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FINAL REPORT

In Respect Of

HYDROMET MODEL 1

for

FORECASTING OF SEASONAL & 10 DAILY INFLOWS INTO MANGLA RESERVOIR

Study Awarded By

PCRWR - MINISTRY OF SCEINCE & TECHNOLOGY

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REFERENCES

1. Manuals relating to use of SPSS Model.
2. Statistical Analysis (A Computer Oriented Approach) BY A.A. AFIFI, S.P. AZEN.
3. Harza Reports.
4. Annual Reports of Rivers and Climatological Data of Pakistan (WAPDA) Vol. I (Discharge).
5. Annual Reports of Rivers and Climatological Data of Pakistan (WAPDA) Vol. II (Rain).
6. Annual Reports of Rivers and Climatological Data of Pakistan (WAPDA) Vol. III (Climate).
7. Old Departmental Studies.

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PREFACE

Pakistan's Water Resources Management is primarily carried through the operation of the country's three major storages at Tarbela, Chashma and Mangla. Tarbela and Mangla Dams play a singular role in catering for the country's power & irrigation needs. The upper catchments of the two major reservoirs provide an attractive ground for the deposition of snow during winter and occasonally during summer due to following geographic features.

a) Catchements are located sufficiently northward to fall within the direct track of the extra tropical low pressure systems called the " Westerly Waves ".

b) about 80% of the catchments are suffiently elevated to record below freezing temperature during the winter months, while a sizeable portion (about 10-15 %) remains under below freezing temerature even during summers.

c) The orographic lifting of the monsoon airmass along the southern and south easterly slopes of the lower catchments results in occasional heavy rainfall below about 5000 meters and snowfall above this altitude during the summer monsoon months.

The above features constitute favourable hydrometeorological settings to providing substantial

quantities of water into our river systes even under the conditions of low monsoon activety.If properly managed, it could cater for most of the country's water and power demands provided that sufficient snow cover is available during winter. However the melt water yields are subject to large scale variations due to the changes in the intensity and frequency of the westerly systems from year to year. This causes particulary large scale variations in the summer flows causing sweer shortfalls Notably in spring and early summer when several weeks of reduced power generation and shortages of Irrigation Water can become serious national concerns.Under this situation Medium to Long term hydrological forecasts can be of immense help to the managers in formulating the most appropriate dam operating procedures. Additionally the intensity of the rainfall during the period of picked up monsoon activity needs to be predicted to provide a proper scientific basis for optimum utilization of the scare water Resources. WAPDA being mindful of the problem did carry out a number of small scale studies to monitor snow and the resulting runoff in some of the catchments using satelite imageries (avaailable since last 20 years now). Some other studies were based upon the use of short period snow data obtained by mounting snow monitoring expeditions for the limited period of time for a part of the Mangla catchment. No worthwhile benefits could be obtained through such costly attemps for very obvious reasions. Recently a full scale attempt in forecasting the 10-daily and seasonal inflow into

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Mangla Reservoir was made by engaging a Canadian Expert who used the University of British Colombia (UBC) snow melt model for this purpose. This attempt too did not yield tangible results. WAPDA's snow and ice hydrology project presently underway with the Canadian assistance is also a big step in the same direction. The project, besides same other related functions is meant to cater for the seasonal and 10-daily inflow forecasts for Indus basin river system. All such approaches are based upon the direct monitoring of snow pack by remote recording of the snow and climate date utilizing a sophisticated date communication system entainling substantial running costs. However while WAPDA was busy finding a solution to the problems of long term hydrological forecasting, the Pakistan Council of Research in Water Resources (PCRWR) acting under the instructions of the Ministry of Science and Technology offered to assist in the Water Related Research studies by providing as much financial and instituional support as was considered necessary on the basis of the proposals to be submitted by the prospective researchers. Consequently the Principal Investigator submitted a research proposal for forecasting the seasonal and 10_daily inflows both for Mangla and Tarbela reservoirs. The Council however allowd the submission of Mangla proposal and advised to defer the Tarbela study untill after the Mangla study have been finalised and accepted. Therefore, the Mangla proposal was submitted abd after passing through a number of screeming tests, was finally accepted by the Council. The proposal was based upon

the concept of indiret snow pack assesment through the application of Meteorlogical approach (which was outside the perveiw of a hydrologist or an Engineer). The pricipal investigator and some of his colleages had the unique advantage of being the professional Meteorlogists and then having long standing experience in the field of flood forecasting using computerised hydrological models. Induction of the Co-Principal Investigator filled up the technical gap on same aspects of applied hydroloy.

The success of study is amply demonstrated by the accuracy of the results for the period of verification.

The Principal Investigator and the research team is extremely indebted to the PCRWR and Through that to the Ministry of Science & Tecnology for providing the financial and institutional support without which this important study could not be under taken.

The research team is specially grateful to DR.N.M. Awan, the Previous Chairman of the Council, for approving the study project and DR. B.A. Chandio (the Present Chairman of the Council) for the tremendous personal interest and the un.indered support that he lend to the study project.

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The Principal Investigator is personally grateful to Mr. Asif H. Qazi, the Chairman Federal Flood Commission, initially for drawing the attention of the Principal Investigator towards this important problem and fianlly for giving extremly meaningful Commments on the theoratical aspects of the study.

1. INTRODUCTION:

Basic source of runoff into Mangla is the precipitation, both as snow as well as rain. Snowmelt constitutes the base flow upon which the rainstorms create the surface runoff resulting in the sharp fluctuations as short duration peaks.Seasonally the flows are the lowest during winter (October to January) and touch the highest level usually from May to June. Unlike Tarbela, rainfall plays an extremely significant role in Mangla catchement.Upper parts of the basin are supplied by snowmelt while below Kohala the basin specially in case of high floods (during summer) is essentialy a rainfall catchement. A thorough knowledge of the snowmelt and rainfall process is a prerequisite to any worthwhile attempt in forecasting the inflow into Mangla. The study therefore has two components, a hydrological component and a meteorological component. The hydrological component relates to the study in respect of snowmelt runoff, while the meteorological component pertains to the forecasting of surface runoff due to rain within the lower catchement of Mangla. Again two types of forecasts are computed. A seasonal forecast (based upon the previous winters meteorological data) to provide a fairly reasonable estimate of the future summer flows, and a 10 daily forecast based upon the prevailing hydrological conditions in the river system, the thermal conditions and the estimate of the available snow pack as provided by the seasonal forecast procedure. The Mangla catchment characteristics show that it has two peak flow conditions one in June and second in August. The higher June flows are caused by the higher snowmelt due to the increased temperature, while the August peak is the result of the rainfall combined with the snowmelt.

Snow estimation which is considered the starting point for snowmelt runoff computation, has been done indirectly through the meteorological data including the data on the westerly low pressure systems which cause the snowfall during winter. This is the most unconventional approach, which makes it a new model in all respects, the model has thus been named as " Mangla Hydromet model I "

2. HYDROMETEOROLOGICAL FEATURES OF THE BASIN:

The hydrometeorological features of the basin can be categorised as:-

- Meteorological features
- Hydrological features

2.1 METEOROLOGICAL FEATURES:

Meteorologicaly two distinct seasons along with their respective weather systems occur in Pakistan as a whole. The two seasons are the summer or the monsoon season, and the winter or the season of the Westerly waves. Spring and autumn constitute the periods of transition and are meteorologically called the pre-monsoon and post-monsoon seasons respectively. Mangla catchment has the unique distinction of lying in the path of active monsoon track as well as the general track of the winter westerly waves.

Winter season or the season of the westerlies starts from November while the summer monsoon rains begin to affect the southern parts of

the basin from middle or last week of June. The rainfall pattern of the two seasons are indicated by the isohyetal maps of November-May and June-October respectively.

2.1.1 WINTER SEASON OR THE SEASON OF THE WESTERLY WAVES:

During winter the extra tropical cyclones (known as western disturbances) move at regular intervals across the basin from west to east. These systems are usually associated with well marked cold and warm fronts (Exhibit I) The thermal conditions over the mountaneous region are such that almost whole of the basin including the Greater Hamalayas, the Pir Panjal and Hazara ranges remain below freezing temperatures.

2.1.1.1 PATTERN OF PRECIPITATION:

During Winter the precipitation is caused by the western disturbances with or without the linked frontal systems. Precipitation occures at a relatively uniform rate and is generally light except when associated with a cold front. The normal rate has been observed to be around 0.1"-0.2"/hour,which may reach 0.4"-0.6"/hr in extreme cases. The axis of maximum precipitation during winter lies at an altitude of about 8000'-10000' a.m.s.l. with the maximum isohyetal of 54" enclosing Sonamarg area and of 20" enclosing Palandri region.(Exhibit II)

The winter precipitation (which mostly gets deposited in the form of snow) is extremely important as a source of runoff during summer. It has been estimated that precipitation in winter forms more than 60%

of the annual precipitation over the Greater Hamalayas and the amount of runoff caused by it during summer is far more than the runoff due to the rainfall. The winter precipitation, intensity and duration provide a fairly good indication to the activity of the westerly waves.

2.1.2 SUMMER WEATHER SEASON OR THE MONSOON SEASON:

Pakistan in general and Mangla catchment in particular is strongly affected by the Monsoon weather system. The monsoon airmass is essentially a tropical maritime airmass drawn from Arabian sea and Bay of Bengal in the form of SW and SE air currents respectively.

Accentuation of the seasonal low (over SE Baluchistan,Southern Punjab and adjoining Sind areas) initiates the creation of SW monsoon pulse from the Arabian sea. The air current moving along Sind and Rajistan area starts affecting Mangla catchment by the end of June. Simultaneously the Inter Tropical Convergence Zone (ITCZ) develops along central India causing the advance of the SEasterly current from the Bay of Bengal. The two warm and moist air currents meet along the North-east Pakistan and Kashmir including Mangla catchment as indicated in the Exhibit III. Frequent heavy rains with diurnal variations occur under these conditions,which cause substantial rise in the river runoff. However,extremely high flows generally do not occur under this situation because the rainfall occurs in short spells with dry intervals. The second situation which is often associated with heavy flooding is the approach of a tropical depression/monsoon low from Bay of Bangal. Such monsoon lows originate from the Bay and moving across India in a general north westerly direction may reach Mangla catchment

during the period from July to September. Chances of monsoon lows directly affecting Mangla catchement increase with the advance of the monsoon season i.e. towards August/September. Under this situation heavy continuous precipitation over a period of 1 to 3 days occurs in the catchment.A typical situation of this type which caused heavy flooding in 1976 is shown as Exhibit IV.

2.1.2.1 PATTERN OF MONSOON PRECIPITATION:

Lower part of the Mangla catchement lies within the track of the active monsoon current. The tropical depressions (which are reduced to the strength of a monsoon low) also move up to the catchment occasionally specially during the late summer season. Poonch catchement and the Jhelum catchement below Muzaffarabad is the region often recieving heavy downpour. The occasions of real heavy downpour are relativily few and occur when the monsoon low directly affects the region. Under this situation rainfall may continue for as long as 72 hours at a stretch. However most of the rainfall is caused by the accentuation of the seasonal low or the incursion of the South-East monsoon current from the Bay of Bengal or both. 3"-4" of precipitation in 24 hours is quite common, while 6"-8" may also occur at times. Most of the intense rainfall bursts occur between 2AM to 10AM and 2PM to 6PM. Higher intensity rain bursts occur mostly during the morning hours only, which is the typical diurnal variation pattern of the monsoon rainfall and is caused by the late night/early morning cooling resulting in the condensation and then the precipitation of the available moisture.

The isohyetal map of June-October(Exhibit V) is a fair picture of the depth and distribution of rainfall over the basin. This is the period when high intensity rains occur. The 24 hours maximum rainfall isohyetal map gives a picture of the extreme rainfall condition that have or may occur during 24-hours period.(Exhibit VI)

2.1.3 THERMAL CONDITIONS:

Thermal conditions play an important role in the development of conditions that determine the type of precipitation (i.e. snow or rain) and their amounts and intensities. Snowmelt is also a function of heating and it starts over a snow covered area when the surface air temperature exceeds 0½C and continues to melt as long as above 0½C temperatures prevail. Since the maximum temperature was considered to represent a realistic index to the thermal conditions, it was necessary to find out the temporal and spatial monthly variation of this parameter. It was observed that a belt of the highest mean daily maximum temperatures moved from the coastal areas of Makran and Sind in May and gradually shifted Northwards to the Hamalayan ranges and the Korakaram mountains by middle of August.

Following table indicates the monthwise regional variation of the maximum temperature based upon the inferences drawn from the maximum temperature variation map placed at Exhibit VII.

THE HOTTEST MONTH	AREA WHERE THE HOTTEST MEAN DAILY MAXIMUM TEMPERATURE OF THE SEASON HAD OCCURED.
May	Southern Sind Coastel areas along Makran coast
June	Planes and the valleys of the Indus Basin southwest of Pir Panjal and Hazara ranges, South and East of Safed Koh and Suleman ranges and in the Makran coastel basin.
July	Kashmir valleys & Southern slopes of the Greater Hamalayas. Deosi, Hindu Kush,Safed Koh Central Broh ranges and closed basin of Kharan desert.
July & August	Gilgit,Baltistan north of Chitral valley and tops of the Hamalaya ranges and the areas along the northern and northeastern parts of Baluchistan.

The advance of southwest monsoon appears to be on the heals of the advancing belt of the highest mean daily maximum temperatures. It also indicates that the monsoon current does not go beyond the Greater Hamalayas range.

The variation of the thermal condition with altitude was also studied.It was found that the lapse rate of mean daily surface air temperature over the country ranged from 1.6-2.8 ½C/1000 ft. The lapse rate of temperature in the Mangla basin appeared to be of the order of about 2.0 ½C/1000 feet (Exhibit VIII).

2.2 HYDROLOGICAL FEATURES:

2.2.1 PHYSIOGRAPHIC CHARACTERISTICS:

A brief introduction to the geography and physical features of Mangla basin would be helpful while discussing the hydrological characteristics of the region.

2.2.1.1 GEOGRAPHICAL FEATURES:

The geographical features of the basin i.e. its shape, orientation, slope, position and elevations of the hill ranges and the meteorological systems that affect it during the rainy seasons determine the precipitation amounts and their distribution at different altitudes and on the exposed and lee side slopes of the hill ranges (Exhibit IX and X).

The catchment has four distinct topographic regions.The area wise distribution of all the Jhelum tributaries is indicated at Exhibit XI.

2.2.1.1.1 THE GREATER HAMALAYAS AND HAZARA RANGES - NORTHERN BOUNDARY:

Mangla basin (12870 Sq. Miles) is located at the southern slopes of the northwestern terminus of the Greater Hamalayan mountains in the north east of Pakistan. While the Greater Hamalayas form its eastern and northern boundries, the Hazara range covers its western boundry. The slopes of the Greater Hamalayas because of their location, orientation, high altitudes and wide coverage serve as a big storage for the winter precipitation (snowfall).

2.2.1.1.2 THE PIR PANJAL & THE SWALIKS:

Pir Panjal range (12000-15000 ft a.m.s.l.) while extending from SE to NW divides the basin into two sub basins so that 1/3 or less of it lies to the southwest and about 2/3 or more of it to its north and north east. Mangla reservoir (900 feet a.m.s.l.) lies in the last range of the Swaliks at the southwestern edge of the basin.

2.2.1.1.3 VALLEYS OF POONCH AND LOWER JHELUM:

From Mangla reservoir the basin rises through Swaliks to Pir Panjal range in the north/northeast and Hazara/Murree Hills (8000-10000 feet a.m.s.l.) in the west. Poonch & Lower Jhelum valleys are the main valleys in this region.

2.2.1.1.4 VALLEYS OF KASHMIR, NEELUM AND KUNHAR:

To the north of Pir Panjal lie the valleys of Kashmir (Upper Jhelum),Neelum & Kunhar that converge in the neighbourhood of Muzaffarabad. The basin in this section rises along the southern and southwestern slopes of the Greater Hamalayas (15000-17000 feet a.m.s.l.) to its tops that separate it from the Chenab catchment in the east & Indus catchment in the north & west.

2.2.1.2 TRIBUTARY NETWORK:

The Jhelum River orignates at Anantnag in the valley of Kashmir. It flows predominantly from east to west on the lee side of Pir Panjal range till it reaches its extreme western edge near Muzaffarabad, Neelum river also joins it at this point. Wular Lake lies about the middle of the Jhelum River in the valley. In this section it is fed by numerous tributaries and nullahs that drain the southern and south eastern slopes of the Greater Hamalayas and the northern slopes of the Pir Panjal range.

From Muzaffarabad the Jhelum river turns southwards and at some distance above Kohalla the Kunhar river joins it. It continues to move southwards until it flows into Mangla Reservoir. Poonch and Kanshi rivers flow directly into the reservoir to the left and right of the Jhelum river respectively.

The Greater Hamalayas, the Pir Panjal & Hazara ranges and the

Swaliks divide the basin into five sub basins that are named after the principal tributaries namely Neelum, Kunhar, Upper Jhelum, Lower Jhelum and Poonch.

The runoff flowing through each is measured at the following sites:

NAME OF THE SUB BASIN	SITE
Neelum	Muzaffarabad
Kunhar	Garhi Habibullah
Upper Jhelum	Domel
Lower Jhelum	Kohala
Poonch	Kotli
Whole Basin	Mangla

A catchmentwise brief description of the hydromet features of each sub basin are given below:

2.2.1.2.1 UPPER JHELUM: (VALLEY OF KASHMIR)

The main river starts in this subbasin from Anantnag from the

Greater Hamalays with snow covered peaks some of which reach above 17000′ a.m.s.l. The mean annual precipitation is about 55", 60% of it occurs in winter and about 40% in Summer. The highest daily Rainfall intensities of 6"-10" have been recorded over the Hamalayan slopes & 4"-5" in the valley and adjacent areas during monsoon months.

NEELUM RIVER:

It is the largest tributary of Jhelum river and drains about 2840 Sq. miles of the slopes of the Greater Hamalayas (17000 ft. a.m.s.l.). Much of the drainage water has its origin in glaciers and permanent snowfields. The mean annual precipitation is about 50 inches. About 30-35% of it falls in summer and about 65-70% in winter, the highest daily intensities of 4"-8" inches have been recorded during monsoon.

2.2.1.2.2 KUNHAR RIVER:

It rises at about 14000 feet a.m.s.l. in Kaghan Valley and drains the catchment of about 940 sq. mile. The snow covered heights range from 15000 to 17000 feet a.m.s.l. Mean annual precipitation of the area is about 50" being adjacent to Neelum, the rainfall conditions are almost the same as those of Neelum.

2.2.1.2.3 LOWER JHELUM:

It flows through a narrow gorge from Muzaffarabad to Mangla.Mean

annual preciitation is about 56". The river has flashy discharge both in Summer and Winter. Being adjacent to Poonch catchment it receives almost 60% of the annual precipitation during Summer and 40% during winter. The hourly and daily rainfall intensities are almost the same as that of Poonch. The snowmelt contribution is during early summer and is less as compared to the Poonch catchment.

2.2.1.2.4 POONCH:

Poonch river drains an area of more than 1650 Sq. Miles. The estimated mean annual precipitation of about 61 inches makes it the major rainfall area of the basin. About 60% of the rain falls in summer and 40% in winter. The recorded intensity of 4"-5"/hour and 14"/day have been experienced in this part of the catchment during summer monsoon. There are no glaciers or permanent snowfields in the stretch of Pir Panjal range. Summer snowmelt makes a substantial contribution to river flow during early summer (premonsoon).

2.2.2 SNOWMELT:

Transfer of heat in the form of solar insolation provides the basic cause for the thermal conditions necessary for the melting of snow. The process of transfer of heat to the snow is caused by

- absorbed solar radiation.
- net long wave radiation.
- convective heat transfer from air.

- latent heat of vaporisation by condensation from air.
- rain falling on snow.
- under lying ground (negligibel amount).

Air temperature near the snow is largely a result of physical integration of the same modes of heat exchange which melt snow. Also each mode of heat exchange can be related to air temperature. Under normal wind conditions, maximum daily temperature or temperature range is an index to solar radiation. Long wave radiation can be expressed as a linear function of air temperasture for its usual range. In basins where summer season is marked with consistency in rise and fall of daily maximum and minimum temperatures and their range the daily maximum temperature for practical purposes reflects all the above mentioned three conditions.

The consistency in the shape of the snowmelt hydrograph and the day to day varying snowmelt rates are related to permanent characteristic of the basin topography. Despite the significant effect of the monsoon rainfall the snowmelt plays a predominent role in the inflow constitution of the Mangla reservoir. Accelerated snowmelt contribution commences in April, when the low level snow fields start to melt. The advance of the summer season accompanied by the rise of temperature takes the snowmelt process to higher and higher altitudes.

Initially the shifting of the belt of active snowmelt zone to higher levels also results in contineous increase in the snowmelt contributing area as well as in the time of concentration (Exhibit XII)

However after a certain optimum level, the further rise in the snow line causes a decrease in the snowmelt contributing area and thus the snowmelt. The level of maximum snowmelt occurs at the end of May and the begining of June within 9000-12000 feet level.

At higher elevation the snow being thicker and denser has the higher water equivalent content and thus off sets to some degree the effect of the decrease in the areal temperature. The falling trend of the hydrograph in September indicates the reversal in the temperature variation from rising to falling trend. The highest snow level is around 17000 feet a.m.s.l. The rise in the snowmelt level causes a proportional increase in the time of concentration. The travel time of snowmelt is minimum when the active snowmelt occurs at lower levels and reaches its maximum when the active snowmelt occurs over the remotest parts of the region close to the permanent glaciers.

2.2.2.1 PERIOD OF SNOWMELT:

The peak snowmelt occurs about the end of May and beginning of June. The period from April to June when the melting takes place at lower altitudes is the dry summer season. Rising temperatures are mainly responsible for the inflows to Mangla because the snowmelt process is not affected by the weak rainfall spells during this premonsoon period.

Activity of the monsoon during July to September is mainly concentrated over the basin southwest of Pir Panjal and Hazara ranges

which are almost cleared of snow by then. The Kashmir valley and the slopes of the Greater Hamalays below 10,000-12000 feet a.m.s.l. are also snow free during this period while snowmelt shifts to higher altitudes where vast areas are still under snow.
The higher altitude snow line over Hamalaya range remains above the region of significant rainfall and thus the snowmelt is not affected by rainfall.

Major factor in conventional exchange of sensible heat are the temperature gradient in the air immediately above snow and the intensity of turbulent mixing as expressed by horizental wind speed.

The hydromet conditions resulting in runoff change daily through the summer season with changes in

a) The thermal conditions of the environment
b) The area of the active snowmelt belt.
c) The soil conditions of the snowmelt belt
d) The distance of the belt of active snowmelt levels from the inflow point

The diurnal cycle of heat exchange and of snowmelt makes the day a logical and convenient time unit related to snowmelt.

The most widely applied method for estimating basin-wide snowmelt is the use of degree day factor, a factor that is a function of a[illegible]e freezing temperature on any day. This is because the snowmelt at temperatures appreciably below 0½C is almost insignificant.

The snowmelt conditions in the Mangla basin are not so significantly disturbed by rainfall. The high terrain of the mountain areas have great quantity of snow accumulation. The period of significant snowmelt starts with the end of the spring rainy season.The period from middle of April to June is the dry summer season and the snowmelt continues without significant rainfall occurences. By the time monsoon rainfall season sets in, the major part of the snow region upto 10,000 feet a.m.s.l. has been cleared of snow. The level of the significant monsoon rainfall is below the snow line during the period from July to September.

2.2.3 RUN OFF GENERATING PRECIPITATION PATTERN:

The isohyetal map of mean annual rainfall over the basin indicates the rainfall ranging from 30"-70" (Exhibit XIII). The spatial distribution of rainfall shows two areas of maximum rainfall of the order of 70". The lower Jhelum, Poonch and Southern areas of Kunhar and Neelum valley are enclosed by one isohyet cell of 70" while the other cell encompases Sonamarg and the adjoining areas. Both these cells lie on the exposed slopes of Pir Panjal and the Greater Hamalayan ranges respectively.The area of minimum rainfall is covered by the isohyet of 30" and lies over lee side of Pir Panjal, adjoining Kashmir valley and the tops of the Greater Hamalayan range.

The mean annual isohyetal pattern combines both winter mean rainfall and summer mean rainfall conditions (Exhibit II and Exhibit V). The seasonal patterns are identical in shape (distribution) to the

Annual rainfall pattern but differ in regional distribution of rainfall amounts. The probable maximum storm (PMS) studies for Mangla had shown that duration of PMS will not exceed 72 hours and will be characterised by prolonged burst of heavy rainfall during the night time separated by less intense rain during day. The heaviest precipitation will probably occur early in its life.

In general as we move northwards, precipitation increases with height along the exposed slopes of Pir Panjal and Greater Hamalayas and reaches its maximum between 6000-10000 feet a.m.s.l. during summer and about 8000-12000 feet a.m.s.l. in winter. Further advance to the higher altitude results in decrease of precipitation so that the tops receive the minimum share. A close relationship between the elevation, barrier and precipitation is thus clearly visible.

The 24 hours recorded rainfall (Exhibit VI) follows the same pattern as that of the annual and seasonal mean isohyetal maps especially the summer mean isohyetal. The highest intensities of 10"-14" were recorded over exposed slopes of Pir Panjal during summer season and the lowest intensities had occurred on the lee side of the Pir Panjal range including the Kashmir valley.Anotner area of highest intensity of the order of 8"-10" lies over southern slopes of the Greater Hamalayas around Sonamerg.Thus the 24 Hour rainfall distribution follows much the same pattern as observed for annual distribution pattern described earlier. The probable maximum storm (PMS) study of Mangla indicates following observation about rainfall characterists:-

2.2.3.1

The major contribution to large floods at Mangla is due to storm runoff from the poonch and Lower Jhelum Basins.Higher flows are generated when the two peaks from Poonch and Lower Jhelum basins coincide. Such situations occur quite frequently during the periods of strong monsoon incursion.

2.2.3.2

The runoff from much of the catchment will first have to travel through the plains of the Kashmir valley before reaching the Wular lake and large marshy area with its maze of channels. Much of the flood runoff will be observed in this area and the contribution from above Sopar will result in high baseflow condition and shall not occur as a flood wave. During a major weather system (a tropical monsoon depression) affecting the central Mangla basin, the observation of time to peak at Baramula and Mangla indicate that due to enormous storage capacity of the Wullar lake the peak at Baramula shall take much longer time as compared to the peak due to the rainfall at lower Mangla catchment at Mangla.As an example during the floods of 1928 and 1929 the peaks at Mangla were recorded about eight days ealier than at Baramula).

2.2.3.3

The upper Jhelum catchment above Domel may also experience heavy rainfall both in its lower reaches and along the high North eastern slopes of Pir Panjal Range. The resulting runoff which reaches the river below Soper will rapidly flow down through the main axis of the Pir Panjal mountains to join Neelum and Kunhar rivers further down.

2.2.3.4

The axis of maximum precipitation during winter lies at an altitude of about 8000′-10000′ a.m.s.l. with the maximum, isohyetal of 45" enclosing Sonamarg area and of 35" enclosing Palandri region.The maximum rainfall intensities (6"-8") occur during late night or early morning due to the diurnal cooling effect.

2.2.3.5

The Summer isohyetal map (June to October) . shows that the 60% of the annual rainfall of Murree hills and Pir Panjal occurs during these months. The axis of maximum precipitation lies at an altitude of about 4000′-6000′ a.m.s.l. with maximum isohyetal of 40" over Palandri and its neighbouhood. A relationship between the summer precipitation, barrier to the monsoon current and station elevation has already been developed and is shown in Exhibit XIV.

2.2.4 A regionwise synopsis of the annual and seasonal rainfall distribution and hourly daily intensities is given below:

2.2.4.1 Southern slopes of Pir Panjal range and eastern slopes of Murree Hills.

Tributaries drained:- Kanshi,Poonch, Lower Jhelum.

PERIOD OR RAINFALL	RAINFALL
Mean Anual Precipitation	50"-70"
Mean June to October	30"-40"

Mean November to May	20"-30"
24 Hours Max.(summer)	10"-14"

July and August are the main rainy months

2.2.4.2 Kashmir valley and northern slope of Pir Panjal.

Tributaries drained:- Upper Jhelum

PERIOD OR RAINFALL	AMOUNT OF RAINFALL
Mean Anual Precipitation	30"-40"
Mean June to October	9"-15"
Mean November to May	21"-25"
24 Hours Max.(summer)	4"-6"

2.2.4.3 The Greater Hamalayas and Hazara Ranges.

Tributaries drained:- Neelum,Kunhar & tributaries draining the slopes of Greater Hamalayas into Upper Jhelum

PERIOD OR RAINFALL	AMOUNT OF RAINFALL
Mean Annual Precipitation	50-70"
Mean June to October	15-25"
Mean November to May	35-45"
24 Hours Max.(summer)	6-10"

Runoff response to rainfall is immediate throughout the basin,except the Wullar lake region. Because of the peculiar characteristics of its basin and channel,time to peak does not exceed 24 hours while recession extends over two or three days. Snowmelt hydrograph behaves differently and the whole of the summer season is covered by a single hydrograph with peak at the end of May & begining of June as is clearly indicated by the Kohala mean maximum and minimum hydrograph placed at Exhibit XV.

2.2.4.4 RUNOFF HYDROGRAPH:

The seasonal hydrograph for Mangla (Exhibit XVI) reflects three distinct conditions of runoff regime.

(a)

The section of the hydrograph covering early April belongs to the closing period of spring season and begining of dry summer season. The snowpacks start melting at lower altitudes of about 5000 ft a.m.s.l. and Precipitation in the form of rainfall may occur over these snow covered areas and accelarate the process of snowmelt. The Sharp rise in the seasonal hydrograph after April indicates accelerated snowmelt rate as compared to the rates of snowmelt observed during spring.

(b)

The section of the hydrograph covering the period from May to June is contributed mostly by snowmelt. Occasions of heavy rain during this period are rare. High snowmelt rate during the period from last week

of May to the 1st week of June as depicted by the hydrograph peak, go to indicate that the maximum snow pack area comes under active snowmelt process during that period.

(c)

The section of the hydrograph covering the period from July to September belongs to the monsoon period.

The contribution of monsoon rainfall to this section of the hydrograph is mostly from the Poonch & Lower Jhelum catchments and from areas of Neelum valley close to Muzaffarabad which are mostly snow free by then. The rains that occur over Greater Hamalayas mountain are also mostly below snow line and thus do not affect the snowmelt rates significantly. The impact of the rainfall on the snowmelt hydrograph is visible in the form of checked recession during July and August. This section of the hydrograph reflects the combined effect of the continued high thermal conditions on snowmelt and of the monsoon season rainfall spell that persists till August. The rapid fall of the hydrograph that begins from September till October is an indication of the reduced rainfall as well as snowmelt process. Ten daily hydrograph (Exhibit XVII) for the year 1976 provides a typical example incorporating the effect of heavy rainfall spells during monsoon upon the normal snowmelt runoff conditions of this basin and thus deserves a detailed discusion.

2.2.5 10-DAILY MEAN HYDROGRAPH OF THE YEAR 1976:

Some of the important characteristic of this hydrograph are

detailed below

(1)

The hydrograph follows almost the same pattern as that of the seasonal hydrograph discharge with peak occuring at the end of the May and begininng of June.

(2)

Unlike the seasonal snowmelt hydrograph the rise and fall of this hydrograh depicts wave-like pattern which appears to synchronise with the corresponding variations in the thermal condition as indicated through the changes in the maximum temperature.

(3)

The rainfall component of the runoff appears as a sharp rise and fall extending over 3-4 days with the peak occuring within 1 to 2 day of rainfall. Its shape reflects the intensity amount and duration of rainfall spell.

(4)

The snowmelt runoff hydrograph is not as steep as is the rainfall runoff hydrograph. The duration of rise in the hydrograph due to the increased snowmelt caused by heat spell is gradual and goes over more than two and in certain situations upto 6 days. This happens mostly during the months of May/June. Ten daily mean hydrograph of 1976 of Mangla (Exhibit XVII) damps out the daily short range fluctuation and gives a better picture of the thermal and precipitation effects.

3. FORECAST PROCEDURE:

The study has two distinct components relating to the following two types of forecasts.

- The seasonal inflow forecast.
- The 10-daily inflow forecast.

3.1 BASIC CONCEPTS INVOLVED IN THE FORMULATION OF FORECAST METHODOLOGY:

Following salient hydrometeorological characteristic of the catchment (as already brought out in the foregoing paragraphs) provide basic infrastructure upon which the two forecasting procedures have been based.

(1) Extreme seasonal variability in precipitation occurs both in winter as well as in Summer. Consequently no worthwhile seasonal forecast can be made without a knowledge of the available winter precipitation/snow pack.

(2) The westerly waves (which is the meteorological system responsible for the deposition of snow during winter) are more intense along the upper part of catchment, where they may continue depositing snow till as late as May.

(3) The intensity and frequency of the westerly waves and thus the

winter time snowfall over the catchment can be indirectly inferred from the precipitation record of the meteorological stations within the catchment.

(4) The thermal conditions related to the snow melt process can be adequately represented in terms of maximum temperatures recorded at the available meteorological stations.

(5) The belt of maximum temperature shifts gradually northwards with the season and reaches the upper catchment of river Neelum during July/August.

(6) Almost complete melting of the winter snowfall takes place during Summer so that for total seasonal runoff volume forecast computation, the consideration of the thermal condition becomes relatively less important.

(7) During winter months the runoff is mostly due to the ground water contribution and to some extent due to the snow melt. The rainfall contribution is relatively insignificant.

(8) The effect of the rainfall on the seasonal runoff generally ranges between 10-20%. Only in a very few exceptional cases it may reach a limit of 35%.

