UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CROSS-SECTION, VELOCITY, AND BEDLOAD DATA AT TWO EROSION SITES ON THE TANANA RIVER NEAR FAIRBANKS, ALASKA, 1979

by Robert L. Burrows

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Prepared in cooperation with Alaska District and Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers

Anchorage, Alaska
1980

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

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ILLUSTRATIONS

FACTORS FOR CONVERSION OF UNITS

The following factors may be used to convert the commonly used American units herein to the International System of Units (SI).

Multiply American units	By	To obtain SI units
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
pound (lb)	0.4536	kilogram (kg)
ton, short	0.9072	metric ton (tonne)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
pound per foot (lb/ft)	1.488	kilogram per meter (kg/m)

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ABSTRACT

In an effort to relate river processes to vertical and lateral erosion at two sites on the Tanana River in the vicinity of Fairbanks, measurements of depth, velocity, and bedload-transport rates were made at several sections at each site.

To facilitate comparison of the river processes and ongoing erosion, compilation and graphic presentation of the velocity distributions and bedload-transport rates are presented in conjunction with cross-section configuration immediately adjacent to the area of erosion.

Dry sieve analyses of the bedload samples give particle-size distribution. Approximately 85-95 percent of the material in transport at both sites was in the sand range (>0.062 millimeter <2.0 millimeters).

INTRODUCTION

To facilitate the monitoring of the fluvial processes related to erosion on the Tanana River, the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) requested that the U.S. Geological Survey collect and compile selected river-hydraulic and bedload-transport data at two sites during the period of principal runoff in 1979.

One of the sites is near the Fairbanks International Airport on the right,or north bank, and the other site is at a dike near North Pole on the right,or north bank (fig. 1). The airport location is the site of an experimental ice revetment constructed by CRREL in January-March 1979, which failed during spring breakup. This site has been subject to rapid erosion which threatens the airport railroad spur, and major slumping of the bank occurred in May 1979. The State of Alaska Department of Transportation (Alaska DOT) constructed a rock revetment at this site from July 16 to August 29, 1979. The erosion site near North Pole is at a dike constructed by the Corps of Engineers in 1974-75, and is the location of several types of experimental revetment built by the Corps and CRREL.

CRREL requested that the Survey measure stream velocities near the bank at several specific sections and collect bedload-transport data at one section. Discharge measurements of only the flow immediately adjacent to the two sites were to be made during high and low flow at the airport and at high flow at the dike. The concern was the erosion of the right bank at both sites. Therefore, mostly partial rather than complete cross sections were measured. Measurements and sampling were done only in the main channel.

The Corps of Engineers District Office, Anchorage, Alaska, requested that the Survey monitor changes in the channel configuration at several of the CRREL sections along the right bank at the airport site.

This report is principally a graphical presentation of the data collected in 1979 at both sites. The text is devoted to the explanation of figures. The primary purpose of this report is to provide CRREL and the Corps of Engineers with information related to the erosion occurring at the two sites.

This program was funded by the Corps of Engineers through a cooperative agreement with the U.S. Geological Survey. CRREL provided the surveying, maps, and on-site location markers necessary for data collection. Aerial photographs were provided by the Corps of Engineers. All data collection and compilation were performed by Survey personnel.

DATA COLLECTION

Measurements of depth and velocity and collection of bedload samples were made from a boat. The boat was positioned using sextant readings on a base line for cross-channel stationing and visual reference to range markers on the cross-section ends for on-station positioning.

Depths were obtained through the use of either a recording fathometer or sounding with a cable-suspended weight. Generally, the fathometer was used when velocities were not being measured.

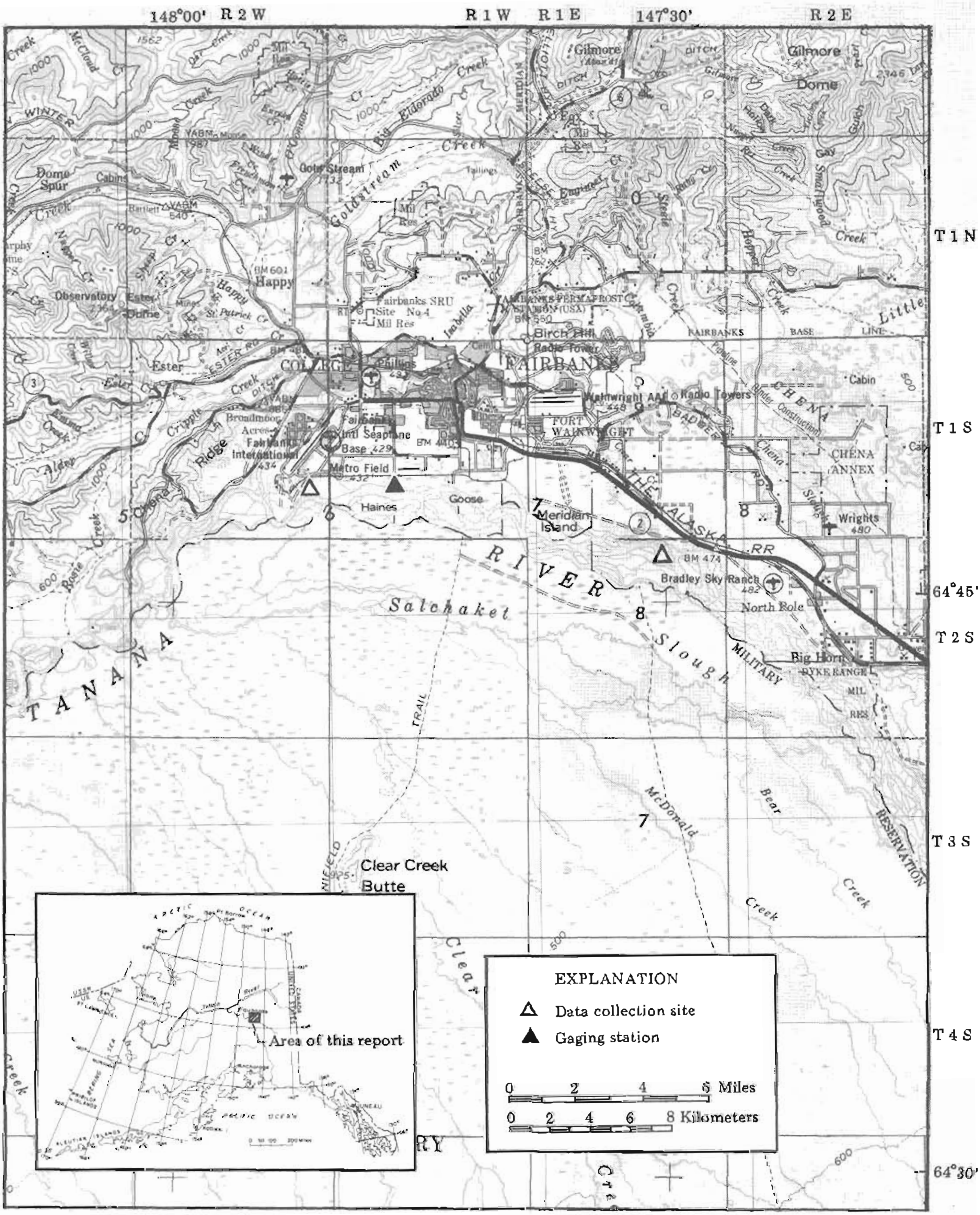

Figure 1. – Location of Tanana River, data-collection sites, gaging station, and Fairbanks.

Velocities were measured with a Price AA current meter using standard Survey methods (Buchanan and Somers, 1969). Point velocities were usually obtained at each of several stations on the specified cross sections. To define vertical distribution, velocities were determined 1 ft above the streambed, at 20, 40, 60, and 80 percent of depth, and near the surface. The mean for each vertical was computed by averaging all the point velocities in the vertical. Surface velocities were usually measured several tenths of a foot below the water surface; some of these may be slightly in error due to the bobbing motion of the boat at stations in the most turbulent flow.

Main channel discharge was determined on June 25, August 16, and October 2 at the airport site, and on August 17 at the dike site near North Pole.

Mean daily values of total discharge of the Tanana (not including flow in Salchaket Slough) were obtained from records for the gaging station Tanana River at Fairbanks (station 15485500) for the period of principal runoff (fig. 2). Streamflow data for this station are available in the annual publications of the Survey entitled "Water-Resources Data for Alaska."

Bedload samples were collected using a Helley-Smith bedload sampler (Helley and Smith, 1971). The Survey has not officially adopted the Helley-Smith as standard equipment, and results obtained through its use cannot be certified for accuracy. However, the Survey has recently issued provisional guidelines for use of the Helley-Smith sampler pending further research and testing. The sampler has been used since 1977 on the Tanana River (Burrows, Parks, and Emmett, 1979), and a field determination of the sediment-trapping characteristics of the Helley-Smith bedload sampler (Emmett, 1979) indicates that no correction factor need be applied to the bedload data as collected.

Bedload samples of 30-second duration were taken at every 50 ft of main channel width. Individual samples were weighed to determine transport rates, in (lb/ft)/s, but composites of samples were used for dry sieve analyses to determine particle-size distribution. Equal weight was given to each sample in computing the average transport rate.

All water-surface elevations were referenced to the National Geodetic Vertical Datum of 1929. The water-surface elevation was determined during each visit at section 8+00 at the airport site and section 4+50 at the dike. These single water-surface elevations were used to compute bed elevations at all cross sections measured.

DATA FOR AIRPORT SITE AT FAIRBANKS

Figure 3 is an aerial photograph of the Tanana River in the vicinity of Fairbanks International Airport. The photograph shows the reach of the river past the airport erosion site, the section of eroding bank, and, in particular, the airport railroad spur.

Figure 4 is a sketch showing the stationing along the right bank, the ice revetment in relation to the railroad, and the edge of the bank on two different dates, as surveyed by CRREL.

