QC
990
.P29
W42
1968
v.1

WEST PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY
WATER AND SOILS INVESTIGATION DIVISION
SURFACE WATER HYDROLOGY PROJECT

1968 ANNUAL REPORT
OF
RIVER AND CLIMATOLOGICAL DATA
OF
WEST PAKISTAN

ATMOSPHERIC SCIENCES
LIBRARY
APR 17 1972
N.O.A.A.
U.S. Dept. of Commerce

VOL. I

RIVER DISCHARGE, SEDIMENT AND QUALITY DATA

PREPARED BY SURFACE WATER HYDROLOGY PROJECT
WAPDA LAHORE

'72 1585

National Oceanic and Atmospheric Administration

Climate Database Modernization Program

ERRATA NOTICE

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages
Faded or light ink
Binding intrudes into the text

This document has been imaged through the NOAA Climate Database Modernization Program. To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or www.reference@nodc.noaa.gov.

LASON
Imaging Subcontractor
12200 Kiln Court
Beltsville, MD 20704-1387
March 28, 2002

PREFACE

This report is published by Water and Soils Investigation Division, WAPDA, with co-operation and support of other Divisions and formations especially Directorate General of Planning and Investigation, and I.B.P.

The report consists of three volumes: Surface flow, sediment and chemical composition data as Volume I, daily and hourly precipitation and snow data as Volume II, evaporation, temperatures, solar radiation and wind movement data as Volume III. Previously the report was published in one volume from 1960 to 1962 and in two volumes from 1963 to 1965. These changes from time to time, were necessitated due to increase in stations all of which could not be accommodated in one volume.

All the field records presented herein were collected, evaluated and compiled by the personnel of Surface Water Hydrology Project under the direction of the undersigned. Chemical analysis of water samples was done in the Quality of Water Laboratory, WASID.

(Ch. Mohammad Umar),
Chief Engineer,
Water and Soils Investigation Division.
WAPDA.

Lahore August 1970.

TECHNICAL STAFF OF SURFACE WATER HYDROLOGY PROJECT

C. M. Umar	Chief Engineer WASID
Asrar Ahmad Qureshi	Project Director
M. Iqbal Varaich	Attached Officer
Javed Saleem Qamar	Senior Engineer
Rashid Beg Akhtar	Senior Engineer
Sh. Mohammad Hussain	Senior Engineer
Khalid Jawed	Senior Engineer
M. Saleem Warsi	Senior Engineer
M. Hassan Mian	Senior Engineer

JUNIOR ENGINEERS

Wasiq Yar	Tariq Masood
Saeed-ul-Hassan Shah	M. Abdul Shakoor
M. Munir Chughtai	Aman Ullah Khan
Fazal-e-Ahad Awan	Rana Riaz Ahmad
M. Hayat	Ch. Zia Ullah
Tauqir Hussain	Pervaiz Anjum
Zamir Hussain	Mahboob Ahmed
Mohammad Farooq	Bashir Ahmed
Abdul Haq	Javed Majid
Hussain Ahmad	Abdul Latif

JUNIOR RESEARCH OFFICERS

M. Jahangir Khan	Sh. Mohammad Bashir
Ch. Sana Ullah	Mohammad Rafique
Sh. Naeem-ud-Din	

(Typed by Mohammad Ramzan, Steno/typist)

CONTENTS

Page

INTRODUCTION. 1

DEFINITION OF TERMS AND ABBREVIATIONS 2

EXPLANATION OF DATA

River discharge, sediment and chemical data. . . 3
Maps of location 9

RIVER DISCHARGE, SEDIMENT AND CHEMICAL DATA

DISCHARGE STATION RECORDS (arranged in downstream order)

Indus River Basin
Gilgit River at Gilgit 17
Hunza River at Dainyor Bridge 23
Gilgit River at Alam Bridge. 28
Indus River at Partab Bridge. 29
Indus River near Darband. 35
Siran River at Thapla. 41
Chitral River at Chitral 47
Kabul River at Warsak. 53
Swat River near Kalam 59
Swat River at Chakdara. 65
Bara River at Jhansi Post 71
Kabul River at Nowshera. 77
Kalpani River near Risalpur 83
Indus River at Mandori (about 5 miles d/s Attock Bridge) 88
Haro River near Khanpur. 95
Haro River at Sanjwal. 101
Kohat Toi at Jarma Weir. 109
Soan River at Chirah 115
Ling River near Kahuta. 121
Soan River near Rawalpindi 129
Sil River near Chahan 135
Soan River at Dhok Pathan. 143
Kurram River at Thal 149
Tochi River at Tangi Post. 155
Tank Zam near Jandola. 161
Gomal River at Kot Murtaza 165
Chenab River Basin
Chenab River at Alexandria Bridge. 171

CONTENTS

Page

Jhelum River Basin
Kishanganga at Muzaffarabad. 177
Kunhar River at Naran. 183
Kunhar River at Khanian. 189
Kunhar River near Garhi Habib Ullah. . . . 195
Jhelum River at Kohala. 201
Bishan Daur Kas near Missa. 207
Poonch River near Kotli. 213
Jhelum River at Mangla Cableway 219
Nari River Basin
Khost River at Chappar Rift 227
Nari River near Sibi 233
Chakkar River at Talli Tangi. 239
Bolan River at Kundlani Bridge. 245
Gaj Nai near Jubble. 251
Indus River near Sehwan 257
Hub River at Bund Murad Khan. 263
Kud River near Mai Gondrani 269
Porali River at Sinchi Bent 275

DATA AT MISCELLANEOUS SITES

Summary of discharge measurements 282
Summary of sediment analysis data 290
Summary of chemical analysis data 298

Organization

The Surface Water Circle was created by WAPDA with effect from Ist July 1960 with the responsibility of collecting surface water data required for WAPDA Projects and General Investigations. The Mangla Hydrometeorological Division was used as a nucleus and various project hydrologic activities were included. The circle was designated as Surface Water Hydrology Project in June 1966.

Purpose and scope of report

The purpose of this report is to present the data collected by the Surface Water Hydrology Project in 1968, its nineth year of operation. This is the nineth in a series of annual reports to be published. The report is being published in three volumes. In this volume of the report observations taken at discharge stations by the Surface Water Hydrology Project are documented.

The data in this volume include river discharge, suspended sediment concentration, chemical analysis and water temperature. Most of these data were published in preliminary form at monthly intervals during 1968. As more data became available revisions were made wherever accuracy of the records was found to be below acceptable standards. This volume supersedes the earlier monthly publications of 1968.

Maps on pages 9 to 14 show the hydrologic stations that have been operated and for which data are published. Some stations were operated for which only field data have been published because the records were incomplete or found to be below acceptable standards. These are indicated on the map as "Partial records" Only stations that are operated by the Surface Water Hydrology Project and for which records are published in this report are shown on the maps.

Discharge records are being collected by other agencies at some of the stations operated by the Surface Water Hydrology Project. Past records are available for some of these stations. These are discussed under "records available" in each station description. A more complete listing of availability of records is given in the "Inventory of Surface Water Hydrology Stations".

The data given herein were collected and computed by the best methods available and are considered to be accurate enough for general use. All field data and computations by the Surface Water Hydrology Project are on record in Lahore and open to inspection.

DEFINITION OF TERMS AND ABBREVIATIONS

The definitions of hydrologic terms as used in this report are given below:

Cusec (Cubic foot per second) is the rate of discharge of a stream whose cross-sectional area is one square foot and whose velocity is one foot per second.

Cusecs per square mile (cs/mi) is the average rate of discharge from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Runoff in inches (in) is the quantity of water discharged from an area (drainage basin) in a given period of time, measured in terms of mean depth over the area.

Acre foot (ac ft) is the quantity of water required to cover an acre of area to a depth of one foot.

PPM Parts per million.

me/l (Milliequivalents per litre), one thousandth of an equivalent of an ion or a compound in one litre of solution.

RIVER DISCHARGE, SEDIMENT AND CHEMICAL COMPOSITION DATA

Gauge height record

Records of river stage are obtained either from periodic readings of a staff gauge, or wire weight gauge, or from an automatic water-stage recorder which gives a continuous record of stage fluctuations. The non-recording gauges are generally read five times daily during periods of low flow and at more frequent intervals during floods.

Daily mean gauge heights for non-recording gauges are the arithmetic average of the observations during periods of uniform flow or are computed from gauge-height graphs based on observations during periods of rapidly changing stage. Daily mean gauge heights for automatic recording gauges are computed directly from the pen trace.

Discharge measurement

Measurements of discharge are made using the small Price AA Current meter and following the general methods used by the U.S. Geological Survey. This method consists of taking depths and observations of velocity in a cross-section of the stream, with the sections spaced so that not more than 5 percent of the discharge is measured in any one section. Velocity observations between 40 and 70 seconds are taken at 0.2 and 0.8 of the depth. If the flow is shallow, the velocity observation is taken only at 0.6 or 0.5 of the depth. In very small streams a pygmy current meter is used. Various suspensions for the current meters are used. These include calibrated rods for wading measurements and lines with sounding weights suspended from reels for use on bridges, overhead cableways, or boats.

The frequency of discharge measurement varies from station to station depending on such factors as stability of the channel and importance or accessibility of the station. At most stations, measurements are made twice a month except during flood periods when these may be made as often as several times a day.

Discharge computations

Daily mean discharges are computed by application of daily mean gauge heights to rating tables prepared from stage-discharge relation curves based on discharge measurements. Any day showing rapid changes of gauge height is subdivided for daily discharge computation. Any extensions to the rating curves that are necessary to define extremes of discharge are made on the basis of logarithmic plotting, velocity, area studies, or indirect determinations of peak discharge such as slope-area or contracted opening measurements or computation of flow over dams or weirs.

The discharge is computed by the shifting-control methods if the stage-discharge relation is subject to change because of frequent changes in the physical features that form the control. In this method correction factors, based on discharge measurements are used in applying the gauge heights to the rating tables.

Presentation of discharge data

The data presented for a discharge station include a station description and a table of daily, monthly and yearly discharges. Observations of sediment concentration and results of chemical analysis which are also listed, are described separately.

The description of each discharge station gives location, drainage area, records available, average discharge, extremes of discharge, description of the gauge, methods of measurement and remarks concerning accuracy, factors affecting the record and items of general interest. The location of the discharge station and the drainage area are taken from the most accurate maps available. Under "Records available" are listed, first those records obtained by the Surface Water Hydrology Project and then known records obtained by other agencies. "Average discharge" for the period of record is given only for stations with four years or more of record. Under "Extremes", the maximum instantaneous gauge heights and discharges observed for the current year and for the period of record are given. It should be noted that in the case of a non-recording gauge the highest gauge height observed may be considerably lower than the actual maximum figure. For the minimum discharge, the daily mean figure is given rather than an instantaneous value because, quite frequently, the instantaneous minimum discharge is caused by artificial means such as changes in irrigation diversion and is, therefore not representative of the flow except for a very short period.

In the table of daily discharge, the figures given are derived from gauge heights, with exceptions noted at the bottom of the page. Days on which discharge measurements were made are indicated by asterisks except where they were made very frequently in which case the frequency is indicated under "Discharge measurements" in the station description.

In the monthly summary at the bottom of the table of daily discharge, the line headed "mean" gives the average flow for the month in cubic feet per second; mean per square mile (cs/mi); runoff depth in inches over the drainage basin (in) and acre-feet (af) or million acre-feet (maf). Values for cubic feet per second per square mile and runoff depth in inches are omitted if consumptive use or diversions in or out of the drainage basin make these values unrepresentative of natural conditions.

The yearly values shown are the average flow in cubic feet per second, the average runoff in cubic feet per second per square mile, the total runoff depth in inches over the drainage basin, the total runoff in acre feet and the maximum and minimum daily mean discharge.

Downstream order of stations

Discharge stations are listed in downstream order along the Indus main stem. Stations on a tributary entering above a main stem station are listed before that station. If the tributary enters between two main stem stations it is listed between them. A similar order is followed in listing stations as first rank, second rank and other ranks of tributaries. To indicate the rank of any tributary, each indention in the listing of gauging stations in the table of contents of this report represents one rank. This downstream order and system of indention show which gauging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gauging station is located.

Accuracy of discharge data

Accuracy of stream flow records depends primarily on (1) stability of the stage-discharge relation, or if the relation is unstable, frequency of discharge measurements; (2) accuracy of observations of stage and measurements of discharge; (3) accuracy of interpretation of the field data.

In this volume, probable accuracy of discharge records is evaluated as follows:

Excellent	..	probable error less than	5%
Good	..	probable error less than	10%
Fair	..	probable error less than	15%
Poor	..	probable error greater than	15%

In general, monthly and annual mean values are more accurate than daily values because of compensation of random errors.

Discharge at partial-record stations and miscellaneous sites.

The number of streams on which stream flow information is desired exceeds the number of stream-gauging stations it is feasible to operate at one time, so the Surface Water Hydrology Project, WAPDA has collected limited streamflow data at sites other than full time stream-gauging stations. Data collected at these partial-record stations or at miscellaneous sites are usable in preliminary, low or perennial flow analysis. Often partial-record stations are operated initially until the necessity of the data justifies building major discharge measuring cableways or security and access allow full time collection of streamflow data.

Discharge measurements made in 1968 for these sites in the area covered in this report, are presented under "Data at Miscellaneous Sites".

Sedimentation data

Suspended sediment concentration is determined from water samples collected using sediment samplers designed to take in water without disturbing the flow. The samplers are of two general types. The depth-integrating sampler takes water in continuously while the sampler is moved at a uniform rate in a vertical section, from the surface to the bottom and back. The point-integrating sampler is used to obtain a sample at a specific point in the vertical.

Samples are usually taken at three verticals in the stream, so located that each represents approximately one-third of the flow. At low stages when the water is relatively clear, only one sample may be taken at the centre of the flow. A set of samples is taken at the time of each discharge measurement, but may be taken more frequently during monsoon season at certain important stations. Water temperature is observed at the time of each sampling.

The samples are analysed either for total concentration by drying and weighing, or for particle size distribution by use of bottom withdrawal or visual accumulation tubes, pipettes and sieves using distilled water as settling media. It should be noted that these samples include only sediment suspended in water and not that transported as bed load.

Results of analyses of sediment samples for each discharge station are listed in chronological order following the table of daily discharges. The figures given on each line are the total concentration in parts per million of suspended solids by weight and the size distribution in percent of the total. The temperatures and discharges given are instantaneous values for the time at which samples were taken.

Chemical analysis

All natural waters contain dissolved mineral matter. As streams flow from the head reaches to the plains or sea, the water is in contact with soils or rocks and dissolves some materials. The quantities of dissolved mineral matter depend primarily on the type of rocks or soils the water comes in contact with and the duration of the contact. Most streams are fed by both surface runoff and ground water, which reflect the chemical character of their concentration. Groundwater is generally more highly mineralized than natural surface runoff because it remains in contact with the rocks and soils for much longer

periods. The concentration of dissolved solids in a river is frequently increased by man made causes namely from drainage of mines or oil fields, increased disposal of industrial and municipal wastes and drainage from irrigated land.

The samples for chemical analysis have been collected at or near points on streams where gauging stations are operated by the Surface Water Hydrology Project, for which chemical analysis has been made by the Quality of Water Laboratory of Water and Soils Investigation Division of WAPDA.

The following determinations are made on the samples:

Calcium (Ca) is determined by titration with the versenate (E.D.Y.S) using ammonium purpurate indicator in the presence of sodium hydroxide solution and colour change.

Magnesium (Mg) is determined by titration similar to calcium and colour change. Calcium and Magnesium are calculated as: Vol. of versenate X normality of versenate X 1000/ml in aliquat.

Sodium (Na) is determined by Sodium Flame Photometer.

Carbonate and Bicarbonate (CO_3 and HCO_3) are determined by titrating the water sample with a standard solution of sulphuric acid using phenal - phthalein and methyl orange indicators. The end points of titration are selected as the inflection point in the titration of sodium carbonate with sulphuric acid. The carbonate end-point is taken at pH 8.2 and the bicarbonate at pH 4.5.

Chloride (Cl) is determined by titrating the sample with standard silver nitrate solution using potassium chromate as indicator.

Sulphate (SO_4) is determined by adding known quantity of barium chloride to the sample to precipitate all the sulphate ions.

Dissolved Solids (D.S.) are determined by evapo ration to give the total amount of soluble salts per million cc of water. A known volume of the water sample is evaporated at 105°C.

Electrical conductivity (EC) is measured by means of a Wheatstone Bridge where resistance is equated to the resistance of the unknown solution surrounding electrodes in a conductivity cell. The conduct-

ivity is expressed in micro-mhos per centimeter usually at 25°C. Conductivity is closely related to the sum of cations and anions in solution and is a rapid method to know the total dissolved solids in a solution.

pH — the hydrogen ion concentration is determined by a pH meter using glass and calomel-Kol electrodes.

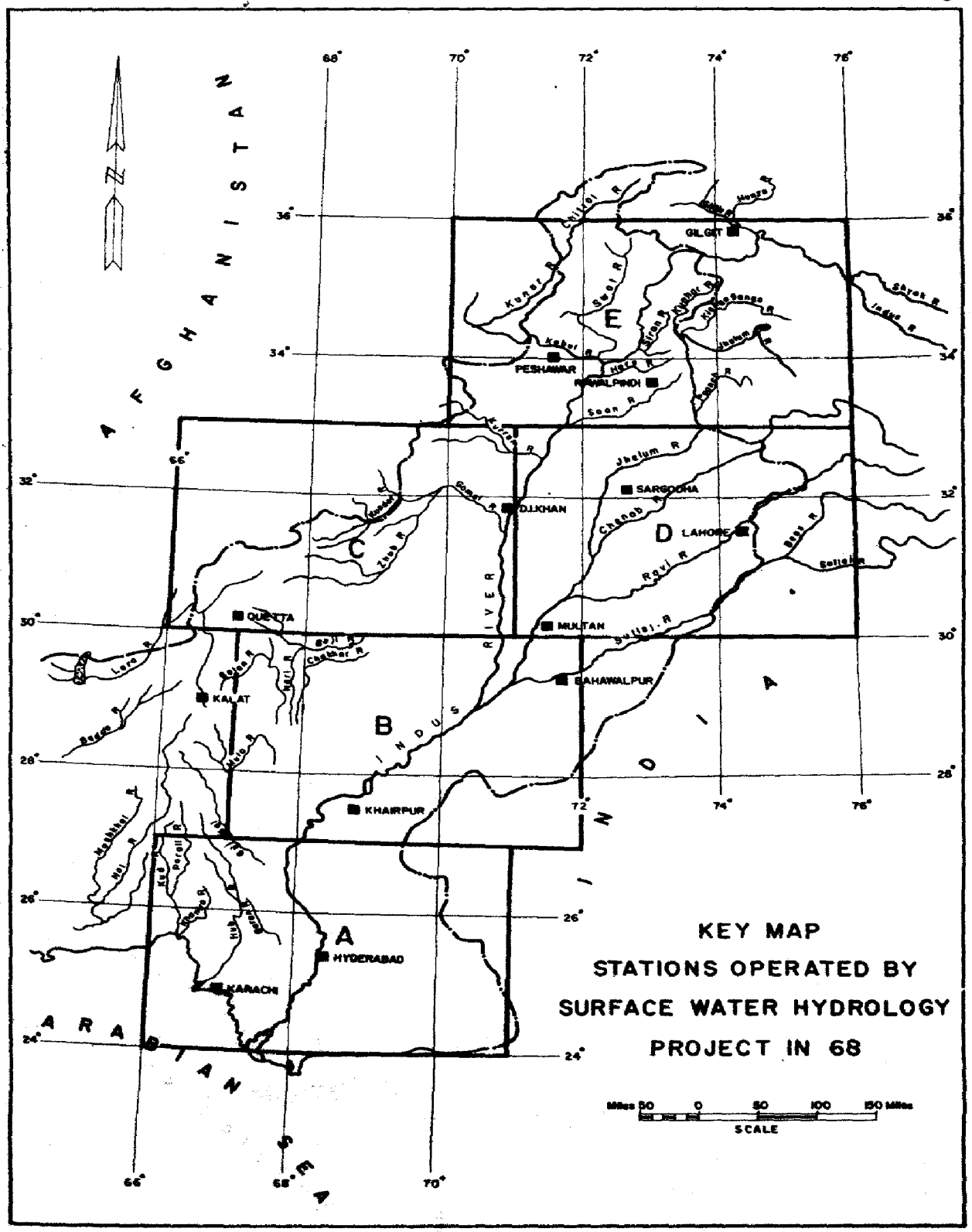
Sodium Adsorption Ratio (SAR) is an index of the sodium or alkali hazard expressing the relative activity of sodium ions in exchange reactions with the soil. It is expressed as follows:

$$SAR = \frac{Na^{+}}{\left(\frac{Ca^{++} + Mg^{++}}{2}\right)^{\frac{1}{2}}}$$

Where the concentrations of the three soluable cations are given in milliequivalents per litre (me/l).

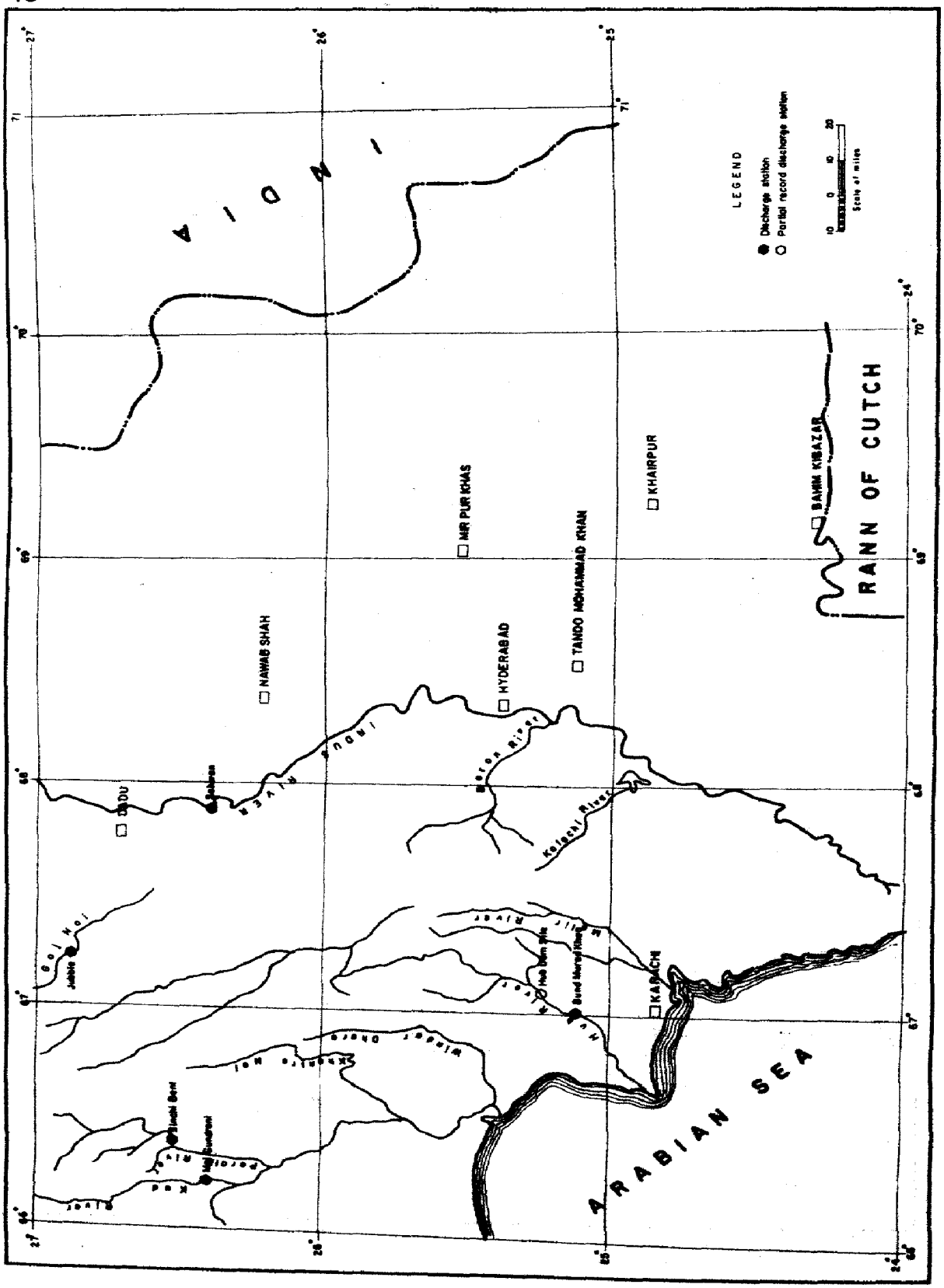
Residual Carbonate (Res CO_3) is expressed as the sum of the Carbonate and Bicarbonate anions minus the sum of the Calcium and Magnesium cations.

$$Res\ CO_3 = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++}).$$

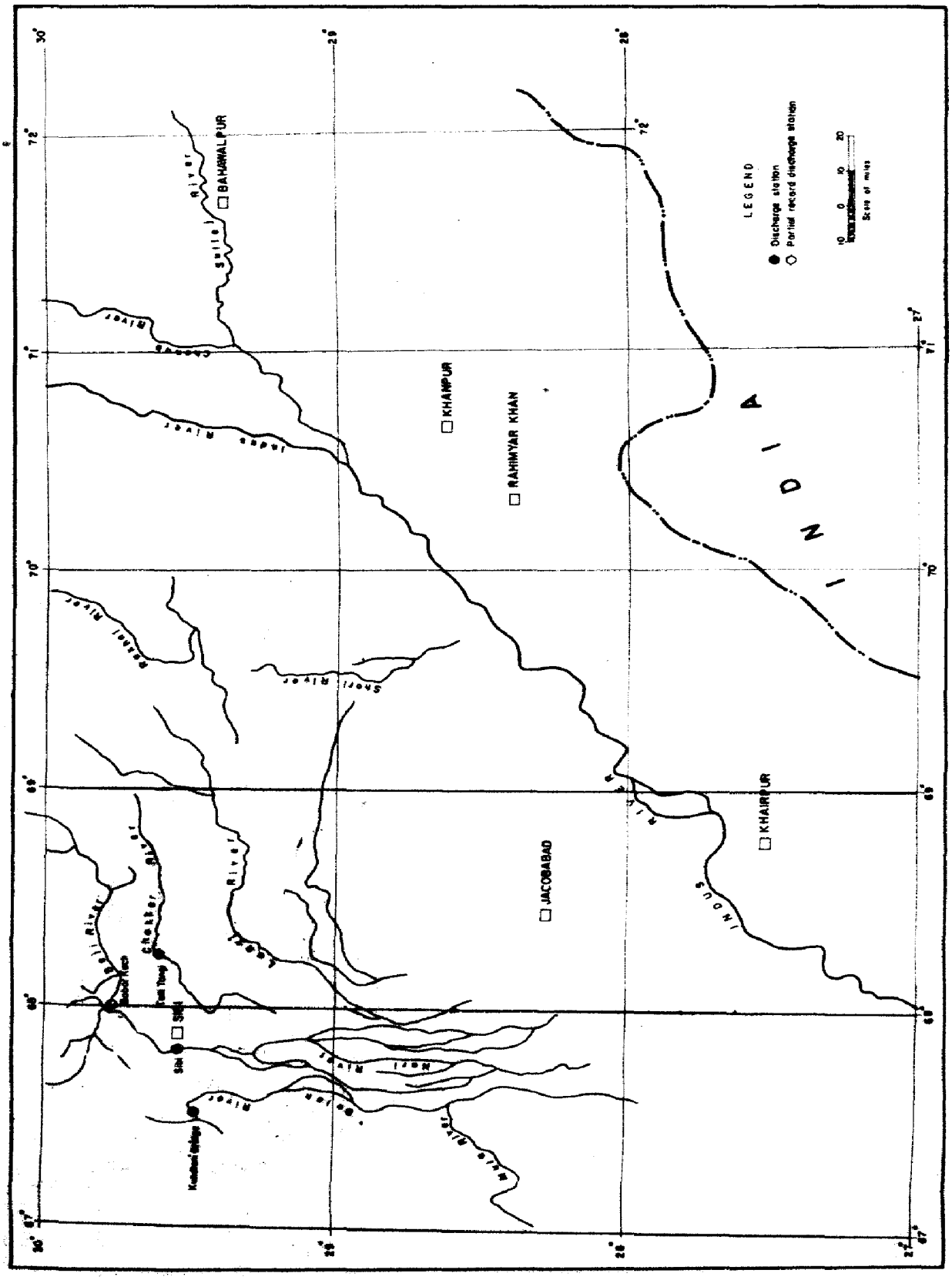


KEY MAP
STATIONS OPERATED BY
SURFACE WATER HYDROLOGY
PROJECT IN 68

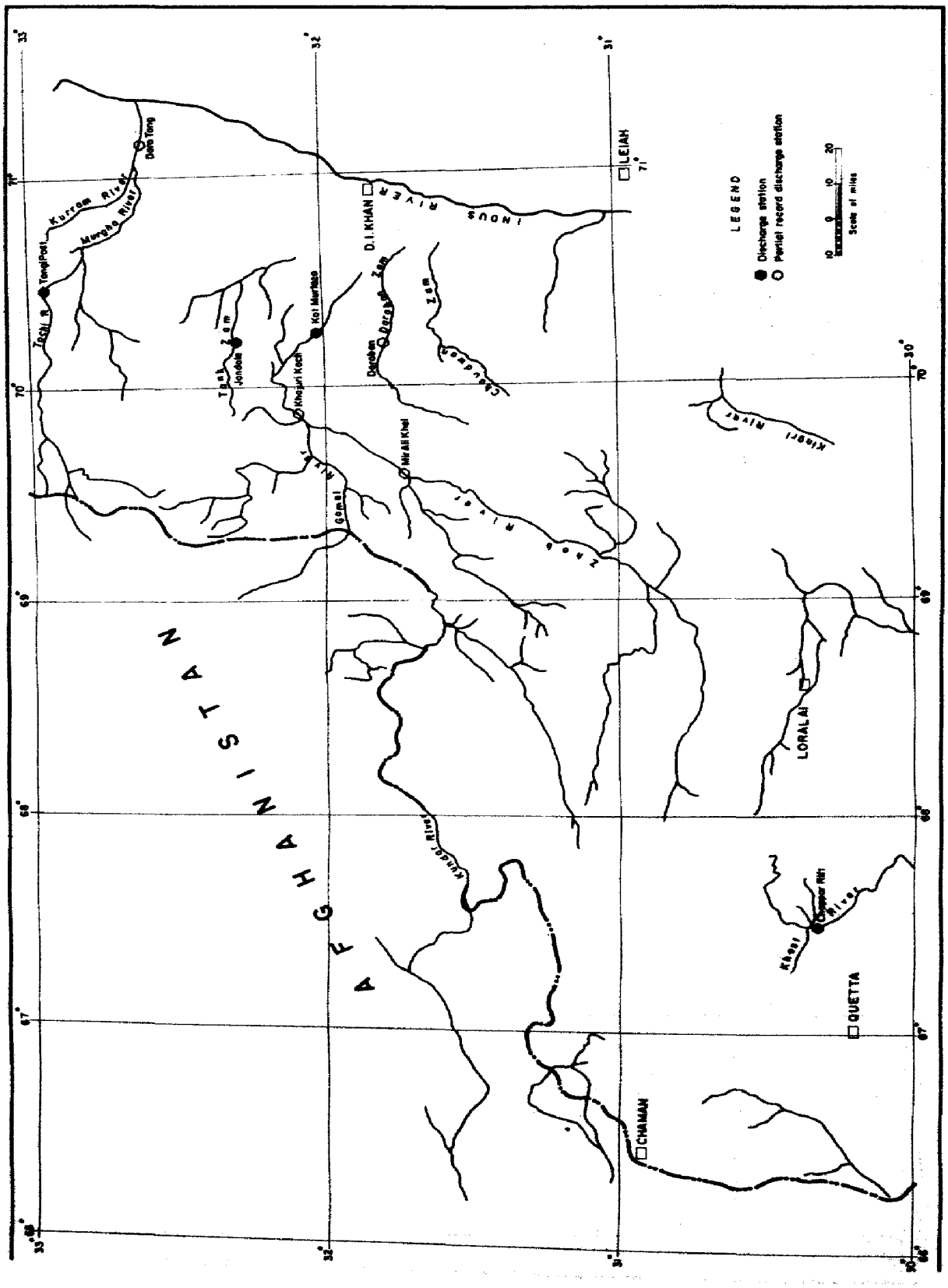
MAP AREA A


INDIA
RANN OF CUTCH
ARABIAN SEA
LEGEND
Discharge station
Partial record discharge station
Scale of miles
BAHIM KIBAZAR
KHAIRPUR
TANDO MOHAMMAD KHAN
MIR PUR KHAS
HYDERABAD
NAWAB SHAH
DADU
KARACHI
Jubbie
Bund Murad Khan
Hub Dam Site
Sinchi Bent
Mal Sundrani
Kalachi River
Baran River
Indus River
Gaj Nai
Hub River
Windar Dhara
Khantra Nai
Parali River
Kad River

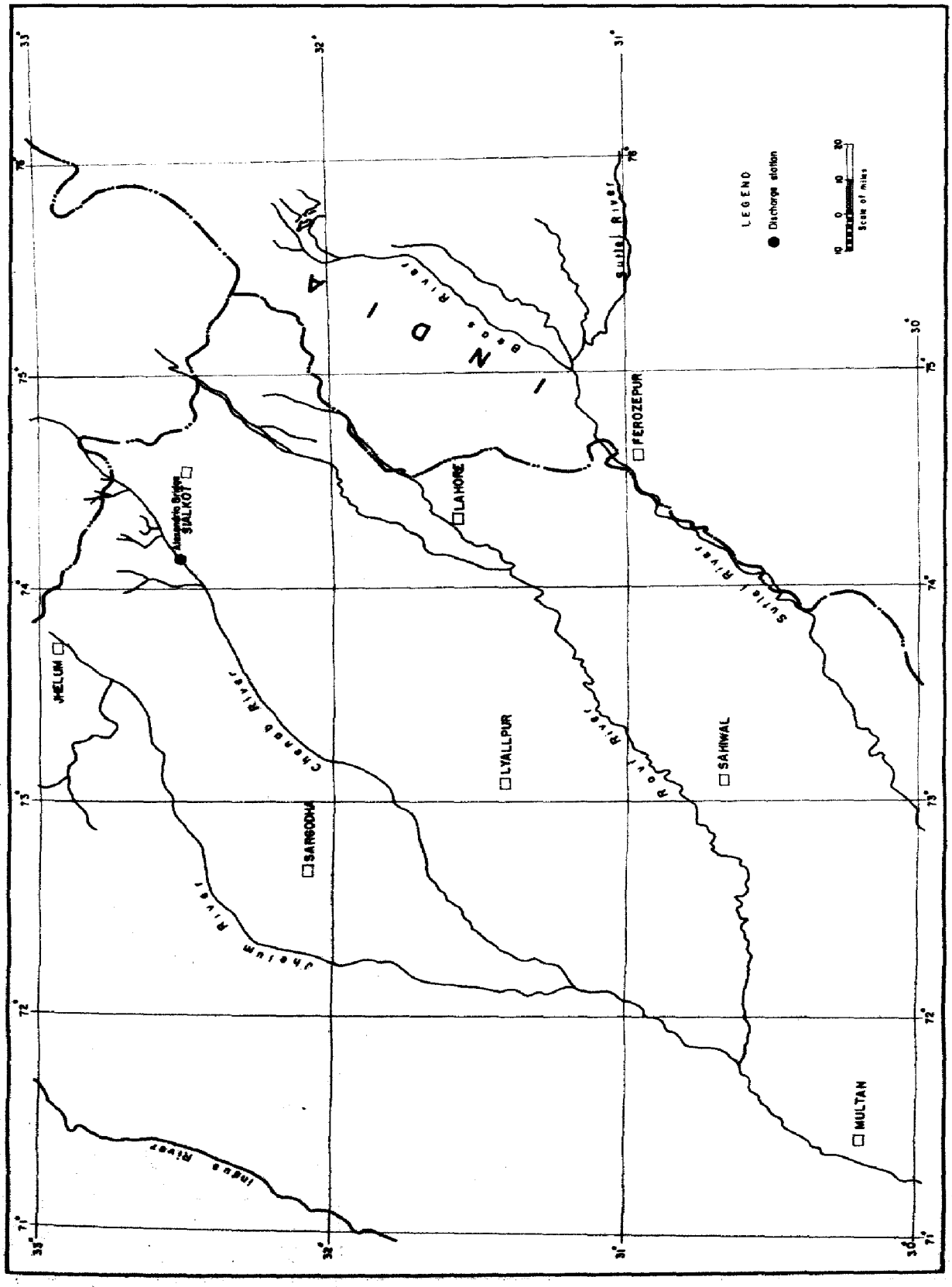
MAP AREA B


LEGEND
Discharge station
Partial record discharge station
Scale of miles
INDIA
BAHAWALPUR
KHANPUR
RAHIMYAR KHAN
JACOBABAD
KHAIRPUR
Sutlej River
Chenab River
Indus River
Rakhal River
Shori River
Lakhi River
Chakkar River
Bali River
Nari River
Bolan River
Mula River
Indus River

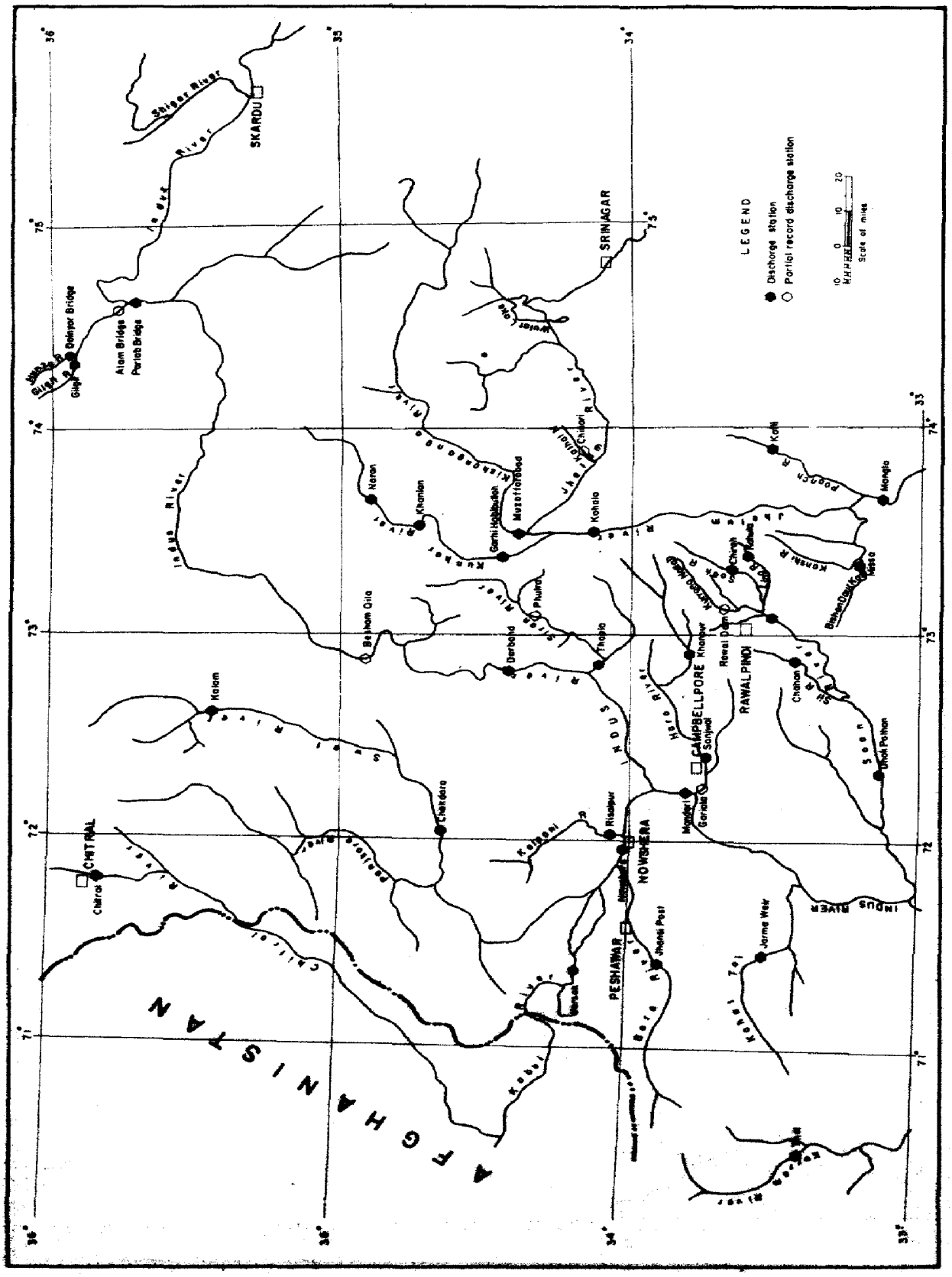
MAP AREA C


AFGHANISTAN
INDUS RIVER
D.I.KHAN
LEIAH
LORALAI
QUETTA
CHAMAN
Kurram River
Murgha River
Tochi R.
Tangi Post
Dara Tang
Tank Zam
Jondola
Kot Murtaza
Khajuri Kach
Daraban
Daraban Zam
Chaudwan Zam
Mir Ali Khel
Gomal River
Zhob River
Kingri River
Kundar River
Khost River
Chappar Rift
LEGEND
Discharge station
Partial record discharge station
Scale of miles

MAP AREA D


INDIA
Indus River
Jhelum River
Chenab River
Ravi River
Sutlej River
Sutlej River
JHELUM
SIALKOT
Alexandria Bridge
LAHORE
FEROZEPUR
LYALLPUR
SARGODHA
SAHIWAL
MULTAN
LEGEND
Discharge station
Scale of miles
0
10
20
30
70°
71°
72°
73°
74°
75°
76°
29°
30°
31°
32°
33°

MAP AREA E


LEGEND
Discharge station
Partial record discharge station
Scale of miles
SKARDU
SRINAGAR
CHITRAL
PESHAWAR
NOWSHERA
CAMPBELLPORE
RAWALPINDI
Shigar River
Indus River
Kabul River
Kunhar River
Jhelum River
Poonch R.
Kohat Tal
Kalpani R.
Swat River
Chitral River
Panjkora River
Hara River
Sirag River
Kishanganga River
Kunhar River
Jhelum River
Kohala
Muzaffarabad
Garhi Habibullah
Naran
Khanian
Chidori
Kohli
Mangla
Chirgh
Rawal Dam
Khanpur
Sanjwal
Garlala
Mandari
Risalpur
Jhansi Post
Jarma Weir
Dhok Pathan
Chanan
Thapla
Darband
Phulra
Besham Qila
Kalam
Chakdara
Chitral
Mossa
Bishan Daul
Kohat
Kohat Tal
Kabul River
Bara River
Sawat River
Indus River
Jhelum River
Kunhar River
Kishanganga River
Shigar River
Indus River
Gilgit
Dainyor Bridge
Alam Bridge
Partab Bridge
AFGHANISTAN
36°
35°
34°
33°
75°
74°
73°
72°
71°

RIVER DISCHAGE, SEDIMENT AND QUALITY STATION RECORD

(Arranged in downstream order)

Blank page retained for pagination

Location Latitude 35°56', Longitude 74°19', on left bank under bridge at Gilgit, 3½ miles upstream from Hunza River and 23 miles up-stream from Indus River.

Drainage area 4,670 square miles.

Records available Discharge records computed from January 1960 to date by Surface Water Hydrology Project WAPDA. Discharge measurements and gauge height record September 1959 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 10,300 cusecs (7,500,000 acre feet per year or 30.1 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge during the year 49,300 cusecs on 9 July (gauge height 16.10 feet); minimum daily discharge 1,510 cusecs on 26 February.

1960-1968: Maximum discharge observed 83,400 cusecs on 12 July 1960; minimum daily discharge 1,450 cusecs on 28 March 1966.

Gauge Enamelled plates graduated to 0.1 foot fastened to abutment under left end of bridge at Gilgit. Gauge set to arbitrary datum.

Measurements Forty five discharge measurements were made from the bridge by current meter at 0.2 & 0.8 depth. Forty sets of sediment samples were taken by depth integrating method using D-49 sampler from the bridge. Eighteen of these were analysed for particle size distribution and the rest for total concentration. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge: The control for this station is a rocky riffle which shifts nearly continuously. Previous rating dated 18.4.66 was used as it was confirmed by measurement made in 1968. Daily discharges were computed from this rating curve with shift adjustments where necessary.

Remarks Record good.

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,410	1,850	1,630	1,670	5,260	15,800
2	a 2,320	1,890	1,660	1,650	*4,330	18,800
3	*2,230	1,950	1,700	1,620	3,900	18,500
4	2,310	1,980	*1,780	1,620	3,650	19,300
5	2,440	2,030	1,780	1,630	3,410	17,800
6	2,470	2,060	1,780	1,670	*3,240	*22,300
7	2,480	2,040	1,780	1,680	3,040	25,600
8	*2,510	*2,030	1,760	1,690	2,960	31,900
9	2,440	2,020	*1,760	1,690	2,900	35,000
10	2,440	1,970	a 1,750	1,690	2,840	38,200
11	2,410	1,910	1,740	1,660	2,770	*39,500
12	2,310	1,890	1,740	*1,640	3,000	38,700
13	2,240	1,890	1,700	1,690	3,620	33,100
14	2,140	1,910	1,710	1,680	4,440	31,300
15	*2,040	*1,840	*1,760	1,710	4,370	31,200
16	2,060	1,800	1,780	1,730	*4,0[illegible]	35,500
17	2,140	1,820	1,790	1,710	4,060	*39,600
18	2,170	1,820	1,790	1,730	4,540	38,600
19	*2,230	1,820	1,860	1,740	5,670	38,500
20	2,200	1,840	1,800	1,910	6,800	38,000
21	2,170	*1,860	1,800	*2,130	*8,800	38,200
22	2,100	1,800	1,770	2,500	9,380	39,600
23	2,040	1,700	1,740	2,750	9,530	40,800
24	2,020	1,590	1,710	2,800	10,900	40,800
25	1,970	1,530	1,740	3,410	13,500	*42,900
26	*1,950	*1,510	1,730	3,810	10,300	43,900
27	1,970	1,580	1,740	*3,700	8,700	41,700
28	1,950	1,590	*1,740	3,690	8,300	38,000
29	1,950	1,600	1,710	3,570	9,830	32,700
30	1,950	———	1,700	3,550	10,800	31,000
31	1,970	———	1,670	———	12,100	———
Mean	2,190	1,830	1,750	2,190	6,130	33,200
Cs/mi	0.47	0.39	0.37	0.47	1.31	7.11
In	0.54	0.42	0.43	0.52	1.51	7.94
Maf	1 .135	.105	.107	.130	.377	1.98

1968 year: Mean 11,100 Cs/sq mi 2.38 Inches 32.4

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	32,600	30,300	11,900	7,680	3,990	2,690
2	*35,700	29,800	12,100	7,600	3,970	2,720
3	36,400	30,100	12,300	*7,450	3,830	2,810
4	37,400	29,900	12,400	7,150	3,720	2,840
5	38,500	*30,400	12,400	6,950	3,690	2,780
6	*41,000	35,300	12,400	6,700	3,640	2,690
7	43,000	39,000	12,300	6,450	3,600	2,750
8	45,100	39,000	12,100	6,200	3,550	2,740
9	*45,700	*36,700	12,200	6,060	3,550	2,750
10	44,900	34,500	12,000	5,970	3,580	2,810
11	44,800	32,100	12,100	5,720	3,520	2,810
12	43,300	*33,100	12,500	5,330	3,470	2,800
13	42,600	33,000	12,500	5,260	3,430	2,750
14	43,800	34,300	12,900	5,150	3,410	2,720
15	*42,900	36,400	12,900	5,070	3,250	2,690
16	41,300	34,300	12,800	4,880	3,240	*2,690
17	40,000	*31,500	*12,000	4,860	3,200	2,690
18	36,600	29,800	11,500	4,650	3,240	2,690
19	30,600	*29,500	10,500	4,630	3,160	2,660
20	28,900	28,300	9,890	4,560	3,140	2,600
21	28,400	28,100	* 9,620	*4,500	3,160	2,540
22	26,800	28,300	9,530	4,440	3,120	a 2,500
23	23,800	25,600	*9,650	4,420	*3,060	2,470
22	22,600	22,600	9,620	4,330	3,030	2,450
25	22,900	20,400	9,100	4,290	2,950	2,350
26	24,800	18,300	*8,780	4,250	2,900	*2,320
27	27,200	*16,600	8,400	4,230	2,860	2,310
28	30,300	14,900	8,200	4,210	2,770	2,310
29	30,100	13,700	8,050	4,160	2,750	2,370
30	30,600	12,600	7,750	4,100	2,690	2,480
31	*30,700	11,800	———	4,030	———	2,420
Mean	35,300	28,100	11,000	5,330	3,320	2,620
Cs/mi	7.56	6.02	2.36	1.14	0.71	0.56
In	8.71	6.93	2.63	1.32	0.79	0.65
Maf	2.17	1.73	.655	.328	.197	.161

M. Acre-feet 8.08 Max Day 45,700 Min Day 1,510

Suspended sediment concentration - 1968

Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
3 Jan	2,230		9			
8 Jan	2,510		9			
15 Jan	2,040		17			
19 Jan	2,230		60			
26 Jan	1,950		4			
8 Feb	2,030		22			
15 Feb	1,840		22			
21 Feb	1,860		40			
26 Feb	1,510		53			
4 Mar	1,780		11			
9 Mar	1,760		44			
15 Mar	1,760		11			
28 Mar	1,740		7			
27 Apr	3,720		83			
6 Jun	22,700	48	1,970	59	35	6
11 Jun	40,600	53	2,120	50	40	10
17 Jun	40,200	54	816	23	61	16
25 Jun	43,000	50	994	33	53	14
2 Jul	37,800	53	1,890	15	53	32
6 Jul	42,300	54	2,940	22	54	24
9 Jul	47,900	54	401	17	61	22
12 Jul	41,600	52	352	20	55	25
15 Jul	44,400	52	2,880	21	36	43
23 Jul	23,900	54	479	30	35	35
31 Jul	32,200	53	2,160	13	50	37
5 Aug	31,500	56	1,560	31	40	29
9 Aug	38,100	54	1,410	36	34	30
12 Aug	34,300	56	1,280	35	45	20
17 Aug	32,500	57	1,270	37	34	29
19 Aug	30,200	52	1,240	38	34	28
27 Aug	16,900	56	370	63	24	13
17 Sep	12,100	56	425	20	46	34
21 Sep	9,650	60	212			
23 Sep	9,800	64	99			
26 Sep	8,950	62	99			
3 Oct	7,450	57	55			
21 Oct	4,500	55	27			
23 Nov	3,060	50	32			
16 Dec	2,690	45	23			
26 Dec	2,310	43	28			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

GILGIT RIVER AT GILGIT

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER											PARTS PER MILLION					$EC \times 10^6$ at 25°C.	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
15	1.37	0.73	0.40		0.18	1.86	0.10	1.00			2.50	2.54				138	250	8.21	0	0.4
Feb																				
8	1.47	0.73	0.30		0.18	1.26	0.14	1.00			2.50	2.58				140	250	8.21	0	0.3
Mar																				
4	1.58	0.77	0.40		0.18	1.35	0.14	1.10			2.75	2.77				140	260	8.21	0	0.4
Apr																				
27	1.05	0.90	0.30		0.18	1.08	0.10	0.90			2.25	2.26				115	210	8.22	0	0.3
Jun																				
6	1.26	0.34	0.15		0	1.20	0.10	0.40			1.75	1.70				86	160	7.94	0	0.2
11	0.84	0.66	0.30		0	1.29	0.15	0.30			1.80	1.74				94	170	7.79	0	0.3
25	1.05	0.45	0.15		0	1.07	0.10	0.40			1.65	1.57				82	150	7.85	0	0.2
Jul																				
2	0.84	0.46	0.30		0	1.03	0.10	0.35			1.60	1.48				78	150	7.85	0	0.3
6	0.95	0.45	0.40		0	1.20	0.15	0.30			1.80	1.65				84	170	7.79	0	0.5
12	0.95	0.35	0.30		0	1.03	0.15	0.30			1.60	1.48				78	150	7.70	0	0.3
15	0.95	0.55	0.40		0	1.20	0.10	0.40			1.90	1.70				88	180	7.80	0	0.5
Aug																				
5	1.06	0.36	0.25		0	1.30	0.09	0.18			1.67	1.57				82	150	8.13	0	0.9
12	1.11	0.26	0.25		0	1.25	0.14	0.18			1.62	1.57				82	150	8.03	0	1.0
19	1.11	0.21	0.25		0	1.25	0.09	0.23			1.57	1.54				80	150	8.03	0	1.0
27	0.94	0.38	0.22		0	1.05	0.09	0.38			1.54	1.52				82	150	8.00	0	1.0
Sep																				
17	1.32	0.16	0.22		0	1.15	0.14	0.23			1.70	1.52				84	150	8.02	0	0.8
21	1.16	0.26	0.41		0	1.25	0.19	0.50			1.83	1.94				98	180	7.99	0	0.5
23	1.16	0.37	0.50		0	1.30	0.19	0.60			2.03	2.09				106	190	8.05	0	0.6
26	1.16	0.37	0.41		0	1.25	0.19	0.58			1.94	2.02				100	180	8.10	0	0.5
Oct																				
3	1.55	0.48	0.10		0	1.44	0.19	0.44			2.13	2.07				112	190	7.95	0	0.1
21	1.49	0.51	0.20		0	1.44	0.19	0.64			2.20	2.27				120	200	7.95	0	0.2
Nov																				
23	1.55	0.60	0.20		0	1.44	0.19	0.68			2.35	2.31				118	200	8.00	0	0.2
Dec																				
26	1.50	0.48	0.20		0	1.44	0.19	0.58			2.18	2.21				118	200	7.80	0	0.2

Blank page retained for pagination

Location Latitude 35°55', Longitude 74°23', near Dainyor village about 5 miles east of Gilgit Town and ½ mile upstream from confluence with Gilgit River.

Drainage area 5,080 square miles.

Records available Record available from September 1965 to date with Surface Water Hydrology Project WAPDA. Periodic discharge measurements started from 5 November 1965.

Extremes Maximum discharge observed during the year 80,300 cusecs on 9 August (gauge height 13.40 feet); minimum daily discharge 1,030 cusecs on 23 March.

1966-68: Maximum discharge 182,000 cusecs on 30 June 1967 (gauge height 21.90 feet - gauge set to arbitrary datum); Minimum daily discharge 1,030 on 23 March 1968.

Gauge Zero to 5 feet with 0.1 graduations painted on boulder on left bank downstream of bridge; from 5' and above enamelled gauge plates graduated to 0.1 feet; gauge read to hundredth of a foot five times a day or more often during floods; gauge set to a arbitrary datum.

Measurements Twenty seven discharge measurements were made during the year using .2 & .8 depth method from bridge. Twenty six sets of sediment samples were taken by depth integrating method using D-49 sampler from bridge. Seventeen of these were analysed for particle size distribution and the rest for total concentration. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge Rating table dated 5.8.68 was used from 1 Jan to 31 December. Discharges were computed with shift adjustments as necessitated by the periodic discharge measurements.

Remarks Record fair.

HUNZA RIVER AT DAINYOR BRIDGE

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	1,530	1,470	1,470	1,030	3,320	11,000
2	1,500	1,470	1,470	1,040	3,270	12,400
3	1,470	1,470	1,470	1,040	2,920	*11,900
4	1,460	1,460	1,500	1,050	2,780	11,800
5	1,600	1,460	1,460	1,080	2,620	12,200
6	1,560	1,440	1,440	1,080	2,560	13,200
7	1,530	1,420	1,440	1,080	2,340	14,700
8	1,530	1,390	1,430	1,050	2,220	*18,100
9	1,530	1,360	1,430	1,040	2,140	21,900
10	1,530	1,310	1,420	1,050	2,090	25,400
11	1,530	1,310	1,400	1,080	2,070	29,100
12	1,530	1,230	*1,430	1,080	2,240	29,700
13	1,530	1,320	1,430	1,100	2,510	*24,600
14	1,490	1,360	1,440	1,100	2,780	21,700
15	1,440	1,360	1,370	1,130	2,890	*23,300
16	1,430	1,330	1,330	1,130	3,240	25,300
17	1,440	1,310	1,310	1,180	3,520	28,300
18	1,440	1,320	1,270	1,330	4,120	29,900
19	1,460	1,330	1,240	1,440	4,420	30,700
20	1,460	1,360	1,180	1,500	5,000	32,300
21	1,470	1,390	1,110	1,720	5,320	38,200
22	1,470	1,420	*1,040	2,140	5,690	32,400
23	1,460	1,430	1,030	2,340	5,960	33,900
24	1,460	*1,400	1,100	2,340	6,200	35,700
25	1,460	1,420	1,100	2,560	5,790	41,000
26	1,470	1,420	1,080	2,780	8,050	42,000
27	1,470	1,430	1,080	3,010	7,790	42,300
28	1,470	1,440	1,050	*2,870	7,520	39,100
29	1,470	1,460	1,040	2,780	8,050	30,200
30	1,460	———	1,040	3,190	*9,270	29,000
31	1,460	———	1,030	———	8,740	———
Mean	1,490	1,390	1,280	1,610	4,430	26,400
Cs/mi	0.29	0.27	0.25	0.32	0.87	5.20
In	0.34	0.29	0.29	0.35	1.01	5.79
Maf	.092	.080	.079	.096	.273	1.57

1968 year: Mean 14,000 Cs/sq mi 2.76 Inches 37.5

Note: * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	28,900	64,700	13,700	9,120	3,110	2,040
2	33,700	65,300	14,700	9,190	2,960	2,110
3	38,300	65,900	18,000	9,150	2,960	2,140
4	41,500	64,200	*20,600	*8,170	2,730	2,180
5	46,500	66,800	20,400	7,300	2,580	2,140
6	52,500	71,700	20,600	7,160	2,510	2,140
7	*59,700	74,100	19,200	6,440	2,510	2,110
8	64,600	*72,000	18,600	5,760	2,510	2,110
9	66,900	74,300	18,300	5,360	*2,960	2,050
10	69,300	72,200	17,400	5,100	2,960	2,050
11	*72,300	69,600	17,500	4,780	2,960	2,020
12	71,700	62,800	18,200	4,480	2,920	2,070
13	70,900	64,600	19,200	4,180	2,920	2,070
14	*70,500	65,300	20,400	3,970	2,780	*2,040
15	61,900	*68,100	20,900	3,910	2,640	2,020
16	53,200	63,700	20,100	3,800	2,560	2,020
17	49,400	62,600	17,900	3,630	2,450	2,040
18	48,400	*64,800	17,200	3,630	2,420	2,040
19	46,500	64,400	*14,400	3,570	2,340	2,040
20	43,200	64,300	12,900	3,430	2,340	2,000
21	40,800	61,500	12,100	3,350	2,340	1,960
22	35,600	54,100	12,900	*3,290	2,300	1,960
23	30,300	40,100	13,900	3,320	2,300	1,930
24	29,000	33,700	14,700	3,270	2,300	1,930
25	*32,800	29,700	*13,800	3,320	2,260	1,930
26	39,300	*22,400	12,800	3,270	2,260	1,930
27	45,700	18,400	12,400	3,270	2,180	1,890
28	54,500	17,700	10,800	3,240	2,140	*1,800
29	*61,800	16,500	9,650	3,220	2,110	1,760
30	63,900	14,800	9,270	3,220	2,040	1,760
31	65,900	13,600	———	3,140	———	1,760
Mean	51,300	53,700	16,100	4,780	2,550	2,000
Cs/mi	10.1	10.6	3.17	0.94	0.50	0.39
In	11.6	12.2	3.53	1.08	0.56	0.45
Maf	3.15	3.30	.957	.294	.151	.123

M. Acre-feet 10.2 Max Day 74,300 Min Day 1,030

HUNZA RIVER AT DAINYOR BRIDGE

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
24 Feb	1,530		128			
12 Mar	1,430		153			
22 Mar	1,040		131			
28 Apr	2,870		155			
3 Jun	11,700	59	4,130	7	37	56
8 Jun	18,200	50	10,500	45	28	27
13 Jun	24,100	54	6,390	22	42	36
15 Jun	22,700	56	5,660	17	49	34
7 Jul	58,700	53	12,300	36	43	21
11 Jul	72,700	54	12,500	34	36	30
14 Jul	69,700	52	7,070	26	51	23
25 Jul	34,800	53	5,830	36	40	24
29 Jul	59,700	55	7,510	30	45	25
8 Aug	70,700	53	8,820	46	39	15
15 Aug	68,700	55	8,670	46	39	15
18 Aug	60,700	57	7,770	47	32	21
26 Aug	22,100	56	2,260	43	34	23
4 Sep	20,600	50	3,080	48	47	5
19 Sep	14,700	54	1,640	42	42	16
22 Sep	13,200	53	1,990	27	61	12
25 Sep	13,700	54	1,830	20	70	10
4 Oct	8,050	52	701			
22 Oct	3,320	52	95			
9 Nov	2,960	48	100			
14 Dec	2,040	44	47			
28 Dec	1,760	38	26			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

HUNZA RIVER AT DAINYOR BRIDGE

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER											PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C.$	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
24	1.47	1.63	0.65		0.18	1.44	0.10	2.00			3.75	3.72				230	370	8.31	0	0.5
Mar																				
12	1.79	1.71	0.70		0.18	1.66	0.14	2.30			4.20	4.28				264	400	8.21	0	0.5
May																				
7	1.05	0.55	0.40		0	1.29	0.15	0.60			2.00	2.04				110	200	7.90	0	0.4
Jun																				
3	1.37	0.68	0.45		0	1.41	0.15	0.95			2.50	2.51				130	240	7.76	0	0.4
8	1.26	0.74	0.15		0	1.24	0.10	0.90			2.15	2.24				122	220	7.90	0	0.2
13	1.26	0.59	0.45		0	1.41	0.15	0.80			2.30	2.36				126	230	7.97	0	0.5
15	1.26	0.64	0.40		0	1.41	0.10	0.70			2.30	2.21				120	220	7.72	0	0.4
Jul																				
11	1.26	0.54	0.25		0	1.33	0.10	0.60			2.05	2.03				116	200	7.94	0	0.3
14	1.26	0.64	0.25		0	1.41	0.19	0.50			2.15	2.10				118	210	7.96	0	0.3
25	1.16	0.42	0.50		0	1.40	0.14	0.50			2.08	2.04				112	200	8.05	0	0.6
Aug																				
8	1.21	0.32	0.41		0	1.35	0.09	0.50			1.94	1.94				110	200	8.00	0	0.5
15	1.27	0.22	0.55		Traces	1.39	0.09	0.60			2.04	2.08				110	200	8.18	0	0.6
18	1.36	0.19	0.55		Traces	1.39	0.09	0.50			2.10	1.98				108	200	8.12	0	0.6
26	1.36	0.47	0.55		Traces	1.49	0.09	0.76			2.38	2.34				128	230	8.02	0	0.6
Sep																				
4	1.11	0.47	0.55		Traces	1.39	0.09	0.55			2.13	2.03				110	200	8.05	0	0.6
19	1.36	0.38	0.55		Traces	1.39	0.09	0.70			2.29	2.18				116	210	8.12	0	0.6
22	1.27	0.56	0.55		0	1.39	0.09	0.85			2.38	2.33				122	220	7.90	0	0.6
25	1.27	0.56	0.55		0	1.39	0.09	0.85			2.38	2.33				124	220	7.90	0	0.6
Oct																				
4	1.62	0.63	0.20		0	1.53	0.14	0.72			2.45	2.39				146	240	8.00	0	0.2
22	0.89	1.87	0.29		0	1.89	0.19	1.00			3.07	3.08				180	300	7.95	0	0.2
Nov																				
9	2.20	1.01	0.37		0	2.11	0.19	1.23			3.58	3.53				202	330	8.00	0	0.3
Dec																				
14	3.11	0.66	0.50		0	2.47	0.24	1.47			4.27	4.18				246	400	7.85	0	0.4
28	2.36	1.22	0.40		0.18	2.07	0.19	1.60			3.98	4.04				232	380	8.20	0	0.3

GILGIT RIVER AT ALAM BRIDGE - 1968

Location Latitude 35°45', Longitude 74°37', on right bank about two miles upstream from confluence with Indus River and ½ mile upstream from Alam Bridge on Gilgit-Bunji Road.

