3	10.0
	50			1.77	33.3	66.7	26.1	7.2
	85			1.75	33.9	66.1	27.5	6.4
12	10	CoS	(2.65)	1.77	33.4	66.6	29.8	3.6
	20	"		1.76	33.7	66.3	27.9	5.8
	30	"		1.67	36.9	63.1	33.0	3.9
	50	"		1.73	34.8	65.2	31.6	3.2
	85	"		1.76	33.5	66.5	30.2	3.3
13	10		(2.65)	1.83	30.9	69.1	19.5	11.4
	20			1.78	33.3	66.7	22.7	10.6
	30			1.75	34.1	65.9	25.6	8.5
	50			1.70	35.7	64.3	26.2	9.5
	85			1.66	37.2	62.8	26.9	10.3
14	10		(2.65)	1.76	33.6	64.4	17.3	15.9
	20			1.72	35.0	65.0	23.6	11.4
	30			1.70	35.8	64.2	26.2	9.6
	50			1.54	44.8	55.2	38.2	6.5

No. 15	10		(2.65)	1.77	33.4	66.6	26.1	7.3
	20			1.85	30.2	69.8	26.0	4.2
	30			1.80	32.1	67.9	21.6	10.5
	50			1.74	34.4	65.6	24.4	10.0
	85			1.70	35.9	64.1	27.8	8.1
16	10		(2.65)	1.89	28.7	71.3	14.7	14.0
	20			1.85	30.3	69.7	21.1	9.2
	30			1.77	33.3	66.7	26.5	6.8
	50			1.75	34.1	65.9	27.2	6.9
	85			1.74	34.3	65.7	28.4	5.9
17	10	S	(2.65)	1.77	33.3	66.7	19.9	13.4
	20	"		1.68	36.8	63.2	23.3	13.5
	30	"		1.62	38.7	61.3	24.9	13.8
	50	"		1.65	37.5	62.5	27.5	10.0
	85	"		1.62	38.9	61.1	28.3	10.6
18	10		(2.65)	1.74	34.5	65.5	26.5	8.0
	20			1.68	36.8	63.2	29.1	7.7
	30			1.70	35.9	64.1	29.3	6.6
	50			1.70	35.8	64.2	27.5	8.3
	85			1.84	30.7	69.3	26.4	4.3

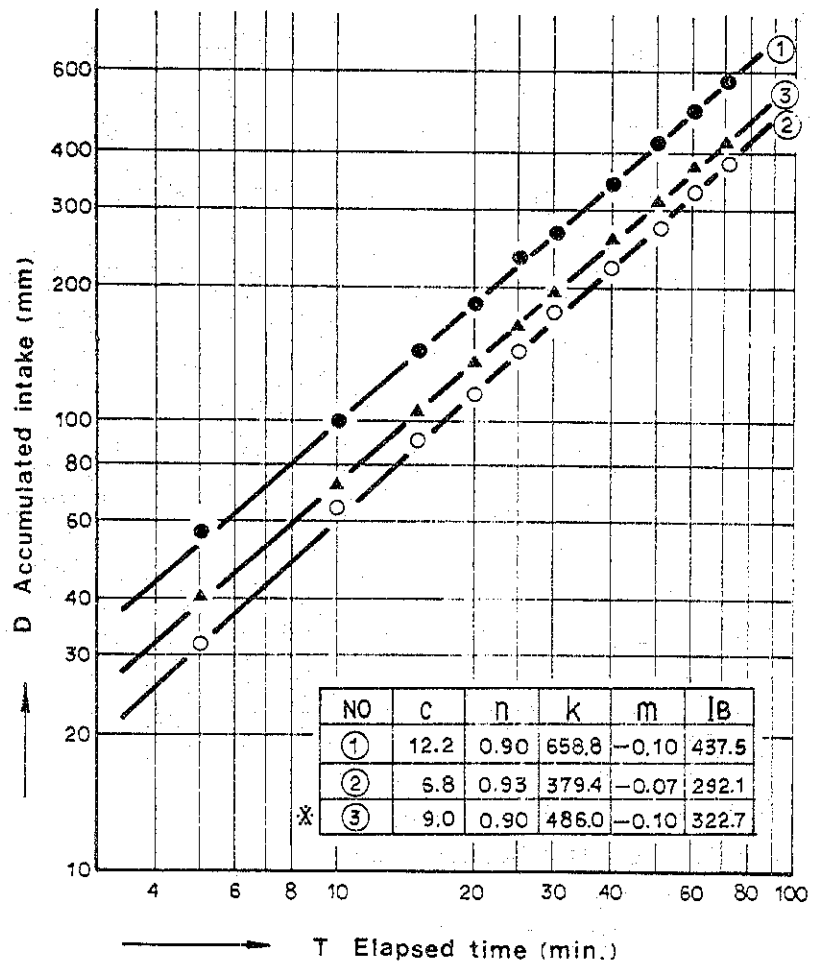
(1) Real-Specific Gravity (Assumed value)

(2) Apparent-Specific Gravity

(3) Field Capacity Condition

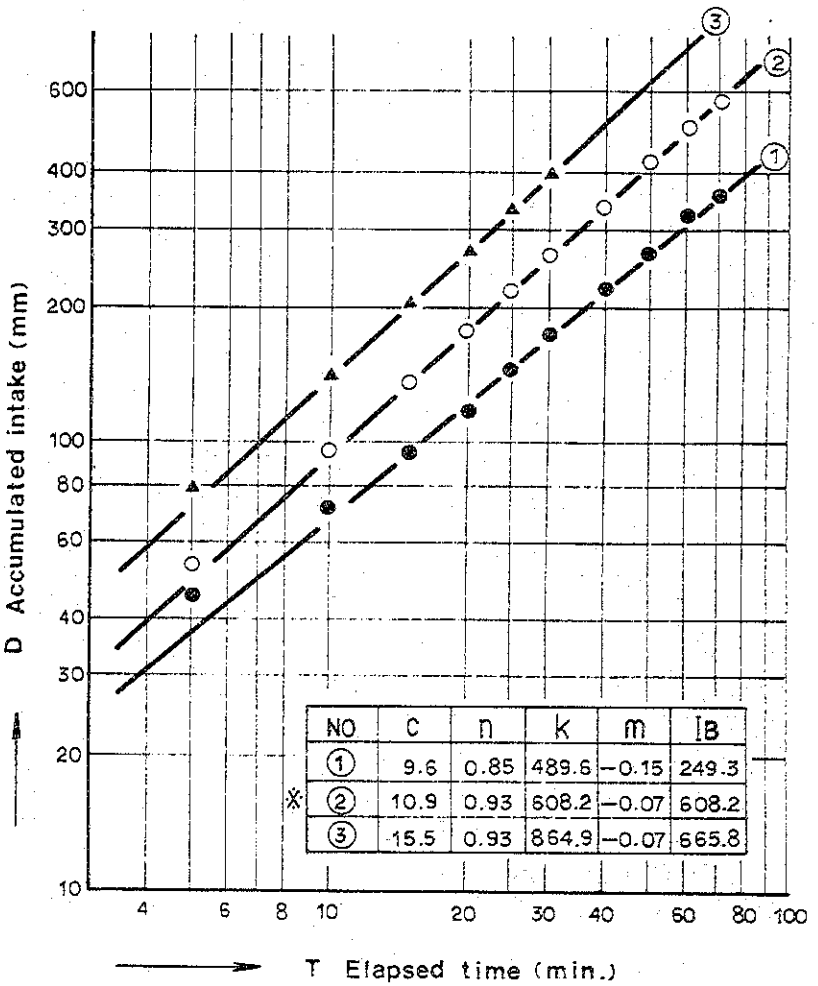
Fig. IV.D.12 Intake Curves

NO. 1



NO	C	n	k	m	IB
①	12.2	0.90	658.8	−0.10	437.5
②	6.8	0.93	379.4	−0.07	292.1
※ ③	9.0	0.90	486.0	−0.10	322.7

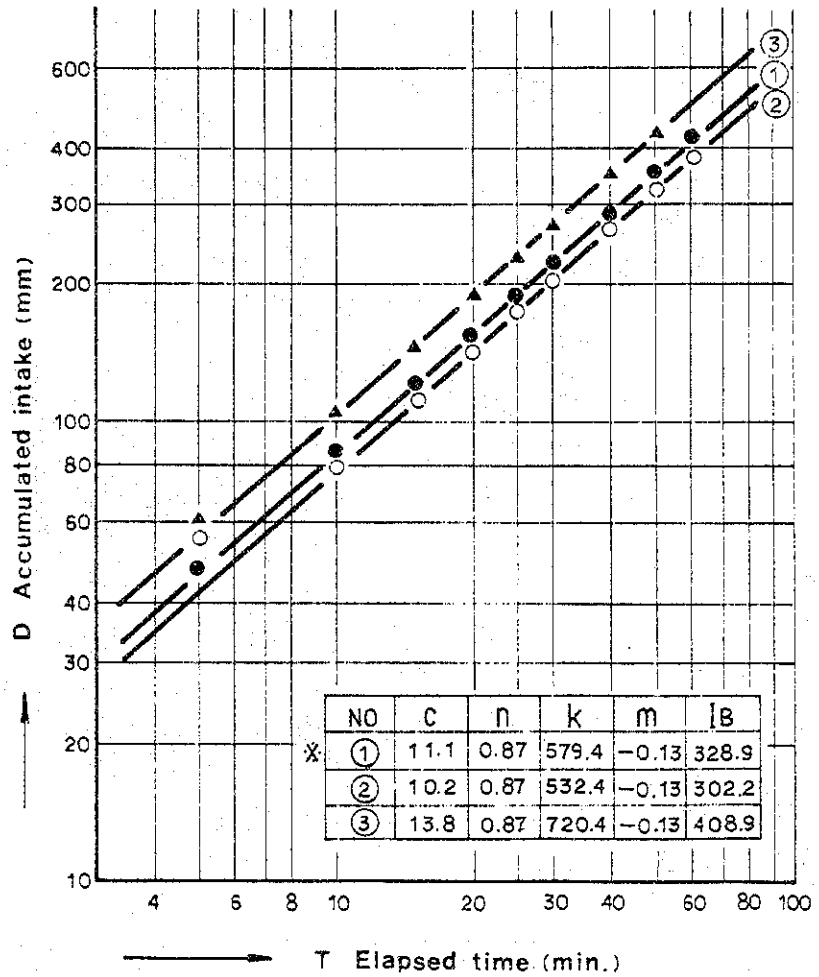
NO. 2



NO	C	n	k	m	IB
①	9.6	0.85	489.6	−0.15	249.3
※ ②	10.9	0.93	608.2	−0.07	608.2
③	15.5	0.93	864.9	−0.07	665.8

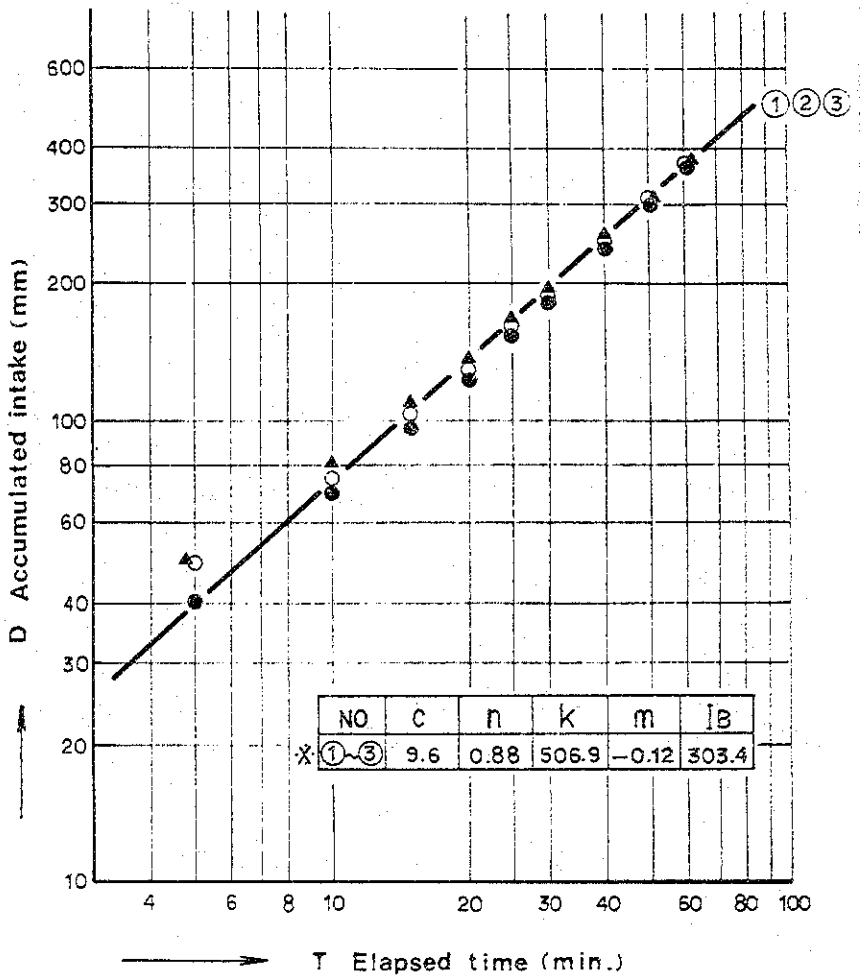
Intake Curves

NO. 3



NO	C	n	k	m	IB
※ ①	11.1	0.87	579.4	−0.13	328.9
②	10.2	0.87	532.4	−0.13	302.2
③	13.8	0.87	720.4	−0.13	408.9