(9) The contribution of snow melt starts reducing by the middle of August and gets almost completely cut off by early October.

(10) Rainfall contributes significantly to the Poonch and the lower part of the Jhelum catchment and is the cause of the major peaks into Mangla reservoir.

(11) Rainfall effect on the short period (10 days or more) is significant and cannot be ignored, making the rainfall forecast a prerequisite to the hydrological forecast.

(12) Dictates of temperature and snow pack variability make it technically unrealistic to apply a single regression equation for the 10 daily computations for the whole season or even for the whole month, Consequently a unique and separate relationship is necessary for each 10 daily period.

3.2 SEASONAL FORECAST COMPUTATIONS.

The seasonal and ten daily forecast procedures, both deal with the snow melt and rainfall components of the runoff seperately. It is thus necessary to bifercate the total runoff hydrograph into rainfall runoff and snow melt runoff hydrographs. This hydrograph seperation have been done with the concept that the snow melt constitutes the baseflow while the rainfall provides the surface runoff part of the hydrograph component to form the total runoff hydrograph.
Thus the total area under the baseflow part of the hydrograph constitutes the total runoff volume due to the snowmelt, while the total area under the peaks(above the baseflow) constitutes the total volume due to the rainfall.

The two components of the inflow volume were worked out seperately for the total number of years for which data is used.Thus two data series of the two volumes became available. Since the snowmelt volume is by far the most important of the two, SPSS model computations were carried out to compute the total seasonel volume due to snowmelt. The rainfall effect was then catered for through the methods described as a part of the meteorological component.

3.2.1 THE SEASONAL SNOWMELT COMPUTATIONAL PROCEDURE.

The forecast procedure is based upon the use of SPSS model using stepwise technique of regression analysis.Data from 1976 to 1989 was used for computing the parameters.while the data for the years 1971 to 1975 and 1990, 1991 was set aside for the verification purpose. Computer programes to accomplish the computational process are shown in Annexures I to V.

In the course of study the following independent variables were considered and used for developing the regression plane.

- Total winter (November-March) rain of Astore.
- Total winter (November-March) rain of Murree.
- Total winter (November-March) rain of Muzaffarabad.
- Total winter (November-March) rain of Balakot.
- Inflow volumes for the month of March.
- Number of days of the westerly waves affecting the basin during November to March.

After a large number of runs of the SPSS model and a critical analysis of the results, the following independent variables were finally selected.

- Total winter (Nov. to March) rain of Astore.
- Total winter (Nov. to March) rain of Murree.
- No. of days of the westerly waves.
- Inflow volume during March.

The regression equation for computing the seasonal forecast of the inflow volume is given as under.

$$Y = B0 + B1*X1 + B2*X2 + B3*X3 + B4*X4$$

Where

B0 = 2802.9979 (Constant)

B1 = 7.4298 (Coefficient of Astore rain)

B2 = 2.36036 (Coefficient of Muz_abad rain)

B3 = 22.22315 (Coefficient of number of days of westerly waves)

B4 = 1.02263 (Coefficient of total March Inflow Volume of the same year)

X1 = Astore total rain (November to March)

X2 = Muz_abad total rain (November to March)

X3 = Number of days of westerly waves during preceding winter

X4 = Total March Inflow volume of thw same year.

3.2.2 RAINFALL EFFECT ON THE SEASONAL FORECAST:

Rainfall effect on the seasonal forecast volume is catered for as follows.

Mean of the total seasonal rainfall of Kotli, Seher Kakota, Palandri and Mangla is computed for all the years used in the model. The data series thus obtained is split into two series.

1) Series consisting of only those years for which mean Rainfall is greater than 1000 mm. (1975-78,82-84,88)

2) Series consisting of only those years for which mean Rainfall is less than 1000 mm. (1979-81, 85-87, 89-91)

SPSS model was used to develop the regression equations between the Total Seasonal Mangla inflow volume and the seasonal snowmelt volume for each series seperately.

For the first series, the regression equation is

(a) $$Y_H = C + b * X_H$$

Where

C = 1152.91208 (Constant)

b = 0.98353 (Snowmelt regression coefficient)

X_H = Snowmelt volume

For the second series, the regression equation is

(b) $Y_L = C + b * X_L$

Where

C = -936.99045 (Constant)

b = 1.21961 (Snowmelt regression coefficient)

X_L = Snowmelt volume

A long range monsoon forecast provides the basis upon which the mean of the above referred meteorological stations of the catchment is estimated and classified as high or low. Above normal (greater than 1000 mm.) rain year is classified as high rainfall year and the value YH provides the forecast volume in that case while in case of below normal rain year the value YL as determined from equation (b) provides the answer.

3.3 TEN DAILY FORECAST PROCEDURE:

Procedure for ten daily inflow forecast for Mangla has the following salient features:

- Upper Jhelum, Neelum and Kunhar basins have been treated separately and not as a single catchment. Thus three separate sets of relationships have been derived one for each sub basin.

- The runoff of the Poonch river was considered to provide an index of the rainfall of the lower Jhelum catchment.

- Run off at Kohala is assumed to indicate the combined run off of the Jhelum, Neelum, and Kunhar rivers i.e. no apprecaiable additions due to rainfall or losses due to evaporation etc take place within this short reach.

- Mangla inflow computations includes only two independent variables i.e. Kohala discharge and Poonch discharge (the rainfall effect between Kohala and Mangla has been indirectly reflected through the poonch discharge).The contribution to Mangla inflow due to Kanshi river is negligible.

The Kharif season from April to September has been divided into 10 day periods and the relationships have been determined for each period separately. These period are as follow:-

10-day periods

Months	(1)	(2)	(3)
April,June,Sept.	1-10	11-20	21-30
Aug.,May, July.	1-10	11-20	21-31

(a) The multivariate relationships of Poonch were developed separately for the following run off conditions.

(i) Less than or equal 10,000 cusecs

(ii) Greater than 10,000 cusecs

Thus in all 92 multivariate correlation relationships have been developed for the inflow discharge on 10-day basis at the sites of Domel, Muzaffarabad, Garhihabibullah, Kohala, Poonch and Mangla.

- The relationships of Domel, Muzaffarabad & Garhihabibullah forecast 10 future daily run off values with the observed and forecasted maximum tempratures over each sub-basin. The relationship for Kohala forecasts the combined effect of the inflows from the above three sites. All these relationships account for snowmelt run off which forms the major portion of the flows into Mangla Reservoir.

The relationship for Poonch forecasts 10 future daily run off values with the observed and forecast rainfall conditions over the Poonch catchment. These forecast values are also an index of the

rainfall conditions over the basin and the neighbouring sub-basin i.e. lower Jhelum.

The set of dependent and independent variables used in the development of 92 regression equations is given below:-

DEPENDENT VARIABLE	INDEPENDENT VARIABLES
1. Ten daily discharges of Domel (Note) One relationship for each 10-day period would be computed from 1st April to 30th September i.e. a total of 18 relations.	i) Daily discharge of Domel for the preceding 20 days ii) Daily maximum tempertures of Astore, Balakot & Muzaffarabad for the preceding 20-days. iii) Forecast daily maximum temperatures of Astore, Balakot and Muzaffrabad for the following 10 days (i.e. the forecast period).
2. Ten daily discharges of Muzaffarabad. (18 relations as per the period mentioned in 1)	i) Daily discharges of Muzaffarabad for the preceding 20 days (ii), (iii) As above.
3. Ten daily discharges of Garhihabibullah. (18 relations as per the period mentioned in 1)	i) Daily discharges of Garhihabibullah for the preceding 20 days. ii) (iii) As above.

4. Ten daily discharges of Kohala (18 relations as per the period mentioned in 1)	i) Daily discharges of Kohala for the preceding 20 days. ii) Ten days forecast discharges of Domel, Muzaffarabad and Garhihabibullah as computed at 1-3 above for the forecast period.
5(a). Ten daily discharge of Poonch (Kotli) with flows less than or equal to 10,000 cs (1 relation as per the period mentioned in 1)	i) Daily discharges of Poonch for the preceding 20 days. ii) Daily rainfall of Kotli, Palandri, Sehr Kakota & Mangla for the preceding 20 days. iii) Forecast daily rainfall of above stations for the following 10 days i.e. the forecast period.
5(b). Ten daily discharge of Poonch (Kotli) with flows greater than 10,000 cusecs (1 relation as per the period mentioned in 1)	i) Daily discharges of Poonch for the preceding 20 days. ii) Daily rainfall of Kotli Palandri, Sehr Kakota & Mangla for the preceding 20 days. iii) Forecast daily rainfall of above stations for the following 10 days i.e. the forecast period.

6. Ten daily discharges of Mangla (18 relations as per the period mentioned in 1)	i) Daily discharges of Mangla for the preceding 20 days. ii) Daily forecast discharges of Kohala as determined vide 4 above for the following 10 days (i.e. the forecast period). iii) Daily forecast discharges of Poonch as determined vide 5(a) & 5(b) above for the following 10 days (forecast period).

4. REGRESSION EQUATIONS:

The regression equations for all the ten daily periods used for the computations of the respective discharges are given as under:-

4.1 For The Period 01/04 to 10/04

Site	Equation
1. G.Habibullah	QH = C + M19*MX19 + B8*BX8 + QH20*QHX20

WHERE

M19 = 0.02429, (Muzaffarabad maximum temperature coefficient of 19th day.)
B8 =-0.01403, (Ballakot maximum temperature coefficient of 8th day.)
QH20 = 0.86086(Habib discharge coefficient of 20th day.)
C = 0.04459

2. Muzaffar Abad

QM = C + A11*AX11 + A14*AX14 + M15*MX15 + M18*MX18 + M20*MX20 + QM3*QMX3 + QM20*QMX20

WHERE

A11 =-0.10723, A14 = 0.13139, (Astore maximum temperature coefficient of 11th and 14th day respectively.)
M15 = 0.07220, M18 = 0.11632, M20 = 0.18182, (Muzaffarabad maximum temperature coefficient of 15th, 18th and 20th day respectively.)
QM3 = 0.29902, QM20 = 0.79328 (Muzafferabad discharge coefficient of 3rd and 20th day respectively.)
C = -8.39196

3. Domel

QD = C + A1*AX1 + M2*MX2 + B4*BX4 + QD11*QDX11 + QD18*QDX18 + QD19*QDX19 + QD20*QDX20

WHERE

A1 =-0.12770, (Astore maximum temperature coefficient of 1st day.)
M2 =-0.06473, (Muzaffarabad maximum temperature coefficient of 2nd day.)
B4 =-0.06902, (Ballakot maximum temperature coefficient of 4th day.)
QD11 = 0.06114, QD18 = 0.13646, QD19 =-0.30278, QD20 = 1.05765 (Domel discharge coefficient of 11th, 18th, 19th and 20th day respectively.)
C = 4.86906

4. Kohala

QK = C + QH19*QHX19 + QH20*QHX20 + QM19*QMX19 + QM20*QMX20 + QD19*QDX19 + QD20*QDX20 + QK17*QKX17 + QK20*QKX20

WHERE

QH19 =-6.11738, QH20 =10.40784, (Habib discharge

coefficient of 19th and 20th day respectively.)
QM19 =-0.81331, QM20 = 0.54208, (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
QD19 = 0.51132, QD20 =-0.39496, (Domel discharge

coefficient of 19th and 20th day respectively.)
QK17 = 0.17591, QK20 = 0.53027 (Kohala discharge coefficient of 17th and 20th day respectively.)
C = 0.80244

5. Poonch

QP = C + PK16*PKX16 + PK17*PKX17 + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP16*PPX16 + PP19*PPX19 + PP20*PPX20 + PS18*PSX18 + PS19*PSX19 + PM20*PMX20

WHERE

PK16 = 0.02981, PK17 = 0.03014, PK18 = 0.02577, PK19 = 0.01826, PK20 = 0.03752, (Kohala precipitation coefficient of 16th, 17th, 18th, 19th and 20th day respectively.)
PP16 = 0.01040, PP19 = 0.01429, PP20 = 0.02925, (Palandri precipitation coefficient of 16th, 19th and 20th day respectively.)
PS18 = 0.01539, PS19 = 0.01856, (Sahar Kakota precipitation coefficient of 18th and 19th day respectively.)
PM20 = 0.02022(Mangla precipitation coefficient of 20th day.)
C = 3.55809

6. Mangla

QM = C + QK16*QKX16 + QK20*QKX20 + QP19*QPX19 + QP20*QPX20 + QMN20*QMNX20

WHERE

QK16 =-0.18434, QK20 = 0.97096, (Kohala discharge coefficient of 16th and 20th day respectively.)
QP19 =-0.74744, QP20 = 1.67744, (Poonch discharge coefficient of 19th and 20th day respectively.)
QMN20 = 0.17843(Mangla discharge coefficient of 20th day.)
C = 2.47603

4.2 For The Period 11/04 to 20/04

Site	Equation
1. G.Habibullah	QH = C + B20*BX20 + QH20*QHX20

WHERE

B20 = 0.02845, (Ballakot maximum temperature coefficient of 20th day.)
QH20 = 0.87740(Habib discharge coefficient of 20th day.)
C = -0.22160

2. Muzaffar Abad QM = C + A16*AX16 + A20*AX20 + QM19*QMX19 + QM20*QMX20

WHERE

A16 =-0.15346, A20 = 0.25468, (Astore maximum temperature coefficient of 16th and 20th day respectively.)
QM19 =-0.28759, QM20 = 1.28025 (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
C = -1.20857

3. Domel QD = C + A6*AX6 + A20*AX20 + QD20*QDX20

WHERE

A6 =-0.18471, A20 = 0.27296, (Astore maximum temperature coefficient of 6th and 20th day respectively.)
QD20 = 0.94839(Domel discharge coefficient of 20th day.)
C = -0.67638

4. Kohala QK = C + QH19*QHX19 + QH20*QHX20 + QM19*QMX19 + QM20*QMX20 + QD19*QDX19 + QD20*QDX20 + QK20*QKX20

WHERE

QH19 =-4.39983, QH20 = 4.45227, (Habib discharge coefficient of 19th and 20th day respectively.)
QM19 =-0.54317, QM20 = 0.44334, (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
QD19 = 0.58596, QD20 =-0.79340, (Domel discharge coefficient of 19th and 20th day respectively.)
QK20 = 1.10087(Kohala discharge coefficient of 20th day.)
C = 2.09561

5. Poonch QP = C + PK18*PKX18 + PK20*PKX20 + PP16*PPX16 + PP20*PPX20 + PS20*PSX20

WHERE

PK18 = 0.06922, PK20 = 0.12547, (Kohala precipitation coefficient of 18th and 20th day respectively.)
PP16 = 0.07580, PP20 = 0.09820, (Palandri precipitation coefficient of 16th and 20th day respectively.)
PS20 = 0.25634(Sahar Kakota precipitation coefficient of 20th day.)
C = 8.37074

6. Mangla QM = C + QK19*QKX19 + QK20*QKX20 + QP19*QPX19 + QP20*QPX20 + QMN20*QMNX20

WHERE

QK19 = 0.11452, QK20 = 0.85168, (Kohala discharge coefficient of 19th and 20th day respectively.)
QP19 = 0.04129, QP20 = 1.38129, (Poonch discharge coefficient of 19th and 20th day respectively.)

QMN20 =-0.14495(Mangla discharge coefficient of 20th day.)
C = 7.11422

For The Period 21/04 to 30/04

Site	Equation
1. G.Habibullah	QH = C + M20*MX20 + QH16*QHX16 + QH20*QHX20

WHERE

M20 = 0.07301, (Muzaffarabad maximum temperature coefficient of 20th day.)
QH16 = 0.22028, QH20 = 0.74057(Habib discharge coefficient of 16th and 20th day respectively.)
C = -1.66921

2. Muzaffar Abad

QM = C + A8*AX8 + A16*AX16 + M6*MX6 + M20*MX20 + B17*BX17 + QM20*QMX20

WHERE

A8 =-0.26083, A16 =-0.19401, (Astore maximum temperature coefficient of 8th and 16th day respectively.)
M6 = 0.18787, M20 = 0.35271, (Muzaffarabad maximum temperature coefficient of 6th and 20th day respectively.)
B17 =-0.15179, (Ballakot maximum temperature coefficient of 17th day.)
QM20 = 0.82290(Muzafferabad discharge coefficient of 20th day.)
C = 0.36649

3. Domel

QD = C + A8*AX8 + A14*AX14 + A17*AX17 + M4*MX4 + M20*MX20 + B2*BX2 + QD16*QDX16 + QD20*QDX20

WHERE

A8 =-0.36077, A14 = 0.24268, A17 = 0.42605, (Astore maximum temperature coefficient of 8th, 14th and 17th day respectively.)
M4 =-0.21763, M20 = 0.23672, (Muzaffarabad maximum temperature coefficient of 4th and 20th day respectively.)
B2 = 0.16331, (Ballakot maximum temperature coefficient of 2nd day.)
QD16 = 0.29253, QD20 = 0.86267(Domel discharge coefficient of 16th and 20th day respectively.)
C =-14.33563

4. Kohala

QK = C + QD16*QDX16 + QK20*QKX20

WHERE

QD16 = 0.66158, (Domel discharge coefficient of 16th day.)

QK20 = 0.63924 (Kohala discharge coefficient of 20th day.)
C = 2.49359

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP18*QPX18 + QP20*QPX20 + QMN19*QMNX19

WHERE

QK20 = 0.82049, (Kohala discharge coefficient of 20th day.)
QP18 =-1.25100, QP20 = 2.02283, (Poonch discharge coefficient of 18th and 20th day respectively.)
QMN19 = 0.20360 (Mangla discharge coefficient of 19th day.)
C = 0.82867

4.4 Regression Equations For Computing 10 Daily Mean Inflow of Mangla For The Period 01/05 to 10/05

Site	Equation
1. G.Habibullah	QH = C + B11*BX11 + B14*BX14 + B16*BX16 + B20*BX20 + QH9*QHX9 + QH13*QHX13 + QH17*QHX17 + QH19*QHX19 + QH20*QHX20 WHERE B11 =-0.03973, B14 =-0.04783, B16 =-0.04209, B20 = 0.06978, (Ballakot maximum temperature coefficient of 11th, 14th, 16th and 20th day respectively.) QH9 = 0.22959, QH13 =-0.12077, QH17 = 0.26483, QH19 =-0.41780, QH20 = 0.99633 (Habib discharge coefficient of 9th, 13th, 17th, 19th and 20th day respectively.) C = 2.19989
2. Muzaffar Abad	QM = C + M11*MX11 + B6*BX6 + B15*BX15 + B20*BX20 + QM9*QMX9 + QM18*QMX18 + QM20*QMX20 WHERE M11 =-0.12946, (Muzaffarabad maximum temperature coefficient of 11th day.) B6 = 0.11516, B15 =-0.20159, B20 = 0.16158, (Ballakot maximum temperature coefficient of 6th, 15th and 20th day respectively.) QM9 = 0.17968, QM18 =-0.15183, QM20 = 0.81340 (Muzafferabad discharge coefficient of 9th, 18th and 20th day respectively.) C = 6.93826
3. Domel	QD = C + M12*MX12 + M13*MX13 + M19*MX19 + B18*BX18 + QD20*QDX20 WHERE M12 = 0.11179, M13 =-0.17748, M19 = 0.15444, (Muzaffarabad maximum temperature coefficient of 12th, 13th and 19th day respectively.) B18 =-0.12865, (Ballakot maximum temperature coefficient of 18th day.) QD20 = 0.94669(Domel discharge coefficient of 20th day.) C = 2.44695
4. Kohala	QK = C + QH17*QHX17 + QH18*QHX18 + QH19*QHX19 + QH20*QHX20 + QM17*QMX17 + QM18*QMX18 + QM19*QMX19 + QM20*QMX20 + QD15*QDX15 + QD17*QDX17 + QD18*QDX18 + QD19*QDX19 + QD20*QDX20 + QK20*QKX20 WHERE QH17 = 0.01775, QH18 =-0.40146, QH19 =-0.74010,

QH20 = 0.69397, (Habib discharge coefficient of 17th, 18th, 19th and 20th day respectively.)
QM17 =-0.00558, QM18 =-0.37200, QM19 =-0.11574, QM20 = 0.15368, (Muzafferabad discharge coefficient of 17th, 18th, 19th and 20th day respectively.)
QD15 = 0.35245, QD17 = 0.03740, QD18 = 0.23659, QD19 =0.27124, QD20 =-0.86270, (Domel discharge coefficient of 15th, 17th, 18th, 19th and 20th day respectively.)
QK20 = 1.05259 (Kohala discharge coefficient of 20th day.)
C = 8.05628

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969(Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP7*QPX7 + QP14*QPX14 + QP16*QPX16 + QP20*QPX20

WHERE

QK20 = 0.97457, (Kohala discharge coefficient of 20th day.)
QP7 = 0.23174, QP14 =-0.48157, QP16 =-0.31428, QP20 = 1.18633(Poonch discharge coefficient of 7th, 14th, 16th and 20th day respectively.)
C = 2.0476

4.5 For The Period 11/05 to 20/05

Site	Equation
1. G.Habibullah	QH = C + M20*MX20 + QH1*QHX1 + QH20*QHX20

WHERE

M20 = 0.04632, (Muzaffarabad maximum temperature coefficient of 20th day.)
QH1 = 0.17800, QH20 = 0.74174 (Habib discharge coefficient of 1st and 20th day respectively.)
C = -0.69134

2. Muzaffar Abad QM = C + A4*AX4 + A10*AX10 + A11*AX11 + M8*MX8 + M11*MX11 + M20*MX20 + B13*BX13 + B15*BX15 + B20*BX20 + QM4*QMX4 + QM10*QMX10 + QM20*QMX20

WHERE

A4 =-0.20989, A10 =-0.38130, A11 =-0.18998, (Astore maximum temperature coefficient of 4th, 10th and 11th day respectively.)
M8 =-0.16995, M11 = 0.31424, M20 = 0.35164, (Muzaffarabad maximum temperature coefficient of 8th, 11th and 20th day respectively.)
B13 =-0.30141, B15 = 0.18414, B20 =-0.33146, (Ballakot maximum temperature coefficient of 13th, 15th and 20th day respectively.)
QM4 =-0.11151, QM10 = 0.28095, QM20 = 0.76090 (Muzafferabad discharge coefficient of 4th, 10th and 20th day respectively.)
C = 16.08687

3. Domel QD = C + A2*AX2 + M7*MX7 + B9*BX9 + QD11*QDX11 + QD19*QDX19 + QD20*QDX20

WHERE

A2 =-0.25574, (Astore maximum temperature coefficient of 2nd day.)
M7 =-0.09985, (Muzaffarabad maximum temperature coefficient of 7th day.)
B9 =-0.17595, (Ballakot maximum temperature coefficient of 9th day.)
QD11 = 0.15791, QD19 =-0.23042, QD20 = 1.03182 (Domel discharge coefficient of 11th, 19th and 20th day respectively.)
C = 14.15573

4. Kohala QK = C + QM19*QMX19 + QM20*QMX20 + QD20*QDX20 + QK20*QKX20

WHERE

QM19 =-0.36472, QM20 = 0.64827, (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
QD20 = 0.20475, (Domel discharge coefficient of 20th day.)
QK20 = 0.69068(Kohala discharge coefficient of 20th day.)
C = 4.80838

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK10*QKX10 + QK14*QKX14 + QK19*QKX19 + QK20*QKX20 + QP20*QPX20 + QMN20*QMNX20

WHERE

QK10 = 0.16720, QK14 = 0.16591, QK19 = 0.53824, QK20 = 0.39728, (Kohala discharge coefficient of 10th, 14th, 19th and 20th day respectively.)
QP20 = 2.03780, (Poonch discharge coefficient of 20th day.)
QMN20 =-0.27128(Mangla discharge coefficient of 20th day.)
C = -3.46207

4.6 For The Period 21/05 to 30/05

Site	Equation
1. G.Habibullah	QH = C + M20*MX20 + QH1*QHX1 + QH20*QHX20

WHERE

M20 = 0.04632, (Muzaffarabad maximum temperature coefficient of 20th day.)
QH1 = 0.17800, QH20 = 0.74174(Habib discharge coefficient of 1st and 20th day respectively.)
C = -0.69134

2. Muzaffar Abad

QM = C + A4*AX4 + A10*AX10 + A11*AX11 + M8*MX8 + M11*MX11 + M20*MX20 + B13*BX13 + B15*BX15 + B20*BX20 + QM4*QMX4 + QM10*QMX10 + QM20*QMX20

WHERE

A4 =-0.20989, A10 =-0.38130, A11 =-0.18998, (Astore maximum temperature coefficient of 4th, 10th and 11th day respectively.)
M8 =-0.16995, M11 = 0.31424, M20 = 0.35164, (Muzaffarabad maximum temperature coefficient of 8th, 11th and 20th day respectively.)
B13 =-0.30141, B15 = 0.18414, B20 =-0.33146, (Ballakot maximum temperature coefficient of 13th, 15th and 20th day respectively.)
QM4 =-0.11151, QM10 = 0.28095, QM20 = 0.76090 (Muzafferabad discharge coefficient of 4th, 10th and 20th day respectively.)
C = 16.08687

3. Domel

QD = C + A2*AX2 + M7*MX7 + B9*BX9 + QD11*QDX11 + QD19*QDX19 + QD20*QDX20

WHERE

A2 =-0.25574, (Astore maximum temperature coefficient of 2nd day.)
M7 =-0.09985, (Muzaffarabad maximum temperature coefficient of 7th day.)
B9 =-0.17595, (Ballakot maximum temperature coefficient of 9th day.)
QD11 = 0.15791, QD19 =-0.23042, QD20 = 1.03182(Domel discharge coefficient of 11th, 19th and 20th day respectively.)
C = 14.15573

4. Kohala

QK = C + QM19*QMX19 + QM20*QMX20 + QD20*QDX20 + QK20*QKX20

WHERE

QM19 =-0.36472, QM20 = 0.64827, (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
QD20 = 0.20475, (Domel discharge coefficient of 20th day.)
QK20 = 0.69068 (Kohala discharge coefficient of 20th day.)
C = 4.80838

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 =0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969(Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK10*QKX10 + QK14*QKX14 + QK19*QKX19 + QK20*QKX20 + QP20*QPX20 + QMN20*QMNX20

WHERE

QK10 = 0.16720, QK14 = 0.16591, QK19 = 0.53824, QK20 = 0.39728, (Kohala discharge coefficient of 10th, 14th, 19th and 20th day respectively.)
QP20 = 2.03780, (Poonch discharge coefficient of 20th day.)
QMN20 =-0.27128(Mangla discharge coefficient of 20th day.)
C = -3.46207

4.7 Regression Equations For Computing 10 Daily Mean Inflow of Mangla For The Period 01/6 to 10/6

Site	Equation
1. G.Habibullah	QH = C + QH19*QHX19 + QH20*QHX20

WHERE

QH19 =-0.45065, QH20 = 1.35962 (Habib discharge coefficient of 19th and 20th day respectively.)
C = 0.83213

2. Muzaffar Abad QM = C + A17*AX17 + A18*AX18 + A20*AX20 + QM20*QMX20

WHERE

A17 =-0.17997, A18 =-0.15233, A20 = 0.35175, (Astore maximum temperature coefficient of 17th, 18th and 20th day respectively.)
QM20 = 0.94678 (Muzafferabad discharge coefficient of 20th day.)
C = 1.15914

3. Domel QD = C + A2*AX2 + M11*MX11 + QD16*QDX16 + QD20*QDX20

WHERE

A2 =-0.12702, (Astore maximum temperature coefficient of 2nd day.)
M11 = 0.07675, (Muzaffarabad maximum temperature coefficient of 11th day.)
QD16 = 0.37586, QD20 = 0.66435 (Domel discharge coefficient of 16th and 20th day respectively.)
C = -1.64323

4. Kohala QK = C + QK20*QKX20

WHERE

QK20 = 1.00555(Kohala discharge coefficient of 20th day.)
C = -0.18037

5. Poonch QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP18*QPX18 + QP20*QPX20

WHERE

QK20 = 0.96259, (Kohala discharge coefficient of 20th day.)
QP18 = 0.89083, QP20 = 1.18940 (Poonch discharge coefficient of 18th and 20th day respectively.)
C = -3.96508

4.8 For The Period 11/06 to 20/06

Site Equation

1. G.Habibullah

QH = C + A4*AX4 + A17*AX17 + M20*MX20 + B1*BX1 + B6*BX6 + QH9*QHX9 + QH20*QHX20

WHERE
A4 =-0.05848, A17 =-0.10348, (Astore maximum temperature coefficient of 4th and 17th day respectively.)
M20 = 0.05054, (Muzaffarabad maximum temperature coefficient of 20th day.)
B1 =-0.04268, B6 =-0.03983,(Ballakot maximum temperature coefficient of 1st and 6th day respectively.)
QH9 = 0.07875, QH20 = 0.92723 (Habib discharge coefficient of 9th and 20th day respectively.)
C = 4.46606

2. Muzaffar Abad

QM = C + A4*AX4 + A9*AX9 + M9*MX9 + M17*MX17 + M19*MX19 + M20*MX20 + B2*BX2 + B10*BX10+ B18*BX18 + QM11*QMX11 + QM20*QMX20

WHERE

A4 =-0.16878, A9 =-0.32285, (Astore maximum temperature coefficient of 4th and 9th day respectively.)
M9 = 0.18071, M17 = 0.18744, M19 = 0.18808, M20 = 0.16808, (Muzaffarabad maximum temperature coefficient of 9th, 17th, 19th and 20th day respectively.)
B2 =-0.16040, B10 =-0.35408, B18 =-0.25461, (Ballakot maximum temperature coefficient of 2nd, 10th and 18th day respectively.)
QM11 = 0.17680, QM20 = 0.68131(Muzafferabad discharge coefficient of 11th and 20th day respectively.)
C = 14.79611

3. Domel

QD = C + A1*AX1 + A14*AX14 + M7*MX7 + M9*MX9 + QD20*QDX20

WHERE

A1 =-0.06643, A14 = 0.04251, (Astore maximum temperature coefficient of 1st and 14th day respectively.)
M7 =-0.02835, M9 =-0.04356, (Muzaffarabad maximum temperature coefficient of 7th and 9th day respectively.)
QD20 = 0.95324 (Domel discharge coefficient of 20th day.)
C = 3.64357

4. Kohala

QK = C + QD18*QDX18 + QD20*QDX20 + QK19*QKX19 + QK20*QKX20

WHERE

QD18 = 0.65539, QD20 =-0.62337, (Domel discharge coefficient of 18th and 20th day respectively.)
QK19 =-0.33915, QK20 = 1.28481 (Kohala discharge coefficient of 19th and 20th day respectively.)
C = 0.99685

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951,

PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP16*QPX16 + QP20*QPX20 + QMN1*QMNX1

WHERE

QK20 = 0.97594, (Kohala discharge coefficient of 20th day.)
QP16 = 1.08172, QP20 = 1.09241, (Poonch discharge coefficient of 16th and 20th day respectively.)
QMN1 =-0.07591 (Mangla discharge coefficient of 1st day.)
C = -0.43871

4.9 For The Period 21/06 to 30/06

Site Equation

1. G.Habibullah

QH = C + A12*AX12 + M9*MX9 + M10*MX10 + M14*MX14 + B7*BX7 + B20*BX20 + QH16*QHX16 + QH19*QHX19 + QH20*QHX20

WHERE

A12 = 0.05549 (Astore maximum temperature coefficient of 12th day.)
M9 =-0.04116, M10 =-0.04576, M14 =-0.06012 (Muzaffarabad maximum temperature coefficient of 9th, 10th and 14th day respectively.)
B7 =-0.08251, B20 = 0.06283, (Ballakot maximum temperature coefficient of 7th and 20th day respectively.)
QH16 = 0.34055, QH19 =-0.18856, QH20 = 0.95141(Habib discharge coefficient of 16th, 19th and 20th day respectively.)
C = 4.06263

2. Muzaffar Abad

QM = C + A17*AX17 + M2*MX2 + M9*MX9 + M18*MX18 + B3*BX3 + B7*BX7 + B8*BX8 + B15*BX15 + QM20*QMX20

WHERE

A17 =-0.13258, (Astore maximum temperature coefficient

of 17th day.)
M2 =-0.19437, M9 =-0.11172, M18 =-0.09019, (Muzaffarabad maximum temperature coefficient of 2nd, 9th and 18th day respectively.)
B3 = 0.22412, B7 =-0.14379, B8 = 0.12331, B15 = 0.16578, (Ballakot maximum temperature coefficient of 3rd, 7th, 8th and 15th day respectively.)
QM20 = 1.03444 (Muzafferabad discharge coefficient of 20th day.)
C = 4.27243

3. Domel

QD = C + A1*AX1 + A18*AX18 + A20*AX20 + M2*MX2 + M17*MX17 + B18*BX18 + QD5*QDX5 + QD20*QDX20

WHERE

A1 = 0.03335, A18 = 0.06139, A20 = 0.08622, (Astore maximum temperature coefficient of 1st, 18th and 20th day respectively.)
M2 =-0.05159, M17 = 0.04161, (Muzaffarabad maximum temperature coefficient of 2nd and 17th day respectively.)
B18 =-0.05470, (Ballakot maximum temperature coefficient of 18th day.)
QD5 =-0.03698, QD20 = 1.04616 (Domel discharge coefficient of 5th and 20th day respectively.)
C = -2.41021

4. Kohala

QK = C + QH9*QHX9 + QH20*QHX20 + QM1*QMX1 + QM7*QMX7 + QD20*QDX20 + QK20*QKX20

WHERE

QH9 =-0.36601, QH20 = 1.76761, (Habib discharge coefficient of 9th and 20th day respectively.)
QM1 = 0.20911, QM7 =-0.27722, (Muzafferabad discharge coefficient of 1st and 7th day respectively.)
QD20 = 0.62284, (Domel discharge coefficient of 20th day.)
QK20 = 0.51844(Kohala discharge coefficient of 20th day.)
C = 4.05916

