PRELIMINARY TREND ANALYSES OF STREAM DISCHARGE AND SEDIMENT DATA FOR THE DEMONTRATION EROSION CONTROL PROJECT, NORTH-CENTRAL MISSISSIPPI, JULY 1985 THROUGH SEPTEMBER 1991

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INTRODUCTION

In 1984, Congress directed the U.S. Army Corps of Engineers and the U.S. Department of Agriculture, Soil Conservation Service, to establish demonstration watersheds to address critical erosion and sedimentation problems. The Demonstration Erosion Control (DEC) Project is in the Yazoo River basin in north-central Mississippi. It is part of an ongoing joint-agency program of planning, design, construction, monitoring, and evaluation to alleviate flooding, erosion, sedimentation, and water-quality problems by applying environmentally sound management practices in several watersheds located in the bluff hills above the Mississippi River alluvial plain.

In July 1985, at the request of the Interagency Task Force on Yazoo Basin Foothills Erosion and Flood Control, and in cooperation with the Corps of Engineers, the U.S. Geological Survey (USGS) began collecting sediment data for the Yazoo River basin DEC project. Data were to be collected prior to, during, and after watershed-conservation and channel-stability measures were implemented in the study area. This paper presents preliminary results of trend analyses for daily mean values of stream discharge, suspended-sediment concentration, and sediment discharge for eight USGS DEC project sites for six years of data-collection, specifically, the period July 1985 through September 1991. These data are available in the USGS Water Data Storage and Retrieval system (WATSTORE) and have been published annually in the report series, "Water Resources Data-Mississippi," since 1989.

DESCRIPTION OF STUDY AREA, SAMPLING SITES, AND DATA-COLLECTION ACTIVITIES

The study area for the Yazoo River basin DEC project consists of six watersheds in north-central Mississippi (Fig. 1). In downstream order, they are the (1) Hotopha Creek, (2) Otoucalofa Creek, (3) Peters (Long) Creek, (4) Hickahala-Senatobia Creek, (5) Batupan Bogue, and (6) Black Creek watersheds. The loess hills of the Yazoo River basin were selected for the DEC project because the area is characterized by having large losses of soil and agrichemicals from agricultural lands and excessive upland and channel erosion by streams on unstable, deeply incised channels. The sparsely populated study area consists largely of forests, pastures, and farmlands.

For the study period July 1985 through September 1991, sediment data-collection activities were conducted at eight sites in the six watersheds. USGS station (downstream order) numbers, names, drainage areas, latitude-longitude locations, and periods of record are listed in Table 1. Specific start dates vary from site to site. Sediment data-collection activities have been extended for six of the eight sites into the current (1993) water year; however, activities were suspended at two sites, Senatobia Creek, near Senatobia, and Fannegusha Creek, near Howard, in calendar year 1989 at the request of the cooperator. Drainage areas of the sites range from 35.1 mi2 for Hotopha Creek near Batesville to 240 mi2 for Batupan Bogue at Grenada. More complete site descriptions are available in "Water Resources Data-Mississippi" (Plunkett et al. 1992).

Stream discharge is routinely measured by personnel of the USGS once every 6 weeks and during selected storms. From July 1985 through September 1991, about 550 stream discharge measurements from the eight study sites were analyzed, reviewed, and stored in USGS computer files. The measurements are used to establish and verify stage-discharge relations at each site, which are used to compute instantaneous stream discharges from stage data recorded by automatic stage recorders. Instantaneous stream discharges are then used to compute daily mean values of stream discharge according to standard USGS procedures (Kennedy 1983).

Suspended-sediment samples were collected in a consistent manner at each site by observers, automatic point samplers, and personnel of the USGS. Observers collect single, vertically integrated samples 3 days a week (Monday, Wednesday, and Friday) and supplemental samples during selected storms. Each site is equipped with a PS-69 automatic point sampler (pumping-sample device developed in 1969), which is stage-activated during storms. USGS personnel collect samples on a biweekly basis and during selected storms. Samples collected by USGS personnel may include single, vertically integrated samples, but typically are multiple, vertically integrated samples taken at several sections across the stream. The sampling procedures used are described by Guy and Norman (1970).

From July 1985 through September 1991, about 20,000 suspended-sediment samples from the eight study sites were analyzed and reviewed, and data were stored in USGS computer files. Measurable storm runoff was sampled at the eight sites for suspended-sediment concentration during 30 of 43 storms in 1986; 103 of 142 storms in 1987; 84 of 107 storms in 1988; 143 of 192 storms in 1989; 105 of 141 storms in 1990; and 177 of 212 storms in 1991. Sediment samples were used to compute daily mean values of suspended-sediment concentration and sediment discharge according to standard USGS procedures (Porterfield 1972). Statistical summaries and graphical representations of daily mean values of suspended-sediment concentration and sediment discharge, as well as daily mean values of stream discharge, are presented in the more detailed report, "Preliminary Summaries and Trend Analyses of Stream Discharge and Sediment Data for the Yazoo River Basin Demonstration Erosion Control Project, North-Central Mississippi, July 1985 Through September 1991" (Rebich 1993).

