QC
990
.P2
W42
1969
v.1

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

1969 ANNUAL REPORT OF RIVER AND CLIMATOLOGICAL DATA OF WEST PAKISTAN

VOL. I

RIVER DISCHARGE, SEDIMENT AND QUALITY DATA

ATMOSPHERIC SCIENCES
LIBRARY

N.O.A.A.
U. S. Dept. of Commerce

PREPARED BY SURFACE WATER HYDROLOGY PROJECT
WASID WAPDA, LAHORE

74 4168

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 Director General of Planning and Investigation and Tarbela Dam Project.

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, relative humidity 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,

Lahore July 1971.

Blank page retained for pagination

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. 29
Indus River at Partab Bridge. 35
Indus River at Besham Qila. 41
Indus River near Darband. 49
Siran River near Phulra. 55
Siran River at Thapla. 61
Chitral River at Chitral 67
Kabul River at Warsak. 73
Swat River near Kalam 79
Swat River at Chakdara. 85
Bara River at Jhansi Post 91
Kabul River at Nowshera. 97
Kalpani River near Risalpur 103
Indus River at Mandori(about 5 miles d/s Attock Brd.) 108
Haro River near Khanpur. 115
Haro River at Sanjwal. 123
Haro River at Gariala. 129
Soan River at Chirah 137
Ling River near Kahuta. 143
Soan River near Rawalpindi 151
Sil River near Chahan 157
Soan River at Dhok Pathan. 165
Kurram River at Thal 173
Tochi River at Tangi Post. 179
Gomal River at Kot Murtaza 183
Jhelum River Basin
Kishanganga River at Muzaffarabad. 189
Kunhar River at Naran 195
Kunhar River at Khanian 201
Kunhar River near Garhi Habib Ullah 205
Jhelum River at Kohala 211

CONTENTS

Page

Jhelum River at Narot. 217
Bishan Daur Kas near Missa 223
Poonch River near Kotli 229
Jhelum River at Mangla Cableway. 235
Nari River Basin
Khost River at Chappar Rift 241
Nari River near Sibi 247
Chakkar River at Talli Tangi. 253
Bolan River at Kundlani Bridge. 255
Gaj Nai near Jubble. 261
Indus River near Sehwan 267
Hub River at Bund Murad Khan. 273
Kud River near Mai Gondrani 279
Porali River at Sinchi Bent 285

DATA AT MISCELLANEOUS SITES

Summary of discharge measurements 292
Summary of sediment analysis data 296
Summary of chemical analysis data 298

(Typed by Mohammad Ramzan Steno/typist)

Organisation

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 1969, its tenth year of operation. This is the tenth 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.

Maps on pages 9 to 13 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 from 08:00 to 16:00 hours 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 charge 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 ofthe 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 miscellaneious 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 ofthe data justifies building major discharge measuring cableways or security and access allow full time collection of streamflow data.

Discharge measurements made in 1969 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 is 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 phenolphathalein and methyl orange indicators. The end points of titration are selected as the inflection point in the titration of sodiumcarbonate 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 evaporation 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 conduc-

tivity 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.

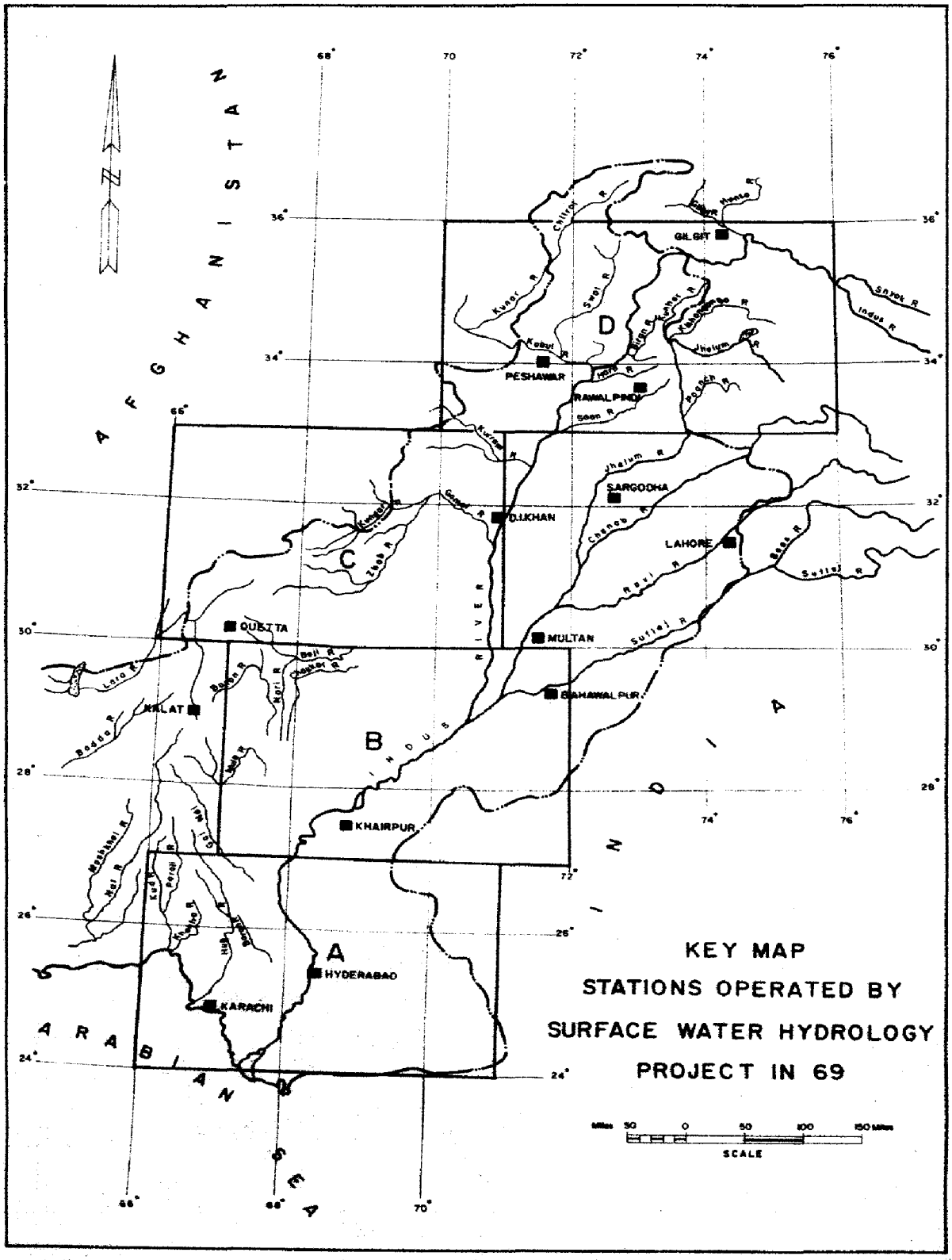
Sodium Adsorption Ratio (SAR) is an index of the sodium or alkali hazard expressing the relative activity of sodium ions in exchange reactions with the soil. It is expressed as follows:

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

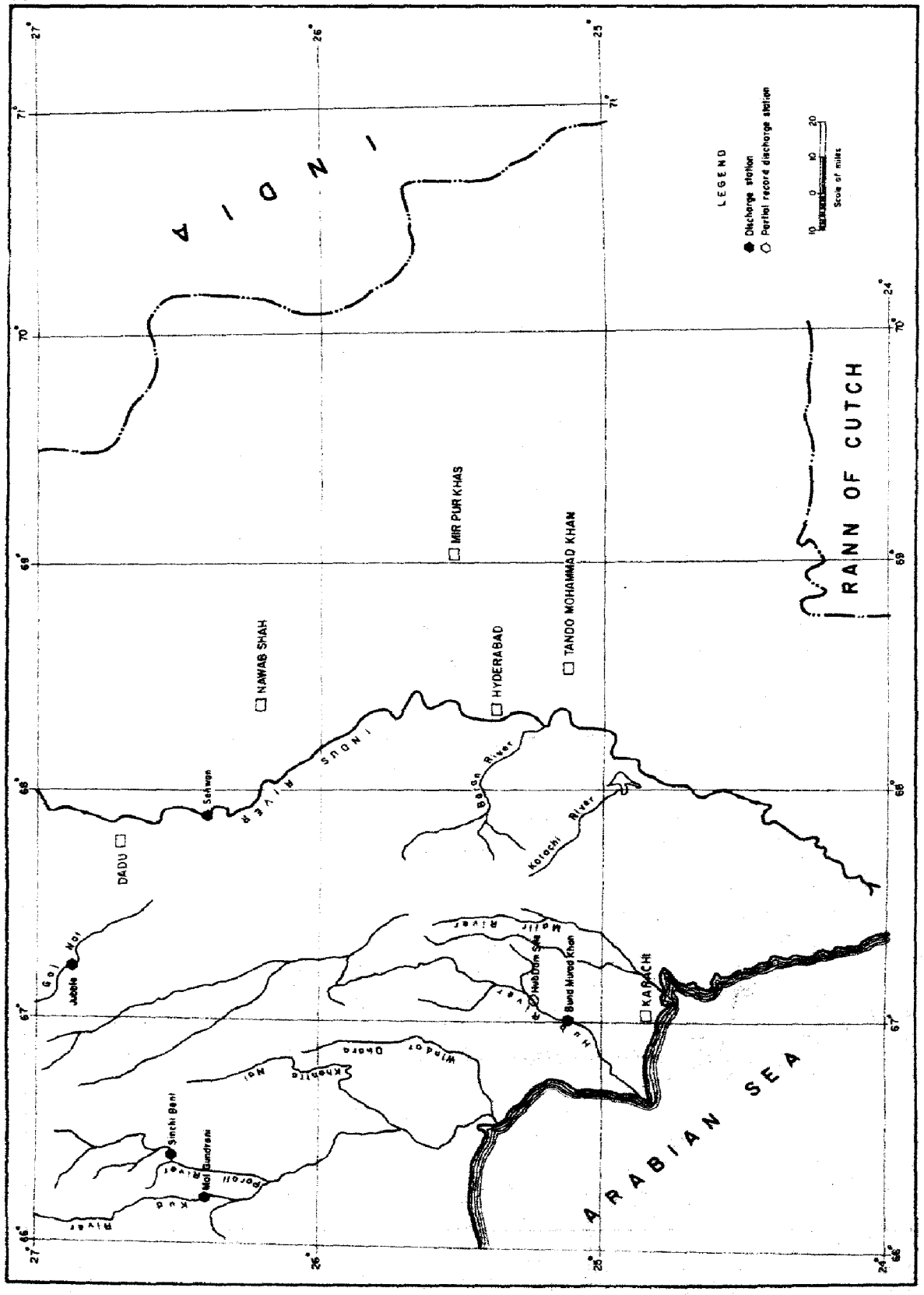
Where the concentrations of the three solvable cations are given in milliequivalents per litre (me/l).

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.

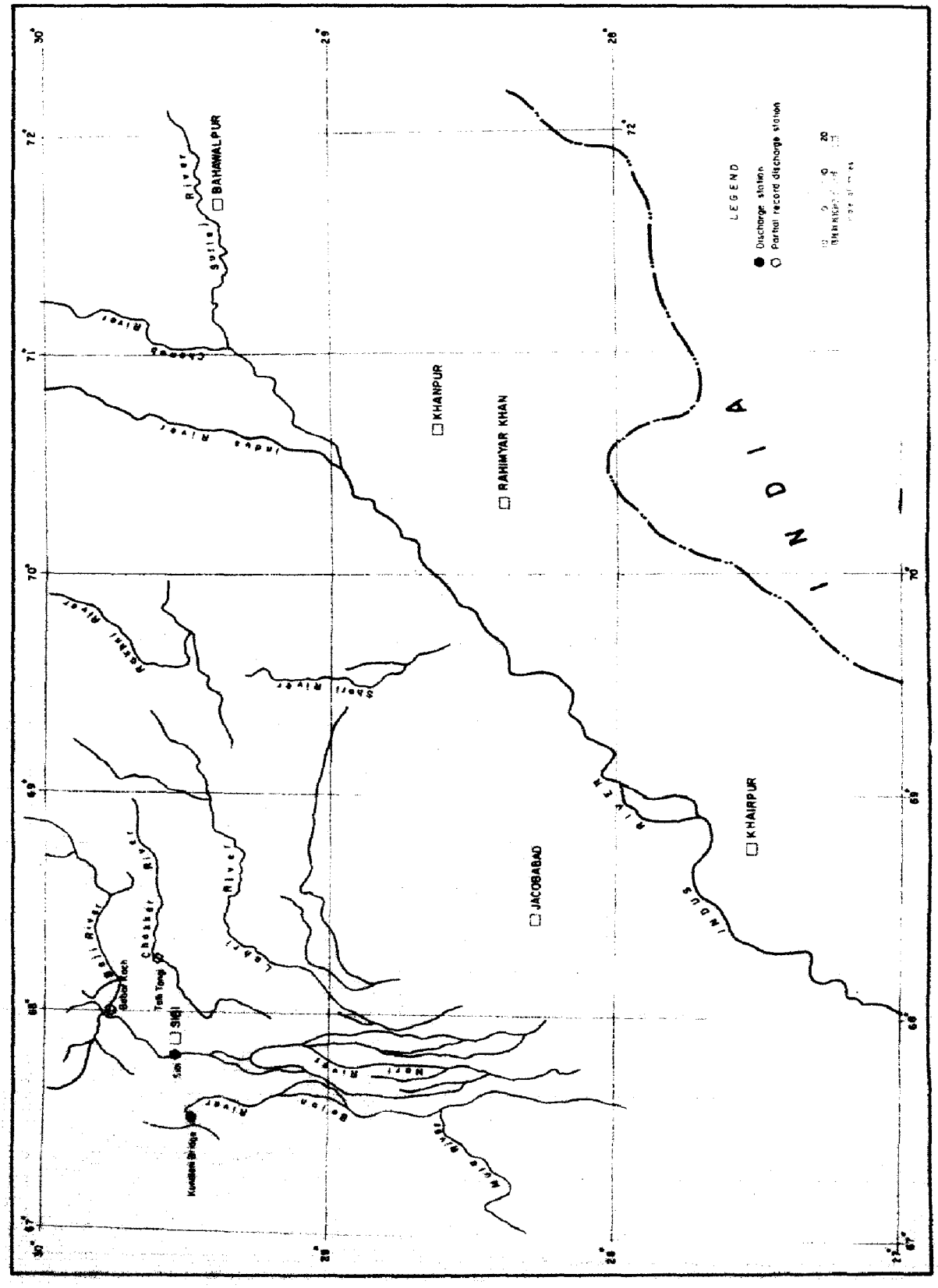
$$Res\ CO_3 = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++}).$$


AFGHANISTAN
INDIA
ARABIAN SEA
INDUS RIVER
GILGIT
PESHAWAR
RAWALPINDI
SARGODHA
D.I.KHAN
LAHORE
QUETTA
MULTAN
BAHAWALPUR
KALAT
KHAIRPUR
HYDERABAD
KARACHI
A
B
C
D
Kabul R
Kunar R
Swat R
Chitral R
Indus R
Shyok R
Jhelum R
Sohan R
Soan R
Kurram R
Gomal R
Zhob R
Chenab R
Ravi R
Sutlej R
Beas R
Bolan R
Nari R
Bell R
Dasht R
Hab R
Lora R
Bodda R
Mashkai R
Nal R
Kaj R
Porali R
Khaja R
Hub R
Gaj R
Indus R
Malir R
Kabul R
Swat R
Chitral R
Panjkora R
Kunar R
Kurram R
Jhelum R
Chenab R
Ravi R
Sutlej R
Beas R
Soan R
Sohan R
Indus R
Shyok R
Bolan R
Nari R
Bell R
Dasht R
Lora R
Bodda R
Mashkai R
Nal R
Kaj R
Porali R
Khaja R
Hub R
Gaj R
Malir R
68°
70
72°
74°
76°
36°
34°
32°
30°
28°
26°
24°
66°
68°
70°
74°
76°
72°
KEY MAP
STATIONS OPERATED BY
SURFACE WATER HYDROLOGY
PROJECT IN 69
Miles 50 0 50 100 150 Miles
SCALE

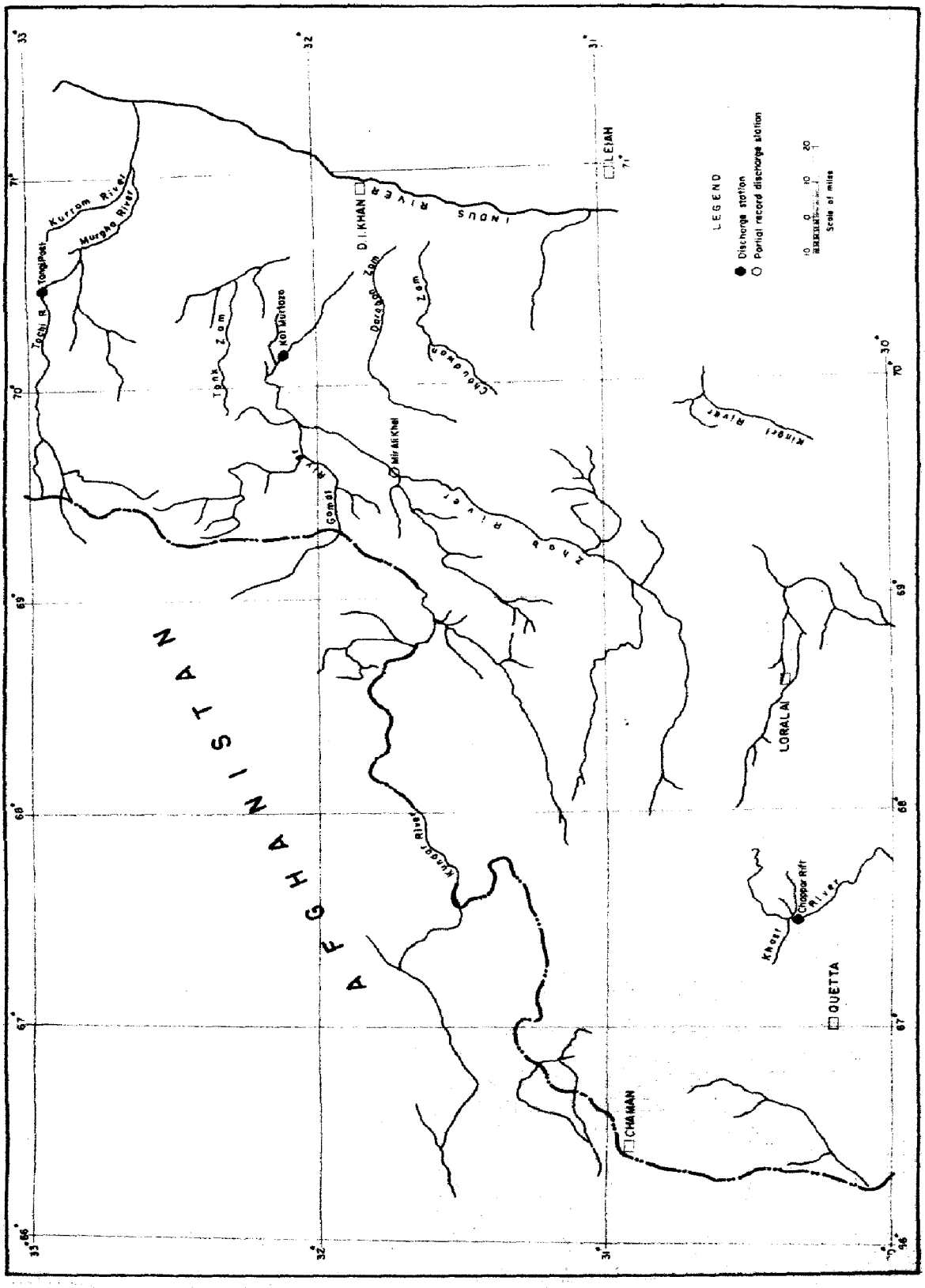
MAP AREA A


INDIA
LEGEND
Discharge station
Partial record discharge station
Scale of miles
RANN OF CUTCH
MIR PUR KHAS
TANDO MOHAMMAD KHAN
HYDERABAD
NAWAB SHAH
DADU
KARACHI
INDUS RIVER
Sehwan
Kotachi River
Baran River
Hab Dam Site
Band Murad Khan
Mail River
Hab River
Wind or Dhora
Khaddia Nai
Sinchi Bani
Mai Bandrani
Porali River
Kud River
Jabla
Lai Nai
ARABIAN SEA

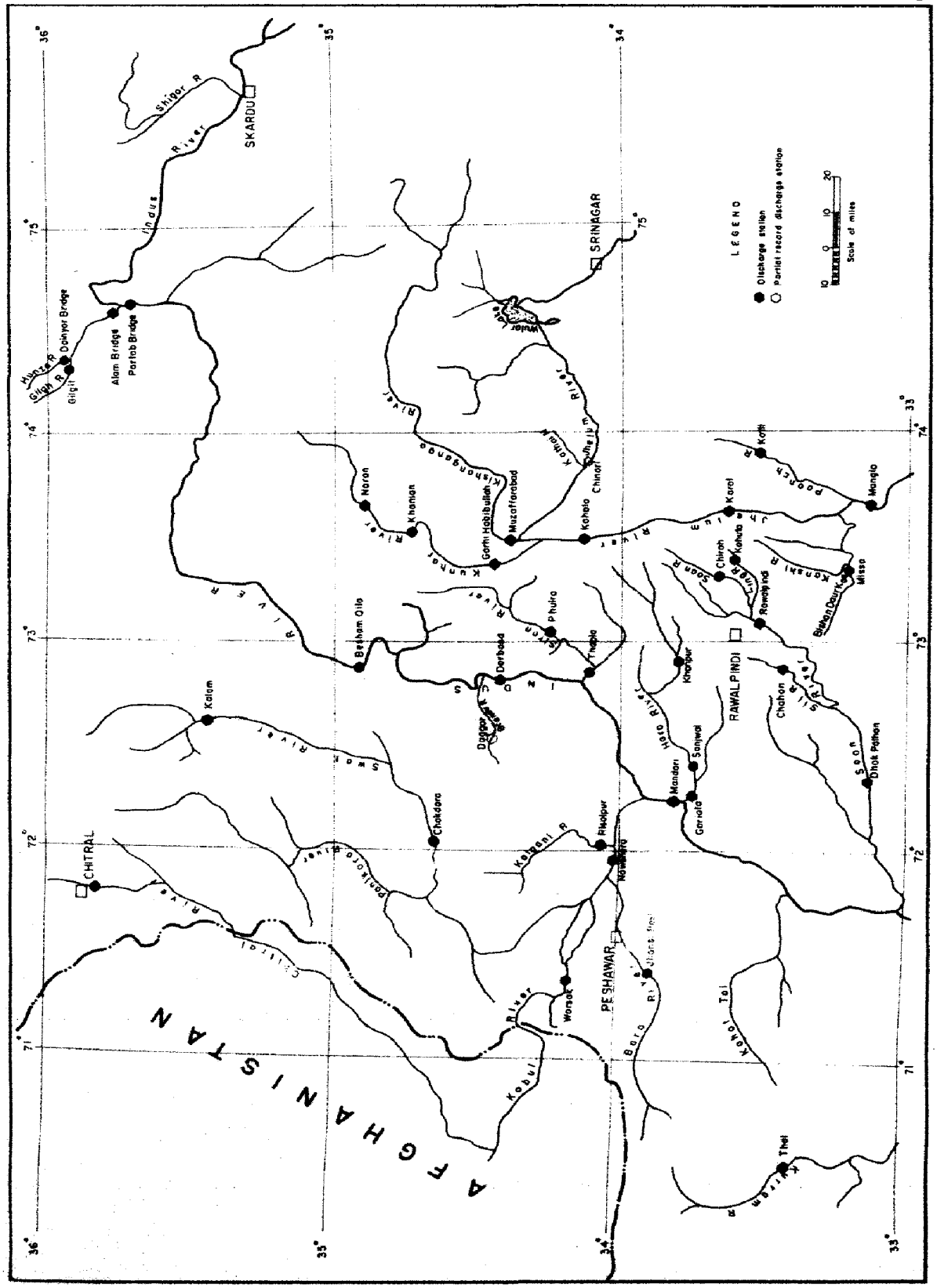
MAP AREA B


BAHAWALPUR
KHANPUR
RAHIMYAR KHAN
JACOBABAD
KHAIRPUR
Sutlej River
Chenab River
Indus River
Ravi River
Sohni River
Jhelum River
Chenab River
Lahri River
Nari River
Bolan River
Mula River
Indus
Sabar Kach
Tak Tong
Sibi
Kundian Bridge
LEGEND
Discharge station
Partial record discharge station
INDIA

MAP AREA C


AFGHANISTAN
Kurram River
Murghe River
Tochi R.
Tochi Post
Kot Murtaza
Tank Zam
Gomal
Mir Ali Khel
Daraban Zam
Chaudwan Zam
D.I.KHAN
INDUS RIVER
LEIAH
ZHOB RIVER
Khaisor River
Ringhi River
LORALAI
Khost
Chapper Rift
QUETTA
CHAMAN
LEGEND
Discharge station
Partial record discharge station
Scale of miles
10 0 10 20
33°
32°
31°
30°
71°
70°
69°
68°
67°
66°

MAP AREA D


LEGEND
Discharge station
Partial record discharge station
Scale of miles
SKARDU
SRINAGAR
CHITRAL
PESHAWAR
RAWALPINDI
AFGHANISTAN
Indus River
Shigar R
Hunza R
Gilgit R
Gilgit
Doikhor Bridge
Alam Bridge
Partab Bridge
Jhelum River
Kishanganga River
Kunhar River
Naran
Khanian
Garhi Habibullah
Muzaffarabad
Kohala
Chinari
Kotlai
Karol
Kotli
Mangla
Poonch R
Jhelum River
Chirah
Kahuta
Rawalpindi
Soan R
Kanshi R
Murree
Bhatian Dara
Chakwal
Chakwal Tal
Soan River
Chakdara
Kalam
Swat River
Barham Gila
Dargai
Daggar
Swat R
Indus River
Phulra
Thapla
Khoshar
Haro River
Saniwal
Mandari
Gerala
Chaghan
Soan R
Dhok Pathan
Kabul River
Kabul R
Pikalpur
Nowshera
Warsak
Bara R
Khyber Pass
Kurram R
Thal
Kohat
Kohat Tal

Blank page retained for pagination

RIVER DISCHARGE, SEDIMENT AND CHEMICAL 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 upstream from Indus River.

Drainage Area 4,670 square miles.

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

Average Discharge 10,400 cusecs (7,550,000 acre feet per year or 30.3 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge during the year 45,800 cusecs on 12 August (gauge height 16.10 feet); minimum daily discharge 1,710 cusecs on 7-8 March.

1960- 1969: Maximum discharge observed 83,400 cusecs on 12 July 1960; minimum daily discharge 1,450 cusecs on 28 March 1966.

Gauge Enamelled plates graduate to 0.1 foot, fastened to abutment under left end of bridge at Gilgit. Gauge read from 0800 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Thirty two discharge measurements were made from the bridge by current meter using 0.2 & 0.8 depth method. Thirty two sets of sediment samples were taken by depth integration method using D-49 sampler from the bridge. Ten of these were analysed for particle size distribution and the rest for total concentration. Eight 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 1969. Daily discharges were computed with shift adjustments where necessary.

Remarks Record good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	2,370	2,110	1,780	1,760	2,160	20,300
2	2,310	2,140	1,780	1,740	2,110	21,900
3	2,310	2,040	1,780	1,740	2,140	17,800
4	2,310	1,980	1,760	*1,740	2,230	16,500
5	2,310	1,950	1,740	1,740	2,380	13,500
6	2,310	1,900	1,740	1,790	2,750	12,800
7	2,340	1,900	1,710	1,980	3,190	15,100
8	2,310	1,880	1,710	2,210	3,520	18,200
9	2,280	1,940	1,740	2,420	3,920	*19,400
10	2,280	2,000	1,760	2,410	4,190	22,200
11	2,250	1,980	1,760	2,310	4,380	20,600
12	2,250	*1,950	1,780	2,420	*4,370	19,400
13	2,280	1,950	1,780	2,320	4,380	21,300
14	2,230	1,930	1,800	2,270	4,060	24,100
15	2,170	1,900	1,830	2,380	3,860	*27,600
16	2,160	1,900	1,830	2,710	3,790	29,800
17	2,170	1,880	*1,800	2,600	3,880	32,600
18	2,170	1,880	1,820	2,370	4,350	35,400
19	2,170	*1,850	1,830	2,280	4,560	36,600
20	2,180	1,850	*1,830	2,250	4,180	*37,500
21	2,110	1,780	1,790	*2,210	4,570	38,900
22	2,110	1,760	1,780	2,160	5,420	33,900
23	2,140	1,760	1,760	2,100	5,690	29,200
24	2,090	1,780	1,740	2,110	*5,350	28,200
25	2,030	1,780	1,820	2,090	6,680	30,500
26	2,130	1,780	2,040	2,140	8,300	*31,800
27	2,090	a 1,780	1,800	2,160	9,620	35,000
28	2,030	1,780	1,780	2,240	10,900	35,600
29	1,980	———	1,780	2,160	14,000	34,500
30	2,060	———	1,760	2,160	*17,100	32,400
31	2,110	———	1,760	———	18,800	———
Mean	2,190	1,900	1,790	2,170	5,700	26,400
Cs/mi	0.47	0.41	0.38	0.46	1.22	5.65
In	0.54	0.42	0.44	0.52	1.41	6.31
Maf	.135	.105	.110	.129	.351	1.57

1969 Year: Mean 11,100 Cs/sq mi 2.38 Inches 32.3

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

GILGIT RIVER AT GILGIT

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	31,900	26,300	15,900	7,580	4,380	3,240
2	35,700	29,600	15,400	7,500	4,310	3,170
3	*38,200	31,800	14,100	7,330	4,270	3,090
4	39,200	32,600	12,800	7,250	4,210	3,150
5	38,400	34,000	*12,600	*6,930	4,160	3,190
6	39,500	36,100	12,500	6,750	4,120	3,190
7	39,900	*37,000	13,000	6,580	4,120	3,110
8	41,300	37,800	13,500	6,600	4,040	3,140
9	*41,300	37,800	12,600	6,630	4,010	3,110
10	40,700	39,900	12,100	*6,600	3,970	3,090
11	38,700	43,100	11,800	6,500	3,920	a 3,050
12	38,500	*42,400	*11,800	6,480	3,860	3,010
13	39,300	38,700	11,900	6,250	*3,900	2,960
14	40,900	38,900	12,000	5,970	3,790	2,950
15	41,200	36,800	11,700	5,900	3,720	*2,840
16	39,600	36,700	10,700	5,790	3,650	2,870
17	37,100	37,100	9,920	5,510	3,600	2,960
18	38,400	35,300	*9,440	5,280	3,580	2,920
19	41,400	34,300	9,100	5,220	3,580	2,930
20	43,100	31,800	8,850	5,180	3,580	2,890
21	*45,000	*28,000	8,600	4,920	3,550	2,840
22	43,600	24,800	8,400	4,820	3,480	2,830
23	43,100	22,600	8,150	4,760	3,350	2,750
24	43,800	20,700	8,080	4,690	3,400	2,680
25	41,800	19,200	7,900	4,630	3,380	2,690
26	40,100	18,100	7,800	4,570	3,240	2,660
27	38,500	17,300	7,700	*4,540	3,200	*2,630
28	37,300	16,200	7,700	4,540	3,190	2,630
29	32,200	15,600	7,650	4,570	*3,190	2,630
30	*29,100	*15,900	7,580	4,570	3,240	2,660
31	25,300	16,000	------	4,480	------	2,680
Mean	38,800	30,100	10,700	5,770	3,730	2,920
Cs/mi	8.31	6.45	2.29	1.24	0.80	0.63
In	9.59	7.43	2.56	1.42	0.89	0.72
Maf	2.39	1.85	.637	.355	.222	.180

M.Acre-feet. 8.03 Max Day 45,000 Min Day 1,710

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Feb	1,950	42	20			
14 Feb	1,859	45	25			
17 Mar	1,800	56	25			
20 Mar	1,830	55	43			
4 Apr	1,740	58	20			
21 Apr	2,200	59	24			
12 May	4,460	65	37			
24 May	5,460		56			
30 May	16,100	58	817	46	27	27
9 Jun	18,500	54	127			
15 Jun	28,100	56	1,910	70	21	9
20 Jun	37,800	60	1,000	26	52	22
26 Jun	30,500	62	204			
3 Jul	40,900	57	1,520	60	34	6
9 Jul	44,400	56	3,100	63	26	11
21 Jul	47,900	56	3,790	58	35	7
30 Jul	29,900	56	846	41	45	14
7 Aug	38,500	58	1,810	19	70	11
12 Aug	45,800	54	6,800	63	29	8
21 Aug	29,900	52	452	35	31	34
30 Aug	16,400	58	131			
5 Sep	12,400	54	108			
12 Sep	12,100	60	59			
18 Sep	9,590	55	24			
27 Sep	7,750	56	18			
5 Oct	6,880	56	36			
10 Oct	6,630	57	42			
27 Oct	4,540	51	33			
13 Nov	3,900	53	41			
29 Nov	3,190	43	30			
15 Dec	2,840	37	14			
27 Dec	2,630	41	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.

GILGIT RIVER AT GILGIT

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										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	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Feb																				
12	1.38	0.93	0.14		Traces	1.47	0.19	0.77			2.45	2.43				144	240	8.1	0	0.1
19	1.32	0.88	0.14		Traces	1.39	0.19	0.81			2.34	2.39				138	230	8.2	0	0.1
Mar																				
17	1.43	0.99	0.14		Traces	1.47	0.19	1.03			2.56	2.69				152	250	8.2	0	0.1
20	1.43	0.82	0.14		Traces	1.47	0.19	0.76			2.39	2.42				132	230	8.1	0	0.1
Apr																				
4	1.48	0.94	0.14		Traces	1.47	0.19	0.93			2.56	2.59				148	250	8.1	0	0.1
May																				
30	0.91	0.57	0.10		0	1.06	0.19	0.26			1.58	1.51				84	150	8.0	0	0.2
Jun																				
9	0.68	0.53	0.10		0	0.47	0.19	0.16			1.31	1.32				76	130	7.9	0	0.2
26	0.91	0.41	0.34		0	1.28	0.10	0.29			1.66	1.67				80	150	8.1	0	0.4

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 WASID, WAPDA. Periodic discharge measurements started from 5 November 1965.

Average Discharge 13,800 cusecs (10,000,000 acre-feet per year or 36.9 inches runoff per year). Average taken for 4 years from 1966 to 1969.

Extremes Maximum discharge observed during the year 83,700 cusecs on 11 August (gauge height 13.80 feet); minimum daily discharge 1,310 cusecs from 5 to 8 March.

1966-69: 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 Staff gauge with 0.1 foot graduations on left bank downstream of bridge; gauge read to hundredth of a foot from 08:00 to 16:00 hours daily during low flow and more often during floods. Set to a arbitrary datum.

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

Determination of Discharge Rating table dated 20.6.67 was used. Discharges were computed with shift adjustments as necessitated by the periodic discharge measurements.

Remarks Record good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	1,760	1,470	1,340	1,340	1,460	16,000
2	1,720	1,500	1,340	1,400	1,380	17,400
3	1,740	1,520	1,340	1,430	1,520	*16,500
4	1,770	1,520	1,340	1,430	1,530	14,100
5	1,770	1,520	1,310	1,430	1,870	12,400
6	1,770	1,490	1,310	*1,720	2,210	11,300
7	1,670	1,490	1,310	1,910	2,650	11,200
8	1,580	1,500	1,310	2,550	3,330	12,400
9	1,580	1,530	1,340	2,800	4,170	13,600
10	1,550	1,530	1,340	2,800	4,210	14,500
11	1,550	1,530	1,370	3,070	3,970	*15,300
12	1,530	1,530	1,370	3,360	3,640	14,100
13	1,530	*1,550	1,550	2,960	*3,970	14,000
14	1,570	1,550	1,550	2,800	3,970	14,900
15	1,570	1,550	*1,550	3,300	3,900	15,900
16	1,490	1,550	1,720	3,360	3,670	18,900
17	1,490	*1,550	1,720	2,960	4,640	22,200
18	1,450	1,520	1,720	2,800	4,760	*24,800
19	1,490	1,400	1,680	2,340	4,420	28,100
20	1,470	1,400	1,650	2,320	4,680	*40,300
21	1,470	1,400	1,550	2,130	5,600	31,300
22	1,470	1,400	1,550	1,910	6,500	29,100
23	1,470	1,400	1,550	*1,760	6,630	27,300
24	1,470	1,400	1,580	1,700	5,980	23,200
25	1,650	1,400	*1,580	1,720	*6,460	23,000
26	1,490	1,400	1,580	1,740	7,600	*23,500
27	1,490	1,400	1,490	1,680	8,350	26,600
28	1,490	1,340	1,430	1,630	9,250	28,400
29	1,470	———	1,400	1,610	10,800	30,200
30	1,470	———	1,400	1,520	13,300	29,700
31	1,470	———	1,400	———	15,100	———
Mean	1,560	1,480	1,470	2,180	5,210	20,700
Cs/mi	0.31	0.29	0.29	0.43	1.03	4.07
In	0.35	0.30	0.33	0.48	1.18	4.54
Maf	.096	.082	.090	.130	.320	1.23

1969 Year: Mean 13,900 Cs/sq mi 2.74 Inches 37.3

Note : * Discharge measurement made on this day.

HUNZA RIVER AT DAINYOR BRIDGE

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	28,500	46,100	31,400	9,800	3,360	2,700
2	30,400	52,600	31,700	9,550	3,240	2,650
3	*33,900	60,100	27,600	9,250	3,210	2,550
4	39,600	67,100	24,300	9,650	3,150	2,450
5	40,900	72,400	23,400	*8,800	3,070	2,450
6	42,400	*76,000	21,600	8,600	2,990	2,550
7	46,400	77,300	22,400	8,500	2,960	2,450
8	48,600	78,200	21,000	8,500	*2,930	2,450
9	*49,800	79,000	*18,000	*8,550	2,960	*2,450
10	48,200	77,500	16,400	8,700	2,960	2,550
11	45,900	78,400	15,900	8,750	2,960	2,600
12	43,500	*73,500	*16,100	8,350	2,930	2,570
13	45,300	71,100	16,600	8,100	2,930	2,550
14	50,200	69,900	17,800	8,000	2,900	2,450
15	*51,000	62,700	17,400	8,000	2,900	2,410
16	46,600	64,000	14,300	7,120	2,900	2,660
17	43,700	62,500	12,500	6,500	2,900	2,340
18	48,000	65,100	*12,300	6,150	2,850	2,660
19	55,400	61,700	12,200	5,270	2,830	2,340
20	60,300	48,900	12,900	5,030	2,800	2,340
21	65,500	*37,300	11,600	4,460	*2,830	2,230
22	67,800	33,400	10,500	4,240	2,830	2,150
23	70,100	31,500	10,400	4,140	2,830	2,110
24	71,600	29,900	9,900	4,100	2,800	*2,030
25	72,600	29,300	*9,150	3,930	2,750	2,030
26	69,100	29,400	8,750	3,970	2,700	1,990
27	67,100	28,400	8,700	*3,970	2,600	1,950
28	62,600	27,300	8,850	4,000	2,550	2,030
29	*48,600	*27,800	9,050	3,830	2,500	2,030
30	44,300	29,700	9,250	3,640	2,850	1,990
31	42,100	31,300	———	3,450	———	2,070
Mean	51,000	54,200	16,100	6,610	2,900	2,350
Cs/mi	10.0	10.7	3.17	1.30	0.57	0.46
In	11.6	12.3	3.53	1.50	0.64	0.53
Maf	3.13	3.33	.956	.406	.173	.144

M.Acre-feet. 10.1 Max Day 79,000 Min Day 1,310

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Feb	1,550	44	101			
17 Feb	1,550	43	79			
15 Mar	1,550	52	222			
25 Mar	1,580	64	231			
6 Apr	1,720	56	244			
23 Apr	1,760	57	233	8	49	43
13 May	4,000	54	1,350	40	45	15
25 May	6,590	56	1,850	31	44	25
3 Jun	16,600	56	3,830	38	43	29
11 Jun	15,400	56	3,260	39	37	24
18 Jun	24,800	54	5,470	51	39	10
20 Jun	34,800	56	17,500	31	64	5
26 Jun	23,500	60	4,420	55	31	14
3 Jul	33,800	52	4,180	36	37	27
9 Jul	49,700	54	18,900	66	24	10
15 Jul	51,600	53	18,700	69	23	8
21 Jul	66,600	60	5,160	5	65	30
28 Jul	64,600	50	6,070	31	61	8
6 Aug	75,600	52	8,740	21	57	22
12 Aug	70,600	52	11,000	44	41	15
21 Aug	37,700	56	3,610	43	43	14
29 Aug	27,600	54	1,710	22	78	
9 Sep	18,000	52	847	18	44	38
12 Sep	15,500	53	866	5	48	47
18 Sep	12,200	56	415	18	31	51
25 Sep	9,100	55	402	7	42	41
5 Oct	8,950	52	304			
9 Oct	8,550	53	330			
27 Oct	4,000	48	109			
8 Nov	2,930	50	78			
21 Nov	2,830	43	70			
9 Dec	2,450	45	46			
24 Dec	2,030	40	72			

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.

IRNZA RIVER AT DAINYOR BRIDGE

Chemical Analysis of Water Samples - 1969

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.	$EC \times 10^6$ at 25°C	pH	Res CO_3 me/l	SAR
Feb																				
13	2.07	1.45	0.41		0.09	1.61	0.14	2.15			3.93	3.99				252	390	8.2	0	0.3
17	2.07	1.55	0.34		0.09	1.61	0.14	2.06			3.96	3.90				248	390	8.2	0	0.3
Mar																				
15	2.07	1.08	0.50		0.18	1.65	0.19	1.59			3.65	3.61				216	360	8.3	0	0.4
25	2.07	1.39	0.48		0.18	1.65	0.19	2.02			3.94	4.04				252	400	8.3	0	0.4
Apr																				
6	2.12	1.34	0.48		0.18	1.79	0.19	1.76			3.94	3.92				244	390	8.2	0	0.4
May																				
25	1.59	0.83	0.18		Trace	1.56	0.19	0.76			2.60	2.51				144	250	8.2	0	0.2
Jun																				
11	1.54	0.55	0.18		0	1.46	0.19	0.73			2.27	2.38				128	220	8.2	0	0.2
26	0.92	0.87	0.34		0	1.60	0.20	0.31			2.13	2.11				116	200	8.2	0	0.4

Blank page retained for pagination

Location Latitude 35°45', Longitude 74°37', on left 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, WASID, WAPDA from 1 January 1966 to date. Gauge height record since 29 December 1965.

Extremes Maximum discharge during the year 137,000 cusecs on 11 August (gauge height 22.60); minimum daily discharge 4,620 cusecs on 16 February.

1966-69, 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum. Initially the gauge was on right bank but shifted to left bank on 16.4.69.

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

Determination of discharge Rating table dated 21.12.70 was developed from all the vailable measurements in 1969 and 1970. This table was used with shift adjustments were indicated necessary.

Remarks The measurements showed an appreciable scatter, probably due to questionable gauge height data. Hence the record has been treated as fair only.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	5,010	4,720	4,820	5,040	5,460	32,900
2	5,010	4,710	4,840	5,040	5,390	38,200
3	5,000	4,700	4,890	5,040	5,490	40,000
4	5,000	4,700	4,960	5,040	5,710	37,300
5	4,980	4,700	5,040	5,040	6,160	32,100
6	4,980	4,700	5,120	5,040	6,680	30,100
7	4,980	4,670	5,190	5,140	7,470	31,700
8	4,980	4,660	5,230	6,000	8,600	33,200
9	4,970	4,660	5,280	6,400	9,650	36,100
10	4,970	4,660	5,260	*6,580	10,500	39,600
11	4,960	4,660	5,310	6,860	10,500	44,500
12	4,910	4,650	5,360	7,230	10,100	*40,700
13	4,880	4,640	5,230	6,840	10,700	41,500
14	4,860	4,640	5,180	6,640	*10,500	43,900
15	4,840	*4,630	5,150	6,840	10,200	51,100
16	4,830	*4,620	5,190	6,980	10,100	57,600
17	4,830	4,630	5,250	7,330	9,830	63,700
18	4,830	4,650	*5,280	7,100	9,100	68,100
19	4,830	4,660	*5,310	6,920	9,580	71,700
20	4,820	4,650	5,190	6,660	10,400	93,800
21	4,800	4,660	5,260	6,320	9,200	*74,400
22	4,800	4,680	5,260	5,940	13,700	71,800
23	4,800	4,700	5,220	5,580	13,900	70,200
24	4,800	4,730	5,150	5,520	14,900	66,500
25	4,800	4,840	5,130	5,500	16,200	65,400
26	4,800	4,820	5,130	5,540	18,400	65,900
27	4,800	4,800	5,130	*5,500	*21,000	68,700
28	4,760	4,880	5,100	5,540	22,500	72,700
29	4,760	———	5,090	5,570	24,600	*70,400
30	4,740	———	5,070	5,520	26,900	69,100
31	4,730	———	5,020	———	29,200	———
Mean	4,870	4,690	5,150	6,010	12,300	54,100
Cs/mi	0.58	0.46	0.51	0.60	1.22	5.36
In	0.56	0.48	0.59	0.66	1.41	5.98
Maf	.300	.261	.317	.358	.759	3.22

1969 Year: Mean 27,900 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 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	68,000	76,700	49,200	19,900	8,700	6,400
2	73,700	87,700	48,300	19,600	8,580	6,400
3	78,800	97,300	46,500	19,200	*8,500	6,300
4	*84,700	104,000	39,700	19,200	8,500	6,240
5	89,800	*107,000	37,400	19,200	8,400	6,200
6	87,700	108,000	37,300	19,300	8,380	*6,200
7	88,400	116,000	37,900	17,900	8,330	6,200
8	92,000	121,000	37,900	17,300	8,300	6,180
9	94,000	125,000	35,500	17,400	8,300	6,120
10	90,800	132,000	32,400	17,800	8,250	6,100
11	92,700	136,000	31,700	*17,500	*8,130	a 6,070
12	88,700	132,000	31,900	17,300	8,130	6,040
13	88,600	*122,000	32,700	16,700	8,050	6,000
14	91,900	112,000	*34,400	16,100	8,000	6,000
15	88,600	112,000	36,700	15,400	7,800	5,950
16	88,700	115,000	34,900	14,800	7,750	5,940
17	*82,400	113,000	31,900	14,000	7,730	5,920
18	86,700	*114,000	30,400	12,900	7,630	5,920
19	97,500	107,000	29,200	12,500	7,500	5,860
20	103,000	96,000	25,700	11,900	7,300	5,820
21	112,000	76,900	*24,200	11,500	7,100	5,650
22	119,000	67,000	23,100	*10,700	*7,000	*5,410
23	*120,000	59,200	22,900	10,400	7,000	5,340
24	123,000	*53,100	23,300	10,300	6,880	5,250
25	121,000	49,500	21,700	10,200	6,800	5,200
26	118,000	50,100	21,900	10,000	6,780	5,200
27	111,000	49,200	20,100	10,000	6,560	5,200
28	106,000	43,700	*20,300	10,300	6,500	5,140
29	91,000	44,100	21,600	10,100	6,480	5,140
30	79,500	45,300	20,700	9,350	6,440	5,140
31	73,700	48,500	------	8,830	------	5,130
Mean	94,500	91,000	31,400	14,400	7,660	5,800
Cs/mi	9.36	9.01	3.11	1.43	0.76	0.57
In	10.8	10.4	3.47	1.65	0.85	0.66
Maf	5.81	5.59	1.87	.888	.456	.356

M.Acre-feet. 20.2 Max Day 136,000 Min Day 4,620

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Feb	4,630	45	51			
16 Feb	4,620	44	57			
18 Mar	5,280	53	176			
19 Mar	5,300	53	93			
10 Apr	6,500	61	526	5	41	54
27 Apr	5,500	53	151			
14 May	10,500	60	623	40	38	22
27 May	21,300	61	2,020	42	36	22
12 Jun	40,600	54	3,470	65	22	13
21 Jun	73,700	57	2,960	34	48	18
29 Jun	70,500	56	5,050	75	17	8
4 Jul	84,500	56	2,630	32	49	19
10 Jul	90,500	54	9,810	66	24	10
17 Jul	81,400	54	4,280	49	38	13
23 Jul	11,900	54	13,900	69	21	10
5 Aug	106,000	54	9,450	47	40	13
13 Aug	60,400	54	3,830	10	60	30
18 Aug	113,000	56	5,890	42	44	14
24 Aug	53,200	56	2,980	66	34	
1 Sep	47,500	57	1,370	29	45	26
14 Sep	35,000	56	817	15	51	34
21 Sep	24,100	56	279			
28 Sep	20,300	54	285			
11 Oct	17,500	55	231			
22 Oct	10,600	53	87			
3 Nov	8,500	53	89			
22 Nov	7,000	41	59			
6 Dec	6,200	42	44			
22 Dec	5,360	40	120			

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 ALAM BRIDGE

Chemical Analysis of Water Samples - 1969

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
	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION							
Feb																				
15	1.91	1.19	0.31		0.18	1.65	0.19	1.48			3.41	3.50				204	340	8.2	0	0.2
16	2.12	0.93	0.35		0.18	1.65	0.19	1.43			3.40	3.45				206	340	8.2	0	0.3
Mar																				
18	1.52	1.15	0.25		0	1.75	0.29	1.00			2.92	3.04				172	290	7.8	0	0.3
19	1.99	0.94	0.31		0.18	1.61	0.14	1.24			3.24	3.17				184	310	8.2	0	0.3
May																				
27	1.19	0.90	0.18		0	1.46	0.19	0.73			2.27	2.38				132	220	8.1	0	0.2
Jun																				
29	0.91	0.42	0.29		0	1.38	0.18	0.18			1.62	1.66				82	150	8.2	0.05	0.4

Blank page retained for pagination

Location Latitude 35°45', Longitude 74°37', on right bank under the bridge, 1 mile downstream from the confluence of Gilgit River.

