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2 GEOLOGICAL SURVEY 2

3 SCOUR AND FILL IN A STREAM CHANNEL,

EAST FORK RIVER, WESTERN WYOMING 3

5 By Edmund D. Andrews 5

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## METRIC CONVERSION TABLE

Inch-pound units used in this report may be expressed as metric units by use of the following conversion factors:

<i>Multiply inch-pound unit</i>	<i>By</i>	<i>To obtain metric unit</i>
inch	25.40	millimeter (mm)
foot (ft)	0.3048	meter
foot per second	0.3048	meter per second
square foot (ft <sup>2</sup> )	0.0929	square meter
cubic foot (ft <sup>3</sup> )	0.02832	cubic meter
cubic foot per second (ft <sup>3</sup> /s)	0.02832	cubic meter per second
mile	1.609	kilometer
square mile	2.590	square kilometer
pound per second (lb/s)	0.45	kilogram per second
pound per foot per second [(lb/ft)/s]	1.49	kilogram per meter per second
ton	0.9072	metric ton



# SCOUR AND FILL IN A STREAM CHANNEL, EAST FORK RIVER, WESTERN WYOMING

By Edmund D. Andrews

## ABSTRACT

Frequent soundings of 11 cross sections located on the East Fork River, western Wyoming, during a spring flood revealed two sequences of channel scour and fill. All sections either scoured or filled at the flood crests relative to their low flow condition. The sections which scoured at high flow (called scouring sections) generally tended to fill at low flow. Conversely, the sections which filled at high flow (called filling sections) generally tended to scour at low flow. The critical discharge at which the character of a section changed from scouring to filling or vice-versa was approximately the bankfull discharge. Therefore, at any discharge except bankfull, some sections were accumulating bed material (fill), while others were being depleted of bed material (scour).

The mean at-a-station hydraulic geometry of the East Fork River agrees with the theoretical minimum-variance hydraulic geometry. Thus, on the average, the East Fork River accommodates a change in discharge by mutually minimizing the adjustment of velocity, width, and depth. The hydraulic geometry of every cross section, however, deviated from the mean of the reach, and the associated sequence of scour and fill was a consequence of the deviation. The scouring sections had larger velocity and smaller width and roughness hydraulic exponents than the mean of the reach. Consequently, the sediment-transport rate varied more rapidly with discharge in the scouring sections than the mean of the reach. Hence, these sections had relatively large sediment-transport rates and scoured when discharge exceeded bankfull, and relatively small sediment-transport rates and filled when discharge was less than bankfull. Conversely, the filling sections had smaller velocity and larger width and roughness hydraulic exponents than the mean of the reach. Consequently, the sediment-transport rate varied with discharge in the filling sections less rapidly than the mean of the reach. These sections had relatively small sediment-transport rates and filled when discharge exceeded bankfull, and relatively large sediment-transport rates and scoured when discharge was less than bankfull.

## INTRODUCTION

The hydraulic characteristics of a self-formed alluvial channel are not uniquely determined by its water and sediment discharge. That is, there are more dependent variables--velocity, width, depth, roughness, and slope--than there are independent variables and relations linking them. Langbein (1964) contended, however, that an alluvial channel tends toward a hydraulic condition in which a change in the independent variables is distributed among the dependent variables in such a way as to minimize the change required by any one variable. This hydraulic condition was shown to be the most probable and agrees well with the empirical mean.

An alluvial stream is constantly remaking its channel as it meanders across its flood plain. Periodic channel features such as bends, straight reaches, riffles, and pools, as well as chance encounters with random features such as differences in bank material, vegetation, or an outcrop of resistant bedrock, may constrain the free adjustment of one or more hydraulic variables and thus prevent the hydraulic characteristics of a particular reach from adjusting to the most probable condition. Consequently, through any appreciable length of channel, significant variation in channel width, depth, roughness, slope, and velocity is found. Each section of channel, however, appears to be in quasi-equilibrium with the imposed water and sediment discharge.

As a result of the variation in hydraulic characteristics, the transport rate of bedload sediment may not be the same for all cross sections at a given discharge. When there is a difference between the inflow and outflow of the bed material in a reach, bed material will either be stored or depleted and the mean bed elevation will change accordingly. Such changes in bed elevation during the passage of a flood are generally termed scour and fill. Scour and fill are not solely a redistribution of bed material along the channel affected by longitudinal differences in the bedload-transport rate. They are also important short-term hydraulic adjustments that tend to smooth out irregularities and thereby maintain the channel in quasi-equilibrium.

Scour and fill are frequently observed at streamflow-gaging stations and bridge crossings; however, little is known about the process or the hydraulics controlling it. Because the measurement of channel hydraulic characteristics is normally limited to a cross section rather than an extensive length of channel, it is not known whether scour and fill are localized phenomena or are more or less continuous along the stream. Similarly, the hydraulic characteristics associated with scour and fill are poorly understood. This paper reports on an investigation of scour and fill as a hydraulic adjustment to the variation in discharge and sediment load.

Appreciation is expressed to Luna B. Leopold for many thoughtful discussions and for providing the unique measurements of bedload transport which made these investigations possible. W. W. Emmett and C. F. Nordin of the U.S. Geological Survey provided most of the field equipment, as well as some data.

#### Previous Observations of Scour and Fill

Substantial channel scour is observed at some streamflow-gaging stations as flood discharge increases. In a few instances, 60 percent or more of the increase in depth is due to scouring of the river bed. Perhaps the best known examples of channel scour are those documented for the gaging stations on the Colorado River at the Grand Canyon, Ariz., and on the Rio Grande at Bernalillo, N. Mex. Leopold and Maddock (1953a) discussed in considerable detail the at-a-station hydraulic geometries and the associated patterns of channel scour and fill at these gaging stations. An important feature of the phenomena at the Grand Canyon gaging station is that the cross section filled as the discharge increased from low flow, at approximately 12,000 ft<sup>3</sup>/s, and then scoured continuously as the discharge increased to the flood crest at approximately 120,000 ft<sup>3</sup>/s. After the flood crest, the section continued to scour slowly, so that the mean bed elevation at a

given discharge after the flood crest was significantly below the mean bed elevation at the same discharge before the flood crest. When the flood had subsided, the cross section began to fill, and by the following spring, the bed elevation had returned to the preflood level.

A slightly different sequence of scour and fill was observed at the Bernalillo gaging station. No fill was observed prior to the flood crest. Instead, the section scoured progressively as discharge increased and the maximum depth of scour occurred at the flood crest. As discharge decreased, the section filled, so that by the time the flood had subsided, the mean bed elevation had returned to nearly the preflood level.

In considering river-bed scour in a reach of the middle Rio Grande, including the Bernalillo gaging station, Lane and Borland (1954) contended that the depth of scour typically observed at gaging-station cross sections could not be representative of any significant length of channel. They noted that the average annual volume of material entering the Elephant Butte Reservoir downstream from the gaging stations corresponded to less than 0.1 foot of material removed from the channel upstream; whereas, the average depth of scour at the gaging stations was nearly 5 feet. Therefore, the material scoured from one cross section must be deposited as fill in a cross section some short distance downstream. In particular, they believed that channel scour was limited to contracted reaches, and inferred that the scoured material would be deposited where the channel widened. Channel scour appears to be more common than it really is, they asserted, because gaging stations are usually located in contracted reaches.

Previously, Leopold and Maddock (1953b) had shown that the suspended-sediment load of the middle Rio Grande increased downstream between tributaries. Furthermore, they showed that the river bed was generally at a lower elevation after the spring flood. Therefore, they concluded that some scour, though not necessarily as much as observed at the gaging stations, occurred throughout long reaches of the channel.

Uncertainty over channel behavior arises because most of our information regarding rivers is collected at isolated cross sections. Only limited data are normally collected about the hydraulic geometry of the immediate reach near a gaging station. Even fewer data are collected concerning the channel more than a few channel widths upstream or downstream from the gaging station. Emmett and Leopold (1965) discussed three streams--one ephemeral and two perennial--for which channel scour and fill had been studied at several cross sections. All three studies indicate that scour was more or less continuous through the study reaches at flood flows, and therefore was independent of channel configuration, riffles and pools, straight reaches, and bends.

The Arroyo de los Frijoles is an ephemeral sand-bedded channel near Santa Fe, N. Mex. (Leopold and others, 1966). Scour chains installed at 51 cross sections showed that scour occurred throughout a reach of 6 miles during a flood. Scour chains are a simple and efficient method to record the maximum depth of scour through a reach of channel; however, they have a particular drawback. As the authors noted, "The observations are deficient in not showing what was happening in the reach at any one instance of time. Therefore, one cannot be sure that scour at some cross sections was not accompanied by fill at others and then



the process reversed at a different discharge." Some investigators, notably Colby (1964b), believed that the maximum depth of scour recorded by scour chains is not always indicative of a change in the mean bed elevation of the cross section. Lateral migration of sand bars and anti-dunes (Foley, 1975) have been suggested as possible explanation for the observed depth and longitudinal continuity of the channel scour.

Emmett and Leopold (1965) also discussed data from two perennial streams, the Popo Agie River near Hudson, Wyo., and the Rio Grande del Ranchos near Talpa, N. Mex. Their data were obtained at cross sections surveyed once at high flow in the spring and again during low flow later in the summer. A comparison of the two surveys showed that the mean bed elevation through the reach was generally lower at high flow than at low flow. As they had observed previously on the Arroyo de los Frijoles, the depth and continuity of scour did not appear to be associated with channel configuration or width of the cross sections.

### Study Approach

The purpose of this study was to describe the sequence of scour and fill during a flood at several cross sections, located every few channel widths along a reach of stream. Data also were collected on the hydraulic characteristics of each section in an attempt to relate scour and fill to specific flow conditions.

Luna B. Leopold planned and arranged for the construction of a bedload trap located on the East Fork River near Boulder, Wyo. A description of its main features and 3 years of data have been published by Leopold and Emmett (1976). In order to utilize these unique measurements, a study reach was selected for this investigation in the vicinity of the bedload trap. Because scour and fill are a local depletion and accumulation of bed material, knowledge of the bedload-sediment discharge and its variation along the channel is essential to an understanding of the process.

The East Fork River is a major tributary of the Green River, and drains approximately 194 square miles along the southwest flank of the Wind River Mountains. The study area lies close to the mountain front within a belt of Pleistocene outwash terraces (fig. 1). The East Fork River has a typical snowmelt runoff with strong diurnal fluctuations and multiple seasonal peaks (fig. 2). The peak discharge of nearly 1,600 ft<sup>3</sup>/s in 1974 has a recurrence interval of approximately 5 years.

The East Fork River has a sinuous channel with large, prominent, sandy point bars. Medium to coarse sand is the predominant bed material, although gravel bars are important channel features. The streambanks are typically stratified with a basal member of gravel (median diameter=21-45 mm), overlain by sand, silt, and a thick grass sod. The gravel layer is poorly consolidated and therefore easily eroded where streamflow impinges upon the bank, especially along the outside of a bend. Although gravel constitutes approximately 25 percent of the channel bed, as will be discussed in detail later, medium to coarse gravel-sized material constitutes less than 8 percent of the bedload discharge of the East Fork River (W. W. Emmett, written commun., 1977).

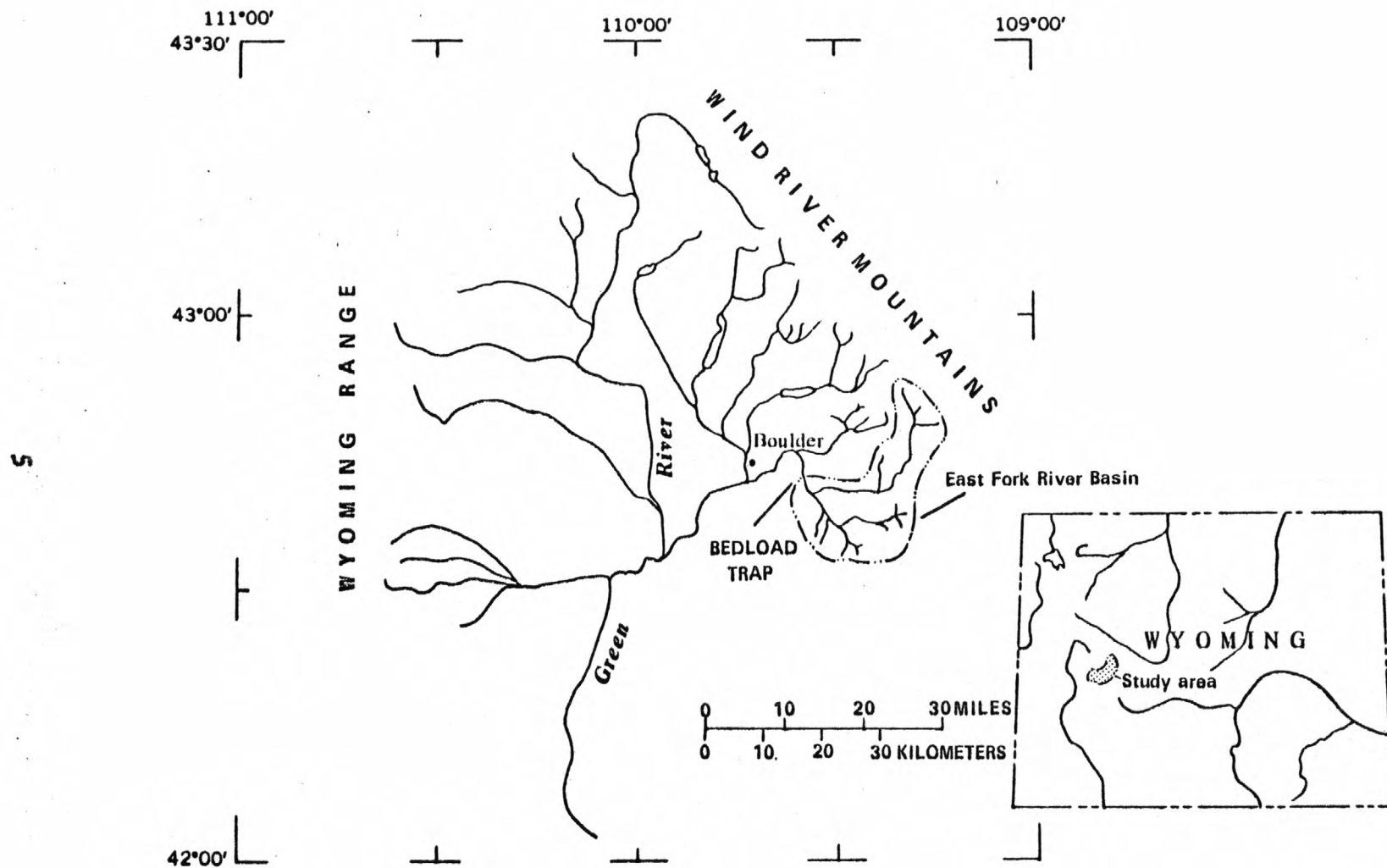


Figure 1.-- Location of study area.

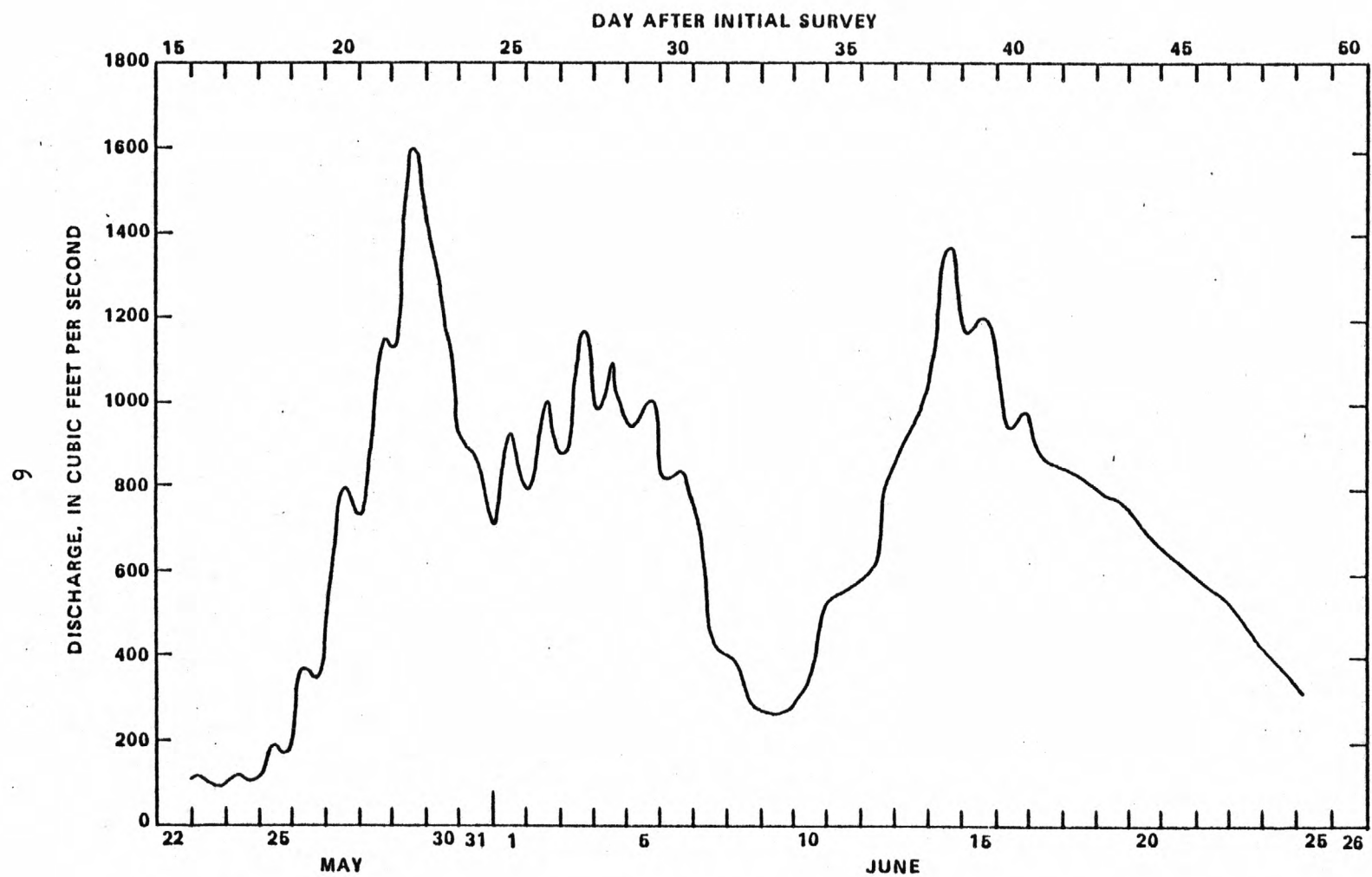


Figure 2.-- Snowmelt hydrograph at the bedload-trap gage, May - June, 1974.



Eleven cross sections were established in a study reach of approximately 1,400 feet (fig. 3). The cross sections were monumented and surveyed with rod and level on May 8, 1974, before the spring flood. At flood flow, it was impossible to wade the stream; therefore, headed cableways were installed at each section. The sections were sounded at stations spaced every 2 feet across the channel by measuring the depth of flow with a wading rod from a light aluminum boat attached to the cableway. The mean bed elevation of a cross section on a given day was computed by subtracting the flow depth from the water-surface elevation at each station, summing across the channel bed, and dividing by the number of stations. The accumulation of bed material in a section, as shown by an increase in the mean bed elevation with respect to the initial survey on May 8, 1974, was classified as fill. The depletion of bed material in a section, as shown by a decrease in the bed elevation with respect to the initial survey, was classified as scour. Most sections were sounded daily during periods when the daily peak discharges were changing rapidly, and every second or third day when the daily peaks were about equal. The cross-section survey data are summarized in the Basic Data section (table 4) at the back of the report.

A cantilever-type gage plate was installed at each cross section to determine water-surface elevation. The channel area was determined for each survey by planimetering a plot of the cross section. A stage-discharge relation was determined for each cross section by correlating the stage at each section with discharge measured at the road bridge. Because the cross-sectional area, width, discharge, and slope were known, it was possible to compute the hydraulic geometry of each cross section.

An approximation regarding overbank flow was made so that the hydraulic characteristics of the sections could be determined for discharges exceeding the bankfull stage of 820 ft<sup>3</sup>/s. At the flood crest, the flood plain was covered to a depth of a foot or more. By and large, however, this was standing water, with nearly the entire discharge flowing between the tops of the channel banks. Hence, the hydraulic geometry for each cross section has been calculated from the cross-sectional area and width of flowing water, using the entire discharge as measured at the road bridge where the flow was confined. In general, the interface between flowing and standing water was within the projection of the banks above the surface of the flood plain.

The water-surface slope through the study reach was surveyed on 17 occasions, covering the entire range of flood discharges from 40 to 1,600 ft<sup>3</sup>/s. Total-energy slopes between adjacent cross sections were computed for each survey and are summarized in the Basic Data section (table 5) at the back of the report. The mean energy slope ( $S_e$ ) through the entire study reach was computed for each survey by a least-squares method. Although the mean energy slope of the study reach varied from survey to survey, no systematic variation with discharge was apparent. The average mean energy slope through 1,360 feet of the study reach was 0.00084. This value differs somewhat from the mean value of 0.0007 measured by Leopold and Emmett (1977), through the 700-foot-long reach centered on the bedload trap.

