Station Evaluation
Lubbock River near Atlin
(09AA007)

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Vancouver, B.C.

October 1987

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ABSTRACT

This report provides a cursory analysis of the streamflow data collected at this station. Rating curves have been inspected for appropriate extensions. The high and low flow characteristics have been compared to those of two neighbouring streams and methods of data computation have been noted. The effects of various physical conditions in the channel have been related to the quality of the record. The adverse hydraulic features of the channel were not given serious consideration when first locating this stream gauging station.

In general, an adequate job has been done in the measurement program to account for the shifting control.

The accuracy of the ice period estimates is uncertain as well as the periods of variable backwater.

The accuracy of the data produced for this station is assessed only as fair because of adverse measuring conditions, periods of backwater from various causes and long periods of estimated flow under ice conditions.

Table of Contents

ILLUSTRATIONS

① USE OF WALK-IN SHELTER (ON WOOD STAVE STILLING WELL) DISCONTINUED 1981. INTAKE PIPES HAD SHEARED. PERIOD 1982 - 1987 COVERED BY STREAMFACE CULVERT WELL (C/W CALIFORNIA SHELTER).
STEEL WALK-IN SHELTER, SERVO/MANOMETER AND NEW CABLEWAY INSTALLED SEP. 1987. NEW CABLEWAY APPROX. 40m D/S OF PREVIOUS CABLEWAY ∴ CROSS SECTION WILL BE CHANGED.

1. INTRODUCTION

Streamflow records are among the most valuable of all hydrologic factors used in basin planning. The flow of streams is a sensitive indicator of climatic variations as runoff is the residual of precipitation after the requirements for evapotranspiration have been satisfied. Streamflow records to be used in any analysis involving the record as a whole should be checked for quality. The primary purpose of station evaluation, therefore, is to assess the quality of data being gathered at hydrometric stations.

This report was undertaken to provide a quality assessment of the streamflow data collected at this station.

1.1 Purpose of Station

This station was established November 5, 1954 to assess the inflow contribution from the Yukon Territory to Northwest Power Industries Hydro Proposal in British Columbia.

1.2 Station Description

This station was established with a 22" diameter culvert well and float-operated A-35 recorder in a California shelter referenced to an outside staff gauge. A cableway was constructed May 21, 1964 for high water measurements. The station was upgraded in October 1969 with an Armco walk-in shelter. A cross section under the cableway is shown in Figure 1 which indicates the stream bed is fairly stable and not always subject to scouring at high flow. Winter measurements are made at the mouth of the river where flows are 10% higher than at the station. The river channel and recorder installation are shown in Figure 2.

1.3 Flow Computations

Gauge heights are computed from an automatic chart trace and converted to flows from the various rating curves used throughout the period of operation. There have been twenty-one rating curves used to obtain twenty-nine years of record. An average of four open water measurements has been used to define each rating curve. Flow under ice conditions has been estimated from the use of an average of just over two measurements per winter season, air temperatures, and hydrographing with other streams in the area. In some of the earlier records the effective gauge height method was used to estimate data.

1.4 Factors Affecting Quality of Stage Record During Open Water

(a) Variable backwater conditions caused by:
Aquatic growth in stream channel
Driftwood forming in control
Bank cave-ins
Trees falling in stream channel

(b) Reasons for water levels not being recorded:
Intake pipes too high to register low water
Intake pipes plugged
Intake pipes broken off

(c) Other periods of missing record have been caused by clock stoppages and no chart paper.

(d) Questionable record obtained when water levels in well produced by seepage only.

2.0 Quality of Data

2.1 Maximum Flows

An inspection of past rating curves from 1955 to 1983 indicate that the control is somewhat unstable throughout the entire range of stage as shown in Figure 3, where selected discharges are plotted against stage for the period each rating curve has been used. A large scatter shows throughout the range of stage on the logarithmic plot of stage versus discharge as shown in Figure 4.

The maximum daily discharge expressed as the annual maximum discharge per square kilometre of drainage area was tested for homogeneity with surrounding basins. The results are shown in Figure 5. Lubbock River shows some minor variations with respect to the pattern stations from year to year but in general shows a consistent relationship. Gladys and M'Clintock Rivers are used as the pattern basins in this study.

In the earlier record not much thought was given to convergence of the rating curves at the top end. However, in the last few years a general effort has been made towards convergence to the high water measurements obtained on June 6 and 12, 1972.

An analysis of measurement data used to develop Rating Curves 13 and 14 indicates that the stage-velocity relationship is very erratic, which no doubt is caused in part by the orientation of the cableway with respect to channel configuration. See Figure 6. When analyzed, the measurement of June 10, 1982 appears to have been affected by backwater conditions. Rating Curve 14 has been distorted to accommodate the above measurement as shown in Figure 7.

Rating curves in general have been adequately defined in the upper region but lack any indication of what level overbank flow occurs.

The effect that some high flows have on the channel bed are shown in Figure 8.

The highest discharge measurement taken during the operation of this station was obtained on June 6, 1972 with a flow of 22.7 m^3/s at a stage of 3.22 m. Flow was confined within the banks at this elevation.

The maximum instantaneous and maximum daily discharge data test random, independent, and homogeneous and show no trend based on non-parameter tests.

2.2 Low Flows

Minimum flows usually occur in March during the ice period but occasionally occur in late August. The ice generally forms in late October or early November and melts by early May. This stream is affected by ice an average of 188 days per year as shown in Figure 9. Records for the periods of ice effect each year are estimated from an average of just over two measurements, comparison with hydrographs of other streams, and temperature records at Atlin. The accuracy of this method of estimating stream flow record is impossible to assess without a concentrated metering program.

The lowest measurement to date was made on March 11, 1959 for a flow of 0.56 m^3/s. The lowest estimated mean daily flow shown in the published data files is 1.41 m^3/s which occurred on April 14, 1983.

The minimum daily discharge data test random, independent, homogeneous and do not show a trend based on non-parametric tests.

2.3 Annual Flow

The long-term mean annual discharge for this station is 4.19 m^3/s. Open water records estimated have amounted to less than 6 percent of the total record produced. Record estimated for the ice period amounts to 45 percent of the total record.