Drainage area 55,100 square miles (revised in 1969).

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

Average Discharge 60,600 cusecs (43,900,000 acre feet per year or 13.9 inches runoff per year). Average taken for 8 years from 1962 to 1969.

Extremes Maximum discharge during the year 299,000 cusecs on 11 August (gauge height 70.90 feet); minimum daily discharge 10,800 on many days in March.

1962-69: Maximum discharge 437,000 cusecs on 29 July 1963; minimum daily discharge 8,800 cusecs on 13 March 1963.

Gauge Enamelled plates fixed on concrete blocks on right bank and set to arbitrary datum. Prior to 5.8.69, gauge painted on plastered strip on left abutment under the bridge. Gauge read from 08:00 to 16:00 hours daily during low flow and more often during floods.

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

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

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	12,000	11,200	11,000	11,000	12,100	83,400
2	12,000	11,400	11,000	11,000	12,100	86,200
3	11,900	11,300	10,900	11,100	12,100	88,100
4	11,800	11,200	10,900	11,100	12,000	83,000
5	11,600	11,200	10,900	11,100	12,200	70,700
6	11,600	11,200	10,900	11,100	13,100	63,500
7	11,600	11,200	10,900	11,300	14,200	60,600
8	11,700	11,200	10,900	11,800	15,900	61,500
9	11,800	11,200	10,800	12,500	*18,900	71,800
10	11,900	11,200	10,800	13,000	20,700	77,500
11	11,900	11,200	10,800	13,300	21,800	88,600
12	11,700	11,200	10,900	13,700	22,600	*84,500
13	11,600	11,200	11,000	13,800	22,500	81,200
14	11,600	11,200	11,100	13,700	*21,800	83,100
15	11,500	*11,200	11,200	*13,400	21,100	87,200
16	11,400	*11,200	11,300	14,000	19,400	104,000
17	11,500	11,200	11,400	14,400	18,900	124,000
18	11,500	11,200	*11,400	14,300	18,500	151,000
19	11,500	11,200	*11,500	14,000	18,200	167,000
20	11,400	11,200	11,500	14,000	18,400	189,000
21	11,400	11,100	11,400	13,800	23,600	*180,000
22	11,400	11,100	11,400	13,300	24,100	174,000
23	11,500	11,100	11,300	12,900	24,000	146,000
24	11,500	11,100	11,200	12,400	25,300	133,000
25	11,500	11,000	11,200	12,300	29,000	127,000
26	11,400	11,000	11,200	12,300	29,600	131,000
27	11,400	11,000	11,200	12,100	*35,700	137,000
28	11,400	11,000	11,200	12,100	39,800	145,000
29	11,400	———	11,000	12,200	43,800	*148,000
30	11,300	———	10,900	12,200	58,900	136,000
31	11,100	———	10,900	———	71,100	———
Mean	11,600	11,200	11,100	12,600	24,200	112,000
Cs/mi	0.21	0.20	0.20	0.23	0.44	2.03
In	0.24	0.21	0.23	0.26	0.51	2.27
Maf	.712	.620	.682	.752	1.49	6.67

1969 Year: Mean 61,100 Cs/sq mi 1.11 Inches 15.1

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	131,000	149,000	*130,000	38,600	19,400	14,600
2	137,000	171,000	131,000	38,100	19,200	14,600
3	147,000	196,000	126,000	36,900	*19,000	14,600
4	*158,000	214,000	120,000	35,400	18,800	14,500
5	169,000	*243,000	119,000	34,300	18,500	14,400
6	175,000	260,000	110,000	33,100	18,300	*14,500
7	187,000	282,000	105,000	32,300	18,200	14,400
8	201,000	290,000	99,700	31,600	18,200	14,300
9	213,000	291,000	88,800	31,200	18,100	14,300
10	*217,000	294,000	75,200	31,200	17,900	14,200
11	209,000	297,000	66,800	*31,200	*17,800	14,100
12	208,000	292,000	64,600	31,000	17,600	14,100
13	216,000	*280,000	64,700	29,800	17,400	14,100
14	220,000	270,000	*67,900	29,000	17,400	14,000
15	217,000	263,000	67,900	28,200	17,200	13,900
16	203,000	257,000	61,900	27,500	16,900	13,800
17	*198,000	254,000	49,400	26,600	16,600	13,700
18	189,000	*257,000	50,000	25,300	15,900	13,700
19	191,000	257,000	51,000	24,400	15,900	13,700
20	201,000	231,000	*50,700	24,000	15,800	13,700
21	224,000	187,000	49,600	23,300	15,700	13,600
22	253,000	157,000	47,700	*22,500	*15,700	*13,500
23	*268,000	136,000	46,000	22,100	15,600	13,200
24	279,000	*124,000	44,900	21,800	15,400	13,000
25	283,000	121,000	43,900	21,500	15,200	13,000
26	273,000	120,000	42,700	21,100	15,000	13,000
27	260,000	116,000	40,900	20,800	14,800	12,900
28	235,000	111,000	*39,100	20,600	14,800	12,900
29	200,000	114,000	38,700	20,800	14,700	12,900
30	166,000	121,000	38,800	20,600	14,600	13,000
31	147,000	127,000	———	19,800	———	13,100
Mean	206,000	209,000	71,100	27,600	16,900	13,800
Cs/mi	3.74	3.79	1.29	0.50	0.31	0.25
In	4.30	4.38	1.44	0.58	0.34	0.29
Mar	12.6	12.9	4.23	1.70	1.00	.848

M. Acre-feet. 44.2 Max Day 297,000 Min Day 10,800

INDUS RIVER AT PARTAB BRIDGE

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Feb	11,200	46	29			
16 Feb	11,200	45	23			
18 Mar	11,500	55	87			
19 Mar	11,500	52	66			
15 Apr	13,400	57	319			
28 Apr	12,100	53	110			
14 May	21,500	58	342			
27 May	35,400	64	2,780	63	25	12
12 Jun	82,000	56	4,540	78	14	8
21 Jun	180,000	62	1,510	15	61	24
29 Jun	146,000	57	2,410	66	26	8
4 Jul	157,000	60	1,720	30	61	9
10 Jul	216,000	56	3,780	50	41	9
17 Jul	199,000	58	3,490	49	47	4
23 Jul	269,000	56	6,940	76	21	3
5 Aug	247,000	60	10,800	72	28	
13 Aug	278,000	55	2,300	9	63	28
18 Aug	261,000	58	2,650	16	71	13
24 Aug	124,000	58	6,320	84	16	
1 Sep	130,000	61	978	13	53	34
14 Sep	68,600	56	408	9	55	36
20 Sep	50,600	54	363			
28 Sep	39,000	58	239			
11 Oct	31,200	55	489	40	30	30
22 Oct	22,300	54	107			
3 Nov	18,900	53	125			
11 Nov	17,800	53	84			
22 Nov	15,700	43	94			
6 Dec	14,500	43	57			
22 Dec	13,400	40	59			

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 PARTAB BRIDGE

Chemical Analysis of Water Samples - 1969

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.			ns/l	
Feb																				
15	1.82	0.70	0.35		0.18	1.42	0.19	1.15			2.87	2.94				160	280	8.2	0	0.3
16	1.80	0.72	0.35		0.18	1.42	0.19	1.02			2.87	2.81				156	280	8.2	0	0.3
Mar																				
18	1.74	0.67	0.35		0.18	1.42	0.19	1.02			2.76	2.81				164	280	8.2	0	0.3
19	1.74	0.78	0.31		0.09	1.61	0.14	0.96			2.83	2.80				152	270	8.2	0	0.3
May																				
27	1.14	0.95	0.21		0	1.56	0.19	0.60			2.30	2.35				136	230	8.2	0	0.2
Jun																				
29	1.03	0.30	0.29		0	1.38	0.10	0.18			1.62	1.66				84	150	8.2	0.05	0.4

Blank page retained for pagination

Location Latitude 34°56', Longitude 72°53', on right bank about half a mile from Besham Qila post and about 55 miles from Saidu Sharif on Indus valley road.

Drainage area 62,700 square miles.

Record available Mean daily discharge record computed from January 1969 to date by Surface Water Hydrology Project, WASID, WAPDA. The discharge measurements were started in November 1968 and the staff gauge was installed on 23.5.68.

Extremes Maximum discharge during the year 389,000 cusecs on 25 July (gauge height 50.90); minimum daily discharge 13,100 cusecs on 21 January.

Gauge Enamelled plates installed in Steps on right bank and read at one hour interval for the whole day throughout the year. Gauge set to arbitrary datum.

Measurements Ninety two discharge measurements were made from the cableway by current meter using 0.2 and 0.8 depth method. Ninety sets of sediment samples were taken by depth integration method using D-49 sampler from the cableway. Thirty five of these were analysed for particle size distribution and the rest for total concentration. Ten Surface samples were collected and analysed for chemical composition.

Determination of discharge Rating table dated 23-2-70 was develop from all the available measurements. This table was applied to mean daily gauge heights to compute mean daily discharge, with shift adjustments.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	15,200	14,600	15,700	23,900	26,800	*140,000
2	15,100	14,500	15,200	23,300	26,200	155,000
3	15,200	14,500	15,600	23,300	26,400	159,000
4	14,900	14,500	16,700	23,200	26,800	155,000
5	14,600	14,500	17,000	23,300	29,800	137,000
6	14,700	14,400	18,400	24,500	33,500	124,000
7	14,100	14,300	18,600	26,500	37,000	120,000
8	*14,000	14,300	18,300	29,400	44,300	124,000
9	14,400	14,000	19,100	31,700	53,200	134,000
10	14,400	13,500	19,000	35,100	55,200	145,000
11	14,400	13,400	19,100	38,400	55,200	147,000
12	14,300	13,400	19,100	41,900	55,100	152,000
13	14,000	14,900	19,700	37,900	55,200	147,000
14	13,900	14,800	20,400	35,800	53,600	149,000
15	13,800	14,800	21,700	43,700	49,100	159,000
16	13,800	14,800	21,400	45,200	44,800	175,000
17	*13,500	14,900	22,200	46,400	*44,100	193,000
18	13,400	14,600	25,400	39,800	46,800	217,000
19	13,400	14,300	30,200	35,500	48,600	232,000
20	13,300	14,000	26,500	37,000	48,400	252,000
21	13,100	13,600	23,500	36,000	*51,000	273,000
22	13,500	13,400	22,200	32,600	55,500	242,000
23	13,300	13,500	21,600	30,600	60,500	206,000
24	13,200	14,900	20,900	27,900	*62,800	187,000
25	13,600	15,300	33,300	26,600	64,400	179,000
26	19,600	15,000	35,000	26,500	68,000	182,000
27	17,300	16,800	28,100	26,000	74,200	181,000
28	15,100	16,400	24,800	33,600	*84,600	194,000
29	14,500	———	*23,400	31,600	97,400	199,000
30	14,400	———	22,500	*28,700	110,000	190,000
31	14,100	———	22,300	———	127,000	———
Mean	14,400	14,500	21,800	32,200	55,300	175,000
Cs/mi	0.23	0.23	0.35	0.51	0.88	2.79
In	0.26	0.24	0.40	0.57	1.02	3.11
M.Acre-ft.	.885	.805	1.34	1.92	3.40	10.4

1969 Year: Mean 86,700 Cs/sq mi 1.38 Inches 18.8

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	180,000	177,000	157,000	55,000	*30,100	20,100
2	184,000	190,000	157,000	*54,800	29,000	20,200
3	198,000	223,000	156,000	*53,900	28,700	*20,100
4	*218,000	261,000	147,000	51,600	28,200	19,900
5	*230,000	*293,000	145,000	*49,800	*27,700	19,700
6	*243,000	*333,000	*140,000	*47,800	27,700	*19,500
7	264,000	*355,000	*136,000	46,800	27,600	19,400
8	289,000	*367,000	*131,000	*45,300	27,300	*19,200
9	308,000	*372,000	121,000	44,200	*27,200	19,000
10	*314,000	372,000	108,000	43,800	27,000	18,800
11	306,000	374,000	n96,400	45,400	*26,700	18,600
12	*295,000	372,000	90,500	*45,100	27,000	18,400
13	298,000	353,000	88,500	43,300	26,400	18,400
14	*307,000	337,000	*91,100	42,100	25,900	18,800
15	*319,000	*320,000	93,700	*41,300	25,500	18,700
16	*314,000	*310,000	90,300	*40,500	25,000	18,200
17	*284,000	*302,000	*81,800	39,300	*24,400	18,100
18	*259,000	*302,000	75,300	37,900	23,900	17,900
19	*260,000	*304,000	*72,700	*36,500	23,700	17,800
20	*279,000	*292,000	*71,900	35,400	23,500	*17,800
21	*307,000	*243,000	*70,000	34,300	23,100	17,700
22	*331,000	*202,000	*68,400	*33,100	22,800	17,600
23	*349,000	*175,000	66,000	32,200	*22,600	*17,300
24	*366,000	157,000	*63,900	*31,400	22,400	*17,000
25	*376,000	*147,000	*62,000	30,700	*22,000	16,700
26	357,000	*143,000	*60,300	29,900	21,700	16,600
27	*339,000	143,000	*58,800	29,500	21,300	16,500
28	*308,000	141,000	*57,000	35,700	20,900	16,500
29	*264,000	141,000	*55,700	*38,500	*20,600	16,500
30	*222,000	145,000	*55,100	33,500	*20,300	16,400
31	*184,000	152,000	———	31,500	———	*16,300
Mean	282,000	258,000	95,600	40,600	25,000	18,200
Cs/mi	4.50	4.11	1.52	0.65	0.40	0.29
In	5.19	4.74	1.70	0.75	0.44	0.33
M.Acre-ft.	17.4	15.9	5.69	2.50	1.49	1.12

M. Acre-feet: 62.9 Max Day 376,000 Min Day 13,100

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
8 Jan	14,300	42	50			
17 Jan	13,500	43	38			
29 Mar	23,000	57	167			
30 Apr	28,200	57	184			
17 May	43,500	58	291			
21 May	51,700	70	105			
24 May	66,500	68	137			
28 May	83,600	60	134			
1 Jun	142,000	62	116			
4 Jul	224,000	58	1,530	33	57	10
5 Jul	235,000	58	1,500	27	60	13
6 Jul	251,000	59	1,210	22	67	11
10 Jul	319,000	58	5,410	63	29	8
12 Jul	292,000	57	2,320	16	64	20
13 Jul	302,000	59	14,700	71	22	7
14 Jul	312,000	58	2,290	18	73	9
15 Jul	326,000	58	1,320	26	61	13
16 Jul	313,000	59	1,910	32	60	8
17 Jul	285,000	60	1,930	42	44	14
18 Jul	259,000	60	2,960	54	41	5
19 Jul	267,000	58	2,700	12	74	14
20 Jul	284,000	58	2,180	20	65	15
21 Jul	207,000	58	2,730	42	26	32
22 Jul	338,000	58	2,810	27	61	12
23 Jul	356,000	60	3,190	36	54	10
24 Jul	368,000	63	2,750	44	39	17
25 Jul	384,000	62	4,930	63	27	10
28 Jul	312,000	58	2,210	37	52	11
30 Jul	218,000	58	4,140	65	30	5
31 Jul	180,000	59	6,480	66	32	2
5 Aug	292,000	58	9,550	6	57	37
6 Aug	330,000	57	7,020	5	52	43
7 Aug	356,000	57	7,870	2	56	42
8 Aug	369,000	58	6,380	9	62	29
9 Aug	374,000	58	6,840	6	22	72
16 Aug	308,000	59	2,320	18	59	23
17 Aug	301,000	59	7,190	62	32	6
18 Aug	303,000		6,250	8	58	34
19 Aug	304,000	60	3,040	24	59	17
20 Aug	297,000	60	5,740	16	74	10

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
21 Aug	242,000	60	5,430	36	57	7
22 Aug	253,000	60	1,020	23	58	19
23 Aug	169,000	60	3,360	19	51	30
24 Aug	169,000	60	96			
25 Aug	149,000	60	112			
26 Aug	145,000	60	1,100	34	54	12
4 Sep	145,000	61	139			
5 Sep	149,000	60	162			
6 Sep	142,000	61	166			
7 Sep	138,000	61	260			
14 Sep	92,700	59	154			
17 Sep	79,700	59	118			
19 Sep	71,800	59	291			
20 Sep	72,400	59	247			
21 Sep	70,000	59	231			
22 Sep	68,600	59	204			
24 Sep	64,100	59	193			
25 Sep	61,600	59	168			
27 Sep	58,800	59	185			
28 Sep	56,700	59	157			
29 Sep	55,600	59	132			
2 Oct	54,800	59	184			
3 Oct	53,600	59	119			
5 Oct	50,300	58	104			
6 Oct	47,600	58	66			
8 Oct	45,000	58	161			
12 Oct	44,600	58	109			
15 Oct	41,400	58	124			
16 Oct	40,400	58	88			
19 Oct	36,400	58	89			
22 Oct	33,000	58	172			
24 Oct	31,500	58	69			
26 Oct	60,000	59	252			
29 Oct	39,200	57	137			
1 Nov	30,200	57	251			
5 Nov	27,700	57	187			
9 Nov	27,100	57	131			
11 Nov	26,600	56	240			
17 Nov	24,300	56	160			
23 Nov	22,600	56	101			

INDUS RIVER AT BESHAM QILA

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
25 Nov	21,900	56	57			
29 Nov	20,500	56	128			
30 Nov	20,300	50	66			
3 Dec	20,100	56	99			
6 Dec	19,500	56	104			
8 Dec	19,100	50	122			
20 Dec	17,800	45	95			
23 Dec	17,300	44	105			
24 Dec	16,700	44	156			
31 Dec	16,300	43	89			

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

INDUS RIVER AT KESHAN QILA

Chemical Analysis of Water Samples - 1969

	MILLIEQUIVALENTS PER LITER												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 8	2.05	0.81	0.30		0	1.93	0.24	0.89			3.16	3.06				174	300	7.8	0	0.3
Mar 29	0.99	0.69	0.10		0	1.22	0.14	0.50			1.78	1.86				96	170	7.6	0	0.1
Apr 30	1.24	0.59	0.25		0	1.29	0.19	0.69			2.08	2.17				120	210	7.6	0	0.3
May 21	1.37	0.41	0.32		0	1.26	0.19	0.64			2.10	2.09				116	200	7.8	0	0.4
24	1.37	0.52	0.18		0	1.36	0.19	0.62			2.07	2.17				114	200	7.9	0	0.2
28	1.03	0.63	0.11		0	1.16	0.19	0.39			1.77	1.74				96	170	8.0	0	0.1
Jul 31	1.14	0.30	0.34		0	1.38	0.20	0.22			1.78	1.80				96	170	8.1	0	0.4
Aug 23	1.21	0.70	0.21		0	1.56	0.20	0.39			2.12	2.15				112	200	8.1	0	0.2
Sep 24	1.10	0.81	0.25		0	1.38	0.20	0.51			2.16	2.09				116	200	7.9	0	0.3
Nov 23	1.55	0.57	0.28		0	1.60	0.19	0.70			2.40	2.49				130	230	7.7	0	0.3

Blank page retained for pagination

Location Latitude 34°24', Longitude 72°48', on left bank 4 miles downstream from Kotkai, 5 miles upstream from the confluence 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, WASID, WAPDA. Gauge height record November 1954 to September 1958 by Dams Investigation Circle.

Average Discharge 85,500 cusecs (61,900,000 acre-feet per year or 18.1 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge during the year 373,000 cusecs on 10 August (gauge height 1307.90 feet); minimum daily discharge 14,700 cusecs on 20-24 January.

1955-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Datum reduced level.

Measurements Forty one discharge measurements were made during the year using 0.2 and 0.8 depth method from car on overhead cableway. Sixty sets of sediment samples were taken by depth integration or point integration method using D-49 or P-50 sampler. Thirty nine 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 channel control in solis rock. Sand moves in the reach. Rating dated 2.5.67 was used to compute daily mean discharges.

Remarks Record good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	16,000	17,400	19,100	26,300	*29,000	*143,000
2	16,000	16,700	18,100	26,000	27,800	*162,000
3	*16,000	16,300	17,700	*25,700	28,000	170,000
4	15,600	16,000	18,900	25,500	28,000	172,000
5	15,600	15,800	18,900	25,200	30,400	152,000
6	15,500	*16,000	18,800	25,900	33,600	134,000
7	15,300	15,800	21,200	27,400	37,200	126,000
8	15,000	15,800	20,500	30,500	42,100	130,000
9	15,300	15,600	20,400	32,400	52,500	141,000
10	15,600	15,200	20,500	33,900	55,000	*153,000
11	15,500	15,000	21,000	39,700	56,000	158,000
12	15,500	15,000	20,900	45,900	55,200	165,000
13	15,500	17,700	22,300	41,100	56,600	162,000
14	15,300	18,700	22,900	37,400	55,000	161,000
15	15,300	17,700	23,000	38,000	51,700	170,000
16	*15,200	17,700	23,700	46,200	45,900	187,000
17	15,000	17,900	23,700	54,600	44,700	208,000
18	14,900	*17,700	26,400	44,200	*44,900	232,000
19	15,000	16,800	35,500	37,700	48,300	*248,000
20	14,700	16,300	32,400	38,300	47,800	261,000
21	15,000	16,000	*28,200	*39,200	49,700	286,000
22	14,800	15,600	25,400	35,300	52,600	264,000
23	14,700	15,600	25,000	32,600	59,400	239,000
24	14,700	16,100	24,000	30,500	62,700	210,000
25	14,900	18,500	24,200	29,000	63,400	*200,000
26	16,500	17,700	46,200	28,200	67,000	201,000
27	21,000	22,100	33,700	27,400	72,200	205,000
28	17,800	21,100	29,200	29,300	80,700	215,000
29	16,300	------	26,600	34,500	96,700	223,000
30	16,000	------	25,500	31,200	111,000	216,000
31	15,600	------	25,100	------	129,000	------
Mean	15,600	15,900	24,500	34,000	55,300	190,000
Cs/mi	0.24	0.26	0.38	0.53	0.86	2.96
In	0.28	0.27	0.44	0.59	0.99	3.30
Maf	.962	.940	1.51	2.02	3.40	11.3

1969 Year: Mean 90,100 Cs/sq mi 1.41 Inches 19.1

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	201,000	198,000	159,000	*54,200	32,200	21,300
2	204,000	207,000	159,000	53,900	31,000	21,400
3	*217,000	*236,000	*158,000	52,700	30,300	*21,300
4	235,000	267,000	153,000	51,000	29,600	21,000
5	*249,000	294,000	145,000	49,000	29,400	20,900
6	259,000	*320,000	141,000	47,300	29,000	20,800
7	274,000	344,000	136,000	45,800	28,500	20,500
8	295,000	*354,000	133,000	44,300	28,200	20,400
9	311,000	359,000	*123,000	43,700	*27,400	20,200
10	*315,000	366,000	109,000	43,400	26,900	20,200
11	311,000	*365,000	96,500	*45,800	26,800	20,000
12	303,000	366,000	88,300	45,600	27,100	19,800
13	303,000	350,000	86,600	43,500	27,100	19,800
14	310,000	340,000	95,400	42,800	26,200	19,800
15	316,000	325,000	95,900	42,300	25,900	19,600
16	316,000	313,000	91,800	41,600	25,400	19,200
17	306,000	306,000	82,500	39,900	24,900	18,800
18	*282,000	309,000	75,200	38,400	24,400	18,600
19	275,000	313,000	*74,900	37,000	24,200	18,300
20	288,000	309,000	71,500	*35,600	24,200	18,100
21	306,000	282,000	69,800	34,600	23,800	*17,900
22	*328,000	230,000	67,900	33,300	23,400	17,800
23	342,000	192,000	65,900	32,600	23,000	17,700
24	*356,000	165,000	64,200	*32,300	*22,700	17,500
25	365,000	142,000	62,300	31,500	22,400	17,300
26	361,000	151,000	60,300	30,700	22,000	17,100
27	344,000	*148,000	*58,400	33,000	21,700	16,900
28	321,000	142,000	56,300	40,600	*21,600	*16,500
29	298,000	141,000	55,000	46,500	21,500	16,700
30	258,000	*146,000	54,000	37,300	21,500	16,600
31	215,000	153,000	———	33,700	———	16,700
Mean	292,000	262,000	96,300	41,400	25,700	19,000
Qa/mi	4.56	4.09	1.50	0.65	0.40	0.30
Ia	5.26	4.72	1.68	0.74	0.45	0.34
Ref	18.0	16.1	5.73	2.55	1.53	1.17

M. Acre-feet. 65.2 Max Day 366,000 Min Day 14,700

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
3 Jan	16,000	46	26			
16 Jan	15,200	44	50			
6 Feb	16,100	46	42			
18 Feb	17,700	51	69			
12 Mar	20,900	58	40			
21 Mar	28,400	55	120			
3 Apr	26,000	60	46			
21 Apr	39,300	56	288			
1 May	29,000	60	39			
18 May	46,000	67	240			
1 Jun	143,000	60	2,170	48	44	8
2 Jun	164,000	60	3,300	58	31	11
4 Jun	170,000	60	2,050	51	31	18
6 Jun	136,000	60	2,090	58	29	13
8 Jun	127,000	61	2,580	71	17	12
10 Jun	151,000	61	3,070	70	15	15
12 Jun	161,000	61	3,670	72	14	14
15 Jun	166,000	61	993	49	28	23
17 Jun	201,000	61	3,460	68	15	7
19 Jun	245,000	60	3,960	77	19	4
21 Jun	277,000	60	8,670	84	14	2
23 Jun	249,000	59	3,970	71	21	8
25 Jun	199,000	59	2,950	76	19	5
27 Jun	200,000	59	2,230	75	17	8
29 Jun	219,000	59	1,750	71	20	9
1 Jul	205,000	59	3,460	82	16	2
3 Jul	212,000	59	4,710	89	8	3
5 Jul	254,000	59	5,140	83	13	4
9 Jul	311,000	59	4,250	77	18	5
10 Jul	314,000	59	4,090	67	27	6
11 Jul	311,000	60	4,670	71	25	4
13 Jul	301,000	60	3,110	58	27	15
15 Jul	315,000	61	4,090	60	28	12
16 Jul	317,000	61	6,550	79	15	6
18 Jul	283,000	61	6,310	78	15	7
21 Jul	300,000	61	4,500	63	29	8
22 Jul	339,000	63	7,810	73	21	6
23 Jul	337,000	65	5,450	61	31	8
24 Jul	364,000	65	5,670	62	28	10
3 Aug	236,000	63	4,580	65	25	10

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
6 Aug	316,000	66	6,750	39	28	33
8 Aug	349,000	63	8,770	64	25	11
11 Aug	366,000	65	12,300	74	19	7
17 Aug	306,000	63	6,760	67	24	9
27 Aug	147,000	63	3,130	69	18	13
30 Aug	149,000	64	4,620	79	13	8
3 Sep	160,000	63	3,790	71	17	12
9 Sep	123,000	60	1,850	47	36	17
19 Sep	72,000	61	648	25	49	26
27 Sep	58,500	62	302			
1 Oct	54,500	63	173			
11 Oct	46,000	60	159			
20 Oct	35,400	59	97			
24 Oct	32,400	59	64			
9 Nov	27,600	56	73			
24 Nov	22,800	49	50			
28 Nov	21,600	49	32			
3 Dec	21,400	49	38			
21 Dec	17,900	45	31			
28 Dec	16,500	46	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.

IRONS RIVER NEAR BARBAND

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25°C	pH	Res CO_3 me/l	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.				
Jan																				
3	1.76	0.48	0.40		0	1.62	0.19	0.75			264	256				148	250	8.0	0	0.4
16	1.65	0.54	0.40		0	1.62	0.19	0.75			259	256				144	240	8.0	0	0.4
Feb																				
6	1.92	0.76	0.32		0.19	1.67	0.29	0.88			3.00	3.03				176	300	8.3	0	0.2
18	1.56	0.94	0.25		Trace	1.57	0.28	0.78			2.73	2.64				144	250	8.2	0	0.2
Mar																				
12	1.21	1.18	0.25		Trace	1.37	0.29	1.84			2.56	2.70				150	250	8.2	0	0.2
21	1.35	0.33	0.31		Trace	1.15	0.19	0.68			1.99	2.02				116	200	8.1	0	0.3
Apr																				
3	1.37	0.58	0.20		0	1.17	0.19	0.93			2.15	2.29				124	210	7.3	0	0.2
21	1.05	0.63	0.16		0	1.10	0.19	0.73			1.84	2.02				108	180	7.3	0	0.2
Jun																				
25	1.14	0.30	0.18		0	1.16	0.19	0.26			1.62	1.61				84	150	8.2	0	0.2
Jul																				
3	1.16	0.23	0.18		0	1.16	0.19	0.22			1.57	1.57				80	150	8.2	0	0.2
29	1.08	0.80	0.40		0	1.29	0.20	0.19			1.68	1.68				88	160	8.1	0.01	0.5
Aug																				
27	1.05	0.49	0.25		0	1.28	0.15	0.37			1.79	1.80				98	170	7.9	0	0.3
Sep																				
19	0.94	0.81	0.23		0	1.28	0.15	0.41			1.98	1.84				100	180	7.9	0	0.2
Oct																				
1	1.10	0.75	0.16		0	1.38	0.10	0.58			2.01	2.06				116	200	7.9	0	0.2
Nov																				
5	1.31	0.67	0.28		0	1.50	0.19	0.46			2.26	2.15				120	210	7.9	0	0.3

SIRAN RIVER NEAR PHULRA - 1969

Location Latitude 34°20', Longitude 73°05', on right bank, nearly 2 miles from Phulra village; the site approachable from Khaki village on Mansehra - Oghi road.

Drainage area 408 square miles

Records available Mean daily discharge record from January 1969 to date by Surface Water Hydrology Project, WASID, WAPDA. Periodic discharge measurements started from September 1968

Extremes The highest flood during the year occurred on 28 July but the gauge height data or flood marks were not recorded; minimum daily discharge 178 cusecs on many days in December.

Gauge Enamelled plates fixed in steps and read from 08:00 to 16:00 hours daily upto 30.6.69 and hourly readings for the whole day observed for the rest of the year. Zero R.L. of gauge as per levelling in January 1969 is 2274.78 feet above mean sea level.

Measurements Fifty one discharge measurements were made during the year by current meter using 0.2 and 0.8 or 0.6 depth method. Low flow measurements were made by wading and high flow measurements were made from the cableway 150 feet upstream of the gauge. Forty five sets of sediment samples were taken by depth integration method using DH-48 sampler while wading and D-49 sampler from the cableway. Nine of these were analysed for particle size distribution. Ten surface samples were collected and analysed for chemical composition.

Determination of discharge The channel has an unstable bed liable to shifting. The stage - discharge relation is controlled by channel characteristics. Rating table dated 1.7.1970 was applied to mean daily gauge heights to compute mean daily discharges with shift adjustments where indicated necessary by the periodic measurements.

Remarks Record fair, annual figures could not be computed as the highest peak could not be ascertained.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	278	1,050	969	1,140	746	799
2	276	752	901	1,140	714	749
3	273	583	881	1,130	724	746
4	268	567	864	1,080	685	736
5	252	513	881	1,060	711	634
6	252	456	908	1,010	772	596
7	*252	429	939	*1,090	*743	*564
8	*249	414	949	1,160	*990	510
9	249	*400	973	1,180	*1,280	489
10	252	398	986	1,200	*1,400	483
11	247	392	1,000	1,280	1,250	444
12	244	387	1,030	1,780	1,110	*429
13	*252	1,310	1,090	1,400	1,210	400
14	254	1,210	1,060	1,280	1,380	374
15	249	830	1,100	1,660	1,280	350
16	244	743	1,060	1,670	1,060	332
17	240	854	1,060	1,600	1,000	330
18	240	847	1,360	1,320	963	335
19	227	733	1,920	1,180	918	353
20	220	688	1,540	*1,410	854	*403
21	218	656	1,380	1,240	803	356
22	220	621	1,320	1,090	830	324
23	204	615	1,290	1,010	*793	302
24	196	786	1,270	935	769	264
25	194	874	1,640	905	714	196
26	580	854	2,120	871	717	180
27	525	1,340	1,690	806	711	194
28	353	1,180	1,410	963	727	218
29	*297	———	1,300	929	749	240
30	268	———	1,190	840	756	288
31	254	———	1,170	———	756	———
Mean	269	732	1,200	1,180	907	421
Cs/mi	0.66	1.79	2.94	2.89	2.22	1.03
In	0.76	1.87	3.40	3.22	2.56	1.15
Acre-ft.	16,500	40,600	73,900	70,100	55,800	25,000

1969 Year: Mean Cs/sq mi Inches

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	295	382	222	521	618	244
2	252	348	210	477	624	235
3	231	317	*200	317	602	224
4	*244	*1,190	198	429	534	*218
5	395	444	178	307	426	222
6	314	358	817	266	384	214
7	264	1,670	449	242	366	218
8	*307	660	*304	224	*350	210
9	350	*1,120	259	210	330	204
10	*441	*3,250	222	194	302	208
11	*398	1,550	*216	1,230	304	214
12	358	1,030	202	854	528	210
13	348	*909	194	363	459	208
14	438	*2,680	1,830	*997	343	204
15	*417	1,310	870	1,200	317	196
16	343	1,030	450	596	302	202
17	292	970	335	389	304	204
18	*268	*1,270	290	340	*288	196
19	271	1,500	*256	322	324	200
20	*429	1,330	244	302	343	*220
21	403	1,070	224	285	340	210
22	*860	1,900	216	*264	317	214
23	647	806	212	247	302	212
24	*1,250	*576	222	*249	292	186
25	*1,720	534	222	242	285	184
26		*564	244	212	273	178
27		483	249	429	266	178
28		453	247	2,390	256	*178
29	*592	432	244	2,130	*254	188
30	459	317	*235	966	252	196
31	412	235	---	793	---	208
Mean		990	342	580	363	206
Cs/mi		2.43	0.84	1.42	0.89	0.50
In		2.80	0.94	1.64	0.99	0.58
Acre-ft.		60,900	20,400	35,700	21,600	12,700

Acre-feet: Max Day Min Day

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
7 Jan	252	46	77			
13 Jan	249	45	75			
28 Jan	297	46	65			
9 Feb	403	49	127			
7 Apr	1,120	60	219			
20 Apr	1,410	47	243			
7 May	752	72	76			
9 May	1,290	52	582			
10 May	1,450	61	531			
23 May	796	58	102			
7 Jun	580	69	94			
12 Jun	477	71	128			
20 Jun	489	71	105			
4 Jul	233	82	49			
8 Jul	376	79	273			
10 Jul	528	77	82			
11 Jul	384	76	42			
15 Jul	471	80	14			
18 Jul	276	86	124			
20 Jul	644	76	223			
22 Jul	1,500	81	13,300	40	51	9
24 Jul	1,140	80	9,620	44	47	9
25 Jul	1,560	81	13,000	61	33	6
26 Jul	3,500	74	2,810	21	57	22
29 Jul	519	84	60			
4 Aug	2,080	78	4,280	9	69	22
9 Aug	2,100	79	3,980	9	79	12
10 Aug	4,280	76	9,570	17	68	15
13 Aug	816	76	143			
14 Aug	6,380	75	5,810	17	72	11
18 Aug	1,340	77	2,840	28	45	27
24 Aug	605	80	181			
3 Sep	212	98	76			
8 Sep	312	80	18			
11 Sep	229	82	19			
30 Sep	247	79	12			
14 Oct	932		338			
22 Oct	261		49			
24 Oct	242	66	34			
8 Nov	345	52	120			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
18 Nov	285	53	28			
29 Nov	247	51	26			
4 Dec	214	49	26			
20 Dec	227	48	120			
28 Dec	174	45	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.

SIRAN RIVER NEAR PHULRA

Chemical Analysis of Water Samples - 1969

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	F	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.				
Jan																				
7	1.99	0.68	0.37		Traces	2.56	0.24	0.25			3.04	3.05				156	290	8.2	0	0.3
13	2.03	0.43	0.40		0.18	2.43	0.19	0.10			2.86	2.90				158	270	8.2	0.15	0.4
24	1.65	0.33	0.40		0	1.98	0.19	0.20			2.38	2.37				126	230	8.0	0	0.4
Apr																				
7	1.10	0.37	0.14		0	1.17	0.19	0.24			1.51	1.60				84	150	7.5	0	0.2
20	1.05	0.42	0.14		0	1.17	0.19	0.20			1.61	1.56				86	150	7.4	0	0.2
Jun																				
20	1.60	0.62	0.26		0	1.90	0.19	0.35			2.48	2.44				138	240	8.2	0	0.2
Jul																				
11	1.60	0.51	0.21		0	1.90	0.19	0.22			2.32	2.31				130	230	8.2	0	0.2
Oct																				
14	1.55	0.63	0.33		0	2.00	0.24	0.20			2.51	2.44				130	230	8.0	0	0.3
Nov																				
8	1.94	0.63	0.38		0	2.60	0.19	0.12			2.95	2.91				152	270	8.1	0.03	0.3
Dec																				
4	2.12	0.92	0.38		0.20	2.50	0.19	0.52			3.52	3.41				184	320	8.3	0	0.3

Location Latitude 34°06', Longitude 72°52', on left bank a quarter of a mile upstream from Thaple 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, WASID, 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 and Power Department.

Average Discharge 1,140 cusecs (828,000 acre-feet per year or 14.4 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 34,800 cusecs on 26 July (gauge height 12.90 feet); minimum daily discharge 345 cusecs on 28 December.

1960-1969: 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 from 08:00 16:00 hours daily during low flow and more often during floods. Zero R.L. of the gauge 1270.20.

Measurements Thirty seven 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 from Thapla Bridge. Thirty four 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. Four of these were analysed for particle size distribution. Fifteen 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 rating table dated 20.5.66 with shift adjustments.

Remarks Record good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	490	1,040	1,640	1,680	992	860
2	476	1,090	1,440	1,720	915	893
3	483	830	1,320	1,580	840	904
4	462	*750	1,500	1,430	882	937
5	483	780	1,270	*1,340	810	904
6	462	730	959	1,280	915	800
7	469	680	948	1,390	915	790
8	462	660	1,040	1,520	937	680
9	469	633	992	1,520	*1,130	651
10	462	606	992	1,560	1,460	690
11	462	579	*1,000	1,670	1,330	615
12	469	554	1,070	2,700	1,280	570
13	462	2,900	1,080	2,000	1,720	579
14	469	2,690	1,050	1,680	1,880	562
15	*462	1,430	1,130	1,500	2,070	490
16	476	*1,100	1,200	2,160	1,390	490
17	469	1,610	1,100	2,630	1,210	483
18	469	1,200	1,190	1,610	1,120	476
19	476	981	3,010	1,440	1,180	455
20	476	760	3,450	1,390	1,210	506
21	483	830	2,050	*1,500	a 1,120	522
22	498	800	1,810	1,320	1,000	483
23	498	740	1,970	1,210	1,030	469
24	490	690	1,700	1,090	1,040	448
25	498	1,360	1,900	1,000	992	434
26	506	1,150	5,460	970	915	420
27	554	a 1,100	3,250	915	*871	427
28	700	a 1,050	2,360	959	871	434
29	*720	———	1,760	1,120	850	414
30	651	———	1,780	1,090	830	*414
31	633	———	*1,730	———	850	———
Mean	504	1,050	1,710	1,500	1,110	593
Cs/mi	0.47	0.97	1.58	1.39	1.03	0.55
In	0.54	1.01	1.83	1.55	1.19	0.61
Acre-ft.	31,000	58,200	105,000	89,200	68,500	35,300

1969 Year: Mean 987 Cs/sq mi 0.91 Inches 12.4

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	498	490	*434	408	882	427
2	427	448	414	757	800	420
3	414	414	*427	530	750	414
4	*408	1,200	408	871	690	*414
5	554	642	360	554	670	402
6	*483	427	619	490	633	408
7	434	*3,810	710	462	597	402
8	455	1,320	498	441	579	396
9	506	1,470	427	427	554	390
10	615	5,580	396	414	538	384
11	490	4,250	384	414	538	a 381
12	448	*1,780	*366	859	579	a 379
13	434	*1,610	384	624	*710	378
14	792	4,730	2,930	*1,070	597	378
15	*615	2,160	1,340	1,560	538	378
16	469	1,670	740	948	506	372
17	441	1,490	*579	651	498	366
18	414	1,720	506	579	498	360
19	*414	3,140	469	522	506	360
20	490	2,160	448	490	710	360
21	*469	1,400	427	469	579	372
22	1,950	3,680	408	448	530	*366
23	*1,080	1,410	396	434	498	360
24	*2,380	1,080	396	*420	490	360
25	2,010	1,080	414	420	483	350
26	8,590	992	402	408	462	350
27	2,620	830	420	402	455	350
28	3,810	690	402	8,640	448	345
29	937	588	414	4,650	*441	350
30	*651	*514	*408	1,530	434	355
31	562	462	——	1,050	——	355
Mean	1,100	1,720	564	1,030	573	377
Cs/mi	1.02	1.59	0.52	0.95	0.53	0.35
In	1.17	1.83	0.58	1.10	0.59	0.40
Acre-ft.	67,400	106,000	33,600	63,400	34,100	23,200

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	462		73			
29 Jan	710	45	84			
16 Feb	1,270		119			
11 Mar	2,030		67			
31 Mar	1,720	69	229			
5 Apr	1,370		133			
21 Apr	1,490		327			
9 May	1,270	56	161			
27 May	893	30	70			
9 Jun	651	80	51			
30 Jun	384	78	29			
4 Jul	384	87	32			
6 Jul	455	88	167			
15 Jul	554	84	136			
21 Jul	448	90	49			
23 Jul	790	84	399			
24 Jul	2,570	84	11,200			
30 Jul	624	84	49			
7 Aug	2,680	82	4,710	16	55	29
12 Aug	1,620	76	949	7	53	40
13 Aug	2,230	65	852	18	37	45
13 Aug	1,460	86	408	6	59	35
30 Aug	490	80	54			
1 Sep	420	78	157			
3 Sep	396	98	180			
12 Sep	360	86	36			
17 Sep	562	82	45			
30 Sep	390	80	22			
14 Oct	1,150	70	4,690	22	61	17
24 Oct	420	70	29			
13 Nov	642	66	115			
29 Nov	441	54	34			
4 Dec	408	60	70			
22 Dec	366	53	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.

SIRAN RIVER AT THAPLA

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										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																				
15	2.22	1.20	0.38		0.27	2.47	0.69	0.36			3.80	3.79				186	350	8.2	0	0.3
24	2.09	0.89	0.50		0	2.70	0.19	0.50			3.48	3.39				178	300	8.0	0	0.4
Feb																				
4	2.20	0.53	0.40		0.39	2.15	0.29	0.36			3.13	3.19				160	290	8.4	0	0.3
16	1.21	1.20	0.25		0.19	1.96	0.19	0.36			2.66	2.70				136	250	8.3	0	0.2
Mar																				
11	1.65	0.77	0.25		Traces	2.06	0.19	0.30			2.67	2.55				138	250	8.1	0	0.2
31	1.32	0.99	0.19		0.18	1.56	0.19	0.51			2.50	2.44				140	240	8.2	0	0.2
Apr																				
5	1.43	0.82	0.19		0.18	1.56	0.19	0.66			2.44	2.59				136	240	8.2	0	0.2
21	1.37	0.68	0.19		Traces	1.56	0.19	0.52			2.24	2.27				128	220	8.2	0	0.2
May																				
9	1.09	0.64	0.25		0	1.47	0.19	0.40			1.98	2.06				118	200	7.5	0	0.3
Jun																				
30	1.63	1.14	0.40		0.29	2.38	0.19	0.33			3.17	3.19				172	300	8.4	0	0.3
Jul																				
15	1.65	1.18	0.40		0.29	2.38	0.19	0.33			3.23	3.19				170	300	8.4	0	0.3
25	1.31	0.93	0.40		0	2.24	0.20	0.24			2.64	2.68				144	250	7.7	0	0.4
Oct																				
14	1.76	0.63	0.28		0	2.45	0.15	0.16			2.67	2.76				140	250	7.7	0.06	0.2
Nov																				
13	1.50	0.98	0.46		0.20	2.47	0.20	0.10			2.94	2.97				160	280	8.3	0.19	0.4
Dec																				
4	2.19	1.12	0.41		0	2.95	0.24	0.53			3.72	3.72				196	340	8.2	0	0.3

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, WASID, WAPDA from August 1963. Gauge height only, at times from January 1960 to October 1963 by P.W.D. B & R.

Average discharge 8,640 cusecs (6,250,000 acre-feet per year or 26.6 inches runoff per year). Average taken for 5 years from 1964 to 1967 and 1969.

Extremes Maximum discharge observed during the year 39,400 cusecs on 10 August (gauge height 9.25); minimum daily discharge 2,580 cusecs on 21 January.

1964-67,69: Maximum discharge 39,400 cusecs on 10 August 1969; 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. Gauge read from 08:00 to 16:00 hours daily during low flow and more often during floods.

