Contract Report 572

CRITICAL TRENDS ASSESSMENT PROJECT REPORT:

Trends in Suspended Sediments and Sedimentation in Illinois Streams, Rivers, Lakes, and Reservoirs

by Abiola A. Akanbi and Misganaw Demissie
Office of Sediment & Wetland Studies
Illinois State Water Survey

Prepared for the
Illinois Department of Energy and Natural Resources
Springfield, Illinois

June 1994

Illinois State Water Survey
Hydrology Division
Champaign, Illinois

A Division of the Illinois Department of Energy and Natural Resources

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ABSTRACT

This report constitutes the erosion and sedimentation component of the Critical Trends Assessment Project (CTAP). It describes the development of a database on suspended sediment data for all gaged streams and rivers in Illinois. The database also includes information on the surveyed capacity of all lakes and reservoirs used for water supply. The sediment data were obtained from state and federal agencies that have collected such data for the last 20 years.

The sediment data were analyzed for spatial and temporal trends using a total of 59 instream sediment gaging stations for the spatial analysis and 20 stations for the temporal trends analysis. The lake sedimentation data were also analyzed to determine the annual sediment yield of the streams that discharge into 118 lakes and reservoirs in the state. The spatial distribution of instream sediment yield identifies four sediment yield regions in Illinois. The regions along the Illinois River and in west-central Illinois are the highest sediment producing areas, along with some areas in southern Illinois, while the northeastern and central sections have the lowest sediment yield.

Temporal trends in the sediment data were evaluated by fitting regression lines to the distribution of concentration and load with time. The two record periods with the highest number of active stations, 1981-1988 and 1975-1988, were used for the analysis. The results indicate that more than 60 percent of the stations showed decreasing trends in suspended sediment concentration and load, implying that the rate of streambank and soil erosion has been declining since 1975, with the highest rate of decline occurring in the Illinois River valley.

TRENDS IN EROSION AND SEDIMENTATION IN ILLINOIS

by
Abiola A. Akanbi and Misganaw Demissie
Illinois State Water Survey

INTRODUCTION

Illinois has a significant number of surface water resources in the form of streams, lakes, and reservoirs. These resources perform many beneficial functions, serving as domestic and industrial water supply, recreation, and habitat for fish and other aquatic organisms. The quality of these resources is greatly affected by the accumulation of sediments. The continuous accumulation of fine sediments in aquatic habitats gradually degrades the quality of these habitats and eventually renders them unsuitable for fish and other organisms. In addition to its physical effects on aquatic environments, sediment also has biological and chemical effects. Many chemicals from agricultural and industrial sources have a great affinity for fine sediment, resulting in the accumulation of pollutants in bottom sediments. Such accumulation remains a source of pollution for a long time. Because of its widespread and long-term effects on the quality of aquatic environments, sedimentation has been identified by the State Water Plan Task Force as the top environmental problem in Illinois. It is therefore essential that the rates of sedimentation in rivers, lakes, and reservoirs are evaluated to provide valuable information on the quality of aquatic environments in the state.

Sediments in streams, lakes, and reservoirs are supplied by soil erosion, a natural process that gradually reshapes the surface of the earth. Under natural conditions, this process is gradual and its negative impacts minimal. However, soil erosion is significantly accelerated by human activities such as agricultural practices, construction, mining, timber harvest, and water resources management projects. It is estimated that the rate of soil erosion under present land management practices in Illinois is two to six times the natural rate of erosion. Such a high rate has prompted many state and federal agencies to identify soil erosion as one of the major environmental problems in the state.

The amount of sediment transported by streams and rivers is directly related to the rate of erosion in the watershed. The sediment in streams and rivers is monitored by sampling the water and determining the concentration of sediment in the sample. In Illinois, a significant amount of suspended sediment and lake sedimentation data are collected under different programs by different agencies. All the sediment data can then be entered into a single database, checked, and evaluated. The data can be further analyzed to identify trends in the fluctuation of concentration on load over time and to evaluate the spatial distribution of instream sediment yield.

Scope of Work

The task objectives of the erosion-sedimentation component of the Critical Trends Assessment Project (CTAP) are:

1. To compile all available suspended sediment data and lake/reservoir sedimentation data from various agencies in the state and develop a database for all sediment data after checking for errors and inconsistencies.
2. To analyze the sediment data for temporal trends and spatial distribution of suspended sediment concentration and load, and to present some of the results on Geographic Information System (GIS)-based maps.

THE SEDIMENT DATABASE

This chapter describes the development of the suspended sediment database. The database includes information on suspended sediment data for all gaged streams and rivers in Illinois and the surveyed capacity of lakes and reservoirs that are used for water supply. The suspended sediment and lake sedimentation data were obtained from various sources, including the Illinois State Water Survey (ISWS), the U.S. Geological Survey (USGS), and the Illinois Environmental Protection Agency (IEPA).

Suspended Sediment Data

The USGS data are mean daily water discharge and suspended sediment concentrations for 39 monitoring stations. Three of the stations are on the Mississippi River, and two stations are located on the main stem of the Illinois River. The remaining 34 stations are on the tributary streams of the Illinois, Ohio, and Mississippi Rivers. Record length varies from 1 to 16 years for the period of record from 1972 to 1990.

The ISWS data include instantaneous suspended sediment concentrations and water discharges measured weekly and sometimes daily at 59 stations. These stations are part of the observation network established by the Water Survey for monitoring air, water, and suspended sediments in Illinois. The sediment network was started in 1981 with the distribution of 50 monitoring sites around the state. All the sediment monitoring sites are located in the vicinity of USGS river gaging stations so that the sediment loads at these sites can be calculated from instantaneous discharges obtained from rating tables supplied by the USGS. Over a period of ten years, the number of monitoring sites dropped from 50 stations in water year (WY) 1981 to 13 by WY 1990.

The IEPA database, STORET, contains records from 239 suspended sediment measuring stations for the period of record from 1971 to 1990. The sediment data in the STORET database are instantaneous concentrations taken at irregular intervals, and many of the stations have less than one year of record. The sediment data for the 239 stations are included in the sediment database. However, the trend analyses described below used records from only 58 stations with ten or more data points each.

A summary of the records in the database, including information on the sources of data, the number of monitoring stations, the frequency of data collection, and the periods of records, is given in table 1. The distribution of the suspended sediment sites in operation between 1971 and 1990 is shown in figure 1a, and the combined total for the three data sources is shown in figure 1b. Selecting stations with ten or more data sets reduced the number of IEPA sites included in the trend analysis to 58 stations. Figure 2a shows the distribution of the sediment stations in terms of the numbers of years of available records, while figure 2b shows the combined total number of stations for the three agencies. Most stations have fewer than five years of record.

Table 1. Summary of Suspended Sediment Records in the Sediment Database

Source of data	*Number of monitoring stations*	*Frequency of data collection*	*Period of record*
ISWS sediment network	59	Instantaneous daily & weekly	1981-1990
USGS	39	Mean daily	1972-1990
IEPA STORET	239	Instantaneous weekly, periodic	1971-1990
ISWS lake sedimentation	118	Periodic surveys	1924-1986

Table 2 contains detailed information on the sediment stations, including station name, drainage area, river basin name, period of record, and type and frequency of record. The locations of the sediment gaging stations are shown in figure 3.

Lake Sedimentation Data

The lake sedimentation data were obtained from reports on previous studies conducted by the Water Survey. Survey data from 118 lakes and reservoirs were included in the sediment database (table 1). The spatial distribution of the locations of the surveyed reservoirs covers most of the state except for the northeastern corner. Table 3 summarizes the reservoir sites and includes information on watershed drainage area, township range and section, and the number of lake surveys conducted since the

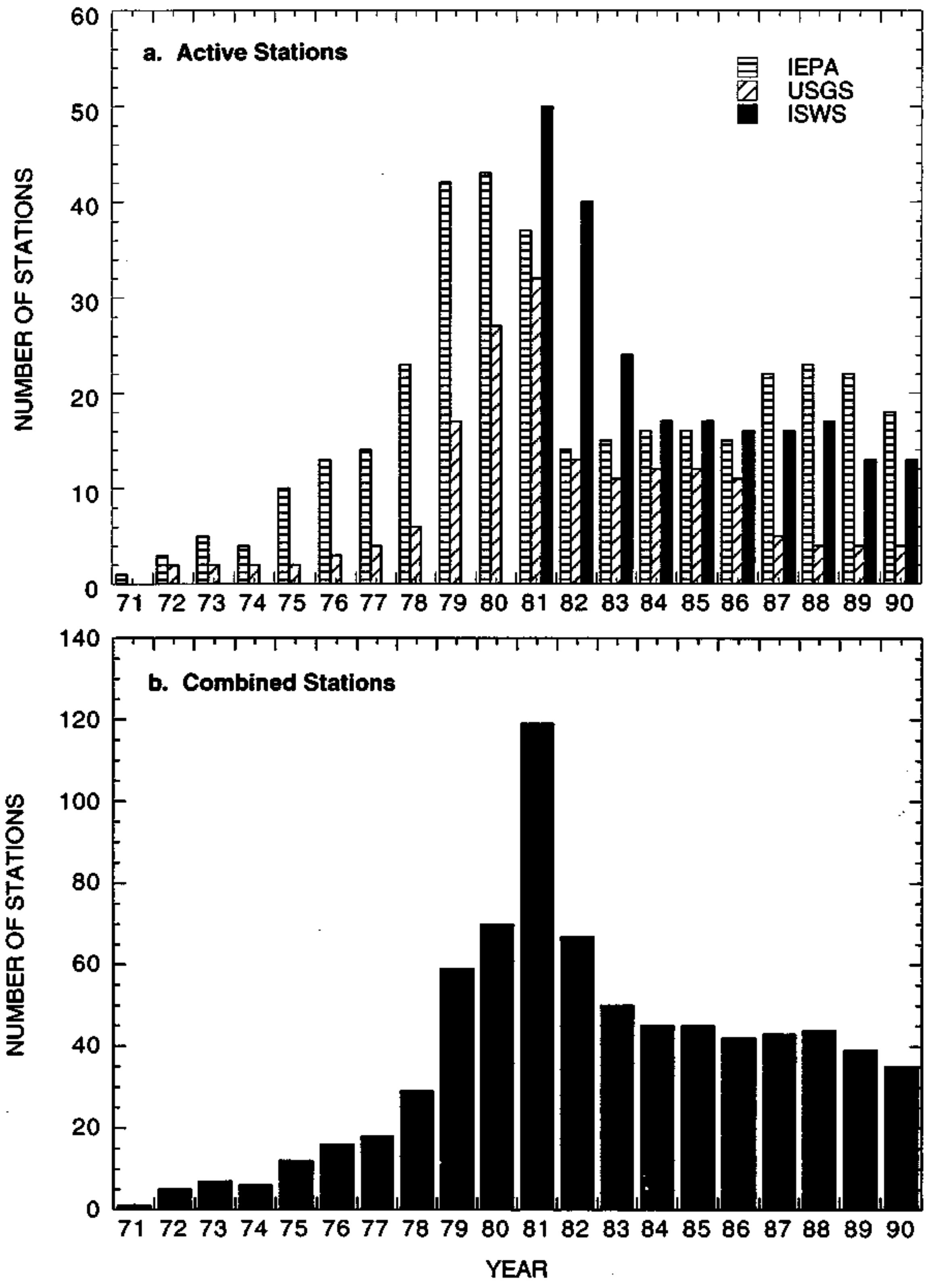

Figure 1. Sediment gaging stations, 1971 to 1990

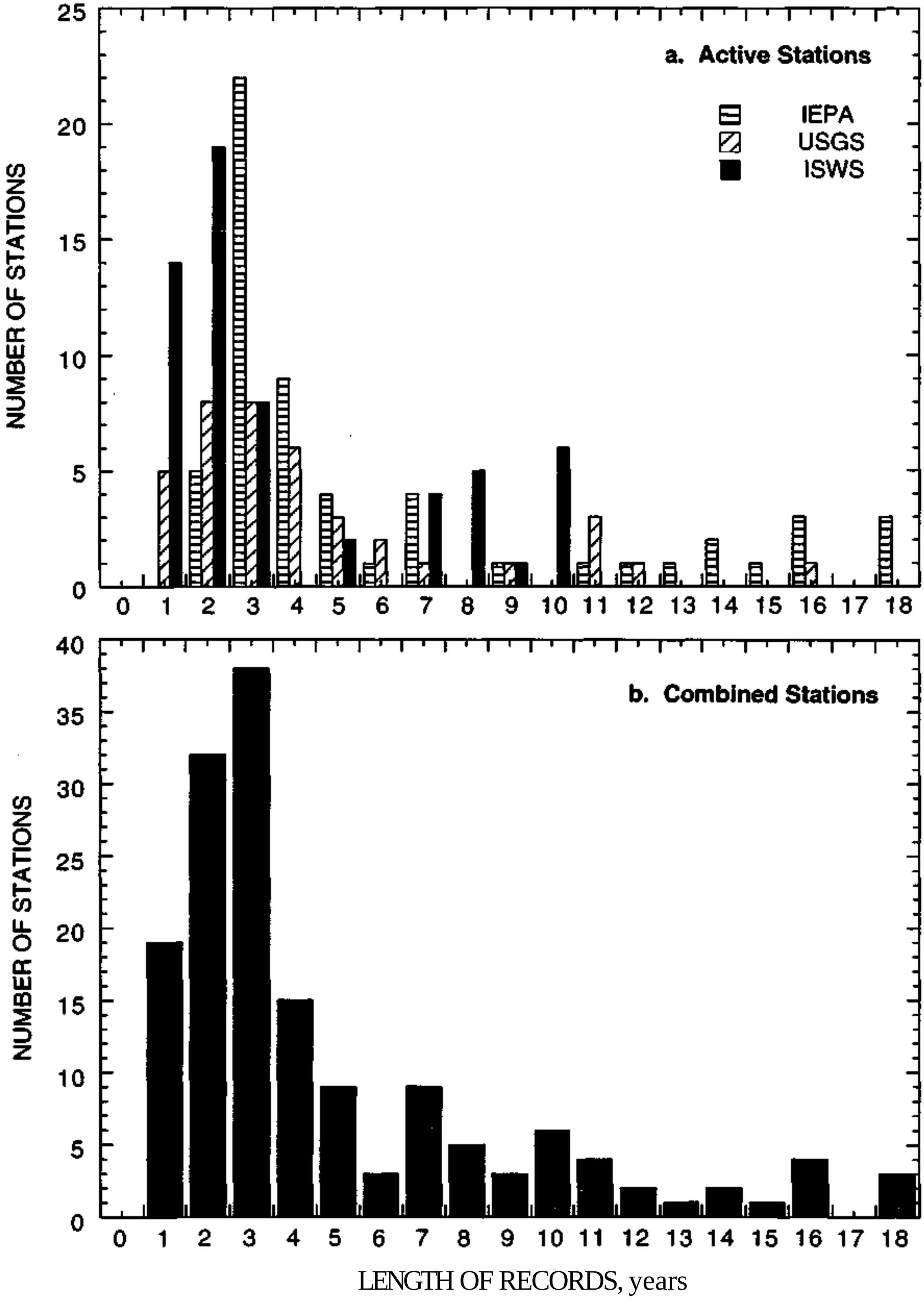

Figure 2. Suspended sediment gaging stations by record lengths, 1971 to 1990

Table 2. Summary of Location Information for Stations in Illinois

Station code	USGS station number	USGS station name	Drainage area (sq mi)	River basin	Period of record	Type and frequency of record (collecting agency, years)		
						Mean daily	*Instantaneous weekly*	*Instantaneous sporadic*
101	05418950	Apple River near Elizabeth	207	Apple	1981-82		SWS 1981-82	
102	05435500	Pecatonica River at Freeport	1326	Rock	1981-82,2/84-90		SWS 81-82, 2/84-90	
103	05437500	Rock River at Rockton	6363	Rock	1981-90		SWS 1981-90	
104	05438500	Kishwaukee River near Belvidere	538	Rock	1981-82		SWS 1981-82	
105	05440000	Kishwaukee River near Perryville	1099	Rock	4/79-81,83-90	USGS 4/79-81	SWS 1983-90	IEPA 1/79-8/81
106	05439500	South Branch Kishwaukee River near Fairdale	387	Rock	1981-82		SWS 1981-82	
107	05550000	Fox River at Algonquin	1403	Fox	1981-82,4/87-90		SWS 1981-82	IEPA 4/87-8/90
108	05529000	Des Plaines River at Des Plaines	360	Des Plaines	1981		SWS 1981	
109	05532500	Des Plaines River at Riverside	630	Des Plaines	1/79-82,87-90	USGS 4/79-82		IEPA 1/79-82,87-90
110	05551200	Ferson Creek near St. Charles	51.7	Fox	1981-82		SWS 1981-82	
111	05439000	South Branch Kishwaukee River at DeKalb	77.7	Rock	1980-81	USGS 1980-81		
112	05444000	Elkorn River near Penrose	146	Rock	1981-82		SWS 1981-82	
113	05446500	Rock River near Joslin	9549	Rock	5/75-4/84	USGS 5/80-82	SWS 1983	IEPA 5/75-4/84
114	05551540	Fox River at Montgomery	1732	Fox	1981-83		SWS 1981-83	
115	05539000	Hickory Creek at Joliet	107	Des Plaines	1981		SWS 1981	
116	05540500	DuPage River at Shorewood	324	DuPage	1981,4/87-8/90		SWS 1981	IEPA 4/87-8/90
117	05552500	Fox River at Dayton	2642	Fox	1981,4/87-90		SWS 1981	IEPA 4/87-90
118	05556500	Big Bureau Creek at Princeton	196	Bureau	1981-90		SWS 1981-90	
119	05447500	Green River near Geneseo	1003	Green	3/78-81,83	USGS 3/78-81	SWS 1983	IEPA 5/78-8/81
120	05466500	Edwards River near New Boston	445	Edwards	1/79-81	USGS 1/79-81		IEPA 3/79-81
121	05466000	Edwards River near Orion	155	Edwards	1981-82		SWS 1981-82	
122	05555300	Vermilion River near Lenore	1251	Vermilion	6/80-81,84-90	USGS 6/80-81	SWS 1984-90	IEPA 7/79-7/81
123	05542000	Mazon River near Coal City	455	Mazon	1981-90		SWS 1981-90	
124	05527500	Kankakee River near Wilmington	5150	Kankakee	3/79-90	USGS 1979-82	SWS 1983-90	IEPA 3/79-8/81,8/87-7/90
125	05520500	Kankakee River near Momence	2294	Kankakee	3/79-90	USGS 1979-81	SWS 1982-85, 88-90	IEPA 3/79-7/81,4/87-8/90
126	05568800	Indian Creek River near Wyoming	62.7	Spoon	7/79-81	USGS 1981		IEPA 7/79-81
127	05467000	Pope Creek near Keithsburg	183	Pope Creek	1981-82		SWS 1981-82	
130	05536000	North Branch Chicago River at Niles	100	Chicago	85-86,7/88,8/90	USGS 1985-86		IEPA 85-8/86,7/88,8/89
131	05558300	Dlinois River at Henry	13543	Illinois	1983-86	USGS 1984-86		IEPA 1983-86
141	05532000	Addison Creek at Bellwood	17.9	Illinois	6/88-6/89			IEPA 6/88-6/89
142	05536995	Chicago Sanitary & Ship Canal at Romeoville	739	Illinois	4/87-90			IEPA 4/87-90
143	05546700	Fox River near Channel Lake	871	Illinois	12/75-7/77			IEPA 12/75-7/77
144	05548280	Nippersink Creek near Spring Grove	192	Illinois	12/75-7/77,7/78			IEPA 12/75-7/77,7/88
203	05437630	Spring Cr. at McFarland Road near Rockford	2.44	Rock	6/79-81	USGS 6/79-81		IEPA 6/79-81

Table 2. Continued

Station code	USGS station number	USGS station name	Drainage area (sqmi)	River basin	Period of record	Type and frequency of record (collecting agency, years): Mean daily	Instantaneous weekly	Instantaneous sporadic
204	05437632	Spring Cr. at Rock Valley College at Rockford	2.81	Rock	6/79-81	USGS 6/79-81		IEPA 7/79-81
227	05543500	Illinois River at Marseilles	8259	Illinois	5/75-90			EPA 5/75-90
228	05469000	Henderson Creek near Oquawka	432	Henderson	4/78-81,84-88	USGS 4/78-81	SWS 1984-88	IEPA 5/78-81
229	05569500	Spoon River at London Mills	1062	Spoon	1981-88		SWS 1981-87	
230	05566500	East Branch Panther Creek at El Paso	30.5	Mackinaw	1981-82		SWS 1981-82	
231	05554490	Vermilion River at McDowell	551	Vermilion	1981-82		SWS 1981-82	
232	05526000	Iroquois River near Chebanse	2091	Kankakee	1979-83,87-90	USGS 1979-81	SWS 1982-83	IEPA 79-81,87-90
233	05525000	Iroquois River at Iroquois	686	Kankakee	71-72,79-83,90	USGS 1979-80	SWS 1981-83	IEPA 71-72,79-80,90
234	05525500	Sugar Creek at Milford	446	Kankakee	1981,8/87-90		SWS 1981	IEPA 4/81,8/87-90
235	05564400	Money Creek near Towanda	49	Mackinaw	1981		SWS 1981	
235	05567500	Mackinaw River near Congerville	767	Mackinaw	1983-84	USGS 1983-84		
236	05567510	Mackinaw River below Congerville	776	Mackinaw	1981-86	USGS 1983-86	SWS 1981-82	IEPA 5/83-86
237	05568005	Mackinaw River below Green Valley	1092	Mackinaw	1981		SWS 1981	
238	05570350	Big Creek at St. David	28	Spoon	1972-80	USGS 1972-80		IEPA 12/71-6/73,7/76-5/78
239	05570370	Big Creek near Bryant	41.2	Spoon	1972-87	USGS 1972-87		IEPA 12/72-8/75,3/77-1/87
240	05570380	Slug Run near Bryant	7.12	Spoon	1976-80	USGS 1976-80		IEPA 4/78-6/80
241	05570000	Spoon River at Serville	1636	Spoon	1971-4/82,86-90	USGS 1981		IEPA 12/71-4/82,86-90
242	05584500	La Moine River at Colmar	655	La Moine	1981-88		SWS 1981-88	
243	05495500	Bear Creek near Marceline	349	Bear Creek	1981-82		SWS 1981-82	
244	05584685	Grindstone Creek near Birmingham	45.4	La Moine	1981	USGS 1981		
245	05585000	La Moine River at Ripley	1293	I a Moine	1981,84-90	USGS 1981	SWS 1984-90	
246	05583000	Sangamon River near Oakford	5093	Sangamon	3/79-90	USGS 1981-86		IEPA 3/79-7/81,1/83-90
247	05582000	Salt Creek near Greenview	1804	Sangamon	1981-83		SWS 1981-83	
248	05578500	Salt Creek near Rowell	355	Sangamon	1981-83		SWS 1981-83	
249	05572000	Sangamon River at Monticello	550	Sangamon	1981-90		SWS 1981-90	
250	03336900	Salt Fork near St. Joseph	134	Vermilion	1981-82		SWS 1981-82	
251	03339000	Vermilion River near Danville	1290	Vermilion	1981		SWS 1981	
252	05576500	Sangamon River at Riverton	2618	Sangamon	1981-83		SWS 1981-83	
253	05586100	Illinois River at Valley City	26564	Illinois	6/75-90	USGS 2/80-90		IEPA 6/75-90
254	05576022	South Fork Sangamon River below Rochester	870	Sangamon	1981-82		SWS 1981-82	
255	05591200	Kaskaskia River at Cook Mills	473	Kaskaskia	1/79-90	USGS 1/79-90		IEPA 3/79-6/90
261	05569968	Turkey Creek near Fiatt	11.5	Illinois	5/78-4/81			IEPA 5/78-4/81
262	05570330	West Branch Big Creek near Canton	4.24	Illinois	5/78-5/80			IEPA 5/78-5/80
356	03343550	Embarras River near Oakland	542	Embarras	1/79-82	USGS 1/79-82		EPA 3/79-82
357	03344000	Embarras River near Diona	919	Embarras	1981-83		SWS 1981-83	

Table 2. Concluded

Station code	USGS station number	USGS station name	Drainage area (sq mi)	River basin	Period of record	Type and frequency of record (collecting agency, years): Mean daily	Instantaneous •weekly	Instantaneous sporadic
358	05592100	Kaskaskia River near Cowden	1330	Kaskaskia	1981-82		SWS 1981-82	
359	05587000	Macoupin Creek near Kane	868	Macoupin	1981		SWS 1981	
360	05592800	Hurricane Creek near Mulberry Grove	152	Kaskaskia	1981		SWS 1981	
361	05592500	Kaskaskia River at Vandalia	1904	Kaskaskia	1981-90		SWS 1981-90	
362	03345500	Embarras River at Ste. Marie	1516	Embarras	1981-90		SWS 1981-88	IEPA 11/86-90
363	03346000	North Fork Embarras River near Oblong	318	Embarras	1981-83		SWS 1981-83	
364	03378900	Little Wabach River at Louisville	745	L. Wabash	3/77-81	USGS 3/77-81		EPA 3/77-7/81
365	05593520	Crooked Creek near Hoffman	254	Kaskaskia	1981-82		SWS 1981-82	
366	05594000	Shoal Creek near Breese	735	Kaskaskia	1981-83		SWS 1981-83	
367	05594800	Silver Creek near Freeburg	464	Kaskaskia	6/79-90		SWS 1981-90	IEPA 6/79-5/81
368	03380500	Skillet Fork at Wayne City	464	L. Wabash	1981		SWS 1981	
369	03379600	Little Wabash River at Blood	1387	L. Wabash	1981-82		SWS 1981-82	
370	03381500	Little Wabash River at Carmi	3102	L. Wabash	1977-8/79,81-85		SWS 1981-85	EPA 1977-8/79
371	05597000	Big Muddy River at Plumfield	794	Big Muddy	1981-82		SWS 1981-82	
373	05599500	Big Muddy River at Murphysboro	2169	Big Muddy	5/75-90	USGS 5/80-90		EPA 5/75-90
374	05597500	Crab Orchard Creek near Marion	31.7	Big Muddy	1981		SWS 1981	
375	03382170	Brushy Creek near Harco	13.3	Saline	6/79-81	USGS 2/80-81		EPA 6/79-7/81
376	03382100	South Fork Saline River near Carrier Mills	147	Saline	6/79-81	USGS 1980-81		EPA 6/79-8/81
377	03384450	Lusk Creek near Eddyville	42.9	Lusk	11/79-81	USGS 1/80-81		EPA 11/79-8/81
378	03612000	Cache River at Forman	244	Cache	1981-90		SWS 1981-90	
379	05594100	Kaskaskia River near Venedy Station	4393	Kaskaskia	5/75-90	USGS 5/80-90		EPA 5/75-8/88
380	05587455	Mississippi River below Grafton	171300	Mississippi	5/89-90			EPA 5/89-90
381	05587550	Mississippi River below Alton	171500	Mississippi	1/75-9/89			EPA 1/75-9/89
382	05594090	Sugar Creek at Albers	124	Kaskaskia	6/79-5/81			EPA 6/79-5/81
383	05595200	Richland Creek near Hecker	129	Kaskaskia	6/79-5/81			EPA 6/79-5/81
384	05595226	Doza Creek near Lenzburg	18	Kaskaskia	5/78-5/80			EPA 5/78-5/80
385	05595228	South Branch Doza Creek near Lenzburg	8	Kaskaskia	5/78-4/80			EPA 5/78-4/80
386	03381495	Little Wabash River at Main Street at Carmi	3088	Wabash	10/79-2/86			EPA 10/79-2/86
387	05597280	Little Muddy River near Elkville	213	Big Muddy	6/79-5/81			EPA 6/79-5/81
388	03382160	Bankston Fork near Crab Orchard	1.9	Saline	5/78-5/80			EPA 5/78-5/80
389	03382045	Little Cana Creek near Creal Spring	1.45	Saline	5/78-5/80			EPA 5/78-5/80
390	03612500	Ohio R. at Lock & Dam 53, near Grand Chain	203100	Ohio	2/73-90			EPA 2/73-90
392	05587500	Mississippi River at Alton	171500	Mississippi	10/75-85	USGS 1981-85		EPA 10/75-9/76,1/83-3/85
393	07020500	Mississippi River at Chester	708200	Mississippi	1980-86	USGS 1980-86		
394	07022000	Mississippi River at Thebes	713200	Mississippi	1/73-90	USGS 1981-86		EPA 1/73-90
444	05584680	Grindstone Creek near Industry	3535	La Moine	1981	USGS 1981		

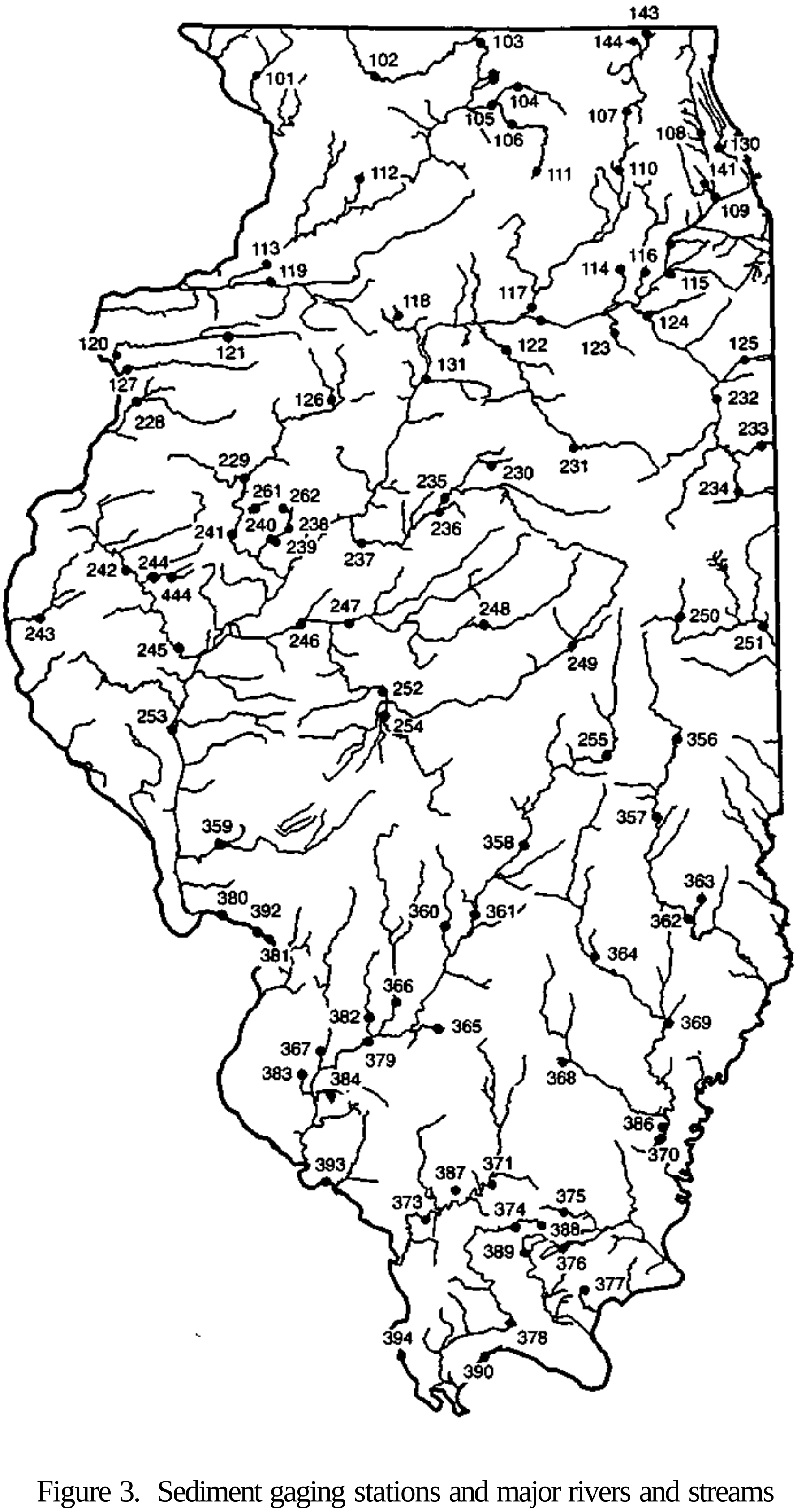

Figure 3. Sediment gaging stations and major rivers and streams

Table 3. Summary of ISWS Lake Sedimentation Data

County and reservoir codes	*Reservoir name*	*Drainage area (sq mi)*	*Township, range, and section*	*Year of construction/ original capacity survey*	*Year of Survey*			**No. of** *records*
1-1	CBQ Reservoir	2.13	01N06W35	1875	1962			2
1-2	Clayton Reservoir	3.17	01S05W2	1943	1962			2
1-3	Saukenauk Lake	1.54	02N08W9	1953	1962			2
3-1	Ayer's Reservoir	1.9	06N03W21	1906	1958			2
5-1	Mt. Sterling Reservoir	1.8	01S03W4	1935	1951	1954	1962	4
5-2	Hambaugh-Martin #1	2.09	02S02W33	1961	1972			2
9-1	Virginia Reservoir	0.83	18N10W34	1933	1950	1964	1982	4
11-1	Lake Taylorville	131.3	13N02W36	1962	1977			2
12-1	Craig & Davidson Lake	0.67	09N12W8	1947	1959			2
12-2	Stevenson's Lake	0.37	11N13W32	1950	1959			2
13-1	Brown Park Lake	1.47	03N06E33	1938	1959			2
13-2	Greendale Lake	9.5	03N05E31	1927	1940			2
13-3	Patterson Lake	1.27	05N05E17	1926	1959			2
14-1	Carlyle Lake @445	2719	02N02W18	1971	1976			2
15-1	Lake Charleston	811	12N09E25	1947	1960	1974		3
15-2	Ridge Lake	1.41	11N09E13	1941	1947			2
15-3	Lake Paradise	18.1	11N07E8	1908	1979			2
15-4	Oakland Lake	14.31	14N11E18	1937	1954	1972	1973	4
18-1	Vevay Park Lake	0.25	10N10E26	1906	1959			2
26-1	Farina Lake	0.35	05N04E25	1928	1958			2
26-2	Etcheson's Lake	0.17	07N01E31	1943	1958			2
28-1	Christopher City Reservoir	0.93	06S01E16	1925	1960			2
28-2	ICRR Reservoir, Thompsonville	1.8	07S04E3	1926	1960			2
28-3	Valier Outing Club Reservoir	2.47	05S01E36	1922	1957			2
28-4	West Frankfort Reservoir (New)	7.62	07S04E18	1945	1960			2
28-5	West Franklin Reservoir (Old)	4.03	07S04E19	1926	1936			2

Table 3. Continued

County and reservoir codes	*Reservoir name*	*Drainage area (sq mi)*	*Township, range, and section*	*Year of construction/ original capacity survey*	*Year of survey*			*No. of records*
28-6	Rend Lake @ 405	488	06S02E3	1970	1980			*2*
29-1	Astoria Reservoir	0.42	03N01E15	1924	1962			2
29-2	Avon Reservoir Lake	3.09	08N01E20	1906	1962			2
29-3	Canton Lake	15	07N05E30	1939	1960			2
31-1	Greenfield Pond	0.23	10N10W10	1924	1952			2
31-2	Roodhouse Park District	0.45	12N11W19	1917	1952			2
31-3	Whitehall Lake	0.97	12N12W36	1897	1952			2
31-4	Woodbine Country Club Lake	0.33	11N10W16	1926	1952			2
34-1	Carthage Reservoir	3.07	05N07W13	1926	1949	1955	1962	4
37-1	Johnson Sauk Trail Lake	1.37	16N05E35	1958	1981			2
39-1	Little Cedar Lake	6.53	10S02W35	1969	1976			2
39-2	Carbondale Reservoir	3.3	09S01W33	1926	1948			2
41-1	ICRR Reservoir Bluford	3.35	02S04E35	1926	1960			2
41-2	Packerwood Lake (Farrell Lake)	0.52	02S02E11	1945	1960			2
41-3	Miller Lake	4.65	01S03E32	1944	1953			2
41-4	Jaycee Lake (Mt. Vernon Reservoir)	2.61	02S03E8	1908	1924	1925	1959	4
48-1	Lake Bracken	8.91	10N10E14	1923	1936	1949	1962	4
48-2	Lake Calhoun	13.1	13N04E23	1924	1936	1947		3
48-3	Lake Storey	7.07	12N01E32	1928	1962			2
48-4	CB&Q Reservoir, Rio	0.4	13N01E20	1888	1962			2
55-1	Argyle Lake	6.56	05N03W6	1950	1962			2
55-2	Spring Lake	20.2	06N03W15	1927	1951	1968		3
55-3	Lake Vermont	2.3	04N01W25	1942	1962	1980		3
57-1	Lake Bloomington	61	25N02E1	1929	1948	1952	1955	4
57-2	Dawson Lake	4.5	23N04E35	1964	1986			2

Table 3. Continued

County and reservoir codes	Reservoir name	Drainage area (sq mi)	Township, range, and section	Year of construction/ original capacity survey	Year of Survey					No. of records
58-1	Lake Decatur	906	16N02E22	1922	1936	1946	1956	1966	1983	6
59-1	Arctic Lake	0.53	09N07W11	1922	1949	1954	1961			4
59-2	Bunker Hill Reservoir	7.19	07N08W16	1937	1954					2
59-3	Lake Carlinville	25.4	09N07W10	1929	1949	1954	1959	1986		5
59-4	Edwards Lake	0.7	08N06W17	1949	1958					2
59-5	Old Gillespie Lake	5.73	08N07W10	1922	1954					2
59-6	King's Lake	0.38	07N06W16	1921	1958					2
59-7	Mt. Olive lake	5.21	08N06W28	1938	1958	1981				3
59-8	Rinaker Lake	0.49	09N07W6	1904	1958					2
59-9	Lake Staunton	3.68	07N06W20	1926	1954	1978				3
59-10	Wilsonville, Milne Pond #4	5.29	07N07W10	1916	1958					2
59-11	Old Olive Reservoir	0.7	07N06W3	1896	1981					2
60-1	Highland Silver Lake	49.3	04N05W30	1962	1981	1984				3
60-2	Schaefer Lake	0.09	05N07W30	1937	1949					2
61-1	ICRR Reservoir, Kinmundy	0.55	04N03E28	1902	1959					2
61-2	Raccoon Lake	48.4	01N01E8	1943	1959					2
61-3	Salem Reservoir	4.02	02N02E2	1912	1960					2
65-1	GM&O Lake, Tallula	0.85	17N08W12	1902	1952					2
66-1	Matherville Lake	0.33	15N02W28	1925	1962					2
66-2	Nelson Lake	0.5	15N04W15	1938	1962					2
68-1	Panama Lake	0.85	07N04W22	1928	1958					2
68-2	Walton Park Lake	2.04	08N05W9	1862	1959					2
68-3	Lake Lou Yaeger	115	09N05W35	1965	1977					2
69-1	Anderson Pond	0.63	16N11W28	1909	1952					2
69-2	Conlee Pond	0.39	14N09W5	1944	1952					2
69-3	Elliot State Bank Pond	0.31	14N10W9	1900	1952					2

Table 3. Continued

County and reservoir codes	Reservoir name	Drainage area (sq mi)	Township, range, and section	Year of construction/ original capacity survey	Year of Survey				No. of records
69-4	Franklin Outing Club Lake	0.45	14N08W31	1905	1952				2
69-5	Lake Jacksonville	10.8	14N10W9	1940	1952	1986			3
69-6	Langdon Pond	0.36	14N09W31	1907	1952				2
69-7	Morgan Lake	2.75	15N10W33	1900	1952				2
69-8	Mauvaiseterre Lake	32.6	15N10W28	1921	1952	1979			3
69-9	Waverly Lake	9.24	13N08W5	1939	1952	1971			3
73-1	Lake Duquoin	10.73	05S01W29	1939	1957				2
75-1	Old Pittsfield Lake	1.64	05S04W13	1925	1962				2
75-2	Lake Pittsfield (New-Big Blue Lake)	11.1	05S03W16	1961	1974	1979	1985		4
79-1	Coulterville Reservoir	1.22	04S05W11	1939	1954				2
80-1	Borah Lake (New Olney Reservoir)	3.36	04N10E22	1954	1960				2
83-1	Eldorado Reservoir	2.23	08S06E13	1920	1949				2
83-2	Dering Coal Pond	0.22	08S06E13	1919	1949				2
84-1	Aschauer Pond	0.53	17N03W31	1939	1952				2
84-2	Davis, Hose & Davis Pond	0.21	16N07W1	1942	1952				2
84-3	Lake George	0.13	17N05W12	1936	1952				2
84-4	Schmidt Pond	1.31	14N06W14	1943	1952				2
84-5	Lake Springfield	265	15N05W12	1934	1948	1965	1977	1984	5
87-1	Lake Mattoon	39.7	10N06E1	1958	1980				2
87-2	Lake Shelbyville @599.7	1054	11N04E8	1970	1980				2
88-1	Armstrong Pond	0.45	13N06E4	1950	1962				2
88-2	Ewan Pond	1.25	14N06E29	1935	1962				2
89-1	Lake Le-Aqua-Na	3.67	28N06E17	1955	1981				2
91-1	Alto Pass Reservoir	0.62	11S02W10	1967	1976				2
91-2	Anna State Hospital	0.97	12S02W14	1914	1036	1953			3

Table 3. Concluded

County and reservoir codes	Reservoir name	Drainage area (sq mi)	Township, range, and section	Year of con-struction/ original capacity survey	Year of Survey		No. of records
91-3	Dongola City Reservoir	3.55	13S01W25	1970	1981		2
92-1	Lake Vermilion	298	20N11W31	1925	1963	1976	3
95-1	Ashley Lake	1.21	02S01W14	1940	1954	1985	3
95-2	Nashville Reservoir	1.39	02S02W19	1935	1954		2
96-1	Steiner Lake	0.31	01S08E33	1945	1960		2
97-1	Norris City	0.83	06S08E27	1936	1954		2
98-1	Lake Carlton	2.31	21N05E6	1969	1975		2
100-1	Baker's Lake	0.26	10S02E14	1937	1951		2
100-2	Crab Orchard Lake	196	09S01E19	1940	1951	1963	3
100-3	Fluck's Lake	0.34	09S02E22	1919	1951		2
100-4	Herrin Reservoir	1.78	09S02E6	1913	1951		2
100-5	Herrin Reservoir	3.13	10S02E20	1927	1936		2
100-6	Johnston City Reservoir	3.85	08s03E27	1922	1957		2
100-7	Knights of Pythias Lake	0.26	09S03E33	1925	1951		2
100-8	Little Grassy Lake	15.1	10S01E30	1942	1951		2
100-9	Marion Reservoir	6.48	10S02E2	1921	1951		2

reservoirs were built. The locations of the reservoir sites are identified in figure 4. Most of the lakes and reservoirs are located in the western and southern parts of the state. The northern section of the state has fewer reservoirs due to the abundance of ground-water resources serving as the primary water supply for communities in the area and because Lake Michigan has been the water supply for the Chicago area for many years.

