WATER QUALITY STATUS REPORT NO. 96

SOUTH FORK CLEARWATER RIVER TURBIDITY

Idaho County, Idaho

1988

Idaho Department of Health and Welfare
Division of Environmental Quality
Water Quality Bureau
1410 N. Hilton
Boise, Idaho 83706-1253

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ABSTRACT

A turbidity monitoring study was conducted on the South Fork Clearwater River (So. Fk.) by the Idaho Department of Health & Welfare, Division of Environmental Quality during 1988 from February to November. A total of 19 stations were monitored in the watershed. The study was initiated to determine the principal tributary turbidity sources to the So. Fk. near the mouth at Stites, upstream to the American River/Red River confluence near Elk City. These two tributaries are the largest in the drainage and their confluence forms the So. Fk. of the Clearwater River. Turbidity was measured and discharge was estimated on a monthly basis at each station, except for the period of March, April, and May when readings of turbidity were made bi-weekly. Turbidity peaks were higher from the lower elevation tributaries which drain predominantly agricultural land. One tributary (John's Creek), produced very low levels of turbidity. This drainage has only limited development and timber harvest activities. It could be used as a baseline reference station for future studies in the So. Fk. watershed. The study showed turbidity can be used as a screening tool to identify tributaries with levels of development that may adversely effect water quality. Therefore, turbidity should be used as one of the parameters to consider when prioritizing water quality related projects.

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INTRODUCTION

The South Fork Clearwater River is one of the important contributors of flow to the Clearwater River system. It enters the Middle Fork of the Clearwater River at Kooskia and originates at the watershed divide with the Salmon River. The elevation range is from 1300 feet at Kooskia to 8938 feet at Buffalo Hump.

This drainage was selected for study based on visual observations of the turbidity contribution to the Middle Fork Clearwater River at Kooskia which is often evident at periods of high flow and storm runoff.

The drainage area for the basin is approximately 1,150 square miles. The average annual flow at the Stites gaging station is 1,109 cubic feet per second (cfs). The extreme discharge outside the period of record occurred on June 8, 1964 with a reconstructed flow from high water marks of 17,500 cfs. The extreme for the period of record occurred on May 29, 1912 with a flow of 10,700 cfs. Low flow of record was 72 cfs on November 28, 1976.

Activities within the drainage include; agricultural practices on the upland plateaus, adjacent river slopes, benches, and upper meadows; silvicultural practices with accompanying road construction, livestock grazing, mining, and many forms of recreation. The current activities that affect water quality are different than historic impacts. The past evidence of gold mining which included hydraulic and dredge mining would indicate that water quality was greatly impacted due to those activities. All of the larger streams show signs of dredge mining and many sites show evidence of hydraulic mining. Fires have had an impact on the watershed and have affected slope stability and water quality.

Designated beneficial uses of the South Fork clearwater River and its tributaries include:

- Domestic Water Supply
- Agricultural Water Supply
- Cold Water Biota
- Salmonid Spawning
- Primary Contact Recreation
- Secondary Contact Recreation
- Special Resource Water

This drainage provides important steelhead and chinook salmon spawning and rearing habitat as well as habitat for bull trout, rainbow, cutthroat, small mouth bass, brook trout, and mountain white fish. Therefore, these beneficial uses must be protected from degradation as well as all beneficial uses listed above and others not listed.

METHODS

Sample Stations

Seventeen tributaries and two main stream stations were sampled during the study period. The stations are numbered and named such that they are easy to locate and identify (Table 1). The stations were located near Stites, upstream to the American River/Red River confluence (Figure 20).

Initially 13 sample stations were selected for the study. These stations were to sample turbidity from the major drainages within the watershed and thus represent the major turbidity sources. When these stations were reviewed on the ground it was discovered that two o f the sites were across the river with no access for most of the season, therefore, the two stations of Butcher Creek and Ten Mile Creek were dropped from the study. As sampling progressed, additional drainages were included. These were Rabbit Creek, Earthquake Creek, Cougar Creek, Rainey Day Creek, and Leggett Creek since they would represent smaller drainages and were accessible for sampling. The smaller drainages were added to determine differences in turbidity between the major tributaries and the minor ones. The sampling stations are listed in Table 1 with their STORET number, location by latitude, longitude, and elevation. They are listed in order of location traveling up the drainage starting at the station at Stites.

The larger upper tributaries of Newsome Creek, Clearwater River, Crooked River, American River, Red River, and the South Fork have had extensive dredge and placer mining activity in the historic past. There is still considerable interest and activity in mining at this time. If the price of gold were to increase, there is indications that another surge in mining activity could occur in the area. The lower tributaries have had mining activity int he past but not to the extent of those mentioned above.

The tributaries of Cottonwood, Three Mile, Rabbit, and Sally Ann Creeks have a large percentage of their acreage under cultivation as well as some logging the canyons.

The tributaries of John's Creek and Silver Creek are relatively unentered drainages as far as timber harvest is concerned and are included as possible reference sites that may represent base line conditions for the watershed.

TABLE 1: SAMPLE POINTS BY NAME, NUMBER, LOCATION AND ELEVATION

NAME	STORET #	LATITUDE	LONGITUDE	ELEVATION
SF Clrw.Stites	2020336	46 05 12	115 58 30	1380
Cottonwood Cr.	2020337	46 04 52	115 58 35	1380
Three Mile Cr.	2020338	46 03 00	115 58 45	1400
Rabbit Cr.	2020356	46 04 00	115 58 34	1400
Sally Ann Cr.	2020339	46 00 34	115 57 45	1500
SF Forest Bdry.	2020357	45 53 20	116 02 00	2023
Earthquake Cr.	2020358	45 51 05	116 00 20	2156
Mill Cr.	2020341	45 49 48	115 55 52	2320
Meadow Cr.	2020342	45 59 38	115 55 43	2331
Johns Cr.	2020343	45 49 26	115 53 21	2400
Cougar Cr.	2020359	45 49 23	115 51 35	2478
Peasley Cr.	2020360	45 49 00	115 49 07	2720
Silver Cr.	2020344	45 48 20	115 47 26	2812
Rainey Day Cr.	2020361	45 48 13	115 41 35	3400
Leggett Cr.	2020362	45 49 37	115 37 34	3630
Newsome Cr.	2020346	45 49 43	115 36 52	3640
Crooked River	2020347	45 49 27	115 31 46	3819
American River	2020188	45 51 30	115 28 30	3840

SOUTHFORK OF CLEARWATER SAMPLING STATIONS

(FIGURE 20)

