UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SEDIMENT ANALYSES FOR SELECTED SITES ON THE SOUTH PLATTE RIVER IN COLORADO AND NEBRASKA, AND THE NORTH PLATTE AND PLATTE RIVERS IN NEBRASKA--SUSPENDED SEDIMENT, BEDLOAD, AND BED MATERIAL

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DEFINITIONS

Bedload is the sediment that is moved along in essentially continuous contact with the streambed.

Depth-integrated sample is a sample of sediment that is accumulated continuously in a sampler that moves vertically at a constant transit rate and that admits water and sediment mixture at a velocity about equal to the stream velocity at every point of the sampler's travel.

Particle size at given percent finer (D_s) is the size of sediment for which s percent of the sample is finer.

Size-distribution curves are determined by sieve analysis for bed samples and by a visual accumulation tube for suspended sediment. The size distribution curve is the fraction, or percentage by weight, of a sediment sample that is smaller or larger than a given size plotted against particle size.

Suspended sediment is the sediment that is moved in suspension in water and is maintained in suspension by the upward components of turbulent currents or by colloidal suspension.

Suspended-sediment load, in metric tons per day, is the suspended-sediment concentration, in milligrams per liter, x water discharge, in cubic meters per second, x 0.0864.

Water discharge is the volume of water passing a cross section of a stream per unit time.

SEDIMENT ANALYSES FOR SELECTED SITES ON THE SOUTH PLATTE RIVER IN COLORADO AND NEBRASKA, AND THE NORTH PLATTE AND PLATTE RIVERS IN NEBRASKA--SUSPENDED SEDIMENT, BEDLOAD, AND BED MATERIAL

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ABSTRACT

Sediment samples were collected on the South Platte, North Platte, and Platte Rivers in Colorado and Nebraska during the 1979 and 1980 runoff seasons. Suspended-sediment concentrations ranged from 62 to 3,705 milligrams per liter and the maximum load was 45,547 metric tons per day. The percentage of suspended sediment smaller than sand (less than 0.062 millimeter) was as follows: 23 to 78 percent for the South Platte River, 9 to 30 percent for the North Platte River, and 2 to 89 percent for the Platte River. Bedload-transport rates ranged from 0.0085 to 0.67 kilogram per second per meter of channel width for the entire study area. The median grain size of bedload ranged from 0.6 to 2.6 millimeters for the South Platte River, 0.5 to 0.8 millimeter for the North Platte River, and 0.6 to 1.2 millimeters for the Platte River. The median grain size of bed material for the South Platte River ranged from 0.3 to 2.4 millimeters, compared to 0.5 to 0.9 millimeter for the North Platte River, and 0.4 to 3.1 millimeters for the Platte River.

INTRODUCTION

The Platte River in Nebraska is one of the most important rivers of the Great Plains, not only because of the agriculture within its basin, but especially because it is unique as a habitat for several species of migrating waterfowl. Included in these species are the sandhill and whooping cranes, which require a wide and shallow channel for roosting and breeding. These channel requirements have become a concern in recent years because of the narrowing of the Platte River channel; the question is how much water is required to maintain the channel as a desirable migratory bird habitat.

If a determination could be made of the water discharge necessary to maintain the channel at some designated width, then a best management program could be instituted to accomplish this objective. In several current (1981) studies, different methods are being examined to predict this discharge (which is known as the effective discharge). All these methods require knowledge of the sediment-size distribution, transport rate, and the water discharge. This report presents the data that are needed to determine these relationships for the prediction of effective discharge. This report was prepared as part of the U.S. Geological Survey's study of the upper Platte

River basin that is being conducted in cooperation with the U.S. Fish and Wildlife Service, the U.S. Water and Power Resources Service (formerly the U.S. Bureau of Reclamation), and the States of Colorado, Nebraska, and Wyoming.

PHYSICAL SETTING

The South Platte and North Platte Rivers originate as snowmelt streams high in the Rocky Mountains of Colorado. They flow across the Great Plains to form the Platte River at their confluence in North Platte, Nebraska (fig. 1).

The South Platte originates in the central part of Colorado, flows southeastward to a point about 100 km (kilometers) southwest of Denver, flows northeastward, leaves the mountains about 50 km southwest of Denver, flows through Denver, and continues northeastward to the confluence with the North Platte River at North Platte, Nebraska. Total drainage area of the South Platte River is about 62,900 km^2 (square kilometers), and the river is about 720 river km long (Bentall, 1975, p. 6). The reach of the South Platte River studied extends from Greeley, Colorado, to the confluence with the North Platte River at North Platte, Nebraska, a distance of about 380 river km.

From it origin in north-central Colorado, the North Platte River flows northward into east-central Wyoming near Casper, and then flows southeastward to the confluence with the South Platte River at North Platte, Nebraska. The North Platte drains about 99,400 km^2 and is about 1,050 river km long. The reach of the North Platte River studied extends from Lake McConaughy near Ogallala, Nebraska, to the confluence with the South Platte River, a distance of about 86 river km.

The Platte River is formed at the confluence of the North Platte and South Platte Rivers at North Platte, Nebraska. The Platte generally flows eastward through Nebraska to the Missouri River at the eastern edge of the State. The reach of the Platte River studied extends from North Platte to Louisville, Nebraska, a distance of about 460 river km.

DATA COLLECTION

Twenty-one stations were established as points of data collection (table 1, fig. 1). Primary station identification is the eight-digit U.S. Geological Survey station number. The first two digits of this number refer to the major drainage basin in which the station is located. In this study, all stations have the prefix 06 for the Missouri River basin. The last six digits refer to the individual station location with increasing numbers referring to locations progressively farther downstream. The site numbers (1-21) used in this report (fig. 1 and tables) also increase with locations progressively downstream.

Table 1.--*Number and name of sediment-collection stations*

SITE NUMBER IN FIGURE 1	U.S. GEOLOGICAL SURVEY STATION NUMBER	STATION NAME
1	06691000	NORTH PLATTE RIVER NEAR SUTHERLAND, NEBRASKA
2	06693000	NORTH PLATTE RIVER AT NORTH PLATTE, NEBRASKA
3	06754000	SOUTH PLATTE RIVER NEAR KERSEY, COLORADO
4	06758500	SOUTH PLATTE RIVER NEAR WELDONA, COLORADO
5	06760000	SOUTH PLATTE RIVER AT BALZAC, COLORADO
6	06764000	SOUTH PLATTE RIVER AT JULESBURG, COLORADO
7	06765500	SOUTH PLATTE RIVER AT NORTH PLATTE, NEBRASKA
8	06766000	PLATTE RIVER AT BRADY, NEBRASKA
9	06766500	PLATTE RIVER NEAR COZAD, NEBRASKA
10	06768000	PLATTE RIVER NEAR OVERTON, NEBRASKA
11	06770000	PLATTE RIVER NEAR ODESSA, NEBRASKA
12	06770500	PLATTE RIVER NEAR GRAND ISLAND, NEBRASKA
13	06772000	PLATTE RIVER NEAR CENTRAL CITY, NEBRASKA
14	06772800	PLATTE RIVER NEAR CLARKS, NEBRASKA
15	06772850	PLATTE RIVER NEAR SILVER CREEK, NEBRASKA
16	06774000	PLATTE RIVER NEAR DUNCAN, NEBRASKA
17	06794700	PLATTE RIVER NEAR SCHUYLER, NEBRASKA
18	06796000	PLATTE RIVER NEAR NORTH BEND, NEBRASKA
19	06796500	PLATTE RIVER NEAR FREMONT, NEBRASKA
20	06796550	PLATTE RIVER NEAR VENICE, NEBRASKA
21	06805500	PLATTE RIVER NEAR LOUISVILLE, NEBRASKA

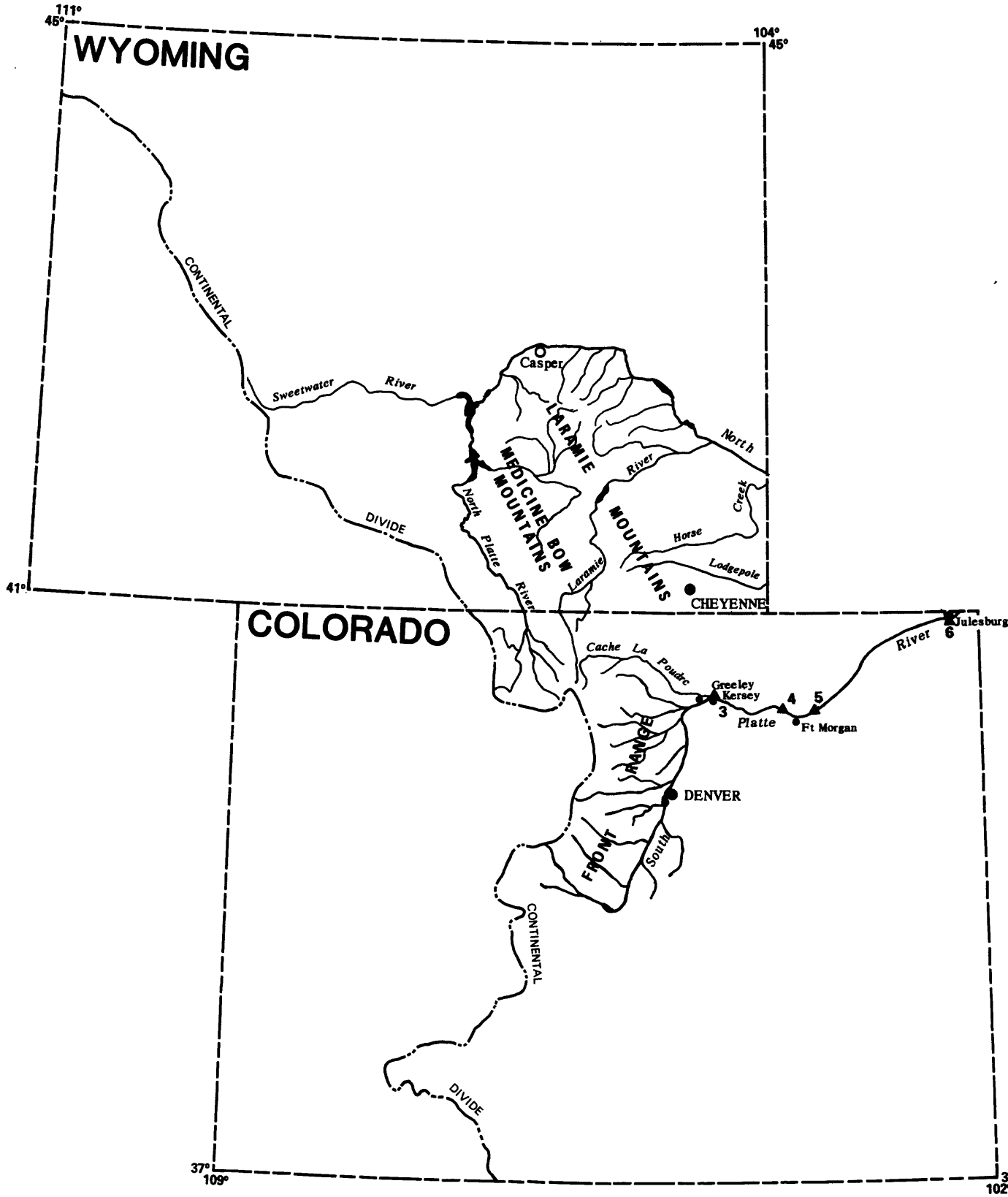

Figure 1.-- Map showing location of sediment-collection stations.

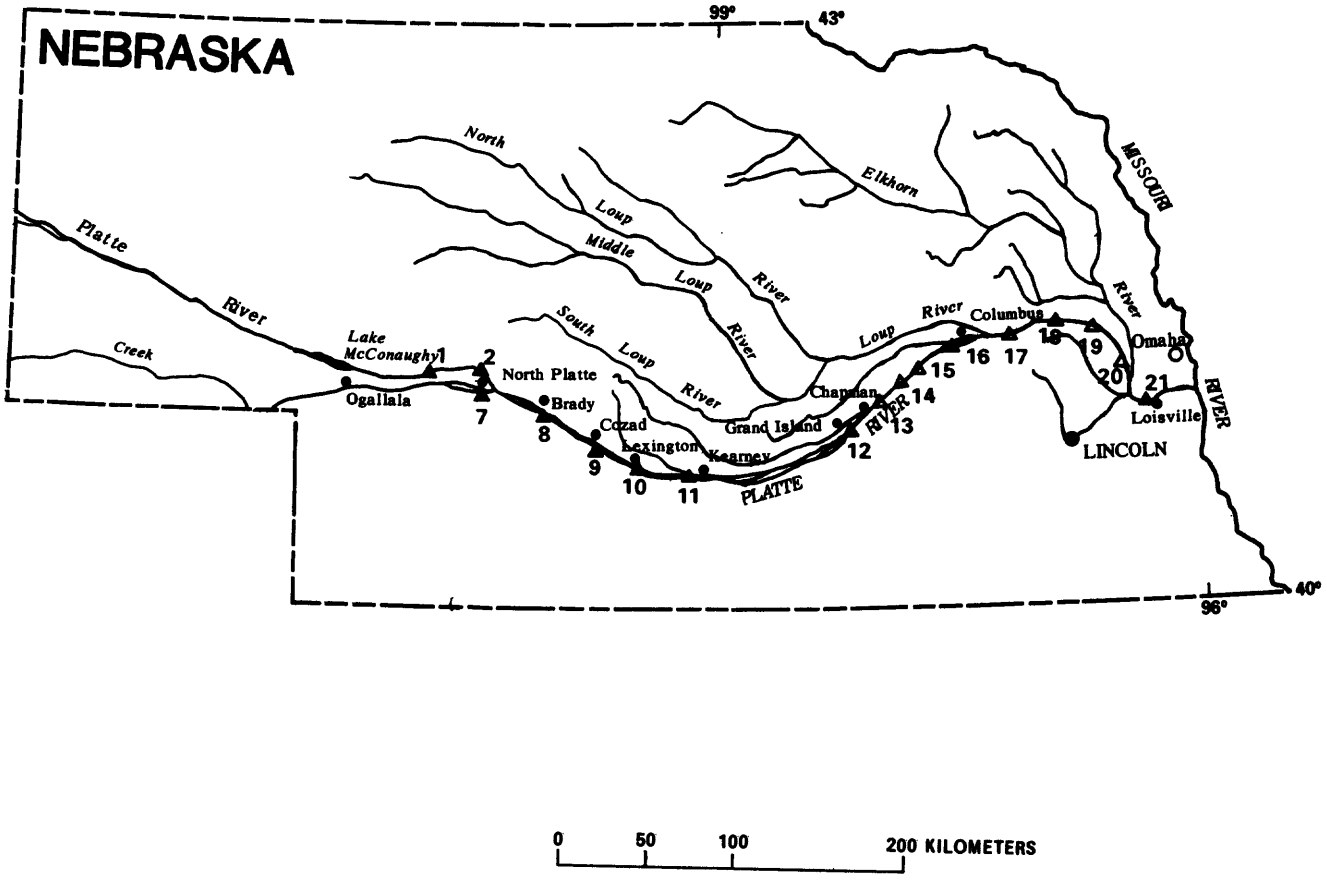

Figure 1.--Continued.

Station locations were chosen at existing data stations along the North and South Platte Rivers and the Platte River. The stations were located at bridge crossings for convenience of sampling at high flows and also were used at low flows to maintain consistency in the data. The sampling was done during May through September when the North Platte, South Platte, and Platte Rivers have their largest and smallest flows so that extreme flows could be sampled.

Stream Discharge

Mean annual precipitation in the study area ranges from 315 mm (millimeters) at Greeley, Colorado, to 629 mm at Grand Island, Nebraska. Precipitation occurs both as snow and rain throughout the area. This can be compared to a mean annual runoff of about 7.4 mm at Grand Island. This value corresponds to a mean annual discharge of about 35.6 m^3/s (cubic meters per second) at Grand Island. Mean annual discharge is equaled or exceeded about 36 percent of the time. The high-flow season caused by spring snowmelt extends from early May to early July.

Water-discharge measurements (table 2) were made at the time of sediment sampling. The frequency of sampling was variable among stations and during the study. The major emphasis and most frequent sampling occurred in the critical reach of study while samples outside this reach were collected to supplement these data. The critical reach, as defined by the U.S. Fish and Wildlife Service, is the 120-river km reach between Lexington and Chapman, Nebraska.

Suspended Sediment

Suspended-sediment concentrations were determined by collecting depth-integrated water samples at equal-width increments using either a DH-48 or D-74 sampler (Guy and Norman, 1970). The determined values of concentrations at the stations sampled are listed in table 3. The suspended-sediment load also is shown in table 3. The size gradation of the suspended sediment is shown in table 4. Some of the samples listed in table 3 are not shown in table 4 because the sample collected was not large enough for analysis.

Bedload

Bedload-transport rates were determined by the use of a Helley-Smith bedload sampler. Procedures described by Emmett (1980) and Helley and Smith (1971) were used in the study.

The bedload-transport rates determined are presented in table 3. The complete grain-size distribution data for the bedload-transport rates listed in table 3 are presented in table 5. The statistical summary of the grain-size distribution presented in table 5 is provided in table 6. The statistical

Table 2.--*Summary of water-discharge measurements*

[M = METERS; M^3/S = CUBIC METERS PER SECOND; M/S = METERS PER SECOND; ^oC = DEGREES CELSIUS]

SITE NUMBER IN FIGURE 1	DATE	TIME	STAGE (M)	DISCHARGE (M^3/S)	WIDTH (M)	MEAN DEPTH (M)	MEAN VELOCITY (M/S)	AREA (M^2)	WATER TEMPERATURE (^oC)
1	8/ 9/79	800	0.59	22.6	83.5	0.39	0.70	32.3	21.0
1	8/11/79	1555	.69	27.9	89.3	.49	.64	43.7	21.0
2	8/ 8/79	940	1.02	16.2	76.2	.32	.67	24.3	23.0
2	8/12/79	930	1.19	31.4	75.3	.59	.70	44.6	18.5
2	5/13/80	1630	1.07	17.5	76.5	.40	.58	30.4	17.0
2	6/ 5/80	1630	1.22	26.3	76.5	.55	.63	42.0	27.5
2	8/ 4/80	930	1.50	58.4	89.3	.73	.90	64.8	20.0
2	8/ 5/80	930	1.50	58.4	89.3	.73	.90	64.8	20.0
3	6/27/79	1200	1.64	71.2	96.0	.85	.87	81.4	
3	7/15/79	1055	.91	11.9	49.4	.32	.76	15.6	21.5
3	8/21/79	930	1.79	98.8	111	1.04	.86	115	23.0
3	9/25/79	955	1.05	20.5	51.2	.51	.79	26.1	17.0
3	5/ 6/80	1230	2.78	351	197	1.91	.93	376	13.5
4	6/20/79	1200	2.53	234	105	1.64	1.36	172	
4	6/26/79	1200	1.83	92.7	88.4	.95	1.10	84.2	
4	7/18/79	1200	.99	9.80	38.4	.38	.67	14.6	
4	8/16/79	1200	1.58	53.2	83.8	.70	.90	59.0	23.0
4	9/26/79	1200	1.19	17.7	39.6	.56	.79	22.3	17.5
5	6/20/79	1700	2.76	253	302	1.06	.79	321	20.5
5	6/25/79	1250	2.41	107	85.6	1.21	1.03	104	
5	7/17/79	1430	1.19	7.50	40.5				
5	8/17/79	1230	1.73	39.5	72.5	.66	.82	47.9	23.0
5	9/27/79	820	1.11	4.30	27.7	.28	.56	7.7	16.0
5	7/ 2/79	1400	1.52	36.6	92.4	.49	.80	45.5	
6	7/17/79	900	.87	2.18	16.5	.24	.55	4.0	24.0
6	8/15/79	1230	1.01	5.21	23.8	.33	.67	7.8	15.0
6	9/27/79	1255	1.00	5.64	21.3	.40	.65	8.6	22.0
7	7/29/79	930	1.63	8.18	30.8	.36	.74	11.1	22.5
7	8/ 8/79	745	1.51	4.50	31.7	.22	.66	6.9	22.0
7	5/22/80	1300	3.44	351	146	1.53	1.57	224	19.0
7	6/ 5/80	1300	2.98	189	148	1.11	1.15	164	23.5
7	6/12/80	1100	2.72	113	139	.71	1.14	99.0	22.5
7	6/22/80	1230	2.52	78.3	142	.59	.94	83.4	23.0
7	6/26/80	1025	2.33	47.2	122	.44	.87	54.1	27.0
7	6/29/80	1115	2.18	32.4	121	.41	.65	50.0	23.0
8	8/10/79	1145	.80	19.1	65.5	.50	.59	32.5	
9	7/15/79	1200	.48	1.50	22.9	.15	.45	3.3	
9	8/ 8/79	1530	.49	1.08	20.4	.32	.17	6.5	
10	7/18/79	1030	.50	16.7	116	.29	.50	33.1	21.0
10	8/15/79	1130	.40	6.54	81.1	.20	.40	16.2	17.0
10	5/ 1/80	1330	1.08	146	198	.86	.85	171	17.5
10	6/ 4/80	1150	1.37	254	204	1.13	1.10	231	24.0
10	6/11/80	1000	.99	126	200	.79	.80	158	22.0
10	5/21/80	815	.86	89.3	192	.61	.76	117	20.5
10	6/23/80	750	.79	65.4	188	.46	.75	87.2	23.0
10	6/24/80	830	.97	70.5	189	.49	.76	92.9	24.5
10	6/25/80	900	.59	46.8	154	.44	.69	67.9	24.0
10	6/28/80	1800	.43	22.7	116	.32	.62	36.8	30.0
11	7/17/79	1630	.48	8.69	83.5	.21	.50	17.4	
11	8/15/79	1500	.39	1.93	29.9	.16	.39	4.9	
12	8/16/79	1045	.43	8.10	138	.15	.40	20.4	18.0
12	4/30/80	1200	1.01	142	266	.65	.83	172	18.0
12	5/15/80	1145	1.32	271	268	1.02	.99	273	15.0
12	5/21/80	930	1.32	250	268	.97	.96	261	18.2
12	6/ 3/80	1210	1.35	304	268	1.06	1.07	285	22.0
12	6/10/80	1600	1.13	207	260	.79	1.00	206	26.0
12	6/20/80	1000	.98	124	242	.60	.86	145	21.0
12	6/24/80	940	.97	115	243	.59	.80	144	24.5
12	6/27/80	1100	.84	63.0	230	.41	.66	95.4	27.5
16	7/24/79	1100	.53	22.7	194	.24	.48	47.3	
16	8/17/79	1030	.26	4.81	98.8	.15	.32	15.0	24.0
18	8/20/79	1230	.46	42.3	248	.35	.49	85.7	25.5