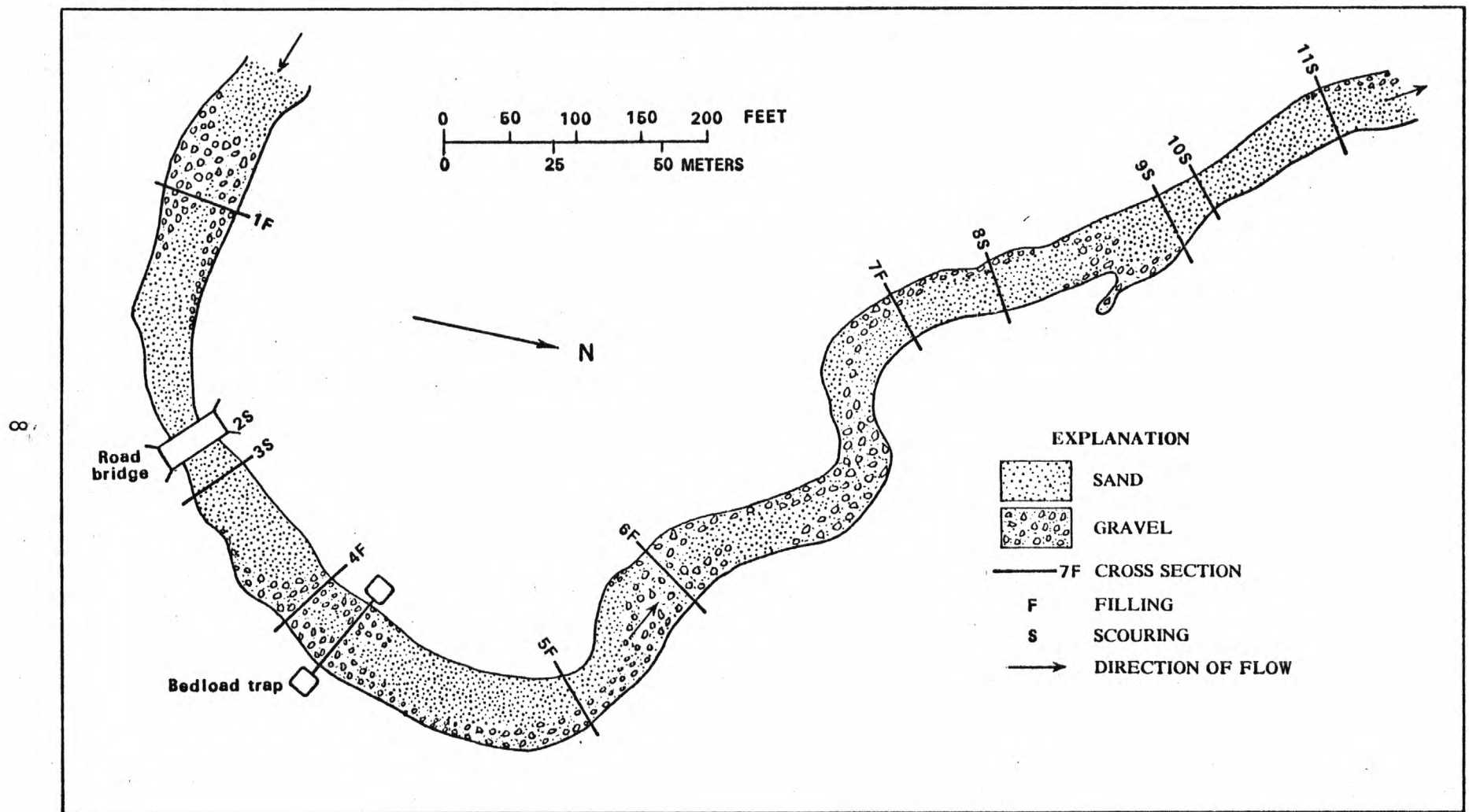


Figure 3.--Location of cross sections in the study reach.

## OBSERVATIONS OF SCOUR AND FILL

### Scouring Cross Sections

Significant scour was measured in 6 of the 11 cross sections at the major flood crests. These will be referred to as scouring sections, and are indicated by an "S" added to the section number. Two slightly different sequences of scour and fill were measured in the scouring sections during the 1974 flood. Sections 8S, 9S, 10S, and 11S responded to the flood discharge in a manner similar to that of the Colorado River at the Grand Canyon. Initially, the four sections filled as the discharge increased from 200 to approximately 800 ft<sup>3</sup>/s. As soon as the discharge exceeded the bankfull stage, these sections proceeded to scour. Data were not collected at section 8S during the first flood crest. However, because section 8S filled as the discharge increased to 800 ft<sup>3</sup>/s, and subsequently scoured during the second major flood crest, it has been associated with sections 9S, 10S, and 11S. Sections 2S and 3S responded to the flood discharge in a similar manner to that measured in the Rio Grande at Bernalillo, N. Mex. No fill was observed at any time in either section 2S or 3S during the 1974 flood. Both of these sections scoured progressively as discharge increased and then filled as discharge decreased.

The sequence of scour and fill measured at section 9S during the initial rise in stage on May 26-29 is illustrated in figure 4. The initial survey was made on May 8 at a discharge of 200 ft<sup>3</sup>/s, and the mean bed elevation on that day was chosen as the datum to which resurveys were compared. The discharge remained fairly constant until May 26, when a rapid rise in stage began (fig. 2). On May 27, the discharge had increased to 822 ft<sup>3</sup>/s, and section 9S had filled with sand. The increase in mean bed elevation was +0.16 foot. By the next day, May 28, the discharge had increased to 1,150 ft<sup>3</sup>/s, and section 9S had scoured to a gravel bed. The mean bed elevation on May 28 was -0.41 foot, relative to the May 8 survey. Cross sections 10S and 11S responded to the rapidly increasing discharge between May 26-29 in the same way as did section 9S.

The changes in mean bed elevation at sections 8S, 9S, 10S, and 11S, during the entire 1974 flood, are shown in figure 5, which is based on data in the Basic Data section (table 6) at the back of the report. Each resurvey of a section has been numbered by the consecutive days since the initial survey of May 8 (day 1). Two major flood crests occurred on May 29 (day 22), and June 14 (day 38). A smaller crest passed through the study reach on June 3 (day 27). The section records are complicated by varying degrees of hysteresis similar to that observed in the Colorado River at the Grand Canyon. The depth of scour or fill at a given discharge was frequently different during the increasing stage than it was during the decreasing stage. In spite of some obvious discrepancies, the sequence of scour and fill was generally similar in sections 8S, 9S, 10S, and 11S. After a slight net fill had accumulated as the initial increase in stage began, sections 8S, 9S, 10S, and 11S scoured as flood crests passed through the study reach. With the exception of section 8S, these sections then filled as discharge decreased. Three distinct hysteresis loops (days 1-24, 24-31, and 34-46) associated with the two major and one minor flood crests are shown in figures 5b (section 9S), c (section 10S), and d (section 11S). Each loop depicts scour as discharge increased and fill as discharge decreased.

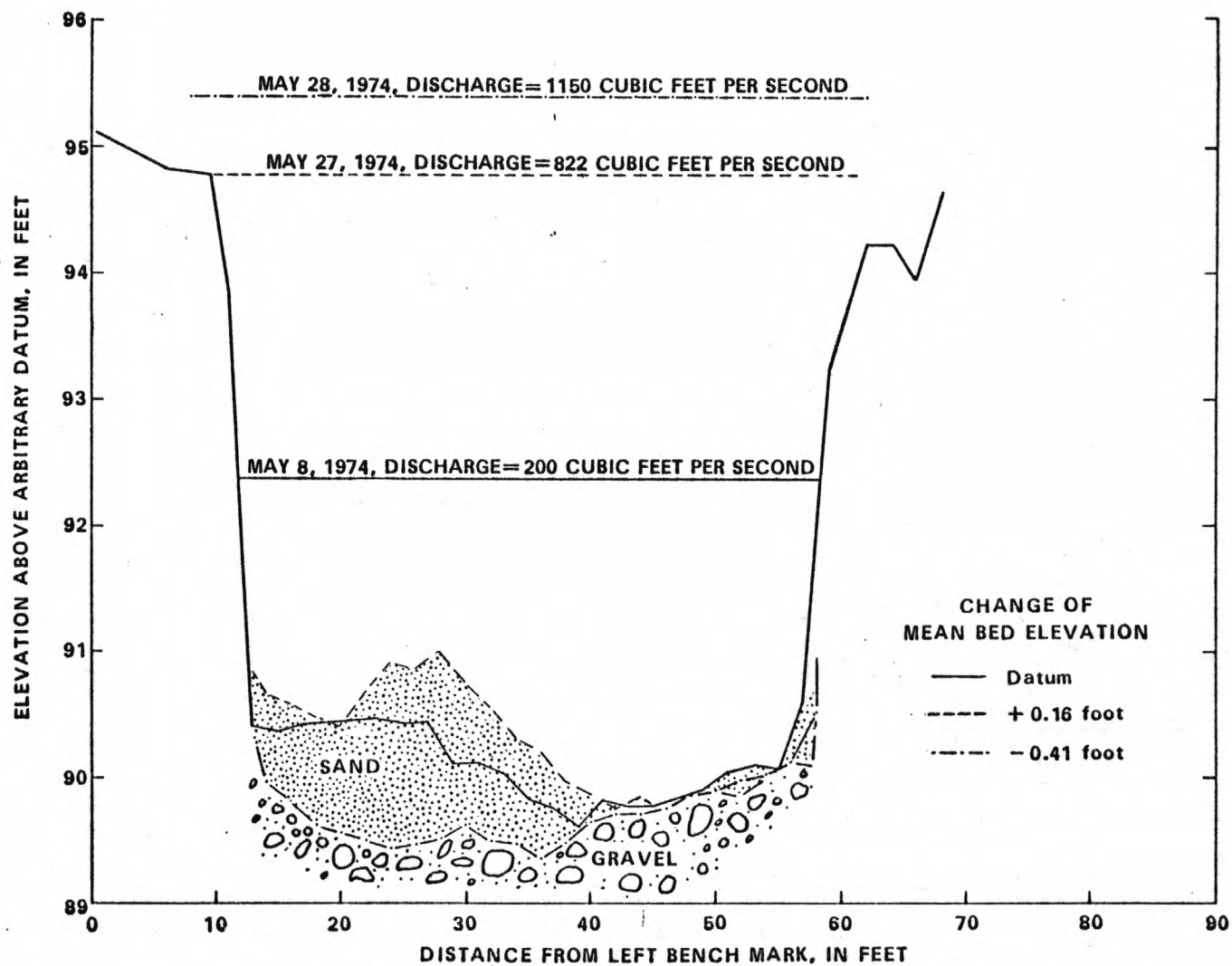


Figure 4.--Scouring cross section 9S. Data from tables 4 and 6.

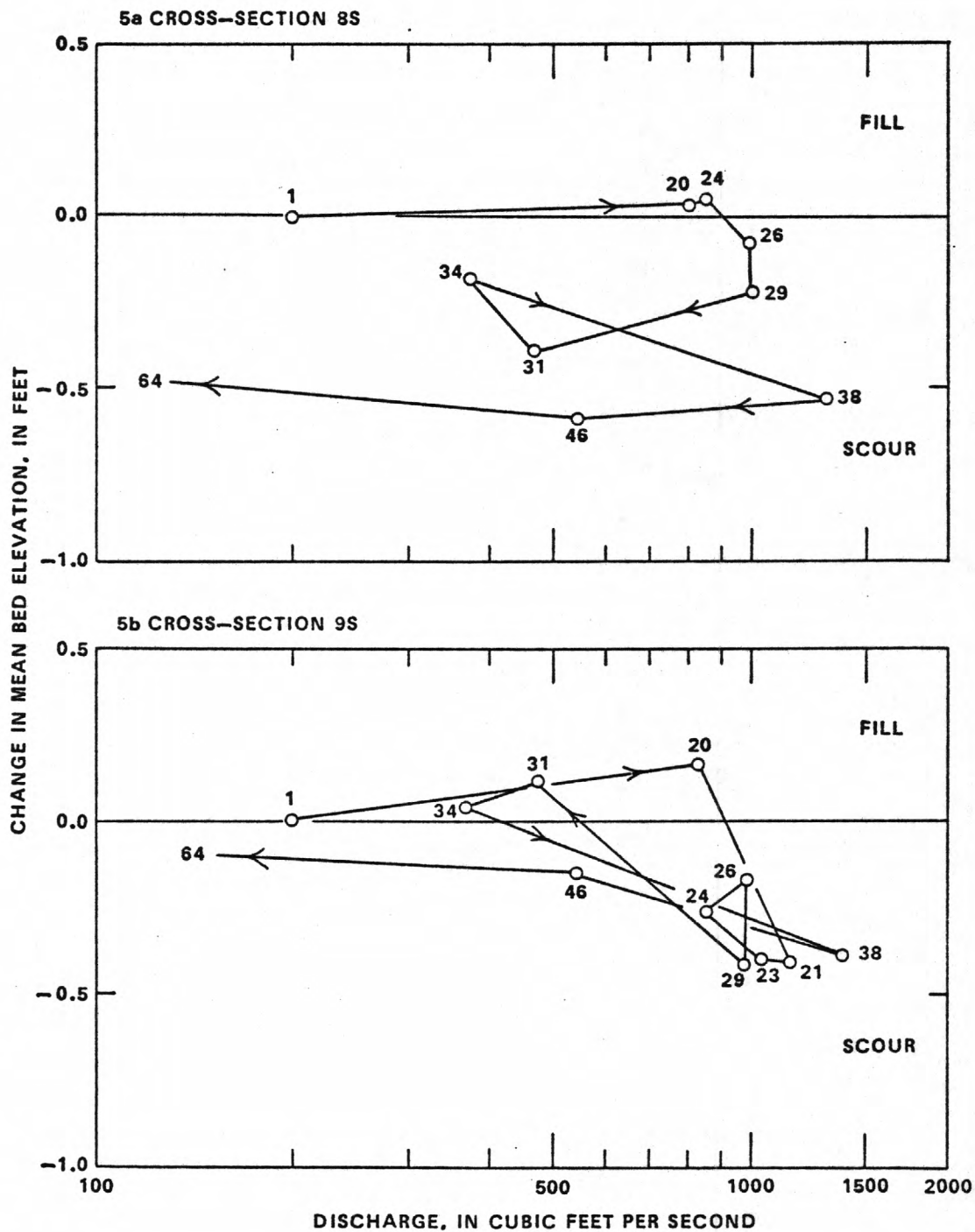


Figure 5a, b.--Variation in mean bed elevation of scouring cross sections 8S and 9S during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.

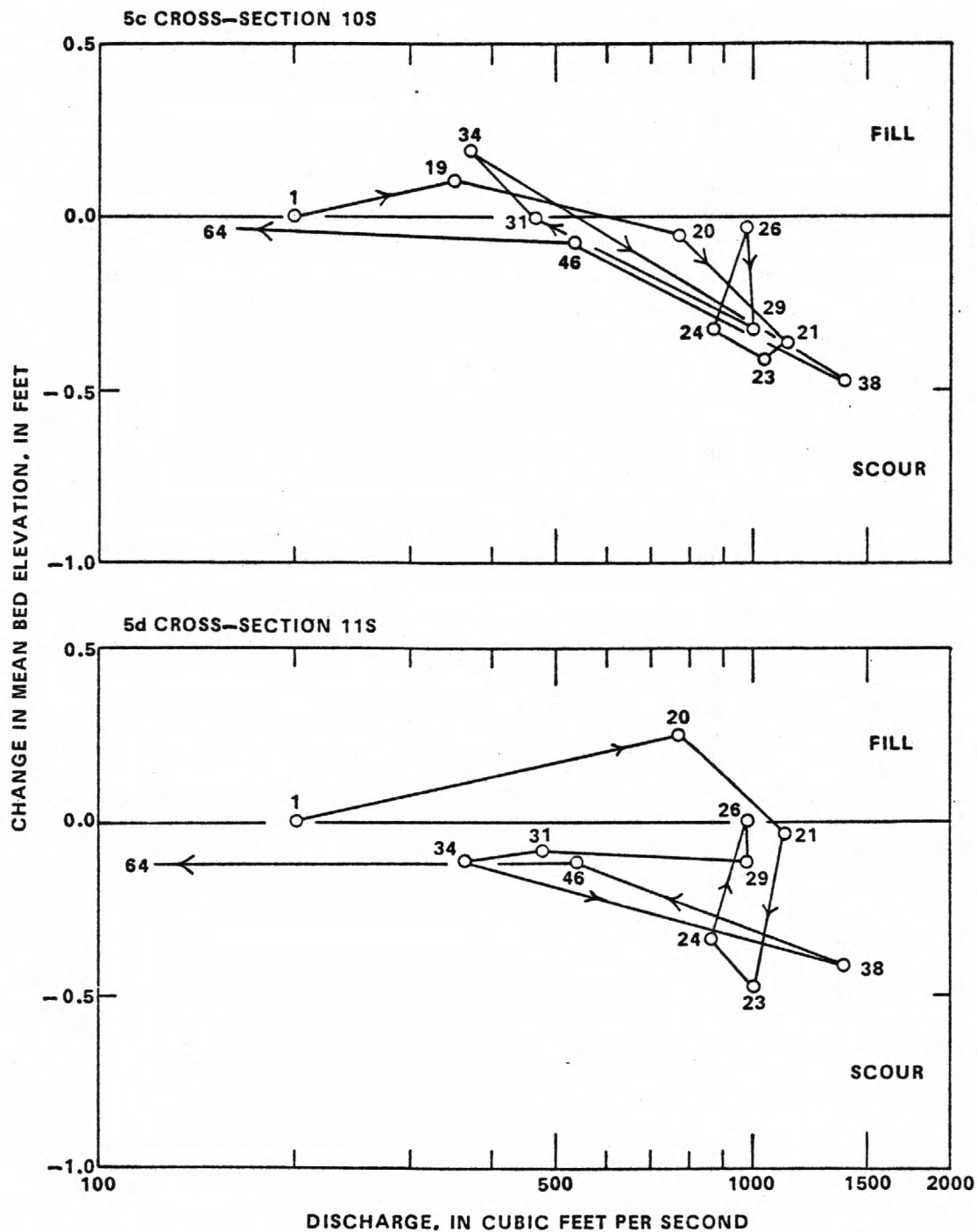


Figure 5c, d.--Variation in mean bed elevation of scouring cross sections 10S and 11S during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.



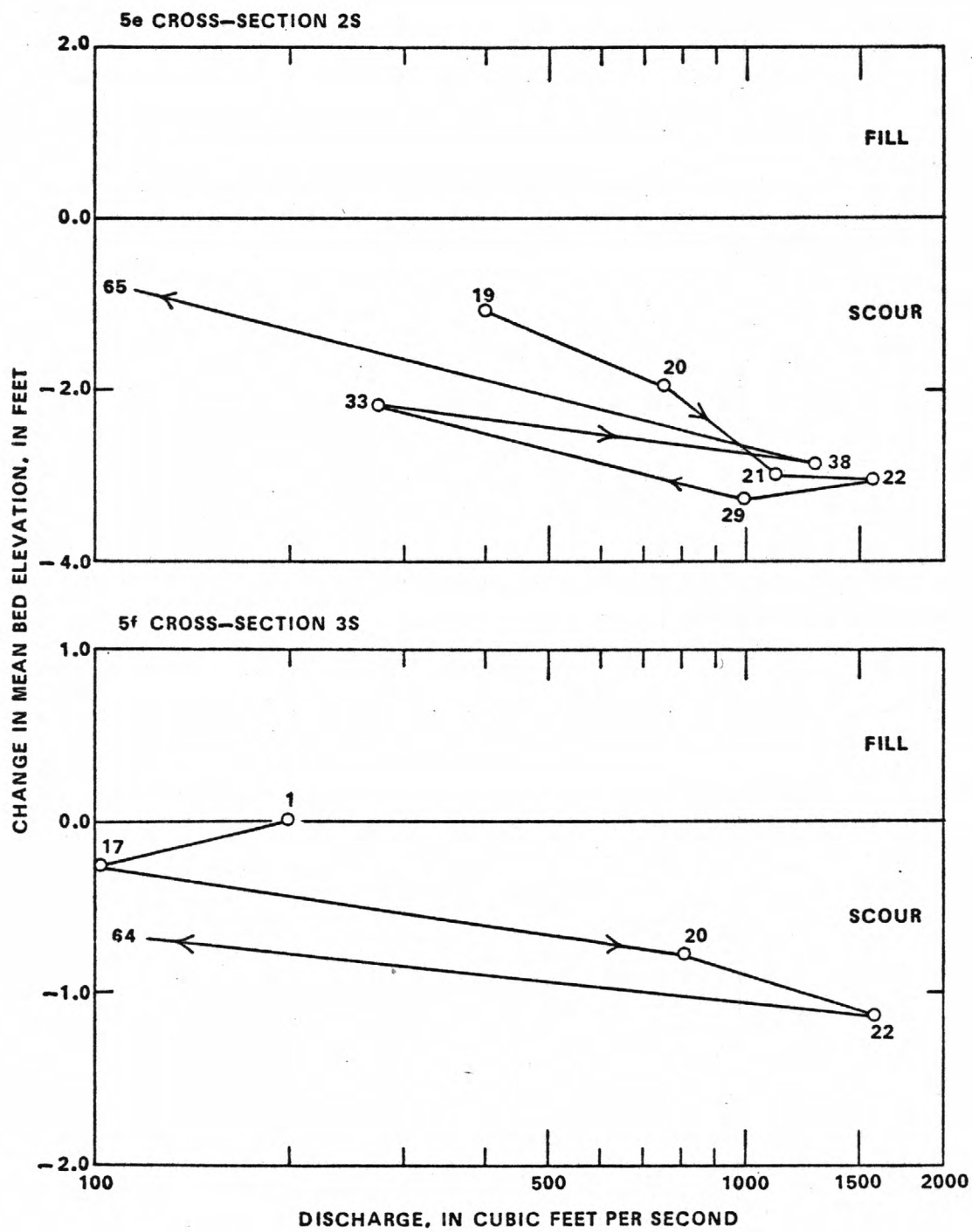


Figure 5e, f.—Variation in mean bed elevation of scouring cross sections 2S and 3S during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.

