FLOOD FREQUENCY ANALYSIS AT SOME TYPICAL DISCHARGE MEASURING SITES OF PAKISTANI RIVERS

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ABSTRACT

A study is presented on the flood frequency studies of different rivers in Pakistan at some typical discharge measuring sites utilizing maximum yearly flows and doing calculations by both graphical as well as analytical approaches of computing frequency curves with a view to know the probability of future floods equalling or exceeding the previous maximum yearly flow. The study is of immense value in locating the critical hydraulic structures so that necessary arrangements could be made well in advance regarding the prevention of huge losses likely to our during future floods. Moreover it is also possible to determine the probability of occurrence of a given magnitude of flood at various discharge measuring sites of Pakistani Rivers with the help of constructed frequency curves.

INTRODUCTION

Our country has experienced major floods during the years 1955, 1959, 1973, 1976, 1980, 1988 and 1992. Necessary uptodate data on these floods is available in terms of maximum yearly flows [1,2] and some basic studies have already been conducted [3]. But the author is of the opinion that no serious effort has been made to critically analyze this data with a view to determine the flood producing characteristics of different rivers of Pakistan. Therefore, the first phase of study is presented giving calculations on the two

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Types of computations of frequency curves, viz, graphical method and analytical method. Although the paper has been written keeping in view the devastations of 1992 floods, yet it is likely to prove very important in giving basic understanding on flood problem analysis. Table-1 gives maximum peak flows during 1992 floods.

Table - 1: Maximum discharges in the drivers at different sites during 1992 floods.

River	site	maximum discharges (cusecs x 1000)
Indus	Kalabagh	846
	Taunsa	655
	Guddu	1087
	Sukkur	1068
	Kotri	689
Jhelum	Mangla	932
	Rasul	952
Chenab	Marala	839
	Khanki	910
	Qadirabad	949
	Trimmu	888
	Shershah	393
	Punjnad	872
Ravi	Jassar	149
	Balloki	102
Sutlej	Sulemanki	193
	Islam	183

Basic Information on Frequency Studies

In engineering problems it is usually impossible or infeasible to identify and analyze the entire population (data) because most of the problems involve natural phenomena on which recorded data is relatively limited.

Gausian or normal distribution is one of the most commonly used probability distribution which is closely approximated by most of the natural phenomina. This distribution is completely specified by the two parameters, viz, population mean and population variance which can not be determined from the populations of natural phenomena as only a few recorded events are available. Therefore, usually an assumption is made that the sample mean is equal to the population mean and sample standard deviation is assumed to be equal to the population standard deviation. With the increase in sample size, the accuracy of analysis starts improving. Generally stream flow data does not seem to be adequately described by the normal distribution because lower bound or stream flow is zero rather than minus infinity [9]. However if logarithms of stream flow are used in the analysis, the resulting data conforms to known characteristics of normal distribution as when stream flow approaches zero its logarithm approaches minus infinity. In many practical applications it si desirable to work with the frequency of occurrence rather than probability of occurrence as the two are directly related also.

Probability Analysis for Hydrologic Engineering

The primary consideration in selection of data for a frequency study depends a lot on the objectives of frequency analysis. If the objective is to estimate the damages associated with the instantaneous peak flows then peak flows are selected from record. In the hydrologic data, occasionally, a run-off record may be interrupted by a period of one or more years due to known or unknown reasons. If the interruption has been caused by a known reason (destruction of a gauging station by a large flood) then failure to fill in the record for that flood would have a biasing effect on the analysis and therefore should be avoided [9]. However if the cause of interruption is known to be independent of flow magnitude, the entire interruption period may be eliminated without any biasing effect. As mentioned already there are two approaches of estimating frequency curves, viz, graphical approach and analytical approach. In both the approaches calculations are made in tabular form and in the end Frequency curves are drawn.

Computation of Frequency Curves by Graphical Method

This method can be used for any type of study as graphical methods are generally applicable and the data can be easily observed and compared with the computed results. The plotting grid commonly used in studies of flood flow frequencies is the logarithmic normal (log-probability) grid which is designed so that logarithmic normal frequency distribution would plot as a straight line. The plotting grid used for flood stage frequencies is the arithmetic probability (arithmetic normal) grid. These plotting grids should contain a horizontal scale of exceeding interval as well as a horizontal scale of exceeding frequencies and a vertical scale of flood flow.

Basic Steps for Graphical Method

1. Record yearly maximum floods.
2. Arrange in ascending order.
3. Calculate number of time 'n' the peak was equalled or exceeded.
4. Calculate the probable percentage of future years (P) in which flood greater than previous maximum would occur.

   P = 100n/y where y = total number of years of record.
5. Calculate future flood frequency I, where I = 100/P.
6. Express item No.2 in terms of mean flood.
7. Calculate variation from Mean.
8. Calculate coefficient of variation.
9. Plot the probability curves.

Accuracy of frequency Analysis

Although it has been covered exhaustively elsewhere [4,9] there are many researchers and engineers who believe that the developed Frequency curves based on Pearsons functions, and other graphical methods rely on past floods and do not take into account the other important factors totalling to almost 23[5,6]. But there are others who have devoted volumes on the topic speaking in favour of the method [7]. The author is of the opinion that the method may not be exact but it definitely provides some insight to the flood producing characteristics of our rivers. The method seems to give better results for downstreams discharge measuring sites.

Uses of Frequency Studies

The following may be the possible uses of frequency studies:

1. Comparisons of coefficients of variations of various sites.
2. Study of flooding.
3. Economic justification of flood control.

The method necessarily ends up with plotting of flood frequency probability curves which are normally extrapolated.

Analytical Method of Flood Frequency Analysis

The analytical method of computing a frequency curve is limited almost exclusively to producing curves of maximum annual stream flows [8,9] and it gives more reliable results than those predicted by graphical Methods. The most commonly used analytical frequency procedure is logarithmic pearson's type III distribution which requires three parameters for completely specifying the problem mathematically. These parameters include the sample mean X, sample variance S^2, and skew g. Pearson's type III distribution is particularly useful for hydrologic investigations because skew parameter (g) permits fitting of non-normal samples to the distribution. When g = 0 log-Pearson type III distribution becomes a two parameter distribution identical to log-

normal distribution. The distribution is fitted by calculating sample mean, variance and skew by using following equations.

$$\overline{X} = \frac{\Sigma X}{N} \quad \text{..... (1)}$$

$$S^2 = \frac{\Sigma x^2}{N-1} = \frac{\Sigma X^2 - (\Sigma X)^2/N}{N-1} \quad \text{..... (2)}$$

$$g = \frac{N(\Sigma x^3)}{(N-1)(N-2)S^3} = \frac{N^2(\Sigma X^3) - 3N(\Sigma X)(\Sigma X^2) + 2(\Sigma X)^3}{N(N-1)(N-2)S^3} \quad \text{..... (3)}$$

Where

$\overline{X}$	=	Logarithm of max. Annual flood.
$\overline{X}$	=	Mean of logarithm of max. Annual floods.
x	=	$\overline{X} - \overline{X}$, the deviation of a single maximum flood from the mean flood.
N	=	No. of years of record.
S^2	=	Unadjusted variance.
g	=	unadjusted skew co-efficient.

The square root of variance is standard deviation S' representing slope of curve and skew represents the degree of curvature of curve.

Frequently first two parameters are required for fitting cumulative frequency curves. Computation of unadjusted frequency curve is accomplished by computing the logarithms of stream flows corresponding to selected points (exceeding frequency) on frequency scale. The points ordinarily selected are shown as column headings on table 2. The number of points needed to define a curve depends on degree of curvature (i.e., skew). For skew values near zero, fewer points are needed while for skew values near one, all of the points shown in table 2 should be used. The selected excedence frequency points are labelled as P_∞ where subscript ∞ indicating infinite sample size. Since sample size is usually finite in hydrologic studies an adjustment of excedence frequency P_∞ is necessary before plotting the frequency curves.

The logarithm of event magnitudes corresponding to each of selected P∞ points are computed from following equation:

$$\log Q@\ P\infty = \overline{X} + K@\ P\infty\ S \quad \ldots\ldots\ldots\ldots (4)$$

Where;

log Q@ P∞ =The logarithm of flow corresponding to a specified value of P∞ .

K@ P∞= The deviation from mean $\{(X-\overline{X})/S\}$ of the event with an excedence frequency of P∞ . k values are obtained from table 2 for each value of P∞ required to define a curve.

Equation 4 is solved by using computed values of $\overline{X}$ and S and obtaining k value from table 2 corresponding to computed skew 'g' and to the selected point P∞ .

An adjustment is then made to account for actual sample size by modifying the P∞ exceeding frequency values to an expected probability value Pn. This adjustment is carried out by substituting PN value from table 3 for value of P∞ before plotting frequency curves. For samples having less than 100 events, skew is often assumed to be zero. The skewness of annual flood peaks is effected by physical geographic features. In pearson's type III distribution negative skew (Ravi at Sidhnai) indicates wide flood plain or sizeable area in form of ponds, whereas a positive skew co-efficient (of Remaining rivers) indicates that peak from two or more tributaries any arrive at the concerned discharge measuring site at the same time.

Computation of Curve

1. For selected values of P∞ tabulate k values obtained from table 2 corresponding to adopted skew Co-efficient (zero for less than 100 events).

2. Multiply each of these by standard deviation and add each product in turn to mean logarithm according to eqn. 4.

3. Tabulate Pn values from table 3 com corresponding to selected P∞ values and the value of N-1.

4. Plot antilogarithm of each of the sums obtained in step 2 above against corresponding Pn values obtained in step 3.

Results of Analysis

The calculations for computing frequency curves by both graphical as well as analytical method using pearsons type III distribution are given in Appendices A & B respectively, while Appendix C represents plotted frequency curves based on graphical and analytical method on the same probability paper for each site. Calculations were made on computer using Lotus 123 Version 2.3.

The following table presents the results of frequency analysis by the analytical as well as graphical methods for the selected discharge measuring sites of Pakistani Rivers.

Table - 1 : Results of Analysis.

River/Site	Year of Record	Mean Flood Cfs	CV	Analytical Computed Values of		Exceeding Chance % of Average Flood	
				S	g	%PN For Prev. Maxima	
Ravi/Sidhnai	71	59299	1.007	0.323	-0.7836	0.16	32
Indus/Taunsa	37	461437	0.23	0.097	0.1769	0.20	43
Jhelum/Mangla	71/45*	212177	0.987	0.265	1.28	1.4	32
Jhelum/Rasul	71	242098	0.934	0.326	0.4396	1.2	32
Chenab/Shershah	63	293588	0.547	0.21	0.6512	1.2	34

* Used in frequency computations.

SUMMARY AND CONCLUSIONS

The results of first phase of the study have been presented in this paper in form of tables and graphs. The work on remaining discharge measuring Sites of Pakistani Rivers is being carried out and will become available in near future. The following conclusions may be drawn from the present study.

1. For Jhelum at Mangla and Rasul, the two curves tend to be closer but the observed data points are widely spaced on the average graphical curve. For Ravi at Sidhnai both curves are very close to each other. The same may be said about Chenab at Shershah. For Indus at Taunsa both curves are almost the same.

2. Both graphical as well as analytical methods seem to give almost same results which is also clear from the close proximity of the two curves. However for extra polation purposes analytical frequency curves may be preferred.

