

DRILL LOGS

Note No : U85-1 Location : Upstream dam axis, Left abutment

Ground height : EL. 329.23m G.W.L : EL. 307.83m


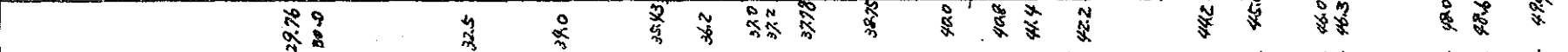
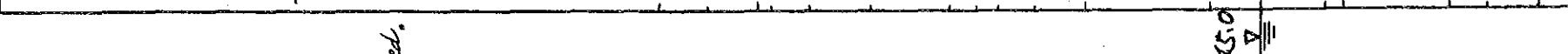

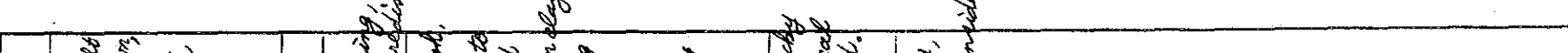
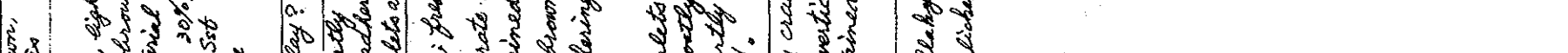
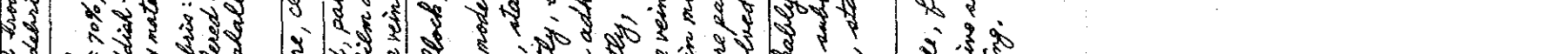
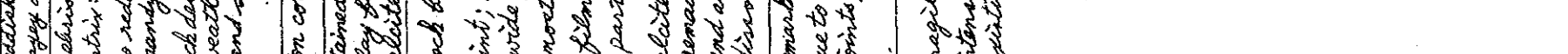
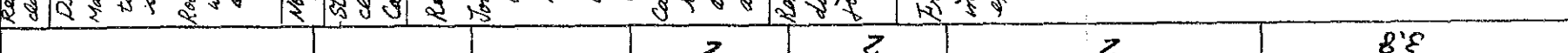

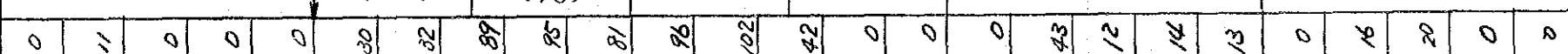
Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	
10m (3,4,5) N=14	18	D	Partly weathered	D	A	C	0	Clayey material with weathered and weak fragments
20m (9,9,10) N=29	29	F	Completely weathered	D	A	C	0	Crushed by finger, craky, intercalating clay to sand
30m (9,30,63) N=143	29	F	Partly weathered	D	A	C	20	Light brown, weathered into core of rock blocks, slightly softened, clay film adheres to joints.
26	26	F	Highly weathered	C	II	C	59	Calcite veinlets are dissolved. Bedding; 0-10°
27	27	F	Highly weathered	C	II	C	66	Mixture of clayey material and fragile rock blocks
8.7	8.7	F	Highly weathered	D	A	C	27	Sandstone; craky, stained along joints, rather hard
10.8	10.8	F	Moderately weathered	B	II	C	50	Shale; flaky, fragile, fossil
11.5	11.5	F	Moderately weathered	B	II	C	24	Bedding; 10°-20°
12.3	12.3	F	Moderately weathered	B	II	C	46	Remarkably flaky and clayey
12.5	12.5	F	Moderately weathered	B	II	C	10	Sandstone; somewhat craky, Rock blocks are fossil. Some joints are stained. Calcite veinlets are dissolved almost.
13.9	13.9	F	Moderately weathered	B	II	C	42	Shale; flaky and fragile
14.5	14.5	F	Moderately weathered	B	II	C	56	Bedding; 20°-30°
15.0	15.0	F	Moderately weathered	B	II	C	35	
15.3	15.3	F	Moderately weathered	B	II	C	26	
16.7	16.7	F	Moderately weathered	B	II	C	10	
17.3	17.3	F	Moderately weathered	B	II	C	10	
18.2	18.2	F	Moderately weathered	B	II	C	10	
19.6	19.6	F	Moderately weathered	B	II	C	10	
20.2	20.2	F	Moderately weathered	B	II	C	10	
21.4	21.4	F	Moderately weathered	B	II	C	10	
21.8	21.8	F	Moderately weathered	B	II	C	10	
22.2	22.2	F	Moderately weathered	B	II	C	10	
23.5	23.5	F	Moderately weathered	B	II	C	10	
24.9	24.9	F	Moderately weathered	B	II	C	10	

Depth (m)	Column section	Rock grade	Weathered zone	Foundation classification				Permeability		Description
				Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
25.6	25.6	F		D	IV	d	11			Flaky and clayey, slickenside is developed.
26.0	26.0						16			
26.4	26.4						37			Somewhat craky, Every joint is fossil.
26.7-7	26.7-7						11			Calcite veinlets are fossil.
28.4	28.4	D	Rock	B	II	a	63	5.6 Lu	5	Bedding; 20°-30°
30.0	30.0						0			Shale; flaky and clayey
30.2	30.2						0			Sandstone; craky and brittle,
31.0	31.0	F		C	IV	d	13	6.4 Lu	5	
31.4	31.4						33			Siltstone; flaky and clayey
31.6	31.6						0			Sandstone; craky and brittle
31.9-32	31.9-32						15			Sandstone dominant, rather hard, considerably craky,
32.8	32.8	E		B	II	d	67	4.1 Lu	5	Shale and siltstone; almost stiff, partly flaky,
33.0	33.0						10			Slickenside is developed.
33.6	33.6						28			Bedding; 10°-20°
33.8-9	33.8-9						40			Shale / argillaceous sandstone alternation; somewhat soft,
34.5	34.5						24			slickenside dominant, clay film adhesion partly, flaky and clayey partly
34.8-42	34.8-42						45			Sandstone; considerably craky, somewhat brittle
34.9-5	34.9-5						15			Mixture of brittle blocks of sandstone and flaky material of shale
35.7	35.7						0			
37.05	37.05						0			
37.2	37.2						35			
37.4-5	37.4-5						0			
37.7-8	37.7-8						0			
38.4-38.6	38.4-38.6						0			
38.3-35	38.3-35						0			
40.35	40.35						0			
41.85	41.85						0			
44.0	44.0						0			
44.5	44.5						0			
44.8	44.8						0			
45.4	45.4						0			
45.5-6	45.5-6						0			
46.9-45	46.9-45						0			
47.8-48	47.8-48						0			
48.1	48.1						0			
48.5	48.5						0			
48.7	48.7						0			
49.5	49.5						0			
52.2	52.2						0			

Hole No : U85-2 Location : Upstream dam axis, Left abutment

Ground height : EL. 289.3/m G.W.L : EL. 244.3/m

Depth (m)	Column section	Foundation classification						Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
0.8							0			Reddish brown, clayey debris
1.0							11			Debris
1.2							0			Matrix: 70%, light to reddish brown, sandy material
1.4							0			Rock debris: 30%, weathered Sst and shale
1.6							0			
1.8							0			
2.0							0			
4.5		F	CU	D	D		0			Non core, clay?
5.2										
5.4-5.85										
5.85-5.95		E	MT	B	II	C-d	30			Stained, partly clay film adhering
6.1							32			Calcite veinlets and dissolved.
6.35										Rock block; fresh
6.55										Joint; moderate to wide, stained
12.2		D	MT ? SW	B	I-II		89			mostly, brown clay film adhering partly,
							95			Calcite veinlets remain mostly and are partly dissolved.
							81			
							96			
							102			
							42			Remarkably crumbly due to subvertical joints, stained.
							0			
14.0		E	MT	B	II-III	C				
14.2							0			
							0			Fragile, flaky, intensive slickenside existing.
							0			
							43			
							12			
							14			
19.38							13			
19.48							0			
							16			
							20			
							0			
							23			
							3.8			
22.0							0			
22.32							16			
							20			
							0			
							23			
							3.8			
24.38							0			
24.63							0			

Depth (m)	Column section	Foundation classification						Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
29.76		H	F	B. C. D	A. P. A	a. d	19	15	3.57	
30.0							24	26	13	
32.5							19	22	9.1	
34.0							15	0	10	
35.43							0	23	10	
36.2							16	0	4.2	
37.0							35	20	4.6	
37.2							17	0	4.6	
37.8							20	19	12	
38.35							14	0	4.6	
40.0							19	0	4.6	
40.8							0	0	4.6	
41.4							0	0	4.6	
42.2							0	0	4.6	
44.2							0	0	4.6	
45.0							0	0	4.6	
46.0							0	0	4.6	
46.3							0	0	4.6	
48.0							0	0	4.6	
48.6							0	0	4.6	
49.9							0	0	4.6	

Hole No: U85-3 Location: Upstream dam axis, Left abutment

Ground height: EL. 289.45m G.W.L: EL. 257.15m

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Breaking point (kg/cm ²) Lugeon value	
28.2		F	CW	C D	0		Mixture of weathered soft blocks and clay
28.5		E	HW	C	11		
28.9		D	(HW) B	II	58	(1100 Lu)	
3.4		F	C	D	32		
3.8					0		
5.1							
25.5		E	HW	C	0	(480 Lu)	Brown, weathered into rock blocks, parted from hair cracks, mostly less than pebble size, partly comprising fresh blocks of cobble size, Every joint is stained. Most joints intercalate clay film.
25.9		D	(HW) B	III	12		
26.8		E	HW	C	25		
28.0					28		
28.3		D	(HW) B	II	10		
28.6		E	HW	C	45	29 Lu	Calcrete veinlets are dissolved mostly. Remarkably deteriorated along bedding (30°), flaky, slickenside intensive
28.7					31		
28.8					85		
28.9		C	F	I	52	(610 Lu)	Bedding; 30° Fresh, moderate hard, Joints; sub-vertical to 60° dominant, dark gray silty film adhering partly, striation existing partly
29.0					76		
29.1					32		
29.2					56		
29.3					65		
29.4					88		
29.5					0	28 Lu	Bedding; 20-30°, Intensive slickenside along bedding, Shale; flaky to clayey, Sandstone; cracky
29.6					0		
29.7					0		
29.8					10		
29.9		E					
30.0							

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Breaking point (kg/cm ²) Lugeon value	
28.0-28.2		E		C	10		Moderate hard, Cracky and brittle due to numerous sub-vertical cracks, Mixture of rock blocks of pebble size (50-70%) and small fragments (30-50%)
28.2-28.5					11	(180 Lu)	
28.5-28.9					15		
28.9-29.0					0		
29.0-29.1					0		
29.1-29.2					36		
29.2-29.3					27	(71000 Lu)	Shale is flaky to clayey almost. Intensive slickenside is developed along bedding. Bedding; 30°
29.3-29.4					0		
29.4-29.5					34		
29.5-29.6					54		
29.6-29.7					22		
29.7-29.8					22		
29.8-29.9					47	30 Lu	Moderate hard, Cracky and brittle due to sub-vertical joints and numerous calcite veinlets
29.9-30.0					43		
30.0-30.1					19		
30.1-30.2							
30.2-30.3					15		
30.3-30.4					28	2.5 Lu	Shale and alternating beds of shale and argillaceous sandstone are flaky to clayey remarkably due to disturbance.
30.4-30.5					17		
30.5-30.6					0		
30.6-30.7					32	3.3 Lu	Sandstone is moderate hard, but cracky and brittle.
30.7-30.8					33		
30.8-30.9					0		
30.9-31.0					19		
31.0-31.1							
31.1-31.2					80		not deteriorated

Hole No : U85-4 Location : right abutment Upstream dam axis,

Ground height : EL. 276.16m G.W.L : EL. 246.66m

Depth (m)	Foundation classification				Permeability		Description
	Rock grade	Weathered zone	Hardness	Joint interval Joint condition	RQD (%)	Lugeon value Breaking point (kg/cm ²)	
27.35	F	CR	C	TD	0		Mixture of weathered rock blocks of sandstone and decomposed sandy to clayey material, containing plants root.
27.42			D	A	0		
28.0					35	(85)	See foot note (1) Alternating beds of shale and very fine sandstone, dip 50°, cracky, brown clay adhering
28.5			C	TD	14		
29.0			C	TD	14		
29.5					0		Easily parted from bedding, intensive slickenside existing partly
30.0			C	TD	0		
30.5			C	TD	26	(52)	5cm thick gray clay at boundary
31.0			C	TD	15		Sandstone; jointed in subvertical direction, stained shale, mudstone; fragile, clay layer and slickenside existing
31.5			B	TD	0		Bedding: 5°-10° Major part is fleaky to clayey. Slickenside is developed.
32.0			C	TD	0		Bedding: 5° Major part is stiff but shows slickenside in bedding.
32.5			C	TD	22		Clay layers of 5 to 10cm thick are intercalated along bedding.
33.0			C	TD	50		Rock blocks; fresh Every joint is stained.
33.5			C	TD	36		Joint; fresh, dark gray silty film adhering partly, pyritized
34.0			C	TD	35		Sit; undisturbed shale, mostly stiff, partly deteriorated into clay, slickenside existing
34.5			C	TD	40		
35.0			C	TD	47		

(1) 37-38.5m; gray clay, including weathered sandstone of granule to small pebble size and fresh shale fragments. The sandstone blocks are subrounded.
Dip of clay layer is 40°.

Depth (m)	Foundation classification				Permeability		Description
	Rock grade	Weathered zone	Hardness	Joint interval Joint condition	RQD (%)	Lugeon value Breaking point (kg/cm ²)	
38.5	E	F	B.C	TD	0		
39.0			B.C	TD	60		
39.5			B.C	TD	60		
40.0			B.C	TD	20		
40.5			B.C	TD	0		
41.0			B.C	TD	30		
41.5			B.C	TD	60		
42.0			B.C	TD	40		
42.5			B.C	TD	10		
43.0			B.C	TD	75		
43.5			B.C	TD	0		
44.0			B.C	TD	15		
44.5			B.C	TD	30		
45.0			B.C	TD	70		
45.5			B.C	TD	50		
46.0			B.C	TD	60		
46.5			B.C	TD	50		
47.0			B.C	TD	80		
47.5			B.C	TD	95		
48.0			B.C	TD	100		
48.5			B.C	TD	70		
49.0			B.C	TD	80		
49.5			B.C	TD	30		
50.0			B.C	TD	30		
50.5			B.C	TD	35		

Hole No : *U85-5* Location : *Upstream dam axis, right abutment*

Ground height : *EL. 329.61* GWL : *EL. 290.36*

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	
2.8								Clayey debris containing weathered fragments and plant-roots
2.0		F	CD	D	IV	d		Decomposed into sandy material with remarkably fragile blocks
2.5							12	
5.0		E	HT	C, D	II, IV	c	46	Rock blocks; light brown, 235-5.0; partly fragile and crumbled by fingers.
							18	5.0-8.9: soft mostly joints; stained
8.3				C	IV, III, II	c	21	
							54	
							32	
9.3							55	Sandstone; light grey partly tinged with light brown
9.8		E	HT, MN	B, C	II, IV	c	62	Joints; stained slightly
13.1							75	Bedding; 10° slickenside and clay film in mudstone and shale layers
14.1		D	SW	B	I, II	b	40	
							60	
							90	
16.57		F	MT	C	IV, III, II	d	30	Alternating beds of shale and sandstone, shale dominant?
17.0							20	
17.83							30	Shale; grayish black, almost fragile and flaky
							0	
							0	
							0	
20.2		F	F	C	IV, III, II	d	10	Sandstone; moderately hard, craky
							45	Mixture of slightly weathered parts and moderately weathered parts
							50	
							20	
							10	

Depth (m)	Column section	Rock grade	Weathered zone	Foundation classification				Permeability		Description
				Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
29.65		E	MT	B, C	II, III	c	20	25	25	
							30			
							20			
							10			
							0			
							0			
33.0		D	SW	B	III	b	13	3	25	
							30			
							97			Sandstone intercalating shale layers
							70			
							80		4.4	Sandstone; fresh, moderately hard to hard, crackly.
							55			
							80			
							15			Shale; fragile and flaky mostly
39.25							45			
40.40							0			
40.83							0			
44.50							0			
							0			
							0			
							0			
47.42							65		4.5	
47.21							10			
48.0							0			
48.7							0			
49.0							0			
52.0							0			

Hole No : D85-1 Location : Downstream dam axis, left abutment

Ground height : EL. 328.54m G.W.L : EL. 285.44m

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
				Hardness	Joint interval	Joint condition		
10m (2,4,8) N=18								Colluvial deposits; clay containing weathered and fragile debris, pebbles to granule size, reddish brown
20m (3,9,10) N=29								Light brown, decomposed, fragile
30m (9,10,15) N=38								Light brown, Shale is deteriorated along bedding (20°), flaky and clayey. Sandstone is cracky and weathered into blocks. Joints are stained and intercalate brown clay.
36		F	CW	D	D			
46		E	HW	C				
50-55								
65								
70		F	(CW)	D				
79		E						
90								
100		F						
107.5								
110.5								
118-122								
121-124								
122-123								
131-135		D						
133								
143-148								
143.5								
156		E						
162								
166								
218		C	SW	B				
225								
232		F						
235								
237								
243.5								

Bedding; 10°
Mixture of fragile parts and flaky to clayey parts, slickenside intensive
Sandstone with numerous laminae of shale. Bedding; 5°-10°, easily parted from bedding

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
				Hardness	Joint interval	Joint condition		
26.2		E	MT	C				intensive slickenside at bedding, stained mostly
26.9								
30.5								
30.6								
33.0								
34.5								
34.5								
34.7								
34.9								
38.2-38		C	SW	B				Sandstone; Most joints are fresh. Some joints are stained and intercalate clay film. Sub-vertical joints with calcite veinlet are dominant. Shale; bedding 5°-10°, fresh, More than half part is clayey to flaky. Remaining part is undisturbed but fragile.
37.85								
38.9		F	(F)	D				
39.6								
39.8								
40.3								
40.9-41								
42.95		D	MT	B				Sandstone; Most joints are stained and partly intercalate brown clay. Calcite veinlets are dissolved almost. Shale; bedding 5°; fresh, mostly clayey to flaky, slickenside intensive
43.6		F	(F)	D				
44.5-2		C	(SW)	B				
45.5								
45.8		F	(F)	C.D				
470-47		E	MT	B				
483.5-48								
52.0								

Hole No : *D85-2* Location : *Downstream dam axis, Left abutment*

Ground height : *EL. 292.60m* G.W.L : *EL. 264.5 m*

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	
0.55	X						0	<i>Top soil, brown clay, including plant roots and small fragments of colluvial deposits.</i>
10m (2, 4, 6) N=15	0.0						0	<i>brown clay with fragile fragments of sst and shale.</i>
20m (3.5, 8) N=20	0.0						0	<i>Mixture of clayey material and weathered rock debris, clayey material dominant.</i>
30m (4.5, 8) N=20	0.0						0	<i>See footnote (1)</i>
28-32		F	CTD	C	IV	d	0	<i>Core recovery: 80-85%, Brown, weathered into rock blocks. Every joints are stained. Clay film, brown, adheres to some joints.</i>
30-33							0	<i>Core recovery: 70%, Grey, partly light brown along joints. Rock blocks are fresh mostly. Every joints are stained. Clay film adheres to some joints.</i>
37-41							13	<i>Core recovery: 85%, Grey partly tinged with light brown, Rock blocks are fresh mostly. Most joints are fresh. Some joints are stained brown to dark brown. Brown clay film adheres partly. Calcite veinlets are dissolved partly.</i>
46-48							23	<i>Core recovery: 90%</i>
45-23							13	
240							23	

- (1) *Sliding surface possibly; brown clay including shale and sst fragments, 0.5-1cm, subrounded, glossy surface.*
- (2) *Sliding surface possibly; brown clay, extremely cohesive, including subrounded fragments of sst and fragile fragments of shale.*

