# FINAL REPORT

## VOLUME III SUPPORTING REPORT

## C. HYDROLOGY

**STUDY**
**ON**
**INTEGRATED WATER RESOURCES DEVELOPMENT**
**IN THE CAÑETE RIVER BASIN**
**IN**
**THE REPUBLIC OF PERU**

**FINAL REPORT**
**VOLUME III**
**SUPPORTING REPORT**

# C: Hydrology

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# Chapter 1 Hydrology

## 1.1 Introduction

The hydrological aspects of the river basin have been studied by reviewing the previous study reports and available hydrological data. The results of the previous study reports are elaborated by use of additional up-to-date data and information.

### (1) River Basin

The Cañete river basin is located at the latitude 11°55'S to 13°15'S, the longitude 75°30'W to 76°30'W and the altitude 0 to 5,900 m. The basin boundary of the major tributaries and specific areas, and the longitudinal profile of the Cañete river are examined based on the 1:100,000 topographic map. The catchment area at the Socsi station is 5,890 $km^2$ and catchment areas at major points are shown on Figure 1.1.1.

The total length of the Cañete river mainstream is approximately 230 km and the average slope is 1/53 (=1.9%). Longitudinal profile of the Cañete river and the catchment area at major points are shown on Figure 1.1.2 and summarized in Table 1.1.1.

Average of annual mean rainfall at the rainfall stations in Cañete river basin ranges from 10 mm in lower basin to 900 mm in upper basin. The annual mean discharge at Socsi station is 45 $m^3/s$ and the basin average annual mean rainfall at the same station is estimated as 460 mm, therefore the annual run off ratio at Socsi station can be expressed as approximately 0.6.

### (2) Data Collection

Hydrological observations of rainfall and river water level in the Study Area have been operated by the following agencies:

- SENAMHI: Servicio Nacional de Meteorología e Hidrología
- ELECTROPERU
- SEDAPAL: Servicio de Agua Potable y Alcantarillado de Lima
- Cementos Lima S.A.

Available records of monthly rainfall at seven stations, daily rainfall at another eight stations and daily discharge at seven stations are collected and listed in Table 1.1.2.

All collected data are stored in digital medias to use for detailed analysis. Location of the gauging stations is shown on Figure 1.1.3. Monthly rainfall table based on the collected monthly data is compiled in the attached Data Book "Data on monthly rainfall based on the monthly data".

(3) Measurement of Water Level and Flow Velocity

Additional water level and flow velocity measurement was commenced by the Study Team at five stations in the selected three sites along the Cañete river. General location of three measurement sites is shown on Figure 1.1.4 and the progress of measurement is summarized in Table 1.1.3. These measurements have been continued during Phase I Study period. The results of these observations will be utilized to calibrate the discharge records, and to examine the hydro-geological conditions of the infiltration flow areas in the upper stretch of the Cañete river basin in Phase II Study.

## 1.2 Rainfall Analysis

(1) Available Daily Rainfall Data

Daily rainfall records from 1964 to 1997 at eight stations (Tanta, Vilca, Carania, Yauyos, Huantan, Colonia, Huangascar and Pacaran) in the Cañete river basin are collected.

Data on annual rainfall at these eight stations are summarized below.

**Annual Rainfall (mm)**

| Station | Elevation(m) | Maximum | Mean | Minimum |
|---|---|---|---|---|
| Tanta | 4,300 | 1,294.0 | 799.2 | 386.9 |
| Vilca | 3,800 | 3,073.9 | 909.8 | 256.4 |
| Carania | 3,850 | 916.3 | 545.2 | 184.7 |
| Yauyos | 2,850 | 872.0 | 356.4 | 21.7 |
| Huantan | 3,300 | 1,474.1 | 656.2 | 139.6 |
| Colonia | 3,350 | 805.1 | 453.5 | 116.9 |
| Huangascar | 2,550 | 647.1 | 272.2 | 89.4 |
| Pacaran | 700 | 41.1 | 14.9 | 0.7 |

Monthly rainfall tables based on the collected daily rainfall at each station are shown in Table 1.2.1 and the conditions of missing records are summarized in the following table.

**Daily Rainfall Records (34 years: 1964 - 1997)**

| Station | Sample (days) | Missing ratio |
|---|---|---|
| Tanta | 12,054 | 2.9% |
| Vilca | 12,263 | 1.3% |
| Carania | 12,034 | 3.1% |
| Yauyos | 9,190 | 26.0% |
| Huantan | 8,631 | 30.5% |
| Colonia | 8,764 | 29.4% |
| Huangascar | 11,961 | 3.7% |
| Pacaran | 8,299 | 33.2% |

Missing data in this period are filled with estimated daily rainfall by means of correlation method on close stations. Table 1.2.2 shows summary of correlation formula and coefficient on each station and the condition of the adopted correlation formula is illustrated on Figure 1.2.1. Correlation formulas are made on the monthly mean rainfall on any two rainfall stations because the correlations of daily rainfall dose not give a good correlation coefficient. The estimated complete daily rainfall series from 1964 to 1997 is compiled in the Data Book "Data on monthly rainfall estimated by the correlation method" as a monthly table of each station.

(2) Probability Analysis

Probability analysis of annual rainfall and annual maximum daily rainfall at the above eight stations are examined by means of Gumbel method (extreme value distribution).

Those results are compiled in the Data Book "Data on probability analysis of rainfall", and summarized in Table 1.2.3 and illustrated on Figure 1.2.2. Probable value on any return period can be calculated regardless of that sample size, but the accuracy of results and the limits of application depend on those sample sizes. These results can be applied for further study on probable design rainfall in consideration of those application limits.

(3) Areal Daily Rainfall

Basin average daily rainfall that is an average depth of rainfall over a specific area is estimated by means of the Thiessen method with the estimated complete daily rainfall series from 1964 to 1997. Figure 1.2.3 shows Thiessen polygon based on the available eight rainfall stations in Cañete river basin and those effective areas at particular points are shown in Table 1.2.4. Calculated basin average daily rainfalls from 1964 to 1997 at five hydrological stations (Tanta, Aguas Calientes, Tinco de Alis, Chavin and Socsi) are utilized as a basic input for runoff calculation mode. Estimated basin average rainfall is given in Table 1.2.5 as a monthly table and the annual value is summarized below.

**Basin Average Annual Rainfall (mm)**

| Point | Maximum | Mean | Minimum |
|---|---|---|---|
| Imperial | 834.9 | 459.1 | 119.3 |
| Socsi | 836.9 | 460.7 | 120.0 |
| Chavin | 1,182.6 | 662.4 | 203.1 |
| Tinco de Alis | 1,869.5 | 808.5 | 337.8 |
| Aguas Calientes | 1,288.1 | 780.5 | 386.3 |
| Tanta | 1,283.7 | 777.9 | 385.9 |

## 1.3 Runoff Analysis

(1) Available Daily Discharge Data

Records on daily mean discharge at following seven water level stations in the Cañete river basin are available within the period shown in the following table and a monthly discharge table based on the collected daily mean discharge is shown in Table 1.3.1.

**Summary of Water Level Station in the Cañete River Basin**

| Station | River | Catchment($km^2$) | Operation | Observation Period |
|---|---|---|---|---|
| Imperial | Cañete | 5,900 | SENAMHI | 1-Jan.-1926 - 30-Apr.-1968 |
| Socsi | Cañete | 5,890 | SENAMHI | 1-Jan.-1965 - |
| Chavin | Cañete | 3,265 | ELECTROPERU | 1-Jun.-1985 - |
| Tinco de Alis | Cañete | 930 | ELECTROPERU | 8-Feb.-1986 - |
| AguasCalientes | Cañete | 352 | ELECTROPERU | 1-Jul.-1986 - |
| Tanta | Cañete | 172 | ELECTROPERU | 1-Jul.-1986 - |
| Tomas | Alis | 142 | ELECTROPERU | 12-Feb.-1986 - |

Annual runoff ratio is calculated using the annual mean discharge based on the daily discharge records and the annual basin average rainfall at the each station. Annual runoff ratio at Tanta, Aguas Calientes, Tinco de Alis, Chavin, Socsi and Imperial station is 0.88, 0.72, 0.48, 0.46, 0.56 and 0.58, respectively. Conditions of these calculation results are compiled in the Data Book "Data on Annual runoff ratio". These runoff ratios are employed for the calibration of runoff calculation model at each station.

Missing data of daily discharge records from 1986 to 1997 at five stations (Tanta, Aguas Calientes, Tinco de Ails, Chavin and Socsi) are filled with estimated daily discharge by means of correlation method on close stations. The condition of missing records is summarized in the following table.

**Daily Discharge Record (12 years: 1986 - 1997)**

| Station | Sample (days) | Missing ratio |
|---|---|---|
| Tanta | 3,578 | 18.4% |
| Aguas Calientes | 2,969 | 32.3% |
| Tomas | 4,036 | 7.9% |
| Tinco de Alis | 3,805 | 13.2% |
| Chavin | 3,413 | 22.1% |
| Socsi | 4,382 | 0.0% |

Adopted correlation formulas and coefficients on each station are summarized in Table 1.3.2 and illustrated on Figure 1.3.1. Based on the estimated complete daily discharge series of from 1986 to 1997, annual mean discharge at Tanta, Aguas Calientes, Tinco de Alis, Chavin and Socsi station is 3.14, 5.82, 11.96, 33.83 and 44.92 $m^3/s$, respectively.

Figure 1.3.2 shows the duration curve of daily discharge from 1986 to 1997 at five stations. Monthly discharge based on the complete data series of daily discharge from 1986 to 1997 is applied to the preliminary water balance study and those monthly tables at each station are compiled in the Data Book "Data on monthly discharge estimated by the correlation method".

(2) Probability Analysis

Probability analysis of annual maximum daily discharge, annual maximum peak discharge, annual mean discharge and annual seasonal mean discharge, are examined.

These results will be discussed in the subsequent sections.

(3) Runoff Calculation

The Tank Model method is applied for runoff calculation model. Available daily discharge records at each station are utilized to calibrate the each basin model, and the complete data series of basin average daily rainfall from 1964 to 1997 are employed as the model input. Each parameter of five basin models (Tanta, Aguas Calientes, Tinco de Alis, Chavin and Socsi) is calibrated through trial and error processes, and summarized in Table 1.3.3.

Figure 1.3.3 shows the results of runoff calculation by Tank model. Principally, each basin model is calibrated in consideration of minimizing of the difference between observed and calculated discharge on the following conditions.

・Shape of the hydrograph in low water period
・Volume of discharge
・Characteristics of discharge duration curve

Results of the runoff calculation are adopted as complete daily discharge series from 1964 to 1997 when both of the observed daily discharge and the estimated

daily discharge by correlation method are not available. In conclusion, the complete daily discharge series from 1964 to 1997 in combination with the observed daily discharge, estimated daily discharge by correlation method and calculated daily discharge by Tank model, is applied for the detailed water balance study in the Cañete river basin and summarized in Table 1.3.4 as a monthly table of each station.

## 1.4 Flood Discharge

(1) Relationship between Daily Discharge and Peak Discharge

Available data on instantaneous flood peak discharge in Cañete river basin is limited in this study phase, and discharge hydrograph from 1986 to 1999 at Chavin station is only available for the study on characteristics of instantaneous flood peak discharge (peak discharge).

Relationship between daily mean discharge and peak discharge is studied to clarify characteristics of flood peak discharge at specific point. Using the results of probability analysis of annual maximum daily mean discharge and annual maximum instantaneous peak discharge at Chavin station (compiled in the Data Book "Data on probability analysis based on the discharge hydrograph at Chavin station"), the relationship between probable specific daily discharge of *T*-year return period ($q_{day}(T)$) and probable specific peak discharge of *T*-year return period ($q_{peak}(T)$) is examined.

The relationship is plotted on Figure 1.4.1 and can be expressed as following formula.

$$q_{peak}(T) = 1.42 \times (q_{day}(T) - 0.01) \qquad (q_{day}(T) > 0.034)$$

(2) Probable Daily Discharge

Annual maximum daily mean discharges at six stations (Tanta, Aguas Calientes, Tinco de Alis, Chavin Socsi and Imperial) are available in Cañete river basin. Using the results of probability analysis of these six stations, studies are made on probable specific daily discharge ($q_{day}(T)$. Results of probability analysis are compiled in the Data Book "Data on probability analysis of discharge". Probable specific daily discharge at each station is illustrated on Figure 1.4.2.

According to the Figure 1.4.2, results at Tanta and Aguas Calientes station as smaller catchment in upper basin show different characteristics from other stations in middle and lower basin, because of those rainfall characteristics, geological features, and so on.

Results of probable specific daily discharge at Socsi + Imperial (combination of data at Socsi and Imperial, those data can be combined because the catchment area and the location of both stations are considerably same) shows the highest value on return period more than 20-year among the results of middle and lower basin.

In consideration of accuracy and availability of data, results of probability analysis at Socsi + Imperial are to be used for further study. Probable specific daily discharge at Socsi + Imperial is summarized below and could be applied to the middle and lower Cañete river basin.

**Probable Specific Daily Discharge ($m^3/s/km^2$)**

| T | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 |
|---|---|---|---|---|---|---|---|---|
| $q_{dav}(T)$ | 0.0541 | 0.0791 | 0.0956 | 0.1115 | 0.1320 | 0.1474 | 0.1627 | 0.1829 |

(3) Probable Peak Discharge

On the assumption that two results mentioned in previous paragraphs could be applied to the middle and lower Cañete river basin, the probable peak discharge at particular point can be estimated by the probable specific peak discharge as summarized below.

This result will be applied for estimation of design flood.

**Probable Specific Peak Discharge ($m^3/s/km^2$)**

| T | 2 | 5 | 10 | 20 | 50 | 100 | 200 | 500 |
|---|---|---|---|---|---|---|---|---|
| $q_{peak}(T)$ | 0.0626 | 0.0981 | 0.1216 | 0.1441 | 0.1732 | 0.1951 | 0.2168 | 0.2455 |

## 1.5 Drought Discharge

(1) Available Data

Daily mean discharge at Socsi and Imperial station gives the longer observed records, and those data can be combined because the catchment area and the location of both stations are considerably same. Daily mean discharge at Socsi+Imperial (combination of data at Socsi and Imperial) from 1926 to 1997 is used for this study.

(2) Probability Analysis

Probable drought discharge is examined using log-extreme value distribution on annual mean discharge of hydrological water year that is a period of one year from September to August, and annual seasonal mean discharge in drought period as June to September, July to October and July to September. These

seasonal mean discharges are shown in Table 1.5.1 and results of the probability analysis are summarized in the following table and compiled in the Data Book "Data on probability analysis of discharge in low water period".

**Probable Drought Discharge ($m^3/s$)**

| Period | Statistical Parameters | | | Return period (year) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | ST-DV | 2 | 5 | 10 | 20 | 30 | 50 | 100 |
| Sep - Aug | 63 | 48.6 | 17.9 | 48.2 | 34.2 | 27.2 | 21.9 | 19.3 | 16.5 | 13.3 |
| Jun - Sep | 66 | 13.4 | 2.7 | 13.6 | 11.2 | 9.9 | 8.8 | 8.2 | 7.5 | 6.7 |
| Jul - Oct | 66 | 11.8 | 2.3 | 12.0 | 9.9 | 8.8 | 7.8 | 7.3 | 6.7 | 6.0 |
| Jul - Sep | 66 | 11.7 | 2.2 | 11.9 | 9.9 | 8.7 | 7.8 | 7.3 | 6.7 | 6.0 |

The seasonal drought discharge in 1960 and 1992 shows the droughtiest year within available records. According to the results, the drought magnitude can be estimated as approximately 20 to 30-year return period in 1960 and 30 to 50-year return period in 1992.

## 1.6 Sediment Load and Evaporation

(1) Sediment Load

El Platanal report in 1987 shows measurement record of sediment load at Chavin in 1986, with an estimate of annual volume of sediment load at 1.7 million tons, which suggest a specific yield at Chavin (3,265 $km^2$) to be 430 $m^3/km^2$/year (1$m^3$=1.2 ton).

The results of the measurement are listed in Table 1.6.1.

The same El Platanal report gives results of grain size analysis of riverbed materials on the following four samples and the results are shown on Figure 1.6.1.

- Sample 1: at "Puente Chavin", from the left bank
- Sample 2: about 1 km upstream from "Puente Chavin", from "river edge"
- Sample 3: at Central Platanal, from the sand beach
- Sample 4: at Central Platanal, from "river edge"

According to the Figure 1.6.1, there is an apparent distribution between the sample No.1 and 3 taken from the river sand bank, and sample No. 2 and 4 taken from riverbed.

Meanwhile about 80 % of the material taken from sand bank is smaller than 1 mm, the riverbed material includes only about 50 % finer than 1 mm and about 20 % of the material is lager than 2 mm. The difference can be probably be explained by the fact that the sand bank material includes a large portion of

suspended sediment load and wash load which deposited there during the flood season.

(2) Evaporation

Data on evaporation in the Cañete river basin are collected from three meteorological stations. Table 1.6.2 compares the annual and monthly mean evaporation recorded at the Cañete station at 150 m, the Pacaran station at 700 m and the Yauyos station at 2,850 m.

The table indicates that there is a clear trend as far as the three stations are concerned in annual mean evaporation, of which value increases as elevation rises, in spite that the temperature goes down as elevation rises. The fact implies that there may be more important factors which influence the value of evaporation, such as sunshine hour, wind velocity, relative humidity, etc.

It is also seen from the table that there is a reverse phenomenon between the records observed at stations situated at lower elevation in coastal area (Cañete and Pacaran) and those observed at stations located at wet catchment (Yauyos). The records at the former stations show high evaporation during the months from December to March and low evaporation in the months of June to August, whereas those at the latter station show high evaporation during the period of July to October. This may also be attributed to the fact that the sunshine hour is very short in the coastal areas during the period of June to August.

El Platanal report in 1987 gives an estimate of monthly rate (mm) of evaporation from reservoirs, as listed below.

**Free-water Surface Evaporation(mm)**

| Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yauyos | 60 | 46 | 49 | 68 | 91 | 105 | 116 | 119 | 111 | 106 | 100 | 86 | 1,057 |
| Pacaran | 91 | 90 | 103 | 88 | 77 | 59 | 61 | 69 | 80 | 90 | 91 | 98 | 997 |
| Cañete | 103 | 100 | 106 | 97 | 68 | 41 | 40 | 45 | 55 | 73 | 82 | 99 | 909 |

Note) Pan coefficient 0.75 is adopted.

# TABLES

# Table 1.1.1 Longitudinal Profile

| Section | Distance (km) | Elevation (m.msl) | Remarks |
|---|---|---|---|
| 0k | 0.0 | 0 | Estuary |
| | 2.5 | 25 | |
| | 5.0 | 50 | |
| 10k | 10.0 | 100 | |
| | 13.0 | 136 | |
| | 15.0 | 150 | |
| | 17.5 | 200 | |
| 20k | 20.0 | 234 | |
| | 21.2 | 250 | |
| | 25.0 | 290 | R Intake Weir (Station: Toma Imperial) |
| | 26.0 | 300 | |
| | 27.5 | 316 | R Station: Socsi (Socsi Bridge) |
| 30k | 30.0 | 343 | |
| | 30.2 | 345 | Proposed Intake Dam (Socsi) |
| | 30.7 | 350 | |
| | 35.0 | 400 | |
| | 38.8 | 450 | |
| 40k | 40.0 | 466 | |
| | 42.5 | 500 | |
| | 45.0 | 550 | |
| | 45.3 | 555 | Bridge |
| | 49.0 | 600 | |
| 50k | 50.0 | 627 | |
| | 51.7 | 650 | |
| | 55.0 | 700 | |
| | 57.5 | 750 | |
| | 59.0 | 783 | Proposed Intake Dam (Zuniga) |
| | 59.8 | 800 | |
| 60k | 60.0 | 808 | |
| | 61.0 | 850 | |
| | 64.0 | 900 | |
| | 67.0 | 950 | |
| | 68.0 | 967 | L Quebrada Una Huatana |
| | 69.3 | 988 | L Rio Huangascar |
| 70k | 70.0 | 1,000 | |
| | 72.0 | 1,033 | San Jeronimo Bridge |
| | 73.0 | 1,050 | |
| | 76.0 | 1,095 | L Rio Cacra |
| | 76.3 | 1,100 | |
| | 77.0 | 1,150 | L Rio Tupe |
| 80k | 80.0 | 1,195 | |
| | 80.3 | 1,200 | |
| | 81.5 | 1,250 | |
| | 82.0 | 1,300 | |
| | 84.0 | 1,350 | |
| | 85.5 | 1,400 | |
| | 88.0 | 1,428 | L Station: Chavin |
| | 89.9 | 1,450 | |
| 90k | 90.0 | 1,455 | |
| | 91.0 | 1,500 | |
| | 92.0 | 1,533 | Proposed Intake Dam (Capillucas) |
| | 92.5 | 1,550 | |
| | 93.5 | 1,564 | R Quebrada Cajalay |
| | 96.0 | 1,600 | |
| | 99.0 | 1,650 | |
| 100k | 100.0 | 1,665 | |
| | 102.0 | 1,696 | Potential Dam (Calachota) |
| | 102.5 | 1,704 | R Rio Aucampa |
| | 105.5 | 1,750 | |
| | 107.0 | 1,800 | |
| | 107.6 | 1,850 | |
| | 109.5 | 1,900 | |
| 110k | 110.0 | 1,931 | L Quebrada Pampas |
| | 110.3 | 1,950 | |
| | 112.0 | 2,000 | |
| | 113.0 | 2,020 | Potential Dam (Auco) |
| | 114.5 | 2,050 | |
| | 116.0 | 2,100 | |
| | 119.0 | 2,150 | |
| 120k | 120.0 | 2,183 | |
| | 120.5 | 2,200 | |
| | 122.0 | 2,250 | |
| | 123.0 | 2,300 | |
| | 126.5 | 2,344 | R Rio Yauyos |
| | 127.0 | 2,350 | |
| | 129.0 | 2,400 | |
| 130k | 130.0 | 2,433 | |
| | 130.5 | 2,450 | |
| | 131.5 | 2,500 | |
| | 133.0 | 2,550 | |
| | 134.0 | 2,600 | |
| | 135.0 | 2,625 | L Rio Huantan |
| | 136.0 | 2,650 | |
| | 137.5 | 2,700 | |
| 140k | 140.0 | 2,736 | |
| | 141.0 | 2,750 | |
| | 142.0 | 2,800 | Proposed Dam (Morro de Arica) |
| | 144.5 | 2,850 | |
| | 147.0 | 2,900 | |
| | 148.0 | 2,925 | L Rio Laraos |
| | 149.0 | 2,950 | |
| 150k | 150.0 | 2,975 | |
| | 151.0 | 3,000 | |
| | 153.0 | 3,050 | |
| | 154.5 | 3,100 | L Rio Alis |
| | 154.6 | 3,103 | Station: Tinco de Alis |
| | 156.0 | 3,150 | |
| | 157.0 | 3,200 | |
| | 157.5 | 3,213 | R Quebrada Miraflores |
| | 159.0 | 3,250 | |
| 160k | 160.0 | 3,300 | |
| | 160.7 | 3,350 | |
| | 161.0 | 3,355 | Lag. Piquicocha |
| | 164.0 | 3,400 | |
| | 166.5 | 3,450 | |
| | 167.0 | 3,500 | |
| | 168.0 | 3,550 | |
| 170k | 170.0 | 3,593 | |
| | 170.3 | 3,600 | |
| | 172.5 | 3,650 | |
| | 175.0 | 3,700 | |
| | 176.0 | 3,750 | |
| | 179.3 | 3,800 | |
| 180k | 180.0 | 3,821 | |
| | 181.0 | 3,850 | |
| | 186.0 | 3,900 | |
| | 186.3 | 3,915 | Quebrada Eslansa |
| | 187.0 | 3,950 | |
| 190k | 190.0 | 3,992 | |
| | 190.6 | 4,000 | |
| | 193.0 | 4,050 | |
| | 195.0 | 4,075 | Quebrada Chunararan |
| | 197.0 | 4,100 | |
| | 199.0 | 4,150 | |
| | 199.8 | 4,166 | Station: Aguas Calientes |
| 200k | 200.0 | 4,170 | |
| | 201.5 | 4,200 | |
| | 202.7 | 4,208 | Proposed Dam (Lag. Paucarcocha) |
| | 204.0 | 4,216 | Lag. Paucarcocha |
| | 209.2 | 4,250 | |
| 210k | 210.0 | 4,264 | |
| | 210.5 | 4,273 | Station: Tanta |
| | 212.0 | 4,300 | |
| | 213.5 | 4,350 | |
| | 216.5 | 4,400 | |
| 220k | 220.0 | 4,420 | |
| | 221.5 | 4,429 | |
| | 226.0 | 4,450 | |
| | 226.2 | 4,600 | |
| | 226.5 | 4,800 | |
| | 227.5 | 4,850 | Upper end |
| | 227.7 | 4,900 | |
| | 228.0 | 5,000 | |
| | 228.3 | 5,200 | |
| | 229.2 | 5,400 | |
| | 229.5 | 5,600 | |
| | 229.8 | 5,800 | |
| 230k | 230.0 | 5,897 | The highest: 5,897m |

Note) L : Left bank
R : Right bank

## Table 1.1.2 Data Collected

| Data | Station | N | 1960's | | | | | | | | | | 1970's | | | | | | | | | | 1980's | | | | | | | | | | 1990's | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Discharge | Imperial | 9 | D | D | D | D | D | D | D | D | D | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Discharge | Socsi | 33 | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | M | M | D | D | D | D | | D | D | D | D | D | D | D | | |
| Discharge | Chavin | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | | |
| Discharge | TincodeAlis | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | D | D | D | | | D | D | D | D | D | D | D | | |
| Discharge | AguasCalientes | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | D | D | D | | D | D | D | D | D | D | D | D | | |
| Discharge | Tanta | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | | |
| Discharge | Tomas | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Discharge Hydrograph | Chavin | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rainfall | Tanta | 35 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Rainfall | Vilca | 35 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Rainfall | Siria | 8 | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rainfall | Sunca | 8 | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rainfall | Yauricocha | 11 | M | M | M | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rainfall | Carania | 35 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Rainfall | Yauyos | 27 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | D | D | | | | | | | D | D | D | D | D | D | D | D | | |
| Rainfall | Huantan | 27 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | | | | | | | | |
| Rainfall | Colonia | 25 | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | | | | | | | | | |
| Rainfall | Huangascar | 34 | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Rainfall | Pacaran | 29 | | | | | | M | D | D | D | D | D | D | D | D | D | D | D | M | M | M | M | | | | | | | D | D | D | D | D | D | D | D | D | D | D | D | D |
| Rainfall | Canete | 34 | M | M | M | M | M | M | M | M | M | M | M | M | | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | | M | M | M | M | | | | |
| Rainfall | Huacarpana | 18 | | | | | | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | |
| Rainfall | Castrovirreyna | 13 | | | | | | | | M | M | M | M | M | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | | | | |
| Rainfall | Yanac | 15 | | | | | | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | | | | | | | | | | | | | | | | | | | | |

M: Monthly data
D: Daily data

# Table 1.1.3 Progress of Discharge Measurement

**(Cañete River Basin)**

| Gauging Nº | Date | Section Wide (m) | Section Area ($m^2$) | Mean Depth (m) | Mean Velocity (m/s) | Mean Level (m) | Discharge ($m^3/s$) | Method | Depth difference (H.I.) | Moist Perimeter (m) | Hydraulic Radio (m) | $R^{2/3}$ | $S^{0.5}/N$ | Observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **STATION :** | **TRAGADERO 1 (upstream of infiltration flow)** | | | | | | | | | | | | | |
| 1 | 18.07.1999 | 15.000 | 2.465 | 0.164 | 0.235 | 0.170 | 0.579 | 0.600 | -0.100 | 15.329 | 0.161 | 0.296 | 0.794 | |
| 2 | 01.08.1999 | 15.000 | 2.405 | 0.160 | 0.193 | 0.160 | 0.463 | 0.600 | -0.140 | 15.321 | 0.157 | 0.291 | 0.662 | |
| 3 | 01.08.1999 | 15.000 | 2.405 | 0.160 | 0.199 | 0.160 | 0.479 | 0.600 | -0.140 | 15.321 | 0.157 | 0.291 | 0.684 | |
| 4 | 15.08.1999 | 15.000 | 2.280 | 0.152 | 0.196 | 0.150 | 0.447 | 0.600 | -0.140 | 15.304 | 0.149 | 0.281 | 0.698 | |
| 5 | 15.08.1999 | 15.000 | 2.460 | 0.164 | 0.187 | 0.150 | 0.459 | 0.600 | -0.150 | 15.328 | 0.160 | 0.295 | 0.632 | |
| 6 | 02.09.1999 | 16.000 | 2.710 | 0.169 | 0.231 | 0.180 | 0.627 | 0.600 | -0.110 | 16.339 | 0.166 | 0.302 | 0.766 | |
| 7 | 02.09.1999 | 16.000 | 2.740 | 0.171 | 0.244 | 0.180 | 0.668 | 0.600 | -0.120 | 16.343 | 0.168 | 0.304 | 0.802 | |
| 8 | 16.09.1999 | 15.500 | 2.778 | 0.180 | 0.200 | 0.165 | 0.554 | 0.600 | -0.145 | 15.858 | 0.175 | 0.313 | 0.637 | |
| 9 | 16.09.1999 | 15.500 | 2.778 | 0.180 | 0.210 | 0.165 | 0.580 | 0.600 | -0.145 | 15.858 | 0.175 | 0.313 | 0.668 | |
| 10 | 01.10.1999 | 17.000 | 3.420 | 0.200 | 0.320 | 0.210 | 1.089 | 0.600 | -0.140 | 17.402 | 0.197 | 0.338 | 0.942 | |
| 11 | 01.10.1999 | 17.000 | 3.420 | 0.200 | 0.320 | 0.210 | 1.101 | 0.600 | -0.140 | 17.402 | 0.197 | 0.338 | 0.953 | |
| 12 | 02.10.1999 | 17.500 | 4.103 | 0.230 | 0.390 | 0.230 | 1.611 | 0.600 | -0.170 | 17.969 | 0.228 | 0.374 | 1.051 | |
| 13 | 15.10.1999 | 18.000 | 4.015 | 0.220 | 0.380 | 0.220 | 1.545 | 0.600 | -0.160 | 18.446 | 0.218 | 0.362 | 1.064 | |
| 14 | 15.10.1999 | 18.000 | 4.015 | 0.220 | 0.390 | 0.220 | 1.567 | 0.600 | -0.160 | 18.446 | 0.218 | 0.362 | 1.079 | |
| 15 | 15.10.1999 | 18.000 | 4.025 | 0.220 | 0.380 | 0.220 | 1.522 | 0.600 | -0.160 | 18.447 | 0.218 | 0.362 | 1.043 | |
| 16 | 01.11.1999 | 19.000 | 4.690 | 0.250 | 0.490 | 0.260 | 2.294 | 0.600 | -0.160 | 19.494 | 0.241 | 0.387 | 1.265 | |
| 17 | 01.11.1999 | 19.000 | 4.690 | 0.250 | 0.480 | 0.260 | 2.231 | 0.600 | -0.160 | 19.494 | 0.241 | 0.387 | 1.230 | |
| 18 | 02.11.1999 | 19.000 | 4.670 | 0.250 | 0.490 | 0.260 | 2.284 | 0.600 | -0.170 | 19.492 | 0.240 | 0.386 | 1.268 | |
| **STATION :** | **TRAGADERO 3 (downstream of infiltration flow)** | | | | | | | | | | | | | |
| 1 | 02.09.1999 | 9.000 | 1.783 | 0.198 | 0.089 | 0.250 | 0.158 | 0.600 | -0.140 | 9.396 | 0.190 | 0.330 | 0.268 | |
| 2 | 16.09.1999 | 8.500 | 1.195 | 0.140 | 0.050 | 0.200 | 0.059 | 0.600 | -0.100 | 8.781 | 0.136 | 0.265 | 0.185 | |
| 3 | 02.10.1999 | 9.000 | 2.338 | 0.260 | 0.150 | 0.350 | 0.352 | 0.600 | -0.110 | 9.519 | 0.246 | 0.392 | 0.384 | |
| 4 | 15.10.1999 | 9.000 | 2.288 | 0.250 | 0.170 | 0.330 | 0.382 | 0.600 | -0.140 | 9.508 | 0.241 | 0.387 | 0.432 | |
| 5 | 15.10.1999 | 9.000 | 2.128 | 0.240 | 0.170 | 0.330 | 0.367 | 0.600 | -0.090 | 9.473 | 0.225 | 0.369 | 0.466 | |
| 6 | 02.11.1999 | 10.000 | 3.290 | 0.330 | 0.220 | 0.440 | 0.728 | 0.600 | -0.160 | 10.658 | 0.309 | 0.457 | 0.484 | |
| 7 | 02.11.1999 | 10.000 | 3.290 | 0.330 | 0.240 | 0.440 | 0.778 | 0.600 | -0.160 | 10.658 | 0.309 | 0.457 | 0.518 | |
| **STATION :** | **UCHUCCHACA (upstream of filtration outflow)** | | | | | | | | | | | | | |
| 1 | 19.07.1999 | 14.000 | 1.970 | 0.141 | 0.032 | 0.260 | 0.064 | 0.600 | 0.020 | 14.281 | 0.138 | 0.267 | 0.122 | |
| 2 | 15.10.1999 | 15.000 | 4.170 | 0.280 | 0.150 | 0.420 | 0.630 | 0.600 | 0.010 | 15.556 | 0.268 | 0.416 | 0.364 | |
| 3 | 15.10.1999 | 15.000 | 4.170 | 0.280 | 0.140 | 0.420 | 0.577 | 0.600 | 0.010 | 15.556 | 0.268 | 0.416 | 0.333 | |
| 4 | 01.11.1999 | 15.000 | 5.735 | 0.380 | 0.290 | 0.500 | 1.656 | 0.600 | -0.050 | 15.765 | 0.364 | 0.510 | 0.567 | |
| 5 | 01.11.1999 | 15.000 | 5.735 | 0.380 | 0.270 | 0.500 | 1.553 | 0.600 | -0.050 | 15.765 | 0.364 | 0.510 | 0.531 | |
| **STATION :** | **PACHACHACA (downstream of filtration outflow)** | | | | | | | | | | | | | |
| 1 | 19.07.1999 | 16.000 | 3.990 | 0.249 | 0.471 | 0.210 | 1.881 | 0.600 | -0.300 | 16.499 | 0.242 | 0.388 | 1.215 | |
| 2 | 02.08.1999 | 16.000 | 3.960 | 0.248 | 0.479 | 0.210 | 1.897 | 0.600 | -0.330 | 16.495 | 0.240 | 0.386 | 1.240 | |
| 3 | 16.08.1999 | 16.000 | 3.740 | 0.234 | 0.467 | 0.200 | 1.748 | 0.600 | -0.300 | 16.468 | 0.227 | 0.372 | 1.256 | |
| 4 | 16.08.1999 | 16.000 | 3.770 | 0.236 | 0.462 | 0.200 | 1.743 | 0.600 | -0.300 | 16.471 | 0.229 | 0.374 | 1.236 | |
| 5 | 01.09.1999 | 16.000 | 3.810 | 0.238 | 0.444 | 0.190 | 1.692 | 0.600 | -0.320 | 16.476 | 0.231 | 0.377 | 1.179 | |
| 6 | 01.09.1999 | 16.000 | 3.780 | 0.236 | 0.441 | 0.190 | 1.667 | 0.600 | -0.310 | 16.473 | 0.229 | 0.375 | 1.177 | |
| 7 | 15.09.1999 | 16.000 | 3.920 | 0.250 | 0.410 | 0.190 | 1.622 | 0.600 | -0.330 | 16.490 | 0.238 | 0.384 | 1.078 | |
| 8 | 15.09.1999 | 16.000 | 3.930 | 0.250 | 0.430 | 0.190 | 1.698 | 0.600 | -0.330 | 16.491 | 0.238 | 0.384 | 1.124 | |
| 9 | 01.10.1999 | 16.000 | 4.200 | 0.260 | 0.400 | 0.200 | 1.686 | 0.600 | -0.350 | 16.525 | 0.254 | 0.401 | 1.000 | |
| 10 | 01.10.1999 | 16.000 | 4.200 | 0.260 | 0.440 | 0.200 | 1.834 | 0.600 | -0.350 | 16.525 | 0.254 | 0.401 | 1.088 | |
| 11 | 15.10.1999 | 16.000 | 5.310 | 0.330 | 0.500 | 0.270 | 2.656 | 0.600 | -0.340 | 16.664 | 0.319 | 0.467 | 1.072 | |
| 12 | 15.10.1999 | 16.000 | 5.310 | 0.330 | 0.540 | 0.270 | 2.860 | 0.600 | -0.340 | 16.664 | 0.319 | 0.467 | 1.154 | |
| 13 | 01.11.1999 | 16.000 | 6.280 | 0.390 | 0.610 | 0.330 | 3.827 | 0.600 | -0.370 | 16.785 | 0.374 | 0.519 | 1.174 | |
| 14 | 01.11.1999 | 16.000 | 6.280 | 0.390 | 0.630 | 0.330 | 3.940 | 0.600 | -0.370 | 16.785 | 0.374 | 0.519 | 1.208 | |
| **STATION :** | **PUENTE CHAVIN** | | | | | | | | | | | | | |
| 1 | 02.08.1999 | 28.500 | 17.030 | 0.598 | 0.863 | 0.830 | 14.690 | 0.600 | -0.170 | 29.695 | 0.573 | 0.690 | 1.250 | |
| 2 | 02.08.1999 | 28.500 | 16.720 | 0.590 | 0.850 | 0.830 | 14.303 | 0.600 | -0.170 | 29.673 | 0.563 | 0.682 | 1.255 | |
| 3 | 17.08.1999 | 28.500 | 16.065 | 0.564 | 0.847 | 0.800 | 13.604 | 0.600 | -0.200 | 29.627 | 0.542 | 0.665 | 1.273 | |
| 4 | 17.08.1999 | 28.500 | 16.065 | 0.564 | 0.777 | 0.800 | 12.484 | 0.600 | -0.200 | 29.627 | 0.542 | 0.665 | 1.169 | |
| 5 | 18.08.1999 | 28.500 | 16.153 | 0.567 | 0.818 | 0.800 | 13.209 | 0.600 | -0.180 | 29.634 | 0.545 | 0.667 | 1.225 | |
| 6 | 18.08.1999 | 28.500 | 16.153 | 0.567 | 0.756 | 0.800 | 12.209 | 0.600 | -0.180 | 29.634 | 0.545 | 0.667 | 1.133 | |
| 7 | 03.09.1999 | 28.500 | 15.615 | 0.548 | 0.755 | 0.790 | 11.790 | 0.600 | -0.190 | 29.596 | 0.528 | 0.653 | 1.156 | |
| 8 | 03.09.1999 | 28.500 | 15.615 | 0.548 | 0.804 | 0.790 | 12.559 | 0.600 | -0.190 | 29.596 | 0.528 | 0.653 | 1.232 | |
| 9 | 16.09.1999 | 28.500 | 13.178 | 0.460 | 0.820 | 0.760 | 10.795 | 0.600 | -0.190 | 29.425 | 0.448 | 0.585 | 1.399 | |
| 10 | 17.09.1999 | 26.000 | 14.843 | 0.570 | 0.760 | 0.790 | 11.233 | 0.600 | 0.010 | 27.142 | 0.547 | 0.669 | 1.132 | |
| 11 | 17.09.1999 | 26.000 | 14.843 | 0.570 | 0.800 | 0.770 | 11.844 | 0.600 | -0.010 | 27.142 | 0.547 | 0.669 | 1.193 | |
| 12 | 03.10.1999 | 26.000 | 15.815 | 0.610 | 0.810 | 0.800 | 12.817 | 0.600 | -0.050 | 27.217 | 0.581 | 0.696 | 1.164 | |
| 13 | 03.10.1999 | 26.000 | 15.815 | 0.610 | 0.830 | 0.800 | 13.077 | 0.600 | -0.050 | 27.217 | 0.581 | 0.696 | 1.187 | |
| 14 | 17.10.1999 | 26.000 | 17.123 | 0.660 | 0.850 | 0.840 | 14.588 | 0.600 | -0.030 | 27.317 | 0.627 | 0.732 | 1.163 | |
| 15 | 17.10.1999 | 26.000 | 17.123 | 0.660 | 0.890 | 0.840 | 15.164 | 0.600 | -0.030 | 27.317 | 0.627 | 0.732 | 1.209 | |
| 16 | 03.11.1999 | 26.000 | 17.783 | 0.680 | 0.900 | 0.860 | 16.031 | 0.600 | -0.030 | 27.368 | 0.650 | 0.750 | 1.202 | |
| 17 | 03.11.1999 | 26.000 | 17.783 | 0.680 | 0.930 | 0.860 | 16.457 | 0.600 | -0.030 | 27.368 | 0.650 | 0.750 | 1.234 | |

