CHAPTER 11 HYDRO-METEOROLOGICAL STUDY

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CHAPTER 11 HYDRO-METEOROLOGICAL STUDY

11.1 General

(1) Objectives and Scope of Study

Analysis and estimation of the river flow, flood discharge and evaporation as well as other hydrological parameters at the proposed project sites are essential in determining the technically optimum development plan and design conditions for the facilities to be built.

During the study, the following works were carried out:

- collection of meteorological data, rainfall data, discharge data and so forth
- visiting the proposed sites as well as some of the observation stations to assess hydrological conditions
- preparation of the technical specifications for a supplementary hydrological survey that could give precious data to secure a proper accuracy in the analysis
- thorough analysis of the hydrological parameters which were required for the optimization study

(2) Hydro-meteorological Conditions of the Konkan Region

The project sites are located in the Konkan Region which is a narrow terrain between the west coast and the Sahyadri range covering about 30,400 km^2 in area. This region consists of five districts, namely, Greater Bombay, Thane, Raigad, Ratnagiri and Sindhudurg.

Topographically, it is sloping from east to west and , except for a hilly area near the Sahyadri range, the altitude varies from about EL+90 m to sea level. The proposed dam sites are located in and near the Sahyadri range and they have an altitude from about EL+100 to 900 m.

Climatically, there are three seasons as below:

(a) Summer from March to the middle of June

The average atmospheric temperature in May is about 30°C and the average relative humidity is about 68% in the coastal area.

(b) Rainy season from the middle of June to the middle of October

The average atmospheric temperature in this season is about 27.5°C and the relative humidity is about 85% on average.

(c) Winter from the middle of October to February

The average atmospheric temperature in January is about 24°C and the relative humidity is about 65% on average.

The Konkan Region lies in the high rainfall zone having annual rainfall exceeding 1,905 mm. The precipitation is generally brought by the south-west monsoon currents and about 90% of annual rainfall is received in the rainy season. The average annual rainfall in each district is as shown below:

1) Thane ------- 2,235 mm
2) Raigad ------- 3,091 mm
3) Ratnagiri, Sindhudurg ------- 3,043 mm

[Source: Manual of Minor Irrigation Works published by the Irrigation Department (GOMID)]

The rainfall is heaviest on the Sahyadri edge, where the rainfall is over 6,000 mm, and it reduces towards the sea. The above aspects can be seen in Fig. 11.1-1 which shows the isohyets of the Konkan Region.

11.2 Data Obtained

(1) Rainfall Data

The reports on daily rainfall data of the west flowing river basins in a period from 1978 to 1992, which were prepared by the Irrigation Project Investigation Division in Thane, were obtained. They include data from some of the raingauge stations located in the Belgaum, Satara, Kolhapur, Nasik and Pune Districts bordering the Konkan Region. Hourly rainfall data recorded at the automatic raingauge stations is also available in the reports.

During the year 1992, there were, in total, 407 nos. of working raingauge stations (174 nos. of automatic & 233 nos. of ordinary raingauges) under the control of different organizations (Irrigation Dept. (GOMID) - 352 nos., Railway Dept. - 1 no., TATA H.E. Company - 3 nos., I.M.D. - 8 nos., Revenue Dept. - 43 nos.) as against 106 nos. of working raingauge stations in

the year 1978. The districtwise and basinwise details of raingauge stations are given in Tables 11.2-1 and 11.2-2 respectively.

Rainfall data recorded over a period of more than 10 years is available at 215 raingauge stations. This could be very useful for the hydrological analysis of the project. Longitudes, latitudes and altitudes of the raingauge stations are not indicated in the reports, but some of them were provided by the counterpart agency during this study.

In addition to the above data, annual rainfall data in the Thane and Raigad Districts measured by GOMID and the Revenue Dept. was also provided by GOMID. Some of the stations give annual rainfalls over a period of 92 years (1901 - 1992).

(2) Discharge Data

The reports on river gauge data in the west flowing river basins in a period from June, 1980 to May, 1993 were obtained. They were also prepared by the Irrigation Project Investigation Division in Thane.

As of May, 1993, 51 nos. of river gauge stations were in operation (A type - 7 nos., B type - 16 nos., C type - 28 nos.) under the control of the Irrigation Dept. as against 22 nos. in the year 1980. Tables 11.2-3 and 11.2-4 show the districtwise and basinwise details of river gauge stations respectively.

The discharge is measured three times a day at 8:30, 14:30 and 17:30 hours, and then daily mean discharge is obtained by averaging the measurements. In A and B type stations, velocity of flow is measured by current meters and water level is measured by automatic recorders. In C type stations, the velocity is measured by wooden floats or current meters, and the water level is measured manually every hour from 8:30 to 17:30 hours.

(3) Meteorological Data

Meteorological data such as atmospheric temperature, humidity, wind, evaporation and so forth have been observed in many stations operated by GOMID and other organizations. Among them, the data observed at three representative stations were obtained for this study:

(a) Khapri station in the Thane District : 1989 - 1992
(15 km south-west to the Jalond site)

(b) Pastewadi station in the Ratnagiri District : 1990 - 1992
(15 km south-west to the Marleshwar site)

(c) Tillariwadi station in the Sindhudurg District : 1992 - 1995
(10 km south-west to the Hevale site)

Tables 11.2-5 through 11.2-10 are the summaries of data at the above stations (excluding evaporation which will be discussed in Section 11.6 hereinafter). The tables show that most rain fell between June and October (so-called rainy season) and the maximum temperature in this period was lower than in other months.

From the data mentioned above, it is obvious that the flows in the rivers are generated grossly from the rainfall during the rainy season and, in the remaining months, the flows are nil or negligibly small.

At the beginning of the study, the specifications for the hydrological survey were prepared by the JICA Study Team and the details were discussed with the counterpart agency. So far, the survey has not yet been taken up. It is suggested that, as data to be obtained from the specified survey is essential for a detailed study of the project, the survey should be undertaken as soon as possible.

11.3 Rainfall

(1) Annual Rainfalls at 32 Proposed Sites

From the obtained data, annual rainfalls near the 32 sites initially proposed were picked out as shown in Table 11.3-1. These rainfalls were used to derive dependable annual inflows for the initial site selection, by which 3 sites, Jalond, Marleshwar and Hevale, were selected for the further study.

(2) Annual Rainfalls at 3 Selected Sites

As the previous section (1) gives only the preliminary information required for the initial site selection, further examination of rainfall data is necessary for selection of the optimum site and development scheme. For the examination, several gauging stations located within 30 km from the Jalond, Marleshwar and Hevale sites were selected as shown in Tables 11.3-2 through 11.3-4 and 11.3-8 (see Appendices 11-1 through 11-3 as well).

(a) Examination of data by the double-mass curve method

First, the consistency of the data was checked by the double-mass curve method. Because of the limitation of data availability, data from 1981 to 1992 for Jalond and Hevale and from 1982 to 1992 for Hevale were used for this work.

(i) Jalond: Figs. 11.3-1 through 11.3-4

Clear break points were found in the series of the data for Dand, Jawhar, Khodwapada, Kothale and Phangloshi. The inconsistency in the data series at each station was adjusted to the slope of recent data series (the reason for the break is unknown from the available data and information). A missing record in 1986 at Moroshi was also estimated. Results of the work are shown in Table 11.3-5.

(ii) Marleshwar: Figs. 11.3-5 and 11.3-6

Clear break points were found in the series of the data for Kadwai and Sangave, and the inconsistency was adjusted by the same means as for Jalond. A missing record in 1990 at Kurdhunda was also estimated. Table 11.3-6 shows the results.

(iii) Hevale: Figs. 11.3-7 through 11.3-9

Clear break points were found in the series of the data for Patye, Shirange and Tillariwadi, and the inconsistency was adjusted by the same means as for Jalond. Table 11.3-7 shows the results.

(b) Examination of data variation in relation to variation of altitudes

This matter is one of the hydrological concerns in the study since the existing raingauge stations are located at relatively low altitudes while the catchment areas of the dam sites are located at high altitudes. Altitudes and average annual rainfalls (adjusted ones as mentioned in (1) above) are shown in Table 11.3-8. The data for Jalond and Hevale were plotted and the correlation between the altitudes and the rainfalls was checked (refer to Figs. 11.3-10 and 11.3-11). The data for Marleshwar was not used because the amount of data is too small.

As seen in the figures, the correlation of the two elements is very weak. It is considered that this implies that 1) data at each station represents a very small area, and 2) difference in rainfall by area or by sub-basin is great. However, there is no alternative but to use this weak correlation for adjusting the data at the stations to that of the catchment areas for the dam sites.

From the figures, the following increase rates were obtained:

- Jalond : 2.3% per 100 m increase in altitude
- Hevale : 4.7% per 100 m increase in altitude

It was decided by an arbitrary judgment that an increase rate of 3.5% per 100 m can be applied for all sites.

(3) Monthly Areal Rainfall for 3 Selected Sites

Monthly areal rainfall for each site was derived considering the locations of the raingauge stations and the altitude of catchment area.

(a) Jalond

The average altitudes of the catchment areas for the upper and lower dam sites are EL+900 m and EL+100 m respectively. For the study, 4 raingauge stations - Kundachiwadi, Moroshi, Phangloshi and Waliware - among the 12 stations shown in Table 11.3-5 were selected. These are located very close to the site.

For the lower dam site, it is unnecessary to adjust the data at the 4 stations since their altitudes are almost the same as the catchment area as exhibited in Table 11.3-8. Monthly areal rainfall was derived by, first, adjusting monthly data from 1981 to 1986 at Phangloshi by multiplying it by a coefficient of 0.87 (refer to Table 11.3-5) and secondly, simply averaging the data of the 4 stations (1978 - 1992).

It is considered that, for the upper dam site, the monthly areal rainfall estimated for the lower dam site should be used without increasing it by an altitude adjustment coefficient since it is located on the east of the Sahyadri range where annual rainfall is less than on the west.

Table 11.3-9 shows the monthly areal rainfall for the upper and lower dam sites.

(b) Marleshwar

The average altitudes of the catchment areas for the upper and lower dam sites are EL+900 m and EL+400 m respectively. For the study, 2 raingauge stations - Pastewadi and Sangave - among the 4 stations shown in Table 11.3-6 were selected. The closest station to the site is Pastewadi, but it is located in the Kajvi sub-basin adjacent to the Shastri sub-basin where the site is located. Sangave is the second nearest station and is located in the Shastri sub-basin.

First, the monthly rainfall from 1982 to 1987 at Sangave was adjusted by using a coefficient of 0.71 (refer to Table 11.3-6).

Secondly, the monthly rainfalls from 1982 to 1992 at both stations were adjusted by applying the altitude adjustment coefficients derived from the increase rate of 3.5% per 100 m. The Pastewadi and Sangave stations are located at EL+90 m and 150 m respectively. Assuming that both are located at EL+100 m, the altitude adjustment coefficients become 1.31 for the upper dam site and 1.11 for the lower dam site.

Finally, the monthly rainfall at the site was computed by simply averaging the data of both stations obtained above. Tables 11.3-10 and 11.3-11 show monthly areal rainfalls for the upper and lower dam sites respectively.

(c) Hevale (lower dam site)

Monthly areal rainfall was derived for the lower dam site only since the upper dam is of a man-made type.

Data at the Kodali station located in the catchment area of the site was adopted. It is considered that the site can be duly represented by this data because of a small catchment area of 22.46 km^2. As the altitude at this station (EL+725 m) is almost equivalent to the average altitude of the catchment area (EL+600 m), no adjustment is required. Table 11.3-12 shows the monthly areal rainfall for the lower dam site.

(4) Rainfall Cycle

Among the long-term rainfall data measured by the Revenue Dept., the data at 3 stations, Khalapur (Raigad District), Mahad (Raigad District) and Jawhar (Thane District) were

arbitrarily selected for the study. These stations have annual rainfall data over a 92-year period from 1901 to 1992 as shown in Table 11.3-13. Figs. 11.3-12 through 11.3-14 show the annual rainfall and 5-year or 10-year moving average.

There is heavy fluctuation in the series of rainfall data. It is difficult to read the rainfall cycles from the figures, but, if anything, the following can be read:

(a) Khalapur — Short cycle change in a period of 3 to 6 years
Long cycle change in a period of 20 to 25 years

(b) Mahad — Short cycle change in a period of 3 to 5 years
Long cycle change in a period of 15 to 20 years

(c) Jawhar — Short cycle change in a period of 3 to 5 years
Long cycle change in a period of 20 to 25 years

From the above, it is considered that a short cycle change in a 4-year period and a long cycle change in a 20-year period are prevailing in the Konkan Region.

11.4 Low Flow Analysis

(1) Annual Inflow used for the Initial Site Selection

(a) Run-off coefficient

It is described, in the detailed project reports for other projects in the Konkan Region, that a run-off coefficient of 0.9 is a conservative (safer) value for the calculation of design floods. Adequacy of this coefficient must be examined.

First, a mean run-off coefficient was derived ,as shown in Table 11.4-1, from the rainfall and discharge data in the year 1992 published by the Irrigation Project Investigation Division. According to the table, the mean run-off coefficient for the Konkan Region is obtained as 0.88.

Next, a run-off coefficient was estimated by using the guidelines presented by US Soil Conservation Service.

Assumption:

Land use : Mixture of fallow, row crops, small grain and woods

Soil group : "D" considering the steepness of land (low infiltration)

From Table 11.4-2, the Curve Number of 77 ~ 94 was obtained. Adopting the Curve Number of 85 (average), the percentage of direct run-off against rainfall of 8 ~ 20 inches is obtained as 87 ~ 90% from Fig. 11.4-1.

From the above examination, it was decided to adopt the following run-off coefficients for the preliminary flow and flood estimation:

(i) For the calculation of design floods : 0.9

(ii) For the calculation of annual yield : 0.85

(b) Annual inflow

For the initial site selection, annual inflows to the proposed sites were estimated by using the annual rainfall data observed in the vicinities of the sites and the run-off coefficient of 0.85. In the calculation of annual inflow, the second lowest annual rainfall among the data observed in a period from 1978 to 1992 was adopted (refer to Table 11.3-1). Table 11.4-3 shows the results. In the table, the total loss due to evaporation and infiltration is assumed as being 3,000 mm per annum (this subject is discussed in Section 11.6 hereinafter).

(2) Low Flow Analyses for 3 Selected Sites

The Tank Model was used for the analysis. The typical layout of the model is as shown in Fig. 11.4-2.

First, the run-off characteristics were examined by using the monthly rainfall data and the monthly flow data at the following stations:

(a) Near the Jalond site : Sajgaon (about 15 km south of the site)

(b) Near the Marleshwar site : Pastewadi (about 10 km south-west of the site)

(c) Near the Hevale site : Shirshingi (about 35 km north-west of the site)

These stations have relatively small catchment areas and their hydrological conditions are deemed to be similar to ones in the selected sites.

Tables 11.4-4 through 11.4-6 show the input data such as catchment areas, rainfall data, river flow data, assumed evaporation loss, etc. After considerable trial and error testing for the 3 stations selected above, the best-fitting results were obtained. The results of the analyses (actual flow and simulated flow) are exhibited in Figs. 11.4-3 through 11.4-5. The correlation coefficients between the actual and simulated flows are:

	Sajgaon	Pastewadi	Shirshingi
Correlation coeff.	0.96	0.89	0.92

The case of Sajgaon gives the best correlation, while the correlation coefficient for Pastewadi is not at a satisfactory level. The amount of actual river flow data at the Sajgaon station is much less than for the other cases, and this very much contributes to the better result. Although a correlation coefficient is one of determinants, it was finally decided to adopt the run-off characteristics obtained for Shirshingi considering the overall similarity of the simulated flow to the actual one and reliability of the results (sample sizes, correlation coefficients).

Number of tanks : 3

Coeff. of tankholes :

	Cu	Cm	Cd	Cb
1st tank	0	0.55	0.42	0.008
2nd tank	0	0.30	0.45	0.001
3rd tank	0	0	0.30	0

Height of tankholes (mm) :

	Hu	Hm	Hd
1st tank	0	150	20
2nd tank	0	50	5
3rd tank	0	0	5

By using the above run-off characteristics and the monthly areal rainfall obtained in Section 11.3-(3) (see Tables 11.3-9 through 11.3-12), the monthly flows at the Jalond, Marleshwar and Hevale sites were derived as summarized in Tables 11.4-7 through 11.4-11.

From the mean flow obtained by the above analyses and the average annual rainfall, it was found that the run-off coefficient could be within a range of 0.85 - 0.92. There is a tendency that the more the annual rainfall, the higher the run-off coefficient.

11.5 Flood Estimation

It was decided to use the Rational Formula for the flood estimation from the following reasons:

- The catchment areas of the proposed sites are small and, topographically, very steep. Therefore, it is estimated that the travel time of water from the hydraulically most distance point to the dam site is short.
- Judging from the rainfall and river flow data, base run-off is considered to be nil or negligible.
- Unit hydrographs are unavailable.

(1) Rainfall Intensity

It is necessary, first of all, to determine the rainfall intensity to be used in the Rational Formula. For this purpose, the rainfall data observed in the Konkan Region was examined.

Table 11.5-1 shows the hourly distribution of rainfall at more than 250 mm/day. From this table, the highest percentage of one-hour rainfall to the daily rainfall is found to be 19.32% at 18:00 hour in the data of the Pastewadi station. In this study, we adopt 25% to be on the safe side.

Rainfall intensity = Probable daily rainfall x 25%

(2) Preliminary Flood Estimation

Raingauge stations which are located near each proposed site and have rainfall data over a longer period than 10 years were selected. The maximum daily rainfall of each year at each station was extracted and statistically analyzed by using the Hazen Plot for obtaining probable daily rainfall. Table 11.5-2 is a summary of this work. The probable rainfalls shown in the table were used to estimate the floods for both upper and lower dam sites.

The rainfall data used for the above analysis has to be examined and correlated, if necessary, considering the locations and altitudes of raingauge stations. Furthermore, it is necessary to examine whether or not the same rainfall data can be applied for both upper and lower dam sites. For these purposes, it is required to obtain data such as the locations (longitudes, latitudes and altitudes) of the existing stations, rainfall data at new stations to be established by GOMID for the study and so forth. As such data were unavailable at the preliminary

study stage, the floods were simply computed by using the probable daily rainfall, the percentage of rainfall intensity obtained in the previous section and the Rational Formula.

Table 11.5-3 shows the floods with a 30-year and 1,000-year probability. For reference, the floods estimated by using the Inglis Formula introduced in the M.I. Manual are also shown in the table.

(3) Flood Estimation for the 3 Selected Sites

In the low flow analyses for the 3 selected sites described in Section 11.4-(2), the monthly rainfall data at the following stations were used:

(a) Jalond --------- Kundachiwadi, Moroshi, Phangloshi and Waliware
(b) Marleshwar --------- Pastewadi and Sangave
(c) Hevale --------- Kodali

Probable rainfall could be obtained by statistically analyzing a series of the annual maximum daily rainfall at each station. Theoretically, this probable rainfall must be converted to one at the proposed site considering the locations of the raingauge stations and the site as discussed in the previous section. However, it is regrettable to say that the hydrological survey proposed by the JICA Study Team has not yet been conducted, and consequently, useful data for the conversion is still unavailable. Further, although the monthly rainfall data was adjusted considering the altitude of the raingauge station, daily data should not be adjusted in the same manner. Thus, it was decided that no adjustment for probable daily rainfall should be made.

Table 11.5-4 shows the annual maximum daily rainfall at the stations listed above. These data were statistically analyzed using the Hazen Plot, the Thomas Plot, the Gumbel's Method and the Iwai's Method for the return periods of 10, 30, 100, 200 and 1,000 years, and the Hershfield's Method for the probable maximum precipitation (PMP). For the return periods of 10, 30, 100, 200 or 1,000 years, the maximum one among the probable rainfalls obtained by the 4 methods was adopted. The results are shown in Table 11.5-5 .

It is to be noted that the reliability of the results in the table is low because of the small sample sizes (length of records is 15 years or shorter at all stations). Therefore, in order to minimize an error risk, the probable rainfalls obtained were averaged as shown in the table. The following is the adopted probable daily rainfall for each return period for each site:

Site	Probable Daily Rainfall (mm)					
	10-yr	30-yr	100-yr	200-yr	1,000-yr	PMP
Jalond	269.8	336.5	412.6	461.9	586.4	935.1
Marleshwar	384.8	477.9	577.6	634.7	806.4	1,039.4
Hevale	355.8	414.6	477.6	513.7	597.3	948.0

The one-hour rainfall intensity for flood estimation can be derived by multiplying the above probable daily rainfall by 0.25 according to the study in Section 11.5-(1).

The run-off coefficient of 0.9 was used in the preliminary flood estimation. However, taking into consideration the studies in Section 11.4 and that much antecedent rainfall is expected prior to the occurrence of the storm in question, the run-off coefficient used for the flood estimation should be set higher than 0.9. Thus, the run-off coefficient was assumed as being 0.95.

Following the above study results, the probable floods for the proposed sites can be obtained as summarized in Table 11.5-6.

11.6 Evaporation and Infiltration Losses

The Manual of Minor Irrigation Works (M.I. Manual) mentions that the average evaporation loss throughout the year for Deccan is 0.022 ft/day (= 6.7 mm/day) over the mean area and this is used in the preliminary study reports prepared by GOMID. On the other hand, it is noted in the detailed project reports for other projects, that the average evaporation loss is 5.56 mm/day according to the data observed at the agriculture meteorological station at Karjat (Raigad District) over a period from 1961 to 1979.

Since the Konkan Region is located in a high rainfall zone where the above meteorological station also exists, the evaporation loss is deemed to be smaller than the average one for Deccan. Therefore, the evaporation loss of 5.56 mm/day was adopted in the preliminary study stage (for the initial site selection).

Further study was conducted after obtaining the evaporation data at the Khapri, Pastewadi and Tillariwadi meteorological stations. These stations are located within 15 km from the selected sites - Jalond, Marleshwar and Hevale - as described in Section 11.2. The observed data, which are summarized in Tables 11.6-1 through 11.6-3, are the losses from the evaporation pans, but not from ponds. It is well known that the evaporation loss from ponds is much less than from evaporation

pans. Therefore, it was assumed that the evaporation loss to be used for the optimization study is 75% of the loss observed at each station. The results are shown in the tables.

Regarding the infiltration loss, no information is available. It was assumed for the study that the infiltration loss from ponds is 50% of the evaporation loss.

	Jalond			Marleshwar			Hevale		
	Evapo. (mm/d)	Infilt. (mm/d)	Total (mm/d)	Evapo. (mm/d)	Infilt. (mm/d)	Total (mm/d)	Evapo. (mm/d)	Infilt. (mm/d)	Total (mm/d)
Jan.	4.4	2.2	6.6	2.8	1.4	4.2	3.5	1.8	5.3
Feb.	4.7	2.4	7.1	4.0	2.0	6.0	4.0	2.0	6.0
Mar.	5.9	3.0	8.9	5.1	2.6	7.7	4.4	2.2	6.6
Apr.	6.8	3.4	10.2	5.9	3.0	8.9	5.0	2.5	7.5
May	7.4	3.7	11.1	6.0	3.0	9.0	4.9	2.5	7.4
Jun.	4.3	2.2	6.5	2.9	1.5	4.4	3.2	1.6	4.8
Jul.	1.9	1.0	2.9	1.3	0.7	2.0	2.1	1.1	3.2
Aug.	1.4	0.7	2.1	1.3	0.7	2.0	2.3	1.2	3.5
Sep.	1.9	1.0	2.9	1.8	0.9	2.7	2.8	1.4	4.2
Oct.	2.5	1.3	3.8	2.3	1.2	3.5	2.7	1.4	4.1
Nov.	3.4	1.7	5.1	2.7	1.4	4.1	3.4	1.7	5.1
Dec.	3.8	1.9	5.7	2.7	1.4	4.1	3.4	1.7	5.1
Total (mm)	1,470	744	2,214	1,178	601	1,779	1,266	641	1,907

11.7 Sedimentation

A sedimentation rate of 668 m^3/km^2/year is used in the preliminary study reports on the proposed pumped storage hydroelectric power development prepared by GOMID, while a rate of 480 m^3/km^2/year was adopted for other projects in the Raigad and Ratnagiri Districts. In order to determine a sediment yield to be used for this master plan study, sedimentation data of the existing 76 reservoirs in Maharashtra State was examined as discussed below.

First, the correlation of the data regarding catchment areas, annual rainfall and sediment yield rates was tested, however, no significant correlation was found between them.

Secondly, the correlation between the catchment areas and sediment yield rates was re-examined since it has been found by some investigators that the sediment yield varies in proportion to the catchment

area raised by a power. By the regression analysis of the samples excluding outlying data, the following equation was obtained (refer to Fig. 11.7-1):

$$Qs = 686.49 \times A^{-0.0181}$$

where,

Qs : Sediment yield rate ($m^3/km^2/year$)

A : Catchment area (km^2)

Thus, the sediment yield rates at the proposed sites can be obtained as shown in the table below.