Depth (m)	Column section	Rock grade	Weathered zone	Foundation classification				Permeability		Description
				Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
28.1		D	F	B	II	a	0	28	39	<i>Almost fresh, partly stained slightly, 14R to dark gray clay film adheres in subvertical joints.</i>
28.3							0			
30.0		F		D	V	d	0			
31.5		E		B	IV	d	18			
31.75							19			
33.4							0			
35.0		F		C	V	d	12			
35.48							0			
37.3							35	11		
38.52		E		B	I	d	48			
38.74							44			
39.52							0			
41.32							42			
42.85		F		D	V	d	0			
43.85							0			
45.0							10			
46.5							0			
47.0							0			
48.0							0			
49.0							0			
50.0							0			

Hole No : D85-3 Location : Downstream dam axis, left abutment

Ground height : EL. 265.6/m G.W.L : EL. 248.4/m

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Classifi. criteria	RQD (%)	Lugeon value	Breaking point (kg/cm ²)
10	X					0		Top soil, brown clay containing plants, roots and rock debris
10m (1,2,3) N=8						0		Mixture of brown clay and weathered rock debris (sst, pebbles size, soft)
20m (1,1,2) N=5		F	CT	C	A, D	0		
30m (6,7,8) N=24				D		11		Brown clay with rounded rock fragments (sst, gravel), slickenside surface
40				D	A	0		Bedding: 10°-20°
50				D	A	0		Sst: weathered, soft, shale: fragile to flaky, slickenside existing
60-65				C	III	11		Every joint is stained
70-75				C	III	0		32-42: clayey to fragile due to disturbance
80-85				C	III	43		Tinged with light brown, Every joint is stained
90-95				C	III	44		Bedding: 20°-30°
100-105				C	III	35		Joint: mostly fresh, partly stained along bedding plane and sub-vertical joint
110-115				C	III	64		Sst: fresh
120-125				C	III	71		Shale and Mud: mostly stiff but slickenside existing in bedding
130-135				C	III	30		32-45: flaky to clayey
140-145				C	III	94		to clayey
150-155				C	III	60		Bedding: 30°
160-165				C	III	74		Fresh, moderate hard
170-175				C	III	100		
180-185				C	III	90		Flaky to clayey
190-195				C	III	11		Mudstone (alternating beds of very fine sandstone, mudstone and shale)
200-205				C	III	56		stiff but intensive slickenside along bedding (30°)
210-215				C	III	82		Moderate hard, calcite veinlets in subvertical joints
220-225				C	III	72		
230-235				C	III	80		
240-245				C	III	100		

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Classifi. criteria	RQD (%)	Lugeon value	Breaking point (kg/cm ²)
25-30				C	A, D	32		Bedding: 20°
30-35				C	A, D	32		Mixture of moderate hard sandstone and fragile shale
35-40				C	A, D	29		and mudstone, sst: moderate to closely jointed,
40-45				C	A, D	43		subvertical joints
45-50				C	A, D	78		developing, calcite veinlets in sub-vertical joints
50-55				C	A, D	45		Shale and Mud: mostly flaky to clayey, intensive slickenside at 25:25-25:35
55-60				C	A, D	90		
60-65				C	A, D	33		
65-70				C	A, D	55		
70-75				C	A, D	10		
75-80				C	A, D	0		
80-85				C	A, D	42		
85-90				C	A, D	0		
90-95				C	A, D	13		
95-100				C	A, D	25		
100-105				C	A, D	45		
105-110				C	A, D	20		
110-115				C	A, D	0		
115-120				C	A, D	40		
120-125				C	A, D	0		
125-130				C	A, D	0		
130-135				C	A, D	0		
135-140				C	A, D	0		
140-145				C	A, D	10		
145-150				C	A, D	25		

Ground height : EL. 287.56m G.W.L : EL. 267.46m

201

- B-108 -

Ground height : EL. 328.78m G.W.L : EL. 283.28m

Since, core recovery in a section from 30 to 45m in depth is around 70% and pieces of sample below the depth of 30m are put in wrong order, classification on layers below the depth of 30m is not sure.

- B-109 -

Hole No : D85-6 Location : Left bank saddle

Ground height : EL. 330.75m GWL : EL. 303.80m

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	
0.3							0-0.3; black soil
1.3							0.3-1.3; reddish brown, residual soil
4.4		F	CM	D	IV	d	Excessively soft blocks with sandy to clayey material
6.2		E	HT	C	III		Light brown, soft blocks
6.9							Light brown, soft and fragile, easily parted from bedding (5°-10°), stained, clay film adhering
7.1							
7.4							
7.6							
8.5							
10.0							
10.2							
11.3							
15.1		E, D	MT, C	C, III	II, III	d	Rock blocks; gray, tinged with brown, joints; stained, clay film adhering, calcite veinlets are dissolved.
19.1							
21.1							
21.4							
21.5							
21.7							
21.9							
22.2							
22.5							
22.7							
24.1-2							
24.5-6							
25.0							
26.1							
26.5-7							
26.8-9							
27.35							
27.75							
28.75							
30.0		C		B, III	II, III	a	Shale is undisturbed but fragile and parted from bedding easily.

Hole No : D85-7 Location : 500m downstream of left bank

Ground height : EL. 280m GWL : EL. 253.7m

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	
1.0							
1.5		F	CM	D	IV	d	
3.4		E		B, C	II, III	c	
4.6		F		C	IV	d	
6.9		D	HT	B	I, II	c	
12.0		F		C	II, IV	c	
14.5		E		B, C	II, IV	d	
14.9		D	MT	B	II	c	
14.9		E		B	II, IV	d	
19.1		D		B	I, II	c	
23.0		C	F	B	I, II, IV	a	
24.3		E		B, C	II, IV	a, d	
28.0		C		B	II, IV	a	

Hole No : S85-1 Location : No.1 saddle

Ground height : EL. 317.00 m G.W.L : EL. 310.85 m

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	
0.5	X							Top soil, dark grey
2.3								Silty clay, calcareous, light grey tinged with
2.85								2.0m
3.75								4.0m
								6.0m
								8.0m
9.25								10.0m
13.1								
13.9								
14.6								
16.0								
17.6								
20.0								

N-value
measured, estimated

(2, 4, 6) , 15 1.0m

(2, 2, 5) , 11 2.0m

(2, 3, 4) , 11 3.0m

(4, 8, 11) , 29 5.0m

(3, 5, 9) , 21 7.0m

(10, 30, 20) , 75 9.0m

(3, 3, 5) , 12 11.0m

(6, 13, 19) , 18 13.0m

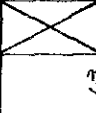
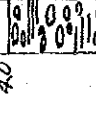

(30, 50) , >120 15.0m

(50) , >150 17.0m

Highly shattered, flaky shale

Hole No : S85-2 Location : No. 2 saddle

Ground height : EL. 317.91 G.W.L : EL. 307.11

Depth (m)	Column section	Geological name	Color	Penetration resistance		Coefficient of permeability (cm/sec)	Description
				Measured value	Estimated value		
13		Top soil	Brown	10m N=7 (2, 12, 3)	7		Plant-roots bearing
20		Sandy clay	Brown	20m N=9 (2, 3, 4) 30m N=8 (2, 3, 4)	10 9	20m 4.5×10^{-4}	Carbonaceous matter bearing, 3.5-4.0; tinged with white
40		Clayey gravel	Reddish brown	50m N=27 (4, 8, 15)	12	40m $< 1 \times 10^{-7}$	Rounded and weathered gravels of pebbles size, Sandstone and quartz
60		Sandy gravel	Brown	70m N=24 (5, 11, 8)	15	60m 2.6×10^{-5}	Mature; silty to coarse sand, angular, felsic fragments rich, carbonaceous matter
80		Gravelly fine sand	Light brown	90m N=17 (4, 6, 7)	12	80m 5.4×10^{-6}	bearing, intercalated clay layers
100		Gravelly clay	Brown	110m N=35 (5, 9, 21) 130m N=40 (6, 12, 22)	15 18	100m 2.6×10^{-4}	Muddy fine sand with small pebbles
150		Silty clay	Blackish gray	150m N=10 (19, 20, 21) 170m N=27 (4, 9, 14)	57 12		
170		Clay	Blackish gray	180m N=18 (4, 5, 8) 210m N=23 (6, 8, 9)	21 25	200m 1.8×10^{-5}	Sandy clay with small pebbles
220		Clay	Blackish gray	230m N=22 (5, 9, 10) 250m N=16 (4, 5, 7)	25 18		

28.1	Clay	Blackish gray	27.0m N=25 (5, 7, 14)	30.0m 4.9×10^{-4}	31.5-31.6; fine to medium sand, muddy and lignitic
31.5 31.6	Clay	Dark gray			A joint with slickenside is in clay.
34.3 34.5 34.8	Lignite Lignite Lignite	Black			
37.9	Silty fine sand	Dark gray			
40.0	Sandstone	Blackish gray			Fresh, somewhat craky

Hole No : S85-3 Location : No.2 saddle

Ground height : EL. 308.34 G.W.L : EL. 290.09

Depth (m)	Column section	Geological name	Colour	Penetration resistance		Coefficient of permeability (cm/sec)	Description
				Measured value	Estimated value		
1.7			Brown	1.0m N=7 (1,3,4)	9	2.0m N=5 (1,3,2)	Mixture of white clay and crimson clay, volcanic ash origin?
3.3		Clay	White to crimson	3.0m N=8 (2,2,4)	9	4.0m N=3 (1,3,2)	
6.5			White to crimson	5.0m N=9 (2,4,3)	10	6.0m N=10 (2,4,3)	
7.0			Reddish brown	7.0m N=10 (6,1,21)	18	8.0m N=11 (6,1,21)	
8.0		Gravelly fine sand		8.0m N=12 (2,8,9)	12	9.0m N=13 (2,8,9)	
8.5				11.0m N=15 (16,17,18)	48	12.0m N=16 (16,17,18)	
9.0				13.0m N=17 (4,4,4)	12	14.0m N=18 (4,4,4)	
11.0				15.0m N=20 (12,15,17)	36	16.0m N=21 (12,15,17)	
12.0				18.0m N=23 (8,16,20)	39	19.0m N=24 (8,16,20)	
13.0				20.0m N=25 (17,17,20)	51	21.0m N=26 (17,17,20)	
15.2				22.0m N=28 (10,16,20)	54	23.0m N=29 (10,16,20)	
15.5				24.0m N=30 (9,9,12)	31	25.0m N=31 (9,9,12)	
16.0							
16.5							
18.1							
20.0							
21.0							
21.2							
21.9							
22.3							
22.5							
22.7							
23.0							
24.2							
25.0							

27.9	Clay	Black gray	27.0m N=36 (6,9,11)	30	28.0m N=37 (6,9,11)	30	29.0m N=38 (6,9,11)	30	30.0m N=39 (6,9,11)	30	31.0m N=40 (6,9,11)	30	32.0m N=41 (6,9,11)	30	33.0m N=42 (6,9,11)	30	34.0m N=43 (6,9,11)	30	35.0m N=44 (6,9,11)	30	36.0m N=45 (6,9,11)	30	37.0m N=46 (6,9,11)	30	38.0m N=47 (6,9,11)	30	39.0m N=48 (6,9,11)	30	40.0m N=49 (6,9,11)	30	41.0m N=50 (6,9,11)	30	42.0m N=51 (6,9,11)	30	43.0m N=52 (6,9,11)	30	44.0m N=53 (6,9,11)	30	45.0m N=54 (6,9,11)	30	46.0m N=55 (6,9,11)	30	47.0m N=56 (6,9,11)	30	48.0m N=57 (6,9,11)	30	49.0m N=58 (6,9,11)	30	50.0m N=59 (6,9,11)	30	51.0m N=60 (6,9,11)	30	52.0m N=61 (6,9,11)	30	53.0m N=62 (6,9,11)	30	54.0m N=63 (6,9,11)	30	55.0m N=64 (6,9,11)	30	56.0m N=65 (6,9,11)	30	57.0m N=66 (6,9,11)	30	58.0m N=67 (6,9,11)	30	59.0m N=68 (6,9,11)	30	60.0m N=69 (6,9,11)	30	61.0m N=70 (6,9,11)	30	62.0m N=71 (6,9,11)	30	63.0m N=72 (6,9,11)	30	64.0m N=73 (6,9,11)	30	65.0m N=74 (6,9,11)	30	66.0m N=75 (6,9,11)	30	67.0m N=76 (6,9,11)	30	68.0m N=77 (6,9,11)	30	69.0m N=78 (6,9,11)	30	70.0m N=79 (6,9,11)	30	71.0m N=80 (6,9,11)	30	72.0m N=81 (6,9,11)	30	73.0m N=82 (6,9,11)	30	74.0m N=83 (6,9,11)	30	75.0m N=84 (6,9,11)	30	76.0m N=85 (6,9,11)	30	77.0m N=86 (6,9,11)	30	78.0m N=87 (6,9,11)	30	79.0m N=88 (6,9,11)	30	80.0m N=89 (6,9,11)	30	81.0m N=90 (6,9,11)	30	82.0m N=91 (6,9,11)	30	83.0m N=92 (6,9,11)	30	84.0m N=93 (6,9,11)	30	85.0m N=94 (6,9,11)	30	86.0m N=95 (6,9,11)	30	87.0m N=96 (6,9,11)	30	88.0m N=97 (6,9,11)	30	89.0m N=98 (6,9,11)	30	90.0m N=99 (6,9,11)	30	91.0m N=100 (6,9,11)	30	92.0m N=101 (6,9,11)	30	93.0m N=102 (6,9,11)	30	94.0m N=103 (6,9,11)	30	95.0m N=104 (6,9,11)	30	96.0m N=105 (6,9,11)	30	97.0m N=106 (6,9,11)	30	98.0m N=107 (6,9,11)	30	99.0m N=108 (6,9,11)	30	100.0m N=109 (6,9,11)	30	101.0m N=110 (6,9,11)	30	102.0m N=111 (6,9,11)	30	103.0m N=112 (6,9,11)	30	104.0m N=113 (6,9,11)	30	105.0m N=114 (6,9,11)	30	106.0m N=115 (6,9,11)	30	107.0m N=116 (6,9,11)	30	108.0m N=117 (6,9,11)	30	109.0m N=118 (6,9,11)	30	110.0m N=119 (6,9,11)	30	111.0m N=120 (6,9,11)	30	112.0m N=121 (6,9,11)	30	113.0m N=122 (6,9,11)	30	114.0m N=123 (6,9,11)	30	115.0m N=124 (6,9,11)	30	116.0m N=125 (6,9,11)	30	117.0m N=126 (6,9,11)	30	118.0m N=127 (6,9,11)	30	119.0m N=128 (6,9,11)	30	120.0m N=129 (6,9,11)	30	121.0m N=130 (6,9,11)	30	122.0m N=131 (6,9,11)	30	123.0m N=132 (6,9,11)	30	124.0m N=133 (6,9,11)	30	125.0m N=134 (6,9,11)	30	126.0m N=135 (6,9,11)	30	127.0m N=136 (6,9,11)	30	128.0m N=137 (6,9,11)	30	129.0m N=138 (6,9,11)	30	130.0m N=139 (6,9,11)	30	131.0m N=140 (6,9,11)	30	132.0m N=141 (6,9,11)	30	133.0m N=142 (6,9,11)	30	134.0m N=143 (6,9,11)	30	135.0m N=144 (6,9,11)	30	136.0m N=145 (6,9,11)	30	137.0m N=146 (6,9,11)	30	138.0m N=147 (6,9,11)	30	139.0m N=148 (6,9,11)	30	140.0m N=149 (6,9,11)	30	141.0m N=150 (6,9,11)	30	142.0m N=151 (6,9,11)	30	143.0m N=152 (6,9,11)	30	144.0m N=153 (6,9,11)	30	145.0m N=154 (6,9,11)	30	146.0m N=155 (6,9,11)	30	147.0m N=156 (6,9,11)	30	148.0m N=157 (6,9,11)	30	149.0m N=158 (6,9,11)	30	150.0m N=159 (6,9,11)	30	151.0m N=160 (6,9,11)	30	152.0m N=161 (6,9,11)	30	153.0m N=162 (6,9,11)	30	154.0m N=163 (6,9,11)	30	155.0m N=164 (6,9,11)	30	156.0m N=165 (6,9,11)	30	157.0m N=166 (6,9,11)	30	158.0m N=167 (6,9,11)	30	159.0m N=168 (6,9,11)	30	160.0m N=169 (6,9,11)	30	161.0m N=170 (6,9,11)	30	162.0m N=171 (6,9,11)	30	163.0m N=172 (6,9,11)	30	164.0m N=173 (6,9,11)	30	165.0m N=174 (6,9,11)	30	166.0m N=175 (6,9,11)	30	167.0m N=176 (6,9,11)	30	168.0m N=177 (6,9,11)	30	169.0m N=178 (6,9,11)	30	170.0m N=179 (6,9,11)	30	171.0m N=180 (6,9,11)	30	172.0m N=181 (6,9,11)	30	173.0m N=182 (6,9,11)	30	174.0m N=183 (6,9,11)	30	175.0m N=184 (6,9,11)	30	176.0m N=185 (6,9,11)	30	177.0m N=186 (6,9,11)	30	178.0m N=187 (6,9,11)	30	179.0m N=188 (6,9,11)	30	180.0m N=189 (6,9,11)	30	181.0m N=190 (6,9,11)	30	182.0m N=191 (6,9,11)	30	183.0m N=192 (6,9,11)	30	184.0m N=193 (6,9,11)	30	185.0m N=194 (6,9,11)	30	186.0m N=195 (6,9,11)	30	187.0m N=196 (6,9,11)	30	188.0m N=197 (6,9,11)	30	189.0m N=198 (6,9,11)	30	190.0m N=199 (6,9,11)	30	191.0m N=200 (6,9,11)	30	192.0m N=201 (6,9,11)	30	193.0m N=202 (6,9,11)	30	194.0m N=203 (6,9,11)	30	195.0m N=204 (6,9,11)	30	196.0m N=205 (6,9,11)	30	197.0m N=206 (6,9,11)	30	198.0m N=207 (6,9,11)	30	199.0m N=208 (6,9,11)	30	200.0m N=209 (6,9,11)	30	201.0m N=210 (6,9,11)	30	202.0m N=211 (6,9,11)	30	203.0m N=212 (6,9,11)	30	204.0m N=213 (6,9,11)	30	205.0m N=214 (6,9,11)	30	206.0m N=215 (6,9,11)	30	207.0m N=216 (6,9,11)	30	208.0m N=217 (6,9,11)	30	209.0m N=218 (6,9,11)	30	210.0m N=219 (6,9,11)	30	211.0m N=220 (6,9,11)	30	212.0m N=221 (6,9,11)	30	213.0m N=222 (6,9,11)	30	214.0m N=223 (6,9,11)	30	215.0m N=224 (6,9,11)	30	216.0m N=225 (6,9,11)	30	217.0m N=226 (6,9,11)	30	218.0m N=227 (6,9,11)	30	219.0m N=228 (6,9,11)	30	220.0m N=229 (6,9,11)	30	221.0m N=230 (6,9,11)	30	222.0m N=231 (6,9,11)	30	223.0m N=232 (6,9,11)	30	224.0m N=233 (6,9,11)	30	225.0m N=234 (6,9,11)	30	226.0m N=235 (6,9,11)	30	227.0m N=236 (6,9,11)	30	228.0m N=237 (6,9,11)	30	229.0m N=238 (6,9,11)	30	230.0m N=239 (6,9,11)	30	231.0m N=240 (6,9,11)	30	232.0m N=241 (6,9,11)	30	233.0m N=242 (6,9,11)	30	234.0m N=243 (6,9,11)	30	235.0m N=244 (6,9,11)	30	236.0m N=245 (6,9,11)	30	237.0m N=246 (6,9,11)	30	238.0m N=247 (6,9,11)	30	239.0m N=248 (6,9,11)	30	240.0m N=249 (6,9,11)	30	241.0m N=250 (6,9,11)	30	242.0m N=251 (6,9,11)	30	243.0m N=252 (6,9,11)	30	244.0m N=253 (6,9,11)	30	245.0m N=254 (6,9,11)	30	246.0m N=255 (6,9,11)	30	247.0m N=256 (6,9,11)	30	248.0m N=257 (6,9,11)	30	249.0m N=258 (6,9,11)	30	250.0m N=259 (6,9,11)	30	251.0m N=260 (6,9,11)	30	252.0m N=261 (6,9,11)	30	253.0m N=262 (6,9,11)	30	254.0m N=263 (6,9,11)	30	255.0m N=264 (6,9,11)	30	256.0m N=265 (6,9,11)	30	257.0m N=266 (6,9,11)	30	258.0m N=267 (6,9,11)	30	259.0m N=268 (6,9,11)	30	260.0m N=269 (6,9,11)	30	261.0m N=270 (6,9,11)	30	262.0m N=271 (6,9,11)	30	263.0m N=272 (6,9,11)	30	264.0m N=273 (6,9,11)	30	265.0m N=274 (6,9,11)	30	266.0m N=275 (6,9,11)	30	267.0m N=276 (6,9,11)	30	268.0m N=277 (6,9,11)	30	269.0m N=278 (6,9,11)	30	270.0m N=279 (6,9,11)	30	271.0m N=280 (6,9,11)	30	272.0m N=281 (6,9,11)	30	273.0m N=282 (6,9,11)	30	274.0m N=283 (6,9,11)	30	275.0m N=284 (6,9,11)	30	276.0m N=285 (6,9,11)	30	277.0m N=286 (6,9,11)	30	278.0m N=287 (6,9,11)	30	279.0m N=288 (6,9,11)	30	280.0m N=289 (6,9,11)	30	281.0m N=290 (6,9,11)	30	282.0m N=291 (6,9,11)	30	283.0m N=292 (6,9,11)	30	284.0m N=293 (6,9,11)	30	285.0m N=294 (6,9,11)	30	286.0m N=295 (6,9,11)	30	287.0m N=296 (6,9,11)	30	288.0m N=297 (6,9,11)	30	289.0m N=298 (6,9,11)	30	290.0m N=299 (6,9,11)	30	291.0m N=300 (6,9,11)	30	292.0m N=301 (6,9,11)	30	293.0m N=302 (6,9,11)	30	294.0m N=303 (6,9,11)	30	295.0m N=304 (6,9,11)	30	296.0m N=305 (6,9,11)	30	297.0m N=306 (6,9,11)	30	298.0m N=307 (6,9,11)	30	299.0m N=308 (6,9,11)	30	300.0m N=309 (6,9,11)	30	301.0m N=310 (6,9,11)	30	302.0m N=311 (6,9,11)	30	303.0m N=312 (6,9,11)	30	304.0m N=313 (6,9,11)	30	305.0m N=314 (6,9,11)	30	306.0m N=315 (6,9,11)	30	307.0m N=316 (6,9,11)	30	308.0m N=317 (6,9,11)	30	309.0m N=318 (6,9,11)	30	310.0m N=319 (6,9,11)	30	311.0m N=320 (6,9,11)	30	312.0m N=321 (6,9,11)	30	313.0m N=322 (6,9,11)	30	314.0m N=323 (6,9,11)	30	315.0m N=324 (6,9,11)	30	316.0m N=325 (6,9,11)	30	317.0m N=326 (6,9,11)	30	318.0m N=327 (6,9,11)	30	319.0m N=328 (6,9,11)	30	320.0m N=329 (6,9,11)	30	321.0m N=330 (6,9,11)	30	322.0m N=331 (6,9,11)	30	323.0m N=332 (6,9,11)	30	324.0m N=333 (6,9,11)	30	325.0m N=334 (6,9,11)	30	326.0m N=335 (6,9,11)	30	327.0m N=336 (6,9,11)	30	328.0m N=337 (6,9,11)	30	329.0m N=338 (6,9,11)	30	330.0m N=339 (6,9,11)	30	331.0m N=340 (6,9,11)	30	332.0m N=341 (6,9,11)	30	333.0m N=342 (6,9,11)	30	334.0m N=343 (6,9,11)	30	335.0m N=344 (6,9,11)	30	336.0m N=345 (6,9,11)	30	337.0m N=346 (6,9,11)	30	338.0m N=347 (6,9,11)	30	339.0m N=348 (6,9,11)	30	340.0m N=349 (6,9,11)	30	341.0m N=350 (6,9,11)	30	342.0m N=351 (6,9,11)	30	343.0m N=352 (6,9,11)	30	344.0m N=353 (6,9,11)	30	345.0m N=354 (6,9,11)	30	346.0m N=355 (6,9,11)	30	347.0m N=356 (6,9,11)	30	348.0m N=357 (6,9,11)	30	349.0m N=358 (6,9,11)	30	350.0m N=359 (6,9,11)	30	351.0m N=360 (6,9,11)	30	352.0m N=361 (6,9,11)	30	353.0m N=362 (6,9,11)	30	354.0m N=363 (6,9,11)	30	355.0m N=364 (6,9,11)	30	356.0m N=365 (6,9,11)	30	357.0m N=366 (6,9,11)	30	358.0m N=367 (6,9,11)	30	359.0m N=368 (6,9,11)	30	360.0m N=369 (6,9,11)	30	361.0m N=370 (6,9,11)	30	362.0m N=371 (6,9,11)	30	363.0m N=372 (6,9,11)	30	364.0m N=373 (6,9,11)	30	365.0m N=374 (6,9,11)	30	366.0m N=375 (6,9,11)	30	367.0m N=376 (6,9,11)	30	368.0m N=377 (6,9,11)	30	369.0m N=378 (6,9,11)	30	370.0m N=379 (6,9,11)	30	371.0m N=380 (6,9,11)	30	372.0m N=381 (6,9,11)	30	373.0m N=382 (6,9,11)	30	374.0m N=383 (6,9,11)	30	375.0m N=384 (6,9,11)	30	376.0m N=385 (6,9,11)	30	377.0m N=386 (6,9,11)	30	378.0m N=387 (6,9,11)	30	379.0m N=388 (6,9,11)	30	380.0m N=389 (6,9,11)	30	381.0m N=390 (6,9,11)	30	382.0m N=391 (6,9,11)	30	383.0m N=392 (6,9,11)	30	384.0m N=393 (6,9,11)	30	385.0m N=394 (6,9,11)	30	386.0m N=395 (6,9,11)	30	387.0m N=396 (6,9,11)	30	388.0m N=397 (6,9,11)	30	389.0m N=398 (6,9,11)	30	390.0m N=399 (6,9,11)	30	391.0m N=400 (6,9,11)	30	392.0m N=401 (6,9,11)	30	393.0m N=402 (6,9,11)	30	394.0m N=403
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Hole No: 585-4