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310,

PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP20*QPX20

WHERE

QK20 = 0.96261, (Kohala discharge coefficient of 20th day.)
QP20 = 2.30213(Poonch discharge coefficient of 20th day.)
C = -4.36591 5

* Y *

4.10 Regression Equations For Computing 10 Daily Mean Inflow of Mangla For The Period 01/07 to 10/07

Site	Equation
1. G.Habibullah	QH = C + A1*AX1 + A8*AX8 + M3*MX3 + M20*MX20 + B8*BX8 + QH20*QHX20 WHERE A1 =-0.05123, A8 =-0.07477, (Astore maximum temperature coefficient of 1st and 8th day respectively.) M3 = 0.06126, M20 = 0.05538, (Muzaffarabad maximum temperature coefficient of 3rd and 20th day respectively.) B8 =-0.05808, (Ballakot maximum temperature coefficient of 8th day.) QH20 = 0.84309(Habib discharge coefficient of 20th day.) C = 2.03055
2. Muzaffar Abad	QM = C + M17*MX17 + B6*BX6 + QM13*QMX13 + QM19*QMX19 + QM20*QMX20 WHERE M17 = 0.20814, (Muzaffarabad maximum temperature coefficient of 17th day.) B6 =-0.19266, (Ballakot maximum temperature coefficient of 6th day.) QM13 = 0.17749, QM19 =-0.54187, QM20 = 1.32728 (Muzafferabad discharge coefficient of 13th, 19th and 20th day respectively.) C = -0.73291
3. Domel	QD = C + A1*AX1 + A19*AX19 + M14*MX14 + B14*BX14 + QD20*QDX20 WHERE A1 = 0.08334, A19 = 0.11101, (Astore maximum temperature coefficient of 1st and 19th day respectively.) M14 =-0.07500, (Muzaffarabad maximum temperature coefficient of 14th day.) B14 = 0.16352, (Ballakot maximum temperature coefficient of 14th day.) QD20 = 1.02557(Domel discharge coefficient of 20th day.) C = -8.27818
4. Kohala	QK = C + QH1*QHX1 + QH20*QHX20 + QM16*QMX16 + QD4*QDX4 + QD10*QDX10 + QK20*QKX20

WHERE

QH1 =-0.49767, QH20 = 1.63478, (Habib discharge coefficient of 1st and 20th day respectively.)
QM16 = 0.16561, (Muzafferabad discharge coefficient of 16th day.)
QD4 =-0.78404, QD10 = 1.46087, (Domel discharge coefficient of 4th and 10th day respectively.)
QK20 = 0.42680(Kohala discharge coefficient of 20th day.)
C = 2.65784

5. Poonch

QP = C + PK4*PKX4 + PK5*PKX5 + PK6*PKX6 + PK10*PKX10 + PK11*PKX11 + PK12*PKX12 + PK13*PKX13 + PK14*PKX14 + PK15*PKX15 + PP5*PPX5 + PP6*PPX6 + PP10*PPX10 + PP19*PPX19 + PP20*PPX20 + PS1*PSX1 + PS2*PSX2 + PS3*PSX3 + PS7*PSX7 + PS9*PSX9 + PS12*PSX12 + PS13*PSX13 + PS14*PSX14 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM8*PMX8 + PM9*PMX9 + PM10*PMX10

WHERE

PK4 = 0.00981, PK5 = 0.01444, PK6 = 0.01377, PK10 = 0.01283, PK11 = 0.01520, PK12 = 0.01310, PK13 = 0.01921, PK14 = 0.01491, PK15 = 0.01266, (Kohala precipitation coefficient of 4th, 5th, 6th, 10th, 11th, 12th, 13th, 14th and 15th day respectively.)
PP5 =-0.00752, PP6 =-0.00868, PP10 = 0.00951, PP19 = 0.00891, PP20 = 0.02497, (Palandri precipitation coefficient of 5th, 6th, 10th, 19th and 20th day respectively.)
PS1 = 0.01469, PS2 = 0.01098, PS3 = 0.01173, PS7 = 0.01091, PS9 = 0.01127, PS12 = 0.01299, PS13 = 0.00820, PS14 = 0.00854, PS18 = 0.01777, PS19 = 0.02379, PS20 = 0.02647, (Sahar Kakota precipitation coefficient of 1st, 2nd, 3rd, 7th, 9th, 12th, 13th, 14th, 18th, 19th and 20th day respectively.)
PM8 = 0.01034, PM9 = 0.01066, PM10 = 0.00969 (Mangla precipitation coefficient of 8th, 9th and 10th day respectively.)
C = 3.11020

6. Mangla

QM = C + QK20*QKX20 + QP20*QPX20

WHERE

QK20 = 1.00522, (Kohala discharge coefficient of 20th day.)
QP20 = 1.60439 (Poonch discharge coefficient of 20th day.)
C = -3.41481

4.11 For The Period 11/07 to 20/07

Site	Equation
1. G.Habibullah	QH = C + M4*MX4 + M12*MX12 + B3*BX3 + B9*BX9 + B11*BX11 + B18*BX18 + QH1*QHX1 + QH20*QHX20

WHERE

M4 =-0.08262, M12 = 0.07874, (Muzaffarabad maximum temperature coefficient of 4th and 12th day respectively.)
B3 = 0.06124, B9 = 0.09223, B11 =-0.07996, B18 = 0.04592, (Ballakot maximum temperature coefficient of 3rd, 9th, 11th and 18th day respectively.)
QH1 = 0.13196, QH20 = 0.79031 (Habib discharge coefficient of 1st and 20th day respectively.)
C = -3.53992

2. Muzaffar Abad QM = C + A14*AX14 + M13*MX13 + M20*MX20 + B6*BX6 + B12*BX12 + QM1*QMX1 + QM10*QMX10 + QM17*QMX17 + QM18*QMX18 + QM20*QMX20

WHERE

A14 = 0.11153, (Astore maximum temperature coefficient of 14th day.)
M13 =-0.12130, M20 = 0.22512, (Muzaffarabad maximum temperature coefficient of 13th and 20th day respectively.)
B6 = 0.20694, B12 = 0.28510, (Ballakot maximum temperature coefficient of 6th and 12th day respectively.)
QM1 = 0.14648, QM10 = 0.08609, QM17 =-0.19180, QM18 = 0.31570, QM20 = 0.52192 (Muzafferabad discharge coefficient of 1st, 10th, 17th, 18th and 20th day respectively.)
C =-21.86661

3. Domel QD = C + B12*BX12 + B18*BX18 + QD20*QDX20

WHERE

B12 = 0.09665, B18 =-0.09410, (Ballakot maximum temperature coefficient of 12th and 18th day respectively.)
QD20 = 0.67414(Domel discharge coefficient of 20th day.)
C = 0.30635

4. Kohala QK = C + QD17*QDX17 + QD18*QDX18 + QD20*QDX20 + QK20*QKX20

WHERE

QD17 =-0.94308, QD18 = 1.92926, QD20 =-0.85421, (Domel discharge coefficient of 17th, 18th and 20th day respectively.)
QK20 = 0.85668 (Kohala discharge coefficient of 20th day.)
C = 3.67030

5. Poonch

QP = C + PK4*PKX4 + PP6*PPX6 + PP12*PPX12 + PP18*PPX18 + PS13*PSX13 + PS20*PSX20 + PM14*PMX14 + PM16*PMX16

WHERE

PK4 = 0.31085, (Kohala precipitation coefficient of 4th day.)
PP6 = 0.50764, PP12 = 0.17121, PP18 =-0.10487, (Palandri precipitation coefficient of 6th, 12th and 18th day respectively.)
PS13 =-0.16169, PS20 = 0.21425, (Sahar Kakota precipitation coefficient of 13th and 20th day respectively.)
PM14 = 0.30434, PM16 = 0.19860, (Mangla precipitation coefficient of 14th and 16th day respectively.)
C = 13.25102

6. Mangla

QM = C + QK20*QKX20 + QP20*QPX20

WHERE

QK20 = 0.95200, (Kohala discharge coefficient of 20th day.)
QP20 = 1.27868(Poonch discharge coefficient of 20th day.)
C = 0.76906

4.12 For The Period 21/07 to 30/07

Site Equation

1. G.Habibullah

QH = C + A12*AX12 + B9*BX9 + QH20*QHX20

WHERE

A12 =-0.05524, (Astore maximum temperature coefficient of 12th day.)
B9 = 0.06173, (Ballakot maximum temperature coefficient of 9th day.)
QH20 = 0.91998(Habib discharge coefficient of 20th day.)
C = 0.09058

2. Muzaffar Abad

QM = C + M20*MX20 + QM12*QMX12 + QM20*QMX20

WHERE

M20 = 0.19280, (Muzaffarabad maximum temperature coefficient of 20th day.)
QM12 = 0.15365, QM20 = 0.86658,(Muzafferabad discharge coefficient of 12th and 20th day respectively.)
C = -7.00900

3. Domel

QD = C + QD20*QDX20

WHERE

QD20 = 1.00085(Domel discharge coefficient of 20th day.)
C = 0.20192

4. Kohala

QK = C + QD15*QDX15 + QK13*QKX13 + QK20*QKX20

WHERE

QD15 = 0.43821, (Domel discharge coefficient of 15th day.)
QK13 = 0.26395, QK20 = 0.61079,(Kohala discharge coefficient of 13th and 20th day respectively.)
C = -0.56032

5. Poonch

QP = C + PK20*PKX20 + PP14*PPX14 + PS9*PSX9 + PS18*PSX18 + PS20*PSX20 + PM5*PMX5 + PM19*PMX19

WHERE

PK20 = 0.02700, (Kohala precipitation coefficient of 20th day.)
PP14 = 0.01861, (Palandri precipitation coefficient of 14th day.)
PS9 = 0.02202, PS18 = 0.03461, PS20 = 0.03834, (Sahar Kakota precipitation coefficient of 9th, 18th and 20th day respectively.)
PM5 = 0.02202, PM19 = 0.02684 (Mangla precipitation coefficient of 5th and 19th day respectively.)
C = 11.21568

6. Mangla

QM = C + QK19*QKX19

WHERE

QK19 = 1.12042 (Kohala discharge coefficient of 19th day.)
C = 9.48948

4.13 Regression Equations For Computing 10 Daily Mean Inflow of Mangla For The Period 01/08 to 10/08

Site	Equation
1. G.Habibullah	QH = C + A2*AX2 + M3*MX3 + M16*MX16 + B14*BX14 + B16*BX16 + B20*BX20 + QH2*QHX2 + QH18*QHX18 + QH20*QHX20

WHERE

A2 =-0.05539, (Astore maximum temperature coefficient of 2nd day.)
M3 =-0.12038, M16 = 0.09742, (Muzaffarabad maximum temperature coefficient of 3rd and 16th day respectively.)
B14 = 0.06990, B16 =-0.12245, B20 = 0.06655, (Ballakot maximum temperature coefficient of 14th, 16th and 20th day respectively.)
QH2 = 0.16319, QH18 = 0.27742, QH20 = 0.60626,(Habib discharge coefficient of 2nd, 18th and 20th day respectively.)
C = 1.33683

2. Muzaffar Abad

QM = C + A1*AX1 + M3*MX3 + B2*BX2 + B9*BX9 + B20*BX20 + QM20*QMX20

WHERE

A1 =-0.31561, (Astore maximum temperature coefficient of 1st day.)
M3 =-0.44221, (Muzaffarabad maximum temperature coefficient of 3rd day.)
B2 = 0.25860, B9 =-0.15823, B20 = 0.31705, (Ballakot maximum temperature coefficient of 2nd, 9th and 20th day respectively.)
QM20 = 0.86658 (Muzafferabad discharge coefficient of 20th day.)
C = 12.84045

. Domel

QD = C + M3*MX3 + M19*MX19 + M20*MX20 + B16*BX16 + B17*BX17 + QD3*QDX3 + QD20*QDX20

WHERE

M3 =-0.32716, M19 = 0.13378, M20 =-0.14608, (Muzaffarabad maximum temperature coefficient of 3rd, 19th and 20th day respectively.)
B16 =-0.25585, B17 =-0.13078, (Ballakot maximum temperature coefficient of 16th and 17th day respectively.)
QD3 = 0.21242, QD20 = 0.86980, (Domel discharge coefficient of 3rd and 20th day respectively.)
C = 16.82637

4. Kohala

QK = C + QK20*QKX20

WHERE
QK20 = 0.88078 (Kohala discharge coefficient of 20th day.)
C = 4.12947

5. Poonch

QP = C + PK20*PKX20 + PP14*PPX14 + PS9*PSX9 + PS18*PSX18 + PS20*PSX20 + PM5*PMX5 + PM19*PMX19

WHERE

PK20 = 0.02700, (Kohala precipitation coefficient of 20th day.)
PP14 = 0.01861, (Palandri precipitation coefficient of 14th day.)
PS9 = 0.02542, PS18 = 0.03461, PS20 = 0.03834, (Sahar Kakota precipitation coefficient of 9th, 18th and 20th day respectively.)
PM5 = 0.02202, PM19 = 0.02684,(Mangla precipitation coefficient of 5th and 19th day respectively.)
C = 11.21568

6. Mangla

QM = C + QK20*QKX20 + QP8*QPX8 + QP19*QPX19 + QP20*QPX20

WHERE

QK20 = 1.13553, (Kohala discharge coefficient of 20th day.)
QP8 = 0.35364, QP19 =-0.20373, QP20 = 1.16688(Poonch discharge coefficient of 8th, 19th and 20th day respectively.)
C = -5.67059

4.14 For The Period 11/08 to 20/08

Site Equation

G.Habibullah

QH = C + M2*MX2 + M5*MX5 + B2*BX2 + QH3*QHX3 + QH19*QHX19 + QH20*QHX20

WHERE

M2 = 0.09328, M5 = 0.03402, (Muzaffarabad maximum temperature coefficient of 2nd and 5th day respectively.)
B2 =-0.06917, (Ballakot maximum temperature coefficient of 2nd day.)
QH3 = 0.15985, QH19 = 0.21420, QH20 = 0.51547,(Habib discharge coefficient of 3rd, 19th and 20th day respectively.)
C = -1.94941

2. Muzaffar Abad QM = C + M2*MX2 + B5*BX5 + QM20*QMX20

WHERE
M2 = 0.09058, (Muzaffarabad maximum temperature coefficient of 2nd day.)
B5 = 0.08335, (Ballakot maximum temperature coefficient of 5th day.)
QM20 = 0.92993 (Muzafferabad discharge coefficient of 20th day.)
C = -4.78969

3. Domel QD = C + M7*MX7 + M19*MX19 + B9*BX9 + QD13*QDX13 + QD19*QDX19 + QD20*QDX20

WHERE

M7 = 0.04326, M19 =-0.07398, (Muzaffarabad maximum temperature coefficient of 7th and 19th day respectively.)
B9 = 0.06029, (Ballakot maximum temperature coefficient of 9th day.)
QD13 =-0.10628, QD19 = 0.33406, QD20 = 0.71423,(Domel discharge coefficient of 13th, 19th and 20th day respectively.)
C = -0.25286

4. Kohala QK = C + QM1*QMX1 + QM6*QMX6 + QK19*QKX19 + QK20*QKX20

WHERE

QM1 =-0.14110, QM6 = 0.26249, (Muzafferabad discharge coefficient of 1st and 6th day respectively.)
QK19 = 0.21512, QK20 = 0.62114,(Kohala discharge coefficient of 19th and 20th day respectively.)
C = 2.00442

5. Poonch QP = C + PK11*PKX11 + PK12*PKX12 + PK14*PKX14 + PK15*PKX15 + PK16*PKX16 + PK17*PKX17 + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP16*PPX16 + PP19*PPX19 + PP20*PPX20 + PS13*PSX13 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM20*PMX20

WHERE

PK11 = 0.02116, PK12 = 0.01613, PK14 = 0.01522, PK15 = 0.02409, PK16 = 0.02663, PK17 = 0.02696, PK18 = 0.02603, PK19 = 0.01857, PK20 = 0.03275, (Kohala precipitation coefficient of 11th, 12th, 14th, 15th, 16th, 17th, 18th, 19th and 20th day respectively.)
PP16 = 0.00968, PP19 = 0.01463, PP20 = 0.02754, (Palandri precipitation coefficient of 16th, 19th and 20th day respectively.)
PS13 = 0.01113, PS18 = 0.01464, PS19 = 0.01642, PS20 = 0.01834, (Sahar Kakota precipitation coefficient of 13th, 18th, 19th and 20th day respectively.)
PM20 = 0.01919 (Mangla precipitation coefficient of 20th day.)
C = 2.96597

6. Mangla

QM = C + QK19*QKX19 + QP10*QPX10 + QP15*QPX15 + QP20*QPX20 + QMN9*QMNX9 + QMN12*QMNX12

WHERE

QK19 = 0.76156, (Kohala discharge coefficient of 19th day.)
QP10 = 0.17100, QP15 = 0.31287, QP20 = 1.64261, (Poonch discharge coefficient of 10th, 15th and 20th day respectively.)
QMN9 = 0.07950, QMN12 = 0.08848, (Mangla discharge coefficient of 9th and 12th day respectively.)
C =-13.36487

4.15 For The Period 21/08 to 30/08

Site Equation

1. G.Habibullah

QH = C + A4*AX4 + M1*MX1 + B15*BX15 + QH10*QHX10 + QH15*QHX15 + QH16*QHX16 + QH20*QHX20

WHERE

A4 =-0.03737, (Astore maximum temperature coefficient of 4th day.)
M1 = 0.03872, (Muzaffarabad maximum temperature coefficient of 1st day.)
B15 =-0.05065, (Ballakot maximum temperature coefficient of 15th day.)
QH10 =-0.16929, QH15 = 0.24854, QH16 = 0.18322, QH20 = 0.56503(Habib discharge coefficient of 10th, 15th, 16th and 20th day respectively.)
C = 1.96734

2. Muzaffar Abad

QM = C + A4*AX4 + A16*AX16 + A20*AX20 + B13*BX13 + QM20*QMX20

WHERE

A4 =-0.19441, A16 = 0.11054, A20 = 0.12848, (Astore maximum temperature coefficient of 4th, 16th and 20th day respectively.)
B13 = 0.17134, (Ballakot maximum temperature coefficient of 13th day.)
QM20 = 0.87010 (Muzafferabad discharge coefficient of 20th day.)
C = -5.04043

3. Domel

QD = C + B11*BX11 + B14*BX14 + B17*BX17 + QD20*QDX20

WHERE

B11 =-0.09025, B14 =-0.06940, B17 =-0.06313, (Ballakot maximum temperature coefficient of 11th, 14th and 17th day respectively.)
QD20 = 0.99667 (Domel discharge coefficient of 20th day.)
C = 6.81671

4. Kohala

QK = C + QM19*QMX19 + QM20*QMX20 + QK18*QKX18 + QK20*QKX20

WHERE

QM19 = 0.21024, QM20 =-0.09054, (Muzafferabad discharge coefficient of 19th and 20th day respectively.)
QK18 = 0.27338, QK20 = 0.64783, (Kohala discharge coefficient of 18th and 20th day respectively.)
C = -0.45017

5. Poonch

QP = C + PK17*PKX17 + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP16*PPX16 + PP20*PPX20 + PS20*PSX20 + PM20*PMX20

WHERE

PK17 = 0.11085, PK18 = 0.12197, PK19 = 0.06881, PK20 = 0.16548, (Kohala precipitation coefficient of 17th, 18th, 19th and 20th day respectively.)
PP16 = 0.11780, PP20 = 0.09917, (Palandri precipitation coefficient of 16th and 20th day respectively.)
PS20 = 0.27013, (Sahar Kakota precipitation coefficient of 20th day.)
PM20 = 0.07542 (Mangla precipitation coefficient of 20th day.)
C = 0.00000

6. Mangla

QM = C + QK17*QKX17 + QK19*QKX19 + QP19*QPX19 + QP20*QPX20

WHERE

QK17 = 0.44696, QK19 = 0.51352, (Kohala discharge coefficient of 17th and 19th day respectively.)
QP19 =-0.76137, QP20 = 2.70417,(Poonch discharge coefficient of 19th and 20th day respectively.)
C = -2.89181

4.16 Regression Equations For Computing 10 Daily Mean Inflow of Mangla For The Period 01/09 to 10/09

Site	Equation
1. G.Habibullah	QH = C + M1*MX1 + B7*BX7 + QH16*QHX16 + QH20*QHX20

WHERE

M1 = 0.06164, (Muzaffarabad maximum temperature coefficient of 1st day.)
B7 =-0.08070, (Ballakot maximum temperature coefficient of 7th day.)
QH16 = 0.24423, QH20 = 0.68895,(Habib discharge coefficient of 16th and 20th day respectively.)
C = 0.50137

2. Muzaffar Abad QM = C + A14*AX14 + M3*MX3 + B2*BX2 + B7*BX7 + QM19*QMX19 + QM20*QMX20

WHERE

A14 = 0.07416, (Astore maximum temperature coefficient of 14th day.)
M3 = 0.09438, (Muzaffarabad maximum temperature coefficient of 3rd day.)
B2 =-0.08519, B7 =-0.11482, (Ballakot maximum temperature coefficient of 2nd and 7th day respectively.)
QM19 =-0.26778, QM20 = 1,14298,(Muzafferabad discharge coefficient of 19th and 20th day respectively.)
C = 2.32786

3. Domel QD = C + A13*AX13 + M14*MX14 + B6*BX6 + B10*BX10 + QD20*QDX20

WHERE

A13 = 0.05866, (Astore maximum temperature coefficient of 13th day.)
M14 =-0.08775, (Muzaffarabad maximum temperature coefficient of 14th day.)
B6 =-0.10455, B10 =-0.05678, (Ballakot maximum temperature coefficient of 6th and 10th day respectively.)
QD20 = 0.94270 (Domel discharge coefficient of 20th day.)
C = 6.89346

4. Kohala QK = C + QK20*QKX20

WHERE

QK20 = 0.98865 (Kohala discharge coefficient of 20th day.)
C = -0.05585

5. Poonch

QP = C + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP18*PPX18 + PS18*PSX18 + PS20*PSX20

WHERE

PK18 = 0.01956, PK19 = 0.02872, PK20 = 0.02878, (Kohala precipitation coefficient of 18th, 19th and 20th day respectively.)
PP18 = 0.01238, (Palandri precipitation coefficient of 18th day.)
PS18 = 0.01863, PS20 = 0.01287,(Sahar Kakota precipitation coefficient of 18th and 20th day respectively.)
C = 4.03069

6. Mangla

QM = C + QK20*QKX20 + QP19*QPX19 + QP20*QPX20 + QMN20*QMNX20

WHERE

QK20 = 0.82312, (Kohala discharge coefficient of 20th day.)
QP19 =-1.47982, QP20 = 1.54724, (Poonch discharge coefficient of 19th and 20th day respectively.)
QMN20 = 0.53572(Mangla discharge coefficient of 20th day.)
C = -4.59205

4.17 For The Period 11/09 to 20/09

Site	Equation
1. G.Habibullah	QH = C + A4*AX4 + QH18*QHX18 + QH20*QHX20

WHERE

A4=-0.00953 (Astore maximum temperature coefficient of 4th day.)
QH18= 0.25732 QH20= 0.62733 (Habib discharge coefficient of 18th and 20th day respectively.)
C = 0.39403

2. Muzaffar Abad QM = C + M16*MX16 + M20*MX20 + QM20*QMX20

WHERE

M16=-0.03680 M20= 0.05301 (Muzaffarabad maximum temperature coefficient of 16th and 20th day respectively.)
QM20= 0.91176 (Muzafferabad discharge coefficient of 20th day.)
C = -0.10095

3. Domel

QD = C + M8*MX8 + M18*MX18 + B6*BX6 + B11*BX11 + B13*BX13 + B15*BX15 + QD18*QDX18 + QD20*QDX20

WHERE

M8=-0.05373 M18=-0.06049 (Muzaffarabad maximum temperature coefficient of 8th and 18th day respectively.)
B6= 0.03766 B11= 0.05968 B13=-0.05224 B15=-0.03024 (Ballakot maximum temperature coefficient of 6th 11th 13th and 15th day respectively.)
QD18= 0.13450 QD20= 0.76408 (Domel discharge coefficient of 18th and 20th day respectively.)
C = 3.61140

4. Kohala

QK = C + QM20*QMX20 + QD20*QDX20 + QK20*QKX20

WHERE

QM20= 0.23512 (Muzafferabad discharge coefficient of 20th day.)
QD20= 0.56076 (Domel discharge coefficient of 20th day.)
QK20= 0.46640 (Kohala discharge coefficient of 20th day.)
C = 2.19401

5. Poonch

QP = C + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP18*PPX18 + PP19*PPX19 + PS18*PSX18 + PS19*PSX19 + PS20*PSX20 + PM18*PMX18 + PM20*PMX20

WHERE

PK18= 0.05413 PK19= 0.04999 PK20= 0.05539 (Kohala precipitation coefficient of 18th 19th and 20th day respectively.)
PP18= 0.02423 PP19= 0.04168 (Palandri precipitation coefficient of 18th and 19th day respectively.)
PS18= 0.02823 PS19= 0.04994 PS20= 0.03668 (Sahar Kakota precipitation coefficient of 18th 19th and 20th day respectively.)
PM18= 0.01924 PM20= 0.02428 (Mangla precipitation coefficient of 18th and 20th day respectively.)
C = 0.00000

6. Mangla

QM = C + QK20*QKX20 + QP19*QPX19 + QP20*QPX20 + QMN19*QMNX19

WHERE

QK20= 0.67737 (Kohala discharge coefficient of 20th day.)
QP19=-1.67023 QP20= 2.39540 (Poonch discharge coefficient of 19th and 20th day respectively.)
QMN19= 0.26643 (Mangla discharge coefficient of 19th day.)
C = 1.56382

4.18 For The Period 21/09 to 30/09

Site Equation

1. G.Habibullah QH = C + A6*AX6 + A15*AX15 + A20*AX20 + M19*MX19 + B6*BX6 + QH20*QHX20

WHERE

A6 = 0.01218, A15 = 0.00452, A20 = 0.00823, (Astore maximum temperature coefficient of 6th, 15th and 20th day respectively.)
M19 = 0.01129, (Muzaffarabad maximum temperature coefficient of 19th day.)
B6 =-0.01436, (Ballakot maximum temperature coefficient of 6th day.)
QH20 = 0.68169(Habib discharge coefficient of 20th day.)
C = 0.10927

2. Muzaffar Abad QM = C + A18*AX18 + QM20*QMX20

WHERE

A18 = 0.01035, (Astore maximum temperature coefficient of 18th day.)
QM20 = 0.89618 (Muzafferabad discharge coefficient of 20th day.)
C = 0.29240

3. Domel QD = C + M11*MX11 + QD18*QDX18 + QD19*QDX19 + QD20*QDX20

WHERE

M11 = 0.05214, (Muzaffarabad maximum temperature coefficient of 11th day.)
QD18 = 0.23652, QD19 = 0.24093, QD20 = 0.40449,(Domel discharge coefficient of 18th, 19th and 20th day respectively.)
C = -1.23981

4. Kohala QK = C + QK20*QKX20

WHERE

QK20 = 0.93660 (Kohala discharge coefficient of 20th day.)
C = 0.51838

5. Poonch QP = C + PK18*PKX18 + PK19*PKX19 + PK20*PKX20 + PP18*PPX18 + PS18*PSX18 + PS20*PSX20

WHERE

PK18 = 0.01956, PK19 = 0.02872, PK20 = 0.02878, (Kohala

precipitation coefficient of 18th, 19th and 20th day respectively.)
PP18 = 0.01238, (Palandri precipitation coefficient of 18th day.)
PS18 = 0.01853, PS20 = 0.01287,(Sahar Kakota precipitation coefficient of 18th and 20th day respectively.)
C = 4.03069

6. Mangla

QM = C + QK20*QKX20 + QP19*QPX19 + QP20*QPX20

WHERE

QK20 = 0.88846, (Kohala discharge coefficient of 20th day.)
QP19 =-0.69143, QP20 = 1.79089,(Poonch discharge coefficient of 19th and 20th day respectively.)
C = 1.80888

YASIN

3.3.2. FORECAST COMPUTATIONAL PROCESS:

Ten daily inflow computations at Mangla is carried out on day to day basis with the help of the computrised model. The computations are carried out in the following steps.

step 1: Forecast discharge computations for sub catchments of rivers Kunhar, Neelum, and Jhelum at Garhihabibullah, Muzaffarabad and Domel respectively.

Step 2: Forecast computations of Kohala discharge.

Step 3: Forecast computations of Poonch dischage (at Kotli)

Step 4: Mangla inflow forecast computations.

Step1:- FORECAST DISCHARGE COMPUTATIONS AT GARHIHABIBULLAH, MUZAFFARABAD AND DOMEL.

A total of previous 20 days maximum temperature data of the sub catchment of Kunhar, Neelum and Jhelum (upstream of Domel) is used for computations. Discharge data of the previous 20 days is used for the assesment of the initial conditions. The model computes the forecast for the 21st day, using the temperature and discharge data of day 1st to day 20th.

Then for computing the forecast for 22nd day, the computed

discharge value for the 21st day shall be used as an input, while the discharge data for 1st is elliminated. Forecast temperature for the 21st is used while the maximum temperature data of the day 1st is elliminated. This way the forecast for 22nd is computed. This process is carried forward over a total of ten days period to compute a daily forecast for the future 10 days.

Step2:- KOHALA FORECAST COMPUTATIONS:

Kohala forecast computations are based upon the computations of step one above. In order to compute the discharge for the 21st day the observed discharges from 1st to 20th for the sites Garhihabibullah , Muzafferabad, Domel are used as input to the model alongwith the Kohala discharge values from 1st to 20th . The model then computes forecast for 21st day, which shall now become a part of input data for Kohala for the subsequent model run by elliminating the data for 1st day. Thus the total length of data shall remain the same i.e. 20 days. The data of 21st for Domel, Muzafferabad and Garhihabibullah used in Kohala computations shall already be available from step one.

The process is continued and at the end of each model run a forecast value for Kohala is obtained. This way ten forecast values for Kohala are obtained.

Step3:- POONCH RIVER DISCHARGE COMPUTATIONS:

Rainfall to run off transformations is required for the Poonch river subcatchment, since it is essentially the rain fed sub catchment.

Rainfall data of Sehar Kakota , Kotli, Palandri and Mangla is used as independent inputs against the Kotli discharge as the dependent variable. 1st to 20th day rainfall data is used for computing the forecast discharge for the 21st day at Kotli. Subsequent discharge forecast is obtained by providing the forecast rainfall (in milimeters) for the above four sites. The ellimination of the old data in favour of the latest one to maintain a total of 20 days data is done in a simillar manner as described in step one above.

Step4:- MANGLA INFLOW FORECAST:

Kohala discharge and the Poonch discharge constitute the two inputs to this all important part of the model. In order to compute the Mangla inflow for 21st day the data for 1st to 20th for Kohala and Poonch is used along with the inflow data of Mangla for the same period. Forecast of 21st thus obtained is used as input while maintaining the same data length (data of 16th is elliminated for all inputs). This yields the forecast inflow for 22nd day.The process is continued on day to day computational basis, till such time that the inflow discharge for Mangla for all the ten days period is obtained.The mean of the ten values thus obtained gives the ten days mean inflow discharge for Mangla.

A typical example showing the actual computations with the help of regression equations relating to 10 day forecasts (Period June 21-30,1988) for the sites Garhihabibullah, Muzaffarabad, Domel, Kohala, Poonch and Mangla are listed as Annexure VI.

3.3.3. METEOROLOGICAL FORECAST PROCEDURE:

The meteorological forecast forms an important component of the overall forecasting procedure for 10 daily forecast. Analogue method is used to estimate the forecast rainfall for future five days. Under stable meteorological conditions (A dry spell or well marked rain spell)., the period of forecast could be extended to 10 days as well. The forecast method (which would be further improved with the time) is based upon the identification of the set of meteorological factors related to the rainfall (both positively as well as negatively). It has been assumed that the effect of the meteorological factors on the catchment precipitation would be very similar in future to what has been recorded in the past i.e. the same or similar intensity of rain related meteorological factors shall cause the similar pattern of rainfall (both in terms of amount as well as areal distribution) in future as had occured in the past. Since it is always not one but a number of factors (with interrelated effect) which together cause a certain type of weather, it is therefore necessary to formulate a scheme through which a certain weightage could be assigned to each such factor. The weightage shall be reflected qualitatively in terms of relative priority in the identification process. A large number of occasions when the rain occured in the Mangla catchment have been recorded along with the set of meteorological factors which caused it. This data have been computrised. A computer programme (as listed as Annexure VII) which runs in the conversational mode, asks for the factors systematically as per the laid down scheme. The operator has already with him the factors identified from the current meteorological

charts etc and is thus in a position to answer the question one by one. When a certain factor is identified the computer scanes through the total list of recorded rain events and then formulates a new list elliminating those events in which the identified factor was absent. Thus a new list of events (in which the identified factors contributed to the rainfall) emerges out of the previous total list. Then the next factor is identified and the computer now formulates a new list(out of the previous list) in which the second factor also played its role in the precipitation process. This way eventually a final list consisting of only those rain events in which all the identified factors were present is presented by the computer on the screen along with the amount and areal extent of the precipitation that occured during past events. Rain forecast is then inferred in the light of the past record and the current meteorological situation. A total number of 13 factors listed below have been used in the programme for forecasting the catchment rainfall.

