

Chapter-1 INTRODUCTION

1.1 Preamble

Punjab is the most populous and industrialized province of Pakistan. Rapid urbanization, haphazard industrial development, and continuous population explosion have resulted in degradation of natural resources to an alarming stage. In Punjab municipal wastewater from almost all major towns in addition to industrial effluents is discharged into various streams without treatment which ultimately reach the rivers. This has given rise to serious water pollution and human health hazards. Municipal wastes contaminate water bodies with pathogens whereas industrial wastes introduce a variety of chemicals of concern to environment and human health. In addition the biodegradable organic matter in municipal and industrial wastewaters results in the depletion of dissolved oxygen in water necessary for fish life.

In agricultural areas of the country excessive use of fertilizers and pesticides also adds to surface and groundwater pollution. In particular, during rainfalls the surface overflows reach the rivers carrying large quantities of pollutants. Discharge of excessive quantities of fertilizers may give rise to eutrophication in the receiving water bodies whereas fish may accumulate excess concentrations of heavy metals to affect consumers' health. Certain heavy metals may also badly harm the aquatic life.

The effect of pollution of municipal and industrial discharges in rivers is not pronounced during high flow seasons. However during low flow conditions it becomes hazardous in certain reaches resulting in the depletion of dissolved oxygen.

Increasing trends of pollution of water bodies has become a matter of great concern, yet no systematic studies have been undertaken to assess the levels of prevailing pollution and to anticipate the future trends to this effect, Regular monitoring of river water is not being done in the country except for GEMS water quality project (Aziz, 2001). Many reasons to this effect include lack of laboratory facilities, non-availability of laboratory staff and financial constraints.

The problem of pollution of surface water bodies due to anthropogenic activities is so sever that EPA, Punjab planned to evaluate the qualities of surface water sources in a systematic way with the objective of combat their respective pollution problem(s).

Environment Protection Department Government of Punjab decide to monitor the Quality of River Jhelum under its ADP Project” Monitoring of Surface water Bodies in Punjab”. The river was decided to be monitored right from its originating point to its point of its joining with river Chenab and to suggest the various options for improvement of environment of Jhelum River.

1.2 Objectives

The overall objectives of the study are as follows:

- 1.2.1 To study pollution status of River Jhelum from New Bong Village Laheri, District Jhelum to Jhang before mixing into river Chenab.
- 1.2.2 To carry out the laboratory analysis regarding water quality of the river and various point sources adding pollution to the river Jhelum and comparison with NEQS.

- 1.2.3 To describe the threats posed to environment arid communities due to the present water quality situation in the Jhelum River.
- 1.2.4 To present the statistical evidences of events causing hazards to environment and communities.
- 1.2.5 To assess various mitigation measures and provide different options available for controlling river water pollution
- 1.2.6 Analyze and provide recommendations for each option based on environmental considerations and its social acceptability by the communities.
- 1.2.7 Sharing reports with concerned agencies to prepare action plan for control of deterioration of water bodies.
- 1.2.8 Involve all stakeholders including provincial and district governments, community representatives, NGOs and activists in development of options through consultative workshops.
- 1.2.9 Suggest concerned District Government for preparation of detailed project (PC-I) to control pollution of River Jhelum/Surface water source(s) in their respective Districts.

1.3 Scope of Work

- 1.3.1 Conducting field visits to identify sampling points on various tributaries and in the river along with selection of groundwater and soil sampling locations.
- 1.3.2 Sampling of river water and its tributaries to determine the existing water quality.

- 1.3.3 Estimation of pollution loads entering the river through its tributaries, various sewage outfalls, nullahs and drains.
- 1.3.4 Assessment of the prevailing environmental pollution based on the sample analyses.
- 1.3.5 Impact studies of River Jhelum pollution on the ambient environment including aquatic and human health and soil.
- 1.3.6 Propose strategic and technical measures to combat environmental pollution in the study area along with feasibility and economical analysis of different treatment options.

Chapter-2 Project Implementation Methodology

2.1 Introduction

This chapter presents the methodology followed for monitoring the quality of all types of point sources of pollution of surface water as well as the water quality of the surface water body with object to ascertain the effect of pollution on the respective water source. This chapter also presents requirement for sampling program, guideline for sampling program including sampling site location, the list of pollution parameters.

2.2 Methodology

Methodology to achieve the aforementioned objectives comprised of but not limited to followings:

2.2.1 Stakeholder consultative workshop

Methodology for implementation of the scheme was shared with line departments in a consultative seminar. The objective involved was to make necessary improvements in the project implementation methodology, if necessary.

2.2.2 Lesion with Line Departments

EPA representative visited various Government Departments to hold meetings for collection of relevant data on matters of river pollution and its control. These Departments/Organizations included the followings

- ◆ Irrigation and Power Department, Government of Punjab
- ◆ Directorate of land Reclamation Irrigation & Power Department

- ◆ Office of Executive Engineer, Drainage Section, I&P Department.
- ◆ Town Municipal Administration (TMAs), Jhelum
- ◆ Institute of Environmental Engineering and Research, University of Engineering & Technology, Lahore.

Data collected from various research reports on Jhelum River water quality and its assimilative capacity and stream pollution control was studied to be benefited for achievement of aforementioned objectives.

2.2.3 Identification of Pollution Sources

Task of identification of the sources of pollution that affect the river water quality was accomplished by literature review and a detailed field survey. EPA field offices were asked to identify the points of disposal of effluent of all types into the river passing in their respective districts. Later on detailed physical surveys were conducted to mark their location on the maps.

Based on the field survey and literature reviews following sources of pollution are identified:

a) Sewage pumping station

Sewage pumping stations that discharge untreated municipal sewage.

b) Irrigation Canals & Lakes

Following irrigation canal of Irrigation and Power Department join river Jhelum to augment flow of river at various locations along its length.

- i. Combined over flow water of Jatlee & Rehman Pur Head Works before mixing with River Jhelum, near Sukh Chain Pur Village, A.J.K.Pakistan.
- ii. Chashma / Sind - Jhelum Rabta Canal before mixing with River Jhelum, District Khushab.

c) Wastewater Drains

In addition to disposal points marked as pumping stations, various wastewater carrying drains dispose off effluent into the river Jhelum. These mainly include the followings:

- i) Nullah Jaba
- ii) Dengi Pullee Drain
- iii) Piran Ghaib Drain
- iv) Shamali Mohallah Drain
- v) Salman Paras Drain
- vi) Wastewater Drain of Saraye Alam Gir City
- vii) Mandi Baha-ud-Din drain
- viii) Bhera Drain
- ix) Saim Nullah Bunsu
- x) Ghag Drain
- xi) Khushab Drain
- xii) Joharabad Drain
- xiii) Dhup Sari Drain
- xiv) Kaka Drain
- xv) Derkhan Wala Drain
- xvi) Rani Wah Drain

2.2.4 Sampling

EPA laboratory staff and concerned District Officers Environment conducted physical survey (areas of their jurisdiction) to undertake the sampling.

Following sampling methodology was adopted:

- i) Sampling of point sources
- ii) River Jhelum sampling U/S of the point source
- iii) River Jhelum Sampling D/S of the point source after mixing

Based on the physical survey and numbers of point sources disposing effluent into the River Jhelum, forty eight (48) sampling points were identified for sampling. **Figure 2.1** indicates the location of the sampling points along the river Jhelum and point sources of pollution. **Table 2.1** indicates the locations of the various sampling points fixed along the river length and on the point sources of the river Jhelum.



The sampling was conducted by qualified staff of EPA Punjab Laboratories. Measurements of Dissolved Oxygen (DO), temperature and pH were made on the site during sampling. The samples were collected in polystyrene bottles ranging in

capacity from 0.5 to 1.5 L. The bottles were thoroughly washed with water, before taking samples.

Sulfuric acid and Nitric acid were used as preservatives in sampling bottles for trace elements and nitrate determination respectively. All samples were brought to the laboratory and kept in refrigeration at a temperature of 4°C till analysis.

2.2.5 Analysis

Analysis of the wastewater samples was carried out in EPA Laboratory, Lahore. Samples were analyzed according to the standard procedure as described in “Standard Methods for Examination of Water and Wastewater “by WPCF, AWWF & APHA 18th edition was followed, to obtain base line information on industrial effluent along with pollution load study.



Table 2.1**Sampling Points along River Jhelum and Sources of Pollution**

Sample No.	Location of Sampling Points
S-1	Mangla Lake, Jhelum
S-2	River Jhelum originating point, near New Bong Village Laheri, District Jhelum.
S-3	River Jhelum before mixing with over flow water of Jatlee & Rehman Pur Head Works near Village Jalal Pur Balj, Jhelum.
S-4	Combine over flow water of Jatlee & Rehman Pur Head Works before mixing with River Jhelum, near Sukh Chain Pur Village, A.J.K. Pakistan.
S-5	River Jhelum after mixing with over flow water of Jatlee & Rehman Pur Head Works & before mixing with Nullah Jaba, near Sukh Chain Pur Village, A.J.K. Pakistan.
S-6	Nullah Jaba before mixing with River Jhelum near Bhag, Tehsil Saraye Alam Gir, District Gujrat.
S-7	River Jhelum before entering into Jhelum city near Village Fazyal Pur, District Jhelum.
S-8	River Jhelum before mixing with Denge Pullee drain, near Bela Restaurant, Jhelum.
S-9	Dengi Pullee Drain, before mixing with River Jhelum near Bela Restaurant, Jhelum.
S-10	River Jhelum after mixing with Denge Pullee drain & before mixing with Piran Ghaib drain near Mohalla Piran Ghaib, Jhelum.
S-11	Piran Ghaib drain before mixing with River Jhelum near Mohalla Piran Ghaib, Jhelum.
S-12	River Jhelum before mixing with Shamali Mohallah drain & after mixing with Piran Ghaib Drain near Shamali Mohallah, Jhelum.
S-13	Shamali Mohallah Drain before mixing with River Jhelum.