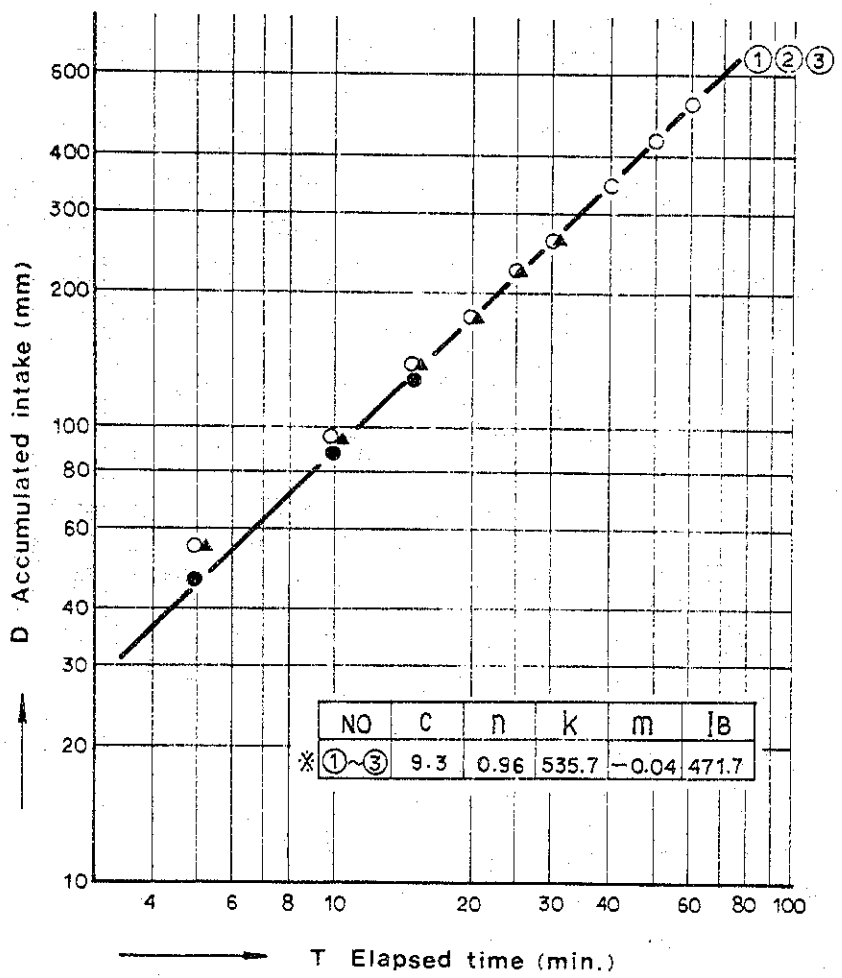
NO. 4



NO	C	n	k	m	IB
※ ①~③	9.6	0.88	506.9	−0.12	303.4

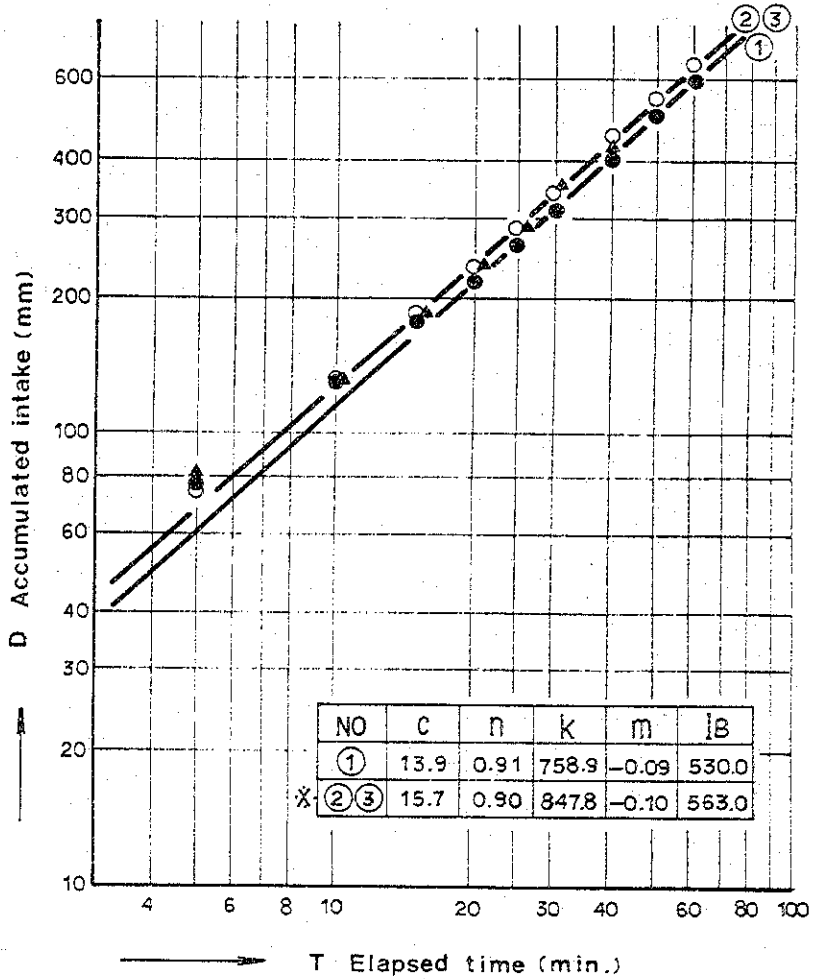
Intake Curves

NO. 5



NO	C	n	k	m	lB
※ ①~③	9.3	0.96	535.7	−0.04	471.7

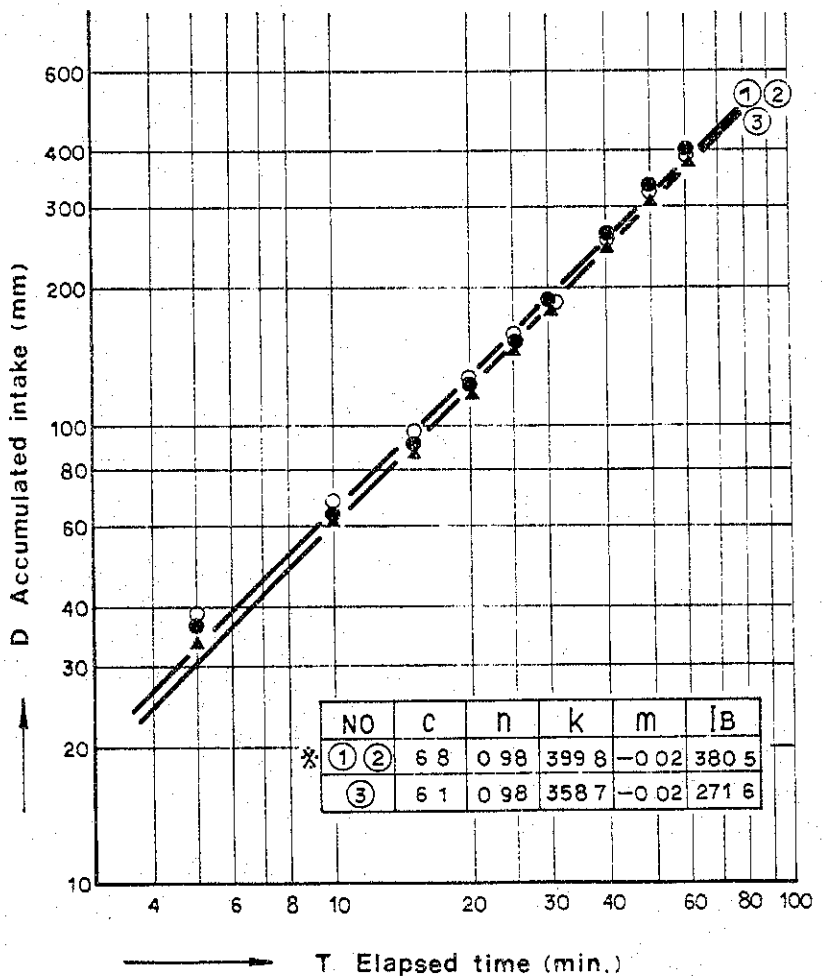
NO. 6



NO	C	n	k	m	lB
①	13.9	0.91	758.9	−0.09	530.0
※ ②③	15.7	0.90	847.8	−0.10	563.0

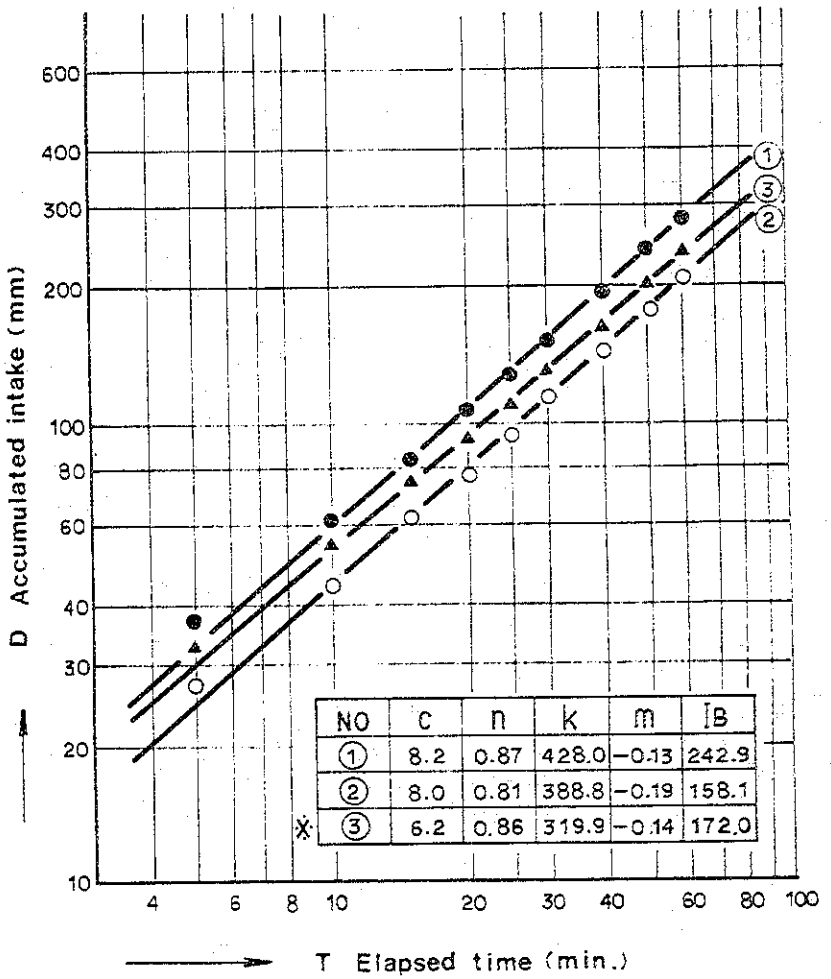
Intake Curves

NO. 7



NO	c	n	k	m	IB
※ ① ②	6 8	0 98	399 8	−0 02	380 5
③	6 1	0 98	358 7	−0 02	271 6

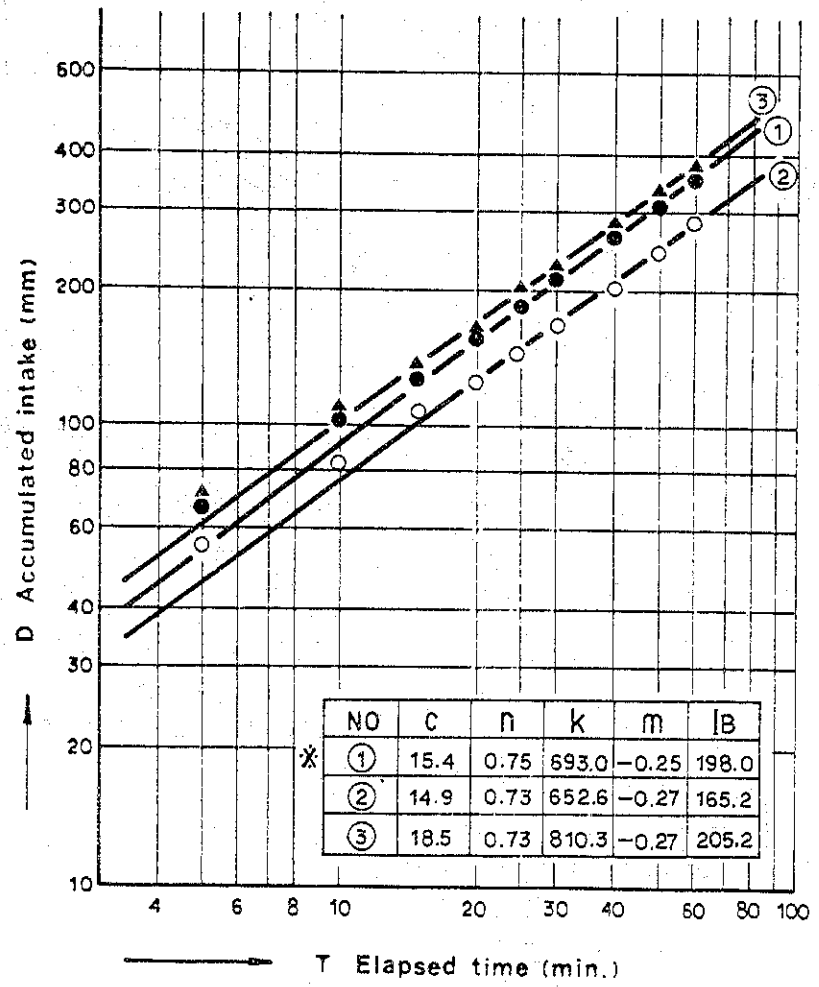
NO. 8



NO	c	n	k	m	IB
①	8.2	0.87	428.0	−0.13	242.9
②	8.0	0.81	388.8	−0.19	158.1
※ ③	6.2	0.86	319.9	−0.14	172.0

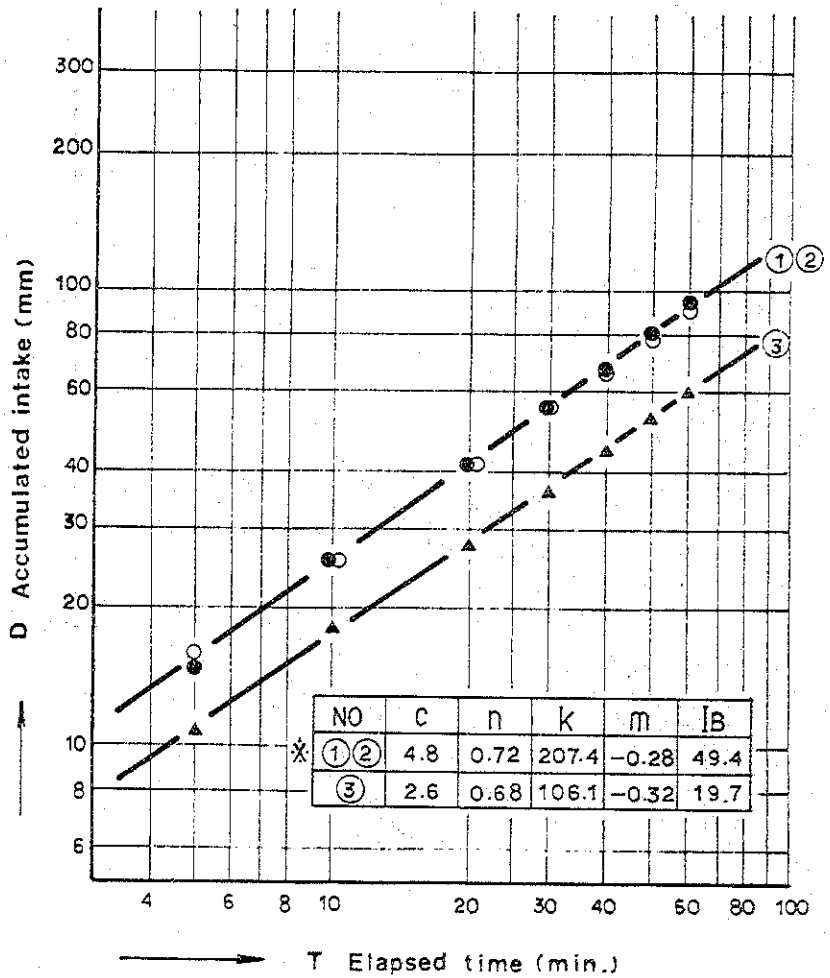
Intake Curves

NO. 9



※ NO	C	n	k	m	IB
①	15.4	0.75	693.0	−0.25	198.0
②	14.9	0.73	652.6	−0.27	165.2
③	18.5	0.73	810.3	−0.27	205.2

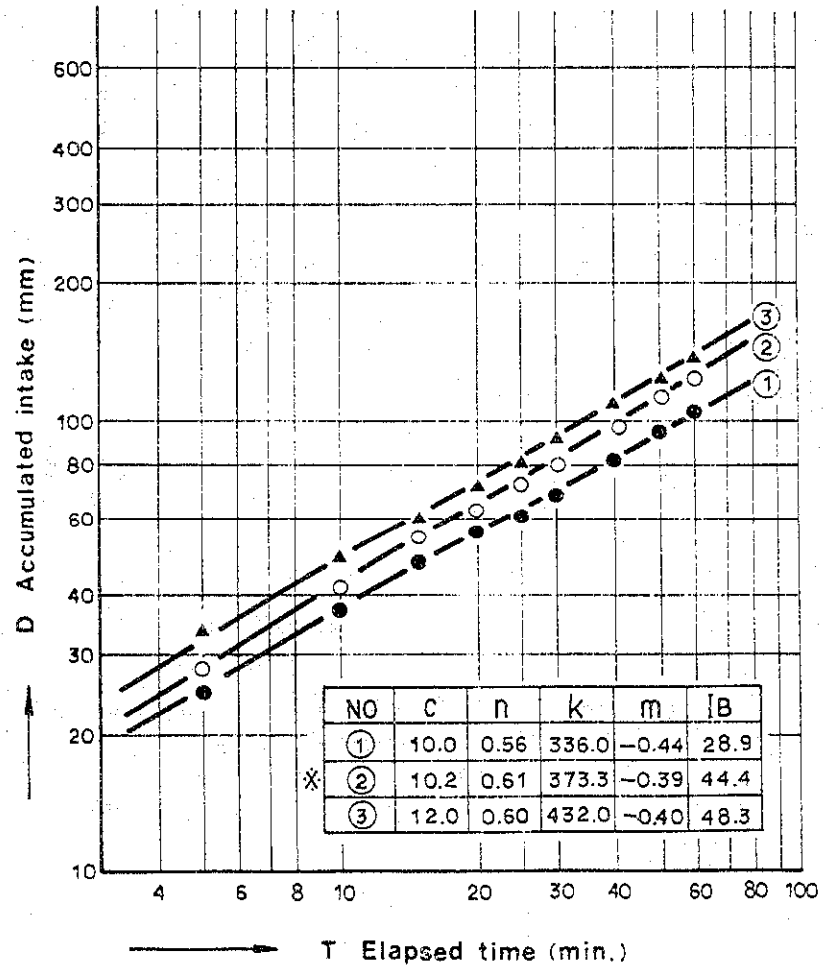
NO. 10



※ NO	C	n	k	m	IB
①②	4.8	0.72	207.4	−0.28	49.4
③	2.6	0.68	106.1	−0.32	19.7

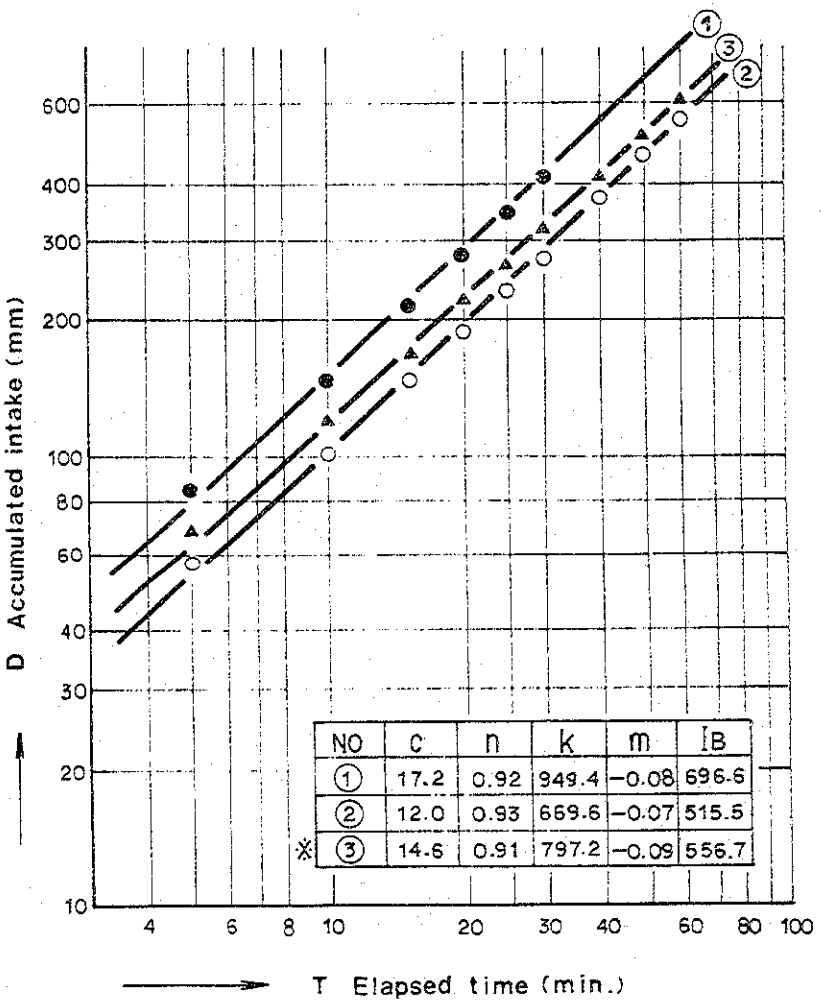
Intake Curves

NO. 11



NO	C	n	k	m	IB
①	10.0	0.56	336.0	−0.44	28.9
※ ②	10.2	0.61	373.3	−0.39	44.4
③	12.0	0.60	432.0	−0.40	48.3