Site	Lower dam site		Upper dam site	
	Catchment area (km^2)	Sediment yield rate ($m^3/km^2/year$)	Catchment area (km^2)	Sediment yield rate ($m^3/km^2/year$)
Jalond	3.43	645.0	20.68	593.4
Marleshwar	23.20	590.1	8.15	620.6
Hevale	22.46	591.1	-	-

Table 11.2-1 Districtwise Number of Raingauge Stations

AR : Automatic Raingauge
OR : Ordinary Raingauge

Name of District	Irrigation Dept.			Railway Dept.			TATA H.E.			I.M.D.			Revenue Dept.			Grand Total
	OR	AR	Total	OR	AR	Total	OR	AR	Total	OR	AR	Total	OR	AR	Total	
Gr. Bombay	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	2
Thane	85	58	143	-	-	-	-	-	-	-	1	1	12	-	12	156
Raigad	26	35	61	1	-	1	3	-	3	-	1	1	13	-	13	79
Ratnagiri	33	29	60	-	-	-	-	-	-	-	1	1	9	-	9	72
Sindhudurg	14	36	50	-	-	-	-	-	-	3	-	3	6	-	6	59
Satara	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Kolhapur	2	7	9	-	-	-	-	-	-	-	-	-	-	-	-	9
Belgaum	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
Nasik	20	1	21	-	-	-	-	-	-	-	-	-	3	-	3	24
Pune	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	183	169	352	1	-	1	3	-	3	3	5	8	43	-	43	407

Source : Daily Rainfall Data of West Flowing River Basins, 1992
published by Irrigation Project Investigation Division in Thane

Table 11.2-2 Basinwise Number of Raingauge Stations

AR : Automatic Raingauge OR : Ordinary Raingauge

Name of Basin	Irrigation Dept.			Railway Dept.			TATA H.E.			I.M.D.			Revenue Dept.			Grand Total
	OR	AR	Total	OR	AR	Total	OR	AR	Total	OR	AR	Total	OR	AR	Total	
Damanganga	19	4	23	-	-	-	-	-	-	-	-	-	2	-	2	25
Vaitarna	36	29	65	-	-	-	-	-	-	-	1	1	6	-	6	72
Ulhas	54	39	93	-	-	-	-	-	-	-	2	2	8	-	8	103
Patalganga	11	10	21	1	-	1	2	-	2	-	-	-	4	-	4	28
Amba	3	2	5	-	-	-	-	-	-	-	1	1	1	-	1	7
Kundalika	1	3	4	-	-	-	1	-	1	-	-	-	1	-	1	6
Mhasala, Savitri	4	9	13	-	-	-	-	-	-	-	-	-	6	-	6	19
Bharja	-	1	1	-	-	-	-	-	-	-	-	-	1	-	1	2
Vashisthi	15	7	22	-	-	-	-	-	-	1	-	1	4	-	4	27
Shastri	9	11	20	-	-	-	-	-	-	-	-	-	2	-	2	22
Kajavi	2	2	4	-	-	-	-	-	-	-	1	1	-	-	-	5
Muchkundi	5	3	8	-	-	-	-	-	-	-	-	-	1	-	1	9
Kodovali	3	3	6	-	-	-	-	-	-	-	-	-	1	-	1	7
Vaghotan	3	4	7	-	-	-	-	-	-	-	-	-	-	-	-	7
Kharada, Achara	2	2	4	-	-	-	-	-	-	1	-	1	1	-	1	6
Gad	6	5	11	-	-	-	-	-	-	-	-	-	2	-	2	13
Karli	5	13	18	-	-	-	-	-	-	-	-	-	2	-	2	20
Terekhol	1	2	3	-	-	-	-	-	-	1	-	1	1	-	1	5
Tillari	4	18	22	-	-	-	-	-	-	-	-	-	-	-	-	22
Krishna	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	183	169	352	1	-	1	3	-	3	3	5	8	43	-	43	407

Source : Daily Rainfall Data of West Flowing River Basins, 1992
published by Irrigation Project Investigation Division in Thane

Table 11.2-3 Districtwise Number of Rivergauge Stations

(as of May, 1993)

Name of District	Type A	Type B	Type C	Total
Thane	2	5	9	16
Raigad	3	4	6	13
Ratnagiri	-	3	7	10
Sindhudurg	2	4	6	12
Total	7	16	28	51

Source : Daily Discharge Data of West Flowing River Basins
published by Irrigation Project Investigation Division in Thane

Table 11.2-4 Basinwise Number of Rivergauge Stations

(as of May, 1993)

Name of Basin	Type A	Type B	Type C	Total
Damanganga	-	-	4	4
Vaitarna	2	3	1	6
Ulhas	-	2	6	8
Patalganga	1	2	1	4
Amba	1	1	-	2
Savitri	1	1	3	5
Bharja	-	-	1	1
Vashisthi	-	-	2	2
Shastri	-	-	1	1
Kajavi	-	1	-	1
Muchkundi	-	1	-	1
Kodovali	-	1	1	2
Vaghotan	-	1	2	3
Kharada, Achara	-	-	1	1
Gad	-	2	1	3
Karli	1	1	-	2
Terekhol	-	-	2	2
Tillari	1	-	1	2
Mandvi Valley	-	-	1	1
Total	7	16	28	51

Source : Daily Discharge Data of West Flowing River Basins
published by Irrigation Project Investigation Division in Thane

Table 11.2-5 Meteorological Data at Khapri (1)

Year : 1989 EL.+82.8 m N 19° 20' 00" E 73° 35' 00"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	0	346	918	871	374	16	0	0
Rainy day (day)						20	30	29	19	3		
Temperature (℃)												
Max.	35	37	39	44	42	38	32	31	32	35	42	37
Min.	14	15	16	18	21	22	22	24	24	23	19	15
Humidity (%)												
Max.	91	79	82	76	85	96	96	95	92	95	95	90
Min.	18	19	17	16	22	50	62	90	50	40	22	40
Wind velocity (km/hr)												
Day	4.5	4.4	2.6	2.8	4.0	4.6	4.4	4.1	2.3	2.7	6.3	-
Night	3.2	4.4	1.6	2.2	2.6	1.3	2.2	1.7	1.7	2.2	8.0	-

Year : 1990

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	72	413	842	1086	327	282	0	0
Rainy day (day)					6	22	30	31	21	9		
Temperature (℃)												
Max.	36	36	40	42	42	36	29	28	27	35	33	33
Min.	18	20	19	21	23	22	20	23	23	17	16	15
Humidity (%)												
Max.	90	85	84	78	90	92	95	98	95	90	86	85
Min.	35	40	40	39	45	44	70	80	80	40	45	50
Wind velocity (km/hr)												
Day	-	6.5	5.2	6.6	3.9	4.6	9.9	4.0	3.0	3.2	2.2	1.0
Night	-	3.5	4.7	4.4	1.6	2.3	4.7	2.6	2.3	2.4	1.3	0.4

Year : 1991

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	0	696	1,012	631	102	0	0	0
Rainy day (day)						14	29	31	14			
Temperature (℃)												
Max.	34	36	41	42	42	41	30	28	32	35	36	35
Min.	9	10	11	20	24	25	18	17	17	9	20	14
Humidity (%)												
Max.	90	85	85	90	85	95	98	99	99	95	90	91
Min.	40	40	40	40	40	44	68	75	65	50	45	26
Wind velocity (km/hr)												
Day	0.7	0.7	3.7	5.9	7.1	7.4	7.8	5.8	3.2	3.0	4.0	3.8
Night	0.4	0.3	2.4	4.7	5.1	4.5	4.4	3.0	1.5	3.4	3.6	4.0

Table 11.2-6 Meteorological Data at Khapri (2)

Year : 1992 EL+82.8 m N 19° 20' 00" E 73° 35' 00"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	0	282	390	728	323	86	0	0
Rainy day (day)						10	25	27	12	7		
Temperature (℃)												
Max.	36	36	37	41	42	41	33	31	33	36	37	37
Min.	14	14	17	23	33	22	21	20	20	15	12	9
Humidity (%)												
Max.	85	88	82	85	85	92	95	98	99	95	80	82
Min.	40	46	26	44	45	52	65	75	70	58	47	45
Wind velocity (km/hr)												
Day	4.5	5.0	4.7	5.1	7.1	7.6	7.7	3.9	3.1	1.9	3.6	4.6
Night	3.7	4.0	4.3	4.2	5.6	5.5	4.7	3.2	2.9	1.6	2.7	2.6

Year : 1993

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	0	348	1,182	541	533	200	0	0
Rainy day (day)						16	28	29	23	14		
Temperature (℃)												
Max.	38	39	41	44	44	44	35	33	37	32	30	28
Min.	8	8	12	15	20	20	20	20	19	20	15	17
Humidity (%)												
Max.	-	-	-	-	-	92	92	92	92	92	92	90
Min.	-	-	-	-	-	48	71	77	77	39	28	13
Wind velocity (km/hr)												
Day	4.2	5.4	6.3	6.1	7.8	8.8	5.1	5.8	4.3	3.1	3.6	4.6
Night	2.6	3.7	3.9	3.9	4.7	4.6	2.4	2.2	1.3	1.1	1.7	2.1

Year : 1994

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	0	577	1,352	827				
Rainy day (day)						22	31	29				
Temperature (℃)												
Max.	29	29	28	32	32	32	29	29				
Min.	14	16	18	13	23	20	20	21				
Humidity (%)												
Max.	91	89	92	85	88	92	92	92				
Min.	15	15	13	10	21	37	77	77				
Wind velocity (km/hr)												
Day	4.3	4.9	5.1	4.6	6.9	7.5	8.2	6.9				
Night	2.1	2.7	2.3	2.9	3.3	4.2	3.7	2.3				

Table 11.2-7 Meteorological Data at Pastewadi (1)

Year : 1990 EL+81.3 m N 16° 58' 13" E 73° 42' 49"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	0	134	796	1,519	1,656	411	173	57	0
Rainy day (day)					12	28	31	31	25	11	4	
Temperature (℃)												
Max.							30	29	30	32	32	31
Min.							24	23	25	25	22	21
Humidity (%)												
Max.							92	92	92	92	92	85
Min.							77	84	77	61	64	67
Average wind velocity (km/hr)							7.8	6.2	1.9	2.0	1.5	2.6

Year : 1991

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	10	34	887	2,047	1,073	237	70	5	0
Rainy day (day)				2	4	22	31	31	14	5	1	
Temperature (℃)												
Max.	32	32	36	36	37	37	30	28	31	33	32	30
Min.	17	20	24	28	29	25	25	24	25	25	23	20
Humidity (%)												
Max.	85	84	85	86	86	92	92	92	93	93	84	83
Min.	58	52	48	51	57	59	76	81	80	66	59	46
Average wind velocity (km/hr)	2.3	3.3	3.8	4.8	5.7	5.1	6.5	5.3	2.1	2.1	2.6	3.0

Year : 1992

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	14	11	581	1,390	1,187	486	186	0	0
Rainy day (day)				2	2	18	26	30	18	9		
Temperature (℃)												
Max.	32	32	36	35	36	36	32	30	32	31	34	35
Min.	20	21	23	27	29	26	26	24	23	18	18	15
Humidity (%)												
Max.	82	83	85	85	86	92	92	92	96	92	93	93
Min.	48	48	48	55	56	68	71	77	73	72	66	41
Average wind velocity (km/hr)	3.0	4.0	4.3	4.8	6.3	6.1	6.0	5.0	3.1	2.5	3.3	4.3

Table 11.2-8 Meteorological Data at Pastewadi (2)

Year : 1993 EL.+81.3 m N 16° 58' 13" E 73° 42' 49"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)												
Rainy day (day)												
Temperature (℃)												
Max.	37	38	42	42	42	40	32	30	30	34	35	34
Min.	15	17	18	24	28	24	24	25	24	24	24	18
Humidity (%)												
Max.	82	91	84	85	85	92	92	92	96	92	92	85
Min.	49	32	32	38	32	40	66	64	57	70	53	48
Average wind velocity (km/hr)	3.7	4.5	4.7	5.1	6.5	6.1	5.6	5.2	2.5	2.4	4.0	5.1

Year : 1994

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)												
Rainy day (day)												
Temperature (℃)												
Max.	37	39	40	40	40	39	29	31	32	36	35	35
Min.	17	16	17	24	28	24	21	24	24	24	18	16
Humidity (%)												
Max.	85	81	85	87	86	96	95	92	92	92	86	90
Min.	52	52	43	50	57	62	84	72	65	65	53	36
Average wind velocity (km/hr)	3.7	4.6	4.8	5.5	7.0	6.2	0.7	6.3	4.1	2.9	3.7	3.8

Table 11.2-9 Meteorological Data at Tillariwadi (1)

Year : 1992 EL+36.5 m N 15° 45' 30" E 74° 03' 20"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	0	0	0	6	34	1,163	1,255	1,231	300	128	17	0
Rainy day (day)				2	4	21	26	31	18	11	6	
Temperature (℃)												
Max.				40	41	37	36	29	34	35	37	35
Min.				20	25	22	23	24	22	23	21	12
Humidity (%)												
Max.				92	92	96	96	96	96	92	92	91
Min.				16	34	42	55	72	52	49	46	37
Average wind velocity (km/hr)				3.8	4.1	2.5	3.8	4.4	3.4	2.3	2.4	2.9

Year : 1993

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)												
Rainy day (day)												
Temperature (℃)												
Max.	35	36	38	38	39	37	30	30	31	33	35	35
Min.	15	15	17	20	27	25	24	24	24	25	26	21
Humidity (%)												
Max.	91	91	91	92	92	92	92	92	92	92	88	88
Min.	35	36	36	38	40	41	72	77	66	61	54	41
Average wind velocity (km/hr)	2.3	2.7	3.4	3.4	3.7	4.2	4.5	4.3	3.2	2.6	2.0	1.4

Year : 1994

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)												
Rainy day (day)												
Temperature (℃)												
Max.	36	36	38	37	38	35	28	29	34	35	35	35
Min.	17	17	19	23	26	25	23	25	24	24	25	18
Humidity (%)												
Max.	87	86	87	91	88	92	92	92	92	92	92	91
Min.	36	34	33	36	39	48	88	77	51	48	45	51
Average wind velocity (km/hr)	1.4	1.5	2.7	3.0	2.4	3.6	5.1	4.1	3.2	2.5	3.2	1.4

Table 11.2-10 Meteorological Data at Tillariwadi (2)

Year : 1995 EL.+36.5 m N 15° 45' 30" E 74° 03' 20"

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)												
Rainy day (day)												
Temperature (℃)												
Max.	36	37	38	40	40	37	31	34	33	37	37	36
Min.	17	19	18	24	25	25	24	24	24	25	22	16
Humidity (%)												
Max.	91	91	90	85	88	92	92	92	92	92	91	91
Min.	42	37	32	33	36	43	69	61	58	43	36	48
Average wind velocity (km/hr)	1.5	1.4	1.4	1.9	3.8	2.8	3.7	3.5	3.5	2.6	2.4	2.6

Table 11.3-1 Annual Rainfall for Initial Site Selection

Unit : mm (1/3)

Site No. / RGS / Year	1, 3, 22				10, 11, 24, 25		14, 17, 21, 29, 30		20, 32		18, 28	6, 7		2			
	HWE Office	Khopoli	Karjat	Khalapur	Poladpur	Chatav	Pastewadi	Deorukh	Kodali	Sargave	Shirange	Phangloshi	Waliware	Nandgaon	Otman	Dudhanoli	Tulai
1978	-	-	2922.0	3706.0	4032.0	-	4630.8	4525.0	-	-	-	2445.7	-	-	2416.6	-	-
1979	4001.6	3000.0	2727.0	3031.0	3562.0	-	3734.2	3642.0	-	-	-	2150.8	-	-	3129.4	-	2245.3
1980	4766.0	3977.0	3343.0	3274.0	3330.0	-	3984.4	3544.0	6314.5	-	-	2710.2	3352.7	-	3017.2	-	3490.7
1981	4520.0	3845.2	3215.0	3285.0	3758.0	-	4433.0	4074.0	6087.5	2832.8	3828.5	2856.4	3025.7	3259.4	2935.2	2755.1	3088.6
1982	3524.3	2917.0	2827.0	2962.0	3066.0	4178.6	4031.4	3529.0	5867.5	3696.8	4635.2	2357.1	1648.3	2485.7	2505.0	2083.3	1880.1
1983	4616.0	4400.1	3901.0	4276.0	4064.0	5061.6	5435.7	4992.5	6874.5	4784.6	5287.8	3538.0	3075.0	3059.6	3013.0	3093.4	3491.2
1984	4663.0	3705.0	4707.0	3410.0	3749.0	4489.6	3534.0	3534.0	5794.5	4082.7	4047.5	3101.4	2644.6	2739.4	2767.2	2216.2	2506.6
1985	3756.0	3139.0	3067.0	2756.0	3556.0	4444.4	4231.6	3798.0	5134.8	3542.4	3531.7	2750.8	2267.2	2183.7	2297.4	2142.2	2090.6
1986	3900.0	3274.0	2664.0	2659.0	2935.0	3862.0	3107.8	2919.0	4312.5	3124.9	2958.0	2457.6	2371.9	2313.6	1951.2	2298.6	2135.0
1987	2856.0	2398.0	2244.0	2129.0	3158.0	4217.0	3420.4	3458.0	4223.0	2671.4	-	1379.2	1602.2	1884.6	1942.2	1890.0	1584.8
1988	3569.0	3716.0	3678.0	3666.0	3866.0	5987.0	4832.8	4528.0	6953.0	5142.1	4542.8	2757.6	2435.9	3351.8	3240.6	2976.2	2935.0
1989	4306.0	4134.0	2960.0	3348.0	3270.0	4133.8	3962.2	3644.0	5570.4	2535.1	1661.1	2282.8	2695.0	2225.8	2409.4	2309.6	2566.0
1990	6107.0	5357.0	4660.0	4251.0	4741.0	6113.0	4745.5	4895.0	6586.0	3846.2	4767.8	3297.2	3225.0	3624.2	3743.0	3075.6	3059.4
1991	4654.0	3738.0	3793.0	4689.0	4088.0	4710.3	4362.5	4135.5	6127.0	4215.6	3689.2	3416.6	3267.8	2983.9	3200.0	2423.2	2740.5
1992	3838.0	3175.0	3157.0	4197.0	3111.0	3986.9	3855.6	3780.0	5263.0	4390.4	4331.3	2530.8	1601.6	2702.1	2727.0	1799.6	2245.6
Average	4219.8	3626.8	3324.3	3442.6	3579.1	4653.1	4153.3	3933.2	5277.6	3738.6	3934.6	2668.8	2554.7	2734.5	2753.0	2421.8	2575.7
Second Lowest	3524.3	2917.0	2664.0	2659.0	3066.0	3986.9	3420.4	3458.0	4312.5	2671.4	2958.0	2150.8	1602.2	2185.7	1951.2	1890.0	1880.1
Average of Second Lowest	2941				3526		3439		2671		2958	1877		1976			

Unit : mm (2/3)

Site No. / RGS / Year	4						5		8, 9			12, 13		15			16
	Deogaon	Nirgudpada	Sakerpada	Jogalwadi	Khodale	Suryamal	Dand	Kasara	Dolkham	Kothale	Talawade	Chatav	Chiplun	Ghonsari	Phondaghat	Sangulwadi	Vaghoore
1978	-	-	-	2662.1	2397.0	2613.7	-	2066.8	-	-	-	-	4018.0	5063.9	5109.4	4540.8	7897.4
1979	-	-	-	2300.8	2219.1	2725.6	-	2258.0	-	-	-	-	3261.3	3437.0	2841.8	3519.4	3773.8
1980	-	-	-	2845.2	2843.6	3232.4	-	2157.6	-	-	-	-	3417.0	4120.1	4290.2	3850.9	7215.6
1981	3377.0	3882.2	3570.6	3586.0	3402.2	3877.0	2763.3	2709.2	2647.6	3247.9	3290.0	-	3475.0	5009.2	4839.4	4591.6	6734.8
1982	2200.3	2581.0	2288.2	2519.0	2206.2	2045.2	2141.5	1854.7	1882.0	2328.0	2438.7	4178.6	3371.0	3993.4	4123.4	3657.8	7038.4
1983	2921.2	3160.8	3139.8	3219.4	3045.4	3284.0	3314.3	3029.4	3217.8	3390.0	3874.3	5061.6	5130.0	5334.0	5457.4	5160.6	6203.4
1984	2992.8	3465.0	3107.0	2761.2	2789.8	3042.7	2352.1	2653.5	2248.3	2749.2	2870.5	4489.6	3184.0	3762.2	3695.6	3720.8	5865.0
1985	2369.2	2707.6	2768.8	2408.0	2165.6	2355.5	1903.8	1993.3	1770.9	2483.2	2417.8	4444.4	3798.0	4125.0	4509.7	3530.8	5722.9
1986	2123.8	2262.4	2305.2	2238.4	2152.0	2365.8	1954.8	1506.0	2239.1	2248.3	2397.0	3862.0	2901.0	2935.7	3186.6	2858.4	5407.2
1987	1853.2	1750.4	1510.8	1921.2	2054.2	2352.4	1880.0	1983.2	2093.5	1954.3	1905.2	4217.0	3062.0	3753.6	3677.0	3407.0	5778.5
1988	3125.8	3507.6	3039.0	3035.5	3032.2	3072.2	3470.4	2862.2	3982.0	3621.0	3870.1	5987.0	3526.2	4491.2	4738.6	4314.8	7718.0
1989	2119.4	2943.4	2443.6	2267.8	2689.4	2494.6	2363.6	2482.8	2680.0	1868.8	3171.8	4133.8	3251.0	3639.8	3905.2	3527.8	6326.0
1990	3347.0	4305.3	4000.0	3429.6	3334.1	3660.2	3520.2	2887.7	4060.0	2799.8	3827.4	6113.0	4160.0	4265.0	4367.4	3907.0	-
1991	2719.0	3147.8	3047.8	2387.0	2544.4	3362.6	2555.2	2022.9	3020.0	2486.2	2554.5	4710.3	3664.0	3107.8	4006.2	3531.4	-
1992	2126.0	3012.0	2521.2	2236.0	2367.0	2139.4	2121.2	2106.8	2489.0	2703.8	2147.8	3986.9	2817.0	2629.6	3383.0	3324.6	-
Average	2606.2	3060.5	2811.8	2654.5	2616.1	2841.6	2528.4	2304.9	2644.2	2656.7	2897.1	4653.1	3535.7	3977.8	4142.1	3829.6	6306.8
Second Lowest	2119.4	2262.4	2288.2	2236.0	2152.0	2139.4	1903.8	1854.7	1882.0	1954.3	2147.8	4133.8	2901.0	2935.7	3186.6	3324.6	5407.2
Average of Second Lowest	2200						1879		1995			2901		3149			5407

Table 11.3-1 Annual Rainfall for Initial Site Selection

Unit : mm (3/3)

Site No. / RGS / Year	19			23, 26			27	31
	Patye	Sargave	Tillariwadi	Vaghotre	Amboli	Tillariwadi	Kankumbhi	Sakurli
1978	-	-	5131.9	7897.4	8163.2	5131.9	7557.6	2881.3
1979	-	-	3612.6	3773.8	5642.6	3612.6	4583.4	2551.3
1980	-	-	5362.8	7215.6	7799.3	5362.8	7828.0	2931.3
1981	3106.7	2832.8	4530.8	6734.8	7829.8	4530.8	7504.4	2921.8
1982	4173.7	3696.8	4545.8	7038.4	7285.8	4545.8	7242.8	2306.6
1983	4895.6	4784.6	5191.5	6203.4	6560.8	5191.5	6503.8	3461.0
1984	4579.1	4082.7	4402.7	5865.0	6276.4	4402.7	6115.8	2588.4
1985	4350.7	3542.4	4274.8	5722.9	7189.0	4274.8	5515.3	2702.0
1986	2311.1	3124.9	3388.4	5407.2	5414.2	3388.4	4632.8	2635.2
1987	-	2671.4	2964.2	5778.5	4874.0	2964.2	4424.2	2219.8
1988	4638.7	5142.1	5227.4	7718.0	6862.6	5227.4	5969.6	3939.4
1989	2074.4	2535.1	2362.6	6326.0	6252.2	2362.6	5476.1	2596.4
1990	4466.6	3846.2	4594.6	-	7744.4	4594.6	-	4305.6
1991	3539.9	4213.6	3855.5	-	5568.0	3855.5	-	3315.0
1992	4084.4	4390.4	4134.9	-	8556.6	4134.9	-	2275.2
Average	3838.3	3738.6	4238.7	6306.8	6801.3	4238.7	6112.8	2875.4
Second Lowest	2311.1	2671.4	2964.2	5407.2	5414.2	2964.2	4583.4	2219.8
Average or Second Lowest		2491			2964		4583	2220

Source : Daily Rainfall Data of West Flowing River Basins, 1978 ~ 1992

Notes : 1) The average of annual rainfall data was examined by comparing with the Isohyets shown in Fig. 11.1-1 and, in case that it was considered that the data may cause an overestimation of second lowest annual rainfall, the data was neglected as shown.

2) Names of sites corresponding to the site numbers shown in the table shall be refered to Fig. 11.1-1.

Table 11.3-2 Annual Rainfall at Raingauge Stations near Jalond Site (Original Data)

(mm)

Year	Borli	Dand	Dolkham	Jawhar	Khodwapada	Kothale	Kundachiwadi	Lakhechiwadi	Moroshi	Phangloshi	Talawade	Waliware	Ave.
1971									2,180				2,180
1972									2,423				2,423
1973				3,469					3,713				3,591
1974				2,289					2,773				2,531
1975				3,579					4,276				3,928
1976				4,587					1,864	3,937			3,463
1977				2,263					2,779	4,151			3,064
1978				2,325					2,675	2,446			2,482
1979				2,847					2,285	2,151			2,428
1980				2,835			2,718		2,861	2,710		3,353	2,895
1981	2,800	2,763	2,648	3,912	2,819	3,248	3,048	2,977	3,088	2,856	3,290	3,026	3,040
1982	2,858	2,142	1,882	2,392	2,253	2,328	1,914	2,320	1,891	2,357	2,439	1,648	2,202
1983	3,525	3,314	3,218	2,920	3,500	3,390	3,705	3,730	2,999	3,538	3,874	3,073	3,399
1984	3,071	2,352	2,248	2,549	2,655	2,749	3,001	2,632	2,750	3,101	2,871	2,645	2,719
1985	2,366	1,904	1,171	2,242	2,191	2,483	2,625	2,262	2,368	2,751	2,418	2,267	2,254
1986	2,506	1,955	2,239	2,140	2,025	2,248	2,784	1,981		2,458	2,397	2,372	2,282
1987	1,887	1,880	2,094	1,781	1,774	1,954	1,585	1,493	1,501	1,379	1,905	1,602	1,736
1988	4,869	3,470	3,982	2,475	3,366	3,621	2,971	3,895	2,697	2,758	3,870	2,436	3,368
1989	3,162	2,364	2,680	1,958	2,078	1,869	3,069	2,949	2,407	2,283	3,172	2,695	2,557
1990	3,327	3,520	4,060	2,760	3,131	2,800	3,894	3,644	3,377	3,297	3,827	3,225	3,405
1991	4,717	2,555	3,020	2,348	2,629	2,486	3,628	3,177	2,911	3,417	2,555	3,268	3,059
1992	2,802	2,121	2,489	2,052	2,047	2,704	2,320	2,502	1,710	2,531	2,148	1,602	2,252
Average	3,158	2,528	2,644	2,686	2,539	2,657	2,866	2,797	2,644	2,831	2,897	2,555	2,729

Source : Rainfall data obtained from GOMID.