PRELIMINARY TREND ANALYSES OF STREAM DISCHARGE AND SEDIMENT DATA

Trend analyses of stream discharge and sediment data for the DEC project sites are needed to help evaluate the effectiveness of management practices used to alleviate flooding, erosion, sedimentation, and water-quality problems. Management practices include bank stabilization, energy-reduction structures in a study stream, and sediment-reduction structures in fields that drain into a study stream. Trends in sediment data over time may be used to indicate whether management practices have changed suspended-sediment concentration and sediment discharge. In addition, trends in sediment data may indicate if the factors that contribute to sedimentation and erosion have changed. The following paragraphs include a discussion of the trend analyses procedures used to detect trends in the data from the eight sites and a presentation of the results of the preliminary trend analyses of the data at these sites.

Trend Analyses Procedures

Two overall types of trend analyses used to identify trends in hydrologic time series data include step-trend and monotonic trend analyses. Step-trend analyses are used to detect changes in a constituent for a period of time prior to and after a specific event. For example, step-trend analyses would be performed to detect changes in suspended-sediment concentration prior to and after construction of a dam on a waterway. These analyses require knowledge of the event before examination of the data (Hirsch et al. 1991). Monotonic trend analyses are performed on data that consistently increase or decrease over time without regard to any specific pattern (Hirsch et al. 1991). The sediment data collected for the DEC project were collected prior to, during, and after flooding-erosion management practices were implemented. However, these practices were not implemented simultaneously in each watershed over a short time period; rather, they were implemented gradually from watershed to watershed. Therefore, monotonic trend analyses were used instead of step-trend analyses.

After a trend analysis method has been selected, parametric or non-parametric procedures are selected. Parametric procedures are used for data with specific distributions, typically normal distributions. Non-parametric procedures are used when the distribution of the data is unknown. Water-quality (and sediment) data, in general, are seasonal, skewed, and serially correlated, and follow criteria for use of a non-parametric procedure (Smith et al. 1982). Therefore, the monotonic, nonparametric Seasonal Kendall test for trend was selected to detect trends in stream discharge, suspended-sediment concentration, and sediment discharge data for the eight sites. In addition, the Seasonal Kendall Slope Estimator was used to indicate magnitude and direction of detected trends, and flow-adjustment procedures were used to attempt to remove stream discharge as a source of variance in suspended-sediment concentration and sediment discharge data. Brief explanations of the Seasonal Kendall test, the Seasonal Kendall Slope Estimator, and flow adjustment are presented in the following paragraphs.

Seasonal Kendall Test: The Seasonal Kendall test for trend is based on the Kendall's Tau test, which is a distribution-free test that uses the ranks of the data instead of the magnitudes (Smith et al. 1982). In this test, a positive value for the test statistic (Kendall's Tau) indicates an upward trend, a negative value indicates a downward trend, and a value close to zero indicates no trend (Hirsch et al. 1982). The Seasonal Kendall test is a modification of the Kendall's Tau test in which test statistics are computed for several "seasons" in a period of a year to compare several years of record. The Seasonal Kendall test minimizes the effects of seasonal variability on the detection of trends by comparing only values from the same season of each year (Schertz 1990). A season does not necessarily mean a climatic season, but is defined in this report as a "period of a year from which a single value will be selected to compare to values from the same season or period from other years" (Schertz 1990). The test statistics for each season are then summed to determine an overall test statistic for the period of record.

The hypothesis of the Seasonal Kendall test is that no trend exists in the time series of data tested. A "p-value" associated with the results of the test is the probability that a trend resulted from a chance arrangement of the data rather than an actual change in the data (Schertz 1990). The p-value associated with the trend result is then compared to a pre-selected level of significance. If the p-value is less than the pre-selected level of significance, then one would accept that a trend in the data does exist (or that the hypothesis of no trend is rejected). A formal explanation and derivation of the Seasonal Kendall test is given by Hirsch and others (1982).

Requirements for the Seasonal Kendall test include an adequate period of record, number of seasons, and pre-selected level of significance. First, a minimum of 5 to 10 years of record is considered adequate to conduct trend analyses (Hirsch et al. 1982; Schertz 1990). For the eight DEC project sites, four sites had more than 5 years of record: Hotopha Creek near Batesville, Otoucalofa Creek Canal near Water Valley, Hickahala Creek near Senatobia, and Batupan Bogue at Grenada. Of the remaining sites, two had nearly 5 years of record: Peters (Long) Creek near Pope and Harland Creek near Howard; and two sites had less than 4 years of record: Senatobia Creek, near Senatobia, and Fannegusha Creek, near Howard. Trend analyses were conducted at the four sites with greater than 5 years of record and at the two sites with nearly 5 years of record. Trend analyses were not conducted for the two sites with less than 4 years of record. Also, trend analyses were conducted on an individual site basis only and were not used to compare sites or watersheds. To compare sites or watersheds, the period of record analyzed is required to be of comparable length for all sites (Schertz 1990).

