Dissolved Organic Carbon

Introduction

Dissolved organic carbon (DOC) was defined in this study as the carbon component of organic material <0.45 um in size. DOC enters riverine ecosystems throughout their length from upstream, OM degradation, groundwater, producer/consumer exudates and excretions (Cummins, 1979). DOC is utilized solely by bacteria as a direct food source since there is no functional macroinvertebrate group capable of feeding directly on DOC (Cummins, 1979).

Baseline:

During both the1984 and 1985 sampling periods (Figure 63) there is a consistent diluting of mainstem DOC downstream of the confluence of the Watonwan and Blue Earth Rivers (S2). The Le Sueur River (S7) tended to have greater concentrations than at S6, but did not appear to impact mainstem concentrations a great distance downstream. This is evident because DOC mean concentrations at S8 were lower than or the same as at S6. Concentration means during the early and late sampling periods of 1984 and 1985, show very little variation for their respective years. One can therefore conclude that similar to VPOM, DOC is not correlated with flow since both years were very different in regard to flow, similar to VPOM. Several studies have reported weak positive correlations between DOC and flow (Lewis and Tyburczy, 1974; Fisher and Likens, 1973; Larson, 1978), while others have found weak negative correlations (Fisher, 1977). When looking at sampling date concentrations, there does not appear to be any significant changes in DOC throughout the sampling periods of both 1984 and 1985.

DOC does not contribute as large a proportion to total OM in transport as does VPOM, however it is greater in proportion that CPOM and FPOM. The percentage of total OM in the DOC size classification was 28.6%, 67.5%, and 33.7% in 1984, and 23.0%, 19.9%, and 29.3% in 1985 during the entire, early and late sampling periods respectively (Table VII). DOC was slightly greater as a percentage of total OM during the late sampling periods of 1984 and 1985. This may have been caused by the greater rates of productivity and metabolism expected to occur during the late summer period.

The reservoir did not appear to impact downstream DOC concentrations.

Peaks:

DOC concentrations during the peak-events reached maximum baseline concentrations at certain downstream sties. The 8-9 event did not appear to have a greater impact on downstream , when compared to the latter two events, as was evident with the other size classifications of OM (Figure 64).

Contrary to what has been observed with a majority of the parameters analyzed, DOC concentrations did not appear to be greater at S6 and S8 than S5 concentrations during the 8-26 and 8-30 events (Figures 65, 66). Site S3 possessed lower concentrations than S5 during the 8-9 event, but had greater concentrations during the latter two events. Site S6 possessed lower concentrations than S5 during the 8-26 peak-event, and possessed a lower peak concentration (5.8 mg/l) than did S5 (8.0 mg/l) during the 8-30 event. However, site S8 did demonstrate the usual pattern, as with most parameters, of a greater peak concentration than at sites S5 and S6 during the 8-30 peak event. Although the peak concentration at S8 was only 0.6 mg/l greater than the peak concentration at S5, S8 possessed a 59% increase from the pre-sample while S5 possessed a 16% increase from its pre-sample reading to its peak concentration.

The peaking operation of the dam appeared to resemble a natural hydrologic event of one to two inches in rainfall, but cannot be concluded to resemble early season high water conditions due to the lack of consistent increases to maximum baseline concentrations.

During the 8-9 event, DOC concentrations at S5 peaked as the ascending leg gave way to the peak plateau, but also peaked for a second time at 100 minutes into the peak-event. This second peak in concentration also appears with the parameter Filterable Phosphorus during the same peak-event, at the same 100-minute sample time. The two parameters were linked to one another in some way during this particular event. The two parameters had one characteristic in common in that they were both in the dissolved state, and therefore could not have been directly associated with suspended detritus or seston. This association was not observed during the latter two peak-events. An explanation of the significance of the association between these two parameters during the particular event, other than what has been stated, cannot be given at this time.

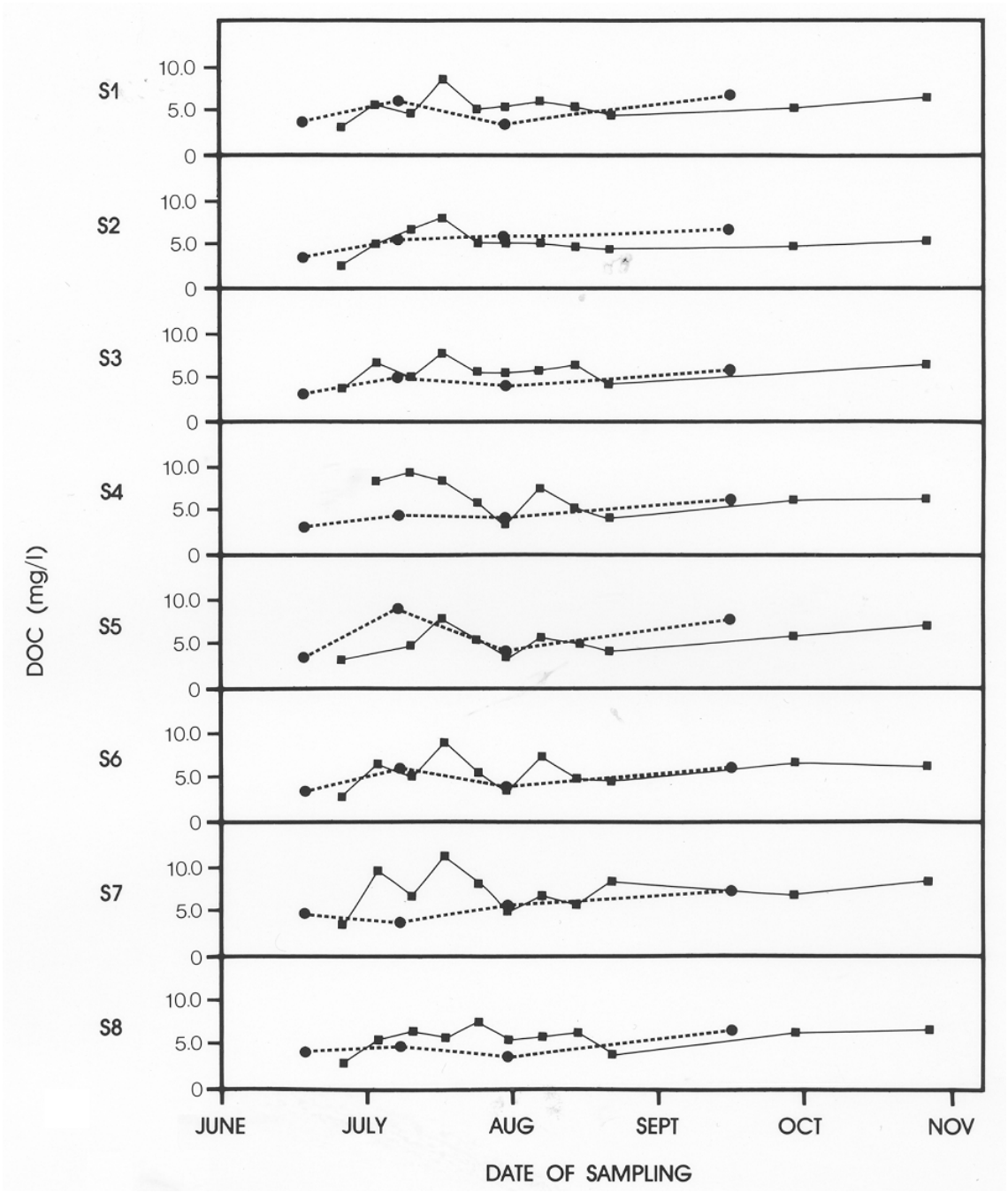

Figure 63. Baseline Dissolve Organic Carbon for 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8.