# Table 1.2.1 Rainfall Records



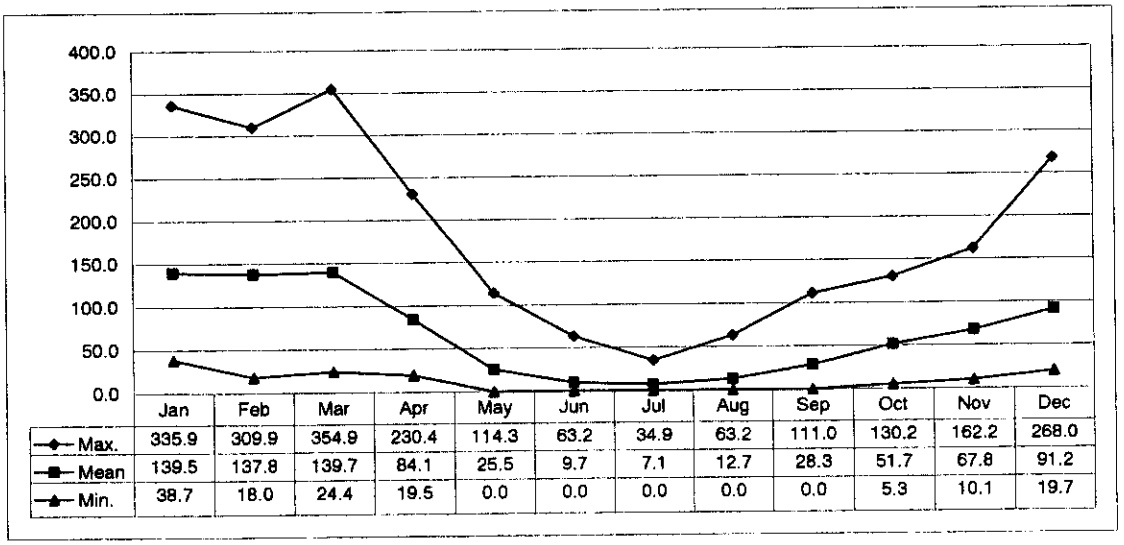
**Monthly Rainfall (mm)**

Station: Tanta

Longitude: W 76° 01'
Latitude: S 12° 08'
Altitude: 4,300

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 89.9 | 159.7 | 212.1 | 93.4 | 21.1 | 6.5 | 0.0 | 1.1 | 10.0 | 49.8 | 68.3 | 76.3 | 788.2 |
| 1965 | 98.1 | 274.7 | 114.3 | 67.0 | 29.5 | 0.0 | 7.6 | 1.1 | 3.1 | 44.8 | 10.1 | 90.7 | 741.0 |
| 1966 | 159.6 | 115.3 | 159.3 | 99.5 | 21.3 | 0.0 | 0.0 | 4.4 | 32.6 | 84.2 | 79.6 | 151.1 | 906.9 |
| 1967 | 184.1 | 233.4 | 133.6 | 52.8 | 42.8 | 0.0 | 15.3 | 3.7 | 22.8 | 100.7 | 25.9 | 43.8 | 858.9 |
| 1968 | 138.6 | 138.6 | 134.1 | 38.6 | 5.1 | 0.0 | 2.2 | 23.3 | 68.9 | 116.3 | 69.7 | 75.5 | 810.9 |
| 1969 | 94.7 | 163.6 | 125.4 | 114.7 | 0.0 | 4.3 | 0.0 | 5.1 | 40.3 | 113.9 | 143.7 | 268.0 | 1,073.7 |
| 1970 | 335.9 | 18.0 | 135.5 | 160.5 | 74.3 | 0.0 | 8.6 | 0.0 | 111.0 | 29.3 | 109.9 | 187.7 | 1,170.7 |
| 1971 | 76.8 | 180.5 | 215.3 | 69.9 | 0.0 | 0.0 | 0.0 | 28.1 | 0.0 | 35.3 | 48.3 | 185.6 | 839.8 |
| 1972 | 131.0 | 75.4 | 354.9 | 230.4 | 0.0 | 0.0 | 14.4 | 9.0 | 0.0 | 63.5 | 94.5 | 78.4 | 1,051.5 |
| 1973 | 230.4 | 108.0 | 185.7 | 153.9 | 56.1 | 0.0 | 6.3 | 18.3 | 104.6 | 125.5 | 87.2 | 159.7 | 1,235.7 |
| 1974 | 259.2 | 259.5 | 250.2 | 111.7 | 22.8 | 17.5 | 0.0 | 30.8 | 15.7 | 29.8 | 84.9 | 103.8 | 1,185.9 |
| 1975 | 111.0 | 109.6 | 218.4 | 196.6 | 84.3 | 10.7 | 0.0 | 16.1 | 58.2 | 91.1 | 42.2 | 84.8 | 1,023.0 |
| 1976 | 159.7 | 160.3 | 127.8 | 34.7 | 22.3 | 25.4 | 14.8 | 8.2 | 0.0 | 21.0 | 40.5 | 56.6 | 671.3 |
| 1977 | 131.8 | 115.8 | 141.3 | 74.9 | 19.5 | 0.0 | 0.0 | 1.0 | 14.9 | 32.2 | 68.7 | 52.5 | 652.6 |
| 1978 | 71.0 | 84.3 | 95.3 | 77.3 | 24.5 | 3.5 | 0.0 | 11.0 | 27.8 | 53.2 | 18.4 | 30.2 | 496.5 |
| 1979 | 43.1 | 100.6 | 97.9 | 53.8 | 17.0 | 6.2 | 0.0 | 0.0 | 8.1 | 12.6 | 26.3 | 21.3 | 386.9 |
| 1980 | 71.1 | 36.4 | 90.5 | 19.5 | 2.2 | 0.0 | 9.7 | 9.6 | 5.5 | 71.7 | 77.0 | 57.4 | 450.6 |
| 1981 | 92.0 | 182.1 | 219.3 | 29.4 | 0.0 | 0.0 | 0.0 | 9.6 | 16.1 | 31.8 | 49.9 | 41.0 | 671.2 |
| 1982 | 95.6 | 73.8 | 79.4 | 57.8 | - | 0.0 | 3.1 | 4.5 | 12.5 | 31.6 | 94.6 | 47.0 | - |
| 1983 | - | - | - | - | - | - | - | - | - | 9.1 | 21.8 | 56.7 | - |
| 1984 | 102.1 | 122.4 | 84.9 | 50.7 | 50.6 | 63.2 | 1.0 | 5.3 | 2.3 | 14.2 | 46.9 | 73.7 | 617.3 |
| 1985 | 101.2 | 90.7 | 115.6 | 95.7 | 21.1 | 15.7 | 12.1 | 18.9 | 3.4 | 25.5 | 37.7 | 47.8 | 585.4 |
| 1986 | 105.9 | 182.9 | 146.2 | 151.4 | 114.3 | 59.1 | 34.9 | 63.2 | 76.6 | 130.2 | 59.5 | 78.2 | 1,202.4 |
| 1987 | 175.6 | 132.3 | 37.0 | 24.3 | 0.0 | 7.2 | 9.3 | 20.1 | 5.8 | 13.0 | 30.6 | 48.3 | 503.5 |
| 1988 | 72.1 | 67.1 | 100.2 | 51.1 | 8.4 | 3.4 | 7.8 | 12.2 | 3.1 | 5.3 | 51.6 | 65.3 | 447.6 |
| 1989 | 98.4 | 72.0 | 107.9 | 50.5 | 15.4 | 3.1 | 5.6 | 16.1 | 9.7 | 28.1 | 120.4 | 19.7 | 546.9 |
| 1990 | 38.7 | 32.7 | 64.1 | 79.7 | 15.8 | 16.9 | 24.9 | 19.8 | 34.6 | 11.3 | 85.6 | 67.7 | 491.8 |
| 1991 | 108.7 | 88.3 | 73.7 | 71.4 | 45.6 | 16.1 | 11.7 | 14.7 | 3.4 | 22.6 | 53.9 | 42.8 | 552.9 |
| 1992 | 61.2 | 52.3 | 78.5 | 20.6 | 3.1 | 6.7 | 13.6 | 14.6 | 15.1 | 47.1 | 56.2 | 81.0 | 450.0 |
| 1993 | 213.4 | 243.7 | 199.6 | 120.7 | 29.6 | 8.5 | 7.5 | 8.5 | 35.7 | 101.4 | 162.2 | 163.2 | 1,294.0 |
| 1994 | 228.7 | 309.9 | 154.4 | 103.4 | 33.0 | 33.2 | 14.4 | 9.6 | 87.6 | 38.4 | 86.3 | 97.6 | 1,196.5 |
| 1995 | 213.4 | 76.5 | 165.7 | 54.9 | 13.4 | 2.6 | 1.7 | 0.0 | 36.8 | 66.1 | 81.4 | 135.6 | 848.1 |
| 1996 | 223.9 | 230.5 | 166.0 | 129.8 | 16.1 | 0.0 | 0.0 | 11.4 | 16.6 | 61.4 | 34.8 | 134.1 | 1,024.6 |
| 1997 | 177.1 | 253.6 | 24.4 | 36.1 | 5.4 | - | - | 21.4 | 50.2 | 45.6 | 135.1 | 178.0 | - |
| 1998 | 248.4 | 142.1 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 335.9 | 309.9 | 354.9 | 230.4 | 114.3 | 63.2 | 34.9 | 63.2 | 111.0 | 130.2 | 162.2 | 268.0 | 1,294.0 |
| Mean | 139.5 | 137.8 | 139.7 | 84.1 | 25.5 | 9.7 | 7.1 | 12.7 | 28.3 | 51.7 | 67.8 | 91.2 | 799.2 |
| Min. | 38.7 | 18.0 | 24.4 | 19.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.3 | 10.1 | 19.7 | 386.9 |
| N | 34 | 34 | 33 | 33 | 32 | 32 | 32 | 33 | 33 | 34 | 34 | 34 | 31 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 335.9 | 309.9 | 354.9 | 230.4 | 114.3 | 63.2 | 34.9 | 63.2 | 111.0 | 130.2 | 162.2 | 268.0 |
| Mean | 139.5 | 137.8 | 139.7 | 84.1 | 25.5 | 9.7 | 7.1 | 12.7 | 28.3 | 51.7 | 67.8 | 91.2 |
| Min. | 38.7 | 18.0 | 24.4 | 19.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.3 | 10.1 | 19.7 |

# Table 1.2.1 Rainfall Records

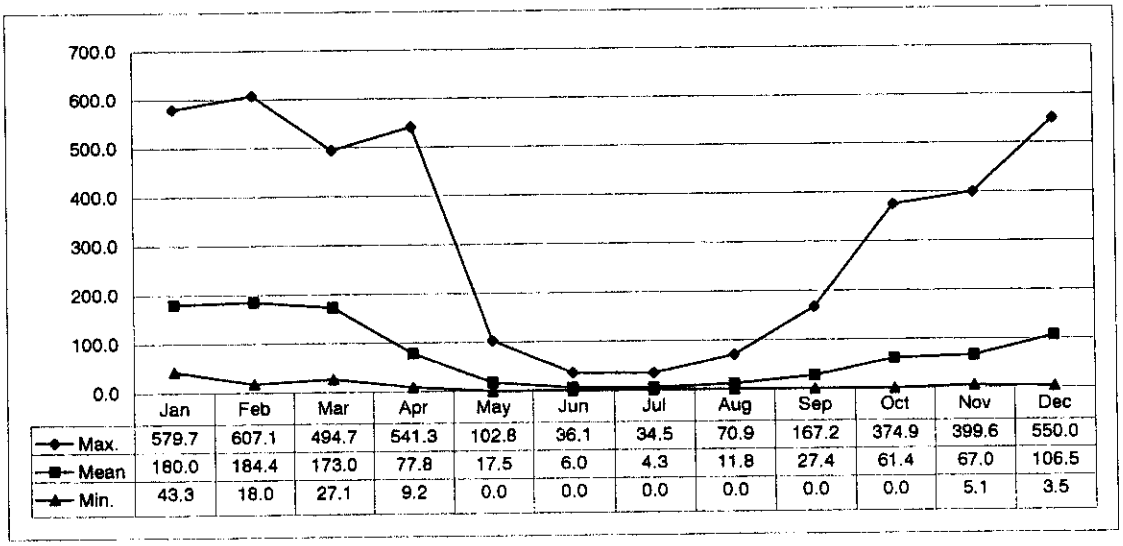
**Monthly Rainfall (mm)**

Station: Vilca

Longitude: W 75° 49'
Latitude: S 12° 07'
Altitude: 3,800

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 236.2 | 209.7 | 128.2 | 143.2 | 20.1 | 0.0 | 0.0 | 0.0 | 29.0 | 57.0 | 36.8 | 42.8 | 903.0 |
| 1965 | 120.9 | 225.2 | 135.4 | 37.7 | 11.2 | 0.0 | 15.8 | 32.4 | 60.2 | 61.5 | 68.7 | 141.7 | 910.7 |
| 1966 | 189.4 | 103.7 | 179.0 | 51.8 | 21.0 | 9.9 | 3.4 | 1.8 | 51.2 | 170.3 | 148.7 | 190.2 | 1,120.4 |
| 1967 | 283.2 | 450.2 | 454.1 | 38.4 | 10.4 | 10.9 | 9.6 | 20.5 | 53.7 | 95.6 | 123.2 | 116.2 | 1,666.0 |
| 1968 | 168.3 | 199.2 | 114.5 | 27.6 | 1.5 | 8.5 | 0.0 | 0.3 | 12.6 | 45.1 | 64.3 | 3.5 | 645.4 |
| 1969 | 43.3 | 66.3 | 41.3 | - | 8.0 | 0.2 | 0.0 | 2.9 | 37.7 | 57.4 | 42.9 | 190.9 | - |
| 1970 | 142.2 | 102.3 | 89.7 | 63.4 | 26.3 | 0.0 | 0.0 | 0.0 | 42.7 | 66.9 | 39.9 | 114.9 | 688.3 |
| 1971 | 173.0 | 216.1 | 133.5 | 9.2 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 7.4 | 61.3 | 601.8 |
| 1972 | 106.9 | 100.2 | 200.6 | 21.9 | 0.3 | 0.0 | 1.1 | 0.0 | 8.1 | 88.0 | 67.1 | 67.2 | 661.4 |
| 1973 | 123.5 | 105.0 | 105.3 | 29.5 | 1.7 | 0.0 | 0.0 | 8.8 | 8.4 | 56.5 | 169.2 | 177.2 | 785.1 |
| 1974 | 254.7 | 210.5 | 155.8 | 38.1 | 5.5 | 9.3 | 0.0 | 70.9 | 0.0 | 18.0 | 9.4 | 44.9 | 817.1 |
| 1975 | 98.9 | 189.3 | 227.4 | 47.7 | 5.0 | 0.0 | 0.0 | 6.3 | 32.2 | - | 97.6 | 167.8 | - |
| 1976 | 294.0 | 149.3 | 193.1 | 62.3 | 0.9 | 0.0 | 0.0 | 29.8 | 47.4 | 0.0 | 5.1 | 27.3 | 809.2 |
| 1977 | 117.9 | 198.9 | 169.9 | 28.2 | 0.0 | 0.0 | 1.2 | 0.0 | 0.5 | 23.3 | 55.3 | 33.3 | 628.5 |
| 1978 | 147.2 | 172.1 | 77.3 | 28.3 | 0.0 | 0.0 | 2.0 | 4.8 | 2.4 | 9.4 | 17.8 | 58.7 | 520.0 |
| 1979 | 54.7 | 213.8 | 281.1 | 31.0 | 0.8 | 0.0 | 0.0 | 0.9 | 2.1 | 6.2 | 15.8 | 49.5 | 655.9 |
| 1980 | 62.3 | 63.2 | 263.4 | 55.4 | 6.9 | 0.0 | 1.5 | 0.0 | 10.5 | 156.5 | 63.6 | 85.5 | 768.8 |
| 1981 | 234.5 | 270.7 | 310.8 | 136.5 | 1.0 | 0.0 | 0.0 | 0.0 | 14.1 | 54.0 | 92.0 | 76.9 | 1,190.5 |
| 1982 | 252.9 | 217.9 | 176.6 | 99.2 | 0.0 | 7.4 | 0.0 | 0.0 | 3.1 | 18.6 | 53.7 | 73.3 | 902.7 |
| 1983 | 92.5 | 101.9 | 49.6 | 32.3 | 13.0 | 7.1 | 0.0 | 0.0 | 6.2 | 0.0 | 13.3 | 38.0 | 353.9 |
| 1984 | 153.7 | 346.0 | 201.5 | 140.9 | 102.8 | 36.1 | 0.0 | 0.0 | 0.0 | 39.4 | 62.0 | 144.5 | 1,226.9 |
| 1985 | 141.9 | 145.9 | 139.2 | 43.4 | 32.5 | 27.8 | 4.4 | 0.0 | 19.6 | 36.5 | 46.0 | 51.8 | 689.0 |
| 1986 | 239.4 | 269.0 | 231.0 | 167.1 | 54.9 | 0.0 | 2.0 | 0.0 | 17.0 | - | 7.9 | 71.2 | - |
| 1987 | 331.1 | 146.0 | 74.1 | 18.4 | 3.5 | 13.0 | 0.0 | 0.0 | 14.3 | 101.7 | 117.2 | 122.3 | 941.6 |
| 1988 | 228.1 | 210.0 | 228.3 | 124.9 | 54.7 | 5.1 | 0.0 | 0.0 | 18.6 | 43.8 | 51.3 | 156.1 | 1,120.9 |
| 1989 | 169.8 | 190.6 | 182.2 | 81.8 | 23.9 | 15.0 | 5.3 | 0.0 | 14.6 | 14.7 | 54.5 | 76.6 | 829.0 |
| 1990 | 120.0 | 86.2 | 58.2 | 56.1 | 9.6 | 2.3 | 7.2 | 16.1 | 18.7 | 29.6 | 28.2 | 38.9 | 471.1 |
| 1991 | 62.8 | 33.6 | 126.2 | 76.6 | 4.5 | 0.8 | 0.0 | 28.8 | 37.8 | 0.0 | 17.6 | 40.3 | 429.0 |
| 1992 | 88.0 | 18.0 | 50.7 | 21.2 | 13.5 | 9.9 | 9.4 | 2.0 | 0.0 | 0.4 | 11.4 | 31.9 | 256.4 |
| 1993 | 141.5 | 173.0 | 90.6 | 114.2 | 50.7 | 11.7 | 31.5 | 28.2 | 167.2 | 374.9 | 399.6 | 550.0 | 2,133.1 |
| 1994 | 579.7 | 607.1 | 494.7 | 541.3 | 65.7 | 21.1 | 14.3 | 70.6 | 120.4 | 213.0 | 69.1 | 276.9 | 3,073.9 |
| 1995 | 336.0 | 251.0 | 433.3 | 135.6 | 34.0 | 0.0 | 34.5 | 0.0 | - | 40.0 | 39.7 | 79.2 | - |
| 1996 | 160.0 | 78.4 | 56.6 | 43.2 | 6.7 | 0.3 | 0.0 | 35.7 | 14.8 | 41.1 | 75.8 | 71.5 | 584.1 |
| 1997 | 151.5 | 168.3 | 27.1 | 21.9 | 4.9 | - | - | 40.8 | 39.1 | 45.3 | 104.3 | 147.2 | - |
| 1998 | 199.1 | 165.0 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 579.7 | 607.1 | 494.7 | 541.3 | 102.8 | 36.1 | 34.5 | 70.9 | 167.2 | 374.9 | 399.6 | 550.0 | 3,073.9 |
| Mean | 180.0 | 184.4 | 173.0 | 77.8 | 17.5 | 6.0 | 4.3 | 11.8 | 27.4 | 61.4 | 67.0 | 106.5 | 909.8 |
| Min. | 43.3 | 18.0 | 27.1 | 9.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 | 3.5 | 256.4 |
| N | 35 | 35 | 34 | 33 | 34 | 33 | 33 | 34 | 33 | 32 | 34 | 34 | 29 |



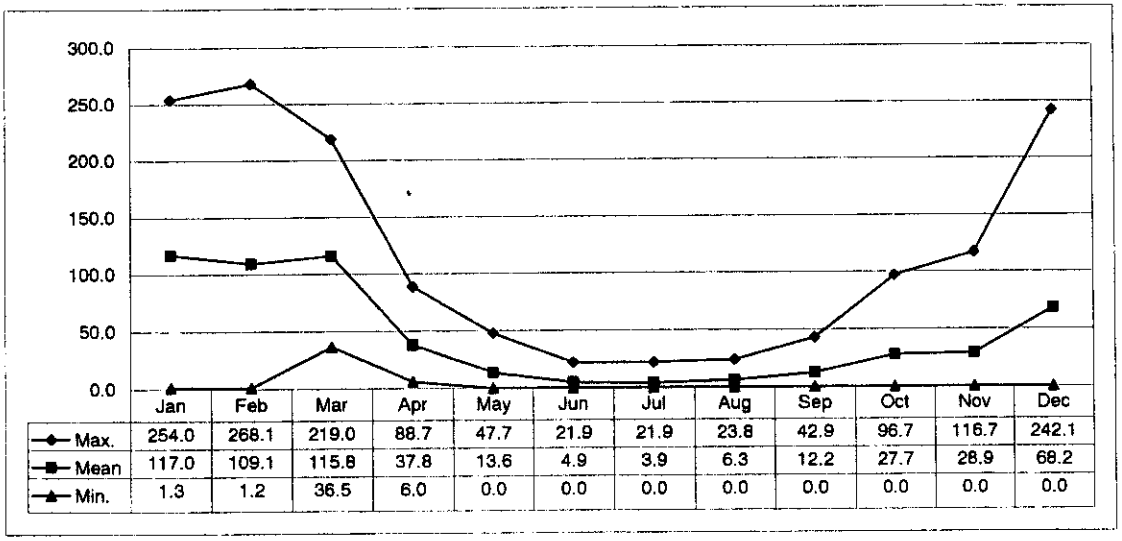
**Monthly Rainfall (mm)**

Station: Carania

Longitude: W 75° 52'
Latitude: S 12° 21'
Altitude: 3,850

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 50.4 | 168.8 | 169.7 | 36.7 | - | - | - | 0.0 | 27.1 | 25.6 | 23.4 | 52.0 | - |
| 1965 | 76.0 | 220.9 | 118.9 | 9.2 | 14.9 | 4.0 | 4.0 | 14.4 | 14.5 | 26.6 | 21.6 | 70.2 | 595.2 |
| 1966 | 101.8 | 81.9 | 101.6 | 47.9 | 9.9 | 0.0 | 1.4 | 0.0 | 25.7 | 96.7 | 42.1 | 87.3 | 596.3 |
| 1967 | 174.1 | 212.4 | 141.9 | 36.5 | 18.1 | 8.6 | 21.9 | 12.3 | 19.2 | 31.6 | 12.7 | 44.2 | 733.5 |
| 1968 | - | 51.2 | 81.7 | 8.7 | 16.9 | 12.2 | 9.4 | 21.0 | 13.3 | 42.4 | 28.0 | 47.6 | - |
| 1969 | 58.0 | 29.8 | 101.1 | 40.6 | 0.0 | 6.0 | 1.6 | 16.0 | 19.9 | 46.8 | 84.6 | 242.1 | 646.5 |
| 1970 | 223.4 | 38.6 | 108.1 | 42.9 | 30.2 | 0.0 | 1.6 | 1.3 | 37.5 | 37.0 | 7.5 | 51.2 | 579.3 |
| 1971 | 139.5 | 137.3 | 134.3 | 17.9 | 2.1 | 2.4 | 0.0 | 1.4 | 0.0 | 13.0 | 8.0 | 103.8 | 559.7 |
| 1972 | 137.3 | 138.8 | 219.0 | 88.7 | 3.3 | 0.0 | 6.2 | 0.0 | 19.9 | 47.7 | 24.3 | 70.5 | 755.7 |
| 1973 | 254.0 | 130.9 | 195.3 | 75.8 | 43.0 | 0.0 | 0.0 | 12.9 | 2.6 | 37.3 | 15.3 | 149.2 | 916.3 |
| 1974 | 139.2 | 79.6 | 59.1 | 6.0 | 3.7 | 10.8 | 0.0 | 10.7 | 19.9 | 0.0 | 21.4 | 20.0 | 370.4 |
| 1975 | 76.4 | 70.1 | 180.6 | 55.0 | 37.6 | 19.9 | 17.8 | 23.8 | 42.9 | 24.5 | 62.7 | 101.8 | 713.1 |
| 1976 | 203.0 | 159.7 | 117.7 | 32.5 | 5.2 | 4.1 | 0.0 | 15.5 | 21.0 | 1.4 | 1.9 | 34.2 | 596.2 |
| 1977 | 69.8 | 90.3 | 101.7 | 31.6 | 12.6 | 2.4 | 3.8 | 0.0 | 15.1 | 0.0 | 71.7 | 21.0 | 420.0 |
| 1978 | 111.7 | 68.7 | 41.7 | 50.3 | 21.3 | 0.0 | 0.0 | - | - | 27.4 | 45.6 | 77.5 | - |
| 1979 | 17.8 | 121.7 | 98.2 | 7.8 | 6.0 | 11.0 | 0.0 | 1.4 | 7.3 | 0.4 | 0.4 | 10.8 | 282.8 |
| 1980 | 45.4 | 45.6 | 36.5 | 24.7 | 12.4 | 5.0 | 20.9 | 0.0 | 7.0 | 52.2 | 33.1 | 53.3 | 336.1 |
| 1981 | 101.6 | 163.5 | 117.2 | 56.9 | 2.6 | 4.4 | 6.0 | 12.6 | 4.0 | 27.1 | 40.4 | 44.2 | 580.5 |
| 1982 | 60.6 | 86.1 | 98.0 | 31.7 | 11.0 | 4.4 | 10.9 | 5.7 | 23.6 | 62.9 | 116.7 | 41.2 | 552.8 |
| 1983 | 48.2 | 2.4 | 132.2 | 29.8 | 33.7 | 11.2 | 3.1 | 13.7 | 12.4 | 11.1 | 17.1 | 55.6 | 370.5 |
| 1984 | 84.6 | 102.1 | 80.7 | 47.2 | 31.7 | 11.3 | - | 5.3 | 20.1 | 25.7 | 29.6 | 56.2 | - |
| 1985 | 44.9 | 42.8 | 79.1 | 38.6 | 39.1 | 19.9 | 15.9 | - | - | - | - | - | - |
| 1986 | - | 268.1 | 160.0 | 78.0 | 47.7 | 0.0 | 0.9 | 0.6 | 0.0 | 5.5 | 30.5 | 79.1 | - |
| 1987 | 250.2 | 75.0 | 47.8 | 21.4 | 0.0 | 0.0 | 0.0 | 14.3 | 0.0 | 0.0 | 15.1 | 29.2 | 453.0 |
| 1988 | 236.1 | 78.7 | 111.6 | 29.8 | 16.6 | 0.0 | 0.0 | 0.0 | 0.0 | 30.8 | 0.0 | 132.1 | 635.7 |
| 1989 | 139.4 | 156.9 | 215.5 | 30.5 | 7.1 | 0.6 | 0.0 | 3.5 | 6.9 | 41.4 | 12.9 | 0.0 | 614.7 |
| 1990 | 74.3 | 84.6 | 102.7 | 48.7 | 16.5 | 21.9 | 0.0 | 0.4 | 6.8 | 10.8 | 11.6 | 86.7 | 465.0 |
| 1991 | 79.4 | 73.5 | 131.4 | 27.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 41.0 | 3.3 | 12.9 | 369.2 |
| 1992 | 1.3 | 1.2 | 54.7 | 24.7 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 67.7 | 0.0 | 34.8 | 184.7 |
| 1993 | 136.8 | 134.6 | 113.8 | 41.8 | 1.1 | 0.0 | 0.0 | 6.0 | 5.2 | 16.3 | 76.6 | 141.4 | 673.6 |
| 1994 | 131.3 | 159.2 | 111.3 | 32.2 | 0.0 | 0.0 | 0.0 | 0.0 | 2.7 | 2.7 | 24.9 | 32.0 | 496.3 |
| 1995 | 86.9 | 49.1 | 65.2 | 29.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.2 | 0.0 | 37.9 | 278.7 |
| 1996 | 203.4 | 210.9 | 178.3 | 65.6 | 0.0 | 0.0 | 0.0 | 0.4 | 2.1 | 22.7 | 11.9 | 114.3 | 809.6 |
| 1997 | 128.9 | 156.8 | 130.5 | 37.1 | 3.6 | 0.0 | 0.0 | 7.9 | 14.1 | 28.0 | 58.6 | 115.5 | 681.0 |
| 1998 | 176.2 | 126.3 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 254.0 | 268.1 | 219.0 | 88.7 | 47.7 | 21.9 | 21.9 | 23.8 | 42.9 | 96.7 | 116.7 | 242.1 | 916.3 |
| Mean | 117.0 | 109.1 | 115.8 | 37.8 | 13.6 | 4.9 | 3.9 | 6.3 | 12.2 | 27.7 | 28.9 | 68.2 | 545.2 |
| Min. | 1.3 | 1.2 | 36.5 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 184.7 |
| N | 33 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 32 | 33 | 33 | 33 | 28 |



# Table 1.2.1 Rainfall Records (4/8)

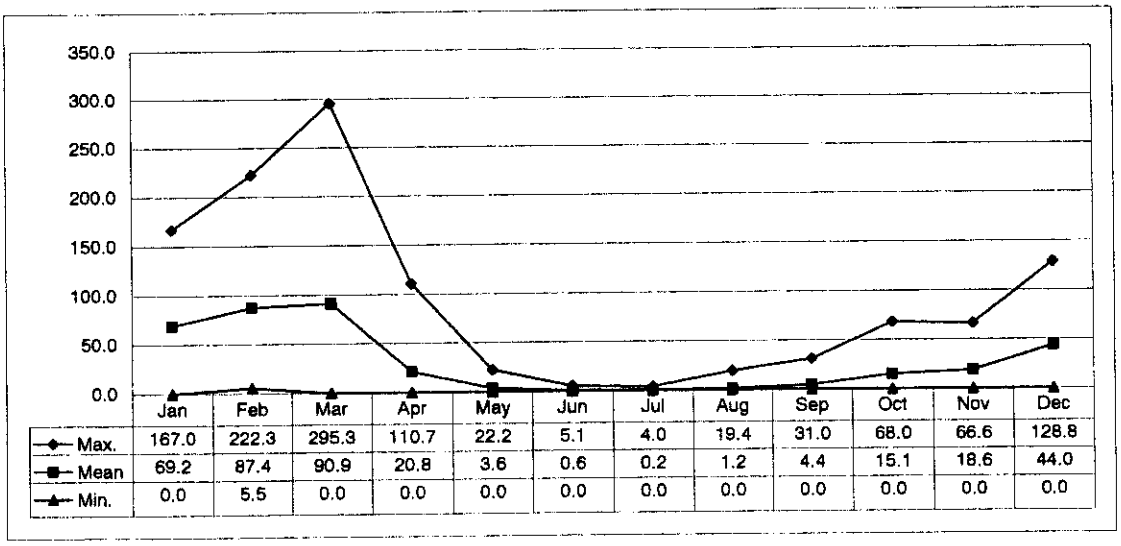
**Monthly Rainfall (mm)**

Station: Yauyos

Longitude: W 75° 55'
Latitude: S 12° 27'
Altitude: 2,850

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 31.3 | 93.9 | 97.4 | 35.2 | 1.8 | 0.0 | 0.0 | 0.0 | 4.4 | 16.4 | 18.0 | 44.0 | 342.4 |
| 1965 | 47.2 | 151.0 | 58.8 | 9.7 | 0.0 | 0.0 | 0.0 | 0.0 | 7.6 | 7.0 | 7.3 | 40.5 | 329.1 |
| 1966 | 84.1 | 70.9 | 80.6 | 8.0 | 2.8 | 0.0 | 0.0 | 0.0 | 9.8 | 68.0 | 7.0 | 52.5 | 383.7 |
| 1967 | 150.9 | 222.3 | 142.2 | 22.4 | 1.7 | 0.0 | 0.3 | 0.4 | 7.2 | 31.2 | 2.8 | 26.6 | 608.0 |
| 1968 | 69.3 | 43.0 | 77.1 | 21.4 | - | 0.0 | - | - | - | - | - | - | - |
| 1969 | 45.2 | 68.6 | 69.7 | 32.7 | 0.0 | 2.8 | 0.5 | 1.0 | 7.3 | 46.0 | 33.9 | 125.7 | 433.4 |
| 1970 | 35.6 | 80.5 | 74.8 | 43.2 | 22.2 | 0.0 | 0.0 | 0.0 | 31.0 | 14.8 | 20.5 | 40.9 | 363.5 |
| 1971 | 119.0 | 115.2 | 169.4 | 10.2 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 2.0 | 77.4 | 499.4 |
| 1972 | 137.9 | - | 259.1 | 43.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 128.8 | - |
| 1973 | 167.0 | 173.6 | 295.3 | 110.7 | 14.2 | 0.0 | 0.0 | 1.9 | 6.3 | 10.4 | 12.5 | 80.1 | 872.0 |
| 1974 | 135.8 | 140.9 | 115.0 | 8.3 | 0.0 | 0.0 | 0.0 | 7.1 | 0.0 | 5.7 | 37.6 | 34.4 | 484.8 |
| 1975 | 18.8 | 85.2 | 127.8 | 14.3 | 18.0 | 4.8 | 0.0 | 0.0 | 2.5 | 15.3 | 22.8 | 85.7 | 395.2 |
| 1976 | 119.2 | 142.9 | 128.6 | 19.9 | 0.0 | 5.1 | 0.0 | 0.0 | 3.8 | 0.0 | 0.0 | 43.8 | 463.3 |
| 1977 | 39.4 | 101.0 | 54.4 | 15.3 | 12.0 | 0.0 | 0.0 | 0.0 | 7.6 | 3.0 | 66.6 | 26.9 | 326.2 |
| 1978 | 80.0 | 55.5 | 13.2 | 39.2 | 0.0 | 0.0 | 0.0 | 0.0 | 7.4 | 18.9 | 30.5 | 27.4 | 272.1 |
| 1979 | 13.9 | 51.9 | 58.0 | 3.3 | 0.0 | 0.0 | 0.8 | 0.0 | 1.0 | 9.0 | 0.0 | 0.0 | 137.9 |
| 1980 | 23.0 | 17.3 | 88.1 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 7.4 | 30.3 | 19.8 | 4.3 | 194.2 |
| 1981 | 87.6 | 140.8 | 112.1 | 34.1 | 0.0 | 0.0 | 0.0 | 19.4 | 0.0 | 17.3 | 35.2 | 31.7 | 478.2 |
| 1982 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1983 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1984 | 43.9 | - | 32.6 | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.9 | 12.7 | - |
| 1985 | 30.3 | 47.5 | 91.5 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 25.8 | - | - | - |
| 1986 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1987 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1988 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1989 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1990 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1991 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1992 | 0.0 | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.6 | 1.3 | 5.3 | 21.7 |
| 1993 | 59.1 | 44.0 | 89.6 | 15.5 | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 21.9 | 29.2 | 6.5 | 267.5 |
| 1994 | 63.2 | 100.6 | 21.1 | 20.5 | 13.4 | 1.9 | 0.0 | 0.0 | 0.0 | 0.7 | 26.5 | 14.1 | 262.0 |
| 1995 | 35.5 | 18.4 | 49.6 | 12.4 | 0.3 | 0.0 | 0.0 | 0.0 | 5.4 | 3.5 | 30.0 | 52.0 | 207.1 |
| 1996 | 91.8 | 98.1 | 48.0 | 9.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 2.1 | 26.7 | 277.3 |
| 1997 | 44.2 | 61.1 | 9.9 | 0.4 | 1.4 | 0.0 | 0.0 | 0.7 | 2.4 | 14.8 | 17.1 | 68.7 | 220.7 |
| 1998 | 95.1 | 54.5 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 167.0 | 222.3 | 295.3 | 110.7 | 22.2 | 5.1 | 4.0 | 19.4 | 31.0 | 68.0 | 66.6 | 128.8 | 872.0 |
| Mean | 69.2 | 87.4 | 90.9 | 20.8 | 3.6 | 0.6 | 0.2 | 1.2 | 4.4 | 15.1 | 18.6 | 44.0 | 356.4 |
| Min. | 0.0 | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21.7 |
| N | 27 | 25 | 26 | 26 | 25 | 26 | 25 | 25 | 25 | 25 | 23 | 24 | 22 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 167.0 | 222.3 | 295.3 | 110.7 | 22.2 | 5.1 | 4.0 | 19.4 | 31.0 | 68.0 | 66.6 | 128.8 |
| Mean | 69.2 | 87.4 | 90.9 | 20.8 | 3.6 | 0.6 | 0.2 | 1.2 | 4.4 | 15.1 | 18.6 | 44.0 |
| Min. | 0.0 | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