Table 11.3-3

Annual Rainfall at Raingauge Stations near Marleshwar Site (Original Data)

(mm)

Year	Kadwai	Kurdhunda	Pastewadi	Sangave	Average
1978		4,156	4,631		4,394
1979		3,217	3,734		3,476
1980		3,670	3,984		3,827
1981	4,174	3,973	4,433		4,193
1982	3,858	3,608	4,031	3,836	3,833
1983	5,746	5,129	5,434	5,319	5,407
1984	3,648	3,424	3,534	3,376	3,496
1985	4,249	3,795	4,232	3,927	4,051
1986	2,811	2,657	3,108	2,944	2,880
1987	2,622	3,272	3,420	3,621	3,234
1988	4,059	3,950	4,833	3,085	3,982
1989	4,095	3,550	3,962	2,399	3,502
1990	4,868		4,745	2,796	4,136
1991	4,302	3,714	4,363	2,932	3,828
1992	4,799	3,605	3,856	2,542	3,701
Average	4,103	3,694	4,153	3,343	3,847

Source : Rainfall data obtained from GOMID.

Table 11.3-4 Annual Rainfall at Raingauge Stations near Hevale Site (Original Data)

(mm)

Year	Amboli	Patye	Sargave	Shirange	Tillariwadi	Dhamne	Kodali	Dhekoli	Vaghotre	Average
1978	8,163				5,132	4,271		2,391	7,897	5,571
1979	5,643				3,613			3,447		4,234
1980	7,799				5,363	4,155	6,314	3,223	7,216	5,678
1981	7,830	3,107	2,833	3,829	4,531	3,976	6,088	2,682	6,735	4,623
1982	7,286	4,174	3,697	4,635	4,546	3,662	5,868	2,696	7,038	4,845
1983	6,561	4,896	4,785	5,288	5,192	4,015	6,875	3,041	6,203	5,206
1984	6,276	4,579	4,083	4,048	4,403	3,143	5,795	2,424	5,865	4,513
1985	7,189	4,351	3,542	3,532	4,275	3,088	5,135	2,178	5,723	4,335
1986	5,414	2,311	3,125	2,958	3,388	2,674	4,313	1,976	5,407	3,507
1987	4,874		2,671			2,208	4,223	1,728	5,779	3,581
1988	6,863	4,639	5,142	4,543	5,227	3,567	6,953	2,827	7,718	5,275
1989	6,252	2,074	2,535	1,661	2,363	3,228	5,570	12,800	6,326	4,757
1990	7,744	4,467	3,846	4,768	4,595	4,284	6,586			5,184
1991	5,568	3,540	4,214	3,689	3,856	4,276	6,127			4,467
1992	8,557	4,084	4,390	4,331	4,135	4,800	5,263			5,080
Average	6,801	3,838	3,739	3,935	4,330	3,668	5,778	3,451	6,537	4,715

Source : Rainfall data obtained from GOMID.

Table 11.3-5 Adjusted / Estimated Annual Rainfall at Raingauge Stations near Jalond Site

(mm)

Year	Borli	Dand		Dolkham	Jawhar		Khodwapada		Kothale		Kundachiwadi	Lakhechiwadi	Moroshi	Phangloshi		Talawade	Waliware	Ave.
		Adjusted	Coeff.		Adjusted	Coeff.	Adjusted	Coeff.	Adjusted	Coeff.				Adjusted	Coeff.			
1971													2,180					2,180
1972													2,423					2,423
1973					3,469								3,713					3,591
1974					2,289								2,773					2,531
1975					3,579								4,276					3,928
1976					4,587								1,864	3,937				3,463
1977					2,263								2,779	4,151				3,064
1978					2,325								2,675	2,446				2,482
1979					2,847								2,285	2,151				2,428
1980					2,835						2,718		2,861	2,710			3,353	2,895
1981	2,800	2,431	0.88	2,648	2,485	0.64	2,516	0.89	2,544	0.78	3,048	2,977	3,088	2,486	0.87	3,290	3,026	2,778
1982	2,858	1,885	0.88	1,882	2,077	0.64	2,011	0.89	1,823	0.78	1,914	2,320	1,891	2,051	0.87	2,439	1,648	2,067
1983	3,525	3,314	0.88	3,218	2,536	0.64	3,123	0.89	2,655	0.78	3,705	3,730	2,999	3,079	0.87	3,874	3,073	3,236
1984	3,071	2,352		2,248	2,213	0.64	2,369	0.89	2,153	0.78	3,001	2,632	2,750	2,699	0.87	2,871	2,645	2,584
1985	2,366	1,904		1,171	1,947	0.64	1,955	0.89	1,945	0.78	2,625	2,262	2,368	2,394	0.87	2,418	2,267	2,135
1986	2,506	1,955		2,239	2,140		1,807	0.89	1,761	0.78	2,784	1,981	**2,004**	2,139	0.87	2,397	2,372	2,174
1987	1,887	1,880		2,094	1,781		1,583	0.89	1,530	0.78	1,585	1,493	1,501	1,379		1,905	1,602	1,685
1988	4,869	3,470		3,982	2,475		3,004	0.89	2,836	0.78	2,971	3,895	2,697	2,758		3,870	2,436	3,272
1989	3,162	2,364		2,680	1,958		2,078		1,869		3,069	2,949	2,407	2,283		3,172	2,695	2,557
1990	3,327	3,520		4,060	2,760		3,131		2,800		3,894	3,644	3,377	3,297		3,827	3,225	3,405
1991	4,717	2,555		3,020	2,348		2,629		2,486		3,628	3,177	2,911	3,417		2,555	3,268	3,059
1992	2,802	2,121		2,489	2,052		2,047		2,704		2,320	2,502	1,710	2,531		2,148	1,602	2,252
Average	3,158	2,479		2,644	2,548		2,354		2,259		2,866	2,797	2,615	2,700		2,897	2,555	2,651

Notes : Estimated rainfalls are expressed by bold figures.
Adjusted rainfalls were obtained by multiplying the original data by coefficients indicated in the table.

Table 11.3-6

Adjusted / Estimated Annual Rainfall at Raingauge Stations near Marleshwar Site

(mm)

Year	Kadwai		Kurdhunda	Pastewadi	Sangave		Average
	Adjusted	Coeff.			Adjusted	Coeff.	
1978			4,156	4,631			4,394
1979			3,217	3,734			3,476
1980			3,670	3,984			3,827
1981	4,174		3,973	4,433			4,193
1982	4,280	1.11	3,608	4,031	2,738	0.71	3,664
1983	6,375	1.11	5,129	5,434	3,796	0.71	5,184
1984	4,047	1.11	3,424	3,534	2,410	0.71	3,354
1985	4,714	1.11	3,795	4,232	2,803	0.71	3,886
1986	3,119	1.11	2,657	3,108	2,101	0.71	2,746
1987	3,957	1.11	3,272	3,420	2,584	0.71	3,308
1988	4,059		3,950	4,833	3,085		3,982
1989	4,095		3,550	3,962	2,399		3,502
1990	4,868		**4,168**	4,745	2,796		4,144
1991	4,302		3,714	4,363	2,932		3,828
1992	4,799		3,605	3,856	2,542		3,701
Average	4,399		3,726	4,153	2,744		3,796

Notes : Estimated rainfall is expressed by bold figures.
Adjusted rainfalls were obtained by multiplying the original data by coefficients indicated in the table.

Table 11.3-7 Adjusted / Estimated Annual Rainfall at Raingauge Stations near Hevale Site

(mm)

Year	Amboli	Patye		Sargave	Shirange		Tillariwadi		Dhamne	Kodali	Dhekoli	Vaghotre	Average
1978	8,163						5,132		4,271		2,391	7,897	5,571
1979	5,643						3,613				3,447		4,234
1980	7,799						5,363		4,155	6,314	3,223	7,216	5,678
1981	7,830	2,676	0.86	2,833	3,296	0.86	3,652	0.81	3,976	6,088	2,682	6,735	4,419
1982	7,286	3,595	0.86	3,697	3,990	0.86	3,664	0.81	3,662	5,868	2,696	7,038	4,611
1983	6,561	4,216	0.86	4,785	4,552	0.86	4,185	0.81	4,015	6,875	3,041	6,203	4,937
1984	6,276	3,943	0.86	4,083	3,484	0.86	3,549	0.81	3,143	5,795	2,424	5,865	4,285
1985	7,189	3,747	0.86	3,542	3,040	0.86	3,446	0.81	3,088	5,135	2,178	5,723	4,121
1986	5,414	1,990	0.86	3,125	2,546	0.86	2,731	0.81	2,674	4,313	1,976	5,407	3,353
1987	4,874	**3,188**		2,671	**2,937**		**3,077**		2,208	4,223	1,728	5,779	3,409
1988	6,863	4,639		5,142	4,543		5,227		3,567	6,953	2,827	7,718	5,275
1989	6,252	2,074		2,535	1,661		2,363		3,228	5,570	12,800	6,326	4,757
1990	7,744	4,467		3,846	4,768		4,595		4,284	6,586			5,184
1991	5,568	3,540		4,214	3,689		3,856		4,276	6,127			4,467
1992	8,557	4,084		4,390	4,331		4,135		4,800	5,263			5,080
Average	6,801	3,513		3,739	3,570		3,906		3,668	5,778	3,451	6,537	4,571

Notes : Estimated rainfalls are expressed by bold figures.
Adjusted rainfalls were obtained by multiplying the original data by coefficients indicated in the table.

Table 11.3-8
Raingauge Stations near Jalond, Marleshwar and Hevale Sites

Site	Station	Latitude	Longitude	Altitude (m)	Ave. Annual Rainfall (mm)
Jalond	Borli	N 19° 38' 15"	E 73° 34' 15"	610.0	3,158
	Dand	N 19° 38' 30"	E 73° 31' 30"	305.0	2,479
	Dolkham	N 19° 30' 14"	E 73° 34' 30"	N.A.	2,644
	Jawhar	N 19° 14' 00"	E 73° 54' 30"	430.0	2,548
	Khodwapada	N 19° 29' 00"	E 73° 31' 15"	259.0	2,354
	Kothale	N 19° 37' 30"	E 73° 34' 30"	320.0	2,259
	Kundachiwadi	N 19° 25' 00"	E 73° 39' 00"	160.0	2,866
	Lakhechiwadi	N 19° 29' 15"	E 73° 33' 15"	387.0	2,797
	Moroshi	N 19° 21' 00"	E 73° 42' 00"	125.0	2,615
	Phangloshi	N 19° 23' 00"	E 73° 40' 00"	140.0	2,700
	Talawade	N 19° 34' 45"	E 73° 32' 00"	275.0	2,897
	Waliware	N 19° 22' 00"	E 73° 45' 00"	240.0	2,555
Marleshwar	Kadwai	N 17° 16' 30"	E 73° 34' 00"	125.0	4,399
	Kurdhunda	N 17° 09' 03"	E 73° 29' 47"	24.0	3,726
	Pastewadi	N 16° 58' 13"	E 73° 42' 41"	90.0	4,153
	Sangave	N 17° 04' 30"	E 73° 32' 30"	150.0	2,744
Hev	Amboli	N 16° 00' 00"	E 74° 00' 00"	750.0	6,801
	Patye	N 15° 45' 30"	E 74° 07' 00"	65.0	3,513
	Sargave	N 15° 46' 30"	E 74° 08' 30"	75.0	3,739
	Shirange	N 15° 43' 45"	E 74° 04' 30"	77.0	3,570
	(MET)	N 15° 45' 00"	E 74° 15' 00"	55.0	3,906
	Dhamne	N 15° 47' 30"	E 74° 18' 30"	753.0	3,668
	Kodali	N 15° 48' 30"	E 74° 11' 00"	725.0	5,778
	Dhekoli	N 15° 49' 45"	E 74° 21' 15"	850.0	3,451
	Vaghotre	N 15° 51' 00"	E 74° 07' 00"	950.0	6,537

Source : Data sheets obtained from GOMID.

Table 11.3-9
Monthly Areal Rainfall for the Upper and Lower Dam Site, Jalond

(mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1980	0	0	0	0	0	737	968	1,317	328	4	0	0	3,354
1981	0	0	0	0	0	382	1,471	787	294	91	0	0	3,025
1982	0	0	0	0	0	335	603	630	44	36	0	0	1,648
1983	0	0	0	0	0	444	915	1,118	529	67	0	0	3,073
1984	0	0	0	0	0	347	1,124	788	245	140	0	0	2,644
1985	0	0	0	0	0	281	1,106	735	121	24	0	0	2,267
1986	0	0	0	0	0	500	784	959	130	0	0	0	2,373
1987	0	0	0	0	0	172	511	784	104	31	0	0	1,602
1988	0	0	0	0	0	198	1,516	380	301	44	0	0	2,439
1989	0	0	0	0	0	417	934	1,061	283	0	0	0	2,695
1990	0	0	0	0	0	766	883	970	369	238	0	0	3,226
1991	0	0	0	0	0	721	1,305	1,113	129	0	0	0	3,268
1992	0	0	0	0	0	97	355	763	358	28	0	0	1,601
Mean	0	0	0	0	0	415	960	877	249	54	0	0	2,555

Source : Daily rainfall data of west flowing river basins, 1980 - 1992, obtained from GOMID

Table 11.3-10
Monthly Areal Rainfall for the Upper Dam Site, Marleshwar

(mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1982	0	0	0	0	39	777	1,652	1,357	334	134	133	0	4,425
1983	0	0	0	0	0	1,632	1,480	1,859	942	98	7	0	6,018
1984	0	0	0	0	0	1,019	1,667	718	313	171	7	0	3,895
1985	0	0	0	0	28	1,435	1,423	1,113	211	361	26	0	4,598
1986	0	0	0	0	9	1,158	864	1,188	114	28	44	0	3,404
1987	0	0	0	0	28	694	1,401	1,200	269	272	18	0	3,881
1988	0	0	0	0	7	973	2,299	1,117	715	57	0	0	5,169
1989	0	0	0	0	3	1,308	1,591	873	327	63	1	0	4,166
1990	0	0	0	0	147	910	1,506	1,697	409	202	69	0	4,941
1991	0	0	0	0	22	1,003	2,401	1,039	232	71	3	0	4,772
1992	0	0	0	0	7	664	1,497	1,292	518	203	0	0	4,181
Mean	0	0	0	0	26	1,052	1,616	1,223	399	151	28	0	4,495

Table 11.3-11
Monthly Areal Rainfall for the Lower Dam Site, Marleshwar

(mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1982	0	0	0	0	33	659	1,399	1,150	283	113	113	0	3,750
1983	0	0	0	0	0	1,246	1,130	1,419	719	75	5	0	4,594
1984	0	0	0	0	0	778	1,273	548	239	131	5	0	2,973
1985	0	0	0	0	22	1,096	1,086	850	161	276	20	0	3,510
1986	0	0	0	0	7	884	659	907	87	21	33	0	2,599
1987	0	0	0	0	22	530	1,069	916	205	208	13	0	2,962
1988	0	0	0	0	6	743	1,755	853	546	44	0	0	3,946
1989	0	0	0	0	2	999	1,215	667	250	48	1	0	3,180
1990	0	0	0	0	112	695	1,150	1,296	313	155	53	0	3,772
1991	0	0	0	0	17	766	1,833	794	177	54	3	0	3,643
1992	0	0	0	0	6	507	1,143	986	396	155	0	0	3,192
Mean	0	0	0	0	20	809	1,246	944	307	116	22	0	3,465

Source : Daily rainfall data of west flowing river basins, 1982 - 1992, obtained from GOMID

Table 11.3-12
Monthly Areal Rainfall for the Lower Dam Site, Hevale

(mm)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1980	0	0	0	0	0	1,839	2,273	1,902	269	32	0	0	6,315
1981	0	0	0	0	0	910	2,069	2,495	614	0	0	0	6,088
1982	0	0	0	0	104	741	2,244	2,382	225	152	20	0	5,868
1983	0	0	0	0	0	1,549	2,253	1,937	944	150	42	0	6,875
1984	0	0	0	4	7	1,416	2,299	1,499	399	146	23	0	5,793
1985	0	0	0	0	34	1,439	1,531	1,573	296	262	0	0	5,135
1986	0	0	0	0	10	1,497	1,291	1,204	144	27	141	0	4,314
1987	0	0	0	5	44	666	1,868	1,037	408	181	14	0	4,223
1988	0	0	0	0	0	1,107	3,320	1,522	945	59	0	0	6,953
1989	0	0	0	7	68	2,210	1,699	1,104	409	65	7	0	5,569
1990	0	0	0	0	130	1,489	2,300	1,830	663	146	28	0	6,586
1991	0	0	0	68	186	929	2,954	1,639	228	116	7	0	6,127
1992	0	0	0	0	0	1,266	1,764	1,652	378	156	47	0	5,263
Mean	0	0	0	6	45	1,312	2,143	1,675	456	115	25	0	5,778

Source : Daily rainfall data of west flowing river basins, 1980 - 1992, obtained from GOMID

Table 11.3-13 Annual Rainfall Data (for Examination of Rainfall Cycle)

Year	Khalapur	Mahad	Jawhar	Year	Khalapur	Mahad	Jawhar
1901	3,400	3,295	2,657	1947	1,210	4,276	3,452
1902	2,713	2,364	3,163	1948	3,073	3,087	2,977
1903	3,307	3,431	3,250	1949	3,484	3,747	3,211
1904	2,329	2,354	2,699	1950	2,634	3,218	3,694
1905	1,824	2,492	2,618	1951	2,520	3,206	2,673
1906	3,091	2,970	2,632	1952	2,414	2,377	3,171
1907	2,955	3,356	3,222	1953	3,262	3,249	3,376
1908	3,114	3,522	3,250	1954	4,336	4,343	3,850
1909	3,033	3,555	3,569	1955	3,926	4,033	3,094
1910	2,976	3,153	2,906	1956	4,432	4,178	4,780
1911	2,527	2,196	3,220	1957	3,483	3,331	2,830
1912	2,885	3,582	3,752	1958	4,261	4,433	4,576
1913	3,204	2,793	4,116	1959	4,118	4,814	4,666
1914	4,457	3,964	4,228	1960	3,782	5,100	2,959
1915	2,644	2,971	3,600	1961	4,348	5,092	2,753
1916	3,760	3,634	3,462	1962	3,645	4,177	3,030
1917	3,806	4,173	3,650	1963	4,119	3,839	3,224
1918	1,434	1,871	2,291	1964	5,992	2,944	3,694
1919	3,414	3,501	3,789	1965	3,000	2,375	3,033
1920	1,976	2,600	2,544	1966	2,706	2,265	2,952
1921	2,606	3,141	3,376	1967	2,317	3,050	4,550
1922	2,849	3,202	3,345	1968	2,326	3,477	3,729
1923	2,770	3,026	2,939	1969	3,177	6,282	4,574
1924	2,565	2,285	2,925	1970	4,049	4,229	3,830
1925	2,296	2,316	2,765	1971	2,690	3,055	3,596
1926	3,728	3,649	3,240	1972	1,740	2,536	2,274
1927	2,902	3,539	3,520	1973	3,954	3,488	3,469
1928	2,845	3,497	3,317	1974	3,069	3,013	2,289
1929	2,419	2,720	2,781	1975	3,834	4,109	3,579
1930	3,247	3,703	3,789	1976	3,594	4,144	4,742
1931	4,452	4,111	3,383	1977	3,568	3,466	2,765
1932	2,842	3,332	3,547	1978	3,706	3,251	2,071
1933	3,200	4,044	3,999	1979	3,031	3,032	2,847
1934	3,425	3,385	3,300	1980	3,274	3,300	2,835
1935	3,035	2,676	3,129	1981	3,285	3,739	2,912
1936	3,652	2,993	3,175	1982	2,962	2,753	2,518
1937	4,558	3,730	3,735	1983	4,276	3,983	3,016
1938	3,182	3,945	3,858	1984	3,410	2,915	2,550
1939	4,106	2,474	3,052	1985	2,756	3,093	2,147
1940	2,582	3,392	3,903	1986	2,659	2,578	1,889
1941	4,657	1,924	3,321	1987	2,129	2,645	1,802
1942	4,289	3,341	3,854	1988	3,666	3,523	2,475
1943	3,250	3,240	3,489	1989	3,348	3,209	1,957
1944	3,258	2,899	3,939	1990	4,251	4,158	2,738
1945	4,685	3,354	3,734	1991	4,689	3,491	2,353
1946	4,630	4,175	3,709	1992	4,197	3,159	2,033

Source : Data obtained from GOMID. The measurement was undertaked by the Revenue Department.

Table 11.4-1 Run-off Coefficient derived from Rainfall and Discharge Data

Location (Disch. Station) <Rain Station>	Catchment Area (km^2)	Annual Discharge ($10^6 m^3$)	Effective Rainfall (mm)	Observed Rainfall (mm)	Run-off Coefficient	Basin (District)
(Chowk) <Chowk>	57.02	146.82	2574.89	3352.10	0.77	Patalganga (Raigad)
(Kalamb) <Kalamb>	147.11	539.56	3667.73	2666.60	1.38 (note)	Ulhas (Raigad)
(Awalegaon) <Awalegaon>	59.62	165.40	2774.24	3195.00	0.87	Karli (Sindhudurg)
(Shirshingi) <Shirshingi>	35.48	132.02	3720.97	4412.20	0.84	Terekhol (Sindhudurg)
(Ghonsari) <Ghonsari>	38.49	81.17	2109.02	2629.60	0.80	Gad (Sindhudurg)
(Tillari K.K) <Tillariwadi>	419.74	1184.58	2822.18	4134.90	0.68	Tillari (Sindhudurg)
<Deokhindpada> (Deokhindpada)	22.00	72.44	3292.73	2291.20	1.44 (note)	Ulhas (Thane)
(Nampada) <Nampada>	196.88	283.24	1438.64	1753.40	0.82	Ulhas (Thane)
(Andhari) <Andhari>	332.50	671.97	2020.96	1822.30	1.11	Vaitarna (Thane)
(Khadkhad) <Khadkhad>	14.25	25.03	1756.49	2321.10	0.76	Damanganga (Thane)
(Shelawali) <Shelawali>	127.50	195.20	1530.98	1727.10	0.89	Ulhas (Thane)
(Karak) <Karak>	27.35	97.05	3548.45	3612.00	0.98	Kodovali (Ratnagiri)
(Latwan) <Latwan>	12.40	42.95	3463.71	2937.40	1.18	Bharja (Ratnagiri)
(Raipatan) <Raipatan>	14.27	50.01	3504.56	3391.20	1.03	Kodavali (Ratnagiri)
(Chatav) <Chatav>	118.90	469.02	3944.66	3986.90	0.99	Vashisti (Ratnagiri)
(Pastewadi) <Pastewadi>	47.40	111.05	2342.83	3855.60	0.61	Kajvi (Ratnagiri)
				Mean	0.88	

(note) : These figures are not used for obtaining a mean run-off coefficient.

Table 11.4-2

Run-off Curve Numbers for Hydrologic Soil-cover Complexes

Land use or cover	Treatment or practice	Hydrologic condition for infiltrating	Hydrologic soil group			
			A	B	C	(D)
• Fallow	SR		77	86	91	94
• Row crops	SR	Poor	72	81	88	91
	SR	Good	67	78	85	89
	C	Poor	70	79	84	88
	C	Good	65	75	82	86
	C&T	Poor	66	74	80	82
	C&T	Good	62	71	78	81
• Small grain	SR	Poor	65	76	84	88
	SR	Good	63	75	83	87
	C	Poor	63	74	82	85
	C	Good	61	73	81	84
	C&T	Poor	61	72	79	82
	C&T	Good	59	70	78	81
Close-seeded legumes [1] or rotation meadow.	SR	Poor	66	77	85	89
	SR	Good	58	72	81	85
	C	Poor	64	75	83	85
	C	Good	55	69	78	83
	C&T	Poor	63	73	80	83
	C&T	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	C	Poor	47	67	81	88
	C	Fair	25	59	75	83
	C	Good	6	35	70	79
Meadow (permanent).		do	30	58	71	78
• Woods (farm woodlots).		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads			59	74	82	86
Roads (dirt) [2] (hard surface). [2]			72	82	87	89
			74	84	90	92

[1] Close-drilled or broadcast.

[2] Including right-of-way.

[3] See sec. A-5.

SR = Straight row.
C = Contoured.
T = Terraced.
C&T = Contoured and terraced.

(U.S. Soil Conservation Service.)