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

Determination of discharge The control for this station is a rocky riffle which shifts nearly continuously. Rating table dated 27.8.68 was 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.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	3,100	3,060	*2,690	3,840	5,610	13,900
2	3,040	2,900	2,720	4,020	4,840	*15,200
3	3,060	*2,850	2,780	*4,130	5,130	15,100
4	3,080	2,880	2,780	4,170	*5,410	13,700
5	3,040	2,800	2,890	4,220	5,890	*12,100
6	3,020	2,800	3,000	4,300	6,360	11,900
7	3,000	2,790	3,080	4,350	6,390	12,400
8	2,980	2,800	3,060	4,410	6,090	13,200
9	2,960	2,800	3,020	4,410	5,610	14,400
10	2,940	2,710	2,980	*4,390	6,060	*15,100
11	2,930	2,880	2,940	4,660	6,480	15,600
12	2,890	3,000	2,960	4,890	6,780	16,000
13	*2,940	2,830	3,020	5,110	*7,120	16,100
14	2,980	3,000	*3,080	5,280	7,280	15,100
15	2,940	3,200	3,120	5,520	7,680	16,400
16	2,890	*3,040	3,170	5,750	8,120	*17,100
17	2,830	2,940	3,210	*5,920	8,020	17,400
18	2,780	2,890	3,270	5,640	7,510	17,900
19	2,690	2,870	3,330	5,440	7,160	18,300
20	*2,610	2,850	3,410	5,010	6,900	*18,800
21	2,580	2,830	3,490	4,800	7,120	20,100
22	2,690	2,810	3,450	4,500	7,440	19,500
23	2,720	2,790	3,390	4,300	7,810	*20,300
24	2,790	2,780	3,370	4,390	*7,980	21,700
25	2,830	2,760	3,330	*4,680	8,630	22,800
26	2,890	2,700	*3,370	4,870	9,390	22,100
27	2,910	2,630	3,430	5,230	8,810	21,200
28	2,870	2,650	3,450	5,520	10,500	19,900
29	2,940	———	3,550	6,000	11,200	20,400
30	2,980	———	3,610	6,450	*13,400	21,200
31	2,940	———	3,720	———	13,600	———
Mean	2,900	2,850	3,180	4,870	7,620	17,200
Cs/mi	0.66	0.65	0.72	1.11	1.73	3.91
In	0.76	0.67	0.83	1.24	2.00	4.35
Maf	.178	.158	.196	.290	.469	1.02

1969 Year: Mean 10,000 Cs/sq mi 2.27 Inches 30.8

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*21,700	26,800	15,600	7,000	4,410	3,740
2	22,100	28,600	15,000	6,810	4,260	3,780
3	23,100	29,900	*14,000	6,720	4,630	3,720
4	*24,200	31,800	13,200	6,630	4,440	3,670
5	25,100	32,500	12,600	*6,510	*4,060	3,610
6	25,500	34,100	12,600	6,270	4,020	*3,590
7	*26,000	34,600	12,300	6,270	3,970	3,550
8	27,700	36,500	12,100	*6,300	3,970	3,530
9	29,200	36,300	*11,600	6,300	3,970	3,510
10	*31,300	37,200	11,300	6,210	3,890	3,490
11	29,000	37,300	11,400	6,150	3,890	3,470
12	28,600	36,900	11,700	*6,030	*4,220	3,450
13	28,500	34,700	12,100	5,690	4,130	3,430
14	28,000	35,300	12,600	5,550	3,780	*3,410
15	*29,500	35,300	11,700	5,440	3,550	3,390
16	29,000	33,900	10,000	*5,280	3,510	3,370
17	28,700	33,200	*9,140	5,230	3,470	3,330
18	31,300	31,500	8,780	5,210	*3,470	3,290
19	*32,000	30,300	8,630	5,060	3,570	*3,230
20	33,500	26,700	8,290	*5,080	*3,570	3,210
21	*35,000	*24,600	7,980	4,820	3,610	3,190
22	35,400	23,900	7,880	4,830	3,720	3,170
23	35,900	*20,800	*7,780	4,750	3,720	3,150
24	36,100	18,800	7,540	*4,800	3,860	3,250
25	35,500	*17,600	*7,510	4,630	*3,930	*3,220
26	34,800	16,900	7,380	4,500	3,890	3,230
27	34,100	16,700	7,220	4,410	3,740	3,210
28	31,400	*15,600	7,120	4,390	3,630	3,190
29	29,700	14,900	7,090	4,520	3,610	3,170
30	29,000	15,200	*7,000	4,820	*3,670	3,250
31	27,300	*15,600	———	*4,570	———	*3,130
Mean	29,600	27,900	10,300	5,510	3,870	3,380
Cs/mi	6.73	6.34	2.34	1.25	0.88	0.77
In	7.76	7.30	2.61	1.44	0.98	0.89
Maf	1.82	1.71	.613	.339	.230	.208

M.Acre-ft.7.23 Max Day 37,300 Min Day 2,580

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	2,940	45	58			
20 Jan	2,610	41	19			
3 Feb	3,150	38	30			
16 Feb	3,040	41	139			
1 Mar	2,690	45	131			
3 Apr	4,150	50	127			
17 Apr	5,940	47	1,600	22	50	28
30 May	13,600	57	14,200	42	34	24
2 Jun	15,100	50	11,300	55	34	11
5 Jun	12,100	53	2,150	4	73	23
10 Jun	15,100	48	1,940	4	76	20
16 Jun	17,000	56	2,340	3	70	27
20 Jun	18,500	59	2,180	6	65	29
23 Jun	20,300	54	3,080	5	59	36
1 Jul	21,600	58	3,000	19	49	32
4 Jul	24,100	56	3,330	8	49	43
7 Jul	26,300	54	3,200	16	65	19
10 Jul	31,500	54	13,500	26	55	19
15 Jul	29,700	51	3,090	17	50	33
19 Jul	32,100	50	3,070	7	58	35
21 Jul	35,600	52	2,060	46	35	19
21 Aug	23,800	50	4,050	38	40	22
23 Aug	20,700	59	2,080	30	34	36
25 Aug	17,200	61	2,700	49	18	33
28 Aug	15,200	56	3,000	8	48	44
31 Aug	15,700	58	137			
3 Sep	13,600	54	226			
9 Sep	11,300	60	240			
17 Sep	9,140	50	285			
23 Sep	7,680	70	273			
25 Sep	7,480	52	93			
30 Sep	7,060	50	76			
5 Oct	8,490	50	74			
8 Oct	6,270	50	140			
12 Oct	6,060	48	62			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
16 Oct	5,360	48	306			
20 Oct	5,010	47	241			
24 Oct	4,750	45	116			
31 Oct	4,520	50	112			
5 Nov	4,060	46	81			
18 Nov	3,490	55	72			
25 Nov	3,950	52	185			
30 Nov	3,670	50	87			
6 Dec	3,610	44	135			

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

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

24,900 cusecs (18,100,000 acre-feet per year or 13.0 inches runoff per year). Average taken for 9 calender years from 1961 to 1969.

Extremes Maximum discharge observed during the year 80,200 cusecs on 12 July (gauge height 12.70 feet); minimum daily discharge 6,050 cusecs on 10 February (affected by power regulation).

1897-1969: 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).

1920-1969: Minimun 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. 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 six discharge measurements were made during the year using 0.2 and 0.8 depth method at michni bridge about one mile downstream. Twenty six sets of sediment samples were taken by the depth-integration method unsing D-49 sampler from the bridge and six of these were analysed for particle size distribution. Eleven surface samples were collected and analysed for chemical composition.

Determination of discharge Rating date 29.8.67 was continued. Daily mean discharge 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

KABUL RIVER AT WARSAK

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	9,270	8,470	7,220	15,500	15,000	56,800
2	8,830	7,430	7,330	15,900	16,200	57,500
3	8,330	7,070	9,630	14,500	14,700	57,300
4	*8,400	7,460	7,910	14,000	15,600	55,500
5	8,370	7,190	7,870	18,000	15,200	52,100
6	6,400	7,220	7,700	17,500	15,900	43,000
7	7,360	6,560	6,720	*17,100	18,300	44,500
8	7,670	6,640	8,190	20,600	20,800	48,700
9	7,610	6,300	6,990	21,600	31,200	51,800
10	9,190	6,050	8,880	27,100	*35,700	*55,100
11	8,580	*6,860	10,500	32,300	35,900	56,200
12	7,850	7,100	8,680	36,400	35,600	53,600
13	9,030	6,560	*8,050	36,700	35,800	54,900
14	8,870	7,150	8,950	29,300	37,900	55,700
15	8,400	7,520	10,800	28,300	36,600	59,400
16	8,190	7,070	13,300	39,100	30,200	61,500
17	9,510	7,160	13,100	40,500	27,400	64,800
18	8,580	8,580	14,600	30,200	27,100	67,700
19	8,090	7,150	19,000	28,200	28,600	70,600
20	8,990	7,070	20,700	29,600	27,000	70,300
21	8,870	6,980	17,100	37,100	27,500	71,600
22	8,050	6,230	18,900	32,700	30,100	67,400
23	8,020	6,740	18,300	*28,700	33,500	59,700
24	*8,300	7,920	18,200	23,400	34,200	56,800
25	7,580	6,640	18,100	20,900	34,100	56,800
26	8,180	*6,890	21,600	21,100	*34,300	57,700
27	8,920	6,680	20,000	20,300	37,100	58,600
28	8,400	6,300	*16,800	20,700	39,400	60,500
29	8,910	———	18,200	20,500	42,000	*60,100
30	8,300	———	13,800	15,800	52,800	58,300
31	7,770	———	14,800	———	56,000	———
Mean	8,350	7,040	13,000	25,100	30,400	58,200
Cs/mi	0.32	0.27	0.50	0.97	1.17	2.24
In	0.37	0.28	0.57	1.08	1.35	2.50
Maf	.513	.391	.797	1.49	1.87	3.46

1969 Year: Mean 23,600 Cs/sq mi 0.91 Inches 12.34

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	57,200	40,600	21,800	9,820	10,300	8,120
2	56,900	38,200	22,500	9,070	8,920	8,510
3	56,600	41,500	23,200	9,210	8,330	7,880
4	59,400	44,500	21,500	10,500	8,510	8,470
5	62,000	46,900	20,000	8,840	9,070	7,880
6	60,000	47,600	19,200	9,670	7,980	7,700
7	60,100	50,000	19,200	10,500	9,270	8,330
8	61,700	52,800	*18,100	8,830	8,470	8,050
9	62,500	55,100	17,300	9,390	8,680	8,230
10	61,300	55,300	17,500	9,220	8,470	7,550
11	53,700	59,000	16,800	10,300	8,400	7,430
12	58,700	57,100	16,200	9,080	8,910	8,050
13	55,100	56,800	16,000	10,600	9,150	8,400
14	*54,300	52,700	17,000	9,860	9,070	7,580
15	57,000	56,100	18,300	8,710	*8,950	7,460
16	57,500	53,300	*18,100	10,600	8,910	7,190
17	54,700	49,400	17,400	9,640	8,830	7,610
18	52,700	48,800	15,300	11,000	8,470	7,770
19	53,900	46,100	13,500	9,910	8,230	7,430
20	58,700	*44,400	13,400	8,950	8,650	7,580
21	59,600	40,000	12,300	9,020	8,680	7,370
22	59,000	36,500	12,500	9,040	8,470	7,160
23	59,000	34,300	*11,900	8,720	8,650	7,520
24	*58,800	32,000	11,900	9,010	8,650	7,220
25	59,300	28,300	12,300	8,840	8,750	7,460
26	55,900	*26,700	11,100	7,130	7,770	7,130
27	57,400	25,700	*11,400	8,240	*7,670	7,700
28	52,500	23,900	9,910	8,370	8,300	7,280
29	50,400	22,700	11,000	9,550	8,330	*7,190
30	46,100	*21,400	10,300	10,600	8,470	7,220
31	43,900	21,400	———	9,550	———	7,700
Mean	56,600	42,200	15,900	9,410	8,640	7,680
Cs/mi	2.18	1.62	0.61	0.36	0.33	0.30
In	2.51	1.87	0.68	0.42	0.37	0.34
Maf	3.48	2.60	.946	.579	.514	.472

M.Acre-ft. 17.1 Max Day 71,600 Min Day 6,050

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
4 Jan	12,100	45	128			
24 Jan	9,150	52	33			
11 Feb	6,500	50	43			
26 Feb	8,990	61	42			
13 Mar	12,100	66	41			
28 Mar	20,000	66	115			
7 Apr	25,900	70	78			
23 Apr	30,600	64	183			
10 May	35,700	69	276			
26 May	34,600	77	259			
10 Jun	57,300	79	1,740	29	42	29
29 Jun	59,500	72	1,570	39	35	26
14 Jul	46,600	70	1,890	56	21	23
24 Jul	63,100	78	2,140	40	25	35
20 Aug	44,400	75	4,960	9	72	19
26 Aug	26,100	79	13,000	18	29	53
30 Aug	21,600		550	5	75	20
8 Sep	16,800	79	230			
16 Sep	18,700	74	177			
23 Sep	13,500	75	184			
27 Sep	13,000	74	293			
9 Oct	9,310	62	137			
21 Oct	11,700	74	215			
15 Nov	9,870	64	77			
27 Nov	6,620	51	30			
29 Dec	6,800	52	56			

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.

Chemical Analysis of Water Samples - 1969

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																				
4	2.04	1.70	0.60		0.18	2.52	0.49	1.12			4.34	4.31				242	400	8.2	0	0.4
24	2.05	1.49	0.60		0.18	2.61	0.49	0.92			4.14	4.20				240	390	8.2	0	0.5
Feb																				
11	1.59	1.56	0.70		0.39	2.30	0.49	0.52			3.85	3.70				200	360	8.3	0	0.5
26	2.53	1.04	0.73		0.29	2.59	0.59	0.92			4.30	4.39				244	420	8.3	0	0.5
Mar																				
13	1.90	1.25	0.70		0.19	2.35	0.48	0.94			3.85	3.96				212	370	8.2	0	0.6
28	1.41	1.22	0.64		0.19	1.96	0.48	0.73			3.27	3.36				176	310	8.2	0	0.6
Apr																				
7	1.57	0.95	0.64		0	1.93	0.38	0.94			3.16	3.30				176	300	7.7	0	0.6
Jul																				
24	1.08	0.53	0.34		0	1.50	0.20	0.26			1.95	1.96				104	190	8.1	0	0.4
Aug																				
20	0.99	0.75	0.18		0	1.46	0.20	0.22			1.92	1.88				104	180	8.2	0	0.2
Sep																				
27	1.32	1.23	0.33		0	1.91	0.35	0.47			2.88	2.73				148	260	8.0	0	0.2
Oct																				
21	1.65	1.26	0.41		0.20	1.96	0.30	0.70			3.32	3.16				172	300	8.3	0	0.3

Blank page retained for pagination

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, WASID, 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 3,190 cusecs (2,310,000 acre - feet per year or 55.5 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 16,100 cusecs on 24 July (gauge height 14.85 feet); minimum daily discharge 436 cusecs on 20 February.

1961-1969: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to 6004.90 datum (checked in 1968).

Measurements Twenty nine discharge measurements were made during the year using 0.2 and 0.8 or 0.6 depth method from car on overhead cableway near the gauge. Twenty eight sets of sediment samples were taken by the depth-integration method using D-49 sampler from the cableway. All of them were analysed for total concentration. Eight surface samples were collected 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 Record good. Probable diurnal fluctuations during melting period has not been defined.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	536	476	480	1,210	1,330	7,150
2	480	492	484	1,140	1,390	7,560
3	476	500	488	1,220	1,490	8,020
4	508	504	488	1,320	1,530	7,600
5	496	500	492	1,400	1,890	6,190
6	508	488	492	1,620	2,330	6,470
7	512	454	492	1,840	2,740	6,890
8	520	468	496	2,050	3,780	*7,520
9	512	484	504	2,080	4,720	8,020
10	500	488	516	2,360	4,440	8,770
11	476	492	604	2,660	4,160	7,330
12	488	492	675	2,480	4,190	8,020
13	500	484	750	2,210	3,780	8,890
14	476	476	815	2,230	3,500	9,180
15	500	468	900	2,740	*3,150	9,910
16	500	484	922	2,540	3,100	10,100
17	500	476	988	2,240	3,000	11,100
18	508	448	1,070	2,060	3,180	11,800
19	500	468	1,080	1,890	2,980	11,600
20	492	436	*916	2,010	2,990	*12,500
21	492	454	922	1,870	3,400	*12,200
22	500	460	952	1,740	3,920	11,100
23	492	468	880	1,670	4,090	9,960
24	500	476	916	*1,600	4,020	10,100
25	488	436	1,010	1,650	4,390	11,100
26	488	484	1,320	1,670	4,840	11,800
27	472	484	1,110	1,580	5,420	12,100
28	454	480	1,020	1,500	*5,780	*11,800
29	468	—	976	1,470	5,900	11,700
30	468	—	1,000	1,410	6,890	10,600
31	472	—	1,110	—	7,120	—
Mean	493	476	802	1,850	3,720	9,570
Cs/mi	0.63	0.61	1.03	2.37	4.77	12.3
In	0.73	0.64	1.19	2.64	5.50	13.7
Maf	.030	.026	.049	.110	.229	.569

1969 Year: Mean 3,730 Cs/sq mi 4.78 Inches 64.9

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	11,600	7,720	4,100	1,770	1,120	780
2	12,700	9,210	4,090	1,650	1,100	780
3	13,400	10,600	3,640	1,630	1,070	765
4	13,800	11,600	3,370	1,600	1,040	760
5	14,000	*13,000	3,370	*1,570	1,020	800
6	14,200	*13,700	3,360	1,570	*1,040	*760
7	14,100	*13,800	3,160	1,530	1,040	745
8	14,600	*14,000	3,080	1,510	1,020	745
9	14,800	14,000	*2,870	1,480	1,000	735
10	14,600	14,200	2,720	1,410	988	705
11	12,700	13,500	2,710	1,600	964	700
12	11,500	12,300	2,740	1,420	994	685
13	12,400	11,400	2,840	1,390	1,010	656
14	13,300	11,500	3,330	1,370	855	652
15	*12,700	9,990	3,560	1,350	825	690
16	*13,000	9,060	2,980	1,320	855	690
17	12,900	8,890	2,720	1,280	850	675
18	12,700	8,680	2,540	1,240	820	675
19	13,500	8,460	2,430	1,230	785	665
20	14,700	7,520	*2,270	1,230	790	596
21	15,100	6,560	2,130	1,220	890	620
22	15,000	5,720	2,030	1,190	785	620
23	14,700	5,310	2,010	1,170	840	620
24	15,000	4,860	1,910	1,130	825	616
25	14,100	4,740	1,900	*1,100	820	616
26	*12,800	4,480	1,840	1,100	825	628
27	*12,100	4,240	1,800	1,080	790	*624
28	*11,000	4,100	1,760	1,070	810	608
29	*9,570	4,130	1,760	1,250	*810	600
30	*8,460	*4,240	1,760	1,210	800	624
31	7,140	4,260	———	1,170	——	616
Mean	13,000	8,900	2,690	1,350	913	679
Cs/mi	16.7	11.4	3.45	1.73	1.17	0.87
In	19.2	13.1	3.85	1.99	1.31	1.00
Maf	.798	.547	.160	.083	.054	.042

M.Acre-ft. 2.70 Max Day 15,100 Min Day 436

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
21 Feb	454	38	57			
20 Mar	922	47	35			
24 Apr	1,600	42	10			
15 May	3,090	48	45			
28 May	5,750	49	76			
8 Jun	7,500	47	61			
20 Jun	12,500	49	213			
21 Jun	12,300	49	69			
28 Jun	11,900	48	78			
6 Jul	12,400	50	144			
15 Jul	12,900	53	159			
16 Jul	12,400	48	135			
26 Jul	12,300	50	91			
27 Jul	11,600	50	129			
28 Jul	10,500	51	109			
29 Jul	8,650	51	90			
30 Jul	8,020	48	75			
5 Aug	13,000	50	91			
7 Aug	13,500	50	136			
8 Aug	13,700	52	112			
30 Aug	4,420	54	148			
9 Sep	2,910	47	63			
20 Sep	2,220	50	245			
25 Oct	1,100	47	135			
10 Nov	970	43	78			
29 Nov	815	38	34			
6 Dec	755	38	69			
27 Dec	616	38	23			

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 - 1969

	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25^oC	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	
Feb 21	0.77	0.33	0.06		0	0.73	0.19	0.25			1.16	1.17				60	110	7.6	0	0.1
Mar 20	1.43	1.77	0.31		0.29	2.20	0.19	0.78			3.51	3.46				192	330	8.3	0	0.2
Apr 24	0.98	0.12	0.11		0	0.83	0.14	0.25			1.21	1.22				70	120	7.5	0	0.1
May 28	0.57	0.26	0.05		0	0.68	0.09	0.13			0.88	0.90				48	80	7.7	0	0.1
Jul 30	0.91	0.21	0.34		0	0.18	0.10	0.16			1.46	1.44				78	140	8.0	0.06	0.5
Aug 30	0.27	0.36	0.29		0	0.52	0.10	0.29			0.92	0.91				52	90	7.5	0	0.5
Sep 20	0.33	0.25	0.16		0	0.44	0.20	0.08			0.74	0.72				38	70	7.7	0	0.3
Nov 6	0.78	0.32	0.18		0	1.00	0.19	0.07			1.28	1.26				66	120	7.5	0	0.2

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, WASID, WAPDA. Gauge heights December 1958 to June 1962 by Hydrology Directorate of Irrigation and Power Department, Peshawer. Record based on estimated discharges September 1911 to date with some periods missing by Malakand Division of Irrigation Department.

Average discharge 6,340 cusecs (4,590,000 acre-feet or 38.6 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 34,800 cusecs on 10 August (gauge height 6.90 feet); minimum daily discharge 1,210 cusecs on 17 February.

1961-1969: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to 2239.55 datum (Checked in 1968). Cheak bar in forward position 28.80.

Measurements Sixty three discharge measurements were made during the year by current meter using 0.2 and 0.8 depth method from Chakdara Bridge. Fifty Six sets of sediment samples were taken by the depth integration method using D-49 sampler from the bridge, one sample was analysed for particle size distribution and the rest were analysed for total concentration. Eleven surface samples were collected and analysed for chemical composition.

Determination of discharge Previous rating dated 18.7.65 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	1,410	2,230	2,730	5,280	5,350	16,700
2	1,400	1,920	2,480	4,810	5,120	17,200
3	*1,350	1,690	2,250	4,850	5,200	16,300
4	1,440	1,650	2,710	*4,580	5,280	17,400
5	1,410	1,620	2,710	5,080	6,490	*13,800
6	1,410	1,510	2,980	5,390	7,700	12,400
7	*1,380	1,480	3,640	5,780	8,450	13,500
8	1,400	*1,450	3,380	6,490	*10,600	14,800
9	1,400	1,440	3,440	*6,660	*15,100	15,800
10	1,400	*1,440	3,610	7,240	13,600	16,600
11	1,350	1,380	3,840	8,600	12,800	14,700
12	1,330	1,230	4,260	10,200	*10,300	15,800
13	*1,350	*1,780	4,770	8,750	10,100	*16,700
14	1,310	3,610	4,920	*7,750	9,950	17,200
15	1,270	2,580	4,960	9,250	9,150	18,100
16	1,270	2,090	*4,920	10,300	7,560	18,100
17	1,270	*2,790	5,080	*9,150	*7,470	19,000
18	1,270	2,270	6,070	7,240	7,560	*20,100
19	1,270	1,920	9,150	6,240	*7,900	*19,400
20	1,240	1,750	7,560	8,050	7,800	20,600
21	1,230	1,690	*5,590	*10,900	*8,250	19,500
22	1,240	1,580	5,000	8,450	9,300	17,200
23	1,230	1,510	*5,080	6,880	10,800	16,400
24	1,210	1,730	4,810	6,030	9,900	16,100
25	1,210	2,340	5,940	*5,390	10,700	17,200
26	1,730	1,980	*12,600	5,550	*11,600	17,700
27	2,710	2,800	7,850	5,000	12,700	[illegible]
28	2,000	3,610	5,990	*7,420	13,600	17,800
29	1,710	———	5,040	6,660	15,800	17,400
30	1,660	———	4,690	5,820	16,600	15,700
31	1,590	———	4,730	———	17,000	———
Mean	1,430	1,970	4,930	6,990	9,970	16,900
Cs/mi	0.64	0.88	2.21	3.13	4.47	7.58
In	0.74	0.92	2.55	3.50	5.16	8.46
Maf	.088	.109	.303	.416	.613	1.01

1969 Year: Mean 7,360 Cs/sq mi 3.30 Inches 44.80

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	16,400	12,400	6,320	2,870	3,040	1,640
2	17,600	13,500	*6,530	*3,040	2,980	1,620
3	*18,900	14,700	6,150	2,900	2,790	1,590
4	20,000	15,600	5,700	2,840	2,580	1,530
5	*20,800	17,200	5,390	2,710	2,530	1,580
6	21,500	17,600	5,430	2,610	2,430	1,590
7	22,000	19,400	5,430	2,630	2,370	1,580
8	*22,300	19,800	5,390	2,530	2,200	1,510
9	*22,800	19,400	5,080	2,460	2,230	1,510
10	*20,300	24,500	*4,770	2,480	2,160	*1,480
11	*18,900	*27,300	4,440	2,840	2,090	1,470
12	*16,200	*21,200	4,510	*4,010	2,140	1,450
13	17,000	*17,900	4,510	2,980	*2,140	1,510
14	19,600	*17,800	7,290	2,980	2,090	1,420
15	17,800	*17,000	7,650	3,840	1,960	*1,410
16	18,100	*15,100	7,380	3,380	1,730	1,440
17	18,200	*14,600	5,780	2,980	1,820	1,410
18	18,600	14,400	4,960	2,790	1,780	1,410
19	*19,300	15,700	4,510	2,710	1,770	*1,400
20	*23,300	13,600	4,220	2,630	1,940	1,380
21	24,700	*11,600	4,080	2,460	2,000	1,370
22	24,800	10,300	3,740	2,370	1,860	*1,370
23	*25,400	8,400	3,510	2,270	1,680	1,350
24	*25,400	7,750	3,540	2,270	1,750	*1,350
25	*24,100	7,200	3,480	2,200	*1,750	1,340
26	22,300	7,110	3,380	2,140	1,710	1,350
27	21,800	*6,880	*3,220	2,410	*1,710	1,350
28	19,900	6,530	2,950	6,840	1,750	1,340
29	16,600	6,200	2,870	9,900	1,680	1,370
30	14,800	6,320	2,840	5,120	1,620	1,370
31	12,600	6,360	———	3,710	———	1,300
Mean	20,100	14,000	4,840	3,220	2,080	1,440
Cs/mi	9.01	6.28	2.17	1.44	0.93	0.65
In	10.4	7.23	2.42	1.67	1.04	0.75
Mar	1.23	.860	.288	.198	.124	.089

M.Acre-feet. 5.33 Max Day 27,300 Min Day 1,210

SWAT RIVER AT CHAKDARA

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
3 Jan	1,410	44	11			
7 Jan	1,380	45	43			
13 Jan	1,350	43	155			
14 Jan	2,070	47	48			
8 Feb	1,450	46	41			
10 Feb	1,450	45	21			
13 Feb	1,510	46	58			
17 Feb	2,790	50	111			
16 Mar	4,730	52	229			
21 Mar	5,590	61	101			
23 Mar	5,040	62	82			
26 Mar	12,700	57	151			
4 Apr	5,040	60	117			
9 Apr	4,330	60	157			
14 Apr	7,900	60	122			
17 Apr	9,400	57	268			
25 Apr	5,430	54	24			
28 Apr	7,510	56	55			
8 May	10,200	62	196			
9 May	15,200	60	78			
12 May	10,600	61	84			
17 May	7,560	62	110			
19 May	8,050	62	177			
21 May	8,250	62	128			
26 May	11,800	68	150			
5 Jun	14,400	83	154			
13 Jun	16,700	60	195			
18 Jun	20,100	62	994			
19 Jun	19,800	58	564	3	17	80
30 Jun	15,900	58	255			
3 Jul	20,100	66	221			
5 Jul	22,000	65	150			
8 Jul	17,300	68	147			
9 Jul	24,100	68	222			
10 Jul	21,500	67	167			
11 Jul	19,800	63	124			
12 Jul	17,500	62	201			
19 Jul	20,700	62	129			
20 Jul	25,200	69	195			
23 Jul	26,000	69	179			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
24 Jul	27,600	65	193			
25 Jul	23,500	70	158			
21 Aug	11,400	70	129			
27 Aug	6,930	63	143			
10 Sep	4,890	75	173			
22 Sep	3,310	64	268			
2 Oct	2,870	64	99			
12 Oct	4,040	63	117			
13 Nov	2,200	60	92			
25 Nov	1,780	57	31			
27 Nov	1,730	52	42			
10 Dec	1,470	51	69			
15 Dec	1,410	49	307			
19 Dec	1,400	50	36			
22 Dec	1,370	48	31			
24 Dec	1,350	48	47			

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 - 1969

Date	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION				$EC \times 10^6$ 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 7	1.40	0.57	0.15		0	1.80	0.19	0.17			2.12	2.16				118	200	8.0	0	0.2
Feb 13	1.36	0.42	0.20		Traces	1.57	0.19	0.41			1.98	2.17				116	200	8.2	0	0.2
Mar 16	0.55	0.92	0.05		0	1.22	0.14	0.29			1.52	1.65				84	150	7.9	0	0.1
Mar 26	0.66	0.71	0.05		0	1.02	0.14	0.37			1.42	1.53				84	140	7.7	0	0.1
Apr 4	0.87	0.28	0.11		0	0.91	0.14	0.25			1.26	1.30				72	120	7.9	0	0.1
Apr 21	0.87	0.23	0.11		0	0.83	0.14	0.25			1.21	1.22				72	120	7.8	0	0.1
May 8	0.45	0.54	0.08		0	0.63	0.14	0.24			1.07	1.01				60	100	7.6	0	0.1
May 26	0.34	0.43	0.08		0	0.58	0.14	0.11			0.85	0.83				44	80	7.4	0	0.1
Jul 23	0.34	0.21	0.34		0	0.42	0.15	0.29			0.89	0.86				46	80	7.5	0	0.7
Aug 27	0.55	0.29	0.15		0	0.73	0.10	0.14			0.99	0.97				50	90	7.8	0	0.3
Sep 27	0.93	0.24	0.20		0	1.08	0.20	0.08			1.37	1.36				72	130	7.7	0	0.3

Location Latotide 33°32', 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, WASID, WAPDA. Gauge height record from January 1959 to June 1962 with discharge measurements starting in 1961 by Peshawar Division of Hydrology Directorate, Irrigation and Power Department.

Average Discharge 365 cusecs (265,000 acre-feet per year or 6.95 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 5,660 cusecs 27 July (gauge height 7.30 feet); minimum daily discharge 46 cusecs on 10 August.

1961-69: Maximum discharge 11,200 cusecs on 25 March 1967 minimum daily discharge 46 cusecs on 10 August 1969.

Gauge Enamelled staff gauge graduated to 0.02 foot and read to 0.01 foot from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to 1705.57 datum (checked in 1968).

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

SARA RIVER AT JHANSI POST

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	206	198	235	305	253	253
2	210	194	230	300	248	222
3	210	190	226	290	244	214
4	206	190	222	290	239	222
5	206	190	214	285	206	206
6	206	190	244	285	187	183
7	202	187	239	280	285	173
8	202	183	239	271	295	*173
9	202	183	239	*230	358	162
10	198	*183	248	364	850	155
11	198	183	271	300	422	155
12	202	180	*275	440	315	155
13	206	248	275	315	*706	145
14	206	216	280	315	1,810	139
15	*202	214	285	341	1,040	136
16	202	214	300	353	594	136
17	198	214	310	*300	520	142
18	194	210	310	271	480	139
19	194	210	353	271	493	136
20	190	206	310	386	*416	145
21	190	202	331	342	404	136
22	190	*202	342	300	410	*129
23	187	202	404	257	358	220
24	187	202	353	257	310	180
25	*187	206	347	253	305	142
26	187	230	422	257	271	166
27	190	220	*380	253	257	123
28	190	225	315	310	248	117
29	187	—	310	315	226	206
30	187	—	310	295	214	173
31	190	—	310	—	206	—
Mean	197	203	294	301	425	166
Cs/mi	0.28	0.28	0.41	0.42	0.60	0.23
In	0.32	0.30	0.48	0.47	0.69	0.26
Acre-ft.	12,100	11,300	18,100	17,900	26,100	9,880

1969 Year: Mean 230 Cs/sq mi 0.32 Inches 4.38

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	139	169	93	117	214	152
2	103	*129	*88	123	210	149
3	98	112	222	123	202	149
4	90	95	123	133	194	*149
5	93	85	152	126	187	145
6	88	75	214	123	438	155
7	88	68	535	*126	230	152
8	88	68	410	133	206	145
9	1,180	59	218	142	198	145
10	*359	46	190	149	190	145
11	310	147	*162	155	183	142
12	136	129	139	183	239	140
13	159	248	123	364	198	139
14	133	719	*166	347	190	139
15	133	280	447	862	183	136
16	133	*180	336	481	180	136
17	115	139	214	214	180	139
18	109	120	187	202	180	139
19	95	266	169	*194	176	142
20	95	289	149	194	173	142
21	93	410	*136	194	169	139
22	90	315	123	190	*166	136
23	90	*417	117	194	166	139
24	269	226	117	218	162	136
25	109	176	120	202	162	136
26	290	248	*117	210	159	139
27	*1,060	222	126	198	159	*142
28	355	210	123	257	155	139
29	218	*173	120	549	152	139
30	314	120	117	310	152	139
31	244	88	—	244	—	136
Mean	222	194	185	234	192	142
Cs/mi	0.31	0.27	0.25	0.33	0.26	0.20
In	0.36	0.31	0.29	0.38	0.30	0.23
Acre-ft.	13,600	12,000	11,000	14,400	11,400	8,730

Acre-feet. 167,000 Max Day 1,810 Min Day 46

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	202	49	35			
25 Jan	187	56	33			
10 Feb	183	49	37			
12 Mar	271	65	822	1	61	38
27 Mar	364	65	835	3	37	60
9 Apr	230	75	167			
17 Apr	300	73	231			
13 May	673	68	5,960	5	45	50
20 May	416	73	1,700	9	36	55
8 Jun	173	85	147			
22 Jun	129	70	200			
10 Jul	285	81	2,080	15	61	24
18 Jul	109	82	24			
27 Jul	93	87	62			
16 Aug	180	83	90			
23 Aug	375	79	13,400	7	30	63
29 Aug	166	77	170			
2 Sep	90	80	300			
11 Sep	162	73	170			
14 Sep	169	72	32,200	9	56	35
21 Sep	133	77	251			
26 Sep	117	76	253			
7 Oct	126	73	86			
19 Oct	194	65	57			
22 Nov	166	47	290			
4 Dec	152	52	32			
27 Dec	142	50	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.

BABA RIVER AT JEANSI POST

Chemical Analysis of Water Samples - 1969

	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION							
											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.	EC x 10^6 at 25^oC	pH	Res CO_3 me/l	SAR
Jan																				
15	2.12	1.51	0.40		0.27	3.11	0.29	0.36			4.03	4.01				218	370	8.2	0	0.3
25	2.27	1.42	0.40		0.27	3.11	0.29	0.32			4.09	3.99				220	370	8.3	0	0.3
Feb																				
10	1.92	1.76	0.45		0.29	2.69	0.39	0.82			4.13	4.19				220	390	8.3	0	0.3
Mar																				
12	1.36	1.52	0.25		Traces	2.45	0.29	0.54			3.13	3.28				180	310	8.2	0	0.2
27	1.37	1.31	0.21		0.19	2.25	0.29	0.55			3.09	3.28				176	300	8.3	0	0.2
Apr																				
9	1.68	1.42	0.31		0.16	2.31	0.38	0.73			3.41	3.60				200	340	8.3	0	0.3
17	1.46	1.32	0.34		0.18	2.21	0.19	0.68			3.12	3.26				180	310	8.2	0	0.3
Jun																				
22	0.92	1.77	0.55		0.32	2.24	0.40	0.30			3.24	3.26				184	320	8.4	0	0.5
Jul																				
27	1.14	2.07	0.49		0.21	2.94	0.35	0.33			3.70	3.83				200	350	8.3	0	0.4
Aug																				
28	0.99	1.97	0.42		0.21	2.70	0.30	0.19			3.38	3.40				180	320	8.3	0	0.4
Sep																				
14	1.37	1.92	0.33		0.29	2.65	0.40	0.25			3.62	3.59				196	350	8.3	0.35	0.3
Oct																				
19	1.32	1.54	0.31		0.20	2.16	0.30	0.56			3.17	3.22				174	300	8.3	0	0.3
Nov																				
22	1.55	1.55	0.38		0	3.00	0.29	0.20			3.48	3.49				180	320	8.2	0	0.3

Blank page retained for pagination

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, WASID, 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 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 107,000 cusecs on 11 July (gauge height 11.54 feet); minimum daily discharge 6,390 cusecs on 10 February.

1961-1969: 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 (checked in 1968).

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

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

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	9,950	9,630	13,200	*26,400	23,900	81,400
2	11,200	10,500	11,600	25,800	22,700	80,400
3	10,900	9,110	11,900	26,200	*22,500	81,300
4	10,300	8,830	12,700	23,600	22,200	83,500
5	10,200	7,910	11,600	24,900	22,800	77,500
6	9,750	8,230	11,500	26,300	24,200	65,800
7	7,870	8,270	12,200	27,900	27,900	62,300
8	8,870	7,350	11,900	30,800	32,600	64,700
9	*9,790	7,470	13,800	*34,000	45,500	*71,400
10	9,270	6,390	12,400	35,800	*53,600	73,700
11	11,600	6,500	*15,500	43,500	55,600	75,800
12	9,910	7,230	17,400	*52,200	50,700	*75,200
13	10,300	7,550	15,500	*56,600	51,600	74,600
14	10,800	9,910	16,700	46,200	54,900	77,400
15	10,700	*12,700	*17,800	42,500	*55,000	80,400
16	9,990	12,400	20,500	*57,000	48,000	*83,800
17	10,200	11,900	21,700	64,600	40,800	88,100
18	11,000	13,000	22,500	53,200	40,200	94,000
19	10,500	12,500	27,500	45,800	40,700	98,500
20	9,870	10,400	*33,300	45,000	*41,400	*98,700
21	11,400	10,300	26,700	61,800	40,900	102,000
22	9,790	9,470	25,700	*59,800	43,400	99,700
23	9,470	8,350	24,400	51,700	47,400	88,700
24	9,510	* 8,990	25,900	43,300	*50,200	81,000
25	8,910	10,400	*25,400	38,700	48,800	80,500
26	8,630	9,750	*39,900	35,700	49,900	83,400
27	10,500	10,800	38,600	32,400	52,100	*83,500
28	11,700	13,000	31,300	30,800	53,600	88,000
29	*11,500	———	29,100	*32,000	62,400	87,300
30	10,800	———	26,800	28,600	*68,800	84,100
31	9,470	———	25,400	———	78,900	———
Mean	10,200	9,600	21,000	40,100	44,300	82,200
Cs/mi	0.30	0.28	0.61	1.17	1.30	2.40
In	0.34	0.29	0.71	1.31	1.49	2.68
Maf	.624	.533	1.29	2.39	2.72	4.89

1969 Year : Mean 34,000 Cs/sq mi 0.99 Inches 13.48

Note : * Discharge measurement made on this day.

KABUL RIVER AT NOWSHERA

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	83,900	59,100	26,100	11,100	*15,000	9,150
2	84,300	55,100	26,100	11,000	13,200	9,390
3	86,600	56,600	27,900	11,600	11,900	9,070
4	90,100	61,700	*24,900	10,800	11,300	9,190
5	95,100	64,700	24,000	11,200	11,000	8,870
6	96,000	67,200	22,500	10,200	10,900	*8,710
7	94,300	71,400	22,400	10,900	10,700	8,990
8	96,400	75,700	21,800	10,400	*10,700	8,950
9	*99,100	77,900	21,400	9,830	10,400	9,230
10	102,000	79,700	20,400	9,910	10,200	8,390
11	101,000	91,300	19,300	10,200	9,870	8,470
12	94,300	88,700	18,900	12,400	10,300	8,310
13	81,500	82,000	18,500	13,300	10,600	9,030
14	82,900	74,600	19,800	15,000	11,200	9,350
15	85,500	78,000	26,100	12,300	10,600	8,030
16	*86,300	75,600	28,300	16,300	10,400	8,110
17	82,700	67,600	25,000	14,800	9,950	8,070
18	80,200	*70,400	21,000	12,800	9,990	8,150
19	79,100	69,100	*19,200	13,000	9,710	8,110
20	*84,500	65,700	17,600	10,900	*9,830	8,310
21	90,200	59,600	a 16,000	10,900	9,870	8,030
22	88,800	54,000	* 15,000	*10,500	9,830	7,990
23	89,700	46,900	a 14,500	10,400	9,990	7,870
24	*96,000	42,800	a 14,000	9,870	9,870	*7,990
25	95,100	*38,500	a 13,500	10,000	9,790	7,790
26	89,500	38,000	*12,400	9,630	9,230	7,870
27	87,300	34,700	12,700	8,510	8,870	7,910
28	90,900	31,200	12,100	14,500	9,150	8,230
29	*79,700	28,600	*11,300	19,500	9,150	7,830
30	*69,400	26,600	11,500	21,500	9,150	8,190
31	65,400	*25,600	———	17,000	———	*8,070
Mean	88,000	60,000	19,500	12,300	10,400	8,440
Cs/mi	2.57	1.75	0.57	0.36	0.30	0.25
In	2.97	2.02	0.64	0.41	0.34	0.28
Maf	5.41	3.69	1.16	.754	.620	.519

M.acre-ft. 24.6 Max Day 102,000 Min Day 6,390

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Jan	9,870	46	254			
29 Jan	11,800	53	82			
15 Feb	12,900	55	148			
11 Mar	16,100	66	72			
15 Mar	19,000	68	231			
20 Mar	30,800	64	166			
24 Mar	9,590	60	84			
25 Mar	27,200	66	245			
26 Mar	44,100	61	158			
1 Apr	29,600	68	160			
9 Apr	34,900	68	249			
12 Apr	53,700	63	242			
13 Apr	56,800	63	217			
16 Apr	58,000	65	285			
22 Apr	60,300	64	1,390	10	77	13
29 Apr	34,000	64	177			
3 May	23,100	69	267			
10 May	53,400	68	218			
15 May	55,800	63	3,420	8	48	44
20 May	42,200	71	204			
24 May	50,700	67	1,510	34	40	26
30 May	68,400	72	214			
9 Jun	71,800	70	1,390	42	43	15
12 Jun	75,700	69	1,400	37	42	21
16 Jun	83,900	69	1,340	30	45	25
20 Jun	100,000	70	1,250	31	39	30
27 Jun	83,200	69	217			
9 Jul	98,700	73	2,580	3	58	39
16 Jul	87,000	72	5,820	3	44	53
24 Jul	93,400	76	2,150	16	70	14
29 Jul	78,300	74	1,090	6	73	21
30 Jul	68,400	72	1,040	9	70	21
1 Aug	58,600	72	2,340	40	53	7
8 Aug	73,600	75	2,360	8	62	30
12 Aug	87,000	76	6,030	15	55	30
18 Aug	69,700	78	2,380	5	70	25
25 Aug	38,100	76	145			
31 Aug	26,400	76	3,900	17	69	14
4 Sep	25,300	76	191			
19 Sep	19,500	74	105			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
22 Sep	16,800	75	127			
26 Sep	12,100	74	44			
29 Sep	9,470	78	130			
22 Oct	11,200	71	240			
1 Nov	15,800	70	259			
8 Nov	10,700	68	92			
6 Dec	8,830	54	200			
24 Dec	8,550	52	109			
31 Dec	8,750	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.

KABUL RIVER AT NOWSHERA

Chemical Analysis of Water Samples - 1969

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																				
9	2.15	1.49	0.70		0.18	2.61	0.49	1.02			4.34	4.30				246	400	8.2	0	0.5
29	1.95	1.53	0.70		0.18	2.41	0.49	0.98			4.18	4.06				248	400	8.2	0	0.5
Feb																				
15	2.09	0.96	1.90		0.19	2.64	0.80	1.20			4.95	4.83				256	450	8.2	0	1.5
Mar																				
11	1.74	1.04	0.65		0.19	2.06	0.48	0.75			3.43	3.48				192	340	8.2	0	0.5
26	1.47	0.78	0.29		Traces	1.96	0.29	0.30			2.54	2.55				144	250	8.2	0	0.2
Apr																				
13	1.24	0.60	0.41		0	1.47	0.38	0.47			2.25	2.32				128	220	7.3	0	0.4
22	1.36	1.00	0.31		0	1.75	0.19	0.83			2.67	2.77				144	250	7.6	0	0.3
Aug																				
1	0.93	0.49	0.21		0	1.46	0.20	0.12			1.63	1.78				90	160	8.2	0.04	0.3
Sep																				
22	1.54	1.06	0.38		0	2.16	0.25	0.47			2.98	2.88				156	270	8.1	0	0.3
Oct																				
22	1.86	1.05	0.71		0.20	2.16	0.30	0.75			3.68	3.41				192	330	8.3	0	0.6

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 30 June 1969 Surface Water Hydrology Project, WASID, WAPDA.

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

Extremes Record available upto 30 June 1969.

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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Zero R.L. of gauge 930.22 (checked in 1968).

Measurements Nine discharge measurements were made upto 30 June 1969; 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. Nine sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from the bridge. All were analysed for total concentration. Seven 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 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. Site was closed on 30 June 1969.

KALPANI RIVER NEAR RISALPUR

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	939	981	1,280	834	510	432
2	1,700	1,170	1,140	742	510	427
3	1,600	1,030	1,050	646	495	423
4	1,560	1,020	988	620	486	418
5	1,560	1,010	939	615	468	418
6	1,580	988	911	605	459	409
7	1,570	1,000	883	509	459	468
8	1,580	967	766	585	459	418
9	*1,570	946	700	555	459	414
10	1,570	946	*640	540	615	396
11	1,570	925	615	575	585	384
12	1,550	918	610	*640	550	376
13	1,550	1,290	600	610	459	376
14	1,530	*1,750	590	615	620	376
15	1,550	1,740	590	625	1,040	372
16	1,530	1,230	590	670	960	372
17	1,480	2,590	590	736	904	372
18	1,480	1,750	610	640	712	380
19	1,480	1,560	724	575	670	427
20	1,460	1,350	1,310	620	610	432
21	1,420	1,470	1,030	*814	570	505
22	1,410	1,480	960	688	550	a455
23	1,420	1,420	1,280	620	545	a425
24	1,470	1,460	1,200	555	500	a409
25	890	*1,430	1,030	530	*486	a400
26	772	1,380	2,960	515	463	a390
27	869	a1,360	*1,610	510	454	a382
28	932	1,370	1,220	505	445	a380
29	*754	------	a1,130	510	441	a378
30	742	------	1,030	515	436	a378
31	724	------	960	---	441	---
Mean Cs/mi	1,350	1,300	985	613	560	406
In Acre-ft	82,900	72,500	60,600	36,500	34,400	24,200

1969 Year: Mean Cs/sq mi Inches

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

Blank page retained for pagination

KALPANI RIVER NEAR RISALPUR

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Percent Silt	Percent Clay
9 Jan	1,570	53	69			
29 Jan	754	54	100			
14 Feb	1,670	56	127			
25 Feb	1,430	60	113			
10 Mar	640	75	128			
27 Mar	1,480	61	204			
12 Apr	646	75	265			
21 Apr	808	78	152			
25 May	486	83	83			

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.