Table 3.--*Summary of sediment data*

[M^3/S = CUBIC METERS PER SECOND; MG/L = MILLIGRAMS PER LITER; TONS/D = METRIC TONS PER DAY; KG/S/M = KILOGRAMS PER SECOND PER METER]

STTE NUMBER IN FIGURE 1	DATE	WATER DISCHARGE (M^3/S)	SUSPENDED-SEDIMENT CONCENTRATION (MG/L)	SUSPENDED-SEDIMENT DISCHARGE (TONS/D)	UNIT BEDLOAD TRANSPORT RATE (KG/S/M)	BEDLOAD-TRANSPORT RATE (TONS/D)
1	8/ 9/79	22.6	370	720	0.058	420
1	8/11/79	27.9	120	290	.059	450
2	8/ 8/79	16.2	170	240	.043	280
2	8/12/79	31.4	350	950	.048	310
2	5/13/80	17.5	1430	2160	.043	281
2	5/ 5/80	26.3	140	320	.028	184
2	8/ 4/80	58.4	310	1560	.123	944
2	8/ 5/80	58.4	370	1870	.089	688
3	6/27/79	71.2	710	4370		
3	7/15/79	11.9	140	140		
3	8/21/79	98.8	1000	8540		
3	9/25/79	20.5	84	150	.087	383
3	5/ 6/80	351	950	28800	.267	28300
4	6/20/79	234	190	3840		
4	6/26/79	92.7	410	3280		
4	7/18/79	9.80	580	490	.026	87.5
4	8/16/79	53.2	400	1840		
4	9/26/79	17.7	100	150	.070	239
5	6/20/79	253	520	11400		
5	6/25/79	107	900	8320		
5	7/17/79	7.50	900	580		
5	8/17/79	39.5	1350	4610		
5	9/27/79	4.30	100			
6	7/17/79	2.18			.013	18.6
6	8/15/79	5.21			.008	17.3
6	9/27/79	5.64			.036	66.7
7	7/28/79	8.18	130	100	.033	88.0
7	8/ 8/79	4.50	62		.038	104
7	5/22/80	351	1160	35200	.670	8410
7	6/ 5/80	189	570	9310	.371	4720
7	6/12/80	113	390	3810	.313	3740
7	6/22/80	78.3	350	2370	.250	3060
7	6/26/80	47.2	190	770	.125	1310
7	6/29/80	32.4	170	480	.045	470
10	7/18/79	16.7			.051	511
10	8/15/79	6.54	69		.009	63.6
10	5/ 1/80	146	2120	26700	.203	3460
10	6/ 4/80	254	240	5270	.353	6210
10	6/11/80	126	220	2400	.105	1810
10	6/21/80	89.3	190	1470	.091	1500
10	6/23/80	65.4	130	730	.130	2100
10	6/24/80	70.5	110	670	.107	1740
10	6/25/80	46.4	70	280	.045	602
10	6/28/80	22.7			.017	169
12	8/16/79	8.10	100	100	.010	113
12	4/30/80	142	3710	45500	.218	4990
12	5/15/80	271	330	7730	.241	5570
12	5/21/80	250	270	5830	.293	6780
12	6/ 3/80	304	270	7090	.386	9920
12	6/10/80	207	120	2150	.185	4150
12	6/20/80	124	230	2460	.107	2230
12	6/24/80	115	180	1790	.121	2530
12	6/27/80	63.0	120	650	.075	1490

Table 4.--*Grain-size distribution of suspended sediment*

SITE NUMBER IN FIGURE 1	DATE	PERCENTAGE FINER THAN INDICATED SIEVE SIZE: SIEVE SIZE (MILLIMETERS)								
		1.0	0.7	0.5	0.35	0.25	0.175	0.125	0.088	0.062
1	8/ 9/79	100	100	94	64	57	49	35	21	10
1	8/11/79	100	100	100	97	94	75	44	38	30
2	8/12/79	100	100	95	95	92	83	69	49	26
2	8/ 4/80	100	100	99	96	87	73	50	25	21
2	8/ 5/80	100	100	98	97	84	65	41	14	9
3	6/19/79	69	62	53	43	34	28	26	26	26
3	6/27/79	100	95	78	58	49	41	38	36	36
3	8/21/79	100	100	99	99	95	91	86	82	78
3	5/ 6/80	100	100	100	87	85	66	60	57	53
4	6/26/79	100	100	99	96	89	82	74	71	70
4	8/16/79	100	100	97	92	81	64	52	48	47
4	8/16/79	100	97	96	89	82	75	73	71	68
4	9/26/79	100	100	100	100	98	83	77	62	56
4	9/26/79	100	100	100	99	95	83	73	67	64
5	6/20/79	100	100	98	90	74	47	35	31	31
5	6/25/79	100	98	92	84	75	62	55	51	49
5	7/17/79	100	100	97	95	82	39	31	30	30
5	8/17/79	100	100	97	90	82	69	61	47	42
7	6/14/79	97	85	66	46	38	31	28	27	26
7	7/ 2/79	100	100	100	97	89	72	54	52	51
7	8/15/79	92	63	45	34	24	23	23	23	23
7	5/22/80	68	65	63	60	57	54	53	53	52
7	6/ 5/80	100	100	98	91	80	69	64	63	61
7	6/22/80	100	100	98	95	86	78	74	73	71
7	6/26/80	100	100	99	97	88	77	74	72	69
10	5/ 1/80	92	74	52	29	12	4	3	3	3
10	6/11/80	100	100	99	96	91	80	74	70	69
10	6/11/80	100	100	99	96	91	80	74	70	69
10	6/21/80	100	100	100	98	96	90	85	83	81
10	6/23/80	100	100	100	100	97	87	83	82	80
10	6/24/80	100	100	100	100	97	81	75	72	69
10	6/25/80	100	100	100	100	100	99	98	95	89
12	8/16/79	100	100	97	94	89	85	78	70	61
12	4/30/80	81	62	40	26	12	3	2	2	2
12	5/15/80	100	100	99	98	70	40	22	19	18
12	5/21/80	100	99	97	89	67	43	28	25	2
12	6/10/80	100	100	100	91	64	49	41	40	40
12	6/24/80	100	100	100	98	92	71	62	59	59
12	6/27/80	100	100	100	100	98	84	78	74	73

Table 5.--*Grain-size distribution of bedload*

SITE NUMBER IN FIGURE 1	DATE	PERCENTAGE FINER THAN INDICATED SIEVE SIZE SIEVE SIZE (MILLIMETERS)								
		16.0	8.0	4.0	2.0	1.0	0.5	0.25	0.125	0.062
1	8/ 9/79	100	99	94	84	61	26	3	0.0	0.0
1	8/11/79	100	99	93	80	59	35	6	.0	.0
2	8/ 8/79	100	100	97	89	74	47	7	.1	.0
2	8/12/79	100	100	98	91	73	40	5	.2	.0
2	5/13/80	100	100	96	90	76	47	5	.2	.0
2	6/ 5/80	100	100	98	90	77	53	8	.2	.0
2	8/ 4/80	100	97	89	77	59	33	4	.2	.0
2	8/ 5/80	100	99	94	86	72	47	5	.2	.0
3	9/25/79	97	94	83	66	46	25	4	.0	.0
3	5/ 6/80	88	79	63	43	25	13	3	.1	.1
4	7/18/79	100	98	90	75	54	30	4	.1	.0
4	9/26/79	100	99	93	78	56	28	5	.2	.0
6	7/17/79	100	100	97	89	72	37	3	.0	.0
6	8/15/79	100	99	96	89	74	38	10	1	.7
6	9/27/79	100	100	96	83	60	27	4	.1	.0
7	7/28/79	100	99	88	68	41	11	.6	.1	.0
7	8/ 8/79	100	100	94	75	43	13	.3	.0	.0
7	5/22/80	93	90	80	61	37	13	2	.0	.0
7	6/ 5/80	100	94	82	67	48	24	2	.0	.0
7	6/12/80	100	95	85	70	52	26	3	.0	.0
7	6/22/80	100	97	87	72	52	24	2	.0	.0
7	6/26/80	100	98	91	77	57	24	.9	.0	.0
7	6/29/80	100	99	96	87	68	33	2	.0	.0
10	7/18/79	100	99	95	85	68	32	2	.0	.0
10	8/15/79	100	100	97	85	65	28	2	.3	.1
10	5/ 1/80	94	93	84	68	48	22	3	.0	.0
10	6/ 4/80	100	96	86	69	45	17	2	.0	.0
10	6/11/80	100	95	85	68	46	23	7	.2	.1
10	6/21/80	100	98	90	74	53	21	3	.0	.0
10	6/23/80	100	98	88	71	49	23	3	.0	.0
10	6/24/80	100	97	86	69	45	20	2	.0	.0
10	6/25/80	100	99	89	71	42	15	.3	.0	.0
10	6/28/80	100	99	93	80	62	27	2	.1	.0
12	8/16/79	100	100	98	91	75	43	4	.0	.0
12	4/30/80	100	98	94	81	59	24	3	.0	.0
12	5/15/80	100	99	94	83	61	30	5	.0	.0
12	5/21/80	100	98	92	79	60	27	4	.0	.0
12	6/ 3/80	98	94	86	72	51	23	3	.0	.0
12	6/10/80	100	98	91	80	64	36	5	.0	.0
12	6/20/80	100	99	96	88	73	44	7	.0	.0
12	6/24/80	100	99	94	83	63	33	5	.0	.0
12	6/27/80	100	99	96	89	71	36	2	.0	.0

Table 6.--*Statistical data, grain-size distribution of bedload*

SITE NUMBER IN FIGURE 2	DATE	PARTICLE-SIZE (MILLIMETERS) AT GIVEN PERCENTAGE FINER; PERCENTAGE FINER PARAMETER									
		5	16	25	35	50	65	75	84	90	95
1	8/ 9/79	0.3	0.4	0.5	0.6	0.8	1.1	1.5	2.0	2.9	4.5
1	8/11/79	.2	.3	.4	.5	.8	1.2	1.7	2.4	3.2	4.6
2	8/ 8/79	.2	.3	.4	.4	.5	.8	1.0	1.5	2.1	3.1
2	8/12/79	.3	.3	.4	.5	.6	.8	1.1	1.5	1.9	2.8
2	6/ 5/80	.2	.3	.4	.4	.5	.7	.9	1.4	2.0	2.9
2	8/ 4/80	.3	.4	.4	.5	.8	1.2	1.8	2.9	4.2	6.1
2	8/ 5/80	.3	.3	.4	.4	.5	.8	1.1	1.8	2.8	4.4
2	5/13/80	.2	.3	.4	.4	.5	.8	1.0	1.4	2.0	3.3
3	9/25/79	.3	.4	.5	.7	1.1	2.0	2.8	4.1	5.8	9.7
3	5/ 6/80	.3	.6	1.0	1.5	2.6	4.4	6.7	11.6	19.2	
4	7/18/79	.3	.4	.5	.6	.9	1.4	2.0	2.9	4.0	5.4
4	9/26/79	.2	.4	.5	.6	.9	1.3	1.8	2.5	3.3	4.6
6	7/17/79	.3	.4	.4	.5	.6	.9	1.1	1.6	2.2	3.1
6	8/15/79	.2	.3	.4	.5	.6	.8	1.1	1.6	2.2	3.6
6	9/27/79	.3	.4	.5	.6	.8	1.1	1.5	2.1	2.7	3.7
7	8/ 8/79	.4	.6	.7	.9	1.2	1.6	2.0	2.6	3.3	4.3
7	7/28/79	.4	.6	.7	.9	1.3	1.8	2.4	3.4	4.3	5.5
7	6/ 5/80	.3	.4	.5	.7	1.1	1.9	2.8	4.4	6.0	8.5
7	5/22/80	.4	.6	.7	1.0	1.5	2.3	3.3	5.3	8.7	25.1
7	6/12/80	.3	.4	.5	.6	1.0	1.6	2.5	3.9	5.3	7.8
7	6/22/80	.3	.4	.5	.7	1.0	1.5	2.2	3.4	4.5	6.2
7	6/26/80	.3	.4	.5	.6	.9	1.3	1.8	2.7	3.9	5.6
7	6/29/80	.3	.4	.5	.5	.7	.9	1.3	1.8	2.4	3.6
10	7/18/79	.3	.4	.5	.5	.7	.9	1.3	1.9	2.6	3.9
10	8/15/79	.3	.4	.5	.6	.8	1.0	1.4	1.9	2.5	3.4
10	5/ 1/80	.3	.4	.5	.7	1.1	1.8	2.6	4.1	6.3	25.2
10	6/ 4/80	.3	.5	.6	.8	1.1	1.8	2.5	3.7	4.9	6.9
10	6/11/80	.2	.4	.5	.7	1.1	1.8	2.6	3.9	5.3	8.0
10	6/21/80	.3	.4	.6	.7	.9	1.4	2.0	2.9	4.0	5.6
10	6/23/80	.3	.4	.5	.7	1.0	1.6	2.3	3.2	4.3	6.0
10	6/24/80	.3	.5	.6	.8	1.1	1.8	2.5	3.7	4.9	6.7
10	6/25/80	.4	.5	.7	.9	1.2	1.7	2.3	3.2	4.1	5.1
10	6/28/80	.3	.4	.5	.6	.8	1.1	1.6	2.4	3.3	4.8
12	8/16/79	.3	.3	.4	.5	.6	.8	1.0	1.4	1.9	2.6
12	6/ 3/80	.3	.4	.5	.7	1.0	1.5	2.2	3.6	5.4	9.1
12	4/30/80	.3	.4	.5	.6	.8	1.2	1.6	2.3	3.1	4.6
12	5/15/80	.3	.4	.5	.6	.8	1.1	1.5	2.1	2.9	4.4
12	5/21/80	.3	.4	.5	.6	.8	1.2	1.7	2.5	3.5	5.1
12	6/10/80	.3	.4	.4	.5	.7	1.0	1.6	2.4	3.6	5.4
12	6/20/80	.2	.3	.4	.4	.6	.8	1.1	1.6	2.3	3.5
12	6/24/80	.3	.4	.4	.5	.8	1.1	1.5	2.1	2.9	4.4
12	6/27/80	.3	.4	.4	.5	.7	.9	1.1	1.6	2.2	3.4

summaries present grain diameters at given percent-finer values. Particle-size gradation curves for the data listed in table 5 are shown in figures 2-9. The stations have been separated into individual plots for the convenience of the reader.

Bed Material

Bed-material samples were collected at the time of each measurement and additional samples were taken at other sites to determine the change in bed-material size in a downstream direction. The bed-material samples were obtained using a BMH 60 (Guy and Norman, 1970). Data on the size analysis of each sample are given in table 7. The data listed in table 7 are the weighted mean grain-size distribution of each station, and each was determined by giving each sample a weight proportional to the increment of channel width it represents. A statistical summary of the grain-size distributions is given in table 8. These are the data giving grain diameters at given percent-finer values. The size gradation curves for each sample given in table 7 are shown in figures 10-27.

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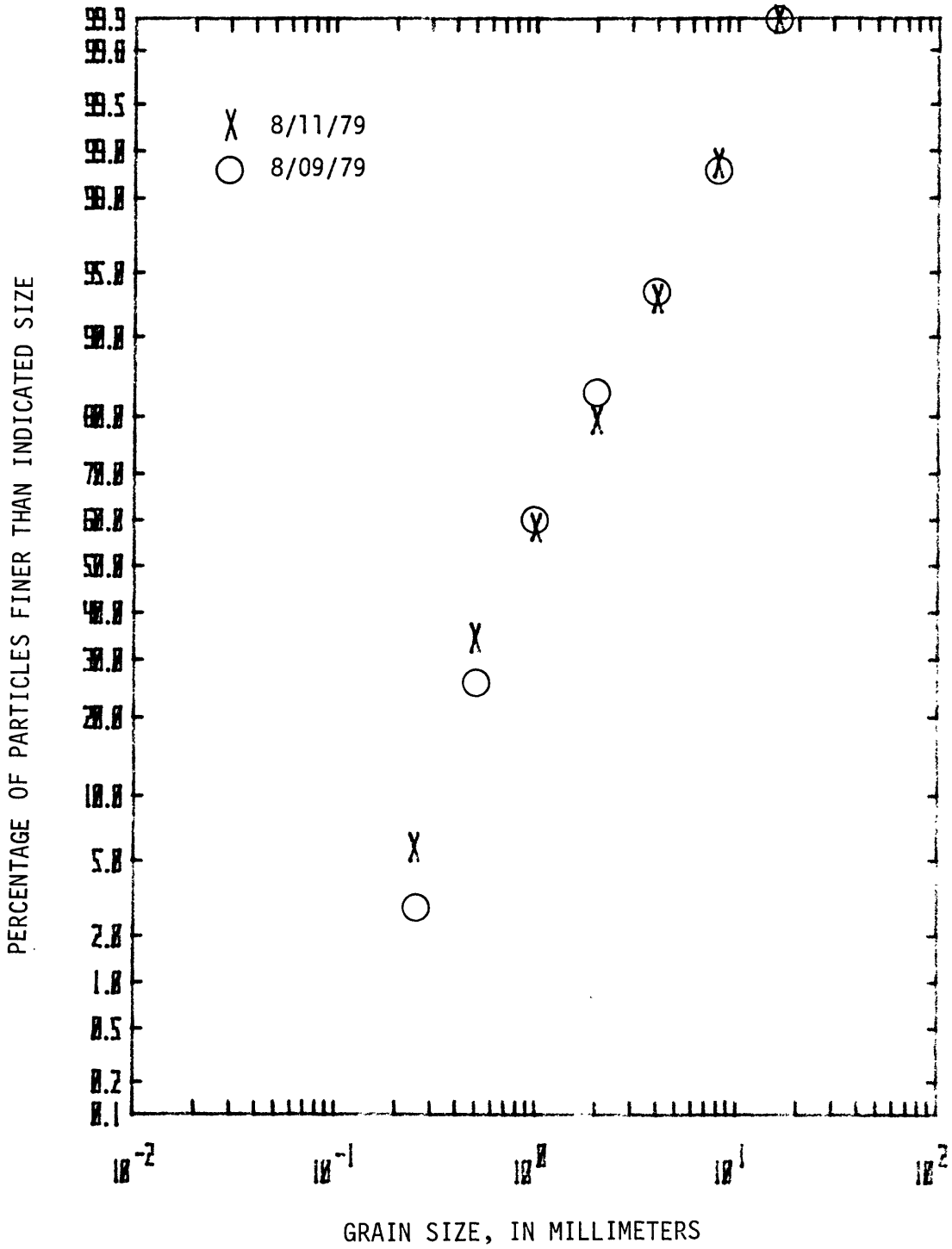

Figure 2.--Grain-size distribution of bedload for station 06691000, North Platte River near Sutherland, Nebraska.

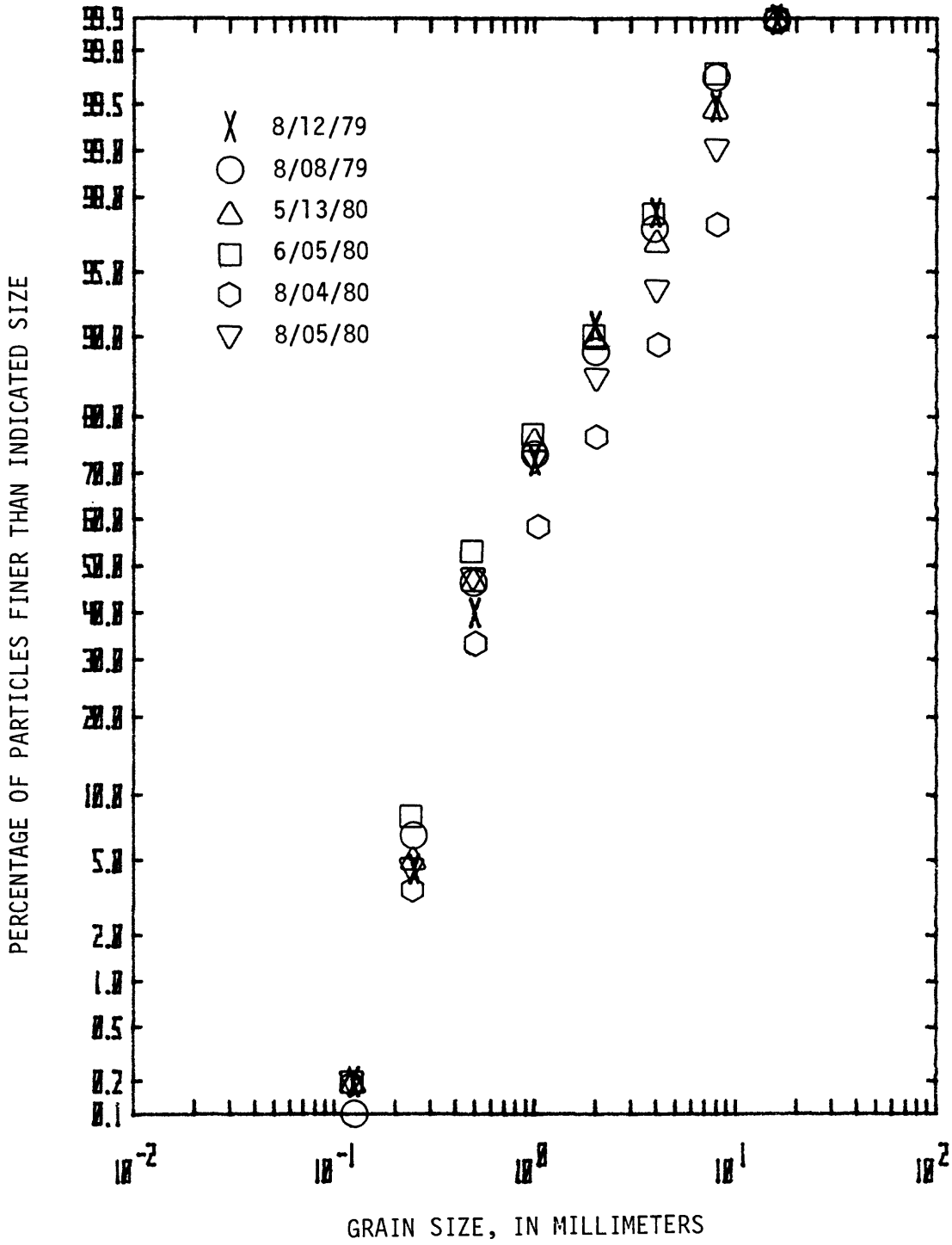

Figure 3.--Grain-size distribution of bedload for station 06693000, North Platte River at North Platte, Nebraska.

