Station Evaluation

ILLECILLEWAET RIVER AT GREELEY
(08ND013)

A.G. Smith

Planning and Studies Section
Water Resources Branch
Vancouver, B.C.
July 1987

TABLE OF CONTENTS

Table of Contents (continued)

ILLUSTRATIONS

Abstract

The streamflow data collected at this station has been analyzed superficially in this report. Some rating curves have been inspected for appropriate extensions. The high and mean flow characteristics have been compared to those of neighbouring streams and methods of computation have been noted. The effect of various physical conditions on the development of data have been related to the quality of the record.

The flood of July 12, 1983 was overestimated by approximately 35 per cent.

The diversion for domestic water supply uses a small portion of minimum daily discharge from the station.

The maximum daily discharge and annual runoff appear to be homogeneous with the surrounding basins.

Periods of lost or inaccurate stage record reduced the accuracy of the estimated discharge.

An adequate job has been achieved in the measurement program to account for the shifting control.

The accuracy of the ice period estimates is always uncertain where a small error can result in a large percentage error in the mean daily.

The accuracy of the data produced from this station could only be assessed as fair.

1.0 Introduction

The mean daily flows from this station have been proposed as the database to be used in the testing of various models during the W.M.O. Workshop on Real-Time Intercomparison of Hydrological Models. The purpose of this report is to assess the quality of data collected at this station.

1.1 Purpose of Station

The station was established on November 18, 1963 for real-time inflow studies to Arrow Reservoir.

1.2 Station Description

This station was established with a wood stave well, float operated A-35 recorder, and cableway. A Telemark, Memomark, and DCP have been installed at the station and referenced to the inside gauge. There have been various long periods of time when there has been no outside gauge. High water measurements are made from the cableway. A cross section under the cableway is shown in Figure 1 which indicates the stream bed is very unstable and subject to scouring during high flows. Low water measurements are made by wading at various locations near the cableway.

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 nineteen rating curves used to obtain twenty years of record. An average of nine measurements has been used to define each open water rating curve. Flow under ice conditions has been estimated from the use of an average of two measurements per season, air temperatures, and hydrographing with other streams in the area.

1.4 Factors Affecting Stage Records

a. Bulldozing in the channel April 10 to 14 in 1967 affected the high water control.
b. Dyke work in 1968 negated the rating curve from November 25 to December 31 in that year.
c. Dyke work in early 1969 again affected the stage records. The coffer dam used to control flow for repairs to the domestic water supply pipeline was assumed to have washed out on the rising stage.
d. Stage record affected again by coffer dam beginning November 4, 1972.
e. No high water measurements taken during 1980 and 1981 due to condemned cableway.
f. Periods of missing records have been caused by: clock stoppages, rollers jammed, pen failure, no chart paper and clock weight interfering with float in frost tube.
g. Silted intake pipes.

2.0 Quality of Data

2.1 Maximum Flows

An inspection of past rating curves indicates that the control is unstable throughout the entire range of stage as shown in Figure 2, 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 3.

The maximum daily discharge expressed as the annual maximum discharge per square kilometre of drainage area was tested for homogeneity with the surrounding basins. The results are shown in Figure 4. On the basis of a variance ratio test (F-test) at the signficance level of 5% the basin record is homogeneous with the surrounding basins in its flood-producing characteristics.

In general, the rating curves for this station have not been converging at the top end which would indicate that there is no channel control.

The rule for estimating high flow is that the estimated flow should not exceed double the highest measured flow that was used to establish the rating curve. This criterion was violated in estimating the instantaneous peak flow of July 12, 1983.

The maximum instantaneous discharge value estimated by an indirect measurement technique is 440 m3/s at a stage of 4.022 metres. Overbank flow occurs near the stage of 3.25 metres which means the rating curve was extended beyond its application limit. This is shown in Figure 5 for curves #17 and #18. The flow of 591 m3/s estimated from the curve is nearly 35% higher than that calculated from the slope-area analysis. This indicates that backwater is caused by a channel restriction 60 metres below the cableway.

The effect of the high flow on the channel bed at the cableway can be seen in Figure 1.

The highest discharge measurement taken during the operation of this station was obtained on June 1, 1972 with a flow of 348 m3/s at a stage of 3.12 m. Flow was still within the banks at this elevation.

There are 6 instantaneous discharge values that have been estimated from rating curves extended to overbank elevations. Half of these discharge values are expected to need less than 10% adjustment.