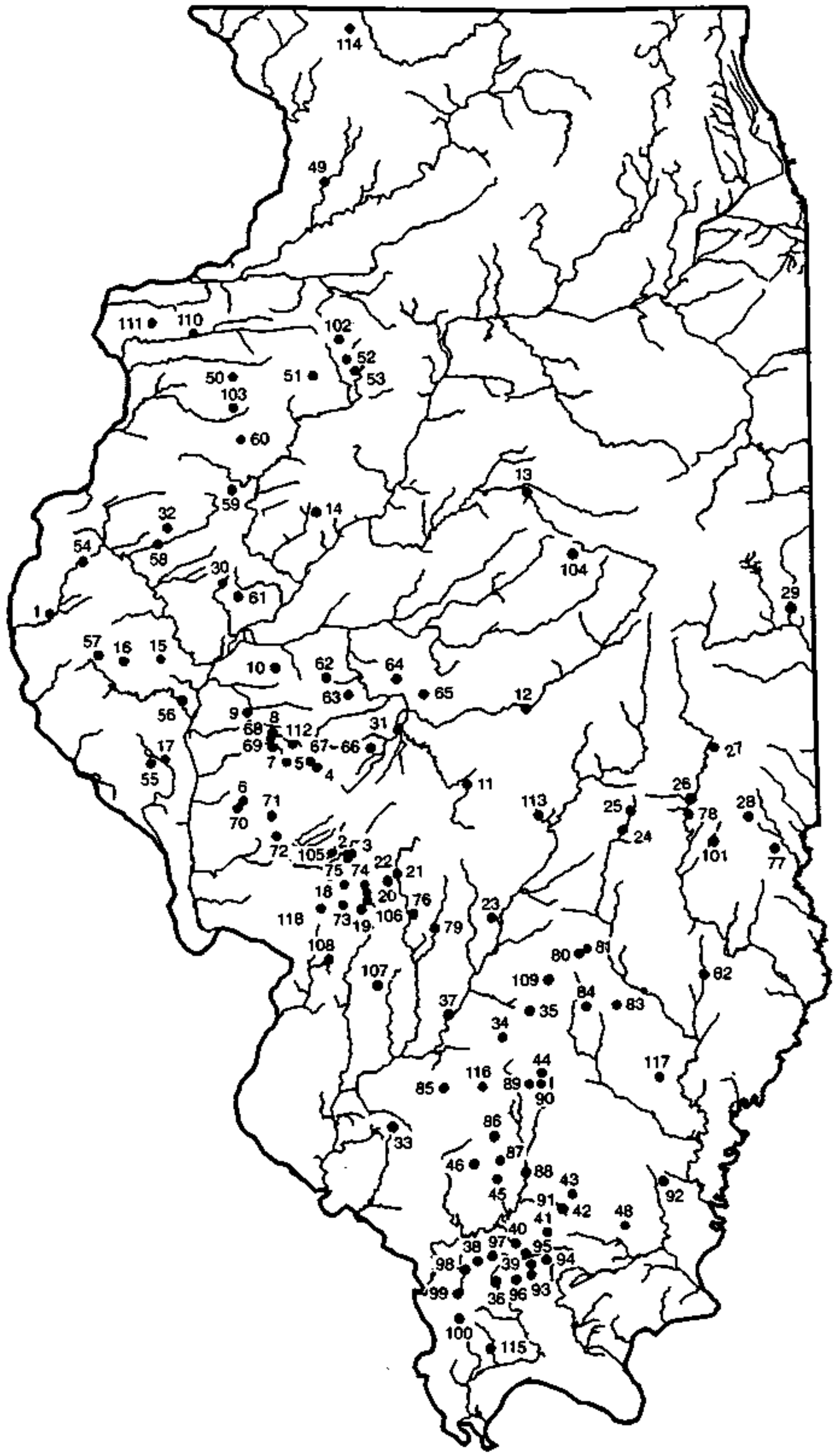

Figure 4. Map of Illinois showing locations of 118 reservoir sedimentation survey sites and major rivers and streams

REGIONAL DISTRIBUTION OF SUSPENDED SEDIMENTS

The analysis described in this section involves a determination of the regional distribution of annual suspended sediment yield for the drainage basins upstream of the sediment and streamgaging stations in the state. The annual sediment load was analyzed for the 34 USGS sediment gaging sites on the tributaries of the Illinois and Mississippi Rivers. A ten-year period from 1978 to 1987 was selected for analysis, since the highest number of active gaging stations were then in operation. Annual sediment yields for the years during which some of the stations were inactive were estimated from sediment discharge-water discharge rating curves. The rating curves were obtained from the measured mean daily sediment and mean daily water discharge for those years during which the sediment stations were maintained by the ISWS, USGS, and IEPA.

A plot of the annual sediment yield against the annual water discharge showed the stations clustered into four distinct groups. This grouping was used to classify the watershed drainage areas upstream of the sediment gaging sites into four sediment yield rate regions. A map of the regional distribution of sediment yield rates for the watersheds was produced on a GIS-based map.

Spatial Distribution of Sediment Yield

The spatial distribution of sediments transported in Illinois rivers and streams can be examined by analyzing the variation in observed annual sediment load data from station to station. It was shown in the previous section that most of the sediment stations do not have complete daily suspended sediment discharge records. Several gaps exist in the mean daily suspended sediment load records as well, but these can be filled by estimating the loads using predictive sediment transport equations. The sediment transport equations were derived from regression relations between the measured mean daily sediment loads and the corresponding mean daily water discharges for all available records at each station.

Demissie et al. (1992) tested several regression equations and recommended the following nonlinear regression relation for predicting the mean daily suspended sediment load, Q_s , using the mean daily water discharge, Q_w:

$$\log Q_s = a + b\,(\log Q_w)^c \qquad (1)$$

where a, b, and c are regression coefficients. This nonlinear sediment transport equation was used in the following analysis. Data pairs in which the water discharge values are below 1 cubic foot per second (cfs) were excluded from the analysis because the equation breaks down when the logarithm of numbers less than one is evaluated. This should have little effect on the results, since only a small portion of the total annual suspended sediment load is transported during periods of low flow.

All available pairs of sediment load and water discharge data for each of the sediment stations were used in the nonlinear regression analysis. The regression parameters and the coefficient of determination are shown in table 4 for the 34 USGS stations' records. The regression parameters were obtained by minimizing the difference in the sums of the measured and predicted mean daily sediment loads. The coefficient of determination describes how much of the variability in the suspended sediment load is explained by the linear regression equation between Q_s and Q_w. The values of the coefficient of determination in table 4 are generally high except at five stations where it dropped below 0.75.

Figure 5 shows an example of the sediment rating relation for the sediment station on the Kishwaukee River near Perryville. Similar plots have been generated for the other 33 stations (see appendix A).

Due to the previously discussed differences in the lengths of data records for each of the 34 tributary stations, it was necessary to select a short period to determine the distribution of suspended sediment load transport in tributary streams. Figure 3 reveals that the greatest number of active USGS sediment stations operated between 1978 and 1987. This ten-year period was selected for subsequent analysis. Tables 5 and 6 show the annual water discharge and corresponding annual sediment loads for the sediment gaging stations during the selected period.

The annual suspended sediment load was plotted against the annual water discharge (figure 6) for the 34 tributary stations. Four distinct clusters of stations can be

Table 4. Regression Coefficients and Coefficient of Determination Values for the Rating Curves

SWS station number	*USGS station number*	*USGS station name*	*Regression coefficients* Coeff A	Coeff B	Coeff C	*Coefficient of determination*
105	05440000	Kishwaukee River near Perryville	0.8986	0.0310	3.5	0.7646
109	05532500	Des Plaines River at Riverside	-1.3372	0.5383	1.7	0.8879
111	05439000	South Branch Kishwaukee River at DeKalb	-0.4134	0.5475	1.7	0.8496
113	05446500	Rock River near Joslin	2.1603	0.0002	6.4	0.7076
119	05447500	Green River near Geneseo	-0.6689	0.4775	1.8	0.8478
120	05466500	Edwards River near New Boston	-1.2492	1.1022	1.3	0.8661
122	05555300	Vermilion River near Lenore	-1.5459	0.7624	1.5	0.8908
124	05527500	Kankakee River near Wilmington	1.1545	0.0099	3.9	0.8132
125	05520500	Kankakee River near Momence	1.4807	0.0008	5.8	0.7059
126	05568800	Indian Creek River near Wyoming	-2.3893	1.3732	1.0	0.8173
130	05536000	North Branch Chicago River at Niles	-6.4816	5.2403	0.5	0.8591
203	05437630	Spring Creek at McFarland Road Near Rockford	-1.2990	1.0071	1.0	0.8114
204	05437632	Spring Creek at Rock Valley College at Rockford	-1.3049	1.0724	1.0	0.8186
228	05469000	Henderson Creek near Oquawka	-1.4510	1.0215	1.4	0.8751
232	05526000	Iroquois River near Chebanse	0.0247	0.2136	2.1	0.8664
233	05525000	Iroquois River at Iroquois	0.5304	0.0641	3.0	0.6919
235	05567500	Money Creek near Towanda	0.1169	0.1161	2.7	0.9025
236	05567510	Mackinaw River below Congerville	0.0776	0.1923	2.3	0.8365
238	05570350	Big Creek at St. David	-1.1985	0.5976	1.5	0.5508
239	05570370	Big Creek near Bryant	-1.4184	1.3380	1.3	0.8015
240	05570380	Slug Run near Bryant	-0.6151	1.0799	1.7	0.6920
241	05570000	Spoon River at Serville	-5.7361	3.5569	0.8	0.9474
244	05584685	Grindstone Creek near Birmingham	-1.7633	1.6264	1.2	0.9471
245	05585000	La Moine River at Ripley	-5.0418	3.7130	0.7	0.9341
246	05583000	Sangamon River near Oakford	-3.2246	1.7923	1.0	0.8770
255	05591200	Kaskaskia River at Cook Mills	-0.1784	0.3250	1.8	0.8280
356	03343550	Embarras River near Oakland	-0.6069	0.5359	1.6	0.8097
364	03378900	Little Wabash River at Louisville	-1.0644	1.1244	1.1	0.8870
373	05599500	Big Muddy River at Murphysboro	0.8297	0.0878	2.5	0.7504
375	03382170	Brushy Creek near Harco	-1.0944	1.3244	1.0	0.8086
376	03382100	South Fork Saline River near Carrier Mills	-1.9760	1.2426	1.3	0.9445
377	03384450	Lusk Creek near Eddyville	-1.8305	0.6327	1.8	0.8422
379	05594100	Kaskaskia River near Venedy Station	0.3889	0.2327	1.9	0.8490
444	05584680	Grindstone Creek near Industry	-1.9152	1.8688	1.1	0.9457

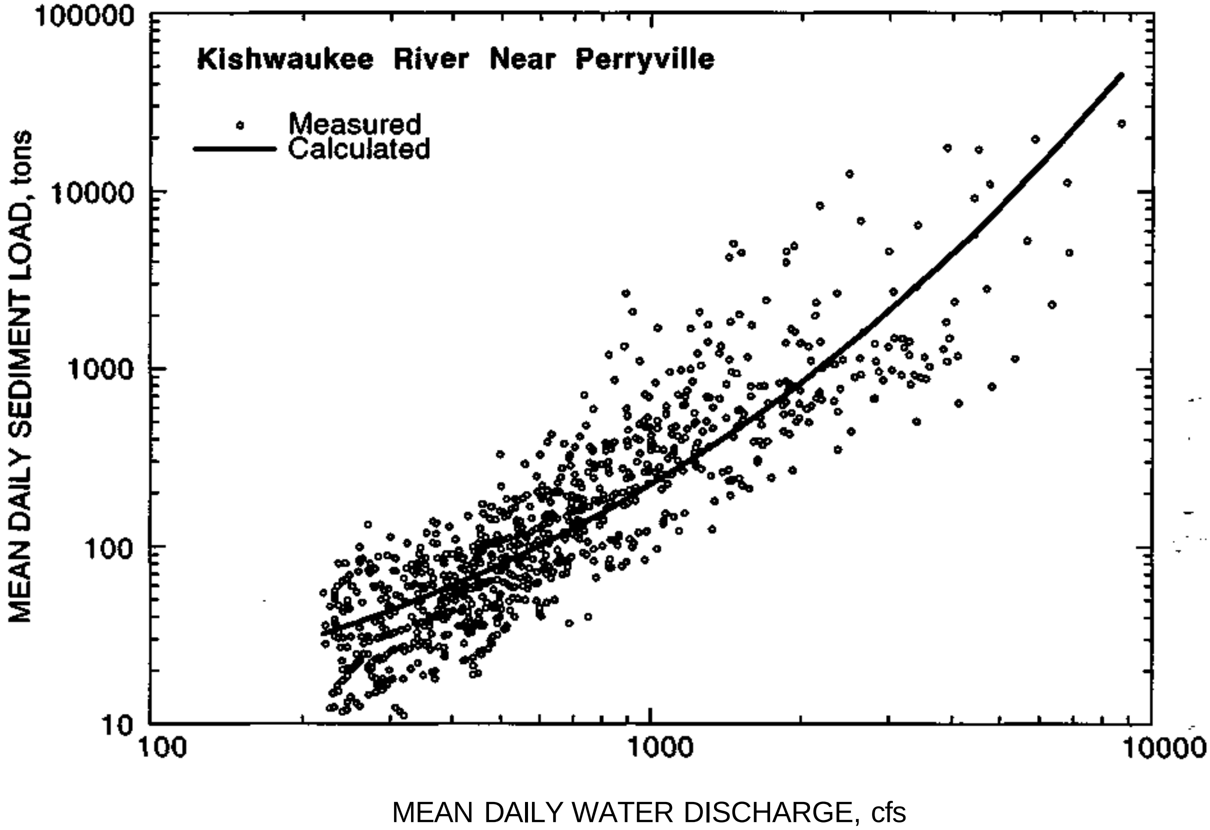

Figure 5. Comparison of sediment rating curve with data for Kishwaukee River near Perryville

Table 5. Annual Water Discharge of Tributary Streams in Illinois (cfs) for Water Years 1978-1987

Station number	*WY78*	*WY79*	*WY80*	*WY81*	*WY82*	*WY83*	*WY84*	*WY85*	*WY86*	*WY87*
105	343400.0	500517.0	276283.0	254629.0	329338.0	517311.0	296020.0	285628.0	426391.0	322795.0
109	221366.0	309138.0	206208.0	214448.0	240349.0	339258.0	281719.0	240377.0	316607.0	312555.0
111	-	-	26867.1	20822.0	24137.6	43884.6	19630.2	18687.2	29930.7	29506.3
113	2567210.0	3230190.0	2201050.0	2320540.0	3142030.0	3337520.0	2524000.0	2883290.0	3773580.0	2855170.0
119	335401.0	356513.0	196189.0	271142.0	331956.0	325511.0	239316.0	247922.0	302624.0	272120.0
120	144191.0	133992.0	87376.0	145305.0	225845.0	174126.0	102579.0	126984.0	138046.0	79158.0
122	396988.0	487950.0	312303.0	435556.0	579757.0	573021.0	403731.0	260622.0	441334.0	294568.0
124	1847458.0	1851863.0	1447091.0	2198730.0	2458080.0	2436438.0	2261662.0	2094358.0	2224696.0	1734190.0
125	819942.0	792575.0	687728.0	1054647.0	1089814.0	1025167.0	796962.0	907316.0	844946.0	753061.0
126	20076.1	20263.7	12315.1	21089.4	28171.8	21639.3	15624.7	19320.4	19436.1	14719.4
130	42170.0	51160.0	37823.0	40076.0	43007.0	57098.0	51541.0	39309.0	56182.0	44892.0
203	-	116.2	296.5	568.0	-	-	-	-	-	-
204	-	168.0	362.3	682.8	-	-	-	-	-	-
228	161592.0	131836.0	86346.0	110624.0	231882.0	149534.7	106190.0	117140.0	112238.0	96758.2
232	787924.0	782532.0	548397.0	718154.0	1084782.0	844675.0	866691.0	655790.0	877912.0	458757.0
233	242173.0	213870.0	190564.0	219490.0	304934.0	255795.0	259661.0	226543.0	304641.0	180720.0
236	-	-	-	-	-	-	291516.3	209928.0	246217.3	-
238	10632.8	9746.0	6454.4	6508.2	12206.9	14703.1	10399.9	7976.1	4233.6	-
239	16303.3	13843.2	9084.5	13120.0	16120.2	21579.4	15563.8	11130.7	14212.5	9638.9
240	766.8	2230.3	2057.3	999.8	1331.9	2277.4	3386.9	2360.9	1412.1	2874.3
241	579028.0	471940.0	287990.0	542495.0	645827.0	647035.0	440044.0	496665.0	481317.0	405834.0
244	-	-	-	-	-	-	-	-	13975.0	-
245	508893.0	251785.0	169505.0	497395.0	502383.0	483776.0	404040.0	460081.0	505538.0	345873.0
246	1657078.0	1743193.0	583245.0	1792282.0	1784602.0	2119908.0	1760606.0	1237661.0	1579581.0	1013627.0
253	-	-	6788810.0	10194560.0	11561220.0	12497590.0	10006190.0	9178420.0	9542800.0	7729210.0
255	216093.0	211473.0	67690.3	152031.0	213051.6	194394.4	216754.5	137845.7	178851.0	95599.6
356	-	255472.0	101306.8	200849.3	254923.0	22137.0	-	-	-	-
364	280359.8	334691.0	119571.7	110413.2	320553.0	-	-	-	-	-
373	583094.0	1199199.0	344245.0	454274.0	764398.0	1410277.0	975068.0	1337573.0	823502.0	389700.0
375	3497.4	7133.8	2512.7	3751.9	5399.2	-	-	-	-	-
376	41570.8	96325.2	33804.7	39285.2	60094.1	120990.7	59782.7	121087.0	58503.2	19229.6
377	16217.0	33066.6	16905.8	15863.9	16730.5	41474.7	23610.1	41241.7	21502.8	7342.0
379	1604040.0	1873688.0	526670.0	633777.0	1889691.0	2130758.0	2435360.0	1975247.0	1269421.0	628146.0
444	-	-	-	10115.1	-	-	-	-	-	-

Table 6. Annual Sediment Discharge of Tributary Streams in Illinois (tons) for Water Years 1978-1987

Station number	*WY78*	*WY79*	*WY80*	*WY81*	*WY82*	*WY83*	*WY84*	*WY85*	*WY86*	*WY87*
105	447112.2	1574135.0	138913.5	84371.2	191115.7	662265.2	171795.1	242919.4	298245.4	257318.9
109	38234.5	108005.6	37210.1	33501.8	41840.2	120136.5	56850.8	63099.7	72920.0	150055.5
111	-	-	9145.3	12473.8	8074.6	39221.3	6665.5	7528.3	13036.7	19115.0
113	1530589.8	6812876.6	720380.1	880798.5	1640102.0	2209351.2	897423.9	2846982.2	2289560.4	1367597.5
119	446509.9	766678.1	190220.2	554051.5	375969.9	524801.9	181744.2	393124.8	412049.8	462759.4
120	511995.7	506193.4	303111.6	525921.4	1007646.4	781484.3	173795.1	737361.5	449489.7	93284.4
122	325018.3	1411890.9	574105.1	842223.3	1394821.1	1954242.5	553875.4	510774.3	738205.9	516471.2
124	418232.9	932636.6	678008.9	1362112.0	776708.1	1218197.9	981325.1	1132973.0	863379.2	332043.3
125	140010.8	157706.3	121273.5	323279.4	323136.0	225027.6	128981.3	210163.0	125037.3	94307.3
126	113981.5	174528.1	100466.0	132646.3	305729.7	132458.9	29021.7	405317.7	65087.0	34991.6
130	6969.1	10631.0	5136.8	5808.5	7747.0	12076.8	9619.7	6354.9	12387.8	10009.1
203	-	15.0	29.1	1159.4	-	-	-	-	-	-
204	-	17.2	44.3	1390.6	-	-	-	-	-	-
228	695851.8	378875.5	257768.9	349008.6	6215671.5	528064.8	160469.8	448799.8	218310.2	493761.6
232	400360.1	559499.3	364472.6	422162.9	965780.2	475941.6	618820.4	489927.1	476557.3	124603.8
233	77032.5	93130.6	69283.8	73150.8	188934.4	89054.4	114973.8	131786.5	120418.5	38313.5
236	-	-	-	-	-	-	395354.0	465000.7	203461.9	
238	44462.5	835807.1	1593.4	2933.1	24864.6	37742.4	7894.0	12135.8	10674.4	
239	16203.2	15129.7	18770.2	18167.5	20022.1	21194.9	12269.8	12947.2	16210.6	9891.9
240	981.9	997.1	1256.9	364.6	379.5	1772.6	5423.1	1139.9	606.3	11670.6
241	2569038.7	2577533.6	1603107.6	2017151.0	3866719.3	4989224.3	1566557.1	4901924.3	1785992.9	2450858.5
244	-	-	-	58302.2	-	-	-	-	-	-
245	1700040.2	657340.8	562611.2	1673210.0	1578037.6	1961537.6	1074059.9	2318160.4	1840572.8	1441597.7
246	520054.5	675306.8	139193.7	2807231.0	43449510.0	899140.2	1737680.0	1097815.0	1534164.0	258445.3
253	-	-	7178171.0	7431352.0	9018179.0	596470.0	5213619.3	5437637.3	7881933.8	4629186.1
255	38420.6	170725.8	11343.3	44203.3	30835.5	78539.0	45557.4	44824.2	42921.8	15459.6
356	-	224579.0	46405.0	109788.4	97958.5	5638.6	-	-	-	-
364	150597.3	313099.9	141193.5	128133.6	274384.6	-	-	-	-	-
373	182806.8	523760.1	68695.2	183270.6	303759.1	451508.1	199069.4	351864.1	206956.0	238296.5
375	1179.1	2816.4	4359.8	15692.6	2605.1	-	-	-	-	-
376	60780.0	255823.3	19755.5	57146.3	207923.0	581925.8	67582.0	291210.1	70241.2	10775.5
377	2630.7	26673.5	1972.3	5217.5	9433.4	92751.4	4123.5	73143.3	5782.1	1327.0
379	673613.5	940960.7	195375.7	427856.1	980952.2	1006518.0	969672.9	750481.1	485288.1	279116.3
444	-	-	-	29926.1	-	-	-	-	-	-

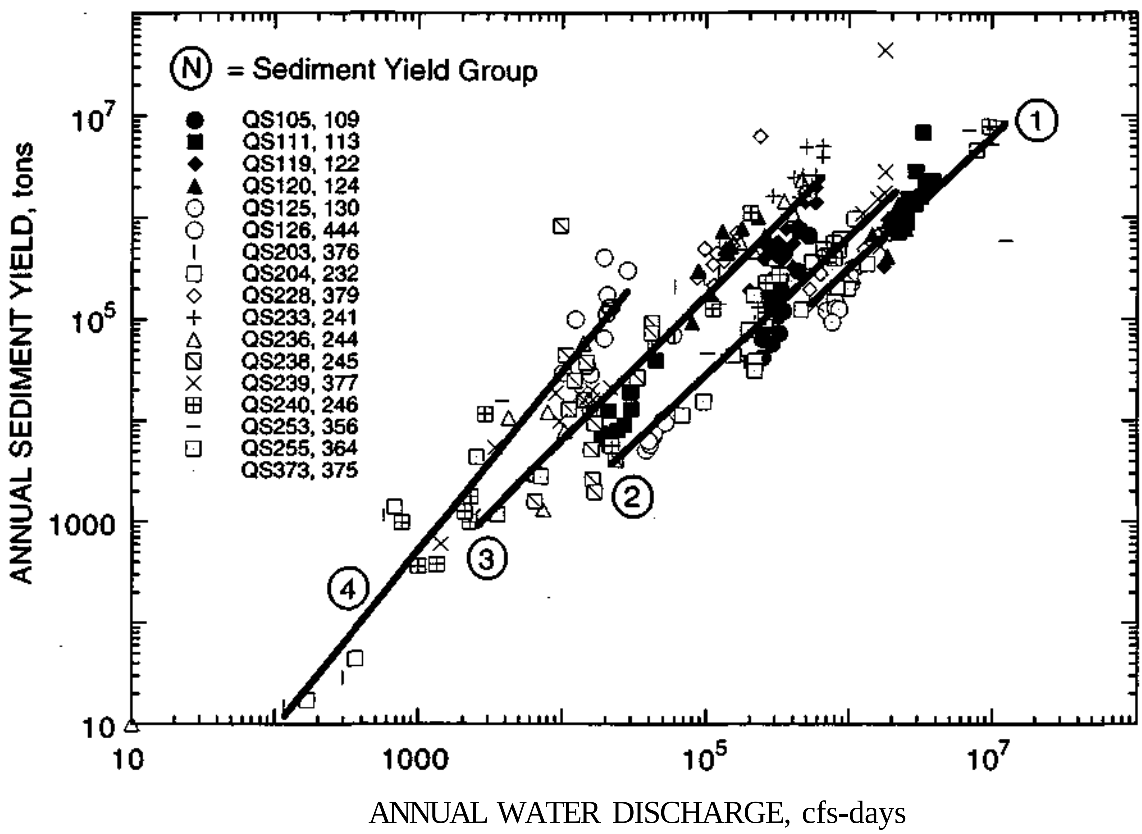

Figure 6. Sediment yield-water discharge rating relations for Illinois streams

identified from this plot, suggesting that in Illinois, the annual sediment yield rates for drainage basins of tributary streams can be grouped into four regions. The sediment yield rates for each of these regions are given by the equation of the regression line fitted to the data points in each cluster. The equations for the regression lines are:

$$\text{REGION 1:}\quad \log Q_{as} = -2.2781 + 1.296 (\log Q_{aw}),\quad R^2=0.8801 \qquad (2)$$

$$\text{REGION 2:}\quad \log Q_{as} = -2.3028 + 1.352 (\log Q_{aw}),\quad R^2=0.8862 \qquad (3)$$

$$\text{REGION 3:}\quad \log Q_{as} = -1.9056 + 1.428 (\log Q_{aw}),\quad R^2=0.9405 \qquad (4)$$

$$\text{REGION 4:}\quad \log Q_{as} = -2.5577 + 1.760 (\log Q_{aw}),\quad R^2=0.9336 \qquad (5)$$

where Q_{as} is the annual suspended sediment load, Q_{aw} is the annual water discharge, and R^2 is the coefficient of determination. The high values of R^2 indicate very strong correlations between Q_{as} and Q_{aw}.

Figure 7 shows the regional distribution of the sediment yield regions based on the foregoing analysis. The highest sediment yield rate occurs in region 4, as represented by equation 5. The lowest sediment yield rate occurs in region 1.

Lake Sedimentation Patterns

Lake sedimentation data were analyzed to determine the sediment yield rates at both lakes and reservoirs. The sedimentation rate in a reservoir for the period of time between two reservoir surveys is the difference in reservoir capacity between the two surveys. The conversion of the measured accumulated sediment in the lake to the equivalent sediment yield requires a knowledge of the reservoir trap efficiency. This value is obtained from an empirical relationship in which the trap efficiency is a function of the ratio between reservoir capacity and inflow (Brune, 1953). The trap efficiency curves developed by Brune are shown in figure 8. Several procedures are available for estimating the average annual inflow to reservoirs (Bhowmik et al., 1986), including the isolines shown in figure 9, which was developed by the Upper Mississippi River Basin Commission (Singh & Durgunoglu, 1988). The reservoir capacities obtained from

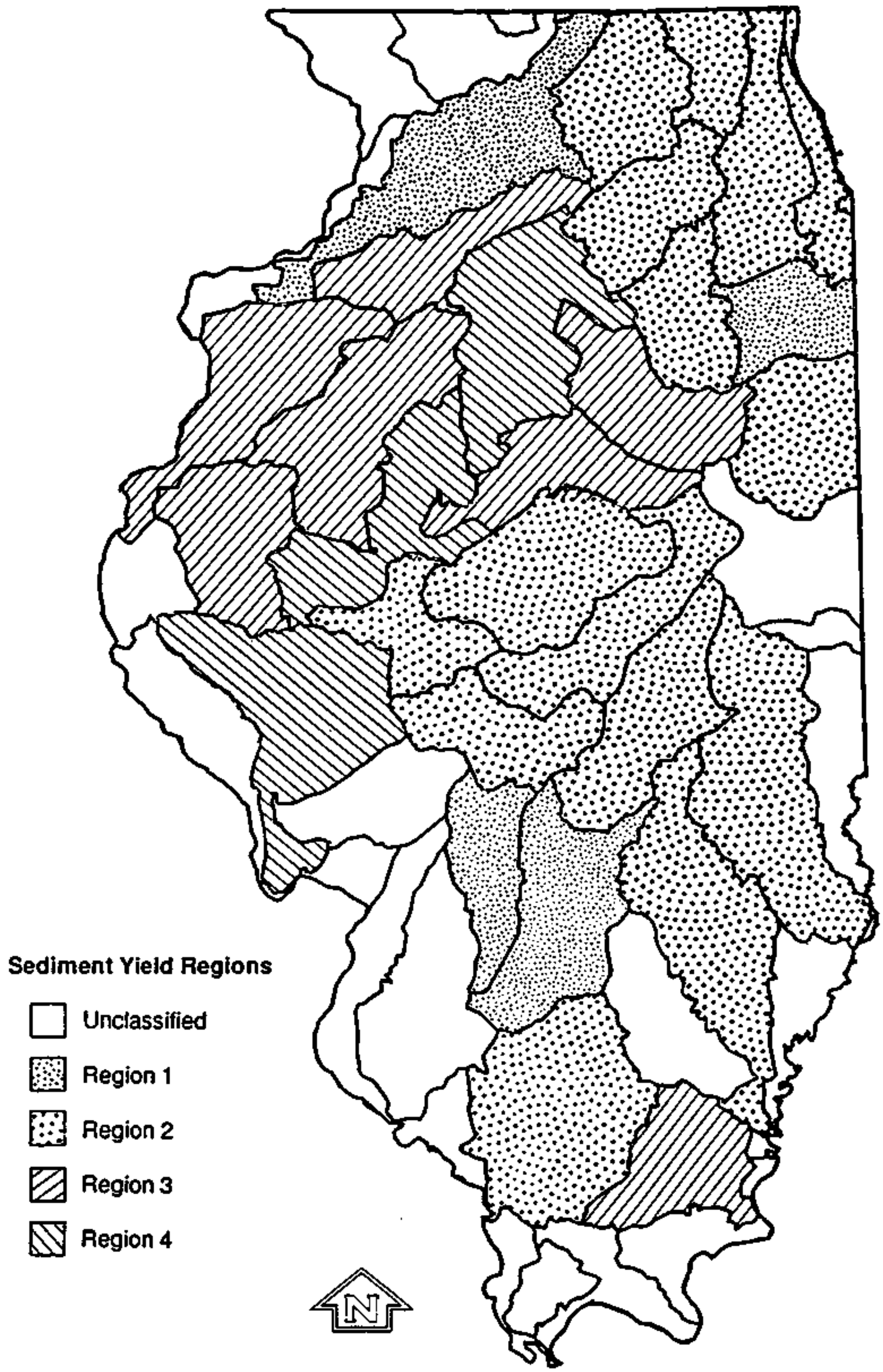

Figure 7. Regional distribution of sediment yield rates in tributary drainage basins

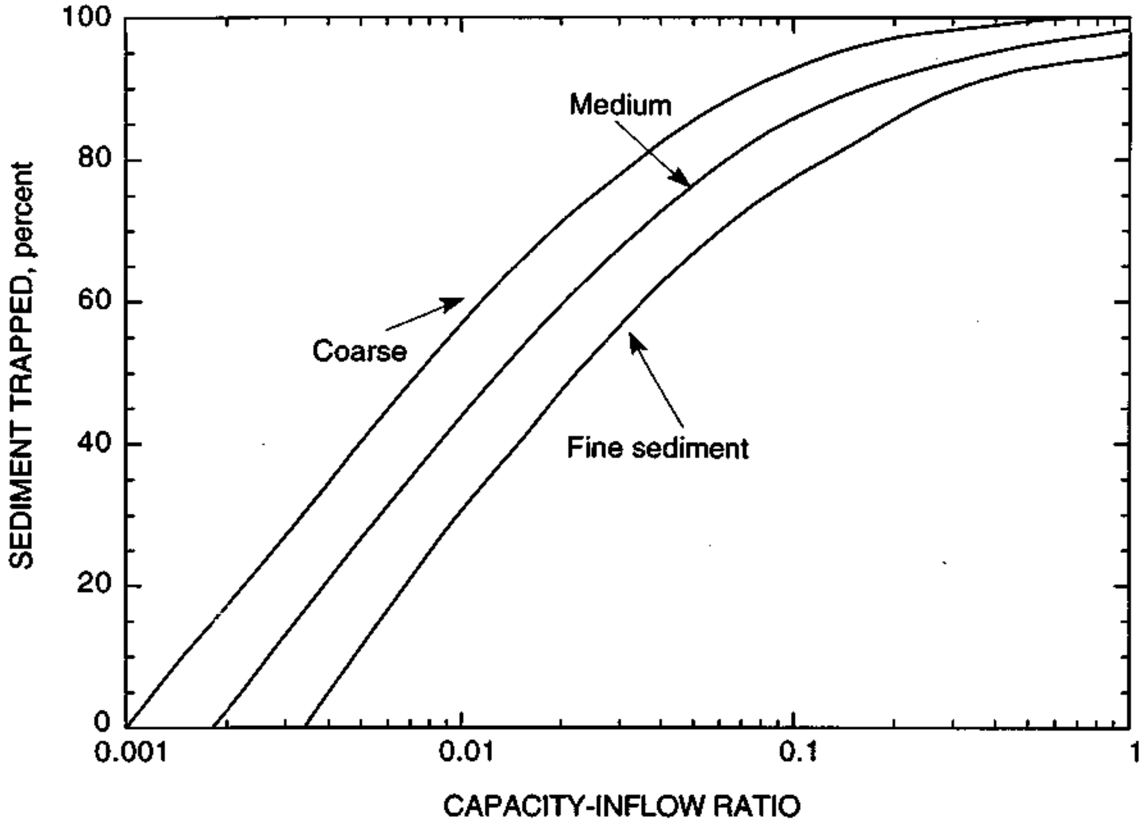

Figure 8. Trap efficiency of a man-made lake (after Brune, 1953)

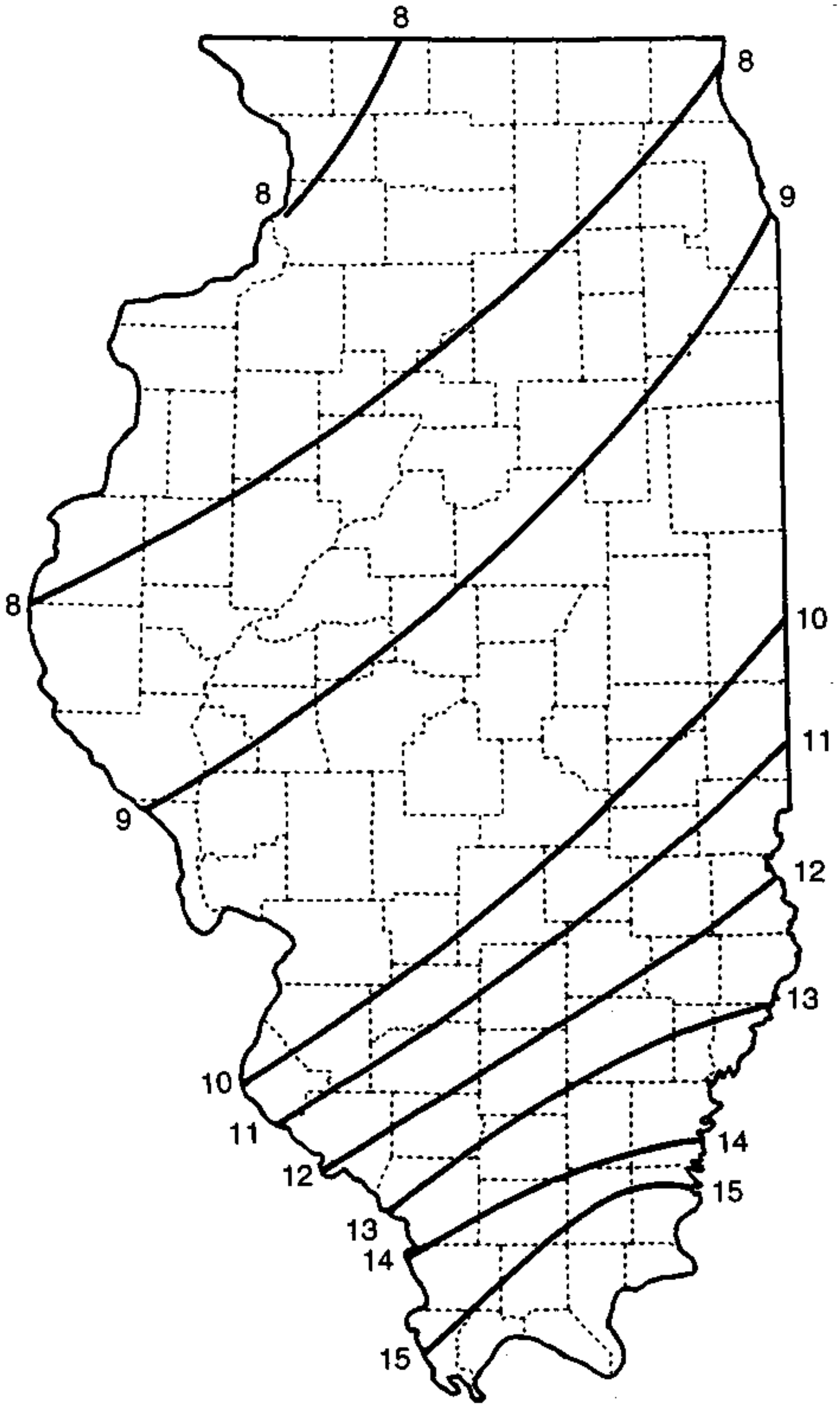

Figure 9. Average annual runoff for Illinois (inches per square mile)
(from Singh and Durgunoglu, 1988)

sedimentation surveys are shown in table 7. The following procedure was used to compute the annual sediment yields shown in the table:

Procedure for Computing Annual Sediment Yields

1. Estimate the average annual inflow, I, from figure 9 for each lake or reservoir by identifying its location on the map.
2. Compute the reservoir capacity-inflow ratio, C/I, for the period between two sedimentation surveys and assume that C is equal to the reservoir capacity of the first survey.
3. Determine the trap efficiency for the calculated capacity-inflow ratio using Brune's curves (figure 8).
4. The average annual sediment yield at a reservoir is obtained by taking the products of the volume of sediment, the average unit weight (taken as 50 pounds per cubic foot [lb/ft^3] when the unit weight for the lake sediment is unknown), and the drainage area, and dividing by the trap efficiency.

The computed average annual sediment yields for the 118 lakes and reservoirs in Illinois are shown in the last column in table 7. The annual sediment yield has been plotted against the annual inflow to the reservoir, as shown in figure 10. No distinct clustering of reservoir sites occurs as was observed for the stream monitoring stations. Instead, the relationship between the sediment yield and inflow falls within a narrow band with upper and lower limits. This can be attributed to a lack of actual data on the annual inflow to the lake, which was estimated from figure 9. An additional source of error could be the assumption of 50 lb/ft^3 for the unit weight of the lake sediment whenever it is not known.

Nevertheless, the annual sediment yield-inflow ratio falls within the same range as the stream sediment relation shown in figure 6. However, for the reasons stated previously, the lake sedimentation data were not used in the analysis of the regional distribution of sediment yield.