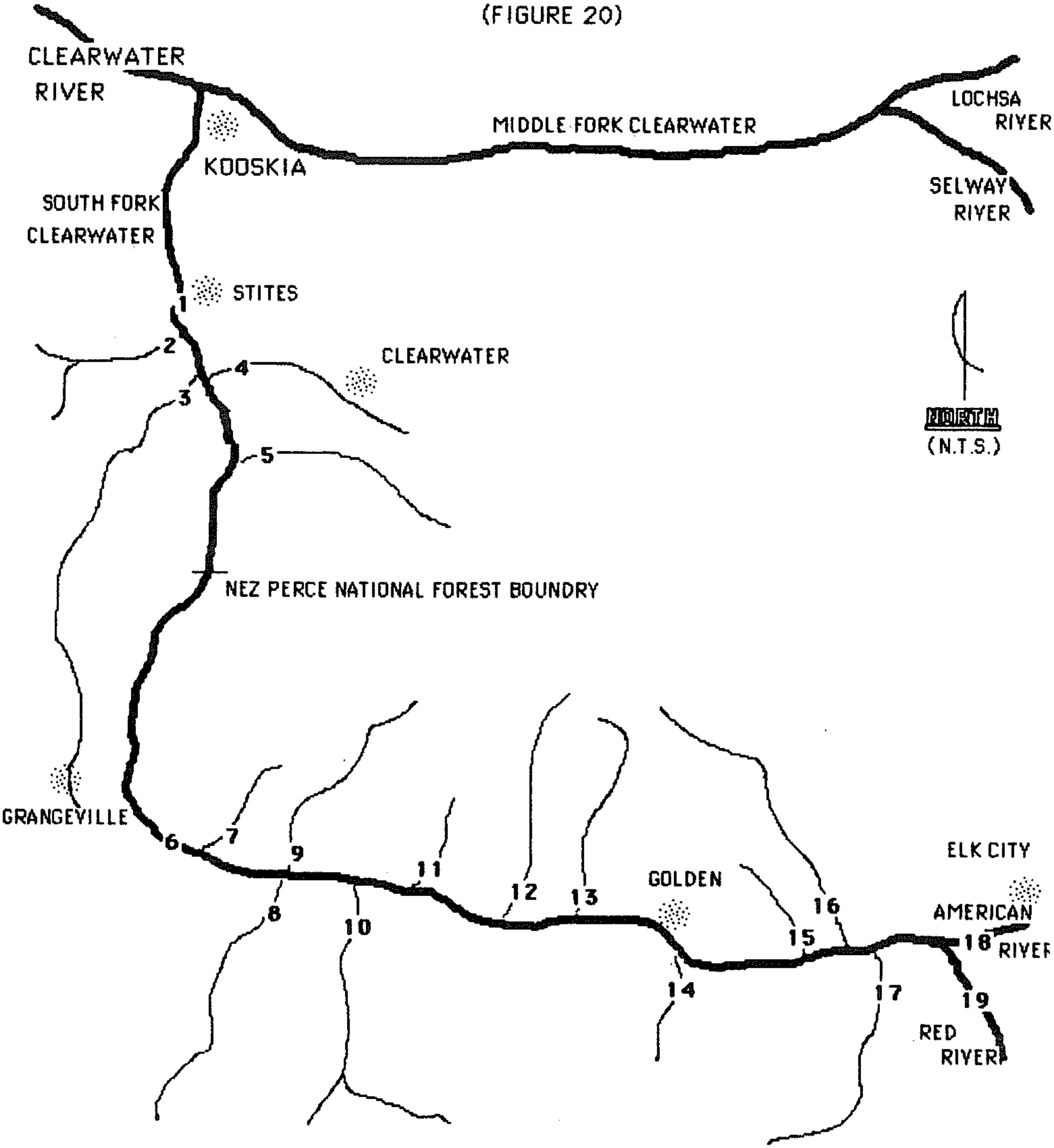
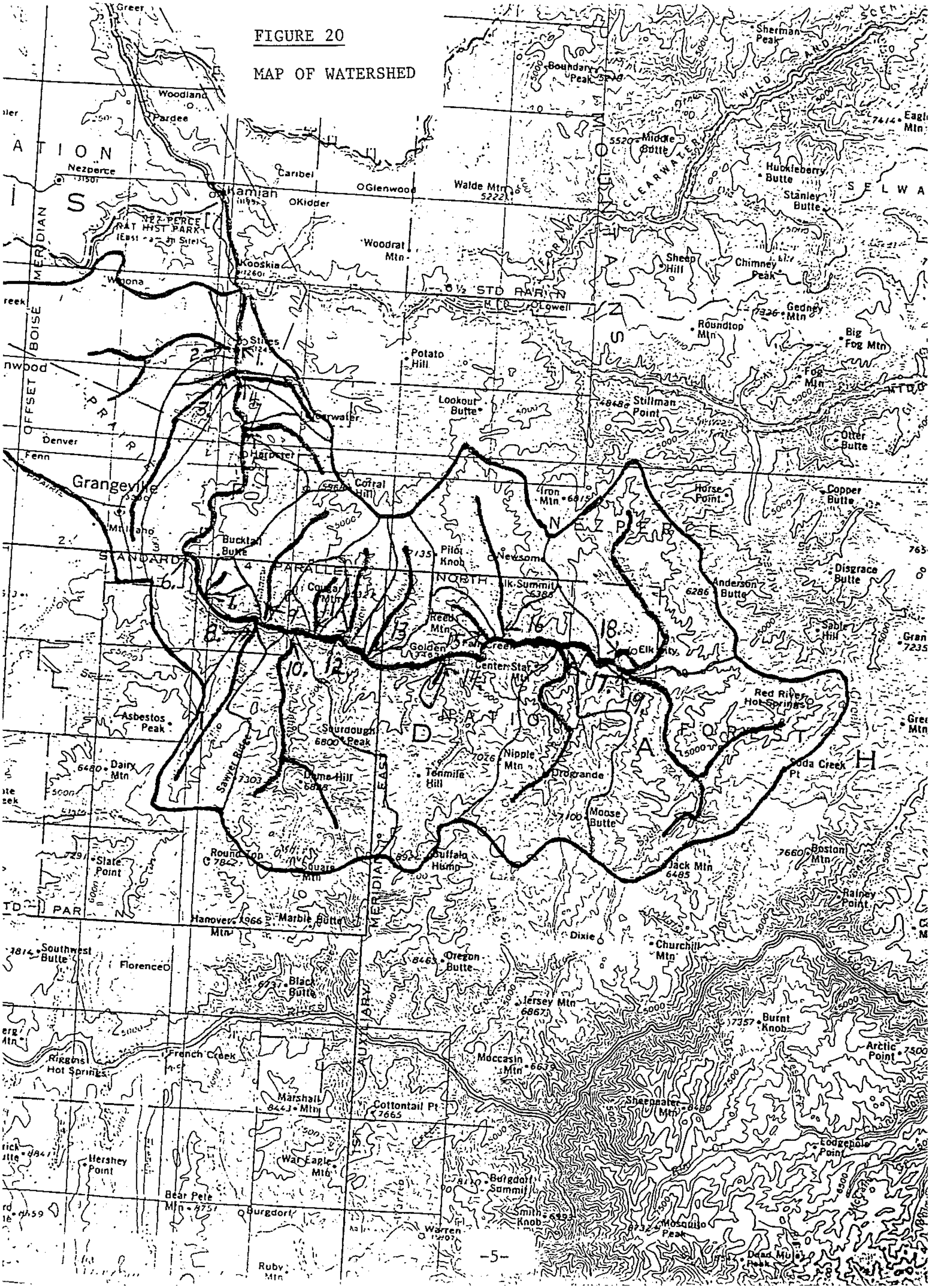


FIGURE 20

MAP OF WATERSHED



Sample Frequency

Samples were collected monthly, beginning in February and running through November, except for the stations above Silver Creek which were ice and snow covered and were started in March. Prior to March these upper stations did not appear to have high turbidity. Samples were collected bi-weekly during the months of March, April, and May in an effort to sample through the spring runoff in the tributaries.

Parameters

The objectives of the study were to determine a quick assessment method of prioritizing drainages with respect to water quality impacts. The parameters considered were those that could be taken quickly in the field. Turbidity and flow (estimated) best satisfied the objectives of the study.

Turbidity

Turbidity is defined as the condition of water resulting from suspended mater that retards the passage of light through the column. Water is turbid when suspended material is conspicuous. Turbidity is measured by use of a turbidimeter. It is expressed in e=nephelometric turbidity units (NTU), which is a scale value which relates to light transmittance through the water sample, and can be used for comparison of samples.

Sample readings were taken immediately on site after collection by use of a portable Hach turbidimeter (Model 16800). After the collection bottle was removed from the DH 48, the bottle was agitated to assure thorough mixing of the contents, then an 18 ml. sample was obtained in the test tube and placed in the turbidimeter to obtain the reading. The test tube was thoroughly rinsed between each reading and the outside was wiped clean of any prints of moisture on the surface by use of a soft absorbent disposable towel.

The parameter of turbidity was selected since it is an obvious visual indication of water quality that the general public can relate to. It is easy to measure and inexpensive to collect compared to other parameters that could be used to meet the same objectives. There is a great deal of traffic up the South Fork of the Clearwater River and individuals often comment to the Division of Environmental Quality on changes they notice in turbidity, especially increases.

Discharge

Discharge is the measurement of the quantity of water flowing past a point at any given time. It is often expressed in cubic feet per second (cfs). The discharge was estimated rather than measured for all stations except the Stites station. It was concluded that the objectives of the study could be met by estimating rather than measuring the discharge. The estimated volume measurement was obtained by best professional judgement. To obtain the measured parameter of discharge would have required more time and expense. The Stites discharge would have required more time and expense. The Stites gage site is a USGS station at which discharge records are collected and maintained.

Sample Collection

Samples were collected at each station by use of a hand held DH 48 integrating sediment sampler. One sample was taken at each location at mid-stream. At high flow the river samples were collected from bridges or culverts by using a rope suspended DH 59 integration sediment sampler. Usually four or five samples were collected per site and located as spaced intervals across the bridge. These samples were combined in a sample splitter container, then one sample was drawn off and the reading was taken. At low flows the station was waded and samples were taken with the DH 48 sampler. The sample sites of Crooked River, Newsome Creek, John's Creek, Meadow Creek, and Mill Creek that were too high at peak runoff to wade were collected closer to the side of the stream where samples could be taken safely.

Quality Assurance

In this study quality assurance was accomplished by taking duplicate sample readings on every 10th station sampled. If a difference was noted when the sample was read in he turbidimeter, a third sample was taken and the recorded value was an average of the three sample readings. This was seldom necessary as the readings on the second sample collected were nearly always identical to the first readings.