# Table 1.2.1 Rainfall Records

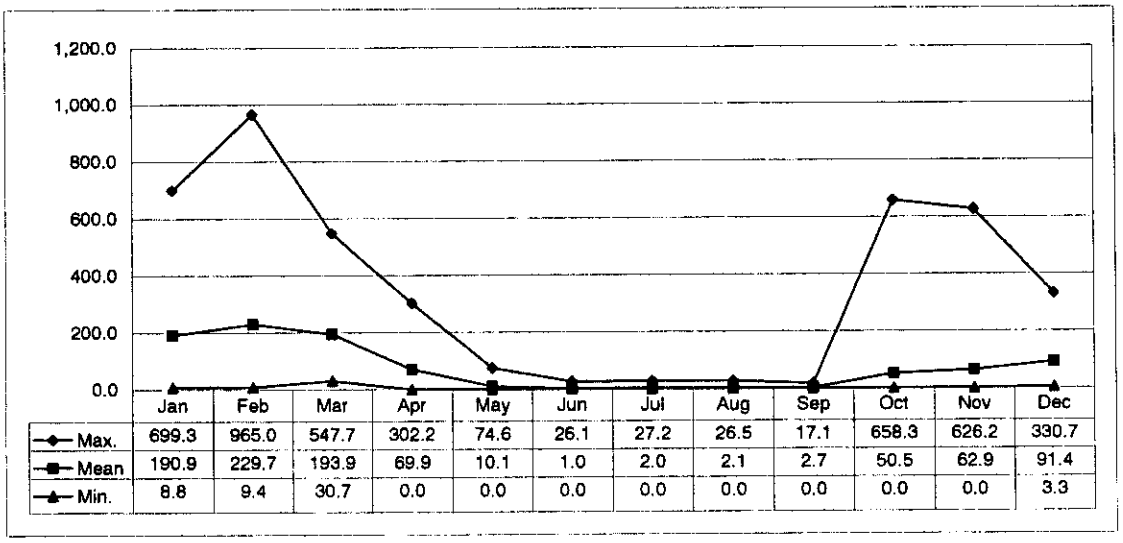
**Monthly Rainfall (mm)**

Station: Huantan

Longitude: W 75° 47'
Latitude: S 12° 28'
Altitude: 3,300

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 64.8 | 289.9 | 139.8 | 2.9 | 54.0 | 0.0 | 0.0 | 0.0 | 4.7 | 6.6 | 3.4 | 85.6 | 651.7 |
| 1965 | 55.5 | 220.0 | 74.6 | 24.4 | 2.7 | 0.0 | 0.0 | 0.0 | 0.0 | 14.0 | 14.7 | 71.9 | 477.8 |
| 1966 | 159.7 | 136.6 | 142.7 | 80.2 | 8.4 | 0.0 | 0.0 | 0.0 | 17.1 | 137.9 | 8.9 | 81.5 | 773.0 |
| 1967 | 294.2 | 433.6 | - | 44.5 | 5.0 | 0.0 | 0.0 | 0.0 | 12.7 | 6.2 | - | - | - |
| 1968 | 11.5 | 9.4 | 33.8 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 10.2 | 0.0 | 28.2 | 46.1 | 139.6 |
| 1969 | 28.6 | 33.5 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 20.6 | 11.2 | 118.1 | - |
| 1970 | 162.0 | 59.1 | 37.0 | 13.6 | 21.1 | 0.0 | 0.0 | 0.0 | 0.2 | 32.8 | 0.0 | 21.6 | 347.4 |
| 1971 | 113.7 | 98.5 | 201.8 | 171.8 | 16.6 | 0.0 | 0.0 | 2.1 | 0.0 | 7.8 | 5.1 | 71.5 | 688.9 |
| 1972 | 191.6 | 89.6 | 466.9 | 69.6 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 28.3 | 18.8 | 132.0 | 998.1 |
| 1973 | 224.1 | 53.0 | 346.3 | 150.4 | 0.3 | 0.0 | 0.0 | 5.0 | 8.3 | 21.5 | 46.6 | 101.6 | 957.1 |
| 1974 | 156.9 | 147.9 | 134.4 | 39.8 | 11.4 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 12.4 | 45.6 | 553.2 |
| 1975 | 24.9 | 51.1 | 145.4 | 11.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13.5 | 156.3 | 402.7 |
| 1976 | 286.8 | 144.0 | 96.8 | 46.8 | 0.0 | 0.0 | 13.6 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 | 593.6 |
| 1977 | 67.7 | 202.0 | 131.7 | 24.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 24.4 | - |
| 1978 | 153.4 | 17.7 | 30.7 | 11.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.3 | 0.0 | 70.8 | 293.7 |
| 1979 | 8.8 | 221.6 | 228.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - | - | - | - |
| 1980 | 179.4 | - | - | - | 12.5 | 0.0 | 7.6 | - | - | 28.5 | 97.5 | 188.9 | - |
| 1981 | 541.4 | 965.0 | - | 203.7 | 0.0 | 0.0 | 0.0 | 9.3 | 0.0 | 25.2 | - | 125.8 | - |
| 1982 | 325.0 | - | 44.2 | 10.1 | 0.0 | 0.0 | 0.0 | 0.0 | 2.4 | 658.3 | 349.7 | 3.3 | - |
| 1983 | 39.5 | 21.4 | 339.5 | 31.2 | 0.0 | 0.0 | 0.0 | 26.5 | 0.0 | 0.0 | 21.4 | 330.7 | 810.2 |
| 1984 | 699.3 | 765.1 | 547.7 | 120.0 | 0.0 | 26.1 | 0.0 | 0.0 | 0.0 | 162.6 | 626.2 | - | - |
| 1985 | 43.7 | 419.1 | 162.2 | 166.7 | 74.6 | - | - | - | - | - | - | - | - |
| 1986 | 127.3 | 439.1 | 351.3 | 302.2 | 53.5 | 0.0 | 27.2 | 0.0 | 0.0 | 0.0 | 0.0 | 173.5 | 1,474.1 |
| 1987 | 402.0 | 350.7 | 246.6 | 43.9 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 0.0 | 60.1 | - |
| 1988 | 409.0 | 251.9 | 364.5 | - | - | - | - | - | - | - | - | - | - |
| 1989 | 223.5 | 239.1 | 125.9 | 88.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 4.6 | 682.1 |
| 1990 | 159.9 | 84.7 | 67.5 | 19.0 | 1.4 | 0.0 | - | 0.0 | - | - | - | - | - |
| 1991 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1992 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1993 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1994 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1995 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1996 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1997 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 699.3 | 965.0 | 547.7 | 302.2 | 74.6 | 26.1 | 27.2 | 26.5 | 17.1 | 658.3 | 626.2 | 330.7 | 1,474.1 |
| Mean | 190.9 | 229.7 | 193.9 | 69.9 | 10.1 | 1.0 | 2.0 | 2.1 | 2.7 | 50.5 | 62.9 | 91.4 | 656.2 |
| Min. | 8.8 | 9.4 | 30.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.3 | 139.6 |
| N | 27 | 25 | 23 | 24 | 26 | 25 | 24 | 23 | 21 | 23 | 20 | 21 | 15 |



# Table 1.2.1 Rainfall Records (6/8)

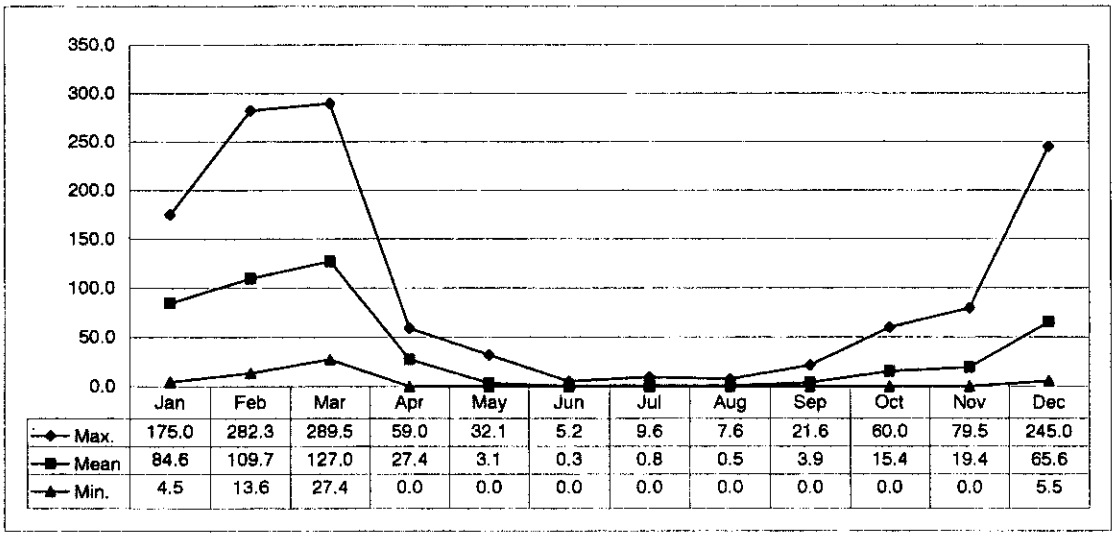
**Monthly Rainfall (mm)**

Station: Colonia

Longitude: W 75° 53'
Latitude: S 12° 38'
Altitude: 3,350

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 22.8 | 89.1 | 135.2 | 59.0 | 3.2 | 0.0 | 0.0 | 0.0 | 0.1 | 11.8 | 1.0 | 57.0 | 379.2 |
| 1965 | 71.2 | 151.0 | 83.8 | 13.6 | 0.0 | 0.0 | 0.0 | 1.5 | 2.9 | 1.6 | 2.4 | 33.1 | 361.1 |
| 1966 | 81.0 | 109.0 | 145.1 | 9.5 | 0.2 | 0.0 | 0.0 | 0.0 | 8.0 | 48.0 | 17.7 | 79.0 | 497.5 |
| 1967 | 103.9 | 214.9 | 156.6 | 47.6 | 2.8 | 0.0 | 0.0 | 0.2 | 5.0 | 21.7 | 7.4 | 13.8 | 573.9 |
| 1968 | 65.1 | 52.1 | 115.0 | 8.9 | 2.5 | 0.0 | 0.1 | 1.4 | 0.0 | 2.7 | 5.0 | 23.7 | 276.5 |
| 1969 | 58.7 | 104.7 | 117.1 | 24.7 | 0.0 | 0.0 | 6.5 | 0.0 | 0.0 | 33.6 | 32.7 | 139.6 | 517.6 |
| 1970 | 175.0 | 68.3 | 59.4 | 44.9 | 32.1 | 0.0 | 0.0 | 0.0 | 21.6 | 8.4 | 11.2 | 20.0 | 440.9 |
| 1971 | 130.8 | 103.7 | 289.5 | 36.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 245.0 | 805.1 |
| 1972 | 104.5 | 99.7 | 245.5 | 34.8 | 0.0 | 0.0 | 2.7 | 0.0 | 3.7 | 20.6 | 6.0 | 85.6 | 603.1 |
| 1973 | 82.3 | 64.5 | 215.7 | 34.5 | 3.3 | 0.0 | 0.0 | 0.0 | 16.5 | 24.0 | 40.2 | 128.8 | 609.8 |
| 1974 | 156.1 | 154.5 | 92.9 | 41.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 24.2 | 53.9 | 523.5 |
| 1975 | 59.3 | 101.2 | 132.0 | 22.2 | 18.2 | 0.0 | 0.0 | 0.0 | 18.8 | 7.7 | 24.8 | 86.3 | 470.5 |
| 1976 | 141.2 | 156.5 | 134.3 | 32.6 | 3.5 | 5.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 44.8 | 518.1 |
| 1977 | 4.5 | 282.3 | 103.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.4 | 14.1 | 62.6 | 18.5 | 493.2 |
| 1978 | 101.5 | 49.4 | 104.8 | 40.7 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 41.0 | 22.5 | 58.3 | 419.6 |
| 1979 | 44.1 | 129.5 | 222.5 | 10.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.7 | - | - |
| 1980 | 87.9 | 13.6 | 103.4 | 3.4 | 0.0 | 0.0 | 9.6 | 0.0 | 4.3 | 27.1 | - | 15.4 | - |
| 1981 | 74.8 | 135.0 | 104.2 | 38.2 | 0.0 | 0.0 | 0.0 | 7.6 | 0.0 | 1.7 | 23.9 | 104.5 | 489.9 |
| 1982 | - | 148.8 | 75.6 | 36.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 60.0 | 79.5 | 5.5 | - |
| 1983 | 48.3 | 49.6 | 212.2 | 30.0 | 6.4 | 3.1 | 0.0 | 0.0 | 5.0 | 7.8 | 11.7 | 45.2 | 419.3 |
| 1984 | 143.1 | 168.6 | 158.3 | 33.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 37.0 | 28.5 | - | - |
| 1985 | 21.0 | 53.5 | 27.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.0 | 116.9 |
| 1986 | 33.1 | 47.5 | 40.8 | 19.4 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22.3 | 148.3 | 314.4 |
| 1987 | 100.8 | 63.5 | 29.8 | 7.4 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 15.6 | 20.8 | 240.3 |
| 1988 | 119.5 | 131.6 | 71.3 | 56.8 | - | - | - | - | - | - | - | - | - |
| 1989 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1990 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1991 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1992 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1993 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1994 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1995 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1996 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1997 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 175.0 | 282.3 | 289.5 | 59.0 | 32.1 | 5.2 | 9.6 | 7.6 | 21.6 | 60.0 | 79.5 | 245.0 | 805.1 |
| Mean | 84.6 | 109.7 | 127.0 | 27.4 | 3.1 | 0.3 | 0.8 | 0.5 | 3.9 | 15.4 | 19.4 | 65.6 | 453.5 |
| Min. | 4.5 | 13.6 | 27.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.5 | 116.9 |
| N | 24 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 22 | 20 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 175.0 | 282.3 | 289.5 | 59.0 | 32.1 | 5.2 | 9.6 | 7.6 | 21.6 | 60.0 | 79.5 | 245.0 |
| Mean | 84.6 | 109.7 | 127.0 | 27.4 | 3.1 | 0.3 | 0.8 | 0.5 | 3.9 | 15.4 | 19.4 | 65.6 |
| Min. | 4.5 | 13.6 | 27.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.5 |

# Table 1.2.1 Rainfall Records

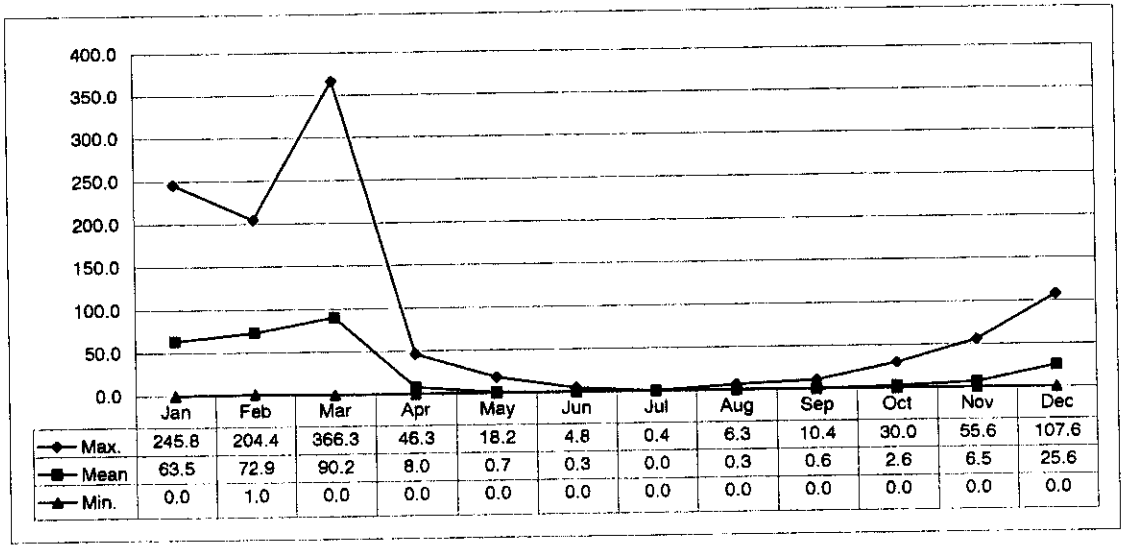
**Monthly Rainfall (mm)**

Station: Huangascar

Longitude: W 75° 50'
Latitude: S 12° 54'
Altitude: 2,550

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1965 | 45.7 | 58.9 | 35.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 1.4 | 141.6 |
| 1966 | 21.2 | 47.5 | 91.4 | 3.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 27.0 | 5.9 | 14.6 | 211.3 |
| 1967 | 144.8 | 204.4 | 117.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 4.9 | 0.0 | 2.2 | 473.8 |
| 1968 | 0.3 | 13.0 | - | 3.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.8 | 0.5 | - |
| 1969 | 11.2 | 78.6 | 169.5 | 7.5 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 0.9 | 55.6 | 53.8 | 381.9 |
| 1970 | 245.8 | 16.4 | 26.6 | 5.4 | 1.8 | 0.0 | 0.0 | 0.0 | 10.4 | 0.0 | 1.6 | 8.2 | 316.2 |
| 1971 | 57.4 | 63.1 | 141.7 | 3.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.5 | 0.0 | 39.1 | 305.2 |
| 1972 | 92.4 | 44.2 | 366.3 | 31.5 | 0.0 | 0.0 | 0.1 | 0.0 | 2.0 | 0.0 | 9.9 | 34.6 | 581.0 |
| 1973 | 85.0 | 106.0 | 82.7 | 34.7 | 1.7 | 0.0 | 0.4 | 0.0 | 0.5 | 3.2 | 4.7 | 45.9 | 364.8 |
| 1974 | 41.3 | 36.1 | 84.3 | 2.9 | 0.0 | 2.5 | 0.0 | 0.0 | 2.3 | 0.0 | 0.4 | 21.5 | 191.3 |
| 1975 | 29.6 | 72.2 | 205.2 | 2.0 | 0.9 | 1.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 28.2 | 339.6 |
| 1976 | 131.3 | 128.9 | - | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.9 | - |
| 1977 | 3.0 | 195.5 | 202.5 | 7.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.1 | 22.5 | 441.1 |
| 1978 | 28.4 | 12.9 | 66.6 | 6.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 | 117.3 |
| 1979 | 21.2 | 72.0 | 126.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 220.9 |
| 1980 | 45.3 | 22.2 | 17.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.5 | 7.5 | 10.7 | 110.3 |
| 1981 | 37.2 | 40.6 | 75.5 | 25.9 | 0.0 | 0.0 | 0.0 | 4.8 | 0.0 | 0.0 | 0.0 | 72.0 | 256.0 |
| 1982 | 38.2 | 126.4 | 41.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30.0 | 39.6 | 1.6 | 276.8 |
| 1983 | 13.2 | 14.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 62.2 | 89.4 |
| 1984 | 152.6 | 144.8 | 104.0 | 32.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 37.0 | 54.0 | 524.4 |
| 1985 | 15.2 | 82.4 | 15.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 105.7 | 218.9 |
| 1986 | 166.6 | 178.3 | 154.0 | 10.7 | 18.2 | 0.0 | 0.0 | 6.3 | 0.0 | 0.0 | 5.4 | 107.6 | 647.1 |
| 1987 | 43.0 | 46.2 | 44.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 133.9 |
| 1988 | 86.5 | 66.4 | 64.0 | 46.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 263.2 |
| 1989 | 162.7 | 123.3 | 126.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | - |
| 1990 | 27.0 | 1.0 | 89.7 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.5 | 28.1 | 155.8 |
| 1991 | 22.1 | 55.1 | 67.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 144.9 |
| 1992 | 0.0 | 10.0 | 1.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | - |
| 1993 | 26.5 | 63.3 | 85.0 | 32.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 23.3 | 234.1 |
| 1994 | 94.4 | 91.0 | 52.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.0 | 254.2 |
| 1995 | 21.5 | 36.5 | 81.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 14.0 | 23.8 | 179.9 |
| 1996 | 69.4 | 50.5 | 29.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.0 | 159.4 |
| 1997 | 49.8 | 23.3 | 31.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 8.5 | 44.4 | 159.8 |
| 1998 | 129.3 | 154.7 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 245.8 | 204.4 | 366.3 | 46.3 | 18.2 | 4.8 | 0.4 | 6.3 | 10.4 | 30.0 | 55.6 | 107.6 | 647.1 |
| Mean | 63.5 | 72.9 | 90.2 | 8.0 | 0.7 | 0.3 | 0.0 | 0.3 | 0.6 | 2.6 | 6.5 | 25.6 | 272.2 |
| Min. | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 89.4 |
| N | 34 | 34 | 31 | 32 | 33 | 32 | 33 | 33 | 33 | 33 | 33 | 33 | 29 |



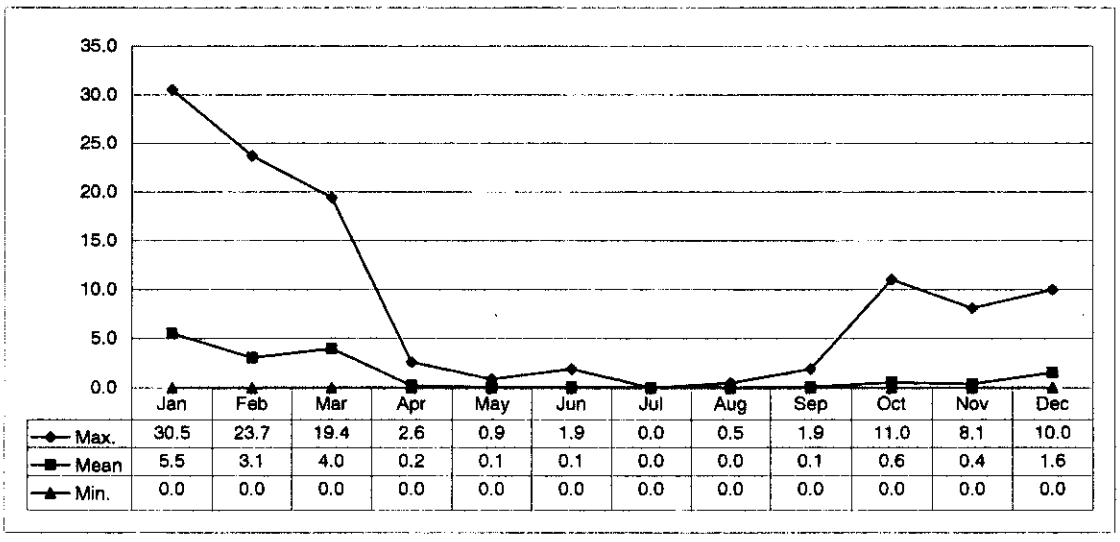
**Monthly Rainfall (mm)**

Station: Pacaran

Longitude: W 76° 03'
Latitude: S 12° 52'
Altitude: 700

Source: Cementos Lima / SENAMHI (daily rainfall)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1965 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1966 | 2.5 | 0.0 | 3.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| 1967 | 5.2 | 23.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28.9 |
| 1968 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | - |
| 1969 | - | 7.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 11.0 | 0.0 | 0.9 | - |
| 1970 | 30.5 | 0.4 | 3.0 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 2.9 | 41.1 |
| 1971 | 2.2 | 1.8 | 7.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 11.7 |
| 1972 | 7.8 | 3.7 | 18.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 9.5 | 39.2 |
| 1973 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 10.0 | 10.3 |
| 1974 | 0.6 | 3.7 | 6.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 10.3 |
| 1975 | 0.0 | 0.0 | 19.4 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 19.7 |
| 1976 | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |
| 1977 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1978 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1979 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1980 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1981 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1982 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1983 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1984 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | 10.9 | 5.1 | 2.6 | 0.0 | 0.2 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.3 | 1.6 | 21.2 |
| 1987 | 0.8 | 5.0 | 5.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11.7 |
| 1988 | 7.9 | 5.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 13.4 |
| 1989 | - | - | 8.8 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - |
| 1990 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.2 |
| 1991 | 0.0 | 0.6 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 4.2 |
| 1992 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| 1993 | 0.0 | 0.3 | 5.0 | 0.5 | - | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.7 | - |
| 1994 | 13.9 | 0.7 | 0.0 | 2.6 | 0.9 | 1.9 | 0.0 | 0.2 | 0.3 | 0.0 | 0.1 | 0.0 | 20.6 |
| 1995 | 1.9 | 1.3 | 8.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 8.1 | 0.0 | - |
| 1996 | 5.0 | 5.6 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 12.3 |
| 1997 | 6.6 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 | 14.4 |
| 1998 | 23.0 | 2.0 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 30.5 | 23.7 | 19.4 | 2.6 | 0.9 | 1.9 | 0.0 | 0.5 | 1.9 | 11.0 | 8.1 | 10.0 | 41.1 |
| Mean | 5.5 | 3.1 | 4.0 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.6 | 0.4 | 1.6 | 14.9 |
| Min. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |
| N | 22 | 23 | 23 | 23 | 22 | 23 | 23 | 23 | 23 | 22 | 23 | 22 | 18 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 30.5 | 23.7 | 19.4 | 2.6 | 0.9 | 1.9 | 0.0 | 0.5 | 1.9 | 11.0 | 8.1 | 10.0 |
| Mean | 5.5 | 3.1 | 4.0 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.6 | 0.4 | 1.6 |
| Min. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

## Table 1.2.2 Summary of Correlation Formula and Coefficient

| y \ x | Tanta | Vilca | Carania | Yauyos | Huantan | Colonia | Huangascar | Pacaran |
|---|---|---|---|---|---|---|---|---|
| Tanta | | - y=0.5962x r=0.6077 | 1 y=1.1613x r=0.7564 | - y=1.5657x r=0.6835 | - y=0.3686x r=0.3159 | - y=1.1467x r=0.6432 | - y=1.3243x r=0.4880 | - y=15.5640x r=0.4675 |
| Vilca | 1 y=1.0872x r=0.6077 | | 2 y=1.3717x r=0.5757 | - y=1.6979x r=0.4189 | - y=0.4993x r=0.5568 | - y=1.3131x r=0.6054 | - y=1.6371x r=0.4203 | - y=16.6960x r=0.2317 |
| Carania | 2 y=0.6782x r=0.7564 | - y=0.4482x r=0.5757 | | 1 y=1.1635x r=0.7808 | - y=0.3378x r=0.5259 | - y=0.8987x r=0.6987 | - y=1.1301x r=0.6446 | - y=11.8410x r=0.4243 |
| Yauyos | - y=0.4507x r=0.6835 | - y=0.2870x r=0.4189 | 1 y=0.6770x r=0.7808 | | - y=0.2859x r=0.4654 | 2 y=0.7511x r=0.7595 | - y=0.8242x r=0.6042 | - y=7.5752x r=0.3861 |
| Huantan | - y=1.1308x r=0.3159 | 2 y=1.1443x r=0.5568 | 1 y=1.6039x r=0.5259 | - y=1.6519x r=0.4654 | | - y=1.6689x r=0.4663 | - y=1.9972x r=0.4634 | - y=16.0690x r=0.3094 |
| Colonia | - y=0.6126x r=0.6432 | - y=0.5092x r=0.6054 | 3 y=0.8153x r=0.6987 | 1 y=1.0366x r=0.7595 | - y=0.3006x r=0.4663 | | 2 y=1.0035x r=0.6973 | - y=9.9058x r=0.3826 |
| Huangascar | - y=0.4149x r=0.4880 | - y=0.3014x r=0.4203 | - y=0.5768x r=0.6446 | - y=0.7412x r=0.6042 | - y=0.2389x r=0.4634 | 1 y=0.6898x r=0.6973 | | 2 y=9.9014x r=0.6601 |
| Pacaran | - y=0.0326x r=0.4675 | - y=0.0209x r=0.2317 | - y=0.0402x r=0.4243 | - y=0.0610x r=0.3861 | - y=0.0274x r=0.3094 | 2 y=0.0488x r=0.3826 | 1 y=0.0663x r=0.6601 | |

: adopted for estimation of missing records

## Table 1.2.3 Results of Probability Analysis

Probability Analysis of Annual Rainfall (mm/year)

| Station | Statistical Parameters | | | Return period (year) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | ST-DV | 2 | 5 | 10 | 20 | 50 | 100 |
| Tanta | 31 | 799.2 | 276.7 | 756.9 | 1038.0 | 1224.1 | 1402.6 | 1633.7 | 1806.8 |
| Vilca | 29 | 909.8 | 556.1 | 825.1 | 1393.6 | 1770.0 | 2131.1 | 2598.4 | 2948.6 |
| Carania | 28 | 545.2 | 171.4 | 519.2 | 695.1 | 811.5 | 923.2 | 1067.8 | 1176.2 |
| Yauyos | 22 | 356.4 | 173.1 | 330.6 | 513.0 | 633.8 | 749.7 | 899.7 | 1012.1 |
| Huantan | 15 | 656.2 | 318.3 | 610.6 | 964.1 | 1198.1 | 1422.6 | 1713.2 | 1931.0 |
| Colonia | 20 | 453.5 | 146.5 | 431.9 | 588.1 | 691.5 | 790.8 | 919.2 | 1015.4 |
| Huangascar | 29 | 272.2 | 143.6 | 250.3 | 397.2 | 494.4 | 587.6 | 708.3 | 798.8 |
| Pacaran | 18 | 14.9 | 11.5 | 13.2 | 25.7 | 34.0 | 41.9 | 52.2 | 59.9 |

Probability Analysis of Annual Maximum Daily Rainfall (mm/day)

| Station | Statistical Parameters | | | Return period (year) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | ST-DV | 2 | 5 | 10 | 20 | 50 | 100 |
| Tanta | 31 | 21.2 | 8.2 | 20.0 | 28.3 | 33.8 | 39.1 | 46.0 | 51.1 |
| Vilca | 29 | 26.0 | 9.6 | 24.5 | 34.4 | 40.9 | 47.1 | 55.2 | 61.3 |
| Carania | 27 | 18.8 | 4.9 | 18.1 | 23.1 | 26.4 | 29.6 | 33.8 | 36.9 |
| Yauyos | 22 | 21.0 | 6.3 | 20.1 | 26.7 | 31.1 | 35.3 | 40.7 | 44.8 |
| Huantan | 15 | 28.5 | 7.9 | 27.4 | 36.2 | 42.0 | 47.6 | 54.8 | 60.2 |
| Colonia | 19 | 22.3 | 11.5 | 20.6 | 33.0 | 41.2 | 49.1 | 59.2 | 66.9 |
| Huangascar | 28 | 22.0 | 8.6 | 20.7 | 29.5 | 35.3 | 40.9 | 48.1 | 53.5 |
| Pacaran | 17 | 3.8 | 2.4 | 3.5 | 6.1 | 7.9 | 9.6 | 11.8 | 13.4 |

Table 1.2.4 Distribution of the Effective Area for the Rainfall Station

(Unit: km$^2$)

| No. | Point | Remarks | Cumulative Area | Sub-basin Area | Effective area for the rainfall station | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Pacaran | Huangascar | Colonia | Tanta | Vilca | Huantan | Yauyos | Carania |
| 1 | Tanta Station | Tanta Station | 172 | 172 | | | | 166.6 | 1.1 | | | 4.3 |
| 2 | Potential dam site (Paucarcocha) | Potential dam site (Paucarcocha) | 303 | 131 | | | | 131.0 | | | | |
| 3 | Aguas Calientes Station | Aguas Calientes Station | 352 | 49 | | | | 49.0 | | | | |
| 4 | Before Quebrada Chunararan | | 376 | 24 | | | | 24.0 | | | | |
| 4 | After Quebrada Chunararan | | 449 | 73 | | | | 38.5 | 34.5 | | | |
| 5 | Before Quebrada Eslansa | | 476 | 27 | | | | 9.6 | 17.4 | | | |
| 5 | After Quebrada Eslansa | | 543 | 67 | | | | 10.8 | 56.2 | | | |
| 6 | Before Quebrada Miraflores | | 816 | 273 | | | | | 252.4 | | | 20.6 |
| 6 | After Quebrada Miraflores | | 923 | 107 | | | | 3.7 | 15.7 | | | 87.6 |
| 7 | Before Rio Alis | Tinco de Alis Station | 930 | 7 | | | | | | | | 7.0 |
| 7 | After Rio Alis | | 1,365 | 435 | | | | | 274.3 | 55.8 | | 104.9 |
| 8 | Before Rio Laraos | | 1,400 | 35 | | | | | | | | 35.0 |
| 8 | After Rio Laraos | | 1,579 | 179 | | | | | | 126.9 | | 52.1 |
| 9 | Potential dam site (Morro de Arica) | Potential dam site (Morro de Arica) | 1,653 | 74 | | | | | | | | 74.0 |
| 10 | Before Rio Huantan | | 1,719 | 66 | | | | | | 19.7 | 2.0 | 44.3 |
| 10 | After Rio Huantan | | 2,133 | 414 | | | 44.2 | | | 369.8 | | |
| 11 | Before Rio Yauyos | | 2,185 | 52 | | | | | | 17.6 | 32.4 | 2.0 |
| 11 | After Rio Yauyos | | 2,273 | 88 | | | | | | | 64.1 | 23.9 |
| 12 | Before Quebrada Pampas | | 2,519 | 246 | | | 86.0 | | | 66.0 | 94.0 | |
| 12 | After Quebrada Pampas | Potential dam site (Auco) | 2,652 | 133 | | | 133.0 | | | | | |
| 13 | Before Quebrada Aucamoi | | 2,708 | 56 | | | 30.1 | | | | 25.9 | |
| 13 | After Quebrada Aucamoi | Potential dam site (Calachota) | 3,027 | 319 | | | 83.5 | | | | 235.5 | |
| 14 | Before Quebrada Cajalay | | 3,127 | 100 | | | 100.0 | | | | | |
| 14 | After Quebrada Cajalay | | 3,211 | 84 | 12.4 | | 71.6 | | | | | |
| 15 | Potential dam site (Capillucas) | Potential dam site (Capillucas) | 3,213 | 2 | | | 2.0 | | | | | |
| 16 | Chavin Station | Chavin Station | 3,265 | 52 | 7.7 | | 44.3 | | | | | |
| 17 | Before Quebrada Tupe | | 3,391 | 126 | 23.1 | 14.7 | 88.2 | | | | | |
| 17 | After Quebrada Tupe | | 3,635 | 244 | | 41.7 | 202.3 | | | | | |
| 18 | Before Rio Cacra | | 3,636 | 1 | | 1.0 | | | | | | |
| 18 | After Rio Cacra | | 4,292 | 656 | | 446.3 | 168.0 | | | 41.7 | | |
| 19 | Before Rio Huangascar | | 4,325 | 33 | 6.2 | 26.8 | | | | | | |
| 19 | After Rio Huangascar | | 4,879 | 554 | | 554.0 | | | | | | |
| 20 | Before Quebrada Una Huatana | | 4,881 | 2 | 2.0 | | | | | | | |
| 20 | After Quebrada Una Huatana | | 5,046 | 165 | 29.1 | 135.9 | | | | | | |
| 21 | Proposed Intake (Zuniga) | Proposed Intake (Zuniga) | 5,237 | 191 | 191.0 | | | | | | | |
| 22 | Proposed Intake (Socsi) | Proposed Intake (Socsi) | 5,804 | 567 | 567.0 | | | | | | | |
| 23 | Socsi Station | Socsi Station | 5,890 | 86 | 86.0 | | | | | | | |
| 24 | Toma Imperial | Toma Imperial | 5,900 | 10 | 10.0 | | | | | | | |
| | | | | 5,900 | 935 | 1,220 | 1,053 | 433 | 652 | 698 | 454 | 456 |