Table 7. Annual Sediment Load Data for Reservoirs and Lakes in Illinois

County and reservoir codes	***Reservoir name***	***Survey year***	***Elapsed years since last survey***	***Drainage area (sq mi)***	***Reservoir capacity, C (acre-ft)***	***Volume of sediment (acre-ft)***	***Annual inflow, I (in.)***	***Annual inflow, I (acre-ft)***	***C/I***	***Trap efficiency***	***Deposited sediment (tons/acre)***	***Annual sediment yield (tons/sq mi)***	***Annual sediment yield (tons)***
1-1	CBQ Reservoir	1875	87	2.13	140.6	117.3	8.4	955.8	0.15	0.89	1.21	774.5	1649.7
		1962			23.3								
1-2	Clayton Reservoir	1943	19	3.17	225.3	53.2	8.4	1422.4	0.16	0.91	1.65	1057.0	3350.8
		1962			172.1								
1-3	Saukenauk Lake	1953	9	1.54	453.6	35.3	8.4	691.0	0.66	0.97	4.46	2859.4	4403.4
		1962			418.3								
3-1	Ayer's Reservoir	1906	52	1.9	200	50	9.8	994.7	0.20	0.92	0.93	599.0	1138.2
		1958			150								
5-1	Mt. Sterling Reservoir	1935	16	1.8	306	57.7	8.5	817.3	0.37	0.95	3.58	2296.6	4133.9
		1951	3	1.8	248.3		8.5	817.3	0.30	0.94	5.05	3239.5	5831.2
		1954			233.2	15.1							
		1954	8	1.8	295.2		8.5	817.3	0.36	0.95	4.06	2603.1	4685.6
		1962			262.5	32.7							
5-2	Hambaugh-Martin # 1	1961	11	2.09	426.6	51.3	8.5	949.0	0.45	0.96	3.95	2531.3	5290.3
		1972			375.3								
9-1	Virginia Reservoir	1933	17	0.83	154	38	8.8	390.2	0.39	0.95	4.82	3087.2	2562.4
		1950	14		116								
		1964	18	0.83	217	38	8.8	390.2	0.56	0.96	4.50	2885.3	2394.8
		1982			179								
11-1	Lake Taylorville	1962	15	131.3	9406	1492	9.5	66631.9	0.14	0.89	1.45	926.9	121707.0
		1977			7914								
12-1	Craig & Davidson Lake	1947	12	0.67	187.8	12.6	11.5	411.6	0.46	0.96	2.77	1777.8	1191.1
		1959			175.2								
12-2	Stevenson's Lake	1950	9	0.37	52.1	5.6	11.5	227.3	0.23	0.93	3.07	1969.2	728.6
		1959			46.5								
13-1	Brown Park Lake	1938	21	1.47	49.1	11.3	11.6	910.9	0.05	0.77	0.81	517.7	761.0
		1959			37.8								
13-2	Greendale Lake	1927	13	9.5	306	45.9	11.6	5886.8	0.05	0.77	0.82	525.6	4993.5
		1940			260.1								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
13-3	Patterson Lake	1926	33	1.27	316.8	35.7	11.6	787.0	0.40	0.95	1.52	976.5	1240.1
		1959			281.1								
14-1	Carlyle Lake @445	1971	5	2719	220269	3261	10.5	1525080.1	0.14	0.89	0.46	293.5	798029.0
		1976			217008								
15-1	Lake Charleston	1947	13	811	2128.7	838.2	10.2	441891.0	0.00	0.27	0.50	320.7	260056.9
		1960	14	811	1290.5	425.9	10.2	441891.0	0.00	0.22	0.29	185.7	150586.1
		1974			864.6								
15-2	Ridge Lake	1941	6	1.41	187.4	15.5	10.2	768.3	0.24	0.93	3.35	2145.4	3025.0
		1947			171.9								
15-3	Lake Paradise	1908	71	18.1	2042	635	10.2	9862.2	0.21	0.93	0.90	578.6	10472.7
		1979			1407								
15-4	Oakland Lake	1937	17	14.31	94	26	10	7644.2	0.01	0.44	0.41	264.5	3785.3
		1954			68								
		1954	18	14.31 .	91	21	10	7644.2	0.01	0.44	0.31	201.8	2887.5
		1972	1		70								
		1973			115								
18-1	Vevay Park Lake	1906	53	0.25	67.4	12.9	11	146.9	0.46	0.96	1.72	1104.4	276.1
		1959			54.5								
26-1	Farina Lake	1928	30	0.35	16.4	3.1	11	205.7	0.08	0.84	0.60	382.8	134.0
		1958			13.3								
26-2	Etcheson's Lake	1943	15	0.17	19.7	3.7	9.8	89.0	0.22	0.93	2.65	1699.1	288.8
		1958			16								
28-1	Christopher City Reservoir	1925	35	0.93	383.9	30.3	13	645.8	0.59	0.96	1.65	1056.0	982.0
		1960			353.6								
28-2	ICRR Reservoir, Thompsonville	1926	34	1.8	352.4	51.8	13.6	1307.7	0.27	0.93	1.55	991.1	1784.0
		1960			300.6								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
28-3	Valier Outing Club Reservoir	1922	35	2.47	369	49	13	1715.3	0.22	0.93	1.04	663.7	1639.4
		1957			320								
284	West Frankfort Reservoir (New)	1945	15	7.62	2654.7	263.9	13.8	5617.3	0.47	0.96	4.09	2619.1	19957.4
		1960			2390.8								
28-5	West Franklin Reservoir (Old)	1926	10	4.03	1608	93	13.8	2970.8	0.54	0.96	4.08	2617.8	10549.7
		1936			1515								
28-6	Rend Lake @405	1970	10	488	184700	7700	13.5	351923.1	0.52	0.96	2.79	1789.9	873468.8
		1980			177000								
29-1	Astoria Reservoir	1924	38	0.42	67.2	34.1	8.4	188.5	0.36	0.94	3.86	2475.3	1039.6
		1962			33.1								
29-2	Avon Reservoir Lake	1906	56	3.09	192.8	83.7	8.1	1337.0	0.14	0.89	0.92	591.9	1828.8
		1962			109.1								
29-3	Canton Lake	1939	21	15	3513	490	8.4	6730.8	0.52	0.96	2.75	1764.6	26468.8
		1960			3023								
31-1	Greenfield Pond	1924	28	0.23	67.2	10.5	9.2	113.0	0.59	0.96	2.89	1849.5	425.4
		1952			56.7								
31-2	Roodhouse Park District	1917	35	0.45	61.6	7.7	9.2	221.2	0.28	0.93	0.89	572.5	257.6
		1952			53.9								
31-3	Whitehall Lake	1897	55	0.97	459.3	51.6	9.2	476.7	0.96	0.98	1.68	1074.8	1042.5
		1952			407.7								
31-4	Woodbine Country Club Lake	1926	26	0.33	58.5	15.1	9.2	162.2	0.36	0.94	3.18	2038.9	672.8
		1952			43.4								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
34-1	Carthage Reservoir	1926	23	3.07	406.3	97.9	8	1312.0	0.31	0.94	2.51	1606.3	4931.2
		1949	6	3.07	308.4	15	8	1312.0	0.24	0.93	1.49	953.6	2927.4
		1955 .			293.4								
		1955	7	3.07	373.4	96.8	8	1312.0	0.28	0.93	8.23	5274.5	16192.8
		1962			276.6								
37-1	Johnson Sauk Trail Lake	1958	23	1.37	543.8	72.3	8	585.5	0.93	0.98	3.98	2549.7	3493.1
		1981			471.5								
39-1	Little Cedar Lake	1969	7	6.53	757.4	101.6	13.8	4813.8	0.16	0.91	4.15	2659.9	17369.3
		1976			655.8								
39-2	Carbondale Reservoir	1926	22	3.3	1386	193	13.6	2397.4	0.58	0.96	4.70	3015.6	9951.6
		1948			1193								
41-1	ICRR Reservoir Bluford	1926	34	3.35	670.7	61	12.5	2236.9	0.30	0.94	0.97	620.4	2078.5
		1960			609.7								
41-2	Packerwood Lake (Farrell Lake)	1945	15	0.52	35.6	8.2	12	333.3	0.11	0.87	2.05	1315.9	684.3
		1960			27.4								
41-3	Miller Lake	1944	9	4.65	1746.4	87.6	12	2980.8	0.59	0.96	3.70	2374.5	11041.3
		1953			1658.8								
41-4	Jaycee Lake (Mt. Vernon Reservoir)	1908	16	2.61	600.2	54.9	12	1673.1	0.36	0.94	2.38	1523.0	3975.1
		1924	1		545.3								
		1925	34	2.61	1201.2	116.8	12	1673.1	0.72	0.97	2.31	1477.7	3856.7
		1959			1084.4								
48-1	Lake Bracken	1923	13	8.91	2881	221	8	3807.7	0.76	0.97	3.34	2142.0	19085.6
		1936	13	8.91	2660	208	8	3807.7	0.70	0.97	3.15	2016.0	17962.9
		1949	13	8.91	2452	186	8	3807.7	0.64	0.97	2.81	1802.8	16063.0
		1962			2266								
48-2	Lake Calhoun	1924	12	13.1	285.6	148.9	8	5598.3	0.05	0.77	2.09	1339.6	17548.9
		1936			136.7								
		1936	11	13.1	273.1	160.7	8	5598.3	0.05	0.77	2.46	1577.2	20661.4
		1947			112.4								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
48-3	Lake Storey	1928	34	7.07	2089.7	169.7	8	3021.4	0.69	0.97	1.24	792.6	5603.5
		1962			1920								
48-4	CB&Q Reservoir, Rio	1888	74	0.4	22.4	13.9	8	170.9	0.13	0.88	0.91.	581.1	232.4
		1962			8.5								
55-1	Argyle Lake	1950	12	6.56	1979.9	149.1	8.1	2838.5	0.70	0.97	3.32	2126.4	13949.3
		1962			1830.8								
55-2	Spring Lake	1927	24	20.2	503.6	319.6	8	8632.5	0.06	0.80	1.40	897.4	18127.3
		1951			184								
		1951	17	20.2	372.4	200.4	8	8632.5	0.04	0.73	1.36	870.6	17585.5
		1968			172								
		1968			2880								
55-3	Lake Vermont	1942	20	2.3	366	74	8.3	1019.8	0.36	0.94	2.91	1863.7	4286.5
		1962	18	2.3	292	69	8.3	1019.8	0.29	0.94	3.01	1930.9	4441.0
		1980			223								
57-1	Lake Bloomington	1929	19	61	6654	592	8.9	29001.1	0.23	0.93	0.93	598.1	36484.9
		1948	4	61	6062	157	8.9	29001.1	0.21	0.93	1.18	753.5	45960.5
		1952	3	61	5905	42	8.9	29001.1	0.20	0.92	0.42	271.7	16571.7
		1955			5863								
57-2	Dawson Lake	1964	22	4.5	1619	144	9.1	2187.5	0.74	0.97	2.55	1633.0	7348.5
		1986			1475								
58-1	Lake Decatur	1922	14	906	19738	2808	9.5	459775.6	0.04	0.73	0.52	330.3	299208.6
		1936	10	906	16930	2363	9.5	459775.6	0.04	0.73	0.61	389.1	352507.8
		1946	10	906	14567	490	9.5	459775.6	0.03	0.68	0.14	86.6	78472.1
		1956			14077								
		1956	10	906	22200	1400	9.5	459775.6	0.05	0.73	0.36	230.5	208849.3
		1966	17	906	20800	2000	9.5	459775.6	0.05	0.73	0.30	193.7	175503.6
		1983			18800								
59-1	Arctic Lake	1922	27	0.53	175.6	16.1	9.5	269.0	0.65	0.97	1.97	1263.1	669.5
		1949	5	0.53	159.5	7.3	9.5	269.0	0.59	0.96	4.87	3124.9	1656.2
		1954	7	0.53	152.2	4.6	9.5	269.0	0.57	0.96	2.19	1406.5	745.4
		1961			147.6								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
59-2	Bunker Hill Reservoir	1937	17	7.19	133	97	9.5	3648.8	0.04	0.73	1.85	1183.9	8511.9
		1954			36								
59-3	Lake Carlinville	1929	20	25.4	2350	240	9.5	12890.0	0.18	0.91	0.88	565.4	14360.4
		1949	5	25.4	2110	60	9.5	12890.0	0.16	0.91	0.88	565.4	14360.4
		1954	5	25.4	2050	100	9.5	12890.0	0.16	0.91	1.47	942.3	23934.1
		1959	27	25.4	1950	300	9.5	12890.0	0.15	0.90	0.83	529.3	13444.4
		1986			1650								
59-4	Edwards Lake	1949	9	0.7	74.2	6.2	9.5	355.2	0.21	0.93	1.80	1152.4	806.7
		1958			68								
59-5	Old Gillespie Lake	1922	32	5.73	799	103	9.5	2907.9	0.27	0.93	1.03	657.8	3769.1
		1954			696								
59-6	King's Lake	1921	37	0.38	158.6	19.1	9.5	192.8	0.82	0.97	2.38	1525.1	579.5
		1958			139.5								
59-7	Mt. Olive lake	1938	20	5.21	464.8	118.4	9.5	2644.0	0.18	0.91	2.12	1359.8	7084.5
		1958	23	5.21	346.4	64	9.5	2644.0	0.13	0.88	1.03	660.9	3443.5
		1981			282.4								
59-8	Rinaker Lake	1904	54	0.49	160.5	24.7	9.5	248.7	0.65	0.97	1.63	1048.0	513.5
		1958			135.8								
59-9	Lake Staunton	1926	28	3.68	1248	108	9.5	1867.5	0.67	0.97	1.84	1176.7	4330.3
		1954	24	3.68	1140	91	9.5	1867.5	0.61	0.97	1.80	1156.7	4256.8
		1978			1049								
59-10	Wilsonville, Milne Pond #4	1916	42	5.29	296.1	154.5	9.5	2684.6	0.11	0.87	1.36	870.4	4604.6
		1958			141.6								
59-11	Old Olive Reservoir	1896	85	0.7	452	70	9.5	355.2	1.27	0.98	2.04	1307.3	915.1
		1981			382								
60-1	Highland Silver Lake	1962	19	49.3	7340	990	9.8	25808.8	0.28	0.93	1.93	1237.6	61013.6
		1981	3	49.3	6350	130	9.8	25808.8	0.25	0.93	1.61	1029.2	50741.9
		1984			6220								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
60-2	Schaefer Lake	1937	12	0.09	20.2	2.6	9.8	47.1	0.43	0.95	4.31	2759.6	248.4
		1949			17.6								
61-1	ICRR Reservoir, Kinmundy	1902	57	0.55	174.1	25	11	323.2	0.54	0.96	1.41	904.6	497.5
		1959			149.1								
61-2	Raccoon Lake	1943	16	48.4	5650	420	11.3	29215.8	0.19	0.91	1.01	649.0	31413.5
		1959			5230								
61-3	Salem Reservoir	1912	48	4.02	597.1	66.2	11.2	2405.1	0.25	0.93	0.63	401.7	1615.0
		1960			530.9								
65-1	GM&O Lake, Tallula	1902	50	0.85	31.7	16.3	9	408.7	0.08	0.84	0.78	497.2	422.6
		1952			15.4								
66-1	Matherville Lake	1925	37	0.33	137.6	25.2	8	141.0	0.98	0.98	3.58	2293.4	756.8
		1962			112.4								
66-2	Nelson Lake	1938	24	0.5	66.7	15.4	8	213.7	0.31	0.94	2.32	1486.8	743.4
		1962			51.3								
68-1	Panama Lake	1928	30	0.85	177.8	25.9	9.6	435.9	0.41	0.95	1.82	1164.3	989.7
		1958			151.9								
68-2	Walton Park Lake	1862	97	2.04	376.3	189.1	9.6	1046.2	0.36	0.94	1.73	1107.1	2258.5
		1959			187.2								
68-3	Lake Lou Yaeger	1965	12	115	15837	1931	9.6	58974.4	0.27	0.93	2.56	1638.5	188428.2
		1977			13906								
69-1	Anderson Pond	1909	43	0.63	266.6	32.9	8.9	299.5	0.89	0.97	2.13	1363.5	859.0
		1952			233.7								
69-2	Conlee Pond	1944	8	0.39	8.9	1.4	9	187.5	0.05	0.77	0.99	634.6	247.5
		1952			7.5								
69-3	Elliot State Bank Pond	1900	52	0.31	47.1	11.5	9	149.0	0.32	0.94	1.29	826.5	256.2
		1952			35.6								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
69-4	Franklin Outing Club Lake	1905	47	0.45	328.3	27.6	9	216.3	1.52	0.98	2.26	1450.1	652.5
		1952			300.7								
69-5	Lake Jacksonville	1940	12	10.8	6680	220	9	5192.3	1.29	0.98	2.94	1886.3	20372.4
		1952	34	10.8	6460	630	9	5192.3	1.24	0.98	2.97	1906.5	20590.3
		1986			5830								
69-6	Langdon Pond	1907	45	0.36	56.8	12	9	173.1	0.33	0.94	1.34	858.2	308.9
		1952			44.8								
69-7	Morgan Lake	1900	52	2.75	126	53	9	1322.1	0.10	0.86	0.73	469.3	1290.6
		1952			73								
69-8	Mauvaiseterre Lake	1921	31	32.6	1504.6	489.4	9	15673.1	0.10	0.86	0.96	613.2	19990.9
		1952	27	32.6	1015.2	387.3	9	15673.1	0.06	0.80	0.93	599.0	19526.4
		1979			627.9								
69-9	Waverly Lake	1939	13	9.24	308.3	69.7	9.1	4491.7	0.07	0.82	1.20	770.6	7120.4
		1952	19	9.24	238.6	79.2	9.1	4491.7	0.05	0.77	1.00	638.0	5895.3
		1971			159.4								
73-1	Lake Duquoin	1939	18	10.73	2003	133	12.5	7164.8	0.28	0.93	1.26	806.4	8652.2
		1957			1870								
75-1	Old Pittsfield Lake	1925	37	1.64	333.3	79.2	8.75	766.6	0.43	0.95	2.33	1496.2	2453.7
		1962			254.1								
75-2	Lake Pittsfield (New-Big Blue Lake)	1961	13	11.1	3580	570	8.75	5188.3	0.69	0.97	6.92	4434.7	49225.2
		1974	5	11.1	3010	140	8.75	5188.3	0.58	0.96	4.46	2861.5	31762.5
		1979	6	11.1	2870	110	8.75	5188.3	0.55	0.96	2.92	1873.6	20796.9
		1985			2760								
79-1	Coulterville Reservoir	1939	15	1.22	200	12	11.75	765.8	0.26	0.93	1.20	767.8	936.8
		1954			188								

Table 7. Continued

County and reservoir codes	*Reservoir name*	*Survey year*	*Elapsed years since last survey*	*Drainage area (sq mi)*	*Reservoir capacity, C (acre-ft)*	*Volume of sediment (acre-ft)*	*Annual inflow, I (in.)*	*Annual inflow, I (acre-ft)*	*C/I*	*Trap efficiency*	*Deposited sediment (tons/acre)*	*Annual sediment yield (tons/sq mi)*	*Annual sediment yield (tons)*
80-1	Borah Lake (New Olney Reservoir)	1954	6	3.36	1555.3	37.9	12.3	2207.7	0.70	0.97	3.29	2110.6	7091.6
		1960			1517.4								
83-1	Eldorado Reservoir	1920	29	2.23	844.4	118.4	15	1786.9	0.47	0.96	3.24	2076.9	4631.4
		1949			726								
83-2	Dering Coal Pond	1919	30	0.22	89.3	16.3	15	176.3	0.51	0.96	4.37	2801.6	616.3
		1949			73								
84-1	Aschauer Pond	1939	13	0.53	18.3	8.9	9.2	260.5	0.07	0.82	2.68	1715.5	909.2
		1952			9.4								
84-2	Davis, Hose & Davis Pond	1942	10	0.21	35.8	3.1	9.1	102.1	0.35	0.94	2.67	1710.2	359.1
		1952			32.7								
84-3	Lake George	1936	16	0.13	3.8	2.3	9.1	63.2	0.06	0.80	2.35	1505.2	195.7
		1952			1.5								
84-4	Schmidt Pond	1943	9	1.31	6	2.6	9.3	650.8	0.01	0.44	0.85	545.8	715.0
		1952			3.4								
84-5	Lake Springfield	1934	14	265	59900	2600	9.3	131650.6	0.45	0.96	1.24	795.0	210669.6
		1948	17	265	57300	2300	9.3	131650.6	0.44	0.96	0.90	579.1	153474.3
		1965	12	265	55000	1700	9.3	131650.6	0.42	0.95	0.96	612.8	162394.7
		1977	7	265	53300	1100	9.3	131650.6	0.40	0.95	1.06	679.8	180135.3
		1984			52200								
87-1	Lake Mattoon	1958	22	39.7	13160	1500	10	21207.3	0.62	0.97	3.01	1928.1	76546.4
		1980			11660								
87-2	Lake Shelbyville @599.7	1970	10	1054	208000	8000	10.2	574294.9	0.36	0.94	1.37	879.3	926808.5
		1980			200000								
88-1	Armstrong Pond	1950	12	0.45	40.6	2.3	8	192.3	0.21	0.93	0.78	498.7	224.4
		1962			38.3								
88-2	Ewan Pond	1935	27	1.25	61.6	21	8	534.2	0.12	0.87	1.22	778.9	973.6
		1962			40.6								

Table 7. Continued

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
89-1	Lake Le-Aqua-Na	1955	26	3.67	578.7	91.5	8	1568.4	0.37	0.95	1.71	1099.2	4034.1
		1981			487.2								
91-1	Alto Pass Reservoir	1967	9	0.62	128.1	20.1	14	463.7	0.28	0.93	6.58	4218.0	2615.2
		1976			108								
91-2	Anna State Hospital	1914	22	0.97	81	10	14.5	751.3	0.11	0.87	0.92	586.6	569.0
		1936			71								
		1936	17	0.97	287	14	14.5	751.3	0.38	0.95	1.52	973.2	944.0
		1953			273								
91-3	Dongola City Reservoir	1970	11	3.55	666	108	15	2844.6	0.23	0.93	5.05	3238.5	11496.8
		1981			558								
92-1	Lake Vermilion	1925	38	298	8514	3196	9.8	156004.3	0.05	0.77	0.62	399.2	118948.9
		1963	13	298	5318	677	9.8	156004.3	0.03	0.68	0.44	279.9	83399.7
		1976			4641								
95-1	Ashley Lake	1940	14	1.21	174	12	11.8	762.7	0.23	0.93	1.29	829.5	1003.7
		1954	31	1.21	162	39	11.8	762.7	0.21	0.93	1.90	1217.5	1473.2
		1985			123								
95-2	Nashville Reservoir	1935	19	1.39	320	31	11.5	853.9	0.37	0.95	2.10	1345.5	1870.3
		1954			289								
96-1	Steiner Lake	1945	15	0.31	53.7	5.1	12.9	213.6	0.25	0.93	2.00	1284.3	398.1
		1960			48.6								
97-1	Norris City	1936	18	0.83	140	13	14	620.7	0.23	0.93	1.59	1018.9	845.7
		1954			127								
98-1	Lake Carlton	1969	6	2.31	846	24	8	987.2	0.86	0.97	3.03	1944.0	4490.7
		1975			822								
100-1	Baker's Lake	1937	14	0.26	24	2.3	14.5	201.4	0.12	0.87	1.23	790.9	205.6
		1951			21.7								

Table 7. Concluded

County and reservoir codes	Reservoir name	Survey year	Elapsed years since last survey	Drainage area (sq mi)	Reservoir capacity, C (acre-ft)	Volume of sediment (acre-ft)	Annual inflow, I (in.)	Annual inflow, I (acre-ft)	C/I	Trap efficiency	Deposited sediment (tons/acre)	Annual sediment yield (tons/sq mi)	Annual sediment yield (tons)
100-2	Crab Orchard Lake	1940	11	196	74400	3300	14.5	151816.2	0.49	0.96	2.71	1736.3	340312.5
		1951	12	196	71100	4100	14.5	151816.2	0.47	0.96	3.08	1977.4	387578.1
		1963			67000								
100-3	Fluck's Lake	1919	32	0.34	58.1	11.3	14.2	257.9	0.23	0.93	1.90	1216.2	413.5
		1951			46.8								
100-4	Herrin Reservoir	1913	38	1.78	199	21	14.5	1378.7	0.14	0.89	0.59	379.9	676.2
		1951			178								
100-5	Herrin Reservoir	1927	9	3.13	804	100	14.4	2407.7	0.33	0.94	6.42	4112.6	12872.3
		1936			704								
100-6	Johnston City Reservoir	1922	35	3.85	471	77	14	2879.3	0.16	0.91	1.07	683.8	2632.7
		1957			394								
100-7	Knights of Pythias Lake	1925	26	0.26	74.6	9.9	14.5	201.4	0.37	0.95	2.62	1678.8	436.5
		1951			64.7								
100-8	Little Grassy Lake	1942	9	15.1	26116	376	14.5	11696.0	2.23	0.98	4.80	3074.5	46424.5
		1951			25740								
100-9	Marion Reservoir	1921	30	6.48	705	115	14.4	4984.6	0.14	0.89	1.13	723.8	4690.4
		1951			590								
111-1	Lake Peoria	1903	62	14165	120000	47100	8.25	6242588.1	0.02	0.58	0.16	100.7	1426359.8
		1965	11	14165	72900	16300	8.25	6242588.1	0.01	0.48	0.37	237.3	3361875.0
		1976	9	14165	56600	18300	8.25	6242588.1	0.01	0.41	0.59	381.3	5400731.7
		1985			38300								

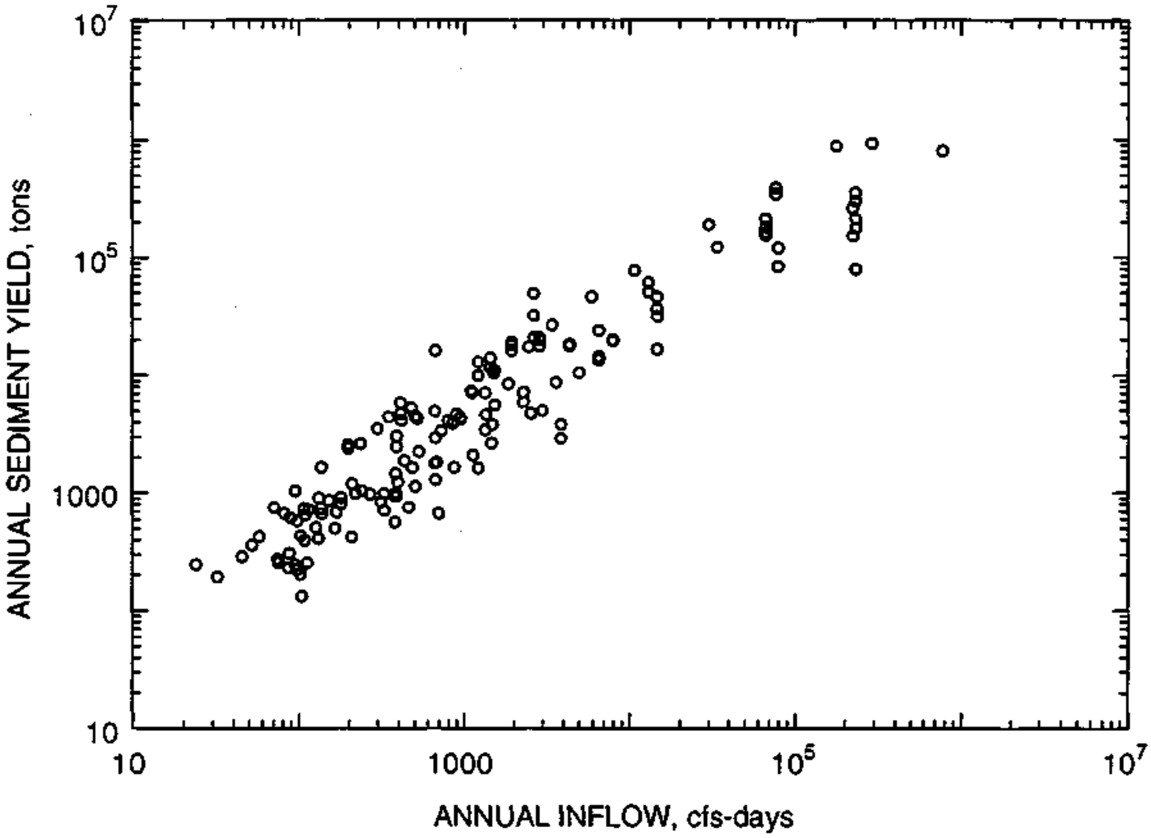

Figure 10. Sediment yield-inflow rating relations for Illinois lakes and water supply reservoirs

TRENDS IN SEDIMENT CONCENTRATIONS AND LOADS

The temporal trend analysis for Illinois sediments involved fitting linear regression lines to suspended sediment data for selected gaging stations. The slopes of the regression lines were used as indicators of trends in the distribution of suspended sediment concentration and load over time. Plots of the sediment concentration and load data for the IEPA and ISWS sediment gaging sites and the regression lines were visually examined to determine whether the regression lines give a true picture of the trends in the data sets and if they support the results of the statistical test. The ISWS and IEPA data reveal that the greatest number of active sediment stations operated between 1981 and 1988. However, when the IEPA data set was considered alone, the 1975-1980 period showed the highest number of gaging stations in operation. The sediment records for these two periods have therefore been selected for the analysis of temporal trends in suspended sediment data in Illinois.

Linear Trend Analysis

The linear trend analysis involves the evaluation of trends in instantaneous suspended sediment concentration and load data from the ISWS and IEPA databases. The sediment concentration and load data have been fitted to a linear regression model of the form:

$$y = \beta_0 + \beta_1 x \qquad (6)$$

where y is the sediment concentration or load, x is the time, β_1 is the slope parameter, and B_0 is the intercept. The computed magnitude of the slope parameter is not a good indicator of a strong relationship between y and x. That is, the regression slope value cannot be used to measure the existence of trends in the distribution of sediment concentration or load with time. However, temporal trends in the sediment data can be evaluated by testing some hypotheses involving the regression line slope. The test procedure requires the assumption that the model errors, ε_1, are normally and independently distributed with mean zero and variance, σ^2 .

The hypothesis that the regression slope, β_1, is equal to an arbitrarily chosen value, β_z, is given by:

$$H_0: \beta_1 = \beta_z \qquad (7)$$

or alternatively,

$$H_1: \beta_1 \neq \beta_z$$

where a two-sided alternative is assumed. Since the model errors, ε_1, are normally and independently distributed, the observations, y_i, and coefficient, β_1, are also normally distributed. Therefore, for a sample of size n, the test statistic is given by:

$$t_0 = \frac{\beta_1 - \beta_z}{S / \sqrt{\sum x_i^2 - \left(\frac{\sum x_i}{n}\right)^2}} \qquad (8)$$

In other words, the sample is distributed as a student t distribution with (n-2) degrees of freedom if:

$$H_0: \beta_1 = \beta_z$$

Now the expression for evaluating the sample variance is S^2 = SSE/(n-2), and the error sum of squares, SSE, is expressed as:

$$SSE = \sum x_i^2 - \beta_0 \sum y_i - \beta_1 \sum x_i y_i$$

The test statistic, t_0, is used to test the validity of the hypothesis, H_0: $\beta_1 = \beta_z$ by comparing the observed value of t_0, which is calculated from equation 8, with the upper $\alpha/2$ percentage point of the t_n-2 distribution (i.e., $t_{\alpha}/2$ n-2) and rejecting the null hypothesis if:

$$|t_0| > t_{\frac{\alpha}{2},n-2}$$

Of interest is the special case of equation 7, when $\beta_z = 0$, i.e.,

$$H_0: \beta_1 = 0 \qquad (9)$$

or alternatively,

$$H_1: \beta_1 \neq 0$$

This hypothesis provides the tool to evaluate the significance of the regression slope parameter. When the hypothesis H_0: $\beta_1 = 0$ is not rejected, the implication is that no strong linear relationship exists between y and x. Hence, no trend is observed in the distribution of sediment concentration or load with time. However, if the hypothesis H_0: $\beta_1 = 0$ is rejected, then the independent variable x is of value in explaining the variability of y. That is, the data can be used to argue strongly for the existence of a linear relationship between sediment concentration or load and time. It is useful, however, to note the limitation of the procedure outlined above: acceptance of the hypothesis H_0: $\beta_1 = 0$ could also imply that the true relationship between y and x is not linear and could be fitted with a higher order polynomial.

The instantaneous suspended sediment concentration and load data collected by the ISWS and IEPA have been fitted to the linear regression model in equation 6. Appendices B and C contain plots, respectively, of sediment load and concentration and the regression lines for the ISWS data for the entire length of record at each station. Similar plots for the IEPA sediment concentration data are given in appendix D.

As shown in figure 2, more than 50 stations were in operation during each year in the period between 1979 and 1988. However, because the period between 1981 and 1988 had the highest number of stations in operation, this period was selected for the analysis. For longer records, eight IEPA stations were found to have sediment concentration records extending from 1975 to 1988. To include the record outside this period, for example, between 1971 and 1990, would extend into periods with only two active sediment collecting sites, making it impossible to develop a statewide picture of the spatial distribution of concentration and load. Therefore, a separate analysis was performed for sediment concentration data for the eight IEPA stations that were active between 1975 and 1988.

Water Years 1981-1988

Table 8 shows the results of the trend analysis for suspended sediment loads for the ten ISWS gaging sites active between WY 1981 and 1988. IEPA station records were not included in this analysis because suspended sediment load cannot be calculated for those stations due to the lack of instantaneous water discharge data. The test statistic at a significance level of $\alpha=0.1$ indicates that seven of the ten stations have regression slopes that show decreasing load trends with time. The regression slopes for the remaining three stations do not indicate any trends in suspended sediment load with time. The spatial distribution of the trends in suspended sediment load for the ISWS records is shown in figure 11.

A similar procedure was used to analyze instantaneous suspended sediment concentration data. The ISWS and IEPA station records were combined for this analysis. Twenty ISWS and IEPA sediment stations operated continuously from 1981 to 1988. Table 9 shows the calculated regression slopes and the t statistic for the corresponding regression slopes. Fifteen of the stations show significant decreasing trends in the variation of instantaneous sediment concentration with time at a significance level of $\alpha=0.1$. The remaining five stations do not show any significant trend in concentration. The spatial distribution of the trends in suspended sediment concentration is shown in figure 12.

In both figures 11 and 12, approximately 70 to 75 percent of the stations show significant decreasing trends in suspended sediment load and concentration between WY 1981 and 1988. Higher magnitudes of the regression slope are observed among the stations located in the western section of the state. The highest slope magnitudes occur

Table 8. Test of Significance for Linear Regression Slope for Instantaneous Suspended Sediment Load, 1981-1988

Station no.	*Regression slope*	*t (a=0.1)*	*Trend*
102	-0.1674	-2.731	Decreasing
103	-0.2966	-2.591	Decreasing
105	-1.0617	-5.116	Decreasing
118	-0.2222	-0.638	No
123	-0.3002	-1.426	No
229	-4.9158	-5.278	Decreasing
242	-2.4153	-5.397	Decreasing
249	-0.2273	-1.727	Decreasing
361	-0.6932	-3.855	Decreasing
362	-0.0531	-0.120	No

Table 9. Test of Significance for Linear Regression Slope for Instantaneous Suspended Sediment Concentration, 1981-1988

Station no.	*Regression slope*	*t (a=0.1)*	*Trend*
102	-0.0189	-1.8074	Decreasing
103	-0.0514	-4.2592	Decreasing
105	-0.0290	-1.1694	No
118	-0.0770	-1.3439	No
123	-0.0530	-4.1045	Decreasing
227	-0.0128	-4.8988	Decreasing
229	-0.5508	-7.0264	Decreasing
239	-0.2450	-2.2365	Decreasing
242	-0.2990	-7.015	Decreasing
246	-0.5731	-5.6175	Decreasing
249	-0.0214	-1.7156	Decreasing
253	-0.2766	-3.2845	Decreasing
255	-0.0275	-0.9252	No
361	-0.0813	-5.0653	Decreasing
362	-0.0678	-1.9787	Decreasing
373	-0.0075	-0.3739	No
379	-0.0058	-0.1879	No
381	-0.1091	-4.0696	Decreasing
390	-0.0305	-2.6240	Decreasing
394	-0.1008	-2.2747	Decreasing

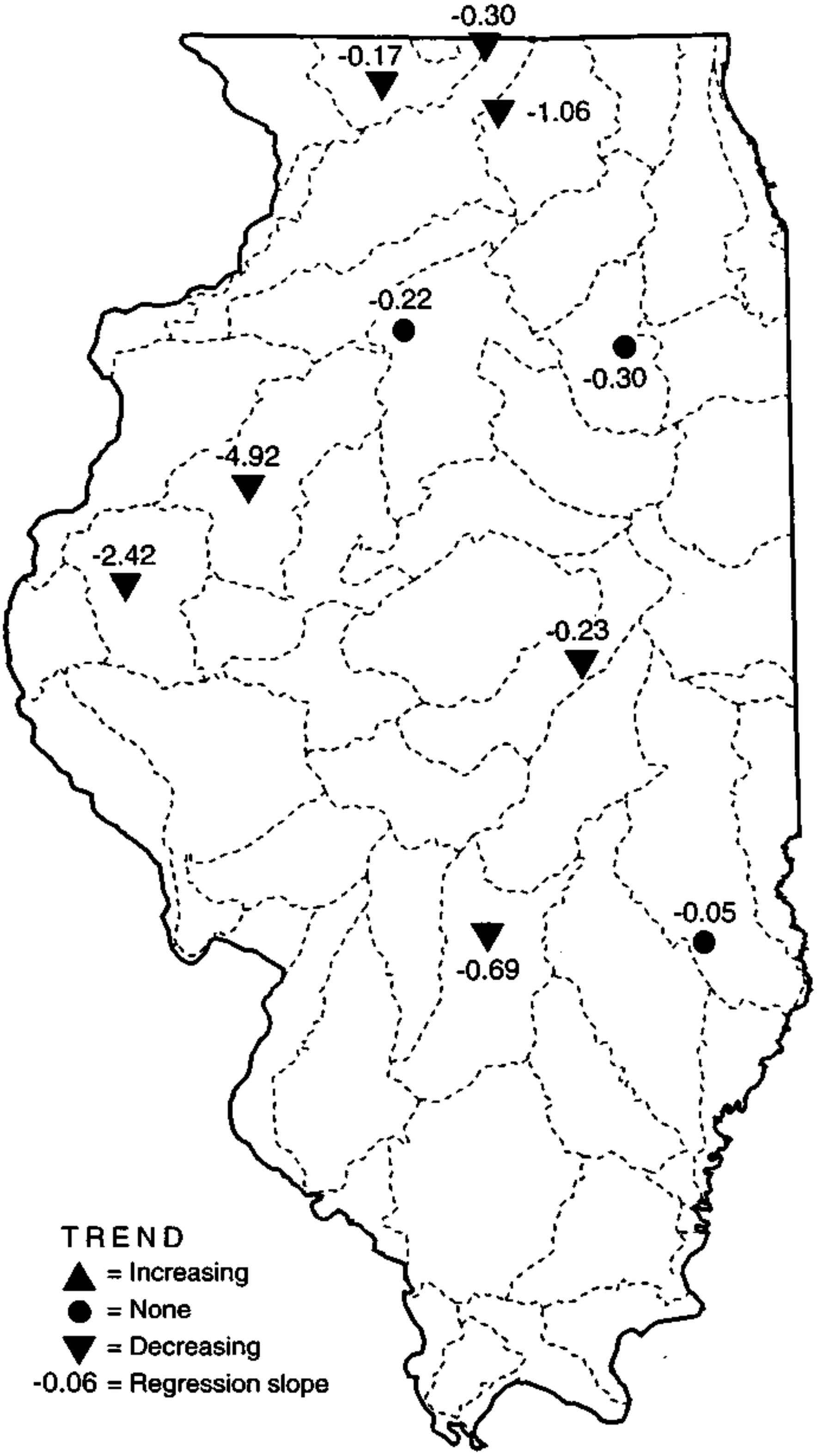

Figure 11. Trends in linear regression slope at a = 0.1 significance level for suspended sediment load data collected between 1981 and 1988

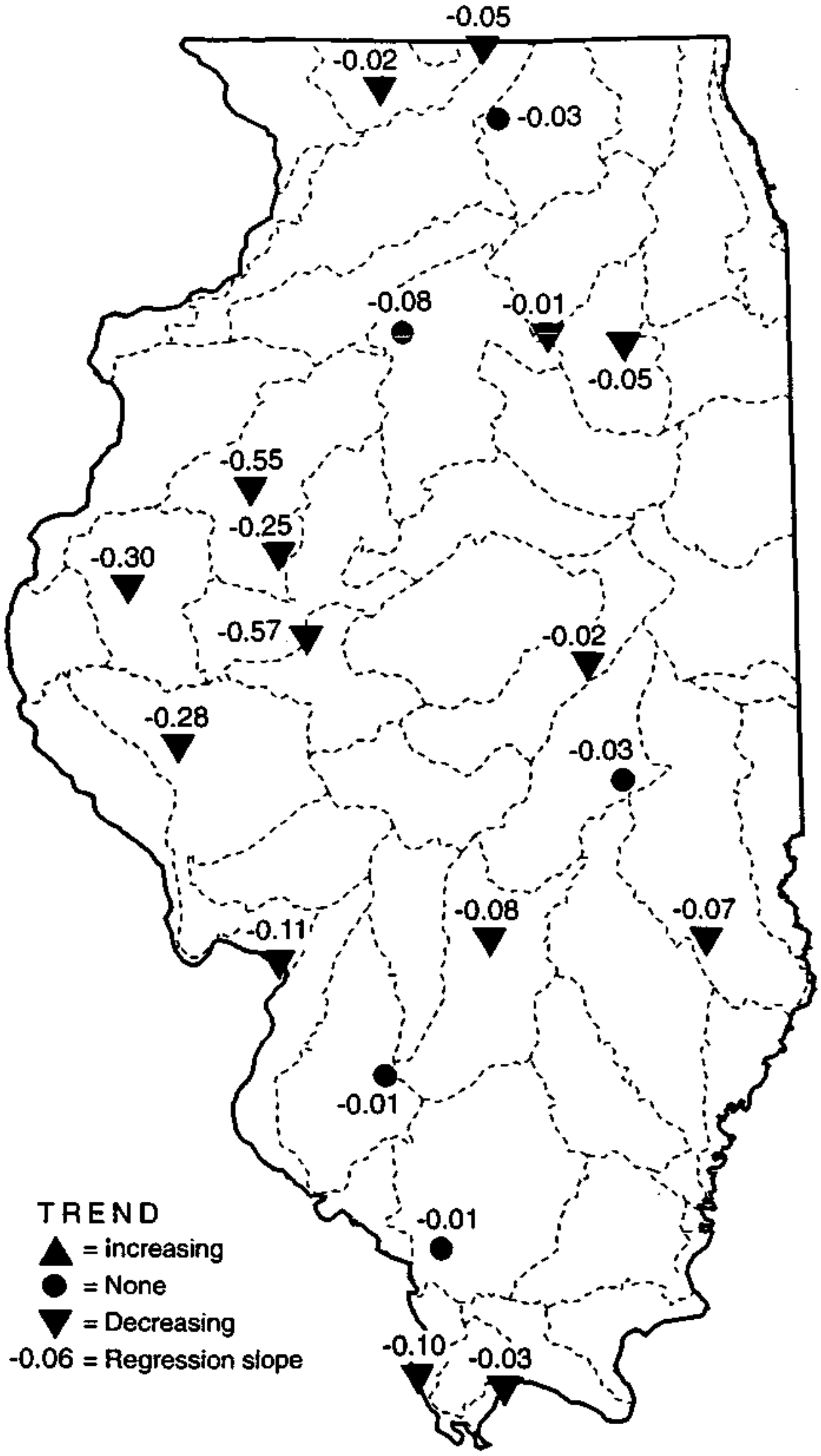

Figure 12. Trends in linear regression slope at a = 0.1 significance level for suspended sediment concentration data collected between 1981 and 1988

at stations located in the lower segment of the Illinois River basin, suggesting that a significant reduction in the rate of streambank erosion occurred in the Illinois River basin between 1981 and 1988.

Water Years 1975-1988

Since the maximum length of record in the IEPA data is 20 years, compared to ten years for the ISWS, analysis included only the concentration data for the eight IEPA stations active between 1975 and 1988. The suspended sediment concentration data for these stations were fitted to the linear regression model in equation 6 following the procedure discussed in the previous sections. The results of the t statistic test for the regression slopes are shown in table 10. Five of the stations show significantly decreasing trends in suspended sediment concentration with time at $a=0.1$. The remaining three stations show no significant trend in the variability of concentration with time. Figure 13 shows the spatial distributions of the trend results for the eight stations.

Table 10. Test of Significance for Linear Regression Slope
for Instantaneous Suspended Sediment Concentration, 1975-1988

Station no.	*Regression slope*	*t (a=0.1)*	*Trend*
227	-0.0398	-3.4506	Decreasing
239	-0.6125	-6.6765	Decreasing
253	-0.0292	-0.7464	No
373	-0.0255	-1.8505	Decreasing
379	-0.0073	-0.4386	No
381	-0.0394	-2.7528	Decreasing
390	-0.0064	-1.2025	No
394	-0.0484	-2.2832	Decreasing

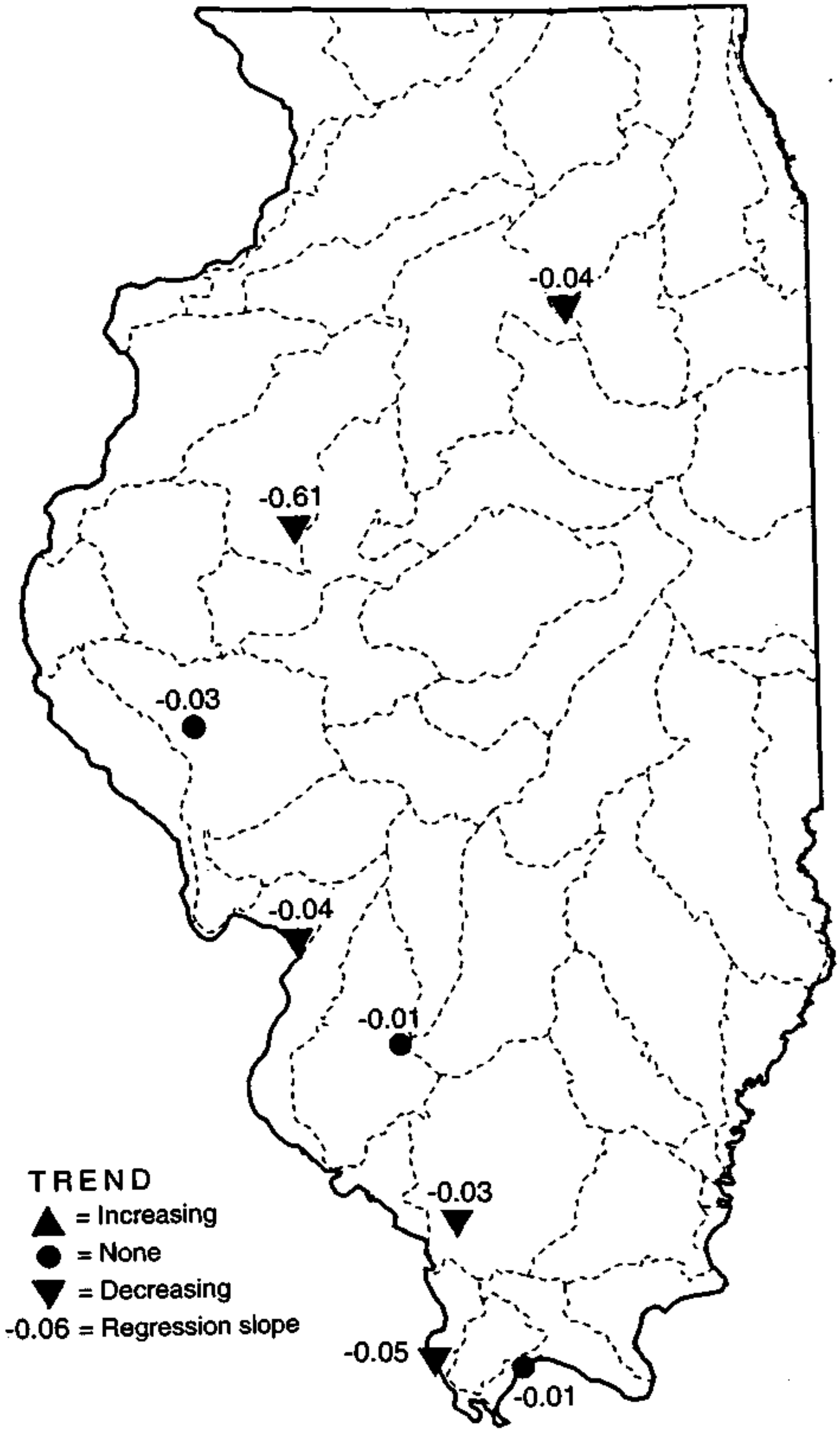

Figure 13. Trends in linear regression slope at a = 0.1 significance level for suspended sediment concentration data collected between 1975 and 1988

CONCLUSIONS

For the first time, analyses of spatial and temporal trends in suspended sediment concentration and load have been performed using all available sediment data from Illinois streams, lakes, and reservoirs. Since the accumulation of sediments has adverse effects on the quality of the state's water resources, the spatial and temporal trend analyses described in this report are suitable for evaluating any improvement or further degradation of the water resources and aquatic habitats in Illinois.

The spatial trend analysis has resulted in the identification of four sediment yield rate regions in Illinois. The highest rate of sediment yield was found predominantly in the immediate drainage areas around the Illinois River, while the lowest yield rate areas were found within the Kankakee and Kaskaskia drainage basins. Due to the lack of actual data on the annual inflow to the reservoirs and the unit weight of the lake sediments, lake sedimentation data were not included in the spatial trend analysis.

Linear trend analysis results indicate that seven of the ten ISWS gaging station records showed decreasing trends in the variation of suspended sediment load for the period between 1981 and 1988. Moreover, 15 of the 20 ISWS and IEPA station records showed similar results for the same periods of record. In general, approximately 70 percent of the stations showed decreasing trends in suspended sediment concentrations and loads between WY 1981 and 1988. Decreasing trends were also observed in the sediment concentration records of approximately 60 percent of the IEPA sediment gaging sites in operation between 1975 and 1988. However, the lack of long-term records and adequate distribution of sediment gaging sites prevented development of a clear picture of the temporal and regional distribution of trends in suspended sediment concentration and load in Illinois.

REFERENCES

Bhowmik, N.G., G.R. Adams, A.P. Bonini, A.M. Klock, and M. Demissie. 1986. *Sediment Loads in Illinois Streams and Rivers,* Illinois State Water Survey Report of Investigation 106, Champaign, Illinois.