The number of seasons used to perform the Seasonal Kendall test was selected to represent the range of values in the sediment data for a year of record; however, a large number of seasons could cause potential problems with the trend test, such as eliminating independence in the test data (Hirsch and Slack 1984). Because of the large number of daily mean values of stream discharge, suspended - sediment concentration, and sediment discharge used for this study, trend analyses were performed on subsets of daily mean values based on 12 seasons per year or one set of values per month. For example, the first subset was formed by selecting daily mean values of stream discharge, suspended - sediment concentration, and sediment discharge computed on the 15th day of each month for the period of record at all of the sites that trend analyses were performed. The day of the month used to form the subsets of data was selected at the discretion of the author. This procedure was then repeated by forming similar subsets of data for the 8th and 22nd days of each month. The replicate subsets were formed to support an overall trend result at a particular site.

A level of significance is pre-selected to indicate whether the results of the Seasonal Kendall test conducted on a particular subset is considered statistically significant. If the p-value of the trend test is less than the pre-selected level of significance, then the result can be considered statistically significant as stated earlier. The author chose a pre-selected level of significance of 0.1, the same as that used by Smith and others (1982).

<u>Seasonal Kendall Slope Estimator:</u> After using the Seasonal Kendall test to identify trends in the sediment data, the Seasonal Kendall Slope Estimator is used to estimate the magnitude and direction of the trend. The magnitude is expressed as a slope (value per unit time), although linearity is not implied in the trend. This slope estimate is the median of the differences (expressed as slopes) of the ordered pairs of data compared in the trend test. The median of differences is the change per year due to the trend (Smith et al. 1982). Because the median of the differences is used, this slope estimate is resistant to extreme values (or outliers) and to seasonal variation (Hirsch et al. 1982). A positive value of the slope estimate indicates an increasing trend, and a negative value indicates a decreasing trend. The Seasonal Kendall Slope Estimator was computed for all trend analyses at the six sites analyzed.

Flow Adjustment: Suspended-sediment concentration and sediment discharge are strongly correlated with stream discharge. Suspended-sediment concentration and sediment discharge generally increase as stream discharge increases because of the transport of particulates within stormwater runoff (Schertz 1990). The relations between suspended-sediment concentration and stream discharge and between sediment discharge and stream discharge are similar at all of the DEC project sites. If the variability due to stream discharge is removed, trend testing would have greater probability of detecting a trend when one exists, and the trend would not be an artifact of the history of stream discharge at a particular site (Schertz 1990). Therefore, a statistically significant trend would indicate changes in the factors that contribute to sedimentation and erosion at a particular site.

The technique used to remove the effects of stream discharge on suspended-sediment concentration and sediment discharge is to compute a time series of flow-adjusted concentrations (FACs) and test this time series for trend. The FAC is defined in this report as a residual computed by subtracting a predicted daily mean value from an actual daily mean value of suspended-sediment concentration or sediment discharge. Predicted daily mean values are computed from a mathematical expression that describes the relation between stream discharge and suspended-sediment concentration or between stream discharge and sediment discharge.

Many expressions that describe the relation between stream discharge and suspended-sediment concentration or between stream discharge and sediment discharge at a particular site were considered. Such expressions included linear regression, multiple regression (quadratic polynomial regression), and locally weighted scatterplot smooths (LOWESS) (see Helsel and Hirsch (1992) for a more detailed explanation of LOWESS). All of the expressions were evaluated to determine a "best" expression that described the relation between stream discharge and suspended-sediment concentration or sediment discharge at a particular site. The procedure to select the best expression is presented in a report by Schertz (1990) and was followed for each of the DEC project sites analyzed in this report.

Trend Analyses Results

The results of the trend analyses for the six DEC sites analyzed are presented in Table 2. All of the data subsets are transformed using natural logs prior to trend testing. Log transformations are typically used for data that have ranges of more than one magnitude (Helsel and Hirsch 1992). P-values are reported as decimal values rather than percentages in Table 2 as a basis of comparison to the pre-selected level of significance of 0.1. Slope estimates are computed as change in log units per year, but are reported in Table 2 as percentage change per year for easier interpretation and convention.

For the purposes of this report, consistent trend results refer to p-values associated with an individual trend test that are consistently below 0.1 for all three replicate subsets of data analyzed at a particular site. For example, p-values associated with trend tests conducted on the time series of stream discharge for subsets of data formed on the 15th, 8th, and 22d days of the month were 0.0023, 0.0003, and 0.0001, respectively, for Hotopha Creek, near Batesville (Table 2). These three p-values were consistently less than 0.1 indicating a statistically significant trend in the stream discharge data at this site. In addition, the respective slope estimates associated with these trend tests were consistently positive indicating an increase in stream discharge over time for this site.

Trend results are also considered consistent in this report when p-values associated with an individual trend test are consistently above 0.1 for all three replicate subsets of data analyzed at a particular site regardless of consistency in slope estimate direction. For example, p-values associated with trend tests conducted on time series of flow-adjusted suspended-sediment concentration for subsets of data formed on the 15th, 8th, and 22d days of the month were 1.0000, 0.4478, and 0.8610, respectively, for Hickahala Creek, near Senatobia (Table 2), indicating that no statistically significant trend was detected. Slope estimates associated with these tests were all consistently negative for the replicate subsets of data. In another example, p-values associated with trend tests conducted on time series of sediment discharge for subsets of data formed on the 15th, 8th, 22d days of the month were 0.8790, 0.4752, and 0.2839, respectively, for Otoucalofa Creek Canal, near Water Valley, also indicating that no statistically significant trend was detected. Slope estimates associated with these tests alternated from negative to positive to negative, respectively. Although no statistically significant trends were detected in either example, the trend results were considered consistent because the p-values associated with the respective trend results were all consistently above 0.1 for each replicate subset of data.