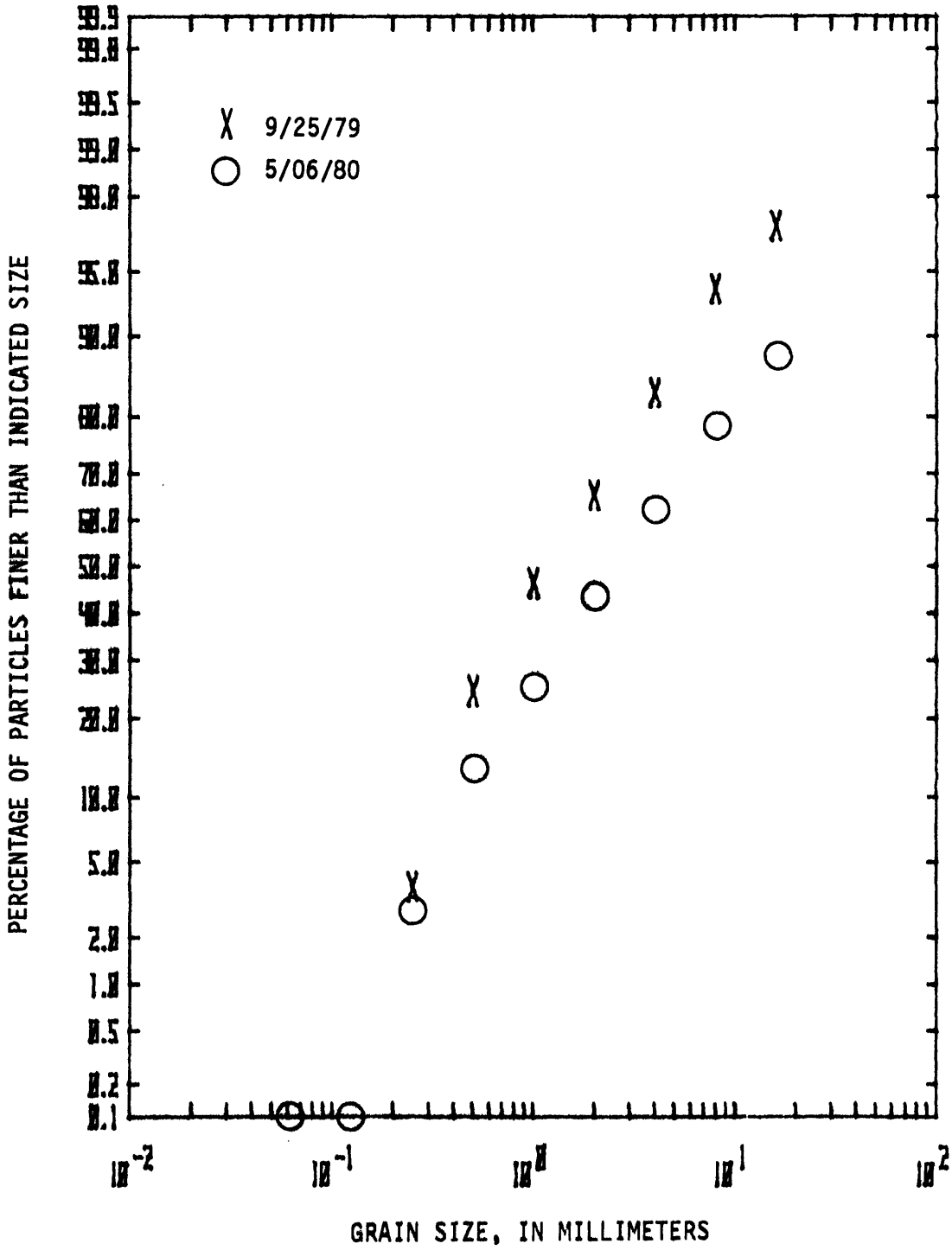

Figure 4.--Grain-size distribution of bedload for station 06754000, South Platte River near Kersey, Colorado.

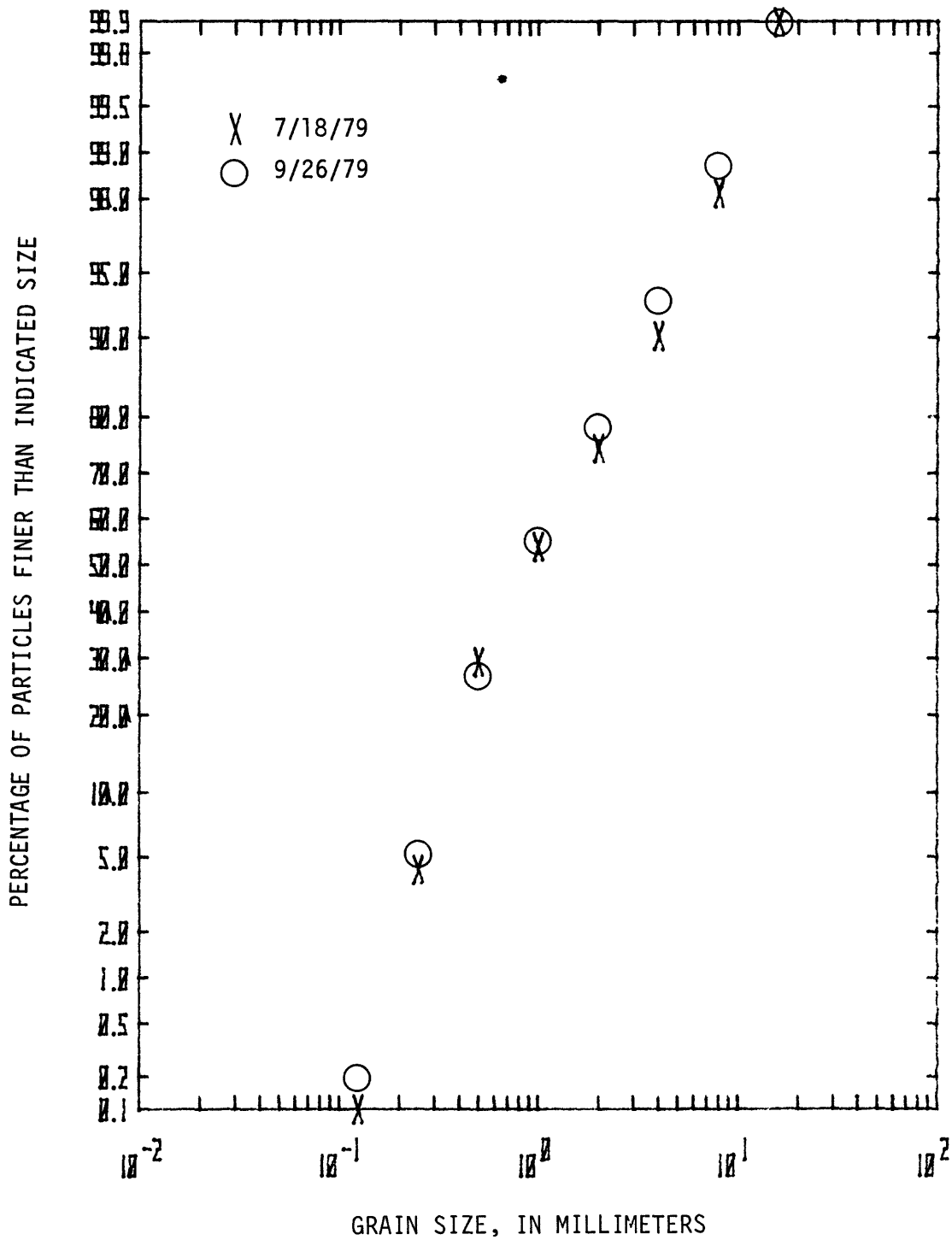

Figure 5.--Grain-size distribution of bedload for station 06758500, South Platte River near Weldona, Colorado.

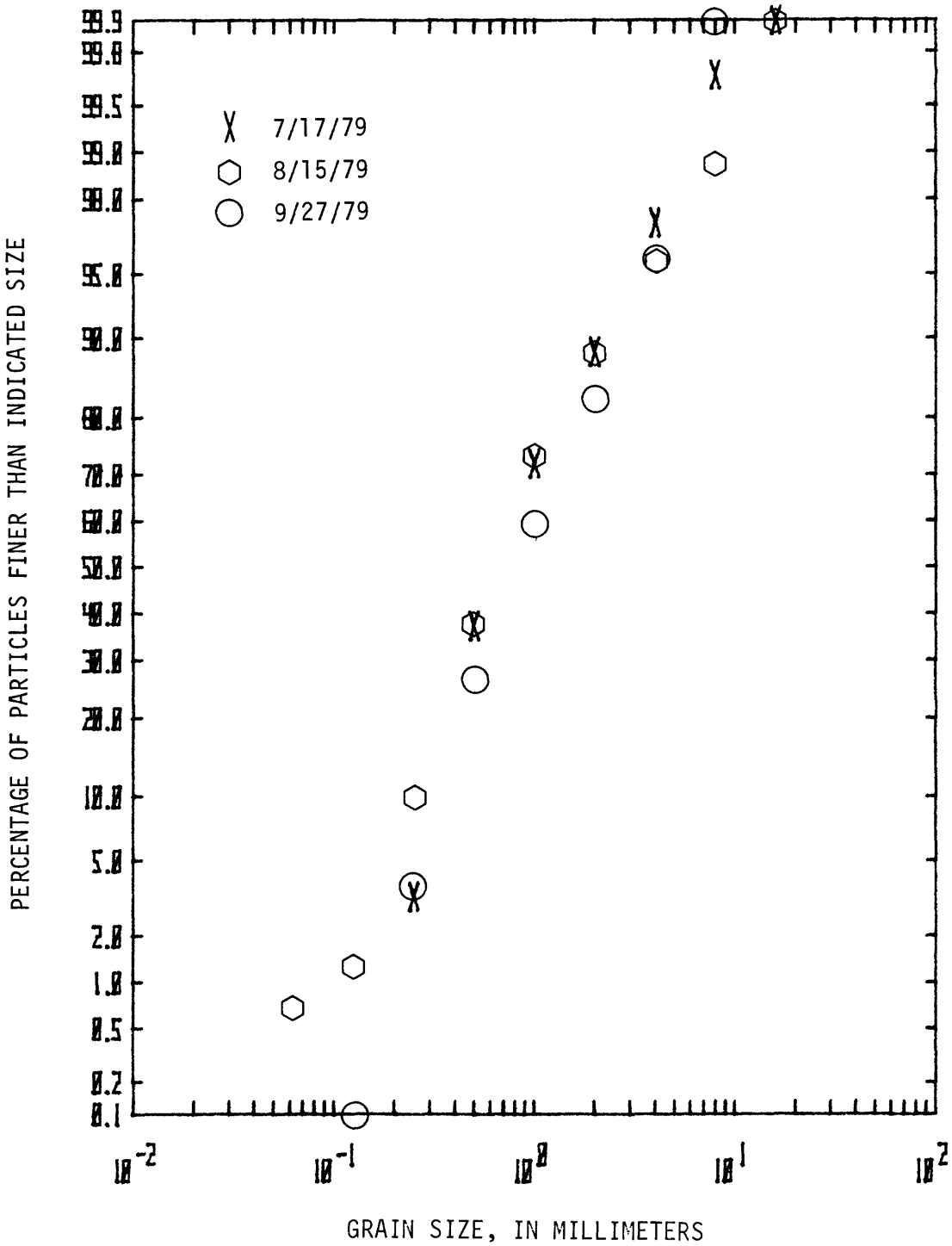

Figure 6.-Grain-size distribution of bedload for station 06764000, South Platte River at Julesburg, Colorado.

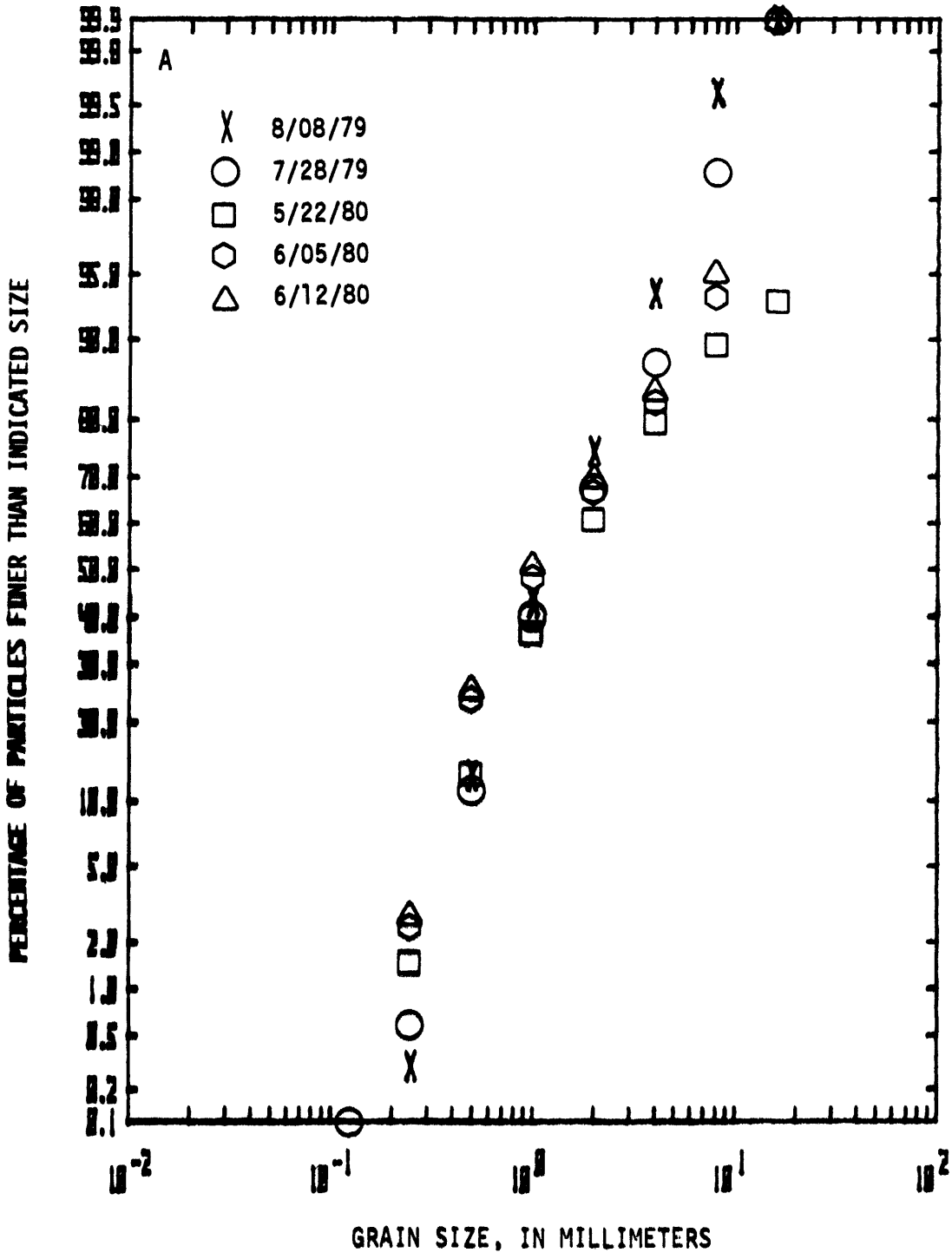

Figure 7.-- Grain-size distribution of bedload for station 06765500, South Platte River at North Platte, Nebraska: A. August 8, 1979 to June 12, 1980.

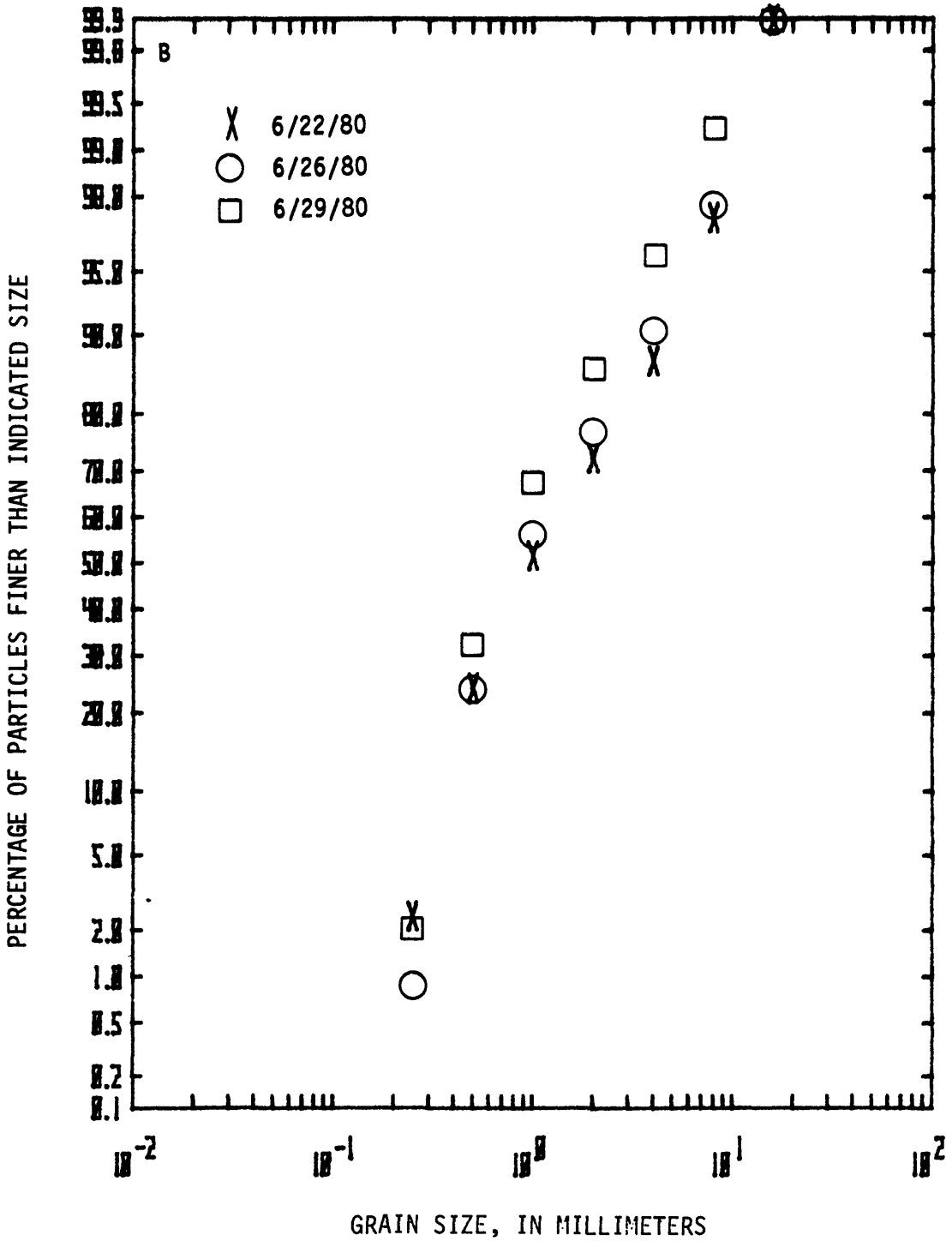

Figure 7.-- Grain-size distribution of bedload for station 06765500, South Platte River at North Platte, Nebraska -- Continued: B. June 22, 1980 to June 29, 1980.