3. Co-efficient of variation CV and standard deviation for Indus at Taunsa are the smallest indicating that frequency analysis yields better results for down stream discharge measuring sites.

4. At the analyzed discharge measuring sites, the probability of exceeding a given flood magnitude may be directly read from corresponding frequency curves which clearly suggests the importance of these curves.

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References:

1. 1992 Floods/Rains Damage Restoration Project Report, W&A Division, NESPAK, Nov. 1992.

2. "One the Study of 1992 Floods and its effects on Punjab", Rizwan, S.A.,Chishti, F.A. - Paper submitted to Pakistan Engineering Congress, Symposium on Floods 1992.

3. Umbrella PC-I Form "Flood Sector Projects of Punjab Province", NESPAK, W&A Division, Report March, 1988.

4. "Engineering for Dam", Creager, W.P., Justin, J.D. and Hinds, Vol-1, John Wiley and Sons Inc. 1966, pp. 99-205.

5. Hayford and Folse, "A new method of estimating stream flows" Carnegie Institute Publication No. 400 Washington, 1929.

6. Allen Hazen, "Floods Flows", John Wiley and Sons Inc. 1930, pp. 53,87.

7. H. Alden Foster, "Theoretical Efficiency Curves and their Application to Engineering Problems", Trans. Am. Soc. Civil Engineering, 1914, p. 1539 adm. 1924.

8. Spiegel, M. R. "Schaum's outline series on statistics", McGraw Hill International Publishers, 1981, pp. 122-140, 201-216.

9. Hydrologic Engineering Methods for Water Resources Development, Vol. 3. The hydrologic Engineering Center; Corps. of Engineers, U.S. Army, Davis California, April, 1975, pp. (4-08) to (9-15).

Table - 2: Pearson Type III Coordinates

g (Skew Co-efficient)	k = Magnitude in standard deviations from mean for excedence percentages of:												
	0.01	0.1	1.0	5	10	30	50	70	90	95	99	99.9	99.99
1.0	5.92	4.54	3.03	1.87	1.34	0.38	-0.16	-0.61	-1.12	-1.31	-1.59	-1.80	-1.88
0.8	5.48	4.25	2.90	1.83	1.34	0.42	-0.13	-0.60	-1.16	-1.38	-1.74	-2.03	-2.18
0.6	5.04	3.96	2.77	1.79	1.33	0.45	-0.09	-0.58	-1.19	-1.45	-1.88	-2.28	-2.53
0.4	4.60	3.67	2.62	1.74	1.32	0.48	-0.06	-0.57	-1.22	-1.51	-2.03	-2.54	-2.92
0.2	4.16	3.38	2.48	1.69	1.30	0.51	-0.03	-0.55	-1.25	-1.58	-2.18	-2.81	-3.32
0.0	3.73	3.09	2.33	1.64	1.28	0.52	0.00	-0.52	-1.28	-1.64	-2.33	-3.09	-3.73
-0.2	3.32	2.81	2.18	1.58	1.25	0.55	0.03	-0.51	-1.30	-1.69	-2.48	-3.38	-4.16
-0.4	2.92	2.54	2.03	1.51	1.22	0.57	0.06	-0.48	-1.32	-1.74	-2.62	-3.67	-4.60
-0.6	2.53	2.28	1.88	1.45	1.19	0.58	0.09	-0.45	-1.33	-1.79	-2.77	-3.96	-5.04
-0.8	2.18	2.03	1.74	1.38	1.16	0.60	0.13	-0.42	-1.34	-1.83	-2.90	-4.25	-5.48
-1.0	1.88	1.80	1.59	1.31	1.12	0.61	0.16	-0.38	-1.34	-1.87	-3.03	-4.54	-5.92
Skew Coefficients Commonly Used													
0.00	3.73	3.09	2.33	1.64	1.28	0.52	0.00	-0.52	-1.28	-1.64	-2.33	-3.09	-3.73
-0.04	3.65	3.03	2.30	1.63	1.27	0.53	0.01	-0.52	-1.28	-1.65	-2.36	-3.15	-3.82
-0.12	3.48	2.92	2.24	1.60	1.26	0.54	0.02	-0.51	-1.29	-1.67	-2.42	-3.26	-3.99
-0.23	3.26	2.77	2.16	1.57	1.25	0.55	0.03	-0.50	-1.30	-1.70	-2.50	-3.42	-4.23
-0.32	3.08	2.68	2.09	1.54	1.23	0.56	0.05	-0.49	-1.31	-1.72	-2.56	-3.55	-4.42
-0.37	2.98	2.58	2.05	1.52	1.22	0.57	0.06	-0.48	-1.32	-1.73	-2.60	-3.63	-4.53
-0.40	2.92	2.54	0.03	1.51	1.22	0.57	0.06	-0.48	-1.32	-1.74	-2.62	-3.67	-4.60

Note: Approximate transformations between normal deviate (X) and Pearson Type III deviate k can be accomplished with the following equation:

$$k = 2/g\{ g/6(x - g/6) + 1]^3 - 1\}$$

Table - 3: P_N VERSUS P_∞ IN PERCENT

For use with samples drawn from a normal population

\ P_∞ N-1\	50.0	30.0	10.0	5.0	1.0	0.1	0.01
1.	50.0	37.2	24.3	20.4	15.40	12.1	10.200
2.	50.0	34.7	19.3	14.6	9.00	5.7	4.300
3.	50.0	33.6	16.9	11.9	6.40	3.5	2.300
4.	50.0	33.0	15.4	10.4	5.00	2.4	1.370
5.	50.0	32.5	14.6	9.4	4.20	1.79	0.920
6.	50.0	32.2	13.8	8.8	3.60	1.38	0.660
7.	50.0	31.9	13.5	8.3	3.20	1.13	0.500
8.	50.0	31.7	13.1	7.9	2.90	0.94	0.390
9.	50.0	31.6	12.7	7.6	2.70	0.82	0.310
10.	50.0	31.5	12.5	7.3	2.5	0.72	0.250
11.	50.0	31.4	12.3	7.1	2.30	0.64	0.210
12.	50.0	31.3	12.1	6.9	2.20	0.58	0.180
13.	50.0	31.2	11.9	6.8	2.10	0.52	0.160
14.	50.0	31.1	11.8	6.7	2.00	0.48	0.140
15.	50.0	31.1	11.7	6.6	1.96	0.45	0.130
16.	50.0	31.0	11.6	6.5	1.90	0.42	0.120
17.	50.0	31.0	11.5	6.4	1.84	0.40	0.110
18.	50.0	30.9	11.4	6.3	1.79	0.38	0.100
19.	50.0	30.9	11.3	6.2	1.74	0.36	0.091
20.	50.0	30.8	11.3	6.2	1.70	0.34	0.084
21.	50.0	30.8	11.2	6.1	1.67	0.33	0.078
22.	50.0	30.8	11.1	6.1	1.63	0.31	0.073
23.	50.0	30.7	11.1	6.0	1.61	0.30	0.068
24.	50.0	30.7	11.0	6.0	1.58	0.29	0.064
25.	50.0	30.7	11.0	5.9	1.55	0.28	0.060
26.	50.0	30.6	10.9	5.9	1.53	0.278	0.057
27.	50.0	30.6	10.9	5.9	1.51	0.26	0.054
28.	50.0	30.6	10.9	5.8	1.49	0.26	0.051
29.	50.0	30.6	10.8	5.8	1.47	0.25	0.049
30.	50.0	30.6	10.8	5.8	1.45	0.24	0.046
40.	50.0	30.4	10.6	5.6	1.33	0.20	0.034
60.	50.0	30.3	10.4	5.4	1.22	0.16	0.025
120.	50.0	30.2	10.2	5.2	1.11	0.13	0.017
∞	50.0	30.0	10.0	5.0	1.00	0.10	0.010

Note: P_N values above are usable approximately with Pearson Type III distributions having small skew coefficients.

"Appendix - A"

ANALYTICAL FREQUENCY CURVE COMPUTATIONS

ANNUAL ANALYTICAL PEAK FLOW COMPUTATIONS OF FREQUENCY ANALYSIS OF

INDUS RIVER AT TANUSA BARRAGE

WATER YEAR	FLOW 'CFS	LOG (X)	2 (X)	3 (X)	DEV (x)	2 x	3 x
1956	517962.39	5.71	32.60	186.17	0.054	0.003	0.0002
1957	525942.45	5.72	32.72	187.15	0.064	0.004	0.0003
1958	786931.30	5.90	34.81	205.38	0.244	0.060	0.0145
1959	511959.69	5.71	32.60	186.17	0.054	0.003	0.0002
1960	376969.56	5.58	31.14	173.74	−0.076	0.006	−0.0004
1961	475943.49	5.68	32.26	183.25	0.024	0.001	0.0000
1962	311963.85	5.49	30.14	165.47	−0.166	0.028	−0.0046
1963	353962.75	5.55	30.80	170.95	−0.106	0.011	−0.0012
1964	502955.64	5.70	32.49	185.19	0.044	0.002	0.0001
1965	433959.9	5.64	31.81	179.41	−0.016	0.000	0.0000
1966	512948.37	5.71	32.60	186.17	0.054	0.003	0.0002
1967	449955.33	5.65	31.92	180.36	−0.006	0.000	0.0000
1968	435972.57	5.64	31.81	179.41	−0.016	0.000	0.0000
1969	464962.06	5.67	32.15	182.29	0.014	0.000	0.0000
1970	367965.51	5.57	31.02	172.81	−0.086	0.007	−0.0006
1971	392964.99	5.59	31.25	174.68	−0.066	0.004	−0.0003
1972	375960.66	5.58	31.14	173.74	−0.076	0.006	−0.0004
1973	567961.35	5.75	33.06	190.11	0.094	0.009	0.0008
1974	368954.19	5.57	31.02	172.81	−0.086	0.007	−0.0006
1975	523965.09	5.72	32.72	187.15	0.064	0.004	0.0003
1976	674950.65	5.83	33.99	198.16	0.174	0.030	0.0053
1977	442963.95	5.65	31.92	180.36	−0.006	0.000	0.0000
1978	507934.35	5.71	32.60	186.17	0.054	0.003	0.0002
1979	387950.97	5.59	31.25	174.68	−0.066	0.004	−0.0003
1980	424955.85	5.63	31.70	178.45	−0.026	0.001	0.0000
1981	391976.31	5.59	31.25	174.68	−0.066	0.004	−0.0003
1982	375960.66	5.58	31.14	173.74	−0.076	0.006	−0.0004
1983	301971.12	5.48	30.03	164.57	−0.176	0.031	−0.0055
1984	509947.02	5.71	32.60	186.17	0.054	0.003	0.0002
1985	306965.14	5.49	30.14	165.47	−0.166	0.028	−0.0046
1986	504969.31	5.70	32.49	185.19	0.044	0.002	0.0001
1987	312952.53	5.50	30.25	166.38	−0.156	0.024	−0.0039
1988	560934.66	5.75	33.06	190.11	0.094	0.009	0.0008
1989	560016.6	5.75	33.06	190.11	0.094	0.009	0.0008
1990	501966.96	5.70	32.49	185.19	0.044	0.002	0.0001
1991	456946.71	5.66	32.04	181.32	0.004	0.000	0.0000
1992	654929.88	5.82	33.87	197.14	0.164	0.027	0.0044
	17140533.3	209.27	1183.94	6700.29	−0.002	0.341	0.0055

