CHAPTER XIII RECOMMENDATIONS

The Project was studied in detail and the documents for international tendering were prepared. The cost for the Project was newly estimated and is reported under "Confidential" cover.

Seeing these study results, the study team recommends that the Project as the first phase of 80 km of the Trans Island Highway be commenced as soon as possible to achieve the National Goal. Other technical recommendations for the Project are given below :

1. The importance of establishing a proper maintenance system and organization after completion of the Project with particular attention to the construction on swamp and soft ground.

   As with any road, the project road will require proper maintenance in the future, to ensure continuing traffic safety. Such maintenance is required irrespective of construction method and quality. For this reason, maintenance teams, provided with necessary equipment, should be assigned at suitable locations. Road sections crossing poor ground, such as swamp land or soft material, will need particularly careful monitoring and appropriate maintenance in the future. Potential problems can be minimized at the construction stage, but such maintenance cannot be avoided altogether. These points will be covered in a maintenance manual which will be prepared during the construction stage.

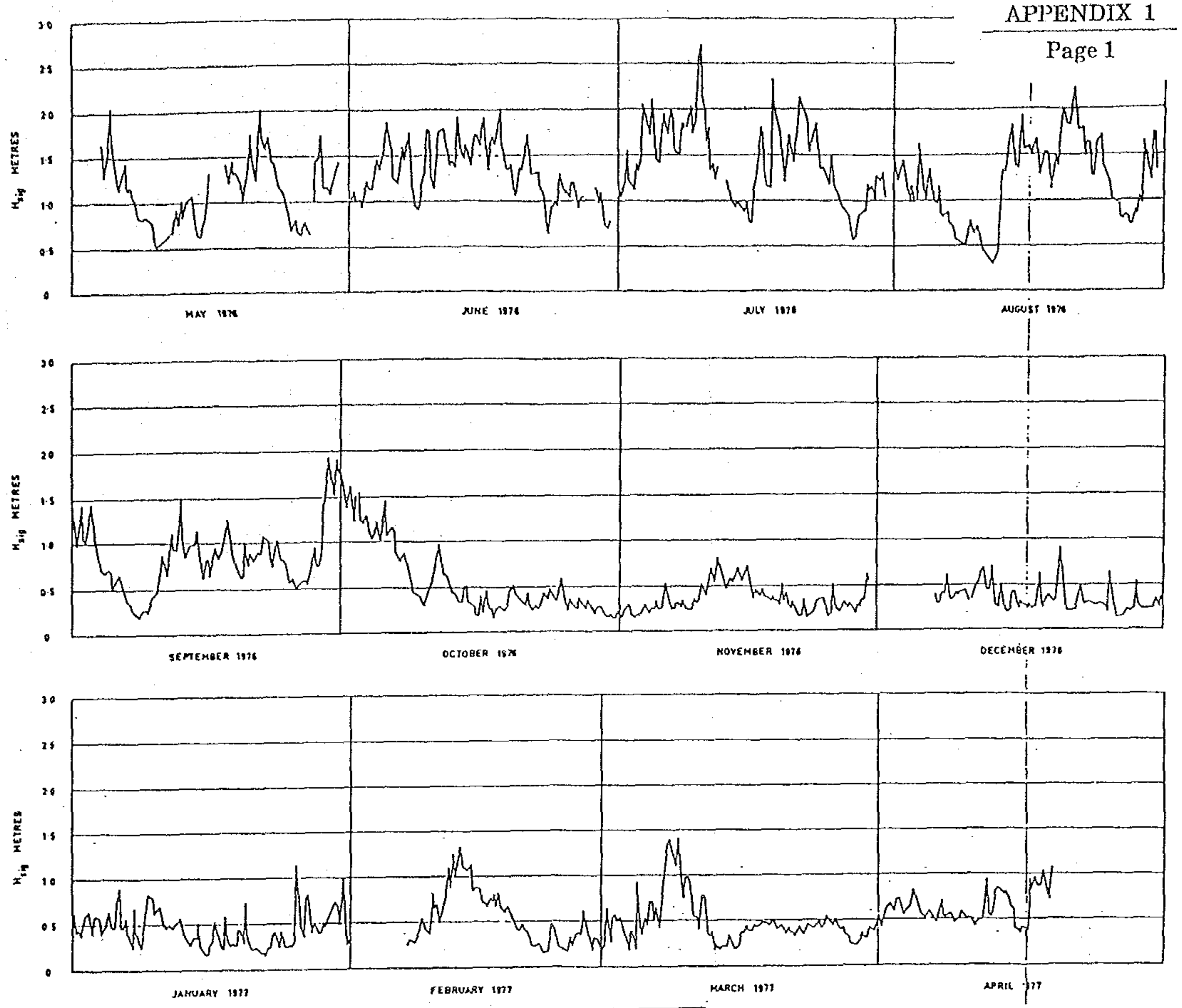
2. The importance of future hydrological observation on a continuous basis to monitor flood regimes based upon much longer term records.

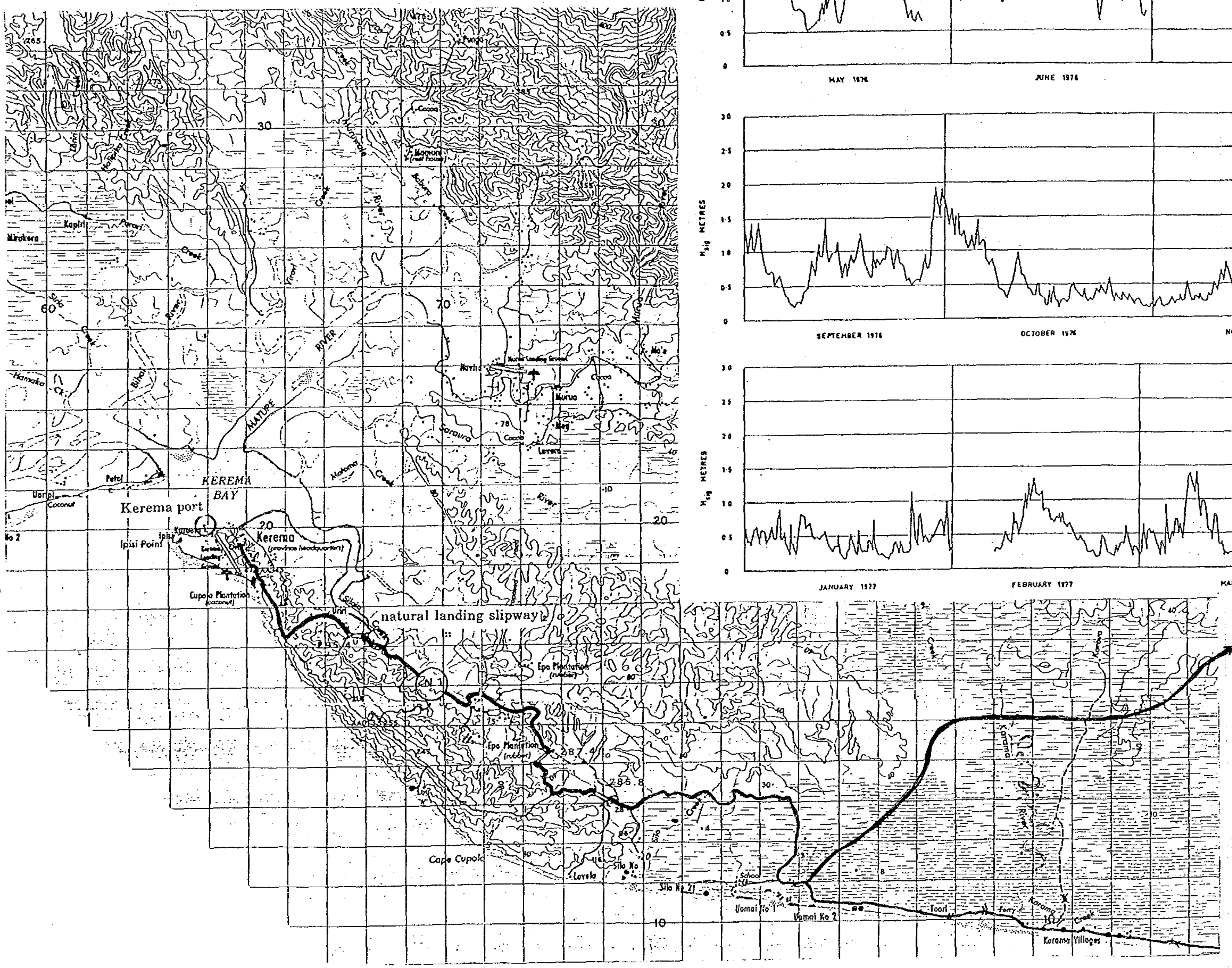
   The hydrological and hydraulic analyses were based on the limited data and topographical maps available to the study team; detailed large scale maps covering the flood areas were not available. The use of limited records meant that assumptions had to be made in the flood water level analysis. Although the study team took every care to ensure the accuracy of the analyses, it is advisable that the validity of the assumptions and the analysis be checked by continued observation of water levels on the following rivers: (1) Miaru River (2) Kapuri River (3) Lakekamu River (4) Tauri river. Furthermore, the performance of drainage pipes and culverts should be checked regularly.

3. The necessity for countermeasure against possible scouring of bridge pier foundations including necessary protection of river banks, after completion of the Project.

   Local scouring of riverbeds and erosion of banks always occurs in rivers flowing through alluvial deposits. These problems are particularly likely following alterations to flow patterns, for example due to the construction of a bridge pier. Therefore regular inspections should be made of likely areas of scouring; rock dumping around pier foundations and river protection works will be necessary if these inspections discover incipient problems of this nature. Further details can be included in the maintenance manual.

CONTENTS OF APPENDICES





Source : WABO POWER PROJECT

WAVE HEIGHTS RECORDED BY WAVERIDER BUOY AT KEREMA
MAY 1976 TO APRIL 1977

FIGURE F-16

Fig.2 - 1 WAVE HEIGHT ON THE COAST

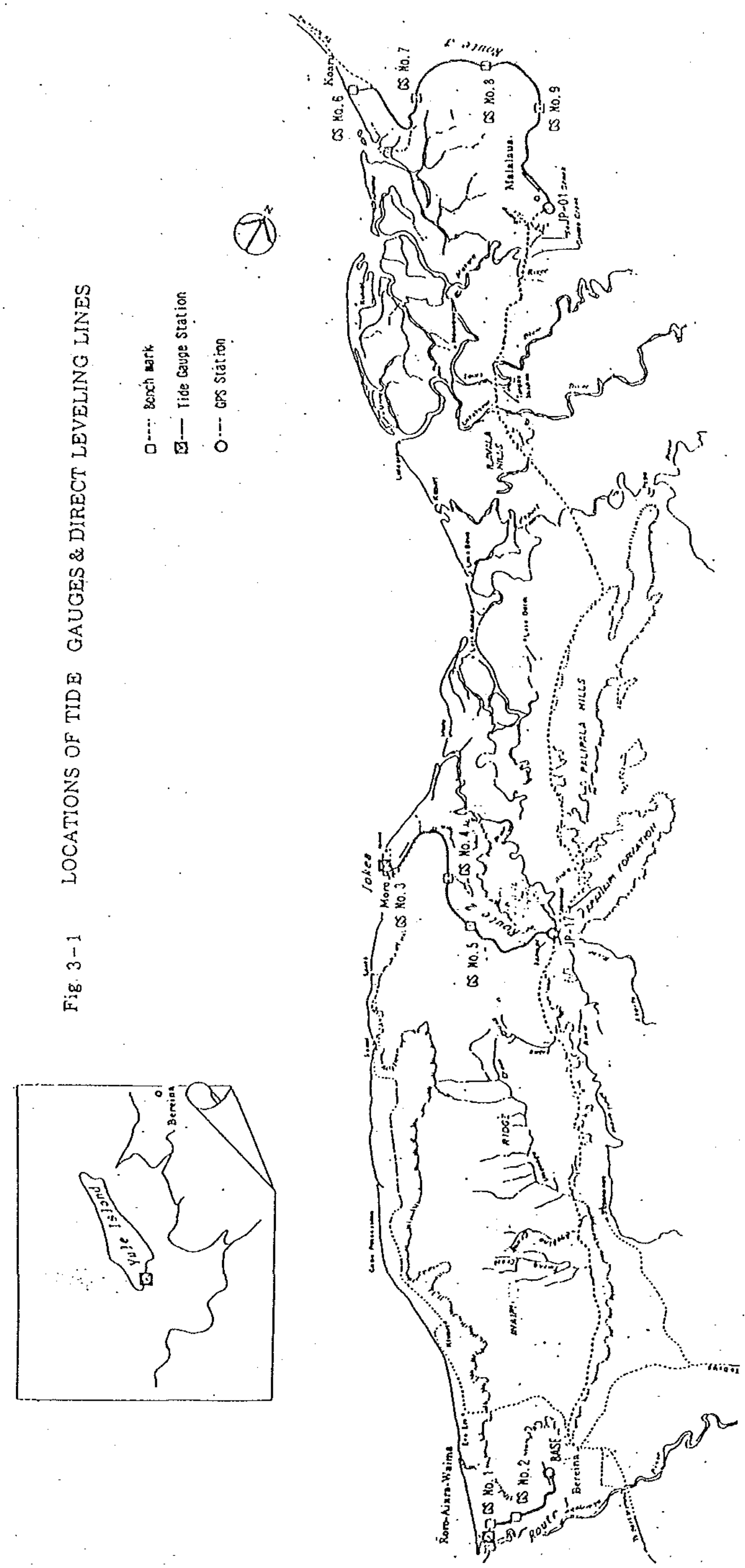
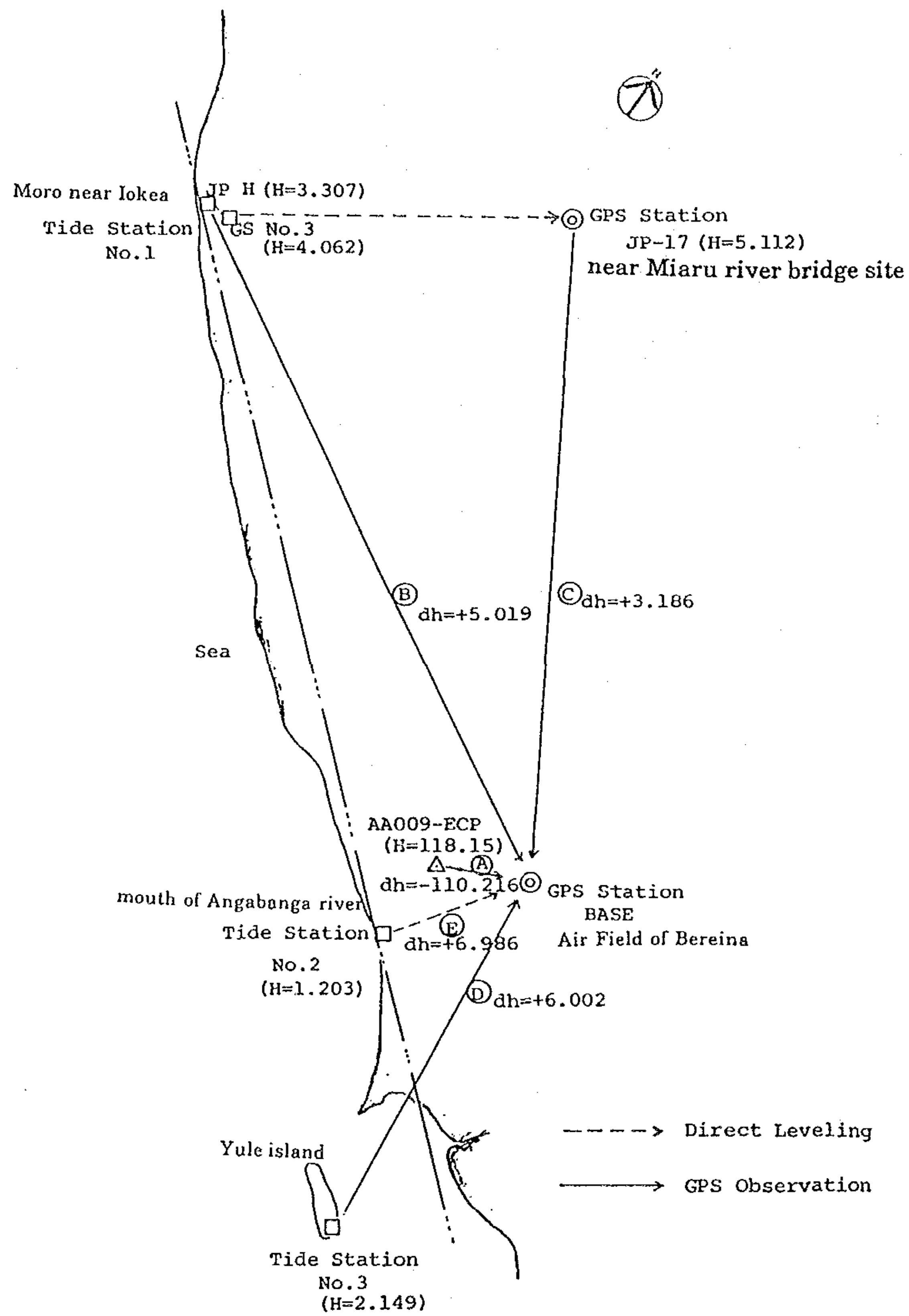


Fig. 3-1 LOCATIONS OF TIDE GAUGES & DIRECT LEVELING LINES

Fig 3-2 ELEVATION SURVEY (A TO E LINES)



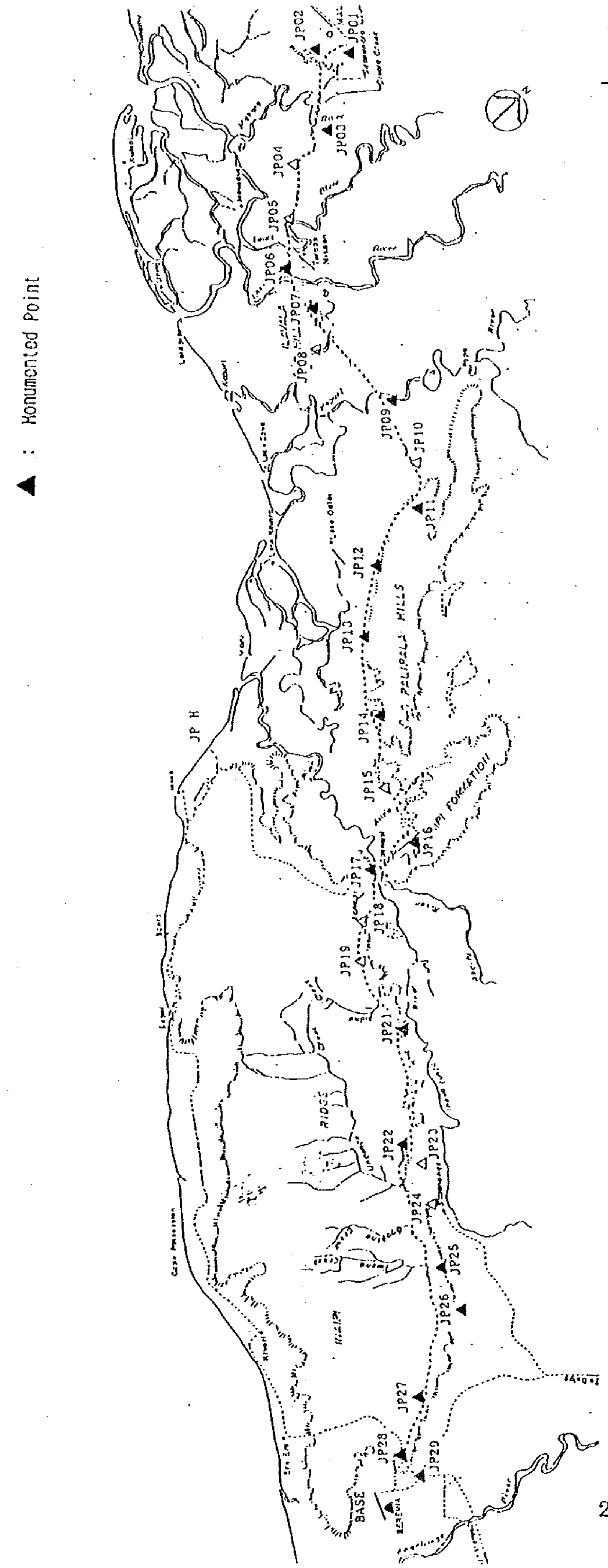
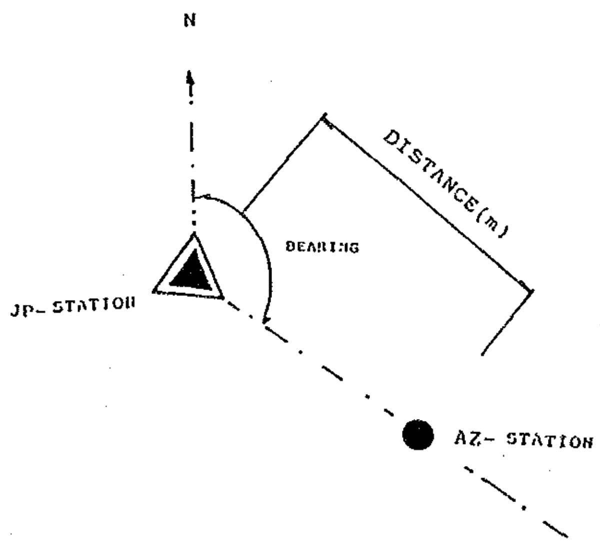


Fig.3-3 LOCATIONS OF 20 MONUMENTED CONTROL POINTS

Table 3-3. AZIMUTH OF PHOTO SIGNALS

STATION	BEARING	DISTANCE(m)
JP-01(AZ-01)	311 36 38.17	534.370
JP-02(AZ-02)	53 58 20.66	400.247
JP-03(AZ-03)	324 44 47.09	192.553
JP-06(AZ-06)	7 34 42.77	237.100
JP-07(AZ-07)	157 40 23.47	470.864
JP-09(AZ-09)	88 21 51.81	185.966
JP-11(AZ-11)	9 42 31.66	377.928
JP-12(AZ-12)	166 14 55.37	285.380
JP-13(AZ-13)	339 35 26.53	300.504
JP-14(AZ-14)	145 36 29.57	226.668
JP-16(AZ-16)	180 12 52.30	169.327
JP-17(AZ-17)	140 48 12.56	123.810
JP-21(AZ-21)	253 50 20.52	146.071
JP-22(AZ-22)	291 55 47.90	216.000
JP-25(AZ-25)	62 06 42.06	161.005
JP-26(AZ-26)	68 55 37.20	187.086
JP-27(AZ-27)	153 10 07.36	133.008
JP-28(AZ-28)	75 47 14.57	374.009
JP-29(AZ-29)	36 28 29.87	277.273



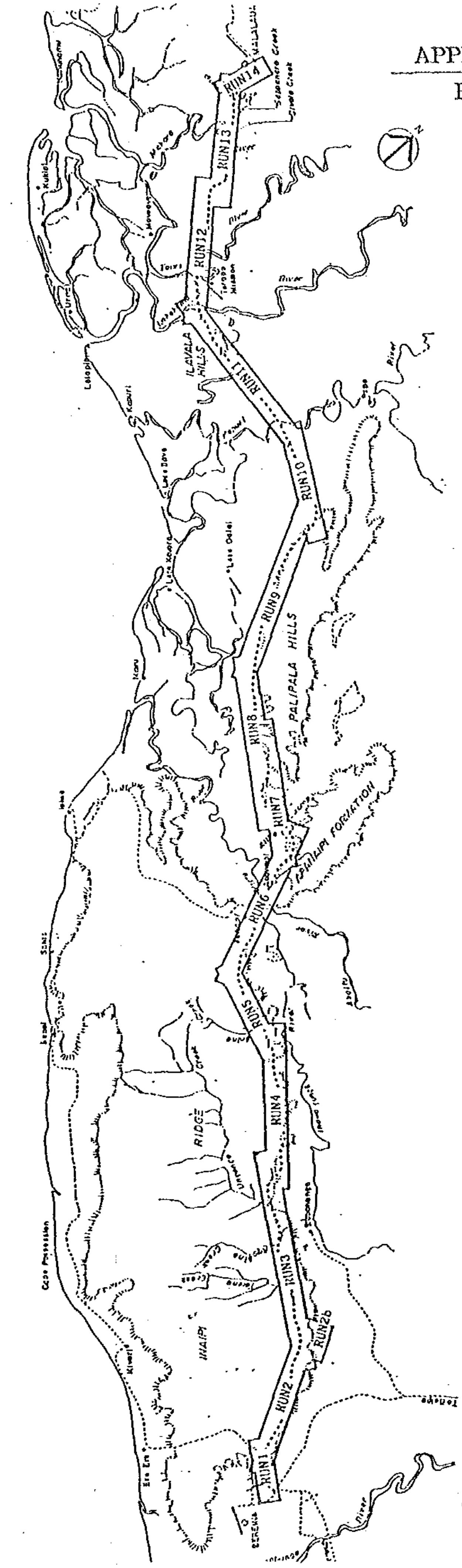
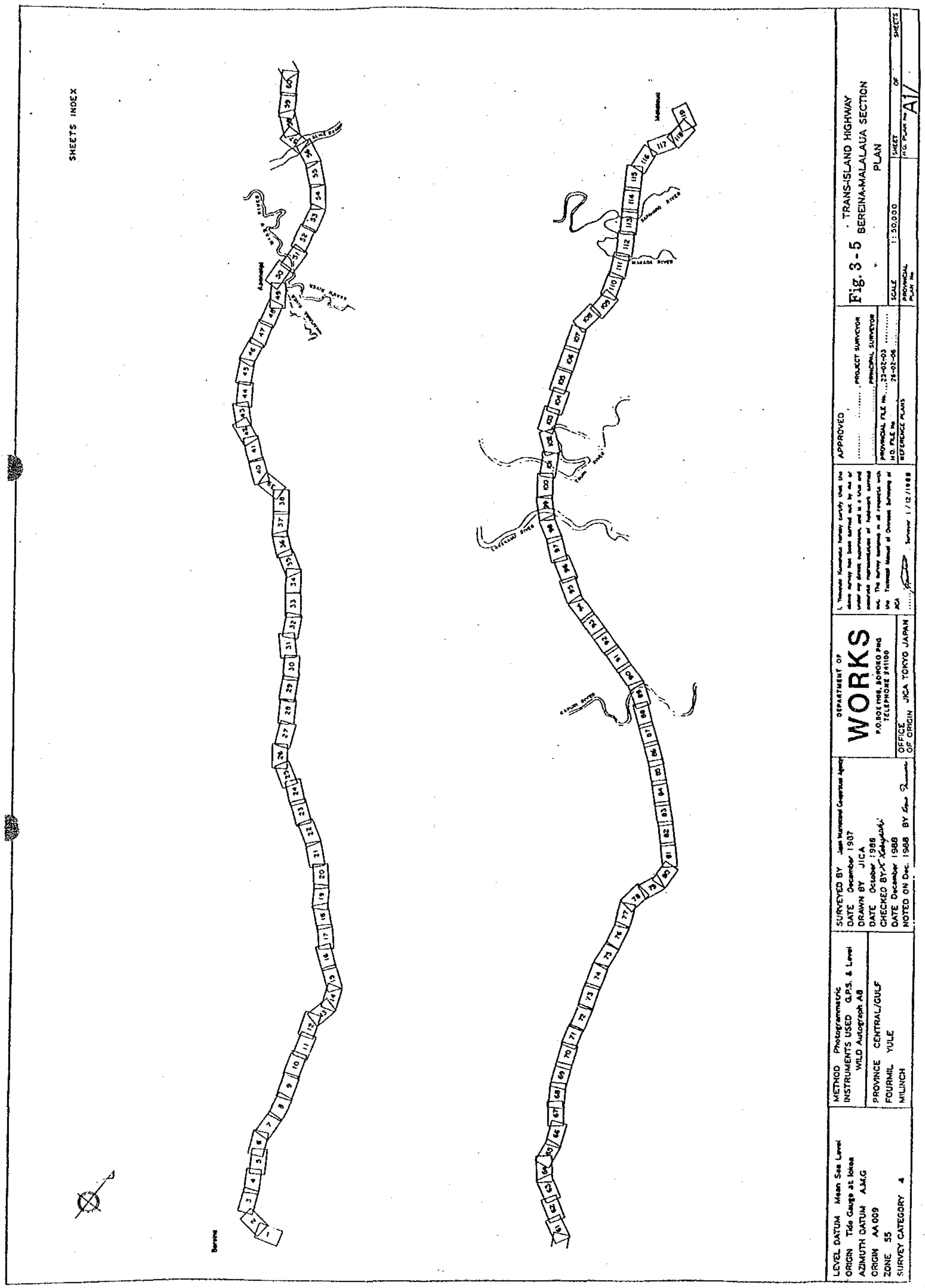
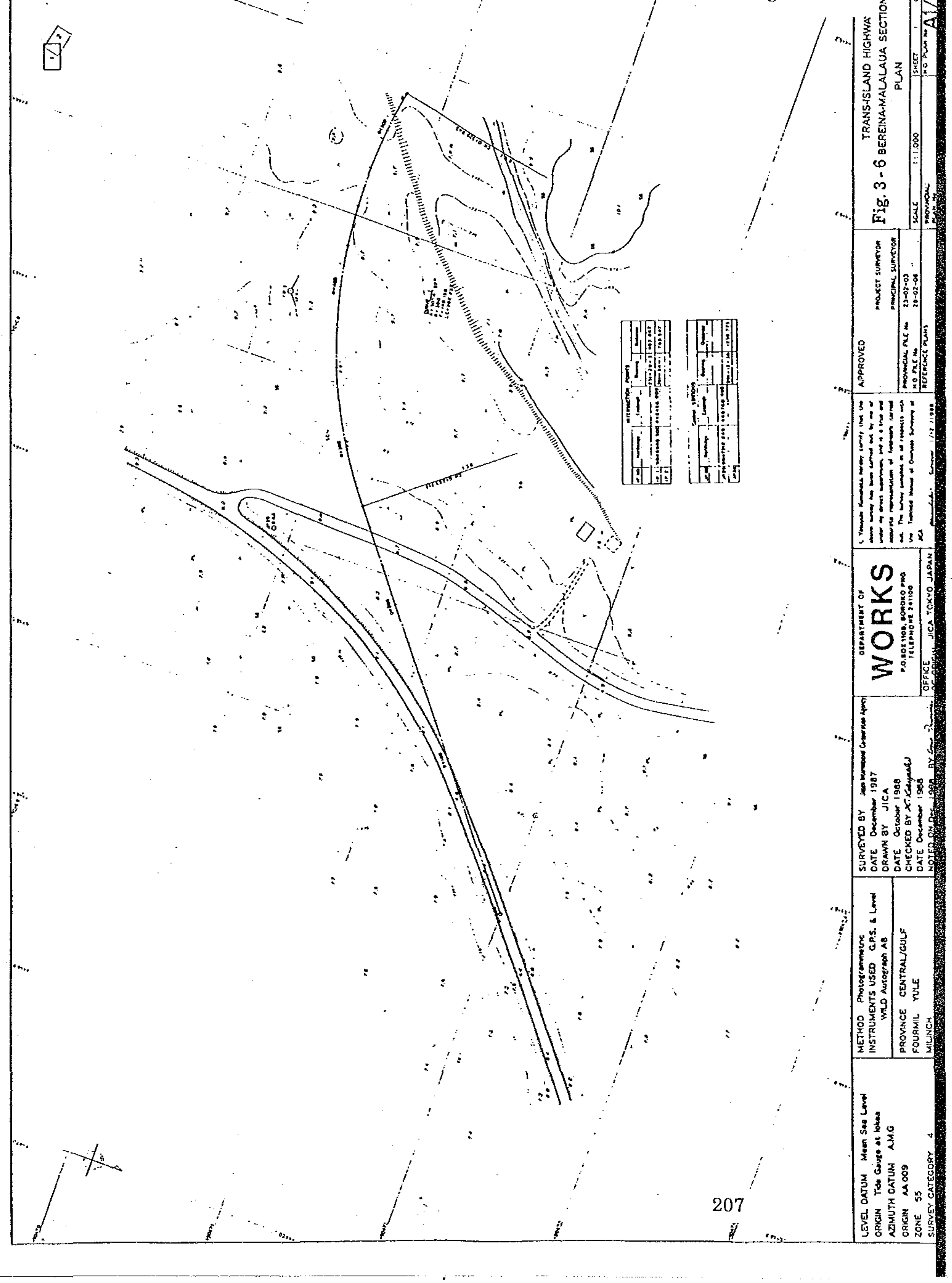


Fig.3-4 14 COURSES FOR AERIAL PHOTO GRAPHY


SHEETS INDEX
LEVEL DATUM Mean Sea Level
ORIGIN Tide Gauge at Iokea
AZIMUTH DATUM A.M.G
ORIGIN AA 009
ZONE 55
SURVEY CATEGORY 4
METHOD Photogrammetric
INSTRUMENTS USED G.P.S. & Level
WILD Autograph A8
PROVINCE CENTRAL/GULF
FOURMIL YULE
MILINCH
DRAWN BY JICA
DATE October 1988
DATE December 1988
DEPARTMENT OF
WORKS
OFFICE OF ORIGIN JICA TOKYO JAPAN
APPROVED
PROJECT SURVEYOR
PRINCIPAL SURVEYOR
REFERENCE PLANS
SCALE 1:50,000
Fig. 3-5 TRANS-ISLAND HIGHWAY
BEREINA-MALALAUA SECTION
PLAN


LEVEL DATUM Mean Sea Level
ORIGIN Tide Gauge at Iokea
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ORIGIN AA 009
ZONE 55
SURVEY CATEGORY 4
METHOD Photogrammetric
INSTRUMENTS USED G.P.S. & Level
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SCALE 1:1,000
Fig. 3-6 TRANS-ISLAND HIGHWAY
BEREINA-MALALAUA SECTION
PLAN

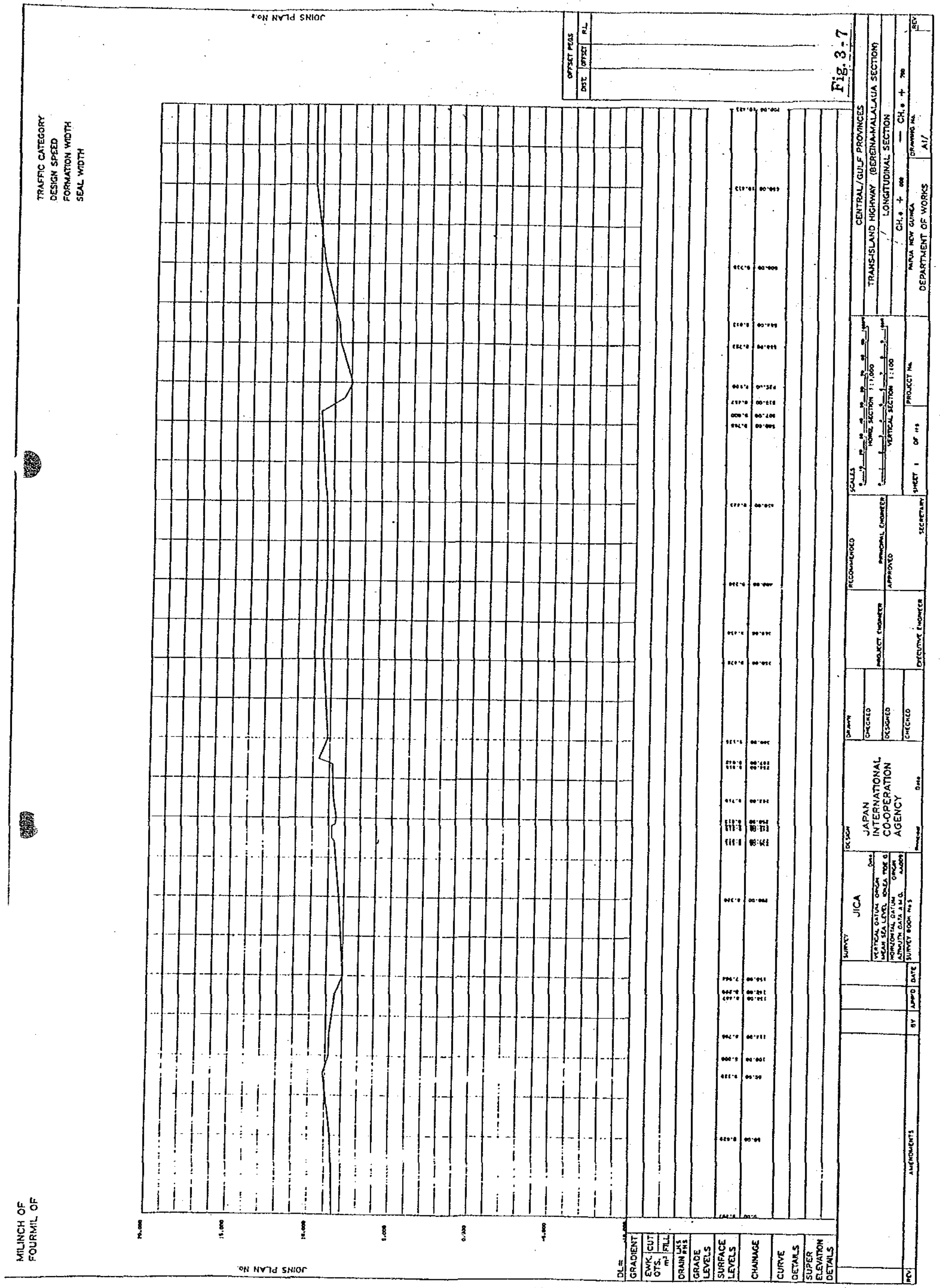


Fig. 3-7
CENTRAL/GULF PROVINCES
TRANS-ISLAND HIGHWAY (BEREINA-MALALAUA SECTION)
LONGITUDINAL SECTION
PAPUA NEW GUINEA
DEPARTMENT OF WORKS
JAPAN INTERNATIONAL CO-OPERATION AGENCY
JICA
TRAFFIC CATEGORY
DESIGN SPEED
FORMATION WIDTH
SEAL WIDTH
GRADIENT
GRADE LEVELS
SURFACE LEVELS
CHAINAGE
CURVE DETAILS
SUPER ELEVATION DETAILS
JOINS PLAN No.