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

2.2 Low Flows

Minimum flows usually occur during the ice period which generally starts in December and ends in February or March. This stream is affected by ice on the average of 80 days per year as as shown in Figure 6. Records for the periods of ice effect are estimated from an average of two measurements, comparison of hydrographs of other streams, and temperature records at Revelstoke. The accuracy of this method of estimating streamflow record is not possible to assess without a concentrated measuring program.

The lowest measurement to date was made February 8, 1973 for flow of 3.99 m3/s. The lowest mean daily flow of 3.94 m3/s occurred on March 24, 1964.

A sixteen inch pipeline carries water from Greeley Creek to the City of Revelstoke. Greeley Creek is a tributary to the Illecillewaet River above the gauging station.

The average water usage during the winter months is approximately 30,000,000 gallons per month (0.04 m3/s). The consumption triples in the summer months to around

90,000,000 gallons per month (0.13 m3/s).

The minimum daily discharge data test independent, homogeneous and do not show a trend based on non-parametric tests. The minimum data does, however, test non-random at the 5% level of significance which may be due to the small variation of the minimum daily discharge from year to year.

2.3 Annual Flow

The mean annual discharge for this station is 53.7 m3/s. Open water records estimation has amounted to 5% of the total record produced. The annual runoff has been tested by use of the double-mass curve, Figure 7, and found to be homogeneous with other basins in the area. The volume of flow for the ice periods is small and any inaccuracy would have little effect on the mean annual discharge. Record estimation for the ice period has amounted to 23% of the total record produced.

2.4 Assessment of Quality

The overbank rating has not been defined for this station. Therefore, any high flow estimate above the approximate stage of 3.2 m is unreliable.

Enough measurements have been obtained to follow most of the shifts in control throughout the low and medium range of stage during open water periods although the timing of measurements has not always been suitable. A shifting control does not always mean poor record. It is a matter of how well the measurement program is planned.

The ice period record is at best an educated guess guided by an average of two measurements, temperature record, and hydrographs from neighbouring stations.

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

3.0 Recommendations

If possible, this station should be relocated to a section with a stable control. A stable control would reduce the number of measurements required to produce good records and make for more efficient operation of the station. The overbank rating should be defined as soon as possible in order to verify peak discharges above the approximate elevation of 3.2 metres.

4.0 Conclusions

The undefined overbank rating will not affect any discharges except those obtained from extended rating curves beyond overbank elevations.

Estimated flow during ice periods is of unknown accuracy and could mean considerable discrepancies in mean daily flow.

The amount of water diverted from the basin during the winter months ranges from a low of 0.5 percent of daily flow to a high of 1.0 percent of the daily flow.

The channel work, missed stage record, ice periods, shifting of control and silted intake pipes will all have their effect on the accuracy of data produced from this station. The accuracy of the data can only be assessed as fair.