Section 2S was located on the downstream side of the road bridge and section 3S was located 25 feet farther downstream in a reach of channel modified by the construction of the bridge and a berm along the left bank. These sections had a slightly different sequence of scour and fill than that measured in the four self-formed scouring sections. The variation in mean bed elevation during the 1974 flood at section 2S is shown in figure 5e and at section 3S in figure 5f. No net fill was measured in either section. Both sections scoured progressively as discharge increased and then filled as discharge decreased.

### Filling Cross Sections

Significant fill was measured in 5 of the 11 sections of the flood crests. These will be referred to as filling sections and are indicated by an "F" added to the section number. The sequence of scour and fill in the filling sections was the inverse of that measured in the scouring sections. Sections 5F, 6F, and 7F scoured slightly as the discharge increased to bankfull stage and then filled as the flood crests passed through the study reach. Sections 1F and 4F filled progressively as discharge increased from low flow to the flood crests. In general, the filling sections scoured as discharge decreased.

The sequence of scour and fill measured at section 6F during the initial rise in stage is illustrated in figure 6. The section was first surveyed on May 8 at a discharge of  $200 \text{ ft}^3/\text{s}$  and the mean bed elevation on this day was chosen as the datum. On May 27, section 6F was sounded as the discharge crested at  $820 \text{ ft}^3/\text{s}$ . The channel bed had scoured slightly, and the mean bed elevation was  $-0.07$  foot below the May 8 survey. The predominance of gravel-size bed material in section 6F probably limited the depth of scour. The following day, May 28, section 6F was sounded again during a discharge of  $1,140 \text{ ft}^3/\text{s}$ , as shown in figure 6. This survey showed that an extensive fill of sand had accumulated against the right bank and the mean bed elevation was  $+0.27$  foot above that observed on May 8.

The variations of mean bed elevation measured at sections 1F, 4F, 5F, 6F, and 7F, during the entire spring flood, are shown in figure 7. The common characteristic of these sections was a net fill at discharges greater than  $820 \text{ ft}^3/\text{s}$ . The records, however, differ in other details. Sections 5F, 6F, and 7F scoured initially as discharge increased from 200 to  $800 \text{ ft}^3/\text{s}$ , and then filled as the flood crest passed through the study reach. In contrast, no net scour was observed at any discharge in either sections 1F or 4F.

The tendency to scour as discharge decreased also varied among the filling sections. Sections 4F, 5F, and 6F scoured whenever the discharge decreased, with few exceptions. The effects of the three flood peaks on days 22, 27, and 38 were particularly apparent at section 4F (fig. 7b). As each peak approached, section 4F filled; it then scoured as discharge decreased after the peak. Although the data are not as complete for sections 5F and 6F, the sequence of scour at flows less than  $820 \text{ ft}^3/\text{s}$  and of fill at flows greater than  $820 \text{ ft}^3/\text{s}$  is shown in figures 7c and d. Sections 1F and 7F show only a slight tendency to scour as discharge decreased.

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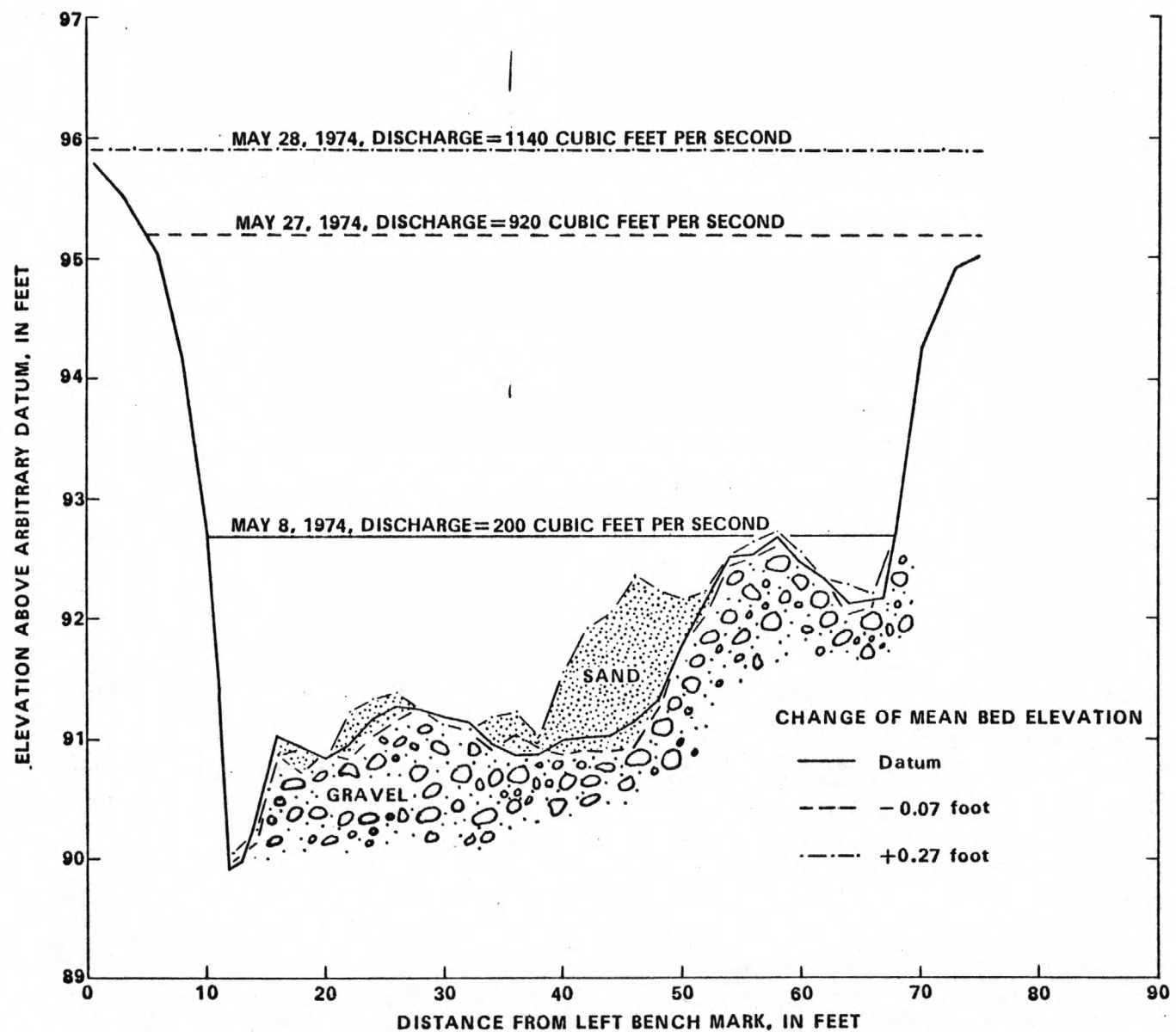


Figure 6.--Filling cross section 6F. Data from tables 4 and 6.

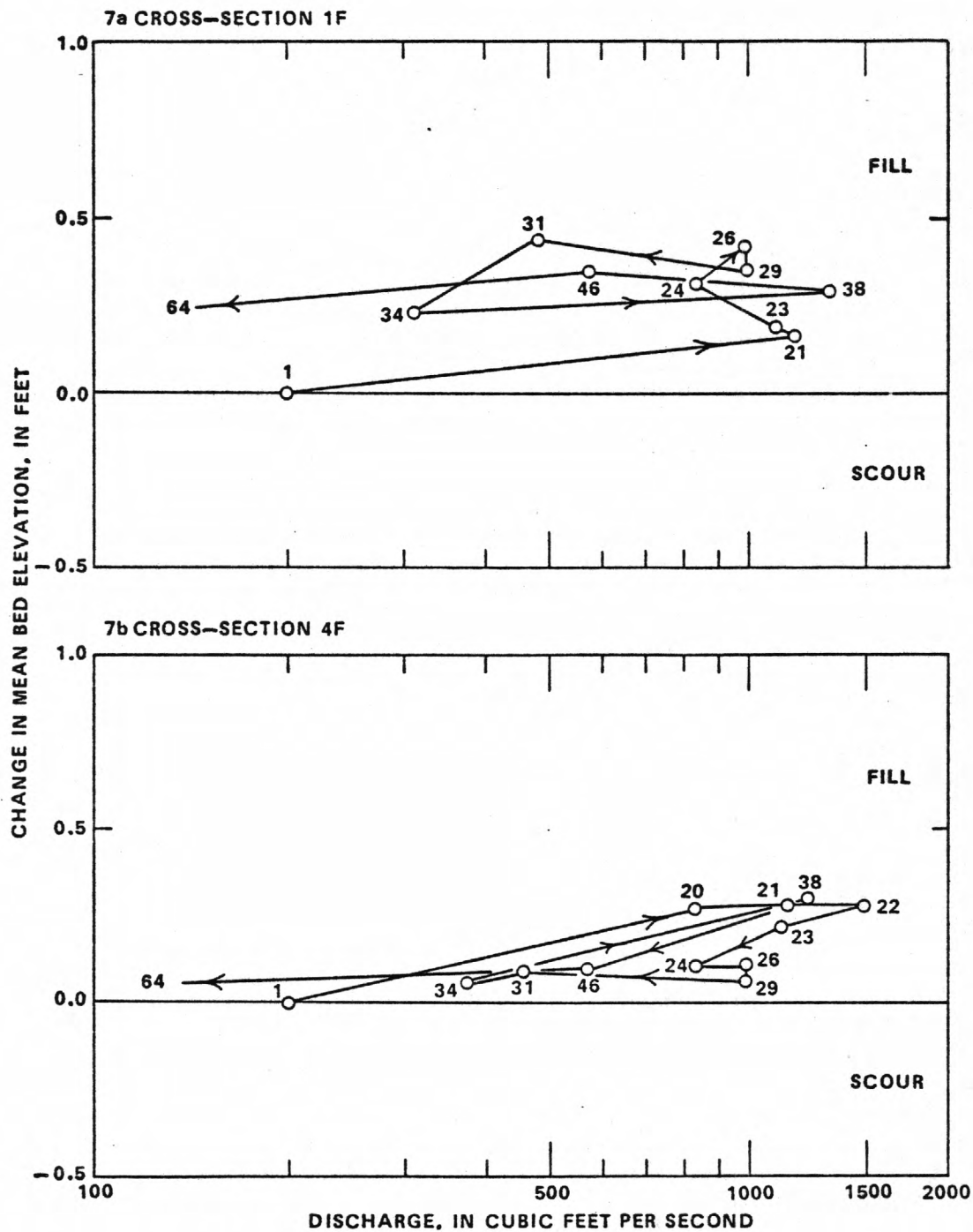


Figure 7a, b.--Variation in mean bed elevation of filling cross sections 1F and 4F during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.

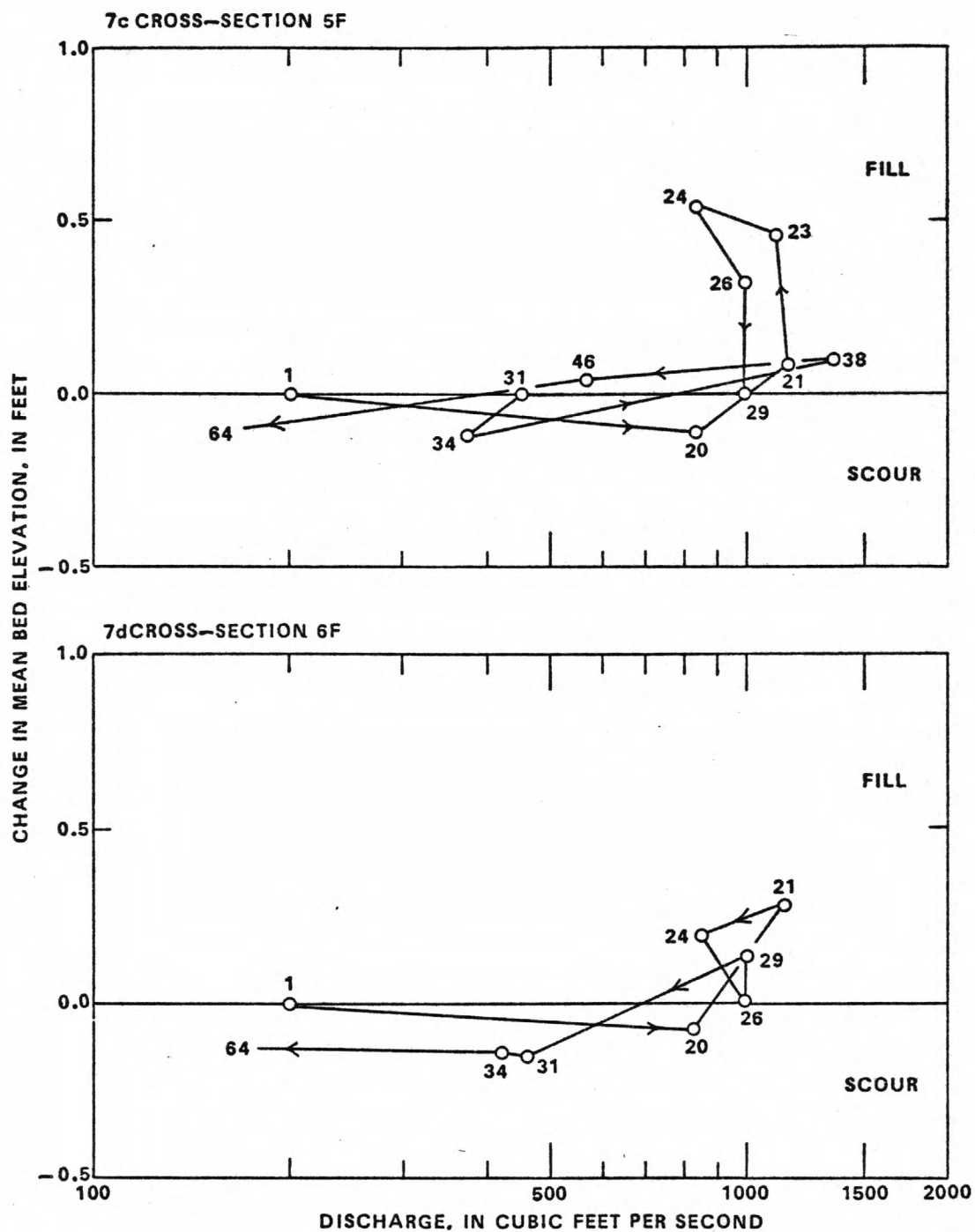


Figure 7c, d.--Variation in mean bed elevation of filling cross sections 5F and 6F during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.

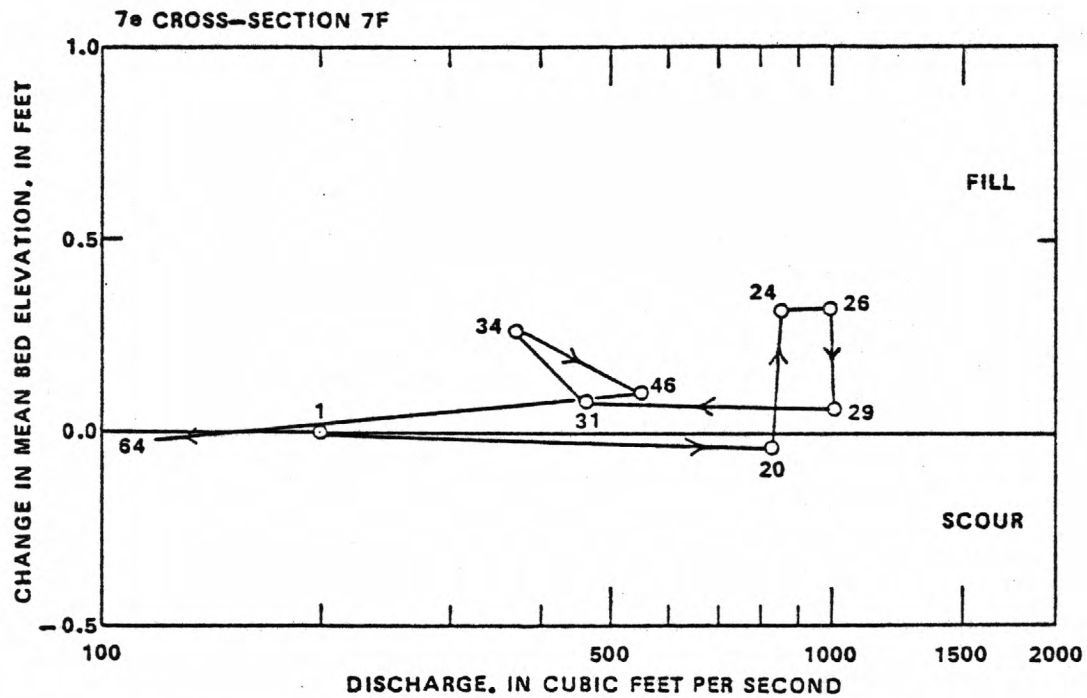


Figure 7e.-- Variation in mean bed elevation of filling cross section 7F during the 1974 spring flood. Each resurvey is identified by the number of consecutive days since the initial survey on May 8. Data from table 6.



All cross sections were surveyed for the last time on July 10, 1974 (day 64), at a discharge of  $40 \text{ ft}^3/\text{s}$ . Figures 5a, b, c, d, e, and f and 7a, b, c, d, and e indicate that the mean bed elevations of the several scouring and filling sections were tending to return to their preflood (May 8) values. Only sections 4F and 10S, however, had completely returned to their preflood conditions. The mean bed elevations of all other sections, except 1F, were scoured from -0.10 to -0.40 foot below their respective May 8 elevations. Thus, it appears that immediately after the spring flood, the East Fork River study reach was generally scoured and thus depleted in bed material relative to its preflood condition.

The supply of sand to the East Fork River is discussed by Andrews (1977). It was shown that the East Fork River channel was relatively depleted in sediment at the end of the snowmelt flood. During the summer months, Muddy Creek, a small tributary upstream of the bedload trap, supplied a quantity of sediment to the East Fork River channel equal to approximately one-half of its annual sediment load. The addition of this material is probably responsible for the replenishment of sand-sized bed material within the study reach. When several of the sections were resurveyed during May 1975, the mean bed elevations of all sections had returned to within a few hundredths of a foot of the preflood elevation of the preceding year.

The measurements of scour and fill made by several previous investigators have already been summarized. Data from the East Fork River are in good agreement with most of their measurements. Although some of the previous data appear to be contradictory, this is due largely to differences in the type, frequency, and areal extent of the measurements. For example, scour-chain data commonly have shown that most cross sections scour below their preflood level at some time or another during a flood--regardless of channel configuration. Had scour chains been installed at the cross sections along the East Fork River, similar results would have been recorded. Net scour, in fact, was observed in all except two of the sections along the East Fork River. However, the sections did not scour at the same time of discharge. Sections 5F, 6F, and 7F initially scoured below their preflood level and then accumulated a net fill when the discharge exceeded  $820 \text{ ft}^3/\text{s}$ . Conversely, sections 8S, 9S, 10S, and 11S initially filled and then scoured below their preflood level when the discharge exceeded  $820 \text{ ft}^3/\text{s}$ . Thus, whereas most of the sections along the East Fork River scoured below their preflood bed elevations, scour did not occur simultaneously in all sections.

#### HYDRAULIC GEOMETRY OF SCOURING AND FILLING CROSS SECTIONS

Two general sequences of scour and fill have been described. It has been shown that at any time or discharge during the flood, some sections were filling while others were scouring. Then later, at a larger or smaller discharge, the sections which had filled, scoured; and the sections which had scoured, filled. It is logical, therefore, to determine a relation between the sequence of scour and fill at a section and the local hydraulic characteristics of the channel. This may be done using hydraulic geometry.

Leopold and Maddock (1953a) found that the variation of the hydraulic factors, mean velocity ( $\bar{u}$ ), width ( $w$ ), mean depth ( $\bar{d}$ ), and friction factor ( $ff$ ) with increasing discharge at a section could be described broadly by a set of simple power equations:

$$\bar{u}=kQ^m,$$

$$w=aQ^b,$$

$$\bar{d}=cQ^f,$$

and

$$ff=eQ^y.$$

These relations are called the "hydraulic geometry" of the cross section. The hydraulic exponents,  $m$ ,  $b$ ,  $f$ , and  $y$ , describe the rate of change of the hydraulic variables,  $\bar{u}$ ,  $w$ ,  $\bar{d}$ , and  $ff$ , in order to accommodate changes of water discharge.