Drainage area 10,100 square miles.

Records available Discharge record by Surface Water Hydrology Project WAPDA from 1 January 1966 to date. Gauge height record since 29 December 1965.

Extremes Data for 1968 was not computed.

1966-67: Maximum discharge 208,000 cusecs on 30 June 1967 (estimated); minimum daily discharge 3,160 cusecs on many days of March and April 1966.

Gauge Enamelled plates graduated to 0.1' and read at one hour interval eight times a day. Gauge set to arbitrary datum.

Measurements Eighteen discharge measurements were made during the year using 0.2 & 0.8 depth method from the bridge. Sixteen sets of sediment samples were taken by depth integrating method using D-49 sampler from the bridge. Nine of these were analysed for particle size distribution and the rest for total concentration. Seventeen surface samples were collected and analysed for chemical composition.

Determination of discharge Gauge height record collected during the year was not reliable, hence computations for mean daily discharges were not made.

Remarks The records of actual discharge observations, sediment and chemical samples are documented under "Data at Miscellaneous Sites".

Location Latitude 35°44', Longitude 74°37', on left bank under the bridge, 1 mile downstream from mouth of Gilgit River.

Drainage area 57,500 square miles.

Records available Discharge record by Surface Water Hydrology Project WAPDA from January 1962 to date. Gauge height record by Hydrology Directorate of Irrigation Department from September 1959 to June 1962 with partial discharge records.

Average Discharge 60,500 cusecs (43,800,000 acre feet per year or 14.3 inches runoff per year). Average taken for 7 years from 1962 to 1968.

Extremes Maximum discharge during the year 281,000 cusecs on 13 July (gauge height 69.50 feet); minimum daily discharge 10,400 on many days of April.

1962-68: Maximum discharge 437,000 cusecs on 29 July 1963; minimum daily discharge 8,800 cusecs on 13 March 1963.

Gauge Painted on plastered strip on left bridge abutment and set to arbitrary datum.

Measurements Nineteen discharge measurements were made from bridge by current meter using 0.2 and 0.8 depth method. Eighteen sets of samples were taken by depth integrating method using D-49 sampler. Eleven of these were analysed for particle size distribution and the rest for total concentration. Seventeen surface samples were collected and analysed for chemical composition.

Determination of discharge Rating table dated 17.9.63 was continued through out the year.

Remarks Record fair.

INDUS RIVER AT PARTAB BRIDGE

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	12,500	11,300	10,600	10,600	18,200	*48,500
2	12,200	11,300	10,600	10,600	17,900	57,500
3	12,000	11,300	10,600	10,600	17,800	65,100
4	11,900	11,300	10,600	10,600	17,700	70,100
5	11,900	11,200	10,500	10,600	17,500	67,100
6	11,900	11,200	10,400	10,600	16,700	70,400
7	11,700	11,300	10,400	10,700	16,200	84,900
8	11,600	11,300	10,400	10,800	15,400	98,400
9	11,600	11,300	10,400	10,800	15,000	106,000
10	11,800	11,300	10,400	10,800	14,600	113,000
11	11,900	11,300	10,400	10,800	14,700	123,000
12	11,900	11,200	10,500	10,900	15,200	137,000
13	12,100	11,200	10,600	11,000	16,000	130,000
14	12,100	11,100	10,600	11,000	16,800	126,000
15	11,900	11,000	10,400	11,000	18,100	130,000
16	11,900	11,000	10,400	11,000	19,400	137,000
17	11,900	11,000	10,500	11,100	20,200	150,000
18	11,800	11,000	10,600	11,200	22,200	163,000
19	11,600	11,000	10,600	11,200	23,200	*163,000
20	11,600	10,900	10,600	11,700	24,300	158,000
21	11,600	10,800	10,600	12,500	26,300	166,000
22	11,600	10,800	10,700	13,300	30,800	*166,000
23	11,600	10,800	10,700	13,900	36,500	178,000
24	11,600	10,800	10,600	14,500	39,200	194,000
25	11,800	*10,700	10,600	15,000	43,000	211,000
26	11,800	10,600	*10,500	15,800	42,000	216,000
27	11,900	10,600	10,400	17,200	41,200	213,000
28	11,800	10,600	10,400	17,800	39,000	192,000
29	11,600	10,600	10,400	*17,800	36,500	156,000
30	11,600	———	10,500	17,900	40,800	135,000
31	11,500	———	10,600	———	42,400	———
Mean	11,800	11,000	10,500	12,400	25,000	134,000
Cs/mi	0.21	0.19	0.18	0.22	0.43	2.33
In	0.24	0.21	0.21	0.24	0.50	2.60
Maf	.709	.634	.647	.740	1.54	7.98

1968 year: Mean 62,500 Cs/sq mi 1.09 Inches 14.8

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	127,000	233,000	74,500	43,400	17,800	13,600
2	131,000	228,000	74,700	42,300	17,800	13,600
3	145,000	228,000	81,700	41,600	17,400	13,600
4	163,000	229,000	87,800	40,300	17,200	13,500
5	172,000	240,000	92,400	*37,200	16,900	13,500
6	183,000	256,000	89,500	35,000	16,600	13,500
7	199,000	269,000	83,800	32,700	16,300	13,500
8	219,000	275,000	80,700	29,600	16,200	13,600
9	243,000	278,000	77,800	26,300	16,000	13,500
10	256,000	272,000	*76,600	25,200	15,800	13,500
11	266,000	*267,000	74,300	24,500	15,800	13,500
12	272,000	262,000	74,500	24,100	15,800	13,500
13	279,000	260,000	77,100	23,700	15,800	13,500
14	275,000	270,000	80,300	23,100	a15,600	13,400
15	264,000	268,000	85,900	22,500	a15,400	13,400
16	252,000	254,000	86,000	22,100	a15,200	13,300
17	236,000	243,000	79,600	21,400	a15,000	13,200
18	226,000	243,000	72,200	20,700	*14,800	13,100
19	*220,000	246,000	65,700	20,200	14,700	13,000
20	207,000	*240,000	60,100	19,800	14,700	12,600
21	*202,000	234,000	59,100	19,800	14,600	12,300
22	190,000	223,000	61,200	19,400	14,600	12,100
23	161,000	198,000	64,900	19,200	14,600	11,800
24	142,000	165,000	68,100	19,000	14,600	11,700
25	135,000	143,000	66,100	18,900	14,500	*11,800
26	142,000	124,000	61,000	18,600	14,400	12,100
27	160,000	103,000	*66,100	18,500	14,300	12,200
28	181,000	*92,200	*53,200	18,300	13,900	12,200
29	198,000	85,300	49,100	18,200	13,700	12,100
30	*205,000	79,500	45,000	18,200	13,500	11,800
31	222,000	76,900	———	*18,000	———	11,800
Mean	202,000	212,000	72,300	25,200	15,500	12,900
Cs/mi	3.51	3.69	1.26	0.44	0.27	0.22
In	4.06	4.26	1.40	0.51	0.30	0.26
Maf	12.4	13.1	4.30	1.55	.919	.793

M. Acre-feet 45.3 Max Day 279,000 Min Day 10,400

INDUS RIVER AT PARTAB BRIDGE

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
25 Feb	10,600		31			
26 Mar	10,500		33			
29 Apr	17,800		248			
19 Jun	163,000	53	4,390	14	65	21
22 Jun	170,000	54	3,750	23	51	26
19 Jul	221,000	55	4,780	51	30	19
21 Jul	200,000	55	4,580	56	31	13
30 Jul	205,000	54	5,350	49	29	22
11 Aug	266,000	55	6,400	43	42	15
20 Aug	238,000		7,070	60	24	16
28 Aug	91,000	60	4,950	83	8	9
10 Sep	77,000	60	4,490	79	16	5
27 Sep	56,900	65	404			
28 Sep	54,400	61	736	16	33	51
5 Oct	36,600	60	1,320	42	12	46
31 Oct	18,000	55	62			
18 Nov	14,800	51	68			
25 Dec	11,900	43	29			

Note : Sand is all sizes above 0.025 m
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

INDUS RIVER AT PARTAB BRIDGE

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C.$	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
25	1.37	1.03	0.60		0.09	1.53	0.14	1.30			3.00	3.06				194	300	8.20	0	0.5
Mar																				
26	1.47	1.53	0.60		0.18	1.48	0.19	1.80			3.60	3.65				194	340	8.21	0	0.5
Jun																				
19	1.26	0.44	0.25		0	1.29	0.14	0.50			1.95	1.98				106	180	7.95	0	0.3
22	1.26	0.54	0.25		0	1.24	0.19	0.60			2.05	2.03				112	200	7.96	0	0.3
Jul																				
19	1.05	0.55	0.40		0	1.29	0.20	0.40			2.00	1.89				94	190	7.76	0	0.4
21	1.09	0.17	0.50			1.30	0.09	0.35			1.76	1.74				94	170	7.97	0.04	0.6
30	1.25	0.22	0.55			1.35	0.14	0.61			2.02	2.10				110	200	7.90	0	0.7
Aug																				
11	1.25	0.22	0.55			1.30	0.14	0.61			2.02	2.05				112	200	7.90	0	0.7
20	1.25	0.22	0.55			1.50	0.14	0.40			2.02	2.04				110	200	7.90	0.03	0.7
28	1.30	0.27	0.55			1.25	0.14	0.71			2.12	2.10				118	210	7.98	0	0.6
Sep																				
10	1.30	0.38	0.60			1.40	0.19	0.61			2.28	2.20				124	220	7.80	0	0.7
27	1.25	0.22	0.55			1.20	0.14	0.72			2.02	2.06				110	200	7.97	0	0.7
28	1.25	0.32	0.45			1.20	0.14	0.71			2.02	2.05				114	200	7.85	0	0.5
Oct																				
5	1.33	0.70	0.29		0	1.53	0.29	0.63			2.32	2.45				122	230	8.00	0	0.3
31	1.78	0.68	0.37		Traces	1.62	0.24	0.80			2.83	2.66				146	250	8.18	0	0.3
Nov																				
18	1.76	0.59	0.40		0	1.80	0.19	0.70			2.75	2.69				158	260	8.05	0	0.4
Dec																				
25	1.77	0.90	0.37		0	1.89	0.29	1.00			3.04	3.18				164	280	7.90	0	0.4

Blank page retained for pagination

INDUS RIVER NEAR DARBAND - 1968

Location Latitude 34°24', Longitude 72°48', on left bank 4 miles downstream from Kotkai, 5 miles upstream from mouth of Unar River 6 miles upstream from Darband.

Drainage area 64,100 square miles.

Records available December 1959 to date by Surface Water Hydrology Project WAPDA. Gauge height record November 1954 to Sep tember 1958 by Dams Investigation Circle.

Average Discharge 85,000 cusecs (61,600,000 acre-feet per year or 18.0 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge during the year 344,000 cusecs on 14 July (gauge height 1305.25 feet); minimum daily discharge 13,500 cusecs on 13-15 February.

1955-68: Maximum discharge 480,000 cusecs on 16 July 1957 (gauge height, 1320.5 feet from floodmarks); minimum daily discharge 12,500 cusecs on 31 January & 1 February 1966.

Gauge Masonry pillars with enamelled plates or painting graduated to 0.1 foot from R.L. 1258 to R.L. 1323, read to 0.05 foot nine times daily and more often during floods. Datum reduced level.

Measurements Thirty four discharge measurements were made during the year using 0.2 and 0.8 depth metnod from car on overhead cableway. Seventy six sets of sediment samples were taken by depth integrating or point integrating method using D-49 or P-46 samplers. Fifty six of these were analysed for particle size distribution and the rest for total concentration. Twenty four surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a channel control in solid rock. Sand moves in the reach. Rating dated 2.5.67 was used to compute daily mean discharges.

Remarks Record good.

INDUS RIVER NEAR DARBAND

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	16,300	14,700	15,300	16,900	64,900	87,300
2	16,000	14,400	15,000	16,700	64,200	98,900
3	15,800	14,100	15,100	16,200	58,300	111,000
4	15,600	14,000	15,000	16,400	52,500	117,000
5	15,600	13,800	15,100	17,000	45,800	118,000
6	15,300	14,300	15,200	18,400	43,700	122,000
7	15,800	14,300	15,400	27,700	*40,200	136,000
8	15,800	14,600	15,900	25,800	37,200	160,000
9	15,800	14,300	16,200	23,900	35,200	188,000
10	16,000	14,100	16,000	23,700	33,400	214,000
11	15,800	14,000	16,600	*21,900	31,800	239,000
12	15,600	*13,800	16,600	22,200	32,800	244,000
13	15,500	13,500	16,600	26,200	36,300	244,000
14	*15,300	13,500	17,900	23,900	42,100	223,000
15	15,200	13,500	16,700	28,600	*44,100	*209,000
16	15,000	13,700	16,700	*25,400	41,900	210,000
17	14,900	13,900	*17,400	23,800	40,600	223,000
18	14,500	*13,800	19,600	23,100	41,100	234,000
19	14,300	13,800	23,100	24,000	44,600	235,000
20	*14,500	14,100	20,400	26,700	49,900	229,000
21	14,900	15,100	19,600	29,000	56,100	223,000
22	14,700	14,700	17,900	31,700	64,200	227,000
23	14,400	14,400	17,000	36,900	69,100	242,000
24	14,700	14,100	16,400	37,000	73,100	263,000
25	14,600	14,100	16,400	39,500	77,400	277,000
26	14,400	15,300	20,200	*43,400	77,600	*296,000
27	14,900	*18,800	21,000	44,800	71,700	304,000
28	14,900	16,800	*20,700	48,200	68,400	284,000
29	15,300	15,700	18,700	48,200	66,800	237,000
30	15,200	———	17,700	55,100	72,400	200,000
31	15,100	———	17,000	———	81,500	———
Mean	15,200	14,500	17,400	28,700	53,500	207,000
Cs/mi	0.24	0.23	0.27	0.45	0.83	3.23
In	0.27	0.24	0.31	0.50	0.96	3.59
Maf	.936	.831	1.07	1.71	3.29	12.3

1968 year: Mean 85,900 Cs/sq mi 1.34 Inches 18.2

Note : * Discharge measurement made on this day.

INDUS RIVER NEAR DARBAND

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	176,000	286,000	90,800	63,700	27,800	18,400
2	176,000	285,000	89,000	59,600	28,200	18,100
3	192,000	276,000	92,100	56,500	27,000	18,100
4	*212,000	*272,000	101,000	54,800	*26,200	18,100
5	226,000	275,000	*108,000	51,300	25,400	18,400
6	243,000	294,000	112,000	48,100	25,200	18,400
7	259,000	311,000	108,000	45,900	*24,600	18,400
8	285,000	323,000	104,000	43,200	24,200	*18,400
9	310,000	328,000	103,000	40,300	23,800	18,400
10	326,000	325,000	99,900	38,500	23,800	18,400
11	*334,000	322,000	98,500	36,600	23,800	24,100
12	341,000	319,000	95,700	34,800	23,800	25,100
13	342,000	303,000	*97,200	*33,400	23,600	21,400
14	342,000	314,000	102,000	34,100	23,400	21,000
15	339,000	320,000	108,000	32,800	23,000	20,900
16	319,000	318,000	115,000	32,000	22,500	*19,800
17	302,000	299,000	115,000	31,400	22,100	19,500
18	281,000	288,000	108,000	30,600	22,100	19,300
19	269,000	291,000	*99,600	30,000	21,600	18,800
20	*261,000	291,000	88,700	29,500	21,500	18,400
21	253,000	283,000	83,100	29,200	21,600	18,100
22	243,000	280,000	82,900	29,000	21,600	17,700
23	221,000	264,000	84,200	28,600	21,200	17,700
24	189,000	225,000	88,800	*28,600	20,900	17,500
25	168,000	*186,000	92,700	28,200	20,900	16,900
26	*165,000	159,000	90,300	28,000	20,500	16,300
27	178,000	136,000	*84,900	27,400	20,200	16,300
28	200,000	118,000	79,800	27,200	*19,800	16,400
29	238,000	108,000	74,800	27,000	19,500	16,300
30	278,000	*102,000	69,600	25,800	19,500	16,300
31	286,000	*95,800	———	27,800	———	*15,800
Mean	257,000	258,000	95,600	36,600	23,000	18,600
Cs/mi	4.01	4.02	1.49	0.57	0.36	0.29
In	4.61	4.64	1.66	0.66	0.40	0.33
Maf	15.8	15.9	5.69	2.25	1.37	1.14

M. Acre-feet. 62.3 Max Day 342,000 Min Day 13,500

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
14 Jan	15,300	48	30			
20 Jan	14,600	48	61			
12 Feb	13,800	54	44			
18 Feb	13,800	49	48			
27 Feb	18,900	57	75			
17 Mar	17,500	59	21			
28 Mar	20,500	60	54			
11 Apr	21,900	59	44			
16 Apr	25,400	67	85			
26 Apr	43,300	63	195			
7 May	40,200	57	119			
15 May	43,800	64	147			
15 Jun	209,000	62	1,940	55	31	14
26 Jun	297,000	61	3,600	53	24	23
4 Jul	212,000	66	2,390	53	28	19
6 Jul	240,000	63	3,240	62	27	11
8 Jul	288,000	62	3,570	59	30	11
9 Jul	309,000	64	4,240	67	29	4
10 Jul	326,000	61	7,290	60	31	9
11 Jul	336,000	62	3,730	46	39	15
12 Jul	342,000	64	3,860	37	42	21
13 Jul	342,000	64	4,440	43	42	15
14 Jul	343,000	63	5,570	48	39	13
15 Jul	338,000	64	4,670	58	25	17
16 Jul	326,000	60	5,600	57	31	12
17 Jul	305,000	62	5,300	59	33	8
18 Jul	380,000	62	7,150	69	20	11
20 Jul	262,000	63	4,530	62	26	12
22 Jul	245,000	62	4,850	62	28	10
24 Jul	198,000	63	3,440	66	25	9
26 Jul	162,000	63	3,470	67	24	9
28 Jul	190,000	63	4,670	51	37	12
30 Jul	276,000	64	6,130	54	36	10
31 Jul	290,000	64	5,920	61	30	9
2 Aug	289,000	64	10,300	68	22	10
4 Aug	273,000	63	5,220	66	28	6
6 Aug	291,000	63	8,630	65	26	9
7 Aug	310,000	63	6,840	62	28	10
8 Aug	322,000	62	5,800	44	42	14
9 Aug	330,000	62	6,180	50	43	7

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Aug	329,000	64	6,040	48	39	13
11 Aug	325,000	64	6,200	49	37	14
12 Aug	321,000	64	5,550	50	39	11
13 Aug	307,000	64	6,180	57	32	11
14 Aug	317,000	65	6,070	57	32	11
15 Aug	321,000	64	5,670	48	40	12
16 Aug	319,000	64	6,300	58	33	9
18 Aug	287,000	66	5,850	54	36	10
20 Aug	294,000	64	5,230	48	41	11
22 Aug	282,000	66	5,990	40	48	12
24 Aug	228,000	63	5,850	57	36	7
26 Aug	163,000	63	3,840	51	40	9
29 Aug	108,000	62	4,350	66	29	5
31 Aug	95,500	60	3,500	66	27	7
3 Sep	91,600	60	2,350	64	27	9
5 Sep	105,000	61	3,820	71	18	11
7 Sep	108,000	62	3,060	71	19	10
9 Sep	102,000	63	3,600	76	17	7
11 Sep	98,500	62	2,220	65	26	9
13 Sep	95,900	62	1,570	55	24	21
15 Sep	106,000	63	1,270	52	39	9
17 Sep	113,000	60	1,950	66	23	11
19 Sep	99,600	61	1,310	52	39	9
22 Sep	82,900	61	1,100	61	24	15
24 Sep	87,100	61	1,110	60	28	12
26 Sep	90,100	60	1,510	55	25	20
27 Sep	84,100	60	1,010	29	44	27
29 Sep	75,000	60	857	29	44	27
13 Oct	33,400		247			
24 Oct	28,600	58	40			
4 Nov	26,200	54	48			
7 Nov	24,600	54	51			
28 Nov	19,800	59	30			
8 Dec	18,400	47	52			
16 Dec	19,800	49	36			
31 Dec	15,800	50	19			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

INDUS RIVER NEAR DARBAND

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	PARTS PER MILLION SiO_2	Fe	B	D.S. by Evap.	EC x 10^6 at 25°C.	pH	Res CO_3 me/l	SAR
Feb																				
27	1.65	0.70	0.40		Traces	1.51	0.09	1.05			2.75	2.65				164	260	8.14	0	0.4
Mar																				
17	1.65	0.70	0.40		0	1.47	0.09	1.10			2.75	2.66				150	260	7.99	0	0.4
Apr																				
11	1.45	0.75	0.30		0	1.42	0.14	0.80			2.50	2.36				134	230	7.97	0	0.3
16	1.47	0.43	0.30		0	1.65	0.09	0.40			2.20	2.14				114	200	7.93	0	0.3
May																				
15	1.26	0.49	0.30		0	1.18	0.14	0.70			2.05	2.02				110	200	7.46	0	0.3
Jun																				
15	1.16	0.34	0.15		0	1.20	0.15	0.40			1.65	1.75				94	160	7.99	0	0.2
20	1.37	0.13	0.25		0	1.20	0.10	0.40			1.75	1.70				94	160	7.90	0	0.3
Jul																				
4	1.05	0.35	0.35		0	1.11	0.20	0.50			1.75	1.81				94	170	7.99	0	0.4
11	1.36	0.74	0.25		0.17	1.87	0.15	0.30			2.35	2.49				124	230	8.28	0	0.2
20	1.36	0.54	0.30		0.17	1.64	0.10	0.40			2.20	2.31				120	220	8.29	0	0.3
26	1.15	0.75	0.50		0	1.89	0.20	0.50			2.40	2.59				126	230	7.90	0	0.5
Aug																				
4	0.99	0.71	0.30		0.08	1.13	0.15	0.55			2.00	1.91				98	180	8.21	0	0.3
10	1.31	0.39	0.30		0.08	1.09	0.20	0.55			2.00	1.92				98	180	8.27	0	0.3
25	1.05	0.65	0.30		0.08	1.13	0.15	0.65			2.00	2.01				104	190	8.22	0	0.3
31	1.31	0.49	0.30		0.08	1.25	0.25	0.55			2.10	2.13				110	200	8.23	0	0.3
Sep																				
5	1.33	0.35	0.15		0	1.23	0.14	0.51			1.83	1.88				100	180	7.85	0	0.2
13	1.22	0.35	0.22		0	1.19	0.14	0.61			1.79	1.94				102	180	7.86	0	0.3
19	1.33	0.35	0.22		0	1.28	0.14	0.51			1.90	1.93				105	190	7.86	0	0.2
29	1.27	0.35	0.22		0	1.28	0.14	0.45			1.84	1.87				98	180	7.88	0	0.3
Oct																				
13	1.55	0.31	0.45		0	1.30	0.24	0.83			2.31	2.37				142	230	8.10	0	0.5
Nov																				
7	1.32	1.13	0.28		0	1.60	0.14	1.10			2.73	2.84				166	270	7.70	0	0.3
28	1.60	0.64	0.28		0	1.62	0.34	0.57			2.52	2.53				144	240	7.90	0	0.3
Dec																				
3	1.59	0.65	0.40		0	1.62	0.19	0.81			2.64	2.62				150	250	8.10	0	0.4
16	1.82	0.64	0.92		0	2.38	0.29	0.79			3.38	3.46				200	330	7.20	0	0.08

SIRAN RIVER AT THAPLA - 1968

Location Latitude 34°06', Longitude 72°52', on left bank a quarter of a mile upstream from Thapla Bridge and about 4 miles upstream from Indus River.

Drainage area 1,080 square miles.

Records available Discharge record March 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights only January 1944 to May 1954 by Dams Investigation Circle (data with IBDB, Lahore) Record April 1959 to December 1960 by Hydrology Directorate of Irrigation Department.

Average Discharge 1,160 cusecs (842,000 acre-feet per year or 14.6 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 33,100 cusecs on 11 August (gauge height 12.40 feet); minimum daily discharge 320 cusecs on 27 October.

1960-1968: Maximum discharge 56,800 cusecs on 8 September 1961; minimum daily discharge 190 cusecs on 22 June 1960.

Gauge Enamelled plates graduated to 0.1 foot and read to hundredths, nine times a day and more often during floods. Zero R.L. of the gauge 1270.20.

Measurements Thirty one discharge measurements were made during the year by current meter at 0.2 and 0.8 or .6 depth. Low water measurements were made by wading and high water measurements from Thapla Bridge. Twenty nine sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler while making observations from Thapla Bridge during high flows. Seven of these were analysed for particle size distribution. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge The channel is composed of small shingle and sand which shifts nearly continuously. Mean daily discharges were computed by applying gauge heights with shift adjustments to rating table dated 28.5.65.

Remarks Record good.

SIRAN RIVER AT THAPLA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	637	877	1,390	866	1,330	664
2	a 623	790	1,110	800	1,220	673
3	a 608	740	1,040	746	1,030	691
4	594	710	1,010	730	1,040	673
5	562	700	*982	720	855	710
6	538	910	946	780	1,240	682
7	538	844	934	1,060	1,060	664
8	523	790	910	982	844	682
9	538	770	a 922	922	750	610
10	546	*730	a 934	1,290	646	602
11	682	700	946	*934	628	602
12	646	673	994	800	570	1,430
13	655	655	899	1,320	546	958
14	646	700	910	1,690	*554	800
15	619	673	888	1,870	637	*619
16	570	655	790	1,190	554	619
17	570	637	800	970	602	530
18	562	646	1,060	866	578	586
19	546	*691	2,250	1,080	602	538
20	586	899	1,350	1,240	586	474
21	982	1,470	1,500	1,290	700	453
22	899	1,130	1,070	1,300	1,100	432
23	770	994	934	1,010	760	439
24	673	877	866	1,240	730	397
25	833	811	866	1,160	760	336
26	710	934	1,330	*1,200	750	*586
27	720	2,060	1,220	1,150	770	538
28	780	1,830	1,390	1,130	790	467
29	750	1,640	*994	1,100	664	538
30	970	———	1,010	1,040	*664	474
31	1,020	———	946	———	682	———
Mean	674	908	1,070	1,080	782	616
Cs/mi	0.62	0.84	0.99	1.00	0.72	0.57
In	0.73	0.91	1.14	1.12	0.83	0.64
Ac-ft.	41,400	52,200	65,800	64,400	48,100	36,600

1968 year: Mean 1,000 Cs/sq mi 0.93 Inches 12.7

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

SIRAN RIVER AT THAFLA

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	411	1,500	637	425	336	467
2	360	1,230	610	411	1,040	467
3	*336	958	562	404	619	460
4	594	790	523	481	404	439
5	397	730	488	460	586	*446
6	384	5,370	488	562	655	474
7	378	2,110	467	1,070	*628	488
8	432	*1,550	488	720	628	474
9	1,210	1,990	502	740	646	474
10	*6,190	5,260	474	578	637	488
11	1,270	12,000	439	537	700	1,530
12	2,060	5,650	439	578	602	3,330
13	566	3,660	418	*554	594	2,190
14	1,890	3,670	411	628	619	899
15	1,810	*6,750	397	586	586	1,010
16	1,060	4,060	390	509	a 566	790
17	750	2,870	446	516	546	*740
18	810	3,380	425	481	538	700
19	562	*8,720	384	446	516	691
20	730	3,810	384	418	530	655
21	899	2,610	372	418	530	a 631
22	2,160	2,780	360	404	530	a 616
23	*3,770	2,780	354	397	509	602
24	982	1,730	354	372	502	578
25	710	1,440	348	366	509	554
26	*538	1,270	*348	348	495	546
27	446	1,100	354	320	488	538
28	432	982	354	*325	488	502
29	*6,500	*877	384	336	*481	495
30	9,420	*770	390	336	467	*467
31	2,750	700	———	336	———	467
Mean	1,640	3,000	433	486	566	749
Cs/mi	1.52	2.78	0.40	0.45	0.52	0.69
In	1.76	3.21	0.45	0.52	0.58	0.80
Ac-ft.	101,000	185,000	25,800	29,900	33,700	46,000

Acre-feet. 730,000 Max Day 12,000 Min Day 320

SIRAN RIVER AT THAPLA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Feb	710		9			
19 Feb	664		26			
5 Mar	994		45			
29 Mar	994		80			
11 Apr	932		226			
26 Apr	1,220		159			
14 May	610	71	30			
30 May	673		35			
15 Jun	637	85	145			
26 Jun	910	86	156			
3 Jul	325	89	32			
10 Jul	3,260	80	5,960	17	57	26
23 Jul	2,390	78	3,440	18	52	30
26 Jul	516	80	90			
29 Jul	4,680	80	8,370	10	46	44
29 Jul	8,520	80	23,800	13	46	41
8 Aug	1,700	81	2,950	4	30	66
15 Aug	9,250	78	9,360	57	32	11
19 Aug	6,840	80	12,800	16	46	38
29 Aug	877	80	73			
30 Aug	750	76	116			
26 Sep	330		103			
13 Oct	562		42			
28 Oct	325		46			
7 Nov	610	66	68			
29 Nov	481	52	28			
5 Dec	453	51	29			
17 Dec	730	52	45			
30 Dec	474	45	66			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SIRAN RIVER AT THAPLA

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				$EC \times 10^6$ at	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.	$25^\circ C$.		me/l	
Feb																				
10	0.93	1.97	0.36		0.18	2.70	0.19	0.15			3.26	3.22				185	310	8.27	0	0.3
Mar																				
5	2.10	0.90	0.45		0.13	2.48	0.09	0.65			3.45	3.35				184	320	8.24	0	0.4
29	2.00	0.60	0.40		0.09	2.23	0.09	0.60			3.00	3.01				150	280	8.15	0	0.4
Apr																				
11	1.95	0.75	0.40		Traces	2.13	0.09	0.70			3.10	2.92				160	280	8.12	0	0.3
26	1.35	0.65	0.30		-	1.69	0.14	0.40			2.30	2.23				130	220	7.94	0	0.3
May																				
14	1.58	0.82	0.40		0.18	2.09	0.14	0.40			2.80	2.81				144	260	8.21	0	0.4
30	1.26	0.94	0.45		0.36	1.84	0.14	0.30			2.65	2.64				144	260	8.30	0	0.4
Jun																				
15	1.58	0.87	0.30		0.34	1.89	0.20	0.30			2.75	2.73				142	260	8.35	0	0.3
26	2.00	0.60	0.30		0.34	1.89	0.10	0.60			2.90	2.93				158	290	8.32	0	0.3
Jul																				
3	1.15	1.15	0.40		0.51	1.72	0.15	0.40			2.70	2.78				142	260	8.35	0	0.4
10	1.78	0.42	0.40		0	2.15	0.10	0.30			2.60	2.55				138	250	7.80	0	0.4
23	1.57	0.63	0.30		0	1.93	0.10	0.50			2.50	2.53				138	250	7.90	0	0.3
29	1.78	0.42	0.40		0	2.06	0.15	0.30			2.60	2.51				140	250	7.70	0	0.4
Aug																				
8	1.68	0.73	0.60		0.40	1.82	0.24	0.45			3.01	2.91				152	290	8.40	0	0.5
15	1.31	0.59	0.45		0.16	1.57	0.14	0.60			2.35	2.47				128	230	8.20	0	0.5
29	1.57	0.68	0.45		0.16	1.90	0.15	0.60			2.70	2.81				142	270	8.24	0	0.4
30	1.72	0.83	0.55		0.24	2.22	0.20	0.45			3.10	3.21				164	300	8.37	0	0.5
Sep																				
26	1.66	1.07	0.50		0.09	2.62	0.19	0.30			3.23	3.20				195	320	8.24	0	0.4
Oct																				
13	1.88	1.22	0.70		0	3.10	0.29	0.42			3.80	3.81				220	380	8.10	0	0.6
28	2.22	0.94	0.65		0.40	2.70	0.29	0.48			3.81	3.87				220	380	8.38	0	0.5
Nov																				
29	1.81	1.51	0.35		0	3.10	0.19	0.31			3.67	3.60				190	350	8.15	0	0.3
Dec																				
17	2.33	0.77	0.40		0.18	2.92	0.29	0.15			3.50	3.54				202	340	8.20	0	0.3
30	2.33	0.88	0.48		0.27	2.88	0.29	0.26			3.69	3.70				180	340	8.25	0	0.4

Blank page retained for pagination

Location Latitude 35°50', Longitude 71°48', on left bank just downstream from the suspension bridge, nearly half a mile from Chitral.

Drainage area 4,400 square miles.

Records available Discharge record by Surface Water Hydrology Project WAPDA from August 1963. Gauge height only, at times from January 1960 to October 1963 by P.W.D. B & R.

Average Discharge 8,300 cusecs (6,010,000 acre-feet per year or 25.6 inches runoff per year). Average taken for 4 years from 1964 to 1967.

Extremes Data incomplete, highest peak occurred in August and the suspension bridge was damaged, the data for the period 4 August to 20 August was not computed.

1964-67: Maximum discharge 37,200 cusecs on 27 July 1965; Minimum daily discharge 1,640 cusecs on 10 March 1964.

Gauge Staff gauge fixed on pillars on left bank downstream of the bridge. Set to arbitrary datum.

Measurements Fifty four discharge measurements were made during the year using 0.2 and 0.8 depth method from bridge. Forty - nine sets of sediment samples were taken by depth integration method using D-49 sampler. Thirteen of these were analysed for particle size distribution and the rest for total concentration. Three surface samples were collected and analysed for chemical composition.

Determination of discharge The control for this station is a rocky riffle which shifts nearly continuously. Rating table dated 27.8.68 was developed and used. Discharges were computed by applying daily mean gauge heights to above rating with shift adjustments as indicated necessary by the measurements.

Remarks Record fair.

CHITRAL RIVER AT CHITRAL

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,760	2,400	2,170	2,160	*4,870	8,740
2	2,740	2,420	2,160	*2,190	5,210	9,780
3	2,740	2,390	2,160	2,190	5,720	*10,300
4	2,720	*2,390	2,140	2,200	6,150	10,800
5	2,700	2,370	2,140	2,220	5,690	11,200
6	2,690	2,350	2,130	2,240	5,080	12,700
7	*2,630	2,330	2,140	2,250	4,800	14,300
8	2,630	2,320	2,130	2,300	*4,660	16,200
9	2,610	2,300	2,130	*2,320	4,440	14,800
10	2,600	2,300	2,110	2,300	4,330	16,800
11	2,580	2,300	2,190	2,300	4,220	*18,300
12	2,560	2,280	2,250	2,300	4,440	19,800
13	2,560	2,270	2,270	2,320	4,550	18,300
14	*2,580	2,270	2,270	2,320	4,890	16,900
15	2,600	2,270	2,250	2,330	*5,180	17,800
16	2,580	2,270	2,240	*2,320	4,680	18,500
17	2,560	2,250	2,220	2,280	4,550	*18,500
18	2,560	2,240	2,200	2,280	4,630	18,600
19	2,540	2,240	2,200	2,250	4,870	18,500
20	2,520	2,240	2,190	2,390	4,920	18,800
21	*2,510	2,220	2,190	2,810	5,060	*19,000
22	2,490	2,220	2,170	2,910	5,280	20,100
23	2,470	2,200	2,190	3,120	*5,390	21,700
24	2,450	2,200	2,200	*3,370	5,310	22,500
25	2,420	2,200	2,190	3,590	5,260	23,200
26	2,420	2,190	2,190	3,820	5,080	23,700
27	2,400	2,190	2,170	4,060	5,230	22,800
28	*2,400	2,190	2,160	4,240	5,410	*21,800
29	2,390	2,170	2,160	4,500	5,750	20,600
30	2,390	———	2,160	4,700	6,750	19,700
31	2,390	———	2,140	———	7,950	———
Mean	2,560	2,280	2,180	2,750	5,170	17,500
Cs/mi	0.58	0.52	0.50	0.63	1.18	3.98
In	0.67	0.56	0.57	0.80	1.35	4.44
Maf	.157	.131	.134	.164	.318	1.04

1968 year: Mean Cs/sq mi Inches

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

CHITRAL RIVER AT CHITRAL

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	21,000	33,300	9,680	7,540	4,700	3,670
2	*26,500	33,200	9,640	7,120	4,750	*3,590
3	26,700	33,300	*9,780	6,900	4,550	3,530
4	27,500		9,570	6,870	*4,390	3,450
5	*28,500		9,820	6,420	4,330	3,430
6	31,100		10,800	6,330	4,190	3,410
7	*34,400		*11,100	*6,120	4,040	3,390
8	*39,400		10,700	5,970	3,930	3,350
9	40,200		11,100	5,660	3,860	*3,330
10	39,900		10,900	5,310	3,800	3,310
11	39,300		10,800	5,110	*3,930	3,290
12	*39,300		*10,600	5,280	3,930	3,250
13	38,000		10,900	5,060	3,950	3,210
14	37,100		11,200	*4,890	4,000	3,190
15	*35,800		11,800	4,800	4,040	3,190
16	34,700		*12,300	4,700	4,040	*3,170
17	32,300		12,300	4,660	4,170	3,150
18	*28,900		10,700	4,550	*4,190	3,130
19	25,600		10,900	4,480	4,110	3,120
20	*24,600		10,100	4,410	4,080	3,100
21	24,500	*36,500	10,000	*4,370	4,020	3,100
22	24,700	35,800	10,500	4,300	3,950	a 3,090
23	*22,600	*26,100	*10,300	4,520	3,930	*3,080
24	22,500	26,300	10,300	4,280	3,910	3,060
25	24,000	24,800	9,710	4,190	*3,840	3,040
26	24,800	*18,300	9,530	4,130	3,820	3,040
27	*27,800	15,200	9,060	4,080	3,890	3,020
28	30,800	*13,600	8,250	*4,890	3,930	3,000
29	*33,700	12,900	7,780	5,010	3,860	3,000
30	33,800	11,200	*7,680	4,920	3,780	*2,980
31	33,500	*10,800	———	4,770	———	3,120
Mean	30,800		10,300	5,210	4,060	3,220
Cs/mi	7.00		2.34	1.18	0.92	0.73
In	8.07		2.60	1.37	1.03	0.84
Maf	1.89		.611	.321	.242	.198

M. Acre-feet. Max Day Min Day

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
7 Jan	2,650	35	77			
14 Jan	2,580	37	81			
28 Jan	2,400	41	98			
4 Feb	2,390	40	155			
11 Feb	2,300	40	18			
18 Feb	2,240	42	39			
26 Feb	2,190		72			
4 Mar	2,140	42	10			
11 Mar	2,170	40	42			
18 Mar	2,200	43	65			
25 Mar	2,190	42	30			
2 Apr	2,190	50	27			
9 Apr	2,320	46	59			
16 Apr	2,330	45	159			
28 Jun	21,000	57	172			
2 Jul	27,500	50	2,440	58	24	18
5 Jul	29,400	53	4,760	59	29	12
7 Jul	35,100	54	6,180	40	31	29
8 Jul	40,100	53	6,210	22	55	23
12 Jul	40,800	53	5,470	40	41	19
15 Jul	34,400	56	4,540	50	30	20
18 Jul	27,900	54	4,350	60	30	10
20 Jul	25,000	52	2,490	55	26	19
27 Jul	29,000	55	5,070	51	26	23
29 Jul	34,500	52	5,370	48	35	17
4 Aug	35,100	52	5,730	50	33	17
21 Aug	36,600	56	3,610	26	49	25
23 Aug	26,500	45	3,200	45	42	13
26 Aug	18,500	42	241			
28 Aug	13,900	40	163			
31 Aug	11,000	45	142			
3 Sep	9,600	50	45			
7 Sep	11,400	51	129			
12 Sep	10,400	52	146			
16 Sep	12,600	50	95			
30 Sep	7,850	51	231			
7 Oct	6,270	43	268			
14 Oct	4,990	46	42			
21 Oct	4,280	50	90			
28 Oct	4,990	41	71			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
4 Nov	4,460	42	87			
11 Nov	4,000	40	79			
18 Nov	4,170	45	114			
25 Nov	3,860	42	148			
2 Dec	3,610	43	30			
9 Dec	3,330	40	30			
16 Dec	3,150	41	76			
23 Dec	3,080	40	27			
30 Dec	2,980	42	41			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

CHITRAL RIVER AT CHITRAL

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION				EC x 10^6	pH	Res CO_3	SAR
											TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.	25°C.			
Jun 28	1.10	0.90	0.40		0.17	1.19	0.14	0.85			2.40	2.35				122	230	8.27	0	0.4
Jul 7	1.15	0.85	0.40		0.10	1.23	0.19	0.80			2.40	2.32				116	220	8.28	0	0.4
Aug 21	1.15	0.65	0.40		0.10	1.23	0.10	0.70			2.20	2.13				106	200	8.20	0	0.4

Location Latitude 34°11', Longitude 71°24', on right bank at upstream end of Warsak headworks, 2½ miles downstream from Warsak Dam, 18 miles upstream from mouth of Swat River.

Drainage area 26,000 square miles.

Records available January 1961 to date by Surface Water Hydrology Project WAPDA. Gauge height record October 1897 to date (October 1918 to September 1920 missing) by Irrigation Department, Peshawar. Gauge-height record March 1949 to January 1960 with discharge measurements April 1955 to January 1960 by Warsak Dam Project. Discharge measurements 1949 to 1951 by consultants Merz, Rendall and Vatten.

Average discharge or 12.5 inches 24,000 cusecs (17,400,000 acre-feet per year runoff per year) for 40 years, 1920-1959 (Water years).

25,100 cusecs (18,200,000 acre-feet per year or 13.1 inches runoff per year). Average taken for 8 calender years from 1961 to 1968.

Extremes Maximum discharge observed during the year 107,000 cusecs on 13 June (gauge height 14.38 feet); minimum daily discharge 6,560 cusecs on 9 March (affected by power regulation).

1897-1968: Maximum discharge 170,000 cusecs (estimated) on 24 June 1922 (gauge height 15.9 feet, present datum), observed maximum discharge 151,000 cusecs on 19 April 1965 (gauge height 16.64).

1920-1968: Minimum unregulated daily discharge observed 3,100 cusecs on 10 March 1926; lowest mean monthly discharge 4,200 cusecs in February 1956.

Gauge Continuous water stage recorder in masonry shelter set to arbitrary datum. Prior to 22 February 1962 enamelled gauge plates graduated to 0.1 foot on upstream face of Warsak Canal Headworks. Zero of outside enamelled gauge at R.L. 1,114.54 (rechecked in 1968).

Measurements Twenty five discharge measurements were made during the year using 0.2 and 0.8 depth method at Michni bridge about one mile downstream. Twenty five sets of sediment samples were taken by the depth-integration method using D-49 sampler from the bridge and seven of these were analysed for particle size distribution. Twenty three surface samples were analysed for chemical composition.

Determination of discharge Rating dated 29.8.67 was continued. Daily mean discharges were computed by applying daily mean gauge heights to this rating. Zero shift was used throughout the year.

Remarks Record good. During low-water periods flow is affected by regulation from Warsak power station. Figures given include flow of Warsak canal but exclude the flow through irrigation tunnel if any.

KABUL RIVER AT WARSAK

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	14,000	7,280	8,440	9,550	78,400	52,900
2	13,600	8,020	7,740	7,810	68,800	54,100
3	14,200	7,980	*8,330	8,680	57,200	55,700
4	10,500	7,670	8,020	9,860	48,400	58,600
5	10,600	8,120	8,190	11,100	45,600	60,300
6	8,680	8,120	7,810	*18,200	41,400	61,900
7	8,830	7,950	7,740	31,100	37,800	65,600
8	8,650	7,980	7,430	31,500	33,800	68,100
9	7,770	6,800	7,460	29,500	31,900	73,100
10	7,950	8,540	9,910	26,900	28,700	82,400
11	12,300	6,650	13,300	25,700	26,200	91,700
12	15,200	7,700	15,200	*24,900	*25,800	91,200
13	*14,200	8,020	13,300	25,100	25,300	87,500
14	12,400	*6,710	15,700	29,100	28,300	*80,300
15	11,500	6,860	16,300	33,600	30,000	75,700
16	8,440	7,190	15,000	32,700	33,000	74,300
17	9,690	7,400	15,400	29,100	28,700	78,000
18	8,830	6,560	16,500	26,100	28,900	77,000
19	8,540	6,770	23,800	27,900	31,500	80,800
20	9,780	7,220	24,800	28,000	34,300	78,000
21	9,690	7,490	21,100	31,300	36,900	77,500
22	9,550	7,670	18,400	37,600	38,800	77,400
23	9,350	6,950	17,500	44,200	37,100	79,200
24	8,160	8,230	16,200	45,300	40,300	82,700
25	*7,610	*7,520	16,900	45,000	45,500	82,500
26	7,840	7,950	16,700	*44,700	50,700	86,600
27	7,910	7,980	16,200	44,100	46,300	89,100
28	6,950	9,470	13,200	51,000	44,800	80,300
29	7,770	8,470	*15,400	45,800	44,000	76,300
30	7,810	———	12,800	60,200	48,000	66,100
31	8,680	———	13,700	———	*55,700	———
Mean	9,900	7,630	13,800	30,500	40,400	74,800
Cs/mi	0.38	0.29	0.53	1.17	1.55	2.88
In	0.44	0.32	0.61	1.31	1.79	3.21
Maf	.609	.439	.850	1.82	2.48	4.45

1968 year: Mean 28,000 Cs/sq mi 1.08 Inches 14.7

Note: * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	65,600	54,700	19,000	12,000	12,100	8,580
2	69,200	54,700	18,700	10,000	11,200	8,370
3	73,300	53,000	17,500	10,800	10,400	7,910
4	*74,500	54,000	17,500	*10,400	9,700	8,440
5	74,000	52,400	18,700	10,000	8,950	8,160
6	79,500	58,200	*18,000	10,700	8,830	8,090
7	79,200	*61,400	18,300	11,100	9,470	9,190
8	83,300	61,700	18,000	10,500	8,330	8,750
9	91,500	57,400	17,700	10,000	9,150	8,720
10	92,000	55,300	17,400	9,470	8,230	9,690
11	83,400	56,100	17,100	10,900	8,790	11,500
12	80,900	57,900	*16,900	10,000	8,300	11,100
13	84,500	51,200	16,500	9,230	8,750	11,500
14	81,200	58,300	16,700	8,680	*8,370	*11,900
15	82,200	*58,300	17,600	10,000	8,830	10,500
16	76,100	58,600	18,400	9,550	9,510	9,390
17	70,000	45,700	18,100	10,300	8,330	8,020
18	62,100	44,200	17,500	8,370	8,830	8,990
19	59,600	45,400	16,200	9,350	8,680	9,230
20	54,400	44,800	15,800	10,000	8,830	10,300
21	51,900	43,400	18,000	11,800	9,910	12,800
22	49,200	43,700	13,400	10,000	9,070	9,550
23	49,800	41,600	13,500	10,800	9,910	6,740
24	45,800	36,700	*13,700	10,700	9,350	10,400
25	41,400	35,300	13,100	10,900	9,110	10,700
26	46,700	33,500	13,000	11,800	8,400	7,810
27	49,600	*28,400	13,000	9,780	8,750	7,010
28	54,700	25,300	12,600	*9,780	*8,610	6,710
29	*59,900	23,800	10,800	11,400	7,840	6,860
30	56,300	23,000	12,100	11,300	8,580	7,160
31	56,800	20,900	------	9,430	------	8,050
Mean	67,100	46,400	16,200	10,300	9,100	9,100
Cs/mi	2.58	1.78	0.62	0.40	0.35	0.35
In	2.97	2.06	0.69	0.46	0.39	0.40
Maf	4.12	2.85	.962	.633	.542	.560

M. Acre-feet. 20.3 Max Day 92,000 Min Day 6,560

KABUL RIVER AT WARSAK

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	16,500	50	40			
25 Jan	7,400	51	9			
14 Feb	6,480	53	175			
25 Feb	9,550	57	44			
3 Mar	7,950	60	126			
29 Mar	18,000	61	120			
6 Apr	21,000	65	214			
12 Apr	25,900	69	116			
26 Apr	46,100	70	453	17	48	35
12 May	26,600	80	3,180			
31 May	62,000	71	871			
14 Jun	80,600	66	1,460	37	48	15
4 Jul	71,900	70	930	27	55	18
29 Jul	55,100	69	1,720	40	46	14
7 Aug	55,500	71	6,910	19	47	34
15 Aug	46,500	75	2,010	11	60	29
27 Aug	27,200	72	1,230	1	63	36
6 Sep	18,500	78	219			
12 Sep	16,300	77	213			
24 Sep	13,700	73	143			
4 Oct	12,300	74	27			
28 Oct	10,600	65	47			
14 Nov	11,700		37			
28 Nov	9,780	68	11			
14 Dec	10,200	54	20			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KABUL RIVER AT DARUNTA

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
13	1.85	1.55	0.91			2.88	0.59	0.80			431	427				246	410	7.95	0	0.7
25	1.85	1.65	0.83			2.88	0.44	1.00			443	432				241	410	7.92	0	0.6
Feb																				
14	1.46	1.84	0.68		0.18	2.82	0.49	0.50			3.98	3.99				234	370	8.23	0	0.5
25	1.55	1.95	0.68		0.18	2.71	0.58	0.60			4.18	4.07				250	380	8.20	0	0.5
Mar																				
3	1.55	1.95	0.61		Trace	3.00	0.49	0.50			4.11	3.99				234	370	8.10	0	0.5
29	1.44	1.75	0.55		0.18	2.48	0.49	0.50			3.74	3.65				200	360	8.20	0	0.4
Apr																				
13	1.37	0.73	0.40		0.08	1.41	0.09	1.00			2.50	2.58				144	250	8.15	0	0.4
26	1.37	0.83	0.40		0.08	1.47	0.14	1.00			2.60	2.69				144	250	8.15	0	0.4
May																				
12	1.68	0.82	0.40		0.27	1.58	0.24	0.80			2.90	2.89				158	280	8.28	0	0.4
31	1.26	0.54	0.30		0.18	1.31	0.24	0.50			2.10	2.23				130	210	8.20	0	0.3
Jun																				
14	1.10	0.70	0.40		0.08	1.23	0.20	0.65			2.20	2.16				110	200	8.26	0	0.4
Jul																				
4	0.94	0.81	0.30		0.08	1.19	0.20	0.65			2.05	2.12				110	200	8.20	0	0.3
28	1.72	0.38	0.30		0.08	1.49	0.25	0.65			2.40	2.47				122	240	8.20	0	0.3
Aug																				
7	1.57	0.68	0.30		0.08	1.45	0.20	0.95			2.55	2.68				124	240	8.20	0	0.3
15	1.33	0.49	0.35		0	1.55	0.20	0.43			2.17	2.18				110	200	8.10	0	0.4
Sep																				
6	1.55	0.59	0.35		0.13	1.47	0.20	0.54			2.49	2.34				128	240	8.20	0	0.3
12	1.64	0.61	0.35		0.18	1.51	0.17	0.54			2.60	2.40				130	240	8.23	0	0.3
24	1.72	0.85	0.57		0	1.60	0.19	1.18			3.14	2.97				144	280	8.10	0	0.5
Oct																				
4	1.59	0.97	0.57		0	1.80	0.19	1.07			3.13	3.06				184	290	8.12	0	0.5
28	1.81	1.02	0.65		0	2.10	0.29	1.05			3.48	3.44				200	340	8.18	0	0.6
Nov																				
14	2.05	0.94	0.35		0.18	2.20	0.39	0.55			3.34	3.32				198	330	8.25	0	0.3
28	2.05	1.16	0.42		0.09	2.29	0.44	0.79			3.63	3.61				204	340	8.20	0	0.3
Dec																				
14	1.88	1.43	0.80		0.27	2.38	0.54	0.84			4.11	4.03				208	380	8.25	0	0.6

Blank page retained for pagination

SWAT RIVER NEAR KALAM - 1968

Location Latitude 35°30', Longitude 72°35', on right bank about 2 miles downstream from Kalam.

Drainage area 780 square miles.

Records available January 1961 to date by Surface Water Hydrology Project WAPDA. September 1958 to June 1962 by Hydrology Directorate of Irrigation Department, Peshawar. Record from 1955 to 1958 by Malakand Division of Irrigation Department.

Average discharge 3,120 cusecs (2,270,000 acre-feet per year or 54.4 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 15,500 cusecs on 9 July (gauge height 14.70 feet); minimum daily discharge 430 cusecs on 22 February.

1961-1968: Maximum discharge 18,400 cusecs on 4 July 1964; minimum daily discharge 293 cusecs on 9 February 1967.

Gauge Staff gauge graduated and read to hundredth of a foot and readings taken 9 times a day or more often during floods. Gauge set to 6004.90 datum (checked in 1968).

Measurements Twenty three discharge measurements were made during the year using 0.2 and 0.8 or .6 depth method from car on overhead cableway near the gauge. Twenty one sets of sediment samples were taken by the depth-integration method using a D-49 sampler from the cableway. All of them were analysed for total concentration. Eighteen surface samples were taken and analysed for chemical composition.

Determination of discharge Rating dated 4.7.67 was continued. Daily mean discharges were computed using above rating with shift adjustments as indicated necessary by discharge measurements.

Remarks Records fair. Probable diurnal fluctuations during melting period has not been defined.