The annual runoff has been tested by use of the double-mass curve technique as shown in Figure 10. A decided change in slope is noted at the 1979 point. The later period is somewhat drier than the earlier one. This break tested by the variance ratio test indicates that at the 1 and 5 percent significance levels the break is unlikely to have occurred by chance.

A split sample of the above periods of annual runoff tested for homogeneity indicates that at both the 1 and 5 percent levels of significance there is a location difference between the two samples.

The volume of annual discharge for the ice period is a considerable portion of the total discharge (40%) and any inaccuracies would have a significant effect on the mean annual discharge.

2.4 Assessment of Quality

Most rating curves have been adequately defined and, in general, enough measurements have to be taken to follow most shifts in control throughout the total range of flow. The variable backwater conditions caused by driftwood, falling trees, log jams, and sloughing banks leave a measure of doubt as to the accuracy of some record.

The ice period record is at best an educated guess guided by an average of just over two measurements per season,(2) temperature

(2) THIS HAS BEEN UPGRADED TO 3 MEAS./SEASON.

records, and hydrographs from neighbouring streams. Since the considerable volume of the total annual flow is from flow under ice some measure of inaccuracy exists in the calculation of the annual volume.

The reliability of the stage-discharge relationship for the low stages is poor at times. The control is in a continual process of shifting caused either by ice, high flows or erratic velocity profiles.

3.0 Recommendations

If possible, this station should be relocated to a section with a stable control and where the channel is more conducive to laminar flow.

The overbank flow elevation should be located on all future rating curves. TO BE DONE IN 1988.

Further hydrologic analysis is required to find the reason for the non-homogeneity between the annual runoff for the periods 1968/79 and 1980/86.

In order to improve the estimation of flow rates under ice conditions a program should be initiated as soon as possible to make use of a flow model.

4.0 Conclusions

This stream does not have a quick response to precipitation, thus allowing adequate time to define the upper end of the rating curves.

Estimated flow during ice periods is of unknown accuracy. Since flow under ice conditions produces a large portion of the annual runoff. Accuracy is of utmost importance.

More analysis should be done of measurement data that do not plot within acceptable limits.

Missed stage record, ice periods, variable backwater from various causes, silted and broken intake pipes and variable current direction in relation to the cableway all have their effect on the accuracy of data produced from this station. This stream appears to be unique in the area in its runoff characteristics.

Accuracy of the data from this station can only be assessed as fair.

Figures 1 - 10

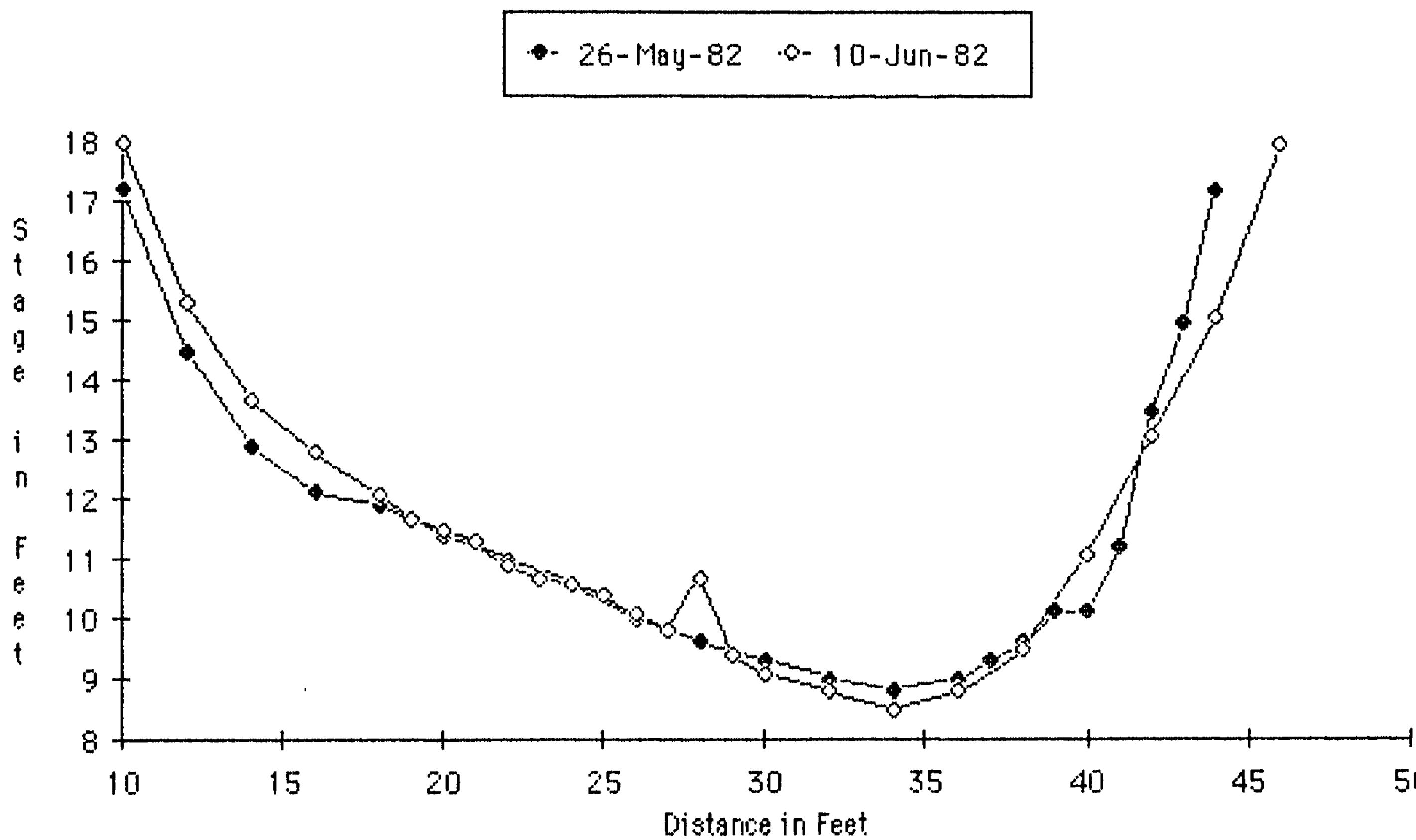
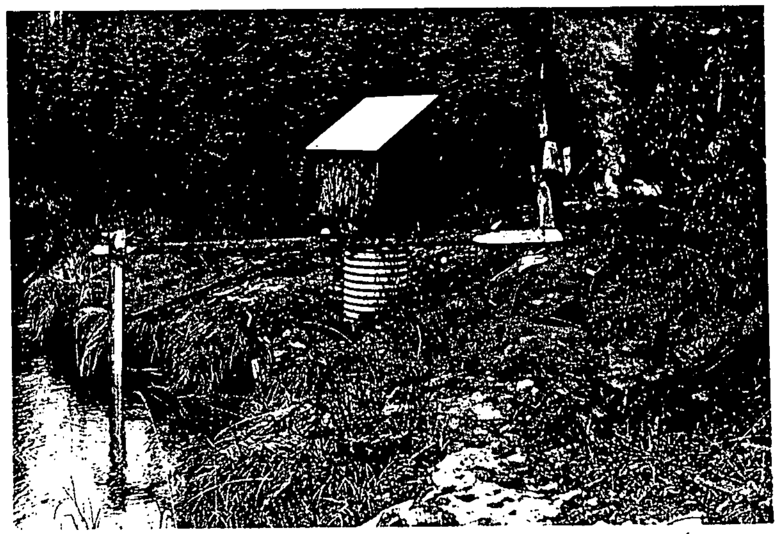


