

3. Survey on River Bed Materials

Survey on River Bed Materials

1) Introduction

The conduct of the Survey on River Bed Materials is one important direct method of obtaining information related to the river bed conditions in the Study area. The results of the survey will be vital in evaluating the sediment yield and estimating the sediment transport of the rivers around the Mayon Volcano. The survey was undertaken from November 1998 to January 1999.

2) Objective

The objective of this survey is to examine the river bed conditions at the disaster prone rivers where no measurements of river bed materials have been undertaken.

3) Scope of Work

3)-1 Location of measurements

The river bed materials surveys were carried out at the following seventeen (17) rivers.

River system	River
Yawa River System	Yawa
	Pawa-Burabod
	Budiao
	Analing
Quinali (A) River System	Quirangay
(Upstream of the Bicol river)	Tumpa
	Maninila
	Masarawag
	Ogsong
	Nasisi
Quinali (B) River System	Buang
	Quinali (B)
	San Vicente
Arimbay River System	Arimbay
Padang River System	Padang
Basud River System	Basud
Bulawan River System	Bulawan

3)-2 Sampling method

Sampling river bed material was done on at least two (2) locations along each river course. Total number of sampling location was sixty four (64) points in seventeen (17) rivers. The sampling point was the same location as the cross section survey carried out. Exact point on a river was measured with proper location, which is instructed by Engineer at the site.

A photograph was taken before diggings with ruler-bar to measure the long grain diameter of over larger gravel. Ruler-bar was made by of wood and steel-plate, which is 2.0m square length and 1cm mark with degrees. Rough location maps describes sample-logging sheets and add to photograph in the site.

Basically one sample was picked out from one sampling point, accordingly total number of the samples was 64. Soil sampling was carried out 30cm in depth below the river bed surface.

3)-3 Recording of measurement results

The following items are precisely recorded on the standard form.

- Sampling logs
- Summary Sheets containing results of sieve analysis and specific gravity test
- Cumulative Sieve Curve Graphs

3)-4 Numbers of measurement

Numbers of measurement are as follows:

River system	River	Number of Measurement	
		Sieve Analysis	Specific Gravity
Yawa River System	Yawa	4	
	Pawa-Burabod	5	1
	Budiao	5	
	Anoling	5	1
Quinali (A) River System (Upstream of the Bicol river)	Quirangay	4	
	Tumpa	3	
	Maninila	3	
	Masarawag	4	1
	Ogsong	4	
Quinali (B) River System	Nasisi	3	
	Buang	2	
	Quinali (B)	4	
	San Vicente	5	
Arimbay River System	Arimbay	2	
Padang River System	Padang	2	1
Basud River System	Basud	4	1
Bulawan River System	Bulawan	5	
Total		64	5

4) Interim Results of the Survey

4)-1 Date of field sampling

The field sampling was carried out for the period from December 7 to December 16, 1998.

4)-2 Results of measurements

a) Sieve analysis

Cumulative passing rate on sieve size of 2.0 mm which is taken an average of each river is as follows:

River system	River	Cumulative passing rate on sieve size of 2.0 mm (%)
Yawa River System	Yawa	21.25
	Pawa-Burabod	40.40
	Budiao	25.60
	Anoling	26.50

Quinali (A) River System	Quirangay	41.00
(Upstream of the Bicol river)	Tumpa	69.50
	Maninila	45.67
	Masarawag	27.50
	Ogsong	38.33
	Nasisi	32.00
Quinali (B) River System	Buang	19.50
	Quinali (B)	39.00
	San Vicente	37.00
Arimbay River System	Arimbay	20.50
Padang River System	Padang	21.00
Basud River System	Basud	22.00
Bulawan River System	Bulawan	23.60

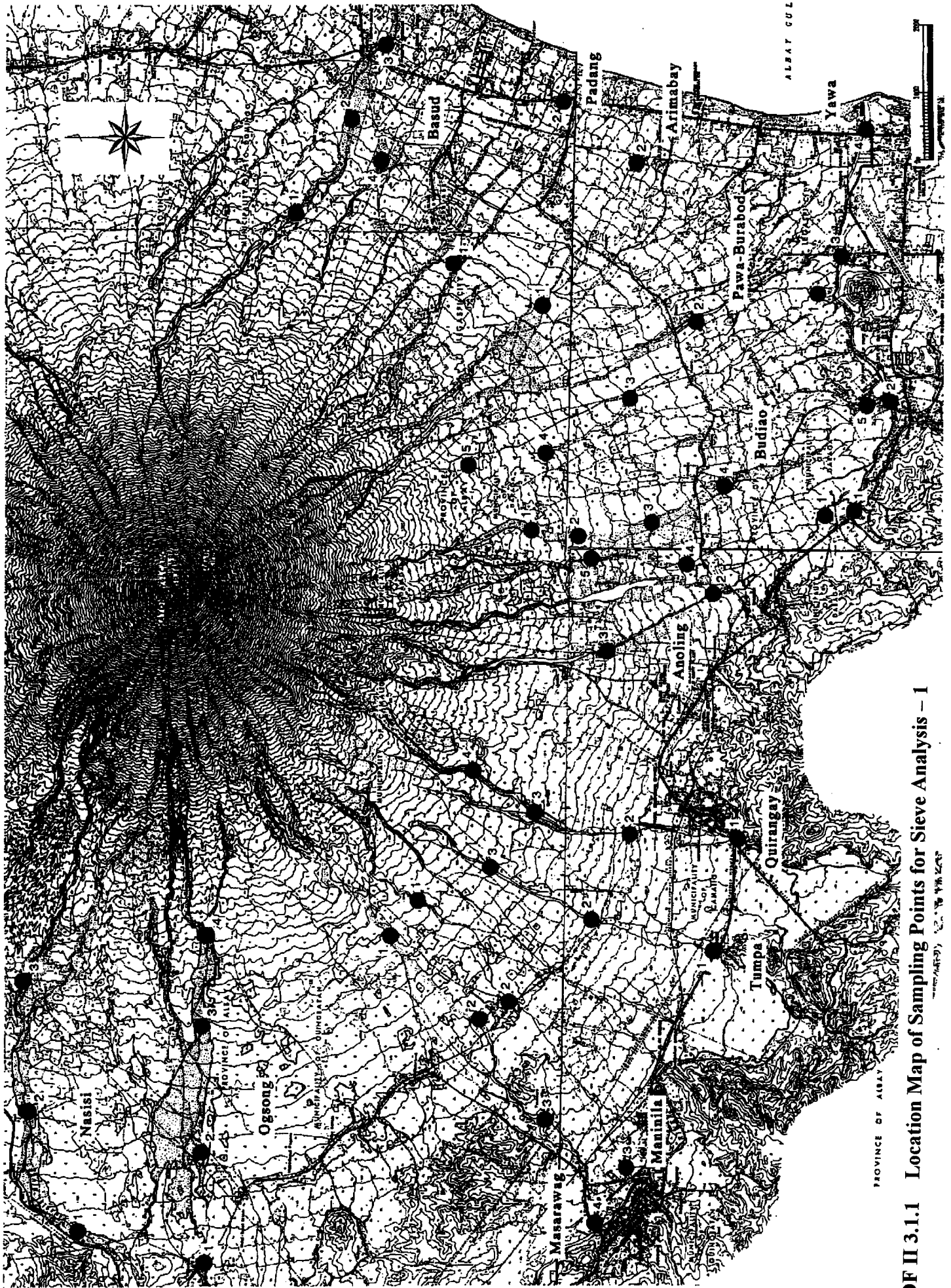
b) Specific gravity analysis
Specific gravity analysis are as follows;

River system	River	Specific gravity analysis	
		Coarse aggregate	Fine aggregate
Yawa River System	Pawa-Burabod	2.572	2.744
	Budiao	5	1
	Analing	2.598	2.876
Quinali (A) River System	Masarawag	2.473	2.842
Padang River System	Padang	2.585	2.737
Basud River System	Basud	2.565	2.732
Total	6		

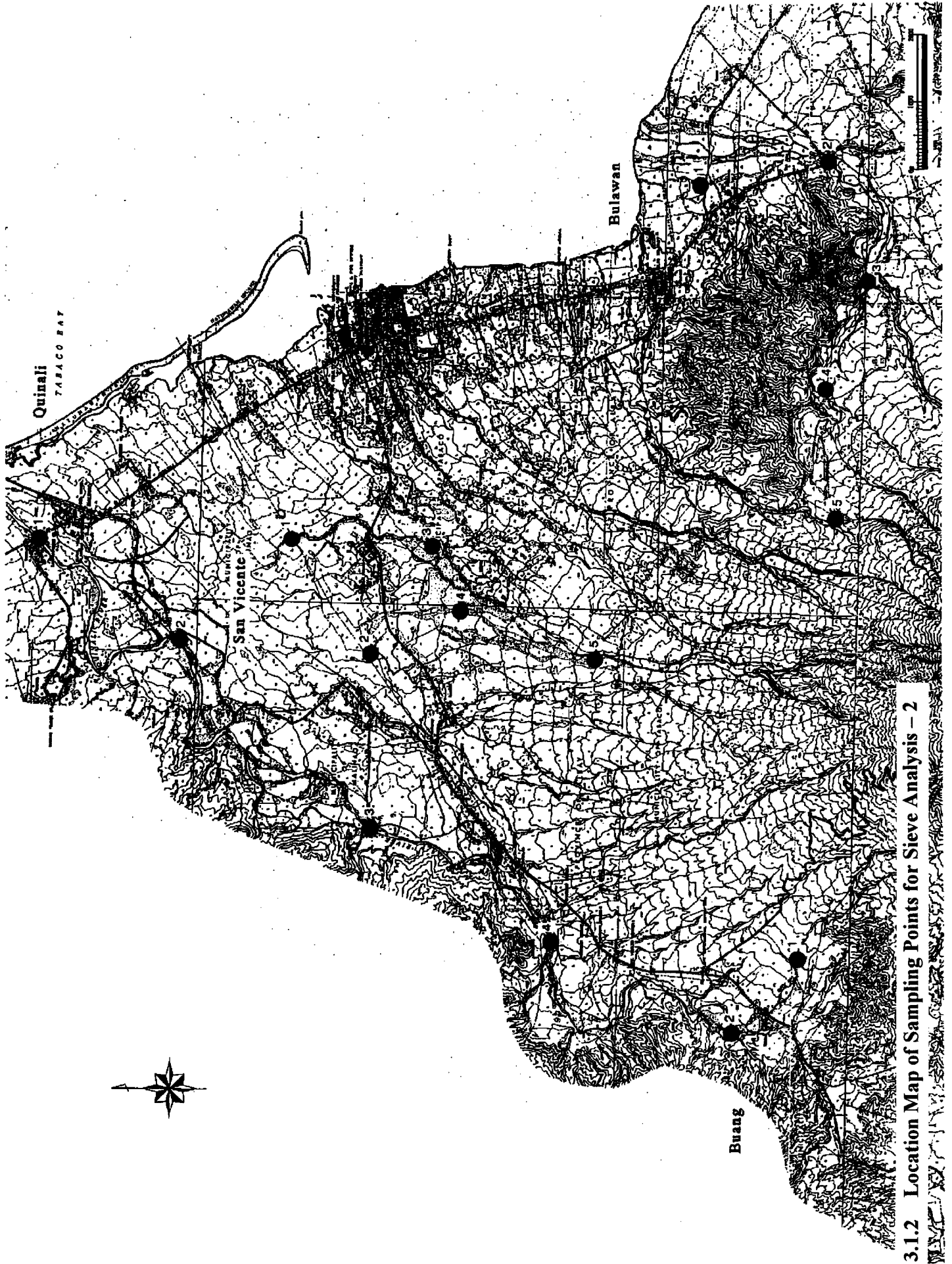
Density test was carried out grayish brown porous stone, brownish and dark red stone and grayish and black andesite stone, which classified on each specific gravity sites.

c) Others
Total weight of sample weight and size of big stone and number of pieces greater than 5.0 cm were measured on all sampling sites.