Sample No.	Location of Sampling Points
S-14	Salman Paras drain before mixing into River Jhelum near Mohalla Salman Paras, Jhelum.
S-15	River Jhelum before mixing with drain of Saraye Alam Gir city near Railway Bridge, Jhelum.
S-16	Waste water drain of Saraye Alam Gir city before mixing with River Jhelum, near Railway Bridge, Jhelum.
S-17	River Jhelum after mixing with Salman Paras drain, & Waste water drain of Saraye Alam Gir city near G.T. Road Jhelum.
S-18	River Jhelum, downstream of Cantt area drain, Jhelum Cantt
S-19	River Jhelum, Pind Dadan Khan near ICI's water supply system
S-20	River Jhelum near Jalal pur Sharif, Tehsil Pind Dadan Khan
S-21	River Jhelum at village Lillah, exit point of District Jhelum
S-22	River Jhelum entry point into District Mandi Bahau Din & before mixing with Mandi Bahau Din Drain at Rasool Head Works, District Mandi Baha uddin.
S-23	Mandi Baha uddin drain before mixing into River Jhelum near Village Uthyala Syedan, District Mandi Baha uddin.
S-24	River Jhelum exit point, District Mandi Bahau Din & Entry Point into District Sargodha & before mixing with Bhera Drain near Chak Nizam, Tehsil Malikwal, District Mandi Baha uddin.
S-25	Bhera Drain before mixing with River Jhelum near Village Hajka Sharif, Tehsil Bhalwal, District Sargodha.
S-26	River Jhelum after mixing with Bhera drain, near Village Hajka Sharif, Tehsil Bhalwal, District Sargodha.
S-27	River Jhelum before mixing with Saim Nullah Bunsi, District Khushab.
S-28	Saim Nullah Bunsi before mixing with River Jhelum, District Khushab.

Sample No.	Location of Sampling Points
S-29	River Jhelum before mixing with Ghag Drain & after mixing with Saim Nullah Bunsu, District Khushab.
S-30	Ghag drain before mixing with River Jhelum at Moza Ghag, District Khushab.
S-31	River Jhelum after mixing with Ghag Drain, District Khushab.
S-32	River Jhelum before mixing with Khushab Drain, Moza Manzoor, District Khushab.
S-33	Khushab drain before mixing with River Jhelum, Tehsil & District Khushab.
S-34	River Jhelum after mixing with Khushab drain & before mixing with Joharabad drain at Jalal Pur Syedan, District Khushab.
S-35	Joharabad drain before mixing with River Jhelum, Tehsil & District Khushab.
S-36	River Jhelum after mixing with Joharabad drain & before mixing with Dhup Sari drain at Hamokey, District Khushab.
S-37	Dhup Sari Drain before mixing with River Jhelum, District Khushab.
S-38	River Jhelum after mixing with Dhup Sari drain & before mixing with Chashma / Sind-Jhelum Rabta Canal, District Khushab.
S-39	Chashma / Sind-Jhelum Rabta Canal, before mixing with River Jhelum, District Khushab.
S-40	River Jhelum after mixing with Chashma / Sind-Jhelum Rabta Canal & before mixing with Kaka Drain, District Khushab.
S-41	Kaka drain before mixing with River Jhelum, District Khushab.
S-42	River Jhelum entry point into District Jhang & exit point of District Khushab & before mixing with Derkhan Wala Drain, Moza Jhok Usman, Tehsil & District Jhang.
S-43	Derkhan Wala drain before mixing with River Jhelum, Moza Kanjri Wala, Tehsil & District Jhang.

Sample No.	Location of Sampling Points
S-44	River Jhelum before mixing with Rani Wah drain & after mixing with Derkhan Wala drain, near Moza Qadir Pur, Bukhsha Thatee Kharey Dee, Tehsil & District Jhang.
S-45	Rani Wah drain before mixing with River Jhelum near Moza Qadir Pur, Bukhsha Thatee Kharey Dee, Tehsil & District Jhang.
S-46	River Jhelum after mixing Rani Wah Drain near Moza Qadir Pur Bukhsha, Thatee Kharey Dee, Tehsil & District Jhang.
S-47	River Jhelum before mixing with River Chenab near Moza Shakree, Athara Hazari Road, Tehsil & District Jhang.
S-48	Kallar Kahar Lake, District Chakwal

2.3 Description of Project Area

2.3.1 Project Area Description

Jhelum River is a river that flows in India and Pakistan. It is the largest and most western of the five rivers of Punjab, and passes through Jhelum District. It is a tributary of the Chenab River and has a total length of about 480 miles (774kilometers).

The river Jhelum rises from a spring at Verinag situated at the



foot of the Pir Panjal in the south-eastern part of the valley of Kashmir in India. It flows through Srinagar and the Wular Lake before entering Pakistan through a deep narrow gorge. The Kishenganga (Neelum) River, the largest tributary of the Jhelum, joins it near Muzaffarabad, as does the next largest, the Kunhar River of the Kaghan valley. It also connects with Pakistan and Pakistan-held Kashmir on Kohala Bridge east of Circle Bakote. It is then joined by the Poonch River, and flows into the Mangla Dam reservoir in the district of Mirpur.

Jhelum enters the Punjab in the Jhelum District. From there, it flows through the plains of Pakistan's Punjab, forming the boundary between the Chaj and Sindh Sagar Doabs. It ends in a confluence with the Chenab at Trimmu in District Jhang. The Chenab merges with the Sutlej to form the Panjnad River which joins the Indus River at Mithankot.

Jhelum city is located in northern Punjab Province, Jhelum District, Pakistan. Jhelum lies on the right bank of the Jhelum River. The name of the city is derived from the words Jal (pure water) and Ham (snow), as the river that flows through the river originates in the Himalayas. There are numbers of industry in and around Jhelum city include a tobacco factory, wood, marble, glass and flour mills.

Lying at 32°56' North latitude and 73°44' East longitude, Jhelum is located just 1 hour and 30 minutes drive from the Capital of Pakistan Islamabad, and 3 Hours drive from the heart of Punjab Lahore. Jhelum is linked with these cities through the National Highway N-5. Few other cities which are as far as 1 to 2 hours drive are Gujarat popular for Fan industry and Gujranwala Popular as Industrial City of Pakistan. Chakwal was also a part of Jhelum until division of

the Jhelum District into two districts. On the other side Jhelum is linked with MirPur Azad Kashmir popular as mini England.

Jhelum is hot in summer, dry and mild in winter with maximum mean temperature in summer, in June, 45.7 degree centigrade, whereas in winter, in January; the minimum temperature as recorded is 1.8 degree centigrade respectively. Average annual rainfall is about 900 mm (about 35 inches) which is

General Information	
Country	Pakistan
Province	Punjab
District	Jhelum
Coordinates	32°56'00"N 73°44'00"E 32.933333°N 73.733333°E
Area	22 km ² (8 sq mi)
Calling code	0544
Time zone	PST (UTC+5)
Population	145,847 (1998)
Estimate	172,073 (2009)
Density	7,821/km ² (20,256/sq mi)
Government	
Nazim (Mayor)	Chaudhry Farrukh Altaf
No. of Union Councils	7

much below the required quantity but in the rainy season the water torrents flow from North to the river Jhelum with a very fast speed and cause damages to the crops, bridges, roads and are responsible for the soil erosion in the District.

In the past few years, the city has experienced rapid expansion and has become a vibrant economic and cultural center. Estimated Population of Jhelum City in 2009 is 172,073 and Area of Jhelum City is about 22 km².

Chapter-3 Pollution

Load on River Jhelum

This chapter describes the results of the analysis of the samples collected during December, 2008 from the various sampling points along the river and its point sources of the pollution.

3.1 Water Quality of the River Jehlum

Water quality of the River Jhelum can be determined by the results of the samples taken from different points. Details of the analysis of individual samples are given along with the sources from where they were taken.

3.1.1 Mangla Lake, Jhelum

The Dissolved Oxygen (DO) level at this sampling point was found as 8.2 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.4 mg/l and 8.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.1 below.

Table-3.1

Wastewater analysis report of the Mangla Lake, Jhelum

S #	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	13.6
2	Value of pH	6-9	7.2
3	Dissolved Oxygen	-	8.2
4	Biochemical Oxygen	80 mg/l	2.4
5	Chemical Oxygen Demand	150 mg/l	8.4
6	Total Dissolved Solids	3500 mg/l	100
7	Total Suspended Solids	200 mg/l	60

8	Chloride (Cl ⁻¹)	1000 mg/l	15
9	Sulphate (SO ₄) ⁻²	600 mg/l	22
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.003
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.074
14	Copper	1.0 mg/l	0.054
15	Cadmium	0.1 mg/l	0.057
16	Chromium	1.0 mg/l	0.039
17	Zinc	5.0 mg/l	0.0
18	Iron	8.0 mg/l	0.092
19	Nickel	1.0 mg/l	0.451
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	07
22	Calcium (Ca)	-	28
23	Potassium (K)	-	21

Remarks: The parameters analyzed are within the NEQS limits.

3.1.2 River Jhelum Originating Point, New Bong Village Laheri, District Jhelum.

The Dissolved Oxygen level at this sampling point was found as 8.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.2 mg/l and 10.6 mg/l respectively. The detailed analysis report of the sample collected from this point is given in

Table-3.2

Wastewater analysis report of the River Jhelum Originating Point, New Bong Village Laheri, District Jhelum

S #	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	11.39

2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	8.5
4	Biochemical Oxygen	80 mg/l	3.2
5	Chemical Oxygen Demand	150 mg/l	10.6
6	Total Dissolved Solids	3500 mg/l	140
7	Total Suspended Solids	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	20
9	Sulphate (SO ₄) ⁻²	600 mg/l	24
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.005
12	Cyanide (As CN')	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.032
14	Copper	1.0 mg/l	0.029
15	Cadmium	0.1 mg/l	0.025
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.046
18	Iron	8.0 mg/l	0.263
19	Nickel	1.0 mg/l	0.018
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	07
22	Calcium (Ca)	-	23
23	Potassium (K)	-	2.2

Remarks: The parameters analyzed are within the NEQS limits.

3.1.3 River Jhelum before mixing with over flow water of Jatlee & Rehman Pur Head Works near Village Jalal Pur Balj Jhelum.