# Table 1.2.5 Basin Average Rainfall (1/6)

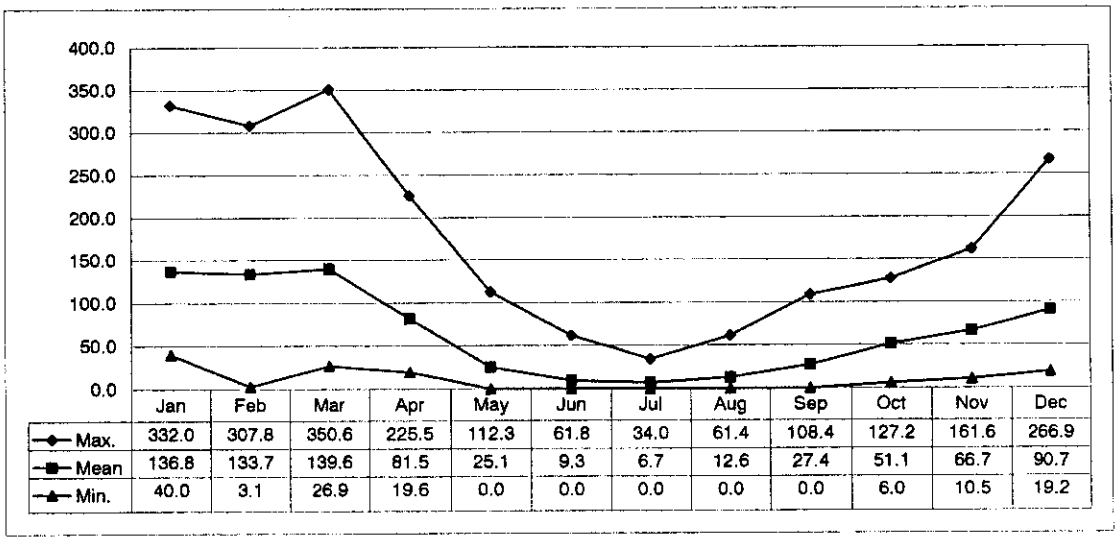
**Monthly Rainfall (mm)**

Station: No.1: Tanta

Longitude: W 76° 01'
Latitude: S 12° 07'
Altitude: 4,278

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 89.7 | 160.4 | 210.3 | 92.1 | 20.7 | 6.3 | 0.0 | 1.1 | 10.5 | 48.9 | 66.9 | 75.4 | 782.3 |
| 1965 | 97.8 | 273.0 | 114.8 | 65.2 | 29.1 | 0.1 | 7.5 | 1.4 | 3.5 | 44.3 | 10.5 | 90.4 | 737.6 |
| 1966 | 158.5 | 114.3 | 157.8 | 97.6 | 21.0 | 0.0 | 0.0 | 4.3 | 32.3 | 85.0 | 79.2 | 149.9 | 899.9 |
| 1967 | 184.7 | 234.3 | 135.7 | 52.2 | 42.2 | 0.2 | 15.4 | 3.9 | 22.8 | 99.0 | 26.2 | 44.1 | 860.7 |
| 1968 | 136.4 | 136.7 | 132.7 | 37.8 | 5.3 | 0.3 | 2.3 | 23.1 | 67.2 | 113.9 | 68.5 | 74.3 | 798.5 |
| 1969 | 93.3 | 159.7 | 124.5 | 113.0 | 0.0 | 4.3 | 0.0 | 5.4 | 39.7 | 111.8 | 141.5 | 266.9 | 1,060.1 |
| 1970 | 332.0 | 18.9 | 134.6 | 156.9 | 72.8 | 0.0 | 8.3 | 0.0 | 108.4 | 29.7 | 106.7 | 183.8 | 1,152.1 |
| 1971 | 79.0 | 180.1 | 212.9 | 68.2 | 0.1 | 0.1 | 0.0 | 27.2 | 0.0 | 34.5 | 47.0 | 182.7 | 831.8 |
| 1972 | 131.1 | 77.1 | 350.6 | 225.5 | 0.0 | 0.0 | 14.0 | 8.7 | 0.6 | 63.1 | 92.5 | 78.1 | 1,041.3 |
| 1973 | 230.4 | 108.6 | 185.3 | 151.3 | 55.6 | 0.0 | 6.1 | 18.0 | 101.4 | 123.1 | 85.8 | 159.3 | 1,224.9 |
| 1974 | 256.4 | 254.6 | 245.0 | 108.4 | 22.2 | 17.3 | 0.0 | 30.4 | 15.7 | 29.0 | 82.7 | 101.4 | 1,163.1 |
| 1975 | 110.3 | 109.1 | 217.6 | 192.1 | 82.9 | 10.9 | 0.6 | 16.3 | 57.7 | 89.5 | 43.0 | 85.6 | 1,015.6 |
| 1976 | 161.7 | 160.4 | 128.1 | 34.8 | 21.7 | 24.6 | 14.3 | 8.5 | 0.6 | 20.3 | 39.3 | 55.7 | 670.0 |
| 1977 | 130.0 | 115.6 | 140.3 | 73.5 | 19.2 | 0.1 | 0.1 | 1.0 | 14.8 | 31.4 | 68.6 | 51.6 | 646.2 |
| 1978 | 72.3 | 84.6 | 93.7 | 76.4 | 24.3 | 3.4 | 0.0 | 10.7 | 27.1 | 52.4 | 19.0 | 31.6 | 495.5 |
| 1979 | 42.3 | 101.9 | 99.2 | 52.5 | 16.6 | 6.4 | 0.0 | 0.0 | 8.1 | 12.1 | 25.5 | 21.3 | 385.9 |
| 1980 | 70.2 | 36.6 | 90.2 | 19.6 | 2.5 | 0.1 | 9.9 | 9.3 | 5.5 | 71.3 | 75.8 | 57.6 | 448.6 |
| 1981 | 92.8 | 182.2 | 217.5 | 30.7 | 0.1 | 0.1 | 0.2 | 9.5 | 15.6 | 31.7 | 50.1 | 41.2 | 671.7 |
| 1982 | 95.7 | 75.0 | 80.2 | 57.4 | 12.6 | 0.1 | 3.3 | 4.5 | 12.7 | 32.4 | 94.9 | 47.0 | 515.8 |
| 1983 | 55.9 | 3.1 | 152.1 | 34.3 | 38.8 | 12.8 | 3.6 | 15.8 | 14.2 | 9.0 | 21.5 | 56.4 | 417.5 |
| 1984 | 102.0 | 123.2 | 85.7 | 51.2 | 50.5 | 61.8 | 1.0 | 5.2 | 2.7 | 14.5 | 46.4 | 73.6 | 617.8 |
| 1985 | 99.8 | 90.1 | 114.9 | 93.9 | 21.5 | 15.9 | 12.2 | 18.3 | 3.4 | 25.3 | 37.7 | 47.5 | 580.5 |
| 1986 | 106.8 | 185.7 | 147.0 | 149.6 | 112.3 | 57.4 | 34.0 | 61.4 | 74.3 | 127.2 | 58.3 | 78.2 | 1,192.2 |
| 1987 | 178.2 | 131.0 | 37.6 | 24.0 | 0.0 | 6.9 | 9.1 | 19.9 | 5.7 | 13.2 | 30.5 | 48.3 | 504.4 |
| 1988 | 77.4 | 68.2 | 101.0 | 50.9 | 8.8 | 3.3 | 7.6 | 11.8 | 3.0 | 6.0 | 50.2 | 67.3 | 455.5 |
| 1989 | 100.0 | 74.8 | 111.0 | 50.0 | 15.0 | 3.0 | 5.4 | 15.6 | 9.8 | 28.3 | 117.3 | 19.2 | 549.4 |
| 1990 | 40.0 | 34.5 | 64.9 | 78.6 | 15.7 | 17.0 | 24.2 | 19.2 | 33.8 | 11.3 | 83.3 | 67.8 | 490.3 |
| 1991 | 108.0 | 87.6 | 75.6 | 70.6 | 44.2 | 15.6 | 11.4 | 14.3 | 3.5 | 22.8 | 52.4 | 42.0 | 548.0 |
| 1992 | 59.7 | 50.7 | 77.7 | 20.6 | 3.0 | 6.5 | 13.1 | 14.1 | 14.6 | 47.3 | 54.4 | 79.4 | 441.1 |
| 1993 | 211.0 | 240.7 | 196.6 | 119.0 | 28.9 | 8.2 | 7.5 | 8.4 | 35.6 | 101.1 | 161.6 | 165.1 | 1,283.7 |
| 1994 | 228.6 | 307.8 | 155.4 | 104.4 | 32.3 | 32.3 | 14.2 | 9.9 | 85.5 | 38.7 | 84.7 | 96.9 | 1,190.7 |
| 1995 | 210.8 | 77.1 | 164.9 | 54.9 | 13.2 | 2.6 | 1.9 | 0.0 | 35.8 | 64.4 | 79.0 | 132.9 | 837.5 |
| 1996 | 223.0 | 229.3 | 165.7 | 127.5 | 15.6 | 0.0 | 0.0 | 11.2 | 16.3 | 60.3 | 34.6 | 133.5 | 1,017.0 |
| 1997 | 175.8 | 250.8 | 26.9 | 36.0 | 5.4 | 0.0 | 0.0 | 21.2 | 49.2 | 45.3 | 133.2 | 176.3 | 920.1 |
| 1998 | 246.0 | 142.0 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 332.0 | 307.8 | 350.6 | 225.5 | 112.3 | 61.8 | 34.0 | 61.4 | 108.4 | 127.2 | 161.6 | 266.9 | 1,283.7 |
| Mean | 136.8 | 133.7 | 139.6 | 81.5 | 25.1 | 9.3 | 6.7 | 12.6 | 27.4 | 51.1 | 66.7 | 90.7 | 777.9 |
| Min. | 40.0 | 3.1 | 26.9 | 19.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 | 10.5 | 19.2 | 385.9 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 332.0 | 307.8 | 350.6 | 225.5 | 112.3 | 61.8 | 34.0 | 61.4 | 108.4 | 127.2 | 161.6 | 266.9 |
| Mean | 136.8 | 133.7 | 139.6 | 81.5 | 25.1 | 9.3 | 6.7 | 12.6 | 27.4 | 51.1 | 66.7 | 90.7 |
| Min. | 40.0 | 3.1 | 26.9 | 19.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 | 10.5 | 19.2 |

# Table 1.2.5 Basin Average Rainfall (2/6)

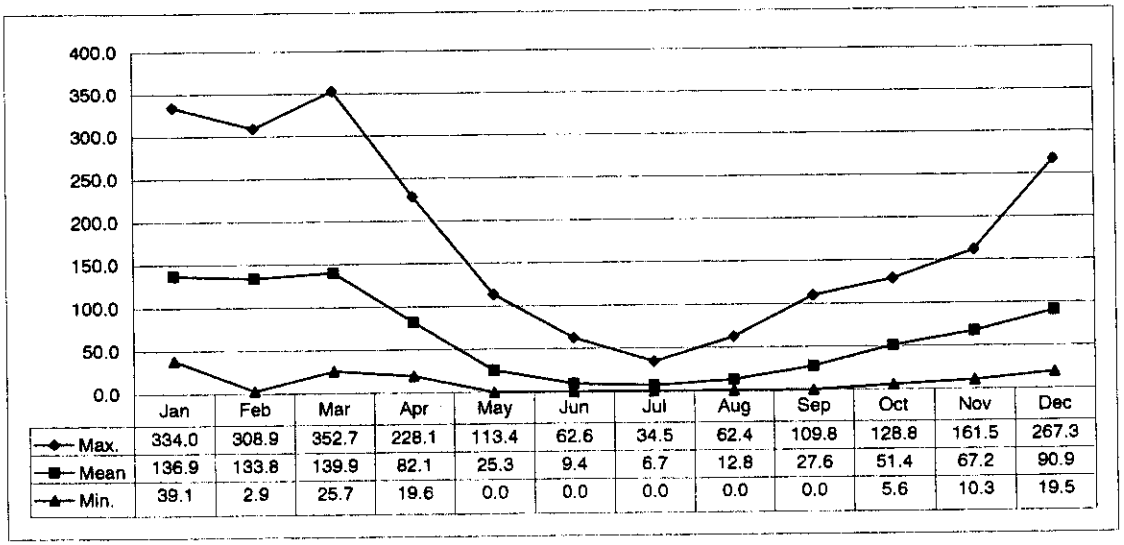
**Monthly Rainfall (mm)**

Station: No.3: Aguas Calientes

Longitude: W 75° 57'
Latitude: S 12° 05'
Altitude: 4,110

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 90.0 | 159.8 | 211.2 | 92.9 | 20.8 | 6.4 | 0.0 | 1.1 | 10.1 | 49.5 | 67.8 | 75.8 | 785.4 |
| 1965 | 98.1 | 273.9 | 114.2 | 66.4 | 29.4 | 0.0 | 7.6 | 1.3 | 3.2 | 44.7 | 10.3 | 90.5 | 739.6 |
| 1966 | 158.9 | 115.0 | 158.7 | 98.7 | 21.1 | 0.0 | 0.0 | 4.3 | 32.4 | 84.5 | 79.2 | 150.5 | 903.3 |
| 1967 | 184.3 | 233.7 | 134.5 | 52.5 | 42.3 | 0.1 | 15.5 | 3.8 | 22.7 | 99.8 | 26.1 | 44.0 | 859.3 |
| 1968 | 137.5 | 137.4 | 133.4 | 38.0 | 5.1 | 0.2 | 2.3 | 23.2 | 68.1 | 115.1 | 69.0 | 74.9 | 804.2 |
| 1969 | 94.1 | 161.7 | 124.7 | 113.9 | 0.0 | 4.4 | 0.0 | 5.2 | 40.0 | 112.9 | 142.7 | 267.3 | 1,066.9 |
| 1970 | 334.0 | 18.2 | 134.7 | 158.7 | 73.5 | 0.0 | 8.5 | 0.0 | 109.8 | 29.4 | 108.3 | 185.8 | 1,160.9 |
| 1971 | 77.6 | 179.8 | 214.0 | 68.9 | 0.0 | 0.0 | 0.0 | 27.7 | 0.0 | 35.0 | 47.6 | 184.2 | 834.8 |
| 1972 | 131.0 | 76.2 | 352.7 | 228.1 | 0.0 | 0.0 | 14.3 | 8.9 | 0.2 | 63.1 | 93.6 | 78.1 | 1,046.2 |
| 1973 | 230.1 | 108.0 | 185.6 | 152.6 | 55.8 | 0.0 | 6.2 | 18.1 | 103.0 | 124.2 | 86.4 | 159.5 | 1,229.5 |
| 1974 | 257.7 | 257.5 | 247.6 | 110.0 | 22.4 | 17.4 | 0.0 | 30.6 | 15.8 | 29.3 | 84.0 | 102.5 | 1,174.8 |
| 1975 | 110.5 | 109.3 | 218.2 | 194.4 | 83.3 | 10.9 | 0.2 | 16.3 | 57.8 | 90.3 | 42.5 | 85.2 | 1,018.9 |
| 1976 | 160.5 | 160.2 | 127.7 | 34.8 | 22.0 | 25.0 | 14.6 | 8.4 | 0.3 | 20.7 | 40.0 | 56.2 | 670.4 |
| 1977 | 131.0 | 115.6 | 141.0 | 74.3 | 19.5 | 0.0 | 0.0 | 1.0 | 14.7 | 31.7 | 68.7 | 51.9 | 649.4 |
| 1978 | 71.8 | 84.4 | 94.7 | 76.8 | 24.5 | 3.5 | 0.0 | 10.9 | 27.4 | 52.6 | 18.9 | 30.7 | 496.2 |
| 1979 | 42.6 | 101.1 | 98.7 | 53.2 | 16.8 | 6.2 | 0.0 | 0.0 | 8.0 | 12.5 | 26.0 | 21.2 | 386.3 |
| 1980 | 71.0 | 36.6 | 90.0 | 19.6 | 2.4 | 0.1 | 9.8 | 9.5 | 5.6 | 71.8 | 76.3 | 57.2 | 449.9 |
| 1981 | 92.3 | 182.0 | 218.5 | 29.9 | 0.0 | 0.1 | 0.1 | 9.7 | 16.1 | 32.0 | 49.9 | 41.0 | 671.6 |
| 1982 | 95.4 | 74.2 | 80.2 | 57.6 | 12.7 | 0.1 | 3.3 | 4.6 | 12.8 | 32.1 | 94.7 | 47.0 | 514.7 |
| 1983 | 56.2 | 2.9 | 153.0 | 34.5 | 39.0 | 13.0 | 3.6 | 15.8 | 14.3 | 9.2 | 21.8 | 56.7 | 420.0 |
| 1984 | 102.0 | 123.0 | 85.4 | 51.0 | 50.5 | 62.6 | 1.0 | 5.4 | 2.6 | 14.3 | 46.7 | 73.5 | 618.0 |
| 1985 | 100.5 | 90.0 | 115.1 | 94.8 | 21.5 | 15.9 | 12.0 | 18.7 | 3.4 | 25.5 | 37.6 | 47.7 | 582.7 |
| 1986 | 106.0 | 184.3 | 146.4 | 150.6 | 113.4 | 58.2 | 34.5 | 62.4 | 75.5 | 128.8 | 58.9 | 78.1 | 1,197.1 |
| 1987 | 177.1 | 131.9 | 37.4 | 24.2 | 0.0 | 7.1 | 9.3 | 20.0 | 5.7 | 12.9 | 30.6 | 48.2 | 504.4 |
| 1988 | 74.4 | 67.6 | 100.7 | 51.1 | 8.6 | 3.3 | 7.6 | 12.1 | 3.1 | 5.6 | 50.9 | 66.5 | 451.5 |
| 1989 | 99.1 | 73.5 | 109.3 | 50.4 | 15.4 | 3.1 | 5.6 | 15.9 | 9.6 | 28.2 | 119.0 | 19.5 | 548.6 |
| 1990 | 39.1 | 33.5 | 64.3 | 79.2 | 15.9 | 17.0 | 24.5 | 19.6 | 34.1 | 11.2 | 84.4 | 68.1 | 490.9 |
| 1991 | 108.1 | 88.1 | 74.6 | 70.9 | 45.1 | 15.9 | 11.5 | 14.5 | 3.4 | 22.6 | 53.1 | 42.4 | 550.2 |
| 1992 | 60.2 | 51.7 | 78.3 | 20.7 | 3.1 | 6.6 | 13.4 | 14.4 | 14.9 | 47.2 | 55.4 | 80.2 | 446.1 |
| 1993 | 212.4 | 241.9 | 198.4 | 119.6 | 29.1 | 8.4 | 7.4 | 8.6 | 35.8 | 101.0 | 161.5 | 164.0 | 1,288.1 |
| 1994 | 228.4 | 308.9 | 154.9 | 104.0 | 32.5 | 32.8 | 14.2 | 9.6 | 86.5 | 38.2 | 85.4 | 96.7 | 1,192.1 |
| 1995 | 212.5 | 76.6 | 165.4 | 54.6 | 13.2 | 2.6 | 1.8 | 0.0 | 36.5 | 65.2 | 80.5 | 134.1 | 843.0 |
| 1996 | 223.6 | 229.7 | 166.0 | 128.9 | 15.9 | 0.0 | 0.0 | 11.4 | 16.5 | 60.8 | 34.4 | 133.3 | 1,020.5 |
| 1997 | 176.4 | 252.0 | 25.7 | 36.2 | 5.4 | 0.0 | 0.0 | 21.2 | 49.7 | 45.3 | 133.8 | 177.2 | 922.9 |
| 1998 | 247.2 | 141.9 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 334.0 | 308.9 | 352.7 | 228.1 | 113.4 | 62.6 | 34.5 | 62.4 | 109.8 | 128.8 | 161.5 | 267.3 | 1,288.1 |
| Mean | 136.9 | 133.8 | 139.9 | 82.1 | 25.3 | 9.4 | 6.7 | 12.8 | 27.6 | 51.4 | 67.2 | 90.9 | 780.5 |
| Min. | 39.1 | 2.9 | 25.7 | 19.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 | 10.3 | 19.5 | 386.3 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |



# Table 1.2.5 Basin Average Rainfall (3/6)

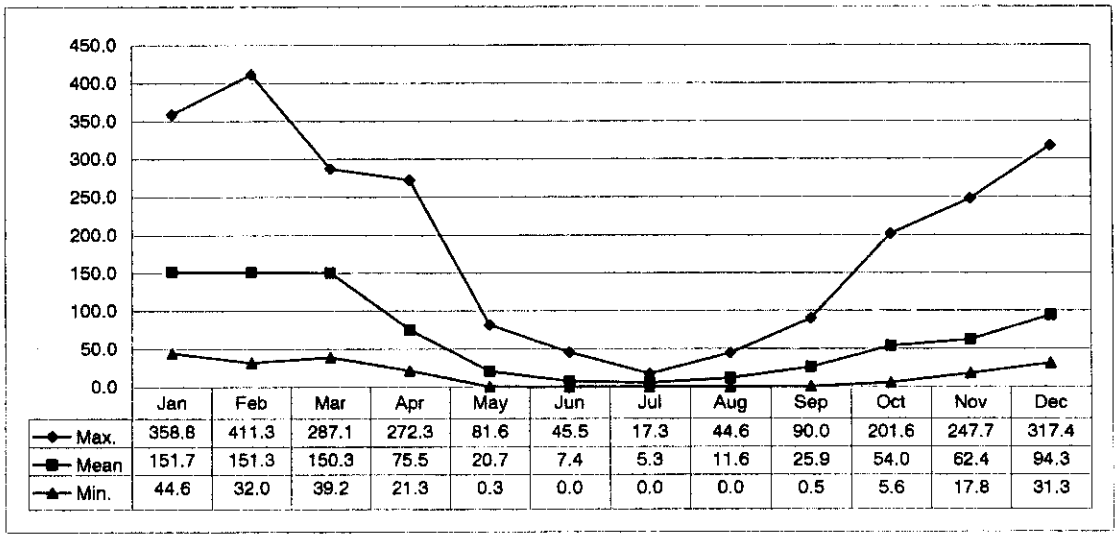
**Monthly Rainfall (mm)**

Station: No.7: Tinco de Alis

Longitude: W 75° 48'
Latitude: S 12° 17'
Altitude: 3,350

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 144.0 | 181.4 | 172.6 | 106.2 | 18.1 | 3.0 | 0.0 | 0.5 | 19.8 | 49.7 | 49.9 | 59.6 | 804.8 |
| 1965 | 104.6 | 248.0 | 123.4 | 47.5 | 20.1 | 0.5 | 10.5 | 15.6 | 27.7 | 49.3 | 35.3 | 108.9 | 791.4 |
| 1966 | 164.4 | 106.4 | 160.0 | 73.6 | 19.7 | 4.1 | 1.6 | 2.9 | 39.3 | 120.7 | 102.7 | 158.9 | 954.3 |
| 1967 | 223.1 | 318.8 | 265.0 | 45.2 | 26.4 | 5.5 | 13.8 | 11.7 | 35.0 | 89.6 | 63.9 | 73.2 | 1,171.2 |
| 1968 | 139.8 | 152.0 | 119.1 | 30.1 | 5.2 | 5.2 | 2.2 | 13.7 | 38.9 | 78.0 | 62.1 | 42.7 | 689.0 |
| 1969 | 69.0 | 107.0 | 88.4 | 109.1 | 3.3 | 2.8 | 0.2 | 5.7 | 36.8 | 82.5 | 95.2 | 233.2 | 833.2 |
| 1970 | 242.8 | 54.9 | 113.6 | 106.1 | 49.3 | 0.0 | 4.2 | 0.2 | 73.9 | 45.7 | 68.2 | 140.7 | 899.6 |
| 1971 | 123.8 | 189.4 | 171.7 | 38.5 | 0.3 | 0.3 | 0.0 | 13.4 | 0.5 | 18.1 | 26.7 | 124.6 | 707.3 |
| 1972 | 121.9 | 93.4 | 274.9 | 127.6 | 0.5 | 0.0 | 8.0 | 4.1 | 5.8 | 71.4 | 74.4 | 72.7 | 854.7 |
| 1973 | 190.2 | 109.8 | 154.1 | 93.3 | 32.3 | 0.0 | 2.9 | 13.7 | 52.6 | 85.9 | 111.3 | 165.6 | 1,011.7 |
| 1974 | 241.9 | 216.6 | 187.5 | 68.3 | 13.4 | 13.3 | 0.0 | 44.6 | 10.0 | 21.3 | 46.1 | 69.3 | 932.3 |
| 1975 | 101.8 | 136.7 | 217.1 | 117.9 | 46.2 | 7.5 | 2.3 | 13.1 | 45.7 | 85.7 | 67.3 | 120.9 | 962.2 |
| 1976 | 219.9 | 155.6 | 153.2 | 45.4 | 11.5 | 12.4 | 6.9 | 17.8 | 21.8 | 9.9 | 21.0 | 41.8 | 717.2 |
| 1977 | 118.4 | 146.2 | 147.5 | 50.3 | 10.6 | 0.3 | 1.0 | 0.5 | 9.2 | 24.4 | 63.7 | 40.5 | 612.6 |
| 1978 | 107.1 | 118.0 | 81.2 | 53.9 | 14.1 | 1.6 | 0.8 | 6.9 | 14.7 | 32.3 | 21.6 | 47.9 | 500.1 |
| 1979 | 44.6 | 149.5 | 172.4 | 38.5 | 9.0 | 4.3 | 0.0 | 0.6 | 5.5 | 8.4 | 18.9 | 31.3 | 483.0 |
| 1980 | 64.5 | 48.6 | 153.9 | 34.9 | 5.4 | 0.7 | 7.8 | 4.4 | 7.8 | 103.8 | 65.7 | 68.2 | 565.7 |
| 1981 | 151.2 | 215.6 | 243.2 | 76.4 | 0.7 | 0.6 | 0.8 | 6.2 | 13.6 | 40.4 | 65.5 | 55.9 | 870.1 |
| 1982 | 155.0 | 133.9 | 121.1 | 71.0 | 7.3 | 3.6 | 2.9 | 2.9 | 10.0 | 30.4 | 80.8 | 56.8 | 675.7 |
| 1983 | 69.8 | 42.9 | 108.6 | 33.1 | 27.8 | 10.4 | 2.1 | 9.2 | 10.8 | 5.6 | 17.8 | 49.0 | 387.1 |
| 1984 | 120.8 | 210.7 | 131.7 | 86.9 | 69.5 | 45.5 | 0.5 | 3.2 | 3.7 | 25.7 | 50.8 | 100.6 | 849.6 |
| 1985 | 110.5 | 106.9 | 120.7 | 67.3 | 28.1 | 21.1 | 9.4 | 8.9 | 9.6 | 29.5 | 39.5 | 47.3 | 598.8 |
| 1986 | 160.1 | 228.6 | 182.2 | 148.5 | 81.6 | 27.7 | 17.3 | 29.9 | 42.8 | 118.7 | 34.8 | 75.5 | 1,147.7 |
| 1987 | 248.4 | 130.7 | 53.5 | 21.7 | 1.4 | 8.7 | 4.4 | 11.2 | 8.5 | 47.4 | 63.9 | 76.1 | 675.9 |
| 1988 | 156.5 | 126.9 | 153.5 | 78.7 | 28.3 | 3.7 | 3.7 | 5.7 | 9.0 | 24.4 | 44.9 | 110.5 | 745.8 |
| 1989 | 132.7 | 131.1 | 152.0 | 60.8 | 17.8 | 7.5 | 4.7 | 8.0 | 11.3 | 24.2 | 80.0 | 40.4 | 670.5 |
| 1990 | 76.5 | 61.0 | 66.4 | 66.2 | 13.4 | 11.6 | 14.5 | 15.9 | 24.5 | 18.7 | 52.9 | 58.6 | 480.2 |
| 1991 | 86.2 | 64.5 | 102.4 | 67.9 | 23.2 | 7.7 | 5.4 | 18.6 | 17.0 | 15.8 | 32.7 | 38.0 | 479.4 |
| 1992 | 64.5 | 32.0 | 64.2 | 21.3 | 7.0 | 7.1 | 10.1 | 7.6 | 7.1 | 30.9 | 30.9 | 55.1 | 337.8 |
| 1993 | 174.3 | 200.9 | 144.4 | 107.9 | 34.4 | 8.7 | 16.3 | 16.2 | 85.1 | 201.6 | 247.7 | 317.4 | 1,554.9 |
| 1994 | 358.8 | 411.3 | 287.1 | 272.3 | 42.0 | 24.0 | 12.6 | 33.2 | 90.0 | 104.8 | 71.4 | 162.0 | 1,869.5 |
| 1995 | 246.8 | 144.1 | 261.4 | 84.6 | 20.1 | 1.3 | 14.8 | 0.0 | 38.7 | 48.1 | 54.0 | 100.3 | 1,014.2 |
| 1996 | 195.1 | 166.0 | 123.5 | 86.4 | 10.1 | 0.1 | 0.0 | 19.6 | 14.0 | 48.2 | 48.4 | 106.2 | 817.6 |
| 1997 | 160.6 | 206.4 | 39.2 | 30.2 | 5.0 | 0.0 | 0.0 | 27.4 | 41.2 | 43.2 | 112.9 | 157.6 | 823.7 |
| 1998 | 219.1 | 149.5 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 358.8 | 411.3 | 287.1 | 272.3 | 81.6 | 45.5 | 17.3 | 44.6 | 90.0 | 201.6 | 247.7 | 317.4 | 1,869.5 |
| Mean | 151.7 | 151.3 | 150.3 | 75.5 | 20.7 | 7.4 | 5.3 | 11.6 | 25.9 | 54.0 | 62.4 | 94.3 | 808.5 |
| Min. | 44.6 | 32.0 | 39.2 | 21.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.5 | 5.6 | 17.8 | 31.3 | 337.8 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 358.8 | 411.3 | 287.1 | 272.3 | 81.6 | 45.5 | 17.3 | 44.6 | 90.0 | 201.6 | 247.7 | 317.4 |
| Mean | 151.7 | 151.3 | 150.3 | 75.5 | 20.7 | 7.4 | 5.3 | 11.6 | 25.9 | 54.0 | 62.4 | 94.3 |
| Min. | 44.6 | 32.0 | 39.2 | 21.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.5 | 5.6 | 17.8 | 31.3 |

# Table 1.2.5 Basin Average Rainfall (4/6)

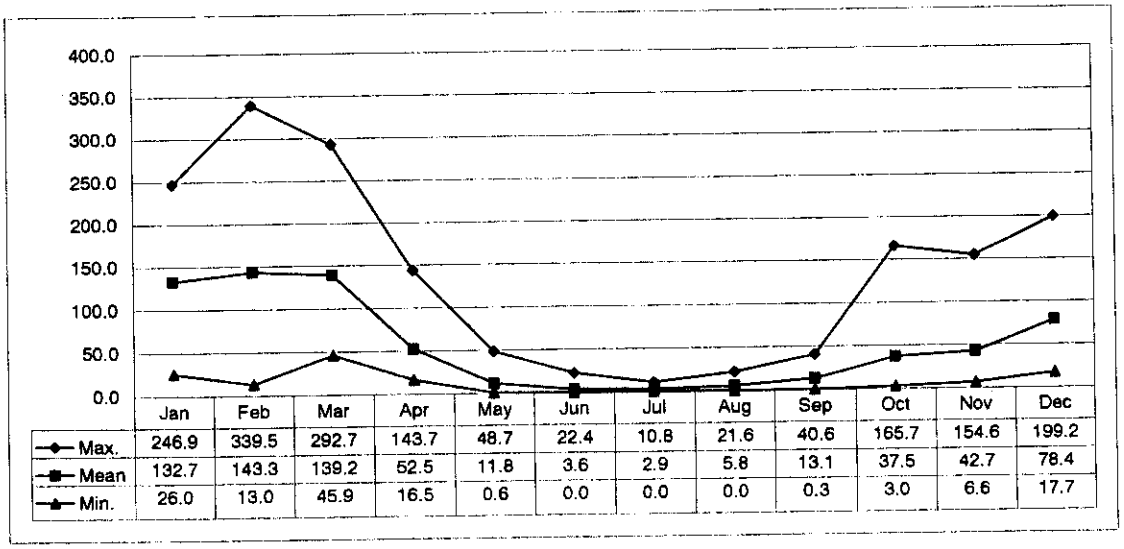
**Monthly Rainfall (mm)**

Station: No.16: Chavin

Longitude: W 75° 57'
Latitude: S 12° 45'
Altitude: 1,350

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 87.8 | 174.5 | 144.1 | 62.3 | 18.8 | 0.9 | 0.0 | 0.1 | 12.5 | 27.3 | 23.2 | 59.6 | 611.1 |
| 1965 | 78.4 | 204.9 | 97.5 | 26.5 | 8.9 | 0.5 | 4.6 | 8.8 | 16.2 | 26.0 | 22.5 | 76.4 | 571.2 |
| 1966 | 131.9 | 104.7 | 137.4 | 49.3 | 10.6 | 2.0 | 0.8 | 0.9 | 24.4 | 104.7 | 52.1 | 108.4 | 727.2 |
| 1967 | 204.6 | 308.1 | 222.7 | 40.3 | 11.9 | 3.3 | 7.1 | 6.3 | 21.0 | 46.3 | 35.7 | 55.6 | 962.9 |
| 1968 | 83.2 | 82.7 | 90.5 | 16.5 | 5.3 | 3.4 | 2.5 | 8.4 | 16.8 | 34.9 | 35.4 | 35.6 | 415.2 |
| 1969 | 52.0 | 74.5 | 102.7 | 67.9 | 1.6 | 1.8 | 1.5 | 3.7 | 16.6 | 50.1 | 52.7 | 174.3 | 599.4 |
| 1970 | 174.1 | 63.8 | 79.7 | 56.7 | 32.8 | 0.0 | 1.3 | 0.2 | 36.8 | 32.5 | 28.7 | 68.7 | 575.3 |
| 1971 | 127.6 | 141.2 | 190.7 | 56.1 | 3.7 | 0.3 | 0.0 | 4.3 | 0.3 | 9.0 | 10.3 | 121.1 | 664.6 |
| 1972 | 134.8 | 104.3 | 292.7 | 73.7 | 0.6 | 0.0 | 3.6 | 1.1 | 5.5 | 42.2 | 36.6 | 94.2 | 789.3 |
| 1973 | 174.2 | 99.9 | 223.2 | 88.9 | 16.6 | 0.0 | 0.8 | 7.2 | 21.6 | 43.5 | 65.7 | 132.6 | 874.2 |
| 1974 | 183.8 | 165.3 | 132.6 | 40.0 | 7.0 | 5.7 | 0.0 | 21.6 | 4.8 | 8.5 | 28.2 | 49.2 | 646.7 |
| 1975 | 64.0 | 102.7 | 171.2 | 52.1 | 23.4 | 4.8 | 2.4 | 6.7 | 24.1 | 38.9 | 44.1 | 118.0 | 652.4 |
| 1976 | 208.5 | 150.9 | 133.8 | 39.9 | 4.5 | 5.6 | 4.8 | 9.3 | 13.1 | 3.0 | 6.6 | 33.4 | 613.4 |
| 1977 | 70.8 | 173.9 | 120.1 | 27.0 | 6.0 | 0.3 | 0.7 | 0.1 | 6.8 | 12.0 | 74.1 | 28.4 | 520.2 |
| 1978 | 114.8 | 75.7 | 61.3 | 38.3 | 6.3 | 0.5 | 0.4 | 2.4 | 6.3 | 24.8 | 20.8 | 55.1 | 406.7 |
| 1979 | 31.0 | 148.5 | 177.4 | 16.8 | 3.3 | 2.4 | 0.1 | 0.4 | 5.0 | 4.3 | 8.1 | 17.7 | 415.0 |
| 1980 | 83.7 | 43.4 | 112.9 | 25.6 | 5.8 | 0.7 | 8.3 | 1.3 | 7.8 | 63.3 | 53.5 | 73.8 | 480.1 |
| 1981 | 208.1 | 339.5 | 180.0 | 92.0 | 0.6 | 0.6 | 0.8 | 8.9 | 5.7 | 26.8 | 52.9 | 75.7 | 991.6 |
| 1982 | 149.9 | 196.2 | 91.3 | 43.6 | 4.2 | 2.5 | 3.0 | 2.0 | 8.2 | 165.7 | 135.2 | 32.1 | 833.9 |
| 1983 | 53.9 | 34.7 | 168.2 | 29.8 | 16.8 | 6.3 | 1.2 | 10.7 | 6.9 | 5.2 | 16.0 | 103.0 | 452.7 |
| 1984 | 229.0 | 286.7 | 206.5 | 73.0 | 31.8 | 22.4 | 0.1 | 1.6 | 3.2 | 52.8 | 154.6 | 120.9 | 1,182.6 |
| 1985 | 64.8 | 148.1 | 104.6 | 60.6 | 29.7 | 16.9 | 9.9 | 2.6 | 8.9 | 25.4 | 28.4 | 37.6 | 537.5 |
| 1986 | 117.6 | 237.6 | 181.1 | 136.2 | 48.7 | 7.7 | 10.8 | 8.3 | 13.7 | 46.8 | 20.7 | 105.1 | 934.3 |
| 1987 | 246.9 | 146.5 | 86.0 | 22.0 | 0.7 | 3.6 | 1.3 | 11.1 | 3.7 | 22.2 | 33.7 | 53.5 | 631.2 |
| 1988 | 214.2 | 144.2 | 171.5 | 58.9 | 21.2 | 1.5 | 1.1 | 1.5 | 4.1 | 26.6 | 17.1 | 113.3 | 775.2 |
| 1989 | 154.5 | 155.1 | 149.8 | 52.4 | 8.5 | 3.5 | 1.9 | 2.9 | 5.9 | 17.7 | 30.0 | 18.9 | 601.1 |
| 1990 | 83.5 | 58.6 | 74.1 | 37.0 | 8.1 | 7.9 | 4.7 | 6.0 | 12.0 | 13.4 | 25.4 | 69.9 | 400.6 |
| 1991 | 75.2 | 69.8 | 120.5 | 40.3 | 7.2 | 2.2 | 1.5 | 7.8 | 8.0 | 25.8 | 12.5 | 20.9 | 391.7 |
| 1992 | 26.0 | 13.0 | 45.9 | 18.3 | 3.0 | 2.9 | 3.5 | 2.5 | 2.0 | 40.9 | 10.2 | 34.9 | 203.1 |
| 1993 | 139.3 | 144.0 | 126.4 | 63.2 | 15.0 | 3.6 | 7.3 | 9.3 | 40.6 | 103.4 | 146.6 | 199.2 | 997.9 |
| 1994 | 227.8 | 269.2 | 177.9 | 143.7 | 21.9 | 9.2 | 4.8 | 15.4 | 36.9 | 49.4 | 45.5 | 87.7 | 1,089.4 |
| 1995 | 147.3 | 89.1 | 155.2 | 52.0 | 8.7 | 0.4 | 7.1 | 0.0 | 17.2 | 22.7 | 28.8 | 68.4 | 596.9 |
| 1996 | 186.2 | 175.9 | 131.3 | 59.2 | 3.5 | 0.1 | 0.0 | 8.7 | 6.0 | 27.2 | 25.9 | 93.6 | 717.6 |
| 1997 | 128.0 | 160.1 | 72.1 | 26.3 | 3.8 | 0.0 | 0.0 | 14.8 | 21.9 | 32.8 | 71.6 | 129.1 | 660.5 |
| 1998 | 185.5 | 128.3 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 246.9 | 339.5 | 292.7 | 143.7 | 48.7 | 22.4 | 10.8 | 21.6 | 40.6 | 165.7 | 154.6 | 199.2 | 1,182.6 |
| Mean | 132.7 | 143.3 | 139.2 | 52.5 | 11.8 | 3.6 | 2.9 | 5.8 | 13.1 | 37.5 | 42.7 | 78.4 | 662.4 |
| Min. | 26.0 | 13.0 | 45.9 | 16.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.3 | 3.0 | 6.6 | 17.7 | 203.1 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |



# Table 1.2.5 Basin Average Rainfall (5/6)

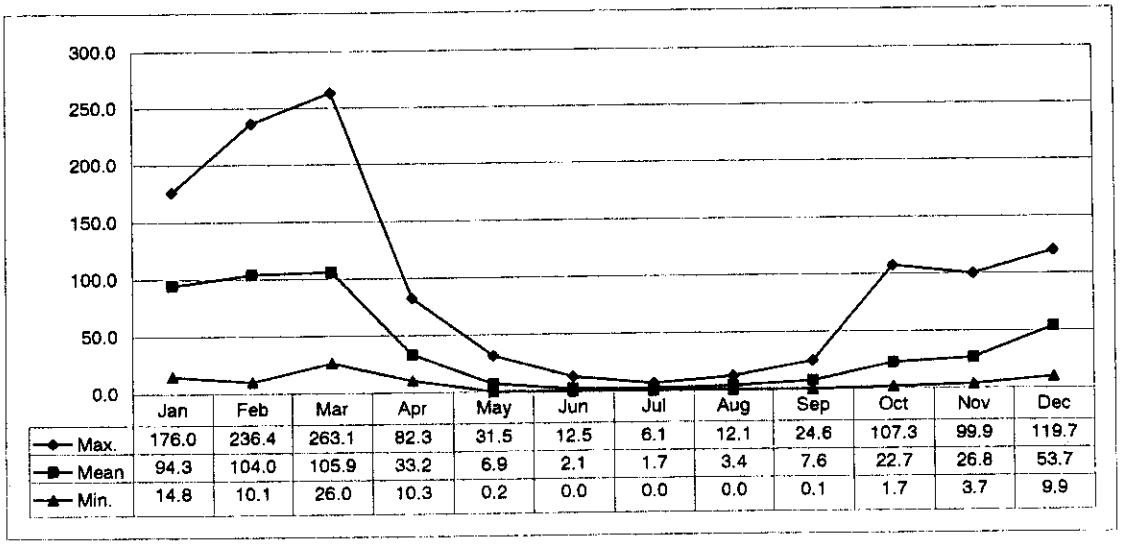
**Monthly Rainfall (mm)**

Station: No.23: Socsi

Longitude: W 76° 12'
Latitude: S 13° 02'
Altitude: 350

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 54.6 | 119.0 | 111.4 | 48.1 | 11.4 | 0.5 | 0.0 | 0.1 | 7.0 | 17.8 | 13.0 | 46.8 | 429.7 |
| 1965 | 59.3 | 139.7 | 68.6 | 16.1 | 4.8 | 0.3 | 2.7 | 5.2 | 9.3 | 14.6 | 12.9 | 45.7 | 379.2 |
| 1966 | 85.4 | 77.1 | 107.7 | 29.3 | 5.9 | 1.1 | 0.5 | 0.5 | 14.3 | 68.3 | 31.7 | 69.9 | 491.7 |
| 1967 | 154.1 | 236.4 | 161.7 | 26.1 | 6.8 | 1.9 | 3.9 | 3.6 | 12.1 | 28.2 | 20.5 | 33.0 | 688.3 |
| 1968 | 51.6 | 52.6 | 68.3 | 10.6 | 3.4 | 1.8 | 1.4 | 4.9 | 9.3 | 19.4 | 20.3 | 21.8 | 265.4 |
| 1969 | 36.1 | 67.2 | 102.5 | 41.6 | 0.8 | 2.1 | 1.3 | 1.8 | 9.2 | 32.2 | 43.2 | 119.7 | 457.7 |
| 1970 | 166.7 | 44.4 | 55.4 | 36.6 | 21.1 | 0.0 | 0.7 | 0.1 | 24.6 | 19.1 | 16.9 | 41.8 | 427.4 |
| 1971 | 94.1 | 100.4 | 160.4 | 35.6 | 2.1 | 0.2 | 0.0 | 2.4 | 0.1 | 5.0 | 5.7 | 94.9 | 500.9 |
| 1972 | 104.6 | 76.1 | 263.1 | 50.3 | 0.2 | 0.0 | 2.1 | 0.6 | 3.5 | 25.5 | 23.0 | 68.0 | 617.0 |
| 1973 | 122.1 | 83.0 | 159.8 | 60.1 | 9.7 | 0.0 | 0.6 | 4.0 | 13.4 | 26.9 | 40.9 | 95.3 | 615.8 |
| 1974 | 123.5 | 112.9 | 100.1 | 26.7 | 3.8 | 3.5 | 0.0 | 12.1 | 3.3 | 4.7 | 17.7 | 36.4 | 444.7 |
| 1975 | 46.3 | 80.1 | 151.5 | 30.9 | 14.6 | 2.9 | 1.5 | 3.7 | 14.6 | 22.1 | 26.5 | 79.5 | 474.2 |
| 1976 | 156.0 | 123.8 | 104.3 | 24.8 | 2.9 | 3.4 | 2.7 | 5.1 | 7.0 | 1.7 | 3.7 | 23.7 | 459.1 |
| 1977 | 41.0 | 162.0 | 119.4 | 16.7 | 3.3 | 0.2 | 0.4 | 0.1 | 4.3 | 7.6 | 48.8 | 22.3 | 426.1 |
| 1978 | 78.8 | 48.7 | 56.7 | 25.7 | 3.3 | 0.2 | 0.2 | 1.3 | 3.8 | 16.9 | 13.1 | 36.4 | 285.1 |
| 1979 | 25.3 | 109.7 | 144.5 | 10.3 | 1.7 | 1.4 | 0.1 | 0.2 | 2.8 | 2.3 | 5.4 | 9.9 | 313.6 |
| 1980 | 64.1 | 30.5 | 74.5 | 14.8 | 3.3 | 0.3 | 5.3 | 0.6 | 4.9 | 38.7 | 33.7 | 45.6 | 316.3 |
| 1981 | 132.8 | 213.8 | 125.4 | 60.9 | 0.3 | 0.3 | 0.5 | 6.8 | 3.0 | 14.9 | 31.7 | 66.9 | 657.3 |
| 1982 | 96.7 | 151.1 | 65.9 | 27.2 | 2.4 | 1.4 | 1.7 | 1.1 | 4.4 | 107.3 | 92.2 | 18.7 | 570.1 |
| 1983 | 36.8 | 26.4 | 112.0 | 19.0 | 9.7 | 3.8 | 0.7 | 6.0 | 4.2 | 3.5 | 9.8 | 76.4 | 308.3 |
| 1984 | 176.0 | 208.6 | 153.3 | 50.9 | 17.6 | 12.5 | 0.1 | 0.8 | 1.8 | 33.4 | 99.9 | 82.0 | 836.9 |
| 1985 | 41.1 | 106.9 | 64.7 | 34.7 | 17.0 | 9.5 | 5.7 | 1.3 | 5.1 | 14.4 | 16.3 | 45.4 | 362.1 |
| 1986 | 104.6 | 175.9 | 138.1 | 81.2 | 31.5 | 4.2 | 6.1 | 6.2 | 7.7 | 26.1 | 14.4 | 93.5 | 689.5 |
| 1987 | 156.4 | 98.8 | 61.6 | 13.0 | 0.4 | 2.0 | 0.7 | 6.6 | 2.1 | 12.4 | 20.2 | 31.7 | 405.9 |
| 1988 | 150.0 | 106.2 | 116.1 | 46.8 | 12.0 | 0.8 | 0.6 | 0.9 | 2.2 | 15.2 | 9.5 | 64.3 | 524.6 |
| 1989 | 133.3 | 126.4 | 121.1 | 31.5 | 4.8 | 1.9 | 1.0 | 1.7 | 3.2 | 12.1 | 16.7 | 10.3 | 464.0 |
| 1990 | 55.1 | 33.0 | 67.0 | 20.9 | 4.4 | 4.5 | 2.7 | 3.4 | 6.8 | 7.6 | 16.7 | 48.1 | 270.2 |
| 1991 | 48.9 | 54.8 | 87.7 | 22.6 | 3.9 | 1.2 | 0.9 | 4.4 | 4.4 | 14.7 | 7.1 | 11.8 | 262.4 |
| 1992 | 14.8 | 10.1 | 26.0 | 10.5 | 1.8 | 1.5 | 2.0 | 1.5 | 1.2 | 24.1 | 5.7 | 20.8 | 120.0 |
| 1993 | 88.7 | 97.8 | 97.2 | 43.5 | 8.5 | 1.9 | 4.0 | 5.2 | 22.7 | 59.2 | 85.2 | 117.4 | 631.3 |
| 1994 | 154.4 | 177.9 | 112.3 | 82.3 | 13.4 | 5.4 | 2.7 | 8.7 | 20.5 | 27.4 | 27.7 | 53.8 | 686.5 |
| 1995 | 90.5 | 59.3 | 108.9 | 30.2 | 4.9 | 0.2 | 4.0 | 0.0 | 10.1 | 13.7 | 22.6 | 47.4 | 391.8 |
| 1996 | 127.9 | 118.9 | 84.7 | 34.4 | 1.9 | 0.0 | 0.0 | 4.8 | 3.4 | 15.4 | 14.4 | 57.6 | 463.4 |
| 1997 | 87.4 | 100.3 | 48.3 | 15.0 | 2.2 | 0.0 | 0.0 | 8.5 | 12.9 | 20.1 | 43.2 | 88.5 | 426.4 |
| 1998 | 142.9 | 108.9 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 176.0 | 236.4 | 263.1 | 82.3 | 31.5 | 12.5 | 6.1 | 12.1 | 24.6 | 107.3 | 99.9 | 119.7 | 836.9 |
| Mean | 94.3 | 104.0 | 105.9 | 33.2 | 6.9 | 2.1 | 1.7 | 3.4 | 7.6 | 22.7 | 26.8 | 53.7 | 460.7 |
| Min. | 14.8 | 10.1 | 26.0 | 10.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 1.7 | 3.7 | 9.9 | 120.0 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |



# Table 1.2.5 Basin Average Rainfall

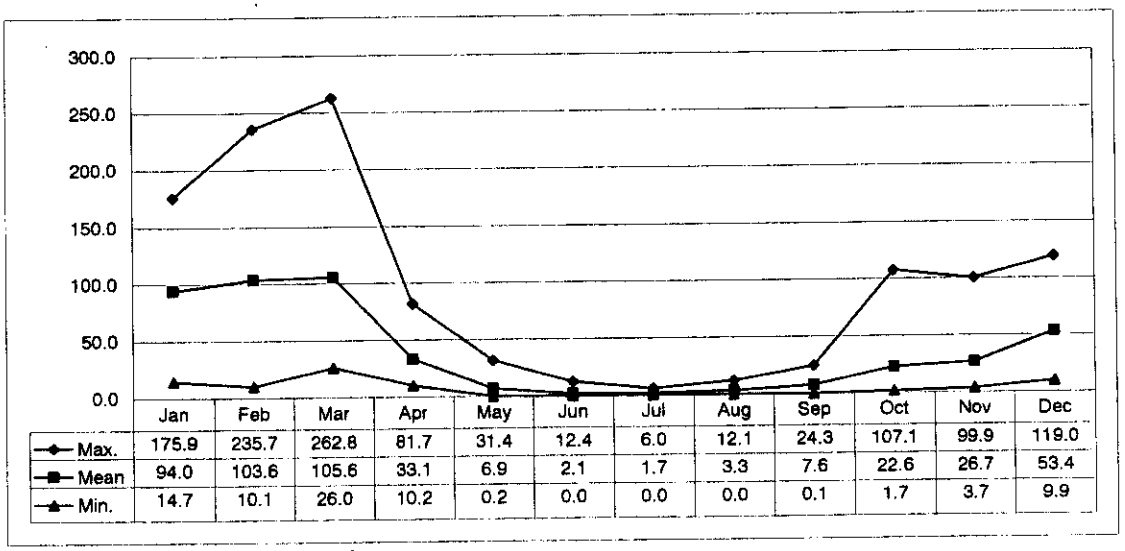
**Monthly Rainfall (mm)**

Station: No.24: Imperial

Longitude: W 76° 12'
Latitude: S 13° 02'
Altitude: 250

Note: based on the data observed + estimated by correlation method

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 54.0 | 118.4 | 111.1 | 48.1 | 11.4 | 0.5 | 0.0 | 0.1 | 7.0 | 17.8 | 13.0 | 46.6 | 428.0 |
| 1965 | 59.2 | 139.2 | 68.2 | 15.9 | 4.8 | 0.3 | 2.7 | 5.2 | 9.3 | 14.6 | 12.7 | 45.6 | 377.7 |
| 1966 | 85.1 | 77.0 | 107.5 | 29.2 | 5.9 | 1.1 | 0.5 | 0.5 | 14.3 | 68.2 | 31.6 | 69.3 | 490.2 |
| 1967 | 153.8 | 235.7 | 161.0 | 26.1 | 6.7 | 1.9 | 3.9 | 3.5 | 12.0 | 28.0 | 20.3 | 32.8 | 685.7 |
| 1968 | 51.4 | 52.6 | 68.0 | 10.6 | 3.4 | 1.8 | 1.4 | 4.9 | 9.2 | 19.4 | 20.1 | 21.7 | 264.5 |
| 1969 | 36.0 | 67.1 | 102.2 | 41.2 | 0.8 | 2.1 | 1.3 | 1.8 | 9.2 | 32.1 | 43.1 | 119.0 | 455.9 |
| 1970 | 166.2 | 44.3 | 55.0 | 36.3 | 21.1 | 0.0 | 0.7 | 0.1 | 24.3 | 18.8 | 16.7 | 41.6 | 425.1 |
| 1971 | 93.8 | 99.6 | 160.3 | 35.4 | 2.1 | 0.2 | 0.0 | 2.4 | 0.1 | 5.0 | 5.7 | 94.9 | 499.5 |
| 1972 | 104.1 | 75.8 | 262.8 | 50.3 | 0.2 | 0.0 | 2.1 | 0.6 | 3.5 | 25.1 | 22.9 | 67.7 | 615.1 |
| 1973 | 121.8 | 82.6 | 159.4 | 59.9 | 9.6 | 0.0 | 0.6 | 4.0 | 13.3 | 26.7 | 40.6 | 95.1 | 613.6 |
| 1974 | 123.1 | 112.3 | 100.0 | 26.6 | 3.8 | 3.5 | 0.0 | 12.1 | 3.3 | 4.6 | 17.6 | 36.3 | 443.2 |
| 1975 | 46.2 | 80.0 | 151.0 | 30.8 | 14.6 | 2.8 | 1.5 | 3.7 | 14.6 | 22.1 | 26.5 | 78.9 | 472.7 |
| 1976 | 155.0 | 123.5 | 104.0 | 24.8 | 2.9 | 3.4 | 2.6 | 5.1 | 6.9 | 1.7 | 3.7 | 23.6 | 457.2 |
| 1977 | 40.6 | 161.8 | 119.1 | 16.7 | 3.3 | 0.2 | 0.4 | 0.1 | 4.2 | 7.6 | 48.8 | 22.2 | 425.0 |
| 1978 | 78.4 | 48.5 | 56.7 | 25.7 | 3.3 | 0.2 | 0.2 | 1.3 | 3.7 | 16.9 | 13.1 | 36.4 | 284.4 |
| 1979 | 25.2 | 109.1 | 144.2 | 10.2 | 1.7 | 1.4 | 0.1 | 0.2 | 2.8 | 2.3 | 5.3 | 9.9 | 312.4 |
| 1980 | 64.0 | 30.5 | 74.5 | 14.8 | 3.3 | 0.3 | 5.3 | 0.6 | 4.9 | 38.7 | 33.7 | 45.4 | 316.0 |
| 1981 | 132.5 | 213.3 | 124.8 | 60.7 | 0.3 | 0.3 | 0.5 | 6.8 | 3.0 | 14.8 | 31.7 | 66.7 | 655.4 |
| 1982 | 96.2 | 150.5 | 65.8 | 27.1 | 2.4 | 1.4 | 1.7 | 1.1 | 4.4 | 107.1 | 91.9 | 18.6 | 568.2 |
| 1983 | 36.8 | 26.4 | 111.9 | 19.0 | 9.7 | 3.7 | 0.7 | 6.0 | 4.2 | 3.5 | 9.7 | 76.4 | 308.0 |
| 1984 | 175.9 | 208.0 | 152.9 | 50.7 | 17.5 | 12.4 | 0.1 | 0.8 | 1.8 | 33.4 | 99.9 | 81.5 | 834.9 |
| 1985 | 40.9 | 106.4 | 64.3 | 34.6 | 17.0 | 9.5 | 5.6 | 1.3 | 5.1 | 14.3 | 16.2 | 45.3 | 360.5 |
| 1986 | 104.5 | 175.5 | 137.7 | 80.9 | 31.4 | 4.2 | 6.0 | 6.2 | 7.7 | 26.0 | 14.4 | 93.0 | 687.5 |
| 1987 | 156.0 | 98.5 | 61.5 | 13.0 | 0.4 | 2.0 | 0.7 | 6.6 | 2.1 | 12.4 | 19.8 | 31.7 | 404.7 |
| 1988 | 149.8 | 106.1 | 115.8 | 46.7 | 12.0 | 0.7 | 0.5 | 0.9 | 2.2 | 15.2 | 9.5 | 64.1 | 523.5 |
| 1989 | 133.1 | 126.1 | 121.0 | 31.4 | 4.7 | 1.9 | 1.0 | 1.7 | 3.2 | 12.1 | 16.6 | 10.2 | 463.0 |
| 1990 | 55.0 | 33.0 | 66.9 | 20.7 | 4.4 | 4.5 | 2.7 | 3.4 | 6.7 | 7.6 | 16.6 | 48.0 | 269.5 |
| 1991 | 48.7 | 54.8 | 87.4 | 22.5 | 3.8 | 1.2 | 0.9 | 4.3 | 4.4 | 14.7 | 7.0 | 11.8 | 261.5 |
| 1992 | 14.7 | 10.1 | 26.0 | 10.4 | 1.7 | 1.5 | 2.0 | 1.5 | 1.1 | 24.1 | 5.6 | 20.6 | 119.3 |
| 1993 | 88.4 | 97.4 | 96.8 | 43.4 | 8.4 | 1.9 | 4.0 | 5.2 | 22.4 | 58.9 | 84.6 | 116.6 | 628.0 |
| 1994 | 153.8 | 177.3 | 111.9 | 81.7 | 13.4 | 5.3 | 2.7 | 8.6 | 20.4 | 27.3 | 27.6 | 53.1 | 683.1 |
| 1995 | 89.5 | 58.9 | 108.5 | 30.0 | 4.8 | 0.2 | 4.0 | 0.0 | 10.0 | 13.6 | 22.5 | 47.2 | 389.2 |
| 1996 | 127.7 | 118.7 | 84.4 | 34.2 | 1.9 | 0.0 | 0.0 | 4.8 | 3.4 | 15.4 | 14.4 | 57.3 | 462.2 |
| 1997 | 86.9 | 99.8 | 48.3 | 15.0 | 2.2 | 0.0 | 0.0 | 8.4 | 12.9 | 20.0 | 43.1 | 88.0 | 424.6 |
| 1998 | 142.4 | 108.8 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 175.9 | 235.7 | 262.8 | 81.7 | 31.4 | 12.4 | 6.0 | 12.1 | 24.3 | 107.1 | 99.9 | 119.0 | 834.9 |
| Mean | 94.0 | 103.6 | 105.6 | 33.1 | 6.9 | 2.1 | 1.7 | 3.3 | 7.6 | 22.6 | 26.7 | 53.4 | 459.1 |
| Min. | 14.7 | 10.1 | 26.0 | 10.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 1.7 | 3.7 | 9.9 | 119.3 |
| N | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 175.9 | 235.7 | 262.8 | 81.7 | 31.4 | 12.4 | 6.0 | 12.1 | 24.3 | 107.1 | 99.9 | 119.0 |
| Mean | 94.0 | 103.6 | 105.6 | 33.1 | 6.9 | 2.1 | 1.7 | 3.3 | 7.6 | 22.6 | 26.7 | 53.4 |
| Min. | 14.7 | 10.1 | 26.0 | 10.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 1.7 | 3.7 | 9.9 |

# Table 1.3.1 Discharge Records



**Monthly Discharge ($m^3/s$)**

Station: Imperial / Socsi

Longitude: W -
Latitude: S -
Altitude: -

Source: before 1964:Toma Imperial; after 1965: Socsi

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1926 | 62.6 | 164.5 | 100.3 | 162.3 | 46.3 | 15.0 | 12.0 | 10.0 | 11.0 | 12.0 | 27.5 | 28.7 | 54.4 |
| 1927 | 72.0 | 63.1 | 81.6 | 50.4 | 35.7 | 19.7 | 17.3 | 10.0 | - | - | - | - | - |
| 1928 | 25.3 | 69.2 | 116.1 | 70.7 | 30.4 | 16.9 | 13.3 | 11.9 | 12.1 | 14.8 | 15.1 | 19.3 | 34.6 |
| 1929 | 56.5 | 66.3 | 202.9 | 95.8 | 26.9 | 16.4 | 12.7 | 11.6 | 12.1 | 13.6 | 17.5 | 31.8 | 47.0 |
| 1930 | 120.8 | 107.8 | 111.5 | 61.6 | 40.0 | 19.9 | 14.2 | 12.5 | 11.9 | 13.4 | 25.6 | 19.6 | 46.6 |
| 1931 | 36.2 | 36.2 | 61.4 | 50.0 | 23.2 | 15.0 | 12.6 | 11.8 | 11.7 | 12.6 | 14.4 | 46.1 | 27.6 |
| 1932 | 102.4 | - | - | 156.3 | 54.6 | 18.7 | 14.1 | 10.8 | 10.0 | 10.7 | 20.2 | 38.0 | - |
| 1933 | 74.2 | 83.4 | 122.2 | 64.0 | 24.7 | 17.6 | 14.5 | 13.0 | 11.7 | 11.5 | 12.0 | 26.2 | 39.6 |
| 1934 | 95.7 | 141.0 | 213.7 | 100.9 | 38.4 | 24.1 | 20.0 | 13.6 | 12.2 | 13.9 | 16.8 | 16.8 | 58.9 |
| 1935 | 78.5 | 93.4 | 271.8 | 108.7 | 42.4 | 24.8 | 19.2 | 13.1 | 12.7 | 14.0 | 16.2 | 62.7 | 63.1 |
| 1936 | 181.2 | 128.7 | 141.1 | 55.7 | 20.6 | 16.8 | 12.1 | 9.9 | 9.3 | 16.7 | 16.8 | 16.9 | 52.2 |
| 1937 | 85.6 | 109.5 | 164.5 | 51.8 | 27.0 | 19.7 | 13.3 | 9.8 | 9.1 | 9.9 | 16.2 | 53.0 | 47.5 |
| 1938 | 85.5 | 250.5 | 79.5 | 55.4 | 21.8 | 13.6 | 13.2 | 11.7 | 10.5 | 9.5 | 11.0 | 16.0 | 48.2 |
| 1939 | 51.1 | 99.1 | 193.5 | 106.6 | 34.4 | 17.0 | 13.4 | 11.4 | 9.5 | 9.3 | 13.2 | 32.9 | 49.3 |
| 1940 | 72.3 | 50.6 | 81.7 | 56.4 | 25.8 | 15.5 | 12.0 | 10.4 | 10.3 | 10.8 | 15.7 | 16.2 | 31.5 |
| 1941 | 110.4 | 110.4 | 90.3 | 26.1 | 21.8 | 13.6 | 9.8 | 9.0 | 8.7 | 11.5 | 13.8 | 36.8 | 38.5 |
| 1942 | 86.3 | 130.3 | 127.5 | 48.6 | 38.6 | 18.2 | 14.6 | 12.2 | 10.7 | 10.1 | 10.9 | 19.5 | 44.0 |
| 1943 | 115.0 | 220.2 | 126.6 | 98.7 | 29.5 | 18.2 | 13.1 | 11.0 | 10.5 | 12.4 | 12.6 | 43.8 | 59.3 |
| 1944 | 142.3 | 209.1 | 192.7 | 67.9 | 33.5 | 20.8 | 15.8 | 13.1 | 11.4 | 10.5 | 11.6 | 16.9 | 62.1 |
| 1945 | 65.3 | 100.9 | 188.1 | 73.2 | 24.4 | 15.2 | 11.9 | 9.5 | 8.6 | 8.0 | 20.6 | 61.9 | 49.0 |
| 1946 | 128.4 | 161.2 | 236.4 | 103.3 | 42.0 | 23.6 | 16.1 | 13.3 | 11.7 | 14.1 | 30.3 | 73.9 | 71.2 |
| 1947 | 100.4 | 88.9 | 167.1 | 57.6 | 35.7 | 22.6 | 13.6 | 11.2 | 10.0 | 11.7 | 12.0 | 21.1 | 46.0 |
| 1948 | 100.2 | 115.4 | 111.8 | 90.0 | 59.3 | 26.8 | 16.0 | 11.4 | 10.2 | 26.7 | 34.8 | 16.3 | 51.6 |
| 1949 | 55.6 | 85.6 | 118.5 | 73.6 | 33.6 | 18.7 | 12.2 | 10.1 | 9.3 | 9.1 | 23.9 | 13.5 | 38.6 |
| 1950 | 64.6 | 92.1 | 81.6 | 72.6 | 32.8 | 15.3 | 12.0 | 9.7 | 8.1 | 8.8 | 13.4 | 80.5 | 41.0 |
| 1951 | 99.7 | 183.7 | 269.0 | 90.5 | 29.1 | 21.0 | 14.9 | 12.4 | 10.7 | 9.9 | 48.0 | 60.7 | 70.8 |
| 1952 | 137.5 | 138.7 | 164.6 | 70.3 | 21.0 | 14.7 | 15.0 | 12.8 | 12.5 | 11.3 | 17.7 | 37.8 | 54.5 |
| 1953 | 98.8 | 254.1 | 127.5 | 51.0 | 22.9 | 17.2 | 14.9 | 11.7 | 10.8 | 11.3 | 48.4 | 64.4 | 61.1 |
| 1954 | 145.5 | 191.1 | 223.8 | 54.0 | 33.4 | 23.1 | 16.0 | 12.0 | 10.2 | 12.6 | 59.9 | 45.9 | 69.0 |
| 1955 | 139.4 | 246.7 | 379.0 | 124.9 | 40.8 | 21.9 | 16.7 | 12.2 | 10.1 | 14.2 | 11.2 | 16.7 | 86.2 |
| 1956 | 35.8 | 265.5 | 116.4 | 79.7 | 35.6 | 23.7 | 12.9 | 9.9 | 8.5 | 8.4 | 8.8 | 9.8 | 51.3 |
| 1957 | 24.3 | 133.9 | 145.6 | 88.1 | 35.1 | 14.3 | 10.0 | 7.5 | 7.1 | 7.6 | 9.7 | 13.5 | 41.4 |
| 1958 | 30.9 | 59.5 | 105.3 | 45.7 | 19.4 | 11.8 | 9.3 | 7.8 | 7.0 | 8.6 | 8.9 | 11.1 | 27.1 |
| 1959 | 11.0 | 142.8 | 137.3 | 70.5 | 21.4 | 14.1 | 11.1 | 8.3 | 7.2 | 10.7 | 11.1 | 50.9 | 41.4 |
| 1960 | 134.4 | 126.2 | 43.9 | 24.8 | 19.4 | 11.2 | 8.3 | 6.8 | 6.5 | 8.8 | 10.3 | 11.3 | 34.3 |
| 1961 | 58.3 | 228.7 | 301.0 | 166.1 | 38.9 | 21.6 | 11.5 | 9.4 | 8.0 | 7.6 | 27.8 | 103.2 | 81.8 |
| 1962 | 106.4 | 128.9 | 207.3 | 55.3 | 19.6 | 14.7 | 13.4 | 11.4 | 10.4 | 8.8 | 9.3 | 17.4 | 50.2 |
| 1963 | 130.8 | 122.4 | 124.3 | 92.0 | 29.2 | 26.5 | 14.6 | 11.7 | 11.1 | 11.2 | 26.7 | 98.5 | 58.3 |
| 1964 | 54.6 | 107.9 | 121.9 | 100.6 | 48.2 | 24.2 | 13.2 | 9.8 | 9.3 | 8.6 | 11.0 | 14.0 | 43.6 |
| 1965 | 37.8 | 124.0 | 120.3 | 60.8 | 35.7 | 15.2 | 9.5 | 12.6 | 10.4 | 10.8 | 16.3 | 20.9 | 39.5 |
| 1966 | 30.2 | 26.4 | 49.1 | 26.6 | 15.2 | 11.0 | 9.5 | 8.8 | 8.8 | 10.3 | 21.7 | 30.2 | 20.7 |
| 1967 | 101.2 | 289.0 | 165.0 | 69.5 | 38.3 | 26.1 | 19.9 | 15.9 | 15.8 | 33.6 | 25.7 | 31.4 | 69.3 |
| 1968 | 17.4 | 41.9 | 49.2 | 21.9 | 16.7 | 13.0 | 9.9 | 9.2 | 9.6 | 10.6 | 16.0 | 14.7 | 19.2 |
| 1969 | 31.2 | 49.6 | 94.7 | 52.5 | 22.4 | 14.1 | 12.1 | 10.3 | 7.5 | 19.3 | 13.7 | 138.1 | 38.8 |
| 1970 | 278.5 | 131.4 | 85.7 | 27.0 | 16.8 | - | - | - | - | 13.6 | 16.0 | 31.8 | - |
| 1971 | 113.7 | 155.5 | - | - | 23.7 | 13.8 | 15.2 | 15.2 | 14.0 | 11.1 | 8.7 | 46.3 | - |
| 1972 | 169.4 | 251.1 | 689.2 | 211.7 | 40.1 | 20.4 | 11.2 | 11.9 | - | - | - | 66.6 | - |
| 1973 | - | 221.0 | 290.2 | 202.3 | 66.3 | 22.9 | 14.7 | 10.9 | 10.0 | 12.7 | 19.0 | 78.1 | - |
| 1974 | 96.8 | 154.8 | 127.9 | 48.2 | 27.5 | 22.2 | 18.3 | 15.4 | 13.9 | 13.4 | 13.8 | 15.1 | 47.3 |
| 1975 | 28.4 | 40.7 | 181.0 | 74.2 | 44.3 | 24.2 | 14.5 | 10.8 | 10.0 | 11.7 | 19.1 | 37.3 | 41.4 |
| 1976 | 111.9 | 194.3 | 149.0 | 69.1 | 33.0 | 24.7 | 18.0 | 14.1 | 12.9 | 13.7 | 13.5 | 20.3 | 56.2 |
| 1977 | 51.0 | 116.0 | 112.2 | 41.1 | 26.7 | 17.7 | 15.5 | 13.9 | 13.7 | 13.5 | 40.0 | 33.4 | 41.2 |
| 1978 | 56.5 | 102.5 | 58.2 | 50.4 | 27.1 | 19.2 | 15.1 | 13.6 | 12.7 | 13.8 | 35.7 | 41.6 | 37.2 |
| 1979 | 39.0 | 107.3 | 129.5 | 58.4 | 22.7 | 16.4 | 14.9 | 10.3 | 10.0 | 10.5 | 11.2 | 13.4 | 37.0 |
| 1980 | 41.1 | 35.9 | 50.8 | 46.3 | 19.5 | 13.6 | 13.4 | 11.2 | 9.8 | 24.5 | 29.1 | 44.4 | 28.3 |
| 1981 | 61.7 | 158.8 | 147.6 | 85.9 | 25.1 | 19.2 | 15.4 | 12.6 | 11.0 | 12.1 | 24.5 | 44.4 | 51.5 |
| 1982 | 57.1 | 99.1 | 70.3 | 60.7 | 31.2 | 19.3 | 13.4 | 11.2 | 6.8 | 21.9 | 85.6 | 73.8 | 45.9 |
| 1983 | 59.4 | 42.8 | 90.3 | 104.1 | 34.6 | 22.2 | 16.5 | 15.1 | - | - | - | - | - |
| 1984 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | 135.1 | 204.0 | 232.5 | 172.7 | 70.7 | 29.8 | 21.2 | 16.7 | 14.0 | 12.4 | 13.9 | 42.6 | 80.5 |
| 1987 | 160.3 | 130.7 | 59.5 | 22.5 | 11.3 | 9.7 | 10.1 | 9.5 | 9.1 | 8.4 | 10.1 | 17.1 | 38.2 |
| 1988 | 73.7 | 82.9 | 46.0 | 44.0 | 18.0 | 15.5 | 12.7 | 11.7 | 11.7 | 11.3 | 10.4 | 15.7 | 29.5 |

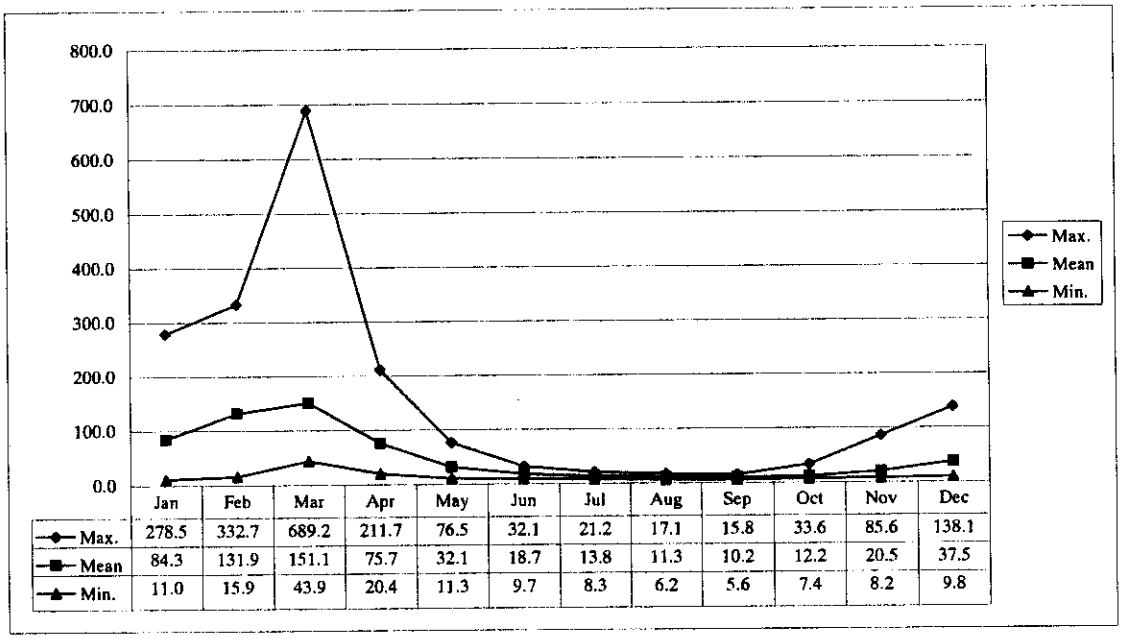
**Monthly Discharge ($m^3/s$)**

Station: Imperial / Socsi

Longitude: W -
Latitude: S -
Altitude: -

Source: before 1964:Toma Imperial; after 1965: Socsi

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989 | 79.7 | 135.6 | 145.5 | 79.1 | 17.6 | 15.9 | 12.6 | 11.2 | 10.5 | 12.0 | 18.6 | 10.6 | 45.7 |
| 1990 | 34.6 | 26.7 | 78.2 | 28.0 | 18.6 | 15.0 | 11.1 | 8.8 | 7.6 | 12.6 | 36.2 | 42.6 | 26.7 |
| 1991 | 59.5 | 97.7 | 216.0 | 73.9 | 49.7 | 32.1 | 19.7 | 11.3 | 7.8 | 9.0 | 20.2 | 15.3 | 51.0 |
| 1992 | 22.4 | 15.9 | 74.8 | 36.2 | 21.2 | 12.1 | 8.3 | 6.2 | 5.6 | 7.4 | 8.2 | 10.1 | 19.0 |
| 1993 | 31.6 | 191.0 | 238.2 | 112.3 | 47.8 | 21.6 | 13.6 | - | 7.6 | 9.8 | 35.9 | 119.5 | - |
| 1994 | 153.5 | 332.7 | 213.1 | 75.0 | 76.5 | 30.2 | 20.9 | 17.1 | 12.4 | 11.3 | 18.9 | 17.2 | 81.6 |
| 1995 | 89.4 | 111.3 | 202.1 | 53.8 | 23.7 | 16.2 | 11.7 | 9.0 | 8.9 | 10.3 | 24.8 | 25.5 | 48.9 |
| 1996 | 132.8 | 176.6 | 181.1 | 122.6 | 48.2 | 17.3 | 13.6 | 9.3 | 9.3 | 9.5 | 11.2 | 18.7 | 62.5 |
| 1997 | 87.2 | 147.3 | 78.2 | 20.4 | 16.5 | 13.1 | 10.5 | 9.0 | 7.8 | 8.7 | 25.1 | 69.8 | 41.1 |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 278.5 | 332.7 | 689.2 | 211.7 | 76.5 | 32.1 | 21.2 | 17.1 | 15.8 | 33.6 | 85.6 | 138.1 | 86.2 |
| Mean | 84.3 | 131.9 | 151.1 | 75.7 | 32.1 | 18.7 | 13.8 | 11.3 | 10.2 | 12.2 | 20.5 | 37.5 | 47.9 |
| Min. | 11.0 | 15.9 | 43.9 | 20.4 | 11.3 | 9.7 | 8.3 | 6.2 | 5.6 | 7.4 | 8.2 | 9.8 | 19.0 |
| N | 69 | 69 | 68 | 69 | 70 | 69 | 69 | 68 | 66 | 67 | 67 | 68 | 62 |



# Table 1.3.1 Discharge Records (3/9)

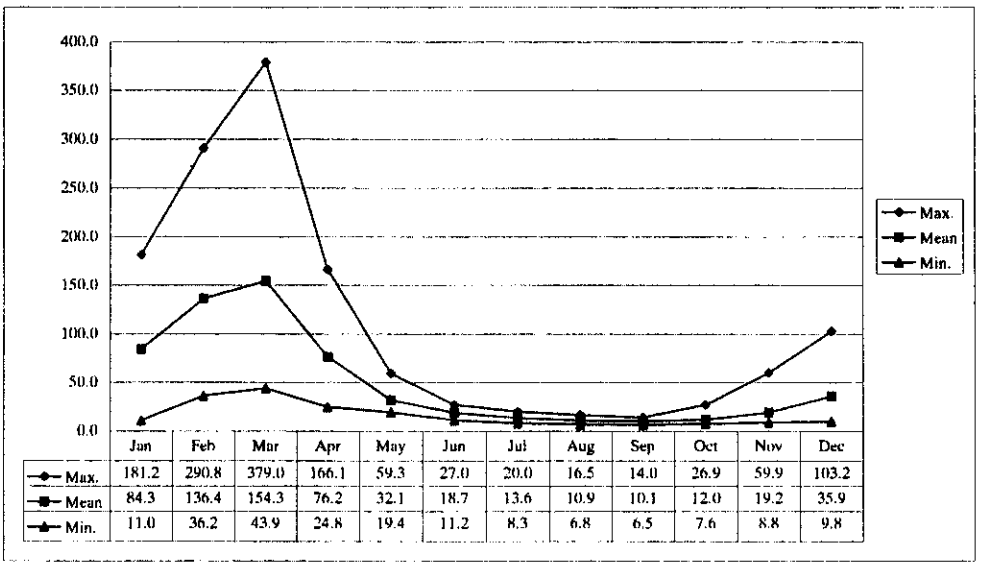
**Monthly Discharge ($m^3/s$)**

Station: Toma Imperial — Longitude: W -

Latitude: S -

Source: ELECTROPERU, El Platanal Feasibility Study 1987, Volume II-A, Annex 1.14 — Altitude: -