3.1 Location Map of Sampling Points for Sieve Analysis



DF II 3.1.1 Location Map of Sampling Points for Sieve Analysis - 1



DF II 3.1.2 Location Map of Sampling Points for Sieve Analysis - 2

3.2 Results of Sieve Analysis for each River and Sampling Point

DT II 3.2.1 Results of Sieve Analysis for Each River

Basin	Sieve Analysis		Specific Gravity	Density Test (g/cc)	type A			type B		s/a (%) <80mm	
	d50 (mm)	d90 (mm)			all	s/a (%) <100mm	>150mm	s/a (%) all	>150mm	type A (%)	type B (%)
Yawa	96.75	170.25			2 ~ 3	17 ~ 24	30 ~ 70	22	0	33 ~ 38	
Pawa Burabod	344.00	486.00	2.658	2.364	1 ~ 2	27 ~ 24	40 ~ 95			27 ~ 49	93
Budiao	73.60	276.40			1 ~ 4	26 ~ 35	35 ~ 90	11 ~ 25	0	18 ~ 42	61
Anoling	189.20	266.00	2.712	2.384	1 ~ 4	20 ~ 27	20 ~ 95			34 ~ 51	
Average	175.89	299.66	2.685	2.374						28 ~ 45	77
Lahar										50 ~ 65	80~90
Quinali(A)											
Quirangay	107.60	193.35			1 ~ 4	16 ~ 28	20 ~ 90	100	0		
Tumpa	93.47	197.20			1 ~ 2	21 ~ 23	55 ~ 75	95	0		
Maninila	406.67	550.00			1 ~ 2	19 ~ 30	75 ~ 85				
Masarawag	102.50	160.00	2.658	2.381	1 ~ 4	18 ~ 31	35 ~ 90	37	0		
Ogsong	140.09	205.50			1 ~ 3	11 ~ 25	60 ~ 65	95	0		
Nasisi	246.67	360.00			1	15 ~ 19	95				
Quinali(B)	147.54	235.05			1	12 ~ 24	65 ~ 90	100	0		
Buang	312.50	595.00			1	16 ~ 20	85 ~ 99				
San Vicente	83.94	134.20			1 ~ 3	6 ~ 31	55 ~ 90	6 ~ 35	0		
Arimbay	225.00	335.00			1	16 ~ 25	65 ~ 85				
Padang	165.00	340.00	2.661	2.419	1 ~ 2	21 ~ 22	60 ~ 90				
Basud	282.50	480.00	2.649	2.345	1	20 ~ 27	80 ~ 95				
Bulawan	194.00	334.00			1 ~ 2	13 ~ 33	70 ~ 95				
Average	188.88	312.82	2.668	2.379	1 ~ 3	17 ~ 26	53 ~ 88				

DT II 3.2.2 Results of Sieve Analysis for Sampling Point (1/3)

River system	River name	Sample point	Weight of Sample(kg)	Weight of Big Stone(kg)	Sieve Analysis		Specific Gravity	Density Test(g/cc)	
					d50(mm)	d90(mm)		Gr. Br. Stone	Dr. Rd. Stone
Yawa River system	Yawa	S-1	31.133	3.401	130.00	260.00			
		S-2	32.010	3.610	160.00	260.00			
		S-3	31.266	3.311	91.00	150.00			
		S-4	32.601	3.481	6.00	11.00			
		Sub Ave.	31.753	3.451	96.750	170.250			
	Pawa Burabod	S-1	31.601	3.311	100.00	120.00			
		S-2	32.631	3.602	600.00	900.00			
		S-3	30.112	3.611	160.00	250.00	2.658	1.382	1.831
		S-4	30.542	3.286	200.00	260.00			2.364
		S-5	30.701	3.453	660.00	900.00			
	Sub Ave.	31.117	3.362	344.000	486.000				
	Budiao	S-1	31.124	3.411	200.00	280.00			
		S-2	30.202	3.302	95.00	220.00			
		S-3	30.021	3.500	42.00	800.00			
		S-4	30.462	3.402	12.00	41.00			
S-5		30.111	3.395	19.00	41.00				
Sub Ave.	30.384	3.302	73.600	276.400					
Anuling	S-1	31.212	3.101	380.00	480.00				
	S-2	30.021	3.611	105.00	180.00				
	S-3	32.611	3.560	160.00	200.00	2.712	1.362	1.690	
	S-4	31.866	3.210	91.00	120.00			2.384	
	S-5	32.161	3.357	210.00	350.00				
Sub Ave.	31.574	3.414	189.200	266.000					
Average		31.207	175.888	299.663					
Quinali (A) River system	Quirangay	S-1	16.240	3.527	0.38	1.40			
		S-2	31.146	3.611	230.00	370.00			
		S-3	30.602	3.411	90.00	160.00			
		S-4	30.554	3.516	110.00	250.00			
		Sub Ave.	27.136	3.516	107.595	195.350			

DT II 3.2.2 Results of Sieve Analysis for Sampling Point (2/3)

River system	River name	Sample point	Weight of Sample(kg)	Weight of Big Stone(kg)	Sieve Analysis		Specific Gravity	Density Test(g/cc)		
					d50(mm)	d90(mm)		Gr. Br. Stone	Dr. Rd. Stone	Gr. Bl. Stone
	Tumpa	S-1	32.866		0.40	1.60				
		S-2	31.106	3.600	160.00	370.00				
		S-3	30.661	3.310	120.00	220.00				
		Sub Ave.	31.544	3.455	93.467	197.200				
	Maninila	S-1	30.611	3.611	700.00	910.00				
		S-2	32.866		400.00	480.00				
		S-3	30.101	3.220	120.00	260.00				
		Sub Ave.	31.193	3.416	406.667	550.000				
	Masarawag	S-1	30.113	3.811	210.00	360.00				
		S-2	31.101	3.340	95.00	120.00	2.658	1.365	1.707	2.381
		S-3	32.069	3.211	102.00	120.00				
		S-4	32.612	3.276	3.00	40.00				
Ogsong	Sub Ave.	31.474	3.410	102.500	160.000					
	S-1	33.621		0.35	2.00					
	S-2	32.902		120.00	250.00					
	S-3	30.668	3.520	320.00	390.00					
Nasisi	S-4	30.133	3.310	120.00	180.00					
	Sub Ave.	31.831	3.415	140.088	205.500					
	S-1	30.866	3.764	240.00	360.00					
	S-2	33.640		290.00	370.00					
Average	S-3	31.101	3.300	210.00	350.00					
	Sub Ave.	31.869	3.532	246.667	360.000					
		30.841	3.457	182.830	278.008					
		30.776	3.126	420.00	850.00					
Quinali (B) River system	Buang	S-1	30.776	3.126	420.00	850.00				
		S-2	30.386	3.598	205.00	340.00				
	Sub Ave.	30.581	3.362	312.500	595.000					
	Quinali	S-1	26.623		0.15	0.18				
S-2		31.703	3.662	180.00	240.00					
S-3		30.966	3.400	270.00	460.00					
S-4		30.340	3.906	140.00	240.00					

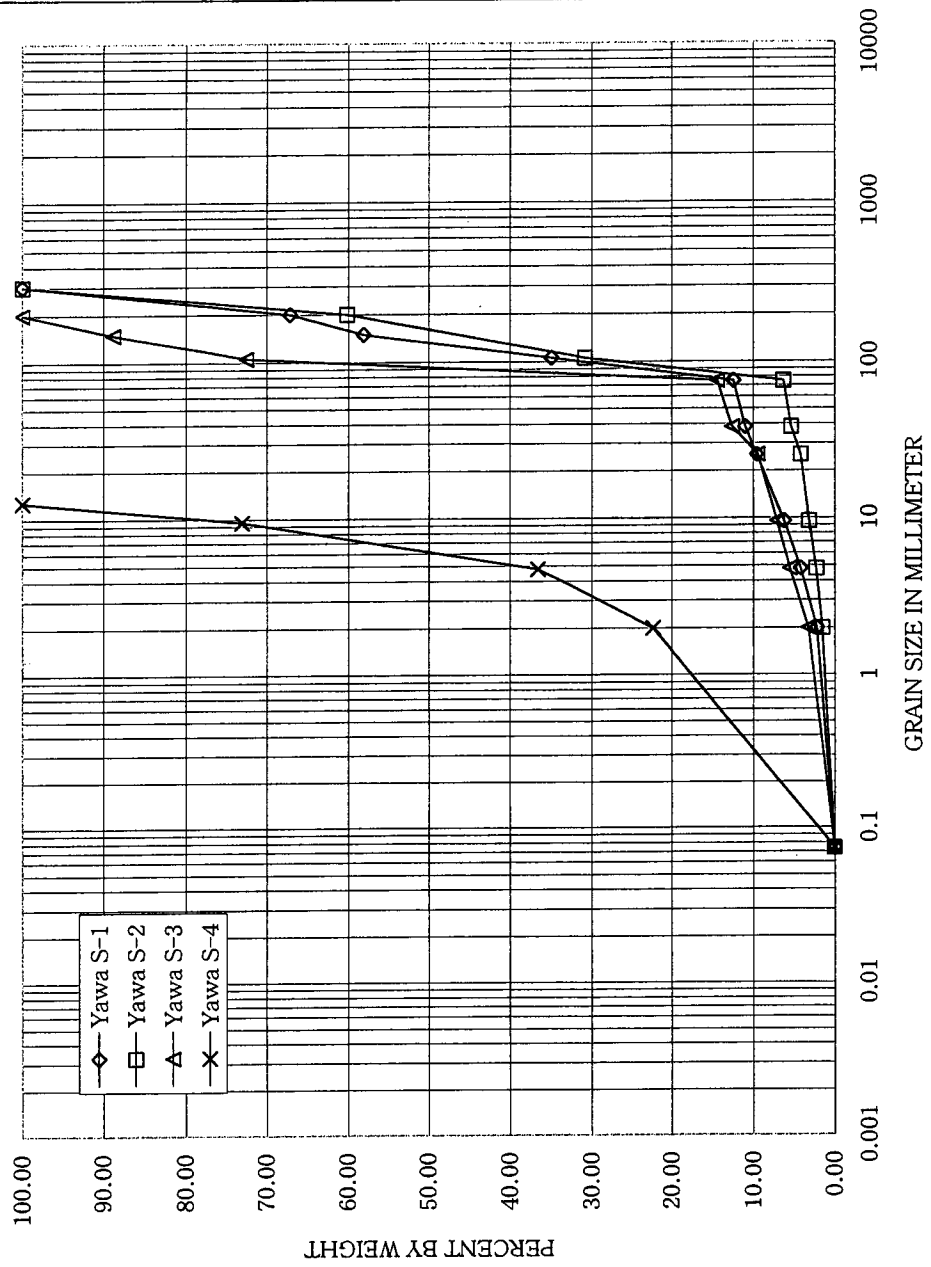
DT II 3.2.2 Results of Sieve Analysis for Sampling Point (3/3)