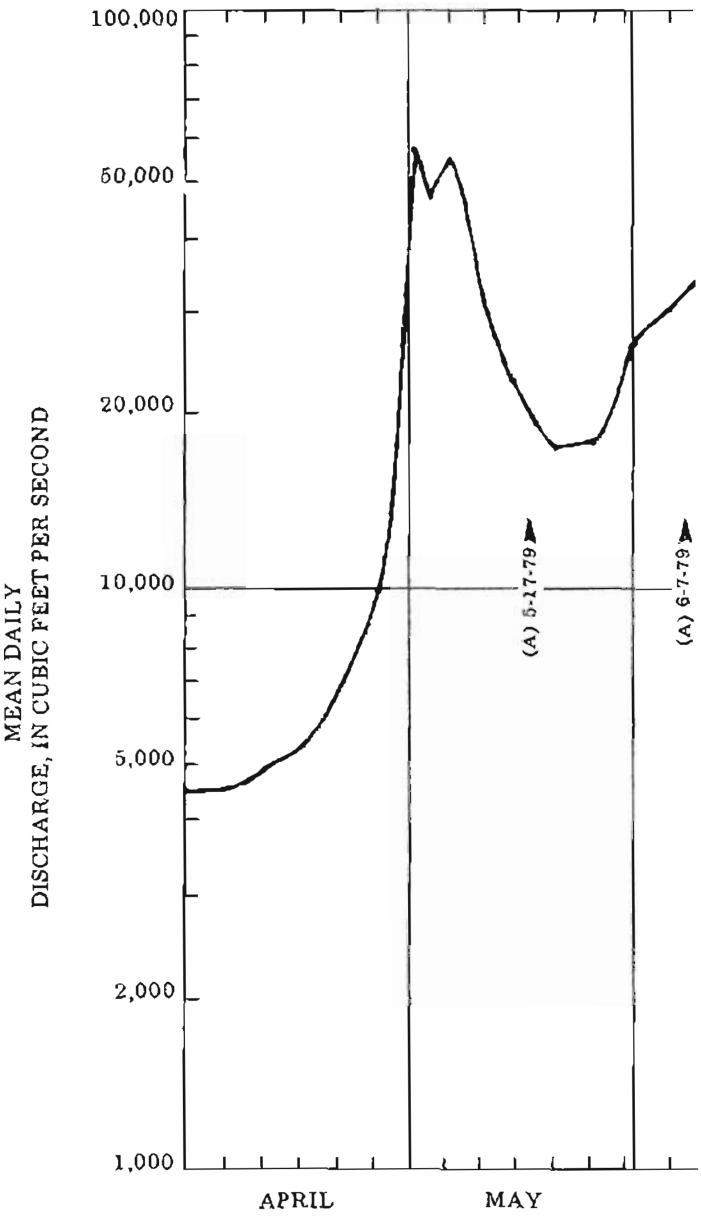

Figure 2.-- Hydrogr
Fairbank

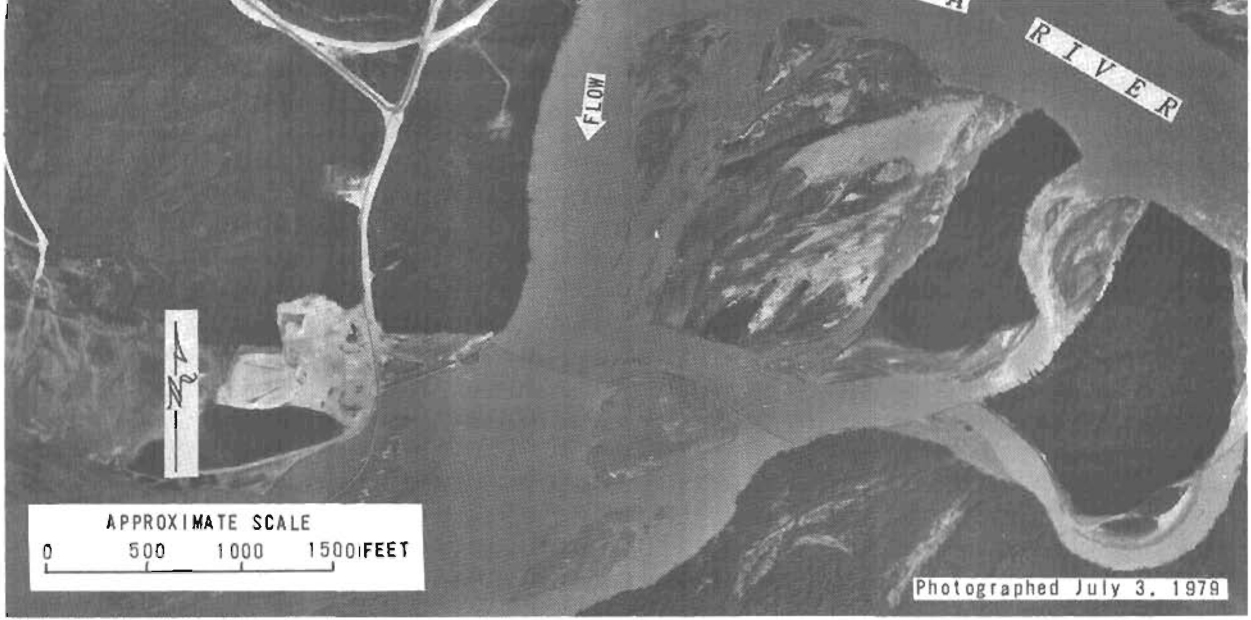

Photo by North Pacific Aerial Surveys, Inc.
Courtesy of U.S.Army Corps of Engineers

Figure 3. -- Data-collection site near airport at Fairbanks.

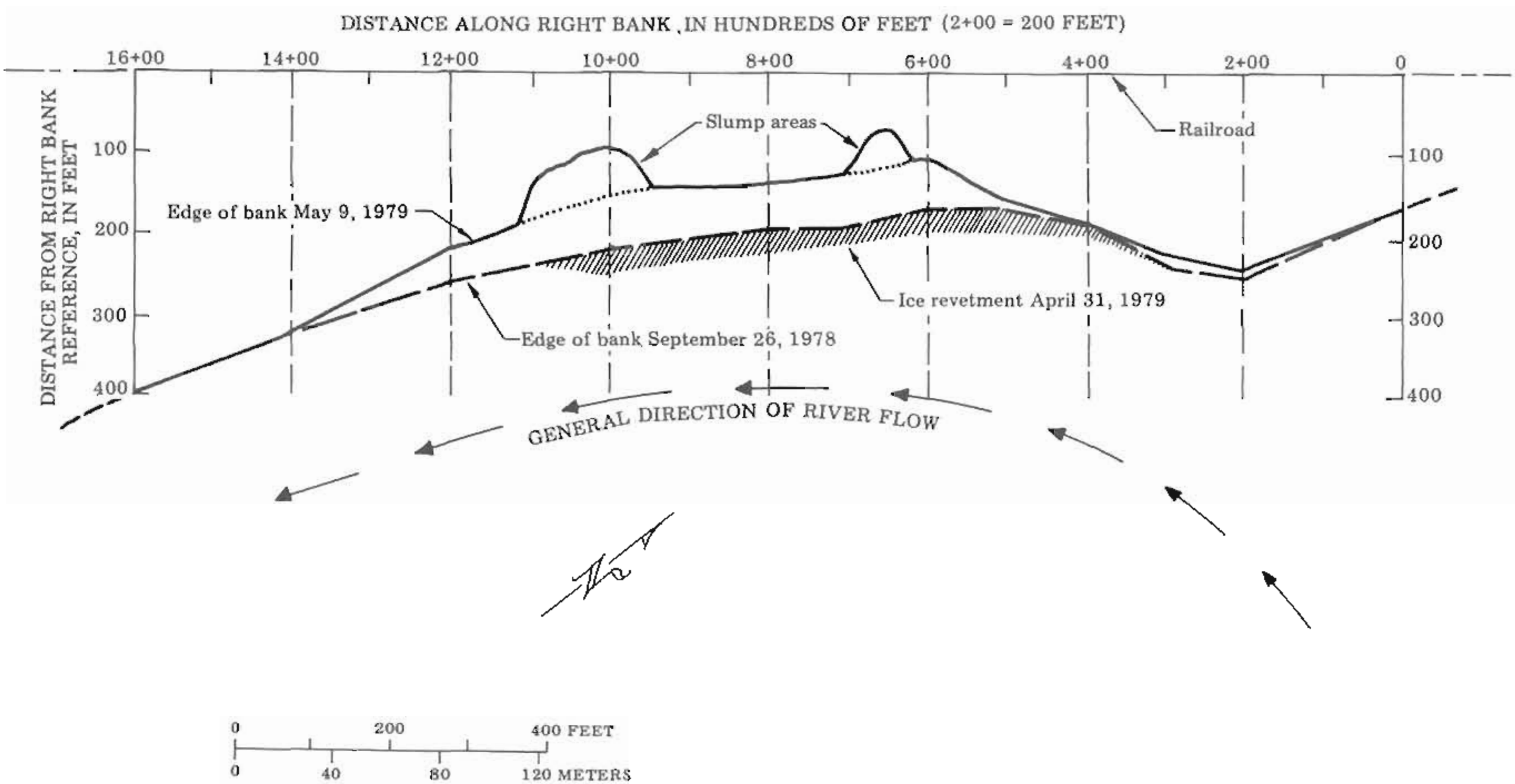

Figure 4. -- Plan sketch showing location of ice revetment and edge of bank at airport site as surveyed by CRREL on indicated dates.

Figures 5a-f show the cross sections and partial cross sections along the right bank at the airport site. The cross-channel stationing shown was measured from the right bank reference, which is the railroad spur.

Sections are shown in downstream order. In those cases where both soundings and fathometer traces were obtained, both sets of results were plotted. The differences between these results are due more to the difficulty of repositioning the boat at a given location on the cross section than to inaccuracies in either method of measuring depth.

Cross-section data collected at sections 6+00, 8+00, and 10+00 before and after Alaska DOT constructed a rock revetment are shown in figures 6, 7, and 8. This revetment extends from station 1+50 to 15+00. The work was not completed until August 29, but the revetment at section 6+00, 8+00, and 10+00 had been finished when data were collected on August 16. Additional material was placed near section 2+00 on October 2, 1979.

In addition to the data presented in these figures, several individual depths along other sections at the airport site were measured. These measurements were made at the request of Alaska DOT during and following construction of the revetment. While depths and elevations shown below are accurate, distances from the bank are estimated. All measurements are given in feet.

Section	August 16			September 6			October 2		
	Dist. from bank	Depth	Elev.	Dist. from bank	Depth	Elev.	Dist. from bank	Depth	Elev.
2+00	--	--	--	--	--	--	75	25	394.1
15+00	50	44	380.5	100	36	384.8	--	--	--
16+00	80	41	383.5	150	39	381.8	--	--	--

Vertical velocity distributions at cross section 6+00 are shown in figures 9a and b, 8+00 in figures 10a-d, and 10+00 in figures 11a-d. Velocities are shown at points, and the mean for each vertical is shown above the station.

Velocities at 80 percent of the depth and bedload-transport rates across the channel at section 8+00 for June 25 and August 16 are shown in figures 12 and 13. Velocities were taken from measurements made on the two dates. Bedload-transport rates were computed from the weights of samples collected at the points shown. The cross sections in the top of the figures allow comparisons between depth, velocities, and transport rates. The transport rate at station 560 for June 25 may be anomalously high for the corresponding velocity. Neglecting this sample, the average transport rate across the section is 0.079 (lb/ft)/s. Including the sample, the average transport rate is 0.083 (lb/ft)/s. The lower value is shown on figure 12.

The average transport rates shown in figures 12 and 13 give loads of 1,690 tons per day and 330 tons per day on June 25 and August 16 respectively. Water discharge measured in this channel was 28,600 ft^3/s and 38,200 ft^3/s on these two days.

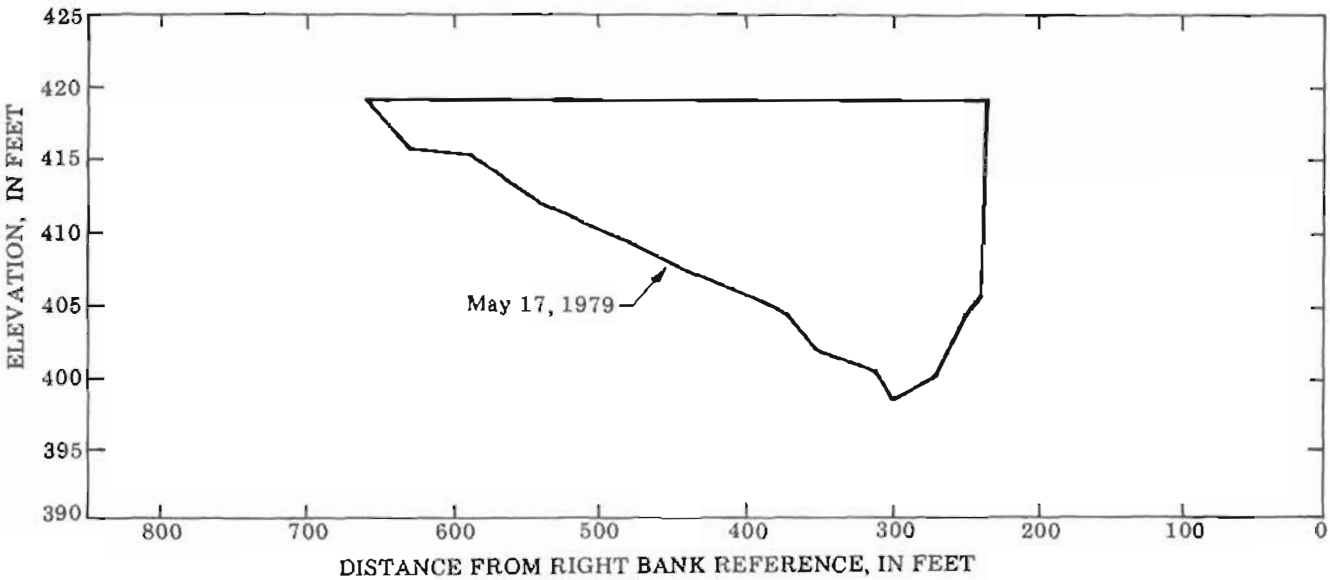

Figure 5e. – Cross section 12+00 at airport site.