SWAT RIVER NEAR KALAM

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	552	454	488	568	5,260	5,340
2	548	451	484	560	4,800	5,480
3	548	451	488	600	4,100	5,900
4	524	496	480	725	3,570	5,160
5	528	457	464	830	3,260	5,160
6	528	464	464	1,010	2,790	6,540
7	528	468	460	1,020	2,520	7,310
8	532	472	472	910	2,420	7,900
9	524	472	476	880	2,270	8,280
10	576	439	480	820	2,220	*8,750
11	520	445	480	820	2,220	8,890
12	528	442	476	*994	2,340	8,750
13	488	464	480	922	2,800	7,800
14	484	476	516	964	3,440	7,760
15	500	*451	524	958	3,120	8,240
16	492	451	560	905	3,070	8,890
17	516	445	612	910	2,780	9,210
18	496	442	690	1,020	2,790	9,520
19	508	448	660	1,260	4,100	9,520
20	524	457	652	1,530	4,020	9,650
21	504	445	560	1,810	3,740	*9,700
22	480	430	*556	2,250	4,110	9,730
23	516	445	560	2,100	4,130	10,400
24	524	460	580	2,380	4,620	10,500
25	472	480	596	2,770	5,370	12,200
26	508	480	616	3,200	4,350	12,100
27	508	488	604	3,400	3,540	12,000
28	492	480	588	3,270	3,540	11,600
29	496	488	568	3,450	4,060	9,670
30	572	—	552	5,320	5,280	9,280
31	454	—	564	———	4,890	———
Mean	511	460	540	1,610	3,600	8,710
Cs/mi	0.66	0.59	0.79	2.06	4.62	11.2
In	0.76	0.64	0.80	2.30	5.32	12.5
Ac-ft.	31,400	26,500	33,200	95,500	221,000	518,000

1968 year: Mean 3,090 Cs/sq mi 3.96 Inches 53.9

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	9,910	7,900	2,710	1,780	958	648
2	10,700	7,860	2,640	1,730	905	652
3	10,900	7,780	2,670	1,700	845	656
4	10,700	7,580	2,880	1,600	840	652
5	11,200	*7,640	3,000	1,520	845	636
6	12,000	8,350	3,120	1,550	840	665
7	12,600	8,020	3,050	1,450	810	640
8	13,700	7,580	*3,060	1,380	830	648
9	*14,800	7,190	3,060	1,320	*845	624
10	14,300	7,020	3,020	1,310	840	612
11	14,100	8,170	3,020	1,260	840	608
12	13,000	7,540	3,010	*1,270	800	612
13	*12,200	7,000	3,220	1,260	760	608
14	12,500	*7,340	3,430	1,240	705	604
15	11,100	7,080	3,450	1,170	700	604
16	9,700	6,710	3,260	1,150	720	616
17	9,080	7,000	2,980	1,110	705	628
18	7,740	*6,440	*2,670	1,080	710	628
19	6,800	6,470	2,560	1,060	*725	628
20	7,080	6,560	2,160	1,040	730	624
21	6,950	6,740	2,160	1,040	725	616
22	7,210	6,720	2,190	1,020	*705	608
23	6,850	5,370	2,270	*994	*705	604
24	6,620	4,950	2,350	982	*685	584
25	6,810	4,590	2,390	976	636	572
26	7,310	*4,270	2,190	958	624	*560
27	7,840	3,940	*2,120	952	608	536
28	*8,260	3,440	2,030	964	600	528
29	8,600	3,190	1,890	976	596	576
30	8,370	3,020	1,790	958	616	568
31	8,060	2,760	———	946	——	556
Mean	9,900	6,330	2,680	1,220	748	610
Cs/mi	12.7	8.12	3.44	1.56	0.96	0.78
In	14.6	9.36	3.83	1.80	1.07	0.90
Ac-ft.	609,000	389,000	159,000	74,900	44,500	37,500

Acre-feet. 2,240,000 Max Day 14,800 Min Day 430

SWAT RIVER NEAR KALAM

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Feb	451		28			
22 Mar	556	58	29			
12 Apr	1,000	40	128			
17 May	2,760	52	42			
10 Jun	8,940	54	42			
21 Jun	9,440	53	57			
9 Jul	14,300	56	153			
13 Jul	12,100	53	188			
28 Jul	8,150	58	100			
5 Aug	7,620	56	130			
14 Aug	7,089	53	204			
18 Aug	6,210	59	107			
26 Aug	4,220	53	50			
8 Sep	2,960	51	43			
18 Sep	2,520	49	39			
27 Sep	2,010	50	39			
12 Oct	1,270	48	16			
23 Oct	982	46	34			
9 Nov	850	42	10			
19 Nov	725	42	7			
26 Dec	556	32	41			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SWAT RIVER NEAR KALAM

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				MOx10^6 at 25°C.	pH	Bes CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
15	0.95	0.35	0.25		0	0.80	0.10	0.65			1.55	1.55				84	150	7.90	0	0.3
Mar																				
22	0.91	0.38	0.12		0	1.10	0.19	0.10			1.41	1.39				80	130	8.02	0	0.5
Apr																				
12	0.84	0.16	0.25		0	0.57	0.10	0.60			1.25	1.27				72	120	7.91	0	0.4
May																				
17	1.05	0.15	0.15		0	0.90	0.14	0.30			1.35	1.34				74	130	7.95	0	0.2
Jun																				
10	0.42	0.48	0.15		0	0.42	0.15	0.50			1.05	1.07				52	100	7.86	0	0.2
21	0.53	0.17	0.15		0	0.34	0.10	0.40			0.85	0.84				42	80	7.86	0	0.2
Jul																				
9	0.63	0.27	0.15		0	0.46	0.15	0.50			1.05	1.11				52	100	7.85	0	0.2
13	0.42	0.23	0.30		0	0.34	0.10	0.50			0.95	0.94				48	90	7.60	0	0.5
28	0.21	0.24	0.25		0	0.25	0.10	0.35			0.70	0.70				38	70	7.55	0	0.5
Aug																				
5	0.31	0.34	0.30		0	0.34	0.10	0.45			0.95	0.89				52	90	7.68	0	0.5
14	0.84	0.36	0.30		Traces	1.02	0.10	0.30			1.50	1.42				76	140	8.20	0	0.4
18	0.21	0.39	0.15		0	0.29	0.10	0.40			0.75	0.79				48	80	8.18	0	0.2
26	0.68	0.42	0.25		0	0.72	0.10	0.45			1.35	1.27				66	120	8.05	0	0.3
Sep																				
8	0.55	0.19	0.25		0	0.50	0.09	0.41			0.99	1.00				60	100	7.15	0	0.4
27	1.49	0.22	0.41		0	1.35	0.19	0.58			2.12	2.12				122	200	7.98	0	0.4
Oct																				
23	1.55	0.16	0.23		0	1.39	0.34	0.20			1.94	1.93				116	190	8.00	0	0.2
Nov																				
19	1.00	0.28	0.10		0	1.12	0.14	0.15			1.38	1.41				76	130	8.05	0	0.1
Dec																				
26	1.83	0.15	0.30		0	1.89	0.14	0.20			2.28	2.23				118	200	8.00	0	0.3

Blank page retained for pagination

Location Latitude 34°38', Longitude 72°02', on downstream railing of Chakdara Bridge near left bank, and 4 miles upstream from Amandara Headworks of Upper Swat Canal.

Drainage area 2,230 square miles.

Records available Discharge record November 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights December 1958 to June 1962 by Hydrology Directorate of Irrigation Department, Peshawar. Record based on estimated discharges September 1911 to date with some periods missing by Malakand Division of Irrigation Department.

Average discharge 6,220 cusecs (4,500,000 acre-feet or 37.9 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 32,700 cusecs on 30 July (gauge height 6.60 feet); minimum daily discharge 1,060 cusecs on 17 February.

1961-68: Maximum discharge 35,400 cusecs on 31 July 1966; minimum daily discharge 708 cusecs on 27 February 1963.

Gauge Wire weight gauge read to 0.01 foot nine times a day or more often during floods. Gauge set to 2238.55 datum (checked in 1968). Checkbar in forward position 28.80.

Measurements Thirty discharge measurements were made during the year by current meter at 0.2 and 0.8 depth from Chakdara Bridge. Twenty nine sets of sediment samples were taken by the depth-integration method using a D-49 sampler from the bridge. One sample was analysed for particle size distribution and the rest were analysed for total concentration. Seventeen surface samples were collected and analysed for chemical composition.

Determination of discharge Previous rating dated 18.7.66 was continued to compute discharges. Shift adjustments were made as indicated by discharge measurements.

Remarks Record good.

SWAT RIVER AT CHAKDARA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	1,680	1,280	1,780	2,390	16,400	13,200
2	a 1,650	1,230	1,730	2,250	14,500	14,000
3	1,610	1,230	1,690	2,070	12,000	14,400
4	1,540	1,200	1,750	2,320	10,900	13,900
5	1,480	1,230	1,820	2,790	9,350	14,000
6	1,510	1,380	1,770	3,670	8,450	16,500
7	1,450	1,240	1,770	6,700	7,800	18,400
8	1,450	1,190	1,800	5,000	7,150	19,600
9	1,420	1,180	1,780	4,260	6,570	20,700
10	1,450	1,130	a 1,920	4,150	6,280	20,600
11	1,480	1,120	2,040	3,510	5,900	*22,400
12	1,420	1,090	2,320	3,640	5,860	20,600
13	*1,410	1,100	2,300	*2,040	6,620	19,700
14	1,350	1,120	3,160	5,590	7,700	19,100
15	1,310	1,080	2,560	7,290	8,050	19,100
16	1,310	1,080	2,340	5,160	7,470	20,200
17	1,340	1,060	2,730	4,400	6,960	21,000
18	1,300	1,080	5,040	5,280	7,850	21,100
19	1,260	1,140	6,320	5,080	9,700	20,900
20	1,540	1,420	6,410	5,820	9,700	20,800
21	1,470	2,110	4,370	6,660	9,200	21,000
22	1,350	1,580	3,380	7,700	a 9,480	21,700
23	1,300	1,410	2,900	8,850	9,750	21,400
24	1,350	1,300	*2,610	7,850	9,350	21,400
25	1,330	1,350	2,530	8,550	9,400	22,500
26	1,270	2,070	2,900	9,550	9,450	22,900
27	1,340	3,510	4,190	10,500	9,650	22,600
28	1,420	2,660	3,740	10,600	9,150	22,700
29	1,510	2,000	3,250	9,150	10,100	19,600
30	1,470	———	2,760	17,300	11,900	18,600
31	1,370	———	2,510	——→	12,900	———
Mean	1,420	1,430	2,840	6,000	9,210	19,500
Cs/mi	0.64	0.64	1.27	2.69	4.13	8.74
In	0.74	0.69	1.47	3.00	4.76	9.75
Maf	.088	.083	.175	.357	.566	1.16

1968 year: Mean 6,810 Cs/sq mi 3.05 Inches 41.5

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	19,100	15,300	3,900	2,460	2,430	1,330
2	19,800	14,900	3,770	2,390	*2,560	1,260
3	19,900	14,900	3,740	2,430	2,410	1,270
4	20,500	15,300	3,640	2,710	2,140	*1,340
5	21,100	15,100	3,710	2,460	*2,040	1,340
6	22,200	18,400	3,670	2,370	1,940	1,340
7	22,600	14,600	*3,840	2,580	1,900	1,500
8	*23,400	*14,100	4,190	2,390	1,820	1,450
9	25,100	14,200	3,840	2,340	1,800	1,470
10	24,100	14,600	3,740	2,340	1,800	1,730
11	23,100	15,700	3,840	2,230	1,820	*5,370
12	23,200	15,500	3,770	2,200	1,820	4,550
13	23,600	15,200	4,010	2,070	*1,770	*2,900
14	22,300	15,300	4,220	2,580	1,680	2,560
15	*20,500	16,300	4,440	*2,230	*1,660	2,840
16	19,200	15,100	4,890	2,230	1,610	2,430
17	18,500	*13,100	4,960	2,090	*1,560	2,200
18	16,400	12,400	4,400	2,040	1,530	2,140
19	14,900	14,400	*4,040	1,960	1,510	2,000
20	14,700	12,500	3,440	1,920	1,500	1,900
21	15,100	11,800	3,130	1,920	1,510	1,800
22	14,700	12,500	3,010	1,880	1,530	1,730
23	14,400	10,900	3,040	1,840	*1,470	1,660
24	13,600	9,100	3,010	*1,840	1,380	1,660
25	14,200	8,250	2,900	1,780	1,350	1,590
26	16,600	7,600	2,870	*1,730	1,370	*1,560
27	15,500	6,150	[illegible]760	1,690	*1,370	1,470
28	[illegible]6,400	*5,310	[illegible],810	1,620	1,340	1,500
29	*21,500	4,920	2,660	1,960	1,310	1,470
30	26,500	4,510	*2,560	*2,930	*1,300	*1,480
31	16,700	4,080	-----	2,300	-----	1,420
Mean	19,300	12,300	3,630	2,180	1,710	1,940
Cs/mi	8.65	5.52	1.63	0.98	0.77	0.87
In	6.37	1.81	1.81	1.13	0.85	1.00
Maf	1.18	.758	.216	.134	.102	.120

M. Acre-feet. 4.94 Max Day 26,500 Min Day 1,060

SWAT RIVER AT CHAKDARA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	1,410	54	64			
24 Mar	2,580	63	40			
13 Apr	1,980	54	57			
15 May	7,750	65	71			
11 Jun	20,400	65	146			
8 Jul	23,100	70	138			
15 Jul	19,800	72	121			
29 Jul	21,300	68	1700	6	67	27
8 Aug	14,100	64	44			
17 Aug	13,200	64	76			
28 Aug	5,630	65	47			
7 Sep	3,940	65	60			
19 Sep	4,110	64	146			
30 Sep	2,580	64	16			
15 Oct	2,230	62	20			
24 Oct	1,840	67	15			
26 Oct	1,730	61	44			
30 Oct	2,950	56	129			
2 Nov	2,560	54	16			
13 Nov	1,780	53	16			
15 Nov	1,660	54	4			
17 Nov	1,580	52	21			
23 Nov	1,480	50	5			
27 Nov	1,350	48	13			
30 Nov	1,300	48	4			
4 Dec	1,340	45	5			
11 Dec	7,380	47	250			
13 Dec	2,930	48	32			
30 Dec	1,480	46	37			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SWAT RIVER AT CHAKDARA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C.$	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
13	1.26	0.54	0.30		0	1.51	0.14	0.45			2.10	2.10				104	190	7.90	0	0.3
Mar																				
24	1.10	0.30	0.20		0.18	1.22	0.19	0.11			1.60	1.70				95	150	8.28	0	0.8
May																				
13	0.84	0.16	0.15		0	0.83	0.10	0.30			1.15	1.23				74	120	7.99	0	0.2
18	0.84	0.16	0.15		0	0.67	0.05	0.45			1.15	1.17				74	110	7.85	0	0.2
Jun																				
11	0.63	0.32	0.15		0	0.72	0.10	0.35			1.10	1.17				58	110	8.04	0	0.2
Jul																				
8	0.42	0.38	0.15		0	0.46	0.10	0.40			0.95	0.96				48	90	7.78	0	0.2
15	2.52	0.78	0.70		0.24	2.12	0.39	1.30			4.00	4.05				220	400	8.52	0	0.5
29	1.05	0.25	0.25		0	1.14	0.10	0.30			1.55	1.54				72	140	7.99	0	0.3
Aug																				
8	0.36	0.39	0.30		0	0.51	0.10	0.50			1.05	1.11				56	100	7.70	0	0.5
17	0.68	0.47	0.30		0	0.85	0.14	0.40			1.45	1.39				66	130	7.90	0	0.4
28	0.84	0.36	0.30		0	0.97	0.10	0.35			1.50	1.42				70	140	7.35	0	0.4
Sep																				
7	0.88	0.29	0.35		0	1.00	0.09	0.46			1.52	1.55				90	150	7.80	0	0.5
30	1.11	0.28	0.35		0	1.30	0.14	0.31			1.74	1.75				100	170	7.92	0	0.4
Oct																				
24	1.22	0.27	0.18		0	1.30	0.14	0.15			1.67	1.68				90	160	8.00	0	0.2
30	1.27	0.22	0.13		0	1.44	0.14	0.10			1.62	1.68				94	160	8.00	0	0.2
Nov																				
13	1.44	0.16	0.10		0	1.44	0.14	0.15			1.70	1.73				92	160	7.95	0	0.1
Dec																				
11	1.11	0.28	0.20		0	1.17	0.14	0.21			1.59	1.52				80	150	8.00	0	0.2

Blank page retained for pagination

Location Latitude 33°52', Longitude 71°24', on right bank 200 feet downstream from Jhansi Post Bridge, 6 miles downstream from Mastura River and 12 miles southwest of Peshawar.

Drainage area 713 square miles.

Records available Discharge record January 1961 to date by Surface Water Hydrology Project WAPDA. Gauge height record from January 1959 to June 1962 with discharge measurements starting in 1961 by Peshawar Division of Hydrology Directorate, Irrigation Department.

Average Discharge 382 cusecs (277,000 acre-feet per year or 7.27 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year ~~12,900~~ 2,900 cusecs 25 May (gauge height 6.90 feet); minimum daily discharge 194 cusecs on 6 September.

1961-68: Maximum discharge 11,200 cuseds on 25 March 1967; minimum daily discharge 66 cusecs on 3 September 1964.

Gauge Enamelled staff gauge graduated to 0.02 foot and read to 0.01 foot 5 times daily or more often during floods. Gauge set to 1705.57 datum (checked in 1968).

Measurements Twenty eight discharge measurements were made during the year by current meter at 0.2 and 0.8 depth. Low water was measured by wading in vicinity of gauge and high water was measured from Jhansi Post Bridge. Twenty eight sets of sediment samples were taken by depth integration method using DH-48 sampler when wading or D-49 sampler from the bridge. Twelve of these were analysed for particle size distribution and the rest for total concentration. Twenty four surface samples were taken and analysed for chemical composition.

Determination of discharge Rating dated 27.4.62 was used for computing discharges by applying gauge heights with shift adjustments based on periodical discharge measurements.

Remarks Record fair.

BARA RIVER AT JHANSI POST

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	320	290	300	416	1,100	1,070
2	a 311	280	305	392	1,010	1,040
3	a 303	275	*315	404	970	1,010
4	295	275	320	440	940	950
5	285	275	320	*513	880	910
6	275	270	331	758	785	880
7	285	266	336	664	690	794
8	280	266	353	698	633	749
9	275	262	375	785	609	723
10	270	257	a 393	706	586	740
11	275	257	a 411	732	564	715
12	270	253	428	830	*513	1,130
13	*270	*253	480	732	513	*723
14	266	248	506	1,000	528	656
15	266	248	486	960	556	617
16	262	248	513	850	535	578
17	262	244	571	821	564	542
18	257	248	817	900	571	528
19	266	295	640	812	812	499
20	331	310	785	821	950	486
21	285	285	528	930	1,030	480
22	285	271	480	950	648	453
23	*275	*266	447	900	617	656
24	266	262	440	880	594	549
25	262	290	480	970	1,260	493
26	257	325	486	920	1,320	480
27	257	331	*499	*940	1,110	473
28	266	315	460	960	*1,020	434
29	315	305	453	880	990	404
30	295	----	440	1,150	980	392
31	290	----	434	----	990	----
Mean	280	275	456	790	802	672
Cs/mi	0.39	0.39	0.64	1.11	1.12	0.94
In	0.45	0.42	0.74	1.24	1.30	1.05
Ac-ft.	17,200	15,800	28,000	47,000	49,300	40,000

1968 year: Mean 424 Cs/sq mi 0.59 Inches 8.11

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

BARA RIVER AT JHANSI POST

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	386	271	300	235	364	222
2	375	290	271	239	320	222
3	358	257	239	244	*285	222
4	347	413	218	422	271	218
5	380	433	202	392	257	218
6	358	598	194	375	248	230
7	*347	*460	*362	453	244	226
8	342	347	517	386	239	222
9	364	453	325	347	244	239
10	375	521	271	392	253	253
11	392	428	271	358	271	310
12	466	380	248	320	331	*253
13	499	305	*235	353	290	239
14	528	*290	230	*440	262	239
15	486	315	214	369	257	235
16	506	310	447	320	253	230
17	776	280	325	315	248	230
18	422	253	486	290	244	226
19	358	*275	*453	271	239	226
20	375	285	347	262	235	222
21	336	295	310	248	235	a 222
22	300	342	300	239	230	a 222
23	325	358	285	244	230	222
24	300	386	271	235	235	218
25	280	358	262	226	230	218
26	271	416	257	222	*230	214
27	257	380	252	*214	226	214
28	*253	353	248	218	226	210
29	239	404	*252	290	226	210
30	280	428	248	271	226	206
31	266	*342	---	280	---	*210
Mean	372	362	295	305	255	227
Cs/mi	0.52	0.51	0.41	0.43	0.36	0.32
In	0.60	0.59	0.46	0.49	0.40	0.37
Ac-ft.	22,900	22,300	17,500	18,800	15,200	14,000

Acre-feet. 308,000 Max Day 1,320 Min Day 194

BARA RIVER AT JHANSI POST

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	271	48	30			
23 Jan	271		163			
13 Feb	253	52	13			
23 Feb	266		40			
3 Mar	315	62	2,670	29	37	34
27 Mar	493	59	1,380	16	67	17
5 Apr	513	66	1,640	15	59	26
27 Apr	940	70	4,000	7	68	25
12 May	499	75	196			
28 May	1,000	87	2,010	15	62	23
13 Jun	696	70	1,620	7	33	60
7 Jul	347	79	75			
28 Jul	248	81	1,470	7	43	50
7 Aug	386	85	1,430	4	35	61
14 Aug	280	87	106			
19 Aug	300	78	595	9	23	68
31 Aug	331	82	171			
7 Sep	295	79	820	0	18	82
13 Sep	230	84	53			
19 Sep	447	72	2,050	2	29	69
23 Sep	290	88	102			
29 Sep	253	74	41			
14 Oct	440	65	6,990	1	50	49
27 Oct	214	59	31			
3 Nov	285	56	118			
26 Nov	230	61	83			
12 Dec	248	54	58			
31 Dec	214	46	39			

Note: Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

BARA RIVER AT JHANSI POST

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
13	1.90	1.50	0.60		0	3.48	0.24	0.39			4.00	4.11				233	410	8.07	0.08	0.5
23	1.85	1.45	0.60		C	3.48	0.24	0.39			3.90	4.11				232	400	7.99	0.18	0.5
Feb																				
13	1.03	1.97	0.42		0.18	2.48	0.24	0.40			3.42	3.30				180	320	8.28	0	0.3
23	1.55	1.85	0.42		0.18	3.10	0.29	0.20			3.82	3.77				200	360	8.20	0	0.3
Mar																				
3	1.03	1.97	0.36		0.18	2.60	0.29	0.20			3.36	3.27				170	310	8.20	0	0.3
27	1.03	1.97	0.30		Traces	2.82	0.19	0.20			3.30	3.21				170	310	8.00	0	0.2
Apr																				
27	1.58	1.12	0.30		0.17	1.91	0.09	0.90			3.00	3.07				170	300	8.12	0	0.3
May																				
12	1.16	1.74	0.25		0.16	2.02	0.24	0.70			3.15	3.12				152	300	8.28	0	0.2
28	1.26	1.14	0.30		0.18	1.80	0.24	0.50			2.70	2.72				158	250	8.20	0	0.3
Jun																				
13	1.05	1.35	0.45		0.17	1.61	0.19	0.90			2.85	2.87				148	270	8.52	0	0.4
Jul																				
7	1.26	1.30	0.55		0.24	1.74	0.34	0.90			3.11	3.22				164	300	8.60	0	0.5
28	0.96	1.57	0.65		0.24	2.12	0.29	0.60			3.18	3.25				170	310	8.40	0	0.6
Aug																				
7	1.21	1.28	0.80		0.24	1.99	0.24	0.80			3.27	3.27				176	320	8.30	0	0.7
14	1.22	1.14	0.70		0.20	2.00	0.29	0.61			3.06	3.10				168	300	8.30	0	0.7
19	1.22	1.35	0.57		0.20	2.05	0.29	0.61			3.14	3.15				170	300	8.30	0	0.5
Sep																				
7	1.44	1.29	0.35		0.20	2.30	0.19	0.40			3.08	3.09				166	300	8.35	0	0.3
19	1.66	1.38	0.57		0.30	2.30	0.19	0.82			3.61	3.61				194	350	8.30	0	0.5
29	1.44	1.50	0.82		0.20	2.40	0.29	0.82			3.76	3.71				198	360	8.24	0	0.7
Oct																				
14	1.81	1.07	0.57		0	2.60	0.19	0.68			3.45	3.47				194	320	8.18	0	0.5
27	1.65	1.51	0.65		0.20	2.70	0.29	0.72			3.81	3.91				224	360	8.26	0	0.5
Nov																				
3	1.55	1.33	0.23		0.18	2.52	0.19	0.25			3.11	3.14				176	300	8.25	0	0.2
26	1.99	1.43	0.23		0.27	2.84	0.19	0.36			3.65	3.66				202	350	8.25	0	0.2
Dec																				
12	1.83	1.38	0.50		Traces	3.01	0.29	0.34			3.71	3.64				196	340	8.15	0	0.4
31	2.29	1.28	0.50		0.36	3.06	0.29	0.26			4.07	3.97				218	370	8.28	0	0.4

Blank page retained for pagination

KABUL RIVER AT NOWSHERA – 1968

Location Latitude 34°01', Longitude 71°58', on left bank at upstream side of boat bridge of Nowshera.

Drainage area 34,200 square miles.

Records available January 1961 to date by Surface Water Hydrology Project WAPDA (periodic discharge measurements started in May 1960). Gauge heights only, at various times for many years, by Building and Roads Branch P.W.D. Nowshera.

Average Discharge 34,200 cusecs (24,700,000 acre-feet per year or 13.7 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 143,000 cusecs on 11 July (gauge height 13.85 feet); minimum daily discharge 6,600 cusecs on 24 December.

1961–1968: Maximum discharge 223,000 cusecs on 23 May 1965; minimum daily discharge 4,820 cusecs on 4 March 1961.

Gauge Automatic water stage recorder installed in gauge shelter on left bank about 300 feet upstream from the boat bridge and about ¼ mile upstream from road-rail bridge. Prior to 22 February 1962 enamelled gauge plates graduated to 0.02 foot fastened on downstream end of first bridge pier from left bank. Zero R.L. of inside staff gauge 925.33 S.P.D. (checked in 1968).

Measurements Twenty three discharge measurements were made periodically during the year by current meter at 0.2 and 0.8 depth from upstream side of railway bridge. Twenty two sets of sediment samples were taken by the depth-integration method using D-49 sampler from the railway bridge. Eight of these were analysed for particle size distribution and the rest for total concentration. Twenty surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a sandy bed which appears to shift nearly continuously. Discharge was computed for the year by applying daily mean gauge heights to rating table dated 27.7.64 with shifts as indicated to be necessary by discharge measurements.

Remarks Record fair.

KABUL RIVER AT NOWSHERA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	19,200	12,700	13,200	21,700	112,000	71,900
2	18,700	11,200	12,800	18,900	112,000	72,800
3	18,100	10,900	12,200	16,700	90,100	75,000
4	17,400	11,100	11,900	16,900	73,700	79,800
5	14,700	10,900	11,900	16,400	64,600	80,900
6	14,000	11,400	*11,500	20,100	62,000	84,300
7	12,700	11,900	12,000	*30,400	*54,900	90,500
8	12,700	11,400	11,000	35,600	49,000	96,300
9	11,400	10,300	10,900	32,100	44,900	102,000
10	11,200	9,790	12,300	32,500	40,500	110,000
11	11,500	10,600	15,800	*32,000	36,600	122,000
12	15,800	9,070	18,000	29,600	33,700	132,000
13	16,900	10,100	19,900	34,900	*31,800	130,000
14	16,100	* 9,990	20,800	33,600	35,300	122,000
15	*15,600	8,870	24,300	36,700	40,300	114,000
16	14,500	9,270	23,700	34,000	43,300	108,000
17	11,900	8,710	20,100	32,500	43,100	112,000
18	12,800	8,950	23,600	29,200	*39,800	114,000
19	11,200	8,350	31,500	29,900	40,700	115,000
20	13,600	10,100	34,200	a 34,000	45,700	118,000
21	15,900	11,300	*32,200	38,500	47,300	113,000
22	14,500	11,100	27,600	39,100	50,500	113,000
23	13,300	10,900	23,600	42,600	50,800	115,000
24	12,400	9,910	23,400	45,500	51,600	121,000
25	11,000	10,700	23,500	46,900	58,500	a 126,000
26	10,700	10,100	24,700	49,700	68,700	131,000
27	11,100	*12,500	28,700	62,200	65,000	134,000
28	10,400	15,800	27,600	a 64,700	59,900	129,000
29	10,600	15,500	23,600	67,100	57,400	118,000
30	*12,100	------	23,500	*98,500	59,200	105,000
31	13,100	------	21,700	------	71,700	------
Mean	13,700	10,800	20,400	37,400	56,000	[illegible]
Cs/mi	0.40	0.32	0.60	1.09	1.64	[illegible]19
In	0.46	0.34	0.69	1.22	1.89	3.54
Maf	.843	.622	1.25	2.23	3.44	[illegible]

1968 year: Mean 39,100 Cs/sq mi 1.14 Inches 15.5

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KABUL RIVER AT NOWSHERA

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	96,700	80,600	26,300	13,000	12,800	9,910
2	101,000	77,100	24,500	12,200	14,700	9,910
3	108,000	76,200	22,200	11,000	13,900	9,870
4	111,000	75,700	*21,200	12,200	12,400	8,830
5	110,000	75,000	22,800	12,200	11,300	9,430
6	115,000	80,800	20,900	11,400	10,800	9,230
7	120,000	90,900	20,800	*11,400	10,200	9,990
8	*124,000	86,700	21,000	11,900	10,300	10,400
9	133,000	84,200	20,400	11,300	*10,200	10,400
10	142,000	*77,600	20,100	10,600	10,200	10,600
11	139,000	81,400	20,100	10,300	10,600	13,300
12	130,000	93,200	18,900	11,500	9,910	17,600
13	126,000	81,400	18,800	10,200	10,500	15,600
14	130,000	76,500	19,500	9,870	10,600	14,800
15	126,000	81,100	19,700	9,110	10,500	*14,200
16	119,000	79,300	20,700	11,300	10,900	14,100
17	108,000	70,900	22,600	10,900	10,100	12,100
18	98,700	65,000	21,400	9,630	10,200	10,800
19	89,500	67,900	19,600	9,070	10,200	12,100
20	82,800	68,700	18,600	10,100	9,790	11,700
21	78,500	65,900	17,700	11,900	10,700	13,100
22	73,500	71,700	18,100	10,900	11,600	13,400
23	79,100	68,300	15,600	10,900	11,000	11,200
24	*71,400	56,800	15,000	11,100	*11,300	6,600
25	61,100	51,500	*14,800	11,100	10,500	12,000
26	62,300	49,200	14,800	12,100	10,300	11,900
27	67,100	43,300	14,200	9,950	9,550	8,630
28	60,000	*38,400	13,800	11,200	9,750	7,430
29	81,400	34,600	13,300	*11,500	9,710	7,430
30	88,500	31,000	12,200	13,200	8,990	7,830
31	89,000	28,200	------	12,500	------	8,630
Mean	101,000	68,000	19,000	11,100	10,800	11,100
Cs/mi	2.95	1.99	0.56	0.32	0.32	0.32
In	3.39	2.29	0.62	0.38	0.35	0.37
Maf	6.19	4.18	1.13	.685	.642	.680

M. Acre-feet. 28.4 Max Day 142,000 Min Day 6,600

KABUL RIVER AT NOWSHERA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	15,400	52	88			
30 Jan	11,900	53	43			
14 Feb	11,400		34			
27 Feb	12,500	60	84			
21 Mar	29,400	70	147			
7 Apr	29,600	66	1,810	27	57	16
11 Apr	28,800	64	143			
30 Apr	78,400	66	880	14	55	31
7 May	55,200	63	1,930	57	39	4
13 May	34,400	70	3,820	22	45	33
18 May	40,000	74	635			
8 Jul	126,000	74	2,370	31	57	12
24 Jul	66,500	77	1,610	35	23	42
10 Aug	79,600	77	2,890	25	46	29
28 Aug	39,400	74	1,520	38	41	21
4 Sep	21,000	91	104			
25 Sep	15,400	75	72			
7 Oct	11,000	72	121			
29 Oct	10,900	61	28			
9 Nov	9,910	64	137			
24 Nov	11,000	60	166			
15 Dec	14,000	56	141			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KABUL RIVER AT NOWSHERA

Chemical Analysis of Water Samples – 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
15	1.85	1.65	1.20			3.25	0.59	1.20			4.70	5.04				285	460	7.99	0	0.9
30	1.6	1.95	1.70			3.34	0.74	1.40			5.30	5.48				288	500	7.98	0	1.3
Feb																				
14	1.94	1.76	0.95		0.28	2.71	0.49	1.32			4.65	4.80				264	460	8.25	0	0.7
27	1.98	1.67	0.95		0.28	2.76	0.53	1.27			4.60	4.84				260	450	8.25	0	0.7
Mar																				
21	1.73	0.92	0.61		0.18	2.06	0.39	0.47			3.26	3.10				168	300	8.18	0	0.5
Apr																				
7	1.58	0.92	0.55		0.17	1.78	0.29	0.90			3.05	3.14				174	300	8.24	0	0.5
11	1.52	0.78	0.45		0.17	1.65	0.09	0.90			2.75	2.81				154	270	8.20	0	0.4
30	1.26	0.44	0.30		0	1.28	0.24	0.60			2.00	2.12				114	200	8.11	0	0.3
May																				
13	1.47	1.03	0.35		0.16	1.71	0.19	0.70			2.85	2.75				136	270	8.29	0	0.3
Jul																				
8	1.16	0.39	0.25		0.08	1.10	0.15	0.50			1.80	1.83				90	170	8.22	0	0.3
24	1.26	0.44	0.40		0.16	1.15	0.25	0.60			2.10	2.16				110	200	8.38	0	0.4
Aug																				
10	1.44	0.50	0.35		0	1.61	0.16	0.43			2.29	2.20				112	200	8.18	0	0.4
28	1.55	0.54	0.41		Traces	1.78	0.19	0.54			2.50	2.51				130	240	8.18	0	0.4
Sep																				
4	1.65	0.81	0.65		0.20	1.70	0.30	0.64			3.11	2.84				152	280	8.30	0	0.6
25	1.69	0.88	0.50		0.22	1.78	0.23	0.86			3.07	3.09				152	280	8.27	0	0.4
Oct																				
7	1.28	1.50	0.65		0.19	1.78	0.29	1.18			3.43	3.44				170	300	8.20	0	0.6
29	1.76	1.18	0.82		Traces	2.30	0.29	1.08			3.76	3.67				218	360	8.10	0	0.7
Nov																				
9	1.99	1.11	0.48		0.18	2.34	0.39	0.65			3.58	3.56				208	340	8.25	0	0.4
24	2.22	1.09	0.69		0	2.70	0.49	0.75			4.00	3.94				218	380	7.90	0	0.5
Dec																				
15	2.00	1.26	0.65		0.18	2.47	0.59	0.58			3.91	3.82				210	350	8.20	0	0.6

Blank page retained for pagination

Location Latitude 34°05', Longitude 72°02', on bridge pier near left bank, 300 feet upstream from Kandar Murdara pumping station, one mile east of Risalpur Cantonement, 4 miles upstream from Kabul River.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA.

Average Discharge 1,060 cusecs (763,000 acre-feet per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 17,500 cusecs on 15 August (gauge height 12.70 feet); minimum daily discharge 292 cusecs on 5 July.

1960-68: Maximum discharge observed 34,900 cusecs on 30 August 1962; minimum daily discharge 272 cusecs on 2 September 1966.

Gauge Enamelled gauge plates fastened to bridge pier read 5 times daily or more often during floods. Zero R.L. of gauge 930.22 (checked in 1968).

Measurements Twenty four discharge measurements were made during the year by current meter using 0.2 and 0.8 depth method. Measurements were made by wading at low flows and from the bridge during high flows. Twenty three sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from the bridge. Three of these were analysed for particle size distribution and the rest for total concentration. Twenty two surface samples were taken and analysed for chemical composition.

Determination of discharge This stream has a sandy bed that shifts continuously. Rating curve dated 12.9.63 was used for discharge computations with shift adjustments based on discharge measurements to compensate for changes in channel.

Remarks Record good. Diversion into watershed by Upper Swat Canal, hence runoff in inches over the drainage area not computed.

KALPANI RIVER NEAR RISALPUR

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,420	1,810	a 1,430	904	967	520
2	a 2,290	1,730	a 1,350	869	712	486
3	2,150	1,680	a 1,270	841	535	472
4	1,920	1,660	a 1,200	676	525	481
5	1,830	1,660	a 1,120	635	545	481
6	1,850	1,930	*1,040	610	580	472
7	1,840	1,700	967	932	700	468
8	1,810	1,630	911	676	635	468
9	1,810	1,620	1,390	a 694	575	472
10	1,820	1,640	a 1,230	712	545	a 462
11	1,800	1,630	1,070	*595	530	a 452
12	1,800	1,620	946	615	510	a 542
13	1,750	1,620	925	635	481	a 431
14	*1,740	*1,620	953	766	*477	a 421
15	1,740	1,290	883	1,190	472	a 411
16	1,740	855	820	897	*472	a 401
17	1,720	814	766	784	472	a 390
18	1,700	814	1,010	682	*477	380
19	1,950	883	1,490	620	468	405
20	4,860	5,310	3,210	570	500	468
21	2,890	2,260	1,790	560	525	368
22	1,860	1,820	1,190	550	540	332
23	1,750	1,730	1,090	575	530	*360
24	1,680	1,680	1,060	525	550	595
25	1,650	1,730	*1,030	520	545	520
26	1,620	*1,730	1,250	510	664	555
27	1,650	a 1,650	1,330	481	640	530
28	2,010	a 1,580	1,190	477	605	530
29	1,900	a 1,500	1,090	477	585	560
30	*2,400	———	1,060	*565	570	565
31	1,950	———	967	———	550	———
Mean	2,000	1,700	1,190	671	564	463
Cs/mi						
In						
Ac-ft.	123,000	97,600	73,400	40,000	34,700	27,600

1968 year: Mean 1,120 Cs/sq mi Inches

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	486	760	981	376	827	754
2	427	605	748	372	967	742
3	376	580	*694	364	848	754
4	352	540	682	560	855	754
5	292	530	682	405	876	736
6	328	931	670	*376	869	778
7	*400	3,070	664	380	869	932
8	525	2,500	*658	409	*869	841
9	525	2,010	615	396	862	834
10	1,470	1,550	600	388	869	869
11	1,310	*4,570	580	396	876	1,220
12	820	9,090	525	405	904	1,550
13	625	3,490	515	409	911	1,130
14	814	2,990	495	427	932	1,090
15	682	11,300	472	436	918	*1,130
16	454	4,470	459	450	918	1,130
17	400	2,500	525	441	883	1,070
18	320	2,470	490	450	869	1,030
19	304	7,010	463	454	869	1,020
20	400	4,310	454	472	876	a 1,010
21	2,160	9,090	436	477	883	1,000
22	3,180	12,200	423	481	827	a 1,000
23	960	4,280	409	481	827	1,000
24	620	1,740	*392	486	*820	995
25	*540	1,500	392	490	820	988
26	490	1,360	392	510	802	967
27	486	1,170	392	515	796	946
28	477	*1,770	388	*525	790	932
29	1,360	1,120	384	535	778	932
30	1,810	855	384	640	760	946
31	967	946	---	706	---	932
Mean Cs/mi In	786	3,270	532	458	859	968
Ac-ft.	48,300	201,000	31,700	28,200	51,100	59,500

Acre-feet. 816,000 Max Day 11,300 Min Day 292

KALPANI RIVER NEAR RISALPUR

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
14 Jan	1,740	54	171			
30 Jan	2,450	51	750	6	53	41
2 Feb	1,620		165			
26 Feb	1,730	58	116			
6 Mar	967	67	70			
25 Mar	1,030	70	168			
11 Apr	595	75	183			
30 Apr	565	78	162			
14 May	477	83	118			
18 May	477	80	88			
23 Jun	332		47			
7 Jul	316	93	71			
25 Jul	540	83	137			
11 Aug	5,010	79	4,730	2	64	34
28 Aug	1,850	84	1,810	5	67	28
3 Sep	706	90	135			
8 Sep	630	88	159			
24 Sep	388	84	174			
6 Oct	376	69	98			
28 Oct	525	67	104			
8 Nov	869	76	145			
24 Nov	869	61	159			
15 Dec	1,130	63	161			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KALPANI RIVER NEAR RISALPUR

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
14	1.85	1.05	1.34		0	3.48	0.24	0.30			4.24	4.02				226	390	8.03	0.58	1.1
30	1.75	1.25	3.05		0	4.46	0.69	0.72			6.05	5.87				343	560	8.11	1.46	2.5
Feb																				
14	1.03	1.97	1.35		0.18	3.48	0.39	0.10			4.35	4.15				224	420	8.28	0.66	1.1
26	1.03	1.97	1.42		0.28	3.52	0.39	0.20			4.42	4.39				224	420	8.33	0.80	1.2
Mar																				
6	1.55	1.75	2.18		0.47	4.28	0.63	0.10			5.48	5.48				334	500	8.40	1.45	1.7
25	1.27	2.13	1.96		0.56	4.13	0.39	0.20			5.36	5.28				312	520	8.42	1.29	1.5
Apr																				
11	0.95	1.75	3.10		0.35	3.83	0.54	0.98			5.80	5.70				340	550	8.25	1.48	2.7
30	1.05	1.95	3.62		0.44	4.23	0.54	1.39			6.62	6.60				370	610	8.27	1.67	3.0
May																				
18	0.95	2.05	3.20		0.45	3.47	0.69	1.60			6.20	6.21				320	570	8.38	0.92	2.6
Jun																				
23	0.53	1.86	3.50		0.68	2.89	0.69	1.75			5.89	6.01				336	580	8.74	1.28	3.2
Jul																				
7	0.56	2.12	3.50		0.68	2.97	0.69	2.10			6.20	6.44				340	590	8.71	0.95	3.0
25	1.74	1.30	2.56		0.25	2.84	0.54	1.94			5.60	5.57				290	510	8.55	0.85	2.1
Aug																				
11	1.33	0.45	3.30		0.30	2.60	0.53	0.71	0.90		5.08	5.04				316	500	8.35	1.12	3.5
28	1.33	1.29	2.56		0.40	3.50	0.58	0.56	0.47		5.48	5.51				314	550	8.40	1.28	2.5
Sep																				
3	0.88	1.64	2.76		0.30	3.05	0.58	0.82	0.42		5.28	5.17				296	520	8.52	0.83	2.4
8	1.11	1.62	2.96		0.40	3.50	0.68	0.82	0.40		5.69	5.80				324	560	8.43	1.17	2.5
24	1.55	2.12	3.20		0.30	4.70	0.78	0.61	0.42		6.87	6.81				400	680	8.10	1.33	2.4
Oct																				
6	1.05	2.48	2.77		0.49	3.81	0.78	1.17			6.30	6.25				386	620	8.53	0.77	2.1
28	1.55	2.29	2.66		0.40	4.20	0.49	1.25			6.50	6.34				398	630	8.32	0.76	2.0
Nov																				
9	1.94	1.26	1.34		0.45	3.60	0.49	0.10			4.54	4.64				262	430	8.40	0.85	1.1
24	2.10	1.37	1.51		0.36	3.87	0.39	0.41			4.98	5.03				284	480	8.25	0.76	1.1
Dec																				
15	2.69	0.92	2.00		0.45	3.69	0.49	0.93			5.61	5.56				300	510	8.32	0.53	1.5

INDUS RIVER AT MANDORI - 1968
(About 5 Miles Downstream from Attock Bridge)

Location Latitude 33°47', Longitude 72°15', on right bank near Mandori village, about 6 miles downstream from old site and about 7 miles downstream from mouth of Kabul River.

Drainage area 102,000 square miles.

Records available Preliminary daily discharge record from April 1868 to date in record of Surface Water Hydrology Project, record computed from rating curve based on float-measurements May to October 1948 by Irrigation Research Institute Lahore and the measurements made by Surface Water Hydrology Project in 1960. Gauge height record of old gauge April 1868 to date in office of Discharge Division, Hydrology Directorate of Irrigation Department, Lahore.

Discharge measurements were made by current meter from a boat near Mandori village by Surface Water Hydrology Project starting July 1960. A new gauge was installed near Mandori village on right bank in late 1964.

Average discharge 126,000 cusecs (91,200,000 acre-feet per year or 16.8 inches runoff per year) for 92 years, 1869-1961, from preliminary computations by Tippetts-Abbett-McCarthy-Stratton International Corp.

127,000 cusecs (92,100,000 acre-feet per year or 16.9 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 548,000 cusecs on 14 July (gauge height 47.26 feet); minimum daily discharge 23,600 cusecs on 19 February.

1868-1968: Maximum discharge observed 820,000 cusecs 28 August 1929 (gauge height 66.5 feet). Peak of 18 August 1929 (689,000 cusecs) was caused by breaching of glacial dam on Shyok River. Flood peak of 1841, caused by breaching of land slide block on main Indus River, is reputed to have been considerably higher than any other peak known. Minimum discharge observed 19,000 cusecs 11 February 1967.

Gauge Staff gauge (enamelled plates) fixed on masonry pillars on right bank near Mandori village, read nine times a day or more often during floods. Gauge installed in late 1964. Servo-manometer with recorder installed in masonry shelter in May 1966. Prior to this, staff gauge on left bank painted on wall of Attock Fort (0-32 feet), on masonry pillar on right bank (32-54 feet) and on downstream right corner of Kass Nallah Bridge about one furlong upstream (54-70 feet).

INDUS RIVER AT MANDORI - 1968
(About 5 miles Downstream from Attock Bridge)

Measurements Eighteen discharge measurements were made by current meter at 0.2 and 0.8 depth from boat during the year. Sixteen sets of sediment samples were taken by depth integration method using D-49 sampler from boat. Seven of these were analysed for particle size distribution and rest for total concentration. Ten surface samples were collected and analysed for chemical composition.

Determination of Discharge Rating dated 27.5.67 was continued. This rating is same as dated 6.8.1966 above 19.0 feet of gauge height. The above rating was used with shift adjustments where indicated necessary by periodic discharge measurements.

Remarks Records fair.

INDUS RIVER AT MANDORI

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	38,100	30,300	31,400	37,300	177,000	171,000
2	38,300	28,200	29,900	34,400	174,000	181,000
3	37,100	27,900	28,300	31,100	143,000	198,000
4	37,000	27,700	28,200	31,700	119,000	211,000
5	33,600	27,600	27,900	31,300	104,000	216,000
6	32,900	28,400	28,100	34,400	100,000	216,000
7	30,700	28,800	27,700	45,700	91,400	227,000
8	30,400	28,300	27,200	63,400	81,600	254,000
9	30,000	27,600	27,600	59,100	*76,000	279,000
10	29,600	25,900	28,000	59,000	70,700	310,000
11	29,800	28,900	30,500	56,800	65,000	348,000
12	33,100	25,500	34,500	52,200	61,700	393,000
13	37,500	26,200	36,500	57,100	63,300	408,000
14	35,900	26,800	*37,200	59,400	68,600	398,000
15	33,600	24,700	42,300	69,300	78,200	370,000
16	31,600	24,000	40,600	69,600	81,300	354,000
17	28,800	23,700	37,000	63,700	81,200	363,000
18	28,500	24,100	40,900	57,800	77,300	*380,000
19	28,100	23,600	57,600	*56,200	80,600	383,000
20	33,500	27,600	67,000	58,000	92,700	385,000
21	36,100	31,200	65,000	63,000	103,000	379,000
22	32,100	29,900	55,000	69,000	117,000	396,000
23	30,300	28,900	46,300	81,600	123,000	381,000
24	29,800	*27,000	43,200	87,200	130,000	407,000
25	28,600	27,600	41,200	91,000	141,000	427,000
26	27,700	27,500	43,900	96,200	*159,000	449,000
27	28,000	32,900	50,800	110,000	152,000	470,000
28	28,600	36,900	53,200	116,000	139,000	464,000
29	*29,100	35,000	44,600	121,000	130,000	*423,000
30	30,500	------	42,100	115,000	134,000	355,000
31	31,000	------	38,600	------	159,000	------
Mean	31,900	28,000	39,800	65,900	109,000	340,000
Cs/mi	0.31	0.27	0.39	0.65	1.07	3.33
In	0.36	0.30	0.45	0.72	1.23	3,72
Maf	1.96	1.61	2.44	3.92	6.69	20.2

1968 year: Mean 134,000 Cs/sq mi 1.31 Inches 17.9

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	309,000	387,000	126,000	77,000	41,700	31,600
2	298,000	404,000	119,000	72,100	48,400	31,000
3	312,000	408,000	119,000	67,700	43,500	30,800
4	333,000	390,000	120,000	66,300	42,300	*29,900
5	351,000	390,000	127,000	64,100	40,100	30,700
6	370,000	413,000	130,000	60,200	38,900	30,400
7	395,000	449,000	125,000	58,900	37,900	31,000
8	426,000	468,000	120,000	55,700	38,300	32,200
9	466,000	476,000	115,000	52,100	37,100	31,700
10	510,000	464,000	111,000	49,100	37,600	31,600
11	529,000	479,000	109,000	47,400	37,300	37,500
12	531,000	487,000	106,000	*46,700	37,500	57,800
13	531,000	456,000	107,000	44,200	37,500	55,200
14	545,000	443,000	*111,000	42,600	37,500	40,300
15	*538,000	486,000	117,000	42,100	*37,400	39,500
16	516,000	467,000	126,000	42,800	36,600	38,700
17	473,000	430,000	130,000	41,400	36,600	35,700
18	433,000	398,000	123,000	40,300	35,600	*33,900
19	398,000	422,000	*115,000	37,900	35,300	34,100
20	377,000	412,000	104,000	38,900	34,600	33,600
21	370,000	402,000	97,000	39,300	34,800	33,800
22	355,000	400,000	96,000	39,100	35,900	33,800
23	340,000	386,000	94,300	38,000	34,900	32,400
24	*289,000	327,000	98,300	38,400	35,200	28,600
25	244,000	270,000	105,000	37,800	35,000	31,300
26	232,000	229,000	105,000	38,200	33,900	31,800
27	242,000	*197,000	101,000	*37,700	32,700	29,200
28	262,000	175,000	95,300	37,300	32,700	27,600
29	299,000	156,000	89,100	37,900	32,100	27,400
30	350,000	145,000	81,000	41,000	31,000	27,800
31	373,000	135,000	-------	42,600	------	27,600
Mean	387,000	373,000	111,000	47,600	37,000	33,800
Cs/mi	3.79	3.66	1.09	0.47	0.36	0.33
In	4.37	4.21	1.21	0.54	0.40	0.38
Maf	23.8	22.9	6.59	2.93	2.20	2.08

M. Acre-feet. 97.3 Max Day 545,000 Min Day 23,600

INDUS RIVER AT MANDORI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
29 Jan	29,200	48	163			
24 Feb	28,100	58	44			
14 Mar	40,100	60	65			
19 Apr	53,600	69	210			
9 May	77,500	63	336			
26 May	162,000	68	1,500	51	30	19
29 Jun	430,000	62	2,160	42	44	14
15 Jul	537,000	67	2,560	14	75	11
24 Jul	288,000	66	4,230	64	28	8
27 Aug	197,000	66	4,350	56	38	6
14 Sep	110,000	68	621	18	38	44
19 Sep	113,000	64	1,660	56	27	17
12 Oct	45,600	65	251			
15 Nov	37,800	58	317			
4 Dec	30,100	51	228			
18 Dec	33,900	59	143			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

INDUS RIVER AT MANDORI (ATTOCK)

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Apr 19	1.68	0.92	0.65		0.17	1.83	0.34	0.90			3.25	3.24				172	300	8.21	0	0.6
May 26	1.58	0.62	0.40		0.18	1.35	0.15	0.90			2.60	2.58				140	250	8.26	0	0.4
Jun 29	1.26	0.34	0.25		0	1.29	0.15	0.40			1.85	1.84				92	170	8.18	0	0.3
Jul 15	1.26	0.34	0.30		0	1.29	0.15	0.50			1.90	1.94				98	180	8.13	0	0.3
24	1.26	0.44	0.30		0	1.37	0.14	0.50			2.00	2.01				112	200	7.99	0	3.1
Sep 14	1.27	0.46	0.35		0.19	1.19	0.19	0.45			2.08	2.02				110	200	8.28	0	0.4
19	1.22	0.40	0.22		0	1.28	0.14	0.40			1.84	1.82				98	180	8.02	0	0.2
Oct 12	1.49	0.83	0.55		0	1.58	0.19	0.80			2.87	2.57				144	240	8.15	0	0.5
Dec 4	1.94	0.93	0.40		0.09	2.11	0.39	0.51			3.27	3.10				174	290	8.20	0	0.3
18	1.88	1.01	0.20		0	2.16	0.39	0.44			3.09	2.99				182	300	8.05	0	0.2

Blank page retained for pagination

HARO RIVER NEAR KHANPUR - 1968

Location Latitude 33°48', Longitude 72°54', on right bank one furlong upstream from Taxila-Haripur Road bridge and 2⅛ miles south west of Khanpur.

Drainage area 300 square miles.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA.

Average Discharge 311 cusecs (225,000 acre-feet per year or 14.1 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 12,300 cusecs on 19 August (gauge height 6.30 feet); minimum daily discharge 17 cusecs on 24 June.

1960-68: Maximum discharge 19,300 cusecs on 25 March 1967; minimum daily discharge 12 cusecs on 12 February 1963.

Gauge Enamelled gauge plates graduated to 0.1 foot fastened to masonry pillars, read to hundredths of a foot 9 times daily or more often during flood period. Arbitrary datum.

Measurements Thirty seven discharge measurements were made periodically during the year by current meter at 0.2 and 0.8 depth by wading at low discharges and from bridge at medium and high discharges. Twenty seven sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from the bridge. Eight of these were analysed for particle size distribution and the rest for total concentration. Twenty one surface samples were collected and analysed for chemical composition.

Determination of discharge Low water rating affected by changes in heading of small irrigation canal just downstream from gauge. Discharges were computed using rating dated 9.5.62 with shift adjustments as indicated necessary by discharge measurements.

Remarks Record fair, does not include the canal on left bank which may carry considerable portion of low-water discharge.

HARO RIVER NEAR KHANPUR

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	403	373	673	309	165	76
2	a 380	360	601	* 298	148	71
3	360	353	573	287	148	60
4	328	347	563	282	148	141
5	316	335	554	271	215	71
6	303	403	554	361	232	* 52
7	309	366	554	287	172	47
8	277	353	525	361	*165	45
9	261	328	483	250	128	41
10	255	322	a 478	309	114	58
11	292	316	474	250	111	39
12	*261	309	457	246	111	137
13	266	303	433	277	111	62
14	250	303	*418	*303	108	52
15	246	298	396	335	122	43
16	228	298	388	282	105	35
17	219	292	381	250	105	35
18	215	287	544	232	93	27
19	206	316	544	219	90	29
20	675	924	620	210	105	23
21	483	986	601	*206	168	24
22	381	817	*491	202	165	18
23	360	748	449	202	103	19
24	347	704	425	195	120	17
25	*341	*662	410	183	73	19
26	335	683	410	176	80	183
27	353	973	381	206	93	45
28	366	829	381	176	85	29
29	403	725	*360	165	* 83	47
30	396	—	347	168	76	29
31	388	—	322	—	71	—
Mean	329	494	477	257	123	53
Cs/mi	1.10	1.65	1.59	0.86	0.41	0.18
In	1.26	1.77	1.83	0.95	0.47	0.20
Ac-ft.	20,200	28,400	29,300	15,300	7,560	3,120

1968 year: Mean 300 Cs/sq mi 1.00 Inches 13.6

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	20	353	224	172	100	95
2	30	*683	215	183	183	93
3	33	573	206	161	114	88
4	120	316	202	183	122	90
5	56	335	198	215	103	88
6	47	*481	172	250	100	88
7	41	328	161	500	93	95
8	35	*360	172	210	83	88
9	*677	760	176	158	78	85
10	*141	*546	179	128	76	83
11	95	2,530	191	128	76	191
12	*191	2,500	198	*128	80	103
13	*278	1,520	215	117	69	a103
14	639	1,750	194	183	* 65	103
15	261	*2,760	*195	176	60	* 90
16	183	1,180	224	122	60	96
17	183	*694	206	120	83	95
18	210	3,290	148	111	100	* 83
19	176	5,620	144	117	93	83
20	187	2,620	148	108	90	83
21	183	2,370	*187	100	85	80
22	465	1,200	168	76	80	a 78
23	*292	563	148	76	78	76
24	232	360	183	85	76	76
25	191	322	219	73	73	a 74
26	179	250	191	* 69	78	73
27	168	189	187	71	73	69
28	168	215	172	67	88	56
29	565	241	165	69	93	50
30	360	232	161	93	100	50
31	316	224	—	76	—	50
Mean	217	1,150	185	140	88	86
Cs/mi	0.72	3.83	0.62	0.47	0.29	0.29
In	0.83	4.41	0.69	0.54	0.33	0.33
Ac-ft.	13,300	70,500	11,000	8,580	5,260	5,270

Acre-feet. 218,000 Max Day 5,620 Min Day 17

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Jan	261	62	40			
25 Jan	341	46	135			
25 Feb	662	54	50			
14 Mar	418	60	15			
22 Mar	466	55	43			
29 Mar	360		20			
2 Apr	303	54	25			
21 Apr	206	78	40			
8 May	172	66	104			
29 May	80	84	19			
6 Jun	50	85	35			
10 Jul	144	85	301			
12 Jul	198	81	3,070	1	36	63
13 Jul	725	80	21,000	1	94	5
23 Jul	303	79	1,530	2	66	32
2 Aug	1,340	83	15,400	4	78	18
6 Aug	1,230	80	26,800	2	86	12
8 Aug	491	79	1,740	4	61	35
10 Aug	474	78	1,230	3	41	56
15 Aug	4,490	86	6,750	14	71	15
17 Aug	760	84	281			
15 Sep	198	82	65			
21 Sep	183	82	121			
12 Oct	134	69	42			
14 Nov	62		29			
15 Dec	90	60	60			
18 Dec	67	58	10			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

HARO RIVER NEAR KHANPUR

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
12	1.96	1.14	0.28		0	1.67	0.14	1.50			3.38	3.31				212	35	7.98	0	0.2
25	2.06	1.54	0.35		0	2.45	0.14	1.40			3.95	3.99				240	390	8.19	0	0.3
Feb																				
25	2.06	1.54	0.35		0	2.55	0.14	1.40			3.95	4.09				245	390	7.62	0	0.3
Mar																				
14	1.55	1.45	0.25		0.18	2.06	0.19	0.80			3.25	3.23				184	320	8.18	0	0.2
29	1.65	1.25	0.25		0.18	2.48	0.24	0.30			3.15	3.20				170	300	8.20	0	0.2
Apr																				
2	1.65	1.25	0.25		0.18	2.35	0.14	0.40			3.15	3.07				174	300	8.21	0	0.2
21	2.10	1.30	0.40		0	2.13	0.14	1.50			3.80	3.77				216	360	7.98	0	0.3
May																				
8	2.42	1.28	0.40		0	2.32	0.14	1.70			4.10	4.16				230	410	7.95	0	0.3
29	1.79	1.31	0.30		0.18	1.71	0.19	1.40			3.40	3.48				204	330	8.25	0	0.3
Jun																				
6	1.79	1.61	0.75		0	1.93	0.14	2.20			4.15	4.27				230	410	7.97	0	0.6
Jul																				
9	2.05	1.85	0.55		0	2.19	0.19	2.10			4.45	4.48				272	440	7.90	0	0.4
13	2.78	1.07	0.60		0	2.06	0.19	2.30			4.45	4.55				268	440	7.95	0	0.4
23	2.31	0.79	0.25		0.16	1.50	0.14	1.60			3.35	3.40				190	330	8.23	0	0.2
Aug																				
6	2.31	0.89	0.40		0	1.97	0.19	1.40			3.60	3.56				202	340	8.10	0	0.3
10	2.10	1.15	0.45		0.17	1.36	0.20	2.10			3.70	3.83				220	370	8.13	0	0.4
15	2.06	0.69	0.45		0	2.04	0.19	1.10			3.20	3.43				174	[illegible]	8.00	0	0.4
Sep																				
15	2.27	0.93	0.35		0.19	1.88	0.19	1.35			3.55	3.61				205	350	8.25	0	0.3
21	2.44	1.57	0.30		0.10	2.00	0.19	1.96			4.31	4.25				244	410	8.25	0	0.3
Oct																				
12	2.25	1.17	0.45		0	2.18	0.19	1.48			3.87	3.85				238	[illegible]	[illegible] 15	[illegible]	0.3
Nov																				
14	2.55	1.08	0.28		0	2.40	0.14	1.35			3.91	3.89				238		[illegible] 10	[illegible]	0.2
Dec																				
15	2.94	1.13	0.18		0.09	3.52	0.29	1.32			4.25	4.22				230	380	8.20	0	0.1

Blank page retained for pagination

HARO RIVER AT SANJWAL – 1968

Location Latitude 33°45', Longitude 72°26', near dam site at Sanjwal village, about 5 miles downstream from Grand Trunk Road, about 20 miles upstream from Indus River.

Drainage area 695 square miles.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge height record and measurements 1959 to June 1962 by Hydrology Directorate of Irrigation Department. Details of record obtained from old Irrigation Project Circle gauge, a quarter of a mile upstream from present gauge, not known.

Average discharge 620 cusecs (449,000 acre-feet per year or 12.1 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 21,700 cusecs on 30 July (gauge height 26.20 feet); minimum daily discharge 236 cusecs on 8 July.

1960-68: Maximum discharge 53,300 cusecs on 2 September 1961; minimum daily discharge 215 cusecs on 19 June 1966.

Gauge Staff gauge graduated at 0.1 foot intervals painted on masonry base on bedrock from 5.5 to 36.0 feet on left bank and on steel angle from 36.0 to 46.0 on right bank, gauge read five to seven times a day or more often during floods.