Figures 1 - 7

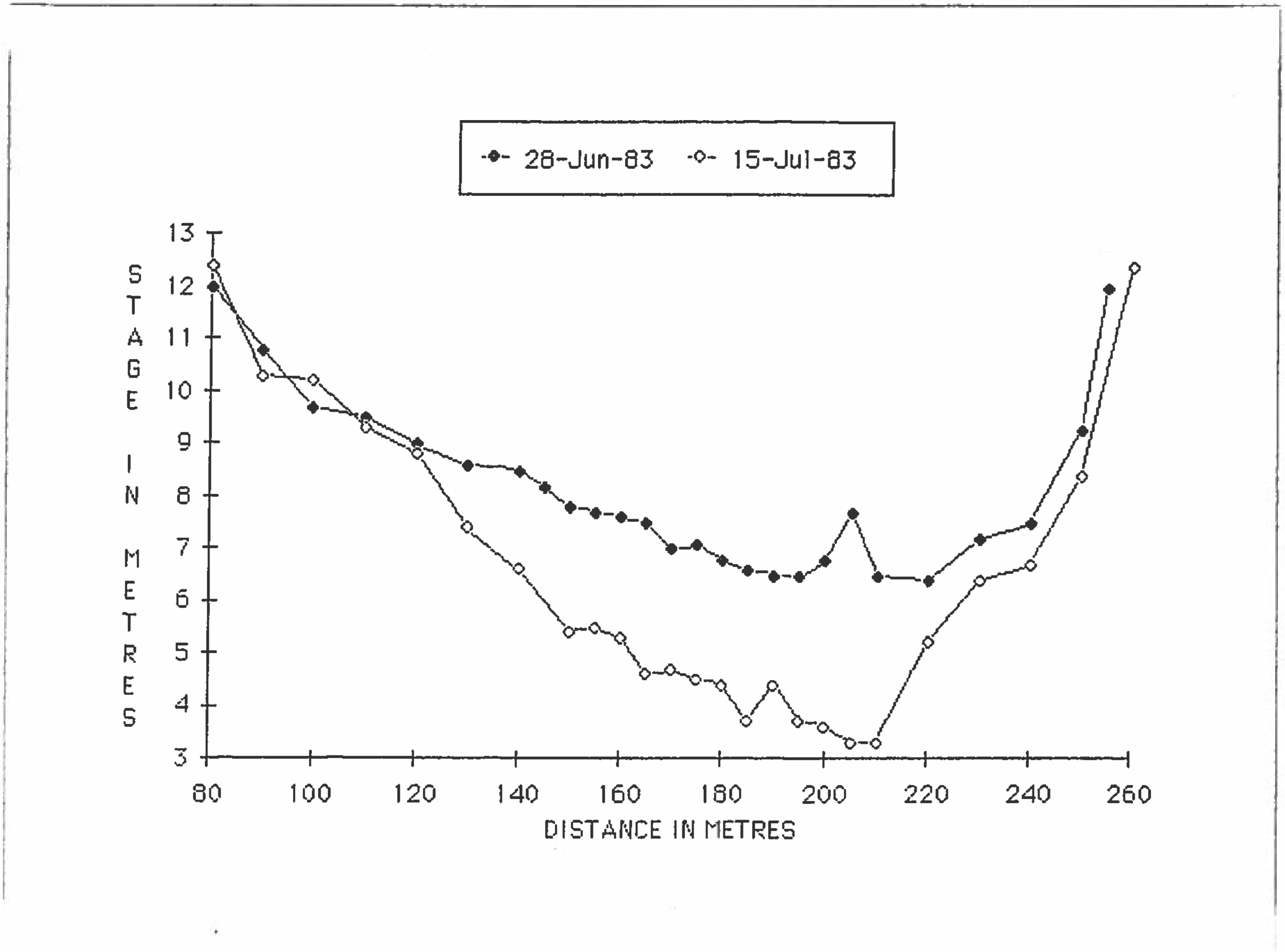

Figure 1

Cross Section of Illecillewaet River at Cableway

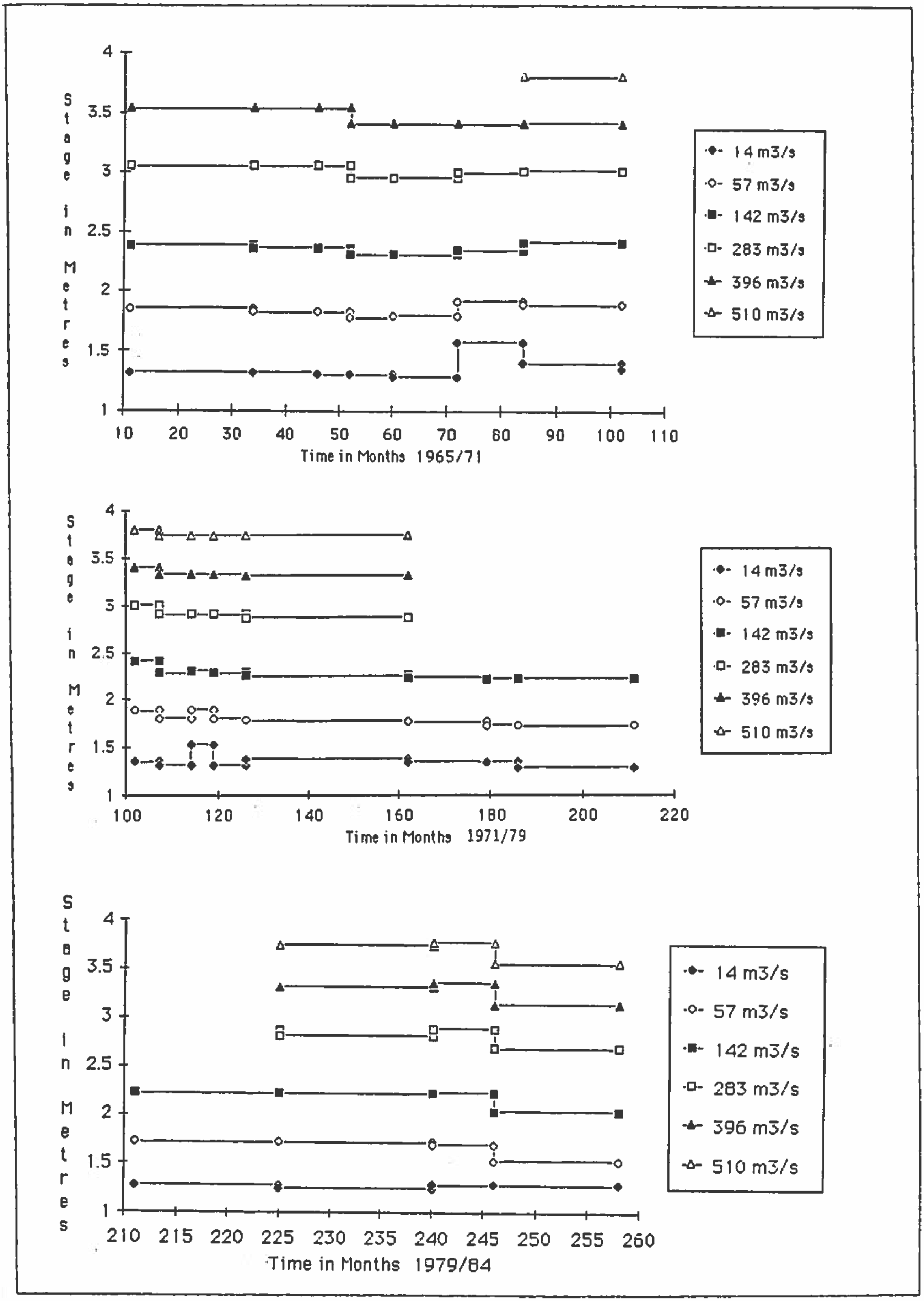
Stage in Metres
Time in Months 1965/71
Time in Months 1971/79
Time in Months 1979/84
14 m3/s
57 m3/s
142 m3/s
283 m3/s
396 m3/s
510 m3/s