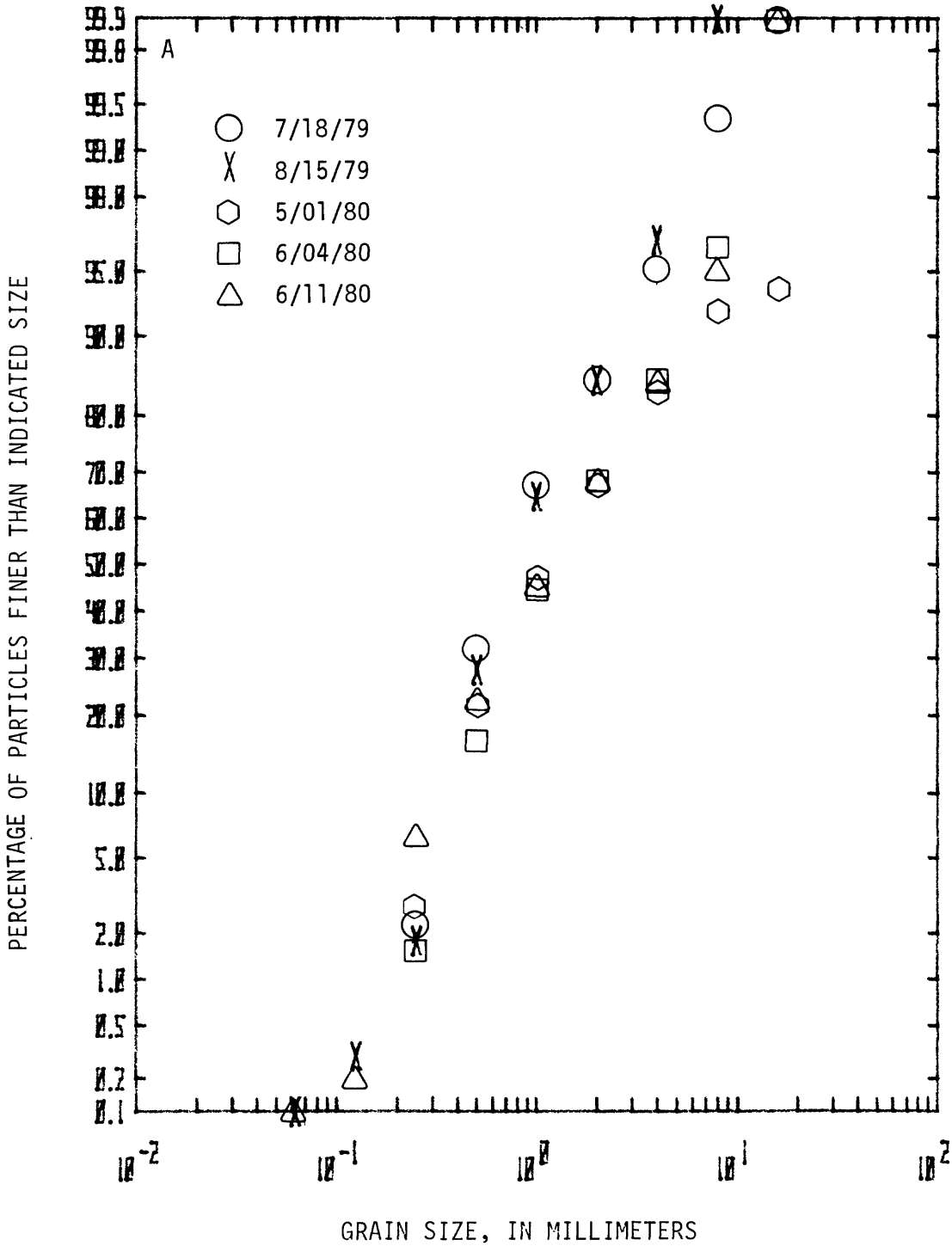

Figure 8.-- Grain-size distribution of bedload for station 06768000, Platte River near Overton, Nebraska: A. July 18, 1979 to June 11, 1980.

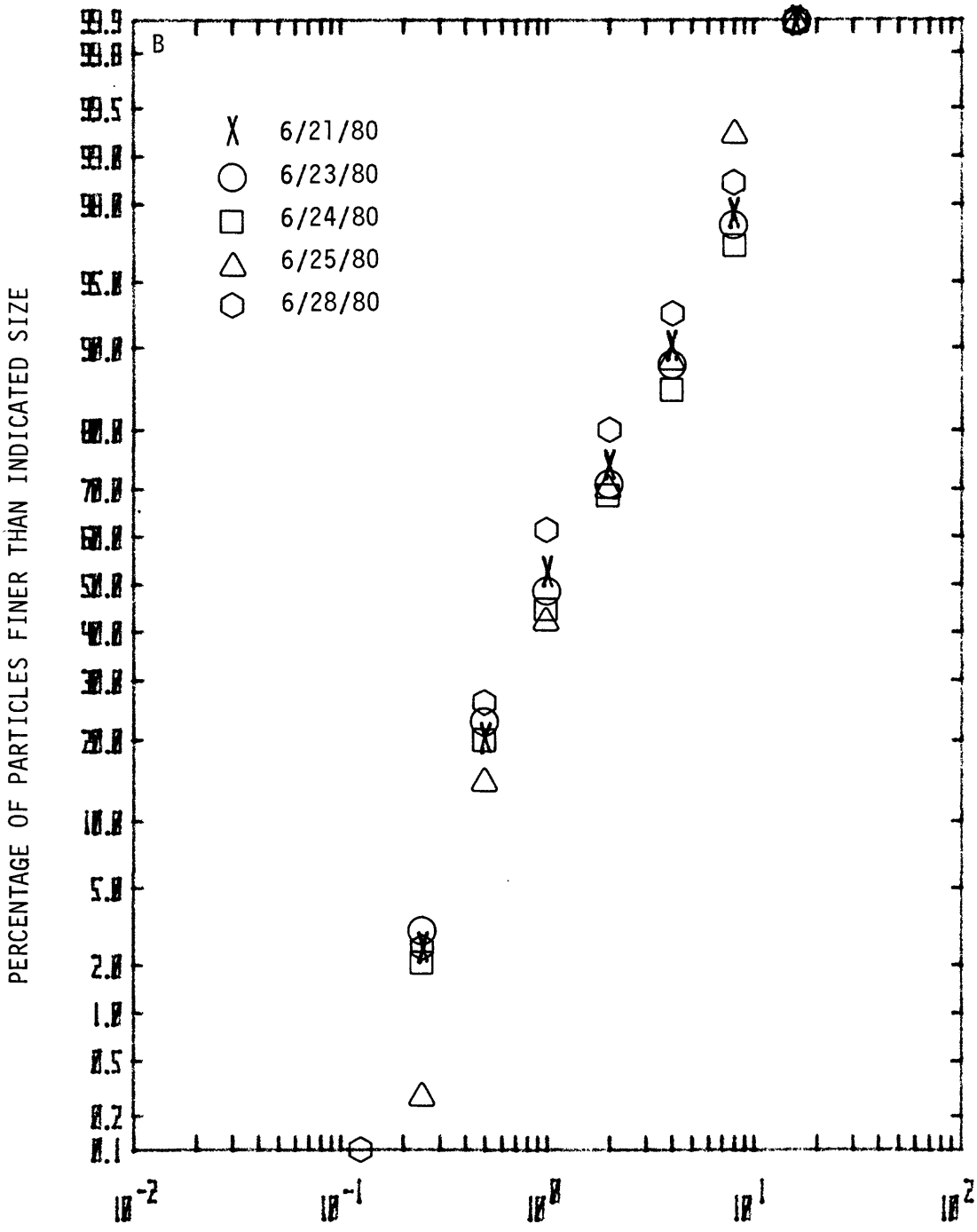

Figure 8.-- Grain-size distribution of bedload for station 06768000, Platte River near Overton, Nebraska -- Continued: B. June 21, 1980 to June 28, 1980.

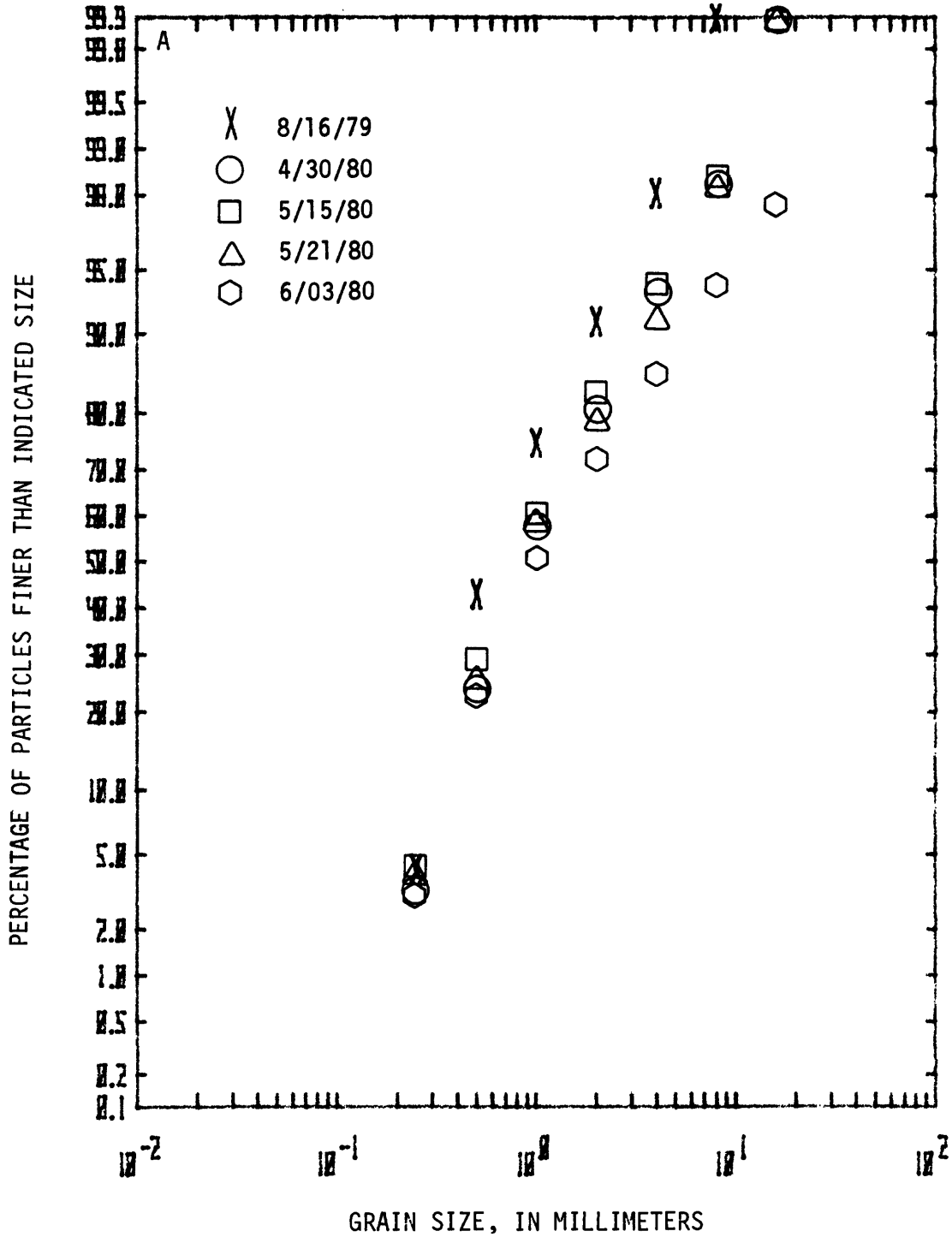

Figure 9.-- Grain-size distribution of bedload for station 06770500, Platte River near Grand Island, Nebraska: A. August 16, 1979 to June 3, 1980.

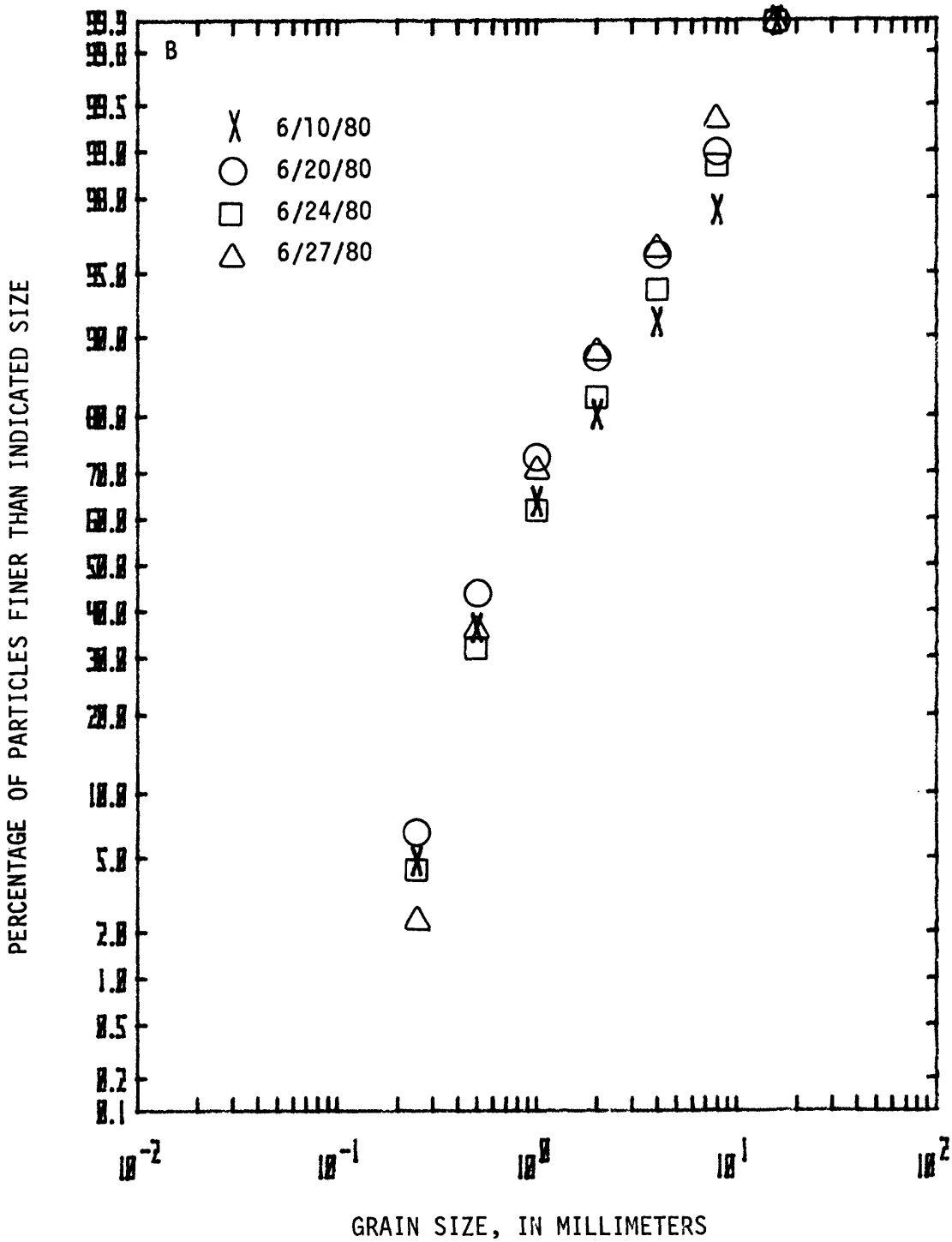

Figure 9.-- Grain size distribution of bedload for station 06770500, Platte River near Grand Island, Nebraska -- Continued: B. June 10, 1980 to June 27, 1980.

Table 7.--*Grain-size distribution of bed-material*

SITE NUMBER (FIGURE 1)	DATE	PERCENTAGE FINER THAN INDICATED SIEVE SIZE — SIEVE SIZE (MILLIMETERS)								
		16.0	8.0	4.0	2.0	1.0	0.5	0.25	0.125	0.062
1	6/28/79	100	100	99	92	76	46	10	1	0.2
1	8/ 9/79	99	96	89	75	54	32	15	5	.7
1	8/11/79	98	95	89	77	60	38	12	2	.2
2	8/ 8/79	100	98	89	77	62	41	11	2	.2
2	8/12/79	100	99	97	89	73	43	9	.9	.0
2	8/21/79	100	99	95	87	69	41	9	.5	.0
2	5/13/80	100	99	94	85	71	51	26	11	1
2	5/ 5/80	100	99	97	92	79	53	20	8	1
2	8/ 4/80	100	98	94	87	72	45	12	.8	.1
2	8/ 5/80	100	98	94	88	74	50	18	2	.0
3	6/27/79	98	94	82	62	45	26	9	2	.8
3	7/16/79	95	84	68	43	28	13	3	.5	.1
3	8/21/79	98	93	84	70	54	31	10	1	.2
3	9/25/79	95	84	74	63	48	28	15	9	3
3	5/ 6/80	95	86	72	57	44	29	18	16	15
4	6/20/79	99	94	85	65	42	18	5	2	.6
4	6/26/79	99	93	83	61	40	17	4	.4	.1
4	7/18/79	100	95	82	59	46	29	6	.4	.1
4	9/26/79	100	97	86	64	43	19	4	2	2
5	6/20/79	99	97	92	83	76	65	45	18	5
5	6/25/79	100	98	94	84	69	45	20	6	1
5	7/17/79	100	97	87	69	52	28	6	.6	.1
5	8/17/79	100	99	90	78	61	30	9	2	.5
5	9/27/79	100	98	91	79	61	34	4	.2	.0
6	6/14/79	100	97	91	79	66	44	18	2	.9
6	6/27/79	100	99	93	72	49	20	3	.1	.0
6	7/ 2/79	100	98	91	74	54	26	8	3	.9
6	7/17/79	100	95	87	64	45	22	3	.1	.0
6	8/15/79	98	90	76	60	44	22	4	.3	.1
6	9/27/79	100	97	90	75	51	23	5	.3	.0
7	7/28/79	98	93	78	54	35	16	3	.1	.0
7	8/ 8/79	96	91	78	59	37	14	.9	.0	.0
7	8/21/79	96	87	76	64	46	25	8	1	.3
7	5/22/80	100	98	94	85	65	32	6	.7	.1
7	6/12/80	87	92	84	72	59	29	4	.2	.1
7	6/22/80	98	90	78	64	48	26	4	.3	.0
7	6/26/80	89	80	65	52	42	27	6	.4	.0
7	6/29/80	100	96	86	72	54	25	2	.0	.0
7	7/26/80	100	97	87	74	57	27	2	.0	.0
8	6/28/79	100	100	98	91	70	30	5	.2	.0
8	8/10/79	100	98	89	76	57	29	5	.1	.0
9	7/15/79	100	100	97	88	72	28	2	.0	.0
9	7/20/79	98	90	79	60	44	23	3	.7	.0
9	8/ 8/79	99	96	82	66	46	22	5	.8	.2
10	7/18/79	100	80	57	39	23	9	1	.0	.0
10	8/15/79	96	92	80	62	40	18	3	.2	.0
10	5/ 1/80	100	96	89	76	59	33	10	.8	.0
10	6/ 4/80	100	97	87	71	58	42	21	8	4
10	6/11/80	100	98	92	80	58	27	8	.9	.1
10	6/21/80	100	98	93	82	63	32	7	.2	.0
10	6/23/80	99	94	82	68	50	25	7	.3	.0
10	6/24/80	100	94	82	67	49	28	7	.1	.0
10	6/25/80	98	89	74	58	42	23	5	.3	.0
10	6/28/80	99	93	82	68	51	24	6	.1	.0
11	7/17/79	100	97	92	86	74	39	5	.3	.2
11	8/15/79	100	98	88	74	52	24	5	.0	.0
12	8/16/79	100	99	94	82	66	37	7	.2	.1
12	8/27/79	100	98	94	82	71	47	8	.3	.0
12	4/29/80	100	99	94	82	64	39	8	.7	.3
12	4/30/80	100	99	96	88	74	45	11	.1	.0

Table 7.--*Grain-size distribution of bed-material* --Continued

SITE NUMBER IN FIGURE 1	DATE	PERCENTAGE FINER THAN INDICATED SIEVE SIZE SIEVE SIZE (MILLIMETERS)								
		16.0	8.0	4.0	2.0	1.0	0.5	0.25	0.125	0.062
12	5/15/80	100	98	92	83	66	36	5	0.0	0.0
12	5/21/80	100	100	95	86	69	40	7	.0	.0
12	6/ 3/80	100	97	90	77	57	29	6	1	.0
12	6/10/80	100	98	92	84	68	40	8	.1	.0
12	6/20/80	100	99	94	81	61	35	7	.1	.0
12	6/24/80	100	100	96	87	73	43	9	.2	.0
12	6/27/80	100	98	95	86	70	41	10	.5	.0
13	8/19/79	100	99	94	83	64	32	5	.1	.0
15	8/17/79	100	99	95	85	66	34	5	.0	.0
16	8/18/79	100	98	95	89	77	48	9	.4	.0
18	8/20/79	100	100	97	91	81	56	12	.7	.1
19	8/19/79	100	99	96	86	73	53	18	4	2
20	8/19/79	100	100	99	96	89	68	19	2	.4
21	8/19/79	100	100	98	91	82	62	25	10	3