Prior to use, the turbidimeter was calibrated against the laboratory turbidimeter located at the Lewiston Office of the Division of Environmental Quality.

RESULTS AND DISCUSSION

Runoff Characteristics of the Drainage

Figures 1-19 (Appendix A), graph the results of sampling done throughout the 1988 sampling season. They illustrate turbidity vs discharge comparison for each of the sampled stations by date.

During the winter season when the stream channels were frozen over, there was no evidence of turbidity in the streams. The snow melt advanced from the low elevation tributaries up the South Fork of the Clearwater River drainage to the higher elevations. The drainages with a south exposure melted off more rapidly than those with a north exposure at the same corresponding elevation. Turbidity of each tributary increased in response to the increased runoff and overland flow of melt water.

The watersheds of Cottonwood, Three Mile, Rabbit and Sally Ann Creeks melted off earlier than watersheds above the Forest Boundary of Highway 14 up the South Fork of the Clearwater River. Snow was largely melted on these lower drainages by the March 23 reading date.

For most stations, the peak in turbidity from snowmelt preceded the peak discharge for the station. This is the customary response with the turbidity peak occurring during the rising limb of the hydrograph. Turbidity peaks were higher from tributaries below the Forest Boundary. These drainages have predominantly agricultural activities compared to those higher in the drainage that are predominantly timbered. The higher peaks and generally higher turbidity readings indicate the higher erosion rates which occur from tilled land compared to forested lands.

Data indicated a secondary peak in turbidity at most stations that corresponded to a relatively minor response in the hydrograph. The June 27 sampling was done during a rainy period. The highest summer turbidity of 345 NTU's occurred in Three Mile Creek (see Figure 3). This turbidity peak was much higher than the snowmelt peak of March 23. However, the March 23 peak also corresponded to the snowmelt peak of other low elevation drainages. The response from Three Mile Creek was definitely from the rapid runoff with accompanying erosion from the agricultural lands in the upper reaches of the drainage.

Peak turbidity was generally higher from the stations below the Forest Boundary than above except for some individual readings from the small drainages of Earthquake, Cougar, Rainey Day, and Leggett Creeks. The high reading in Cougar Creek occurred during the storm event of June 27. The high readings of Earthquake, Rainey Day, and Leggett Creeks occurred just prior to the peak discharge, as was typical for all stations. The peaks of the upper drainages were not as high as the peaks of the lower drainages with the exception of Rainey Day and Cougar Creeks. The peak turbidity of Cottonwood Creek was lower than expected by comparison with that of the other lower drainages since it likewise originates from the farmed plateau land. It is presumed that the actual peak turbidity that occurred was missed by the monthly sampling frequency.

Direct sources of turbidity to the South Fork Clearwater River were observed to add significantly to the turbidity sampled at the Forest boundary station. The sources observed were from unstable and poorly vegetated cut slopes along the Highway 14 right-of-way and the Cal-Ida Mine pit runoff. These sources were observed to add turbidity to the South Fork which partially explains the higher reading at peak turbidity on April 14. This reading was higher than the peak turbidity of any sampled tributary above that station on that date.

The data indicate that John's Creek and Silver Creek have the least turbidity of any of the tributaries sampled. This correlates with the information provided by the Forest Service on the amount of activity taking place within these drainages compared to other drainages within the watershed. A difference in these two tributaries shows up, however, by comparing Figures 10 and 13. John's Creek shows no response in either discharge or turbidity from the rainfall of June 27 while Silver Creek shows a rise in both discharge and turbidity ont he June 27 date. Information provided by the Forest Service reveals current logging activity within the Silver Creek drainage compared to no logging activity within the John's creek drainage. John's Creek is the most unimpacted tributary in the watershed.

Turbidity levels in Mill creek and Meadow Creek are quite comparable throughout the sampling season except that Meadow Creek showed higher turbidity earlier in the season than Mill Creek probably explained by the higher level of activities within the Meadow Creek drainage. Both drainages showed a significant increase in turbidity with the rainfall of June 27, followed by low concentrations of turbidity through the remainder of the season.

The tributaries of Newsome, Crooked River, American River and Red River all measured about the same concentration of turbidity and pattern of runoff. The response of each to the storm event of June 27 was consistent with a definite increase in turbidity. Crooked River showed a much higher rise in turbidity however than the other three tributaries. These tributaries likely have comparable levels of activities taking place within their drainages.

The upper tributaries which contribute the greater part of the flow to the South Fork Clearwater River had lower turbidity readings than lower elevation and/or smaller watersheds, with the exception of John's Creek and Silver Creek tributaries. Of the upper tributaries, the Red River watershed had the highest peak turbidity but also the highest discharge, indicating a higher level of sediment delivered to the South Fork than the other upper tributaries.

Indications are as ground or channel disturbance activities increase turbidity increases during events that cause runoff, mainly spring snowmelt and summer storms (freshets). Turbidity appears to be a good indicator of the extent of ground disturbing activities occurring within a watershed.

<u>Tributary Prioritization</u>

One objective of the study is to prioritize the tributaries for further studies to determine turbidity sources and treatment recommendations within the tributaries.

The following prioritization of tributaries includes considerations other than turbidity peaks. Prioritization is based on turbidity, level of activity causing turbidity, and discharge contributing to the flow of the South Fork Clearwater River. The prioritization is given by groups of tributaries that are identified as Priority 1,2, and 3.

Table 2: Prioritization of Tributaries by Groups for Additional Studies

PRIORITY 1	PRIORITY 2	PRIORITY 3
Cottonwood Cr.	Red River	Meadow Creek
Three Mile Cr.	American River	Mill Creek
Rabbit Creek	Crooked River	Cougar Creek
Sally Ann Cr.	Newsome Cr.	Peasley Creek
Silver Creek		

CONCLUSIONS

1. Sub-drainages within a watershed exhibited different turbidity values during the study period.

2. Turbidity levels within tributary streams respond to runoff events with the peak turbidity generally preceding the peak discharge.

3. Watersheds with agricultural lands in the lower end of the watershed (below the Forest Boundary) had higher turbidities than exclusively forested watersheds.

4. Drainages with greater levels of activities had higher turbidity than those with little or no activity, therefore, turbidity can be used in the scoping process to identify and priorities drainages for future study.

5. Sampling of turbidity should be more frequent than monthly or bi-weekly to better define the turbidity changes and to avoid missing peak turbidity and runoff events.

RECOMMENDATIONS

1. John's Creek and Wing Creek (although not a part of the study) should be used as pristine reference site watersheds. These basins would offer good information for future comparisons and as a pre-treatment record, as they are now included in the Wing-Twenty Mile EIS for future activity including road construction and timber harvest.

2. Further investigation into land use and treatment alternatives should proceed in the South Fork Clearwater River watersheds according to the priorities established by this report.

3. Silver Creek can be used as baseline for near pristine or lightly developed watershed as compared to John's Creek which is pristine.

4. If a similar study is initiated, sampling should be weekly in order to better define the graph of turbidity.

5. Discharge should be determined by a more accurate method than estimation in future studies of this type.

ACKNOWLEDGEMENTS

The assistance of the following individuals and organizations is acknowledged and appreciated: Mark Von Lindern, DEQ/LFO Supervisor, for his review, assistance, and encouragement in the preparation of this report; Nick Gerhardt and Don Ruark, Nez Perce National Forest, for their review of the Study Plan and assistance in the location of the sampling stations; U. S. Geological Survey, for supplying stream flow data for South Fork Clearwater River.