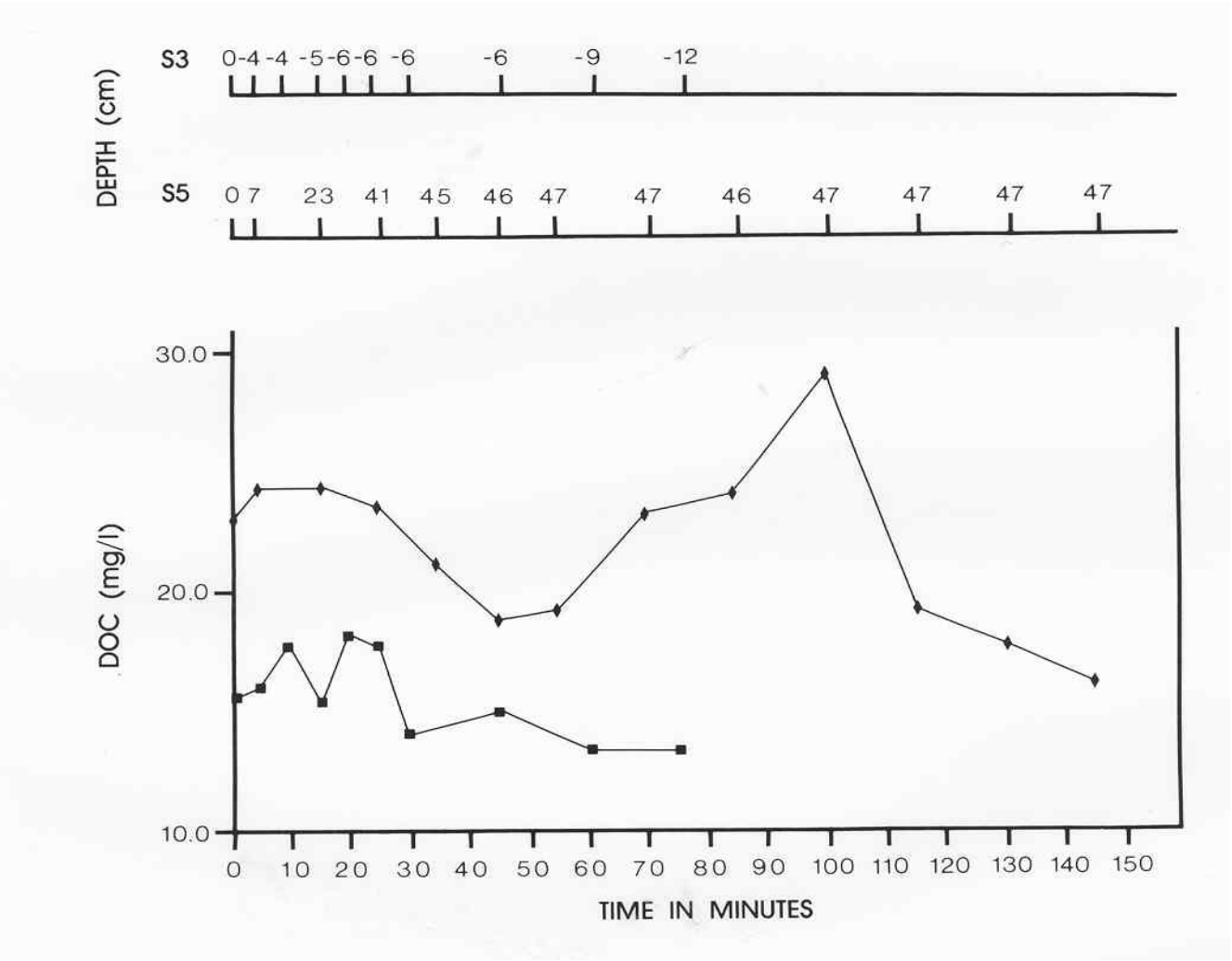

Figure 64. Dissolved Organic Carbon for peak event of August 9, 1985 at Sites S3 (■) and S5 (♦)

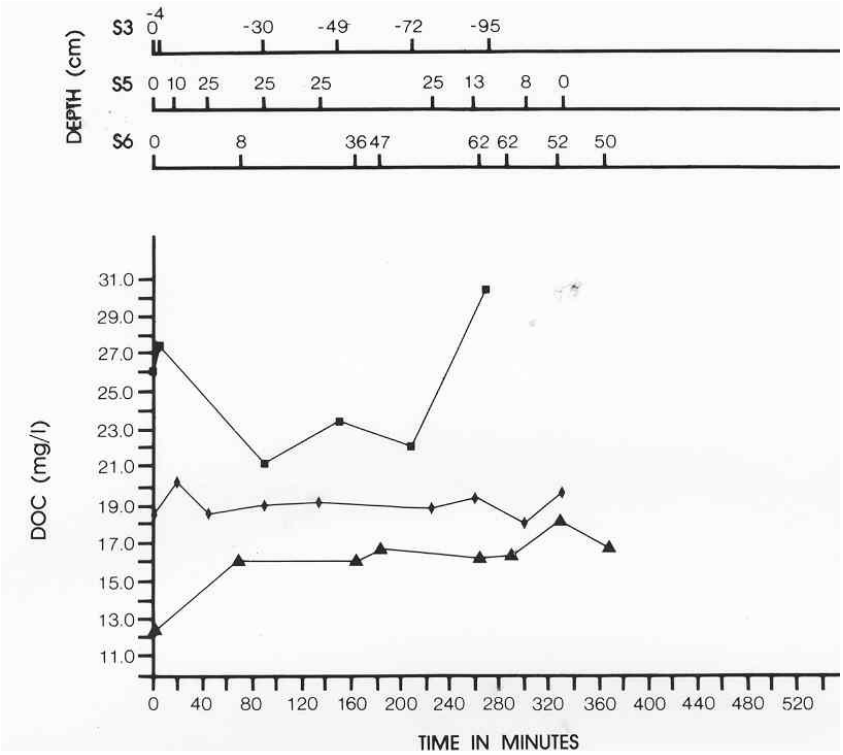

Figure 65. Dissolved Organic Carbon for peak event of August 26, 1985 at Sites S3 (■), S5 (♦) and S6 (▲).

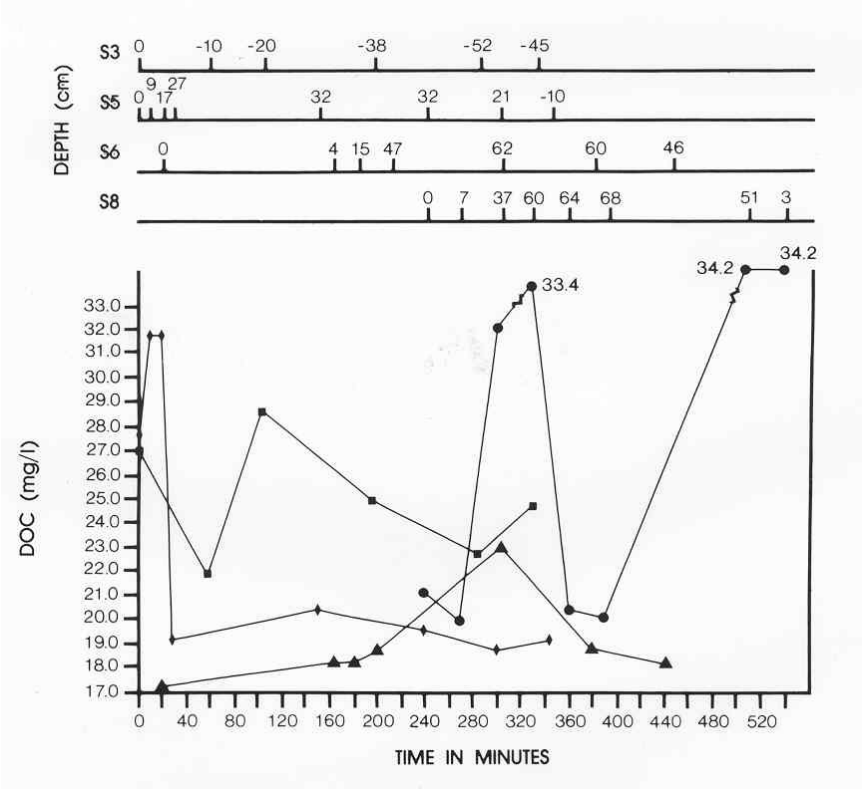

Figure 66. Dissolved Organic Carbon for peak event of August 30, 1985 at Sites S3 (■), S5 (♦), S6 (▲) and S8 (●) .

Sediments

Suspended Sediments

Introduction

The suspended sediments grain size data for both baseline and peaks are first treated as a whole and then broken down and discussed individually for coarse and medium silt (0.062 mm-0.016 mm), fine and very fine silt (0.016 mm-0.004 mm), and clay (less than 0.004 mm). Data for percent organic content of suspended sediments are treated both as percent organic matter silt and clay combined (everything less than 0.062 mm, also known as fines) and as percent organic matter clay (everything less than 0.004 mm).

Total Suspended Sediments

Baseline:

Integrated suspended sediment sample data at all sites for 1984 and 1985 are shown in Table XI and Figure 67. The mean suspended sediment data for each wet and dry period of 1984 and 1985 are shown in Table XII. In both 1984 and 1985 the early (June-July) to late (August to September) period showed almost a 50% decrease in suspended sediments even though we went from normal to dry in 1984 and dry to wet in 1985. Similarly, the reservoir acted as a trap in the two early periods with no apparent affect in the late periods even though the wet/dry cycle reversed itself from 1984 to 1985. The seasonal landscape changes may be affecting the results and overriding the hydrology. After the crop canopy is closed, much of the energy from falling rain is dissipated on the crops and not the soil surface. Less sediment is dislodged and carried with runoff compared to when the canopy is open. No consistent pattern of increase or decrease as one proceeds downstream of the reservoir was observed in either year.

Peaks:

Suspended sediment concentrations for the three 1985 peaking events are shown in Table XIII.

8/9: The August 9 event at Site 3 showed a significant increase from the 8-7 baseline of 0.04 g/L (Table XI). This event was preceded by 9 days of no rain. The same relationship held for site 5. Site 5 showed an increase in the ascending leg and early plateau followed by a drop off.

8/26: The August 26 event was immediately preceded by abnormally high precipitation. The values for the pre-event corresponded closely to the 8-13 baseline data. Sites 3 and 5 showed little change over the course of the event indicating the reservoir had little effect. Site 6 however showed a dramatic increase (almost 400%).

8/30: The August 30 event was proceeded the day before by a 2.62 inch precipitation event. The pre-event data as on 8-26 corresponded closely to 8-13 baseline data. Unlike 8-26 and 8-9, Site 3 showed a significant increase in suspended sediment during the event. Site 5 and 6 showed an initial increase in the ascending leg and then dropped back to pre-event levels or lower (Site 6). Site 8 increased significantly to the end of the plateau.

Table XI: Baseline Suspended Sediment- grams per liter for each sampling date in the 1984 and 1985 sampling seasons at Sites S1-S8.