River system	River name	Sample point	Weight of Sample(kg)	Weight of Big Stone(kg)	Sieve Analysis		Specific Gravity	Density Test(g/cc)	
					d50(mm)	d90(mm)		Gr. Br. Stone	Dr. Rd. Stone
San Vicente		Sub Ave.	29.908	3.656	147.538	235.045			
		S-1	31.102	3.102	4.00	30.00			
		S-2	32.116	3.966	6.70	31.00			
		S-3	32.302	3.321	110.00	210.00			
		S-4	31.660	3.811	94.00	120.00			
		S-5	33.124		205.00	280.00			
Average		Sub Ave.	32.061	3.550	83.940	134.200			
		Average	30.850	3.523	181.326	321.415			
			31.668	3.592	300.00	470.00			
Arimbay		S-1	31.668	3.592	300.00	470.00			
		S-2	30.110	3.102	150.00	200.00			
Average		Average	30.889	3.347	225.000	335.000			
		Padang	32.146	3.110	210.00	320.00			
		S-2	31.103	3.910	120.00	360.00	2.661	1.354	1.721
Average		Average	31.625	3.510	165.000	340.000			
		Basud	31.740	3.176	380.00	750.00			
Basud		S-1	31.740	3.176	380.00	750.00			
		S-2	32.116	3.850	310.00	460.00	2.649	1.362	1.744
		S-3	31.860	3.086	190.00	350.00			
		S-4	33.141	3.211	250.00	360.00			
Average		Average	32.214	3.331	282.500	480.000			
		Bulawan	30.966	3.290	200.00	360.00			
Bulawan		S-1	30.966	3.290	200.00	360.00			
		S-2	30.812	3.286	160.00	240.00			
		S-3	31.166	3.221	210.00	350.00			
		S-4	30.766	3.200	150.00	360.00			
		S-5	31.046	3.801	250.00	360.00			
Average		Average	30.951	3.360	194.000	334.000			

3.3 Sieve Curve Graphs for each River

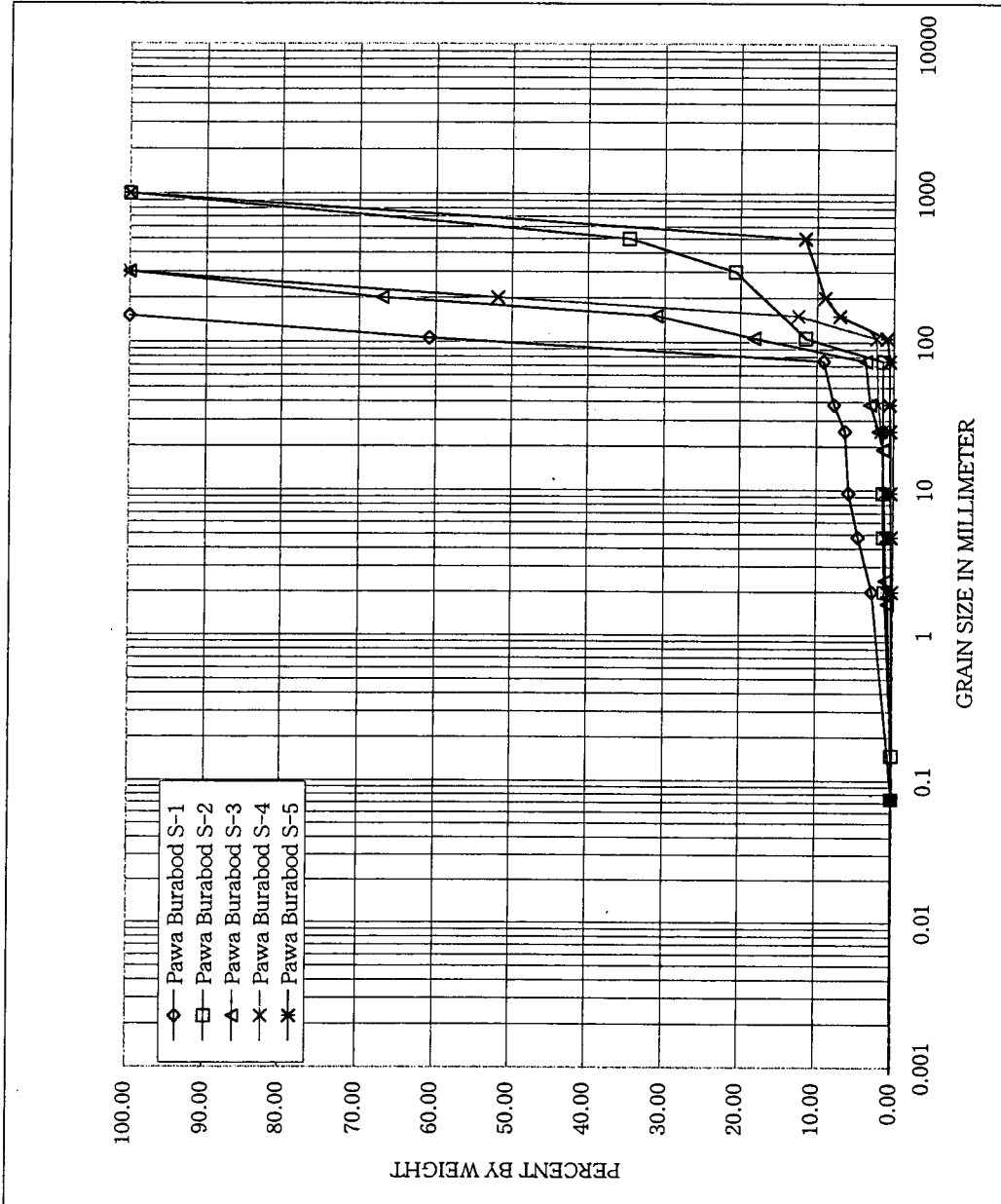
DF II 3.3 Sieve Analysis (Yawa River)

Sieve Size (mm)	PERCENT PASSING (%)			
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4
1001mmover				
500~1000				
400~500				
300~400	100.00	100.00		
200~300	67.17	60.10	100.00	
150~200	58.10		88.82	
106~150	34.96	30.86	72.53	
75~106	12.39	6.28	14.43	
63.5~75				
52.8~63.5				
38.1~52.8	11.03	5.34	12.55	
25.4~38.1	9.54	4.14	9.38	
19.1~25.4				
12.7~19.1				100.00
9.52~12.7	6.20	3.08	7.07	73.13
4.75~9.52	4.09	2.20	5.48	36.60
2.38~4.75				
2.00~2.38	2.11	1.51	3.17	22.28
1.65~2.00				
1.19~1.65				
0.84~1.19				
0.59~0.84				
0.42~0.59				
0.297~0.42				
0.26~0.297				
0.177~0.26				
0.149~0.177				
0.074~0.149	0.00	0.00	0.00	0.00
0.000001~0.074				
$d_{50} =$	130.00	160.00	91.00	6.00
$d_{90} =$	260.00	260.00	150.00	11.00



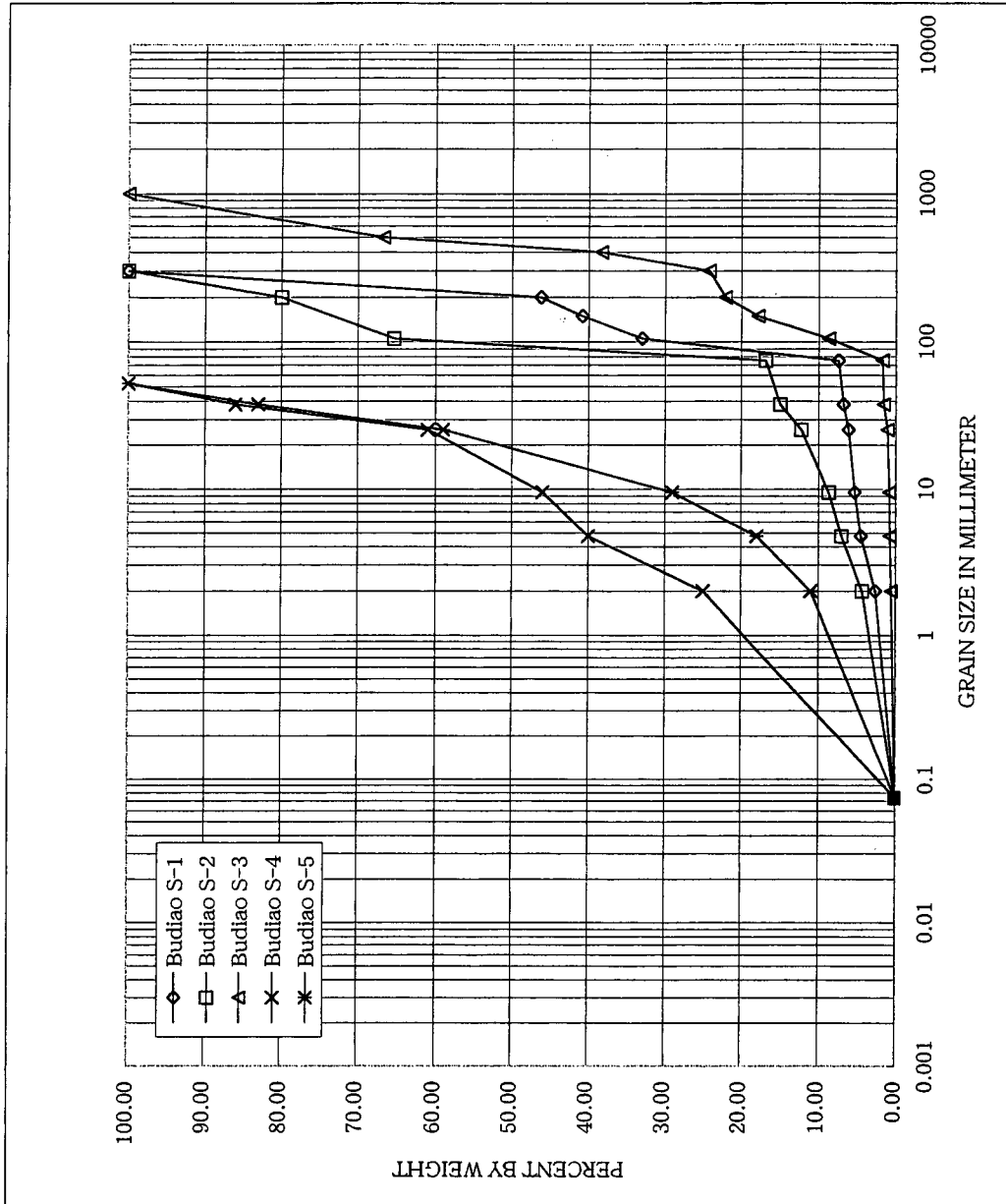
DF II 3.3 Sieve Analysis (Pawa-Burabod River)

Sieve Size (mm)	PERCENT PASSING (%)				
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4	No.5 S-5
1001 ^{mm} over	100.00	100.00			100.00
500~1000		34.72			11.56
400~500					
300~400		20.62	100.00	100.00	
200~300			66.98	51.88	8.91
150~200	100.00		31.19	12.46	6.97
106~150	60.77	11.43	18.14	2.20	0.78
75~106	9.12	1.32	3.57		0.49
63.5~75					
52.8~63.5					
38.1~52.8	7.66		3.02	1.94	0.46
25.4~38.1	6.20		1.90	1.52	0.38
19.1~25.4			1.32		
12.7~19.1					
9.52~12.7	5.75	1.29		1.17	0.31
4.75~9.52	4.47	1.22		0.99	0.23
2.38~4.75			0.98		
2.00~2.38	2.74	1.09		0.79	0.17
1.65~2.00			0.68		
1.19~1.65					
0.84~1.19					
0.59~0.84					
0.42~0.59					
0.297~0.42					
0.26~0.297					
0.177~0.26					
0.149~0.177		0.11			
0.074~0.149	0.00	0.06	0.00	0.00	0.00
0.000001~0.074		0.00			
d_{50} =	100.00	600.00	160.00	200.00	660.00
d_{90} =	120.00	900.00	250.00	260.00	900.00