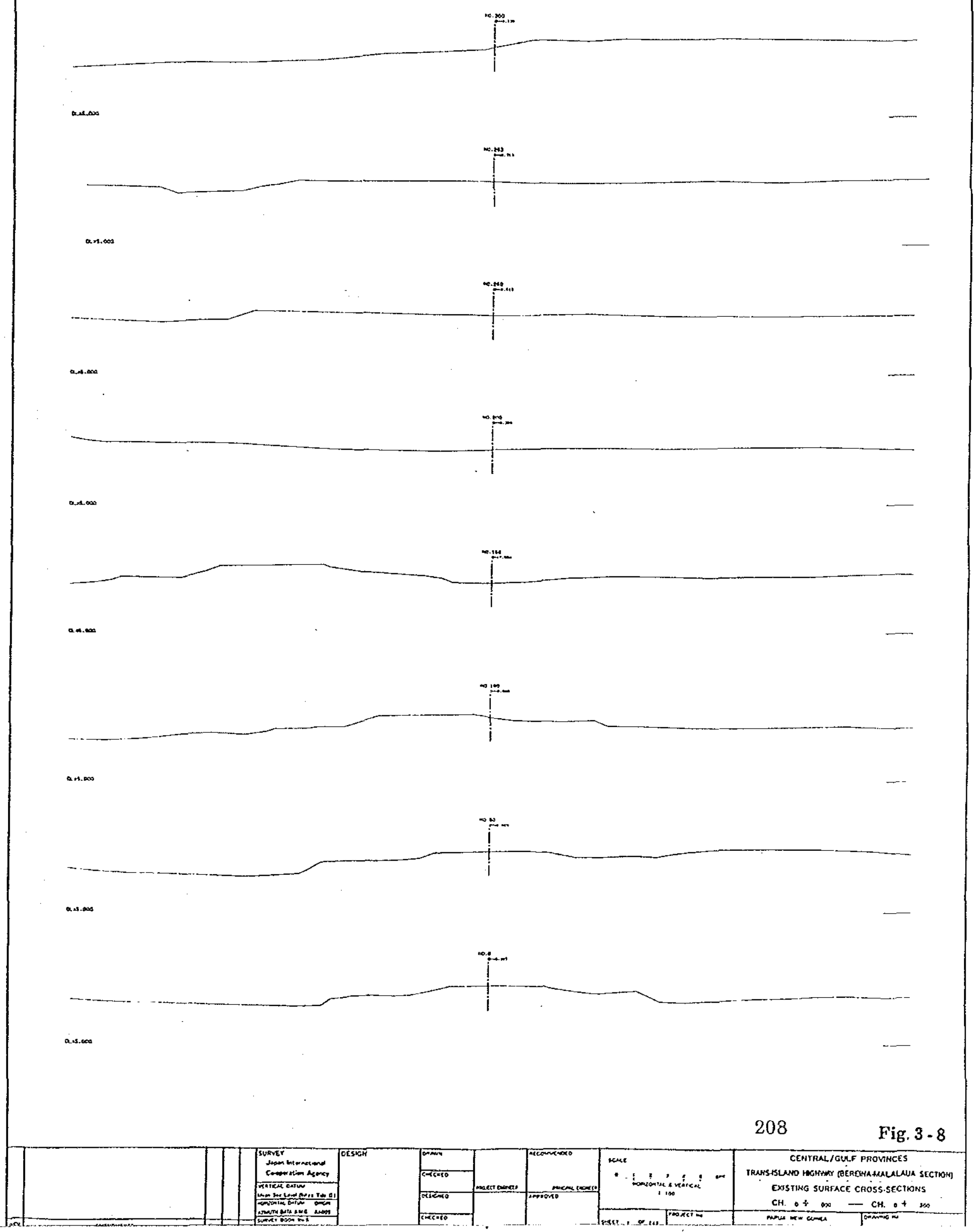

CENTRAL/GULF PROVINCES
TRANS-ISLAND HIGHWAY (BEREINA-MALALAUA SECTION)
EXISTING SURFACE CROSS-SECTIONS
SURVEY
Japan International Cooperation Agency
DESIGN
PAPUA NEW GUINEA

Fig. 3-8

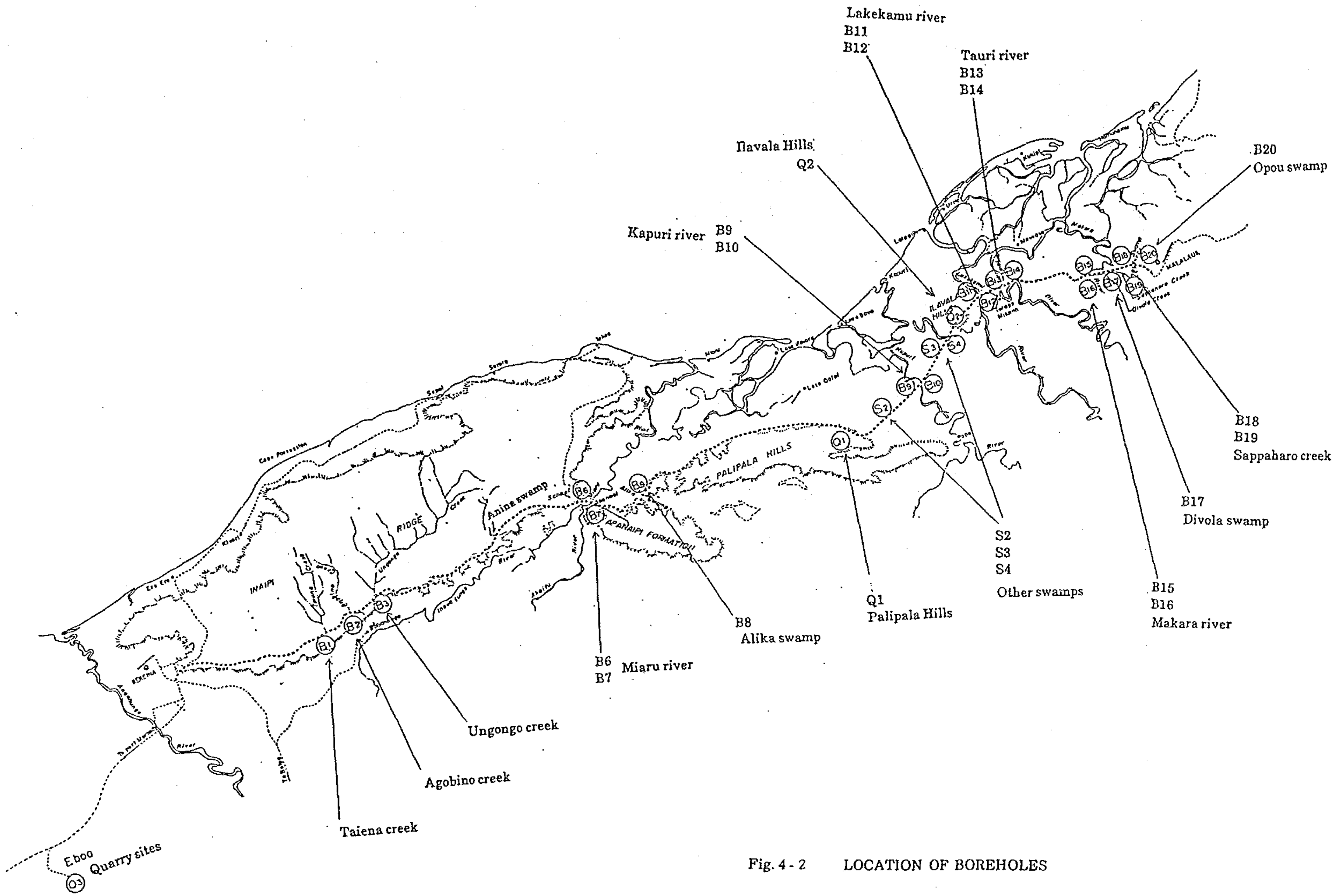


Fig. 4 - 2 LOCATION OF BOREHOLES

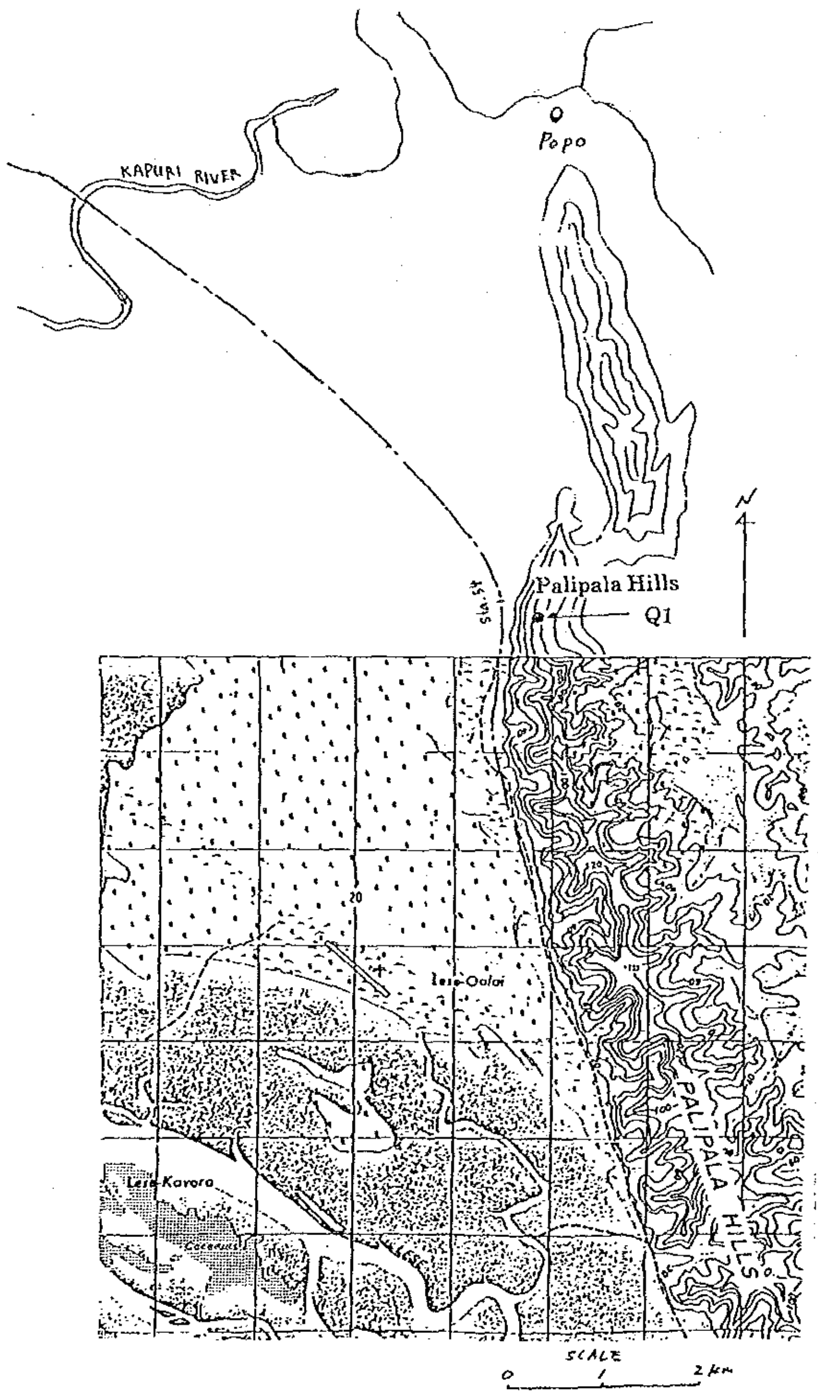


Fig. 4 - 3 LOCATION OF BOREHOLE Q1 (PALIPALA HILLS)

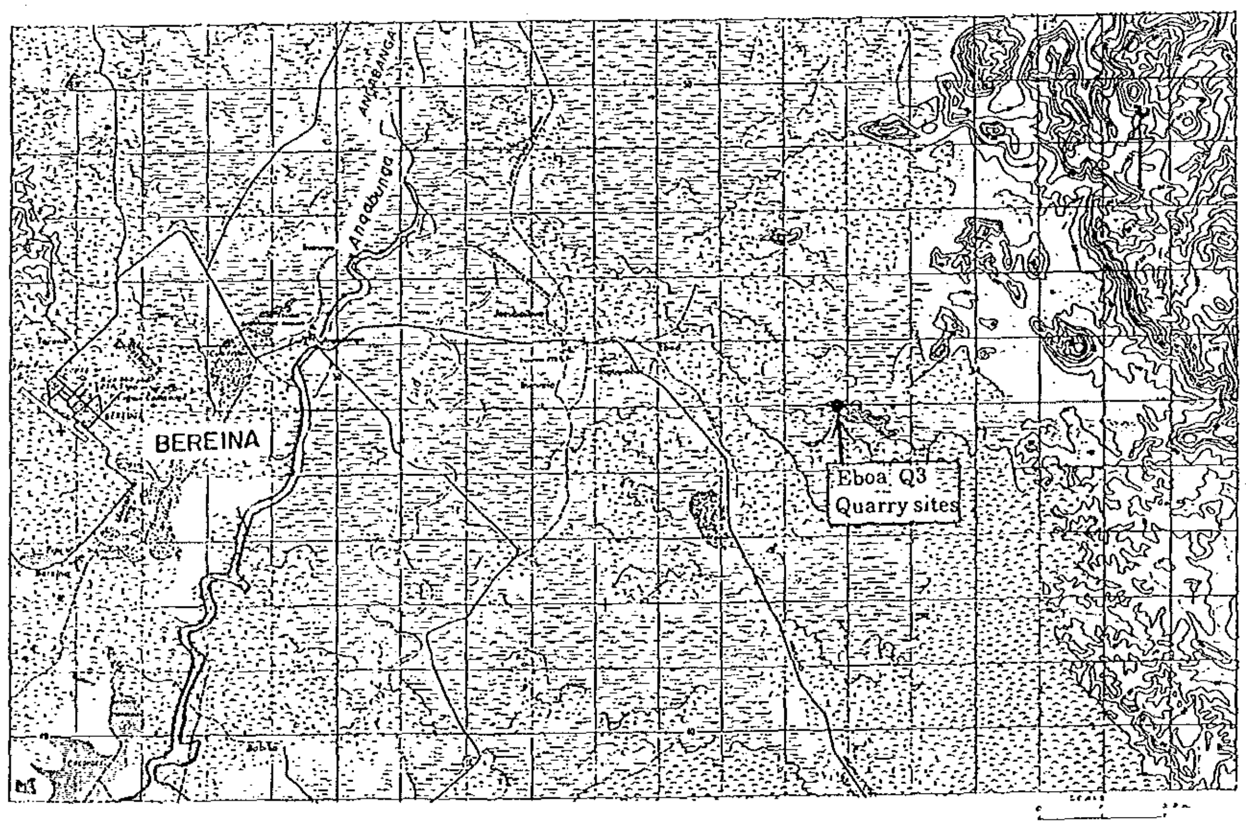


Fig. 4 - 5 LOCATION OF BOREHOLE Q3 (EBOA QUARRY SITE)

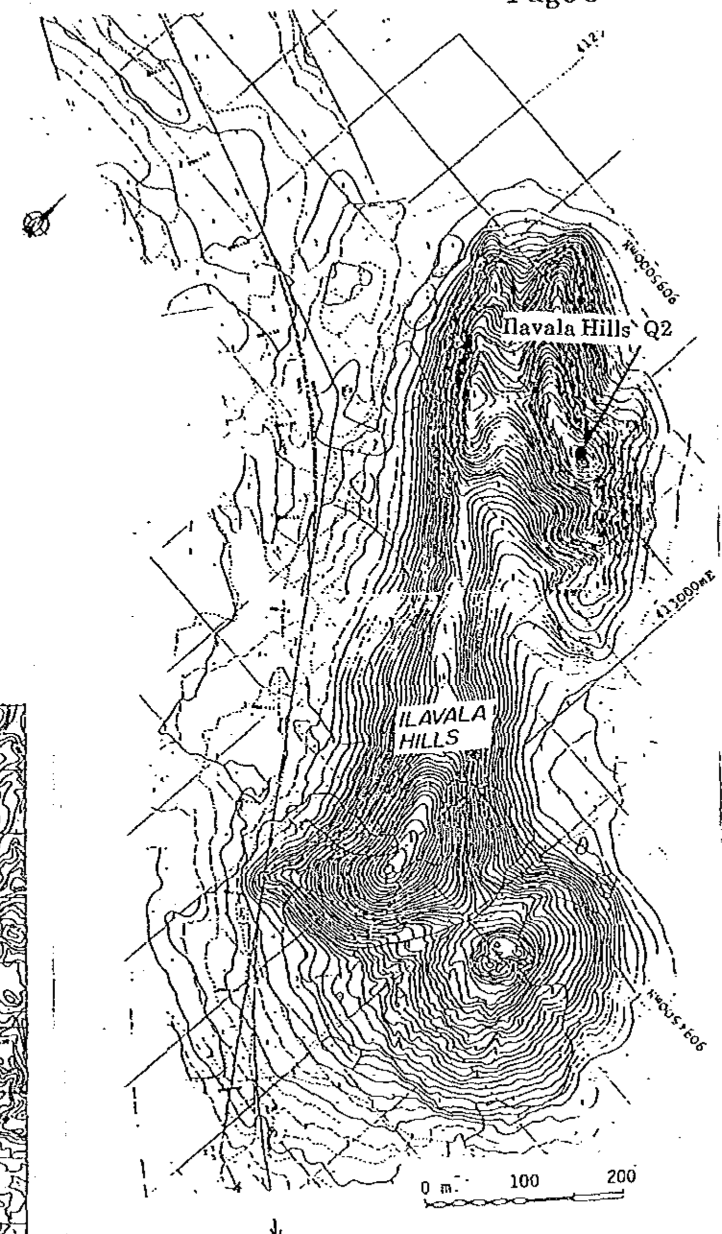


Fig. 4 - 4 LOCATION OF BOREHOLE Q2 (ILAVALA HILLS)

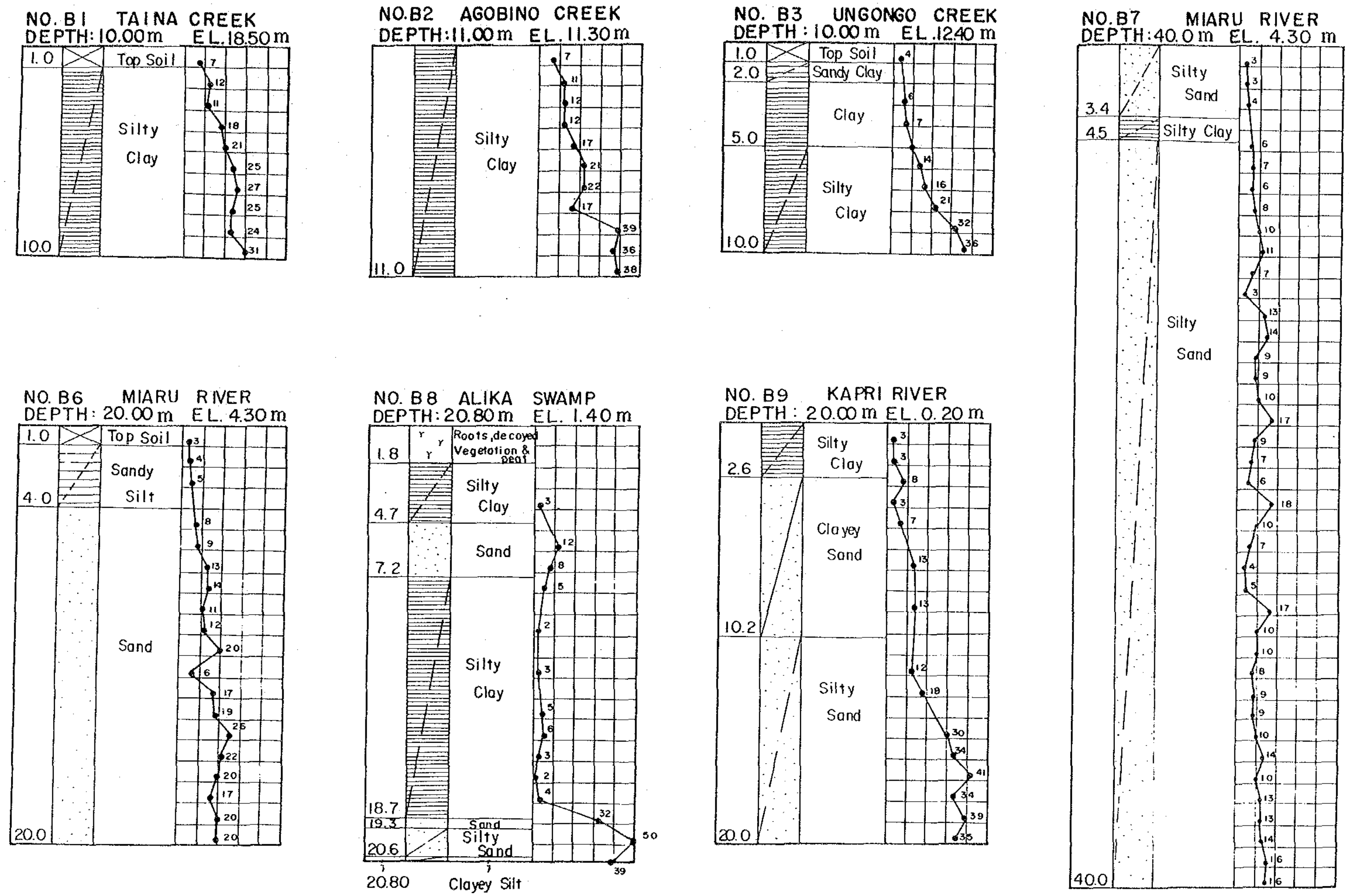
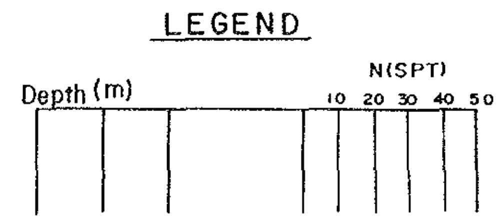


Fig. 4-6 SUMMARY OF DRILLING LOGS (1)



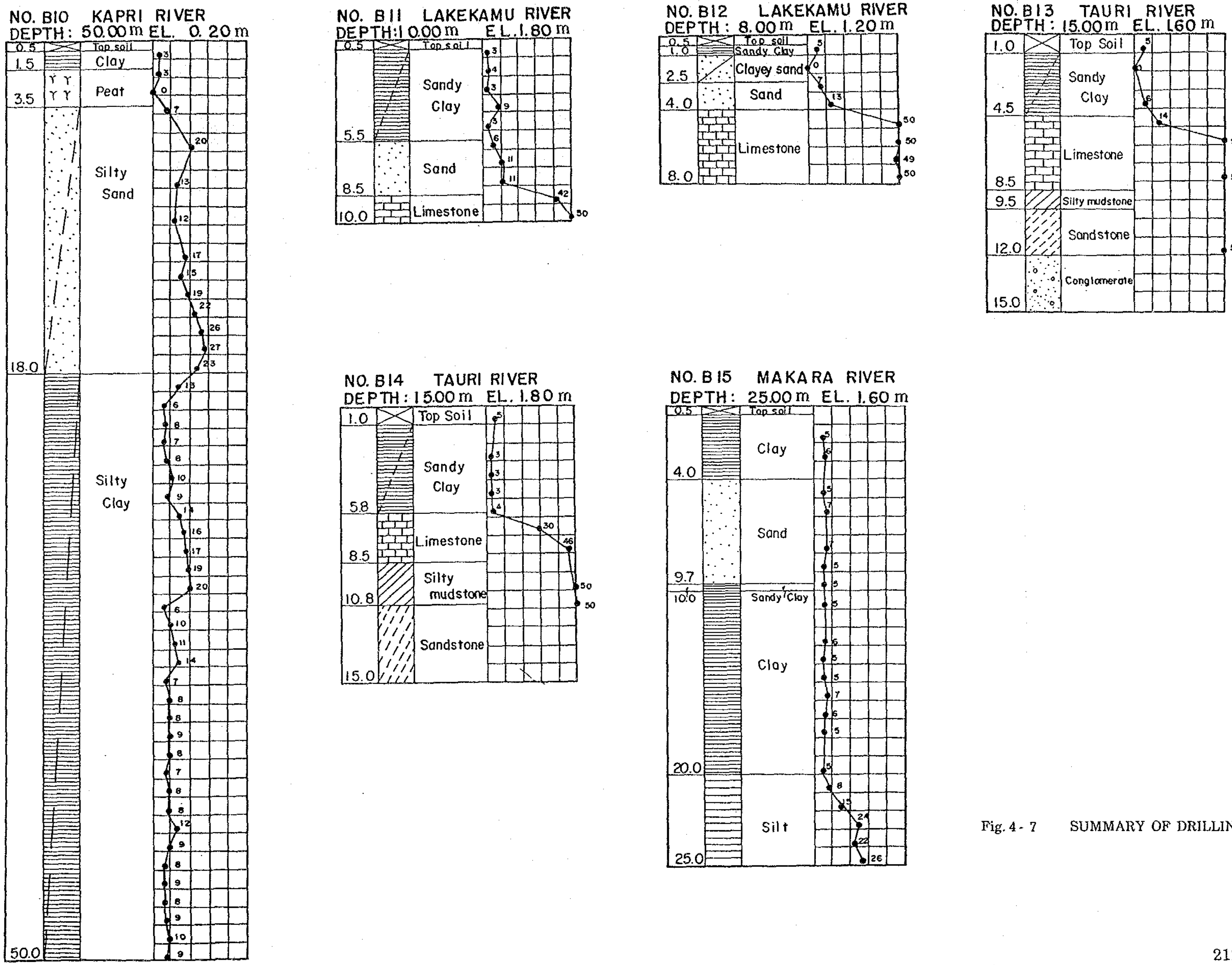


Fig. 4-7 SUMMARY OF DRILLING LOGS (2)

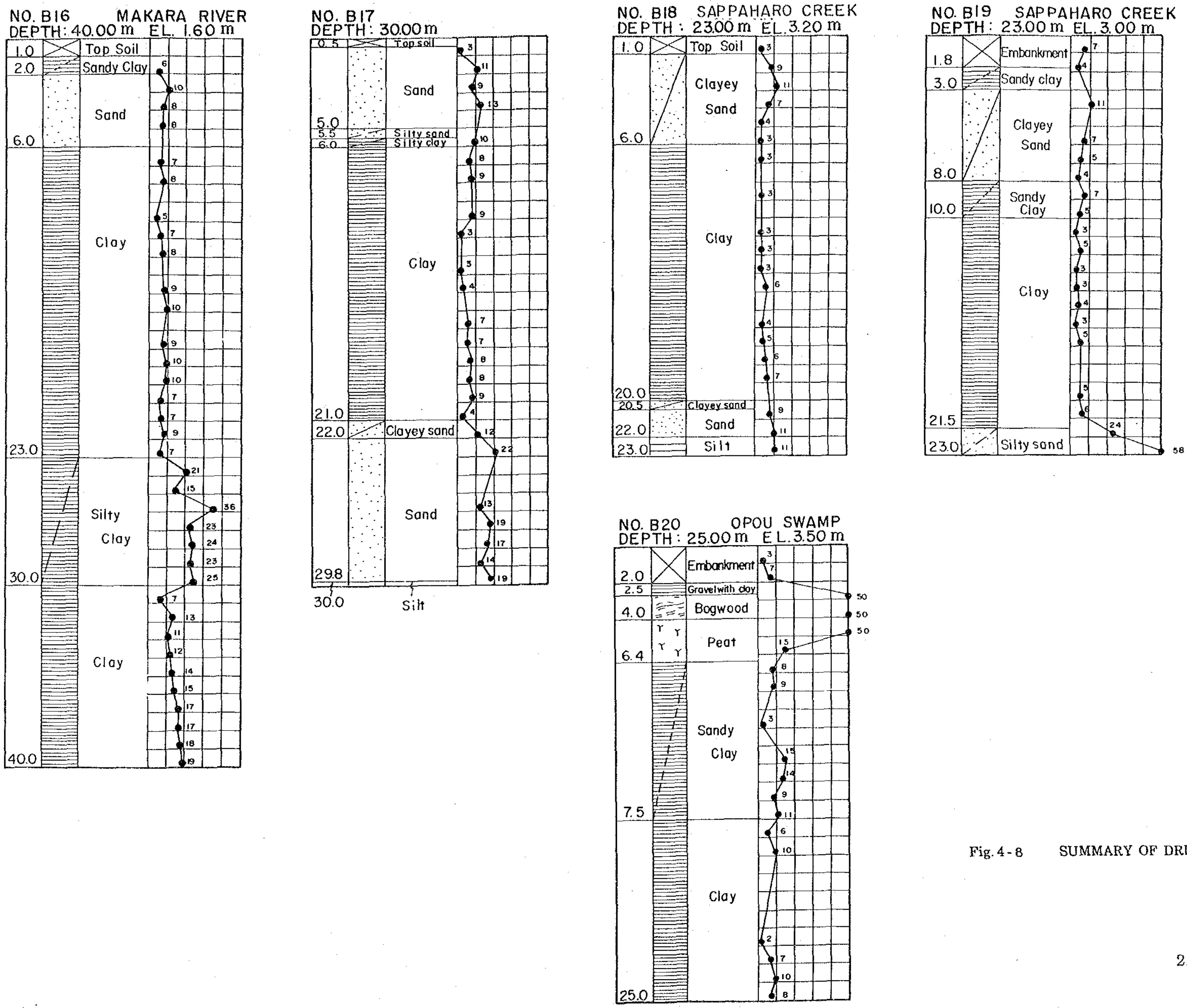


Fig. 4-8 SUMMARY OF DRILLING LOGS (3)

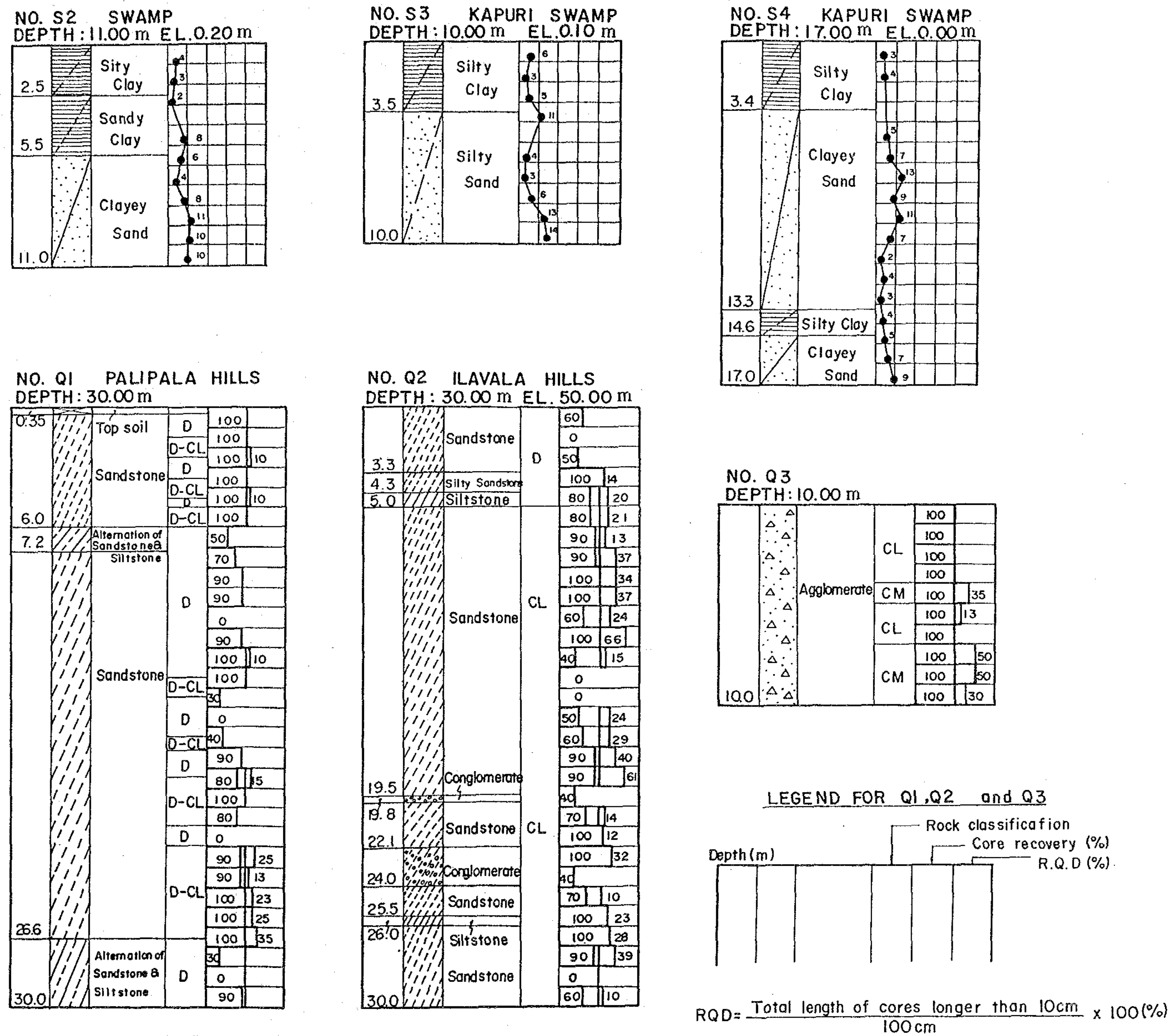


Fig. 4-9 SUMMARY OF DRILLING LOGS (4)