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APPENDIX A

Turbidity vs Discharge Graphs

FIGURE 1 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR SO. FK. CLEARWATER AT STITES DURING 1988

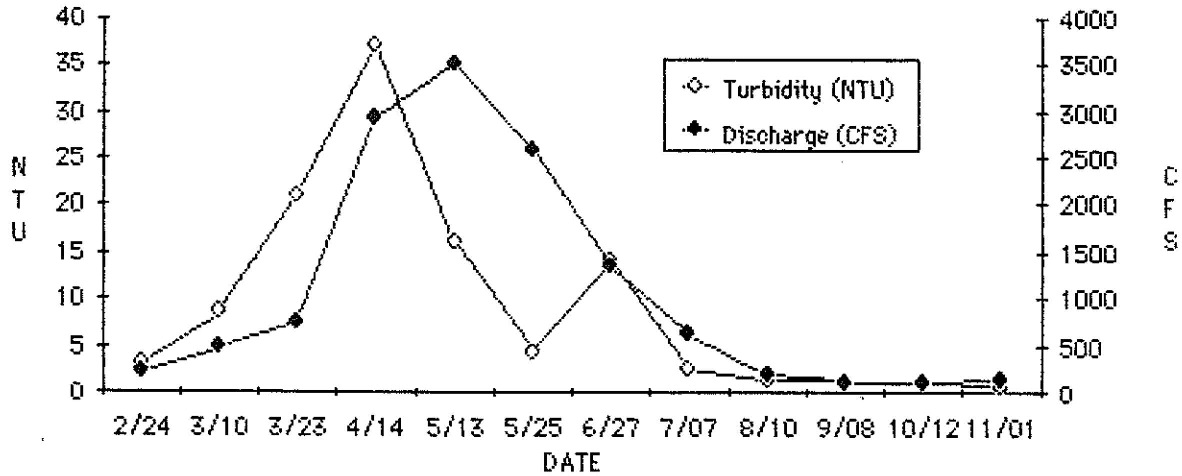


FIGURE 2 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR COTTONWOOD CREEK DURING 1988

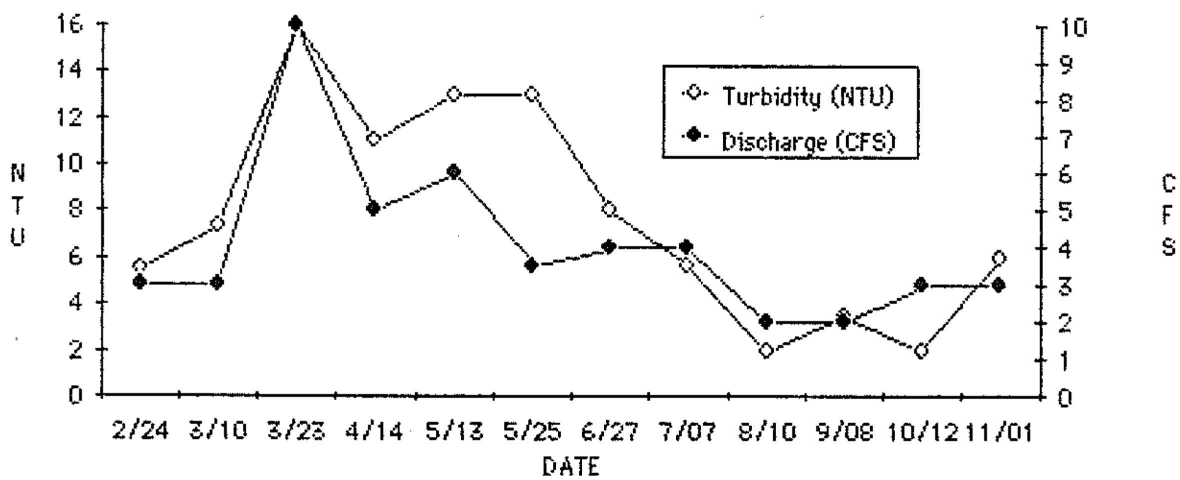


FIGURE 3 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR THREE MILE CR. DURING 1988

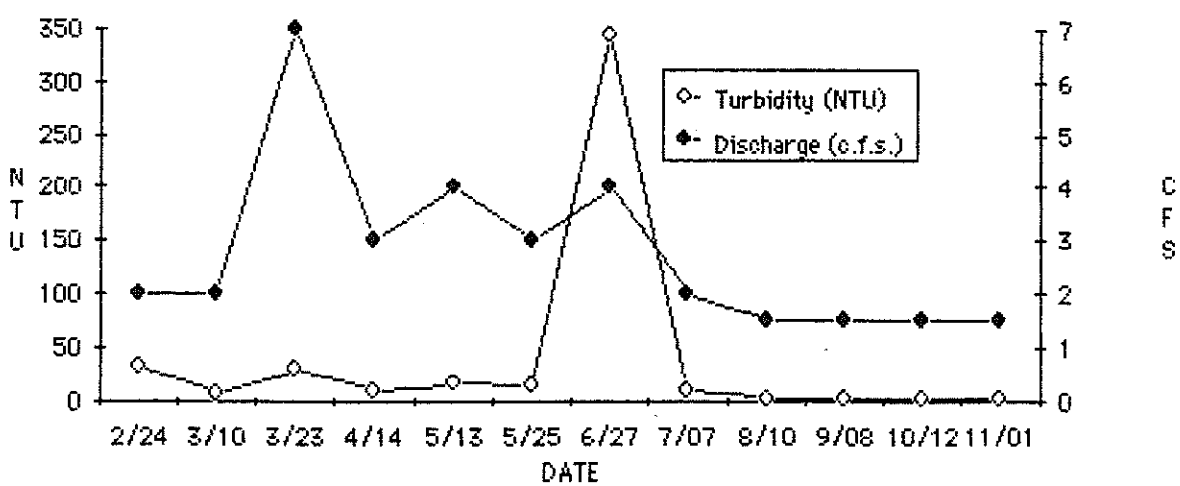


FIGURE 4 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR RABBIT CR DURING 1988

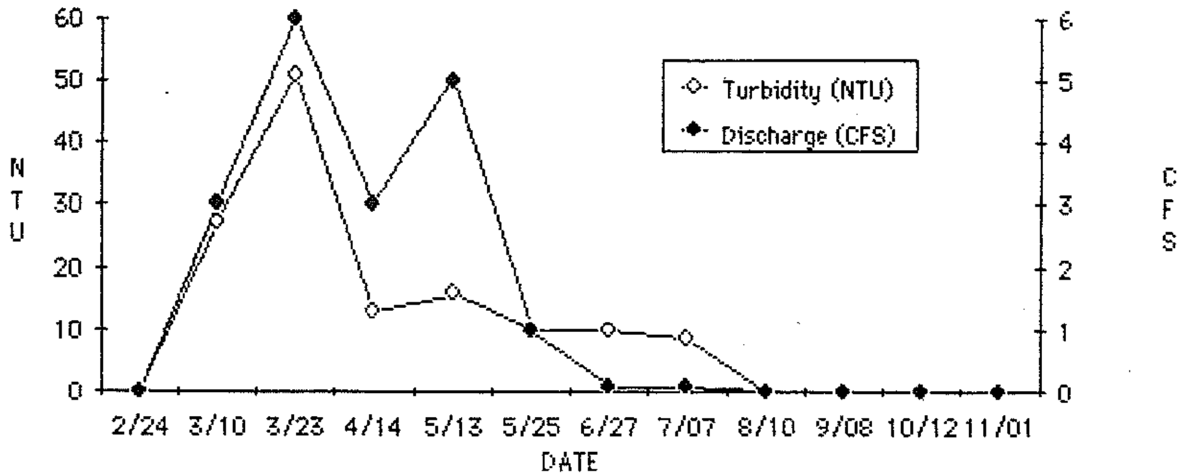


FIGURE 5 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR SALLY ANN CR DURING 1988

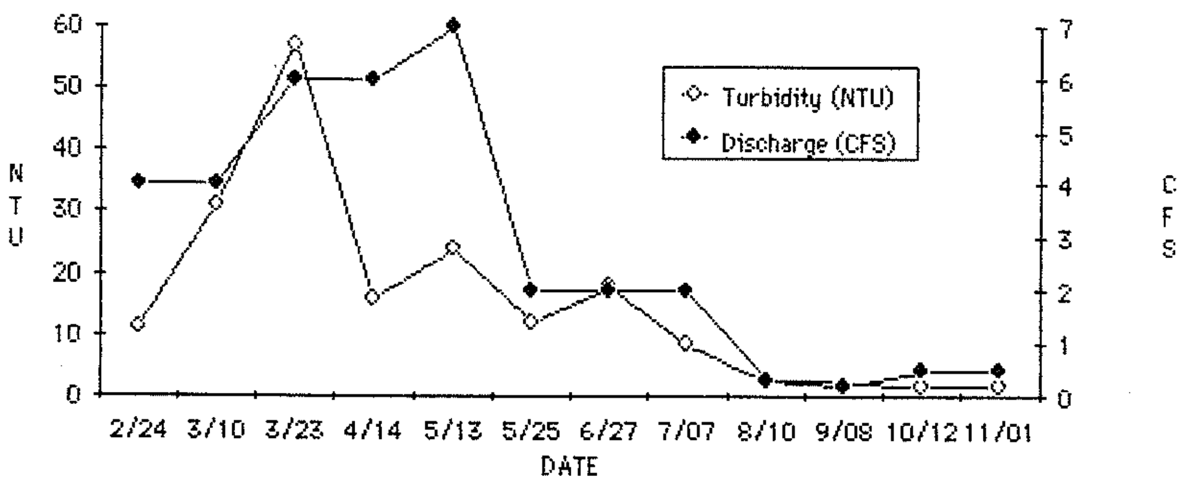


FIGURE 6 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR FOREST BOUNDARY DURING 1988