Hole No: 585-4

Ground height : EL. 305.56

Depth (m)	Column section	Geological name	Color	Penetration resistance		Coefficient of permeability (cm/sec)	Description
				Measured value	Estimated value		
0.9	Top soil	Top soil	Dark gray	1.0m N=7 (1, 3, 3)			Plant-roots bearing
2.5	Sandy silt	Sandy silt	Light gray	2.0m N=50 (3, 1, 10)	9	2.0m 14/10 ⁻⁷	comprising numerous of gray Vol. ash origin?
3.6	Clay	Clay	White	3.0m N=9 (2, 3, 4)	25	4.0m 14/10 ⁻⁷	Vol. ash origin? 2.5-3.6; brownish 3.6-6.0; crimson 6.0-6.6; mixture of brown and white
6.0				5.0m N=13 (3, 4, 6)	10	6.0m 14/10 ⁻⁷	
6.6					15	8.0m 14/10 ⁻⁷	
7.3			Brown	7.0m N=48 (9, 15, 24)	27		Clayey, a little small pebbles
10.0		Fine sand		9.0m N=13 (4, 9, 13)	25		Pure, felsic fragments dominant
13.0			Reddish brown	11.0m N=25 (5, 9, 11)	15	10.0m 3.1/10 ⁻⁷	Fine to medium, felsic fragments dominant, sub-angular
		Gravelly sand		13.0m	13		Matrix: coarse sand, felsic, sub-angular
				15.0m N=57 (5, 6, 16)	16		Gravel: ϕ 1-5cm sandstone, 23, rounded
				17.0m N=70 (20, 20, 30)	60		
				19.0m N=35 (10, 20, 25)	30	20.0m 8.0/10 ⁻⁵	
21.3				21.0m N=40 (9, 11, 20)	30		Fine to medium sand with rounded gravels of ϕ 1-5cm in size
23.3				23.0m N=33 (9, 11, 13)	36		Carbonaceous matter bearing
25.3				25.0m N=57 (16, 19, 22)	61		Silty, carbonaceous matter bearing
27.0				27.0m N=46 (10, 13, 23)	54		Carbonaceous matter bearing
27.6		Silt					
28.0		Fine to medium sand	Bluish gray			30.0m 1.1/10 ⁻⁷	28.0-29.3: tinged with light brown

[illegible]

Hole No : Q85-1 Location : No.2 quarry site

Ground height : EL. 346.907m G.W.L : EL.

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Lugeon value	
1.0		F	CW	Hardness	0		Residual soil with plant-roots
2.0				Joint interval	0		Decomposed, soft, easily broken by finger
5.0		F		Hardness	0		Some parts are broken by finger
5.3				Joint interval	0		Soft and fragile.
7.0		E	HW	Hardness	45		Bedding; 60°
8.6				Joint interval	88		
9.2		E	HW	Hardness	100		Weathered and tinged with brown
11.1				Joint interval	50		into rock blocks, soft to moderate hard,
13.2		E	HW	Hardness	40		Every joint is stained. Brown and clayey material adheres to joints.
14.0				Joint interval	24		
14.6		E	HW	Hardness	16		Calcite veinlets are dissolved mostly.
15.1				Joint interval	65		
16.3		E	HW	Hardness	73		Remarkably sheared, flaky to clayey, intensive slickenside is developed.
18.9				Joint interval	22		
19.1		E	HW	Hardness	14		
20.1				Joint interval	0		
20.6		E	HW	Hardness	0		
24.0				Joint interval	0		
25.0		E	HW	Hardness	0		
29.0				Joint interval	29		

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Lugeon value	
30.2		F	MW	Hardness	0		240-30.2; Alternating beds of sandstone and shale, cyclic layers of 10 to 30 cm thick
32.15				Joint interval	0		
32.2		C	F	Hardness	77		Shale layers are disturbed and changed into clayey material.
32.9				Joint interval	8		
33.85		C	F	Hardness	65		
34.3				Joint interval	75		
36.5		E	SW	Hardness	52		do-, Sandstone is craky.
37.9				Joint interval	57		
38.0		E	SW	Hardness	0		
38.1				Joint interval	13		
38.8		E	SW	Hardness	0		
39.1				Joint interval	62		
39.8		D		Hardness			
40.0				Joint interval			

Hole No : Q85-2 Location :

Ground height : EL. G.W.L : EL.

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Hardness	Joint interval	Joint condition	RQD (%)	
6.0		F	CT	D	D		0	Brown, almost decomposed into fragile fragments and clayey material
7.1							0	
7.4							0	
8.1							0	
8.3							0	
10.3							0	
10.5							0	
11.5							13	
11.6							27	
12.5							0	
13.5							0	
13.7							0	
14.5							10	
14.6							17	
15.5							0	
16.5							20	
17.7							0	
20.0							0	
22.55							12	
24.63							0	
25.0							0	

Depth (m)	Column section	Rock grade	Weathered zone	Foundation classification				Permeability		Description
				Hardness	Joint interval	Joint condition	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
25.6				B	III	b	0			
27.9							10			
28.5							13			
35.0							0			
35.3							0			
37.1							13			
37.4							0			
37.5							10			
37.6							15			
37.7							0			
37.8							0			
37.9							0			
38.0							0			
38.1							0			
38.2							0			
38.3							0			
38.4							0			
38.5							0			
38.6							0			
38.7							0			
38.8							0			
38.9							0			
39.0							0			
39.1							0			
39.2							0			
39.3							0			
39.4							0			
39.5							0			
39.6							0			
39.7							0			
39.8							0			
39.9							0			
40.0							0			

Hole No : 085-3 Location :

Ground height : EL. 323.452 m G.W.L : EL.

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Breaking point (kg/cm ²) Lugeon value	
0.4					0		Dark brown, top soil
1.0		F	CT	Hardness D Joint interval IV Joint condition d	0		Brown, residual soil Soft, possible to crush by finger
2.0				Hardness C Joint interval IV Joint condition d	0		Light brown, soft, cracky
3.0				Hardness C Joint interval IV Joint condition d	10		Light brown, parted from hair cracks, cracks are stained and intercalate clay film.
4.5				Hardness C Joint interval IV Joint condition d	10		Light brown, bedding; 20°
5.4				Hardness C Joint interval IV Joint condition d	57		Shale layers; disturbed, fleshy to clayey, intensive slicken- side developed
5.9				Hardness C Joint interval IV Joint condition d	62		Sandstone at the upper and lower of shale layers; cracky.
6.0				Hardness C Joint interval IV Joint condition d	14		Calcite veinlets are dissolved mottly.
7.9				Hardness C Joint interval IV Joint condition d	60		Rock blocks; fresh mottly, moderate hard.
8.5				Hardness C Joint interval IV Joint condition d	19		Joint; stained mottly, intercalate clay film.
9.5				Hardness C Joint interval IV Joint condition d	22		Calcite veinlets are dissolved partly.
10.0				Hardness C Joint interval IV Joint condition d	48		Light brown, slightly softened, Every joints are stained. Clay film adheres to most joints.
11.0				Hardness C Joint interval IV Joint condition d	70		
12.0				Hardness C Joint interval IV Joint condition d	92		
12.1				Hardness C Joint interval IV Joint condition d	86		
12.6				Hardness C Joint interval IV Joint condition d	56		
13.0				Hardness C Joint interval IV Joint condition d	86		
14.9				Hardness C Joint interval IV Joint condition d	55		
17.0				Hardness C Joint interval IV Joint condition d	73		
17.1				Hardness C Joint interval IV Joint condition d	34		
19.5				Hardness C Joint interval IV Joint condition d	57		
19.7				Hardness C Joint interval IV Joint condition d	30		
19.8				Hardness C Joint interval IV Joint condition d	20		
20.0				Hardness C Joint interval IV Joint condition d			
20.1				Hardness C Joint interval IV Joint condition d			
21.5				Hardness C Joint interval IV Joint condition d			
21.6				Hardness C Joint interval IV Joint condition d			
23.9				Hardness C Joint interval IV Joint condition d			
24.0				Hardness C Joint interval IV Joint condition d			
24.5				Hardness C Joint interval IV Joint condition d			
25.0				Hardness C Joint interval IV Joint condition d			

Depth (m)	Column section	Foundation classification			Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Breaking point (kg/cm ²) Lugeon value	
27.3				Hardness B Joint interval IV Joint condition d	91		Rock blocks are fresh. Most joints are stained. Clay film adheres to some joints.
27.5				Hardness B Joint interval IV Joint condition d	82		
27.8				Hardness B Joint interval IV Joint condition d	75		
28.0				Hardness B Joint interval IV Joint condition d	18		Light brown, cracky, stained, clayey film in cracks
30.5				Hardness C Joint interval IV Joint condition d	45		Shale layers are fleshy to clayey. Sandstone layers are brittle due to hair cracks and calcite veinlets.
31.1				Hardness C Joint interval IV Joint condition d	22		
31.7				Hardness C Joint interval IV Joint condition d	52		
32.0				Hardness C Joint interval IV Joint condition d	12		
32.7				Hardness C Joint interval IV Joint condition d	49		Rock blocks and joints are fresh.
33.0				Hardness C Joint interval IV Joint condition d	68		Shale layers are disturbed and fleshy to clayey.
33.7				Hardness C Joint interval IV Joint condition d	67		
34.1				Hardness C Joint interval IV Joint condition d	59		
37.5				Hardness C Joint interval IV Joint condition d	44		
38.0				Hardness C Joint interval IV Joint condition d	10		
38.5				Hardness C Joint interval IV Joint condition d			
40.0				Hardness C Joint interval IV Joint condition d			
44.9				Hardness C Joint interval IV Joint condition d			Shale layers, except at 3.0-6.0m and 14.9-20.1m in depth respectively, are disturbed and deteriorated into fleshy to clayey material. Intensive slickenside is developed in the layers. While shale layers at the said 3.0-6.0m and 14.9-20.1m are undisturbed, the layers are fragile and parted from bedding. Slickenside and clayey film due to disturbance respectively are observed partly.

Hole No : 785-1

Ground height : EL. 106.30m G.W.L : EL. 98.8 m

[illegible]

Hole No : 785-2
 Location : Extension, tailrace,
 Tenom Pangi,

Ground height : EL. 103.00 m G.W.L : EL. 98.7 m

Depth (m)	Column section	Foundation classification				Permeability		Description
		Rock grade	Weathered zone	Classifi. criteria	RQD (%)	Lugeon value	Breaking point (kg/cm ²)	
24.7		E	F	B, C	D	IV	0	River deposits, sandy gravel ranging in size from granule to boulder, max ϕ : 40cm, gravel content: 20 to 9%, matrix; muddy sand
25.0					0	0	0	Bedrock, argillaceous sandstone with shale layers, bedding: 70°

P - Q GRAPHS

(RESULT OF WATER PRESSURE TEST)