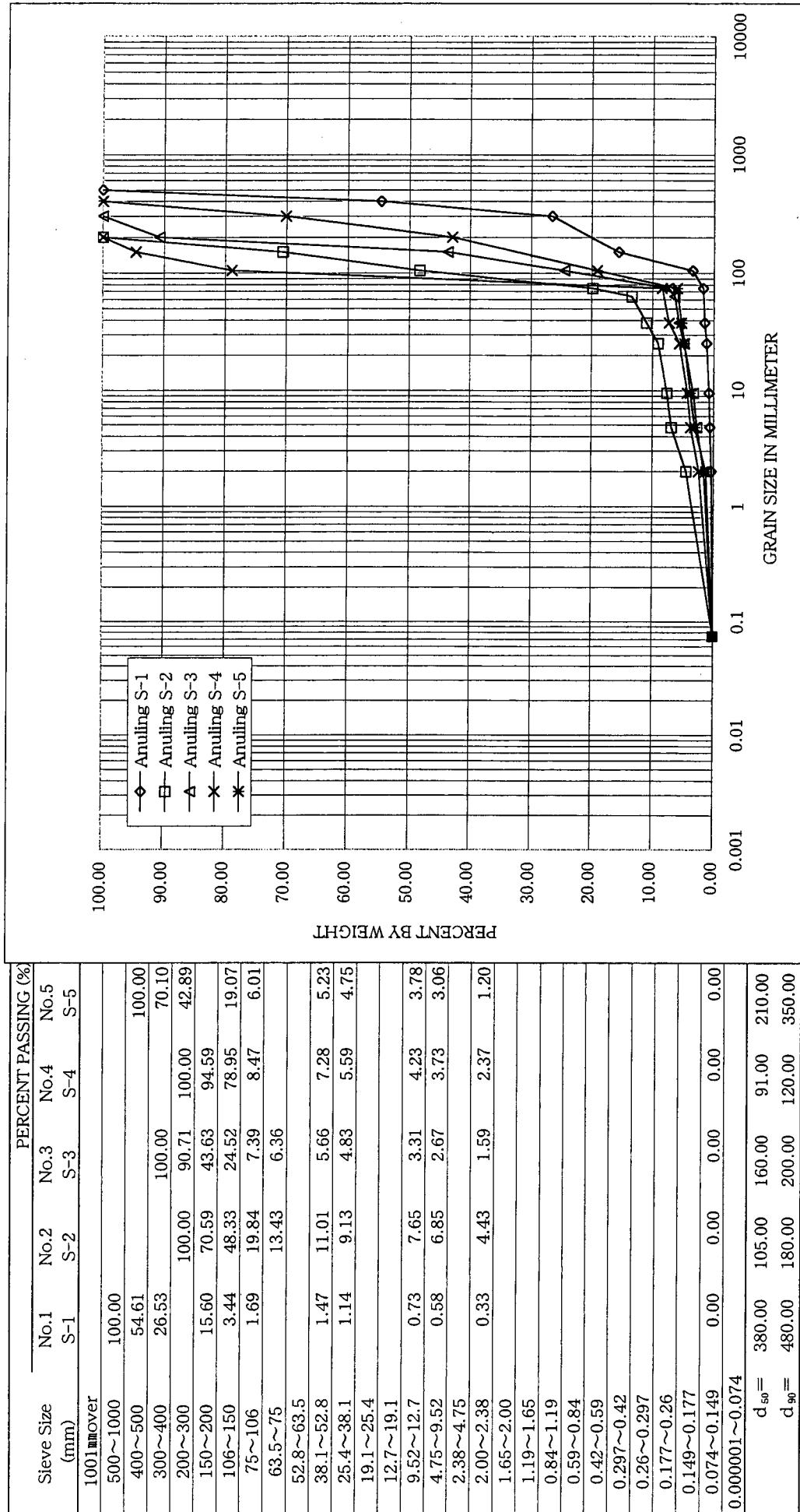


DF II 3.3 Sieve Analysis (Budiao River)

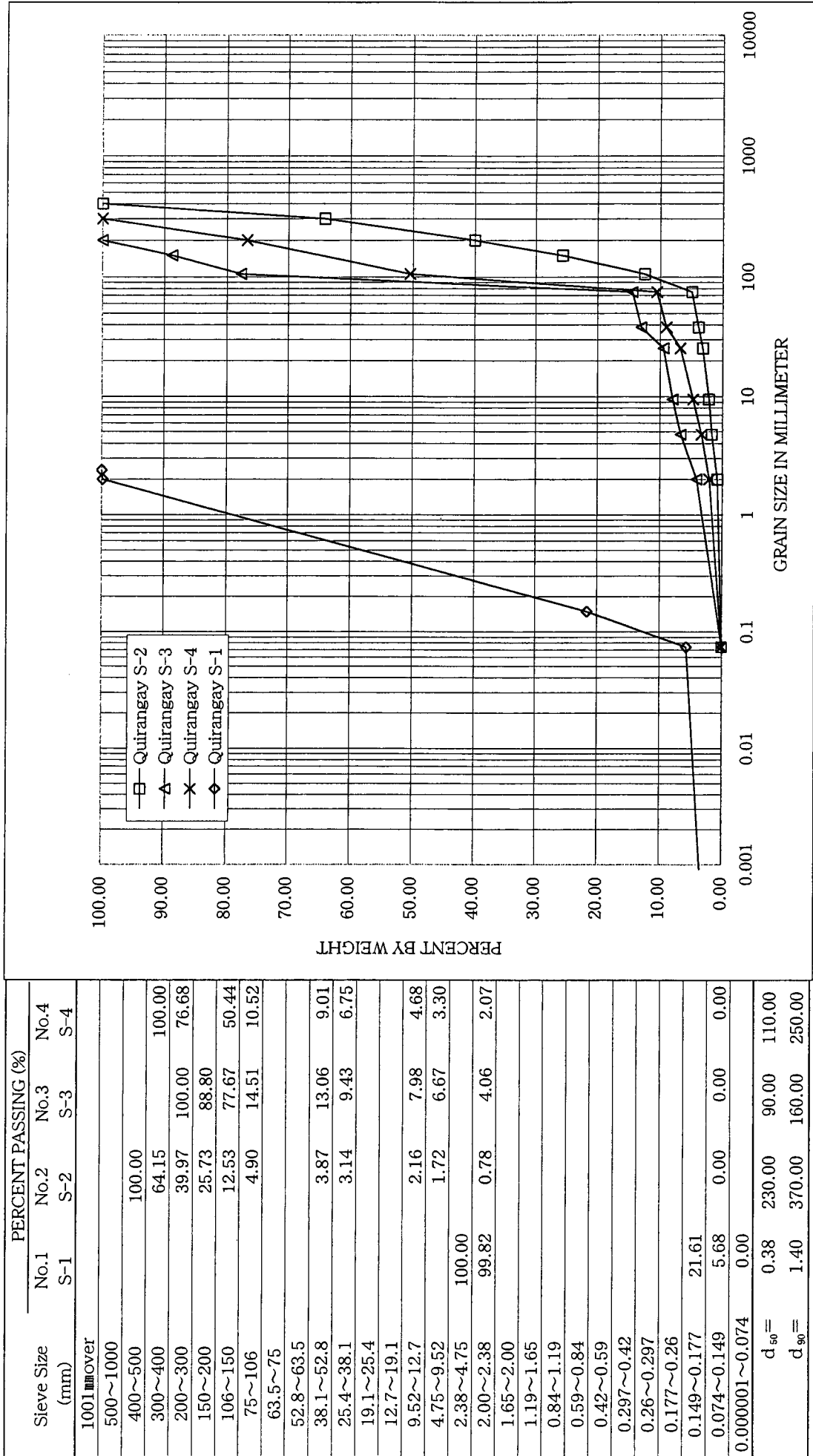
Sieve Size (mm)	PERCENT PASSING (%)				
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4	No.5 S-5
1001mmover			100.00		
500~1000			66.76		
400~500			38.26		
300~400	100.00	100.00	24.23		
200~300	46.18	79.99	22.11		
150~200	40.80		17.83		
106~150	32.95	65.34	8.67		
75~106	7.45	16.80	1.73		
63.5~75					
52.8~63.5				100.00	100.00
38.1~52.8	6.78	14.95	1.57	86.00	83.00
25.4~38.1	6.19	12.26	1.09	61.00	59.00
19.1~25.4					
12.7~19.1					
9.52~12.7	5.37	8.74	0.83	46.00	29.00
4.75~9.52	4.55	7.06	0.71	40.00	18.00
2.38~4.75					
2.00~2.38	2.61	4.37	0.54	25.00	11.00
1.65~2.00					
1.19~1.65					
0.84~1.19					
0.59~0.84					
0.42~0.59					
0.297~0.42					
0.26~0.297					
0.177~0.26					
0.149~0.177					
0.074~0.149	0.00	0.00	0.00	0.00	0.00
0.000001~0.074					
d_{50} =	200.00	95.00	420.00	12.00	19.00
d_{90} =	280.00	220.00	800.00	41.00	41.00



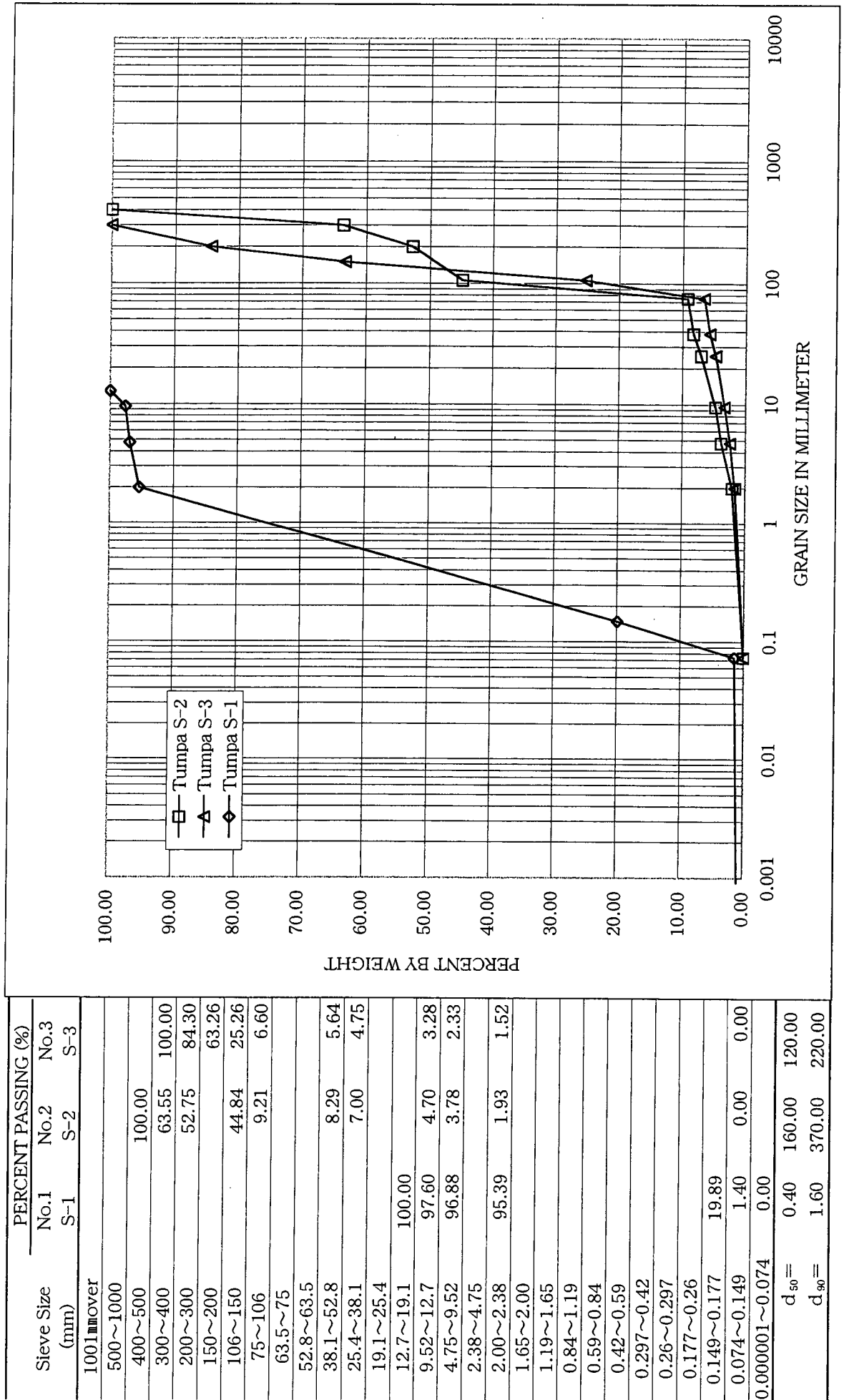
DF II 3.3 Sieve Analysis (Anoling River)