Table 11.4-3 Annual Inflow for Initial Site Selection

(1/4)

Items		Unit	1. Ulhas	2. Sidgarh	3. Amba	4. Pinjal	5. Kengadi	6. Kalu	7. Jalond	8. Kolmanpada
Second Lowest Annual Rainfall (1)		mm	2,941	1,976	2,941	2,200	1,879	1,877	1,877	1,995
Annual Evaporation & Infiltration Loss (2)		mm	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Upper Dam	Catchment Area (3)	km^2	6.68	1.00	6.21	2.85	2.45	3.10	20.68	3.38
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	16,698,998	1,679,600	15,524,069	5,329,500	3,913,018	4,945,895	32,993,906	5,731,635
	Surface Area (5)	km^2	1.27	0.20	0.47	0.07	0.99	0.54	1.78	0.35
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	3,810,000	600,000	1,410,000	210,000	2,970,000	1,620,000	5,340,000	1,050,000
	Effective Annual Inflow [(4)-(6)]	m^3	12,888,998	1,079,600	14,114,069	5,119,500	943,018	3,325,895	27,653,906	4,681,635
Lower Dam	Catchment Area (3)	km^2	4.56	0.92	7.99	32.11	5.48	2.71	3.43	3.31
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	11,399,316	1,545,232	19,973,802	60,045,700	8,752,382	4,323,670	5,472,394	5,612,933
	Surface Area (5)	km^2	0.26	0.14	0.23	1.04	0.27	0.15	0.55	0.17
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	780,000	420,000	690,000	3,120,000	810,000	450,000	1,650,000	510,000
	Effective Annual Inflow [(4)-(6)]	m^3	10,619,316	1,125,232	19,283,802	56,925,700	7,942,382	3,873,670	3,822,394	5,102,933

Table 11.4-3 Annual Inflow for Initial Site Selection

(2/4)

Items		Unit	9. Chomai	10. Savitri	11. Madhaliwadi	12. Vaitarni	13. Morawadi	14. Gadgadi	15. Aruna	16. Kharari
Second Lowest Annual Rainfall (1)		mm	1,995	3,526	3,526	2,901	2,901	3,439	3,149	5,407
Annual Evaporation & Infiltration Loss (2)		mm	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Upper Dam	Catchment Area (3)	km^2	2.83	5.51	2.68	1.28	-	0.78	4.78	3.22
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	4,798,973	16,514,021	8,032,228	3,156,288	-	2,280,057	12,794,387	14,798,959
	Surface Area (5)	km^2	0.85	0.4	0.33	0.25	-	0.35	0.27	0.52
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	2,550,000	1,200,000	990,000	750,000	-	1,050,000	810,000	1,560,000
	Effective Annual Inflow [(4)-(6)]	m^3	2,248,973	15,314,021	7,042,228	2,406,288	-	1,230,057	11,984,387	13,238,959
Lower Dam	Catchment Area (3)	km^2	2.48	7.41	6.79	9.61	-	13.92	2.82	9.12
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	4,205,460	22,208,511	20,350,309	23,696,819	-	40,690,248	7,548,153	41,915,064
	Surface Area (5)	km^2	0.46	0.47	0.60	0.38	-	0.49	0.23	0.25
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	1,380,000	1,410,000	1,800,000	1,140,000	-	1,470,000	690,000	750,000
	Effective Annual Inflow [(4)-(6)]	m^3	2,825,460	20,798,511	18,550,309	22,556,819	-	39,220,248	6,858,153	41,165,064

Table 11.4-3 Annual Inflow for Initial Site Selection

(3/4)

Items		Unit	17. Kundi	18. Jalware	19. Tillariwadi	20. Tillari F.	21. Marleshwar	22. Valvand	23. Shemi	24. Kudanbudrak
Second Lowest Annual Rainfall (1)		mm	3,439	2,958	2,491	2,671	3,439	2,941	2,964	3,526
Annual Evaporation & Infiltration Loss (2)		mm	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Upper Dam	Catchment Area (3)	km^2	1.67	2.47	-	3.22	8.15	2.68	47.00	4.20
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	4,881,661	6,210,321	-	7,311,622	23,823,673	6,699,598	118,411,800	12,587,820
	Surface Area (5)	km^2	0.63	0.34	-	0.52	1.57	0.78	0.59	0.33
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	1,890,000	1,020,000	-	1,560,000	4,710,000	2,340,000	1,770,000	990,000
	Effective Annual Inflow [(4)-(6)]	m^3	2,991,661	5,190,321	-	5,751,622	19,113,673	4,359,598	116,641,800	11,597,820
Lower Dam	Catchment Area (3)	km^2	9.9	9.41	-	22.46	23.20	6.40	10.57	12.60
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	28,939,185	23,659,563	-	50,999,697	67,817,080	15,999,040	26,630,058	37,763,460
	Surface Area (5)	km^2	0.69	0.28	-	0.45	0.75	0.84	0.22	0.34
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	2,070,000	840,000	-	1,350,000	2,250,000	2,520,000	660,000	1,020,000
	Effective Annual Inflow [(4)-(6)]	m^3	26,869,185	22,819,563	-	49,649,697	65,567,080	13,479,040	25,970,058	36,743,460

Table 11.4-3 Annual Inflow for Initial Site Selection

(4/4)

Items		Unit	25. Kaudoshi	26. Kumbhavde	27. Mundirichi	28. Virdi	29. Bamnoli	30. Kinjale	31. Khakharwadi	32. Hevale
Second Lowest Annual Rainfall (1)		mm	3,526	2,964	4,583	2,958	3,439	3,439	2,220	2,671
Annual Evaporation & Infiltration Loss (2)		mm	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Upper Dam	Catchment Area (3)	km^2	4.88	4.32	-	-	-	-	-	-
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	14,625,848	10,883,808	-	-	-	-	-	-
	Surface Area (5)	km^2	0.30	0.98	0.21	0.17	0.56	0.23	0.24	0.32
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	900,000	2,940,000	630,000	510,000	1,680,000	690,000	720,000	960,000
	Effective Annual Inflow [(4)-(6)]	m^3	13,725,848	7,943,808	-	-	-	-	-	-
Lower Dam	Catchment Area (3)	km^2	14.76	15.53	9.83	7.46	18.31	4.81	5.95	22.46
	Annual Inflow (4) [0.85x(1)x(3)]	m^3	44,237,196	39,126,282	38,293,257	18,756,678	53,522,877	14,060,352	11,227,650	50,992,061
	Surface Area (5)	km^2	0.47	0.86	0.85	0.54	0.55	0.28	0.35	0.50
	Evapo. & Infilt. (6) [(2)x(5)]	m^3	1,410,000	2,580,000	2,550,000	1,620,000	1,650,000	840,000	1,050,000	1,500,000
	Effective Annual Inflow [(4)-(6)]	m^3	42,827,196	36,546,282	35,743,257	17,136,678	51,872,877	13,220,352	10,177,650	49,492,061

Table 11.4-4 Data Sheet for Low Flow Analysis at Sajgaon

Catchment Area (km^2)
47.78
Atmospheric Temperature (°C)
26
Antecedent Rainfall (mm)
0
Number of Tank
4

Initial Storage of Tank (mm)	T1	T2	T3	T4	TR
	0	0	0	0	0

Initial Snow Depth (mm)	Snow1	Snow2	Snow3	Snow4
	0	0	0	0

Portion of Area	ca1	ca2	ca3	ca4
	1	0	0	0

Difference of Altitude	fa1	fa2	fa3	fa4
	0	0	0	0

Rain Monthly Coeff.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	0	0	0	0	0	0	0	0	0	0	0	0

Monthly Evapo. (mm/M)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	150	150	150	150	150	150	75	75	75	75	150	150

Coeff. of Tankholes	Cu	Cm	Cd	Cb
	0	0.2	0.4	0.35
	0	0.2	0.3	0.2
	0	0	0.1	0
	0	0	0	0

Hight of Tankholes (mm)	Hu	Hm	Hd
	0	100	50
	0	50	20
	0	0	10
	0	0	0

Rainfall Data (mm)

SY	SM	SD	EY	EM	ED
1984	1	1	1992	12	31

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1988	0	0	0	0	0	246	1,562	736	974	34	0	0	3,552
1989	0	0	0	0	0	586	1,375	980	331	3	0	0	3,275
1990	0	0	0	0	48	513	1,238	2,138	285	167	0	0	4,389
1991	0	0	0	0	0	486	1,868	847	93	18	0	0	3,312
1992	0	0	0	0	0	190	684	1,474	370	133	0	0	2,851

River Flow Data (m^3/s)

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1988	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1989	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1990	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1991	-1	-1	-1	-1	-1	0	22.26	11.42	3.84	1.69	0	0	3.32
1992	0	0	0	0	0	0.87	2.77	10.87	1.91	0.39	0	0	1.42

Table 11.4-5 Data Sheet for Low Flow Analysis at Pastewadi

Catchment Area (km^2)

47.4

Atmospheric Temperature (℃)

26

Antecedent Rainfall (mm)

0

Number of Tank

4

Initial Storage of Tank (mm)	T1	T2	T3	T4	TR
	0	0	0	0	0

Initial Snow Depth (mm)	Snow1	Snow2	Snow3	Snow4
	0	0	0	0

Portion of Area	ca1	ca2	ca3	ca4
	1	0	0	0

Difference of Altitude	fa1	fa2	fa3	fa4
	0	0	0	0

Rain Monthly Coeff.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	0	0	0	0	0	0	0	0	0	0	0	0

Monthly Evapo. (mm/M)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	150	150	150	150	150	150	75	75	75	75	150	150

Coeff. of Tankholes	Cu	Cm	Cd	Cb
	0	0.3	0.55	0.015
	0	0.2	0.2	0.005
	0	0	0.1	0
	0	0	0	0

Hight of Tankholes (mm)	Hu	Hm	Hd
	0	100	50
	0	50	20
	0	0	10
	0	0	0

Rainfall Data (mm)

SY	SM	SD	EY	EM	ED
1984	1	1	1992	12	31

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1984	0	0	0	14	0	817	1,561	666	320	193	3	0	3,575
1985	0	0	0	0	27	1,289	1,320	1,039	219	319	18	0	4,232
1986	0	0	0	0	10	1,069	770	1,127	96	11	25	0	3,108
1987	0	0	0	0	0	22	626	1,189	1,020	306	213	2	38	3,416
1988	0	0	0	0	12	13	765	2,188	1,416	706	34	0	0	4,833
1989	0	0	0	0	2	4	1,200	1,584	814	311	46	2	0	3,963
1990	0	0	0	0	0	134	796	1,519	1,656	411	173	57	0	4,746
1991	0	0	0	0	10	34	887	2,047	1,073	237	70	5	0	4,363
1992	0	0	0	0	14	11	581	1,390	1,187	486	186	0	0	3,856

River Flow Data (m^3/s)

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1984	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1985	-1	-1	-1	-1	-1	6.06	10.24	8.05	1.43	2.11	0.42	0.11	1.98
1986	0	0	0	0	0	4.43	11.97	16.92	1.02	0.35	0.14	0.03	2.53
1987	0	0	0	0	0	1.40	16.08	13.88	4.09	1.25	0.19	0.06	2.71
1988	0	0	0	0	0	7.95	59.84	37.70	26.26	5.16	0.30	0.07	11.15
1989	0	0	0	0	0	15.24	46.39	27.84	8.43	3.55	0.15	0.03	8.15
1990	0	0	0	0	0	6.66	30.37	33.21	6.91	1.31	0.23	0.05	6.24
1991	0	0	0	0	0	0.92	38.15	17.35	1.77	0.26	0.14	0.05	4.56
1992	0	0	0	0	0	1.37	16.31	17.17	5.34	1.20	0.23	0.07	3.11

Table 11.4-6 Data Sheet for Low Flow Analysis at Shirshingi

Catchment Area (km^2)
35.48
Atmospheric Temperature ($^{\circ}C$)
26
Antecedent Rainfall (mm)
0
Number of Tank
4

Initial Storage of Tank (mm)	T1	T2	T3	T4	TR
	0	0	0	0	0

Initial Snow Depth (mm)	Snow1	Snow2	Snow3	Snow4
	0	0	0	0

Portion of Area	ca1	ca2	ca3	ca4
	1	0	0	0

Difference of Altitude	fa1	fa2	fa3	fa4
	0	0	0	0

Rain Monthly Coeff.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	0	0	0	0	0	0	0	0	0	0	0	0

Monthly Evapo. (mm/M)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	150	150	150	150	150	150	75	75	75	75	150	150

Coeff. of Tankholes	Cu	Cm	Cd	Cb
	0	0.55	0.42	0.008
	0	0.3	0.45	0.001
	0	0	0.3	0
	0	0	0	0

Hight of Tankholes (mm)	Hu	Hm	Hd
	0	150	20
	0	50	5
	0	0	5
	0	0	0

Rainfall Data (mm)

SY	SM	SD	EY	EM	ED
1984	1	1	1992	12	31

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1984	0	0	0	0	0	1116	1812	1086	379	428	0	0	4821
1985	0	0	0	0	43	1773	2214	1301	217	357	0	0	5905
1986	0	0	0	0	0	1180	1279	1178	224	0	0	0	3861
1987	0	0	0	0	0	213	1259	912	170	288	57	34	2933
1988	0	0	0	0	34	779	2247	1544	970	181	0	0	5755
1989	0	0	0	0	23	1505	1757	996	400	113	0	0	4794
1990	0	0	0	0	379	1328	1833	1563	438	176	29	0	5746
1991	0	0	0	15	108	615	1776	1032	160	65	0	0	3771
1992	0	0	0	4	67	986	1237	1568	356	140	45	0	4412

River Flow Data (m^3/s)

Year	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1984	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1985	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1986	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1987	0	0	0	0	0	1.34	21.01	18.5	6.39	5.39	1.58	1.27	4.69
1988	0	0	0	0	0	3.86	37.33	46.27	18.4	4.54	1.79	0.16	9.45
1989	0	0	0	0	0	9.8	26.68	19.57	8.56	5.68	0.7	0.11	5.99
1990	0	0	0	0	0	6.46	22.54	17.94	6.01	1.39	0.58	0.38	4.66
1991	0	0	0	0	0	1.62	22.82	15.66	2.16	0.78	0.41	0.13	3.69
1992	0	0	0	0	0	4.66	15.26	21.57	5.83	1.39	0.62	0.31	4.17

Table 11.4-7
Simulated Monthly Flow for the Upper Dam Site, Jalond

(m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1980	0.00	0.00	0.00	0.00	0.00	4.40	7.06	9.73	2.46	0.15	0.00	0.00	2.00
1981	0.00	0.00	0.00	0.00	0.00	1.65	10.77	5.84	2.11	0.44	0.00	0.00	1.76
1982	0.00	0.00	0.00	0.00	0.00	1.29	4.26	4.53	0.31	0.17	0.00	0.00	0.89
1983	0.00	0.00	0.00	0.00	0.00	2.13	6.61	8.23	3.99	0.37	0.00	0.00	1.79
1984	0.00	0.00	0.00	0.00	0.00	1.38	8.16	5.79	1.73	0.80	0.00	0.00	1.50
1985	0.00	0.00	0.00	0.00	0.00	0.87	8.02	5.39	0.76	0.20	0.00	0.00	1.29
1986	0.00	0.00	0.00	0.00	0.00	2.56	5.64	7.02	0.87	0.00	0.00	0.00	1.36
1987	0.00	0.00	0.00	0.00	0.00	0.26	3.32	5.66	0.64	0.22	0.00	0.00	0.86
1988	0.00	0.00	0.00	0.00	0.00	0.35	10.96	2.80	2.10	0.28	0.00	0.00	1.39
1989	0.00	0.00	0.00	0.00	0.00	1.92	6.75	7.81	2.07	0.01	0.00	0.00	1.57
1990	0.00	0.00	0.00	0.00	0.00	4.62	6.43	7.12	2.72	1.55	0.00	0.00	1.89
1991	0.00	0.00	0.00	0.00	0.00	4.27	9.58	8.26	0.89	0.00	0.00	0.00	1.94
1992	0.00	0.00	0.00	0.00	0.00	0.01	1.83	5.47	2.60	0.23	0.00	0.00	0.85
Mean	0.00	0.00	0.00	0.00	0.00	1.98	6.88	6.44	1.79	0.34	0.00	0.00	1.47

Table 11.4-8
Simulated Monthly Flow for the Lower Dam Site, Jalond

(m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1980	0.00	0.00	0.00	0.00	0.00	0.73	1.17	1.61	0.41	0.02	0.00	0.00	0.33
1981	0.00	0.00	0.00	0.00	0.00	0.27	1.79	0.97	0.35	0.07	0.00	0.00	0.29
1982	0.00	0.00	0.00	0.00	0.00	0.21	0.71	0.75	0.05	0.03	0.00	0.00	0.15
1983	0.00	0.00	0.00	0.00	0.00	0.35	1.10	1.37	0.66	0.06	0.00	0.00	0.30
1984	0.00	0.00	0.00	0.00	0.00	0.23	1.35	0.96	0.29	0.13	0.00	0.00	0.25
1985	0.00	0.00	0.00	0.00	0.00	0.14	1.33	0.89	0.13	0.03	0.00	0.00	0.21
1986	0.00	0.00	0.00	0.00	0.00	0.43	0.94	1.16	0.14	0.00	0.00	0.00	0.23
1987	0.00	0.00	0.00	0.00	0.00	0.04	0.55	0.94	0.11	0.04	0.00	0.00	0.14
1988	0.00	0.00	0.00	0.00	0.00	0.06	1.82	0.46	0.35	0.05	0.00	0.00	0.23
1989	0.00	0.00	0.00	0.00	0.00	0.32	1.12	1.30	0.34	0.00	0.00	0.00	0.26
1990	0.00	0.00	0.00	0.00	0.00	0.77	1.07	1.18	0.45	0.26	0.00	0.00	0.31
1991	0.00	0.00	0.00	0.00	0.00	0.71	1.59	1.37	0.15	0.00	0.00	0.00	0.32
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.91	0.43	0.04	0.00	0.00	0.14
Mean	0.00	0.00	0.00	0.00	0.00	0.33	1.14	1.07	0.30	0.06	0.00	0.00	0.24

Table 11.4-9
Simulated Monthly Flow for the Upper Dam Site, Marleshwar

(m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1982	0.00	0.00	0.00	0.00	0.00	1.86	4.80	4.00	0.99	0.30	0.18	0.00	1.02
1983	0.00	0.00	0.00	0.00	0.00	4.46	4.35	5.47	2.88	0.24	0.01	0.00	1.46
1984	0.00	0.00	0.00	0.00	0.00	2.59	4.86	2.11	0.89	0.41	0.01	0.00	0.91
1985	0.00	0.00	0.00	0.00	0.00	3.86	4.17	3.26	0.60	0.97	0.04	0.00	1.08
1986	0.00	0.00	0.00	0.00	0.00	3.02	2.50	3.45	0.31	0.08	0.01	0.00	0.79
1987	0.00	0.00	0.00	0.00	0.00	1.60	4.06	3.52	0.78	0.71	0.03	0.00	0.90
1988	0.00	0.00	0.00	0.00	0.00	2.45	6.73	3.33	2.14	0.14	0.00	0.00	1.24
1989	0.00	0.00	0.00	0.00	0.00	3.47	4.66	2.57	0.94	0.13	0.00	0.00	0.99
1990	0.00	0.00	0.00	0.00	0.07	2.41	4.38	4.99	1.24	0.51	0.09	0.00	1.15
1991	0.00	0.00	0.00	0.00	0.00	2.54	7.03	3.11	0.66	0.14	0.00	0.00	1.14
1992	0.00	0.00	0.00	0.00	0.00	1.51	4.34	3.80	1.55	0.52	0.00	0.00	0.98
Mean	0.00	0.00	0.00	0.00	0.01	2.71	4.72	3.60	1.18	0.38	0.03	0.00	1.06

Table 11.4-10
Simulated Monthly Flow for the Lower Dam Site, Marleshwar

(m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1982	0.00	0.00	0.00	0.00	0.00	4.26	11.52	9.59	2.34	0.68	0.42	0.00	2.43
1983	0.00	0.00	0.00	0.00	0.00	9.35	9.37	11.81	6.18	0.46	0.01	0.00	3.11
1984	0.00	0.00	0.00	0.00	0.00	5.29	10.49	4.51	1.85	0.82	0.02	0.00	1.93
1985	0.00	0.00	0.00	0.00	0.00	8.05	8.97	7.02	1.23	2.02	0.09	0.00	2.30
1986	0.00	0.00	0.00	0.00	0.00	6.21	5.35	7.42	0.59	0.21	0.00	0.00	1.66
1987	0.00	0.00	0.00	0.00	0.00	3.14	8.73	7.57	1.62	1.46	0.06	0.00	1.90
1988	0.00	0.00	0.00	0.00	0.00	4.99	14.53	7.17	4.57	0.33	0.00	0.00	2.65
1989	0.00	0.00	0.00	0.00	0.00	7.21	10.04	5.50	1.96	0.32	0.00	0.00	2.10
1990	0.00	0.00	0.00	0.00	0.06	4.83	9.44	10.78	2.63	1.04	0.20	0.00	2.44
1991	0.00	0.00	0.00	0.00	0.00	5.19	15.19	6.68	1.36	0.34	0.00	0.00	2.42
1992	0.00	0.00	0.00	0.00	0.00	2.94	9.34	8.17	3.29	1.05	0.00	0.00	2.08
Mean	0.00	0.00	0.00	0.00	0.01	5.59	10.27	7.84	2.51	0.79	0.07	0.00	2.28

Table 11.4-11
Simulated Monthly Flow for the Lower Dam Site, Hevale

(m^3/s)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1980	0.00	0.00	0.00	0.00	0.00	14.04	18.48	15.57	2.29	0.26	0.00	0.00	4.24
1981	0.00	0.00	0.00	0.00	0.00	6.23	16.65	20.35	5.30	0.04	0.00	0.00	4.09
1982	0.00	0.00	0.00	0.00	0.03	5.02	18.05	19.46	2.01	0.97	0.07	0.00	3.85
1983	0.00	0.00	0.00	0.00	0.00	11.60	18.26	15.85	7.97	1.08	0.16	0.00	4.61
1984	0.00	0.00	0.00	0.00	0.00	10.48	18.61	12.29	3.31	0.95	0.09	0.00	3.84
1985	0.00	0.00	0.00	0.00	0.00	10.68	12.37	12.76	2.46	1.87	0.00	0.00	3.37
1986	0.00	0.00	0.00	0.00	0.00	11.16	10.43	9.71	1.11	0.23	0.38	0.00	2.77
1987	0.00	0.00	0.00	0.00	0.00	4.18	14.97	8.45	3.30	1.23	0.06	0.00	2.71
1988	0.00	0.00	0.00	0.00	0.00	7.89	26.86	12.66	7.91	0.41	0.00	0.00	4.68
1989	0.00	0.00	0.00	0.00	0.00	17.16	13.87	8.97	3.32	0.38	0.00	0.00	3.66
1990	0.00	0.00	0.00	0.00	0.12	11.43	18.64	14.98	5.59	1.00	0.10	0.00	4.36
1991	0.00	0.00	0.00	0.00	0.32	6.99	23.87	13.55	1.90	0.67	0.02	0.00	4.00
1992	0.00	0.00	0.00	0.00	0.00	9.22	14.23	13.44	3.16	1.03	0.17	0.00	3.46
Mean	0.00	0.00	0.00	0.00	0.04	9.70	17.33	13.70	3.82	0.78	0.08	0.00	3.82