1. Position of the seasonal low.
2. Intensity of seasonal low in terms of closed isobars.
3. Seasonal low's position at 5000'feet level.
4. Strength of southwesterly wind at 3000'feet level.
5. Surface position of Monsoon low.
6. Intensity of monsoon low in terms of closed isobars.
7. Position of monsoon low at 5000'feet level.
8. Surface wind speed of the monsoon current.
9. Wind speed at 5000' feet of the monsoon current.
10. Depth of monsoon current in thousand of feet.
11. Position of Intratropical Convergence Zone.

12. Position of western disturbance at 500 mb.
13. Position of western disturbance at 300 mb.

The rainfall forecast shall then be used to compute the rainfall runoff or the surface runoff contribution to the total Mangla inflow through the discharge computations of Poonch river.

3.3.4 ASSESSMENT OF THE MODEL ACCURACY:

3.3.4.1 SEASONAL FORECAST:

Assessment of the model accuracy was done by computing the forecasts for all the years individually. As mentioned earlier the data for the years 1976 to 1989 was actually used towards model formulation of the snow melt component of the seasonal runoff. The data for the years 1971 to 1975 and 1990, 1991 was set aside for the independent varification of the forecast. Thus the forecast for the years 1976 to 1989 provides an indication of the general health of the model, while the model output for the years 1971 to 1975 and 1990, 1991 is the real test of the model accuracy.

A bar graph placed as (Exhibit XVIII) provides the comparison between the actual and the forecast. Average error appers to be less than 5% , while the error is less than even 2% for the years 1971 and 1972. Only for the year 1975 the error is close to about 23% . This depicts an extremely encouraging situation. The model is thus fully trust worthy and is expected to yeild reliable results in future, with average error expected between 5-10 % , while only in rare cases it may reach 20 % .

3.3.4.2. TEN DAILY FORECAST:

The model formulation for ten daily forecast computation was based upon the data for the years 1980 to 1987. This relatively short data period was caused by non availability of the past (historical) data of the hydrological sites. Despite short period of data the last three years data i.e. for the years 1988, 1989 and 1990 was set aside for verification purpose and was not used up in the model formulation. The model results for the three test years are listed in the tables A.1, A.2 and A.3. Three bar graphs pertaining to the three years i.e. 1988,89 and 1990 are places as Exhibit XIX,XX and XXI. The percentage error in the ten daily forecast in 64% of the cases is below 10% while in all cases it is well within 25% limit of accuracy and touches this limit in two cases only. The forecast for the ten daily period from 11th July to 20th July 1990 is missing. This is because data required by the model for the computation of this forecast was not available.

It is thus concluded that despit the lack of sufficient data the model even in this form is operationally usable. It is however strongly felt that more data is required to strengthen its base and further improve the results. The improvement in this model shall therefore be continued by incorporating the hydrometeorological data which shall become available (at the end of each year) in future. The model is based upon inherently sound scientific consideration and is expected to provide an extremely useful information to WAPDA in the form of 10 daily inflow forecast for Mangla.

10-DAILY FORECAST EVALUATION TABLE (A-1)

PERIOD: (APRIL - SEPTEMBER)

YEAR 1988:

MONTH	PERIOD	ACTUAL	COMP.	% ERROR.
APRIL	01 - 10	38.5	41.2	-7.0
	11 - 20	54.9	54.2	+1.3
	21 - 30	61.2	62.1	-1.5
MAY	01 - 10	61.5	56.3	+8.5
	11 - 20	54.3	56.5	-4.1
	21- 31	51.4	53.6	-4.3
JUNE	01 - 10	50.1	50.9	-1.6
	11 - 20	41.0	39.4	+3.9
	21 - 30	59.5	56.5	+5.0
JULY	01 - 10	60.4	56.0	+7.3
	11 - 20	105.9	90.3	+14.7
	21 - 31	96.3	90.4	+6.1
AUGUST	01 - 10	87.6	78.8	+10.0
	11 - 20	55.0	49.7	+9.6
	21 - 31	36.0	33.8	+6.1
SEPTEMBER	01 - 10	23.6	26.9	-14.0
	11 - 20	19.9	15.3	+23.1
	21 - 31	23.3	19.0	+18.5

10-DAILY FORECAST EVALUATION TABLE (A-2)

PERIOD: (APRIL - SEPTEMBER)

YEAR 1989:

MONTH	PERIOD	ACTUAL	COMP.	% ERROR.
APRIL	01 - 10	36.5	31.8	+12.9
	11 - 20	33.8	36.4	-7.7
	21 - 30	34.2	37.0	-8.2
MAY	01 - 10	51.7	47.4	+8.3
	11 - 20	62.0	57.8	+6.8
	21 - 31	72.7	70.8	+2.6
JUNE	01 - 10	89.9	90.4	-0.6
	11 - 20	65.5	65.3	+.3
	21 - 30	50.8	50.6	+.4
JULY	01 - 10	46.6	47.3	-1.5
	11 - 20	54.7	58.2	-6.4
	21 - 31	62.3	55.6	+10.8
AUGUST	01 - 10	78.4	75.8	+3.3
	11 - 20	42.5	43.3	-1.9
	21 - 31	37.8	33.0	+12.7
SEPTEMBER	01 - 10	22.1	24.0	- 8.6
	11 - 20	16.7	15.4	+ 7.8
	21 - 31	18.5	16.0	+13.6

10-DAILY FORECAST EVALUATION TABLE (A-3)

PERIOD: (APRIL - SEPTEMBER)

YEAR 1990:

MONTH	PERIOD	ACTUAL	COMP.	% ERROR.
APRIL	01 - 10	51.0	52.6	-3.2
	11 - 20	54.2	42.2	+22.1
	21 - 30	65.4	63.3	+3.2
MAY	01 - 10	78.7	61.8	+21.5
	11 - 20	98.3	74.4	+24.3
	21- 31	82.4	75.9	+7.9
JUNE	01 - 10	62.6	60.9	+2.7
	11 - 20	52.5	47.0	+10.5
	21 - 30	73.3	58.3	+20.5
JULY	01 - 10	71.2	59.2	+16.9
	11 - 20	Data not available.		
	21 - 31	40.7	49.6	-21.9
AUGUST	01 - 10	48.8	39.4	+19.3
	11 - 20	41.6	36.2	+13.0
	21 - 31	34.3	33.0	+3.8
SEPTEMBER	01 - 10	33.2	35.8	-7.8
	11 - 20	23.5	19.0	+19.0
	21 - 31	19.2	20.1	-4.7

4. CONCLUDING REMARKS:

The study provides a new tool for the seasonal and 10 daily inflow forecasting into Mangla reservoir. The approach is absolutely unique and unconvensional. The model is capable of incorporating new inputs (if considered relevent) and thus has the easy provision for further improvement specially in as far as 10 daily forecast is concerned. The results in respect of seasonal forecasts are exceedingly accurate and thus substantiate the authenticity of the basic concepts involved and the approach adopted.

Ten daily forecasts computational procedure above Kohala uses the maximum temperature data since it is essentially computes the amount of melt-water yeild under the changing thermal conditions. Computations between Kohala and Mangla are based upon thermal as well as precipitation considerations.

The accuracy in this case is also well within acceptible limits. Average error being within 10% and the maximum 20%.

Further improvement of this part of the model could also be undertaken during the years to come when more data becomes available. In the meantime this part of the model is also fully useable for all practical purposes and applications.

* Yasin*

```
*-----------------------------------------------------------------
*       Programme Written by : Mr. Tajdar Hussain, Meteorologist.
*       Programme Name : MFM20.for
*       This program creats data file to be used in SPSS/PC+ for
*       Flood Routing
*       Program opens four types of raw data files viz;
*       Type-1: Mean Daily Discharge
*       Type-2: Daily  Max. Temperature
*       Type-3: Daily Rain fall
*
*-----------------------------------------------------------------
*       Program Begins
*
$Storage:2
$Debug
*
        Program MAKEFILE
*
        Character*20 IFFQ, IFFMxT, IFFMiT, IFFCC, IFFRf, OFFMD
        Character*20 IFN(5)
        Integer      FM, FD, DIM(12), D, DS, DE, DSL, DEL, DSC, DEC
        Integer      RD, DL, DC, DD, FY, Y, FN, DE1, DE2, DEC1, DEC2
        Integer    TEMP,TEMP1
        Real       Q(12,31), Q1(12,31), Q2(12,31), Q4(12,31)
        REAL QD(12,31),Q3(12,31)
*
        Data DIM/31,28,31,30,31,30,31,31,30,31,30,31/
*
*       Statement to clear screen.
        Write(*,'(1x,2a)') Char(27), '[2J'
*
        Write(*,
     +'(1(/),'' Enter Output file name for merged data       : ''\)')
        Read (*,'(a)') OFFMD
        Open (10, File=OFFMD,  Status='Old')
*
*       Procedure to select forcast period.
*
        Write(*,
     +'(/,'' Enter Beginning Date for forcast data [Month, Day] ''\)')
        Read(*,*) IM,ID
        Write(*,
     +'(/,'' Enter  Ending   Date for forcast data [Month, Day] ''\)')
        Read(*,*) FM,FD
*
        Write(*,'(1(/),'' Enter Beginning year : ''\)')
        Read (*,*) IY
*
        Write(*,'(1(/),'' Enter  Ending   year : ''\)')
        Read (*,*) FY
        Write(*,'(1(/),'' Enter Number Of Inputs : '',\)')
        Read(*,*) INP
*
        Do 001 Y=IY, FY
*
        If (Mod(Y,4) .Eq. 0) DIM(2)=29
*
```

```
*       Statement to clear screen.
        Write(*,'(1x,2a)') Char(27), '[2J'
*
        Write(*,'(2(/),'' Enter file names for the year '',i4)') Y
*       Procedure to read input, output file name and to open it.
*
        Write(*,
     +'(4(/),'' Enter output file name for Discharge              ''\)')
        Read (*,'(a)') IFFQ
        Open (1, File=IFFQ,   Status='Old')
*
        Write(*,
     +'(1(/),'' Enter First input File Name  ''\)')
        Read (*,'(a)') IFFMxT
        Open (2, File=IFFMxT, Status='Old')
        If(inp.eq.2)go to 450
*
        Write(*,
     +'(1(/),'' Enter Second Input File Name :''\)')
        Read (*,'(a)') IFFMiT
        Open (3, File=IFFMiT, Status='Old')
        If(inp.eq.3)go to 450
*
        Write(*,
     +'(1(/),'' Enter Third Input File Name ''\)')
        Read (*,'(a)') IFFCC
        Open (4, File=IFFCC , Status='Old')
        If(inp.eq.4)go to 450
*
        Write(*,
     +'(1(/),'' Enter Fourth Input File Name ''\)')
        Read (*,'(a)') IFFRf
        Open (5, File=IFFRf,  Status='Old')
450     continue
**
        Write(*,'(// '' Reading data''\)')
        Do 100 D=1,31
        Read (1,'(1x,12f9.1)',Err=777,End=999) (Q(M,D),M=1,12)
        Read (2,'(1x,12F9.1)') (Q1(M,D),M=1,12)
        If(inp.eq.2)go to 550
        Read (3,'(1x,12F9.1)') (Q2(M,D),M=1,12)
        If(inp.eq.3)go to 550
        Read (4,'(1x,12F9.1)')(Q3(M,D),M=1,12)
        If(inp.eq.4)go to 550
        Read (5,'(1x,12f9.1)') (Q4(M,D), M=1,12)
550     continue
100     Continue
        Write(*,'(/ '' Reading completed'')')
        Do 200 M=IM, FM
        If (M .Eq. FM) DIM(M)=FD
                Do 300 D=ID, DIM(M)
                IF(D.GT.20)THEN
                RD=D-20
                LOS1=RD
                LOE1=RD+9
                LOS2=LOE1+1
                LOE2=LOS2+9
```

```
      WRITE(10,'(F7.1)')Q(M,D)
      WRITE(10,'(10F7.1)')(Q1(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q1(M,J),J=LOS2,LOE2)
      IF(INP.EQ.2)THEN
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q2(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q2(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.2)GOTO 650
      IF(INP.EQ.3)THEN
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q3(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q3(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.3)GOTO 650
      IF(INP.EQ.4)THEN
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q4(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q4(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.4)GOTO 650
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
650   CONTINUE
      ENDIF
      IF(D.LE.20.AND.D.GT.11)THEN
      RD=20-D
      TEMP=0
      TEMP1=0
      LOS1=DIM(M-1)-RD
      LOE1=LOS1+9
      IF(LOE1.GT.DIM(M-1))LOE1=LOE1-DIM(M-1)
      LOS2=LOE1+1
      LOE2=LOS2+9
      WRITE(10,'(F7.1)')Q(M,D)
      WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS1,DIM(M-1)),
     +(Q1(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q1(M,J),J=LOS2,LOE2)
      IF(INP.EQ.2)THEN
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,DIM(M-1)),
     +(Q(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS1,DIM(M-1)),
     +(Q2(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q2(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.2)GOTO 655
      IF(INP.EQ.3)THEN
```

```
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,DIM(M-1)),
     +(Q(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS1,DIM(M-1)),
     +(Q3(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q3(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.3)GOTO 655
      IF(INP.EQ.4)THEN
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,DIM(M-1)),
     +(Q(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS1,DIM(M-1)),
     +(Q4(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q4(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.4)GOTO 655
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,DIM(M-1)),
     +(Q(M,J),J=1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
655   CONTINUE
      ENDIF
      IF(D.EQ.11)THEN
      RD=20-D
      LOS1=DIM(M-1)-RD
      LOE1=LOS1+9
      LOS2=LOE1+1
      IF(LOS2.GT.DIM(M-1))LOS2=LOS2-DIM(M-1)
      LOE2=LOS2+9
      WRITE(10,'(10F7.1)')Q(M,D)
      WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q1(M,J),J=LOS2,LOE2)
      IF(INP.EQ.2)THEN
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q2(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.2)GO TO 657
      IF(INP.EQ.3)THEN
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
311   FORMAT(5X,'D LOS1 LOE1 LOS2 LOE2',/,5X,5I10)
      ELSE
      WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q3(M,J),J=LOS2,LOE2)
      ENDIF
      IF(INP.EQ.3)GO TO 657
      IF(INP.EQ.4)THEN
      WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
      WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
      ELSE
      WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS1,LOE1)
```

```
              WRITE(10,'(10F7.1)')(Q4(M,J),J=LOS2,LOE2)
              ENDIF
              IF(INP.EQ.4)GO TO 657
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q(M,J),J=LOS2,LOE2)
657           CONTINUE
              ENDIF
              IF(D.LE.10.AND.D.GT.1)THEN
              RD=20-D
              LOS1=DIM(M-1)-RD
              LOE1=LOS1+9
              LOS2=LOE1+1
              LOE2=LOS2+9
              IF(LOE2.GT.DIM(M-1))LOE2=LOE2-DIM(M-1)
              WRITE(10,'(F7.1)')Q(M,D)
              WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q1(M,J),J=1,LOE2)
              IF(INP.EQ.2)THEN
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q(M,J),J=1,LOE2)
              ELSE
              WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q2(M,J),J=1,LOE2)
              ENDIF
              IF(INP.EQ.2)GO TO 658
              IF(INP.EQ.3)THEN
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q(M,J),J=1,LOE2)
              ELSE
              WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q3(M,J),J=1,LOE2)
              ENDIF
              IF(INP.EQ.3)GO TO 658
              IF(INP.EQ.4)THEN
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q(M,J),J=1,LOE2)
              ELSE
              WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q4(M,J),J=1,LOE2)
              ENDIF
              IF(INP.EQ.4)GO TO 658
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
              WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,DIM(M-1)),
     +        (Q(M,J),J=1,LOE2)
658           CONTINUE
              ENDIF
              IF(D.EQ.1)THEN
              RD=20-D
              LOS1=DIM(M-1)-RD
```

```
                LOE1=LOS1+9
                LOS2=LOE1+1
                LOE2=LOS2+9
                WRITE(10,'(F7.1)')Q(M,D)
                WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q1(M-1,J),J=LOS2,LOE2)
                IF(INP.EQ.2)THEN
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,LOE2)
                ELSE
                WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q2(M-1,J),J=LOS2,LOE2)
                ENDIF
                IF(INP.EQ.2)GOTO 670
                IF(INP.EQ.3)THEN
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,LOE2)
                ELSE
                WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q3(M-1,J),J=LOS2,LOE2)
                ENDIF
                IF(INP.EQ.3)GOTO 670
                IF(INP.EQ.4)THEN
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,LOE2)
                ELSE
                WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q4(M-1,J),J=LOS2,LOE2)
                ENDIF
                IF(INP.EQ.4)GOTO 670
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS1,LOE1)
                WRITE(10,'(10F7.1)')(Q(M-1,J),J=LOS2,LOE2)
670             CONTINUE
                ENDIF
300             CONTINUE
***             ID=1
200             CONTINUE
                CLOSE(2)
                CLOSE(3)
                CLOSE(4)
                CLOSE(5)
001             CONTINUE
                CLOSE(1)
*
                Stop
*
777   If(Y .Lt. 1900) Y=Y+1900
      Write(*,'('' Invalid Data after '',2(I2,''-''),i4,'' in file '',a)
     +')    M, D, Y, IFN(FN)
      Stop ' Please check input file'
*
999   If(Y .Lt. 1900) Y=Y+1900
      Write(*,'('' Data Misssing after '',2(I2,''-''),i4,'' in file '',a)
     +')    M, D, Y, IFN(FN)
      Stop ' Please check last record of input file'
*
```

```
$storage:2
$debug
C          Programme : PARG.FOR
C       Programme written by : M.Yasin S.O. Flood forecasting & Warning
C       Centre,Lahore for picking up the Coefficient from a file i.e
C       "SPSS.LIS" and rewriting them in the files as written in the
C        file "FILE.SPS".
C       ------------------------------------------------------------
C      Files Used by this programme:
C      SPSS.LIS : SPSS package always creats the resulted file"SPSS.LIS",
C      FILE.SPS : This file contains the name of those files in which
C                 the coefficients will be writen.
c        ---------------------------------------------
C       Variables & Characters:
C       parh  :   Parameters
C       Var   :   Abbreviation for station name with element i.e
C                Temperature,  Rain or Discharge.
C       Line :   This stands for whole the line as 80 characters and other
C                charaters i.e. nam, ma, fil, nam1, a1 and out are used
C                for putting the different conditions by truncating the line
C                Moreover bx,cx,dx,and dy are used to balance the line in
C                file " Spss.lis"
C     ---------------------------------------------------------------
C       Programme begins

        dimension parh(50)
        character line*80,nam*25,var(50)*4,ma*3,fil*3,nam1*25,a1*14
        character  out*23
        open(1,file='file.sps',status='old')
        a1='\spss\spss.lis'
        open(3,file=a1,status='old')

C       This loop reads the File names to Write the Parameters
C       for each Ponits.

            do 60 mt=1,6
        read(1,'(a)',end=99)fil
        open(2,file=fil,status='old')
12      continue

C       This loop reads the File " Spss.lis" then pick up the required
C       Parameters.

        do 10 i=1,1000
        read(3,'(a)',end=99)line
        nam1=line(20:)
        ma=line(24:)
        out=line(7:)
        if(out.eq.'procedure was completed')goto 61
        if(ma.eq.'PIN'.or.ma.eq.'POU')then
        do 30 n=1,L
        write(2,'(a,6x,f13.6)')var(n),parh(n)
        write(*,'(5x,a,6x,f13.6)')var(n),parh(n)
30      continue
```

```
C       This loop initinalizes the Dimension for variables i.e Station
C       Names,  and Parametrs.

                do 15 mb=1,50
        var(mb)=0
        parh(mb)=0
15      continue
        endif

        if(nam1.eq.'Variables in the Equation')then
        read(3,'(a)')line
        read(3,'(a)')line
        read(3,'(a)')line

C       This loop reads the required parameters only.

               do 20 k=1,50
        L=K
        read(3,'(a,6x,f13.6,f12.6,f11.6,f10.4,f7.5)',err=12)var(k),
     #parh(k),bx,cx,dx,dy
        if(var(k).eq.'(Con')goto 12
20      continue
        endif
10      continue
61      continue
        close(2)
60      continue
99      continue
        close(1)
        close(3)
        end
```

II

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```
$storage:2
$debug
*       Programme :  PARARA.FOR
*       Programme written by : M.Yasin S.O.
*       Picks up the Coefficients from  file(s) " pp1,pp2 ,...PP6 "and
*        rewrites them in the required form.
C      ------------------------------------------------------------
C       Files used by this Programme:
C       P_arrang  :  It writes the coefficients in the required way in
C                    this file.
C       File.par  :  This file contains the name of the files from which
C                    Parameters have to be read.
C      ------------------------------------------------------------------
        dimension parh(20)
        character nam*4,ma*2,ca*2,pf*3

                open(1,file='p_arrang',status='new')
                open(3,file='file.par',status='old')

*       This loop open the files to read the co-efficients for differents
*       forecasting points not more than six (6).

                        do 12 km=1,6
        read(3,'(a)',end=99)pf
        open(2,file=pf,status='old')
*       if(km.eq.5)then
*        read(2,*)(parh(m),m=1,20)
*       write(1,'(20f10.6)')(parh(m),m=1,20)
*        read(2,*)(parh(m),m=1,20)
*       write(1,'(20f10.6)')(parh(m),m=1,20)
*       read(2,*)(parh(m),m=1,20)
*       write(1,'(20f10.6)')(parh(m),m=1,20)
*        read(2,*)(parh(m),m=1,20)
*       write(1,'(20f10.6)')(parh(m),m=1,20)
*        read(2,*)(parh(m),m=1,20)
*       write(1,'(20f10.6)')(parh(m),m=1,20)
*        read(2,*)pcon
*       write(1,'(f10.6)')pcon
*        else

        n=4
        if(km.eq.5)n=5
        if(km.eq.6)n=3

*       This loop reads the name of the Parameters written the
C       file "file.par"

                  do 10 i=1,n
        read(3,'(a)')ca
*       Loops 17 and 11 reads and writes the Parameters in the
C       symetrical forms as required.

                  do 17 k=1,20
        parh(k)=0
17      continue
```

```
            do 11 j=1,20

      read(2,'(a,6x,f13.6)',end=15)nam,coeff
      nam1=nam(:2)
      ma=nam( 3:)
      if(nam1.eq.ca)then
      if(ma.eq.'01')l=01
      if(ma.eq.'02')l=02
      if(ma.eq.'03')l=03
      if(ma.eq.'04')l=04
      if(ma.eq.'05')l=05
      if(ma.eq.'06')l=06
      if(ma.eq.'07')l=07
      if(ma.eq.'08')l=08
      if(ma.eq.'09')l=09
      if(ma.eq.'10')l=10
      if(ma.eq.'11')l=11
      if(ma.eq.'12')l=12
      if(ma.eq.'13')l=13
      if(ma.eq.'14')l=14
      if(ma.eq.'15')l=15
      if(ma.eq.'16')l=16
      if(ma.eq.'17')l=17
      if(ma.eq.'18')l=18
      if(ma.eq.'19')l=19
      if(ma.eq.'20')l=20

      write(*,'(2x,''nam1  ca    ma = ''a,2x,a,2x,a)')nam1,ca,ma

      parh(l)=coeff
      endif
11    continue
15    continue

      write(1,'(20f9.5)')(parh(m),m=1,20)

      rewind(2)
10    continue

      write(1,'(1x,f9.5)')coeff
*     endif
12    continue
99    continue
      close(1)
      close(2)
      close(3)
      stop
      end
```

```
$STORAGE:2
$DEBUG
C       Programme : DATINP.FOR
C       Programmer : M.Yasin Senior Observer.
C       This programme enter the Discharge/Rainfall Data in the file
C       " t20.dat " and then copy this to s20.dat  for the required
C       period, and calculate the actual mean value for the said Period
C       for Mangla.
C       ---------------------------------------------------
C       Files  used by this Programme :
C       ..................................
C       CO: This file contains Original Data file's Names from which Data
C           will be extracted.
C       \nln\data: The next data values  is writtes in this file to use as
C                  a forecasted Values by the programme " Maninfr.for "
C       s20.dat:  The programme reads 20 values from this file at a time
C        and  so on.
C       t20.dat:  The Programme writes new 20 values in this file.
C       mn1:      The programme writes actual 10 days mean, Preiod of
C                 Forecasts etc. in this file.
C        ---------------------------------------------------
C       Variables Description:
C       M = Month ,
C       num1 = Intinal Date,
C       num2 = Final Date
C       Dat1..13 = Data from  the first file .. 13th file.
C       Charecters:  SN1 = Station Name, and Ye = Year
C    ------------------------------------------------------------------------
C       Programme Begins

        DIMENSION DAT1(31,12),DAT2(31,12),DAT3(31,12),DAT4(31,12)
        DIMENSION DAT5(31,12),DAT6(31,12),DAT7(31,12),dt(31,12)
        DIMENSION DAT8(31,12),DAT9(31,12),DAT10(31,12),dat11(31,12)
        DIMENSION DAT12(31,12),DAT13(31,12),DAT(60)

        CHARACTER SN1(10)*9,filn(13)*8,ye*2

        OPEN (1,FILE='co',STATUS='OLD')
        open(6,file='\nln\data',status='new')

        write(*,'(5x,'' Month for which data is required ? '',$)')
                     read(*,'(i2)')m
        WRITE(*,'(5X,''Give the starting date for input data ?  '',$)')
                     read(*,'(i2)')num1
        WRITE(*,'(5X,''Give the ending  date for input data ?   '',$)')
                     read(*,'(i2)')num2
        num=num2-num1

C       This loop  gets the next file for reading the Data

                Do 10 i=1,14

        READ(1,'(a)',end=99)filn(i)
        ye = filn(i)(6:)
        open(2,file=filn(i),status='old')
```

```
C       This loop reads the data i.e Temperature, Rainfal and Discharges
C       at  different sites .

                do 20 i1=1,35

        if(i.eq.1)READ(2,'(1X,12f9.1)',end=9)(dat1(i1,j),j=1,12)
        if(i.eq.2)READ(2,'(1X,12f9.1)',end=9)(dat2(i1,j),j=1,12)
        if(i.eq.3)READ(2,'(1X,12f9.1)',end=9)(dat3(i1,j),j=1,12)
        if(i.eq.4)READ(2,'(1X,12f9.1)',end=9)(dat4(i1,j),j=1,12)
        if(i.eq.5)READ(2,'(1X,12f9.1)',end=9)(dat5(i1,j),j=1,12)
        if(i.eq.6)READ(2,'(1X,12f9.1)',end=9)(dat6(i1,j),j=1,12)
        if(i.eq.7)READ(2,'(1X,12f9.1)',end=9)(dat7(i1,j),j=1,12)
        if(i.eq.8)READ(2,'(1X,12f9.1)',end=9)(dat8(i1,j),j=1,12)
        if(i.eq.9)READ(2,'(1X,12f9.1)',end=9)(dat9(i1,j),j=1,12)
        if(i.eq.10)READ(2,'(1X,12f9.1)',end=9)(dat10(i1,j),j=1,12)
        if(i.eq.11)READ(2,'(1X,12f9.1)',end=9)(dat11(i1,j),j=1,12)
        if(i.eq.12)READ(2,'(1X,12f9.1)',end=9)(dat12(i1,j),j=1,12)
        if(i.eq.13)READ(2,'(1X,12f9.1)',end=9)(dat13(i1,j),j=1,12)

20      continue
9       continue
10      continue
99      continue
        close(2)
        close(1)

        OPEN (4,FILE='\nln\S20.DAT',STATUS='OLD')
        OPEN (5,FILE='\nln\T20.DAT',STATUS='OLD')

C       This loop reads the 20 values ,turn by turn, from the file
C       " s20.dat "

                do 60 i=1,100

        READ(4,600,end=999)SN1(1),(DAT(J),J=1,10)
        READ(4,600)SN1(1),(DAT(J),J=11,20)
        j=21

C       This loop transfers the required data into array dat(j)
C       and at the end it writes this data in the file "t20.dat"

                do 8 nn=num1,num2

        if(i.eq.1)dat(j)=dat1(nn,m)
        if(i.eq.2)dat(j)=dat2(nn,m)
        if(i.eq.3)dat(j)=dat3(nn,m)
        if(i.eq.4)dat(j)=dat4(nn,m)
        if(i.eq.5)dat(j)=dat5(nn,m)
        if(i.eq.6)dat(j)=dat6(nn,m)
        if(i.eq.7)dat(j)=dat7(nn,m)
        if(i.eq.8)dat(j)=dat8(nn,m)
        if(i.eq.9)dat(j)=dat9(nn,m)
        if(i.eq.10)dat(j)=dat10(nn,m)
```

```
      if(i.eq.11)dat(j)=dat11(nn,m
      if(i.eq.12)dat(j)=dat12(nn,m
      if(i.eq.13)dat(j)=dat13(nn,m
      j=j+1
8     continue

      WRITE(5,600)SN1(1),(DAT(J),J=num+2,11+num)
      WRITE(5,600)SN1(1),(DAT(J),J=num+12,num+21)

60    continue
999   continue
600   FORMAT(1X,A,10F9.1)
      CLOSE(4)
      CLOSE(5)
      if(num2.gt.27)then
      m=m+1
      num2=0
      endif
      sm=0
      in5=num2+5
      IN7=NUM2+7
      IN10=NUM2+10
      write(6,'(i2)')num+1

C     This loop writes the next Values (Forecasted)in the file
C      "\nln\data" and calculate the sum and 10-days mean and
C     at the end writes it in the file " MN1 " for the use of
C     comparison etc. by the next programme.

              do 11 k=num2+1,num2+10
      write(6,'(f5.1)')dat1(k,m)
      write(6,'(f5.1)')dat2(k,m)
      write(6,'(f5.1)')dat3(k,m)
      write(6,'(f5.1)')dat8(k,m)
      write(6,'(f5.1)')dat9(k,m)
      write(6,'(f5.1)')dat10(k,m)
      write(6,'(f5.1)')dat11(k,m)
*      write(6,'(f5.1)')dat13(k,m)
      sm=sm+dat13(k,m)
      if(k.eq.in5)sm5=sm/5.
      if(k.eq.in7)sm7=sm/7.
      if(k.eq.in10)sm10=sm/10.
11    continue
      open(7,file='\nln\mn1',status='new')
      num1=num2+1
      if(num1.ge.28)num1=1
      num2=num1+num
      write(7,'(3f9.1,3i6,2x,a)')sm5,sm7,sm10,m,num1,num2,ye
      STOP '                Normal end of datinp.for'
      END
```

IV

```
$storage:2
$debug
*       MEDIUM RANGE RUN OFF FORECAST MODEL FOR MANGLA RESERVOIR.
*       PROGRAM NAME = MANINF.FOR
*       ------------------------------------------------------------------
*       PRGRAM TO CALCULATE THE DAILY MEAN DISCHARGES AT
*       1.G.HABIBULLAH
*       2.MUZAFFARABAD
*       3.DOMEL
*         BY USING THE TEMPERATURES OF ASTORE, MUZAFFAERABAD & BALAKOT.
*       4.ROUTING THE THREE LEGS TO COMPUTE THE DISCHARGES AT KOHALA
*       5.USING DISCHARGES AT KOHALA & RAINFALL IN THE LOWER JHELUM
*         CATCHMENT TO COMPUTE THE MEAN DISCHARGES INTO MANGLA LAKE.
*       ------------------------------------------------------------------
*       THE PROGRAM HAS BEEN DESIGNED TO COMPUTE DAILY MEAN DISCHARGES
*       OR TO COMPUTE THE MEAN DISCHARGES OVER A CERTAIN PERIOD OF TIME.
*       ------------------------------------------------------------------
*       PROGRAMMER:TAJDAR HUSSAIN (METEOROLOGIST) F.F.& W.C.LAHORE.
*       ------------------------------------------------------------------
        REAL MUZQ(12),KOHQ(12),MANQ(12),MUZMX(12),KOHM,MANM,MUZT,KOHT
        REAL MUZM,PONQ(12),KOTP,SEHP,PULP,MANP(12),tmh(3),tmm(3),tmd(3)
        DIMENSION DAT1(25),DAT2(25),DAT3(25),DAT4(25),DAT5(25),tmk(3)
        DIMENSION PAR1(20),PAR2(20),PAR3(20),PAR4(20),PAR5(20),tmp(3)
        DIMENSION FCT(15),ASTMX(12),HABQ(12),ASTMN(12),datx(20),tmg(3)
        DIMENSION BALMX(12),DOMQ(12),KOTP(12),PULP(12),SEHP(12)
        CHARACTER*13 GH,MZ,DM,KL,MG,NAM1,NAM2,NAM3,NAM4,NAM5,PO,ye*2
        GH='G.HABIBBULLAH'
        MZ='MUZAFFARABAD'
        DM='DOMEL'
        KL='KOHALA'
        PO='PONCH'
        MG='MANGLA'
        OPEN(1,FILE='MANGLAR.DAT',STATUS='OLD')
        OPEN(2,FILE='MANGLAR.PAR',STATUS='OLD')
        OPEN(3,FILE='RES.TEP',STATUS='NEW')
        OPEN(4,FILE='FLOWR',STATUS='NEW')
        open(5,file='Mean',status='new')
        open(7,file='mn1',status='old')
        read(7,'(3f9.1,3i6,2x,a)')tmn5,tmn7,tmn10,mth,num1,num2,ye
        WRITE(*,'(2X,''PERIOD OF FORECAST ?  '',/)')
        READ(*,*)NDF
        DO 560 I=1,NDF
        WRITE(*,'(2X,''ASTORE MAX TEMP'',I2,''   DAYS AHEAD  '',/)')I
        READ(*,'(F7.1)')ASTMX(I)
        WRITE(*,'(2X,''MUZBAD MAX TEMP'',I2,''   DAYS AHEAD   '',/)')I
        READ(*,'(F7.1)')MUZMX(I)
        WRITE(*,'(2X,''BALAKOT MAX TEMP.'',I2,''   DAYS AHEAD  '',/)')I
        READ(*,'(F7.1)')BALMX(I)
        WRITE(*,'(2X,''KOTLI RAIN. '',I2,''     DAYS AHEAD   '',/)')I
        READ(*,'(F7.1)')KOTP(I)
        WRITE(*,'(2X,''PULUNDRI RAIN. '',I2,''    DAYS AHEAD '',/)')I
        READ(*,'(F7.1)')PULP(I)
        WRITE(*,'(2X,''SEHRKAKOTA RAIN. '',I2,''  DAYS AHEAD '',/)')I
        READ(*,'(F7.1)')SEHP(I)
        WRITE(*,'(2X,''MANGLA RAIN. '',I2,''      DAYS AHEAD '',/)')I
```