Figure 1 Cross Sections of Lubbock River at Cableway



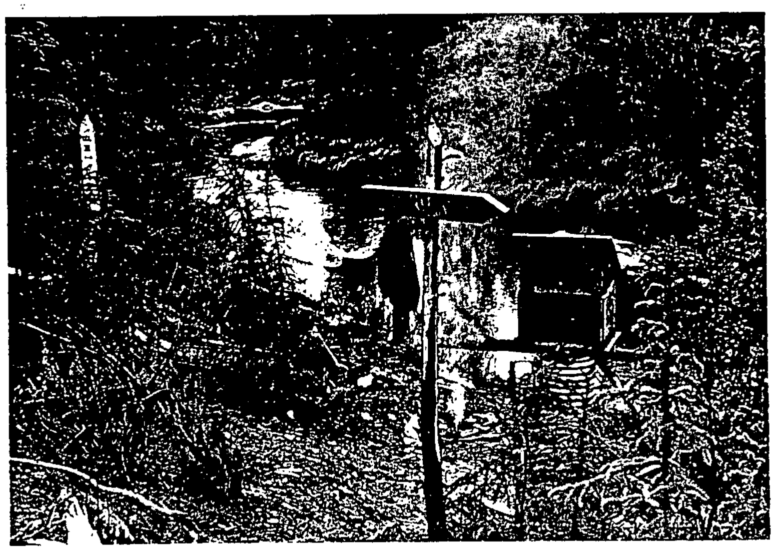
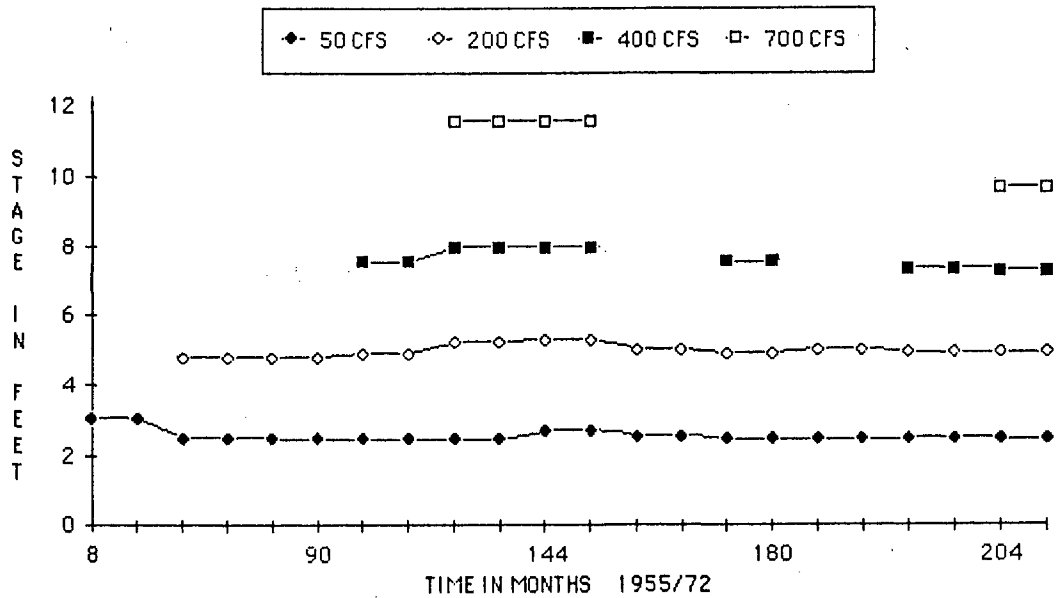