Table 4-3 SUMMARY OF PRESSIOMETER TEST RESULTS

HOLE NO.	TEST DEPTH (m)	WL (m)	Po (kg/cm^2)	Pf (kg/cm^2)	Pl (kg/cm^2)	E (kg/cm^2)	NOTES
B7	1.90	0.94	0.2	1.2	1.8	5.66	Silty sand N=3
B7	5.60	1.05	0.4	3.2	3.8	15.26	Silty sand N=6
B7	6.90	1.00	0.6	1.8	2.8	8.06	Silty sand N=6
B10	3.20	0.95	0.2	1.8	2.7	13.44	Peaty clay N=2
B11	5.20	0.89	0.25	1.25	2.0	8.92	Sandy clay N=3-6
B13	3.00	0.70	0.4	1.0	2.4	15.26	Sandy clay N=4
B14	3.50	0.70	0.4	1.0	1.7	5.00	Sandy clay N=1
B18	6.30	0.67	0.2	2.4	3.1	21.50	Clay N=3
B20	7.50	0.80	0.75	1.75	2.50	9.37	Sandy clay N=8-9

WL : Water level in borehole

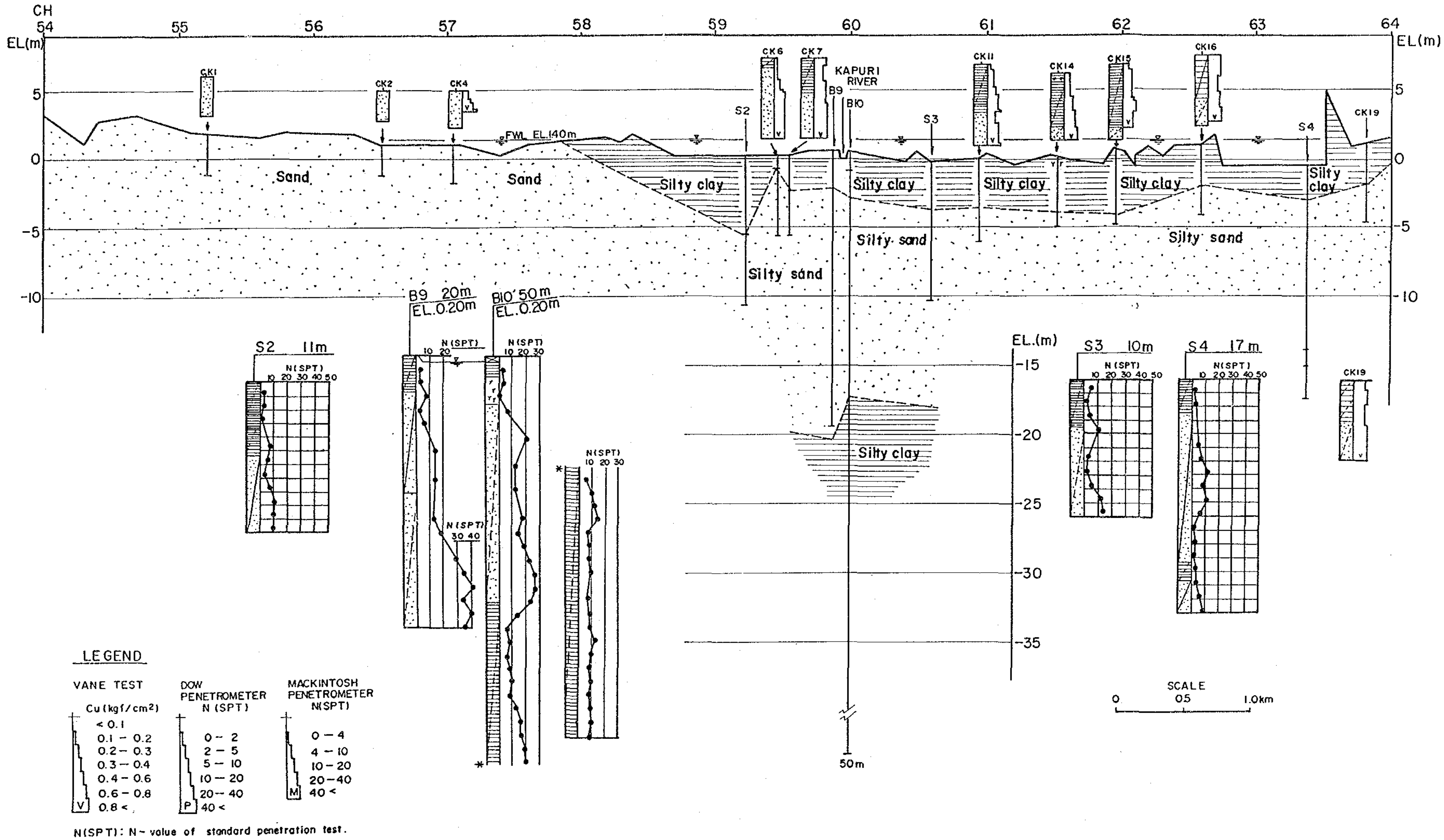


Fig. 4-10 SCHEMATIC GEOLOGICAL PROFILE (KAPURI SWAMP)

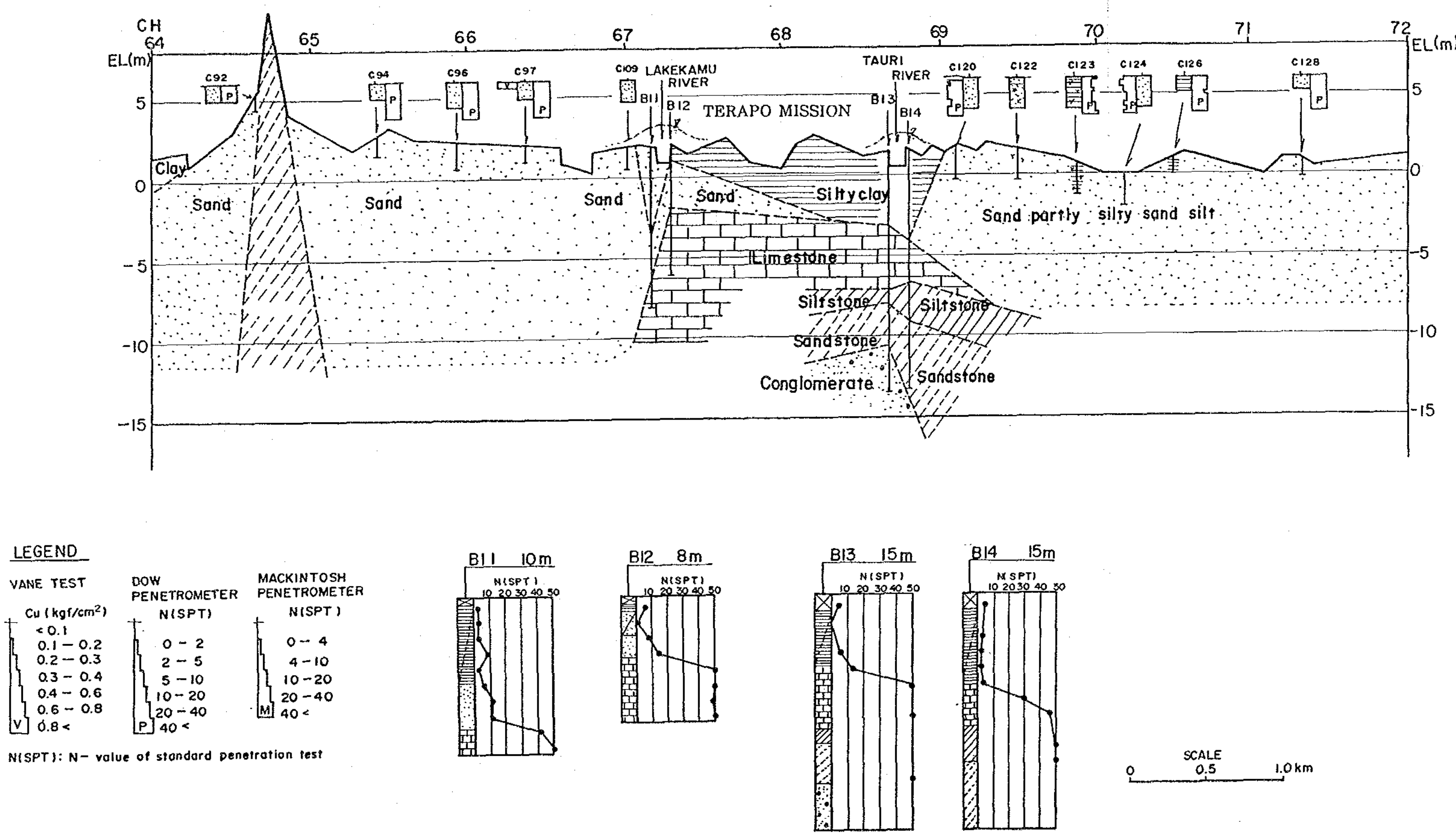


Fig. 4-11 SCHEMATIC GEOLOGICAL PROFILE (TERAPO MISSION)

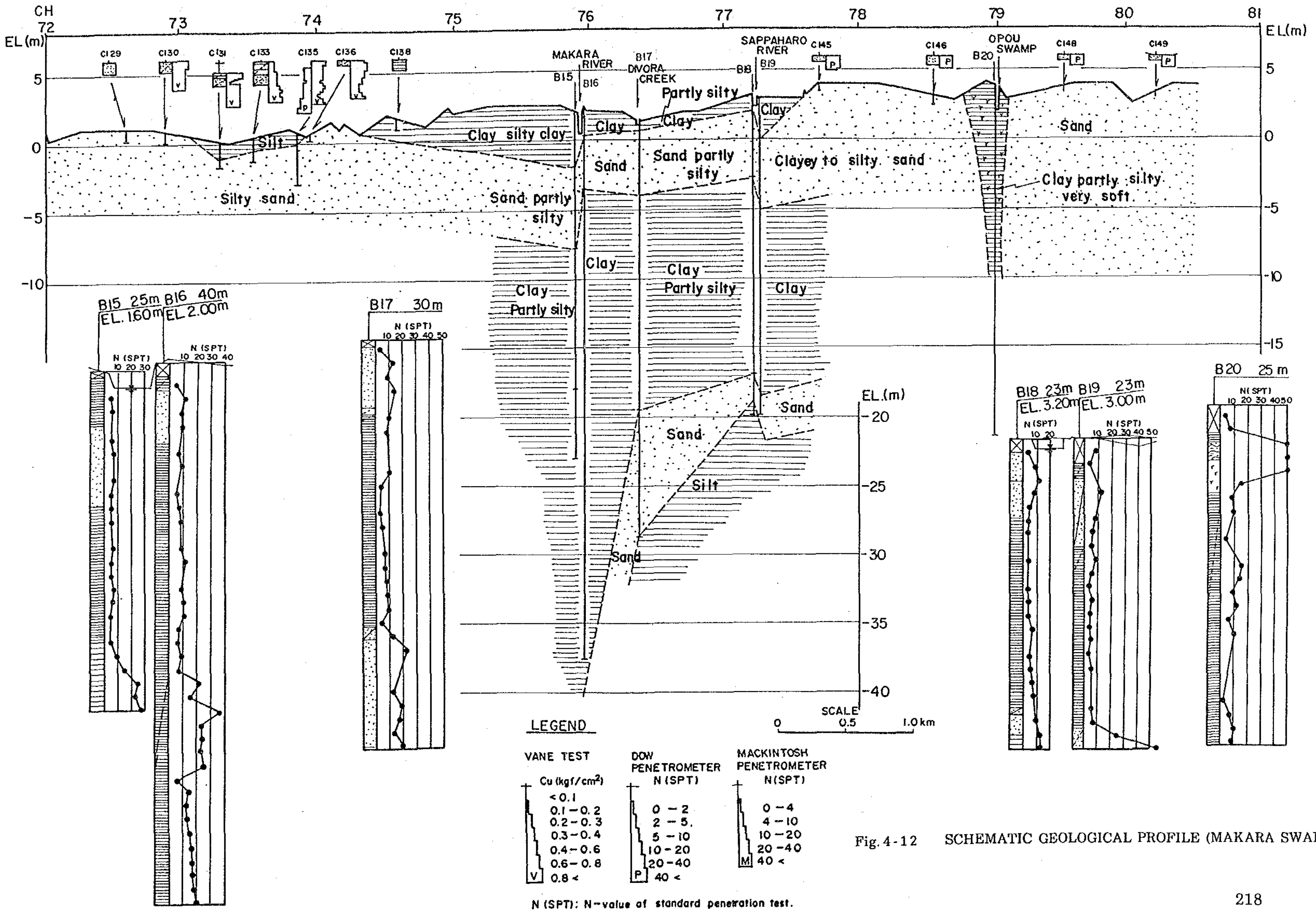


Fig. 4-12 SCHEMATIC GEOLOGICAL PROFILE (MAKARA SWAMP)

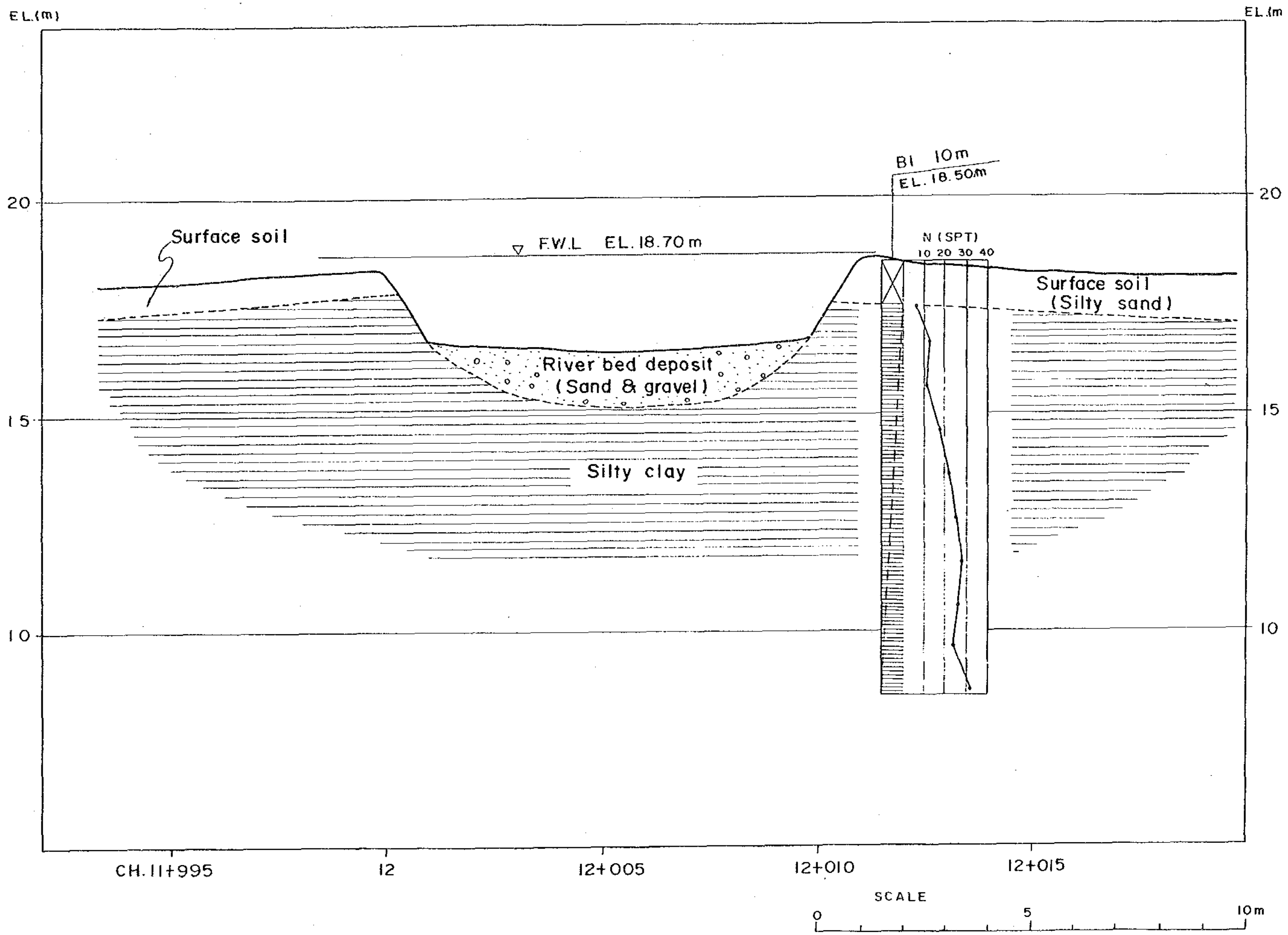


Fig. 4-13 GEOLOGICAL PROFILE OF TAIENA CREEK

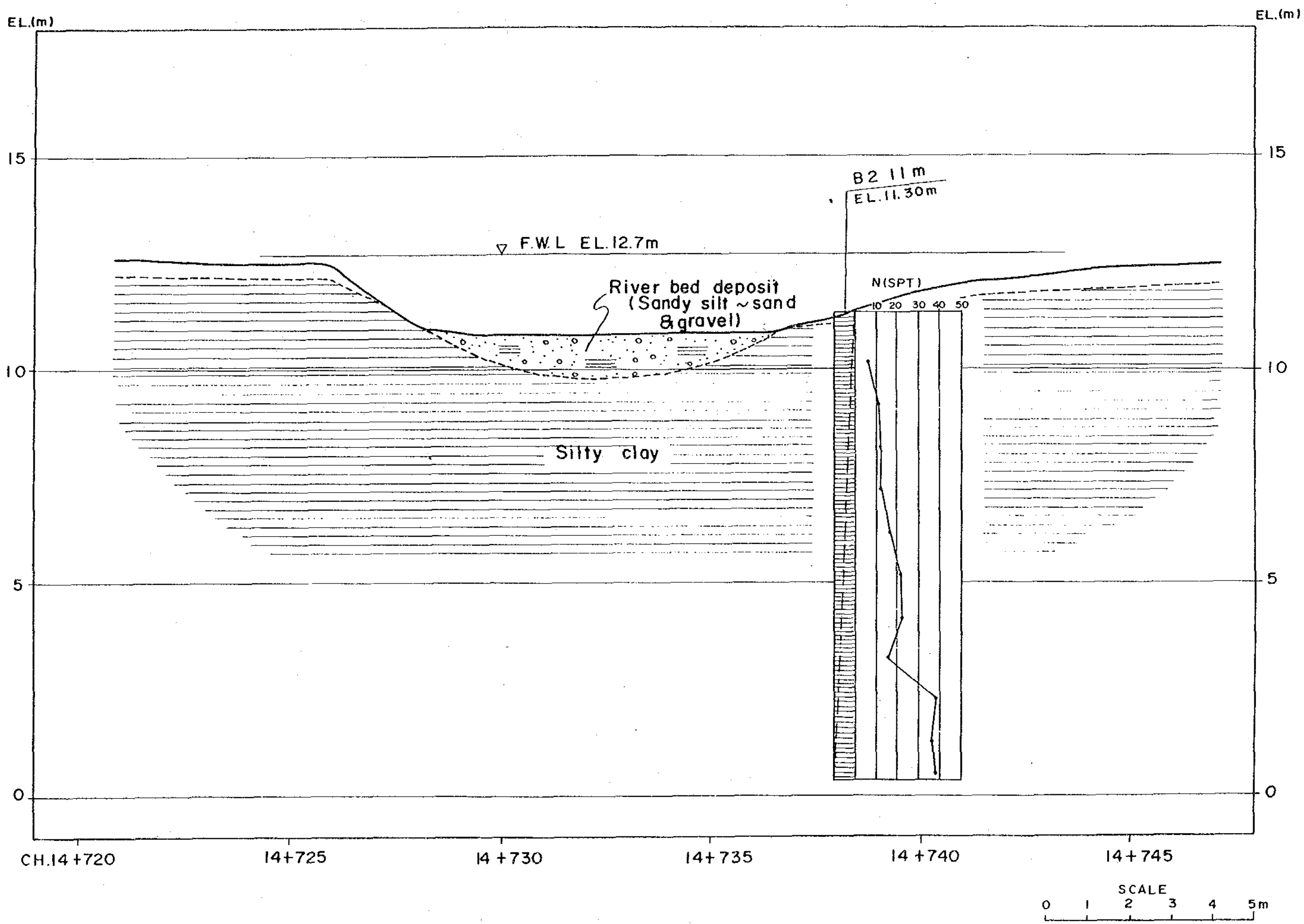


Fig. 4-14 GEOLOGICAL PROFILE OF AGOBINO CREEK

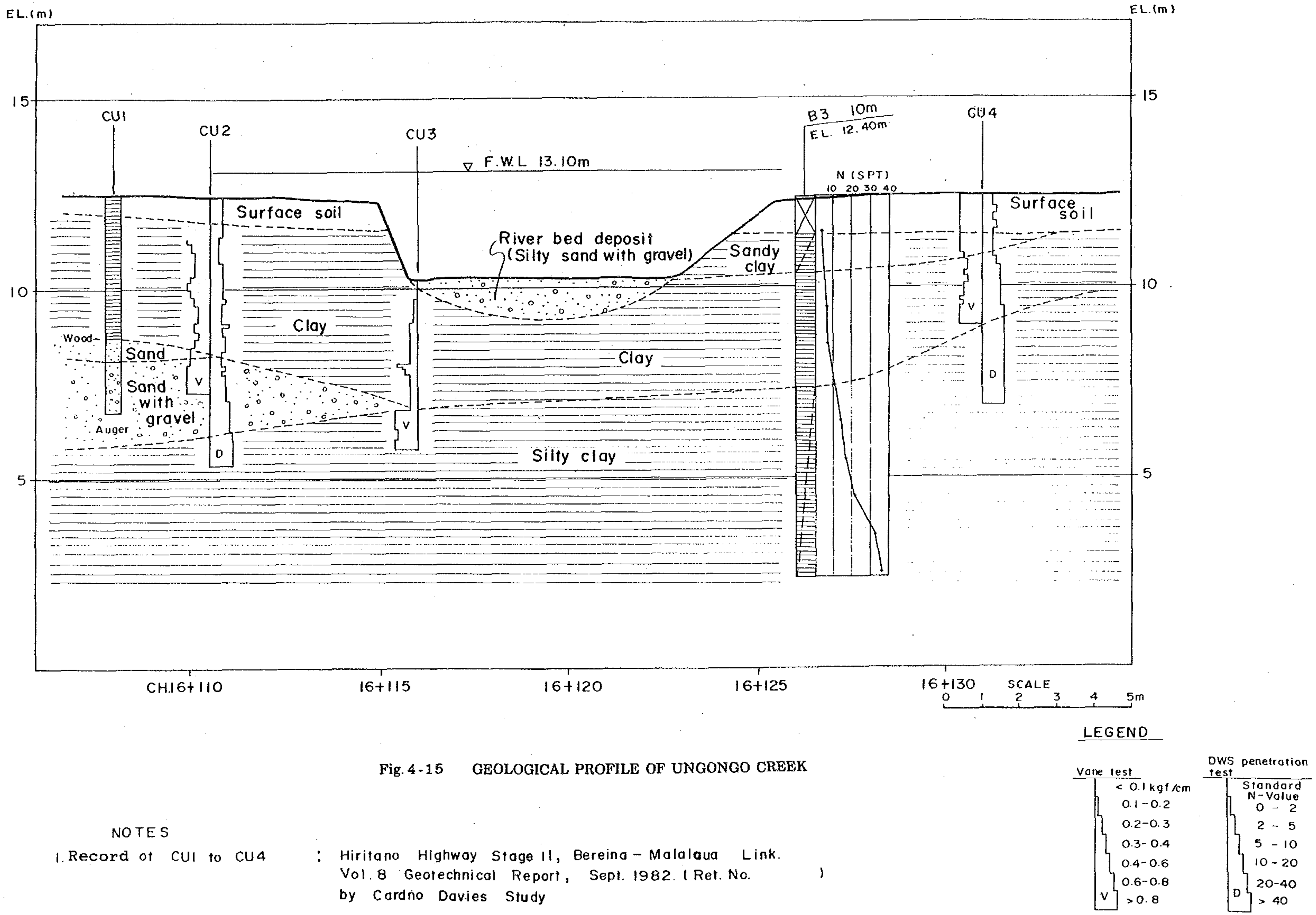


Fig. 4-15 GEOLOGICAL PROFILE OF UNGONGO CREEK

NOTES

1. Record of CU1 to CU4 : Hiritano Highway Stage II, Bereina - Malalaua Link. Vol. 8 Geotechnical Report, Sept. 1982. (Ref. No.)
by Cardno Davies Study

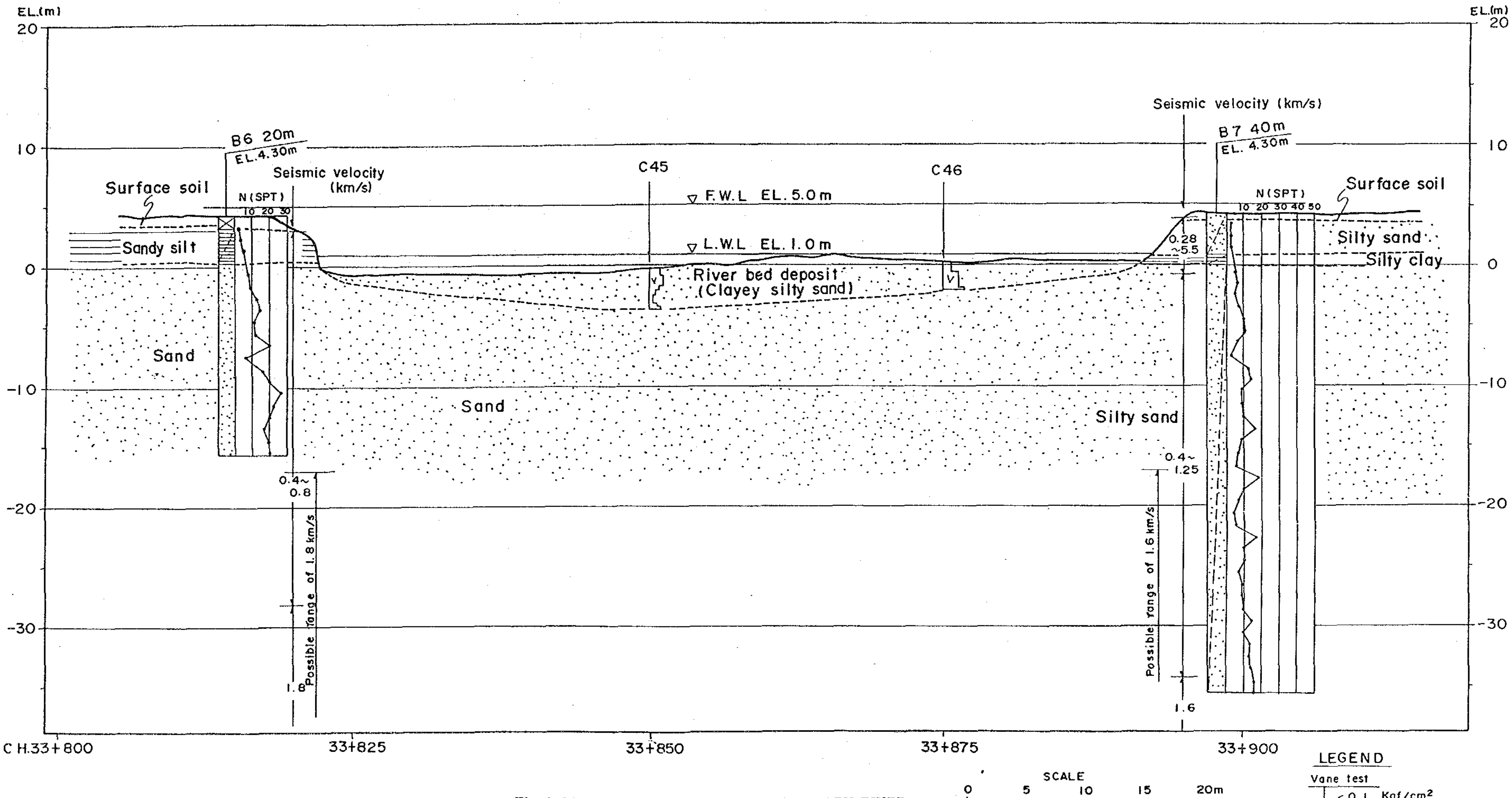


Fig. 4-16 GEOLOGICAL PROFILE OF MIARU RIVER

LEGEND

Vane test

< 0.1	Kgf/cm²
0.1~0.2	
0.2~0.3	
0.3~0.4	
0.4~0.6	
V 0.6~0.8	
>0.8	

NOTES

1. Record of CA1 to CA13 : Hiritano Highway Stage II, Bereina - Malalaua Link. Vol. 8 Geotechnical Report, Sept. 1982. (Ret. No.)
2. Record of seismic investigation : Geophysical Investigation of Bridge sites, Bereina - Malalaua Road. Dec. 1980. (Ret. No.) by Cardno & Davies Study

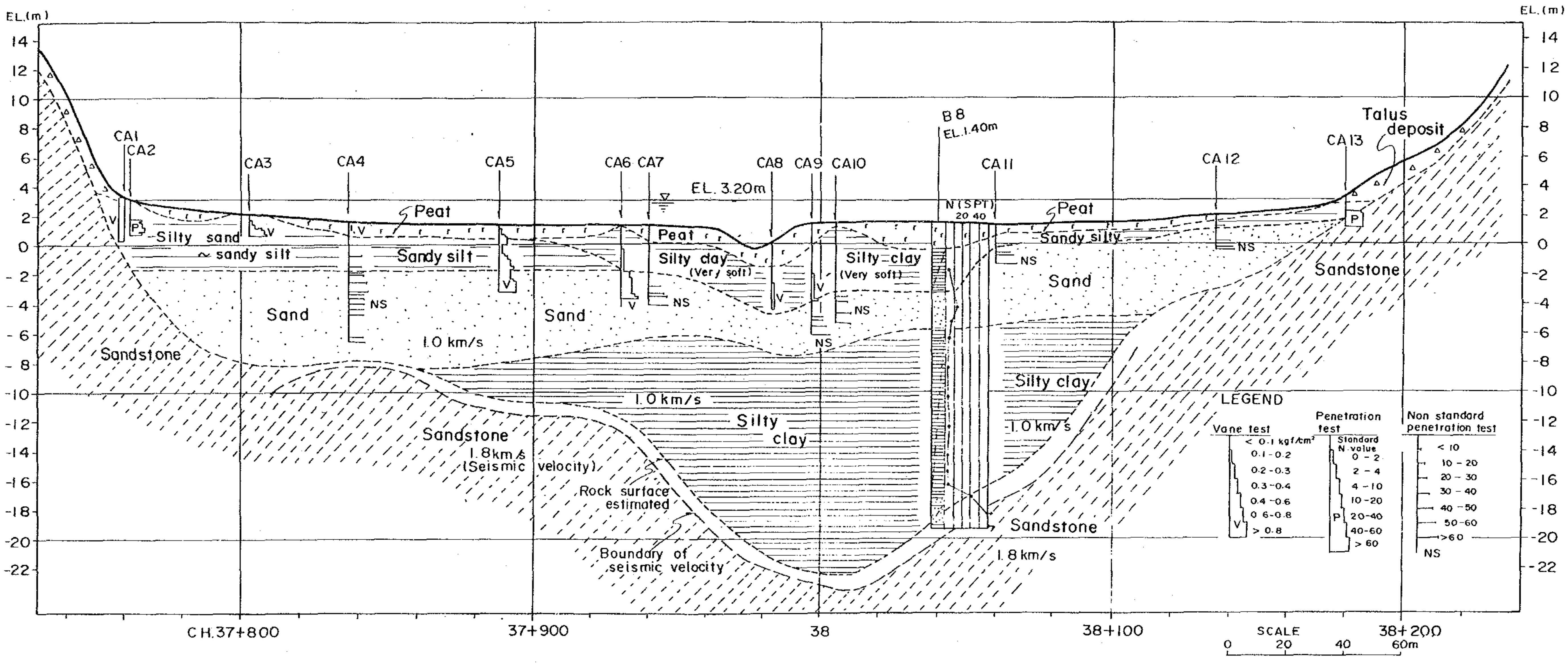


Fig. 4-17 GEOLOGICAL PROFILE OF ALIKA SWAMP

NOTES

1. Record of CA1 to CA13 — Hiritano Highway Stage II, Bereina – Malalaua Link. Vol. 8 Geotechnical Report, Sept. 1982. (Ref. No.)
2. Record of seismic investigation — Geophysical Investigation of Bridge sites, Bereina - Malalaua Road. Dec. 1980. (Ref. No.) by Cardno & Davies Study