The hydraulic geometries of sections 6F and 10S are compared in figure 8. Several important differences between the hydraulic characteristics of the two sections are shown. First, the width of the filling section increased more rapidly with discharge ( $b=0.21$ ) than the scouring section ( $b=0.06$ ). Hydraulic roughness expressed by the Darcy-Weisbach friction factor decreased rapidly with increasing discharge in the scouring section ( $y=-0.62$ ). In contrast, roughness decreased only slightly with increasing discharge in the filling section ( $y=-0.05$ ). Mean depth varied with discharge at approximately the same rate in both section 6F ( $f=0.51$ ) and 10S ( $f=0.42$ ). Probably the most striking difference between the hydraulic characteristics of sections 6F and 10S was due to the respective slopes of the mean velocity versus discharge relations. As shown, sections 6F and 10S had the same mean velocity at a discharge of approximately 500 ft<sup>3</sup>/s. Mean velocity increased slowly with discharge in filling section 6F ( $m=0.28$ ), relative to scouring section 10S ( $m=0.52$ ). Thus, at discharges less than approximately 500 ft<sup>3</sup>/s, section 6F had a greater mean velocity than did section 10S. At discharges greater than approximately 500 ft<sup>3</sup>/s, the relation was reversed and the mean velocity through section 10S exceeded that of section 6F. This discharge-related reversal of mean velocity is significant because, empirically, velocity is the single hydraulic variable most closely related to the sediment-transport rate.

The hydraulic exponents of velocity, depth, width, and friction factor for the 11 cross sections are listed in table 1. The mean hydraulic exponents for the entire study reach also are shown. The distinctions drawn between the hydraulic exponents of sections 6S and 10S are true for all scouring and filling sections. The velocity exponent ( $m$ ) of every filling section was less than the mean value for the study reach, whereas the velocity exponent of every scouring section was greater than the mean value of the study reach. Likewise, every filling section had a width exponent ( $b$ ) greater than the reach mean--with one exception, section 1F--and the scouring sections had width exponents less than the mean of the study reach, with the exception of sections 2S and 3S. The filling sections had friction factor exponents larger than the mean, and scouring sections had friction factor exponents smaller than the mean. The depth exponent ( $f$ ) varied from section to section, but, as noted before, did not appear to be significantly different in scouring as compared to filling sections.

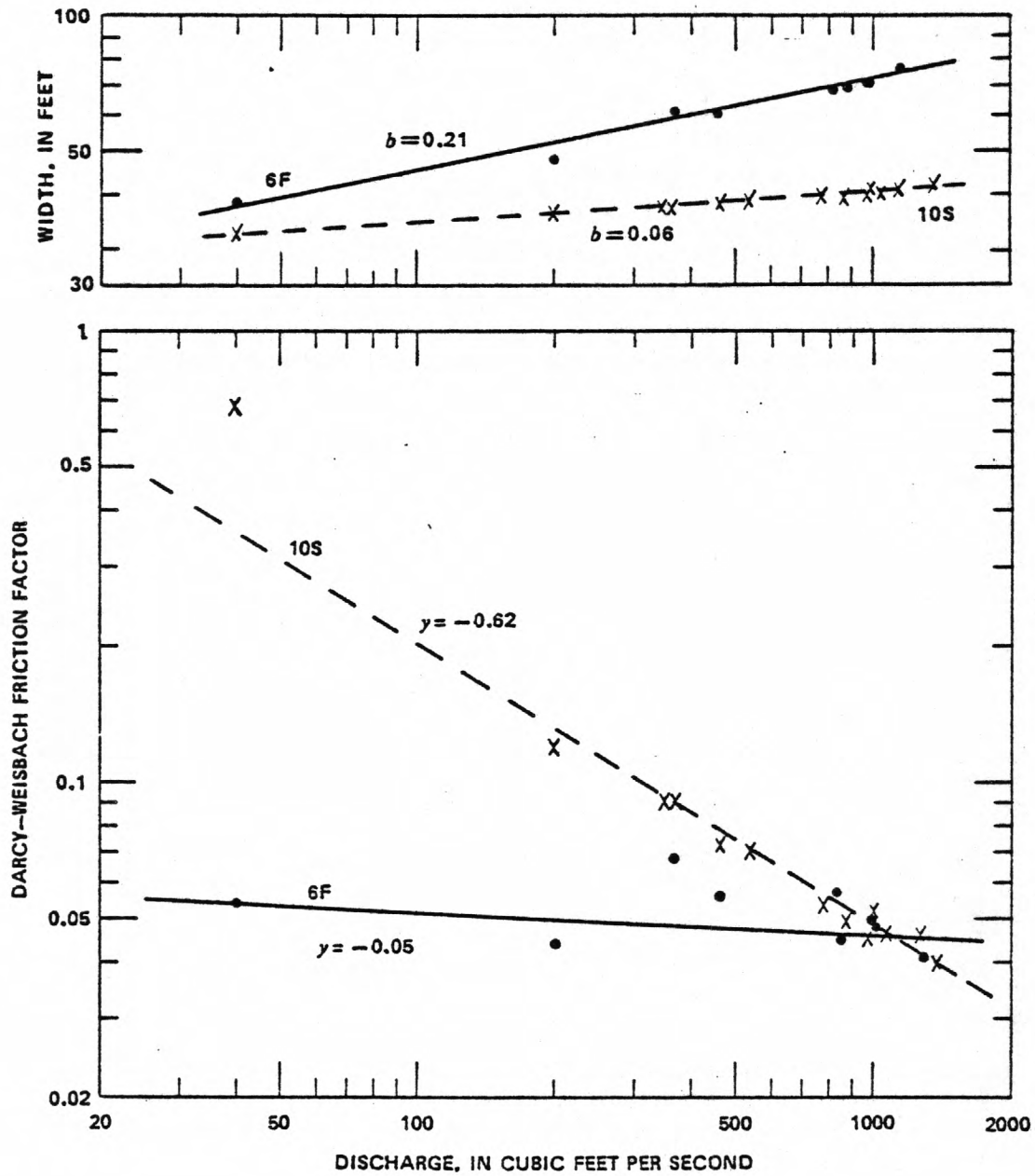


Figure 8.—Comparison of the hydraulic geometries of cross sections 6F and 10S.  
Data from table 6.

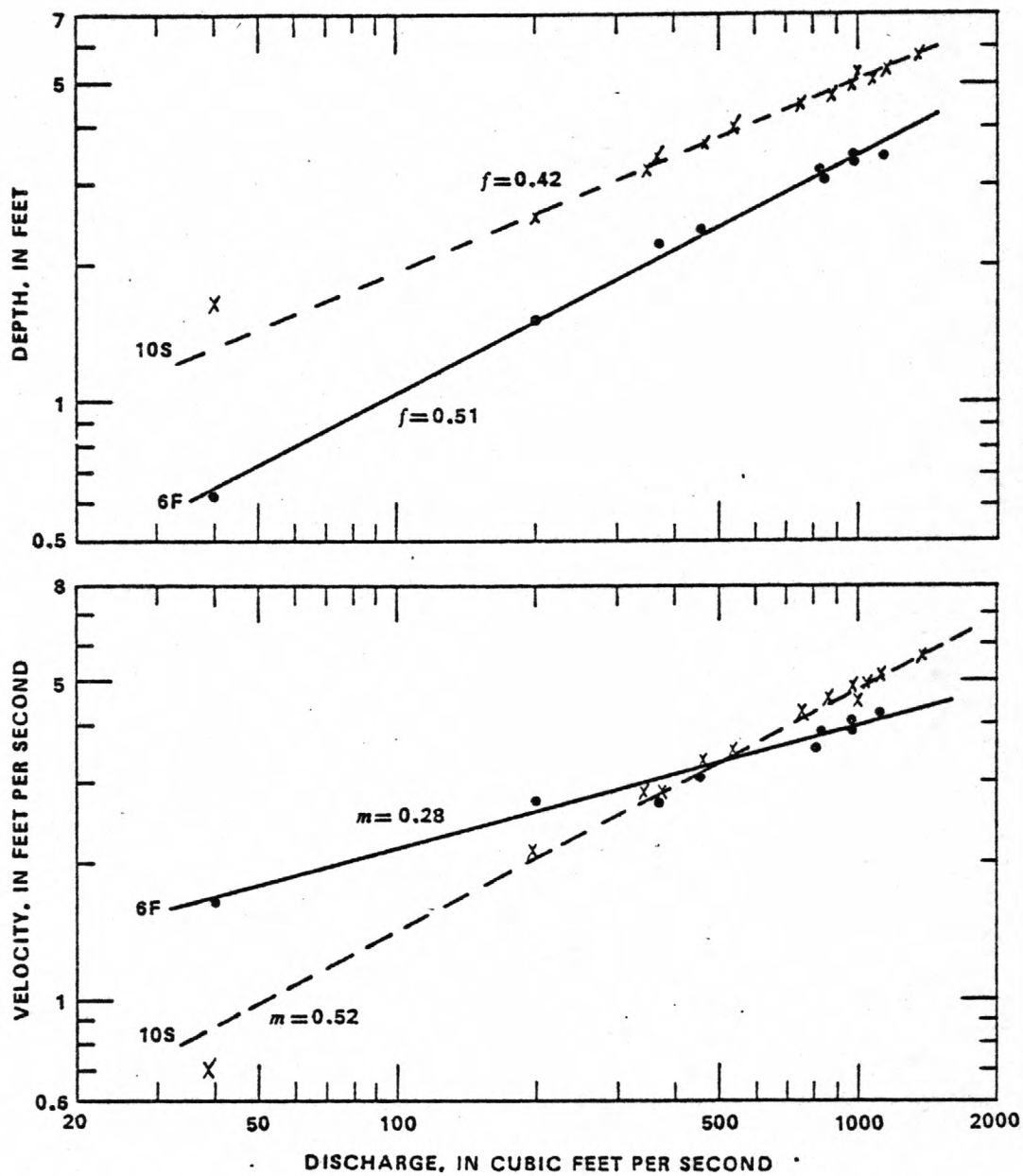


Figure 8.--Comparison of the hydraulic geometries of cross sections 6F and 10S.  
 Data from table 6--continued.

Table 1.--Hydraulic exponents of selected  
cross sections

Cross- section number	Hydraulic exponents <sup>1</sup>			
	<i>m</i>	<i>f</i>	<i>b</i>	<i>y</i> <sup>2</sup>
1F	0.30	0.60	0.10	0.00
2S	.45	.35	.20	-.55
3S	.44	.41	.15	-.47
4F	.24	.61	.16	.13
5F	.33	.45	.23	-.21
6F	.28	.51	.21	-.05
7F	.32	.45	.23	-.19
8S	.40	.57	.08	-.23
9S	.48	.48	.04	-.48
10S	.52	.42	.06	-.62
11S	.43	.49	.08	-.37
Mean exponents	0.38	0.48	0.14	-0.28
Mean exponents of streams in mid- western United States <sup>3</sup>	0.34	0.40	0.26	-0.24
Minimum variance exponents <sup>4</sup>	0.35	0.42	0.25	-0.28

<sup>1</sup> $\bar{u} = Q^m$ ,  $\bar{d} = Q^f$ ,  $\bar{w} = Q^b$ ,  $ff = Q^y$ .

<sup>2</sup>Computed by assuming a constant energy slope.

<sup>3</sup>Leopold and Maddock (1953a).

<sup>4</sup>Langbein (1964, p. 308).

In summary,

$$m_{\text{filling}} < m_{\text{mean}} < m_{\text{scouring}},$$

$$f_{\text{filling}} \sim f_{\text{mean}} \sim f_{\text{scouring}},$$

$$b_{\text{filling}} > b_{\text{mean}} > b_{\text{scouring}},$$

and

$$y_{\text{filling}} > y_{\text{mean}} > y_{\text{scouring}}.$$

Thus, the filling and scouring sections had distinctly different hydraulic geometries.

The discussion thus far has focused on the hydraulic geometries of the cross sections, because our purpose was to relate changes in the hydraulic factors with discharge to changes in bed elevation with discharge. It is also worthwhile to compare the relative values of width, depth, velocity, and friction factor in scouring and filling sections. Section 10S was deeper and narrower than section 6F during the entire range of flood discharge (fig. 8). Section 10S was relatively rough during small flows but became significantly smoother as discharge increased, whereas section 6F was relatively smooth at all discharges. There was a reversal in the relative magnitudes of mean velocity through the two sections as discharge increased. Mean velocity increased with discharge in both sections, but at significantly different rates. Hence, during smaller discharges, section 6F had a greater mean velocity than did section 10S. At larger discharges, however, section 10S had a greater mean velocity than section 6F.

The hydraulic characteristics of the 11 cross sections at a discharge of 820 ft<sup>3</sup>/s, the mean bankfull discharge of the study reach, are compared in table 2. The scouring sections were narrower and deeper than the mean conditions

Table 2.--Bankfull hydraulic characteristics of selected cross sections<sup>1</sup>

Cross-section number	Velocity (ft/s)	Depth (ft)	Width (ft)	Roughness
1F.....	3.15	3.05	86	0.067
2S.....	3.15	4.82	54	.11
3S.....	2.95	4.30	65	.11
4F.....	4.25	2.95	66	.035
5F.....	3.93	3.30	64	.046
6F.....	3.70	3.25	68	.051
7F.....	3.65	3.57	63	.058
8S.....	3.95	3.95	52	.055
9S.....	3.75	4.40	50	.068
10S.....	4.49	4.73	39	.051
11S.....	3.85	4.10	52	.060
Mean values....	3.71	3.86	60	.061

<sup>1</sup>Velocity, depth, width, and roughness were calculated from the respective hydraulic geometry relations, using the mean bankfull discharge (820 ft<sup>3</sup>/s) of the study reach.



of the reach, with the exception of section 3S. Conversely, the filling sections were wider and shallower than the mean condition of the reach. Broadly, this distinction between scouring and filling sections was true for the range of flood discharges.

Mean velocity at bankfull discharge varies from section to section, although there is no apparent difference in the bankfull mean velocity between scouring and filling sections. Owing to the difference in velocity exponents as previously discussed, the filling sections had a greater mean velocity at smaller discharges, and scouring sections had a greater mean velocity at larger discharges.

#### RIFFLES AND POOLS

Previous investigators have reported significantly different hydraulic geometries for adjacent riffles and pools. Keller (1971) measured the variation in velocity 0.05 foot above the bed of a riffle and pool over a range of discharges. At the smallest discharge, the bottom velocity of the riffle was much greater than that of the pool. The bottom velocity of the pool, however, increased more rapidly with discharge, so that at the largest discharge observed, the bottom velocities through the riffle and pool were equal.

Richards (1976a) compared the hydraulic geometries of two pairs of adjacent riffles and pools. The velocity exponents ( $m$ ) of the pools were larger than those of the riffles. These observations, however, were limited to a relatively small range of discharges, and hence the mean velocity through the riffles was always greater than it was through the pools. No consistent relation between either the depth or width exponents of riffles and pools was shown. Richards (1976b) compared the width and depth of six riffles and pools. The riffles tended to be wider and shallower than the pools at all discharges.

The cross sections along the East Fork River were selected to be representative of the full range of channel characteristics between riffles and pools within the study reach. The water surface and bed profile of the study reach at a discharge of 85 ft<sup>3</sup>/s are shown in figure 9. Section 6F was identified as a riffle on the basis of a steep water-surface slope, a topographic high in the bed, and coarse bed material. Section 10S was identified as a pool on the basis of a flat water-surface slope, a topographic low in the bed, and fine bed material. The distinctive hydraulic geometries of sections 6F and 10S (fig. 8) are in agreement with the observations of previous investigations. Section 6F--a riffle--was wider and shallower at all flood discharges than was section 10S--a pool. Section 6F had a smaller velocity and larger width and roughness exponents than did section 10S. The depth exponents of the sections were similar. The data are particularly significant in that they include a large range of discharges and show that the mean velocity of the pool, in fact, exceeded that of the riffle at approximately the bankfull discharge.

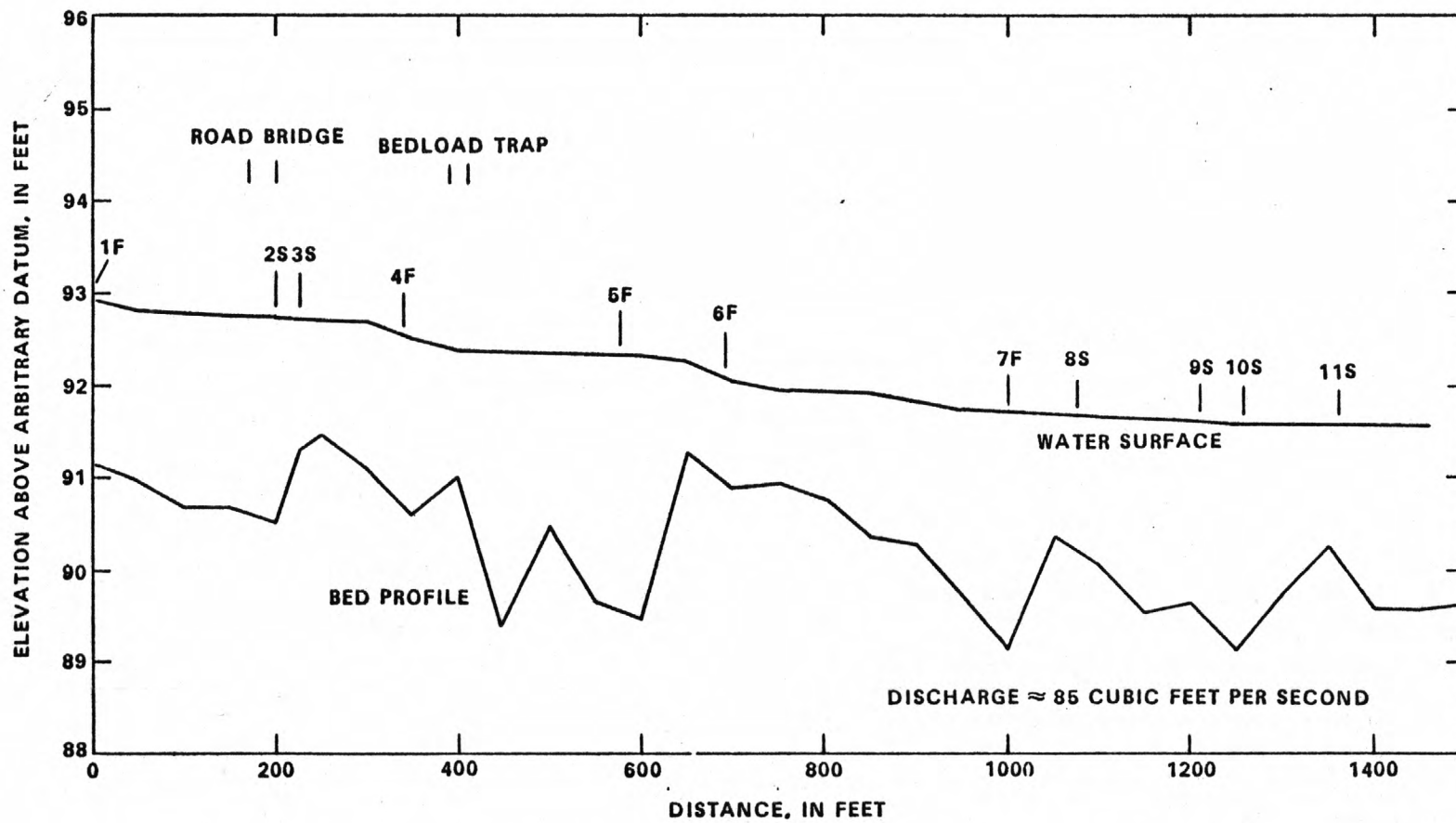


Figure 9.--Water surface and bed profile of the study reach.

Most of the cross sections were neither riffle nor pool. Their water-surface slope, bed topography, and bed-material size were intermediate between those of sections 6F and 10S. However, the hydraulic geometries of all filling sections deviated in a similar way from the mean hydraulic geometry of the study reach. Likewise, the hydraulic geometries of all scouring sections deviated in a similar way from the mean hydraulic geometry of the study reach. Thus, the filling sections had riffle-like hydraulic geometries and the scouring sections had pool-like hydraulic geometries (table 1). It must be stressed that most of the filling and scouring sections were not riffles and pools by conventional definitions. Their hydraulic geometries did, however, deviate from the mean hydraulic geometry of the reach in the same manner as did riffles and pools.

The factors which cause the difference in the hydraulic geometries of the scouring and filling cross sections are not well understood, and hence, a complete explanation cannot be given at this time. It is possible, however, to outline some of the important factors. The pool-and-riffle sequence is probably the most common channel feature of streams whose sediment load includes some gravel. Langbein and Leopold (1968) have shown that coarse particles in transport will be concentrated into waves. The crests of these waves are riffles and the troughs are pools. Because these gravel waves will form whenever a limited supply of gravel is being transported, the pool-and-riffle sequence may be regarded as a primary channel feature.

The data for the East Fork River show that there is a systematic longitudinal variation in channel morphology and bed material associated with the pool-and-riffle sequence. These differences in channel characteristics are probably responsible in large measure for the different hydraulic geometries of the scouring and filling cross sections. At small discharges, the scouring (pool-like) sections were relatively deep and rough, and had small velocities. Because the rate of change of velocity with increasing discharge was large compared to the rate of change of depth, there must have been a concomitant increase in slope and (or) decrease in roughness with increasing discharge. Based on the data collected for this investigation, it was concluded that slope did not change with discharge in the cross sections studied. Therefore, the scouring sections must have become significantly smoother as discharge increased. Consequently, the relatively rapid rate of change of velocity with discharge in the scouring sections was due to both increasing depth and decreasing roughness.