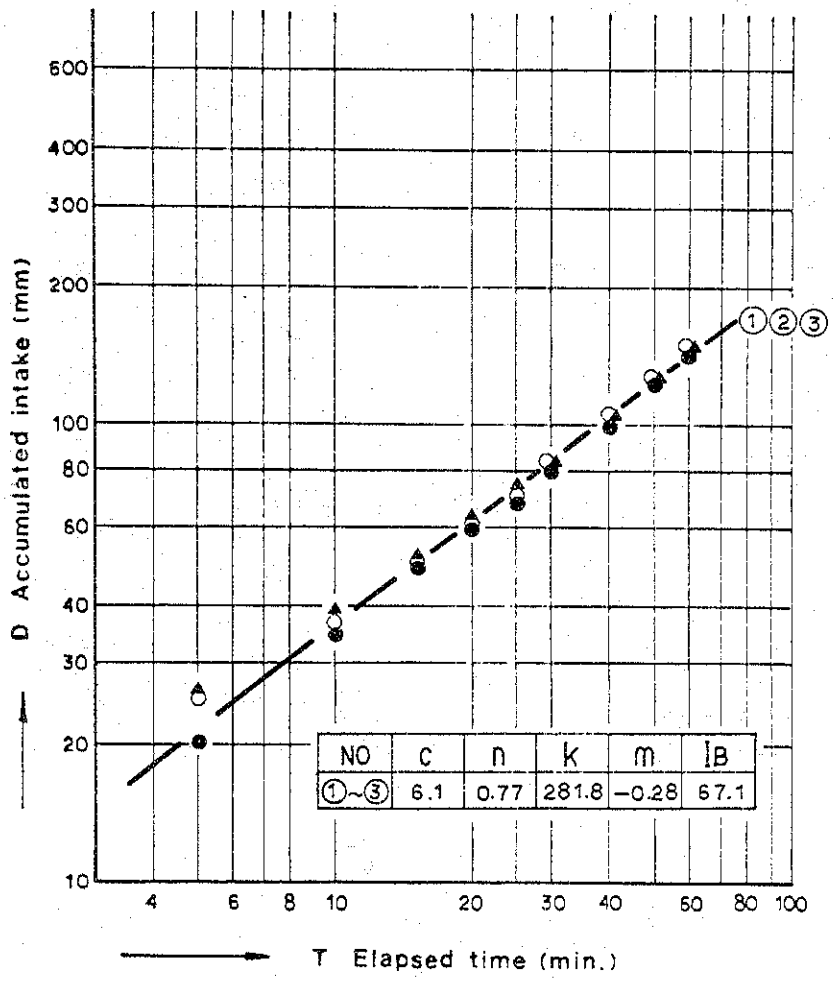
NO. 12



NO	C	n	k	m	IB
①	17.2	0.92	949.4	−0.08	696.6
②	12.0	0.93	669.6	−0.07	515.5
※ ③	14.6	0.91	797.2	−0.09	556.7

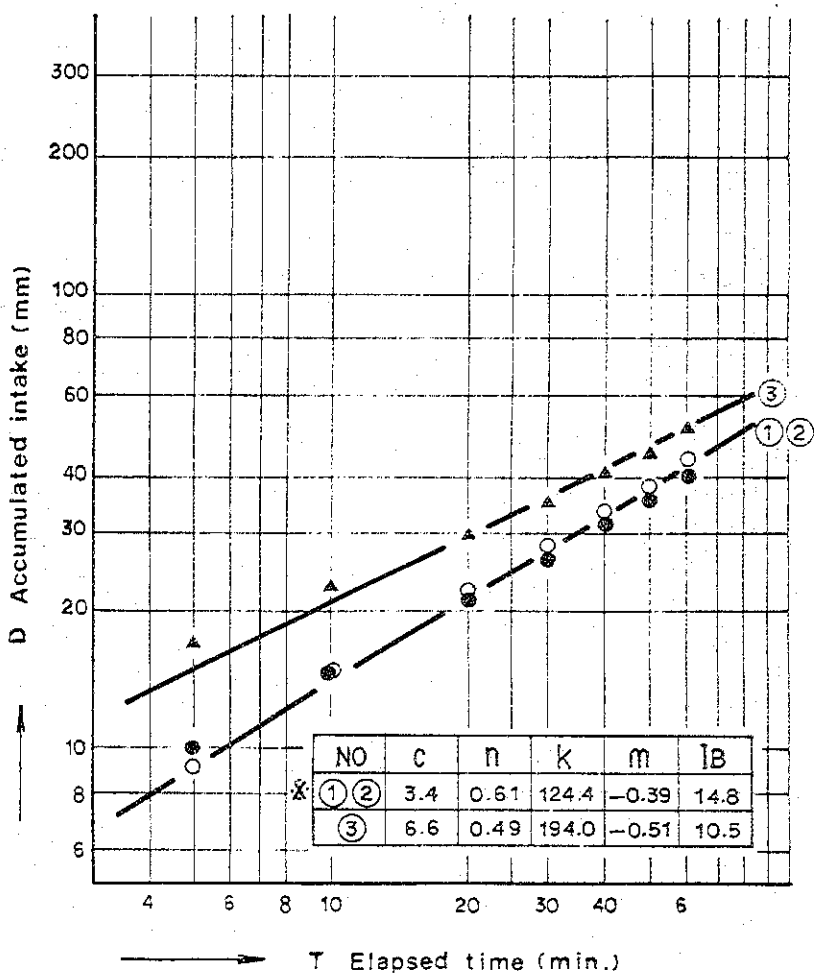
Intake Curves

NO. 13



NO	c	n	k	m	IB
①~③	6.1	0.77	281.8	−0.28	67.1

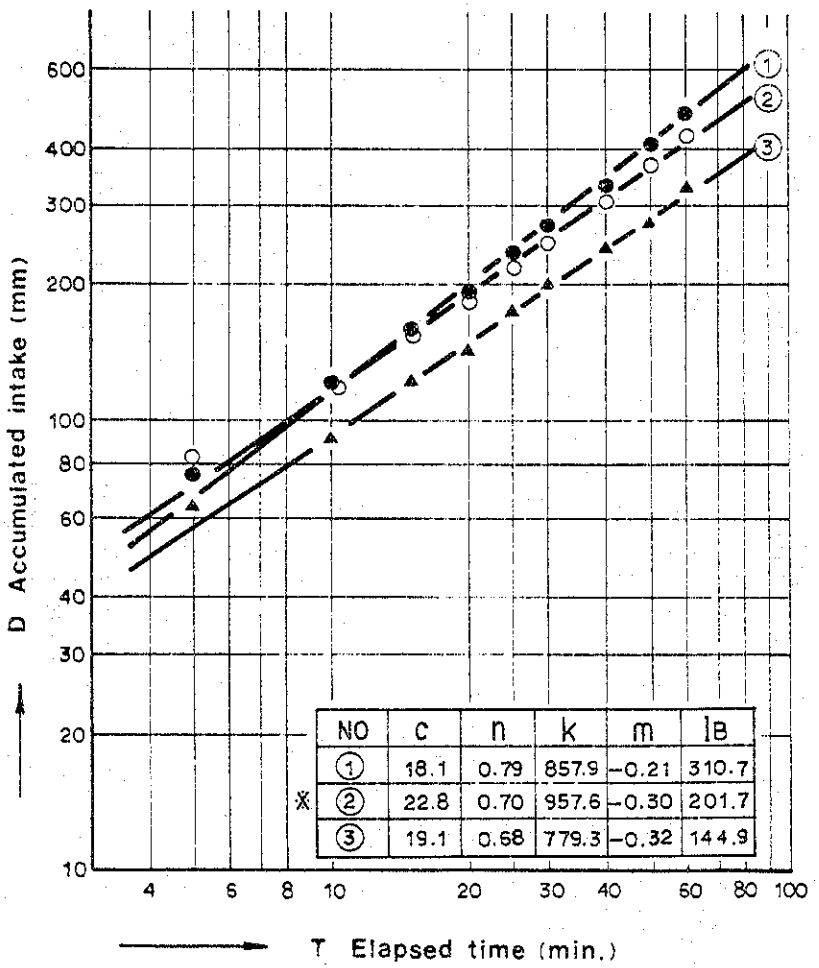
NO. 14



NO	c	n	k	m	IB
※ ①②	3.4	0.61	124.4	−0.39	14.8
③	6.6	0.49	194.0	−0.51	10.5

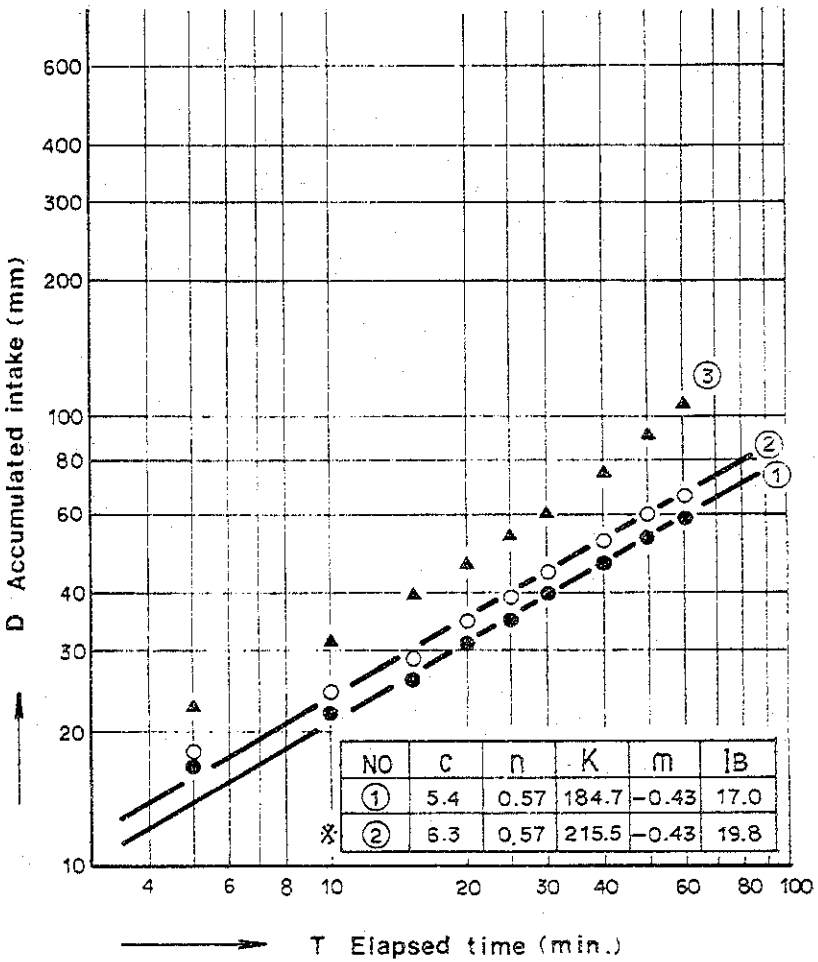
Intake Curves

NO. 15



NO	c	n	k	m	lB
①	18.1	0.79	857.9	−0.21	310.7
※ ②	22.8	0.70	957.6	−0.30	201.7
③	19.1	0.68	779.3	−0.32	144.9