Inconsistent trend results refer to p-values associated with an individual trend test that are not consistently below or above 0.1 for the three subsets of data at a particular site. For example, p-values associated with the trend tests conducted on the time series of suspended-sediment concentration for subsets of data formed on the 15th, 8th, and 22d days of the month were 0.0739, 0.1782, and 0.2835, respectively, for Hotopha creek, near Batesville (Table 2). These p-values were not all below or above 0.1; therefore no assessment of trend in suspended-sediment concentration over time can be made at this particular site.

Trends were detected in stream discharge for all subsets of data at each site analyzed, except for the subset of stream discharges formed on the 15th day of the month at Batupan Bogue at Grenada. In addition, slope estimates indicated an increase in stream discharge for the study period where trends in stream discharge were detected. The increase in stream discharge at the six DEC sites was supported by the annual mean stream discharge extremes generally having lowest annual means in the 1988 water year and highest annual means in the 1989 and 1991 water years, which is consistent with rainfall conditions in the study area. Annual mean stream discharge extremes are discussed in the report by Rebich (1993).

Trends were detected in flow-adjusted suspended-sediment concentration at Hotopha Creek, near Batesville. For subsets of flow-adjusted suspended-sediment concentration data formed on the 15th, 8th, and 22d days of the month, p-values were 0.0019, 0.0089, and 0.0739, respectively, indicating a statistically significant trend at Hotopha Creek (Table 2). Slope estimates associated with these tests were all negative, which may indicate a decrease in the factors that contribute to sedimentation and erosion at this site.

The relation of flow-adjusted suspended-sediment concentration and time is plotted in Figure 2 for the subset of data formed on the 15th of the month at this site. Each data point represents a residual defined earlier as the difference between actual and predicted values of suspended-sediment concentration. The trend line in Figure 2 is based on an equation derived during trend computations and is provided for purposes of illustration only. Although the trend line is depicted as linear in Figure 2, a linear trend for this data subset (which represents the entire data set) is not assumed. Rather, the trend line represents the relative decrease in flow-adjusted, log-transformed suspended-sediment concentration per year at this site.

Similar trends were detected at Otoucalofa Creek Canal, near Batesville, for flow-adjusted suspended-sediment concentration and flow-adjusted sediment discharge. For subsets of flow-adjusted suspended-sediment concentration data formed on the 15th, 8th, and 22d days of the month, p-values were 0.0002, 0.0374, and 0.0001, respectively, indicating a statistically significant trend (Table 2). For subsets of flow-adjusted sediment discharge data formed on the 15th, 8th, and 22d days of the month, p-values were 0.0014, 0.0374, and 0.0001, respectively, also indicating a statistically significant trend (Table 2). Slope estimates associated with both sets of trend results were all negative, which may indicate a decrease in the factors that contribute to sedimentation and erosion at this site.

The relation of flow-adjusted suspended-sediment concentration and time is plotted in Figure 3 for the subset of data formed on the 15th of the month at this site. As on Figure 2, each data point represents a residual defined as the difference between actual and predicted values of suspended-sediment concentration (natural log-transformed). Once again, the trend line in Figure 3 is based on an equation derived during trend computations and is provided for purposes of illustration only. A linear trend is also not assumed for this data subset although the trend line is depicted as linear in Figure 3.

Trend analyses generally were inconsistent or no statistically significant trends were detected; however, for unadjusted and flow-adjusted suspended-sediment concentration and sediment discharge when comparing the three subsets of data at most of the remaining sites analyzed. The inconsistencies may be attributed to an insufficient period of record at each site. The study period may be too short to indicate consistent trend results in the suspended-sediment concentration and sediment discharge due to the high degree of variability in stream discharge from water year to water year. The largest amount of record collected at any site was 6.25 years, which is near the minimum amount considered adequate to attempt trend testing.

SUMMARY AND CONCLUSIONS

This paper presents preliminary results of trend analyses of daily mean values of stream discharge, suspended-sediment concentration, and sediment discharge for six of the eight sites in the Yazoo River

Basin Demonstration Erosion Control project in north-central Mississippi for the study period July 1985 through September 1991. About 550 stream discharge measurements and about 20,000 suspended-sediment samples were analyzed and reviewed, and data were stored in USGS computer files. Stream discharge measurements and sediment samples were used to compute daily mean values of stream discharge, suspended-sediment concentration, and sediment discharge.

The Seasonal Kendall trend test was used to detect trends in daily mean values of stream discharge, suspended-sediment concentration, and sediment discharge for the DEC project sites. Only six of the eight sites had sufficient data on which to perform the trend analyses. Trend analyses were also conducted for flow-adjusted suspended-sediment concentration and sediment discharge. These analyses were conducted on residuals computed from expressions describing relations between suspended-sediment concentration and stream discharge or sediment discharge and stream discharge.