In contrast, the filling sections were relatively shallow, smooth, and had large velocities at small discharges. With increasing discharge, the rate of change of velocity was approximately proportional to the square root of the rate of change of depth. Because slope did not change with discharge, the channel roughness of the filling sections remained nearly constant as discharge increased.

Because the physical configuration of the stream bed was not measured in the present investigation, changes in the stream bed associated with changes in the computed values of roughness must be inferred. The filling sections had a gravel or mixed sand-and-gravel bed at small discharges, whereas the scouring sections had a predominantly sand bed, as shown in figure 3. Throughout the study reach, the sand bed formed dunes. In the scouring sections, these dunes were 0.6 to 1.0 foot high, whereas in the filling sections, they were 0.2 to 0.4 foot high.

The smaller dunes in the filling sections were probably due to the shallower, faster flow, and the thinner deposit of sand-size bed material compared to that of the scouring sections. Because of the larger dunes and greater part of the stream bed covered by dunes, the scouring sections were significantly rougher at small discharges than were the filling sections. As discharge increased, the dunes in the scouring sections probably flattened and were definitely eliminated at the time of flood crests, because these sections scoured to a gravel bed. Thus, the relative bed roughness of the scouring sections decreased significantly with increasing discharge, as indicated by the computed values in roughness. In contrast, the height of dunes in the filling sections probably increased as sand accumulated on the bed. Mean depth, however, also increased with discharge so that the relative bed roughness of the filling sections remained about constant, as indicated by the computed values of roughness.

In summary, for the cross sections studied in this investigation, the redistribution of sand-size bed material from the scouring to the filling sections appears to be associated with significant changes in stream-bed configuration. These changes, in turn, affect channel roughness and probably account for the different rates of change of velocity with discharge in the scouring and filling sections.

#### BEDLOAD-TRANSPORT RATE VERSUS DISCHARGE RELATIONS OF SCOURING AND FILLING CROSS SECTIONS

The process of scour and fill in an alluvial channel is due to a local depletion or accumulation of bed material. An increase in the mean bed elevation of a given reach can occur only when the volume of material transported into the reach exceeds the volume of material transported out of the reach. Conversely, a decrease in the mean bed elevation results when the volume of material transported out of the reach is greater than the supply. Whether a particular cross section scours or fills depends on the transport rate of bed material through the cross section compared to the rest of the channel--and especially the short reach immediately upstream. Several examples of cross sections that scour within one range of discharge and fill within another have already been cited. Such occurrences must be the consequence of a relatively large bedload-transport rate compared to the rest of the channel for the discharges at which scour occurs. Conversely, the cross section must fill over the range of discharge when its bedload-transport rate is small compared to that of the rest of the channel. In order to account for the pattern of scour and fill through the study reach, the rate of change of bedload transport with discharge (that is, the slope of the bedload-transport rate versus discharge relation) must vary from section to section. To confirm this hypothesis, a relation between discharge and bedload-transport rate was computed for each section by correlating flow conditions at the section with the flow conditions and bedload-transport rate measured at the bedload trap.



Empirically, fluid velocity has been found to correlate well with the bedload-transport rate. The transport rate of bedload material per foot of width is expressed as a function of mean channel velocity in figure 10. Plots of this type have been used before, notably by Colby (1964a) and Maddock (1969), and have proven to be a simple, effective way to organize bedload-transport data. For the range of mean velocities, depths, and bed-material sizes found in the study reach, the effect of depth on the bedload-transport rate is insignificant and may be ignored (Colby, 1964a; C. F. Nordin, oral commun., 1977).

The scatter of data in figure 10 is due in part to the variations in the grain size of transported material. During the initial increase in stage, when appreciable quantities of bedload began to move, the median grain size in transport was approximately 0.60 mm. As discharge increased, the size of bedload material also increased, to a maximum of 1.5 mm at the flood crest. With decreasing discharge, grain size decreased, but slowly, as compared to the coarsening which occurred during the increasing discharge. Thus, after the initial increase in discharge, the median grain size at the smallest transport rate was 0.90 mm. Subsequent increases and decreases in discharge follow the relation traced by decreasing discharge after the initial increase.

A possible source for the comparatively finer material transported during the initial increase is indicated by the sequence of scour and fill already described. The last survey, on July 10, 1974, showed that the mean bed elevation of all cross sections except 1F and 10S was below their preflood level.

By the spring of 1975, however, the mean bed elevation of these cross sections had returned to the preflood level of a year before. As much as 0.5 foot of material had been deposited in some sections by low flow during the year.

R. H. Meade (written commun., 1977) systematically measured the thickness of sand-size bed material in the East Fork River channel for a distance of nearly 2.5 miles upstream from the bedload trap. A size-statified bed normally was measured. The surface layer, approximately 0.3 foot thick, was significantly finer, median diameter=0.5 mm, than the underlying material, median diameter=1 to 2 mm.

Scour of this relatively finer surficial material during the first increase in discharge probably accounts qualitatively for the smaller median diameter of material transported during the first few days of the spring flood.

A relation between discharge ( $Q$ ) and bedload-transport rate ( $i_b$ ) may be derived for each cross section by combining the velocity-versus-discharge relation of the section with the relation between mean velocity and the bedload-transport rate per foot of channel width measured at the bedload trap (shown by the trend line in fig. 10). In order to compute the whole channel bedload-transport rate through a cross section for any given discharge, the transport rate per foot of width ( $i_b$ ) must be multiplied by the active bed width of the section. Choosing the active bed width is, of course, subject to some error. In all instances, the determination of active bed width was made by noting the break in slope between bed and bank, and the intersection between bed material and bank material. The width of bed is assumed to remain constant through the spring flood.

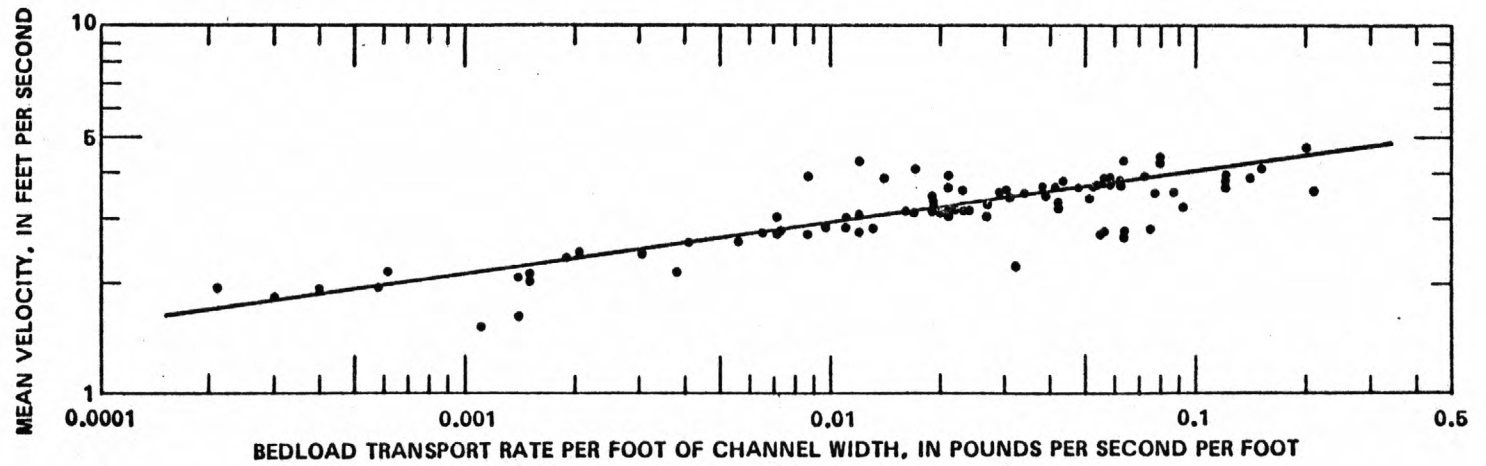


Figure 10.--Unit bedload--transport rate versus mean velocity relation for the bedload trap. Sediment loads are expressed as dry weight. Data from Leopold and Emmett (1976, 1977).

The relations between discharge and whole channel bedload-transport rate for the eight cross sections located in self-formed reaches of the channel are compared in figure 11. This figure confirms the supposition that the cross sections have different bedload-transport rate versus discharge relations. The  $I_b$  versus  $Q$  relations of the scouring cross sections are characterized by having steeper slopes than the filling cross sections. This, of course, is a direct result of the relatively large velocity exponents of the scouring sections. At discharges greater than 800 ft<sup>3</sup>/s the scouring cross sections have a greater bedload-transport rate than the filling cross sections, as one would expect. Conversely, at discharges less than 800 ft<sup>3</sup>/s, the scouring cross sections have lesser bedload-transport rates than the filling cross sections. This agrees with the observation that cross sections 8S, 9S, 10S, and 11S, all showed some fill at discharges between 200 and 800 ft<sup>3</sup>/s, while sections 5F, 6F, and 7F scoured slightly. No scour was observed in section 1F, and this is compatible with its relatively small bedload-transport rate at any discharge. Thus, the bedload-transport rate versus discharge relations computed for the eight self-formed cross sections agree well with the observed sequence of scour and fill in the sections.

#### CROSS SECTIONS IN AN ALTERED REACH OF CHANNEL

The  $I_b$  versus  $Q$  relations computed for cross sections 2S, 3S, and 4F, are not consistent with the scour and fill recorded at these sections. These sections were located in a reach of channel modified by the construction of the road bridge and a berm along the left bank (fig. 3). The  $I_b$  versus  $Q$  relations for sections 2S and 3S do not agree with the large observed depth of scour. On the other hand, cross section 4F filled, in spite of a large computed  $I_b$  versus  $Q$  relation.

The cross-channel velocity distribution provides at least a part of the explanation for the apparently small bedload transport through cross sections 2S and 3S. In most natural cross sections, the horizontal velocity distribution is relatively uniform. However, at section 2S, and to a lesser extent, at section 3S, the horizontal velocity distribution was nonuniform. Flow was concentrated by the bridge piers so that the velocity was very large between the piers and small around and behind them. Discharge measurements, however, were made from the road bridge, so that the velocity is known in 2-foot-wide verticals. When the whole channel bedload-transport rate is calculated from the velocity in each vertical and then summed across the channel, rather than using the mean velocity of the entire cross section, the transport rate versus discharge relation for section 2S is more than doubled, and then agrees with its scouring character. This is true because the whole channel bedload-transport rate is proportional to the mean flow velocity to some power  $z$ ,

$$i_b \propto (\bar{u})^z.$$



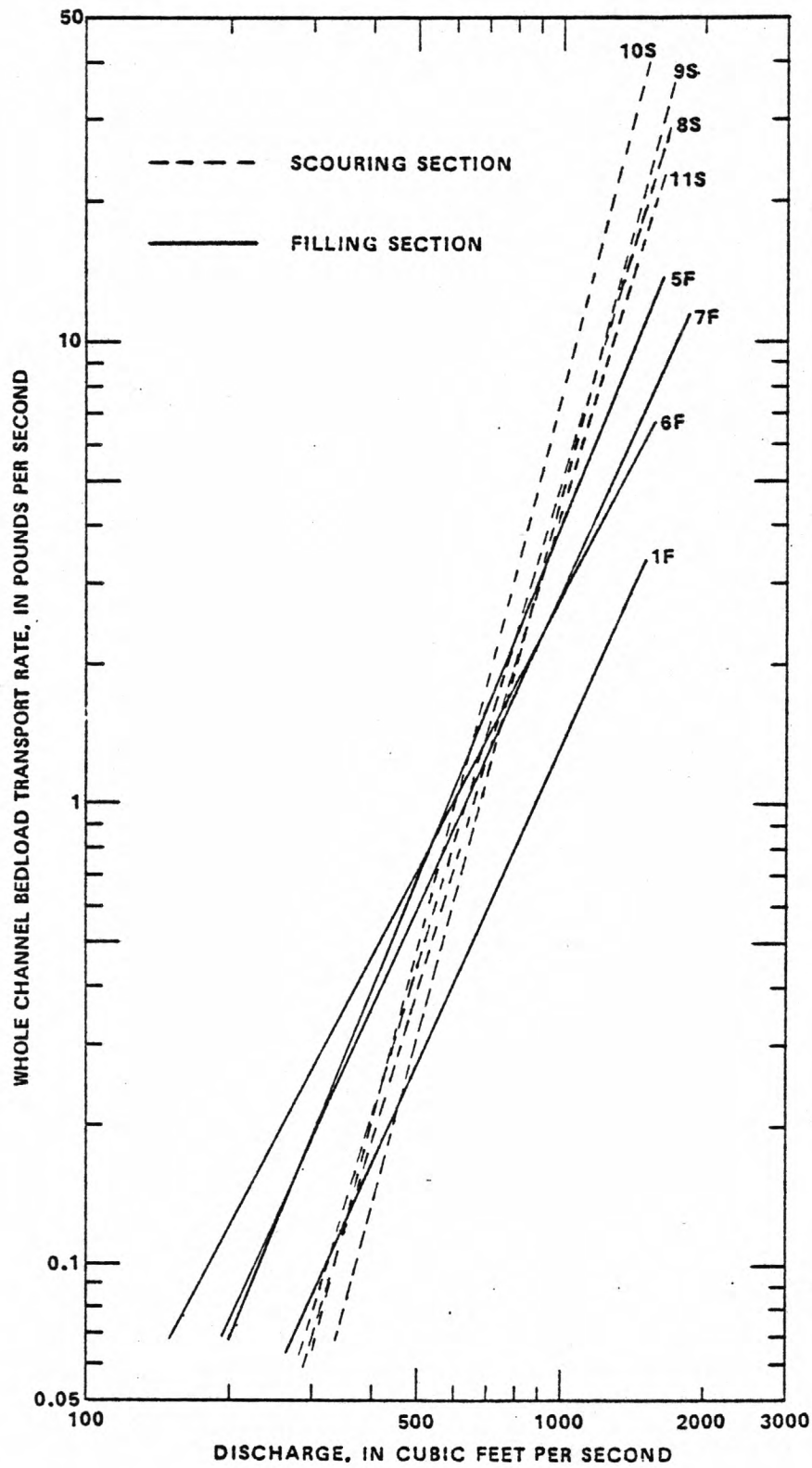


Figure 11.--Whole channel bedload-transport rate versus discharge relations for self-formed cross sections.

In general,

$$(\bar{u})^{\xi} < \sum_{i=1}^N \frac{u_i^{\xi}}{N}$$

even though  $\bar{u}$  is defined by  $(\bar{u}) = \sum_{i=1}^N \frac{u_i}{N}$ .

where  $u_i$  = mean flow velocity in feet per second in the  $i$ th vertical, and  $N$  = number of verticals. Thus, bedload-transport relations based upon a correlate with mean velocity will tend to underestimate the transport rate where there is an appreciable cross-channel variation of velocity.

When the cross-channel velocity distribution is fairly uniform, the mean velocity can be used to calculate the bedload-transport rate without appreciable error. However, for cross sections which have widely variable velocity, the calculated transport rate is much too small. In the instance of section 2S, the bedload-transport rate at the flood crest, calculated by summing verticals, is approximately 13 lb/s. This value is comparable to the maximum transport rates calculated for the other scouring cross sections (fig. 11).

Cross section 4F was located 140 feet downstream from the road bridge. The section filled during increasing discharge and scoured during decreasing discharge. Cross section 4F also has the characteristics of the other filling cross sections, including small velocity and large width and roughness exponents.

Although the bedload-transport rate did not increase rapidly with discharge, the ordinate intercept was much larger than any of the other bedload-transport rate versus discharge relations. Therefore, the bedload-transport rate was greater through cross section 4F than the mean of the study reach for most discharges, and only approximated the bedload-transport rate through the scouring cross sections near the flood crest. In view of these very large transport rates, it appears surprising that section 4F would accumulate sediment (fill). However, owing to the large volume of material scoured from beneath the road bridge as discharge increased, the supply of bedload sediment to section 4F was much larger than was the average condition of the study reach. Thus, cross section 4F appears to be a filling section which was adjusted to the large volume of sediments scoured from beneath the road bridge.

A bedload-sediment budget between cross sections 1F and 4F from May 26 to May 29 supports this supposition (table 3). The sediment loads transported past these two sections were calculated from the respective  $I_b$  versus  $Q$  relations and the flood hydrograph (fig. 2). Approximately 730 tons of bedload sediment were transported through cross section 1F and 986 tons through cross section 4F during the increasing discharges of the first flood crest. In order to estimate the volume of bed material scoured and filled within the reach during this period, it was assumed that the depth of scour and fill and channel width varied linearly through the reach, the depth of scour was symmetrical about the road bridge, from 25 feet upstream to 25 feet downstream, and the transition from fill to scour occurred halfway between section 1F and the road bridge. Based on these

Table 3.--Estimated bedload-sediment<sup>1</sup> budget between cross sections 1F to 4F, May 26-29, 1974

Interval <sup>2</sup>	Mean daily discharge (ft <sup>3</sup> /s)	Inflow of bedload-sediment through section 1F <sup>3</sup> (tons)	Bed material scoured from within reach <sup>4,5</sup> (tons)	Outflow of bedload-sediment through section 4F <sup>3</sup> (tons)
May 26-27	516	146	112	258
May 27-28	808	240	81	326
May 28-29	1,290	344	38	402
TOTAL		730	231	986

<sup>1</sup>Dry weight.

<sup>2</sup>Noon to noon.

<sup>3</sup>The quantities of bedload-sediment transport through sections 1F and 4F were calculated by combining the relation between mean velocity and unit bedload-transport rate measured at the bedload trap on May 25-29 with the respective mean velocity versus discharge relations of the sections.

<sup>4</sup>The volume of bed material scoured and filled between sections 1F and 4F was calculated by assuming that both the depth of scour and fill and channel width varied linearly through the reach, the depth of scour was symmetrical about the road bridge, from 25 feet upstream to 25 feet downstream, and the transition from fill to scour occurred halfway between section 1F and the road bridge.

<sup>5</sup>Specific density of material is 1.3.

assumptions and the computed changes in bed elevation at each section, a net estimated scour of 231 tons occurred between cross sections 1F and 4F from May 26 to May 29. The computed inflow of bedload sediment plus the volume of material derived from within the reach, approximately 961 tons, is comparable to the computed outflow, approximately 986 tons. Although these calculations are only estimates, the good numerical agreement indicates that the relation between the bedload-transport rate and mean velocity shown in figure 10 was the same for all sections, and that the hydraulic characteristics of section 4F have adjusted to provide the mean velocity necessary to transport the larger sediment load supplied to it.

## SUMMARY AND CONCLUSIONS

The mean at-a-station hydraulic geometry of the East Fork River agrees with the theoretical minimum variance hydraulic geometry. Thus, on the average, the East Fork River accommodates a change in discharge by mutually minimizing the adjustment of velocity, width, and depth. The hydraulic geometry of a given cross section, however, may deviate significantly from the mean reach and minimum variance condition. Periodic channel features, such as riffles and pools, plus chance encounters with differences in bank material, vegetation, or a bedrock outcrop, limit the free adjustment of one or more hydraulic variables. The effects of a constraint placed upon the adjustment of one variable are absorbed by all the other hydraulic variables, so as to minimize the adjustment made by any one. Thus, the hydraulic geometry of a section is deflected from the minimum variance condition. The hydraulic geometries of the 11 cross sections along the East Fork River, in fact, were distributed about the mean reach and minimum variance condition.

The cross sections occur in two distinctive groups, each with a characteristic hydraulic geometry and sequence of scour and fill. Significant scour was observed in six sections at the flood crests. These sections had larger velocity and smaller width and roughness exponents than the mean reach condition. The scouring sections also tended to be narrower and deeper than the mean reach condition for the entire range of flood discharges. Significant fill was measured in five cross sections at the flood crests. These sections had smaller velocity and larger width and roughness exponents than the mean reach condition. The filling sections tended to be wider and shallower than the mean reach condition. Filling and scouring sections had similar depth exponents.

The most significant hydraulic difference between the scouring and filling sections was an inversion in the relative magnitude of velocity through the respective sections as discharge increased. At discharges less than approximately 500 ft<sup>3</sup>/s, the filling section had a larger velocity than the scouring section. As indicated by the respective velocity exponents, velocity increases more rapidly with discharge in the scouring sections than in the filling sections. Thus, at discharges greater than bankfull stage, 820 ft<sup>3</sup>/s, the scouring sections had a larger velocity than the filling sections.

Sediment-transport rates measured at the bedload trap were well correlated with mean velocity. Therefore, a relation between discharge and whole channel bedload-transport rate was computed for each section by combining the velocity versus discharge relation of the section with the velocity versus bedload-transport rate relation at the bedload trap. The sequence of scour and fill measured at a section and the computed relation between discharge and whole channel bedload-transport rate are in good agreement. The bedload-transport rate ( $I_b$ ) was similar in most cross sections at discharges near bankfull stage, 820 ft<sup>3</sup>/s. However, the slopes of the bedload-transport curves ( $I_b$  versus  $Q$ ) of the scouring sections were steeper than those of the filling sections. Consequently, the scouring sections had relatively large sediment-transport rates and scoured when discharge exceeded bankfull stage, and they had relatively small sediment-transport rates and filled when discharge was less than bankfull stage.



Conversely, the filling sections had relatively small sediment-transport rates and filled when discharge exceeded bankfull stage, and they had relatively large sediment-transport rates and scoured when discharge was less than bankfull stage.