Precipitation	Rainfall and Deviation (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	.39	.14	.26	.16	-	.22	.16	.25
			6/15/84	.51	.60	.17	.11	.06	-	.38	.23
			6/27/84	.12	.11	.19	.14	.29	.08	.22	.37
	2.4 (-1.7)	1870	7/12/84	.22	.23	.19	.22	.08	.24	.18	.16
			7/17/84	.34	.27	.42	.34	.03	.21	.09	.10
			7/30/84	.17	.20	.19	.13	.18	.26	.19	.22
Dry	2.9 (-0.8)	313	8/8/84	.20	.20	.10	.08	.18	.13	-	-
			8/21/84	.11	.12	.14	.10	.13	.11	.28	.13
	1.7 (-1.3)	134	9/5/84	.09	.09	.10	.11	.09	.13	.07	.14
			9/28/84	.12	.10	.11	.13	.12	.10	.11	.10
	5 (3.3)	193	10/27/84	.12	.13	.11	.12	.10	.08	.15	.13
Very Dry	2.4 (-2.5)	933	6/24/85	.29	.26	.25	.31	.29	.19	.24	.27
	2.2 (-2)	262	7/2/85	.25	.29	.22	.26	.19	.19	.18	.20
			7/11/85	.16	.23	.14	.16	.15	.13	.10	.48
			7/22/85	.17	.14	.28	.06	.08	.11	-	.48
Abnormally Wet	9.1 (5.3)	159	8/7/85	.07	.04	.04	.11	.08	.07	.12	.11
			8/13/85	.16	.11	.10	.03	.17	.13	.10	.10
	5.3 (2.2)	684	9/27/85	.03	.22	.22	.11	.10	.13	.02	.17

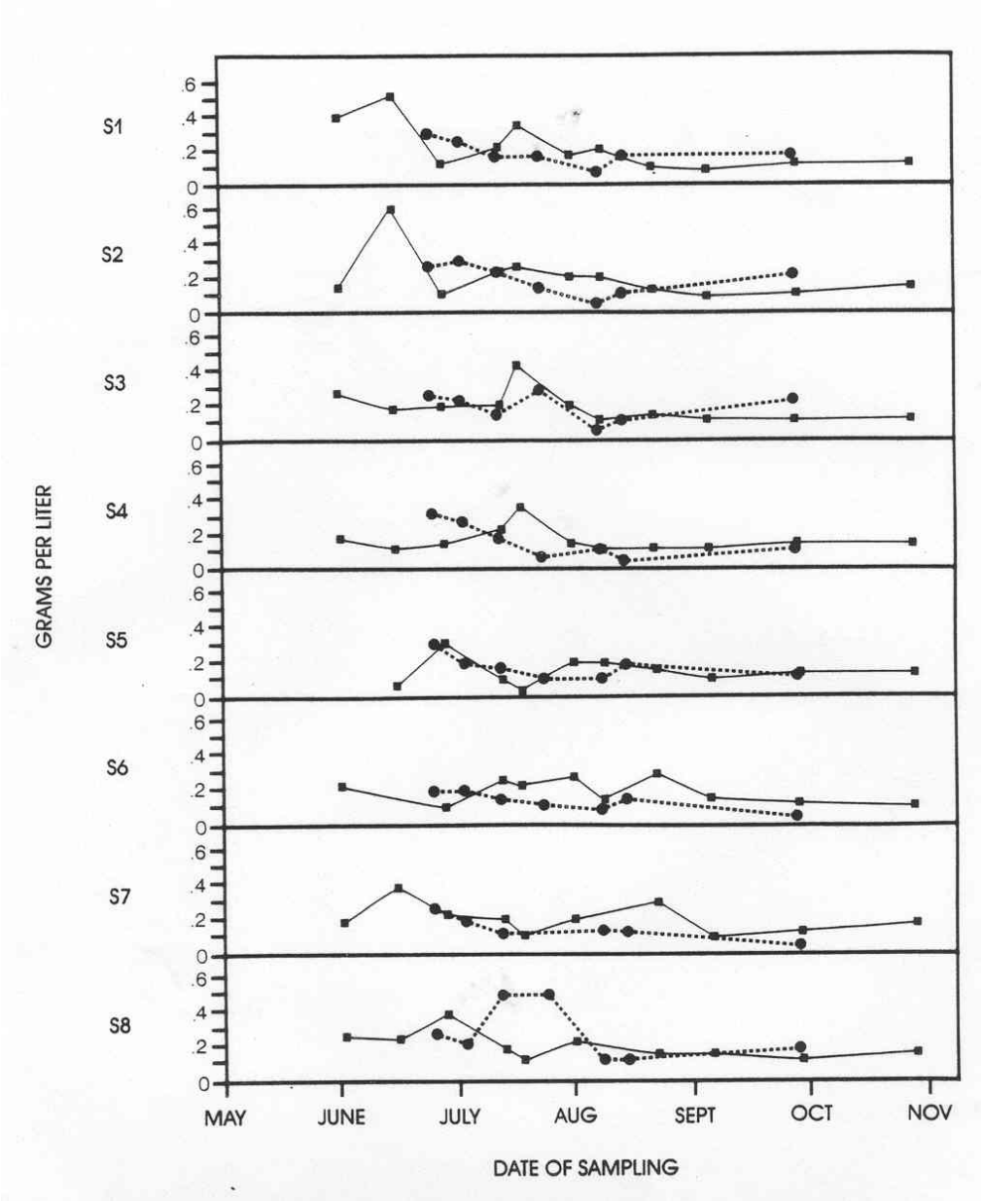

Figure 67. Baseline suspended sediment-grams per liter for 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8.

Table XII: Summary of baseline suspended sediments (grams/liter) and corresponding percent grain size and organic matter by precipitation periods and sampling sites.

Precipitation	Date	S1	S2	S3	S4	S5	S6	S7	S8	$\overline{X}$*
Normal	6/1-7/30 1984	0.29 45 53 18 54 37	0.26 31 54 23 41 46	0.24 34 72 23 67 43	0.18 34 40 13 69 53	0.13 34 48 12 75 52	0.20 45 37 20 85 39	0.20 31 54 24 55 45	0.22 20 20 22 54 58	0.22 34 47 19 63 47
Dry	8/8-9/28 1984	0.13 25 47 18 60 57	0.13 28 41 15 63 58	0.11 13 76 35 87 52	0.11 9 79 21 73 70	0.13 15 47 15 73 70	0.12 31 93 24 57 45	0.15 26 52 12 60 60	0.12 41 59 13 72 49	0.12 24 56 19 58 68
Very Dry	6/24-7/22 1985	0.22 37 34 21 49 42	0.23 44 45 20 35 46	0.22 44 33 14 42 45	0.20 5 23 40 43 55	0.18 6 52 16 59 77	0.16 14 41 17 56 69	0.17 22 57 30 49 48	0.36 50 59 12 60 38	0.22 28 43 21 49 53
Abnormally Wet	8/7-9/27 1985	0.9 3 36 16 58 81	0.12 40 58 10 93 50	0.12 26 49 42 68 31	0.08 24 47 9 60 67	0.12 62 81 0 68 38	0.11 62 34 8 44 51	0.08 40 44 44 46 16	0.13 26 73 0 67 73	0.11 35 53 16 63 51

Key	
Mean Suspended Sediments (Grams/Liter)	
Mean % Coarse and Medium Silt	Mean % Organic Silt and Clay
Mean % Fine and Very Fine Silt	Mean % Organic Clay
Mean % Clay	

* Mean of S1-S

Table XIII: Grams per liter of suspended sediment for 1985 peaks.

9-Aug			26-Aug			30-Aug		
Site	Time	g	Site	Time	g	Site	Time	g
3	*0	.22	3	*0	.14	3	*0	.1
	5	.22		5	.16		60	.09
	10	.2		90	.16		105	.16
	15	.22		150	.11		195	.05
	20	.21		210	.16		285	.23
	25	.25		270	.12		330	.26
	30							
	45	.2	5	*0	.12	5	*0	.16
	60	.24		20	.12		10	.12
	75	.23		45	.15		20	.25
				**90	.11		**30	.12
5	*0	.21		135	.18		150	.18
	5	.09		225	.13		240	.01
	15	.2		***260	.16		***300	.11
	25	.34		300			345	.18
	**35	.24		330	.23			
	45	.28				6	*20	.2
	55	.2	6	*0	.12		164	.12
	85	.22		72	.12		180	.08
	100	.21		162	.17		210	.29
	115	.2		182	.25		**305	.17
	130	.25		**262	.44		380	.08
	145	.05		292			***445	.08
				***332	.29			
				367	.21	8	*240	.11
							270	.14
							300	.17
							**330	.18
							360	.29
							390	.27
							***510	.34
							540	.24

* Pre Event
** Plateau
*** Descending Leg

Suspended Sediment: Coarse and Medium Silt

Baseline:

The percent of suspended sediment that is coarse and medium silt by date and site is shown in Table XIV and Figure 68. The values of percent coarse and medium silt ranged from 95% to 0%, with seasonal means ranging from 62% to 3% (Tables XIV and XII). Early and late seasons for 1984 showed a decrease in means for seven out of eight sites (Site 8 being the exception) with 1985 not showing any evident trend (Table XII). The overall seasonal means for the combined eight sites showed a seasonal decrease in 1984 and increase in 1985. This follows the precipitation cycles. Only in the dry season of 1985 does the reservoir act as a trap for coarse and medium silts. However, the levels still increase progressively downstream of the dam. During the wet period of 1985 the reservoir did not act as a trap for the category course and medium silts. A relationship of higher percentage coarse and medium silt to suspended sediment concentration was not apparent.

Peaks:

The concentrations were generally lower at Site 3 (start of reservoir) than at Site 5 (the first downstream site), although data were mixed for all three peaks. It appears there was some suspended sediment released from the reservoir. Downstream of the reservoir, there was a decrease on August 26 and on August 30 an increase from Sites 5 to 6 and decrease from 6 to 8 (Table XV). However, these data were very mixed and no clear pattern was discernable.

Table XIV: Baseline total percent of suspended sediments that is coarse and medium silt for each sampling date of the 1984 and 1985 sampling seasons of Sites S1-S8.