The Dissolved Oxygen level at this sampling point was found as 8.8 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to

be 3.8 mg/l and 8.6 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.3.

Table-3.3

Wastewater analysis report of the River Jhelum before mixing with over flow water of Jatlee & Rehman Pur Head Works

S #	PARAMETERS	N.E.Q.S.	Results
1	Temperature	=<3° C	15.9
2	Value of pH	6-9	8.3
3	Dissolved Oxygen	-	8.8
4	Biochemical Oxygen	80 mg/l	3.8
5	Chemical Oxygen Demand	150 mg/l	8.6
6	Total Dissolved Solids (TDS)	3500 mg/l	160
7	Total Suspended Solids	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	32
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.525
12	Cyanide (As CN')	1.0 mg/l	0.598
13	Manganese	1.5 mg/l	0.037
14	Copper	1.0 mg/l	0.031
15	Cadmium	0.1 mg/l	0.026
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.124
18	Iron	8.0 mg/l	0.285
19	Nickel	1.0 mg/l	0.014
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	70
22	Calcium (Ca)	-	24
23	Potassium (K)	-	2.2

Remarks: The parameters analyzed are within the NEQS limits

3.1.4 **Combine over flow water of Jatlee & Rehman Pur Head Works before mixing with River Jhelum, near Sukh Chain Pur Village, A.J.K. Pakistan**

The Dissolved Oxygen level at this sampling point was found as 8.1 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 5.2 mg/l and 22.8 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.4

Table-3.4

Wastewater analysis report of the Combined Over Flow Water of Jatlee & Rehman Pur Head Works before mixing with River Jhelum, near Sukh Chain Pur Village, A.J.K. Pakistan

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	14.2
2	Value of pH	6-9	8.8
3	Dissolved Oxygen	-	8.1
4	Biochemical Oxygen	80 mg/l	5.2
5	Chemical Oxygen Demand	150 mg/l	22.8
6	Total Dissolved Solids (TDS)	3500 mg/l	120
7	Total Suspended Solids	200 mg/l	100
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	20
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.380
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.041
14	Copper	1.0 mg/l	0.032
15	Cadmium	0.1 mg/l	0.022
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.0121
18	Iron	8.0 mg/l	0.314

19	Nickel	1.0 mg/l	0.016
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	7.0
22	Calcium (Ca)	-	23
23	Potassium (K)	-	20

Remarks: The parameters analyzed are within the NEQS limits.

3.1.5 River Jhelum after mixing with over flow water of Jatlee & Rehman Pur Head Works & before mixing with Nullah Jaba, near Sukh Chain Pur Village, A.J.K. Pakistan.

The Dissolved Oxygen level at this sampling point was found as 8.7 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.4 mg/l and 9.2 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.5.

Table-3.5

Wastewater analysis report of the River Jhelum after mixing with over flow water of Jatlee & Rehman Pur Head Works & before mixing with Nullah Jaba

#	PARAMETERS	N.E.Q.S.	Results
1	Temperature	=<3° C	14.4
2	Value of pH	6-9	8.8
3	Dissolved Oxygen	-	8.7
4	Biochemical Oxygen Demand	80 mg/l	4.4
5	Chemical Oxygen Demand	150 mg/l	9.2
6	Total Dissolved Solids (TDS)	3500 mg/l	70
7	Total Suspended Solids (TSS)	200 mg/l	150
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	16

10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.346
12	Cyanide (As CN')	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.029
14	Copper	1.0 mg/l	0.018
15	Cadmium	0.1 mg/l	0.020
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.012
18	Iron	8.0 mg/l	0.290
19	Nickel	1.0 mg/l	0.018
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	07
22	Calcium (Ca)	-	23
23	Potassium (K)	-	2.0

Remarks: The parameters analyzed are within the NEQS limits

.1.6 Nullah Jaba before mixing with River Jhelum near Bhag Nagar Tehsil Saraye Alam Gir District Gujrat.

The Dissolved Oxygen level at this sampling point was found as 7.3 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.8 mg/l and 8.6 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.6

**Table-3.6
Wastewater analysis report of the Nullah Jaba before mixing with River Jhelum near Bhag Nagar**

S #	PARAMETERS	N.E.Q.S.	Results
1	Temperature	=<3° C	13.9
2	Value of pH	6-9	7.8
3	Dissolved Oxygen	-	7.3
4	Biochemical Oxygen	80 mg/l	2.8

5	Chemical Oxygen	150 mg/l	8.6
6	Total Dissolved Solids	3500 mg/l	110
7	Total Suspended Solids	200 mg/l	130
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	18
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.347
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.124
14	Copper	1.0 mg/l	0.047
15	Cadmium	0.1 mg/l	0.068
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.132
18	Iron	8.0 mg/l	0.342
19	Nickel	1.0 mg/l	0.019
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	08
22	Calcium (Ca)	-	24
23	Potassium (K)	-	2.0

Remarks: The parameters analyzed are within the NEQS limits

3.1.7 River Jhelum before entering into Jhelum City near Village Fazyal Pur, District Jhelum

The Dissolved Oxygen level at this sampling point was found as 8.3 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.4 mg/l and 10.6 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.7.

Table-3.7**Wastewater analysis report of the River Jhelum before entering into Jhelum City**

S#	PARAMETERS	N.E.Q.S.	RESULT
1	Temperature	=<3° C	14.9
2	Value of pH	6-9	7.8
3	Dissolved Oxygen	-	8.3
4	Biochemical Oxygen	80 mg/l	3.4
5	Chemical Oxygen Demand	150 mg/l	10.6
6	Total Dissolved Solids (TDS)	3500 mg/l	140
7	Total Suspended Solids	200 mg/l	70
8	Chloride (Cl ⁻¹)	1000 mg/l	20
9	Sulphate (SO ₄) ⁻²	600 mg/l	24
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻)	10 mg/l	0.04
12	Cyanide (As CN ⁻)	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.045
14	Copper	1.0 mg/l	0.022
15	Cadmium	0.1 mg/l	0.019
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.051
18	Iron	8.0 mg/l	0.33
19	Nickel	1.0 mg/l	0.015
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	08
22	Calcium (Ca)	-	25
23	Potassium (K)	-	24

Remarks: The parameters analyzed are within the NEQS limits.

3.1.8 River Jhelum before mixing with Denge Pullee Drain near Bela Restaurant Jhelum.

The Dissolved Oxygen level at this sampling point was found as 8.8 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.6 mg/l and 8.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.8.

Table-3.8

Wastewater analysis report of the River Jhelum before Mixing with Denge Pullee Drain

S#	PARAMETERS	N.E.Q.S.	RESULT
1	Temperature	=<3° C	11.9
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	8.8
4	Biochemical Oxygen	80 mg/l	2.6
5	Chemical Oxygen Demand	150 mg/l	8.4
6	Total Dissolved Solids (TDS)	3500 mg/l	160
7	Total Suspended Solids	200 mg/l	60
8	Chloride (Cl ⁻¹)	1000 mg/l	40
9	Sulphate (SO ₄) ⁻²	600 mg/l	26
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.01
12	Cyanide (As CN')	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.039
14	Copper	1.0 mg/l	0.026
15	Cadmium	0.1 mg/l	0.021
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.049
18	Iron	8.0 mg/l	0.295
19	Nickel	1.0 mg/l	0.022

20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	10
22	Calcium (Ca)	-	25
23	Potassium (K)	-	23

Remarks: The parameters analyzed are within the NEQS limits

3.1.9 Dengi Pullee Drain before mixing with River Jhelum near Bela Resturent Jhelum.

The Dissolved Oxygen level at this sampling point was found as 7.1 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 6.4 mg/l and 23.5 mg/l respectively. This drain is responsible for adding 0.02975 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in the Table-3.9.

Table-3.9

Waste water Analysis Report of Dengi Pullee Drain before mixing with River Jhelum

S #	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	10.8
2	Value of pH	6-9	8.5
3	Dissolved Oxygen	-	7.1
4	Biochemical Oxygen	80 mg/l	6.4
5	Chemical Oxygen Demand	150 mg/l	23.5
6	Total Dissolved Solids (TDS)	3500 mg/l	600
7	Total Suspended Solids	200 mg/l	60
8	Chloride (Cl ⁻¹)	1000 mg/l	65
9	Sulphate (SO ₄) ⁻²	600 mg/l	122
10	Sulfide	1.0 mg/l	12

11	Fluoride (As F ⁻)	10 mg/l	0.05
12	Cyanide (As CN ⁻)	1.0 mg/l	1.56
13	Manganese	1.5 mg/l	0.042
14	Copper	1.0 mg/l	0.033
15	Cadmium	0.1 mg/l	0.042
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.052
18	Iron	8.0 mg/l	0.323
19	Nickel	1.0 mg/l	0.025
20	Oil & Grease	10 mg/l	0.9
21	Sodium (Na)	-	51
22	Calcium (Ca)	-	56
23	Potassium (K)	-	86

Remarks: The values of Sulfide and Cyanide exceed the NEQS Limits.

3.1.10 River Jhelum after mixing with Denge Pullee Drain & before mixing with Piran Ghaib Drain near Mohalla Piran Ghaib Jhelum

The Dissolved Oxygen level at this sampling point was found as 7.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 1.2 mg/l and 8.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.10.

Table-3.10

W	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	12.2
2	Value of pH	6-9	8.08

3	Dissolved Oxygen	-	7.6
4	Biochemical Oxygen	80 mg/l	1.2
5	Chemical Oxygen Demand	150 mg/l	8.4
6	Total Dissolved Solids	3500 mg/l	120
7	Total Suspended Solids	200 mg/l	120
8	Chloride (Cl ⁻¹)	1000 mg/l	30
9	Sulphate (SO ₄) ⁻²	600 mg/l	24
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.03
12	Cyanide (As CN ['])	1.0 mg/l	0.266
13	Manganese	1.5 mg/l	0.035
14	Copper	1.0 mg/l	0.024
15	Cadmium	0.1 mg/l	0.022
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.045
18	Iron	8.0 mg/l	0.264
19	Nickel	1.0 mg/l	0.020
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	08
22	Calcium (Ca)	-	24
23	Potassium (K)	-	2.7

Remarks: The parameters analyzed are within the NEQS limits.