Figure 2 Photographs of the Recorder Installation on River Channel

THESE PHOTOS PRIOR TO 1968



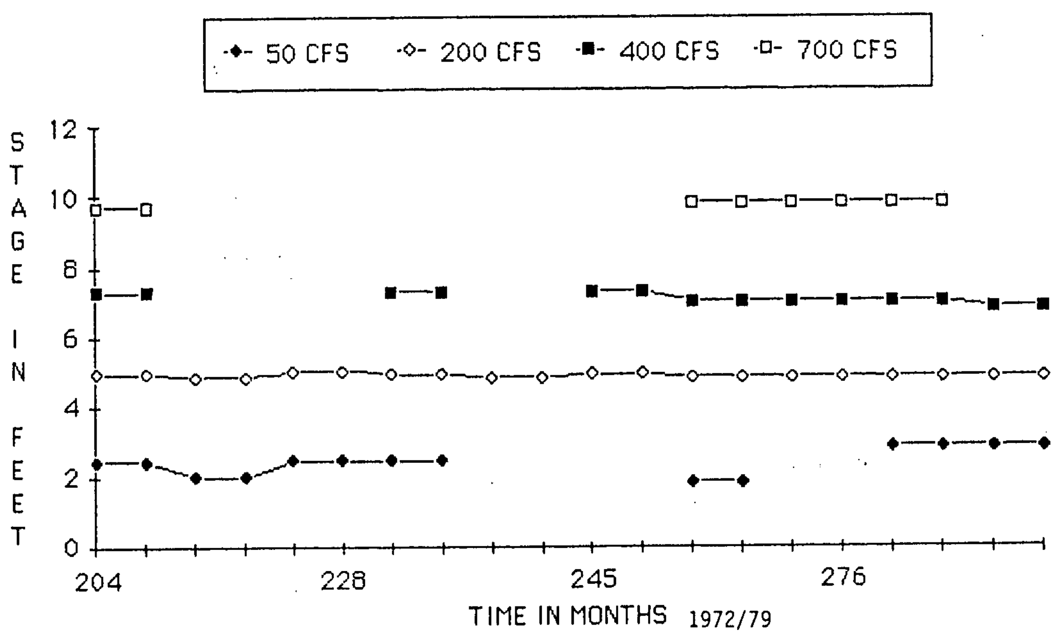
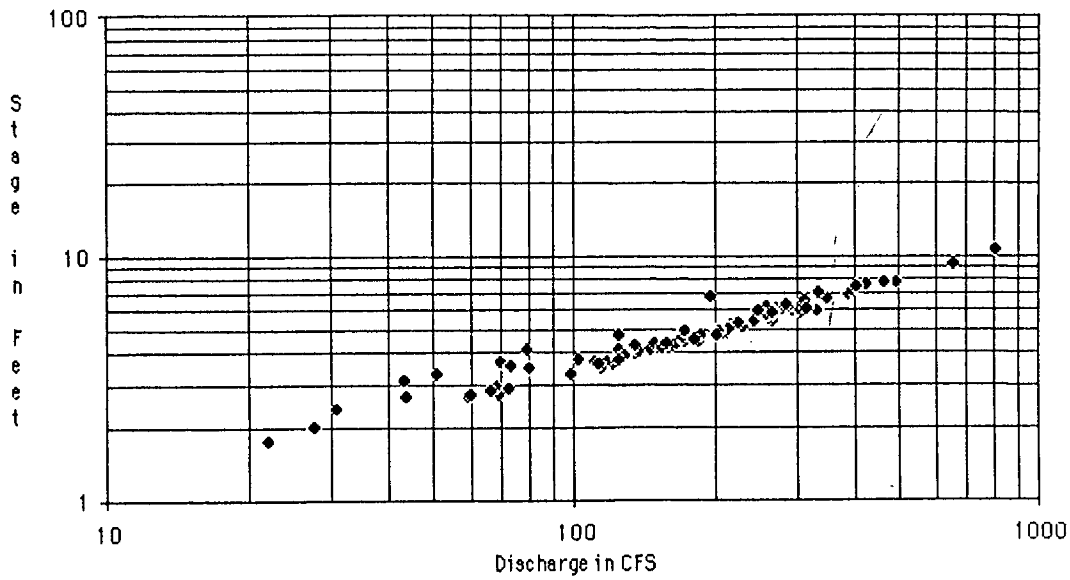