Hole No. U85-1

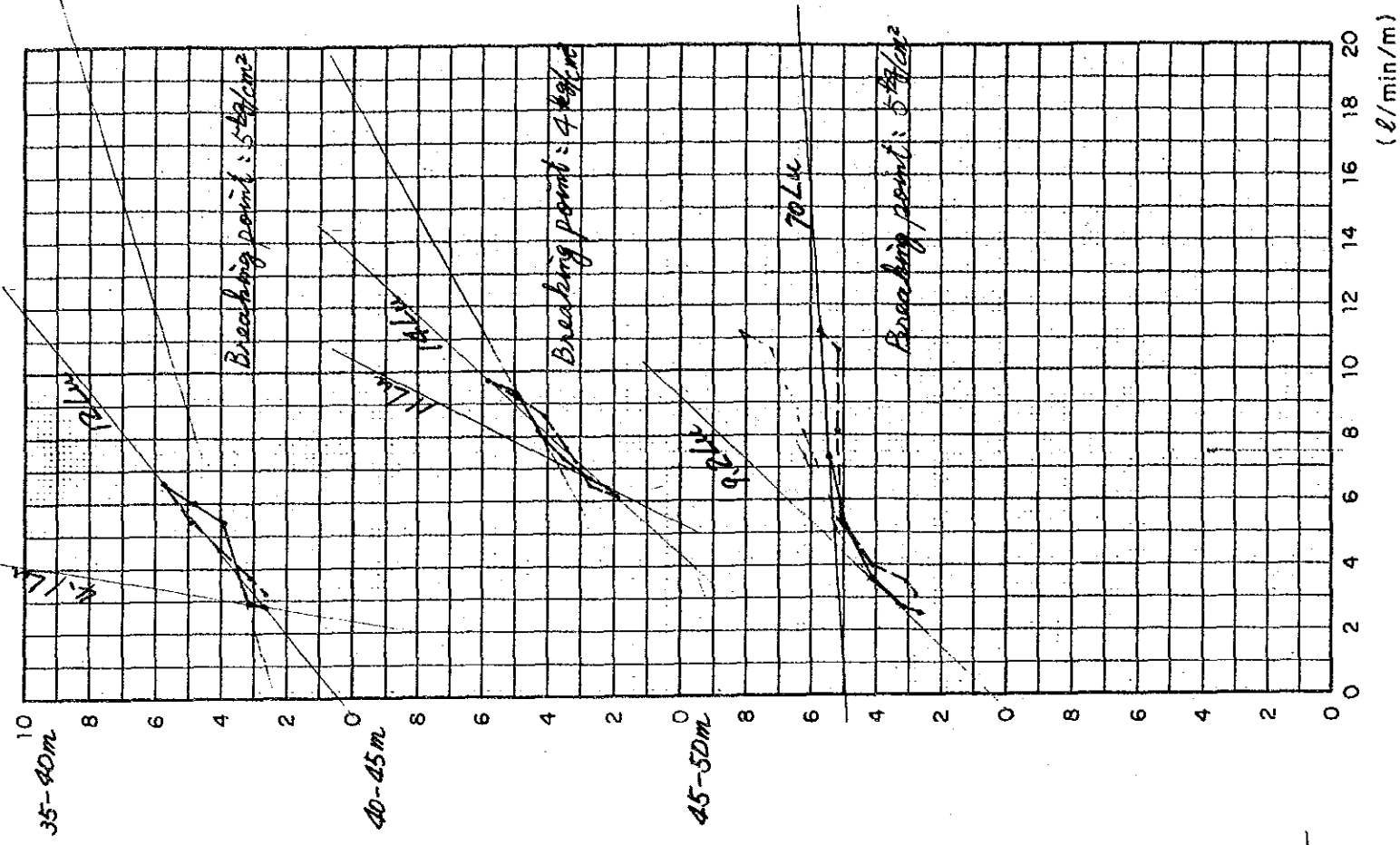
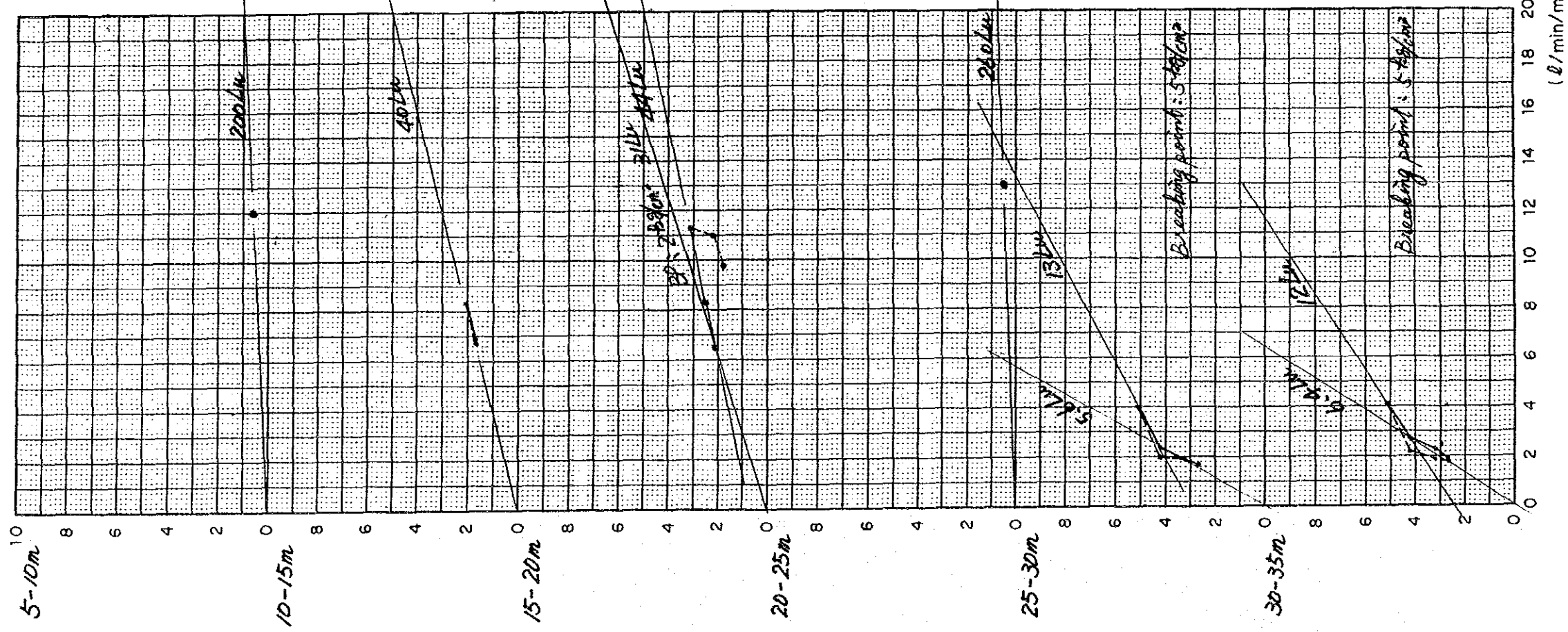
Location ; Main dam, upstream dam axis, Crest of left abutment

Ground height ; EL. 329.23m

Groundwater level ; 21.37m in depth

(kg/cm²)

(kg/cm²)

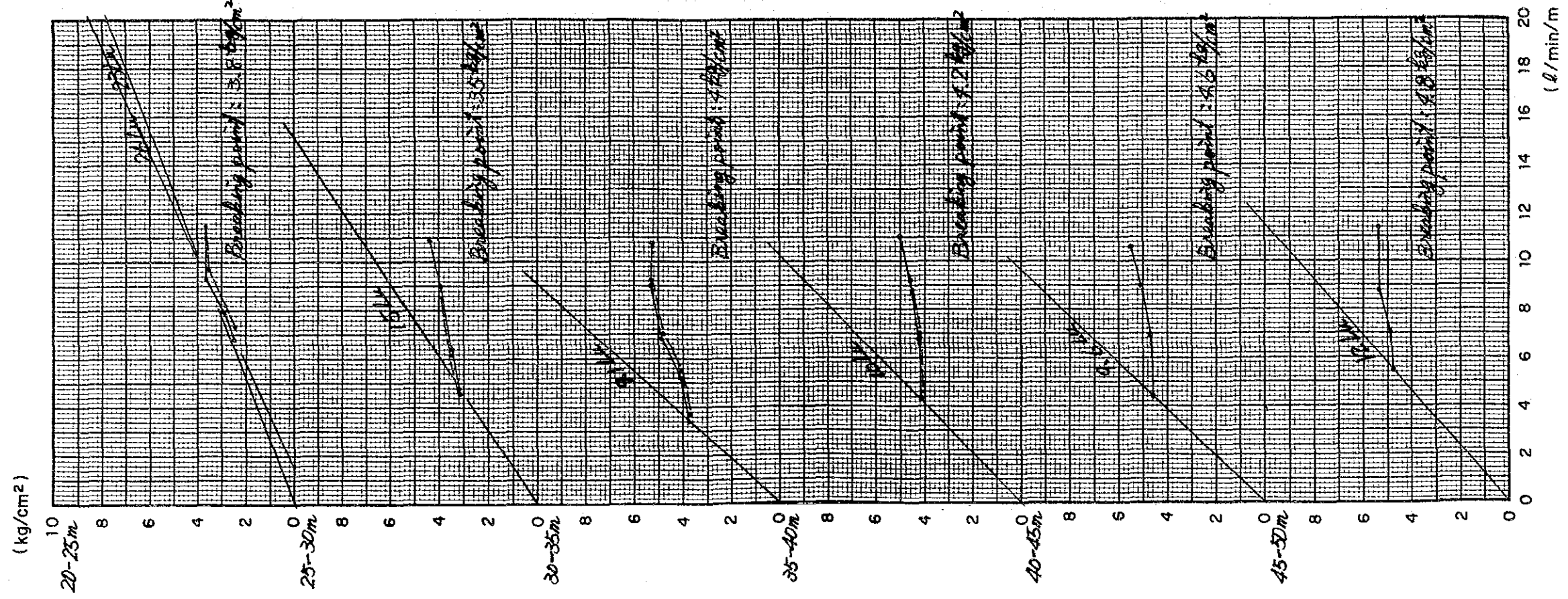
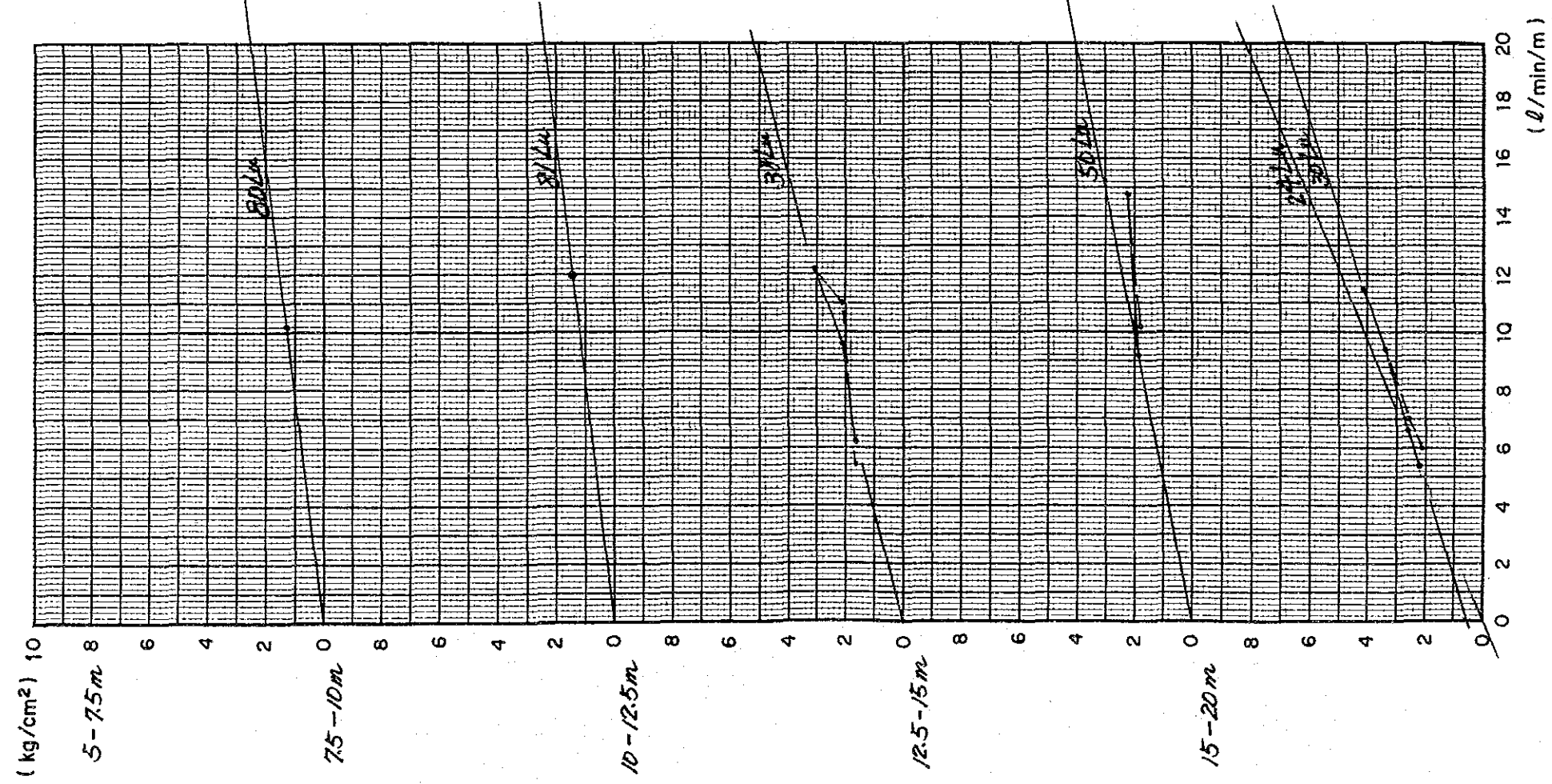
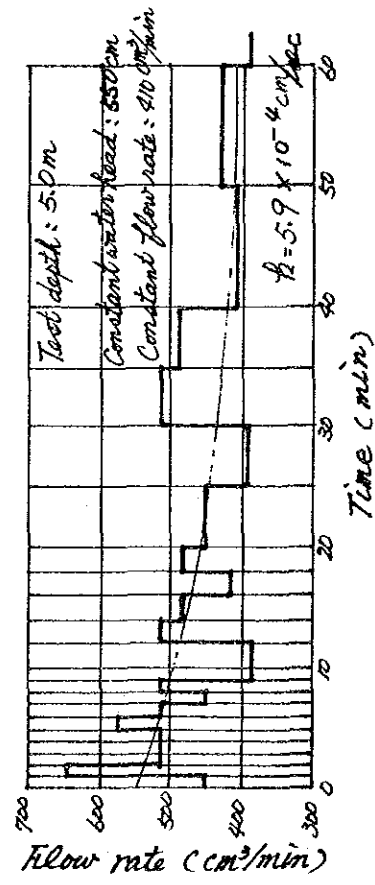


Hole No. U85-2

Location; Main dam, upstream dam axis, middle part of left abut.

Ground height; EL. 289.31m

Groundwater level; 45m in depth

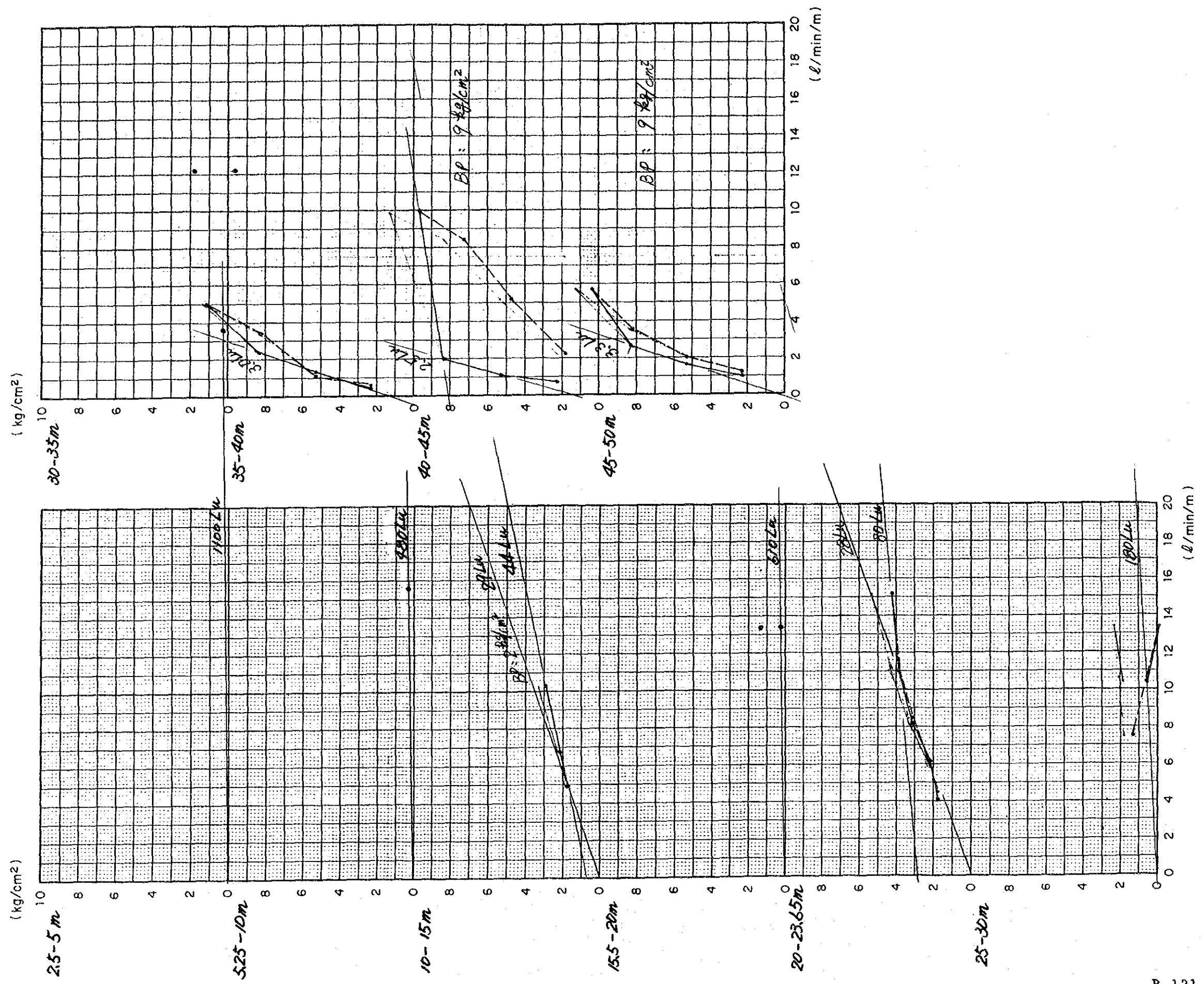


Hole No. U85-3

Location ; Main dam, upstream dam axis, lower part of left abut.