3.1.11 Piran Ghaib Drain before mixing with River Jhelum near Mohalla Piran Ghaib, Jhelum.

The Dissolved Oxygen level at this sampling point was found as 0.8 mg/l. Biochemical Oxygen Demand (BOD₅) and

Chemical Oxygen Demand (COD) of the River were found to be 90 mg/l and 240 mg/l respectively. This drain is responsible for adding 0.63855 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in the Table-3.11.

Table-3.11

**Piran Ghaib Drain before Mixing with River Jhelum
near Mohalla Piran Ghaib Jhelum Piran Ghaib Drain**

S	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	13.7
2	Value of pH	6-9	7.8
3	Dissolved Oxygen	-	0.8
4	Biochemical Oxygen	80 mg/l	90
5	Chemical Oxygen Demand	150 mg/l	240
6	Total Dissolved Solids	3500 mg/l	940
7	Total Suspended Solids	200 mg/l	340
8	Chloride (Cl ⁻¹)	1000 mg/l	135
9	Sulphate (SO ₄) ⁻²	600 mg/l	246
10	Sulfide	1.0 mg/l	4.0
11	Fluoride (As F ⁻)	10 mg/l	0.002
12	Cyanide (As CN ⁻)	1.0 mg/l	4.5
13	Manganese	1.5 mg/l	0.056
14	Copper	1.0 mg/l	0.048
15	Cadmium	0.1 mg/l	0.065
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.121
18	Iron	8.0 mg/l	0.361
19	Nickel	1.0 mg/l	0.022

20	Oil & Grease	10 mg/l	2.4
21	Sodium (Na)	-	110
22	Calcium (Ca)	-	64
23	Potassium (K)	-	33

Remarks: The values of BOD, COD, TSS, Sulfide and Cyanide exceed the NEQS limits.

3.1.12 River Jhelum before Mixing With Shamali Mohallah Drain & After Mixing With Piran Ghaib Drain Near Shamali Mohallah, Jhelum

The Dissolved Oxygen level at this sampling point was found as 8.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.0 mg/l and 19.6 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.12.

Table-3.12
Wastewater analysis report of the River Jhelum Before Mixing With Shamali Mohallah Drain & After mixing Piran Ghaib Drain Near Shamali Mohallah, Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULT
1	Temperature	=<3° C	12.5
2	Value of pH	6-9	7.9
3	Dissolved Oxygen	-	8.6
4	Biochemical Oxygen	80 mg/l	4.0
5	Chemical Oxygen Demand	150 mg/l	19.6
6	Total Dissolved Solids (TDS)	3500 mg/l	240
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	30
9	Sulphate (SO ₄) ⁻²	600 mg/l	56

10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻)	10 mg/l	0.021
12	Cyanide (As CN ⁻)	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.032
14	Copper	1.0 mg/l	0.025
15	Cadmium	0.1 mg/l	0,021
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.292
19	Nickel	1.0 mg/l	0.012
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	10
22	Calcium (Ca)	-	25
23	Potassium (K)	-	2.7

Remarks: The parameters analyzed are within the NEQS limits.

3.1.13 Shamali Mohallah Drain Before Mixing With River Jhelum

The Dissolved Oxygen level at this sampling point was found as 0.7 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 124 mg/l and 336 mg/l respectively. This drain is responsible for adding 0.63708 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.13

Table-3.13

Shamali Mohallah Drain Before Mixing With River Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULT
1	Temperature	=<3° C	13.7
2	Value of pH	6-9	7.7
3	Dissolved Oxygen	-	0.7
4	Biochemical Oxygen	80 mg/l	124
5	Chemical Oxygen Demand	150 mg/l	336
6	Total Dissolved Solids (TDS)	3500 mg/l	900
7	Total Suspended Solids	200 mg/l	340
8	Chloride (Cl ⁻¹)	1000 mg/l	180
9	Sulphate (SO ₄) ⁻²	600 mg/l	168
10	Sulfide	1.0 mg/l	12
11	Fluoride (As F ['])	10 mg/l	0.003
12	Cyanide (As CN ['])	1.0 mg/l	11.6
13	Manganese	1.5 mg/l	0.049
14	Copper	1.0 mg/l	0.044
15	Cadmium	0.1 mg/l	0.074
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.11
18	Iron	8.0 mg/l	0.321
19	Nickel	1.0 mg/l	0.021
20	Oil & Grease	10 mg/l	4.7
21	Sodium (Na)	-	120
22	Calcium (Ca)	-	64
23	Potassium (K)	-	39

Remarks: The values of BOD, COD, TSS, Sulfide, and Cyanide exceed the NEQS limits.

3.1.14 **Salman Paras Drain Before Mixing into River Jhelum near Mohalla Salmsn Paras Jhelum.**

The Dissolved Oxygen level at this sampling point was found as 0.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 186 mg/l and 456 mg/l respectively. This drain is responsible for adding 3.8225 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.14

Table-3.14
Wastewater analysis report of the Salman Paras Drain before Mixing into River Jhelum near Mohalla Salman Pras Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.5
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	0.5
4	Biochemical Oxygen	80 mg/l	186
5	Chemical Oxygen Demand	150 mg/l	456
6	Total Dissolved Solids (TDS)	3500 mg/l	850
7	Total Suspended Solids	200 mg/l	350
8	Chloride (Cl ⁻¹)	1000 mg/l	110
9	Sulphate (SO ₄) ⁻²	600 mg/l	172
10	Sulfide	1.0 mg/l	12
11	Fluoride (As F ¹)	10 mg/l	0.672
12	Cyanide (As CN ¹)	1.0 mg/l	44.7
13	Manganese	1.5 mg/l	0.053
14	Copper	1.0 mg/l	0.049
15	Cadmium	0.1 mg/l	0.067
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.109

18	Iron	8.0 mg/l	0.211
19	Nickel	1.0 mg/l	0.027
20	Oil & Grease	10 mg/l	4.3
21	Sodium (Na)	-	120
22	Calcium (Ca)	-	58
23	Potassium (K)	-	36

Remarks:- The values of BOD, COD, TSS, Sulfide and Cyanide exceed the NEQS limits.

3.1.15 River Jhelum before Mixing With Drain of Saraye Alam Gir City Near Railway Bridge Jhelum.

The Dissolved Oxygen level at this sampling point was found as 7.9 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.1 mg/l and 9.1 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.15.

Table-3.15
Wastewater analysis report of the River Jhelum before Mixing with Drain of Saraye Alam Gir City near Railway Bridge Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.7
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	7.9
4	Biochemical Oxygen	80 mg/l	3.1
5	Chemical Oxygen Demand	150 mg/l	9.1
6	Total Dissolved Solids (TDS)	3500 mg/l	300
7	Total Suspended Solids	200 mg/l	100
8	Chloride (Cl ⁻¹)	1000 mg/l	50
9	Sulphate (SO ₄) ⁻²	600 mg/l	30

10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻)	10 mg/l	0.477
12	Cyanide (As CN ⁻)	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.034
14	Copper	1.0 mg/l	0.026
15	Cadmium	0.1 mg/l	0.022
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.301
19	Nickel	1.0 mg/l	0.017
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	38
22	Calcium (Ca)	-	22
23	Potassium (K)	-	2.7

Remarks: The parameters analyzed are within the NEQS limits.

3.1.16 Waste water Drain of Saraye Alam Gir City before Mixing With River Jhelum near Railway Bridge Jhelum.

The Dissolved Oxygen level at this sampling point was found as 0.4 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 104 mg/l and 216 mg/l respectively. This drain is responsible for adding 1.0941 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in the Table-3.16.

Table-3.16

Waste water Drain of Saraye Alam Gir City before Mixing with River Jhelum near Railway Bridge Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	15.0
2	Value of pH	6-9	7.5

3	Dissolved Oxygen	-	0.4
4	Biochemical Oxygen	80 mg/l	104
5	Chemical Oxygen Demand	150 mg/l	216
6	Total Dissolved Solids (TDS)	3500 mg/l	700
7	Total Suspended Solids	200 mg/l	400
8	Chloride (Cl ⁻¹)	1000 mg/l	100
9	Sulphate (SO ₄) ⁻²	600 mg/l	148
10	Sulfide	1.0 mg/l	4
11	Fluoride (As F ['])	10 mg/l	0.578
12	Cyanide (As CN ['])	1.0 mg/l	8.2
13	Manganese	1.5 mg/l	0.118
14	Copper	1.0 mg/l	0.082
15	Cadmium	0.1 mg/l	0.054
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.135
18	Iron	8.0 mg/l	0.515
19	Nickel	1.0 mg/l	0.113
20	Oil & Grease	10 mg/l	2.2
21	Sodium (Na)	-	88
22	Calcium (Ca)	-	23
23	Potassium (K)	-	23

Remarks: The values of BOD, COD, TSS, Sulfide and Cyanide exceed the NEQS limits.

3.1.17

River Jhelum after Mixing with Salman Paras Drain & Waste water Drain of Saraye Alam Gir City near G.T. Road Jhelum.

The Dissolved Oxygen level at this sampling point was found as 8.2 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.0 mg/l and 10.2 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.17

Table-3.17
Wastewater analysis report of the River Jhelum After
Mixing with Salman Paras Drain & Waste water Drain of
Saraye Alam Gir City near G.T. Road Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	12.4
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	8.2
4	Biochemical Oxygen	80 mg/l	4.0
5	Chemical Oxygen Demand	150 mg/l	10.2
6	Total Dissolved Solids (TDS)	3500 mg/l	110
7	Total Suspended Solids (TSS)	200 mg/l	130
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	23
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.489
12	Cyanide (As CN')	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.044
14	Copper	1.0 mg/l	0.065
15	Cadmium	0.1 mg/l	0.031
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.360
19	Nickel	1.0 mg/l	0.018
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	11
22	Calcium (Ca)	-	27
23	Potassium (K)	-	2.2

Remarks: The parameters analyzed are within the NEQS limits

3.1.18 River Jhelum, downstream Cantt area drain, Jhelum Cantt

The Dissolved Oxygen level at this sampling point was found as 8.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.5 mg/l and 16 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.18

Table-3.18
River Jhelum, downstream Cantt area drain, Jhelum Cantt

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	19.2
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	8.6
4	Biochemical Oxygen	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	16
6	Total Dissolved Solids (TDS)	3500 mg/l	280
7	Total Suspended Solids	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	150
9	Sulphate (SO ₄) ⁻²	600 mg/l	58
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.395
12	Cyanide (As CN ['])	1.0 mg/l	0.003
13	Manganese	1.5 mg/l	0.125
14	Copper	1.0 mg/l	0.068
15	Cadmium	0.1 mg/l	0.005
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.013
18	Iron	8.0 mg/l	0.350
19	Nickel	1.0 mg/l	0.011
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	8
22	Calcium (Ca)	-	22

23	Potassium (K)	-	6
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Remarks: The parameters analyzed are within the NEQS limits.