Figure 2

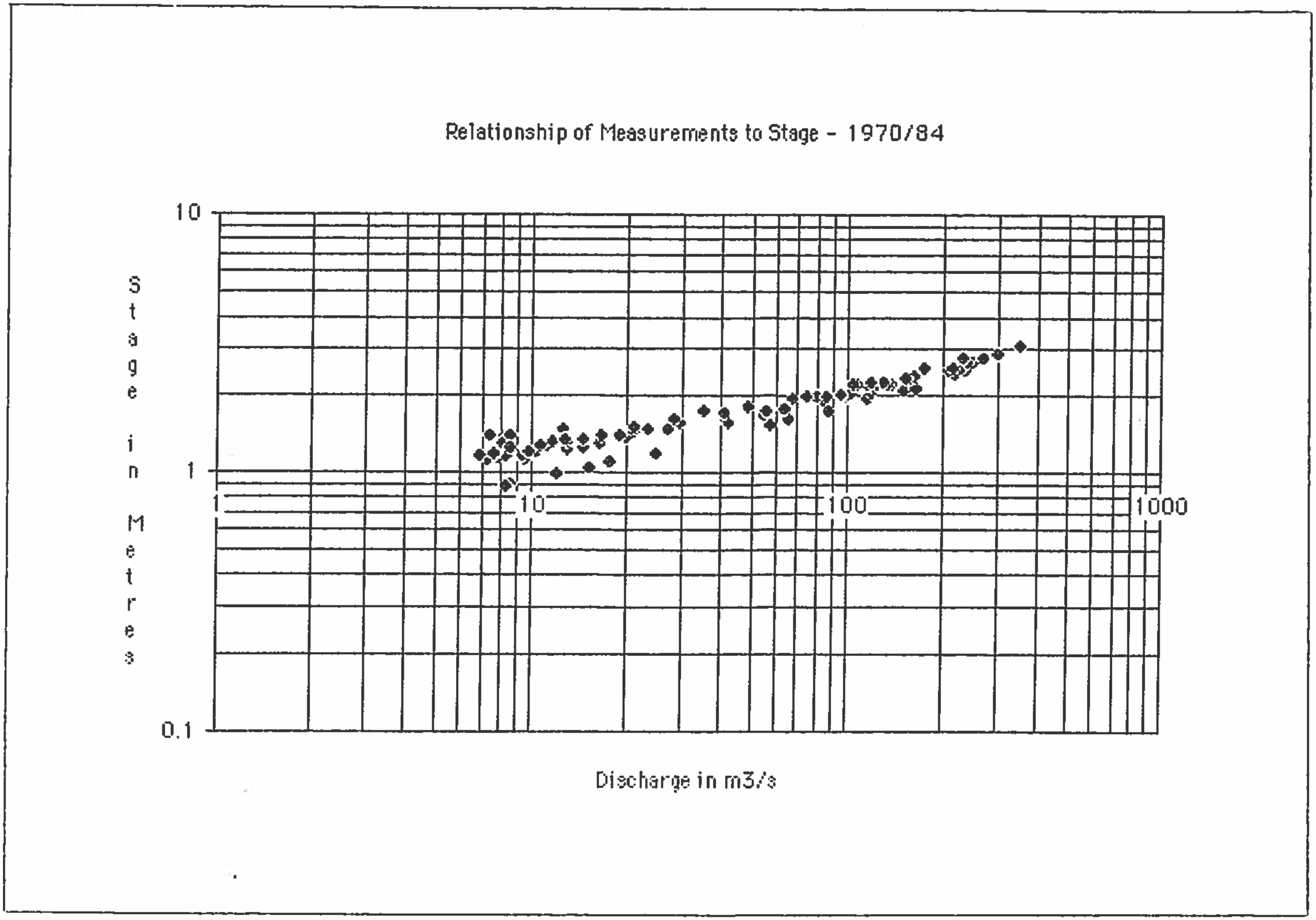

Figure 3

Composite Curve of Open Water Measurements