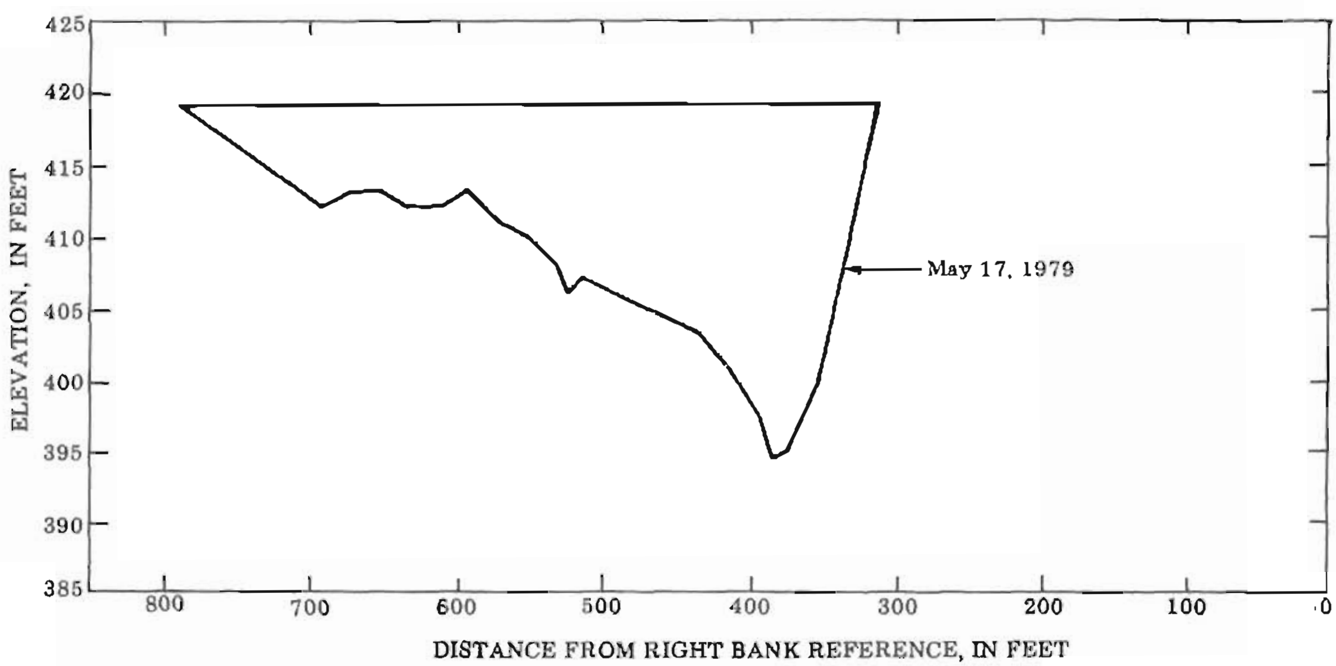

Figure 5f. -- Cross section 14+00 at airport site.

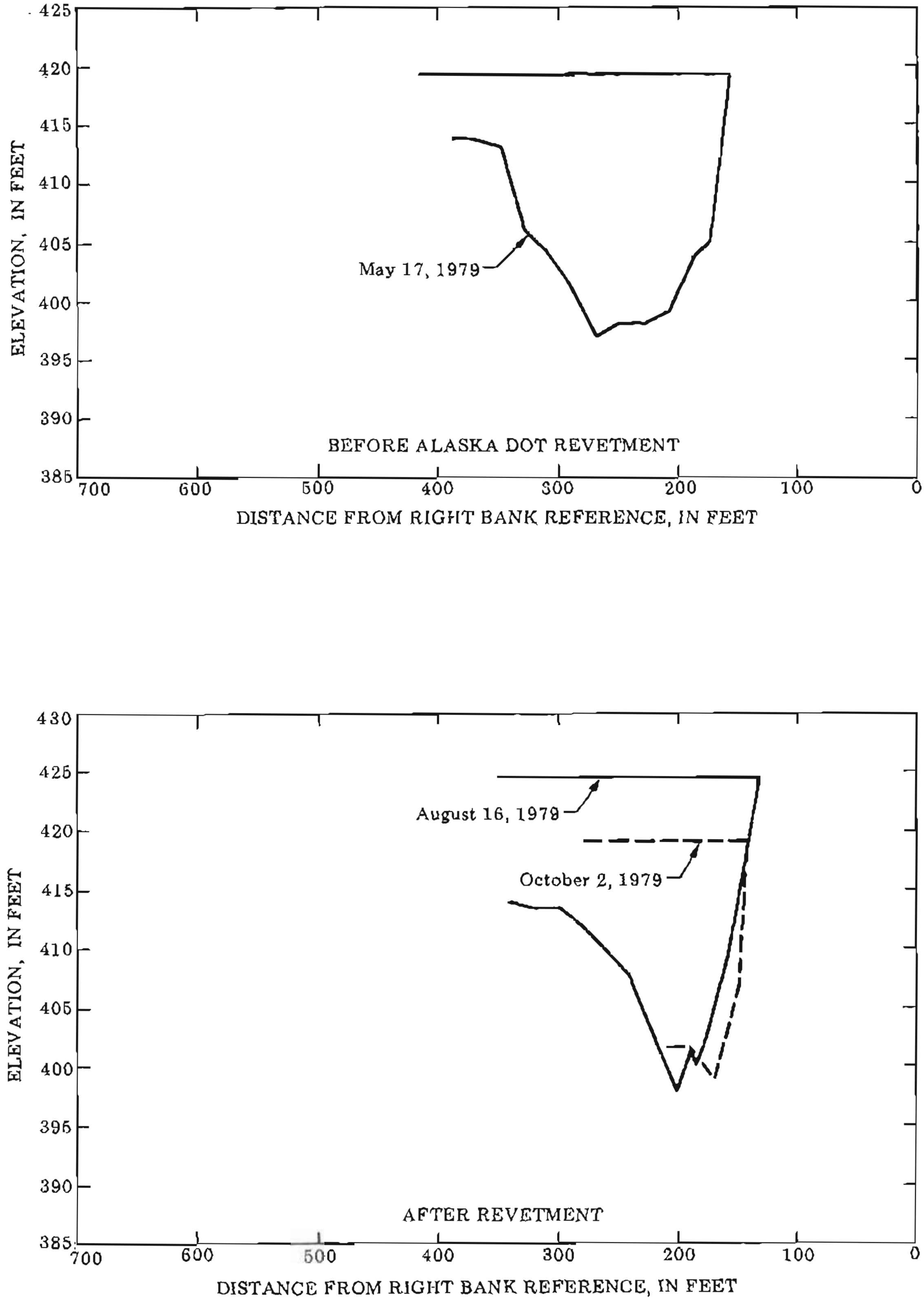

Figure 6. -- Cross section 6+00 , airport site,before and after revetment.

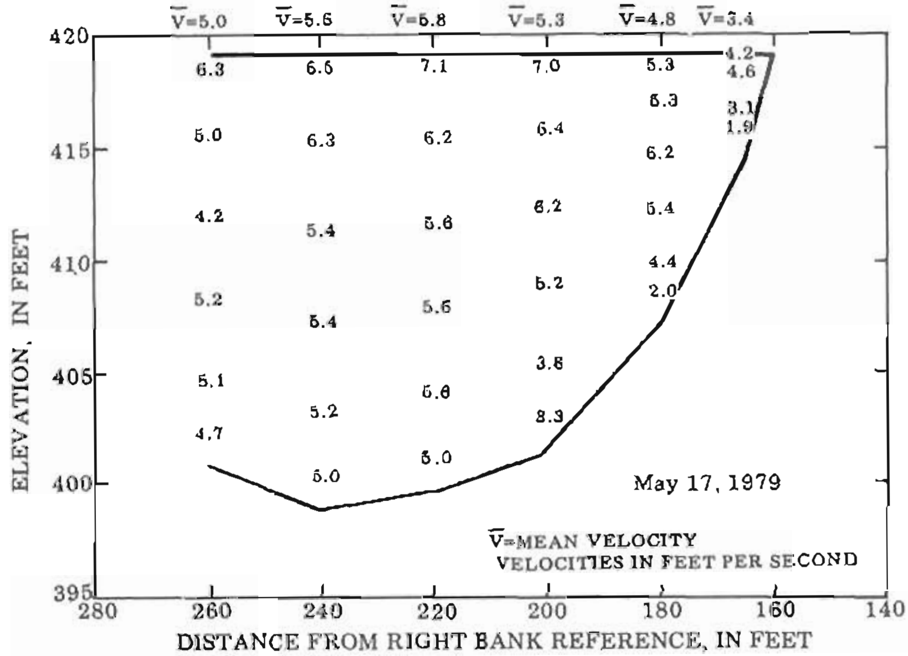

Figure 9a.– Velocity distribution, near right bank, at cross section 6+00, airport site.

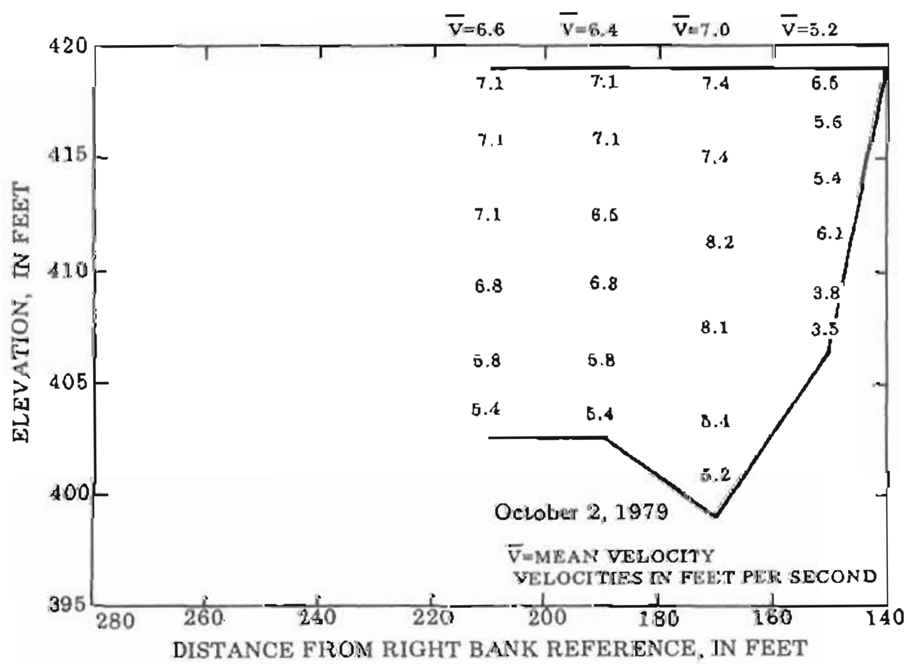

Figure 9b.-- Velocity distribution, near right bank, at cross-section 6+00, airport site.

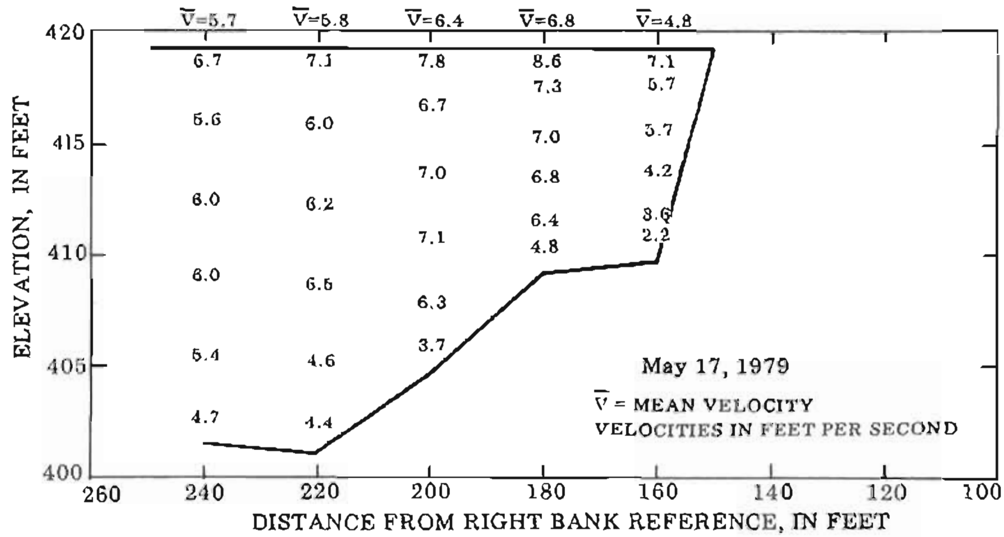

Figure 10a.--Velocity distribution, near right bank, at cross section 8+00, airport site.