Trends were detected in stream discharge at each site except Batupan Bogue at Grenada indicating an increase in stream discharge for the study period, which is consistent with rainfall conditions in the study area. Trends were detected in flow-adjusted suspended-sediment concentration at Hotopha Creek near Batesville and in flow-adjusted suspended - sediment concentration and flow-adjusted sediment discharge at Otoucalofa Creek Canal, near Water Valley, indicating a possible decrease in the factors that contribute to sedimentation and erosion at these two sites. Trend analyses generally were inconsistent or no statistically significant trends were detected, however, for unadjusted and flow-adjusted suspended-sediment concentration and sediment discharge at most of the remaining sites analyzed. This was probably due to insufficient periods of record.

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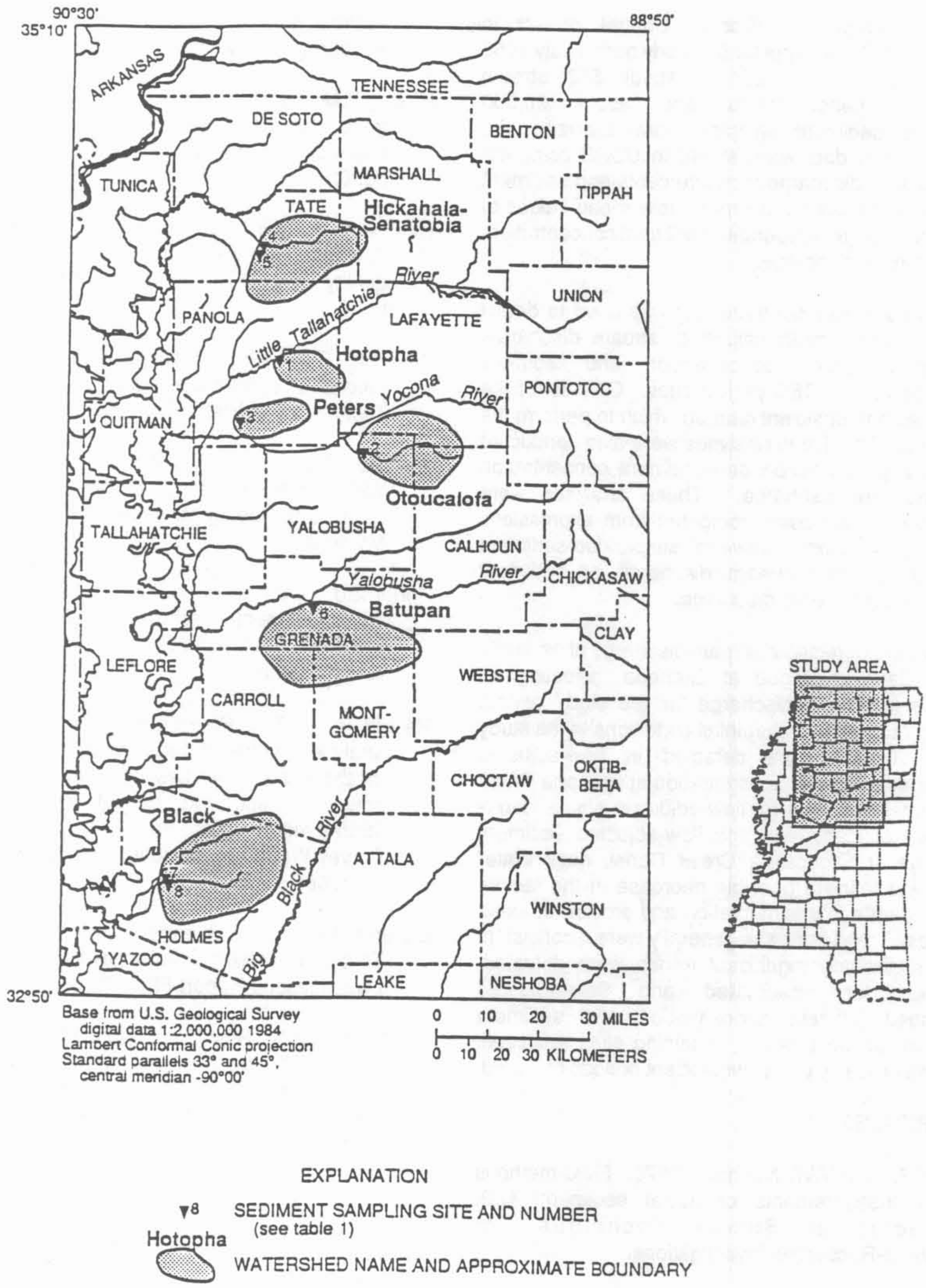

Figure 1. -- Location of study area and sediment sampling sites.