Precipitation	Rainfall and Deviation (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	57.58	22.81	41.44	28.99	- - -	11.96	0.00	19.33
			6/15/84	48.37	6.34	55.56	68.75	40.74	0.00	39.75	10.42
Early			6/27/84	48.08	73.33	0.00	39.34	33.33	55.56	35.50	29.78
	2.4 (-1.7)	1870	7/12/84	39.78	23.96	12.62	14.29	68.57	85.86	41.38	63.64
			7/17/84	63.89	49.56	73.60	32.64	15.63	77.52	35.29	0.00
			7/30/84	12.33	10.47	19.15	18.18	12.99	39.45	35.87	0.00
Dry	2.9 (-0.8)	313	8/8/84	12.72	18.82	26.14	11.76	11.14	27.00	26.00	26.12
			8/21/84	60.64	62.89	5.08	9.76	3.74	54.02	63.01	76.83
Late	1.7 (-1.3)	164	9/5/84	0.00	16.88	0.00	0.00	15.07	21.82	0.00	17.21
			9/28/84	26.26	11.11	20.48	12.96	28.57	18.95	15.88	44.30
	5 (3.3)	193	10/27/84	23.08	1.89	6.52	40.00	30.00	34.78	26.61	33.02
Very Dry	2.4 (-2.5)	933	6/24/85	24.11	18.52	3.10	18.69	0.00	23.46	6.80	20.00
Early	2.2 (-2)	262	7/2/85	31.78	36.88	51.06	0.00	0.00	0.00	50.64	29.07
			7/11/85	14.81	50.00	55.00	2.22	0.00	20.56	9.20	75.99
			7/22/85	77.30	68.37	65.27	0.00	24.78	12.78	- - -	75.99
Abnormally	9.1 (5.3)	159	8/7/85	0.00	0.00	0.00	54.74	38.80	83.61	25.96	20.22
Wet			8/13/85	9.16	65.63	8.53	0.00	66.19	57.94	0.00	23.53
Late	5.3 (2.2)	684	9/27/85	0.00	54.83	69.78	15.63	79.54	43.51	95.24	34.06

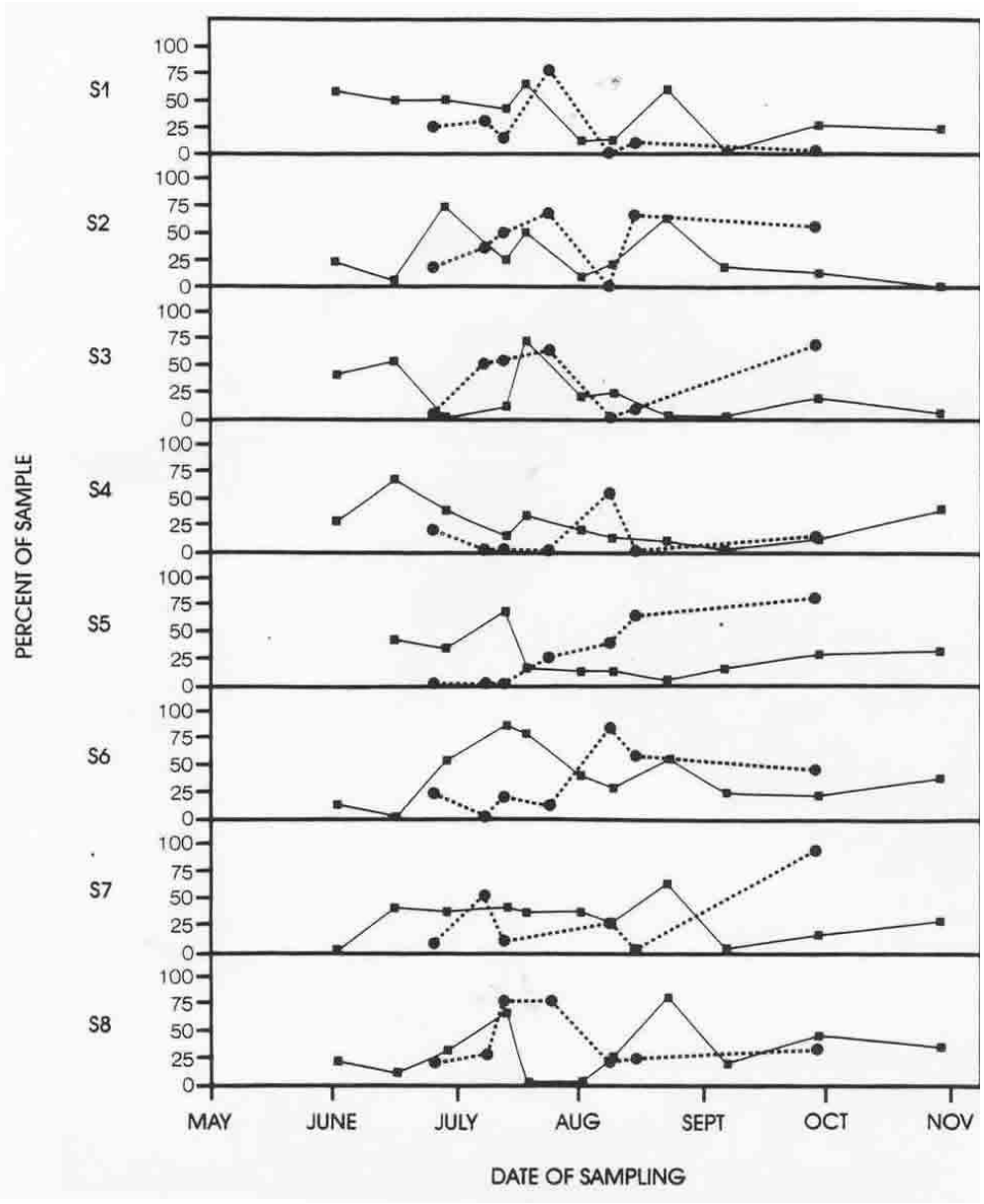

Figure 68. Baseline suspended sediment- percent of sample that is coarse and medium silt for the 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8.

Table XV: Percent of suspended sediment that is coarse and medium silt for 1985 peaks.

9-Aug			26-Aug			30-Aug		
Site	Time	%	Site	Time	%	Site	Time	%
3	*0	46.81.	3	*0	46.72	3	*0	23.53
	5	43.96		5	13.76		60	0.00
	10	11.76		90	14.60		105	0.00
	15	7.53		150	0.00		195	31.58
	20	6.74		210	15.59		285	51.57
	25	3.51		270	0.00		330	19.82
	30							
	45	11.90	5	*0	50.64	5	*0	18.32
	60	45.54		20	44.00		10	0.00
	75	6.32		45	29.69		20	21.13
				**90	0.00		**30	68.27
5	*0	58.43		135	41.67		150	14.77
	5	33.33		225	57.52		240	41.00
	15	35.71		***260	54.14		***300	0.00
	25	58.74		300	87.34		345	52.00
	**35	31.68		330	76.17			
	45	46.09				6	*20	0.00
	55	0.00	6	*0	25.00		164	0.00
	85	51.61		72	32.70		180	0.00
	100	18.89		162	23.81		210	33.47
	115	44.19		182	47.37		**305	71.83
	130	10.48		**262	27.57		380	0.00
	145	0.00		292			***445	83.80
				***332	67.80			
				367	32.78	8	*240	58.89
							270	48.31
							300	0.00
							**330	38.06
							360	61.94
							390	31.16
							***510	32.87
							540	4.50

* Pre Event
** Plateau
*** Descending Leg

Suspended Sediment: Fine and Very Fine Silt

Baseline:

The percent of suspended sediment that is fine and very fine silt by date and site is shown in Table XVI and Figure 69. In most cases the fine and very fine silt makes up the smallest component of the suspended sediment (Table XII). In a fair number of cases there was no suspended sediment in the fine and very fine category, especially in the later period of 1985 where there was none in 16 out of 24 samples (Table XVI). The baselines for 1984 and 1985 tended to follow each other closely by date (Figure 69). The reservoir does not appear to be acting as a settling basin in any consistent fashion. A relationship of fine and very fine silt percentage to concentration of suspended sediment was not apparent.

Peaks:

All three peak-events at Site 3 started at 0.0% suspended fine silt and very fine silt and reached significant amounts although the readings were without pattern and highly mixed (Table XVII). The outlet from the dam, Site 5, showed higher concentrations sporadically than the pre-values indicating some flushing of reservoir sediments. No downstream pattern was discernable during any of the peaks.

Table XVI: Baseline total percent of suspended sediment that's fine and very fine silt

Precipitation	Rainfall and Deviation Index (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	13.94	28.07	7.20	24.63	---	33.70	43.48	17.31
			6/15/84	23.72	21.19	38.89	0.00	0.00	75.00	23.60	29.17
			6/27/84	30.76	6.67	29.27	0.00	22.76	7.41	16.25	9.57
	2.4 (-1.7)	1870	7/12/84	29.03	40.63	52.43	56.04	2.86	0.00	20.69	27.27
			7/17/84	0.00	23.89	0.00	0.00	28.13	0.00	28.57	46.43
			7/30/84	9.59	18.60	13.58	0.00	15.58	2.75	10.86	0.00
Dry	2.9 (-0.8)	313	8/8/84	44.24	30.00	11.36	0.00	29.056	53.70	16.67	13.43
			8/21/84	6.38	18.56	10.17	12.20	.54	17.24	0.00	0.00
	1.7 (-1.3)	164	9/5/84	14.10	0.00	65.48	35.56	25.81	17.27	32.76	40.16
			9/28/84	7.07	12.34	55.56	36.11	0.00	9.47	6.54	0.00
	5 (3.3)	193	10/27/84	5.77	44.34	9.78	0.00	3.75	0.00	25.81	0.00
Very Dry	2.4 (-2.5)	933	6/24/85	16.07	35.19	22.42	15.5	16.94	8.64	42.71	21.74
	2.2 (-2)	262	7/2/85	14.95	4.10	5.32	17.43	0.00	18.29	0.00	0.00
			7/11/85	36.27	17.86	0.00	37.04	35.43	40.19	45.95	11.88
			7/22/85	15.60	21.37	28.87	92.16	13.93	0.00	---	11.88
Abnormally Wet	9.1 (5.3)	159	8/7/85	0.00	0.00	87.88	0.00	0.00	0.00	62.50	0.00
			8/13/85	48.09	0.00	39.02	0.00	0.00	23.36	69.14	0.00
	5.3 (2.2)	684	9/27/85	0.00	29.57	0.00	28.13	0.00	0.00	0.00	0.00