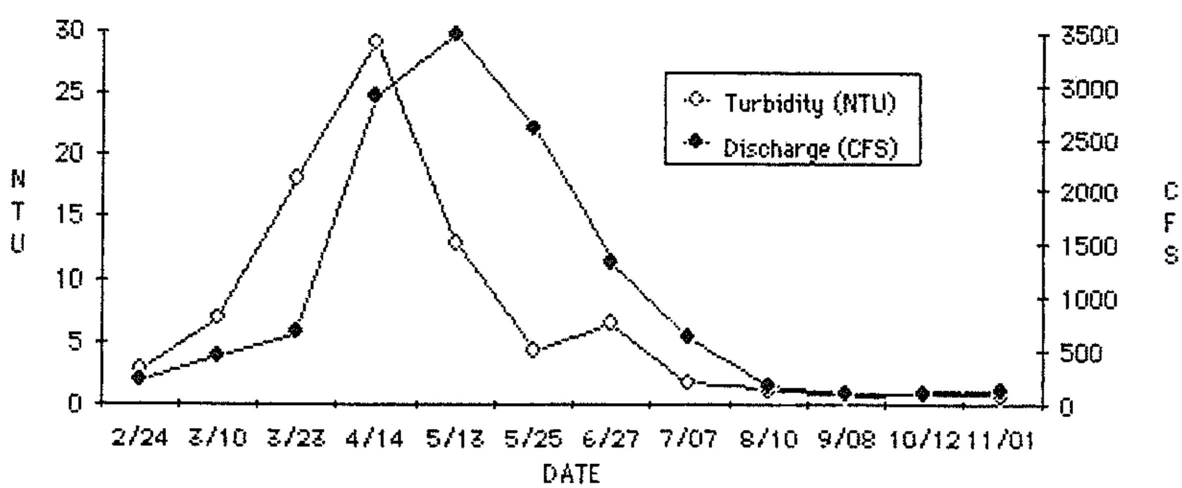


FIGURE 7 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR EARTHQUAKE CR DURING 1988

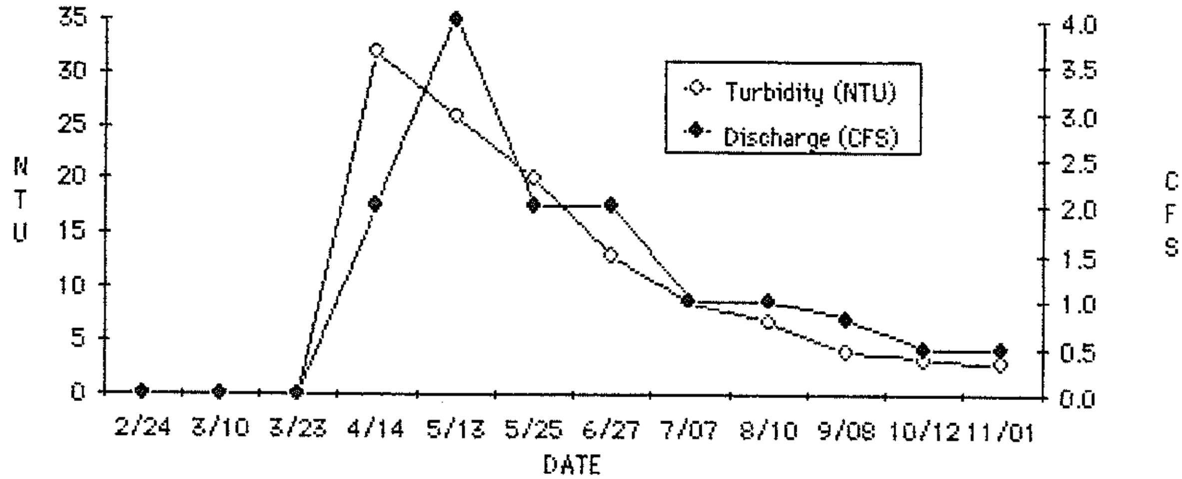


FIGURE 8 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR MILL CR DURING 1988

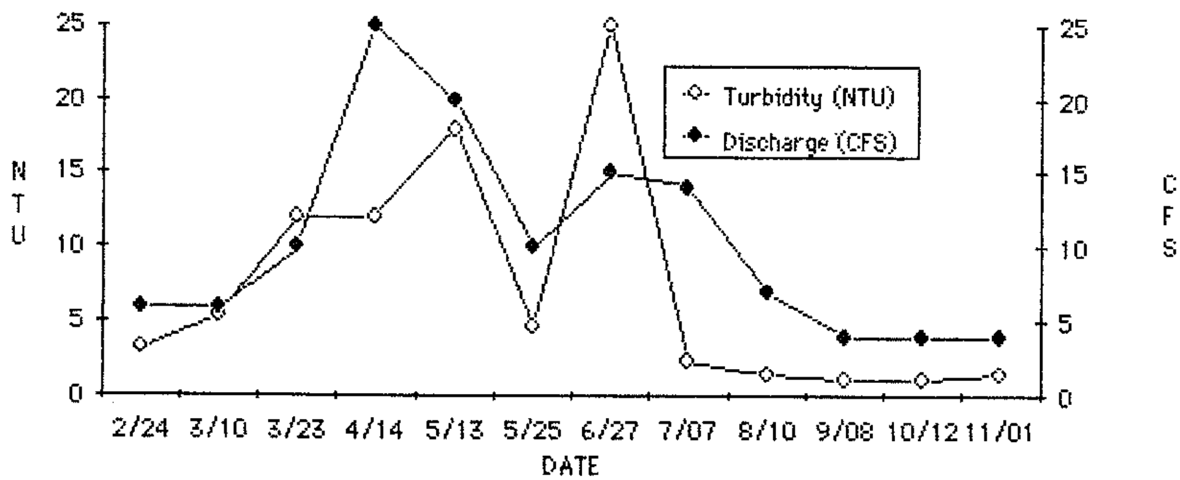


FIGURE 9 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR MEADOW CR DURING 1988

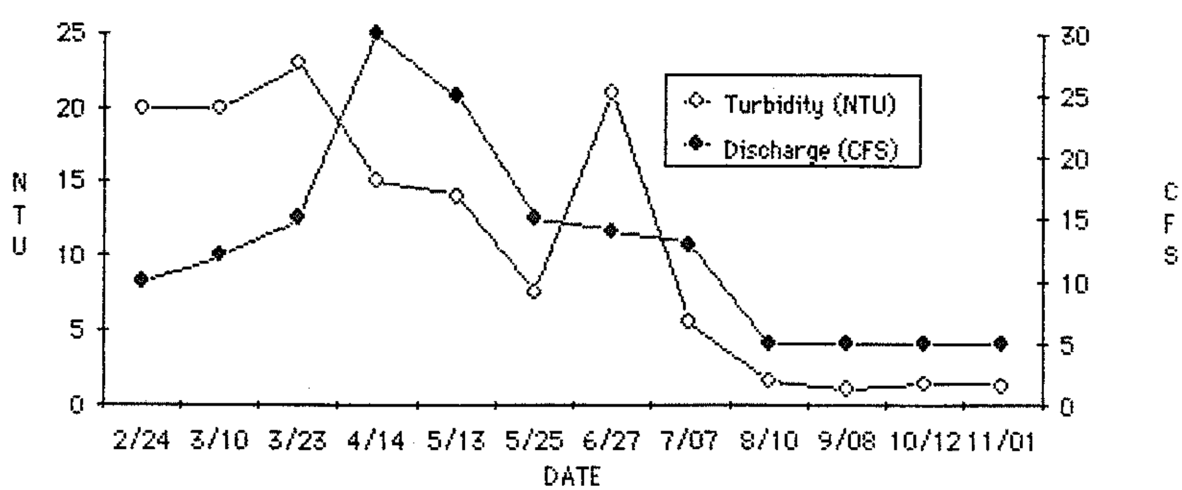


FIGURE 10 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR JOHNS CR DURING 1988