Figure 3 Stage Relationship with Selected Discharge

RELATIONSHIP OF MEASUREMENTS TO STAGE - 1954/79



RELATIONSHIP OF MEASUREMENTS TO STAGE - 1980/84

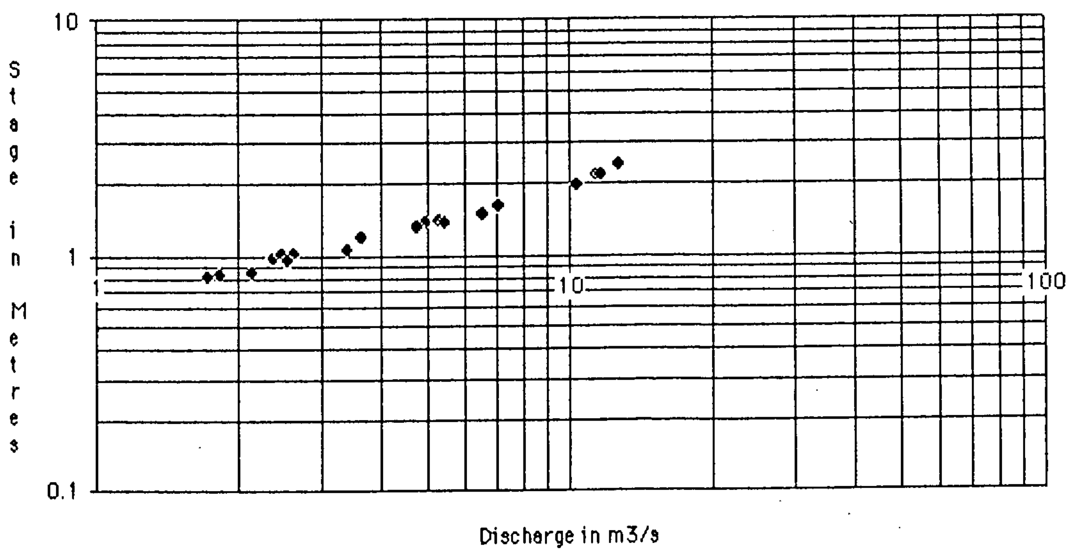


Figure 4 Composite Curve of Open Water Measurements

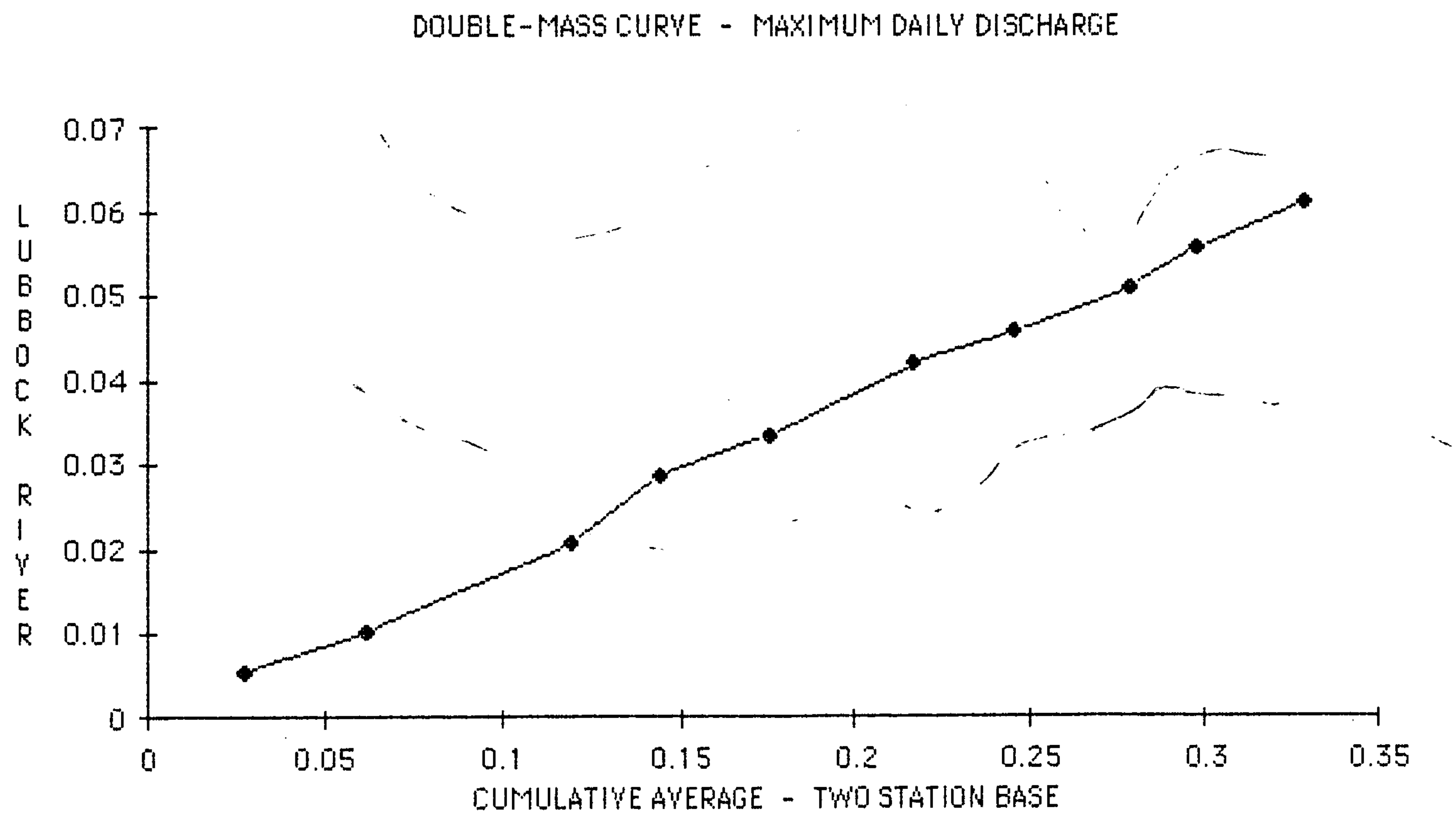
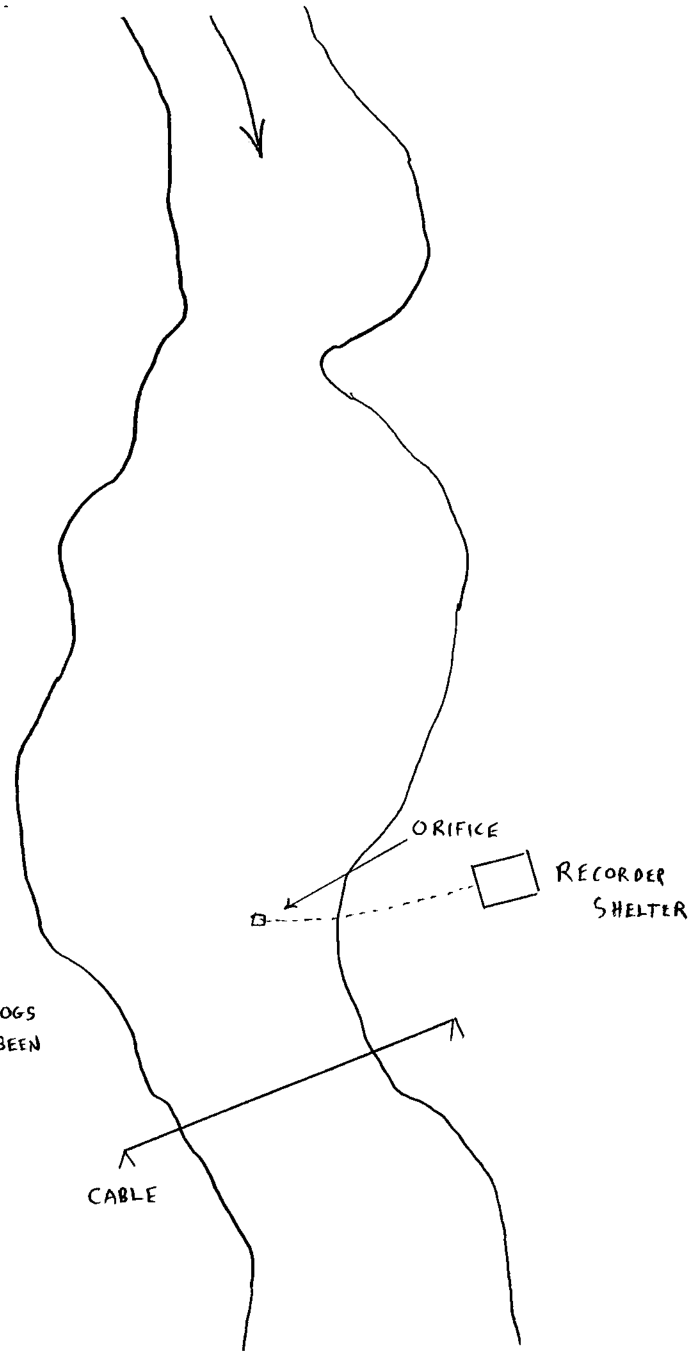


Figure 5 Double-Mass Curve of Maximum Daily Discharge



ALL SUBMERGED STUMPS, LOGS AND BEAVER DAMS HAVE BEEN REMOVED FROM CHANNEL.