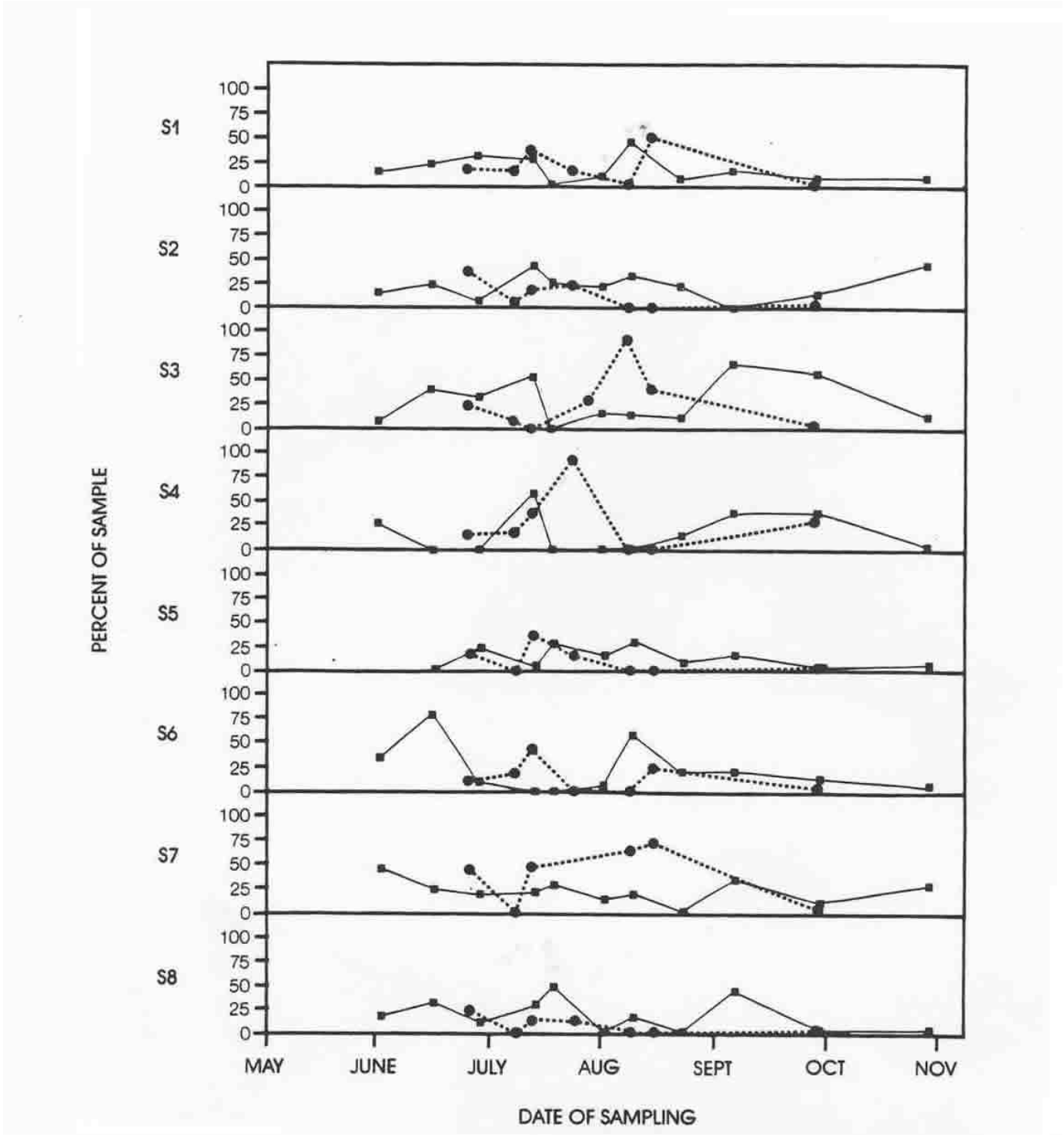

Figure 69. Baseline suspended sediment- percent of sample that is fine and very fine silt for the 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8

Table XVII: Percent of suspended sediment that is fine and very fine silt for 1985 peaks.

9-Aug			26-Aug			30-Aug		
Site	Time	%	Site	Time	%	Site	Time	%
3	*0	0.00	3	*0	0.00	3	*0	0.00
	5	0.00		5	29.36		60	28.00
	10	8.23		90	10.22		105	51.15
	15	0.00		150	0.00		195	0.00
	20	3.37		210	23.70		285	0.00
	25	0.93		270	16.34		330	49.99
	30							
	45	0.00	5	*0	23.08	5	*0	35.88
	60	0.00		20	0.00		10	0.00
	75	29.47		45	0.00		20	20.19
				**90	74.73		**30	0.00
5	*0	7.87		135	12.50		150	40.27
	5	5.56		225	0.00		240	12.50
	15	0.00		***260	27.82		***300	29.03
	25	10.50		300	2.53		345	37.33
	**35	16.83		330	19.68			
	45	31.30				6	*20	79.52
	55	52.33	6	*0	0.00		164	0.00
	85	0.00		72	26.53		180	19.70
	100	0.00		162	21.09		210	0.00
	115	0.00		182	13.88		**305	0.00
	130	0.00		**262	42.97		380	0.00
	145	0.00		292			***445	0.00
				***332	4.49			
				367	39.44	8	*240	0.00
							270	48.31
							300	56.25
							**330	0.00
							360	21.86
							390	0.00
							***510	43.94
							540	54.00

* Pre Event
** Plateau
*** Descending Leg

Suspended Sediment: Clay

Baseline:

The percent of suspended sediment that is clay by date and site is shown in Table XVIII and Figure 70. Clay represents the dominant component of the suspended sediment in most cases both by individual samples and seasonal means (Tables XVIII, XII). The dry seasons averaged slightly higher mean percents than the wet seasons even though these two reversed themselves in 1984 and 1985 (Table XII). The reservoir, Site 4, revealed clay percentages that were generally higher than the water coming in and generally lowered downstream of the dam. Similarity in percent clay between the two years was seen by date except for Site 5 and 7 (Figure 70). There was no discernable relationship between suspended sediment concentrations and percentage clay.

Peaks:

In all three peaks at Site 5 there was an initial significant increase in percent clay during the ascending leg (Table XIX). This indicates contribution from the reservoir. During the 8/9 peak, Site 3 was consistently higher than Site 5, and during the 8/26 peak, Site 3 was consistently higher than Sites 5 and 6. The 8/30 peaks did not show these relationships.

Table XVIII: Baseline total percent of suspended sediment that is clay for each sampling date of the 1984 and 1985 sampling seasons at Sites S1-S8.

Precipitation	Rainfall and Deviation (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	28.48	49.12	51.36	46.38	---	54.34	56.52	63.46
			6/15/84	27.91	72.47	5.58	31.25	59.26	25.00	36.65	60.41
			6/27/84	21.16	20.00	70.73	60.65	56.09	62.97	50.75	60.65
	2.4 (-1.7)	1870	7/12/84	31.19	35.41	34.95	29.67	28.57	14.14	37.93	9.09
			7/17/84	36.11	26.55	25.40	67.36	43.76	22.48	36.14	53.57
			7/30/84	78.09	70.93	66.67	81.82	71.43	57.80	53.27	100.00
Dry	2.9 (-0.8)	313	8/8/84	43.04	51.18	62.50	88.24	59.81	19.37	57.33	60.45
			8/21/84	32.98	18.55	84.75	78.04	89.72	28.74	36.99	23.17
	1.7 (-1.3)	164	9/5/84	85.90	83.12	34.52	64.44	59.12	60.91	67.24	57.37
			9/28/84	66.67	76.55	23.96	50.93	71.43	71.58	77.58	55.70
	5 (3.3)	193	10/27/84	71.15	53.77	83.70	60.00	66.25	65.22	47.58	66.98
Very Dry	2.4 (-2.5)	933	6/24/85	59.82	46.29	74.48	65.81	83.06	67.90	50.49	58.26
	2.2 (-2)	262	7/2/85	53.27	59.02	56.35	82.57	100.00	81.71	49.36	70.93
			7/11/85	48.92	67.86	45.00	60.74	64.57	39.25	44.82	12.13
			7/22/85	7.10	10.26	5.86	7.86	61.29	87.22	---	12.13
Abnormally Wet	9.1 (5.3)	159	8/7/85	100.00	100.00	12.12	45.26	61.20	16.39	11.54	78.78
			8/13/85	42.75	34.37	52.45	100.00	33.81	81.30	30.86	76.47
	5.3 (2.2)	684	9/27/85	100.00	15.60	30.22	56.24	20.46	56.49	4.76	65.04