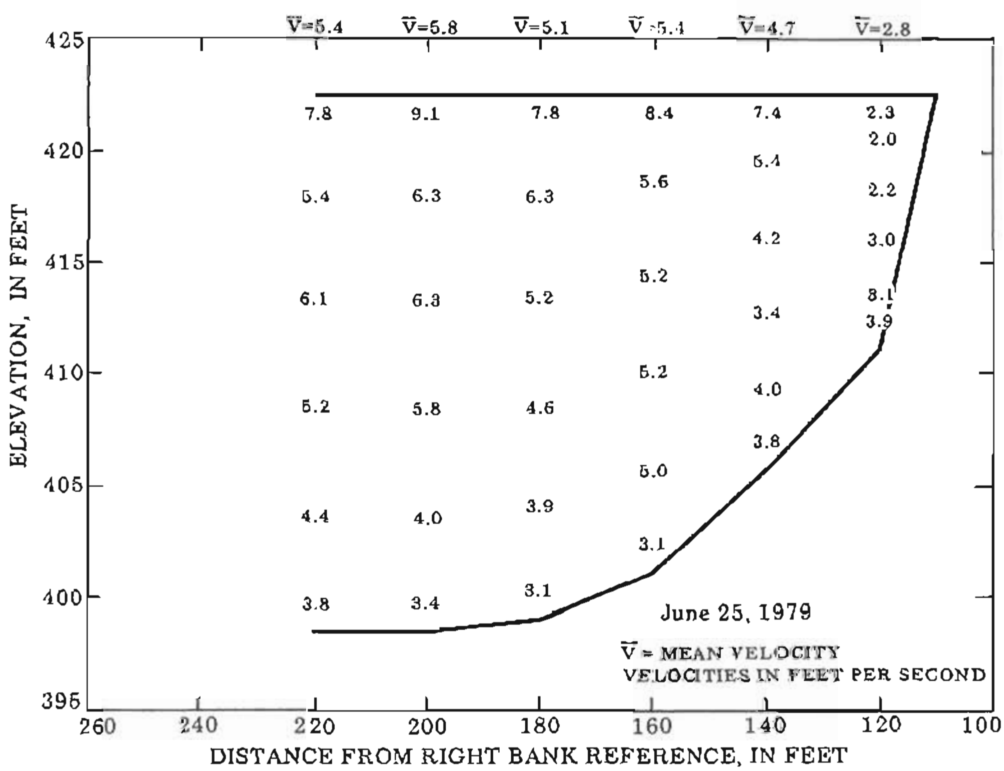

Figure 10b.--Velocity distribution, near right bank, at cross section 8+00, airport site.

Figure 10c. – Velocity distribution, near right bank, at cross section 8+00, airport site.

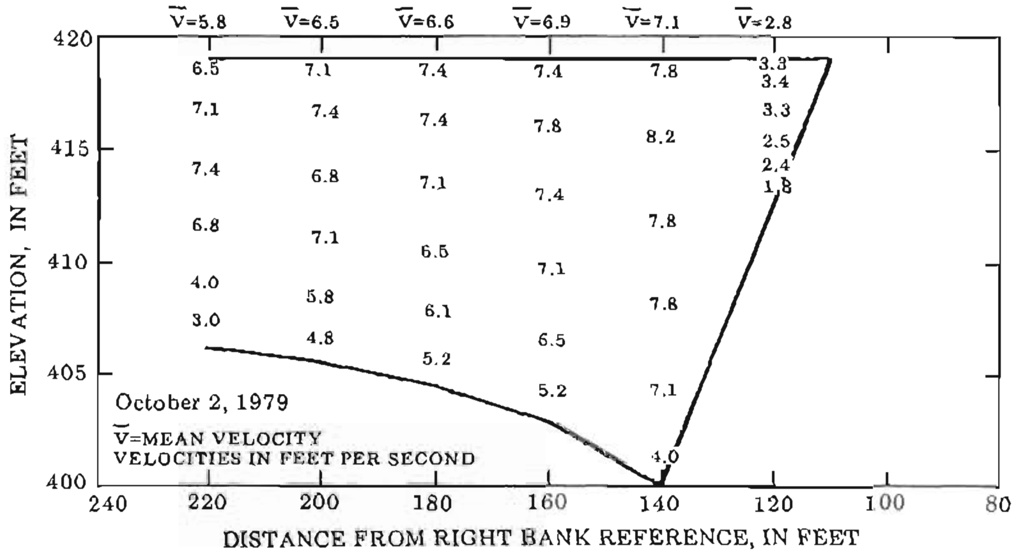

Figure 10d. -- Velocity distribution, near right bank, at cross section 8+00, airport site.

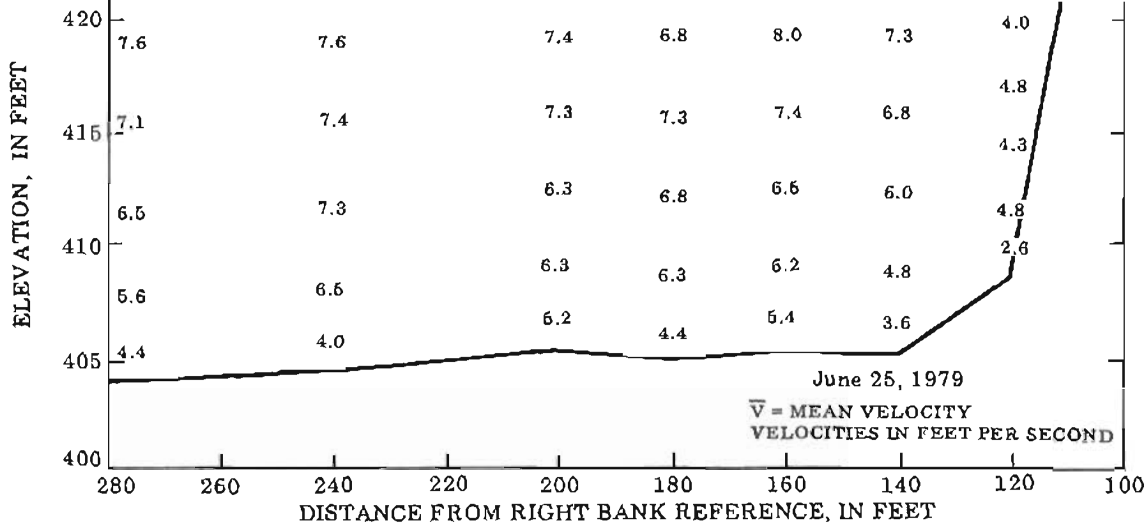

Figure 11b. -- Velocity distribution, near right bank, at cross section 10+00, airport site.

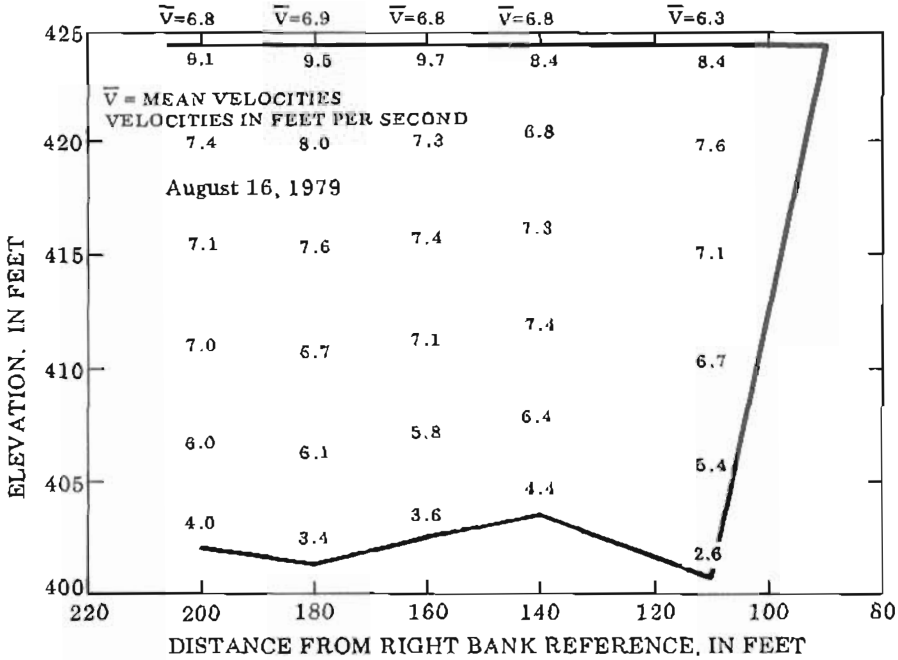

Figure 11c. -- Velocity distribution, near right bank, at cross section 10+00, airport site.

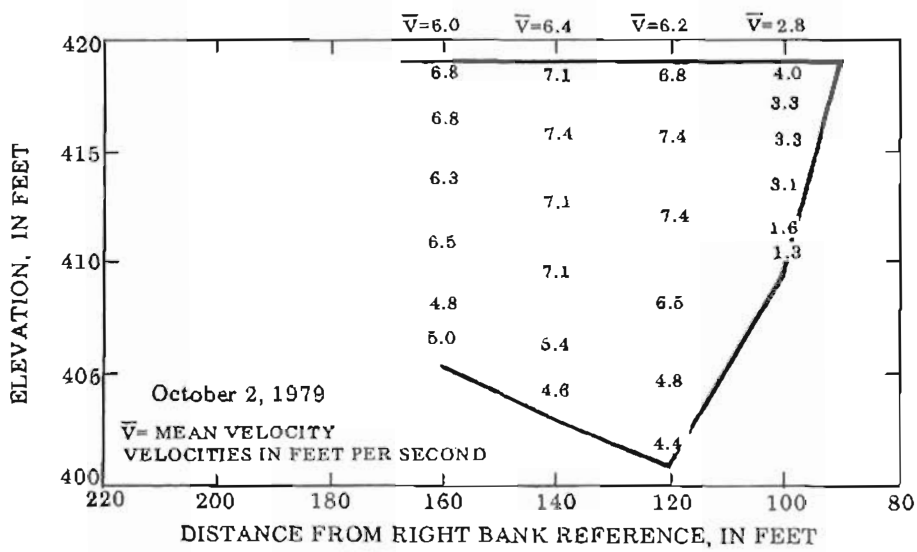

Figure 11d. -- Velocity distribution, near right bank, at cross section 10+00, airport site.

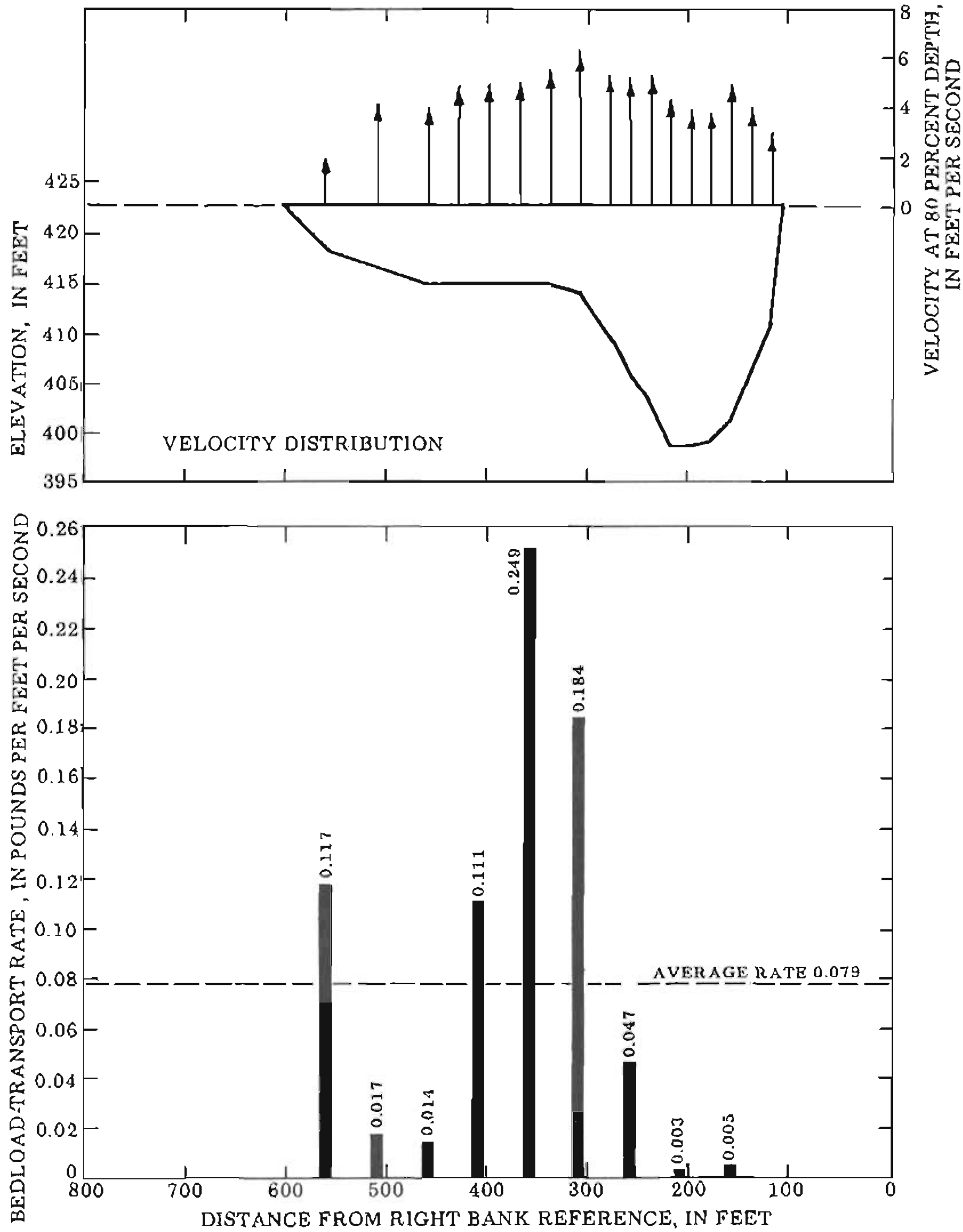

Figure 12. -- Cross section 8+00 showing velocity distribution and bedload-transport rates, airport site, June 25, 1979. Top: velocity distribution at 80 percent of depth. Bottom: bedload-transport rates.