DF II 3.3 Sieve Analysis (Quirangay River)

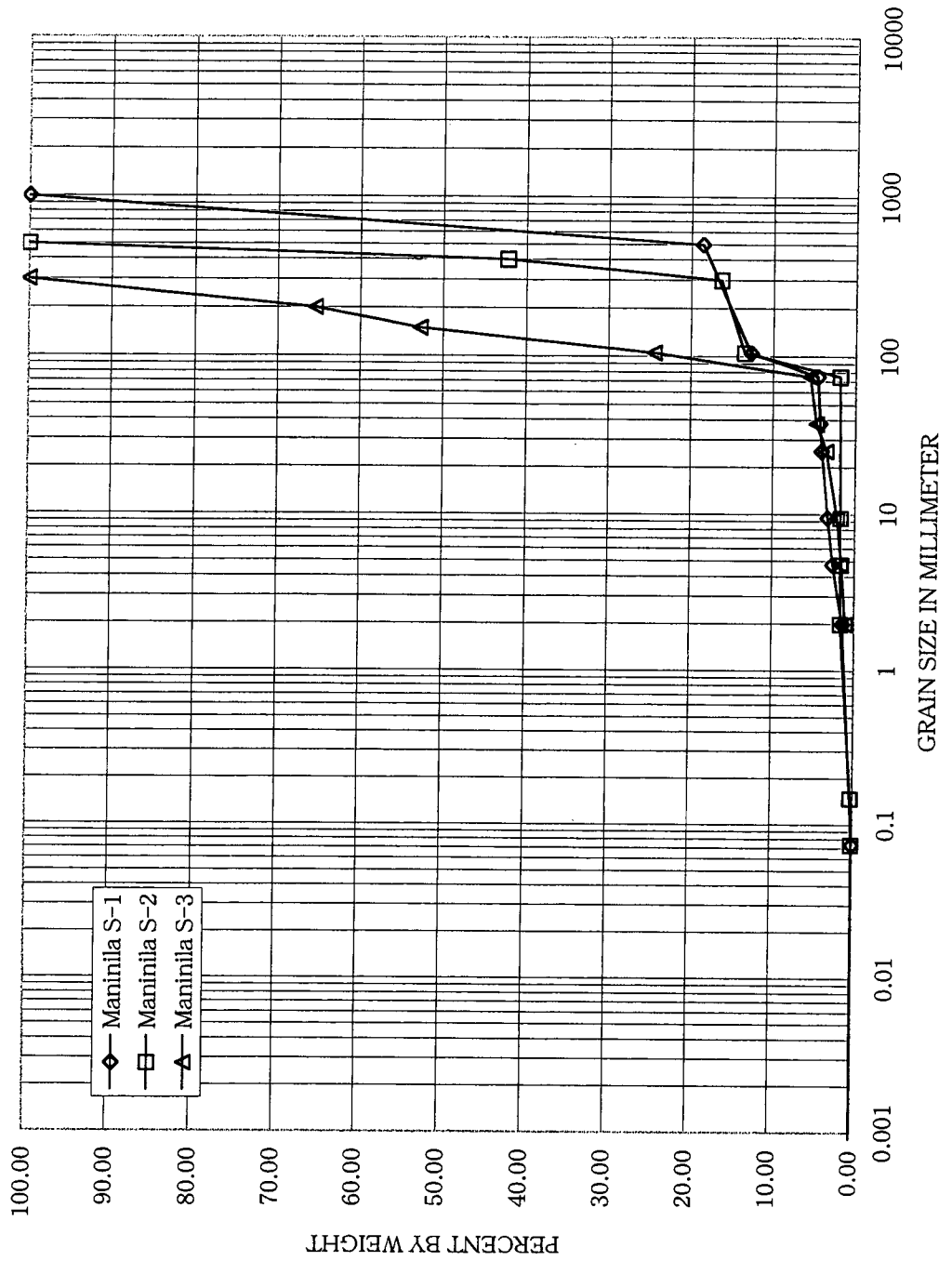


DF II 3.3 Sieve Analysis (Tumpa River)



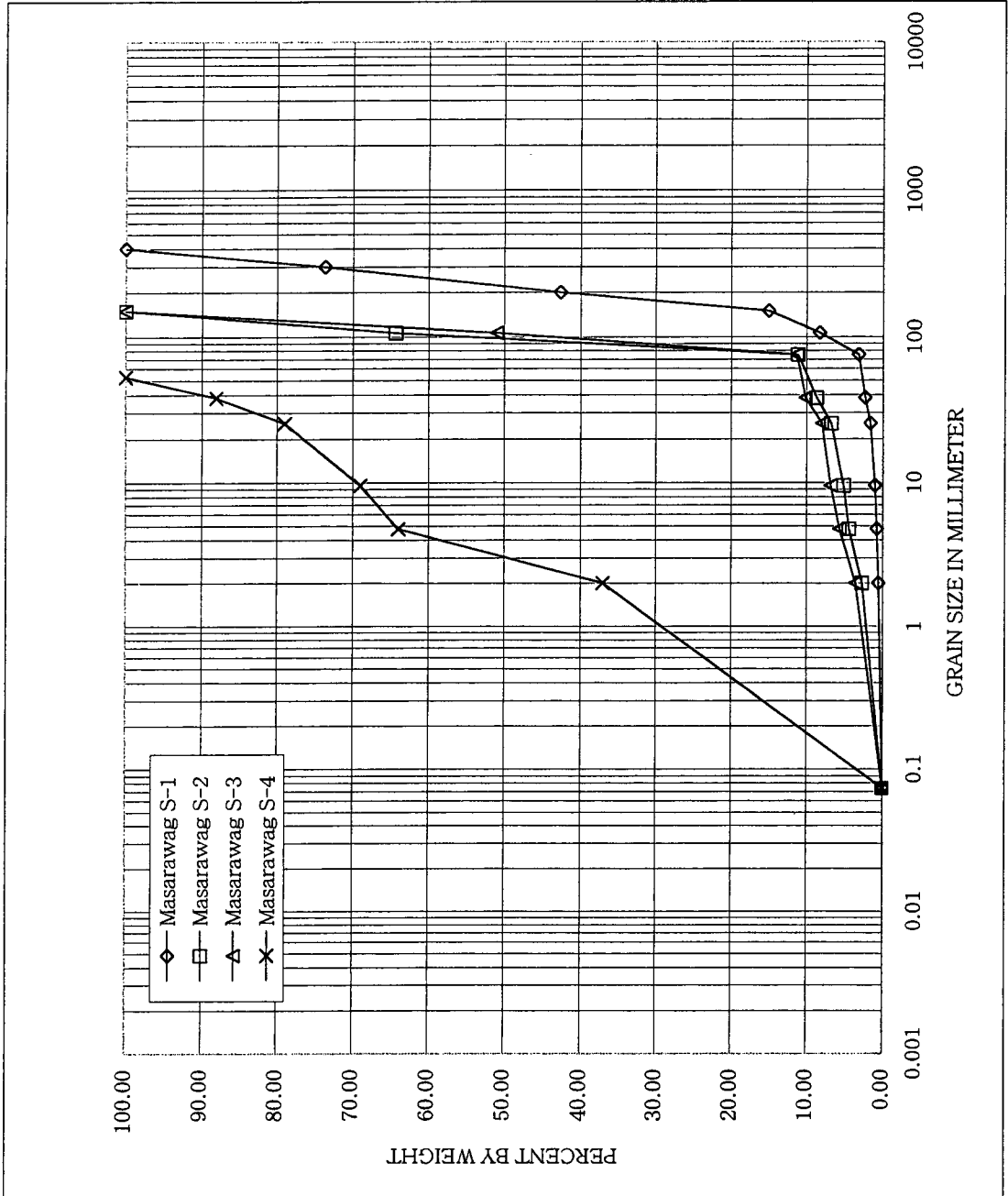
DF II 3.3 Sieve Analysis (Maninila River)

Sieve Size (mm)	PERCENT PASSING (%)		
	No.1 S-1	No.2 S-2	No.3 S-3
100mm over	100.00		
500~1000	18.60	100.00	
400~500		42.16	
300~400		16.29	100.00
200~300			65.42
150~200			52.61
106~150	12.59	13.35	24.44
75~106	4.56	1.80	5.47
63.5~75			
52.8~63.5			
38.1~52.8	4.29		4.71
25.4~38.1	4.06		3.45
19.1~25.4			
12.7~19.1			
9.52~12.7	3.29	1.69	2.08
4.75~9.52	2.60	1.68	1.53
2.38~4.75			
2.00~2.38	1.37	1.59	1.04
1.65~2.00			
1.19~1.65			
0.84~1.19			
0.59~0.84			
0.42~0.59			
0.297~0.42			
0.26~0.297			
0.177~0.26			
0.149~0.177		0.20	
0.074~0.149	0.00	0.09	0.00
0.000001~0.074		0.00	
d ₅₀ =	700.00	400.00	120.00
d ₉₀ =	910.00	480.00	260.00