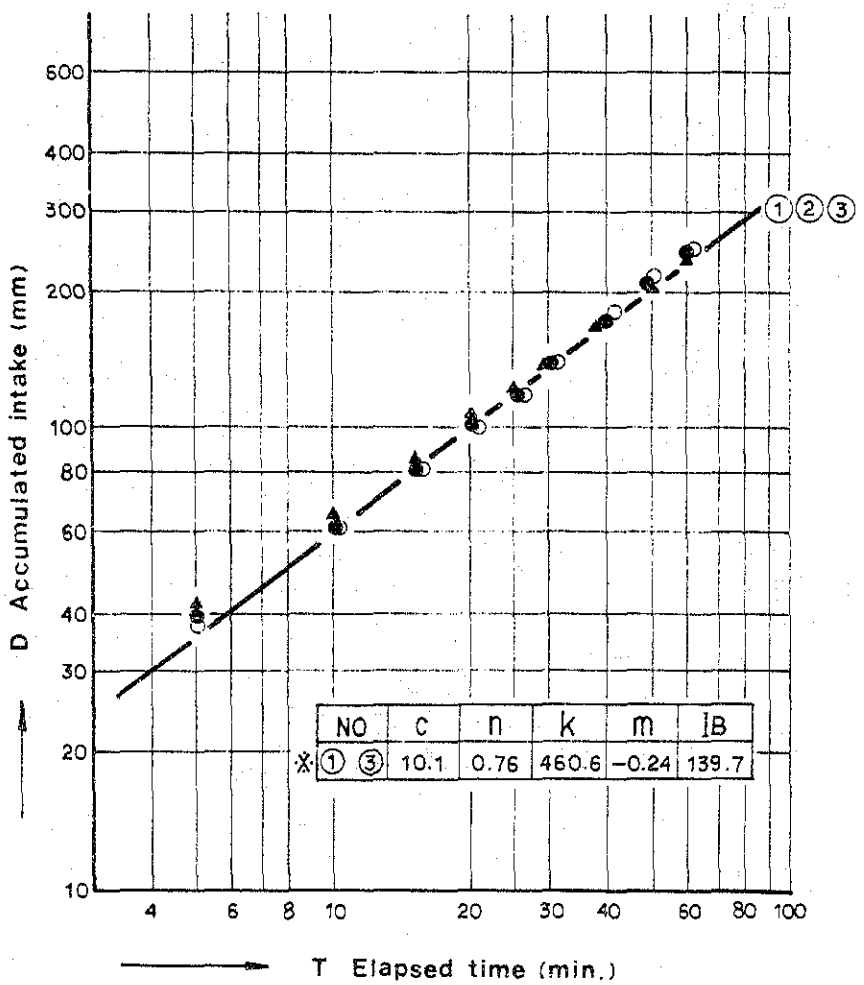
NO. 16



NO	c	n	K	m	lB
①	5.4	0.57	184.7	−0.43	17.0
※ ②	6.3	0.57	215.5	−0.43	19.8

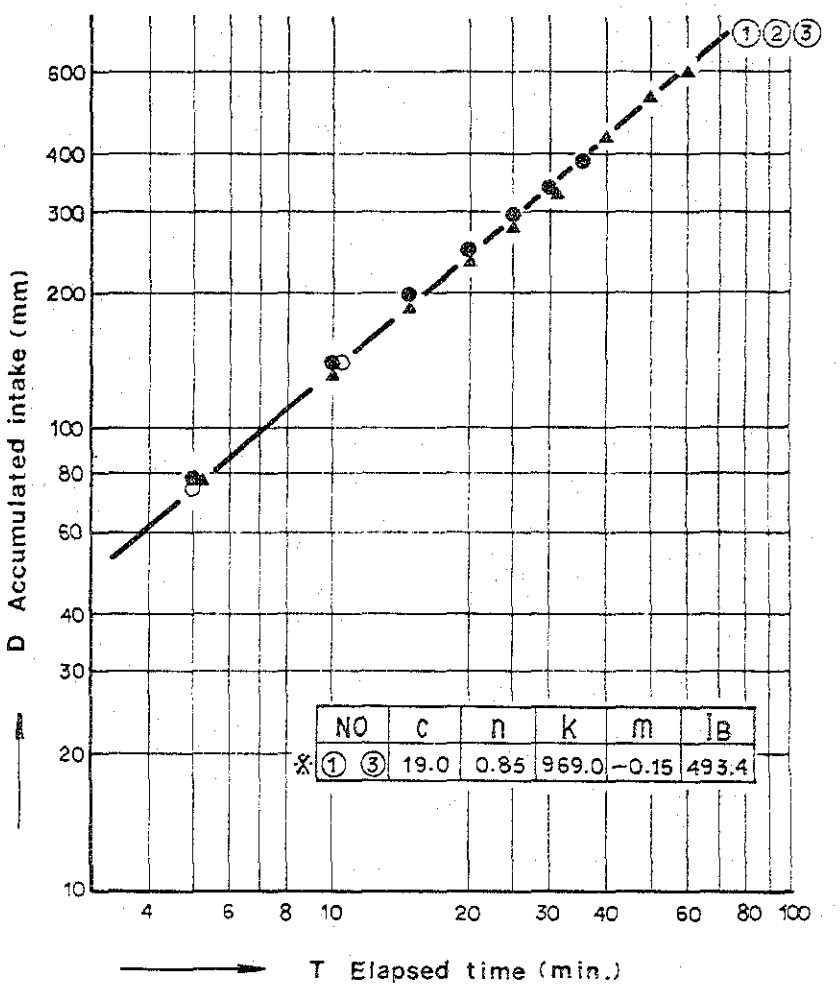
Intake Curves

NO. 17



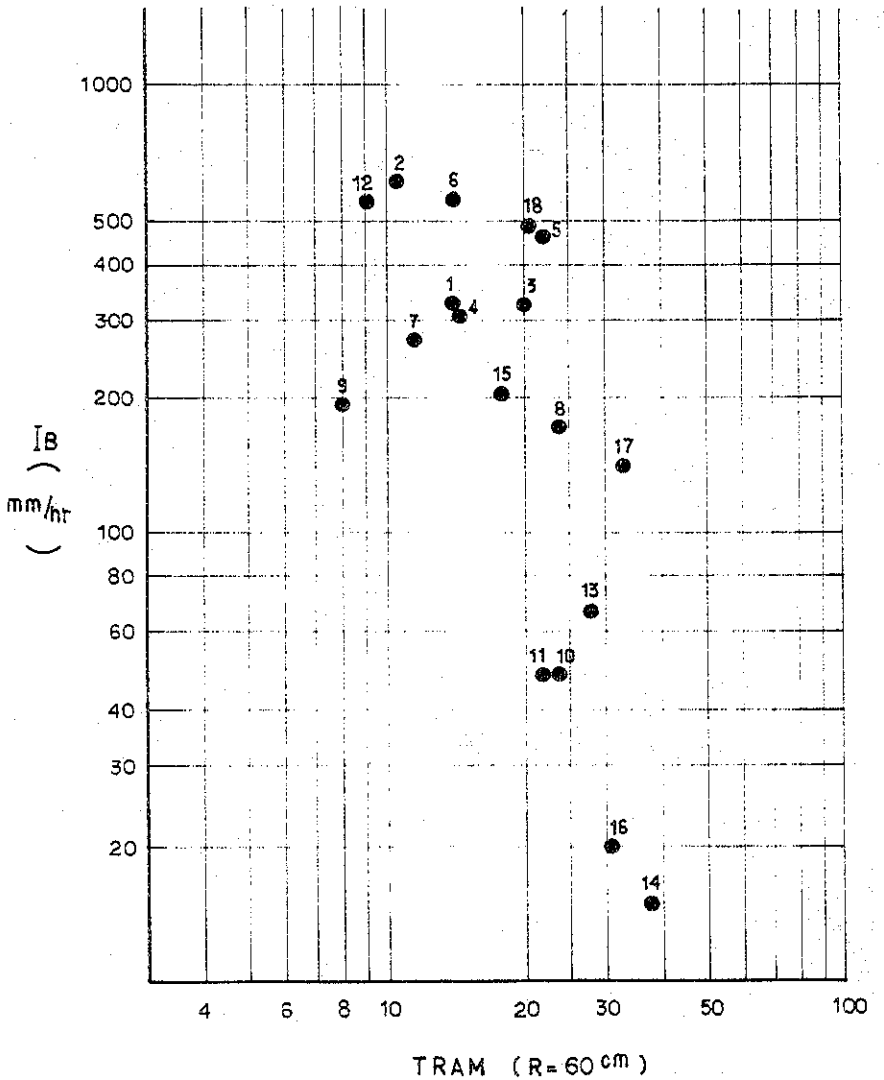
NO	c	n	k	m	IB
※ ① ③	10.1	0.76	460.6	−0.24	139.7

NO. 18



NO	c	n	k	m	IB
※ ① ③	19.0	0.85	969.0	−0.15	493.4

TRAM – I_B Fig. IV.D.13 TRAM and Take on Each Depth TRAM – I_B



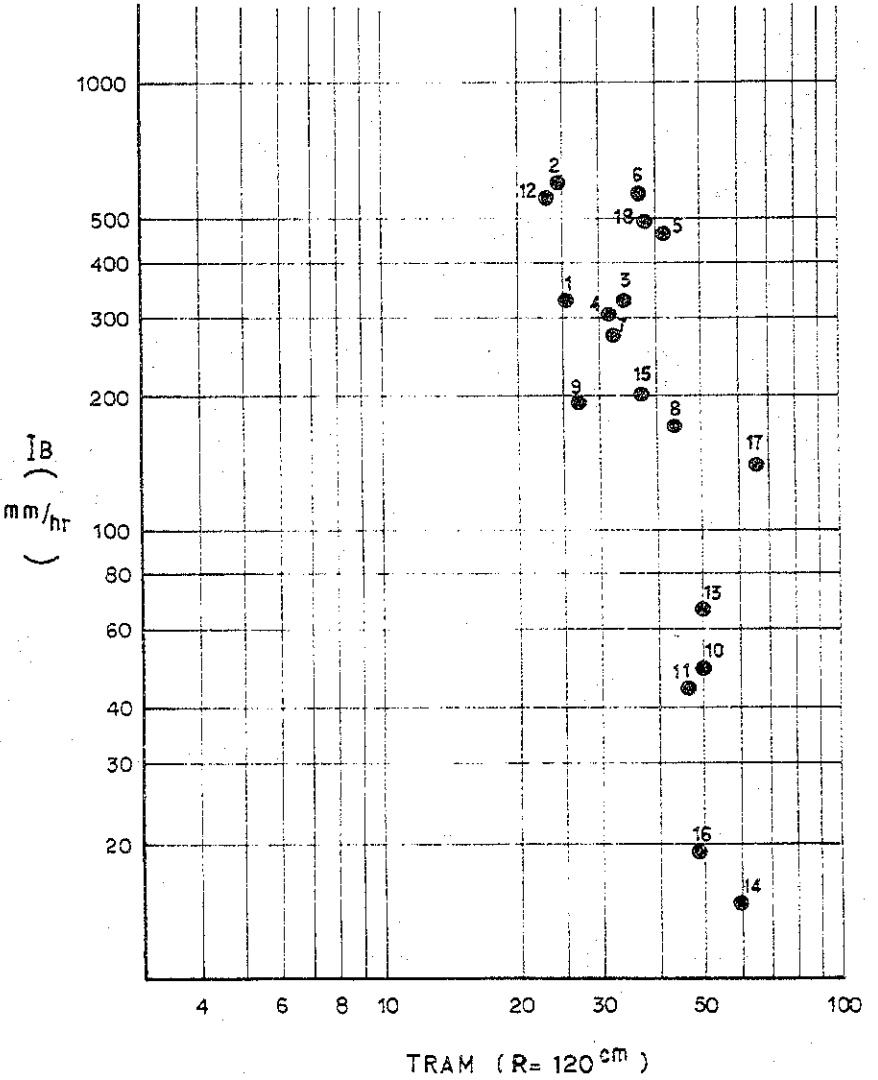


Table IV.D.11 Retained Soil Moisture Percentage, Available Moisture, Total Readily Available Moisture and Cylinder Intake Rate

Experiment Point	Moisture retention					T R A M				Cylinder Intake Rate			
	Depth	pF1.5	FC24	Wp	AM per 10cm	I	II	III	IV	C	n	I_B	K_{10}
	cm	v%	v%	v%	mm	mm	mm	mm	mm			mm/hr	cm/sec
No. 1	0 ~ 5	7.0	5.3	1.6	3.7	9.4	14.1	17.8	22.3	9.0	0.90	322.7	1.02×10^{-2}
	10	8.5	5.5	1.7	3.8				25.6				
	20	9.1	4.6	1.4	3.2								
	30	10.1	4.8	1.5	3.3								
	50	10.5	4.5	1.4	3.1								
	85	9.1	3.1	0.9	2.2								
No. 2	0 ~ 5	6.8	3.9	1.2	2.7	6.9	10.3	14.2	17.7	10.9	0.93	608.2	2.03×10^{-2}
	10	7.0	4.0	1.2	2.8				24.4				
	20	9.7	4.3	1.3	3.0								
	30	9.0	5.8	1.8	4.0								
	50	9.9	7.0	2.3	4.7								
	85	10.4	9.0	3.0	6.0								
No. 3	10	10.2	7.8	2.5	5.3	13.3	19.9	23.5	29.4	11.1	0.87	328.9	1.52×10^{-2}
	20	7.0	6.0	1.9	4.1				34.0				
	50	8.1	6.4	2.0	4.4								
	85	8.6	5.6	1.7	3.9								
No. 4	10	7.7	5.7	1.8	3.9	9.8	14.6	20.3	25.3	9.6	0.88	303.4	1.40×10^{-2}
	20	9.2	6.2	2.0	4.2				31.3				
	50	10.2	7.3	2.4	4.9								

No. 4	85	10.6	8.1	2.7	5.4								
No. 5	10	13.8	8.5	2.8	5.7	14.3	21.4	27.5	34.4	9.3	0.96	471.7	1.08×10^{-2}
	20	11.7	7.8	2.5	5.3				41.5				
	30	13.9	8.3	2.7	5.6								
	50	14.3	9.0	3.0	6.0								
	85	22.2	23.0	8.8	14.2								
No. 6	10	9.7	5.4	1.7	3.7	9.3	13.9	23.8	29.7	15.7	0.90	563.0	1.83×10^{-2}
	20	12.9	8.7	2.9	5.8				36.5				
	30	12.0	7.5	2.4	5.1								
	50	13.2	9.2	3.1	6.1								
	85	14.9	10.8	3.7	7.1								
No. 7	10	5.6	4.5	1.4	3.1	7.8	11.6	21.0	26.3	6.1	0.98	271.6	1.65×10^{-2}
	20	9.5	7.8	2.5	5.3				31.0				
	30	7.9	5.8	1.8	4.0								
	50	8.5	7.0	2.3	4.7								
	85	7.2	6.2	2.0	4.2								
No. 8	10	10.9	9.6	3.2	6.4	16.0	24.0	32.8	40.9	6.2	0.86	172.0	1.44×10^{-2}
	20	12.3	10.1 (6.3)	3.4	6.7				43.5				
	30	10.7	6.0	(2.0)	(4.3)								*Water doesn't reach below 30 cm.
	50	12.0	(7.1)	(2.3)	(4.8)	( ) calculation values (FC = 0.44 PF $^{1.12}_{1.5}$)							
	85	9.9	(5.7)	(1.8)	(3.9)								
No. 9	10	6.7	3.1	0.9	2.2	5.5	8.3	15.5	19.4	15.4	0.75	198.0	1.54×10^{-2}
	20	9.3	5.9	1.9	4.0				27.3				
	30	11.8	6.9	2.2	4.7								
	50	13.3	10.5	3.6	6.9								

No. 10	10	12.6	9.6	3.2	6.4	16.0	24.0	33.3	41.6	4.8	0.72	49.4	1.17×10^{-2}
	20	13.8	10.5	3.6	6.9				49.8				
	30	13.5	9.9	3.3	6.6								
	50	15.2	11.4	3.9	7.5								
	85	15.3	12.0	4.2	7.8								
No. 11	10	12.8	8.7	2.9	5.8	14.5	21.8	29.3	36.6	10.2	0.61	44.4	8.70×10^{-3}
	20	10.5	8.8	2.9	5.9				45.8				
	30	11.2	10.0	3.4	6.6								
	50	8.6	7.2	2.3	4.9								
	85	9.5	6.4	2.0	4.4								
No. 12	10	7.4	3.6	1.1	2.5	6.3	9.4	16.3	20.3	14.6	0.91	556.7	2.13×10^{-2}
	20	9.2	5.8	1.8	4.0				23.0				
	30	6.1	3.9	1.2	2.7								
	50	5.1	3.2	0.9	2.3								
	85	5.3	3.3	1.0	2.3								
No. 13	10	15.7	11.4	3.9	7.5	18.8	28.1	36.3	45.3	6.1	0.77	67.1	1.45×10^{-2}
	20	13.5	10.6	3.6	7.0				50.5				
	30	11.3	8.5	2.8	5.7								
	50	11.5	9.5	3.2	6.3								
	85	10.3	10.3	3.5	6.8								
No. 14	10	17.9	15.9	5.8	10.1	25.0	37.5	44.0	55.0	3.4	0.61	14.8	4.27×10^{-3}
	20	16.8	11.4	3.9	7.5				60.0				
	30	17.1	9.6	3.2	6.4								
	50	17.9	6.5	2.1	4.4								

No. 15	10	8.5	7.3	2.4	4.9	9.6	18.3	19.5	36.8	22.8	0.70	20.17	1.57×10^{-2}
	20	11.1	4.2	1.3	2.9								
	30	18.3	10.5	3.6	6.9								
	50	14.3	10.0	3.4	6.6								
	85	9.1	8.1	2.7	5.4								
No. 16	10	14.4	14.0	5.0	9.0	20.3	30.5	37.8	47.2	6.3	0.57	19.8	6.29×10^{-3}
	20	10.7	9.2	3.1	6.1				49.3				
	30	8.6	6.8	2.2	4.6								
	50	8.2	6.9	2.2	4.7								
	85	6.2	5.9	1.9	4.0								
No. 17	10		13.4	4.7	8.7	21.8	32.6	43.5	54.4	10.1	0.76	139.7	1.91×10^{-2}
	20		13.5	4.8	8.7				65.8				
	30		13.8	4.9	8.9								
	50		10.0	3.4	6.6								
	85		10.6	3.6	7.0								
No. 18	10		8.0	2.6	5.4	13.5	20.3	26.5	33.1	19.0	0.85	493.4	1.87×10^{-2}
	20		7.7	2.5	5.2				37.8				
	30		6.6	2.1	4.5								
	50		8.3	2.7	5.6								
	85		4.3	1.3	3.0								

Note: FC ..... Field Capacity
Wp ..... Wilting point

AM ..... Available Moisture (FC-WP)
TRAM .... Total Readily Available Mositure

TRAM Group
I: Root Zone Depth 40 cm
II: " 60 cm
III: " 80 cm
IV: " 100 cm (upper), 120 cm (lower)

It is assumed that a layer where crops consume 40% of the total moisture is named 1st layer.
" 30% " 2nd " .
" 20% " 3rd " .
" 10% " 4th " .

Table IV.D.12 Crops and Root Depth

	Planting Rate	Root Depth	Consumptive Use
Vegetable (winter)	%	m	mm/day
Berseem	16.5	0.6 ~ 0.9	6.8 (Apr.)
Potato	13.5	0.4 ~ 0.6	6.5 (")
Tomato	13.5	0.7 ~ 1.0	4.7 (Mar.)
Barley	1.5	1.0 ~ 1.5	3.9 (Dec.)
Strawberry	0.375	0.2 ~ 0.3	4.0 (Dec.)
Bean	0.375	0.5 ~ 0.7	4.0 (")
Sorghum	10	1.0 ~ 2.0	7.9 (June)
Vegetable (summer)			
Sesame	6.5		7.9 (June)
Cucumber	14.625	0.7 ~ 1.2	6.9 (June)
Watermelon	11.25	1.0 ~ 1.5	6.8 (")
Ground-Nut	3	0.5 ~ 1.0	6.8 (July)
Tomato	0.375	0.7 ~ 1.0	9.7 (June)
Fodder			
Alfalfa	2.875	1.0 ~ 2.0	7.9 (June)
Nepia G.	2.875	0.5 ~ 1.5	7.5 (")
Fruits			
Citrus	48.5	1.2 ~ 1.5	6.3 (June)
		Average	6.7 (June)

Table IV.D.13 Comparison of Pressure-Systems

		Low-Pressure	Intermediate-Pressure	High-Pressure
Pressure		0.5 ~ 2.0 kg/cm^2	2.0 ~ 4.0	4.0 ~
Capacity		6 ~ 20 ℓ/min.	10 ~ 40	40 ~ 2000
Crops		High quality	Vegetables Fruits	Fodder, Fruits
Water drop size		Small	Medium	Large
Facilities costs	Movable	400 LE/fed	230	200
	Fixed	3,140 LE/fed	2,000	1,160

Table IV.D.14 Comparison of Transfer Systems

Transfer System		Character	Construction Costs
Hand-moved		. Low cost . Large number of labours are needed	230 LE/fed
Permanent (underground)		. High cost . Stand in the way of farming . Labourers are not need	2,000
Surface fixed		. High cost . Do not obstruct farming during plowing . Labourers can be reduced	2,000
Self-moved	Side wheel	. Labourers can be reduced . Not suitable for tall plants	1,330
	Tractor	. Labourers can be reduced	830

Unit Water Requirement

Calculation of peak unit water requirement.

i) Sprinkler irrigation method (for vegetables)

$$q = 2.78 \frac{0.42 \cdot A \cdot E}{F \cdot H}$$

q: Unit duty of water (ℓ/sec/fed)

A: Average irrigation area (1 fed)

E: Water quantity per irrigation

$$E = \frac{6.7 \text{ mm} \times 4 \text{ days}}{0.85} = 31.5 \text{ mm}$$

F: Intermittent days (4 days)

H: Irrigation hours (18 hours)

(a) 24 hours irrigation

$$q = 2.78 \times \frac{0.42 \times 1 \times 31.5}{4 \times 24} = 0.3831 \text{ ℓ/sec/fed.}$$

(b) 18 hours irrigation

$$q = 2.78 \times \frac{0.42 \times 1 \times 31.5}{4 \times 18} = 0.5183 \text{ ℓ/sec/fed.}$$

ii) Drip irrigation method

24 hours irrigation

$$E = \frac{6.7 \times 5}{0.9} = 37.2 \text{ mm}$$

F = 5 days

H = 24 hours

$$q = 2.78 \times \frac{0.42 \times 1 \times 37.2}{5 \times 24} = 0.3620 \text{ ℓ/sec/fed.}$$

Windbreak Plan

i) Objectives

According to the climatological data, wind velocity in the Project area is from 6 knots to 9 knots (1 knot = 0.5144 m/sec) throughout the year. Strong winds named Khamasine blow between the middle March and early April from the west or the southwest. These strong winds transport large amounts of sand. Therefore, windbreaks of Casurina Equisetifolia are planned to protect young plants and fruit trees during the flowering season.

ii) Function and Effect of the Windbreaks

A windbreaks effective area is relative to its height. This also depends on the formation of the trees and their location. In general, the length of a windbreaks effective area is between 5 and 8 times its height, in some cases it is 20 times.
For example, a windbreak of Casurina 7 meters in height has an effective area whose length is between 60 meters to 70 meters.