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## BASIC DATA



Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974

CROSS SECTION NO. 1											
Date	May 8	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	93.43	96.63	96.27	95.66	96.05	96.08	94.46	94.25	96.88	94.90	92.38
Discharge (ft <sup>3</sup> /s)	200	1,150	1,080	814	975	975	480	303	1,300	560	40
ELEVATION, IN FEET											
Distance, in feet											
0	96.05	96.09									96.06
1											
2	95.54	95.69									
3											
4	95.51	95.70									
5											
6	95.21	95.35									95.51
7											
8		94.58									
9	94.37										94.63
10		94.43									
11	94.31										
12	94.10	94.45	94.39	94.48		94.39					94.44
13											
14	93.36	92.86	93.95	93.68	93.86	93.85	93.86	93.83	93.90	93.86	93.72
15											
16	92.90	93.30	93.05	93.21	93.19	93.10	93.39	93.45	93.46	93.18	93.18
17	91.60										91.63
18		91.71	91.57	91.55	91.57	91.56	91.54	91.58	91.60	91.57	91.60
19	91.50										
20		91.73	91.57	91.64	91.63	91.63	91.58	91.63	91.72	91.62	91.60
21	91.53										
22		91.82	91.79	91.83	91.67	91.85	91.70	91.78	91.80	91.68	91.71
23	91.77										
24		91.91	91.86	91.86	91.80	91.88	91.92	91.89	91.91	91.80	91.70
25	91.78										
26		91.83	91.86	91.89	91.84	91.80	91.84	91.82	91.88	91.85	91.74
27	91.76										
28		91.85	92.91	91.96	91.83	91.86	91.92	91.88	91.93	91.90	91.83
29	91.81										
30		91.95	91.97	91.98	91.99	91.90	91.98	91.92	91.92	92.00	91.94
31	91.93										
32		92.08	92.11	92.10	92.08	92.04	92.07	91.99	92.10	91.98	92.02
33	92.01										
34		92.24	92.27	92.20	92.20	92.20	92.17	92.21	92.26	92.10	92.14
35	92.23										
36		92.61	92.49	92.48	92.55	92.53	92.48	92.47	92.58	92.32	92.37
37	92.52										
38		92.73	92.55	92.77	92.63	92.72	92.70	92.66	92.72	92.57	92.67
39	92.63										
40		92.79	92.72	92.74	92.69	92.73	92.68	92.67	92.73	92.62	92.69
41	92.77										
42		93.07	93.19	93.18	93.02	93.08	92.99	93.03	93.10	93.02	92.93
43	92.86										
44		93.16	93.27	93.22	93.21	93.24	93.14	93.13	93.20	93.11	93.13
45	93.06										
46		93.17	93.23	93.31	93.26	93.28	93.36	93.25	93.28	93.29	93.23
47	93.09										
48		93.15	93.21	93.23	93.20	93.23	93.18	93.18	93.28	93.17	93.17
49	93.09										
50		93.23	93.33	93.31	93.19	93.26	93.24	93.23	93.33	93.14	93.22
51	93.09										
52		93.21	93.29	93.33	93.22	93.23	93.22	93.23	93.21	93.21	93.26
53	93.16										
54		93.23	93.32	93.33	93.19	93.21	93.21	93.20	93.33	93.06	93.26
55	93.06										

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 1--Continued											
Date	May 8	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	93.43	96.63	96.27	95.66	96.05	96.08	94.46	94.25	96.88	94.90	92.38
Discharge (ft <sup>3</sup> /s)	200	1,150	1,080	814	975	975	480	303	1,300	560	40
ELEVATION, IN FEET											
Distance, in feet											
56		93.15	93.19	93.49	93.17	93.30	93.19	93.26	93.30	93.18	93.31
57	93.02										
58		93.10	93.18	93.47	93.42	93.58	93.20	93.25	93.23	93.15	93.28
59	93.00										
60		93.03	93.02	93.42	93.45	93.47	93.19	93.17	93.18	93.12	93.20
61	92.86										
62		92.73	92.78	93.21	93.49	93.47	93.03	92.80	93.06	92.90	92.84
63	92.51										
64		92.42	92.60	93.24	92.87	93.03	93.03	92.60	92.88	92.80	92.42
65	92.14										
66		92.31	92.44	93.09	92.81	92.90	92.95	92.43	92.68	92.60	92.10
67	91.82										
68		92.01	91.91	92.85	93.01	92.76	92.99	92.41	92.37	92.70	91.93
69	91.60										
70		91.94	91.72	92.46	92.98	92.23	92.84	92.13	92.12	92.69	91.79
71	91.49										
72		91.67	91.60	91.64	92.75	91.93	92.68	92.37	91.93	92.58	91.69
73	91.40										
74		91.61	91.65	91.44	92.62	91.86	92.74	92.17	91.88	92.25	91.64
75	91.31										
76		91.50	91.42	91.57	92.44	91.66	92.54	91.64	91.80	92.18	91.39
77	91.19										
78		91.47	91.40	91.76	92.05	92.01	92.33	91.33	91.88	92.15	91.25
79	91.19										
80		91.50	91.39	91.61	92.00	91.81	92.46	91.71	91.70	92.17	91.25
81	91.21										
82		91.49	91.30	91.43	91.96	92.00	92.15	91.63	91.68	91.92	91.22
83	91.27										
84		91.57	91.35	91.46	91.67	91.88	92.11	91.63	91.76	92.10	91.28
85	91.37										
86		91.75	91.57	91.61	91.63	91.79	92.10	91.78	91.86	92.18	91.53
87	91.53										
88	92.80	92.85	92.39	92.34	92.37	92.29	92.28	92.25	92.25	92.90	91.89
89	93.57										93.46
90	94.16	93.85	94.19	94.06	94.19	94.22	94.46		94.28	94.17	
91											
92	94.73	94.77	94.79	94.86	94.82	94.83			94.96		94.87
93											
94		94.72									
95	94.44								94.70		
96		94.59									94.55
97											
98		94.69									
99											
100		94.61									
101											
102											
103											
104	94.70										94.65
105											
106											
107											
108	95.39										95.64

Table 4.--Soundings of cross sections, BedLoad Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 2								
Date	May 26	May 27	May 28	May 29	June 5	June 9	June 14	July 11
Water surface elevation (feet)	94.11	95.50	96.33	97.00	96.10	93.60	96.60	92.26
Discharge (ft <sup>3</sup> /s)	398	759	1,120	1,580	1,000	275	1,280	40
ELEVATION, IN FEET								
Distance, in feet								
0								
1								
2								
3								
4			95.30	96.50				
5								
6			95.30	96.00				
7								
8			94.80	95.00				
9								
10		95.00	94.80	94.60	95.30			
11								
12		94.70	94.50	94.60	95.30			
13								
14		94.30	95.30	94.60	94.30			
15								
16		94.40	94.40	94.30	93.10			
17								
18		94.60	94.80	94.40	93.50			
19								
20		94.50	94.40	94.90	95.10			
21								94.89
22		94.20	94.40	94.50	94.70		95.10	
23								
24	93.10	92.30	93.50	93.30	93.60	93.30	93.70	93.47
25								92.20
26	91.80	91.60	91.60	92.10	92.00	91.70	92.10	92.20
27								
28	91.10	90.70	91.10	90.70	90.90	90.60	91.10	91.37
29								
30	91.10	90.30	90.00	88.80	89.90	91.50	89.80	91.32
31								
32	90.30	88.70	88.50	88.40	88.60	88.50	88.70	91.32
33								
34	90.00	88.50	87.80	87.30	87.40	88.50	88.30	91.25
35								
36	90.10	88.30	87.80	86.70	86.50	88.20	87.90	91.33
37								
38	89.80	88.40	87.70	86.70	86.80	88.60	87.30	91.14
39								
40	89.60	88.50	87.10	86.70	86.50	88.70	86.90	90.98
41								
42	89.80	88.70	87.10	87.40	86.40	88.60	87.10	91.03
43								
44	90.10	89.00	87.40	87.50	86.20	88.70	87.30	91.53
45								
46	89.90	88.70	86.70	87.30	85.80	88.00	86.70	91.48
47								
48	89.50	88.50	86.30	86.50	86.30	87.40	86.30	91.49
49								
50	89.50	88.00	86.20	87.30	86.70	87.00	86.90	90.53
51								
52	89.40	87.70	87.00	87.70	88.10	88.30	87.40	90.06
53								
54	89.20	88.20	87.90	90.10	88.30	89.30	89.00	89.61
55								
56	90.30	90.30	89.50	90.60	90.70	90.70	89.70	90.68
57								
58	90.50	91.20	91.10	91.40	91.30	91.30	91.30	91.24
59								
60	91.40	91.70	91.90	92.00	92.10	92.10	92.00	
61								
62	91.60	91.60	91.90	92.10	92.00	92.20	92.00	92.20

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 3					
Date	May 8	May 24	May 27	May 29	July 10
Water surface elevation (feet)	93.26	92.67	95.59	96.85	92.26
Discharge (ft <sup>3</sup> /s)	200	104	810	1,560	40
ELEVATION, IN FEET					
Distance, in feet					
0	96.33				96.31
1					
2	96.29				
3					
4	96.31				
5					
6					
7					
8	96.19				96.25
9					
10					
11	95.36				95.33
12	94.19		94.73		
13					94.13
14	94.18		94.39		
15					
16	93.61		94.50		
17					
18	94.65		94.73		
19					94.99
20			94.75		
21	94.65				
22			94.71		
23					
24	93.83		93.92	94.97	93.88
25	93.23				92.15
26	91.78	92.48	92.23	93.90	92.15
27	91.55				
28		92.26	91.29	93.23	90.38
29	91.96				
30	91.72	91.57	91.26	91.65	90.05
31	91.39				
32		91.07	91.32	90.85	90.05
33	90.97				
34		91.17	91.22	90.37	90.48
35	90.90				
36		91.11	91.02	90.29	90.87
37	90.89				
38		90.96	91.27	90.45	90.99
39	90.80				
40		90.96	90.94	90.45	91.11

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 3--Continued					
Date	May 8	May 24	May 27	May 29	July 10
Water surface elevation (feet)	93.26	92.67	95.59	96.85	92.26
Discharge (ft <sup>3</sup> /s)	200	104	810	1,560	40
ELEVATION, IN FEET					
Distance, in feet					
41	90.89				
42		90.74	90.94	90.07	91.35
43	90.81				
44		90.72	90.47	89.99	91.47
45	90.79				
46		90.71	90.32	89.55	91.55
47	90.96				
48		90.64	90.37	89.35	91.57
49	90.94				
50		90.64	89.93	89.65	91.59
51	90.54				
52		90.60	89.51	89.45	91.48
53	90.63				
54		90.62	89.71	89.15	90.96
55	90.91				
56		90.65	89.52	89.01	90.96
57	91.07				
58		90.66	88.78	88.65	90.70
59	91.05				
60		90.57	88.44	88.41	89.97
61	90.88				
62		90.25	88.23	88.61	89.00
63	90.97				
64		88.82	88.57	88.55	88.12
65	90.97				
66		89.37	88.79	88.35	87.67
67	90.86				
68		89.87	89.79	88.45	88.09
69	90.72				
70		90.92	90.76	88.41	90.83
71	90.94				
72	92.65	92.67	92.54		91.23
73	93.29				92.24
74	94.04		94.13		
75	93.83		95.59		
76					94.81
77	96.69				96.37
78	97.11				
79					
80	97.73				97.65
81					
82					
83					
84	98.05				
85					
86	98.02				97.99

Table 4.--Soundings of cross sections, Badload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 4													
Date	May 8	May 27	May 28	May 29	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	93.12	95.51	96.25	96.77	96.14	95.47	95.88	95.89	94.30	93.97	96.51	94.70	92.08
Discharge (ft <sup>3</sup> /s)	200	814	1,150	1,480	1,100	822	985	980	448	371	1,220	560	40
ELEVATION, IN FEET													
Distance, in feet													
0	96.07												96.10
1													
2													
3													
4													
5													
6													95.43
7													
8	95.82												
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													94.64
21													
22													
23													
24	94.04												
25													
26													
27													
28													
29													92.44
30													
31													
32													
33													
34													
35													
36													92.96
37													
38													
39													
40													94.97
41													
42													
43													
44													
45													
46													
47	96.59												
48			96.15										94.26
49		95.51											
50	94.54	94.83	95.07		94.51								
51													
52		94.36	94.44		94.36	94.30	94.84	94.31	94.30		94.36		94.01
53	93.97												
54		93.80	93.33	93.91	93.84	93.55	93.85	93.66	93.94	93.84	93.56	93.85	93.80
55													
56	93.17	93.45	92.18	93.22	93.29	93.22	93.47	93.45	93.58	93.68	93.53	93.60	93.43
57	92.36												
58	91.82	92.20	92.16	93.21	92.29	91.95	92.18	92.05	92.17	92.21	92.51	92.21	92.08
59													
60	91.80	92.07	92.12	92.87	92.62	92.29	92.06	92.13	92.00	91.88	93.04	91.94	91.94



Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 4--Continued													
Date	May 8	May 27	May 28	May 29	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	93.12	95.51	96.25	96.77	96.14	95.47	95.88	95.89	94.30	93.97	96.51	94.70	92.08
Discharge (ft <sup>3</sup> /s)	200	814	1,150	1,480	1,100	822	985	980	448	371	1,220	560	40
ELEVATION, IN FEET													
Distance, in feet													
61													
62	91.77	92.01	92.40	92.58	92.59	92.32	92.17	91.77	91.80	91.74	92.89	91.88	91.67
63													
64	91.76	91.81	92.55	92.66	92.56	92.35	92.16	91.91	91.88	91.81	92.66	91.82	91.68
65													
66	92.00	92.33	92.77	92.75	92.49	92.27	92.08	92.10	92.05	91.97	92.61	92.02	91.86
67													
68	92.25	92.58	92.55	92.34	92.36	92.34	92.39	92.31	92.25	92.29	92.41	92.18	92.16
69													
70	92.34	92.64	92.50	92.47	92.33	92.28	92.27	92.23	92.25	92.24	92.66	92.27	92.12
71													
72	92.50	92.58	92.57	92.63	92.60	92.41	92.50	92.52	92.67	92.50	92.81	92.33	92.21
73													
74	92.60	92.73	92.68	92.74	92.72	92.62	92.66	92.74	92.73	92.69	92.91	92.72	92.42
75													
76	92.61	92.73	92.67	92.69	92.79	92.69	92.73	92.74	92.80	92.79	92.76	92.76	92.56
77													
78	92.65	92.79	92.77	92.80	92.68	92.57	92.70	92.69	92.73	92.68	92.71	92.65	92.60
79													
80	92.69	92.76	92.90	93.22	92.84	92.64	92.76	92.79	92.75	92.69	92.62	92.67	92.52
81													
82	92.43	92.61	92.65	92.95	92.67	92.55	92.59	92.57	92.68	92.61	92.61	92.63	92.57
83													
84	92.20	92.73	92.37	93.09	92.42	92.47	92.38	92.38	92.36	92.47	92.47	92.49	92.39
85													
86	91.99	92.53	92.17	92.36	92.20	92.08	92.12	92.13	92.17	92.11	92.16	92.20	92.22
87													
88	91.82	92.26	91.95	91.68	91.86	91.86	91.88	91.89	91.95	91.92	91.99	91.93	91.92
89													
90	91.60	92.13	91.87	91.66	91.72	91.63	91.72	91.71	91.72	91.71	91.76	91.76	91.71
91													
92	91.53	91.76	92.07	91.20	91.64	91.55	91.58	91.58	91.57	91.58	91.61	91.70	91.54
93													
94	91.45	91.75	91.80	91.27	91.42	91.47	91.44	91.51	91.52	91.42	91.49	91.58	91.47
95													
96	91.37	91.71	91.88	91.24	91.31	91.27	91.29	91.28	91.28	91.26	91.28	91.25	91.36
97													
98	91.24	91.53	91.50	91.06	91.24	91.25	91.26	91.31	91.28	91.19	91.23	91.32	91.15
99													
100	91.05	91.43	91.25	91.04	91.24	91.19	91.20	91.17	91.15	91.14	91.15	91.20	91.17
101													
102	90.94	91.09	91.05	90.94	91.02	91.04	91.06	91.00	91.05	91.02	91.08	91.09	91.04
103													
104	91.05	91.03	91.00	90.89	91.04	90.95	91.00	91.01	91.02	90.98	91.03	91.08	90.96
105													
106	91.28	91.29	91.31	91.38	91.42	91.35	91.38	91.39	91.48	91.30	91.37	91.29	91.10
107													
108	92.05	92.03	92.13	92.11	92.12	92.15	92.18	92.24	92.22	92.08	92.10	92.13	91.54
109													92.03
110		92.79	92.84	92.91	92.85	92.83	92.83	92.84	93.04	93.12	92.91	92.96	
111	93.12												
112		94.16	93.85		93.89	94.27	94.15	94.16	94.30	93.99	94.39	94.45	93.12
113	94.63												
114		95.09	95.00		94.94		94.98	95.64			95.67		94.18
115	95.58	95.51	96.25		95.40	95.47							95.33
116	97.95												
117													95.72
118	98.36												98.11
119													
120	98.36												98.35
121													
122													98.36

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 5												
Date	May 8	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.87	95.37	96.10	95.86	95.43	95.65	95.80	94.25	93.94	96.44	94.65	91.86
Discharge (ft <sup>3</sup> /s)	200	822	1,140	1,070	834	985	990	450	371	1,330	555	40
ELEVATION, IN FEET												
Distance, in feet												
0	95.78											95.77
1												
2	95.66											
3												
4												
5												95.62
6			95.74									
7												
8			95.68									95.61
9	95.53											
10		95.37	95.50	95.65		95.58	95.65			95.56		
11	95.04											
12	95.00	95.21	95.24	95.15	95.45	95.28	95.39			95.38		95.19
13												
14	93.96	94.37	95.02	94.97	94.89	94.64	94.30	94.25		94.42	94.50	
15									93.94			
16	93.88	94.03	94.46	95.08	94.95	94.73	94.23	93.83	93.78	94.18	93.60	93.28
17												
18	93.79	93.59	94.63	94.91	94.79	94.46	94.52	93.74	93.63	93.80	93.36	93.04
19												
20	93.69	93.59	94.29	94.60	94.43	94.16	93.68	93.50	93.42	93.44	93.51	92.96
21												
22	93.59	93.53	94.24	94.37	94.24	94.14	93.78	93.50	93.38	94.06	93.44	93.02
23												
24	93.49	93.33	93.63	94.44	94.11	94.13	93.70	93.53	93.15	94.03	93.47	92.86
25												
26	93.36	92.80	93.69	94.38	94.31	94.10	93.38	93.45	92.92	93.86	93.45	92.70
27												
28	93.27	92.29	93.69	94.33	94.25	93.90	93.26	93.30	92.86	93.61	93.13	92.60
29												
30	93.11	92.72	93.33	93.79	94.07	93.44	93.19	93.07	92.76	93.19	92.67	92.39
31												
32	92.96	92.15	93.02	93.26	93.99	93.29	92.99	92.67	92.60	92.74	93.01	92.16
33												
34	92.65	92.29	92.11	93.12	93.84	92.90	92.63	92.87	92.36	92.19	92.90	92.04
35												
36	92.18	92.20	91.81	92.97	93.48	92.93	92.44	92.83	92.35	92.26	92.85	91.80
37												
38	91.95	91.90	91.58	92.63	93.01	92.96	91.86	92.22	91.96	92.14	92.40	91.68
39												
40	91.47	91.67	91.70	92.00	92.19	92.36	91.41	91.64	91.67	92.04	91.90	91.62

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 5--Continued												
Date	May 8	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.87	95.37	96.10	95.86	95.43	95.65	95.80	94.25	93.94	96.44	94.65	91.86
Discharge (ft <sup>3</sup> /s)	200	822	1,140	1,070	834	985	990	450	371	1,330	555	40
ELEVATION, IN FEET												
Distance, in feet												
41												
42	91.18	91.49	90.98	91.44	91.77	91.74	91.08	91.43	91.41	91.44	91.60	91.46
43												
44	91.03	90.80	90.94	91.07	91.48	91.22	90.72	90.94	91.04	91.12	91.42	91.23
45												
46	90.76	90.75	90.92	91.13	91.23	90.81	90.52	90.35	90.36	90.79	90.75	90.93
47												
48	90.53	90.63	90.59	90.62	90.58	90.36	90.27	90.18	90.09	90.34	90.61	90.58
49												
50	90.37	90.35	90.14	89.97	89.99	89.85	89.85	89.87	89.98	89.94	89.93	90.13
51												
52	90.07	89.99	89.48	89.66	89.71	89.56	89.52	89.56	89.62	89.57	89.55	89.72
53												
54	89.70	89.34	89.38	89.60	89.55	89.48	89.46	89.50	89.49	89.52	89.35	89.38
55												
56	89.42	89.47	89.56	89.62	89.53	89.57	89.50	89.59	89.49	89.54	89.59	89.38
57												
58	89.49	89.67	89.65	89.83	89.80	89.75	89.63	89.73	89.74	89.82	89.87	89.64
59												
60	89.87	90.03	89.96	90.07	89.99	89.93	89.86	90.09	89.94	89.96	89.93	89.81
61												
62	90.09	90.11	90.06	90.38	90.28	90.26	90.24	90.31	90.24	90.19	90.31	90.09
63												
64	90.33	90.49	90.61	90.69	90.68	90.66	90.55	90.49	90.58	90.74	90.70	90.44
65												
66	90.82	91.00	91.03	91.20	91.01	91.07	91.01	91.05	91.09	91.12	91.11	90.87
67												
68	91.53	91.60	91.68	91.68	91.59	91.59	91.48	91.60	91.59	91.59	91.56	91.37
69												
70	92.00	91.96	91.51	92.50	92.43	92.32	92.44	91.95	91.79	92.25	91.85	91.65
71												
72	93.05	92.27	93.18	93.25	93.28	93.36	92.80	93.12	92.99	93.19	92.70	92.62
73												
74	93.34	93.64	93.46	93.58	93.22	93.55	93.59	93.69	93.78	93.57	93.75	93.03
75			94.06	96.00	93.78							
76	96.33	94.28						94.25	93.94	96.16		
77												96.11
78	96.60											
79												96.54
80												
81												
82												
83												
84												96.17
85	96.10											