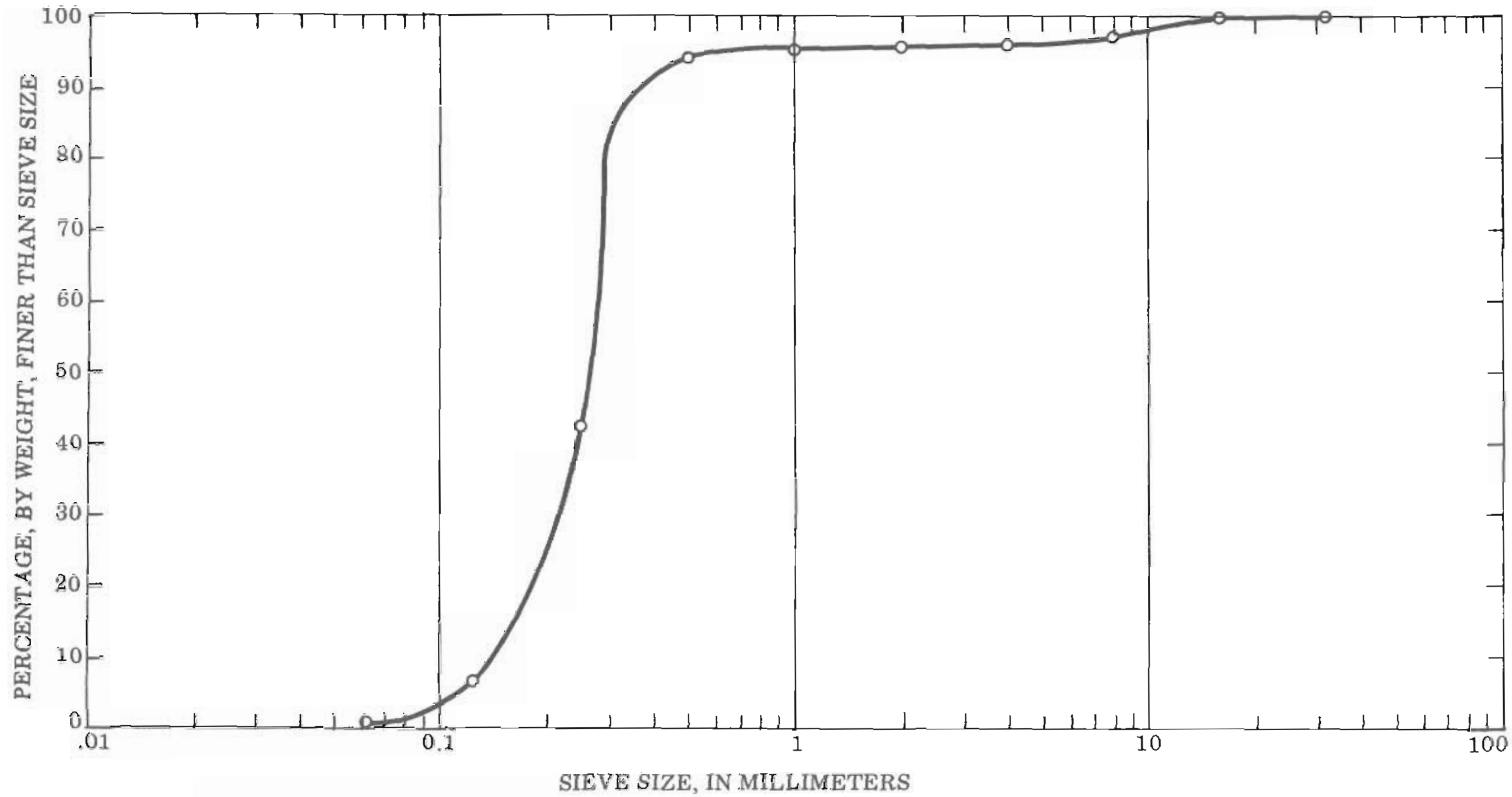

Figure 14.--Composite particle-size distribution of bedload, June 25, 1979, section 8+00, airport site.

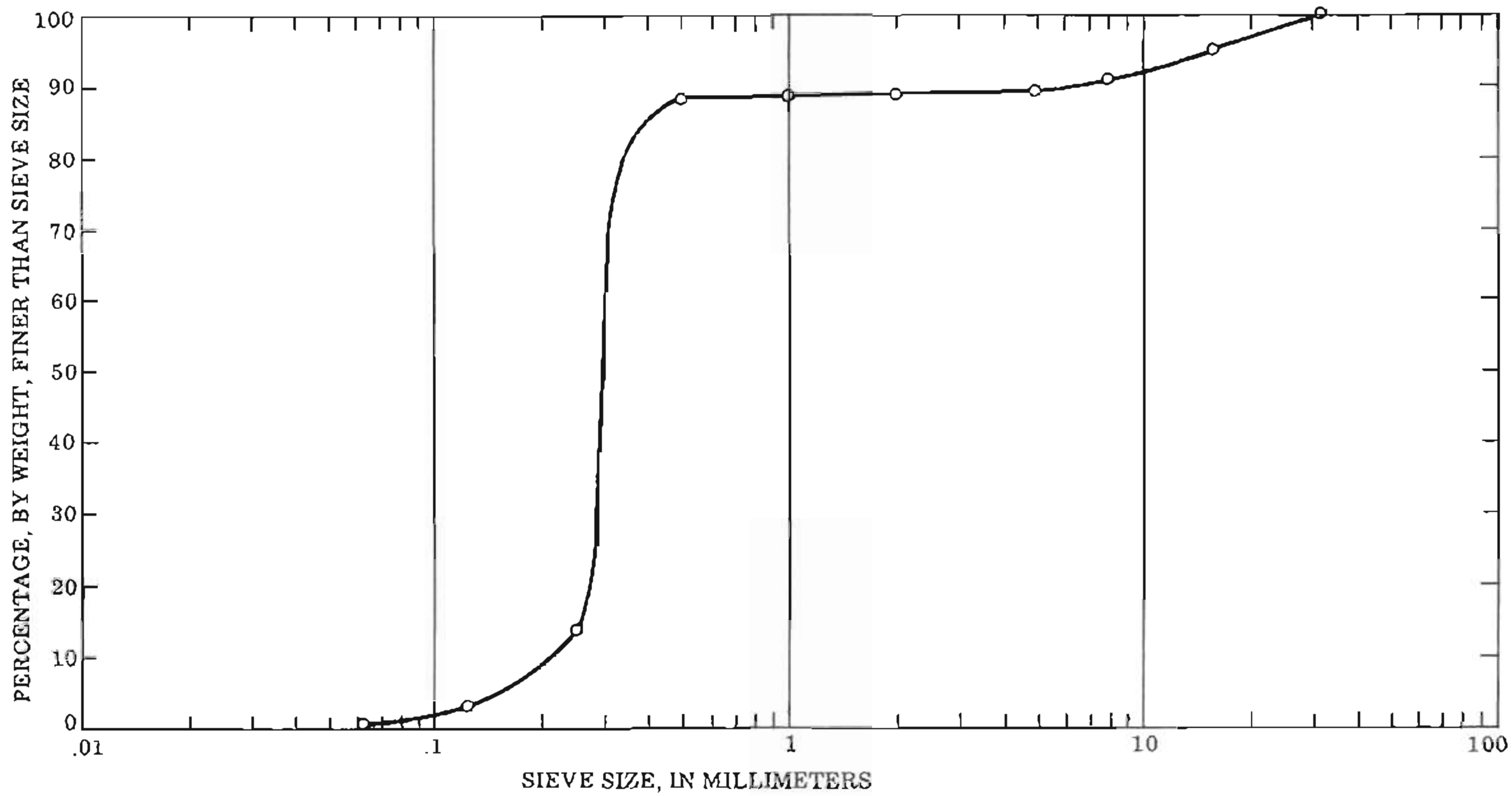

Figure 15. -- Composite particle-size distribution of bedload, August 16, 1979, section 8+00, airport site.

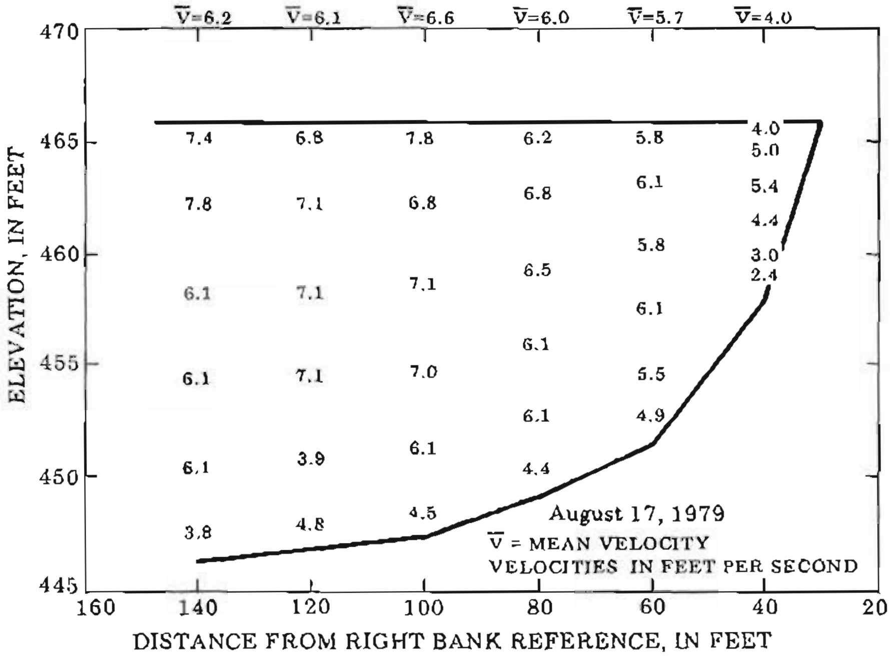

Figure 20a.–Velocity distribution near right bank, at cross section 7+00, dike site.

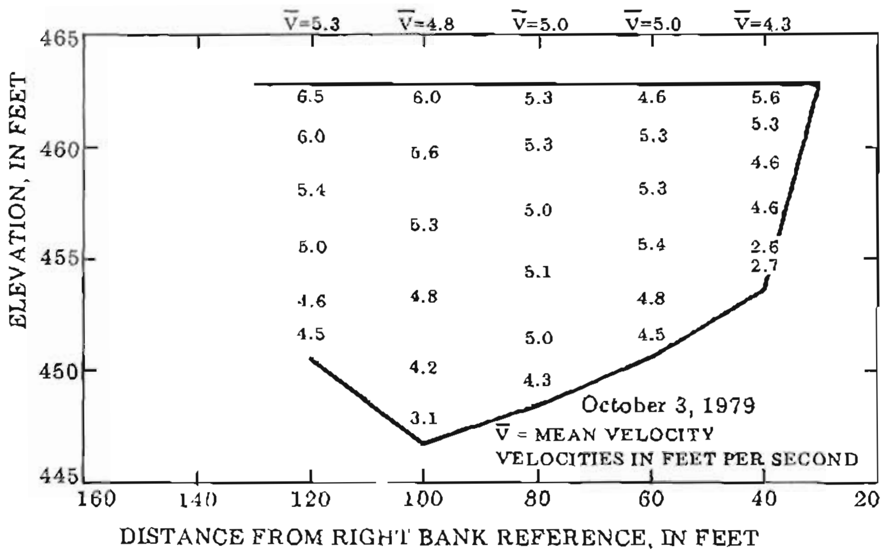

Figure 20b.–Velocity distribution near right bank, at cross section 7+00, dike site.