N = 37

EX = 209.27

$\bar{X}$ = EX/N = 5.656

$\sum X^2$ = 1183.94

$(\sum X)^2/N$ = 1183.619

$\sum x^2$ = 0.3202

$S^2 = Ex/N-1$ = 0.009472

$\sum x^3$ = 0.0055

$g = N(Ex)/(N-1)(N-2)S^3$ = 0.176961

S = 0.097

P ∞	0.1	1	10	50	90	99	99.9
K (TAB.2)	3.09	2.33	1.28	0	−1.28	−2.33	−3.09
Log Q @P (Eq.4)	5.956	5.882	5.78	5.656	5.532	5.43	5.356
Q @P ∞	903649	762079	602560	452696	340408	269153	226996
PN (TAB.3)	0.216	1.376	10.68	50	89.32	98.62	99.78

ANNUAL ANALYTICAL PEAK FLOW COMPUTATIONS OF FREQUENCY ANALYSIS OF

JEHLUM AT MANGLA

WATER YEA	FLOW 'CFS	LOG (X)	2 (X)	3 (X)	DEV (x)	2 x	3 x
1922	103000	5.01	25.10	125.75	-0.217	0.047	-0.0102
1923	84000	4.92	24.21	119.10	-0.307	0.094	-0.0289
1924	156000	5.19	26.94	139.80	-0.037	0.001	-0.0001
1925	107000	5.03	25.30	127.26	-0.197	0.039	-0.0076
1926	148000	5.17	26.73	138.19	-0.057	0.003	-0.0002
1927	165000	5.22	27.25	142.24	-0.007	0.000	0.0000
1928	590000	5.77	33.29	192.10	0.543	0.295	0.1601
1929	1040000	6.02	36.24	218.17	0.793	0.629	0.4987
1930	170000	5.23	27.35	143.06	0.003	0.000	0.0000
1931	230000	5.36	28.73	153.99	0.133	0.018	0.0024
1932	118000	5.07	25.70	130.32	-0.157	0.025	-0.0039
1933	195000	5.29	27.98	148.04	0.063	0.004	0.0003
1934	183000	5.26	27.67	145.53	0.033	0.001	0.0000
1935	106000	5.03	25.30	127.26	-0.197	0.039	-0.0076
1936	146000	5.16	26.63	137.39	-0.067	0.004	-0.0003
1937	89000	4.95	24.50	121.29	-0.277	0.077	-0.0213
1938	132000	5.12	26.21	134.22	-0.107	0.011	-0.0012
1939	96000	4.98	24.80	123.51	-0.247	0.061	-0.0151
1940	107000	5.03	25.30	127.26	-0.197	0.039	-0.0076
1941	162000	5.21	27.14	141.42	-0.017	0.000	0.0000
1942	89000	4.95	24.50	121.29	-0.277	0.077	-0.0213
1943	125000	5.10	26.01	132.65	-0.127	0.016	-0.0020
1944	199000	5.30	28.09	148.88	0.073	0.005	0.0004
1945	101000	5.00	25.00	125.00	-0.227	0.052	-0.0117
1946	225000	5.35	28.62	153.13	0.123	0.015	0.0019
1947	131000	5.12	26.21	134.22	-0.107	0.011	-0.0012
1948	441000	5.64	31.81	179.41	0.413	0.171	0.0704
1949	155000	5.19	26.94	139.80	-0.037	0.001	-0.0001
1950	279000	5.45	29.70	161.88	0.223	0.050	0.0111
1951	121000	5.08	25.81	131.10	-0.147	0.022	-0.0032
1952	239000	5.37	28.84	154.85	0.143	0.020	0.0029
1953	311000	5.49	30.14	165.47	0.263	0.069	0.0182
1954	232000	5.37	28.84	154.85	0.143	0.020	0.0029
1955	175000	5.24	27.46	143.88	0.013	0.000	0.0000
1956	303000	5.48	30.03	164.57	0.253	0.064	0.0162
1957	140000	5.15	26.52	136.59	-0.077	0.006	-0.0005
1958	520000	5.72	32.72	187.15	0.493	0.243	0.1198
1959	845000	5.93	35.16	208.53	0.703	0.494	0.3474
1960	150000	5.18	26.83	138.99	-0.047	0.002	-0.0001
1961	149000	5.17	26.73	138.19	-0.057	0.003	-0.0002
1962	155000	5.19	26.94	139.80	-0.037	0.001	-0.0001
1963	80000	4.90	24.01	117.65	-0.327	0.107	-0.0350
1964	85000	4.93	24.30	119.82	-0.297	0.088	-0.0262
1965	88000	4.94	24.40	120.55	-0.287	0.082	-0.0236
1966	89000	4.95	24.50	121.29	-0.277	0.077	-0.0213
	9548000	235.21	1232.48	6475.44	-0.005	3.083	1.0022

N = 45

EX = 235.21

$\bar{X}$ = EX/N = 5.227

EX^2 = 1232.48

$(EX)^2/N$ = 1229.416

EX^3 = 3.0635

$S^2 = Ex/N - 1$ = 0.070068

$g = N(Ex^3)/(N-1)(N-2)S^3$ = 1.280879

S = 0.265

P %	0.1	1	10	50	90	99	99.9
K (TAB.2)	3.09	2.33	1.28	0	-1.28	-2.33	-3.09
Log Q @p % (Eq 4)	6.046	5.844	5.566	5.227	4.888	4.61	4.408
Q @P %	1111732	698232	368129	168655	77268	40738	25586
P_N (TAB.3)	0.192	1.308	10.56	50	89.44	98.69	99.808

ANNUAL ANALYTICAL PEAK FLOW COMPUTATIONS OF FREQUENCY ANALYSIS OF

JEHLUM AT RASUL

WATER YEAR	FLOW 'CFS	LOG (X)	2 (X)	3 (X)	DEV (x)	2 x	3 x
1922	133000	5.12	26.21	134.22	−0.097	0.009	−0.0009
1923	136000	5.13	26.32	135.01	−0.087	0.008	−0.0007
1924	154000	5.19	26.94	139.80	−0.027	0.001	0.0000
1925	132000	5.12	26.21	134.22	−0.097	0.009	−0.0009
1926	154000	5.19	26.94	139.80	−0.027	0.001	0.0000
1927	205000	5.31	28.20	149.72	0.093	0.009	0.0008
1928	663000	5.82	33.87	197.14	0.603	0.364	0.2193
1929	875000	5.94	35.28	209.58	0.723	0.523	0.3779
1930	249000	5.40	29.16	157.46	0.183	0.033	0.0061
1931	271000	5.43	29.48	160.10	0.213	0.045	0.0097
1932	110000	5.04	25.40	128.02	−0.177	0.031	−0.0055
1933	136000	5.14	26.42	135.80	−0.077	0.006	−0.0005
1934	149000	5.17	26.73	138.19	−0.047	0.002	−0.0001
1935	115000	5.06	25.60	129.55	−0.157	0.025	−0.0039
1936	180000	5.26	27.67	145.53	0.043	0.002	0.0001
1937	93000	4.97	24.70	122.76	−0.247	0.061	−0.0151
1938	124000	5.09	25.91	131.87	−0.127	0.016	−0.0020
1939	112000	5.05	25.50	128.79	−0.167	0.028	−0.0047
1940	106000	5.03	25.30	127.26	−0.187	0.035	−0.0065
1941	208000	5.32	28.30	150.57	0.103	0.011	0.0011
1942	105000	5.02	25.20	126.51	−0.197	0.039	−0.0076
1943	155000	5.19	26.94	139.80	−0.027	0.001	0.0000
1944	231000	5.36	28.73	153.99	0.143	0.020	0.0029
1945	150000	5.18	26.83	138.99	−0.037	0.001	−0.0001
1946	140000	5.15	26.52	136.59	−0.067	0.004	−0.0003
1947	68000	4.83	23.33	112.68	−0.387	0.150	−0.0580
1948	730000	5.86	34.34	201.23	0.643	0.413	0.2658
1949	165000	5.22	27.25	142.24	0.003	0.000	0.0000
1950	350000	5.54	30.69	170.03	0.323	0.104	0.0337
1951	275000	5.44	29.59	160.99	0.223	0.050	0.0111
1952	240000	5.38	28.94	155.72	0.163	0.027	0.0043
1953	375000	5.57	31.02	172.81	0.353	0.125	0.0440
1954	425000	5.63	31.70	178.45	0.413	0.171	0.0704
1955	210000	5.32	28.30	150.57	0.103	0.011	0.0011
1956	375000	5.57	31.02	172.81	0.353	0.125	0.0440
1957	175000	5.24	27.46	143.88	0.023	0.001	0.0000
1958	675000	5.83	33.99	198.16	0.613	0.376	0.2303
1959	876000	5.94	35.28	209.58	0.723	0.523	0.3779
1960	860000	5.93	35.16	208.53	0.713	0.508	0.3625
1961	110000	5.04	25.40	128.02	−0.177	0.031	−0.0055
1962	143000	5.16	26.63	137.39	−0.057	0.003	−0.0002
1963	96000	4.98	24.80	123.51	−0.237	0.056	−0.0133
1964	335000	5.53	30.58	169.11	0.313	0.098	0.0307
1965	185000	5.27	27.77	146.36	0.053	0.003	0.0001
1966	270000	5.43	29.48	160.10	0.213	0.045	0.0097
1967	106000	5.03	25.30	127.26	−0.187	0.035	−0.0065
1968	63000	4.80	23.04	110.59	−0.417	0.174	−0.0725
1969	101000	5.00	25.00	125.00	−0.217	0.047	−0.0102
1970	43000	4.63	21.44	99.25	−0.587	0.345	−0.2023
1971	21000	4.32	18.66	80.62	−0.897	0.805	−0.7217
1972	105000	5.02	25.20	126.51	−0.197	0.039	−0.0076
1973	270000	5.43	29.48	160.10	0.213	0.045	0.0097
1974	69000	4.84	23.43	113.38	−0.377	0.142	−0.0535
1975	126000	5.10	26.01	132.65	−0.117	0.014	−0.0016
1976	269000	5.43	29.48	160.10	0.213	0.045	0.0097
1977	59000	4.77	22.75	108.53	−0.447	0.200	−0.0893
1978	101000	5.00	25.00	125.00	−0.217	0.047	−0.0102
1979	65000	4.81	23.14	111.28	−0.407	0.166	−0.0674
1980	76000	4.88	23.81	116.21	−0.337	0.114	−0.0383
1981	112000	5.05	25.50	128.79	−0.167	0.028	−0.0047
1982	86000	4.93	24.30	119.82	−0.287	0.082	−0.0235
1983	241000	5.38	28.94	155.72	0.163	0.027	0.0043
1984	98000	4.99	24.90	124.25	−0.227	0.052	−0.0117
1985	64000	4.81	23.14	111.28	−0.407	0.166	−0.0674
1986	113000	5.05	25.50	128.79	−0.167	0.028	−0.0047
1987	125000	5.10	26.01	132.65	−0.117	0.014	−0.0016
1988	255000	5.41	29.27	158.34	0.193	0.037	0.0072
1989	163000	5.21	27.14	141.42	−0.007	0.000	0.0000
1990	119000	5.08	25.81	131.10	−0.137	0.019	−0.0026
1991	89000	4.95	24.50	121.29	−0.267	0.071	−0.0190
1992	952000	5.98	35.76	213.85	0.763	0.582	0.4442
	15917000	370.39	1939.6	10197.22	−0.017	7.428	1.0363