Table 8.--*Statistical data, grain-size distribution of bed-material*

SITE NUMBER IN FIGURE 1	DATE	PARTICLE-SIZE (MILLIMETERS) AT GIVEN PERCENTAGE FINER: PERCENTAGE FINER PARAMETER									
		5	15	25	35	50	65	75	84	90	95
1	6/28/79	0.2	0.3	0.4	0.4	0.5	0.8	1.0	1.3	1.8	2.4
1	8/ 9/79	.1	.3	.4	.6	.9	1.4	2.0	3.0	4.4	7.2
1	9/11/79	.2	.3	.4	.5	.7	1.2	1.8	2.8	4.3	8.0
2	8/ 8/79	.2	.3	.4	.4	.7	1.1	1.8	2.9	4.2	5.8
2	8/12/79	.2	.3	.4	.4	.6	.8	1.1	1.5	2.1	3.2
2	8/21/79	.2	.3	.4	.5	.6	.9	1.2	1.7	2.4	3.9
2	5/13/80	.1	.2	.2	.3	.5	.8	1.2	1.9	2.8	4.4
2	6/ 5/80	.1	.2	.3	.4	.5	.7	.9	1.3	1.8	2.9
2	8/ 4/80	.2	.3	.3	.4	.6	.8	1.1	1.7	2.6	4.4
2	8/ 5/80	.2	.2	.3	.4	.5	.8	1.1	1.6	2.5	4.5
3	6/27/79	.2	.3	.5	.7	1.2	2.2	3.0	4.4	6.1	9.3
3	7/14/79	.3	.6	.9	1.4	2.4	3.6	5.3	8.1	10.7	15.4
3	8/21/79	.2	.3	.4	.6	.9	1.6	2.5	4.0	5.9	9.5
3	9/25/79	.1	.3	.4	.6	1.1	2.2	4.2	8.0	10.9	16.0
3	5/ 6/80	.0	.1	.4	.7	1.4	2.8	4.5	7.1	10.0	15.3
4	6/20/79	.3	.5	.6	.8	1.3	2.0	2.7	3.8	5.5	8.6
4	6/26/79	.3	.5	.7	.9	1.4	2.2	3.0	4.3	6.1	9.1
4	7/18/79	.2	.4	.5	.7	1.3	2.3	3.1	4.3	5.6	7.8
4	9/26/79	.3	.5	.6	.8	1.3	2.1	2.7	3.8	4.8	6.5
5	6/20/79	.1	.1	.2	.2	.3	.5	.9	2.2	3.3	5.5
5	6/25/79	.1	.2	.3	.4	.6	.9	1.3	2.1	2.9	4.4
5	7/17/79	.2	.4	.5	.6	.9	1.7	2.4	3.5	4.6	6.4
5	8/17/79	.2	.3	.4	.6	.8	1.1	1.8	2.8	4.0	5.2
5	9/27/79	.3	.4	.4	.5	.8	1.1	1.7	2.6	3.8	5.4
6	6/14/79	.2	.2	.3	.4	.6	1.0	1.6	2.6	3.8	6.2
6	6/27/79	.3	.5	.6	.7	1.0	1.6	2.1	2.8	3.5	4.7
6	7/ 2/79	.2	.4	.5	.6	.9	1.4	2.1	2.9	3.8	5.6
6	7/17/79	.3	.4	.6	.8	1.2	2.0	2.7	3.6	4.9	7.6
6	8/15/79	.3	.4	.6	.8	1.3	2.4	3.8	5.7	8.0	11.2
6	9/27/79	.3	.4	.5	.7	1.0	1.5	2.0	2.9	4.0	6.3
7	7/28/79	.3	.5	.7	1.0	1.7	2.7	3.7	5.1	6.7	10.1
7	8/ 8/79	.4	.5	.7	.9	1.5	2.4	3.6	5.4	7.6	13.1
7	8/21/79	.2	.4	.5	.7	1.2	2.1	3.7	6.6	9.6	14.4
7	5/22/80	.2	.4	.4	.5	.7	1.0	1.4	1.9	2.8	4.5
7	6/12/80	.3	.4	.5	.6	.8	1.4	2.3	4.0	6.5	4.8
7	6/22/80	.3	.4	.5	.7	1.1	2.1	3.5	5.5	8.1	11.4
7	6/26/80	.2	.4	.5	.7	1.7	4.0	6.2	10.7	17.5	
7	6/29/80	.3	.4	.5	.7	.9	1.5	2.3	3.6	4.9	7.1
7	7/26/80	.3	.4	.5	.6	.9	1.4	2.1	3.4	4.7	6.7
8	6/28/79	.2	.4	.5	.6	.7	.9	1.1	1.5	1.9	2.7
8	8/10/79	.2	.4	.5	.6	.9	1.3	1.9	2.9	4.1	5.8
9	7/15/79	.3	.4	.5	.6	.7	.9	1.1	1.6	2.2	3.2
9	7/20/79	.3	.4	.5	.8	1.3	2.4	3.4	5.3	8.0	11.4
9	8/ 8/79	.3	.4	.6	.7	1.1	1.9	2.8	4.3	5.4	7.4
10	7/18/79	.4	.7	1.1	1.7	3.1	5.0	6.8	8.4	9.2	10.3
10	8/15/79	.3	.5	.6	.9	1.4	2.2	3.2	4.8	6.8	13.3
10	5/ 1/80	.2	.3	.4	.5	.8	1.2	1.9	3.0	4.4	7.3
10	6/ 4/80	.1	.2	.3	.4	.7	1.4	2.3	3.4	4.7	6.8
10	6/11/80	.2	.4	.5	.6	.8	1.2	1.7	2.4	3.5	5.0
10	6/21/80	.2	.3	.4	.5	.8	1.1	1.5	2.2	3.2	5.1
10	6/23/80	.2	.4	.5	.7	1.0	1.8	2.7	4.3	5.8	8.3
10	6/24/80	.2	.4	.5	.6	1.0	1.9	2.8	4.3	5.8	8.3
10	6/25/80	.3	.4	.5	.8	1.4	2.7	4.2	6.0	8.3	11.6
10	6/28/80	.2	.4	.5	.7	1.0	1.8	2.8	4.5	6.3	9.2
11	7/17/79	.2	.3	.4	.5	.6	.8	1.1	1.8	3.1	5.9
11	8/15/79	.3	.4	.5	.7	.9	1.5	2.1	3.1	4.3	5.9
12	8/16/79	.2	.3	.4	.5	.7	1.0	1.4	2.2	3.0	4.5
12	8/27/79	.2	.3	.4	.4	.5	.8	1.3	2.2	3.0	4.6
12	4/29/80	.2	.3	.4	.5	.7	1.0	1.5	2.2	3.1	4.4
12	4/30/80	.2	.3	.4	.4	.6	.8	1.0	1.6	2.2	3.6

Table 8.-- *Statistical data, grain-size distribution of bed-material* -- Continued

SITE NUMBER IN FIGURE 1	DATE	PARTICLE-SIZE (MILLIMETERS) AT GIVEN PERCENTAGE FINER; PERCENTAGE FINER PARAMETER									
		5	16	25	35	50	65	75	84	90	95
12	5/15/80	0.2	0.4	0.4	0.5	0.7	1.0	1.4	2.2	3.3	5.3
12	5/21/80	.2	.3	.4	.5	.6	.9	1.2	1.8	2.5	3.9
12	6/ 3/80	.2	.4	.5	.6	.8	1.3	1.8	2.8	4.0	6.2
12	6/10/80	.2	.3	.4	.5	.6	.9	1.3	2.0	3.2	5.2
12	6/20/80	.2	.3	.4	.5	.7	1.1	1.6	2.3	3.1	4.5
12	6/24/80	.2	.3	.4	.4	.6	.8	1.1	1.7	2.4	3.7
12	6/27/80	.2	.3	.4	.5	.6	.9	1.2	1.8	2.5	3.9
13	8/18/79	.3	.4	.4	.5	.7	1.0	1.5	2.2	3.0	4.4
15	8/17/79	.3	.4	.4	.5	.7	1.0	1.3	2.0	2.7	4.1
15	8/18/79	.2	.3	.4	.4	.5	.7	1.0	1.5	2.2	4.0
18	8/20/79	.2	.3	.3	.4	.5	.6	.8	1.2	1.8	3.0
19	8/19/79	.1	.2	.3	.4	.5	.7	1.1	1.8	2.5	3.7
20	8/19/79	.2	.2	.3	.3	.4	.5	.6	.8	1.1	1.8
21	8/19/79	.0	.2	.3	.3	.4	.5	.8	1.1	1.8	2.6

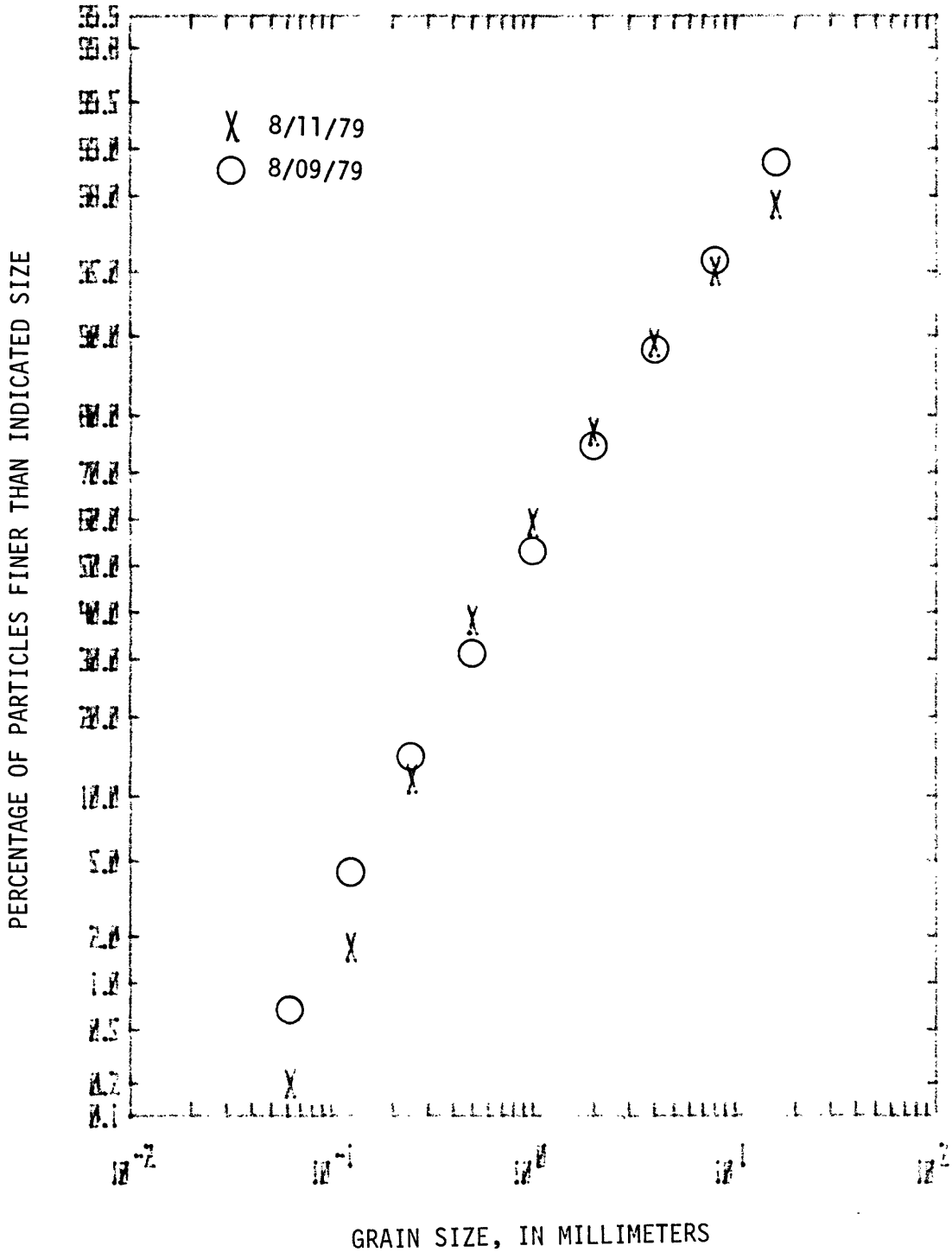

Figure 10.--Bed-material size distribution for station 06691000, North Platte River near Sutherland, Nebraska.

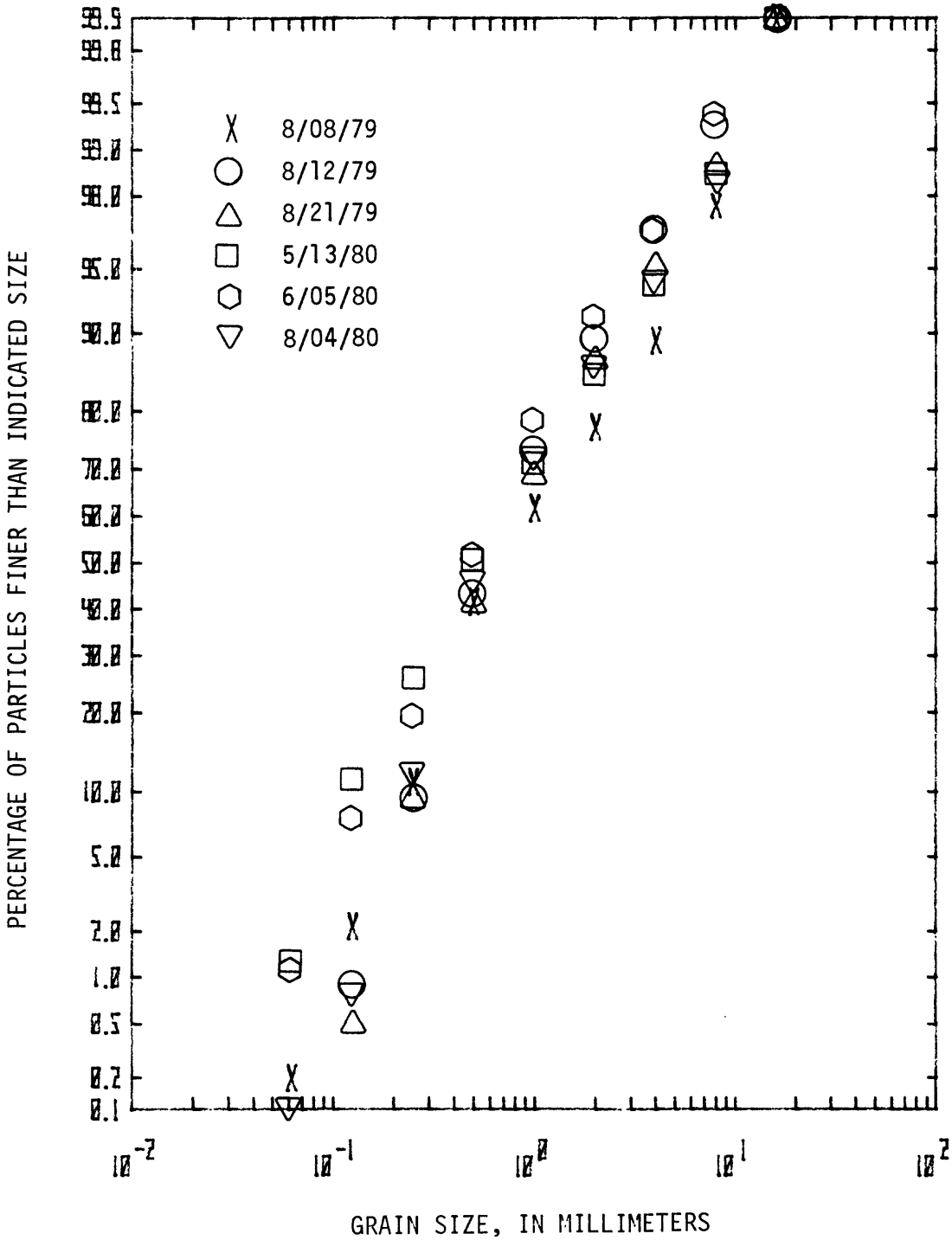

Figure 11.--Bed-material size distribution of station 06693000, North Platte River at North Platte, Nebraska.

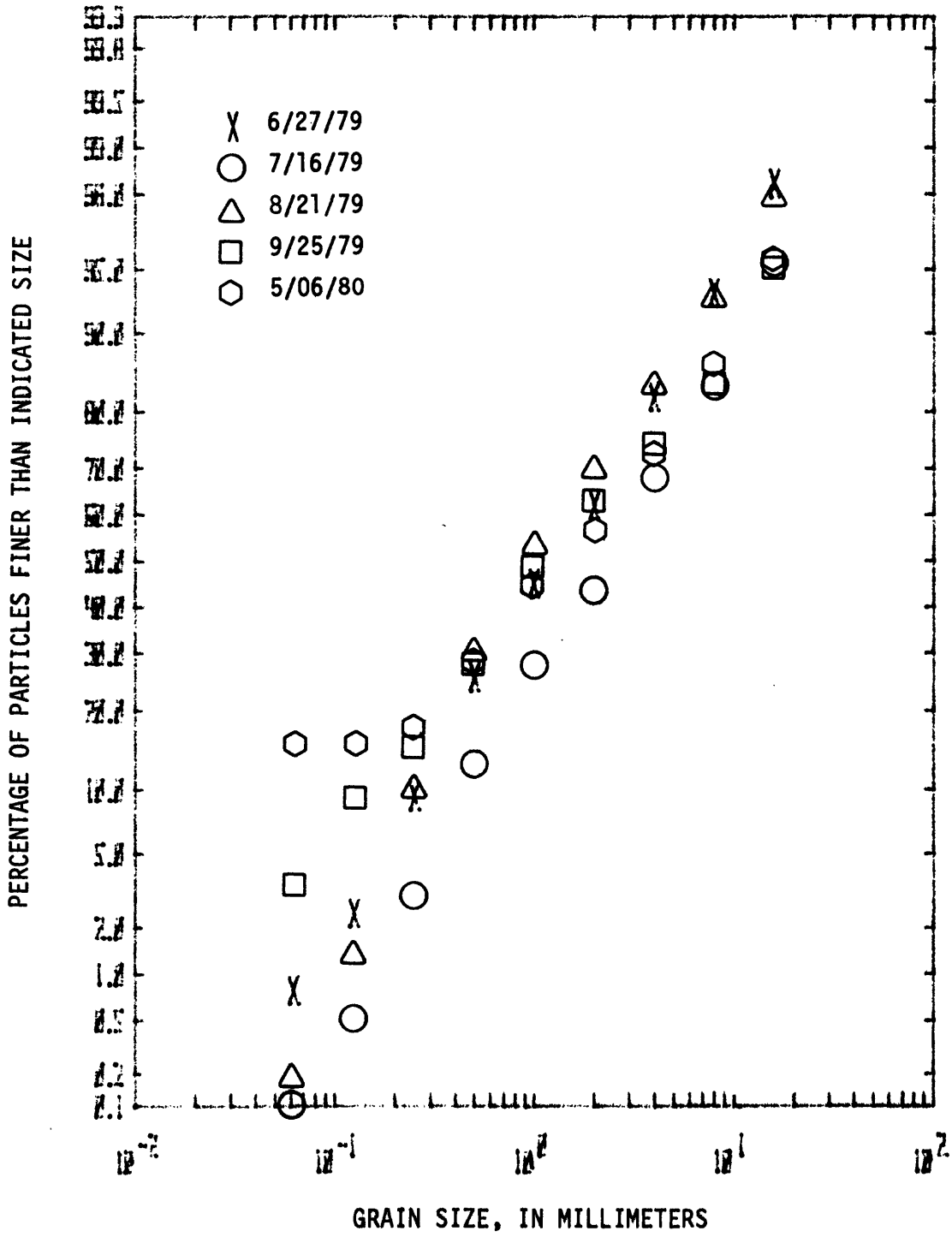

Figure 12.--Bed-material size distribution for station 06754000, South Platte River near Kersey, Colorado.

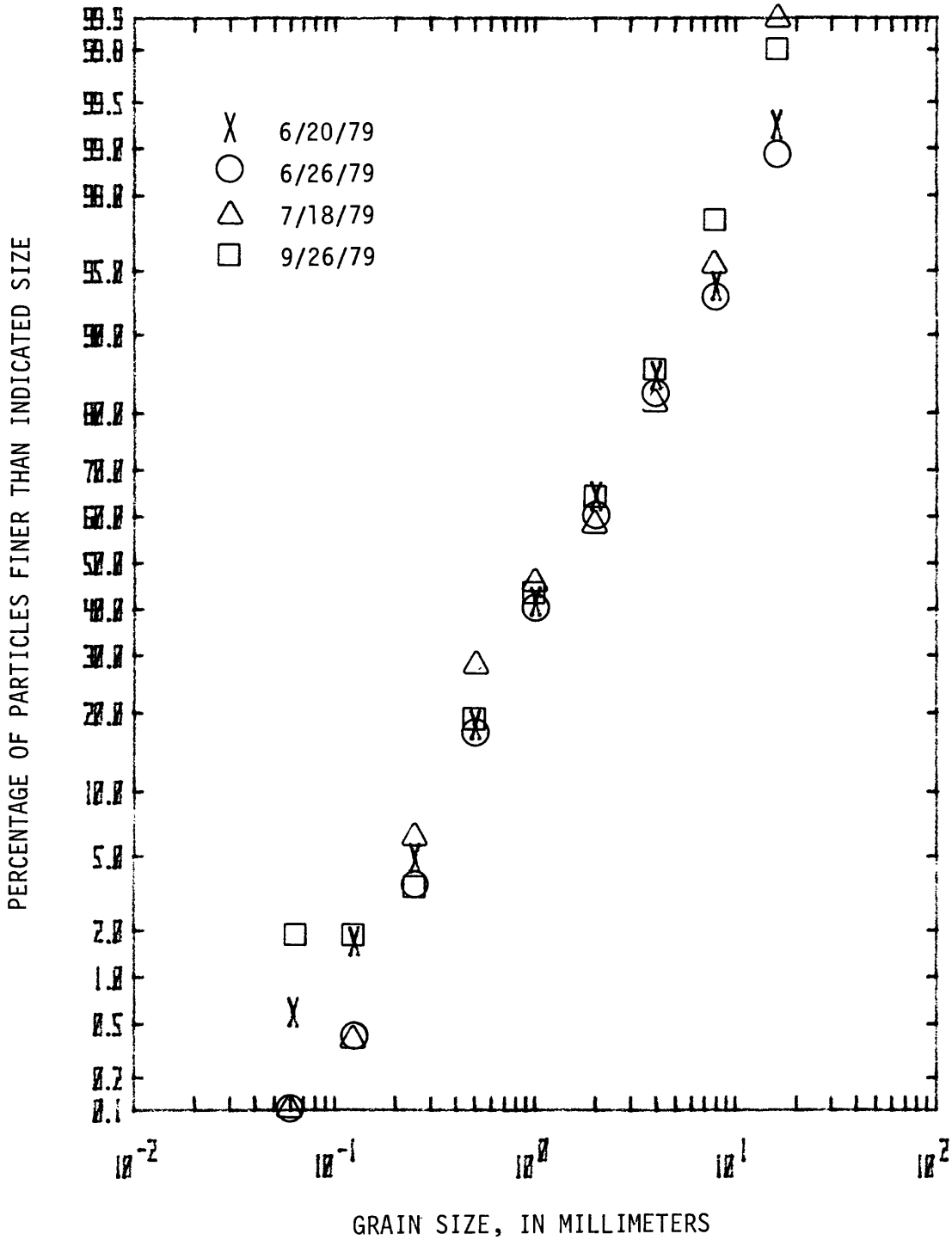

Figure 13.--Bed-material size distribution for station 06758500, South Platte River near Weldona, Colorado.