Ground height ; EL. 269.45m

Groundwater level ; 12.30m in depth



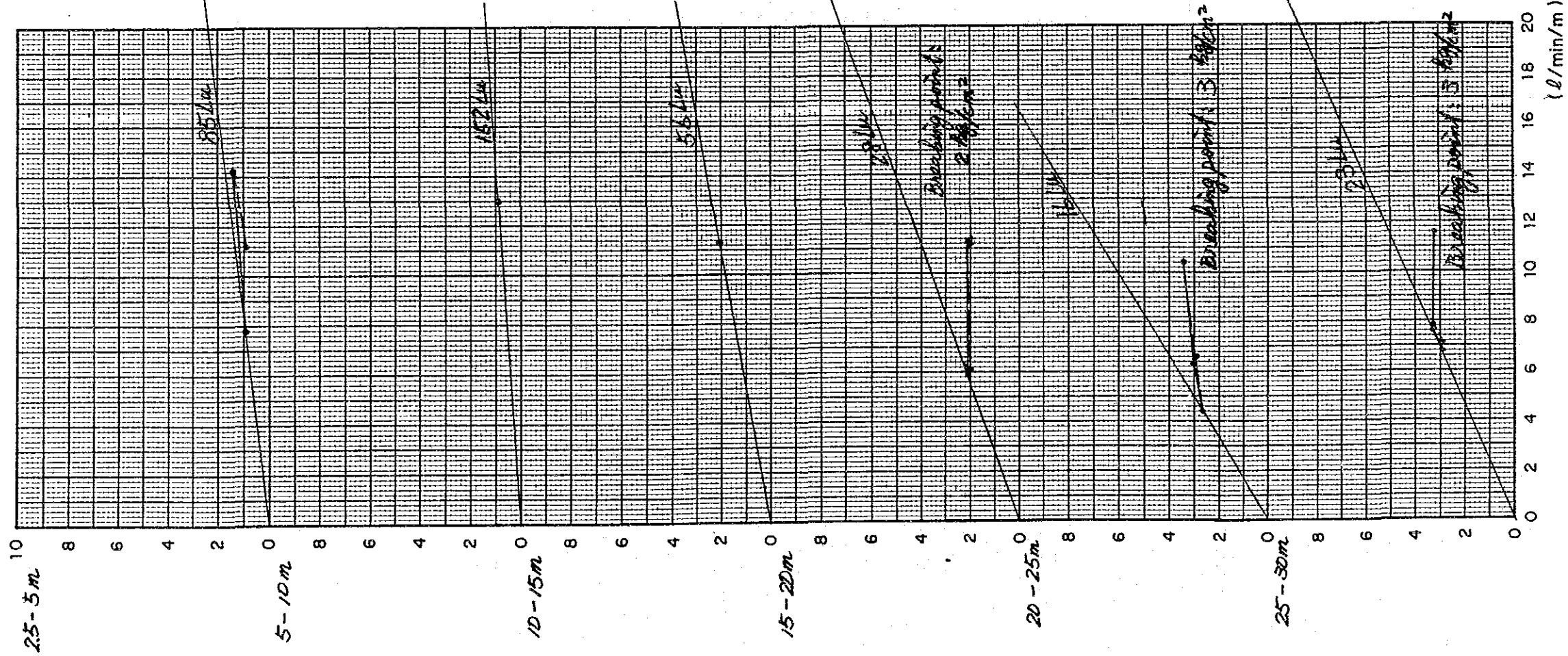
Hole No. U85-4

Location; Main dam, upstream dam axis, middle portion of right abutment

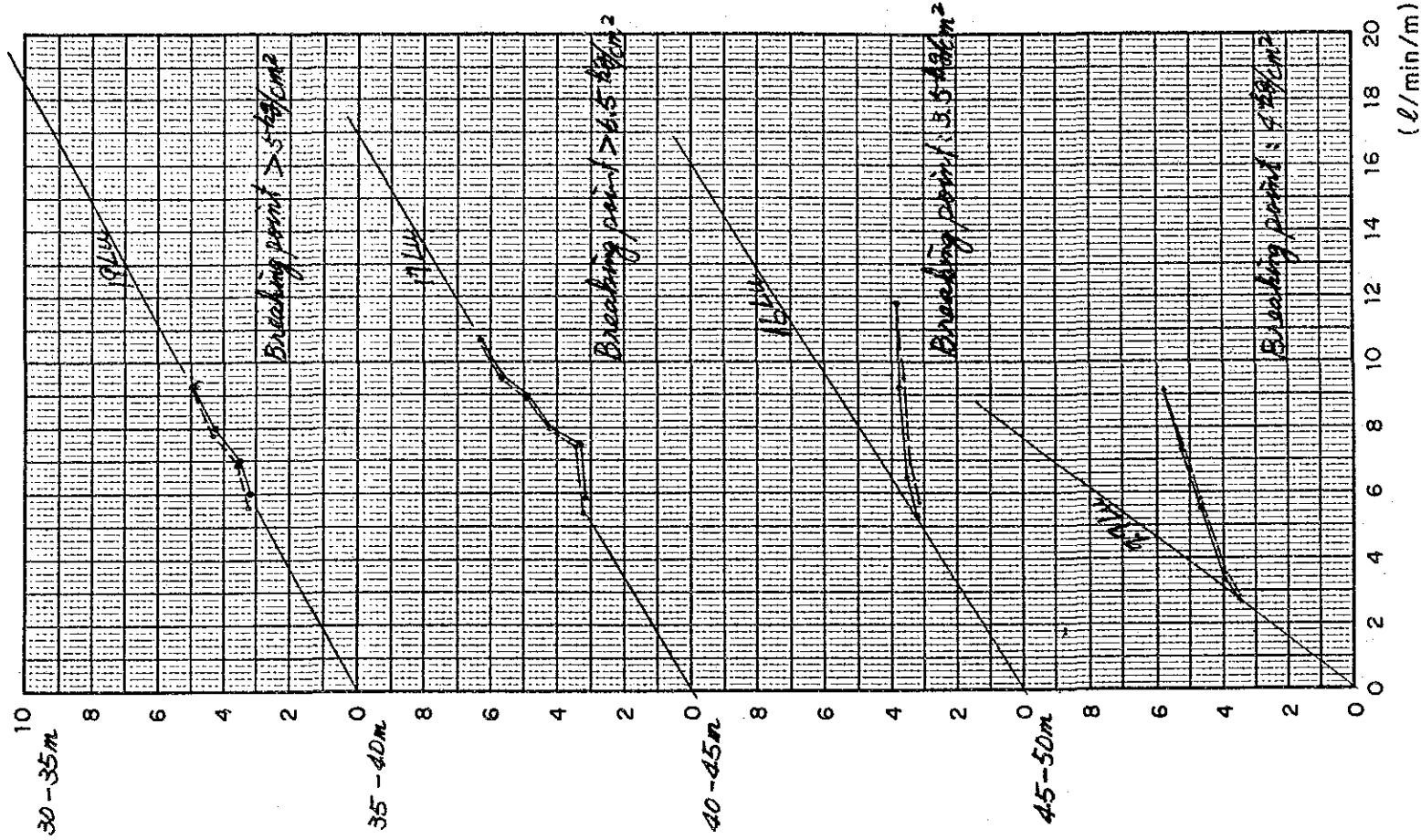
Ground height; EL. 276.16 m

Groundwater level; 29.5 m in depth

(kg/cm²)



(kg/cm²)



(l/min/m)

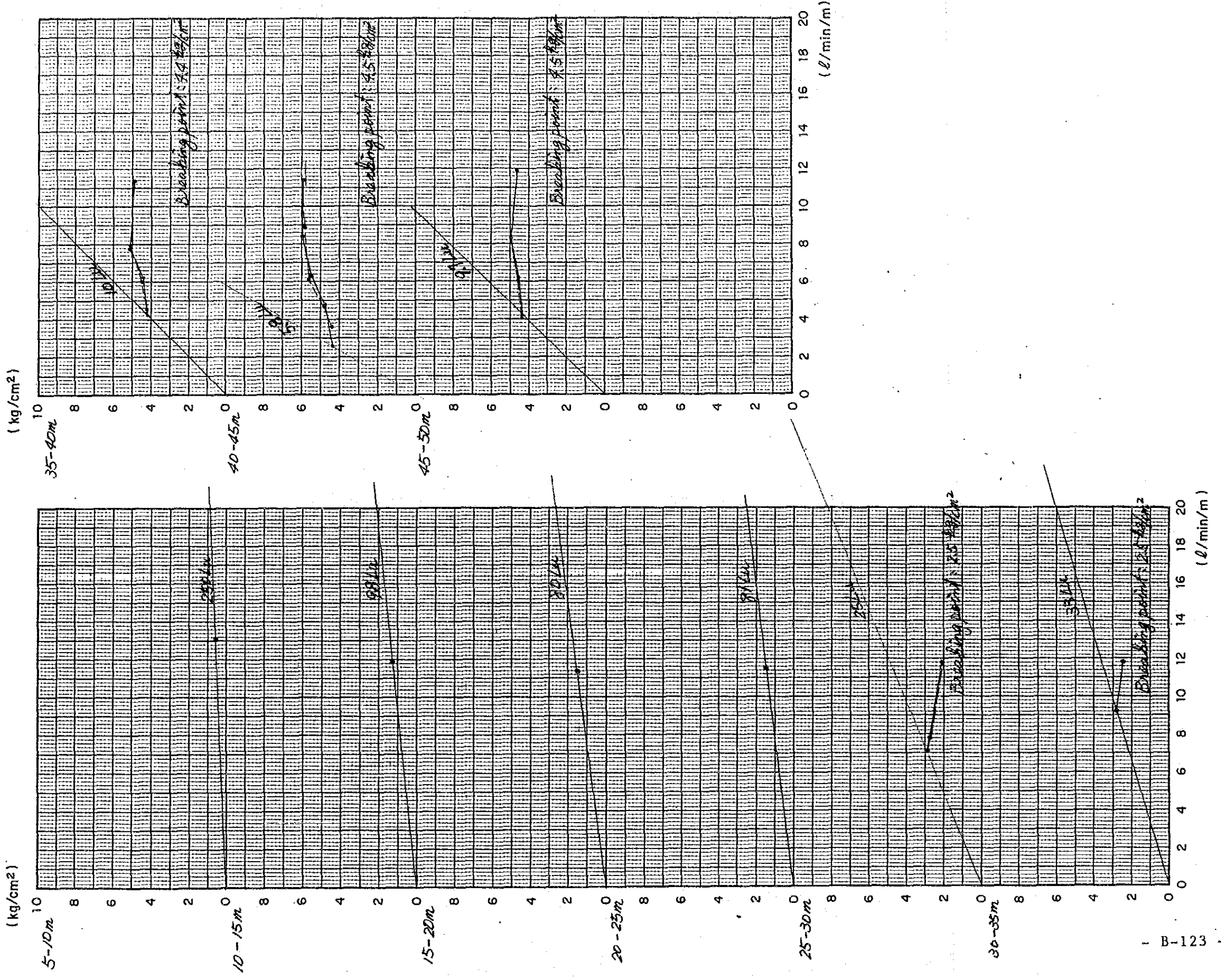
(l/min/m)

Hole No. U85-5

Location; Main dam, upstream dam axis, crest of right abutment

Ground height; EL 329.61 m

Groundwater level; 39.25 m in depth

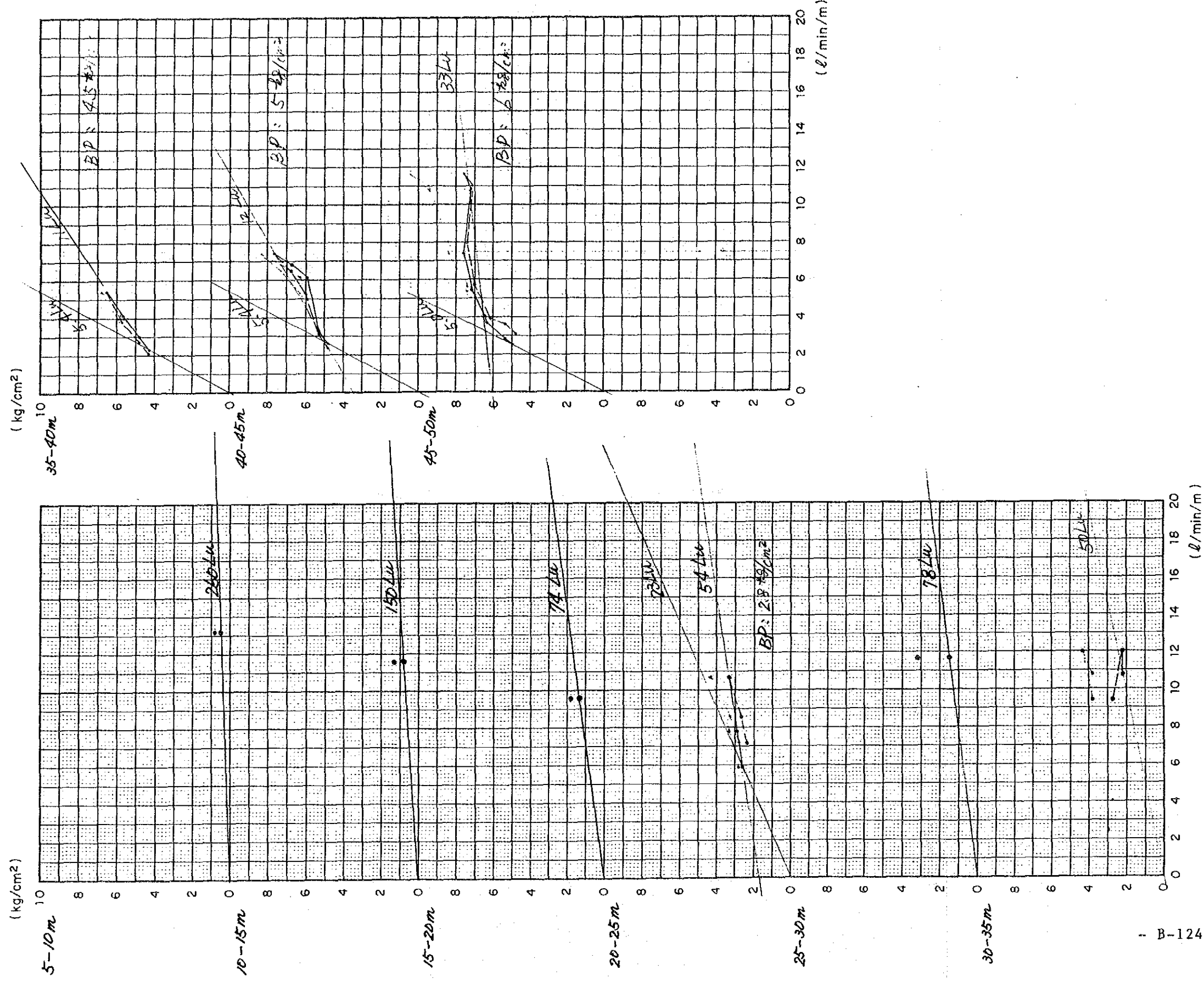


Hole No. D85-1

Location; Main dam, downstream dam axis, crest of left abutment

Ground height; EL. 328.54 m

Groundwater level; 43.1 m in depth



Hole No. D85-2

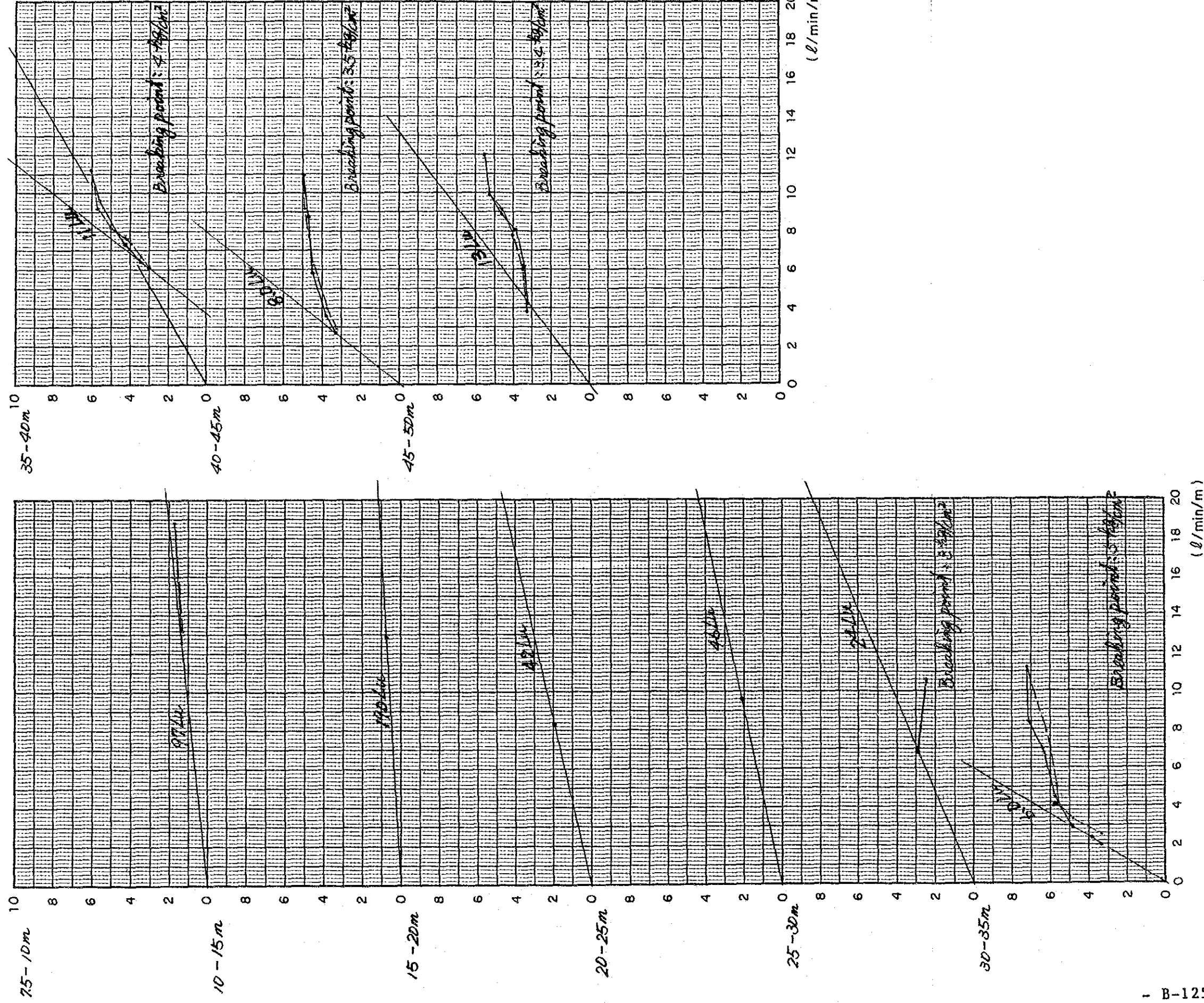
Location; Main dam, downstream dam axis, middle part of left abutment

Ground height; EL. 292.60 m

Groundwater level; 28.10 m in depth

(kg/cm²)

(kg/cm²)



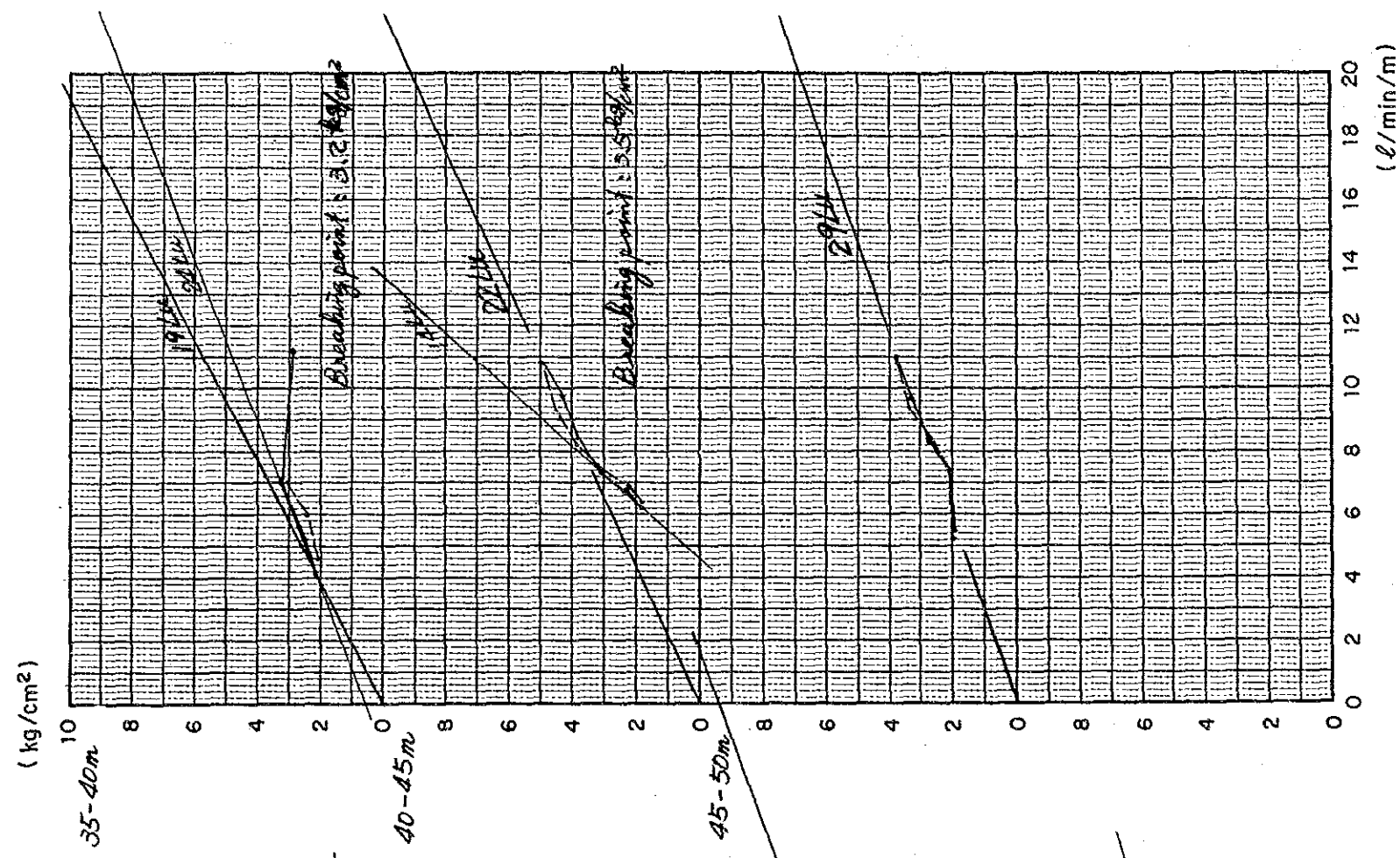
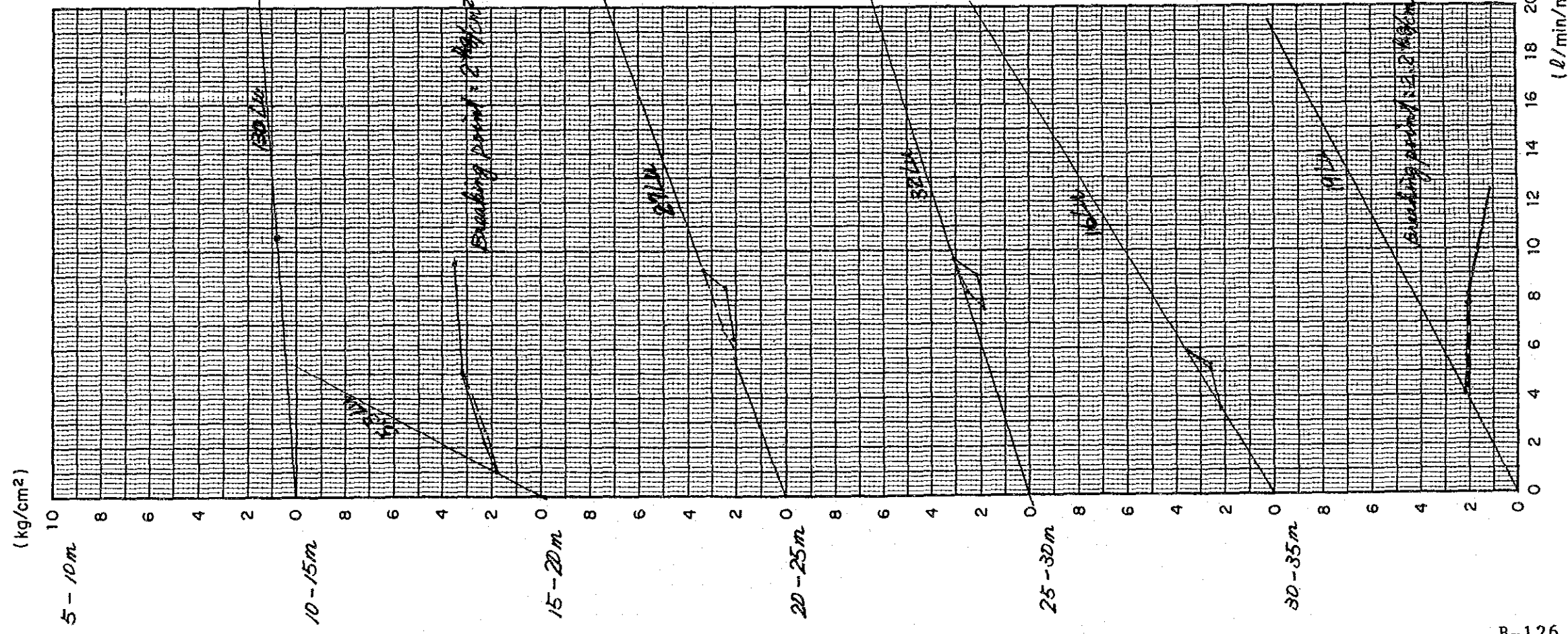
(l/min/m)