KALAMAZOO RIVER NEAR KIMBERLY

Chemical Analysis of Water Samples - 1949

Date	Milliequivalents per Liter												Parts per Million				10×10^6 at 25°C	pH	Bas CO_3	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Sum Cations	Sum Anions	SiO_2	Fe	F	D.S. by Evap.			me/l	
Jan																				
9	1.84	1.18	0.68		0.36	2.70	0.39	0.27			3.62	3.72				204	390	8.3	0.04	0.5
29	2.70	1.98	2.50		0.54	4.77	0.59	1.18			7.18	7.08				419	660	8.3	0.63	1.5
Feb																				
14	1.48	1.14	2.45		0.58	3.38	0.59	0.85			5.07	4.80				280	480	8.4	1.34	1.9
Mar																				
10	1.42	1.62	2.70		0.39	3.72	0.69	0.98			5.74	5.78				318	530	8.3	1.07	2.2
27	0.77	2.07	2.00		0.39	3.13	0.58	0.84			4.84	4.94				284	450	8.3	0.68	1.8
Apr																				
12	1.03	1.96	2.68		0.37	3.59	0.59	1.15			5.61	5.70				324	530	8.3	0.97	2.1
21	1.41	1.84	2.52		0.59	3.77	0.57	1.04			5.77	5.93				328	540	8.4	1.07	2.0

INDUS RIVER AT MANDORI - 1969
(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 the confluence of Kabul River.

Drainage area 102,000 square miles.

Records available The daily discharge record (preliminary) from April 1868 to December 1961 with Surface Water Hydrology Project, record computed from rating curve based on float-measurements made in 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 from April 1868 to date in the office of Discharge Division, Hydrology Directorate of Irrigation and Power Department, Lahore.

Discharge measurements were made by current meter from a boat near Mandori village by Surface Water Hydrology Project starting July 1960 and daily discharge record available since January 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 16.6 inches runoff per year) for 92 years, 1869-1961, from preliminary computations by Tippette-Abbett-McCarthy-Stratton International Corp.

127,000 cusecs (92,000,000 acre-feet per year or 16.9 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 470,000 cusecs on 12 August (discharge estimated); minimum daily discharge 23,300 cusecs on 11 February.

1868-1969: 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 on 11 February 1967.

Gauge Staff gauge (enamelled plates) fixed on masonry pillars on right bank near Mandori village, read at one hour interval for the whole day. Gauge installed in late 1964. Servomanometer 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 - 1969
(About 5 miles Downstream from Attock Bridge)

Measurements Twenty eight discharge measurement were made by current meter using 0.2 and 0.8 depth method from a boat equipped with 40 H.P. outboard motor during the year. Twenty six sets of sediment samples were taken by depth integration method using D-49 sampler from boat. Ninteen of these were analysed for particle size distribution and rest for total concentration. Fifteen 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. The discharges for June, July, August were estimated in comparisan with discharges of Indus near Darband as the measurements made during these months were very poor.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	28,300	27,400	34,400	50,300	55,800	226,000
2	30,600	30,300	32,900	51,200	52,800	244,000
3	30,300	27,700	30,300	51,200	52,100	253,000
4	29,300	26,400	32,100	48,600	51,000	257,000
5	29,100	26,100	30,900	48,200	52,500	231,000
6	28,900	26,000	30,800	50,900	56,900	202,000
7	26,500	26,000	32,000	52,700	58,500	190,000
8	27,100	*25,200	31,800	56,200	70,700	196,000
9	27,600	24,900	33,400	61,400	*91,700	214,000
10	27,400	24,400	32,800	65,900	115,000	228,000
11	29,200	23,300	*34,800	77,200	123,000	235,000
12	28,300	24,000	37,200	99,100	117,000	242,000
13	27,700	26,600	37,100	112,000	120,000	238,000
14	*28,200	35,800	38,100	93,800	126,000	240,000
15	28,900	35,300	39,900	84,800	126,000	252,000
16	27,100	35,900	42,600	112,000	104,000	272,000
17	26,800	33,700	45,000	*129,000	87,800	298,000
18	27,600	33,300	47,000	112,000	85,000	327,000
19	27,300	33,700	61,400	89,100	88,000	348,000
20	26,700	30,000	85,700	83,100	86,400	361,000
21	27,400	*28,900	67,700	103,000	*87,300	390,000
22	27,000	28,000	58,500	104,000	92,600	365,000
23	26,600	26,600	57,400	87,900	105,000	329,000
24	26,200	27,000	56,600	76,400	113,000	292,000
25	*25,800	30,100	54,800	67,800	115,000	282,000
26	25,600	29,700	*90,300	63,700	120,000	283,000
27	33,700	30,100	92,100	61,800	129,000	290,000
28	32,400	36,400	70,900	60,500	142,000	304,000
29	28,900	------	59,400	69,200	165,000	312,000
30	27,700	------	55,500	65,000	189,000	302,000
31	26,600	------	50,200	------	214,000	------
Mean	28,100	29,000	48,500	76,300	103,000	273,000
Cs/mi	0.28	0.28	0.48	0.75	1.01	2.68
In	0.32	0.30	0.55	0.83	1.16	2.99
Maf	1.73	1.61	2.98	4.54	6.33	16.3

1969 Year: Mean 127,000 Cs/sq mi 1.25 Inches 16.8

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	286,000	259,000	180,000	66,200	50,100	32,300
2	290,000	264,000	183,000	66,800	47,200	*31,700
3	305,000	294,000	183,000	65,700	44,500	31,400
4	327,000	331,000	178,000	63,000	43,100	31,500
5	346,000	360,000	171,000	62,900	41,700	31,600
6	357,000	389,000	165,000	59,300	41,800	31,100
7	370,000	420,000	162,000	57,200	40,500	30,700
8	393,000	432,000	157,000	57,300	40,900	30,500
9	412,000	439,000	152,000	54,200	40,200	30,200
10	419,000	452,000	141,000	54,100	*39,200	30,500
11	414,000	462,000	*126,000	*55,000	39,100	30,100
12	399,000	458,000	115,000	62,200	39,300	30.400
13	386,000	435,000	110,000	58,800	40,900	30,500
14	395,000	420,000	116,000	61,600	39,400	30,500
15	403,000	406,000	134,000	58,500	38,600	29,500
16	404,000	391,000	134,000	59,300	37,200	29,200
17	390,000	376,000	121,000	57,400	36,300	28,200
18	364,000	382,000	105,000	52,500	36,100	28,300
19	356,000	386,000	*96,200	51,700	35,600	28,500
20	374,000	378,000	92,100	48,600	*35,500	27,600
21	398,000	244,000	90,000	46,400	35,200	28,200
22	419,000	289,000	86,200	44,800	34,800	28,100
23	434,000	241,000	83,300	43,400	34,800	27,900
24	455,000	210,000	79,700	41,900	34,400	27,700
25	463,000	183,000	77,400	41,700	34,000	27,300
26	460,000	191,000	74,300	40,700	33,000	27,100
27	435,000	185,000	*72,700	38,200	31,500	26,800
28	417,000	175,000	70,500	67,900	31,700	27,300
29	380,000	171,000	67,700	77,000	31,900	26,900
30	329,000	174,000	67,000	*70,200	31,900	*26,800
31	282,000	180,000	———	55,600	———	27,200
Mean	383,000	325,000	119,000	56,100	38,000	29,200
Cs/mi	3.75	3.19	1.17	0.55	0.37	0.29
In	4.32	3.67	1.31	0.63	0.42	0.33
Maf	23.5	20.0	7.12	3.45	2.26	1.80

M. Acre-feet. 91.6 Max Day 463,000 Min Day 23,300

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
14 Jan	28,200	48	128			
25 Jan	25,800	53	44			
8 Feb	24,800	50	130			
21 Feb	29,100	54	136			
11 Mar	36,700	66	451	36	44	20
26 Mar	117,000	57	1,780	37	50	13
17 Apr	132,000	65	1,550	50	34	16
9 May	94,500	70	520	53	44	3
21 May	88,400	70	602	49	34	17
11 Jun	235,000	62	2,240	61	29	10
30 Jun	302,000	64	987	45	46	9
11 Jul	414,000	68	1,600	22	58	20
18 Jul	364,000	67	2,630	44	41	15
28 Jul	417,000	59	4,330	24	57	19
3 Aug	294,000	64	4,330	71	22	7
8 Aug	432,000	63	2,520	27	54	19
20 Aug	378,000	64	3,560	32	53	15
29 Aug	171,000	66	1,520	40	45	15
11 Sep	127,000	68	1,270	31	43	26
19 Sep	97,200	64	1,430	73	16	11
27 Sep	73,800	66	853	60	21	19
11 Oct	55,800	65	627	41	42	17
30 Oct	70,000	65	2,870	18	68	14
10 Nov	39,300	62	258			
20 Nov	35,100	58	204			
2 Dec	31,900	48	241			

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

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 10^6 at 25^oC.	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	1.77	1.01	0.70		0.18	2.11	0.39	0.68			3.48	3.36				180	320	8.2	0	0.6
25	1.72	1.08	0.50		0.18	2.07	0.30	0.83			3.30	3.38				194	320	8.2	0	0.4
Feb																				
8	1.94	0.97	0.65		0.29	2.00	0.39	0.66			3.56	3.34				191	330	8.3	0	0.5
Mar																				
11	1.66	0.75	0.40		0.19	1.76	0.33	0.66			2.81	2.94				174	300	8.3	0	0.4
26	1.43	0.77	0.35		Traces	1.81	0.24	0.67			2.55	2.72				144	250	8.2	0	0.3
Apr																				
17	1.42	0.41	0.20		0	1.47	0.29	0.41			2.03	2.17				120	200	8.1	0	0.2
May																				
9	1.49	0.61	0.25		0	1.42	0.19	0.78			2.35	2.39				128	220	7.8	0	0.2
Jun																				
11	1.19	0.14	0.18		0	1.06	0.19	0.24			1.51	1.49				80	140	8.2	0	0.2
Jul																				
11	2.05	0.50	0.21		0	2.33	0.19	0.24			2.76	2.76				160	270	7.8	0	0.2
Aug																				
3	1.21	0.69	0.28		0	1.56	0.15	0.45			2.18	2.16				120	200	8.1	0	0.3
29	1.10	0.54	0.19		0	1.46	0.20	0.25			1.83	1.91				102	180	8.2	0	0.2
Sep																				
11	0.99	0.76	0.23		0	1.47	0.20	0.28			1.98	1.95				104	180	7.9	0	0.2
Oct																				
11	1.21	1.02	0.28		0	1.77	0.30	0.48			2.51	2.55				144	250	7.7	0	0.3
Nov																				
10	1.75	0.83	0.32		0	1.96	0.20	0.90			2.90	3.06				156	280	8.1	0	0.3
Dec																				
2	1.76	1.00	0.49		0	2.20	0.29	0.70			3.25	3.19				170	300	8.0	0	0.4

Blank page retained for pagination

Location Latitude 33°48', Longitude 72°54', on right bank one furlong upstream from taxila-Haripur Road bridge and 2½ miles south west of Khanpur.

Drainage area 300 square miles.

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

Average Discharge 296 cusecs (214,000 acre-feet per year or 13.4 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 17,700 cusecs on 28 October (gauge height 7.65 feet); minimum daily discharge 10 cusecs on 5 July.

1960-69: Maximum discharge 19,300 cusecs on 25 March 1967; minimum daily discharge 10 cusecs on 5 July 1969.

Gauge Enamelled gauge plates graduated to 0.1 foot fastened to masonry pillars, read to hundredths of a foot from 08:00 to 16:00 hours daily during low flow and more often during flood period. R.L of the gauge as per levelling in April 1969 is 1771.64.

Measurements One hundred and five discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 depth method by wading at low discharges and from bridge at medium and high discharges. Ninety five sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from the bridge. Twenty five 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 Low water rating affected by changes in heading of a small irrigation canal just downstream from gauge. Discharges were computed using ratings dated 9.5.62 and 2.10.65 from 1.1.69 to 12.8.69, 27.9.69 to 31.12.69 and 13.8.69 to 26.9.69 respectively, 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.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	47	510	179	373	100	85
2	45	172	172	347	80	83
3	43	137	161	322	54	95
4	50	125	154	316	50	80
5	56	*103	144	303	69	69
6	65	95	141	373	47	43
7	58	90	131	360	58	29
8	54	88	125	328	*69	19
9	49	88	117	322	45	23
10	45	88	111	309	95	41
11	45	85	*105	*303	65	39
12	41	83	111	292	93	49
13	*65	329	111	255	267	*21
14	73	506	134	206	255	27
15	56	282	137	198	198	30
16	52	237	141	176	141	30
17	52	328	141	151	125	36
18	41	261	151	*111	103	22
19	47	237	287	134	103	23
20	41	224	449	144	*90	73
21	47	215	277	179	93	27
22	26	*202	246	128	83	32
23	29	198	322	103	88	93
24	29	195	266	108	76	69
25	24	198	298	95	71	36
26	*32	187	608	131	49	50
27	111	a 189	360	117	52	23
28	78	191	322	120	56	*86
29	56	——	*282	241	47	67
30	50	——	261	137	65	54
31	38	——	266	——	90	—
Mean	50	202	216	223	93	49
Cs/mi	0.17	0.67	0.72	0.74	0.31	0.16
In.	0.19	0.70	0.83	0.83	0.36	0.18
Acre-ft.	3,060	11,200	13,600	13,300	5,710	2,880

1969 Year : Mean 160 Cs/sq mi 0.53 Inches 7.24

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	39	56	*117	41	215	39
2	18	*49	*101	*62	179	39
3	15	*41	220	113	*168	*39
4	*11	*228	*261	21	141	38
5	10	*90	160	*85	*130	*35
6	a 11	69	*137	49	120	35
7	*12	*558	*160	*41	*110	35
8	17	266	*144	*41	105	35
9	*155	*261	96	26	*95	33
10	128	*282	*104	*30	*85	33
11	76	*403	96	45	a 80	a 33
12	*35	*1,730	*92	*73	a 76	33
13	43	*798	89	67	a 73	*32
14	108	*537	*2,030	*120	a 71	30
15	*90	655	*521	83	a 70	29
16	45	*471	*208	*134	a 70	26
17	35	693	*160	67	a 74	26
18	*22	*989	101	*52	*77	*26
19	*22	*2,560	*101	47	65	24
20	26	378	*89	*35	67	*30
21	43	*305	*54	38	60	50
22	*220	301	80	*35	56	39
23	161	*261	*64	35	56	22
24	215	227	*42	*32	56	21
25	*158	*234	*84	27	*52	21
26	187	208	*94	*27	47	21
27	154	*176	*54	23	43	*21
28	274	153	45	*5,700	43	16
29	117	*137	*49	*766	38	16
30	83	147	*45	303	39	17
31	67	*131	—	*246	—	*29
Mean	84	432	187	273	85	30
Cs/mi	0.28	1.44	0.62	0.91	0.28	0.10
In	0.32	1.66	0.69	1.05	0.32	0.11
Acre-ft.	5,150	26,600	11,100	16,800	5,080	1,830

Acre-feet: 116,000 Max Day 5,700 Min Day 10

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 Jan	62	56	12			
26 Jan	35	60	6			
5 Feb	103	56	18			
22 Feb	202	58	36			
11 Mar	195	64	16			
29 Mar	282	72	156			
11 Apr	303	68	59			
18 Apr	111	72	95			
8 May	73	88	45			
20 May	90	70	49			
13 Jun	19	87	15			
28 Jun	98	83	1,650	5	69	26
2 Jul	14	78	40			
4 Jul	11	80	82			
7 Jul	11	86	23			
9 Jul	58		58			
9 Jul	108	88	1,790	4	66	30
9 Jul	544	80	26,300		37	63
12 Jul	26	91	58			
15 Jul	111	76	3,650	3	26	71
18 Jul	19	92	23			
19 Jul	26	92	90			
22 Jul	151	77	26,500	1	42	57
25 Jul	165	81	621	11	35	54
2 Aug	54	80	95			
3 Aug	39	88	94			
4 Aug	206	84	11,000		56	44
5 Aug	76	90	290			
7 Aug	725	78	27,100	2	54	44
9 Aug	282	82	2,550	5	35	60
10 Aug	316	87	4,710	1	54	45
11 Aug	525	86	7,580	2	37	61
12 Aug	737	76	4,780	6	75	19
13 Aug	682	78	5,540	2	50	48
14 Aug	415	79	3,600		62	38
16 Aug	420	87	4,100	1	37	62
18 Aug	548	90	2,190	5	44	51
19 Aug	4,480	73	21,600	1	67	32
22 Aug	346	76	1,060	8	55	37
23 Aug	268	76	2,410	1	49	50

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
25 Aug	227	86	270			
27 Aug	180	88	246			
27 Aug	117	85	244			
29 Aug	150	78	183			
31 Aug	137	79	146			
1 Sep	114	88	90			
4 Sep	242	74	27,100	2	48	50
6 Sep	123	79	63			
7 Sep	193	80	144			
8 Sep	126	83	1,280	1	19	80
8 Sep	131	87	64			
10 Sep	58	80	80			
12 Sep	94	77	31			
14 Sep	3,460	75	22,500	1	84	15
15 Sep	355	74	198			
16 Sep	208	73	257			
17 Sep	163	73	117			
19 Sep	128	73	73			
20 Sep	387	79	90			
21 Sep	62	72	153			
23 Sep	54	75	31			
24 Sep	52	75	29			
25 Sep	120	69	2,140	4	51	45
26 Sep	87	69	36			
27 Sep	52	82	71			
30 Sep	43	84	45			
2 Oct	137	76	151			
5 Oct	88	74	180			
6 Oct	21	80	76			
8 Oct	35	81	71			
10 Oct	32	78	79			
12 Oct	141	72	240			
14 Oct	266	78	1,900	3	22	75
16 Oct	187	69	178			
18 Oct	52	76	54			
20 Oct	41	76	69			
22 Oct	35	74	65			
24 Oct	32	75	44			
26 Oct	27	76	45			
28 Oct	12,000	53	32,600	8	81	11

HARO RIVER NEAR KHANPUR

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
29 Oct	573	66	2,280	2	59	39
31 Oct	183	71	256			
3 Nov	176	66	82			
5 Nov	130	71	78			
7 Nov	112	72	99			
9 Nov	95	72	80			
10 Nov	85	60	23			
25 Nov	52	59	89			
3 Dec	39	56	102			
5 Dec	35	61	51			
13 Dec	32	53	70			
18 Dec	26	58	77			
20 Dec	50	57	48			
27 Dec	21	54	88			
31 Dec	29	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.

HARO RIVER NEAR KHERPUR

Chemical Analysis of Water Samples - 1969

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 13	2.77	1.23	0.30		0.18	2.47	0.24	1.32			4.30	4.21				222	400	8.2	0	0.2
Feb 5	2.70	1.15	0.20		0.18	2.34	0.24	1.23			4.05	3.99				234	380	8.2	0	0.1
Mar 11	1.67	2.16	0.17		0.39	2.05	0.24	1.48			4.00	4.16				230	390	8.4	0	0.1
29	1.81	1.34	0.15		Traces	1.66	0.19	1.56			3.30	3.41				196	330	8.2	0	0.1
Apr 11	2.40	1.01	0.20		0.19	2.11	0.19	1.16			3.61	3.65				220	360	8.3	0	0.15
18	2.56	1.06	0.20		0.19	2.15	0.19	1.31			3.82	3.84				224	380	8.3	0	0.15
May 8	2.53	0.83	0.25		0	1.93	0.19	1.61			3.61	3.73				208	350	8.0	0	0.1
Jul 2	2.06	1.33	0.80		0	1.75	0.39	2.02			4.19	4.16				246	410	8.0	0	0.6
Aug 7	3.41	1.89	0.28		0	1.90	0.15	3.37			5.58	5.42				328	530	7.8	0	0.2
19	1.98	0.77	0.25		0	2.29	0.10	0.54			2.90	2.93				158	270	8.1	0	0.2
Sep 25	1.96	0.91	0.25		0	2.01	0.40	0.70			3.12	3.11				170	300	7.9	0	0.2
Oct 28	2.23	1.18	0.18		0	2.65	0.10	0.67			3.59	3.42				192	330	7.9	0	0.1
Nov 10	2.52	1.67	0.23		0	2.55	0.20	1.66			4.42	4.41				236	400	7.9	0	0.2
Dec 31	2.29	[illegible]	0.25		0	2.20	0.19	1.61			3.96	4.00				226	390	8.1	0	0.2

Blank page retained for pagination

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, WASID, WAPDA. Gauge height record and measurements 1959 to June 1962 by Hydrology Directorate of Irrigation and Power Department. Details of record obtained from old Irrigation Project Circle gauge, a quarter of a mile upstream from present gauge, not known.

Average discharge 600 cusecs (435,000 acre-feet per year or 11.7 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 37,400 cusecs on 12 August (gauge height 36.30 feet); minimum daily discharge 225 cusecs on 3 August.

1960-69: 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 4.5 to 37.0 feet on left bank and on angle iron from 36.0 to 46.0 on right bank, gauge read from 08:00 to 16:00 hours daily during low flow and more often during floods.

Measurements Sixty discharge measurements were made periodically by current meter using 0.2 and 0.8 depth method, by wading in low flows and from car on overhead cableway half a mile upstream from gauge in high flows. Fifty five sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from cableway. Fourteen 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 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 good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	309	*546	365	385	295	244
2	314	624	349	352	285	242
3	309	409	329	324	280	242
4	302	357	*316	302	276	242
5	305	326	302	293	274	*242
6	305	*314	291	291	270	241
7	*305	307	287	278	268	239
8	302	298	287	272	267	239
9	302	295	280	274	268	238
10	307	293	272	272	298	241
11	300	295	274	*268	289	239
12	295	293	*270	267	278	238
13	307	*441	272	274	486	*236
14	307	*920	268	270	655	*241
15	311	*628	272	291	*586	241
16	*300	506	272	300	409	238
17	302	431	274	283	344	241
18	293	520	283	*287	305	238
19	293	461	339	278	298	*238
20	298	428	*642	291	278	239
21	298	413	506	307	*256	236
22	295	400	451	289	259	236
23	*293	363	488	289	259	236
24	293	*355	435	272	258	244
25	293	368	409	270	*253	242
26	*291	365	1,680	270	248	239
27	302	516	*743	263	245	239
28	289	413	600	276	244	238
29	289	—	513	283	245	*239
30	289	—	461	311	244	238
31	298	—	422	—	242	—
Mean	300	424	424	289	305	240
Cs/mi	0.43	0.61	0.61	0.42	0.44	0.35
In	0.50	0.64	0.70	0.46	0.51	0.38
Acre-ft.	18,400	23,600	26,100	17,200	18,800	14,300

1969 Year: Mean 428 Cs/sq mi 0.62 Inches 8.35

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	285	238	329	235	448	256
2	298	*226	314	235	416	256
3	245	225	295	232	380	*258
4	247	*539	386	232	355	256
5	242	372	311	235	336	258
6	241	278	278	235	311	259
7	238	3,560	293	236	307	263
8	238	668	276	233	291	256
9	274	*425	267	235	285	258
10	*302	403	*263	*231	274	254
11	278	*1,230	256	231	*274	256
12	253	11,400	259	270	283	258
13	*248	*2,350	256	248	289	258
14	250	865	1,740	703	293	259
15	254	*1,160	1,510	357	276	259
16	*251	788	516	285	270	254
17	242	*738	383	259	267	261
18	*236	*3,670	*346	258	265	259
19	235	*5,020	305	253	270	259
20	233	1,100	287	250	272	*258
21	*236	*660	276	253	*267	256
22	286	*590	265	253	256	256
23	*293	544	265	248	261	256
24	721	*468	261	247	256	256
25	*397	*910	740	245	258	258
26	291	*1,090	*336	245	254	258
27	295	502	250	248	254	256
28	929	*431	242	*6,340	254	259
29	*428	400	239	1,880	253	254
30	270	377	236	774	251	254
31	245	352	—	537	—	*259
Mean	306	1,340	399	539	291	257
Cs/mi	0.44	1.93	0.57	0.78	0.42	0.37
In	0.51	2.22	0.64	0.89	0.47	0.43
Acre-ft.	18,800	82,500	23,800	33,200	17,300	15,800

Acre-feet: 310,000 Max Day 11,400 Min Day

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
7 Jan	311	60	19			
16 Jan	298	56	27			
23 Jan	298	58	10			
26 Jan	289	60	22			
1 Feb	355		37			
6 Feb	314	58	33			
14 Feb	860	53	681	2	42	56
15 Feb	628	60	290			
24 Feb	357		52			
4 Mar	311	56	11			
12 Mar	268	80	42			
20 Mar	1,090	66	3,500	1	54	45
27 Mar	788		2,140	1	42	57
11 Apr	265	71	16			
18 Apr	285	68	41			
15 May	583	70	163			
21 May	259	78	98			
25 May	258	79	39			
13 Jun	235	78	50			
14 Jun	239	90	42			
19 Jun	236	85	30			
25 Jun	244	90	29			
29 Jun	238	80	39			
10 Jul	355	90	20			
13 Jul	248	82	42			
16 Jul	251	92	24			
18 Jul	235	90	20			
21 Jul	233	82	25			
22 Jul	251	80	66			
25 Jul	406	83	818	31	40	29
29 Jul	336	85	1,680	9	40	51
2 Aug	225	88	146			
4 Aug	224	83	116			
9 Aug	422	80	384			
11 Aug	1,310	81	5,550	1	62	37
15 Aug	975	81	4,890	1	67	32
17 Aug	700	86	2,180	1	45	54
18 Aug	3,670	76	9,315	4	66	30
19 Aug	11,700	91	13,500	7	57	36
21 Aug	620	82	593	5	51	44

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
22 Aug	569	79	265			
24 Aug	451	82	151			
25 Aug	1,690	84	6,810	4	67	29
26 Aug	656	78	699	7	55	38
28 Aug	435	82	138			
10 Sep	261	89	46			
18 Sep	357	84	109			
26 Sep	319	75	147			
10 Oct	231	78	95			
28 Oct	6,270	61	12,400	2	66	32
6 Nov	311	70	50			
11 Nov	272	66	28			
21 Nov	268	62	17			
3 Dec	254	56	61			
20 Dec	258	55	48			
31 Dec	254	55	56			

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 SANJVAL

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				EC x 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																				
23	3.13	1.55	0.70		0.27	3.19	0.35	1.51			5.38	5.32				296	500	8.3	0	0.5
Feb																				
6	2.69	1.71	0.60		0.18	3.33	0.24	1.28			5.00	5.0				300	490	8.2	0	.4
Mar																				
4	2.16	1.48	0.70		0.29	2.98	0.39	0.64			4.34	4.30				232	400	8.3	0	0.5
27	2.51	0.90	0.32		0	2.45	0.24	1.10			3.73	3.79				220	370	7.9	0	0.2
Apr																				
11	2.23	1.56	0.63		0.39	2.60	0.29	1.17			4.42	4.45				264	440	8.3	0	0.5
12	2.66	1.49	0.68		0.19	2.94	0.34	1.34			4.83	4.81				292	480	8.3	0	0.5
May																				
15	1.26	2.10	0.50		0.17	1.89	0.24	1.71			3.86	4.01				220	380	8.3	0	0.4
Jun																				
5	1.95	1.77	0.70		0.19	1.90	0.39	2.09			4.42	4.57				260	440	8.3	0	0.5
Jul																				
10	1.76	1.58	1.00		0.19	2.33	0.29	1.55			4.34	4.36				240	420	8.3	0	0.8
Aug																				
4	2.75	1.76	0.90		0	4.05	0.10	1.19			5.41	5.34				296	500	7.3	0	0.6
9	2.03	1.47	0.71		0	2.75	0.30	1.11			4.21	4.16				240	400	7.8	0	0.5
18	1.71	0.46	0.36		0	2.08	0.20	0.36			2.53	2.64				144	250	8.1	0	0.4
25	2.38	0.96	0.70		0	2.29	0.30	1.40			4.04	3.99				232	390	8.2	0	0.5
Sep																				
18	1.10	2.40	0.70		0	2.25	0.30	1.68			4.20	4.23				236	400	8.1	0	0.5
Oct																				
10	1.87	1.95	0.68		Traces	2.94	0.30	1.52			4.50	4.76				268	450	7.9	0	0.5
28	1.94	0.77	0.20		0	2.26	0.10	0.42			2.91	2.78				156	270	7.8	0	0.2
Nov																				
11	2.03	2.39	0.85		0.20	3.53	0.30	1.22			5.27	5.85				296	500	9.3	0	0.6
Dec																				
3	2.80	1.61	0.69		0	3.20	0.19	1.71			5.10	5.10				272	470	8.2	0	0.5
20	2.24	1.93	0.70		0	3.00	0.29	1.61			4.87	4.90				278	480	8.2	0	0.5

Location Latitude 33°45', Longitude 72°15', about 1000 feet upstream of the bridge on Cambellpur - Basal Road, nearly 5 miles from Cambellpur.

Drainage area 1,180 square miles.

Record available Mean daily discharge record from January 1969 to date by Surface Water Hydrology Project, WASID, WAPDA. Periodic discharge measurements started 15 October 1968.

Extremes Maximum discharge during the year 46,000 cusecs on 12 August (gauge height 14.50); minimum daily discharge 230 cusecs on 21 June.

Gauge. Staff gauge (enamelled plates) installed in steps on right bank gauge read to hundredth of a foot from 08:00 to 16:00 hours daily during low flow and more often during floods; zero R.L. of gauge 887.31 as per levelling carried out in March 1969.

Measurements Ninety discharge measurements were made during the year by current meter using 0.2 and 0.8 depth method. Low flow measurements were made by wading and the high flow measurements were made from a cableway about 250 upstream from the gauge. Eighty three sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading and D-49 sampler from the cableway. Twenty one 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 The river bed is liable to shifting. Rating table dated 31.12.69 was developed from the available measurements. This table was used to compute mean daily discharge with shift adjustments as indicated necessary by the periodic discharge measurements.

Remarks Record good.

HARO RIVER AT GARIALA

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	360	418	452	*418	360	261
2	360	800	418	392	308	268
3	353	505	392	360	287	255
4	375	*418	368	338	281	268
5	368	384	353	315	274	255
6	368	*368	*345	315	274	255
7	*375	353	330	294	*268	*255
8	368	345	323	280	268	255
9	368	345	*315	287	268	248
10	368	*330	308	*280	300	248
11	368	338	308	280	294	248
12	368	*323	308	308	287	*248
13	368	505	300	308	730	248
14	368	1,180	300	294	2,160	242
15	368	752	287	300	1,380	242
16	368	631	287	315	*559	242
17	384	622	*287	*308	435	242
18	384	586	294	294	360	242
19	392	532	401	294	345	242
20	360	496	1,270	300	*323	248
21	*338	478	604	323	315	230
22	338	452	505	338	294	235
23	338	426	740	*300	287	*242
24	338	*409	*577	287	*281	261
25	368	418	496	280	281	255
26	368	409	2,210	280	274	248
27	368	700	1,130	280	268	242
28	*368	541	776	280	*268	235
28	375	---	443	287	261	*242
30	375	---	426	*294	268	242
31	360	---	409	---	261	---
Mean	365	502	515	308	414	248
Cs/mi	0.31	0.43	0.44	0.26	0.35	0.21
In	0.36	0.44	0.50	0.29	0.40	0.23
Acre-ft.	22,500	27,900	31,700	18,300	25,400	14,800

1969 Year: Mean 562 Cs/sq mi 0.48 Inches 6.44

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*255	287	*345	248	622	274
2	*409	*300	323	*338	487	281
3	287	274	*308	281	452	*281
4	268	465	*360	255	435	281
5	*255	*473	345	255	409	281
6	255	248	*281	255	401	274
7	248	6,050	315	242	375	274
8	242	1,730	*287	242	353	281
9	274	514	268	242	338	287
10	*496	*443	*281	*242	323	287
11	478	*1,240	255	235	*315	a 284
12	330	*17,000	*248	437	*360	281
13	294	*4,880	248	401	345	281
14	*281	*1,310	*2,280	1,350	384	281
15	287	*2,140	*2,810	650	353	*274
16	287	*1,010	905	505	338	274
17	*268	902	*487	384	*330	268
18	255	*10,400	*401	338	330	268
19	255	*6,800	353	330	325	268
20	*248	1,690	*323	308	330	268
21	1,750	*788	300	294	315	274
22	*934	660	*281	294	*330	*268
23	287	622	274	287	300	268
24	*1,850	*541	*268	287	294	274
25	523	*832	592	274	287	274
26	287	*3,240	*469	274	287	274
27	287	*740	294	281	281	274
28	774	*541	*274	5,570	281	274
29	469	*452	268	*2,830	*274	281
30	315	409	*261	874	274	*268
31	287	*384	---	613	---	274
Mean	443	2,170	490	626	350	276
Cs/mi	0.38	1.84	0.42	0.53	0.30	0.23
In	0.43	2.12	0.46	0.61	0.33	0.27
Acre-ft.	27,200	134,000	29,200	38,500	20,800	17,000

Acre-feet: 407,000 Max Day 17,000 Min Day 230

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
7 Jan	360		10			
21 Jan	330	55	9			
28 Jan	368		47			
4 Feb	418		103			
6 Feb	368	66	33			
10 Feb	323		59			
12 Feb	330	60	20			
24 Feb	418	65	33			
6 Mar	353	70	12			
9 Mar	315	72	25			
17 Mar	281	72	18			
24 Mar	577	76	169			
1 Apr	409	80	61			
10 Apr	287	66	6			
17 Apr	308	60	15			
23 Apr	308	60	12			
30 Apr	255	70	10			
7 May	268	80	30			
16 May	496	80	160			
20 May	330	86	41			
24 May	287	82	22			
28 May	274	84	39			
7 Jun	255	82	79			
12 Jun	248	80	56			
23 Jun	242	83	135			
29 Jun	248	88	22			
1 Jul	308	85	188			
2 Jul	435	84	142			
5 Jul	248	92	167			
10 Jul	435	84	59			
14 Jul	287	83	59			
17 Jul	268	92	59			
20 Jul	248	91	23			
22 Jul	812	84	4,660	11	70	19
24 Jul	2,060	82	3,950	28	68	4
2 Aug	294	97	142			
5 Aug	401	96	2,790	2	37	61
8 Aug	1,210	85	4,490	4	48	48
10 Aug	418	90	286			
11 Aug	2,850	84	16,000	2	60	38

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Aug	34,300	78	14,000	7	68	25
13 Aug	4,720	80	20,900	3	42	55
14 Aug	1,170	83	2,530	1	62	37
15 Aug	1,490	82	2,280	3	42	55
16 Aug	972	83	4,200	2	32	66
18 Aug	21,500	80	7,080	6	73	21
19 Aug	3,860	82	6,950	3	45	52
21 Aug	800	82	1,950	7	61	32
24 Aug	550	86	394			
26 Aug	8,150	78	8,830	6	60	34
27 Aug	650	84	625	9	49	42
28 Aug	505	90	303			
29 Aug	435	92	144			
31 Aug	375	89	109			
1 Sep	330	90	99			
3 Sep	308	92	96			
4 Sep	505	90	167			
8 Sep	287	90	61			
10 Sep	248	93	71			
12 Sep	235	93	31			
14 Sep	2,580		5,570	13	68	19
15 Sep	2,380		8,110	3	86	11
15 Sep	2,670		6,100	2	61	37
17 Sep	443		676	1	32	67
18 Sep	392	82	130			
20 Sep	323	84	71			
22 Sep	268	80	95			
24 Sep	261	78	77			
26 Sep	452	76	6,440	1	45	54
28 Sep	274	76	162			
30 Sep	248	79	87			
2 Oct	384	84	241			
10 Oct	242	82	94			
29 Oct	2,020	68	17,700	1	66	33
11 Nov	300	67	8			
12 Nov	353	64	54			
17 Nov	338	64	12			
22 Nov	300	58	8			
29 Nov	274	54	58			
3 Dec	281	62	80			

HARO RIVER AT GARIALA

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Dec	274	56	58			
22 Dec	268	55	107			
30 Dec	268	58	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.

HARD RIVER AT GARIALA

Chemical Analysis of Water Samples - 1969

	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																				
7	2.86	1.71	0.75		0.36	3.24	0.39	1.37			5.32	5.36				294	500	8.3	0	0.5
Feb																				
6	1.79	1.43	0.89		0.19	2.64	0.47	0.97			4.11	4.27				230	400	8.3	0	0.7
10	2.20	1.23	0.89		0.29	2.74	0.49	0.93			4.32	4.45				240	400	8.3	0	0.7
12	2.00	1.44	0.89		0.39	2.69	0.44	0.94			4.33	4.26				244	400	8.4	0	0.7
Mar																				
6	2.27	1.42	0.80		0.39	2.69	0.40	0.82			4.49	4.30				232	400	8.4	0	0.6
9	1.25	2.48	0.80		0.19	2.55	0.39	1.42			4.53	4.55				264	450	8.3	0	0.6
24	2.40	1.38	0.80		0.39	2.35	0.49	1.41			4.58	4.64				272	460	8.3	0	0.6
Apr																				
10	2.40	1.48	0.68		0.19	2.79	0.39	1.26			4.56	4.63				268	450	8.3	0	0.5
23	2.70	1.39	0.75		0.27	2.43	0.31	1.92			4.84	4.93				264	450	8.3	0	0.5
May																				
16	0.88	2.53	0.60		0.17	2.11	0.39	1.39			4.01	4.06				232	400	8.2	0	0.5
Jun																				
23	1.71	1.73	0.80		0.19	1.85	0.39	1.88			4.24	4.31				236	410	8.3	0	0.6
Jul																				
2	1.88	1.82	1.18		0.29	2.18	0.19	2.17			4.88	4.83				264	450	8.4	0	0.9
Aug																				
5	1.59	0.85	0.56		0	2.02	0.30	0.70			3.00	3.02				164	290	7.9	0	0.4
Sep																				
14	1.98	1.04	0.78		0	2.70	0.50	0.52			3.80	3.72				200	350	7.7	0	0.6
Oct																				
10	1.71	2.11	0.68		0	2.75	0.30	1.46			4.50	4.51				264	450	7.9	0	0.5
29	1.94	1.37	0.23		0	2.26	0.20	0.96			3.54	3.42				188	330	7.9	0	0.2
Nov																				
11	1.75	2.30	0.68		0	2.85	0.20	1.66			4.73	4.71				264	450	8.2	0	0.5

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, WASID, WAPDA. Record 1959 to June 1962 by Hydrology Directorate of Irrigation and Power Department.

Average discharge 146 cusecs (106,000 acre-feet per year or 15.7 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during the year 13,600 cusecs on 17 August (gauge height 9.10 feet); minimum daily discharge 0.8 cusecs on 26-28 December.

1960-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Zero of gauge datum is at R.L. 1845.75 (checked in 1969).

Measurements Thirty three 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 were taken by depth integration method using DH-48 sampler by wading and D-49 sampler from bridge. Twelve 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 dated 3.1.70 was used to compute discharges. Shift adjustments were applied as determined by periodical discharge measurements.

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

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	16	944	40	45	31	6.4
2	15	81	38	41	*25	5.4
3	14	39	35	39	21	5.0
4	13	32	*32	36	17	4.2
5	13	*27	31	35	16	4.0
6	12	26	30	33	15	3.8
7	10	21	29	30	16	*3.6
8	11	18	28	25	13	2.6
9	*11	17	27	24	10	2.4
10	9.2	20	26	20	11	2.2
11	8.0	18	25	20	12	2.2
12	7.8	17	24	*24	36	2.0
13	18	19	24	23	98	1.6
14	13	120	23	20	72	1.8
15	17	93	22	18	63	2.0
16	13	81	21	18	33	3.2
17	8.9	138	20	18	24	2.4
18	7.6	88	19	16	21	1.4
19	7.6	70	53	15	19	2.0
20	7.6	62	126	16	*20	11
21	5.8	56	48	34	18	12
22	5.8	52	38	26	16	8.3
23	5.2	48	155	17	15	*11
24	*5.0	46	82	14	15	8.0
25	4.8	*50	110	12	13	6.2
26	4.6	45	237	11	10	4.8
27	6.2	a 43	*108	10	9.5	3.2
28	7.8	a 42	75	9.5	7.6	2.0
29	7.0	——	57	233	7.0	1.2
30	7.2	——	57	46	6.8	2.2
31	6.8	——	51	——	6.8	——
Mean	9.7	83	55	31	23	4.3
Cs/sq	0.08	0.65	0.44	0.25	0.18	0.03
In	0.09	0.68	0.50	0.27	0.21	0.04
Acre-ft.	595	4,590	3,350	1,840	1,380	254

1969 Year: Mean 58 Cs/sq mi 0.46 Inches 6.21

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	2.4	25	*22	6.0	*19	*3.2
2	1.8	16	21	5.8	15	3.4
3	1.6	11	20	5.4	14	3.2
4	2.8	7.6	*19	5.6	12	3.8
5	2.8	*5.4	17	5.8	11	3.4
6	2.4	390	165	5.8	10	3.2
7	2.8	109	*110	5.8	9.2	3.0
8	3.8	100	64	5.0	8.6	3.2
9	147	320	49	4.4	8.0	3.2
10	49	102	43	3.8	7.2	3.2
11	26	*417	41	3.6	6.8	3.0
12	13	978	39	19	6.8	3.2
13	13	152	38	23	6.8	3.2
14	209	68	484	*58	9.8	2.8
15	44	*184	*152	108	8.9	3.2
16	21	82	63	48	7.4	2.4
17	*14	1,620	39	38	7.0	2.4
18	7.2	*403	30	27	6.0	1.6
19	6.0	360	24	23	5.2	1.4
20	4.8	122	19	18	5.4	1.4
21	42	728	15	15	5.4	1.4
22	33	415	*11	12	5.6	*1.2
23	15	81	9.2	10	4.8	1.2
24	771	59	7.6	8.9	4.4	1.0
25	341	98	6.6	7.4	*4.4	1.0
26	185	75	7.2	6.2	4.2	0.8
27	671	42	7.6	5.2	4.0	0.8
28	*1,130	34	6.4	1,470	3.6	0.8
29	*79	31	6.4	205	3.4	1.6
30	42	28	6.0	35	3.2	1.8
31	32	25	——	26	——	2.2
Mean	126	229	51	68	6.9	2.3
Cs/mi	1.00	1.82	0.41	0.54	0.05	0.02
In	1.16	2.09	0.45	0.63	0.07	0.02
Acre-ft.	7,770	14,100	3,060	4,200	450	141

Acre-feet. 41,700 Max Day 1,520 Min Day 0.8

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Jan	11	50	35			
24 Jan	5.0	54	273			
5 Feb	27	47	107			
25 Feb	49	52	22			
4 Mar	32	65	11			
27 Mar	108	66	790	3	27	70
12 Apr	24	72	15			
26 Apr	11	70	30			
2 May	24	77	254	2	8	90
20 May	20	70	47			
7 Jun	2.4	80	25			
23 Jun	12	74	165			
17 Jul	15	74	630	12	19	69
24 Jul	786	78	3,560	9	46	45
28 Jul	670	76	7,460	8	48	44
29 Jul	75	80	1,490	2	19	79
11 Aug	894	84	1,940	2	74	24
15 Aug	179	78	603	1	22	77
19 Aug	242	82	2,880	1	23	76
1 Sep	21	87	30			
4 Sep	19	75	21			
7 Sep	97	76	1,080	4	34	62
15 Sep	124	74	1,570	1	13	86
22 Sep	11	84	115			
25 Sep	6.8	72	64			
27 Sep	7.2	80	41			
28 Sep	6.2	72	47			
14 Oct	33	77	163			
27 Oct	5.2	72	73			
1 Nov	16	72	1,050	1	8	91
25 Nov	4.4	56	22			
27 Dec	1.2	51	52			

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 CHIRAN

Chemical Analysis of Water Samples - 1969

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 $25^\circ C$	pH	Res CO_3 me/l	SAR
	Millieqivalents per Litre												Parts per Million							
Jan 9	1.66	1.01	0.90		0.18	2.88	0.29	0.25			3.57	3.60				178	330	8.2	0.39	0.2
Feb 5	1.45	0.42	0.40		0	2.02	0.17	0.11			2.27	2.30				130	210	7.9	0.15	0.4
25	1.41	0.78	0.70		0.49	2.00	0.14	0.21			2.89	2.84				152	270	8.4	0.30	0.7
Mar 4	1.51	1.08	0.80		0.49	2.29	0.29	0.35			3.40	3.42				172	310	8.3	0.18	0.7
27	0.99	0.90	0.19		Traces	1.81	0.19	0.15			2.08	2.15				116	200	8.2	0	0.2
Apr 12	1.57	0.79	0.74		0.39	2.25	0.29	0.32			3.10	3.25				176	300	8.3	0.28	0.7
May 2	1.47	0.73	0.41		0.18	1.84	0.19	0.43			2.61	2.64				136	240	8.3	0	0.4
Jun 23	1.49	0.95	0.91		0.29	2.53	0.19	0.26			3.35	3.27				170	300	8.4	0.38	0.8
Jul 17	0.99	1.11	1.68		0.31	2.49	0.70	0.26			3.80	3.76				204	350	8.4	0.68	1.7
Aug 5	1.25	0.97	0.42		0.20	2.28	0.15	0.12			2.64	2.75				144	250	8.3	0.26	0.4
11	1.87	0.73	0.79		0	2.81	0.40	0.15			3.39	3.36				176	310	7.8	0.21	0.7
Sep 7	1.38	1.01	0.78		0.19	2.65	0.20	0.08			3.17	3.12				168	290	8.3	0.45	0.7
Oct 14	1.21	1.33	0.87		0.20	2.85	0.30	0.19			3.41	3.54				180	330	8.3	0.51	0.8
Nov 1	1.31	0.85	0.32		0	2.26	0.20	0.05			2.48	2.51				132	230	8.2	0.10	0.3
Dec 22	1.57	1.32	0.93		0.20	3.20	0.19	0.21			3.82	3.80				200	350	8.3	0.51	0.8

Blank page retained for pagination

Location Latitude 33°36', Longitude 73°22', on Sihala-Azad Pattan Road bridge, ¾ mile west of Kahuta and 18 miles east of Rawalpindi.

Drainage area 56 square miles.

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

Average discharge 60 cusecs (43,100 acre-feet per year or 14.4 inches runoff per year). Average taken for 8 years from 1962 to 1969.

Extremes Maximum discharge observed during the year 12,400 cusecs on 17 August (gauge height 10.80 feet) from rating curve extended above 3,000 cusecs by velocity-area and conveyance studies; minimum daily discharge zero cusecs on 11-12 June.

July 1961-1969: Maximum discharge observed 24,300 cusecs on 15 July 1964, (high water measurement of unknown date at 18.0 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 from 08:00 to 16:00 hours daily during low flow and more often during flood season. Zero R.L. of wire-weight gauge 1854.01.