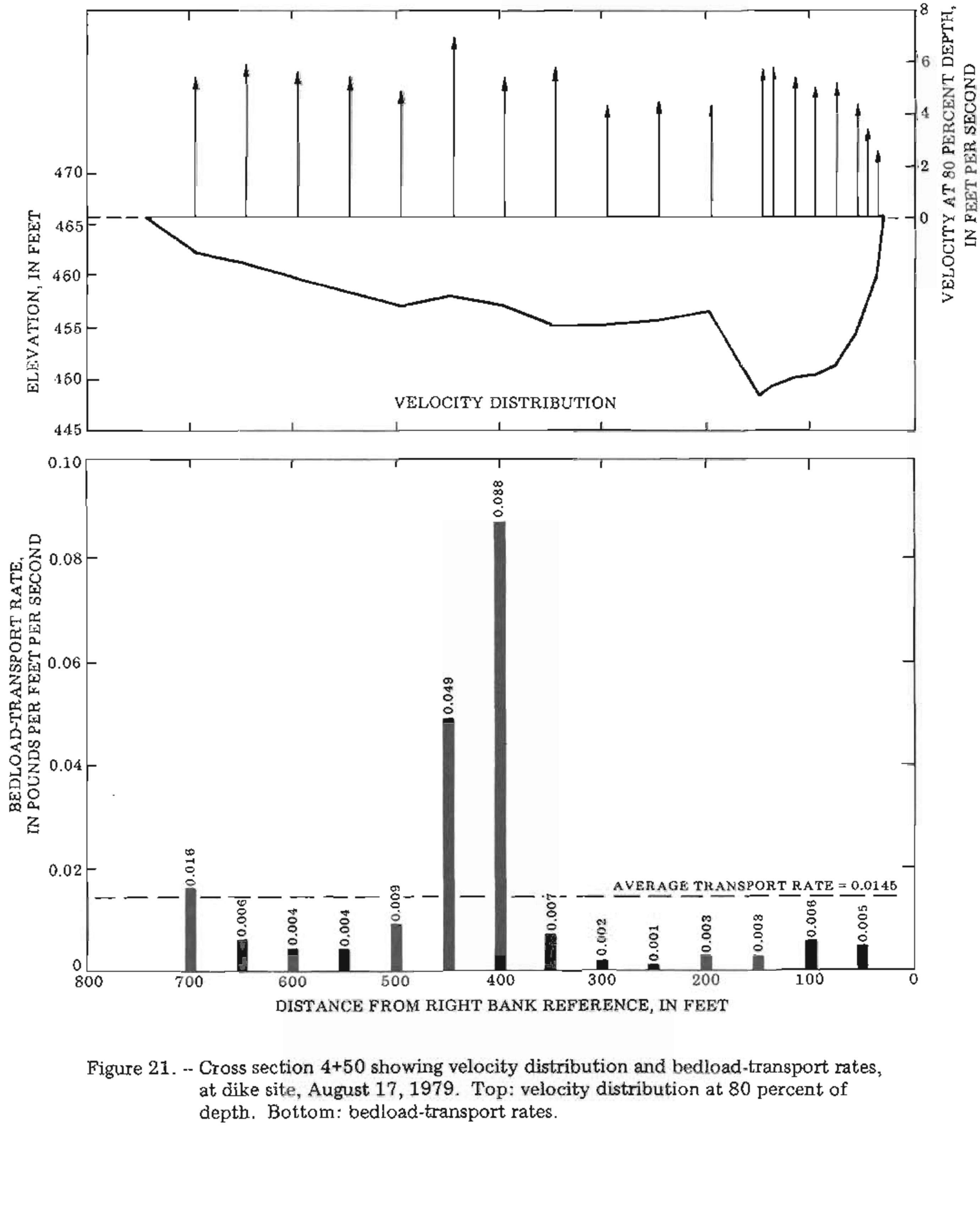

Figure 21. -- Cross section 4+50 showing velocity distribution and bedload-transport rates, at dike site, August 17, 1979. Top: velocity distribution at 80 percent of depth. Bottom: bedload-transport rates.

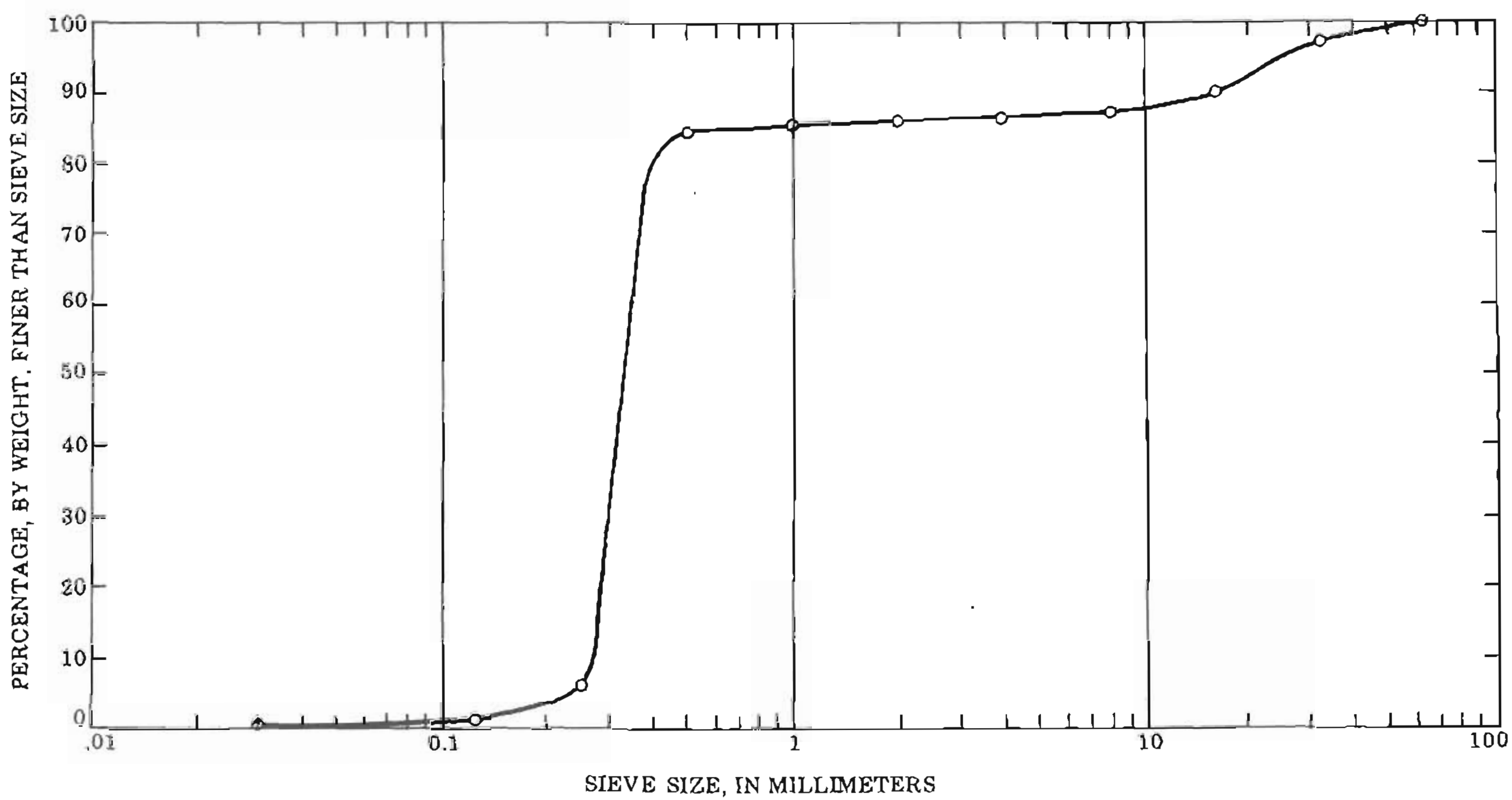

Figure 22. – Composite particle-size distribution of bedload, August 17, 1979, section 4+50, dike site.

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Emmett, W. W., 1979, A field calibration of the sediment-trapping characteristics of the Helley-Smith bedload sampler: U.S. Geological Survey Open-File Report 79-411, 96 p.

Helley, E. J., and Smith, Winchell, 1971, Development and calibration of a pressure-difference bedload sampler: U.S. Geological Survey open-file report, 18 p.

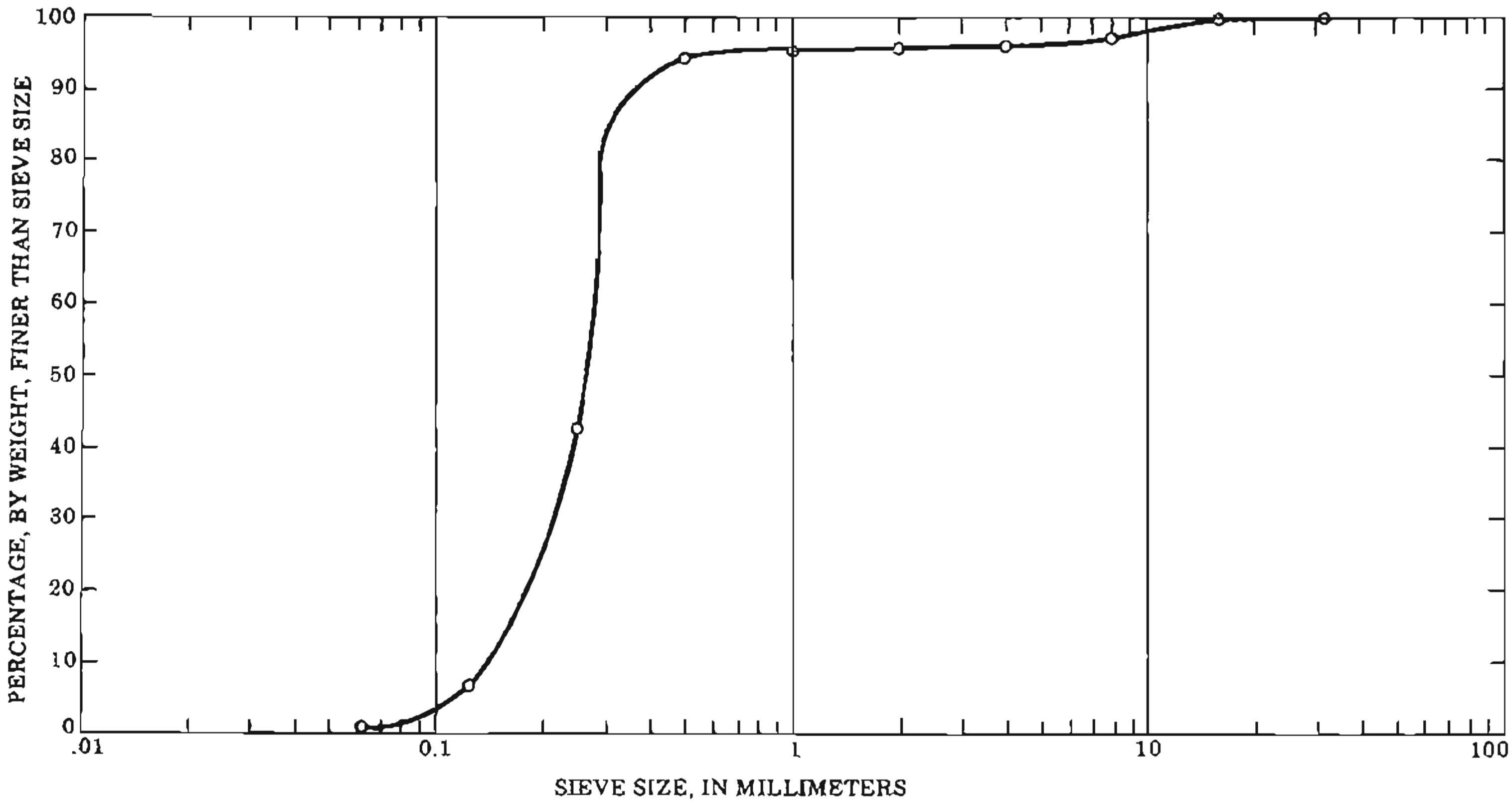

Figure 14.--Composite particle-size distribution of bedload, June 25, 1979, section 8+00, airport site.