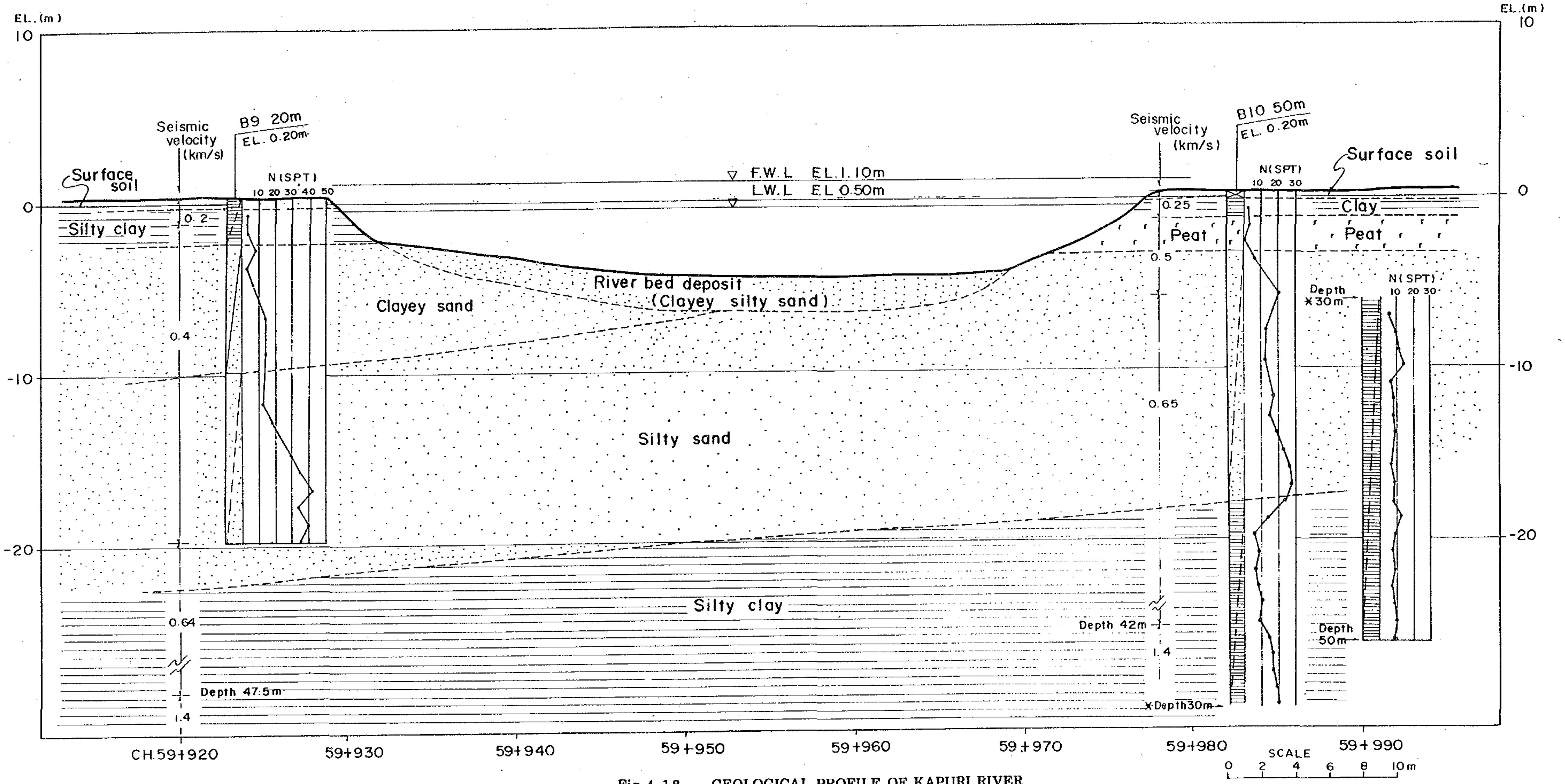


Fig. 4-18 GEOLOGICAL PROFILE OF KAPURI RIVER

Record of seismic investigation ; Geophysical Investigation of Bridge sites, Bereina-Malatoua Road.
Dec. 1980. (Ref. No.) by Cardno & Davies Study

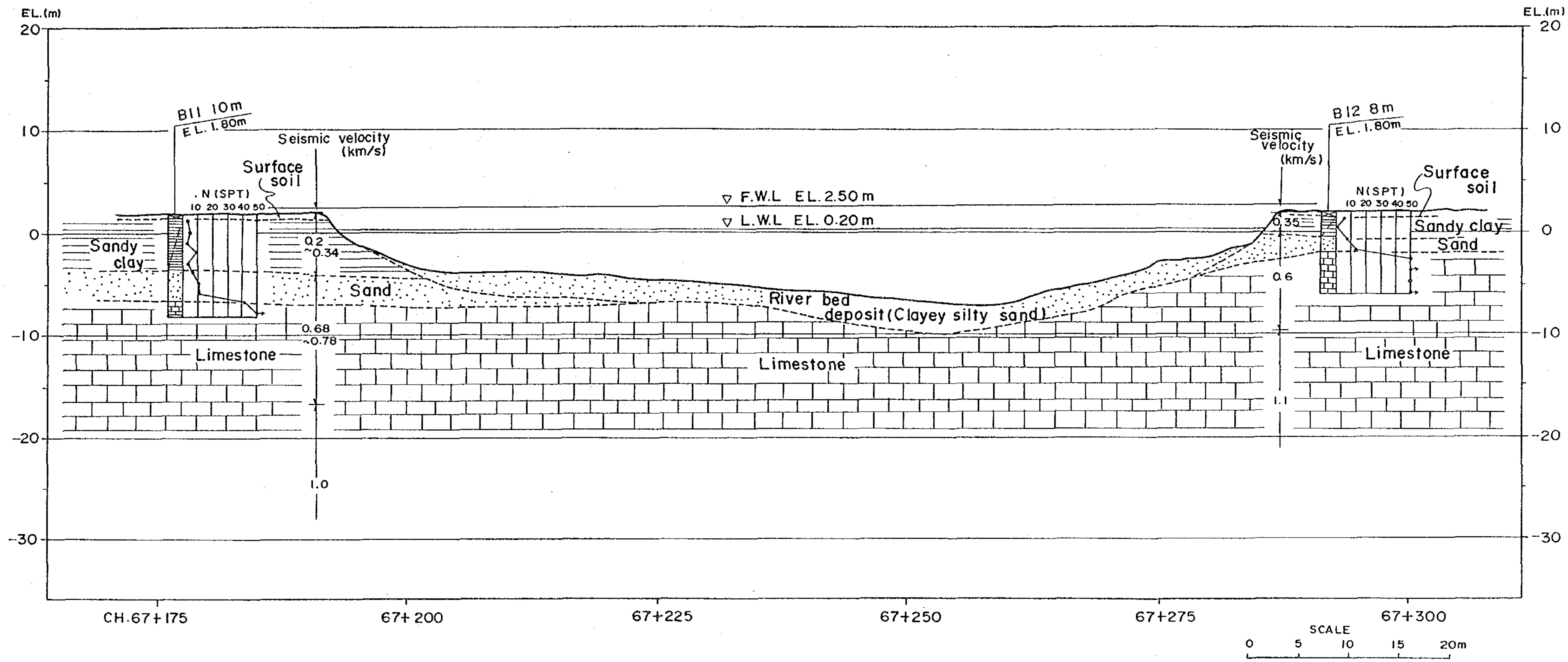


Fig. 4-19 GEOLOGICAL PROFILE OF LAKEKAMU RIVER

Record of seismic investigation Geophysical Investigation of Bridge sites, Bereina-Malalaua Road. Dec. 1980. (Ref. No.) by Cardno & Davies Study

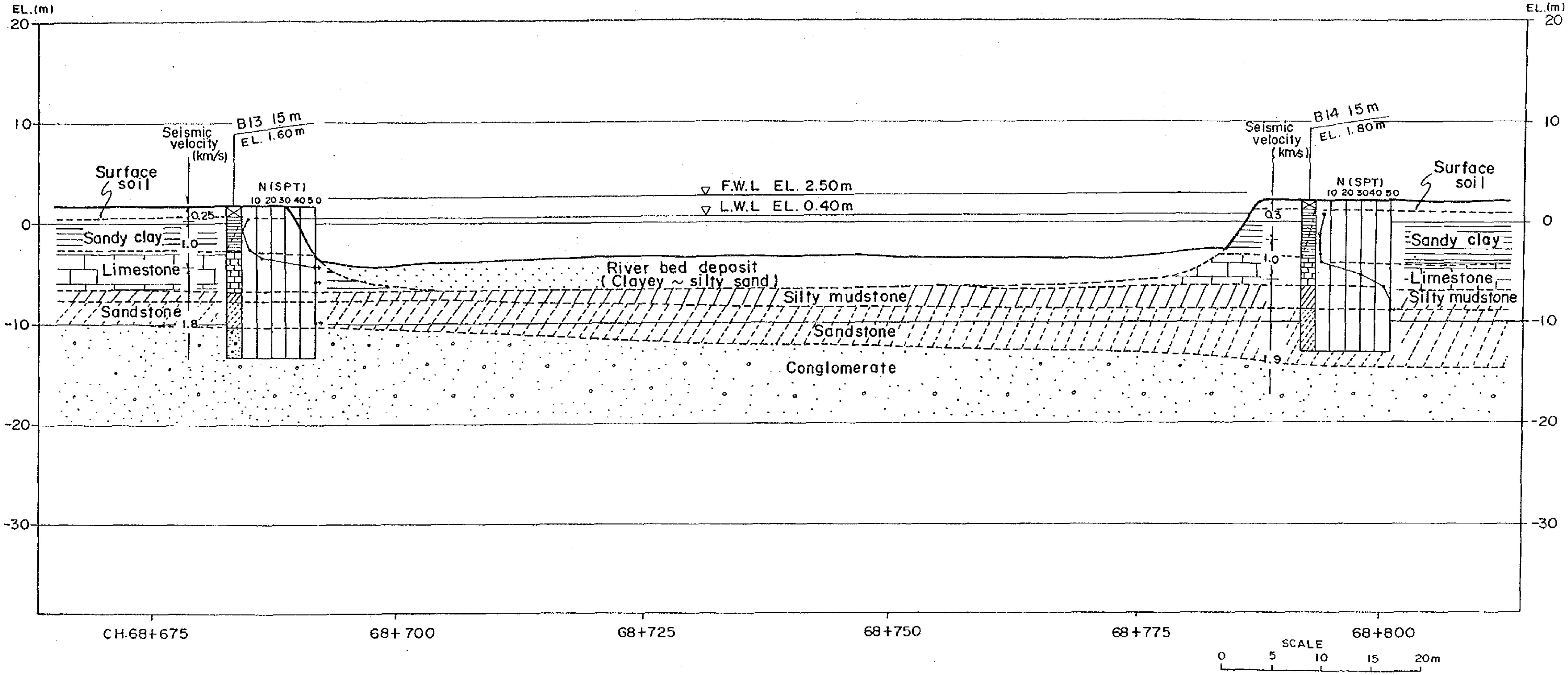


Fig. 4-20 GEOLOGICAL PROFILE OF TAURI RIVER

Record of seismic investigation : Geophysical Investigation of Bridge sites, Bereina-Malalaua Road.
Dec.1980. by Cardno & Davies Study

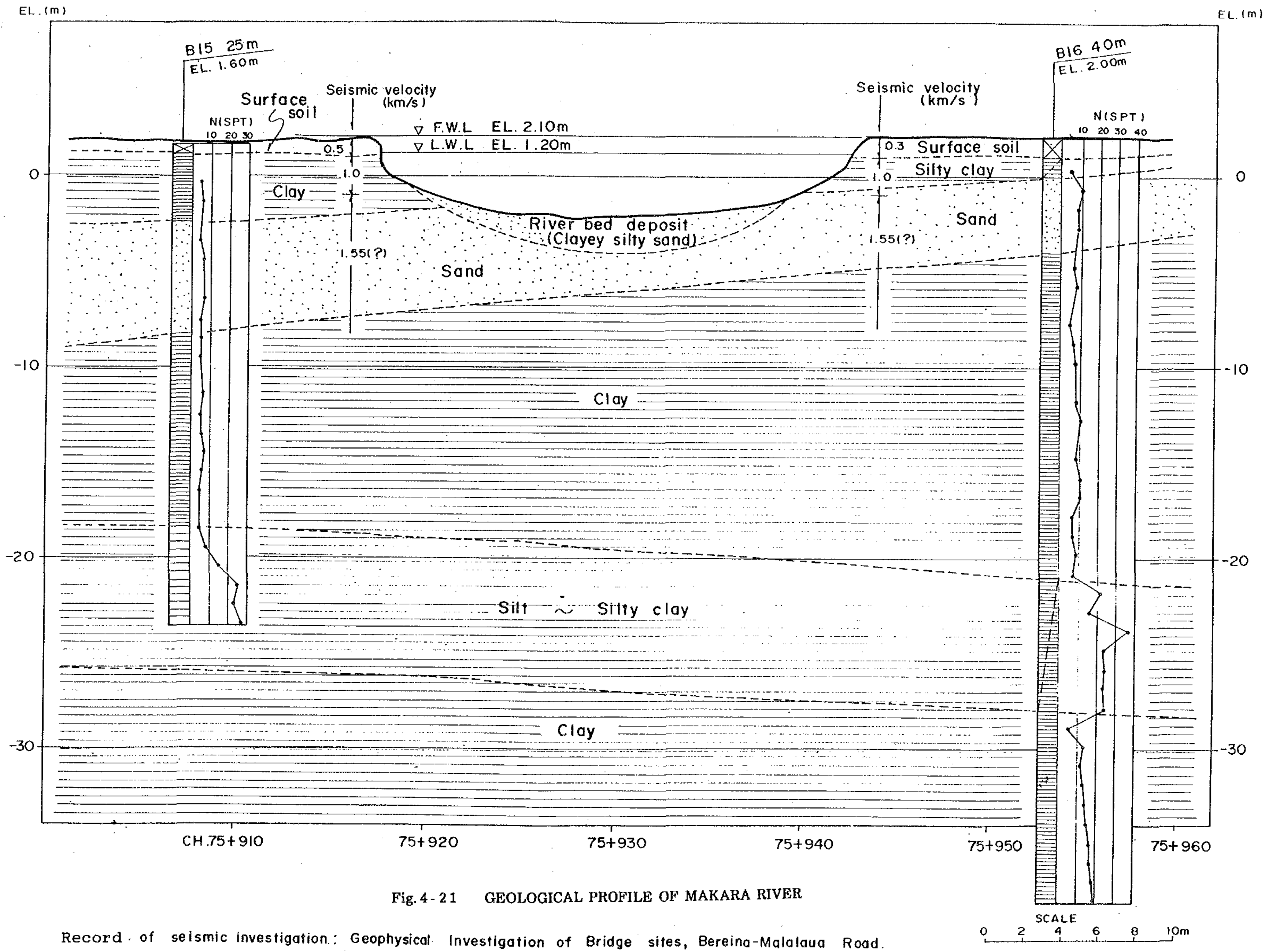


Fig. 4-21 GEOLOGICAL PROFILE OF MAKARA RIVER

Record of seismic investigation : Geophysical Investigation of Bridge sites, Bereina-Malalaua Road.
Dec.1980. by Cardno & Davies Study.

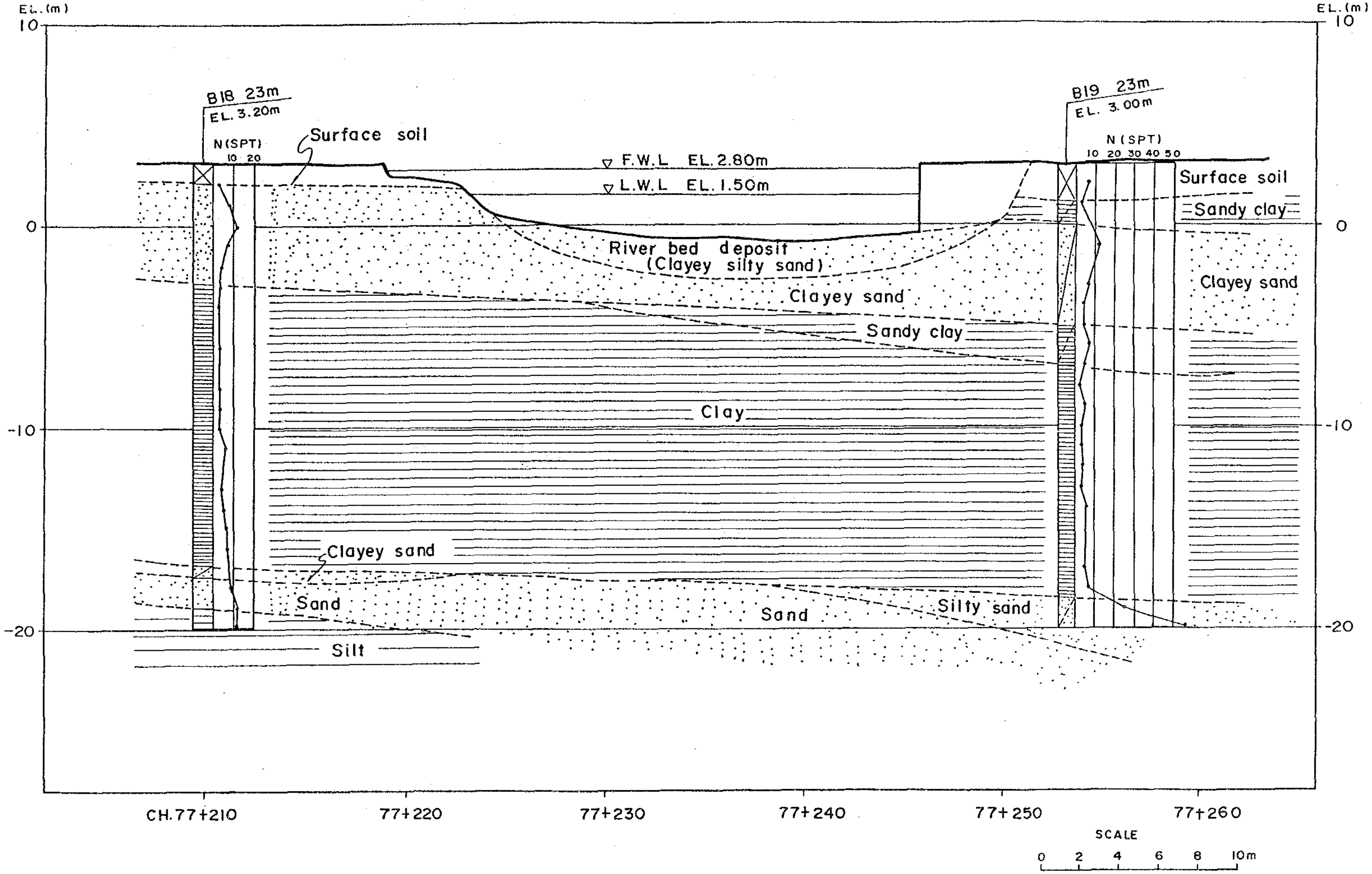


Fig. 4-22 GEOLOGICAL PROFILE OF SAPPAHARO RIVER

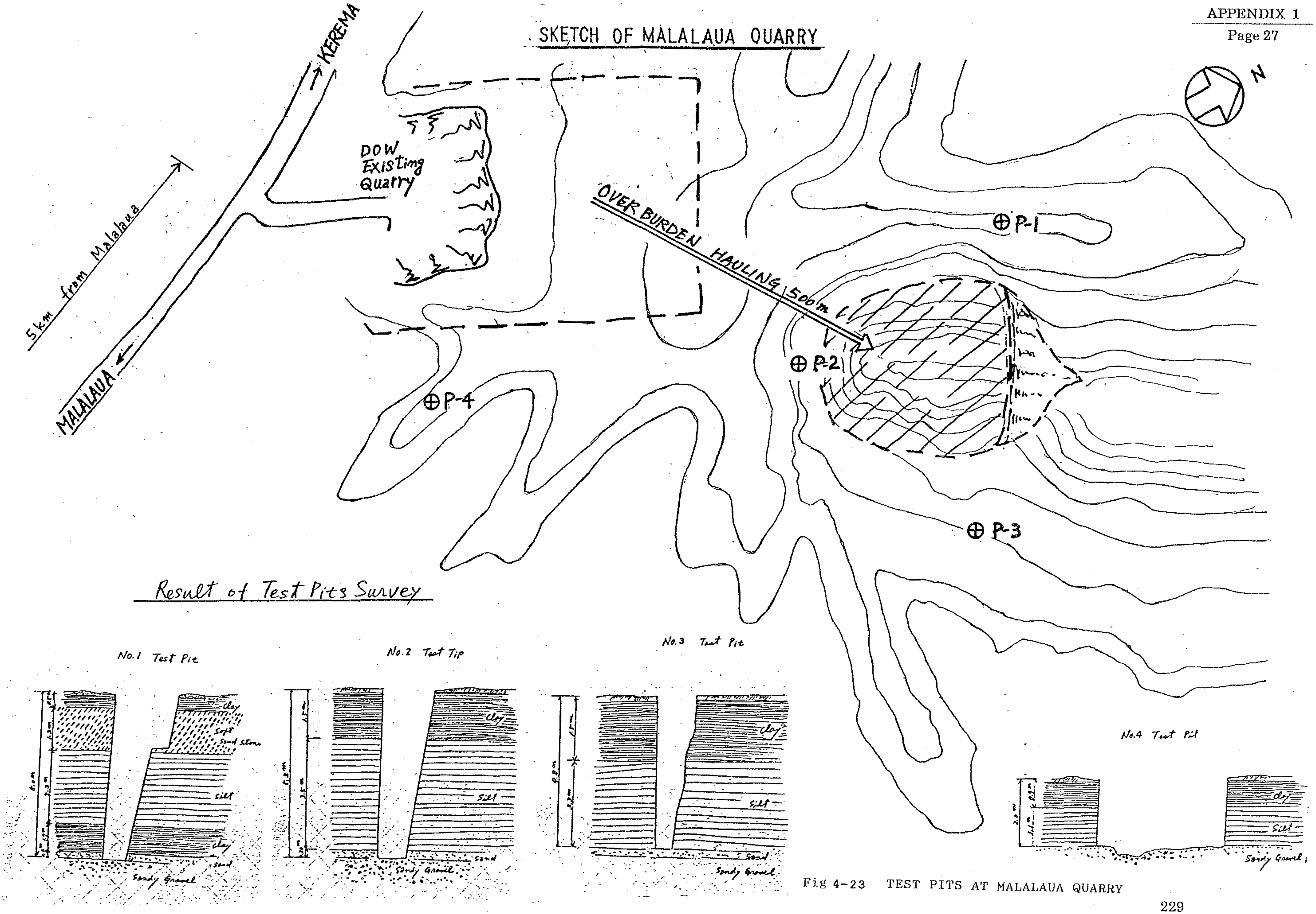


Fig 4-23 TEST PITS AT MALALAUA QUARRY

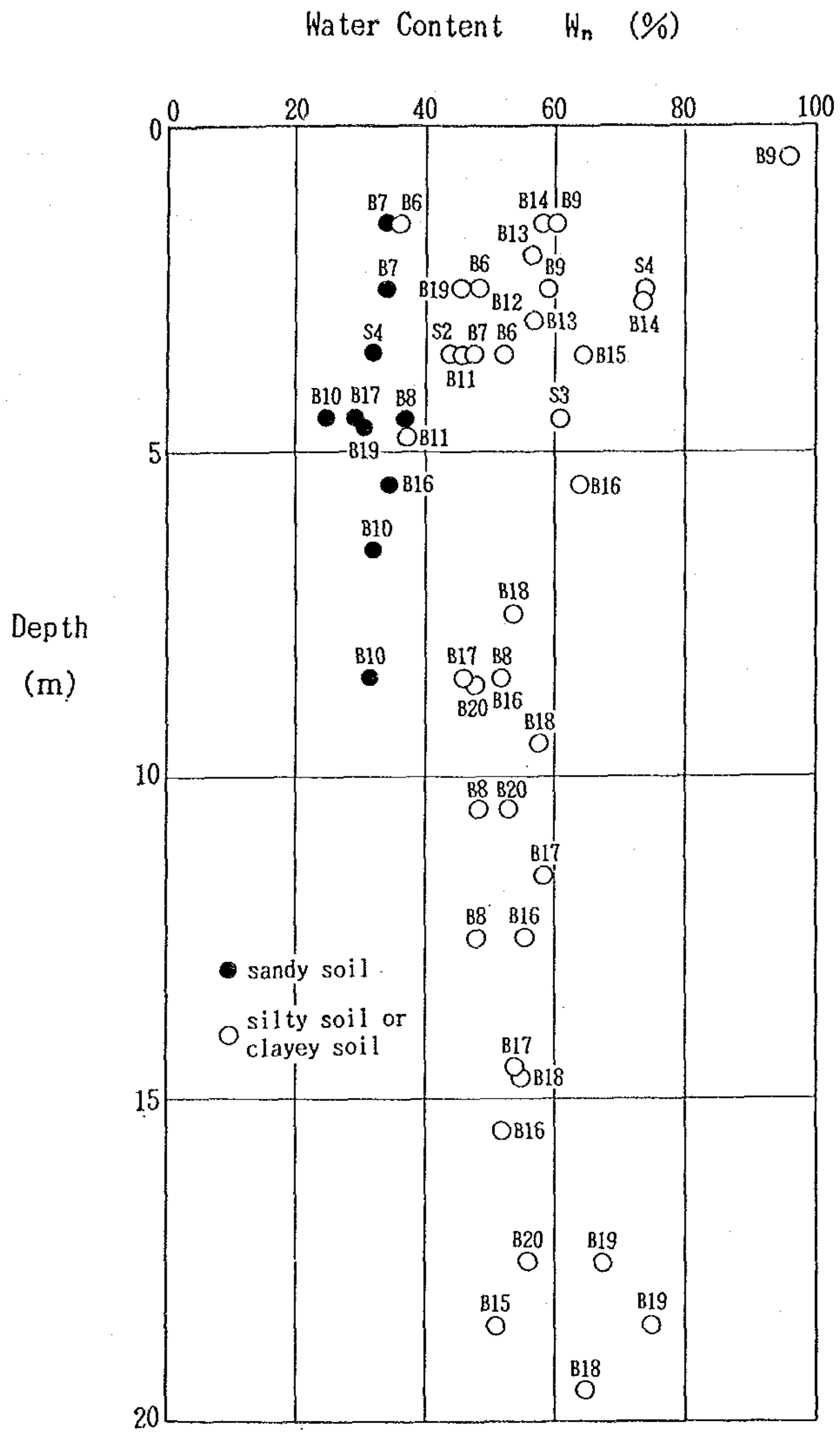


Fig. 4-24 WATER CONTENT (Wn) AND DEPTH OF SAMPLE

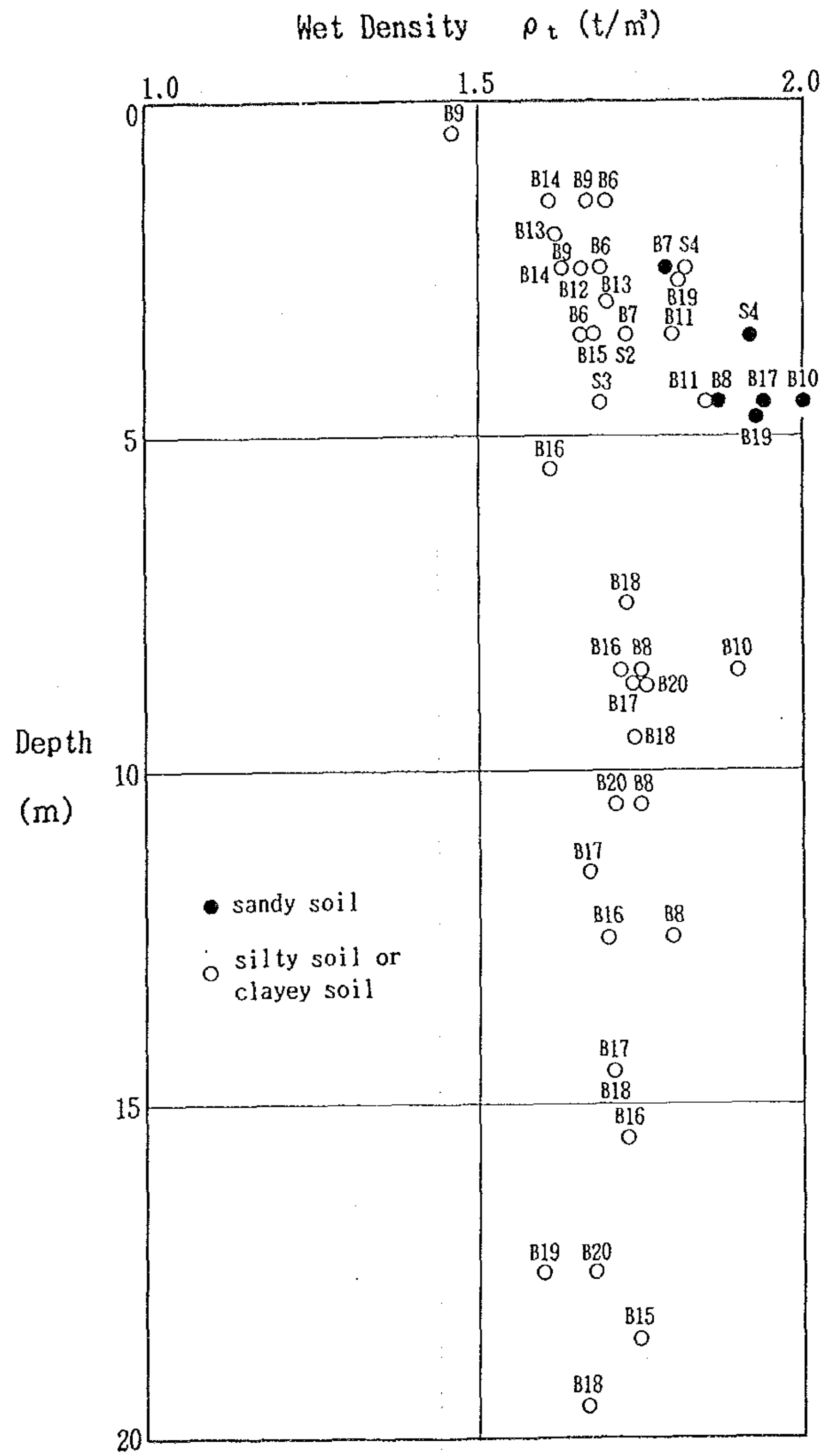


Fig. 4-25 WET DENSITY (ρt) AND DEPTH OF SAMPLE

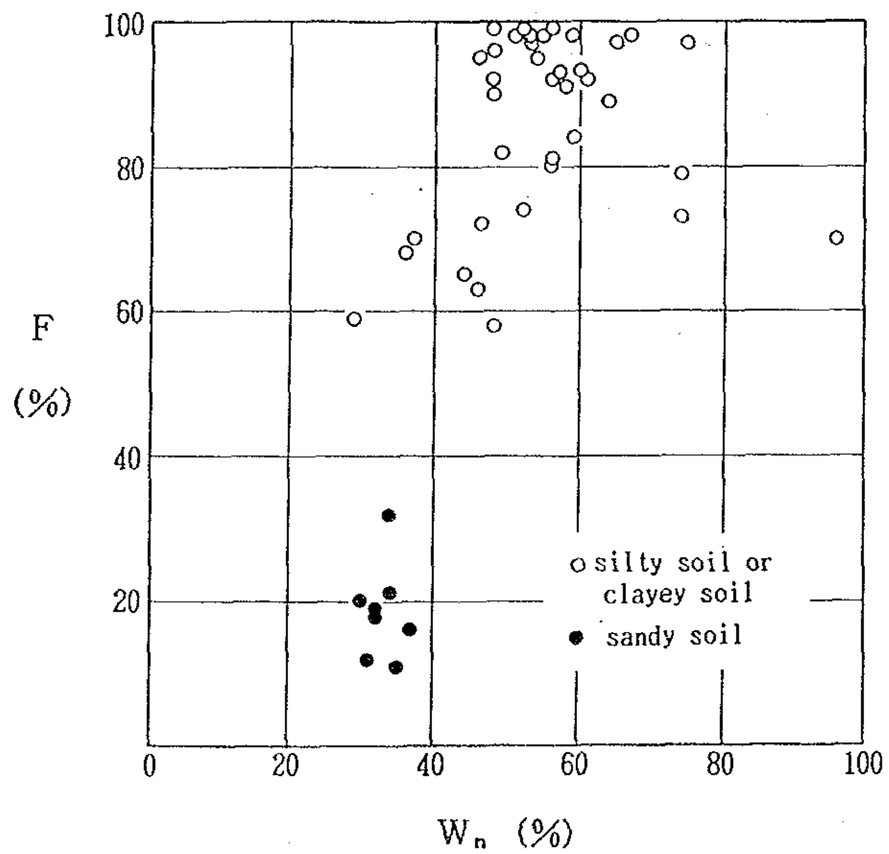


Fig. 4-26 NATURAL WATER CONTENT AND FINE-GRAINED SOIL CONTENT (F)

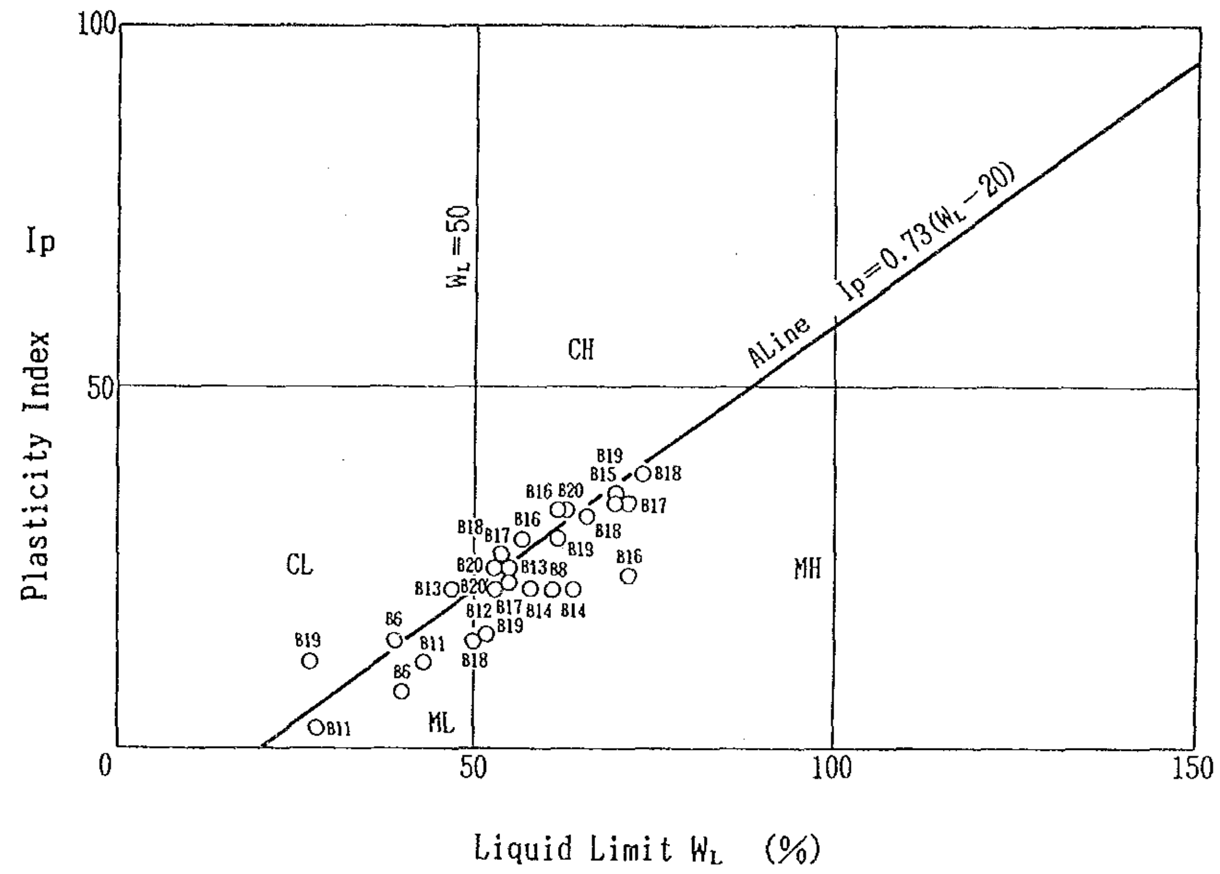


Fig. 4-27 PLASTICITY CHART (Ip & W_L)