In areas where wind speeds are relatively slow it is said that a windbreak effective area is between 100 meters and 150 meters in length.

Location of Windbreak

i) Position and Direction

The windbreak is located where it displays greatest efficiency and occupies a relatively small area. A windbreak for fields is generally located around the fields and its direction is set at a right angle to the wind direction. A secondary windbreak is set at right angles to the main windbreak.

ii) Length and Width

Generally the width of the main windbreak is between 2 and 4 times its height. There are between 1 and 7 rows of trees planted.
A secondary windbreak has between 1 and 2 rows of trees. Therefore, a main windbreak is 30 meters in width, while a secondary windbreak is 10 meters in width depending upon sites where are set.

In this Project, the width and number of rows of trees for windbreaks are designed as shown in Fig. IV.D.16, 17.

The results are based on the fact that the wind speed of the Project area is relatively slow throughout the year, the period of heavy winds (Khamasine) occurs for less than one month and forest efficiency is sufficient to protect fields from sandstorms.

Plant Varieties and Planting Pattern

i) Plant Varieties

Plant varieties are chosen as follows: depending on dry resistance and salinity resistance.

1. Casurina Equisetifolia
2. Eucalyptus Camaldulensis
3. Tamarix

ii) Planting Pattern

Planting patterns are shown in Fig.

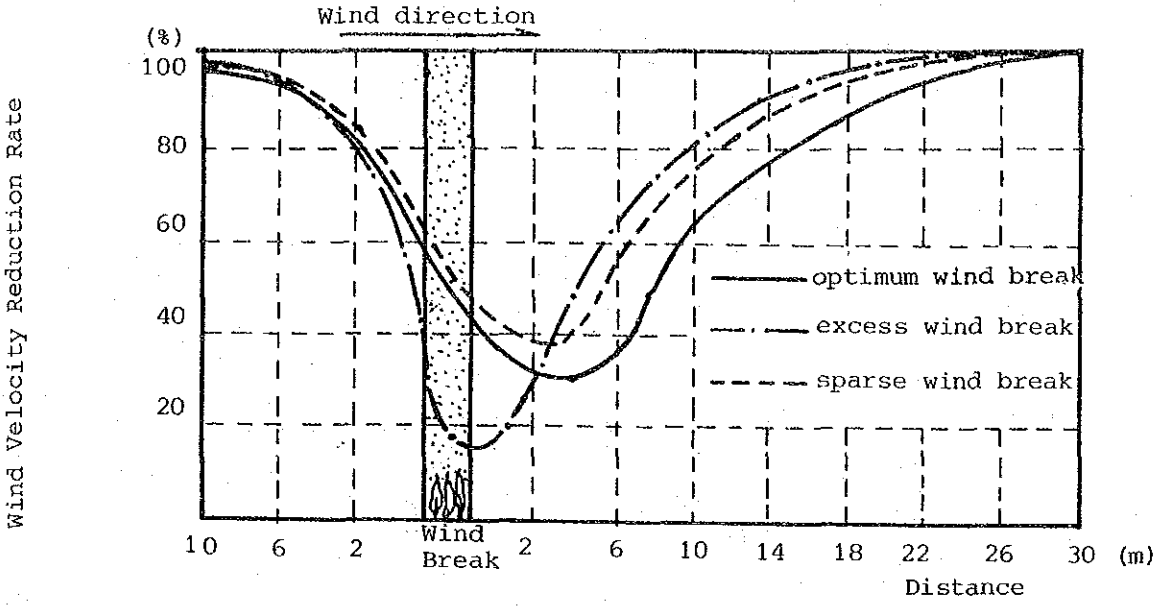


Fig. IV.D.14 Relation between Windbreak Density and Wind Distance Velocity Reduction Dimination

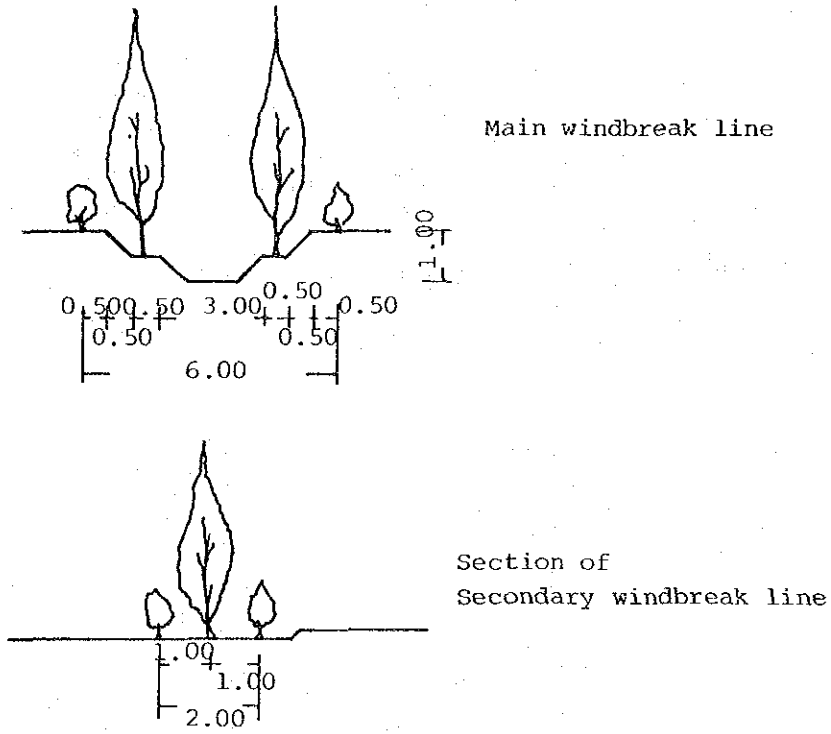
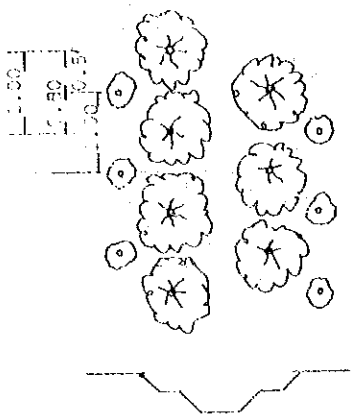


Fig. IV.D.15 Section of Windbreak

Fig. IV.D.16 Disposition of Windbreak



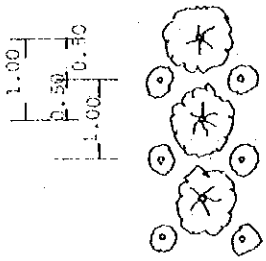


Fig. IV.D.17 Plan of Windbreak

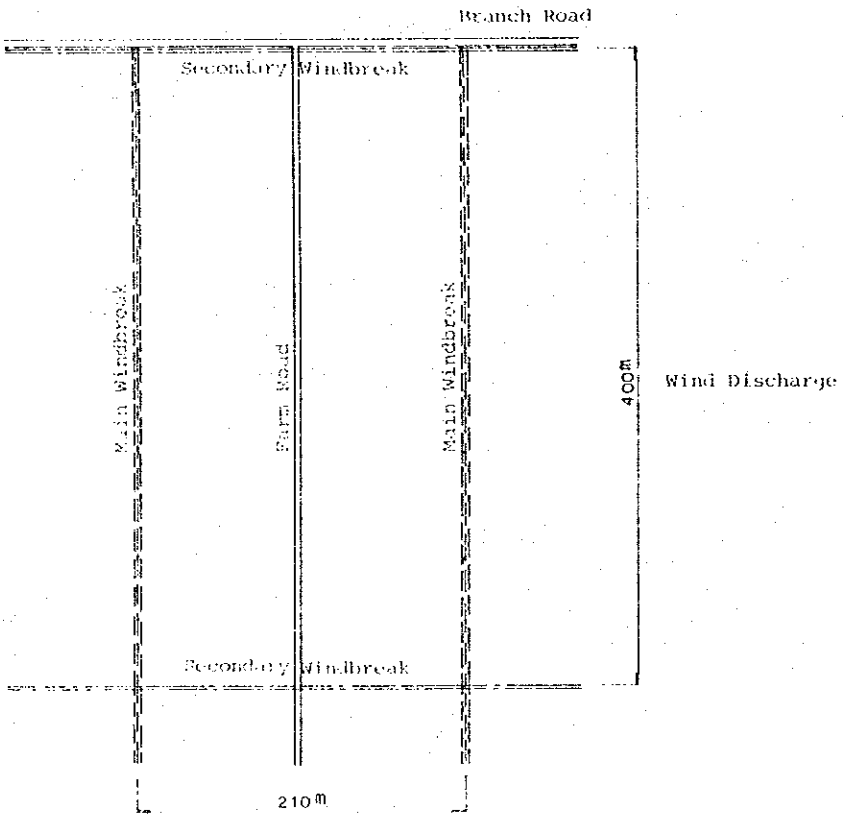


Fig. IV.D.18 ROAD STANDARD SECTION S=1:50

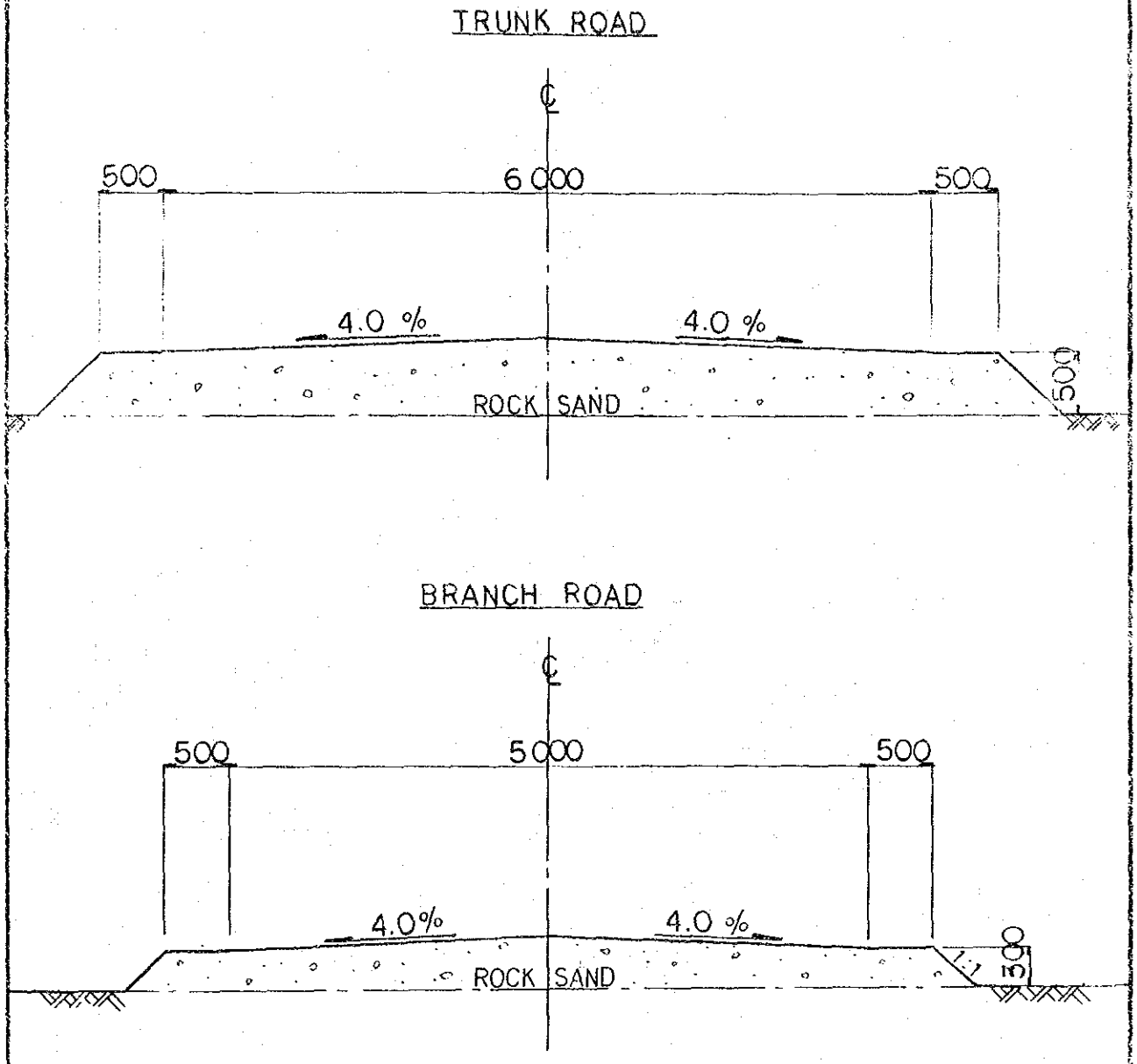
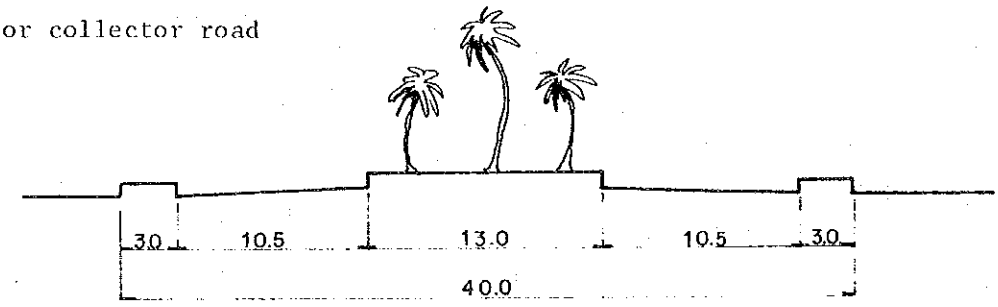
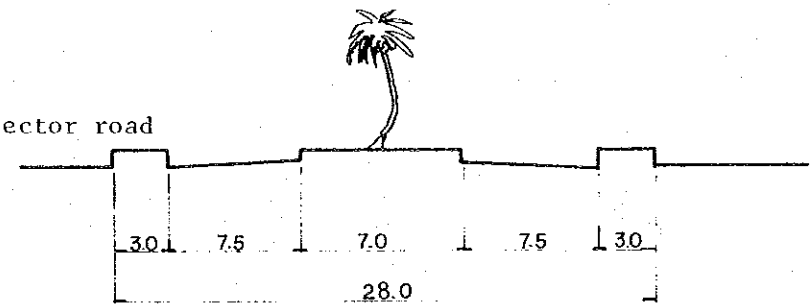