3.1.19 River Jhelum, Pind Dadan Khan, near ICI water supply system

The Dissolved Oxygen level at this sampling point was found 8.4 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.5 mg/l and 24 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.19

Table-3.19

Wastewater analysis report of the River Jhelum, Pind Dadan Khan, near ICI water supply system

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	24.4
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	8.4
4	Biochemical Oxygen	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	24
6	Total Dissolved Solids (TDS)	3500 mg/l	270
7	Total Suspended Solids	200 mg/l	30
8	Chloride (Cl ⁻¹)	1000 mg/l	100
9	Sulphate (SO ₄) ⁻²	600 mg/l	52
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.166
12	Cyanide (As CN ['])	1.0 mg/l	0.002
13	Manganese	1.5 mg/l	0.125
14	Copper	1.0 mg/l	0.065

15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.011
18	Iron	8.0 mg/l	0.348
19	Nickel	1.0 mg/l	0.009
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	5
22	Calcium (Ca)	-	22
23	Potassium (K)	-	5.1

Remarks: The parameters analyzed are within the NEQS limits.

3.1.20 River Jhelum, near Jalal pur Sharif, Tehsil Pind Dadan Khan

The Dissolved Oxygen level at this sampling point was found as 8.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.7 mg/l and 12 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.20.

Table-3.20

Wastewater analysis report of the River Jhelum, near Jalal pur Sharif, Tehsil Pind Dadan Khan

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	22.7
2	Value of pH	6-9	7.7
3	Dissolved Oxygen	-	8.5
4	Biochemical Oxygen	80 mg/l	2.7
5	Chemical Oxygen Demand	150 mg/l	12
6	Total Dissolved Solids (TDS)	3500 mg/l	260
7	Total Suspended Solids	200 mg/l	20

8	Chloride (Cl ⁻¹)	1000 mg/l	100
9	Sulphate (SO ₄) ⁻²	600 mg/l	48
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.299
12	Cyanide (As CN ['])	1.0 mg/l	0.005
13	Manganese	1.5 mg/l	0.127
14	Copper	1.0 mg/l	0.068
15	Cadmium	0.1 mg/l	0.005
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.012
18	Iron	8.0 mg/l	0.351
19	Nickel	1.0 mg/l	0.01
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	6
22	Calcium (Ca)	-	24
23	Potassium (K)	-	11.6

Remarks: The parameters analyzed are within the NEQS limits.

3.1.21 River Jhelum at village Lillah, exit point, District Jhelum

The Dissolved Oxygen level at this sampling point was found as 9.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.7 mg/l and 28 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.21

Table-3.21
Wastewater analysis report of River Jhelum at village Lillah, exit point, District Jhelum

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	21.0

2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	9.5
4	Biochemical Oxygen	80 mg/l	3.7
5	Chemical Oxygen Demand	150 mg/l	28
6	Total Dissolved Solids (TDS)	3500 mg/l	300
7	Total Suspended Solids	200 mg/l	70
8	Chloride (Cl ⁻¹)	1000 mg/l	60
9	Sulphate (SO ₄) ⁻²	600 mg/l	68
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.144
12	Cyanide (As CN ['])	1.0 mg/l	0.002
13	Manganese	1.5 mg/l	0.122
14	Copper	1.0 mg/l	0.060
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.019
18	Iron	8.0 mg/l	0.192
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	28
22	Calcium (Ca)	-	26
23	Potassium (K)	-	2.0

Remarks: The parameters analyzed are within the NEQS limits.

3.1.22 River Jhelum Entry Point into District Mandi Bahau Din & Before Mixing With Mandi Bahau Din Drain at Rasool Head Works District Mandi Bahau Din.

The Dissolved Oxygen level at this sampling point was found as 8.3 mg/l. Biochemical Oxygen Demand (BOD₅) and

Chemical Oxygen Demand (COD) of the River were found to be 4.5 mg/l and 20.7 mg/l respectively. The detailed analysis report of the sample collected from this point is given in the Table-3.22.

Table-3.22
Wastewater analysis report of the River Jhelum Entry Point Into District Mandi Bahau Din & Before Mixing With Mandi Bahau Din Drain At Rasool Head Works District Mandi Bahau Din.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	14.4
2	Value of pH	6-9	8.3
3	Dissolved Oxygen	-	8.3
4	Biochemical Oxygen	80 mg/l	4.5
5	Chemical Oxygen Demand	150 mg/l	20.7
6	Total Dissolved Solids (TDS)	3500 mg/l	220
7	Total Suspended Solids	200 mg/l	1460
8	Chloride (Cl ⁻¹)	1000 mg/l	15
9	Sulphate (SO ₄) ⁻²	600 mg/l	56
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.390
12	Cyanide (As CN ['])	1.0 mg/l	1.17
13	Manganese	1.5 mg/l	0.071
14	Copper	1.0 mg/l	0.041
15	Cadmium	0.1 mg/l	0.024
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.014
18	Iron	8.0 mg/l	0.321
19	Nickel	1.0 mg/l	0.021
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	23

23	Potassium (K)	-	6.3
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Remarks: The value of TSS exceeds the NEQS limits

3.1.23 Mandi Bahau Din drain Before Mixing into River Jhelum near Village Uthyala Syedan District Mandi Bahau Din.

The Dissolved Oxygen level at this sampling point was found as 0.9 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 48 mg/l and 128 mg/l respectively. This drain is responsible for adding 0.78681 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in the Table-3.23.

Table-3.23
Wastewater analysis report of Mandi Baha uddin drain Before Mixing into River Jhelum near Village Uthyala Syedan District Mandi Bahau Din

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	15
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	0.9
4	Biochemical Oxygen	80 mg/l	48
5	Chemical Oxygen Demand	150 mg/l	128
6	Total Dissolved Solids (TDS)	3500 mg/l	1160
7	Total Suspended Solids	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	205
9	Sulphate (SO ₄) ⁻²	600 mg/l	253
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ¹)	10 mg/l	0.570
12	Cyanide (As CN ¹)	1.0 mg/l	1.23

13	Manganese	1.5 mg/l	0.119
14	Copper	1.0 mg/l	0.060
15	Cadmium	0.1 mg/l	0.071
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.102
18	Iron	8.0 mg/l	0.771
19	Nickel	1.0 mg/l	0.014
20	Oil & Grease	10 mg/l	3.4
21	Sodium (Na)	-	280
22	Calcium (Ca)	-	40
23	Potassium (K)	-	24.4

Remarks: The value of Cyanide exceeds the NEQS limits

3.1.24 River Jhelum Exit Point District Mandi Baha uddin & Entry Point Into District Sargodha & Before Mixing With Bhera Drain Near Chak Nizam Tehsil Malikwal District Mandi Bahau Din.

The Dissolved Oxygen level at this sampling point was found as 7.79 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.1 mg/l and 23.7 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.24

Table-3.24

Wastewater analysis report of the River Jhelum Exit Point District Mandi Bahau Din & Entry Point Into District Sargodha & Before Mixing With Bhera Drain Near Chak Nizam Tehsil Malikwal District Mandi Bahau Din

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	13.4
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	7.79

4	Biochemical Oxygen	80 mg/l	4.1
5	Chemical Oxygen Demand	150 mg/l	23.7
6	Total Dissolved Solids (TDS)	3500 mg/l	200
7	Total Suspended Solids	200 mg/l	240
8	Chloride (Cl ⁻¹)	1000 mg/l	15
9	Sulphate (SO ₄) ⁻²	600 mg/l	42
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻¹)	10 mg/l	0.310
12	Cyanide (As CN ⁻¹)	1.0 mg/l	0.113
13	Manganese	1.5 mg/l	0.073
14	Copper	1.0 mg/l	0.061
15	Cadmium	0.1 mg/l	0.019
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.390
19	Nickel	1.0 mg/l	0.014
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	17
22	Calcium (Ca)	-	25
23	Potassium (K)	-	3.7

Remarks: The parameters analyzed are within the NEQS limits.