Table 11.5-1 Rainfall Distribution

	Time	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	Total
1. Pastewadi (30-7-79)	Rainfall (mm/h)	2.0	0.0	5.7	2.3	1.5	8.6	11.2	9.1	32.8	6.0	7.4	0.4	0.3	0.5	20.0	53.0	18.4	16.6	15.0	9.0	17.9	9.1	9.0	10.0	265.8
	Accumulation	2.0	2.0	7.7	10.0	11.5	20.1	31.3	40.4	73.2	79.2	86.6	87.0	87.3	87.8	107.8	160.8	179.2	195.8	210.8	219.8	237.7	246.8	255.8	265.8	
	Accum / Total (%)	0.8	0.8	2.9	3.8	4.3	7.6	11.8	15.2	27.5	29.8	32.6	32.7	32.8	33.0	40.6	60.5	67.4	73.7	79.3	82.7	89.4	92.9	96.2	100.0	
	Rain / Total (%)	0.8	0.0	2.1	0.9	0.6	3.2	4.2	3.4	12.3	2.3	2.8	0.2	0.1	0.2	7.5	19.9	6.9	6.2	5.6	3.4	6.7	3.4	3.4	3.8	
2. Anjiwadi (28-7-82)	Rainfall (mm/h)	6.4	3.6	2.6	0.4	5.7	13.1	6.1	4.1	38.0	23.4	29.2	9.2	33.0	48.4	20.5	7.9	5.5	5.0	4.5	4.7	0.2	1.6	10.0	1.3	284.4
	Accumulation	6.4	10.0	12.6	13.0	18.7	31.8	37.9	42.0	80.0	103.4	132.6	141.8	174.8	223.2	243.7	251.6	257.1	262.1	266.6	271.3	271.5	273.1	283.1	284.4	
	Accum / Total (%)	2.3	3.5	4.4	4.6	6.6	11.2	13.3	14.8	28.1	36.4	46.6	49.9	61.5	78.5	85.7	88.5	90.4	92.2	93.7	95.4	95.5	96.0	99.5	100.0	
	Rain / Total (%)	2.3	1.3	0.9	0.1	2.0	4.6	2.1	1.4	13.4	8.2	10.3	3.2	11.6	17.0	7.2	2.8	1.9	1.8	1.6	1.7	0.1	0.6	3.5	0.5	
3. Pastewadi (27-6-83)	Rainfall (mm/h)	0.2	4.8	10.0	1.0	0.0	1.4	0.0	0.1	1.1	3.5	6.5	10.9	9.0	21.5	24.0	32.0	34.0	74.0	32.0	58.0	39.0	2.0	17.5	0.6	383.1
	Accumulation	0.2	5.0	15.0	16.0	16.0	17.4	17.4	17.5	18.6	22.1	28.6	39.5	48.5	70.0	94.0	126.0	160.0	234.0	266.0	324.0	363.0	365.0	382.5	383.1	
	Accum / Total (%)	0.1	1.3	3.9	4.2	4.2	4.5	4.5	4.6	4.9	5.8	7.5	10.3	12.7	18.3	24.5	32.9	41.8	61.1	69.4	84.6	94.8	95.3	99.8	100.0	
	Rain / Total (%)	0.1	1.3	2.6	0.3	0.0	0.4	0.0	0.0	0.3	0.9	1.7	2.8	2.3	5.6	6.3	8.4	8.9	19.3	8.4	15.1	10.2	0.5	4.6	0.2	
4. Poinar (27-6-83)	Rainfall (mm/h)	2.7	3.3	0.7	0.8	0.5	0.5	1.0	0.0	4.5	16.0	19.0	6.0	25.0	30.0	50.0	15.0	15.0	60.0	37.8	4.7	5.7	2.3	6.6	5.4	312.5
	Accumulation	2.7	6.0	6.7	7.5	8.0	8.5	9.5	9.5	14.0	30.0	49.0	55.0	80.0	110.0	160.0	175.0	190.0	250.0	287.8	292.5	298.2	300.5	307.1	312.5	
	Accum / Total (%)	0.9	1.9	2.1	2.4	2.6	2.7	3.0	3.0	4.5	9.6	15.7	17.6	25.6	35.2	51.2	56.0	60.8	80.0	92.1	93.6	95.4	96.2	98.3	100.0	
	Rain / Total (%)	0.9	1.1	0.2	0.3	0.2	0.2	0.3	0.0	1.4	5.1	6.1	1.9	8.0	9.6	16.0	4.8	4.8	19.2	12.1	1.5	1.8	0.7	2.1	1.7	
5. Anjiwade (26-6-83)	Rainfall (mm/h)	21.0	14.7	3.3	23.5	30.5	27.0	41.0	41.1	25.4	26.5	38.0	65.0	10.5	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	373.4
	Accumulation	21.0	35.7	39.0	62.5	93.0	120.0	161.0	202.1	227.5	254.0	292.0	357.0	367.5	373.3	373.3	373.3	373.3	373.3	373.3	373.3	373.3	373.3	373.3	373.4	
	Accum / Total (%)	5.6	9.6	10.4	16.7	24.9	32.1	43.1	54.1	60.9	68.0	78.2	95.6	98.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
	Rain / Total (%)	5.6	3.9	0.9	6.3	8.2	7.2	11.0	11.0	6.8	7.1	10.2	17.4	2.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
6. Tillariw. (26-6-83)	Rainfall (mm/h)	0.6	21.2	9.5	6.1	8.4	7.8	12.7	9.4	2.5	8.8	7.8	1.0	7.6	19.0	5.5	16.3	4.8	19.0	11.7	21.8	52.5	40.0	36.0	24.5	354.5
	Accumulation	0.6	21.8	31.3	37.4	45.8	53.6	66.3	75.7	78.2	87.0	94.8	95.8	103.4	122.4	127.9	144.2	149.0	168.0	179.7	201.5	254.0	294.0	330.0	354.5	
	Accum / Total (%)	0.2	6.1	8.8	10.6	12.9	15.1	18.7	21.4	22.1	24.5	26.7	27.0	29.2	34.5	36.1	40.7	42.0	47.4	50.7	56.8	71.7	82.9	93.1	100.0	
	Rain / Total (%)	0.2	6.0	2.7	1.7	2.4	2.2	3.6	2.7	0.7	2.5	2.2	0.3	2.1	5.4	1.6	4.6	1.4	5.4	3.3	6.1	14.8	11.3	10.2	6.9	
7. Patye (26-6-83)	Rainfall (mm/h)	2.0	12.5	15.6	10.0	6.2	6.3	6.1	7.7	1.5	3.4	8.5	2.5	2.3	15.2	10.0	10.0	0.2	9.0	4.0	16.0	50.0	30.0	50.0	36.2	315.2
	Accumulation	2.0	14.5	30.1	40.1	46.3	52.6	58.7	66.4	67.9	71.3	79.8	82.3	84.6	99.8	109.8	119.8	120.0	129.0	133.0	149.0	199.0	229.0	279.0	315.2	
	Accum / Total (%)	0.6	4.6	9.5	12.7	14.7	16.7	18.6	21.1	21.5	22.6	25.3	26.1	26.8	31.7	34.8	38.0	38.1	40.9	42.2	47.3	63.1	72.7	88.5	100.0	
	Rain / Total (%)	0.6	4.0	4.9	3.2	2.0	2.0	1.9	2.4	0.5	1.1	2.7	0.8	0.7	4.8	3.2	3.2	0.1	2.9	1.3	5.1	15.9	9.5	15.9	11.5	
8. Sargave (26-6-83)	Rainfall (mm/h)	2.2	3.3	14.5	8.0	8.8	1.6	1.3	0.3	9.0	1.0	0.0	10.0	6.4	2.2	16.4	15.0	11.8	2.7	5.4	0.7	32.0	33.5	46.5	61.7	294.3
	Accumulation	2.2	5.5	20.0	28.0	36.8	38.4	39.7	40.0	49.0	50.0	50.0	60.0	66.4	68.6	85.0	100.0	111.8	114.5	119.9	120.6	152.6	186.1	232.6	294.3	
	Accum / Total (%)	0.7	1.9	6.8	9.5	12.5	13.0	13.5	13.6	16.6	17.0	17.0	20.4	22.6	23.3	28.9	34.0	38.0	38.9	40.7	41.0	51.9	63.2	79.0	100.0	
	Rain / Total (%)	0.7	1.1	4.9	2.7	3.0	0.5	0.4	0.1	3.1	0.3	0.0	3.4	2.2	0.7	5.6	5.1	4.0	0.9	1.8	0.2	10.9	11.4	15.8	21.0	
9. Shivapur (26-6-83)	Rainfall (mm/h)	27.0	15.3	9.9	3.3	23.5	25.9	37.1	33.0	41.5	28.5	27.0	32.5	47.5	21.5	23.0	32.5	13.0	8.6	23.4	12.2	25.8	25.5	27.0	10.9	575.4
	Accumulation	27.0	42.3	52.2	55.5	79.0	104.9	142.0	175.0	216.5	245.0	272.0	304.5	352.0	373.5	396.5	429.0	442.0	450.6	474.0	486.2	512.0	537.5	564.5	575.4	
	Accum / Total (%)	4.7	7.4	9.1	9.6	13.7	18.2	24.7	30.4	37.6	42.6	47.3	52.9	61.2	64.9	68.9	74.6	76.8	78.3	82.4	84.5	89.0	93.4	98.1	100.0	
	Rain / Total (%)	4.7	2.7	1.7	0.6	4.1	4.5	6.4	5.7	7.2	5.0	4.7	5.6	8.3	3.7	4.0	5.6	2.3	1.5	4.1	2.1	4.5	4.4	4.7	1.9	
10. Shirange (15-8-83)	Rainfall (mm/h)	12.0	22.5	5.0	10.0	9.1	6.9	12.5	8.0	3.9	0.0	0.0	16.5	1.1	7.5	25.0	3.3	8.7	5.2	15.5	64.0	20.0	0.4	5.0	2.5	264.6
	Accumulation	12.0	34.5	39.5	49.5	58.6	65.5	78.0	86.0	89.9	89.9	89.9	106.4	107.5	115.0	140.0	143.3	152.0	157.2	172.7	236.7	256.7	257.1	262.1	264.6	
	Accum / Total (%)	4.5	13.0	14.9	18.7	22.1	24.8	29.5	32.5	34.0	34.0	34.0	40.2	40.6	43.5	52.9	54.2	57.4	59.4	65.3	89.5	97.0	97.2	99.1	100.0	
	Rain / Total (%)	4.5	8.5	1.9	3.8	3.4	2.6	4.7	3.0	1.5	0.0	0.0	6.2	0.4	2.8	9.4	1.2	3.3	2.0	5.9	24.2	7.6	0.2	1.9	0.9	
11. Shivdav (26-6-83)	Rainfall (mm/h)	5.0	15.5	6.5	21.0	22.0	32.0	28.0	30.0	30.0	42.0	20.5	47.5	17.9	12.6	0.1	0.4	3.0	13.0	8.0	2.5	2.5	1.0	0.3	1.2	362.5
	Accumulation	5.0	20.5	27.0	48.0	70.0	102.0	130.0	160.0	190.0	232.0	252.5	300.0	317.9	330.5	330.6	331.0	334.0	347.0	355.0	357.5	360.0	361.0	361.3	362.5	
	Accum / Total (%)	1.4	5.7	7.4	13.2	19.3	28.1	35.9	44.1	52.4	64.0	69.7	82.8	87.7	91.2	91.2	91.3	92.1	95.7	97.9	98.6	99.3	99.6	99.7	100.0	
	Rain / Total (%)	1.4	4.3	1.8	5.8	6.1	8.8	7.7	8.3	8.3	11.6	5.7	13.1	4.9	3.5	0.0	0.1	0.8	3.6	2.2	0.7	0.7	0.3	0.1	0.3	
12. Chatav (17-7-84)	Rainfall (mm/h)	5.6	10.7	0.4	1.4	2.7	14.2	11.7	12.8	39.5	25.8	56.0	12.6	12.4	22.2	31.0	4.4	21.1	25.5	31.8	42.1	28.2	10.3	9.1	9.7	441.2
	Accumulation	5.6	16.3	16.7	18.1	20.8	35.0	46.7	59.5	99.0	124.8	180.8	193.4	205.8	228.0	259.0	263.4	284.5	310.0	341.8	383.9	412.1	422.4	431.5	441.2	
	Accum / Total (%)	1.3	3.7	3.8	4.1	4.7	7.9	10.6	13.5	22.4	28.3	41.0	43.8	46.6	51.7	58.7	59.7	64.5	70.3	77.5	87.0	93.4	95.7	97.8	100.0	
	Rain / Total (%)	1.3	2.4	0.1	0.3	0.6	3.2	2.7	2.9	9.0	5.8	12.7	2.9	2.8	5.0	7.0	1.0	4.8	5.8	7.2	9.5	6.4	2.3	2.1	2.2	
Rain / Total Ave. (%)		1.9	3.0	2.1	2.2	2.7	3.3	3.8	3.4	5.4	4.2	4.9	4.8	3.9	5.0	5.6	4.7	3.3	5.7	4.5	5.8	6.6	3.7	5.3	4.2	352.2
Ave. Accum. (%)		1.9	4.9	7.0	9.2	11.9	15.2	19.0	22.4	27.8	32.0	36.9	41.7	45.6	50.6	56.2	60.9	64.2	69.9	74.4	80.2	86.8	90.5	95.8	100.0	

Source : Daily Rainfall Data of West Flowing River Basins, 1979 ~ 1984 published by Irrigation Project Investigation Division in Thane

Table 11.5-2 Probable Daily Rainfall

No	Dam Site	Raingauge Station	Probable Daily Rainfall (mm)			
			30 yrs	100 yrs	1000 yrs	10000 yrs
4	Pinjal	Deogaon	292.5	339.4	427.5	522.8
		Nirgudpada	305.2	338.2	396.4	455.3
		Sakerpada	288.3	318.9	372.9	427.3
		Jogalwadi	284.7	321.2	387.2	455.8
		Khodale	258.3	289.1	344.1	400.6
		Suryamal	288.7	325.7	392.7	462.2
		Average	266.3	322.1	386.8	454.0
5	Kungadi	Dand	246.8	278.8	336.9	397.3
		Kasara	223.0	245.2	283.9	322.6
		Average	234.9	262.0	310.4	360.0
8	Kolmanpada	Dolkham	302.1	365.8	492.3	637.6
9	Choranai	Kothale	200.5	217.2	246.0	274.1
		Talawade	266.7	302.0	366.1	432.9
		Average	256.4	295.0	368.1	448.2
7	Jalond	Phangloshi	278.2	324.3	411.3	506.0
6	Kalu	Waliware	314.8	381.7	514.4	667.1
2	Sidgarh	Nandgaon	351.0	416.1	541.8	682.0
		Otman	270.4	303.6	363.2	424.6
		Dadhanoli	402.5	505.0	717.8	975.2
		Tulai	378.7	462.9	632.0	829.0
		Average	350.7	421.9	563.7	727.7
1	Ulhas	H.W.E.'s Office	515.1	606.5	781.2	974.1
3	Amba	Khopoli	493.8	602.2	819.1	1070.9
22	Valvand	Karjat	341.6	393.5	490.0	593.2
		Khalapur	356.6	413.2	519.2	633.6
		Average	426.8	503.9	652.4	818.0
10	Savitri	Potadpur	293.9	330.7	397.2	465.9
11	Madhaliwadi	Chatav	394.1	439.6	520.9	603.9
24	Kudanbudrak	Average	344.0	385.2	459.1	534.9
25	Kaudoshi					
12	Vaitami	Chatav	394.1	439.6	520.9	603.9
13	Morawadi	Chiplun	298.7	334.7	399.4	465.8
		Average	346.4	387.2	460.2	534.9
14	Gadgadi	Pastewadi	405.7	461.7	564.3	672.1
17	Kundi	Deorukh	427.1	529.5	738.9	987.9
21	Marleshwar	Average	416.4	495.6	651.6	830.0
29	Bamnoli					
30	Kinjale					
15	Aruna	Ghonsari	288.5	320.5	377.1	434.7
		Phondaghat	285.5	317.0	372.7	429.3
		Sangulwadi	278.6	306.5	355.3	404.2
		Average	284.2	314.7	368.4	422.7
20	Tillari Forebay	Kodali	378.1	417.9	488.0	558.6
32	Hevale					
23	Shemi	Vaghotre	439.6	484.1	562.2	640.4
26	Kumbhavde	Amboli	527.3	614.3	778.3	956.7
		Tillariwadi	346.4	385.5	455.1	525.9
		Average	437.8	494.6	598.5	707.7
16	Kharari	Vaghotre	439.6	484.1	562.2	640.4
19	Tillariwadi	Patye	384.8	445.0	557.5	678.5
		Sargave	368.2	412.6	492.3	574.1
		Tillariwadi	346.4	385.5	455.1	525.9
		Average	366.5	414.4	501.6	592.8
18	Jalwara	Shirange	369.1	422.2	520.0	623.6
28	Virdi					
27	Mundirichi	Kankumbhi	444.5	505.0	615.6	731.5
31	Khakharwadi	Sakurli	241.4	271.5	325.6	381.4

Table 11.5-3 Probable Floods for Initial Site Selection

Dam Site	Upper Dam						Lower Dam					
	Catchment Area	Flood by M.I Manual - Inglis	Probable Floods 1,000-year		30-year		Catchment Area	Flood by M.I. Manual - Inglis	Probable Floods 1,000-year		30-year	
	km²	m³/s	mm/hr	m³/s	mm/hr	m³/s	km²	m³/s	mm/hr	m³/s	mm/hr	m³/s
1 Ulhas	6.68	200	163	272	107	178	4.56	146	163	186	107	122
2 Sidgarh	1.00	37	141	35	88	22	0.92	34	141	32	88	20
3 Amba	6.21	189	163	253	107	166	7.99	231	163	326	107	213
4 Pinjal	2.85	97	97	69	72	51	32.11	609	97	777	72	575
5 Kengadi	2.45	85	78	47	59	36	5.48	170	78	106	59	80
6 Kalu	3.10	104	129	100	79	61	2.71	93	129	87	79	53
7 Jalond	20.68	459	103	531	70	359	3.43	114	103	88	70	60
8 Kolmanpada	3.38	113	92	78	64	54	3.31	111	92	76	64	53
9 Choranai	2.83	96	92	65	64	45	2.48	86	92	57	64	40
10 Savitri	5.51	171	115	158	86	118	7.41	217	115	213	86	159
11 Madhaliwadi	2.68	92	115	77	86	58	6.79	203	115	195	86	146
12 Vaitarni	1.28	46	115	37	87	28	9.61	266	115	276	87	208
13 Merawadi	-	-	115	-	87	-	-	-	115	-	87	-
14 Gadgadi	0.78	29	163	32	104	20	13.92	349	163	567	104	362
15 Aruna	4.78	152	92	110	71	85	2.82	96	92	65	71	50
16 Kharari	3.22	108	141	113	110	89	9.12	256	141	320	110	251
17 Kundi	1.67	60	163	68	104	43	9.90	272	163	403	104	258
18 Jalwara	2.47	85	130	80	92	57	9.41	262	130	306	92	217
19 Tillariwadi	-	-	125	-	92	-	-	-	125	-	92	-
20 Tillari Forebay	3.22	108	122	98	95	76	22.46	485	122	685	95	531
21 Marleshwar	8.15	234	163	332	104	212	23.20	495	163	945	104	604
22 Valvand	2.68	92	163	109	107	71	6.40	193	163	261	107	171
23 Shemi	47.00	767	150	1758	109	1286	10.57	286	150	395	109	289
24 Kudanbudrak	4.20	136	115	120	86	90	12.60	325	115	361	86	271
25 Kaudoshi	4.88	155	115	140	86	105	14.76	364	115	423	86	317
26 Kumbhavde	4.32	139	150	162	109	118	15.53	377	150	581	109	425
27 Mundirichi	-	-	154	-	111	-	9.83	271	154	378	111	273
28 Virdi	-	-	130	-	92	-	7.46	219	130	242	92	172
29 Bamnoli	-	-	163	-	104	-	18.31	423	163	746	104	477
30 Kinjale	-	-	163	-	104	-	4.81	153	163	196	104	125
31 Khakharwadi	-	-	81	-	60	-	5.95	182	81	121	60	90
32 Hevale	-	-	122	-	95	-	22.46	485	122	685	95	531

Table 11.5-4 Annual Maximum Daily Rainfall

(mm)

Site / Year / RGS	Jalond				Marleshwar		Hevale
	Kundachiwadi	Moroshi	Phangloshi	Waliware	Pastewadi	Sangave	Kodali
1978		177.8	128.0		238.8		
1979		114.2	140.6		178.4		
1980	123.6	121.2	148.2	155.2	257.8		215.0
1981	123.6	195.8	176.4	180.0	206.6	154.2	203.0
1982	117.0	183.2	151.8	66.4	224.8	247.8	280.0
1983	187.4	278.4	255.4	201.8	395.2	496.8	345.0
1984	181.0	214.4	165.8	204.4	244.0	323.6	268.5
1985	158.0	143.6	143.4	127.4	194.2	251.4	238.0
1986	161.0	128.0	119.4	109.8	189.0	161.2	203.0
1987	148.4	106.8	92.2	116.4	175.8	182.4	218.0
1988	226.6	222.4	199.2	199.2	288.0	129.2	331.0
1989	275.4	211.2	192.0	264.8	381.4	222.4	308.0
1990	144.0	147.4	149.0	166.4	310.6	163.8	278.0
1991	341.0	223.4	300.2	233.8	306.2	176.6	345.0
1992	127.4	103.4	108.4	105.2	291.4	187.8	218.0

Source : Daily Rainfall Data of West Flowing River Basins, 1978 - 1992
published by the Irrigation Project Investigation Division in Thane

Table 11.5-5 Probable Daily Rainfall

Site	Station	Probable Daily Rainfall (mm)					
		10-yr	30-yr	100-yr	200-yr	1,000-yr	PMP
Jalond	Kundachiwadi	290.1	363.0	454.7	528.0	729.1	953.6
	Moroshi	259.7	316.7	378.1	413.5	497.4	891.7
	Phangloshi	255.0	313.9	377.1	413.3	497.0	860.0
	Waliware	274.5	352.4	440.3	492.9	621.9	1,035.2
	Average	**269.8**	**336.5**	**412.6**	**461.9**	**586.4**	**935.1**
Marleshw	Pastewadi	372.9	447.4	527.2	572.9	678.7	1,040.1
	Sangave	396.7	508.3	627.9	696.4	934.0	1,038.7
	Average	**384.8**	**477.9**	**577.6**	**634.7**	**806.4**	**1,039.4**
Heval	**Kodali**	**355.8**	**414.6**	**477.6**	**513.7**	**597.3**	**948.0**

Table 11.5-6 Probable Floods

Site			Return Periods					
			10-yr	30-yr	100-yr	200-yr	1,000-yr	PMF
Jalond	L.D (CA = 3.43 km^2)	Rainfall intensity (mm/hr)	67.5	84.1	103.2	115.5	146.6	233.8
		Flood (m^3/s)	**61.1**	**76.1**	**93.4**	**104.5**	**132.7**	**211.6**
	U.D (CA = 20.68 km^2)	Rainfall intensity (mm/hr)	67.5	84.1	103.2	115.5	146.6	233.8
		Flood (m^3/s)	**368.1**	**459.1**	**562.9**	**630.2**	**800.0**	**1,275.8**
Marleshwar	L.D (CA = 23.20 km^2)	Rainfall intensity (mm/hr)	96.2	119.5	144.4	158.7	201.6	259.9
		Flood (m^3/s)	**589.0**	**731.5**	**884.0**	**971.5**	**1,234.2**	**1,590.9**
	U.D (CA = 8.15 km^2)	Rainfall intensity (mm/hr)	96.2	119.5	144.4	158.7	201.6	259.9
		Flood (m^3/s)	**206.9**	**257.0**	**310.6**	**341.3**	**433.6**	**558.9**
Hevale	L.D (CA = 22.46 km^2)	Rainfall intensity (mm/hr)	89.0	103.7	119.4	128.4	149.3	237.0
		Flood (m^3/s)	**527.2**	**614.3**	**707.7**	**761.2**	**885.1**	**1,404.7**

Table 11.6-1 Evaporation at Khapri (For Jalond Site)

(mm/day)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1989	5.35	6.06	8.25	9.46	10.05	4.15	3.01	2.39	2.95	3.72	4.92	4.96
1990	5.60	7.46	8.02	9.76	9.22	4.38	2.30	1.80	1.95	3.14	4.45	5.61
1991	9.30	4.58	6.08	8.13	10.16	6.24	2.91	1.25	2.41	3.85	5.37	4.95
1992	4.65	6.12	7.66	9.15	9.77	7.97	3.48	2.18	2.57	3.15	4.62	6.00
1993	6.30	7.44	8.19	8.89	9.47	6.31	2.35	2.72	2.96	2.91	3.39	3.74
1994	3.96	5.90	8.72	9.07	10.57	5.07	1.19	1.21				
Average (A)	5.86	6.26	7.82	9.08	9.87	5.69	2.54	1.93	2.57	3.35	4.55	5.05
A x 75%	4.40	4.70	5.87	6.81	7.41	4.27	1.91	1.44	1.93	2.52	3.41	3.79
								Annual total			1471 mm	

Table 11.6-2 Evaporation at Pastewadi (For Marleshwar Site)

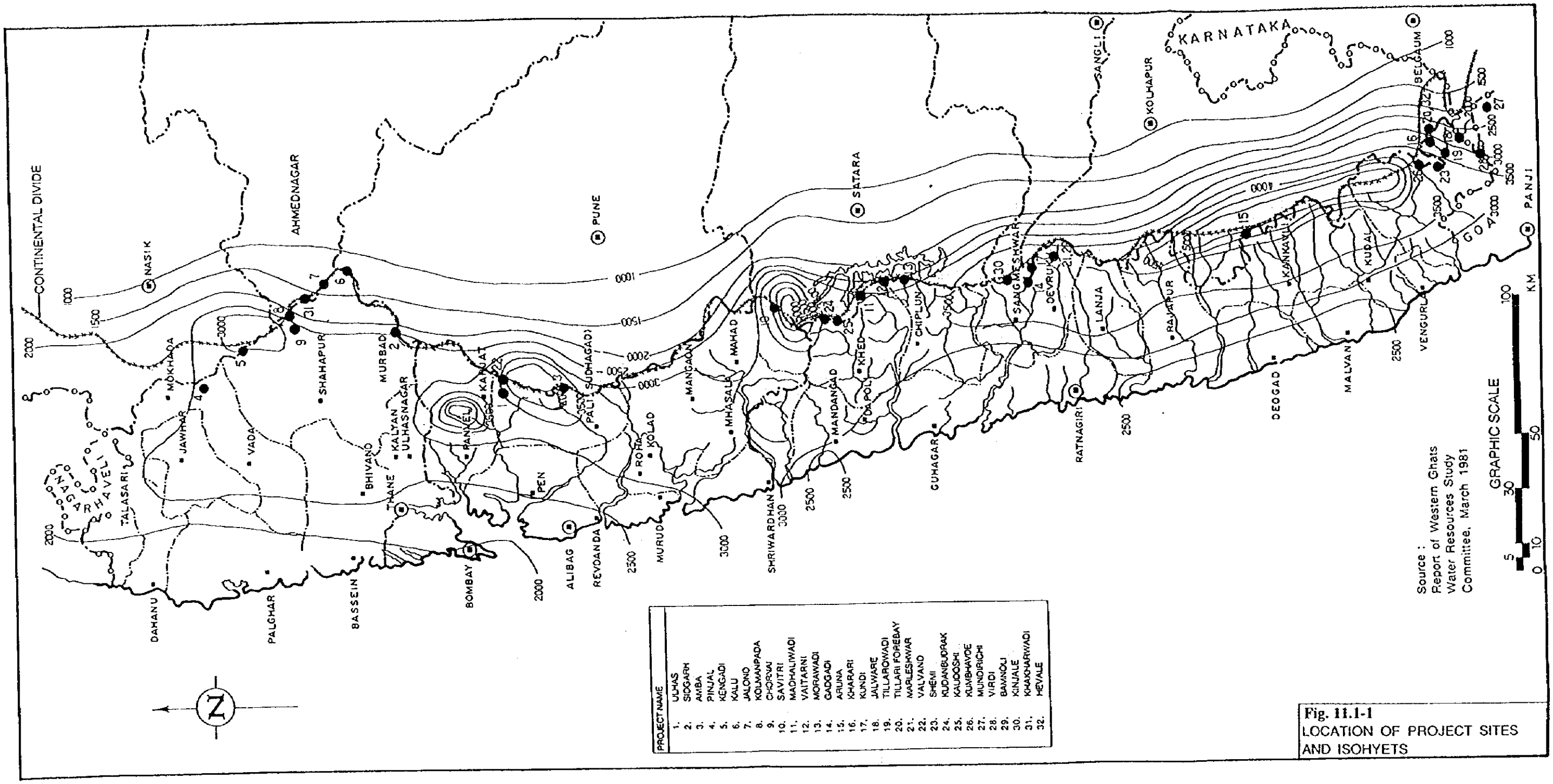
(mm/day)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1990							2.24	1.29	1.80	3.52	3.49	3.93
1991	3.68	4.51	6.00	6.47	6.94	3.00	1.23	1.13	2.99	3.58	4.60	4.74
1992	4.64	5.31	7.50	8.38	9.25	6.18	2.16	2.01	3.37	3.74	3.59	2.74
1993	3.13	5.86	6.60	8.14	8.02	4.06	1.30	2.24	2.17	2.80	3.60	2.90
1994	3.14	6.05	7.65	8.22	10.17	2.70	1.49	1.76	2.19	2.47	2.93	3.87
1995	3.96	5.02	6.28		5.88	3.67	2.32	2.20	2.21	2.40	3.61	3.29
Average (A)	3.71	5.35	6.81	7.80	8.05	3.92	1.79	1.77	2.46	3.09	3.64	3.58
A x 75%	2.78	4.01	5.10	5.85	6.04	2.94	1.34	1.33	1.84	2.31	2.73	2.68
								Annual total			1183 mm	

Table 11.6-3 Evaporation at Tillariwadi (For Hevale Site)

(mm/day)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1992				7.70	6.42	5.62	3.05	2.34	3.45	3.53	3.90	4.03
1993	4.18	5.19	5.97	6.32	6.25	4.26	3.03	3.43	3.37	3.42	4.20	4.02
1994	4.82	5.05	5.60	5.86	7.65	2.62	2.64	2.89	4.07	3.56	5.25	5.15
1995	4.97	5.59	5.81	6.86	6.01	4.33	2.54	3.35	3.76	3.93	4.84	4.76
Average (A)	4.66	5.28	5.79	6.69	6.58	4.21	2.82	3.00	3.66	3.61	4.55	4.49
A x 75%	3.49	3.96	4.35	5.01	4.94	3.16	2.11	2.25	2.75	2.71	3.41	3.37
								Annual total			1260 mm	