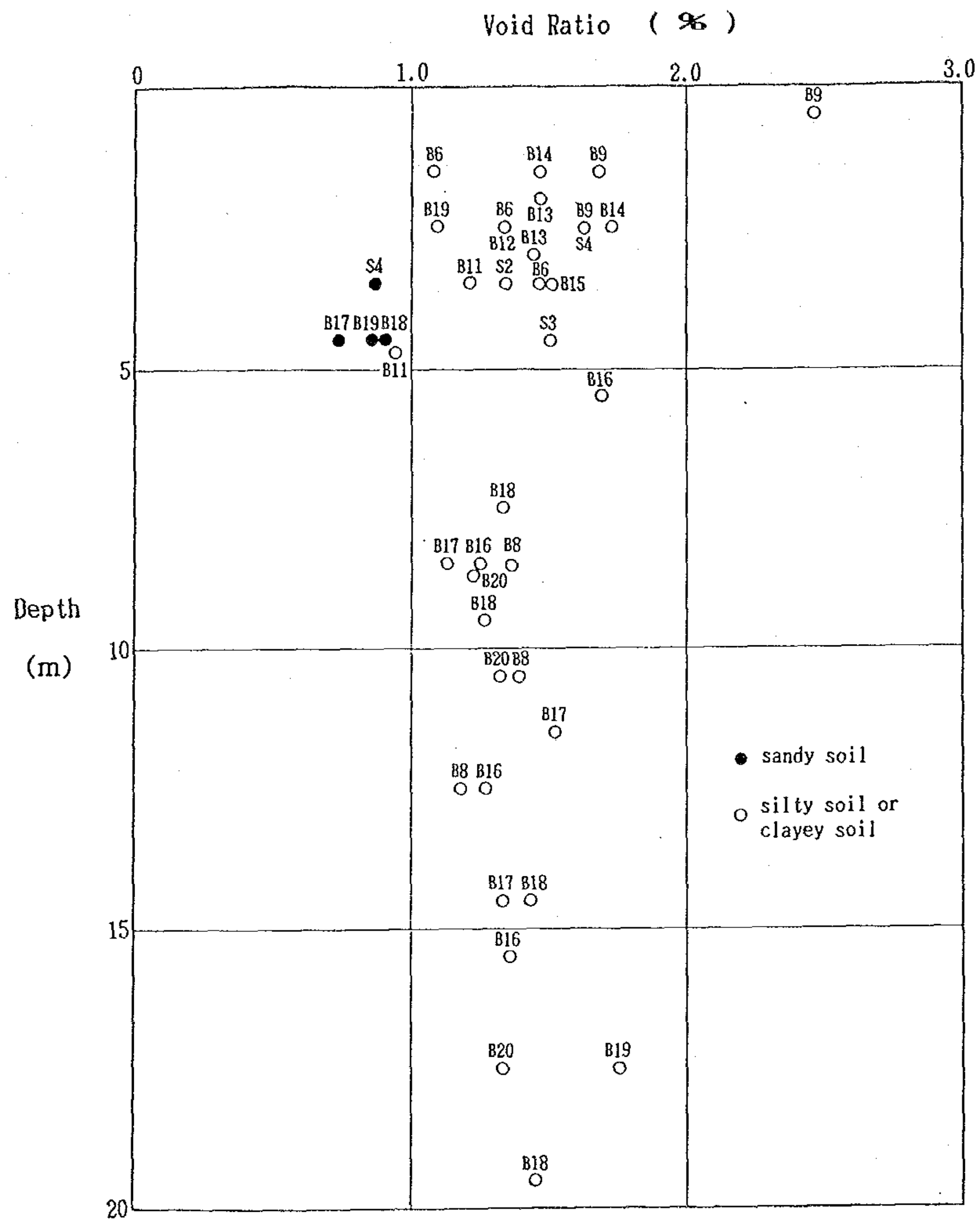


Fig. 4-28 VOID RATIO(S) AND DEPTH OF SAMPLE

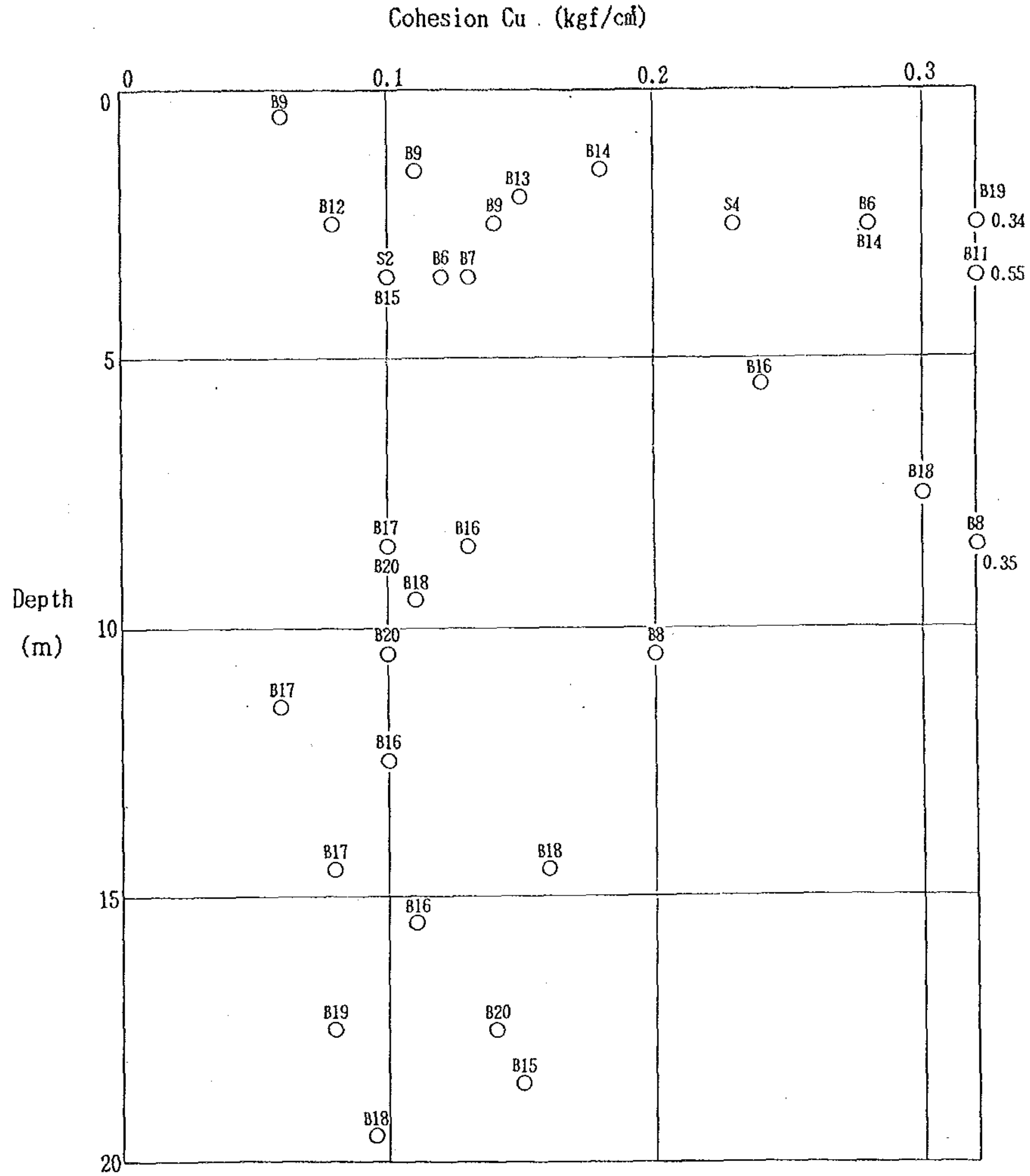


Fig. 4-29 COHESION (Cu) AND DEPTH OF SAMPLE

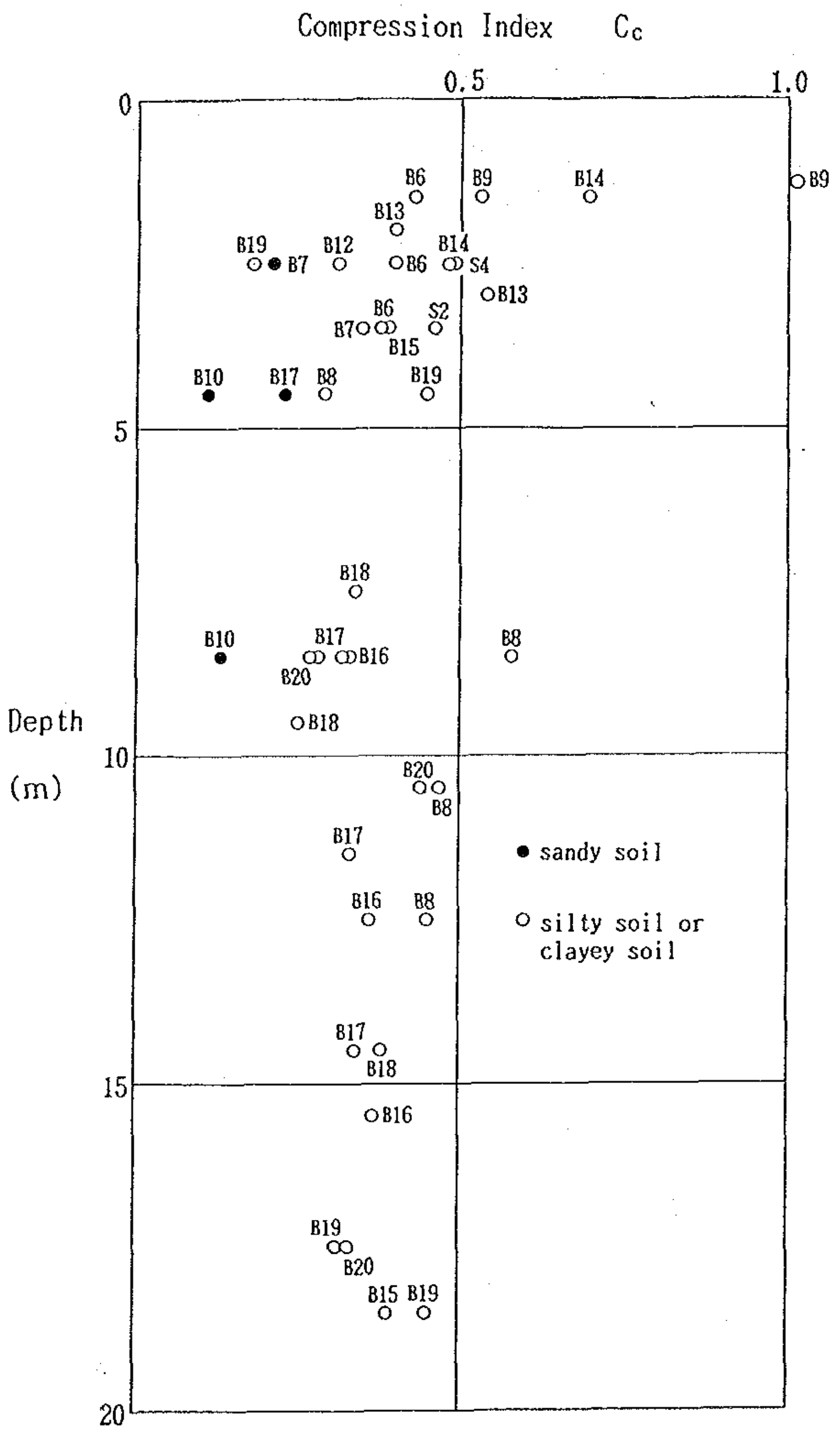


Fig. 4-30 COMPRESSION INDEX (Cc) AND DEPTH OF SAMPLE

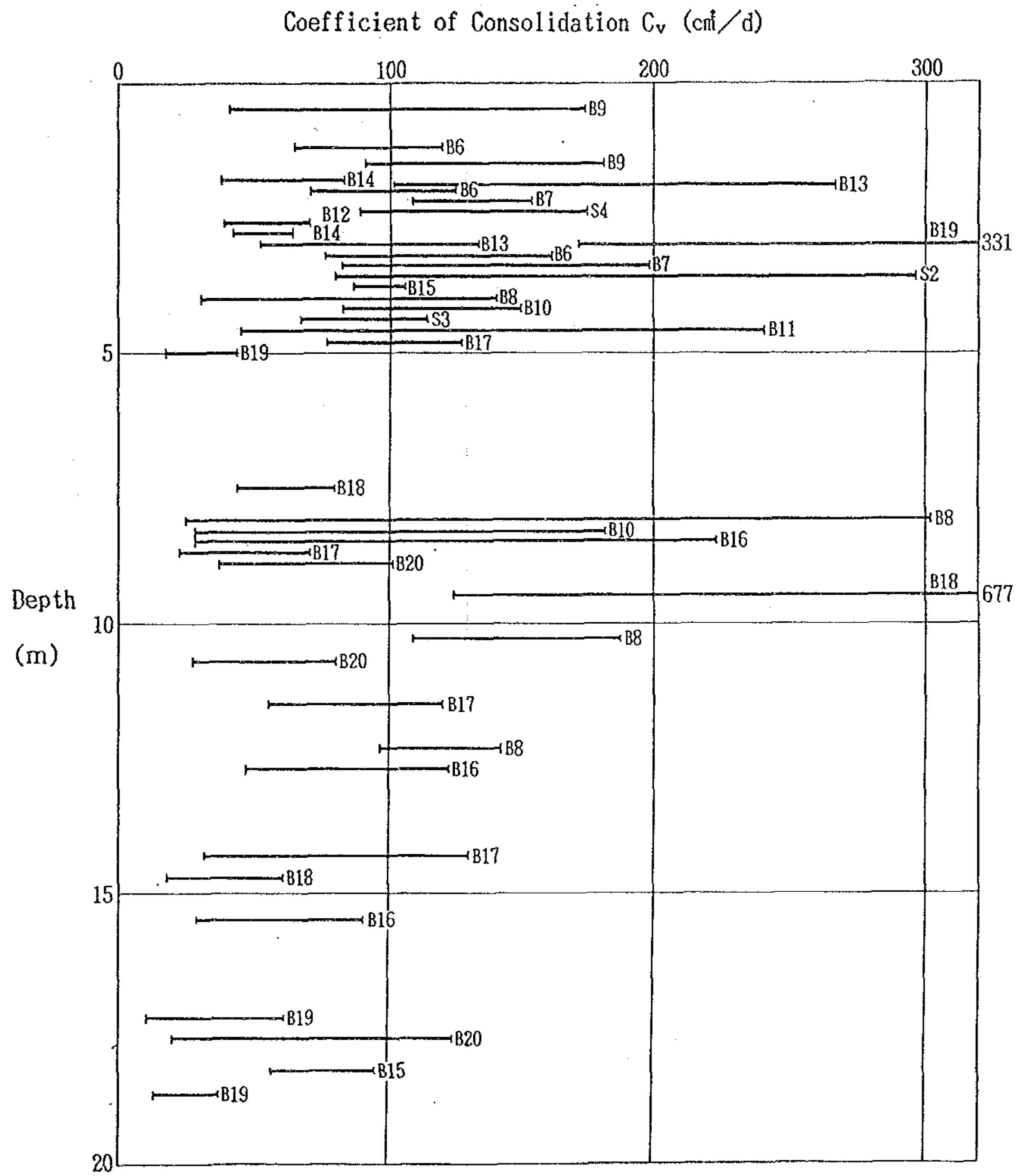


Fig. 4-31 COEFFICIENT OF CONSOLIDATION (Cv) AND DEPTH OF SAMPLE

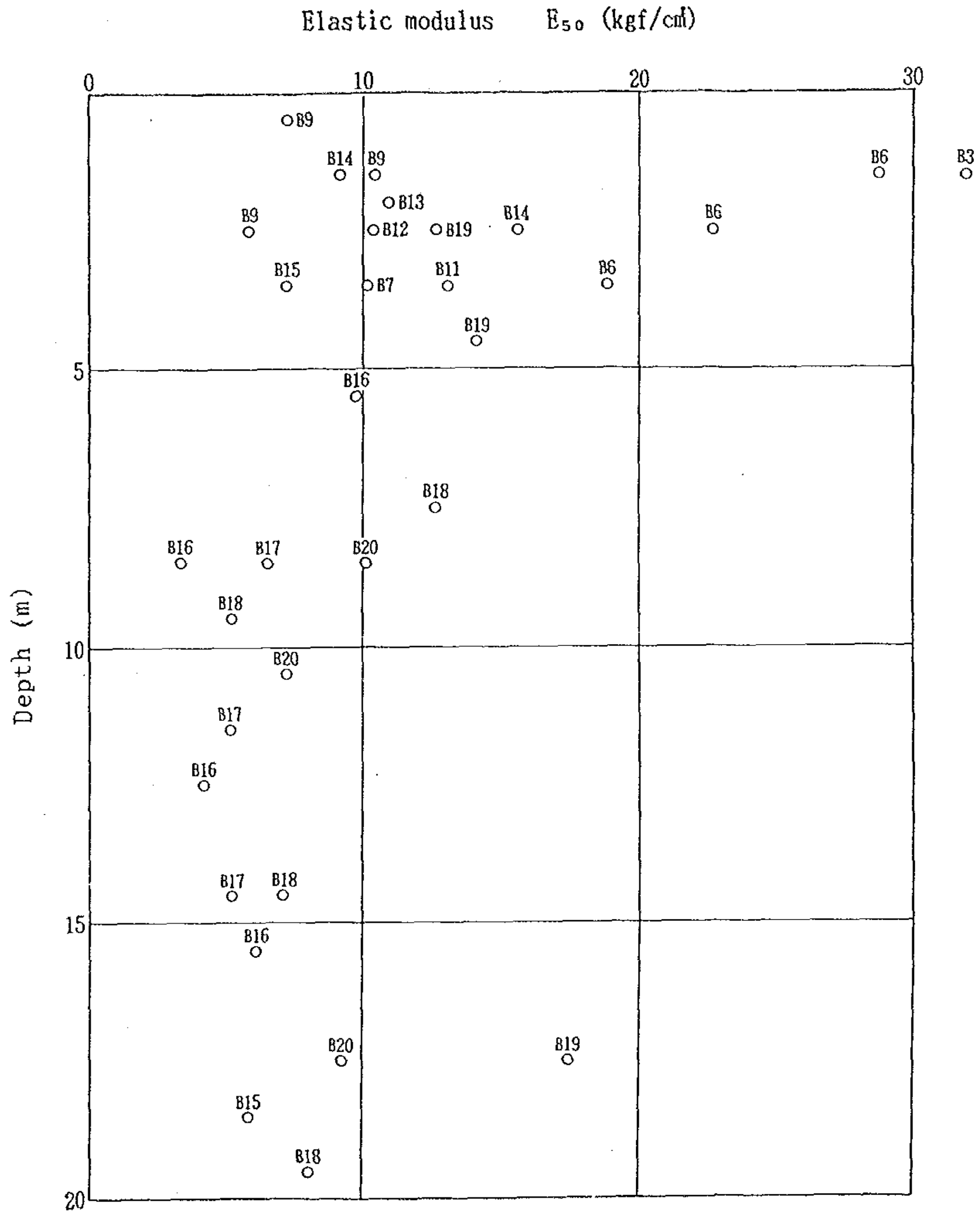


Fig. 4-32 ELASTIC MODULUS (E50) AND DEPTH OF SAMPLE

Table 4-8 TEST RESULTS OF SUBBASE MATERIALS (1)

Test Item	Location		Existing Borrow Pit near Bereina 88/234(A)	88/234(B)	88/234(C)	DOW Spec. Type B (75mm)
Natural W		%	5.9	7.0	6.6	
Atterberg	LL	%	37	41	38	≤ 30
Limits	PL	%	20	18	18	
	PI	%	16	23	20	≤ 10
Sieve	75	mm	100	100	96	100
Analysis	37.5	mm	87	88	82	60 - 100
Percent	19	mm	72	80	69	40 - 80
by wt.	9.5	mm	57	68	55	30 - 60
passing	4.75	mm	43	55	42	20 - 45
	2.36	mm	38	46	36	15 - 35
	425	um	21	24	18	8 - 22
	75	um	14	15	11	3 - 15
Std.	MDD	t/m³	2,090	2,085	2,045	
Compaction	Opt	w %	8.9	10.6	10.9	
Soaked	CBR	%	35	30	30	≥ 25
CBR	DD	t/m³	2,100	2,000	2,051	
	W	%	9.0	10.7	10.7	

Table 4-9 TEST RESULTS OF SUBBASE MATERIALS (2)

Test Item	Location		Existing Borrow Pit near Babanovga Village 88/265(A)	88/265(B)	88/265(C)	DOW Spec. Type B (75mm)
Natural W		%	5.6	5.8	6.0	
Atterberg	LL	%	39	40	41	≤ 36
Limits	PL	%	25	26	26	
	PI	%	14	14	15	≤ 10
Sieve	75	mm	100		100	100
Analysis	37.5	mm	91	100	97	60 - 100
Percent	19	mm	80	82	79	40 - 80
by wt.	9.5	mm	60	59	55	30 - 60
passing	4.75	mm	44	41	40	20 - 45
	3.26	mm	36	34	34	15 - 35
	425	um	15	17	18	8 - 22
	75	um	9	10	11	3 - 15
Std.	MDD	t/m³	2,085	2,060	2,050	
Compaction	Opt	w %	10.3	10.0	10.4	
Soaked	CBR	%	15	15	15	≥ 25
CBR	DD	t/m³	1,978	2,024	2,035	
	W	%	11.4	10.2	10.7	

Table 4-10 TEST RESULTS OF SUBBASE MATERIALS (3)

Test Item	Location		Malalaua North 2km Existing Borrow Pit 88/309	88/318		DOW Spec. Type B (75mm)
Natural W		%	8.4	10.0		
Atterberg	LL	%	34	28		≤ 30
Limits	PL	%	24	21		
	PI	%	11	7		≤ 10
Sieve	75	mm				100
Analysis	37.5	mm	89	94		60 - 100
Percent	19	mm	82	89		40 - 80
by wt.	9.5	mm	66	75		30 - 60
passing	4.75	mm	53	60		20 - 45
	2.36	mm	45	51		15 - 35
	425	um	18	25		8 - 22
	75	um	8	13		3 - 15
Mod.	MDD	t/m³	2,030	2,140		
Compaction	Opt	w %	11.1	8.9		
Soaked	CBR	%	25	15	18	≥ 25
CBR	DD	t/m³	2,009	2,039	2,076	
	W	%	10.5	10.1	9.7	

Table 4-11 SUBBASE IMPROVED BY CEMENT (1)

Test Items			Location: Existing Borrow Pit Near Bereina 88/234(A)	88/234(B)	DOW Spec. Type B (75mm)
Natural W		%	5.9	7.0	
Atterberg	LL	%	37	41	≤ 30
Limits	PL	%	20	18	
	PI	%	16	23	≤ 10
Sieve	75	mm	100	100	100
Analysis	37.5	mm	87	88	60 - 100
Percent	19	mm	72	80	40 - 80
by wt.	9.5	mm	57	68	30 - 60
passing	4.75	mm	43	55	20 - 45
	2.36	mm	38	46	15 - 35
	425	um	21	24	8 - 22
	75	um	14	15	3 - 15
Portland Cement Type A Addition			1.0 %	2.0 %	
Atterterg Limits	LL	%	38	37	≤ 30
	PL	%	34	34	
	PI	%	4	3	≤ 10

Table 4-12 SUBBASE IMPROVED BY CEMENT (2)

Test Items			Location: Existing Borrow Pit Near Babanongo 88/265 (A)		DOW Spec. Type B (75mm)
Natural W			5.9		
Atterberg	LL	%	39		≤ 30
Limits	PL	%	25		
	PI	%	14		≤ 10
Sieve	75	mm	100		100
Analysis	37.5	mm	91		60 - 100
Percent	19	mm	80		40 - 80
by wt.	9.5	mm	60		30 - 60
passing	4.75	mm	44		20 - 45
	2.36	mm	36		15 - 35
	425	um	15		8 - 22
	75	um	9		3 - 15
Std.	MDD	t/m³	2,085		
Compaction	Opt W	%	10.3		
Soaked	CBR	%	15		≥ 25
CBR	DD	t/m³	1,978		
	W	%	11.4		
Portland Cement Type A Addition			1.0 %	2.0 %	
Atterterg	LL	%	40	39	≤ 30
Limits	PL	%	34	34	
	PI	%	6	5	≤ 10
Soaked	CBR	%	50	110	≥ 25
CBR	DD	t/m³	1,979	2,025	
	W	%	10.9	11.8	

Table 4-13 BASE COURSE IMPROVED BY CEMENT

Test Item			Location: Malalaua North 2km Existing Existing Borrow Pit 88/309	88/318	DOW Spec. Type B (38mm)
Natural W.C.		%	8.4	10	
Atterberg	LL	%	34	28	≤ 25
Limits	PL	%	24	21	
	PI	%	11	7	≤ 6
Sieve	37.5	mm	89	94	100
Analysis	19	mm	82	89	60 - 100
Percent	9.5	mm	66	75	40 - 80
by wt.	4.75	mm	53	60	30 - 60
passing	2.36	mm	45	51	20 - 45
	425	um	18	26	15 - 30
	75	um	8	13	3 - 15
Mod.	MDD	t/m³	2,036	2,140	
Compaction	Opt W	%	11.1	8.9	
Uncombined	Cement*	2 %	9.6	6.0	Road Note 31 Recomended Creiteria
Compressive	Addition	3 %	13.6	12.6	
Strength		4 %	14.0	16.2	25016/in² (18 kg/cm²)
qu kg/cm²		5 %		20.4	

* Type A Portland Cement

Table 4-14 TEST RESULTS OF CRUSHED ROCK (EBOA)

Test Items / Location	Sample taken at quarry face 88/243	Core boring sample *	DOW Specification Surface	DOW Specification Base Course
Specific Gravity (SSD) t/m³	2.24	2.33	—	—
Water Absorption %	4.5	7.3	5.0 Max.	
Los Angeles Abrasion Loss %	24	—	30 Max.	35 Max.
Sodium Sulphate Soundness %	9.1	100	12 Max.	
Flakiness Index %	25	—	30 Max.	

* Tested in NIPPON KOEI Materials Testing Laboratory in Japan.

Table 4-15 TEST RESULTS OF CRUSHED STONE (RIVERS)

Test Items / Location	Angabanga River cobble	Tauri River cobble	DOW Specification Surface
Specific Gravity (SSD) t/m³	2.7	2.6	—
Water Absorption %	1.0	2.9	5.0 Max.
Los Angeles Abrasion Loss %	17	21	30 Max.
Sodium Sulphate Soundness %	1.5	5.7	12 Max.

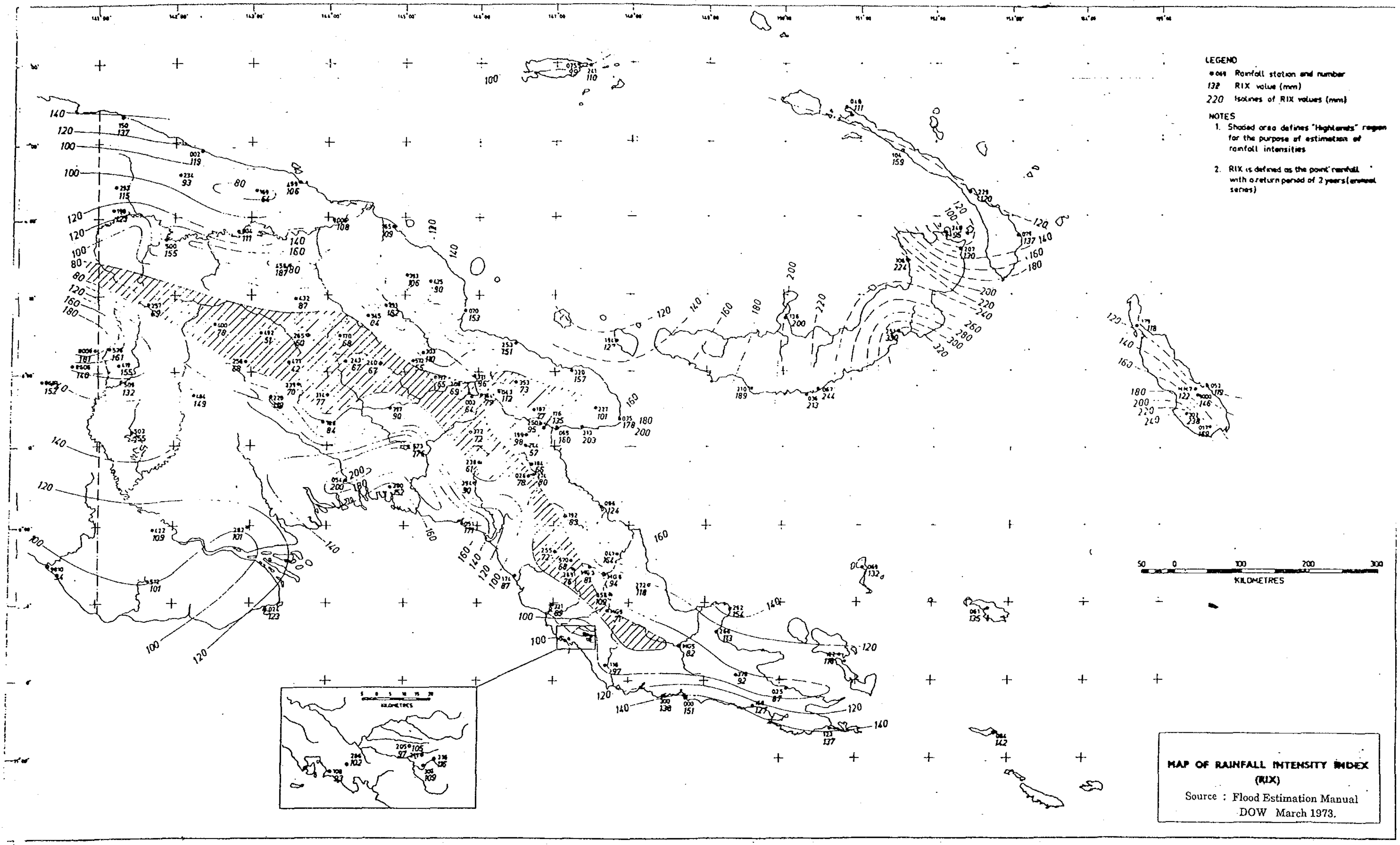


Fig. 5 - 2 MAP OF RAINFALL INTENSITY INDEX (RIX)

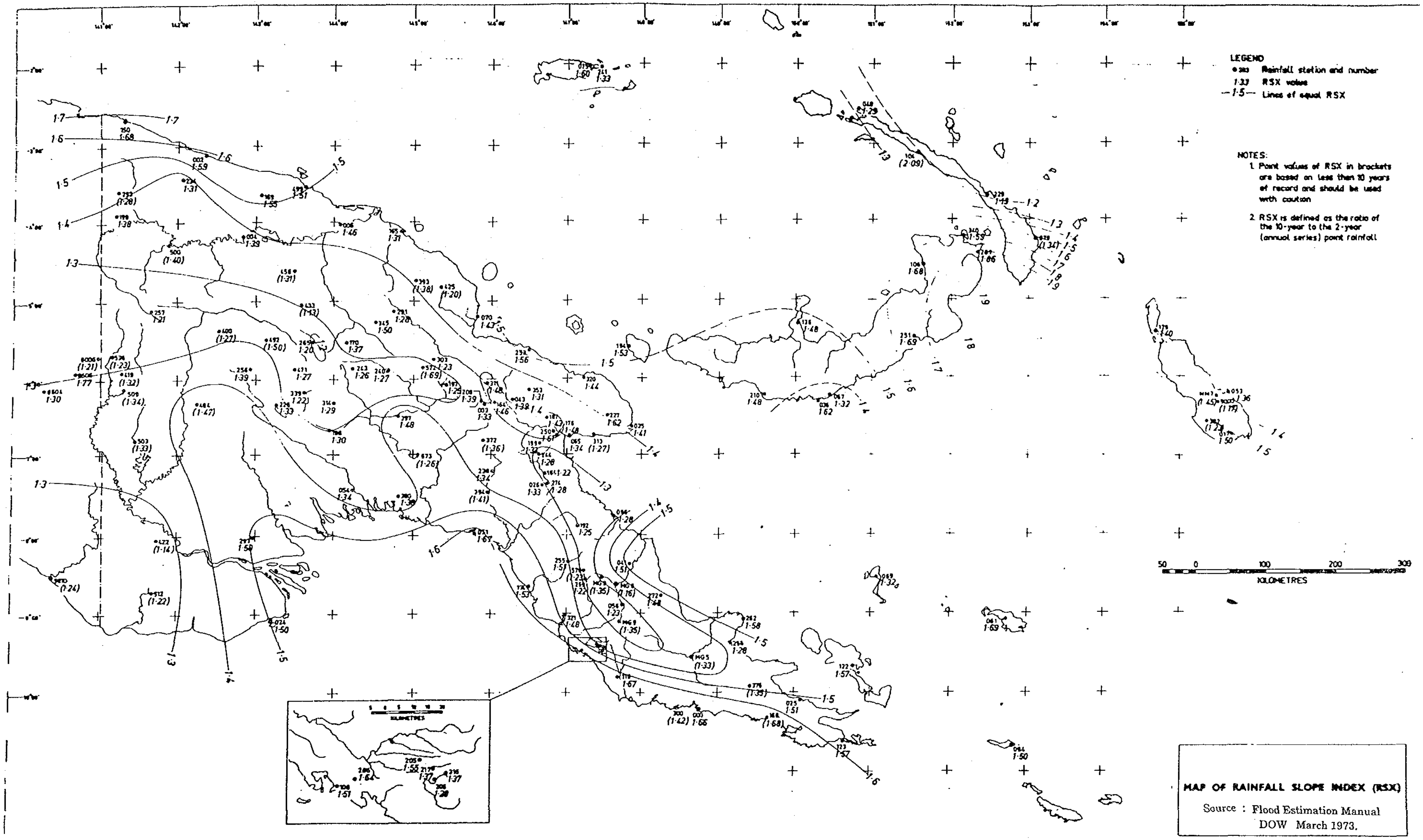


Fig. 5 - 3 MAP OF RAINFALL SLOPE INDEX (RSX)

Table 5-2 PROBABLE PEAK FLOOD DISCHARGE (1/3) ~ (2/3)

PROBABLE PEAK FLOOD DISCHARGE (1/3)

Basin name River name	Angabanga Angabanga river			
Station	Yaifa bridge		Yaifa bridge + Yaifa bridge U/S data	
Catchment area (km^2)	2142.0		2142.0	
Return period (yrs)	P	Sp	P	Sp
100	1255.04	0.586	1253.91	0.585
50	1142.28	0.533	1146.66	0.535
20	988.68	0.462	999.70	0.467
5	750.90	0.351	769.85	0.359
2	561.07	0.262	583.71	0.273
Number of samples	17		21	

Note, P : Peak discharge. (m^3/sec)
Sp : Specific peak discharge ratio. (m^3/sec/km^2)

PROBABLE PEAK FLOOD DISCHARGE (2/3)

Basin name River name	Tauri Tauri river	
Station	Hells gate	
Catchment area (km^2)	2404.0	
Return period (yrs)	P	Sp
100	2198.35	0.914
50	2001.27	0.832
20	1732.77	0.721
5	1316.90	0.548
2	984.66	0.410
Number of samples	29	

Note, P : Peak discharge. (m^3/sec)
Sp : Specific peak discharge ratio. (m^3/sec/km^2)

PROBABLE PEAK FLOOD DISCHARGE (3/3)

Basin name River name	Lakekamu Oreba river			
Station	D/S Biaru bridge		Golden valley	
Catchment area (km^2)	799.3		982.1	
Return period (yrs)	P	Sp	P	Sp
100	223.02	0.279	556.90	0.567
50	206.35	0.258	505.31	0.515
20	183.83	0.230	438.62	0.447
5	148.83	0.186	341.30	0.348
2	120.73	0.151	269.70	0.275
Number of samples	4		21	

Note, P : Peak discharge. (m^3/sec)
Sp : Specific peak discharge ratio. (m^3/sec/km^2)

Table 5-3 DESIGN PEAK FLOOD DISCHARGE ONCE IN 100 YEARS

River	Miaru	Kapuri	Lakekamu	Tauri
Q100 (m^3/sec)	2180	1160	4210	3590
C.A. (km^2)	1721.7	494.0	5393.2	4092.6
Length (km)	83.3	63.5	231.3	250.3
Se (m/km) /1	9.265	4.297	3.766	4.133
Tc (min) /2	1469	1480	4358	4758
V (m/sec) /3	0.945	0.715	0.885	0.877
Sp (m^3/sec/km^2) /4	1.27	2.35	0.78	0.88

/1 Equal area slope of the main stream projected to the catchment divide.
/2 Time of concentration. Estimated by the Bransby Williams formula referring ARR.

$$Tc = \frac{58 * L}{A^{0.1} * Se^{0.2}}$$

/3 Average velocity derived from Length + Tc
/4 Specific flood discharge

Table 5-4 ANNUAL RAINFALL STATISTICS

Station	station no. New	station no. Old	Annual average	Maximum	Minimum	Period
Menyamya	30014	200238	1735.0	2106.3	1272.2	1953-79
Aseki	30019	200295	4231.0	5071.6	3255.6	1961-71
Kwaikuma	30022	200331	2260.8	2757.8	1926.6	1958-71
Marawaka	25023	200655	2233.9	2552.4	1696.6	1969-77
Kwapalem	30086	200366	1688.6	2124.4	1319.6	1961-70
Bereina	55002	200174	1239.9	1681.4	934.5	1955-73
Tapini	55005	200255	2089.6	4117.4	1558.8	1951-73
Fane	55007	200308	2958.8	3332.4	2295.2	1957-85
Guari	55013	200465	2585.9	2967.5	2272.3	1963-70
Kosipe	55016	200570	3134.3	3763.0	2451.1	1964-73
Kamulai	55053	200209	2759.2	2950.0	2577.4	1955-57
Kerau	55056	200215	2236.7	2726.1	1682.5	1955-57
Kerema	60001	200051	3572.0	4762.0	1953.0	1911-85
Terapo	60004	200624	1601.1	1601.1	1601.1	1970
Malalaua	60006	200721	945.9	964.4	927.3	1979-80
Kaintiba	60016	200394	3791.7	5058.7	2744.1	1962-71
Popo	60018	200107	1362.1	1650.5	1089.9	1922-27
Kukipi	60022	200329	1183.3	1300.4	1098.0	1960-62

Unit of rainfall is mm.