3.1.25 Bhera Drain Before Mixing With River Jhelum Near Village Hijka Sharif Tehsil Bhalwal District Sargodha.

The Dissolved Oxygen level at this sampling point was found as 6.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.8 mg/l and 30.8 mg/l respectively. This drain is responsible for adding 0.1041 ton/day of organic load to the

river. The detailed analysis report of the sample collected from this point is given in Table-3.25

Table-3.25

Wastewater analysis report of the Bhera Drain Before Mixing With River Jhelum Near Village Hijka Sharif, Tehsil Bhalwal District Sargodha

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	13.3
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	6.5
4	Biochemical Oxygen	80 mg/l	3.8
5	Chemical Oxygen Demand	150 mg/l	30.8
6	Total Dissolved Solids (TDS)	3500 mg/l	680
7	Total Suspended Solids	200 mg/l	40
8	Chloride (Cl ⁻¹)	1000 mg/l	55
9	Sulphate (SO ₄) ⁻²	600 mg/l	108
10	Sulfide	1.0 mg/l	4.0
11	Fluoride (As F ['])	10 mg/l	0.426
12	Cyanide (As CN ['])	1.0 mg/l	0.233
13	Manganese	1.5 mg/l	0.088
14	Copper	1.0 mg/l	0.055
15	Cadmium	0.1 mg/l	0.076
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.117
18	Iron	8.0 mg/l	0.844
19	Nickel	1.0 mg/l	0.021
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	87
22	Calcium (Ca)	-	29
23	Potassium (K)	-	10.8

Remarks: The value of Sulfide exceeds the NEQS limits

3.1.26 River Jhelum after Mixing with Bhera Drain near Village Hijka Sharif, Tehsil Bhalwal District Sargodha.

The Dissolved Oxygen level at this sampling point was found as 6.7 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.1mg/l and 16.7 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.26

Table-3.26
Wastewater analysis report of the River River Jhelum
After Mixing With Bhera Drain Near Village Hijka Sharif
Tehsil Bhalwal District Sargodha

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	13.1
2	Value of pH	6-9	7.8
3	Dissolved Oxygen	-	6.7
4	Biochemical Oxygen	80 mg/l	2.1
5	Chemical Oxygen Demand	150 mg/l	16.7
6	Total Dissolved Solids (TDS)	3500 mg/l	280
7	Total Suspended Solids	200 mg/l	140
8	Chloride (Cl ⁻¹)	1000 mg/l	30
9	Sulphate (SO ₄) ⁻²	600 mg/l	48
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.172
12	Cyanide (As CN ['])	1.0 mg/l	0.116
13	Manganese	1.5 mg/l	0.074
14	Copper	1.0 mg/l	0.060
15	Cadmium	0.1 mg/l	0.032
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.012
18	Iron	8.0 mg/l	0.401

19	Nickel	1.0 mg/l	0.016
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	36
22	Calcium (Ca)	-	28
23	Potassium (K)	-	4.2

Remarks: The parameters analyzed are within the NEQS limits

3.1.27 River Jhelum before Mixing With Saim Nullah Bunsu District Khushab

The Dissolved Oxygen level at this sampling point was found as 9.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.5 mg/l and 8.5 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.27.

Table-3.27

Wastewater analysis report of the River Jhelum before Mixing with Saim Nullah Bunsu District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	19.5
2	Value of pH	6-9	8.2
3	Dissolved Oxygen	-	9.5
4	Biochemical Oxygen	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	8.5
6	Total Dissolved Solids (TDS)	3500 mg/l	2840
7	Total Suspended Solids	200 mg/l	40
8	Chloride (Cl ⁻¹)	1000 mg/l	35
9	Sulphate (SO ₄) ⁻²	600 mg/l	526
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.723
12	Cyanide (As CN ['])	1.0 mg/l	0.684

13	Manganese	1.5 mg/l	0.122
14	Copper	1.0 mg/l	0.041
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.006
18	Iron	8.0 mg/l	0.058
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	726
22	Calcium (Ca)	-	100
23	Potassium (K)	-	6.3

Remarks: The parameters analyzed are within the NEQS limits

3.1.28 Saim Nullah Bunsi Before Mixing With River Jhelum, District Khushab.

The Dissolved Oxygen level at this sampling point was found as 6.4 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.1 mg/l and 5.0 mg/l respectively. The drain is responsible for adding 0.012844 ton / day of organic load into the river. The detailed analysis report of the sample collected from this point is given in Table-3.28

Table-3.28

Wastewater analysis report of the Saim Nullah Bunsi before Mixing with River Jhelum District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	19.0
2	Value of pH	6-9	7.0
3	Dissolved Oxygen	-	6.4

4	Biochemical Oxygen	80 mg/l	2.1
5	Chemical Oxygen Demand	150 mg/l	5.0
6	Total Dissolved Solids (TDS)	3500 mg/l	30680
7	Total Suspended Solids	200 mg/l	140
8	Chloride (Cl ⁻¹)	1000 mg/l	15517
9	Sulphate (SO ₄) ⁻²	600 mg/l	2884
10	Sulfide	1.0 mg/l	20
11	Fluoride (As F ['])	10 mg/l	0.822
12	Cyanide (As CN ['])	1.0 mg/l	9.29
13	Manganese	1.5 mg/l	0.212
14	Copper	1.0 mg/l	0.05
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.006
18	Iron	8.0 mg/l	0.008
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	7200
22	Calcium (Ca)	-	800
23	Potassium (K)	-	32.4

Remarks: The values of TDS, Chloride, Sulfate, Sulfide and Cyanide exceed the NEQS limits.

3.1.29 River Jhelum before Mixing With Ghag Drain & After Mixing With Saim Nullah Bunsu District Khushab.

The Dissolved Oxygen level at this sampling point was found as 9.8 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.0 mg/l and 8.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.29

Table-3.29

**Wastewater analysis report of the River Jhelum before
Mixing with Ghag Drain & after Mixing with Saim Nullah
Bunsi District Khushab**

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.0
2	Value of pH	6-9	8.2
3	Dissolved Oxygen	-	9.8
4	Biochemical Oxygen	80 mg/l	3.0
5	Chemical Oxygen Demand	150 mg/l	8.0
6	Total Dissolved Solids (TDS)	3500 mg/l	1400
7	Total Suspended Solids	200 mg/l	30
8	Chloride (Cl ⁻¹)	1000 mg/l	625
9	Sulphate (SO ₄) ⁻²	600 mg/l	395
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.760
12	Cyanide (As CN ['])	1.0 mg/l	0.167
13	Manganese	1.5 mg/l	0.123
14	Copper	1.0 mg/l	0.042
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.005
18	Iron	8.0 mg/l	0.06
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	296
22	Calcium (Ca)	-	600
23	Potassium (K)	-	5.2

Remarks: The parameters analyzed are within the NEQS limits

3.1.30 Ghag Drain Before Mixing With River Jhelum at Moza Ghag District Khushab

The Dissolved Oxygen level at this sampling point was found as 8.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 1.5 mg/l and 4.0 mg/l respectively. This drain is responsible for adding 0.00733 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.30

Table-3.30

Wastewater analysis report of the Ghag Drain before Mixing with River Jhelum at Moza Ghag District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	14.0
2	Value of pH	6-9	8.0
3	Dissolved Oxygen	-	8.0
4	Biochemical Oxygen	80 mg/l	1.5
5	Chemical Oxygen Demand	150 mg/l	4.0
6	Total Dissolved Solids (TDS)	3500 mg/l	23010
7	Total Suspended Solids	200 mg/l	110
8	Chloride (Cl ⁻¹)	1000 mg/l	985
9	Sulphate (SO ₄) ⁻²	600 mg/l	5431
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	1.56
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.295
14	Copper	1.0 mg/l	0.051
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.005
18	Iron	8.0 mg/l	0.088
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	2.8
21	Sodium (Na)	-	700

22	Calcium (Ca)	-	650
23	Potassium (K)	-	10.5

Remarks: The values of TDS exceeds the NEQS Limits.

3.1.31 River Jhelum after Mixing With Ghag Drain District Khushab

The Dissolved Oxygen level at this sampling point was found as 9.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.3 mg/l and 6.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.31

Table-3.31

Wastewater analysis report of the River Jhelum after Mixing with Ghag Drain District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.0
2	Value of pH	6-9	7.9
3	Dissolved Oxygen	-	9.0
4	Biochemical Oxygen	80 mg/l	3.3
5	Chemical Oxygen Demand	150 mg/l	6.0
6	Total Dissolved Solids (TDS)	3500 mg/l	1580
7	Total Suspended Solids	200 mg/l	30
8	Chloride (Cl ⁻¹)	1000 mg/l	720
9	Sulphate (SO ₄) ⁻²	600 mg/l	419
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.713
12	Cyanide (As CN ['])	1.0 mg/l	0.13
13	Manganese	1.5 mg/l	0.123
14	Copper	1.0 mg/l	0.043
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0

17	Zinc	5.0 mg/l	0.007
18	Iron	8.0 mg/l	0.061
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	320
22	Calcium (Ca)	-	56
23	Potassium (K)	-	5.3

Remarks: The parameters analyzed are within the NEQS limits

3.1.32 River Jhelum before Mixing With Khushab Drain, Moza Manzoor, District Khushab.

The Dissolved Oxygen level at this sampling point was found as 12.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.5 mg/l and 6.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.32.

Table-3.32

Wastewater analysis report of the River Jhelum before Mixing with Khushab Drain Moza Manzoor District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.0
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	12.0
4	Biochemical Oxygen	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	6.0
6	Total Dissolved Solids (TDS)	3500 mg/l	1440
7	Total Suspended Solids	200 mg/l	100
8	Chloride (Cl ⁻¹)	1000 mg/l	645

9	Sulphate (SO ₄) ⁻²	600 mg/l	296
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻)	10 mg/l	0.297
12	Cyanide (As CN ⁻)	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.11
14	Copper	1.0 mg/l	0.042
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.057
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	450
22	Calcium (Ca)	-	60
23	Potassium (K)	-	5.5

Remarks: The parameters analyzed are within the NEQS limits

3.1.33 **Khushab Drain Before Mixing With River Jhelum Tehsil & District Khushab**

The Dissolved Oxygen level at this sampling point was found as 1.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 305 mg/l and 660 mg/l respectively. This drain is responsible for adding 1.8655 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.33

Table-3.33

Wastewater analysis report of the Khushab Drain before Mixing with River Jhelum Tehsil & District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.4

2	Value of pH	6-9	6.1
3	Dissolved Oxygen	-	1.5
4	Biochemical Oxygen	80 mg/l	305
5	Chemical Oxygen Demand	150 mg/l	660
6	Total Dissolved Solids (TDS)	3500 mg/l	1400
7	Total Suspended Solids	200 mg/l	160
8	Chloride (Cl ⁻¹)	1000 mg/l	405
9	Sulphate (SO ₄) ⁻²	600 mg/l	218
10	Sulfide	1.0 mg/l	8
11	Fluoride (As F ['])	10 mg/l	0.414
12	Cyanide (As CN ['])	1.0 mg/l	0.814
13	Manganese	1.5 mg/l	0.335
14	Copper	1.0 mg/l	0.057
15	Cadmium	0.1 mg/l	0.004
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.014
18	Iron	8.0 mg/l	0.054
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	3.1
21	Sodium (Na)	-	168
22	Calcium (Ca)	-	90
23	Potassium (K)	-	41.9

Remarks: The values of BOD, COD, and Sulfide exceed the NEQS limits.