Measurements Ninety eight discharge measurements were made periodically by current meter at 0.2 and 0.8 depth by wading in low flows and from car on overhead cableway half a mile upstream from gauge in high flows. Eighty four sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from cableway. Thirty eight of these were analysed for particle size distribution and the rest for total concentration. Sixteen surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a rock control apparently not affected by sand movement. Discharges were computed by applying daily mean gauge heights to rating dated 11.5.1962.

Remarks Record fair.

HARO RIVER AT SANJWAL

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	597	612	900	464	309	259
2	551	597	840	*445	302	259
3	541	579	801	431	307	256
4	506	576	752	416	319	268
5	488	572	734	400	524	259
6	461	676	700	383	367	258
7	468	628	696	428	528	256
8	451	576	672	394	*346	254
9	438	555	*636	365	326	253
10	425	548	632	441	305	250
11	502	534	636	391	289	245
12	*445	527	628	368	278	270
13	451	513	597	380	276	300
14	435	*513	597	833	261	256
15	422	502	562	829	265	254
16	403	468	537	534	265	253
17	397	458	509	468	267	*251
18	383	431	558	431	261	247
19	365	499	773	391	261	248
20	921	1,460	1,190	365	267	241
21	905	1,390	1,170	*341	293	245
22	668	1,030	801	331	321	247
23	593	920	708	316	341	242
24	576	860	664	321	305	241
25	576	815	616	314	293	247
26	551	806	656	311	293	924
27	551	985	636	305	283	382
28	593	1,080	612	319	276	298
29	604	945	*565	293	*265	263
30	725	---	530	309	261	*258
31	*668	---	499	---	261	---
Mean	537	712	691	411	307	283
Cs/mi	0.77	1.02	0.99	0.59	0.44	0.41
In	0.89	1.11	1.15	0.66	0.51	0.45
Ac-ft	33,000	41,000	42,500	24,400	18,900	16,800

1968 year; Mean 585 Cs/sq mi 0.84 Inches 11.5

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

HABO RIVER AT SANJWAL

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	250	495	*590	283	413	298
2	244	*749	551	*280	516	300
3	242	*2,560	*520	280	385	298
4	241	706	475	283	*346	300
5	250	468	*438	278	336	302
6	*244	*1,410	394	300	331	309
7	247	*854	357	298	326	314
8	*236	*4,450	*347	*365	316	309
9	238	*941	496	309	314	314
10	*461	1,210	*331	309	314	307
11	*287	*7,390	316	321	329	2,720
12	*800	*2,930	*305	*316	314	1,960
13	454	*1,300	298	309	316	513
14	*961	*1,020	*285	316	314	400
15	*527	*2,960	287	309	314	*360
16	*596	1,680	*323	*302	309	331
17	*969	*1,310	448	*300	307	334
18	530	*1,310	*368	298	305	326
19	*371	**5,980	319	302	*307	331
20	*388	*1,440	*307	*293	305	316
21	*1,270	*2,820	295	302	307	316
22	*4,060	*5,910	*287	300	309	316
23	*1,590	1,360	285	*305	307	314
24	*576	*1,030	*280	302	300	311
25	*451	940	287	305	298	314
26	*431	*875	*274	*302	295	314
27	374	801	278	300	295	314
28	*349	*1,090	*280	295	300	314
29	*1,250	738	278	302	298	314
30	*3,650	*664	278	*309	298	311
31	*659	628	—	302	—	314
Mean	748	1,870	353	302	324	455
Cs/mi	1.08	2.69	0.51	0.43	0.47	0.65
In	1.24	3.11	0.57	0.50	0.52	0.75
Ac-ft	46,000	115,000	21,000	18,600	19,300	28,000

Acre-feet. 425,000 Max Day 7,390 Min Day 236

HARO RIVER AT SANJWAL

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Jan	422	62	62			
31 Jan	652	52	99			
14 Feb	502	58	30			
29 Mar	537	58	21			
2 Apr	428	57	28			
21 Apr	339	86	28			
8 May	346	76	16			
29 May	261	83	15			
30 Jun	253	82	195			
4 Jul	225	82	109			
6 Jul	250	88	145			
8 Jul	241	92	129			
10 Jul	478	80	12,200	3	80	17
12 Jul	1,760	90	29,600	1	98	1
14 Jul	530	90	1,650	20	46	34
14 Jul	1,990	88	13,400	2	59	39
15 Jul	416	80	2,250	4	68	28
16 Jul	910	80	1,060	0	31	69
17 Jul	1,760	78	13,200	6	88	6
17 Jul	2,140	80	587	4	79	17
19 Jul	377	84	152			
20 Jul	445	80	270			
21 Jul	3,440	82	23,200	1	96	3
22 Jul	5,050	80	18,600	11	85	4
22 Jul	9,280	77	15,400	8	84	8
24 Jul	530		1,310	2	44	54
25 Jul	428		270			
26 Jul	388		104			
28 Jul	349		81			
29 Jul	4,070		23,400	3	92	5
30 Jul	3,440		10,500	4	86	10
31 Jul	562		1,100	4	36	60
2 Aug	1,550	85	3,470	2	68	30
3 Aug	3,650	76	10,600	12	75	13
4 Aug	569	88	1,400	5	37	58
5 Aug	438	90	213			
6 Aug	2,600	85	6,030	26	64	10
7 Aug	620	87	4,110	5	83	12
8 Aug	12,300	85	21,500	5	84	11
8 Aug	16,200	83	16,400	6	80	14

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Aug	680	84	767	3	29	68
11 Aug	8,510	78	10,100	7	71	22
11 Aug	3,090	84	13,700	1	67	32
12 Aug	2,980	82	22,800	25	59	16
13 Aug	1,160	90	3,180	8	61	31
14 Aug	935	80	1,730	3	53	44
15 Aug	2,530	80	12,900	2	87	11
15 Aug	5,320	82	15,700	10	75	15
17 Aug	1,310	85	1,000	10	37	53
18 Aug	1,430	83	1,310	10	53	37
19 Aug	10,700	78	12,600	20	74	6
20 Aug	1,220	80	1,190	5	47	48
21 Aug	3,990	78	7,490	9	86	5
22 Aug	18,600	80	20,600	8	85	7
24 Aug	1,050	84	807	2	31	67
26 Aug	870	85	243			
28 Aug	1,970	82	2,860	7	67	26
30 Aug	676	78	96			
1 Sep	600	85	77			
3 Sep	502	80	170			
5 Sep	458	90	48			
8 Sep	321	78	16			
10 Sep	1,950	90	151			
12 Sep	300	80	97			
14 Sep	283	86	89			
16 Sep	276	77	70			
18 Sep	371	80	111			
20 Sep	300	81	43			
22 Sep	274	75	71			
22 Sep	274	85	24			
26 Sep	274	80	35			
28 Sep	272	75	29			
2 Oct	274	75	89			
8 Oct	365	72	54			
12 Oct	324	70	29			
16 Oct	305	73	65			
17 Oct	298	72	42			
20 Oct	298	75	81			
23 Oct	295	70	36			
26 Oct	302	75	29			

HARO RIVER AT SANJWAL

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
30 Oct	300	74	49			
4 Nov	352	72	22			
19 Nov	309	70	34			
15 Dec	360	65	39			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

HARO RIVER AT SAKUWAL

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
12	2.78	1.62	0.60			3.62	0.24	1.60			5.00	5.46				298	500	7.95	0	0.4
Feb																				
14	2.06	1.94	0.49		0.37	2.70	0.39	1.10			4.49	4.56				266	370	8.33	0	0.3
Mar																				
29	1.55	1.45	0.42		0.18	2.45	0.24	0.60			3.42	3.47				200	340	8.18	0	0.3
Apr																				
2	1.75	1.45	0.49		0.18	2.86	0.19	0.30			3.69	3.53				210	350	8.19	0	0.4
21	2.31	1.49	0.70		0.17	2.81	0.29	1.20			4.50	4.47				260	450	8.22	0	0.6
May																				
8	3.15	1.55	0.70		0.27	3.00	0.19	1.80			5.40	5.26				280	500	8.25	0	0.4
29	1.68	1.52	0.70		0.18	2.03	0.24	1.30			3.90	3.95				240	380	8.21	0	0.6
Jun																				
30	2.00	1.30	0.70		0.16	2.33	0.34	1.20			4.00	4.03				236	400	8.21	0	0.6
Jul																				
10	1.37	1.93	0.70		0	2.12	0.19	1.70			4.00	4.01				242	400	7.95	0	0.6
15	1.16	2.24	0.65		0.16	2.06	0.19	1.60			4.05	4.01				240	400	8.27	0	0.4
30	1.78	0.42	0.30		0	1.72	0.15	0.50			2.50	2.37				126	230	7.70	0	0.3
Aug																				
3	1.78	0.52	0.25		0	1.72	0.15	0.50			2.55	2.37				128	230	7.65	0	0.2
8	1.64	0.80	0.45		0	1.87	0.14	0.86			2.89	2.87				146	270	8.14	0	0.4
22	1.99	0.26	0.35		0	2.07	0.19	0.40			2.60	2.66				160	260	7.90	0	0.3
Sep																				
14	2.03	1.50	0.78		0.19	2.18	0.19	1.78			4.31	4.34				262	410	8.30	0	0.6
Oct																				
12	2.31	1.70	0.83		0.19	2.87	0.29	1.50			4.84	4.85				308	490		0	0.6

Blank page retained for pagination

Location Latitude 33°33', Longitude 71°27', on left bank 1½ furlong upstream from Jarma Weir, ⅝ mile upstream from Kohat Bannu Road Bridge, and 5 miles southeast of Kohat.

Drainage area 595 square miles.

Records available Discharge record March 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights only April 1956 to February 1959 by Kohat Irrigation Division, Kohat and February 1959 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 82 cusecs (59,800 acre-feet per year or 1.88 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 11,000 cusecs on 24 August (gauge height 11.89 feet); minimum daily discharge zero cusecs at times.

1956-68: Maximum gauge height observed 7.5 feet on 17 July 1956 (discharge 16,800 cusecs estimated by Irrigation Office Kohat by weir formula), site and datum then in use. Maximum observed discharge 19,500 cusecs on 25 March 1967. River dry at times during most of the years.

Gauge Continuous automatic water-stage recorder in masonry stilling well installed on 22 June 1961. Prior to 14 December 1960 staff gauges set on abutments of Jarma Weir 1½ furlongs downstream. 15 December 1960 to 21 June 1961 staff gauge at present site and datum. Inside staff gauge set to 1495.98 S.P.D. (checked in 1968).

Measurements Eighteen discharge measurements were made periodically by current meter using 0.2 and 0.8 or 0.6 depth methods by wading in the vicinity of the gauge in low and medium discharges, and from road bridge at high discharge. Seventeen sets of sediment samples were taken by depth integrating method using DH-48 sampler by wading and D-49 sampler from bridge. Two of these were analysed for particle size distribution and rest for total concentration. Seventeen surface samples were collected and analysed for chemical composition.

Determination of discharge The channel is composed of small shingle with a flat riffle for a low water control. Previous rating dated 11.8.66 was used to compute discharges. Shifts were applied as indicated by discharge measurements.

Remarks Record fair. River may become dry at certain times due to upstream diversions for irrigation purpose.

KOHAT TOI AT JARMA WEIR

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	7.0	4.5	46	0.3	4.5	23
2	7.5	4.5	38	22	4.7	15
3	7.5	4.5	25	26	0.8	18
4	7.5	3.3	*31	102	0.3	47
5	7.0	3.6	24	42	0.6	32
6	6.0	3.6	23	186	35	76
7	7.0	4.2	25	182	13	243
8	6.5	3.3	26	60	13	214
9	6.0	2.7	25	125	11	179
10	5.0	3.6	30	57	10	141
11	*4,5	2.7	36	33	6.5	181
12	5.5	1.5	30	31	6.0	129
13	5.5	26	36	16	4.5	16
14	16.0	11	49	*18	*3.9	19
15	13	1.5	48	3.9	5.5	*48
16	13	0.9	41	3.9	5.5	41
17	13	0.6	36	3.9	4.2	27
18	9.5	0.5	81	8.5	2.7	21
19	12	8.2	40	3.9	3.3	12
20	55	7.5	321	9.0	7.6	5.0
21	5.0	*4.5	200	69	190	1.4
22	5.0	10	185	62	3.3	1.8
23	5.0	17	185	55	13	5.9
24	5.5	3.6	280	55	35	5.0
25	5.5	18	286	49	1.5	121
26	4.2	14	124	12	1.8	159
27	*2.7	6.5	66	12	3.0	86
28	2.7	7.5	7.5	*13	0.9	65
29	42	51	4.2	10	18	30
30	187	----	6.0	13	761	20
31	5.5	----	*4.2	—	27	—
Mean	16	7.9	76	43	39	66
Cs/mi	0.03	0.01	0.13	0.07	0.07	0.11
In	0.03	0.01	0.15	0.08	0.07	0.12
Ac-ft.	960	457	4,680	2,550	2,370	3,930

1968 year: Mean 36 Cs/sq mi 0.06 Inches 0.81

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	8.5	14	39	0.8	33	9.0
2	6.0	9.5	51	1.1	15	9.5
3	0.6	13	44	1.1	13	13
4	0	14	36	15	*21	12
5	3.4	29	28	133	19	13
6	3.9	79	15	69	19	14
7	0	74	108	55	17	19
8	0	35	159	*8.0	16	*17
9	0.3	498	24	6.5	16	18
10	0.3	14	8.5	7.0	15	25
11	*0.2	15	7.0	5.5	23	58
12	0.3	14	5.5	3.3	21	60
13	33	1.8	3.9	23	24	44
14	34	5.5	2.4	55	20	36
15	41	0	0.9	9.0	19	34
16	26	1.4	0	3.3	18	33
17	30	3.0	0	3.0	19	34
18	31	3.3	0	8.0	19	30
19	42	0.8	9.0	58	20	23
20	25	0	3.6	33	24	20
21	33	1.8	7.0	26	18	20
22	103	128	*6.5	21	17	21
23	84	6.5	3.6	21	18	24
24	39	932	1.5	16	13	19
25	27	*315	1.5	14	9.5	16
26	28	84	1.2	9.5	13	16
27	24	95	1.1	*9.0	12	14
28	15	60	0.6	9.5	10	13
29	17	31	0.6	9.5	10	14
30	14	100	1.8	28	*9.5	14
31	16	36	---	21	----	15
Mean	22	84	19	21	17	23
Cs/mi	0.04	0.14	0.03	0.04	0.03	0.04
In	0.04	0.16	0.04	0.04	0.03	0.04
Ac-ft.	1,360	5,180	1,130	1,310	1,030	1,400

Acre-feet. 26,400 Max Day 932 Min Day 0

KOHAT TOI AT JARMA WEIR

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
11 Jan	4.5	56	16			
27 Jan	2.4		31			
21 Feb	6.0	65	242			
4 Mar	33	69	69			
31 Mar	3.6	69	133			
14 Apr	48	59	1,200	1	41	58
28 Apr	13	80	70			
14 May	4.2		76			
15 Jun	17	75	520			
27 Jul	26	84	92			
25 Aug	188	87	1,080	3	27	70
22 Sep	6.5	78	95			
8 Oct	5.5	70	59			
27 Oct	9.5		14			
4 Nov	20	67	20			
30 Nov	9.5	62	34			
13 Dec	42	55	151			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm. and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KOHAT TOI AT JARMA WEIR

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																			
11	1.55	1.95	2.60			3.81	0.49	1.80			6.10	6.10				347	570	8.08	0.31	2.0
27	1.96	1.74	1.78			3.34	0.49	1.60			5.48	5.43				295	500	8.07	0	1.4
Mar																			
4	0.93	2.27	1.35		0.19	3.30	0.42	0.60			4.53	4.51				290	430	8.22	0.29	1.1
31	0.74	1.76	3.10		0.26	2.49	0.34	2.30			5.60	5.39				300	510	8.26	0.25	2.8
Apr																			
14	0.74	1.46	3.93		0.26	3.07	0.34	2.40			6.13	6.07				320	550	8.20	1.13	3.7
28	1.68	1.52	1.45		0.34	2.26	0.34	1.60			4.65	4.54				234	420	8.22	0	1.1
May																			
14	1.37	1.93	3.37		0.45	3.24	0.64	2.30			6.67	6.63				330	600	8.34	0.39	2.6
Jun																			
15	2.27	0.33	1.57		0.17	1.95	0.34	1.85			4.17	4.31				228	400	8.25	0	1.4
Jul																			
27	0.84	1.76	2.45		0.17	2.33	0.44	2.25			5.05	5.19				270	490	8.34	0	2.1
Aug																			
25	1.21	0.74	1.80		0	2.20	0.49	0.85			3.75	3.54				225	370	8.18	0	1.0
Sep																			
4	1.47	1.79	0.82		0.30	2.65	0.34	1.09			4.08	4.18				232	400	8.30	0	0.6
22	0.83	1.52	4.30		0.54	3.10	1.12	2.17			6.65	6.93				410	650	8.42	1.29	4.0
Oct																			
8	1.54	1.61	2.00		0.40	2.60	0.39	1.68			5.15	5.07				310	510	8.30	0	1.6
27	2.17	1.30	1.35		0	2.95	0.44	1.13	0.35		4.82	4.87				296	480	8.18	0	1.0
Nov																			
4	1.33	1.66	2.00		0.27	2.75	0.59	1.32			4.99	4.93				300	480	8.20	0.03	1.6
30	2.17	1.78	1.00		0.36	3.06	0.39	1.10			4.95	4.91				276	460	8.25	0	0.7
Dec																			
13	2.27	1.63	1.75		0.36	3.15	0.59	1.35			5.65	5.45				308	510	8.30	0	1.3

Blank page retained for pagination

Location Latitude 33°39', Longitude 73°18', on Rawalpindi-Lehtrar road bridge, one mile northeast of Chirah; 12 miles upstream from Ling River and 14 miles east of Rawalpindi.

Drainage area 126 square miles.

Records available Discharge record April 1960 to date by Surface Water Hydrology Project WAPDA. Record 1959 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 157 cusecs (114,000 acre-feet per year or 16.9 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 35,200 cusecs on 19 August (gauge height 16.80 feet); minimum daily discharge 3.6 cusecs on 24-25 May.

1960-68: Maximum discharge observed 46,500 cusecs on 24 August 1967; minimum daily discharge 0 cusecs on many days in June 1963.

Gauge Wire-weight gauge installed on 9 November 1961. Staff gauge on central bridge pier before that date. Gauge read to hundredths of a foot nine times daily and more often during floods. Zero of gauge datum is at R.L. 1845.75 (checked in 1969).

Measurements Thirty four discharge measurements were made periodically by current meter using 0.2 and 0.8 or 0.6 depth method by wading at low discharges and from bridge at medium and high discharges. Thirty two sets of sediment samples taken by depth integrating method using DH-48 sampler by wading and D-49 sampler from bridge. Sixteen of these were analysed for particle size distribution and the rest for total concentration. Twenty surface samples were collected and analysed for chemical composition.

Determination of discharge Rating dated 3.1.70 was used to compute discharges. Shift adjustments were applied as determined by periodical discharge measurements.

Remarks Record fair. Data includes left bank small channel feeding flour mills.

SOAN RIVER AT CHIRAH

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	81	146	209	75	35	12
2	a 78	136	197	65	34	11
3	75	132	179	*64	33	13
4	73	122	161	58	32	11
5	69	116	149	57	33	23
6	65	152	143	55	55	17
7	75	134	134	53	43	13
8	62	120	124	52	35	12
9	59	116	*118	51	35	9.5
10	64	112	a113	49	32	8.3
11	93	108	a109	48	30	7.4
12	65	106	104	46	29	9.8
13	*84	102	97	42	28	23
14	75	112	93	300	28	13
15	69	104	87	143	27	9.5
16	65	*102	79	79	26	7.2
17	63	100	76	59	*25	6.2
18	62	97	*231	54	25	5.2
19	59	167	421	50	24	*4.6
20	1,530	1,020	300	46	24	4.4
21	268	372	272	43	23	5.4
22	167	248	176	42	49	4.8
23	128	221	a 145	43	34	4.4
24	*118	197	114	42	*27	3.6
25	116	182	114	39	28	3.6
26	100	170	112	*38	23	46
27	112	611	104	37	21	21
28	149	336	116	37	20	13
29	215	236	87	36	19	*7.6
30	200	---	85	34	16	7.0
31	167	---	81	---	15	---
Mean	149	203	146	61	29	11
Cs/mi	1.18	1.61	1.16	0.48	0.23	0.09
In	1.36	1.73	1.34	0.54	0.27	0.10
Ac-ft.	9,140	11,700	8,990	3,640	1,800	667

1968 year: Mean 144 Cs/sq mi 1.14 Inches 15.5

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

SOAN RIVER AT CHIRAH

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	6.4	397	161	25	27	9.2
2	6.0	*374	143	25	76	9.2
3	5.6	1,130	132	24	33	8.9
4	5.0	*404	122	24	24	8.9
5	6.2	136	112	54	20	8.9
6	7.0	1,460	106	42	17	8.9
7	*4.8	*254	96	99	15	9.2
8	5.6	*173	88	*53	14	8.9
9	*228	1,560	81	39	13	8.6
10	115	*835	78	32	12	*7.8
11	43	*2,540	73	30	13	9.8
12	571	577	66	28	12	31
13	*215	206	64	27	13	32
14	185	1,200	*59	65	13	21
15	68	*946	55	44	*11	15
16	49	218	52	32	11	14
17	119	167	68	32	10	12
18	132	1,760	59	29	10	10
19	97	*5,090	50	26	10	8.6
20	85	600	45	23	11	7.8
21	175	475	42	21	13	7.4
22	*234	*642	40	21	12	a7.2
23	126	405	38	19	11	a7.0
24	70	348	35	18	11	6.8
25	48	324	33	18	10	7.2
26	44	272	32	17	10	38
27	40	245	30	17	9.8	30
28	38	227	29	16	9.8	24
29	*3,900	212	28	16	9.5	21
30	*238	191	*26	*13	9.2	19
31	174	176	—	16	----	17
Mean	227	759	68	30	16	14
Cs/mi	1.80	6.02	0.54	0.24	0.13	0.11
In	2.08	6.95	0.60	0.28	0.14	0.13
Ac-ft.	14,000	47,000	4,050	1,870	933	861

Acre-feet. 105,000 Max Day 5,090 Min Day 3.6

SOAN RIVER AT CHIRAH

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	88	48	48			
24 Jan	118	47	68			
16 Feb	100	57	22			
8 Mar	124	64	61			
18 Mar	663	65	63			
3 Apr	63	67	36			
26 Apr	39	78	38			
24 May	7.6	82	11,000	2	43	55
19 Jun	4.6	92	28			
29 Jun	7.4	90	486	11	31	58
7 Jul	4.8	94	83			
9 Jul	405	84	4,020	1	60	39
13 Jul	76	90	736	5	26	69
13 Jul	734	89	2, 150	1	51	48
22 Jul	122		1, 750	3	53	44
29 Jul	1, 110		4, 630	1	69	30
30 Jul	191	82	2, 440	16	51	33
2 Aug	840	84	1, 460	3	39	58
3 Aug	376	80	1, 740	1	31	68
4 Aug	1,010	80	2, 190	1	82	17
7 Aug	233	80	1, 990	1	66	33
8 Aug	242	84	1, 140	2	22	76
10 Aug	1, 630	80	1, 600	2	46	52
11 Aug	7, 280	68	7, 530	8	81	11
19 Aug	1, 190	76	2, 470	1	81	17
14 Sep	60	84	49			
30 Sep	26	82	19			
8 Oct	55	68	234			
15 Nov	11	64	46			
21 Nov	13	62	21			
10 Dec	7.8	58	29			
17 Dec	12	52	15			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SOAN RIVER AT CHIRAH

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				MHOx10^6 at 25°C.	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 13	1.75	1.25	0.83			3.44	0.14	0.25			3.83	3.83				200	350	8.17	0.44	0.7
Feb 16	1.87	1.03	0.74		0.36	2.83	0.24	0.31			3.64	3.74				208	360	8.32	0.29	0.6
Mar 8	1.03	2.07	0.74		0.27	3.21	0.24	0.10			3.84	3.82				204	350	8.29	0.38	0.6
18	0.93	2.17	0.74		0.27	3.21	0.29	0.20			3.84	3.97				180	300	8.29	0.38	0.6
Apr 3	1.05	1.25	0.93		0.27	2.55	0.19	0.25			3.23	3.26				170	300	8.20	0.52	0.9
26	1.47	1.23	1.00		0.27	2.91	0.19	0.25			3.70	3.62				200	350	8.25	0.48	0.9
May 24	1.47	0.83	0.93		0.36	2.39	0.24	0.30			3.23	3.29				170	310	8.40	0.45	0.8
Jun 18	1.16	1.54	0.82		0.35	2.69	0.24	0.30			3.52	3.58				202	350	9.30	0.34	0.7
29	1.52	0.78	0.60		0.25	2.15	0.25	0.30			2.90	2.95				158	290	8.27	0.10	0.6
Jul 7	1.57	0.88	0.83		0.51	2.40	0.24	0.25			3.28	3.40				174	320	8.35	0.46	0.7
9	1.62	0.93	0.70		0.17	2.58	0.30	0.25			3.25	3.30				176	320	8.24	0.20	0.6
13	1.36	0.79	0.45		0.17	1.98	0.20	0.25			2.60	2.60				140	260	8.25	0.02	0.4
29	1.47	0.53	0.25		0	1.80	0.14	0.30			2.25	2.24				114	210	7.98	0	0.3
Aug 2	1.47	0.63	0.40		0	1.97	0.15	0.40			2.50	2.52				140	250	7.79	0	0.4
7	1.57	0.63	0.40		0	2.01	0.14	0.40			2.60	2.55				126	240	7.99	0	0.4
Sep 14	1.22	1.24	0.85		0.49	2.33	0.19	0.40			3.31	3.41				190	330	8.38	0.36	0.8
30	1.42	1.14	1.10		0.30	2.65	0.29	0.31			3.66	3.55				204	360	8.20	0.39	1.0
Oct 8	0.99	1.20	0.83		0.19	2.38	0.19	0.30			3.02	3.06				168	290	8.30	0.38	0.8
Nov 15	1.43	1.45	0.69		0	3.10	0.19	0.20			3.57	3.49				198	330	8.20	0.22	0.6
Dec 10	2.43	0.62	0.90		0.36	3.10	0.29	0.17			3.95	3.92				194	330	8.40	0.41	0.7

Blank page retained for pagination

Location Latitude 33°36', Longitude 73°22', on Sihala-Azad Pattan Road bridge, ¾ mile west of Kahuta and 19 miles east of Rawalpindi.

Drainage area 56 square miles.

Records available July 1961 to date by Surface Water Hydrology Project WAPDA.

Average discharge 62 cusecs (45,400 acre-feet per year or 15.2 inches runoff per year). Average taken for 7 years from 1962 to 1968.

Extremes Maximum discharge observed during the year 8,360 cusecs on 29 July (gauge height 9.80 feet) from rating curve extended above 3,000 cusecs by velocity-area and conveyance studies; minimum daily discharge 0.5 cusecs on 7 July.

July 1961-December 1968: Maximum discharge observed 24,300 cusecs on 15 July 1964, (high water measurement of unknown date at 13.0 feet gauge, discharge approximately 30,000 cusecs); minimum discharge 0 cusecs on many days in June 1966.

Gauge Wire-weight gauge fastened to downstream handrail of bridge. Prior to 18 November 1961 staff gauge at same site and datum. Gauge read to 0.01 foot, nine times daily or more often during flood season. Zero R.L. of wire-weight gauge 1854.01 S.P.D.

Measurements Ninety nine discharge measurements made during the year by current meter using 0.2 and 0.8 or 0.6 depth method by wading or from the bridge. Ninety four sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from the bridge. Twenty four of these were analysed for particle size distribution and the rest for total concentration. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a rock channel control probably affected at times by varying mud deposits. Previous rating dated 26.6.67 was used to compute daily discharges from daily mean gauge heights with application of shifts where indicated necessary by discharge measurements.

Remarks Record good.

LING RIVER NEAR KAHUTA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	30	78	49	17	8.3	3.2
2	a27	76	46	16	8.3	13
3	23	62	42	15	7.1	0.9
4	21	51	36	14	6.8	2.6
5	23	44	32	14	6.8	2.4
6	22	73	30	13	43	4.0
7	21	55	29	13	14	3.2
8	21	47	*25	13	11	1.9
9	20	43	23	12	7.4	1.6
10	20	38	a22	12	5.8	56
11	40	34	20	11	5.5	27
12	23	32	20	11	6.0	9.9
13	*35	30	19	10	5.3	14
14	22	30	18	201	*4.8	8.0
15	18	*34	18	43	4.8	5.5
16	15	29	17	19	4.5	4.0
17	14	28	16	16	4.3	*3.2
18	13	27	68	12	5.0	2.6
19	12	30	221	12	4.3	2.4
20	610	749	102	10	4.0	2.2
21	147	187	90	10	3.6	2.8
22	97	81	38	8.6	4.5	1.5
23	76	57	32	10	5.3	1.0
24	*73	49	28	11	21	2.0
25	74	45	25	*11	*10	1.7
26	64	48	25	8.9	9.5	90
27	94	*140	32	9.5	8.3	17
28	157	107	26	9.2	6.5	11
29	171	60	21	8.3	4.0	*13
30	108	—	*20	8.9	4.3	5.5
31	87	—	19	—	5.0	—
Mean	70	82	39	19	8.0	10
Cs/mi	1.25	1.46	0.70	0.34	0.14	0.18
In	1.45	1.57	0.80	0.38	0.17	0.21
Ac-ft.	4,320	4,690	2,400	1,150	494	621

1968 year: Mean 50 Cs/sq mi 0.89 Inches 12.2

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

LING RIVER NEAR KAHUTA

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*3.2	37	23	5.8	*66	0.8
2	2.6	*528	*24	6.5	*52	1.6
3	*2.0	*523	*9.6	*5.5	18	*2.1
4	2.2	72	12	*3.4	10	1.8
5	1.8	*83	*13	*3.6	8.0	2.0
6	1.8	*192	14	20	*6.5	1.0
7	*0.5	51	*15	*151	6.3	*0.9
8	*18	*122	15	50	6.0	1.0
9	*115	*126	15	*11	*5.8	0.7
10	*22	48	*16	4.8	4.5	0.8
11	*14	*157	14	2.6	5.0	*3.6
12	*609	*232	*14	1.5	3.6	*33
13	*63	76	12	1.1	*3.2	23
14	*99	*1,030	*12	*87	3.2	*7.7
15	23	*556	12	50	4.8	5.3
16	*12	*105	*13	27	*5.0	*3.6
17	*7.4	81	*18	*15	4.5	2.6
18	19	*403	20	9.2	2.8	2.0
19	*143	*802	*15	8.3	*4.8	1.3
20	*407	110	12	6.8	3.8	*4.8
21	*503	*81	*11	*5.8	3.6	3.4
22	263	*288	10	6.3	3.6	a3.5
23	*148	75	10	7.4	*2.8	3.6
24	46	*59	*8.3	6.0	1.2	21
25	19	52	8.3	5.8	2.4	*23
26	*12	46	*8.9	*4.8	*1.2	32
27	10	*43	6.8	5.0	1.3	12
28	*8.9	39	*6.8	6.0	0.9	*9.2
29	*1,330	*36	5.0	5.5	a0.9	6.0
30	*72	32	*5.8	*6.0	*1.9	4.3
31	*29	*32	———	5.3	———	4.0
Mean	129	197	13	17	8.1	7.1
Cs/mi	2.30	3.52	0.23	0.30	0.14	0.13
In	2.66	4.06	0.25	0.35	0.16	0.15
Ac-ft.	7,950	12,100	753	1,060	481	440

Acre-feet. 36,500 Max Day 1,330 Min Day 0.9

LING RIVER NEAR KAHUTA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	57	46	93			
24 Jan	70	46	123			
15 Feb	34	50	61			
27 Feb	79	64	37			
8 Mar	26	57	46			
30 Mar	18	65	22			
25 Apr	11	78	93			
14 May	4.3		69			
25 May	11	74	50			
17 Jun	2.8	88	14			
29 Jun	12	84	635	1	15	84
1 Jul	3.0	79	191			
3 Jul	3.2	80	46			
7 Jul	0.4	83	31			
8 Jul	6.8	86	48			
9 Jul	418	79	1,630	2	65	33
10 Jul	22	82	117			
11 Jul	10	88	113			
12 Jul	786	77	3,340	3	71	26
13 Jul	34	87	202			
14 Jul	65	85	240			
16 Jul	11	82	204			
16 Jul	12	89	101			
19 Jul	402	85	1,120	6	55	39
20 Jul	61	84	233			
21 Jul	802	77	3,180	5	79	16
23 Jul	111	79	298			
29 Jul	1,620	77	2,680	3	81	16
31 Jul	32	81	114			
2 Aug	1,470	77	2,670	4	64	32
5 Aug	131	88	207			
6 Aug	675	85	1,490	9	68	23
8 Aug	131	80	2,280	10	42	48
8 Aug	225	84	868	2	39	59
9 Aug	335	78	1,460	3	53	44
11 Aug	458	80	932	3	45	52
12 Aug	865	81	2,350	4	46	50
14 Aug	1,840	78	2,520	5	45	50
14 Aug	1,700	75	4,620	9	47	44
15 Aug	975	77	1,070	3	47	50

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Aug	173	78	205			
16 Aug	93	76	91			
18 Aug	720	82	4,780	6	50	44
19 Aug	3,270	74	2,270	30	50	20
19 Aug	1,900	75	2,340	8	68	24
21 Aug	79	85	58			
22 Aug	438	76	1,130	3	51	46
24 Aug	57	87	42			
27 Aug	41	85	47			
29 Aug	35	84	36			
31 Aug	32	83	61			
2 Sep	24	85	36			
3 Sep	24	84	28			
5 Sep	13	86	226			
7 Sep	15	86	34			
10 Sep	16	86	105			
12 Sep	13	83	33			
14 Sep	12	87	69			
16 Sep	13	84	42			
17 Sep	22	82	45			
19 Sep	14	83	170			
21 Sep	10	83	59			
24 Sep	8.6	85	34			
26 Sep	8.9	80	19			
28 Sep	6.5	81	40			
30 Sep	6.0	80	28			
3 Oct	3.6	80	14			
4 Oct	3.8	74	41			
5 Oct	14	86	24			
7 Oct	329	60	1,690	2	39	59
9 Oct	11	74	135			
14 Oct	183	59	1,170	7	61	32
17 Oct	7.7	70	65			
21 Oct	5.3	73	24			
26 Oct	5.0	71	27			
30 Oct	6.0	72	22			
1 Nov	173	56	352	8	27	65
2 Nov	42	58	276	8	21	71
6 Nov	6.5	66	25			
9 Nov	5.5	69	28			

LING RIVER NEAR KAHUTA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Nov	3.4	64	11			
16 Nov	5.0	66	24			
19 Nov	4.8	64	15			
23 Nov	1.9	62	29			
26 Nov	4.5	54	21			
30 Nov	3.6	60	14			
7 Dec	1.0	60	17			
11 Dec	4.0	56	112			
12 Dec	64	54	67			
14 Dec	6.5	56	66			
16 Dec	3.6	54	36			
20 Dec	3.6	54	22			
25 Dec	18	48	36			
28 Dec	8.9	48	44			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

LING RIVER NEAR KAHUTA

Chemical Analysis of Water Samples - 1968

Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.	EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	KILLIEQUIVALENTS PER LITRE												PARTS PER MILLION						me/l	
Jan																				
13	1.23	1.67	0.91			3.53	0.09	0.19			3.81	3.81				196	350	8.14	0.63	0.8
Feb																				
15	1.03	1.17	0.95		0.18	2.40	0.29	0.30			3.15	3.17				170	290	8.27	0.48	0.9
Mar																				
30	0.82	1.08	1.08		0.18	2.44	0.19	0.20			2.98	3.01				168	290	8.22	0.72	1.1
Apr																				
25	1.79	0.81	0.78		0.18	2.73	0.14	0.40			3.38	3.45				174	310	8.20	0.31	0.7
May																				
14	1.79	1.01	1.22		0.18	3.27	0.19	0.40			4.02	4.04				210	370	8.20	0.65	1.0
25	0.95	1.15	1.37		0.36	2.75	0.24	0.20			3.47	3.55				198	340	8.21	1.01	1.3
Jun																				
17	1.68	0.92	0.50		0.17	2.47	0.14	0.30			3.10	3.08				164	290	8.28	0.04	0.4
29	1.36	0.49	0.60		0.17	1.64	0.25	0.40			2.45	2.46				126	230	8.23	0	0.6
Jul																				
1	1.68	0.32	0.83		0.17	2.24	0.15	0.30			2.83	2.86				142	260	8.25	0.41	0.8
7	1.31	0.94	0.93		0.25	2.51	0.30	0.20			3.18	3.26				162	300	8.27	0.51	0.9
12	1.62	0.18	0.30		0	1.80	0.10	0.20			2.10	2.10				106	200	8.15	0	0.3
20	1.37	0.43	0.30		0.16	1.63	0.10	0.30			2.10	2.19				110	200	7.23	0	0.3
Aug																				
2	1.72	0.25	0.45		0.17	1.62	0.15	0.50			2.42	2.44				140	240	8.13	0	0.5
11	1.52	0.73	0.60		0.25	1.91	0.15	0.55			2.85	2.86				154	270	8.40	0	0.6
19	1.49	0.45	0.35		0.19	1.39	0.14	0.56			2.29	2.28				114	210	8.28	0	0.4
Sep																				
10	1.69	1.31	1.18		0.50	3.14	0.26	0.32			4.18	4.22				212	380	8.22	0.64	1.0
21	1.22	1.40	1.45		0.39	2.17	0.19	1.30			4.07	4.05				236	380	8.40	0	1.3
Oct																				
7	1.37	0.72	0.70		0.19	2.27	0.09	0.25			2.79	2.80				152	260	8.20	0.37	0.7
17	1.71	0.43	0.42		0	2.20	0.14	0.25			2.56	2.59				146	250	8.10	0.06	0.4
Nov																				
1	1.60	0.75	0.60		0	2.45	0.14	0.40			2.95	2.99				164	280	8.00	0.10	0.6
16	1.65	1.09	0.50		0	2.43	0.19	0.64			3.24	3.26				180	300	8.05	0	0.5
Dec																				
12	2.04	0.96	0.80		0.18	3.10	0.24	0.19			3.80	3.71				192	320	8.22	0.28	0.7
25	1.60	0.64	0.80		0	2.70	0.24	0.16			3.04	3.10				162	290	8.00	0.46	0.8

Blank page retained for pagination

Location Latitude 33°33', Longitude 73°06', one quarter mile downstream from mouth of Leh River and Grand Trunk Road bridge and 4 miles southeast of Rawalpindi.

Drainage area 650 square miles.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights only May 1953 to 1958 and discharge record 1958 to June 1962 by Discharge Division of Hydrology Directorate of Irrigation Department.

Average discharge 689 cusecs (499,000 acre-feet per year or 14.4 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 75,800 cusecs on 12 July (gauge height 20.00 feet); minimum daily discharge 64 cusecs on 7 July.

1953-68: Maximum discharge observed 93,700 cusecs on 25 July 1964; minimum daily discharge 15 cusecs on 11-15 May 1953.

Gauge Enamelled gauge plates graduated to 0.02 foot upto 3.33 feet and 0.1 foot beyond; read nine times a day or more often during flood. Zero of gauge datum is at R.L., 1,375.19 (checked in 1969).

Measurements Forty six discharge measurements were made periodically by current meter at 0.2 and 0.8 or 0.6 depth by wading at low flows and from Grand Trunk Road bridge at medium and high flows. Thirty six sets of sediment samples taken by depth integrating method using DH-48 sampler by wading and D-49 sampler from bridge. Twenty one of these were analysed for particle size distribution and the rest for total concentration. Twenty one surface samples were collected and analysed for chemical composition.

Determination of discharge The control at this station is unstable at high flows. Rating curve dated 12.1.1966 was continued. Discharges were computed by applying shifts to gauge heights, as indicated by periodic discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	387	460	423	193	107	84
2	a 331	414	387	170	109	81
3	276	383	348	165	111	77
4	184	352	344	160	115	71
5	170	324	308	150	117	72
6	165	554	300	148	121	73
7	260	437	288	187	248	93
8	184	340	*264	175	163	89
9	158	316	244	150	160	84
10	158	288	230	360	121	78
11	184	268	219	190	113	*133
12	190	256	216	165	105	*102
13	*209	244	212	150	101	105
14	205	*252	209	3,890	*95	133
15	184	244	199	702	92	104
16	173	240	187	316	90	93
17	158	237	170	219	90	86
18	160	226	199	178	93	77
19	148	230	755	163	92	*102
20	3,290	2,070	1,340	158	90	a 98
21	1,550	1,880	1,420	143	98	a 95
22	*644	705	604	135	105	a 91
23	475	510	423	*140	143	a 88
24	428	405	369	140	119	84
25	419	365	344	*138	*102	83
26	405	352	336	125	117	608
27	405	1,370	344	123	105	300
28	515	1,350	320	119	98	*148
29	837	505	*304	111	96	109
30	776	—	252	109	93	99
31	661	—	219	—	90	—
Mean	461	537	380	309	113	118
Cs/mi	0.71	0.83	0.58	0.48	0.17	0.18
In	0.82	0.89	0.67	0.53	0.20	0.20
Ac-ft.	28,300	30,900	23,400	18,400	6,940	7,020

1968 year: Mean 704 Cs/sq mi 1.08 Inches 14.7

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	92	1,400	356	135	266	109
2	78	*10,800	336	130	511	109
3	73	*1,990	320	133	308	111
4	69	*729	300	140	219	111
5	70	405	284	133	181	107
6	70	3,260	268	138	165	115
7	*64	1,550	256	749	158	113
8	65	*7,850	240	758	153	113
9	3,160	*9,270	226	340	145	117
10	428	4,370	216	*247	143	*117
11	*374	9,720	209	155	168	*360
12	*20,500	3,440	199	145	158	373
13	1,010	1,860	187	138	153	316
14	4,030	3,650	*190	408	143	205
15	401	*14,400	196	308	*140	163
16	240	3,400	216	196	*135	148
17	212	1,200	365	160	130	138
18	320	6,850	264	153	130	138
19	292	12,100	230	145	130	133
20	490	2,070	199	143	125	130
21	1,510	3,410	187	143	123	a131
22	1,970	9,870	178	143	*125	a132
23	*678	1,130	170	140	123	133
24	*465	483	165	138	119	128
25	240	655	160	132	115	133
26	160	677	155	128	115	316
27	128	495	150	125	115	276
28	111	595	148	125	113	196
29	*18,300	480	143	123	109	168
30	*1,690	392	*138	*123	109	150
31	606	419	---	119	---	140
Mean	1,870	3,840	222	203	161	165
Cs/mi	2.88	5.91	0.34	0.31	0.25	0.25
In	3.31	6.80	0.38	0.36	0.28	0.29
Ac-ft.	115,000	236,000	13,200	12,500	9,570	10,200

Acre-feet. 511,000 Max Day 20,500 Min Day 64

SOAN RIVER NEAR RAWALPINDI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	240	56	85			
22 Jan	661	49	66			
14 Feb	252	48	58			
29 Mar	296	61	26			
2 Apr	178	66	124			
23 Apr	143	86	83			
25 Apr	140	85	70			
14 May	95	62	16			
15 May	102	78	35			
12 Jun	102	85	31			
19 Jun	105	92	20			
28 Jun	133	89	198			
7 Jul	67	90	53			
11 Jul	344	85	208			
12 Jul	6,600	80	7,470	14	55	31
23 Jul	535	80	1,630	2	87	11
29 Jul	22,700		9,330	5	82	13
30 Jul	1,520	84	2,480	1	83	16
30 Jul	3,680	84	11,100	2	92	6
30 Jul	2,690	82	3,310	2	68	30
2 Aug	18,100	78	9,570	1	92	7
2 Aug	9,810	82	10,400	1	72	27
3 Aug	6,040	76	4,370	18	72	10
3 Aug	4,920	82	727	1	22	77
4 Aug	545	84	3,490	1	89	10
8 Aug	16,300	78	10,700	9	80	11
8 Aug	15,900	78	8,930	5	67	28
9 Aug	13,900	80	6,420	3	64	33
15 Aug	11,000	78	5,230	3	67	30
14 Sep	202	92	69			
30 Sep	138	86	25			
15 Nov	145	56	48			
22 Nov	123	62	53			
10 Dec	117	58	32			
11 Dec	728	58	107			
17 Dec	140	56	93			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SOAN RIVER NEAR RAWALPINDI

Chemical Analysis of Water Samples - 1965

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3 me/l	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.				
Jan																				
13	2.06	1.64	1.29			3.99	0.29	0.70			4.98	4.98				248	460	7.99	0.29	0.9
22	0.93	0.87	0.42			1.95	0.04	0.20			2.22	2.19				108	200	7.80	0.15	0.4
Feb																				
14	1.96	1.64	1.02		0.27	3.54	0.39	0.40			4.62	4.60				258	440	8.30	0.21	0.8
Mar																				
29	0.93	1.07	0.88		0.34	1.97	0.29	0.30			2.88	2.92				150	270	8.28	0.33	1.0
Apr																				
2	1.95	1.35	1.21		0.36	3.47	0.34	0.30			4.51	4.97				264	430	8.30	0.53	0.9
23	2.10	1.20	1.12		0.17	3.44	0.39	0.40			4.42	4.40				240	430	8.20	0.31	0.9
May																				
14	2.42	1.38	1.58		0.72	2.83	0.54	1.30			5.38	5.39				284	500	8.40	0	1.2
25	2.42	1.38	1.52		0.63	3.02	0.59	1.10			5.32	5.34				284	500	8.45	0	1.1
Jun																				
12	2.21	1.69	1.55		0.44	3.38	0.74	0.80			5.45	5.36				304	530	8.32	0	1.2
19	2.42	1.58	1.90		0.61	3.30	0.84	1.20			5.90	5.95				344	590	8.38	0	1.3
28	2.10	0.95	1.30		0.50	2.49	0.49	0.80			4.35	4.28				232	420	8.32	0	1.0
Jul																				
5	2.67	1.48	1.64		0.68	3.18	0.94	1.00			5.79	5.80				316	570	8.45	0	1.1
11	1.39	0.81	2.05		0.16	2.58	0.79	1.30			4.85	4.83				270	470	8.20	0	1.7
12	1.47	0.43	0.40		Trace	1.39	0.19	0.25			2.30	2.33				130	230	8.18	0	0.4
29	1.47	0.33	0.30		0	1.72	0.14	0.30			2.10	2.10				114	210	7.89	0	0.3
Aug																				
8	1.26	0.54	0.55		0	1.72	0.24	0.40			2.35	2.36				120	220	7.80	0	0.6
Sep																				
14	1.93	1.16	1.18		0.59	1.58	0.39	1.75			4.27	4.31				240	420	8.37	0	1.0
30	2.22	1.41	1.45		0.39	3.87	0.49	0.29			5.08	5.04				278	480	8.50	0.63	1.1
Oct																				
10	2.22	1.09	1.45		0.29	3.42	0.39	0.60			4.76	4.70				270	450	8.40	0.40	1.1
Nov																				
15	2.58	1.26	1.43		0	3.90	0.49	1.00			5.27	5.39				311	520	7.95	0.06	1.0
Dec																				
10	2.90	1.54	1.05		0.54	3.78	0.69	0.54			5.49	5.55				286	500	8.55	0	0.7

Blank page retained for pagination

Location Latitude 33°27', Longitude 72°52', on left bank about 2 miles upstream from Chahan village, about 17 miles south-west of Rawalpindi on Pindi-Chakri Road.

Drainage area 93 square miles.

Records available Discharge and gauge height record May 1962 to date by Surface Water Hydrology Project WAPDA.

Average discharge 48 cusecs (34,600 acre-feet per year or 7.00 inches runoff per year). Average taken for 6 years from 1963 to 1968.

Extremes Maximum discharge observed during the year 9,760 cusecs on 12 July (gauge height 12.75 feet); minimum daily discharge 1.6 cusecs on 10 June.

May 1962-December 1968: Maximum discharge observed 20,000 cusecs on 24 August 1965; minimum daily discharge 0.6 cusecs on 9, 24 and 26 June 1967.

Gauge height Continuous automatic water stage recorder in masonry stilling well installed on 26 January 1964. Prior to this staff gauge(enamelled plates)graduated to .01 foot. Zero R.L. of inside staff gauge 1288.13 (checked in 1969).

Measurements One hundred and twenty six discharge measurements were made during the year by current meter at 0.6 or 0.2 and 0.8 depth method. Low water measurements were made by wading and high water measurements from cableway. One hundred and fifteen sets of sediment samples were taken by depth integration method using DH-48 sampler while wading and by D-49 sampler while making observations from cableway during high flows. Thirty of these were analysed for particle size distribution and the rest for total concentration. Nineteen surface samples were collected and analysed for chemical composition.

Determination of discharge The channel is composed of small shingle and sand which shifts nearly continuously; Gauge heights with shift adjustments based on periodic discharge measurements were applied to rating table dated 17.12.1969 to compute mean daily discharges.

Remarks Record good.

SIL RIVER NEAR CHAHAN

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	*11	11	*10	8.2	*4.3	*3.0
2	11	*11	9.6	*7.5	4.6	3.7
3	10	9.6	9.3	7.8	3.4	4.3
4	*12	9.3	8.6	*7.5	*4.6	16
5	12	8.6	* 9.3	7.1	5.2	*10
6	10	*8.9	8.6	8.6	3.7	6.4
7	*10	9.3	8.2	7.1	*4.3	5.2
8	10	*8.9	*8.2	*6.4	4.9	*2.5
9	10	8.6	7.5	6.8	5.2	2.5
10	9.6	7.8	7.1	7.8	*5.2	1.6
11	*10	7.8	7.8	*7.1	4.6	*2.3
12	*9.3	*8.2	8.2	7.5	4.9	3.0
13	9.6	7.1	*8.2	5.5	3.7	*5.5
14	9.6	*6.8	7.8	8.2	*3.7	6.1
15	9.3	7.8	7.8	*8.2	*4.9	4.6
16	8.2	7.8	8.2	8.2	2.7	2.5
17	*10	*7.5	8.2	7.1	3.7	*2.1
18	8.2	7.	*114	*7.1	*5.2	4.0
19	9.3	*47	*374	6.8	3.2	*9.3
20	*74	*374	228	7.1	3.4	7.5
21	32	78	*236	7.1	*4.9	5.8
22	13	19	24	*6.4	4.9	*4.3
23	* 9.6	14	14	6.8	3.2	4.3
24	9.3	10	11	5.8	*3.4	3.2
25	9.3	10	10	*4.3	*3.7	*3.4
26	8.9	9.6	*9.6	4.3	4.3	2.7
27	10	120	8.9	4.9	4.6	*71
28	12	25	9.3	*4.9	*4.6	*7.8
29	*13	13	*8.6	3.4	2.7	*2.1
30	16	—	8.9	4.3	3.0	2.7
31	12	—	8.2	—	2.5	—
Mean	13	27	39	6.7	4.1	7.0
Cs/mi	0.14	0.29	0.42	0.07	0.04	0.08
In	0.16	0.31	0.48	0.08	0.05	0.08
Ac-ft.	810	1,530	2,390	396	252	415

1968 year: Mean 54 Cs/sq mi 0.58 Inches 7.81

Note : * Discharge measurement made on this day.

SIL RIVER NEAR CHAHAN

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*2.5	*32	13	8.9	*38	7.5
2	2.1	615	*12	8.9	*28	6.4
3	2.5	*1,180	12	*8.9	15	7.1
4	*2.1	43	11	8.9	11	7.1
5	2.5	17	*11	8.6	10	7.8
6	*2.3	*675	10	25	8.6	6.4
7	1.9	87	10	*32	*8.6	7.8
8	2.1	*1,350	*10	15	8.9	8.2
9	*2.1	*1,080	9.6	*11	8.6	7.8
10	2.1	*354	9.6	19	8.6	7.5
11	*66	552	*9.3	13	*10	412
12	*1,240	*149	9.3	*11	11	127
13	58	28	8.9	10	10	17
14	*140	18	9.6	*10	* 9.6	11
15	19	*1,400	9.3	10	9.3	*9.6
16	*22	*58	9.3	8.2	8.2	8.2
17	*469	*28	10	*8.2	8.6	8.2
18	34	22	11	8.6	8.6	7.1
19	*15	*1,630	12	8.9	8.2	7.5
20	12	59	10	*8.6	7.5	6.4
21	*567	*177	11	8.6	7.8	7.5
22	*1,370	*517	9.6	8.6	*7.1	6.8
23	*255	*52	*9.6	*8.6	7.1	7.1
24	*31	25	8.9	8.2	7.5	7.5
25	16	18	8.2	8.6	7.5	8.2
26	*12	*15	*9.3	*8.2	7.1	7.5
27	10	13	9.6	7.8	7.1	7.8
28	8.6	*231	8.6	8.6	6.8	8.2
29	7.5	28	9.3	7.5	7.1	7.5
30	*56	16	*10	8.2	7.1	7.5
31	31	15	———	*8.2	———	7.5
Mean	144	338	10	11	10	25
Cs/mi	1.55	3.63	0.11	0.12	0.11	0.27
In	1.78	4.19	0.12	0.13	0.12	0.31
Ac-ft.	8,850	20,800	597	662	612	1,530

Acre-feet. 38,800 Max Day 1,630 Min Day 1.6

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Jan	12	51	176			
4 Jan	12	56	177			
7 Jan	11	57	247			
11 Jan	11	57	144			
12 Jan	10	55	190			
17 Jan	11	54	21			
20 Jan	89	50	1,790	11	50	39
23 Jan	9.3	54	181			
29 Jan	13	51	22			
2 Feb	12	50	23			
6 Feb	9.6	51	17			
8 Feb	9.3	51	24			
12 Feb	7.5	54	17			
14 Feb	4.9	56	20			
17 Feb	7.1	57	18			
19 Feb	36	54	35			
20 Feb	315	52	813	4	36	60
1 Mar	10	61	83			
5 Mar	8.9	61	72			
8 Mar	7.8	63	123			
13 Mar	9.3		104			
18 Mar	12		145			
19 Mar	226	63	1,350	3	24	73
21 Mar	95	66	2,880	4	41	55
26 Mar	10	69	106			
29 Mar	9.3	69	61			
2 Apr	8.2	70	56			
4 Apr	8.9	78	51			
8 Apr	8.2	77	74			
11 Apr	7.5	72	47			
15 Apr	7.5	71	48			
18 Apr	8.6	81	73			
22 Apr	6.8	80	60			
25 Apr	3.4	78	87			
28 Apr	3.4	83	55			
1 May	3.7	81	60			
4 May	3.4	77	53			
7 May	4.0	74	18			
10 May	5.2	74	111			
14 May	3.7	80	14			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 May	6.8	76	86			
18 May	4.9	77	39			
21 May	5.2	75	55			
24 May	2.7	81	37			
25 May	4.0	71	141			
28 May	4.0	80	39			
1 Jun	1.6	85	31			
5 Jun	10	86	57			
8 Jun	2.5	82	16			
11 Jun	2.3	83	22			
13 Jun	7.8	83	27			
17 Jun	1.2	94	22			
19 Jun	3.6	83	201			
22 Jun	3.0	83	103			
25 Jun	4.0	84	37			
27 Jun	330	74	15,800	4	92	4
28 Jun	7.1	78	728	8	28	64
29 Jun	2.3	92	119			
1 Jul	1.2	97	83			
4 Jul	1.1	93	101			
6 Jul	1.9	94	116			
9 Jul	2.1	82	33			
11 Jul	406	85	7,670	7	55	38
11 Jul	17	86	1,890	3	47	50
12 Jul	6,630	75	21,400	23	69	8
12 Jul	1,930	78	13,200	4	92	4
14 Jul	99	84	2,100	7	47	46
16 Jul	20	85	301			
17 Jul	1,580	79	9,470	2	89	9
17 Jul	2,290	77	12,600	7	89	4
19 Jul	15	85	201			
21 Jul	1,110	74	20,200	4	91	5
22 Jul	3,500	73	19,000	20	76	4
22 Jul	1,700	74	12,900	4	91	5
23 Jul	207	77	2,020	3	49	48
24 Jul	33	80	1,920	1	56	43
26 Jul	13	85	238			
29 Jul	6.1	82	203			
30 Jul	172	83	1,580	20	40	40
1 Aug	14	81	123			

SIL RIVER NEAR CHAHAN

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
2 Aug	1,440	80	3,180	2	83	15
3 Aug	750	78	5,580	20	71	9
6 Aug	12	90	509	3	25	72
6 Aug	2,360	79	7,660	3	89	8
8 Aug	4,220	78	14,400	1	89	10
9 Aug	2,700	78	4,700	22	70	8
21 Aug	588	77	5,990	3	79	18
22 Aug	1,220	78	3,170	6	68	26
23 Aug	38	84	6,480	16	73	11
26 Aug	14	85	71			
28 Aug	670	79	5,580	44	47	9
2 Sep	12	83	68			
5 Sep	12	84	76			
8 Sep	10	88	62			
11 Sep	9.6	85	80			
23 Sep	10	87	43			
26 Sep	10	80	36			
30 Sep	10	85	24			
3 Oct	9.6	83	50			
7 Oct	32	81	181			
9 Oct	10	79	30			
12 Oct	12	77	314			
14 Oct	11	73	58			
17 Oct	7.8	75	57			
20 Oct	8.6	73	49			
23 Oct	7.8	70	51			
26 Oct	7.5	74	27			
31 Oct	8.2	65	30			
1 Nov	58	64	675	4	42	54
2 Nov	27	62	185			
7 Nov	8.9	63	40			
11 Nov	10	63	49			
14 Nov	10	59	50			
22 Nov	4.9	59	31			
15 Dec	9.3	56	149			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SIL RIVER NEAR CHANAN

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION				$EC \times 10^6$ at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
12	1.75	0.86	1.51		0	3.06	0.59	0.12			4.12	3.77				222	390	8.04	0.45	1.3
Feb																				
19	1.24	0.75	2.10		0.27	2.84	0.78	0.23			4.09	4.12				216	400	8.29	1.12	2.1
Mar																				
13	0.93	1.07	1.82		0.36	2.06	0.78	0.60			3.82	3.80				210	370	8.25	0.42	1.8
29	1.13	1.07	1.29		0.18	2.54	0.58	0.20			3.49	3.50				190	330	8.20	0.50	1.2
Apr																				
15	0.84	1.26	2.32		0.18	2.59	0.74	0.90			4.42	4.41				240	430	8.21	0.67	2.3
May																				
10	1.05	0.85	2.96		0.54	2.46	1.04	0.80			4.86	4.84				264	460	8.48	1.10	3.0
Jun																				
5	1.05	1.15	2.30		0.44	3.07	1.03	0.20			4.50	4.74				252	450	8.32	1.31	2.2
17	0.84	1.26	2.90		0.35	3.08	1.13	0.40			5.00	4.96				294	500	8.30	1.33	2.8
27	0.95	0.55	2.00		0.17	2.50	0.45	0.40			3.50	3.52				186	350	8.23	1.17	2.3
29	1.20	0.60	2.42		0.34	2.27	0.94	0.50			4.22	4.05				222	400	8.47	0.81	2.5
Jul																				
6	1.10	1.05	2.96		0.51	3.09	1.19	0.40			5.11	5.19				256	500	8.48	1.35	2.9
12	1.47	0.53	0.60		0	2.10	0.30	0.30			2.60	2.70				142	260	7.99	0.10	0.6
Aug																				
2	1.36	0.49	0.70		0.17	1.44	0.20	0.65			2.46	2.46				140	240	8.30	0	0.7
22	1.11	0.47	0.78		0	1.57	0.25	0.39			2.36	2.21				116	210	8.10	0	0.9
Sep																				
8	0.85	1.13	1.74		0.32	2.06	0.84	0.65			3.72	3.87				190	350	8.31	0.40	1.7
23	1.55	0.91	2.15		0.20	2.85	1.13	0.44			4.61	4.62				278	450	8.20	0.59	2.0
Oct																				
23	1.22	1.24	2.38		0.30	2.85	0.14	1.60			4.84	4.89				296	480	8.30	0.69	2.1
Nov																				
11	1.33	1.13	2.10		0.30	3.20	0.14	1.00			4.56	4.64				278	450	8.30	1.04	1.9
Dec																				
15	1.56	0.70	1.35		0.09	2.52	0.69	0.50			3.70	3.80				198	320	8.15	0.26	1.3

Blank page retained for pagination

Location Latitude 33°08', Longitude 72°20', wire-weight gauge fixed on the bridge near Dhok Pathan village on Fateh-Jhang Talagang Road.