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1926 | 62.6 | 164.5 | 100.3 | 162.3 | 46.3 | 15.0 | 12.0 | 10.0 | 11.0 | 12.0 | 27.5 | 28.7 | 54.4 |
| 1927 | 72.0 | 63.1 | 81.6 | 50.4 | 35.7 | 19.7 | 17.3 | 10.0 | - | - | - | - | - |
| 1928 | 25.3 | 69.2 | 116.1 | 70.7 | 30.4 | 16.9 | 13.3 | 11.9 | 12.1 | 14.8 | 15.1 | 19.3 | 34.6 |
| 1929 | 56.5 | 66.3 | 202.9 | 95.8 | 26.9 | 16.4 | 12.7 | 11.6 | 12.1 | 13.6 | 17.5 | 31.8 | 47.0 |
| 1930 | 120.8 | 107.8 | 111.5 | 61.6 | 40.0 | 19.9 | 14.2 | 12.5 | 11.9 | 13.4 | 25.6 | 19.6 | 46.6 |
| 1931 | 36.2 | 36.2 | 61.4 | 50.0 | 23.2 | 15.0 | 12.6 | 11.8 | 11.7 | 12.6 | 14.4 | 46.1 | 27.6 |
| 1932 | 102.4 | - | - | 156.3 | 54.6 | 18.7 | 14.1 | 10.8 | 10.0 | 10.7 | 20.2 | 38.0 | - |
| 1933 | 74.2 | 83.4 | 122.2 | 64.0 | 24.7 | 17.6 | 14.5 | 13.0 | 11.7 | 11.5 | 12.0 | 26.2 | 39.6 |
| 1934 | 95.7 | 141.0 | 213.7 | 100.9 | 38.4 | 24.1 | 20.0 | 13.6 | 12.2 | 13.9 | 16.8 | 16.8 | 58.9 |
| 1935 | 78.5 | 93.4 | 271.8 | 108.7 | 42.4 | 24.8 | 19.2 | 13.1 | 12.7 | 14.0 | 16.2 | 62.7 | 63.1 |
| 1936 | 181.2 | 128.7 | 141.1 | 55.7 | 20.6 | 16.8 | 12.1 | 9.9 | 9.3 | 16.7 | 16.8 | 16.9 | 52.2 |
| 1937 | 85.6 | 109.5 | 164.5 | 51.8 | 27.0 | 19.7 | 13.3 | 9.8 | 9.1 | 9.9 | 16.2 | 53.0 | 47.5 |
| 1938 | 85.5 | 250.5 | 79.5 | 55.4 | 21.8 | 13.6 | 13.2 | 11.7 | 10.5 | 9.5 | 11.0 | 16.0 | 48.2 |
| 1939 | 51.1 | 99.1 | 193.5 | 106.6 | 34.4 | 17.0 | 13.4 | 11.4 | 9.5 | 9.3 | 13.2 | 32.9 | 49.3 |
| 1940 | 72.3 | 50.6 | 81.7 | 56.4 | 25.8 | 15.5 | 12.0 | 10.4 | 10.3 | 10.8 | 15.7 | 16.2 | 31.5 |
| 1941 | 110.4 | 110.4 | 90.3 | 26.1 | 21.8 | 13.6 | 9.8 | 9.0 | 8.7 | 11.5 | 13.8 | 36.8 | 38.5 |
| 1942 | 86.3 | 130.3 | 127.5 | 48.6 | 38.6 | 18.2 | 14.6 | 12.2 | 10.7 | 10.1 | 10.9 | 19.5 | 44.0 |
| 1943 | 115.0 | 220.2 | 126.6 | 98.7 | 29.5 | 18.2 | 13.1 | 11.0 | 10.5 | 12.4 | 12.6 | 43.8 | 59.3 |
| 1944 | 142.3 | 209.1 | 192.7 | 67.9 | 33.5 | 20.8 | 15.8 | 13.1 | 11.4 | 10.5 | 11.6 | 16.9 | 62.1 |
| 1945 | 65.3 | 100.9 | 188.1 | 73.2 | 24.4 | 15.2 | 11.9 | 9.5 | 8.6 | 8.0 | 20.6 | 61.9 | 49.0 |
| 1946 | 128.4 | 161.2 | 236.4 | 103.3 | 42.0 | 23.6 | 16.1 | 13.3 | 11.7 | 14.1 | 30.3 | 73.9 | 71.2 |
| 1947 | 100.4 | 88.9 | 167.1 | 57.6 | 35.7 | 22.6 | 13.6 | 11.2 | 10.0 | 11.7 | 12.0 | 21.1 | 46.0 |
| 1948 | 100.2 | 115.4 | 111.8 | 90.0 | 59.3 | 26.8 | 16.0 | 11.4 | 10.2 | 26.7 | 34.8 | 16.3 | 51.6 |
| 1949 | 55.6 | 85.6 | 118.5 | 73.6 | 33.6 | 18.7 | 12.2 | 10.1 | 9.3 | 9.1 | 23.9 | 13.5 | 38.6 |
| 1950 | 64.6 | 92.1 | 81.6 | 72.6 | 32.8 | 15.3 | 12.0 | 9.7 | 8.1 | 8.8 | 13.4 | 80.5 | 41.0 |
| 1951 | 99.7 | 183.7 | 269.0 | 90.5 | 29.1 | 21.0 | 14.9 | 12.4 | 10.7 | 9.9 | 48.0 | 60.7 | 70.8 |
| 1952 | 137.5 | 138.7 | 164.6 | 70.3 | 21.0 | 14.7 | 15.0 | 12.8 | 12.5 | 11.3 | 17.7 | 37.8 | 54.5 |
| 1953 | 98.8 | 254.1 | 127.5 | 51.0 | 22.9 | 17.2 | 14.9 | 11.7 | 10.8 | 11.3 | 48.4 | 64.4 | 61.1 |
| 1954 | 145.5 | 191.1 | 223.8 | 54.0 | 33.4 | 23.1 | 16.0 | 12.0 | 10.2 | 12.6 | 59.9 | 45.9 | 69.0 |
| 1955 | 139.4 | 246.7 | 379.0 | 124.9 | 40.8 | 21.9 | 16.7 | 12.2 | 10.1 | 14.2 | 11.2 | 16.7 | 86.2 |
| 1956 | 35.8 | 265.5 | 116.4 | 79.7 | 35.6 | 23.7 | 12.9 | 9.9 | 8.5 | 8.4 | 8.8 | 9.8 | 51.3 |
| 1957 | 24.3 | 133.9 | 145.6 | 88.1 | 35.1 | 14.3 | 10.0 | 7.5 | 7.1 | 7.6 | 9.7 | 13.5 | 41.4 |
| 1958 | 30.9 | 59.5 | 105.3 | 45.7 | 19.4 | 11.8 | 9.3 | 7.8 | 7.0 | 8.6 | 8.9 | 11.1 | 27.1 |
| 1959 | 11.0 | 142.8 | 137.3 | 70.5 | 21.4 | 14.1 | 11.1 | 8.3 | 7.2 | 10.7 | 11.1 | 50.9 | 41.4 |
| 1960 | 134.4 | 126.2 | 43.9 | 24.8 | 19.4 | 11.2 | 8.3 | 6.8 | 6.5 | 8.8 | 10.3 | 11.3 | 34.3 |
| 1961 | 58.3 | 228.7 | 301.0 | 166.1 | 38.9 | 21.6 | 11.5 | 9.4 | 8.0 | 7.6 | 27.8 | 103.2 | 81.8 |
| 1962 | 106.4 | 128.9 | 207.3 | 55.3 | 19.6 | 14.7 | 13.4 | 11.4 | 10.4 | 8.8 | 9.3 | 17.4 | 50.2 |
| 1963 | 130.8 | 122.4 | 124.3 | 92.0 | 29.2 | 26.5 | 14.6 | 11.7 | 11.1 | 11.2 | 26.7 | 98.5 | 58.3 |
| 1964 | 54.6 | 107.9 | 121.9 | 100.6 | 48.2 | 24.2 | 13.2 | 9.8 | 9.3 | 8.6 | 11.0 | 14.0 | 43.6 |
| 1965 | 56.8 | 204.4 | 184.2 | 64.1 | 33.7 | 21.5 | 11.3 | 8.3 | 7.8 | 7.9 | 9.5 | 14.8 | 52.0 |
| 1966 | 53.7 | 71.2 | 113.3 | 33.9 | 19.4 | 13.3 | 10.9 | 9.2 | 8.2 | 26.9 | 30.1 | 74.5 | 38.7 |
| 1967 | 88.9 | 290.8 | 232.3 | 69.5 | 35.8 | 27.0 | 20.0 | 16.5 | 14.0 | 21.7 | 16.1 | 19.5 | 71.0 |
| 1968 | 51.7 | 56.7 | 100.4 | 38.9 | - | - | - | - | - | - | - | - | - |
| Max. | 181.2 | 290.8 | 379.0 | 166.1 | 59.3 | 27.0 | 20.0 | 16.5 | 14.0 | 26.9 | 59.9 | 103.2 | 86.2 |
| Mean | 84.3 | 136.4 | 154.3 | 76.2 | 32.1 | 18.7 | 13.6 | 10.9 | 10.1 | 12.0 | 19.2 | 35.9 | 50.9 |
| Min. | 11.0 | 36.2 | 43.9 | 24.8 | 19.4 | 11.2 | 8.3 | 6.8 | 6.5 | 7.6 | 8.8 | 9.8 | 27.1 |
| N | 43 | 42 | 42 | 43 | 42 | 42 | 42 | 42 | 41 | 41 | 41 | 41 | 40 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 181.2 | 290.8 | 379.0 | 166.1 | 59.3 | 27.0 | 20.0 | 16.5 | 14.0 | 26.9 | 59.9 | 103.2 |
| Mean | 84.3 | 136.4 | 154.3 | 76.2 | 32.1 | 18.7 | 13.6 | 10.9 | 10.1 | 12.0 | 19.2 | 35.9 |
| Min. | 11.0 | 36.2 | 43.9 | 24.8 | 19.4 | 11.2 | 8.3 | 6.8 | 6.5 | 7.6 | 8.8 | 9.8 |

# Table 1.3.1 Discharge Records (4/9)

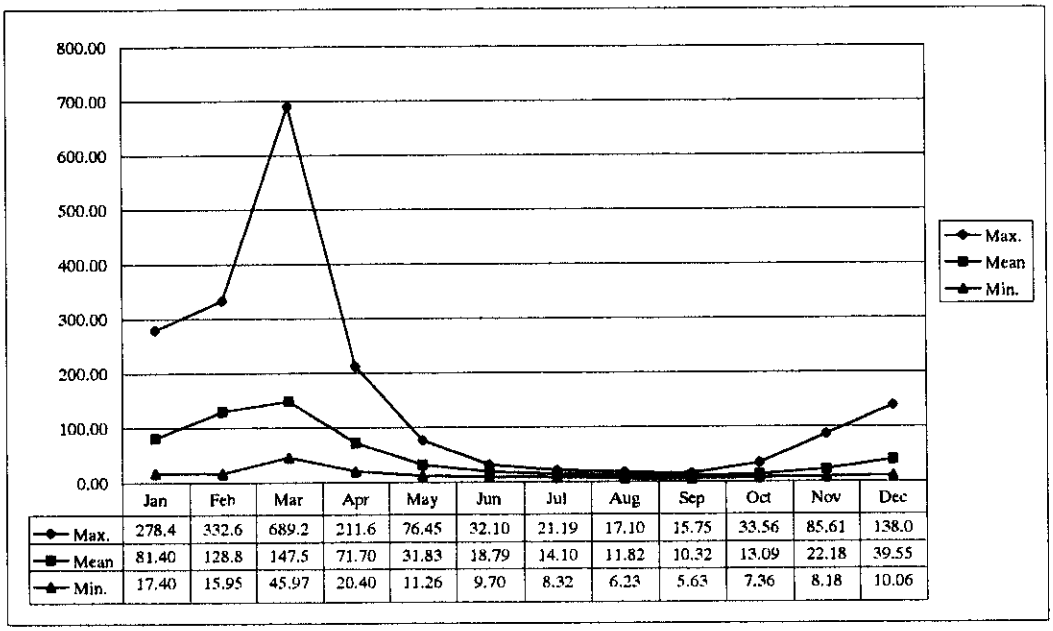
**Monthly Discharge ($m^3/s$)**

Station: Socsi

Longitude: W 76° 12'
Latitude: S 13° 00'
Altitude: 340

Source: Cementos Lima / INRENA

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | 37.80 | 123.95 | 120.29 | 60.78 | 35.75 | 15.23 | 9.49 | 12.64 | 10.39 | 10.79 | 16.31 | 20.94 | 39.53 |
| 1966 | 30.20 | 26.40 | 49.10 | 26.60 | 15.20 | 11.00 | 9.50 | 8.80 | 8.80 | 10.30 | 21.70 | 30.20 | 20.65 |
| 1967 | 101.15 | 288.96 | 164.97 | 69.47 | 38.29 | 26.06 | 19.86 | 15.86 | 15.75 | 33.56 | 25.69 | 31.41 | 69.25 |
| 1968 | 17.40 | 41.90 | 49.20 | 21.90 | 16.70 | 13.00 | 9.90 | 9.20 | 9.60 | 10.60 | 16.00 | 14.70 | 19.18 |
| 1969 | 31.21 | 49.60 | 94.65 | 52.45 | 22.44 | 14.09 | 12.15 | 10.31 | 7.47 | 19.30 | 13.71 | 138.07 | 38.79 |
| 1970 | 278.48 | 131.39 | 85.71 | 27.04 | 16.77 | - | - | - | - | 13.59 | 15.96 | 31.83 | - |
| 1971 | 113.69 | 155.46 | - | - | 23.72 | 13.82 | 15.17 | 15.18 | 13.99 | 11.14 | 8.71 | 46.33 | - |
| 1972 | 169.44 | 251.14 | 689.23 | 211.69 | 40.15 | 20.42 | 11.15 | 11.86 | - | - | - | 66.62 | - |
| 1973 | - | 220.99 | 290.16 | 202.30 | 66.28 | 22.92 | 14.68 | 10.91 | 9.97 | 12.68 | 18.96 | 78.07 | - |
| 1974 | 96.81 | 154.75 | 127.94 | 48.20 | 27.52 | 22.17 | 18.31 | 15.42 | 13.90 | 13.40 | 13.85 | 15.10 | 47.28 |
| 1975 | 28.42 | 40.71 | 180.97 | 74.20 | 44.29 | 24.21 | 14.53 | 10.84 | 9.97 | 11.74 | 19.13 | 37.25 | 41.35 |
| 1976 | 111.93 | 194.34 | 148.97 | 69.09 | 33.00 | 24.72 | 18.03 | 14.13 | 12.85 | 13.70 | 13.54 | 20.28 | 56.22 |
| 1977 | 51.03 | 115.98 | 112.17 | 41.05 | 26.71 | 17.73 | 15.54 | 13.92 | 13.71 | 13.52 | 40.04 | 33.42 | 41.23 |
| 1978 | 56.49 | 102.49 | 58.18 | 50.42 | 27.13 | 19.20 | 15.11 | 13.63 | 12.65 | 13.85 | 35.72 | 41.63 | 37.21 |
| 1979 | 39.04 | 107.26 | 129.52 | 58.38 | 22.74 | 16.39 | 14.94 | 10.28 | 10.04 | 10.52 | 11.20 | 13.38 | 36.97 |
| 1980 | 41.13 | 35.93 | 50.78 | 46.32 | 19.49 | 13.61 | 13.35 | 11.25 | 9.79 | 24.50 | 29.10 | 44.40 | 28.30 |
| 1981 | 61.66 | 158.80 | 147.59 | 85.91 | 25.07 | 19.15 | 15.40 | 12.61 | 11.04 | 12.10 | 24.53 | 44.44 | 51.52 |
| 1982 | 57.07 | 99.07 | 70.33 | 60.71 | 31.19 | 19.28 | 13.40 | 11.15 | 6.80 | 21.86 | 85.61 | 73.80 | 45.86 |
| 1983 | 59.37 | 42.79 | 90.33 | 104.08 | 34.56 | 22.22 | 16.52 | 15.13 | - | - | - | - | - |
| 1984 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | 135.08 | 204.00 | 232.48 | 172.70 | 70.73 | 29.78 | 21.19 | 16.73 | 14.00 | 12.37 | 13.88 | 42.58 | 80.46 |
| 1987 | 160.32 | 130.66 | 59.50 | 22.47 | 11.26 | 9.70 | 10.13 | 9.46 | 9.05 | 8.42 | 10.13 | 17.13 | 38.19 |
| 1988 | 73.68 | 82.91 | 45.97 | 43.97 | 17.96 | 15.50 | 12.71 | 11.73 | 11.69 | 11.27 | 10.41 | 15.72 | 29.46 |
| 1989 | 79.69 | 135.63 | 145.45 | 79.07 | 17.60 | 15.91 | 12.63 | 11.16 | 10.46 | 11.97 | 18.59 | 10.56 | 45.73 |
| 1990 | 34.63 | 26.70 | 78.23 | 28.02 | 18.56 | 14.97 | 11.10 | 8.78 | 7.63 | 12.58 | 36.23 | 42.61 | 26.67 |
| 1991 | 59.47 | 97.69 | 216.02 | 73.92 | 49.66 | 32.10 | 19.69 | 11.29 | 7.81 | 8.97 | 20.15 | 15.30 | 51.01 |
| 1992 | 22.35 | 15.95 | 74.76 | 36.16 | 21.21 | 12.15 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 | 19.03 |
| 1993 | 31.60 | 190.96 | 238.16 | 112.33 | 47.81 | 21.60 | 13.62 | - | 7.62 | 9.81 | 35.89 | 119.45 | - |
| 1994 | 153.55 | 332.68 | 213.06 | 75.00 | 76.45 | 30.17 | 20.87 | 17.10 | 12.43 | 11.29 | 18.90 | 17.24 | 81.56 |
| 1995 | 89.35 | 111.25 | 202.10 | 53.77 | 23.71 | 16.17 | 11.68 | 9.03 | 8.92 | 10.31 | 24.77 | 25.45 | 48.87 |
| 1996 | 132.79 | 176.62 | 181.06 | 122.60 | 48.19 | 17.30 | 13.57 | 9.28 | 9.28 | 9.46 | 11.20 | 18.66 | 62.50 |
| 1997 | 87.23 | 147.32 | 78.16 | 20.40 | 16.50 | 13.14 | 10.50 | 9.00 | 7.84 | 8.72 | 25.07 | 69.85 | 41.14 |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 278.48 | 332.68 | 689.23 | 211.69 | 76.45 | 32.10 | 21.19 | 17.10 | 15.75 | 33.56 | 85.61 | 138.07 | 81.56 |
| Mean | 81.40 | 128.85 | 147.50 | 71.70 | 31.83 | 18.79 | 14.10 | 11.82 | 10.32 | 13.09 | 22.18 | 39.55 | 43.92 |
| Min. | 17.40 | 15.95 | 45.97 | 20.40 | 11.26 | 9.70 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 | 19.03 |
| N | 30 | 31 | 30 | 30 | 31 | 30 | 30 | 29 | 28 | 29 | 29 | 30 | 25 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 278.4 | 332.6 | 689.2 | 211.6 | 76.45 | 32.10 | 21.19 | 17.10 | 15.75 | 33.56 | 85.61 | 138.0 |
| Mean | 81.40 | 128.8 | 147.5 | 71.70 | 31.83 | 18.79 | 14.10 | 11.82 | 10.32 | 13.09 | 22.18 | 39.55 |
| Min. | 17.40 | 15.95 | 45.97 | 20.40 | 11.26 | 9.70 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 |

# Table 1.3.1 Discharge Records (5/9)

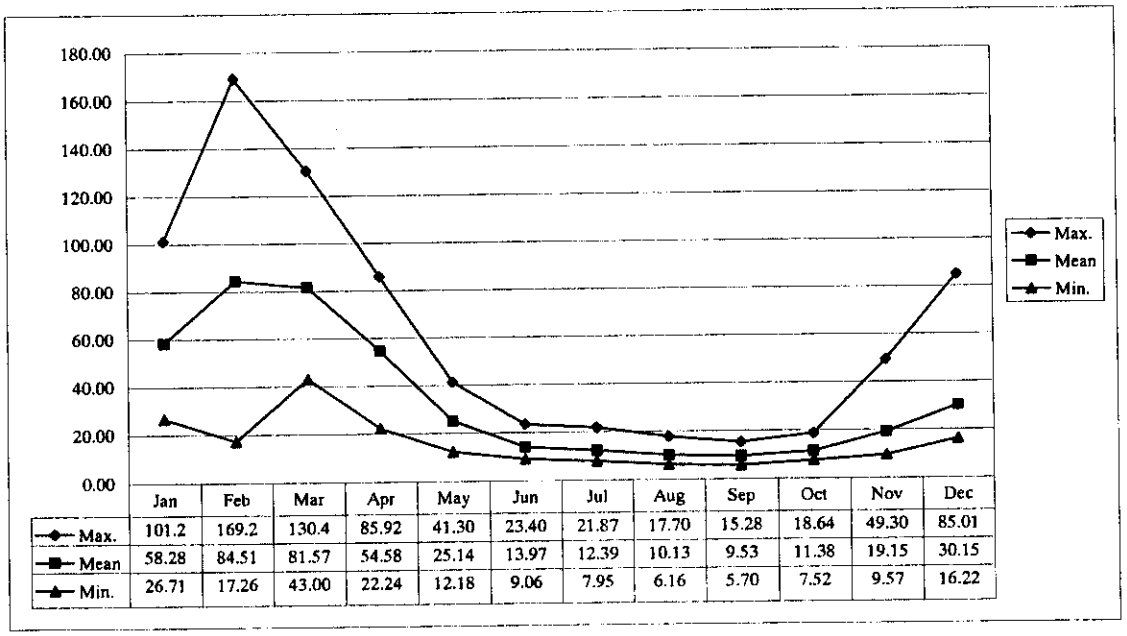
**Monthly Discharge ($m^3/s$)**

Station: Chavin

Longitude: W 75° 56'48"
Latitude: S 12° 44'48"
Altitude: 1,350

Source: Cementos Lima / ELECTROPERU

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1987 | 97.14 | 94.83 | 55.09 | 32.65 | 14.14 | 9.11 | 7.95 | 6.16 | 6.76 | 8.99 | 12.96 | 21.81 | 30.63 |
| 1988 | 53.82 | - | 54.33 | - | 30.27 | 16.34 | 12.37 | 10.54 | 9.61 | 11.11 | - | 19.86 | - |
| 1989 | 70.57 | 96.09 | 130.48 | 85.92 | 41.30 | - | 21.87 | 17.70 | 9.81 | 14.01 | 17.26 | 16.22 | - |
| 1990 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1991 | 35.79 | 52.18 | 81.65 | 37.45 | 25.28 | 15.48 | - | - | - | - | - | - | - |
| 1992 | 26.71 | 17.26 | 43.00 | 22.24 | 13.54 | 10.03 | 8.63 | 8.03 | 7.04 | - | 9.57 | - | - |
| 1993 | 30.55 | 84.48 | 119.06 | 84.13 | 38.82 | 23.40 | 18.41 | 15.51 | 15.28 | 18.64 | 49.30 | 85.01 | 48.55 |
| 1994 | 101.24 | 169.23 | 110.09 | 61.23 | 29.63 | 13.72 | 9.54 | 6.93 | 12.91 | 12.91 | 16.88 | 24.46 | 47.40 |
| 1995 | 38.95 | 40.64 | 70.14 | 43.10 | 18.43 | 12.74 | 11.27 | 9.78 | 9.59 | 9.31 | 19.92 | 22.51 | 25.53 |
| 1996 | 78.45 | 121.38 | 91.53 | 69.93 | 27.82 | 15.87 | 12.65 | 9.58 | 9.04 | 8.56 | 11.12 | 21.20 | 39.76 |
| 1997 | 49.58 | - | 60.30 | - | 12.18 | 9.06 | 8.82 | 6.95 | 5.70 | 7.52 | 16.18 | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 101.24 | 169.23 | 130.48 | 85.92 | 41.30 | 23.40 | 21.87 | 17.70 | 15.28 | 18.64 | 49.30 | 85.01 | 48.55 |
| Mean | 58.28 | 84.51 | 81.57 | 54.58 | 25.14 | 13.97 | 12.39 | 10.13 | 9.53 | 11.38 | 19.15 | 30.15 | 38.37 |
| Min. | 26.71 | 17.26 | 43.00 | 22.24 | 12.18 | 9.06 | 7.95 | 6.16 | 5.70 | 7.52 | 9.57 | 16.22 | 25.53 |
| N | 10 | 8 | 10 | 8 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 7 | 5 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 101.2 | 169.2 | 130.4 | 85.92 | 41.30 | 23.40 | 21.87 | 17.70 | 15.28 | 18.64 | 49.30 | 85.01 |
| Mean | 58.28 | 84.51 | 81.57 | 54.58 | 25.14 | 13.97 | 12.39 | 10.13 | 9.53 | 11.38 | 19.15 | 30.15 |
| Min. | 26.71 | 17.26 | 43.00 | 22.24 | 12.18 | 9.06 | 7.95 | 6.16 | 5.70 | 7.52 | 9.57 | 16.22 |

# Table 1.3.1 Discharge Records

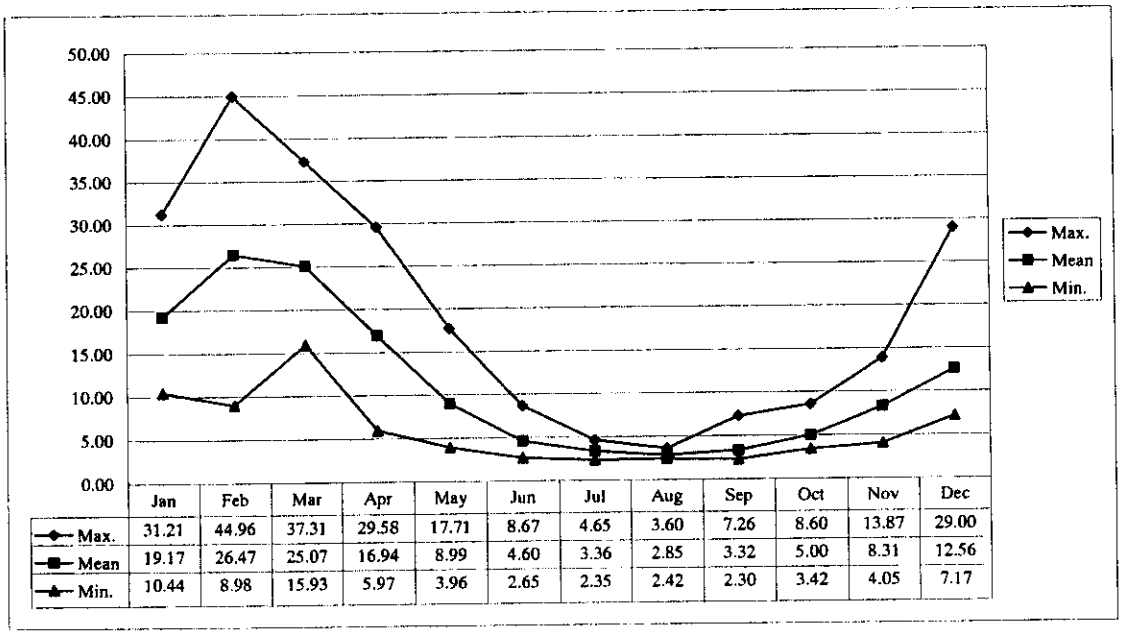
**Monthly Discharge ($m^3/s$)**

Station: Tinco de Alis

Longitude: W 75° 46'53"
Latitude: S 12° 16'26"
Altitude: 3,350

Source: Cementos Lima / ELECTROPERU

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | - | - | 33.85 | - | - | 3.79 | - | - | - | - | 8.05 | 12.60 | - |
| 1987 | - | - | - | 10.95 | 6.30 | 4.11 | 3.23 | 2.85 | 3.01 | 3.98 | 7.52 | 11.70 | - |
| 1988 | 20.55 | 28.65 | 21.07 | 23.37 | 12.48 | 5.57 | 3.30 | 2.84 | 2.88 | 5.02 | 6.13 | 8.68 | 11.71 |
| 1989 | 22.57 | - | - | - | - | - | 4.31 | 3.44 | - | - | 8.51 | - | - |
| 1990 | 14.12 | - | 18.20 | 10.13 | - | - | 3.27 | 2.64 | 2.55 | 5.10 | - | - | - |
| 1991 | 10.44 | - | - | - | - | 4.78 | - | - | - | - | - | - | - |
| 1992 | 14.20 | 8.98 | 18.78 | 9.94 | 4.83 | 3.24 | 3.04 | 2.59 | 2.67 | 4.17 | 5.65 | 7.17 | 7.10 |
| 1993 | 12.83 | 26.94 | 28.68 | 23.01 | 10.85 | 4.63 | 3.53 | 2.54 | 2.30 | 4.04 | - | 29.00 | - |
| 1994 | 31.21 | 44.96 | 37.31 | 29.58 | 17.71 | 8.67 | 4.65 | 3.60 | 7.26 | 8.60 | 13.87 | 11.42 | 18.24 |
| 1995 | 19.52 | 15.41 | 24.21 | 16.04 | 5.76 | 3.39 | 2.71 | 2.82 | 3.20 | 4.24 | 9.55 | 9.92 | 9.73 |
| 1996 | 25.73 | 32.48 | 27.61 | 23.48 | 10.04 | 5.19 | 3.24 | 2.79 | 2.61 | 3.42 | 4.05 | 10.00 | 12.55 |
| 1997 | 20.57 | 27.88 | 15.93 | 5.97 | 3.96 | 2.65 | 2.35 | 2.42 | 3.39 | 6.45 | 11.45 | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 31.21 | 44.96 | 37.31 | 29.58 | 17.71 | 8.67 | 4.65 | 3.60 | 7.26 | 8.60 | 13.87 | 29.00 | 18.24 |
| Mean | 19.17 | 26.47 | 25.07 | 16.94 | 8.99 | 4.60 | 3.36 | 2.85 | 3.32 | 5.00 | 8.31 | 12.56 | 11.87 |
| Min. | 10.44 | 8.98 | 15.93 | 5.97 | 3.96 | 2.65 | 2.35 | 2.42 | 2.30 | 3.42 | 4.05 | 7.17 | 7.10 |
| N | 10 | 7 | 9 | 9 | 8 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 5 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 31.21 | 44.96 | 37.31 | 29.58 | 17.71 | 8.67 | 4.65 | 3.60 | 7.26 | 8.60 | 13.87 | 29.00 |
| Mean | 19.17 | 26.47 | 25.07 | 16.94 | 8.99 | 4.60 | 3.36 | 2.85 | 3.32 | 5.00 | 8.31 | 12.56 |
| Min. | 10.44 | 8.98 | 15.93 | 5.97 | 3.96 | 2.65 | 2.35 | 2.42 | 2.30 | 3.42 | 4.05 | 7.17 |

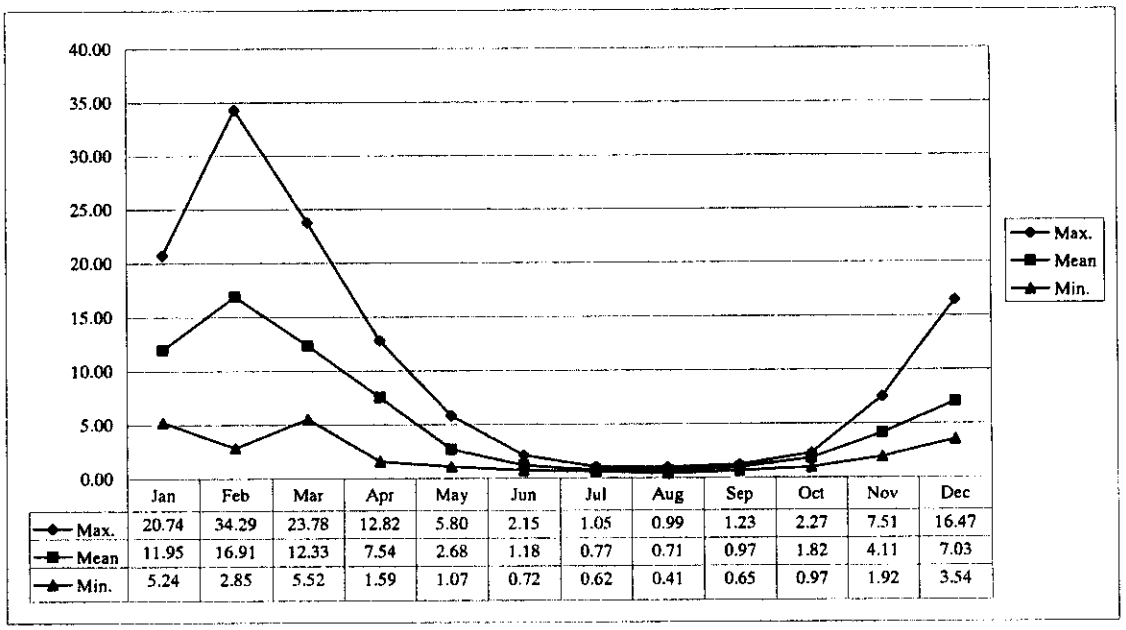
**Monthly Discharge ($m^3/s$)**

Station: Aguas Calientes

Longitude: W 75° 57'06"
Latitude: S 12° 04'58"
Altitude: 4,110

Source: Cementos Lima / ELECTROPERU

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | - | - | - | - | - | - | - | - | - | - | - | 8.11 | - |
| 1987 | 20.74 | 19.96 | 9.26 | 3.49 | 1.61 | - | 0.71 | 0.86 | 1.22 | 2.01 | 4.58 | 5.99 | - |
| 1988 | 13.41 | 17.77 | 10.70 | 11.08 | 4.31 | 1.34 | 0.75 | 0.71 | 1.23 | 2.12 | 2.76 | 5.56 | 5.98 |
| 1989 | 14.30 | - | - | - | - | - | - | - | - | - | - | - | - |
| 1990 | - | - | - | - | - | - | - | - | - | - | 6.08 | 6.31 | - |
| 1991 | 8.34 | 10.31 | - | - | - | - | - | - | - | - | - | - | - |
| 1992 | 5.24 | 2.85 | 8.64 | 3.99 | 1.81 | 0.72 | 0.62 | 0.50 | 0.65 | 2.04 | 2.21 | 3.70 | 2.75 |
| 1993 | 6.71 | - | - | - | - | - | 0.63 | 0.41 | 0.68 | 2.27 | 7.51 | 16.47 | - |
| 1994 | - | 34.29 | 23.78 | 12.82 | 5.80 | 2.15 | 1.05 | 0.63 | 1.21 | 1.38 | 3.64 | 4.37 | - |
| 1995 | 12.57 | 7.24 | 12.99 | 8.35 | 1.90 | 1.01 | 0.70 | 0.99 | 0.99 | 1.62 | 3.61 | 9.28 | 5.10 |
| 1996 | 17.02 | 24.59 | 15.44 | 11.44 | 2.29 | 1.08 | 0.84 | 0.67 | 0.72 | 0.97 | 1.92 | 3.54 | 6.71 |
| 1997 | 9.28 | 18.30 | 5.52 | 1.59 | 1.07 | 0.81 | 0.82 | 0.93 | 1.08 | 2.17 | 4.73 | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 20.74 | 34.29 | 23.78 | 12.82 | 5.80 | 2.15 | 1.05 | 0.99 | 1.23 | 2.27 | 7.51 | 16.47 | 6.71 |
| Mean | 11.95 | 16.91 | 12.33 | 7.54 | 2.68 | 1.18 | 0.77 | 0.71 | 0.97 | 1.82 | 4.11 | 7.03 | 5.13 |
| Min. | 5.24 | 2.85 | 5.52 | 1.59 | 1.07 | 0.72 | 0.62 | 0.41 | 0.65 | 0.97 | 1.92 | 3.54 | 2.75 |
| N | 9 | 8 | 7 | 7 | 7 | 6 | 8 | 8 | 8 | 8 | 9 | 9 | 4 |



# Table 1.3.1 Discharge Records

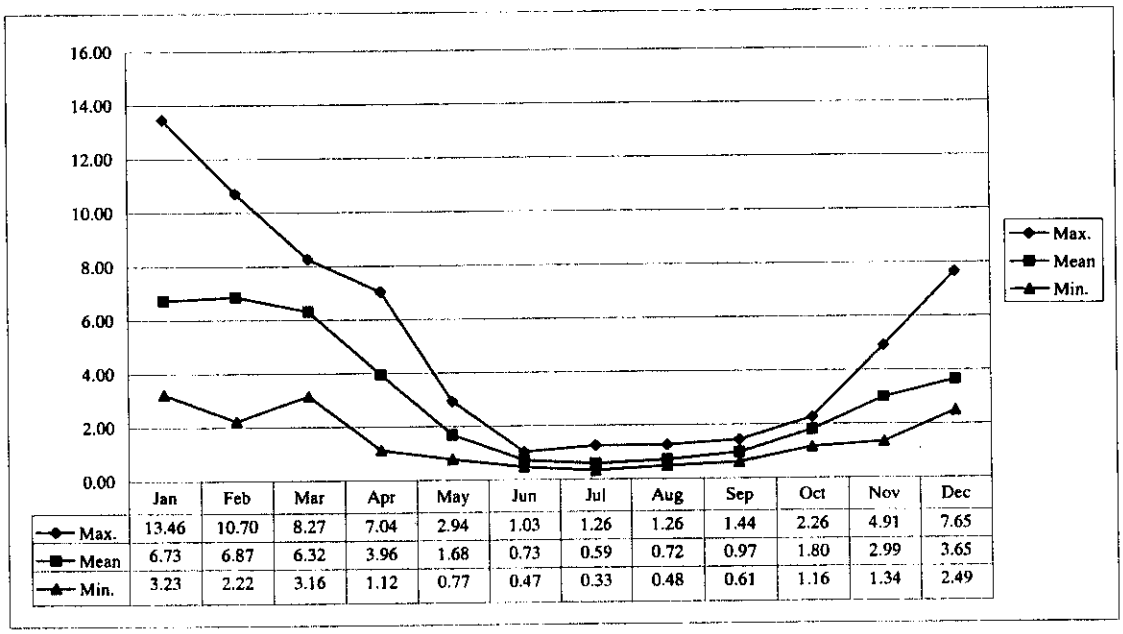
**Monthly Discharge ($m^3/s$)**

Station: Tanta

Longitude: W 76° 00'41"
Latitude: S 12° 06'53"
Altitude: 4,278

Source: Cementos Lima / ELECTROPERU

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | - | - | - | - | - | - | 1.26 | 0.97 | 0.98 | 1.55 | 3.00 | - | - |
| 1987 | 8.55 | 7.47 | 4.60 | 2.63 | 1.32 | 1.03 | 0.86 | 1.26 | 1.44 | 2.19 | 3.64 | 4.86 | 3.32 |
| 1988 | 6.88 | 8.10 | 6.85 | 6.30 | 2.94 | 0.79 | 0.51 | 0.73 | 0.89 | 2.01 | 2.00 | 3.73 | 3.48 |
| 1989 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1990 | - | - | - | 2.82 | - | - | - | - | - | 2.26 | 3.85 | 3.20 | - |
| 1991 | 3.84 | 5.34 | 6.95 | 3.20 | 1.95 | 0.72 | 0.35 | 0.49 | 0.87 | 2.02 | 2.90 | 2.61 | 2.60 |
| 1992 | 3.23 | 2.22 | 5.00 | 2.87 | 1.40 | 0.66 | 0.52 | 0.69 | 1.18 | 1.84 | 1.82 | 2.49 | 1.99 |
| 1993 | 4.25 | 6.60 | 7.72 | 4.91 | 1.37 | 0.60 | 0.33 | - | 0.61 | 2.07 | 4.91 | 7.65 | - |
| 1994 | 8.74 | 9.17 | 6.68 | 5.22 | 2.79 | 1.00 | 0.44 | 0.48 | 1.02 | 1.37 | 2.88 | 2.79 | 3.55 |
| 1995 | 6.26 | 3.24 | 7.62 | 3.49 | 0.97 | 0.47 | 0.58 | 0.78 | 1.10 | 1.49 | 2.95 | 3.02 | 2.67 |
| 1996 | 13.46 | 10.70 | 8.27 | 7.04 | 1.63 | 0.75 | 0.51 | 0.56 | 0.72 | 1.16 | 1.34 | 2.50 | 4.06 |
| 1997 | 5.33 | 8.95 | 3.16 | 1.12 | 0.77 | 0.53 | 0.54 | 0.49 | 0.88 | 1.88 | 3.60 | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 13.46 | 10.70 | 8.27 | 7.04 | 2.94 | 1.03 | 1.26 | 1.26 | 1.44 | 2.26 | 4.91 | 7.65 | 4.06 |
| Mean | 6.73 | 6.87 | 6.32 | 3.96 | 1.68 | 0.73 | 0.59 | 0.72 | 0.97 | 1.80 | 2.99 | 3.65 | 3.09 |
| Min. | 3.23 | 2.22 | 3.16 | 1.12 | 0.77 | 0.47 | 0.33 | 0.48 | 0.61 | 1.16 | 1.34 | 2.49 | 1.99 |
| N | 9 | 9 | 9 | 10 | 9 | 9 | 10 | 9 | 10 | 11 | 11 | 9 | 7 |