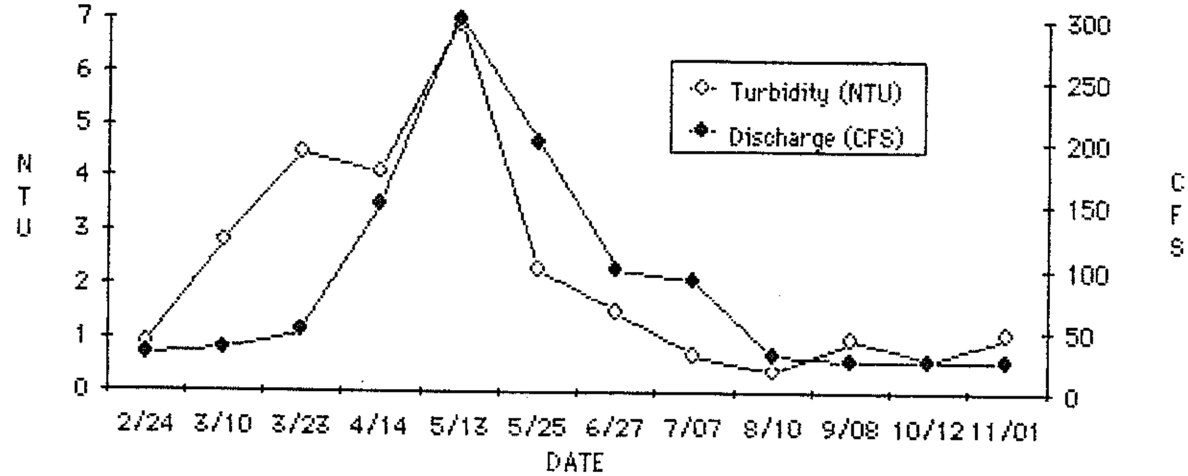


FIGURE 11 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR COUGAR CR DURING 1988

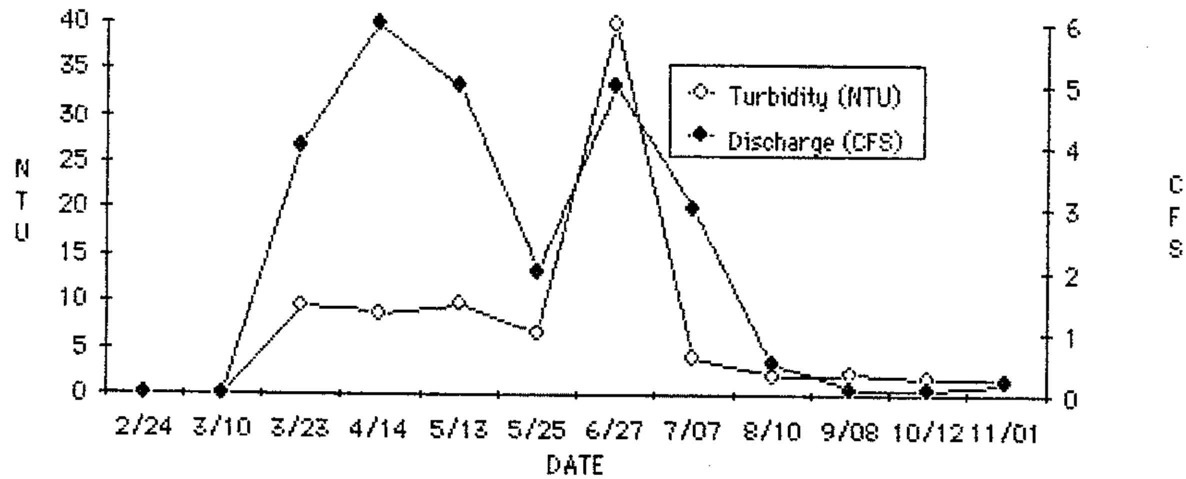


FIGURE 12 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR PEASLEY CR DURING 1988

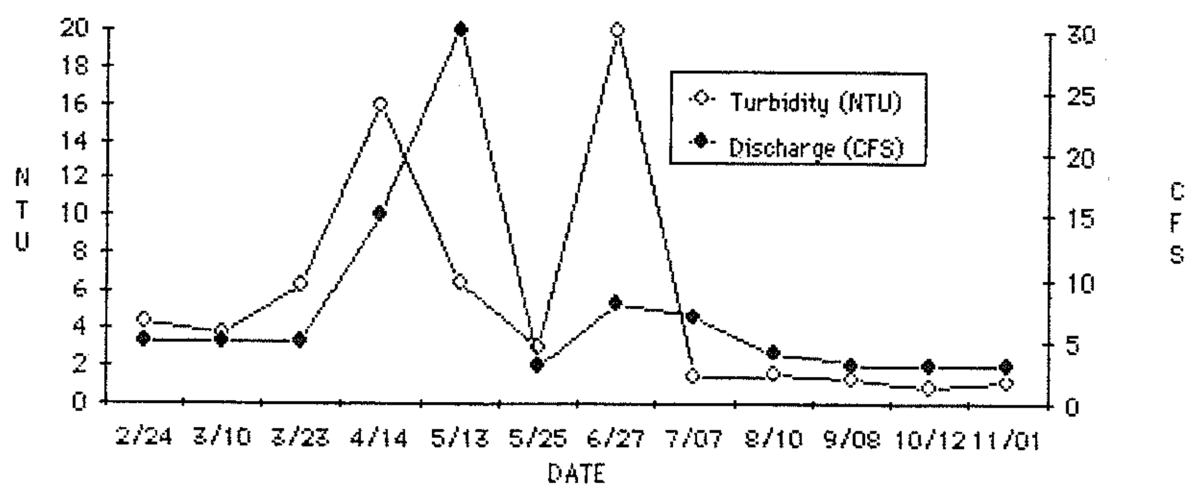


FIGURE 13 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR SILVER CR DURING 1988

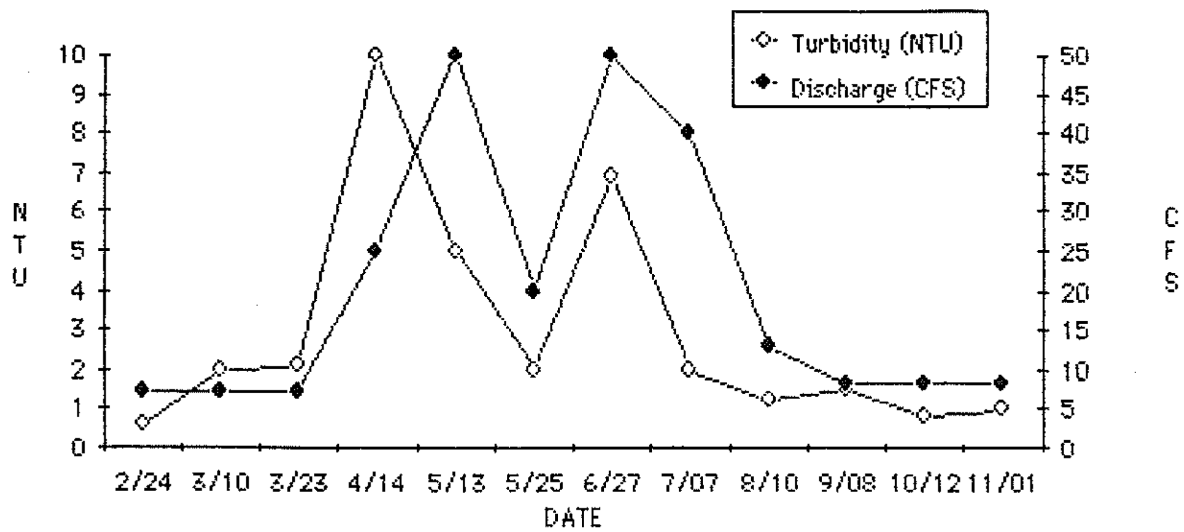


FIGURE 14 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR RAINEY DAY CR DURING 1988

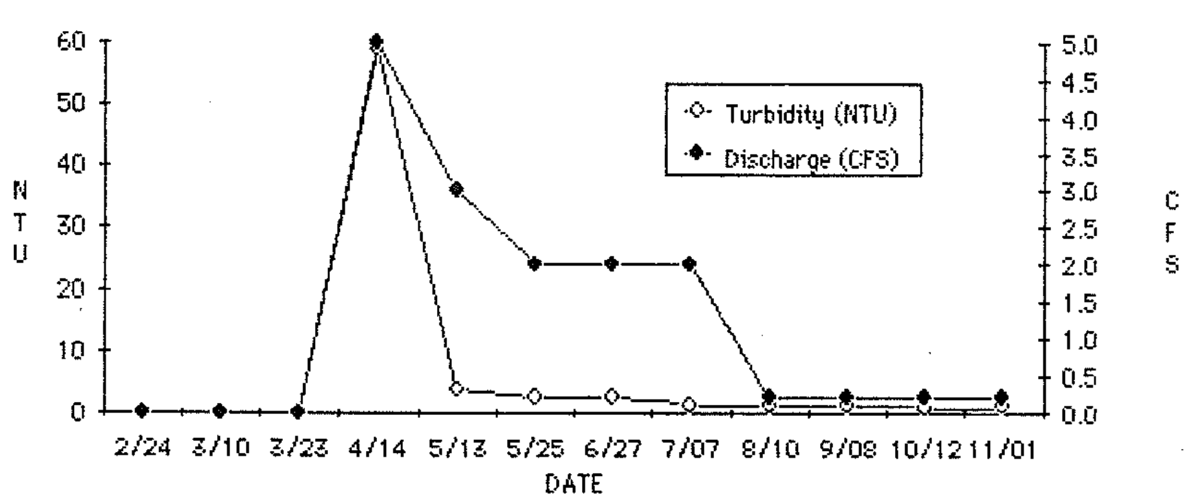


FIGURE15 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR LEGGETT CR DURING 1988