```
      READ(*,'(F7.1)')MANP(I)
560   CONTINUE
      DO 500 N=1,6
      if(n.eq.4.or.n.eq.5 .or.n.eq.6)then
      READ(1,590)NAM1,(DATx(J),J=1,10)
      READ(1,590)NAM1,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM3,(DATx(J),J=1,10)
      READ(1,590)NAM3,(DATx(J),J=11,20)
      if(n.eq.5.or.n.eq.6)then
      READ(1,590)NAM1,(DATx(J),J=1,10)
      READ(1,590)NAM1,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      if(N.eq.6)then
      READ(1,590)NAM1,(DAT1(J),J=1,10)
      READ(1,590)NAM1,(DAT1(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DATx(J),J=1,10)
      READ(1,590)NAM2,(DATx(J),J=11,20)
      READ(1,590)NAM2,(DAT2(J),J=1,10)
      READ(1,590)NAM2,(DAT2(J),J=11,20)
      READ(1,590)NAM3,(DAT3(J),J=1,10)
      READ(1,590)NAM3,(DAT3(J),J=11,20)
      endif
      READ(1,590,END=505)NAM1,(DAT1(J),J=
      READ(1,590,END=505)NAM1,(DAT1(J),J=
      endif
      endif
      READ(1,590)NAM1,(DAT1(J),J=1,10)
      READ(1,590)NAM1,(DAT1(J),J=11,20)
      READ(1,590)NAM2,(DAT2(J),J=1,10)
      READ(1,590)NAM2,(DAT2(J),J=11,20)
      READ(1,590)NAM3,(DAT3(J),J=1,10)
      READ(1,590)NAM3,(DAT3(J),J=11,20)
      if(n.eq.2 .or.n.eq.3)then
      READ(1,590)NAM5,(DATx(J),J=1,10)
      READ(1,590)NAM5,(DATx(J),J=11,20)
      if(n.eq.3)then
      READ(1,590)NAM5,(DATx(J),J=1,10)
      READ(1,590)NAM5,(DATx(J),J=11,20)
      endif
      endif
580   CONTINUE
      READ(1,590)NAM4,(DAT4(J),J=1,10)
      READ(1,590)NAM4,(DAT4(J),J=11,20)
      if(N.eq.5)then
      READ(1,590)NAM5,(DAT5(J),J=1,10)
```

```
      READ(1,590)NAM5,(DAT5(J),J=11,20)
      DO 26 L=1,19
      DAT1(L)=DAT1(L+1)
      DAT2(L)=DAT2(L+1)
      DAT3(L)=DAT3(L+1)
      DAT4(L)=DAT4(L+1)
26    continue
      DAT1(20)=KOTP(1)
      DAT2(20)=PULP(1)
      DAT3(20)=SEHP(1)
      DAT4(20)=manp(1)
      endif
505   CONTINUE
      READ(2,*)(PAR1(J),J=1,20)
      READ(2,*)(PAR2(J),J=1,20)
      READ(2,*)(PAR3(J),J=1,20)
590   FORMAT(1x,A9,10F9.1)
      IF(N.NE.6)then
      READ(2,*)(PAR4(J),J=1,20)
      if(N.eq.5)read(2,*)(par5(j),j=1,20)
      endif
      READ(2,*)CONST
      write(*,'(5x,''  constant  ''f10.6)')const
      DO 10 I=1,NDF
      FCT(I)=0.0
      write(3,590)NAM1,(DAT1(J),J=1,10)
      write(3,590)NAM1,(DAT1(J),J=11,20)
      write(3,590)NAM2,(DAT2(J),J=1,10)
      write(3,590)NAM2,(DAT2(J),J=11,20)
      write(3,590)NAM3,(DAT3(J),J=1,10)
      write(3,590)NAM3,(DAT3(J),J=11,20)
      IF(N.NE.6)THEN
      write(3,590)NAM4,(DAT4(J),J=1,10)
      write(3,590)NAM4,(DAT4(J),J=11,20)
      ENDIF
      IF(N.eq.5)THEN
      write(3,590)NAM5,(DAT5(J),J=1,10)
      write(3,590)NAM5,(DAT5(J),J=11,20)
      ENDIF
      DO 20 K=1,20
      IF(N.EQ.6)then
      FCT(I)=FCT(I)+DAT1(K)*PAR1(K)+DAT2(K)*PAR2(K)+DAT3(K)*PAR3(K)
    elseif(n.eq.5)then
      fct(i)=fct(i)+DAT1(K)*PAR1(K)+DAT2(K)*PAR2(K)+DAT3(K)*PAR3(K)+
   +DAT4(K)*PAR4(K)+DAT5(K)*PAR5(K)
      else
    FCT(i)=FCT(i)+DAT1(K)*PAR1(K)+DAT2(K)*PAR2(K)+DAT3(K)*PAR3(K)+
   +DAT4(K)*PAR4(K)
      endif
20    CONTINUE
      FCT(I)=FCT(I)+CONST
      write(3,'(5x,'' Constant '' f10.6)')const
      write(3,'(5x,''fct(i)'',f10.6)')fct(i)
      DO 30 L=1,19
      DAT1(L)=DAT1(L+1)
      DAT2(L)=DAT2(L+1)
```

V

97

```
      DAT3(L)=DAT3(L+1)
      IF(N.NE.6)DAT4(L)=DAT4(L+1)
30    CONTINUE
      IF(N.EQ.4)THEN
      DAT1(20)=HABQ(I)
      DAT2(20)=MUZQ(I)
      DAT3(20)=DOMQ(I)
      DAT4(20)=FCT(I)
      ELSE IF(N.EQ.5)THEN
      DAT1(20)=KOTP(I+1)
      DAT2(20)=PULP(I+1)
      DAT3(20)=SEHP(I+1)
      DAT4(20)=manp(I+1)
      dat5(20)=fct(i)
      ELSE IF(N.EQ.6)THEN
      DAT1(20)=KOHQ(I)
      DAT2(20)=PONQ(I)
      DAT3(20)=FCT(I)
      ELSE
      DAT1(20)=ASTMX(I)
      DAT2(20)=MUZMX(I)
      DAT3(20)=BALMX(I)
      DAT4(20)=FCT(I)
      ENDIF
10    CONTINUE
750   CONTINUE
      DO 40 I=1,ndf
      if(fct(i).lt.0)fct(i)=2.0
      IF(N.EQ.1)HABQ(I)=FCT(I)
      IF(N.EQ.2)MUZQ(I)=FCT(I)
      IF(N.EQ.3)DOMQ(I)=FCT(I)
      IF(N.EQ.4)KOHQ(I)=FCT(I)
      IF(N.EQ.5)PONQ(I)=FCT(I)
      IF(N.EQ.6)MANQ(I)=FCT(I)
40    CONTINUE
      rewind(1)
500   CONTINUE
      HABT=0
      MUZT=0
      DOMT=0
      KOHT=0
      MANT=0
      PONT=0
      DO 620 I=1,NDF
      HABT=HABT+HABQ(I)
      MUZT=MUZT+MUZQ(I)
      DOMT=DOMT+DOMQ(I)
      KOHT=KOHT+KOHQ(I)
      PONT=PONT+PONQ(I)
      MANT=MANT+MANQ(I)
      if(i.eq.5.or.i.eq.7.or.i.eq.10)then
      if(i.eq.5)k1=1
      if(i.eq.7)k1=2
      if(i.eq.10)k1=3
```

```
      tmh(k1)=habt/float(i)
      tmm(k1)=muzt/float(i)
      tmd(k1)=domt/float(i)
      tmk(k1)=koht/float(i)
      tmp(k1)=pont/float(i)
      tmg(k1)=mant/float(i)
      endif
620   CONTINUE
      HABM=HABT/FLOAT(NDF)
      MUZM=MUZT/FLOAT(NDF)
      DOMM=DOMT/FLOAT(NDF)
      KOHM=KOHT/FLOAT(NDF)
      PONM=PONT/FLOAT(NDF)
      MANM=MANT/FLOAT(NDF)
      WRITE(4,545)NDF
      write(4,'(32x,''For the period''i4''/''i2'' to ''i2''/''i2''/''
     #a,/,)')num1,mth,num2,mth,ye
      write(5,'(,/,20x''FIVE,SEVEN & TEN DAYS MEAN VALUES'',/,
     #20X,35(''='')),/,)')
      write(5,'(20x,''For the period''i4''/''i2'' to ''i2''/''i2''/''
     #a,/,)')num1,mth,num2,mth,ye
      write(5,'(20x,'' 5 days Mean  7 days Mean  10 days Mean'',/,)')
      write(5,'(10x,a9,3f12.1)')gh,(tmh(j),j=1,3)
      write(5,'(10x,a9,3f12.1)')mz,(tmm(j),j=1,3)
      write(5,'(10x,a9,3f12.1)')dm,(tmd(j),j=1,3)
      write(5,'(10x,a9,3f12.1)')kl,(tmk(j),j=1,3)
      write(5,'(10x,a9,3f12.1)')po,(tmp(j),j=1,3)
      write(5,'(10x,a9,3f12.1)')mg,(tmg(j),j=1,3)
      WRITE(4,550)GH,(HABQ(J),J=1,NDF),HABM
      WRITE(4,550)MZ,(MUZQ(J),J=1,NDF),MUZM
      WRITE(4,550)DM,(DOMQ(J),J=1,NDF),DOMM
      WRITE(4,550)KL,(KOHQ(J),J=1,NDF),KOHM
      WRITE(4,550)PO,(PONQ(J),J=1,NDF),PONM
      WRITE(4,550)MG,(MANQ(J),J=1,NDF),MANM
545   FORMAT(30X,'MEAN ',I2,' DAYS FORCASTED DISCHARGES',/,/,30X,
     + 32('-'),/)
550   FORMAT(1X,A9,11F9.1)
      pr5=((tmn5-tmg(1))/tmn5)*100.
      pr7=((tmn7-tmg(2))/tmn7)*100.
      pr10=((tmn10-tmg(3))/tmn10)*100.
      write(5,'(9x,''Mangla.act'',3f12.1)')tmn5,tmn7,tmn10
      write(5,'(10x,'' % Diff  '',3f12.1)')pr5,pr7,pr10
      STOP          'NORMAL EXIT'
      END
```

ACTUAL COMPUTATIONAL PROCESS

Data set and the regression equations indicating the Computation steps for the one ten daily period.

GARI HABIBULLAH:

											PERIOD
ASTX	23.0	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	[1 - 10]
ASTX	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	[11 - 20]
MUZX	44.0	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	[1 - 10]
MUZX	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	[11 - 20]
BALX	40.9	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	[1 - 10]
BALX	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	[11 - 20]
HABQ	12.3	9.1	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	[1 - 10]
HABQ	6.4	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	[11 - 20]

Y(Forecast Discharge for the 21st day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y = 4.06263 + .05549*22.0 - .04116*26.5 - .04576*38.0
- .06012*41.5 - .08251*34.8 +.06283*38.0
+ .34055*6.9 - .18856*10.5 + .95141*11.4

Y(Forecast Discharge for the 21st day) = 10.690990

ASTX	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	[1 - 10]
ASTX	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	[11 - 20]
MUZX	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	[1 - 10]
MUZX	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	[11 - 20]
BALX	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	[1 - 10]
BALX	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	[11 - 20]
HABQ	9.1	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	[1 - 10]
HABQ	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	[11 - 20]

Y(Forecast Discharge for the 22nd day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 22nd day) = 10.050620

ASTX	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	[1 - 10]
ASTX	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	[11 - 20]
MUZX	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	[1 - 10]
MUZX	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	[11 - 20]
BALX	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	[1 - 10]
BALX	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	[11 - 20]
HABQ	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	[1 - 10]
HABQ	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	[11 - 20]

Y(Forecast Discharge for the 23rd day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 23rd day) = 10.669190

ASTX	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	[1 - 10]
ASTX	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	[11 - 20]
MUZX	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	[1 - 10]
MUZX	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	[11 - 20]
BALX	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	[1 - 10]
BALX	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	[11 - 20]
HABQ	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	[1 - 10]
HABQ	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	[11 - 20]

Y(Forecast Discharge for the 24th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 24th day) = 10.243900

ASTX	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	[1 - 10]
ASTX	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	[11 - 20]
MUZX	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	[1 - 10]
MUZX	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	[11 - 20]
BALX	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	[1 - 10]
BALX	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	[11 - 20]
HABQ	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	[1 - 10]
HABQ	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	[11 - 20]

Y(Forecast Discharge for the 25th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 25th day) = 9.960817

ASTX	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	[1 - 10]
ASTX	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	[11 - 20]
MUZX	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	[1 - 10]
MUZX	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	[11 - 20]
BALX	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	[1 - 10]
BALX	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	[11 - 20]
HABQ	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	[1 - 10]
HABQ	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	[11 - 20]

Y(Forecast Discharge for the 26th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 26th day) = 9.970480

ASTX	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	[1 - 10]
ASTX	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	[11 - 20]
MUZX	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	[1 - 10]
MUZX	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	[11 - 20]
BALX	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	[1 - 10]
BALX	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	[11 - 20]
HABQ	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	6.9	[1 - 10]
HABQ	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	[11 - 20]

Y(Forecast Discharge for the 27th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 27th day) = 9.809370

ASTX	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	[1 - 10]
ASTX	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	[11 - 20]
MUZX	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	[1 - 10]
MUZX	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	[11 - 20]
BALX	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	[1 - 10]
BALX	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	[11 - 20]
HABQ	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	6.9	8.8	[1 - 10]
HABQ	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	[11 - 20]

Y(Forecast Discharge for the 28th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 28th day) = 10.035520

ASTX	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	[1 - 10]
ASTX	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	[11 - 20]
MUZX	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	[1 - 10]
MUZX	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	[11 - 20]
BALX	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	[1 - 10]
BALX	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	[11 - 20]
HABQ	5.7	6.0	6.4	7.2	7.8	6.9	6.9	6.9	8.8	9.4	[1 - 10]
HABQ	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	10.0	[11 - 20]

Y(Forecast Discharge for the 29th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 29th day) = 9.510782

ASTX	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	[1 - 10]
ASTX	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	31.0	[11 - 20]
MUZX	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	[1 - 10]
MUZX	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	41.0	[11 - 20]
BALX	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	[1 - 10]
BALX	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	38.2	[11 - 20]
HABQ	6.0	6.4	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	[1 - 10]
HABQ	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	10.0	9.5	[11 - 20]

Y(Forecast Discharge for the 30th day) = 4.06263 + .05549*ASTX12
- .04116*MUZX9 - .04576*MUZX10
- .06012*MUZX14 -.08251*BALX7 + .06283*BALX20
+ .34055*HABQ16 - .18856*HABQ19 + .95141*HABQ20

Y(Forecast Discharge for the 30th day) = 9.907174

MUZAFFARABAD

ASTX	23.0	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	[1 - 10]
ASTX	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	[11 - 20]
MUZX	44.0	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	[1 - 10]
MUZX	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	[11 - 20]
BALX	40.9	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	[1 - 10]
BALX	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	[11 - 20]
MUZQ	40.1	35.0	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	[1 - 10]
MUZQ	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	[11 - 20]

Y(Forecast Discharge for the 21st day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 +.22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 21st day) = 4.27243 - .13258*26.0
- .19437*26.0 - .11172*26.5
- .09019*39.8 +.22412*36.5 - .14379*34.8
+ .12331*34.9 + .16578*40.2 + 1.03444*35.0

Y(Forecast Discharge for the 21st day) = 39.571350

ASTX	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	[1 - 10]
ASTX	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	[11 - 20]
MUZX	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	[1 - 10]
MUZX	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	[11 - 20]
BALX	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	[1 - 10]
BALX	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	[11 - 20]
MUZQ	35.0	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	[1 - 10]
MUZQ	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	[11 - 20]

Y(Forecast Discharge for the 22nd day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 +.22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 22nd day) = 39.648140

ASTX	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	[1 - 10]
ASTX	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	[11 - 20]
MUZX	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	[1 - 10]
MUZX	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	[11 - 20]
BALX	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	[1 - 10]
BALX	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	[11 - 20]
MUZQ	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	[1 - 10]
MUZQ	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	[11 - 20]

Y(Forecast Discharge for the 23rd day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 +.22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 23rd day) = 40.553600

ASTX	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	[1 - 10
ASTX	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	[11 - 20
MUZX	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	[1 - 10
MUZX	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	[11 - 20
BALX	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	[1 - 10
BALX	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	[11 - 20
MUZQ	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	[1 - 10
MUZQ	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	[11 - 20

Y(Forecast Discharge for the 24th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 +.22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 24th day) = 40.335910

ASTX	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	[1 - 10]
ASTX	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	[11 - 20]
MUZX	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	[1 - 10]
MUZX	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	[11 - 20]
BALX	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	[1 - 10]
BALX	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	[11 - 20]
MUZQ	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	[1 - 10]
MUZQ	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	[11 - 20]

Y(Forecast Discharge for the 25th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 + .22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 25th day) = 39.703990

ASTX	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	[1 - 10]
ASTX	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	[11 - 20]
MUZX	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	[1 - 10]
MUZX	38.7	39.5	39.3	38.6	41.0	41.5	41.5	36.7	38.2	40.6	[11 - 20]
BALX	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	[1 - 10]
BALX	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	[11 - 20]
MUZQ	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	[1 - 10]
MUZQ	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	[11 - 20]

Y(Forecast Discharge for the 26th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 + .22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 26th day) = 39.989850

ASTX	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	[1 - 10]
ASTX	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	[11 - 20]
MUZX	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	[1 - 10]
MUZX	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	[11 - 20]
BALX	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	[1 - 10]
BALX	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	[11 - 20]
MUZQ	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	[1 - 10]
MUZQ	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	[11 - 20]

Y(Forecast Discharge for the 27th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 + .22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 27th day) = 37.940330

ASTX	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	[1 - 10]
ASTX	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	[11 - 20]
MUZX	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	[1 - 10]
MUZX	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	[11 - 20]
BALX	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	[1 - 10]
BALX	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	[11 - 20]
MUZQ	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	[1 - 10]
MUZQ	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	[11 - 20]

Y(Forecast Discharge for the 28th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 + .22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 28th day) = 40.094540

ASTX	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	[1 - 10]
ASTX	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	[11 - 20]
MUZX	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	[1 - 10]
MUZX	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	[11 - 20]
BALX	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	[1 - 10]
BALX	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	[11 - 20]
MUZQ	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	[1 - 10]
MUZQ	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	40.1	[11 - 20]

Y(Forecast Discharge for the 29th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9
- .09019*MUZX18 + .22412*BALX3 - .14379*BALX7
+ .12331*BALX8 + .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 29th day) = 38.972600

ASTX	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	[1 - 10]
ASTX	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	31.0	[11 - 20]
MUZX	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	[1 - 10]
MUZX	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	41.0	[11 - 20]
BALX	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	[1 - 10]
BALX	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	38.2	[11 - 20]
MUZQ	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	[1 - 10]
MUZQ	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	40.1	39.0	[11 - 20]

Y(Forecast Discharge for the 30th day) = 4.27243 - .13258*ASTX17
- .19437*MUZX2 - .11172*MUZX9 - .09019*MUZX18
+.22412*BALX3 - .14379*BALX7 + .12331*BALX8
+ .16578*BALX15 + 1.03444*MUZQ20

Y(Forecast Discharge for the 30th day) = 39.338290

DOMEL:

ASTX	23.0	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	[1 - 10]
ASTX	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	[11 - 20]
MUZX	44.0	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	[1 - 10]
MUZX	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	[11 - 20]
BALX	40.9	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	[1 - 10]
BALX	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	[11 - 20]
DOMQ	14.3	14.4	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	[1 - 10]
DOMQ	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	[11 - 20]

Y(Forecast Discharge for the 21st day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 +.04161*MUZX17
- .0547*BALX18 - .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 21st day) = -2.41021 + .03335*23.0
+ .06139*27.0 + .08622*28.0
- .05159*26.0 +.04161*39.5
- .0547*39.8 - .03698*15.4 + 1.04616*10.5

Y(Forecast Discharge for the 21st day) = 11.094720

ASTX	20.0	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	[1 - 10]
ASTX	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	[11 - 20]
MUZX	26.0	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	[1 - 10]
MUZX	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	[11 - 20]
BALX	30.4	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	[1 - 10]
BALX	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	[11 - 20]
DOMQ	14.4	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	[1 - 10]
DOMQ	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	[11 - 20]

Y(Forecast Discharge for the 22nd day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20 - .05159*MUZX2
+.04161*MUZX17 - .0547*BALX18 - .03698*DOMQ5
+ 1.04616*DOMQ20

Y(Forecast Discharge for the 22nd day) = 11.279790

ASTX	22.0	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	[1 - 10]
ASTX	22.0	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	[11 - 20]
MUZX	36.8	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	[1 - 10]
MUZX	42.8	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	[11 - 20]
BALX	36.5	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	[1 - 10]
BALX	40.9	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	[11 - 20]
DOMQ	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	[1 - 10]
DOMQ	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	[11 - 20]

Y(Forecast Discharge for the 23rd day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 23rd day) = 11.377680

ASTX	17.0	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	[1 - 10]
ASTX	24.0	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	[11 - 20]
MUZX	37.0	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	[1 - 10]
MUZX	41.5	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	[11 - 20]
BALX	38.0	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	[1 - 10]
BALX	40.8	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	[11 - 20]
DOMQ	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	[1 - 10]
DOMQ	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	[11 - 20]

Y(Forecast Discharge for the 24th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 24th day) = 11.641520

ASTX	15.0	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	[1 - 10]
ASTX	21.0	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	[11 - 20]
MUZX	33.0	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	[1 - 10]
MUZX	42.0	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	[11 - 20]
BALX	32.6	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	[1 - 10]
BALX	40.2	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	[11 - 20]
DOMQ	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	[1 - 10]
DOMQ	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	[11 - 20]

Y(Forecast Discharge for the 25th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 25th day) = 11.690920

ASTX	19.0	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	[1 - 10]
ASTX	21.0	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	[11 - 20]
MUZX	36.5	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	[1 - 10]
MUZX	38.7	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	[11 - 20]