Drainage area 2,500 square miles.

Records available December 1963 to date by Surface Water Hydrology Project WAPDA.

Average discharge 1,620 cusecs (1,180,000 acre-feet per year or 8.82 inches runoff per year). Average taken for 5 years from 1964 to 1968.

Extremes Maximum discharge observed during the year 121,000 cusecs on 15 August (gauge height 14.50 feet); minimum daily discharge 45 cusecs on 9 June.

1964-68: Maximum discharge observed 209,000 cusecs on 30 July 1967; minimum daily discharge 4.5 cusecs on 12 June 1964.

Gauge Wire weight gauge fastened to upstream hand rail of the bridge. Gauge read to .01 foot five times daily or more often during flood.

Measurements Eighty six discharge measurements made during the year by current meter using 0.2 and 0.8 or 0.6 depth method by wading or from bridge. Seventy five sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from bridge. Forty six of these were analysed for particle size distribution and the rest for total concentration. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a sandy bed which shifts continuously. Rating dated 26.1.1966 was used to compute daily discharges from mean daily gauge heights with shift adjustments as indicated necessary by discharge measurements.

Remarks Record fair.

SOAN RIVER AT DHOK PATHAN

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	a 1,800	1,060	2,520	430	162	71
2	a 1,400	1,130	2,490	324	168	71
3	a 1,000	*536	1,970	*260	151	74
4	784	1,050	1,870	254	136	151
5	512	940	1,770	221	131	109
6	380	812	1,620	208	118	74
7	400	*784	1,600	190	809	50
8	410	812	1,530	195	276	50
9	464	672	1,440	184	118	45
10	512	*574	1,310	184	*95	50
11	500	672	2,020	190	100	50
12	452	672	4,780	420	78	67
13	*360	*616	2,270	276	122	71
14	300	560	1,570	292	104	60
15	276	476	1,260	268	109	*74
16	292	644	2,270	1,020	92	*78
17	324	*644	1,530	826	87	71
18	247	700	1,460	464	74	45
19	221	742	*3,970	390	64	131
20	6,990	1,350	*5,020	*292	292	85
21	6,500	*4,510	4,200	254	350	53
22	2,270	*3,950	2,660	254	268	64
23	714	*3,150	1,770	254	127	64
24	400	2,990	1,260	241	118	64
25	184	2,810	872	221	113	208
26	268	2,320	742	215	136	122
27	276	3,060	742	215	131	140
28	350	3,190	616	202	113	1,110
29	488	3,360	a 558	179	95	*872
30	1,620	———	500	173	88	488
31	*1,270	———	574	——	*81	——
Mean	1,030	1,540	1,900	303	158	155
Cs/mi	0.41	0.62	0.76	0.12	0.06	0.06
In	0.48	0.67	0.87	0.14	0.07	0.07
Ac-ft.	63,400	88,800	117,000	18,000	9,730	9,250

1968 year: Mean 1,780 Cs/sq mi 0.71 Inches 9.69

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

SOAN RIVER AT DHOK PATHAN

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*234	*3,220	784	234	*173	195
2	173	4,880	770	*208	190	190
3	*179	*26,800	728	202	*650	*179
4	113	8,210	630	208	658	190
5	*81	*2,490	524	221	292	190
6	85	*6,900	488	276	350	195
7	67	6,050	452	292	*350	*184
8	*58	*6,370	464	247	340	208
9	48	*24,100	440	*888	340	228
10	*2,280	*14,600	*440	524	300	254
11	*1,800	*24,700	430	500	292	*308
12	6,520	*27,200	370	420	*268	476
13	*18,500	5,490	350	*360	260	*1,330
14	*5,060	4,420	*316	*714	247	728
15	*4,060	*44,300	300	390	254	548
16	*7,120	*15,300	260	308	234	688
17	2,550	2,900	268	247	221	400
18	*3,080	1,800	*616	*430	221	360
19	2,300	*20,000	*440	380	*221	316
20	1,600	*9,800	380	340	215	284
21	*9,520	*6,600	380	292	202	284
22	*9,360	*9,850	390	*254	195	a 370
23	*24,600	12,000	*430	234	190	452
24	10,700	3,000	400	247	179	420
25	* 6,090	*6,340	400	247	*168	370
26	3,880	1,260	350	*254	168	340
27	*2,290	1,030	324	254	168	300
28	2,020	*856	*324	254	168	276
29	2,130	1,260	300	260	*173	254
30	*16,100	1,030	260	254	184	*228
31	8,500	936	---	254	---	215
Mean	4,870	9,800	434	329	262	354
Cs/mi	1.95	3.92	0.17	0.13	0.10	0.14
In	2.25	4.52	0.19	0.15	0.12	0.16
Ac-ft.	300,000	602,000	25,800	20,200	15,600	21,700

Acre-feet. 1,290,000 Max Day 44,300 Min Day 45

SOAN RIVER AT DHOK PATHAN

Suspended sediment concentration – 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	350	58	55			
31 Jan	1,270	52	157			
3 Feb	500	50	31			
7 Feb	784	53	49			
10 Feb	574	56	25			
13 Feb	602	52	39			
23 Feb	3,120	59	2,090	5	45	50
18 Mar	5,680	64	13,300	6	48	46
26 Mar	3,740	66	8,920	1	47	52
3 Apr	260	67	214			
20 Apr	276	89	227			
10 May	95	80	126			
31 May	71	98	141			
29 Jun	798	80	6,000	3	69	28
1 Jul	260	90	1,060	4	44	52
3 Jul	202	90	265			
5 Jul	88	90	251			
8 Jul	64	88	246			
10 Jul	3,500	82	9,970	19	73	8
11 Jul	1,850	86	6,390	1	80	19
13 Jul	9,450	84	20,200	6	85	9
14 Jul	4,620	80	19,200	5	91	4
15 Jul	6,040	78	9,380	7	85	8
16 Jul	13,800	84	28,900	4	92	4
18 Jul	4,700	83	10,900	19	73	8
21 Jul	16,200	82	26,200	4	92	4
22 Jul	42,000	82	32,000	5	91	4
25 Jul	5,460	74	5,950	1	72	27
27 Jul	7,670	78	10,600	2	96	2
27 Jul	2,320	84	6,130	5	66	29
30 Jul	12,500	83	15,300	5	87	8
30 Jul	33,500	80	28,400	6	91	3
1 Aug	2,870	83	5,800	2	79	19
3 Aug	22,700	80	14,600	8	85	7
3 Aug	38,100	84	17,800	9	84	7
5 Aug	2,180	85	2,960	7	60	33
6 Aug	10,500	80	16,300	4	82	14
9 Aug	44,900	84	21,300	6	88	6
10 Aug	45,200	74	16,400	8	83	9
11 Aug	22,300	87	19,800	6	89	5

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	clay
11 Aug	26,100	83	22,400	7	88	5
12 Aug	31,200	80	16,000	8	74	18
15 Aug	10,600	85	16,800	23	71	6
16 Aug	16,000	85	14,800	5	89	6
19 Aug	10,100	84	8,170	3	95	2
19 Aug	44,900	84	22,100	6	88	6
20 Aug	7,180	85	15,400	5	90	5
21 Aug	14,500	89	19,100	5	90	5
22 Aug	43,000	90	23,000	6	88	6
25 Aug	9,820	85	12,100	24	71	5
28 Aug	856	84	1,020	6	53	41
10 Sep	430	90	406			
14 Sep	316	88	344			
8 Sep	476	83	1,450	8	51	41
9 Sep	536	80	6,950	2	90	8
13 Sep	420	93	325			
18 Sep	300	89	285			
2 Oct	221	81	219			
3 Oct	380	75	234			
4 Oct	1,000	74	26,600	2	58	40
8 Oct	452	84	38,900	41	57	2
2 Oct	260	72	176			
1 Nov	208	64	255			
3 Nov	440	65	1,190	10	55	35
3 Nov	1,260	69	4,100	11	73	16
7 Nov	350	72	463	2	24	74
2 Nov	268	69	174			
8 Nov	215	66	265			
5 Nov	168	63	67			
9 Nov	173	63	32			
3 Dec	173	60	109			
7 Dec	184	60	88			
1 Dec	208	57	146			
3 Dec	1,330	58	2,660	4	55	41
0 Dec	228	57	156			

Note : Sand is all sizes abo ve 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

SOAN RIVER AT DHOK PATHAN

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	TOTAL Cations	TOTAL Anions	PARTS PER MILLION SiO_2	Fe	B	D.S. by Evap.	EC x 10^6 at 25°C.	pH	Res CO_3 me/l	SAR
Jan																				
13	2.06	1.04	2.33			3.72	0.89	0.80			5.43	5.41				286	510	8.13	0.62	1.5
31	1.27	1.23	2.95		0.46	3.11	1.27	0.60			5.45	5.44				312	500	8.49	1.07	2.6
Feb																				
23	1.13	1.27	2.19		0.37	2.61	0.79	0.70			4.59	4.47				234	420	8.45	0.59	2.0
Mar																				
20	1.47	0.83	3.10		0.27	2.87	0.89	1.50			5.40	5.53				304	520	8.26	0.84	2.9
Apr																				
20	1.26	0.74	1.37		Traces	2.40	0.39	0.60			3.37	3.39				190	330	8.12	0.40	1.4
May																				
10	1.37	1.08	2.06		0.18	2.87	0.64	0.90			4.51	4.59				260	450	8.20	0.60	1.9
31	1.47	0.93	2.56		0.36	2.70	0.99	1.00			4.96	5.05				288	480	8.27	0.66	2.4
Jun																				
29	1.05	0.65	3.06		0.26	2.27	0.99	1.30			4.76	4.82				266	470	8.28	0.83	2.2
Jul																				
10	1.47	0.73	2.25		0	3.05	0.69	0.80			4.45	4.54				246	440	7.90	0.85	2.1
16	1.16	0.34	2.76		0	2.62	0.99	0.70			4.26	4.31				230	410	7.97	1.12	3.1
22	0.69	0.60	2.32		0.25	2.00	0.49	1.01			3.61	3.75				230	350	8.37	0.96	2.9
30	1.27	0.87	0.93		0.25	1.92	0.35	0.62			3.07	3.14				168	290	8.25	0.03	0.9
Aug																				
3	1.10	1.10	1.18		0.17	1.74	0.39	1.00			3.38	3.30				180	300	8.32	0	1.1
6	0.89	0.66	1.74		0.17	1.74	0.54	0.80			3.29	3.25				180	310	8.30	0.36	2.0
11	1.26	0.47	1.18		0.39	1.68	0.29	0.60			2.91	2.96				170	290	8.32	0.34	1.3
15	1.36	0.69	1.30		0.17	1.96	0.49	0.70			3.35	3.32				180	310	8.21	0.08	1.3
19	1.26	0.74	1.30		0.25	1.62	0.59	0.90			3.30	3.36				180	310	8.37	0	1.3
25	0.89	0.38	3.37		0.25	2.43	0.69	1.17			4.64	4.54				256	440	8.34	1.51	4.2
Sep																				
10	1.15	0.77	1.51		0	2.40	0.59	0.35			3.43	3.34				214	340	8.15	0.48	1.5
18	1.33	0.99	1.88		0.20	2.25	0.84	0.55			3.80	3.84				222	380	8.20	0.53	1.9
Oct																				
2	1.35	0.64	1.74		0.20	2.55	0.74	0.50			3.93	3.99				226	390	8.30	0.56	1.7
Nov																				
1	1.49	1.07	1.70		0	2.80	0.74	0.75			4.26	4.29				248	420	8.10	0.24	1.5
29	1.65	0.92	2.15		0.27	3.01	0.84	0.56			4.72	4.68				254	440	8.35	0.71	1.9
Dec																				
11	1.65	0.92	2.10		0.27	2.97	0.84	0.55			4.67	4.63				258	430	8.25	0.57	1.9

Location Latitude 33°21', Longitude 70°31', wire-weight gauge fixed on the bridge just near Thal village on Thal-Miran Shah Road, nearly 61 miles from Kohat.

Drainage area 2,140 square miles.

Records available July 1967 to date by Surface Water Hydrology Project WAPDA; previous records with Director Hydrology Irrigation and Power Department.

Extremes Maximum discharge observed during the year 6,370 cusecs on 1 May (gauge height 11.87 feet); minimum daily discharge 398 cusecs on 7 September.

Gauge Wire-weight gauge fastened to upstream handrail of bridge; read from 08:00 to 16:00 hours at one hour interval. Gauge set to arbitrary datum.

Measurements Eighty three discharge measurements were made by current meter using .6 or .2 and .8 depth method by wading in low flows and from the bridge in high flows. Seventy three sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from the bridge. Twenty four of these were analysed for particle size distribution and the rest for total concentration. Twenty one surface samples were collected and analysed for chemical composition.

Determination of discharge The river flows in two or three channels under the bridge during high flows. The gauge is fixed in the main channel. The river bed consists of stones and shingles, liable to excessive scouring or deposition. Rating tables dated 4.3.1969 and 5.3.1969 were developed and used with shift adjustments based on discharge measurements from 1 January to 17 March and from 18 March to 31 December respectively.

Remarks Record fair.

KURRAM RIVER AT THAL

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	820	716	682	940	3,980	2,710
2	a 810	700	670	892	2,950	2,710
3	a 800	716	658	800	2,980	3,050
4	790	694	652	700	2,780	2,980
5	764	682	*724	694	2,780	4,050
6	764	670	708	1,830	2,530	2,620
7	764	658	688	1,280	2,200	2,330
8	780	694	646	1,020	2,090	2,130
9	764	740	670	1,830	1,740	1,970
10	716	694	a 675	1,400	1,550	1,830
11	756	688	a 680	1,110	1,410	1,760
12	*728	652	688	1,060	1,340	2,930
13	810	694	652	1,110	1,280	3,200
14	756	682	640	*2,570	1,260	2,690
15	772	676	607	2,350	*1,380	*2,180
16	780	658	624	1,950	1,360	2,070
17	748	658	682	1,760	1,330	1,890
18	780	646	658	1,610	2,530	1,950
19	740	640	658	1,480	2,620	1,680
20	1,330	646	688	1,770	2,600	1,680
21	904	716	646	1,830	3,250	1,500
22	820	*670	569	2,030	2,710	1,480
23	860	670	577	2,240	2,370	1,330
24	860	652	591	2,090	2,130	1,450
25	748	640	756	2,570	3,080	1,520
26	850	870	1,060	2,660	3,400	1,930
27	810	870	988	2,480	2,180	2,050
28	*928	780	820	*2,570	1,950	1,890
29	800	716	952	2,500	4,180	1,570
30	830	———	1,010	3,260	3,200	1,450
31	700	———	*1,030	———	3,200	———
Mean	809	696	721	1,750	2,400	2,150
Cs/mi	0.38	0.33	0.34	0.82	1.12	1.00
In	0.44	0.35	0.39	0.91	1.29	1.12
Acf	49,800	40,000	44,300	104,000	147,000	128,000

1968 year: Mean 1,120 Cs/sq mi 0.52 Inches 7.10

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KURRAM RIVER AT THAL

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	1,360	748	*694	646	716	682
2	1,260	*1,410	*545	658	682	682
3	1,170	*740	*535	664	676	682
4	1,050	*569	*507	682	*676	682
5	1,530	*1,610	*440	708	640	682
6	1,530	*1,930	414	688	635	682
7	1,280	*1,850	*398	1,150	635	740
8	1,230	*1,380	*976	916	635	740
9	1,290	*1,830	*640	850	624	732
10	2,450	*1,410	*565	1,080	618	800
11	1,410	*3,030	*455	860	613	850
12	*1,500	*1,660	*443	*780	700	772
13	*1,510	*1,460	*448	964	694	*748
14	*1,570	*800	*448	904	676	748
15	*1,000	*772	*440	732	670	748
16	* 988	*756	*438	756	670	740
17	* 870	*658	460	748	670	740
18	*1,050	*607	*670	756	670	732
19	*1,170	*565	618	772	670	732
20	*1,520	*561	*557	*764	670	732
21	940	*732	*521	716	670	724
22	*800	*1,310	510	810	664	716
23	*748	*670	*514	694	670	716
24	*664	*541	504	670	670	716
25	*607	*748	*517	658	682	708
26	*596	*670	545	646	682	708
27	*569	*688	*602	640	682	700
28	573	*521	596	635	682	700
29	565	*724	*629	880	682	700
30	573	*800	*591	870	*682	724
31	613	*840	---	756	---	700
Mean	1,100	1,050	541	776	667	724
Cs/mi	0.51	0.49	0.25	0.36	0.31	0.34
In	0.59	0.57	0.28	0.42	0.35	0.39
Acf	67,400	64,600	32,200	47,700	39,700	44,500

Acre-feet 809,000 Max Day 4,180 Min Day 398

KURRAM RIVER AT THAL

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Jan	732		22			
28 Jan	860		25			
22 Feb	670	49	28			
5 Mar	724	60	62			
31 Mar	1,050	64	202			
14 Apr	2,980	57	1,900	16	47	37
28 Apr	2,460	75	1,670	12	65	23
15 May	1,380	74	991	?	71	27
15 Jun	2,220	82	726	22	59	19
12 Jul	1,590	68	8,270	18	66	16
13 Jul	1,680	71	1,100	5	59	36
14 Jul	1,550	76	3,570	10	46	44
15 Jul	1,020	76	169			
16 Jul	1,020	77	519	7	56	37
17 Jul	870	77	415	5	64	31
18 Jul	1,090	76	7,240	1	44	55
19 Jul	928	79	190			
20 Jul	1,640	78	2,970	1	44	55
22 Jul	756	84	144			
23 Jul	764	75	123			
24 Jul	670	75	81			
25 Jul	607	77	67			
26 Jul	601	78	48			
27 Jul	573	80	36			
2 Aug	1,470	79	6,490	1	44	55
3 Aug	740		112			
4 Aug	569	80	109			
5 Aug	1,590	78	1,800	1	41	58
6 Aug	1,950	81	3,160	1	35	64
7 Aug	1,970	79	1,980	1	42	57
8 Aug	1,460	81	111			
9 Aug	1,950		2,000	7	37	56
10 Aug	1,400	80	1,020	2	63	35
11 Aug	2,900	78	3,360	1	40	59
12 Aug	1,740	80	102			
13 Aug	1,660	81	2,410	1	39	60
14 Aug	810	81	172			
15 Aug	772	78	166			
16 Aug	748	81	115			
18 Aug	613	80	149			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
19 Aug	569	80	94			
20 Aug	561	71	105			
21 Aug	764	80	1,610	1	54	45
22 Aug	1,400	72	3,480	0	10	90
23 Aug	607	71	86			
24 Aug	1,050		150			
25 Aug	740	81	1,070	17	23	60
26 Aug	670	79	125			
27 Aug	688	74	121			
28 Aug	514	72	236			
29 Aug	740	71	201			
30 Aug	830	71	1,740	1	54	45
31 Aug	860	73	1,990	1	43	56
1 Sep	708	72	154			
2 Sep	545	74	95			
3 Sep	545	68	78			
4 Sep	517	70	76			
5 Sep	443	71	49			
6 Sep	414	78	196			
7 Sep	400	75	79			
9 Sep	613	76	192			
10 Sep	577	71	168			
11 Sep	458	71	100			
12 Sep	445	83	159			
13 Sep	448		61			
14 Sep	448	78	71			
15 Sep	438	71	69			
16 Sep	440	72	88			
23 Sep	517	70	50			
25 Sep	517	72	20			
27 Sep	607	65	134			
29 Sep	635	69	120			
30 Sep	596	68	23			
12 Oct	736	72	166			
20 Oct	756	72	44			
4 Nov	716	63	16			
30 Nov	682	48	69			
13 Dec	756	53	21			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KUMAH RIVER AT TEAL

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				MHx10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
12	1.85	2.35	0.50			3.81	0.14	1.10			4.70	5.05				276	460	8.04	0	0.3
28	1.85	2.55	0.50			3.90	0.19	1.00			4.90	5.04				280	460	8.00	0	0.3
Feb																				
22	1.13	2.47	0.49		0.28	2.54	0.10	1.80			4.09	4.12				288	390	8.28	0	0.4
Mar																				
5	1.03	1.97	0.49		0.28	2.91	0.14	0.80			3.49	3.53				234	300	8.28	0.19	0.4
31	1.37	2.03	0.60		1.60	2.08	0.19	1.57			4.00	4.00				204	360	8.20	0	0.5
Apr																				
14	1.58	1.72	0.60		0.16	2.13	0.19	1.40			3.90	3.88				210	380	8.18	0	0.5
28	1.68	1.72	0.55		0.16	2.17	0.19	1.40			3.95	3.92				210	380	8.18	0	0.4
May																				
15	1.26	1.94	0.65		0.36	2.16	0.24	1.10			3.85	3.86				200	360	8.30	0	0.5
Jul																				
12	1.47	2.03	0.70		0.34	2.55	0.29	1.80			4.20	4.38				228	410	8.42	0	0.5
13	1.15	1.70	0.65		0.34	1.78	0.25	1.25			3.50	3.62				188	340	8.42	0	0.5
20	1.52	1.58	0.60		0.17	2.21	0.25	1.30			3.70	3.93				200	360	8.34	0	0.5
25	0.98	2.17	0.60		0.34	1.95	0.25	1.35			3.75	3.89				206	370	8.50	0	0.5
Aug																				
4	0.78	2.42	0.70		0.25	2.08	0.24	1.40			3.90	3.97				204	370	8.42	0	0.6
8	1.16	2.04	0.83		0.40	2.30	0.34	1.00			4.03	4.04				220	400	8.32	0	0.7
12	1.16	1.84	0.65		0.40	1.90	0.24	1.10			3.65	3.64				200	360	8.38	0	0.5
14	1.26	1.94	0.60		0.32	2.06	0.19	1.30			3.80	3.87				214	380	8.34	0	0.5
15	1.05	2.45	0.70		0.40	2.38	0.29	1.20			4.20	4.27				222	400	8.45	0	0.5
Oct																				
12	1.66	1.92	0.65		0	2.85	0.24	0.63	0.51		4.23	4.23				262	420	8.18	0	0.5
20	1.66	1.97	0.65		0	2.90	0.24	0.63	0.51		4.28	4.28				254	420	8.18	0	0.5
Nov																				
30	2.04	2.13	0.35		0.36	3.21	0.19	0.79			4.52	4.55				272	440	8.25	0	0.2
Dec																				
13	1.78	1.98	0.55		0.18	3.19	0.29	0.63			4.31	4.29				238	400	8.20	0	0.4

TOCHI RIVER AT TANGI POST - 1968

Location Latitude 32°57', Longitude 70°24', on Bannu-Miran Shah Road bridge about 16 miles west of Bannu.

Drainage area 1,980 square miles.

Records available February 1962 to date by Surface Water Hydrology Project WAPDA.

Average discharge 223 cusecs (162,000 acre-feet per year or 1.61 inches runoff per year). Average taken for 5 years from 1963 to 1966 and 1968.

Extremes Maximum discharge during the year 1,070 cusecs on 30 August (gauge height 12.25 feet); Minimum daily discharge 9.4 cusecs on 23 October.

1962-66, 1968: Maximum discharge observed 32,000 cusecs on 15 August 1964; minimum discharge 2 cusecs on 8 August 1963.

Gauge Wire-weight gauge fastened to downstream handrail of bridge. Gauge read to 0.01 foot, five times daily during low flows and more often during floods.

Measurements Forty one discharge measurements were made during the period by current meter at .6 or .2 and .8 depth by wading at low flows and from bridge at high flows. Thirty nine sets of sediment samples were taken by the depth integrating method using DH-48 sampler while wading or D-49 sampler from the bridge. Three of these were analysed for particle size distribution and the rest for total concentration. Twenty two surface samples were collected and analysed for chemical composition.

Determination of discharge This station has bed of shingle and sand that shifts continuously. Rating curve dated 6.11.1962 continued for use with the shift adjustments based on discharge measurements to compensate for the changes in the channel.

Remarks The discharge figures could be in error by ± 20 %. Peak discharge may not be true as gauge observations were not available for night hours.

TOCHI RIVER AT TANGI POST

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	a 127	133	182	146	105	113
2	a121	133	185	130	105	113
3	115	133	167	125	102	113
4	113	133	*167	123	102	115
5	111	130	173	123	102	118
6	109	125	161	118	98	118
7	115	111	155	170	98	115
8	158	89	149	*164	98	113
9	146	* 89	140	164	96	107
10	133	89	a149	167	96	105
11	130	89	a158	167	*96	105
12	120	89	167	170	98	102
13	113	89	173	173	94	102
14	109	89	179	176	94	102
15	109	92	185	173	94	102
16	109	92	194	173	90	92
17	109	94	*197	164	*85	89
18	109	90	200	*149	102	78
19	107	90	204	152	98	68
20	125	92	211	149	105	a65
21	155	92	218	a142	105	a63
22	155	94	211	a136	105	a77
23	146	*94	200	a 129	107	92
24	133	94	197	a 122	*107	92
25	138	130	191	a 115	109	90
26	138	128	179	a 108	105	90
27	138	149	176	a 101	105	90
28	155	173	170	94	109	90
29	155	179	164	96	113	90
30	146	—	161	98	113	90
31	135	—	158	—	113	—
Mean	128	110	178	141	102	97
Cs/mi	0.06	0.06	0.09	0.07	0.05	0.05
In	0.07	0.06	0.10	0.08	0.02	0.02
Ac-ft.	7,900	6,360	11,000	8,360	6,250	5,750

1968 year: Mean 93 Cs/sq mi 0.05 Inches 0.63

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated

TOCHI RIVER AT TANGI POST

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*90	*115	47	29	a19	15
2	89	115	42	29	a16	15
3	89	118	*35	28	14	16
4	*89	*118	34	28	14	16
5	89	118	33	28	14	16
6	87	*118	33	27	14	17
7	92	120	33	27	14	17
8	*94	*120	*32	27	*14	17
9	94	120	*32	27	14	18
10	94	*120	32	27	14	19
11	*96	120	32	27	14	20
12	102	*120	*32	27	14	20
13	120	118	32	26	14	*23
14	*92	118	*32	26	14	22
15	94	115	32	92	14	19
16	98	*113	*32	*96	14	19
17	100	109	32	138	14	19
18	100	105	*32	115	14	19
19	105	100	32	96	15	19
20	*109	*87	*30	46	15	19
21	107	92	31	14	15	19
22	109	90	*29	10	15	22
23	111	87	31	9.4	15	23
24	111	85	31	*15	15	23
25	111	55	31	15	15	22
26	111	*44	31	16	15	22
27	111	a45	31	17	15	21
28	113	a45	31	18	16	21
29	115	294	29	20	*16	21
30	115	1,040	29	*24	16	*20
31	115	641	—	a21	—	23
Mean	102	155	33	37	15	19
Cs/mi	0.05	0.08	0.02	0.02	0.01	0.01
In	0.06	0.09	0.02	0.02	0.01	0.01
Ac-ft.	6,250	9,530	1,930	2,270	877	1,190

Acre-feet. 67,700 Max Day 1,040 Min Day 9.4

TOCHI RIVER AT TANGI POST

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Feb	89	38	84			
23 Feb	92	40	288			
4 Mar	167	60	170			
17 Mar	197	62	7			
8 Apr	164	50	121			
18 Apr	143	78	87			
11 May	96	74	58			
17 May	85	82	152			
24 May	107	81	51			
21 Jun	63	92	85			
1 Jul	90	92	23			
4 Jul	89	90	119			
8 Jul	94	95	100			
11 Jul	96	94	71			
14 Jul	90	90	139			
20 Jul	109	86	102			
1 Aug	115	82	3,630	5	40	55
4 Aug	118	87	132			
6 Aug	118	78	130			
8 Aug	120	95	27			
10 Aug	120	87	2,650	10	43	47
12 Aug	120	83	73			
16 Aug	113	80	86			
20 Aug	70	85	97			
26 Aug	40	85	40			
3 Sep	35	87	173			
8 Sep	32	84	111			
9 Sep	32	82	76			
12 Sep	32	80	24			
14 Sep	32	87	158			
16 Sep	32	85	111			
22 Sep	30	82	68			
16 Oct	96	72	179			
24 Oct	15	72	26			
30 Oct	24	68	41			
8 Nov	14	53	45			
29 Nov	16	52	48			
13 Dec	23	38	181			
30 Dec	20	34	682	8	56	36

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

TOCHI RIVER AT TAMII POST

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER											PARTS PER MILLION				MOx10^6			
										TOTAL						at			
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.	25°C.	pH	Res CO_3	SAR
																			me/l	
Feb																				
9	0.93	6.27	3.13		0.74	6.01	1.32	2.11			10.33	10.18				600	1,010	8.30	0	1.7
23	1.47	3.58	2.25		0.74	4.98	0.78	0.78			7.30	7.28				410	700	8.38	0.67	1.4
Mar																				
4	1.30	3.80	1.45		0.52	4.00	0.44	1.50			6.55	6.46				390	600	8.35	0	0.9
17	1.58	3.82	1.45		1.24	4.04	0.34	1.30			6.85	6.92				430	640	8.48	0	0.9
Apr																				
8	2.25	5.05	3.37		1.06	4.27	1.03	4.20			10.67	10.56				584	980	8.54	0	1.8
18	2.25	4.95	3.37		1.14	4.00	0.94	4.30			10.57	10.38				580	1,000	8.53	0	1.8
May																				
11	0.52	8.68	6.35		1.71	5.49	2.22	6.60			15.55	16.02				850	1,500	8.50	0	3.0
17	2.00	3.50	1.58		0	4.41	0.54	2.30			7.08	7.25				400	690	8.12	0	1.0
Jun																				
21	0.32	10.68	5.30		1.76	5.98	2.12	7.40			16.30	17.26				980	1,600	8.42	0	2.3
Jul																				
4	1.16	2.05	1.28		0.34	2.25	0.44	1.65			4.49	4.68				260	450	8.50	0	1.0
8	0.85	3.23	1.67		0.51	3.06	0.54	1.62			5.75	5.73				338	570	8.37	0	1.2
11	0.95	2.82	1.30		0.51	2.38	0.49	1.80			5.07	5.18				302	500	8.48	0	1.0
14	0.95	3.02	1.37		0.51	2.63	0.49	1.80			5.34	5.43				320	530	8.50	0	1.0
20	0.84	3.14	1.30		0.42	2.55	0.44	2.15			5.28	5.56				320	530	8.52	0	0.9
Aug																				
10	1.32	3.11	5.81		0.42	2.46	1.03	6.15			10.24	10.06				640	1,000	8.55	0	3.9
26	1.11	8.30	5.10		0.90	5.25	1.98	6.32			14.51	14.35				930	1,400	8.40	0	2.3
Sep																				
3	1.11	1.35	0.70		0	2.00	0.19	0.68	0.30		3.16	3.17				186	300	8.10	0	0.6
Oct																				
24	0.83	9.60	4.54		1.44	6.16	2.07	5.20			14.97	14.87				880	1,400	8.60	0	2.0
Nov																				
8	2.33	2.43	1.20		0.45	3.55	0.49	1.31			5.96	5.80				310	510	8.32	0	0.8
29	2.33	2.46	1.20		0.54	3.46	0.49	1.28			5.99	5.77				306	510	8.35	0	0.8
Dec																				
13	2.27	2.51	1.20		0.36	3.69	0.49	1.33			5.98	5.87				306	510	8.30	0	0.8
30	2.23	2.58	1.00		0.36	3.69	0.49	1.23			5.81	5.77				304	510	8.30	0	0.6

Blank page retained for pagination

Location Latitude 32°20', Longitude 70°09', on abandoned road bridge, 2.5 miles downstream from Jandola and 30 miles north-west of Tank.

Drainage area 840 square miles.

Records available January 1961 to 30 June, 1968 by Surface Water Hydrology Project WAPDA. Gauge height record February 1960 to June 1962 with discharge measurements starting in 1961 by Peshawar Division, Hydrology Directorate of Irrigation Department.

Average discharge 180 cusecs (130,000 acre-feet per year or 2.91 inches runoff per year). Average taken for 5 years from 1962 to 1966.

Extremes Data incomplete. Site closed in July 1968.

1961-66: Maximum discharge observed 29,000 cusecs on 26 July 1961; minimum daily discharge 41 cusecs on 8 July 1964.

Gauge Staff gauge fastened to downstream end of bridge pier near left bank and a gauge painted on the right abutment of the bridge. Wire-weight gauge installed on 18.7.1963 on a vertical angle iron of the bridge, 50 feet to the left of the gauge. Gauge set to arbitrary datum.

Measurements Eleven discharge measurements were made upto 30 June by current meter at .6 or .2 and .8 depths. Ten sets of sediment samples were taken by the depth integrating method using DH-48 sampler. One of these was analysed for particle size distribution and the rest for total concentration. Eleven surface samples were collected and analysed for chemical composition.

Determination of discharge This stream has an unstable gravel bed which shifts continuously. Previous rating dated 27.5.66 was used. Discharges were computed using the above table with shifts adjustments based on discharge measurements.

Remarks Record fair.

TANK ZAM NEAR JANDOLA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	101	62	84	109	99	297
2	99	73	87	104	109	250
3	98	71	102	101	86	241
4	100	71	107	98	105	406
5	99	72	110	94	103	253
6	99	71	116	92	80	103
7	98	70	120	87	74	98
8	95	71	*126	83	73	90
9	100	70	125	81	70	88
10	96	70	125	79	67	86
11	91	71	124	76	65	85
12	88	71	127	73	62	83
13	86	74	129	*71	62	83
14	85	72	131	76	*58	81
15	85	*70	130	76	58	80
16	84	71	127	77	58	79
17	83	70	122	79	58	78
18	81	71	137	83	68	79
19	86	76	131	*88	60	*78
20	114	71	135	88	62	77
21	105	71	130	88	134	76
22	83	68	128	89	127	76
23	79	67	121	89	119	74
24	77	68	120	88	110	75
25	74	68	139	95	109	74
26	71	73	149	90	134	76
27	69	*103	134	88	*119	78
28	*65	95	127	101	120	101
29	66	81	*125	*93	117	95
30	65	—	119	91	153	96
31	65	—	113	—	697	—
Mean	87	73	123	88	110	118
Cs/mi	0.10	0.09	0.15	0.10	0.13	0.14
In	0.12	0.10	0.17	0.12	0.15	0.16
Ac-ft.	5,330	4,190	7,540	5,210	6,780	7,010

1968 year: Mean Cs/sq mi Inches

Note : * Discharge measurement made on this day.

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
28 Jan	66	57	125			
15 Feb	70	50	41			
27 Feb	99		246			
8 Mar	127	60	17			
29 Mar	125	64	129			
13 Apr	71	52	103			
29 Apr	95	78	42			
14 May	58	74	32			
27 May	120	81	830	10	53	37
19 Jun	79	98	30			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

TANK ZAM NEAR JANDOLA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
28	1.70	3.10	2.10		0	3.20	0.39	3.66			6.90	7.25				441	690	8.14	0	1.4
Feb																				
15	1.55	2.85	1.96		0.14	3.06	0.34	2.90			6.36	6.44				430	600	8.12	0	1.3
27	1.65	2.35	1.55		0.05	2.82	0.29	2.40			5.55	5.56				320	510	8.10	0	1.1
Mar																				
8	2.00	2.30	1.80		0.16	2.00	0.44	3.30			6.10	5.90				340	590	8.18	0	1.2
29	2.00	2.20	1.80		0.16	1.91	0.29	3.60			6.00	5.96				340	590	8.16	0	1.2
Apr																				
13	1.58	2.62	1.80		0.16	2.75	0.44	2.45			6.00	5.80				370	580	8.16	0	1.2
19	1.47	2.73	1.58		0.16	2.97	0.39	2.08			5.78	5.60				350	560	8.16	0	1.2
29	1.68	2.72	1.64		0.44	3.11	0.39	2.20			6.04	6.14				390	580	8.30	0	1.1
May																				
14	2.10	2.20	2.25		0.36	2.07	0.39	4.00			6.55	6.82				380	660	8.32	0	1.5
27	2.42	1.38	1.80		0.27	2.25	0.19	2.80			5.60	5.51				300	530	8.30	0	1.3
Jun																				
19	1.89	2.71	2.40		Traces	2.37	0.44	4.50			7.00	7.31				426	700	8.20	0	2.2

Location Latitude 32°09', Longitude 70°04', on left bank one furlong from WAPDA rest house, one mile northwest of Kot Murtaza, 15 miles from Zhob River and 22 miles west of Tank.

Drainage area 13,900 square miles.

Records available Discharges January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights 1956 to 1960 by Dams Investigation Circle and August 1959 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 536 cusecs (389,000 acre-feet per year or 0.52 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 7,360 cusecs on 27 June (gauge height 8.10 feet); minimum daily discharge 73 cusecs on 8 June.

1960-68: Maximum discharge observed 28,200 cusecs on 22 April 1965; minimum daily discharge 34 cusecs on 29 & 30 June 1965.

Gauge Wire-weight gauge fixed on newly constructed bridge in late 1964, 1000' upstream from old gauge consisting of angle iron painted with 0.1 foot graduations, set in river bed and read to 0.1 foot. Gauge set to arbitrary datum.

Measurements Thirty discharge measurements were made during the year by current meter using 0.2 and 0.8 depth method by wading at low stages and from car suspended from overhead cableway at medium and high stages. Twenty two sets of sediment samples were taken by depth integrating method using DH-48 sampler by wading and by D-49 sampler from cableway. Four of these were analysed for particle size distribution and the rest for total concentration. Fourteen surface samples were collected and analysed for chemical composition.

Determination of discharge Rating dated 7.4.69 was used with shift adjustments as necessitated by periodic measurements.

Remarks Record fair.

GOMAL RIVER AT KOT MURTAZA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	a 330	179	268	124	3,300	109
2	a 310	165	212	125	694	149
3	298	165	177	119	487	124
4	258	159	151	110	473	96
5	262	159	133	108	340	86
6	235	157	*193	98	535	86
7	235	149	177	99	191	81
8	258	151	149	144	155	73
9	247	133	a 150	163	139	75
10	255	130	a 145	207	139	172
11	230	118	1,940	167	134	187
12	262	115	1,570	*140	*130	121
13	245	109	1,920	121	126	83
14	238	*161	3,300	131	120	83
15	230	139	1,840	127	121	81
16	217	137	1,110	133	242	81
17	205	136	978	167	124	80
18	195	133	728	175	733	*82
19	183	121	556	*163	414	81
20	243	149	426	153	681	75
21	197	142	361	147	499	78
22	195	142	307	142	644	88
23	195	142	275	136	247	86
24	181	165	255	134	189	74
25	191	*151	230	132	*138	122
26	*179	302	233	130	102	114
27	197	1,480	201	*144	110	965
28	220	517	*179	125	117	923
29	222	273	163	127	222	408
30	218	---	142	2,640	181	261
31	195	---	129	---	103	---
Mean	229	213	600	221	382	171
Cs/mi	0.02	0.02	0.04	0.02	0.03	0.01
In	0.02	0.02	0.05	0.02	0.03	0.01
Ac-ft.	14,100	12,300	36,900	13,200	23,500	10,200

1968 year: Mean 248 Cs/sq mi 0.02 Inches 0.24

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	147	388	121	108	103	110
2	138	149	106	103	99	115
3	121	313	109	106	96	112
4	110	171	105	109	98	110
5	647	193	115	107	100	112
6	340	345	*120	106	99	110
7	147	322	*118	109	*100	115
8	105	524	*121	104	96	117
9	88	447	*115	124	99	119
10	75	250	*114	136	98	135
11	103	263	114	118	99	1,450
12	123	245	114	115	100	418
13	119	145	*112	120	99	286
14	337	260	*114	*120	100	195
15	351	265	*115	113	101	167
16	301	1,660	112	116	100	142
17	140	525	109	1,500	101	120
18	106	255	115	272	101	104
19	392	330	112	205	104	107
20	1,160	179	115	145	103	110
21	1,500	88	*112	136	101	a 110
22	892	*179	* 95	129	104	a 110
23	299	117	* 98	*122	104	106
24	139	80	* 98	118	104	110
25	141	83	* 99	109	106	114
26	137	94	* 99	114	107	109
27	215	*147	105	110	106	104
28	155	116	101	106	109	107
29	118	92	100	106	110	115
30	283	89	105	101	110	109
31	1,040	93	---	101	---	110
Mean	322	271	110	167	102	176
Cs/mi	0.02	0.02	0.01	0.01	0.01	0.01
In	0.03	0.02	0.01	0.01	0.01	0.01
Ac-ft.	19,800	16,700	6,520	10,300	6,060	10,800

Acre-feet. 180,000 Max Day 3,300 Min Day 73

GOMAL RIVER AT KOT MURTAZA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
26 Jan	181	58	64			
14 Feb	55	50	212			
25 Feb	161		1,850	6	46	48
6 Mar	195	64	142			
28 Mar	177	63	125			
12 Apr	165	50	58			
19 Apr	163	80	56			
27 Apr	129	80	107			
12 May	129	70	1,120	40	36	24
25 May	135	60	2,950	1	62	37
18 Jun	82	85	73			
22 Aug	175	80	111			
27 Aug	147	84	2,680	7	25	68
6 Sep	121	80	63			
7 Sep	118	85	145			
13 Sep	112	84	86			
14 Sep	115	82	9			
15 Sep	117	80	197			
25 Sep	98	85	119			
26 Sep	99	87	104			
14 Oct	120	73	84			
23 Oct	123	72	126			

Note : Sand is all sizes above 0.0635 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

GOKAL RIVER AT KOT MURTAZA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				MHOx10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
26	2.03	5.57	7.80		0	3.62	2.42	9.39			15.40	15.43				972	1,430	8.02	0	4.0
Feb																				
14	2.06	4.59	7.60		0.19	3.30	2.35	8.30			14.20	14.14				900	1,330	8.23	0	4.2
25	1.95	2.55	4.57		Traces	3.10	0.98	5.10			9.07	9.18				610	920	8.10	0	3.1
Mar																				
6	1.79	3.71	5.00		0.36	2.55	1.18	6.30			10.50	10.39				660	990	8.21	0	3.0
28	1.79	3.71	5.00		0.26	2.64	1.08	6.40			10.50	10.38				630	1,000	8.26	0	3.0
Apr																				
12	3.15	4.65	7.72		0.36	2.59	1.83	10.60			15.52	15.38				950	1,410	8.20	0	3.9
May																				
12	3.15	4.05	8.15		0.27	2.57	2.42	10.60			15.35	15.86				940	1,450	8.28	0	4.3
25	2.21	3.79	5.18		0.36	3.06	1.48	6.30			11.18	11.20				660	1,050	8.34	0	3.0
Jun																				
18	3.26	4.74	8.10		0.26	2.37	2.67	11.00			16.10	16.30				1,060	1,600	8.32	0	4.1
Aug																				
22	3.44	4.58	8.30		0	3.10	2.72	10.57			16.32	16.39				1,070	1,610	7.98	0	4.2
27	2.99	3.43	9.66		0	2.15	3.41	10.47			16.08	16.03				1,030	1,550	8.18	0	5.4
Sep																				
14	3.44	4.58	8.30		0	2.90	2.62	0.89			16.32	16.41				1,060	1,620	7.98	0	4.1
Oct																				
14	3.33	4.10	6.10		0.27	2.56	2.37	8.59			13.53	13.79				858	1,300	8.40	0	3.2
23	3.83	4.09	6.10		0.18	2.74	2.47	8.75			14.02	14.14				854	1,350	8.25	0	3.1

Blank page retained for pagination

CHENAB RIVER AT ALEXANDRIA BRIDGE - 1968

Location Latitude 32°29', Longitude 74°06', on Alexandria Bridge on Grand Trunk Road, 3 miles north of Wazirabad, 6 miles south of Gujrat and upstream from mouth of Palkhu Nullah.

Drainage area 12,600 square miles.

Records available January 1961 to date by Surface Water Hydrology Project WAPDA. October 1879 with discharges since June 1932 by Discharge Division of Irrigation Department, Lahore. Discharge measurements and gauge height record collected from March 1957 to June 1960 by Ground Water Development Organisation of Irrigation Department.

Average discharge 21,600 cusecs (15,600,000 acre-feet or 22.4 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during the year 131,000 cusecs on 24 July (gauge height 14.65 feet); minimum daily discharge 59 cusecs on 10 December.

1961-68: Maximum discharge 286,000 cusecs on 9 September 1966; minimum daily discharge 48 cusecs on 22 January 1966. Maximum discharge for period of Irrigation Department record not determined as control is unstable.

Gauge Continuous automatic water stage recorder over 14 inch diameter well on downstream side of second highway bridge pier from left bank since March 1957. Wire weight gauge in the close vicinity of recorder also installed. Zero of gauge datum at 726.0 feet reduced levels.

Measurements Thirty five discharge measurements were made periodically during the year by current meter from bridge at 0.2 and 0.8 depth. Wading was done in extremely low flow. Twenty five sets of sediment samples were taken from the bridge by depth integrating method using D-49 sampler and by DH-48 sampler while wading. Thirteen of these were analysed for particle size distribution and the rest for total concentration. Twenty one surface samples were collected and analysed for chemical composition.

Determination of discharge This station has an unstable channel control. Rating dated 28.12.68 was used. Discharges were computed by applying mean daily gauge heights to this rating with shift adjustments based on discharge measurements.

Remarks Record good. Natural flow of stream affected by diversion for Irrigation by Upper Chenab Canal and M.R. Link which take up major portion of flow at times.

CHENAB RIVER AT ALEXANDRIA BRIDGE

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	18,000	12,100	12,200	*3,880	30,900	16,000
2	17,100	9,090	9,530	3,750	32,600	19,200
3	16,200	7,900	7,750	3,750	31,000	21,800
4	15,300	6,470	8,380	3,750	*24,300	20,600
5	14,300	6,080	8,820	4,120	21,200	24,500
6	13,700	5,920	*8,760	6,120	18,400	26,600
7	13,700	8,930	8,820	9,090	13,400	30,100
8	13,400	13,000	8,490	10,800	10,700	37,800
9	13,000	11,100	9,260	9,930	8,980	45,600
10	12,100	9,750	9,640	9,420	7,700	48,900
11	11,800	8,820	9,480	7,900	6,610	50,100
12	12,300	8,320	10,100	5,760	6,880	54,300
13	12,000	7,200	11,400	6,380	9,590	*52,700
14	11,600	8,160	9,990	5,640	13,500	51,200
15	9,590	7,900	9,930	9,640	16,400	50,800
16	* 3,780	8,050	*9,480	12,700	14,800	51,600
17	2,120	8,430	9,200	7,800	12,500	53,200
18	1,670	6,830	10,600	5,840	10,900	55,200
19	1,440	6,700	16,400	5,920	13,300	55,800
20	1,340	11,400	24,700	6,970	17,200	54,900
21	12,200	*33,800	21,100	8,930	21,900	53,800
22	10,900	17,600	13,500	10,600	20,900	53,800
23	6,080	13,600	5,600	12,900	18,200	*59,400
24	4,480	11,400	4,760	15,200	*14,400	62,800
25	3,480	10,200	4,410	*14,900	14,800	60,100
26	4,440	9,420	4,370	14,000	14,100	67,000
27	5,960	9,370	5,950	18,500	13,700	65,900
28	7,040	15,500	8,100	23,300	13,700	57,600
29	8,060	18,900	4,270	25,100	9,700	50,300
30	15,300	———	3,900	27,900	8,760	37,900
31	13,500	———	3,930	———	12,700	———
Mean	9,870	10,800	9,450	10,300	15,600	46,300
Cs/mi	0.78	0.86	0.75	0.82	1.24	3.67
In	0.90	0.92	0.86	0.92	1.43	4.10
Macf	.607	.619	.581	.616	.959	2.76

1968 year: Mean 20,400 Cs/sq mi 1.62 Inches 22.1

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

CHENAB RIVER AT ALEXANDRIA BRIDGE

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	32,400	59,400	20,900	2,880	144	76
2	36,800	61,600	19,300	2,780	144	76
3	43,900	*62,600	22,200	2,720	140	72
4	48,300	*65,400	25,500	2,580	140	65
5	42,000	64,100	27,200	2,450	136	69
6	43,200	64,300	24,700	2,400	132	65
7	50,800	68,400	23,100	2,330	120	65
8	60,100	*72,700	21,800	*2,250	120	62
9	75,100	*72,400	21,100	2,120	116	62
10	86,600	71,000	18,800	1,420	116	59
11	64,100	72,700	16,200	732	112	69
12	79,800	88,000	14,400	*482	108	* 86
13	72,400	86,300	14,000	416	104	551
14	65,000	73,400	15,000	380	*100	628
15	61,400	83,800	17,700	320	97	266
16	*63,400	*79,800	19,700	300	93	176
17	59,900	65,200	18,100	275	93	136
18	60,100	68,800	15,500	253	93	112
19	60,900	*88,300	13,400	225	90	93
20	60,900	*83,000	12,900	221	90	83
21	*70,500	61,400	12,100	216	90	79
22	77,500	84,900	11,200	203	86	69
23	*59,000	112,000	11,200	194	86	65
24	48,000	71,200	12,100	189	86	833
25	34,000	*51,400	12,100	180	* 79	1,560
26	*22,300	44,500	9,870	172	79	1,830
27	24,500	47,400	7,060	168	79	1,870
28	59,300	27,200	* 4,860	164	79	1,810
29	109,000	26,900	3,420	156	76	1,710
30	* 98,200	26,600	3,070	*168	76	1,640
31	* 58,700	25,400	———	168	———	1,560
Mean	59,000	65,500	15,600	952	103	513
Cs/mi	4.68	5.20	1.24	0.08	0.01	0.04
In	5.40	5.99	1.38	0.09	0.01	0.05
Maf	3.63	4.03	.929	.058	.006	.032

M. Acre-feet 14.8 Max Day 112,000 Min Day 59

Suspended Sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
16 Jan	3,000		82			
21 Feb	28,700	57	952	10	51	39
6 Mar	8,870	65	203			
16 Mar	9,200	57	161			
1 Apr	3,850	65	82			
4 May	24,100		375	40	50	10
24 May	14,700		232			
23 Jun	56,000		701	5	50	45
16 Jul	67,400	75	771	5	47	48
21 Jul	70,500	77	1,080	29	65	6
23 Jul	53,800	70	918	5	87	8
25 Jul	22,700	76	730	22	74	4
31 Jul	56,900		1,310	3	71	26
4 Aug	76,400	80	1,310	7	75	18
8 Aug	69,800	74	1,350	7	76	17
9 Aug	73,400	74	1,450	5	73	22
16 Aug	82,400	77	1,520	9	77	14
20 Aug	82,100	80	1,950	13	69	18
25 Aug	48,300	87	231			
9 Sep	22,700	81	324			
15 Sep	20,400	85	262			
28 Sep	4,930		134			
30 Oct	148	70	142			
25 Nov	76	62	40			
12 Dec	90	60	14			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

CHINAB RIVER AT ALEXANDRIA BRIDGE

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION				$EC \times 10^6$ at 25°C.	pH	Res CO_3	SAR
											TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
16	1.96	0.74	0.42			2.17	0.14	0.80			3.15	3.11				174	300	7.55	0	0.4
Feb																				
21	0.82	1.08	0.30		Traces	1.81	0.09	0.30			2.20	2.20				116	210	8.19	0	0.3
Mar																				
6	1.65	0.46	0.20		Traces	1.80	0.14	0.25			2.31	2.19				120	230	8.19	0	0.2
Apr																				
25	1.15	0.45	0.15		0	1.20	0.09	0.45			1.75	1.74				98	170	8.00	0	0.2
May																				
4	1.16	0.34	0.15		0	1.09	0.10	0.46			1.65	1.65				84	150	7.89	0	0.2
24	1.16	0.34	0.15		0	1.14	0.10	0.41			1.65	1.65				84	150	7.68	0	0.2
Jun																				
23	1.16	0.44	0.08		0	1.14	0.14	0.40			1.68	1.68				90	160	8.08	0	0.2
Jul																				
16	1.36	0.19	0.15		0	1.20	0.10	0.45			1.70	1.75				90	160	8.09	0	0.2
21	1.26	0.14	0.25		0	1.20	0.10	0.30			1.65	1.60				88	160	8.09	0	0.4
23	1.15	0.15	0.25		0	0.99	0.10	0.45			1.55	1.54				84	150	8.01	0	0.4
26	1.16	0.34	0.25		0	0.99	0.15	0.60			1.75	1.74				94	170	7.98	0	0.3
31	1.16	0.52	0.40		0.16	1.10	0.10	0.60			2.08	1.96				104	190	8.21	0	0.4
Aug																				
4	1.33	0.14	0.25		0	1.30	0.09	0.35			1.72	1.74				98	170	8.18	0	0.3
9	1.16	0.20	0.25		0	1.25	0.05	0.40			1.61	1.70				88	160	8.10	0	0.3
16	1.55	0.23	0.25		Traces	1.55	0.14	0.35			2.03	2.04				110	200	8.17	0	0.3
25	1.23	0.49	0.35		0	1.15	0.19	0.76			2.07	2.10				112	200	7.90	0	0.4
Sep																				
9	1.40	0.14	0.25		0	1.08	0.20	0.46			1.99	1.74				108	180	7.70	0	0.3
28	1.32	0.22	0.18		0	1.25	0.14	0.47			1.72	1.80				112	190	8.10	0	0.2
Oct																				
30	2.14	1.07	0.50		0.20	2.90	0.14	0.30			3.71	3.54				214	370	8.30	0	0.4
Nov																				
25	2.27	0.72	0.50		0.19	2.37	0.19	0.19			3.49	3.53				200	340	8.20	0.16	0.4
Dec																				
12	2.39	0.84	0.40		0.18	3.06	0.29	0.12			3.63	3.65				198	330	8.20	0.04	0.3

Blank page retained for pagination

Location Latitude 34°22', Longitude 73°28', on left bank under Muzaffarabad road bridge.

Drainage area 2,810 square miles.

Records available Gauge height record from January 1957 to date with Surface Water Hydrology Project WAPDA. Discharge measurements started in November 1962 by Surface Water Hydrology Project. Gauge height record only with Indus Basin Development Board Lahore from 1954 - December 1956.

Average discharge 13,600 cusecs (9,820,000 acre-feet per year or 65.6 inches runoff per year). Average taken for 6 years from 1963 to 1968.

Extremes Maximum discharge observed during the year 52,500 cusecs on 11 June (gauge height 2216.12 feet); minimum daily discharge 1,980 cusecs on 30 January.

1963-68: Maximum discharge observed 70,800 cusecs on 18 June 1966; minimum daily discharge observed 1,740 cusecs on 3 February 1963.

Gauge Enamelled plates, staff gauge read to .01 foot. Gauge read in reduced levels at one hour interval, zero R.L. of gauge being 2200.00 feet.

Measurements Fifty eight discharge measurements were made during the year by current meter at 0.2 and 0.8 depth from road bridge or foot bridge about one furlong downstream of gauge. Forty two sets of sediment samples were taken by the depth integration method using D-49 sampler. Seven of these were analysed for particle size distribution and the rest for total concentration. Fifteen surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a rock channel control, affected at times by sand deposits. Rating dated 22.8.66 was used to compute discharges. Shifts were applied as indicated by discharge measurements.

Remarks Record good.