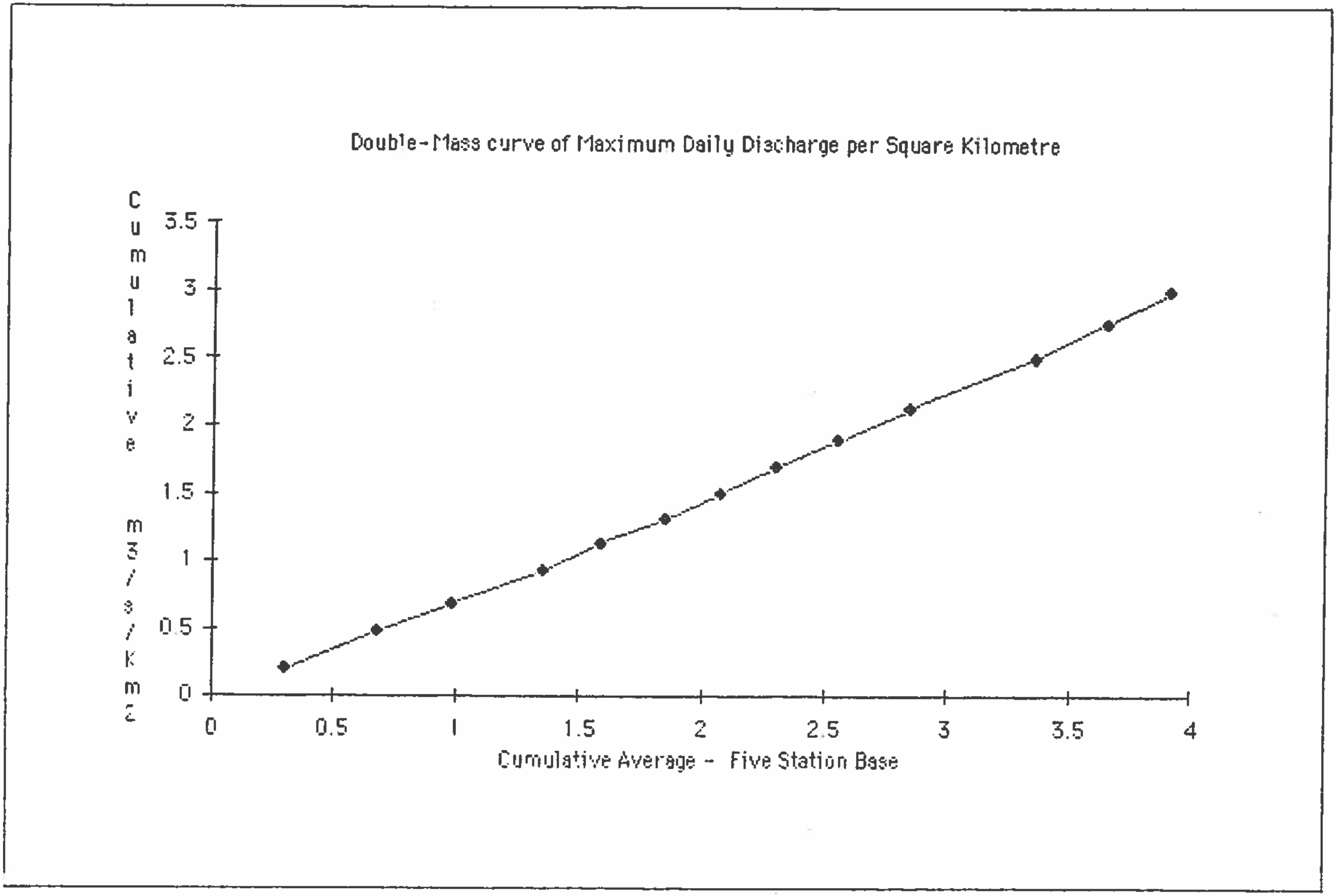

Figure 4

Double-Mass Curve of Maximum Daily Discharge

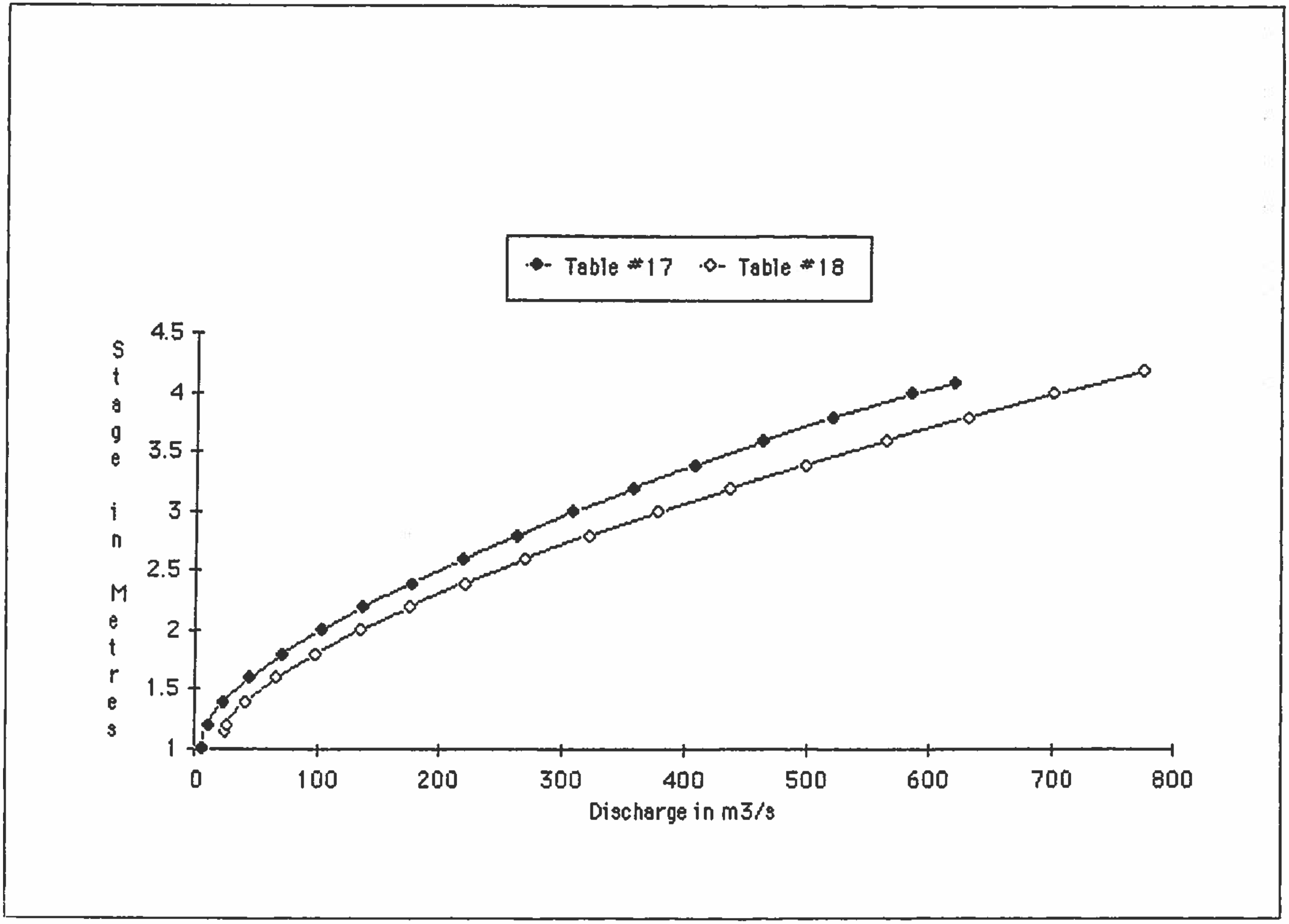