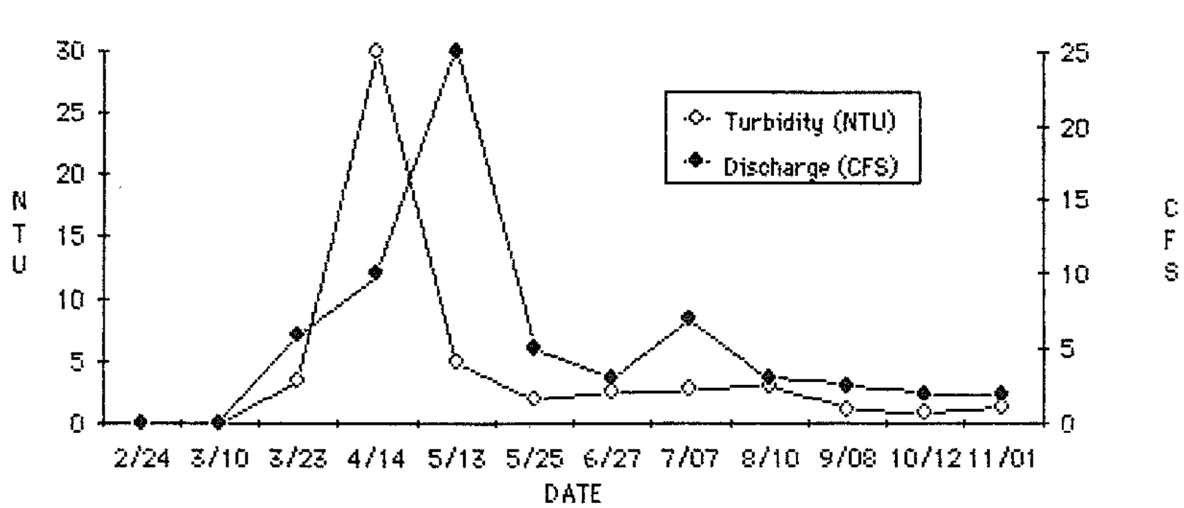


FIGURE 16 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR NEWSOME CR DURING 1988

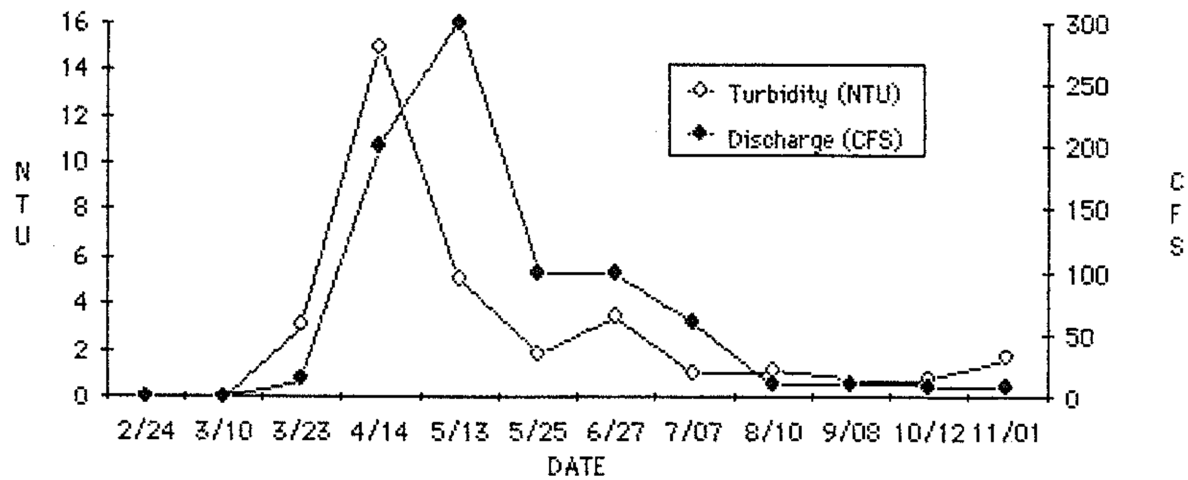


FIGURE 17 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR CROOKED RIVER DURING 1988

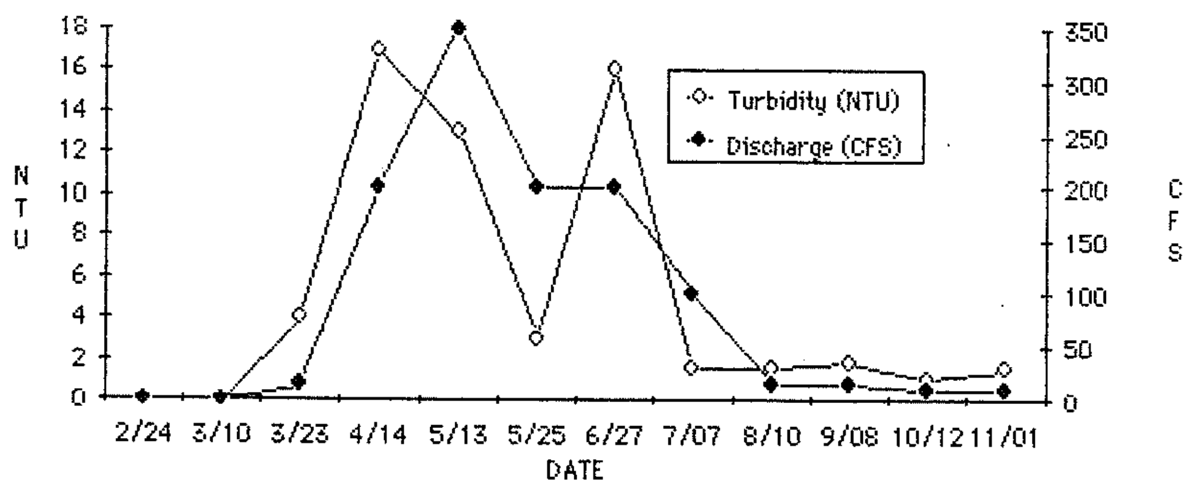


FIGURE 18 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR AMERICAN RIVER DURING 1988

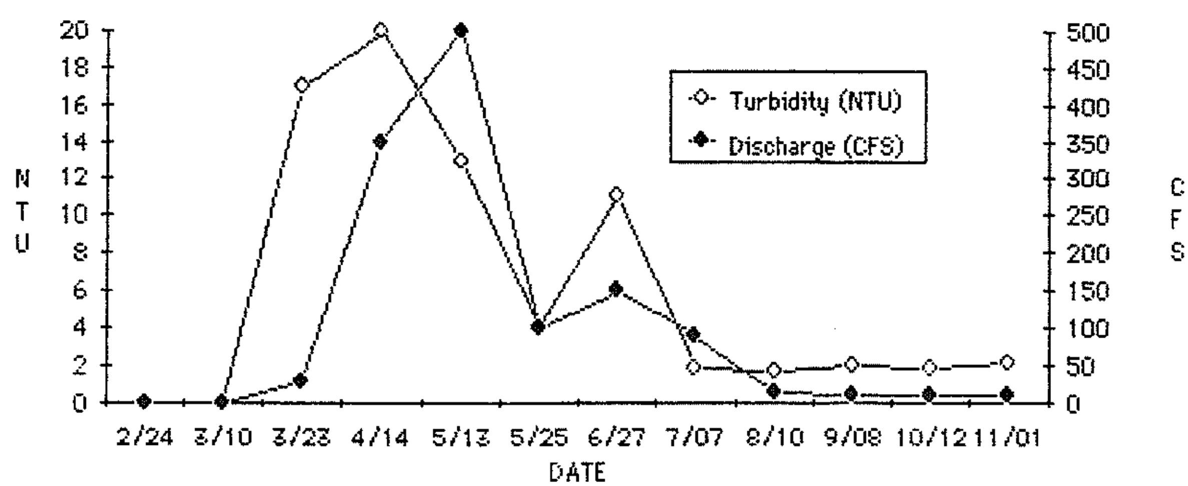
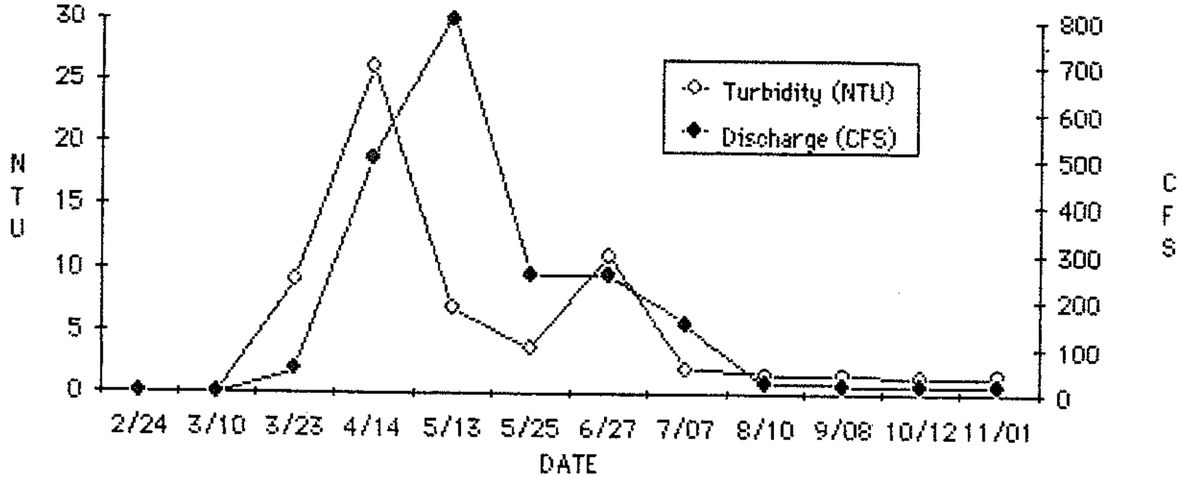