KISHANGANGA AT MUZAFFARABAD

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,230	2,100	3,050	4,840	28,200	26,700
2	2,260	2,140	3,040	5,140	27,400	26,900
3	2,250	2,170	3,180	5,060	22,100	26,100
4	2,320	2,170	3,260	5,460	18,100	29,800
5	2,340	2,170	3,370	6,500	17,200	28,600
6	2,490	*2,200	3,530	7,480	16,500	30,500
7	2,320	2,120	3,610	9,800	15,100	*34,700
8	*2,280	2,100	3,950	10,500	13,100	37,600
9	2,260	2,070	4,270	10,100	*12,400	39,400
10	2,460	2,060	4,460	9,400	11,700	41,400
11	*2,300	2,040	4,680	* 8,400	11,600	46,300
12	2,270	2,070	*4,660	9,230	14,800	42,900
13	2,210	2,070	4,680	10,100	17,900	40,000
14	2,190	*2,080	4,820	10,300	21,200	36,300
15	2,100	2,070	4,940	10,300	18,300	35,300
16	2,050	*2,100	5,020	9,730	16,100	38,600
17	2,060	2,100	*6,300	10,000	15,700	37,400
18	2,100	2,100	7,520	10,600	15,400	34,900
19	*2,110	2,140	7,960	11,500	18,600	35,100
20	2,170	2,280	7,060	13,100	19,900	33,200
21	2,190	2,200	5,900	*15,400	20,500	37,000
22	2,150	*2,170	5,340	17,200	*22,800	*36,300
23	2,100	2,190	4,960	19,100	22,400	*36,400
24	2,170	2,200	5,160	18,700	22,500	37,000
25	2,140	2,190	5,480	20,400	24,700	39,000
26	2,100	2,370	6,560	22,100	24,500	39,500
27	2,150	2,660	6,400	21,600	23,200	35,100
28	2,250	2,710	5,700	23,100	*20,400	32,900
29	*2,140	3,040	5,020	25,300	20,900	26,700
30	1,980	-----	4,660	*26,000	23,400	23,600
31	2,050	-----	4,630	------	24,500	------
Mean	2,200	2,210	4,940	12,900	19,400	34,800
Cs/mi	0.78	0.79	1.76	4.59	6.90	12.4
In	0.90	0.85	2.03	5.11	7.96	13.8
Maf	.135	.127	.304	.767	1.19	2.07

1968 year: Mean 10,900 Cs/sq mi 3.88 Inches 52.9

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KISHANGANGA AT MUZAFFARABAD

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	24,200	15,700	7,360	4,820	4,430	2,300
2	26,900	*15,400	7,680	4,920	*4,140	2,300
3	29,200	15,400	7,940	*4,960	3,640	2,280
4	28,500	*14,900	*8,080	5,080	3,630	2,390
5	27,800	15,300	8,080	4,660	3,430	*2,410
6	28,300	16,900	7,880	4,650	*3,500	2,420
7	31,600	15,500	*7,720	5,060	3,440	2,410
8	32,600	15,500	7,740	*4,730	3,460	2,380
9	34,300	*15,700	7,600	4,540	3,460	*2,370
10	*33,600	16,900	*7,540	4,530	3,430	2,720
11	32,000	*20,600	7,540	4,270	3,440	3,600
12	30,900	21,000	7,560	4,000	3,440	3,230
13	*27,800	20,000	7,600	3,640	3,470	3,080
14	*27,300	17,800	7,680	4,040	*3,500	2,950
15	24,500	18,300	7,760	*4,290	3,510	*2,810
16	*22,100	16,000	*7,560	4,530	3,430	2,720
17	19,200	*14,700	7,340	4,460	3,470	2,590
18	*18,200	14,400	6,960	4,290	3,540	2,450
19	*17,700	14,100	6,520	4,050	3,480	2,450
20	18,300	13,200	*6,420	3,680	3,430	2,430
21	19,800	13,100	6,520	3,540	3,390	2,430
22	18,300	*13,300	6,780	*3,510	3,360	2,380
23	17,800	11,800	*6,800	3,460	3,290	*2,410
24	*15,300	10,600	6,960	3,440	*2,950	2,400
25	14,500	10,400	6,960	3,370	2,800	2,340
26	15,600	*9,170	6,400	*3,270	2,710	2,290
27	*17,500	7,720	6,080	3,150	2,610	2,220
28	19,100	7,360	*5,760	3,120	2,540	2,250
29	20,200	7,280	5,260	3,160	*2,490	2,170
30	*19,000	7,100	4,860	3,630	2,400	2,120
31	16,700	*7,060	———	3,780	———	2,150
Mean	23,500	13,900	7,100	4,080	3,330	2,500
Cs/mi	8.36	4.95	2.53	1.45	1.19	0.89
In	9.65	5.72	2.82	1.68	1.32	1.02
Maf	1.45	.857	.422	.251	.198	.154

M. Acre-feet. 7.93 Max Day 46,300 Min Day 1,980

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
8 Jan	2,350	44	29			
11 Jan	2,320	47	15			
19 Jan	2,130	41	71			
29 Jan	2,130	42	63			
6 Feb	2,220	42	69			
14 Feb	2,150	48	83			
16 Feb	2,120	48	60			
17 Mar	6,700	50	36			
21 Apr	15,100	38	195			
22 May	23,600	53	239			
7 Jun	35,700	60	1,400	67	15	18
10 Jul	38,100	58	1,400	44	43	13
22 Jul	17,800	58	1,030	24	62	14
24 Jul	15,300	60	110			
27 Jul	18,100	63	168			
30 Jul	19,500	61	1,970	25	62	13
2 Aug	15,800	64	229			
4 Aug	15,000	63	195			
9 Aug	16,500	63	594	25	48	27
11 Aug	22,900	68	1,830	15	74	11
17 Aug	14,700	67	214	18	69	13
22 Aug	13,600	67	1,500			
26 Aug	9,500	64	34			
31 Aug	6,940	64	49			
4 Sep	8,500	67	87			
7 Sep	7,520	66	49			
10 Sep	7,600	66	138			
16 Sep	7,700	64	114			
20 Sep	6,280	64	55			
28 Sep	5,440	62	33			
3 Oct	5,160	58	32			
8 Oct	4,630	57	86			
15 Oct	4,290	56	91			
22 Oct	3,470	55	32			
26 Oct	3,370	55	20			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
2 Nov	3,540	53	15			
6 Nov	3,610	52	44			
14 Nov	3,540	48	25			
29 Nov	2,470	48	81			
5 Dec	2,410	46	35			
9 Dec	2,360	47	213			
23 Dec	2,390	41	28			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KISHANGANGA AT MUZAFFARABAD

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																			
8	1.65	0.55	0.18		0	1.62	0.10	0.60			2.38	2.32				122	220	7.75	0	0.1
29	1.65	0.55	0.18		0	1.90	0.10	0.50			2.38	2.40				121	220	7.78	0	0.1
Feb																			
6	1.65	0.75	0.18		0	1.71	0.10	0.70			2.58	2.51				145	240	7.70	0	0.1
Apr																			
21	1.37	0.23	0.25		0	1.43	0.05	0.40			1.85	1.88				96	170	7.92	0	0.3
30	1.26	0.44	0.15		0	1.27	0.10	0.50			1.85	1.87				98	180	7.85	0	0.2
May																			
22	1.16	0.14	0.09		0	1.13	0.10	0.10			1.39	1.33				72	130	8.05	0	0.1
Jun																			
7	1.26	0.24	0.15		0	1.23	0.10	0.20			1.65	1.53				82	150	8.17	0	0.2
Jul																			
10	1.05	0.25	0.25		0	1.07	0.10	0.40			1.55	1.57				88	150	7.99	0	0.3
24	1.05	0.30	0.15		0	1.03	0.10	0.40			1.50	1.53				72	140	7.80	0	0.2
30	1.38	0.46	0.30		0	1.48	0.14	0.58			2.14	2.20				110	200	8.13	0	0.3
Aug																			
2	1.06	0.16	0.30		0	1.10	0.10	0.24			1.52	1.44				76	140	8.20	0	0.4
Sep																			
16	1.11	0.28	0.22		0	1.08	0.14	0.33			1.61	1.55				82	150	7.78	0	0.3
Oct																			
3	1.25	0.45	0.18		0	1.30	0.09	0.33			1.88	1.72				108	170	8.00	0	0.2
Nov																			
2	1.43	0.33	0.18		0	1.35	0.19	0.45			1.94	1.99				120	200	7.60	0	0.2
29	1.49	0.43	0.15		0	1.48	0.19	0.36			2.07	2.03				118	200	7.60	0	0.2

KUNHAR RIVER AT NARAN - 1968

Location Latitude 34°55', Longitude 73°38', near P.W.D. Guest House, 2 furlong upstream from Saiful Maluk Nallah and about half a mile north of Naran.

Drainage area 400 square miles.

Records available Discharge January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights October 1958 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 1,760 cusecs (1,270,000 acre-feet per year or 59.8 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 8,830 cusecs on 25 June (gauge height 9.88 feet); minimum daily discharge 214 cusecs on 1 February.

1959-68: Maximum discharge observed 16,400 cusecs on 25 June 1966; minimum daily discharge 100 cusecs on 28 March 1966.

Gauge Enamelled plates graduated to 0.01 foot and read four to five times daily or more often during flood. Servo-manometer with a recorder (Bubble gauge) in masonry shelter fixed in November 1966; both gauges set to same arbitrary datum.

Measurements Fifteen discharge measurements were made periodically during the year by current meter at 0.2 and 0.8 or 0.6 depth from country made footbridge at the gauge. Three sets of sediment samples taken by depth integration method using D-49 sampler and analysed for total concentration. Ten surface samples were collected and analysed for chemical composition.

Determination of discharge Rating dated 17.7.68 was used. Discharges were computed by applying this rating to the mean daily gauge heights with shift adjustments as indicated by the periodic discharge measurements.

Remarks Record fair. Diurnal fluctuations during melting period has not been defined except for the period when recorder was used.

KUNHAR RIVER AT NARAN

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	321	214	375	*375	1,980	4,350
2	300	245	*342	366	*2,120	4,340
3	315	240	348	384	1,970	4,230
4	308	231	348	423	1,620	4,340
5	312	*233	345	454	1,430	4,840
6	303	253	345	483	1,300	5,200
7	298	260	351	447	1,210	5,590
8	290	258	369	511	1,180	6,380
9	270	260	360	531	1,160	6,880
10	283	275	363	519	1,040	6,940
11	285	280	357	590	1,100	7,180
12	298	270	357	647	1,260	6,680
13	268	265	369	555	1,520	6,560
14	240	313	360	559	1,790	6,230
15	253	310	360	515	1,560	6,650
16	258	308	384	495	*1,480	7,000
17	275	293	430	519	1,410	7,250
18	253	280	444	*587	1,670	7,210
19	260	330	*396	702	2,070	6,980
20	268	333	375	869	2,280	7,130
21	260	290	357	1,030	2,430	7,380
22	248	345	351	1,150	2,510	7,550
23	248	348	357	1,200	2,870	7,550
24	258	333	366	1,280	3,240	7,650
25	240	348	390	1,490	3,680	7,980
26	253	369	384	1,530	2,700	*7,760
27	245	300	357	1,650	2,670	7,260
28	240	384	357	1,600	2,500	6,600
29	248	387	360	1,690	2,790	5,770
30	243	---	360	1,920	*3,610	6,140
31	231	---	366	-----	4,010	-----
Mean	270	295	367	836	2,070	6,450
Cs/mi	0.68	0.74	0.92	2.09	5.18	16.1
In	0.78	0.80	1.06	2.33	5.97	18.0
Ac-ft.	16,600	17,000	22,600	49,700	127,000	384,000

1968 year: Mean 1,830 Cs/sq mi 4.58 Inches 62.4

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	6,430	4,240	1,520	954	603	430
2	6,590	4,160	1,510	936	587	447
3	6,400	4,100	1,520	932	591	454
4	a7,000	4,060	1,510	923	647	465
5	a6,800	4,240	1,540	860	720	465
6	a6,900	4,050	1,510	833	611	468
7	a7,000	4,350	1,490	833	571	461
8	a7,400	4,370	1,530	828	563	465
9	a7,600	4,210	1,460	810	559	469
10	a7,500	4,050	1,460	824	551	458
11	a7,000	3,900	1,470	815	535	433
12	a6,800	3,770	1,480	797	519	539
13	a6,400	3,560	1,480	792	503	465
14	a5,700	3,340	1,460	788	491	458
15	a5,000	3,250	1,460	*770	475	475
16	a4,750	3,240	1,440	684	483	495
17	*4,800	2,940	1,430	595	487	503
18	4,820	2,850	1,410	a580	487	*454
19	4,540	2,780	1,390	a585	*499	440
20	4,920	2,710	1,370	a590	507	458
21	4,650	2,410	1,360	595	507	451
22	4,210	2,300	1,360	571	491	444
23	3,670	2,270	1,350	555	483	451
24	3,270	2,230	1,360	*599	475	440
25	3,450	2,150	1,320	591	465	451
26	3,930	2,080	1,290	583	461	454
27	4,300	1,860	1,180	575	461	454
28	4,460	*1,590	1,070	599	444	465
29	4,620	1,460	977	627	423	458
30	4,230	1,490	959	615	419	465
31	4,210	1,480	———	619	———	465
Mean	5,460	3,080	1,390	718	521	461
Cs/mi	13.7	7.70	3.48	1.80	1.30	1.15
In	15.8	8.88	3.88	2.07	1.45	1.33
Ac-ft.	336,000	189,000	82,600	44,100	31,000	28,400

Acre-feet. 13,30,000 Max Day 7,980 Min Day 214

KUNHAR RIVER AT NARAN

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
28 Aug	1,570	47	121			
15 Oct	761	41	202			
19 Nov	475	37	22			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KUSHAR RIVER AT NARAN

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb 5	1.13	0.37	0.12		0	1.11	0.14	0.26			1.62	1.51				88	150	7.55	0	0.1
Mar 2	1.37	0.53	0.12		0	1.50	0.10	0.60			2.02	2.20				110	200	7.99	0	0.1
Apr 18	1.47	0.13	0.30		0	1.38	0.09	0.50			1.90	1.97				100	180	7.88	0	0.3
May 2	0.95	0.35	0.17		0	0.81	0.05	0.55			1.47	1.41				76	140	7.70	0	0.4
16	1.37	0.63	0.15		0	1.27	0.10	0.75			2.15	2.12				116	210	7.80	0	0.2
30	1.26	0.14	0.15		0.12	1.12	0.10	0.20			1.55	1.60				74	150	8.25	0	0.2
Aug 28	0.26	0.96	0.30		0	0.77	0.10	0.70			1.52	1.57				88	160	7.82	0	0.4
Oct 15	1.11	0.17	0.30		0	0.99	0.09	0.44			1.58	1.52				86	150	7.92	0	0.4
Nov 19	1.21	0.30	0.18		0	1.05	0.14	0.52			1.69	1.71				100	160	7.55	0	0.2
Dec 18	1.99	0.41	0.16		0	1.48	0.19	0.90			2.56	2.57				146	240	7.75	0	0.2

Blank page retained for pagination

KUNHAR RIVER AT KHANIAN - 1968

Location Latitude 34°44', Longitude 73°31', on left bank downstream of Khanian Bridge, 12 miles upstream from Paras and 22 miles upstream from Balakot.

Drainage area 580 square miles.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights only October 1958 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 2,590 cusecs (1,880,000 acre-feet per year or 60.7 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 11,600 cusecs on 25 June (gauge height 15.25 feet); minimum daily discharge 520 cusecs on 21 February.

1960-68: Maximum discharge observed 16,100 cusecs on 29 June 1967; minimum daily discharge 230 cusecs on 9 February 1967.

Gauge Enamelled plates graduated to 0.01 foot and read to .01' nine times a day or more often during floods; old gauge fastened to downstream side of right bridge abutment was abondoned in February 1968 and new gauge installed on left bank; gauge set to arbitrary datum.

Measurements Twelve discharge measurements were made periodically by current meter at 0.2 and 0.8 depth from bridge. Six sets of sediment samples were taken by depth integration method using D-49 sampler. All of them were analysed for total concentration. Nine surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a rock control affected by deteritus from a small stream entering just below the gauge. Rating dated 20.7.68 was used. Mean daily discharges were computed by applying gauge heights to this rating table with shift adjustments as indicated necessary by periodic discharge measurements.

Remarks Records fair. Diurnal fluctuations during melting period has not been defined.

KUNHAR RIVER AT KHANIAN

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	729	618	646	749	3,220	6,360
2	721	569	649	781	2,260	6,850
3	721	550	663	801	3,230	6,840
4	721	541	653	821	2,740	6,810
5	698	604	653	829	2,550	a6,200
6	691	618	670	829	2,200	7,420
7	688	583	677	849	2,100	8,500
8	681	590	677	897	2,050	8,980
9	674	576	677	996	2,060	9,760
10	681	586	681	1,060	1,990	10,300
11	670	569	684	1,160	1,970	10,800
12	618	656	688	1,180	2,310	9,550
13	618	604	681	1,250	2,360	9,800
14	611	569	688	1,260	3,220	9,090
15	600	565	688	1,230	2,740	9,300
16	593	559	745	1,210	2,680	10,000
17	590	*565	841	1,230	*2,520	10,200
18	583	556	910	1,240	2,820	10,200
19	583	535	833	1,600	2,920	9,920
20	579	526	757	1,670	3,080	9,710
21	593	520	717	1,820	3,120	10,200
22	586	556	717	2,150	*3,500	10,100
23	583	559	729	2,280	3,970	10,200
24	583	547	729	2,350	4,400	10,300
25	576	631	833	2,490	4,900	11,000
26	576	663	817	2,620	4,270	*10,700
27	565	583	813	2,960	3,900	10,700
28	614	639	813	2,650	3,910	9,220
29	621	621	793	2,670	*4,560	7,820
30	583	---	749	3,230	5,510	8,210
31	576	---	761	-----	5,640	-----
Mean	629	581	730	1,560	3,220	9,170
Cs/mi	1.08	1.00	1.26	2.69	5.55	15.8
In	1.25	1.08	1.45	3.00	6.39	17.6
Ac-ft.	38,700	33,400	44,900	93,000	198,000	546,000

1968 year: Mean 2,710 Cs/sq mi 4.67 Inches 63.5

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KUNHAR RIVER AT KHANIAN

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	8,730	5,580	2,350	1,470	1,050	801
2	8,820	5,350	2,480	1,470	1,040	793
3	9,200	5,290	2,580	1,450	1,030	789
4	8,570	5,020	2,570	1,540	1,010	785
5	8,710	5,380	2,460	1,410	996	785
6	8,680	5,110	2,430	1,510	996	785
7	9,570	4,590	2,320	1,420	987	777
8	9,850	4,900	2,290	1,360	978	777
9	10,400	4,860	2,220	1,340	969	785
10	9,790	4,710	2,230	1,350	960	805
11	9,330	5,510	2,220	1,270	950	809
12	8,990	4,950	2,230	1,230	937	829
13	8,570	4,990	2,320	1,210	924	821
14	8,700	4,730	2,370	1,260	857	817
15	7,880	4,380	2,380	1,200	861	821
16	6,860	4,080	2,290	*1,200	857	817
17	5,980	4,020	2,120	1,210	861	817
18	*6,060	4,060	2,020	1,190	861	*781
19	6,140	3,980	1,890	1,180	*861	773
20	6,970	*3,950	1,830	1,090	861	765
21	6,710	3,900	1,850	1,030	857	741
22	6,340	3,680	1,860	1,030	857	721
23	5,880	3,380	1,890	*1,040	845	691
24	4,760	3,270	1,910	1,040	837	691
25	5,030	3,180	1,860	1,030	829	688
26	5,400	2,880	1,750	1,030	829	681
27	6,140	2,580	1,690	1,030	821	677
28	6,230	2,460	1,600	1,060	813	670
29	5,880	*2,320	1,530	1,090	809	667
30	5,400	2,270	1,500	1,050	805	696
31	5,130	2,220	———	1,050	———	713
Mean	7,440	4,120	2,100	1,220	905	760
Cs/mi	12.8	7.10	3.62	2.10	1.56	1.31
In	14.8	8.18	4.04	2.43	1.74	1.51
Ac-ft.	458,000	253,000	125,000	75,100	53,800	46,700

Acre-feet. 1,970,000 Max Day 11,000 Min Day 520

KUNHAR RIVER AT KHANIAN

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
17 Feb	565		27			
22 May	4,190	49	209			
30 Jul	5,220	49	150			
20 Aug	3,750	61	74			
29 Aug	2,240	52	44			
16 Oct	1,210	45	39			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KUNHAR RIVER AT KHANIAN

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				$EC \times 10^6$ at	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.	25°C.		me/l	
Feb																				
17	0.93	1.57	0.12		0	1.39	0.09	1.00			2.62	2.48				140	260	7.97	0	0.1
May																				
17	1.47	0.43	0.25		0	1.32	0.10	0.75			2.15	2.17				110	200	7.70	0	0.2
21	1.26	0.14	0.15		0	1.12	0.15	0.25			1.55	1.52				80	150	7.92	0	0.2
Jul																				
30	1.05	0.20	0.15		0	1.11	0.10	0.20			1.40	1.41				68	130	7.33	0	0.2
Aug																				
20	0.73	0.42	0.25		0	0.72	0.15	0.65			1.40	1.52				76	140	7.87	0	0.3
29	1.33	0.30	0.22		0	1.00	0.11	0.80			1.85	1.91				90	160	7.60	0	0.3
Oct																				
16	1.43	0.33	0.40		0	1.19	0.09	0.80			2.16	2.08				126	210	7.95	0	0.4
Nov																				
19	1.98	0.21	0.18		0	1.25	0.10	0.91			2.37	2.26				148	240	7.45	0	0.2
Dec																				
18	2.04	0.31	0.15		0	1.44	0.24	0.90			2.50	2.58				146	240	7.80	0	0.1

Blank page retained for pagination

KUNHAR RIVER NEAR GARHI HABIB ULLAH - 1968

Location Latitude 34°24', Longitude 73°22', on right bank near Jagir village, 2 miles upstream from Garhi Habib Ullah and 14 miles upstream from Jhelum River.

Drainage area 920 square miles.

Records available Discharge record January 1960 to date by Surface Water Hydrology Project WAPDA. Gauge heights only at bridge near Garhi Habib Ullah 1944 to 1954 by Irrigation Branch; 1954 to 1958 by Dams Investigation Circle and 1958 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 3,800 cusecs (2,750,000 acre-feet per year or 56.5 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge during the year 23,700 cusecs on 30 June (gauge height 18.22 feet); minimum daily discharge 787 cusecs on 21 February.

1960-68: Maximum discharge 30,600 cusecs on 9 July 1960; minimum daily discharge 268 cusecs on 9 February 1967.

Gauge Continuous automatic water stage recorder in masonry shelter set to arbitrary datum. Prior to 21 June 1961 staff gauge a short distance upstream set to reduced level.

Measurements Forty nine discharge measurements were made periodically by current meter using 0.2 and 0.8 or 0.6 depth method from car on overhead cableway at the gauge. Thirty one sets of sediment samples taken by depth integration method using D-49 sampler. All were analysed for total concentration. Sixteen surface samples were collected and analysed for chemical composition.

Determination of discharge The stage discharge relation at this site is controlled by channel characteristics. There is continuous movement of boulders and gravel under the influence of high velocities. Previous ratings dated 9.12.65 and 21.10.64 were used from 1.1.68 to 14.4.68 and 15.4.68 to 31.12.68 respectively, to compute discharges with shift adjustments as indicated by periodic discharge measurements.

Remarks Record good.

KUNHAR RIVER NEAR GARHI HABIB ULLAH

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	1,010	859	970	1,270	*5,350	*7,000
2	990	850	990	1,220	5,190	7,420
3	980	841	1,000	1,280	4,910	*7,360
4	980	859	1,010	1,440	4,280	7,560
5	970	895	970	1,570	4,040	7,000
6	1,000	913	950	1,840	3,780	8,190
7	913	868	970	1,960	3,560	*9,540
8	904	868	1,040	1,920	*3,420	10,800
9	913	823	1,050	1,940	3,330	11,700
10	1,010	823	1,030	1,810	3,210	11,800
11	950	832	1,080	1,840	3,240	12,900
12	904	832	1,080	2,180	3,570	11,900
13	904	850	1,080	2,060	3,860	11,700
14	886	877	1,050	*2,080	4,370	10,800
15	868	*850	*980	2,140	*4,070	11,100
16	877	850	1,090	2,070	3,950	11,600
17	868	832	1,320	2,140	3,770	12,000
18	*859	814	1,790	2,350	4,050	11,900
19	859	814	1,570	2,730	4,830	11,300
20	913	859	1,400	3,180	4,940	11,100
21	904	787	*1,280	3,590	*5,040	*11,600
22	832	796	1,200	3,900	5,100	12,000
23	850	814	1,200	4,150	5,330	12,200
24	877	814	1,230	*4,220	*5,780	12,300
25	859	814	1,370	4,530	6,170	13,000
26	850	970	1,590	4,460	5,390	13,200
27	895	1,090	1,480	4,940	4,790	12,200
28	904	1,110	*1,350	4,800	4,660	11,000
29	922	1,030	1,280	4,570	5,220	9,500
30	931	———	1,220	5,170	6,230	9,290
31	904	———	1,240	———	6,570	———
Mean	912	870	1,190	2,780	4,580	10,700
Cs/mi	0.99	0.95	1.29	3.02	4.98	11.6
In	1.14	1.02	1.49	3.37	5.74	13.0
Ac-ft.	56,100	50,100	73,100	165,000	282,000	637,000

1968 year: Mean 3,520 Cs/sq mi 3.83 Inches 52.1

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KUNHAR RIVER NEAR GARHI HABIB ULLAH

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	9,940	6,760	3,100	1,900	1,500	*1,050
2	10,700	6,680	*3,240	1,890	1,330	1,050
3	10,900	6,450	3,310	1,890	*1,390	1,060
4	10,100	*6,260	3,290	2,070	1,370	1,050
5	10,000	6,690	3,100	*1,910	1,360	1,030
6	10,700	6,580	*3,050	2,190	1,350	1,030
7	11,500	5,910	2,930	2,020	1,310	1,030
8	12,000	6,050	2,930	1,920	1,290	*1,020
9	14,500	6,410	2,840	1,870	1,270	1,020
10	*13,100	6,170	2,790	*1,930	1,270	1,160
11	12,000	a7,800	2,760	1,820	1,350	1,400
12	11,600	6,970	*2,760	1,790	1,310	1,270
13	10,800	6,580	2,790	1,760	1,300	1,230
14	10,600	6,310	2,840	*1,880	1,270	1,210
15	9,600	6,160	2,840	1,630	1,260	*1,190
16	*7,830	5,540	*2,780	1,610	1,250	1 110
17	7,830	5,300	2,580	*1,430	1,230	1,120
18	7,590	*5,270	2,450	1,380	1,230	1,110
19	7,530	5,360	2,330	1,380	*1,220	1,070
20	8,040	5,370	*2,240	*1,380	1,210	1,080
21	8,010	*5,240	2,250	1,370	1,210	1,030
22	7,760	5,230	2,290	1,350	1,200	1,030
23	*7,170	*4,540	2,310	1,320	1,210	1,030
24	6,160	4,350	*2,330	1,310	1,190	*1,010
25	6,020	4,250	2,290	*1,310	1,160	1,020
26	6,380	*3,890	2,180	*1,290	1,110	1,010
27	*6,960	3,590	2,110	1,270	1,070	971
28	7,450	*3,390	2,020	1,270	1,060	964
29	7,710	3,170	1,970	1,350	1,050	978
30	7,610	3,100	*1,930	*1,460	1,040	992
31	6,680	3,020	———	1,350	———	*985
Mean	9,190	5,430	2,620	1,620	1,250	1,070
Cs/mi	9.99	5.90	2.85	1.76	1.36	1.16
In	11.5	6.80	3.18	2.03	1.51	1.35
Ac-ft.	565,000	334,000	156,000	99,800	74,100	66,100

Acre-feet. 2,560,000 Max Day 14,500 Min Day 787

KUNHAR RIVER NEAR GARHI HABIB ULLAH

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
18 Jan	1,820	38	45			
15 Feb	1,750	48	45			
29 Feb	1,970	50	41			
15 Mar	1,910		13			
21 Mar	2,140	48	55			
28 Mar	2,270	48	75			
1 May	5,300	55	281			
1 May	5,410	60	259			
15 May	3,850	55	491			
21 May	4,940	54	357			
24 May	5,540	54	290			
4 Jun	7,830	58	307			
7 Jun	9,210	56	305			
21 Jun	11,700	54	293			
10 Jul	12,200	55	281			
16 Jul	7,790	55	179			
23 Jul	7,280	55	208			
27 Jul	7,140	60	352			
2 Aug	6,120	58	265			
18 Aug	5,400	63	273			
21 Aug	4,970	63	223			
26 Aug	4,090	61	222			
12 Sep	2,600	59	87			
24 Sep	2,280	62	44			
5 Oct	1,920	58	45			
10 Oct	1,910	53	59			
20 Oct	1,390	54	103			
25 Oct	1,330	53	35			
30 Oct	1,450	43	20			
3 Nov	1,460	46	56			
24 Dec	1,030	41	6			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KUNHAR RIVER NEAR GARHI HABIB ULLAH

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
15	1.03	1.97	0.25		Traces	1.76	0.19	1.20			3.25	3.15				188	300	8.19	0	0.2
29	0.61	1.49	0.20		0.18	1.93	0.14	0.13			2.30	2.38				124	220	8.27	0.01	0.2
Mar																				
15	2.00	0.88	0.20		0.09	1.93	0.14	0.81			2.30	2.38				124	220	8.27	0.01	0.2
19	1.72	0.87	0.12		0	1.50	0.14	0.57			2.69	2.72				128	230	8.12	0	0.2
21	2.15	0.54	0.20		Traces	1.86	0.14	0.72			2.89	2.72				160	280	8.21	0	0.2
Apr																				
24	1.79	0.36	0.15			1.46	0.10	0.80			2.30	2.36				120	220	7.99	0	0.1
May																				
15	1.58	0.22	0.15		0.16	1.08	0.10	1.60			1.95	1.96				112	180	8.20	0	0.2
Jun																				
4	1.26	0.34	0.15		0	1.20	0.15	0.40			1.75	1.75				94	170	7.99	0	0.2
21	1.15	0.15	0.08		0	1.01	0.14	0.20			1.38	1.35				74	130	7.99	0	0.3
Aug																				
21	1.44	0.33	0.25		0	1.25	0.09	0.60			2.02	1.94				110	200	8.02	0	0.3
Sep																				
12	1.25	0.22	0.55			1.15	0.14	0.82			2.02	2.11				112	200	7.80	0	0.7
26	1.09	0.22	0.22			1.00	0.09	0.45			1.53	1.54				84	150	7.75	0	0.3
Nov																				
3	1.87	0.61	0.18		0	1.45	0.10	1.16			2.66	2.71				154	250	7.20	0	0.2
12	2.04	0.31	0.18		0	1.45	0.10	1.00			2.53	2.55				154	250	7.80	0	0.2
19	2.22	0.29	0.22		0	1.45	0.10	1.20			2.73	2.75				164	270	7.80	0	0.2
Dec																				
24	1.99	0.68	0.30		Traces	1.71	0.19	1.00			2.97	2.90				154	280	8.18	0	0.3

Blank page retained for pagination

Location Latitude 34°07', Longitude 73°30', on left bank upstream of Kohala Bridge on Murree-Muzaffarabad Road. A new gauge was installed nearly 1½ miles downstream of the bridge on right bank near the cableway.

Drainage area 9,610 square miles.

Records available Gauge height record from January 1960 to date by Surface Water Hydrology Project WAPDA. Periodic discharge measurements started from December 1964. Gauge height record from 1899 to date with Hydrology Directorate of Irrigation Department, Lahore.

Average discharge 32,400 cusecs (23,500,000 acre-feet per year or 45.9 inches runoff per year). Average taken for 4 years from 1965 to 1968.

Extremes Maximum discharge during the year 92,100 cusecs on 11 June (gauge height 57.85 feet); minimum daily discharge 6,970 cusecs on 9 December.

1965-68: Maximum discharge observed 132,000 cusecs on 24 April 1965 (gauge height 64.00 feet); minimum daily discharge 3,670 cusecs on 27-28 January 1966.

Gauge Staff gauge fixed on left bank upstream of Kohala Bridge. Lowest gauge piece fixed on bridge pier and approachable from right bank. Gauge being read at one hour interval throughout the year. R.L. of gauge 1828.94.

Measurements Sixty one discharge measurements were made during the year using 0.2 and 0.8 depth method from a cableway nearly 1½ miles downstream of bridge. Fifty four sets of sediment samples were taken by depth integration method using D-49 sampler from cableway. Eleven of these were analysed for particle size distribution and the rest for total concentration. Twenty two surface samples were collected and analysed for chemical composition.

Determination of discharge The station is controlled by the characteristics of the channel. The stage discharge relation could be affected by movement of stones and boulders on the bed of the channel. Rating dated 10.8.68 was used to compute the mean daily discharges.

Remarks Record fair.

JHELUM RIVER AT KOHALA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	9,150	*7,700	14,300	24,800	67,100	57,800
2	9,090	7,660	*14,200	23,400	*67,700	59,200
3	9,030	7,730	14,300	21,700	61,700	58,500
4	9,050	7,700	14,700	21,800	56,900	64,300
5	*9,030	7,720	15,000	22,900	55,400	61,400
6	9,090	7,890	15,700	25,200	51,800	63,100
7	9,060	7,860	16,000	30,200	48,600	71,400
8	*8,670	*7,890	*16,600	32,400	45,100	75,100
9	8,530	7,770	17,100	30,800	*42,900	79,500
10	8,790	7,690	17,500	*30,800	40,700	81,100
11	8,560	7,630	*18,800	30,100	*38,900	86,700
12	8,870	7,610	20,000	31,300	41,200	83,800
13	8,690	7,610	20,200	33,600	44,800	80,500
14	8,190	7,700	20,300	35,400	49,200	77,100
15	8,040	*7,720	20,300	40,400	48,100	75,800
16	*8,030	7,820	*21,200	*40,300	*43,400	77,600
17	8,030	7,830	22,800	38,400	42,500	77,800
18	8,000	7,930	27,500	38,400	42,200	76,900
19	8,000	8,110	32,000	38,600	45,000	75,000
20	8,540	*10,200	31,200	42,800	47,600	*71,200
21	8,100	9,360	30,400	45,800	*48,300	73,300
22	7,790	9,120	27,700	*50,300	*53,800	74,000
23	7,610	9,450	26,900	53,800	52,500	74,500
24	*7,790	9,710	26,700	54,000	52,600	74,500
25	7,870	10,500	27,100	56,800	*55,000	77,100
26	7,660	11,900	29,600	58,800	55,600	79,100
27	7,760	*15,200	29,900	*60,600	52,800	73,600
28	7,960	14,800	27,700	61,700	49,100	68,900
29	8,080	14,600	26,700	62,500	48,100	62,200
30	7,960	———	25,700	63,800	*53,400	*58,600
31	7,650	———	24,300	———	55,400	———
Mean	8,340	9,050	22,300	40,000	50,200	72,300
Cs/mi	0.87	0.94	2.32	4.16	5.22	7.52
In	1.00	1.02	2.68	4.65	6.03	8.40
Maf	.513	.520	1.37	2.38	3.09	4.30

1968 year: Mean 28,000 Cs/sq mi 2.91 Inches 39.7

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	58,700	40,000	21,700	11,000	11,900	7,680
2	61,800	*40,300	*21,700	11,200	*11,700	7,610
3	65,800	a39,000	21,700	11,000	11,400	7,620
4	63,100	38,100	21,500	11,500	11,800	*7,610
5	61,500	37,800	20,700	11,200	11,500	7,470
6	61,900	40,700	*20,100	*11,300	11,300	7,340
7	64,800	35,800	19,900	12,400	11,100	7,230
8	*65,800	34,700	19,200	11,900	10,800	7,100
9	64,600	*36,000	*18,600	11,400	*10,600	6,970
10	70,400	37,200	17,400	*11,800	10,400	7,410
11	*64,800	*42,000	16,400	11,700	10,600	9,530
12	*64,300	42,100	15,800	11,400	10,800	*10,700
13	62,600	41,600	*15,700	11,200	10,800	10,300
14	61,700	39,600	15,400	12,000	10,900	9,500
15	55,900	39,900	16,500	12,000	10,700	9,210
16	52,600	*37,400	16,700	12,100	10,300	9,030
17	*46,800	36,200	*15,500	12,100	* 9,970	8,820
18	43,500	36,200	14,400	11,700	9,720	*8,560
19	41,100	*35,300	13,600	11,200	9,530	8,220
20	43,000	a34,800	13,100	11,200	9,420	8,010
21	46,100	34,400	13,200	11,200	9,350	7,980
22	43,100	*36,400	*13,500	10,900	9,150	7,970
23	42,700	34,800	13,500	10,600	*8,880	7,820
24	*37,400	31,400	14,000	10,500	8,590	*7,650
25	36,100	*31,200	13,700	10,200	8,470	7,630
26	38,500	30,100	13,100	10,000	8,310	7,580
27	41,400	28,000	*12,700	9,780	8,210	7,580
28	*43,100	25,800	12,200	9,570	8,080	7,340
29	48,600	*24,900	11,500	9,560	8,040	*7,070
30	49,300	23,700	*11,000	10,400	*7,870	7,060
31	43,200	22,700	———	10,600	———	7,280
Mean	53,000	35,100	16,100	11,100	10,000	8,030
Cs/mi	5.52	3.65	1.68	1.16	1.04	0.84
In	6.36	4.21	1.87	1.33	1.16	0.96
Maf	3.26	2.16	.960	.684	.595	.494

M. Acre-feet 20.3 Max Day 86,700 Min Day 6,970

JHELUM RIVER AT KOHALA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
5 Jan	8,970	52	46			
8 Jan	8,880	41	82			
16 Jan	8,080	41	30			
24 Jan	7,750	41	71			
1 Feb	7,770	42	33			
8 Feb	7,940	44	43			
15 Feb	7,750	45	38			
20 Feb	10,500	44	1,170	7	63	30
27 Feb	16,700	45	1,820	19	58	23
2 Mar	14,300	51	23			
8 Mar	16,800	54	224			
10 Mar	17,700	62	143			
11 Mar	18,700	52	194			
16 Mar	21,700	53	247			
9 Apr	42,300		103			
16 Apr	39,700	59	1,230	7	37	56
22 Apr	51,400	57	253			
27 Apr	61,100		284			
2 May	69,000	61	278			
11 May	38,500	56	160			
16 May	43,400	57	200			
21 May	50,300	56	92			
22 May	52,700	51	314			
25 May	56,600	57	303			
30 May	55,000	58	132			
12 Jul	65,100	64	1,820	66	28	6
17 Jul	46,300	68	273			
24 Jul	36,600	69	183			
2 Aug	42,300	71	915	36	52	12
9 Aug	36,500	80	1,170	46	40	14
11 Aug	46,000	69	1,300	4	74	22
16 Aug	36,100	72	968	25	54	21
19 Aug	36,800	78	1,250	13	47	40
22 Aug	40,500	74	1,970	12	64	24
29 Aug	25,100	78	135			
2 Sep	22,100	71	144			
6 Sep	20,400	72	111			
9 Sep	18,800	74	65			
13 Sep	15,900	78	77			
17 Sep	15,100	79	88			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
22 Sep	13,800		98			
17 Sep	12,500	65	97			
30 Sep	10,800	74	92			
6 Oct	11,200	59	164			
10 Oct	12,100	60	157			
2 Nov	10,800	52	168			
9 Nov	10,600	53	44			
17 Nov	9,900	54	31			
22 Nov	8,900	54	45			
30 Nov	7,900	52	116			
4 Dec	7,620	54	44			
12 Dec	10,800	50	517	13	77	10
18 Dec	8,500	55	155			
24 Dec	7,620	54	169			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

JHELUM RIVER AT KOHALA

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
20	1.85	0.75	0.18		0	2.13	0.14	0.50			2.78	2.77				155	260	7.75	0	0.1
Mar																				
2	1.85	0.65	0.18		0	2.04	0.10	0.50			2.68	2.64				151	250	7.70	0	0.1
8	1.73	0.38	0.20		0.16	1.78	0.19	0.25			2.31	2.38				156	230	8.25	0	0.2
20	1.92	0.30	0.12		0	1.88	0.14	0.23			2.34	2.25				120	220	7.80	0	0.1
Apr																				
10	1.46	0.80	0.30		0.28	1.78	0.24	0.28			2.56	2.58				140	250	8.30	0	0.3
16	1.47	0.43	0.15		0	1.27	0.10	0.70			2.05	2.07				110	200	7.80	0	0.2
May																				
2	1.47	0.33	0.17		0	1.39	0.10	0.52			1.97	2.01				104	190	7.80	0	0.2
16	1.58	0.22	0.15		0.18	1.31	0.15	0.30			1.95	1.94				112	190	8.20	0	0.2
21	1.37	0.53	0.15		0	1.40	0.14	0.50			2.05	2.04				110	200	8.13	0	0.1
Jul																				
8	1.37	0.23	0.25		0	1.24	0.10	0.50			1.85	1.84				102	180	8.10	0	0.3
28	1.57	0.43	0.30		0.16	1.29	0.20	0.60			2.30	2.25				114	210	8.30	0	0.3
Aug																				
16	1.26	0.49	0.25		0	1.29	0.10	0.50			2.00	1.89				100	180	8.05	0	0.3
29	1.41	0.59	0.40		0.16	1.33	0.25	0.55			2.40	2.29				120	220	8.30	0	0.4
Sep																				
9	1.44	0.38	0.25		0	1.40	0.10	0.43			2.07	1.93				118	200	7.88	0	0.3
22	1.82	0.32	0.25		0	1.50	0.14	0.64			2.39	2.28				130	230	7.80	0	0.2
30	1.48	0.66	0.18		0	1.60	0.14	0.60			2.32	2.34				152	230	8.00	0	0.2
Oct																				
6	1.43	0.92	0.18		0	1.70	0.09	0.69			2.53	2.48				150	240	8.05	0	0.2
Nov																				
2	1.70	0.65	0.18		0	1.65	0.10	0.76			2.53	2.51				154	250	7.80	0	0.2
23	1.76	0.59	0.18		0	1.75	0.14	0.71			2.53	2.60				154	250	7.80	0	0.2
Dec																				
4	1.93	0.53	0.20		0	1.93	0.14	0.58			2.66	2.65				148	250	7.90	0	0.2
24	2.04	0.47	0.20		0	2.07	0.19	0.52			2.71	2.78				158	260	7.85	0	0.2
29	2.10	0.46	0.20		0	2.07	0.19	0.46			2.76	2.72				156	260	7.90	0	0.2

BISHAN DAUR KAS NEAR MISSA - 1968

Location Latitude 33°11', Longitude 73°23', 3 furlongs downstream from the Grand Trunk Road, 1⅛ miles south-east of Bishan Daur and 7 miles south-east of Gujar Khan.

Drainage area 58 square miles.

Records available July 1961 to date by Surface Water Hydrology Project WAPDA.

Average discharge 11 cusecs (8,210 acre-feet per year or 2.66 inches runoff per year). Average taken for 7 years from 1962 to 1968.

Extremes Maximum discharge observed during the year 5,690 cusecs on 22 August (gauge height 9.95 feet). Zero flow for many days.

July 1961-68: Maximum discharge observed 8,550 cusecs on 6 August 1967. Zero flow for many days.

Gauge Continuous automatic water stage recorder with natural channel control. Zero of gauge datum at elevation 1363.2 reduced level.

Measurements Seventy three discharge measurements were made during the period. Low water measurements were made by wading and high water measurements from the highway bridge 3 furlong upstream. Fifty two sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading or D-49 sampler from the bridge. Thirty seven of these were analysed for particle size distribution and the rest for total concentration. Twelve surface samples were collected and analysed for chemical composition.

Determination of discharge This stream has a sandy channel that shifts frequently. Rating table dated 18.10.69 was developed from measurements made in 1968 and upto September 1969. Daily mean discharges were computed by using above table with shift adjustments to the gauge heights.

Remarks Record fair. Mean daily discharge figures shown to first place of decimal only.

BISHAN DAUR KAS NEAR MISSA

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	1.5	3.7	3.5	1.5	0	0
2	1.4	3.2	3.2	1.3	0	0
3	1.3	2.8	2.9	1.3	0	0
4	1.1	*2.8	2.8	1.1	0	0
5	1.0	2.8	2.7	1.1	0	0
6	0.8	3.9	2.3	*0.9	0	0
7	1.0	3.6	2.3	0.9	1.2	0
8	0.9	2.8	2.1	0.8	3.6	0
9	1.0	2.5	1.9	0.8	1.8	0
10	0.8	2.5	2.0	0.8	1.3	0
11	0.8	2.5	2.0	*0.8	0.8	0
12	0.8	*2.5	2.1	0.8	0.7	0
13	*0.7	2.4	1.8	0.8	0.2	0
14	0.7	2.5	*1.7	2.9	0	*0
15	0.7	2.8	1.6	3.9	0	0
16	0.7	2.7	1.6	1.8	0	0
17	0.7	2.5	1.5	1.1	0	0
18	0.7	2.5	3.6	1.0	*0	0
19	0.7	3.7	19	0.8	0	0
20	14	*63	*29	0.8	0	0
21	34	15	26	0.7	0	0
22	*6.5	5.8	6.5	0.6	0	0
23	5.0	4.5	4.5	1.7	0	0
24	6.0	4.2	3.7	0.8	0	0
25	5.0	4.0	3.3	0.5	0	0
26	4.5	3.7	5.5	0.5	0	0
27	5.7	7.0	5.2	0.4	0	34
28	*16	6.0	3.3	0.3	0	47
29	11	3.7	2.5	0.2	*0	8.0
30	8.3	—	1.9	*0.1	0	3.3
31	6.8	—	1.6	—	0	—
Mean	4.5	5.9	5.0	1.0	0.3	3.1
Cs/mi	0.08	0.10	0.09	0.02	0.01	0.05
In	0.09	0.11	0.10	0.02	0.01	0.06
Ac-ft.	278	340	305	61	19	183

1968 year: Mean 19 Cs/sq mi 0.33 Inches 4.35

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

KISHAN DAUR KAS NEAR MISSA

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	1.2	13	6.3	0.9	48	1.9
2	0.3	*263	4.3	0.9	18	1.9
3	0	*173	3.9	0.8	3.6	2.1
4	0	5.0	3.6	0.8	2.1	2.1
5	0	1.4	3.5	0.8	1.8	2.2
6	0	*54	3.0	0.8	1.7	2.2
7	0	22	2.9	11	*1.6	2.2
8	0	*71	2.8	3.6	1.6	2.2
9	*28	*82	2.5	1.8	1.6	2.2
10	4.0	*164	2.7	1.1	1.7	2.2
11	2.9	*792	2.5	0.7	1.8	3.2
12	8.8	* 30	2.3	0.8	1.9	3.2
13	22	16	2.3	0.8	1.9	2.3
14	*50	9.6	2.1	0.8	2.1	3.2
15	30	*476	1.9	0.7	*1.9	2.5
16	93	*39	1.9	0.8	1.9	2.4
17	26	11	1.9	0.7	1.9	2.4
18	*96	*5.3	1.6	0.7	1.8	2.4
19	42	*461	1.6	0.7	1.9	2.3
20	13	*27	*1.9	0.7	1.9	a 2.3
21	*138	*201	2.1	0.7	2.1	a 2.4
22	*545	*1,240	*1.8	0.7	2.1	a 2.4
23	*238	60	1.8	*0.7	1.9	2.4
24	26	20	1.7	0.7	1.9	*2.4
25	*6.8	23	*1.6	0.7	1.9	2.4
26	3.6	9.2	1.4	0.7	1.9	2.4
27	2.7	*7.0	1.1	0.7	1.9	2.4
28	1.9	8.9	*1.0	0.7	1.9	2.4
29	1.6	9.6	0.9	0.7	1.9	2.4
30	*82	*54	0.9	0.8	*1.9	2.4
31	*29	*39	—	0.7	—	2.4
Mean	48	142	2.3	1.2	4.0	2.4
Cs/mi	0.83	2.44	0.04	0.02	0.07	0.04
In	0.96	2.81	0.04	0.02	0.08	0.05
Ac-ft.	2,960	8,700	138	75	238	146

Acre-feet. 13,400 Max Day 1,240 Min Day 0

BISHAN DAUR KAS NEAR MISSA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	0.7	58	58			
22 Jan	6.3	59	6			
28 Jan	14	54	139			
12 Feb	2.5		39			
20 Feb	144	52	2,380	5	50	45
29 Feb	3.7		43			
14 Mar	1.7	70	507	2	16	82
20 Mar	26	57	2,390	3	26	71
6 Apr	0.9	80	82			
11 Apr	0.8	81	59			
9 Jul	192		39,300	8	63	29
9 Jul	105		35,000	3	76	21
14 Jul	14	82	2,000	1	39	60
14 Jul	12	94	2,930	2	46	52
18 Jul	388	84	31,800	3	59	38
18 Jul	290	84	28,000	5	62	33
21 Jul	298	75	21,600	3	65	32
21 Jul	86	88	5,970	1	56	43
22 Jul	448	85	34,200	2	61	37
23 Jul	59	72	4,710	1	19	80
23 Jul	759	72	8,160	2	63	35
30 Jul	35	78	4,070	1	58	41
30 Jul	237	78	7,930	2	47	51
2 Aug	742	78	7,850	2	47	51
2 Aug	156	88	4,680	7	51	42
3 Aug	433	85	4,690	3	36	61
3 Aug	152	78	3,400	8	61	31
6 Aug	278	83	17,900	10	57	33
8 Aug	260	88	15,600	12	56	32
9 Aug	210	78	16,000	9	61	30
10 Aug	470	79	19,600	11	70	19
11 Aug	975	88	6,280	5	62	33
11 Aug	187	85	6,610	7	66	27
15 Aug	1,300	78	10,800	14	74	12
15 Aug	298	78	8,060	7	49	44
16 Aug	39	86	475	1	29	70
18 Aug	5.7	90	74			
19 Aug	654	78	19,200	8	58	34
19 Aug	908	80	22,500	15	65	20
19 Aug	172	85	3,890	5	57	38

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
20 Aug	27	87	265			
21 Aug	578	77	11,600	6	58	36
21 Aug	262	84	6,470	9	42	49
22 Aug	2,560	81	7,040	10	61	29
27 Aug	12	91	143			
30 Aug	176	78	14,800	10	68	22
31 Aug	167	78	18,100	12	65	23
7 Sep	8.5	88	89			
20 Sep	4.0	90	127			
22 Sep	3.7		65			
25 Sep	3.5	76	30			
28 Sep	2.2	90	32			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

NISHAN DAUR KAS NEAR MISSA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
28	1.44	2.56	8.60		0.74	5.95	3.66	2.80			12.60	13.15				780	1200	8.29	0	6.1
Feb																				
20	1.03	1.57	6.09		0.46	3.67	2.54	2.00			8.69	8.67				464	870	8.45	1.53	5.3
Apr																				
6	1.37	1.33	5.60		0.53	3.61	2.52	1.60			8.30	8.26				500	830	8.42	1.44	4.8
Jul																				
14	1.05	0.85	4.80		0	2.06	2.97	1.70			6.70	6.73				374	670	8.16	0.16	4.9
Aug																				
6	1.26	0.69	2.49		0.16	2.10	1.03	1.20			4.44	4.49				244	440	8.24	0.31	2.5
11	1.44	0.43	1.35		0.31	1.99	0.73	0.17			3.22	3.20				192	320	8.20	0.43	1.4
15	1.37	0.63	2.06		0.16	1.86	1.03	1.00			4.06	4.05				222	400	8.33	0.02	2.1
19	1.16	0.44	1.28		0.18	1.98	0.49	0.25			2.88	2.90				164	280	8.20	0.56	1.4
20	1.71	0.64	3.50		0.36	2.70	1.88	0.90			5.85	5.84				336	570	8.30	0.71	3.2
21	1.11	0.28	1.40		Trace	1.90	0.59	0.26			2.79	2.75				158	270	8.15	0.51	1.7
22	0.84	0.61	1.80		0	2.12	0.88	0.48			3.25	3.48				185	320	8.18	0.67	2.1
30	1.31	1.03	5.35		0.39	2.23	2.54	2.54			7.69	7.70				460	770	8.38	0.28	5.0

POONCH RIVER NEAR KOTLI - 1968

Location Latitude 33°29', Longitude 73°53', on left bank just downstream from Ban Nullah, 3 miles southwest of Kotli and 29 miles northeast of Mangla.

Drainage area 1,250 square miles.

Records available Discharge records November 1959 to date(with automatic water-stage recorder since September 1960) by Surface Water Hydrology Project WAPDA. August 1954 to December 1956 by Dams Investigation Circle, data with Indus Basin Development Board, Lahore.

Average discharge 4,180 cusecs (3,030,000 acre-feet per year or 44.5 inches runoff per year). Average taken for 9 years from 1960 to 1968.

Extremes Maximum discharge observed during the year 122,000 cusecs on 29 July (gauge height 19.00 feet); minimum daily discharge 754 cusecs on 31 December.

1960-68: Maximum discharge 327,000 cusecs on 8 September 1966; minimum daily discharge 203 cusecs on 23 January 1961.

Gauge Automatic water-stage recorder in masonry shelter. Prior to September 1960 staff gauges near same site. Zero gauge datum at 1673.31 R.L. The staff being read at one hour interval daily and used for period of no-record shown by the recorder or when it is not working properly.

Measurements Ninety three discharge measurements were made periodically by current meter at 0.2 and 0.8 or 0.6 depth from car on overhead cableway near the gauge. Seventy four sets of sediment samples were taken by depth integration method using D-49. Thirty five of these were analysed for particle size distribution and the rest for total concentration. Twenty three surface samples were collected and analysed for chemical composition.

Determination of discharge This station has an unstable control that shifts readily during the numerous rises that occur. Rating dated 6.5.69 was used. Discharges were computed by shifting control method based on discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,750	*4,400	5,070	3,660	4,780	2,820
2	2,620	3,940	4,900	3,510	4,950	2,870
3	2,510	*3,730	*4,880	3,370	4,040	2,850
4	2,380	3,620	4,820	3,350	3,510	*4,020
5	*2,170	3,390	4,880	*3,690	3,390	*3,490
6	2,450	5,460	4,800	4,590	3,160	2,850
7	2,380	4,610	*4,760	4,610	2,950	2,850
8	2,050	3,900	4,820	4,420	*2,500	*3,370
9	1,910	3,580	4,800	4,360	2,160	3,390
10	2,070	3,490	4,690	4,120	*2,000	3,800
11	2,330	3,480	4,840	3,860	2,160	3,670
12	2,260	3,460	4,820	3,820	2,350	*6,470
13	2,380	3,440	4,650	3,730	2,710	3,620
14	2,180	3,760	4,720	7,690	3,020	3,400
15	2,040	3,530	4,440	13,300	2,620	*3,440
16	2,030	3,400	4,380	6,520	*2,530	3,420
17	2,000	3,420	4,530	5,480	2,440	3,480
18	1,960	3,460	*9,850	5,030	2,510	3,350
19	1,920	3,760	14,800	4,930	2,650	3,460
20	*12,900	19,800	9,900	4,900	3,180	3,460
21	11,000	6,270	7,950	4,970	*4,190	3,350
22	6,250	5,790	6,210	4,880	*6,690	3,280
23	4,440	5,420	*5,680	5,920	5,970	3,240
24	4,340	*5,160	5,220	5,200	*3,530	3,260
25	4,240	5,050	*4,880	4,840	*2,750	4,820
26	4,340	5,280	*8,140	4,670	2,680	5,770
27	7,100	*10,700	*5,550	4,800	2,850	3,980
28	12,100	7,930	4,590	4,780	*2,740	4,480
29	7,750	5,830	3,940	4,760	2,690	3,800
30	4,900	———	3,690	4,800	2,720	3,140
31	4,690	———	3,730	———	2,850	———
Mean	4,080	5,140	5,640	4,950	3,200	3,640
Cs/mi	3.26	4.11	4.51	3.96	2.56	2.91
In	3.76	4.43	5.20	4.42	2.95	3.25
Maf	.251	.296	.347	.295	.197	.217

1968 year: Mean 4,100 Cs/sq mi 3.28 Inches 44.6

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

POONCH RIVER NEAR KOTLI

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	2,800	*6,610	3,670	1,650	3,790	*872
2	2,940	6,690	*3,390	*1,570	*4,750	858
3	2,820	*5,090	3,190	1,530	*2,250	830
4	*3,420	*11,300	3,110	*2,970	1,950	830
5	3,230	9,390	2,950	2,560	*1,860	*816
6	3,640	*23,400	*2,820	2,130	1,750	823
7	3,010	6,540	2,740	*7,690	1,610	809
8	*3,400	7,050	2,630	2,970	1,510	788
9	*7,530	9,640	2,850	2,030	1,440	795
10	*6,140	*9,020	*2,570	*2,350	1,390	809
11	4,780	*30,300	2,420	1,990	1,360	1,080
12	*7,890	12,400	2,840	1,600	1,570	*2,920
13	5,240	9,840	2,480	*1,500	1,480	1,410
14	*8,550	14,500	*2,360	*2,900	1,300	*1,060
15	4,440	*11,100	2,270	2,780	1,300	978
16	*4,460	8,230	2,390	*2,070	1,240	928
17	3,570	8,310	*2,300	1,810	*1,190	886
18	3,370	*13,900	2,210	1,810	1,160	851
19	4,670	*18,500	2,200	1,570	1,150	830
20	4,710	10,400	2,140	*1,460	1,110	802
21	*7,210	7,200	1,990	1,410	1,090	795
22	5,350	*12,100	*1,920	1,360	1,070	809
23	6,960	7,850	1,850	1,300	1,070	802
24	4,990	6,540	1,780	1,290	986	802
25	3,490	*6,740	1,750	1,270	942	879
26	*2,940	5,330	*1,750	1,230	935	879
27	*3,240	4,590	1,730	*1,210	907	*858
28	*6,740	*4,220	1,910	1,180	907	816
29	*42,000	3,960	1,840	1,130	907	*788
30	*7,800	3,880	1,730	1,190	907	760
31	5,940	3,860	———	1,240	——	754
Mean	6,040	9,630	2,390	1,960	1,500	933
Cs/mi	4.83	7.70	1.91	1.57	1.20	0.75
In	5.57	8.88	2.14	1.81	1.34	0.86
Maf	.371	.592	.142	.120	.089	.057

M. Acre-feet 2.97 Max Day 42,000 Min Day 754

POONCH RIVER NEAR KOTLI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
5 Jan	2,110		32			
20 Jan	28,100		3,490	57	31	12
3 Feb	3,920		29			
3 Feb	3,730		31			
24 Feb	5,180		60			
27 Feb	14,400		1,800	59	22	19
3 Mar	5,030		13			
7 Mar	4,880		65			
18 Mar	22,000		157			
23 Mar	5,680		234			
25 Mar	4,690		239	24	12	64
26 Mar	14,600		144			
27 Mar	5,010		195			
5 Apr	3,800		1,380	25	36	39
8 May	2,540		226			
10 May	2,010		46			
13 May	2,680		127			
16 May	2,680		27			
20 May	3,570		542	2	56	42
21 May	8,030	78	4,200	19	62	19
22 May	7,300	80	1,970	9	52	39
24 May	3,420	79	2,030	2	33	65
25 May	2,740	77	110			
28 May	2,740	80	116			
4 Jun	5,090		242			
5 Jun	3,490		2,500	1	71	28
8 Jun	3,620	75	204			
10 Jun	4,260	76	1,190	1	65	34
12 Jun	6,520	82	4,610	6	73	21
4 Jul	4,200		1,350	1	65	34
8 Jul	3,330		182			
9 Jul	12,100	76	9,610	17	57	26
10 Jul	7,680	64	6,840	2	63	35
12 Jul	8,250	62	4,340	16	66	18
14 Jul	8,760	61	7,480	1	65	35
16 Jul	4,800	60	1,820	2	53	45
21 Jul	7,100	58	3,330	8	68	24
25 Jul	3,490	57	47			
29 Jul	87,000	58	10,900	22	56	22
30 Jul	7,350	54	1,810	5	64	31

POONCH RIVER NEAR KOTLI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Aug	11,000	55	2,350	6	78	16
3 Aug	8,490	57	2,660	6	75	19
4 Aug	27,500	52	3,080	7	68	25
6 Aug	56,500	51	9,220	19	67	14
10 Aug	6,190	52	419	4	31	65
11 Aug	23,300	50	2,290	8	73	19
15 Aug	11,400	48	1,480	7	59	34
18 Aug	27,500	43	3,750	24	65	11
19 Aug	37,900	46	2,800	7	69	24
22 Aug	14,700	51	6,400	10	57	33
25 Aug	6,010	42	218			
28 Aug	4,240	44	111			
2 Sep	3,400	48	23			
6 Sep	2,850	42	84			
10 Sep	2,540		46			
14 Sep	2,350		35			
17 Sep	2,380		61			
22 Sep	1,920		42			
26 Sep	1,770		72			
2 Oct	1,600		37			
4 Oct	3,480		3,060	1	55	44
7 Oct	10,900		3,920	16	59	25
10 Oct	2,560		90			
13 Oct	1,500		67			
14 Oct	3,860		753	18	44	38
16 Oct	2,080		55			
20 Oct	1,450		156			
2 Nov	4,900		667	7	58	35
3 Nov	2,250		152			
5 Nov	1,900		42			
10 Nov	1,410		30			
17 Nov	1,190		6			
12 Dec	4,720		862	7	49	44
27 Dec	880		7			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

POONCH RIVER NEAR KOTLI

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
5	2.06	1.14	0.35			3.25	0.14	0.20			3.55	3.59				184	330	7.92	0.05	0.3
20	1.44	0.46	0.10			1.90	0.10	0.10			2.00	2.10				110	190	7.82	0	0.1
Feb																				
24	1.45	0.82	0.20		0.18	2.20	0.19	0.14			2.57	2.71				144	250	8.16	0.26	0.3
27	1.89	0.56	0.30		0.18	2.39	0.14	0.17			2.75	2.86				152	260	8.20	0.12	0.3
Mar																				
3	1.47	0.83	0.30		0.18	2.20	0.10	0.12			2.60	2.60				148	250	8.15	0.08	0.3
13	1.89	0.91	0.25		0.19	2.52	0.05	0.30			3.05	3.06				154	290	8.23	0.21	0.2
May																				
20	1.47	0.63	0.15		Traces	1.89	0.14	0.20			2.25	2.23				114	200	8.20	0	0.1
24	1.47	0.83	0.22		Traces	2.06	0.10	0.40			2.52	2.56				130	230	8.20	0	0.2
28	1.37	0.68	0.15		Traces	1.71	0.10	0.40			2.20	2.21				114	200	8.20	0	0.1
Jun																				
4	1.37	0.73	0.30		0	1.89	0.15	0.40			2.40	2.44				130	240	7.99	0	0.3
12	1.79	0.61	0.45		0.16	2.10	0.14	0.50			2.85	2.90				154	280	8.20	0	0.4
Jul																				
10	1.68	0.32	0.40		Traces	1.76	0.14	0.50			2.40	2.40				134	240	8.10	0	0.4
14	1.68	0.32	0.45		0	1.80	0.14	0.50			2.45	2.44				124	230	7.83	0	0.5
Aug																				
6	1.68	0.62	0.30		0.16	1.90	0.10	0.40			2.60	2.56				128	240	8.30	0	0.3
18	1.69	0.70	0.25		0.19	1.78	0.09	0.50			2.64	2.56				145	250	8.28	0	0.2
19	1.74	0.36	0.30		0.09	1.93	0.14	0.25			2.40	2.41				125	230	8.25	0	0.3
Sep																				
14	1.77	0.37	0.28		0.18	1.94	0.19	0.14			2.42	2.45				132	230	8.20	0	0.3
17	1.55	0.54	0.28		0.18	1.94	0.19	0.14			2.37	2.45				134	230	8.20	0.03	0.3
Oct																				
7	2.10	0.19	0.28		0	2.09	0.19	0.30			2.57	2.58				160	260	8.15	0	0.3
14	1.88	0.52	0.28		0.18	2.20	0.14	0.41			2.68	2.70				160	260	8.20	0	0.3
Nov																				
2	1.37	0.66	0.42		Traces	2.11	0.19	0.23			2.45	2.53				136	230	8.15	0.08	0.4
3	1.99	0.78	0.28		0.09	2.43	0.19	0.20			3.05	2.91				168	290	8.15	0	0.2
Dec																				
12	1.76	0.59	0.40		0	2.29	0.24	0.20			2.75	2.73				140	240	8.00	0	0.4

Location Latitude 33°08', Longitude 73°38'; on right bank one furlong downstream from Mangla bridge, wire-weight fixed on new Mangla Bridge on 8.6.67. Continuous water stage recorder installed in masonry well on 12.5.67.