PROJECT NAME	
1.	ULHAS
2.	SIDGARH
3.	AMBA
4.	PINJAL
5.	KENGADI
6.	KALU
7.	JALOND
8.	KOLMANPADA
9.	CHORVAI
10.	SAVITRI
11.	MADHALIWADI
12.	VAITARNI
13.	MORAWADI
14.	GADGADI
15.	ARUNA
16.	KHARARI
17.	KUNDI
18.	JALWARE
19.	TILLAROWADI
20.	TILLARI FOREBAY
21.	MARLESHWAR
22.	VALVAND
23.	SHEMI
24.	KUDANGUDPAK
25.	KAUDOSHI
26.	KUMBHAVDE
27.	MUNDIRICHI
28.	VIRDI
29.	BAMNOLI
30.	KINJALE
31.	KHAKHARVADI
32.	HEVALE

Fig. 11.1-1
LOCATION OF PROJECT SITES
AND ISOHYETS

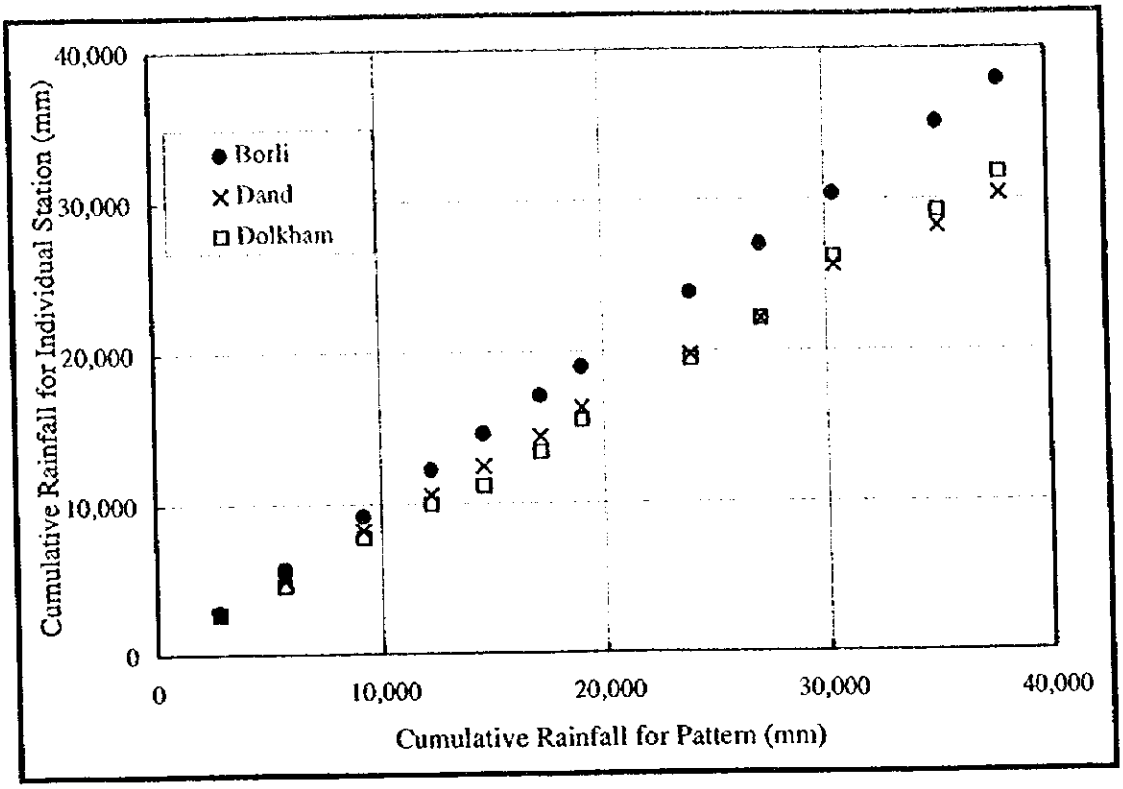


Fig. 11.3-1 Double-mass Curve of Rainfall Data, Jalond (1)
(1981 - 1992)

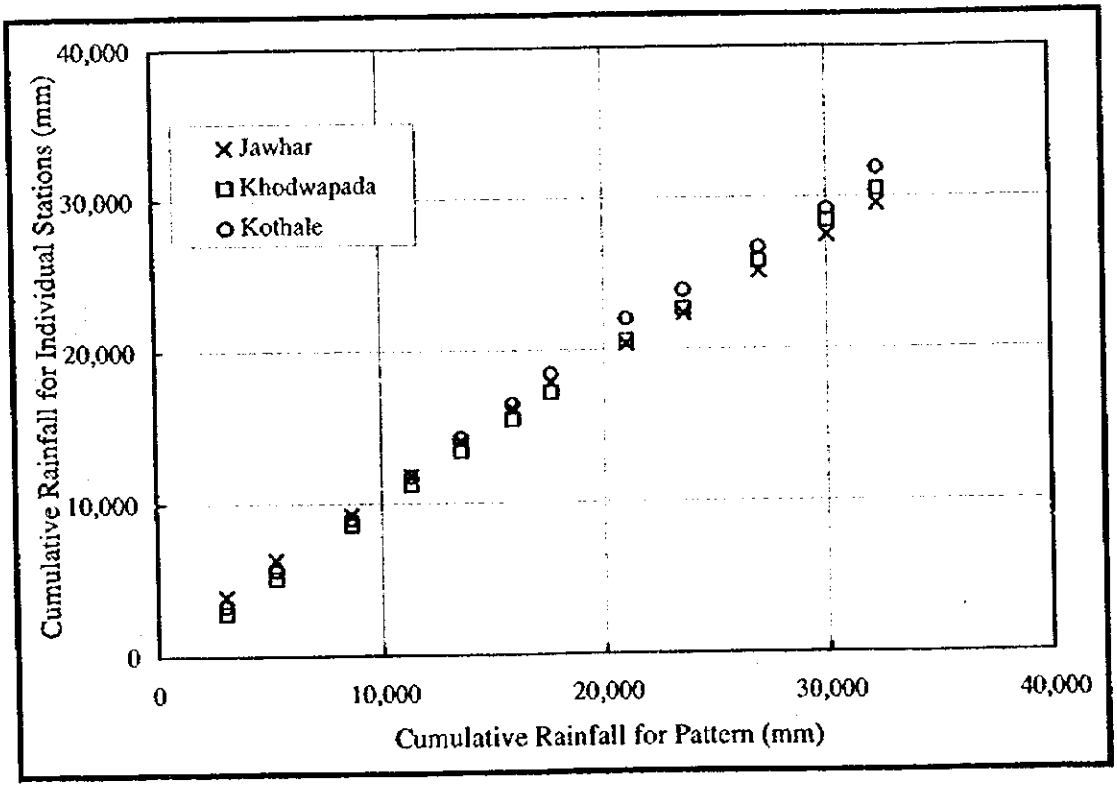


Fig. 11.3-2 Double-mass Curve of Rainfall Data, Jalond (2)
(1981 - 1992)

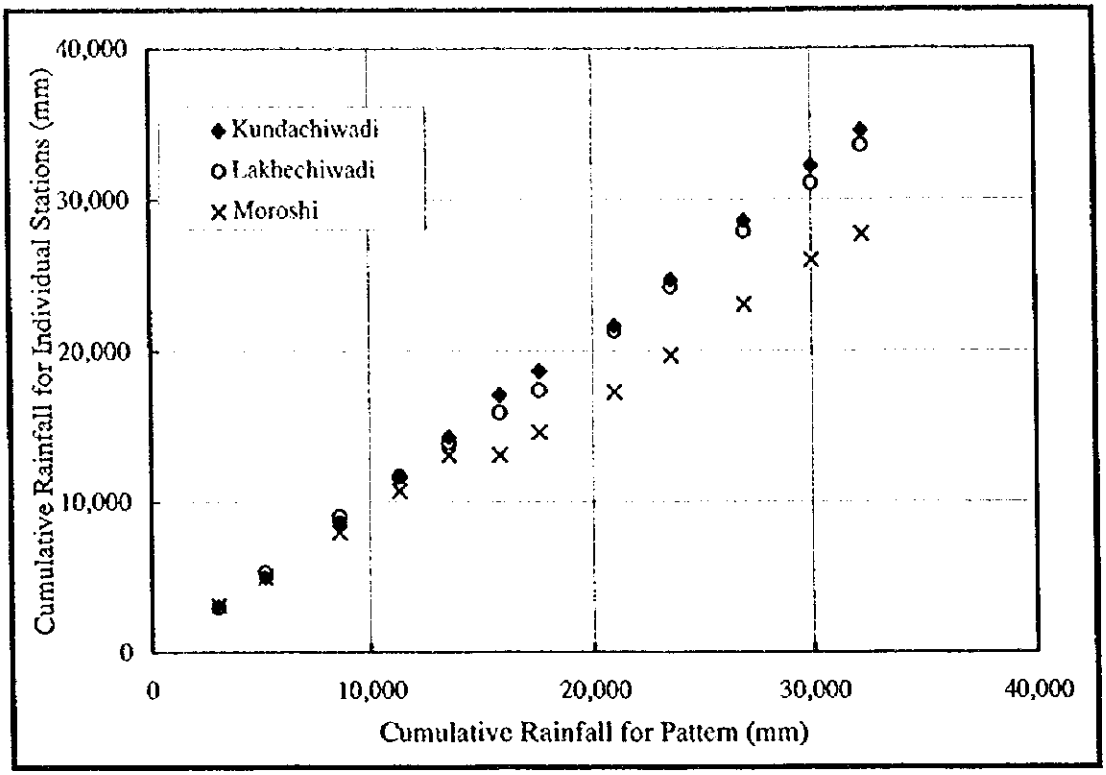


Fig. 11.3-3 Double-mass Curve of Rainfall Data, Jalond (3)
(1981 - 1992)

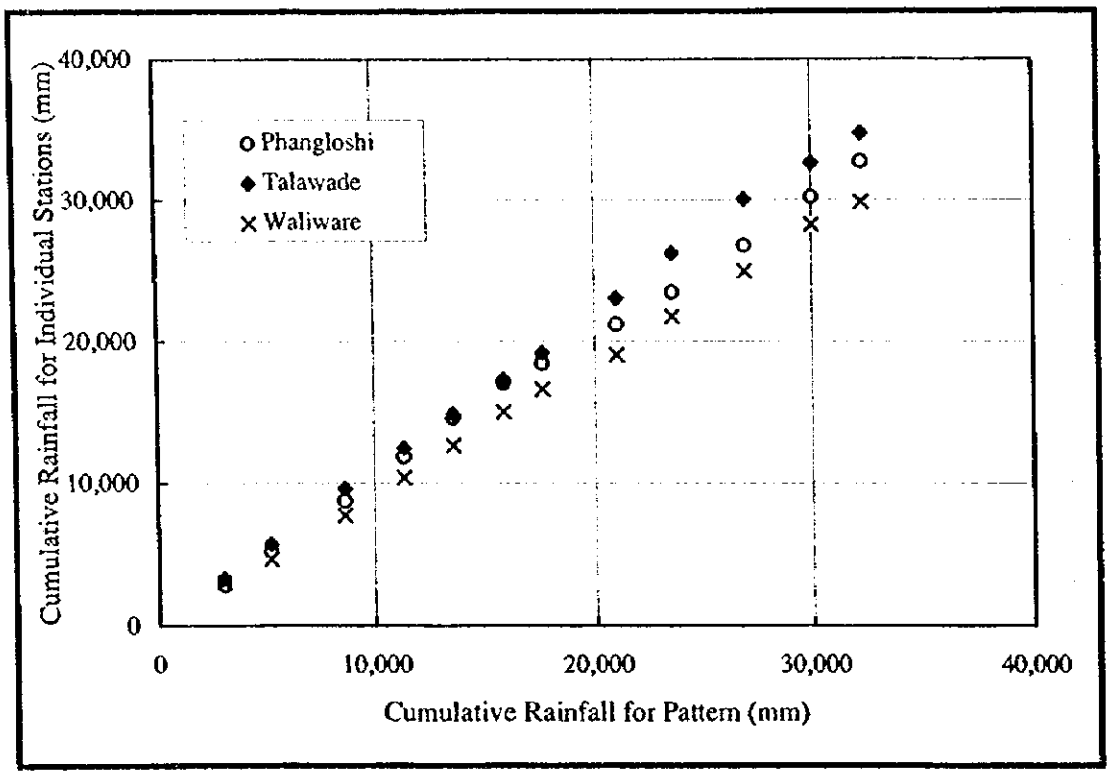


Fig. 11.3-4 Double-mass Curve of Rainfall Data, Jalond (4)
(1981 - 1992)

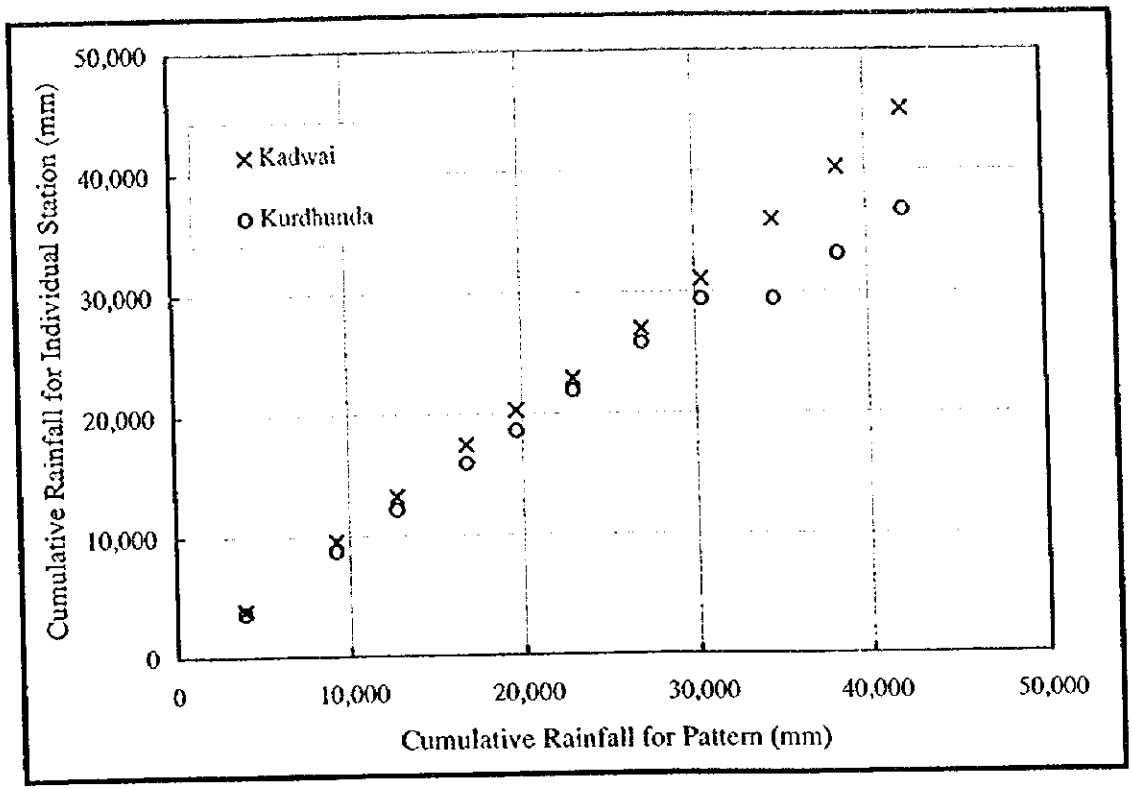


Fig. 11.3-5 Double-mass Curve of Rainfall Data, Marleshwar (1)
(1982 - 1992)

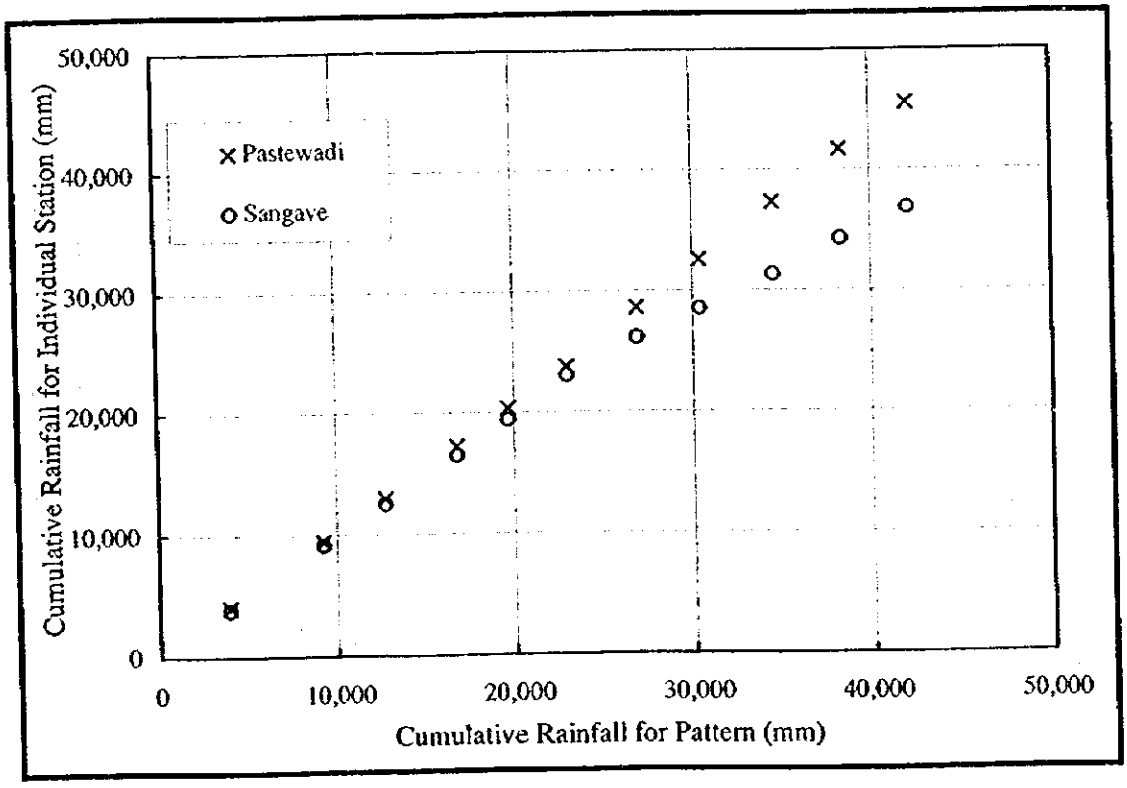


Fig. 11.3-6 Double-mass Curve of Rainfall Data, Marleshwar (2)
(1982 - 1992)

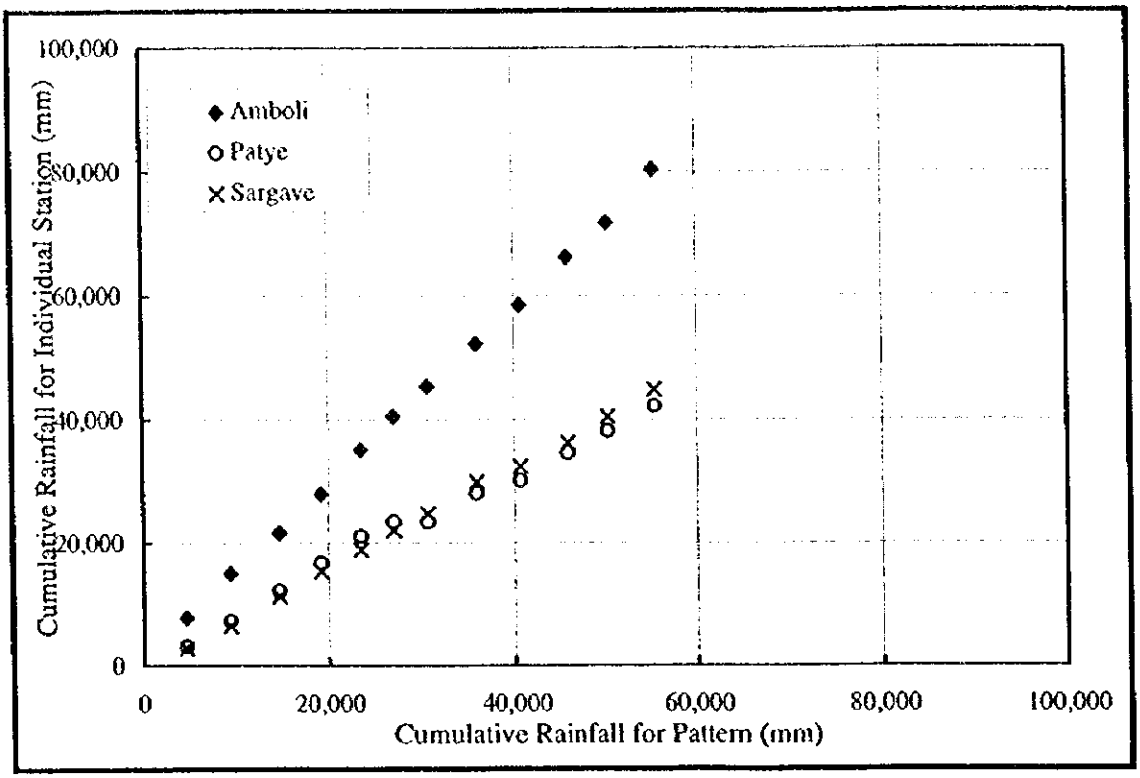


Fig. 11.3-7 Double-mass Curve of Rainfall Data, Hevale (1)
(1981 - 1992)

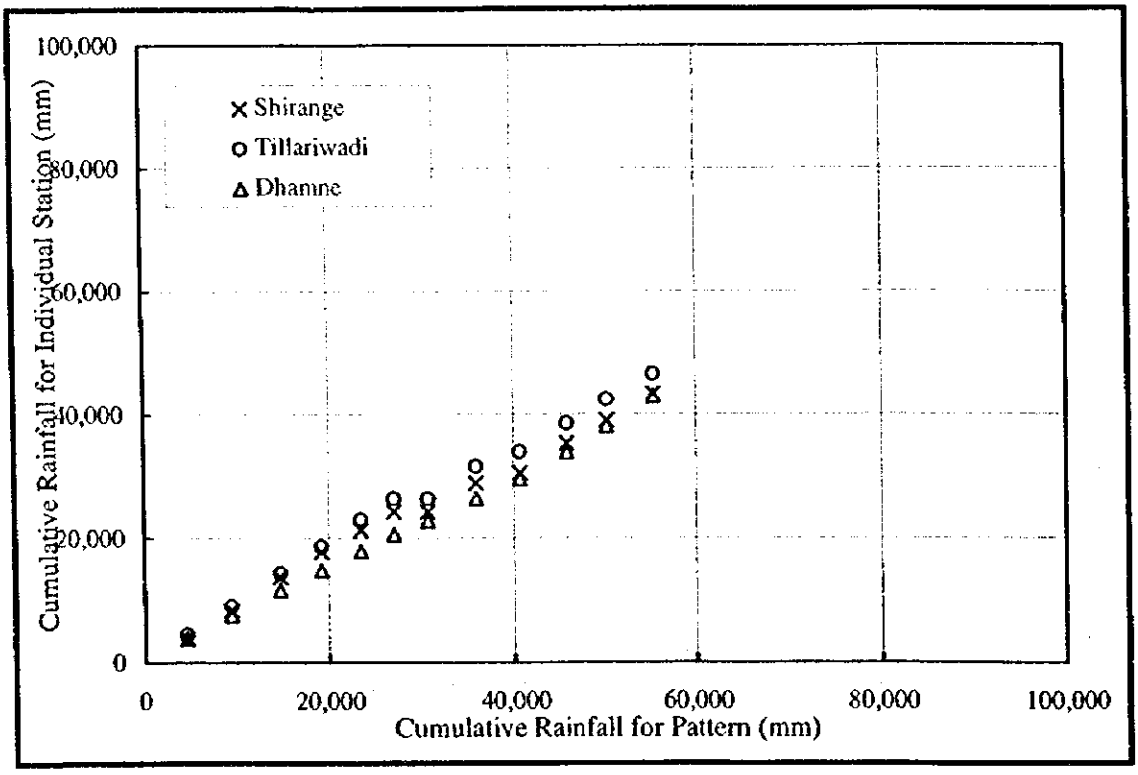


Fig. 11.3-8 Double-mass Curve of Rainfall Data, Hevale (2)
(1981 - 1992)

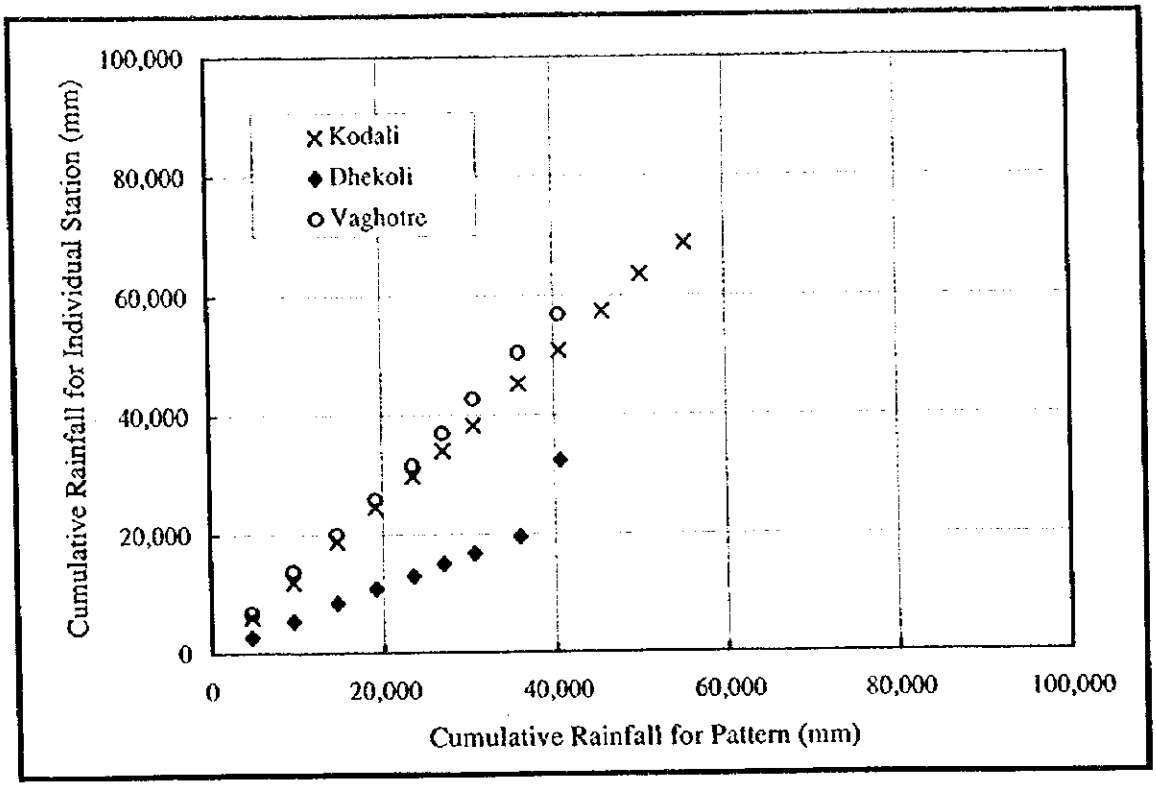


Fig. 11.3-9 Double-mass Curve of Rainfall Data, Hevale (3)
(1981 - 1992)