BALX	30.8	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	[1 - 10]
BALX	37.6	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	[11 - 20]
DOMQ	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	[1 - 10]
DOMQ	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	[11 - 20]

Y(Forecast Discharge for the 26th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 26th day) = 12.244970

ASTX	19.0	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	[1 - 10]
ASTX	26.0	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	[11 - 20]
MUZX	37.0	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	[1 - 10]
MUZX	39.5	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	[11 - 20]
BALX	34.8	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	[1 - 10]
BALX	37.5	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	[11 - 20]
DOMQ	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	[1 - 10]
DOMQ	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	[11 - 20]

Y(Forecast Discharge for the 27th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 27th day) = 12.034830

ASTX	20.0	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	[1 - 10]
ASTX	27.0	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	[11 - 20]
MUZX	37.0	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	[1 - 10]
MUZX	39.8	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	[11 - 20]
BALX	34.9	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	[1 - 10]
BALX	37.5	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	[11 - 20]
DOMQ	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	[1 - 10]
DOMQ	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	[11 - 20]

Y(Forecast Discharge for the 28th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 28th day) = 12.757020

ASTX	20.0	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	[1 - 10]
ASTX	28.0	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	[11 - 20]
MUZX	26.5	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	[1 - 10]
MUZX	38.6	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	[11 - 20]
BALX	25.7	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	[1 - 10]
BALX	36.2	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	[11 - 20]
DOMQ	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	[1 - 10]
DOMQ	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	12.8	[11 - 20]

Y(Forecast Discharge for the 29th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 29th day) = 12.549090

ASTX	18.0	22.0	22.0	22.0	24.0	21.0	21.0	26.0	27.0	28.0	[1 - 10]
ASTX	28.0	29.0	29.0	29.0	29.0	30.0	24.0	28.0	28.0	31.0	[11 - 20]
MUZX	38.0	38.7	41.7	42.8	41.5	42.0	38.7	39.5	39.8	38.6	[1 - 10]
MUZX	41.0	41.5	41.5	36.7	38.2	40.6	43.5	43.2	31.7	41.0	[11 - 20]
BALX	35.4	37.4	38.5	40.9	40.8	40.2	37.6	37.5	37.5	36.2	[1 - 10]
BALX	38.0	39.6	39.4	34.3	35.9	38.3	40.7	41.3	31.3	38.2	[11 - 20]
DOMQ	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	[1 - 10]
DOMQ	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	12.8	12.5	[11 - 20]

Y(Forecast Discharge for the 30th day) = -2.41021 + .03335*ASTX1
+ .06139*ASTX18 + .08622*ASTX20
- .05159*MUZX2 + .04161*MUZX17 - .0547*BALX18
- .03698*DOMQ5 + 1.04616*DOMQ20

Y(Forecast Discharge for the 30th day) = 12.817120

KOHALA

HABQ	12.3	9.1	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	[1 - 10
HABQ	6.4	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	[11 - 20
MUZQ	40.1	35.0	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	[1 - 10
MUZQ	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	[11 - 20
DOMQ	14.3	14.4	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	[1 - 10
DOMQ	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	[11 - 20
KOHQ	63.9	83.4	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	[1 - 10
KOHQ	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	[11 - 20

Y(Forecast Discharge for the 21st day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20

Y(Forecast Discharge for the 21st day) = 4.05916 - .36601*5.7
+ 1.76761*11.4 + .20911*40.1
- .27722*20.8 + .62284*10.5 + .51844*52.1

Y(Forecast Discharge for the 21st day) = 58.293330

HABQ	9.1	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	[1 - 10]
HABQ	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	[11 - 20]
MUZQ	35.0	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	[1 - 10]
MUZQ	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	[11 - 20]
DOMQ	14.4	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	[1 - 10]
DOMQ	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	[11 - 20]
KOHQ	83.4	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	[1 - 10]
KOHQ	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	[11 - 20]

Y(Forecast Discharge for the 22nd day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20

Y(Forecast Discharge for the 22nd day) = 59.750050

HABQ	7.5	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	[1 - 10]
HABQ	7.8	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	[11 - 20]
MUZQ	29.2	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	[1 - 10]
MUZQ	24.8	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	[11 - 20]
DOMQ	15.0	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	[1 - 10]
DOMQ	12.0	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	[11 - 20]
KOHQ	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	[1 - 10]
KOHQ	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	[11 - 20]

Y(Forecast Discharge for the 23rd day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20

Y(Forecast Discharge for the 23rd day) = 58.129360

HABQ	7.8	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	[1 - 10]
HABQ	6.9	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	[11 - 20]
MUZQ	27.0	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	[1 - 10]
MUZQ	24.9	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	[11 - 20]
DOMQ	14.9	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	[1 - 10]
DOMQ	12.1	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	[11 - 20]
KOHQ	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	[1 - 10]
KOHQ	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	[11 - 20]

Y(Forecast Discharge for the 24th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 24th day) = 57.635220

HABQ	7.0	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	[1 - 10]
HABQ	6.9	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	[11 - 20]
MUZQ	24.9	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	[1 - 10]
MUZQ	24.2	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	[11 - 20]
DOMQ	15.4	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	[1 - 10]
DOMQ	11.3	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	[11 - 20]
KOHQ	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	[1 - 10]
KOHQ	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	[11 - 20]

Y(Forecast Discharge for the 25th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 25th day) = 56.077420

HABQ	6.3	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	[1 - 10]
HABQ	6.9	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	[11 - 20]
MUZQ	22.9	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	[1 - 10]
MUZQ	24.3	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	[11 - 20]
DOMQ	15.7	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	[1 - 10]
DOMQ	10.4	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	[11 - 20]
KOHQ	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	[1 - 10]
KOHQ	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	[11 - 20]

Y(Forecast Discharge for the 26th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 26th day) = 54.212380

HABQ	6.0	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	6.9	[1 - 10]
HABQ	8.8	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	[11 - 20]
MUZQ	20.8	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	[1 - 10]
MUZQ	26.8	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	[11 - 20]
DOMQ	15.8	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	[1 - 10]
DOMQ	10.3	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	[11 - 20]
KOHQ	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	[1 - 10]
KOHQ	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	[11 - 20]

Y(Forecast Discharge for the 27th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 27th day) = 52.364570

HABQ	6.1	5.7	6.0	6.4	7.2	7.8	6.9	6.9	6.9	8.8	[1 - 10]
HABQ	9.4	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	[11 - 20]
MUZQ	19.7	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	[1 - 10]
MUZQ	28.9	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	[11 - 20]
DOMQ	14.5	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	[1 - 10]
DOMQ	10.8	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	[11 - 20]
KOHQ	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	[1 - 10]
KOHQ	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	[11 - 20]

Y(Forecast Discharge for the 28th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 28th day) = 50.733180

HABQ	5.7	6.0	6.4	7.2	7.3	6.9	6.9	6.9	8.8	9.4	[1 - 10]
HABQ	10.5	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	10.0	[11 - 20]
MUZQ	19.7	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	[1 - 10]
MUZQ	31.9	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	40.1	[11 - 20]
DOMQ	14.8	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	[1 - 10]
DOMQ	10.2	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	12.8	[11 - 20]
KOHQ	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	[1 - 10]
KOHQ	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	50.7	[11 - 20]

Y(Forecast Discharge for the 29th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 29th day) = 50.235600

HABQ	6.0	6.4	7.2	7.8	6.9	6.9	6.9	8.8	9.4	10.5	[1 - 10]
HABQ	11.4	10.7	10.1	10.7	10.2	10.0	10.0	9.8	10.0	9.5	[11 - 20]
MUZQ	19.9	20.1	21.9	24.8	24.9	24.2	24.3	26.8	28.9	31.9	[1 - 10]
MUZQ	35.0	39.6	39.6	40.6	40.3	39.7	40.0	37.9	40.1	39.0	[11 - 20]
DOMQ	14.0	13.6	12.8	12.0	12.1	11.3	10.4	10.3	10.8	10.2	[1 - 10]
DOMQ	10.5	11.1	11.3	11.4	11.6	11.7	12.2	12.0	12.8	12.5	[11 - 20]
KOHQ	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	[1 - 10]
KOHQ	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	50.7	50.2	[11 - 20]

Y(Forecast Discharge for the 30th day) = 4.05916 - .36601*HABQ9
+ 1.76761*HABQ20 + .20911*MUZQ1
- .27722*MUZQ7 + .62284*DOMQ20 + .51844*KOHQ20
Y(Forecast Discharge for the 30th day) = 48.715090

PONCH
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kotp	6.0	.0	1.8	.0	.0	2.3	.0	.0	.0	.0	[1 - 10]
kotp	.0	.0	.0	8.4	.0	.0	3.0	.0	.0	1.0	[11 - 20]
pulp	8.9	.0	.0	1.3	2.5	5.1	5.1	6.3	.0	.0	[1 - 10]
pulp	.0	.0	2.5	.5	.5	.0	14.0	.0	.0	15.7	[11 - 20]
sehp	.8	.0	.0	.0	.0	.0	.0	15.5	.0	.0	[1 - 10]
sehp	.0	.0	.0	.0	.5	.0	8.1	.0	.0	.0	[11 - 20]
manp	21.8	.0	1.0	.5	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	.0	.0	.0	.0	.0	9.7	.0	.0	.5	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.0	[11 - 20]

Y(Forecast Discharge for the 21st day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10
+.0152*KOTP11 + .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14
+ .01266*KOT15 - .00752*PULP5 -.00868*PULP6 + .00951*PULP10
+ .00891*PULP19 + .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2
+ .01173*SEHP3 + .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12
+ .0082*SEHP13+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19
+.02647*SEHP20

Y(Forecast Discharge for the 21st day) = 3.1102 + .00981*0 + .01444*0
+ .01377*2.3 + .01283*0
+.0152*0 + .0131*0 + .01921*0 + .01491*8.4 + .01266*0
- .00752*2.5 -.00868*5.1 + .00951*0 + .00891*0 + .02497*15.7
+ .01469*.8 + .01098*0 + .01173*0 + .01091*0 + .01127*0
+ .01299*0 + .0082*0+ .00854*0+ .01777*0+.02379*0
+.02647*0

Y(Forecast Discharge for the 21st day) = 3.607828

kotp	.0	1.8	.0	.0	2.3	.0	.0	.0	.0	.0	[1 - 10]
kotp	.0	.0	8.4	.0	.0	3.0	.0	.0	1.0	.0	[11 - 20]
pulp	.0	.0	1.3	2.5	5.1	5.1	6.3	.0	.0	.0	[1 - 10]
pulp	.0	2.5	.5	.5	.0	14.0	.0	.0	15.7	3.8	[11 - 20]
sehp	.0	.0	.0	.0	.0	.0	15.5	.0	.0	.0	[1 - 10]
sehp	.0	.0	.0	.5	.0	8.1	.0	.0	.0	.0	[11 - 20]
manp	.0	1.0	.5	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	.0	.0	.0	.0	9.7	.0	.0	.5	6.1	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.6	[11 - 20]

Y(Forecast Discharge for the 22nd day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20+ .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 22nd day) = 3.630304

kotp	1.8	.0	.0	2.3	.0	.0	.0	.0	.0	.0	[1 - 10]
kotp	.0	8.4	.0	.0	3.0	.0	.0	1.0	.0	.0	[11 - 20]
pulp	.0	1.3	2.5	5.1	5.1	6.3	.0	.0	.0	.0	[1 - 10]
pulp	2.5	.5	.5	.0	14.0	.0	.0	15.7	3.8	1.3	[11 - 20]
sehp	.0	.0	.0	.0	.0	15.5	.0	.0	.0	.0	[1 - 10]
sehp	.0	.0	.5	.0	8.1	.0	.0	.0	.0	.0	[11 - 20]
manp	1.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	.0	.0	.0	9.7	.0	.0	.5	6.1	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.6	[11 - 20]

Y(Forecast Discharge for the 23rd day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 23rd day) = 3.258166

kotp	.0	.0	2.3	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
kotp	8.4	.0	.0	3.0	.0	.0	1.0	.0	.0	.0	[11 - 20]
pulp	1.3	2.5	5.1	5.1	6.3	.0	.0	.0	.0	2.5	[1 - 10]
pulp	.5	.5	.0	14.0	.0	.0	15.7	3.8	1.3	.0	[11 - 20]
sehp	.0	.0	.0	.0	15.5	.0	.0	.0	.0	.0	[1 - 10]
sehp	.0	.5	.0	8.1	.0	.0	.0	.0	.0	.0	[11 - 20]
manp	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	.0	.0	9.7	.0	.0	.5	6.1	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.3	[11 - 20]

Y(Forecast Discharge for the 24th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 24th day) = 3.346261

kotp	.0	2.3	.0	.0	.0	.0	.0	.0	.0	8.4	[1 - 10]
kotp	.0	.0	3.0	.0	.0	1.0	.0	.0	.0	.0	[11 - 20]
pulp	2.5	5.1	5.1	6.3	.0	.0	.0	.0	2.5	.5	[1 - 10]
pulp	.5	.0	14.0	.0	.0	15.7	3.8	1.3	.0	.0	[11 - 20]
sehp	.0	.0	.0	15.5	.0	.0	.0	.0	.0	.0	[1 - 10]
sehp	.5	.0	8.1	.0	.0	.0	.0	.0	.0	.0	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	.0	9.7	.0	.0	.5	6.1	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.3	[11 - 20]

Y(Forecast Discharge for the 25th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10+.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 25th day) = 3.346777

kotp	2.3	.0	.0	.0	.0	.0	.0	.0	8.4	.0	[1 - 10]
kotp	.0	3.0	.0	.0	1.0	.0	.0	.0	.0	.0	[11 - 20]
pulp	5.1	5.1	6.3	.0	.0	.0	.0	2.5	.5	.5	[1 - 10]
pulp	.0	14.0	.0	.0	15.7	3.8	1.3	.0	.0	.0	[11 - 20]
sehp	.0	.0	15.5	.0	.0	.0	.0	.0	.0	.5	[1 - 10]
sehp	.0	8.1	.0	.0	.0	.0	.0	.0	.0	.0	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	.0	9.7	.0	.0	.5	6.1	.0	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.3	[11 - 20]

Y(Forecast Discharge for the 26th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10+.0152*KOTP11
+ .01[illegible]*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 26th day) = 3.453949

kotp	.0	.0	.0	.0	.0	.0	.0	8.4	.0	.0	[1 - 10]
kotp	3.0	.0	.0	1.0	.0	.0	.0	.0	.0	.0	[11 - 20]
pulp	5.1	6.3	.0	.0	.0	.0	2.5	.5	.5	.0	[1 - 10]
pulp	14.0	.0	.0	15.7	3.8	1.3	.0	.0	.0	19.0	[11 - 20]
sehp	.0	15.5	.0	.0	.0	.0	.0	.0	.5	.0	[1 - 10]
sehp	8.1	.0	.0	.0	.0	.0	.0	.0	.0	.8	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	[1 - 10]
manp	9.7	.0	.0	.5	6.1	.0	.0	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.5	[11 - 20]

Y(Forecast Discharge for the 27th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 27th day) = 3.842141

kotp	.0	.0	.0	.0	.0	.0	8.4	.0	.0	3.0	[1 - 10]
kotp	.0	.0	1.0	.0	.0	.0	.0	.0	.0	22.4	[11 - 20]
pulp	6.3	.0	.0	.0	.0	2.5	.5	.5	.0	14.0	[1 - 10]
pulp	.0	.0	15.7	3.8	1.3	.0	.0	.0	19.0	1.3	[11 - 20]
sehp	15.5	.0	.0	.0	.0	.0	.0	.5	.0	8.1	[1 - 10]
sehp	.0	.0	.0	.0	.0	.0	.0	.0	.8	.0	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	.0	.0	9.7	[1 - 10]
manp	.0	.0	.5	6.1	.0	.0	.0	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.8	[11 - 20]

Y(Forecast Discharge for the 28th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20

Y(Forecast Discharge for the 28th day) = 3.821811

kotp	.0	.0	.0	.0	.0	8.4	.0	.0	3.0	.0	[1 - 10]
kotp	.0	1.0	.0	.0	.0	.0	.0	.0	22.4	62.8	[11 - 20]
pulp	.0	.0	.0	.0	2.5	.5	.5	.0	14.0	.0	[1 - 10]
pulp	.0	15.7	3.8	1.3	.0	.0	.0	19.0	1.3	63.5	[11 - 20]
sehp	.0	.0	.0	.0	.0	.0	.5	.0	8.1	.0	[1 - 10]
sehp	.0	.0	.0	.0	.0	.0	.0	.8	.0	11.9	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	.0	9.7	.0	[1 - 10]
manp	.0	.5	6.1	.0	.0	.0	.0	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.8	[11 - 20]

Y(Forecast Discharge for the 29th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18 +.02379*SEHP19 +.02647*SEHP20
Y(Forecast Discharge for the 29th day) = 5.342359

kotp	.0	.0	.0	.0	8.4	.0	.0	3.0	.0	.0	[1 - 10]
kotp	1.0	.0	.0	.0	.0	.0	.0	22.4	62.8	18.3	[11 - 20]
pulp	.0	.0	.0	2.5	.5	.5	.0	14.0	.0	.0	[1 - 10]
pulp	15.7	3.8	1.3	.0	.0	.0	19.0	1.3	63.5	15.2	[11 - 20]
sehp	.0	.0	.0	.0	.0	.5	.0	8.1	.0	.0	[1 - 10]
sehp	.0	.0	.0	.0	.0	.0	.8	.0	11.9	18.5	[11 - 20]
manp	.0	.0	.0	.0	.0	.0	.0	9.7	.0	.0	[1 - 10]
manp	.5	6.1	.0	.0	.0	.0	.0	.0	.0	.0	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	5.3	[11 - 20]

Y(Forecast Discharge for the 30th day) = 3.1102 + .00981*KOTP4
+ .01444*KOTP5 + .01377*KOTP6 + .01283*KOTP10 +.0152*KOTP11
+ .0131*KOTP12 + .01921*KOTP13 + .01491*KOTP14 + .01266*KOT15
- .00752*PULP5 -.00868*PULP6 + .00951*PULP10 + .00891*PULP19
+ .02497*PULP20 + .01469*SEHP1 + .01098*SEHP2 + .01173*SEHP3
+ .01091*SEHP7 + .01127*SEHP9 + .01299*SEHP12 + .0082*SEHP13
+ .00854*SEHP14+ .01777*SEHP18+.02379*SEHP19 +.02647*SEHP20
Y(Forecast Discharge for the 30th day) = 5.057019

MANGLA

KOHQ	63.9	83.4	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	[1 - 10]
KOHQ	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	[11 - 20]
PONQ	4.1	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	[1 - 10]
PONQ	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.0	[11 - 20]
Manq	64.1	67.8	58.4	57.6	43.9	42.9	42.9	46.6	40.0	37.1	[1 - 10]
Manq	37.1	37.1	37.9	41.3	41.3	39.9	36.9	45.7	42.8	50.1	[11 - 20]

Y(Forecast Discharge for the 21st day) = -4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20
Y(Forecast Discharge for the 21st day) = -4.36591 + .96261*52.1
+ 2.30213*3.0
Y(Forecast Discharge for the 21st day) = 52.692460

KOHQ	83.4	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	[1 - 10]
KOHQ	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	[11 - 20]
PONQ	3.8	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	2.4	[1 - 10]
PONQ	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.0	3.6	[11 - 20]
Manq	67.8	58.4	57.6	43.9	42.9	42.9	46.6	40.0	37.1	37.1	[1 - 10]
Manq	37.1	37.9	41.3	41.3	39.9	36.9	45.7	42.8	50.1	52.7	[11 - 20]

Y(Forecast Discharge for the 22nd day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 22nd day) = 60.053520

KOHQ	49.7	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	[1 - 10]
KOHQ	40.9	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	[11 - 20]
PONQ	2.9	2.8	4.6	6.9	2.6	2.2	2.2	2.5	2.4	2.3	[1 - 10]
PONQ	2.9	2.4	2.5	2.7	2.6	3.7	2.9	3.0	3.6	3.6	[11 - 20]
Manq	58.4	57.6	43.9	42.9	42.9	46.6	40.0	37.1	37.1	37.1	[1 - 10]
Manq	37.9	41.3	41.3	39.9	36.9	45.7	42.8	50.1	52.7	60.1	[11 - 20]

Y(Forecast Discharge for the 23rd day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 23rd day) = 61.507520

KOHQ	46.5	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	[1 - 10]
KOHQ	39.0	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	[11 - 20]
PONQ	2.8	4.6	6.9	2.6	2.2	2.2	2.5	2.4	2.3	2.9	[1 - 10]
PONQ	2.4	2.5	2.7	2.6	3.7	2.9	3.0	3.6	3.6	3.3	[11 - 20]
Manq	57.6	43.9	42.9	42.9	46.6	40.0	37.1	37.1	37.1	37.9	[1 - 10]
Manq	41.3	41.3	39.9	36.9	45.7	42.8	50.1	52.7	60.1	61.5	[11 - 20]

Y(Forecast Discharge for the 24th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 24th day) = 59.090720

KOHQ	43.6	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	[1 - 10]
KOHQ	40.2	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	[11 - 20]
PONQ	4.6	6.9	2.6	2.2	2.2	2.5	2.4	2.3	2.9	2.4	[1 - 10]
PONQ	2.5	2.7	2.6	3.7	2.9	3.0	3.6	3.6	3.3	3.3	[11 - 20]
Manq	43.9	42.9	42.9	46.6	40.0	37.1	37.1	37.1	37.9	41.3	[1 - 10]
Manq	41.3	39.9	36.9	45.7	42.8	50.1	52.7	60.1	61.5	59.1	[11 - 20]

Y(Forecast Discharge for the 25th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 25th day) = 58.817850

KOHQ	38.0	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	[1 - 10]
KOHQ	39.0	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	[11 - 20]
PONQ	6.9	2.6	2.2	2.2	2.5	2.4	2.3	2.9	2.4	2.5	[1 - 10]
PONQ	2.7	2.6	3.7	2.9	3.0	3.6	3.6	3.3	3.3	3.3	[11 - 20]
Manq	42.9	42.9	46.6	40.0	37.1	37.1	37.1	37.9	41.3	41.3	[1 - 10]
Manq	39.9	36.9	45.7	42.8	50.1	52.7	60.1	61.5	59.1	58.8	[11 - 20]

Y(Forecast Discharge for the 26th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

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Y(Forecast Discharge for the 26th day) = 57.319500

KOHQ	39.3	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	[1 - 10]
KOHQ	42.2	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	[11 - 20]
PONQ	2.6	2.2	2.2	2.5	2.4	2.3	2.9	2.4	2.5	2.7	[1 - 10]
PONQ	2.6	3.7	2.9	3.0	3.6	3.6	3.3	3.3	3.3	3.5	[11 - 20]
Manq	42.9	46.6	40.0	37.1	37.1	37.1	37.9	41.3	41.3	39.9	[1 - 10]
Manq	36.9	45.7	42.8	50.1	52.7	60.1	61.5	59.1	58.8	57.3	[11 - 20]

Y(Forecast Discharge for the 27th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 27th day) = 55.770910

KOHQ	38.4	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	[1 - 10]
KOHQ	46.9	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	[11 - 20]
PONQ	2.2	2.2	2.5	2.4	2.3	2.9	2.4	2.5	2.7	2.6	[1 - 10]
PONQ	3.7	2.9	3.0	3.6	3.6	3.3	3.3	3.3	3.5	3.8	[11 - 20]
Manq	46.6	40.0	37.1	37.1	37.1	37.9	41.3	41.3	39.9	36.9	[1 - 10]
Manq	45.7	42.8	50.1	52.7	60.1	61.5	59.1	58.8	57.3	55.8	[11 - 20]

Y(Forecast Discharge for the 28th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 28th day) = 54.885860

KOHQ	36.9	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	[1 - 10]
KOHQ	51.5	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	50.7	[11 - 20]
PONQ	2.2	2.5	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	[1 - 10]
PONQ	2.9	3.0	3.6	3.6	3.3	3.3	3.3	3.5	3.8	3.8	[11 - 20]
Manq	40.0	37.1	37.1	37.1	37.9	41.3	41.3	39.9	36.9	45.7	[1 - 10]
Manq	42.8	50.1	52.7	60.1	61.5	59.1	58.8	57.3	55.8	54.9	[11 - 20]

Y(Forecast Discharge for the 29th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 29th day) = 53.268670

KOHQ	37.0	36.8	36.9	40.9	39.0	40.2	39.0	42.2	46.9	51.5	[1 - 10]
KOHQ	52.1	58.3	59.8	58.1	57.6	56.1	54.2	52.4	50.7	50.2	[11 - 20]
PONQ	2.5	2.4	2.3	2.9	2.4	2.5	2.7	2.6	3.7	2.9	[1 - 10]
PONQ	3.0	3.6	3.6	3.3	3.3	3.3	3.5	3.8	3.8	5.3	[11 - 20]
Manq	37.1	37.1	37.1	37.9	41.3	41.3	39.9	36.9	45.7	42.8	[1 - 10]
Manq	50.1	52.7	60.1	61.5	59.1	58.8	57.3	55.8	54.9	53.3	[11 - 20]

Y(Forecast Discharge for the 30th day) = - 4.36591 + .96261*KOHQ20
+ 2.30213*PONQ20

Y(Forecast Discharge for the 30th day) = 56.290190

yasin

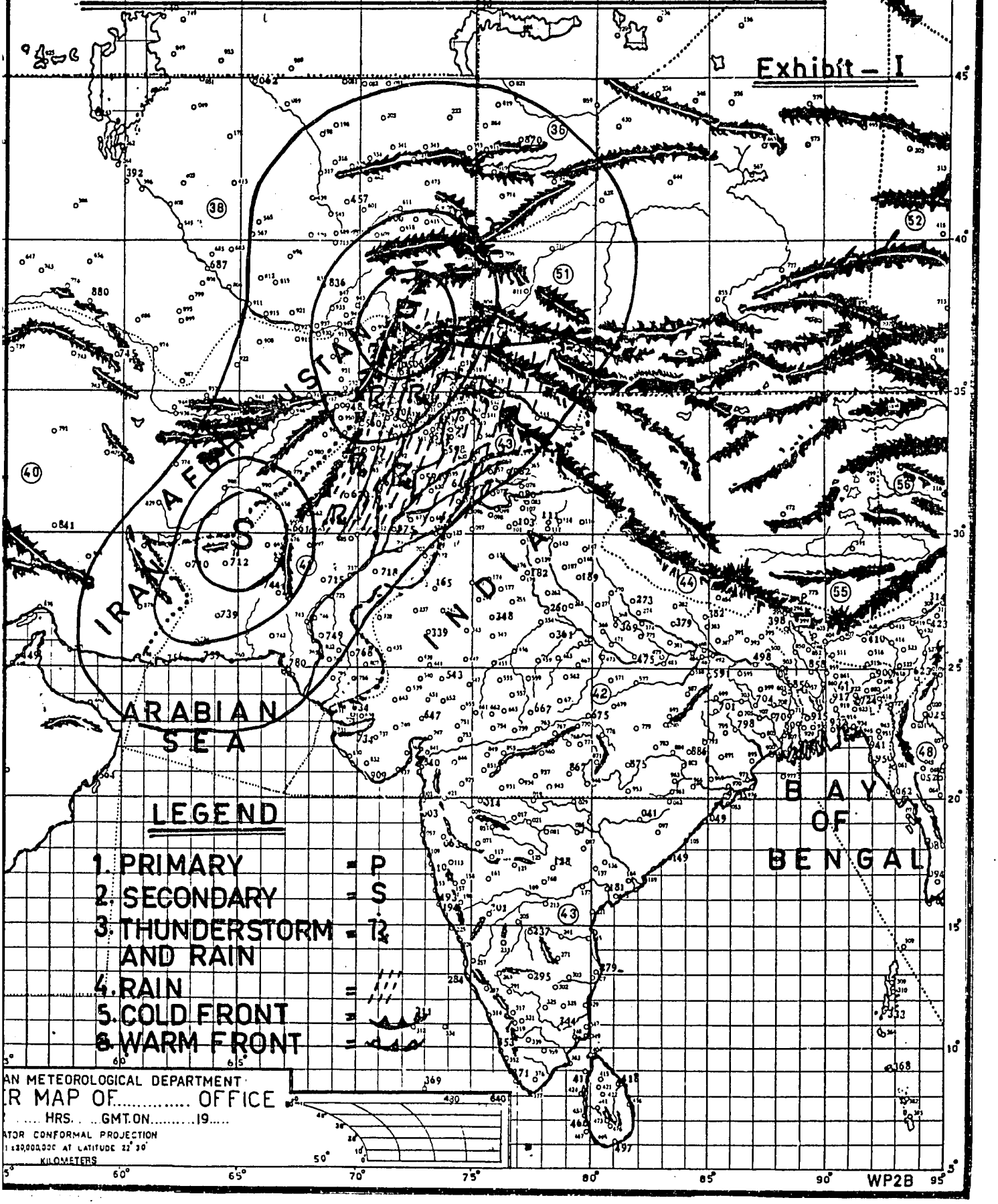
```
$STORAGE:2
$DEBUG
**      Programme " HCS.FOR " ( Historical Climatological Search)
*       This programme after receiving information about the
*       current Synoptic  situations, displays historical events of
*       rainfalls at various Met.Obsys.
*       Programmer : M.Yasin S.O.
        integer islp(20),itc(20),ip5(20),ist3(20),ipom(20),int(20)
        integer ipm5(20),iws(20),iws5(20),idmc(20)
        character date(20)*7,itms*4,lin*127,pwd5(20)*8,pwd3(20)*8
        character lin1(20)*125,lin2(20)*110,lin3(20)*125,lin4(20)*105
        character  tcz(20)*8,ya*11,yn*1
        character*11 nam1,nam2,nam3,nam4,nam5,nam6,cha*4
        mt=0
        OPEN (7,FILE='files.bat',STATUS='OLD')
        do 22 lm=1,100
      if(lm.gt.1)then
        write(*,'(5x,''Do you want to continue ? (Y/N)   ''  $)')
       read(*,'(a)')yn
        endif
       if(yn.eq.'N'.or.yn .eq.'n')goto 999
        read(7,'(6A)',end=999)nam1,nam2,nam3,nam4,nam5,nam6
        write(*,'(1x,6a)')nam1,nam2,nam3,nam4,nam5,nam6
        OPEN (1,FILE=nam1,STATUS='OLD')
        OPEN (2,FILE=nam2,STATUS='new')
        open (3,file=nam3,status='old')
        open (4,file=nam4,status='new')
        open (5,file=nam5,status='old')
        open (6,file=nam6,status='new')
      write(*,'(3x,''islp,itc,ip5,ist3,ipom,int,ipm5,iws,iws5,idmc'')')
        write(*,'(/,5x,'' Give the items  for comparison      ''  $)')
        read(*,'(a)')itms
        write(*,'(5x,'' Give the Value of  ''a '' ? '',  $)')itms
        read(*,*)newn
        open (8,file='itm.lis',status='old')
        do 26 nm=1,20
        read(8,'(A)',end=9)cha
        if(cha.eq.itms)m=nm
26      continue
9       continue
        close(8)
        write(*,'(5x,''m''i4)')m
        do 31 in=1,3
        READ(1,'(2x,a)')lin
        write(2,'(2x,a)')lin
        read(3,'(2x,2a)')lin1(in),lin2(in)
        write(4,'(2x,2a)')lin1(in),lin2(in)
        read(5,'(2x,2a)')lin3(in),lin4(in)
        write(6,'(2x,2a)')lin3(in),lin4(in)
31      continue
        read(1,'(2x,a)',end=21)ya
32      continue
        do 10 i=1,100
      READ(1,'(3x,a,5x,i3,9(6x,i3),3a)',end=21)date(i),islp(i),
     #itc(i),ip5(i),ist3(i),ipom(i),int(i),ipm5(i),iws(i),iws5(i),
     #idmc(i),tcz(i),pwd5(i),pwd3(i)
        read(3,'(2x,2a)')lin1(i) ,lin2(i)
```