CURRENT PLAN VIEW

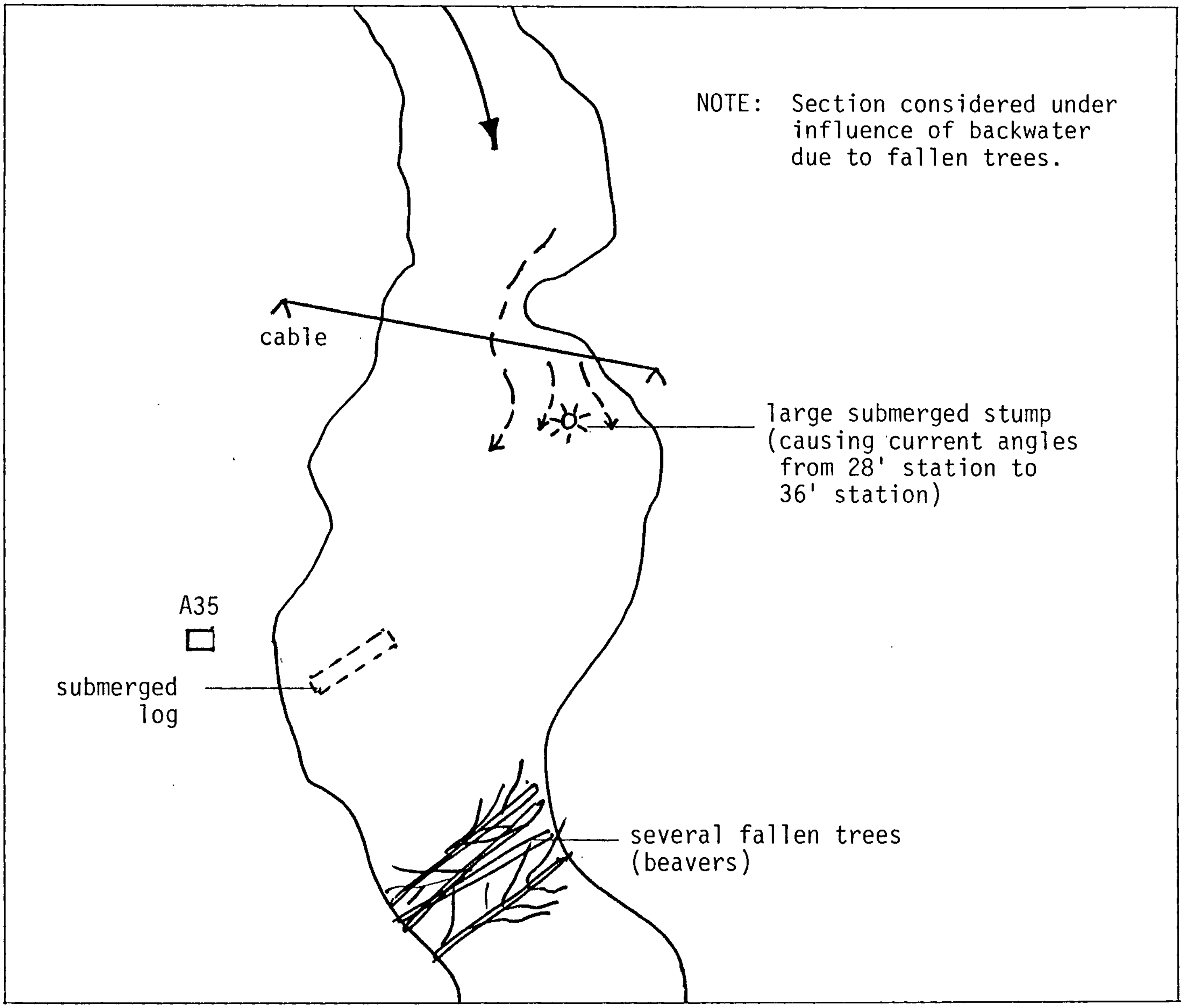


Figure 6 Plan View of Cableway and Stream Channel

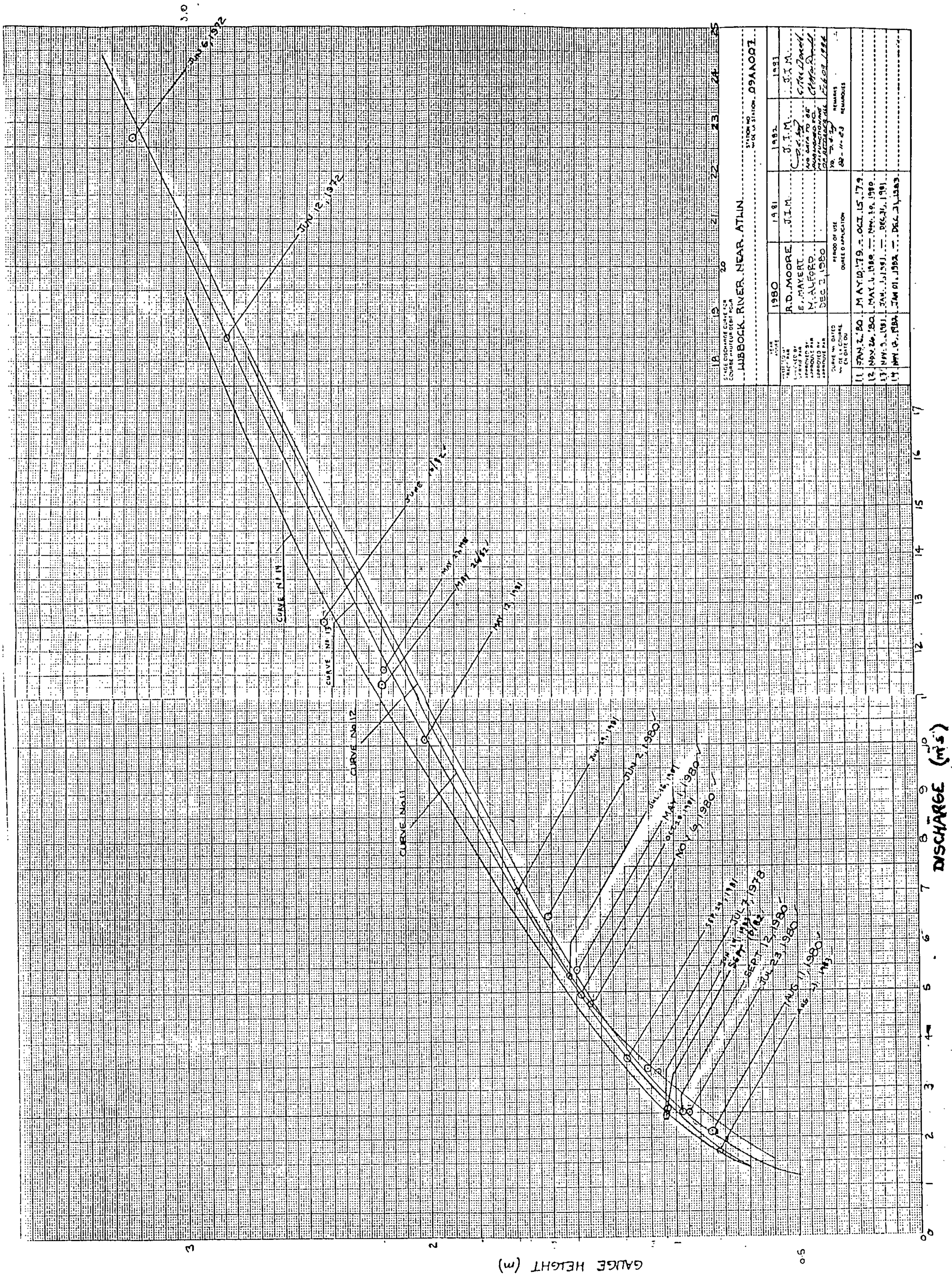