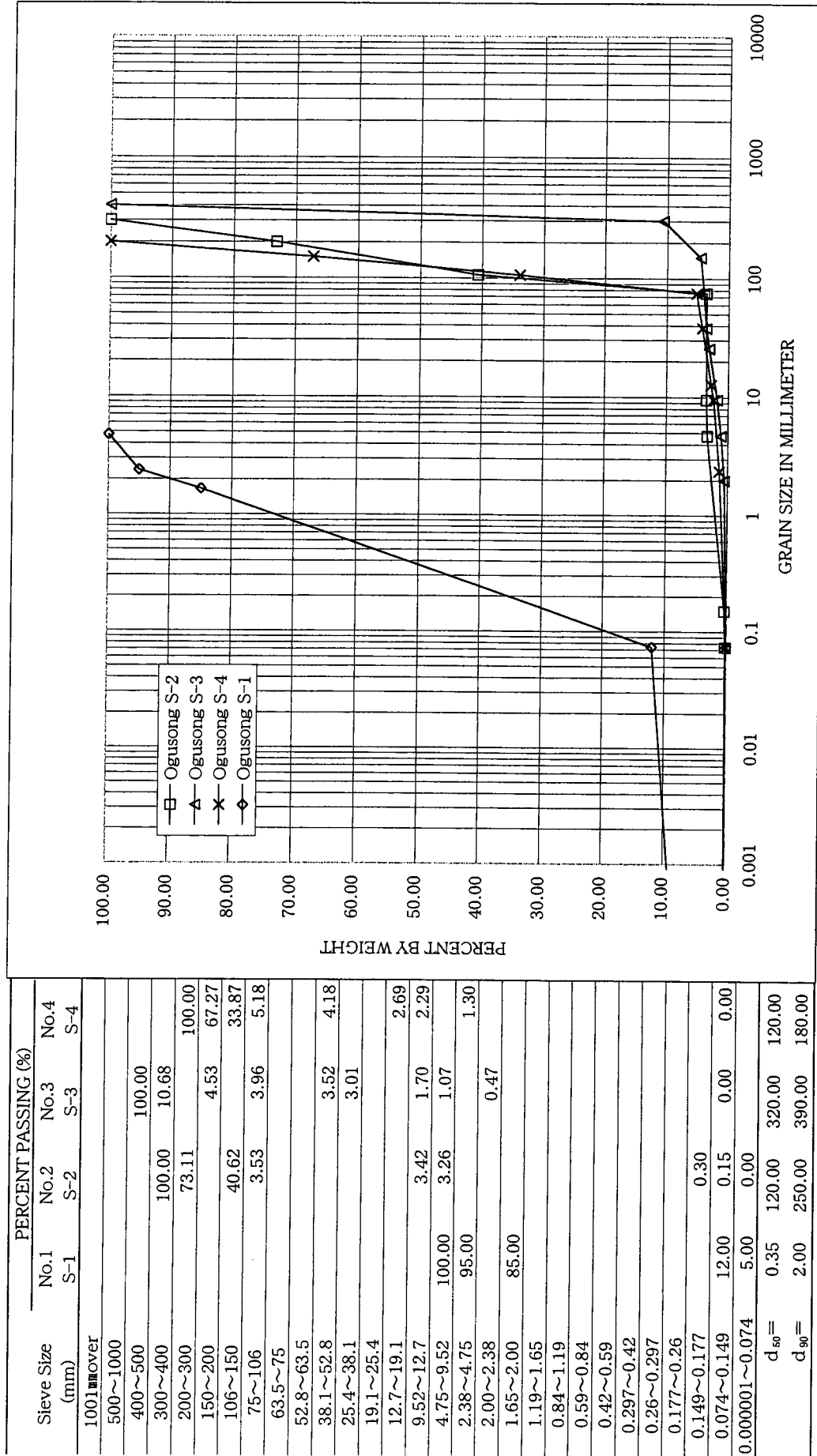


DF II 3.3 Sieve Analysis (Masarawag River)

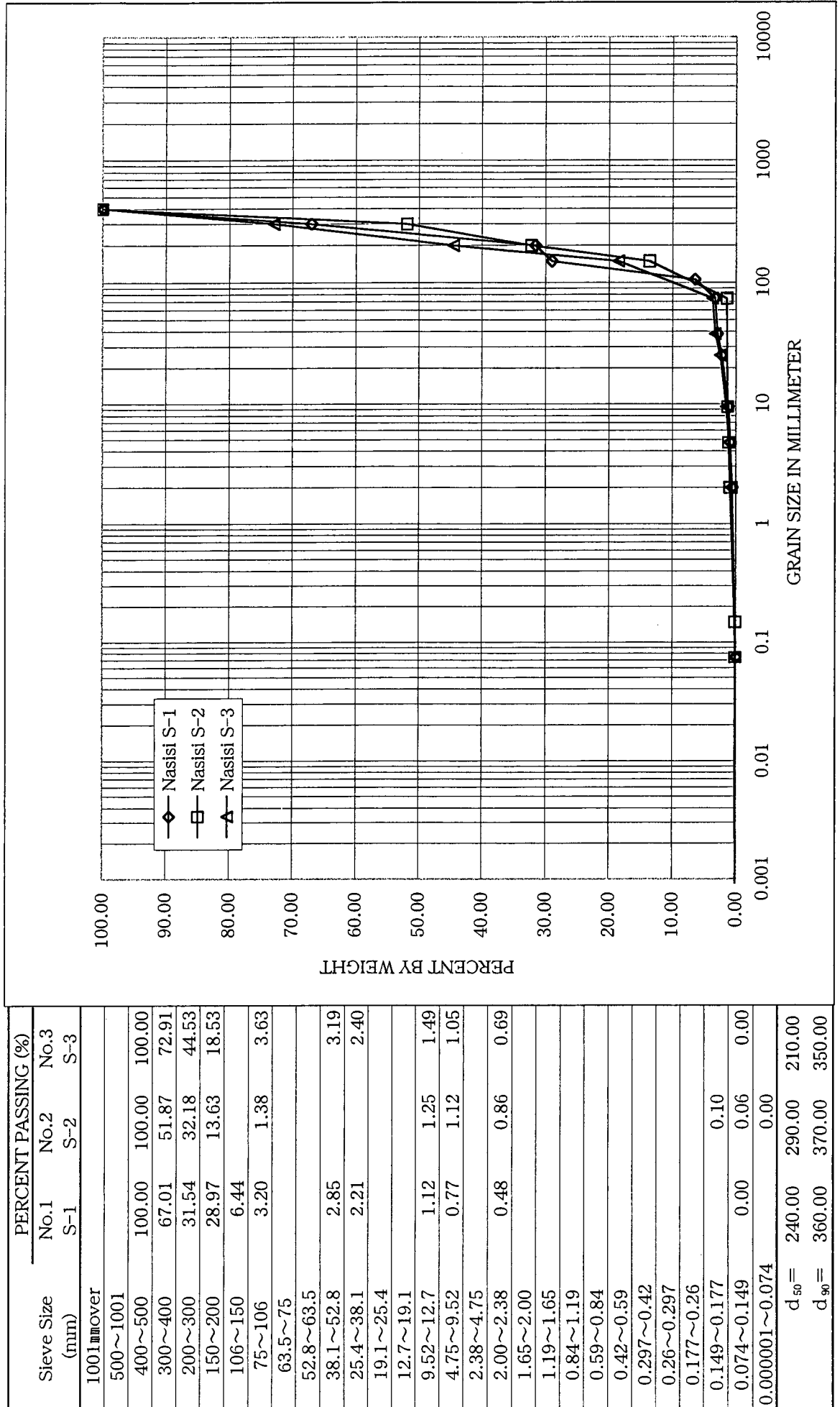
Sieve Size (mm)	PERCENT PASSING (%)			
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4
1001 μ m over				
500~1000	100.00			
400~500	100.00			
300~400	73.70			
200~300	42.58			
150~200	15.00	100.00	100.00	
106~150	8.30	64.36	51.04	
75~106	3.15	11.16	11.36	
63.5~75				
52.8~63.5				100.00
38.1~52.8	2.36	8.72	10.21	88.00
25.4~38.1	1.64	6.78	8.02	79.00
19.1~25.4				
12.7~19.1				
9.52~12.7	0.98	5.11	6.81	69.00
4.75~9.52	0.76	4.42	5.70	64.00
2.38~4.75				
2.00~2.38	0.57	2.72	3.56	37.00
1.65~2.00				
1.19~1.65				
0.84~1.19				
0.59~0.84				
0.42~0.59				
0.297~0.42				
0.26~0.297				
0.177~0.26				
0.149~0.177				
0.074~0.149	0.00	0.00	0.00	0.00
0.000001~0.074				
d_{50} =	210.00	95.00	102.00	3.00
d_{90} =	360.00	120.00	120.00	40.00



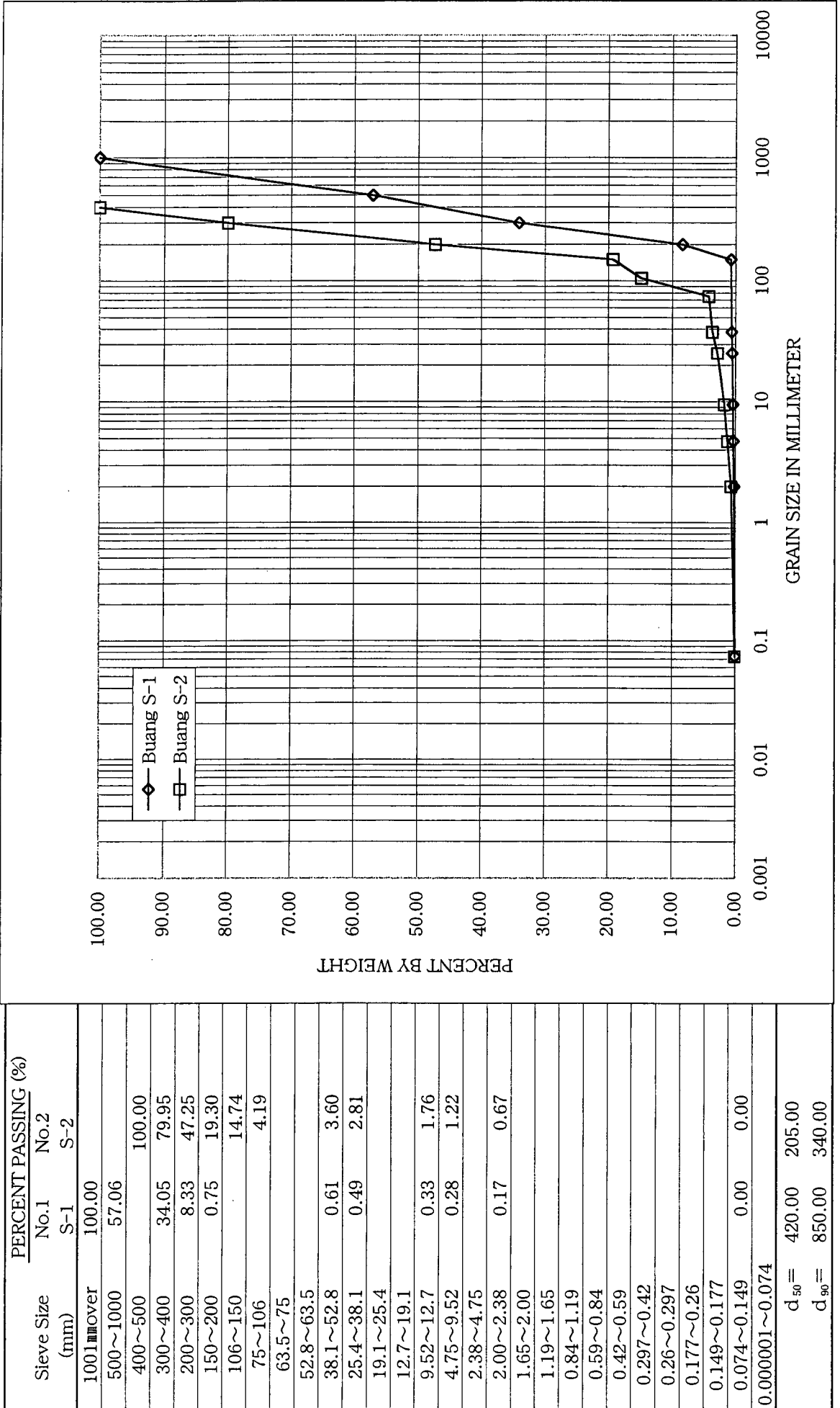
DF II 3.3 Sieve Analysis (Ogsong River)