```
        read(5,'(2x,2a)')lin3(i) ,lin4(i)
        yas=date(i)(:3)
        if(m.eq.1)newc=islp(i)
        if(m.eq.2)newc=itc(i)
        if(m.eq.3)newc=ip5(i)
        if(m.eq.4)newc=ist3(i)
        if(m.eq.5)newc=ipom(i)
        if(m.eq.6)newc=int(i)
        if(m.eq.7)newc=ipm5(i)
        if(m.eq.8)newc=iws(i)
        if(m.eq.9)newc=iws5(i)
        if(m.eq.10)newc=idmc(i)
        if(newn.eq.newc)ipin=newc
        if(yas.eq.'CAS')then
        if(ipin.gt.0)then
        write(2,'(3x,a)')ya
        write(4,'(2x,a)')ya
        write(6,'(2x,a)')ya
        do 34 k=1,i-1
      write(2,'(3x,a,5x,i3,9(6x,i3),3a)')date(k),islp(k),
     #itc(k),ip5(k),ist3(k),ipom(k),int(k),ipm5(k),iws(k),iws5(k),
     #idmc(k),tcz(k),pwd5(k),pwd3(k)
        write(4,'(2x,2a)')lin1(k+1),lin2(k+1)
        write(6,'(2x,2a)')lin3(k+1),lin4(k+1)
34      continue
        ipin=0
        endif
        ya=date(i)
        goto 32
        endif
10      continue
21      continue
        write(2,'(3x,''CASE'')')
        close(1)
        close(2)
        close(3)
        close(4)
        close(5)
        close(6)
22      continue
999     continue.
        STOP '                    Normal exit of Programme " HCS.FOR" '
        END
```

yasin

SKETCH OF A TYPICAL WESTERLY WAVE CAUSING PRECIPITATION IN MANGLA CATCHMENT

Exhibit – I



115

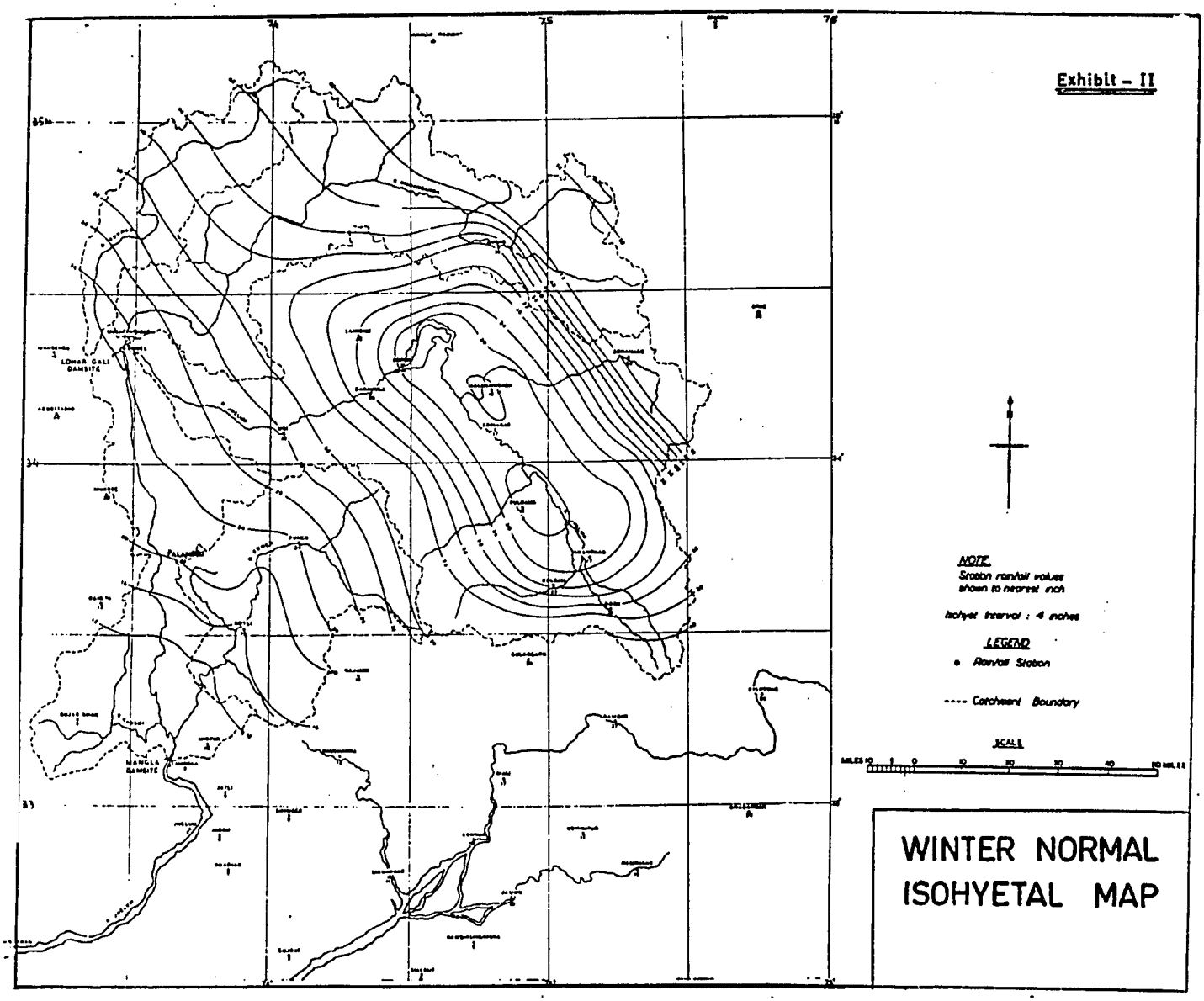
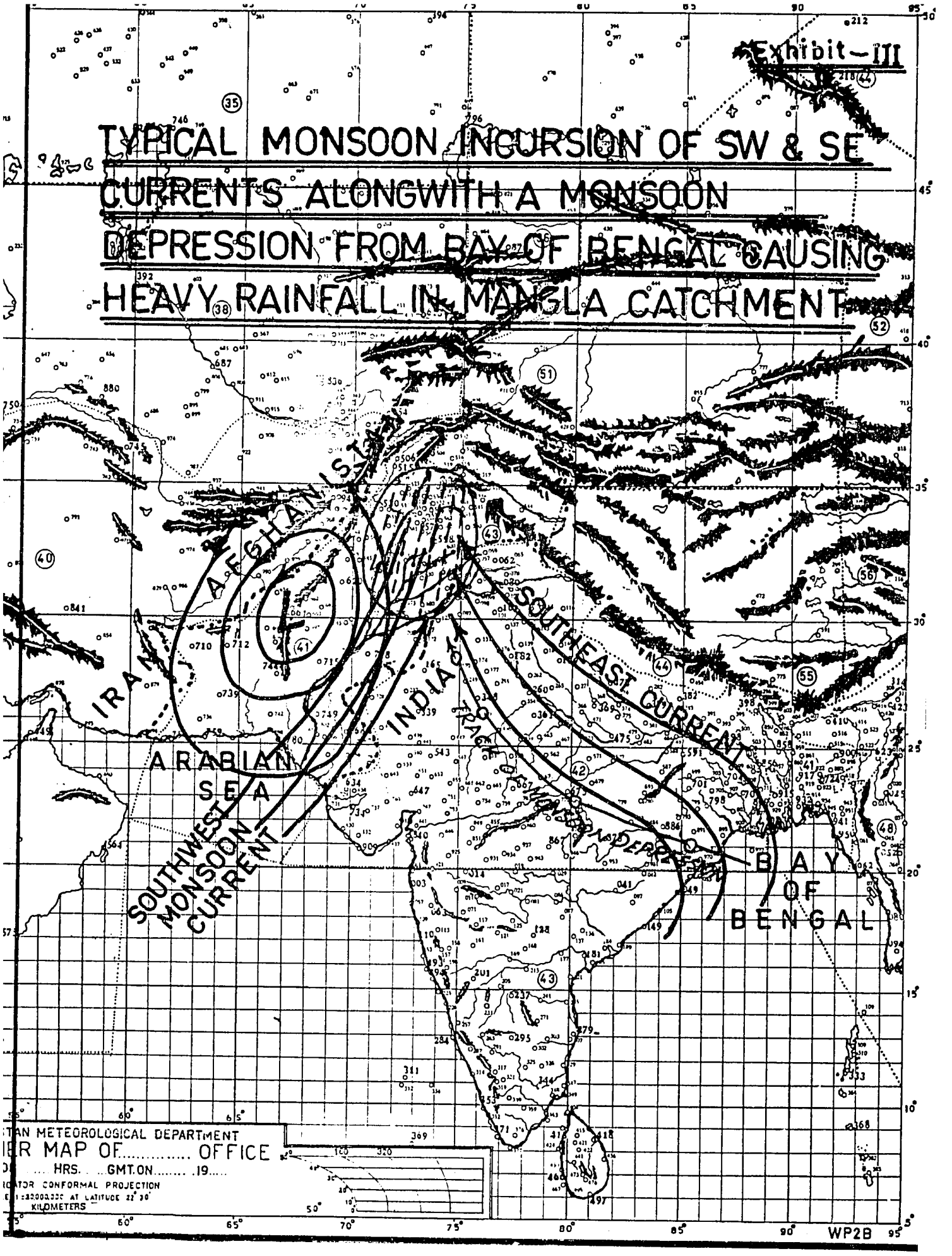
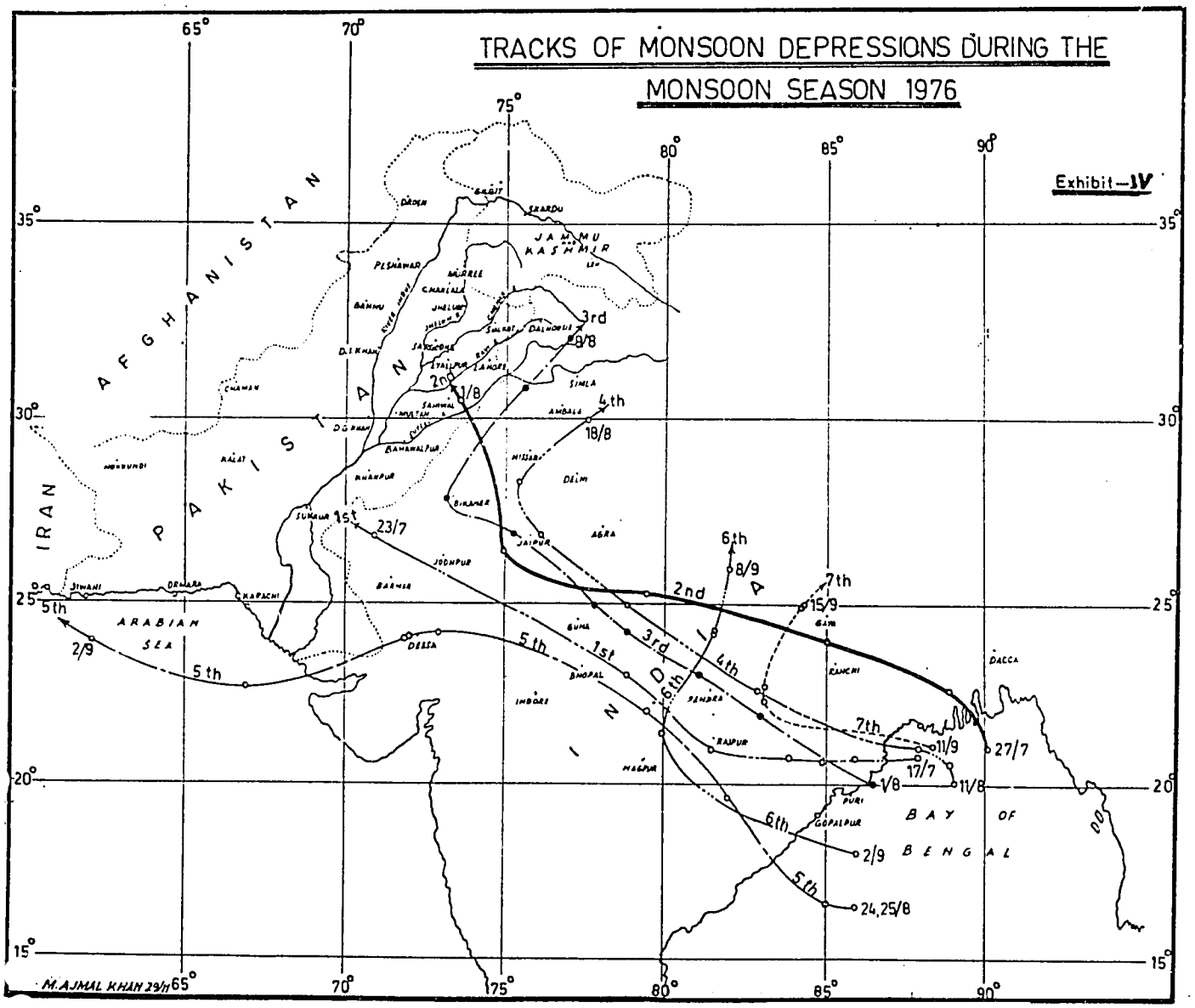


Exhibit – II
NOTE
Station rainfall values shown to nearest inch
Isohyet Interval : 4 inches
LEGEND
Rainfall Station
Catchment Boundary
SCALE
WINTER NORMAL ISOHYETAL MAP

Exhibit – III

TYPICAL MONSOON INCURSION OF SW & SE CURRENTS ALONGWITH A MONSOON DEPRESSION FROM BAY OF BENGAL CAUSING HEAVY RAINFALL IN MANGLA CATCHMENT




TRACKS OF MONSOON DEPRESSIONS DURING THE MONSOON SEASON 1976
Exhibit-IV
AFGHANISTAN
PAKISTAN
IRAN
INDIA
ARABIAN SEA
BAY OF BENGAL
JAMMU KASHMIR
PESHAWAR
MURREE
CHARSADA
JHELUM
DALHOUSIE
SIALKOT
LAHORE
SIMLA
AMBALA
DELHI
AGRA
JAIPUR
BIKANER
JODHPUR
BARMER
BAHAWALPUR
BHAWALPUR
SUKKUR
QUETTA
KARACHI
JIWANI
ORMARA
DESA
BHOPAL
INDORE
NAGPUR
RAIPUR
RANCHI
GAYA
DACCA
PURI
GOPALPUR
1st
2nd
3rd
4th
5th
6th
7th
23/7
1/8
9/8
18/8
8/9
15/9
2/9
11/9
17/7
27/7
1/8
11/8
24,25/8
M.AJMAL KHAN 29/11

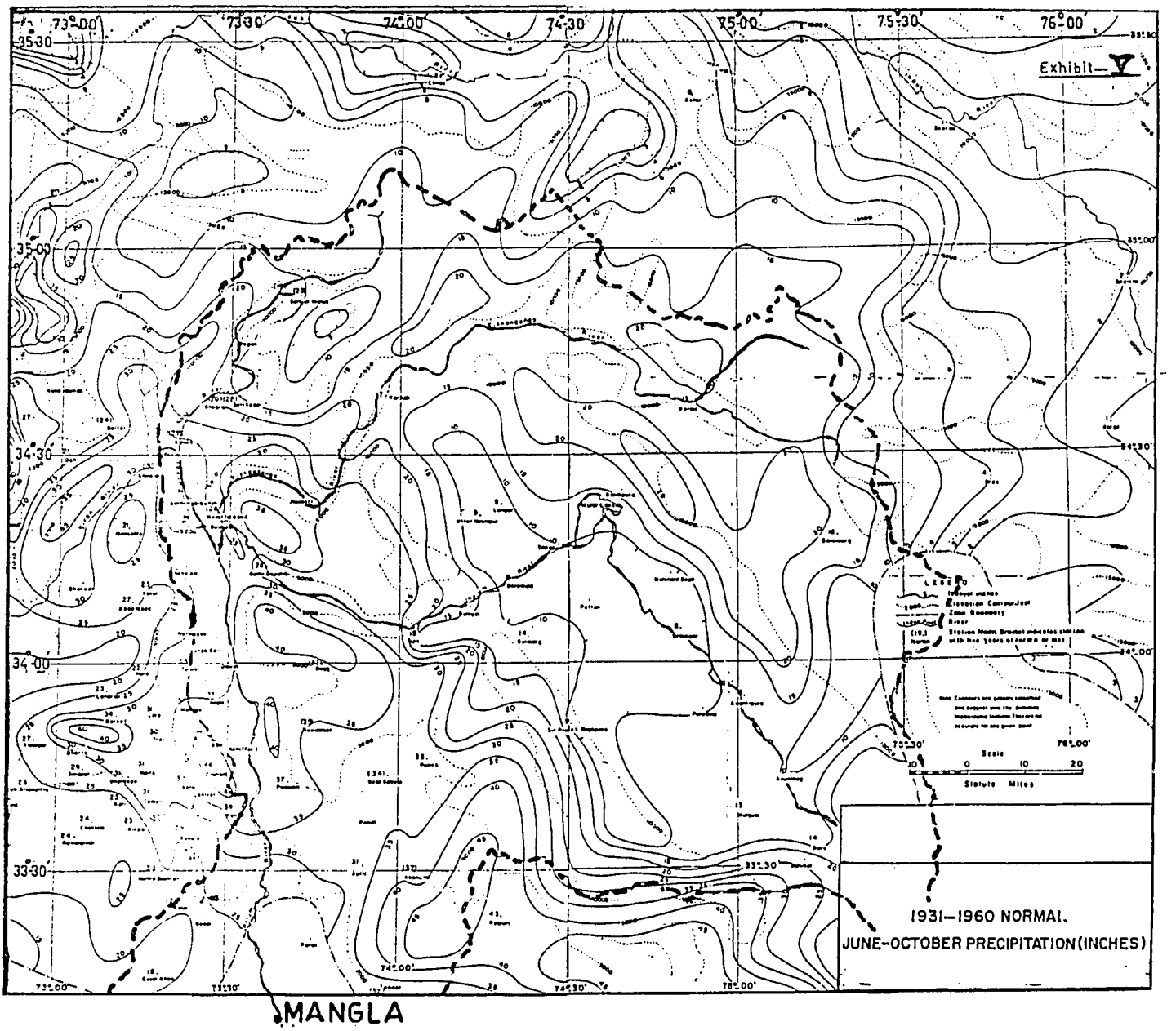
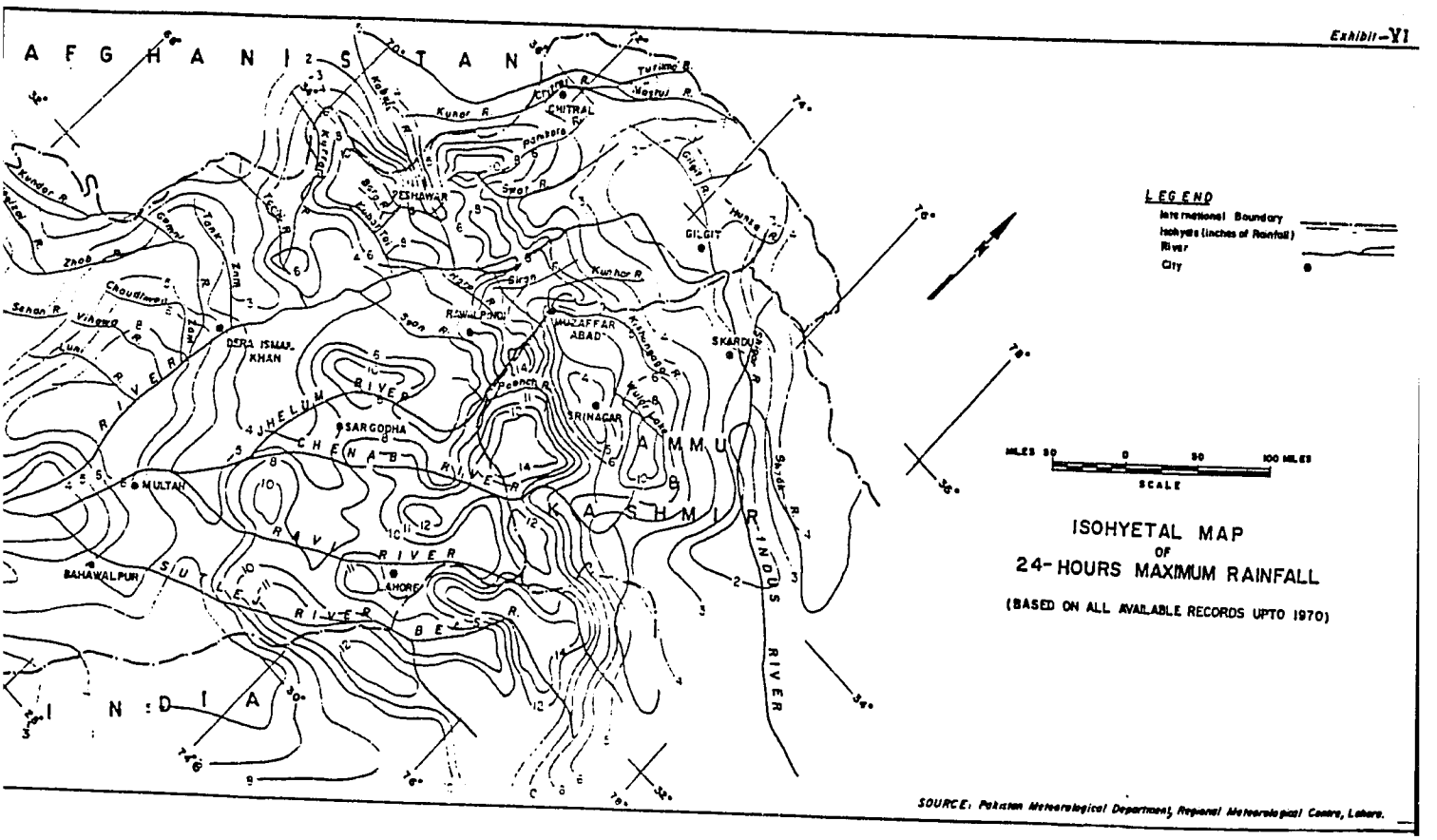

Exhibit—V
73°00'
73°30'
74°00'
74°30'
75°00'
75°30'
76°00'
35°30'
35°00'
34°30'
34°00'
33°30'
LEGEND
Elevation Contour
Zone Boundary
River
Scale
Statute Miles
1931–1960 NORMAL.
JUNE-OCTOBER PRECIPITATION (INCHES)
MANGLA

Exhibit-VI



SOURCE: Pakistan Meteorological Department, Regional Meteorological Centre, Lahore.

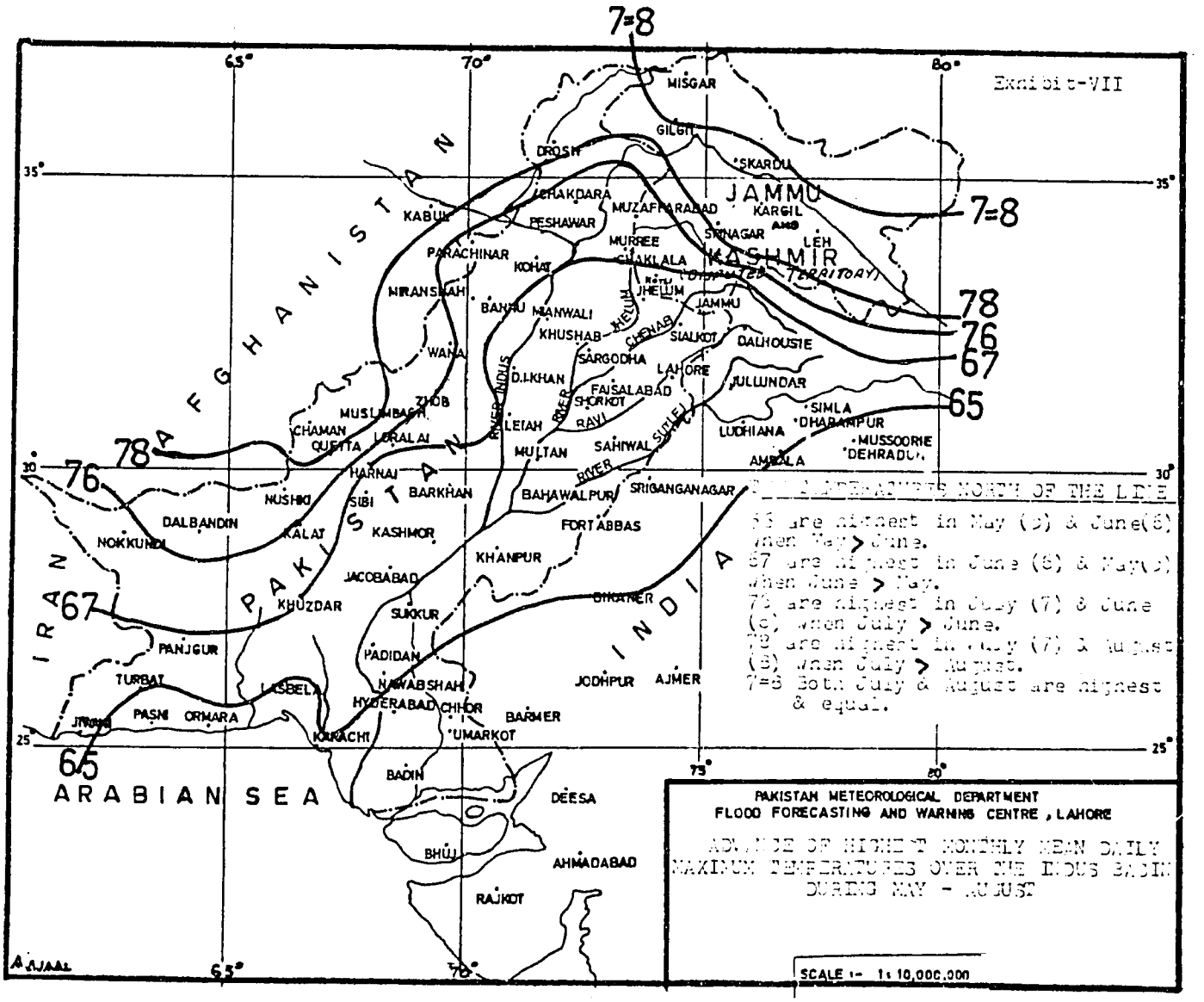
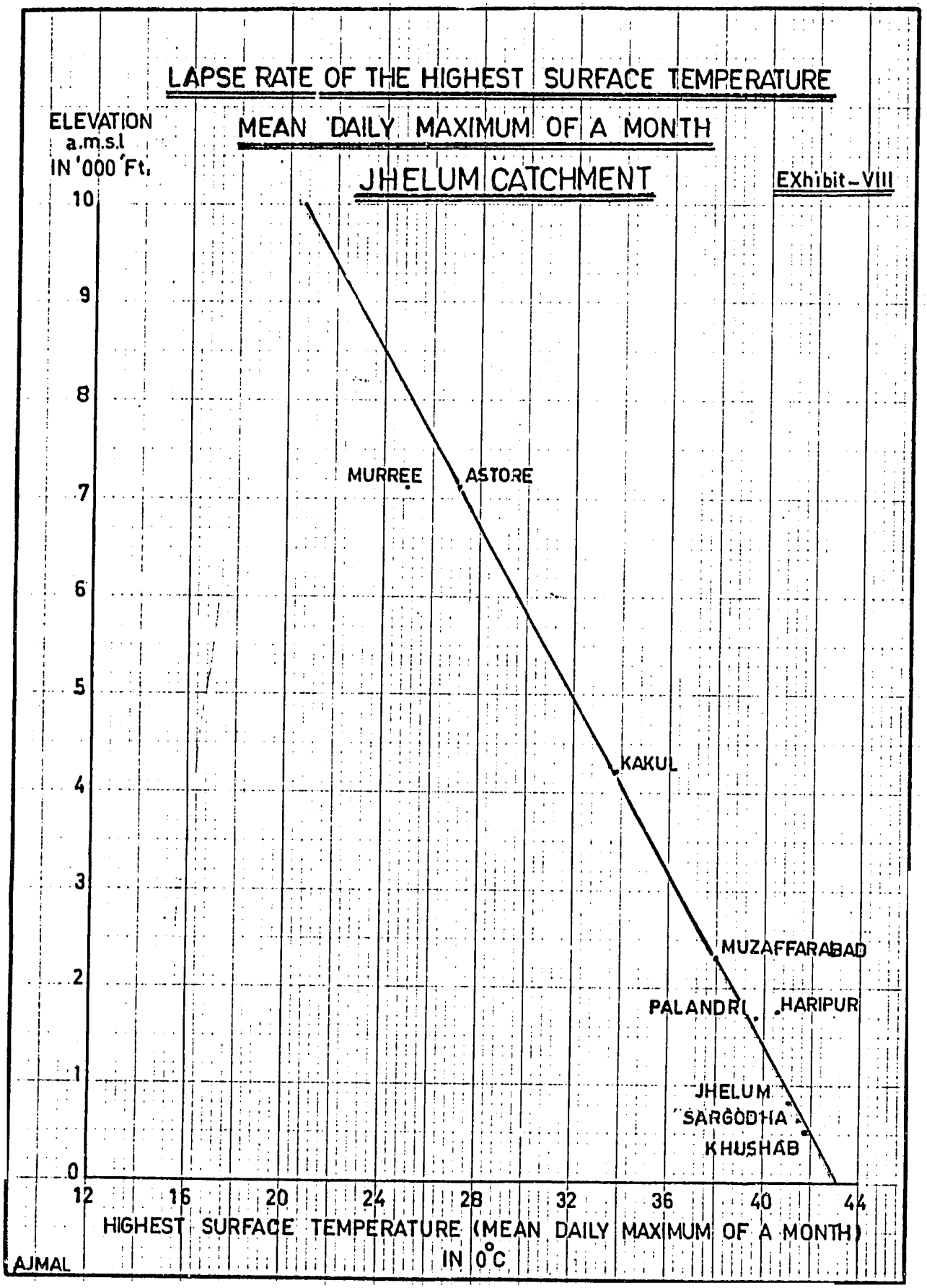


Exhibit-VII
7=8
78
76
67
65
AFGHANISTAN
PAKISTAN
IRAN
INDIA
JAMMU
KASHMIR
(DISPUTED TERRITORY)
ARABIAN SEA
MISGAR
GILGIT
DROSH
SKARDU
LEHAKDARA
MUZAFFARABAD
KARGIL
LEH
KABUL
PESHAWAR
SRINAGAR
MURREE
CHAKLALA
PARACHINAR
KOHAT
JHELUM
MIRANSHAH
BANNU
MIANWALI
JAMMU
KHUSHAB
SIALKOT
DALHOUSIE
WANA
SARGODHA
LAHORE
D.I.KHAN
FAISALABAD
JULLUNDAR
ZHOB
SHORKOT
SIMLA
MUSLIMBAGH
LEIAH
RAVI
LUDHIANA
DHARAMPUR
CHAMAN
QUETTA
LORALAI
MULTAN
SAHIWAL
MUSSOORIE
DEHRADUN
AMBALA
HARNAI
BARKHAN
BAHAWALPUR
SRIGANGANAGAR
NUSHKI
SIBI
DALBANDIN
KALAT
KASHMOR
FORTABBAS
NOKKUNDI
KHANPUR
JACOBABAD
BIKANER
KHUZDAR
SUKKUR
PANJGUR
PADIDAN
TURBAT
NAWABSHAH
JODHPUR
AJMER
LASBELA
HYDERABAD
CHHOR
BARMER
PASNI
ORMARA
KARACHI
UMARKOT
BADIN
DEESA
BHUJ
AHMADABAD
RAJKOT
65°
70°
75°
80°
35°
30°
25°
PAKISTAN METEOROLOGICAL DEPARTMENT
FLOOD FORECASTING AND WARNING CENTRE, LAHORE