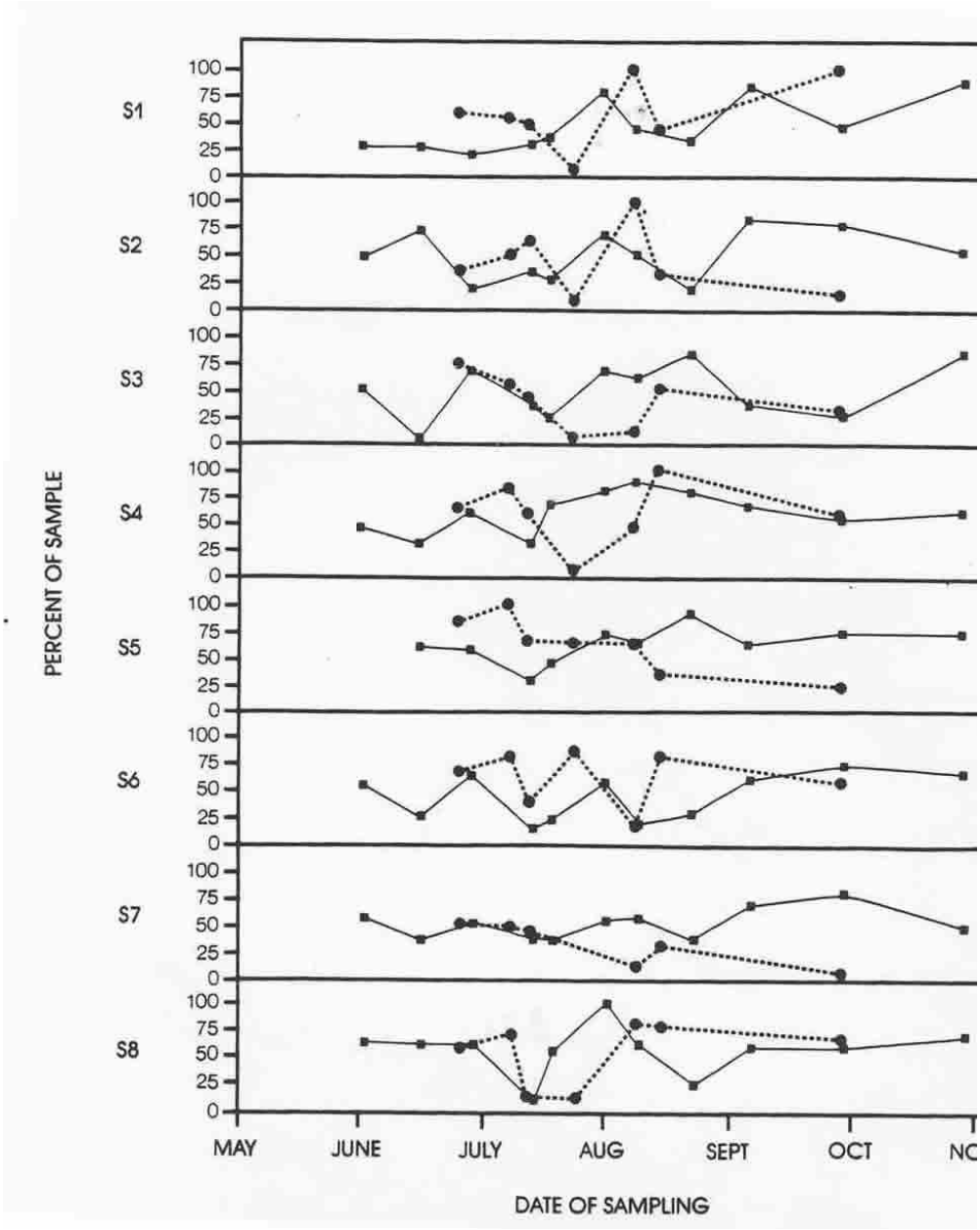

Figure 70. Baseline suspended sediment- percentage of sample that is clay for 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8.

Table XIX: Percent of suspended sediment that is clay for 1985 peaks.

9-Aug			26-Aug			30-Aug		
Site	Time	%	Site	Time	%	Site	Time	%
3	*0	53.19	3	*0	53.28	3	*0	76.47
	5	56.04		5	60.88		60	72.00
	10	80.01		90	75.18		105	48.85
	15	92.47		150	100.00		195	58.42
	20	89.89		210	63.71		285	48.43
	25	63.56		270	83.66		330	39.19
	30							
	45	88.10	5	*0	26.28	5	*0	45.80
	60	54.46		20	56.00		10	100.00
	75	64.21		45	70.31		20	58.68
				**90	25.27		**30	31.73
5	*0	33.70		135	45.82		150	44.96
	5	61.11		225	42.48		240	46.50
	15	64.29		***260	18.04		***300	70.97
	25	30.76		300	10.13		345	10.67
	**35	51.49		330	4.15			
	45	22.61				6	*20	20.48
	55	47.67	6	*0	75.00		164	100.00
	85	48.39		72	40.77		180	80.30
	100	81.11		162	55.10		210	66.53
	115	55.81		182	38.75		**305	28.17
	130	85.52		**262	29.46		380	100.00
	145	100.00		292			***445	17.20
				***332	27.71			
				367	27.78	8	*240	41.11
							270	3.38
							300	43.75
							**330	61.94
							360	16.20
							390	68.84
							***510	23.19
							540	41.50

* Pre Event
** Plateau
*** Descending Leg

Suspended Sediment: Silt and Clay, Percent Organic

Baseline:

The suspended sediment that is organic in the silt and clay fraction (less than 0.063 mm) generally increases from the early season to the late season in both 1984 and 1985. (Tables XII, XX, and Figure 71). The values average around 50 percent. The reservoir in three out of four seasons was a source. No significant progressive downstream effect was seen.

Peaks:

The three peaks all showed an initial decrease from the pre-event with sporadic rises during the event at Site 3 (Table XXI). Site 5, the initial site downstream of the dam and reservoir, showed an increase in percent in all three events indicating a contribution from the reservoir sediment. Sites further downstream did not show an increase indicating some deposition.

Table XX: Baseline total percent of suspended sediment that is organic (both silt and clay) for each sampling date of the 1984 and 1985 sampling seasons at Sites S1-S8.

Precipitation	Rainfall and Deviation (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	16.36	---	72.97	---	---	13.10	37.68	---
			6/15/84	20.93	12.30	---	---	---	---	50.93	12.50
			6/27/84	94.23	88.81	88.89	31.15	21.14	20.37	77.78	31.91
	2.4 (-1.7)	1870	7/12/84	75.27	55.13	67.96	38.46	---	85.86	82.76	---
			7/17/84	68.06	59.23	65.73	33.33	59.38	4.49	40.34	5.36
			7/30/84	45.21	56.82	61.73	58.18	64.94	59.53	31.52	29.09
Dry	2.9 (-0.8)	313	8/8/84	51.52	29.41	72.62	97.61	27.43	50.00	54.00	43.28
			8/21/84	27.63	49.48	98.31	97.87	59.81	49.43	27.40	100.00
	1.7 (-1.3)	164	9/5/84	33.33	12.98	78.57	42.22	24.66	17.27	66.67	33.61
			9/28/84	72.73	72.10	56.02	75.61	74.73	54.68	58.75	60.34
	5 (3.3)	193	10/27/84	21.15	28.30	77.17	29.52	62.50	36.23	17.74	20.75
Very Dry	2.4 (-2.5)	933	6/24/85	46.43	62.96	48.6	20.16	77.42	56.79	94.17	42.61
	2.2 (-2)	262	7/2/85	10.28	25.23	20.48	1.83	45.00	10.40	12.99	19.77
			7/11/85	34.81	37.76	40.83	42.96	48.82	57.94	64.37	86.63
			7/22/85	45.39	56.41	21.34	27.45	37.19	41.49	---	86.63
Abnormally Wet	9.1 (5.3)	159	8/7/85	23.73	---	81.82	77.89	74.63	49.18	44.44	75.28
			8/13/85	43.70	51.04	14.67	17.86	88.48	29.91	44.44	71.76
	5.3 (2.2)	684	9/27/85	39.13	66.13	49.45	45.83	---	24.07	---	---

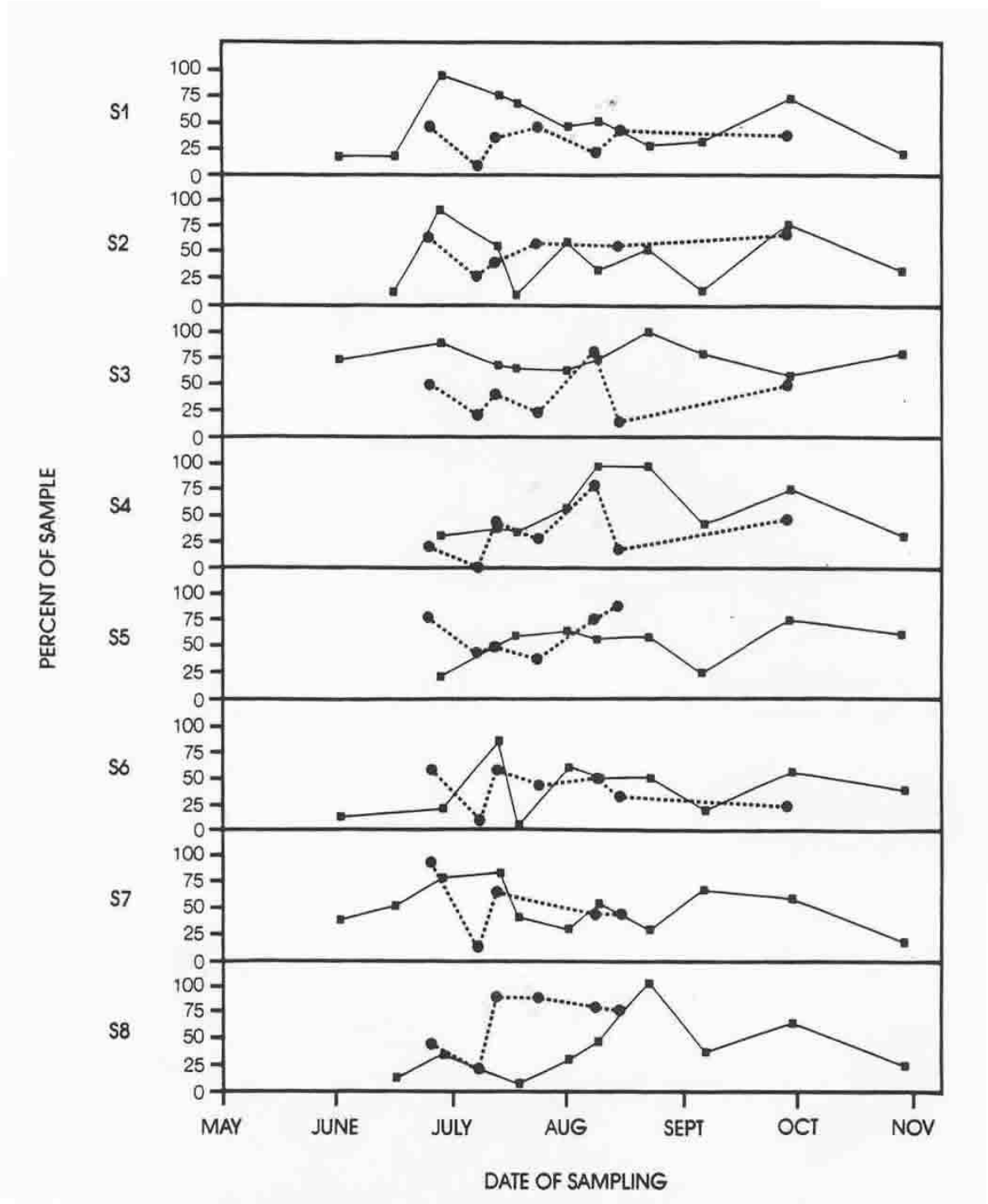

Figure 71. Baseline suspended sediment-percent of sample that is organic (both silt and clay) for the for 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8

Table XXI: Percent of suspended sediment that is organic (silt and clay)