DF II 3.3 Sieve Analysis (Nasisi River)

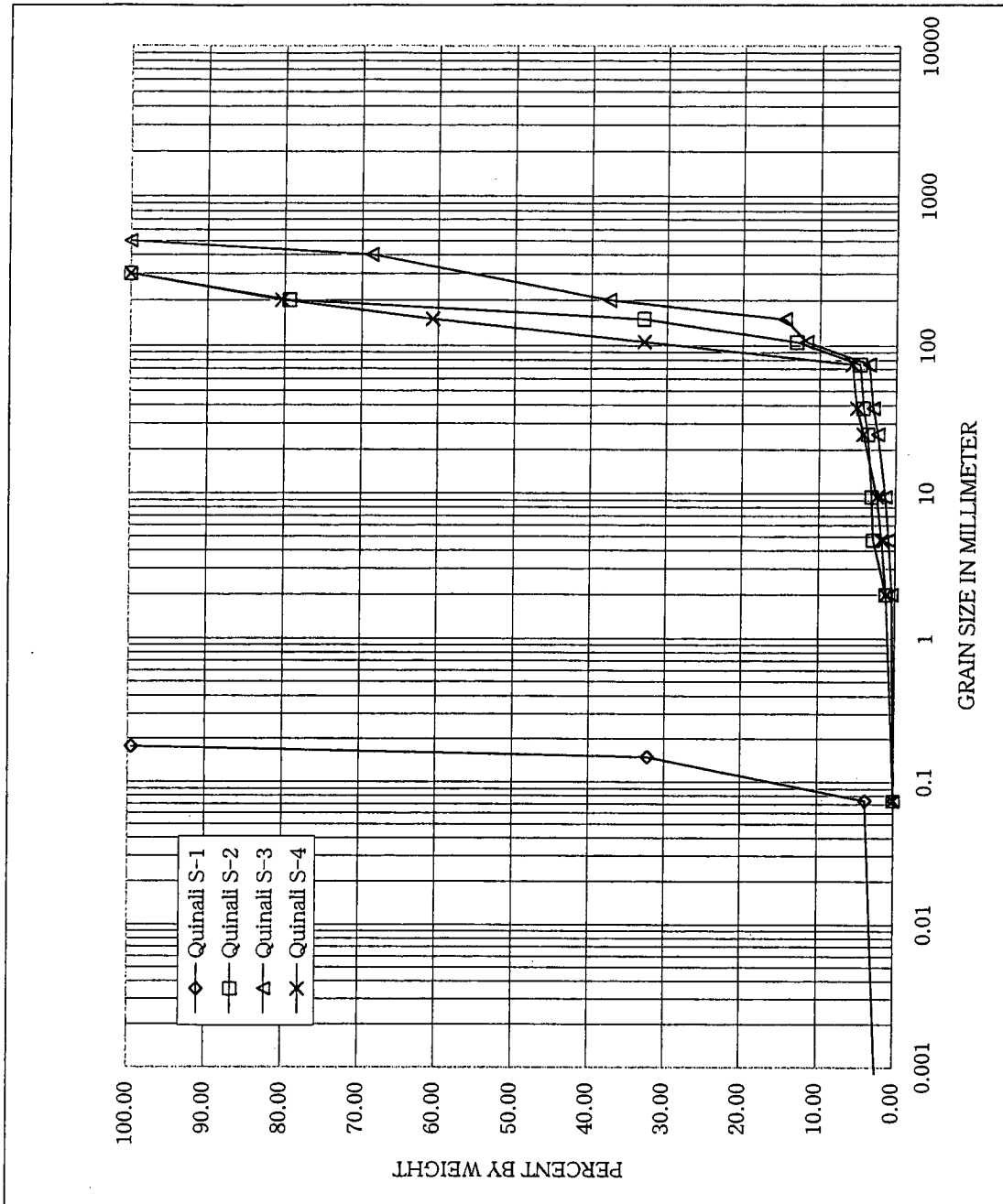


DF II 3.3 Sieve Analysis (Buang River)



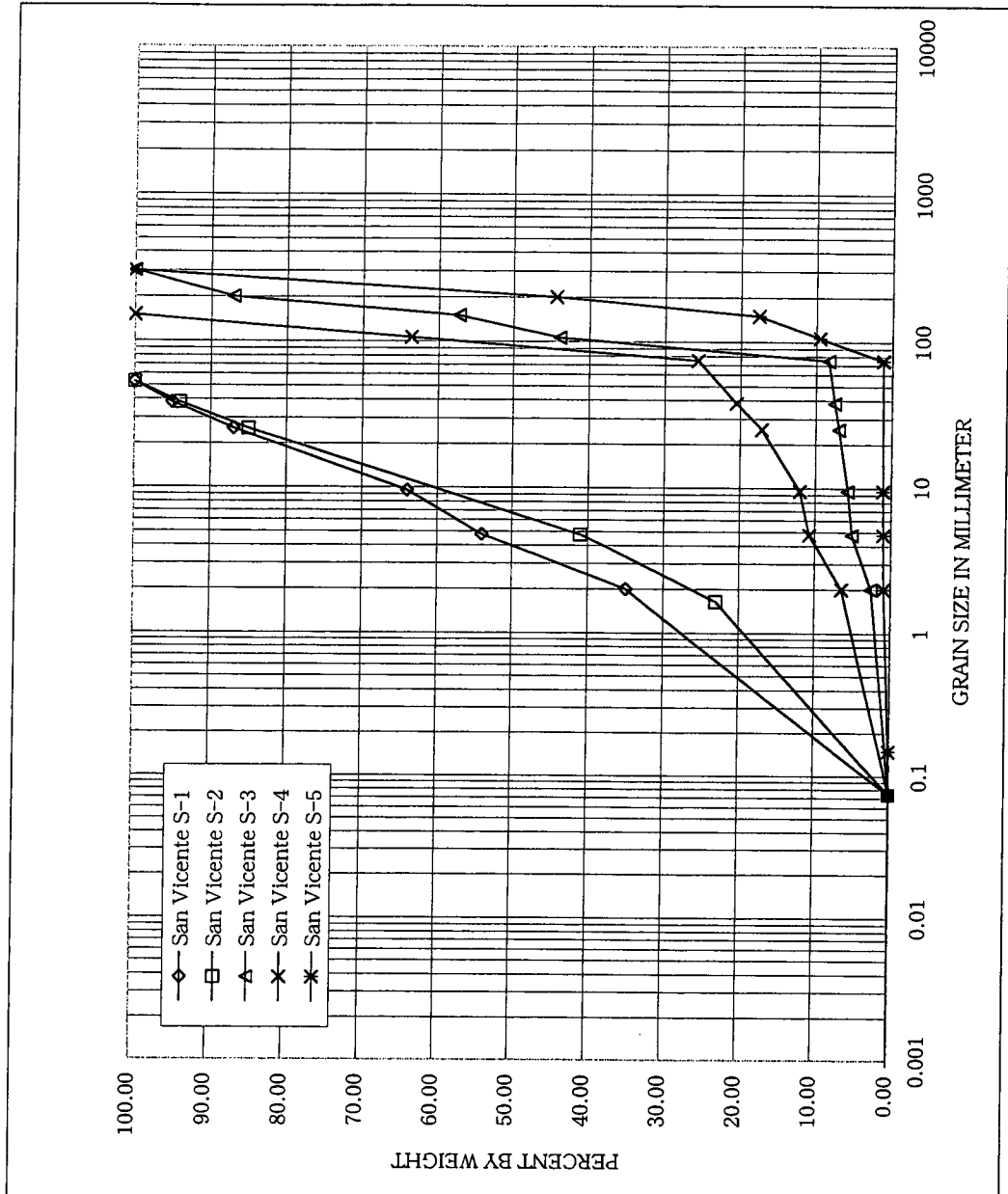
DF II 3.3 Sieve Analysis (Quinali River)

Sieve Size (mm)	PERCENT PASSING (%)			
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4
1001mm over				
500~1001		100.00		
400~500			68.63	
300~400		100.00		100.00
200~300		79.34	37.63	80.37
150~200		33.09	14.57	60.69
106~150		13.04	11.70	33.03
75~106		4.69	3.49	5.66
63.5~75				
52.8~63.5				
38.1~52.8		4.27	2.93	5.09
25.4~38.1		3.61	2.30	4.24
19.1~25.4				
12.7~19.1				
9.52~12.7		3.10	1.29	2.38
4.95~9.52		2.82	0.87	1.75
2.38~4.95				
2.00~2.38		1.13	0.42	1.13
1.65~2.00				
1.19~1.65				
0.84~1.19				
0.59~0.84				
0.42~0.59				
0.297~0.42				
0.26~0.297				
0.177~0.26		99.52		
0.149~0.177		32.22		
0.074~0.149		3.69	0.00	0.00
0.000001~0.074		0.00		
d_{50} =	0.150	180.000	270.000	140.00
d_{90} =	0.180	240.000	460.000	240.00

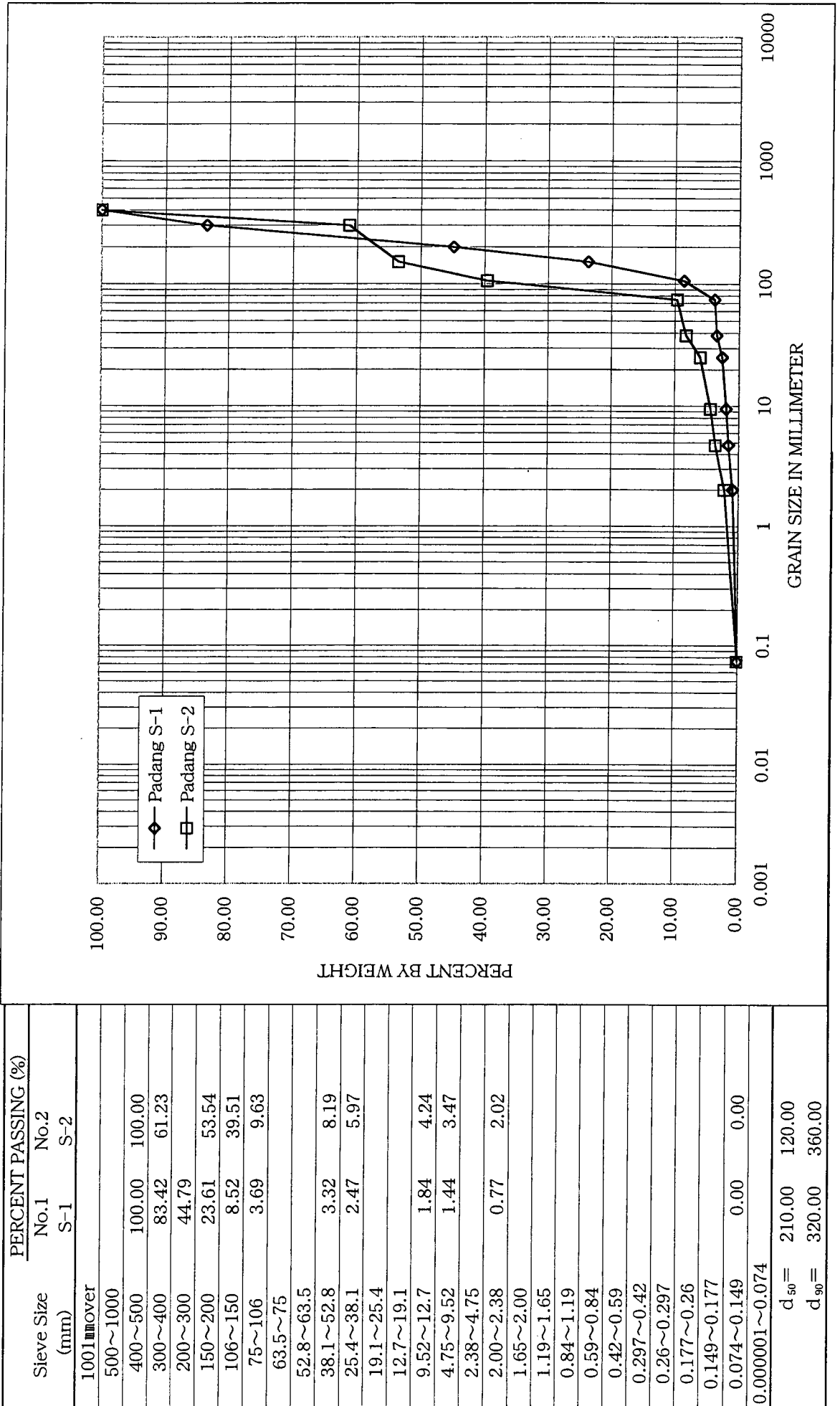


DF II 3.3 Sieve Analysis (San Vicente River)