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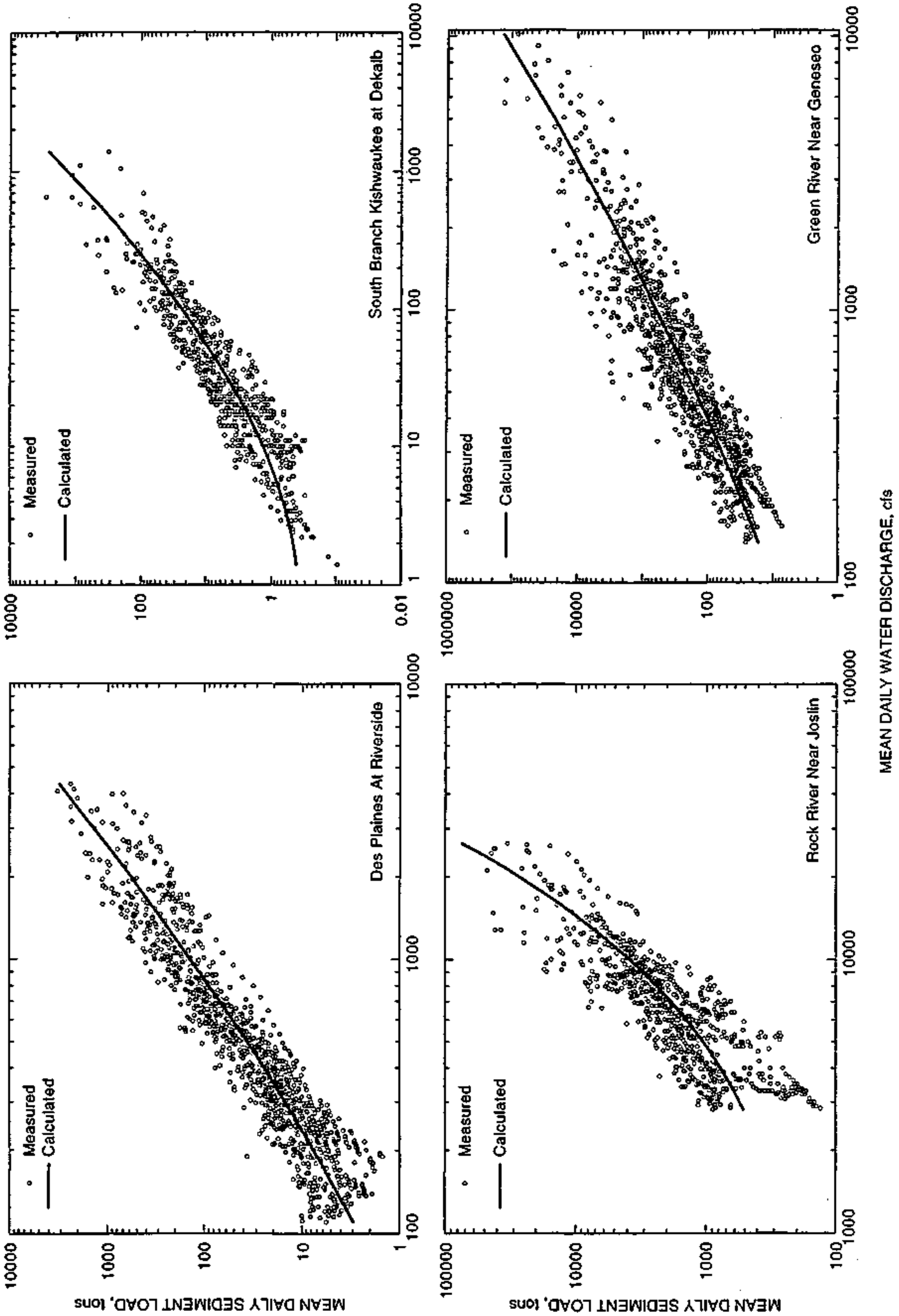
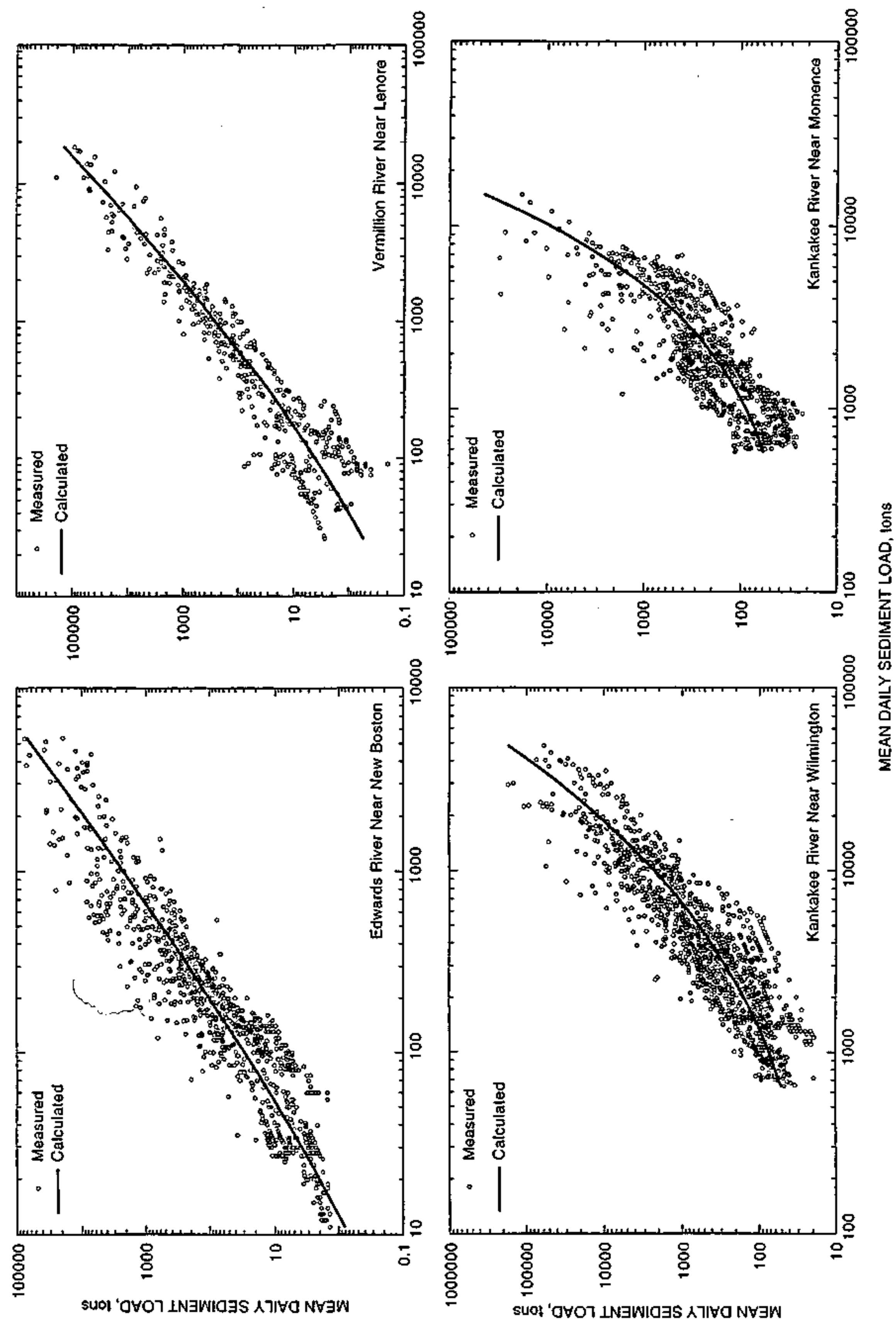
Demissie, M., L. Keefer, and R. Xia. 1992. *Erosion and Sedimentation in the Illinois River*. Illinois Department of Energy and Natural Resources, Contract Report ILENR/RE-WR-92/04, Springfield, Illinois.

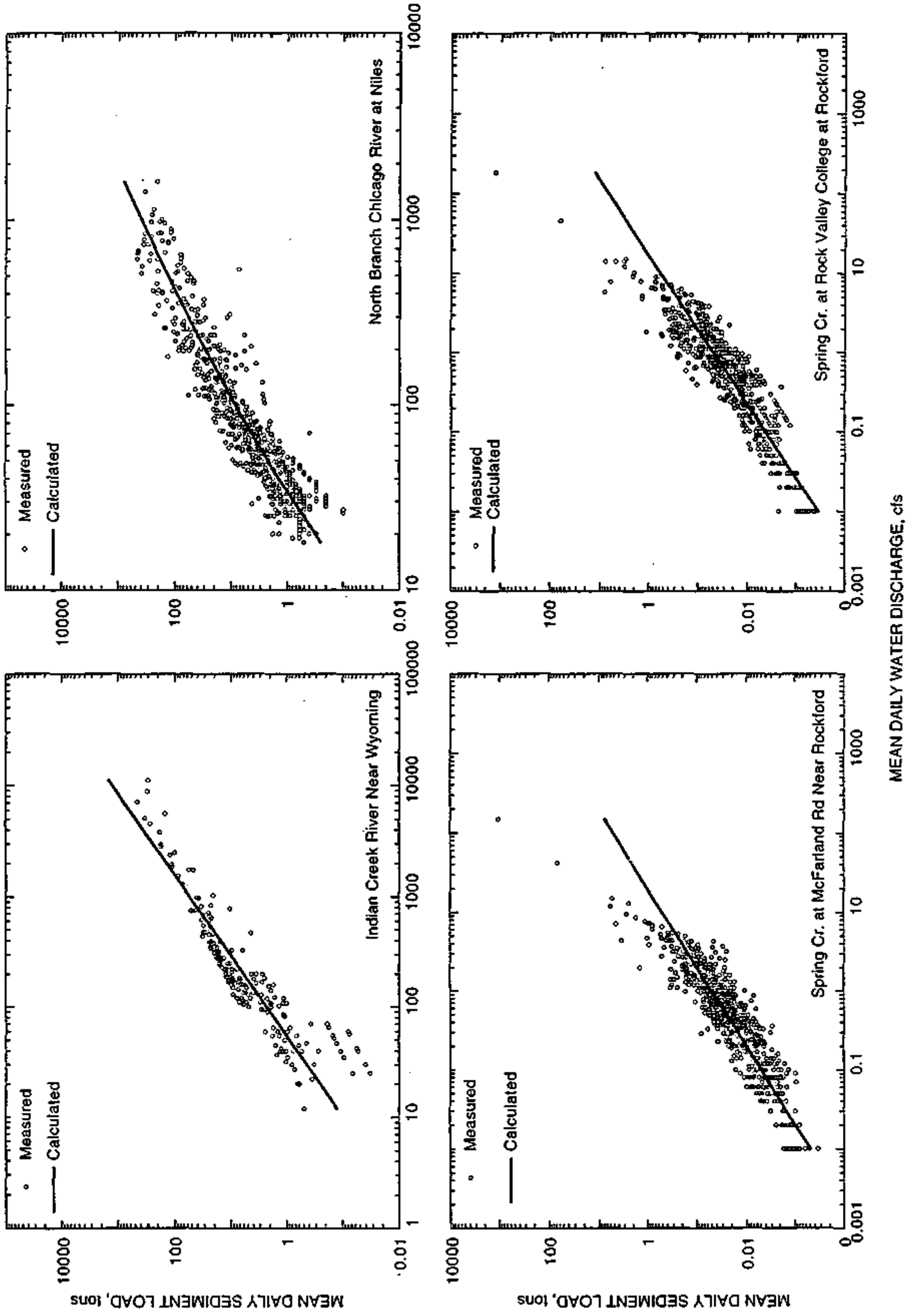
Singh, K.P., and A. Durgunoglu. 1988. *An Improved Methodology for Estimating Future Reservoir Storage Capacities: Application to Surface Water Supply Reservoirs in Illinois,* Illinois State Water Survey Contract Report 446, Champaign, Illinois.

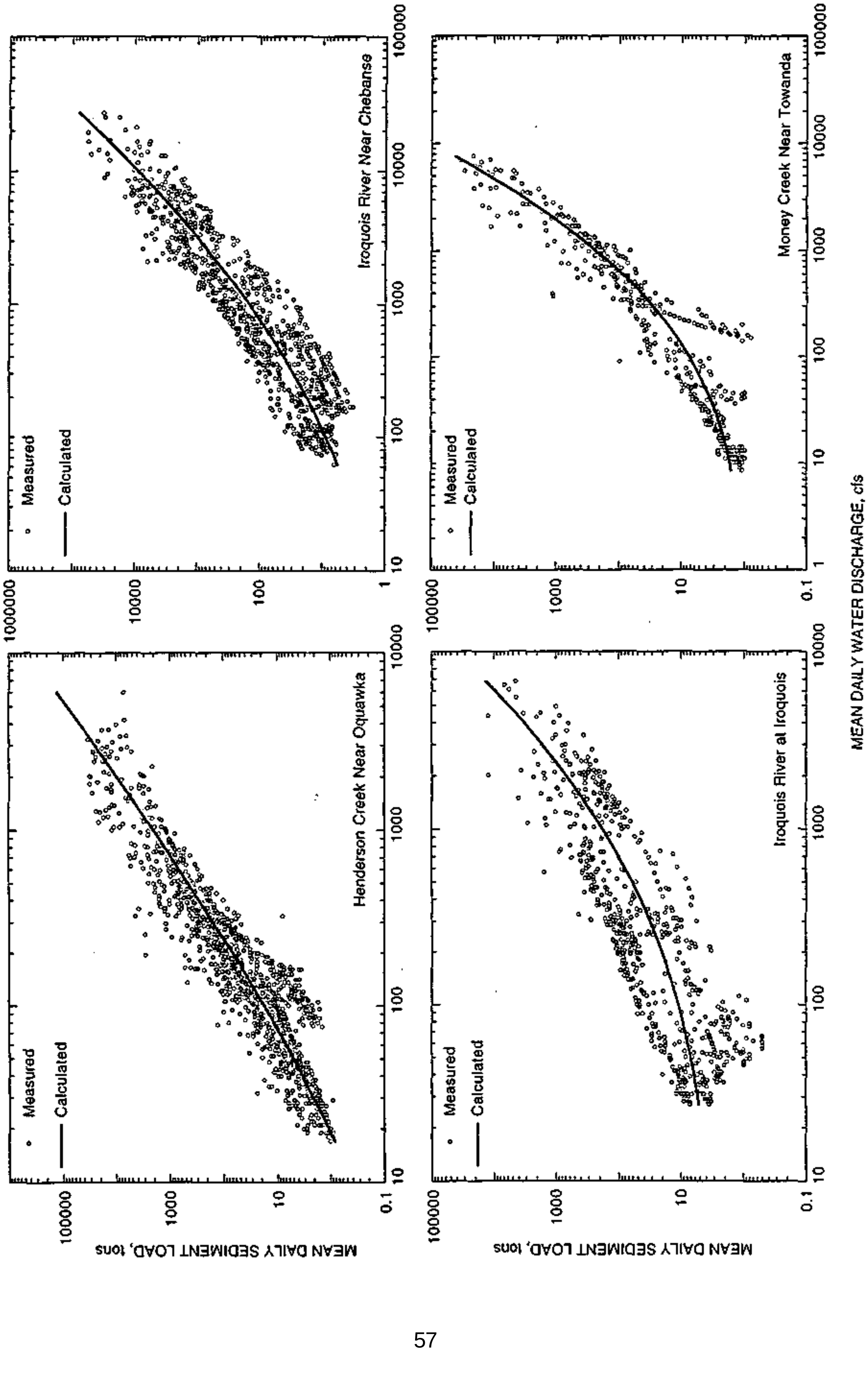
APPENDIX A

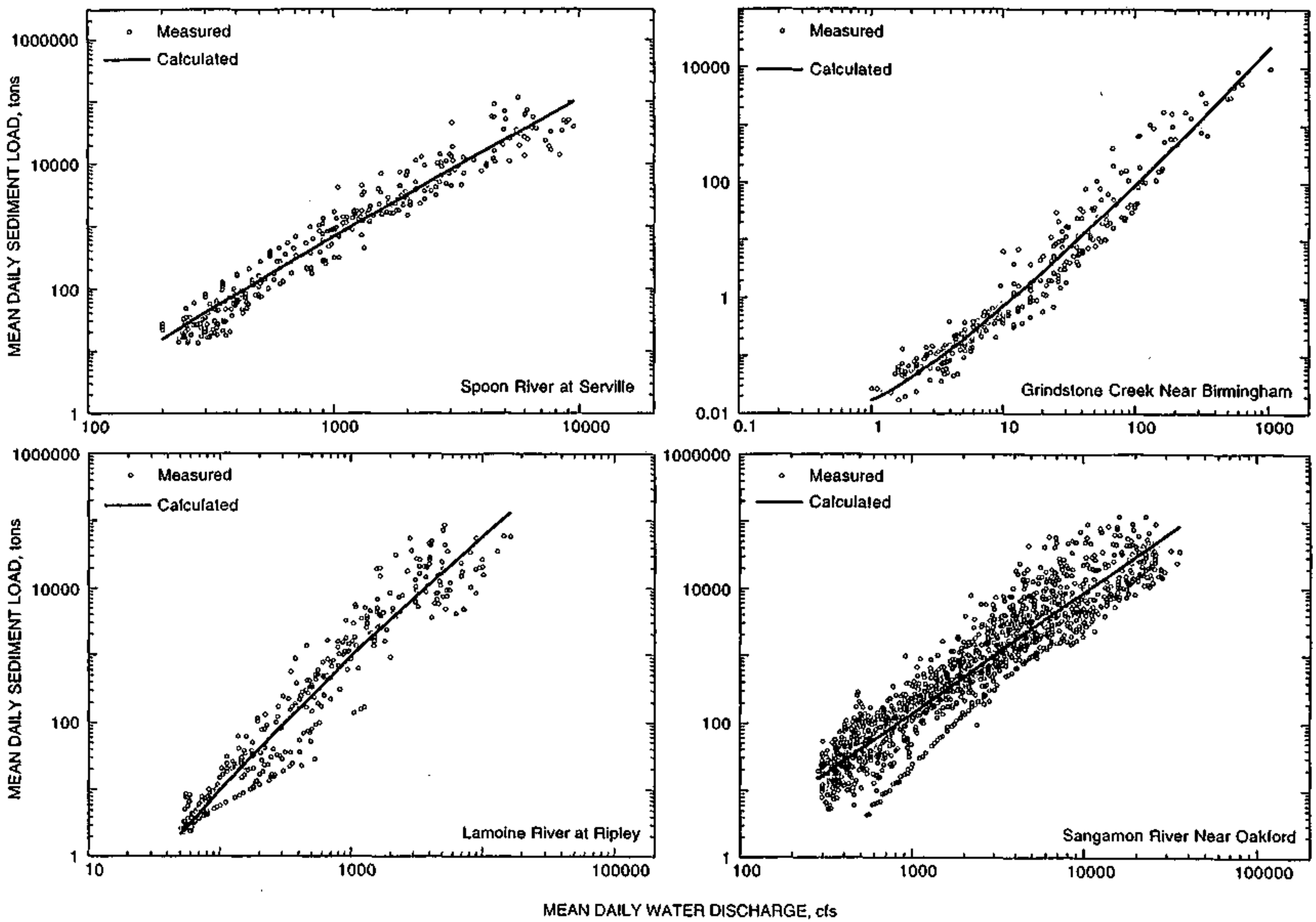
SEDIMENT RATING CURVES FOR TRIBUTARY GAGING STATIONS IN ILLINOIS

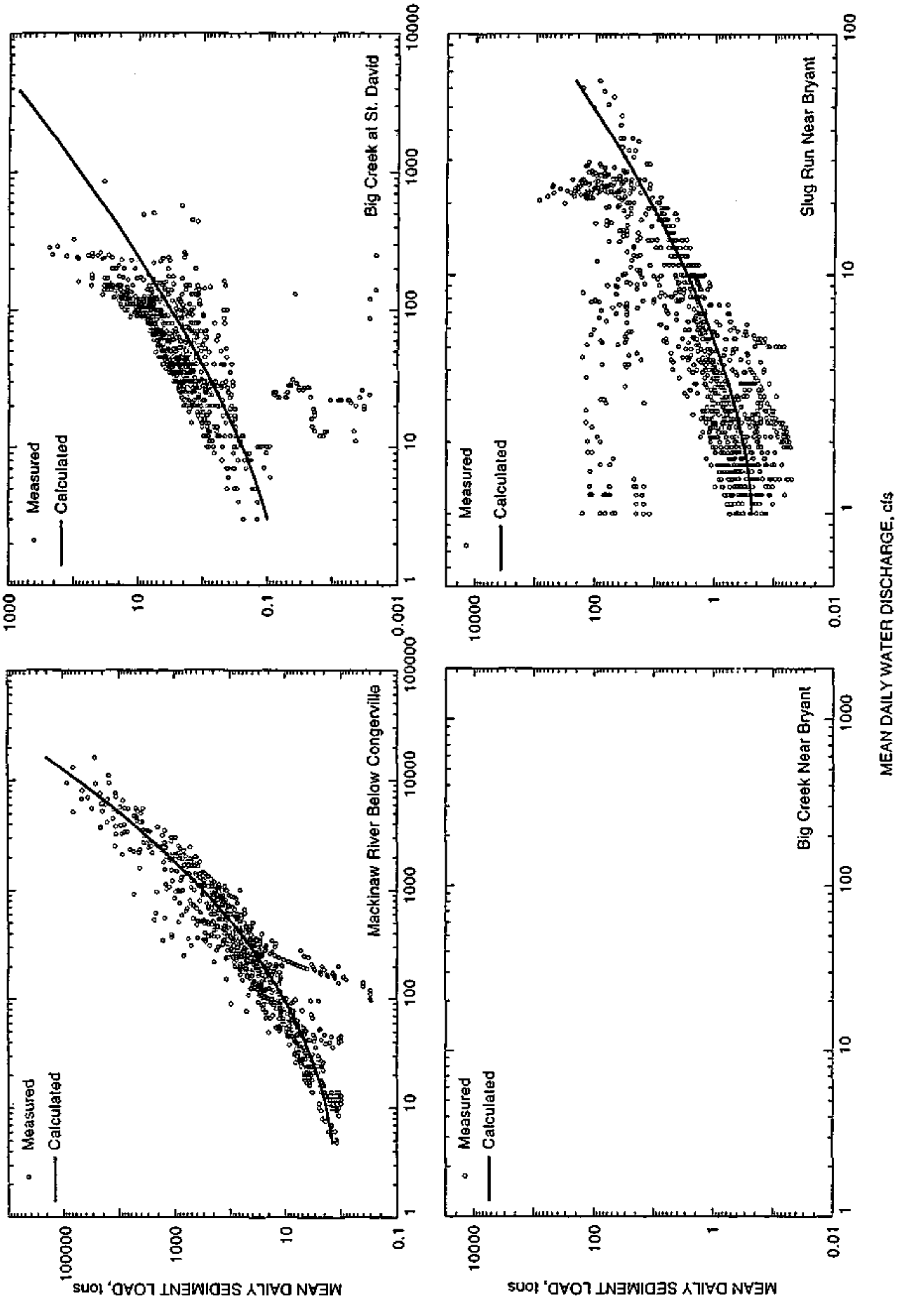

Measured
Calculated
Des Plaines At Riverside
South Branch Kishwaukee at Dekalb
Rock River Near Joslin
Green River Near Geneseo
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs

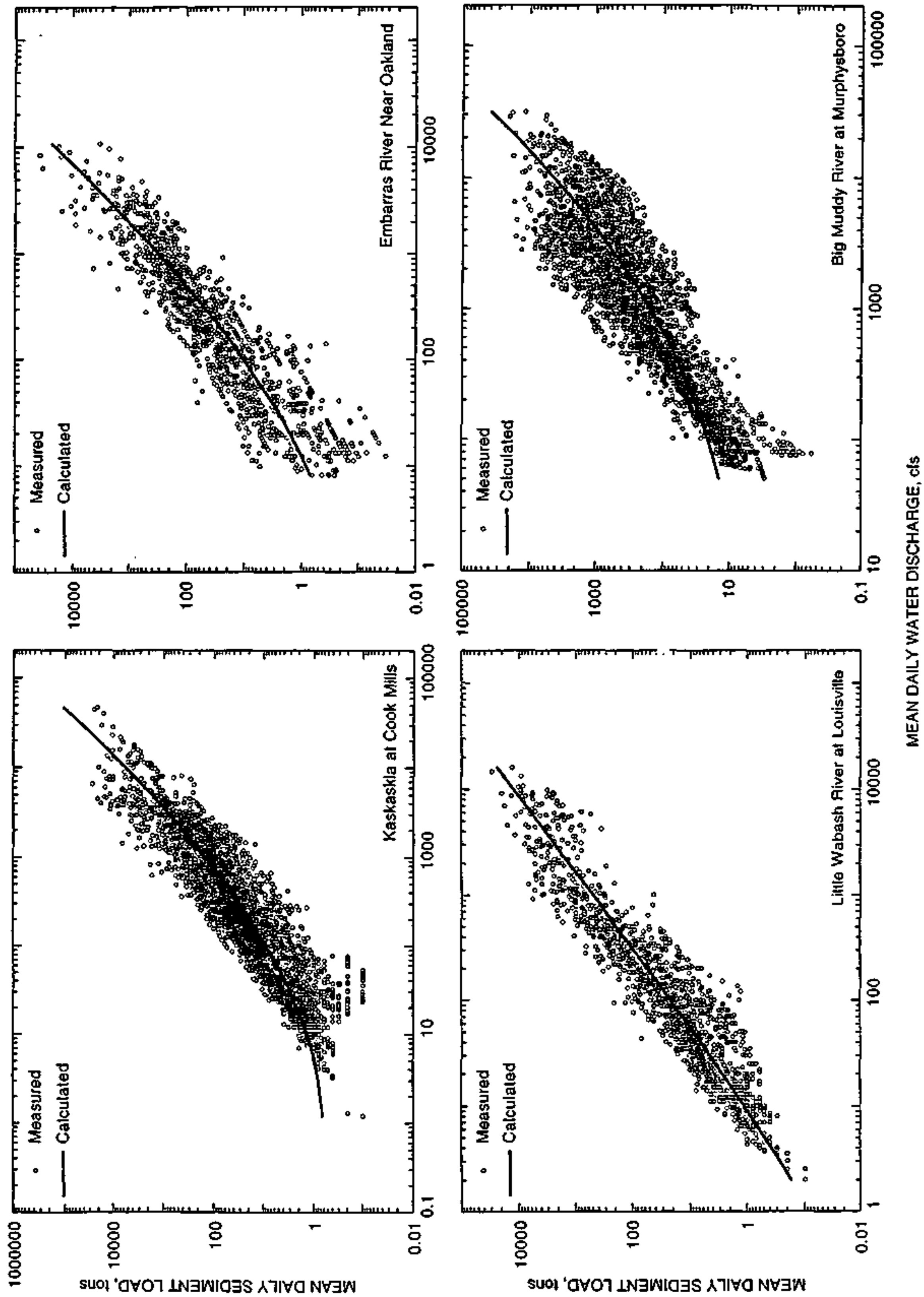

Edwards River Near New Boston
Vermillion River Near Lenore
Kankakee River Near Wilmington
Kankakee River Near Momence
Measured
Calculated
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY SEDIMENT LOAD, tons

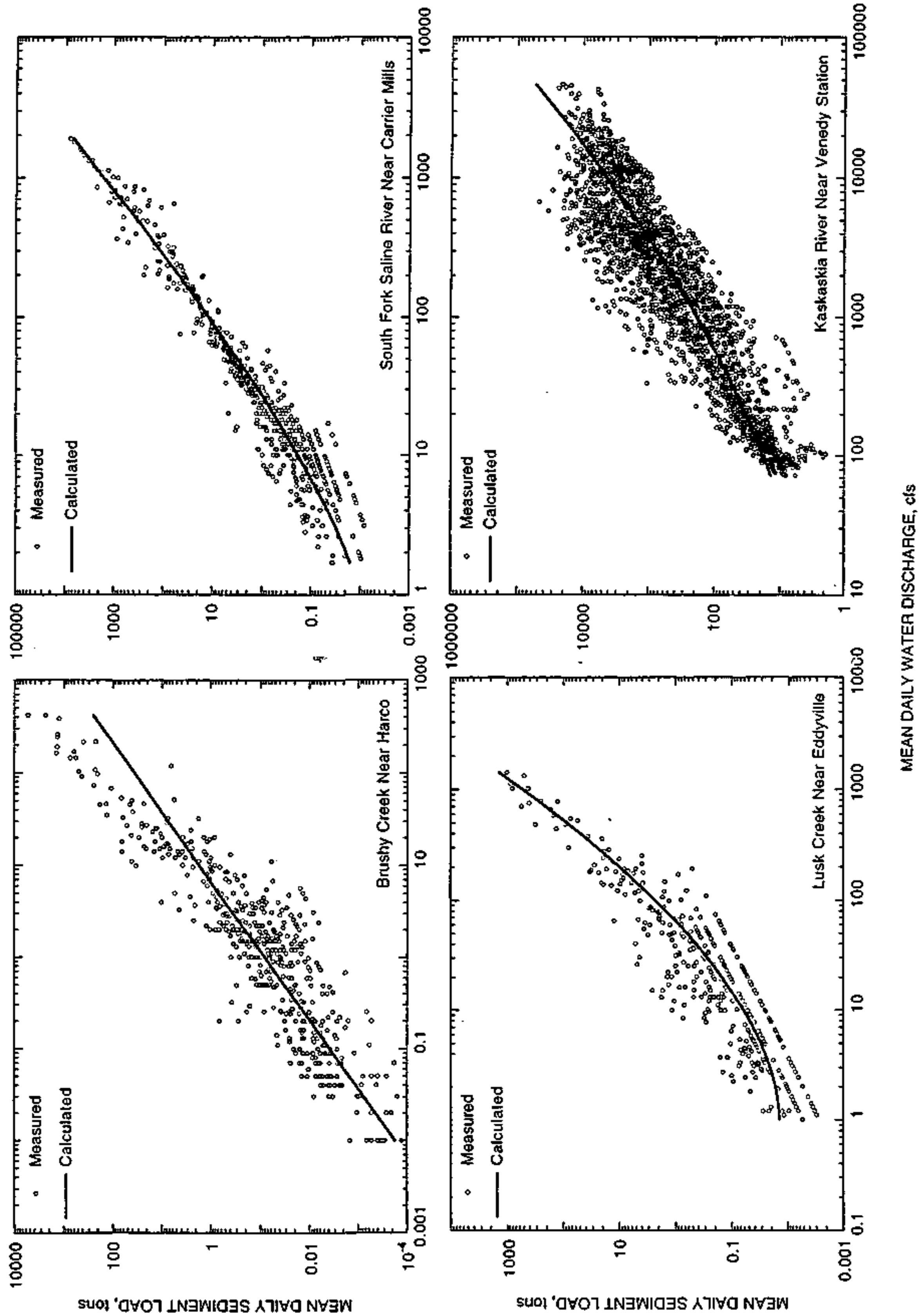

Indian Creek River Near Wyoming
North Branch Chicago River at Niles
Spring Cr. at McFarland Rd Near Rockford
Spring Cr. at Rock Valley College at Rockford
Measured
Calculated
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs

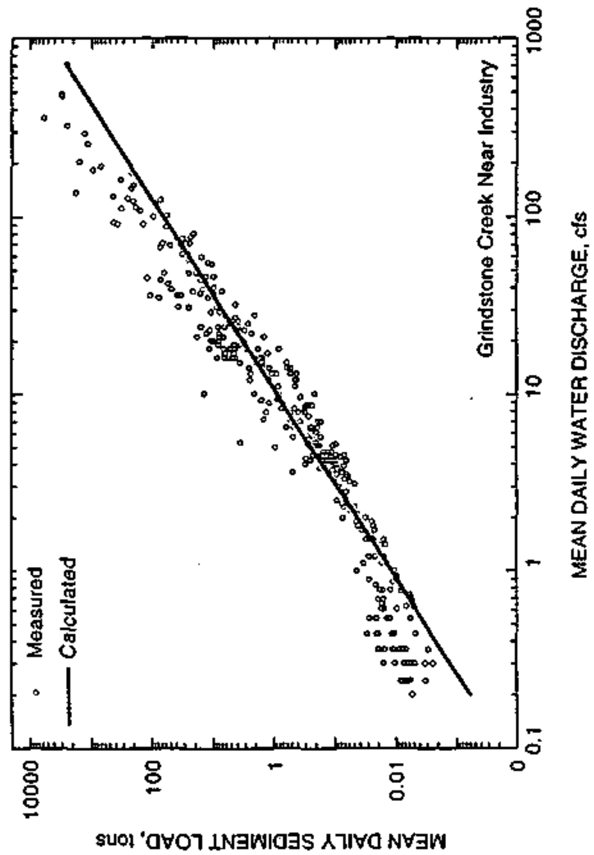

Measured
Calculated
Henderson Creek Near Oquawka
Iroquois River Near Chebanse
Iroquois River at Iroquois
Money Creek Near Towanda
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs
0.1
10
1000
100000
1
100
10000
1000000
10
100
1000
10000
100000


Measured
Calculated
Spoon River at Serville
Grindstone Creek Near Birmingham
Lamoine River at Ripley
Sangamon River Near Oakford
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs


Measured
Calculated
Mackinaw River Below Congerville
Big Creek at St. David
Big Creek Near Bryant
Slug Run Near Bryant
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs

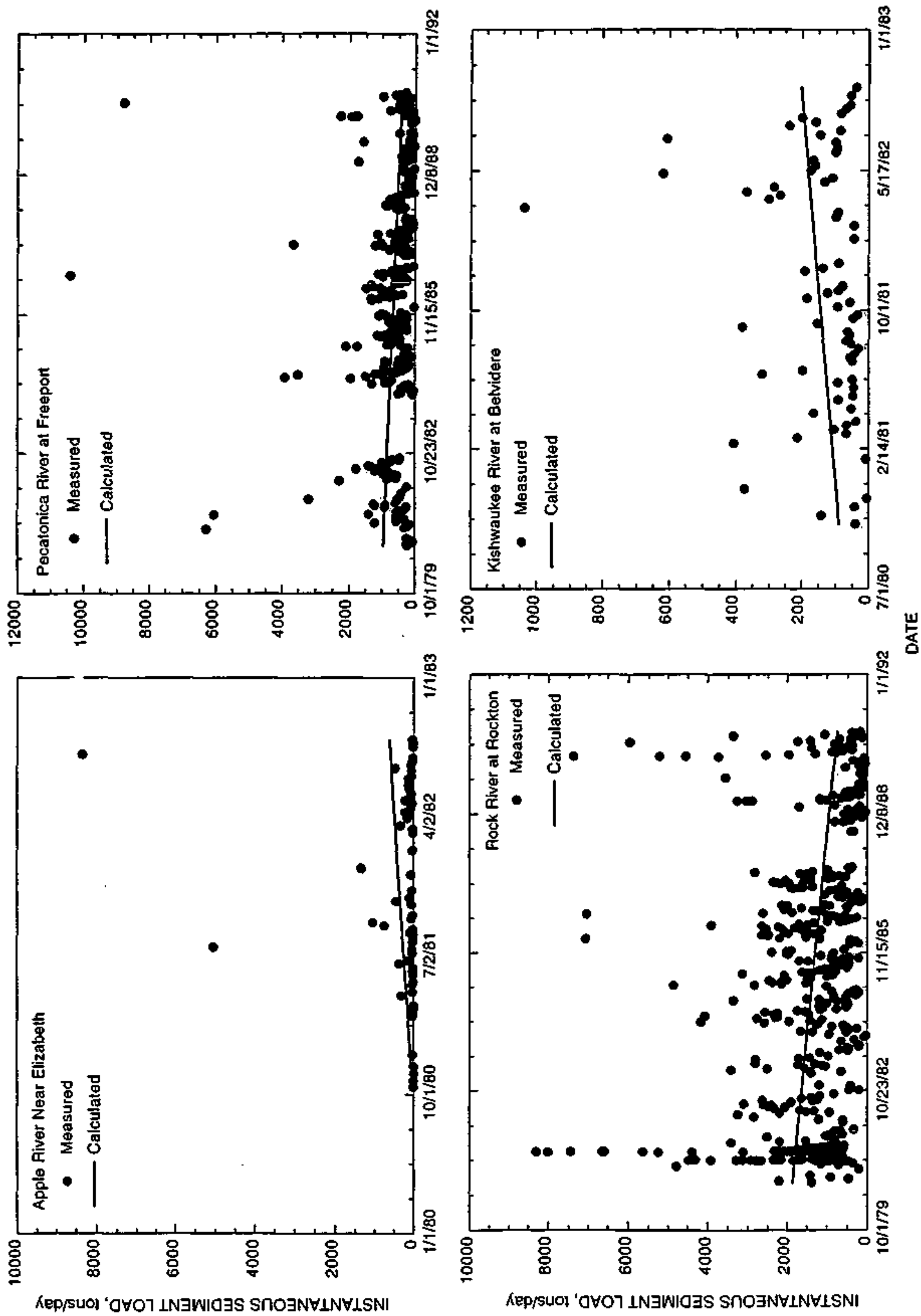

Kaskaskia at Cook Mills
Embarras River Near Oakland
Little Wabash River at Louisville
Big Muddy River at Murphysboro
Measured
Calculated
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs

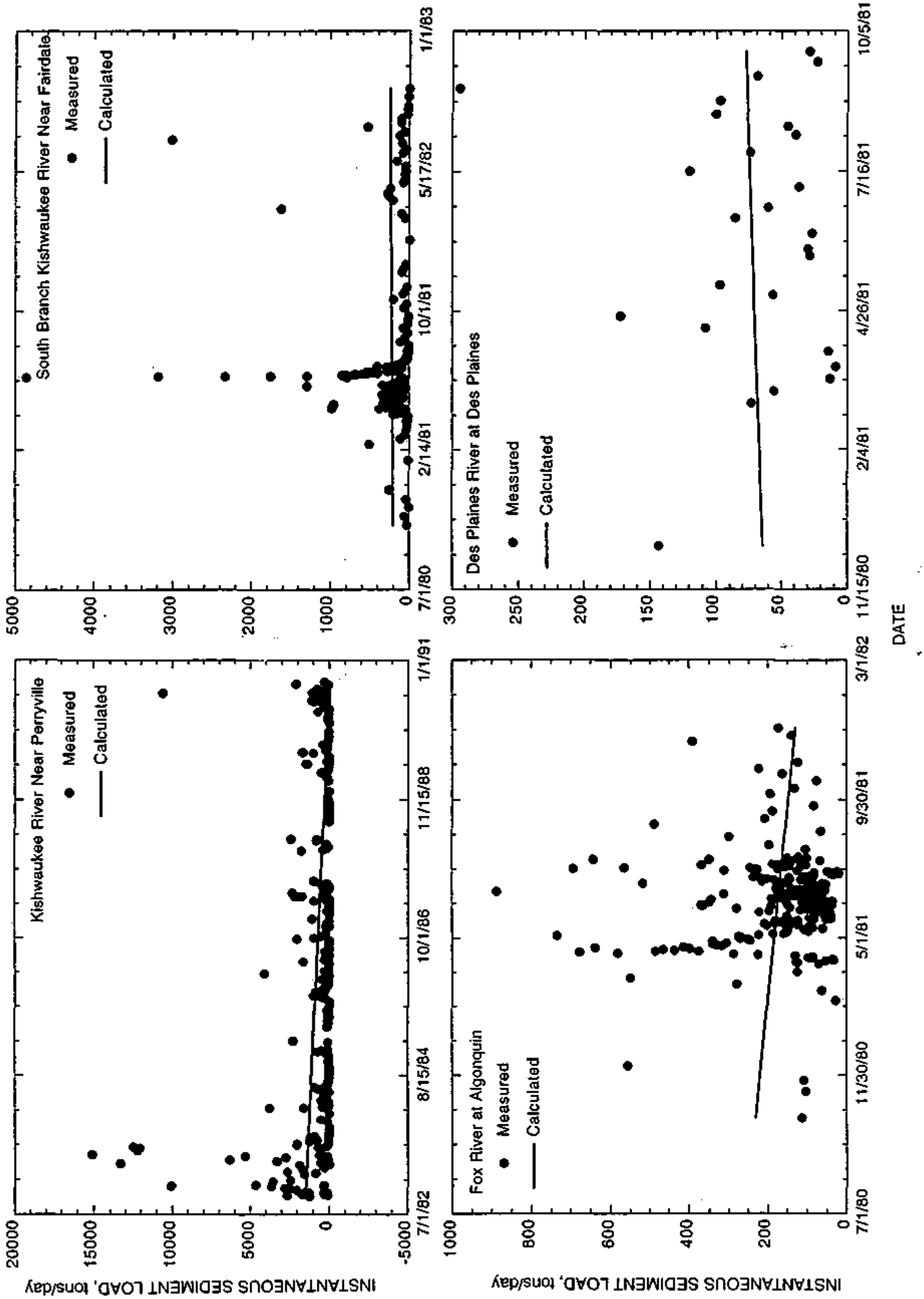

Measured
Calculated
Brushy Creek Near Harco
South Fork Saline River Near Carrier Mills
Lusk Creek Near Eddyville
Kaskaskia River Near Venedy Station
MEAN DAILY SEDIMENT LOAD, tons
MEAN DAILY WATER DISCHARGE, cfs


Measured
Calculated
Grindstone Creek Near Industry
MEAN DAILY SEDIMENT LOAD, tons
10000
100
1
0.01
0
MEAN DAILY WATER DISCHARGE, cfs
0.1
1
10
100
1000

APPENDIX B

PLOTS OF INSTANTANEOUS SUSPENDED SEDIMENT LOAD AND REGRESSION LINES FOR THE ENTTRE RECORD LENGTHS OF ALL ISWS SEDIMENT GAGING SITES


Apple River Near Elizabeth
Measured
Calculated
Pecatonica River at Freeport
Measured
Calculated
Rock River at Rockton
Measured
Calculated
Kishwaukee River at Belvidere
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE



South Branch Kishwaukee River Near Fairdale
Measured
Calculated
Kishwaukee River Near Perryville
Measured
Calculated
Des Plaines River at Des Plaines
Measured
Calculated
Fox River at Algonquin
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
7/1/80
2/14/81
10/1/81
5/17/82
1/1/83
7/1/82
8/15/84
10/1/86
11/15/88
1/1/91
11/15/80
2/4/81
4/26/81
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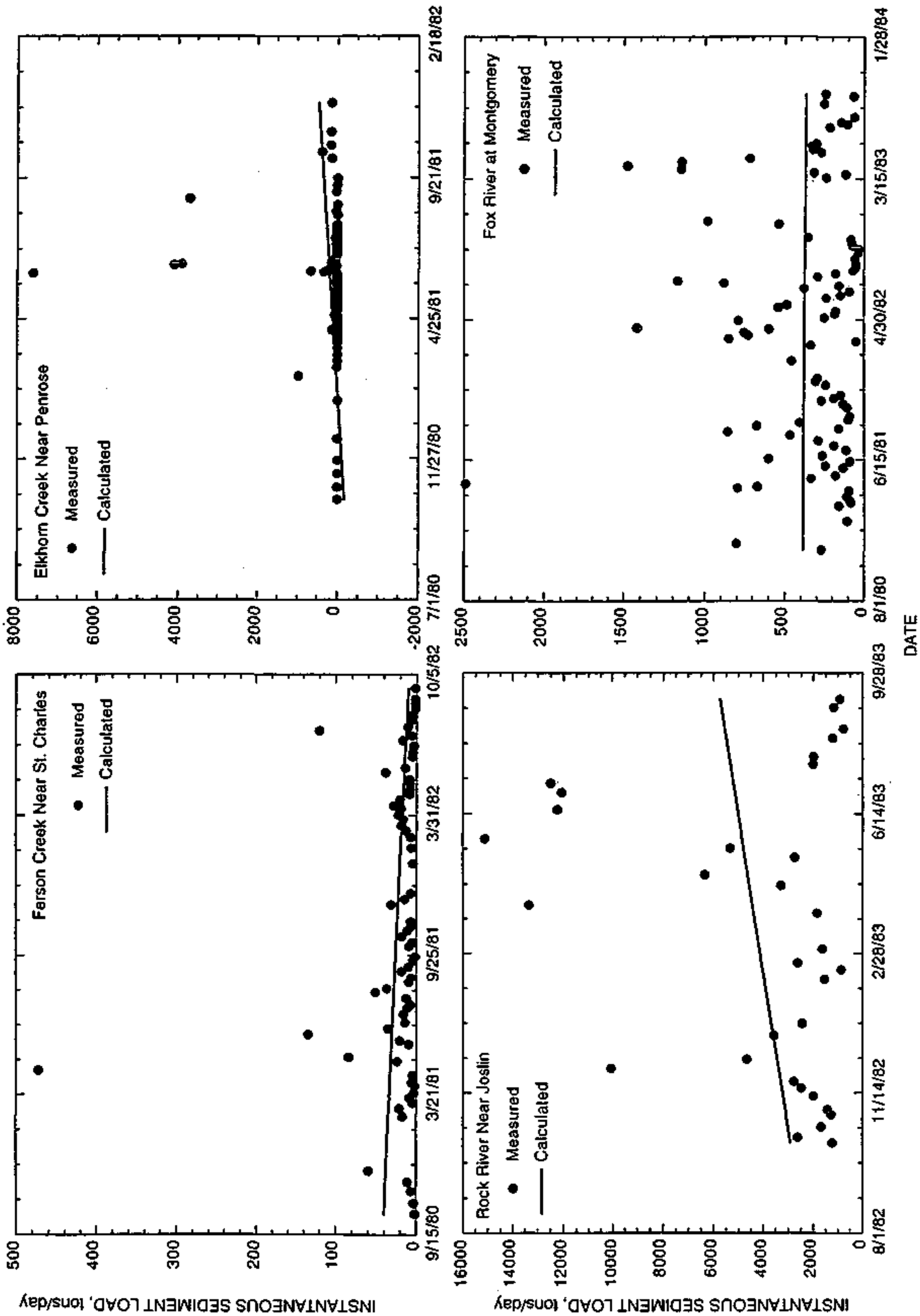
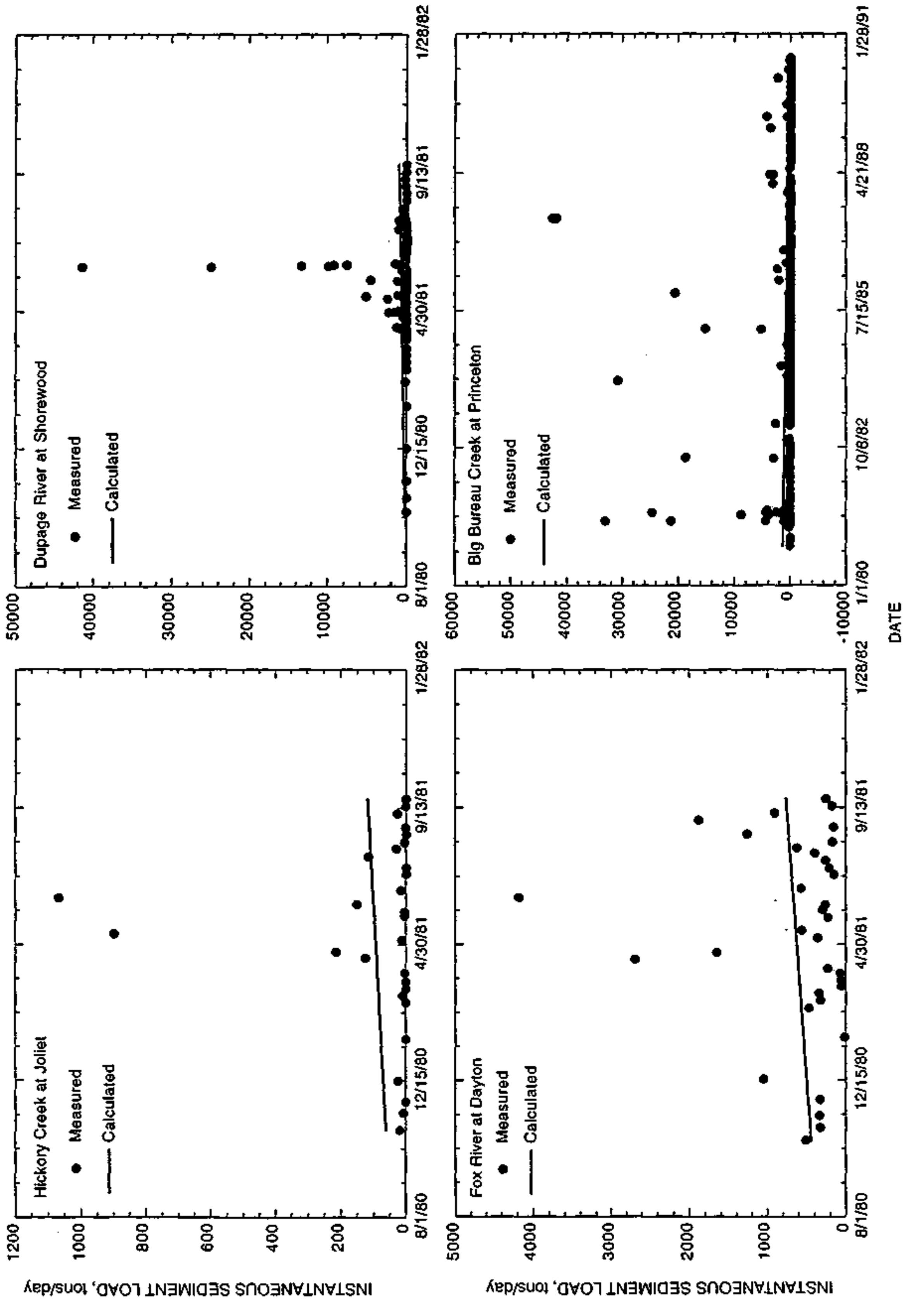
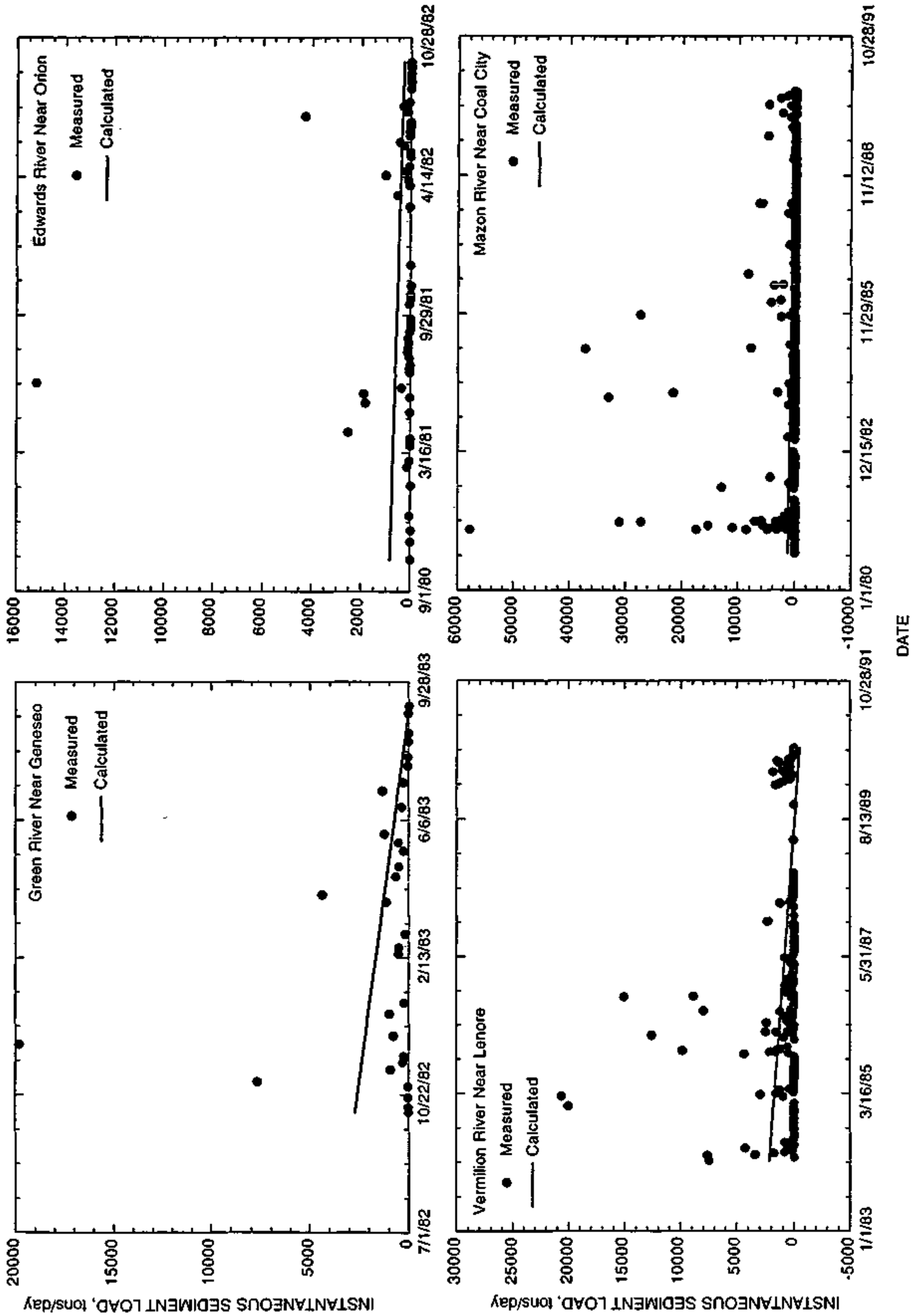
10/5/81
7/1/80
11/30/80
5/1/81
9/30/81
3/1/82



Ferson Creek Near St. Charles
Measured
Calculated
Elkhorn Creek Near Penrose
Measured
Calculated
Rock River Near Joslin
Measured
Calculated
Fox River at Montgomery
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE



Hickory Creek at Joliet
Measured
Calculated
Dupage River at Shorewood
Measured
Calculated
Fox River at Dayton
Measured
Calculated
Big Bureau Creek at Princeton
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
8/1/80
12/15/80
4/30/81
9/13/81
1/28/82
1/1/80
10/6/82
7/15/85
4/21/88
1/28/91


Edwards River Near Orion
Measured
Calculated
Green River Near Geneseo
Vermilion River Near Lenore
Mazon River Near Coal City
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
9/1/80
3/16/81
9/29/81
4/14/82
10/28/82
7/1/82
10/22/82
2/13/83
6/6/83
9/28/83
1/1/80
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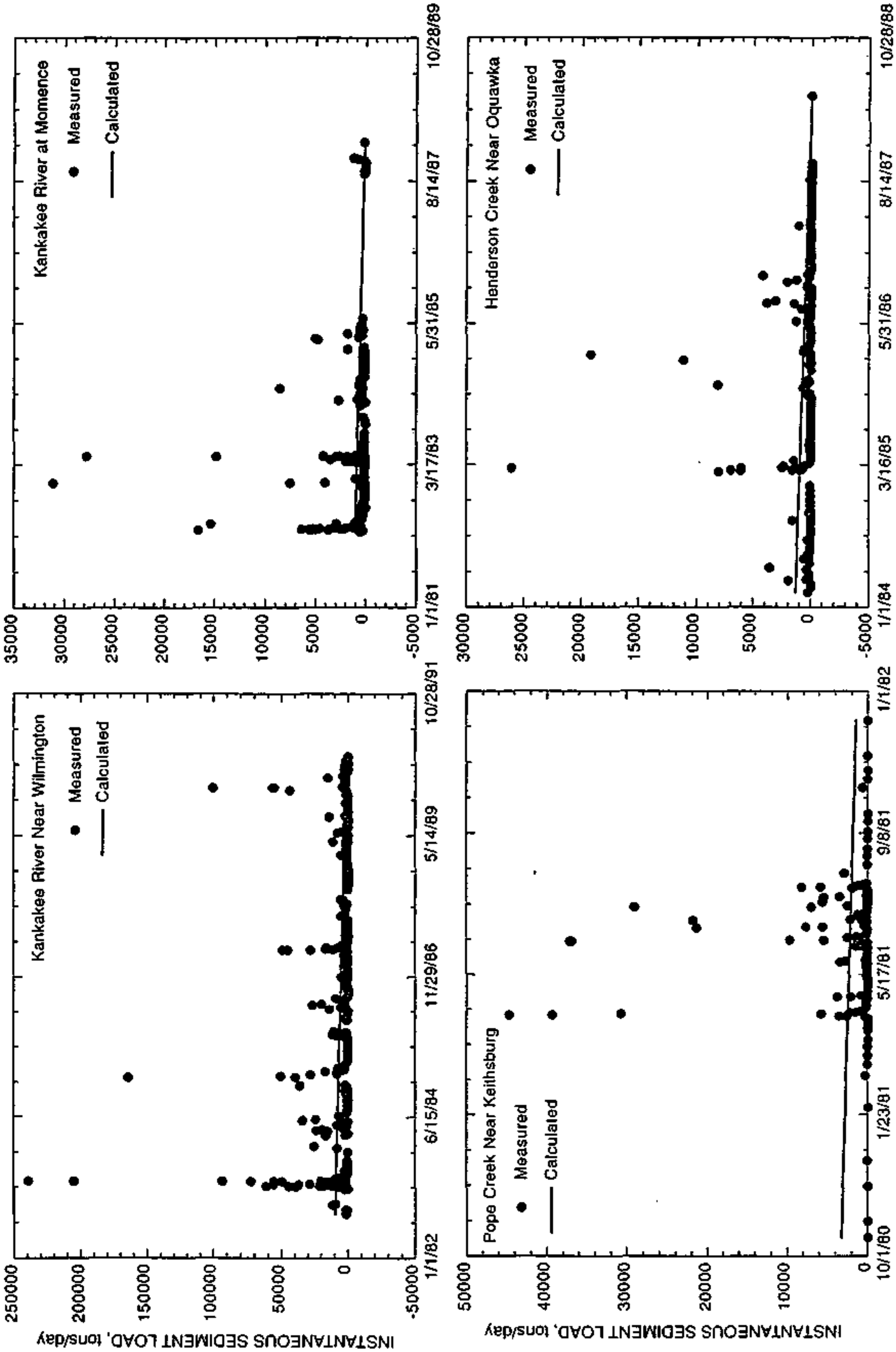
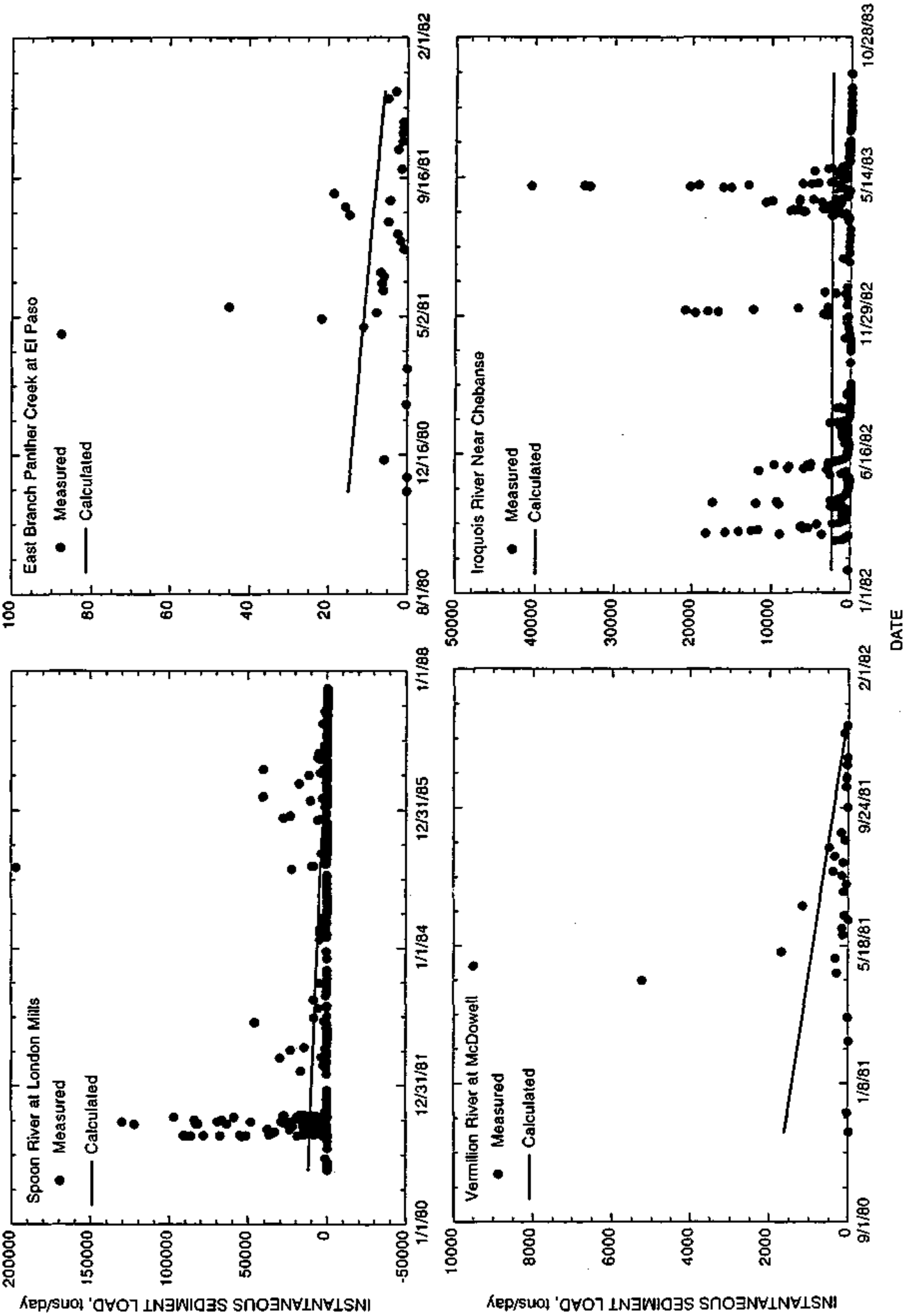
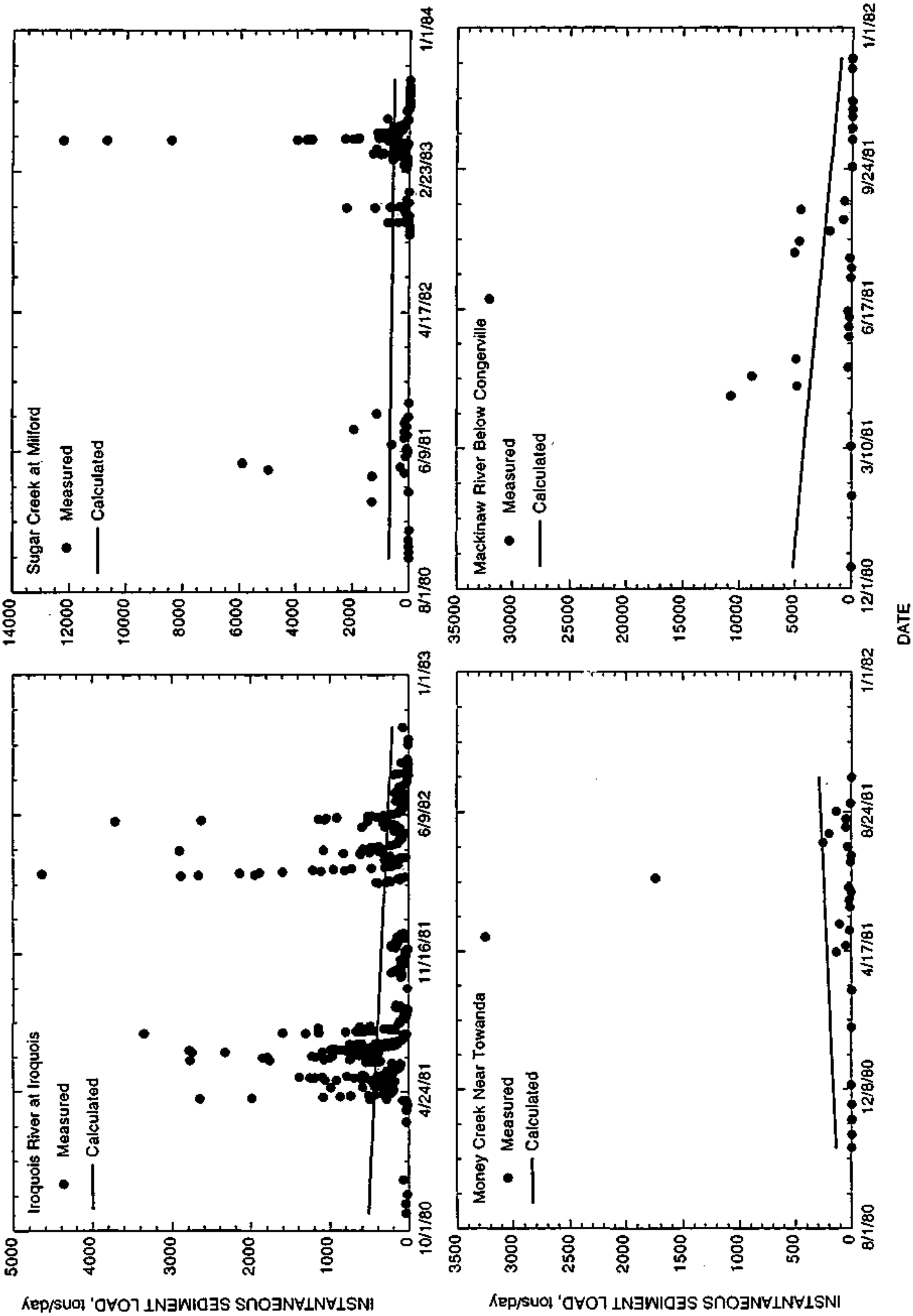
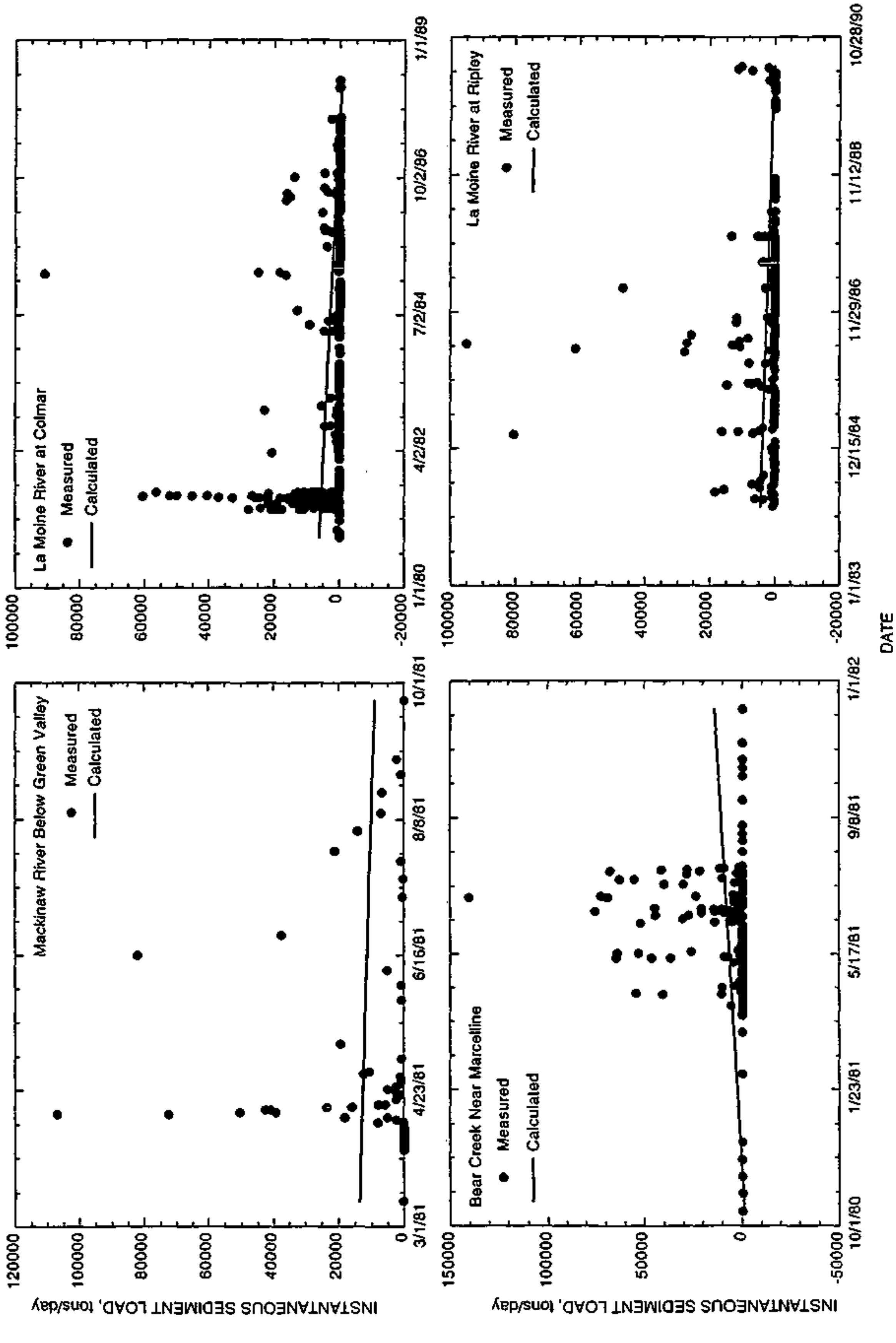
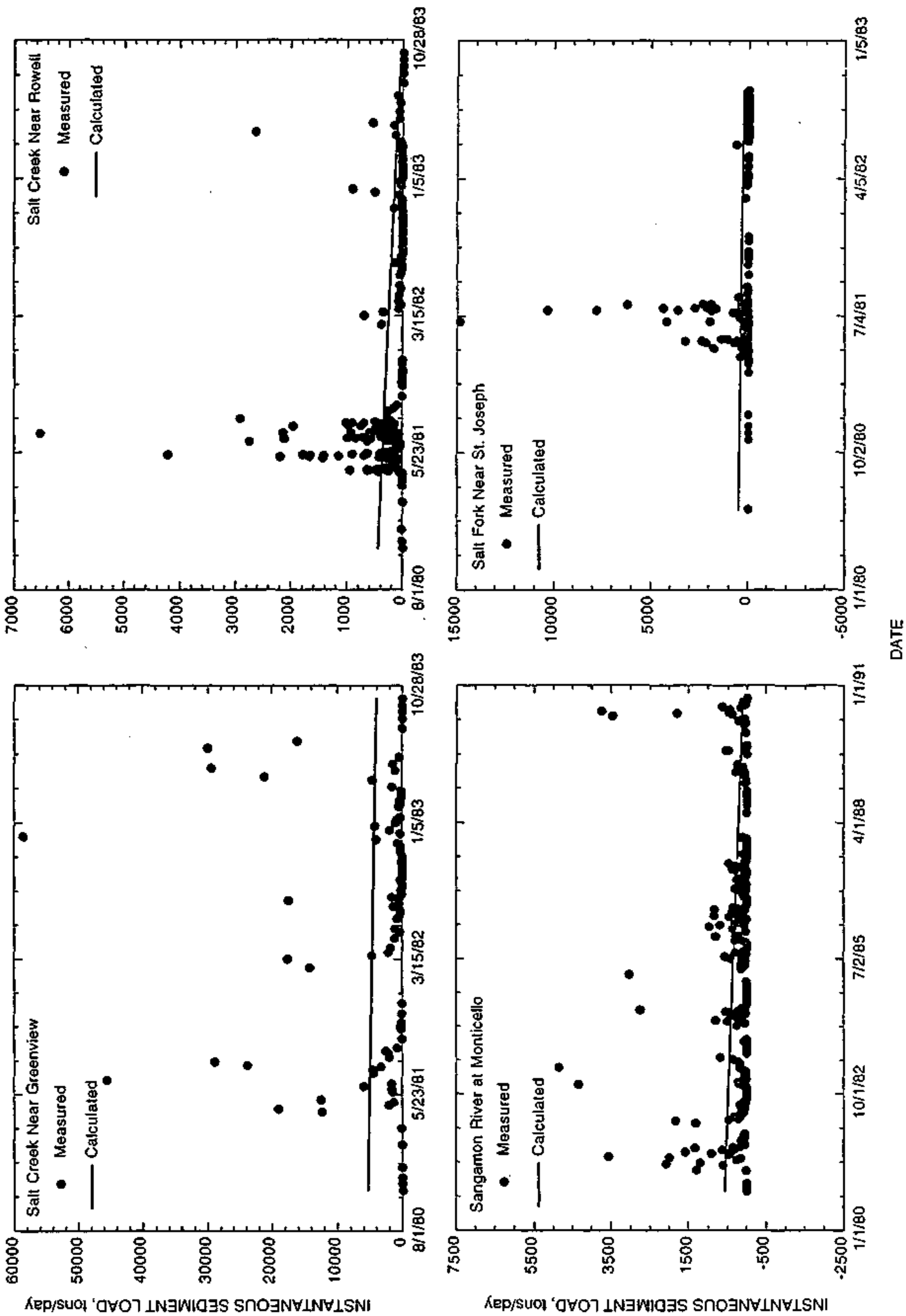
10/28/91
1/1/83
3/16/85
5/31/87
8/13/89


Kankakee River Near Wilmington
Measured
Calculated
Kankakee River at Momence
Measured
Calculated
Pope Creek Near Keithsburg
Measured
Calculated
Henderson Creek Near Oquawka
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE

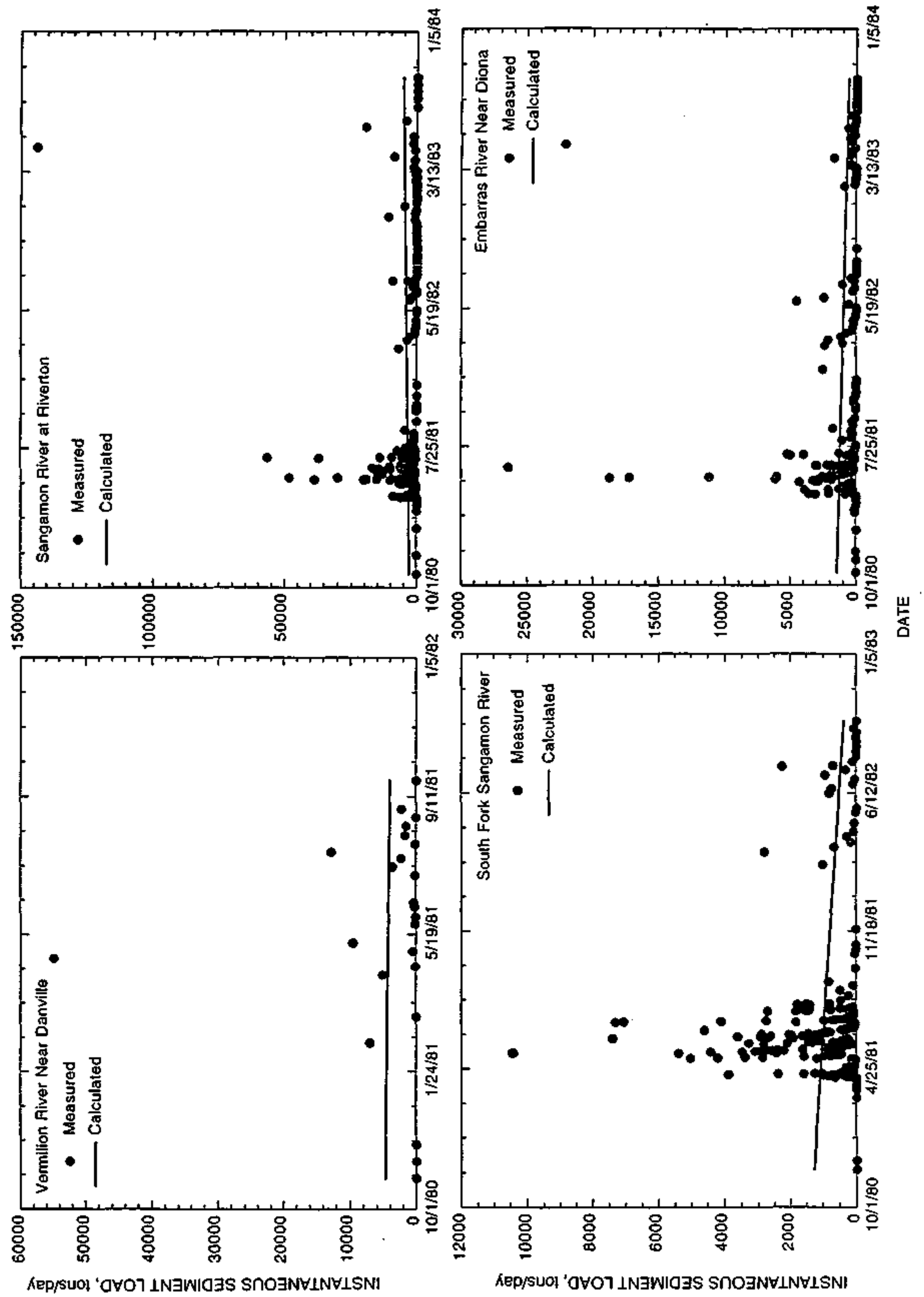

Spoon River at London Mills
Measured
Calculated
East Branch Panther Creek at El Paso
Measured
Calculated
Vermillion River at McDowell
Measured
Calculated
Iroquois River Near Chebanse
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
200000
150000
100000
50000
0
-50000
1/1/80
12/31/81
1/1/84
12/31/85
1/1/88
100
80
60
40
20
0
8/1/80
12/16/80
5/2/81
9/16/81
2/1/82
10000
8000
6000
4000
2000
0
9/1/80
1/8/81
5/18/81
9/24/81
2/1/82
50000
40000
30000
20000
10000
0
1/1/82
6/16/82
11/29/82
5/14/83
10/28/83

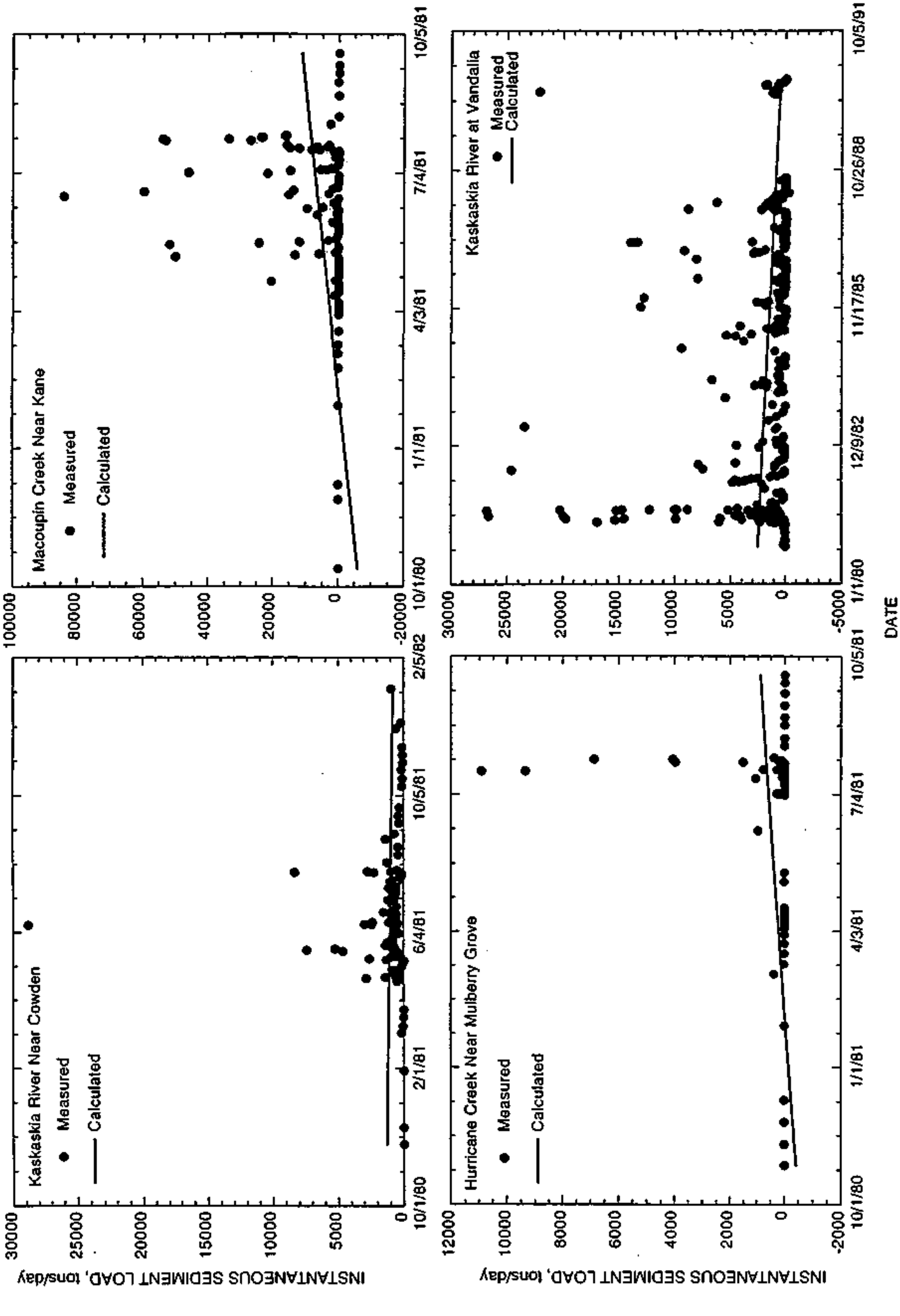

Iroquois River at Iroquois
Measured
Calculated
Money Creek Near Towanda
Measured
Calculated
Sugar Creek at Milford
Measured
Calculated
Mackinaw River Below Congerville
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
10/1/80
4/24/81
11/16/81
6/9/82
1/1/83
8/1/80
12/8/80
4/17/81
8/24/81
1/1/82
8/1/80
6/9/81
4/17/82
2/23/83
1/1/84
12/1/80
3/10/81
6/17/81
9/24/81
1/1/82

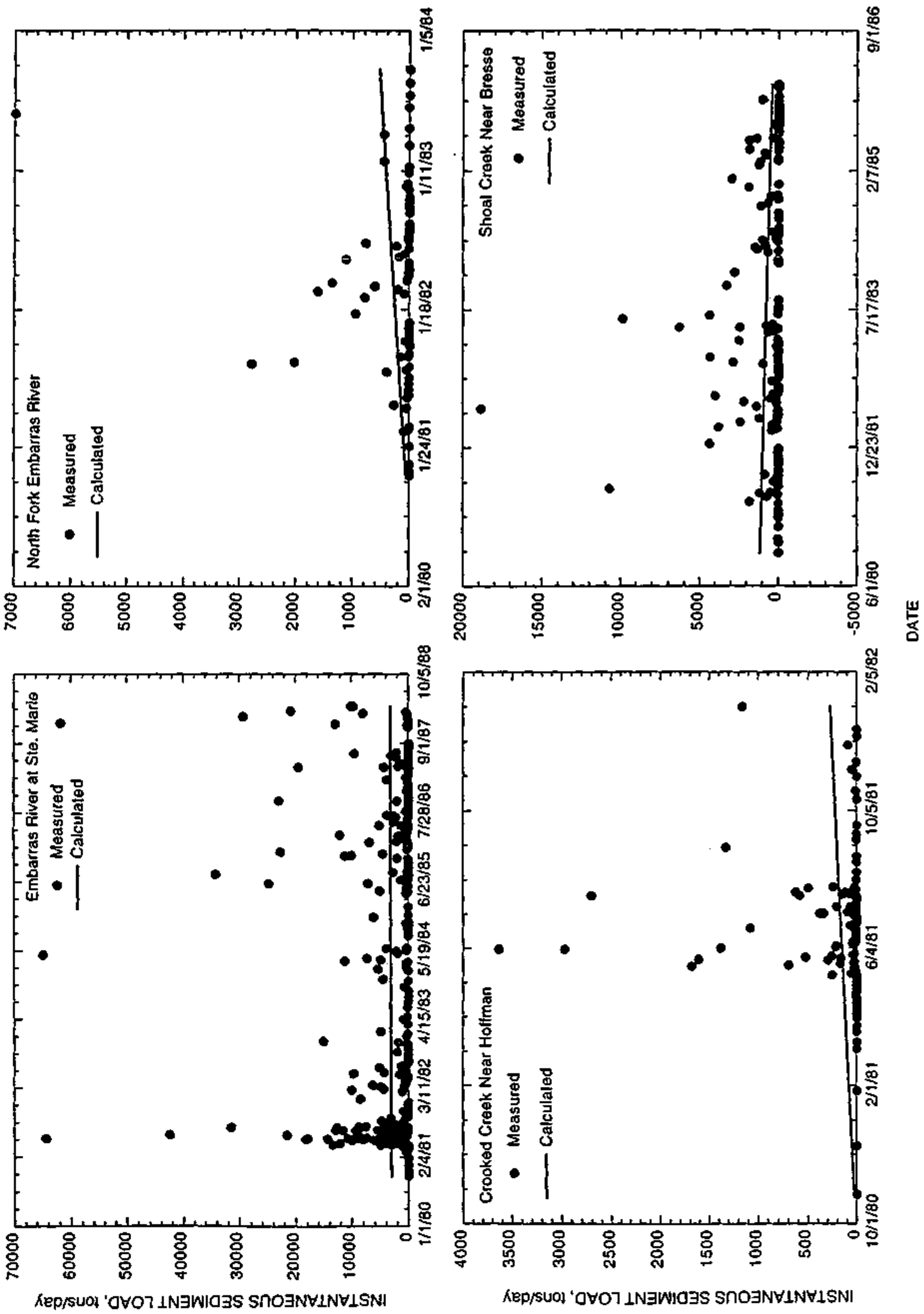

Mackinaw River Below Green Valley
Measured
Calculated
La Moine River at Colmar
Measured
Calculated
Bear Creek Near Marceline
Measured
Calculated
La Moine River at Ripley
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
3/1/81
4/23/81
6/16/81
8/8/81
10/1/81
1/1/80
4/2/82
7/2/84
10/2/86
1/1/89
10/1/80
1/23/81
5/17/81
9/8/81
1/1/82
1/1/83
12/15/84
11/29/86
11/12/88
10/28/90

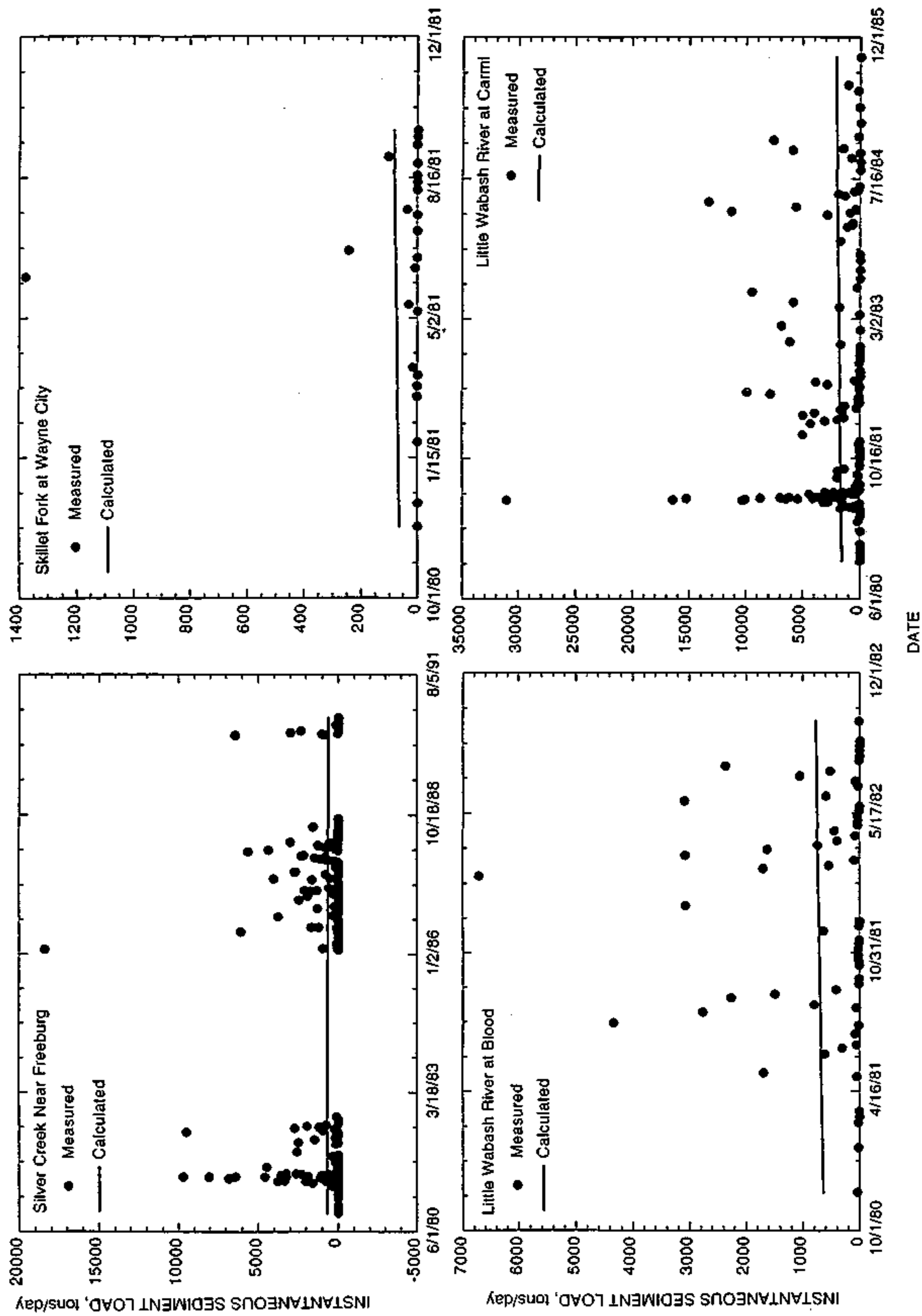


Salt Creek Near Greenview
Measured
Calculated
Salt Creek Near Rowell
Measured
Calculated
Sangamon River at Monticello
Measured
Calculated
Salt Fork Near St. Joseph
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
8/1/80
5/23/81
3/15/82
1/5/83
10/28/83
1/1/80
10/1/82
7/2/85
4/1/88
1/1/91
10/2/80
7/4/81
4/5/82
1/5/83


INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
Vermilion River Near Danville
Measured
Calculated
60000
50000
40000
30000
20000
10000
0
10/1/80
1/24/81
5/19/81
9/11/81
1/5/82
Sangamon River at Riverton
Measured
Calculated
150000
100000
50000
0
10/1/80
7/25/81
5/19/82
3/13/83
1/5/84
South Fork Sangamon River
Measured
Calculated
12000
10000
8000
6000
4000
2000
0
10/1/80
4/25/81
11/18/81
6/12/82
1/5/83
Embarras River Near Diona
Measured
Calculated
30000
25000
20000
15000
10000
5000
0
10/1/80
7/25/81
5/19/82
3/13/83
1/5/84


Kaskaskia River Near Cowden
Measured
Calculated
Macoupin Creek Near Kane
Measured
Calculated
Hurricane Creek Near Mulberry Grove
Measured
Calculated
Kaskaskia River at Vandalia
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE


Embarras River at Ste. Marie
Measured
Calculated
North Fork Embarras River
Measured
Calculated
Crooked Creek Near Hoffman
Measured
Calculated
Shoal Creek Near Bresse
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE


Silver Creek Near Freeburg
Measured
Calculated
Skillet Fork at Wayne City
Measured
Calculated
Little Wabash River at Blood
Measured
Calculated
Little Wabash River at Carmi
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
DATE
6/1/80
3/18/83
1/2/86
10/18/88
8/5/91
10/1/80
1/15/81
5/2/81
8/16/81
12/1/81
4/16/81
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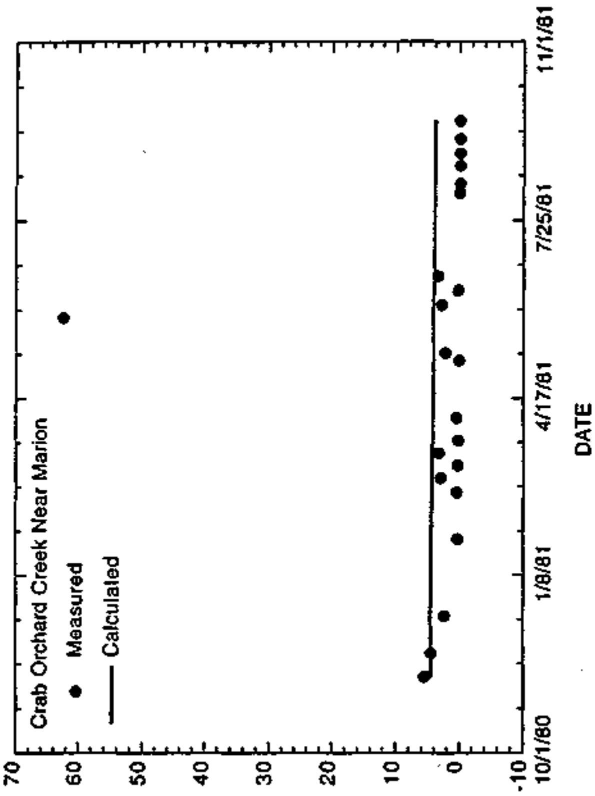
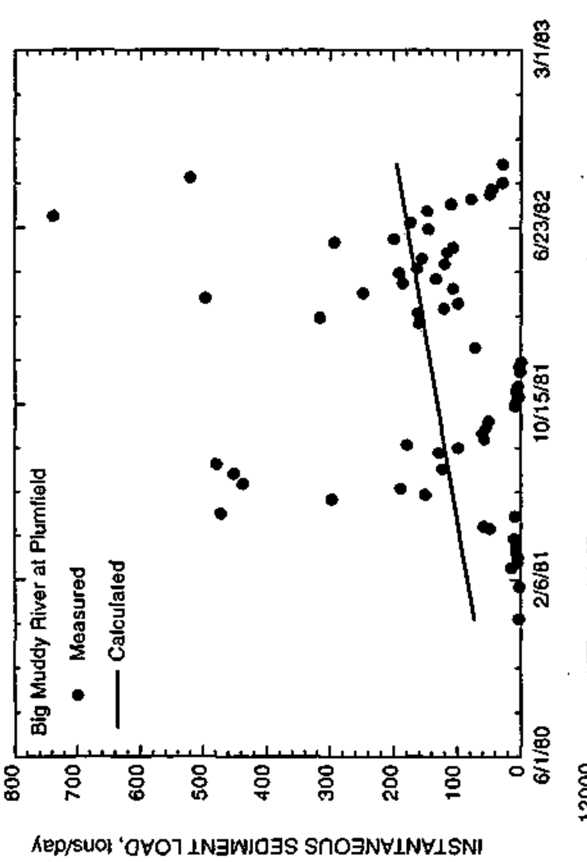
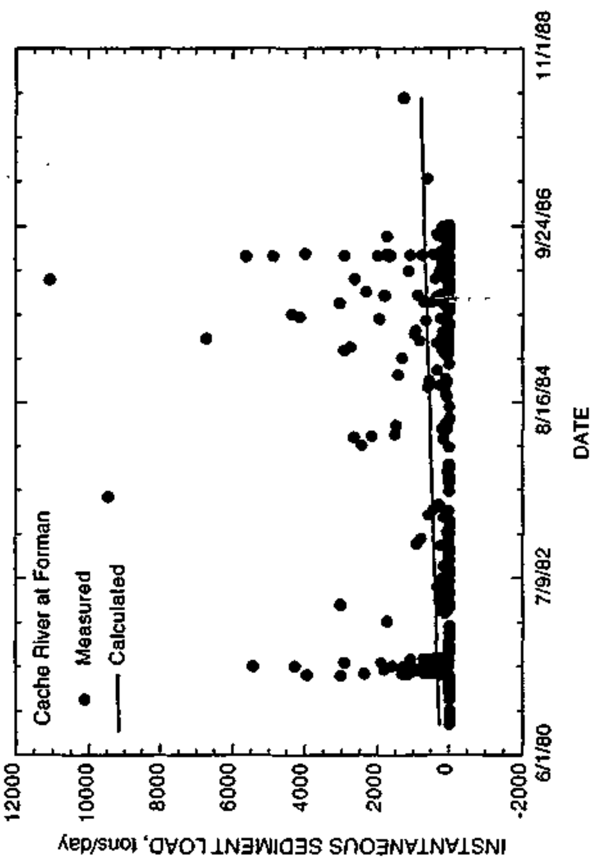
12/1/82
6/1/80
10/16/81
3/2/83
7/16/84
12/1/85

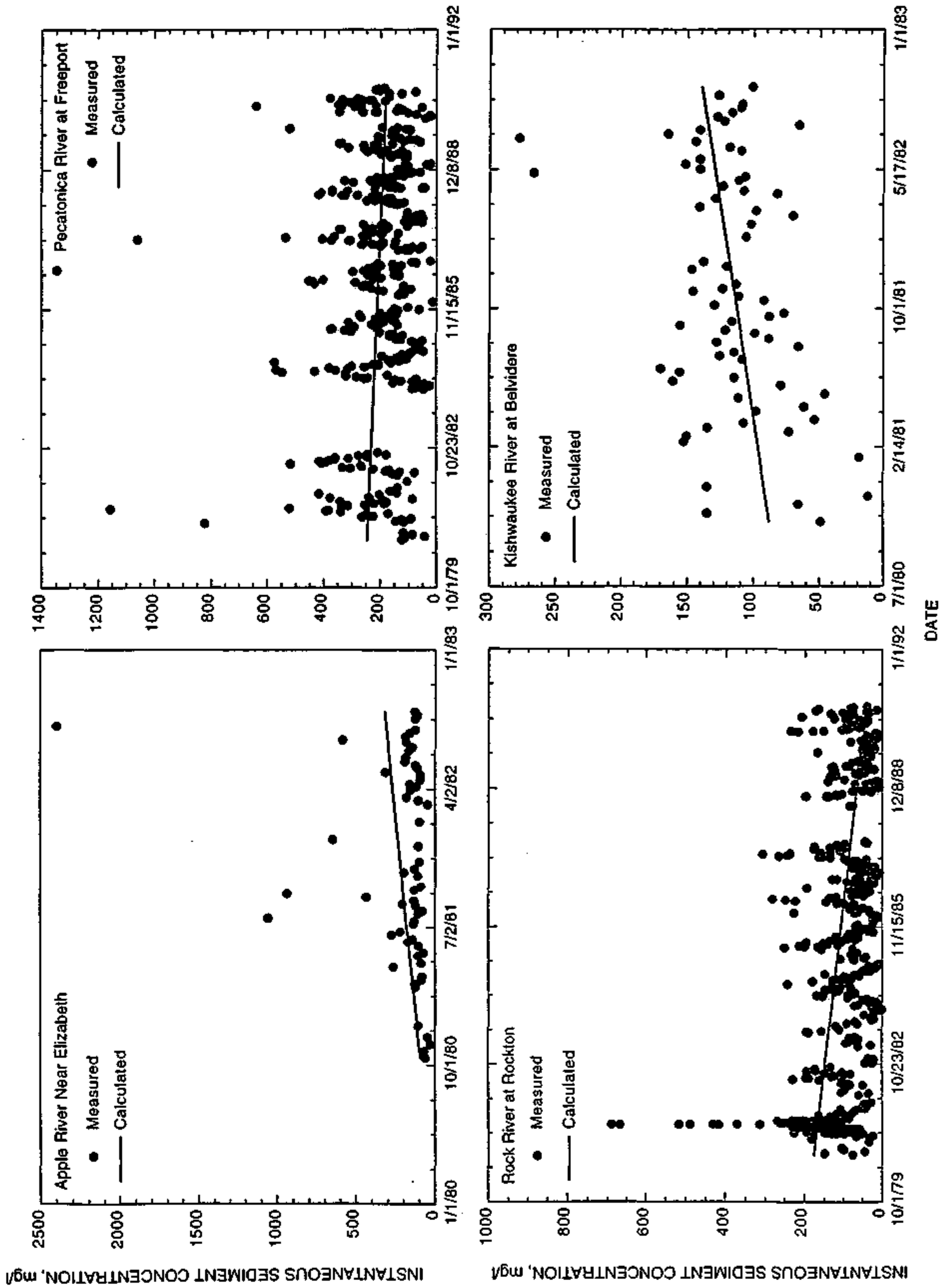

Crab Orchard Creek Near Marion
Measured
Calculated
70
60
50
40
30
20
10
0
-10
10/1/80
1/8/81
4/17/81
7/25/81
11/1/81
DATE


Big Muddy River at Plumfield
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
800
700
600
500
400
300
200
100
0
6/1/80
2/6/81
10/15/81
6/23/82
3/1/83


Cache River at Forman
Measured
Calculated
INSTANTANEOUS SEDIMENT LOAD, tons/day
12000
10000
8000
6000
4000
2000
0
-2000
6/1/80
7/9/82
8/16/84
9/24/86
11/1/88
DATE

APPENDIX C

PLOTS OF INSTANTANEOUS SUSPENDED SEDIMENT CONCENTRATION AND REGRESSION LINES FOR THE ENTIRE RECORD LENGTHS OF ALL ISWS SEDIMENT GAGING SITES



Apple River Near Elizabeth
Measured
Calculated
Pecatonica River at Freeport
Measured
Calculated
Rock River at Rockton
Measured
Calculated
Kishwaukee River at Belvidere
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/80
10/1/80
7/2/81
4/2/82
1/1/83
10/1/79
10/23/82
11/15/85
12/8/88
1/1/92
10/1/79
10/23/82
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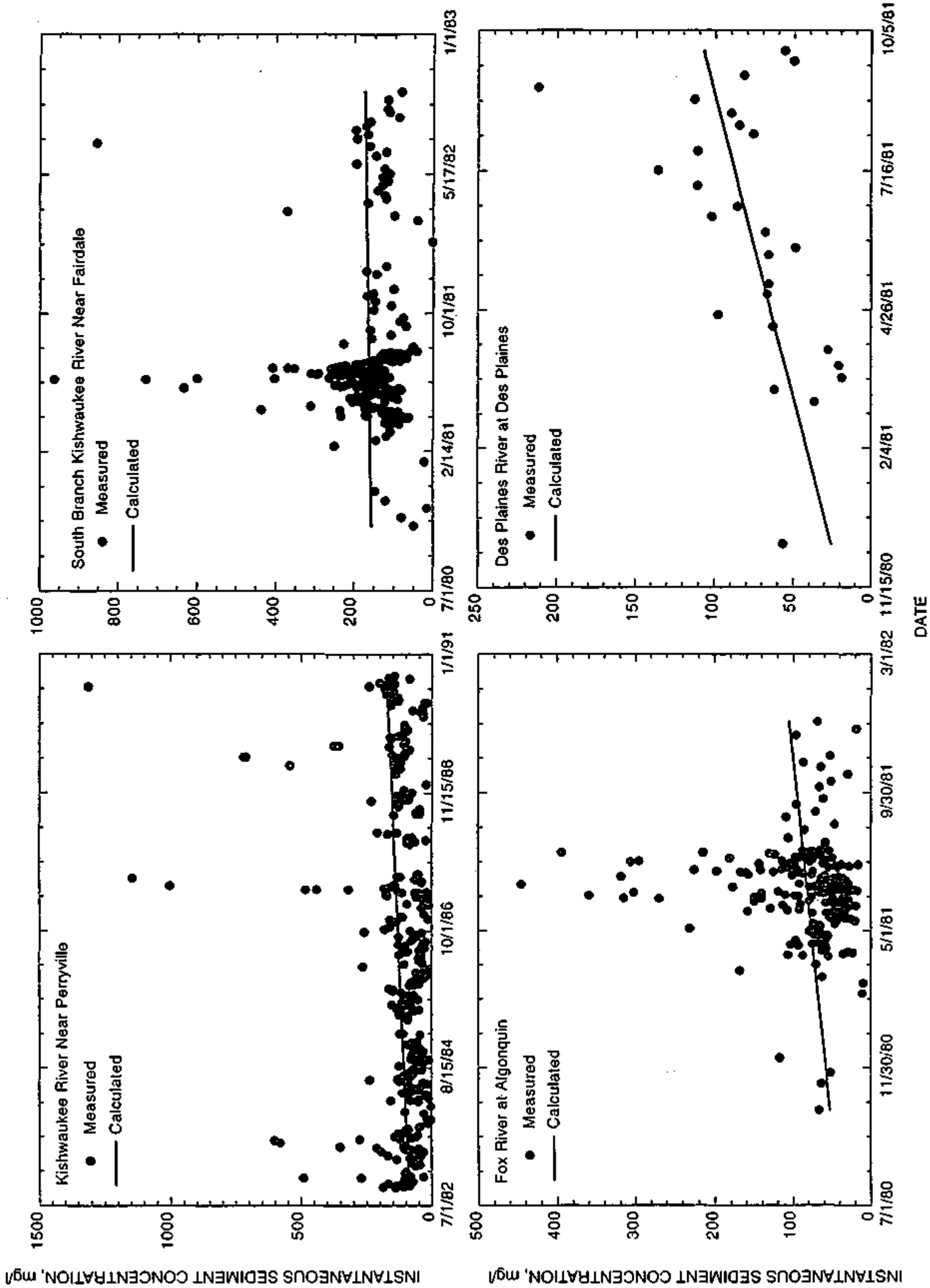
10/1/81
5/17/82
1/1/83


Kishwaukee River Near Perryville
Measured
Calculated
South Branch Kishwaukee River Near Fairdale
Fox River at Algonquin
Des Plaines River at Des Plaines
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
7/1/82
8/15/84
10/1/86
11/15/88
1/1/91
7/1/80
2/14/81
10/1/81
5/17/82
1/1/83
11/30/80
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11/15/80
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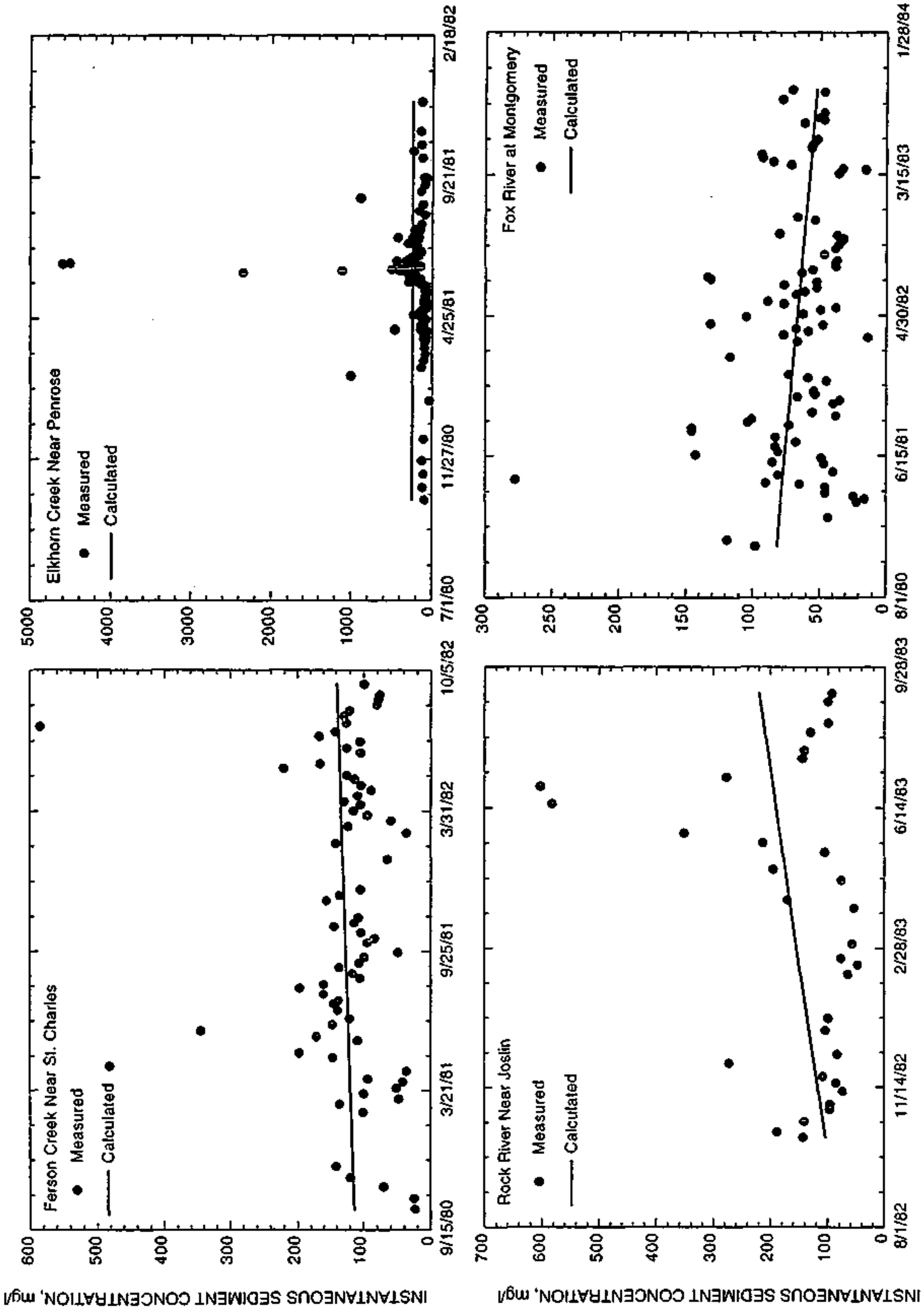
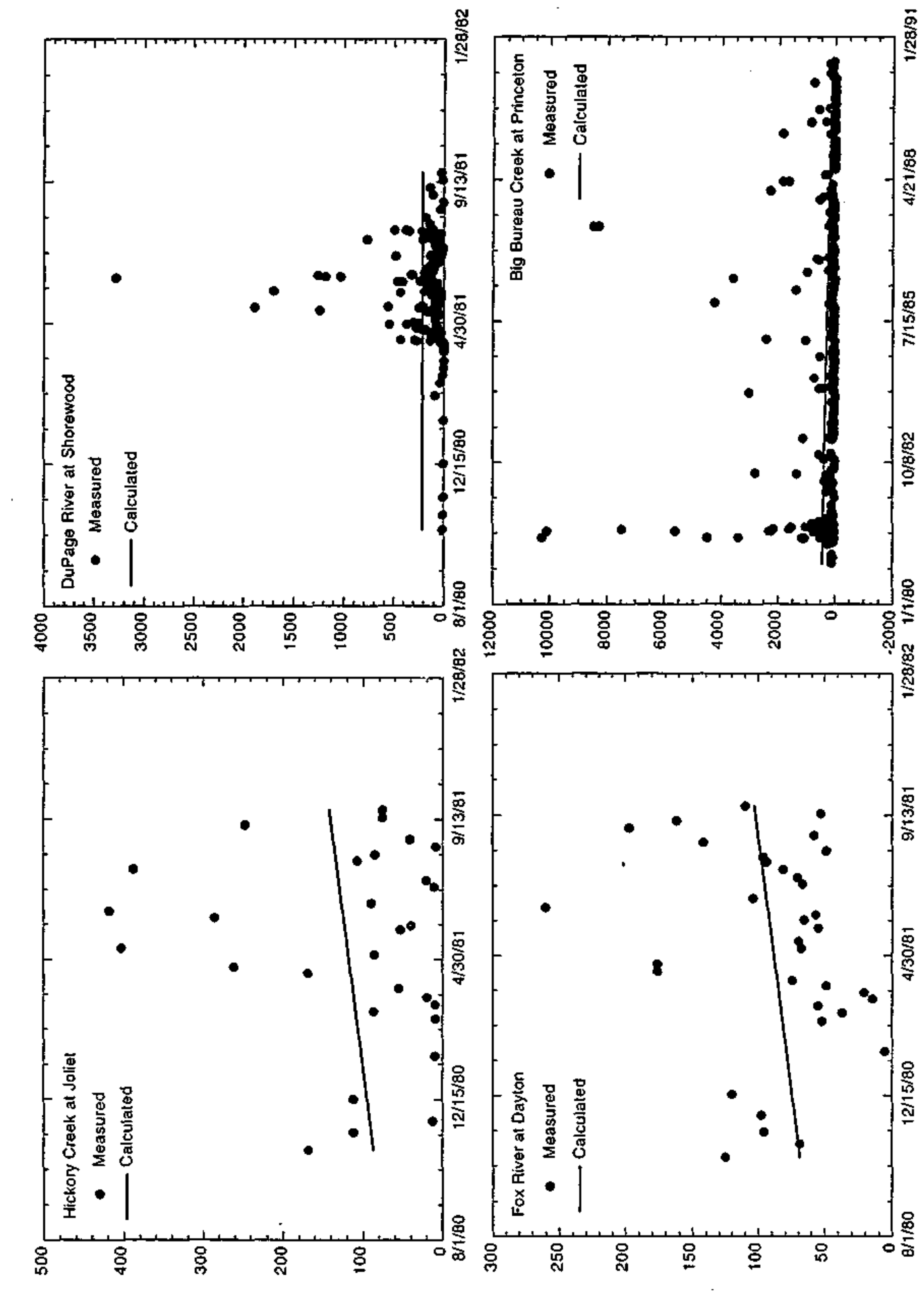
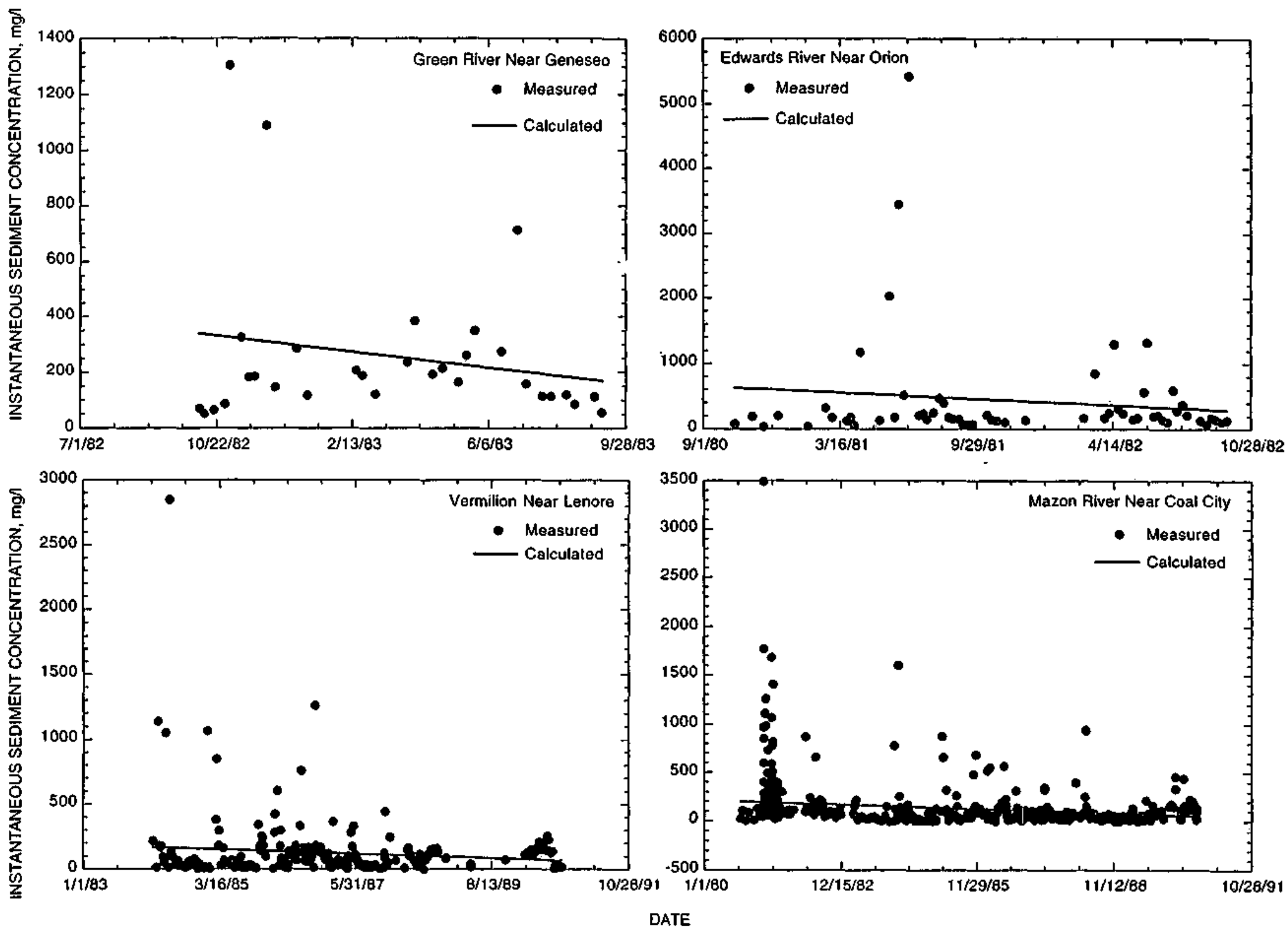
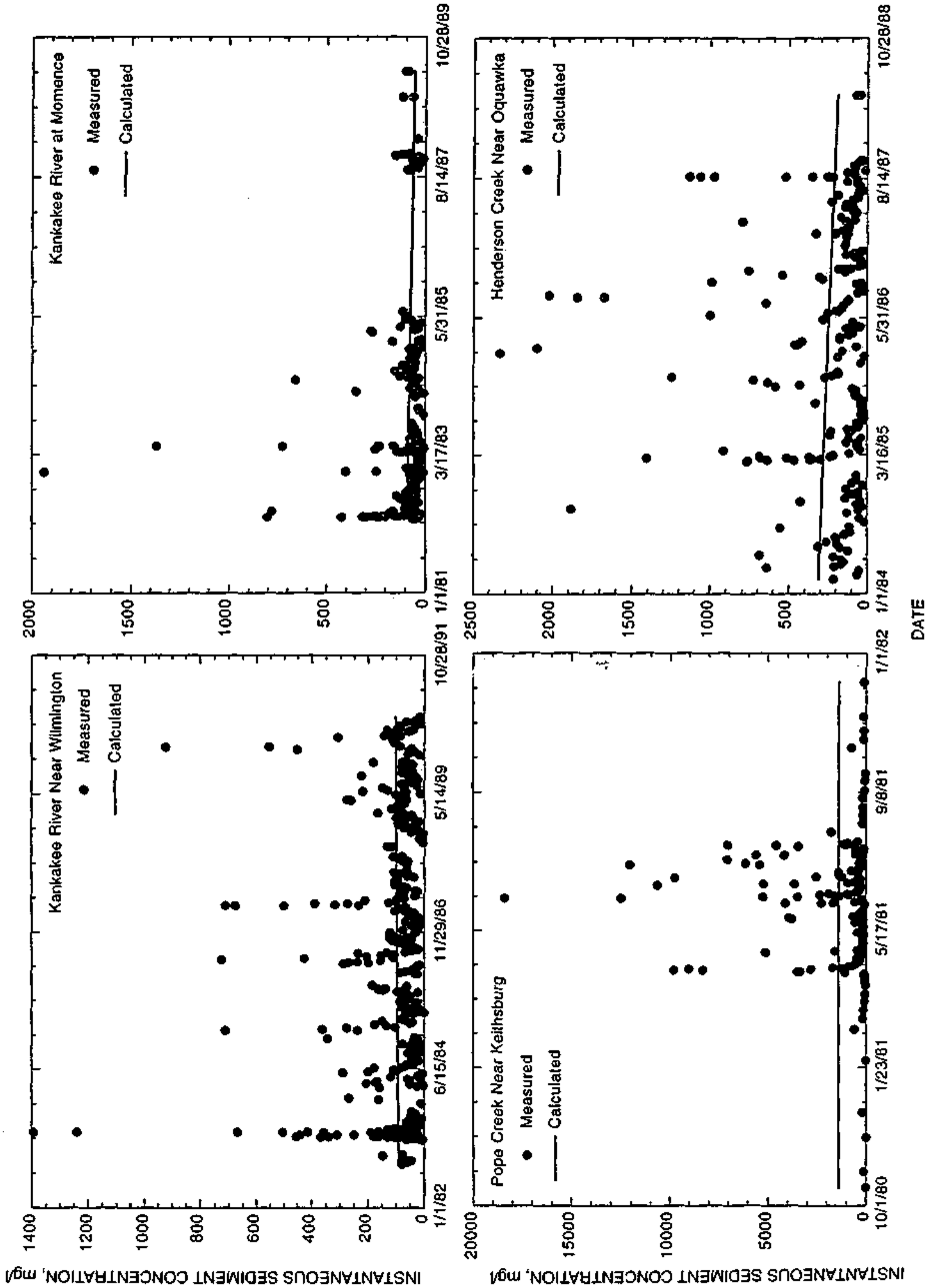
4/26/81
7/16/81
10/5/81

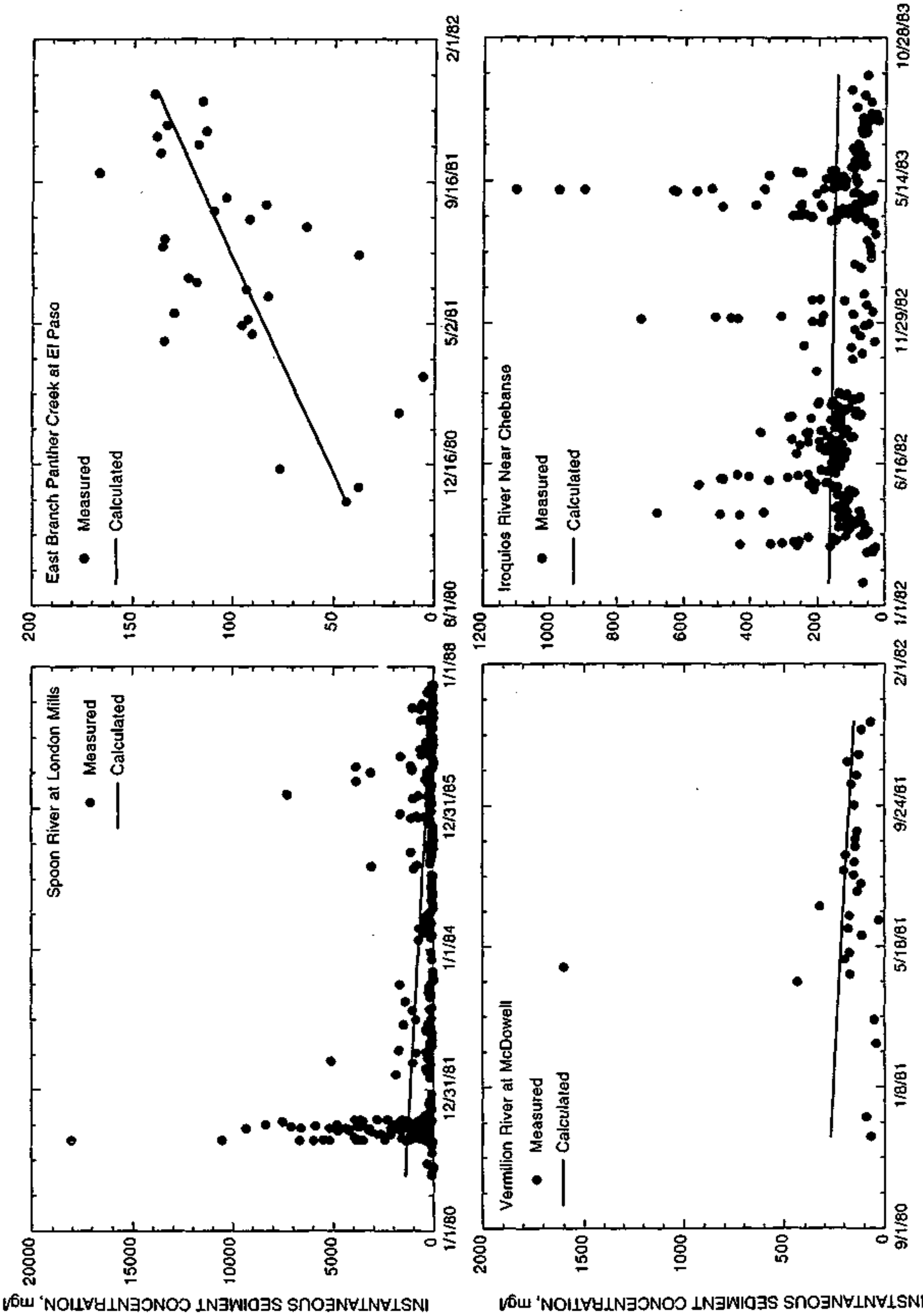

Ferson Creek Near St. Charles
Elkhorn Creek Near Penrose
Rock River Near Joslin
Fox River at Montgomery
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE


Hickory Creek at Joliet
Measured
Calculated
DuPage River at Shorewood
Measured
Calculated
Fox River at Dayton
Measured
Calculated
Big Bureau Creek at Princeton
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
8/1/80
12/15/80
4/30/81
9/13/81
1/28/82
1/1/80
10/8/82
7/15/85
4/21/88
1/28/91

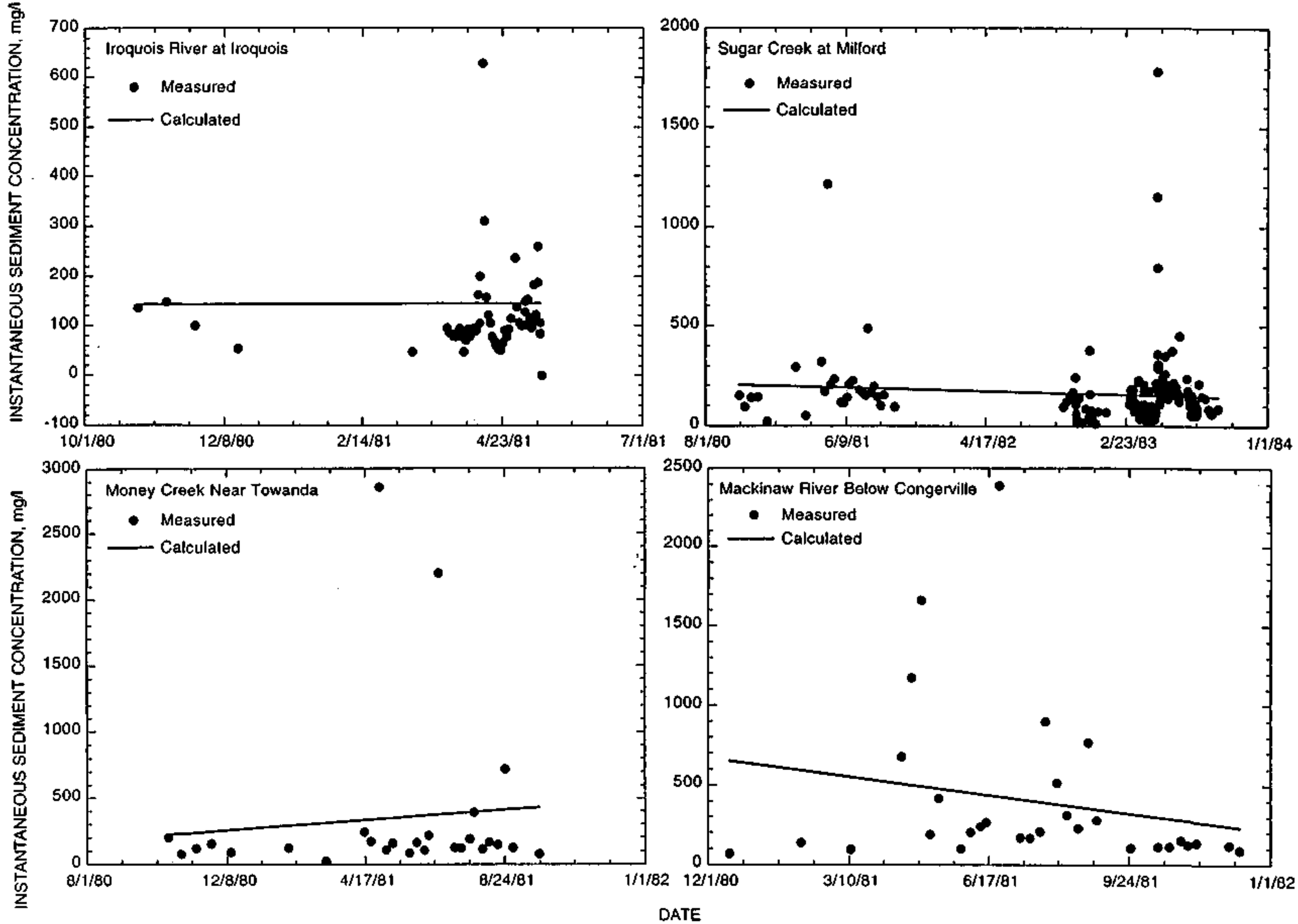

Green River Near Geneseo
Measured
Calculated
Edwards River Near Orion
Measured
Calculated
Vermilion Near Lenore
Measured
Calculated
Mazon River Near Coal City
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
7/1/82
10/22/82
2/13/83
6/6/83
9/28/83
9/1/80
3/16/81
9/29/81
4/14/82
10/28/82
1/1/83
3/16/85
5/31/87
8/13/89
10/28/91
1/1/80
12/15/82
11/29/85
11/12/88
10/28/91



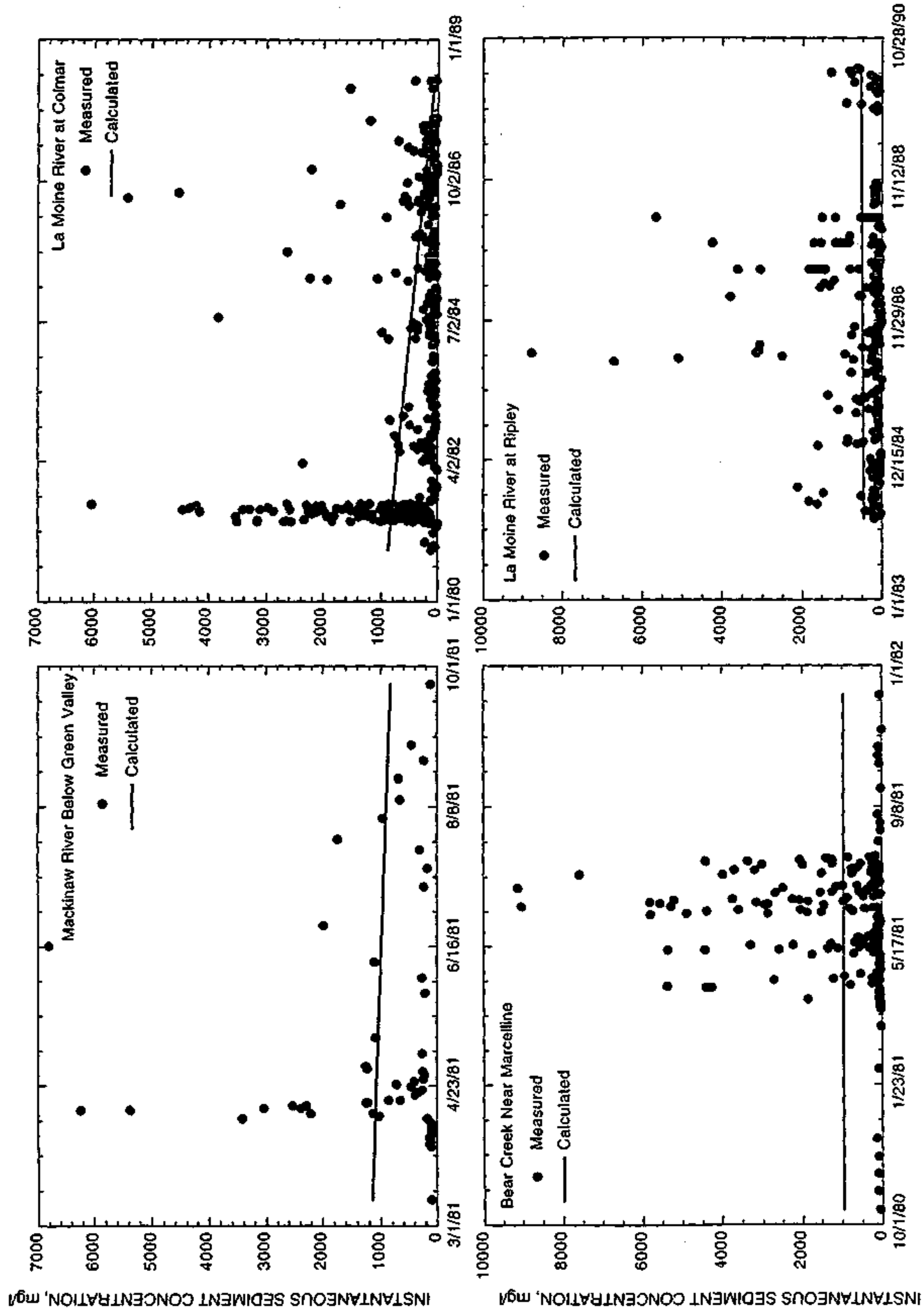
Kankakee River Near Wilmington
Measured
Calculated
Kankakee River at Momence
Measured
Calculated
Pope Creek Near Keithsburg
Measured
Calculated
Henderson Creek Near Oquawka
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/82
6/15/84
11/29/86
5/14/89
10/28/91
1/1/81
3/17/83
5/31/85
8/14/87
10/28/89
10/1/80
1/23/81
5/17/81
9/8/81
1/1/82
1/1/84
3/16/85
5/31/86
8/14/87
10/28/88