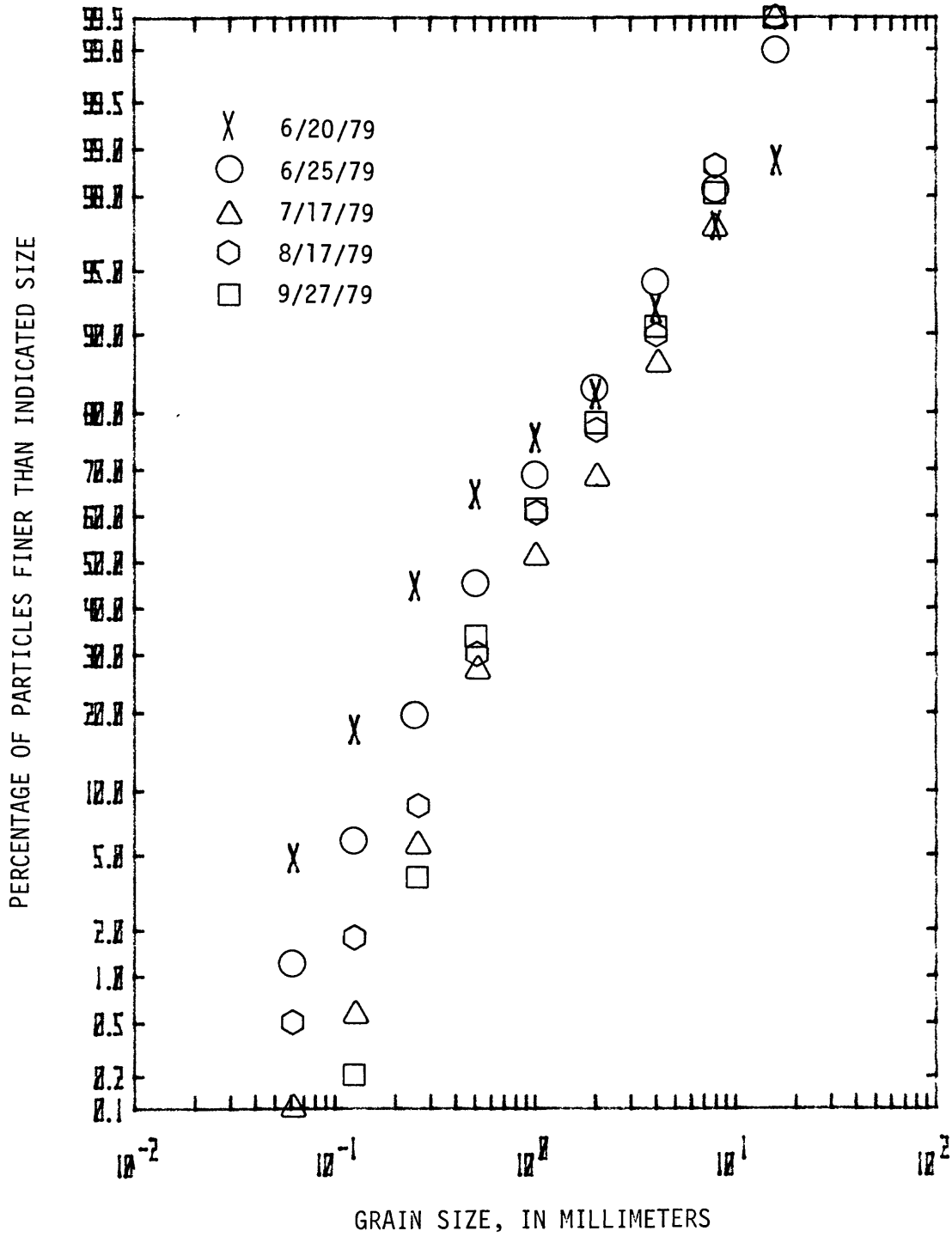

Figure 14.--Bed-material size distribution for station 06760000, South Platte River at Balzac, Colorado.

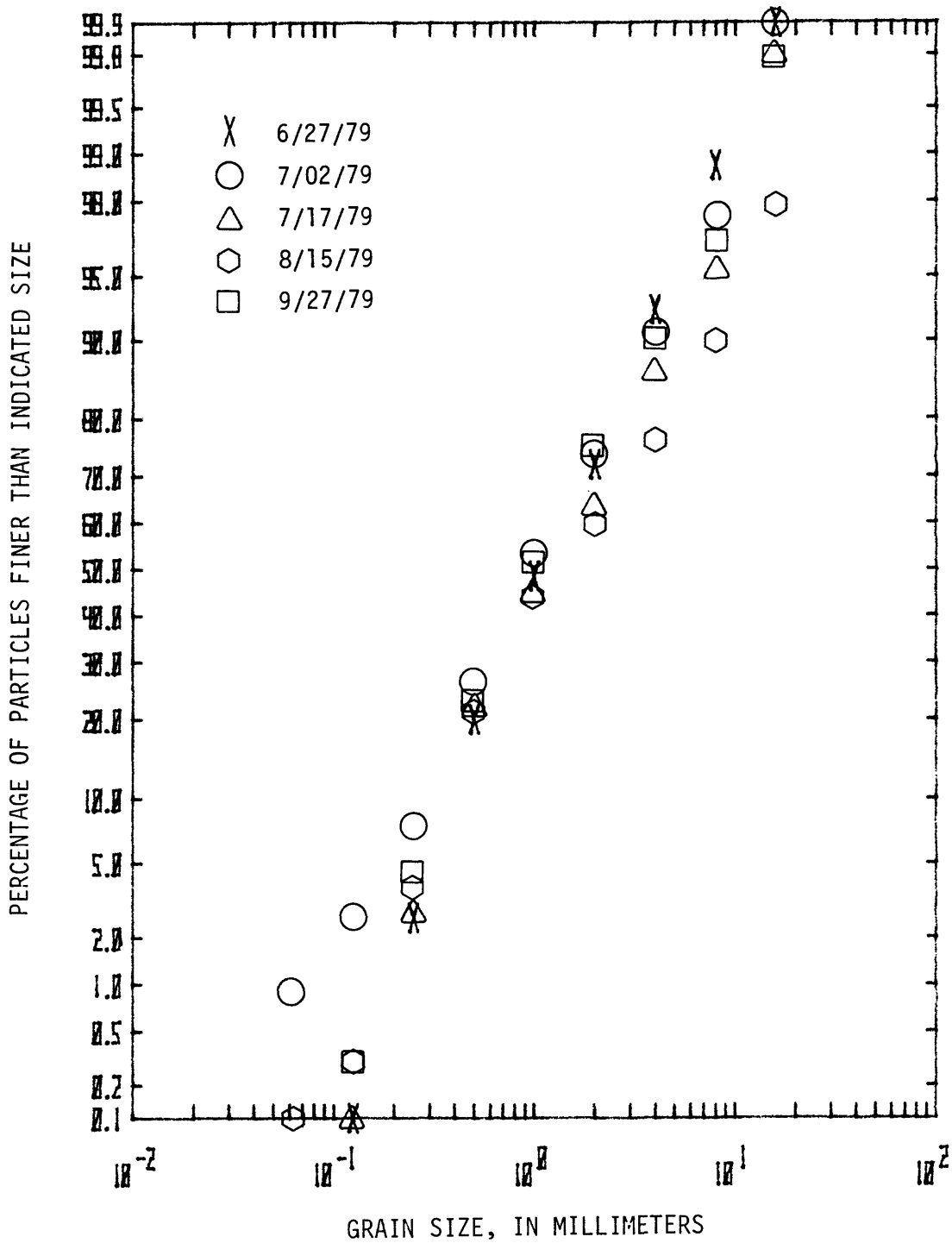

Figure 15.--Bed-material size distribution for station 06764000, South Platte River at Julesburg, Colorado.

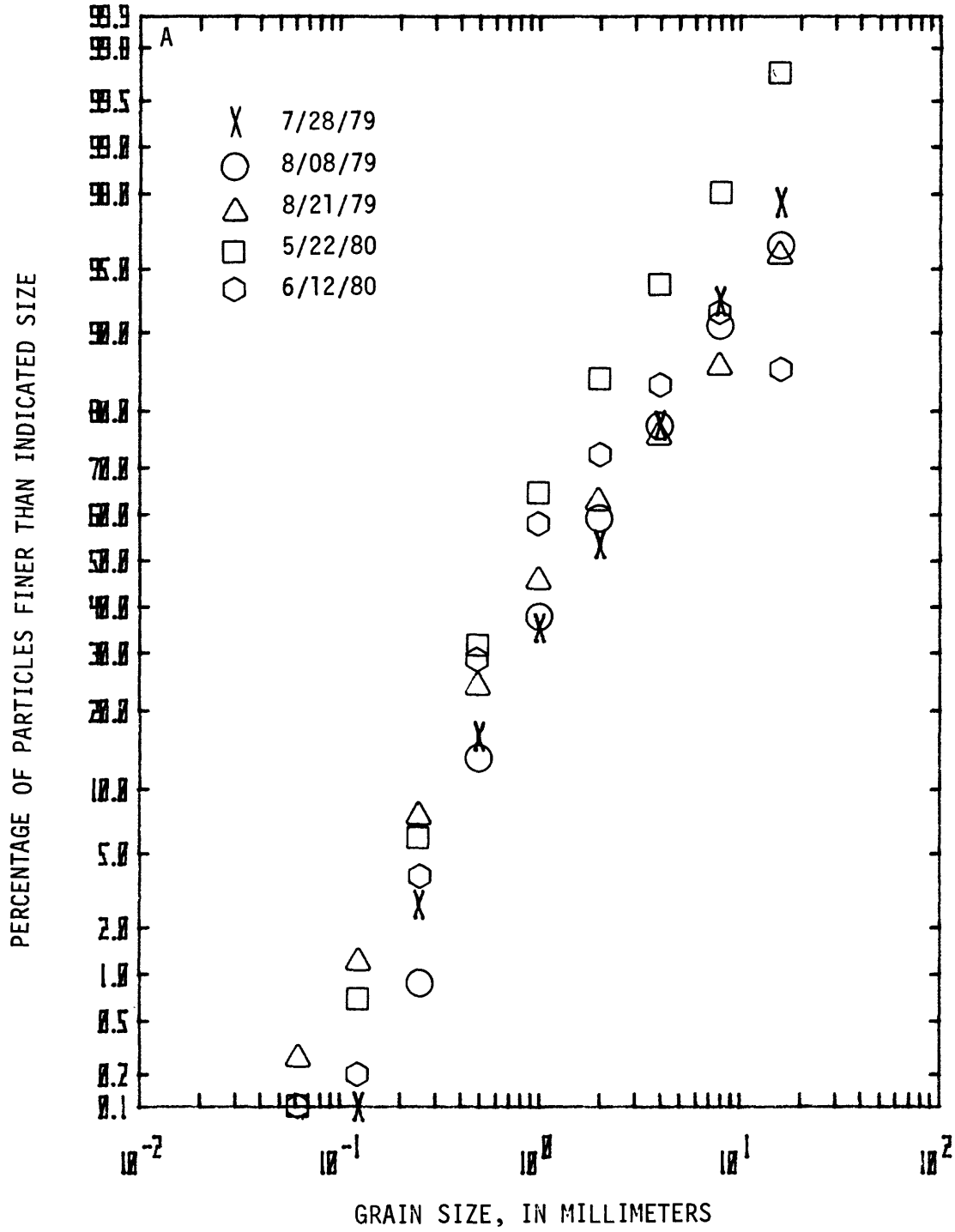

Figure 16.-- Bed-material size distribution for station 06765500, South Platte River at North Platte, Nebraska: A. July 28, 1979 to June 12, 1980.

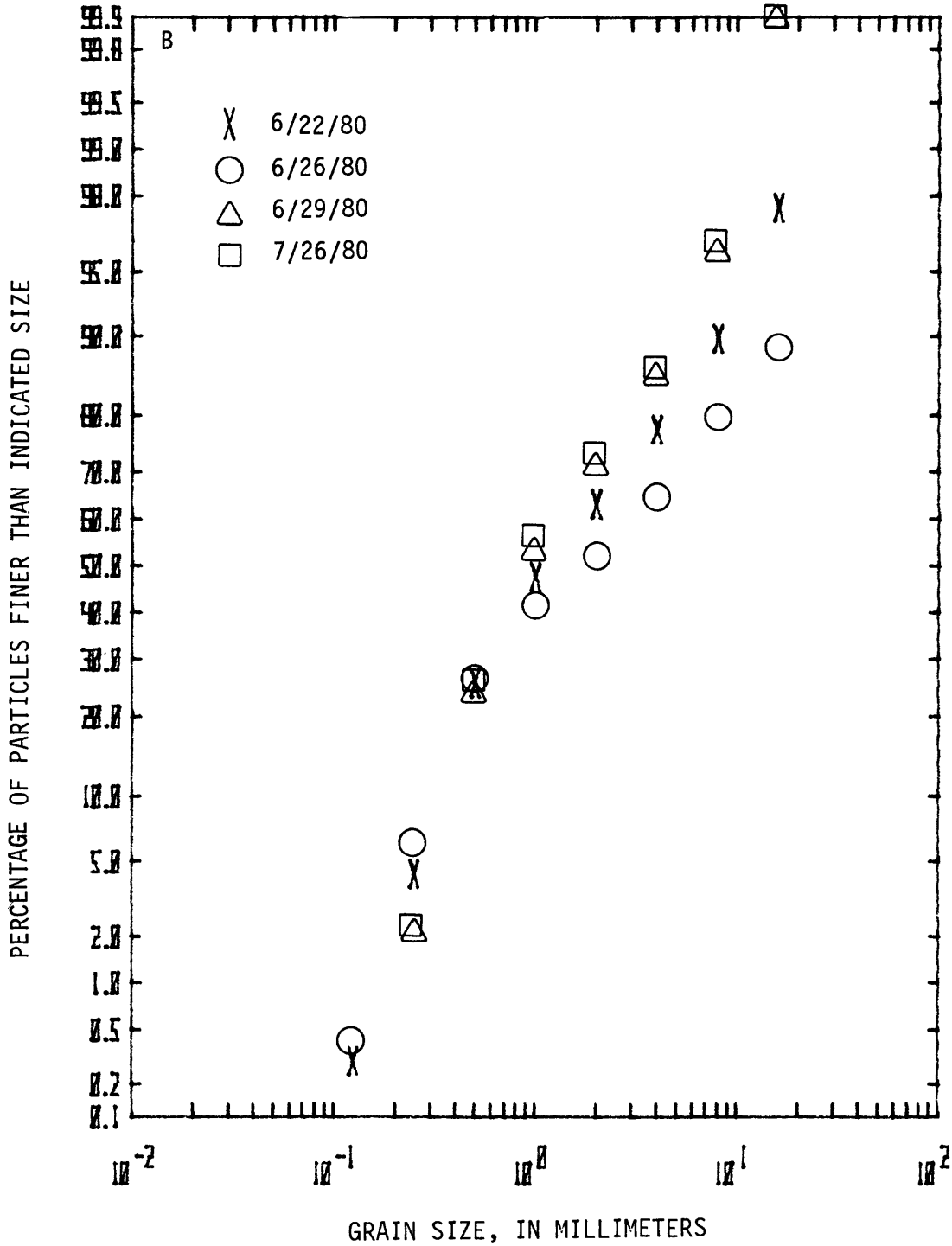

Figure 16.-- Bed-material size distribution for station 06765500, South Platte River at North Platte, Nebraska -- Continued: B. June 22, 1980 to July 26, 1980.

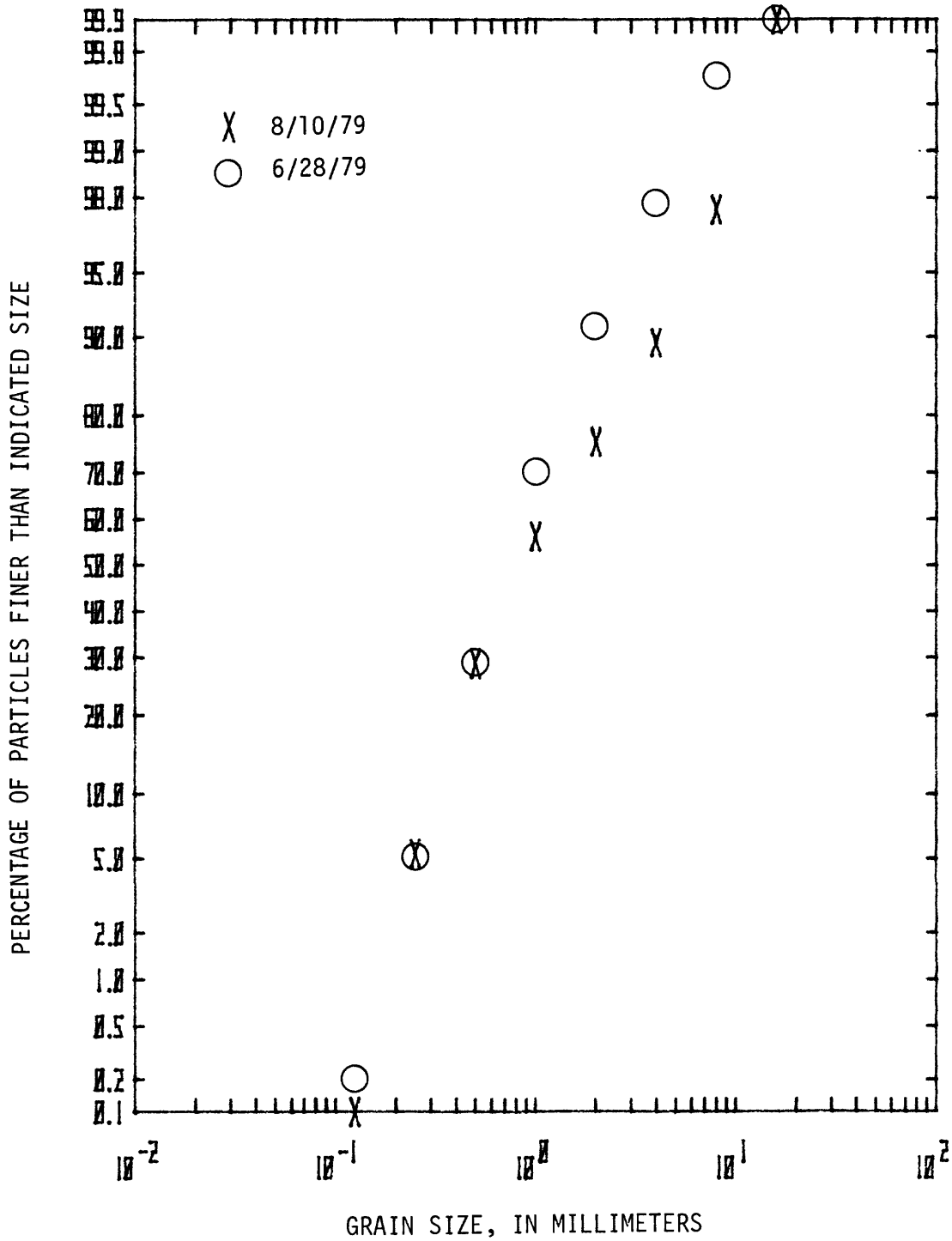

Figure 17.--Bed-material size distribution for station 06766000. Platte River at Brady, Nebraska.

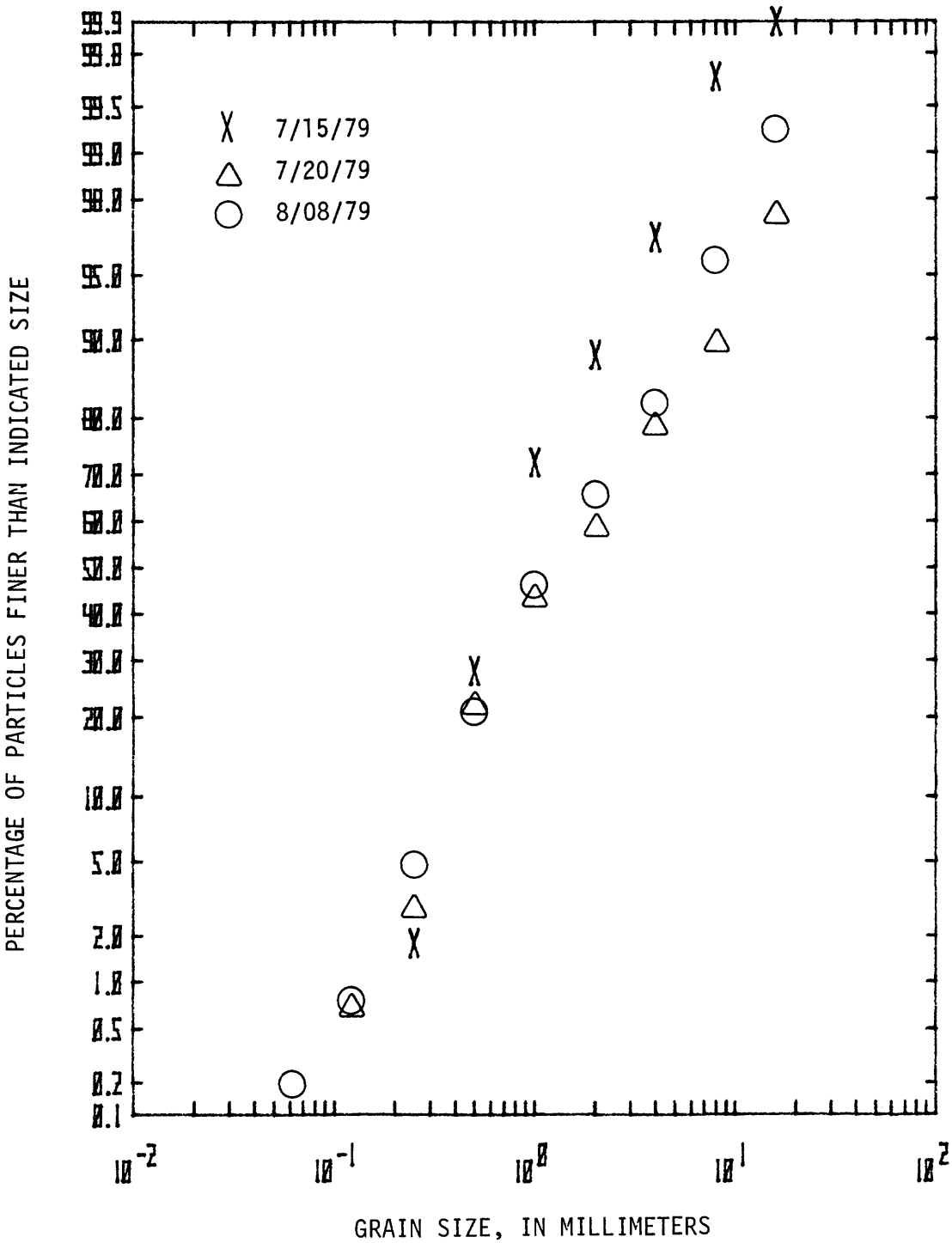

Figure 18.--Bed-material size distribution for station 06766500, Platte River near Cozad, Nebraska.