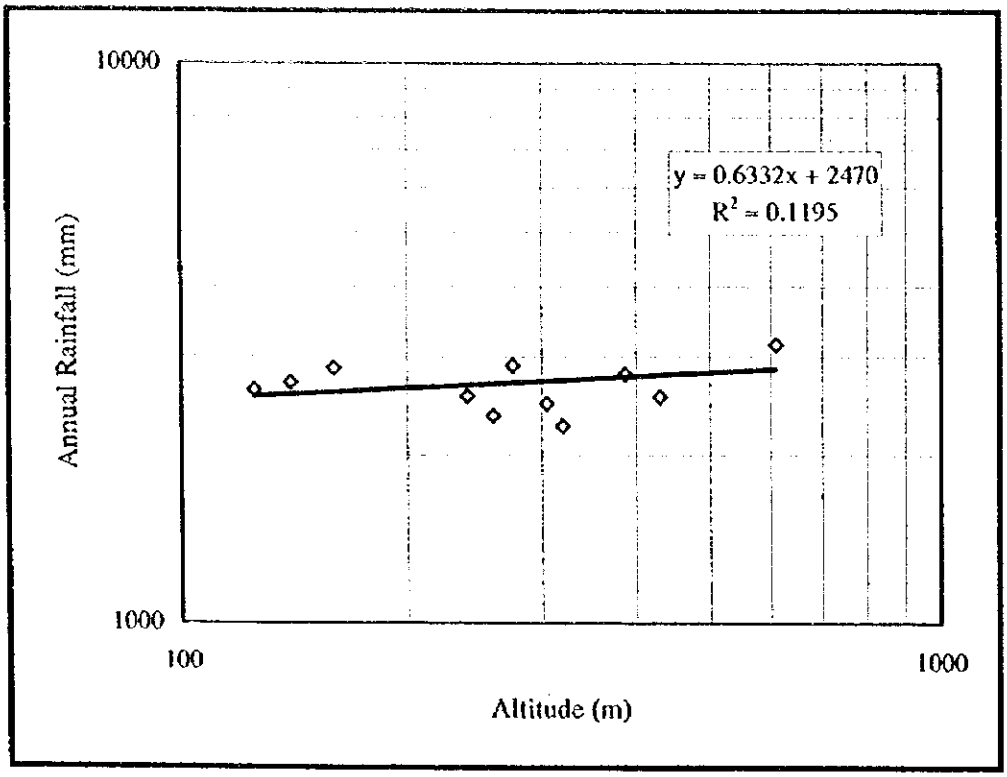


Fig. 11.3-10 Relation between Altitude and Rainfall (Jalond)

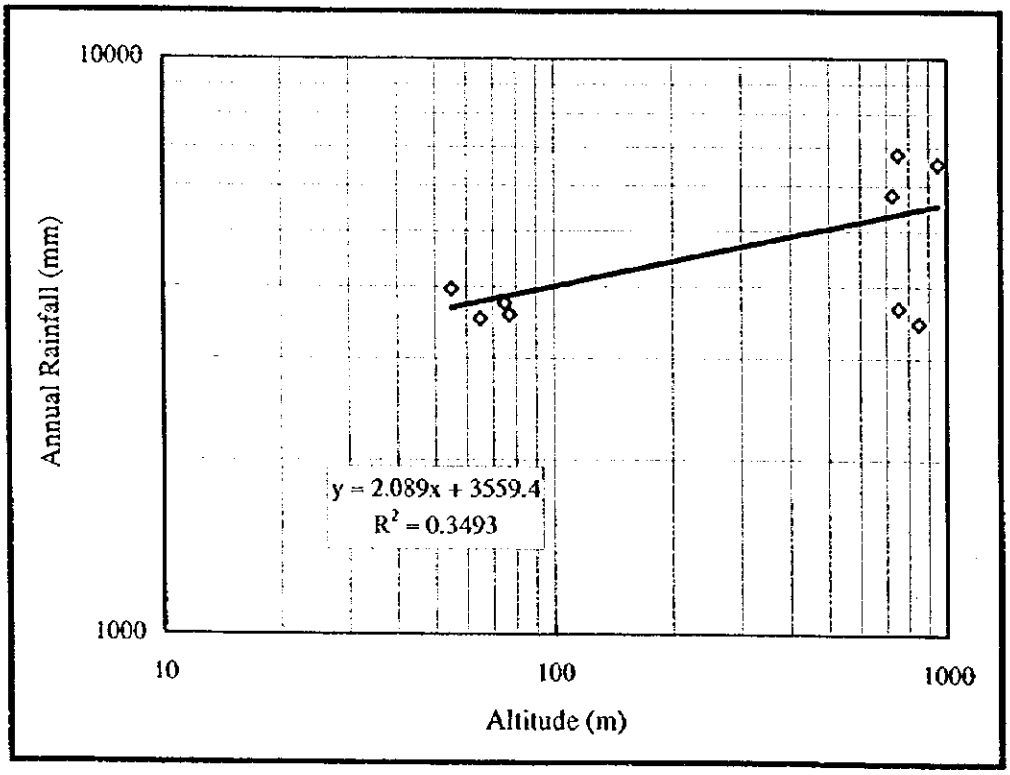


Fig. 11.3-11 Relation between Altitude and Rainfall (Hevale)