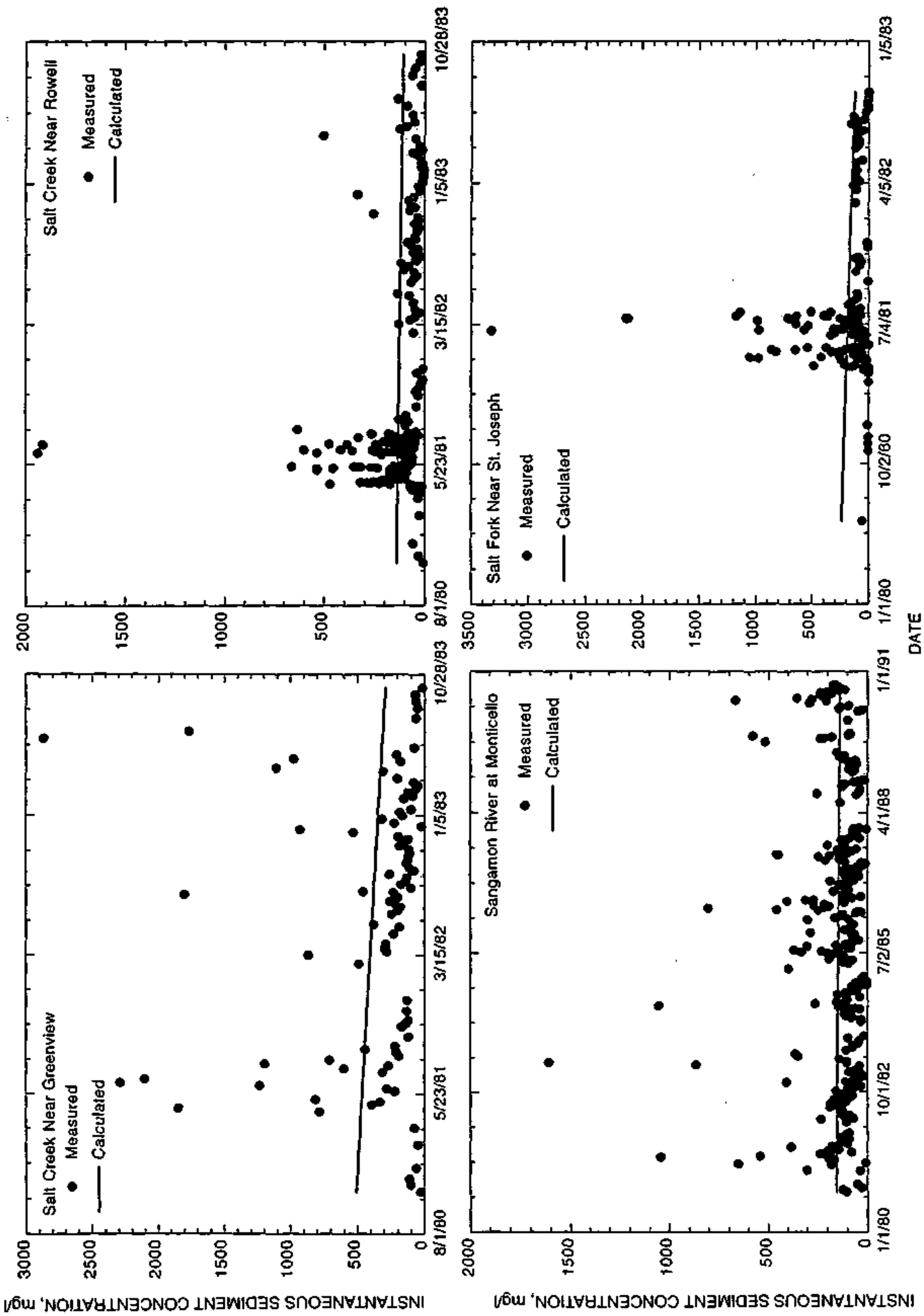
Spoon River at London Mills
Measured
Calculated
East Branch Panther Creek at El Paso
Measured
Calculated
Vermilion River at McDowell
Measured
Calculated
Iroquios River Near Chebanse
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
20000
15000
10000
5000
0
1/1/80
12/31/81
1/1/84
12/31/85
1/1/88
200
150
100
50
0
6/1/80
12/16/80
5/2/81
9/16/81
2/1/82
2000
1500
1000
500
0
9/1/80
1/8/81
5/18/81
9/24/81
2/1/82
1200
1000
800
600
400
200
0
1/1/82
6/16/82
11/29/82
5/14/83
10/28/83

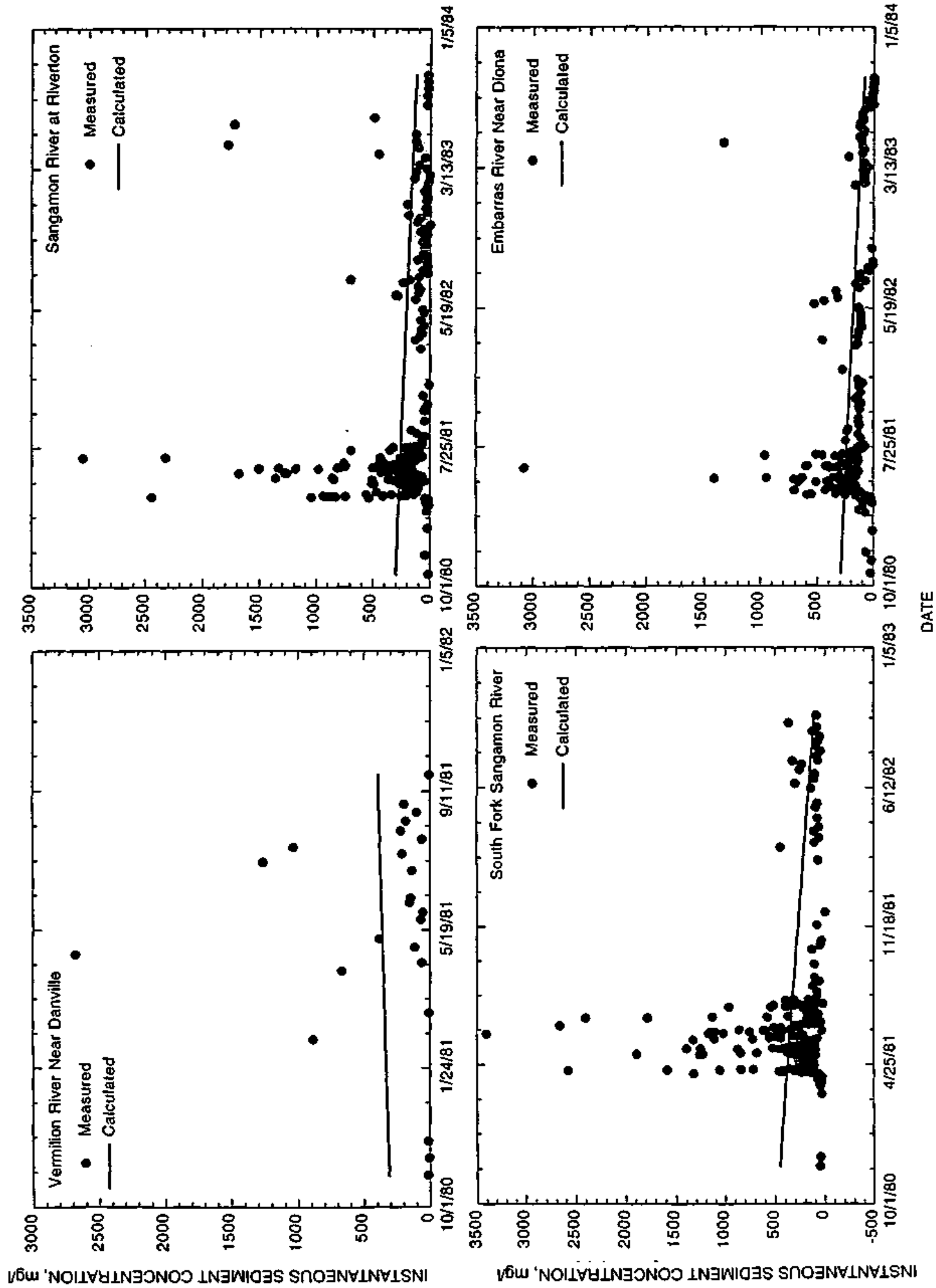


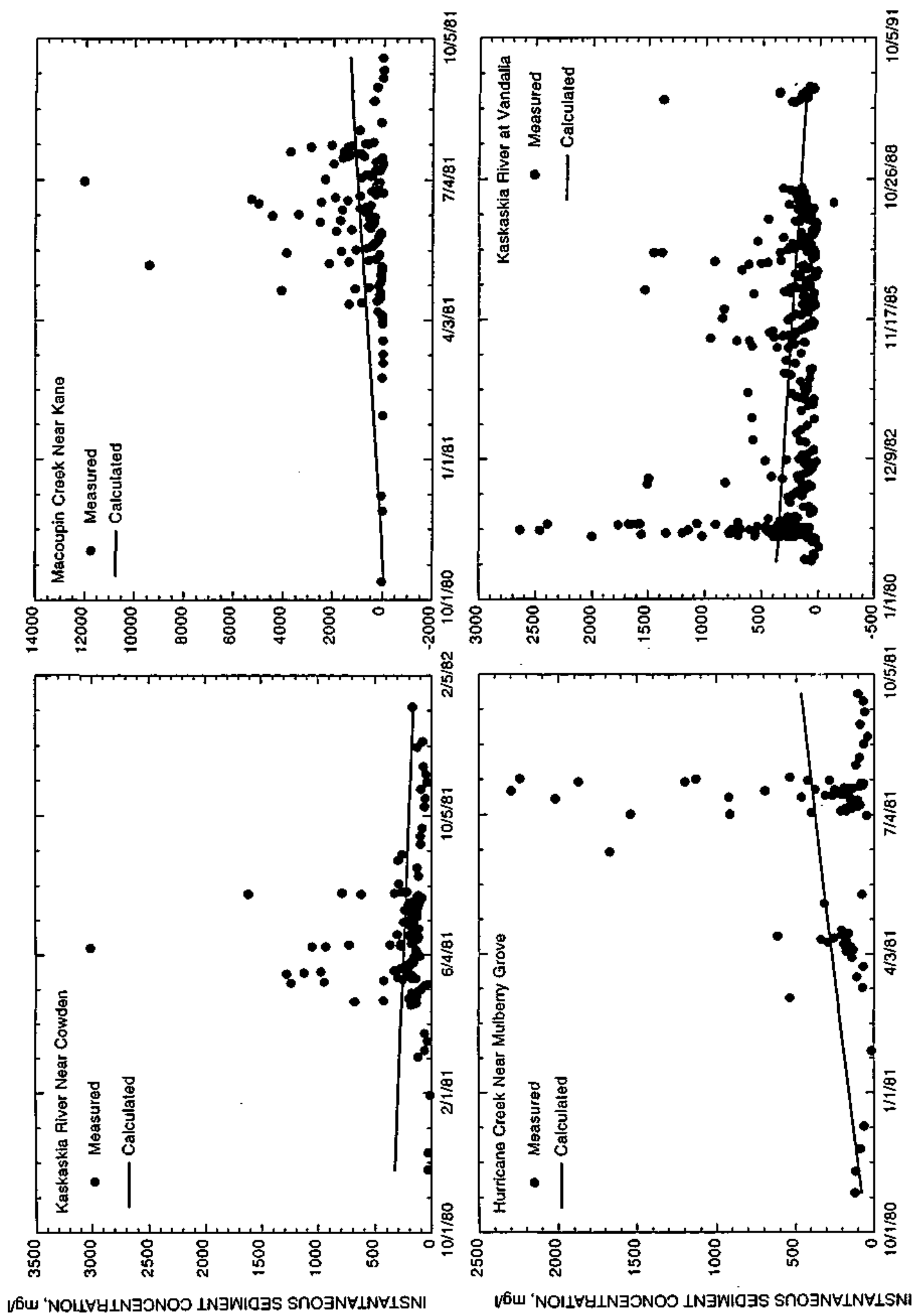
Iroquois River at Iroquois
Measured
Calculated
Sugar Creek at Milford
Measured
Calculated
Money Creek Near Towanda
Measured
Calculated
Mackinaw River Below Congerville
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
10/1/80
12/8/80
2/14/81
4/23/81
7/1/81
8/1/80
6/9/81
4/17/82
2/23/83
1/1/84
4/17/81
8/24/81
1/1/82
12/1/80
3/10/81
6/17/81
9/24/81

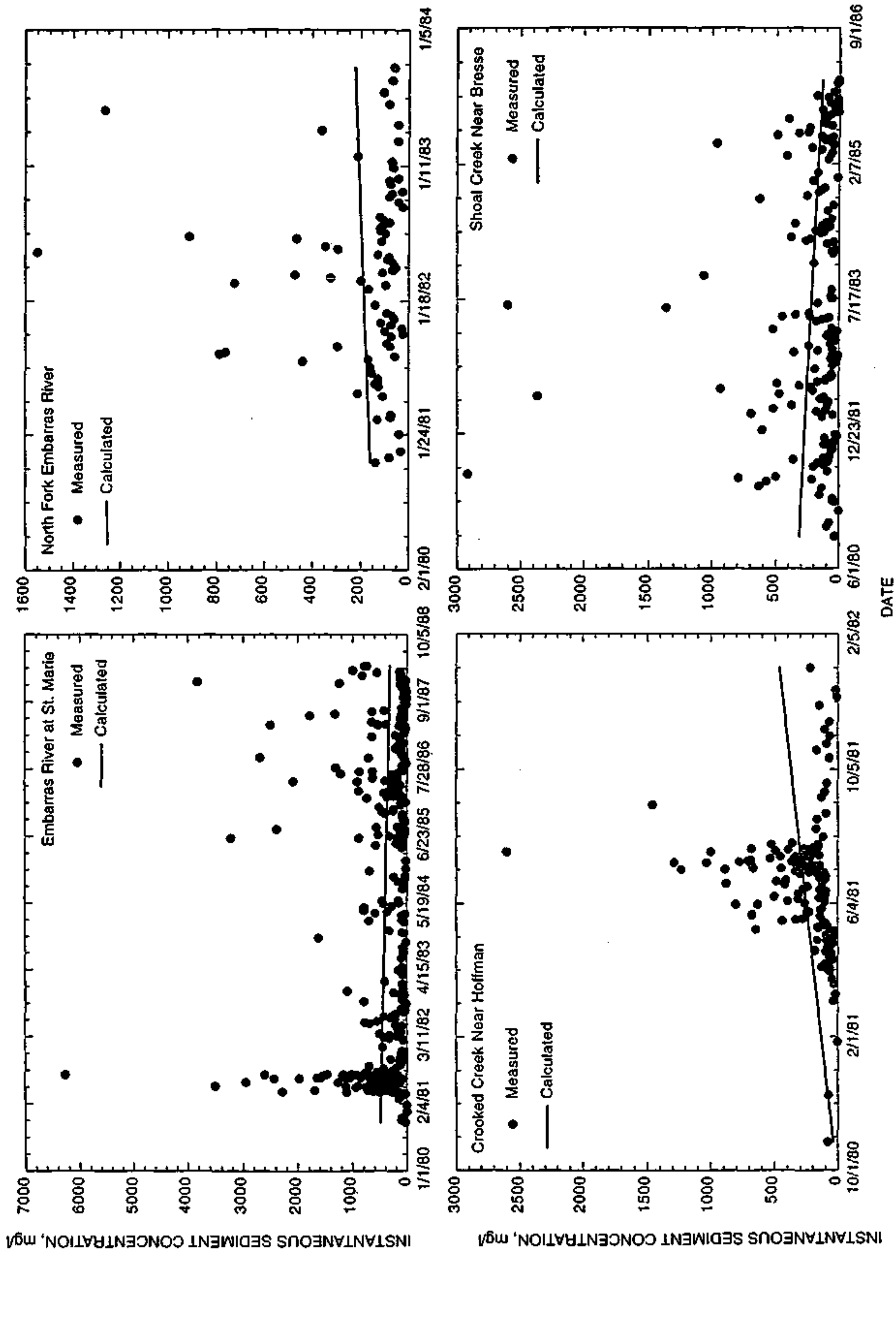


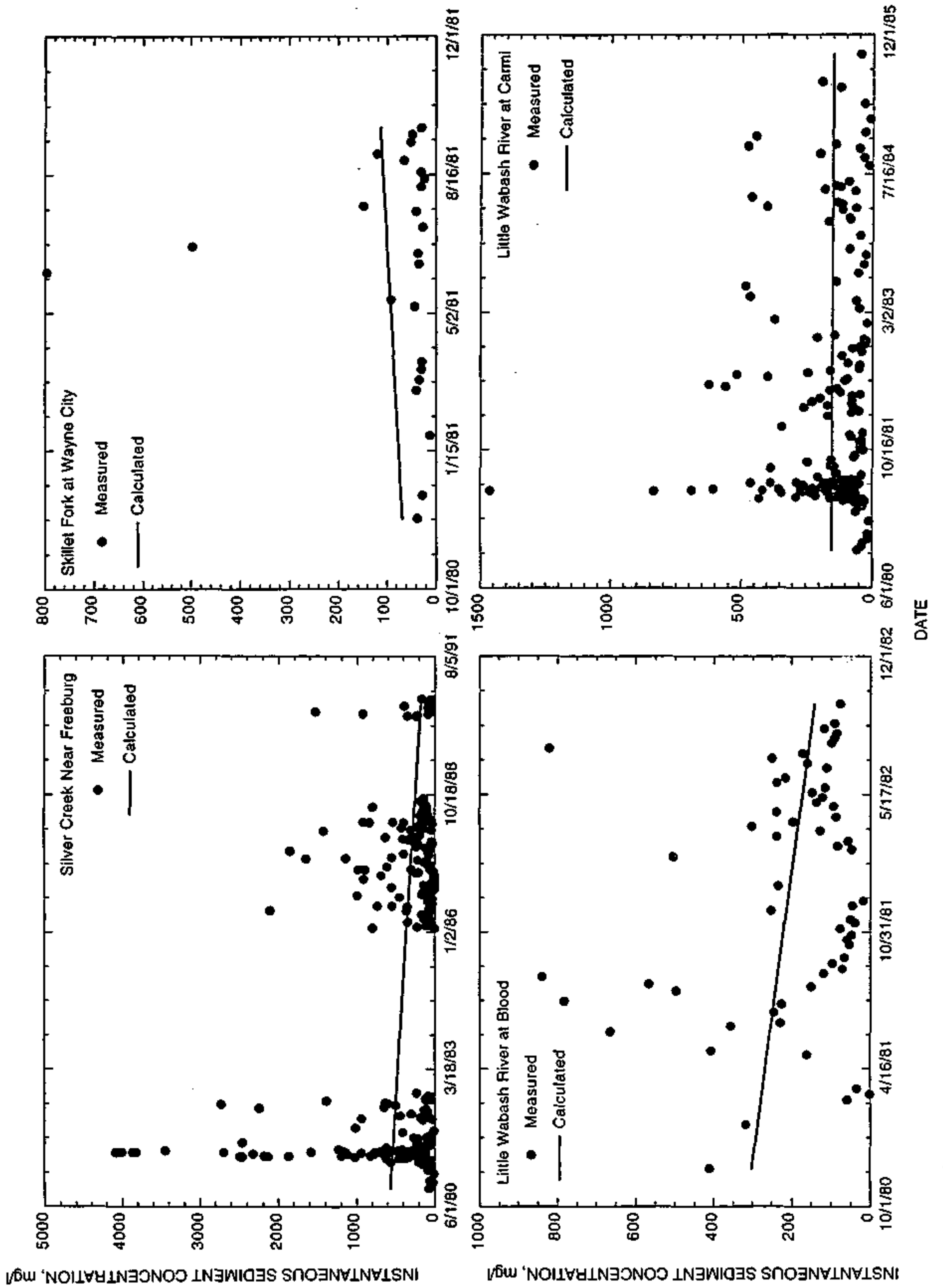
Mackinaw River Below Green Valley
Measured
Calculated
La Moine River at Colmar
Measured
Calculated
Bear Creek Near Marcelline
Measured
Calculated
La Moine River at Ripley
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE

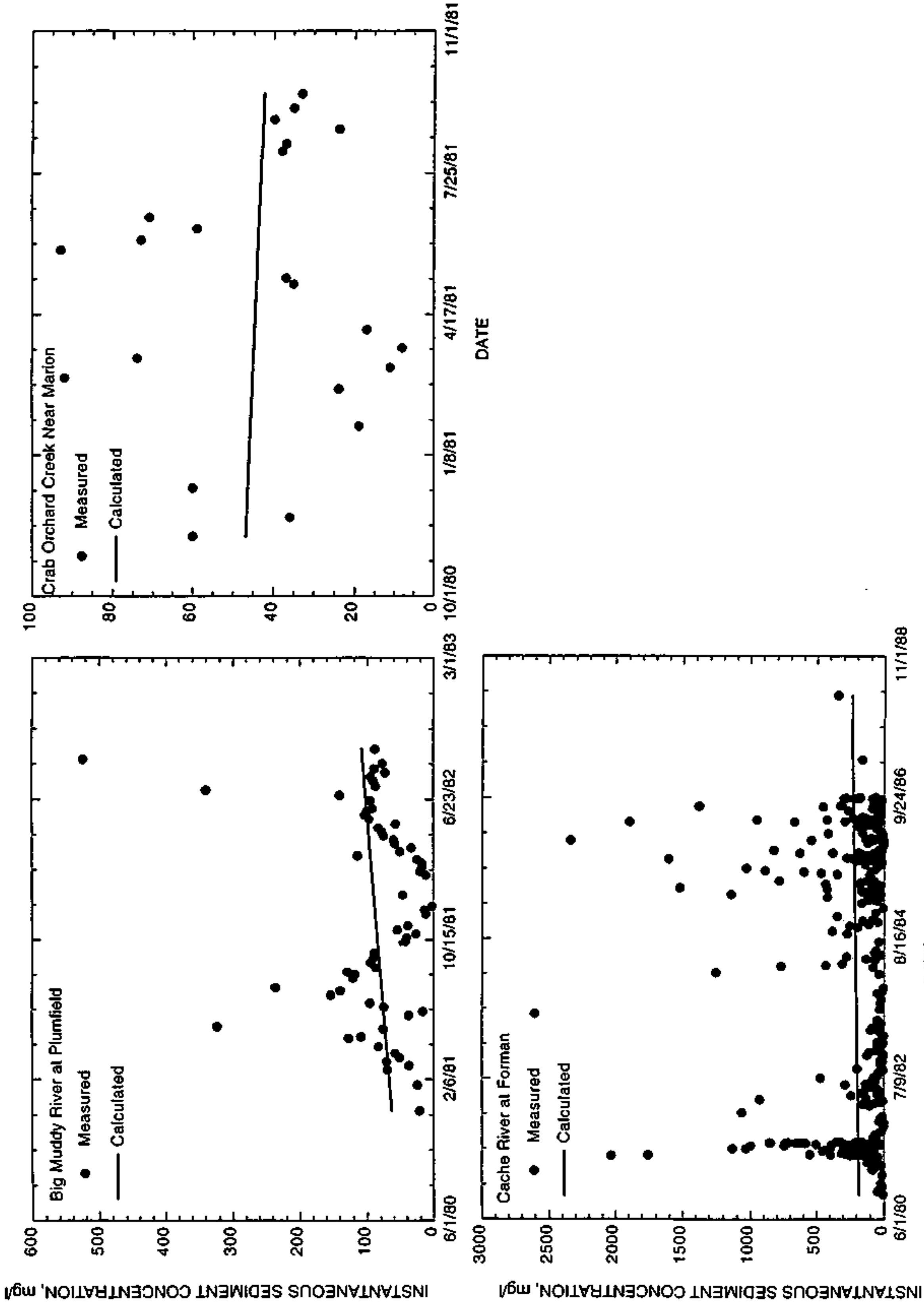

Salt Creek Near Greenview
Measured
Calculated
Salt Creek Near Rowell
Measured
Calculated
Sangamon River at Monticello
Measured
Calculated
Salt Fork Near St. Joseph
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
8/1/80
5/23/81
3/15/82
1/5/83
10/28/83
1/1/80
10/1/82
7/2/85
4/1/88
1/1/91
10/2/80
7/4/81
4/5/82
1/5/83


Vermilion River Near Danville
Measured
Calculated
Sangamon River at Riverton
Measured
Calculated
South Fork Sangamon River
Measured
Calculated
Embarras River Near Diona
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
10/1/80
1/24/81
5/19/81
9/11/81
1/5/82
7/25/81
5/19/82
3/13/83
1/5/84
4/25/81
11/18/81
6/12/82
1/5/83


Kaskaskia River Near Cowden
Measured
Calculated
Macoupin Creek Near Kane
Measured
Calculated
Hurricane Creek Near Mulberry Grove
Measured
Calculated
Kaskaskia River at Vandalia
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE

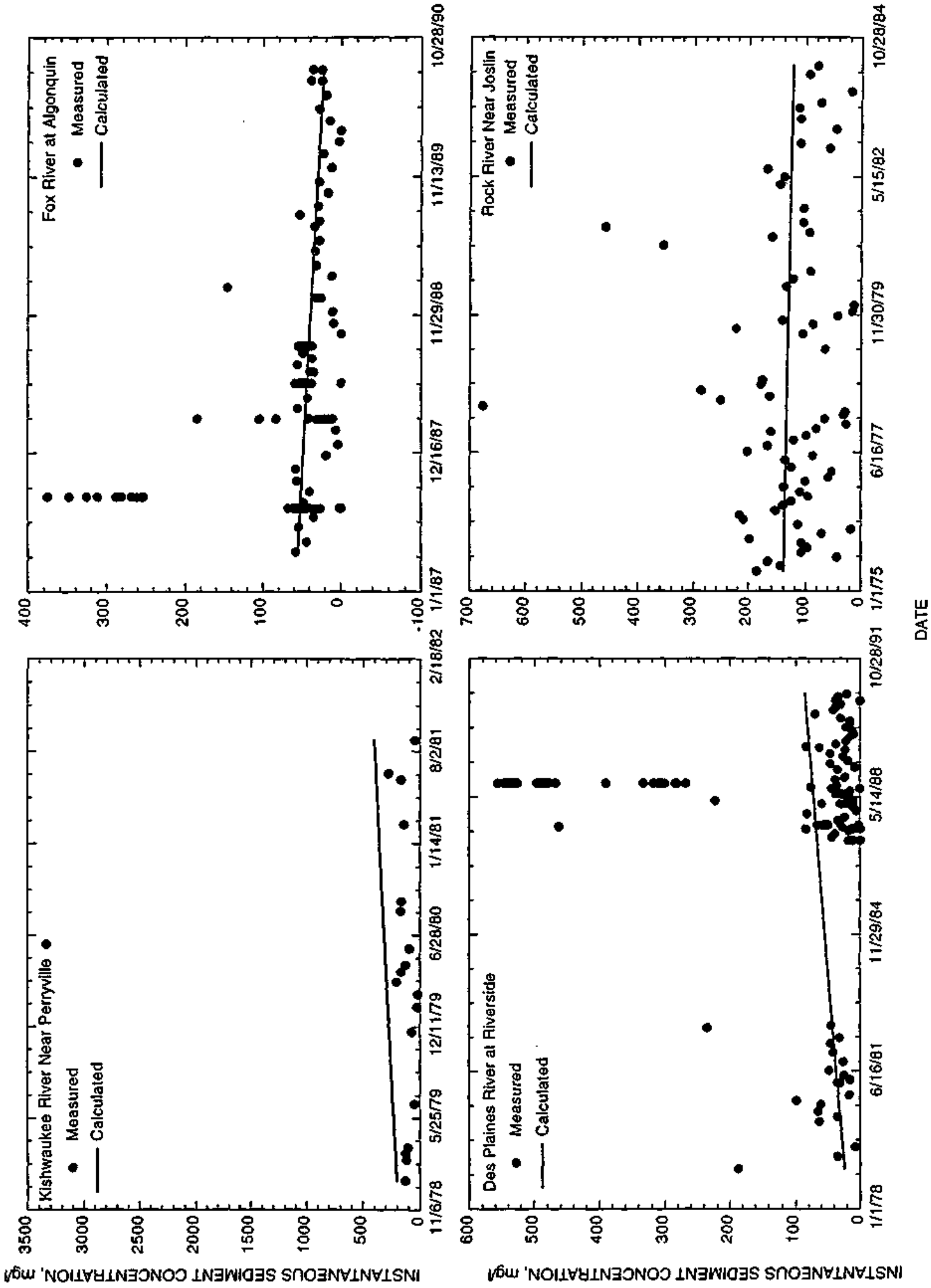

Embarras River at St. Marie
Measured
Calculated
7000
6000
5000
4000
3000
2000
1000
0
1/1/80
2/4/81
3/11/82
4/15/83
5/19/84
6/23/85
7/28/86
9/1/87
10/5/88
North Fork Embarras River
Measured
Calculated
1600
1400
1200
1000
800
600
400
200
0
2/1/80
1/24/81
1/18/82
1/11/83
1/5/84
Crooked Creek Near Hoffman
Measured
Calculated
3000
2500
2000
1500
1000
500
0
10/1/80
2/1/81
6/4/81
10/5/81
2/5/82
Shoal Creek Near Breese
Measured
Calculated
3000
2500
2000
1500
1000
500
0
6/1/80
12/23/81
7/17/83
2/7/85
9/1/86
DATE
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l

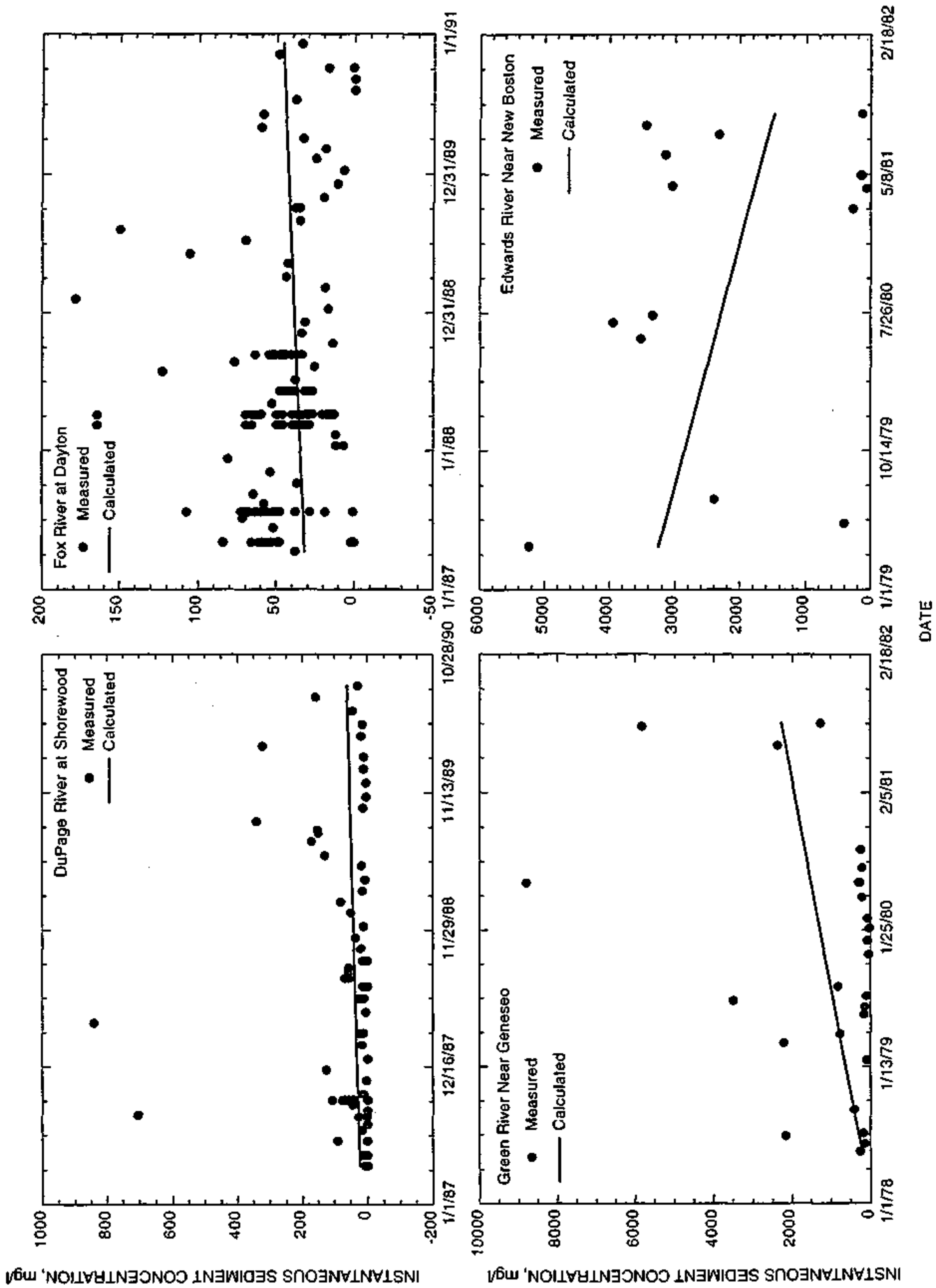

Silver Creek Near Freeburg
Measured
Calculated
Skillet Fork at Wayne City
Measured
Calculated
Little Wabash River at Blood
Measured
Calculated
Little Wabash River at Carmi
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
5000
4000
3000
2000
1000
0
800
700
600
500
400
300
200
100
0
1000
800
600
400
200
0
1500
1000
500
0
6/1/80
3/18/83
1/2/86
10/18/88
8/5/91
10/1/80
1/15/81
5/2/81
8/16/81
12/1/81
10/1/80
4/16/81
10/31/81
5/17/82
12/1/82
6/1/80
10/16/81
3/2/83
7/16/84
12/1/85


Big Muddy River at Plumfield
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
6/1/80
2/6/81
10/15/81
6/23/82
3/1/83
Crab Orchard Creek Near Marion
Measured
Calculated
10/1/80
1/8/81
4/17/81
7/25/81
11/1/81
DATE
Cache River at Forman
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
6/1/80
7/9/82
8/16/84
9/24/86
11/1/88
DATE

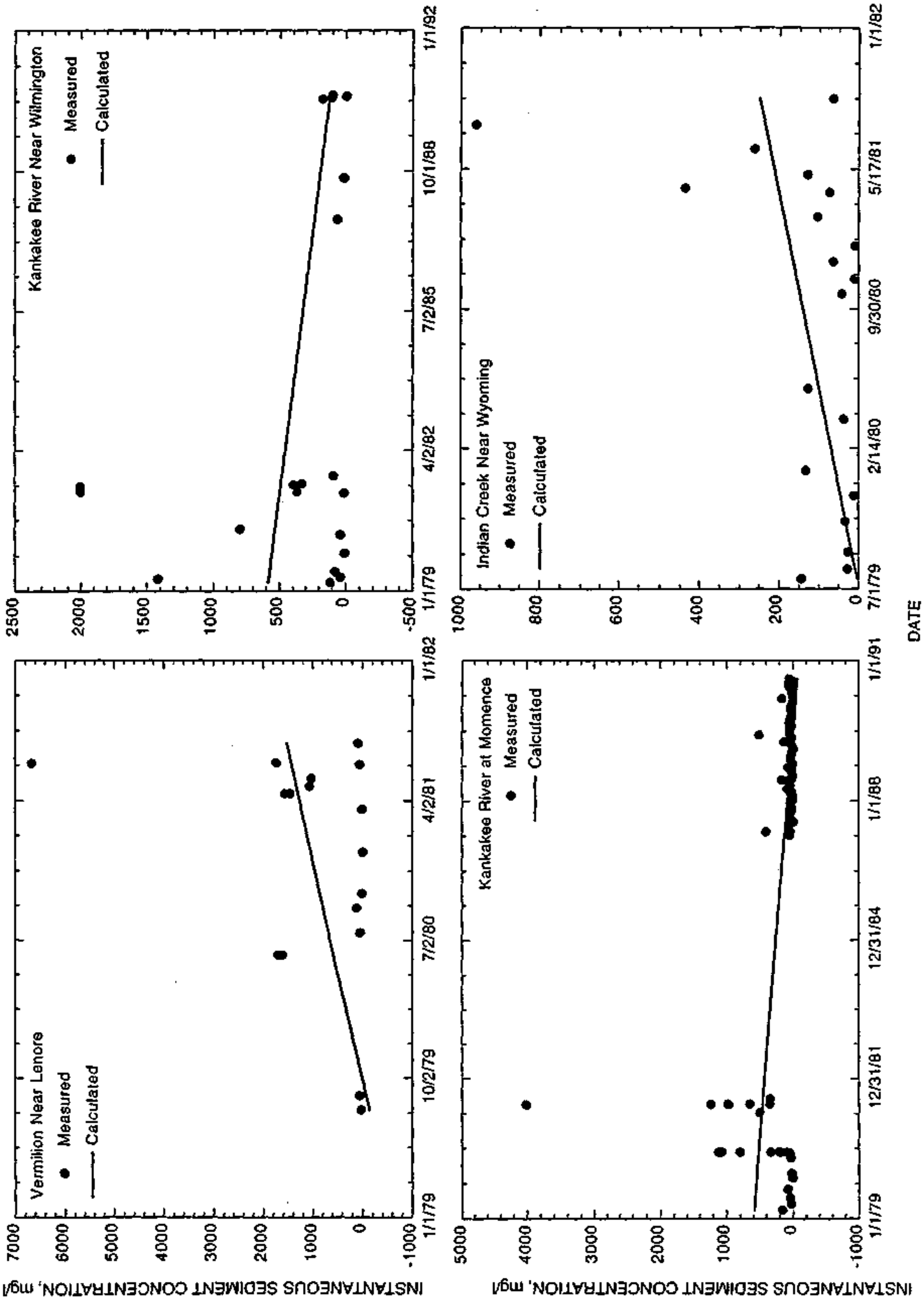
APPENDIX D

PLOTS OF INSTANTANEOUS SUSPENDED SEDIMENT CONCENTRATION AND REGRESSION LINES FOR THE 58 IEPA STATIONS WITH 10 OR MORE DATA POINTS

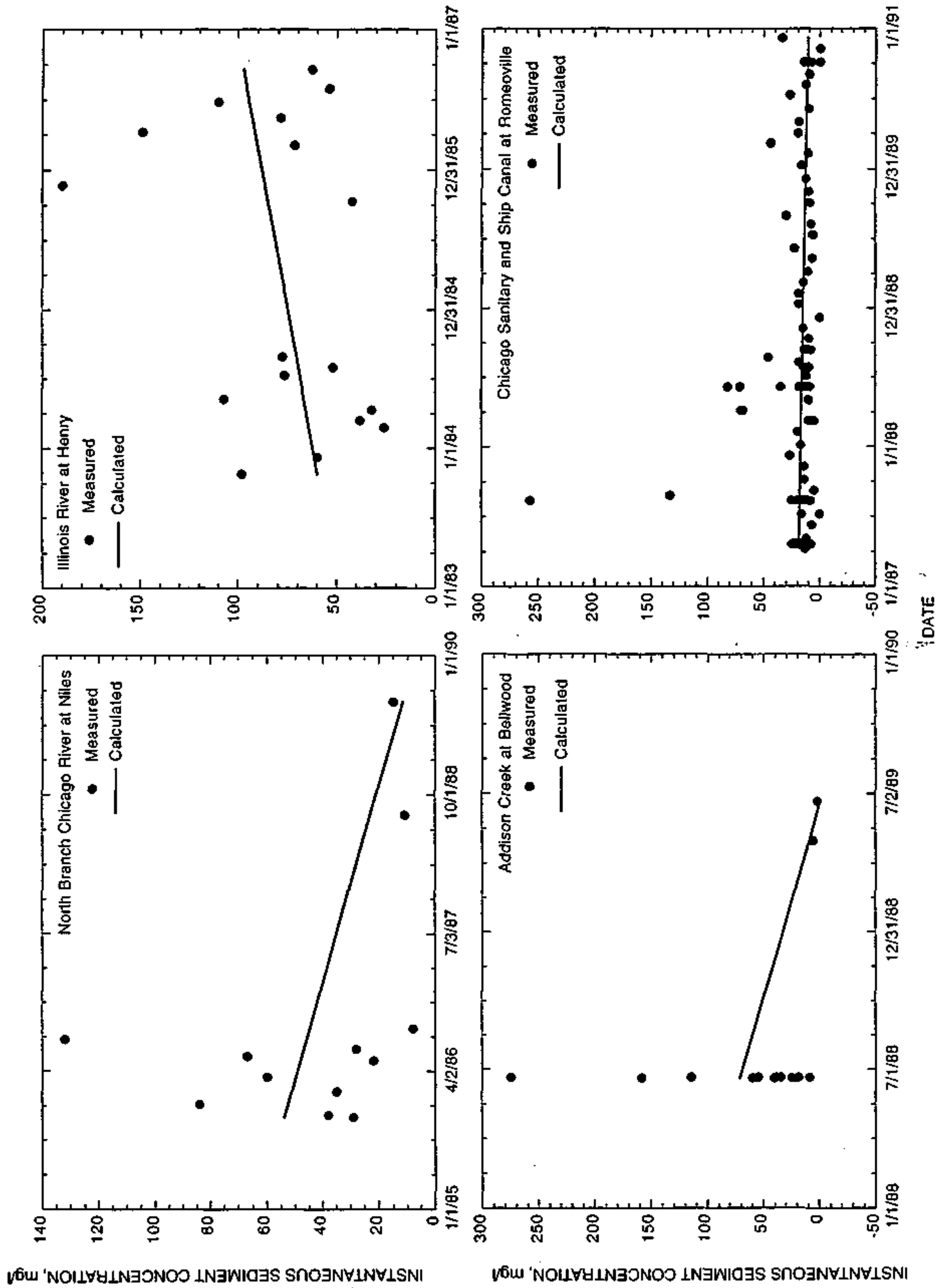

Kishwaukee River Near Perryville
Measured
Calculated
Fox River at Algonquin
Measured
Calculated
Des Plaines River at Riverside
Measured
Calculated
Rock River Near Joslin
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
3500
3000
2500
2000
1500
1000
500
0
400
300
200
100
0
-100
600
500
400
300
200
100
0
700
600
500
400
300
200
100
0
11/6/78
5/25/79
12/11/79
6/28/80
1/14/81
8/2/81
2/18/82
1/1/87
12/16/87
11/29/88
11/13/89
10/28/90
1/1/78
6/16/81
11/29/84
5/14/88
10/28/91
1/1/75
6/16/77
11/30/79
5/15/82
10/28/84