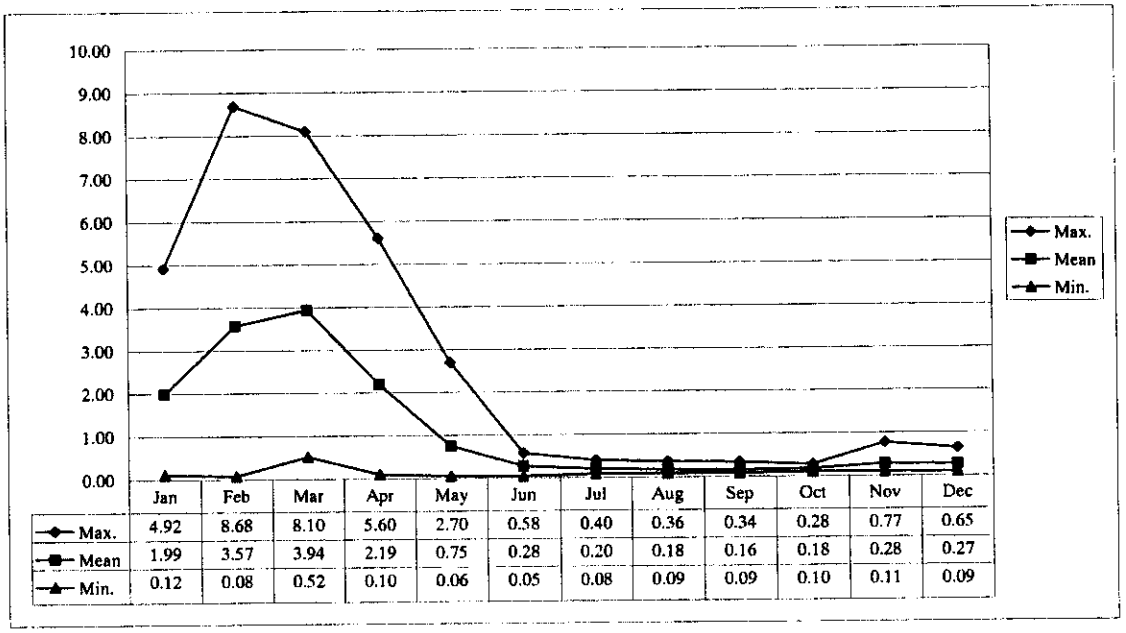
**Monthly Discharge ($m^3/s$)**

Station: Tomas

Longitude: W 75° 44'37"
Latitude: S 12° 13'02"
Altitude: 3,542

Source: Cementos Lima / ELECTROPERU

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1986 | - | - | 7.71 | 4.84 | 2.70 | - | - | - | - | - | - | - | - |
| 1987 | 4.55 | 4.43 | 2.32 | 0.81 | 0.43 | 0.34 | 0.29 | 0.24 | 0.18 | 0.19 | 0.29 | 0.65 | 1.23 |
| 1988 | 4.06 | 8.68 | 1.49 | 1.64 | 0.22 | 0.16 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.15 | 1.41 |
| 1989 | 2.26 | 3.74 | 4.41 | 2.24 | 0.34 | 0.20 | 0.15 | 0.14 | 0.12 | 0.14 | 0.14 | 0.09 | 1.16 |
| 1990 | 0.19 | 0.21 | - | - | 0.15 | 0.16 | 0.14 | 0.09 | 0.10 | 0.12 | 0.45 | 0.63 | - |
| 1991 | 1.04 | 0.63 | 3.02 | 0.81 | 0.30 | 0.18 | 0.13 | 0.10 | 0.10 | 0.12 | 0.15 | 0.10 | 0.56 |
| 1992 | 0.12 | 0.08 | 0.52 | 0.10 | 0.06 | 0.05 | 0.10 | 0.09 | 0.10 | 0.14 | 0.12 | 0.09 | 0.13 |
| 1993 | 0.68 | 5.73 | 5.72 | 3.00 | - | 0.53 | 0.26 | 0.24 | 0.23 | 0.28 | 0.77 | - | - |
| 1994 | 4.92 | 6.79 | 8.10 | 5.60 | 2.36 | 0.58 | 0.40 | 0.36 | 0.34 | 0.27 | 0.27 | 0.26 | 2.52 |
| 1995 | 0.63 | 0.85 | 3.89 | 1.82 | 0.62 | 0.38 | 0.32 | 0.27 | 0.24 | 0.25 | 0.32 | 0.27 | 0.82 |
| 1996 | 1.40 | 4.57 | 3.28 | 2.65 | 0.79 | 0.41 | 0.28 | 0.21 | 0.17 | 0.18 | 0.17 | 0.21 | 1.19 |
| 1997 | - | - | 2.84 | 0.59 | 0.34 | 0.08 | 0.08 | 0.10 | 0.09 | 0.18 | 0.33 | - | - |
| 1998 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1999 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 4.92 | 8.68 | 8.10 | 5.60 | 2.70 | 0.58 | 0.40 | 0.36 | 0.34 | 0.28 | 0.77 | 0.65 | 2.52 |
| Mean | 1.99 | 3.57 | 3.94 | 2.19 | 0.75 | 0.28 | 0.20 | 0.18 | 0.16 | 0.18 | 0.28 | 0.27 | 1.13 |
| Min. | 0.12 | 0.08 | 0.52 | 0.10 | 0.06 | 0.05 | 0.08 | 0.09 | 0.09 | 0.10 | 0.11 | 0.09 | 0.13 |
| N | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 9 | 8 |

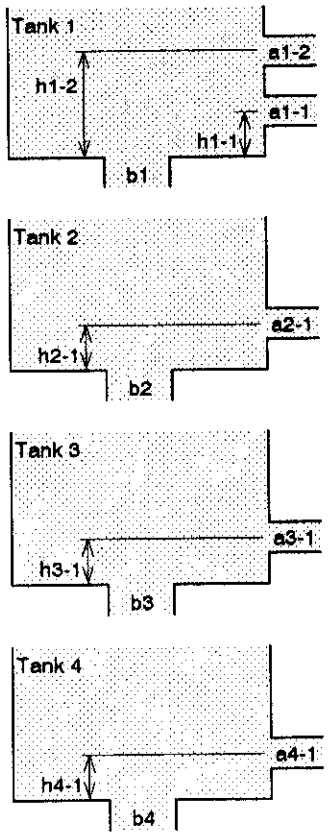


## Table 1.3.2 Summary of Correlation Formula and Coefficient

| y \ x | Tanta | Aguas Calientes | Tomas | Tinco de Alis | Chavin | Socsi |
|---|---|---|---|---|---|---|
| Tanta | | 1<br>$y=0.8428x^{0.901}$<br>r=0.9455 | -<br>$y=2.9824x^{0.4929}$<br>r=0.6695 | 2<br>$y=0.2348x^{1.0203}$<br>r=0.8978 | 3<br>$y=0.1204x^{0.9076}$<br>r=0.8075 | 4<br>$y=0.2133x^{0.8651}$<br>r=0.7310 |
| Aguas Calientes | 1<br>$y=1.3473x^{1.1161}$<br>r=0.9455 | | -<br>$y=5.1479x^{0.6736}$<br>r=0.7453 | 2<br>$y=0.2058x^{1.2789}$<br>r=0.9449 | 3<br>$y=0.0726x^{1.2092}$<br>r=0.8871 | 4<br>$y=0.1391x^{0.958}$<br>r=0.8404 |
| Tomas | -<br>$y=0.2238x^{0.9094}$<br>r=0.6695 | -<br>$y=0.1714x^{0.8245}$<br>r=0.7453 | | -<br>$y=0.0302x^{1.2652}$<br>r=0.8158 | -<br>$y=0.0077x^{1.3003}$<br>r=0.8577 | -<br>$y=0.0.109x^{1.125}$<br>r=0.8689 |
| Tinco de Alis | 3<br>$y=4.7019x^{0.79}$<br>r=0.8978 | 1<br>$y=3.7474x^{0.8094}$<br>r=0.9449 | -<br>$y=12.584x^{0.526}$<br>r=0.8158 | | 2<br>$y=0.485x^{0.9049}$<br>r=0.9159 | 4<br>$y=0.7788x^{0.7248}$<br>r=0.8846 |
| Chavin | -<br>$y=13.327x^{0.7164}$<br>r=0.8075 | -<br>$y=10.438x^{0.6507}$<br>r=0.8871 | -<br>$y=35.636x^{0.5667}$<br>r=0.8577 | 1<br>$y=3.1587x^{0.9275}$<br>r=0.9159 | | 2<br>$y=1.8938x^{0.782}$<br>r=0.9158 |
| Socsi | -<br>$y=14.682x^{0.7769}$<br>r=0.7310 | -<br>$y=10.746x^{0.7372}$<br>r=0.8404 | -<br>$y=45.482x^{0.6711}$<br>r=0.8689 | -<br>$y=2.6413x^{1.0797}$<br>r=0.8846 | 1<br>$y=0.8361x^{1.1005}$<br>r=0.9158 | |

: adopted for estimation of missing records

## Table 1.3.3 Summary of Tank Model Parameters




| Station | Tanta | Aguas Calientes | Tinco de Alis | Chavin | Socsi |
|---|---|---|---|---|---|
| Evaporation (mm/day) | | | | | |
| Non-rainy day | 0.30 | 0.80 | 1.60 | 1.30 | 0.70 |
| Rainy day | 0.15 | 0.40 | 0.80 | 0.65 | 0.35 |
| Catchment Area($km^2$) | 172 | 352 | 930 | 3265 | 5890 |
| Tank 1 | | | | | |
| Initial storage height (mm) | 0 | 0 | 0 | 0 | 0 |
| a1-1 | 0.060 | 0.080 | 0.010 | 0.080 | 0.100 |
| h1-1(mm) | 10 | 10 | 10 | 10 | 10 |
| a1-2 | 0.080 | 0.150 | 0.010 | 0.100 | 0.200 |
| h1-2(mm) | 35 | 30 | 30 | 20 | 20 |
| b1 | 0.2000 | 0.1100 | 0.2000 | 0.2000 | 0.1500 |
| Tank 2 | | | | | |
| Initial storage height (mm) | 0 | 0 | 0 | 0 | 0 |
| a2-1 | 0.0400 | 0.0450 | 0.0500 | 0.0120 | 0.0350 |
| h2-1(mm) | 0 | 10 | 0 | 0 | 0 |
| b2 | 0.0500 | 0.0300 | 0.2000 | 0.0300 | 0.0600 |
| Tank 3 | | | | | |
| Initial storage height (mm) | 0 | 0 | 0 | 0 | 0 |
| a3-1 | 0.0200 | 0.0030 | 0.0050 | 0.0020 | 0.0020 |
| h3-1(mm) | 0 | 0 | 0 | 0 | 0 |
| b3 | 0.0500 | 0.0150 | 0.0080 | 0.0050 | 0.0050 |
| Tank 4 | | | | | |
| Initial storage height (mm) | 1200 | 700 | 2800 | 2000 | 500 |
| a4-1 | 0.00020 | 0.00030 | 0.00010 | 0.00010 | 0.00030 |
| h4-1(mm) | 0 | 0 | 0 | 0 | 0 |
| b4 | 0.0003 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |

Note) ax-x, bx : multiplier of model  hx-x : Storage height (mm)

# Table 1.3.4 Generated Runoff (1/5)

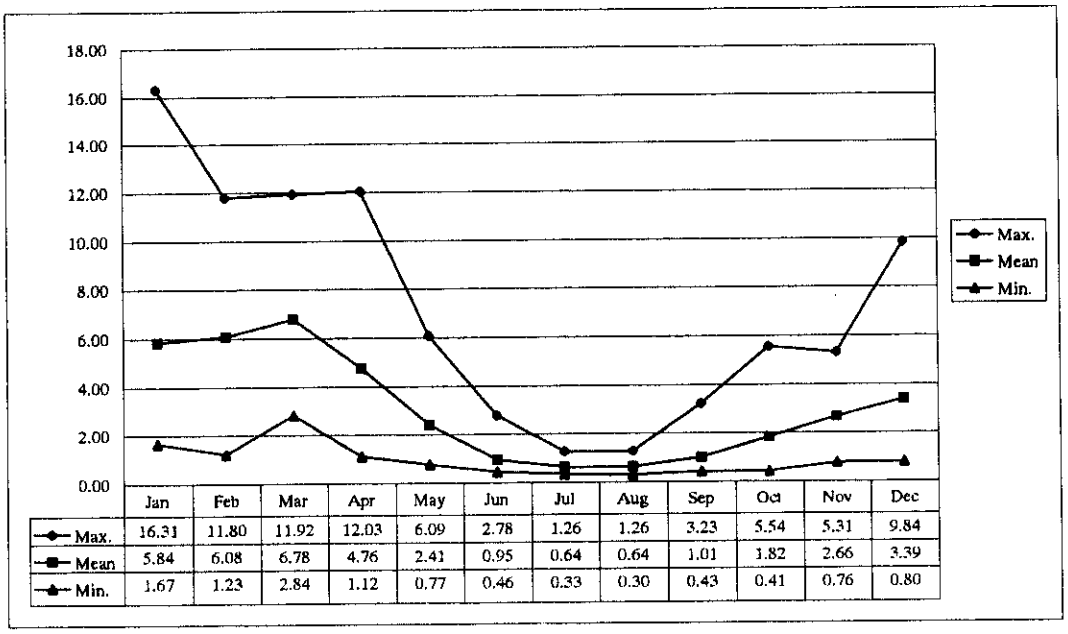
**Monthly Discharge ($m^3/s$)**

Station: Tanta

Longitude: W 76° 00'41"
Latitude: S 12° 06'53"
Altitude: 4,278

Note: observed + estimated by correlation method + calculated by Tank model

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | 0.47 | 0.46 | 0.51 | 0.88 | 3.12 | 2.74 | - |
| 1965 | 4.55 | 8.84 | 8.74 | 3.65 | 2.06 | 0.83 | 0.54 | 0.50 | 0.49 | 1.56 | 1.00 | 1.43 | 2.85 |
| 1966 | 6.00 | 5.58 | 7.57 | 5.10 | 2.76 | 0.65 | 0.47 | 0.49 | 0.62 | 3.16 | 3.17 | 6.19 | 3.48 |
| 1967 | 6.33 | 10.30 | 9.02 | 3.33 | 2.60 | 0.95 | 0.78 | 0.53 | 0.67 | 3.62 | 1.64 | 2.35 | 3.51 |
| 1968 | 4.63 | 5.38 | 5.69 | 4.09 | 1.10 | 0.51 | 0.50 | 0.57 | 2.20 | 4.21 | 4.57 | 3.04 | 3.04 |
| 1969 | 3.47 | 5.05 | 6.99 | 5.43 | 2.14 | 0.56 | 0.54 | 0.53 | 1.10 | 3.29 | 5.31 | 9.84 | 3.69 |
| 1970 | 16.31 | 5.33 | 5.34 | 5.05 | 5.97 | 1.19 | 0.66 | 0.56 | 3.23 | 2.35 | 3.56 | 6.98 | 4.71 |
| 1971 | 5.64 | 5.09 | 10.49 | 5.36 | 1.87 | 0.60 | 0.57 | 1.22 | 0.60 | 1.24 | 1.99 | 4.05 | 3.23 |
| 1972 | 8.86 | 3.75 | 11.73 | 12.03 | 4.33 | 0.81 | 0.87 | 0.67 | 0.61 | 1.03 | 4.07 | 3.27 | 4.34 |
| 1973 | 8.48 | 6.35 | 8.31 | 6.36 | 5.07 | 1.55 | 0.69 | 0.96 | 2.48 | 5.54 | 3.87 | 5.69 | 4.61 |
| 1974 | 10.48 | 11.80 | 11.92 | 7.05 | 3.67 | 1.23 | 0.70 | 0.76 | 1.65 | 1.38 | 2.01 | 4.45 | 4.76 |
| 1975 | 5.12 | 4.53 | 8.31 | 9.35 | 6.09 | 2.23 | 0.83 | 0.72 | 2.05 | 3.76 | 2.62 | 2.86 | 4.04 |
| 1976 | 6.42 | 7.58 | 6.60 | 3.32 | 1.55 | 1.53 | 0.87 | 0.78 | 0.67 | 1.01 | 1.32 | 2.26 | 2.83 |
| 1977 | 4.11 | 6.04 | 6.27 | 4.05 | 2.56 | 0.76 | 0.61 | 0.60 | 0.77 | 1.05 | 2.61 | 2.31 | 2.65 |
| 1978 | 2.60 | 3.97 | 3.81 | 4.38 | 2.40 | 0.72 | 0.56 | 0.63 | 0.97 | 1.82 | 1.85 | 0.96 | 2.06 |
| 1979 | 1.67 | 4.10 | 4.02 | 3.29 | 1.93 | 0.64 | 0.54 | 0.51 | 0.53 | 0.77 | 0.77 | 0.80 | 1.63 |
| 1980 | 2.11 | 2.29 | 2.84 | 2.72 | 0.78 | 0.46 | 0.52 | 0.55 | 0.62 | 1.20 | 3.32 | 3.70 | 1.76 |
| 1981 | 2.68 | 7.05 | 9.47 | 4.72 | 0.96 | 0.46 | 0.45 | 0.47 | 0.83 | 0.82 | 1.95 | 1.88 | 2.65 |
| 1982 | 2.96 | 4.04 | 3.39 | 2.96 | 1.58 | 0.58 | 0.44 | 0.43 | 0.70 | 0.58 | 2.97 | 2.96 | 1.97 |
| 1983 | 2.58 | 1.23 | 4.42 | 2.98 | 1.98 | 0.69 | 0.55 | 0.49 | 0.94 | 0.46 | 0.76 | 1.56 | 1.55 |
| 1984 | 3.45 | 4.87 | 5.04 | 2.61 | 2.04 | 2.78 | 1.20 | 0.41 | 0.43 | 0.41 | 1.35 | 2.45 | 2.25 |
| 1985 | 3.58 | 4.70 | 4.18 | 4.89 | 2.49 | 0.83 | 0.61 | 0.83 | 0.53 | 0.46 | 1.71 | 1.75 | 2.21 |
| 1986 | 5.89 | 9.65 | 8.63 | 7.11 | 3.88 | 0.92 | 1.26 | 0.97 | 0.98 | 1.55 | 3.00 | 4.31 | 4.01 |
| 1987 | 8.55 | 7.47 | 4.60 | 2.63 | 1.32 | 1.03 | 0.86 | 1.26 | 1.44 | 2.19 | 3.64 | 4.86 | 3.32 |
| 1988 | 6.88 | 8.10 | 6.85 | 6.30 | 2.94 | 0.79 | 0.51 | 0.73 | 0.89 | 2.01 | 2.00 | 3.73 | 3.48 |
| 1989 | 6.94 | 7.37 | 9.53 | 7.79 | 3.07 | 2.16 | 1.05 | 0.83 | 0.81 | 1.57 | 2.10 | 1.22 | 3.70 |
| 1990 | 3.66 | 2.40 | 4.58 | 2.82 | 1.62 | 1.21 | 0.79 | 0.63 | 0.61 | 2.26 | 3.85 | 3.20 | 2.30 |
| 1991 | 3.84 | 5.34 | 6.95 | 3.20 | 1.95 | 0.72 | 0.35 | 0.49 | 0.87 | 2.02 | 2.90 | 2.61 | 2.60 |
| 1992 | 3.23 | 2.22 | 5.00 | 2.87 | 1.40 | 0.66 | 0.52 | 0.69 | 1.18 | 1.84 | 1.82 | 2.49 | 1.99 |
| 1993 | 4.25 | 6.60 | 7.72 | 4.91 | 1.37 | 0.60 | 0.33 | 0.30 | 0.61 | 2.07 | 4.91 | 7.65 | 3.44 |
| 1994 | 8.74 | 9.17 | 6.68 | 5.22 | 2.79 | 1.00 | 0.44 | 0.48 | 1.02 | 1.37 | 2.88 | 2.79 | 3.55 |
| 1995 | 6.26 | 3.24 | 7.62 | 3.49 | 0.97 | 0.47 | 0.58 | 0.78 | 1.10 | 1.49 | 2.95 | 3.02 | 2.67 |
| 1996 | 13.46 | 10.70 | 8.27 | 7.04 | 1.63 | 0.75 | 0.51 | 0.56 | 0.72 | 1.16 | 1.34 | 2.50 | 4.06 |
| 1997 | 5.33 | 8.95 | 3.16 | 1.12 | 0.77 | 0.53 | 0.54 | 0.49 | 0.88 | 1.88 | 3.60 | 3.51 | 2.56 |
| 1998 | 9.62 | 7.67 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 16.31 | 11.80 | 11.92 | 12.03 | 6.09 | 2.78 | 1.26 | 1.26 | 3.23 | 5.54 | 5.31 | 9.84 | 4.76 |
| Mean | 5.84 | 6.08 | 6.78 | 4.76 | 2.41 | 0.95 | 0.64 | 0.64 | 1.01 | 1.82 | 2.66 | 3.39 | 3.08 |
| Min. | 1.67 | 1.23 | 2.84 | 1.12 | 0.77 | 0.46 | 0.33 | 0.30 | 0.43 | 0.41 | 0.76 | 0.80 | 1.55 |
| N | 34 | 34 | 33 | 33 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 33 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 16.31 | 11.80 | 11.92 | 12.03 | 6.09 | 2.78 | 1.26 | 1.26 | 3.23 | 5.54 | 5.31 | 9.84 |
| Mean | 5.84 | 6.08 | 6.78 | 4.76 | 2.41 | 0.95 | 0.64 | 0.64 | 1.01 | 1.82 | 2.66 | 3.39 |
| Min. | 1.67 | 1.23 | 2.84 | 1.12 | 0.77 | 0.46 | 0.33 | 0.30 | 0.43 | 0.41 | 0.76 | 0.80 |

# Table 1.3.4 Generated Runoff (2/5)

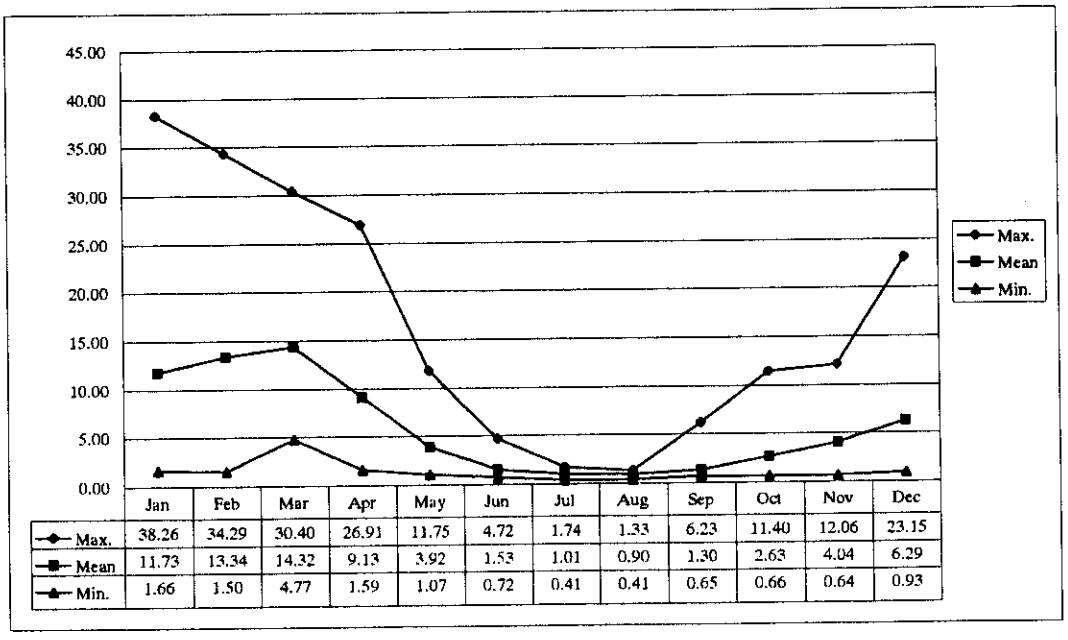
**Monthly Discharge ($m^3/s$)**

Station: Aguas Calientes

Longitude: W 75° 57'06"
Latitude: S 12° 04'58"
Altitude: 4,110

Note: observed + estimated by correlation method + calculated by Tank model

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | 0.83 | 0.79 | 0.76 | 1.10 | 5.07 | 4.43 | - |
| 1965 | 8.70 | 21.66 | 17.88 | 5.95 | 2.86 | 1.27 | 0.88 | 0.80 | 0.77 | 2.19 | 0.82 | 2.26 | 5.50 |
| 1966 | 12.81 | 11.54 | 16.02 | 9.79 | 4.27 | 1.19 | 0.84 | 0.76 | 0.83 | 5.22 | 5.27 | 13.32 | 6.82 |
| 1967 | 13.20 | 25.24 | 18.40 | 5.37 | 3.91 | 1.42 | 1.04 | 0.86 | 0.83 | 6.48 | 1.79 | 3.21 | 6.81 |
| 1968 | 9.53 | 10.30 | 12.33 | 6.86 | 1.46 | 0.99 | 0.85 | 0.85 | 2.84 | 8.19 | 8.71 | 5.01 | 5.66 |
| 1969 | 6.36 | 11.27 | 14.43 | 10.83 | 3.09 | 1.18 | 0.92 | 0.86 | 0.89 | 5.88 | 12.06 | 23.15 | 7.58 |
| 1970 | 38.26 | 7.59 | 11.39 | 10.70 | 11.75 | 1.70 | 1.15 | 0.98 | 6.23 | 2.94 | 6.52 | 15.80 | 9.58 |
| 1971 | 10.76 | 12.28 | 23.72 | 9.16 | 2.72 | 1.31 | 1.04 | 1.33 | 0.99 | 1.54 | 2.44 | 9.76 | 6.42 |
| 1972 | 18.47 | 5.94 | 30.40 | 26.91 | 6.09 | 1.58 | 1.23 | 1.04 | 1.00 | 1.31 | 7.43 | 5.35 | 8.90 |
| 1973 | 20.11 | 11.87 | 18.91 | 13.42 | 9.49 | 2.34 | 1.35 | 1.13 | 4.30 | 11.40 | 6.58 | 12.41 | 9.44 |
| 1974 | 25.56 | 28.29 | 27.23 | 13.48 | 6.38 | 1.90 | 1.46 | 1.33 | 1.54 | 1.30 | 2.72 | 8.62 | 9.98 |
| 1975 | 10.13 | 9.53 | 19.71 | 20.41 | 11.74 | 3.31 | 1.68 | 1.33 | 2.52 | 6.98 | 3.85 | 4.84 | 8.00 |
| 1976 | 13.94 | 16.72 | 13.55 | 5.36 | 2.03 | 1.81 | 1.51 | 1.33 | 1.26 | 1.27 | 1.48 | 3.11 | 5.28 |
| 1977 | 7.98 | 13.26 | 13.06 | 7.21 | 4.09 | 1.58 | 1.25 | 1.18 | 1.15 | 1.14 | 3.74 | 3.22 | 4.90 |
| 1978 | 4.10 | 7.66 | 7.07 | 8.60 | 3.69 | 1.44 | 1.16 | 1.09 | 1.07 | 2.07 | 2.39 | 1.28 | 3.47 |
| 1979 | 1.66 | 8.02 | 7.56 | 5.69 | 2.71 | 1.27 | 1.05 | 1.00 | 0.96 | 0.93 | 0.92 | 0.93 | 2.73 |
| 1980 | 3.03 | 3.18 | 4.77 | 4.18 | 1.17 | 0.89 | 0.84 | 0.81 | 0.79 | 1.79 | 5.55 | 6.67 | 2.81 |
| 1981 | 4.31 | 16.40 | 22.03 | 7.79 | 1.48 | 0.98 | 0.82 | 0.78 | 0.77 | 0.75 | 2.27 | 2.13 | 5.04 |
| 1982 | 5.20 | 7.55 | 5.96 | 4.97 | 1.91 | 1.02 | 0.77 | 0.74 | 0.72 | 0.71 | 5.10 | 4.75 | 3.28 |
| 1983 | 3.87 | 1.50 | 9.36 | 4.24 | 2.54 | 0.98 | 0.77 | 0.73 | 0.70 | 0.66 | 0.64 | 1.34 | 2.28 |
| 1984 | 6.45 | 9.88 | 9.98 | 4.04 | 2.85 | 4.72 | 1.59 | 0.80 | 0.69 | 0.66 | 1.11 | 3.60 | 3.86 |
| 1985 | 6.71 | 9.40 | 8.15 | 9.95 | 3.80 | 1.16 | 0.89 | 0.77 | 0.71 | 0.68 | 1.68 | 1.92 | 3.82 |
| 1986 | 15.16 | 22.63 | 18.82 | 19.25 | 8.20 | 1.14 | 1.74 | 1.31 | 1.32 | 1.62 | 4.48 | 8.11 | 8.65 |
| 1987 | 20.74 | 19.96 | 9.26 | 3.49 | 1.61 | 1.19 | 0.71 | 0.86 | 1.22 | 2.01 | 4.58 | 5.99 | 5.97 |
| 1988 | 13.41 | 17.77 | 10.70 | 11.08 | 4.31 | 1.34 | 0.75 | 0.71 | 1.23 | 2.12 | 2.76 | 5.56 | 5.98 |
| 1989 | 14.30 | 16.05 | 21.69 | 16.94 | 5.28 | 3.43 | 1.34 | 1.00 | 0.96 | 2.25 | 3.24 | 1.62 | 7.34 |
| 1990 | 6.42 | 3.94 | 8.60 | 4.31 | 2.31 | 1.60 | 0.94 | 0.71 | 0.68 | 2.84 | 6.08 | 6.31 | 3.73 |
| 1991 | 8.34 | 10.31 | 11.78 | 4.93 | 2.86 | 0.93 | 0.41 | 0.61 | 1.16 | 3.02 | 4.44 | 3.95 | 4.40 |
| 1992 | 5.24 | 2.85 | 8.64 | 3.99 | 1.81 | 0.72 | 0.62 | 0.50 | 0.65 | 2.04 | 2.21 | 3.70 | 2.75 |
| 1993 | 6.71 | 11.22 | 13.32 | 8.02 | 1.94 | 1.07 | 0.63 | 0.41 | 0.68 | 2.27 | 7.51 | 16.47 | 5.85 |
| 1994 | 15.24 | 34.29 | 23.78 | 12.82 | 5.80 | 2.15 | 1.05 | 0.63 | 1.21 | 1.38 | 3.64 | 4.37 | 8.86 |
| 1995 | 12.57 | 7.24 | 12.99 | 8.35 | 1.90 | 1.01 | 0.70 | 0.99 | 0.99 | 1.62 | 3.61 | 9.28 | 5.10 |
| 1996 | 17.02 | 24.59 | 15.44 | 11.44 | 2.29 | 1.08 | 0.84 | 0.67 | 0.72 | 0.97 | 1.92 | 3.54 | 6.71 |
| 1997 | 9.28 | 18.30 | 5.52 | 1.59 | 1.07 | 0.81 | 0.82 | 0.93 | 1.08 | 2.17 | 4.73 | 7.96 | 4.52 |
| 1998 | 23.32 | 15.31 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 38.26 | 34.29 | 30.40 | 26.91 | 11.75 | 4.72 | 1.74 | 1.33 | 6.23 | 11.40 | 12.06 | 23.15 | 9.98 |
| Mean | 11.73 | 13.34 | 14.32 | 9.13 | 3.92 | 1.53 | 1.01 | 0.90 | 1.30 | 2.63 | 4.04 | 6.29 | 5.82 |
| Min. | 1.66 | 1.50 | 4.77 | 1.59 | 1.07 | 0.72 | 0.41 | 0.41 | 0.65 | 0.66 | 0.64 | 0.93 | 2.28 |
| N | 34 | 34 | 33 | 33 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 33 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 38.26 | 34.29 | 30.40 | 26.91 | 11.75 | 4.72 | 1.74 | 1.33 | 6.23 | 11.40 | 12.06 | 23.15 |
| Mean | 11.73 | 13.34 | 14.32 | 9.13 | 3.92 | 1.53 | 1.01 | 0.90 | 1.30 | 2.63 | 4.04 | 6.29 |
| Min. | 1.66 | 1.50 | 4.77 | 1.59 | 1.07 | 0.72 | 0.41 | 0.41 | 0.65 | 0.66 | 0.64 | 0.93 |

# Table 1.3.4 Generated Runoff (3/5)

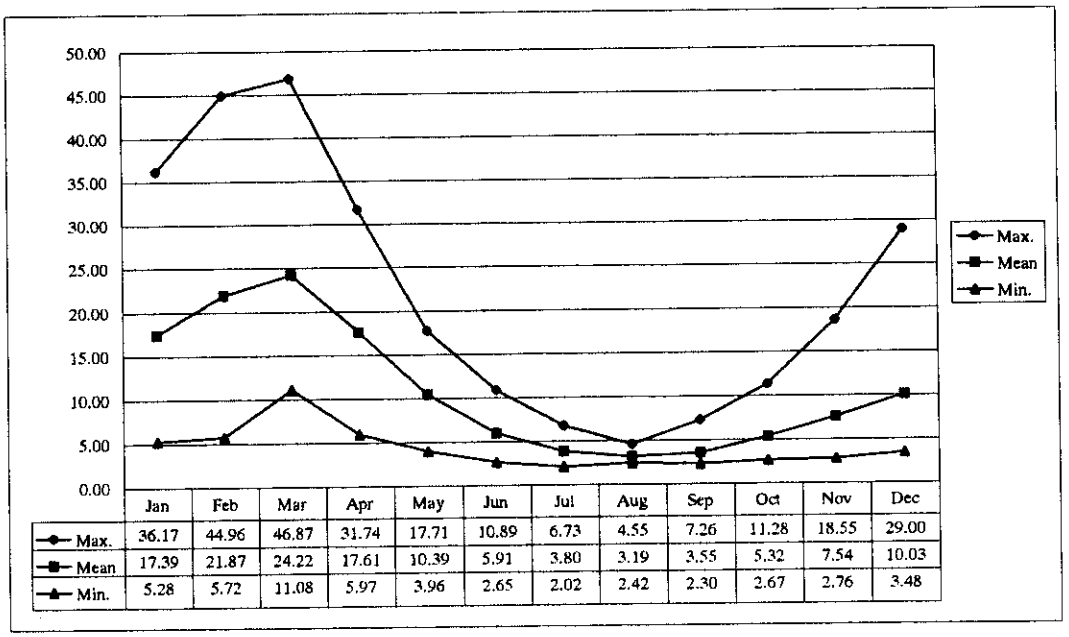
**Monthly Discharge ($m^3/s$)**

Station: Tinco de Alis

Longitude: W 75° 46'53"
Latitude: S 12° 16'26"
Altitude: 3,350

Note: observed + estimated by correlation method + calculated by Tank model

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | 2.98 | 2.92 | 3.12 | 3.32 | 6.53 | 5.34 | - |
| 1965 | 10.77 | 24.23 | 24.90 | 13.49 | 9.34 | 5.66 | 3.21 | 2.97 | 3.07 | 5.24 | 3.59 | 6.08 | 9.38 |
| 1966 | 15.62 | 16.61 | 23.88 | 15.44 | 10.85 | 6.23 | 3.31 | 2.92 | 3.28 | 11.28 | 11.11 | 19.36 | 11.66 |
| 1967 | 24.56 | 43.74 | 46.87 | 24.17 | 15.99 | 10.42 | 6.73 | 4.01 | 3.60 | 9.83 | 6.99 | 10.85 | 17.31 |
| 1968 | 15.23 | 19.27 | 18.64 | 13.75 | 7.49 | 4.35 | 3.27 | 3.26 | 4.06 | 7.00 | 9.26 | 6.35 | 9.33 |
| 1969 | 7.36 | 10.27 | 14.33 | 14.11 | 8.03 | 4.29 | 3.18 | 3.13 | 3.86 | 6.67 | 8.43 | 21.64 | 8.77 |
| 1970 | 36.17 | 20.76 | 20.20 | 16.87 | 15.76 | 7.93 | 4.38 | 3.27 | 6.49 | 6.25 | 7.09 | 14.11 | 13.27 |
| 1971 | 17.39 | 20.82 | 29.27 | 16.90 | 9.84 | 5.57 | 3.43 | 3.59 | 3.26 | 3.56 | 3.73 | 7.73 | 10.42 |
| 1972 | 18.20 | 12.25 | 29.51 | 26.03 | 14.01 | 7.76 | 4.51 | 3.30 | 3.23 | 4.71 | 8.38 | 8.78 | 11.72 |
| 1973 | 19.66 | 17.97 | 23.27 | 18.17 | 13.59 | 7.75 | 4.33 | 3.42 | 4.68 | 9.13 | 11.31 | 17.96 | 12.60 |
| 1974 | 30.17 | 32.95 | 34.48 | 22.29 | 14.85 | 9.18 | 5.56 | 4.35 | 3.93 | 3.68 | 4.31 | 6.96 | 14.39 |
| 1975 | 11.79 | 15.10 | 26.16 | 23.62 | 15.83 | 9.64 | 5.83 | 3.80 | 4.77 | 8.92 | 8.41 | 12.47 | 12.20 |
| 1976 | 24.45 | 26.98 | 25.18 | 17.61 | 10.69 | 7.24 | 4.31 | 3.94 | 4.26 | 3.73 | 3.86 | 4.40 | 11.39 |
| 1977 | 10.42 | 17.58 | 20.71 | 14.51 | 9.18 | 5.25 | 3.60 | 3.54 | 3.52 | 3.58 | 6.92 | 5.54 | 8.70 |
| 1978 | 8.51 | 16.16 | 13.16 | 11.62 | 7.37 | 4.15 | 3.42 | 3.40 | 3.44 | 3.87 | 3.82 | 4.38 | 6.94 |
| 1979 | 5.28 | 15.19 | 20.75 | 13.33 | 7.92 | 4.53 | 3.25 | 3.19 | 3.14 | 3.12 | 3.21 | 3.48 | 7.20 |
| 1980 | 7.06 | 5.72 | 14.05 | 11.43 | 5.87 | 3.29 | 2.97 | 2.92 | 2.87 | 7.28 | 8.94 | 11.02 | 6.95 |
| 1981 | 13.94 | 26.10 | 34.50 | 23.83 | 12.30 | 7.14 | 3.76 | 3.00 | 3.03 | 3.73 | 5.39 | 6.73 | 11.95 |
| 1982 | 13.77 | 20.91 | 17.01 | 15.04 | 8.97 | 4.98 | 3.04 | 2.94 | 2.93 | 3.20 | 7.19 | 8.16 | 9.01 |
| 1983 | 7.70 | 6.24 | 11.08 | 7.11 | 5.41 | 3.11 | 2.82 | 2.88 | 2.75 | 2.67 | 2.76 | 3.61 | 4.84 |
| 1984 | 10.03 | 22.07 | 22.18 | 17.01 | 13.14 | 10.89 | 6.35 | 3.21 | 2.70 | 2.81 | 3.92 | 9.10 | 10.28 |
| 1985 | 11.27 | 15.69 | 16.14 | 14.02 | 9.25 | 5.99 | 3.76 | 2.75 | 2.71 | 2.80 | 3.97 | 3.84 | 7.68 |
| 1986 | 26.09 | 38.73 | 33.85 | 31.74 | 16.75 | 3.79 | 5.61 | 4.55 | 4.63 | 5.22 | 8.05 | 12.60 | 15.97 |
| 1987 | 28.80 | 29.50 | 20.78 | 10.95 | 6.30 | 4.11 | 3.23 | 2.85 | 3.01 | 3.98 | 7.52 | 11.70 | 11.06 |
| 1988 | 20.55 | 28.65 | 21.07 | 23.37 | 12.48 | 5.57 | 3.30 | 2.84 | 2.88 | 5.02 | 6.13 | 8.68 | 11.71 |
| 1989 | 22.57 | 29.23 | 37.54 | 30.81 | 12.37 | 8.77 | 4.31 | 3.44 | 3.33 | 6.40 | 8.51 | 5.00 | 14.36 |
| 1990 | 14.12 | 9.81 | 18.20 | 10.13 | 6.05 | 4.96 | 3.27 | 2.64 | 2.55 | 5.10 | 13.26 | 12.50 | 8.55 |
| 1991 | 10.44 | 18.28 | 28.91 | 15.83 | 10.23 | 4.78 | 2.02 | 2.69 | 4.17 | 7.98 | 10.82 | 9.98 | 10.51 |
| 1992 | 14.20 | 8.98 | 18.78 | 9.94 | 4.83 | 3.24 | 3.04 | 2.59 | 2.67 | 4.17 | 5.65 | 7.17 | 7.10 |
| 1993 | 12.83 | 26.94 | 28.68 | 23.01 | 10.85 | 4.63 | 3.53 | 2.54 | 2.30 | 4.04 | 18.55 | 29.00 | 13.91 |
| 1994 | 31.21 | 44.96 | 37.31 | 29.58 | 17.71 | 8.67 | 4.65 | 3.60 | 7.26 | 8.60 | 13.87 | 11.42 | 18.24 |
| 1995 | 19.52 | 15.41 | 24.21 | 16.04 | 5.76 | 3.39 | 2.71 | 2.82 | 3.20 | 4.24 | 9.55 | 9.92 | 9.73 |
| 1996 | 25.73 | 32.48 | 27.61 | 23.48 | 10.04 | 5.19 | 3.24 | 2.79 | 2.61 | 3.42 | 4.05 | 10.00 | 12.55 |
| 1997 | 20.57 | 27.88 | 15.93 | 5.97 | 3.96 | 2.65 | 2.35 | 2.42 | 3.39 | 6.45 | 11.45 | 15.22 | 9.85 |
| 1998 | 25.18 | 26.18 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 36.17 | 44.96 | 46.87 | 31.74 | 17.71 | 10.89 | 6.73 | 4.55 | 7.26 | 11.28 | 18.55 | 29.00 | 18.24 |
| Mean | 17.39 | 21.87 | 24.22 | 17.61 | 10.39 | 5.91 | 3.80 | 3.19 | 3.55 | 5.32 | 7.54 | 10.03 | 10.90 |
| Min. | 5.28 | 5.72 | 11.08 | 5.97 | 3.96 | 2.65 | 2.02 | 2.42 | 2.30 | 2.67 | 2.76 | 3.48 | 4.84 |
| N | 34 | 34 | 33 | 33 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 33 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 36.17 | 44.96 | 46.87 | 31.74 | 17.71 | 10.89 | 6.73 | 4.55 | 7.26 | 11.28 | 18.55 | 29.00 |
| Mean | 17.39 | 21.87 | 24.22 | 17.61 | 10.39 | 5.91 | 3.80 | 3.19 | 3.55 | 5.32 | 7.54 | 10.03 |
| Min. | 5.28 | 5.72 | 11.08 | 5.97 | 3.96 | 2.65 | 2.02 | 2.42 | 2.30 | 2.67 | 2.76 | 3.48 |