ADVANCE OF HIGHEST MONTHLY MEAN DAILY MAXIMUM TEMPERATURES OVER THE INDUS BASIN DURING MAY - AUGUST
SCALE :- 1: 10,000,000

121


LAPSE RATE OF THE HIGHEST SURFACE TEMPERATURE
MEAN DAILY MAXIMUM OF A MONTH
JHELUM CATCHMENT
Exhibit-VIII
ELEVATION a.m.s.l IN '000' Ft.
10
9
8
7
6
5
4
3
2
1
0
MURREE
ASTORE
KAKUL
MUZAFFARABAD
PALANDRI
HARIPUR
JHELUM
SARGODHA
KHUSHAB
12
16
20
24
28
32
36
40
44
HIGHEST SURFACE TEMPERATURE (MEAN DAILY MAXIMUM OF A MONTH) IN 0°C
AJMAL

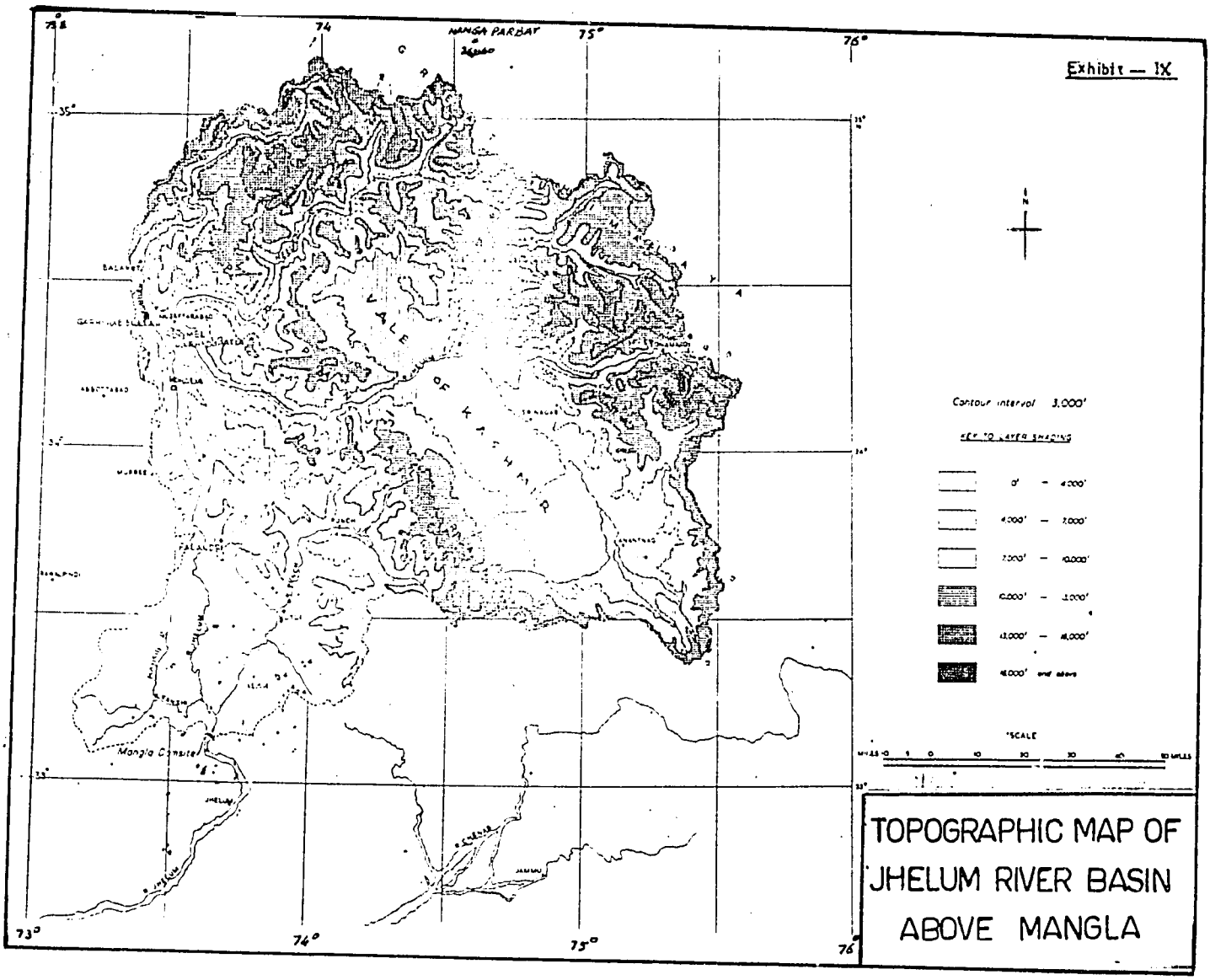


Exhibit — IX
NANGA PARBAT
VALLEY OF KASHMIR
Mangla Dam site
Contour interval 3,000'
KEY TO LAYER SHADING
0' — 4,000'
4,000' — 7,000'
7,000' — 10,000'
10,000' — 13,000'
13,000' — 16,000'
16,000' and above
SCALE
MILES 10 5 0 10 20 30 40 50 MILES
73°
74°
75°
76°
TOPOGRAPHIC MAP OF
JHELUM RIVER BASIN
ABOVE MANGLA

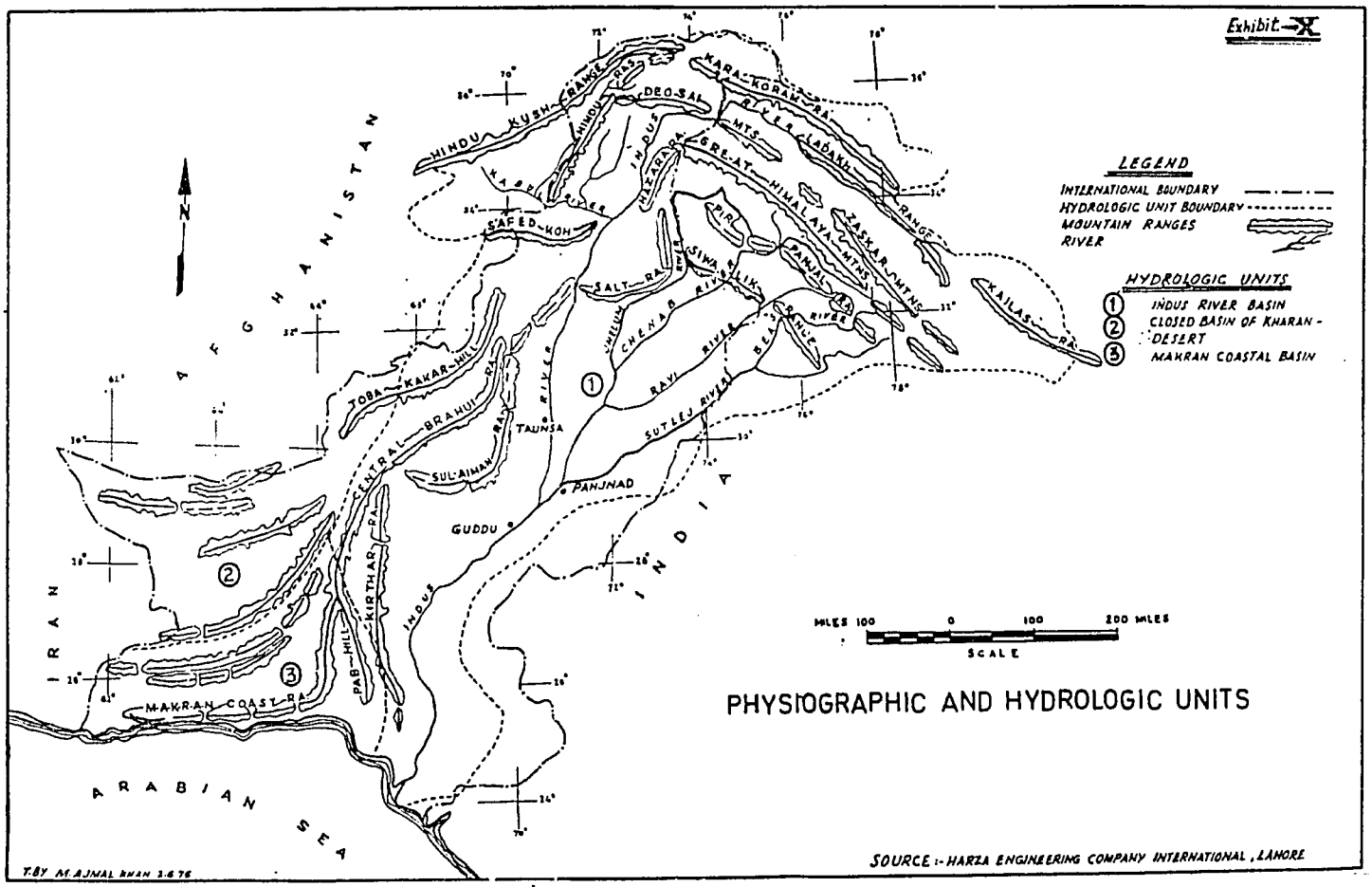


Exhibit-X
LEGEND
INTERNATIONAL BOUNDARY
HYDROLOGIC UNIT BOUNDARY
MOUNTAIN RANGES
RIVER
HYDROLOGIC UNITS
1 INDUS RIVER BASIN
2 CLOSED BASIN OF KHARAN - DESERT
3 MAKRAN COASTAL BASIN
AFGHANISTAN
IRAN
INDIA
ARABIAN SEA
HINDU KUSH RANGE
KARAKORAM RANGE
DEOSAI MTS
GREAT HIMALAYA MTS
ZASKAR MTNS
KAILAS RANGE
SAFED KOH
SALT RANGE
PIR PANJAL RANGE
TOBA KAKAR HILL
BRAHUI RANGE
SUL-AIMAN RANGE
KIRTHAR RANGE
PAB HILL
MAKRAN COAST RANGE
INDUS RIVER
JHELUM RIVER
CHENAB RIVER
RAVI RIVER
SUTLEJ RIVER
BEAS RIVER
TAUNSA
PANJNAD
GUDDU
MILES 100 0 100 200 MILES
SCALE
PHYSIOGRAPHIC AND HYDROLOGIC UNITS
SOURCE:- HARZA ENGINEERING COMPANY INTERNATIONAL, LAHORE
T.BY M.AJMAL KHAN 3.6.76

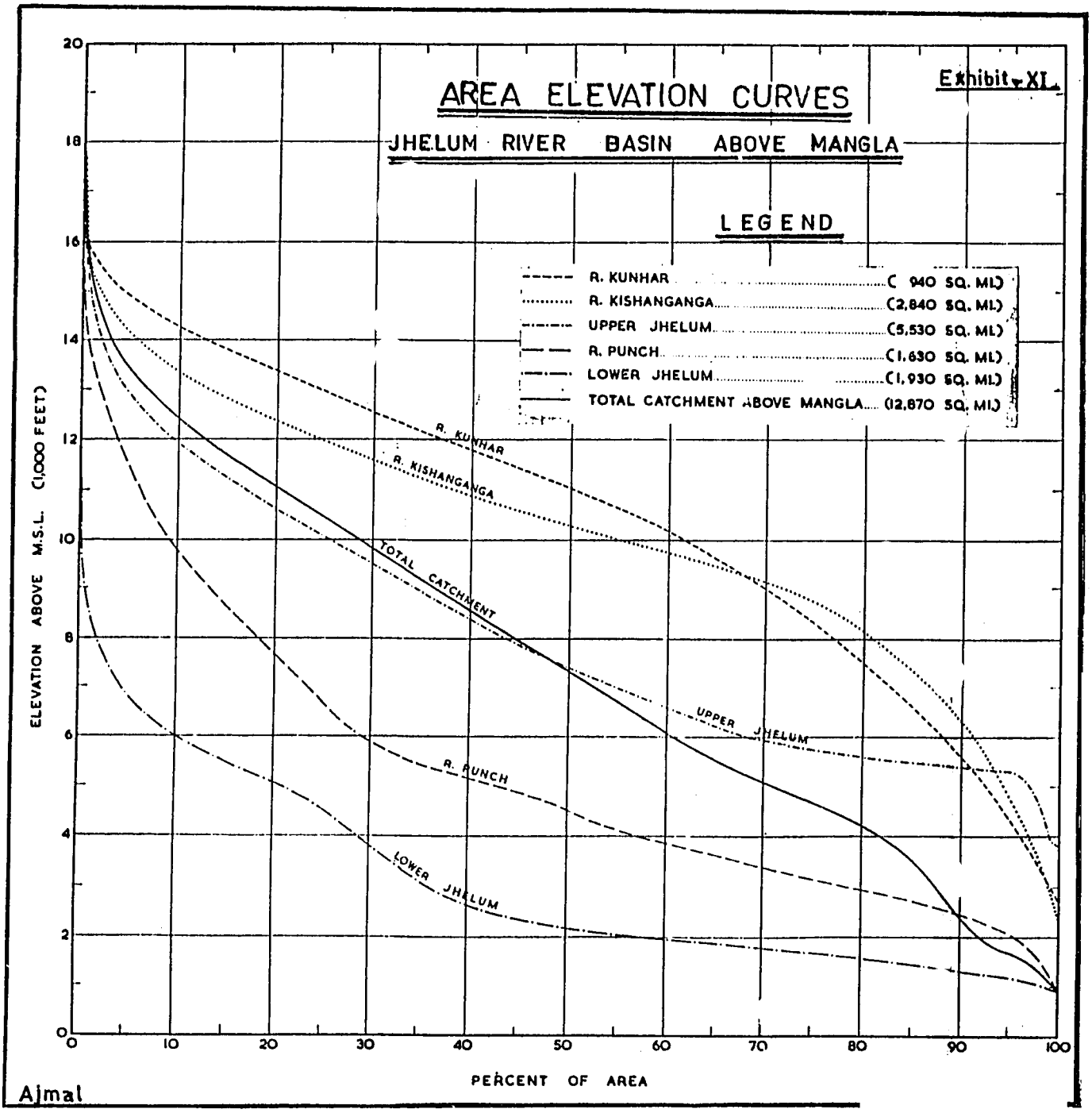


Exhibit-XI
AREA ELEVATION CURVES
JHELUM RIVER BASIN ABOVE MANGLA
LEGEND
R. KUNHAR (940 SQ. MI.)
R. KISHANGANGA (2,840 SQ. MI.)
UPPER JHELUM (5,530 SQ. MI.)
R. PUNCH (1,630 SQ. MI.)
LOWER JHELUM (1,930 SQ. MI.)
TOTAL CATCHMENT ABOVE MANGLA (12,870 SQ. MI.)
R. KUNHAR
R. KISHANGANGA
TOTAL CATCHMENT
UPPER JHELUM
R. PUNCH
LOWER JHELUM
ELEVATION ABOVE M.S.L. (1,000 FEET)
PERCENT OF AREA
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100
Ajmal

Exhibit- XII

VARIATION OF SNOWFALL WITH ALTITUDE

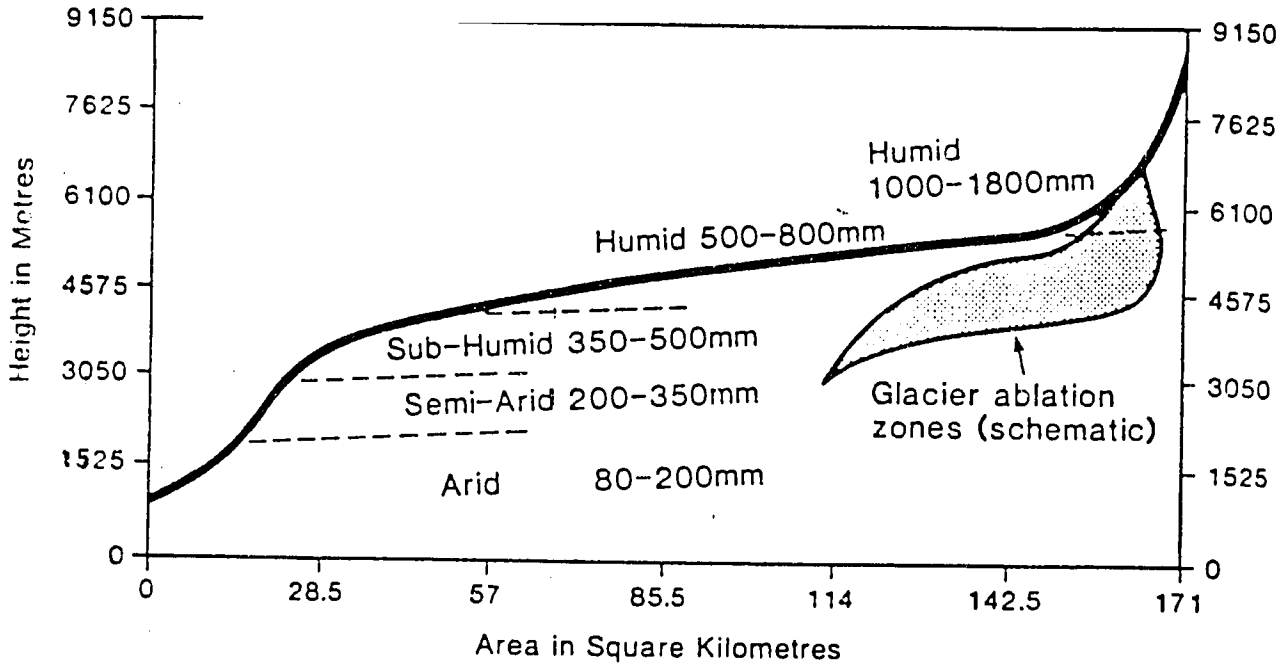
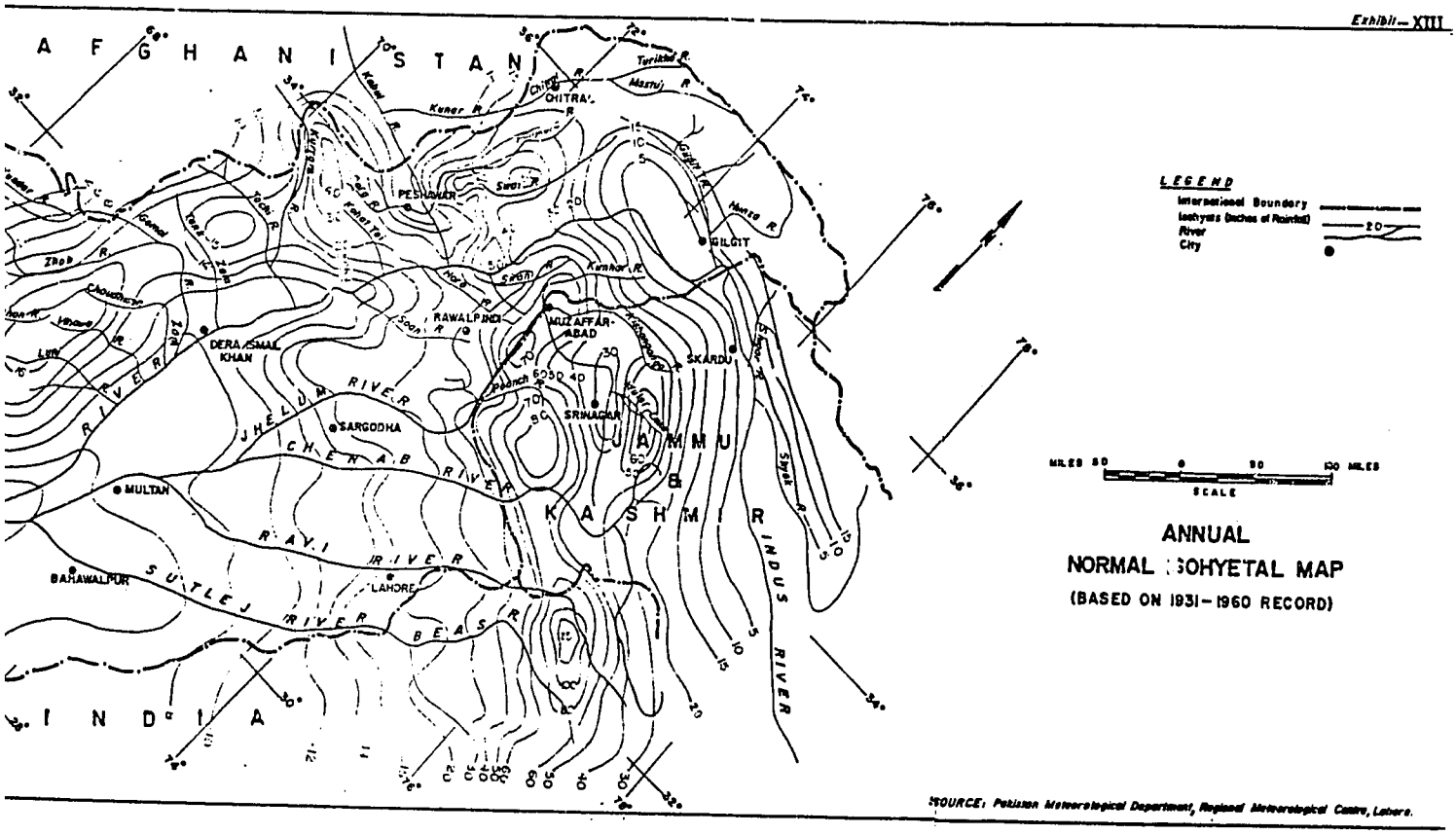


Exhibit — XIII



SOURCE: Pakistan Meteorological Department, Regional Meteorological Centre, Lahore.

EXHIBIT-XIV

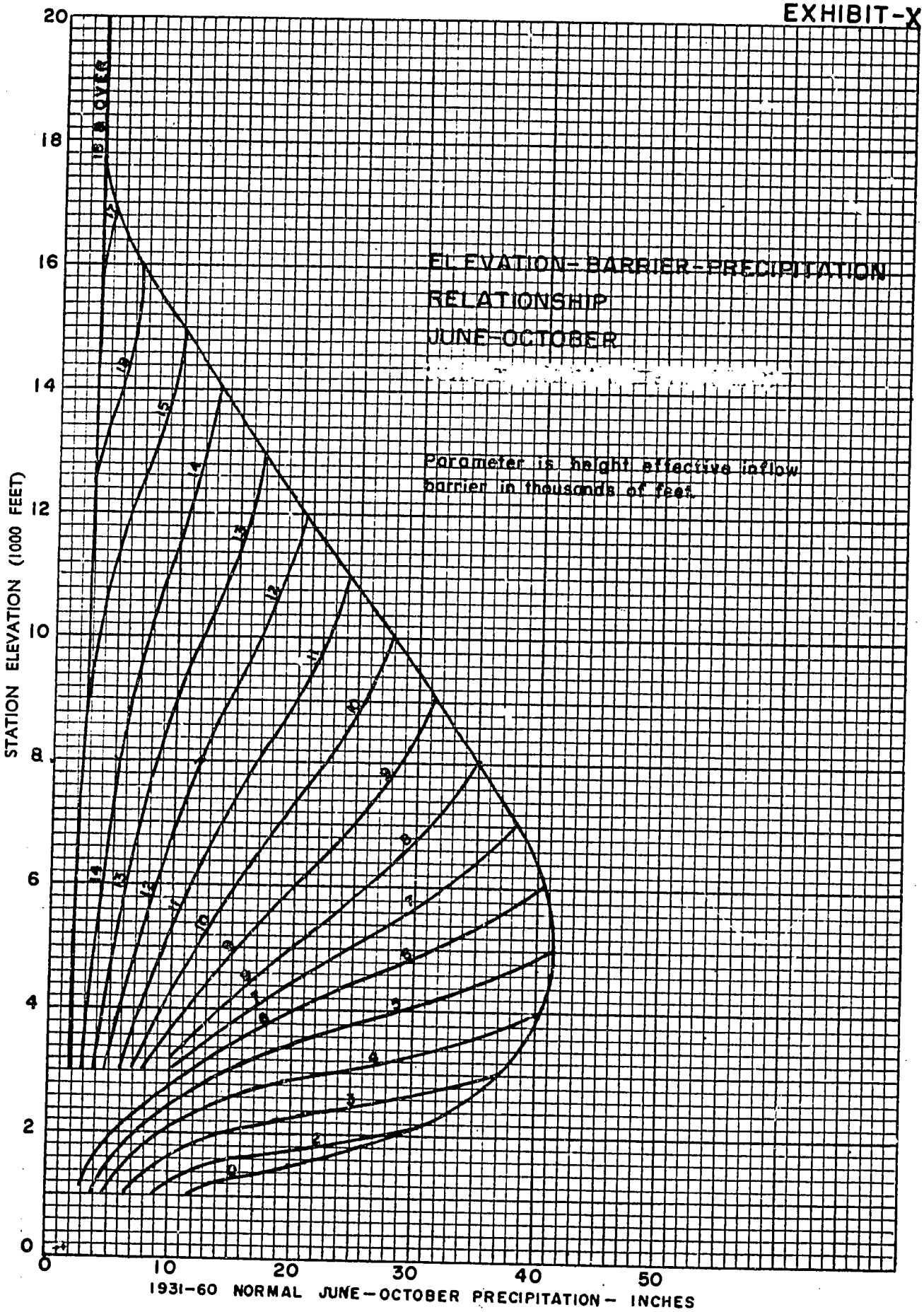


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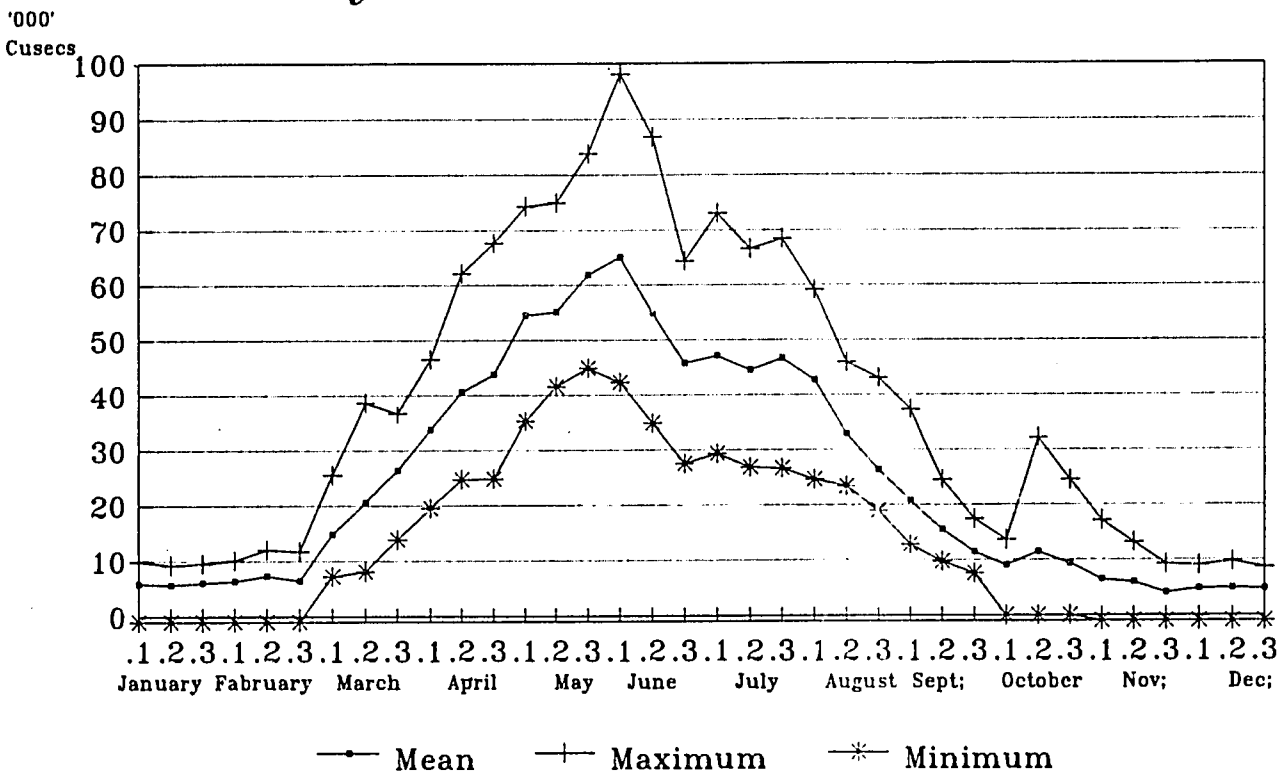
Exhibit XV

Kohala Discharge

10-Day Mean and Extream Values



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Exhibit–XVI

Average: 10–Day Mean and Extreme Daily Discharge of Mangla.

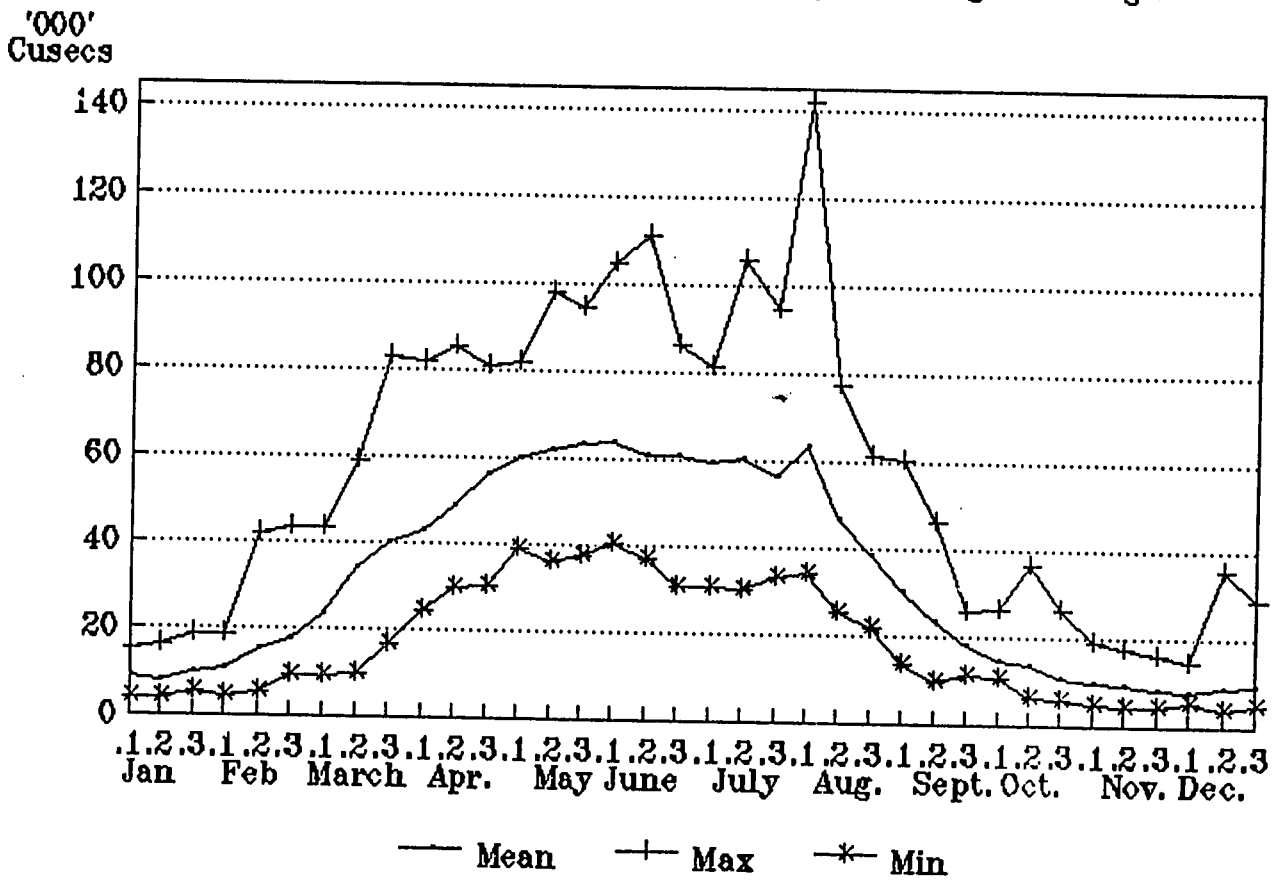
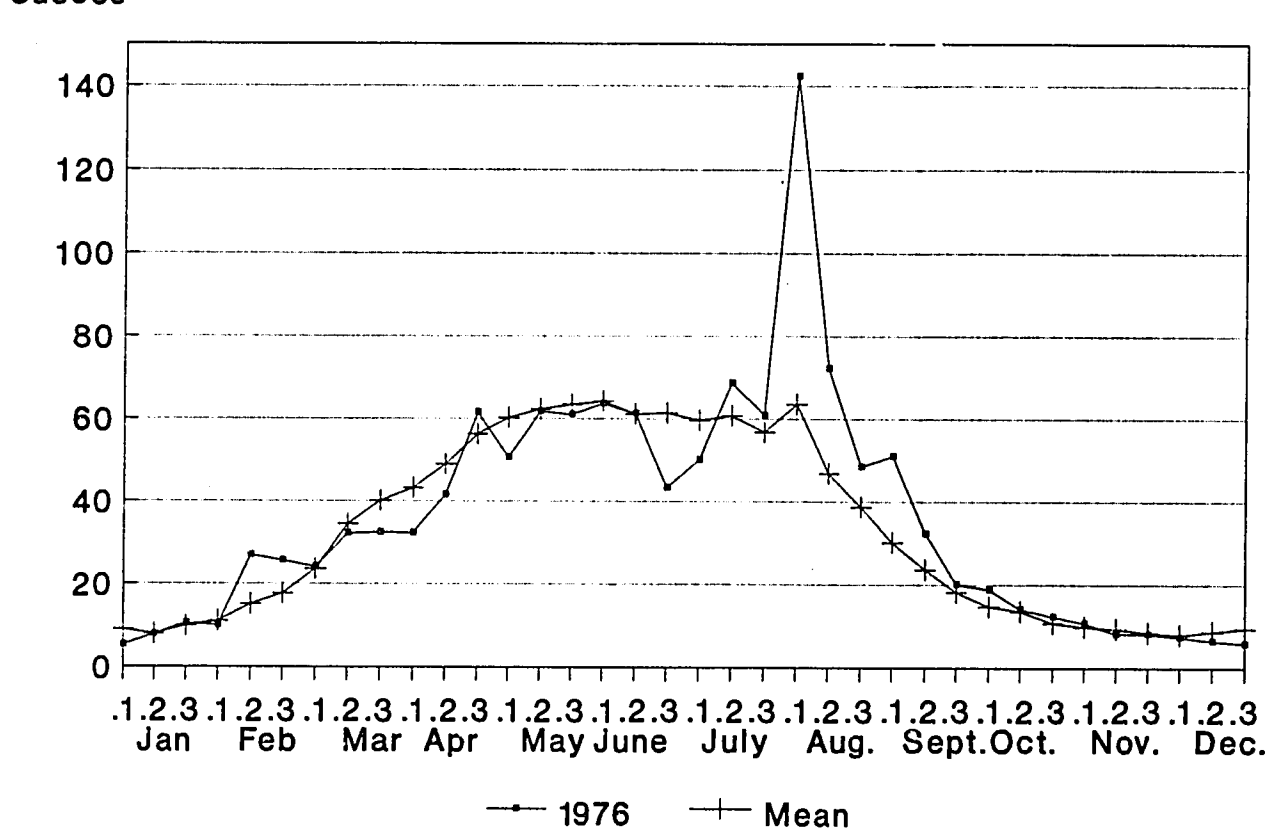


Exhibit-XVII

Average: 10-Day Mean Daily Discharge of Mangla:
10-Day mean Daily Dischagre of Mangla for the year 1976.

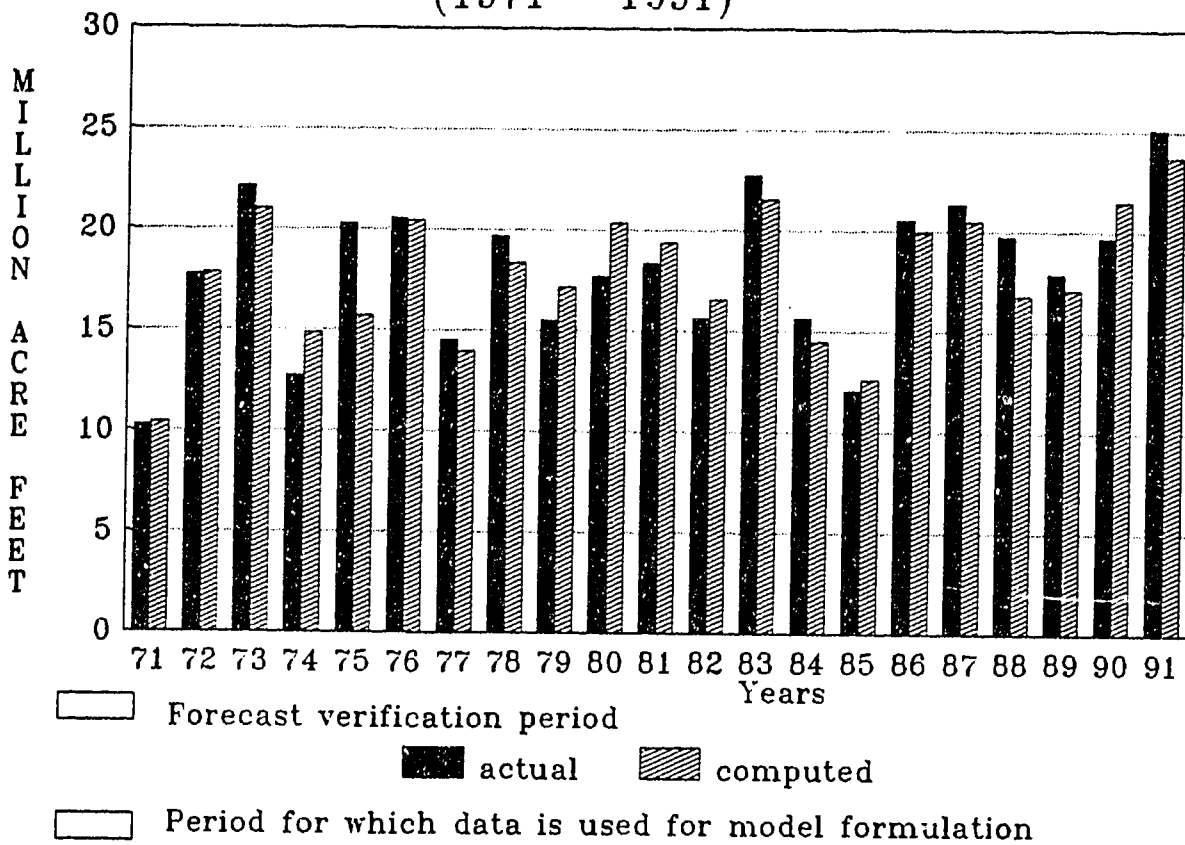


MANGLA RESERVIOR

Exhibt-XVIII

Comparision of actual & computed seasonal (April_Sept.) volumes

(1971 - 1991)



Forecast verification period

actual computed

Period for which data is used for model formulation

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Exhibit-XIX

10-DAILY FORECAST EVALUATION

Period (April-September)

Year 1988

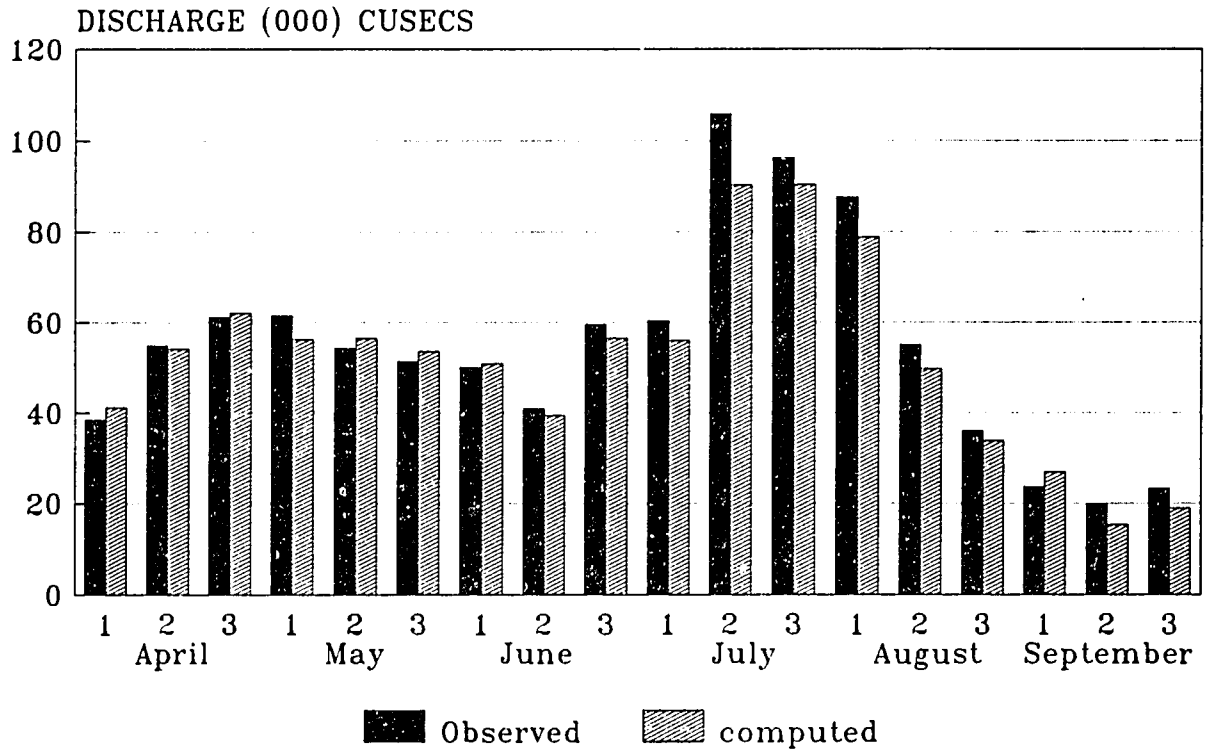

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Exhibit-XX

10-DAILY FORECAST EVALUATION

Period (April-September)

Year 1989

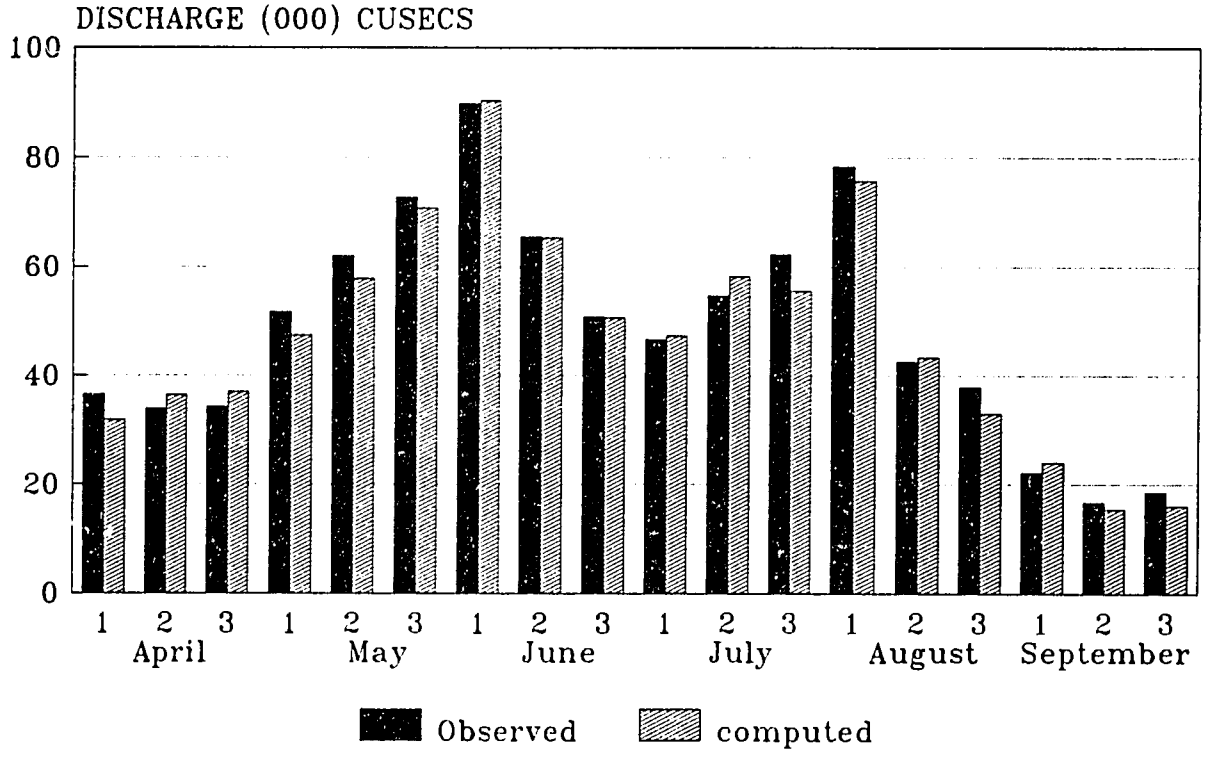

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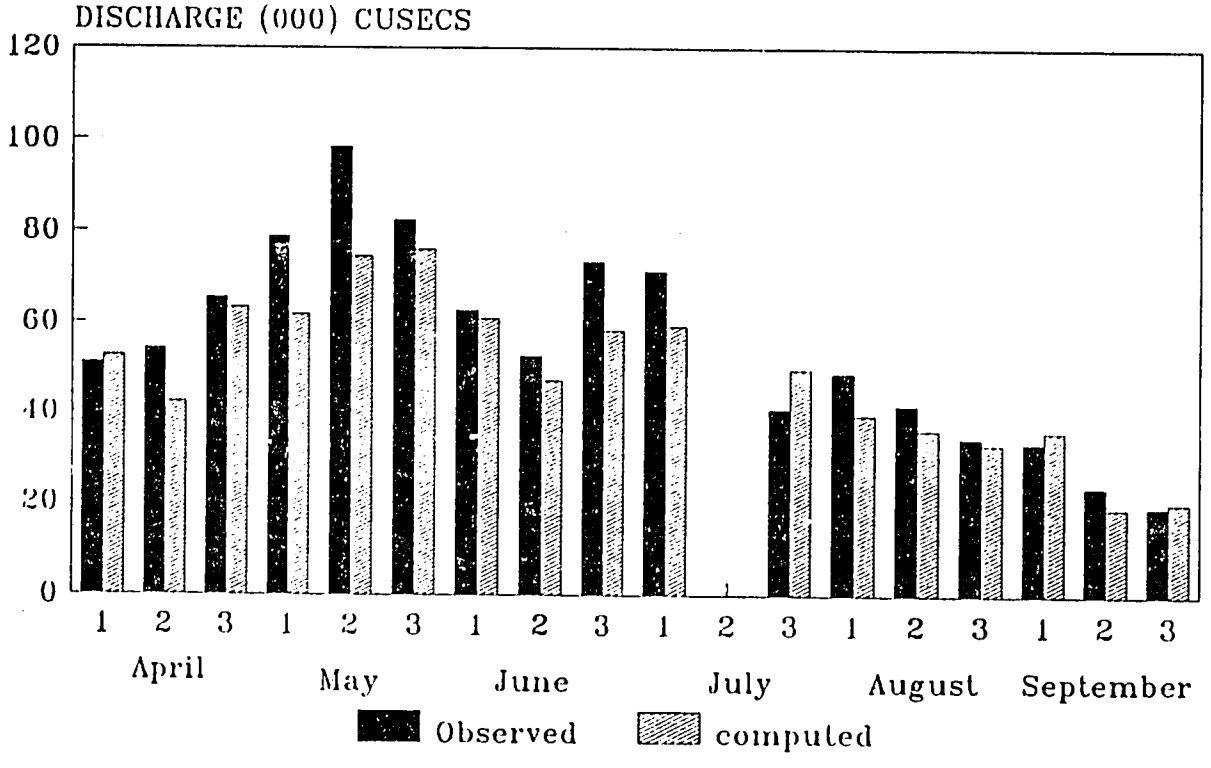
Exhibit-XXI

10-DAILY FORECAST EVALUATION

Period (April-September)

Year 1990



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