Sieve Size (mm)	PERCENT PASSING (%)				
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4	No.5 S-5
1001mmover					
500~1000					
400~500					
300~400		100.00	100.00	100.00	100.00
200~300			87.03	44.33	44.33
150~200			57.18	100.00	17.64
106~150			43.83	63.63	9.49
75~106			8.27	25.57	1.18
63.5~75					
52.8~63.5	100.00	100.00			
38.1~52.8	95.00	94.00	7.44	20.46	
25.4~38.1	87.00	85.00	6.86	17.13	
19.1~25.4					
12.7~19.1					
9.52~12.7	64.00		5.62	12.02	1.05
4.95~9.52	54.00	41.00	5.04	10.74	0.95
2.38~4.95					
2.00~2.38	35.00		2.56	6.39	0.87
1.65~2.00		23.00			
1.19~1.65					
0.84~1.19					
0.59~0.84					
0.42~0.59					
0.297~0.42					
0.26~0.297					
0.177~0.26					
0.149~0.177					0.12
0.074~0.149	0.00	0.00	0.00	0.00	0.01
0.000001~0.074					0.00
d ₅₀ =	4.00	6.70	110.00	94.00	205.00
d ₉₀ =	30.00	31.00	210.00	120.00	280.00

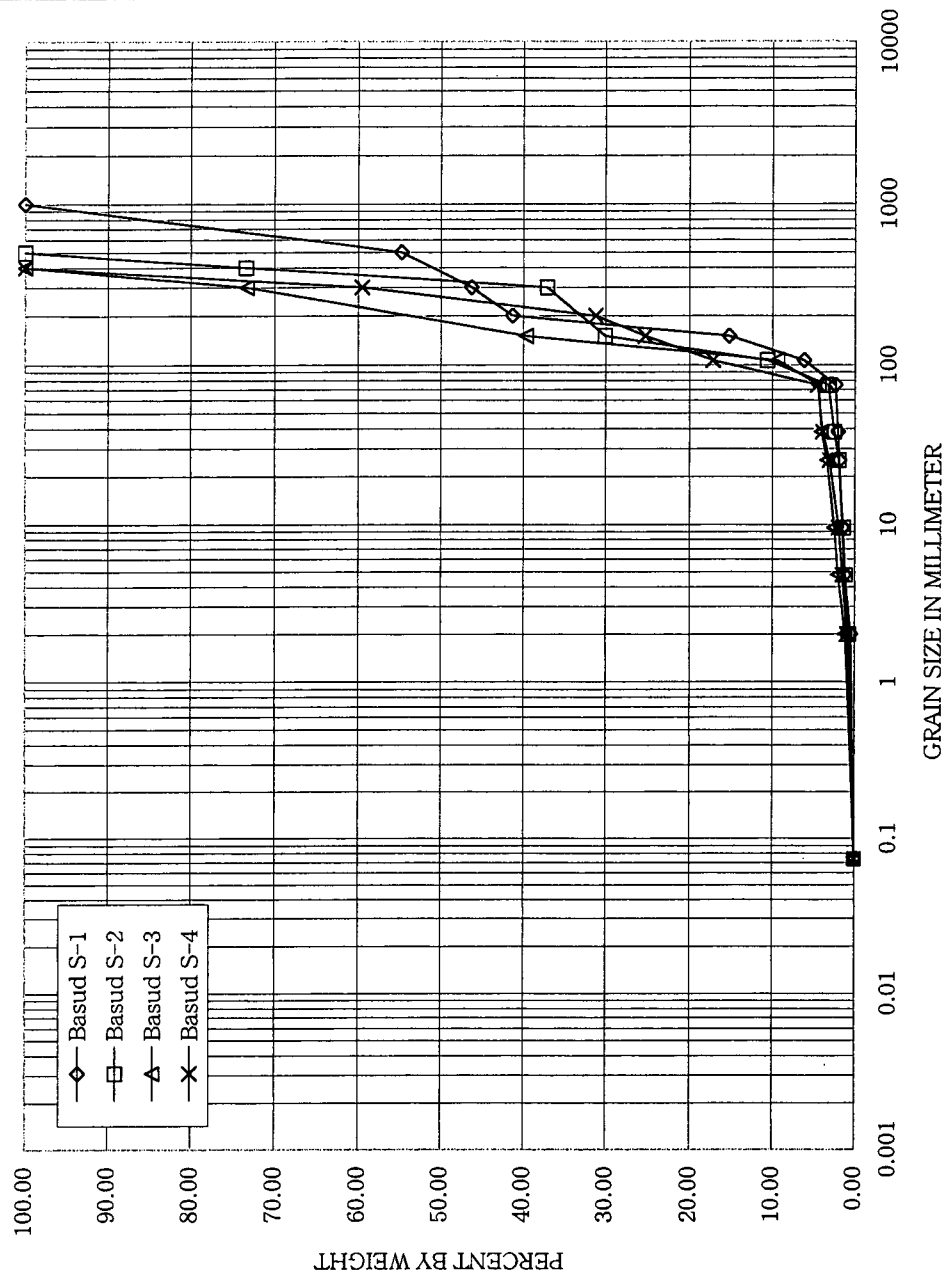


DF II 3.3 Sieve Analysis (Padang River)

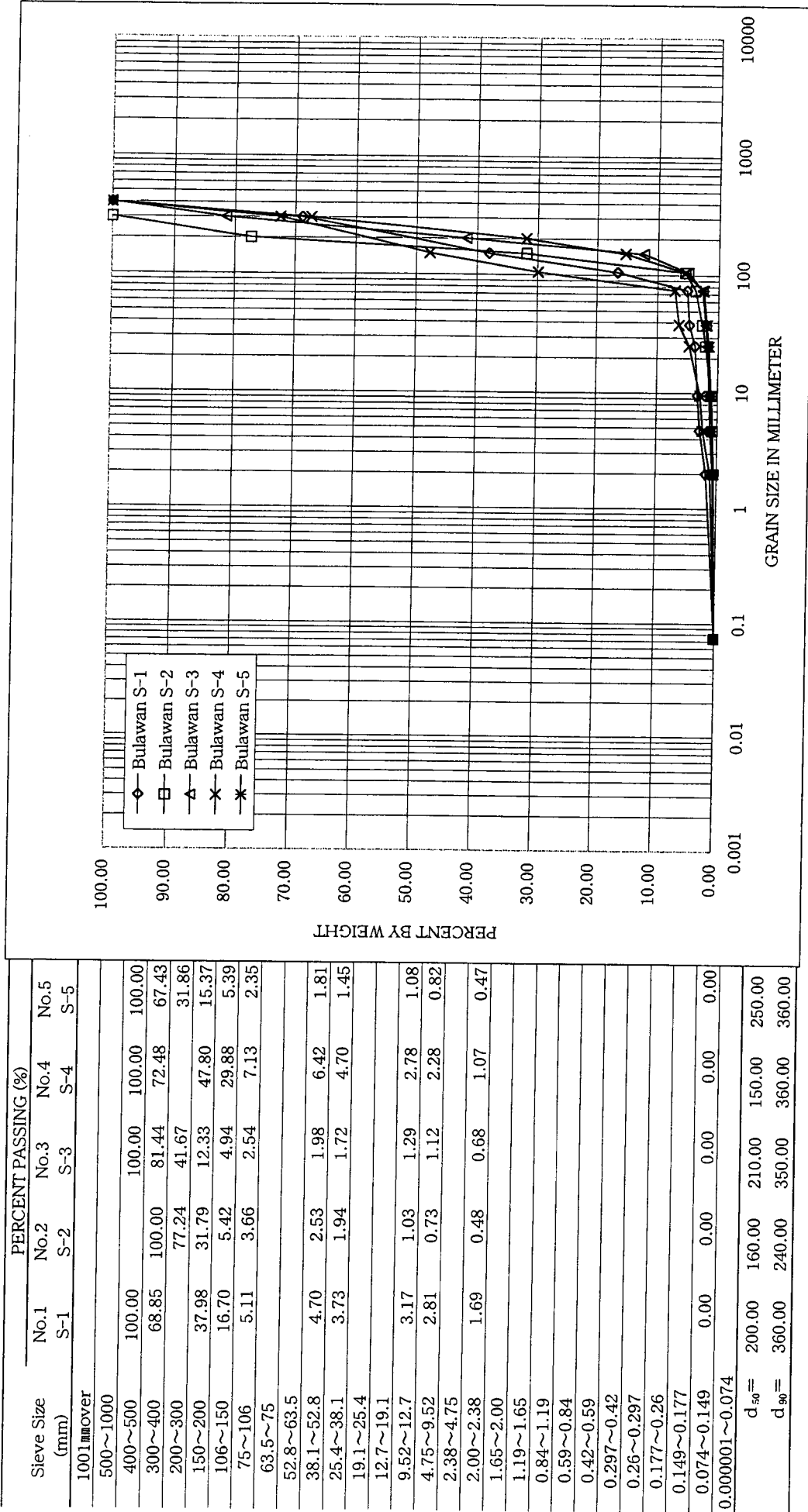


DF II 3.3 Sieve Analysis (Basud River)

Sieve Size (mm)	PERCENT PASSING (%)			
	No.1 S-1	No.2 S-2	No.3 S-3	No.4 S-4
1001mmover	100.00			
500~1000	54.70	100.00		
400~500		73.37	100.00	100.00
300~400	46.25	37.15	73.32	59.53
200~300	41.36			31.24
150~200	15.26	30.13	39.72	25.27
106~150	6.09	10.63	9.34	17.21
75~106	2.34	3.15	4.36	4.48
63.5~75				
52.8~63.5				
38.1~52.8	2.03	2.48	4.06	3.90
25.4~38.1	1.82	1.95	3.36	3.05
19.1~25.4				
12.7~19.1				
9.52~12.7	1.50	1.42	2.49	1.97
4.75~9.52	1.21	1.16	2.01	1.43
2.38~4.75				
2.00~2.38	0.47	0.66	1.18	0.90
1.65~2.00				
1.19~1.65				
0.84~1.19				
0.59~0.84				
0.42~0.59				
0.297~0.42				
0.26~0.297				
0.177~0.26				
0.149~0.177				
0.074~0.149	0.00	0.00	0.00	0.00
0.000001~0.074				
d ₅₀ =	380.00	310.00	190.00	250.00
d ₉₀ =	750.00	460.00	350.00	360.00



DF II 3.3 Sieve Analysis (Bulawan River)



DF II 3.3 Sieve Analysis (Yawa River)