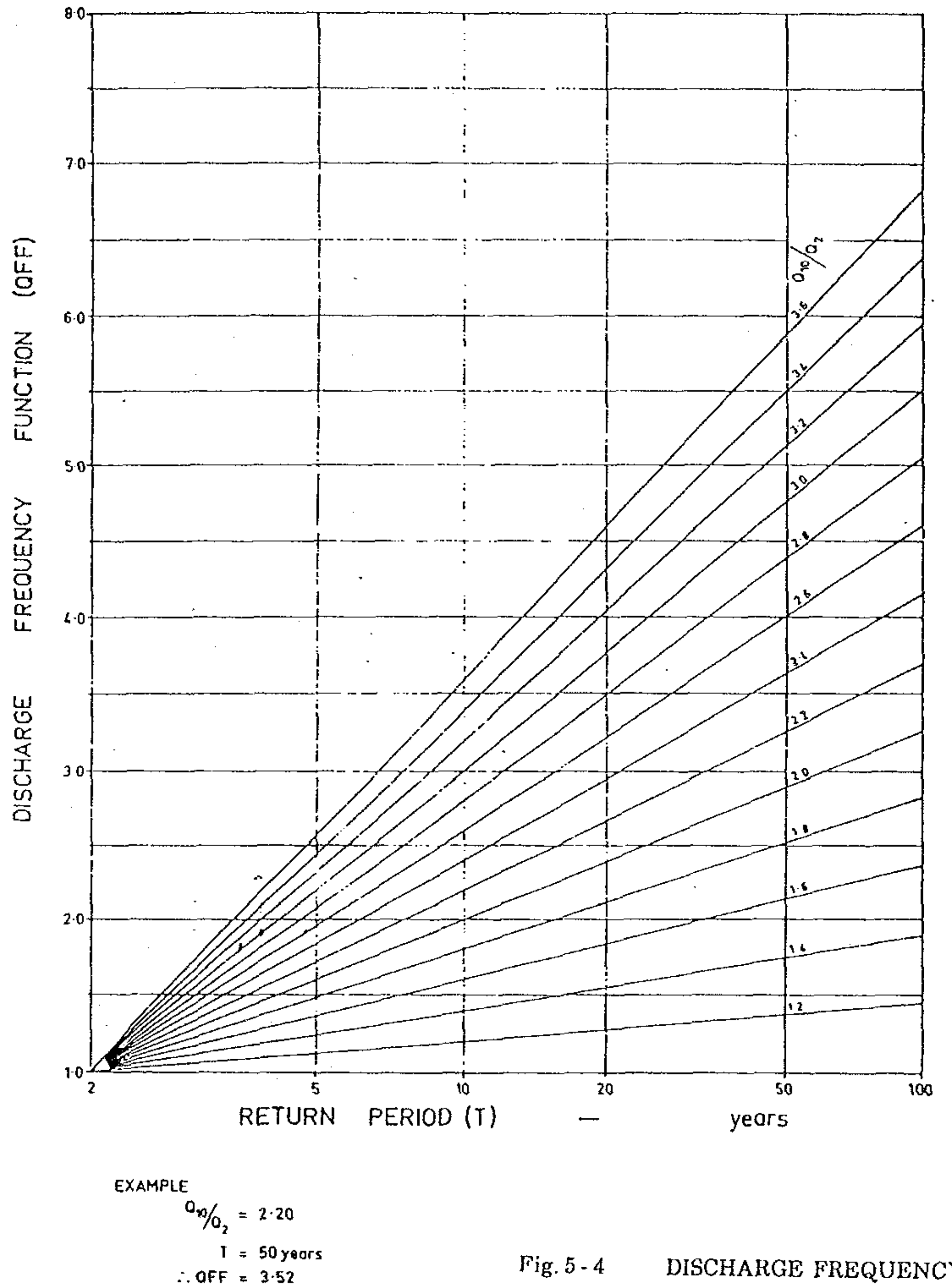


Fig. 5 - 4 DISCHARGE FREQUENCY FUNCTION DIAGRAM

Source : Flood Estimation Manual
DOW March 1973.

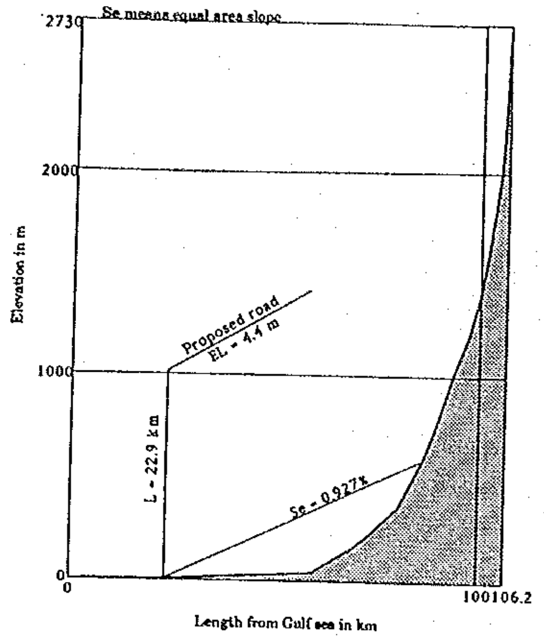


Fig. 5 - 5 MIARU RIVER PROFILE

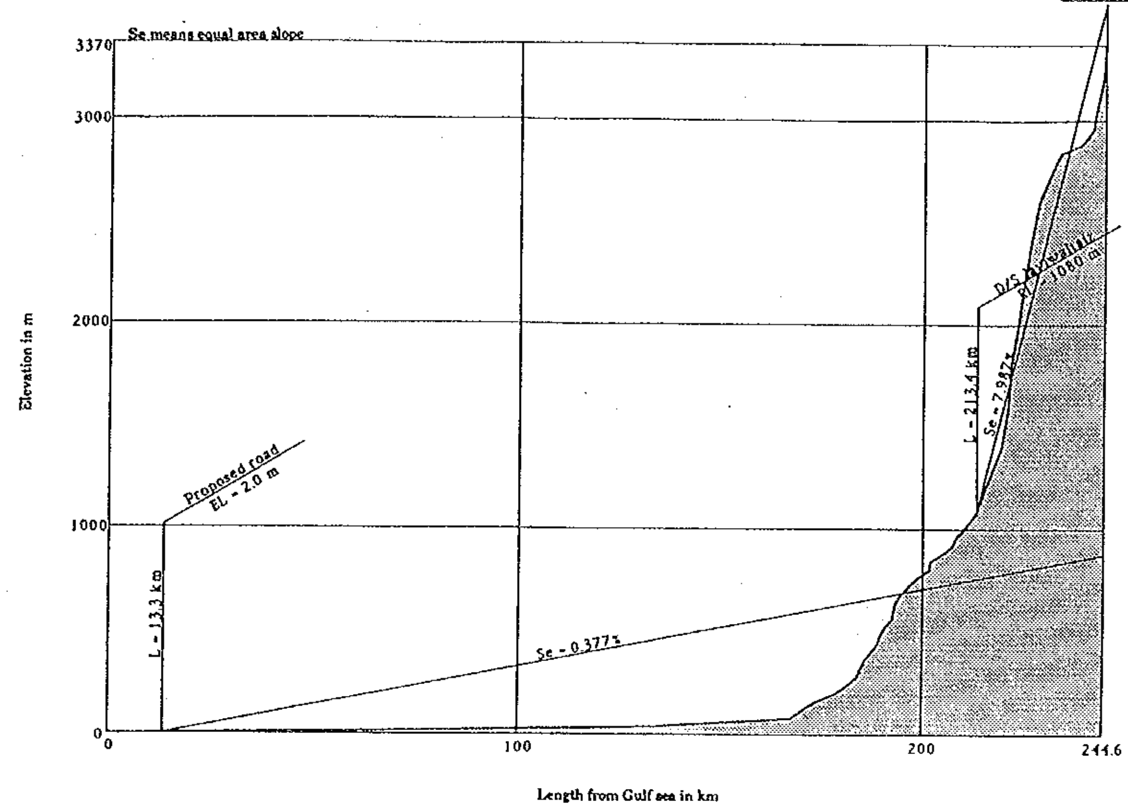


Fig. 5 - 7 LAKEKAMU RIVER PROFILE

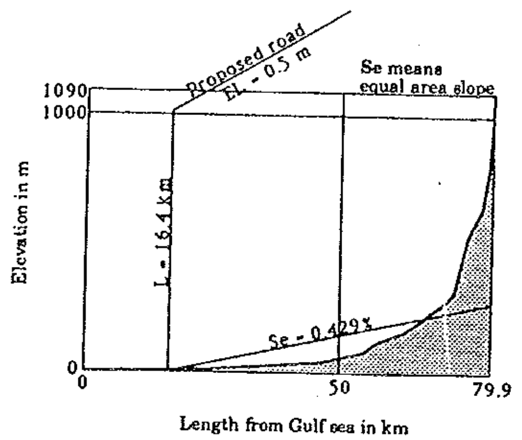


Fig. 5 - 6 KAPURI RIVER PROFILE

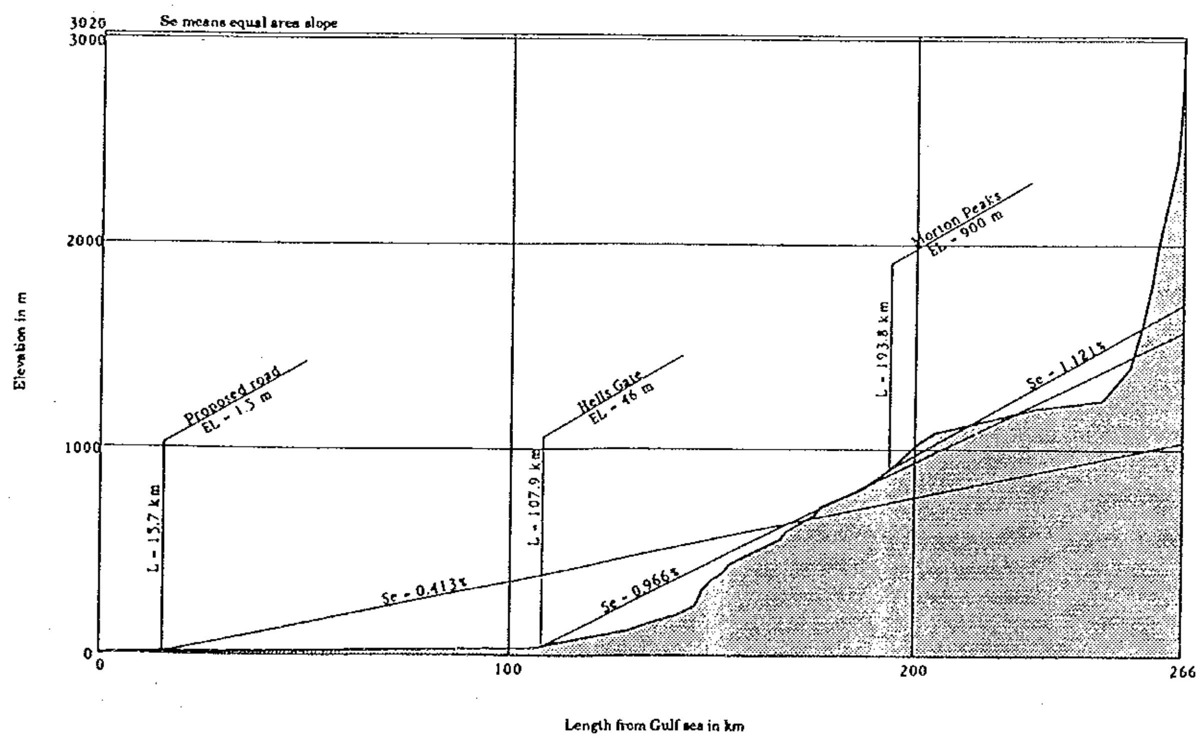


Fig. 5 - 8 TAURI RIVER PROFILE

CATCHMENT MODIFICATION FACTORS

For catchments with abnormal runoff characteristics, the flood discharge estimates obtained using the regional flood frequency method, the simplified method for small areas and the unitgraph method should be modified as the estimates obtained from these methods are for 'average' catchments.

It is not possible with data available at present to recommend objective modification factors to account for the various catchment characteristics; however the modification factors in Papua New Guinea are expected to generally be in the range 0.5 to 1.5. A generalised map of areas with abnormal runoff characteristics is shown on Figure 2. A subjective estimate by the engineer carrying out the flood estimate is required to determine the modification factor to be used in a particular situation. The following table gives a general description of the catchment characteristics which affect the modification factor:

PARAMETER	CHARACTERISTICS PRODUCING HIGH RUNOFF	CHARACTERISTICS PRODUCING LOW RUNOFF
Soils	Shallow, impermeable	Porous, well drained
Vegetation	Sparse vegetation, short grasses	Dense forest with deep ground litter
Relief	Steep slopes, little surface storage	Flat slopes, large surface storage, meandering water-courses
Rainfall Intensity	Exceeding 100 mm/h	Less than 50 mm/h
Catchment Modification Factor	Maximum 1.5	Minimum 0.5

NOTES: Information on the above parameters may be obtained from the CSIRO's Land Research series of reports (Reference 5); this should be supplemented by site inspection where practicable.

Source : Flood Estimation Manual DOW March 1973.

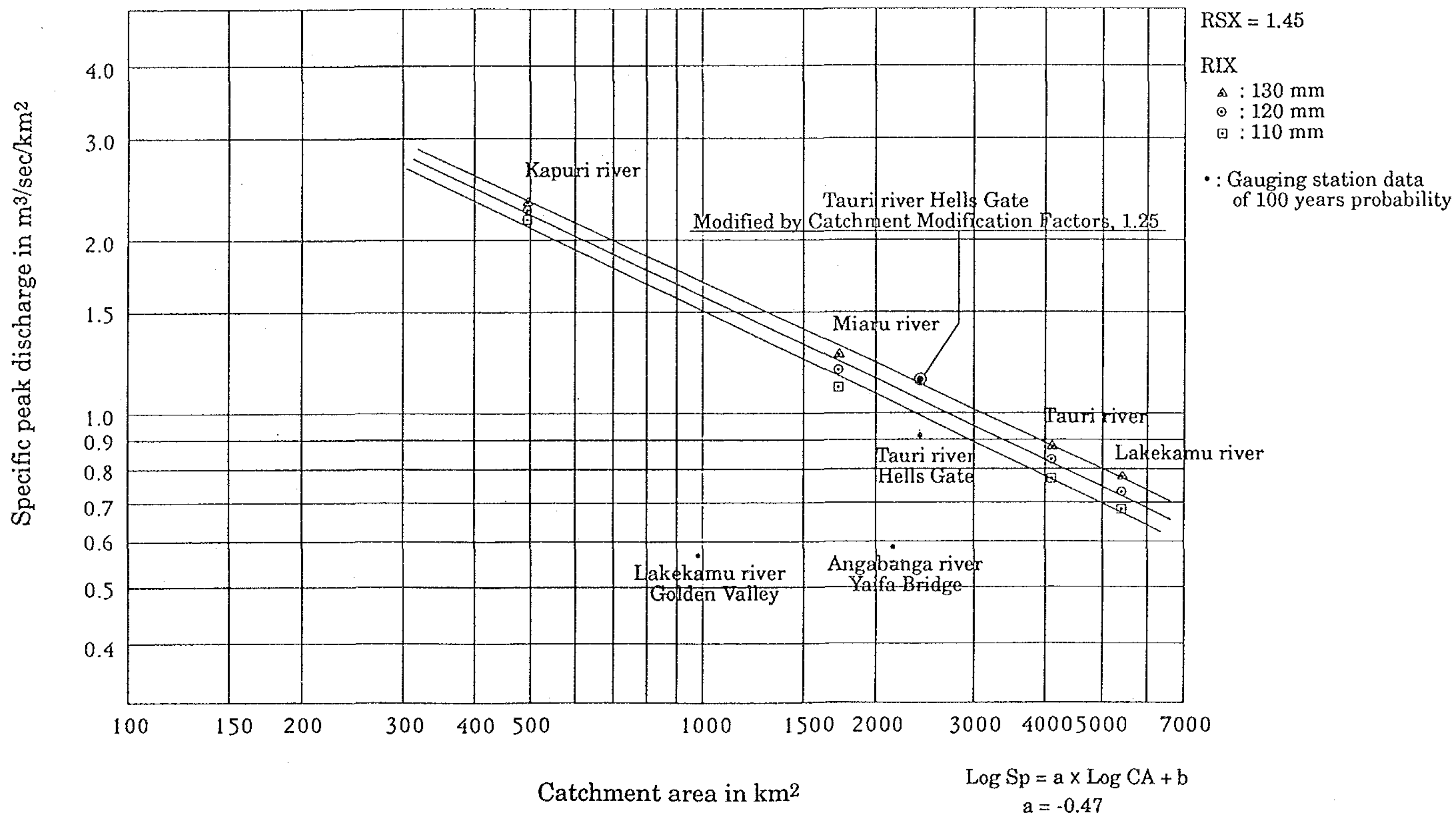


Fig. 5-9 SPECIFIC PEAK DISCHARGE

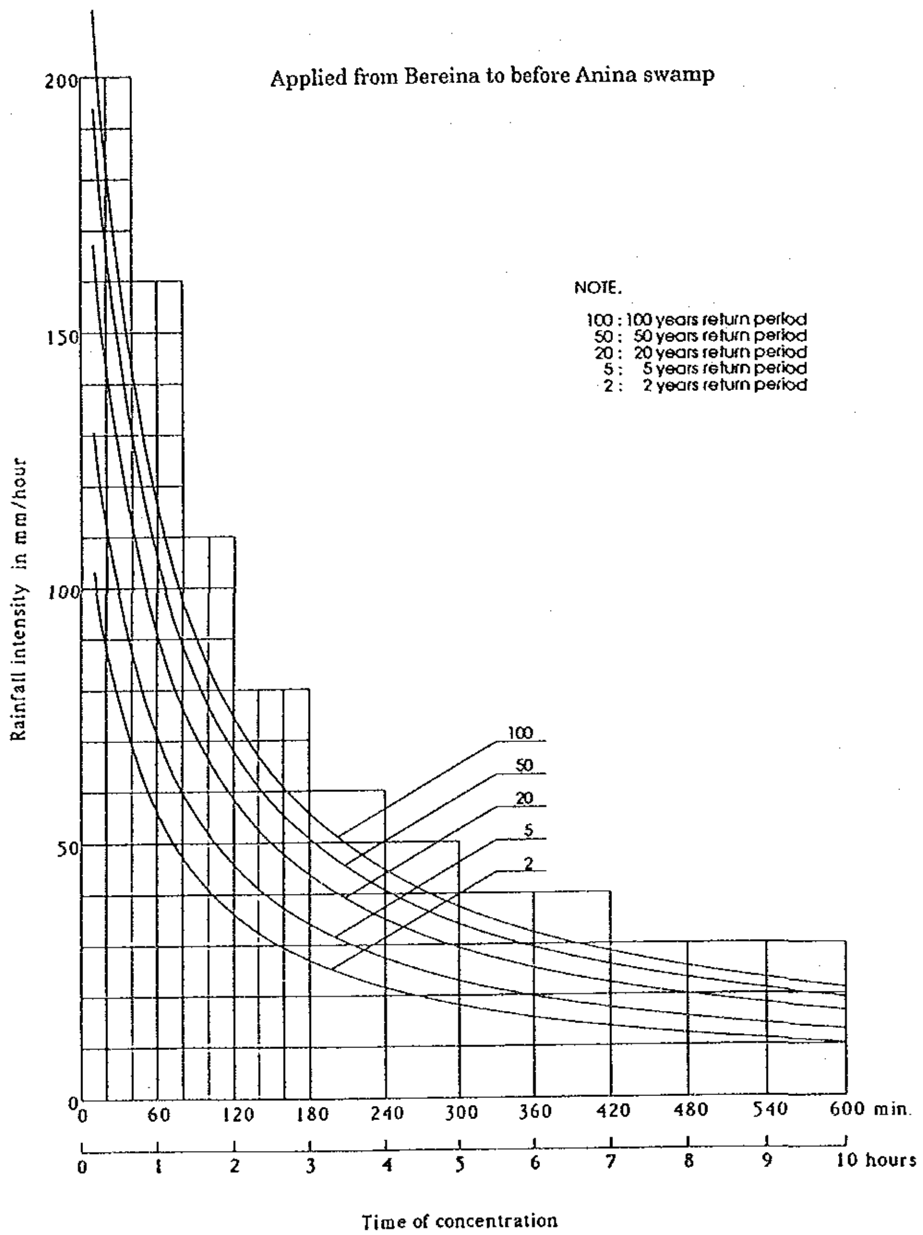


Fig. 5 - 10 RAINFALL INTENSITY CURVE (RIX = 100 mm)

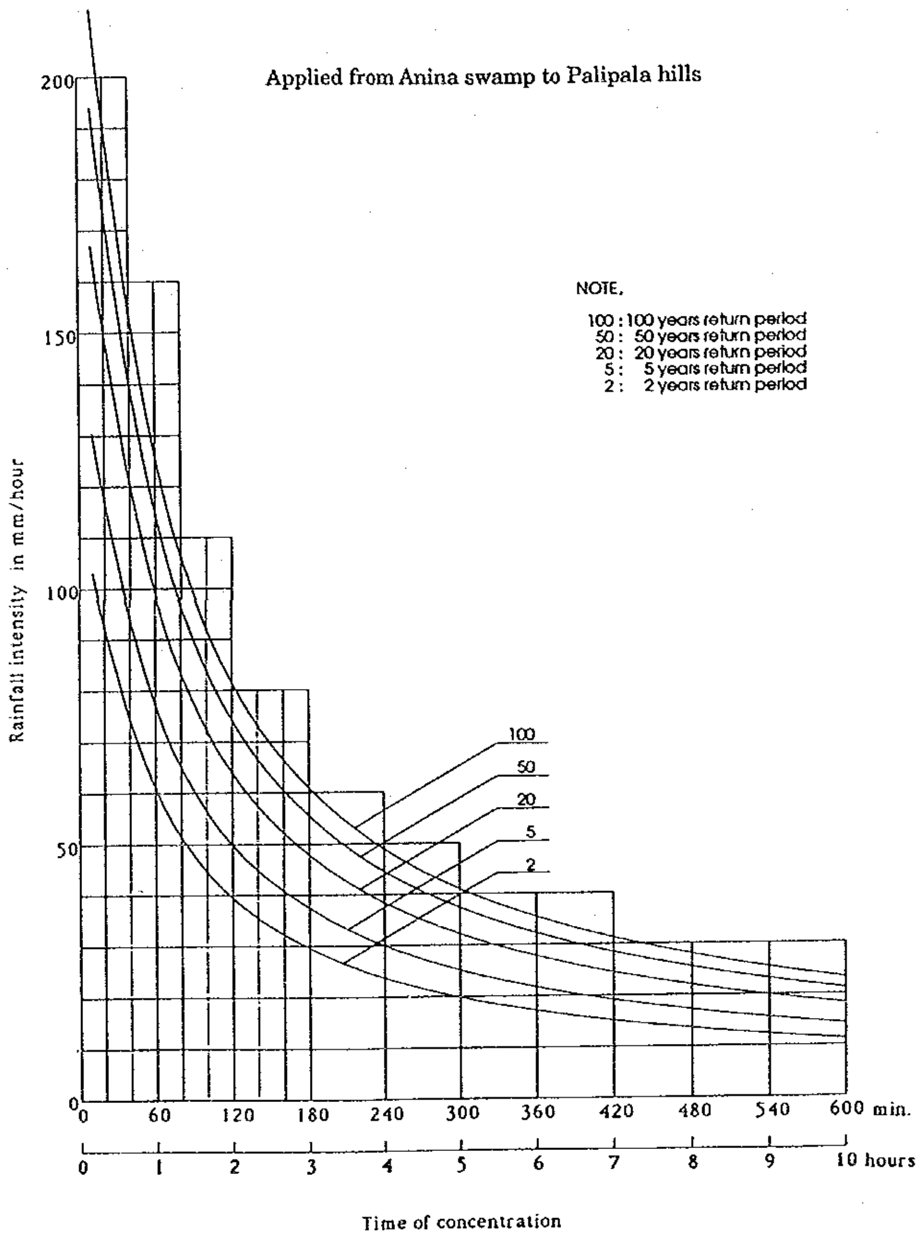


Fig. 5 - 11 RAINFALL INTENSITY CURVE (RIX = 110 mm)

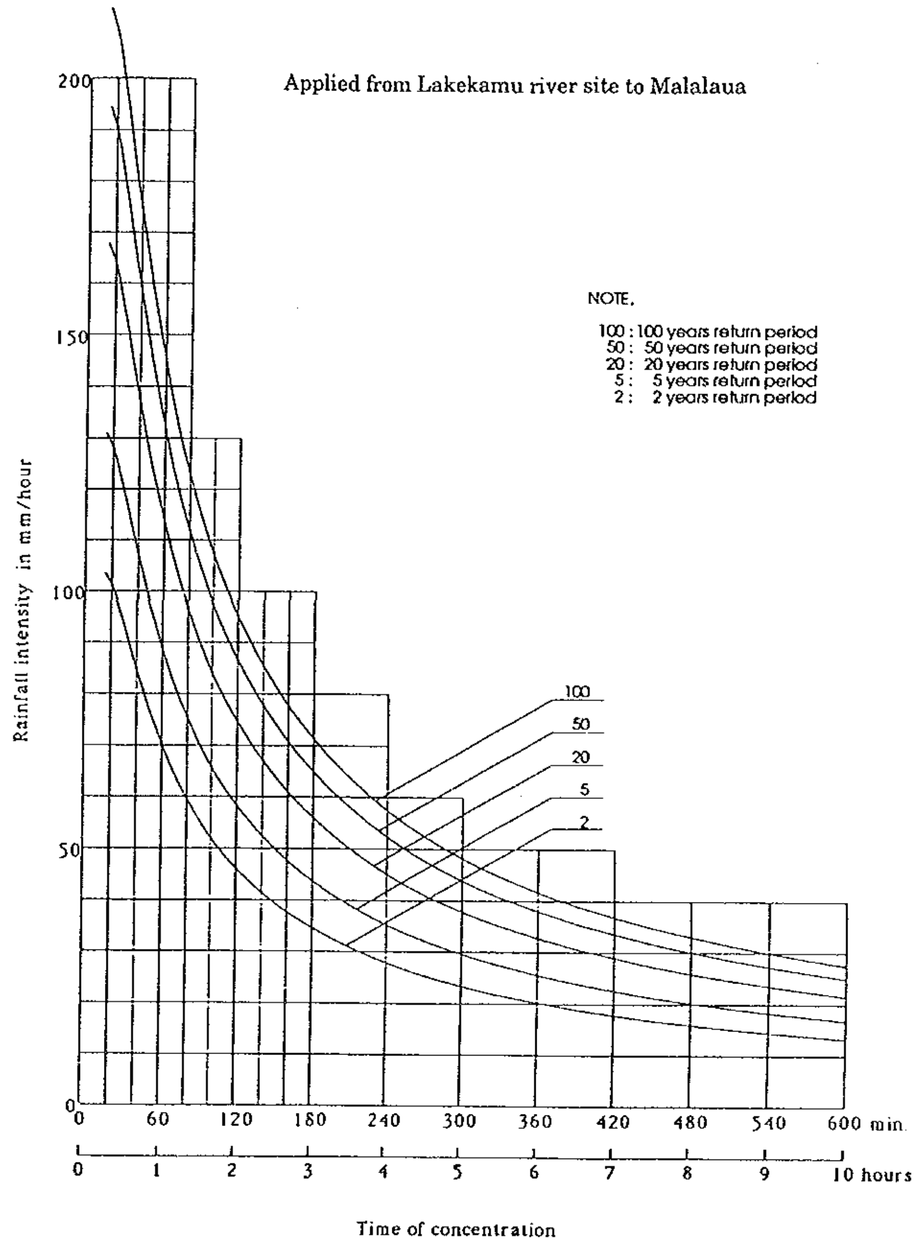


Fig. 5 - 12 RAINFALL INTENSITY CURVE (RIX = 130 mm)

Source : Flood Estimation Manual
DOW March 1973.