Figure 5

Stage-Discharge Curves #17 and #18

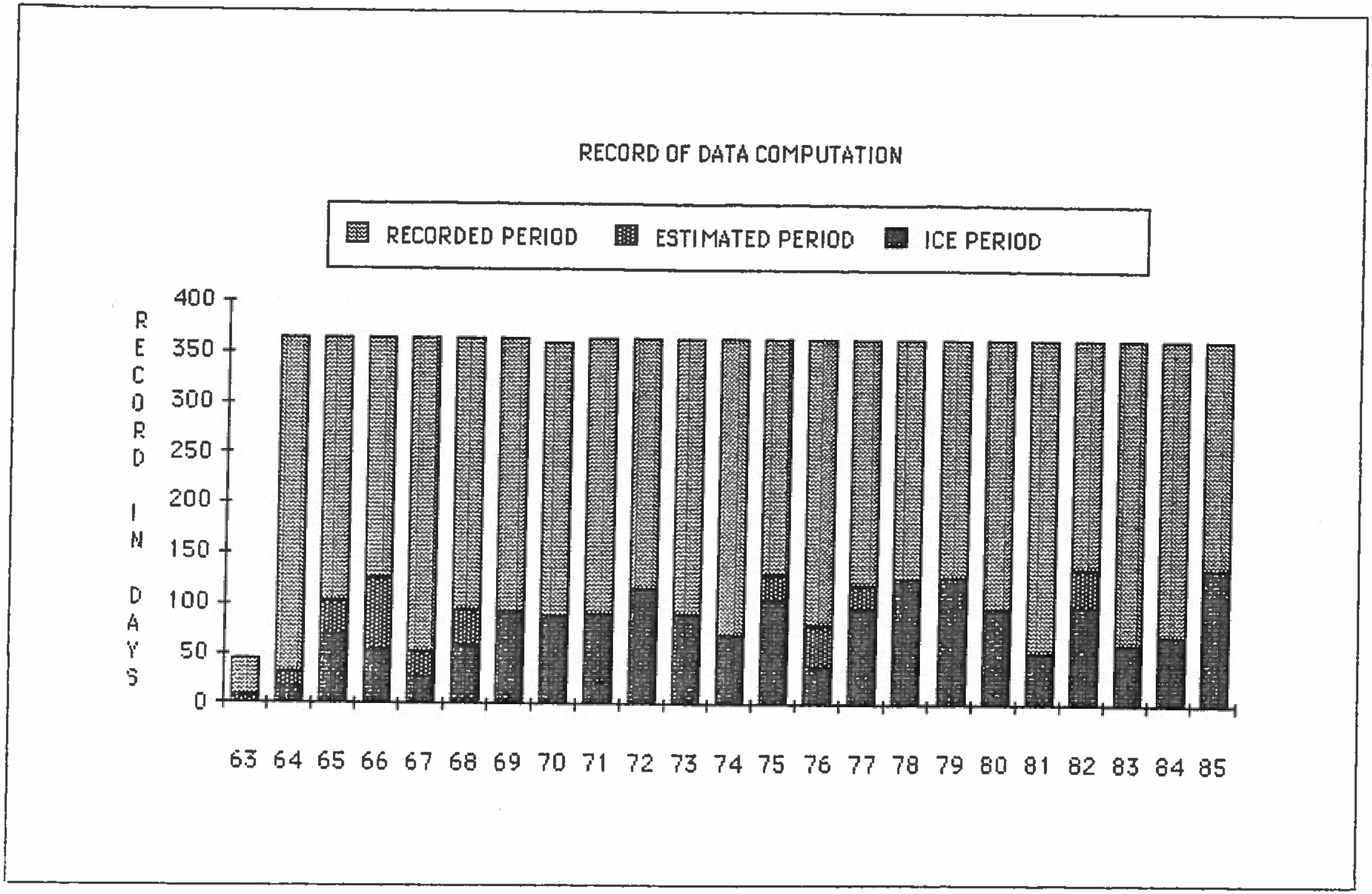

Figure 6