Drainage area 12,900 square miles.

Records available Discharge record June 1958 to December 1966 with automatic water-stage recorder from June 1959 to September 1965 by WAPDA Surface Water Hydrology Project. Gauge height record December 1906 to 1921 and discharge record 1921 to date by Headworks Division. Data available in Hydrology Directorate, Irrigation Branch, Lahore. From 1967 the discharge figures published are the releases through Mangla Dam Spillway only.

Average discharge 31,000 cusecs (22,500,000 acre-feet per year or 32.9 inches runoff per year) for 35 years 1922-56 computed by Hydrology Directorate of Irrigation Department.

33,300 cusecs (24,100,000 acre-feet per year or 35.1 inches runoff per year). Average taken for 9 years from 1958 to 1966. Records computed by Surface Water Hydrology Project. From 1967 the data published is the release through Mangla Reservoir, hence not included in the average.

Extremes 1922-66: Maximum discharge 1,060,000 cusecs on 29 August 1929; minimum discharge approximately 4,500 cusecs.

Gauge Prior to June 1959, staff gauge near the present recorder site was in use. An automatic water stage recorder nearly one furlong downstream of the Mangla bridge was used upto 13.9.65. From 14.9.65 to 11.5.67, old gauge downstream of Mangla Headworks and an automatic water-stage recorder on U.J.C. at R.D. 16,000 were in use. The total flows were computed as discharges downstream of Mangla Headworks plus discharges in U.J.C.

The water-stage recorder was reinstalled on 12.5.67 and a wire-weight gauge was fixed on downstream side of Mangla bridge on 8.6.67. Recorded gauges were used except the period, when water went below the lowest intake pipe of the well. Gauges were computed with the help of wire-weight gauge for such periods.

Measurements One hundred and thirty three discharge measurements were made from the cableway using current meter at 0.2 and 0.8 depth. Eighty eight sets of sediment samples were collected by depth integration method using D-49 sampler. One of these were analysed for particle size distribution and the rest were analysed for total concentration. Twenty two surface samples were collected and analysed for chemical composition.

Determination of discharge Rating table dated 7.8.1969 was used with shift adjustments.

Remarks Record good.

JHELUM RIVER AT MANGLA CABLEWAY

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	6,030	0	*49,600	19,100	64,500	50,800
2	9,450	0	48,800	18,400	*64,800	53,000
3	11,100	0	*48,100	*21,200	63,600	52,600
4	*7,050	0	48,200	19,000	63,800	52,400
5	7,800	0	*50,400	19,900	62,900	*52,400
6	7,980	0	*53,500	21,900	*54,800	52,100
7	8,270	0	52,400	23,000	50,600	52,100
8	7,590	0	52,400	*22,900	50,300	44,900
9	6,330	0	61,800	27,300	*43,200	33,800
10	252	*2,460	72,500	25,200	39,400	*27,400
11	0	27,500	74,200	22,300	*39,300	*23,500
12	0	27,400	65,600	24,200	39,600	27,900
13	0	27,500	*50,100	24,300	43,200	28,600
14	0	*27,500	*41,300	28,600	46,700	*28,600
15	0	26,100	*34,800	*35,500	*52,100	*24,900
16	0	*23,700	28,200	31,400	51,900	25,400
17	0	25,300	22,500	30,600	50,600	48,900
18	0	37,900	*22,600	28,600	51,400	*64,000
19	0	*37,800	22,900	*28,200	54,100	65,500
20	0	37,600	33,000	29,000	*53,200	63,300
21	0	37,500	40,900	27,200	*53,400	60,300
22	0	*37,200	*40,300	28,400	53,200	56,800
23	0	37,000	39,900	30,800	53,100	56,800
24	0	36,800	26,300	*28,600	52,600	56,900
25	0	37,000	21,100	27,200	*52,200	56,800
26	0	37,700	19,000	32,400	51,600	57,400
27	0	*39,900	*14,200	29,900	51,100	57,900
28	0	*50,400	15,400	22,100	50,500	57,900
29	0	49,700	18,600	29,800	50,000	57,900
30	0	———	17,200	53,900	49,600	*57,500
31	0	———	18,700	———	*49,000	———
Mean Cs/mi	2,320	22,900	38,900	27,000	51,800	48,200
In Maf	.143	1.32	2.39	1.61	3.19	2.87

1968 year: Mean 24,100 Cs/sq mi Inches

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	57,100	*6,570	13,700	16,400	24,200	5,250
2	54,700	6,660	*11,900	16,200	*24,700	*6,280
3	49,400	*7,420	13,800	*16,100	24,700	5,210
4	*33,400	6,630	13,800	15,800	24,900	*6,220
5	25,000	6,600	*15,100	* 8,870	*23,300	*4,770
6	*25,400	2,840	11,200	11,100	*22,400	4,750
7	25,500	4,800	*7,560	*9,700	23,300	*4,550
8	25,700	*8,120	25,600	* 6,720	*24,000	5,300
9	19,900	4,720	*34,500	* 6,630	23,700	1,890
10	17,300	0	32,100	* 6,690	23,600	*757
11	17,700	0	29,900	6,840	*23,500	5,250
12	*18,100	1,320	*29,800	*13,500	23,200	5,730
13	18,400	6,900	29,700	21,300	*22,900	3,850
14	18,500	4,180	29,600	*23,900	*26,800	3,340
15	*18,600	2,480	30,600	22,100	*25,400	3,540
16	18,700	7,080	*36,500	21,900	26,500	1,660
17	12,900	*7,170	*38,300	*27,000	30,000	*3,680
18	8,380	7,230	35,500	26,600	*28,900	1,570
19	*6,830	7,290	*32,800	*26,800	26,800	*1,270
20	5,670	*8,420	34,600	26,200	*26,600	a2,170
21	6,240	*12,000	*34,400	*23,500	*29,600	a3,060
22	*7,200	*43,200	32,500	20,400	*30,800	3,960
23	6,540	*46,500	*31,600	30,300	*28,400	3,400
24	*6,480	*25,400	26,700	*21,300	26,100	3,200
25	6,940	9,720	*18,100	20,300	*27,500	3,140
26	6,570	*9,410	16,900	*22,500	20,400	3,100
27	6,570	*7,260	17,700	23,600	*16,700	3,680
28	6,570	7,260	16,700	22,100	16,000	*4,330
29	6,630	*12,700	16,600	22,800	*15,400	3,900
30	*6,840	14,900	16,600	24,700	5,410	1,400
31	*7,710	14,900	———	*24,500	———	1,460
Mean Cs/mi In	17,800	9,990	24,500	18,600	23,900	3,600
Maf	1.09	.614	1.46	1.14	1.42	.221

M. Acre-feet 17.5 Max Day 74,200 Min Day 0

JHELUM RIVER AT MANGLA CABLEWAY

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
4 Jan	3,640	59	34			
10 Feb	27,400	52	121			
12 Feb	27,400	53	21			
14 Feb	27,600	53	19			
16 Feb	24,200	50	33			
19 Feb	37,800	53	7			
22 Feb	37,000	53	29			
27 Feb	38,600	53	19			
28 Feb	49,300	54	13			
1 Mar	49,600	58	36			
3 Mar	48,000	58	61			
5 Mar	47,900	59	20			
6 Mar	54,100	59	471	28	21	51
13 Mar	51,200	59	16			
14 Mar	41,500	59	42			
15 Mar	31,400	58	14			
22 Mar	40,400	62	23			
27 Mar	12,600	62	27			
3 Apr	20,400	64	26			
8 Apr	21,800	65	60			
15 Apr	37,400	67	39			
19 Apr	27,500	67	56			
24 Apr	27,600	67	32			
2 May	64,100	67	60			
6 May	50,900	59	40			
9 May	39,600	63	30			
11 May	39,300	64	21			
15 May	52,200	66	13			
20 May	53,300		26			
21 May	53,300		16			
25 May	52,000		21			
31 May	48,900		91			
5 Jun	52,300		24			
10 Jun	21,600		34			
11 Jun	22,600		14			
14 Jun	29,100		36			
15 Jun	24,900		21			
18 Jun	64,300		28			
30 Jun	57,400		28			
4 Jul	50,200		29			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
6 Jul	25,100		31			
10 Jul	17,400		26			
15 Jul	18,700	75	120			
19 Jul	6,870	85	92			
24 Jul	6,480	82	74			
30 Jul	6,870	92	55			
31 Jul	13,700	84	20			
1 Aug	6,570	78	7			
3 Aug	13,700	74	38			
8 Aug	7,350	76	27			
8 Aug	14,100	76	33			
17 Aug	6,240	89	30			
20 Aug	15,300	77	44			
21 Aug	14,800		25			
22 Aug	60,000	77	132			
23 Aug	45,700	78	19			
26 Aug	12,100	80	48			
27 Aug	8,100	80	34			
29 Aug	14,900	88	34			
2 Sep	13,000	86	11			
5 Sep	15,700	78	22			
7 Sep	8,170	78	90			
9 Sep	33,800		24			
16 Sep	46,100	82	22			
17 Sep	38,500	78	72			
19 Sep	32,500	80	88			
23 Sep	31,900	82	24			
25 Sep	18,000	78	117			
3 Oct	13,700	80	12			
5 Oct	8,770	79	11			
7 Oct	11,100	78	19			
8 Oct	8,280	77	7			
9 Oct	8,310	76	4			
10 Oct	6,690	76	8			
14 Oct	22,600	77	131			
17 Oct	26,500	76	52			
21 Oct	20,400	74	8			
24 Oct	26,600	78	12			
26 Oct	26,800	78	6			
5 Nov	24,100	72	9			

JHELUM RIVER AT MANGLA CABLEWAY

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
6 Nov	22,000	73	12			
8 Nov	23,900	73	17			
14 Nov	29,800	72	13			
15 Nov	22,400	72	17			
18 Nov	26,800	73	19			
21 Nov	32,400	70	16			
23 Nov	30,200	72	1			
2 Dec	4,330	68	11			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

JHELUM RIVER AT MANGLA CARLEWAY

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				ECx10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
10	1.54	0.50	0.20		Traces	1.80	0.14	0.16			2.24	2.10				110	200	8.18	0	0.2
19	1.67	0.38	0.20		Traces	1.86	0.14	0.19			2.25	2.19				116	200	8.19	0	0.2
Mar																				
1	1.73	0.48	0.30		0.18	1.98	0.10	0.19			2.51	2.45				140	230	8.18	0	0.3
22	1.68	0.61	0.25		0.18	1.98	0.14	0.17			2.54	2.47				140	240	8.23	0	0.2
Apr																				
3	1.68	0.52	0.40		0	1.87	0.05	0.68			2.60	2.60				140	240	7.99	0	0.4
24	1.47	0.43	0.30		0	1.69	0.09	0.40			2.20	2.18				114	200	7.94	0	0.3
May																				
2	1.26	0.64	0.15		Traces	1.44	0.10	0.50			2.05	2.04				110	200	8.20	0	0.2
21	1.15	0.25	0.25		0	1.20	0.10	0.30			1.65	1.60				86	160	8.18	0	0.3
Jun																				
5	1.31	0.14	0.30		0	1.33	0.10	0.30			1.75	1.73				88	150	8.18	0	0.3
18	1.20	0.25	0.25		0	1.29	0.10	0.30			1.70	1.69				92	170	8.10	0	0.3
30	1.20	0.14	0.30		0	1.20	0.10	0.40			1.84	1.70				90	160	8.19	0	0.4
Jul																				
6	1.15	0.25	0.25		0	1.11	0.10	0.40			1.65	1.61				90	160	8.18	0	0.3
10	1.20	0.25	0.25		0	1.11	0.10	0.40			1.70	1.61				86	150	8.19	0	0.3
30	1.16	0.14	0.30		0.10	1.05	0.10	0.35			1.60	1.60				82	150	8.22	0	0.4
Sep																				
5	1.21	0.42	0.25		0	1.28	0.14	0.38			1.88	1.80				100	180	8.00	0	0.3
12	1.16	0.37	0.25		0	1.38	0.09	0.28			1.78	1.75				90	170	8.15	0	0.3
16	1.33	0.16	0.20		Traces	1.44	0.09	0.20			1.69	1.73				96	170	8.15	0	0.2
21	1.65	0.32	0.18		0	1.80	0.10	0.20			2.15	2.10				116	210	7.70	0	0.2
Oct																				
5	1.54	0.48	0.18		0	1.75	0.10	0.20			2.20	2.05				122	200	7.80	0	0.2
12	1.15	0.56	0.18		0	1.40	0.14	0.28			1.89	1.82				110	190	8.00	0	0.2
Nov																				
14	1.44	0.27	0.18		0	1.50	0.14	0.26			1.89	1.90				114	190	7.70	0	0.2
25	1.78	0.40	0.15		0	1.93	0.19	0.17			2.33	2.29				124	210	7.80	0	0.2

Blank page retained for pagination

KHOST RIVER AT CHAPPAR RIFT - 1968

Location Latitude 30°20', Longitude 67°30', on right bank just upstream from mouth of Chappar Rift, nine miles upstream from Khost and 20 miles northeast of Quetta.

Drainage area 510 square miles.

Records available July 1961 to date by Surface Water Hydrology Project WAPDA. Periodic discharge measurements started in March 1961.

Average discharge 13 cusecs (9,110 acre-feet per year or 0.32 inches runoff per year). Average taken for 7 years from 1962 to 1968.

Extremes Maximum discharge during the year 922 cusecs on 26 February (gauge height 4.13 feet); minimum daily discharge 3.5 cusecs on many days in October.

1961-68: Maximum discharge observed 5,880 cusecs on 14 July 1964. High water mark at 20.4 feet from unknown date believed to be highest in recent years. Estimated discharge 24,000 cusecs; minimum discharge 2.1 cusecs on 20-23 March 1967.

Gauge Automatic water stage recorder since 14.1.62 set to arbitrary datum. Prior to this gauge readings were taken from a staff fastened to boulders and read to 0.01 foot.

Measurements Thirty three discharge measurements were made by current meter generally at 0.2 and 0.8 depth or 0.6 depth. Low water measurements were made by wading and high water ones from car suspended on overhead cableway. Nineteen sets of sediment samples were taken by the depth-integration method using DH-48 sampler when wading and D-49 sampler from the cableway. Five of these were analysed for particle size distribution and the rest for total concentration. Fifteen surface samples were taken and analysed for chemical composition.

Determination of discharge This station has an unstable bed that shifts continuously. Previous rating dated 14.10.63 with shift adjustments based on periodic discharge measurements, has been used to compute discharge.

Remarks Record fair

KHOST RIVER AT CHAPPAR RIFT

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	6.1	13	126	17	8.2	4.8
2	6.1	13	120	16	8.0	4.8
3	6.3	13	123	16	8.0	4.8
4	6.1	13	113	16	7.7	4.8
5	6.4	15	108	16	7.3	4.8
6	6.4	13	98	17	7.3	4.8
7	6.4	13	87	16	7.3	4.8
8	7.0	13	78	15	7.0	4.8
9	7.4	14	69	15	6.8	4.7
10	7.3	15	78	14	6.7	4.7
11	7.3	15	64	14	6.7	4.7
12	7.4	16	52	13	6.7	4.7
13	7.3	20	59	13	6.7	4.7
14	7.3	22	57	*12	6.6	4.7
15	7.4	23	43	11	6.4	4.7
16	7.6	21	42	10	6.3	4.7
17	7.9	22	39	10	6.3	*4.7
18	7.9	23	35	10	6.6	4.7
19	8.0	37	33	*9.7	6.3	4.7
20	7.9	42	*31	9.5	5.5	4.6
21	8.0	34	28	9.5	5.0	4.6
22	8.7	26	27	9.2	4.8	4.6
23	8.8	26	25	9.0	4.8	4.5
24	9.2	*27	25	9.2	4.9	4.5
25	9.5	35	24	9.0	4.7	4.5
26	11	349	22	8.8	*4.8	4.4
27	12	229	23	8.7	4.8	4.4
28	12	161	22	8.7	4.8	4.4
29	12	150	22	8.5	4.8	4.3
30	12	---	20	8.5	4.9	4.3
31	12	---	19	---	4.8	---
Mean	8.3	49	55	12	6.2	4.6
Cs/mi	0.02	0.10	0.11	0.02	0.01	0.01
In	0.02	0.10	0.12	0.03	0.01	0.01
Ac-ft.	509	2,800	3,400	713	380	276

1968 year: Mean 14 Cs/sq mi 0.03 Inches 0.36

Note : * Discharge measurement made on this day.

KHOST RIVER AT CHAPPAR RIFT

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	4.3	3.9	4.0	3.5	4.5	6.4
2	4.1	4.0	4.0	3.5	4.6	6.4
3	4.1	*3.9	*4.0	3.5	4.7	6.6
4	4.1	3.9	4.0	3.5	4.7	6.7
5	6.1	3.9	*4.0	3.6	4.7	6.7
6	4.7	*3.9	4.0	3.5	4.8	7.6
7	4.1	*13	4.0	3.6	4.8	7.1
8	4.0	*6.4	4.0	3.6	4.9	7.6
9	4.0	5.6	4.0	3.6	5.0	7.7
10	4.3	5.3	4.0	3.6	5.0	7.6
11	4.0	*4.9	*4.0	3.6	5.2	*7.7
12	4.0	4.8	4.0	3.6	5.2	7.7
13	4.0	4.9	*4.0	*3.6	5.3	7.6
14	3.9	4.6	4.0	3.6	5.3	7.7
15	3.9	4.5	*4.0	3.6	5.4	7.6
16	*3.9	4.5	4.0	3.7	5.4	7.6
17	3.9	4.3	*4.0	3.7	5.5	7.6
18	3.9	*4.1	4.0	3.8	5.4	7.4
19	3.9	4.1	4.0	3.8	5.5	7.4
20	3.9	*4.1	4.0	3.8	5.5	7.3
21	3.9	4.1	*4.0	3.9	5.8	7.1
22	3.9	4.1	3.8	3.9	5.8	7.1
23	3.8	*4.4	*3.6	4.0	5.8	7.3
24	*3.9	*4.5	3.6	4.0	5.8	7.0
25	3.9	*10	3.5	4.1	5.8	6.7
26	3.9	3.9	3.5	4.1	6.0	6.8
27	*3.9	*4.0	3.5	4.3	6.0	6.7
28	4.0	4.0	3.5	4.3	6.3	6.8
29	4.0	*4.0	*3.5	4.4	6.3	6.8
30	3.9	4.0	3.5	4.4	6.3	6.8
31	3.9	*4.0	---	4.4	---	6.7
Mean	4.1	4.8	3.9	3.8	5.4	7.2
Cs/mi	0.01	0.01	0.01	0.01	0.01	0.01
In	0.01	0.01	0.01	0.01	0.01	0.02
Ac-ft.	250	297	230	234	320	440

Acre-feet. 9,850 Max Day 349 Min Day 3.5

KHOST RIVER AT CHAPPAR RIFT

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
24 Feb	27	48	2,900	6	34	60
20 Mar	31	58	1,810	12	26	62
14 Apr	12	61	266			
26 May	4.8	72	32			
17 Jun	4.7	65	47			
3 Aug	3.9	65	50			
8 Aug	5.9	68	6,740	5	24	71
11 Aug	5.C	68	154			
18 Aug	4.1	70	84			
23 Aug	4.4	76	28,600	3	55	42
25 Aug	108	68	1,620	0	36	64
27 Aug	4.0	61	156			
31 Aug	4.0	73	42			
5 Sep	4.0	67	35			
13 Sep	4.0	62	36			
17 Sep	4.0	60	54			
23 Sep	3.5	59	84			
29 Sep	3.4	72	143			
13 Oct	3.6	74	19			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KHOST RIVER AT CHAPPER RIFT

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
24	2.06	3.14	5.69		0.27	2.98	1.17	6.40			10.89	10.82				696	1010	8.30	0	3.5
Mar																				
20	1.37	2.43	4.00		0.27	2.07	0.89	4.60			7.80	7.83				470	780	8.26	0	2.9
Apr																				
14	1.16	2.74	3.62		0.36	2.02	0.74	4.50			7.52	7.62				424	710	8.29	0	2.6
May																				
26	1.05	2.65	2.25		0.18	2.25	0.54	3.00			5.95	5.97				350	550	8.20	0	1.7
Jun																				
17	1.37	2.33	1.90		0.17	2.56	0.49	2.40			5.60	5.62				332	520	8.28	0	1.4
Jul																				
16	1.15	2.30	1.58		0.34	1.95	0.59	2.35			5.03	5.23				282	500	8.50	0	1.2
Aug																				
7	2.66	0.92	1.45		0	3.30	0.44	1.38			5.03	5.12				314	510	8.10	0	1.1
8	2.77	1.34	2.66		0.40	2.30	0.69	3.39			6.77	6.78				434	670	8.35	0	1.9
23	2.33	1.90	1.45		0.40	2.80	0.59	1.89			5.68	5.68				362	570	8.45	0	1.0
25	3.33	1.59	8.40		0	3.40	1.38	8.88			13.32	13.66				880	1320	8.02	0	4.9
31	1.44	2.19	1.45		0.40	2.10	0.49	2.03			5.08	5.02				316	500	8.40	0	1.1
Sep																				
23	1.49	2.14	1.45		0.40	2.20	0.59	1.88			5.08	5.07				322	510	8.40	0	1.1
29	1.60	2.25	2.06		0.40	2.40	0.69	2.47			5.91	5.96				372	590	8.35	0	1.5
Oct																				
13	1.43	2.58	1.50		0.18	2.61	0.59	2.18			5.51	5.56				322	530	8.40	0	1.1
Dec																				
11	2.75	2.38	3.10		0.18	3.78	0.79	3.47			8.23	8.22				482	780	8.25	0	1.9

Blank page retained for pagination

Location Latitude 29°31', Longitude 67°49', on Sibi-Quetta highway bridge, 4 miles West of Sibi and 11 miles downstream from Nari Headworks.

Drainage area 8,710 square miles.

Records available May 1961 to date by Surface Water Hydrology Project WAPDA. August 1958 to June 1962 by Hydrology Directorate of Irrigation Department Quetta.

Average discharge 699 cusecs (506,000 acre-feet per year or 1.09 inches runoff per year). Average taken for 6 years from 1962 to 1968 (except 1966).

Extremes Maximum discharge observed during the year 17,800 cusecs on 12 July (gauge height 14.05); minimum daily discharge zero on many days during the year.

1961-68: Maximum discharge 106,000 cusecs on 25 March 1967; river dry at times.

Gauge Wire-weight gauge fastened to upstream handrail of bridge observed to 0.01 foot nine times daily and more often during floods. Gauge set to arbitrary datum.

Measurements Twenty four discharge measurements were made during the year by current meter using 0.2 and 0.8 or 0.6 depth method. Low-water measurements were made by wading and high water measurements were made from the highway bridge. Nineteen sets of sediment samples were taken by depth-integration method using DH-48 sampler when wading or D-49 sampler from bridge. Twelve of these were analysed for particle size distribution and the rest for total concentration. Nine surface samples were collected and analysed for chemical composition.

Determination of discharge Rating dated 7.3.69 was used with shift adjustments where necessary as indicated by discharge measurements.

Remarks Record fair. Diversion at Nari Headworks 11 miles upstream causes river to dry up at times during the year.

NARI RIVER NEAR SIBI

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	406	62	180	0	0	0
2	a 320	45	103	0	0	0
3	234	23	60	0	0	0
4	183	19	33	0	0	0
5	153	18	23	0	0	0
6	190	14	17	0	0	0
7	205	11	13	0	0	0
8	217	8.8	10	0	0	0
9	231	7.0	5.8	0	0	0
10	231	4.6	a 4.6	0	0	0
11	227	2.4	965	0	0	0
12	220	0	759	0	0	0
13	214	0	619	0	0	0
14	211	0	354	0	0	0
15	180	0	729	0	0	0
16	170	144	510	0	0	0
17	*170	75	326	0	0	0
18	68	33	180	*0	0	0
19	29	*22	113	0	*0	*0
20	18	145	85	0	0	0
21	8.8	99	62	0	0	0
22	0	33	51	0	0	0
23	0	47	44	0	0	0
24	0	41	39	0	70	0
25	0	18	28	22	101	0
26	0	8.8	28	0	79	0
27	0	1.2	23	0	71	0
28	75	431	14	0	66	0
29	165	306	*0	0	32	0
30	145	—	0	0	7.0	0
31	74	—	0	—	2.0	—
Mean	140	56	173	0.73	14	
Cs/mi	0.02	0.01	0.02	0.00	0.00	
In	0.02	0.01	0.02	0.00	0.00	
Ac-ft.	8,620	3,210	10,700	44	849	

1968 year: Mean 131 Cs/sq mi 0.02 Inches 0.21

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	530	0	0	0	0
2	91	*262	0	0	0	0
3	160	120	0	0	0	0
4	77	62	0	0	0	0
5	*33	*24	0	0	0	0
6	18	15	*0	0	0	0
7	7.0	*906	0	0	0	0
8	*4.6	825	*0	0	0	0
9	3.6	632	0	0	0	0
10	*1,260	*554	0	0	0	0
11	*2,600	217	0	0	0	*0
12	*7,220	97	*0	0	0	0
13	2,980	19	0	0	0	0
14	783	9.4	0	0	0	0
15	790	*105	0	0	0	0
16	*420	148	*0	0	0	0
17	269	*973	0	*0	0	0
18	287	938	0	0	0	0
19	190	*892	0	0	0	0
20	490	616	*0	0	0	0
21	227	205	0	0	0	0
22	283	77	*0	0	*0	0
23	684	*29	*0	0	0	0
24	3,310	25	*0	0	0	0
25	*2,740	39	0	0	0	0
26	*1,080	7.0	*0	0	0	0
27	862	1.6	0	0	0	0
28	*475	*0.7	*0	0	0	0
29	*211	0	0	0	0	0
30	*95	*0	0	0	0	0
31	41	0	—	0	—	0
Mean	893	269				
Cs/mi	0.10	0.03				
In	0.12	0.04				
Ac-ft.	54,900	16,500				

Acre-feet. 94,800 Max Day 7,220 Min Day 0

NARI RIVER NEAR SIBI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
17 Jan	170	62	308			
19 Feb	18	60	84			
5 Jul	38	87	232			
8 Jul	5.2	90	70			
10 Jul	1,820	94	37,600	10	43	47
12 Jul	17,800	84	46,400	14	52	34
25 Jul	2,880	86	30,600	10	40	50
26 Jul	651	89	20,300	3	24	73
28 Jul	366	93	8,480	4	27	69
29 Jul	224	91	2,500	3	33	64
30 Jul	75	94	254			
7 Aug	664	97	15,600	3	27	70
7 Aug	3,420	92	65,900	6	38	56
10 Aug	406	92	14,200	7	28	65
15 Aug	9.4	86	110			
15 Aug	266	93	1,710	9	23	68
17 Aug	1,800	90	56,600	3	44	53
19 Aug	1,250	93	19,000	7	43	50
28 Aug	0.7	92	111			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

HARI RIVER NEAR SIHI

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
17	2.27	2.73	5.98		0.36	2.79	1.83	6.40			10.98	11.38				698	1050	8.40	0	3.8
Feb																				
19	2.37	1.63	7.70		0.27	2.10	2.05	7.20			11.70	11.62				732	1120	8.30	0	5.4
Jul																				
5	3.15	3.65	8.94		0.16	1.53	1.98	12.00			15.74	15.67				1010	1500	8.40	0	4.9
10	2.67	2.93	7.64		0.16	2.08	1.63	9.30			13.24	13.17				850	1300	8.25	0	4.6
12	2.41	1.69	4.40		0.16	1.91	0.99	5.70			8.50	8.76				550	850	8.23	0	3.1
25	3.88	2.72	9.30		0.16	1.70	2.67	11.20			15.90	15.73				990	1510	8.16	0	5.1
Aug																				
7	5.88	4.00	4.60		0	1.50	1.14	11.51			14.48	14.15				910	1300	8.05	0	2.1
7	6.55	2.12	6.88		0.10	1.55	1.78	11.91			15.55	15.34				1050	1500	8.20	0	3.3
8	6.22	3.06	5.74		0.05	1.53	1.46	11.71			15.02	14.75				980	1400	8.13	0	2.7

Blank page retained for pagination

CHAKKAR RIVER AT TALLI TANGI - 1968

Location Latitude 29°34', Longitude 68°13', on right bank ¼ mile downstream from Talli Tangi, 5 miles northeast of Talli village and 20 miles east of Sibi.

Drainage area 573 square miles.

Records available Discharge records by Surface Water Hydrology Project WAPDA from April 1961 to date, by Hydrology Directorate of Irrigation Department Quetta from November 1958 to June 1962. No record could be collected during the year 1966.

Average discharge 70 cusecs (50,800 acre-feet per year or 1.66 inches runoff per year) for six years from 1962 to 1965 and 1967-68.

Extremes Maximum discharge observed during the year 5,000 cusecs on 10 March (gauge height 7.55 feet); River dry at times.

April 1961-68: Maximum discharge observed 33,000 cusecs on 25 July 1961. River dry at times every year. No record collected in 1966.

Gauge Staff gauge fixed on right bank; observed three times a day during normal flows and hourly readings from 08:00 to 16:00 hours during flood days. Gauge set to arbitrary datum.

Measurements Thirty three discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 depth method or 0.6 depth method. Thirteen sets of sediment samples were taken by the depth integration method using DH-48 sampler while wading or D-49 sampler from the cableway. Six of these were analysed for particle size distribution and the rest for total concentration. Nine surface samples were collected and analysed for chemical composition.

Determination of discharge Channel has a shifting bed. During low flows a katcha bund is usually made by the local people downstream of the gauge for diversion. Rating table dated 7.6.62 was used with shift adjustments as indicated by the individual observations.

Remarks Record fair.

CHAKKAR RIVER AT TALLI TANGI

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	a 11	7.4	a0.5	1.0	0	0
2	a 9.5	7.4	a0.5	1.0	0	0
3	8.2	7.4	a0.5	1.0	0	0
4	8.2	6.6	a0.4	1.0	0	0
5	8.2	6.6	a0.4	1.0	0	0
6	7.4	5.8	a0.4	1.0	0	0
7	6.6	5.8	a0.4	1.0	0	0
8	6.6	5.8	a0.3	1.0	0	0
9	6.6	5.0	a0.3	0.5	0	0
10	5.8	5.0	650	0.5	0	0
11	5.8	4.5	51	0.5	0	0
12	5.8	4.5	12	0	0	0
13	5.0	4.5	0	0	0	0
14	4.5	4.0	81	0	0	0
15	4.5	4.0	18	0	0	0
16	4.5	3.5	11	0	0	0
17	*7.4	3.5	7.4	0	0	0
18	7.4	*3.0	5.8	0	0	0
19	6.6	3.0	4.0	0	0	0
20	6.6	3.0	3.0	0	0	0
21	5.8	2.5	2.0	0	0	0
22	5.8	3.0	1.5	0	0	0
23	5.0	2.5	1.5	0	0	0
24	5.0	2.5	1.0	0	0	0
25	5.0	2.0	0.5	0	0	0
26	4.5	1.5	0.5	0	0	0
27	11	1.0	1.0	0	0	0
28	9.8	0.5	1.0	0	0	0
29	9.0	a0.5	*1.0	0	0	0
30	9.0	—	1.0	0	0	0
31	9.0	—	1.0	—	0	
Mean	6.9	4.0	28	0.3		
Cs/mi	0.01	0.01	0.05	0.00		
In	0.01	0.01	0.06	0.00		
Ac-ft.	427	231	1,700	19		

1968 year: Mean 4.9 Cs/sq mi 0.01 Inches 0.12

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

CHAKKAR RIVER AT TALLI TANGI

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	*0	0	0	0	0
6	0	0	0	0	0	0
7	*0	2.1	0	0	0	0
8	163	*51	0	0	0	*0
9	*46	*23	0	0	0	0
10	*15	11	0	0	0	0
11	8.1	*1.0	0	0	0	0
12	*68	*0.5	0	0	0	0
13	11	4.5	*1.0	0	0	0
14	*13	*28	*1.5	0	0	0
15	9.0	*2,0	0	*0	0	0
16	0	0.5	0	0	0	0
17	0	0	0	0	0	0
18	0	*0.5	0	0	0	0
19	*9.6	*3.0	0	0	0	0
20	*21	1.5	0	0	0	0
21	*7.4	0	0	0	0	0
22	5.0	*0.5	0	0	0	0
23	4.5	0	0	0	0	0
24	22	0	0	0	0	0
25	16	*0	0	0	0	0
26	29	0	*0	0	0	0
27	7.4	0	0	0	0	0
28	4.0	*0	0	0	0	0
29	*1.0	0	*0	0	0	0
30	*0.5	0	0	0	0	0
31	0	0	—	0	—	0
Mean	15	4.2	0.1			
Cs/mi	0.03	0.01	0.00			
In	0.03	0.01	0.00			
Ac-ft.	913	256	4.96			

Acre-feet. 3,550 Max Day 650 Min Day 0

CHAKKAR RIVER AT TALLI TANGI

Suspended sediemnt concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
17 Jan	7.4	60	178			
18 Feb	3.0	58	150			
29 Mar	1.0	68	152			
12 Jul	31	91	3,250	15	50	35
14 Jul	13	89	3,140	13	44	43
19 Jul	27	91	1,770	2	35	63
20 Jul	23	90	2,350	3	26	71
29 Jul	0.5	89	184			
8 Aug	43	88	2,310	7	21	72
9 Aug	25	87	1,610	4	21	75
18 Aug	0.5	86	208			
19 Aug	3.0	85	218			
22 Aug	1.5		285			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

CHAKKAR RIVER AT TALLI TANGI

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE									PARTS PER MILLION					EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL								
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Uhelons	Ahlons	SiO_2	Fe	B	D.S. by Evap.			me/l	
Mar																				
29	20.69	9.61	26.85		0.09	0.99	4.95	50.50			57.15	56.53				3710	4700	8.20	0	2.2
Jul																				
9	16.11	4.98	22.00		0	1.31	2.82	33.50	5.50		43.01	43.13				2620	3650	8.15	0	6.8
12	7.73	6.12	10.56		0.34	1.87	2.37	18.42	1.20		24.41	24.20				1500	2220	8.48	0	4.0
19	13.79	6.01	19.50		0	1.27	3.11	36.10	6.00		46.30	46.48				2800	3700	8.14	0	5.3
20	19.84	7.86	19.50		0	1.36	3.21	36.00	6.80		47.20	47.37				2810	3700	8.12	0	5.2
21	22.05	9.95	26.80		0	1.27	4.85	43.95	7.90		58.20	57.97				3520	4800	8.10	0	7.2
Aug																				
8	13.44	4.96	9.06		0.20	1.30	1.68	20.02	4.00		27.46	27.20				1560	2200	8.20	0	3.0
14	12.59	21.61	28.35		0	2.00	7.52	55.94	1.00		62.55	66.48				3350	4630	8.15	0	6.9
Sep																				
13	34.85	32.55	35.75		0	1.50	25.13	52.01	25.00		103.15	103.64				5420	7200	7.89	0	5.8

Blank page retained for pagination

BOLAN RIVER AT KUNDLANI BRIDGE - 1968

Location Latitude 29°27', Longitude 67°30', on downstream side of Kundlani bridge on Sibi-Quetta highway, twenty-three miles west of Sibi.

Drainage area 1,560 square miles.

Records available May 1961 to date by Surface Water Hydrology Project WAPDA. December 1958 to June 1962 by Hydrology Directorate of Irrigation Department, Quetta.

Average discharge 73 cusecs (52,700 acre-feet per year or 0.63 inches·runoff per year). Average taken for 7 years from 1962 to 1968.

Extremes Maximum discharge observed during the year 3,940 cusecs on 12 July (gauge height 7.90 feet); minimum daily discharge 44 cusecs on many days.

1961-68: Maximum discharge observed 25,100 cusecs on 25 July 1961; minimum daily discharge observed 38 cusecs on 19 July 1961.

Gauge Wire-weight gauge fastened to downstream handrail of bridge; observed to 0.01 foot three times a day and more often during floods. Gauge set to arbitrary datum.

Measurements Twenty eight discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 depth method. Twenty five sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or a D-49 sampler from the bridge. Two of these were analysed for particle size distribution and the rest for total concentration. Fourteen surface samples were collected and analysed for chemical composition.

Determination of discharge The control at this station is a shingle riffle that is reasonably stable except for minor shifting. Discharges were computed by use of previous rating dated 19.10.63 with shift adjustments as indicated necessary by discharge measurements.

Remarks Record good.

BOLAN RIVER AT KUNDLANI BRIDGE

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	57	53	59	48	47	46
2	57	53	58	48	48	46
3	56	52	57	47	45	47
4	55	53	56	48	44	46
5	55	83	55	48	46	46
6	53	58	56	49	48	46
7	52	56	56	a 49	49	47
8	51	57	56	a 49	48	47
9	52	56	*55	a 49	50	46
10	53	56	56	a 49	49	45
11	53	55	57	a 49	49	46
12	54	56	55	a 49	50	46
13	54	57	54	a 49	48	47
14	53	57	55	a 49	49	45
15	*53	57	55	*49	48	44
16	53	57	54	a 49	48	*44
17	54	57	54	a 49	49	44
18	53	56	52	a 49	48	44
19	53	107	53	a 49	*117	44
20	53	*62	52	a 49	a71	44
21	53	56	52	a 49	50	44
22	53	55	52	a 49	46	44
23	52	55	52	a 49	46	44
24	52	57	52	a 49	46	44
25	52	59	52	a 49	47	44
26	53	60	52	49	46	44
27	54	60	50	47	47	44
28	53	59	49	48	46	44
29	53	60	49	48	49	44
30	54	—	*48	47	48	44
31	54	—	48	—	46	—
Mean	53	59	54	49	51	45
Cs/mi	0.03	0.04	0.03	0.03	0.03	0.03
In	0.04	0.04	0.04	0.03	0.04	0.03
Ac-ft.	3,290	3,410	3,290	2,890	3,110	2,680

1968 year: Mean 51 Cs/sq mi 0.03 Inches 0.44

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	44	48	47	47	47	49
2	44	48	47	47	47	49
3	44	*48	47	47	47	49
4	44	48	47	47	47	49
5	44	48	47	47	47	49
6	*44	48	47	47	47	49
7	44	48	*47	47	47	49
8	45	49	47	47	47	50
9	44	*48	47	47	48	50
10	*44	48	47	47	48	50
11	44	49	47	47	48	*50
12	*574	48	47	47	48	50
13	59	48	*47	47	47	50
14	*50	*48	47	47	48	50
15	49	49	47	47	48	50
16	49	49	47	47	48	50
17	49	*49	47	*47	48	50
18	49	48	47	47	48	50
19	49	48	47	47	48	50
20	49	47	47	47	48	50
21	49	47	*47	47	48	50
22	48	*47	47	47	*48	50
23	48	47	47	47	48	50
24	48	47	47	47	48	50
25	48	47	47	*47	48	50
26	49	47	47	47	48	50
27	*48	47	*47	47	48	50
28	48	47	47	47	48	50
29	48	*47	47	47	48	50
30	48	47	47	47	48	50
31	48	47	—	47	—	50
Mean	64	48	47	47	48	50
Cs/mi	0.04	0.03	0.03	0.03	0.03	0.03
In	0.05	0.04	0.03	0.03	0.03	0.04
Ac-ft.	3,950	2,940	2,800	2,800	2,840	3,060

Acre-feet. 37,100 Max Day 574 Min Day 44

BOLAN RIVER AT KUNDLANI BRIDGE

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	53	66	7			
20 Feb	61	63	41			
30 Mar	48	59	93			
15 Apr	48	78	63			
19 May	254	86	1,440	7	24	69
16 Jun	44	90	49			
6 Jul	44	95	17			
10 Jul	44	84	22			
12 Jul	162	92	31,400	2	26	72
14 Jul	49	93	233			
27 Jul	47	96	81			
3 Aug	48	91	67			
3 Aug	47	90	105			
9 Aug	48	90	113			
14 Aug	49	84	19			
17 Aug	49	90	65			
22 Aug	47	90	42			
29 Aug	47	88	13			
7 Sep	47	85	21			
13 Sep	47	83	55			
21 Sep	47	86	19			
27 Sep	47	75	33			
17 Oct	47	76	49			
22 Nov	48	70	28			
11 Dec	50	56	31			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm. and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

BOLAN RIVER AT KUKLANI BRIDGE

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				$Mhos \times 10^6$ at $25^\circ C.$	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 15	2.06	2.74	3.75		0.55	2.51	1.61	3.80			8.55	8.47				528	830	8.45	0	2.5
Feb 20	2.06	2.64	2.86		0.46	2.83	1.17	3.10			7.56	7.56				452	690	8.42	0	1.9
Mar 30	1.58	2.82	4.20		0.36	1.84	1.58	4.80			8.60	8.58				490	830	8.29	0	2.3
Apl 15	1.58	2.47	4.30		0.18	2.02	1.53	4.83			8.35	8.56				520	810	8.35	0	3.0
May 19	1.79	2.91	4.53		0.36	2.02	1.73	5.10			9.23	9.21				600	900	8.30	0	3.0
Jun 16	1.47	2.83	3.72		0.44	2.06	2.27	3.30			8.02	8.07				494	800	8.31	0	2.5
Jul 6	2.78	1.37	3.82		0.24	1.87	1.58	4.45			7.97	8.14				510	880	8.53	0	2.7
12	2.43	2.16	3.60		0	1.91	0.69	5.70			8.19	8.30				510	800	8.05	0	2.4
Aug 3	1.78	3.36	3.52		0.30	2.05	1.58	4.65			8.66	8.58				530	840	8.40	0	2.2
9	1.72	3.59	3.44		0.40	1.90	1.58	4.71			8.75	8.59				510	820	8.40	0	2.1
Sep 7	1.78	3.66	3.25		0.20	2.20	1.58	4.54			8.69	8.52				500	810	8.38	0	2.0
21	2.00	3.31	3.34		0	2.50	1.48	4.61			8.65	8.59				500	810	8.05	0	2.1
Oct 17	1.54	2.64	3.40		0.18	2.43	1.58	3.50			7.58	7.69				474	750	8.40	0	2.4
Dec 11	2.64	2.61	3.40		0.18	3.51	1.58	3.36			8.65	8.63				520	800	8.35	0	2.7

Blank page retained for pagination

Location Latitude 26°53', Longitude 67°14', on right bank nearly 50 miles from Dadu, approachable from Johi Tehsil and 13 miles Northwest of Gaj Rest House.

Drainage area 2,650 square miles.

Records available Discharge record by Surface Water Hydrology Project WAPDA, from November 1965 to date. Periodic discharge observations and gauge record from 24 July 1964 to 4 December 1964 observed by Lower Indus Project also available with this Project.

Extremes Maximum discharge during the year 8,860 cusecs on 12 July (gauge height 7.07 feet); River dry at times during the year.

1966-68: Maximum discharge 76,100 cusecs on 1 August 1967; River dry at times.

Gauge Automatic water stage recorder installed since 23 May 1964. Working of recorder was not satisfactory. Enamelled staff gauge graduated to 0.01 foot upto 7.50 feet and 0.10 foot from 7.50 feet to 15.00 feet fixed on the outer wall of recorder well was used for a part of the year. This gauge was read six times a day during low flows and more often during floods. Gauge set to to arbitrary datum.

Measurements Seveny four discharge measurements were made periodically during the year by current meter at 0.2 and 0.8 or .6 depth depending upon the flow. Low water measurements were made by wading and high water measurements from an overhead cableway. Fifty four sets of sediment samples were taken by the depth integration method using DH-48 sampler while wading or D-49 sampler from the cableway. Fourteen of these were analysed for particle size distribution and the rest for total concentration. Twenty four surface samples were taken and analysed for chemical composition.

Determination of discharge The station has a shifting control affected by the movement of sand and shingle. Rating table dated 28.12.67 was used with shift adjustments as indicated necessary by the periodic measurements.

Remarks Record fair.

GAJ NAI NEAR JUBBLE

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	210	*232	65	24	9.5	142
2	a 206	195	68	22	8.0	63
3	a 203	170	*65	24	6.5	*36
4	200	166	63	24	5.0	24
5	175	*150	60	*22	4.0	24
6	150	134	58	20	3.0	22
7	138	123	53	19	4.0	22
8	134	116	48	17	6.5	*19
9	123	113	a 50	17	6.5	16
10	120	*109	a 53	19	5.0	13
11	116	106	55	17	5.0	11
12	113	102	53	16	4.0	*9.5
13	106	95	58	16	*5.0	8.0
14	102	92	154	16	6.5	8.0
15	99	*92	120	17	*6.5	6.5
16	95	89	86	16	4.0	6.5
17	92	86	*77	14	4.0	8.0
18	89	92	63	*14	353	*8.0
19	86	1,400	55	16	210	*3.0
20	68	*374	48	16	89	3.0
21	*68	205	43	14	53	4.0
22	71	154	*40	11	34	5.0
23	74	130	36	13	*22	5.0
24	71	116	38	13	17	4.0
25	126	102	34	13	14	3.0
26	226	92	45	11	11	*1.0
27	*839	*86	*40	*9.5	8.0	1.0
28	2,730	80	*24	11	5.0	0
29	873	74	22	11	4.0	1.0
30	440	---	24	9.5	*534	*150
31	287	---	22	---	350	---
Mean	272	175	55	16	58	21
Cs/mi	0.10	0.07	0.02	0.01	0.02	0.01
In	0.12	0.07	0.02	0.01	0.03	0.01
Ac-ft.	16,700	10,100	3,410	957	3,560	1,240

1968 year: Mean 90 Cs/sq mi 0.03 Inches 0.47

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

GAJ NAI NEAR JUBBLE

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*48	130	*17	9.5	6.5	13
2	45	71	16	8.0	8.0	11
3	19	*74	14	8.0	6.5	13
4	8.0	*77	11	8.0	6.5	11
5	4.0	89	*11	6.5	*8.0	*11
6	1.0	*498	9.5	6.5	9.5	11
7	*0	158	8.0	8.0	9.5	13
8	0	*154	6.5	6.5	11	14
9	*956	55	6.5	6.5	6.5	13
10	*210	40	*6.5	9.5	6.5	*14
11	77	22	*6.5	9.5	*8.0	17
12	*1,710	*295	6.5	2.0	8.0	*20
13	*987	*518	5.0	2.0	8.0	20
14	*130	*1,130	5.0	2.0	8.0	19
15	58	*215	4.0	*3.0	8.0	*19
16	30	*597	5.0	2.0	8.0	20
17	3.0	*808	4.0	3.0	*6.5	20
18	13	*1,360	577	3.0	8.0	19
19	*5.0	*268	226	4.0	8.0	19
20	3.0	123	55	4.0	8.0	20
21	6.5	*77	28	5.0	8.0	a 19
22	4.0	50	20	6.5	9.5	a 17
23	0	*38	16	8.0	9.5	a 15
24	*537	*253	16	6.5	9.5	13
25	382	58	14	*5.0	9.5	14
26	*190	*42	13	9.5	11	14
27	71	26	13	11	*11	16
28	30	28	9.5	11	9.5	19
29	17	*24	9.5	9.5	13	17
30	*133	16	11	8.0	13	17
31	83	17	----	*6.5	----	17
Mean	186	236	38	6.4	8.7	16
Cs/mi	0.07	0.09	0.01	0.00	0.00	0.01
In	0.08	0.10	0.02	0.00	0.00	0.01
Ac-ft.	11,400	14,500	2,280	393	517	983

Acre-feet. 66,000 Max Day 2,730 Min Day 0

GAJ NAI NEAR JUBBLE

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
21 Jan	71		109			
27 Jan	146	57	12			
1 Feb	220	62	37			
5 Feb	150	67	111			
10 Feb	106	50	58			
15 Feb	89	68	69			
20 Feb	315	66	55			
27 Feb	86	73	68			
3 Mar	65	72	40			
17 Mar	74	81	54			
22 Mar	40	78	75			
27 Mar	40	69	44			
28 Mar	22	73	66			
5 Apr	22	78	84			
27 Apr	11	85	62			
30 Apr	9.5	84	71			
10 May	5.0	90	215			
30 Jun	232	81	2,180	3	22	75
1 Jul	127	90	267			
7 Jul	1.0	92	115			
9 Jul	974	84	11,500	3	43	54
9 Jul	1,900	96	10,300	5	49	46
10 Jul	250	86	277			
12 Jul	4,560	88	13,300	7	48	45
13 Jul	1,530	87	4,080	5	21	74
14 Jul	95	87	78			
19 Jul	5.0	90	59			
26 Jul	130	87	277			
30 Jul	398	90	98			
4 Aug	195	94	173			
6 Aug	1,120	88	20,300	11	55	34
6 Aug	1,100	88	18,600	3	47	50
8 Aug	102		200			
12 Aug	520	80	7,660	11	32	57
13 Aug	590	84	4,610	5	36	59
14 Aug	1,320	82	15,700	16	46	38
15 Aug	244	82	1,090	7	32	61
16 Aug	818	84	14,300	7	43	50
17 Aug	1,620	86	13,000	9	46	45
18 Aug	2,720	81	24,600	6	48	46

GAJ NAI NEAR JUBBLE

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
21 Aug	80	80	60			
26 Aug	32	81	252			
29 Aug	22	75	158			
1 Sep	16	79	70			
5 Sep	11	90	171			
15 Oct	3.0	86	70			
25 Oct	5.0	78	54			
31 Oct	6.5	70	28			
11 Nov	8.0	73	42			
27 Nov	11	68	47			
5 Dec	11	66	34			
10 Dec	14	69	107			
12 Dec	22	66	45			
15 Dec	19	62	29			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

GAT NAI NEAR JUBBLE

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/L	
Jan																				
21	2.27	1.53	3.85		0.18	2.70	1.27	3.30			7.65	7.45				458	730	8.27	0	2.8
27	1.26	1.74	4.80		0.27	1.71	1.63	4.00			7.80	7.61				470	750	8.31	0	3.9
Feb																				
10	1.26	1.74	4.53		0.18	1.84	1.48	4.00			7.53	7.50				420	710	8.22	0	3.7
20	1.68	1.12	3.44		0.18	1.93	1.04	3.10			6.24	6.25				430	600	8.20	0	2.9
Mar																				
3	1.47	1.83	4.63		0.26	1.89	1.43	4.30			7.93	7.88				480	750	8.27	0	3.6
27	1.47	1.53	4.80		0.18	1.71	1.38	4.50			7.80	7.77				490	780	8.23	0	3.9
Apr																				
18	1.68	1.52	5.00		0.27	1.67	1.38	4.97			8.20	8.29				520	800	8.36	0	4.0
30	2.10	1.00	5.00		0.36	1.38	1.48	4.90			8.10	8.12				550	820	8.35	0	4.0
May																				
10	1.47	1.63	4.60		0.17	1.46	1.78	4.20			7.70	7.61				474	760	8.28	0	3.7
30	1.42	1.48	4.80		0.35	1.36	1.76	4.20			7.70	7.67				481	765	8.30	0	4.0
Jun																				
3	1.26	1.54	4.00		0.35	1.89	1.43	3.20			6.80	6.82				392	690	8.30	0	3.4
30	1.32	1.74	4.70		0.34	1.82	1.48	4.55			7.70	7.89				486	770	8.53	0	3.9
Jul																				
1	1.32	1.21	4.50		0.25	1.62	1.33	4.45			7.03	7.25				442	700	8.54	0	4.0
12	0.79	1.50	1.82		0.17	1.87	0.50	1.55			4.11	4.09				222	400	8.22	0	1.7
24	1.57	1.59	4.32		0.34	2.08	1.10	4.00			7.38	7.52				450	720	8.30	0	3.4
30	1.25	1.11	3.93		0.19	1.63	1.27	3.12			6.29	6.21				430	620	8.30	0	3.6
Aug																				
4	1.14	1.33	3.82		0.09	1.83	1.22	3.18			6.29	6.12				420	620	8.25	0	3.4
12	1.71	0.49	1.74		0.09	1.78	0.58	1.52			3.94	3.97				226	390	8.25	0.67	1.7
17	1.75	0.72	1.80		0.19	2.07	0.58	1.64			4.27	4.48				244	420	8.30	0	1.6
Sep																				
5	1.54	1.57	3.70		0.18	1.71	1.19	3.79			6.81	6.87				402	640	8.30	0	3.0
Oct																				
15	1.92	1.61	3.80		0.18	2.79	1.28	3.05			7.33	7.30				432	700	8.35	0	2.9
Nov																				
27	3.29	1.03	4.40		0.49	2.66	1.58	3.86			8.72	8.59				500	800	8.35	0	3.0
Dec																				
10	3.24	0.71	4.40		0.39	2.85	1.63	3.96			8.35	8.23				490	780	8.30	0	3.1
12	2.38	1.88	6.40		0.39	2.69	3.66	3.74			10.66	10.48				640	1000	8.30	0	3.1

Location Latitude 26°23', Longitude 67°53', nearly 5 miles downstream of Sehwan village, 30 miles from Dadu.

Records available Discharge record from January 1968 to date, with periodic discharge measurements since June 1967, by Surface Water Hydrology Project, WAPDA.

Extremes Maximum discharge during the year 3,84,000 cusecs on 26 August (gauge height 112.20 feet); minimum daily discharge 2,110 cusecs on 28 December.

Gauge Staff gauge (enamelled plates) on right bank in two steps, graduated to 0.01 foot and read five to six times daily or more often during high flows, (zero R.L. of the gauge = 81.20 S.P.D.)

Measurements Thirty five discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 depth method, with the help of a boat and out-board motor. Thirty four sets of sediment samples were taken by the depth integrating method using D-49 sampler from the boat. Thirty one of these were analysed for particle size distribution and the rest for total concentration. Twenty four surface samples were collected and analysed for chemical composition.

Determination of discharge Rating tables dated 21.5.69 and 22.5.69 were used, from 1.1.68 to 31.8.68 and 1.9.68 to 31.12.68 respectively, with shift adjustments as indicated necessary by periodic discharge measurements.

Remarks Record fair; runoff in inches over the drainage area has not been computed as there are numerous diversions from the river upstream of this site.

INDUS RIVER NEAR SEHWAN

Discharge in cusecs for year 1968 .

Date	Jan	Feb	Mar	Apr	May	Jun
1	a 35,500	19,500	3,190	45,400	*21,400	20,600
2	a 38,000	19,900	3,050	48,100	19,800	24,500
3	a 43,500	18,600	2,950	49,400	18,500	36,600
4	a 48,000	16,700	2,860	46,500	17,200	51,300
5	a 52,000	14,900	3,050	42,800	16,300	61,500
6	a 58,000	13,800	4,320	*40,000	17,700	57,800
7	a 63,000	12,700	9,160	39,500	20,100	47,100
8	64,800	11,600	10,700	35,800	54,600	*38,600
9	*62,900	10,600	12,100	33,900	99,400	36,100
10	55,700	9,790	a 12,700	32,900	107,000	35,600
11	52,500	9,880	13,200	29,700	92,000	47,200
12	49,100	11,400	11,600	25,100	*82,400	72,300
13	45,300	12,400	12,600	22,700	73,600	91,100
14	40,500	12,500	14,300	20,500	65,500	102,000
15	34,800	11,800	15,400	19,600	61,200	117,000
16	32,800	*11,000	*15,800	18,300	58,100	138,000
17	32,200	9,850	15,400	*16,400	51,300	a156,000
18	30,300	8,350	14,900	15,400	56,700	*174,000
19	28,800	7,500	15,100	15,100	36,800	189,000
20	*28,200	6,780	16,300	16,000	32,800	a 191,000
21	27,500	6,580	17,900	17,400	28,800	a 193,000
22	25,100	5,750	19,800	19,400	25,100	a 195,000
23	24,200	5,340	*23,800	20,800	21,200	a 197,000
24	23,000	4,860	24,800	*20,100	18,000	a 200,000
25	20,500	4,530	25,800	17,900	15,200	a 203,000
26	*20,100	4,210	26,500	15,500	13,900	*206,000
27	19,700	3,940	26,100	15,600	13,700	a 212,000
28	19,100	*3,800	25,100	18,300	14,400	a 218,000
29	17,400	3,460	25,000	20,300	14,600	a 224,000
30	16,500	———	*29,900	21,300	*15,000	a 230,000
31	18,000	———	35,400	———	18,000	———
Mean Cs/mi	36,400	10,100	15,800	26,700	38,700	126,000
In Maf	2.24	.579	.969	1.59	2.38	7.47

1968 year: Mean 82,000 Cs/sq mi Inches

Note : * Discharge measurement made on this day.
a No gauge height record; discharge interpolated.