Measurements One hundred and two 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. One hundred sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from the bridge. Twelve 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 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	*3.4	*530	19	*10	21	2.6
2	*4.5	43	14	9.2	15	1.8
3	5.0	*19	*12	7.4	10	*2.2
4	*5.5	12	8.0	6.5	8.0	1.4
5	5.0	9.5	8.6	*5.0	*7.4	*1.6
6	4.3	8.3	8.0	5.0	4.8	3.0
7	3.0	7.4	6.5	4.3	4.3	*6.0
8	*4.5	*5.8	*5.3	*4.0	*3.8	7.7
9	4.5	4.5	5.3	3.8	2.8	0.4
10	5.0	4.5	5.0	3.8	2.0	*0.5
11	*5.0	3.4	*4.5	*3.6	2.8	0
12	3.0	*3.0	3.6	3.6	*51	0
13	1.3	6.0	3.0	3.6	*98	*0.1
14	*3.0	*59	3.8	*3.4	102	0.2
15	12	39	*2.2	3.2	48	0.2
16	6.8	32	1.6	2.2	*20	*0.4
17	5.3	*104	1.4	1.8	13	*3.8
18	*3.6	43	2.2	1.6	9.9	1.0
19	2.8	24	*32	1.5	8.6	0.7
20	1.5	18	18	2.4	*6.8	1.2
21	1.5	13	14	30	*7.4	0.9
22	2.0	*11	*6.6	21	5.3	0.9
23	1.1	11	*42	10	4.0	4.0
24	2.0	*11	23	6.0	*3.6	13
25	*1.6	10	88	*4.8	3.6	12
26	1.3	*18	*137	3.0	3.4	5.0
27	3.0	21	*21	*3.8	*3.4	4.0
28	*3.0	23	16	1.9	3.6	3.2
29	15	——	14	*338	2.8	2.6
30	11	——	12	38	3.2	3.0
31	6.8	——	11	——	*2.8	——
Mean	4.4	39	18	18	16	28
Cs/mi	0.08	0.70	0.32	0.32	0.29	0.50
In	0.09	0.73	0.37	0.36	0.32	0.55
Acre-ft.	272	2,170	1,090	1,080	957	1,650

1969 Year: Mean 38 Cs/sq mi 0.67 Inches 9.12

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	1.7	18	*21	*6.0	6.3	1.7
2	8.6	18	21	5.5	4.5	*1.4
3	10	17	21	5.3	*4.8	1.3
4	5.0	54	*26	5.0	3.6	1.0
5	3.6	22	21	5.3	4.0	1.0
6	1.5	*227	*24	11	3.4	1.7
7	8.8	*251	*75	8.0	3.2	1.5
8	16	87	43	6.8	3.0	1.3
9	169	113	*55	6.3	3.0	2.0
10	71	84	23	4.5	2.6	1.9
11	28	*452	*22	3.8	2.6	a 2.5
12	13	*130	21	7.4	2.6	3.0
13	7.1	*56	20	6.0	2.4	1.8
14	1,000	*30	*32	36	2.2	2.6
15	32	*89	*104	*56	2.6	2.6
16	8.6	70	*42	20	2.2	1.2
17	6.0	*1,810	25	12	2.4	0.5
18	*4.5	*812	*20	8.3	2.4	0.9
19	6.8	*305	15	6.8	3.0	1.3
20	61	*64	*9.9	6.0	3.0	1.9
21	108	83	9.2	5.3	2.6	0.7
22	*35	*249	*8.9	3.8	2.4	0.9
23	15	*47	*7.4	4.8	2.4	0.9
24	*490	*40	7.1	3.6	3.4	0.5
25	46	44	*6.8	*3.4	*3.2	1.8
26	49	*52	6.8	3.2	2.8	0.8
27	882	22	*6.5	3.4	1.8	*2.0
28	*200	*16	6.5	201	1.9	1.4
29	41	*15	6.3	60	1.4	1.7
30	24	*13	*6.0	38	2.0	1.2
31	21	13	—	11	—	0.6
Mean	109	171	24	18	2.9	1.5
Cs/mi	1.95	3.05	0.43	0.32	0.05	0.03
In	2.24	3.52	0.47	0.38	0.06	0.03
Acre-ft.	6,690	10,500	1,410	1,120	174	90

Acre-feet: 27,200 Max Day 1,810 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Jan	3.4	54	15			
2 Jan	3.4	54	19			
4 Jan	2.8	54	8			
8 Jan	2.8	54	8			
11 Jan	6.0	51	5			
14 Jan	4.5	52	11			
18 Jan	3.6	52	35			
22 Jan	2.0	56	6			
25 Jan	2.0	54	18			
28 Jan	5.0	56	10			
1 Feb	187	52	288			
3 Feb	17	54	112			
8 Feb	5.8	56	42			
12 Feb	3.4	56	22			
14 Feb	87		160			
17 Feb	117	58	106			
22 Feb	9.9	54	37			
24 Feb	11	51	31			
26 Feb	19	54	10			
3 Mar	12	64	12			
8 Mar	5.0	63	18			
11 Mar	4.3	64	17			
15 Mar	2.2	65	10			
19 Mar	46	60	115			
22 Mar	8.9	57	24			
23 Mar	66	59	48			
26 Mar	205	65	748	1	49	50
27 Mar	20	60	126			
1 Apr	9.9	69	37			
5 Apr	5.0	67	8			
8 Apr	4.0	70	17			
11 Apr	3.6	71	32			
14 Apr	3.4	72	12			
25 Apr	4.8	65	18			
27 Apr	3.0	66	11			
29 Apr	725	55	1,250	2	57	41
30 Apr	32	60	122			
5 May	7.1	67	30			
7 May	3.4	76	25			
12 May	96	68	121			

LING RIVER NEAR KAHUTA

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
13 May	179	66	603	2	24	74
16 May	17	69	93			
20 May	7.7	67	28			
21 May	6.5	86	48			
24 May	4.0	80	31			
27 May	3.4	70	52			
31 May	1.8	75	21			
3 Jun	3.4	80	56			
5 Jun	1.4	83	54			
7 Jun	7.1	68	22			
10 Jun	0.6	74	29			
13 Jun	0.1	79	11			
16 Jun	0.2	88	27			
17 Jun	3.8	84	17			
1 Jul	2.2	86	45			
18 Jul	5.0	78	58			
22 Jul	20	76	141			
24 Jul	220	72	706	12	36	52
28 Jul	139	80	482	9	33	58
6 Aug	189	85	2,750	6	72	22
7 Aug	725	80	1,170	2	40	58
11 Aug	320	84	295			
12 Aug	155	80	679	2	50	48
13 Aug	46	84	123			
14 Aug	32	88	52			
15 Aug	27	89	96			
17 Aug	3,180	75	3,360	4	76	20
18 Aug	1,170	76	1,420	5	46	49
19 Aug	287	85	227			
19 Aug	311	80	101			
20 Aug	58	79	42			
22 Aug	499	78	1,230	2	38	60
23 Aug	51	72	277			
24 Aug	38	84	327			
26 Aug	101	78	80			
28 Aug	16	85	6			
29 Aug	15	83	81			
30 Aug	14	78	32			
1 Sep	21	85	19			
2 Sep	21	84	14			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
4 Sep	29	82	33			
6 Sep	37	80	66			
7 Sep	145	84	267			
9 Sep	165	78	1,400	2	50	48
11 Sep	20	82	62			
14 Sep	21	82	45			
15 Sep	203	69	290			
16 Sep	37	78	127			
20 Sep	10	79	127			
23 Sep	7.4	68	53			
25 Sep	6.8	80	29			
27 Sep	6.5	74	19			
30 Sep	5.8	75	62			
1 Oct	6.0	80	80			
15 Oct	68	60	196			
25 Oct	2.8	75	70			
3 Nov	4.5	72	55			
25 Nov	3.2	60	24			
2 Dec	1.2	58	70			
22 Dec	1.8	53	79			

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.

LIKU RIVER NEAR KAMUTA

Chemical Analysis of Water Samples - 1969

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 me/l	SAR
	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION							
Jan																				
18	1.72	0.51	0.30		0.27	1.57	0.20	0.60			2.73	2.64				154	260	8.2	0	0.5
25	1.62	0.98	0.70		0.27	2.44	0.28	0.21			3.30	3.20				174	300	8.2	0.11	0.6
Feb																				
1	1.40	0.16	0.08		0	1.35	0.11	0.24			1.64	1.70				92	160	7.7	0	0.1
14	1.08	0.26	0.14		0	1.17	0.17	0.09			1.48	1.43				80	140	7.7	0	0.8
24	1.89	0.39	0.61		0.39	2.30	0.22	0.16			2.89	3.07				160	280	8.3	0.41	0.6
Mar																				
11	1.65	0.55	0.50		0.29	1.71	0.29	0.29			2.70	2.58				140	250	8.4	0	0.4
19	1.32	0.73	0.63		0.29	1.73	0.29	0.40			2.68	2.71				142	250	8.4	0	0.6
23	1.58	0.52	0.40		0.39	1.61	0.19	0.23			2.50	2.42				132	230	8.3	0.20	0.4
26	1.10	0.47	0.10		0	1.42	0.14	0.20			1.67	1.76				92	160	8.1	0	0.1
Apr																				
14	1.78	0.53	0.60		0.36	2.11	0.20	0.37			2.91	3.04				168	290	8.3	0	0.6
27	1.53	0.46	0.69		0.18	2.15	0.14	0.29			2.68	2.76				144	250	8.2	0.34	0.7
29	1.58	0.36	0.17		0	1.70	0.14	0.32			2.11	2.16				116	200	7.9	0	0.2
30	0.92	0.49	0.11		0	1.10	0.19	0.25			1.52	1.54				88	150	7.6	0	0.1
May																				
13	1.21	0.47	0.30		0.26	1.45	0.09	0.25			1.98	2.05				112	190	8.3	0.03	0.3
27	1.42	0.80	0.21		0.19	1.36	0.29	0.50			2.43	2.34				130	230	8.2	0	0.2
Jun																				
10	1.20	0.57	0.80		0.19	1.33	0.29	0.82			2.57	2.63				144	250	8.3	0	0.9
Jul																				
18	0.93	0.87	0.32		0	2.02	0.15	0.13			2.12	2.30				116	210	8.0	0.22	0.3
Aug																				
6	1.32	0.48	0.42		0	2.02	0.15	0.06			2.22	2.23				124	210	7.9	0.22	0.4
Sep																				
15	1.04	1.40	0.78		0	2.84	0.30	0.30			3.22	3.44				176	310	7.4	0.40	0.7
Oct																				
15	1.10	1.07	0.87		0	2.75	0.20	0.06			3.04	3.01				160	280	8.1	0.58	0.8
Nov																				
3	1.94	0.54	0.32		0	2.45	0.20	0.16			2.80	2.81				146	260	7.8	0	0.3
Dec																				
22	1.57	1.21	0.84		0	3.25	0.19	0.15			3.62	3.59				188	330	8.2	0.47	0.7

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, WASID, 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 653 cusecs (473,000 acre-feet per year or 13.7 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 49,500 cusecs on 19 August (gauge height 14.95 feet); minimum daily discharge 64 cusecs on 7 July.

1953-69: 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 end 0.1 foot beyond, read from 08:00 to 16:00 hours daily during low flow and often during flood. Zero of gauge datum is at R.L. 1,375.19 (checked in 1969).

Measurements Thirty five discharge measurements were made periodically by current meter using 0.2 and 0.8 or 0.6 depth method, 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 integration method using DH-48 sampler by wading and D-49 sampler from bridge. Eleven 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 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	145	*3,050	150	135	219	61
2	130	855	143	125	138	61
3	135	288	*130	121	113	60
4	128	178	128	109	95	60
5	125	160	119	105	86	*60
6	125	133	117	102	86	60
7	128	123	113	98	*84	61
8	125	111	107	96	87	61
9	*121	104	105	95	83	60
10	117	104	102	93	92	61
11	119	105	98	95	88	65
12	119	105	95	96	199	66
13	119	178	96	98	292	64
14	130	776	95	101	487	64
15	135	385	96	*104	590	64
16	130	237	96	102	264	64
17	138	492	96	99	165	64
18	130	374	95	90	148	62
19	125	237	119	90	119	63
20	119	216	403	101	*104	63
21	119	170	272	109	96	58
22	121	165	268	209	89	59
23	*121	153	268	170	83	*86
24	121	148	a 245	105	81	96
25	121	*153	223	98	77	89
26	121	155	1,450	*90	74	84
27	121	a 153	705	92	74	83
28	115	a 152	*272	98	68	78
29	111	—	a 253	906	65	73
30	111	—	233	476	65	72
31	115	—	160	—	64	—
Mean	124	338	221	147	141	67
Cs/mi	0.19	0.52	0.34	0.23	0.22	0.10
In	0.22	0.54	0.39	0.25	0.25	0.12
Acre-feet	7,620	18,800	13,600	8,740	8,680	4,010

1969 Year: Mean 330 Cs/sq mi 0.51 Inches 6.88

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	83	107	145	87	135	75
2	75	96	135	87	123	*74
3	69	89	133	92	111	74
4	69	109	379	86	101	72
5	65	115	165	93	96	72
6	66	*709	522	89	96	74
7	63	*1,550	*586	80	95	74
8	64	489	256	77	*90	73
9	63	1,190	264	81	86	77
10	657	371	317	83	84	74
11	216	2,770	155	81	80	a 74
12	145	11,200	123	395	90	74
13	109	*1,300	115	128	90	73
14	1,380	356	310	*209	90	77
15	795	310	3,060	321	86	78
16	190	650	484	264	93	75
17	*125	5,170	226	181	87	74
18	98	1,360	170	133	87	*74
19	86	*12,000	143	113	84	74
20	146	*1,260	130	105	80	73
21	*2,210	324	117	96	86	74
22	1,010	3,130	113	95	83	73
23	*233	369	107	90	87	73
24	2,990	173	107	84	80	74
25	651	*470	*105	81	*80	75
26	583	1,360	102	75	80	73
27	925	324	101	*73	75	72
28	1,940	226	*98	a 4,500	72	73
29	581	184	99	a 2,200	71	72
30	199	168	77	1,120	77	74
31	140	155	—	216	—	73
Mean	517	1,550	295	368	89	74
Cs/mi	0.80	2.38	0.45	0.57	0.14	0.11
In	0.92	2.75	0.51	0.65	0.15	0.13
Acre-feet	31,800	95,400	17,500	22,600	5,310	4,540

Acre-feet: 239,000 Max Day 12,000 Min Day 58

Suspended Sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Jan	117	54	46			
23 Jan	121	60	15			
1 Feb	9,030	58	5,380	5	59	36
25 Feb	155	60	114			
3 Mar	130	68	34			
28 Mar	264	72	294			
15 Apr	104	77	30			
26 Apr	90	68	10			
7 May	83	86	56			
20 May	101	82	48			
5 Jun	60	84	36			
23 Jun	96	86	16			
4 Jul	72	89	44			
4 Jul	69	90	51			
17 Jul	107	84	163			
21 Jul	5,290	72	9,680	17	54	29
23 Jul	199	85	209			
6 Aug	101	82	84			
7 Aug	3,630	68	3,750	1	65	34
7 Aug	2,540	60	7,660	1	65	34
13 Aug	570	78	759	2	48	50
15 Aug	272	80	188			
19 Aug	9,940	84	6,650	1	51	48
19 Aug	9,130	84	6,380	1	81	18
20 Aug	555	84	1,530	1	54	45
25 Aug	441	82	9,850		60	40
2 Sep	135	90	79			
7 Sep	455	83	1,290	1	10	89
15 Sep	4,030	76	11,900	3	80	17
23 Sep	107	84	58			
28 Sep	95	86	40			
14 Oct	199	78	166			
27 Oct	73	70	53			
8 Nov	89	68	53			
25 Nov	83	58	23			
18 Dec	74	55	146			

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.

SOAP RIVER NEAR RAMALPINEE

Chemical Analysis of Water Samples - 1969

	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C$	pH	Res CO_3	SAR
Date	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 9	2.17	1.35	1.60		0.27	3.82	0.79	0.36			5.12	5.24				306	500	8.2	0.57	1.2
Feb 1	1.41	0.57	1.20		0.18	2.52	0.29	0.23			3.18	3.22				174	300	8.2	0.72	1.2
Mar 3	2.38	1.08	1.25		0.29	3.23	0.49	0.72			4.71	4.73				264	450	8.3	0.06	1.0
28	1.05	1.26	0.60		0.19	2.20	0.29	0.40			2.91	3.08				160	280	8.2	0.08	0.6
Apr 15	2.33	1.03	1.37		0	3.72	0.69	0.35			4.73	4.76				276	470	7.6	0.36	0.9
May 7	2.37	1.20	1.39		Trace	3.69	0.73	0.45			4.96	4.87				284	480	8.2	0.12	1.0
Jun 5	1.99	2.12	1.56		0.39	3.69	0.98	0.63			5.67	5.69				320	530	8.3	0	1.1
Jul 17	1.92	1.15	1.20		0.31	3.01	0.50	0.58			4.27	4.40				248	420	8.4	0.25	1.0
Aug 13	1.15	0.27	0.50		0	1.67	0.20	0.07			1.92	1.94				104	180	7.8	0.25	0.6
Sep 7	0.99	0.81	0.78		0.19	2.06	0.30	0.11			2.58	2.66				144	250	8.3	0.45	0.8
Oct 14	2.20	1.44	1.35		0	3.82	0.60	0.53			5.01	4.95				280	480	7.8	0.16	1.0
Nov 8	2.81	1.56	1.09		0.20	3.53	0.69	0.80			5.46	5.22				296	500	8.3	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 pf 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, WASID, WAPDA.

Average discharge 49 cusecs (35,600 acre-feet per year or 7.16 inches runoff per year). Average taken for 7 years from 1963 to 1969.

Extremes Maximum discharge observed during the year 16,100 cusecs on 12 August (gauge height 15.57 feet); minimum daily discharge 0.7 cusecs on 21 June.

May 1962-1969: 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 seven discharge measurements were made during the year by current meter using 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 seven 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. Twenty three 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 channel is composed of small shingle and sand which shifts nearly continuously; mean daily 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	7.5	17	8.9	6.1	*7.1	5.8
2	8.2	16	*8.9	6.4	7.1	4.0
3	*7.5	10	8.2	*6.1	5.8	3.7
4	7.5	8.6	8.2	5.5	5.2	*3.4
5	7.5	7.5	*7.8	6.8	*6.4	2.3
6	7.1	6.1	6.8	6.4	4.6	2.5
7	7.5	7.5	8.2	*4.6	5.8	*2.7
8	*7.1	6.4	*7.5	4.9	*4.3	2.7
9	6.8	6.4	7.5	4.9	4.0	3.2
10	6.8	6.1	6.8	4.6	4.3	*1.9
11	6.8	6.8	*6.4	5.5	5.8	1.4
12	6.8	*6.1	7.5	*4.9	*7.8	1.6
13	6.8	29	6.4	5.5	*25	2.3
14	6.4	31	*6.4	5.5	*805	*1.6
15	7.8	15	7.1	*5.5	*56	2.7
16	7.1	14	6.1	5.8	18	2.7
17	7.1	16	6.8	6.4	*12	*1.9
18	7.1	*14	*7.5	*5.8	7.1	3.0
19	6.8	11	8.2	5.8	5.5	2.5
20	7.1	*9.6	*7.5	5.5	*5.5	1.9
21	6.4	9.6	8.6	6.1	5.5	*0.7
22	6.4	8.2	9.3	*5.2	3.4	1.1
23	*6.8	9.3	14	5.2	4.0	3.2
24	6.4	8.6	12	5.2	*4.3	*3.0
25	6.4	8.6	121	*4.9	4.0	3.7
26	6.4	*8.9	*217	5.2	4.0	2.5
27	6.8	7.8	*25	4.6	*3.4	2.5
28	6.8	8.2	14	*4.3	3.4	2.3
29	6.4	——	12	4.9	4.0	2.5
30	6.4	——	9.6	5.5	2.7	*1.2
31	4.9	——	*8.6	——	*3.2	——
Mean	6.9	11	19	5.5	34	2.6
Cs/mi	0.07	0.12	0.20	0.06	0.37	0.03
In	0.09	0.13	0.29	0.07	0.42	0.03
Acre-ft.	423	621	1,190	325	2,070	1,520

1969 Year: Mean 57 Cs/sq mi 0.06 Inches 8.06

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	2.7	*4.0	5.5	5.5	*6.6	*6.4
2	*2.5	4.0	4.9	*7.1	a 6.5	6.8
3	4.9	3.7	5.5	5.5	a 6.4	6.8
4	4.9	4.0	4.9	4.6	a 6.3	*7.1
5	*3.4	*3.4	*4.9	5.2	a 6.2	7.1
6	2.7	3.2	4.9	5.2	a 6.1	6.1
7	2.3	*2,440	42	*5.5	a 6.0	7.5
8	6.3	59	*16	4.3	a 5.9	7.1
9	*74	*21	11	5.8	5.8	6.8
10	44	14	*8.6	4.9	5.8	*6.1
11	30	31	6.1	4.3	6.4	6.8
12	*20	*4,380	6.1	245	7.5	5.5
13	8.9	*95	*5.5	a 180	6.8	7.1
14	4.9	23	4.9	a 110	7.1	7.1
15	*4.6	16	*792	a 56	*6.4	*6.8
16	4.6	*12	*49	a 34	7.1	8.6
17	*4.0	11	*17	a 20	6.4	7.5
18	3.4	*591	11	a 12	*5.5	7.1
19	2.5	*1,250	6.8	a 8.2	5.5	*5.8
20	2.3	*1,200	*6.1	a*7.0	5.5	7.5
21	*1,800	*35	5.2	a 6.5	*5.5	6.4
22	*58	19	5.2	a 6.1	6.8	6.8
23	*16	*14	*4.9	5.8	6.4	*6.1
24	*1,730	12	4.6	6.8	5.5	6.8
25	*32	628	4.9	6.8	5.8	6.8
26	*9.3	*535	5.8	5.5	*5.8	*6.1
27	7.5	32	*5.5	5.5	5.5	7.1
28	6.1	*18	5.8	84	6.1	6.1
29	4.3	9.6	6.4	87	6.4	6.4
30	*4.6	*9.3	*5.2	a 21	7.1	6.4
31	4.9	7.1	—	a 11	—	*6.1
Mean	126	370	36	31	6.0	6.7
Cs/mi	1.35	3.97	0.39	0.33	0.06	0.07
In	1.56	4.54	0.43	0.39	0.07	0.08
Acre-ft	7,750	22,800	2,110	1,940	359	414

Acre-feet: 41,500 Max Day 4,380 Min Day 0.7

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Percent Silt	Percent Clay
8 Jan	7.1	50	14			
23 Jan	6.8	59	13			
12 Feb	4.6	55	65			
18 Feb	13	57	47			
20 Feb	9.3	56	36			
26 Feb	9.3	60	49			
2 Mar	8.9	67	51			
3 Mar	10	68	67			
5 Mar	8.9	70	52			
8 Mar	7.5	67	47			
11 Mar	4.6	69	40			
14 Mar	6.1	66	36			
17 Mar	6.4	69	40			
20 Mar	8.9	62	27			
25 Mar	11	70	28			
26 Mar	163	62	1,690		36	63
27 Mar	25	64	218			
31 Mar	9.3	66	48			
3 Apr	4.9	73	61			
7 Apr	3.4	75	46			
12 Apr	3.7	70	109			
15 Apr	4.9	78	49			
18 Apr	4.9	78	21			
22 Apr	4.9	78	44			
25 Apr	4.3	75	31			
28 Apr	4.0	78	40			
1 May	4.9	75	30			
5 May	6.1	79	57			
8 May	3.4	79	46			
12 May	6.1	79	62			
13 May	26	68	82			
14 May	1,640	65	4,720	3	62	35
15 May	45	72	1,030	1	9	90
17 May	13	75	299			
20 May	5.2	82	88			
24 May	2.7	83	80			
27 May	2.7	85	70			
31 May	2.1	88	88			
4 Jun	4.0	82	40			
7 Jun	1.2	92	41			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Jun	2.1	86	53			
14 Jun	1.9	86	68			
17 Jun	1.2	90	77			
21 Jun	1.0	83	91			
24 Jun	2.5	84	78			
28 Jun	1.4	87	62			
30 Jun	1.6	85	42			
2 Jul	2.5	85	53			
5 Jul	2.1	92	62			
9 Jul	97	82	207			
12 Jul	21	85	116			
15 Jul	3.4	85	53			
17 Jul	3.4	85	70			
21 Jul	10,600	78	40,500	14	62	24
21 Jul	3,000	79	19,100	1	41	58
22 Jul	58	79	1,930	2	18	80
23 Jul	12	82	188			
24 Jul	1,870	78	9,300	15	50	35
25 Jul	32	82	1,560	8	24	68
26 Jul	10	83	459	14	31	55
30 Jul	4.9	91	54			
1 Aug	4.0	93	74			
5 Aug	3.2	91	39			
7 Aug	7,700	76	7,670	5	27	68
7 Aug	4,980	75	13,100		56	44
8 Aug	58	82	2,340	1	24	75
9 Aug	21	86	288			
12 Aug	5,680	76	13,400	1	54	45
13 Aug	80	80	1,940	3	42	55
16 Aug	12	93	101			
18 Aug	1,400	81	7,630	4	66	30
19 Aug	6,560	75	10,700	3	60	37
19 Aug	2,090	77	12,200	1	57	42
20 Aug	246	74	2,630	1	48	51
21 Aug	32	83	510	9	63	28
23 Aug	14	86	137			
26 Aug	218	76	3,520	1	37	62
28 Aug	17	87	249			
30 Aug	9.3	87	138			
2 Sep	5.2	81	63			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
8 Sep	17	83	126			
10 Sep	8.9	82	53			
13 Sep	5.5	84	85			
15 Sep	2,700	74	12,400	2	55	43
16 Sep	49	80	919	3	18	79
17 Sep	17	81	739	4	23	73
20 Sep	6.1	79	88			
23 Sep	4.3	81	58			
25 Sep	4.0	91	65			
27 Sep	3.4	80	79			
30 Sep	3.7	80	41			
2 Oct	5.8	76	50			
7 Oct	4.9	78	74			
20 Oct	12	70	72			
1 Nov	10	68	214			
15 Nov	8.9	68	9			
18 Nov	4.9	68	68			
21 Nov	6.8	61	72			
26 Nov	5.5	59	40			
1 Dec	6.4	54	57			
4 Dec	7.5	59	55			
10 Dec	4.6	60	60			
15 Dec	6.4	54	58			
19 Dec	5.5	50	67			
23 Dec	6.4	57	23			
26 Dec	5.8	48	37			
31 Dec	6.1	55	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.

SIL RIVER NEAR CHAMAN

Chemical Analysis of Water Samples - 1969

	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 8	1.93	1.23	1.90		0.45	3.37	0.94	0.21			5.06	4.97				282	470	8.3	0.66	1.5
Feb 12	1.13	1.16	2.45		0.49	2.64	1.08	0.53			4.74	4.74				260	450	8.4	0.84	2.3
Mar 2	1.06	1.27	2.85		0.49	3.13	1.06	0.62			5.18	5.30				272	480	8.3	1.29	2.5
17	1.08	1.33	2.80		0.49	3.13	0.98	0.54			5.21	5.14				280	480	8.3	1.21	2.5
26	1.43	0.35	1.37		0	2.49	0.58	0.28			3.15	3.35				172	300	8.2	0.71	1.4
Apr 15	1.22	0.93	2.62		0.36	2.62	0.78	1.03			4.77	4.79				244	450	8.3	0	2.5
May 13	0.77	1.28	2.52		0.44	2.64	0.98	0.67			4.57	4.73				272	450	8.4	1.03	2.5
14	0.88	1.12	1.65		0.35	2.46	0.58	0.41			3.65	3.80				216	360	8.3	0.81	1.7
Jun 14	0.81	1.07	2.15		0.29	1.56	0.89	1.26			4.03	4.00				232	400	8.4	0	2.2
Jul 21	1.21	1.07	1.12		0	3.01	0.40	0.12			3.40	3.53				184	320	7.8	0.73	1.0
Aug 12	1.37	0.22	0.36		0	1.77	0.10	0.05			1.95	1.92				100	160	8.1	0.18	0.4
Sep 5	1.21	1.05	1.10		0	2.65	0.65	0.10			3.36	3.40				188	320	8.0	0.39	1.0
Nov 1	1.31	0.86	0.72		0	2.26	0.40	0.10			2.84	2.76				148	260	7.9	0.14	0.7
Dec 19	1.12	1.45	2.20		0.30	3.05	0.78	0.73			4.77	4.86				256	450	8.4	0.78	1.09

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, WASID, WAPDA.

Average discharge 1,480 cusecs (1,070,000 acre-feet per year or 8.04 inches runoff per year). Average taken for 6 years from 1964 to 1969.

Extremes Maximum discharge observed during the year 57,500 cusecs on 15 August (gauge height 12.80 feet); minimum daily discharge 19 cusecs on 23-24 June.

1964-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during flood.

Measurements One hundred and eight 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. One hundred and eight sets of sediment samples were taken by the depth-integration method using DH-48 sampler while wading or D-49 sampler from bridge. Sixty three of these were analysed for particle size distribution and the rest for total concentration. Thirteen surface samples were collected and analysed for chemical composition.

Determination of discharge This station has a sandy bed which shifts continuously. Rating dated 25.3.70 was used to compute daily discharges from mean daily gauge heights with shift adjustments as indicated necessary by discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	211	*223	399	*326	*1,320	94
2	199	199	299	267	1,080	70
3	*187	*1,140	243	211	662	58
4	181	710	229	187	389	56
5	187	537	229	181	267	46
6	193	*378	211	*165	*211	44
7	*187	336	205	165	175	42
8	*193	a 305	187	156	146	41
9	170	a 280	181	141	120	*42
10	170	a 250	187	161	123	39
11	a 200	a 228	*165	*156	*94	35
12	229	*213	137	165	90	*35
13	229	*1,100	132	151	1,270	35
14	*199	966	*120	141	*5,890	35
15	223	678	123	132	3,290	35
16	211	*1,140	123	*141	944	35
17	229	1,140	127	137	881	*32
18	217	1,010	141	141	537	26
19	223	944	*223	146	*368	24
20	223	678	275	161	299	25
21	217	566	175	181	259	26
22	*205	*498	*767	175	187	22
23	193	420	662	161	*146	19
24	193	420	389	161	112	19
25	187	389	389	*251	112	26
26	187	a 430	*1,790	193	109	26
27	*181	a 470	*4,080	161	97	*24
28	165	511	1,420	146	87	29
29	146	—	1,050	156	82	26
30	127	—	662	*729	*73	24
31	123	—	433	—	70	—
Mean	193	577	508	192	629	36
Cs/mi	0.08	0.23	0.20	0.08	0.25	0.01
In	0.09	0.24	0.23	0.09	0.29	0.02
Acre-ft.	11,900	32,100	31,200	11,400	38,700	2,160

1969 Year: Mean 758 Cs/sq mi 0.30 Inches 4.13

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*181	446	336	223	2,090	105
2	*42	307	307	*912	1,870	*109
3	35	*243	267	582	1,700	109
4	36	181	243	283	*1,670	*105
5	35	*156	243	235	1,320	109
6	36	141	*235	187	1,010	105
7	*33	*337	*283	165	748	109
8	33	*8,700	259	141	524	105
9	35	1,840	*729	120	*389	109
10	*956	678	524	116	291	105
11	*1,040	*767	*368	109	211	a 105
12	537	*11,800	*524	94	*175	a 103
13	410	*13,800	347	*259	170	101
14	326	*8,530	307	187	146	90
15	*524	*26,900	*420	*368	127	94
16	378	*2,890	*2,700	368	137	90
17	*498	*1,470	2,070	*1,790	120	90
18	326	*9,970	1,080	1,100	116	94
19	243	*7,740	132	662	123	90
20	229	8,960	*368	433	120	87
21	*1,490	*472	357	291	112	84
22	*9,030	378	307	211	105	*90
23	2,180	*1,730	*275	*151	105	90
24	*9,930	1,080	235	146	*101	90
25	6,880	805	217	187	101	94
26	2,040	*4,030	*229	132	101	90
27	630	*2,210	229	141	101	97
28	*2,070	805	243	*120	101	94
29	*2,340	* 498	*235	*2,680	101	110
30	*1,700	459	223	2,990	105	109
31	598	*389	——	2,120	----	*105
Mean	1,450	3,830	476	565	470	99
Cs/mi	0.58	1.53	0.19	0.23	0.19	0.04
In	0.67	1.77	0.21	0.26	0.21	0.05
Acre-ft.	88,900	235,000	28,300	34,700	27,900	6,070

Acre-feet: 548,000 Max Day 26,900 Min Day 19

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
3 Jan	187	58	222			
7 Jan	193	52	158			
8 Jan	175	54	143			
14 Jan	199	55	156			
22 Jan	205	58	127			
27 Jan	187	56	241			
1 Feb	223	61	984	2	33	65
3 Feb	1,010	57	651	3	12	85
6 Feb	347	60	281			
12 Feb	307	58	214			
13 Feb	1,590	48	4,730	6	64	30
16 Feb	1,420	58	1,360	1	43	56
22 Feb	472	67	257			
11 Mar	161	76	58			
14 Mar	123	76	114			
19 Mar	229	82	269			
22 Mar	786	67	986	2	50	48
26 Mar	1,870	70	12,400	3	90	7
27 Mar	3,760	69	4,090	2	58	40
1 Apr	315	80	748	3	27	70
6 Apr	170	80	157			
11 Apr	156	74	185			
16 Apr	137	84	116			
21 Apr	199	65	138			
25 Apr	251	70	82			
30 Apr	498	85	19,300	4	50	46
1 May	1,490	74	2,380	2	60	38
6 May	211		162			
11 May	94	89	140	1	20	79
14 May	14,400	69	1,240			
19 May	399	76	670	3	48	49
23 May	161	74	202			
30 May	79	84	144			
4 Jun	58	99	87			
9 Jun	44	93	96			
12 Jun	35	91	81			
17 Jun	30	100	56			
22 Jun	20	96	121			
27 Jun	25	82	106			
1 Jul	326	85	16,400	1	35	64

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
2 Jul	41	90	235			
7 Jul	27	100	184			
10 Jul	410	85	2,590	15	55	30
10 Jul	3,600	90	32,000	0	47	53
11 Jul	1,340	89	45,300	0	73	27
15 Jul	966	80	23,100	1	40	59
17 Jul	524	92	3,190	16	60	24
21 Jul	5,050	82	32,900	3	51	46
22 Jul	16,300	81	43,800	2	49	49
24 Jul	28,100	84	31,100	8	48	44
28 Jul	3,480	85	31,300	2	62	36
29 Jul	5,140	85	14,200	15	57	28
30 Jul	2,300	86	6,050	21	50	29
30 Jul	2,780	83	4,900	2	57	41
1 Aug	399	97	2,720	5	59	36
3 Aug	267	85	11,800	3	88	9
5 Aug	161	96	322			
7 Aug	127	82	233			
8 Aug	19,300	77	17,600	4	78	18
8 Aug	7,910	81	23,100		89	11
11 Aug	1,210	85	4,320	2	70	28
12 Aug	11,800	82	1,330	24	56	20
12 Aug	29,500	81	25,100	5	77	18
13 Aug	29,500	80	17,200	2	79	19
13 Aug	8,960	82	13,700	3	78	19
14 Aug	9,590	80	24,100	4	81	15
14 Aug	32,900	80	27,600	12	71	17
15 Aug	2,600	80	9,160	3	34	63
15 Aug	38,900	78	22,300	8	76	16
17 Aug	2,330	80	4,540	5	62	33
17 Aug	1,540	90	4,610	3	51	46
18 Aug	11,100	84	22,300	4	89	7
19 Aug	16,300	79	20,500	9	83	8
20 Aug	34,900	79	17,600	1	87	12
21 Aug	446	88	5,200	5	47	48
23 Aug	2,870	83	19,400	1	87	12
26 Aug	3,520	80	16,000	1	81	18
26 Aug	6,990	90	15,200	3	79	18
27 Aug	2,180	83	7,300	2	47	51
29 Aug	566	93	18,000	3	86	11

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
31 Aug	410	86	290			
2 Sep	315	86	296			
6 Sep	243	80	160			
7 Sep	420	71	1,540	4	44	52
9 Sep	767	88	1,600	4	53	43
11 Sep	336	83	295			
12 Sep	678	89	11,000	2	68	30
14 Sep	537	86	10,600	2	67	31
16 Sep	5,600	83	12,500	3	50	47
20 Sep	399	79	1,640	2	39	59
23 Sep	291	83	796	5	33	62
26 Sep	259	80	1,070	3	25	72
29 Sep	243	77	232			
2 Oct	1,540	80	7,900	5	71	24
13 Oct	267	78	7,700	6	70	24
15 Oct	368	76	2,860	6	31	63
17 Oct	1,810	81	2,960	2	71	27
23 Oct	161	81	292			
28 Oct	127	74	306			
29 Oct	4,780	82	12,400	5	62	33
4 Nov	1,730	72	1,070	3	19	78
9 Nov	368	76	295			
12 Nov	175	74	210			
24 Nov	97	64	163			
2 Dec	109	61	257			
4 Dec	109	58	124			
22 Dec	90	58	143			
31 Dec	101	60	112			

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 DEOK PATHAN

Chemical Analysis of Water Samples - 1969

Date	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.	$EC \times 10^6$ at 25°C	pH	Res CO_3	SAR
	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION						me/l	
Feb																				
1	1.46	0.93	3.20		0.18	3.24	1.28	0.77			5.59	5.48				318	530	8.2	1.03	2.9
16	1.30	0.93	3.15		0.37	2.76	1.14	0.99			5.38	5.26				300	500	8.3	0.90	2.9
Mar																				
11	1.18	1.01	2.15		0.37	2.39	0.76	0.78			4.35	4.30				236	400	8.3	0.56	2.1
22	1.46	0.79	2.08		0.37	2.58	0.67	0.67			4.33	4.29				248	420	8.3	0.70	2.0
Apr																				
6	1.09	0.64	1.77		0	2.21	0.67	0.61			3.50	3.49				196	340	7.7	0.48	1.9
May																				
1	1.09	0.95	3.15		0.18	2.67	1.05	1.10			5.19	5.00				288	490	8.2	0.77	3.1
11	1.14	0.96	2.00		0	2.67	0.76	0.73			4.10	4.16				232	400	7.9	0.57	2.0
Jun																				
4	1.37	1.18	2.45		0.29	3.55	0.99	0.19			5.00	5.01				284	500	8.4	1.29	2.2
Jul																				
1	0.92	0.58	3.80		0.19	3.40	1.18	0.62			5.30	5.39				292	500	8.3	2.09	4.4
Aug																				
13	1.60	0.46	0.84		0	2.60	0.38	0.13			2.90	3.03				164	280	8.0	0.54	0.8
Sep																				
2	1.15	0.65	1.27		0	2.39	0.60	0.06			3.07	3.05				158	280	8.1	0.59	1.3
Nov																				
4	1.75	0.73	0.90		0	2.75	0.49	0.16			3.38	3.40				176	310	7.8	0.27	0.9
Dec																				
22	1.57	1.43	2.05		0	3.55	0.88	0.60			5.05	5.03				286	500	8.1	0.55	1.7

Blank page retained for pagination

Lacation 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, WASID, WAPDA; previous records with Director Hydrology Irrigation and Power Department.

Extremes Maximum discharge observed during the year 34,300 cusecs on 19 August (gauge height 15.00 feet); minimum daily discharge 250 cusecs on 10 August.

1968-69: Maximum discharge observed 34,300 cusecs on 19 August 69; minimum daily discharge 250 cusecs on 10 August 1969.

Gauge Wire-weight gauge fastened to upstream handrail of bridge; read from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Twenty six 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. Twenty five sets of sediment samples were taken by depth integration method using DH-48 sampler while wading and D-49 sampler from the bridge. Four 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 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 table dated 5.3.1969 was used with chift adjustments based on discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	*682	694	629	916	840	549
2	664	658	624	860	764	708
3	670	635	624	860	740	553
4	670	640	624	830	732	688
5	670	629	618	820	716	514
6	670	629	613	790	708	495
7	670	624	613	756	740	471
8	670	624	602	748	732	453
9	676	624	613	740	1,210	*456
10	682	624	613	*840	1,200	435
11	682	613	613	940	1,380	428
12	676	*602	624	1,450	1,430	408
13	682	676	624	1,250	1,410	388
14	688	640	*624	1,150	*1,310	538
15	688	664	613	1,760	1,260	507
16	*682	664	607	1,520	1,480	504
17	682	748	602	1,260	1,430	510
18	676	658	780	1,140	1,530	528
19	676	658	1,280	1,990	1,330	492
20	676	658	892	1,460	1,210	514
21	676	658	860	1,340	976	498
22	664	652	880	1,210	*976	489
23	658	*596	1,210	1,120	1,000	462
24	658	596	1,170	1,080	940	462
25	646	596	1,230	*1,020	840	*459
26	658	596	1,340	964	694	553
27	664	a607	1,280	1,050	624	531
28	652	a618	1,140	916	607	507
29	652	---	1,080	904	591	495
30	646	---	*988	870	569	565
31	635	---	988	------	542	---
Mean	669	639	826	1,090	984	505
Cs/mi	0.31	0.30	0.39	0.51	0.46	0.24
In	0.36	0.31	0.44	0.57	0.53	0.26
Acre-ft.	41,100	35,500	50,800	64,600	60,500	30,100

1969 Year: Mean 834 Cs/sq mi 0.39 Inches 5.28

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	528	521	498	565	613	688
2	510	453	486	613	602	694
3	495	380	868	561	618	700
4	486	346	787	569	618	694
5	514	328	618	528	635	688
6	537	302	7,720	521	2,220	682
7	514	284	4,450	524	*1,140	582
8	549	*257	790	510	904	676
9	1,840	260	*501	521	764	670
10	607	250	459	507	740	664
11	405	351	423	*498	740	a662
12	*3,010	360	428	635	1,080	a660
13	716	5,280	448	514	988	658
14	585	1,050	635	521	916	664
15	2,970	629	2,910	1,950	860	640
16	382	640	495	849	800	646
17	322	670	477	477	790	646
18	328	688	483	486	764	635
19	334	10,600	418	480	764	629
20	330	3,030	405	483	756	629
21	314	*5,450	392	483	756	629
22	*318	3,850	388	465	732	635
23	350	1,290	400	462	724	635
24	320	521	*384	471	700	635
25	346	433	396	462	*688	*635
26	338	435	646	453	688	635
27	1,070	*492	535	450	688	635
28	6,100	510	557	856	700	629
29	*1,660	498	*561	*1,210	688	635
30	716	507	553	708	694	635
31	596	483	——	573	——	635
Mean	906	1,330	970	610	812	654
Cs/mi	0.42	0.62	0.45	0.29	0.38	0.31
In	0.49	0.71	0.51	0.33	0.42	0.35
Acre-ft.	55,700	81,600	57,700	37,500	48,300	40,200

Acre-feet: 604,000 Max Day 10,600 Min Day 250

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Jan	670	46	11			
16 Jan	682	50	15			
12 Feb	602	54	21			
23 Feb	596	58	57			
14 Mar	624	60	138			
30 Mar	988		93			
10 Apr	830	70	203			
14 May	1,330	62	8,470	14	40	46
22 May	988	75	286			
9 Jun	462	84	131			
25 Jun	459	85	52			
12 Jul	3,010	76	7,660	4	40	56
22 Jul	334	89	77			
29 Jul	964	86	231			
8 Aug	264	92	131			
21 Aug	772	82	69,100	14	63	23
27 Aug	545	86	115			
9 Sep	495	83	196			
29 Sep	780	80	225			
29 Sep	561	79	81			
11 Oct	480	74	84			
29 Oct	1,640	62	14,700	14	73	13
7 Nov	1,020	69	238			
25 Nov	682	54	76			
25 Dec	629	53	54			

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.

KURRAM RIVER AT THAL

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25^oC	pH	Res CO_3 me/l	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.				
Jan																				
1	1.40	2.13	0.45		0.39	2.15	0.19	1.35			3.98	4.08				232	380	8.3	0	0.3
16	1.29	2.19	0.40		0.39	2.20	0.33	1.11			3.88	4.03				224	380	8.3	0	0.3
Feb																				
12	1.65	1.87	0.90		0.39	2.89	0.30	1.04			4.42	4.62				248	430	8.3	0	0.7
23	1.76	1.91	0.54		0.29	2.98	0.39	0.72			4.21	4.38				248	420	8.3	0	0.4
Mar																				
14	2.32	1.30	0.40		0.39	2.70	0.29	0.88			4.02	4.26				232	400	8.3	0	0.3
30	2.09	1.64	0.39		0.19	2.89	0.29	0.88			4.12	4.25				230	390	8.2	0	0.2
Apr																				
10	1.24	1.95	0.31		0.18	2.31	0.29	0.74			3.50	3.52				204	350	8.2	0	0.2
25	1.41	2.16	0.35		0.18	2.67	0.29	0.95			3.92	4.09				224	390	8.2	0	0.3
Jun																				
25	1.37	2.38	1.05		0.32	3.05	0.50	0.94			4.80	4.71				260	450	8.5	0	0.8
Jul																				
29	0.91	2.16	0.70		0.21	2.99	0.30	0.29			3.77	3.79				212	370	8.3	0.13	0.6
Aug																				
27	1.10	2.23	0.56		0.21	3.01	0.30	0.50			3.89	4.02				226	380	8.3	0	0.4
Sep																				
29	1.21	2.29	0.61		0	3.38	0.55	0.20			4.11	4.13				236	410	8.2	0	0.5
Oct																				
29	1.92	1.15	0.28		0	2.75	0.20	0.28			3.35	3.23				178	310	8.1	0	0.2
Nov																				
25	2.23	2.05	0.45		0.19	3.80	0.19	0.63			4.73	4.81				250	440	8.3	0	0.3
Dec																				
25	2.04	2.28	0.52		0	3.90	0.29	0.68			4.84	4.87				280	480	8.2	0	0.4

Blank page retained for pagination

TOCHI RIVER AT TANGI POST - 1969

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 June 1969 by Surface Water Hydrology Project, WASID, WAPDA. Site closed in June 1969.

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 Data incomplete.

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

Gauge Wire-weight gauge fastened to downstream handrail of bridge. Gauge read to 0.01 foot from 08:00 to 16:00 hours during low flows and more often during floods.

Measurements Tevelve discharge measurements were made upto 30 June 1969 by current meter using .6 or .2 and .8 depth method, by wading at low flows and from bridge at high flows. Twelve sets of sediment samples were taken by the depth integrating method using DH-48 samples while wading. All were analysed for total concentration. Nine 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 charges in the channel.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	22	26	42	a 26	38	14
2	23	26	45	a 22	36	14
3	22	26	50	a 19	34	13
4	22	26	52	a 17	25	13
5	22	26	56	a 16	21	12
6	22	26	62	15	21	11
7	*22	26	70	14	21	11
8	22	26	73	*13	22	11
9	22	26	56	19	21	11
10	23	27	52	146	22	11
11	23	26	a 51	179	26	12
12	24	26	50	194	21	*12
13	24	26	47	96	21	12
14	24	*30	*45	698	21	12
15	24	31	50	351	*21	12
16	*24	32	54	155	21	12
17	24	31	60	*111	21	12
18	24	31	66	105	22	12
19	24	32	71	100	21	13
20	24	31	68	71	20	13
21	24	30	76	68	21	13
22	24	29	83	60	21	14
23	24	31	92	57	20	*14
24	24	*29	76	52	*20	14
25	24	31	*66	48	19	14
26	25	33	a 60	43	18	a 14
27	25	36	a 54	40	18	a 13
28	25	39	a 48	39	17	a 13
29	25	—	a 42	39	17	a 13
30	26	—	a 36	38	16	a 12
31	26	—	a 30	—	15	—
Mean	24	29	58	95	22	13
Cs/mi	0.01	0.01	0.03	0.05	0.01	0.01
In	0.01	0.02	0.03	0.05	0.01	0.01
Acre-ft.	1,450	1,620	3,540	5,650	1,350	748

1969 Year: Mean Cs/sq mi Inches

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

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
7 Jan	22	48	21			
16 Jan	24	45	148			
14 Feb	29	50	190			
24 Feb	29	52	130			
14 Mar	45	70	179			
25 Mar	66	66	142			
8 Apr	13	77	92			
17 Apr	111	71	179			
15 May	21	87	138			
24 May	20	90	279			
12 Jun	12	80	116			
23 Jun	14	82	157			

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 TANGI POST

Chemical Analysis of Water Samples - 1969

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
Jan																				
7	1.32	5.56	2.51		1.47	4.94	1.08	1.77			9.39	9.26				552	860	8.5	0	1.4
16	1.21	5.51	2.45		1.37	4.85	0.99	2.03			9.17	9.24				552	850	8.4	0	1.3
Feb																				
14	1.31	6.61	2.85		1.18	5.49	1.18	2.35			10.77	10.20				576	960	8.7	0	1.4
24	1.20	6.73	2.85		1.57	5.10	1.08	2.45			10.78	10.20				576	950	8.7	0	1.4
Mar																				
14	0.11	8.77	3.45		1.74	4.65	1.65	3.87			12.33	11.91				700	1130	8.7	0	1.5
25	0.11	8.67	3.45		1.64	4.75	1.61	3.75			12.23	11.75				684	1120	8.7	0	1.6
Apr																				
8	0.34	10.89	4.50		2.13	5.14	2.35	5.99			15.73	15.61				928	1470	8.9	0	1.9
17	0.68	6.65	2.80		1.16	4.26	1.32	3.62			10.13	10.36				564	940	8.6	0	1.5
Jun																				
23	0.80	4.42	1.50		0.29	4.22	0.78	1.48			6.72	6.77				392	670	8.3	0	0.9

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, WASID, WAPDA. Gauge heights 1956 to 1960 by Dams Investigation Circle and August 1959 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 500 cusecs (363,000 acre-feet per year or 0.49 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 6,390 cusecs on 15 August (gauge height 7.40 feet); minimum daily discharge 47 cusecs on 4 May.