Figure 7 Distortion of Rating Curve

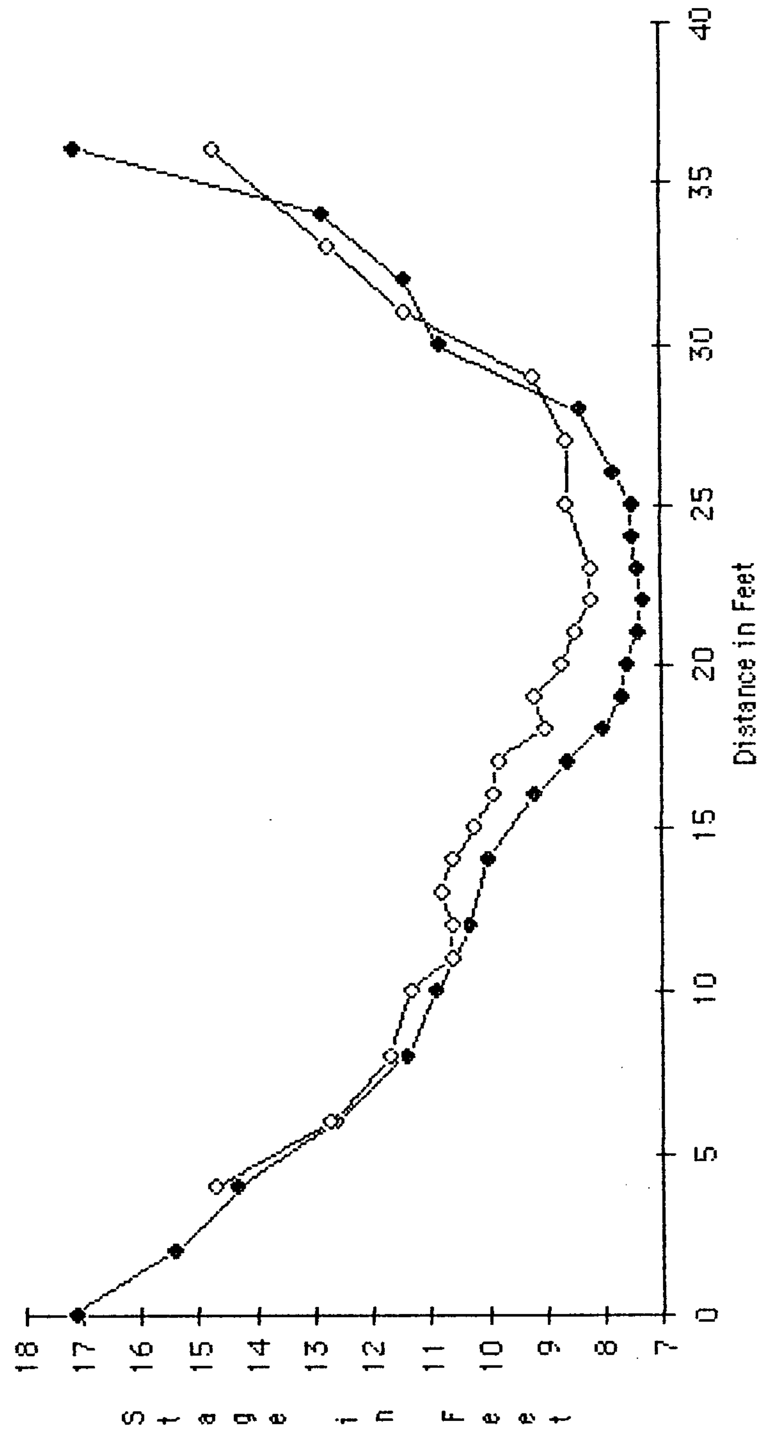


Figure 8 Effect of High Discharge on Channel Bed