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Contd. Jhelum at Rasul (Analytical)

N =	71		
EX =	370.39		
$\bar{X}$ = EX/N =	5.217		
EX^2 =	1939.6		
$(EX)^2/N$ =	1932.235		
EX^3 =	7.3641	$g = N(Ex^3)/(N-1)(N-2)S^3$ =	0.439687
S^2 = Ex/N−1 =	0.106114	S =	0.326

P ∞	0.1	1	10	50	90	99	99.9
K (TAB.2)	3.09	2.33	1.28	0	−1.28	−2.33	−3.09
Log Q ∞P (Eq.4)	6.224	5.977	5.634	5.217	4.8	4.457	4.21
Q ∞P	1674943	946416	430527	164816	63096	28642	16218
PN (TAB.3)	0.155	1.2016	10.366	50	89.634	98.798	99.845

ANNUAL ANALYTICAL PEAK FLOW COMPUTATIONS OF FREQUENCY ANALYSIS OF

RAVI AT SIDHNAI BARRAGE

WATER YEAR	FLOW 'CFS	LOG (X)	2 (X)	3 (X)	DEV (x)	2 x	3 x
1922	45197.696	4.66	21.72	101.19	−0.004	0.000	0.0000
1923	55684.9739	4.75	22.56	107.17	0.086	0.007	0.0006
1924	35981.6033	4.56	20.79	94.82	−0.104	0.011	−0.0011
1925	65183.5522	4.81	23.14	111.28	0.146	0.021	0.0031
1926	45903.91	4.66	21.72	101.19	−0.004	0.000	0.0000
1927	33297.9901	4.52	20.43	92.35	−0.144	0.021	−0.0030
1928	38382.7309	4.58	20.98	96.07	−0.084	0.007	−0.0006
1929	31885.5621	4.50	20.25	91.13	−0.164	0.027	−0.0044
1930	31497.1444	4.50	20.25	91.13	−0.164	0.027	−0.0044
1931	43079.054	4.63	21.44	99.25	−0.034	0.001	0.0000
1932	35487.2535	4.55	20.70	94.20	−0.114	0.013	−0.0015
1933	47987.2413	4.68	21.90	102.50	0.016	0.000	0.0000
1934	28213.2493	4.45	19.80	88.12	−0.214	0.046	−0.0098
1935	38700.5272	4.59	21.07	96.70	−0.074	0.005	−0.0004
1936	48587.5232	4.69	22.00	103.16	0.026	0.001	0.0000
1937	26200.5394	4.42	19.54	86.35	−0.244	0.060	−0.0145
1938	22492.9159	4.35	18.92	82.31	−0.314	0.099	−0.0310
1939	17408.1751	4.24	17.98	76.23	−0.424	0.180	−0.0762
1940	18997.1566	4.28	18.32	78.40	−0.384	0.147	−0.0566
1941	18997.1566	4.28	18.32	78.40	−0.384	0.147	−0.0566
1942	62182.1427	4.79	22.94	109.90	0.126	0.016	0.0020
1943	51906.729	4.72	22.28	105.15	0.056	0.003	0.0002
1944	27295.1711	4.44	19.71	87.53	−0.224	0.050	−0.0112
1945	32309.2905	4.51	20.34	91.73	−0.154	0.024	−0.0037
1946	33509.8543	4.53	20.52	92.96	−0.134	0.018	−0.0024
1947	58580.4513	4.77	22.75	108.53	0.106	0.011	0.0012
1948	69208.972	4.84	23.43	113.38	0.176	0.031	0.0055
1949	46186.3956	4.66	21.72	101.19	−0.004	0.000	0.0000
1950	85910.9331	4.93	24.30	119.82	0.266	0.071	0.0188
1951	33686.4078	4.53	20.52	92.96	−0.134	0.018	−0.0024
1952	51588.9327	4.71	22.18	104.49	0.046	0.002	0.0001
1953	73305.0132	4.87	23.72	115.50	0.206	0.042	0.0087
1954	91278.1595	4.96	24.60	122.02	0.296	0.088	0.0259
1955	109992.8305	5.04	25.40	128.02	0.376	0.141	0.0532
1956	67584.6798	4.83	23.33	112.68	0.166	0.028	0.0046
1957	112464.5795	5.05	25.50	128.79	0.386	0.149	0.0575
1958	100988.602	5.00	25.00	125.00	0.336	0.113	0.0379
1959	104978.7111	5.02	25.20	126.51	0.356	0.127	0.0451
1960	25882.7431	4.41	19.45	85.77	−0.254	0.065	−0.0164
1961	86158.108	4.94	24.40	120.55	0.276	0.076	0.0210
1962	100988.602	5.00	25.00	125.00	0.336	0.113	0.0379
1963	30084.7164	4.48	20.07	89.92	−0.184	0.034	−0.0062
1964	76200.4906	4.88	23.81	116.21	0.216	0.047	0.0101
1965	21610.1484	4.33	18.75	81.18	−0.334	0.112	−0.0373
1966	75706.1408	4.88	23.81	116.21	0.216	0.047	0.0101
1967	29413.8131	4.47	19.98	89.31	−0.194	0.038	−0.0073
1968	46998.5417	4.67	21.81	101.85	0.006	0.000	0.0000
1969	1942.0885	3.29	10.82	35.61	−1.374	1.888	−2.5939
1970	38806.4593	4.59	21.07	96.70	−0.074	0.005	−0.0004
1971	63806.4349	4.80	23.04	110.59	0.136	0.018	0.0025
1972	22104.4982	4.34	18.84	81.75	−0.324	0.105	−0.0340
1973	180013.9486	5.26	27.67	145.53	0.596	0.355	0.2117
1974	30296.5806	4.48	20.07	89.92	−0.184	0.034	−0.0062
1975	121998.4685	5.09	25.91	131.87	0.426	0.181	0.0773
1976	197987.0949	5.30	28.09	148.88	0.636	0.404	0.2573
1977	61899.6571	4.79	22.94	109.90	0.126	0.016	0.0020
1978	75494.2766	4.88	23.81	116.21	0.216	0.047	0.0101
1979	12288.1236	4.09	16.73	68.42	−0.574	0.329	−0.1891
1980	77083.2581	4.89	23.91	116.93	0.226	0.051	0.0115
1981	195974.385	5.29	27.98	148.04	0.626	0.392	0.2453
1982	37499.9634	4.57	20.88	95.44	−0.094	0.009	−0.0008
1983	25988.6752	4.41	19.45	85.77	−0.254	0.065	−0.0164
1984	27507.0353	4.44	19.71	87.53	−0.224	0.050	−0.0112
1985	41596.0046	4.62	21.34	98.61	−0.044	0.002	−0.0001
1986	41384.1404	4.62	21.34	98.61	−0.044	0.002	−0.0001
1987	11899.7059	4.08	16.65	67.92	−0.584	0.341	−0.1992
1988	254978.5647	5.41	29.27	158.34	0.746	0.557	0.4152
1989	65006.9987	4.81	23.14	111.28	0.146	0.021	0.0031
1990	50211.8154	4.70	22.09	103.82	0.036	0.001	0.0000
1991	30084.7164	4.48	20.07	89.92	−0.184	0.034	−0.0062
1992	93891.1513	4.97	24.70	122.76	0.306	0.094	0.0287

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Contd. Ravi at Sidhnai (Analytical)

N =	71		
EX =	331.16		
$\bar{X}$ = EX/N =	4.664		
EX^2 =	1551.87		
$(EX)^2/N$ =	1544.604		
EX^2 =	7.2651	$g = N(Ex)^3/(N-1)(N-2)S^3$ =	−0.78362
S^2 = Ex/N−1 =	0.104071	S =	0.323

P ∞	0.1	1	10	50	90	99	99.9
K (TAB.2)	3.09	2.33	1.28	0	−1.28	−2.33	−3.09
Log Q @p ∞ (Eq .4)	5.662	5.417	5.077	4.664	4.251	3.911	3.666
Q @P ∞	459198	261216	119399	46132	17824	8147	4634
P_N(TAB.3)	0.155	1.2016	10.366	50	89.634	98.7984	99.845

ANNUAL ANALYTICAL PEAK FLOW COMPUTATIONS OF FREQUENCY ANALYSIS OF

CHENAB AT SHERSHAH BRIDGE

WATER YRA	FLOW 'CFS	LOG (X)	2 (X)	3 (X)	DEV (x)	2 x	3 x
1930	384949.62	5.59	31.25	174.68	0.172	0.030	0.0051
1931	206987.22	5.32	28.30	150.57	−0.098	0.010	−0.0009
1932	240990.75	5.38	28.94	155.72	−0.036	0.001	−0.0001
1933	252960.84	5.40	29.16	157.46	−0.018	0.000	0.0000
1934	286964.37	5.45	29.81	162.77	0.042	0.002	0.0001
1935	299969.77	5.48	30.03	164.57	0.062	0.004	0.0002
1936	199971.85	5.30	28.09	148.88	−0.118	0.014	−0.0016
1937	152998.23	5.18	26.83	139.99	−0.238	0.057	−0.0135
1938	226972.68	5.36	28.73	153.99	−0.058	0.003	−0.0002
1939	197963.17	5.30	28.09	148.88	−0.118	0.014	−0.0016
1940	205963.23	5.31	28.20	149.72	−0.108	0.012	−0.0013
1941	192969.15	5.29	27.98	148.04	−0.128	0.016	−0.0021
1942	269965.72	5.46	29.81	162.77	0.042	0.002	0.0001
1943	205963.23	5.31	28.20	149.72	−0.108	0.012	−0.0013
1944	233928.75	5.37	28.84	154.85	−0.048	0.002	−0.0001
1945	205963.23	5.31	28.20	149.72	−0.108	0.012	−0.0013
1946	240990.75	5.38	28.94	155.72	−0.038	0.001	−0.0001
1947	176973.72	5.25	27.56	144.70	−0.168	0.028	−0.0047
1948	459948.06	5.66	32.04	181.32	0.242	0.059	0.0142
1949	239966.76	5.38	28.94	155.72	−0.038	0.001	−0.0001
1950	497941.62	5.70	32.49	185.19	0.282	0.080	0.0224
1951	265990.23	5.42	29.38	159.22	0.002	0.000	0.0000
1952	233964.06	5.37	28.84	154.85	−0.048	0.002	−0.0001
1953	244980.78	5.39	29.05	156.59	−0.028	0.001	0.0000
1954	274958.97	5.44	29.59	160.99	0.022	0.000	0.0000
1955	299958.45	5.48	30.03	164.57	0.062	0.004	0.0002
1956	379970.91	5.58	31.14	173.74	0.162	0.026	0.0043
1957	639923.13	5.81	33.76	196.12	0.392	0.154	0.0602
1958	439962.6	5.64	31.81	179.41	0.222	0.049	0.0109
1959	722936.94	5.86	34.34	201.23	0.442	0.195	0.0864
1960	344978.7	5.54	30.69	170.03	0.122	0.015	0.0018
1961	279972.99	5.45	29.70	161.88	0.032	0.001	0.0000
1962	163979.64	5.21	27.14	141.42	−0.208	0.043	−0.0090
1963	185977.77	5.27	27.77	146.36	−0.148	0.022	−0.0032
1964	309966.49	5.49	30.14	165.47	0.072	0.005	0.0004
1965	174096.36	5.24	27.46	143.88	−0.178	0.032	−0.0056
1966	232975.39	5.37	28.84	154.85	−0.048	0.002	−0.0001
1967	109001.97	5.04	25.40	128.02	−0.378	0.143	−0.0540
1968	250963.48	5.40	29.16	157.46	−0.018	0.000	0.0000
1969	184969.09	5.27	27.77	146.36	−0.148	0.022	−0.0032
1970	90993.87	4.96	24.60	122.02	−0.458	0.210	−0.0961
1971	175985.04	5.25	27.56	144.70	−0.168	0.028	−0.0047
1973	140004.15	5.15	26.52	136.59	−0.268	0.072	−0.0192
1974	704928.84	5.85	34.22	200.20	0.432	0.187	0.0806
1975	159000.93	5.20	27.04	140.61	−0.218	0.048	−0.0104
1976	371955.54	5.57	31.02	172.81	0.152	0.023	0.0035
1978	729928.32	5.86	34.34	201.23	0.442	0.195	0.0864
1979	239976.73	5.37	28.84	154.85	−0.048	0.002	−0.0001
1980	180999.06	5.26	27.67	145.53	−0.158	0.025	−0.0039
1981	457970.7	5.66	32.04	181.32	0.242	0.059	0.0142
1982	187990.44	5.27	27.77	146.36	−0.148	0.022	−0.0032
1983	167969.67	5.23	27.35	143.06	−0.188	0.035	−0.0066
1984	144982.86	5.16	26.63	137.39	−0.258	0.067	−0.0172
1985	308982.5	5.49	30.14	165.47	0.072	0.005	0.0004
1986	281350.09	5.45	29.70	161.88	0.032	0.001	0.0000
1987	143994.18	5.16	26.63	137.39	−0.258	0.067	−0.0172
1988	551930.61	5.74	32.95	189.12	0.322	0.104	0.0334
1989	497871	5.70	32.49	185.19	0.282	0.080	0.0224
1990	197963.17	5.30	28.09	148.88	−0.118	0.014	−0.0016
1991	249994.8	5.40	29.16	157.46	−0.018	0.000	0.0000
1992	978087	5.99	35.88	214.92	0.572	0.327	0.1871
	18098670.15	330.48	1793.08	9743.41	−0.018	2.647	0.35