Method of Data Computation

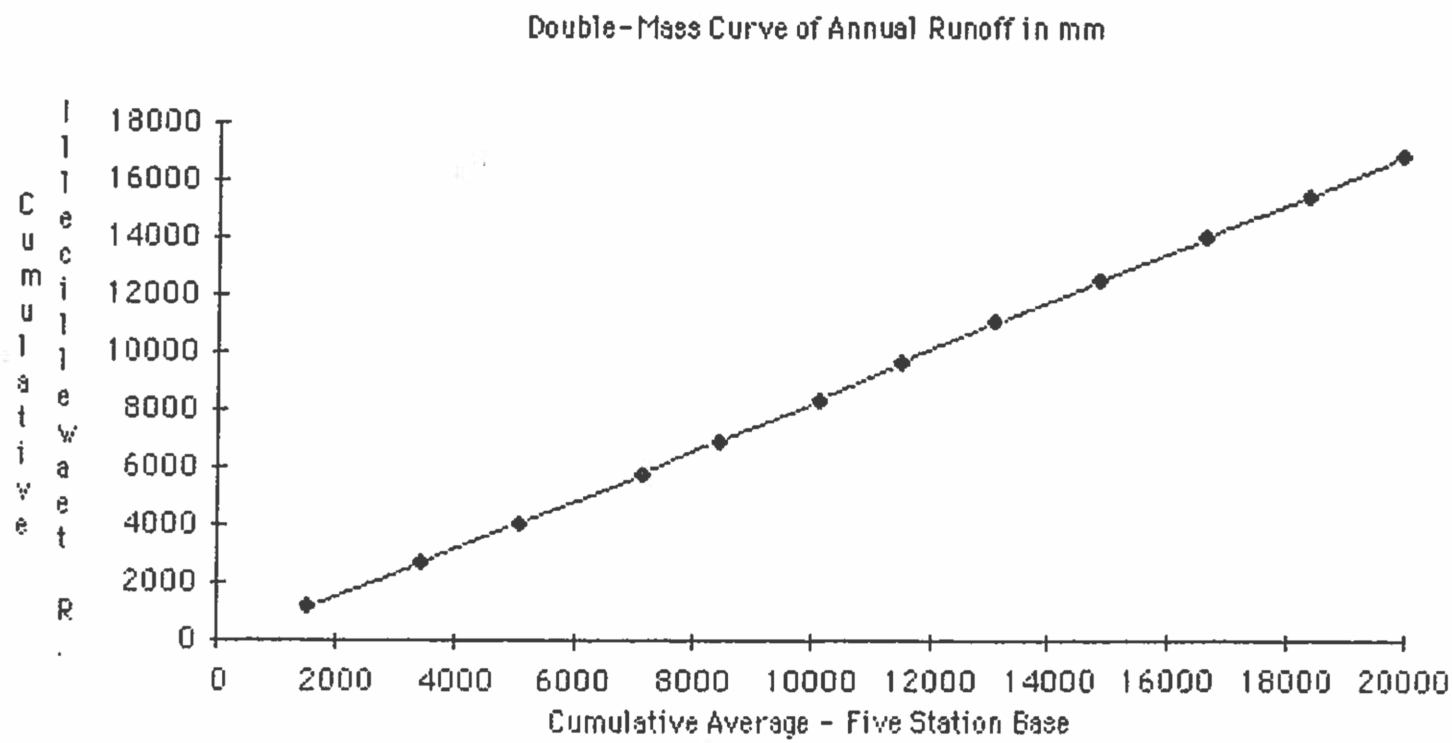

Figure 7

Double-Mass Curve of Annual Runoff