Fig. IV.D.19 Cross Section of Housing Village Road

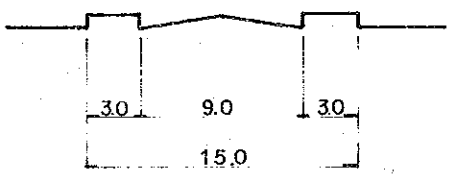
Major collector road



Minor collector road



Residential service street



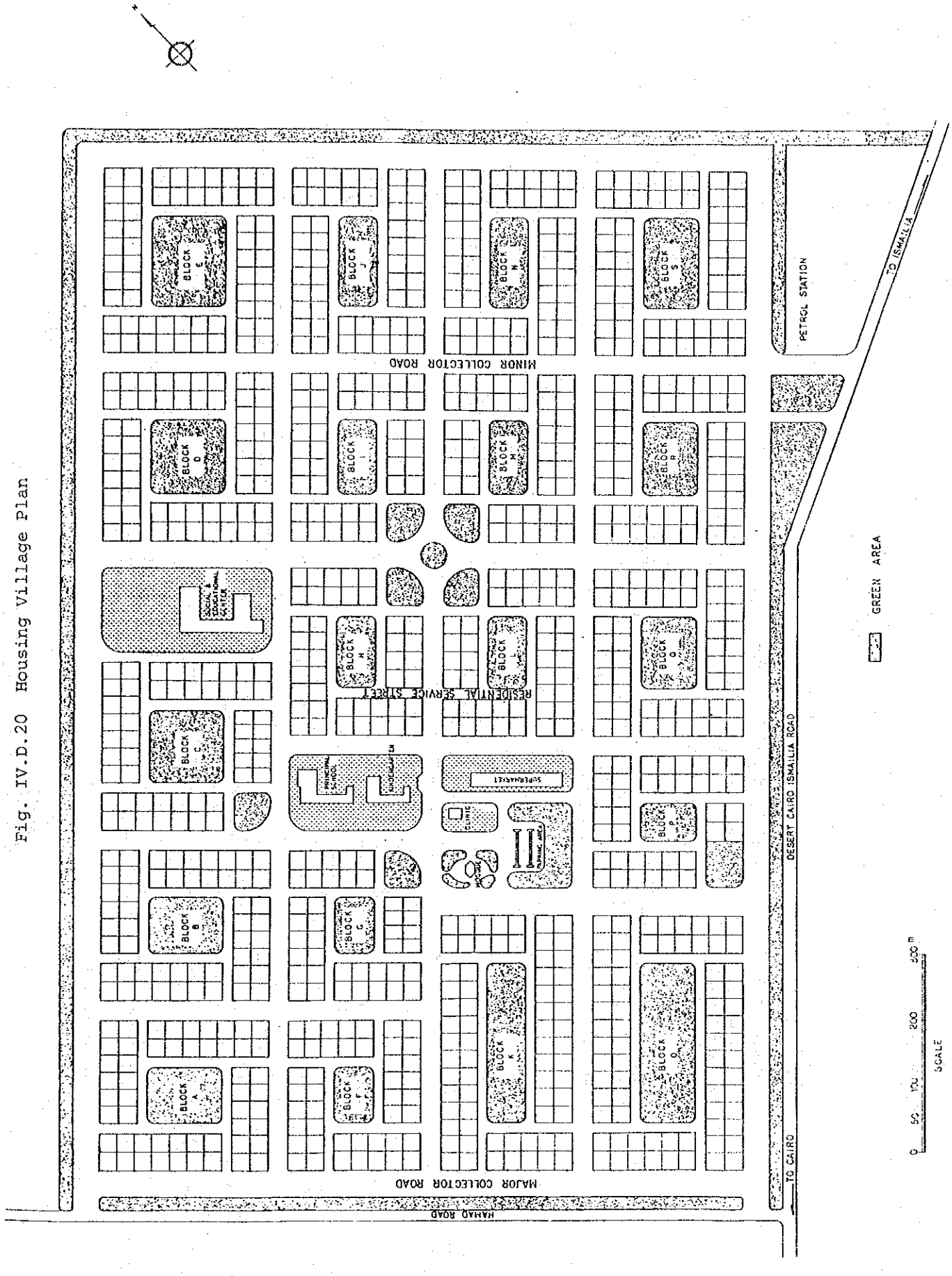


Fig. IV.D.20 Housing Village Plan

E. AGRICULTURAL DEVELOPMENT

Table IV.E.1 Evaluation of Suitable Crops

	Marketability	Profitability	Technical Acceptability in Production and Market
Wheat	A	B	b
Beans	A	B	b
Peas	A	A	a
Ground nut	A	A	a
Sesame	A	B	b
Onion	A	B	b
Tomato	A	A	a
Watermelon	A	A	a
Sweet melon	A	A	a
Potatoes	A	A	a
Cabbages	A	A	a
Lettuce	A	A	a
Carrot	B	A	b
Cucumber	A	A	a
Strawberry	A	A	a
Mango	A	A	a
Grape	A	A	a
Orange	A	A	a
Lemon	A	A	a
Olive	A	A	a
Dates	A	A	a

From Agricultural Division Ismailia Gov.

Table IV.E.2 Cropping Calendar for Some Crops

Ismailia

Crops	Nursery	Planting	Harvesting
Wheat		Oct	May
Barley		Nov	May
Rice		May	End of Sep
Corn		Beginning of Mar	End of Aug
Cotton		Beginning of Mar	End of Sep
Sugar Beet		Beginning of Nov	May
Sunflower		May	End of Sep
Ground nuts		May	Oct
Egyptian Clover (long)		End of Sep	May
Egyptian Clover (short)		End of Sep	End of Jan
Sorghum		May	Sep
Beans		Beginning of Jan	Apr
Potato (summer)		Feb - Mar	Jul
" (Nili)		Sep - Oct	Jan - Feb
" (winter)		Nov - Dec	Mar
Tomato (early summer)	Nov - Dec	Jan - Feb	May - Sep
" (late summer)	Feb	End of Feb - Apr	Beginning of Jan Nov
" (Nili)	May - Jun	Jul - Aug	Nov - Feb
" (winter)	Jul - Aug	Sep - Oct	Jan - Apr
Onion	Jan	Feb - beginning of Mar	Jul
"	Jan	Apr	Sep - Nov
Cucumber (summer)		Feb - Apr	Jul - Sep
" (Nili)		Aug - Sep	Jan
" (winter)		Dec - Jan	Mar - Apr
Watermelon		Feb - Apr	Jul - Sep

Table IV.E.3 Amount of Fertilizers Applied

kg/feddan

Crops	N	P	K
Egyptian clover	-	-	45
Barley	45	-	-
Sorghum	40	30	35
Alfalfa	8	15	-
Napier Grass	170	-	-
Potato	100	60	70
Tomato (winter)	120	-	55
Tomato (summer)	90	15	125
Cucumber	45	15	45
Watermelon	45	15	65
Bean	30	-	-
Groundnut	30	-	90
Sesame	30	-	65
Strawberry	200	45	240
Orange	190	-	-

Table IV.E.4 Application of Organic Mater for Each Crop

(m^3/fed)

	Quantity		Quantity
Fodder Crops (green)		Sweetmelon	10
Maize	6	Carrot	2
Barley	6	Sesame	6
Alfalfa	-	Cucumber	6
Egyptian Clover	-	Potato	10
Napier Grass	-	Strawberry	8
Sorghum	6	Tree Crops	
Legume		Orange	8
Bean	--	Mango	8
Peas	6	Grape	8
Ground-nut	6	Lemon	8
Vegetables and others		Olive	6
Tomato	10	Dates	6
Watermelon	10		

Table IV.E.5 Balance Sheet of Organic Matter by Farm Type

Farm Type	Amount of Organic matter necessary for Cropping	Production of Organic Matter	
		Cattle	Chicken
Compound Type	124 Ton*	90 Ton	20 Ton
Fruit Tree Type	102	55	-
Dairy Cattle Type	110	180	20
Vegetable Type	113	110	20

* $1m^3$ = 0.6 Ton

Table IV.E.6 Cropped Area and Production by Crop in Total Area

Crop	Unit Yield (ton/feddan)	Acreage (feddan)	Production (ton)
Berseem (forage)	20.0	3,060	61,200
Barley (")	10.0	360	3,600
Sorghum (")	20.0	1,845	36,900
Alfalfa (")	40.0	540	21,600
Napier Grass (")	75.0	540	40,500
Potato	7.9	2,340	18,486
Tomato (winter)	5.6	2,475	13,860
" (summer)	7.3	90	657
Cucumber	7.2	2,610	18,792
Watermelon	12.7	1,935	24,575
Bean	0.6	90	54
Groundnut	1.6	720	1,152
Sesame	0.5	1,215	608
Strawberry	8.0	90	72
Orange	6.6	8,505	56,133

Table IV.E.7 Compound Management Type (585 farms)

Crop	Unit Yield (ton/fed)	Cropped Area in 1 farm (fed)	Production in 1 farm (ton)	Production in Total farm (ton)
Egyptian Clover (forage)	20.0	3.0	60.0	35,100
Sorghum (")	20.0	2.0	40.0	23,400
Alfalfa (")	40.0	0.5	20.0	11,700
Napier Grass (")	75.0	0.5	37.5	21,938
Potato	7.9	3.0	23.7	13,865
Tomato (winter)	5.6	3.0	16.8	9,828
Sesame	0.5	1.0	0.5	293
Cucumber	7.2	3.0	21.6	12,636
Watermelon	12.7	3.0	38.1	22,289
Orange	6.6	10.0	66.0	38,610

Fruit Tree type (135 farms)

Crop	Unit Yield (ton/fed)	Cropped Area in 1 farm (fed)	Production in 1 farm (ton)	Production in Total farm (ton)
Egyptian Clover (forage)	20.0	3.0	60.0	8,100
Sorghum (")	20.0	1.0	20.0	2,700
Alfalfa (")	40.0	0.5	20.0	2,700
Napier Grass (")	75.0	0.5	37.5	5,063
Potato	7.9	3.0	23.7	3,200
Sesame	0.5	2.0	1.0	135
Cucumber	7.2	3.0	21.6	2,916
Orange	6.6	13.0	85.8	11,583

Table IV.E.8 Dairy Cattle Type (90 farms)

Crop	Unit Yield (ton/fed)	Cropped Area in 1 farm (fed)	Production in 1 farm (ton)	Production in Total (ton)
Egyptian Clover (forage)	20.0	4.0	80.0	7,200
Barley (")	10.0	4.0	40.0	3,600
Sorghum (")	20.0	4.0	80.0	7,200
Alfalfa (")	40.0	1.0	40.0	3,600
Napier Grass (")	75.0	1.0	75.0	6,750
Cucumber	7.2	4.0	28.8	2,592
Tomato	5.6	2.0	11.2	1,008
Potato	7.9	2.0	15.8	1,422
Groundnut	1.6	2.0	3.2	288
Watermelon	12.7	2.0	25.4	2,286
Orange	6.6	6.0	39.6	3,564

Vegetable type (90 farms)

Crop	Unit Yield (ton/fed)	Cropped Area in 1 farm (fed)	Production in 1 farm (ton)	Production in Total (ton)
Egyptian Clover (forage)	20.0	6.0	120.0	10,800
Sorghum (")	20.0	2.0	40.0	3,600
Alfalfa (")	40.0	1.0	40.0	3,600
Napier Grass (")	75.0	1.0	75.0	6,750
Tomato (winter)	5.6	6.0	33.6	3,024
" (summer)	7.3	1.0	7.3	657
Cucumber	7.2	1.0	7.2	648
Bean	0.6	1.0	0.6	54
Groundnut	1.6	6.0	9.6	864
Sesame	0.5	4.0	2.0	180
Strawberry	8.0	1.0	8.0	720
Orange	6.6	4.0	26.4	2,376

V. PROJECT IMPLEMENTATION

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2. Construction Supervision

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(5) Intake Works

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(7) Farm Pond

(8) Wells

(9) Reclamation

(10) On-Farm Facilities

(11) Roads

(12) Settlement

(13) Supporting Service

(14) Project Facilities

(15) Administration Cost

(16) Consulting Service

A. PROJECT ORGANIZATION

Table V.A.1 Main Governorate Department and National Company in Ismailia

Department of Governorate

(1) Department of Agriculture
(2) Department Veterinary Services
(3) Department of Agricultural Cooperative
(4) Department of Agricultural Reclamation
(5) Department of Public Health
(6) Department of Finance
(7) Department of Supply
(8) Department of Social Affairs
(9) Department of Irrigation and Drainage
(10) Department of Work
(11) Department of Religion and Azhar
(12) Department of Transportation
(13) Department of Wireless and Telephone Transportation
(14) Department of Land Survey
(15) Department of Electricity and Power
(16) Department of Education

National Company

(1) Ismailia MISR Co. for Transportation
(2) Ismailia MISR Co. for Agricultural Development
(3) Ismailia MISR Co. for Fish Farming
(4) Ismailia MISR Co. for Chickens
(5) National Co. for Exportation and Importation of Vegetables and Fruits
(6) National Co. for Animal Development
(7) National Co. for Food
(8) National Co. for Tourism
(9) National Co. for Housing
(10) National Co. for Cloths
(11) Ismailia MISR Co. for Refrigeration
(12) The Saudi Dairy Factory

D. CONSULTING SERVICE

D. CONSULTING SERVICE

1. Detailed Design

The scope of works for the detailed design of the Project is as follows.

(1) Scope of Works and Objectives

The main consultancy services for the Tenth of Ramadan Agricultural Development Project are as follows:

1-1 Review of Present Study and Plan

1-2 Addition of Hydrology, Topographical Survey and Soil Tests and Collection and Analysis of Data

1-3 Execution of the Detailed Design

1-4 Drawing up of an Administration and Management Manual

1-5 Cost Estimation of the Project

1-6 Drawing up of Documents Related to the Project

1-7 Other Related Services

(2) Details of the Works

The main works are as follows.

2-1 As already mentioned above, the following studies shall be carried out.

(1) Reveiw of the irrigation plan

Including review of irrigation water requirements, etc.

(2) Project facilities and civil works

Review of the planned layout for roads, water-works and the capacity of the planned facilities.

(3) Settlement

Review of the planned layout for buildings and review of the waterworks, sewage, electric facilities, etc.

(4) Leaching area drainage

Carrying out boring, pumping-out tests and water analysis.

(5) Financing plan

Investigation of the loan investment plan, repaymanet schedule of several other similar projects.

(6) Crops

Review of the cropping pattern and anticipated production.

(7) Farm management

Extension of production organization and review of land use plan.

2-2 The items below should also be included in the topographical survey, pumping out test, and collection and analysis of additional data.

(1) Topographical survey

- Topographical survey, profile and sectional levelling (for main canal, pump station, farm pond)
- Profile and sectional levelling (for roads, pipelines)

(2) Pumping-out test

- Boring in three locations to carry out water capacity and water analysis

(3) Other related items

- Study of prices of materials and machinery
- Study of the level of experience and competence of local civil engineers
- Also an outline survey of similar projects

2-3 The detailed design and civil work specifications shall cover the following areas.

(1) Pump station
(2) Pipeline
(3) Field irrigation facilities
(4) Roads

2-4 Administration and Management Manuals shall include the following points.

(1) Irrigation facilities

- Canal
- Pump station
- Pipeline
- Sprinklers and other equipment

(2) Roads

- Main roads
- Branch roads

2-5 Estimate of the Project cost shall be based on the detailed design.

2-6 Drawing up of Project Documents

- Instruction to Tender
- Form of Tender
- Conditions of Contract
- General Specifications
- Technical Specifications
- Tender Drawing
- Farm of Agreement and Form of Performance Bond

2-7 Duties to be included in the Project are as follows:

(1) Transfer of Technology

The Consultant should cooperate in the transfer of technology to the counterparts and local consultant engineers.

(3) Duties of the Consultant

The Consultant shall have the following duties during the implementation of the Project.

3-1 Total man-months shall not exceed 100 months.

(4) Assignment of Experts

The following team of experts will be required for implementation of the Project.

(1) Team Leader
(2) Agronomist
(3) Farm Management Expert
(4) Economist
(5) Soil Scientist

(6) Geologist
(7) Boring Engineer
(8) Surveyor
(9) Design Engineer
(10) Agricultural Machinery Engineer
(11) Farm Consolidation Engineer
(12) Irrigation Engineer
(13) Documents Preparation Clerk

(5) Equipment

The equipment listed below will be required for implementation of the Project.

- Survey equipment
- Soil test equipment
- Copy machine
- Pumping-out test equipment
- Calculators, Drafting equipment

(6) Reports

6-1 The Consultant shall prepare reports as listed below.

(1) Inception Report
(2) Implementation Report
(3) Quarterly Progress Report
(4) Monthly Report
(5) Design Report
(6) Design Note

6-2 Reports are to be drawn up using the M.G.S. method.

6-3 The Consultant shall submit all reports, documents, etc. in the English language.

2. Construction Supervision

(1) Scope of Works

1-1 The Consultant shall be responsible for the consultancy services as listed below and will also cooperate in the implementation of the Tenth of Ramadan Agricultural Development Project.

- To provide assistance in the supervision of the Project's construction works.
- To provide assistance and guidance in the management and the administration of the Project.

1-2 Objectives

The Consultant shall assist the Government in the following items to complete the effective implementation of the Project.

1) Assistance in the Supervision of the Construction Works

The Consultant shall provide consultancy services from the preconstruction period until completion of the construction works. Consultancy services shall include operations and assistance.

The Consultant shall provide technical assistance to the Government for managing the project smoothly and inspecting the construction works and giving proper instructions for the supervision of the construction works during the construction period, in order to protect the Government's benefits.

(a) The Consultants will provide assistance and instructions for the following items.

- Review of the detailed design
- Arrangement of the documents and data which are determined upon completion of the detailed design.

- Retrenchment of costs based on the approved design and specification
- Inspection of the structures under construction
- Design modifications during the construction period.
- Inspection of the construction materials
- Supervising the construction schedule
- Execution of additional surveying and testing which are deemed necessary
- Advice on agricultural technology including the farm management program following the completion of constructon
- Advice on operation and maintenance following the completion of construction

(b) Outline of Assistance

- To assist and advise in the supervision and the inspection of the construction works during the construction period.
- To assist and advise in the contract examinations and the evaluations of the contractors including prequalification and the analysis of the contractors ability to fulfill the requirements of the Government.
- To carry out modifications of the construction schedule as required, cooperating with the Government in supervising the construction schedule.
- To cooperate in the administration of payments to contractors and the evaluation of the construction progress by the contractors, fulfilling the requirements of the Government.
- To perform the final inspection of the constructions upon their completion.

1-3 Administration Plan

1) The construction period will be 4 years.

2) To carry out the operation-and-maintenance and the farming program for one year after the construction is completed.

3) To train the members of the cooperative organization and operation-and-maintenance engineers (including overseas training).

4) Total man-months will be 246 M/M for the foreign currency portion and 123 M/M for the local currency portion.

1-4 Personnel to be Dispatched

The team will consist of the following specialists.