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	a 236,000	288,000	356,000	35,000	6,140	3,490
2	a 242,000	250,000	344,000	33,200	5,700	3,370
3	247,000	240,000	334,000	31,700	5,010	3,230
4	248,000	234,000	*204,000	31,700	4,830	3,180
5	255,000	246,000	168,000	34,700	4,700	3,090
6	259,000	266,000	143,000	35,700	4,510	3,370
7	258,000	*280,000	101,000	33,200	4,320	3,700
8	245,000	299,000	84,800	30,300	4,100	4,280
9	223,000	313,000	71,200	28,100	3,980	4,760
10	207,000	323,000	56,700	25,600	3,860	4,590
11	*204,000	328,000	52,200	22,900	3,760	*4,460
12	209,000	333,000	*48,800	21,900	*3,560	4,220
13	212,000	*335,000	48,600	19,800	3,470	3,980
14	221,000	337,000	49,000	18,600	3,410	3,820
15	229,000	339,000	49,200	*17,500	3,370	3,600
16	235,000	341,000	47,900	16,100	4,510	3,010
17	*243,000	347,000	45,100	14,000	6,000	2,800
18	258,000	350,000	*42,800	13,000	6,440	2,640
19	273,000	353,000	44,100	11,800	6,440	2,500
20	290,000	356,000	46,900	10,400	5,830	2,340
21	302,000	361,000	47,800	9,470	*6,110	2,380
22	312,000	365,000	46,900	8,840	6,360	2,410
23	321,000	*373,000	48,100	8,700	6,580	2,500
24	*332,000	378,000	51,000	8,540	6,020	2,640
25	335,000	383,000	52,600	8,310	5,430	2,520
26	339,000	384,000	*54,700	7,460	4,880	2,410
27	345,000	*384,000	51,200	6,720	4,530	2,240
28	344,000	378,000	47,500	5,880	3,960	2,110
29	341,000	374,000	44,300	5,400	3,740	2,290
30	329,000	371,000	38,400	5,650	3,580	8,270
31	*312,000	365,000	------	5,880	------	14,200
Mean Cs/mi In	271,000	331,000	94,000	18,300	4,840	3,690
Maf	16.7	20.4	5.59	1.12	.288	.227

M. Acre-feet. 59.5 Max Day 384,000 Min Day 2,110

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Jan	62,600	58	1,790	20	48	32
20 Jan	29,300	60	1,140			
26 Jan	23,000		912	16	52	32
16 Feb	11,000		697	15	39	46
28 Feb	3,830	70	81			
16 Mar	15,800	78	760	27	32	41
23 Mar	23,900		1,550	31	49	20
30 Mar	29,400	101	1,400	13	41	46
6 Apr	40,000	95	1,640	19	48	33
17 Apr	16,500	84	826	26	36	38
24 Apr	20,500	84	1,670	20	40	40
1 May	21,400	80	1,260	33	37	30
12 May	83,700	78	2,090	6	45	49
22 May	25,700	85	1,230	15	45	40
30 May	14,700	86	1,120	39	37	24
8 Jun	39,900	89	1,270	35	6	59
18 Jun	171,000	90	3,400	6	60	34
26 Jun	205,000	98	2,770	3	53	44
3 Jul	245,000		2,860	5	55	40
11 Jul	204,000	90	3,530	2	60	38
17 Jul	244,000	92	3,320	5	61	34
24 Jul	333,000	90	3,430	19	52	29
31 Jul	312,000	90	3,250	6	52	42
7 Aug	281,000	91	3,970	8	57	35
13 Aug	334,000	91	3,310	8	50	42
27 Aug	384,000	88	3,260	6	59	35
4 Sep	243,000	85	1,530	20	49	31
12 Sep	60,000	87	1,480	1	41	58
18 Sep	52,200	96	1,300	14	50	36
26 Sep	68,500	87	1,910	6	29	65
15 Oct	21,400	92	832	19	47	34
12 Nov	6,050		1,600	20	30	50
21 Nov	9,160		569	21	45	34
11 Dec	7,180	72	35			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

[redacted] RIVER NEAR [redacted]

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITER									PARTS PER MILLION					EC x 10^6 at 25°C	pH	Res CO_3 me/l	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.				
Feb																				
16	2.06	1.14	1.85		0.18	2.52	0.98	1.20			5.05	4.88				296	470	8.38	0	1.5
28	1.15	1.19	1.86		0.26	1.53	0.44	2.00			4.16	4.23				244	410	8.31	0	1.8
Mar																				
16	1.36	1.04	1.58		0.18	1.62	1.28	1.00			3.98	4.08				230	390	8.20	0	1.4
30	1.58	1.02	1.12		0.18	1.66	0.64	1.20			3.72	3.68				204	360	8.20	0	1.0
Apr																				
6	1.47	1.03	2.06		0.18	1.53	1.23	1.66			4.56	4.60				250	450	8.21	0	1.8
17	1.58	1.02	1.58		0.18	1.80	0.84	1.40			4.18	4.22				230	400	8.21	0	1.4
May																				
1	1.58	1.02	1.30		0.26	1.62	0.59	1.30			3.90	3.77				210	360	8.28	0	1.1
30	1.58	0.72	0.78		0.26	1.44	0.39	1.00			3.08	3.09				170	300	8.30	0	0.7
Jun																				
8	1.37	0.63	0.70		0.17	1.37	0.34	0.80			2.70	2.68				142	260	8.28	0	1.0
26	1.37	0.43	0.50		0	1.45	0.29	0.55			2.30	2.29				128	210	8.18	0	0.5
Jul																				
3	1.26	0.44	0.70		0.17	1.32	0.35	0.55			2.30	2.39				126	230	8.31	0	0.7
11	1.20	0.35	0.55		0.16	1.36	0.29	0.55			2.15	2.36				120	220	8.28	0	0.7
17	0.99	0.71	0.60		0.16	1.19	0.29	0.55			2.25	2.19				114	210	8.24	0	0.6
31	1.15	0.70	1.58		0.16	1.27	0.34	0.85			2.50	2.62				134	250	8.40	0	0.7
Aug																				
7	1.31	0.54	0.70		0.16	1.36	0.39	0.80			2.55	2.71				136	250	8.23	0	0.7
13	1.00	0.94	0.60		0.16	1.29	0.29	0.98			2.54	2.72				130	240	8.30	0	0.6
27	1.16	0.82	0.60		0.16	1.45	0.30	0.70			2.58	2.61				134	250	8.23	0	0.6
Sep																				
9	1.43	0.35	1.08		0.09	1.48	0.44	0.78			2.86	2.79				150	270	8.24	0	1.1
12	1.33	0.61	0.70		0.29	1.44	0.29	0.66			2.64	2.68				140	260	8.28	0	0.7
18	1.49	0.50	0.65		0.19	1.49	0.29	0.82			2.64	2.79				142	260	8.22	0	0.7
26	1.26	0.61	0.65		0	1.50	0.19	0.89			2.52	2.58				150	250	8.18	0	0.7
Oct																				
15	1.48	0.56	0.65		0	1.50	0.19	0.97			2.67	2.66				162	250	8.16	0	0.6
Nov																				
12	1.92	0.75	0.70		0.18	2.34	0.59	0.23			3.37	3.34				200	330	8.20	0	0.6
21	2.03	0.96	0.80		0.18	2.70	0.49	0.39			3.79	3.76				218	360	8.35	0	0.6

Blank page retained for pagination

Location Latitude 25°09', Longitude 67°01', at pump house on left bank 2 furlong upstream from weir, 19 miles north of Karachi and 30 miles upstream from Arabian Sea.

Drainage area 3,640 square miles.

Records available Daily discharge 1 July to 10 October 1959 and 30 June 1960 to date by Surface Water Hydrology Project WAPDA. (gauge heights 1 July to 10 October 1959 furnished by WAPDA Karachi Irrigation Project).

Average discharge 390 cusecs (282,000 acre-feet per year or 1.45 inches runoff per year). Average taken for 8 years from 1961 to 1968.

Extremes Maximum discharge observed during year 535 cusecs on 19 August (gauge height 3.73 feet); no flow on many days.

1959-68: Maximum estimated discharge 237,000 cusecs from observed gauge height on 5 July 1959. Maximum flood discharge believed to have been 30 to 50 percent higher than this estimated peak. Periods of no flow occur during most years.

Gauge Automatic water stage recorder installed on 25.9.1962. Also enamelled plates graduated to 0.1 foot and read to 0.01 foot three times daily and more often during flood. Zero of gauge datum at R.L. 124.95.

Measurements Ten discharge measurements were made by wading downstream from bund at low flow. High water rating is computed by weir formulas. Four sets of sediment samples were taken by use of DH-48 sampler. All were analysed for total concentration. Three surface samples were collected and analysed for chemical composition.

Determination of discharge Rating curve based on discharge measurements at low stages and weir formulas at high stages is used at this station. Rating table dated 13.11.1962 was used throughout the year.

Remarks Record fair.

HUB RIVER AT BUND MURAD KHAN

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	224	26	36	3.0	0	0
2	175	26	33	2.6	0	0
3	144	25	29	2.3	0	0
4	112	27	27	2.0	0	0
5	98	27	25	1.5	0	0
6	88	25	24	1.3	0	0
7	78	26	23	1.0	0	0
8	69	27	22	0.9	0	0
9	62	25	20	0.9	0	0
10	59	25	19	0.9	0	0
11	54	24	19	0.6	0	0
12	52	23	18	0	0	0
13	47	23	17	0	0	0
14	45	22	*15	0	*0	0
15	45	20	19	*0	0	*0
16	42	20	19	0	0	0
17	42	20	15	0	0	0
18	40	23	12	0	0	0
19	39	23	9.7	0	0	0
20	37	*27	9.4	0	0	0
21	33	30	9.4	0	0	0
22	33	69	8.2	0	0	0
23	32	57	7.6	0	0	0
24	30	47	6.8	0	0	0
25	29	57	6.8	0	0	0
26	27	52	6.2	0	0	0
27	47	47	5.4	0	0	0
28	39	42	4.3	0	0	0
29	36	39	4.0	0	0	0
30	29	—	3.5	0	0	0
31	26	—	3.3	—	0	—
Mean	62	32	15	0.6		
Cs/mi	0.02	0.01	0.00	0.00		
In	0.02	0.01	0.00	0.00		
Ac-ft.	3,790	1,890	945			

1968 year: Mean 20 Cs/sq mi 0.01 Inches 0.07

Note : * Discharge measurement made on this day.

HUB RIVER AT BUND MURAD KHAN

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	40	29	0	0	0
2	0	30	23	0	0	0
3	0	24	17	0	0	0
4	31	18	15	0	0	0
5	213	12	12	0	0	0
6	152	9.7	9.7	0	0	0
7	102	9.1	8.2	0	0	0
8	74	9.1	6.2	*0	0	0
9	57	6.0	5.2	0	0	0
10	40	*4.0	4.4	0	0	0
11	27	3.1	3.5	0	0	0
12	21	3.0	3.1	0	0	0
13	45	2.6	*0	0	0	0
14	128	2.1	0	0	0	0
15	102	1.4	0	0	0	0
16	107	2.5	0	0	0	0
17	136	88	0	0	0	0
18	120	69	0	0	0	0
19	136	394	0	0	0	0
20	112	235	0	0	0	0
21	74	167	0	0	0	0
22	54	159	0	0	0	0
23	*37	120	0	0	0	0
24	25	*88	0	0	0	0
25	19	64	0	0	0	0
26	14	54	0	0	0	0
27	9.7	47	0	0	0	0
28	7.0	64	0	0	0	0
29	5.2	52	0	0	0	0
30	5.8	42	0	0	0	0
31	42	34	-	0		0
Mean	61	60	4.5			
Cs/mi	0.02	0.02	0.00			
In	0.02	0.02	0.00			
Ac-ft.	3,760	3,680	270			

Acre-feet. 14,300 Max Day 394 Min Day 0

HUB RIVER NEAR BUND MURAD KHAN

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
20 Feb	29	73	114			
14 Mar	16	82	123			
10 Aug	3.5	75	50			
24 Aug	93	72	46			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

HUB RIVER AT HUND MURAD KHAN

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITER											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb 20	3.50	3.50	10.98		0.18	2.32	8.76	6.00			17.98	17.26				1064	1720	8.30	0	5.9
Marr 14	2.84	3.66	13.16		0.27	1.35	9.13	9.00			19.66	19.75				1240	1950	9.26	0	7.3
Jul 23	2.94	3.16	11.06		0.34	1.70	7.72	7.50			17.16	17.26				1100	1710	8.41	0	6.4

Blank page retained for pagination

KUD RIVER NEAR MAI GONDRANI - 1968

Location Latitude 26°24', Longitude 66°14', two miles upstream from ancient caves at Mai Gondrani, 13 miles north-west of Las Bela and 18 miles upstream of Porali River.

Drainage area 805 square miles.

Records available Discharge record from January 1961 to December 1965 (fragementary record January-April, September-November 1961) and gauge height record for 1966 and 1967 by Surface Water Hydrology Project WAPDA.

Average discharge 109 cusecs (78,600 acre-feet per year or 1.83 inches runoff per year) for 5 years from 1962 to 1968 (except 1966-67).

Extremes Maximum discharge during the year 22,600 cusecs on 18 May (gauge height 15.50 feet); minimum daily discharge 0.3 cusecs on 11 May.

1962-68: Maximum discharge 40,000 cusecs on 28 July 1964; minimum daily discharge 0.3 cusecs on 11 May 1968.

Gauge Staff gauge graduated to 0.1 foot and read to nearest hundredth, three times a day or more often during floods. Gauge set to arbitrary datum.

Measurements Fifty one discharge measurements were made during the year by current meter using .2 and .8 depth method or .6 depth method. Thirty four sets of sediment samples were taken by depth integration method using DH-48 sampler while wading or D-49 sampler from cableway. Thirteen of these were analysed for particle size distribution and the rest for total concentration. Fifteen surface samples were collected and analysed for chemical composition.

Determination of discharge Rating table dated 30.3.1960 was used with shift adjustments as indicated necessary by periodic discharge observations.

Remarks Record fair.

KUD RIVER NEAR MAI GONDRANI

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1	79	11	11	4.5	8.4	168
2	55	11	9.2	4.5	6.8	1.7
3	38	11	8.0	4.5	2.5	1.7
4	28	12	6.8	4.2	1.7	1.5
5	25	12	6.4	4.2	1.3	1.5
6	23	12	6.0	4.2	1.2	1.8
7	21	11	6.0	4.5	0.9	1.8
8	21	11	6.0	4.8	0.8	1.8
9	20	11	6.0	4.2	0.4	1.8
10	20	10	5.7	4.2	0.4	1.8
11	18	10	5.4	4.5	0.3	6.8
12	17	10	5.4	4.5	0.9	2.8
13	17	10	129	4.8	0.9	2.0
14	17	12	18	4.5	0.9	2.0
15	16	12	9.2	4.2	0.9	1.9
16	15	11	12	4.2	0.8	1.8
17	14	10	10	4.2	0.8	1.8
18	14	10	8.0	4.2	9,990	1.8
19	14	60	7.2	4.2	1,150	1.9
20	14	26	6.8	4.2	204	1.9
21	13	21	6.8	3.9	*20	1.9
22	13	18	6.8	3.9	15	1.9
23	13	17	6.4	*3.9	11	1.9
24	13	17	6.0	3.9	6.8	1.9
25	13	14	*6.0	4.2	4.5	1.8
26	14	9.6	5.7	4.2	2.5	1.8
27	15	10	5.7	819	1.8	1.8
28	13	11	5.4	1,070	1.2	1.8
29	14	11	5.4	160	2,090	1.9
30	14	—	4.8	32	530	1.9
31	13	—	4.5	———	220	———
Mean	21	14	11	73	461	7.6
Cs/mi	0.03	0.02	0.01	0.09	0.57	0.01
In	0.03	0.02	0.02	0.10	0.66	0.01
Ac-ft.	1,260	816	685	4,350	28,300	450

1968 year: Mean 94 Cs/sq mi 0.12 Inches 1.58

Note : * Discharge measurement made on this day.

KUD RIVER NEAR MAI GONDRANI

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	1.9	30	2.6	1.6	1.8	1.7
2	1.9	*18	2.4	1.6	1.8	1.7
3	*1.8	11	*2.2	1.6	1.7	1.7
4	1.8	*985	2.2	1.6	1.7	1.7
5	*1.9	12	2.2	1.6	1.7	1.7
6	1.9	*1,980	*2.2	1.7	1.7	1.7
7	703	*1,800	2.2	1.7	1.7	1.7
8	*1,090	*558	2,1	1.7	1.7	1.6
9	*100	225	2.2	1.7	1.7	1.6
10	16	*83	2.2	*1.7	1.6	1.6
11	*14	50	*2.2	1.7	1.6	239
12	*6.8	33	2.2	1.7	1.6	37
13	*295	*21	2.2	1.7	1.6	12
14	117	*1,580	2.2	1.7	1.6	10
15	3.3	9.2	*2.2	1.8	1.6	3.6
16	1.8	510	2.2	1.8	1.6	2.6
17	1.1	*2,640	2.2	1.8	1.6	1.9
18	0.8	13	2.2	1.8	1.6	1.8
19	*12	*1,350	2.2	1.8	1.6	1.7
20	2.8	230	*2.1	1.8	1.7	1.6
21	2.8	*86	2.1	1.8	1.6	1.5
22	2.9	58	2.1	1.8	1.6	1.4
23	*3.0	30	2.1	1.8	1.6	1.4
24	2.8	*14	2.1	1.8	1.6	1.4
25	*76	12	*2.1	1.8	1.6	1.4
26	20	*9.2	1.9	1.8	1.6	1.5
27	*85	*6.8	1.8	1.8	1.6	1.5
28	15	6.0	1.8	1.8	1.6	1.5
29	12	*5.4	*1.6	1.8	1.6	356
30	*10	3.9	1.6	1.8	1.6	196
31	*114	*2.8	---	1.8	---	8.8
Mean	88	399	2.1	1.7	1.6	29
Cs/mi	0.11	0.50	0.00	0.00	0.00	0.04
In	0.13	0.57	0.00	0.00	0.00	0.04
Ac-ft.	5,390	24,500	126	107	98	1,790

Acre-feet. 67,900 Max Day 9,990 Min Day 0.3

KUD RIVER NEAR MAI GONDRANI

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
25 Mar	6.0	76	31			
23 Apr	3.9	83	71			
21 May	21	89	99			
3 Jul	5.4	82	58			
5 Jul	1.9	83	64			
8 Jul	557		16,900	8	55	37
9 Jul	112	85	2,010	5	13	82
12 Jul	6.8	80	97			
13 Jul	86	79	8,760	2	44	54
13 Jul	216	92	2,900	1	37	62
19 Jul	14	89	235			
27 Jul	86	79	9,650	1	25	74
30 Jul	10	86	292			
31 Jul	310	85	27,900	8	47	45
2 Aug	17	83	219			
4 Aug	1,480	86	40,000	4	46	50
6 Aug	2,250	85	47,600	8	22	70
7 Aug	3,940	89	28,200	3	67	30
7 Aug	1,940	89	10,000	4	32	64
8 Aug	744	86	19,300	9	44	47
8 Aug	797	93	5,420	6	34	60
13 Aug	21	84	163			
19 Aug	2,110	81	52,800	8	33	59
21 Aug	76	87	210			
24 Aug	14	82	103			
26 Aug	8.8	94	62			
27 Aug	6.8	86	29			
29 Aug	5.1	91	113			
31 Aug	2.8	83	27			
3 Sep	2.2	88	85			
15 Sep	2.2	83	80			
20 Sep	2.1	80	118			
25 Sep	2.1	78	98			
29 Sep	1.6	79	89			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

KUD RIVER NEAR MAI GONDRANI

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Mar																				
25	2.73	2.27	7.40		0.18	1.62	3.21	7.30			12.40	12.31				780	1220	8.20	0	4.7
Apr																				
23	2.31	2.59	6.78		0.18	1.53	3.26	6.80			11.68	11.77				740	1160	8.20	0	4.3
May																				
21	2.32	2.08	5.48		0.18	1.44	2.36	6.20			10.08	10.18				630	1020	8.20	0	3.5
Jul																				
3	1.57	2.93	6.74		0.16	1.36	3.01	6.95			11.29	11.38				720	1120	8.39	0	4.5
8	2.05	1.30	2.66		0.24	1.65	0.99	3.35			6.01	6.23				380	600	8.33	0	2.1
12	1.68	2.72	6.60		0.16	1.27	2.97	6.85			11.00	11.25				710	1100	8.35	0	4.5
13	1.20	1.65	3.20		0.16	1.74	1.38	3.05			6.05	6.33				400	600	8.34	0	2.7
25	4.93	1.97	10.00		0.16	1.53	2.87	12.25			16.90	16.91				1130	1680	8.20	0	5.4
27	2.20	2.50	4.82		0.24	1.74	2.02	5.70			9.52	9.70				540	950	8.33	0	2.3
31	2.43	2.32	5.38		0.32	1.94	2.57	5.49			10.13	10.32				640	1000	8.28	0	3.5
Aug																				
4	1.74	1.42	2.76		0	2.30	0.99	2.65			5.92	5.94				342	580	8.10	0	2.2
6	1.59	1.36	2.76		0	2.22	0.84	2.66			5.71	5.72				336	570	8.00	0	2.3
7	1.64	1.66	2.06		0	2.18	0.79	2.32			5.36	5.29				314	530	8.00	0	1.6
Sep																				
6	3.77	2.86	5.70		0.40	2.70	2.94	6.20			12.33	12.24				780	1230	8.42	0	3.1
25	2.55	2.85	5.86		0.20	2.60	3.18	5.52			11.26	11.50				740	1150	8.32	0	3.6

Blank page retained for pagination

PORALI RIVER AT SINCHI BENT - 1968

Location Latitude 26°30', Longitude 66°23', on right bank about ½ mile upstream from Bela Khuzdar road and Porali River crossing, 22 miles northeast of Bela.

Drainage area 1,560 square miles.

Records available Discharge record from December 1961 to December 1965 and gauge heights record for 1966 and 1967 by Surface Water Hydrology Project WAPDA. Prior to that, occasional gauge heights by Karachi Irrigation Project since July 1960. The site became accessible in early 1968, hence regular discharge observations were started.

Average discharge 126 cusecs (90,600 acre-feet per year or 1.09 inches runoff per year) for four years from 1962 to 1965.

Extremes Maximum discharge observed during the year 14,800 cusecs on 18 May (gauge height 11.48 feet); Minimum daily discharge zero cusecs on many days in April.

1962-65,68: Maximum discharge 48,000 cusecs (gauge height 14.70 feet, datum same as for 1966) on 4 April 1965; minimum daily discharge zero cusecs on many days in April 1968.

Gauge Staff gauge graduated to 0.1 foot and read to nearest hundredth, three times a day or more often during floods. Gauge set to arbitrary datum.

Measurements Thirty six discharge measurements were made during the year by current meter using .2 and .8 depth method or 0.6 depth method. Thirty three sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from the overhead cableway. Eleven of these were analysed for particle size distribution and the rest for total concentration. Sixteen surface samples were collected and analysed for chemical composition.

Determination of discharge The stream has a bed of gravel mixed with fine material which shifts continuously. The site was regularly measured after two years of suspension i.e. 1966 and 1967. High flow observations were not available, hence old rating dated 22.11.65 was used with shift adjustments.

Remarks Record fair; mean daily discharges could be computed from 16 February. Low flow discharges affected by upstream diversions.

PORALI RIVER AT SINCHI BENT

Discharge in cusecs for year 1968

Date	Jan	Feb	Mar	Apr	May	Jun
1			76	0	44	113
2			72	0	36	106
3			68	0	30	102
4			64	0	23	102
5			62	0	23	98
6			58	0	24	90
7			62	0	27	84
8			58	0	29	76
9			58	0	30	64
10			56	0	30	56
11			52	0	29	42
12			52	32	32	30
13			86	0	38	82
14			70	0	44	80
15			66	0	40	76
16		102	64	0	48	74
17		100	54	0	453	6[illegible]
18		94	48	0	2,220	6[illegible]
19		94	48	0	88	6[illegible]
20		92	46	0	76	6[illegible]
21		88	42	0	64	52
22		88	42	0	*54	46
23		86	38	0	52	38
24		84	*44	0	46	36
25		84	38	*12	42	30
26		80	32	14	38	46
27		80	27	48	158	40
28		78	20	1,410	134	38
29		78	15	174	131	34
30		—	9.0	70	125	84
31		—	4.5	—	119	—
Mean			49	58	140	66
Cs/mi			0.03	0.04	0.09	0.04
In			0.04	0.04	0.10	0.05
Ac-ft.			3,040	3,430	8,580	3,920

1968 year: Mean Cs/sq mi Inches

Note : * Discharge measurement made on this day.

PORALI RIVER AT SINCHI BENT

Discharge in cusecs for year 1968

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	58	186	*29	23	17	14
2	60	116	26	21	17	14
3	54	*74	23	20	17	14
4	*34	52	21	21	15	14
5	29	*293	*12	20	15	15
6	23	*1,600	11	21	17	14
7	*29	646	*23	20	18	12
8	*1,050	386	24	20	18	12
9	494	*582	23	20	18	12
10	214	255	21	*21	18	78
11	*60	110	20	21	17	249
12	*392	*48	18	20	15	98
13	386	185	*18	20	17	82
14	198	*1,180	17	18	17	72
15	125	582	15	20	17	52
16	*68	*670	*17	18	18	38
17	52	*834	17	21	17	36
18	*50	*265	20	20	17	29
19	32	454	*20	18	15	26
20	833	*380	21	20	17	24
21	*641	246	21	20	15	20
22	161	161	*21	18	14	17
23	131	110	20	17	15	15
24	106	78	20	15	15	14
25	*1,330	*46	*21	15	14	14
26	255	32	21	17	14	12
27	194	30	21	15	14	12
28	108	*36	*21	17	14	12
29	*70	34	23	*18	14	119
30	495	32	24	17	14	40
31	1,010	30	--	17	--	27
Mean	282	314	20	19	16	39
Cs/mi	0.18	0.20	0.01	0.01	0.01	0.03
In	0.21	0.23	0.01	0.01	0.01	0.03
Ac-ft.	17,300	19,300	1,210	1,170	952	2,390

Acre-feet. * Max Day Min Day

PORALI RIVER NEAR SINGHI BENT

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
24 Mar	38	86	23			
25 Apr	12	89	42			
4 Jul	38	86	43			
7 Jul	29	85	48			
8 Jul	1,160	83	6,570	0	58	42
11 Jul	62	82	27			
12 Jul	392	83	10,800	7	41	52
16 Jul	68	88	115			
18 Jul	52	81	50			
21 Jul	550	85	2,670	9	36	55
25 Jul	755	86	9,270	11	47	42
29 Jul	70	83	11			
3 Aug	78	81	82			
5 Aug	255	83	4,360	7	51	42
6 Aug	1,180	83	18,800	23	47	30
9 Aug	686	81	4,620	12	48	40
12 Aug	50	79	93			
14 Aug	2,640	79	18,300	4	20	76
16 Aug	820	80	4,750	11	47	42
17 Aug	1,640	78	6,700	7	41	52
18 Aug	275	81	100			
20 Aug	392	80	1,100	10	32	58
25 Aug	48	81	38			
28 Aug	36	83	66			
1 Sep	30	80	47			
5 Sep	14	79	30			
7 Sep	27	81	50			
13 Sep	18	80	193			
16 Sep	17	80	26			
19 Sep	21	80	35			
22 Sep	21	79	45			
25 Sep	21	81	66			
28 Sep	21	84	34			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay si all sizes smaller than 0.0055 mm.

PORALI RIVER AT SINCHI BENT

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Mar																				
24	1.58	1.97	4.30		0.27	1.94	2.12	3.67			7.83	8.00				480	780	8.35	0	3.2
Apr																				
25	2.36	1.94	4.20		0.54	2.43	2.22	3.42			8.50	8.61				500	810	8.48	8	2.9
May																				
22	2.94	1.86	4.10		0.63	2.66	1.98	3.75			8.90	9.02				510	820	8.44	0	2.6
Jul																				
4	1.05	2.15	4.80		0.42	1.53	2.37	3.60			8.00	7.92				500	790	8.49	0	3.8
8	1.89	1.21	2.86		0.17	2.04	1.23	2.50			5.96	5.94				326	580	8.35	0	2.3
12	1.52	1.13	2.49		0.25	1.96	1.08	1.95			5.14	5.24				288	510	8.42	0	2.2
21	1.77	0.88	1.74		0.34	1.61	0.89	1.50			4.39	4.34				238	430	8.42	0	1.5
25	1.68	0.87	1.58		0.17	1.87	0.69	1.60			4.13	4.33				226	400	8.23	0	1.4
Aug																				
5	1.68	1.32	2.06		0.40	2.01	1.03	1.70			5.06	5.14				278	500	8.31	0	1.6
6	1.58	1.92	2.96		0.24	3.07	1.48	1.70			6.46	6.49				360	640	8.29	0	2.2
9	1.68	1.52	2.49		0.32	2.18	1.28	1.90			5.69	5.68				314	560	8.28	0	2.0
14	1.26	2.44	2.49		0.16	2.91	1.08	2.00			6.19	6.15				326	580	8.30	0	1.8
16	1.41	1.85	3.30		0.40	2.43	1.63	2.14			6.56	6.60				386	640	8.43	0	2.6
17	1.41	0.93	1.57		0.16	2.06	0.59	1.11			3.91	3.92				230	400	8.18	0	1.5
Sep																				
5	1.37	2.52	4.40		0.40	2.20	2.25	3.38			8.29	8.23				520	830	8.35	0	3.2
29	1.92	2.13	5.00		0.30	2.65	2.25	4.00			9.05	9.20				550	840	8.30	0	3.4

Blank page retained for pagination

MISCELLANEOUS SITES
SUMMARY OF DISCHARGE MEASUREMENT

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Measurements Cusecs
Gilgit	Alam Bridge Lat: 35°45' Long: 74°37'	10,100	25. 2.68	3,580
			26. 3.68	3,470
			29. 4.68	6,520
			1. 6.68	25,200
			19. 6.68	86,100
			19. 7.68	86,100
			21. 7.68	77,300
			30. 7.68	103,000
			11. 8.68	118,000
			20. 8.68	100,000
			24. 8.68	57,900
			11. 9.68	29,300
			27. 9.68	24,000
			28. 9.68	23,100
			5.10.68	15,400
			31.10.68	8,350
			18.11.68	6,510
			25.12.68	5,230
Indus	Besham Qila Lat: 34°56' Long: 72°53'	62,700	6.11.68	23,100
			7.11.68	22,800
			10.11.68	22,800
			10.11.68	22,600
			30.11.68	18,400
			1.12.68	19,100
			7.12.68	17,600
Siran	Phulra Lat: 34°20' Long: 73°05'		1. 9.68	350
			7. 9.68	337
			22. 9.68	231
			28. 9.68	292
			2.10.68	242
			14.10.68	422
			17.11.68	282
			28.11.68	215
			2.12.68	293
			24.12.68	372
Haro	Garial a Lat: 33°45' Long: 72°15'	1,180	15.10.68	374
			16.10.68	330
			27.10.68	322
			20.11.68	355
			25.11.68	358
			1.12.68	340
			5.12.68	347
			10.12.68	373
			13.12.68	780
			16.12.68	421
			23.12.68	363
			30.12.68	364

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Kurrang Nallah	Rawal Dam Lat: 33°40' Long: 73°07'	105	13. 1.68	2.3
			24. 1.68	3.1
			11. 2.68	4.9
			27. 2.68	4.9
			8. 3.68	3.9
			18. 3.68	4.9
			26. 4.68	4.6
			17. 5.68	3.3
			24. 5.68	2.4
			19. 6.68	0
			29. 6.68	0
			7. 7.68	0
			6. 8.68	6,620
			11. 8.68	5,420
			23. 8.68	2.8
			14. 9.68	2.1
			8.10.68	1.9
			21.11.68	4.0
			10.12.68	3.6
Kurram	Dara Tang Lat: 32°36' Long: 71°10'		4. 1.68	1,320
			9. 1.68	1,960
			13. 1.68	1,840
			17. 1.68	1,230
			20. 1.68	15,100
			23. 1.68	1,210
			27. 1.68	1,170
			30. 1.68	903
			3. 2.68	678
			6. 2.68	742
			9. 2.68	627
			12. 2.68	717
			15. 2.68	640
			17. 2.68	684
			20. 2.68	1,140
			23. 2.68	678
			28. 2.68	606
			2. 3.68	669
			15. 3.68	661
			18. 3.68	614
			20. 3.68	598
			22. 3.68	622
			26. 3.68	37,900
			27. 3.68	5,160
			29. 3.68	981

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Kurram	Dara Tang		1. 4.68	574
			3. 4.68	531
			5. 4.68	444
			8. 4.68	621
			10. 4.68	1,180
			12. 4.68	1,090
			15. 4.68	12,700
			16. 4.68	3,830
			18. 4.68	962
			20. 4.68	766
			23. 4.68	730
			25. 4.68	417
			27. 4.68	460
			30. 4.68	9,330
			1. 5.68	3,220
			3. 5.68	4,750
			11. 5.68	612
			13. 5.68	725
			15. 5.68	672
			18. 5.68	439
			19. 5.68	591
			22. 5.68	15,400
			23. 5.68	3,710
			24. 5.68	3,270
			27. 5.68	2,500
			30. 5.68	2,250
			1. 6.68	2,900
			3. 6.68	2,580
			5. 6.68	2,240
			8. 6.68	2,030
			10. 6.68	1,830
			12. 6.68	2,180
			13. 6.68	2,550
			16. 6.68	623
Zhob	Mir Ali Khel	5,730	23. 1.68	73
	Lat: 31°44'		8. 2.68	77
	Long: 69°35'		12. 4.68	47
			17. 5.68	41
			17. 5.68	41
			19. 5.68	248
			23. 5.68	67
			24. 5.68	58
			26. 5.68	45
			28. 5.68	34
			31. 5.68	68

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Zhob	Mir Ali Khel		2. 6.68	41
			4. 6.68	59
			5. 6.68	40
			8. 6.68	77
			9. 6.68	74
			10. 6.68	73
			12. 6.68	66
			14. 6.68	79
			17. 6.68	90
			19. 6.68	82
			25. 6.68	86
			27. 6.68	128
			3. 7.68	80
			4. 7.68	72
			5. 7.68	87
			9. 7.68	32
			10. 7.68	101
			13. 7.68	198
			14. 7.68	235
			17. 7.68	130
			19. 7.68	116
			22. 7.68	56
			24. 7.68	106
			26. 7.68	81
			28. 7.68	89
			30. 7.68	157
			6. 8.68	88
			9. 8.68	93
			15. 8.68	131
			21. 8.68	142
			28. 8.68	79
			31. 8.68	81
			3. 9.68	82
			5. 9.68	97
			8. 9.68	83
			11. 9.68	58
			14. 9.68	51
			21. 9.68	26
			28. 9.68	46
			2.10.68	38
			17.10.68	32
			23.10.68	33
			30.10.68	32

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Zhob	Mir Ali Khel		6.11.68	29
			13.11.68	52
			8.12.68	56
			10.12.68	37
			16.12.68	36
			24.12.68	33
Gomal	Khajuri Kachi	11,200	26. 1.68	472
	Lat: 32°06'		14. 2.68	163
	Long: 69°53'		25. 2.68	194
			6. 3.68	233
			28. 3.68	266
			12. 4.68	259
			27. 4.68	133
			12. 5.68	146
			25. 5.68	196
			18. 6.68	80
Daraban Zam	Zam Tower	410	27. 1.68	13
	Lat: 31°45'		15. 2.68	24
	Long: 70°13'		26. 2.68	28
			7. 3.68	30
			11. 4.68	28
			28. 4.68	28
			13. 5.68	20
			26. 5.68	26
			16. 6.68	18
Kathai Nallah	Chinari		23. 1.68	54
	Lat: 34°09'		16. 2.68	59
	Long: 73°50'		21. 3.68	330
			21. 4.68	225
			25.11.68	43
Jari Kas	Jari Weir		19. 4.68	1,110
			6. 5.68	628
Bong Canal	Foot Bridge		4. 1.68	4,930
			11. 1.68	8,300
			19. 1.68	6,250
			25. 1.68	8,000
			27. 2.68	6,470
			28. 3.68	7,950
			11.10.68	13,600
			11.10.68	14,000

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Beji	Babar Kach Lat: 29°47' Long: 67°59'	6,300	6. 1.68	155
			16. 1.68	141
			25. 1.68	132
			31. 1.68	142
			12. 2.68	110
			21. 2.68	129
			29. 2.68	105
			5. 3.68	101
			25. 3.68	76
			30. 3.68	68
			7. 4.68	74
			15. 4.68	70
			17. 4.68	51
			28. 4.68	55
			6. 5.68	63
			12. 5.68	72
			25. 5.68	80
			1. 6.68	73
			8. 6.68	52
			17. 6.68	49
			2. 7.68	323
			9. 7.68	51
			11. 9.68	45
			16.10.68	73
			10.12.68	58
Hub	Dam Site Lat: 25°15' Long: 67°05'		14. 1.68	58
			17. 1.68	60
			20. 1.68	50
			24. 1.68	49
			27. 1.68	52
			2. 2.68	49
			4. 2.68	41
			7. 2.68	59
			13. 2.68	36
			17. 2.68	44
			21. 2.68	167
			24. 2.68	131
			27. 2.68	74
			2. 3.68	45
			8. 3.68	36
			14. 3.68	55
			19. 3.68	14
			22. 3.68	13

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1968

Stream	Location of measurement site	Drainage area square miles.	Measurements Date	Cusecs
Hub	Dam Site		25. 3.68	8.6
			28. 3.68	6.0
			1. 4.68	5.8
			5. 4.68	2.5
			10. 4.68	2.0
			15. 4.68	2.2
			20. 4.68	2.1
			24. 4.68	1.4
			29. 4.68	2.0
			5. 5.68	0.3
			11. 5.68	1.0
			18. 5.68	1.1
			25. 5.68	1.0
			28. 5.68	0.3
			31. 5.68	46
			5. 6.68	12
			10. 6.68	3.2
			14. 6.68	2.9
			18. 6.68	1.1
			23. 6.68	0.8
			27. 6.68	0.3
			23. 7.68	31
			10. 8.68	6.4
			24. 8.68	90
			13. 9.68	0.2
			18.10.68	0.2
			22.10.68	0.2
			4.12.68	0.2
Windor Dhora	Goth Amun	355	5. 3.68	Dry
	Lat: 25°26'		15. 5.68	Dry
	Long: 66°52'		17. 6.68	Dry

MISCELLANEOUS SITES
SUMMARY OF SEDIMENT DATA

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
GILGIT RIVER AT ALAM BRIDGE						
25 Feb	3,580		40			
26 Mar	3,470		45			
29 Apr	6,520		212			
19 Jun	86,100	50	4,810	41	34	25
19 Jul	86,100	53	4,990	45	27	28
21 Jul	77,300	56	5,780	58	26	16
30 Jul	103,000	55	4,020	27	31	42
11 Aug	118,000	57	17,400	71	21	8
20 Aug	100,000	55	4,660	35	60	5
11 Sep	29,300	52	1,530	43	43	14
27 Sep	24,000	56	804	25	29	46
28 Sep	23,100	57	534	4	41	55
5 Oct	15,400	55	832			
31 Oct	8,350	59	60			
18 Nov	6,510	51	45			
25 Dec	5,230	43	53			
INDUS RIVER NEAR BESHAM QILA						
6 Nov	23,100	51	34			
7 Nov	22,800	51	14			
10 Nov	22,800	49	43			
30 Nov	18,400	47	56			
1 Dec	19,100	47	18			
7 Dec	17,600	47	98			
SIRAN RIVER AT PHULRA						
1 Sep	350		84			
7 Sep	337		123			
22 Sep	231		26			
28 Sep	292		67			
2 Oct	242		28			
14 Oct	422		76			
17 Nov	282	51	67			
28 Nov	215	52	35			
2 Dec	293	52	48			
24 Dec	372	46	42			
HARO RIVER AT GARIALA						
15 Oct	374	73	47			
16 Oct	330	78	61			
20 Nov	355	75	28			
25 Nov	358	75	32			
1 Dec	340	70	38			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
HARO RIVER AT GARIALA						
5 Dec	347	67	8			
10 Dec	373	65	20			
13 Dec	780	60	1,300	2	31	67
16 Dec	421	65	48			
23 Dec	363	60	50			
30 Dec	364	55	18			
KURRANG RIVER AT RAWAL DAM						
13 Jan	2.3	54	59			
24 Jan	3.1	51	21			
11 Feb	4.9	55	55			
27 Feb	4.9	64	68			
18 Mar	4.9	65	8			
26 Apr	4.6	76	22			
24 May	2.4	80	22			
6 Aug	6,620	78	81			
11 Aug	5,420	78	432	2	19	79
23 Aug	2.8	88	95			
14 Sep	2.1	98	96			
8 Oct	1.9	78	58			
10 Dec	3.6	58	48			
KURRAM RIVER AT DARA TANG						
4 Jan	1,320	56	108			
9 Jan	1,960	57	2,770	11	54	35
13 Jan	1,840	55	206			
20 Jan	15,100	53	2,660	8	45	47
23 Jan	1,210	54	2,020	11	68	21
27 Jan	1,170		2,460	8	79	13
30 Jan	903	52	3,040	28	62	10
3 Feb	678	58	308			
6 Feb	742	53	1,800	11	57	32
9 Feb	627	55	233			
12 Feb	717	58	321			
15 Feb	640	57	231			
17 Feb	684	59	198			
20 Feb	1,140	53	289			
23 Feb	678		3,050	10	67	23
2 Mar	669	62	145			
15 Mar	661	67	5,080	2	41	57
18 Mar	614	66	18,300	3	55	42
20 Mar	598	68	2,130	1	58	41
22 Mar	622		4,220	1	28	71

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
		KURRAM RIVER AT DARA TANG				
26 Mar	37,900	65	34,000	9	41	50
27 Mar	5,160	67	4,510	13	55	32
29 Mar	981	69	2,810	1	51	48
1 Apr	574	74	2,380	18	67	15
3 Apr	531	74	2,210	50	31	19
5 Apr	444	71	1,330	43	41	16
8 Apr	621	67	3,030	27	49	24
10 Apr	1,180	70	3,350	43	37	20
12 Apr	1,090	72	2,970	36	49	15
15 Apr	12,700	70	11,100	12	63	25
16 Apr	3,830	71	2,080	11	67	21
18 Apr	962	75	2,160	8	49	43
20 Apr	766	78	2,530	8	63	29
23 Apr	730	80	1,980	11	41	48
25 Apr	417	80	653		48	50
27 Apr	460	80	5,560		[illegible]	38
30 Apr	9,330	80	27,100	1	56	29
1 May	3,220	79	7,100	20	36	44
3 May	4,750	75	1,660	32	28	40
11 May	612	76	1,940	23	36	41
13 May	725	78	6,540	16	54	30
15 May	672	77	1,200	45	31	24
18 May	439	80	1,640	45	36	19
19 May	591	85	1,580	2	51	47
22 May	15,400	80	5,340	25	34	41
23 May	3,710	78	5,060	15	51	30
24 May	3,270	78	3,240	6	62	32
27 May	2,500	85	7,630	14	64	22
1 Jun	2,900		6,890	16	35	49
3 Jun	2,580	88	3,150	4	65	31
5 Jun	2,240	87	2,820	4	58	38
8 Jun	2,030	89	3,340	3	45	52
10 Jun	1,830	90	7,200	1	40	59
12 Jun	2,180	87	3,190	8	49	43
13 Jun	2,550	87	5,020	1	43	56
		ZHOB RIVER NEAR MIR ALI KHEL				
23 Jan	73	44	93			
8 Feb	77	48	163			
12 Apr	47	71	243			
5 Jun	40	85	253			
10 Jun	73	84	178			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
		ZHOB RIVER AT MIR ALI KHEL				
12 Jun	66	95	174			
14 Jun	79	90	147			
5 Jul	87	70	31,500	7	43	50
14 Jul	235	80	32,500	6	33	61
2 Oct	38	70	300			
17 Oct	32	60	235			
8 Dec	56	60	145			
24 Dec	33	45	180			
		GOMAL RIVER AT KHAJURI KACH				
26 Jan	472	54	120			
14 Feb	163	49	130			
25 Feb	194	49	1,810	2	62	36
6 Mar	233	65	18			
28 Mar	266	62	93			
12 Apr	259	85	106			
27 Apr	133	85	100			
12 May	146	70	100			
25 May	186	62	1,820	2	19	79
18 Jun	86		97			
		DARABAN ZAM AT ZAM TOWER				
27 Jan	13	54	58			
15 Feb	24	50	151			
26 Feb	28	42	152			
7 Mar	30	65	33			
11 Apr	28		42			
28 Apr	28	86	32			
13 May	20	80	46			
26 May	26	72	139			
16 Jun	18	90	33			
		KATHAI NALLAH AT CHINARI				
23 Jan	54	44	58			
16 Feb	59	44	49			
21 Mar	330	47	48			
21 Apr	225	35	166			
25 Nov	43	55	33			
		BONG CANAL AT FOOT BRIDGE				
11 Jan	8,300	53	27			
19 Jan	6,250	54	5			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
BEJI RIVER AT BABAR KACH						
6 Jan	155		109			
16 Jan	141		55			
25 Jan	132	62	139			
31 Jan	142	58	49			
12 Feb	110	64	112			
21 Feb	129	64	87			
29 Feb	105	68	106			
5 Mar	101	70	86			
30 Mar	68	66	32			
7 Apr	74	76	107			
15 Apr	70	86	147			
28 Apr	55	84	68			
6 May	63	74	94			
25 May	80	90	101			
1 Jun	73	92	57			
8 Jun	52	92	50			
17 Jun	49	90	70			
2 Jul	323	92	13,000	8	36	56
9 Jul	51	88	24			
11 Jul	45	87	85			
16 Oct	73	80	101			
10 Dec	58	68	138			
HUB RIVER AT DAM SITE						
14 Jan	68	63	59			
17 Jan	60		87			
20 Jan	50	61	23			
24 Jan	49	65	45			
27 Jan	52	57	30			
2 Feb	49	64	53			
4 Feb	41	73	117			
7 Feb	59	62	152			
17 Feb	44		70			
21 Feb	167	65	115			
24 Feb	131		141			
27 Feb	74	85	86			
2 Mar	45	82	92			
8 Mar	36	78	117			
14 Mar	55	80	164			

Suspended sediment concentration - 1968

1968 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
HUB RIVER AT DAM SITE						
19 Mar	14	82	124			
25 Mar	13	80	128			
25 Mar	8.6	83	65			
28 Mar	6.0	78	142			
1 Apr	5.8	80	225			
5 Apr	2.5	80	112			
10 Apr	2.0	82	137			
15 Apr	2.2	70	185			
20 Apr	2.1	77	115			
24 Apr	1.4		105			
29 Apr	2.0	84	188			
5 May	0.3	77	138			
11 May	1.0	88	145			
25 May	1.0	87	61			
5 Jun	12	85	266			
10 Jun	3.2	87	155			
10 Aug	6.4	82	84			
24 Aug	90	79	26			

Note : Sand is all sizes above 0.0625 mm.
Silt is all sizes between 0.0625 mm and 0.0055 mm.
Clay is all sizes smaller than 0.0055 mm.

Blank page retained for pagination

MISCELLANEOUS SITES
SUMMARY OF QUALITY DATA

GILGIT RIVER AT ALAM BRIDGE

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
25	1.47	1.43	0.55		0.18	1.57	0.10	1.60			3.45	3.45				220	320	8.22	0	0.5
Mar																				
26	1.68	1.32	0.55		0.18	1.66	0.10	1.70			3.55	3.64				220	340	8.22	0	0.5
Jun																				
19	1.15	0.45	0.15		0	1.20	0.10	0.50			1.75	1.80				94	170	7.97	0	0.2
Jul																				
19	1.05	0.65	0.30		0.08	1.09	0.20	0.65			2.00	2.02				102	190	8.32	0	0.3
21	1.11	0.36	0.55		0	1.29	0.09	0.68			2.02	2.06				110	200	7.90	0	0.6
30	1.16	0.42	0.55		Traces	1.39	0.09	0.80			2.13	2.28				112	200	8.02	0	0.6
Aug																				
11	1.27	0.36	0.55		Traces	1.39	0.09	0.68			2.18	2.16				108	200	8.04	0	0.6
20	1.21	0.42	0.45		Traces	1.39	0.09	0.63			2.08	2.11				110	200	8.05	0	0.5
24	1.48	0.35	0.45		0	1.39	0.09	0.78			2.28	2.26				116	210	7.85	0	0.5
Sep																				
11	1.27	0.46	0.45		Traces	1.29	0.09	0.84			2.18	2.22				114	210	8.00	0	0.5
27	1.52	0.26	0.55		0	1.70	0.14	0.50			2.33	2.34				126	230	7.98	0	0.6
28	1.52	0.26	0.60			1.55	0.14	0.71			2.38	2.40				132	230	7.85	0	0.6
Oct																				
5	1.54	0.60	0.20		0	1.62	0.19	0.59			2.34	2.40				130	220	8.05	0	0.2
31	1.83	0.86	0.20		Traces	1.80	0.19	0.84			2.89	2.83				160	270	8.18	0	0.2
Nov																				
18	1.89	0.99	0.29		Traces	1.75	0.14	1.25			3.17	3.14				170	280	8.18	0	0.2
Dec																				
16	1.46	0.52	0.20		0	1.53	0.19	0.57			2.18	2.29				124	210	8.10	0	0.2
25	2.00	1.00	0.29		Traces	1.84	0.19	1.28			3.29	3.31				182	300	8.18	0	0.2

INDUS RIVER NEAR BESHAM QILA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				ECx10^6 at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Nov 7	1.77	0.47	0.18		0	1.62	0.24	0.60			2.42	2.46				144	230	8.00	0	0.2
Dec 7	1.93	0.53	0.40		0	1.66	0.19	0.80			2.86	2.65				146	260	8.00	0	0.4

SIRAN RIVER AT PHULRA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				$EC \times 10^6$ at 25°C.	pH	Res CO_3	SAR
										TOTAL									
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Sep																				
1	1.05	1.40	0.55		0.16	2.15	0.20	0.60			3.00	3.14				160	300	8.32	0	0.5
7	2.33	0.66	0.35		0.29	1.48	0.19	1.50			3.34	3.46				190	340	8.22	0	2.9
13	1.77	0.69	0.35		0.09	2.22	0.14	0.40			2.81	2.85				155	270	8.22	0	0.3
22	1.99	0.63	0.35		0.19	2.37	0.14	0.29			2.97	2.99				175	300	8.22	0	0.3
28	2.04	0.75	0.35		0.29	2.42	0.14	0.41			3.14	3.26				165	310	8.35	0	0.3
Oct																				
2	2.27	0.45	0.60		0.40	2.25	0.19	0.47			3.32	3.31				192	330	8.42	0	0.5
14	1.99	0.41	0.60		0.40	1.90	0.19	0.52			3.00	3.01				170	290	8.28	0	0.5
Nov																				
17	1.76	1.02	0.28		0	2.50	0.19	0.50			3.06	3.19				182	300	8.05	0	0.2
28	1.92	0.75	0.35		0	2.50	0.19	0.40			3.02	3.09				182	300	8.10	0	0.3
Dec																				
2	1.98	0.59	0.40		0.18	2.25	0.19	0.36			2.97	2.98				160	270	8.20	0	0.4
24	1.98	0.46	0.40		0.18	2.25	0.19	0.20			2.84	2.82				154	260	8.20	0	0.4
30	1.88	0.68	0.30		Traces	2.38	0.14	0.25			2.86	2.77				152	270	8.18	0.	0.3

HARO RIVER AT CARMALA

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Nov 20	2.31	1.22	1.05		0.09	2.47	0.39	1.60			4.58	4.55				250	410	8.18	0	0.8
Dec 5°	2.75	1.96	0.90		0.18	3.06	0.44	1.90			5.61	5.58				300	520	8.20	0	0.6

KURRAWA WALLAH AT RANAL DAM

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C.$	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
13	2.18	0.71	0.50		0	2.88	0.14	0.49			3.39	3.51				204	330	7.94	0	0.4
Feb																				
11	1.03	1.77	0.36		0.18	2.42	0.24	0.30			3.16	3.14				178	300	8.28	0	0.3
Mar																				
18	1.24	1.56	0.42		0.18	2.56	0.19	0.30			3.22	3.23				190	320	8.28	0	0.4
Apr																				
3	2.10	1.05	0.49		0.19	2.68	0.19	0.55			3.64	3.61				216	360	8.22	0	0.4
26	2.52	0.98	0.65		0.27	2.82	0.29	0.90			4.15	4.18				230	410	8.26	0	0.5
May																				
24	2.31	0.69	0.55		0.54	2.12	0.24	0.70			3.55	3.60				190	340	8.40	0	0.4
Aug																				
6	1.47	0.73	0.40		0	1.53	0.19	0.90			2.60	2.62				134	250	8.10	0	0.4
23	2.10	1.45	0.70		0.34	2.37	0.39	1.45			4.65	4.55				250	410	8.48	0	0.5
Sep																				
14	1.55	0.70	0.50		0.39	1.68	0.19	0.55			2.75	2.81				145	270	8.44	0	0.5
Oct																				
8	2.09	0.63	0.93		0.19	2.77	0.19	0.47			3.65	3.62				208	360	8.40	0.24	0.8
Dec																				
10	2.01	1.40	0.40		0.18	3.01	0.34	0.21			3.81	3.74				202	340	8.30	0	0.3

KURRAM RIVER AT DARA TANG

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE									TOTAL		PARTS PER MILLION				MCx10^6 at 25°C	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
9	3.09	3.91	8.83			4.92	6.13	4.70			15.83	15.75				975	1500	8.01	0	4.7
23	2.37	4.03	8.40			4.46	5.54	4.70			14.80	14.70				896	1400	8.10	0	4.7
Feb																				
12	1.13	3.77	7.20		0.19	3.71	6.27	2.40			12.10	12.57				730	1190	8.23	0	4.6
Mar																				
15	1.47	3.53	6.78		0.54	2.91	4.15	4.10			11.78	11.70				710	1140	8.30	0	4.3
26	2.52	2.48	8.15		0.36	2.82	3.25	5.80			13.15	12.24				740	1200	8.20	0	5.2
Apr																				
8	1.68	2.62	6.50		0.54	3.09	4.00	3.10			10.80	10.73				650	1060	8.35	0	4.4
15	1.39	1.91	6.35		0.36	2.95	3.76	3.00			10.15	10.07				630	1000	8.21	0	4.5
30	2.84	4.15	11.62		0.36	2.79	6.38	9.50			18.62	19.03				1150	1800	8.30	0	6.2
May																				
11	1.89	3.01	8.66		0.54	2.43	6.23	4.50			13.56	13.73				844	1360	8.37	0	5.5
22	1.88	2.02	4.90		0.27	2.70	3.21	3.00			8.80	9.18				560	880	8.28	0	3.5
Jun																				
12	1.59	2.94	7.50		0.34	1.99	4.45	5.45			12.93	12.23				770	1200	8.48	0	5.0

ZHOB RIVER NEAR MIR ALI KHEL

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 23	2.06	3.64	8.60		0.27	2.66	3.48	8.00			14.30	14.41				924	1350	8.29	0	5.1
Apr 12	3.15	2.85	9.60		0.54	2.11	3.41	9.50			15.60	15.56				920	1450	8.35	0	5.5
May 17	2.10	3.30	9.40		0.36	1.84	3.41	9.20			14.80	14.81				864	1390	8.28	0	5.7
Sep 21	2.90	4.33	7.80		0.36	1.91	3.57	8.92			15.03	14.76				940	1450	8.30	0	4.1
Nov 20	1.76	4.49	8.00		0.18	3.06	3.66	7.29			14.25	14.19				830	1310	8.20	0	4.5
Dec 8	3.85	2.25	8.00		0.18	2.88	3.56	7.60			14.10	14.22				840	1310	8.28	0	4.6

GOMAL RIVER AT KHAJURI KACH

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25°C.	pH	Res CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
26	1.97	5.03	7.70		0	3.62	2.42	9.20			14.70	15.24				958	1430	8.02	0	4.1
Feb																				
14	2.06	4.94	7.45		0.19	3.60	2.35	8.30			14.41	14.45				870	1330	8.20	0	4.0
25	1.75	2.95	4.46		0.09	3.10	2.13	4.90			9.16	9.22				600	900	8.15	0	2.9
Mar																				
6	2.10	3.90	5.08		0.18	3.45	1.18	6.30			11.08	11.11				680	1060	8.22	0	2.9
28	1.68	3.82	5.08		0.18	2.64	1.18	6.50			10.58	10.50				650	1010	8.22	0	3.1
Apr																				
12	2.41	4.29	6.35		0.26	2.26	1.68	8.80			13.05	13.00				790	1180	8.27	0	3.5
May																				
12	3.26	4.04	8.15		0.45	2.30	2.42	10.50			15.45	15.67				930	1490	8.37	0	5.0
25	2.81	3.39	5.69		0.27	2.70	1.58	6.90			11.80	11.45				700	1090	8.25	0	3.2
Jun																				
18	3.15	4.25	10.90		0.17	2.51	2.47	13.40			18.30	18.55				1180	1650	8.28	0	5.6

DARBAN ZAM AT ZAM TOWER

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				$EC \times 10^6$ at 25°C	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 27	3.40	2.90	3.12			3.53	0.49	5.50			9.42	9.52				580	870	8.12	0	1.8
Feb 15	4.76	2.74	8.32		0.36	2.82	2.69	10.64			15.82	16.21				1030	1500	8.25	0	4.3
26	1.75	3.25	5.65		0.14	3.43	1.52	5.70			10.65	10.79				740	1050	8.20	0	3.5
Mar 7	1.68	3.42	3.62		0.36	3.23	0.79	4.20			8.72	8.58				540	800	8.20	0	1.6
Apr 11	3.57	3.33	2.96		0.18	2.64	0.24	6.60			9.86	9.68				570	900	8.17	0	1.6
28	3.47	3.63	2.96		0.18	2.73	0.39	6.60			10.06	9.90				580	930	8.20	0	1.6
May 13	3.57	4.13	3.30		0.36	1.71	0.49	8.20			11.00	10.76				630	1000	8.31	0	1.7
26	3.26	4.14	3.30		0.18	2.02	0.49	8.00			10.70	10.69				650	1000	8.20	0	1.7
Jun 16	2.63	4.67	2.80		0.17	2.29	0.54	7.70			10.10	10.70				640	1000	8.28	0	1.5

KATHAI NALLAH NEAR CHINARI

Chemical Analysis of Water Samples - 1968

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				MOx10^6 at 25°C	pH	Res CO_3 me/l	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	P	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.				
Jan 23	1.75	2.25	0.35		0.18	1.58	0.14	2.30			4.35	4.20				224	400	8.54	0	0.2
Feb 16	0.93	2.87	0.35		0.18	1.51	0.14	2.30			4.15	4.13				236	390	8.41	0	0.3
Mar 21	1.34	1.56	0.20		Traces	2.33	0.10	0.80			3.10	3.23				184	300	7.99	0	0.2
Apr 21	1.58	0.62	0.25		0	1.46	0.09	0.80			2.45	2.35				128	230	7.85	0	0.2
Nov 25	2.57	0.91	0.28		0	1.60	0.14	2.05			3.76	3.79				236	390	7.65	0	0.2

HUJI RIVER NEAR BABAR KACH

Chemical Analysis of Water Samples - 1968

Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	TOTAL Cations	TOTAL Anions	PARTS PER MILLION SiO_2	Fe	B	D.S. by Evap.	EC x 10^6 at 25°C	pH	Res CO_3 me/l	SAR
Jan 31	2.37	3.33	6.09		0.27	2.93	2.05	6.56			11.79	11.75				740	1090	8.30	0	4.0
Feb 29	1.79	2.71	8.10		0.27	1.76	2.47	8.35			12.60	12.85				780	1200	8.32	0	5.4
Mar 30	1.79	2.96	8.60		0.27	1.94	2.57	8.78			13.35	13.56				840	1230	8.32	0	5.6
Apr 28	1.94	3.66	8.94		0.63	2.70	2.82	8.40			14.54	14.55				810	1330	8.38	0	5.3
Jun 17	1.79	3.61	8.10		0.35	1.93	3.11	8.20			13.50	13.59				840	1300	8.30	0	4.9
Jul 2	6.51	0.73	4.10		0.34	1.44	1.88	12.41			16.34	16.07				1050	1500	8.40	0	4.8
Sep 11	3.10	3.90	7.40		0.25	2.25	3.07	9.06			14.40	14.63				910	1400	8.50	0	3.9
Oct 16	2.09	3.09	6.60		0.18	2.70	2.57	6.30			11.78	11.75				730	1120	8.40	0	4.1
Dec 10	2.64	3.56	5.80		0.18	3.33	2.28	6.16			12.00	11.95				720	1100	8.20	0	3.3

HUB RIVER AT DAM SITE

Chemical Analysis of Water Samples - 1968

	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				MHOx10^6 at 25°C	pH	Res CO_3	SAR
										TOTAL									
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan																				
14	2.06	2.74	6.40		0.18	2.42	4.80	3.90			11.20	11.30				676	1090	8.29	0	4.1
27	3.19	2.51	8.00		0.28	2.55	5.94	4.50			13.70	13.27				812	1310	8.35	0	4.7
Feb																				
4	3.19	2.49	9.00		0.28	2.50	6.97	5.40			14.68	15.15				924	1480	8.35	0	5.3
7	3.19	3.31	9.58		0.28	2.50	7.32	5.50			16.08	15.60				947	1500	8.33	0	5.3
21	2.99	3.91	9.76		0.36	2.46	7.67	6.00			16.66	16.49				1048	1650	8.40	0	5.3
Mar																				
8	2.68	3.32	11.40		0.18	1.71	8.31	7.30			17.40	17.50				1070	1680	8.21	0	6.6
Apr																				
5	3.66	4.72	15.00		0.36	1.80	11.09	10.30			23.38	23.55				1420	2200	8.36	0	7.3
May																				
5	5.57	5.43	21.00		0.27	1.71	17.52	12.70			32.00	32.20				1960	3050	6.25	0	9.0
25	4.20	4.30	17.20		0.27	1.53	13.16	10.85			25.70	25.81				1580	2350	8.31	0	8.4
31	5.36	5.64	18.00		0.26	1.71	16.63	10.50			29.00	29.10				1960	3000	8.28	0	14.0
Jun																				
18	5.57	6.13	19.50		0.35	1.58	19.60	9.80			31.20	31.33				2010	3150	8.30	0	8.1
Jul																				
23	2.51	3.05	9.60		0.34	1.70	6.68	6.50			15.16	15.22				970	1520	8.30	0	5.8
Aug																				
24	1.69	1.98	4.47		0.40	1.98	3.05	2.78			8.14	8.21				482	800	8.45	0	3.3