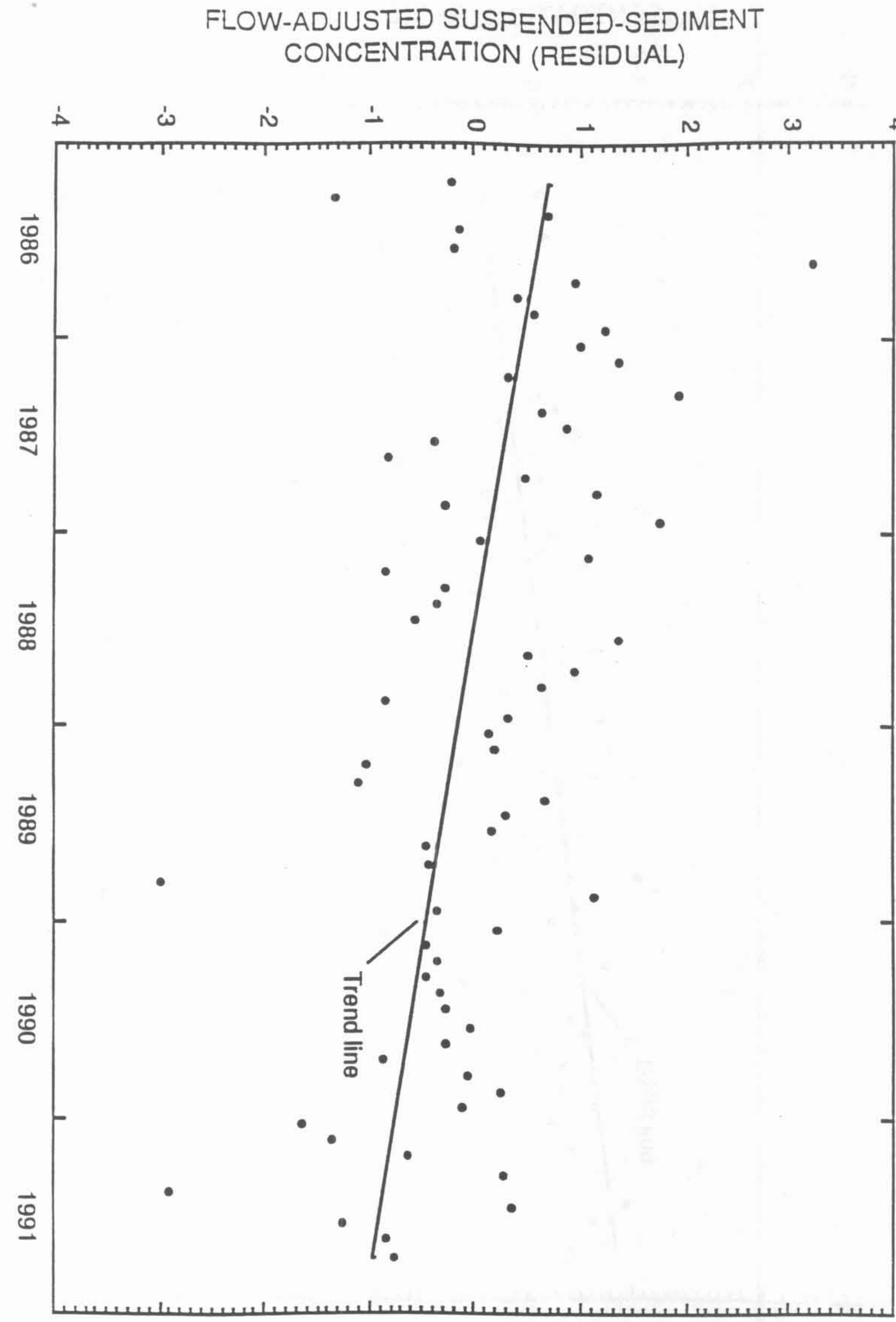

Figure 2. – Flow-adjusted suspended-sediment concentration for the period of record for the subset of data formed on the 15th day of the month for Hotopha Creek near Batesville.