1) P.M. (Project Manager)

2) IRRIGATION DRAINAGE and RECLAMATION ENGINEER

3) EQUIPMENT ENGINEER

4) STRUCTURAL ENGINEER

5) AGRONOMIST

6) O & M ENGINEER

Fig. V.D.1 Engineering service for Detail Design

Position \ Month	1 2 3 4 5 6 7 8 9 10 11 12	Quantity (m/m)
(Foreign)		
1. Project Manager		12
2. Irrigation Engineer		9
3. Civil Engineer		5
4. Engineering Geologist		6
5. Mechanical Engineer		12
6. Electric Engineer		9
7. Architect & Building Engineer		12
8. Design Engineer		12
9. Cost Estimator		9
10. Surveyor		6
11. Construction Planner		9
12. Agronomist		3
13. Economist		6
14. Farm Management Engineer		6
15. Documents Clerk		3 (Sub-total) 119
(Local)		
1. Design Engineer		6
2. Surveyor		9
3. Documents Clerk		3 (Sub-total) 18
		(Total) 137

Fig. V.D.2 Engineering Service for Supervision

Position \ Month	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	Quantity (m/m)
(Foreign)							
1. Project Manager							24
2. Sr. Irrigation Engineer							48
3. Irrigation Engineer							38
4. Civil Engineer							27
5. Architect & Building Engineer							27
6. Mechanical Engineer							39
7. Electric Engineer							25
8. Agronomist							18
						Total	246
(Local)							
1. Irrigation Engineer							48
2. Building Engineer							48
3. Agricultural Engineer							27
						Total	123

E. COST ESTIMATE

Table V.E.1 INVESTMENT COST OF THE PROJECT (1)

Work Item	F/C	L/C	Total
1. Preparatory Work	-	10,000	10,000
2. Main Pump Station	2,434,000	95,000	2,529,000
3. Main & Secondary P.L.	11,887,000	910,000	12,797,000
4. Intake Works	26,000	80,000	106,000
5. Booster Pump Station	5,946,000	404,000	6,350,000
6. Farm Pond	-	1,250,000	1,250,000
7. Wells	1,697,000	173,000	1,870,000
8. Reclamation	-	250,000	250,000
9. On-farm Facilities	10,087,000	385,000	10,472,000
10. Roads	-	1,850,000	1,850,000
11. Supporting Services	556,000	482,000	1,038,000
12. Settlement	-	1,174,000	1,174,000
Sub-Total	32,633,000	7,063,000	39,696,000
13. Project Facilities	-	232,000	232,000
14. Administration Cost	-	720,000	720,000
15. Consulting Services	3,052,000	389,000	3,441,000
Sub-Total	35,685,000	8,404,000	44,089,000
16. Physical Contingency	3,569,000	1,681,000	5,250,000
Total	39,254,000	10,085,000	49,339,000
17. Price Escalation	16,369,000	9,406,000	25,775,000
Grand total	55,623,000	19,491,000	75,114,000

PREPARATORY WORKS (2)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
Preparation	LS	1.0				10,000	10,000	

MAIN PUMP STATION (3)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit price	Amount		
1. Pump	set	6	96,700	580,200		0	580,200	
2. Valve	"	6	50,200	301,200		0	301,200	
3. Crane	LS	1		55,000		0	55,000	
4. Pipe	"	1		95,000		0	95,000	
5. Accessory	"	1		22,700		0	22,700	
6. Water level	"	1		2,800		0	2,800	
7. Panel	"	1		161,300		0	161,300	
8. Generator	"	1		1,007,800		0	1,007,800	
9. Pump house	m^2	450		-	200	90,000	90,000	
10. Freight, etc.	LS	1		138,000		5,000	143,000	
Total				2,434,000		95,000	2,529,000	

MAIN & SECONDARY PIPELINE (4) (a)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
Main Pipe								
1. ϕ1,500 (FRPM)	m	650	278.22	180,843	25.10	16,315	193,158	
2. ϕ1,350 (")	"	4,400	233.66	1,028,104	12.29	93,676	1,121,780	
3. ϕ1,100 (")	"	4,800	160.07	768,336	17.00	81,610	849,936	
4. ϕ1,000 (")	"	2,400	136.65	327,960	16.01	38,424	366,384	
5. ϕ900 (")	"	2,400	109.90	263,760	15.48	37,152	300,912	
6. ϕ800 (")	"	650	93.40	60,710	12.69	8,248.5	68,958.5	
7. ϕ700 (")	"	4,800	76.90	369,120	10.83	51,984	421,104	
8. ϕ600 (")	"	3,900	62.71	244,569	8.71	33,969	278,538	
9. ϕ500 (")	"	2,300	41.58	95,634	7.62	17,526	113,160	
Sub-Total				3,339,036		378,894.5	3,717,930.5	
10. Valve, etc.	L.S	1.0		333,904		0	33,904	
11. Freight, etc.	"	1.0		3,798,000		0	3,798,000	
Total				7,470,940		378,894.5	7,849,834.5	
Secondary Pipe								
1. ϕ800 (FRPM)	m	4,000	109.90	439,600	12.69	50,760	490,360	
2. ϕ500 (")	"	4,000	41.58	166,320	7.62	30,480	196,800	

MAIN & SECONDARY PIPELINE (4) (b)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
3. ϕ450 (FRPM)	m	31,200	33.50	1,045,200	7.61	237,432	1,282,632	
4. ϕ400 (")	"	12,000	25.41	340,920	4.23	50,760	391,680	
5. ϕ350 (")	"	12,000	18.48	221,760	3.68	44,160	265,920	
6. ϕ300 (VP)	"	10,000	11.22	112,200	3.22	32,200	144,400	
7. ϕ200 (")	"	39,200	7.36	288,512	2.17	85,064	373,576	
8. Valve, etc.	L.S	1.0		523,000		0	523,000	
9. Freight, etc.	"	1.0		1,278,000		0	1,278,000	
Total				4,415,512		530,856	4,946,368	
Main & Secondary				11,886,452		909,750.5	12,796,202.5	
10. Miscellaneous	L.S			548		249.5	797.5	
Grand Total				11,887,000		910,000	12,797,000	

INTAKE WORKS (5)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Concrete Works								
(1) Culvert	m^3	157.41	68	10,703.88	112	17,629.92	28,333.80	
(2) Pit	"	124.92	68	8,494.56	112	13,991.04	22,485.60	
(3) Screen (front)	"	15.33	68	1,042.44	112	1,716.96	2,759.40	
(4) Screen (rear)	"	30.11	68	2,047.48	112	3,372.32	5,419.80	
2. Excavation	"	2,125.78		-	0.65	1,381.76	1,381.76	
3. Back-filling	"	818.24		-	0.58	474.58	474.58	
4. Screen	m^2	51.84		-	6.0	311.04	311.04	
5. Gate (3.2x2.7)	Sets	3.0		-	11,000	33,000	33,000	
Sub-Total				25,083.84		76,481.94	101,565.78	
6. Miscellaneous	LS	1.0		916.16		3,518.06	4,434.22	
Total				26,000		80,000	106,000	

BOOSTER PUMP STATION (6)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Pump	set	30	33,200	996,000		-	996,000	10 Block
2. Valve	"	30	10,340	310,200		-	310,200	
3. Crane	"	10	8,350	83,500		-	83,500	
4. Pipe	"	10	15,650	156,500		-	156,500	
5. Accessory	"	10	9,100	91,000		-	91,000	
6. Water level	"	10	3,510	35,000		-	35,000	
7. Panel	"	10	65,450	654,500		-	654,500	
8. Surge tank	"	10	46,500	465,000		-	465,000	
9. Generator	LS	1		2,818,000		-	2,818,000	
10. Pump house	m^2	2,000		-	200	400,000	400,000	
11. Freight, etc.	LS			336,200		4,000	336,200	
Total				5,946,000		404,000	6,350,000	

FARM POND (7)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Excavation (A)	m^3	234		-	0.58	135.72	135.72	(Per Block)
2. " (B)	"	11,454		-	0.65	7,445.10	7,445.10	
3. Banking (A)	"	60		-	0.58	34.80	34.80	
4. " (B)	"	540		-	2.13	1,150.20	1,150.20	
5. Foundation	"	566		-	21.45	12,140.70	12,140.70	
6. Asphalt	"	11		-	80.00	880.00	880.00	
7. Concrete (B)	"	849		-	118.65	100,733.85	100,733.85	
Sub-Total						122,520.37	122,520.37	
8. Miscellaneous	LS					2,479.63	2,479.63	
Total						125,000	125,000	

WELLS (8)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Drilling	Place	30	24,240	727,200	4,020	120,600	847,800	
2. Piping	"	30	4,590	137,700		-	137,700	
3. Pump facilities	"	30	8,250	247,500		-	247,500	
4. Piles unit	"	30	4,207	126,210		-	126,210	
5. Generator	"	30	12,670	380,100		-	380,100	
6. House	"	30		-	1,270	38,100	38,100	
Sub-Total				1,618,710		158,700	1,777,410	
7. Miscellaneous	LS			78,290		14,300	92,590	
Total				1,697,000		173,000	1,870,000	

RECLAMATION (9)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Reclamation	fed	21,524			10.65	229,230.6	229,230.6	
2. Miscellaneous	LS					20,769.4	20,769.4	
Total							250,000	

ON-FARM FACILITIES (10)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Sprinkler & Trickle	fed	19,260	484	9,321,840		-	9,321,840	0.5 fed. H.M. Sprinkler
2. Freight, etc.	LS	1.0		764,390			764,390	0.5 fed. Trickle
3. In-land transport & setting	fed	19,260			20	385,200	385,200	
Sub-Total				10,086,230		385,200	10,471,430	
4. Miscellaneous	LS	1.0		770		-200	570	
Total				10,087,000		385,000	10,472,000	

ROAD (11)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Trunk road	m	30,000			26.43	79,290	79,290	
2. Branch road	"	130,850			13.51	1,767,783.5	1,767,783.5	
3. Miscellaneous	LS					2,926.5	2,926.5	
Total							1,850,000	

SETTLEMENT (12)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
(A) Buildings								
1. Kindergarten	m^2	1,000	-	-	100	100,000	100,000	
2. Principal school	"	3,000	-	-	100	300,000	300,000	
3. Mosque	"	400	-	-	100	40,000	40,000	
4. Health clinic	"	500	-	-	120	60,000	60,000	
5. Social Educational center	"	1,000	-	-	100	100,000	100,000	
Sub-Total						600,000	600,000	
(B) Water Supply System								
1. Asbestos cement pipe (ϕ200)	m	14,000	-	-	19	266,000	260,000	
2. V.P Pipe (ϕ50)	"	27,000	-	-	8	216,000	216,000	
3. Hydrant	Set	54	-	-	1,300	70,200	70,200	
4. Sluice Valve	"	40	-	-	350	14,000	14,000	
5. Miscellaneous	LS					7,800	7,800	
Sub-Total						574,000	574,000	
Total						1,174,000	1,174,000	

SUPPORTING SERVICE (13)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Cooperative office	m^2	800	-	-	100	80,000	80,000	
2. Garage	"	300	-	-	30	9,000	9,000	
3. Coldstorage	Set	1		110,000		10,000	120,000	1,000 m^3
4. Coldstorage house	m^2	450	-	-	80	36,000	36,000	
5. Selection house	"	300	-	-	40	12,000	12,000	
6. Workshop	"	500	-	-	80	40,000	40,000	
7. Warehouse	"	1,000	-	-	60	60,000	60,000	
8. Warehouse	"	800	-	-	60	48,000	48,000	
9. Training center	"	600	-	-	100	60,000	60,000	
10. Breeding center shed	"	4,500	-	-	20	90,000	90,000	
11. Bulkcooler	Sets	10	21,900	219,000	1,900	19,000	238,000	
12. Bulkcooler house	m^2	100	-	-	60	6,000	6,000	10 m^2/set x 10 sets
13. Farm machineries	LS			227,000		12,000	239,000	
Total				556,000		482,000	1,038,000	

PROJECT FACILITIES (14)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. Office	m^2	300		-	100	30,000	30,000	
2. Work shop	"	200		-	80	16,000	16,000	
3. Accommodation	"	1,000		-	120	120,000	120,000	
4. Conveniences	LS	1		-		20,000	20,000	
5. Furniture	"	1		-		7,000	7,000	
Sub-Total				-		193,000	193,000	
6. O.H.	LS	1		-		39,000	39,000	(20%)
Total				-		232,000	232,000	

ADMINISTRATION COST (15)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. P.D.	M/M	120		-	1,000	120,000	120,000	
2. Staff	"	600		-	500	300,000	300,000	
3. Driver	"	720		-	200	144,000	144,000	
4. Postage	LS	1		-		10,000	10,000	
5. Miscellaneous	"	1		-		26,000	26,000	
Sub-Total						600,000	600,000	
6. O.H.	LS	1		-		120,000	120,000	20%
Total				-		720,000	720,000	

CONSULTING SERVICES (16)

(Unit: LE)

Description	Unit	Quantity	Financial Cost				Total	Remarks
			Foreign Currency		Local Currency			
			Unit Price	Amount	Unit Price	Amount		
1. D.D.	LS	1.0						
2. Supervision	LS	1.0						
Sub-Total								(Refer to T.O.R.)
Total				3,052,000		389,000	3,441,000	

VI. ECONOMIC AND FINANCIAL VALIDITY OF THE PROJECT

Comment Economic Internal Rate of Return

Table VI.A.1 Economic and Financial Crop Budget with Project

VI.A.2 Economic Net Income from Crop and Livestock Production

VI.A.3 Economic Net Income from Livestock

VI.A.4 Financial Net Income from Livestock

VI.A.5 Economic and Financial Costs

VI.A.6 B/C Ratio under the Discounted Cash Flow Method

(1) 10% Discount Rate

(2) 11% Discount Rate

(3) 12% Discount Rate

VI.A.7 Summary of Economic Benefits and Costs of the Project (EIRR) - in the Case Including Construction Costs of Tranbart Canal

Economic Internal Rate of Return (EIRR)

Basic Assumption

The basic assumptions underlining the EIRR calculations are as follows:

(1) Prices: In calculating the EIRR, farm gate prices of crops, livestock products and physical inputs which are exported or imported are derived from IBRD's projected world prices. Adjustments are done for freight, quality, less wastage, commission, handling and processing. And those of crops and livestock products which are consumed domestically are estimated on the basis of the weighted average wholesale prices at ROD EL FARRAG (Cairo)Market at 1980 prices.

They are as follows.

Crops	Economic Prices (LE/ton in 1990)
Potatoes	80
Sesame	370
Watermelon	80
Cucumber	105
Tomatoes (winter)	110
Fruits (citrus)	130
Livestock Products	**(LE/kg in 1990)**
Chicken	0.65
Meat	2.6
Milk	0.3
Egg	0.03 (LE/piece)
Inputs	**(LE/ton in 1990)**
Urea	247
Muriate of potash	120
Superphosphate (15% P_2O_5)	68

(2) Crop Yields: Crop yields are assumed to increase gradually, reaching the full potential seven years after implementation of the Project. Average yields are expected in 1997/98 at full development of the Project as follows:

Crops	Unit Yields (ton/feddan)
Potatoes	7.9
Tomatoes (winter)	5.6
Watermelon	12.7
Cucumber	7.2
Sesame	0.5
Fruits (citrus)	6.6

(3) Livestock Production: Livestock production is assumed gradually, reaching the full potential eight years after commencement of the production. Average production is expected in 1997/98 as follows:

Livestock	Unit Production (ton/18,000 feddans)
Chicken	1,053.0
Meat	266.9
Milk	14,499.0
Eggs	10,800.0 (Dozens/18,000 feddans)

(4) Cost of Labour: All farm labour at a seasonally adjusted opportunity cost. The economic cost per man-day is estimated at LE 1.00 which is about 50 per cent of the peak rate.

Results of our field survey show that in 1981/82 the financial wage rate for unskilled labour varies considerably according to location, time of year and type of employer. During busy periods, wages for temporary labour reach a peak of LE 1.70 per day, particularly in May, June, July and October. During the remaining period there is much underemployment and wage levels fall.

In Ismailia area, private employers are paying LE 1.30 - 1.45 per day for casual workers at peak times and around LE 1.00 per day for permanent labourers. On the other hand, in Delta areas, presently, top rates reach LE 2.00 - 2.50 per day and around LE 1.60 per day for some permanent labourers.

The shadow wage rate[1/] varies between seasons. At times of under-employment the shadow wage rates will be considerably less, although at peak times those will be similar to prevailing financial wage rates in the private sector.

(5) Agricultural Development Period: Some project benefits will commence in 1987/88, five years after construction is commenced. It is assumed that the reclaimed farmland is marginally productive in and after the seventh year of Project completion. The World Bank defines marginality as the point when annual return from crops covers annual costs. Practically, the length of the pre-marginality period is the subject of considerable uncertainty and administrative confusion, especially in desert development. In our study, the length is assumed to be seven years after completion of the Project. Also, as it will take several years before the farmers adjust to the new cropping systems, it assumed that full project benefits will not be achieved for several years after all Project construction is completed. The annual benefits derivable from crops would be 27, 29, 32, 35, 60, 73, 80, 87, 94 and 100 per cent of total benefits.

(6) Economic Life of the Project: The economic life of the Project is assumed to be 50 years, taking into consideration the nature of the Project. This is in line with previous agricultural development project practices in similar countries as well as in Egypt.

Economic Costs

The economic costs of the Project consist of the following: i) capital cost for irrigation development facilities and related works (LE 44,404,000), and ii) operation and maintenance (O&M) costs (LE 1,015,000 per year from 1989/90 and onwards). All costs are in constant prices as of 1982.

Economic Benefits

The economic benefits of the Project considered in the EIRR are the difference between the net production value "with" and "without" the Project. The economic benefits increase gradually in years one to seven inclusive to LE 12,812,486 in the 16th year when the fully developed level will be reached.

Economic Internal Rate of Return (EIRR) and Sensitivity Tests

Based on the above assumptions, the EIRRs are calculated for the followng cases.