1960-69: 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 graduation and set in river bed; wire weight gauge read to 0.01 foot from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Seventy seven 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. Fifty nine sets of sediment samples were taken by depth integrating method using DH-48 sampler by wading and by D-49 sampler from cableway. Twenty of these were analysed for particle size distribution and the rest for total concentration. Eleven 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.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	111	94	595	89	50	80
2	112	96	325	77	51	159
3	111	94	179	69	56	144
4	115	88	167	65	47	102
5	*112	*92	175	60	267	82
6	108	89	159	56	175	80
7	112	92	144	51	121	82
8	109	89	163	48	102	76
9	105	86	135	51	96	78
10	106	83	123	125	210	*77
11	103	82	120	630	121	77
12	103	83	*114	419	206	328
13	102	135	104	824	*181	94
14	105	142	103	1,440	193	144
15	103	153	92	684	334	115
16	102	169	88	*535	292	84
17	100	181	84	313	165	77
18	*100	144	441	235	129	129
19	98	*129	337	191	120	76
20	99	133	136	155	111	73
21	98	132	95	454	111	70
22	98	130	102	240	*112	65
23	96	118	88	129	114	68
24	95	123	82	94	105	*72
25	94	118	399	83	100	69
26	93	a 200	325	73	95	71
27	89	a 380	*372	83	96	62
28	87	711	183	74	93	69
29	87	——	138	62	88	165
30	87	——	115	72	86	678
31	94	——	100	——	82	——
Mean	101	149	187	249	133	118
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	0.01
Acre-ft.	6,220	8,260	11,500	14,800	8,150	7,030

1969 Year: Mean 177 Cs/sq mi 0.01 Inches 0.17

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	240	*132	*70	67	83	94
2	169	*108	*51	67	82	94
3	114	*123	*51	112	80	96
4	88	*87	*74	78	82	95
5	72	*88	*70	77	*83	94
6	65	*74	*70	98	84	94
7	60	*76	*58	87	111	*94
8	3,620	*75	*321	82	112	96
9	268	*65	*203	78	106	94
10	105	*80	*108	77	99	94
11	71	*78	69	*77	95	a93
12	61	*80	*53	76	117	a93
13	247	75	*49	76	259	93
14	258	527	51	74	215	93
15	105	3,960	47	73	144	93
16	71	*1,500	*49	72	169	90
17	*59	*1,150	*51	74	115	90
18	73	*322	*51	77	112	89
19	61	*189	53	77	*95	88
20	*58	*848	53	75	96	88
21	*51	866	*53	74	93	89
22	*196	455	54	74	95	90
23	*307	*729	57	*74	93	92
24	*631	393	59	76	92	92
25	*393	468	60	80	90	90
26	*473	*365	61	78	90	89
27	*525	*175	62	78	93	89
28	*1,440	*126	66	80	92	88
29	*1,340	120	67	80	94	89
30	*342	*109	*68	84	93	92
31	*351	*89	—	84	—	90
Mean	384	437	74	79	109	92
Cs/mi	0.03	0.03	0.01	0.01	0.01	0.01
In	0.03	0.04	0.01	0.01	0.01	0.01
Acre-ft.	23,600	26,800	4,380	4,830	6,470	5,640

Acre-feet: 128,000 Max Day 3,960 Min Day 47

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
5 Jan	112	50	54			
18 Jan	100	53	61			
5 Feb	92	52	113			
19 Feb	128	51	114			
27 Mar	386	68	33,700	1	42	57
16 Apr	486	66	37,500	2	39	59
13 May	177	82	285			
22 May	112	80	187			
10 Jun	77	84	119			
24 Jun	72	88	79			
17 Jul	59	86	1,060	18	61	21
20 Jul	59	85	270			
21 Jul	52	87	220			
22 Jul	53	80	141			
22 Jul	583	82	153,000	1	45	54
23 Jul	278	81	21,800	3	41	56
24 Jul	278	79	37,100	1	39	60
25 Jul	375	85	49,300		18	82
26 Jul	520	80	34,500		36	64
27 Jul	573	81	57,500	6	41	53
28 Jul	1,940	72	26,400		16	84
30 Jul	325	75	247			
1 Aug	132	80	130			
2 Aug	115	83	158			
3 Aug	125	83	157			
4 Aug	89	88	192			
5 Aug	89	85	188			
6 Aug	74		167			
7 Aug	76	85	176			
8 Aug	75	83	163			
9 Aug	65	89	9,660	16	67	17
10 Aug	80	88	11,400	11	61	28
11 Aug	78	88	10,200	13	65	22
12 Aug	81	86	7,790	8	62	30
16 Aug	1,440	78	3,940	13	60	27
17 Aug	1,360	78	2,970	18	60	22
18 Aug	331	80	3,060	17	44	39
19 Aug	185		8,720	24	63	13
20 Aug	1,360	80	15,000	5	61	34
23 Aug	1,690	82	8,840	15	62	23

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
26 Aug	365	82	171			
27 Aug	185	85	104			
28 Aug	127	77	205			
30 Aug	109	85	167			
31 Aug	90	86	176			
1 Sep	71	80	317			
8 Sep	410	78	210			
9 Sep	193	80	158			
10 Sep	111	80	260			
12 Sep	53	78	88			
13 Sep	51	81	106			
16 Sep	49	81	111			
18 Sep	51	78	308			
21 Sep	53	70	281			
30 Sep	68	70	105			
23 Oct	74	70	84			
5 Nov	83	73	157			
19 Nov	96	65	230			
7 Dec	94	71	204			

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.

GONAL RIVER AT KOT MURTAZA

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C$	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																				
15	3.79	2.72	7.30		0.39	3.03	2.37	7.66			13.81	13.45				824	1260	8.4	0	4.1
18	3.35	3.16	7.20		0.39	2.94	2.22	8.21			13.71	13.76				816	1250	8.4	0	4.0
Feb																				
5	2.55	3.90	6.90		0.48	2.40	2.25	7.97			13.35	13.10				832	1300	8.4	0	3.8
19	2.83	3.78	6.90		0.58	2.55	2.16	8.12			13.51	13.41				808	1260	8.5	0	3.8
Mar																				
12	2.05	4.33	7.20		0.39	2.13	2.45	8.43			13.58	13.40				808	1280	8.3	0	4.0
27	2.96	3.60	6.20		0.67	2.91	2.49	6.97			12.76	13.04				716	1150	8.5	0	3.4
Apr																				
16	2.05	4.94	7.20		0.58	1.94	2.74	8.56			14.19	13.82				804	1280	8.4	0	3.9
Jun																				
10	2.74	5.31	9.00		0.39	2.33	2.65	11.48			17.05	16.85				960	1550	8.4	0	4.5
Jul																				
31	1.81	4.34	7.45		0.21	2.29	2.70	8.59			13.60	13.79				856	1320	8.3	0	4.2
Aug																				
31	1.81	4.34	7.45		0.21	2.29	2.70	8.59			13.60	13.79				856	1320	8.3	0	4.2
Oct																				
23	2.97	4.55	7.10		0.30	2.60	2.60	9.10			14.62	14.60				928	1440	8.3	0	3.7

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

Drainage area 2,810 squre miles.

Records available Gauge height record from January 1957 to date with Surface Water Hydrology Project, WASID, WAPDA. Discharge measurements started in November 1962 by Surface Water Hydrology Project and discharges computed since January 1963. Gauge height record only with Indus Basin Development Board Lahore from 1954 - December 1956.

Average discharge 13,800 cusecs (10,000,000 acre-feet per year or 66.8 inches runoff per year). Average taken for 7 year from 1963 to 1969.

Extremes Maximum discharge observed during the year 63,000 cusecs on 2 June (gauge height 2217.95 feet); minimum daily discharge 1,730 cusecs on 16 January.

1963-69: Maximum discharge observed 70,800 cusecs on 18 June 1966; minimum daily discharge observed 1,730 cusecs on 16 January 1969.

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 one discharge measurements were made during the year by current meter using 0.2 and 0.8 depth method from road bridge or foot bridge about one furlong downstream of gauge. Forty three sets of sediment samples were taken by the depth integration method using D-49 sampler. Four of these were analysed for particle size distribution and the rest for total concentration. Ten 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 15.9.70 was used to compute discharges.

Remarks Record good.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	*2,220	3,090	3,660	13,000	13,000	55,600
2	2,250	2,320	4,030	14,000	13,300	58,700
3	2,260	2,130	4,030	*15,100	14,800	59,800
4	2,190	*2,700	4,080	14,600	15,800	53,700
5	*2,170	*2,480	4,420	14,200	18,700	44,200
6	2,150	*2,500	4,940	14,300	21,800	38,300
7	2,100	*2,500	5,260	16,900	24,100	40,000
8	2,050	2,420	5,290	19,300	27,000	38,600
9	2,040	*2,370	5,660	20,800	28,400	42,000
10	2,060	2,360	6,290	21,100	*33,900	45,400
11	2,100	*2,380	6,770	*22,500	35,200	43,000
12	2,100	*2,510	7,260	26,100	31,600	38,400
13	2,170	3,130	8,040	23,700	33,600	41,400
14	*2,100	*2,950	8,960	23,200	31,400	46,100
15	1,760	*2,950	9,700	24,100	25,500	46,500
16	1,730	2,880	10,300	29,700	21,400	47,600
17	1,770	*3,170	10,500	28,400	*19,100	*50,000
18	1,940	3,030	12,200	22,800	21,700	52,100
19	2,060	2,870	14,900	18,800	24,100	52,900
20	2,010	2,820	12,800	20,800	24,700	*53,200
21	1,930	2,780	12,300	19,100	27,100	51,800
22	*1,950	2,700	10,900	17,600	32,600	*44,100
23	2,080	2,750	10,100	16,100	38,500	40,700
24	2,000	*3,250	9,360	*14,300	34,300	37,900
25	2,040	3,330	12,600	13,300	32,600	39,500
26	3,030	3,480	17,600	13,000	37,200	38,700
27	3,430	4,160	15,300	12,200	37,300	41,800
28	2,250	3,810	12,200	15,500	42,700	40,200
29	2,130	———	11,400	*18,200	46,900	38,600
30	2,330	———	11,600	14,700	49,700	33,300
31	*2,380	———	12,300	———	53,800	———
Mean	2,150	2,850	9,190	18,600	29,400	45,000
Cs/mi	0.77	1.01	3.27	6.62	10.5	16.0
In	0.88	1.06	3.77	7.38	12.1	17.9
Maf	.132	.158	.565	1.11	1.81	2.68

1969 Year: Mean 15,300 Cs/sq mi 5.43 Inches 74.08

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	34,400	21,900	11,400	5,610	5,660	3,180
2	33,400	*23,200	*10,800	6,000	5,620	3,120
3	38,000	24,200	10,000	5,880	5,480	3,030
4	43,800	24,900	*9,440	5,450	5,400	2,960
5	40,000	*26,100	9,140	*5,140	5,190	2,990
6	41,400	28,400	9,300	4,870	4,990	*2,990
7	44,200	28,400	*8,760	4,750	5,040	*2,900
8	*45,500	26,900	8,100	4,620	5,000	2,820
9	47,500	27,300	7,900	4,540	4,970	2,820
10	44,400	*32,000	7,430	4,540	4,750	2,790
11	43,200	26,100	7,220	*5,380	4,560	2,690
12	41,900	23,600	7,380	5,620	4,950	2,660
13	41,400	*18,900	*7,470	4,950	4,900	2,630
14	39,200	20,500	8,400	4,740	4,610	2,610
15	34,000	19,900	8,340	5,040	4,380	2,560
16	35,100	18,200	7,410	5,380	4,140	2,560
17	35,500	17,900	6,730	*5,280	4,020	2,550
18	35,400	19,200	6,520	4,700	3,910	2,540
19	37,100	18,500	*6,520	4,560	3,730	2,490
20	41,200	17,700	6,380	4,290	3,820	2,450
21	42,900	16,500	*6,240	4,180	3,810	2,390
22	*43,300	16,200	6,200	4,050	3,700	2,320
23	40,800	13,500	*6,250	3,960	3,640	2,320
24	39,700	*12,200	6,240	3,970	3,510	2,300
25	36,200	*11,500	6,000	3,880	3,520	*2,240
26	34,000	11,400	5,800	3,820	3,460	*2,210
27	28,600	11,000	6,620	3,990	3,420	2,230
28	*26,500	11,200	5,500	7,640	3,330	2,300
29	22,400	11,300	5,550	7,660	*3,220	2,260
30	20,500	*11,500	*5,620	6,670	3,210	2,270
31	20,100	11,500	———	6,060	———	2,310
Mean	37,100	19,400	7,460	5,070	4,330	2,600
Cs/mi	13.2	6.90	2.65	1.80	1.54	0.93
In	15.2	7.96	2.96	2.08	1.72	1.07
Maf	2.28	1.19	.444	.312	.258	.160

M.Acre-ft. 11.1 Max Day 59,800 Min Day 1,730

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Jan	2,250	44	12			
5 Jan	2,100	44	52			
14 Jan	2,000	42	59			
31 Jan	2,380	39	56			
9 Feb	2,360	44	59			
14 Feb	3,010	44	77			
17 Feb	3,260	40	66			
4 Mar	4,190	46	149			
21 Mar	11,100	61	107			
26 Mar	18,400	49	1,800	29	41	30
3 Apr	15,300	52	238			
11 Apr	20,300	61	940	16	64	20
24 Apr	14,300	58	73			
29 Apr	19,200	57	385	28	46	26
10 May	35,000	59	297			
17 May	35,000	65	95			
17 Jun	53,500	50	284			
20 Jun	55,100	52	292			
22 Jun	40,400	48	234			
8 Jul	49,400	46	279			
18 Jul	34,500	60	252			
22 Jul	46,900	61	279			
28 Jul	26,400	58	203			
2 Aug	23,000	60	188			
5 Aug	28,500	63	155			
13 Aug	19,000	61	550			
25 Aug	12,100	61	77			
30 Aug	11,600	68	62			
2 Sep	11,200	61	89			
4 Sep	9,650	60	31			
13 Sep	7,550	60	99			
17 Sep	6,660	50	26			
19 Sep	6,620	60	64			
21 Sep	6,270	61	42			
23 Sep	6,420	60	22			
25 Sep	6,090	60	26			
28 Sep	5,480		28			
5 Oct	5,000	61	69			
11 Oct	5,840	55	1,840	9	42	49
17 Oct	5,310	56	34			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
29 Nov	3,230	44	60			
6 Dec	3,000	46	85			
26 Dec	2,210	41	61			

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 RIVER AT MUZAFFARABAD

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25^oC	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 17	1.74	0.34	0.18		0.19	1.47	0.28	0.35			2.28	2.29				120	220	8.2	0	0.2
Mar 4	1.21	0.63	0.04		Traces	1.18	0.19	0.61			1.88	1.98				104	180	8.1	0	0
Apr 3	1.36	0.52	0.20		0	1.15	0.15	0.83			2.08	2.12				112	190	7.7	0	0.2
May 10	1.16	0.46	0.09		0	1.26	0.19	0.27			1.71	1.72				92	160	7.6	0	0.1
17	1.25	0.54	0.11		0	1.46	0.19	0.26			1.90	1.91				104	180	7.9	0	0.1
Jun 22	1.14	0.30	0.10		0	1.26	0.10	0.15			1.54	1.51				82	150	7.9	0	0.1
Jul 8	0.80	0.48	0.14			1.28	0.15	0.08			1.42	1.51				80	140	8.0	0	0.2
Aug 2	0.88	0.28	0.18		0	1.04	0.10	0.24			1.34	1.38				74	130	7.7	0	0.3
Sep 7	0.88	0.55	0.20		0	1.18	0.15	0.26			1.63	1.59				88	150	7.8	0	0.2
Oct 26	1.29	0.74	0.14		0	1.45	0.14	0.54			2.17	2.13				120	210	7.8	0	0.1

KUNHAR RIVER AT NARAN - 1969

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, WASID , WAPDA. Gauge heights October 1958 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 1,790 cusecs (1,300,000 acre-feet per year or 61.1 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 8,990 cusecs on 18 June (gauge height 10.00 feet); minimum daily discharge 207 cusecs on 13-14 February.

1959-69: 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 from 08:00 to 16:00 hours daily during low flow and 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 Sixteen discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 or 0.6 depth method from country made footbridge at the gauge. Twelve sets of sediment samples taken by depth integration method using D-49 sampler and analysed for total concentration. Seven surface samples were collected and analysed for chemical composition.

Determination of discharge Rating dated 17.7.68 was used. Discharges were computed by spplying 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	458	468	405	986	a 1,030	5,180
2	458	468	433	995	a 1,190	4,880
3	458	472	423	1,040	a 1,300	5,180
4	468	483	419	1,080	a 1,500	5,340
5	479	468	433	1,110	a 1,700	5,330
6	465	475	430	954	a 2,000	*5,700
7	458	483	451	1,020	a 2,250	5,780
8	458	483	430	1,190	2,600	6,060
9	461	483	433	1,390	2,730	6,410
10	461	479	437	1,180	2,970	6,650
11	458	465	451	1,090	3,000	6,320
12	440	487	461	977	2,910	6,370
13	465	207	458	981	3,010	6,760
14	461	207	*472	1,010	3,030	7,090
15	461	397	479	977	2,970	7,420
16	458	495	507	1,000	3,000	7,630
17	454	305	515	*1,060	2,980	8,010
18	461	*369	543	1,150	2,880	8,300
19	461	342	607	1,150	2,690	8,090
20	451	333	659	a1,100	2,620	8,170
21	461	387	693	a1,030	2,820	8,000
22	461	375	716	a 1,000	2,950	7,380
23	461	402	756	a 970	2,920	6,770
24	458	412	869	a 940	3,000	6,910
25	458	458	882	a 1,000	3,330	7,400
26	451	451	918	a1,050	3,660	7,420
27	211	409	945	a1,050	3,850	*7,670
28	207	402	941	a1,020	3,990	7,320
29	220	——	959	a1,000	4,290	7,450
30	444	——	945	a 980	4,460	7,550
31	458	——	986	——	4,840	——
Mean	435	417	615	1,050	2,850	6,820
Cs/mi	1.09	1.04	1.54	2.63	7.13	17.1
In	1.25	1.09	1.77	2.93	8.23	19.0
Acre-ft.	26,700	23,100	37,800	62,400	175,000	406,000

1969 Year: Mean 2,130 Cs/sq mi 5.31 Inches 72.4

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	7,260	4,340	1,780	873	846	535
2	7,080	4,480	1,690	869	738	535
3	*6,980	4,680	*1,650	842	693	535
4	7,160	4,850	1,600	846	663	*535
5	7,500	4,920	1,550	806	655	535
6	7,690	4,980	1,390	756	655	519
7	7,840	*4,970	1,420	743	655	507
8	7,840	4,900	1,430	734	659	503
9	7,910	4,870	1,440	720	659	503
10	7,670	4,830	1,390	729	659	487
111	8,000	4,530	1,270	873	647	468
12	8,040	4,070	1,270	792	619	472
13	8,240	3,550	1,330	*815	623	454
14	6,940	3,550	1,480	720	623	447
15	*7,180	3,320	1,280	743	603	423
16	7,180	3,070	1,160	738	583	426
17	7,130	3,220	1,110	689	563	426
18	7,200	3,060	1,060	680	551	412
19	7,540	2,780	*1,050	707	547	412
20	7,840	2,650	1,030	689	547	416
21	7,820	2,460	990	680	547	416
22	7,520	*2,030	986	663	547	419
23	7,370	1,890	981	659	547	419
24	7,130	1,820	932	643	551	405
25	6,770	1,550	891	647	551	405
26	6,260	1,700	878	*611	531	409
27	5,770	1,660	869	611	531	409
28	5,100	1,710	860	611	531	412
29	4,330	1,770	860	651	531	412
30	4,180	1,810	*873	729	535	*416
31	4,150	1,810	---	815	---	416
Mean	6,990	3,280	1,220	732	606	454
Cs/mi	17.5	8.20	3.05	1.83	1.52	1.14
In	20.2	9.47	3.39	2.11	1.69	1.31
Acre-ft	430,000	202,000	72,400	45,000	36,100	27,900

Acre-feet: 1,540,000 Max Day 8,300 Min Day 207

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
14 Mar	472	38	79			
6 Jun	5,640	42	61			
27 Jun	7,270	41	67			
3 Jul	6,840	43	111			
15 Jul	6,840	49	134			
19 Sep	1,040	47	42			
30 Sep	846	48	14			
13 Oct	725	45	10			
5 Nov	655	40	144			
26 Nov	531	42	101			
4 Dec	535	36	55			
30 Dec	416	32	42			

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.

KUMMAR RIVER AT MARAN

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										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	
Feb 18	2.16	0.44	0.14		0	1.54	0.19	0.98			2.74	2.71				160	270	7.8	0	0.1
Mar 14	1.76	0.76	0.07		Traces	1.27	0.19	1.03			2.59	2.49				144	240	8.1	0	0.1
Apr 18	1.91	0.44	0.25		0	1.42	0.14	1.10			2.60	2.66				140	250	7.5	0	0.2
Jun 27	0.97	0.31	0.18		0	1.06	0.10	0.32			1.46	1.48				80	140	8.1	0	0.2
Jul 15	0.68	0.26	0.34		0	0.96	0.15	0.27			1.28	1.38				72	130	7.7	0.2	0.5
Aug 22	0.88	0.45	0.20		0	1.18	0.20	0.21			1.53	1.59				80	140	7.8	0	0.2
Nov 5	1.17	0.39	0.19		0	1.20	0.14	0.34			1.75	1.68				92	160	7.8	0	0.2

Blank page retained for pagination

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 20 June 1969 by Surface Water Hydrology Project, WASID, WAPDA. Gauge heights only October 1958 to June 1962 by Hydrology Directorate of Irrigation Department. Site closed in June 1969.

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 Data incomplete.
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 0.01' from 08:00 to 16:00 hours daily during low flow and 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 Six discharge measurements were made upto June 1969 by current meter using 0.2 and 0.8 depth method from bridge. Six sets of sediment samples were taken by depth integration method using D-49 sample . All of them were analysed for total concentration. Four 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. Site closed in June 1969.

KUNHAR RIVER AT KHANIAN

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	711	841	681	1,580	1,630	9,330
2	698	853	702	1,650	1,720	9,800
3	691	879	735	1,680	1,880	9,750
4	688	888	739	1,690	*1,990	8,640
5	677	874	735	1,720	2,420	7,850
6	670	845	745	1,890	2,790	7,840
7	667	833	757	2,080	3,020	*8,170
8	660	825	773	2,240	3,730	9,240
9	667	817	797	2,380	4,160	8,920
10	656	809	853	*2,480	4,660	9,360
11	635	757	*937	2,580	4,620	8,750
12	628	*711	987	2,480	4,230	9,020
13	646	593	1,070	2,270	4,300	9,300
14	653	642	1,100	3,320	3,770	10,400
15	625	667	1,120	3,180	3,310	10,500
16	625	653	1,190	2,690	3,120	10,700
17	621	660	1,320	2,590	3,160	11,300
18	621	649	1,560	2,310	3,650	11,300
19	618	653	1,450	*2,390	3,400	11,400
20	583	656	1,170	2,390	3,520	11,300
21	579	635	1,120	2,080	3,960	
22	576	628	1,150	2,060	4,780	
23	572	632	1,130	1,940	4,660	
24	572	829	1,160	1,880	4,790	
25	579	801	1,730	1,830	5,240	
26	727	821	1,570	1,770	5,830	
27	745	837	1,490	1,810	6,490	
28	727	674	1,430	1,870	7,030	
29	757	—	1,370	1,890	7,590	
30	805	—	1,390	1,720	8,250	
31	813	—	1,510	—	8,670	
Mean	661	749	1,110	2,080	4,270	
Cs/mi	1.14	1.29	1.91	3.59	7.36	
In	1.31	1.34	2.21	4.13	8.49	
Acre-ft.	40,600	41,600	68,400	126,000	263,000	

1969 Year: Mean Cs/sq mi Inches

Note : * Discharge measurement made on this day.

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Feb	707	34	17			
11 Mar	968	43	64			
10 Apr	2,460	43	140			
19 Apr	2,400	44	124			
4 May	1,970	44	267			
7 Jun	8,110	44	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.

KUNHAR RIVER AT KHANIAN

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at 25°C	pH	Res CO_3 me/l	SAR
	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	Cations	Anions	SiO_2	Fe	B	D.S. by Evap.				
Mar 11	2.53	0.09	0.10		Traces	1.37	0.19	1.02			2.72	2.58				148	250	8.2	0	0.1
Apr 10	1.36	0.53	0.20		0	1.05	0.14	0.91			2.09	2.10				116	200	7.6	0	0.2
May 4	1.60	0.55	0.11		0	1.24	0.14	0.82			2.26	2.20				124	220	7.4	0	0.1
Jun 7	1.14	0.19	0.10		0	0.97	0.19	0.24			1.43	1.40				80	140	7.7	0	0.1

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, WASID, WAPDA. Gauge heights only at bridge near Garhi Habib Ullah 1944 to 1954 by Irrigation and Power Department, 1954 to 1958 by Dams Investigation Circle and 1958 to June 1962 by Hydrology Directorate of Irrigation Department.

Average discharge 3,850 cusecs (2,790,000 acre-feet per year or 57.2 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge during the year 40,900 cusecs on 10 August (gauge height 26.44 feet), minimum daily discharge 791 cusecs on 27 January.

1960-69: Maximum discharge 40,900 cusecs on 10 August 1969; minimum daily discharge 268 cusecs on 9 February 1967.

Gauge Continuous automatic water stage recorder in masonry shelter, zero R.L. of inside gauge 2691.41. Prior to 21 June 1961 staff gauge a short distance upstream set to reduced level.

Measurements Eighty five 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 Sixty eight sets of sediment samples were taken by depth integration method using D-49 sampler. Twelve 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 The stage discharge relation at this site is controlled by channel characteristics. Ther is continuous movement of boulders and gravel under the influence of high velocities. Rating table dated 21.10.64 was used to compute discharges with shift adjustments as indicated by periodic discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	964	1,260	1,320	3,040	2,790	10,800
2	950	1,110	1,310	3,110	2,860	11,100
3	915	1,130	*1,330	*3,170	*3,060	*11,200
4	929	1,130	1,350	3,130	3,250	10,100
5	915	*1,090	*1,390	3,130	3,900	9,000
6	908	1,060	1,380	3,290	4,410	*8,670
7	943	1,040	1,460	3,650	*4,710	9,080
8	915	1,020	1,480	*3,910	5,270	9,290
9	943	1,030	*1,550	3,990	6,860	10,100
10	908	1,040	*1,640	4,250	7,060	10,800
11	887	1,030	1,760	4,620	6,410	*10,000
12	*915	1,050	1,940	*5,200	6,020	10,300
13	943	1,210	2,140	4,450	*5,990	11,200
14	908	1,210	*2,250	4,310	5,500	11,900
15	890	1,210	2,360	5,280	4,870	11,900
16	890	1,160	2,390	5,410	4,460	*12,100
17	880	1,200	2,510	5,070	4,490	12,900
18	901	1,170	3,010	4,250	4,870	*12,900
19	880	1,150	3,210	3,970	4,630	13,800
20	854	1,100	2,710	a3,960	4,830	13,800
21	874	1,110	*2,510	3,950	5,280	*13,300
22	915	1,100	2,560	*3,540	6,060	12,000
23	874	1,110	2,440	3,390	*6,050	11,100
24	874	*1,280	2,390	*3,260	6,120	11,000
25	922	1,230	*3,980	3,140	6,470	11,900
26	1,220	1,270	4,070	3,010	6,900	*11,900
27	791	1,420	3,330	2,900	7,390	12,300
28	809	1,370	3,100	3,310	8,220	11,300
29	*841	———	*2,910	3,140	8,900	11,000
30	1,100	———	2,910	2,910	9,490	11,100
31	1,150	———	2,950	———	10,500	———
Mean	920	1,150	2,310	3,790	5,730	11,300
Cs/mi	1.00	1.25	2.51	4.12	6.23	12.3
In	1.16	1.31	2.90	4.60	7.18	13.7
Maf	.057	.064	.142	.226	.352	.670

1969 Year: Mean 4,250 Cs/sq mi 4.62 Inches 63.0

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	10,800	7,420	3,970	*2,010	1,890	1,170
2	10,600	7,700	3,770	1,970	1,900	1,150
3	11,900	*8,010	3,650	1,920	1,840	1,160
4	*13,000	8,450	3,540	2,020	1,800	a1,160
5	12,700	*8,690	*3,370	1,850	1,760	a1,160
6	a13,100	*10,100	*3,320	1,780	*1,720	a1,150
7	13,500	9,440	3,170	1,710	1,770	a1,140
8	14,300	*8,960	*3,010	1,680	1,670	a1,130
9	14,500	9,230	2,880	1,640	1,650	a1,120
10	13,500	15,000	2,780	1,600	1,580	a1,120
11	*13,600	*9,360	2,680	2,020	*1,530	a1,110
12	12,600	8,540	*2,730	1,880	*1,840	a1,090
13	12,400	7,210	*2,800	1,660	1,580	a1,080
14	11,800	7,410	*3,850	1,710	1,500	a1,060
15	*11,100	7,560	*3,140	1,820	1,420	a1,050
16	11,400	7,390	2,680	1,820	1,400	a1,030
17	11,500	8,420	*2,470	1,610	*1,360	a1,020
18	11,600	7,460	*2,420	1,520	1,330	a 990
19	*12,200	7,030	2,350	1,490	1,350	*978
20	12,900	6,360	*2,310	1,500	1,360	943
21	12,900	5,960	2,230	1,460	1,340	943
22	*12,800	5,480	2,210	1,450	1,300	943
23	12,200	*4,660	*2,220	1,450	1,290	936
24	11,800	4,490	2,130	*1,450	1,270	929
25	11,800	4,350	*2,060	1,390	1,250	929
26	10,800	*4,230	2,020	1,380	1,230	*929
27	*9,680	4,070	*1,960	a1,720	1,230	*922
28	*8,700	*4,040	1,950	*3,350	1,220	901
29	7,620	4,050	1,960	2,910	*1,210	922
30	*7,560	4,110	1,970	2,160	1,190	922
31	7,420	*4,010	———	*1,960	———	901
Mean	11,700	7,070	2,720	1,800	1,490	1,030
Cs/mi	12.7	7.69	2.96	1.96	1.62	1.12
In	14.6	8.86	3.30	2.26	1.81	1.29
Maf	.719	.435	.162	.111	.089	.063

M. Acre-feet: 3.09 Max Day 15,000 Min Day 791

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
9 Jan	978	42	29			
12 Jan	936	41	24			
13 Jan	964	41	17			
19 Jan	880	40	26			
24 Jan	887	41	22			
29 Jan	841	41	17			
5 Feb	1,090	42	66			
24 Feb	1,390	43	243			
5 Mar	1,380	43	101			
9 Mar	1,510	47	201			
14 Mar	2,120	48	188			
21 Mar	2,510	49	255			
25 Mar	4,200	48	4,860	14	76	10
29 Mar	2,870	49	220			
3 Apr	3,040	49	149			
12 Apr	5,310	49	3,030	18	64	18
22 Apr	3,530	49	121			
24 Apr	3,270	48	95			
29 Apr	3,140	50	153			
3 May	3,230	50	258			
7 May	4,780	49	263			
13 May	6,080	50	1,800	58	31	11
23 May	5,670	52	938	32	43	25
3 Jun	11,100	50	278			
6 Jun	8,280	50	125			
11 Jun	10,000	49	911	39	57	4
16 Jun	11,100	51	1,320	49	41	8
21 Jun	12,400	50	163			
26 Jun	12,600	51	287			
4 Jul	12,600	50	7,040	24	58	18
11 Jul	13,100	52	802	56	27	17
19 Jul	11,900	54	215			
22 Jul	12,200	53	327	30	38	32
27 Jul	8,820	53	91			
28 Jul	9,060	54	32			
30 Jul	7,650	54	78			
5 Aug	9,080	56	1,540	59	33	8
6 Aug	10,600	56	2,110	21	60	19
6 Aug	13,300	57	20,000	8	74	18
8 Aug	8,160	62	256			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
23 Aug	4,550	62	108			
26 Aug	4,270	61	128			
28 Aug	3,800	62	107			
5 Sep	3,200	60	113			
6 Sep	3,310	59	41			
8 Sep	2,930	62	81			
12 Sep	2,750	63	37			
13 Sep	2,870	62	32			
14 Sep	4,400	58	127			
14 Sep	4,430	58	129			
15 Sep	3,150	57	84			
17 Sep	2,400	59	53			
20 Sep	2,240	63	14			
23 Sep	2,160	59	23			
25 Sep	1,990	62	26			
27 Sep	2,010	62	27			
1 Oct	2,020	61	125			
31 Oct	1,840	53	24			
6 Nov	1,710	53	103			
11 Nov	2,500	53	68			
12 Nov	1,760	64	102			
17 Nov	999	51	23			
29 Nov	1,210	45	40			
5 Dec	1,150		75			
10 Dec	1,080	56	68			
19 Dec	992	55	74			
26 Dec	978	40	34			
27 Dec	938	44	60			

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 - 1969

Date	MILLIEQUIVALENTS PER LITER											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	TOTAL Cations	TOTAL Anions	SiO_2	Fe	B	D.S. by Evap.			me/l	
Jan 9	2.17	0.55	0.20		0	1.66	0.19	1.00			2.92	2.85				158	270	8.1	0	0.2
Feb 24	2.67	0.50	0.22		0	2.71	0.14	0.55			3.39	3.40				184	330	7.9	0	0.2
Mar 5	2.35	0.56	0.22		0	1.96	0.24	1.06			3.13	3.26				172	300	7.9	0	0.2
14	2.20	0.37	0.01		Traces	1.57	0.19	0.87			2.58	2.63				146	250	8.2	0	0.2
Apr 3	1.80	0.59	0.25		0	1.38	0.14	1.17			2.64	2.69				136	250	7.3	0	0.2
12	1.80	0.60	0.25		0	1.47	0.14	0.94			2.65	2.55				138	250	7.8	0	0.2
May 3	1.71	0.29	0.11		0	1.46	0.19	0.47			2.11	2.12				120	210	8.0	0	0.1
27	1.20	0.41	0.24		0	1.27	0.19	0.35			1.85	1.81				100	180	7.8	0	0.3
Jun 26	1.48	0.29	0.18		0	1.46	0.19	0.29			1.95	1.94				108	190	8.1	0	0.2
Jul 4	1.03	1.19	0.18		0	2.14	0.15	0.17			2.40	2.46				136	240	7.9	0	0.2
Aug 23	1.05	0.54	0.16		0	1.28	0.15	0.30			1.75	1.73				96	170	7.9	0	0.2
Sep 5	1.27	0.64	0.20		0	1.28	0.15	0.70			2.11	2.13				116	200	7.8	0	0.2
Oct 31	1.84	0.55	0.18		0	1.57	0.10	0.85			2.57	2.52				144	250	7.7	0	0.2
Nov 17	2.07	0.69	0.24		0	1.70	0.19	1.10			3.00	2.99				158	280	8.0	0	0.2
Dec 19	1.96	0.82	0.21		0	1.55	0.14	1.24			2.99	2.93				162	280	8.0	0	0.2

Location Latitude 34°07', Longitude 73°30', on right bank nearly ½ miles downstream of Kohala Bridge on Murree-Muzaffarabad Road.

Drainage area 9,610 square miles.

Records available Gauge height record of old gauge from January 1960 to December 1968 by Surface Water Hydrology Project, WASID, WAPDA. Periodic discharge measurements started from December 1964. Gauge height record from 1899 to date with Hydrology Directorate of Irrigation Department, Lahore. The new gauge was established by Surface Water Hydrology Project on right bank since April 1968.

Average discharge 32,200 cusecs (23,300,000 acre-feet per year or 45.5 inches runoff per year). Average taken for 5 years from 1965 to 1969.

Extremes Maximum discharge during the year 98,000 cusecs on 10 August (gauge height 29.80 feet); minimum daily discharge 5,270 cusecs on 29 December.

1965-69: Maximum discharge observed 132,000 cusecs on 24 April 1965 (gauge height 64.00 feet ; old gauges)minimum daily discharge 3,670 cusecs on 27-28 January 1966.

Gauge Staff gauge fixed in steps on right bank near the cableway. Gauge being read at one hour interval throughout the year. R.L. of gauge 1843.27 (levelling in May 1969). Prior to this a staff gauge was fixed on left bank upstream of Kohala bridge and used upto December 1968.

Measurements Seventy seven discharge measurements were made during the year using 0.2 and 0.8 depth method from the cableway nearly 1½ miles downstream of bridge. Sixty sets of sediment samples were taken by depth integration method using D-49 sampler from cableway. Ninateen 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 The station is controlled by the channel characteristics. The stage discharge relation could be affected by movement of stones and boulders on the bed of the channel. Rating dated 28.5.70 was used to compute the mean daily discharges with shift adjustments where indicated necessary by periodic measurements.

Remarks Record fair, may be 5% to 10% on the higher side.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	7,270	13,100	*19,500	38,500	45,900	83,800
2	7,090	10,300	18,600	*38,900	45,300	86,500
3	7,060	*10,600	18,200	39,300	48,000	85,300
4	*6,940	*11,200	18,300	38,500	*48,500	83,000
5	6,800	*11,200	*18,900	36,700	51,000	*75,200
6	6,700	*11,000	19,900	*35,800	55,200	69,500
7	6,640	*10,800	20,600	38,200	58,600	70,300
8	6,560	*10,600	20,800	40,300	61,400	69,600
9	6,530	*10,500	*21,400	42,600	65,000	70,400
10	*6,520	*10,300	22,400	43,700	*69,900	72,900
11	6,470	*10,100	23,500	45,500	70,300	*70,200
12	*6,320	10,100	24,800	*52,100	68,500	67,900
13	6,620	*12,600	26,400	49,800	74,500	68,800
14	6,650	*13,400	27,900	47,300	78,000	71,400
15	6,320	12,500	29,800	53,000	*68,300	72,200
16	6,160	11,900	30,900	60,100	63,600	71,900
17	6,290	12,800	31,400	*56,000	60,500	73,100
18	6,520	13,200	34,700	50,000	60,700	*74,900
19	*6,610	*13,300	49,800	44,300	64,800	76,400
20	6,610	13,300	*45,400	51,600	*65,000	78,200
21	6,410	13,100	38,200	54,100	66,400	77,200
22	6,340	12,900	36,900	*47,900	69,700	70,300
23	*6,560	12,800	37,500	44,200	74,100	*67,000
24	6,410	*13,600	*35,600	41,000	71,600	64,900
25	6,440	15,800	40,800	38,900	69,500	65,700
26	9,140	16,300	52,900	37,400	*71,600	65,600
27	8,480	16,300	46,500	36,400	72,000	66,600
28	8,120	16,000	41,400	41,100	74,400	67,300
29	*8,370	———	39,200	55,100	77,700	*64,200
30	9,430	———	38,200	*49,600	79,400	61,300
31	9,570	———	38,400	———	*82,700	———
Mean	7,030	12,500	31,300	44,900	65,600	72,100
Cs/mi	0.73	1.30	3.26	4.67	6.83	7.50
In	0.84	1.35	3.75	5.22	7.86	8.37
Maf	.432	.693	1.92	2.67	4.03	4.29

1969 Year: Mean 31,100 Cs/sq mi 3.24 Inches 44.00

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	60,100	*40,200	21,400	11,300	13,900	7,430
2	58,400	41,100	20,700	12,300	13,500	7,330
3	60,200	42,100	*19,300	11,600	13,300	7,180
4	64,800	43,500	18,200	11,400	13,000	7,120
5	64,600	*44,100	17,300	10,900	12,400	7,070
6	64,100	45,600	*17,700	*10,400	11,900	7,010
7	66,700	47,000	16,800	10,100	12,000	*6,880
8	69,000	43,600	*16,100	9,840	11,900	6,790
9	*71,400	43,700	15,300	9,680	*11,600	6,680
10	68,900	*52,500	14,500	9,550	11,200	6,620
11	66,700	*48,400	14,100	11,300	10,700	6,560
12	*65,500	45,300	*14,000	12,200	11,500	6,490
13	64,400	39,700	14,100	*10,300	*11,300	6,400
14	63,100	39,400	*18,100	10,100	10,800	6,320
15	58,900	*38,700	17,600	11,200	10,300	6,140
16	58,600	36,200	*15,300	12,400	9,950	6,100
17	58,800	36,500	14,000	11,100	9,700	6,060
18	*59,200	*36,700	*13,600	10,500	9,420	5,980
19	*60,100	36,500	13,400	9,950	9,230	5,890
20	*63,600	35,300	13,000	9,680	*9,190	5,850
21	*65,500	*33,100	*12,700	9,450	9,020	5,710
22	65,500	32,900	12,400	9,190	8,820	5,580
23	62,100	28,600	12,700	9,020	8,690	5,530
24	61,500	*26,200	*12,300	8,970	8,470	5,500
25	59,500	25,200	11,900	8,720	8,260	5,450
26	56,500	24,400	11,700	8,560	8,100	5,400
27	*51,900	*23,200	*11,400	8,970	7,920	5,340
28	49,600	22,700	11,300	*27,500	7,830	5,310
29	42,900	22,500	11,300	23,000	7,690	5,270
30	39,400	22,400	11,300	17,500	7,570	*5,280
31	39,100	*21,700	———	14,500	———	5,430
Mean	60,000	36,100	14,800	11,700	10,300	6,180
Cs/mi	6.24	3.76	1.54	1.22	1.07	0.64
In	7.20	4.33	1.72	1.40	1.20	0.74
Maf	3.69	2.22	.880	.716	.613	.380

M. Acre-feet: 22.5 Max Day 86,500 Min Day 5,270

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Jan	6,520	44	102			
17 Jan	6,310	45	97			
19 Jan	6,670	44	115			
23 Jan	6,530	47	56			
29 Jan	8,400	50	117			
4 Feb	11,400	50	100			
5 Feb	11,200	50	80			
6 Feb	11,100	50	86			
7 Feb	11,000	52	57			
8 Feb	10,500	50	58			
9 Feb	10,500	50	75			
11 Feb	10,100	50	79			
19 Feb	13,500	46	291			
24 Feb	13,700	52	1,290	3	60	37
9 Mar	21,800	60	345	17	52	31
20 Mar	47,100	47	2,380	4	62	34
24 Mar	35,700	60	559	17	24	59
2 Apr	39,700	64	484	37	30	33
6 Apr	36,000	63	174			
12 Apr	53,800	65	1,630	43	43	14
17 Apr	56,700	61	704	5	64	31
22 Apr	48,400	58	551	18	60	22
30 Apr	49,500	50	1,900	13	56	31
4 May	49,100	62	201			
10 May	71,700	62	809	18	61	21
15 May	70,400	58	469	19	49	32
26 May	65,100	62	436	33	42	25
5 Jun	76,900	62	212			
9 Jun	71,600	64	292			
11 Jun	71,500	60	290			
18 Jun	75,300	60	321	36	45	19
23 Jun	68,500	61	291			
29 Jun	65,800	62	276			
9 Jul	73,400	64	413	29	57	14
12 Jul	65,200	70	220			
18 Jul	56,000	75	86			
19 Jul	62,800	66	217			
20 Jul	71,300	68	245			
21 Jul	65,000	66	211			
27 Jul	52,800	69	164			

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
1 Aug	41,700	72	75			
5 Aug	41,800	76	583	16	48	36
10 Aug	65,600	62	1,390	15	57	28
15 Aug	48,300	66	254			
21 Aug	31,700	66	1,720	6	70	24
24 Aug	26,500	70	302			
31 Aug	22,600	68	165			
3 Sep	18,900	66	137			
8 Sep	16,100	64	190			
12 Sep	14,300	65	67			
14 Sep	22,300	64	593	4	69	27
18 Sep	13,600	63	119			
24 Sep	12,400	67	75			
27 Sep	11,400	64	36			
13 Oct	10,300	68	138			
28 Oct	31,400	58	4,200	5	52	43
13 Nov	11,200	52	104			
20 Nov	9,230	50	61			
9 Dec	6,860	48	72			
30 Dec	5,250	48	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.

JHELUM RIVER AT KOHALA

Chemical Analysis of Water Samples - 1969

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																				
10	1.83	0.67	0.17		0.18	1.70	0.24	0.62			2.67	2.74				142	250	8.2	0	0.2
Feb																				
3	1.94	0.45	0.22		0.19	1.66	0.24	0.52			2.61	2.61				140	250	8.2	0	0.2
14	1.84	0.52	0.22		0.19	1.66	0.29	0.49			2.58	2.63				132	250	8.2	0	0.2
Mar																				
1	1.67	0.54	0.18		0	1.80	0.19	0.46			2.39	2.45				124	220	7.8	0	0.2
20	1.63	0.26	0.13		0	1.52	0.19	0.33			2.02	2.04				116	200	7.7	0	0.1
Apr																				
2	1.36	0.42	0.25		0	1.28	0.19	0.66			2.03	2.13				118	200	7.6	0	0.3
12	1.53	0.41	0.25		0	1.47	0.19	0.57			2.19	2.23				124	210	7.7	0	0.2
May																				
4	1.65	0.62	0.18		0.19	1.55	0.29	0.48			2.45	2.51				132	230	8.2	0	0.2
10	1.37	0.52	0.14		0	1.65	0.19	0.23			2.03	2.07				110	200	7.9	0	0.1
Jun																				
9	1.25	0.42	0.20		0	1.36	0.19	0.26			1.87	1.81				96	170	8.1	0	0.2
Jul																				
9	1.04	0.34	0.14		0	1.24	0.15	0.12			1.52	1.51				80	140	7.9	0	0.2
Aug																				
1	0.99	0.49	0.21		0	1.45	0.20	0.09			1.69	1.74				100	170	8.2	0	0.2
5	1.54	0.47	0.19		0	1.87	0.20	0.20			2.20	2.27				124	220	8.2	0	0.2
21	1.26	0.49	0.21		0	1.77	0.10	0.12			1.96	1.99				110	190	8.0	0.02	0.3
Oct																				
28	1.94	0.64	0.20		0	2.06	0.15	0.60			2.78	2.81				152	270	7.9	0	0.2
Nov																				
20	1.85	0.73	0.24		0	1.90	0.19	0.71			2.82	2.80				144	260	7.9	0	0.2
Dec																				
30	1.73	1.00	0.25		0	1.90	0.19	0.86			2.98	2.95				160	280	7.8	0	0.2

Location Latitude 33°36', Longitude 73°37', wire - weight gauge fixed on downstream side of the bridge on Rawalpindi - Kotli (Azad Kashmir) road, nearly 45 miles from Rawalpindi.