Contd. on next page

Contd. Chenab at Shershah (Analytical)

N =	61		
EX =	330.48		
$\bar{X}$ = EX/N =	5.418		
EX^2 =	1793.08		
$(EX)^2/N$ =	1790.443		
EX^3 =	2.6369	$g = N(Ex)^3/(N-1)(N-2)S^3$ =	0.651233
$S^2 = Ex^2/N-1$ =	0.044116	S =	0.21

P ∞	0.1	1	10	50	90	99	99.9
K (TAB.2)	3.09	2.33	1.28	0	−1.28	−2.33	−3.09
Log Q @p (Eq 4)	6.067	5.907	5.687	5.418	5.149	4.929	4.769
Q @P ∞	1166810	807235	486407	261818	140929	84918	58749
PN (TAB−3)	0.16	1.22	10.4	50	89.6	98.78	99.84

"Appendix - B"

GRAPHICAL FREQUENCY CURVE COMPUTATIONS

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

INDUS AT TAUNSA

YEARS	YEARLY PEAK FLOW Qds	Q IN ACENDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE O YEARS P	FUTURE FLOOD FREQUENCY I	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1956	517962.39	301971.12	37	100.00	1.00	0.654	−0.346	0.119
1957	525942.45	306985.14	36	97.30	1.03	0.665	−0.335	0.112
1958	788931.33	311963.85	35	94.59	1.06	0.676	−0.324	0.105
1959	511959.69	312952.53	34	91.89	1.09	0.678	−0.322	0.10
1960	376969.56	353982.75	33	89.19	1.12	0.767	−0.233	0.054
1961	475943.49	367965.51	32	86.49	1.16	0.797	−0.203	0.041
1962	311963.85	368954.19	31	83.78	1.19	0.800	−0.200	0.040
1963	353982.75	375980.88	30	81.08	1.23	0.815	−0.185	0.034
1964	502955.64	375980.88	29	78.38	1.28	0.815	−0.185	0.034
1965	433959.9	376969.56	28	75.68	1.32	0.817	−0.183	0.034
1966	512948.37	387950.97	27	72.97	1.37	0.841	−0.159	0.025
1967	449955.33	391976.31	26	70.27	1.42	0.849	−0.151	0.023
1968	435972.57	392964.99	25	67.57	1.48	0.852	−0.148	0.022
1969	464962.08	424955.85	24	64.86	1.54	0.921	−0.079	0.006
1970	367965.51	433959.9	23	62.16	1.61	0.940	−0.060	0.004
1971	392964.99	435972.57	22	59.46	1.68	0.945	−0.055	0.003
1972	375980.88	442963.95	21	56.76	1.76	0.960	−0.040	0.002
1973	566654.88	442963.95	20	54.05	1.85	0.960	−0.040	0.002
1974	368954.19	449955.33	19	51.35	1.95	0.975	−0.025	0.001
1975	523965.09	456946.71	18	48.65	2.06	0.990	−0.010	0.000
1976	674950.65	464962.08	17	45.95	2.18	1.008	0.008	0.000
1977	442963.95	475943.49	16	43.24	2.31	1.031	0.031	0.001
1978	442963.95	501966.96	15	40.54	2.47	1.088	0.088	0.008
1979	387950.97	502955.64	14	37.84	2.64	1.090	0.090	0.008
1980	424955.85	504968.31	13	35.14	2.85	1.094	0.094	0.009
1981	391976.31	509947.02	12	32.43	3.08	1.105	0.105	0.011
1982	375980.88	511959.69	11	29.73	3.36	1.109	0.109	0.012
1983	301971.12	512948.37	10	27.03	3.70	1.112	0.112	0.012
1984	509947.02	517962.39	9	24.32	4.11	1.122	0.122	0.015
1985	306985.14	523965.09	8	21.62	4.63	1.136	0.136	0.018
1986	504968.31	525942.45	7	18.92	5.29	1.140	0.140	0.020
1987	312952.53	558957.3	6	16.22	6.17	1.211	0.211	0.045
1988	560934.66	560934.66	5	13.51	7.40	1.216	0.216	0.046
1989	558957.3	566654.88	4	10.81	9.25	1.228	0.228	0.052
1990	501966.96	654929.88	3	8.11	12.33	1.419	0.419	0.176
1991	456946.71	674950.65	2	5.41	18.50	1.463	0.463	0.214
1992	654929.88	788931.33	1	2.70	37.00	1.710	0.710	0.504

SUM 17073197 CFS

N = 37

MEAN FLOOD = 461437.7

SUM = 1.9152474

CV = 0.2306541

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY ANALYSIS OF

JEHLUM AT MANGLA

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACCEDING ORDER	NO. OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL.3 INTERVAL MEAN FLOOD	VARIATION FROM MEAN V	Z W
1922	103000	80000	45	100.00	1.00	0.377	−0.623	0.388
1923	84000	84000	44	97.78	1.02	0.396	−0.604	0.365
1924	156000	85000	43	95.56	1.05	0.401	−0.599	0.359
1925	107000	86000	42	93.33	1.07	0.415	−0.585	0.342
1926	148000	89000	41	91.11	1.10	0.419	−0.581	0.337
1927	165000	89000	40	88.89	1.13	0.419	−0.581	0.337
1928	590000	89000	39	86.67	1.15	0.419	−0.581	0.337
1929	1040000	96000	38	84.44	1.18	0.452	−0.548	0.300
1930	170000	101000	37	82.22	1.22	0.476	−0.524	0.275
1931	230000	103000	36	80.00	1.25	0.485	−0.515	0.265
1932	118000	106000	35	77.78	1.29	0.500	−0.500	0.250
1933	195000	107000	34	75.56	1.32	0.504	−0.496	0.246
1934	183000	107000	33	73.33	1.36	0.504	−0.496	0.246
1935	106000	118000	32	71.11	1.41	0.556	−0.444	0.197
1936	146000	121000	31	68.89	1.45	0.570	−0.430	0.185
1937	89000	125000	30	66.67	1.50	0.589	−0.411	0.169
1938	132000	131000	29	64.44	1.55	0.617	−0.383	0.146
1939	96000	132000	28	62.22	1.61	0.622	−0.378	0.143
1940	107000	140000	27	60.00	1.67	0.660	−0.340	0.116
1941	162000	146000	26	57.78	1.73	0.688	−0.312	0.097
1942	89000	148000	25	55.56	1.80	0.698	−0.302	0.091
1943	125000	149000	24	53.33	1.88	0.702	−0.298	0.089
1944	199000	150000	23	51.11	1.96	0.707	−0.293	0.086
1945	101000	155000	22	48.89	2.05	0.731	−0.269	0.073
1946	225000	155000	21	46.67	2.14	0.731	−0.269	0.073
1947	131000	156000	20	44.44	2.25	0.735	−0.265	0.070
1948	441000	162000	19	42.22	2.37	0.764	−0.236	0.056
1949	155000	165000	18	40.00	2.50	0.778	−0.222	0.049
1950	279000	170000	17	37.78	2.65	0.801	−0.199	0.040
1951	121000	175000	16	35.56	2.81	0.825	−0.175	0.031
1952	233000	180000	15	33.33	3.00	0.862	−0.138	0.019
1953	311000	195000	14	31.11	3.21	0.919	−0.081	0.007
1954	232000	199000	13	28.89	3.46	0.938	−0.062	0.004
1955	175000	225000	12	26.67	3.75	1.060	0.060	0.004
1956	303000	230000	11	24.44	4.09	1.084	0.084	0.007
1957	140000	232000	10	22.22	4.50	1.093	0.093	0.009
1958	520000	233000	9	20.00	5.00	1.098	0.098	0.010
1959	845000	279000	8	17.78	5.63	1.315	0.315	0.099
1960	150000	303000	7	15.56	6.43	1.428	0.428	0.183
1961	149000	311000	6	13.33	7.50	1.466	0.466	0.217
1962	155000	441000	5	11.11	9.00	2.078	1.078	1.163
1963	80000	520000	4	8.89	11.25	2.451	1.451	2.105
1964	85000	590000	3	6.67	15.00	2.781	1.781	3.171
1965	88000	845000	2	4.44	22.50	3.989	2.989	8.935
1966	89000	1040000	1	2.22	45.00	4.902	3.902	15.222