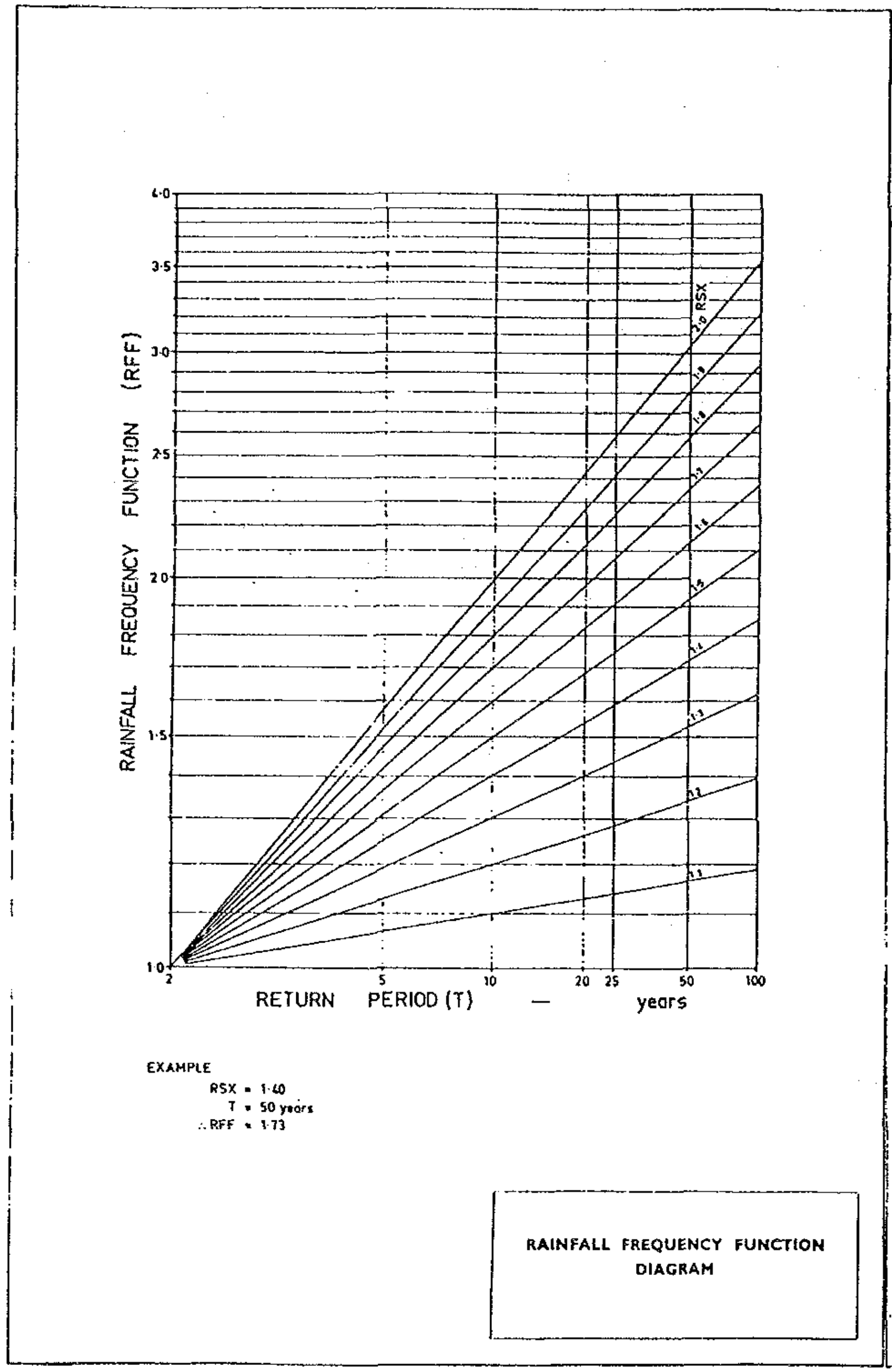


Fig. 5 - 13 RAINFALL FREQUENCY FUNCTION DIAGRAM

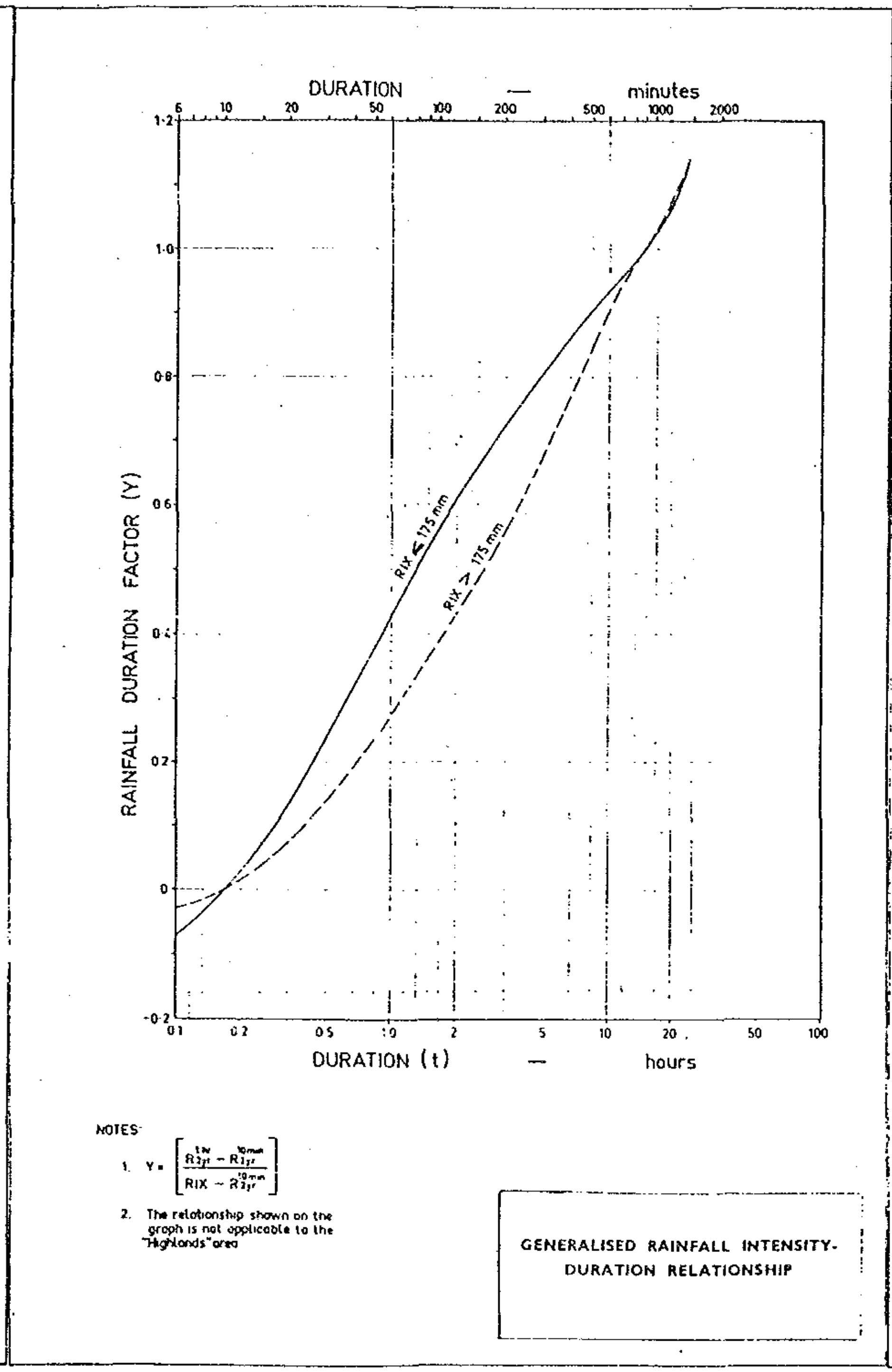


Fig. 5 - 14 GENERALISED RAINFALL INTENSITY

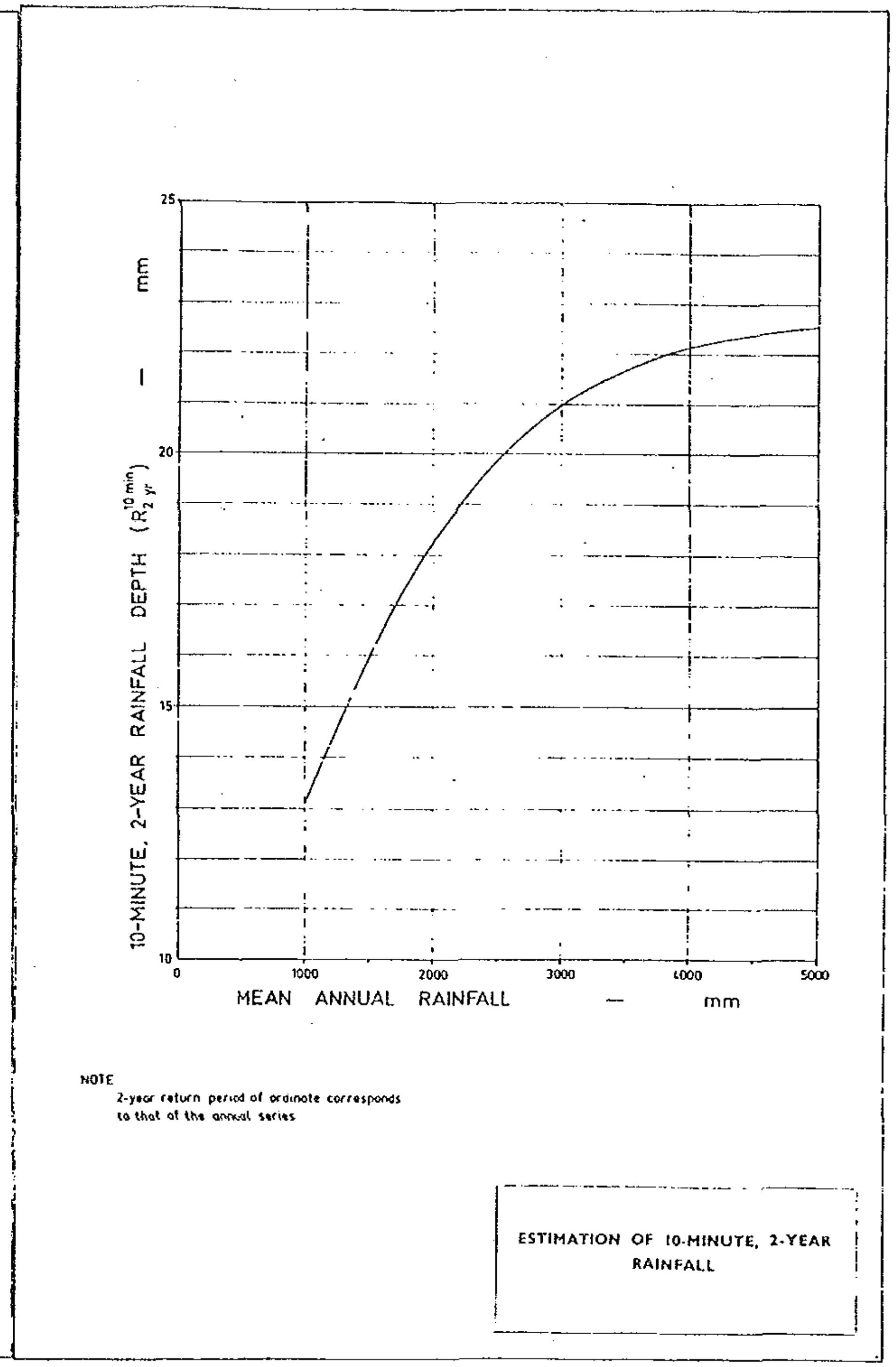


Fig. 5 - 15 ESTIMATION OF 10 MINUTE, 2 - YEAR RAINFALL

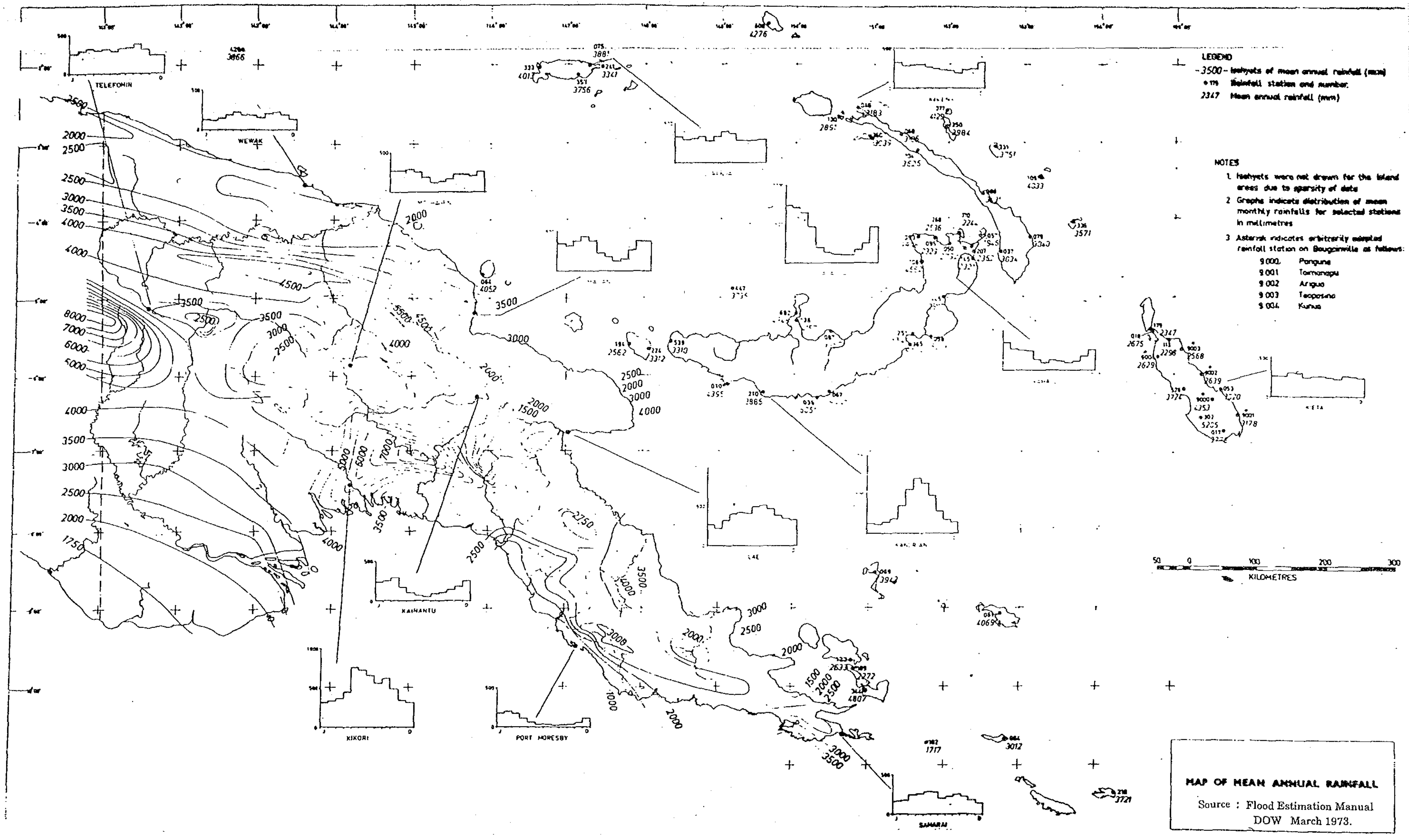


Fig. 5 - 16 MAP OF MEAN ANNUA RAINFALL

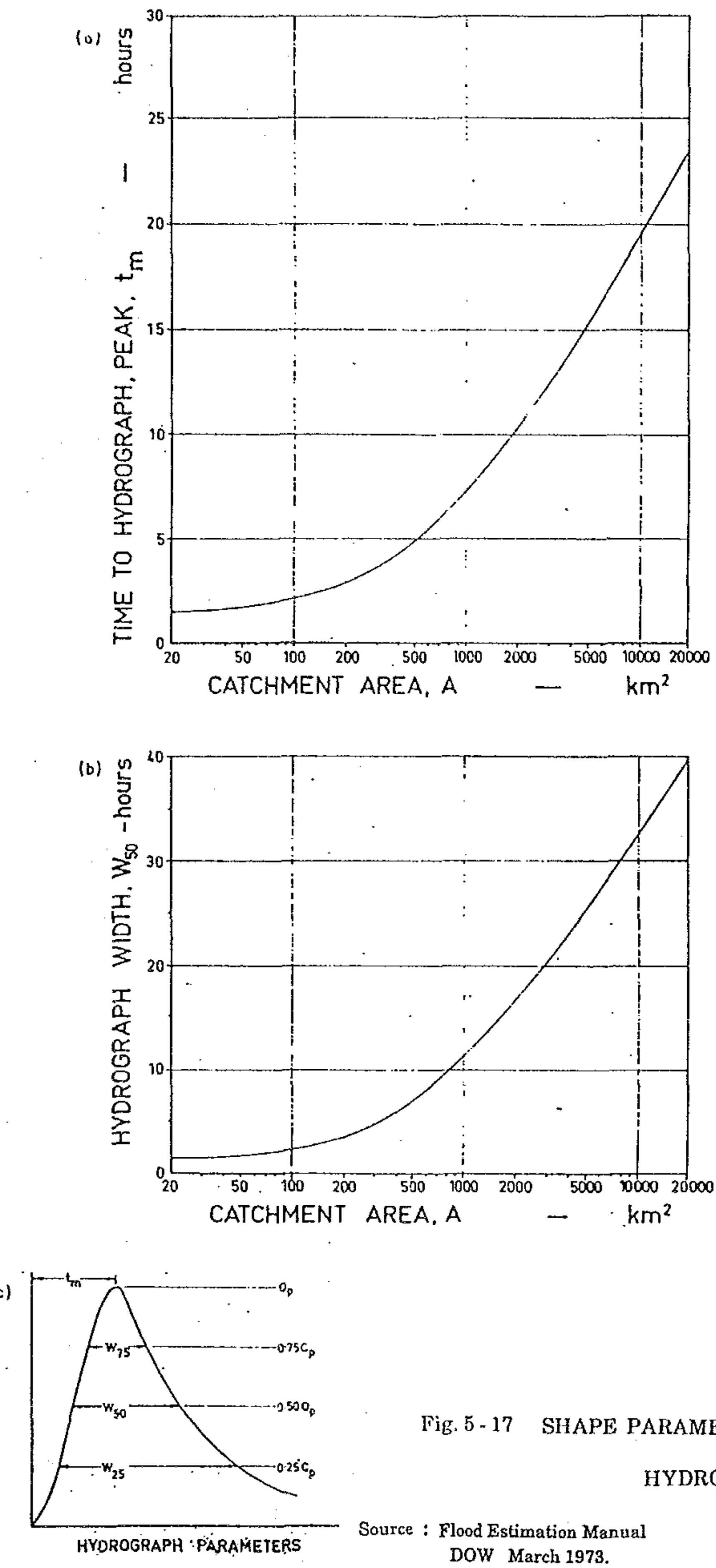


Fig. 5 - 17 SHAPE PARAMETERS FOR TYPICAL HYDROGRAPH

Source : Flood Estimation Manual
DOW March 1973.

Table 5-8 TAIENA AND AGOBINO CREEK FLOOD ANALYSIS

Taiena creek

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
16.400	0.000	0.000
20.000	0.650	1170000.000

Catchment area 9.200 km2
Peak discharge 47.900 m3/s
Time of concentration 225.300 min.

Initial WL. 16.400 m

Assumed channel section data

1	-7.900	100.000	7	0.000	16.400
2	-7.900	18.600	8	4.330	16.750
3	-7.300	18.600	9	5.410	18.300
4	-7.300	18.300	10	7.300	18.300
5	-5.410	18.300	11	7.300	18.600
6	-4.430	16.620	12	7.900	18.600
			13	7.900	100.000

Elevation of inlet = 16.400
- do.- of outlet = 16.383
- do.- length = 8.500 m
- do.- slope = 0.200 %

Assumed roughness coefficient n = 0.1000

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Channel area (m2)	Channel velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	0.000	16.400	0.000	0.000	0.000	0.000	0.
1: 0	0.496	16.896	12.756	3.130	0.228	0.714	22219.
2: 0	0.970	17.370	25.513	7.551	0.380	2.871	84957.
3: 0	1.428	17.828	38.269	12.099	0.487	5.894	184210.
*3:45	1.764	18.164	47.836	15.601	0.552	8.609	280950.
4: 0	1.867	18.267	44.909	16.700	0.570	9.518	314583.
5: 0	2.151	18.551	31.902	20.721	0.539	11.176	417614.
6: 0	2.276	18.676	19.782	22.642	0.542	12.264	467713.
*6:49	2.300	18.700	12.558	23.025	0.547	12.589	477730.
7: 0	2.299	18.699	11.444	23.010	0.547	12.577	477333.
8: 0	2.277	18.677	8.945	22.648	0.542	12.269	467876.
9: 0	2.243	18.643	7.670	22.126	0.535	11.829	454376.
10: 0	2.203	18.603	6.396	21.483	0.526	11.296	438045.
11: 0	2.150	18.550	5.122	20.715	0.539	11.172	417478.
12: 0	2.091	18.491	3.848	19.846	0.527	10.451	394683.
13: 0	2.025	18.425	2.574	18.877	0.512	9.665	370016.
14: 0	1.951	18.351	1.300	17.806	0.495	8.821	343698.
15: 0	1.865	18.265	0.025	16.678	0.570	9.500	313896.
16: 0	1.765	18.165	-	15.612	0.552	8.619	281304.
17: 0	1.670	18.070	-	14.604	0.535	7.807	251757.
18: 0	1.579	17.979	-	13.649	0.517	7.060	225014.
19: 0	1.492	17.892	-	12.747	0.500	6.374	200850.
20: 0	1.408	17.808	-	11.894	0.483	5.744	179053.
21: 0	1.329	17.729	-	11.089	0.466	5.168	159426.
22: 0	1.253	17.653	-	10.329	0.449	4.641	141785.
23: 0	1.181	17.581	-	9.612	0.433	4.160	125957.
24: 0	1.113	17.513	-	8.938	0.416	3.722	111782.
25: 0	1.048	17.448	-	8.303	0.400	3.324	99112.

Agobino creek

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
10.850	0.000	0.000
20.000	0.850	3888750.000

Catchment area 9.300 km2
Peak discharge 59.400 m3/s
Time of concentration 175.200 min.

Initial WL. 10.850 m

Assumed channel section data

1	24.100	100.000	7	36.400	10.850
2	24.100	12.650	8	40.800	11.950
3	24.750	12.650	9	42.300	12.100
4	24.750	12.500	10	42.300	12.650
5	26.000	12.450	11	42.900	12.650
6	28.300	10.850	12	42.900	100.000

Elevation of inlet = 10.850
- do.- of outlet = 10.773
- do.- length = 8.500 m
- do.- slope = 0.900 % Assumed roughness coefficient n = 0.1000

Assumed channel dia 2.100 m x 3
Elevation of inlet = 12.140
- do.- of outlet = 12.063
- do.- length = 8.500 m
- do.- slope = 0.900 % Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Main channel area (m2)	Main channel velocity (m/s)	Main channel Outflow (m3/s)	Storage (m3)	Sub channel area (m2)	Sub channel velocity (m/s)	Sub channel Outflow (m3/s)
0:00	0.000	10.850	0.000	0.000	0.000	0.000	0.			
1: 0	0.733	11.583	20.342	7.397	1.120	8.286	24950.	0.000	0.000	0.000
2: 0	1.308	12.158	40.685	15.356	1.508	23.213	79443.	0.030	0.642	0.058
*2:55	1.725	12.575	59.332	22.215	1.771	40.963	138166.	0.359	1.510	1.625
3: 0	1.756	12.606	57.864	22.762	1.796	42.698	143204.	0.390	1.557	1.822
*3:35	1.845	12.695	45.951	24.382	1.790	46.098	158104.	0.484	1.684	2.445
4: 0	1.811	12.661	37.247	23.751	1.763	44.080	152404.	0.448	1.637	2.200
5: 0	1.540	12.390	19.303	19.077	1.699	33.087	110111.	0.188	1.201	0.676
6: 0	1.214	12.064	11.541	13.884	1.444	20.048	68493.			
7: 0	0.989	11.839	9.509	10.676	1.325	14.149	45470.			
8: 0	0.834	11.684	7.477	8.647	1.205	10.419	32311.			
9: 0	0.705	11.555	5.445	7.060	1.096	7.735	23075.			
10: 0	0.576	11.426	3.414	5.564	0.976	5.427	15391.			
11: 0	0.426	11.276	1.382	3.949	0.818	3.232	8447.			
12: 0	0.229	11.079	-	1.999	0.561	1.122	2439.			
13: 0	0.088	10.938	-	0.731	0.305	0.223	357.			
14: 0	0.022	10.872	-	0.176	0.122	0.021	22.			
15: 0	0.001	10.851	-	0.012	0.020	0.000	0.			
16: 0	0.000	10.850	-	0.000	0.000	0.000	0.			
17: 0	0.000	10.850	-	0.000	0.000	0.000	0.			
18: 0	0.000	10.850	-	0.000	0.000	0.000	0.			
19: 0	0.000	10.850	-	0.000	0.000	0.000	0.			
20: 0	0.000	10.850	-	0.000	0.000	0.000	0.			
21: 0	0.000	10.850	-	0.000	0.000	0.000	0.			

Table 5-9 UNGONG CREEK FLOOD ANALYSIS

Ungongo creek

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
10.200	0.000	0.000
20.000	3.500	17150000.000

Catchment area 61.400 km2
Peak discharge 155.300 m3/s
Time of concentration 461.000 min.

Initial WL. 10.200 m

Assumed channel section data

1	-9.950	100.000	8	2.440	10.300
2	-9.950	12.800	9	4.460	12.100
3	-9.300	12.800	10	5.900	12.400
4	-9.300	12.400	11	8.400	12.400
5	-4.300	12.200	12	8.400	12.800
6	-3.700	10.500	13	8.950	12.800
7	-3.290	10.200	14	8.950	100.000

Elevation of inlet = 10.200
- do.- of outlet = 10.153
- do.- length = 8.500 m
- do.- slope = 0.555 % Assumed roughness coefficient n = 0.1000

Assumed channel dia 2.100 m x 12
Elevation of inlet = 11.000
- do.- of outlet = 10.953
- do.- length = 8.500 m
- do.- slope = 0.555 % Assumed roughness coefficient n = 0.0240

	Water			Main channel				Sub channel		
Time	depth (m)	level (m)	Inflow (m3/s)	area (m2)	velocity (m/s)	Outflow (m3/s)	Storage (m3)	area (m2)	velocity (m/s)	Outflow (m3/s)
0:00	0.000	10.200	0.000	0.000	0.000	0.000	0.			
1: 0	0.444	10.644	20.213	2.451	0.373	0.915	35276.	0.000	0.000	0.000
2: 0	0.877	11.077	40.425	5.434	0.575	3.524	137311.	0.045	0.737	0.400
3: 0	1.278	11.478	60.638	8.450	0.712	12.877	291861.	0.373	1.532	6.861
4: 0	1.631	11.831	80.850	11.293	0.811	27.484	474960.	0.763	2.000	18.328
5: 0	1.942	12.142	101.063	13.955	0.879	44.487	673182.	1.141	2.352	32.218
6: 0	2.227	12.427	121.275	17.411	0.684	59.455	885755.	1.495	2.649	47.538
7: 0	2.489	12.689	141.488	22.047	0.787	80.642	1106373.	1.813	2.909	63.283
*7:41	2.652	12.852	155.300	24.998	0.816	94.106	1256188.	2.002	3.068	73.715
8: 0	2.718	12.918	149.034	26.234	0.839	100.006	1318905.	2.076	3.132	77.995
9: 0	2.835	13.035	128.215	28.458	0.880	110.851	1435553.	2.204	3.245	85.821
*9:43	2.857	13.057	112.826	28.858	0.887	112.831	1457085.	2.226	3.266	87.244
10: 0	2.854	13.054	106.746	28.802	0.886	112.553	1454071.	2.223	3.263	87.044
11: 0	2.802	13.002	85.815	27.831	0.868	107.765	1402150.	2.168	3.213	83.599
12: 0	2.702	12.902	66.611	25.932	0.833	98.554	1303403.	2.058	3.116	76.942
13: 0	2.569	12.769	50.325	23.455	0.816	87.457	1178192.	1.906	2.987	68.312
14: 0	2.418	12.618	38.145	20.791	0.761	74.695	1044155.	1.728	2.840	58.880
15: 0	2.270	12.470	31.259	18.173	0.702	62.790	920338.	1.548	2.693	50.027
16: 0	2.140	12.340	28.981	16.076	0.766	54.960	818007.	1.388	2.561	42.652
17: 0	2.025	12.225	26.951	14.724	0.855	49.043	732056.	1.245	2.441	36.452
18: 0	1.921	12.121	24.921	13.773	0.878	43.299	659011.	1.116	2.330	31.205
19: 0	1.831	12.031	22.891	12.991	0.861	38.101	598795.	1.005	2.232	26.919
20: 0	1.753	11.953	20.861	12.317	0.842	33.748	548455.	0.909	2.143	23.382
21: 0	1.682	11.882	18.831	11.721	0.824	30.046	505240.	0.824	2.061	20.389
22: 0	1.617	11.817	16.801	11.181	0.807	26.826	467130.	0.748	1.984	17.800
23: 0	1.557	11.757	14.771	10.678	0.791	23.950	432652.	0.677	1.910	15.501
24: 0	1.498	11.698	12.741	10.200	0.775	21.333	400726.	0.610	1.835	13.425
25: 0	1.441	11.641	10.711	9.735	0.759	18.909	370554.	0.545	1.760	11.517
26: 0	1.383	11.583	8.681	9.274	0.743	16.628	341534.	0.482	1.682	9.738
27: 0	1.324	11.524	6.651	8.810	0.726	14.462	313203.	0.420	1.600	8.068
28: 0	1.264	11.464	4.621	8.335	0.707	12.391	285186.	0.358	1.510	6.494
29: 0	1.200	11.400	2.591	7.842	0.688	10.405	257160.	0.296	1.410	5.012
30: 0	1.132	11.332	0.561	7.322	0.666	8.505	228821.	0.233	1.296	3.631
31: 0	1.063	11.263	-	6.799	0.642	6.813	201657.	0.174	1.170	2.445
32: 0	1.003	11.203	-	6.353	0.621	5.548	179521.	0.127	1.049	1.600
33: 0	0.950	11.150	-	5.969	0.603	4.604	161328.	0.090	0.932	1.008
34: 0	0.904	11.104	-	5.633	0.585	3.894	146091.	0.061	0.815	0.596
35: 0	0.863	11.063	-	5.336	0.570	3.357	133084.	0.038	0.695	0.318
36: 0	0.826	11.026	-	5.067	0.555	2.950	121766.	0.021	0.564	0.139
37: 0	0.791	10.991	-	4.820	0.541	2.606	111768.			
38: 0	0.758	10.958	-	4.589	0.527	2.419	102726.			
39: 0	0.727	10.927	-	4.367	0.514	2.243	94338.			
40: 0	0.696	10.896	-	4.154	0.500	2.078	86565.			

Table 5-10 ANINA, DIVOLA AND OPOU SWAMP FLOOD ANALYSIS

Anina creek

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
9.000	0.000	0.000
20.000	0.717	3943500.000

Catchment area 4.100 km2
Peak discharge 33.500 m3/s
Time of concentration 130.000 min.

Initial WL. 9.000 m
Assumed channel dia 2.100 m x 4
Elevation of inlet = 9.000
- do.- of outlet = 8.961
- do.- length = 8.500 m
- do.- slope = 0.455 %

Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Channel area (m2)	Channel velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	0.000	9.000	0.000	0.000	0.000	0.000	0.
1: 0	0.790	9.790	15.462	0.705	1.940	5.474	20334.
2: 0	1.428	10.428	30.923	1.486	2.641	15.697	66443.
*2:10	1.525	10.525	33.500	1.605	2.739	17.582	75787.
*2:56	1.717	10.717	21.550	1.835	2.928	21.498	96068.
3: 0	1.716	10.716	20.509	1.834	2.927	21.477	95957.
4: 0	1.506	10.506	8.274	1.581	2.720	17.204	73894.
5: 0	1.195	10.195	5.663	1.197	2.400	11.493	46536.
6: 0	0.959	9.959	4.118	0.906	2.140	7.758	29950.
7: 0	0.763	9.763	2.574	0.675	1.907	5.147	18996.
8: 0	0.575	9.575	1.030	0.465	1.659	3.083	10772.
9: 0	0.359	9.359	-	0.250	1.329	1.331	4208.
10: 0	0.194	9.194	-	0.114	1.011	0.462	1223.
11: 0	0.087	9.087	-	0.046	0.741	0.136	244.
12: 0	0.003	9.003	-	0.009	0.429	0.016	0.
13: 0	0.000	9.000	-	0.009	0.429	0.000	0.
14: 0	0.000	9.000	-	0.009	0.429	0.000	0.
15: 0	0.000	9.000	-	0.009	0.429	0.000	0.
16: 0	0.000	9.000	-	0.009	0.429	0.000	0.
17: 0	0.000	9.000	-	0.009	0.429	0.000	0.
18: 0	0.000	9.000	-	0.009	0.429	0.000	0.

Divola creek

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
1.700	0.000	0.000
2.004	0.400	60800.000

Catchment area 0.400 km2
Peak discharge 6.500 m3/s
Time of concentration 61.700 min.

Initial WL. 1.700 m
Assumed channel dia 2.100 m x 1
Elevation of inlet = 1.700
- do.- of outlet = 1.697
- do.- length = 8.500 m
- do.- slope = 0.038 %

Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Channel area (m2)	Channel velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	0.000	1.700	0.000	0.000	0.000	0.000	0.
1: 0	0.131	1.831	6.321	0.051	0.768	0.039	11329.
*1: 2	0.136	1.836	6.470	0.053	0.780	0.042	12094.
2: 0	0.192	1.892	1.371	0.089	0.927	0.082	24306.
3: 0	0.205	1.905	0.703	0.097	0.957	0.093	27658.
*3:58	0.209	1.909	0.093	0.100	0.966	0.097	28710.
4: 0	0.209	1.909	0.072	0.100	0.966	0.097	28709.
5: 0	0.208	1.908	-	0.099	0.963	0.095	28378.
6: 0	0.206	1.906	-	0.098	0.960	0.094	28036.
7: 0	0.205	1.905	-	0.097	0.957	0.093	27699.
8: 0	0.204	1.904	-	0.097	0.954	0.092	27365.
9: 0	0.203	1.903	-	0.096	0.951	0.091	27035.
10: 0	0.201	1.901	-	0.095	0.949	0.090	26709.
11: 0	0.200	1.900	-	0.094	0.946	0.089	26387.
12: 0	0.199	1.899	-	0.093	0.943	0.088	26069.
13: 0	0.198	1.898	-	0.092	0.940	0.087	25754.
14: 0	0.197	1.897	-	0.092	0.937	0.086	25443.

Opou swamp

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
2.400	0.000	0.000
3.160	2.200	836000.000

Catchment area 2.200 km2
Peak discharge 21.400 m3/s
Time of concentration 130.100 min.

Initial WL. 2.400 m
Assumed channel dia 1.500 m x 2
Elevation of inlet = 2.400
- do.- of outlet = 2.397
- do.- length = 8.500 m
- do.- slope = 0.038 %

Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Channel area (m2)	Channel velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	0.000	2.400	0.000	0.000	0.000	0.000	0.
1: 0	0.111	2.511	9.869	0.033	0.707	0.047	17706.
2: 0	0.221	2.621	19.739	0.090	0.995	0.180	70616.
*2:10	0.239	2.639	21.384	0.101	1.036	0.210	82836.
3: 0	0.304	2.704	13.124	0.143	1.169	0.334	133959.
4: 0	0.337	2.737	5.299	0.165	1.231	0.407	164176.
5: 0	0.350	2.750	3.621	0.175	1.256	0.439	177771.
6: 0	0.360	2.760	2.635	0.182	1.273	0.462	187408.
7: 0	0.366	2.766	1.650	0.186	1.283	0.476	193429.
8: 0	0.368	2.768	0.664	0.187	1.287	0.482	195866.
*8:11	0.368	2.768	0.483	0.187	1.287	0.482	195926.
9: 0	0.367	2.767	-	0.187	1.286	0.480	194937.
10: 0	0.365	2.765	-	0.185	1.283	0.476	193217.
11: 0	0.364	2.764	-	0.184	1.280	0.472	191512.
12: 0	0.362	2.762	-	0.183	1.277	0.468	189821.
13: 0	0.361	2.761	-	0.182	1.274	0.464	188144.
14: 0	0.359	2.759	-	0.181	1.271	0.460	186481.
15: 0	0.357	2.757	-	0.180	1.268	0.456	184833.
16: 0	0.356	2.756	-	0.179	1.265	0.452	183199.
17: 0	0.354	2.754	-	0.178	1.263	0.448	181579.
18: 0	0.353	2.753	-	0.176	1.260	0.444	179972.

Table 5-11 ALIKA SWAMP FLOOD ROUTINE (1)

Alika swamp

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
-0.500	0.000	0.000
5.000	124.300	341825000.000

Catchment area 124.300 km2
Peak discharge 151.500 m3/s
Time of concentration 1000.000 min.