(l/min/m)

Hole No. D85-3 Location; Main dam, downstream dam axis, lower part of left abutment

Ground height; EL. 265.61m

Groundwater level; 17.2m in depth



Hole No. DB5-4

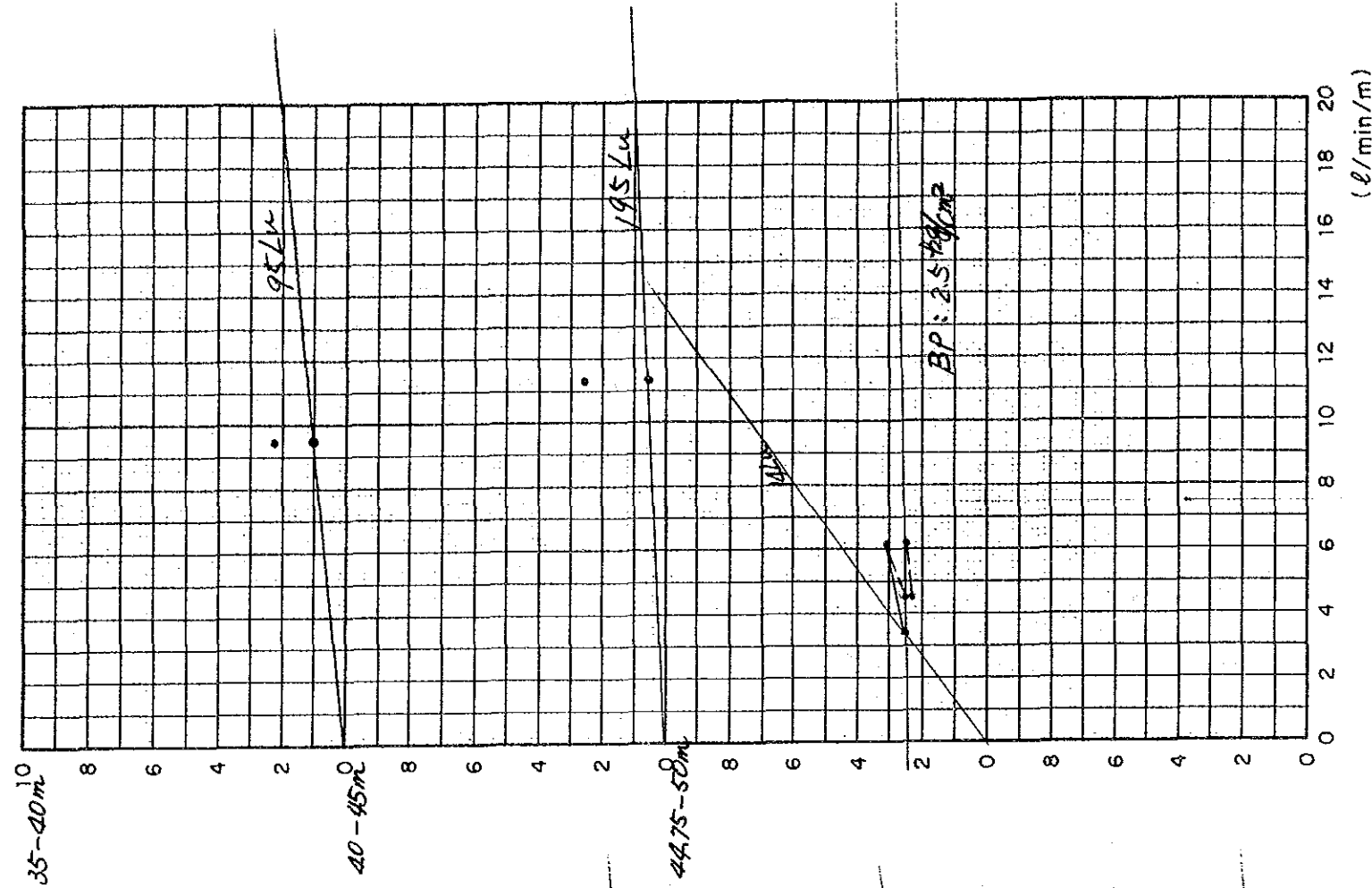
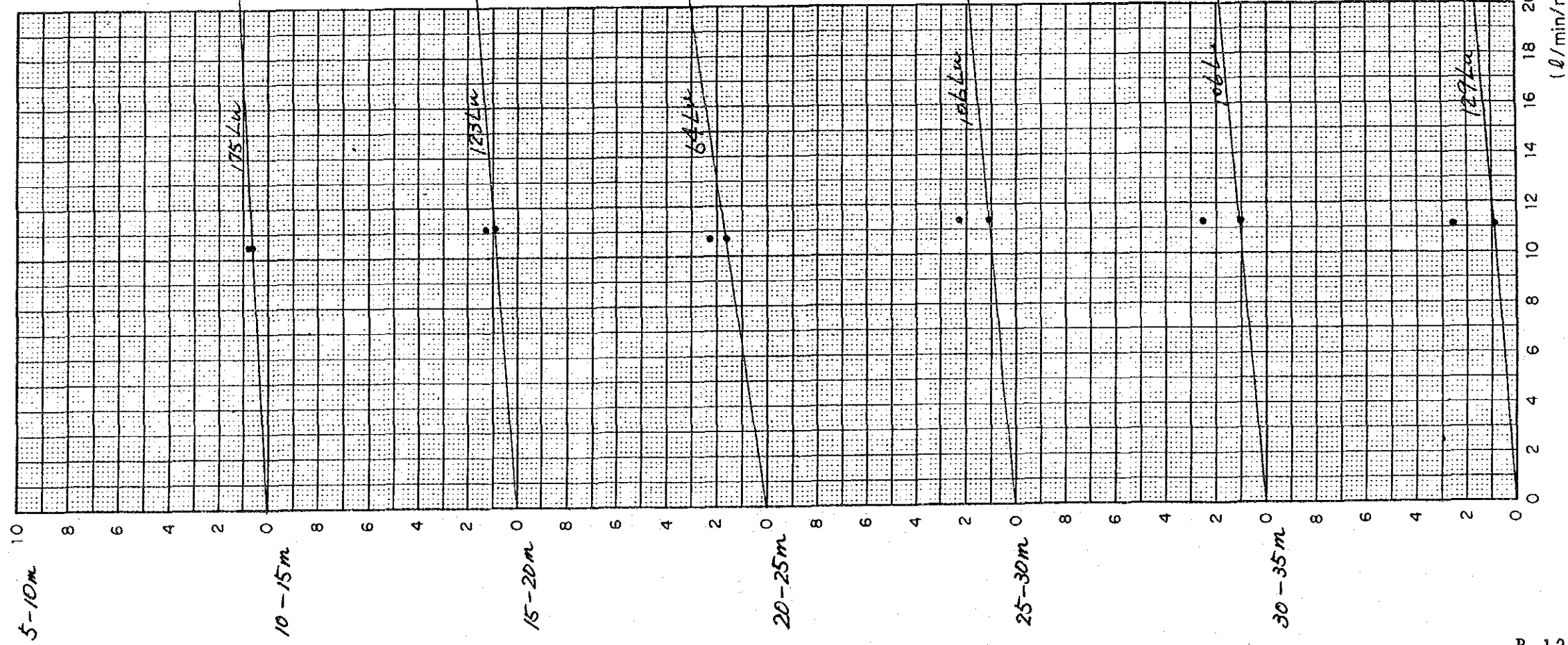
Location; Main dam, downstream dam axis, middle portion of right abutment

Ground height; EL. 287.56 m

Groundwater level; 20.1 m in depth

(kg/cm²)

(kg/cm²)



(l/min/m)

(l/min/m)

Hole No. D85-5

Location; Main dam, downstream dam axis, crest of right abutment

Ground height; EL. 328.78m

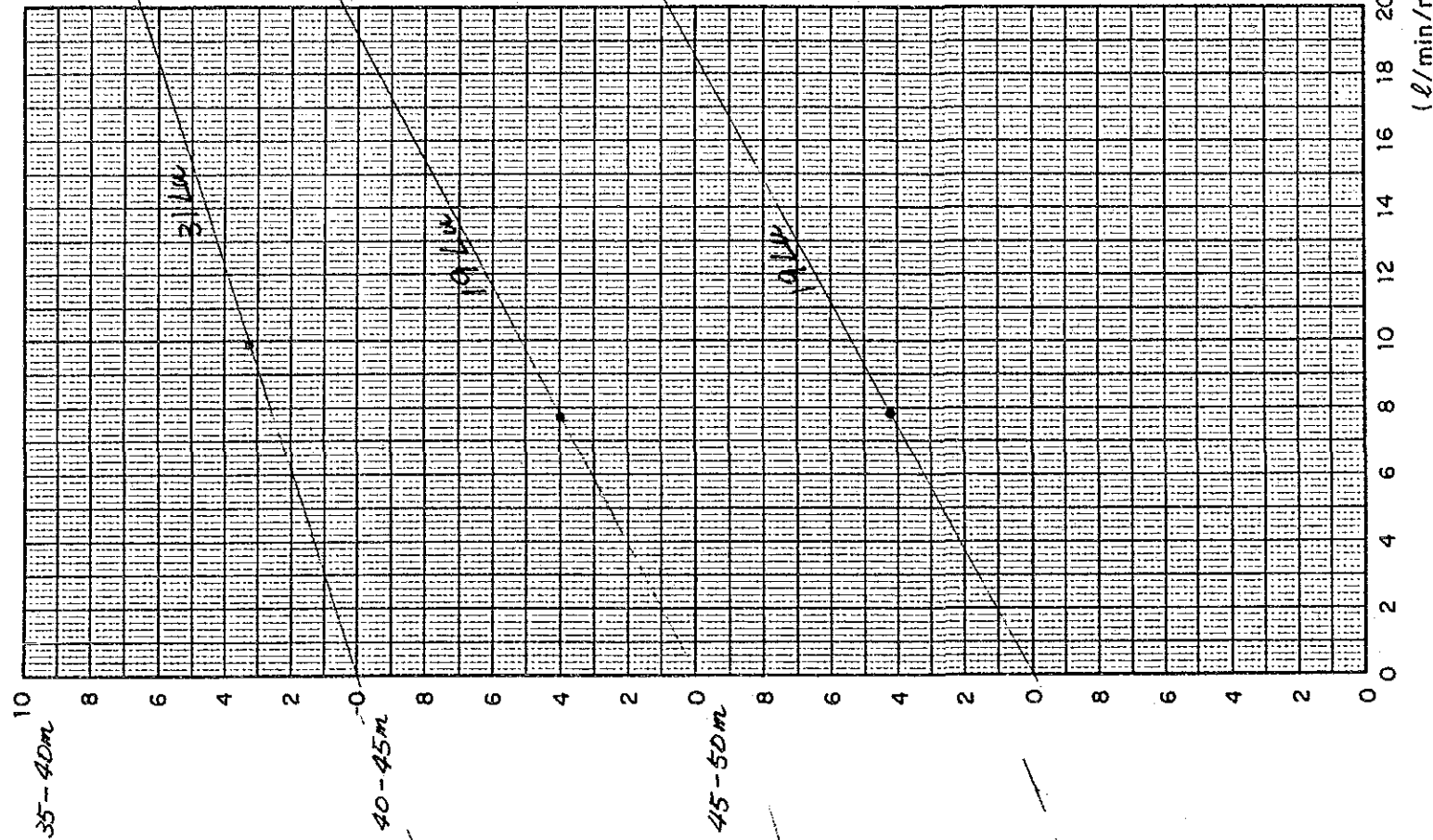
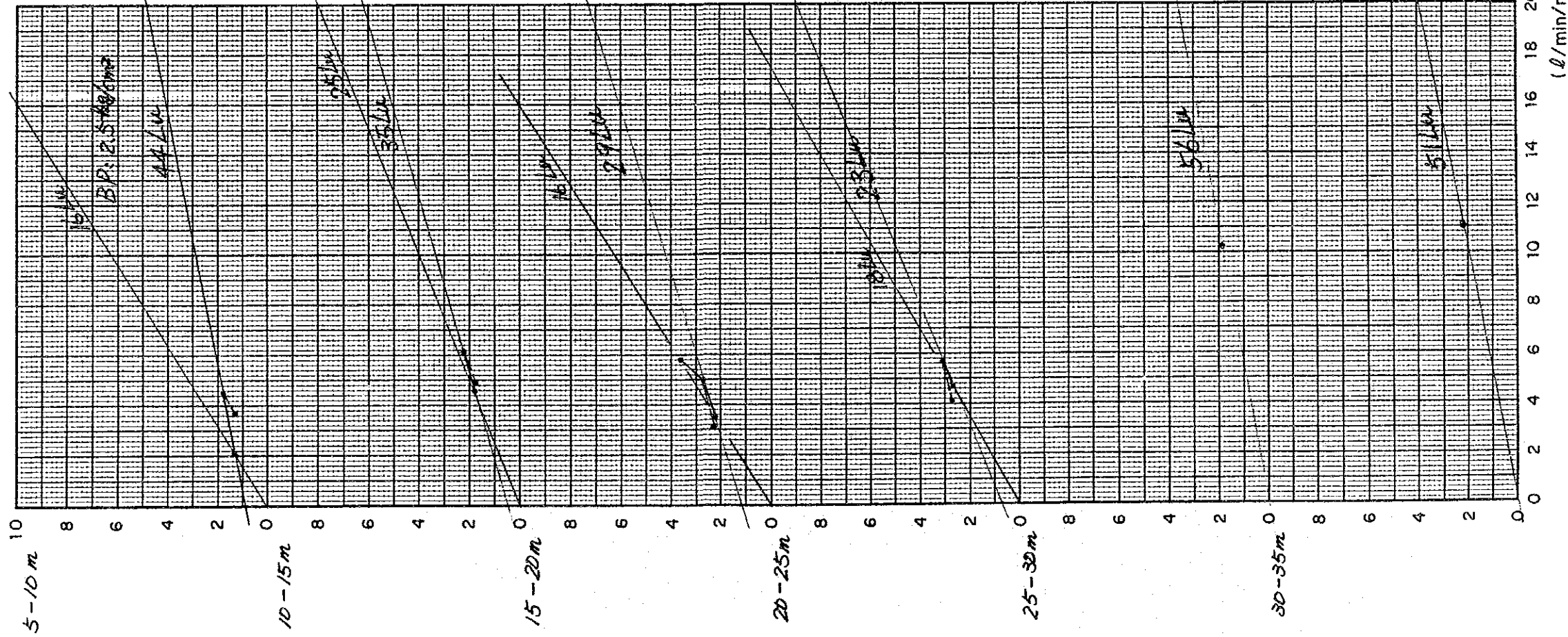
Groundwater level; 45.5m in depth

(kg/cm²)

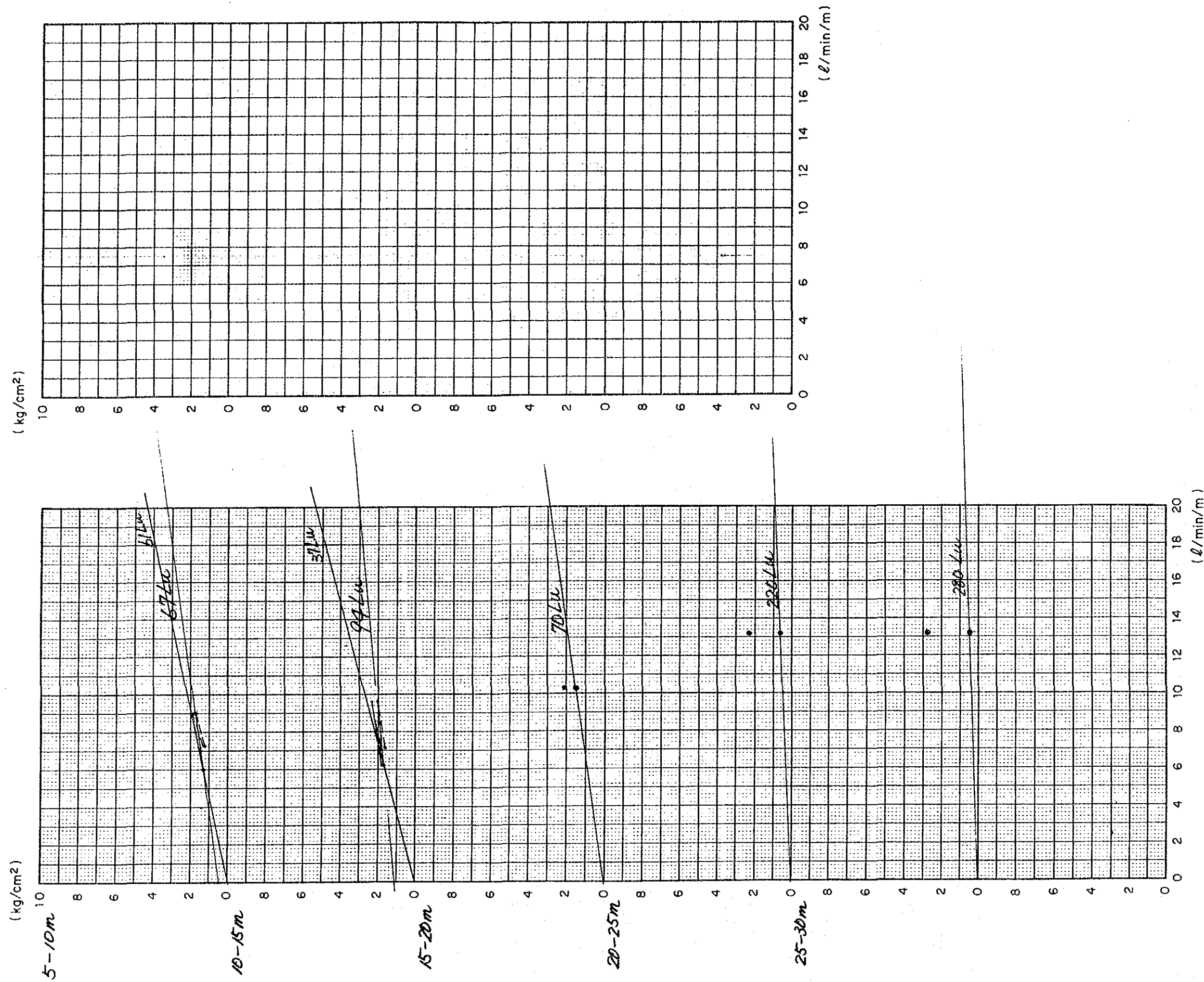
(kg/cm²)