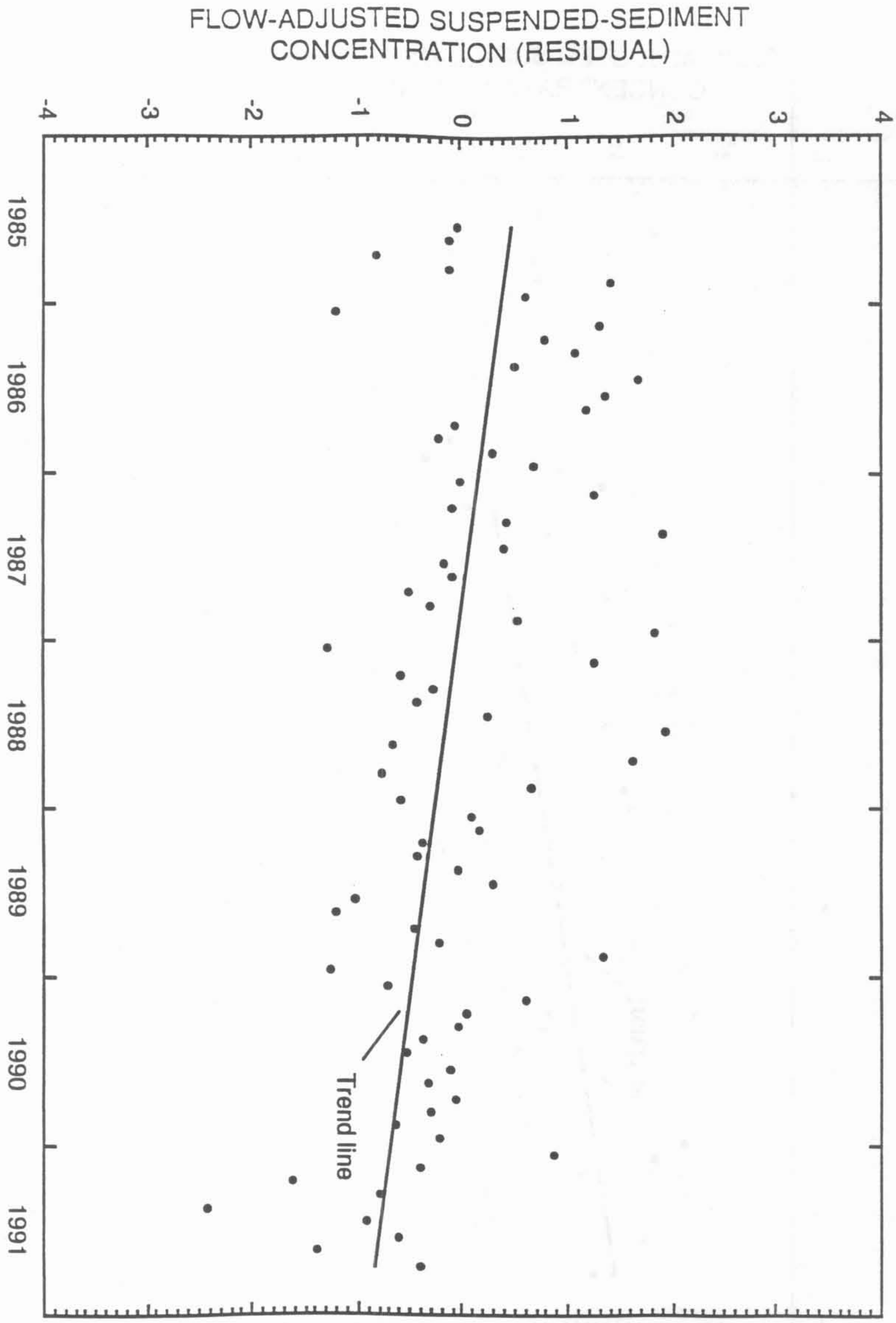

Figure 3. – Flow-adjusted suspended-sediment concentration for the period of record for the subset of data formed on the 15th day of the month for Otoucalofa Creek Canal near Water Valley.

Table 1. -- *Sediment sampling sites and period of record*

Map reference number	Down-stream order number	Station name	Drainage area (square miles)	Latitude	Longitude	Period of record Start	End
1	07273100	Hotopha Creek near Batesville	35.1	34°21'50"	89°52'42"	3-12-86	ongoing
2	07274252	Otoucalofa Creek Canal near Water Valley	97.1	34°08'36"	89°38'59"	7-01-85	ongoing
3	07275530	Peters (Long) Creek near Pope	79.2	34°12'50"	89°58'54"	12-23-86	ongoing
4	07277700	Hickahala Creek near Senatobia	121	34°37'54"	89°55'30"	2-07-86	ongoing
5	07277730	Senatobia Creek near Senatobia	82.0	34°37'02"	89°56'30"	3-01-86	11-30-89
6	07285400	Batupan Bogue at Grenada	240	33°46'26"	89°47'15"	7-10-85	ongoing
7	07287355	Fannegusha Creek near Howard	103	33°08'13"	90°11'40"	3-12-87	5-08-89
8	07287404	Harland Creek near Howard	62.1	33°06'05"	90°10'23"	12-09-86	ongoing

Table 2. -- *Results of the Seasonal Kendall trend tests on subsets of unadjusted and flow-adjusted daily mean values for the Demonstration Erosion Control project sites*

[subset date, date of every month selected to create subsets of data for the period of record on which to perform trend analyses; p-value, dimensionless level of significance; slope estimate, magnitude and direction of trend in percentage change per year; LOWESS, locally weighted scatterplot smooth. All data natural log-transformed.]