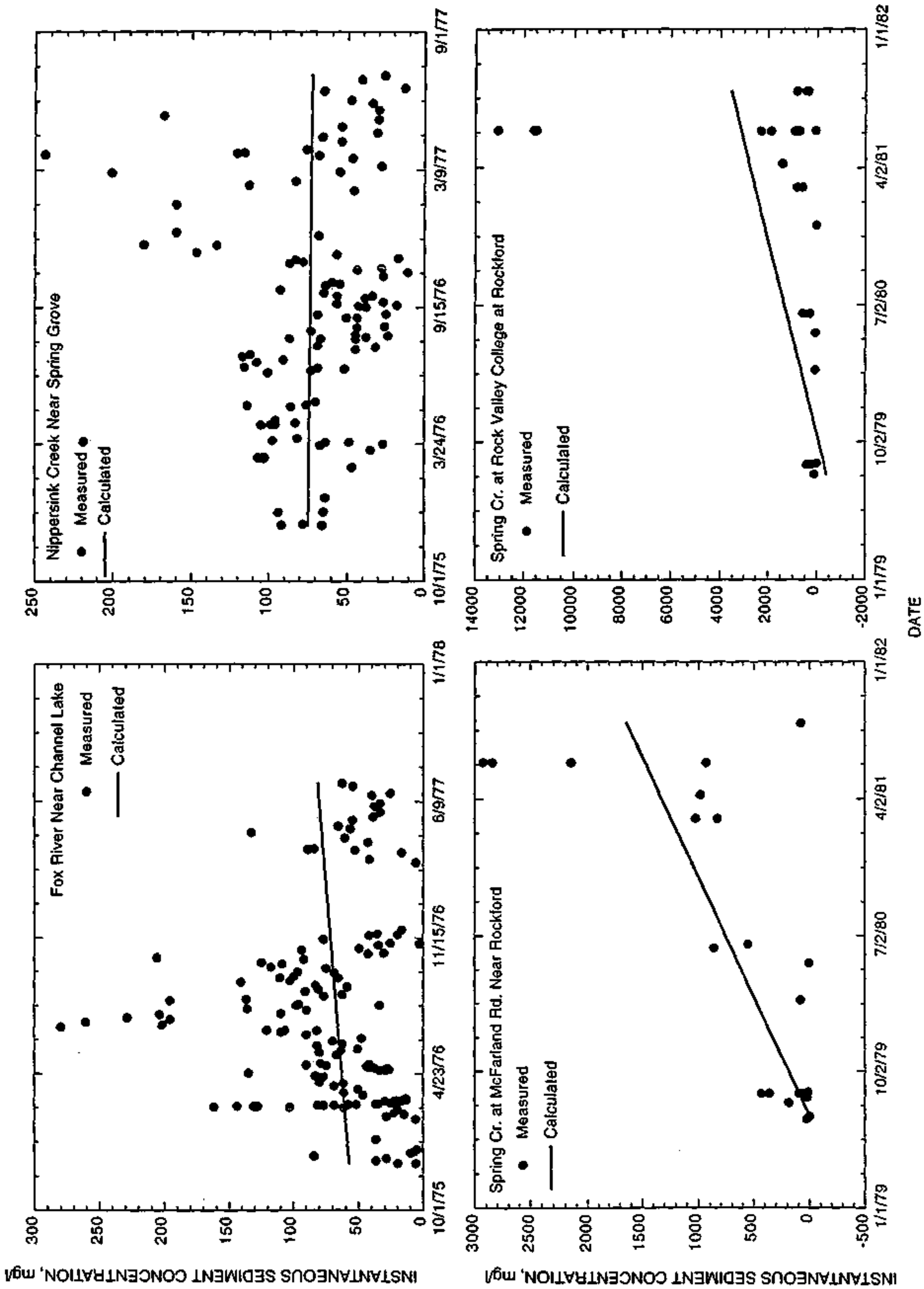


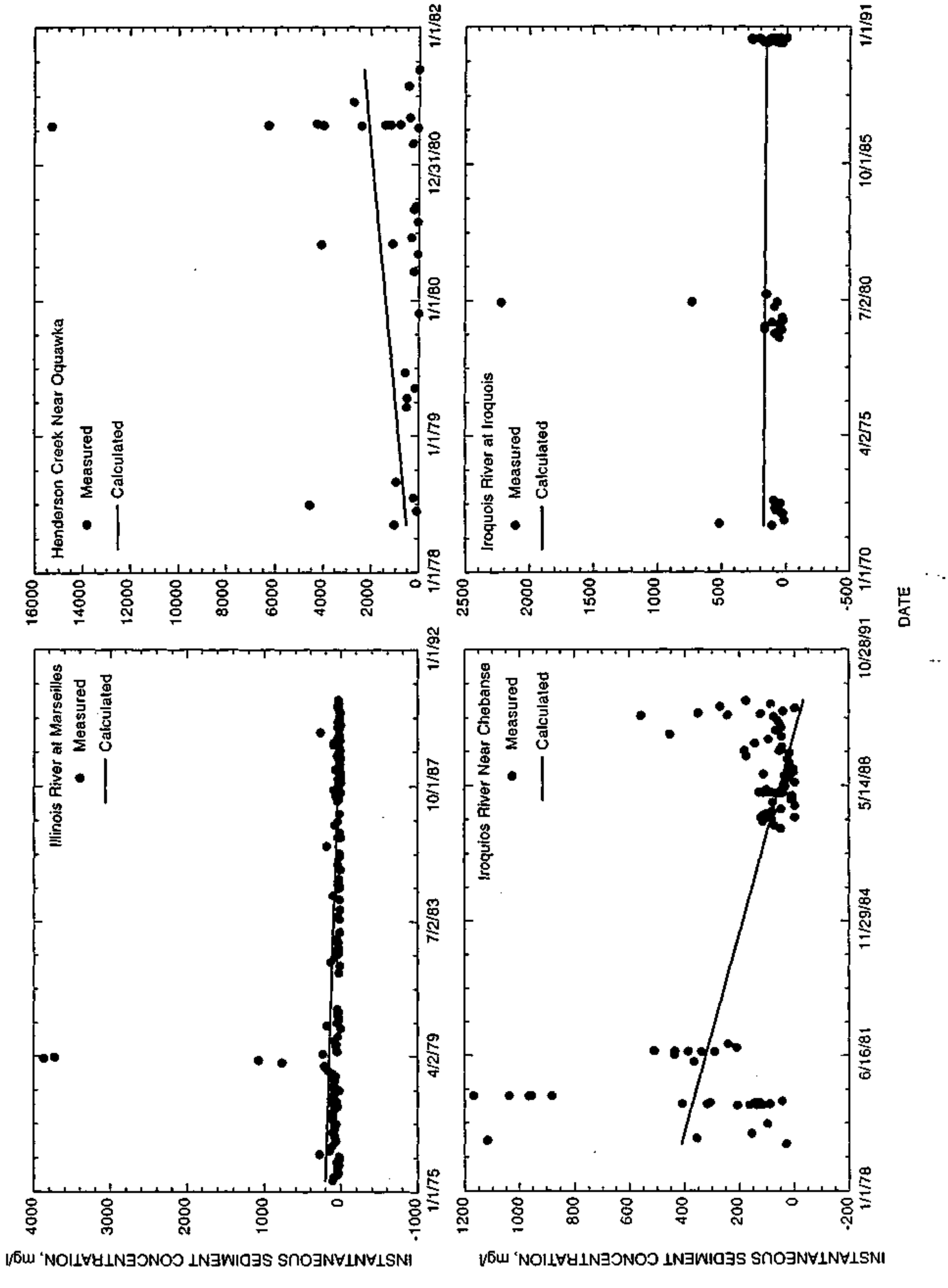
DuPage River at Shorewood
Measured
Calculated
Fox River at Dayton
Measured
Calculated
Green River Near Geneseo
Measured
Calculated
Edwards River Near New Boston
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/87
12/16/87
11/29/88
11/13/89
10/28/90
1/1/88
12/31/88
12/31/89
1/1/91
1/1/78
1/13/79
1/25/80
2/5/81
2/18/82
1/1/79
10/14/79
7/26/80
5/8/81

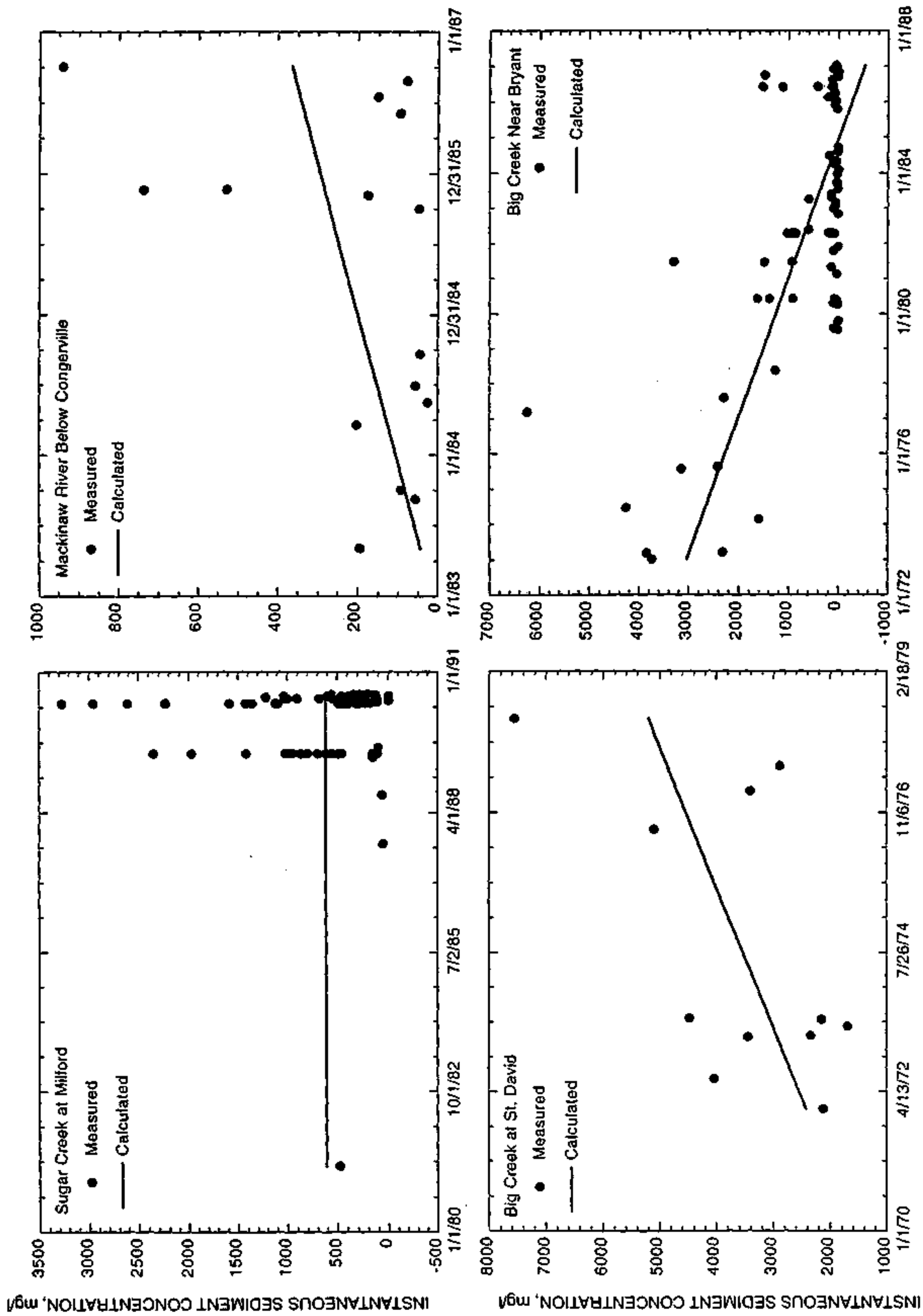


Vermilion Near Lenore
Measured
Calculated
Kankakee River Near Wilmington
Measured
Calculated
Kankakee River at Momence
Measured
Calculated
Indian Creek Near Wyoming
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/79
10/2/79
7/2/80
4/2/81
1/1/82
4/2/82
7/2/85
10/1/88
1/1/92
12/31/81
12/31/84
1/1/88
1/1/91
7/1/79
2/14/80
9/30/80
5/17/81

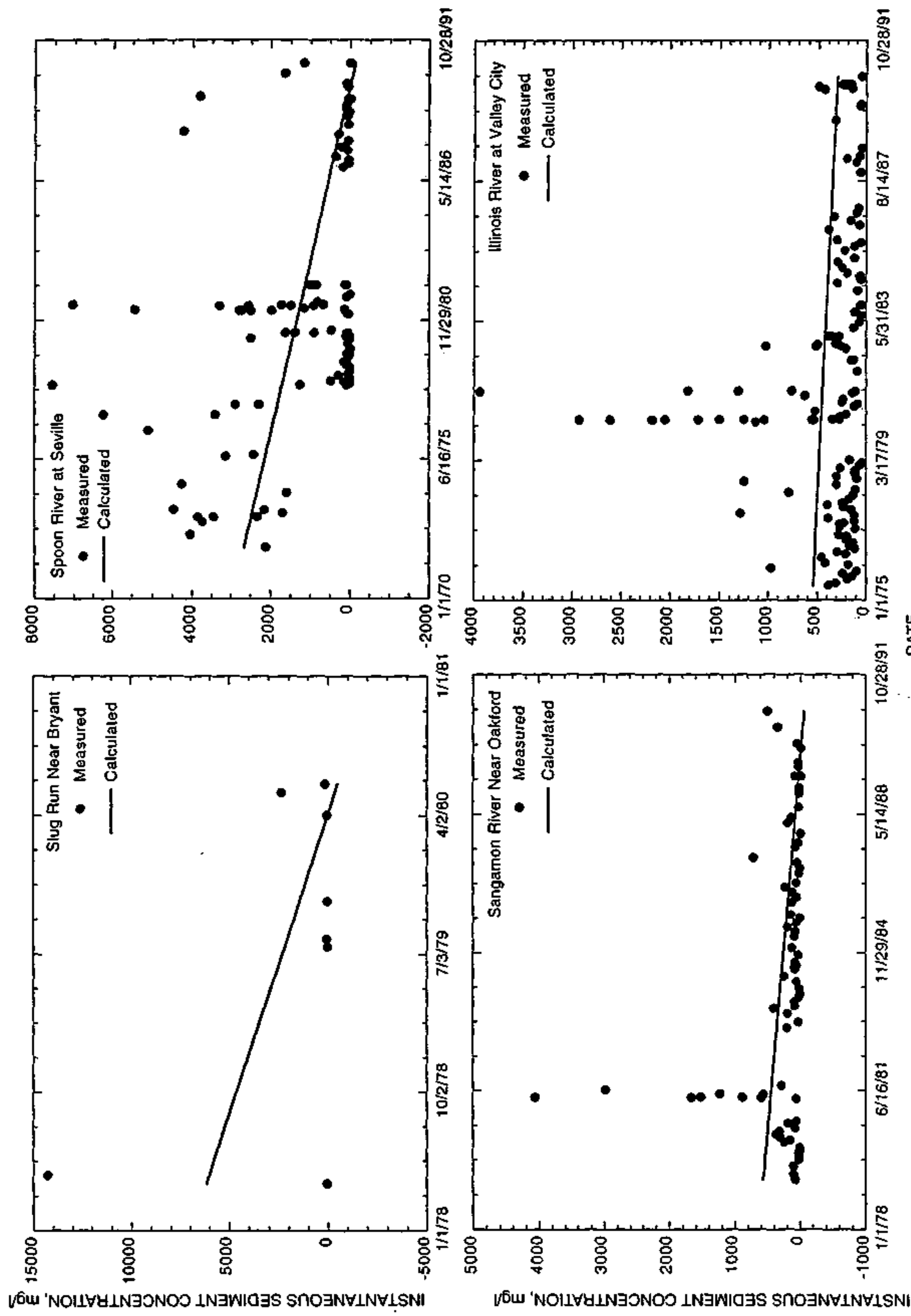

North Branch Chicago River at Niles
Measured
Calculated
Illinois River at Henry
Measured
Calculated
Addison Creek at Bellwood
Measured
Calculated
Chicago Sanitary and Ship Canal at Romeoville
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
140
120
100
80
60
40
20
0
200
150
100
50
0
300
250
200
150
100
50
0
-50
300
250
200
150
100
50
0
-50
1/1/85
4/2/86
7/3/87
10/1/88
1/1/90
1/1/83
1/1/84
12/31/84
12/31/85
1/1/87
1/1/88
7/1/88
12/31/88
7/2/89
1/1/90
1/1/87
1/1/88
12/31/88
12/31/89
1/1/91


Fox River Near Channel Lake
Measured
Calculated
Nippersink Creek Near Spring Grove
Measured
Calculated
Spring Cr. at McFarland Rd. Near Rockford
Measured
Calculated
Spring Cr. at Rock Valley College at Rockford
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
10/1/75
4/23/76
11/15/76
6/9/77
1/1/78
3/24/76
9/15/76
3/9/77
9/1/77
1/1/79
10/2/79
7/2/80
4/2/81
1/1/82

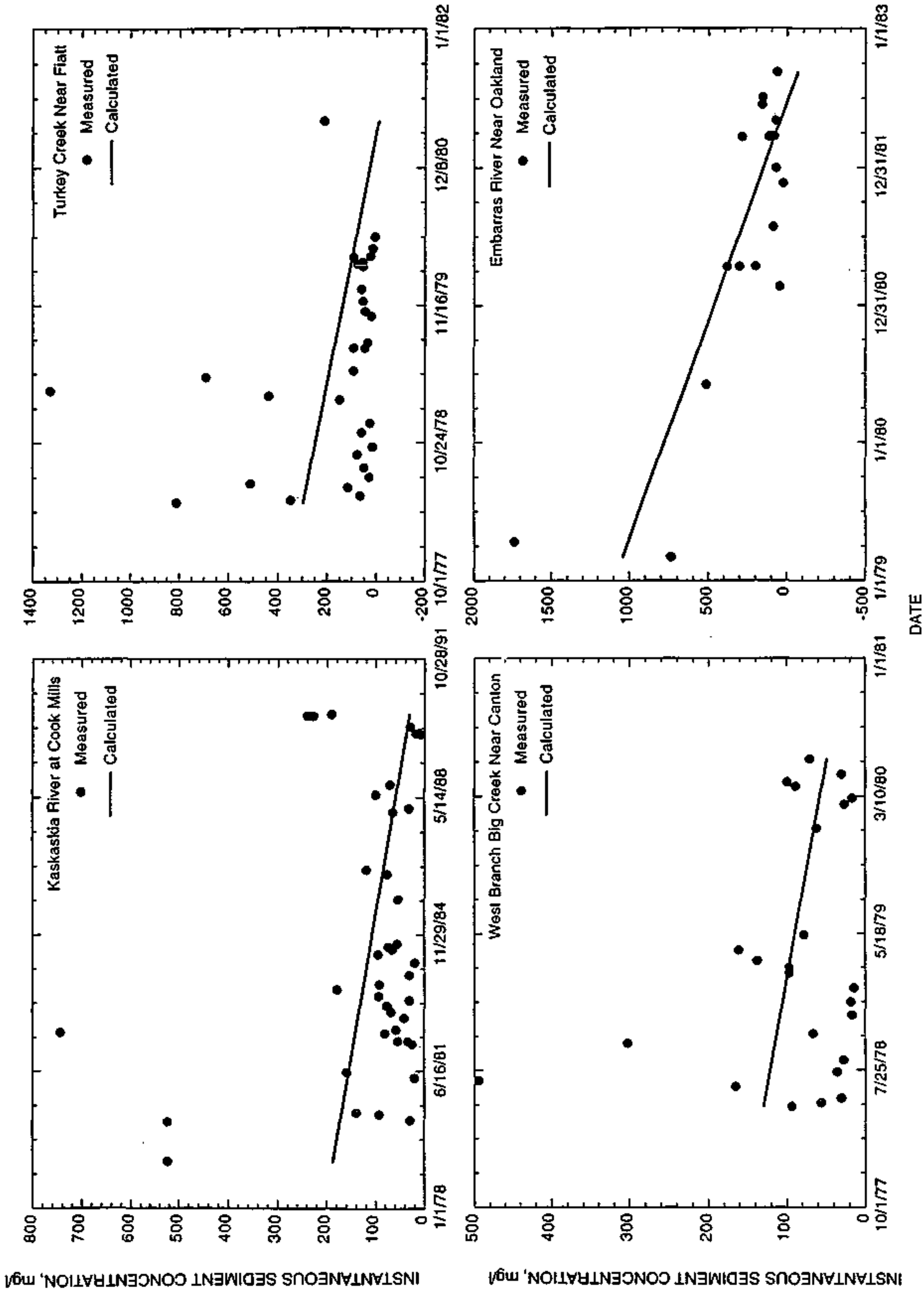

Illinois River at Marseilles
Measured
Calculated
Henderson Creek Near Oquawka
Measured
Calculated
Iroquios River Near Chebanse
Measured
Calculated
Iroquois River at Iroquois
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/75
4/2/79
7/2/83
10/1/87
1/1/92
1/1/78
1/1/79
1/1/80
12/31/80
1/1/82
1/1/78
6/16/81
11/29/84
5/14/88
10/28/91
1/1/70
4/2/75
7/2/80
10/1/85
1/1/91

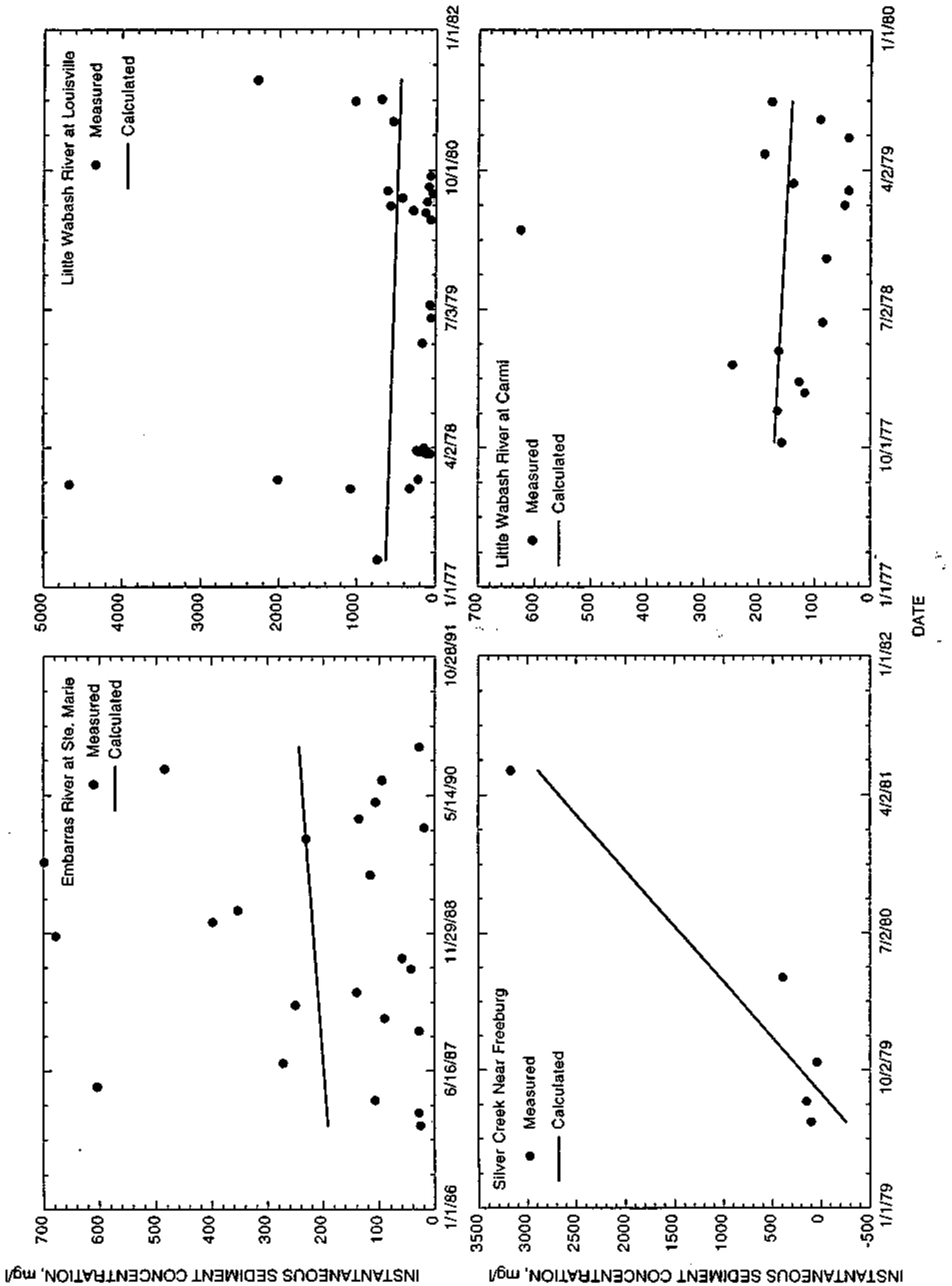


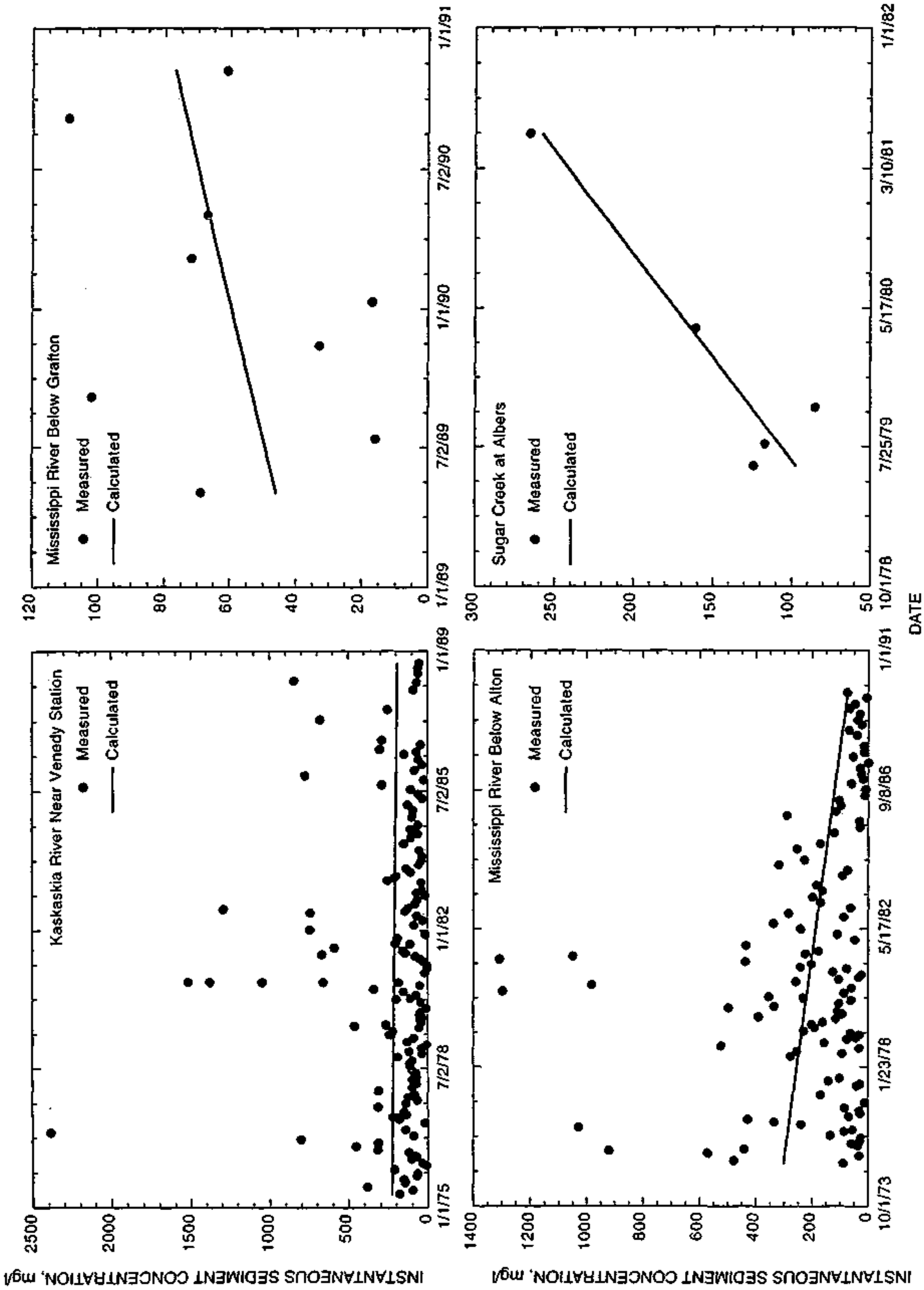
Sugar Creek at Milford
Measured
Calculated
Mackinaw River Below Congerville
Measured
Calculated
Big Creek at St. David
Measured
Calculated
Big Creek Near Bryant
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/80
10/1/82
7/2/85
4/1/88
1/1/91
1/1/83
1/1/84
12/31/84
12/31/85
1/1/87
1/1/70
4/13/72
7/26/74
11/6/76
2/18/79
1/1/72
1/1/76
1/1/80
1/1/84
1/1/88

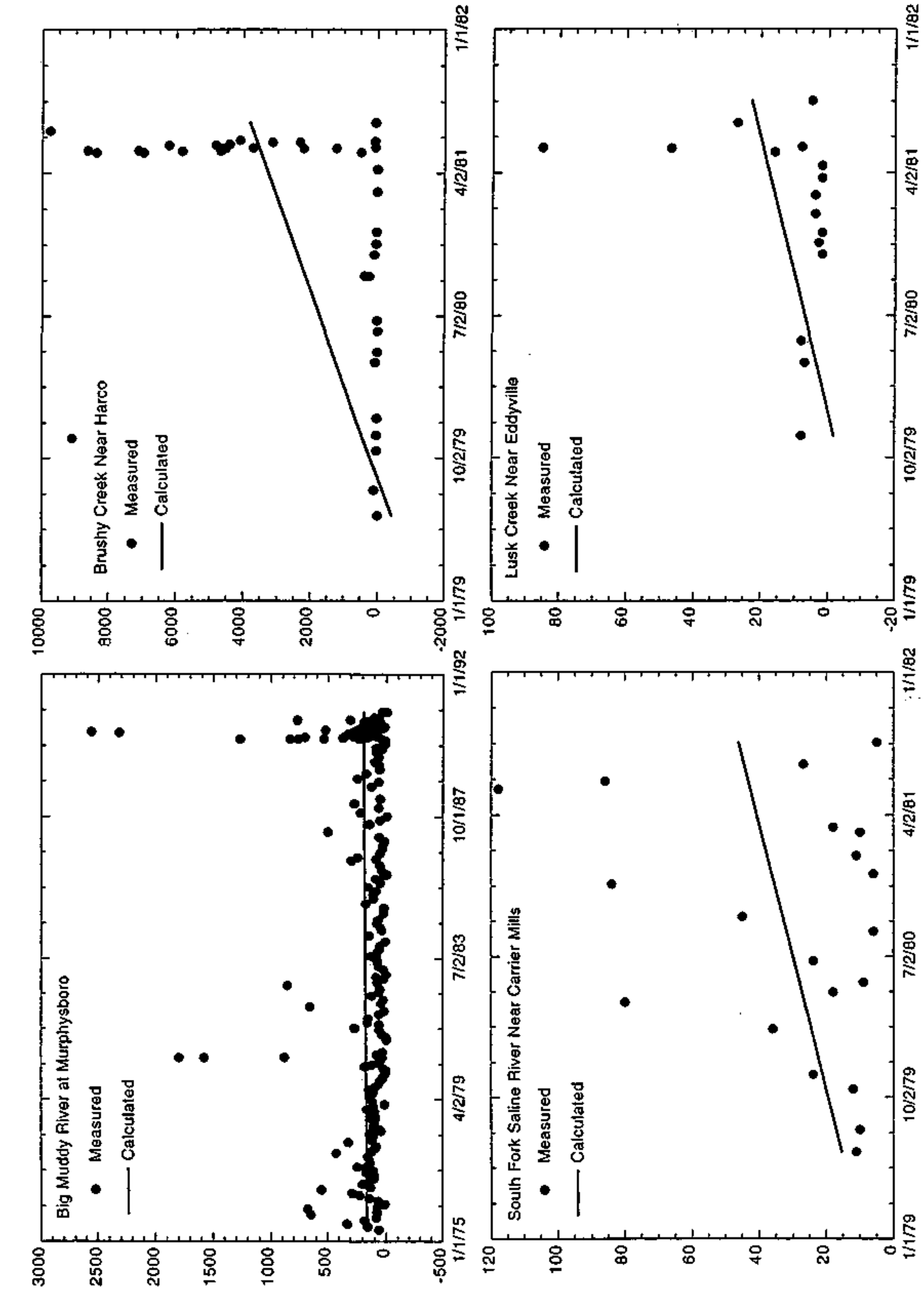


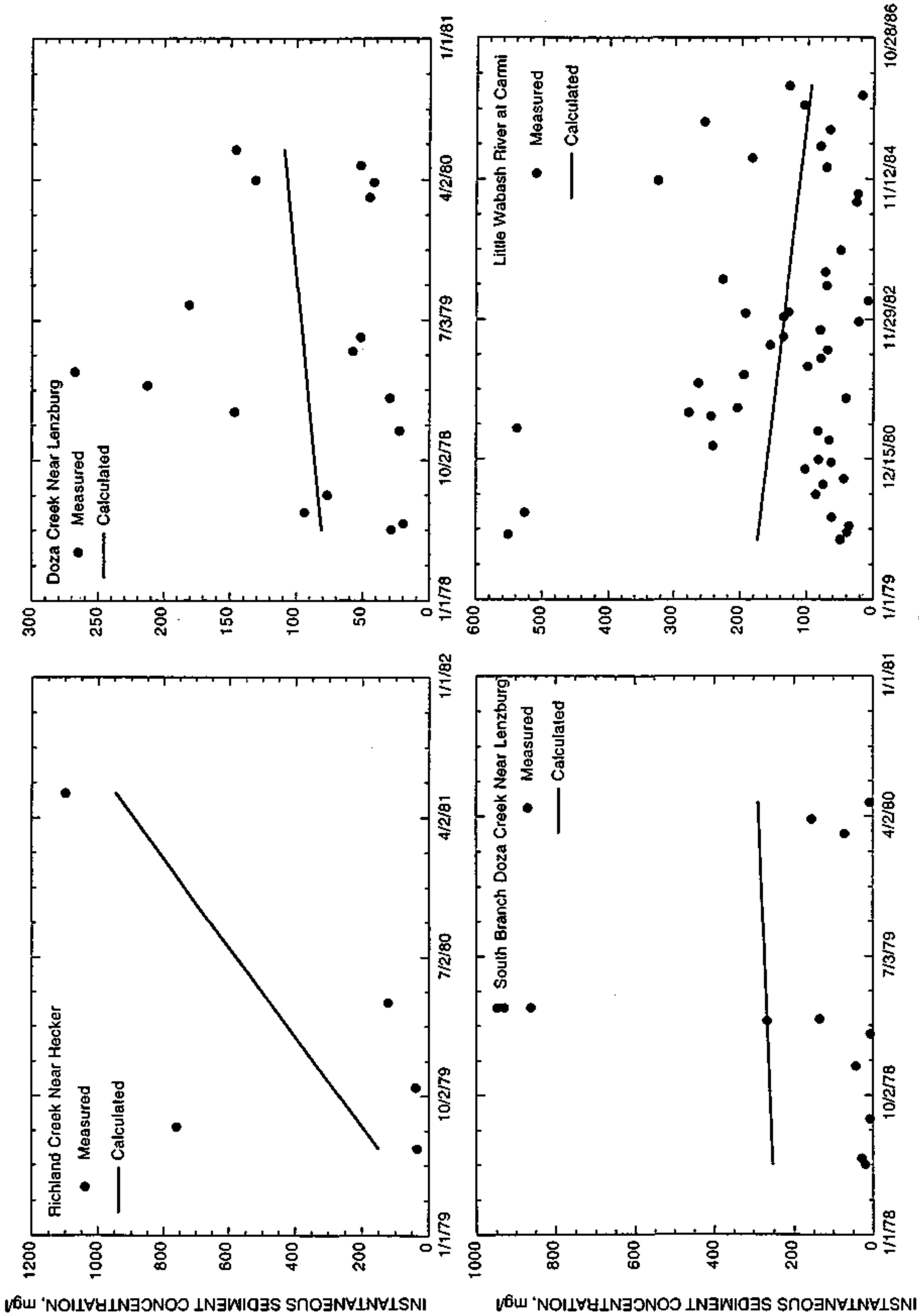
Slug Run Near Bryant
Measured
Calculated
Spoon River at Seville
Measured
Calculated
Sangamon River Near Oakford
Measured
Calculated
Illinois River at Valley City
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/78
10/2/78
7/3/79
4/2/80
1/1/81
1/1/70
6/16/75
11/29/80
5/14/86
10/28/91
1/1/78
6/16/81
11/29/84
5/14/88
10/28/91
1/1/75
3/17/79
5/31/83
8/14/87
10/28/91


Kaskaskia River at Cook Mills
Measured
Calculated
Turkey Creek Near Flatt
West Branch Big Creek Near Canton
Embarras River Near Oakland
1/1/78
6/16/81
11/29/84
5/14/88
10/28/91
10/1/77
10/24/78
11/16/79
12/8/80
1/1/82
7/25/78
5/18/79
3/10/80
1/1/81
1/1/79
1/1/80
12/31/80
12/31/81
1/1/83
DATE
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l

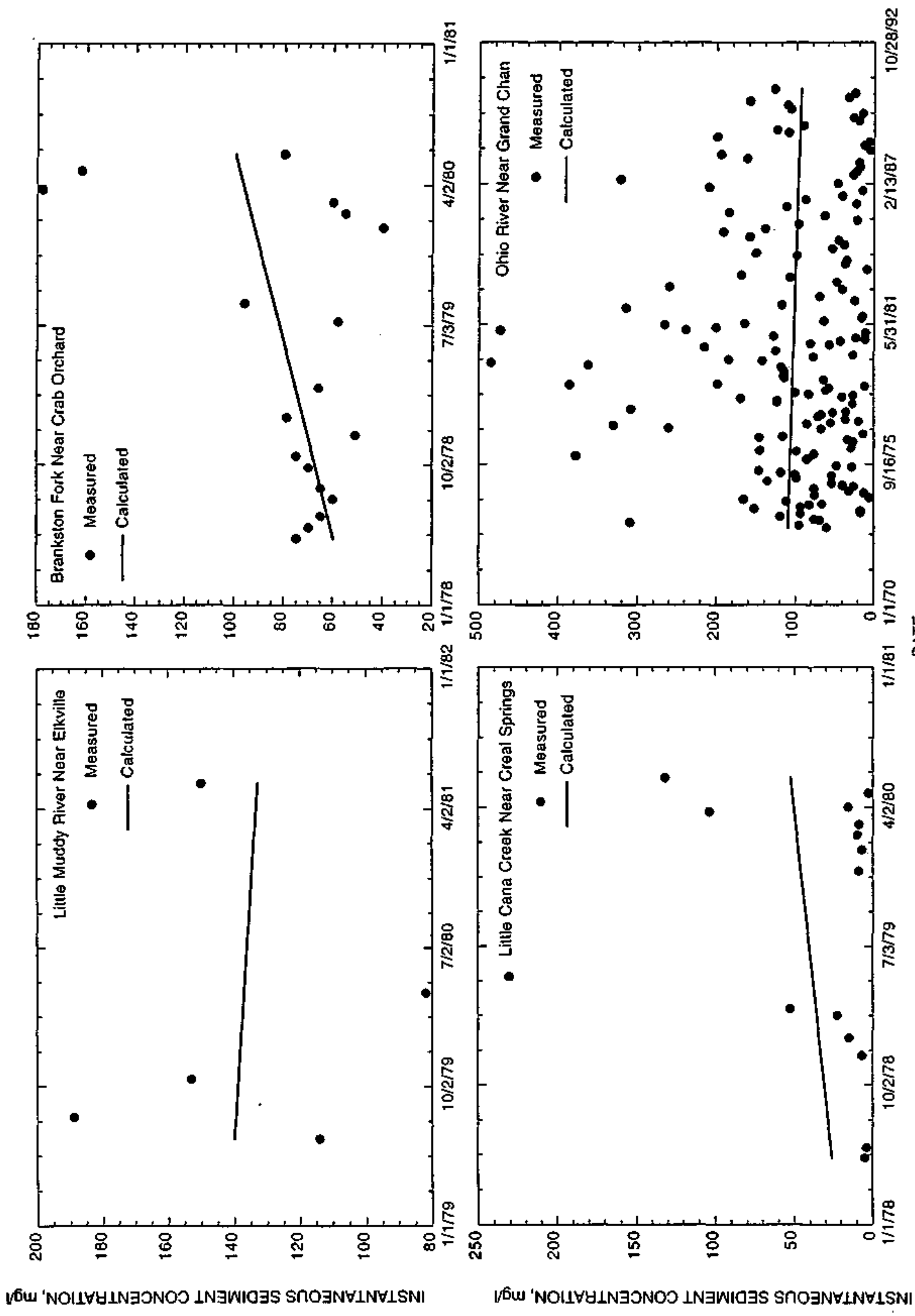

Embarras River at Ste. Marie
Measured
Calculated
Little Wabash River at Louisville
Measured
Calculated
Silver Creek Near Freeburg
Measured
Calculated
Little Wabash River at Carmi
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE

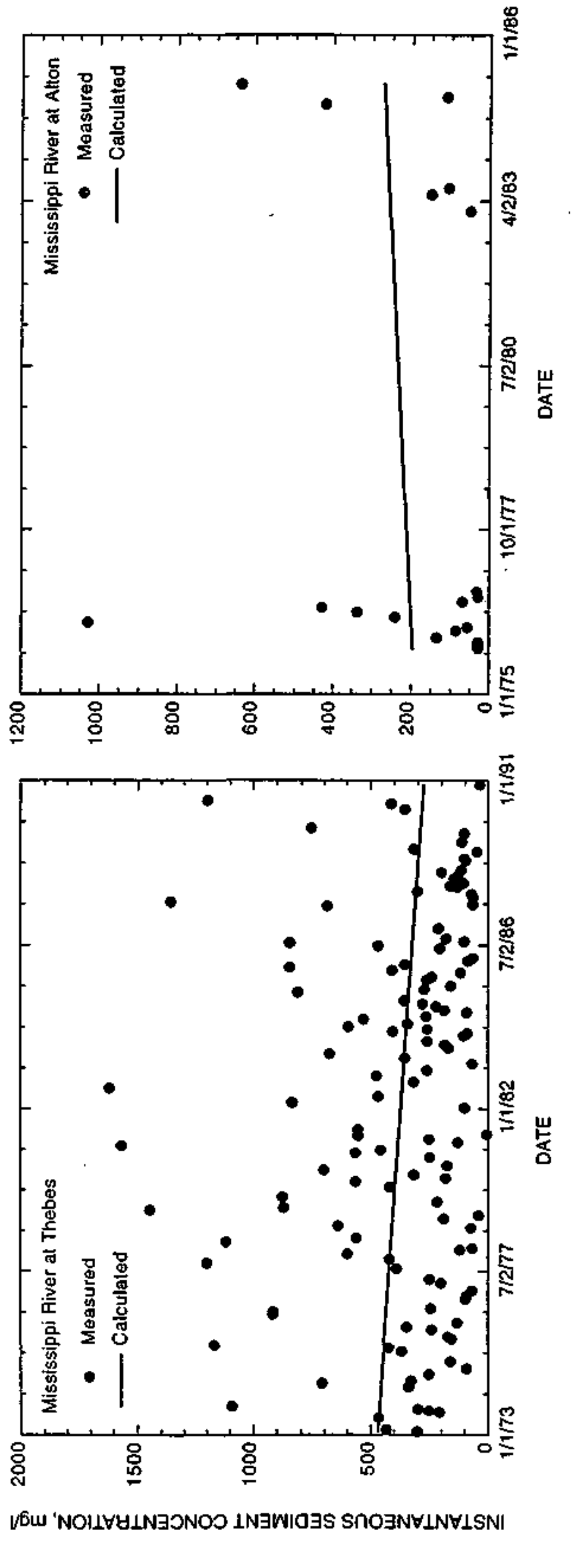

Kaskaskia River Near Venedy Station
Measured
Calculated
Mississippi River Below Grafton
Measured
Calculated
Mississippi River Below Alton
Measured
Calculated
Sugar Creek at Albers
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/75
7/2/78
1/1/82
7/2/85
1/1/89
1/1/89
7/2/89
1/1/90
7/2/90
1/1/91
10/1/73
1/23/78
5/17/82
9/8/86
1/1/91
10/1/78
7/25/79
5/17/80
3/10/81
1/1/82


Big Muddy River at Murphysboro
Measured
Calculated
Brushy Creek Near Harco
Measured
Calculated
South Fork Saline River Near Carrier Mills
Measured
Calculated
Lusk Creek Near Eddyville
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/75
4/2/79
7/2/83
10/1/87
1/1/92
1/1/79
10/2/79
7/2/80
4/2/81
1/1/82
3000
2500
2000
1500
1000
500
0
-500
10000
8000
6000
4000
2000
0
-2000
120
100
80
60
40
20
0
100
80
60
40
20
0
-20



Richland Creek Near Hecker
Measured
Calculated
Doza Creek Near Lenzburg
Measured
Calculated
South Branch Doza Creek Near Lenzburg
Measured
Calculated
Little Wabash River at Carmi
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/79
10/2/79
7/2/80
4/2/81
1/1/82
1/1/78
10/2/78
7/3/79
4/2/80
1/1/81
1/1/79
12/15/80
11/29/82
11/12/84
10/28/86


Little Muddy River Near Elkville
Measured
Calculated
Brankston Fork Near Crab Orchard
Measured
Calculated
Little Cana Creek Near Creal Springs
Measured
Calculated
Ohio River Near Grand Chan
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
DATE
1/1/79
10/2/79
7/2/80
4/2/81
1/1/82
1/1/78
10/2/78
7/3/79
4/2/80
1/1/81
1/1/78
10/2/78
7/3/79
4/2/80
1/1/81
1/1/70
9/16/75
5/31/81
2/13/87
10/28/92



Mississippi River at Thebes
Measured
Calculated
INSTANTANEOUS SEDIMENT CONCENTRATION, mg/l
2000
1500
1000
500
0
1/1/73
7/2/77
1/1/82
7/2/86
1/1/91
DATE
Mississippi River at Alton
Measured
Calculated
1200
1000
800
600
400
200
0
1/1/75
10/1/77
7/2/80
4/2/83
1/1/86
DATE