3.1.34 River Jhelum after Mixing with Khushab Drain & before mixing With Joharabad Drain at Jalal Pur Syedan, District Khushab.

The Dissolved Oxygen level at this sampling point was found as 12.1 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.0 mg/l and 8.0 mg/l respectively. The detailed

analysis report of the sample collected from this point is given in Table-3.34.

Table-3.34

Wastewater analysis report of the River Jhelum after Mixing With Khushab Drain & before mixing With Joharabad Drain at Jalal Pur Syedan, District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.2
2	Value of pH	6-9	8.0
3	Dissolved Oxygen	-	12.1
4	Biochemical Oxygen	80 mg/l	4.0
5	Chemical Oxygen Demand	150 mg/l	8.0
6	Total Dissolved Solids (TDS)	3500 mg/l	1350
7	Total Suspended Solids	200 mg/l	30
8	Chloride (Cl ⁻¹)	1000 mg/l	595
9	Sulphate (SO ₄) ⁻²	600 mg/l	329
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.527
12	Cyanide (As CN ['])	1.0 mg/l	0.705
13	Manganese	1.5 mg/l	0.12
14	Copper	1.0 mg/l	0.042
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.056
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	288
22	Calcium (Ca)	-	60
23	Potassium (K)	-	5.9

Remarks: The parameters analyzed are within the NEQS limits

3.1.35 Joharabad Drain Before Mixing With River Jhelum Tehsil & District Khushab

The Dissolved Oxygen level at this sampling point was found as 2.2 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 430 mg/l and 1356 mg/l respectively. This drain is responsible for adding 0.225 tons/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.35

Table-3.35

Wastewater analysis report of Joharabad Drain before Mixing with River Jhelum Tehsil & District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	17.4
2	Value of pH	6-9	8.1
3	Dissolved Oxygen	-	2.2
4	Biochemical Oxygen	80 mg/l	430
5	Chemical Oxygen Demand	150 mg/l	1356
6	Total Dissolved Solids (TDS)	3500 mg/l	9060
7	Total Suspended Solids	200 mg/l	140
8	Chloride (Cl ⁻¹)	1000 mg/l	2928
9	Sulphate (SO ₄) ⁻²	600 mg/l	2572
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.929
12	Cyanide (As CN ['])	1.0 mg/l	3.37
13	Manganese	1.5 mg/l	0.265
14	Copper	1.0 mg/l	0.06
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.025
18	Iron	8.0 mg/l	0.061
19	Nickel	1.0 mg/l	0.002

20	Oil & Grease	10 mg/l	4.3
21	Sodium (Na)	-	2200
22	Calcium (Ca)	-	35
23	Potassium (K)	-	27.4

Remarks: The values of BOD, COD, TDS, Chloride, Sulfate and Cyanide exceed the NEQS limits.

3.1.36 River Jhelum After Mixing With Joharabad Drain & Dhup Sari Drain Dhup Sari Drain At Hamokey District Khushab

The Dissolved Oxygen level at this sampling point was found as 11.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 3.5 mg/l and 8.5 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.36.

Table-3.36

Wastewater analysis report of the River Jhelum After Mixing With Joharabad Drain & Before Mixing with Dhup Sari Drain Dhup Sari Drain At Hamokey District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.0
2	Value of pH	6-9	7.9
3	Dissolved Oxygen	-	11.5
4	Biochemical Oxygen	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	8.5
6	Total Dissolved Solids (TDS)	3500 mg/l	1460
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	650
9	Sulphate (SO ₄) ⁻²	600 mg/l	320
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.416
12	Cyanide (As CN ['])	1.0 mg/l	0.647

13	Manganese	1.5 mg/l	0.122
14	Copper	1.0 mg/l	0.043
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.006
18	Iron	8.0 mg/l	0.058
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	324
22	Calcium (Ca)	-	65
23	Potassium (K)	-	5.8

Remarks: The parameters analyzed are within the NEQS limits

3.1.37 Dhup Sari Drain before mixing into River Jhelum District Khushab

The Dissolved Oxygen level at this sampling point was found as 9.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 0.8 mg/l and 4.0 mg/l respectively. This drain is responsible for adding 0.088 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.37.

Table-3.37

Wastewater analysis report of the Dhup Sari Drain before mixing into River Jhelum District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.0
2	Value of pH	6-9	8.07
3	Dissolved Oxygen	-	9.0
4	Biochemical Oxygen	80 mg/l	0.8
5	Chemical Oxygen Demand	150 mg/l	4.0
6	Total Dissolved Solids (TDS)	3500 mg/l	4360

7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	1475
9	Sulphate (SO ₄) ⁻²	600 mg/l	1139
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.814
12	Cyanide (As CN ['])	1.0 mg/l	0.08
13	Manganese	1.5 mg/l	0.322
14	Copper	1.0 mg/l	0.051
15	Cadmium	0.1 mg/l	0.004
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.005
18	Iron	8.0 mg/l	0.081
19	Nickel	1.0 mg/l	0.002
20	Oil & Grease	10 mg/l	1.4
21	Sodium (Na)	-	748
22	Calcium (Ca)	-	45
23	Potassium (K)	-	18

Remarks: The values of TDS, Chloride and Sulphate exceed the NEQS limits

3.1.38 River Jhelum after Mixing With Dhup Sari Drain & Before Mixing With Chashma / Sind - Jhelum Rabta Canal, District Khushab.

The Dissolved Oxygen level at this sampling point was found as 10.2 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.3 mg/l and 6.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.38.

Table-3.38

Wastewater analysis report of the River Jhelum After Mixing With Dhup Sari Drain & Before Mixing With Chashma / Sind- Jhelum Rabta Canal, District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.0
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	10.2
4	Biochemical Oxygen	80 mg/l	4.3
5	Chemical Oxygen Demand	150 mg/l	6.0
6	Total Dissolved Solids (TDS)	3500 mg/l	1520
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	625
9	Sulphate (SO ₄) ⁻²	600 mg/l	407
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.556
12	Cyanide (As CN ['])	1.0 mg/l	0.253
13	Manganese	1.5 mg/l	0.124
14	Copper	1.0 mg/l	0.042
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.007
18	Iron	8.0 mg/l	0.058
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	320
22	Calcium (Ca)	-	60
23	Potassium (K)	-	6.2

Remarks: The parameters analyzed are within the NEQS limits

3.1.39 Chashma / Sind - Jhelum Rabta Canal, Before Mixing With River Jhelum District Khushab

The Dissolved Oxygen level at this sampling point was found as 8.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 1.1 mg/l and 3.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.39.

Table-3.39
Wastewater analysis report of the Chashma / Sind -
Jhelum Rabta Canal, before Mixing with River Jhelum
District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	20.0
2	Value of pH	6-9	8.06
3	Dissolved Oxygen	-	8.6
4	Biochemical Oxygen	80 mg/l	1.1
5	Chemical Oxygen Demand	150 mg/l	3.0
6	Total Dissolved Solids (TDS)	3500 mg/l	560
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	110
9	Sulphate (SO ₄) ⁻²	600 mg/l	154
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	1.24
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.0
14	Copper	1.0 mg/l	0.044
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.008
18	Iron	8.0 mg/l	0.051
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	110
22	Calcium (Ca)	-	26

23	Potassium (K)	-	9.6
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Remarks: The parameters analyzed are within the NEQS limits.

3.1.40 River Jhelum After Mixing With Chashma / Sind - Jhelum Rabta Canal, & Before Mixing With Kaka Drain District Khushab.

The Dissolved Oxygen level at this sampling point was found as 9.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.3 mg/l and 4.8 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.40.

Table-3.40

Wastewater analysis report of the River Jhelum After Mixing With Chashma / Sind - Jhelum Rabta Canal & Before Mixing With Kaka Drain, District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	19.0
2	Value of pH	6-9	8.4
3	Dissolved Oxygen	-	9.6
4	Biochemical Oxygen	80 mg/l	2.3
5	Chemical Oxygen Demand	150 mg/l	4.8
6	Total Dissolved Solids (TDS)	3500 mg/l	350
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	35
9	Sulphate (SO ₄) ⁻²	600 mg/l	112
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	1.21
12	Cyanide (As CN ['])	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.122
14	Copper	1.0 mg/l	0.043
15	Cadmium	0.1 mg/l	0.003

16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.006
18	Iron	8.0 mg/l	0.059
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	104
22	Calcium (Ca)	-	23
23	Potassium (K)	-	4.1

Remarks: The parameters analyzed are within the NEQS limits.

3.1.41 **Kaka Drain Before Mixing With River Jhelum District Khushab.**

The Dissolved Oxygen level at this sampling point was found as 9.7 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 2.5 mg/l and 6.5 mg/l respectively. This drain is responsible for adding 0.01529 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.41

Table-3.41

Wastewater analysis report of the Kaka Drain before Mixing with River Jhelum District Khushab

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	18.0
2	Value of pH	6-9	8.4
3	Dissolved Oxygen	-	9.7
4	Biochemical Oxygen	80 mg/l	2.5
5	Chemical Oxygen Demand	150 mg/l	6.5
6	Total Dissolved Solids (TDS)	3500 mg/l	920
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	110
9	Sulphate (SO ₄) ⁻²	600 mg/l	296
10	Sulfide	1.0 mg/l	0.0

11	Fluoride (As F ⁻)	10 mg/l	1.06
12	Cyanide (As CN ⁻)	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.23
14	Copper	1.0 mg/l	0.047
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.005
18	Iron	8.0 mg/l	0.096
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	3.9
21	Sodium (Na)	-	240
22	Calcium (Ca)	-	45
23	Potassium (K)	-	10

Remarks: The parameters analyzed are within the NEQS limits

3.1.42 River Jhelum Entry Point into District Jhang & Exit Point of District Khushab & Before Mixing With Derkhan Wala Drain, Moza Jhok Usman, Tehsil & District Jhang.

The Dissolved Oxygen level at this sampling point was found as 8.4 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 5.0 mg/l and 9.5 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.42.