Cases	EIRR (%)
Project base study	14.6
(i) A 10 per cent reduction of unit prices of upland crops	11.9
(ii) Taking into account construction costs of Tolonbaht Canal	13.3
(iii) A two-year Pogress in Project completion	15.0

Table VI.A.1 Economic and Financial Crop Budget with Project

Economic

Crop	Unit Yield (ton/ feddan)	Unit Price (LE/ ton)	Unit Gross Return (LE/ feddan)	Unit Production Cost (LE/ feddan)	Unit Net Value (LE/ feddan)
Potatoes	7.9	80	632.0	387.4	244.6
Sesame	0.5	370	185.0	114.3	70.7
Watermelon	12.7	80	1,016.0	676.5	339.5
Cucumber	7.2	105	756.0	458.2	297.8
Tomatoes (winter)	5.6	110	616.0	375.6	240.4
Fruits (citrus)	6.6	130	858.0	296.4	561.6

Financial

Crop	Unit Yield (ton/ feddan)	Unit Price (LE/ ton)	Unit Gross Return (LE/ feddan)	Unit Production Cost (LE/ feddan)	Unit Net Value (LE/ feddan)
Potatoes	7.9	77	608.3	396.5	211.8
Sesame	0.5	370	185.0	116.7	68.3
Watermelon	12.7	78	990.6	694.3	296.3
Cucumber	7.2	98	705.6	473.9	231.7
Tomatoes (winter)	5.6	105	588.0	396.4	191.6
Fruits (citrus)	6.6	120	792.0	305.6	486.4

Table VI.A.2 Economic Net Income from Crop and Livestock Production of Entire Project Area in and after the Seventh Year of Project Completion
(in case of compound farm system)

Crop

Crop	Unit Net Value (LE/feddan)	Cropped Acreage (feddan)	Unit Net Value per Unit Farm (LE/Unit Farm)	Number of Unit Farm	Total Net Value (LE/18,000 feddan)
Winter					
Berseem					
Potatoes	244.6	3.0	733.8	900	660,420
Tomatoes	240.4	3.0	721.2	900	649,080
Summer					
Sorghum					
Sesame	70.7	1.0	70.7	900	63,630
Cucumber	297.8	3.0	893.4	900	804,060
Watermelon	339.5	3.0	1,018.5	900	916,650
Perennial					
Alfalfa					
Napier Grass					
Fruits (Citrus)	561.6	10.0	5,616.0	900	5,054,400
Sub-total					8,148,240
Cost of labour					952,573
Total					7,195,667

Livestock

Livestock		Unit Production per Unit Farm (kg or dozen)	Unit Net Value per Unit Farm (LE/Unit Farm)	Number of Unit Farm	Total Net Value (LE/18,000 feddan)
Dairy Cattle	Milk	16,110 kg	2,174.9	900	1,957,365
	Meat	296.6 kg	771.1	900	694,044
Chicken	Chicken	1,170 kg	760.5	900	684,450
	Eggs	12,000 dozen	2,534.4	900	2,280,960
Total					5,616,819
Grand Total					12,812,486

Table VI.A.3 Economic Net Income from Livestock (Unit: 18,000 Feddan)

No.	Year	Production	Unit Price	Production Cost	Net Income	Production	Unit Price	Production Cost	Net Income
		(ton)	(LE/ton)	(LE '000)	(LE '000)	(ton)	(LE/ton)	(LE '000)	(LE '000)
			Meat				Milk		
1	1983/84								
2	1984/85								
3	1985/86								
4	1986/87								
5	1987/88								
6	1988/89								
7	1989/90								
8	1990/91	36.0	2,600	0 1/	93.6	8,100	300	1,336.500	1,093.500
9	1991/92	118.1	2,600	0	307.060	6,318	300	1,042.470	852.930
10	1992/93	100.3	2,600	0	260.780	5,589	300	922.185	754.515
11	1993/94	148.1	2,600	0	385.060	8,019	300	1,323.135	1,082.565
12	1994/95	183.2	2,600	0	476.320	9,477	300	1,563.705	1,279.395
13	1995/96	202.1	2,600	0	525.460	10,449	300	1,724.085	1,410.615
14	1996/97	225.7	2,600	0	586.820	12,312	300	2,031.480	1,621.120
15	1997/98	296.6	2,600	0	694.044	14,499	300	2,392.335	1,957.365
16	1998/99	296.6	2,600	0	694.044	14,499	300	2,392.335	1,957.365
17	1999/00	296.6	2,600	0	694.044	14,499	300	2,392.335	1,957.365
18	2000/01	296.6	2,600	0	694.044	14,499	300	2,392.335	1,957.365
			Chicken				Eggs		
						(dozen)	(LE/dozen)	(LE '000)	(LE '000)
1	1983/84								
2	1984/85								
3	1985/86								
4	1986/87								
5	1987/88								
6	1988/89								
7	1989/90								
8	1990/91					5,400,000	0.96	4,043.520	1,140.480
9	1991/92	891.0	650	0 1/	579.150	7,560,000	0.96	5,660.928	1,596.672
10	1992/93	923.4	650	0	600.210	8,280,000	0.96	6,200.064	1,748.736
11	1993/94	955.8	650	0	621.270	8,640,000	0.96	6,469.632	1,824.788
12	1994/95	988.2	650	0	642.330	9,180,000	0.96	6,873.984	1,938.816

13	1995/96	1,020.6	650	0	663.390	9,720,000	0.96	7,278.336	2,052.864
14	1996/97	1,053.0	650	0	684.450	10,800,000	0.96	8,087.040	2,280.960
15	1997/98	1,053.0	650	0	684.450	10,800,000	0.96	8,087.040	2,280.960
16	1998/99	1,053.0	650	0	684.450	10,800,000	0.96	8,087.040	2,280.960
17	1999/00	1,053.0	650	0	684.450	10,800,000	0.96	8,087.040	2,280.960
18	2000/01	1,053.0	650	0	684.450	10,800,000	0.96	8,087.040	2,280.960

1/: Costs are excluded, since they're by-products.

Table VI.A.4 Financial Net Income from Livestock (Unit: 18,000 Feddan-Unit Farm)

No.	Year	Meat Production (kg)	Meat Unit Price (LE/kg)	Meat Production Cost (LE)	Meat Net Income (LE)	Milk Production (kg)	Milk Unit Price (LE/kg)	Milk Production Cost (LE)	Milk Net Income (LE)
1	1983/84								
2	1984/85								
3	1985/86								
4	1986/87								
5	1987/88								
6	1988/89								
7	1989/90								
8	1990/91	40	2.3	0 [1/]	92.0	9,000	0.25	1,350.0	900.0
9	1991/92	131.2	2.3	0	301.8	7,020	0.25	1,053.0	702.0
10	1992/93	111.4	2.3	0	256.2	6,210	0.25	931.5	621.0
11	1993/94	164.6	2.3	0	378.6	8,910	0.25	1,336.5	891.0
12	1994/95	203.5	2.3	0	468.1	10,530	0.25	1,579.5	1,053.0
13	1995/96	224.5	2.3	0	516.4	11,610	0.25	1,741.5	1,161.0
14	1996/97	250.8	2.3	0	576.8	13,680	0.25	2,052.0	1,368.0
15	1997/98	296.6	2.3	0	682.2	16,110	0.25	2,416.5	1,611.0
16	1998/99	296.6	2.3	0	682.2	16,110	0.25	2,416.6	1,611.0
17	1999/00	296.6	2.3	0	682.2	16,110	0.25	2,416.6	1,611.0
18	2000/01	296.6	2.3	0	682.2	16,110	0.25	2,416.6	1,611.0

No.	Year	Chicken Production (kg)	Chicken Unit Price (LE/kg)	Chicken Production Cost (LE)	Chicken Net Income (LE)	Eggs (piece)	Eggs (LE/piece)	Eggs Production Cost (LE)	Eggs Net Income (LE)
1	1983/84								
2	1984/85								
3	1985/86								
4	1986/87								
5	1987/88								
6	1988/89								
7	1989/90								
8	1990/91					72,000	0.07	4,032.0	1,008.0
9	1991/92	990.0	0.6	0	594.0	100,800	0.07	5,644.8	1,411.2
10	1992/93	1,026.0	0.6	0	615.6	108,000	0.07	6,048.0	1,512.0
11	1993/94	1,062.0	0.6	0	637.2	115,200	0.07	6,451.2	1,612.8
12	1994/95	1,098.0	0.6	0	658.8	122,400	0.07	6,854.4	1,713.6

13	1995/96	1,134.0	0.6	0	680.4	129,600	0.07	7,257.6	1,814.4
14	1996/97	1,170.0	0.6	0	702.0	144,000	0.07	8,064.0	2,016.0
15	1997/98	1,170.0	0.6	0	702.0	144,000	0.07	8,064.0	2,016.0
16	1998/99	1,170.0	0.6	0	702.0	144,000	0.07	8,064.0	2,016.0
17	1999/00	1,170.0	0.6	0	702.0	144,000	0.07	8,064.0	2,016.0
18	2000/01	1,170.0	0.6	0	702.0	144,000	0.07	8,064.0	2,016.0

1/: Costs are excluded, since they're by-products.

Table VI.A.5 Economic and Financial Costs

(Unit: LE '000)

	Items	Foreign Currency	Local Currency		Total Investment Cost	
			Financial Value	Economic Value	Financial Value	Economic Value
1.	Preparatory Work	-	5	5	5	5
2.	Main Pump Station	2,434	28	67	2,462	2,501
3.	Main & Secondary P.L.	11,887	267	643	12,154	12,530
4.	Intake Works	26	24	56	50	82
5.	Booster Pump Station	5,946	121	283	6,067	6,229
6.	Farm Pond	-	500	750	500	750
7.	Wells	1,697	70	103	1,767	1,800
8.	Reclamation	-	125	125	125	125
9.	On-Farm Facilities	10,087	154	231	10,241	10,318
10.	Roads	-	926	924	926	924
11.	Supporting Services	556	242	240	798	796
	Sub-total	32,633	2,462	3,427	35,095	36,060
12.	Project Facilities	-	70	162	70	162
13.	Administration Cost	-	288	432	288	432
14.	Consulting Services	3,052	118	271	3,170	3,323
	Sub-total	35,685	2,938	4,292	38,623	39,977
15.	Physical Contingency	3,569	588	858	4,157	4,427
	Total	39,254	3,526	5,150	42,780	44,404

Table VI-A-6 Benefit-Cost Ratio under the Discounted Cash Flow Method with 12% Discount Rate

(Unit: LE '000)

No.	Year	Capital	O&M Costs	Total Costs	Incremental Benefit	Present Worth Factor (12 %)	Present Worth	
							Investment Costs	Net Incremental Benefits
1	1983/84	1,152		1,152		0.8929	1,029	368
2	1984/85	296		296		0.7972	236	1,074
3	1985/86	15,815		15,815		0.7118	11,257	1,809
4	1986/87	13,176		13,176		0.6355	8,373	2,145
5	1987/88	9,269	338	9,607	648	0.5674	5,451	2,374
6	1988/89	4,696	677	5,373	2,119	0.5066	2,722	2,544
7	1989/90		1,015	1,015	3,999	0.4523	459	2,705
8	1990/91		1,015	1,015	5,312	0.4039	410	2,689
9	1991/92		1,015	1,015	6,584	0.3606	366	2,591
10	1992/93		1,015	1,015	7,901	0.3220	327	2,498
11	1993/94		1,015	1,015	9,410	0.2875	292	2,314
12	1994/95		1,015	1,015	10,477	0.2567	261	2,096
13	1995/96		1,015	1,015	11,308	0.2292	233	1,866
14	1996/97		1,015	1,015	12,209	0.2046	208	1,666
15	1997/98		1,015	1,015	12,669	0.1827	185	1,488
16	1998/99		1,015	1,015	12,813	0.1631	166	1,328
↓	↓		↓	↓	↓	↓	↓	↓
50	2032/33		1,015	1,015	12,813	0.0035	4	44
	Total	44,404	45,675	90,079	531,091		33,322	42,249

$$\text{Benefit-Cost Ratio} = \frac{42,249}{33,322} = 1.27$$

Table VI-A-7 Summary of Economic Benefit and Cost of the Project (EIRR)

- In the Case of the Reduced price of Plant Products -

(Unit: LE '000)

No.	Year	Benefit	Investment Costs	O&M Costs	Total Costs	Net Flow (Incremental Costs)	Present Worth Discounted at 10%	Present Worth Discounted at 12%
1	1983/84		1,152		1,152	-1,152	-1,047	-1,029
2	1984/85		296		296	-296	-245	-236
3	1985/86		15,815		15,815	-15,815	-11,882	-11,257
4	1986/87		13,176		13,176	-13,176	-8,999	-8,374
5	1987/88	370	9,269	338	9,607	-9,237	-5,735	-5,241
6	1988/89	1,544	4,696	677	5,373	-3,829	-2,161	-1,940
7	1989/90	3,095		1,015	1,015	2,080	1,067	941
8	1990/91	4,326		1,015	1,015	3,311	1,545	1,337
9	1991/92	5,280		1,015	1,015	4,265	1,809	1,538
10	1992/93	6,176		1,015	1,015	5,161	1,990	1,662
11	1993/94	7,222		1,015	1,015	6,207	2,176	1,784
12	1994/95	8,012		1,015	1,015	6,997	2,229	1,796
13	1995/96	8,725		1,015	1,015	7,710	2,233	1,767
14	1996/97	9,322		1,015	1,015	8,307	2,187	1,700
15	1997/98	9,649		1,015	1,015	8,634	2,067	1,577
16	1998/99	10,031		1,015	1,015	9,016	1,962	1,471
↓	↓	↓		↓	↓	↓	↓	↓
50	2032/33	10,031		1,015	1,015	9,016	77	31
	Total	414,806	44,404	45,675	90,259	324,547	8,049	-507

$$EIRR = 10 + 2\left(\frac{8,049}{8,049 + 507}\right) = 11.9\%$$

Table VI-A-8 Summary of Benefit and Cost of the Project (EIRR)

- In the Case including Construction Costs of Tolonbaht Canal -

(Unit: LE '000)

No.	Year	Benefit	Investment Costs	O&M Costs	Total Costs	Net Flow (Incremental Costs)	Present Worth Discounted at 12%	Present Worth Discounted at 14%
1	1983/84		5,733		5,733	-5,733	-5,119	-5,029
2	1984/85		296		296	-296	-236	-228
3	1985/86		15,815		15,815	-15,815	-11,257	-10,675
4	1986/87		13,176		13,176	-13,176	-8,374	-7,801
5	1987/88	648	9,269	338	9,607	-8,959	-5,084	-4,653
6	1988/89	2,119	4,696	677	5,373	-3,254	-1,649	-1,482
7	1989/90	3,999		1,015	1,015	2,984	1,349	1,193
8	1990/91	5,312		1,015	1,015	4,297	1,735	1,506
9	1991/92	6,584		1,015	1,015	5,569	2,008	1,713
10	1992/93	7,901		1,015	1,015	6,886	2,217	1,857
11	1993/94	9,410		1,015	1,015	8,395	2,413	1,986
12	1994/95	10,477		1,015	1,015	9,462	2,429	1,964
13	1995/96	11,308		1,015	1,015	10,293	2,359	1,874
14	1996/97	12,209		1,015	1,015	11,194	2,291	1,788
15	1997/98	12,669		1,015	1,015	11,654	2,129	1,633
16	1998/99	12,813		1,015	1,015	11,798	1,925	1,450
↓	↓	↓		↓	↓	↓	↓	↓
50	2032/33	12,813		1,015	1,015	11,798	41	17
	Total	531,091	48,985	45,675	94,660	436,431	4,835	-2,669

$$EIRR = 12 + 2\left(\frac{4,835}{4,835 + 2,669}\right) = 13.3\%$$

Table VI-A-9 Summary of Economic Benefits and Cost of the Project (EIRR)

- In the Case of the Reduced Period of Construction -

(Unit: LE '000)

No.	Year	Benefits	Investment Costs	O&M Costs	Total Costs	Net Flow (Incremental Costs)	Present Worth Discounted at 14%	Present Worth Discounted at 16%
1	1983/84		1,152		1,152	-1,152	-1,015	-997
2	1984/85		296		296	-296	-228	-220
3	1985/86		28,991		28,991	-28,991	-19,568	-18,573
4	1986/87		13,965		13,965	-13,965	-8,268	-7,713
5	1987/88	1,943		1,015	1,015	928	482	442
6	1988/89	4,415		1,015	1,015	3,400	1,549	1,396
7	1989/90	5,639		1,015	1,015	4,624	1,848	1,636
8	1990/91	5,883		1,015	1,015	4,868	1,707	1,485
9	1991/92	8,231		1,015	1,015	7,216	2,219	1,897
10	1992/93	9,590		1,015	1,015	8,575	2,313	1,944
11	1993/94	10,409		1,015	1,015	9,394	2,223	1,836
12	1994/95	11,434		1,015	1,015	10,419	2,163	1,755
13	1995/96	11,937		1,015	1,015	10,922	1,989	1,586
14	1996/97	12,813		1,015	1,015	11,798	1,884	1,477
15	1997/98	12,813		1,015	1,015	11,798	1,652	1,273
16	1998/99	12,813		1,015	1,015	11,798	1,450	1,098
↓	↓	↓		↓	↓	↓	↓	↓
50	2032/33	12,813		1,015	1,015	11,798	17	7
	Total	543,562	44,404	46,690	91,094	452,468	2,634	-2,861

$$EIRR = 14 + 2 \times \left(\frac{2,634}{2,634 + 2,861}\right) = 15.0\%$$