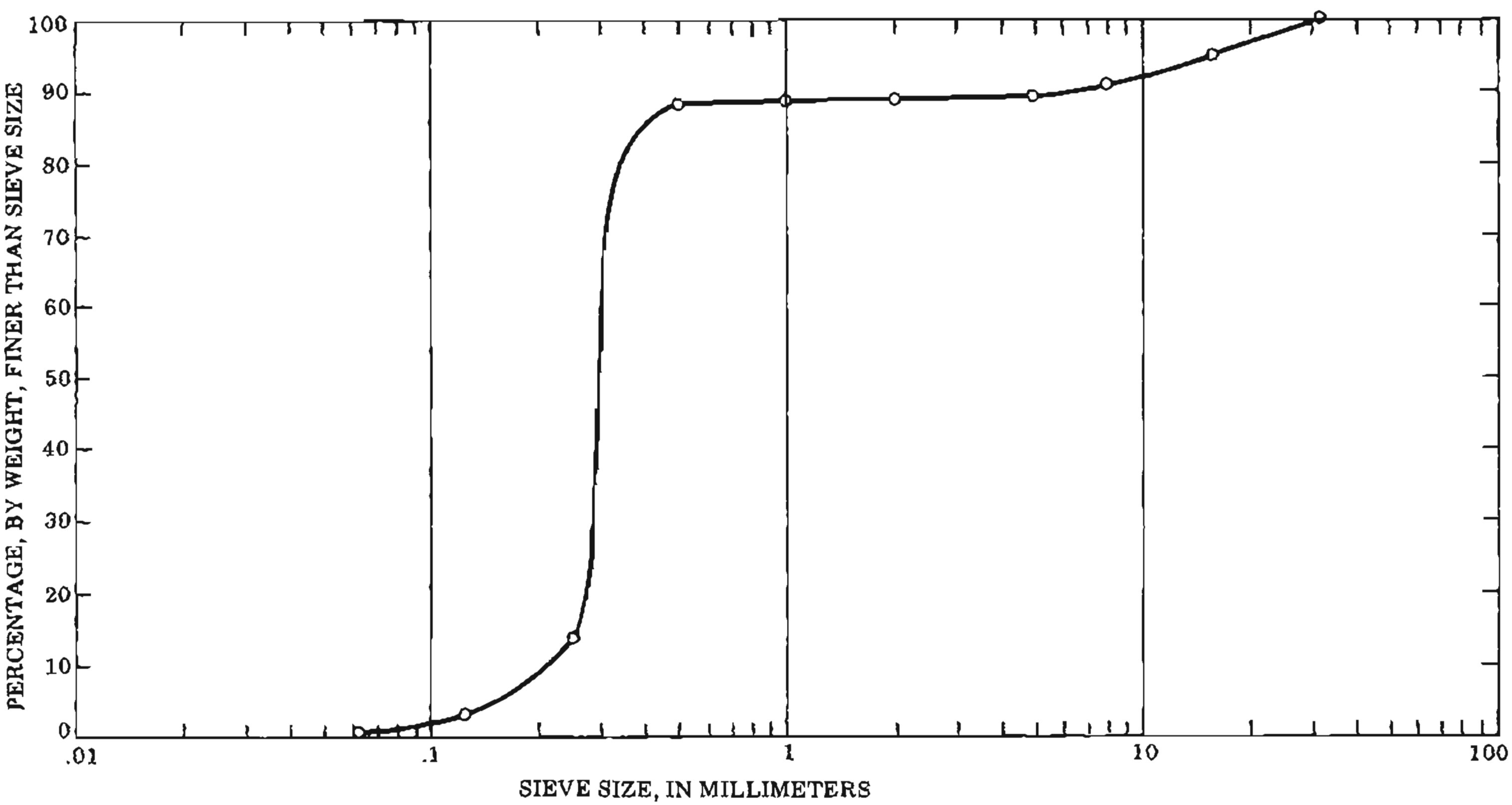

Figure 15. - Composite particle-size distribution of bedload, August 16, 1979, section 8+00, airport site.

Photo by North Pacific Aerial Surveys, Inc.
Courtesy of U.S.Army Corps of Engineers

Figure 16. – Data-collection site at dike near North Pole.

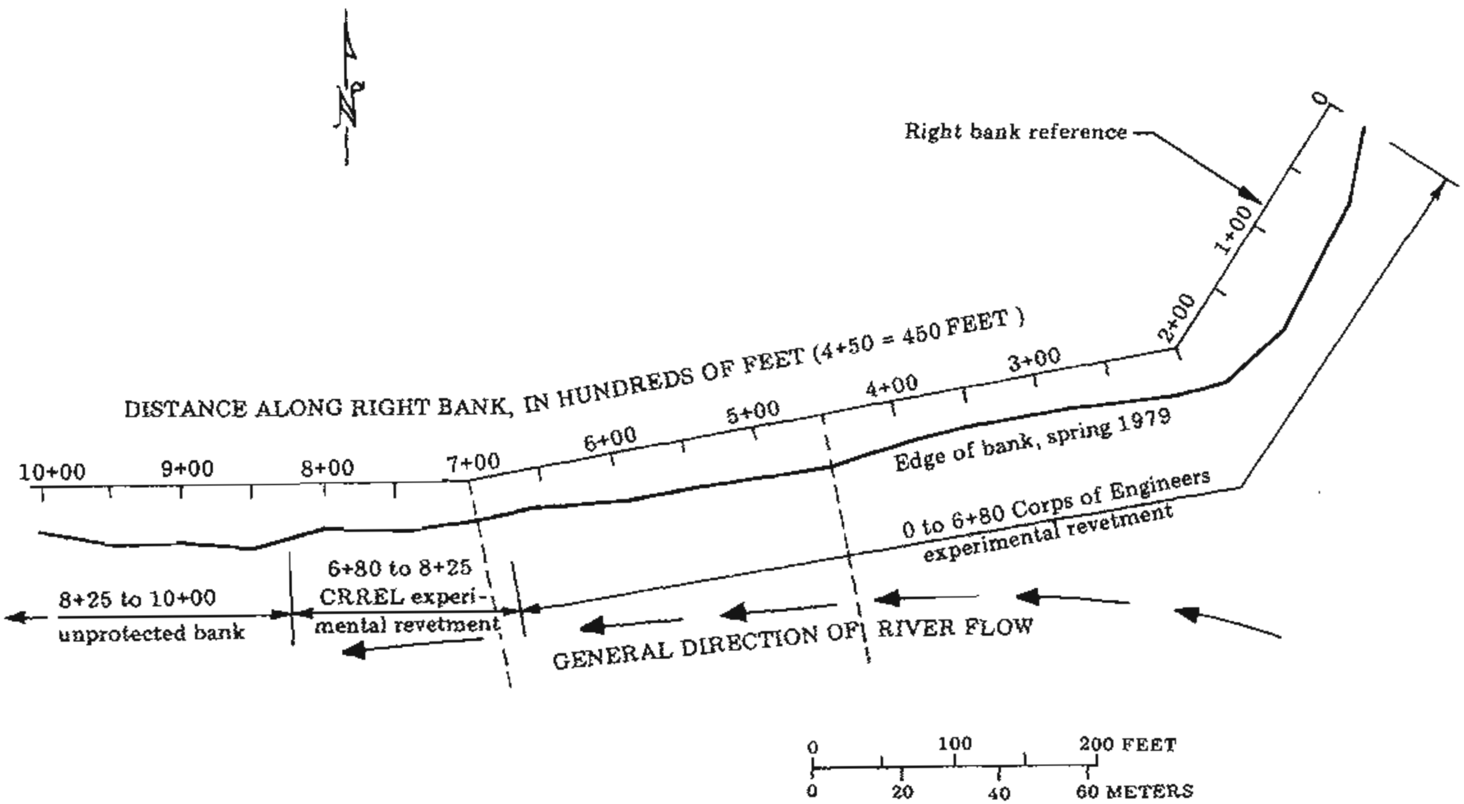

Figure 17. -- Plan sketch showing location of edge of bank at dike site as surveyed by CRREL.

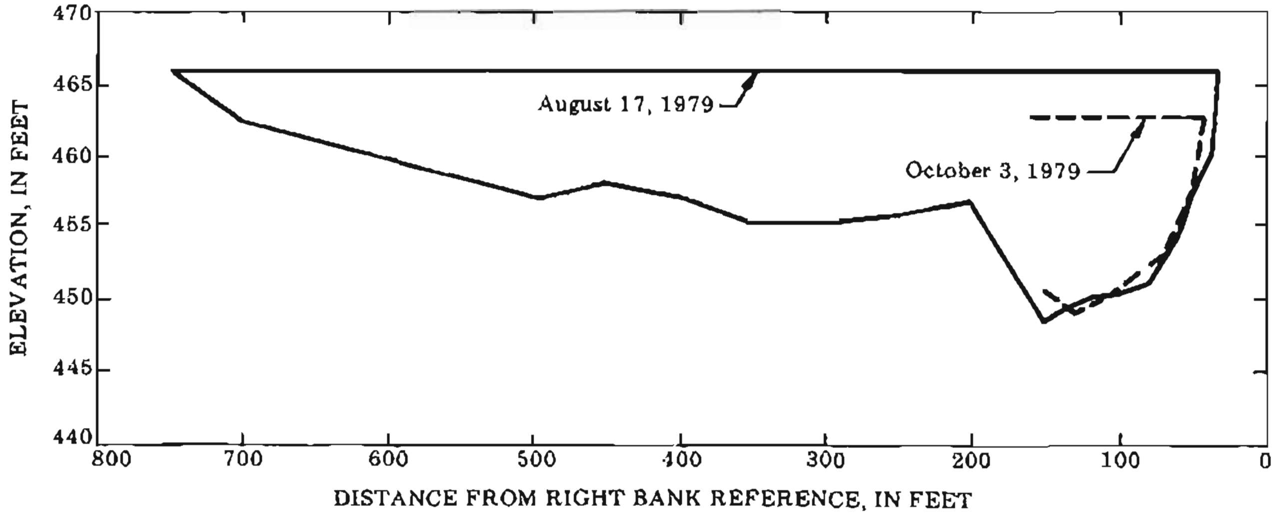

Figure 18a.--Cross section 4+50 at dike site.

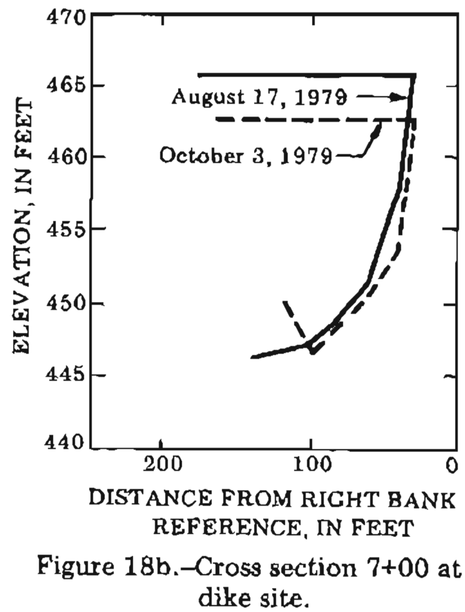

Figure 18b.--Cross section 7+00 at dike site.

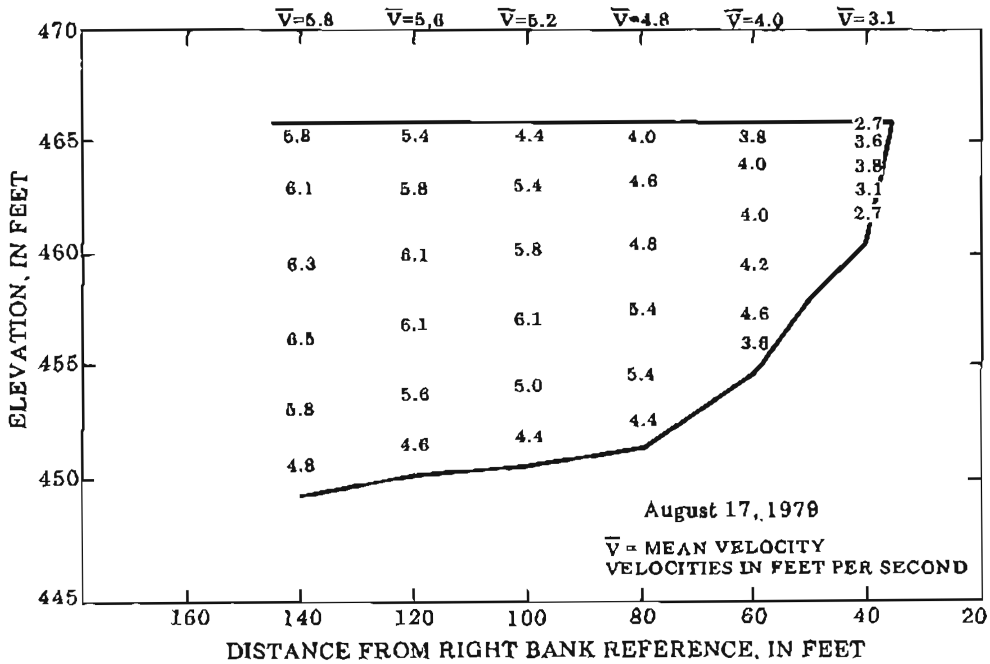

Figure 19a.--Velocity distribution near right bank, at cross section 4+50, dike site.