Data	Subset date	Flow adjustment technique	p-value	Slope estimate (% / year)
HOTOPHA CREEK NEAR BATESVILLE [5.58 YEARS OF DATA]				
stream discharge	15th	not applicable	0.0023	18.98
stream discharge	8th	not applicable	0.0003	26.04
stream discharge	22d	not applicable	0.0001	36.11
suspended sediment	15th	unadjusted	0.0739	-18.00
suspended sediment	8th	unadjusted	0.1782	-8.53
suspended sediment	22d	unadjusted	0.2835	16.19
sediment discharge	15th	unadjusted	1.0000	0.00
sediment discharge	8th	unadjusted	0.9515	1.97
sediment discharge	22d	unadjusted	0.0061	39.14
suspended sediment	15th	multiple regression	0.0019	-25.96
suspended sediment	8th	multiple regression	0.0089	-17.62
suspended sediment	22d	LOWESS	0.0739	-15.68
sediment discharge	15th	multiple regression	0.0008	-21.47
sediment discharge	8th	LOWESS	0.0019	-17.99
sediment discharge	22d	LOWESS	0.1899	-11.64
OTOUCALOFA CREEK CANAL NEAR WATER VALLEY [6.25 YEARS OF DATA]				
stream discharge	15th	not applicable	0.0167	11.55
stream discharge	8th	not applicable	0.0050	14.19
stream discharge	22d	not applicable	0.0013	11.45
suspended sediment	15th	unadjusted	0.1893	-6.27
suspended sediment	8th	unadjusted	0.6477	-3.17
suspended sediment	22d	unadjusted	0.2430	-7.52
sediment discharge	15th	unadjusted	0.8790	-1.56
sediment discharge	8th	unadjusted	0.4752	7.21
sediment discharge	22d	unadjusted	0.2839	-6.01
suspended sediment	15th	LOWESS	0.0002	-19.44
suspended sediment	8th	LOWESS	0.0374	-11.09
suspended sediment	22d	LOWESS	0.0001	-14.62
sediment discharge	15th	LOWESS	0.0014	-18.66
sediment discharge	8th	LOWESS	0.0374	-10.96
sediment discharge	22d	LOWESS	0.0001	-15.36
PETERS (LONG) CREEK NEAR POPE [4.75 YEARS OF DATA]				
stream discharge	15th	not applicable	0.0963	9.09
stream discharge	8th	not applicable	0.0233	18.19
stream discharge	22d	not applicable	0.0008	26.49
suspended sediment	15th	unadjusted	0.5454	8.21
suspended sediment	8th	unadjusted	0.0418	21.23
suspended sediment	22d	unadjusted	0.0418	19.39
sediment discharge	15th	unadjusted	0.2000	20.66
sediment discharge	8th	unadjusted	0.0343	44.31
sediment discharge	22d	unadjusted	0.0083	55.55
suspended sediment	15th	LOWESS	0.4975	-4.69
suspended sediment	8th	LOWESS	0.5977	8.41
suspended sediment	22d	LOWESS	0.8211	-2.83
sediment discharge	15th	LOWESS	0.3271	-6.28
sediment discharge	8th	LOWESS	0.4070	8.92
sediment discharge	22d	LOWESS	1.0000	0.77

Table 2. -- *Results of the Seasonal Kendall trend tests on subsets of unadjusted and flow-adjusted daily mean values for the Demonstration Erosion Control project sites* -- Continued

Data	Subset date	Flow adjustment technique	p-value	Slope estimate (% / year)
HICKAHALA CREEK NEAR SENATOBIA [5.67 YEARS OF DATA]				
stream discharge	15th	not applicable	0.0387	5.23
stream discharge	8th	not applicable	0.0002	8.85
stream discharge	22d	not applicable	0.0001	11.58
suspended sediment	15th	unadjusted	0.2673	7.48
suspended sediment	8th	unadjusted	0.4129	4.78
suspended sediment	22d	unadjusted	0.0410	20.56
sediment discharge	15th	unadjusted	0.1444	12.95
sediment discharge	8th	unadjusted	0.0121	19.75
sediment discharge	22d	unadjusted	0.0061	36.70
suspended sediment	15th	LOWESS	1.0000	-0.10
suspended sediment	8th	multiple regression	0.4478	-5.69
suspended sediment	22d	LOWESS	0.8610	-1.87
sediment discharge	15th	LOWESS	0.9534	0.50
sediment discharge	8th	multiple regression	0.5992	-5.78
sediment discharge	22d	LOWESS	0.9534	-1.68
BATUPAN BOGUE AT GRENADA [6.25 YEARS OF DATA]				
stream discharge	15th	not applicable	0.2851	5.59
stream discharge	8th	not applicable	0.0042	17.55
stream discharge	22d	not applicable	0.0016	17.25
suspended sediment	15th	unadjusted	0.4464	10.46
suspended sediment	8th	unadjusted	0.0038	19.95
suspended sediment	22d	unadjusted	0.2318	9.89
sediment discharge	15th	unadjusted	0.0223	18.39
sediment discharge	8th	unadjusted	0.0020	34.91
sediment discharge	22d	unadjusted	0.0127	22.46
suspended sediment	15th	LOWESS	0.6477	-1.82
suspended sediment	8th	LOWESS	0.0477	11.29
suspended sediment	22d	LOWESS	1.0000	-0.07
sediment discharge	15th	LOWESS	0.7223	1.75
sediment discharge	8th	LOWESS	0.0756	10.00
sediment discharge	22d	LOWESS	0.9587	0.25
HARLAND CREEK NEAR HOWARD [4.83 YEARS OF DATA]				
stream discharge	15th	not applicable	0.0374	14.73
stream discharge	8th	not applicable	0.0181	26.71
stream discharge	22d	not applicable	0.0624	16.00
suspended sediment	15th	unadjusted	0.4598	-7.55
suspended sediment	8th	unadjusted	0.7624	6.35
suspended sediment	22d	unadjusted	0.6058	8.12
sediment discharge	15th	unadjusted	0.6058	11.58
sediment discharge	8th	unadjusted	0.1134	33.02
sediment discharge	22d	unadjusted	0.6574	14.81
suspended sediment	15th	LOWESS	0.2688	-14.94
suspended sediment	8th	LOWESS	0.3271	-10.80
suspended sediment	22d	multiple regression	0.0653	-11.34
sediment discharge	15th	LOWESS	0.0900	-20.59
sediment discharge	8th	LOWESS	0.8211	-6.95
sediment discharge	22d	LOWESS	0.0465	-10.13