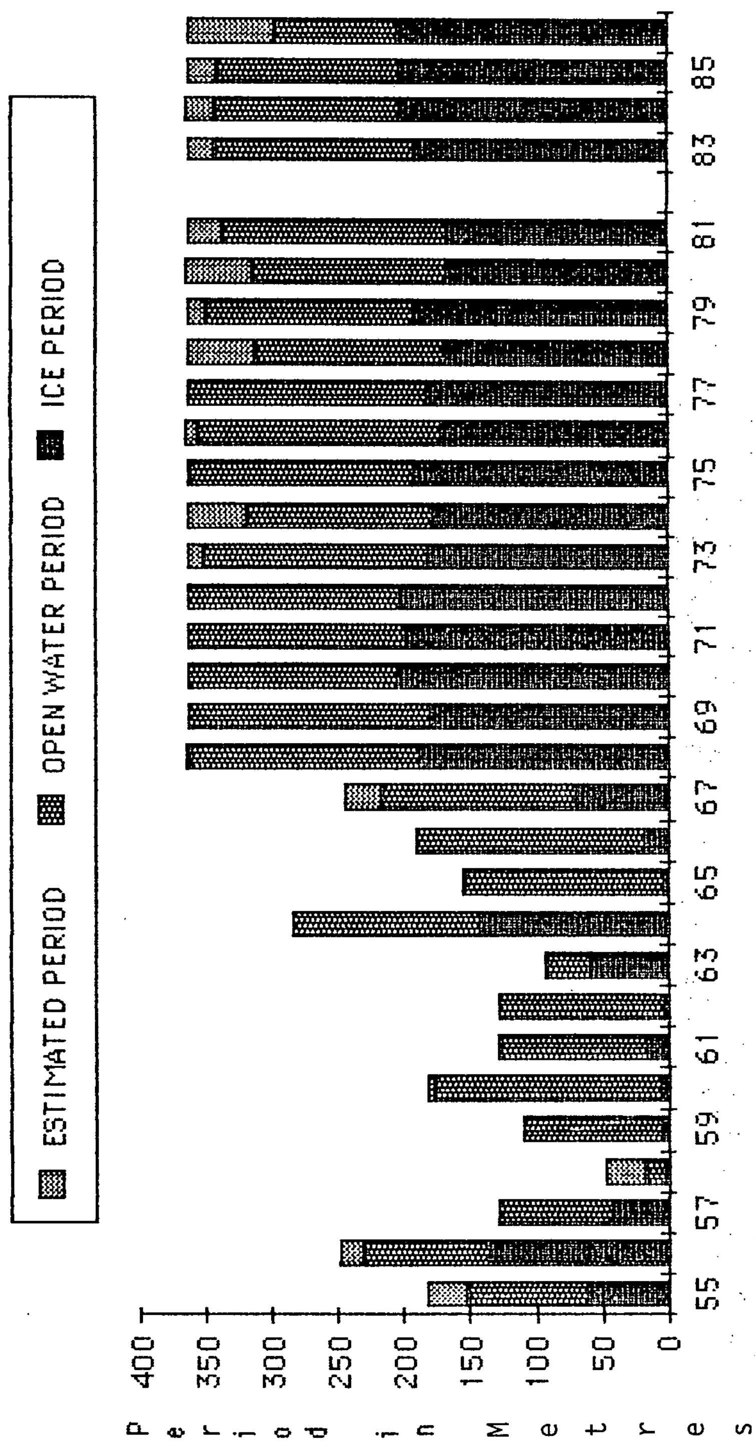


Figure 9 Method of Data Computation

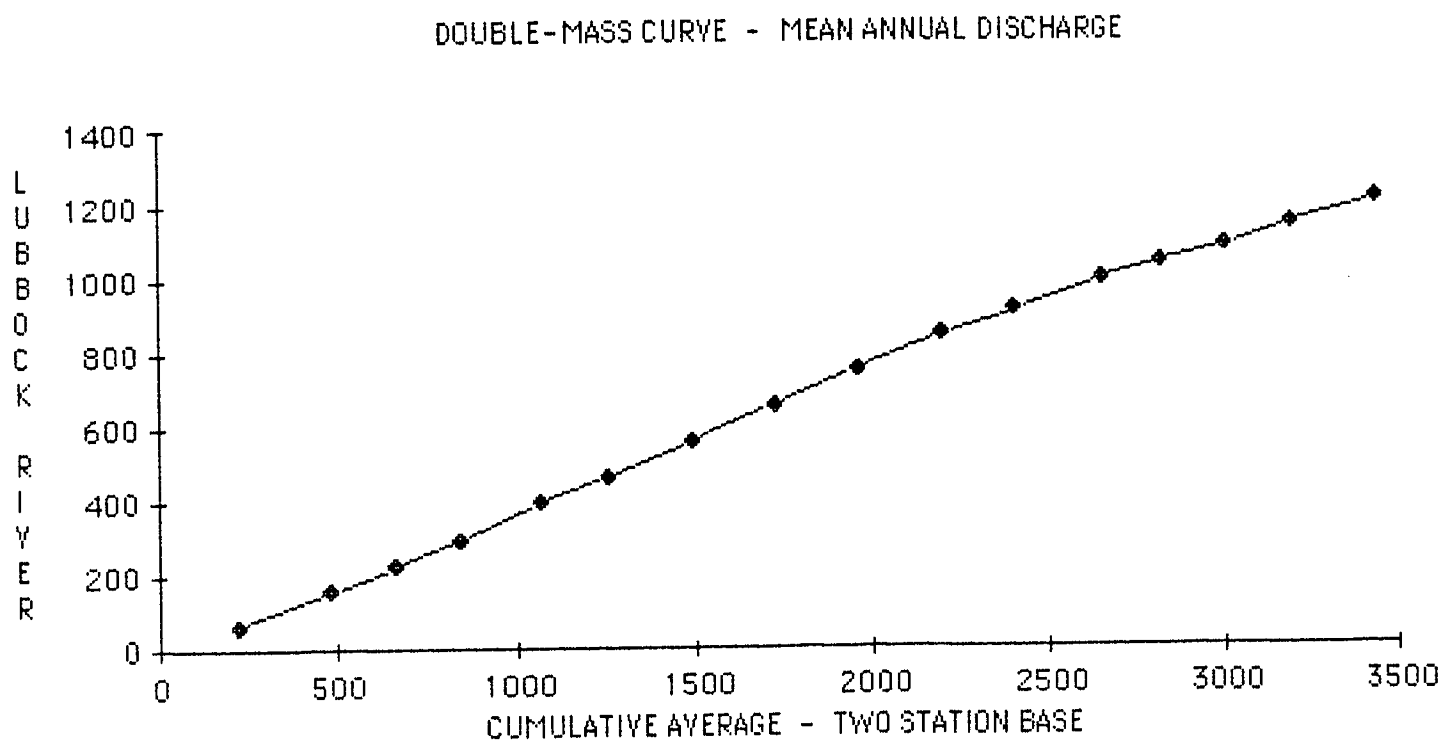


Figure 10 Double-Mass Curve of Annual Runoff