5-10 m

35-40m



Hole No. D85-6 Location ; Main dam , saddle on left bank ridge
 Ground height ; EL. 330.75 m Groundwater level ; 26.95m in depth



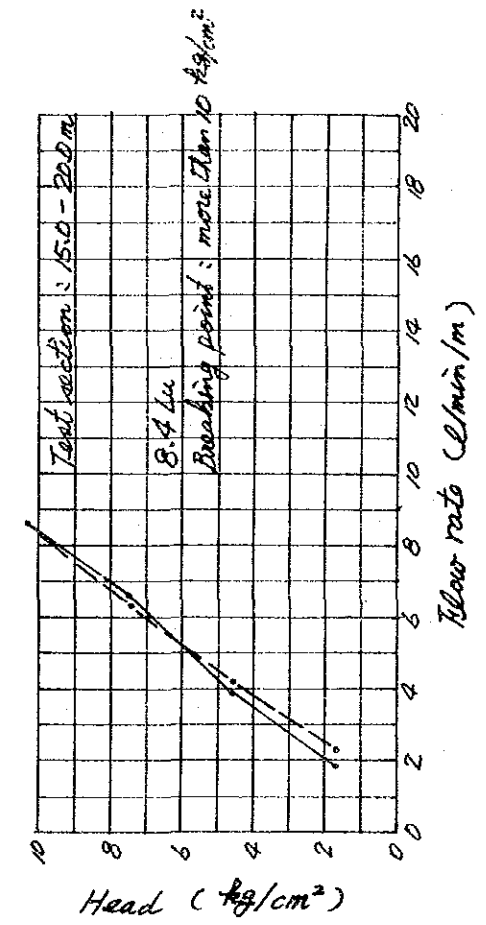
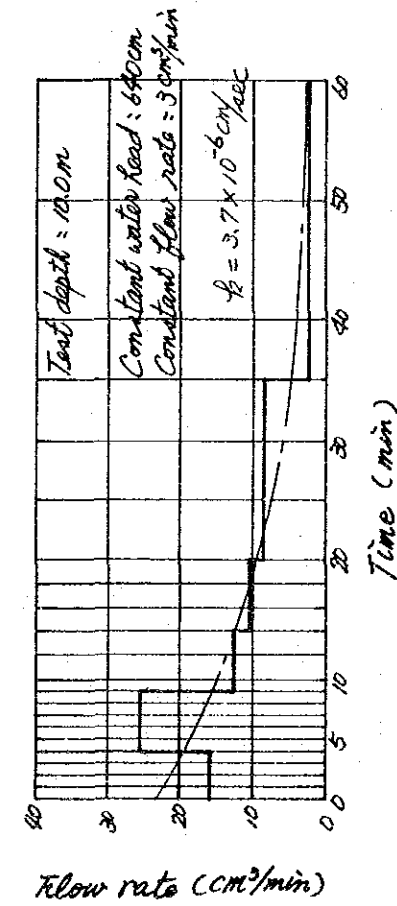
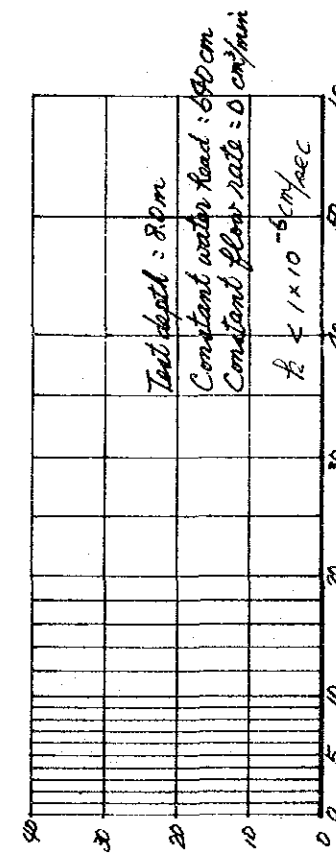
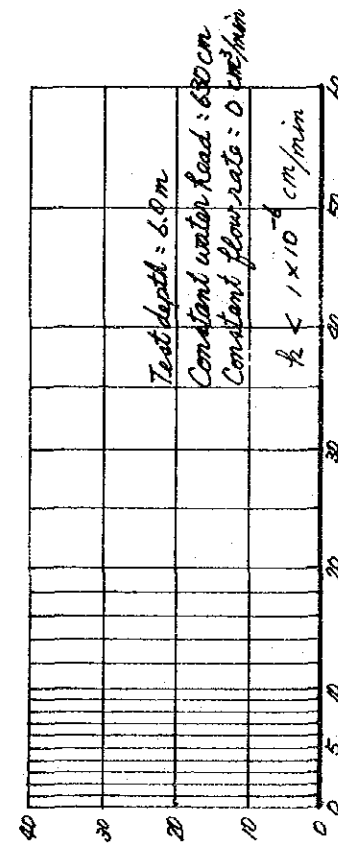
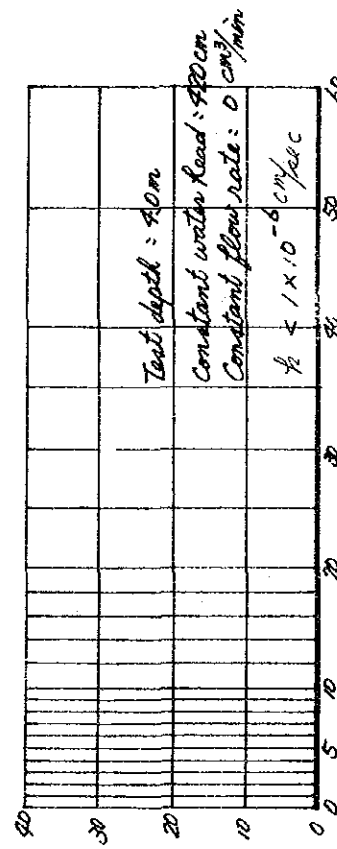
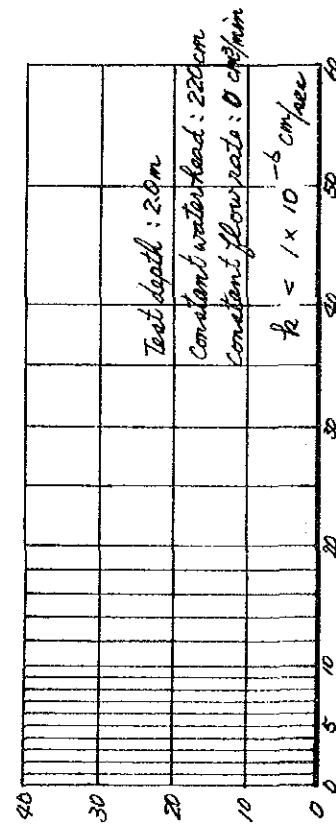
CORRELATION BETWEEN

FLOW RATE AND DURATION

(RESULT OF OPEN - END PIPE TEST)

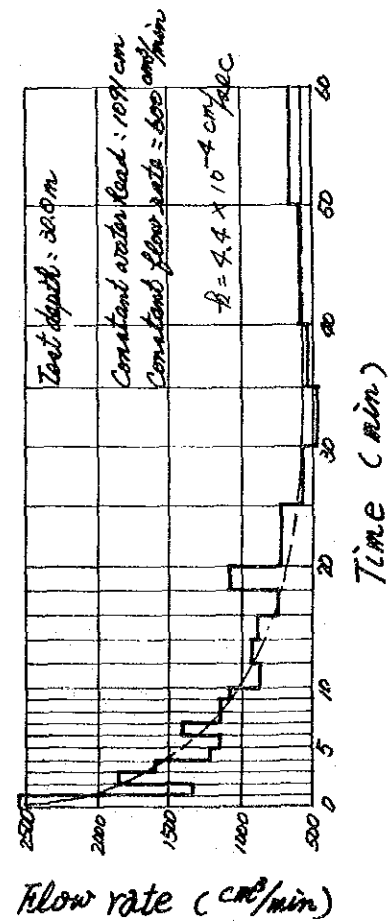
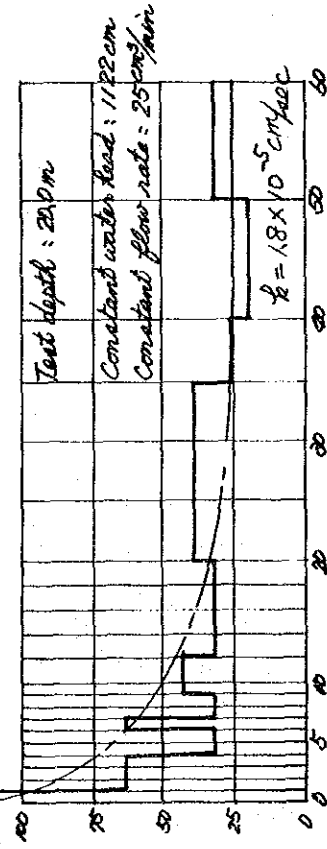
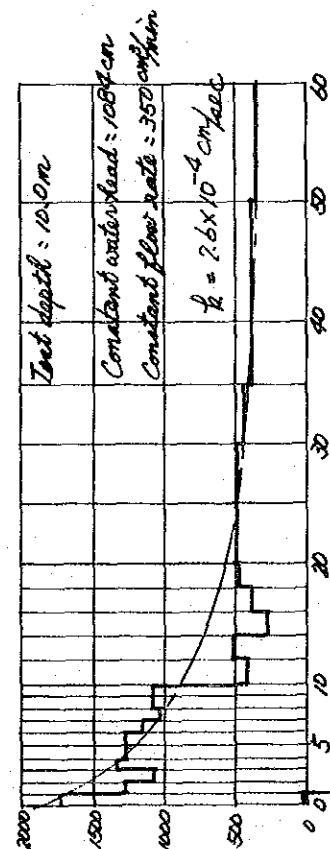
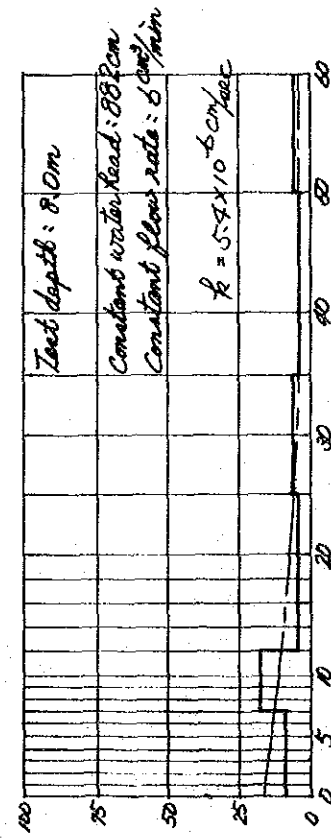
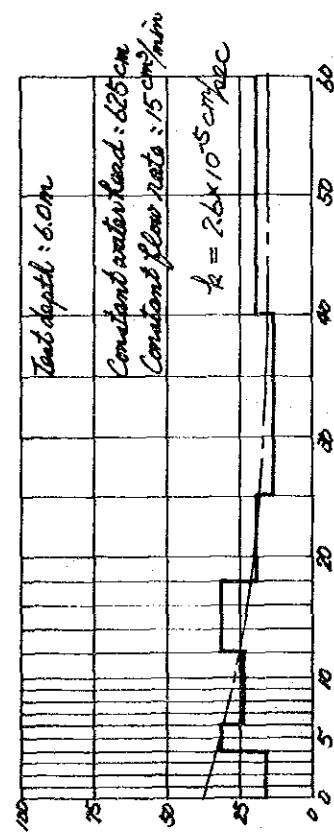
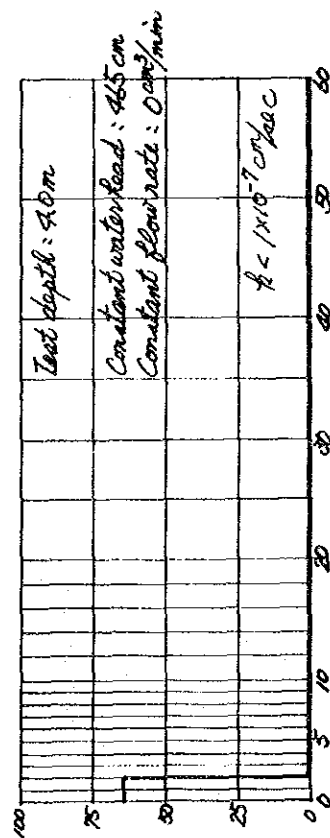
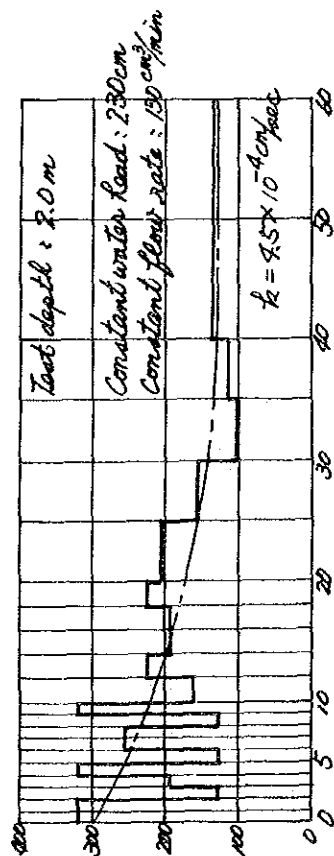
S85-1

Ground height: EL. 317.00 m
Ground water table: 5.15 m in depth
Internal diameter of casing: 7.62 cm



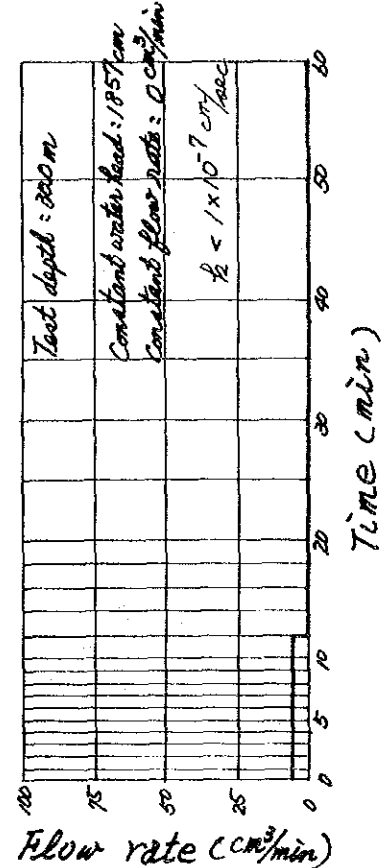
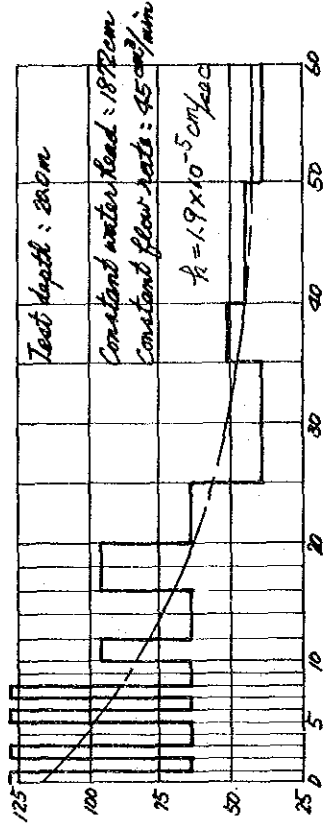
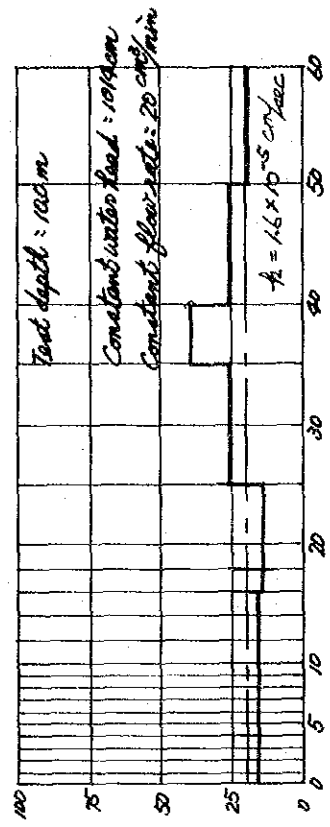
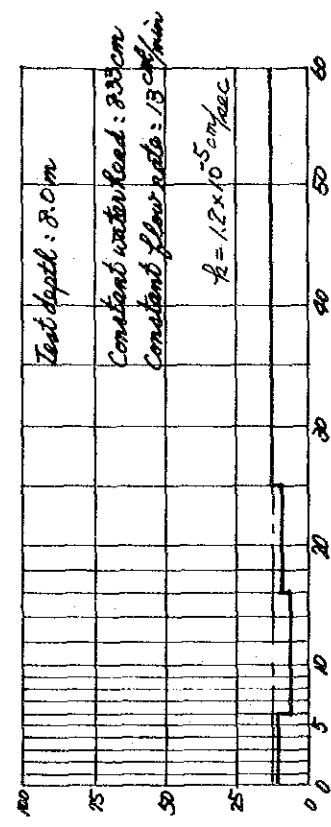
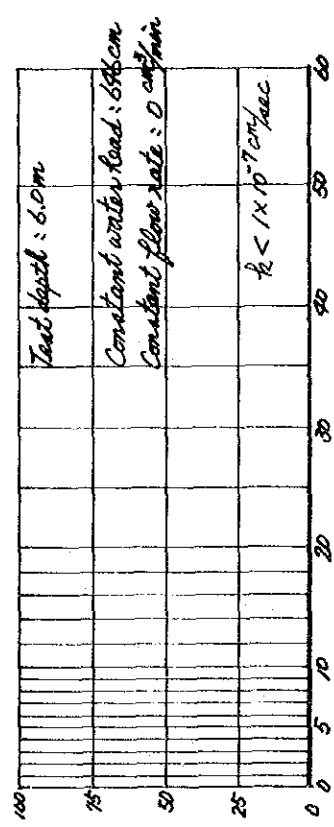
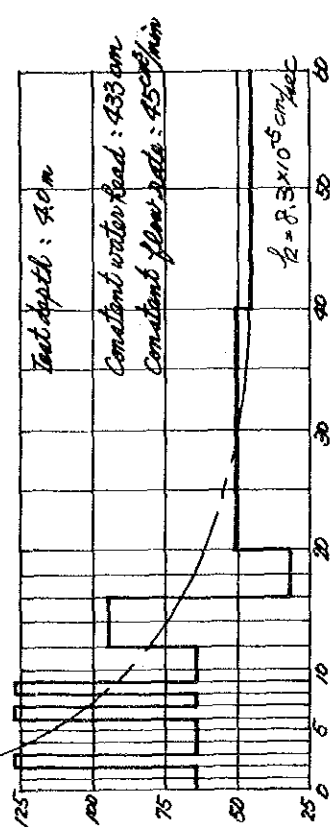
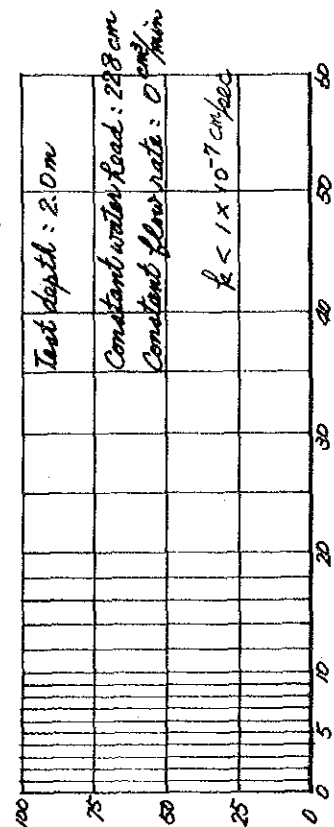
S85-2