Drainage area 10,300 square mile.

Records available Mean daily discharge record from April 1969 to date by Surface Water Hydrology Project, WASID, WAPDA. Gauge height observations were started from 27 January 1969.

Extremes Maximum discharge during the year 88,200 cusecs on 10 August (gauge height 54.06 feet); minimum daily discharge not available as the record is incomplete for low flow.

Gauge Wire - weight gauge read to hundredth of a foot from 08:00 to 16:00 hours or 06:00 to 18:00 hours daily fixed on the downstream side of the bridge. Gauge set to arbitrary datum.

Measurements Forty six discharge observations were made during the year, from the bridge, using 0.2 and 0.8 depth method. Thirty two sets of sediment samples were taken by depth integration method using D-49 sampler from the bridge. Sixteen of these were analysed for particle size distribution and the rest for total concentration. Thirteen Surface samples were collected and analysed for chemical composition.

Determination of discharge Rating curve dated 30.5.70 was developed from all the available measurements. This curve was applied to mean daily gauge heights to compute the mean daily discharges.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1				38,800	47,900	82,500
2				38,600	47,300	83,900
3				39,200	48,700	81,900
4				39,900	49,100	81,500
5				38,600	51,800	74,600
6				37,700	54,800	*70,300
7				39,900	57,700	70,700
8				42,600	*59,500	70,800
9				44,200	63,300	71,100
10				44,300	66,500	73,600
11				46,400	67,700	70,800
12				52,200	66,600	68,300
13				51,600	73,700	69,600
14				49,100	75,500	71,600
15				*47,700	*67,400	71,700
16				*58,700	61,900	72,400
17				56,200	59,600	74,800
18				*50,200	60,600	76,400
19				45,100	63,500	*76,600
20				52,000	63,900	77,400
21				54,000	*65,300	76,900
22				49,000	68,400	71,100
23				*45,300	72,200	67,500
24				43,100	69,600	65,600
25				41,100	68,500	67,200
26				39,500	71,000	*66,700
27				39,000	70,900	68,100
28				40,800	73,300	66,900
29				63,000	75,900	65,300
30				51,400	78,400	63,100
31				———	80,400	———
Mean				46,000	64,500	72,300
Cs/mi				4.47	6.26	7.02
In				4.98	7.22	7.83
Maf				2.74	3.97	4.30

1969 Year : Mean Cs/sq mi inches

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	61,800	45,000	24,700	12,500	16,100	8,030
2	60,200	45,600	*23,800	14,900	15,500	7,870
3	63,300	45,800	22,600	13,600	14,900	7,670
4	66,700	50,800	*21,700	12,800	*14,400	7,580
5	66,200	51,100	*20,600	12,300	13,700	7,490
6	66,800	55,800	22,400	11,700	13,200	7,550
7	67,700	*55,800	20,600	11,400	13,200	7,370
8	71,300	50,900	*18,900	11,100	12,900	*7,210
9	*72,800	52,200	18,400	10,900	12,500	7,100
10	*70,800	*68,900	17,300	10,700	12,100	6,920
11	68,600	52,300	*16,800	14,300	11,700	6,870
12	*66,600	*47,300	16,500	14,400	12,000	6,810
13	66,000	40,900	16,700	11,900	12,500	6,650
14	67,600	39,600	*21,300	12,500	11,800	6,580
15	*60,300	*42,300	20,100	*13,000	11,300	6,460
16	61,700	39,700	17,200	13,400	10,800	6,470
17	*61,400	41,200	*15,500	12,600	10,500	6,430
18	61,600	42,100	14,900	11,700	10,300	6,330
19	62,700	*43,400	14,800	11,000	10,000	6,290
20	67,300	40,200	*14,500	10,900	10,100	6,250
21	67,800	*36,900	14,200	10,600	9,940	*6,140
22	*68,700	*37,900	13,900	10,300	9,760	6,000
23	*54,500	32,600	*14,200	10,200	9,410	5,990
24	68,600	30,200	14,000	10,100	9,170	5,850
25	62,500	*29,700	13,500	*9,890	8,940	5,800
26	62,700	28,700	*13,200	9,660	8,750	5,730
27	*55,800	27,100	12,800	9,880	8,560	5,780
28	60,300	*26,200	12,500	31,500	8,430	5,740
29	49,200	25,500	12,500	25,700	*8,250	5,700
30	44,600	25,800	12,500	21,000	8,140	5,750
31	44,100	*25,100	———	17,700	———	5,710
Mean	63,000	41,200	17,100	13,400	11,300	6,580
Cs/mi	6.12	4.00	1.66	1.30	1.10	0.64
In	7.08	4.61	1.85	1.50	1.22	0.74
Maf	3.89	2.53	1.02	.821	.672	.405

M. Acre-feet: Max Day Min Day

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Apr	48,600	66	823	39	38	23
23 Apr	45,300	60	626	25	24	51
28 Apr	40,000	58	290			
8 May	58,900	75	825	42	43	15
15 May	65,100	62	1,010	40	37	23
21 May	66,100	64	705	27	40	33
6 Jun	70,200	64	671	51	35	14
19 Jun	77,400	62	711	45	40	15
26 Jun	66,400	68	399	33	47	20
27 Jun	57,400	78	2,840	47	46	7
7 Aug	53,200	71	999	7	85	8
10 Aug	87,100	73	7,580	16	64	20
12 Aug	47,800	73	1,580	15	68	17
15 Aug	43,300	73	2,860	29	63	8
19 Aug	39,100	74	2,580	20	58	22
21 Aug	37,200	70	1,260	10	56	34
25 Aug	29,500	73	191			
8 Sep	18,600	68	180			
11 Sep	16,700	72	162			
14 Sep	23,600	76	4,370	3	54	43
17 Sep	15,400	70	186			
20 Sep	14,400	68	171			
21 Sep	14,200	72	92			
23 Sep	13,700	70	88			
26 Sep	13,200	68	141			
29 Sep	12,400	66	90			
15 Oct	13,400	68	293			
25 Oct	9,930	68	85			
4 Nov	14,600	60	245			
29 Nov	8,280	50	64			
8 Dec	7,210	51	69			
21 Dec	6,180	48	186			

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 KAHOT

Chemical Analysis of Water Samples - 1969

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.	$EC \times 10^6$ at 25°C	pH	Res CO_3	SAR
	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION						me/l	
Apr																				
15	1.52	0.37	0.19		0	1.67	0.19	0.25			2.08	2.11				116	200	7.7	0	0.2
23	1.41	0.69	0.10		0	1.66	0.19	0.45			2.20	2.13				128	220	7.7	0	0.1
28	1.24	0.70	0.11		0	1.47	0.19	0.41			2.05	2.07				116	200	7.9	0	0.1
May																				
8	1.30	0.43	0.11		0	1.29	0.19	0.41			1.84	1.89				104	180	7.5	0	0.1
21	0.99	0.74	0.11		0.8	1.32	0.09	0.35			1.84	1.84				104	180	8.2	0	0.1
Jun																				
6	1.03	0.47	0.11		0	1.27	0.14	0.23			1.61	1.64				88	150	7.8	0	0.1
10	1.14	0.30	0.10		0	1.16	0.19	0.22			1.54	1.57				84	150	8.0	0	0.1
Jul																				
27	1.10	0.70	0.21		0	1.50	0.10	0.31			2.01	1.91				108	190	8.1	0	0.3
Aug																				
18	1.54	0.79	0.16		0	2.06	0.10	0.26			2.49	2.42				132	230	8.0	0	0.1
Sep																				
8	1.10	0.96	0.30		0	1.86	0.45	0.10			2.36	2.41				124	220	8.2	0	0.3
Oct																				
15	1.60	0.79	0.24		0	1.94	0.20	0.52			2.63	2.66				144	250	7.8	0	0.2
Nov																				
4	1.84	0.64	0.14		0	1.87	0.29	0.55			2.62	2.71				142	250	7.8	0	0.1
Dec																				
21	1.57	1.00	0.21		0	1.90	0.19	0.63			2.78	2.72				148	260	8.1	0	0.2

Blank page retained for pagination

Location Latitude 33°11', Longitude 73°23', 3 furlongs downstream from the Grand Trunk Road, 1½ 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, WASID, WAPDA.

Average discharge 10.6 cusecs (7,640 acre-feet per year or 2.47 inches runoff per year). Average taken for 8 years for 1962 to 1969.

Extremes Maximum discharge observed during the year 3,040 cusecs on 21 July (gauge height 7.42 feet). Zero flow for many days.

July 1961-69: 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 Forty three discharge measurements were made during the period 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 from the highway bridge 3 furlong upstream. Eighteen sets of sediment samples were taken by depth integrating method using DH-48 sampler while wading or D-49 sampler from the bridge. Fifteen of these were analysed for particle size distribution and the rest for total concentration. Four 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 continued. Daily mean discharges were computed by suing above table with shift adjustments to the gauge heights.

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

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	2.4	5.7	2.5	1.1	2.4	0
2	2.4	3.2	2.3	1.1	1.5	0
3	2.4	2.9	2.2	0.9	1.1	0
4	2.4	2.9	1.9	0.9	0.9	0
5	2.4	2.8	1.8	0.8	0.8	0
6	2.4	2.5	*1.8	0.6	0.6	0
7	2.4	2.4	1.8	0.7	0.5	0
8	2.4	2.4	1.6	0.7	0.4	0
9	2.4	2.4	1.5	0.6	0.3	0
10	2.4	2.4	1.5	0.6	0.2	0
11	2.4	2.4	1.4	0.7	0.1	0
12	*2.4	2.4	1.4	0.8	0	0
13	2.7	4.0	1.2	0.8	13	0
14	2.9	8.3	1.3	0.7	9.7	0
15	2.7	4.4	1.3	1.4	7.3	0
16	2.7	3.7	1.3	1.6	3.0	0
17	2.5	4.0	1.3	1.8	1.5	0
18	2.4	*3.7	1.4	1.4	1.1	0
19	2.4	3.3	2.4	*1.1	0.8	0
20	2.4	2.8	1.9	5.1	*0.8	0
21	2.4	2.4	1.7	2.5	0.5	0
22	2.4	2.4	1.7	2.4	0.4	0
23	2.4	2.3	2.1	1.6	0.2	0
24	2.4	2.3	1.7	1.2	0.1	0
25	2.4	3.0	1.9	0.8	0	0
26	2.4	4.0	3.7	0.6	0	0
27	*2.4	a 3.5	2.9	0.5	0	0
28	2.4	a 3.0	2.1	0.5	0	0
29	2.4	---	1.6	7.4	0	0
30	2.4	---	1.3	4.0	0	0
31	2.4	---	*1.1	---	0	---
Mean	2.4	3.3	1.8	1.5	1.5	0
Cs/mi	0.04	0.06	0.03	0.03	0.03	0
In	0.05	0.06	0.04	0.03	0.03	0
Acre-ft.	151	181	110	89	94	0

1969 Year: Mean 5.0 Cs/sq mi 0.09 Inches 1.18

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

MISHAN DAUR KAS NEAR MISSA

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0.3	0.5	0	0	0.4
2	0	0.1	0.4	0	0	0.4
3	0	0	0.1	0	0	0.5
4	0	0	0	0	0	0.5
5	0	0	0	0	0	0.5
6	0	0	5.9	0	0	0.5
7	0	0.4	13	0	0	0.5
8	0	0.2	*10	0	0	0.5
9	0	0.4	*83	0	0	0.5
10	*6.5	0.4	3.2	0	0	0.5
11	3.0	0.1	*1.5	0	0	a 0.5
12	0.9	*484	1.4	1.0	0	a 0.5
13	0.2	*13	1.1	2.1	0.2	0.5
14	0	5.2	*1.5	3.9	*0.3	0.5
15	32	*80	*97	1.5	0.5	0.5
16	15	12	*14	1.1	0.5	0.5
17	0.7	2.9	3.9	1.2	0.3	*0.5
18	0.3	1.8	2.3	1.1	0.2	0.5
19	0.2	*1.4	1.4	0.7	0.2	0.5
20	0	0.7	1.2	0.6	0.2	0.6
21	*430	*0.7	1.0	0.5	0.2	0.6
22	*57	2.1	0.8	0.4	0.2	0.6
23	*4.0	1.1	0.7	0.4	0.2	0.7
24	*5.0	0.7	0.5	0.3	0.2	0.7
25	*5.0	0.6	0.5	0.3	0.2	0.7
26	*1.7	*31	0.3	0.3	0.3	0.7
27	*0.6	3.0	0.2	0.3	0.3	*0.7
28	26	1.9	0.1	0.3	0.3	0.8
29	4.8	1.3	0	0.2	0.4	0.8
30	1.6	0.8	0	0.2	0.4	0.8
31	0.8	0.6	---	0.1	---	0.8
Mean	19	21	8.2	0.5	0.2	0.6
Cs/mi	0.33	0.36	0.14	0.01	0	0.01
In	0.38	0.41	0.16	0.01	0	0.01
Acre-ft.	1,180	1,280	487	33	10	35

Acre-feet: 3,650 Max Day 484 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Jul	8.5	87	808	5	44	51
21 Jul	379	80	24,400	5	56	39
21 Jul	179	78	15,800	1	58	41
22 Jul	16	80	7,520	0	63	37
23 Jul	4.6	82	691	5	47	48
24 Jul	4.3	82	176			
25 Jul	5.5	88	163			
26 Jul	1.7	93	49			
12 Aug	358	78	20,900	5	72	23
12 Aug	254	78	9,390	1	44	55
13 Aug	8.3	85	1,010	6	28	66
15 Aug	176	80	9,180	1	41	58
26 Aug	56	79	905	9	48	43
8 Sep	12	74	963	3	33	64
9 Sep	281	74	18,900	5	48	47
9 Sep	187	77	8,800	17	49	34
15 Sep	110	72	11,600	10	54	36
15 Sep	239	76	8,220	5	60	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.

KISHAN DAUR KAS NEAR MISSA

Chemical Analysis of Water Samples - 1969

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	
Jul 21	0.99	1.48	3.52		0.21	2.50	2.10	0.95			5.79	5.76				350	590	8.3	0.54	3.6
Aug 12	1.10	1.02	3.03		Traces	2.36	1.40	1.47			5.15	5.23				296	500	8.2	0.24	3.0
Sep 15	0.99	1.13	2.72		0	2.36	1.40	1.02			4.84	4.78				260	450	8.2	0.24	2.6
Dec 27	0.87	3.18	10.60		0.90	6.30	5.40	2.05			14.65	14.65				856	1400	8.5	3.15	7.1

Blank page retained for pagination

POONCH RIVER NEAR KOTLI - 1969

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, WASID, WAPDA. August 1954 to December 1956 by Dams Investigation Circle, data with Indus Basin Development Board, Lahore.

Average discharge 4,140 cusecs (3,000,000 acre feet per year or 44.2 inches runoff per year). Average taken for 10 years from 1960 to 1969.

Extremes Maximum discharge observed during the year 209,000 cusecs on 24 July (gauge height 29.50 feet); minimum daily discharge 540 cusecs on 30 December.

1960-69: 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 of staff gauge at 1673.31 R.L. The staff being read at one hour interval daily and used during the year. The recorder worked during high flow periods only.

Measurements Ninety discharge measurements were made periodically by current meter using 0.2 and 0.8 or 0.6 depth method from car on overhead cableway near the gauge. Sixty five sets of sediment samples were taken by depth integration method using D-49 sampler Forty one 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 an unstable control that shifts readily during the numerous rises that occur. Rating dated 6.5.69 was used. Discharges were computed by shift adjustments based on discharge measurements.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	742	*9,010	3,120	4,480	*5,550	*5,940
2	748	*3,060	3,140	4,480	5,390	5,310
3	742	2,130	3,350	4,260	5,180	4,800
4	742	1,840	3,390	3,960	4,930	*5,050
5	*742	1,860	3,510	3,690	4,900	4,200
6	736	1,560	3,760	3,400	*4,740	3,800
7	736	1,500	3,780	3,460	4,690	3,480
8	730	*1,430	3,820	3,920	4,780	3,330
9	724	1,440	3,800	4,160	5,070	3,110
10	718	1,410	3,710	4,220	6,120	*3,020
11	706	1,400	3,780	4,140	6,850	3,040
12	742	1,350	3,960	4,040	*10,600	3,010
13	*1,000	1,460	4,120	*3,750	*20,300	3,210
14	994	*2,380	4,220	3,920	*15,000	3,110
15	865	*1,770	4,280	4,020	8,050	3,070
16	830	1,520	4,140	5,050	5,920	*3,110
17	795	*3,570	4,020	3,980	4,990	3,230
18	753	3,110	4,990	3,420	4,780	3,550
19	754	2,300	*15,800	*2,970	4,670	*3,980
20	742	1,950	*10,800	*12,100	4,200	4,360
21	742	1,790	5,570	7,650	4,020	4,060
22	742	*1,710	5,220	4,880	4,340	3,730
23	*736	1,670	*10,400	3,980	4,670	4,140
24	736	1,680	*6,050	3,510	*4,610	3,600
25	724	2,110	*9,980	*2,990	4,000	3,300
26	*2,240	2,270	*19,100	2,740	3,940	3,180
27	*3,140	*8,920	8,130	*2,540	3,710	3,040
28	1,790	*3,600	5,900	3,660	3,570	*4,630
29	1,410	———	5,370	*18,400	3,750	3,310
30	*1,160	———	4,950	7,700	*3,960	*4,400
31	1,100	———	4,860	———	*4,020	———
Mean	970	2,490	5,840	4,850	5,850	3,770
Cs/mi	0.78	1.99	4.67	3.88	4.68	3.02
In	0.89	2.08	5.39	4.33	5.39	3.36
Maf	.060	.138	.359	.289	.360	.224

1969 Year: Mean 3,770 Cs/sq mi 3.02 Inches 41.0

Note: * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	3,710	3,580	2,440	2,550	1,080	742
2	3,070	3,350	2,270	*5,120	1,170	736
3	3,120	*4,780	2,180	2,320	1,140	736
4	3,280	*8,570	2,450	1,590	*1,190	724
5	4,060	*20,300	*2,040	1,460	1,170	724
6	3,370	*55,700	*4,230	1,340	1,150	718
7	*3,400	*12,600	3,110	1,230	1,100	718
8	*4,570	*8,200	2,360	*1,170	1,060	*694
9	5,830	*11,100	3,810	1,150	1,050	688
10	5,140	*14,800	*2,260	1,120	1,030	670
11	4,000	8,760	2,010	*4,590	1,030	670
12	3,260	8,430	2,000	3,220	*1,030	682
13	3,820	6,930	2,040	1,120	1,030	670
14	*9,340	6,340	2,510	*1,660	986	664
15	*5,790	*8,170	3,240	3,760	928	646
16	5,050	8,610	*2,680	2,540	879	625
17	3,760	*13,200	2,380	1,660	865	635
18	3,580	*11,300	2,300	1,550	851	625
19	*3,400	8,340	2,030	1,500	*830	*620
20	*6,090	7,480	*1,870	1,430	823	600
21	*9,990	6,230	1,830	1,320	830	600
22	6,590	*7,260	1,670	*1,230	823	595
23	4,800	5,180	1,770	1,240	823	585
24	*39,600	4,380	1,830	1,170	809	570
25	10,000	4,800	1,540	1,140	781	*555
26	9,270	*4,950	1,360	1,160	760	550
27	8,610	3,440	*1,360	1,140	742	540
28	14,000	*3,160	1,330	*1,860	748	545
29	7,530	2,890	1,300	2,220	*742	545
30	5,090	*2,680	1,290	1,620	742	540
31	*3,940	2,620	———	1,120	——	550
Mean	6,680	8,970	2,180	1,850	940	637
Cs/mi	5.34	7.18	1.74	1.48	0.75	0.51
In	6.16	8.27	1.95	1.70	0.84	0.59
Maf	.411	.552	.130	.114	.056	.039

M. Acre-feet: 2.73 Max Day 55,700 Min Day 540

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
5 Jan	736		25			
13 Jan	1,020		26			
26 Jan	2,040	56	74			
27 Jan	3,750	53	861	7	63	30
30 Jan	1,170	55	38			
1 Feb	25,400	53	4,990	21	64	15
1 Feb	10,900	52	3,150	11	47	42
2 Feb	3,210	50	162			
8 Feb	1,430		40			
14 Feb	2,140		92			
17 Feb	4,220		105			
27 Feb	12,200		1,610	15	61	24
28 Feb	3,420		2,620	12	69	19
19 Mar	18,000		2,860	20	65	15
19 Mar	16,300		1,580	9	51	40
20 Mar	9,060		8,770	11	79	10
23 Mar	10,500		1,980	14	60	26
24 Mar	5,480		800			
25 Mar	10,600		7,560		87	13
25 Mar	13,800		2,190	12	43	45
26 Mar	24,700		7,530	26	58	16
19 Apr	2,920		14			
20 Apr	39,600		1,450	5	41	54
29 Apr	37,300		3,830	7	75	18
1 May	5,140		141			
13 May	17,900		2,390	10	68	27
14 May	16,800		1,180	9	72	19
30 May	4,300		4,650	21	73	6
1 Jun	6,670		7,970	2	54	44
4 Jun	5,330		247			
16 Jun	3,210		419	5	44	51
19 Jun	4,220		269			
28 Jun	4,950		12,000	3	52	45
30 Jun	6,630		12,000	3	51	46
14 Jul	19,500		28,700	4	83	13
15 Jul	6,930		5,030	6	72	22
20 Jul	8,050		3,420	8	65	27
21 Jul	18,400		12,800	10	66	24
24 Jul	35,100		7,480	1	77	22
24 Jul	14,400		3,650	14	51	35

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
31 Jul	4,120	86	309			
3 Aug	6,250	76	4,060	2	66	32
4 Aug	15,300	78	5,980	10	74	16
5 Aug	24,700	77	27,100	2	61	37
6 Aug	65,500	78	19,800	29	52	19
6 Aug	21,600	77	2,790	20	45	35
7 Aug	13,200	76	2,380	23	51	26
8 Aug	8,460	78	197			
9 Aug	14,600	78	10,310	23	58	20
10 Aug	26,800	80	9,160	13	65	22
15 Aug	12,900	79	3,690	14	67	19
17 Aug	20,800	78	5,720	15	76	9
22 Aug	9,180	78	1,770	2	44	54
16 Sep	2,500	79	119			
20 Sep	1,850	80	58			
27 Sep	1,340	79	298			
2 Oct	3,940	80	2,700	11	48	41
8 Oct	1,180	79	111			
11 Oct	12,500	80	6,650	16	61	23
14 Oct	2,660		14,900	7	68	25
22 Oct	1,270		4			
26 Oct	2,750		163			
12 Nov	1,030		21			
8 Dec	682	61	71			
19 Dec	620	59	8			

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.

Chemical Analysis of Water Samples - 1969

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	
Jan																			
26	1.72	0.98	0.20		0.27	2.26	0.19	0.18			2.90	2.90				172	290	8.2	0.22	0.2
27	1.88	0.82	0.15		0.27	1.73	0.24	0.58			2.85	2.82				154	260	8.2	0	0.1
Feb																			
1	2.05	0.65	0.10		0.19	2.25	0.19	0.35			2.80	2.98				156	280	8.3	0	0.1
Mar																			
19	2.09	0.75	0.25		0	2.65	0.19	0.19			3.09	3.03				172	300	7.8	0	0.2
23	2.09	0.27	0.15		0	2.25	0.19	0.30			2.51	2.74				144	250	7.8	0	0.1
26	2.14	0.22	0.15		0	2.25	0.19	0.29			2.51	2.73				140	250	7.8	0	0.1
Apr																			
29	1.27	0.83	0.17		Traces	1.80	0.14	0.35			2.27	2.29				126	220	8.1	0	0.2
May																			
13	1.36	0.58	0.14		0.19	1.55	0.14	0.34			2.08	2.22				120	210	8.2	0	0.2
Jun																			
1	1.48	0.69	0.18		0.19	1.74	0.14	0.34			2.35	2.41				128	220	8.2	0	0.1
30	0.91	1.51	0.21		0	2.33	0.10	0.14			2.63	2.57				140	250	8.1	0.01	0.2
Jul																			
31	1.54	0.50	0.28		0.20	2.26	0.20	0.09			2.72	2.75				148	260	8.3	0.02	0.3
Aug																			
17	1.65	0.58	0.35		0	2.38	0.15	0.18			2.58	2.71				144	250	8.1	0.15	0.3
Sep																			
27	1.65	0.95	0.35		Traces	2.55	0.30	0.25			2.95	3.10				164	290	8.2	0	0.3
Dec																			
25	1.94	1.28	0.32		0	3.25	0.19	0.13			3.54	3.57				184	325	8.0	0.03	0.3
29	2.13	1.27	0.43		0	3.55	0.19	0.12			3.83	3.86				200	350	7.8	0.15	0.3

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 Surface Water Hydrology, Project WASID, WAPDA. Gauge height record December 1906 to 1921 and discharge record 1921 to date by Headworks Division. Data available in Hydrology Directorate, Irrigation and Power Department, 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. Record computed by Surface Water Hydrology Project. From 1967 the data published is the release through Mangla Dam Spillway 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. The recorded gauges were used except for 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 Fifty one discharge measurements were made from the cableway by current meter using 0.2 and 0.8 depth method Twenty three sets of sediment samples were collected by depth integration method using D-49 sampler. All were analysed for total concentration. Eleven surface samples were collected and analysed for chemical composition.

Determination of Discharge: Rating table dated 7.8.69 was used with shift adjustments as indicated necessary by the periodic discharge measurements.

Remarks Record good; for certain days, the spillway gates were completely closed but seepage water was measured at the site.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	250	10,200	0	10,900	44,800	74,600
2	0	8,980	0	11,100	44,800	*81,500
3	*1,080	8,700	0	11,200	44,800	86,000
4	185	8,310	0	11,100	44,800	85,000
5	1,090	12,500	0	10,800	44,900	85,800
6	324	17,400	0	14,000	47,900	85,000
7	1,120	16,700	0	25,200	49,600	71,400
8	0	15,400	0	25,100	49,600	63,800
9	*1,330	12,100	0	25,600	50,100	63,400
10	*1,100	8,450	0	27,100	56,500	63,400
11	0	4,950	0	28,000	60,100	63,500
12	1,250	2,320	0	28,400	60,200	61,800
13	1,650	612	0	31,300	63,200	61,100
15	1,150	48	0	33,100	66,800	61,200
15	1,210	0	0	33,600	70,000	61,300
16	765	0	0	34,000	*67,200	61,400
17	2,360	0	0	34,700	67,000	*61,500
18	1,260	0	0	40,400	68,700	61,600
19	1,960	0	0	43,500	48,100	61,800
20	1,710	0	0	43,400	48,400	62,200
21	2,080	0	0	44,100	48,100	63,000
22	672	0	0	44,400	47,100	63,600
23	729	0	0	44,400	46,500	62,500
24	262	0	0	44,300	46,500	60,200
25	3,600	0	0	43,800	46,500	57,700
26	5,100	0	0	43,500	*46,400	58,500
27	8,520	0	0	43,100	46,600	59,000
28	7,980	0	6,880	42,600	47,400	64,400
29	8,240	------	11,300	43,000	48,100	66,300
30	8,350	------	11,500	44,400	48,800	62,300
31	*8,190	------	10,700	------	59,900	------
Mean	2,210	4,520	1,310	32,000	52,300	66,500
Cs/mi						
In						
Mar	.146	.251	.080	1.90	3.22	3.96

1969 Year: Mean 23,400 Cs/sq mi Inches

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	60,000	20,700	19,000	36,000	22,700	11,400
2	59,600	21,900	15,000	35,600	24,800	11,100
3	57,200	22,400	12,800	35,600	21,900	*10,500
4	56,300	22,500	12,700	35,800	21,800	10,300
5	45,500	*24,000	13,000	36,500	21,600	13,800
6	27,900	65,300	17,300	36,700	21,300	12,200
7	21,200	62,900	14,900	36,500	22,900	13,000
8	14,200	74,800	10,100	36,000	22,000	12,000
9	10,900	65,000	14,700	35,400	22,100	*11,200
10	11,000	42,600	11,500	33,900	22,200	6,120
11	6,990	42,600	6,900	*29,200	*21,000	11,000
12	*7,920	43,000	7,200	29,100	21,100	11,000
13	11,400	22,900	*8,490	28,900	21,500	4,780
14	11,400	14,800	10,800	27,000	22,400	4,730
15	*10,300	14,800	23,800	24,500	21,800	4,430
16	5,700	14,800	12,700	24,300	22,500	4,400
17	*5,820	15,800	7,920	24,700	22,400	4,400
18	5,940	*17,300	8,560	22,800	22,200	*3,500
19	4,680	17,900	6,810	23,700	23,100	3,790
20	5,030	32,100	6,900	22,800	*24,400	3,380
21	5,640	*38,800	10,700	21,900	24,700	3,980
22	6,300	26,100	20,600	21,800	23,500	3,280
23	6,330	19,900	22,400	21,700	23,700	3,220
24	6,480	19,500	*26,700	*21,600	25,400	3,180
25	7,980	19,500	31,800	21,300	25,900	8,140
26	*7,950	19,600	31,600	20,900	25,800	5,610
27	7,950	8,280	32,000	21,300	25,300	4,050
28	12,900	8,210	35,300	21,400	26,300	4,480
29	*28,600	12,500	*34,700	21,500	25,800	4,230
30	22,200	18,900	34,800	21,500	23,500	*3,720
31	20,700	19,000	———	21,500	———	3,380
Mean	18,500	26,000	17,400	27,500	23,200	6,910
Cs/mi						
In						
Maf	1.13	1.72	1.03	1.69	1.38	.425

M. Acre-feet 16.9 Max Day 74,800 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
10 Jan	6,660	60	25			
31 Jan	5,130	56	30			
16 May	66,700	66	63			
2 Jun	79,000	72	43			
3 Jun	87,000	68	18			
17 Jun	60,800	66	21			
12 Jul	11,000	69	11			
15 Jul	11,400	70	15			
17 Jul	5,820	81	12			
26 Jul	8,010	70	40			
29 Jul	28,600	70	53			
31 Jul	21,000	71	40			
5 Aug	22,600	71	119			
6 Aug	72,100	78	116			
18 Aug	17,800	74	117			
21 Aug	38,900	74	44			
13 Sep	8,590	75	86			
20 Sep	26,100	78	77			
11 Oct	28,900	74	5			
11 Nov	20,800	72	8			
3 Dec	9,110	64	28			
18 Dec	7,290	63	34			
30 Dec	6,690	62	27			

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 CAUSEWAY

Chemical Analysis of Water Samples - 1969

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																				
10	1.62	0.36	0.15		0	1.84	0.19	0.18			2.13	2.21				120	200	7.7	0	0.2
31	1.57	0.51	0.15		0	1.89	0.19	0.21			2.23	2.29				122	220	7.8	0	0.1
May																				
16	1.43	0.30	0.11		0	1.38	0.14	0.31			1.84	1.83				104	180	7.9	0	0.1
Jun																				
2	1.59	0.74	0.14		0	2.03	0.14	0.42			2.47	2.59				132	230	7.9	0	0.1
17	1.60	0.23	0.28		0	1.65	0.09	0.25			2.11	1.99				108	190	8.2	0	0.3
Jul																				
12	0.96	0.47	0.10		0	1.06	0.17	0.27			1.53	1.52				32	150	8.0	0	0.2
Aug																				
5	0.94	0.33	0.21		0	1.25	0.10	0.18			1.48	1.53				80	140	8.1	0	0.3
Sep																				
10	0.99	0.71	0.20		0	1.38	0.10	0.37			1.90	1.85				96	180	8.2	0	0.2
Oct																				
24	1.16	0.63	0.14		0	1.38	0.10	0.35			1.93	1.83				102	180	7.9	0	0.1
Nov																				
20	1.16	0.59	0.14		0	1.38	0.10	0.35			1.89	1.83				100	180	7.7	0	0.1
Dec																				
9	1.55	0.52	0.09		0	1.85	0.19	0.28			2.26	2.32				126	220	7.4	0	0.2

Blank page retained for pagination

KHOST RIVER AT CHAPPAR RIFT - 1969

Location Latitude 30°20', Longitude 67°30', on right bank just upstream from the 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, WASID, WAPDA. Periodic discharge measurements started in March 1961.

Average discharge 12 cusecs (8,660 acre-feet per year or 0.30 inches runoff per year). Average taken for 8 years from 1962 to 1969.

Extremes Maximum discharge during the year 6,130 cusecs on 22 July (gauge height 8.70 feet), minimum daily discharge 2.6 cusecs on many days in March.

1961-69: Maximum discharge observed 6,130 cusecs on 22 July 1969. 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 Fifty three discharge measurements were made by current meter using 0.2 and 0.8 or 0.6 depth method. Low water measurements were made by wading and high water ones from car suspended on overhead cableway. Thirty seven sets of sediment samples were taken by depth-integration method using DH-48 sampler when wading and D-49 sampler from the cableway. Nine of these were analysed for particle size distribution and the rest for total concentration. Twelve 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 discharges.

Remarks Record fair.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	6.7	5.6	6.3	6.1	6.7	3.7
2	6.4	5.6	6.3	6.1	6.7	4.0
3	6.3	5.8	6.1	6.1	21	3.9
4	6.4	5.6	6.0	6.3	8.0	3.6
5	6.4	5.8	5.9	6.3	3.7	3.7
6	6.4	5.6	5.9	6.4	3.7	3.8
7	6.3	5.8	6.1	6.1	3.6	4.0
8	6.3	5.6	6.6	6.3	3.7	4.0
9	6.1	5.5	*6.4	6.1	3.6	3.9
10	6.1	5.6	6.4	6.1	3.6	3.9
11	6.1	5.6	6.6	7.1	3.5	3.9
12	6.1	5.8	6.4	8.0	3.5	3.9
13	6.0	6.0	6.1	7.9	3.7	3.9
14	6.0	5.9	6.0	7.4	3.7	4.0
15	5.9	5.9	6.0	7.3	3.7	3.9
16	6.0	6.3	6.0	7.3	3.7	3.9
17	6.0	6.3	6.0	7.3	3.7	3.9
18	5.9	6.3	*6.0	7.1	3.7	3.8
19	5.9	*6.3	5.8	7.0	3.7	3.8
20	5.9	6.1	5.9	7.1	3.7	*3.8
21	5.8	6.3	5.9	7.1	3.7	*4.1
22	5.8	6.1	6.3	7.1	3.6	*4.0
23	*5.8	6.1	5.9	7.1	3.6	*4.0
24	5.8	6.0	6.0	7.1	3.7	3.9
25	5.6	6.0	6.7	7.0	3.7	*4.1
26	5.5	6.7	6.3	7.0	3.7	*4.0
27	5.6	6.6	6.3	7.0	*3.7	3.9
28	5.6	6.4	6.1	6.7	3.7	3.9
29	5.8	——	6.1	6.7	3.6	3.8
30	5.6	——	6.0	6.7	3.6	*3.7
31	5.6	——	6.1	——	3.6	——
Mean	6.0	6.0	6.1	6.8	4.6	3.9
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	0.01
Acre-ft.	368	331	378	406	280	231

1969 Year: Mean 7.5 Cs/sq mi 0.01 Inches 0.20

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

KHOST RIVER AT CHAPPAR RIFT

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*3.8	3.8	3.8	3.5	2.6	3.5
2	*3.8	3.8	3.5	4.9	2.6	3.6
3	*4.0	a 3.7	3.3	*3.6	2.6	3.7
4	4.0	a 3.6	*3.4	3.2	*2.6	3.8
5	*4.1	*3.5	3.4	3.2	2.6	3.9
6	*4.2	3.4	3.4	3.1	2.6	4.1
7	4.2	3.3	3.4	3.1	2.6	*4.3
8	*4.2	*3.3	3.4	3.1	2.6	4.3
9	4.1	3.3	*3.4	3.0	2.6	4.3
10	*4.1	3.3	3.4	3.0	2.6	4.3
11	4.2	3.3	3.5	3.0	2.7	4.3
12	4.1	3.3	3.5	3.0	2.8	4.4
13	4.1	*4.0	*3.5	3.0	2.7	4.4
14	*4.1	3.3	3.4	3.1	2.7	4.4
15	4.1	3.4	3.4	2.9	2.7	4.3
16	4.0	3.3	3.4	3.0	2.6	4.3
17	*4.0	3.3	3.4	3.0	2.6	4.3
18	4.1	3.3	3.4	2.9	2.6	4.3
19	4.0	*3.4	3.5	2.9	2.7	4.3
20	*3.9	3.4	*3.4	2.9	2.7	4.1
21	3.9	*234	*3.4	2.8	2.7	4.1
22	*615	*62	3.5	2.8	2.6	4.1
23	*27	*2.8	3.5	2.8	*2.7	4.1
24	*80	*5.5	3.5	2.7	2.8	4.1
25	*68	4.9	3.5	2.7	3.0	4.3
26	*25	4.1	3.4	2.7	3.1	4.3
27	4.3	3.9	*3.4	*2.6	3.1	4.4
28	4.1	3.7	3.5	2.6	3.3	4.4
29	*4.3	3.7	3.5	2.6	3.4	4.4
30	4.1	3.7	3.5	2.7	3.5	4.4
31	4.0	*3.7	—	2.6	—	*4.4
Mean	30	13	3.5	3.0	2.8	4.2
Cs/mi	0.06	0.03	0.01	0.01	0.01	0.01
In	0.07	0.03	0.01	0.01	0.01	0.01
Acre-ft	1,830	795	205	184	165	258

Acre-feet: 5,430 Max Day 615 Min Day 2.6

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
23 Jan	5.8	58	230			
19 Feb	6.3	48	290			
9 Mar	6.4	50	2,540	7	32	61
18 Mar	6.1	42	142			
24 Apr	7.3	68	66			
27 May	3.7	76	36			
20 Jun	3.9	78	111			
21 Jun	3.9	69	43			
22 Jun	3.9	67	106			
23 Jun	3.9	70	114			
25 Jun	4.3	74	173			
26 Jun	4.0	76	107			
30 Jun	3.7	76	73			
1 Jul	3.8	75	72			
2 Jul	4.0	73	76			
5 Jul	4.1	73	154			
6 Jul	4.3	76	172			
8 Jul	4.3	74	186			
14 Jul	4.1	82	200			
17 Jul	4.0	68	117			
22 Jul	4.0	72	280			
23 Jul	20	73	23,400	3	34	63
25 Jul	490	68	22,800	3	18	79
26 Jul	27	70	15,200	2	22	76
5 Aug	3.5	76	18			
13 Aug	5.5	70	9,290	2	27	71
19 Aug	3.4	77	83			
21 Aug	1,230	66	49,300		47	53
22 Aug	54	64	27,800	5	59	36
23 Aug	3.1	70	19,800	4	22	74
24 Aug	6.0	68	21,200	4	28	68
4 Sep	3.3	65	20			
3 Oct	3.2	62	100			
27 Oct	2.5	66	21			
4 Nov	2.6	60	86			
23 Nov	2.7	52	83			
7 Dec	4.3	51	195			

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.

KROOT RIVER AT CHAPPAR RIFT

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										TOTAL		PARTS PER LITER				$EC \times 10^6$ 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 23	1.78	2.97	2.89		0.29	2.64	0.89	3.96			7.64	7.78				432	720	8.2	0	1.9
Feb 19	3.18	2.35	3.70		0.29	3.03	1.08	4.85			9.23	9.25				550	880	8.2	0	2.2
Mar 9	1.76	2.50	2.80		0.39	2.45	0.86	3.32			7.06	7.02				410	680	8.4	0	1.9
18	1.84	2.73	2.70		0.29	2.79	1.20	2.95			7.27	7.23				412	690	8.3	0	1.8
Apr 24	2.77	2.23	2.90		0.64	3.22	0.78	3.27			7.19	7.91				484	780	8.1	0	1.8
May 27	1.46	3.67	2.52		0.35	2.28	0.83	4.16			7.35	7.62				444	700	8.3	0	1.6
Jul 22	1.03	3.24	1.68		0.21	3.26	0.60	1.94			5.95	6.01				344	580	8.3	0	1.1
Aug 5	1.32	2.28	1.75		0.31	2.34	0.60	2.20			5.35	5.45				300	510	8.5	0	1.3
21	0.99	3.26	2.02		0	3.38	0.70	2.27			6.27	6.35				360	600	8.0	0	1.4
Oct 3	1.86	2.33	1.52		0.20	2.75	0.50	2.31			5.71	5.76				308	530	8.3	0	1.1
27	2.52	2.63	1.30		0.60	3.45	0.49	1.92			6.45	6.46				354	600	8.4	0	0.8
Nov 4	1.50	3.10	1.30		0.20	3.10	0.53	2.03			5.90	5.86				318	540	8.3	0	0.9

Blank page retained for pagination

NARI RIVER NEAR SIBI - 1969

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, WASID, WAPDA. August 1958 to June 1962 by Hydrology Directorate Irrigation and Power Department Quetta.

Average discharge 627 cusecs (454,000 acre-feet per year or 0.98 inches runoff per year). Average taken for 7 year from 1962 to 1969 (except 1966).

Extremes Maximum discharge observed during the year 27,800 cusecs on 24 July (gauge height 15.67); minimum daily discharge zero on many days during the year.

1961-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Sixty three 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 from the highway bridge. Seventeen sets of sediment samples were taken by depth-integration method using DH-48 sampler when wading or D-49 sampler from bridge. Nine of these were analysed for particle size distribution and the rest for total concentration. Seven surface samples were collected and analysed for chemical composition.

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

Remarks Record good. 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 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	0	0	181	0	0	0
2	0	0	160	0	0	0
3	0	0	71	0	0	294
4	0	0	45	0	0	109
5	0	0	23	0	0	14
6	0	0	7.6	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	496	0
12	0	0	0	0	267	0
13	16	0	0	4,200	338	0
14	14	0	0	915	145	0
15	*18	0	0	490	217	0
16	9.4	0	0	*252	505	0
17	3.2	0	0	*138	234	*0
18	0	62	0	118	97	0
19	0	17	0	101	38	*0
20	0	4.0	0	91	6.4	0
21	0	*0	0	75	1.6	*0
22	0	0	0	65	*0	*0
23	0	0	0	26	0	0
24	0	0	0	4.0	0	*0
25	0	0	0	0	0	0
26	0	0	114	0	0	*0
27	0	0	65	0	0	0
28	0	69	62	0	0	*0
29	0	—	12	0	0	*0
30	0	—	7.0	0	0	*0
31	0	—	2.0	—	0	—
Mean	2.0	5.4	24	216	76	14
Cs/mi	0.00	0.00	0.00	0.03	0.01	0.00
In	0.00	0.00	0.00	0.03	0.01	0.00
Acre-ft.	120	301	1,490	12,800	4,650	827

1969 Year: Mean 195 Cs/sq mi 0.02 Inches 0.30

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*222	269	1.2	0	0	0
2	*165	188	*0	*0	0	0
3	*237	158	0	0	0	0
4	79	*125	0	0	0	0
5	19	158	*0	0	0	*0
6	5.8	*205	0	0	0	0
7	*0	87	0	0	0	*0
8	0	*47	0	0	0	0
9	0	13	*280	0	*0	0
10	0	*6.4	*173	0	0	0
11	0	0	*15	0	*0	0
12	0	*40	4.6	0	0	0
13	*0	*266	1.6	0	0	0
14	160	*3,200	*0	0	0	0
15	*383	1,710	0	0	0	0
16	*729	983	*0	0	0	0
17	314	571	0	*0	0	0
18	*99	238	0	0	0	0
19	32	63	*0	0	0	0
20	2.8	*32	0	0	*0	0
21	778	4.0	0	0	0	0
22	*2,590	*2,090	*0	0	0	0
23	*2,800	*3,500	0	0	0	0
24	*10,800	*549	0	0	0	0
25	*6,420	480	0	13	0	0
26	*5,980	*259	0	23	0	*0
27	4,360	*338	*0	0	0	0
28	2,930	140	0	0	0	0
29	3,040	20	0	0	*0	0
30	2,490	4.6	0	0	0	0
31	490	2.8	—	0	—	0
Mean	1,440	508	16	1.2	0	0
Cs/mi	0.17	0.06	0.00	0.00	0	0
In	0.19	0.07	0.00	0.00	0	0
Acre-ft.	88,700	31,200	943	71	0	0

Acre-feet: 141,000 Max Day 10,800 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	20	54	100			
16 Apr	259	70	3,780	6	33	61
17 Apr	138	66	816	5	18	77
1 Jul	287	87	5,350	2	21	77
2 Jul	183	85	237			
3 Jul	364	85	5,210	1	36	63
16 Jul	818	90	13,700	3	33	64
18 Jul	111	86	770	6	37	57
4 Aug	130	89	108			
6 Aug	224	95	293			
13 Aug	294	94	310			
14 Aug	4,170	95	10,200	2	26	72
20 Aug	48	88	348			
23 Aug	6,260	91	41,100			
24 Aug	465	96	11,000		17	83
27 Aug	406	96	2,070	4	58	38
9 Sep	460	90	1,170	11	63	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.

BARI RIVER NEAR SIRE

Chemical Analysis of Water Samples - 1969

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.	$EC \times 10^6$ at $25^\circ C$	pH	Res CO_3 me/l	SAR
	Milliequivalents per liter												Parts per million							
Jan 15	2.69	2.80	6.50		0.39	2.64	2.12	7.03			11.99	12.18				700	1120	8.3	0	4.0
Apr 16	5.67	1.89	5.40		0.18	1.38	1.02	10.64			12.96	13.22				788	1210	8.2	0	2.8
17	6.21	2.40	5.05		0.18	1.38	1.12	11.18			13.66	13.86				872	1260	8.2	0	2.4
Jul 24	1.14	2.63	2.58		0	3.47	0.65	2.19			6.35	6.31				372	630	7.8	0	2.0
Aug 23	3.52	1.35	2.80		0	2.29	0.70	4.73			7.67	7.72				484	740	8.1	0	1.8
27	1.04	3.46	4.50		0.19	1.86	1.35	5.94			9.00	9.34				548	880	8.3	0	3.0
Sep 9	2.64	1.39	2.58		Traces	2.06	0.60	4.14			6.61	6.80				400	650	8.2	0	1.8

Blank page retained for pagination

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 574 square miles.

Records vailable Discharge records by Surface Water Hydrology Project, WASID, WAPDA from April 1961 to December 1968 from November 1950 to June 1962 by Hydrology Directorate of Irrigation and Power Department Quetta. No record could be collected during the year 1966.

Average discharge 70 cusecs (50,700 acre-feet per year or 1.66 inches runoff per year) for six years from 1962 to 1965 and 1967-68.

Extremes Site suspended in March 1969.
April 1961-68: Maximum discharge observed 33,000 cusecs on 25 July 1951. River dry at times every year. No record collected in 1966.

Gauge Staff gauge fixed on right bank; observed from 08:00 to 16:00 hours daily during low flow and more often during floods.

Gauge set to arbitrary datum.

Measurements Three discharge measurements were made upto March 1969 by current meter using 0.2 and 0.8 or 0.6 depth method. No sediment sample or surface sample was collected

Remarks Measurements have been included in the partial station record. Site was suspended in March 1969.