FIGURE 19 TURBIDITY (NTU) VS DISCHARGE (CFS) COMPARISON FOR RED RIVER DURING 1988



APPENDIX B

Turbidity vs Discharge Data

STA#	STATION	2/24 FLOW (cfs)	2/24 TURB NTU	3/10 FLOW	3/10 TURB	3/23 FLOW	3/23 TURB	4/14 FLOW	4/14 TURB	5/13 FLOW	5/13 TURB	5/25 FLOW	5/25 TURB	6/27 FLOW	6/27 TURB
1	Clwt/Stites	238.0	3.2	475.0	8.5	734.0	21.0	2920.0	37.0	3510.0	16.0	2600.0	4.3	1360.0	14.0
2	Cottonwood Cr	3.0	5.5	3.0	7.4	10.0	16.0	5.0	11.0	6.0	13.0	3.5	13.0	4.0	8.0
3	Three Mile Cr	2.0	2.3	2.0	8.7	7.0	29.0	3.0	11.0	4.0	18.0	3.0	15.0	4.0	344.0
4	Rabbit Cr	-	-	3.0	27.0	6.0	51.0	3.0	13.0	5.0	16.0	1.0	10.0	0.1	10.0
5	Sally Ann Cr	4.0	11.0	4.0	31.0	6.0	57.0	6.0	16.0	7.0	24.0	2.0	12.0	2.0	18.0
6	Forest Bdry	214.0	2.7	451.0	6.9	676.0	18.0	2886.0	29.0	3466.0	13.0	2581.0	4.3	1340.0	6.5
7	Earthquake Cr	-	-	-	-	-	-	2.0	32.0	4.0	26.0	2.0	20.0	2.0	13.0
8	Mill Cr	6.0	3.2	6.0	5.4	10.0	12.0	25.0	12.0	20.0	18.0	10.0	4.7	15.0	25.0
9	Meadow Cr	10.0	20.0	12.0	20.0	15.0	23.0	30.0	15.0	25.0	14.0	15.0	7.5	14.0	21.0
10	Johns Cr	30.0	0.9	35.0	2.8	50.0	4.5	150.0	4.1	300.0	6.9	200.0	2.3	100.0	1.5
11	Cougar Cr	-	-	-	-	4.0	9.4	6.0	8.7	5.0	9.8	2.0	6.5	5.0	40.0
12	Peasley Cr	5.0	4.3	5.0	3.7	5.0	6.3	15.0	16.0	30.0	6.5	3.0	3.0	8.0	20.0
13	Silver Cr	7.0	0.6	7.0	2.0	7.0	2.1	25.0	10.0	50.0	5.0	20.0	2.0	50.0	6.9
14	Rainey Day Cr	-	-	-	-	-	-	5.0	59.0	3.0	4.0	2.0	2.5	2.0	2.4
15	Leggett Cr	-	-	-	-	6.0	3.5	10.0	30.0	25.0	5.0	5.0	1.9	3.0	2.6
16	Newsome Cr	-	-	-	-	15.0	3.1	200.0	15.0	300.0	5.0	100.0	1.8	100.0	3.5
17	Crooked R	-	-	-	-	15.0	4.0	200.0	17.0	350.0	13.0	200.0	3.0	200.0	16.0
18	American R	-	-	-	-	30.0	17.0	350.0	20.0	500.0	13.0	100.0	4.0	150.0	11.0
19	Red River	-	-	-	-	50.0	9.0	500.0	26.0	800.0	7.0	250.0	3.6	250.0	11.0
	Min.	2.0	0.6	2.0	2.0	4.0	2.1	2.0	4.1	3.0	4.0	1.0	1.8	0.1	1.5
	Max.	238.0	20.0	475.0	31.0	734.0	57.0	2920.0	59.0	3510.0	26.0	2600.0	20.0	1360.0	344.0
	Average	51.9	5.4	91.2	11.2	96.8	16.8	386.4	20.1	495.3	12.3	321.0	6.4	190.0	30.2

STA#	STATION	7/7 FLOW	7/7 TURB	8/10 FLOW	8/10 TURB	9/8 FLOW	9/8 TURB	10/12 FLOW	10/12 TURB	11/1 FLOW	11/1 TURB
1	Clwt/Stites	645.0	2.5	187.0	1.3	108	1.2	112	1.0	147	0.7
2	Cottonwood Cr	4.0	5.6	2.0	2.0	2.0	3.5	3.0	2.0	3.0	6.0
3	Three Mile Cr	2.0	9.3	1.5	2.3	1.5	2.3	1.5	1.5	1.5	1.6
4	Rabbit Cr	0.1	8.5	0.0	-	0.0	-	0.0	-	0.0	-
5	Sally Ann Cr	2.0	8.5	0.3	2.4	0.2	2.3	0.5	1.5	0.5	1.7
6	Forest Bdry	629.0	1.7	179.0	1.1	100	0.7	102	1.0	137	0.7
7	Earthquake Cr	1.0	8.5	1.0	6.9	0.8	3.9	0.5	3.3	0.5	2.9
8	Mill Cr	14.0	2.4	7.0	1.5	4.0	1.1	4.0	1.2	4.0	1.5
9	Meadow Cr	13.0	5.5	5.0	1.6	5.0	1.0	5.0	1.4	5.0	1.3
10	Johns Cr	90.0	0.7	30.0	0.4	25.0	1.0	25.0	0.6	25.0	1.1
11	Cougar Cr	3.0	4.0	0.5	2.1	0.1	2.2	0.1	1.6	0.2	1.5
12	Peasley Cr	7.0	1.5	4.0	1.6	3.0	1.3	3.0	0.8	3.0	1.2
13	Silver Cr	40.0	2.0	13.0	1.2	8.0	1.5	8.0	0.8	8.0	1.2
14	Rainey Day Cr	2.0	1.3	0.2	1.3	0.2	1.1	0.2	0.8	0.2	1.1
15	Leggett Cr	7.0	2.7	3.0	3.0	2.5	1.1	2.0	0.8	2.0	1.3
16	Newsome Cr	60.0	1.0	10.0	1.1	10.0	0.7	9.0	0.8	9.0	1.7
17	Crooked R	100.0	1.5	15.0	1.5	15.0	1.8	10.0	1.0	10.0	1.5
18	American R	90.0	1.9	15.0	1.7	9.0	2.0	9.0	1.8	10.0	2.1
19	Red River	150.0	1.9	20.0	1.5	17.0	1.5	15.0	1.2	15.0	1.4
	Min.	0.1	0.7	0.0	0.4	0.0	0.7	0.0	0.6	0.0	0.7
	Max.	645.0	9.3	187.0	6.9	108	3.9	112	3.3	147	6.0
	Average	97.8	3.7	26.0	1.9	16.4	1.7	16.3	1.3	20.0	1.7