# Table 1.3.4 Generated Runoff (4/5)

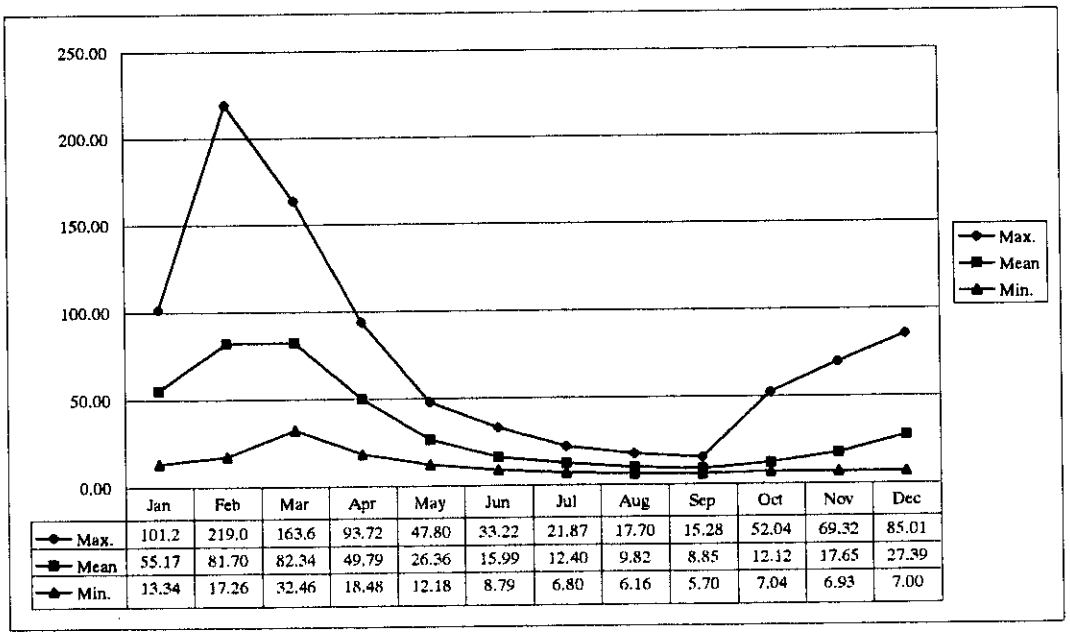
**Monthly Discharge ($m^3/s$)**

Station: Chavin

Longitude: W 75° 56'48"
Latitude: S 12° 44'48"
Altitude: 1,350

Note: observed + estimated by correlation method + calculated by Tank model

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | 7.47 | 7.29 | 7.27 | 7.24 | 10.32 | 14.34 | - |
| 1965 | 31.74 | 96.34 | 65.59 | 34.26 | 19.08 | 12.91 | 9.44 | 7.26 | 7.11 | 8.50 | 7.36 | 13.30 | 26.08 |
| 1966 | 47.97 | 54.09 | 90.05 | 38.32 | 24.27 | 13.96 | 9.96 | 7.26 | 7.02 | 31.76 | 23.25 | 40.07 | 32.33 |
| 1967 | 87.99 | 205.57 | 163.61 | 64.09 | 36.76 | 22.89 | 17.99 | 13.83 | 11.26 | 16.49 | 13.07 | 21.80 | 56.28 |
| 1968 | 29.14 | 35.64 | 39.76 | 28.88 | 14.26 | 10.72 | 8.04 | 7.50 | 7.52 | 8.65 | 13.33 | 10.96 | 17.87 |
| 1969 | 13.34 | 22.13 | 46.96 | 38.10 | 17.93 | 10.63 | 7.89 | 7.21 | 7.27 | 10.68 | 12.96 | 65.99 | 21.76 |
| 1970 | 100.03 | 55.89 | 47.00 | 33.88 | 29.60 | 16.52 | 11.94 | 8.47 | 9.76 | 12.32 | 9.76 | 17.21 | 29.36 |
| 1971 | 46.74 | 69.50 | 112.28 | 49.88 | 30.10 | 16.71 | 12.31 | 9.14 | 7.45 | 7.35 | 7.24 | 30.19 | 33.24 |
| 1972 | 67.47 | 54.50 | 156.64 | 76.98 | 34.04 | 18.50 | 14.00 | 10.32 | 7.77 | 9.30 | 11.26 | 30.61 | 40.95 |
| 1973 | 76.02 | 58.16 | 116.70 | 68.57 | 41.09 | 21.40 | 15.61 | 11.79 | 9.90 | 13.58 | 19.36 | 45.72 | 41.49 |
| 1974 | 91.10 | 100.75 | 93.85 | 48.56 | 28.02 | 18.86 | 14.55 | 11.77 | 9.88 | 8.26 | 8.43 | 11.87 | 37.16 |
| 1975 | 24.64 | 35.15 | 83.10 | 46.92 | 30.11 | 16.77 | 12.43 | 9.36 | 8.57 | 10.85 | 12.89 | 37.03 | 27.32 |
| 1976 | 98.28 | 100.95 | 77.88 | 48.77 | 26.30 | 18.21 | 14.12 | 10.86 | 9.56 | 8.33 | 8.19 | 9.04 | 35.87 |
| 1977 | 19.96 | 73.44 | 69.05 | 39.24 | 19.82 | 13.08 | 9.55 | 8.07 | 7.93 | 7.84 | 20.01 | 17.51 | 25.46 |
| 1978 | 30.54 | 43.83 | 32.46 | 28.76 | 16.97 | 11.17 | 8.23 | 7.66 | 7.53 | 7.80 | 8.52 | 12.56 | 18.00 |
| 1979 | 16.35 | 61.18 | 83.75 | 41.36 | 17.96 | 12.27 | 8.84 | 7.32 | 7.19 | 7.04 | 6.93 | 7.00 | 23.10 |
| 1980 | 21.41 | 21.18 | 37.19 | 29.76 | 13.76 | 8.79 | 6.80 | 6.60 | 6.50 | 11.80 | 17.46 | 36.38 | 18.14 |
| 1981 | 80.78 | 219.07 | 135.09 | 87.64 | 34.35 | 20.87 | 15.60 | 11.51 | 9.12 | 8.15 | 12.01 | 24.30 | 54.87 |
| 1982 | 52.78 | 130.23 | 59.02 | 41.01 | 22.59 | 14.98 | 11.06 | 7.98 | 7.14 | 52.04 | 69.32 | 37.75 | 42.16 |
| 1983 | 25.30 | 19.99 | 60.05 | 45.12 | 21.81 | 13.52 | 10.17 | 7.61 | 7.37 | 7.05 | 7.01 | 24.56 | 20.80 |
| 1984 | 93.60 | 188.94 | 139.00 | 75.94 | 41.82 | 28.16 | 20.13 | 15.00 | 11.33 | 11.05 | 59.50 | 62.86 | 62.28 |
| 1985 | 40.48 | 72.23 | 63.59 | 44.81 | 33.21 | 23.16 | 16.72 | 12.99 | 10.04 | 8.57 | 9.80 | 9.04 | 28.72 |
| 1986 | 76.48 | 97.88 | 82.63 | 93.72 | 47.80 | 10.85 | 19.39 | 16.19 | 14.15 | 12.87 | 15.42 | 33.53 | 43.41 |
| 1987 | 97.14 | 94.83 | 55.09 | 32.65 | 14.14 | 9.11 | 7.95 | 6.16 | 6.76 | 8.99 | 12.96 | 21.81 | 30.63 |
| 1988 | 53.82 | 77.21 | 54.33 | 56.21 | 30.27 | 16.34 | 12.37 | 10.54 | 9.61 | 11.11 | 12.34 | 19.86 | 30.33 |
| 1989 | 70.57 | 96.09 | 130.48 | 85.92 | 41.30 | 33.22 | 21.87 | 17.70 | 9.81 | 14.01 | 17.26 | 16.22 | 46.20 |
| 1990 | 36.68 | 26.38 | 46.39 | 27.04 | 16.71 | 13.77 | 9.48 | 7.76 | 7.53 | 14.12 | 32.87 | 34.35 | 22.76 |
| 1991 | 35.79 | 52.18 | 81.65 | 37.45 | 25.28 | 15.48 | 18.24 | 11.98 | 9.07 | 9.94 | 18.43 | 15.04 | 27.54 |
| 1992 | 26.71 | 17.26 | 43.00 | 22.24 | 13.54 | 10.03 | 8.63 | 8.03 | 7.04 | 9.30 | 9.57 | 13.27 | 15.72 |
| 1993 | 30.55 | 84.48 | 119.06 | 84.13 | 38.82 | 23.40 | 18.41 | 15.51 | 15.28 | 18.64 | 49.30 | 85.01 | 48.55 |
| 1994 | 101.24 | 169.23 | 110.09 | 61.23 | 29.63 | 13.72 | 9.54 | 6.93 | 12.91 | 12.91 | 16.88 | 24.46 | 47.40 |
| 1995 | 38.95 | 40.64 | 70.14 | 43.10 | 18.43 | 12.74 | 11.27 | 9.78 | 9.59 | 9.31 | 19.92 | 22.51 | 25.53 |
| 1996 | 78.45 | 121.38 | 91.53 | 69.93 | 27.82 | 15.87 | 12.65 | 9.58 | 9.04 | 8.56 | 11.12 | 21.20 | 39.76 |
| 1997 | 49.58 | 98.78 | 60.30 | 18.48 | 12.18 | 9.06 | 8.82 | 6.95 | 5.70 | 7.52 | 16.18 | 43.75 | 28.11 |
| 1998 | 83.98 | 82.78 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 101.24 | 219.07 | 163.61 | 93.72 | 47.80 | 33.22 | 21.87 | 17.70 | 15.28 | 52.04 | 69.32 | 85.01 | 62.28 |
| Mean | 55.17 | 81.70 | 82.34 | 49.79 | 26.36 | 15.99 | 12.40 | 9.82 | 8.85 | 12.12 | 17.65 | 27.39 | 33.31 |
| Min. | 13.34 | 17.26 | 32.46 | 18.48 | 12.18 | 8.79 | 6.80 | 6.16 | 5.70 | 7.04 | 6.93 | 7.00 | 15.72 |
| N | 34 | 34 | 33 | 33 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 33 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 101.2 | 219.0 | 163.6 | 93.72 | 47.80 | 33.22 | 21.87 | 17.70 | 15.28 | 52.04 | 69.32 | 85.01 |
| Mean | 55.17 | 81.70 | 82.34 | 49.79 | 26.36 | 15.99 | 12.40 | 9.82 | 8.85 | 12.12 | 17.65 | 27.39 |
| Min. | 13.34 | 17.26 | 32.46 | 18.48 | 12.18 | 8.79 | 6.80 | 6.16 | 5.70 | 7.04 | 6.93 | 7.00 |

# Table 1.3.4 Generated Runoff (5/5)

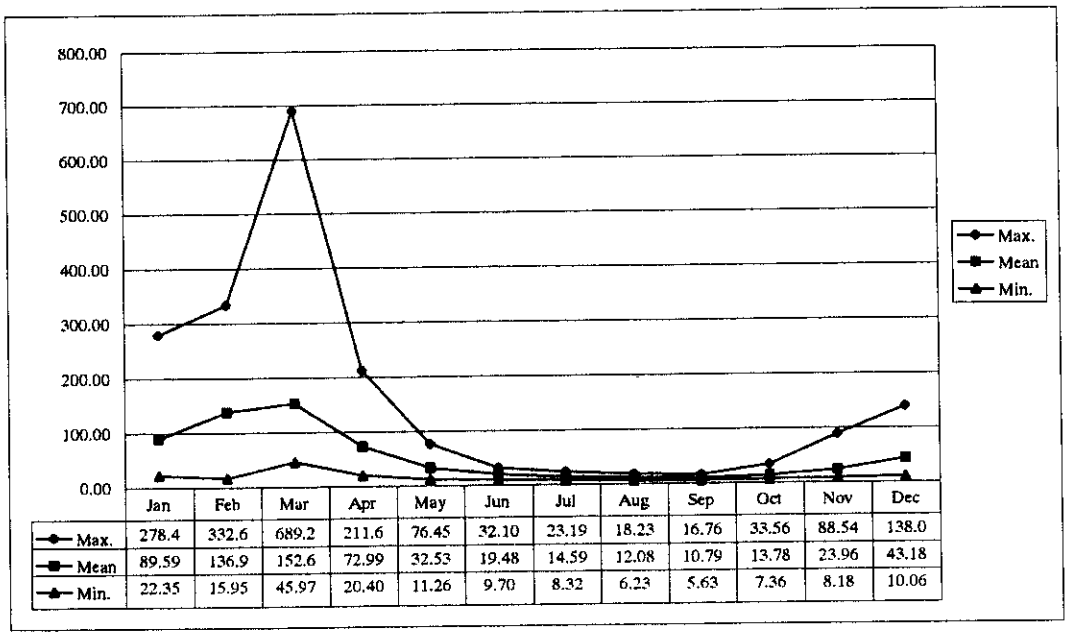
**Monthly Discharge ($m^3/s$)**

Station: Socsi

Longitude: W 76° 12'
Latitude: S 13° 00'
Altitude: 340

Note: observed + estimated by correlation method + calculated by Tank model

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | - | - | - | - | - | - | 9.95 | 9.42 | 9.27 | 9.20 | 16.36 | 27.22 | - |
| 1965 | 37.80 | 123.95 | 120.29 | 60.78 | 35.75 | 15.23 | 9.49 | 12.64 | 10.39 | 10.79 | 16.32 | 20.94 | 39.53 |
| 1966 | 52.63 | 64.24 | 104.35 | 32.50 | 20.77 | 13.22 | 10.46 | 9.38 | 9.56 | 32.57 | 35.89 | 84.35 | 39.16 |
| 1967 | 101.15 | 288.96 | 164.97 | 69.47 | 38.29 | 26.06 | 19.86 | 15.86 | 15.75 | 33.56 | 25.69 | 31.41 | 69.25 |
| 1968 | 50.18 | 57.91 | 94.32 | 37.36 | 20.27 | 14.58 | 12.25 | 9.68 | 9.90 | 12.35 | 26.17 | 34.25 | 31.60 |
| 1969 | 31.21 | 49.60 | 94.65 | 52.45 | 22.44 | 14.09 | 12.15 | 10.31 | 7.47 | 19.30 | 13.71 | 138.07 | 38.79 |
| 1970 | 278.48 | 131.39 | 85.71 | 27.04 | 16.77 | 20.07 | 15.68 | 12.04 | 16.76 | 13.59 | 15.96 | 31.83 | 55.44 |
| 1971 | 113.69 | 155.46 | 196.77 | 76.47 | 23.72 | 13.82 | 15.17 | 15.18 | 13.99 | 11.14 | 8.71 | 46.33 | 57.54 |
| 1972 | 169.44 | 251.14 | 689.23 | 211.69 | 40.15 | 20.42 | 11.15 | 11.86 | 11.45 | 14.99 | 17.31 | 66.62 | 126.29 |
| 1973 | 146.23 | 220.99 | 290.16 | 202.30 | 66.28 | 22.92 | 14.68 | 10.91 | 9.97 | 12.68 | 18.96 | 78.07 | 91.18 |
| 1974 | 96.81 | 154.75 | 127.94 | 48.20 | 27.52 | 22.17 | 18.31 | 15.42 | 13.90 | 13.40 | 13.85 | 15.08 | 47.28 |
| 1975 | 28.42 | 40.71 | 180.97 | 74.20 | 44.29 | 24.21 | 14.53 | 10.84 | 9.97 | 11.74 | 19.13 | 37.25 | 41.35 |
| 1976 | 111.93 | 194.34 | 148.97 | 69.09 | 33.00 | 24.72 | 18.03 | 14.13 | 12.85 | 13.70 | 13.54 | 20.28 | 56.22 |
| 1977 | 51.03 | 115.98 | 112.17 | 41.05 | 26.71 | 17.73 | 15.54 | 13.92 | 13.71 | 13.52 | 40.04 | 33.42 | 41.23 |
| 1978 | 56.49 | 102.49 | 58.18 | 50.42 | 27.13 | 19.20 | 15.11 | 13.63 | 12.65 | 13.85 | 35.72 | 41.63 | 37.21 |
| 1979 | 39.04 | 107.26 | 129.52 | 58.38 | 22.74 | 16.39 | 14.94 | 10.28 | 10.04 | 10.52 | 11.20 | 13.38 | 36.97 |
| 1980 | 41.13 | 35.93 | 50.78 | 46.32 | 19.49 | 13.61 | 13.35 | 11.25 | 9.79 | 24.50 | 29.10 | 44.40 | 28.30 |
| 1981 | 61.66 | 158.80 | 147.59 | 85.91 | 25.07 | 19.15 | 15.40 | 12.61 | 11.04 | 12.10 | 24.53 | 44.44 | 51.52 |
| 1982 | 57.07 | 99.07 | 70.33 | 60.71 | 31.19 | 19.28 | 13.40 | 11.15 | 6.80 | 21.86 | 85.61 | 73.80 | 45.86 |
| 1983 | 59.37 | 42.79 | 90.33 | 104.08 | 34.56 | 22.22 | 16.52 | 15.13 | 10.38 | 9.54 | 9.45 | 48.90 | 38.61 |
| 1984 | 189.64 | 329.94 | 221.12 | 107.16 | 40.86 | 28.79 | 23.19 | 18.23 | 14.65 | 18.02 | 88.54 | 106.86 | 98.92 |
| 1985 | 54.78 | 116.05 | 94.40 | 52.85 | 36.96 | 26.48 | 20.74 | 17.05 | 14.20 | 13.21 | 15.60 | 25.11 | 40.62 |
| 1986 | 135.08 | 204.00 | 232.48 | 172.70 | 70.73 | 29.78 | 21.19 | 16.73 | 14.00 | 12.37 | 13.88 | 42.58 | 80.46 |
| 1987 | 160.32 | 130.66 | 59.50 | 22.47 | 11.26 | 9.70 | 10.13 | 9.46 | 9.05 | 8.42 | 10.13 | 17.13 | 38.19 |
| 1988 | 73.68 | 82.91 | 45.97 | 43.97 | 17.96 | 15.50 | 12.71 | 11.73 | 11.69 | 11.27 | 10.41 | 15.72 | 29.46 |
| 1989 | 79.69 | 135.63 | 145.45 | 79.07 | 17.60 | 15.91 | 12.63 | 11.16 | 10.46 | 11.97 | 18.59 | 10.56 | 45.73 |
| 1990 | 34.63 | 26.70 | 78.23 | 28.02 | 18.56 | 14.97 | 11.10 | 8.78 | 7.63 | 12.58 | 36.23 | 42.61 | 26.67 |
| 1991 | 59.47 | 97.69 | 216.02 | 73.92 | 49.66 | 32.10 | 19.69 | 11.29 | 7.81 | 8.97 | 20.15 | 15.30 | 51.01 |
| 1992 | 22.35 | 15.95 | 74.76 | 36.16 | 21.21 | 12.15 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 | 19.03 |
| 1993 | 31.60 | 190.96 | 238.16 | 112.33 | 47.81 | 21.60 | 13.62 | 10.12 | 7.62 | 9.81 | 35.89 | 119.45 | 69.91 |
| 1994 | 153.55 | 332.68 | 213.06 | 75.00 | 76.45 | 30.17 | 20.87 | 17.10 | 12.43 | 11.29 | 18.90 | 17.24 | 81.56 |
| 1995 | 89.35 | 111.25 | 202.10 | 53.77 | 23.71 | 16.17 | 11.68 | 9.03 | 8.92 | 10.31 | 24.77 | 25.45 | 48.87 |
| 1996 | 132.79 | 176.62 | 181.06 | 122.60 | 48.19 | 17.30 | 13.57 | 9.28 | 9.28 | 9.46 | 11.20 | 18.66 | 62.50 |
| 1997 | 87.23 | 147.32 | 78.16 | 20.40 | 16.50 | 13.14 | 10.50 | 9.00 | 7.84 | 8.72 | 25.07 | 69.85 | 41.14 |
| 1998 | 158.13 | 163.50 | - | - | - | - | - | - | - | - | - | - | - |
| Max. | 278.48 | 332.68 | 689.23 | 211.69 | 76.45 | 32.10 | 23.19 | 18.23 | 16.76 | 33.56 | 88.54 | 138.07 | 126.29 |
| Mean | 89.59 | 136.99 | 152.66 | 72.99 | 32.53 | 19.48 | 14.59 | 12.08 | 10.79 | 13.78 | 23.96 | 43.18 | 51.74 |
| Min. | 22.35 | 15.95 | 45.97 | 20.40 | 11.26 | 9.70 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 | 19.03 |
| N | 34 | 34 | 33 | 33 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 33 |




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | 278.4 | 332.6 | 689.2 | 211.6 | 76.45 | 32.10 | 23.19 | 18.23 | 16.76 | 33.56 | 88.54 | 138.0 |
| Mean | 89.59 | 136.9 | 152.6 | 72.99 | 32.53 | 19.48 | 14.59 | 12.08 | 10.79 | 13.78 | 23.96 | 43.18 |
| Min. | 22.35 | 15.95 | 45.97 | 20.40 | 11.26 | 9.70 | 8.32 | 6.23 | 5.63 | 7.36 | 8.18 | 10.06 |

# Table 1.5.1 Seasonal Discharge

Station: Imperial + Socsi

Source: before 1964:Toma Imperial; after 1965: Socsi

(Unit: $m^3/s$)

| Year | Sep-Aug | Year | Jun | Jul | Aug | Sep | Oct | Jun-Sep | Jul-Oct | Jul-Sep |
|---|---|---|---|---|---|---|---|---|---|---|
| 1925/26 | - | 1926 | 15.0 | 12.0 | 10.0 | 11.0 | 12.0 | 12.0 | 11.3 | 11.0 |
| 1926/27 | 35.8 | 1927 | 19.7 | 17.3 | 10.0 | - | - | - | - | - |
| 1927/28 | - | 1928 | 16.9 | 13.3 | 11.9 | 12.1 | 14.8 | 13.6 | 13.0 | 12.4 |
| 1928/29 | 45.9 | 1929 | 16.4 | 12.7 | 11.6 | 12.1 | 13.6 | 13.2 | 12.5 | 12.1 |
| 1929/30 | 46.9 | 1930 | 19.9 | 14.2 | 12.5 | 11.9 | 13.4 | 14.6 | 13.0 | 12.9 |
| 1930/31 | 26.4 | 1931 | 15.0 | 12.6 | 11.8 | 11.7 | 12.6 | 12.8 | 12.2 | 12.0 |
| 1931/32 | - | 1932 | 18.7 | 14.1 | 10.8 | 10.0 | 10.7 | 13.4 | 11.4 | 11.6 |
| 1932/33 | 41.0 | 1933 | 17.6 | 14.5 | 13.0 | 11.7 | 11.5 | 14.2 | 12.7 | 13.1 |
| 1933/34 | 59.1 | 1934 | 24.1 | 20.0 | 13.6 | 12.2 | 13.9 | 17.5 | 14.9 | 15.3 |
| 1934/35 | 59.3 | 1935 | 24.8 | 19.2 | 13.1 | 12.7 | 14.0 | 17.5 | 14.8 | 15.0 |
| 1935/36 | 56.0 | 1936 | 16.8 | 12.1 | 9.9 | 9.3 | 16.7 | 12.0 | 12.0 | 10.4 |
| 1936/37 | 45.1 | 1937 | 19.7 | 13.3 | 9.8 | 9.1 | 9.9 | 13.0 | 10.5 | 10.7 |
| 1937/38 | 51.6 | 1938 | 13.6 | 13.2 | 11.7 | 10.5 | 9.5 | 12.3 | 11.2 | 11.8 |
| 1938/39 | 47.8 | 1939 | 17.0 | 13.4 | 11.4 | 9.5 | 9.3 | 12.8 | 10.9 | 11.4 |
| 1939/40 | 32.5 | 1940 | 15.5 | 12.0 | 10.4 | 10.3 | 10.8 | 12.1 | 10.9 | 10.9 |
| 1940/41 | 37.0 | 1941 | 13.6 | 9.8 | 9.0 | 8.7 | 11.5 | 10.3 | 9.8 | 9.2 |
| 1941/42 | 45.6 | 1942 | 18.2 | 14.6 | 12.2 | 10.7 | 10.1 | 13.9 | 11.9 | 12.5 |
| 1942/43 | 57.0 | 1943 | 18.2 | 13.1 | 11.0 | 10.5 | 12.4 | 13.2 | 11.8 | 11.5 |
| 1943/44 | 64.5 | 1944 | 20.8 | 15.8 | 13.1 | 11.4 | 10.5 | 15.3 | 12.7 | 13.4 |
| 1944/45 | 44.9 | 1945 | 15.2 | 11.9 | 9.5 | 8.6 | 8.0 | 11.3 | 9.5 | 10.0 |
| 1945/46 | 68.6 | 1946 | 23.6 | 16.1 | 13.3 | 11.7 | 14.1 | 16.2 | 13.8 | 13.7 |
| 1946/47 | 52.3 | 1947 | 22.6 | 13.6 | 11.2 | 10.0 | 11.7 | 14.4 | 11.6 | 11.6 |
| 1947/48 | 48.8 | 1948 | 26.8 | 16.0 | 11.4 | 10.2 | 26.7 | 16.1 | 16.1 | 12.5 |
| 1948/49 | 41.3 | 1949 | 18.7 | 12.2 | 10.1 | 9.3 | 9.1 | 12.6 | 10.2 | 10.5 |
| 1949/50 | 36.4 | 1950 | 15.3 | 12.0 | 9.7 | 8.1 | 8.8 | 11.3 | 9.7 | 9.9 |
| 1950/51 | 69.3 | 1951 | 21.0 | 14.9 | 12.4 | 10.7 | 9.9 | 14.8 | 12.0 | 12.7 |
| 1951/52 | 58.7 | 1952 | 14.7 | 15.0 | 12.8 | 12.5 | 11.3 | 13.8 | 12.9 | 13.4 |
| 1952/53 | 56.5 | 1953 | 17.2 | 14.9 | 11.7 | 10.8 | 11.3 | 13.7 | 12.2 | 12.5 |
| 1953/54 | 69.5 | 1954 | 23.1 | 16.0 | 12.0 | 10.2 | 12.6 | 15.3 | 12.7 | 12.7 |
| 1954/55 | 92.5 | 1955 | 21.9 | 16.7 | 12.2 | 10.1 | 14.2 | 15.2 | 13.3 | 13.0 |
| 1955/56 | 52.6 | 1956 | 23.7 | 12.9 | 9.9 | 8.5 | 8.4 | 13.8 | 9.9 | 10.4 |
| 1956/57 | 41.2 | 1957 | 14.3 | 10.0 | 7.5 | 7.1 | 7.6 | 9.7 | 8.1 | 8.2 |
| 1957/58 | 27.3 | 1958 | 11.8 | 9.3 | 7.8 | 7.0 | 8.6 | 9.0 | 8.2 | 8.0 |
| 1958/59 | 37.7 | 1959 | 14.1 | 11.1 | 8.3 | 7.2 | 10.7 | 10.2 | 9.3 | 8.9 |
| 1959/60 | 37.9 | 1960 | 11.2 | 8.3 | 6.8 | 6.5 | 8.8 | 8.2 | 7.6 | 7.2 |
| 1960/61 | 72.7 | 1961 | 21.6 | 11.5 | 9.4 | 8.0 | 7.6 | 12.6 | 9.1 | 9.6 |
| 1961/62 | 58.6 | 1962 | 14.7 | 13.4 | 11.4 | 10.4 | 8.8 | 12.5 | 11.0 | 11.7 |
| 1962/63 | 49.8 | 1963 | 26.5 | 14.6 | 11.7 | 11.1 | 11.2 | 16.0 | 12.2 | 12.5 |
| 1963/64 | 52.3 | 1964 | 24.2 | 13.2 | 9.8 | 9.3 | 8.6 | 14.1 | 10.2 | 10.8 |
| 1964/65 | 38.2 | 1965 | 15.2 | 9.5 | 12.6 | 10.4 | 10.8 | 11.9 | 10.8 | 10.8 |
| 1965/66 | 19.6 | 1966 | 11.0 | 9.5 | 8.8 | 8.8 | 10.3 | 9.5 | 9.4 | 9.0 |
| 1966/67 | 66.3 | 1967 | 26.1 | 19.9 | 15.9 | 15.8 | 33.6 | 19.4 | 21.3 | 17.2 |
| 1967/68 | 23.8 | 1968 | 13.0 | 9.9 | 9.2 | 9.6 | 10.6 | 10.4 | 9.8 | 9.6 |
| 1968/69 | 28.1 | 1969 | 14.1 | 12.1 | 10.3 | 7.5 | 19.3 | 11.0 | 12.3 | 10.0 |
| 1969/70 | - | 1970 | - | - | - | - | 13.6 | - | - | - |
| 1970/71 | - | 1971 | 13.8 | 15.2 | 15.2 | 14.0 | 11.1 | 14.5 | 13.9 | 14.8 |
| 1971/72 | 123.8 | 1972 | 20.4 | 11.2 | 11.9 | - | - | - | - | - |
| 1972/73 | - | 1973 | 22.9 | 14.7 | 10.9 | 10.0 | 12.7 | 14.6 | 12.1 | 11.9 |
| 1973/74 | 52.6 | 1974 | 22.2 | 18.3 | 15.4 | 13.9 | 13.4 | 17.4 | 15.3 | 15.9 |
| 1974/75 | 39.5 | 1975 | 24.2 | 14.5 | 10.8 | 10.0 | 11.7 | 14.9 | 11.8 | 11.8 |
| 1975/76 | 57.7 | 1976 | 24.7 | 18.0 | 14.1 | 12.9 | 13.7 | 17.4 | 14.7 | 15.0 |
| 1976/77 | 37.9 | 1977 | 17.7 | 15.5 | 13.9 | 13.7 | 13.5 | 15.2 | 14.2 | 14.4 |
| 1977/78 | 36.9 | 1978 | 19.2 | 15.1 | 13.6 | 12.7 | 13.8 | 15.1 | 13.8 | 13.8 |
| 1978/79 | 41.9 | 1979 | 16.4 | 14.9 | 10.3 | 10.0 | 10.5 | 12.9 | 11.4 | 11.8 |
| 1979/80 | 23.1 | 1980 | 13.6 | 13.4 | 11.2 | 9.8 | 24.5 | 12.0 | 14.7 | 11.5 |
| 1980/81 | 52.8 | 1981 | 19.2 | 15.4 | 12.6 | 11.0 | 12.1 | 14.5 | 12.8 | 13.0 |
| 1981/82 | 37.9 | 1982 | 19.3 | 13.4 | 11.2 | 6.8 | 21.9 | 12.7 | 13.3 | 10.5 |
| 1982/83 | 47.8 | 1983 | 22.2 | 16.5 | 15.1 | - | - | - | - | - |
| 1983/84 | - | 1984 | - | - | - | - | - | - | - | - |
| 1984/85 | - | 1985 | - | - | - | - | - | - | - | - |
| 1985/86 | - | 1986 | 29.8 | 21.2 | 16.7 | 14.0 | 12.4 | 20.4 | 16.1 | 17.3 |
| 1986/87 | 41.4 | 1987 | 9.7 | 10.1 | 9.5 | 9.1 | 8.4 | 9.6 | 9.3 | 9.5 |
| 1987/88 | 29.1 | 1988 | 15.5 | 12.7 | 11.7 | 11.7 | 11.3 | 12.9 | 11.8 | 12.0 |
| 1988/89 | 45.5 | 1989 | 15.9 | 12.6 | 11.2 | 10.5 | 12.0 | 12.5 | 11.6 | 11.4 |
| 1989/90 | 22.7 | 1990 | 15.0 | 11.1 | 8.8 | 7.6 | 12.6 | 10.6 | 10.0 | 9.2 |
| 1990/91 | 54.9 | 1991 | 32.1 | 19.7 | 11.3 | 7.8 | 9.0 | 17.7 | 11.9 | 12.9 |
| 1991/92 | 20.8 | 1992 | 12.1 | 8.3 | 6.2 | 5.6 | 7.4 | 8.1 | 6.9 | 6.7 |
| 1992/93 | 58.1 | 1993 | 21.6 | 13.6 | 9.9 | 7.6 | 9.8 | 13.2 | 10.2 | 10.4 |
| 1993/94 | 91.0 | 1994 | 30.2 | 20.9 | 17.1 | 12.4 | 11.3 | 20.1 | 15.4 | 16.8 |
| 1994/95 | 48.1 | 1995 | 16.2 | 11.7 | 9.0 | 8.9 | 10.3 | 11.4 | 10.0 | 9.9 |
| 1995/96 | 64.2 | 1996 | 17.3 | 13.6 | 9.3 | 9.3 | 9.5 | 12.4 | 10.4 | 10.7 |
| 1996/97 | 35.9 | 1997 | 13.1 | 10.5 | 9.0 | 7.8 | 8.7 | 10.1 | 9.0 | 9.1 |
| 1997/98 | - | 1998 | - | - | - | - | - | - | - | - |
| Max. | 123.8 | Max. | 32.1 | 21.2 | 17.1 | 15.8 | 33.6 | 20.4 | 21.3 | 17.3 |
| Mean | 48.6 | Mean | 18.7 | 13.8 | 11.3 | 10.2 | 12.2 | 13.4 | 11.8 | 11.7 |
| Min. | 19.6 | Min. | 9.7 | 8.3 | 6.2 | 5.6 | 7.4 | 8.1 | 6.9 | 6.7 |
| N | 63 | N | 69 | 69 | 69 | 66 | 67 | 66 | 66 | 66 |

Table 1.6.1 Suspended Sediment Transport in Puente Chavin

| Date | Scale (m) | Discharge ($m^3/s$) | Concentration (gr/lt) | Date | Scale (m) | Discharge ($m^3/s$) | Concentration (gr/lt) |
|---|---|---|---|---|---|---|---|
| 21/01/86 | 1.22 | 94.1 | 0.040 | 13/03/86 | 1.50 | 157.5 | 0.118 |
| 23/01/86 | 1.35 | 125.5 | 0.076 | 14/03/86 | 1.52 | 161.8 | 0.205 |
| 24/01/86 | 1.40 | 136.0 | 0.094 | 15/03/86 | 1.58 | 174.5 | 0.168 |
| 25/01/86 | 1.40 | 136.0 | 0.251 | 17/03/86 | 1.68 | 199.4 | 0.175 |
| 28/01/86 | 1.35 | 109.0 | 0.140 | 18/03/86 | 1.55 | 168.3 | 0.108 |
| 29/01/86 | 1.42 | 137.3 | 0.512 | 19/03/86 | 1.50 | 157.5 | 0.096 |
| 30/01/86 | 1.50 | 159.0 | 0.506 | 20/03/86 | 1.50 | 157.5 | 0.102 |
| 31/01/86 | 1.48 | 145.8 | 0.107 | 21/03/86 | 1.50 | 157.5 | 0.065 |
| 23/01/86 | 1.30 | 115.2 | 0.062 | 22/03/86 | 1.54 | 166.1 | 0.115 |
| 24/01/86 | 1.38 | 132.1 | 0.116 | 24/03/86 | 1.48 | 153.1 | 0.087 |
| 28/01/86 | 1.32 | 107.0 | 0.110 | 06/03/86 | 1.74 | 217.5 | 0.364 |
| 29/01/86 | 1.50 | 157.0 | 0.888 | 07/03/86 | 1.72 | 209.6 | 0.328 |
| 08/02/86 | 1.45 | 146.7 | 0.119 | 10/03/86 | 1.52 | 161.8 | 0.139 |
| 10/02/86 | 1.68 | 203.0 | 0.806 | 11/03/86 | 1.50 | 157.5 | 0.095 |
| 11/02/86 | 1.60 | 177.5 | 0.528 | 12/03/86 | 1.48 | 153.1 | 0.078 |
| 12/02/86 | 1.55 | 168.3 | 0.324 | 13/03/86 | 1.50 | 157.5 | 0.096 |
| 13/02/86 | 1.54 | 166.1 | 0.380 | 14/03/86 | 1.52 | 161.8 | 0.144 |
| 14/02/86 | 1.55 | 168.3 | 0.343 | 15/03/86 | 1.55 | 168.3 | 0.235 |
| 15/02/86 | 1.55 | 168.3 | 0.394 | 17/03/86 | 1.65 | 191.4 | 0.167 |
| 17/02/86 | 1.60 | 177.5 | 0.395 | 18/03/86 | 1.55 | 168.3 | 0.095 |
| 18/02/86 | 1.54 | 166.1 | 0.310 | 19/03/86 | 1.50 | 157.5 | 0.090 |
| 19/02/86 | 1.48 | 137.8 | 0.296 | 20/03/86 | 1.48 | 153.1 | 0.067 |
| 20/02/86 | 1.30 | 127.2 | 0.128 | 21/03/86 | 1.50 | 157.5 | 0.076 |
| 21/02/86 | 1.28 | 114.8 | 0.126 | 22/03/86 | 1.54 | 166.1 | 0.077 |
| 22/02/86 | 1.30 | 121.5 | 0.150 | 24/03/86 | 1.48 | 153.1 | 0.068 |
| 08/02/86 | 1.45 | 146.7 | 0.144 | 10/04/86 | 1.47 | 151.0 | 0.055 |
| 10/02/86 | 1.59 | 176.8 | 0.614 | 11/04/86 | 1.40 | 136.0 | 0.035 |
| 11/02/86 | 1.55 | 168.3 | 0.593 | 12/04/86 | 1.39 | 134.0 | 0.134 |
| 12/02/86 | 1.52 | 161.8 | 0.320 | 14/04/86 | 1.36 | 128.1 | 0.128 |
| 13/02/86 | 1.55 | 168.3 | 0.319 | 15/04/86 | 1.36 | 128.1 | 0.072 |
| 14/02/86 | 1.55 | 168.3 | 0.320 | 17/04/86 | 1.29 | 114.3 | 0.113 |
| 18/02/86 | 1.50 | 157.5 | 0.284 | 18/04/86 | 1.26 | 108.4 | 0.066 |
| 06/03/86 | 1.74 | 217.5 | 0.402 | 19/04/86 | 1.25 | 106.4 | 0.129 |
| 07/03/86 | 1.70 | 204.5 | 0.301 | 21/04/86 | 1.21 | 98.6 | 0.093 |
| 10/03/86 | 1.58 | 174.5 | 0.176 | 22/04/86 | 1.18 | 93.4 | 0.114 |
| 11/03/86 | 1.50 | 157.5 | 0.085 | 23/04/86 | 1.14 | 87.3 | 0.079 |
| 12/03/86 | 1.50 | 157.5 | 0.071 | | | | |

Source: ELECTROPERU, El Platanal Hydroelectric Power Plant Feasibility Study, 1987