9-Aug			26-Aug			30-Aug		
Site	Time	%	Site	Time	%	Site	Time	%
3	*0	56.65	3	*0	63.96	3	*0	40.00
	5	48.35		5	43.48		60	5.33
	10	67.06		90	49.64		105	9.16
	15	92.47		150	26.04		195	
	20	37.34		210	22.96		285	74.75
	25	75.36		270	82.69		330	41.89
	30							.
	45	49.53	5	*0	45.19	5	*0	41.22
	60	60.40		20	60.71		10	66.67
	75	36.84		45	22.65		20	74.18
				**90	89.01		**30	20.45
5	*0	34.83		135	71.10		150	47.66
	5	47.22		225	35.29		240	33.00
	15	1.19		***260	6.60		***300	27.96
	25	52.44		300	68.42		345	76.67
	**35	89.11		330	16.06			
	45	60.87				6	*20	37.63
	55	37.21	6	*0	52.00		164	5.29
	85	64.91		72	24.49		180	
	100	41.11		162	6.80		210	22.31
	115	44.19		182	8.61		**305	13.38
	130	55.24		**262	44.32		380	54.93
	145	54.55		292	53.63		***445	
				***332	22.04			
				367	24.44	8	*240	30.00
							270	37.29
							300	15.97
							**330	43.23
							360	28.34
							390	12.99
							***510	26.99
							540	65.50

* Pre Event

** Plateau

*** Descending Leg

Suspended Sediment: Clay, Percent Organic

Baseline:

The suspended sediment that is organic in the clay (less than 0.004 mm) fraction is generally higher than the category clay and silt combined in both periods of both 1984 and 1985 (Table XII, XXII). The percents for 1984 and 1985 show a fair degree of similarity especially in sites downstream of the dam (Figure 72). The reservoir appears to act as a source in three of the four seasons (Tables XII, XXII). No correlation was seen between the total suspended solids and percent of organic clay. No downstream consistent pattern was observed.

Peaks:

At Site 3 the three peaks all started high, declined, and then climbed (Table XXIII). Site 5 did not show any consistent impact of the reservoir. Sites 5 and 6 on 8/26 had the highest percent organic on the ascending leg whereas August 30 had the highest percent on the descending leg.

Table XXII: Baseline total percent of suspended sediment that is organic (clay only)

Precipitation	Rainfall and Deviation (inches)	Mean Monthly Flow (CFS)	Date	S1	S2	S3	S4	S5	S6	S7	S8
Normal	6.9 (2.0)	5184	6/1/84	42.86	---	82.89	---	---	90.29	42.00	---
			6/15/84	43.00	21.67	---	---	---	---	28.81	64.41
			6/27/84	53.13	5.54	44.59	30.98	85.11	62.07	53.70	43.86
	2.4 (-1.7)	1870	7/12/84	91.30	80.77	81.25	92.11	---	86.67	82.35	---
			7/17/84	46.60	27.59	58.56	100.00	83.33	90.90	57.58	61.04
			7/30/84	45.76	69.23	64.86	54.76	57.38	96.88	69.39	88.52
Dry	2.9 (-0.8)	313	8/8/84	55.66	82.76	97.01	84.75	73.33	82.00	72.73	88.89
			8/21/84	66.04	42.11	87.72	98.00	67.65	32.84	61.54	88.06
	1.7 (-1.3)	164	9/5/84	50.75	31.25	65.79	39.51	72.13	43.66	35.71	48.78
			9/28/84	65.79	95.74	95.83	68.18	77.88	69.05	66.67	60.53
	5 (3.3)	193	10/27/84	43.24	37.31	40.83	32.74	64.15	70.00	27.78	53.85
Very Dry	2.4 (-2.5)	933	6/24/85	72.83	---	69.84	80.95	50.38	56.80	93.98	92.11
	2.2 (-2)	262	7/2/85	10.53	8.94	11.38	15.13	25.58	21.42	18.42	20.06
			7/11/85	68.18	60.32	33.57	44.44	78.57	83.33	33.96	57.89
			7/22/85	43.18	---	52.58	31.39	79.73	62.96	---	69.39
Abnormally Wet	9.1 (5.3)	159	8/7/85	85.82	100.00	100.00	38.75	58.93	75.67	69.73	68.85
			8/13/85	41.06	100.00	60.00	51.09	77.27	---	56.18	77.952
	5.3 (2.2)	684	9/27/85	46.31	79.71	43.57	89.19	---	11.88	12.42	54.67

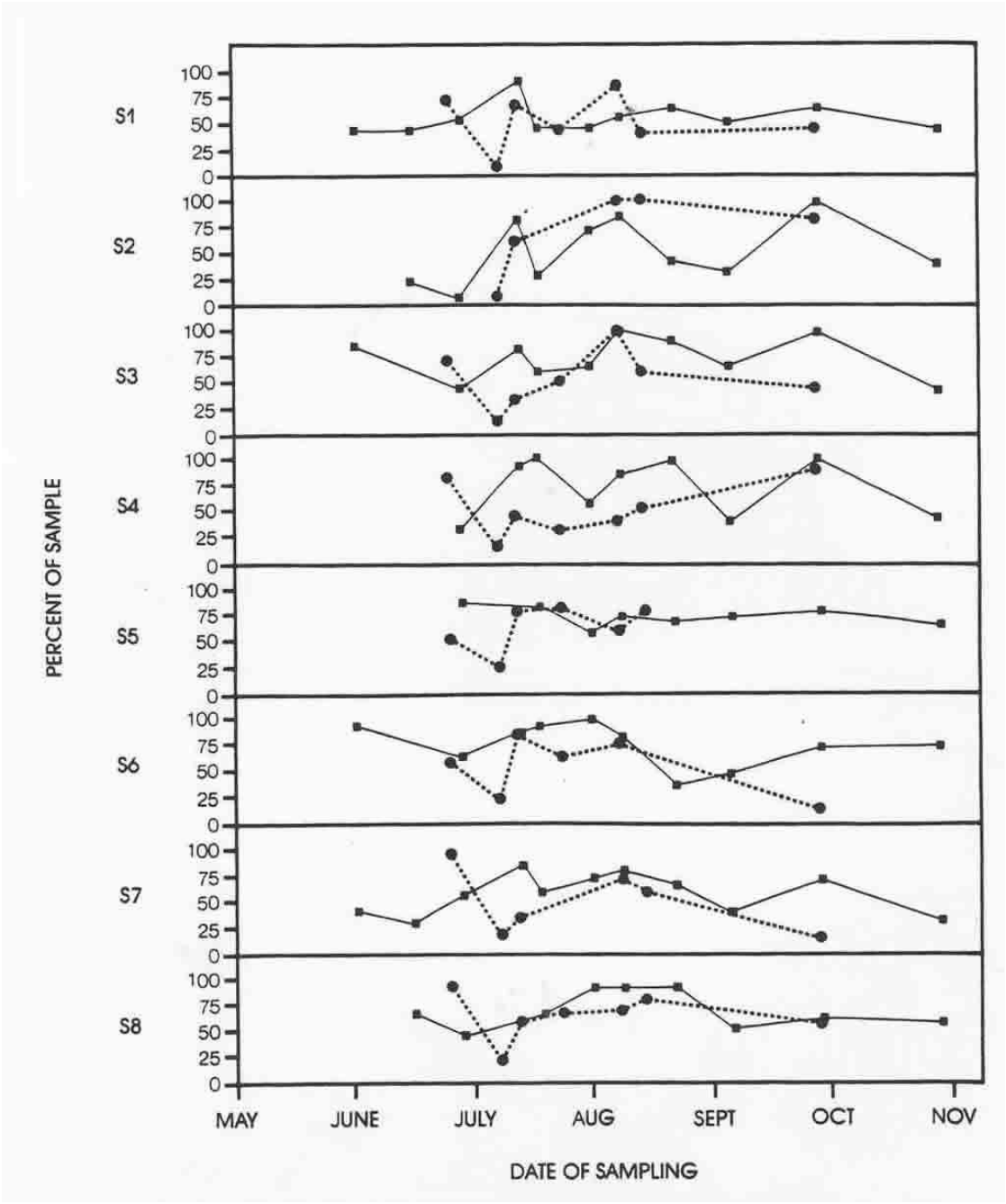

Figure 72. Baseline suspended sediment- percent of sample that is organic (clay only) for 1984 (■) and 1985 (●) sampling seasons at Sites S1-S8.

Table XXIII: Percent of suspended sediment that is organic (clay only)

9-Aug			26-Aug			30-Aug		
Site	Time	%	Site	Time	%	Site	Time	%
3	*0		3	*0	91.07	3	*0	46.43
	5	81.01		5	60.74		60	34.78
	10	86.11		90	12.26		105	4.88
	15	72.22		150	33.33		195	36.11
	20	53.75		210	85.94		285	79.49
	25	12.50		270	36.78		330	50.30
	30							.
	45	42.05	5	*0	23.37	5	*0	33.33
	60	82.98		20	40.19		10	22.41
	75	74.68		45	66.67		20	32.00
				**90	9.32		**30	49.66
5	*0	63.33		135	31.15		150	15.04
	5	53.97		225	8.45		240	38.71
	15	0.15		***260	31.40		***300	86.87
	25	51.39		300	42.03		345	74.14
	**35	60.87		330	8.09			
	45	64.86				6	*20	8.33
	55	37.21	6	*0	66.09		164	33.33
	85	72.41		72	77.50		180	
	100	70.13		162	2.47		210	38.05
	115	18.67		182	74.19		**305	4.00
	130	43.64		**262	59.63		380	54.63
	145	18.52		292	19.35		***445	85.71
				***332	46.15			
				367	52.38	8	*240	55.00
							270	83.54
							300	84.12
							**330	63.46
							360	17.50
							390	47.43
							***510	43.27
							540	

* Pre Event
** Plateau
*** Descending Leg

Reservoir Sediments

Grain Size

The reservoir was sampled 7/20/85-7/30/85 along the 21 transects shown in Figure 73. Samples were from the top two centimeters (cms). Figures 74 show the total grain size distribution. Figure 75 shows the breakdown of the sands and Figure 76, the distribution of the fines. During the reservoir storage phase the water is backed up all the way to transect V. Sampling was conducted within the river channel through N as continuous standing water did not occur on the river (reservoir) flood plain until transect M. Gravel and very coarse sand were seen farthest up the Blue Earth River and the mouth of the Watonwan River (Figure 74). Sands were often the dominant sediment from transect U through transect N. At transects S and T the dominant sands were Fine and Very Fine (Figure 75) which is consistent with the higher silt and clay, low energy environment shown in Figure 74. Sampling Site 3 for water chemistry and suspended sediments was located between transect Q and P which were very similar (Figures 74, 75. 76). Transects U through N showed a general increase in silts and clays with a corresponding decrease in sands (Figure 74). All of these samples are within the river channel. This is also seen in the increase of finer sands downstream (Figure 75). As noted above, transects S and T are the exception here and are probably related to backing up of the Blue Earth by both the sand bar and flow from the Watonwan River.