Initial WL. 3.200 m
Tail WL. 3.200 m

No culvert was assumed.

	Water			Main channel			
Time	depth (m)	level (m)	Inflow (m3/s)	area (m2)	velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	3.200	3.200	0.000	3.464	0.000	0.000	154697005.
1: 0	3.200	3.200	9.090	3.464	0.043	0.000	154713367.
2: 0	3.201	3.201	18.180	3.464	0.087	0.000	154762453.
3: 0	3.202	3.202	27.270	3.464	0.130	0.000	154844263.
4: 0	3.203	3.203	36.360	3.464	0.173	0.000	154958797.
5: 0	3.205	3.205	45.450	3.464	0.217	0.000	155106055.
6: 0	3.207	3.207	54.540	3.464	0.260	0.000	155286037.
7: 0	3.210	3.210	63.630	3.464	0.303	0.000	155498743.
8: 0	3.213	3.213	72.720	3.464	0.346	0.000	155744173.
9: 0	3.216	3.216	81.810	3.464	0.390	0.000	156022327.
10: 0	3.220	3.220	90.900	3.464	0.433	0.000	156333205.
11: 0	3.224	3.224	99.990	3.464	0.476	0.000	156676807.
12: 0	3.228	3.228	109.080	3.464	0.519	0.000	157053133.
13: 0	3.233	3.233	118.170	3.464	0.562	0.000	157462183.
14: 0	3.238	3.238	127.260	3.464	0.605	0.000	157903957.
15: 0	3.244	3.244	136.350	3.464	0.648	0.000	158378455.
16: 0	3.250	3.250	145.440	3.464	0.691	0.000	158885677.
*16:40	3.254	3.254	151.500	3.464	0.720	0.000	159242005.
17: 0	3.256	3.256	149.202	3.464	0.734	0.000	159422430.
18: 0	3.262	3.262	142.129	3.464	0.773	0.000	159946902.
19: 0	3.268	3.268	134.833	3.464	0.809	0.000	160445491.
20: 0	3.274	3.274	127.371	3.464	0.841	0.000	160917498.
21: 0	3.279	3.279	119.803	3.464	0.870	0.000	161362436.
22: 0	3.284	3.284	112.188	3.464	0.897	0.000	161780025.
23: 0	3.288	3.288	104.584	3.464	0.921	0.000	162170202.
24: 0	3.293	3.293	97.049	3.464	0.942	0.000	162533112.
25: 0	3.296	3.296	89.643	3.464	0.962	0.000	162869111.
26: 0	3.300	3.300	82.424	3.464	0.980	0.000	163178766.
27: 0	3.303	3.303	75.450	3.464	0.996	0.000	163462857.
28: 0	3.306	3.306	68.781	3.464	1.010	0.000	163722374.
29: 0	3.309	3.309	62.475	3.464	1.023	0.000	163958518.
30: 0	3.312	3.312	56.591	3.464	1.035	0.000	164172702.
31: 0	3.314	3.314	51.187	3.464	1.045	0.000	164366548.
32: 0	3.316	3.316	46.322	3.464	1.055	0.000	164541893.
33: 0	3.318	3.318	42.054	3.464	1.063	0.000	164700781.
34: 0	3.319	3.319	38.443	3.464	1.071	0.000	164845470.
35: 0	3.321	3.321	35.547	3.464	1.077	0.000	164978428.
36: 0	3.322	3.322	33.424	3.464	1.084	0.000	165102334.
37: 0	3.324	3.324	32.134	3.464	1.090	0.000	165220080.
38: 0	3.325	3.325	31.277	3.464	1.096	0.000	165334218.
39: 0	3.326	3.326	30.419	3.464	1.101	0.000	165445271.
40: 0	3.328	3.328	29.562	3.464	1.107	0.000	165553238.
41: 0	3.329	3.329	28.705	3.464	1.112	0.000	165658120.
42: 0	3.330	3.330	27.848	3.464	1.117	0.000	165759917.
43: 0	3.331	3.331	26.991	3.464	1.122	0.000	165858627.
44: 0	3.332	3.332	26.134	3.464	1.127	0.000	165954253.
45: 0	3.333	3.333	25.277	3.464	1.131	0.000	166046792.
46: 0	3.334	3.334	24.420	3.464	1.136	0.000	166136246.
47: 0	3.335	3.335	23.563	3.464	1.140	0.000	166222615.
48: 0	3.336	3.336	22.706	3.464	1.144	0.000	166305898.
49: 0	3.337	3.337	21.849	3.464	1.148	0.000	166386095.
50: 0	3.338	3.338	20.991	3.464	1.151	0.000	166463207.
51: 0	3.339	3.339	20.134	3.464	1.155	0.000	166537234.
52: 0	3.340	3.340	19.277	3.464	1.158	0.000	166608175.
53: 0	3.341	3.341	18.420	3.464	1.162	0.000	166676030.
54: 0	3.341	3.341	17.563	3.464	1.165	0.000	166740800.
55: 0	3.342	3.342	16.706	3.464	1.168	0.000	166802484.
56: 0	3.343	3.343	15.849	3.464	1.170	0.000	166861083.
57: 0	3.343	3.343	14.992	3.464	1.173	0.000	166916596.
58: 0	3.344	3.344	14.135	3.464	1.175	0.000	166969024.
59: 0	3.345	3.345	13.278	3.464	1.178	0.000	167018366.
60: 0	3.345	3.345	12.420	3.464	1.180	0.000	167064622.
61: 0	3.346	3.346	11.563	3.464	1.182	0.000	167107793.
62: 0	3.346	3.346	10.706	3.464	1.184	0.000	167147879.
63: 0	3.346	3.346	9.849	3.464	1.185	0.000	167184878.
64: 0	3.347	3.347	8.992	3.464	1.187	0.000	167218793.
65: 0	3.347	3.347	8.135	3.464	1.188	0.000	167249622.
66: 0	3.348	3.348	7.278	3.464	1.190	0.000	167277365.
67: 0	3.348	3.348	6.421	3.464	1.191	0.000	167302023.
68: 0	3.348	3.348	5.564	3.464	1.192	0.000	167323595.
69: 0	3.348	3.348	4.707	3.464	1.193	0.000	167342081.
70: 0	3.348	3.348	3.850	3.464	1.193	0.000	167357483.
71: 0	3.349	3.349	2.992	3.464	1.194	0.000	167369798.
72: 0	3.349	3.349	2.135	3.464	1.194	0.000	167379028.
73: 0	3.349	3.349	1.278	3.464	1.195	0.000	167385173.
74: 0	3.349	3.349	0.421	3.464	1.195	0.000	167388232.
75: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
76: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
77: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
78: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
79: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
80: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
81: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
82: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.
83: 0	3.349	3.349	-	3.464	1.195	0.000	167388604.

Table 5-12 ALIKA SWAMP FLOOD ROUTINE (2)

Alika swamp

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
-0.500	0.000	0.000
5.000	124.300	341825000.000

Catchment area 124.300 km2
Peak discharge 151.500 m3/s
Time of concentration 1000.000 min.

Initial WL. 3.200 m
Tail WL. 3.200 m

Assumed channel dia 2.100 m x 3
Elevation of inlet = 0.000
- do.- of outlet = 0.000
- do.- length = 20.350 m
- do.- slope = 0.000 % Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Channel area (m2)	Channel velocity (m/s)	Outflow (m3/s)	Storage (m3)
0:00	3.200	3.200	0.000	3.464	0.000	0.000	154697005.
1: 0	3.200	3.200	9.090	3.464	0.042	0.439	154712578.
2: 0	3.201	3.201	18.180	3.464	0.085	0.879	154759292.
3: 0	3.202	3.202	27.270	3.464	0.127	1.317	154837149.
4: 0	3.203	3.203	36.360	3.464	0.169	1.756	154946149.
5: 0	3.205	3.205	45.450	3.464	0.211	2.196	155086293.
6: 0	3.207	3.207	54.540	3.464	0.254	2.634	155257582.
7: 0	3.209	3.209	63.630	3.464	0.296	3.073	155460015.
8: 0	3.212	3.212	72.720	3.464	0.338	3.511	155693593.
9: 0	3.215	3.215	81.810	3.464	0.380	3.949	155958318.
10: 0	3.219	3.219	90.900	3.464	0.422	4.387	156254191.
11: 0	3.222	3.222	99.990	3.464	0.464	4.825	156581212.
12: 0	3.227	3.227	109.080	3.464	0.506	5.262	156939383.
13: 0	3.231	3.231	118.170	3.464	0.548	5.698	157328705.
14: 0	3.236	3.236	127.260	3.464	0.590	6.135	157749179.
15: 0	3.242	3.242	136.350	3.464	0.632	6.571	158200808.
16: 0	3.247	3.247	145.440	3.464	0.674	7.006	158683592.
*16:40	3.251	3.251	151.500	3.464	0.702	7.296	159022758.
17: 0	3.253	3.253	149.202	3.464	0.716	7.438	159194342.
18: 0	3.259	3.259	142.129	3.464	0.754	7.835	159691309.
19: 0	3.265	3.265	134.833	3.464	0.788	8.192	160161038.
20: 0	3.270	3.270	127.371	3.464	0.819	8.514	160602963.
21: 0	3.275	3.275	119.803	3.464	0.847	8.805	161016717.
22: 0	3.279	3.279	112.188	3.464	0.873	9.066	161402131.
23: 0	3.284	3.284	104.584	3.464	0.895	9.302	161759237.
24: 0	3.287	3.287	97.049	3.464	0.916	9.514	162088271.
25: 0	3.291	3.291	89.643	3.464	0.934	9.704	162389672.
26: 0	3.294	3.294	82.424	3.464	0.950	9.873	162664083.
27: 0	3.297	3.297	75.450	3.464	0.965	10.024	162912355.
28: 0	3.300	3.300	68.781	3.464	0.978	10.157	163135541.
29: 0	3.302	3.302	62.475	3.464	0.989	10.275	163334902.
30: 0	3.304	3.304	56.591	3.464	0.999	10.378	163511906.
31: 0	3.306	3.306	51.187	3.464	1.007	10.469	163668224.
32: 0	3.307	3.307	46.322	3.464	1.015	10.547	163805736.
33: 0	3.309	3.309	42.054	3.464	1.022	10.616	163926527.
34: 0	3.310	3.310	38.443	3.464	1.027	10.676	164032887.
35: 0	3.311	3.311	35.547	3.464	1.033	10.729	164127313.
36: 0	3.312	3.312	33.424	3.464	1.037	10.777	164212507.
37: 0	3.313	3.313	32.134	3.464	1.041	10.821	164291375.
38: 0	3.314	3.314	31.277	3.464	1.045	10.863	164366483.
39: 0	3.315	3.315	30.419	3.464	1.049	10.902	164438359.
40: 0	3.316	3.316	29.562	3.464	1.053	10.940	164507009.
41: 0	3.316	3.316	28.705	3.464	1.056	10.976	164572442.
42: 0	3.317	3.317	27.848	3.464	1.060	11.010	164634664.
43: 0	3.318	3.318	26.991	3.464	1.063	11.042	164693680.
44: 0	3.318	3.318	26.134	3.464	1.066	11.072	164749499.
45: 0	3.319	3.319	25.277	3.464	1.068	11.101	164802127.
46: 0	3.320	3.320	24.420	3.464	1.071	11.128	164851569.
47: 0	3.320	3.320	23.563	3.464	1.073	11.152	164897833.
48: 0	3.321	3.321	22.706	3.464	1.076	11.176	164940925.
49: 0	3.321	3.321	21.849	3.464	1.078	11.197	164980852.
50: 0	3.321	3.321	20.991	3.464	1.079	11.217	165017618.
51: 0	3.322	3.322	20.134	3.464	1.081	11.235	165051232.
52: 0	3.322	3.322	19.277	3.464	1.083	11.251	165081698.
53: 0	3.322	3.322	18.420	3.464	1.084	11.265	165109024.
54: 0	3.323	3.323	17.563	3.464	1.085	11.278	165133214.
55: 0	3.323	3.323	16.706	3.464	1.086	11.290	165154276.
56: 0	3.323	3.323	15.849	3.464	1.087	11.299	165172214.
57: 0	3.323	3.323	14.992	3.464	1.088	11.307	165187036.
58: 0	3.324	3.324	14.135	3.464	1.089	11.313	165198747.
59: 0	3.324	3.324	13.278	3.464	1.089	11.318	165207354.
60: 0	3.324	3.324	12.420	3.464	1.089	11.321	165212861.
61: 0	3.324	3.324	11.563	3.464	1.090	11.322	165215275.
*61:35	3.324	3.324	11.063	3.464	1.090	11.322	165215257.
62: 0	3.324	3.324	10.706	3.464	1.090	11.321	165214602.
63: 0	3.324	3.324	9.849	3.464	1.089	11.320	165210847.
64: 0	3.324	3.324	8.992	3.464	1.089	11.316	165204017.
65: 0	3.323	3.323	8.135	3.464	1.089	11.311	165194118.
66: 0	3.323	3.323	7.278	3.464	1.088	11.304	165181155.
67: 0	3.323	3.323	6.421	3.464	1.087	11.295	165165133.
68: 0	3.323	3.323	5.564	3.464	1.086	11.285	165146060.
69: 0	3.323	3.323	4.707	3.464	1.085	11.273	165123941.
70: 0	3.322	3.322	3.850	3.464	1.084	11.260	165098782.
71: 0	3.322	3.322	2.992	3.464	1.082	11.245	165070588.
72: 0	3.322	3.322	2.135	3.464	1.081	11.228	165039365.
73: 0	3.321	3.321	1.278	3.464	1.079	11.210	165005120.
74: 0	3.321	3.321	0.421	3.464	1.077	11.190	164967859.
75: 0	3.320	3.320	-	3.464	1.075	11.169	164927985.
76: 0	3.320	3.320	-	3.464	1.073	11.147	164887817.
77: 0	3.319	3.319	-	3.464	1.071	11.125	164847726.
78: 0	3.319	3.319	-	3.464	1.069	11.104	164807714.
79: 0	3.319	3.319	-	3.464	1.067	11.082	164767779.
80: 0	3.318	3.318	-	3.464	1.064	11.061	164727922.
81: 0	3.318	3.318	-	3.464	1.062	11.039	164688142.
82: 0	3.317	3.317	-	3.464	1.060	11.017	164648441.
83: 0	3.317	3.317	-	3.464	1.058	10.996	164608817.

Alika swamp

Table 5-13 ALIKA SWAMP FLOOD ROUTINE (3)

Assumed storage at upstream side.

El. (m)	Area (km2)	Vol. (m3)
-0.500	0.000	0.000
5.000	124.300	341825000.000

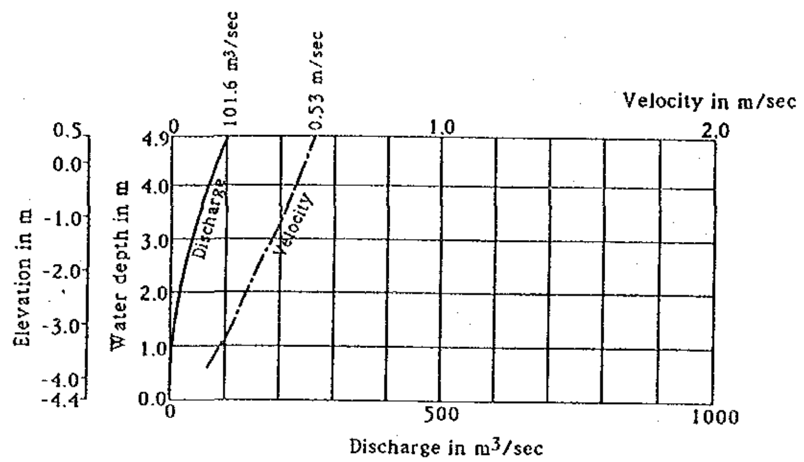
Catchment area 124.300 km2
Peak discharge 151.500 m3/s
Time of concentration 1000.000 min.

Initial WL. 3.200 m
Tail WL. 3.200 m

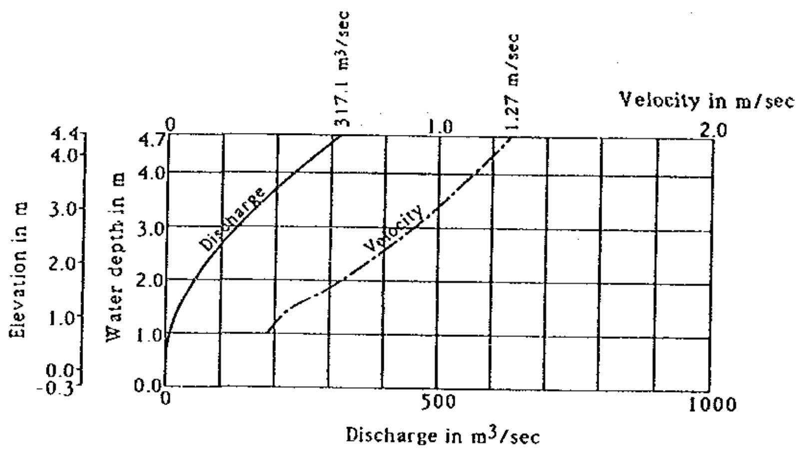
Assumed channel dia 2.100 m x 3
Elevation of inlet = 0.000
- do.- of outlet = 0.000
- do.- length = 20.350 m
- do.- slope = 0.000 % Assumed roughness coefficient n = 0.0240

Assumed channel dia 2.100 m x 6
Elevation of inlet = 2.150
- do.- of outlet = 2.150
- do.- length = 13.900 m
- do.- slope = 0.000 % Assumed roughness coefficient n = 0.0240

Time	Water depth (m)	Water level (m)	Inflow (m3/s)	Main channel area (m2)	Main channel velocity (m/s)	Main channel Outflow (m3/s)	Storage (m3)	Sub channel area (m2)	Sub channel velocity (m/s)	Sub channel Outflow (m3/s)
0:00	3.200	3.200	0.000	3.464	0.000	0.000	154697005.	1.732	0.000	0.000
1: 0	3.200	3.200	9.090	3.464	0.041	0.927	154711705.	1.732	0.048	0.499
2: 0	3.201	3.201	18.180	3.464	0.082	1.848	154755796.	1.732	0.096	0.995
3: 0	3.202	3.202	27.270	3.464	0.123	2.774	154829284.	1.732	0.144	1.494
4: 0	3.203	3.203	36.360	3.464	0.164	3.699	154932168.	1.732	0.192	1.992
5: 0	3.204	3.204	45.450	3.464	0.205	4.623	155064449.	1.732	0.240	2.489
6: 0	3.206	3.206	54.540	3.464	0.246	5.546	155226128.	1.732	0.287	2.987
7: 0	3.209	3.209	63.630	3.464	0.287	6.469	155417206.	1.732	0.335	3.484
8: 0	3.211	3.211	72.720	3.464	0.328	7.393	155637685.	1.732	0.383	3.981
9: 0	3.214	3.214	81.810	3.464	0.369	8.315	155887567.	1.732	0.431	4.478
10: 0	3.218	3.218	90.900	3.464	0.410	9.236	156166853.	1.732	0.479	4.974
11: 0	3.221	3.221	99.990	3.464	0.451	10.158	156475545.	1.732	0.526	5.470
12: 0	3.225	3.225	109.080	3.464	0.492	11.078	156813646.	1.732	0.574	5.966
13: 0	3.230	3.230	118.170	3.464	0.533	11.998	157181159.	1.732	0.622	6.461
14: 0	3.234	3.234	127.260	3.464	0.574	12.917	157578086.	1.732	0.669	6.956
15: 0	3.239	3.239	136.350	3.464	0.614	13.835	158004430.	1.732	0.717	7.450
16: 0	3.245	3.245	145.440	3.464	0.655	14.752	158460195.	1.732	0.765	7.944
*16:40	3.249	3.249	151.500	3.464	0.682	15.363	158780385.	1.732	0.796	8.273
17: 0	3.250	3.250	149.202	3.464	0.696	15.662	158942193.	1.732	0.812	8.434
18: 0	3.256	3.256	142.129	3.464	0.733	16.494	159408755.	1.732	0.855	8.882
19: 0	3.261	3.261	134.833	3.464	0.766	17.238	159846601.	1.732	0.893	9.283
20: 0	3.266	3.266	127.371	3.464	0.795	17.903	160255332.	1.732	0.928	9.641
21: 0	3.270	3.270	119.803	3.464	0.822	18.499	160634726.	1.732	0.959	9.962
22: 0	3.274	3.274	112.188	3.464	0.845	19.031	160984745.	1.732	0.986	10.248
23: 0	3.278	3.278	104.584	3.464	0.866	19.505	161305540.	1.732	1.011	10.504
24: 0	3.282	3.282	97.049	3.464	0.885	19.927	161597456.	1.732	1.033	10.731
25: 0	3.285	3.285	89.643	3.464	0.902	20.300	161861033.	1.732	1.052	10.932
26: 0	3.287	3.287	82.424	3.464	0.916	20.627	162097006.	1.732	1.069	11.108
27: 0	3.290	3.290	75.450	3.464	0.929	20.914	162306311.	1.732	1.084	11.262
28: 0	3.292	3.292	68.781	3.464	0.940	21.162	162490080.	1.732	1.097	11.396
29: 0	3.294	3.294	62.475	3.464	0.949	21.375	162649648.	1.732	1.108	11.511
30: 0	3.296	3.296	56.591	3.464	0.957	21.556	162786548.	1.732	1.117	11.608
31: 0	3.297	3.297	51.187	3.464	0.964	21.708	162902513.	1.732	1.125	11.690
32: 0	3.298	3.298	46.322	3.464	0.970	21.834	162999475.	1.732	1.132	11.758
33: 0	3.299	3.299	42.054	3.464	0.974	21.938	163079568.	1.732	1.137	11.814
34: 0	3.300	3.300	38.443	3.464	0.978	22.022	163145125.	1.732	1.141	11.859
35: 0	3.300	3.300	35.547	3.464	0.981	22.091	163198675.	1.732	1.145	11.896
36: 0	3.301	3.301	33.424	3.464	0.984	22.148	163242949.	1.732	1.148	11.927
37: 0	3.301	3.301	32.134	3.464	0.986	22.196	163280875.	1.732	1.150	11.953
38: 0	3.302	3.302	31.277	3.464	0.988	22.239	163315028.	1.732	1.153	11.976
39: 0	3.302	3.302	30.419	3.464	0.989	22.279	163345947.	1.732	1.155	11.997
40: 0	3.302	3.302	29.562	3.464	0.991	22.314	163373646.	1.732	1.156	12.016
41: 0	3.303	3.303	28.705	3.464	0.992	22.345	163398140.	1.732	1.158	12.033
42: 0	3.303	3.303	27.848	3.464	0.994	22.372	163419445.	1.732	1.159	12.048
43: 0	3.303	3.303	26.991	3.464	0.995	22.395	163437574.	1.732	1.161	12.060
44: 0	3.303	3.303	26.134	3.464	0.995	22.414	163452542.	1.732	1.162	12.070
45: 0	3.303	3.303	25.277	3.464	0.996	22.429	163464364.	1.732	1.162	12.078
46: 0	3.304	3.304	24.420	3.464	0.997	22.440	163473054.	1.732	1.163	12.084
47: 0	3.304	3.304	23.563	3.464	0.997	22.447	163478626.	1.732	1.163	12.088
48: 0	3.304	3.304	22.706	3.464	0.997	22.450	163481094.	1.732	1.163	12.089
*48:25	3.304	3.304	22.349	3.464	0.997	22.450	163481209.	1.732	1.163	12.090
49: 0	3.304	3.304	21.849	3.464	0.997	22.449	163480472.	1.732	1.163	12.089
50: 0	3.304	3.304	20.991	3.464	0.997	22.444	163476775.	1.732	1.163	12.087
51: 0	3.303	3.303	20.134	3.464	0.996	22.436	163470015.	1.732	1.163	12.082
52: 0	3.303	3.303	19.277	3.464	0.996	22.423	163460208.	1.732	1.162	12.075
53: 0	3.303	3.303	18.420	3.464	0.995	22.407	163447367.	1.732	1.161	12.067
54: 0	3.303	3.303	17.563	3.464	0.994	22.387	163431506.	1.732	1.160	12.056
55: 0	3.303	3.303	16.706	3.464	0.993	22.363	163412638.	1.732	1.159	12.043
56: 0	3.303	3.303	15.849	3.464	0.992	22.336	163390777.	1.732	1.158	12.028
57: 0	3.302	3.302	14.992	3.464	0.991	22.304	163365937.	1.732	1.156	12.011
58: 0	3.302	3.302	14.135	3.464	0.989	22.269	163338132.	1.732	1.154	11.992
59: 0	3.302	3.302	13.278	3.464	0.987	22.230	163307375.	1.732	1.152	11.971
60: 0	3.301	3.301	12.420	3.464	0.985	22.187	163273681.	1.732	1.150	11.948
61: 0	3.301	3.301	11.563	3.464	0.983	22.140	163237063.	1.732	1.147	11.923
62: 0	3.300	3.300	10.706	3.464	0.981	22.089	163197534.	1.732	1.145	11.895
63: 0	3.300	3.300	9.849	3.464	0.979	22.035	163155109.	1.732	1.142	11.866
64: 0	3.299	3.299	8.992	3.464	0.976	21.977	163109802.	1.732	1.139	11.835
65: 0	3.299	3.299	8.135	3.464	0.973	21.914	163061626.	1.732	1.136	11.801
66: 0	3.298	3.298	7.278	3.464	0.970	21.848	163010595.	1.732	1.132	11.766
67: 0	3.297	3.297	6.421	3.464	0.967	21.778	162956724.	1.732	1.129	11.728
68: 0	3.297	3.297	5.564	3.464	0.964	21.704	162900026.	1.732	1.125	11.688
69: 0	3.296	3.296	4.707	3.464	0.961	21.626	162840516.	1.732	1.121	11.646
70: 0	3.295	3.295	3.850	3.464	0.957	21.545	162778207.	1.732	1.117	11.602
71: 0	3.295	3.295	2.992	3.464	0.953	21.459	162713115.	1.732	1.112	11.556
72: 0	3.294	3.294	2.135	3.464	0.949	21.369	162645254.	1.732	1.107	11.507
73: 0	3.293	3.293	1.278	3.464	0.945	21.275	162574639.	1.732	1.103	11.457
74: 0	3.292	3.292	0.421	3.464	0.941	21.177	162501283.	1.732	1.097	11.404
75: 0	3.291	3.291	-	3.464	0.936	21.075	162425601.	1.732	1.092	11.349
76: 0	3.290	3.290	-	3.464	0.931	20.973	162349915.	1.732	1.087	11.294
77: 0	3.290	3.290	-	3.464	0.927	20.871	162274596.	1.732	1.082	11.239
78: 0	3.289	3.289	-	3.464	0.922	20.769	162199645.	1.732	1.076	11.184
79: 0	3.288	3.288	-	3.464	0.918	20.666	162125063.	1.732	1.071	11.129
80: 0	3.287	3.287	-	3.464	0.913	20.564	162050849.	1.732	1.066	11.074
81: 0	3.286	3.286	-	3.464	0.909	20.462	161977003.	1.732	1.060	11.019
82: 0	3.285	3.285	-	3.464	0.904	20.359	161903525.	1.732	1.055	10.964
83: 0	3.284	3.284	-	3.464	0.900	20.257	161830417.	1.732	1.050	10.909

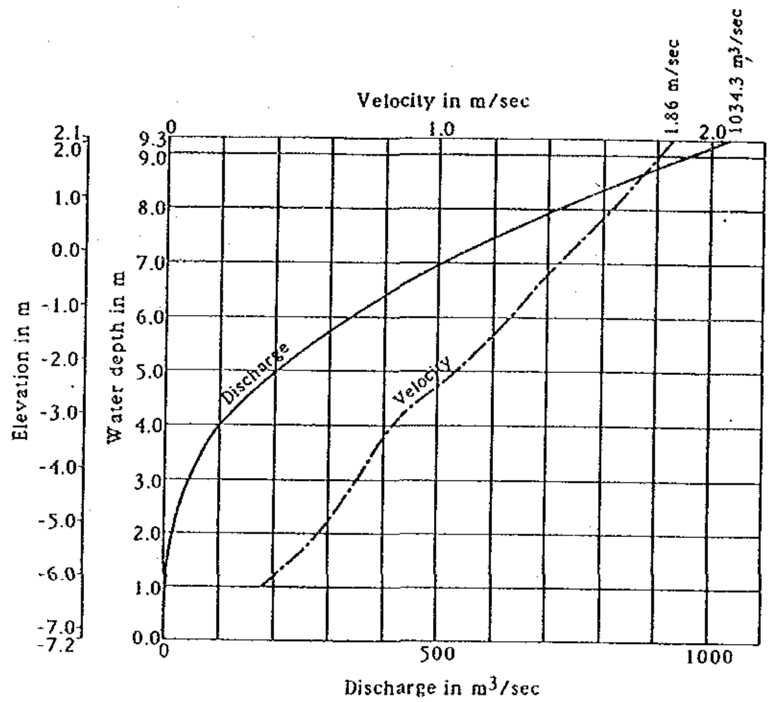


River name : Kapuri river
Assumptions, River bed slope : S = 0.0030 %
Roughness coefficient : n = 0.025



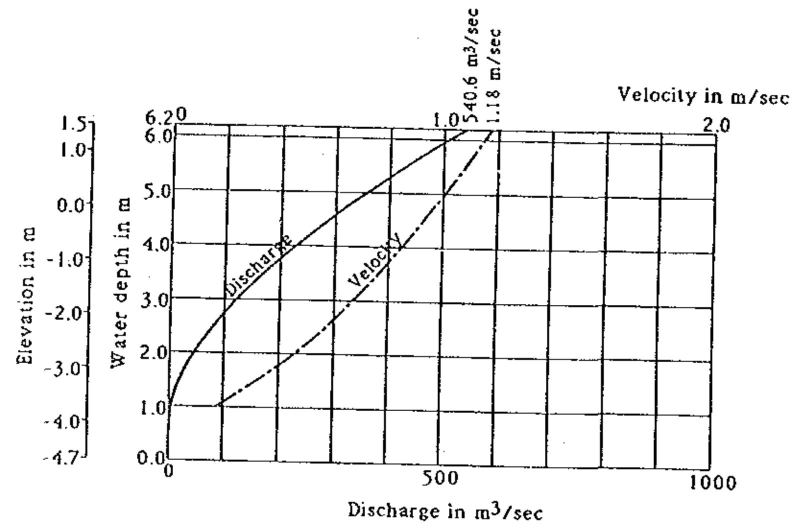
River name : Miaru river
Assumptions, River bed slope : S = 0.0096 %
Roughness coefficient : n = 0.024

UNIFORM FLOW RATING CURVE (1/3)



River name : Lakekamu river
Assumptions, River bed slope : S = 0.0158 %
Roughness coefficient : n = 0.022

UNIFORM FLOW RATING CURVE (2/3)



River name : Tauri river
Assumptions, River bed slope : S = 0.0096 %
Roughness coefficient : n = 0.024

UNIFORM FLOW RATING CURVE (3/3)

Fig. 5 - 18 UNIFORM FLOW RATING CURVE (1/3) ~ (3/3)

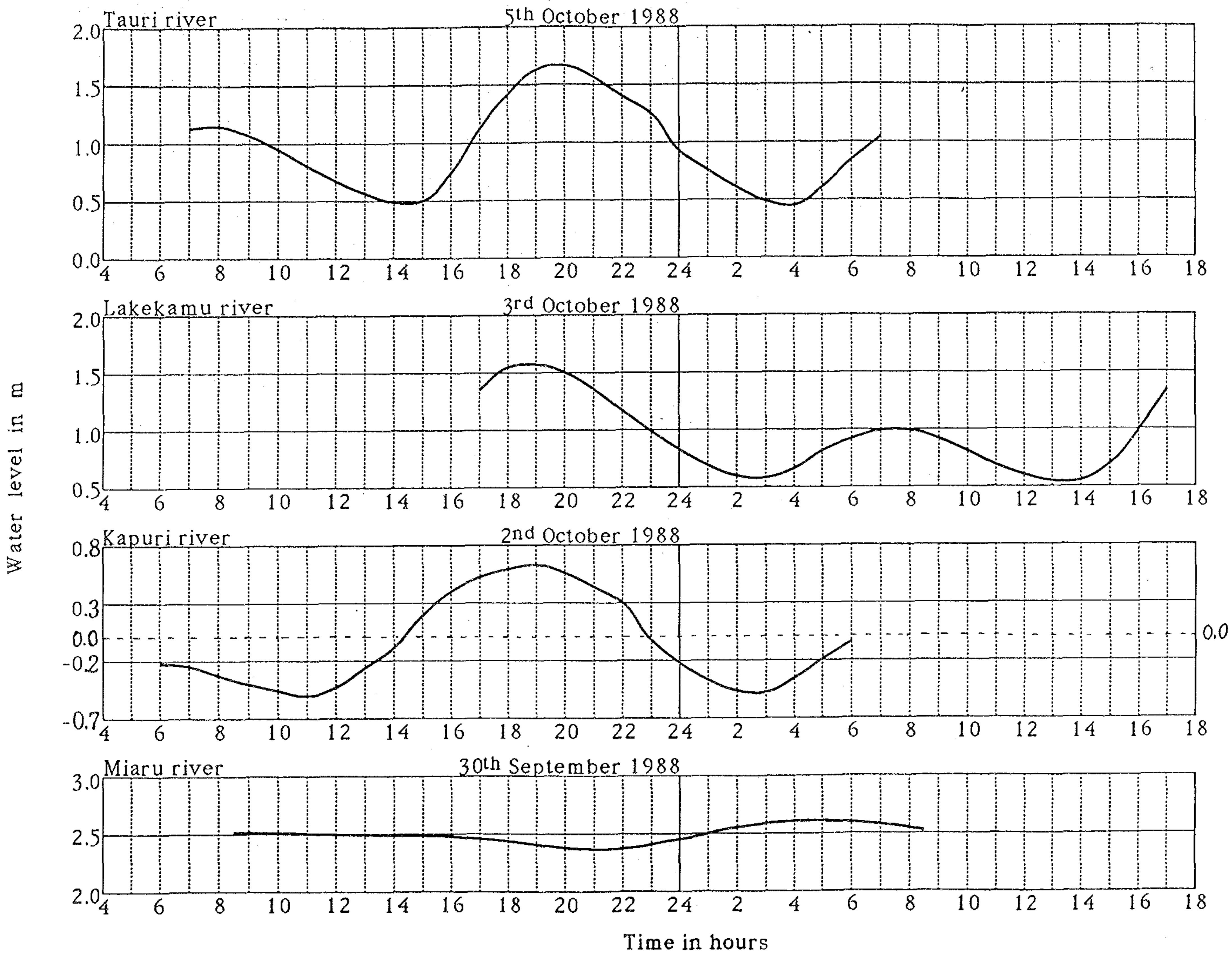


Fig. 5 - 19 WATER LEVEL OBSERVATION