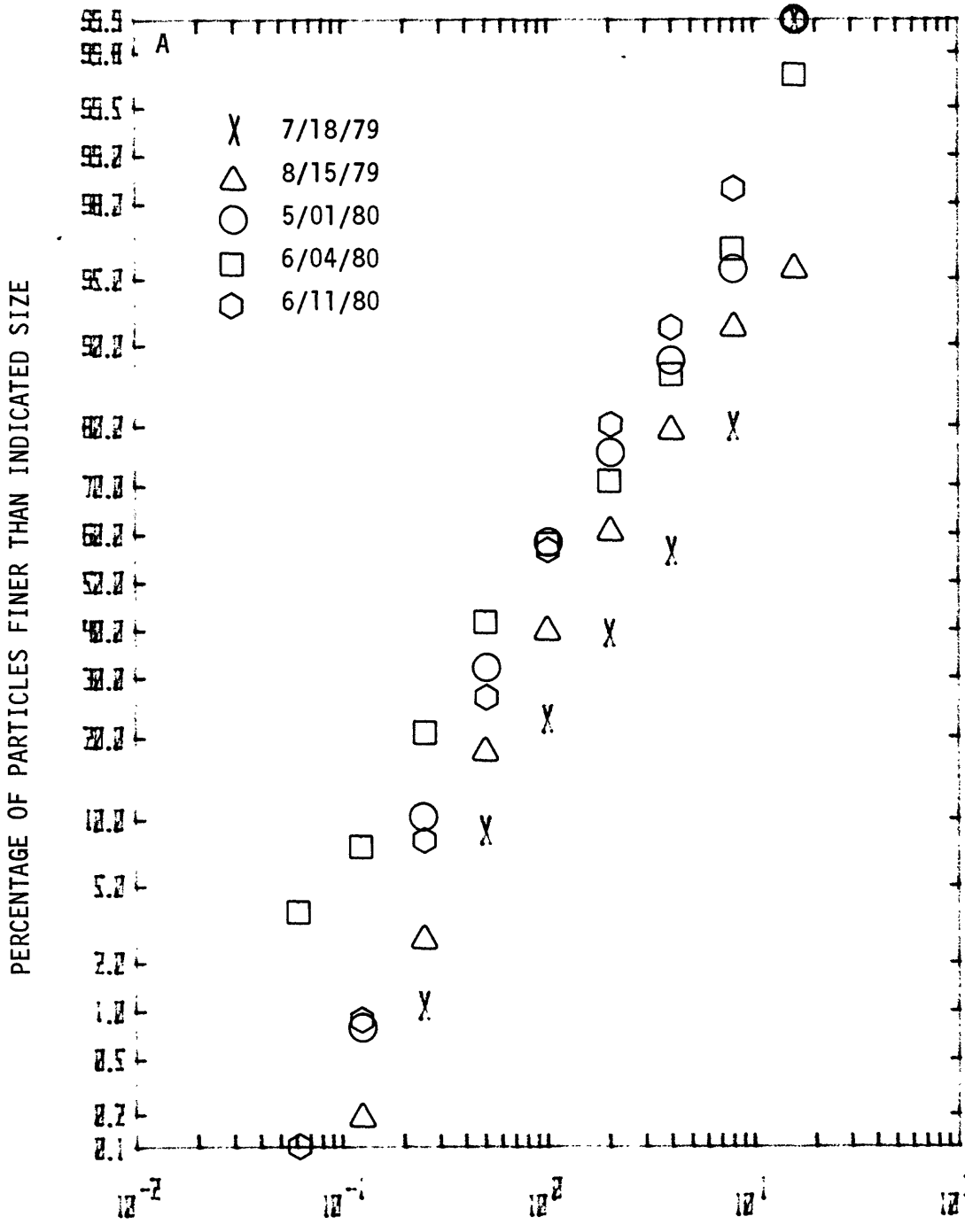

Figure 19.-- Bed-material size distribution for station 06768000, Platte River near Overton, Nebraska: A. July 18, 1979 to June 11, 1980.

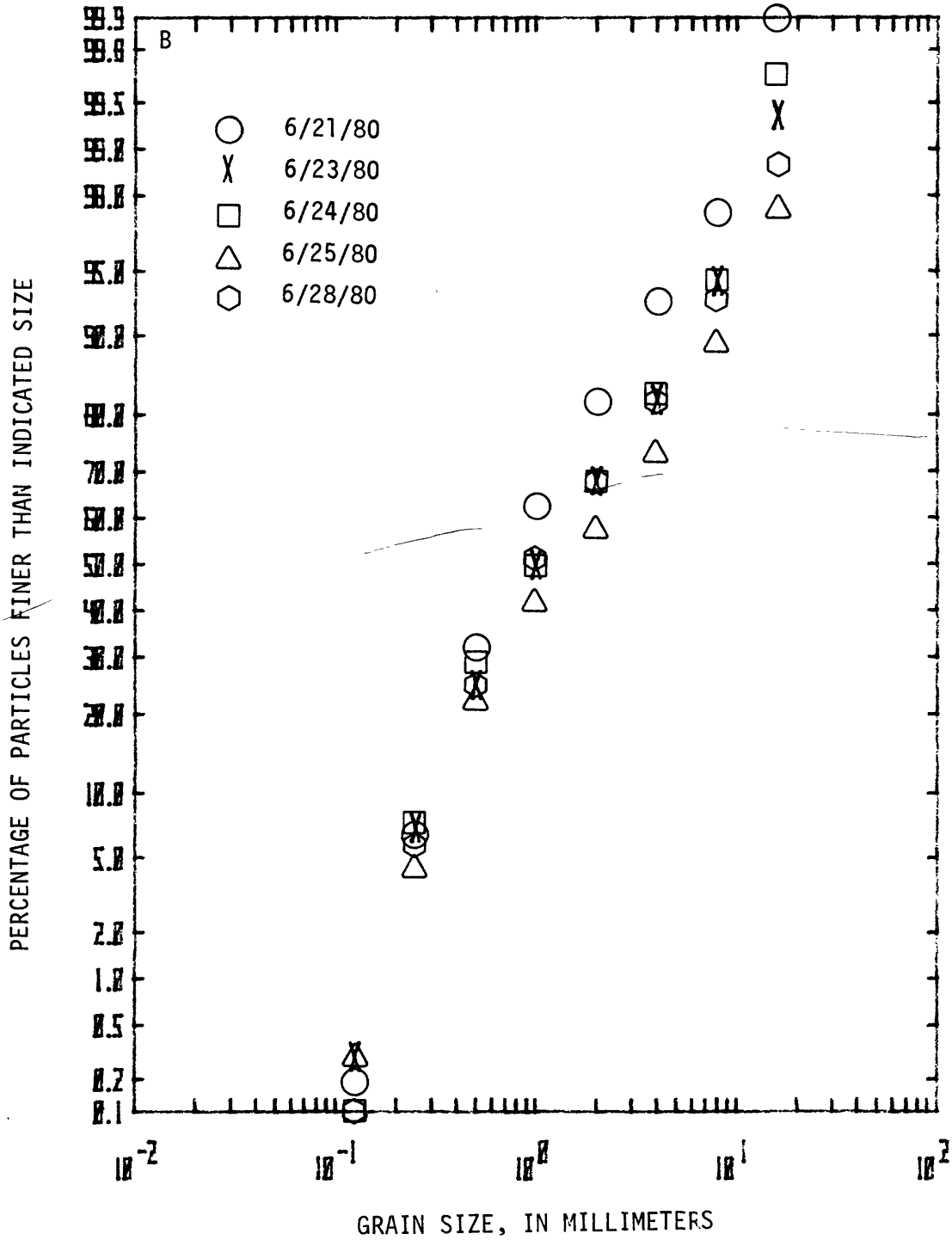

Figure 19.-- Bed-material size distribution for station 06768000, Platte River near Overton, Nebraska -- Continued: B. June 21, 1980 to June 28,1980.

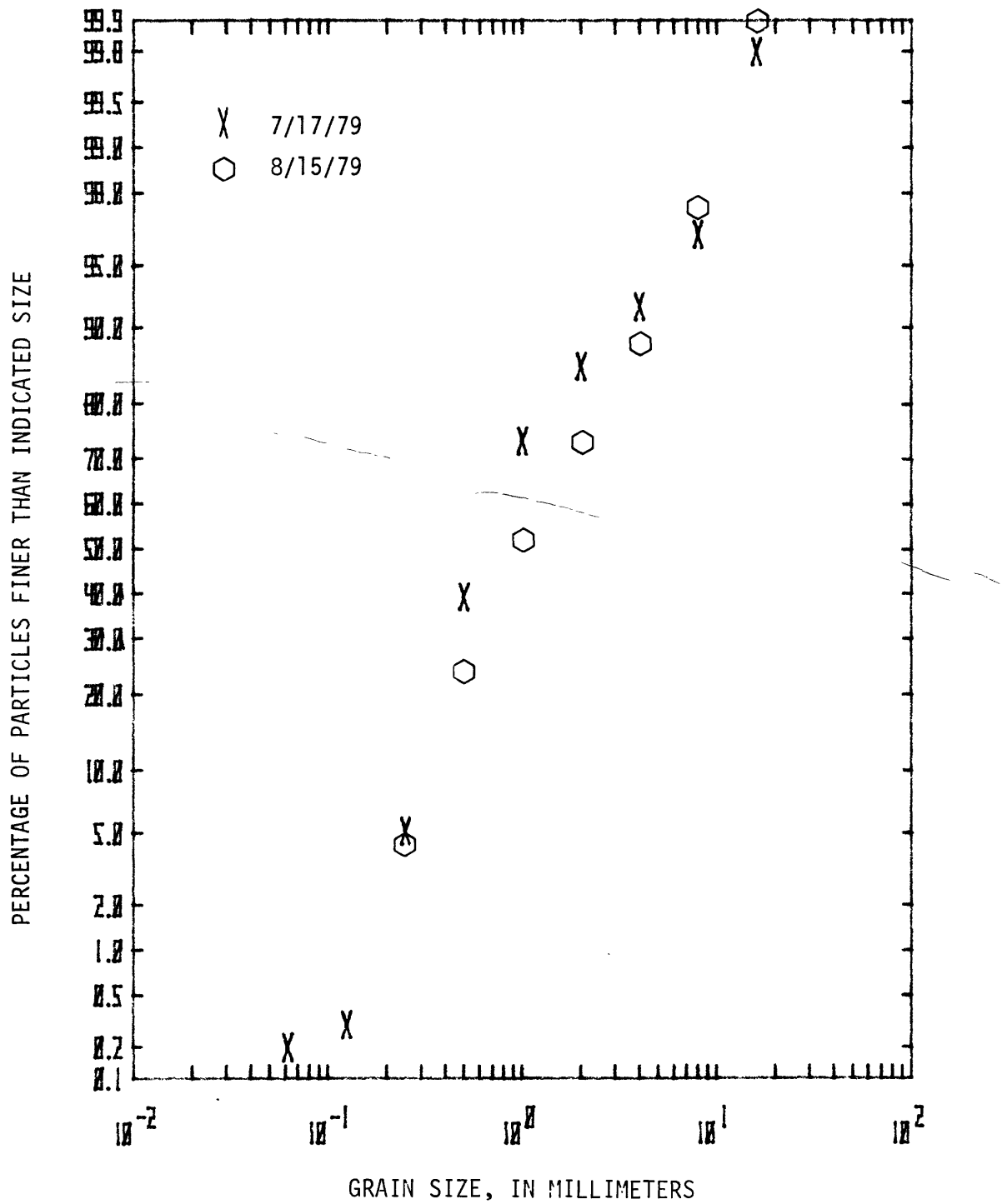

Figure 20.--Bed-material size distribution for station 06770000, Platte River near Odessa, Nebraska.

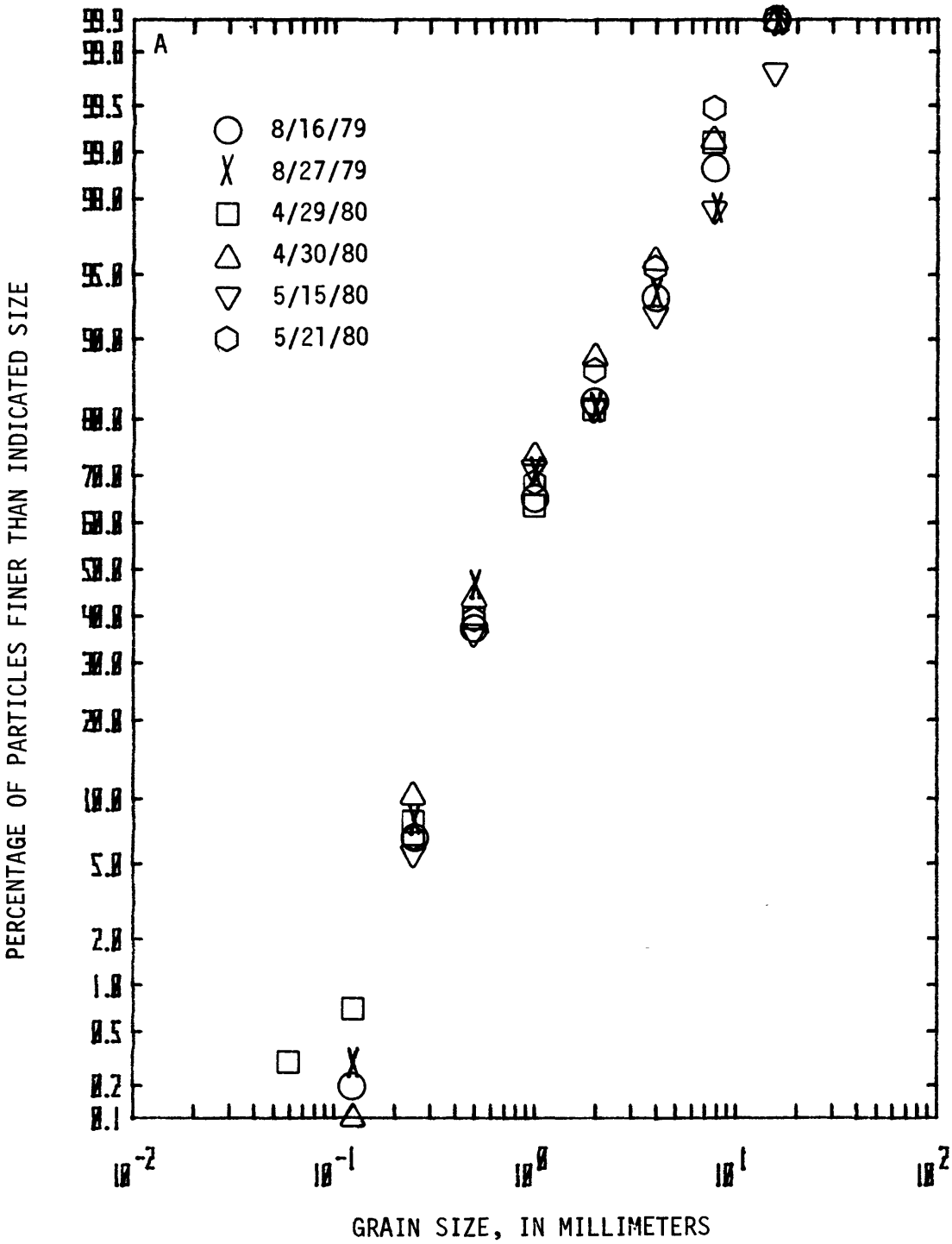

Figure 21.-- Bed-material size distribution for station 06770500, Platte River near Grand Island, Nebraska: A. August 16,1979 to May 21, 1980.

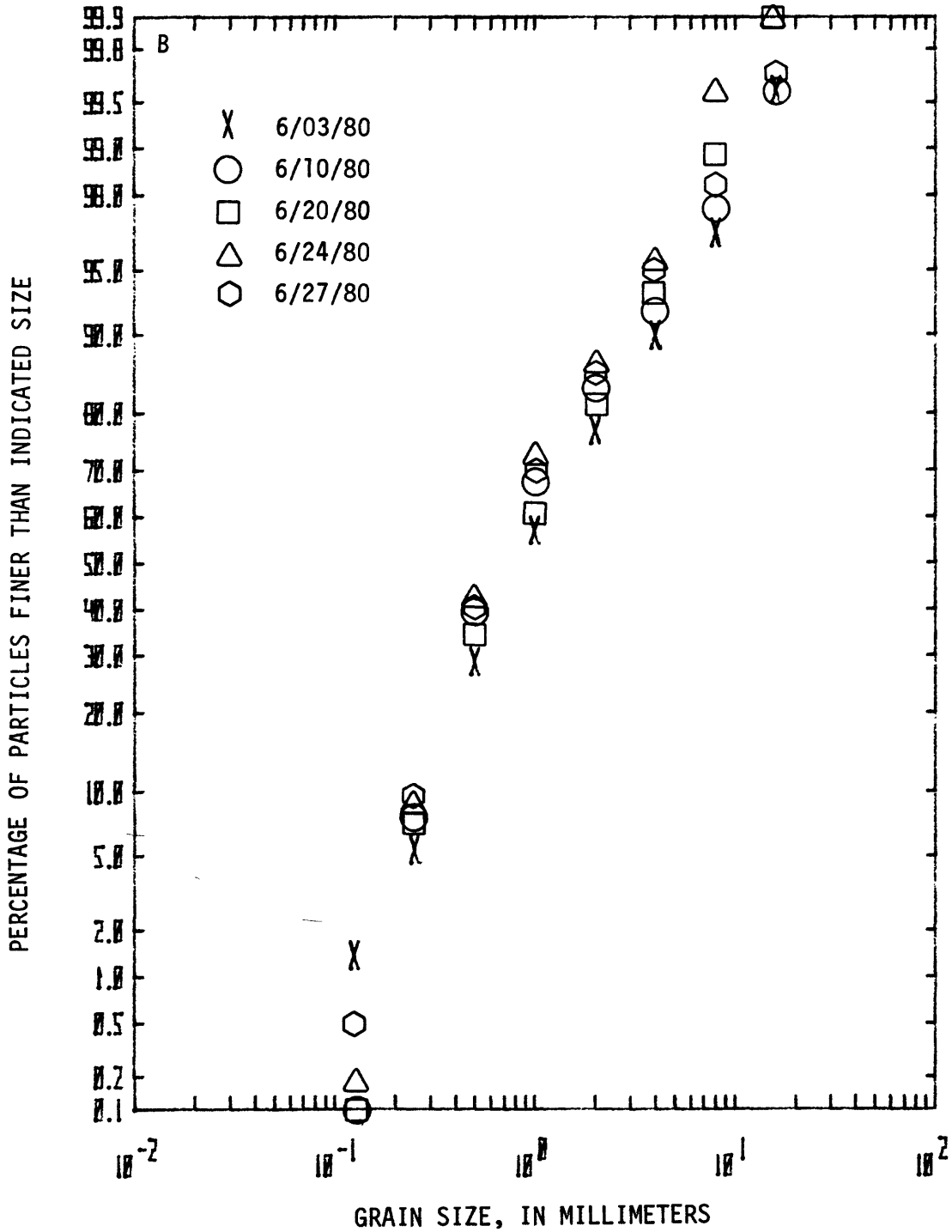

Figure 21.-- Bed-material size distribution for station 06770500; Platte River near Grand Island, Nebraska.-- Continued: B. June 3, 1980 to June 27, 1980.