SUM 9548000 CFS

N : 45

MEAN FLOOD = 212177.7

SUM= 36.870332

CV= 0.72575411

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

JEHLUM AT RASUL

YEARS	YEARLY PEAK FLOW Q cs	Q IN ACCRDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE O YEARS P	PUTURE FLOOD FREQUENCY T	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 'V
1922	133000	21000	71	100.00	1.00	0.087	−0.913	0.834
1923	136000	43000	70	98.59	1.01	0.178	−0.822	0.676
1924	154000	59000	69	97.18	1.03	0.244	−0.756	0.572
1925	132000	63000	68	95.77	1.04	0.260	−0.740	0.547
1926	154000	64000	67	94.37	1.06	0.264	−0.736	0.541
1927	205000	68000	66	92.96	1.08	0.281	−0.719	0.517
1928	663000	69000	65	91.55	1.09	0.285	−0.715	0.511
1929	875000	86000	64	90.14	1.11	0.355	−0.645	0.416
1930	249000	89000	63	88.73	1.13	0.368	−0.632	0.400
1931	274000	93000	62	87.32	1.15	0.384	−0.616	0.379
1932	110000	96000	61	85.92	1.16	0.397	−0.603	0.364
1933	138000	96000	60	84.51	1.18	0.405	−0.595	0.354
1934	149000	101000	59	83.10	1.20	0.417	−0.583	0.340
1935	115000	101000	58	81.69	1.22	0.417	−0.583	0.340
1936	180000	105000	57	80.28	1.25	0.434	−0.566	0.321
1937	93000	105000	56	78.87	1.27	0.434	−0.566	0.321
1938	124000	106000	55	77.46	1.29	0.438	−0.562	0.316
1939	112000	106000	54	76.06	1.31	0.438	−0.562	0.316
1940	106000	110000	53	74.65	1.34	0.454	−0.546	0.298
1941	208000	110000	52	73.24	1.37	0.454	−0.546	0.298
1942	105000	112000	51	71.83	1.39	0.463	−0.537	0.289
1943	155000	112000	50	70.42	1.42	0.463	−0.537	0.289
1944	231000	113000	49	69.01	1.45	0.467	−0.533	0.284
1945	150000	115000	48	67.61	1.48	0.475	−0.525	0.276
1946	140000	119000	47	66.20	1.51	0.492	−0.508	0.259
1947	68000	124000	46	64.79	1.54	0.512	−0.488	0.238
1948	730000	125000	45	63.38	1.58	0.516	−0.484	0.234
1949	165000	126000	44	61.97	1.61	0.520	−0.480	0.230
1950	350000	132000	43	60.56	1.65	0.545	−0.455	0.207
1951	275000	133000	42	59.15	1.69	0.549	−0.451	0.203
1952	240000	136000	41	57.75	1.73	0.562	−0.438	0.192
1953	375000	138000	40	56.34	1.78	0.570	−0.430	0.185
1954	425000	140000	39	54.93	1.82	0.578	−0.422	0.178
1955	210000	143000	38	53.52	1.87	0.591	−0.409	0.168
1956	375000	149000	37	52.11	1.92	0.615	−0.385	0.149
1957	175000	150000	36	50.70	1.97	0.620	−0.380	0.145
1958	675000	154000	35	49.30	2.03	0.636	−0.364	0.132
1959	876000	154000	34	47.89	2.09	0.636	−0.364	0.132
1960	860000	155000	33	46.48	2.15	0.640	−0.360	0.129
1961	110000	163000	32	45.07	2.22	0.673	−0.327	0.107
1962	143000	165000	31	43.66	2.29	0.682	−0.318	0.101
1963	96000	175000	30	42.25	2.37	0.723	−0.277	0.077
1964	335000	180000	29	40.85	2.45	0.743	−0.257	0.066
1965	185000	185000	28	39.44	2.54	0.764	−0.236	0.056
1966	270000	205000	27	38.03	2.63	0.847	−0.153	0.023
1967	106000	208000	26	36.62	2.73	0.859	−0.141	0.020
1968	63000	210000	25	35.21	2.84	0.867	−0.133	0.018
1969	101000	231000	24	33.80	2.96	0.954	−0.046	0.002
1970	43000	240000	23	32.39	3.09	0.991	−0.009	0.000
1971	21000	241000	22	30.99	3.23	0.995	−0.005	0.000
1972	105000	249000	21	29.58	3.38	1.029	0.029	0.001
1973	270000	255000	20	28.17	3.55	1.053	0.053	0.003
1974	69000	269000	19	26.76	3.74	1.111	0.111	0.012
1975	126000	270000	18	25.35	3.94	1.115	0.115	0.013
1976	269000	270000	17	23.94	4.18	1.115	0.115	0.013
1977	59000	274000	16	22.54	4.44	1.132	0.132	0.017
1978	101000	275000	15	21.13	4.73	1.136	0.136	0.018
1979	650000	335000	14	19.72	5.07	1.384	0.384	0.147
1980	760000	350000	13	18.31	5.46	1.446	0.446	0.199
1981	112000	375000	12	16.90	5.92	1.549	0.549	0.301
1982	86000	375000	11	15.49	6.45	1.549	0.549	0.301
1983	241000	425000	10	14.08	7.10	1.755	0.755	0.571
1984	98000	650000	9	12.68	7.89	2.685	1.685	2.839
1985	64000	663000	8	11.27	8.88	2.739	1.739	3.023
1986	113000	675000	7	9.86	10.14	2.788	1.788	3.197
1987	125000	730000	6	8.45	11.83	3.015	2.015	4.061
1988	255000	760000	5	7.04	14.20	3.139	2.139	4.576
1989	163000	860000	4	5.63	17.75	3.552	2.552	6.514
1990	119000	875000	3	4.23	23.67	3.614	2.614	6.834
1991	89000	876000	2	2.82	35.50	3.618	2.618	6.856
1992	952000	952000	1	1.41	71.00	3.932	2.932	8.598

SUM 17189000

N = 71

MEAN FLOOD = 242098.5

SUM = 61.143740

CV= 0.9346025

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD FREQUENCY OF

RAVI AT SIDHNAI BARRAGE

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACCORDING ORDER	NO OF TIME PEAK WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE FLOOD FREQUENCY T	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	2 V
1922	43007.58	11899.47	71	100.00	1.00	0.201	−0.799	0.639
1923	55693.87	12297.88	70	98.59	1.01	0.207	−0.793	0.629
1924	35980.89	17407.83	69	97.18	1.03	0.294	−0.706	0.499
1925	65182.26	18996.78	68	95.77	1.04	0.320	−0.680	0.462
1926	45903	18996.78	67	94.37	1.06	0.320	−0.680	0.462
1927	33297.33	19597.05	66	92.96	1.08	0.330	−0.670	0.448
1928	38381.97	21609.72	65	91.55	1.09	0.364	−0.636	0.404
1929	31864.93	22104.06	64	90.14	1.11	0.373	−0.627	0.393
1930	31496.52	22492.47	63	88.73	1.13	0.379	−0.621	0.385
1931	43078.2	25882.23	62	87.32	1.15	0.436	−0.564	0.318
1932	35486.55	25988.16	61	85.92	1.16	0.438	−0.562	0.316
1933	47986.29	26200.02	60	84.51	1.18	0.442	−0.558	0.312
1934	28212.69	27294.63	59	83.10	1.20	0.460	−0.540	0.291
1935	38699.76	27505.49	58	81.69	1.22	0.464	−0.536	0.287
1936	48586.56	28212.69	57	80.28	1.25	0.476	−0.524	0.275
1937	26200.02	29413.23	56	78.87	1.27	0.496	−0.504	0.254
1938	22492.47	30084.12	55	77.46	1.29	0.507	−0.493	0.243
1939	17407.83	30084.12	54	76.06	1.31	0.507	−0.493	0.243
1940	18996.78	30295.98	53	74.65	1.34	0.511	−0.489	0.239
1941	18996.78	31496.52	52	73.24	1.37	0.531	−0.469	0.220
1942	62180.91	31864.93	51	71.83	1.39	0.538	−0.462	0.214
1943	51905.7	32308.65	50	70.42	1.42	0.545	−0.455	0.207
1944	27294.63	33297.33	49	69.01	1.45	0.562	−0.438	0.192
1945	32308.65	33509.19	48	67.61	1.48	0.565	−0.435	0.189
1946	33509.19	33986.74	47	66.20	1.51	0.568	−0.432	0.187
1947	58579.29	35486.55	46	64.79	1.54	0.598	−0.402	0.161
1948	69207.6	35980.89	45	63.38	1.58	0.607	−0.393	0.155
1949	46186.48	37499.22	44	61.97	1.61	0.632	−0.368	0.135
1950	85909.23	38381.97	43	60.56	1.65	0.647	−0.353	0.124
1951	33686.74	38699.76	42	59.15	1.69	0.653	−0.347	0.121
1952	51587.91	38805.69	41	57.75	1.73	0.654	−0.346	0.119
1953	73303.56	41383.32	40	56.34	1.78	0.698	−0.302	0.091
1954	91276.35	41595.18	39	54.93	1.82	0.701	−0.299	0.089
1955	109990.65	43007.58	38	53.52	1.87	0.725	−0.275	0.075
1956	67580.34	43078.2	37	52.11	1.92	0.726	−0.274	0.075
1957	112462.35	45903	36	50.70	1.97	0.774	−0.226	0.051
1958	100986.6	46186.48	35	49.30	2.03	0.779	−0.221	0.049
1959	104976.63	46997.61	34	47.89	2.09	0.793	−0.207	0.043
1960	25882.23	47986.29	33	46.48	2.15	0.809	−0.191	0.036
1961	86156.4	48586.56	32	45.07	2.22	0.819	−0.181	0.033
1962	100986.6	50210.82	31	43.66	2.29	0.847	−0.153	0.023
1963	30084.12	51587.91	30	42.25	2.37	0.870	−0.130	0.017
1964	76198.98	51905.7	29	40.85	2.45	0.875	−0.125	0.016
1965	21609.72	55693.87	28	39.44	2.54	0.939	−0.061	0.004
1966	75704.64	58579.29	27	38.03	2.63	0.988	−0.012	0.000
1967	29413.23	61898.43	26	36.62	2.73	1.044	0.044	0.002
1968	46997.61	62180.91	25	35.21	2.84	1.049	0.049	0.002
1969	19597.05	63805.17	24	33.80	2.96	1.076	0.076	0.006
1970	38805.69	65005.71	23	32.39	3.09	1.096	0.096	0.009
1971	63805.17	65182.26	22	30.99	3.23	1.099	0.099	0.010
1972	22104.06	67580.34	21	29.58	3.38	1.140	0.140	0.020
1973	180010.38	69207.6	20	28.17	3.55	1.167	0.167	0.028
1974	30295.98	73303.56	19	26.76	3.74	1.236	0.236	0.056
1975	121996.05	75492.78	18	25.35	3.94	1.273	0.273	0.075
1976	197993.17	75704.64	17	23.94	4.18	1.277	0.277	0.077
1977	61898.43	76198.98	16	22.54	4.44	1.285	0.285	0.081
1978	75492.78	77081.73	15	21.13	4.73	1.300	0.300	0.090
1979	12297.88	85909.23	14	19.72	5.07	1.449	0.449	0.201
1980	77081.73	86156.4	13	18.31	5.46	1.453	0.453	0.205
1981	195970.5	91276.35	12	16.90	5.92	1.539	0.539	0.291
1982	37499.22	93889.29	11	15.49	6.45	1.583	0.583	0.340
1983	25988.16	100986.6	10	14.08	7.10	1.703	0.703	0.494
1984	27505.49	100986.6	9	12.68	7.89	1.703	0.703	0.494
1985	41595.18	104976.63	8	11.27	8.88	1.770	0.770	0.593
1986	41993.32	109990.65	7	9.86	10.14	1.855	0.855	0.731
1987	11899.47	112462.35	6	8.45	11.83	1.897	0.897	0.804
1988	254973.51	121996.05	5	7.04	14.20	2.057	1.057	1.118
1989	63805.71	180010.38	4	5.63	17.75	3.036	2.036	4.144
1990	50210.82	195970.5	3	4.23	23.67	3.305	2.305	5.312
1991	30084.12	197993.17	2	2.82	35.50	3.339	2.339	5.469
1992	93889.29	254973.51	1	1.41	71.00	4.300	3.300	10.888