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 6									
Date	May 8	May 27	May 28	May 31	June 2	June 5	June 7	June 10	July 10
Water surface elevation (feet)	92.68	95.20	95.90	95.26	95.50	95.56	93.94	93.71	91.39
Discharge (ft <sup>3</sup> /s)	200	822	1,140	846	985	995	460	371	40
ELEVATION, IN FEET									
Distance, in feet									
0	95.83								95.86
1									
2									
3	95.52								
4			95.50		95.47	95.42			95.45
5		95.20		95.26					
6	95.02	95.06	95.12	95.02	95.00	95.06			
7									
8	94.16	94.54	94.58	94.34	94.27	94.30			94.10
9									
10	92.74	93.82	93.62	93.28	92.94	93.16	93.74	93.55	89.85
11	91.39								
12	89.91	89.97	90.04	90.12	89.98	90.69	89.99	89.99	89.97
13	89.98								
14	90.25	90.13	90.25	90.63	90.52	90.84	90.09	90.11	90.19
15	90.69								
16	91.01	90.89	90.86	90.93	90.88	90.94	90.63	90.71	90.77
17									
18	90.94	90.73	90.93	91.09	90.88	91.09	90.77	90.76	90.70
19									
20	90.84	90.89	90.84	90.93	90.74	91.11	90.59	90.60	90.65
21									
22	90.95	90.83	91.22	91.19	90.91	91.08	90.84	90.78	90.66
23									
24	91.18	91.04	91.33	91.18	91.19	90.96	90.97	90.85	90.63
25									
26	91.28	91.16	91.38	91.08	90.99	91.04	90.66	90.63	90.67
27									
28	91.29	91.28	91.25	90.90	91.01	91.08	90.94	90.76	90.76
29									
30	91.19	91.14	91.13	91.20	90.95	90.88	91.12	90.85	90.84
31									
32	91.15	91.09	91.08	91.08	90.86	91.15	90.89	90.89	90.82
33									
34	90.95	90.92	91.18	91.14	90.98	91.31	90.84	90.82	90.91
35									

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 6--Continued									
Date	May 8	May 27	May 28	May 31	June 2	June 5	June 7	June 10	July 10
Water surface elevation (feet)	92.68	95.20	95.90	95.26	95.50	95.56	93.94	93.71	91.39
Discharge (ft <sup>3</sup> /s)	200	822	1,140	846	985	995	460	371	40
ELEVATION, IN FEET									
Distance, in feet									
36	90.87	91.03	91.22	91.08	90.98	91.30	90.86	90.93	90.94
37									
38	90.99	90.92	91.01	91.04	90.95	91.26	90.85	90.85	90.92
39									
40	91.00	90.88	91.58	91.25	91.31	91.29	90.99	90.91	90.97
41									
42	91.03	90.92	91.93	91.48	91.08	91.19	91.07	91.10	90.98
43									
44	91.03	90.90	92.06	91.86	91.17	91.26	91.08	91.11	91.03
45									
46	91.15	90.95	92.38	91.94	91.60	91.42	91.09	91.18	91.06
47									
48	91.31	91.28	92.25	91.96	91.68	91.48	91.26	91.36	91.32
49									
50	91.78	91.78	92.15	92.21	91.77	91.86	91.63	91.73	91.74
51									
52	92.14	92.09	92.23	92.40	92.15	92.24	92.08	92.19	92.07
53									
54	92.51	92.47	92.52	92.66	92.50	92.46	92.41	92.55	92.44
55									
56	92.56	92.53	92.65	92.71	92.63	92.61	92.47	92.61	92.52
57									
58	92.67	92.62	92.73	92.81	92.65	92.66	92.62	92.66	92.10
59									
60	92.47	92.53	92.56	92.62	92.51	92.46	92.49	92.51	92.45
61									
62	92.35	92.33	92.32	92.43	92.30	92.38	92.38	92.44	92.27
63									
64	92.13	92.07	92.30	92.31	92.18	92.26	92.26	92.34	92.11
65									
66		92.10	92.21	92.26	92.12	92.14	92.09	92.08	92.02
67	92.18								92.21
68	92.71	92.92	93.25	93.30	93.29	93.18	93.19	92.71	
69									
70	94.20	94.28	94.25	94.02	94.58	94.28	93.94	93.71	94.07
71									
72		94.88	94.97		94.88				
73	94.92								94.88
74		94.92	95.09						
75	95.01								94.95

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 7									
Date	May 8	May 27	May 31	June 2	June 5	June 7	June 10	June 22	July 10
Water surface elevation (feet)	92.48	95.09	95.03	95.48	95.51	93.82	93.51	94.17	91.24
Discharge (ft <sup>3</sup> /s)	200	818	846	985	1,000	460	371	548	40
ELEVATION, IN FEET									
Distance, in feet									
0	95.65								95.62
1									
2									
3									
4									95.72
5	95.74								
6	94.28	94.21	93.53	93.76	93.45	93.82		93.97	94.06
7	93.30						93.51		
8		93.80	93.26	92.70	92.68	92.82	93.01	92.95	92.45
9	93.44								
10	92.06	92.22	91.96	91.86	91.81	91.70	92.21	91.99	91.63
11									
12	91.25	91.53	91.38	91.40	91.29	91.39	91.39	91.34	91.06
13									
14	90.46	90.76	90.80	90.88	90.70	90.85	90.90	90.95	90.74
15									
16	89.99	90.17	90.45	90.40	90.44	90.44	90.54	90.64	90.17
17									
18	89.78	90.11	90.22	90.17	90.06	90.17	90.20	90.25	89.94
19									
20	89.57	89.58	89.85	89.90	89.84	89.87	89.93	89.89	89.63
21									
22	89.46	89.54	89.73	89.60	89.61	89.64	89.64	89.70	89.45
23									
24	89.44	89.65	89.73	89.66	89.62	89.74	89.53	89.67	89.50
25									
26	89.46	89.96	89.85	89.78	89.69	89.72	89.61	89.79	89.67
27									
28	89.88	90.01	89.98	89.84	89.93	89.87	89.81	89.92	89.84
29									
30	90.15	90.15	90.14	89.99	89.99	89.82	90.12	89.95	90.00
31									
32	90.35	90.18	90.69	90.10	90.12	89.97	90.36	90.19	90.18
33									
34	90.64	90.13	91.18	90.48	90.16	90.22	90.66	90.42	90.26
35									
36	90.35	90.09	90.88	90.81	90.24	90.22	90.64	90.47	90.34
37									
38	90.75	90.19	91.81	91.18	90.63	90.40	90.41	90.52	90.53
39									
40	90.89	90.27	91.13	91.43	90.69	90.72	90.78	90.57	90.57



Table 4.--Soundings of cross sections, BedLoad Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 7--Continued									
Date	May 8	May 27	May 31	June 2	June 5	June 7	June 10	June 22	July 10
Water surface elevation (feet)	92.48	95.09	95.03	95.48	95.51	93.82	93.51	94.17	91.24
Discharge (ft <sup>3</sup> /s)	200	818	846	985	1,000	460	371	548	40
ELEVATION, IN FEET									
Distance, in feet									
41									
42	90.83	90.61	91.28	91.48	90.83	90.82	91.30	90.58	90.58
43									
44	91.02	90.74	91.05	91.27	90.98	90.87	91.71	90.70	90.74
45									
46	91.11	90.92	91.16	91.54	90.96	90.96	91.81	90.79	90.89
47									
48	91.18	90.97	91.28	91.68	91.09	91.22	91.51	91.12	90.80
49									
50	91.24	91.19	91.45	91.87	91.51	91.70	91.76	91.57	91.10
51									
52	91.16	91.56	91.46	92.23	91.86	91.92	91.91	92.17	90.80
53									91.50
54	91.80	91.85	91.85	92.81	92.36	92.34	92.26	92.72	
55	92.99								92.95
56		93.28	93.33	93.30			93.21	93.29	
57									
58		93.37	93.33				93.23	93.40	93.20
59									
60		93.34	93.46						
61									
62		93.37	93.68				93.26		
63									
64	93.22	93.63	93.73						
65									
66		93.77	94.13			93.82			93.40
67									
68	93.88	94.09							
69									
70		94.39							
71									94.35
72		94.54							
73									
74		94.73							
75									
76	94.81	94.95							
77		95.09							
78	95.04								95.04

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 8										
Date	May 8	May 27	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.39	94.85	94.74	95.20	95.26	93.70	93.39	95.92	93.96	91.20
Discharge (ft <sup>3</sup> /s)	200	818	846	985	1,000	465	369	1,300	540	40
ELEVATION, IN FEET										
Distance, in feet										
0	95.56									95.58
1										
2										
3										
4										
5	95.36									95.45
6										
7										
8	95.13									95.11
9										
10		94.85	94.74	94.57	94.54					
11	93.60					93.70				93.50
12	91.00	93.21	93.02	93.20	93.21	92.78	92.57	92.98	93.12	91.38
13	90.95									91.20
14		91.35	90.93	91.07	90.88	91.17	91.14	91.01	91.04	90.83
15	90.73									
16		90.70	90.69	90.65	90.16	90.12	90.57	90.30	90.34	90.05
17	90.62									
18		90.53	90.49	90.08	89.76	90.11	89.71	90.06	89.63	89.56
19	90.31									
20		90.26	90.24	89.76	89.68	89.62	89.58	89.72	89.46	89.48
21	89.93									
22		90.13	89.76	89.20	89.00	89.27	89.51	89.24	88.96	89.38
23	89.75									
24		89.94	89.88	88.77	88.86	88.92	89.55	88.88	88.84	89.29
25	89.57									
26		89.90	89.79	89.02	88.81	89.00	89.69	89.07	88.81	89.20
27	89.59									
28		89.98	89.89	89.22	89.21	89.20	89.84	89.17	88.99	89.50
29	89.62									
30		89.95	89.93	89.58	89.46	89.18	89.53	89.29	89.26	89.52
31	89.76									
32		90.04	90.19	89.90	89.86	89.47	89.77	89.52	89.26	89.59
33	89.99									
34		90.05	90.13	90.24	90.04	89.85	89.84	89.91	89.38	89.73
35	90.05									

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 8--Continued										
Date	May 8	May 27	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.39	94.85	94.74	95.20	95.26	93.70	93.39	95.92	93.96	91.20
Discharge (ft <sup>3</sup> /s)	200	818	846	985	1,000	465	369	1,300	540	40
ELEVATION, IN FEET										
Distance, in feet										
36		90.09	90.42	90.72	89.98	89.97	90.29	89.97	89.74	89.94
37	90.34									
38		90.15	90.69	90.52	90.12	89.90	90.09	89.90	89.92	90.07
39	90.37									
40		90.12	90.96	90.48	90.57	89.82	90.29	89.77	89.80	90.22
41	90.29									
42		90.17	90.72	90.18	90.86	89.83	90.52	89.60	89.88	90.38
43	90.31									
44		90.46	90.13	90.20	90.76	90.07	90.27	89.60	89.74	90.46
45	90.57									
46		90.52	90.54	90.44	90.64	89.88	90.18	89.58	90.01	90.29
47	90.84									
48		90.56	90.17	90.48	90.70	90.39	90.27	89.75	90.21	90.19
49	90.94									
50		90.58	90.34	90.80	90.76	90.65	90.62	89.92	90.37	90.16
51	90.83									
52		90.69	90.84	90.92	90.98	90.87	90.85	90.24	90.46	90.14
53	91.08									
54		90.87	90.86	91.22	91.11	91.11	90.71	90.70	90.46	90.58
55	91.30									
56	92.23	91.73	91.28	91.38	91.53	92.58	91.21	91.24	91.14	91.38
57										
58	92.35	92.94	92.48	92.67	92.83	92.77	92.73	92.32	92.58	92.33
59	93.40	94.85				93.00	93.39			
60	94.80		94.74	94.89	94.91			94.86	93.96	94.77
61	94.78									
62								94.85		94.81
63										
64										94.43
65										
66										93.92
67										
68										
69										
70										93.99
71										
72										
73										94.43

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 9												
Date	May 8	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.38	94.79	95.40	95.17	94.69	95.12	95.12	93.69	93.38	95.75	93.91	91.20
Discharge (ft <sup>3</sup> /s)	200	822	1,150	1,050	858	985	1,000	470	367	1,390	538	40
ELEVATION, IN FEET												
Distance, in feet												
0	95.12		95.22									95.06
1												
2			95.28									95.11
3												
4			94.80									94.77
5												
6	94.82		94.85									
7												
8			94.93									94.99
9	94.79											94.91
10		94.63	95.40		94.69	94.92	94.72			94.77		
11	93.84											
12	92.41	93.29	92.13	93.17	93.44	93.12	93.20	93.69	93.38	93.28	93.22	93.36
13	90.42											90.18
14		90.69	89.98	90.15	90.01	90.56	90.03	90.57	90.70	89.92	90.11	90.08
15	90.39											
16		90.60	89.82	89.84	90.16	90.53	89.86	90.84	90.88	89.84	90.19	90.38
17	90.43											
18		90.47	89.62	89.65	90.10	90.42	89.72	90.82	90.86	89.71	90.16	90.46
19	90.45											
20		90.41	89.59	89.52	90.19	89.94	89.55	90.86	90.88	89.60	90.09	90.56
21	90.46											
22		90.70	89.50	89.41	90.09	89.90	89.54	90.94	90.81	89.57	90.13	90.85
23	90.48											
24		90.91	89.44	89.47	89.99	89.89	89.72	90.89	90.90	89.65	90.46	90.43
25	90.44											
26		90.89	89.47	89.47	89.87	89.75	89.72	90.84	90.48	89.54	90.41	90.40
27	90.47											
28		91.01	89.53	89.49	89.65	89.98	89.52	90.79	90.45	89.56	90.36	90.34
29	90.13											
30		90.79	89.62	89.53	89.63	89.93	89.61	90.57	90.28	89.52	90.09	90.29
31	90.13											
32		90.59	89.50	89.57	89.67	89.92	89.56	90.07	90.03	89.47	90.03	90.20
33	90.05											
34		90.31	89.47	89.57	89.65	89.86	89.47	89.77	89.54	89.49	89.73	90.10
35	89.83											

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 9--Continued												
Date	May 8	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.38	94.79	95.40	95.17	94.69	95.12	95.12	93.69	93.38	95.75	93.91	91.20
Discharge (ft <sup>3</sup> /s)	200	822	1,150	1,050	858	985	1,000	470	367	1,390	538	40
ELEVATION, IN FEET												
Distance, in feet												
36		90.21	89.37	89.51	89.54	89.57	89.49	89.54	89.82	89.41	89.63	89.96
37	89.79											
38		89.99	89.49	89.47	89.57	89.66	89.50	89.81	89.74	89.47	89.53	89.66
39	89.60											
40		89.87	89.65	89.64	89.67	89.70	89.57	89.79	89.68	89.63	89.66	89.50
41	89.82											
42		89.79	89.71	89.67	89.71	89.68	89.71	89.69	89.78	89.66	89.71	89.64
43	89.78											
44		89.84	89.71	89.77	89.78	89.74	89.75	89.81	89.81	89.73	89.79	89.69
45	89.79											
46		89.76	89.75	89.77	89.82	89.82	89.77	89.82	89.78	89.77	89.73	89.74
47	89.84											
48		89.92	89.88	89.82	89.89	89.89	89.80	89.94	89.78	89.86	89.96	90.05
49	89.91											
50		89.90	89.90	89.92	89.91	89.92	89.81	89.97	89.73	89.88	89.83	89.83
51	90.06											
52		89.89	90.00	90.02	89.86	89.93	89.74	89.97	89.78	89.94	89.81	89.83
53	90.10											
54		90.00	89.99	89.89	89.87	89.90	89.74	89.93	89.86	89.86	89.83	89.85
55	90.06											
56		90.11	90.12	90.32	89.87	90.12	89.82	89.82	89.80	90.40	89.81	89.91
57	90.60											
58		90.10	90.52	90.34	90.45	90.54	90.34	90.48	90.58	90.48	90.44	90.43
59	93.25								93.38			90.80
60		93.79	93.76	93.79	93.81	93.78	93.75	93.69		93.97	93.91	93.60
61	94.10											
62	94.24	94.23	94.23	94.17	94.18	94.24	94.12			94.25		94.18
63												
64		94.25	94.23									94.27
65												
66		93.96	93.88									94.07
67												
68		94.66	93.78									93.78
69												
70		94.11	94.18									94.07
71												
72		94.17	94.18									
73												94.13
74		94.22	94.18									

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 10													
Date	May 8	May 26	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.24	93.13	94.54	95.34	95.06	94.60	94.99	95.08	93.59	93.27	95.68	93.84	96.19
Discharge (ft <sup>3</sup> /s)	200	350	774	1,130	1,040	866	985	1,000	462	367	1,370	535	40
ELEVATION, IN FEET													
Distance, in feet													
0	95.07												95.18
1													
2													94.99
3	94.66												
4													
5	94.08			94.18									94.11
6				94.22									
7	94.09												93.99
8	94.52			94.36			94.51						
9													94.55
10	94.31		94.50	94.57	94.57	94.45	94.47				94.58		
11	93.53												93.65
12		92.33	93.57	93.69	93.86	93.77	92.40	92.18	92.85	92.60	92.24	92.84	91.15
13	90.70												
14	90.35	90.41	90.23	90.21	90.22	90.20	90.17	90.30	90.28	90.51	90.17	90.53	90.28
15													
16	89.79	89.73	89.91	89.87	89.52	89.78	89.77	89.63	89.64	89.79	90.03	89.66	90.02
17													
18	89.45	89.61	89.25	89.36	89.26	89.31	89.03	89.20	88.87	89.56	88.80	89.08	89.28
19													
20	89.40	89.65	89.00	89.04	89.03	89.00	88.93	89.19	89.44	89.62	88.93	89.06	89.28
21													
22	89.58	89.74	89.65	88.92	88.80	88.89	88.71	88.97	89.54	89.52	88.63	89.09	89.36
23													
24	89.85	89.73	89.63	88.87	88.88	88.99	89.48	89.08	89.54	89.37	88.76	89.36	89.45
25													
26	89.81	89.70	89.65	89.06	88.96	89.32	89.79	89.12	89.80	89.39	88.83	89.59	89.59
27													
28	89.79	89.63	89.70	89.06	89.12	89.16	89.89	89.11	89.71	89.77	89.08	89.54	89.58
29													
30	89.32	89.60	89.65	89.21	89.11	89.25	89.79	89.18	89.79	90.27	89.08	89.78	89.65
31													
32	89.44	89.62	89.60	89.08	89.06	89.20	89.89	89.18	89.44	90.22	89.08	89.80	89.68
33													
34	89.40	89.45	89.50	89.16	89.06	89.10	89.94	89.18	89.51	89.54	89.10	89.61	89.15
35													



Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 10--Continued													
Date	May 8	May 26	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.24	93.13	94.54	95.34	95.06	94.60	94.99	95.08	93.59	93.27	95.68	93.84	96.19
Discharge (ft <sup>3</sup> /s)	200	350	774	1,130	1,040	866	985	1,000	462	367	1,370	535	40
ELEVATION, IN FEET													
Distance, in feet													
36	89.31	89.43	89.15	89.07	88.98	89.05	89.57	89.23	89.59	89.65	89.16	89.34	89.65
37													
38	89.09	89.26	89.00	89.07	89.06	89.12	89.22	89.13	89.22	89.57	89.18	89.14	89.48
39													
40	89.30	89.38	89.05	89.03	89.05	89.08	89.16	88.96	89.19	89.47	89.08	89.19	89.20
41													
42	89.06	89.29	89.18	89.22	89.16	89.19	89.14	89.14	89.17	89.22	89.03	89.29	89.11
43													
44	89.55	89.43	89.67	89.75	89.76	89.60	89.69	89.60	89.63	89.57	89.60	89.82	89.59
45													
46	90.26	90.23	90.28	90.55	90.24	90.50	90.57	90.33	90.68	90.27	90.03	90.34	90.06
47													
48	91.44	90.52	90.95	91.57	92.03	91.05	90.99	91.95	92.23	91.09	90.78	92.06	91.03
49	93.44	93.13								93.27			93.58
50			93.69	93.83	93.54	93.75	93.84	93.71			93.83		
51	93.71												
52			93.82	93.90	94.06	93.88	93.84	94.03			93.93		93.92
53	93.84												
54			93.82	93.66			93.87						
55													93.89
56			92.45	93.56									93.59
57													
58			93.65	93.72									
59													93.77
60													
61													
62													
63													
64													92.84
65													
66													
67													
68													
69													
70													94.34
71													
72													
73													
74													94.79