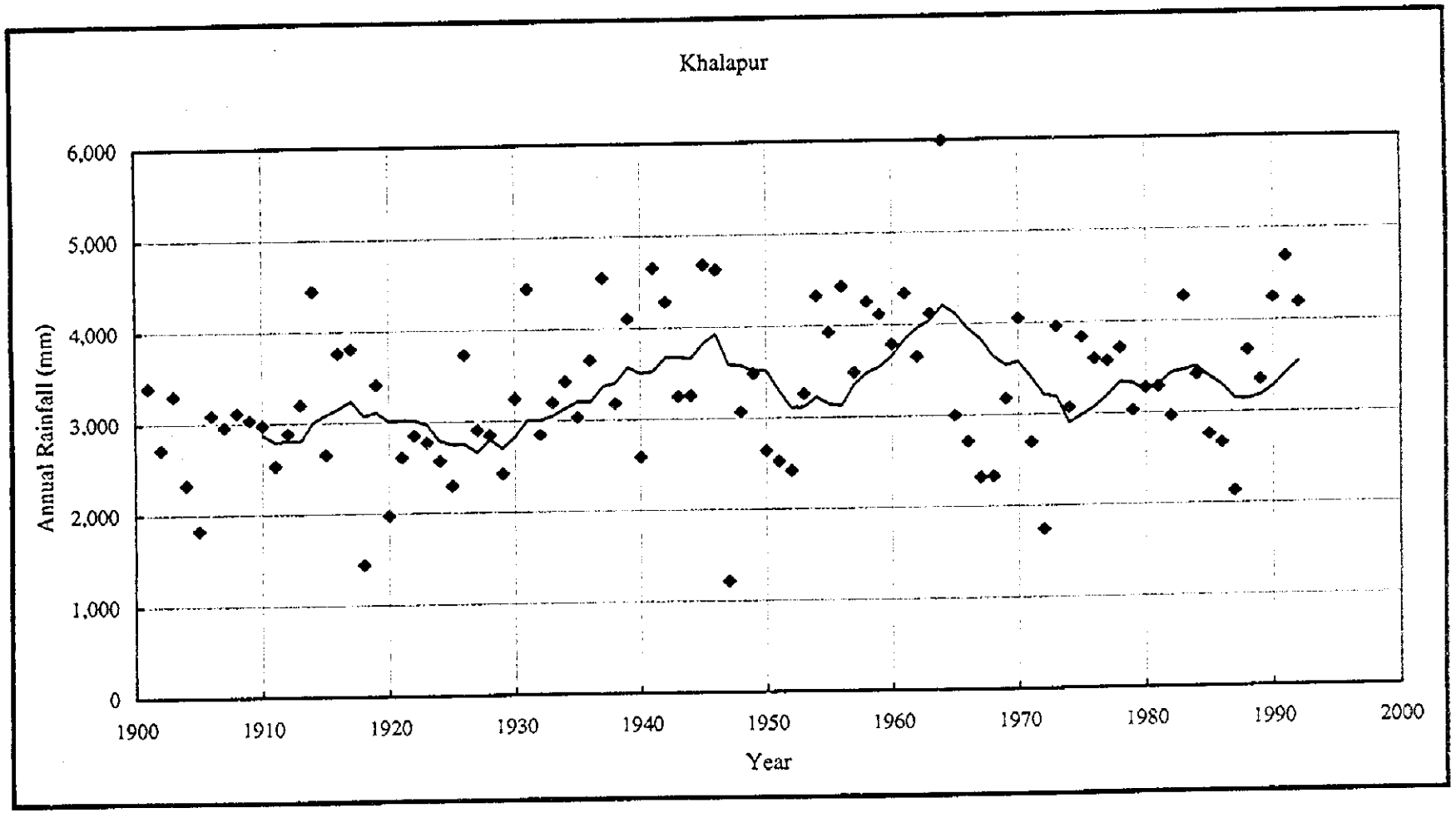


Fig. 11.3-12 10-year Moving Average for Khalapur

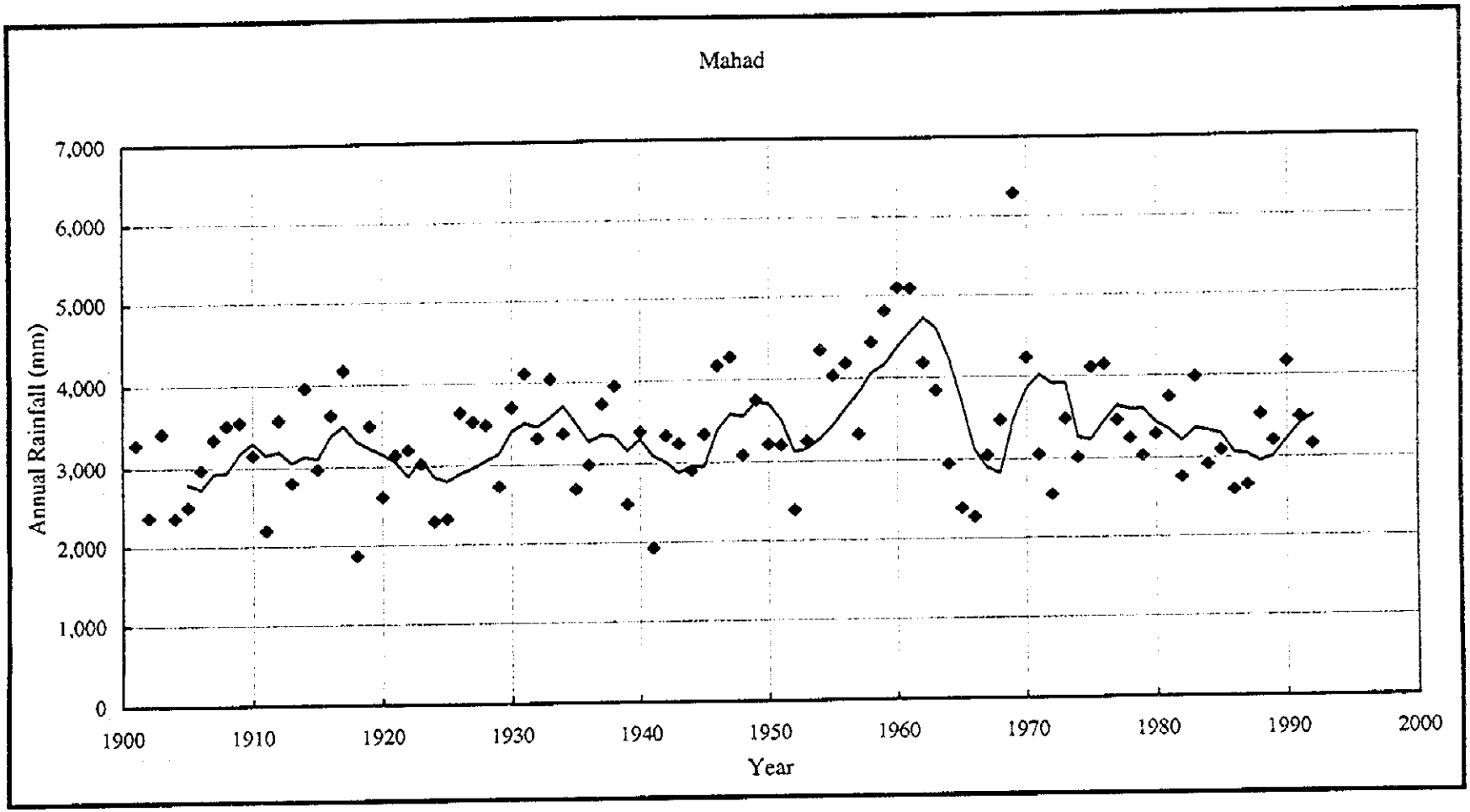


Fig. 11.3-13 5-year Moving Average for Mahad

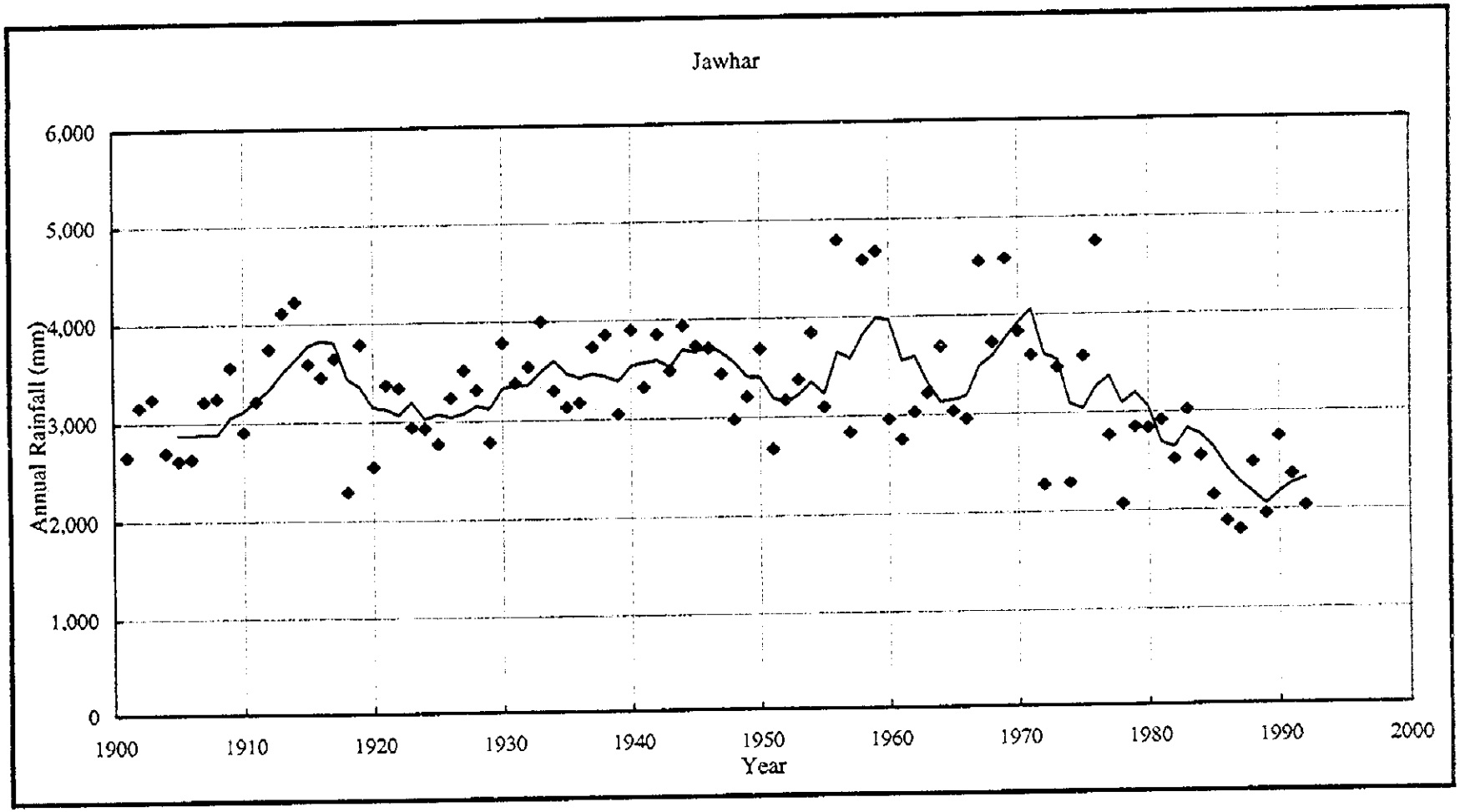


Fig. 11.3-14 5-year Moving Average for Jawhar

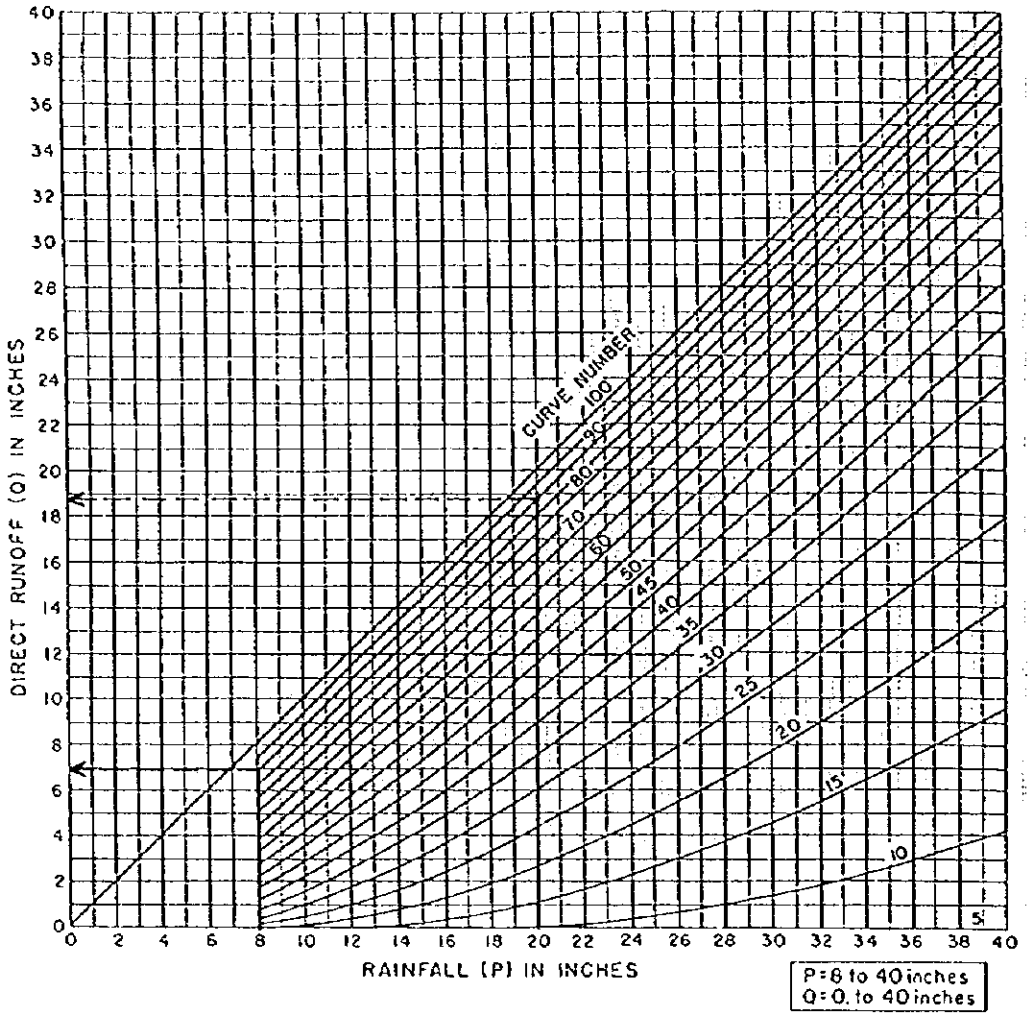


Fig. 11.4-1 Direct Run-off Curve

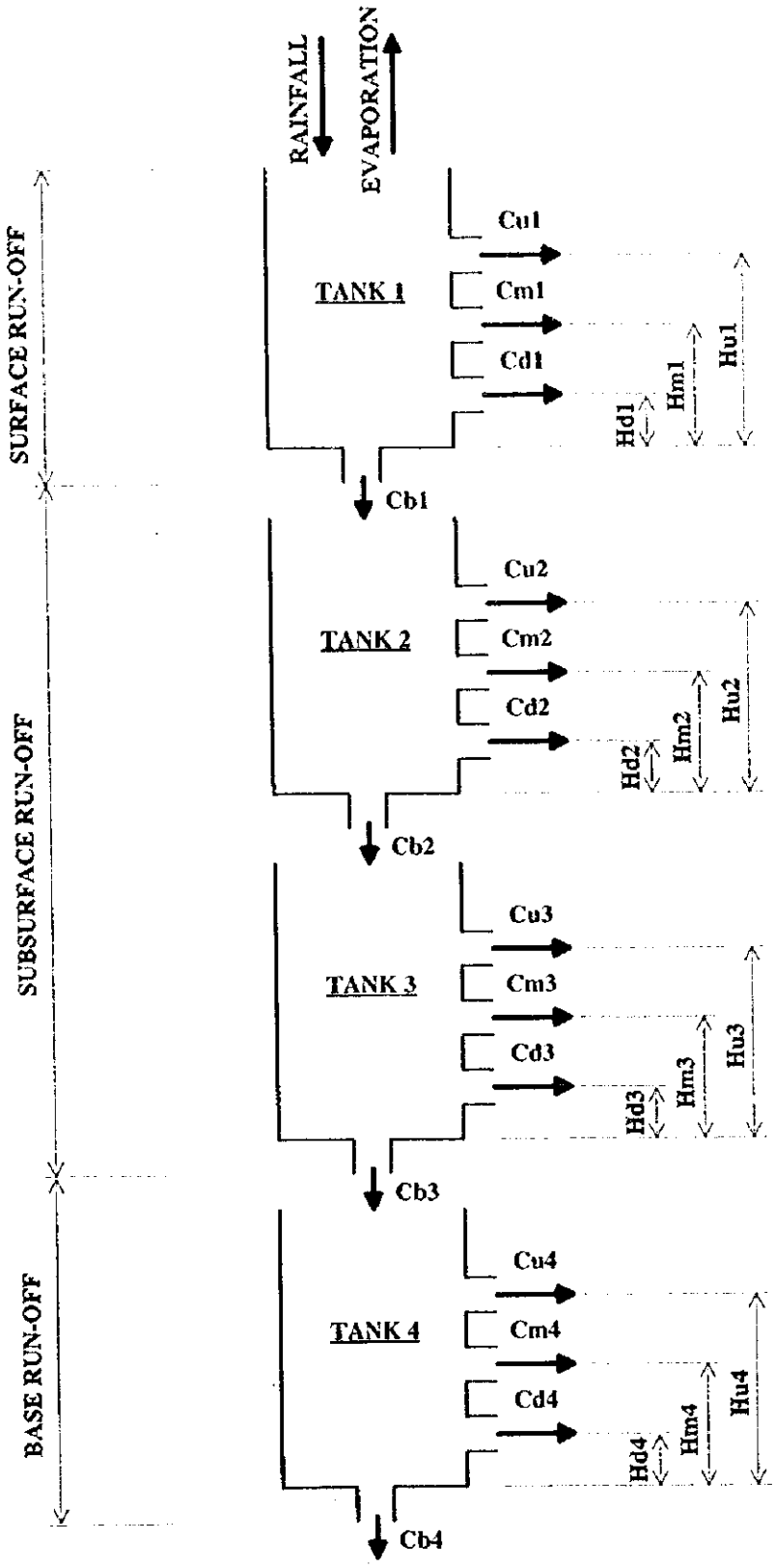


Fig. 11.4-2 Typical Layout of Tank Model

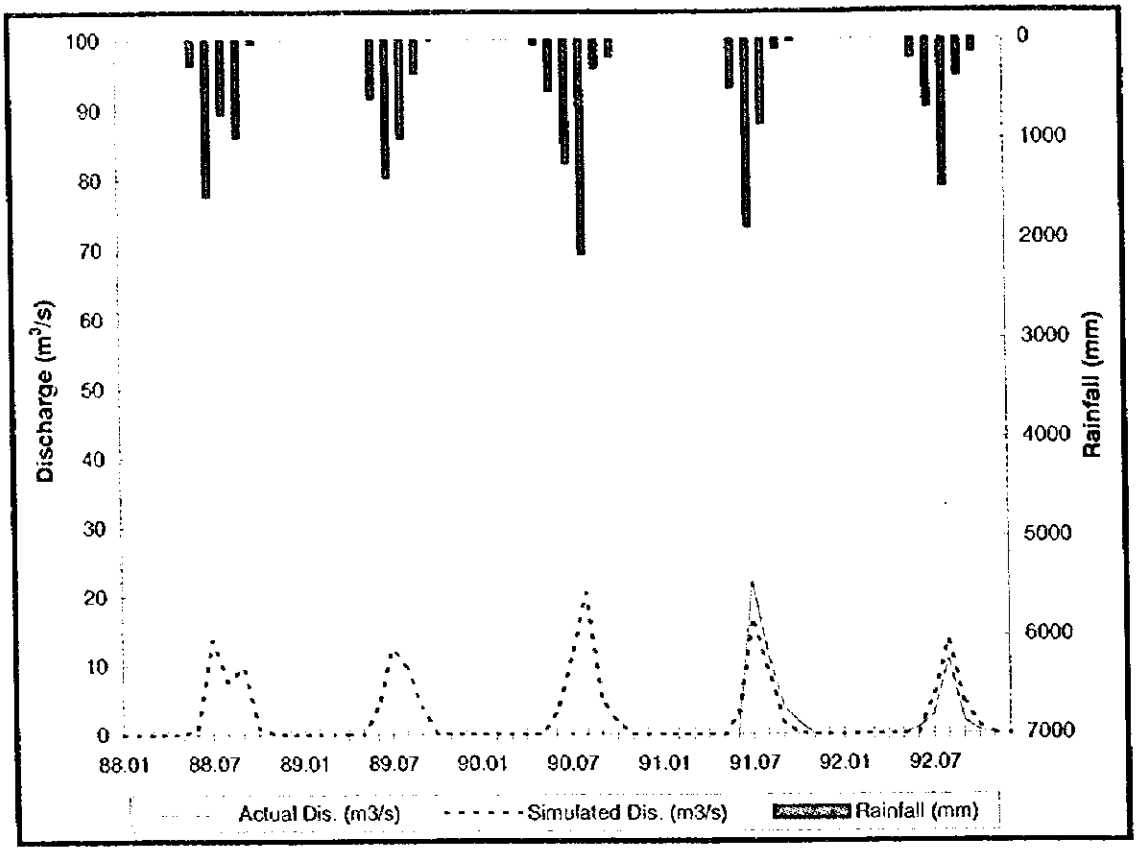
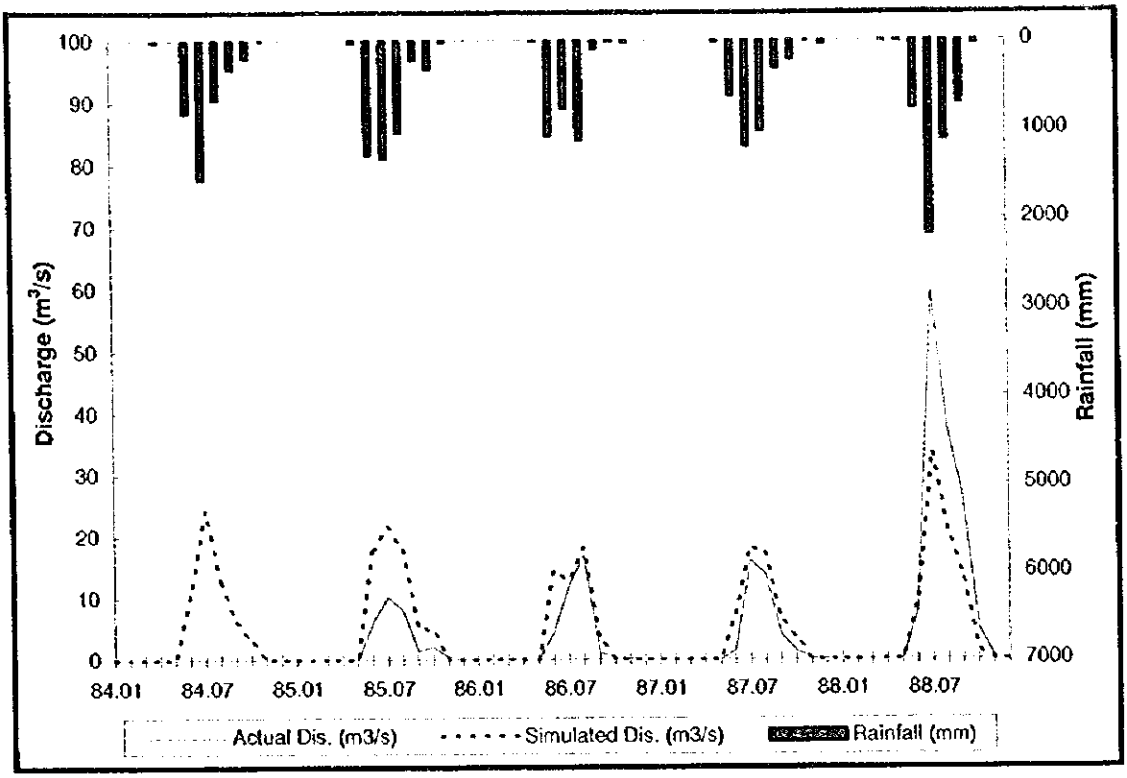


Fig. 11.4-3 Result of Low Flow Analysis for Sajgaon



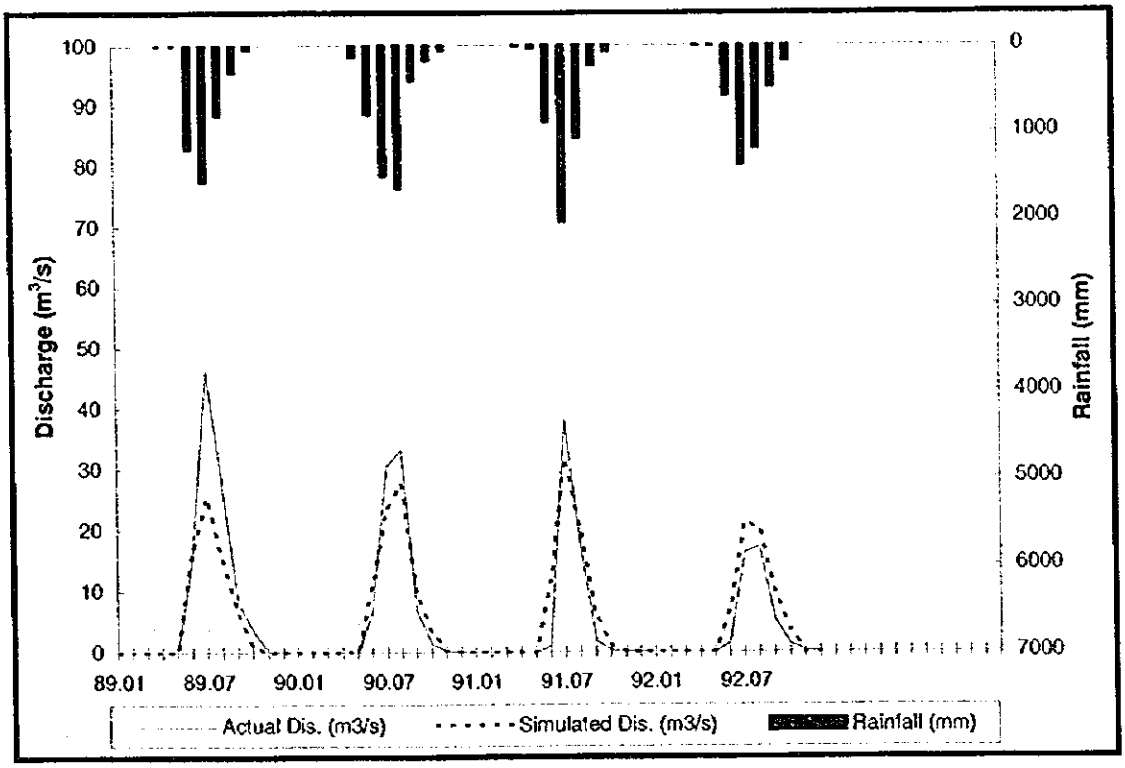


Fig. 11.4-4 Results of Low Flow Analysis for Pastewadi

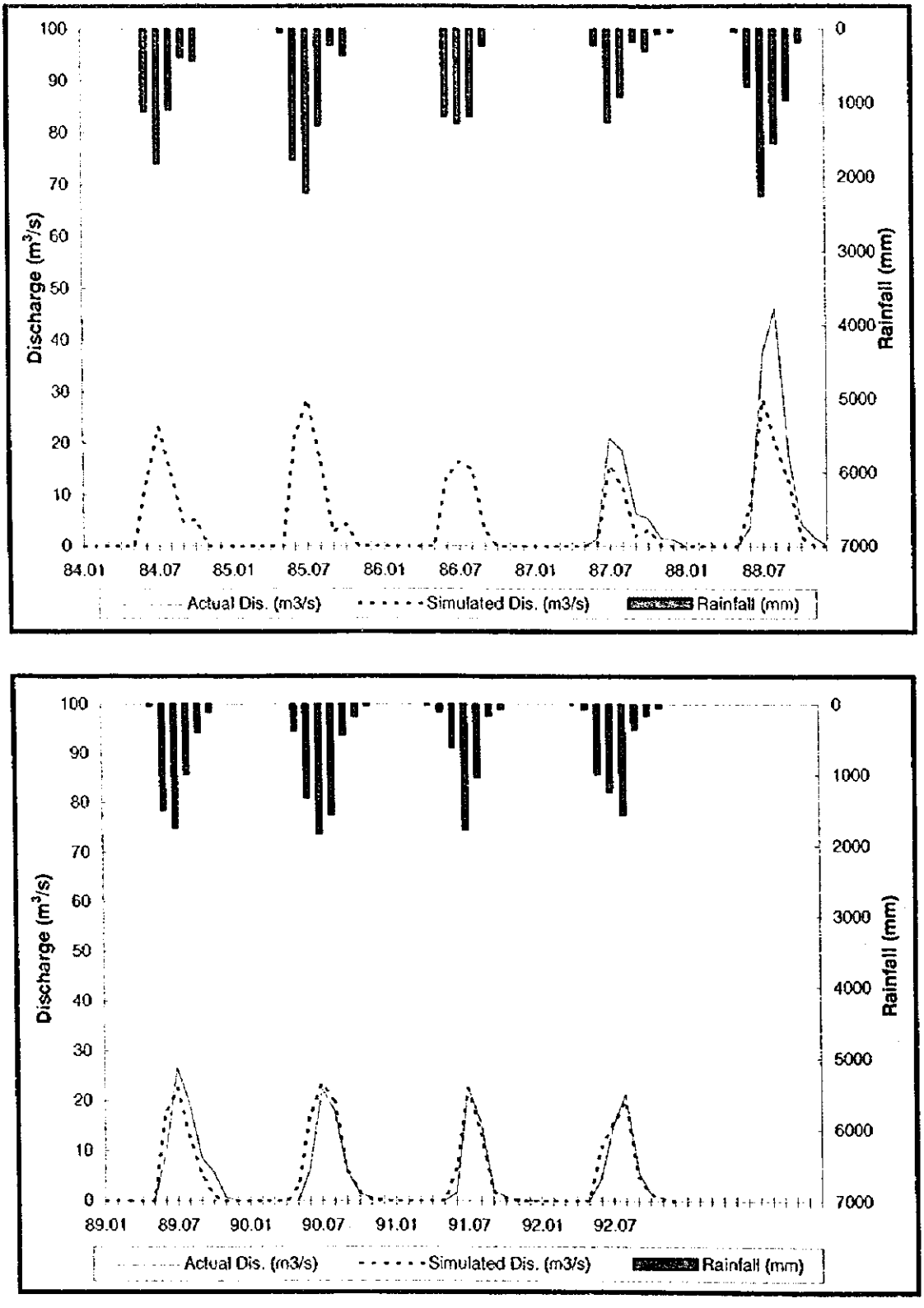


Fig. 11.4-5 Results of Low Flow Analysis for Shirshingi

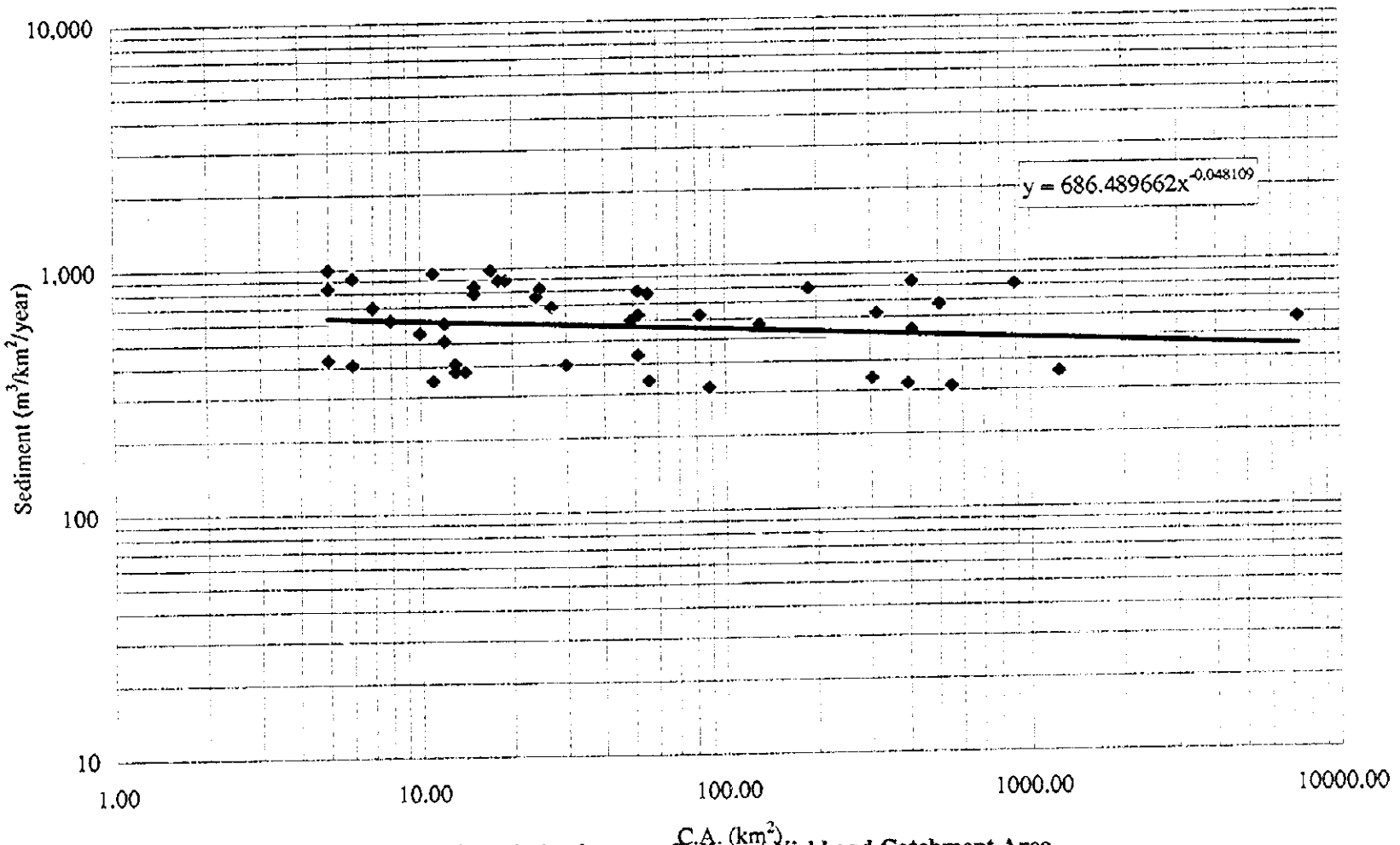
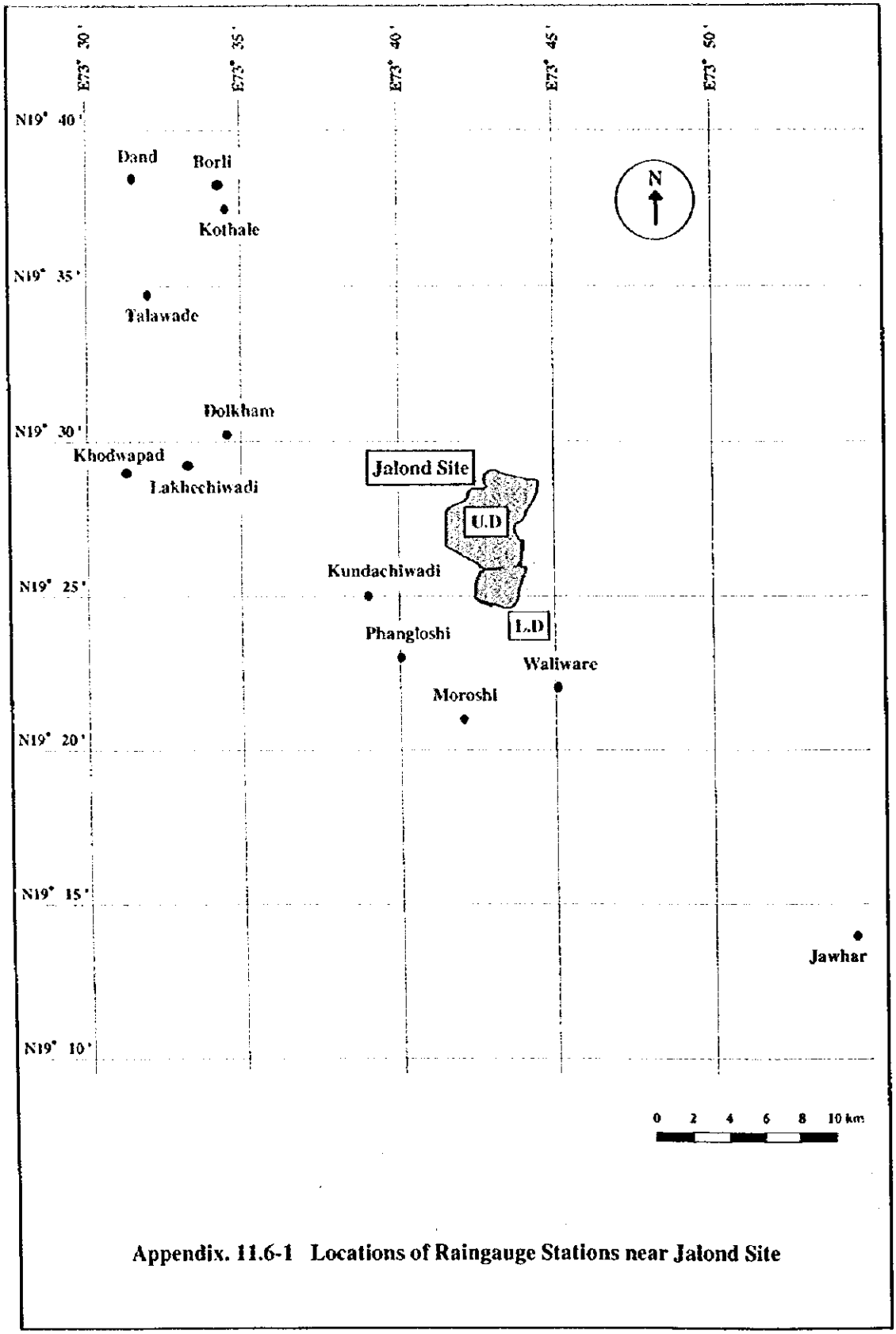
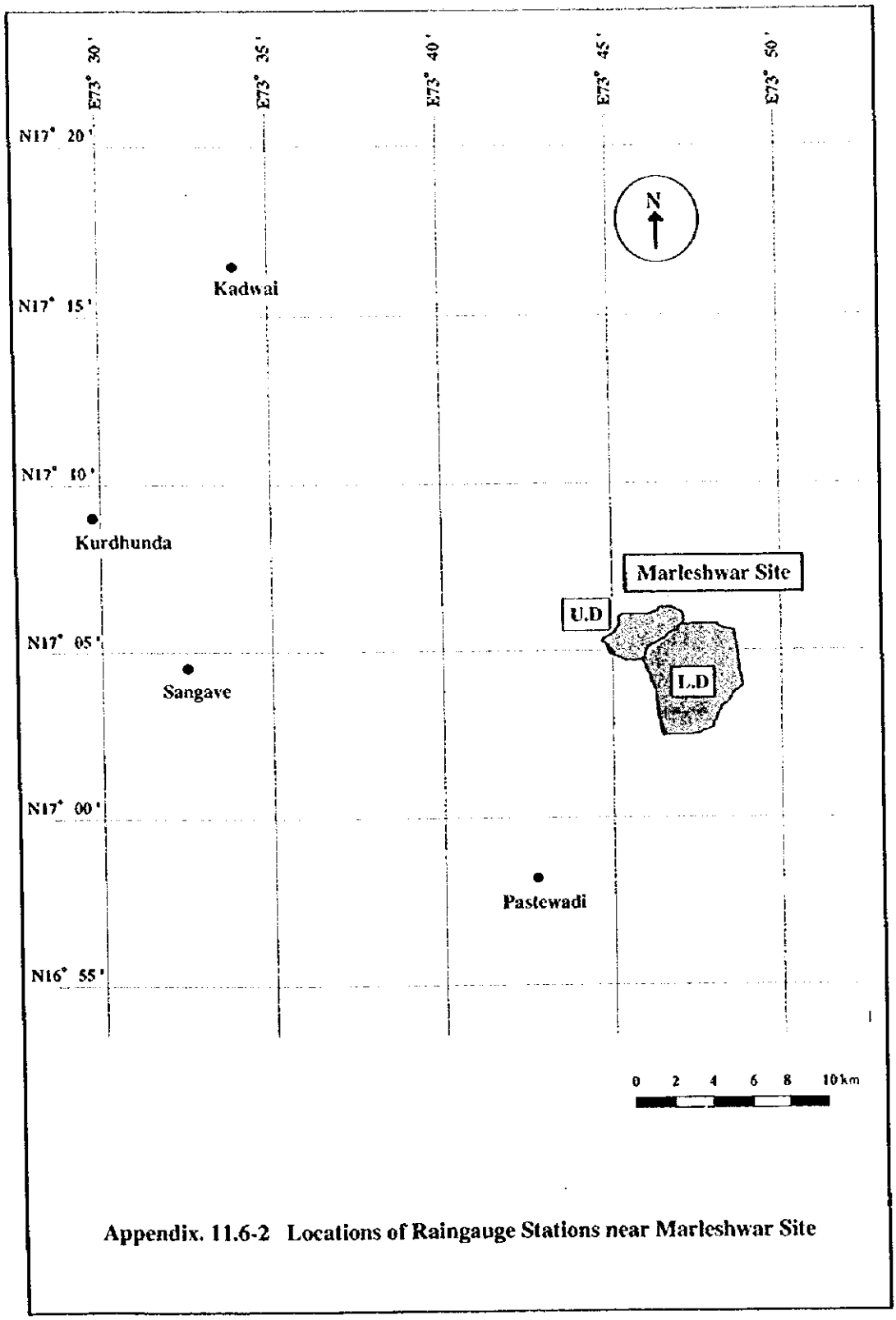


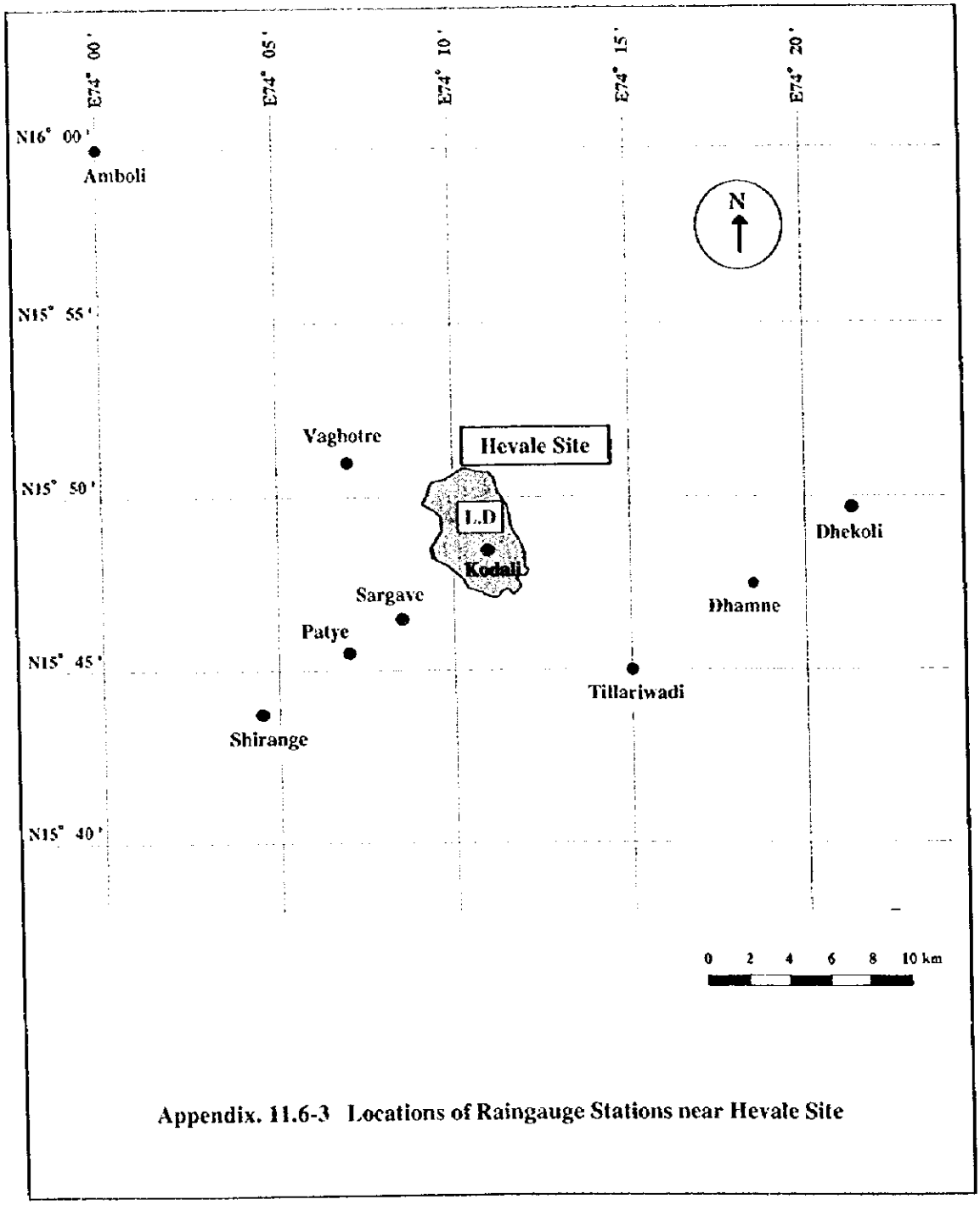
Fig. 11.7-1 Correlation between Sediment Yield and Catchment Area



Appendix. 11.6-1 Locations of Raingauge Stations near Jalond Site



Appendix. 11.6-2 Locations of Raingauge Stations near Marleshwar Site



Appendix. 11.6-3 Locations of Raingauge Stations near Hevale Site