SUM 421...93.7 N = 71 MEAN FLOOD = 59290.91

SUM = 71 CV = 1.0971175

CALCULATIONS FOR PROBABILITY PLOTTINGS OF FLOOD DISCHARGE OF

CHENAB AT SHERSHAH BRIDGE

YEARS	YEARLY PEAK FLOW Q (CFS)	Q IN ACENDING ORDER	NO OF TIMES FLOOD WAS EXCEEDED	PERCENTAGE OF YEARS P	FUTURE PLOOD FREQUENCY I	COL.3 IN TERM OF MEAN FLOOD	VARIATION FROM MEAN V	V^2
1930	364949.62	90993.87	63	100.00	1.00	0.310	−0.690	0.476
1931	206987.22	109001.97	62	87.32	1.15	0.371	−0.629	0.395
1932	240990.75	140004.15	61	85.92	1.16	0.477	−0.523	0.274
1933	252960.84	143994.18	60	84.51	1.18	0.490	−0.510	0.260
1934	266893.75	144982.86	59	83.10	1.20	0.494	−0.506	0.256
1935	298969.77	152998.23	58	81.69	1.22	0.521	−0.479	0.229
1936	196971.85	159000.93	57	80.28	1.25	0.542	−0.458	0.210
1937	152998.23	163979.64	56	78.87	1.27	0.559	−0.441	0.195
1938	226972.68	167969.67	55	77.46	1.29	0.572	−0.428	0.183
1939	197983.17	174996.36	54	76.06	1.31	0.596	−0.404	0.163
1940	205963.23	175985.04	53	74.65	1.34	0.599	−0.401	0.160
1941	192969.15	176973.72	52	73.24	1.37	0.603	−0.397	0.158
1942	289965.72	180999.06	51	71.83	1.39	0.617	−0.383	0.147
1943	205963.23	180999.06	50	70.42	1.42	0.617	−0.383	0.147
1944	233964.06	184989.09	49	69.01	1.45	0.630	−0.370	0.137
1945	205963.23	185977.77	48	67.61	1.48	0.633	−0.367	0.134
1946	240990.75	187990.44	47	66.20	1.51	0.640	−0.360	0.129
1947	176973.72	192969.15	46	64.79	1.54	0.657	−0.343	0.117
1948	459948.06	197983.17	45	63.38	1.58	0.674	−0.326	0.106
1949	239966.76	197983.17	44	61.97	1.61	0.674	−0.326	0.106
1950	497941.62	196971.85	43	60.56	1.65	0.678	−0.322	0.104
1951	265990.23	205963.23	42	59.15	1.69	0.702	−0.298	0.089
1952	233964.06	205963.23	41	57.75	1.73	0.702	−0.298	0.089
1953	244980.78	205963.23	40	56.34	1.78	0.702	−0.298	0.089
1954	274958.97	206987.22	39	54.93	1.82	0.705	−0.295	0.087
1955	299958.45	215814.72	38	53.52	1.87	0.735	−0.265	0.070
1956	379970.91	226972.68	37	52.11	1.92	0.773	−0.227	0.051
1957	639923.13	232975.38	36	50.70	1.97	0.794	−0.206	0.043
1958	439962.6	233964.06	35	49.30	2.03	0.797	−0.203	0.041
1959	722936.94	233964.06	34	47.89	2.09	0.797	−0.203	0.041
1960	344978.7	235976.73	33	46.48	2.15	0.804	−0.196	0.039
1961	279972.99	239966.76	32	45.07	2.22	0.817	−0.183	0.033
1962	163979.64	240990.75	31	43.66	2.29	0.821	−0.179	0.032
1963	185977.77	240990.75	30	42.25	2.37	0.821	−0.179	0.032
1964	309986.49	244980.78	29	40.85	2.45	0.834	−0.166	0.027
1965	174996.36	249994.8	28	39.44	2.54	0.852	−0.148	0.022
1966	232975.38	250983.48	27	38.03	2.63	0.855	−0.145	0.021
1967	109001.97	252960.84	26	36.62	2.73	0.862	−0.138	0.019
1968	250983.48	265990.23	25	35.21	2.84	0.906	−0.094	0.009
1969	184989.09	274958.97	24	33.80	2.96	0.937	−0.063	0.004
1970	90993.87	279972.99	23	32.39	3.09	0.954	−0.046	0.002
1971	175985.04	281965.66	22	30.99	3.23	0.960	−0.040	0.002
1972	180999.06	286893.75	21	29.58	3.38	0.977	−0.023	0.001
1973	140004.15	289965.72	20	28.17	3.55	0.988	−0.012	0.000
1974	704926.84	298969.77	19	26.76	3.74	1.018	0.018	0.000
1975	159000.93	299958.45	18	25.35	3.94	1.022	0.022	0.000
1976	371955.54	308962.5	17	23.94	4.18	1.052	0.052	0.003
1977	215814.72	309986.49	16	22.54	4.44	1.056	0.056	0.003
1978	729926.32	344978.7	15	21.13	4.73	1.175	0.175	0.031
1979	235976.73	371955.54	14	19.72	5.07	1.267	0.267	0.071
1980	180999.06	379970.91	13	18.31	5.46	1.294	0.294	0.087
1981	457970.7	384949.62	12	16.90	5.92	1.311	0.311	0.097
1982	187990.44	439962.6	11	15.49	6.45	1.499	0.499	0.249
1983	167969.67	457970.7	10	14.08	7.10	1.560	0.560	0.313
1984	144982.86	459948.06	9	12.68	7.89	1.567	0.567	0.321
1985	308962.5	497871	8	11.27	8.88	1.696	0.696	0.484
1986	281965.66	497941.62	7	9.86	10.14	1.696	0.696	0.484
1987	143994.18	551930.61	6	8.45	11.83	1.880	0.880	0.774
1988	551930.61	639923.13	5	7.04	14.20	2.180	1.180	1.392
1989	497871	704926.84	4	5.63	17.75	2.401	1.401	1.963
1990	197983.17	722936.94	3	4.23	23.67	2.462	1.462	2.139
1991	249994.8	729926.32	2	2.82	35.50	2.486	1.486	2.209
1992	978087	978087	1	1.41	71.00	3.331	2.331	5.436

SUM = 18496084.

N = 63

MEAN FLOOD = 293588.63

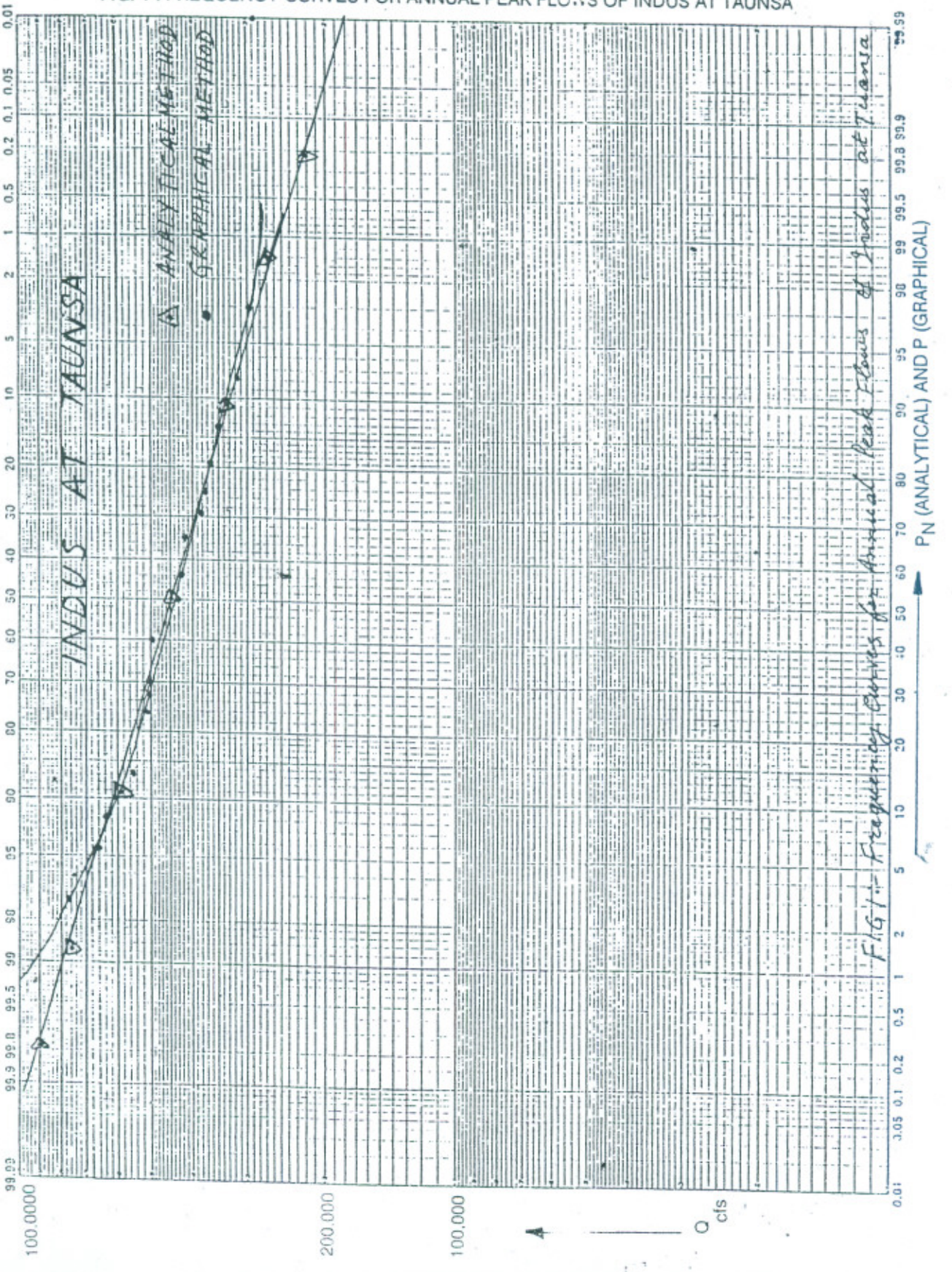
SUM = 20.967948

CV = 0.5475653

"Appendix - C"