Table 4.--Soundings of cross sections, Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION NO. 11												
Date	May 8	May 27	May 28	May 30	May 31	June 2	June 5	June 7	June 10	June 14	June 22	July 10
Water surface elevation (feet)	92.25	94.57	95.28	95.05	94.61	95.00	95.10	93.61	93.24	95.66	93.81	91.18
Discharge (ft <sup>3</sup> /s)	200	800	1,120	1,030	866	985	1,000	475	365	1,370	535	40
ELEVATION, IN FEET												
Distance, in feet												
0	95.34											95.36
1												
2												95.44
3												
4												
5												95.39
6												
7												
8	95.13	94.26				93.37		93.45	93.24			94.98
9			94.93		94.61							
10	92.82	93.72	92.76	92.82	94.20	94.18	94.10	93.61	92.84	92.79	92.99	
11	92.28											
12		91.17	90.57	92.43	91.08	92.68	90.92	91.74	92.69	90.81	91.46	91.10
13	90.76											
14		90.66	90.50	90.52	90.69	90.61	90.56	90.61	90.59	90.48	90.59	90.53
15	90.34											
16		90.29	90.12	90.21	90.12	90.20	90.10	90.17	90.28	90.06	90.23	90.12
17	90.01											
18		89.94	89.75	89.75	89.88	89.86	89.88	89.93	89.82	89.78	89.97	89.84
19	89.64											
20		89.19	89.23	88.95	89.10	89.18	89.21	89.28	89.41	89.17	89.31	89.15
21	89.58											
22		89.15	88.63	88.65	88.67	88.97	88.71	88.69	88.66	88.49	88.72	88.62
23	89.76											
24		89.29	88.68	88.32	88.48	88.35	88.82	88.65	88.43	88.36	88.49	88.60
25	89.74											
26		89.42	88.92	88.23	88.32	88.70	89.05	88.83	88.64	88.24	88.41	88.93
27	89.79											
28		89.67	89.48	88.30	88.59	89.25	89.20	89.01	88.86	88.35	88.93	89.14
29	89.34											
30		89.73	89.60	88.55	88.52	89.40	89.45	89.46	89.06	88.79	89.16	89.46
31	89.68											
32		89.95	89.81	88.63	89.11	89.70	89.72	89.74	89.52	89.16	89.51	89.71
33	89.70											
34		90.19	90.09	89.05	89.61	90.05	89.75	90.06	90.08	89.19	89.76	90.00
35	89.61											
36		90.39	90.30	89.22	89.79	90.19	90.05	90.13	90.32	89.54	90.24	90.11
37	90.21											
38		90.47	90.41	89.64	90.11	90.48	90.12	90.29	90.49	89.74	90.33	90.15
39	90.44											
40		90.69	90.33	90.05	90.14	90.62	90.42	90.45	90.29	90.11	90.53	90.30
41	90.42											
42		90.87	90.45	90.30	90.30	90.55	90.52	90.67	90.51	90.41	90.91	90.50
43	90.37											
44		91.09	90.83	90.57	90.56	90.94	90.69	90.83	90.72	90.64	90.96	90.67
45	90.47											
46		91.12	90.80	90.65	90.73	91.05	90.80	90.83	90.81	90.73	90.91	90.80
47	90.64											
48		91.54	90.86	90.75	90.77	91.20	90.82	90.83	91.05	90.77	90.94	90.86
49	90.79											
50		91.59	90.95	90.92	90.97	91.24	90.90	90.91	91.04	90.85	90.97	90.92
51	90.87											
52		91.70	91.16	90.93	90.76	91.41	90.92	90.91	91.04	90.85	91.03	90.92
53	90.89											
54		91.45	91.47	91.17	90.99	91.30	91.10	91.11	91.10	90.87	90.96	90.82
55	90.86											
56		92.39	92.19	92.55	92.61	92.25	92.51	92.86	92.42	92.20	92.29	91.19
57	92.89							93.61	93.24			
58		93.61	93.60	93.71	93.69	93.64	93.82				93.81	93.52
59	93.69											
60		93.93	93.85	93.99	93.84	93.95	93.99					
61	93.92											93.86
62			93.84			93.90						

Table 5.--Summary data of total-energy water slopes, Bedload Trap reach, East Fork River, May-July 1974

Date		May 8			May 26			May 27			May 28		
Discharge (ft <sup>3</sup> /s)		200			385			750			1,150		
Cross sec- tion no.	Distance (feet)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)
1	0	93.43	93.50	0.18	94.33	94.43	0.26	95.72	95.89	0.25	96.63	96.82	0.23
2	200												
3	225	93.26	93.32	.06	94.09	94.17	-----	95.51	95.64	-----	96.41	96.59	-----
4	340	93.12	93.26		94.05	94.25		95.40	95.67		96.28	96.61	
5	572	92.87	92.97	.29	94.00	94.13	.12	95.26	95.46	.21	96.05	96.35	.26
6	690	92.68	92.80		93.82	93.96		95.11	95.31		95.86	96.13	
7	996	92.48	92.56	.17	93.54	93.66	.30	94.92	95.12	.19	95.77	96.03	.10
8	1,072	92.39	92.47		93.44	93.57		-----	-----		95.57	95.88	
9	1,212	92.38	92.44	.09	93.40	93.50	.12	94.63	94.86	.26	95.43	95.73	.15
10	1,254	92.24	92.31		93.32	93.46		94.52	94.81		95.36	95.80	
11	1,360	92.23	92.29	.13	93.27	93.39	.07	94.49	94.72	.05	95.36	95.67	-----

Mean Energy<sup>1</sup>  
Slope of reach  
( $\bar{S}_e$ )

$$\bar{S}_e = 0.00093$$

$$\bar{S}_e = 0.00078$$

$$\bar{S}_e = 0.00098$$

$$\bar{S}_e = 0.00085$$

Table 5.--Summary data of total-energy water slopes, Bedload Trap reach, East Fork River, May-July 1974--Continued

Date		May 29			May 30			May 31			June 1		
Discharge (ft <sup>3</sup> /s)		1,600			1,240			886			910		
Cross sec- tion no.	Distance (feet)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)
1	0	97.25	97.48	0.28	96.58	96.79	0.17	95.84	96.01	0.14	95.89	96.06	0.04
2	200												
3	225	96.96	97.20	.09	96.51	96.60	----	95.73	95.87	----	95.87	96.02	.01
4	340	96.79	97.11		96.35	96.69		95.67	95.93		95.72	96.01	
5	572	96.60	96.99	.12	96.17	96.49	.20	95.48	95.77	.16	-----	-----	.54
6	690	96.34	96.65		96.00	96.27		95.36	95.59		-----	-----	
7	996	-----	-----	.19	95.79	96.06	.22	95.14	95.38	.18	-----	-----	-----
8	1,072	96.05	96.46		-----	-----		94.85	95.12		-----	-----	
9	1,212	95.88	96.29	.17	95.43	95.75	----	94.73	94.96	.16	94.85	95.09	-----
10	1,254	95.81	96.37		95.35	95.82		94.66	94.96		94.75	95.07	
11	1,360	95.78	96.20	.17	95.36	95.70	.12	94.66	94.89	.07	94.75	95.00	.07
		$\bar{S}_e = 0.00091$			$\bar{S}_e = 0.00085$			$\bar{S}_e = 0.00092$			$\bar{S}_e = 0.00085$		

Table 5.--Summary data of total-energy water slopes, Bedload Trap reach, East Fork River, May-July 1974--Continued

Date		June 2			June 3			June 4			June 9		
Discharge (ft <sup>3</sup> /s)		960			1,100			1,040			273		
Cross sec- tion no.	Distance (feet)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)
69	1	0	96.03	96.20	96.36	96.54	0.09	96.21	96.39	0.16	-----	-----	-----
	2	200		0.09			0.09						----
	3	225	95.96	96.11	96.28	96.45	-----	96.07	96.23	-----	93.57	93.62	-----
	4	340	95.83	96.13	96.15	96.47	.08	96.01	96.32	.12	93.50	93.67	.12
	5	572	95.78	96.05	96.04	96.34	.43	95.91	96.20	.19	93.44	93.55	.55
	6	690	-----	-----	95.87	96.13	.21	95.76	96.01	.19	-----	-----	-----
	7	996	95.39	95.62	95.73	95.98	.15	95.72	95.96	.05	-----	-----	-----
	8	1,072	95.11	95.38	95.49	95.80	.24	95.36	95.65	.31	92.90	93.00	-----
	9	1,212	95.04	95.29	95.35	95.64	.09	95.26	95.53	.13	92.89	93.00	-----
	10	1,254	94.91	95.27	95.26	95.69	.02	-----	-----	.09	92.83	92.93	.07
	11	1,360	94.91	95.18	95.29	95.60	.09	95.15	95.44	-----	92.81	92.91	.02
		$\bar{S}_e = 0.00082$			$\bar{S}_e = 0.00076$			$\bar{S}_e = 0.00071$			$\bar{S}_e = 0.00073$		

Table 5.--Summary data of total-energy water slopes, Bedload Trap reach, East Fork River, May-July 1974--Continued

Date		June 10			June 12			June 14			June 22		
Discharge (ft <sup>3</sup> /s)		369			850			1,380			556		
Cross sec- tion no.	Distance (feet)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)
1	0	94.24	94.34	0.21	95.83	95.99	0.26	96.96	97.17	0.26	94.92	95.04	0.18
2	200												
3	225	94.06	94.13	-----	95.59	95.73	-----	96.71	96.91	-----	94.77	94.86	-----
4	340	93.96	94.15		95.57	95.86		96.56	96.97		94.72	94.96	
5	572	93.90	94.03	.12	-----	-----	.45	96.46	96.81	.16	94.65	94.83	.13
6	690	93.71	93.85	.18			-----	-----	-----	.41	-----	-----	.43
7	996	93.50	93.63	.22			-----			-----			-----
8	1,072	93.39	93.51	.12	94.97	95.22	.21	95.95	96.27	.13	-----	-----	.26
9	1,212	93.38	93.48	.03	94.93	95.15	.07	95.76	96.12	.15			-----
10	1,254	93.29	93.42	.06	94.80	95.10	.05	95.68	96.17	-----	93.89	94.09	.05
11	1,360	93.26	93.38	.04	94.82	95.07	.03	95.66	96.07	.10	93.88	94.05	.04
		$\bar{S}_e = 0.00073$			$\bar{S}_e = 0.00067$			$\bar{S}_e = 0.00083$			$\bar{S}_e = 0.00078$		



Table 5.--Summary data of total-energy water slopes, Bedload Trap reach, East Fork River, May-July 1974--Continued

Date		July 10		
Discharge (ft <sup>3</sup> /s)		40		
Cross sec- tion no.	Distance (feet)	Water surface ele- vation (ft)	Total energy head (ft)	Energy head loss (ft)
1	0	92.38	92.39	0.07
2	200			
3	225	92.31	92.32	.23
4	340	92.08	92.09	.22
5	572	91.86	91.87	.45
6	690	91.39	91.42	.16
7	996	91.24	91.26	.05
8	1,072	91.20	91.21	----
9	1,212	91.20	91.21	.01
10	1,254	91.19	91.20	.01
11	1,360	91.18	91.19	
$\bar{S}_e = 0.00101$				

<sup>1</sup>The mean energy slope of the reach was calculated by a least-squares regression.

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974

CROSS SECTION 1F									
[Distance, 0 + 00 feet; active bed-stations, 18 to 86 feet]									
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>	
May 8	1	93.43	200	96	74	1.30	2.08	92.13	
May 28	21	96.63	1,150	335	88	3.81	3.43	92.31	
May 30	23	96.27	1,080	306	87	3.52	3.53	92.32	
May 31	24	95.66	814	245	85	2.88	3.32	92.45	
June 2	26	96.05	975	272	86	3.16	3.58	92.55	
June 5	29	96.08	975	281	86	3.27	3.47	92.48	
June 7	31	94.46	435	139	78	1.78	3.13	92.58	
June 10	34	94.25	303	137	77	1.78	2.21	92.37	
June 14	38	96.88	1,300	352	89	3.96	3.69	92.43	
June 22	46	94.90	560	184	85	2.16	3.04	92.48	
July 10	64	92.38	40					92.23	

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 2S								
[Distance, 2 + 00 feet; active bed-stations, 24 to 52 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 26	19	94.11	398	146	41	3.56	2.73	90.3
May 27	20	95.50	759	250	54	4.63	3.04	89.2
May 28	21	96.33	1,120	325	63	5.16	3.45	88.4
May 29	22	97.00	1,580	358	63	5.68	4.42	88.3
June 5	29	96.10	1,000	315	58	5.43	3.17	88.1
June 9	33	93.60	275	156	40	3.90	1.76	89.2
June 14	38	96.60	1,280	334	63	5.30	3.83	88.5
July 10	64	92.26	40	43	37	1.16	.93	91.4

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

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CROSS SECTION 3S								
[Distance, 2 + 25 feet; active bed-stations, 26 to 70 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	93.26	200	105	48	2.19	1.90	91.00
May 24	17	92.67	104	88	47	1.87	1.18	90.75
May 27	20	95.59	810	276	66	4.18	2.93	90.20
May 29	22	96.85	1,560	400	69	5.80	3.90	89.86
July 10	64	92.26	40	86	49	1.76	.47	90.50

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Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 4F								
[Distance, 3 + 40 feet; active bed-stations, 58 to 104 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $d$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	93.12	200	66	54	1.22	3.03	91.89
May 27	20	95.51	814	194	66	2.94	4.20	92.16
May 28	21	96.25	1,150	249	70	3.56	4.62	92.18
May 29	22	96.77	1,480	278	71	3.92	5.32	92.18
May 30	23	96.14	1,100	244	69	3.54	4.51	92.11
May 31	24	95.74	822	203	66	3.08	4.05	92.00
June 2	26	95.88	985	226	68	3.32	4.36	92.01
June 5	29	95.89	980	230	68	3.38	4.26	91.98
June 7	31	94.30	448	125	60	2.08	3.58	91.99
June 10	34	93.97	371	111	58	1.91	3.34	91.95
June 14	38	96.51	1,220	258	70	3.69	4.73	92.19
June 22	46	94.70	560	153	62	2.47	3.66	91.99
July 10	64	92.08	40					91.89

Table 6.--*Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued*

CROSS SECTION 5F								
[Distance, 5 + 22 feet; active bed-stations, 16 to 66 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	92.87	200	78	39	2.00	2.56	91.66
May 27	20	95.37	822	225	63	3.57	3.65	91.55
May 28	21	96.10	1,140	261	70	3.73	4.37	91.75
May 30	23	95.86	1,070	231	68	3.40	4.63	92.12
May 31	24	95.43	834	193	63	3.06	4.32	92.20
June 2	26	95.65	985	224	66	3.39	4.40	91.99
June 5	29	95.80	990	244	66	3.70	4.06	91.66
June 7	31	94.25	450	147	61	2.41	3.06	91.66
June 10	34	93.94	371	137	60	2.28	2.71	91.54
June 14	38	96.44	1,330	284	71	4.00	4.68	91.76
June 22	46	94.65	555	170	63	2.70	3.26	91.71
July 10	64	91.86	40	43	35	1.23	.93	91.38



Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 6F								
[Distance, 6 + 90 feet; active bed-stations, 12 to 42 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	92.68	200	73	48	1.52	2.74	91.13
May 27	20	95.20	822	231	69	3.35	3.56	91.06
May 28	21	95.90	1,140	266	76	3.50	4.29	91.40
May 31	24	95.26	846	217	69	3.14	3.90	91.33
June 2	26	95.50	985	249	70	3.56	3.96	91.14
June 5	29	95.56	995	248	70	3.54	4.01	91.27
June 7	31	93.94	460	150	61	2.46	3.07	90.98
June 10	34	93.71	371	138	61	2.26	2.69	90.99
July 10	64	91.39	40	25	39	.64	1.60	90.96

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 7F									
[Distance, 9 + 96 feet; active bed-stations, 12 to 52 feet]									
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>	
May 8	1	92.48	200	88	45	1.96	2.27	90.43	
May 27	20	95.09	818	229	64	3.58	3.57	90.40	
May 31	24	95.03	846	214	64	3.34	3.95	90.74	
June 2	26	95.48	985	247	65	3.80	3.99	90.75	
June 5	29	95.51	1,000	264	65	4.06	3.79	90.49	
June 7	31	93.82	460	155	60	2.58	2.97	90.50	
June 10	34	93.51	371	123	48	2.56	3.02	90.69	
June 22	46	94.17	548	169	63	2.68	3.24	90.53	
July 10	64	91.24	40	39	41	.95	1.03	90.32	

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 8S								
[Distance, 10 + 72 feet; active bed-stations, 14 to 54 feet]								
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	92.39	200	90	47	1.91	2.20	90.32
May 27	20	94.85	818	201	51	3.94	4.07	90.34
May 31	24	94.74	846	200	52	3.85	4.17	90.36
June 2	26	95.20	985	230	53	4.34	4.28	90.24
June 5	29	95.26	1,000	240	53	4.53	4.17	90.10
June 7	31	93.70	465	163	49	3.33	2.85	89.92
June 10	34	93.39	369	143	48	2.98	2.58	90.13
June 14	38	95.92	1,300	285	54	5.28	4.56	89.77
June 22	46	93.96	540	186	50	3.72	2.90	89.74
July 10	64	91.20	40	53	42	1.26	.75	89.93

Table 6.--Summary data of hydraulic characteristics of cross sections in  
the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 9S									
[Distance, 12 + 12 feet; active bed-stations, 14 to 58 feet]									
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed ele- vation (ft) <sup>3</sup>	
May 8	1	92.38	200	104	47	2.21	1.92	90.13	
May 27	20	94.79	822	213	52	4.10	3.86	90.29	
May 28	21	95.40	1,150	270	54	5.00	4.26	89.72	
May 30	23	95.17	1,050	256	53	4.83	4.10	89.73	
May 31	24	94.69	858	226	52	4.35	3.80	89.87	
June 2	26	95.12	985	244	53	4.60	4.04	89.96	
June 5	29	95.12	1,000	256	53	4.83	3.91	89.71	
June 7	31	93.69	470	158	48	3.29	2.97	90.24	
June 10	34	93.38	367	146	47	3.11	2.51	90.17	
June 14	38	95.75	1,390	288	56	5.14	4.83	89.74	
June 22	46	93.91	538	181	49	3.69	2.97	89.98	
July 10	64	91.20	40	50	46	1.09	.80	90.09	

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 10S									
[Distance, 12 + 54 feet; active bed-stations, 18 to 42 feet]									
Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>	
May 8	1	92.24	200	93	36	2.58	2.15	89.45	
May 26	19	93.13	350	124	37.5	3.31	2.82	89.55	
May 27	20	94.54	774	179	39.5	4.53	4.32	89.39	
May 28	21	95.34	1,130	223	41	5.44	5.07	89.09	
May 30	23	95.06	1,040	210	40.5	5.19	4.95	89.04	
May 31	24	94.60	866	189	39.5	4.78	4.58	89.13	
June 2	26	94.99	985	200	40	5.00	4.93	89.42	
June 5	29	95.08	1,000	214	40.5	5.28	4.67	89.13	
June 7	31	93.59	462	140	38	3.68	3.30	89.45	
June 10	34	93.27	367	128	37.5	3.41	2.87	89.63	
June 14	38	95.68	1,370	244	42	5.81	5.61	88.98	
June 22	46	93.84	535	152	38	4.00	3.52	89.38	
July 10	64	91.19	40	55	33	1.67	.73	89.42	

Table 6.--Summary data of hydraulic characteristics of cross sections in the Bedload Trap reach, East Fork River, May-July 1974--Continued

CROSS SECTION 11S

[Distance, 13 + 60 feet; active bed-stations, 14 to 54 feet]

Date	Day no.	Water surface elevation (feet)	Discharge $Q$ (ft <sup>3</sup> /s)	Area $A$ (ft <sup>2</sup> )	Width $W$ (ft)	Depth <sup>1</sup> $\bar{d}$ (ft)	Velocity <sup>2</sup> $\bar{u}$ (ft/s)	Mean bed elevation (ft) <sup>3</sup>
May 8	1	92.25	200	92	45	2.04	2.17	90.15
May 27	20	94.57	800	189	52	3.63	4.23	90.40
May 28	21	95.28	1,120	245	53	4.62	4.57	90.11
May 30	23	95.05	1,030	250	52.5	4.76	4.12	89.68
May 31	24	94.61	866	219	52	4.21	3.95	89.82
June 2	26	95.00	985	219	52	4.21	4.50	90.15
June 5	29	95.10	1,000	232	52.5	4.42	4.31	90.04
June 7	31	93.61	475	154	49	3.14	3.08	90.07
June 10	34	93.24	365	143	48	2.98	2.55	90.03
June 14	38	95.66	1,370	276	53	5.21	4.96	89.74
June 22	46	93.81	535	167	50	3.34	3.20	90.04
July 10	64	91.18	40	47	44	1.07	.85	90.01

$$^1\bar{d} = A/W.$$

$$^2\bar{u} = Q/A.$$

<sup>3</sup>The mean bed elevation was calculated by averaging the bed elevation at even-numbered stations over the width of active bed. For the occasional instances when a cross section was sounded at odd-numbered stations, the bed elevation at even-numbered stations has been determined by linear interpolation.