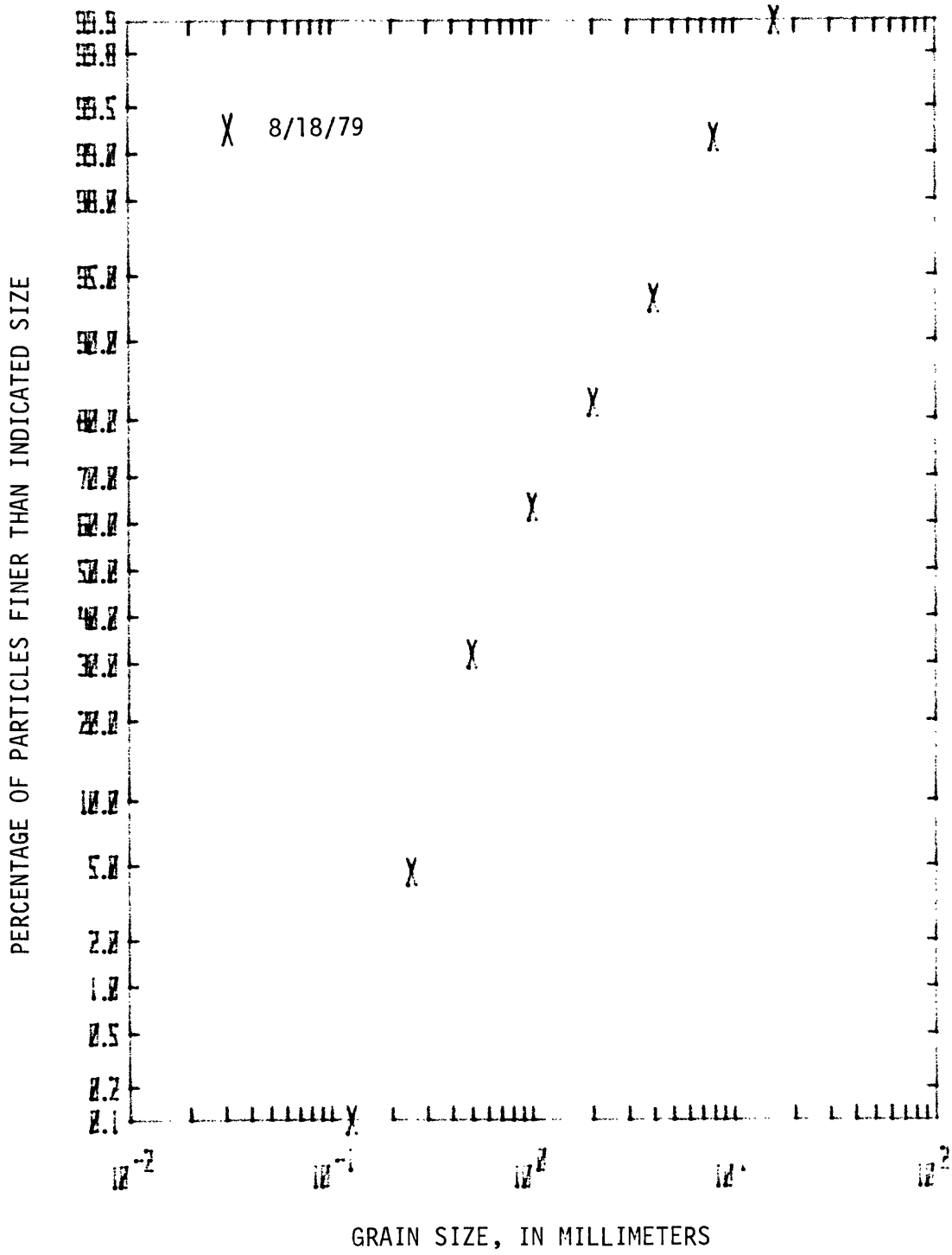

Figure 22.--Bed-material size distribution for station 06772600, Platte River near Central City, Nebraska.

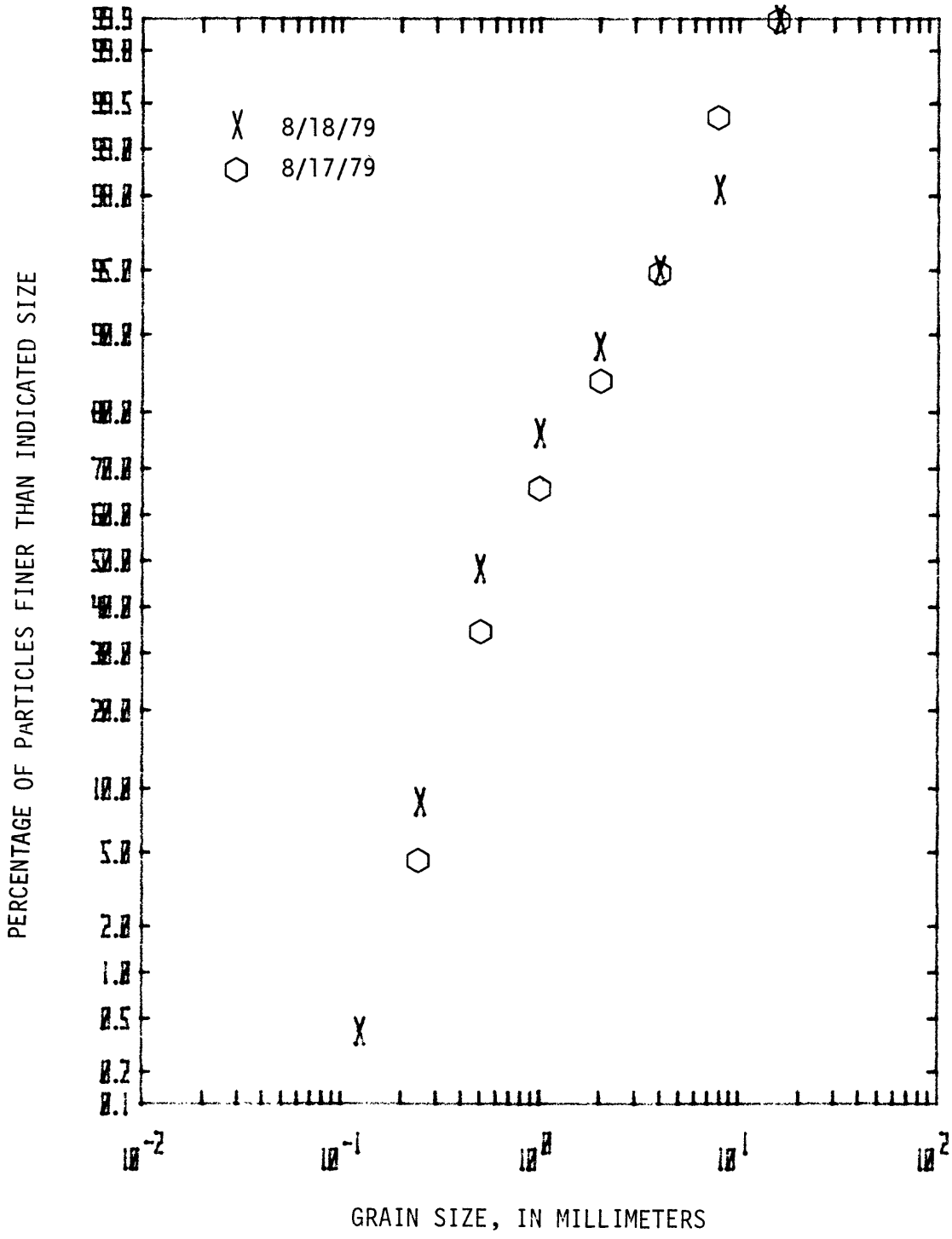

Figure 23.--Bed-material size distribution for station 06774000, Platte River near Duncan, Nebraska.

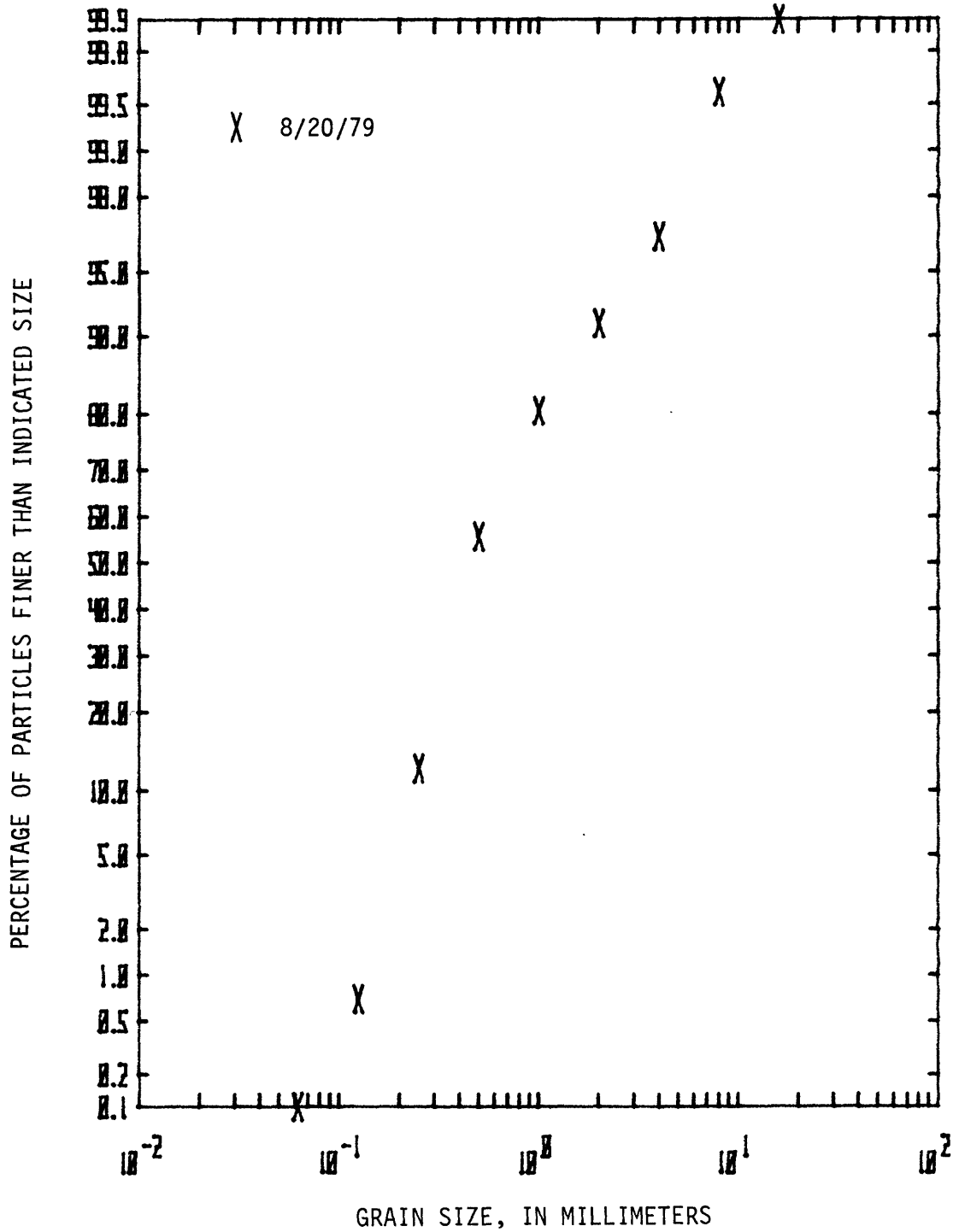

Figure 24.--Bed-material size distribution for station 06796000, Platte River near North Bend, Nebraska.

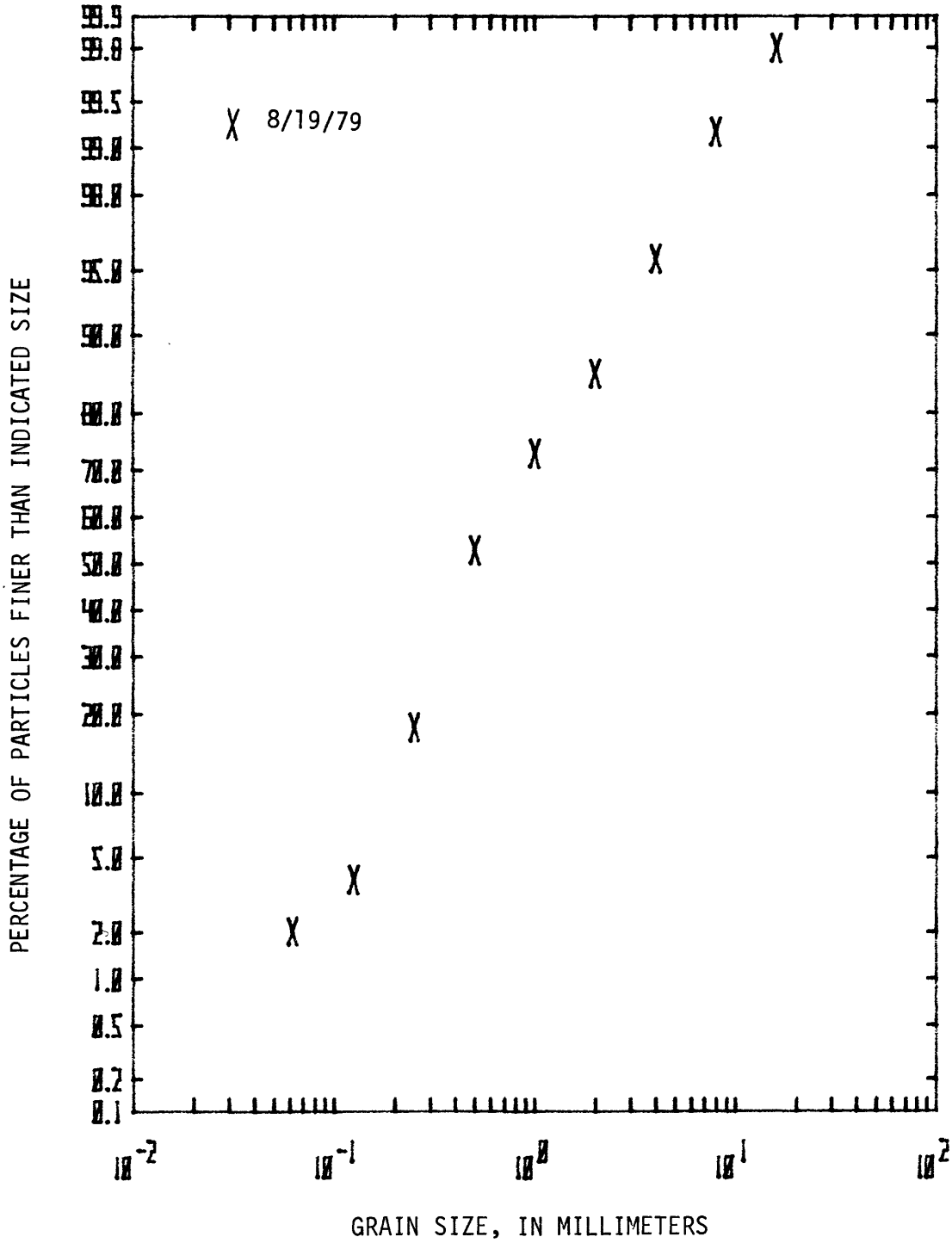

Figure 25.--Bed-material size distribution for station 06796500, Platte River near Fremont, Nebraska.

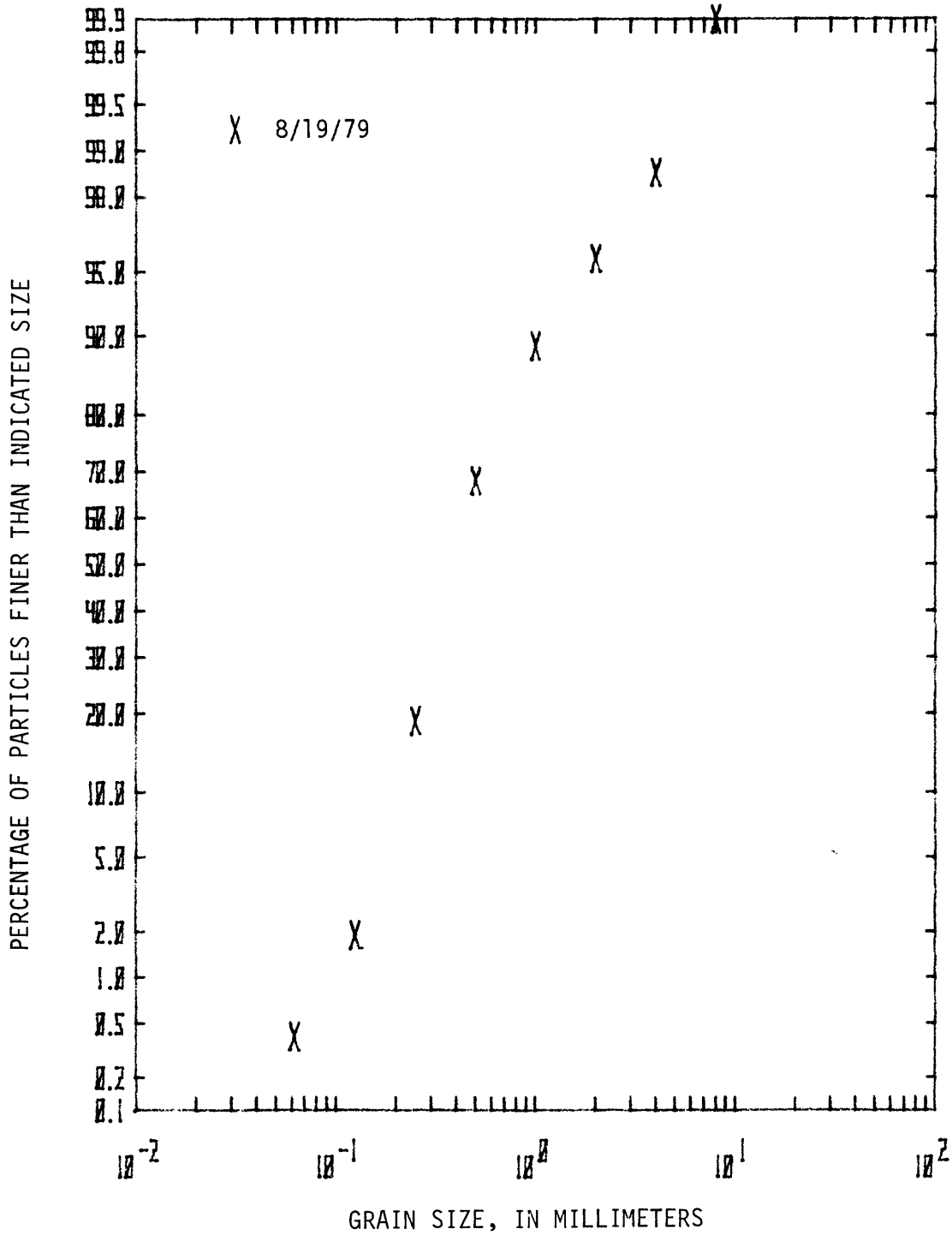

Figure 26.--Bed-material size distribution for station 06796550, Platte River near Venice, Nebraska.

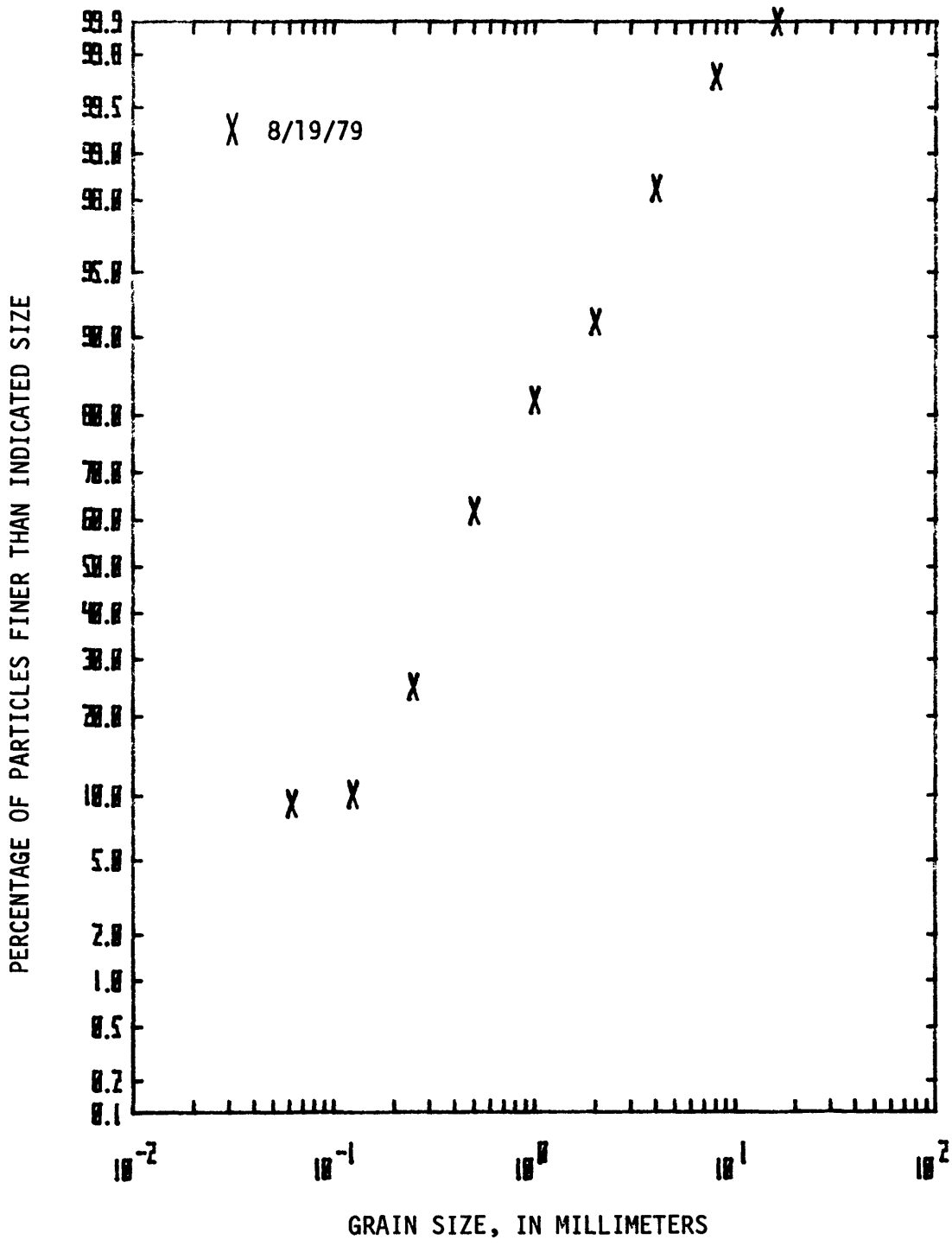

Figure 27.--Bed-material size distribution for station 06805500, Platte River near Louisville, Nebraska.

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