PLOTTING OF FREQUENCY CURVES BY ANALYTICAL/ GRAPHICAL METHODS

FIG. 1 : FREQUENCY CURVES FOR ANNUAL PEAK FLOWS OF INDUS AT TAUNSA



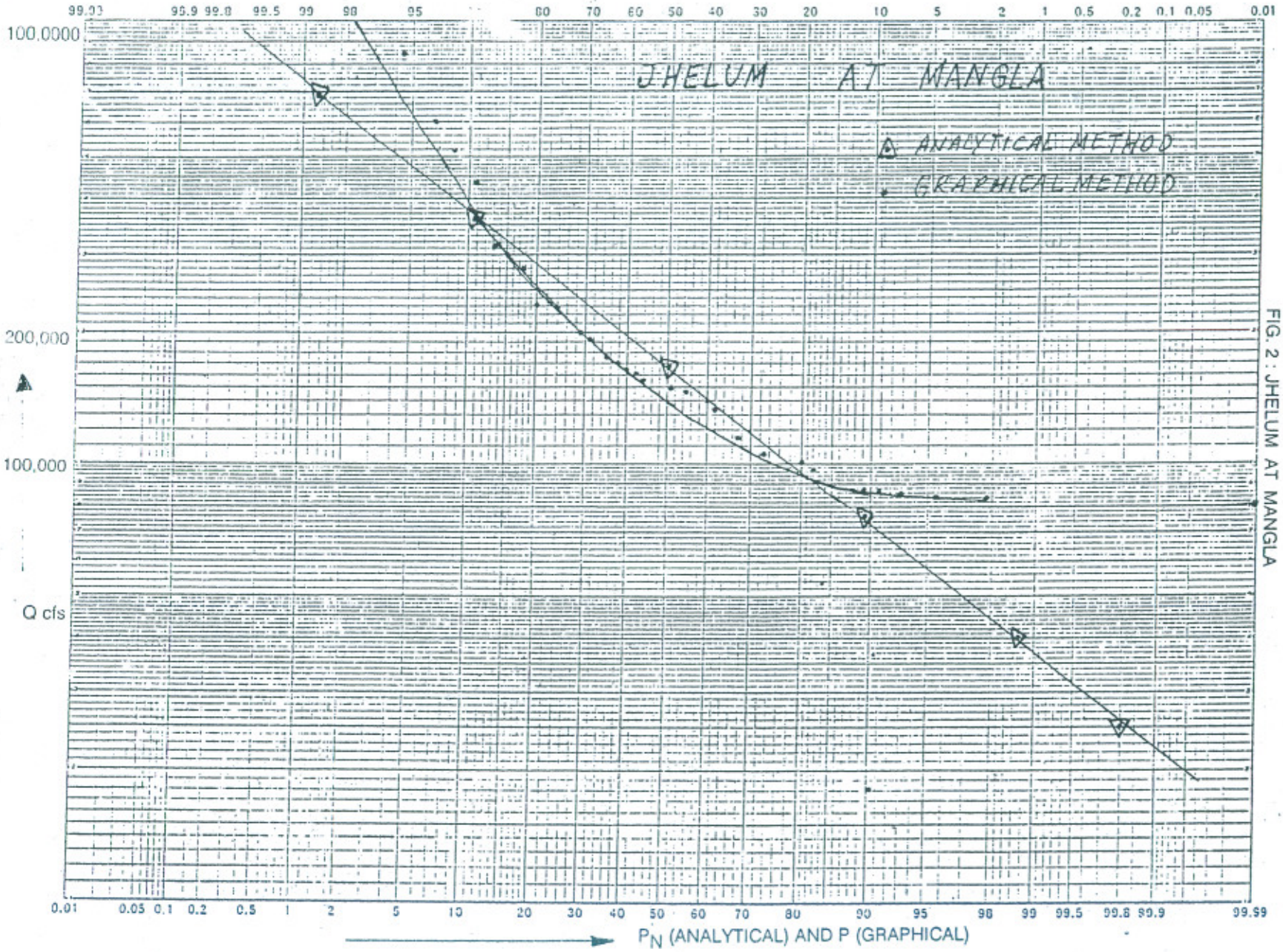


FIG. 2 : JHELUM AT MANGLA

FIG. 3 : JHELUM AT RASUL

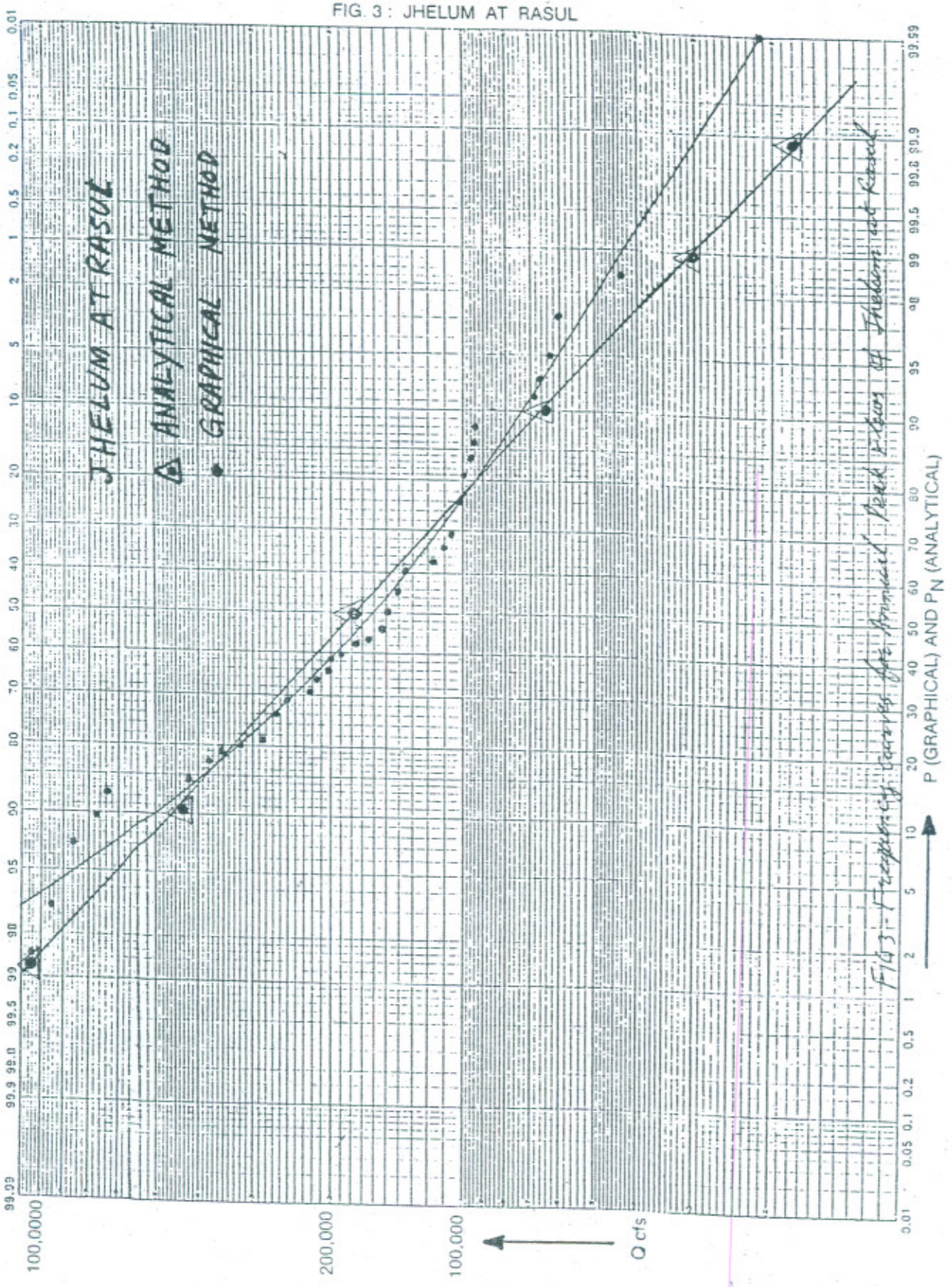


FIG. 4 : RAVI AT SIDHNAI

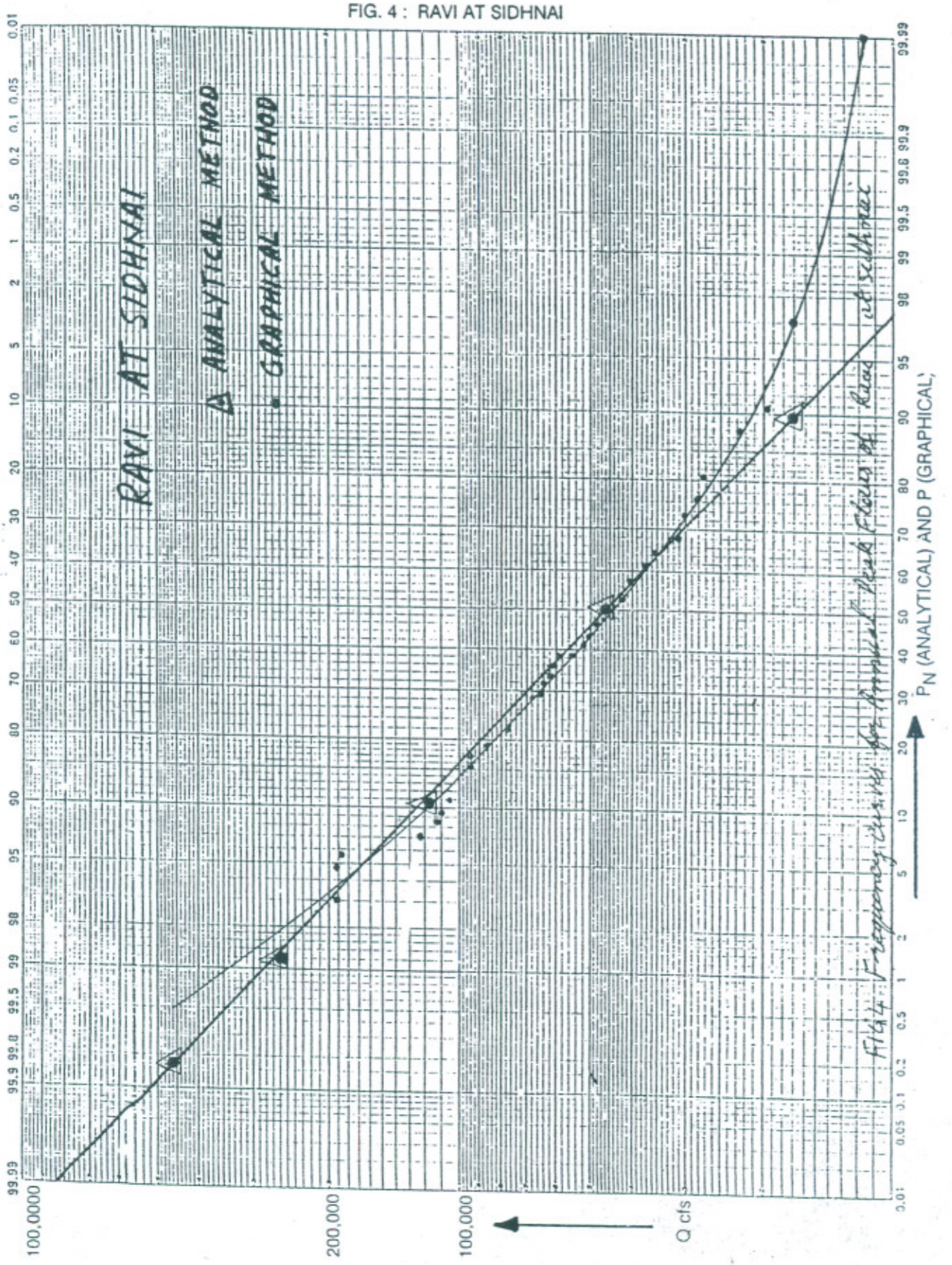


FIG. 5 : CHENAB AT SHERSHAH