From transect M through C within the old river channel there is almost no gravel and very coarse sand (Figure 74). The non-channel reservoir has coarser sediments from M through transect G (Figure 74, 75). From transect F and increasing through C the sediments become coarser in the channel (Figure 72, 75) probably because of the sucking of the finer sediments by the turbines.

The breakdown of the silts and clays, fines, shows remarkable consistency throughout the channel before the true reservoir starts, transects W through N (Figure 76). Downstream of transect N, the percent of coarse and medium silt increases slightly within the channel and more so outside the channel. However in total there is only very limited change or trends seen in the fines. This is probably due to their ease of dispersal and deposition in this low-energy environment which experiences occasional higher flow. This data was collected before major peaking events.

Percent Organic of Fines

The percent of organic for the reservoir fine sediments are shown in Table XXIV. In both the silt and clay category and in the clay only category the highest values are generally found outside the river channel. The distribution of organic content is however very mixed and scattered both in the channel and in the non-channel reservoir.

The Silt-Clay category has occasional samples above 50% but generally in the single digit to 20's. The Clay category, on the other hand, has organic values 2 to 3 times higher on average than the Silt-Clay (Table XXIV). Overall the smaller the sediment grain size the higher the percent organic.

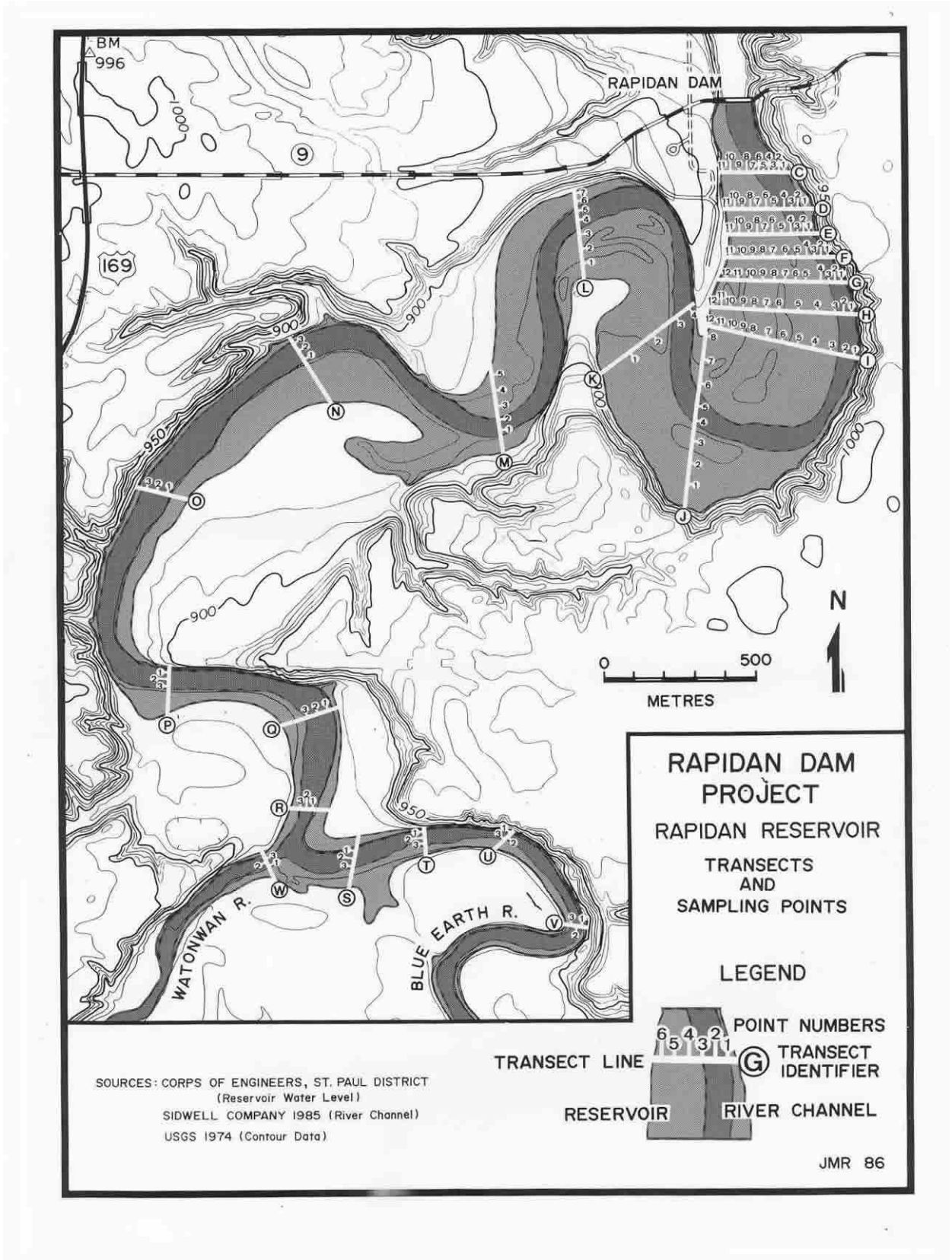

Figure 73. Reservoir transects and sampling sites, July 1985

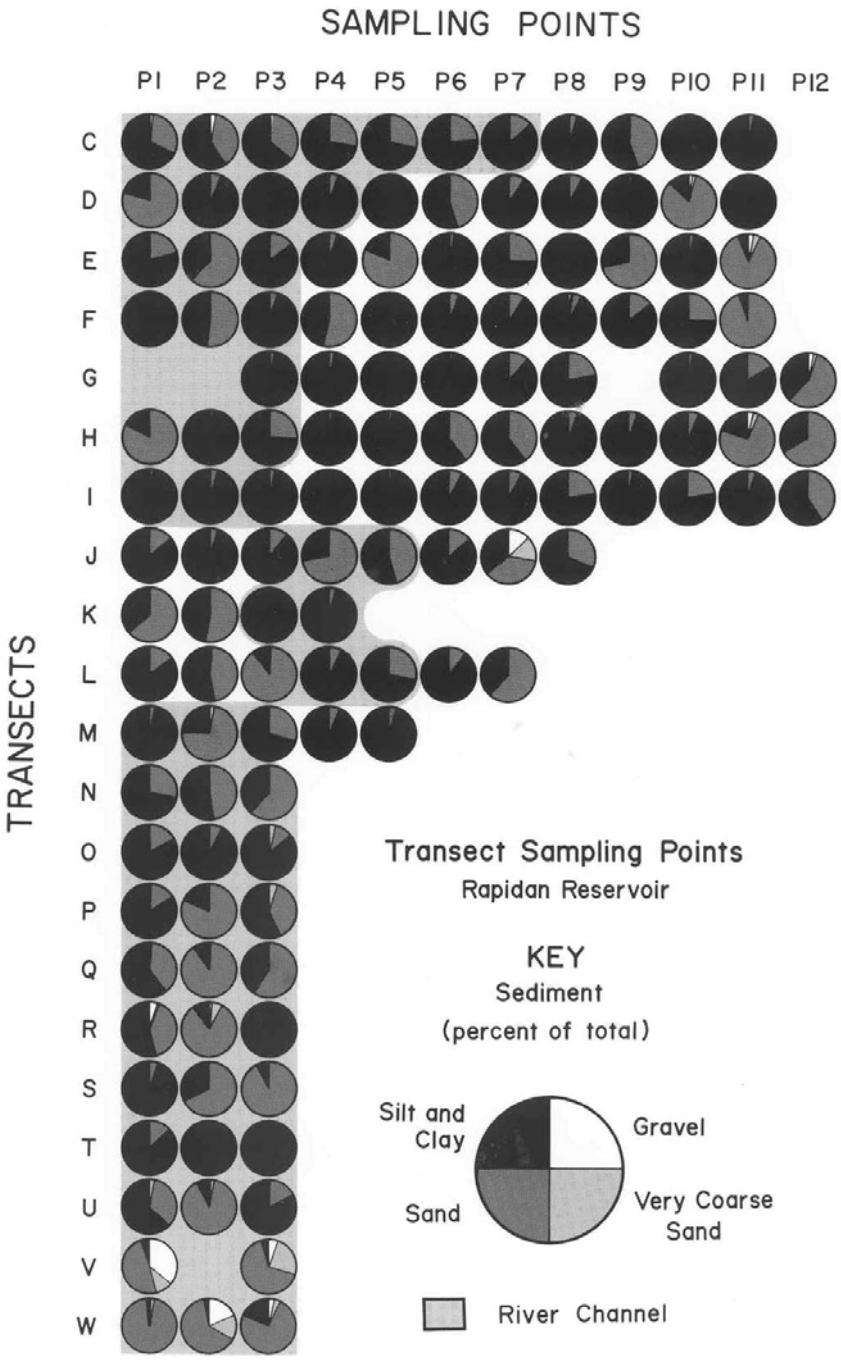

Figure 74. Sediment analysis of grabs taken in the summer of 1985: Gravel (large than 2mm),Very Coarse Sand (2mm-1mm), Sand (1mm to 0.062 mm), and Silt and Clay (less than 0.062 mm).