Blank page retained for pagination

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, WASID, WAPDA. December 1958 to June 1962 by Hydrology Directorate of Irrigation and Power Department, Quetta.

Average discharge 71 cusecs (51,000 acre-feet per year or 0.61 inches runoff per year). Average taken for 8 years from 1962 to 1969.

Extremes Maximum discharge observed during the year 6,090 cusecs on 25 July (gauge height 9.75 feet); minimum daily discharge 40 cusecs on many days.

1961-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Forty one discharge measurements were made periodically during the year by current meter using 0.2 and 0.8 depth method. Twenty four sets of sediment samples were taken by the depth-integration method using DH-48 sampler. All were analysed for total concentration. Nine surface samples were collected and analysed for chemical composition.

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

Remarks Record fair; so observation has made during floods.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	50	50	51	52	50	41
2	50	50	51	52	50	41
3	50	50	50	53	*50	41
4	50	50	50	52	49	41
5	50	50	50	51	50	41
6	50	50	50	51	50	41
7	50	50	50	50	51	41
8	50	50	50	50	52	41
9	50	50	50	50	52	41
10	50	50	50	50	51	41
11	50	50	50	51	68	41
12	50	50	50	51	52	41
13	50	50	50	50	50	41
14	50	50	50	*50	65	41
15	*50	50	50	50	49	41
16	50	50	50	50	43	41
17	50	50	50	50	42	*41
18	50	51	50	50	42	*41
19	50	50	50	50	42	41
20	50	50	50	51	42	*41
21	50	50	*50	50	42	40
22	50	50	50	50	*42	*40
23	50	*51	50	50	43	*40
24	50	51	51	50	43	40
25	50	51	52	50	43	*41
26	50	51	51	50	43	41
27	50	a52	51	51	43	*41
28	50	52	51	49	42	41
29	50	—	51	50	42	*40
30	50	—	51	51	42	*41
31	50	---	51	—	42	—
Mean	50	50	50	51	47	41
Cs/mi	0.03	0.03	0.03	0.03	0.03	0.03
In	0.04	0.03	0.04	0.04	0.03	0.03
Acre-ft.	3,070	2,790	3,100	3,010	2,910	2,430

1969 Year: Mean 54 Cs/sq mi 0.03 Inches 0.46

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	40	47	46	46	47	47
2	*41	47	46	46	47	47
3	41	46	46	46	47	47
4	*41	46	46	46	47	*47
5	*41	47	*46	*46	47	47
6	*41	*47	46	46	47	47
7	41	47	46	46	47	47
8	41	47	46	46	47	47
9	41	46	*46	46	47	47
10	*41	*46	46	46	47	47
11	41	46	46	46	47	a47
12	41	46	46	46	*47	a47
13	48	*46	46	46	47	47
14	47	46	46	46	47	47
15	43	46	45	46	47	47
16	41	46	46	46	47	47
17	41	46	46	*46	47	47
18	41	46	*46	46	47	47
19	41	*46	46	46	47	47
20	41	46	46	46	47	47
21	41	46	*46	a46	47	47
22	311	*46	46	a46	47	47
23	315	*46	46	a46	47	47
24	235	46	46	a46	47	47
25	905	*46	46	a46	47	47
26	774	46	46	46	47	47
27	64	46	46	46	47	47
28	54	*46	46	47	47	47
29	52	46	*46	*47	47	*47
30	51	46	46	47	47	47
31	49	*46	—	47	—	47
Mean	119	46	46	46	47	47
Cs/mi	0.08	0.03	0.03	0.03	0.03	0.03
In	0.09	0.03	0.03	0.03	0.03	0.04
Acre-ft.	7,310	2,840	2,830	2,840	2,800	2,890

Acre-feet: 38,820 Max Day 905 Min Day 40

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
15 Jan	50	64	58			
23 Feb	51	72	54			
21 Mar	50	91	62			
14 Apr	50	86	58			
3 May	50	77	58			
22 May	42	86	62			
17 Jun	41	86	96			
18 Jun	41	96	100			
20 Jun	41	74	98			
22 Jun	40	70	91			
23 Jun	40	91	85			
25 Jun	40	94	95			
27 Jun	41	81	98			
29 Jun	40	82	98			
30 Jun	41	83	95			
2 Jul	41	96	93			
4 Jul	41	82	93			
5 Jul	41	98	93			
6 Jul	41	86	96			
10 Jul	41	88	33			
6 Aug	47	94	70			
31 Aug	46	87	18			
21 Sep	46	84	6			
29 Sep	46	89	9			
17 Oct	46	84	23			
29 Oct	47	78	17			
12 Nov	47	71	23			
4 Dec	47	63	47			
29 Dec	47	62	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.

KOLAN RIVER AT KUNDLANI BRIDGE

Chemical Analysis of Water Samples - 1969

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 15	3.70	1.81	3.41		0.49	2.54	1.54	3.96			8.92	8.58				524	820	8.3	0	2.1
Feb 23	3.56	1.85	3.45		0.68	2.79	1.58	3.54			8.86	8.59				516	820	8.4	0	2.1
Mar 21	1.73	2.74	3.34		0.39	2.45	1.44	3.35			7.81	7.63				472	760	8.4	0	1.3
Apr 14	1.80	2.71	3.50		0.46	2.30	1.51	4.02			8.01	8.29				496	790	8.4	0	2.3
Jul 10	1.30	2.13	3.30		0.32	2.56	1.60	3.49			7.74	7.97				456	770	8.4	0	2.2
Aug 6	1.57	2.67	3.55		0.41	2.39	1.70	3.39			7.79	7.89				464	750	8.6	0	2.5
31	0.77	3.73	3.52		0.29	2.40	1.70	3.77			8.02	8.16				484	790	8.4	0	2.3
Oct 17	1.76	2.80	3.04		0.20	2.65	1.60	3.44			7.60	7.89				460	750	8.3	0	2.0
Nov 12	2.13	3.39	3.32		0.30	3.25	1.57	3.54			9.84	8.66				500	820	8.3	0	2.0

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, WASID, 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 23,000 cusecs on 23 July (gauge height 10.40 feet); River dry at times during the year.

1966-69 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. The gauge was read from 8 A.M to 4 P.M. daily during low flows and more often during floods. Gauge set to Arbitrary datum.

Measurements Forty six discharge measurements were made periodically 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 measurement from an overhead cableway. Thirty five sets of sediment samples were taken by the depth integration method using DH-48 sampler while wading or D-49 sampler from the cableway. Nineteen of these were analysed for particle size distribution and the rest for total concentration. Nineteen surface samples were aken and analysed for chemical composition.

Determination of discharges The station has a shifting control affected by the movement of sand and shingle. Rating table dated 27.12.67 was used with shift adjustment as indicated necessary by the periodic measurements.

Remarks Record good.

GAJ NAI NEAR JUBBLE

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	18	11	8.5	15	0	12
2	18	*9.5	8.0	*13	0	89
3	18	9.5	8.0	11	0	30
4	*19	9.0	7.5	10	0	18
5	19	9.5	6.5	9.0	0	11
6	20	10	5.0	7.5	0	6.5
7	20	10	4.5	5.0	0	2.5
8	18	10	4.0	3.5	0	*1.2
9	18	*9.5	3.0	*2.5	0	0.4
10	18	9.5	3.0	2.5	122	0
11	*18	10	2.5	2	98	0
12	18	10	2.5	2.5	132	0
13	18	9.5	2.0	3.0	42	0
14	18	12	1.8	2.5	20	14
15	18	11	*0	*2.0	16	*383
16	18	*12	0	1.4	12	*54
17	19	12	0	1.0	11	30
18	*19	12	0	*0.8	7.5	22
19	18	12	*130	0.4	6.5	19
20	18	11	47	0.4	5.0	14
21	18	11	31	1.2	3.5	9.0
22	18	11	25	1.0	1.8	5.5
23	18	11	21	0.8	*1.0	1.8
24	18	10	18	0.4	1.0	1.4
25	18	9.5	*1,680	0.2	0.8	0
26	*17	9.5	*488	0.2	0.8	0
27	16	a9.0	176	0	0	0
28	14	a9.0	100	0	0	0
29	12	——	*63	0	0	*1.9
30	12	——	44	0	0	0
31	11	——	25	——	0	---
Mean	17	10	94	3.3	16	24
Cs/mi	0.01	0.00	0.03	0.00	0.01	0.01
In	0.01	0.00	0.04	0.00	0.01	0.01
Acre-ft.	1,070	573	5,780	196	954	1,440

1969 Year : Mean 73 Cs/sq mi 0.03 Inches 0.36

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	36	44	0.8	5.5	6.0
2	0	24	40	0.4	5.5	6.5
3	0	18	40	0.6	4.5	7.0
4	0	14	*42	0.4	4.0	*7.0
5	0	13	37	0.0	3.5	7.5
6	0	11	34	1.0	3.0	7.5
7	0	*10	31	1.2	2.5	7.5
8	0	9.0	38	0.6	2.0	7.0
9	0	8.5	32	0.4	2.5	7.5
10	*162	8.5	26	0.2	2.0	8.0
11	*146	7.5	27	0	2.5	a8.0
12	*176	7.5	24	0	3.0	a8.0
13	*36	720	19	0	3.5	8.5
14	*753	*1,520	14	0	8.5	9.0
15	*120	*848	11	0	9.5	9.5
16	136	1,820	8.5	195	7.0	9.0
17	71	244	8	198	6.5	9.0
18	31	102	7.5	51	6.0	9.5
19	14	51	6.5	21	5.5	9.0
20	9.0	*30	5.0	13	5.0	9.5
21	5.0	37	*4.0	9.0	5.0	10
22	4.5	*440	4.0	6.5	5.0	10
23	4,830	*518	3.0	5.0	5.5	10
24	*1,020	162	2.5	4.5	4.5	*10
25	*2,400	80	2.5	3.0	4.0	11
26	*823	*497	2.0	*3.0	4.5	11
27	215	575	1.8	2.5	5.5	11
28	190	*510	1.6	2.0	*5.0	10
29	90	125	1.4	36	5.0	11
30	53	67	1.4	12	6.0	11
31	71	50	---	7.5	---	11
Mean	366	276	17	19	4.7	8.9
Cs/mi	0.14	0.10	0.01	0.01	0.00	0.00
In	0.15	0.12	0.01	0.01	0.00	0.00
Acre-ft.	22,500	17,000	1,030	1,140	282	548

Acre-feet: 52,500 Max Day 4,830 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
11 Jan	18	60	38			
18 Jan	19	60	25			
26 Jan	17	60	38			
2 Feb	9.5	61	45			
9 Feb	9.5	62	74			
16 Feb	11	64	44			
19 Mar	14.3	73	3,230	7	38	55
25 Mar	5,000	60	6,700	15	56	29
15 Apr	2	77	43			
18 Apr	1	80	50			
23 May	1	80	57			
15 Jun	548	78	11,500	3	33	64
16 Jun	52	74	1,180	2	15	83
29 Jun	11	81	1,840	4	42	54
10 Jul	325	85	15,700	5	36	59
11 Jul	117	81	1,770	6	16	78
12 Jul	280	83	9,130	1	37	62
13 Jul	29	92	255	18	42	40
15 Jul	84	89	335			
19 Jul	12	93	200			
24 Jul	724	90	915	1	19	80
25 Jul	214	83	128			
26 Jul	536	87	690	2	22	76
14 Aug	1,460	83	4,420		25	75
15 Aug	1,050	82	2,580	3	34	63
20 Aug	29	92	19			
22 Aug	2,550	80	9,960	5	52	43
23 Aug	666	80	3,543	1	25	74
26 Aug	1,290	89	7,480	3	52	45
28 Aug	315	88	1,680	3	43	54
26 Oct	2.5	82	45			
7 Nov	2.5	82	44			
28 Nov	5.0	67	39			
4 Dec	7.0	66	37			
24 Dec	10	64	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.

GAJ NAI NEAR JUBBLE

Chemical Analysis of Water Samples - 1969

	MILLIEQUIVALENTS PER LITRE												PARTS PER MILLION				$EC \times 10^6$ at 25°C	pH	Res CO_3 me/l	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.				
Jan																				
4	2.16	1.84	4.40		0.39	2.45	1.58	3.75			8.40	8.07				480	780	8.3	0	3.1
11	1.73	2.27	4.40		0.39	2.30	1.59	3.80			8.40	8.08				480	770	8.3	0	3.1
18	1.54	1.71	4.38		0.19	1.96	1.44	4.05			7.63	7.64				452	700	8.3	0	3.4
26	1.43	1.72	4.34		0.19	2.06	1.44	3.95			7.49	6.64				452	710	8.3	0	3.5
Feb																				
2	1.87	1.28	4.34		0.19	2.06	1.44	4.10			7.49	7.79				452	710	8.3	0	3.5
9	1.81	1.39	4.34		0.39	1.96	1.34	4.10			7.54	7.79				448	710	8.4	0	3.4
16	1.59	1.61	4.34		0.19	2.06	1.44	3.70			7.54	7.39				452	720	8.3	0	3.5
Mar																				
19	3.08	1.22	3.55		0.19	2.06	1.34	4.30			7.85	7.89				472	750	8.3	0	2.4
25	1.87	0.96	1.60		0	2.74	0.67	0.79			4.43	4.20				244	420	7.9	0	1.3
Apr																				
15	1.90	2.08	5.15		0.36	2.11	1.86	5.00			9.13	9.33				568	900	8.4	0	3.7
18	1.74	1.93	4.75		0.36	2.30	1.70	4.33			8.42	8.69				504	800	8.3	0	3.5
May																				
23	1.10	2.31	4.81		0.44	2.46	1.77	3.58			8.22	8.25				508	820	8.4	0	3.7
Jun																				
15	1.88	1.01	1.55		0	2.91	0.69	0.87			4.44	4.47				260	440	7.9	0.02	1.3
Jul																				
24	1.14	1.30	1.60		0	2.19	0.55	1.43			4.04	4.17				228	360	8.2	0	1.5
Aug																				
14	1.59	0.84	1.31		0	1.97	0.70	1.03			3.74	3.70				216	370	8.2	0	1.2
Sep																				
21	1.10	2.40	3.58		0.19	2.65	1.45	2.77			7.08	7.06				436	700	8.3	0	2.7
Oct																				
26	2.09	1.52	3.35		0.20	2.75	1.40	2.74			6.96	7.09				432	690	8.3	0	2.5
Nov																				
28	1.99	2.48	3.78		0.30	2.75	1.38	3.75			8.25	8.18				450	750	8.3	0	3.5
Dec																				
24	1.99	1.83	3.79		0	3.00	1.47	3.25			7.61	7.72				432	710	8.2	0	2.8

Blank page retained for pagination

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, WASID, WAPDA.

Extremes Maximum discharge during the year 452,000 cusecs on 30 August (gauge height 113.33 feet); minimum daily discharge 1,220 cusecs on 2-3 April.

1968-69: Maximum discharge 452,000 cusecs on 30 August 1969 (gauge height 113.33 feet S.P.D); minimum daily discharge 1,220 cusecs on 2-3 April 1969.

Gauge Staff gauge (enamelled plates) on right bank in two steps, graduated to 0.01 foot and read from 08:00 to 16:00 hours daily during low flow and more often during high flows. (Zero R.L. of the gauge = 81.20 S.P.D.).

Measurements Thirty three 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 three sets of sediment samples were taken by the depth integration method using D-49 sampler from the boat. Eighteen 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 22.5.69 was used, 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.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	15,300	*3,250	1,680	1,240	30,200	25,200
2	15,800	2,800	1,440	1,220	32,000	22,500
3	16,400	2,650	1,440	1,220	33,500	20,700
4	15,900	2,530	1,510	1,240	31,100	20,800
5	15,100	2,340	1,510	1,340	27,600	22,000
6	15,000	2,290	1,460	8,570	25,000	22,500
7	14,600	2,210	1,460	22,700	22,800	*37,200
8	13,800	2,170	1,450	25,500	20,700	82,900
9	13,100	2,130	1,440	23,800	17,500	109,000
10	12,500	2,080	1,440	21,400	15,900	127,000
11	12,300	2,040	1,430	21,000	14,500	143,000
12	*11,300	2,000	*1,430	19,800	13,000	149,000
13	10,200	1,970	1,430	*17,700	12,000	134,000
14	9,640	1,940	1,420	16,200	11,200	*113,000
15	9,150	1,930	1,390	15,900	10,500	99,600
16	11,000	1,910	1,350	16,300	9,540	98,800
17	11,800	1,840	1,330	16,200	8,870	109,000
18	11,900	*1,820	1,430	15,600	8,270	117,000
19	11,100	1,820	*1,350	15,100	7,920	122,000
20	9,400	1,800	1,350	14,900	7,700	121,000
21	7,980	1,780	1,320	16,300	*10,400	*114,000
22	6,840	1,770	1,300	26,200	26,500	114,000
23	6,470	1,750	1,290	37,100	40,500	124,000
24	5,880	1,730	1,290	39,600	49,700	136,000
25	6,160	1,720	1,290	37,000	51,700	152,000
26	6,720	1,700	1,270	*38,900	47,600	167,000
27	5,970	a1,690	1,260	44,200	40,500	184,000
28	5,280	1,680	1,260	43,700	*35,800	*197,000
29	4,460	———	1,260	36,900	31,700	211,000
30	3,800	———	1,260	31,400	24,500	219,000
31	3,490	———	1,250	———	28,700	———
Mean	10,300	2,050	1,380	20,900	24,300	110,000
Cs/mi						
In						
Maf	631	.114	.085	1.25	1.49	6.57

1969 Year : Mean 71,700 Cs/sq mi Inches

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

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	221,000	268,000	376,000	28,500	9,920	7,460
2	207,000	*279,000	304,000	25,500	*8,870	7,010
3	197,000	287,000	181,000	*20,500	8,670	6,560
4	190,000	297,000	170,000	17,700	8,640	6,110
5	*194,000	307,000	*144,000	15,700	8,470	5,940
6	196,000	319,000	133,000	15,300	8,010	5,860
7	194,000	329,000	142,000	16,100	7,610	5,730
8	186,000	328,000	139,000	16,000	7,370	5,500
9	178,000	*308,000	134,000	14,600	7,010	*5,180
10	172,000	278,000	130,000	13,700	10,100	4,760
11	170,000	251,000	120,000	13,000	15,600	a4,500
12	*175,000	248,000	107,000	11,800	16,500	a4,400
13	180,000	260,000	*100,000	11,300	15,000	4,220
14	191,000	275,000	89,000	11,800	12,500	3,780
15	202,000	293,000	86,300	11,500	11,300	3,520
16	211,000	*305,000	77,900	11,200	9,610	3,230
17	221,000	315,000	69,700	11,300	8,770	2,980
18	231,000	327,000	60,700	10,300	*8,240	2,820
19	244,000	336,000	54,600	9,820	7,920	2,590
20	*240,000	346,000	*48,200	9,330	7,820	*2,470
21	241,000	*355,000	42,000	8,980	8,080	2,360
22	243,000	366,000	38,000	9,430	8,240	2,240
23	240,000	378,000	39,600	10,100	8,080	2,170
24	248,000	392,000	44,900	10,600	7,730	1,980
25	254,000	403,000	47,300	10,100	7,610	1,940
26	*258,000	412,000	42,600	*9,570	7,580	1,880
27	256,000	421,000	36,400	9,500	7,550	1,800
28	256,000	428,000	34,200	10,600	7,250	6,840
29	257,000	432,000	34,100	12,000	*7,370	14,200
30	258,000	*431,000	32,200	12,200	7,550	14,200
31	265,000	408,000	———	11,100	———	12,600
Mean	219,000	335,000	102,000	13,200	9,170	5,060
Cs/mi						
In						
Maf	13.4	20.6	6.07	.812	.545	.311

M. Acre-feet: 51.9 Max Day 432,000 Min Day 1,220

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
12 Jan	11,500	63	104			
1 Feb	3,360	68	51			
18 Feb	1,820	72	28			
12 Mar	1,430	84	34			
19 Mar	1,350	80	19			
13 Apr	17,300	84	408	13	45	42
26 Apr	38,600	84	908	5	49	46
21 May	9,500	86	63			
28 May	36,200	88	915	12	51	37
7 Jun	36,900	90	1,180			
14 Jun	114,000	91	2,360			
21 Jun	115,000	89	2,260	4	56	40
28 Jun	197,000	90	4,030	8	62	30
5 Jul	194,000	90	3,800	7	59	34
12 Jul	174,000	88	3,740	7	59	34
20 Jul	240,000	89	3,710	6	64	30
26 Jul	258,000	95	3,730	7	63	30
2 Aug	277,000	91	3,970	12	58	30
9 Aug	311,000	92	2,950	6	64	30
16 Aug	303,000	87	3,710	13	56	31
21 Aug	353,000	88	3,140	21	52	27
30 Aug	431,000	95	2,990	23	54	23
5 Sep	144,000	88	2,850	8	72	20
13 Sep	101,000	90	1,900	3	64	33
20 Sep	48,400	86	1,030	20	62	18
28 Sep	34,200	88	742	3	59	38
3 Oct	20,800	88	342			
26 Oct	9,610	80	61			
2 Nov	9,050	80	77			
18 Nov	8,240	73	184			
29 Nov	7,340	64	42			
9 Dec	5,230	70	142			
20 Dec	2,490	67	98			

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 SUKKUR

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE											PARTS PER MILLION				EC x 10^6 at 25°C	pH	Res SO_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	2.38	0.79	1.20		0.29	2.15	0.75	1.04			4.37	4.23				240	400	8.3	0	1.0
Feb 1	2.38	1.26	1.95		0.49	2.40	1.03	1.46			5.59	5.38				320	520	8.3	0	1.5
18	2.06	1.22	1.15		0.29	2.64	0.59	0.77			4.43	4.29				240	420	8.2	0	0.9
Mar 12	1.65	1.34	1.04		0.39	2.25	0.48	0.87			4.03	3.99				216	370	8.3	0	0.9
19	2.64	1.03	1.12		0.39	2.94	0.48	1.07			4.79	4.88				264	440	8.3	0	0.8
Apr 13	2.18	0.23	1.07		0.27	1.56	0.74	0.89			3.48	3.46				208	340	8.2	0	0.1
26	1.63	0.57	0.52		0.18	1.47	0.29	0.83			2.72	2.77				160	270	8.2	0	0.5
May 21	1.21	1.10	0.51		0.17	1.58	0.49	0.67			2.82	2.91				168	280	8.2	0	0.5
28	1.43	0.99	0.62		0.17	1.49	0.68	0.83			3.04	3.17				180	300	8.2	0	0.6
Jun 28	1.48	0.46	0.40		0	1.56	0.29	0.46			2.34	2.31				124	220	8.2	0	0.4
Jul 26	0.91	0.59	0.55		0	1.55	0.30	0.26			2.05	2.11				116	200	8.2	0.05	0.6
Aug 9	1.21	0.59	0.70		0	1.66	0.30	0.65			2.50	2.61				140	250	8.2	0	0.7
Sep 28	1.21	0.91	0.54		0	1.67	0.40	0.66			2.66	2.73				152	260	8.2	0	0.5
Oct 26	1.48	1.01	0.55		Traces	2.06	0.30	0.65			3.04	3.01				180	300	8.2	0	0.5
Nov 29	1.75	0.83	0.69		0	2.30	0.44	0.46			3.27	3.20				174	300	8.0	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, WASID, WAPDA. (gauge heights 1 July to 10 October 1959 furnished by WAPDA Karachi Irrigation Project).

Average discharge 351 cusecs (256,000 acre-feet per year or 1.31 inches runoff per year). Average taken for 9 years from 1961 to 1969.

Extremes Maximum discharge observed during year 3,090 cusecs on 24 July (gauge height 5.00 feet); no flow on many days.

1959-69: 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. Zero of gauge datum at R.L. 124.95, Recorder was used to compute the discharges.

Measurements Thirty two discharge measurements were made by wading downstream from bund at low flow. High water rating is computed by weir formulas. Twenty five sets of sediment samples were taken by use of DH-48 sampler. Four of these were analysed for particle size distribution and the rest for total concentration. Four 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. This rating table dated 13.11.1962 was used throughout the year.

Remarks Record good.

HUB RIVER AT MUND MURAD KHAN

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
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	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	*0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	0	---	0	0	0	0
30	0	---	0	0	0	*0
31	0	---	0	0	0	---

Mean
Cs/mi
In
Acre-ft.

1969 Year: Mean 36 Cs/sq mi 0.01 Inches 0.13

Note : * Discyarge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	0	175	202	0	2.8	0
2	0	136	*144	0	2.6	0
3	0	93	112	0	1.7	0
4	0	83	*88	4.3	1.4	0
5	0	69	69	15	1.0	0
6	0	57	57	7.0	0.8	0
7	0	50	*50	4.1	0.5	0
8	0	32	42	2.5	0.1	0
9	0	*26	98	1.6	0	0
10	0	25	42	1.3	0	0
11	0	*21	*47	1.2	0	0
12	0	18	*59	0.3	0	0
13	0	16	36	0	0	0
14	0	13	25	0	0	0
15	0	11	*15	0	0	0
16	0	8.2	11	0	0	0
17	0	462	8.8	0	0	0
18	*0	968	*7.0	31	0	0
19	0	*506	6.0	25	0	0
20	0	247	4.7	3.7	0	0
21	37	159	3.5	6.4	0	0
22	715	*136	2.8	4.0	0	0
23	196	93	*2.2	2.4	0	0
24	1,630	*64	1.7	6.6	0	0
25	491	62	1.4	15	0	0
26	224	*224	1.4	12	0	0
27	939	183	1.2	8.8	0	0
28	*851	394	0.9	6.4	0	0
29	*420	917	0.5	5.0	0	0
30	*280	448	0.1	4.1	0	0
31	202	315	---	3.1	---	0
Mean	193	194	38	5.5	0.4	
Cs/mi	.05	.05	.01	.00	.00	
In	.06	.06	.01	.00	.00	
Acre-ft.	11,900	11,900	2,260	339	22	

Acre-feet: 26,400 Max Day 1,630 Min Day 0

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
28 Jul	688	86	7,960	5	34	61
29 Jul	394	92	2,610	5	36	59
30 Jul	258	87	758	3	23	74
2 Aug	128		137			
3 Aug	93		68			
4 Aug	78		78			
9 Aug	26		53			
11 Aug	20		13			
13 Aug	15		85			
16 Aug	8.5		31			
19 Aug	595		2,790	1	9	90
22 Aug	107		350			
24 Aug	64		110			
26 Aug	247		99			
2 Sep	159		328			
4 Sep	93		96			
7 Sep	52		94			
11 Sep	34		31			
12 Sep	64		57			
15 Sep	18		65			
18 Sep	7.6		162			
23 Sep	2.2		28			
25 Sep	1.7		38			
23 Oct	2.6		43			
2 Nov	2.0	85	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.

[illegible] WATER AT [illegible]

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER												PARTS PER MILLION				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	T.D.S. by Evap.				
Jul 18	1.60	1.34	2.41		0	2.51	4.35	1.24			5.35	5.40				284	500	8.1	0	2.0
Aug 28	2.62	1.63	5.02		0.31	2.43	6.40	2.[illegible]			9.27	9.23				508	920	8.4	0	3.4
Sep 2	1.54	1.64	2.30		0.[illegible]	4.86	4.35	1.32			5.68	5.62				324	540	8.3	0	2.0
Oct 23	3.68	4.53	11.85		0	1.67	11.40	7.17			20.06	20.44				1[illegible]	2000	8.0	0	5.8

Blank page retained for pagination

NUD RIVER NEAR MAI GONDRANI - 1969

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 date (except for 1966-67 when only gauge height data could be collected) by Surface Water Hydrology Project, WASID, WAPDA; fragmentory record for January-April, September-November 1961, also available.

Average discharge 103 cusecs (74,400 acre-feet per year or 1.72 inches runoff per year) for 6 years from 1962 to 1969 (except 1966-67).

Extremes Maximum discharge during the year 35,400 cusecs on 22 July (gauge height 17.20 feet); minimum daily discharge 0.9 cusecs on many days.

1962-69: 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 from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

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

Determination of discharge Rating table dated 30.3.1964 was used with shift adjustments as indicated necessary by periodic discharge measurements.

Remarks Record fair.

KUD RIVER NEAR MAI GONDRANI

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	5.7	2.3	2.2	1.8	1.4	1.3
2	1.6	2.3	2.2	1.8	1.4	1,080
3	5.1	2.3	2.2	1.8	1.4	2,200
4	4.5	2.3	2.2	1.8	1.4	152
5	3.9	2.3	2.0	1.8	1.4	11
6	3.9	2.3	1.9	1.8	1.4	5.4
7	3.6	2.3	1.8	1.8	1.4	3.6
8	3.3	2.2	1.8	1.8	1.3	2.7
9	3.0	2.2	1.8	1.7	1.3	2.2
10	2.9	2.2	1.9	1.8	190	2.1
11	2.9	2.2	1.9	200	2,220	2.2
12	2.8	2.2	1.9	50	558	2.3
13	3.6	2.3	1.9	14	235	2.2
14	2.9	2.2	1.8	8.4	26	2.3
15	2.8	2.2	1.8	2.9	8.0	140
16	2.7	2.2	1.8	2.6	3.6	430
17	2.6	2.4	1.8	*1.8	2.1	144
18	*2.5	2.4	1.8	1.7	1.7	394
19	2.5	2.4	1.8	1.7	1.4	[illegible]
20	2.5	2.4	1.8	1.5	1.3	176
21	2.5	2.4	1.8	1.5	1.3	160
22	2.4	2.3	1.8	1.4	*1.3	100
23	2.4	2.3	1.8	1.4	1.3	4.8
24	2.4	2.3	1.8	1.4	1.3	4.2
25	2.4	2.3	1.8	1.4	1.3	3.0
26	2.4	2.2	1.8	1.4	1.3	2.4
27	2.3	2.2	1.8	1.4	1.3	2.5
28	2.3	2.2	1.8	1.4	1.3	2.4
29	2.3	——	1.8	1.4	1.3	2.5
30	2.3	——	1.8	1.4	1.3	2.3
31	2.3	——	1.8	——	1.3	——
Mean	2.9	2.3	1.9	11	106	175
Cs/mi	0.00	0.00	0.00	0.01	0.13	0.22
In	0.00	0.00	0.00	0.01	0.15	0.24
Acre-ft.	181	127	115	628	6,490	10,400

1969 Year: Mean 73 Cs/sq mi 0.09 Inches 1.21

Note : * Discharge measurement made on this day.

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	140	6.0	*6.0	1.8	1.6	0.9
2	60	4.8	2.8	1.8	1.5	0.9
3	9.2	3.3	2.2	1.8	1.5	0.9
4	8.0	2.9	1.8	1.8	1.5	0.9
5	7.2	2.6	1.8	1.8	1.5	0.9
6	5.4	*2.3	1.8	1.8	1.4	0.9
7	3.9	2.3	1.8	1.8	1.4	*1.0
8	3.0	2.3	1.8	1.8	1.4	1.0
9	3.0	2.2	1.8	1.8	1.4	1.0
10	2.9	2.2	*1.8	1.8	1.4	1.0
11	3.0	2.3	5.4	1.8	1.4	1.0
12	168	2.3	2.6	1.8	1.4	1.0
13	3,450	*2.3	1.9	1.8	1.4	1.0
14	148	2.3	1.8	1.8	1.2	0.9
15	616	2.2	1.8	6.8	1.2	0.9
16	1,100	10	1.7	9.2	1.2	0.9
17	*50	33	1.7	3.6	1.2	0.9
18	10	12	*1.7	2.6	1.1	1.0
19	3.6	*4.5	1.7	2.0	1.1	1.0
20	1.8	3.3	1.8	1.9	1.1	1.0
21	*132	3.0	1.8	1.8	1.1	1.0
22	463	2.9	1.7	1.8	1.1	1.0
23	7,850	2.9	1.8	1.8	1.0	1.0
24	285	*1,060	1.7	1.8	1.0	1.0
25	1,110	23	*1.7	1.8	1.0	1.0
26	488	63	1.7	1.6	1.0	1.0
27	112	11	1.8	1.6	1.0	1.0
28	53	23	1.8	1.6	*1.0	1.0
29	15	16	*1.8	*1.6	1.0	1.0
30	*11	13	1.8	1.6	1.0	1.0
31	8.4	7.6	——	1.6	——	1.0
Mean	524	43	2.1	2.3	1.2	1.0
Cs/mi	0.65	0.05	0.00	0.00	0.00	0.00
In	0.75	0.06	0.00	0.00	0.00	0.00
Ac-ft.	32,200	2,640	126	139	74	60

Acre-feet 53,200 Max Day 7,850 Min Day 0.9

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
18 Jan	2.5	62	37			
17 Apr	1.8	89	51			
22 May	1.3	98	89			
17 Jul	60	86	6,840	3	20	77
21 Jul	176	56	44,300		48	52
30 Jul	12	86	219			
6 Aug	2.3	82	80			
13 Aug	2.3	84	27			
19 Aug	4.5	93	276			
24 Aug	387	86	43,900	1	45	54
1 Sep	6.0	81	201			
10 Sep	1.8	80	74			
18 Sep	1.7	78	159			
25 Sep	1.7	78	27			
29 Oct	1.6	75	25			
28 Nov	1.0	78	19			
7 Dec	1.0	62	17			

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.

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITER										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 16	4.80	1.28	6.50		0.40	2.35	3.46	6.64			12.58	12.94				740	1190	8.3	0	3.7
Apr 17	1.90	2.19	3.50		0.46	2.39	2.05	3.03			7.59	7.93				472	750	8.3	0	2.5
May 22	1.60	4.18	6.46		0.35	1.71	3.38	7.17			12.24	12.61				796	1220	8.3	0	3.8
Aug 18	2.74	2.35	6.05		0	2.08	3.30	5.83			11.14	11.21				692	1100	8.2	0	3.7
Sep 18	1.76	3.96	6.18		0	2.70	3.60	5.18			11.90	11.48				696	1120	8.2	0	3.7
Oct 28	3.24	2.91	5.70		Trace	2.55	3.00	5.33			11.85	11.68				702	1160	8.2	0	3.2
Nov 28	4.11	2.70	6.32		0	2.90	4.02	5.98			13.13	12.90				752	1200	8.0	0	3.4
Dec 7	3.59	3.43	6.53		0.19	3.20	3.92	5.70			13.55	13.01				780	1240	8.3	0	3.5

Blank page retained for pagination

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 16 February 1968 to date gauge heights record for 1966-67, by Surface Water Hydrology Project, WASID, WAPDA. Prior to that occasional gauge heights by Karachi Irrigation Project since July 1960. The site was not accessible in 1966-67, hence regular discharge observations could not be made.

Average discharge 119 cusecs (86,200 acre-feet per year or 1.04 inches runoff per year) for five years from 1962 to 1965 and 1969.

Extremes Maximum discharge observed furing the year 15,200 cusecs on 15 July (gauge height 9.62 feet); Minimum daily discharge 0.5 cusecs on many days.

1962-65:69 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 1966.

Gauge Staff gauge graduated to 0.1 foot and read to nearest hundredth from 08:00 to 16:00 hours daily during low flow and more often during floods. Gauge set to arbitrary datum.

Measurements Forty discharge measurements were made during the year by current meter using 0.2 and 0.8 or 0.6 depth method by wading during low flows and from cableway during floods. Thirty eight sets of sediment samples were taken by depth integration method using DH-48 sampler while wading and D-49 sampler from the overhead cableway. Thirteen 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 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; low flow discharges affected by upstream diversions.

Discharge in cusecs for year 1969

Date	Jan	Feb	Mar	Apr	May	Jun
1	15	11	14	32	14	64
2	14	12	14	26	12	329
3	14	12	14	21	12	194
4	14	12	12	17	11	26
5	14	12	14	17	11	21
6	14	15	12	17	9.0	18
7	14	15	14	15	11	17
8	14	15	12	15	11	14
9	14	15	12	15	11	*11
10	14	15	11	23	58	9.0
11	14	15	11	27	1,950	6.0
12	14	17	11	21	1,080	6.0
13	14	17	11	20	116	4.5
14	14	17	11	18	52	4.5
15	12	15	11	18	44	66
16	12	17	11	17	40	*858
17	12	17	11	*17	32	*1,080
18	14	17	11	17	21	*990
19	*12	17	11	17	18	*190
20	12	15	*11	17	15	94
21	12	18	11	15	14	60
22	11	17	20	15	*11	30
23	12	17	21	15	9.0	*18
24	11	18	18	14	7.5	15
25	11	15	70	14	7.5	12
26	11	12	220	14	7.5	12
27	11	14	60	14	9.0	*11
28	11	14	44	14	9.0	9.0
29	11	—	36	14	7.5	9.0
30	11	—	34	14	6.0	*353
31	11	—	34	—	6.0	———
Mean	13	15	26	18	117	151
Cs/mi	0.01	0.01	0.02	0.01	0.08	0.10
In	0.01	0.01	0.02	0.01	0.09	0.11
Ac-ft.	781	839	1,600	1,050	7,180	8,990

1969 Year: Mean 95 Cs/sq mi 0.06 Inches 0.84

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

PORALI RIVER AT SINCHI BENT

Discharge in cusecs for year 1969

Date	Jul	Aug	Sep	Oct	Nov	Dec
1	*110	46	11	a0.5	4.5	15
2	84	44	7.5	a0.5	7.5	15
3	128	46	4.5	a0.5	9.0	15
4	*72	46	1.5	a0.5	7.5	14
5	52	*46	a0.5	4.5	a7.0	14
6	38	36	a0.5	4.6	a6.0	12
7	*23	28	*3.0	3.0	a5.0	*12
8	21	24	6.0	4.5	a4.0	12
9	20	*20	4.5	6.0	3.0	9.0
10	20	18	*4.5	6.0	4.5	11
11	18	17	3.0	23	4.5	11
12	134	125	1.5	23	3.0	9.0
13	1,910	116	1.5	13	3.0	11
14	3,430	*104	6.0	24	6.0	11
15	4,150	68	*9.0	a3.5	12	9.0
16	*4,420	*92	7.5	7.5	12	9.0
17	*356	78	4.5	110	9.0	9.0
18	113	56	3.0	24	9.0	9.0
19	78	46	1.5	18	7.5	11
20	*68	34	*1.5	11	6.0	11
21	*701	29	7.5	7.5	9.0	9.0
22	*230	26	11	13	9.0	9.0
23	1,750	*327	12	15	11	11
24	473	*831	11	13	12	11
25	1,390	*319	*9.0	13	12	12
26	*438	*245	6.0	4.5	15	12
27	54	3.0	4.5	*1.5	12	11
28	48	1.5	1.5	3.0	*12	9.0
29	46	a1.0	*1.5	3.0	12	9.0
30	40	a1.0	a0.5	3.0	14	9.0
31	*48	*6.0	—	4.5	—	7.5
Mean	660	93	4.9	12	8.3	11
Cs/mi	0.43	0.06	0.00	0.01	0.00	0.01
In	0.49	0.07	0.00	0.01	0.01	0.01
Ac-ft.	40,600	5,710	292	725	492	671

Acre-feet: 68,900 Max Day 4,420 Min Day 0.5

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Silt	Clay
19 Jan	15	65	30			
20 Mar	6	66	11			
17 Apr	17	84	79			
22 May	11	92	25			
9 Jun	9.0	91	92			
16 Jun	773	86	15,600			
17 Jun	1,100	81	18,000			
18 Jun	1,120	80	31,900		45	55
19 Jun	190	79	6,010		34	66
23 Jun	20	83	108			
27 Jun	12	89	104			
30 Jun	574	83	2,820	3	33	64
4 Jul	74	86	49			
7 Jul	23	86	31			
16 Jul	4,650	82	18,700	2	93	5
17 Jul	320	85	6,300	6	55	39
20 Jul	70	81	43			
21 Jul	950	84	10,100	1	79	20
26 Jul	501	82	10,200	5	80	15
31 Jul	48	78	31			
5 Aug	48	79	44			
9 Aug	20	80	43			
14 Aug	125	81	1,400	1	29	70
16 Aug	305	78	2,250	5	47	48
23 Aug	466	84	16,700	4	79	17
24 Aug	950	83	11,300	12	71	17
25 Aug	494	83	8,130	14	65	21
26 Aug	424	83	4,060	8	26	66
31 Aug	11	83	58			
7 Sep	6.0	88	32			
10 Sep	4.5	87	69			
15 Sep	9.0	95	25			
20 Sep	1.5	79	19			
25 Sep	9.0	88	36			
29 Sep	1.5	85	28			
27 Oct	1.5	74	30			
28 Nov	12	64	18			
7 Dec	12	80	40			

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.

PORALI RIVER AT SINGHI BRST

Chemical Analysis of Water Samples - 1969

Date	MILLIEQUIVALENTS PER LITRE										TOTAL		PARTS PER MILLION				$EC \times 10^6$ at $25^\circ C$	pH	Res CO_3 me/l	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.				
Jan 19	2.59	2.22	4.19		0.68	2.35	2.62	3.18			9.00	8.83				520	840	8.4	0	2.7
Mar 20	2.09	2.21	3.60		0.59	2.45	3.21	2.41			7.90	7.66				456	750	8.4	0	2.7
Apr 17	1.90	2.40	3.58		0.46	2.71	2.10	2.87			7.88	8.14				484	780	8.4	0	2.4
May 22	0.99	3.06	3.71		0.35	2.81	2.05	2.60			7.76	7.81				476	770	8.3	0	2.6
Jul 16	1.08	1.58	1.15		0	2.94	0.50	0.40			3.81	3.84				220	380	8.1	0.28	0.9
Aug 16	2.03	1.89	4.00		0.31	2.08	2.20	3.33			7.92	7.92				480	780	8.5	0	2.9
Oct 27	2.09	2.89	3.35		0.30	3.58	2.30	2.13			8.33	8.31				492	800	8.3	0	2.1
Nov 28	1.84	2.39	3.32		0.30	3.40	2.11	1.51			7.55	7.32				430	710	8.3	0	2.3
Dec 7	2.14	2.37	3.41		0.19	3.60	2.15	1.96			7.92	7.90				442	730	8.3	0	2.3

Blank page retained for pagination

MISCELLANEOUS SITES
SUMMARY OF DISCHARGE MEASUREMENT

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1969

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Measurements Cusecs
Brandu Nallah	Daggar Lat: 34°29' Long: 72°29'	231	22. 9.69	84
			3.10.69	70
			9.11.69	75
			9.11.69	73
			24.11.69	62
			7.12.69	60
			24.12.69	57
Zhob River	Mir Ali Khel Lat: 31°44' Long: 69°35'	5,730	7. 1.69	45
			13. 1.69	41
			19. 1.69	41
			26. 1.69	43
			31. 1.69	40
			4. 2.69	46
			11. 2.69	65
			17. 2.69	79
			31. 3.69	61
			6. 4.69	64
			19. 4.69	79
			22. 4.69	66
			28. 5.69	34
			8. 6.69	33
			16. 6.69	64
			20. 6.69	35
Jhelum River	Chinari Lat: 34°09' Long: 73°50'	5,250	23.10.69	4,800
			10.11.69	4,900
			11.11.69	5,110
			24.11.69	3,750
			2.12.69	3,590
Bong Canal	Foot Bridge (D/s Mangla Reservoir)		19. 2.69	31,000
			25. 2.69	15,100
			4. 3.69	23,300
			1. 4.69	20,400
Beji River	Babar Kach Lat: 29°47' Long: 67°59'	6,300	16. 1.69	47
			21. 2.69	46
			22. 3.69	41
Chakkar River	Talli Tangi Lat: 29°34' Long: 68°13'	573	15. 1.69	Dry
			21. 2.69	Dry
			23. 3.69	Dry

DISCHARGE MEASUREMENTS MADE AT MISCELLANEOUS SITES DURING YEAR - 1969

Stream	Location of measurement site	Drainage area square miles	Measurements Date	Cusecs
Hub River	Dam Site		8. 1.69	1.4
	Lat: 25°15'		24. 1.69	1.4
	Long: 67°05'		13. 3.69	0.2
			14. 4.69	0.2
			20. 5.69	Dry
			8. 6.69	Dry

Blank page retained for pagination

MISCELLANEOUS SITES
SUMMARY OF SEDIMENT DATA

MISCELLANEOUS SITES

Suspended sediment concentration - 1969

1969 Date	Discharge in cusecs	Temp. of Water °F	Total PPM by weight	Percent Sand	Percent Silt	Percent Clay
BRANDU NALLAH AT DAGGAR						
9 Nov	75	66	91			
9 Nov	73	68	69			
24 Nov	62	62	93			
7 Dec	60	58	71			
24 Dec	67	48	38			
ZHOB RIVER NEAR MIR ALI KHEL						
7 Jan	45	45	113			
26 Jan	43	50	277			
11 Feb	65	50	1,220	4	19	77
17 Feb	79	60	877	5	24	71
31 Mar	61	70	158			
6 Apr	64	65	243			
19 Apr	79	60	1,780	2	37	61
22 Apr	66	72	1,100	10	32	58
JHELUM RIVER AT CHINARI						
23 Oct	4,800	65	126			
11 Nov	5,110	58	157			
24 Nov	3,750	50	104			
2 Dec	3,590	49	116			
KEJI RIVER NEAR BABAR KACH						
16 Jan	47	58	79			
21 Feb	46	59	71			
22 Mar	41	80	98			
HUB RIVER AT HUB DAM SITE						
8 Jan	1.4	67	55			
24 Jan	1.4	65	92			

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.

MISCELLANEOUS SITES
SUMMARY OF QUALITY DATA

MISCELLANEOUS SITES - CHEMICAL ANALYSIS OF WATER SAMPLES - 1969

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^oC	pH	Res CO_3 me/l	SAR
	Milliequivalents per litre												Parts per million							
BRANDU RIVER AT DAGGAR																				
Sep 22	1.37	0.75	0.40		0	2.20	0.30	0.08			2.52	2.58				136	240	7.8	0.08	0.4
Nov 24	2.04	0.74	0.41		0	2.80	0.19	0.28			3.19	3.27				176	300	7.9	0.02	0.4
HUB RIVER NEAR MIR ALI KHEL																				
Jan 1	2.70	3.49	8.06		0.88	4.01	2.97	6.19			14.25	14.05				830	1310	8.5	0	4.6
27	1.90	2.27	5.43		0.29	1.91	2.49	5.05			9.60	9.74				612	970	8.4	0	3.8
Feb 12	1.60	2.56	7.10		0.39	3.82	2.20	4.57			11.26	10.98				656	1100	8.4	0.05	4.9
Mar 16	2.21	3.42	8.00		0.29	2.40	3.36	6.87			13.63	12.92				810	1280	8.3	0	4.8
Apr 22	3.22	3.08	9.68		0.46	2.53	3.87	9.22			15.98	16.08				1020	1540	8.4	0	5.4
JHELUM RIVER AT CHINAKI																				
Nov 24	1.95	0.63	0.28		0	2.20	0.19	0.46			2.86	2.85				158	270	7.7	0	0.2
BHUI RIVER NEAR BABAR KACH																				
Jan 16	2.48	3.34	6.80		0.49	2.98	2.57	6.67			12.62	12.71				760	1210	8.3	0	4.0
Feb 21	2.59	2.81	6.40		0.39	2.64	2.39	6.63			11.80	12.05				690	1100	8.3	0	3.9
Mar 22	2.05	3.35	6.30		0.49	2.84	2.40	5.75			11.70	11.48				680	1100	8.4	0	3.8
HUB RIVER AT DAM SITE																				
Jan 8	4.45	2.87	12.96		0.19	2.10	12.42	6.57			21.28	21.28				1280	2100	8.2	0	6.3
24	3.78	4.07	10.20		0.39	2.15	9.00	6.72			18.05	18.26				1060	1680	8.3	0	5.2