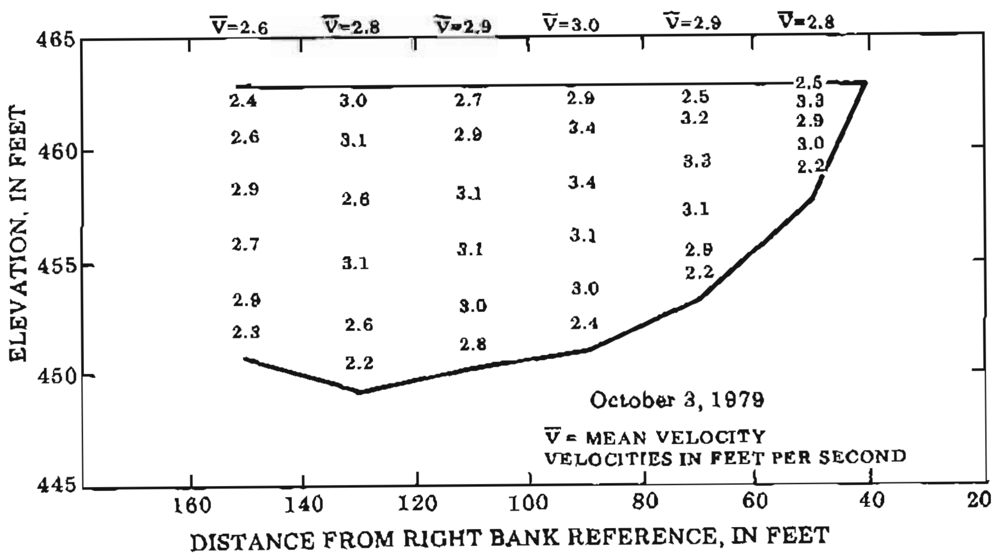

Figure 19b.--Velocity distribution near right bank, at cross section 4+50, dike site.

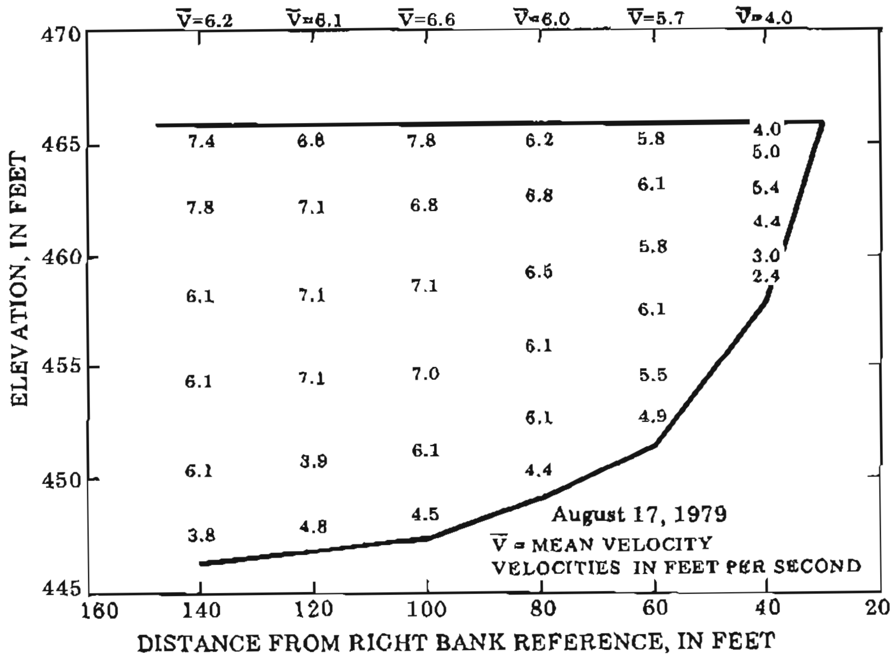

Figure 20a.--Velocity distribution near right bank, at cross section 7+00, dike site.

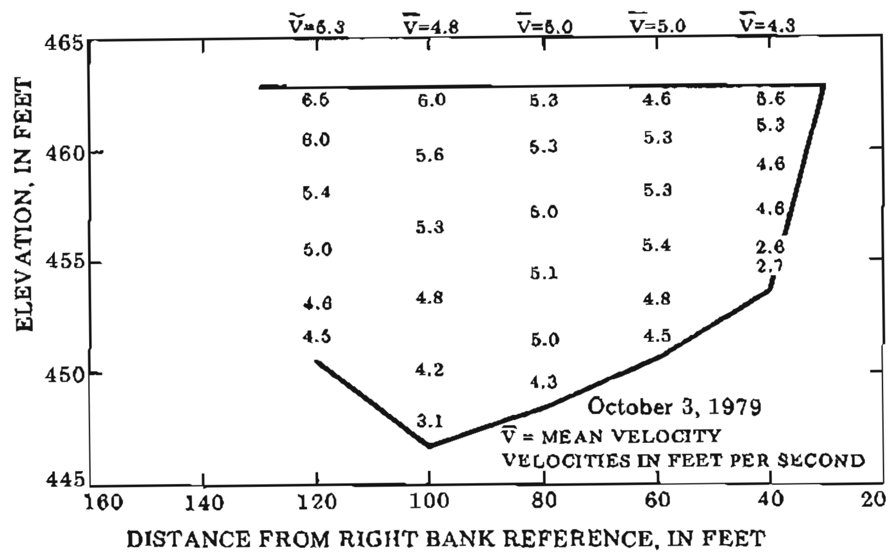

Figure 20b.--Velocity distribution near right bank, at cross section 7+00, dike site.

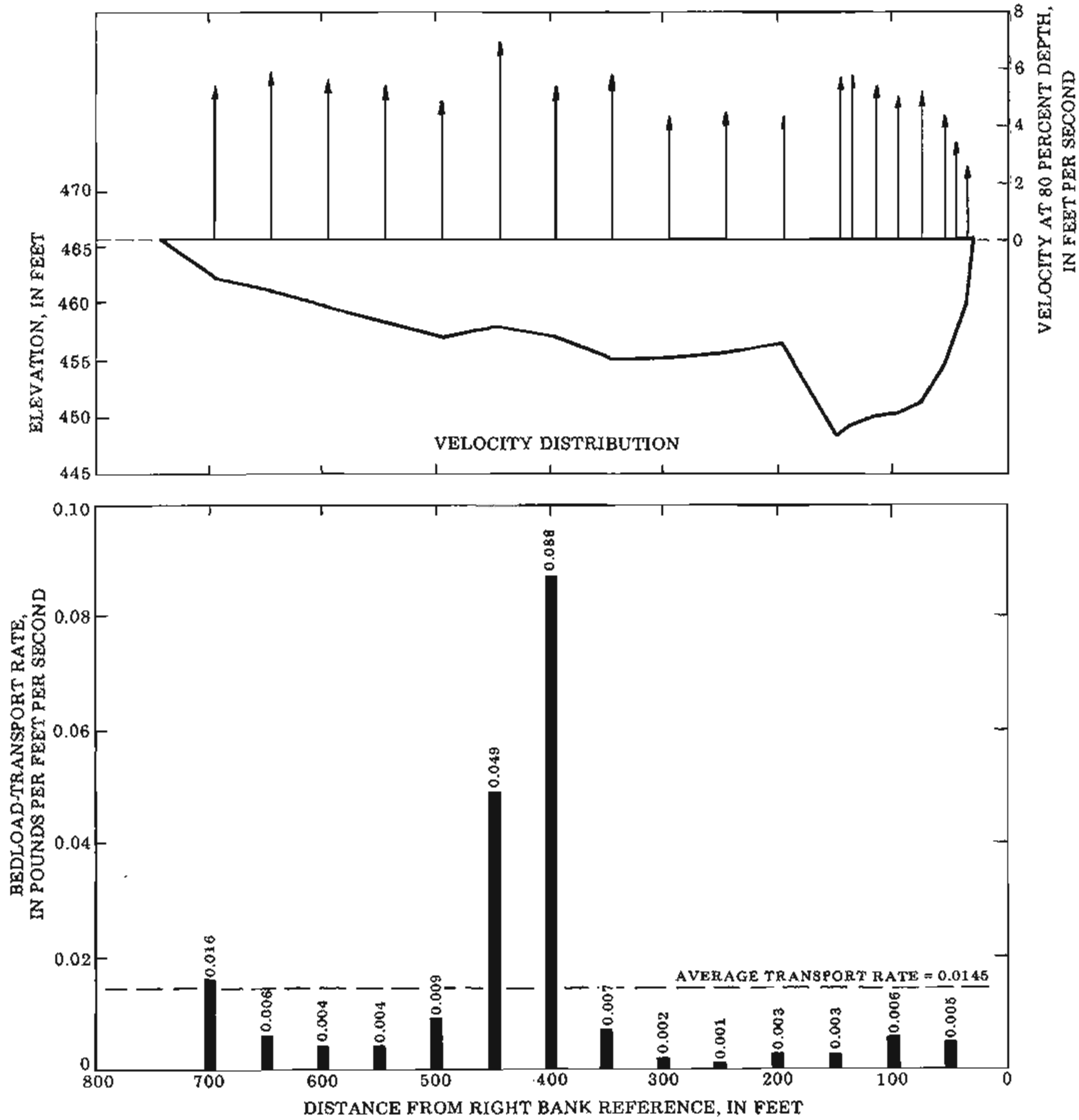

Figure 21. -- Cross section 4+50 showing velocity distribution and bedload-transport rates, at dike site, August 17, 1979. Top: velocity distribution at 80 percent of depth. Bottom: bedload-transport rates.

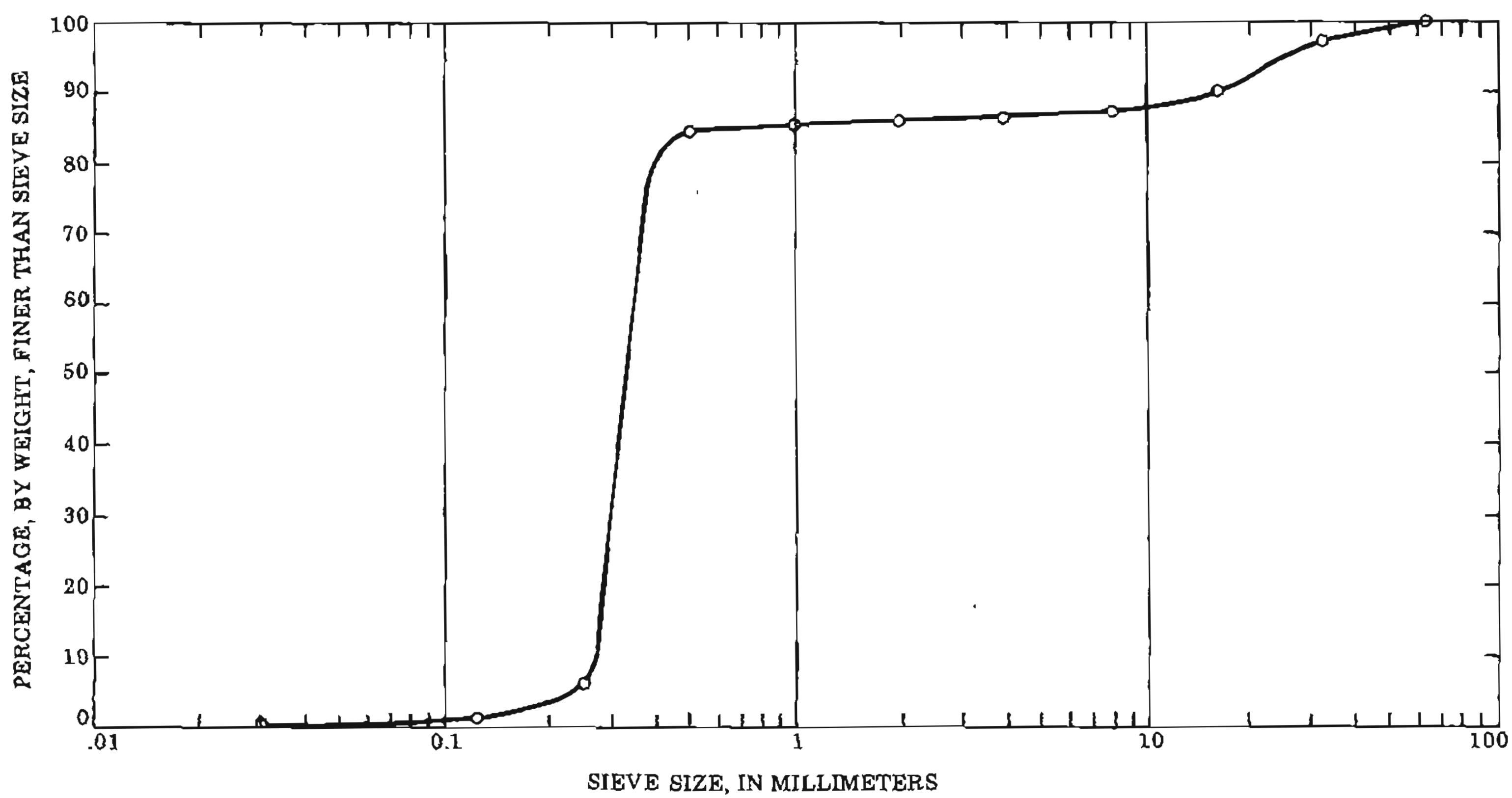

Figure 22. - Composite particle-size distribution of bedload, August 17, 1979, section 4+50, dike site.

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