Ground height: EL. 317.91m
Ground water table: 10.8 m in depth
Internal diameter of casing: 7.62 cm



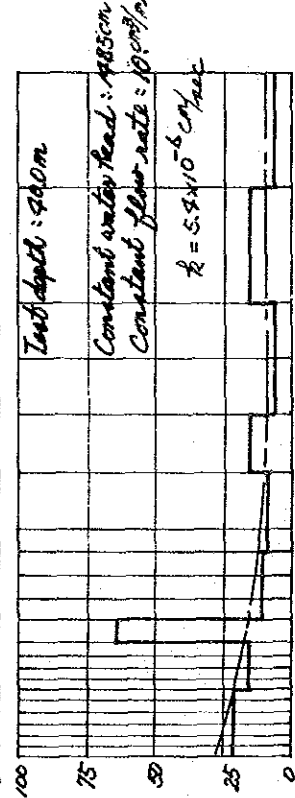
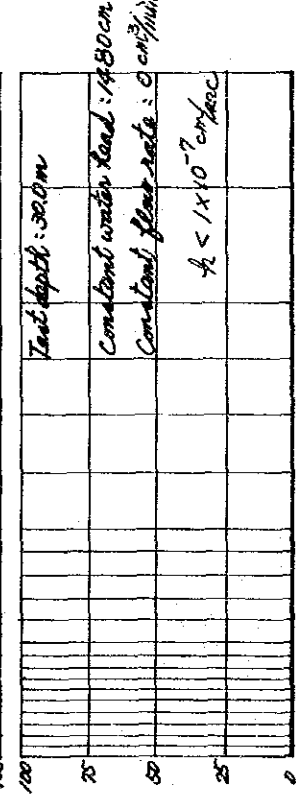
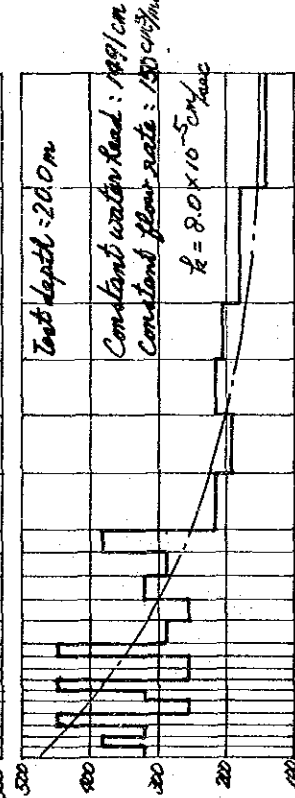
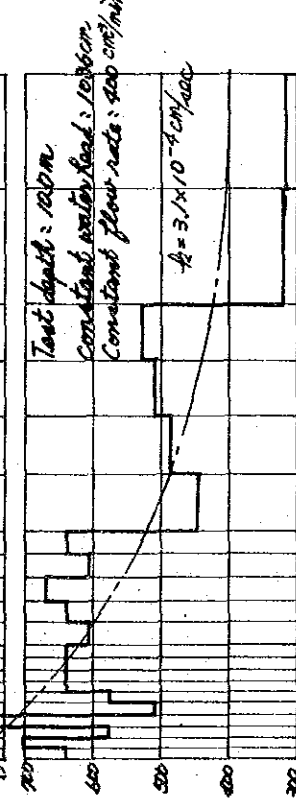
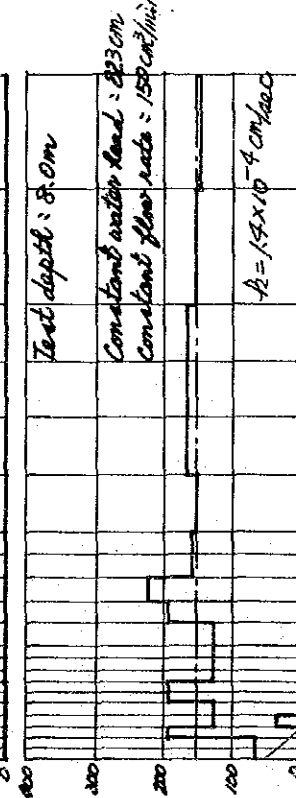
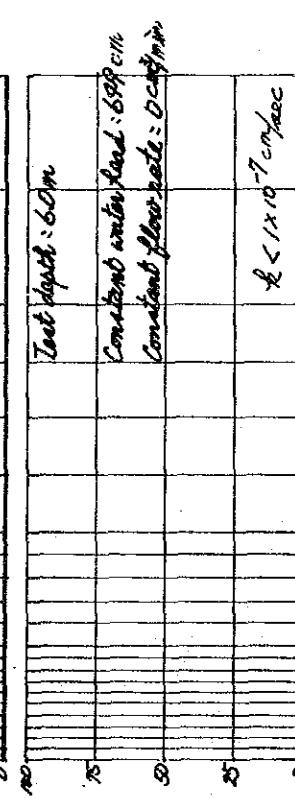
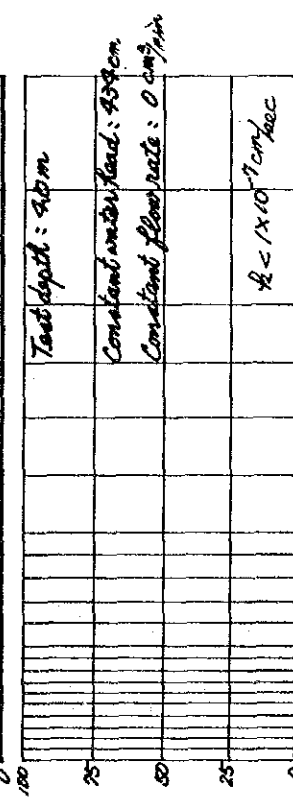
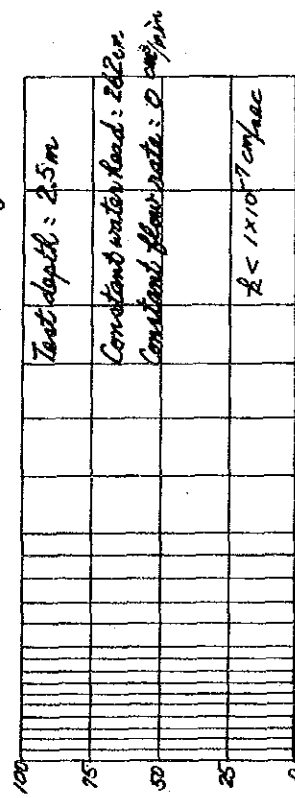
S85-3

Ground height: EL. 308.34 m
Ground water table: 18.25 m in depth
Internal diameter of casing: 7.62 cm



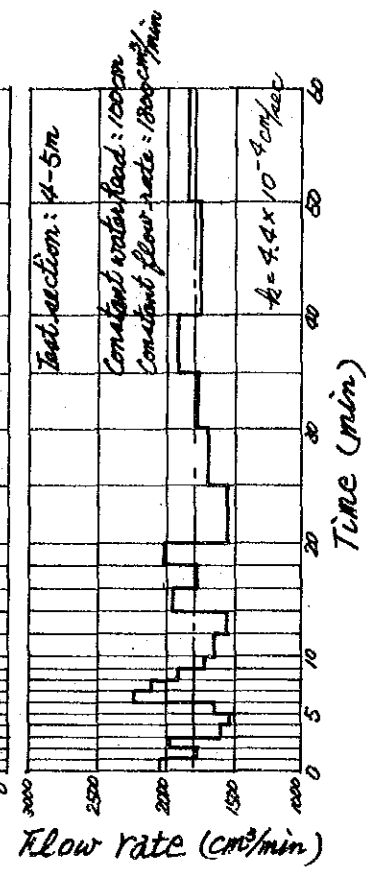
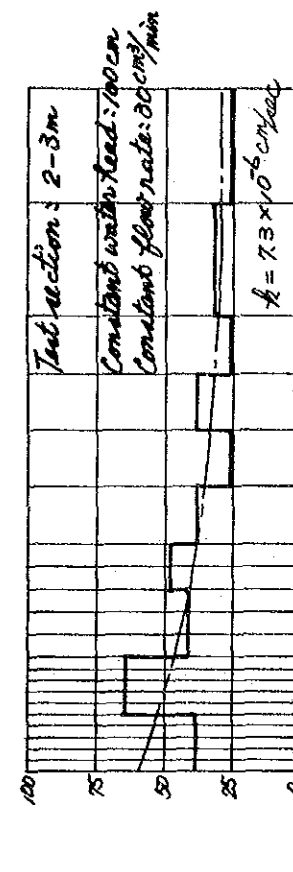
S85-4

Ground height: EL. 305.56 m
Ground water table: 19.7 m in depth
Internal diameter of casing: 7.62 cm



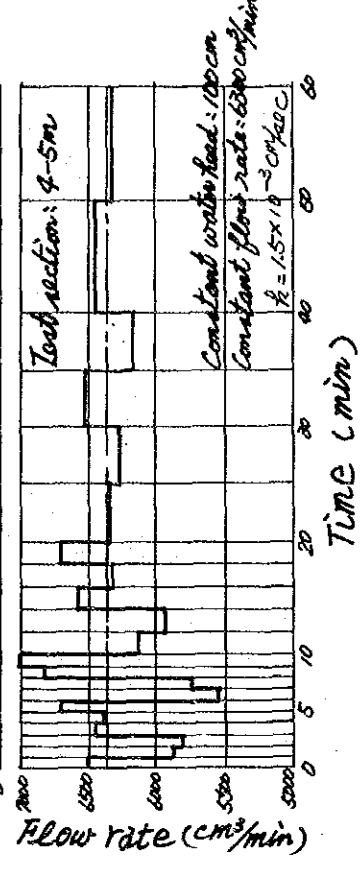
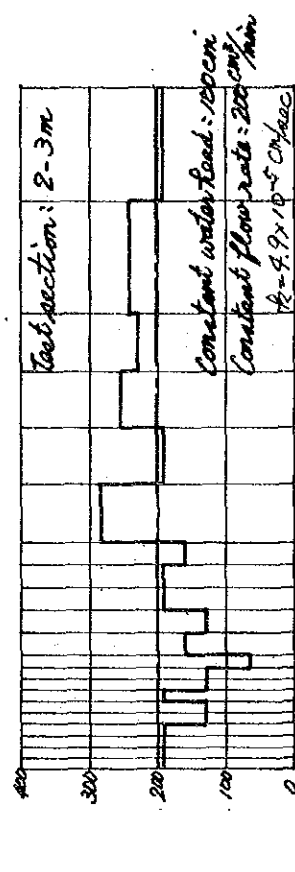
T-1

Ground height: EL.
Internal diameter of test hole: 60 cm



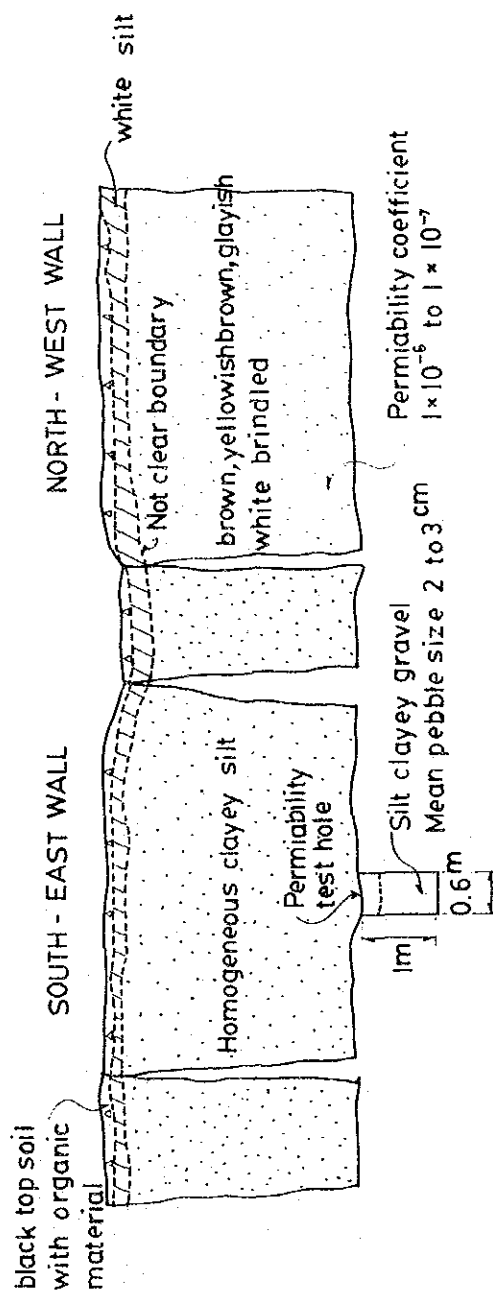
T-2

Ground height: EL.
Internal diameter of test hole: 60 cm

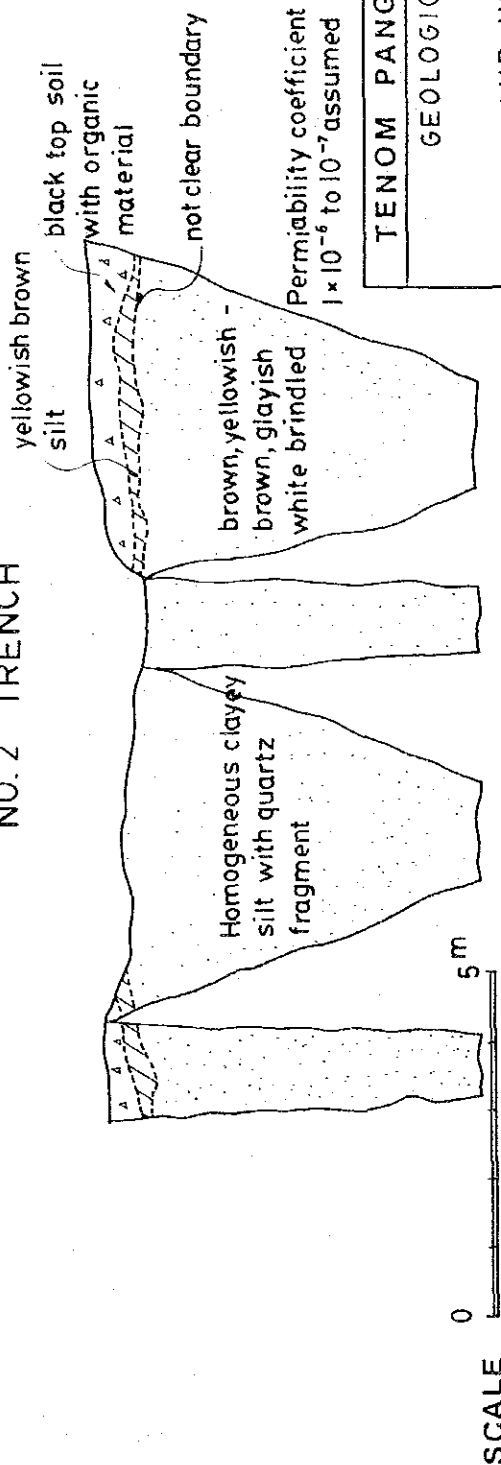


GEOLOGICAL SKETCH OF TRENCH

NO.1 TRENCH



NO. 2 TRENCH



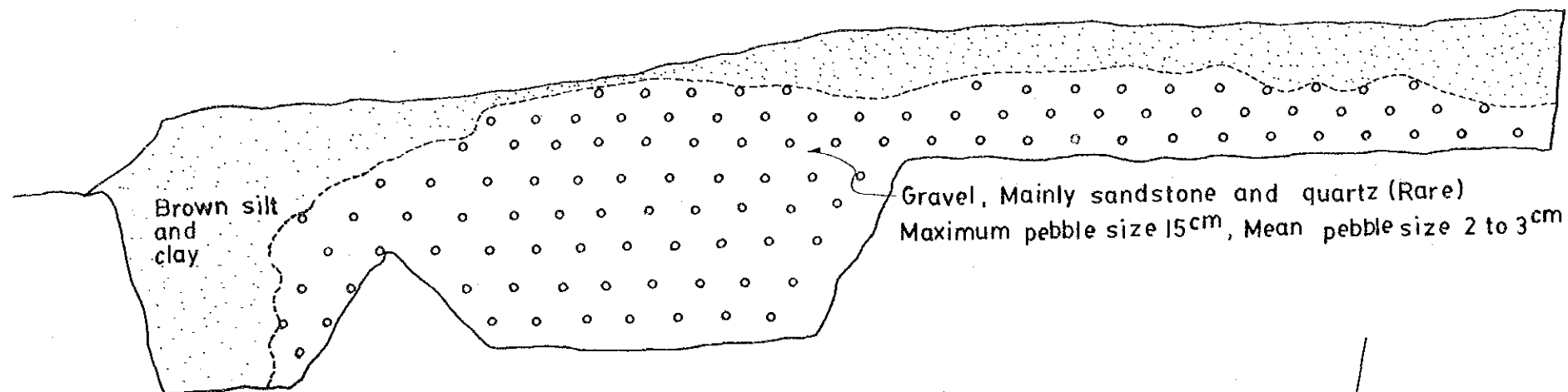
TENOM PANGI PHASE III

GEOLOGICAL SKETCH

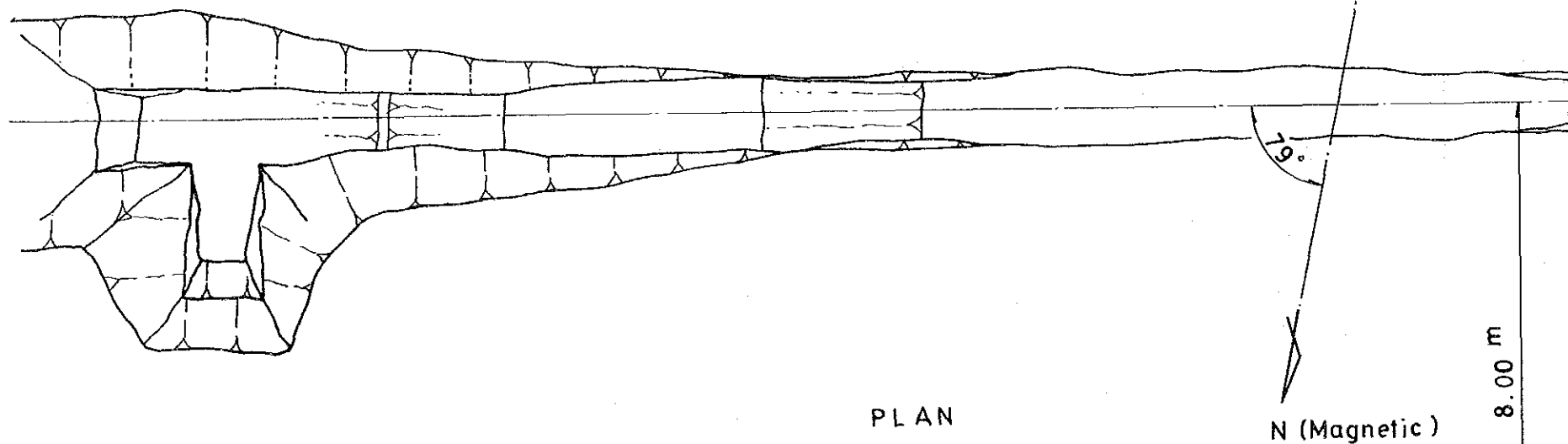
OF

NO.1 AND NO.2 TRENCHES

SEB / JICA



SKETCH OF SOUTH WALL



PLAN

SCALE 0 5 m

TENOM PANGI PHASE III
GEOLOGICAL SKETCH OF NO.3 TRENCH
SEB / JICA