Table-3.42

Wastewater analysis report of the River Jhelum Entry Point into District Jhang & Exit Point of District Khushab & Before Mixing With Derkhan Wala Drain

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.5
2	Value of pH	6-9	7.9
3	Dissolved Oxygen	-	8.4
4	Biochemical Oxygen	80 mg/l	5.0
5	Chemical Oxygen Demand	150 mg/l	9.5
6	Total Dissolved Solids	3500 mg/l	670

7	Total Suspended Solids	200 mg/l	110
8	Chloride (Cl ⁻¹)	1000 mg/l	205
9	Sulphate (SO ₄) ⁻²	600 mg/l	263
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ⁻¹)	10 mg/l	0.114
12	Cyanide (As CN ⁻¹)	1.0 mg/l	0.1
13	Manganese	1.5 mg/l	0.120
14	Copper	1.0 mg/l	0.060
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.008
18	Iron	8.0 mg/l	0.071
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	120
22	Calcium (Ca)	-	31
23	Potassium (K)	-	4.4

Remarks: The parameters analyzed are within the NEQS limits

3.1.43 Derkhan Wala Drain Before Mixing With River Jhelum Moza Kanjri Wala Tehsil & District Jhang.

The Dissolved Oxygen level at this sampling point was found as 0.6 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 260 mg/l and 993 mg/l respectively. This drain is responsible for adding 5.356 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.43

Table-3.43

Wastewater analysis report of the Derkhan Wala Drain before Mixing with River Jhelum Moza Kanjri Wala Tehsil & District Jhang

S#	PARAMETERS	N.E.Q.S.	RESULTS
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1	Temperature	=<3° C	16.2
2	Value of pH	6-9	7.2
3	Dissolved Oxygen	-	0.6
4	Biochemical Oxygen	80 mg/l	260
5	Chemical Oxygen Demand	150 mg/l	993
6	Total Dissolved Solids (TDS)	3500 mg/l	4260
7	Total Suspended Solids	200 mg/l	220
8	Chloride (Cl ⁻¹)	1000 mg/l	415
9	Sulphate (SO ₄) ⁻²	600 mg/l	613
10	Sulfide	1.0 mg/l	128
11	Fluoride (As F ⁻)	10 mg/l	0.546
12	Cyanide (As CN ⁻)	1.0 mg/l	21.1
13	Manganese	1.5 mg/l	0.288
14	Copper	1.0 mg/l	0.065
15	Cadmium	0.1 mg/l	0.005
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.007
18	Iron	8.0 mg/l	0.088
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	3.1
21	Sodium (Na)	-	240
22	Calcium (Ca)	-	112
23	Potassium (K)	-	576

Remarks: The values of BOD, COD, TDS, TSS, Sulfate, Sulfide and Cyanide exceed the NEQS limits.

3.1.44 River Jhelum Before Mixing With Rani Wah Drain & After Mixing With Derkhan Wala drain , Near Moza Qadir Pur Bukhsha Thatee Kharey Dee Tehsil & District Jhang.

The Dissolved Oxygen level at this sampling point was found as 8.1 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 5.3 mg/l and 10.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.44

Table-3.44
Wastewater analysis report of the River Jhelum before
Mixing With Rani Wah Drain & After Mixing With Derkhan
Wala Drain near Moza Qadir Pur Bukhsha, Thatee Kharey Dee,
Tehsil & District Jhang.

S	PARAMETERS		RESULT
1	Temperature	=<3° C	16.3
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	8.1
4	Biochemical Oxygen	80 mg/l	5.3
5	Chemical Oxygen Demand	150 mg/l	10.0
6	Total Dissolved Solids	3500 mg/l	740
7	Total Suspended Solids	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	190
9	Sulphate (SO ₄) ⁻²	600 mg/l	271
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F ['])	10 mg/l	0.320
12	Cyanide (As CN ['])	1.0 mg/l	0.042
13	Manganese	1.5 mg/l	0.121
14	Copper	1.0 mg/l	0.061
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.006
18	Iron	8.0 mg/l	0.375
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	91
22	Calcium (Ca)	-	30
23	Potassium (K)	-	5.00

Remarks: The parameters analyzed are within the NEQS limits.

3.1.45 Rani Wah Drain before Mixing with River Jhelum near Moza Bukhsha Thatee Kharey Dee Tehsil & District Jhang

The Dissolved Oxygen level at this sampling point was found as 0.5 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 150 mg/l and 552 mg/l respectively. This drain is responsible for adding 34.863 ton/day of organic load to the river. The detailed analysis report of the sample collected from this point is given in Table-3.45.

Table-3.45
Wastewater analysis report of the Rani Wah Drain Before Mixing with River Jhelum near Moza Qadir Pur Bukhsha Thatee Kharey Dee, Tehsil & District Jhang

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	17.2
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	0.5
4	Biochemical Oxygen	80 mg/l	150
5	Chemical Oxygen Demand	150 mg/l	552
6	Total Dissolved Solids (TDS)	3500 mg/l	4630
7	Total Suspended Solids	200 mg/l	110
8	Chloride (Cl ⁻¹)	1000 mg/l	2002
9	Sulphate (SO ₄) ⁻²	600 mg/l	831
10	Sulfide	1.0 mg/l	8.0
11	Fluoride (As F ['])	10 mg/l	1.08
12	Cyanide (As CN ['])	1.0 mg/l	2.48
13	Manganese	1.5 mg/l	0.265
14	Copper	1.0 mg/l	0.059
15	Cadmium	0.1 mg/l	0.007
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.019
18	Iron	8.0 mg/l	0.655
19	Nickel	1.0 mg/l	0.011
20	Oil & Grease	10 mg/l	1.8
21	Sodium (Na)	-	1230
22	Calcium (Ca)	-	92

23	Potassium (K)	-	17.2
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Remarks: The values of BOD, COD, TDS, Chloride, Sulfate, sulfide and Cyanide exceed the NEQS limits.

3.1.46 River Jhelum after Mixing with Rani Wah Drain Near Moza Qadir Pur Bukhsha Thatee Kharey Dee Tehsil & District Jhang

The Dissolved Oxygen level at this sampling point was found as 7.7 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 6.5 mg/l and 16.0 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.46.

Table-3.46

Wastewater analysis report of the River Jhelum After Mixing with Rani Wah Drain near Moza Qadir Pur Bukhsha Thatee Kharey Dee Tehsil & District Jhang

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	16.6
2	Value of pH	6-9	7.6
3	Dissolved Oxygen	-	7.7
4	Biochemical Oxygen	80 mg/l	6.5
5	Chemical Oxygen Demand	150 mg/l	16.0
6	Total Dissolved Solids (TDS)	3500 mg/l	820
7	Total Suspended Solids	200 mg/l	120
8	Chloride (Cl ⁻¹)	1000 mg/l	255
9	Sulphate (SO ₄) ⁻²	600 mg/l	242
10	Sulfide	1.0 mg/l	1.0
11	Fluoride (As F ¹)	10 mg/l	0.268
12	Cyanide (As CN ¹)	1.0 mg/l	0.397
13	Manganese	1.5 mg/l	0.112
14	Copper	1.0 mg/l	0.061
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.016
18	Iron	8.0 mg/l	0.077
19	Nickel	1.0 mg/l	0.002

20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	140
22	Calcium (Ca)	-	35
23	Potassium (K)	-	5.7

Remarks The parameters analyzed are within the NEQS limits .

3.1.47 River Jhelum before Mixing with River Chenab near Moza Shakree, Athara Hazari Road Tehsil & District Jhang.

The Dissolved Oxygen level at this sampling point was found as 7.8 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.8 mg/l and 12.5 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.47.

Table-3.47

Wastewater analysis report of the River Jhelum Before Mixing With River Chenab near Moza Shakree Athara Hazari Road, Tehsil & District Jhang

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	17.7
2	Value of pH	6-9	7.9
3	Dissolved Oxygen	-	7.8
4	Biochemical Oxygen	80 mg/l	4.8
5	Chemical Oxygen Demand	150 mg/l	12.5
6	Total Dissolved Solids (TDS)	3500 mg/l	480
7	Total Suspended Solids	200 mg/l	1580
8	Chloride (Cl ⁻¹)	1000 mg/l	140
9	Sulphate (SO ₄) ⁻²	600 mg/l	108
10	Sulfide	1.0 mg/l	0.0

11	Fluoride (As F ⁻)	10 mg/l	0.001
12	Cyanide (As CN ⁻)	1.0 mg/l	0.22
13	Manganese	1.5 mg/l	0.123
14	Copper	1.0 mg/l	0.052
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.085
18	Iron	8.0 mg/l	0.071
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	101
22	Calcium (Ca)	-	27
23	Potassium (K)	-	07

Remarks: The value of TSS exceeds the NEQS limits.

3.1.48 Kallar Kahar Lake, District Chakwal

The Dissolved Oxygen level at this sampling point was found as 4.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 90 mg/l and 264 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.48.

Table-3.48

Wastewater analysis report of the Kallar Kahar Lake, District Chakwal

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	24
2	Value of pH	6-9	8.2
3	Dissolved Oxygen	-	4.0
4	Biochemical Oxygen	80 mg/l	90
5	Chemical Oxygen Demand	150 mg/l	264
6	Total Dissolved Solids (TDS)	3500 mg/l	2240
7	Total Suspended Solids	200 mg/l	20
8	Chloride (Cl ⁻¹)	1000 mg/l	920
9	Sulphate (SO ₄) ⁻²	600 mg/l	448

10	Sulfide	1.0 mg/l	4
11	Fluoride (As F')	10 mg/l	3.26
12	Cyanide (As CN')	1.0 mg/l	1.0
13	Manganese	1.5 mg/l	0.12
14	Copper	1.0 mg/l	0.052
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.002
17	Zinc	5.0 mg/l	0.008
18	Iron	8.0 mg/l	0.095
19	Nickel	1.0 mg/l	0.002
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	380
22	Calcium (Ca)	-	112
23	Potassium (K)	-	2.6

Remarks: The values of BOD, COD, and Sulfide exceed the NEQS limits.

3.2 Conclusion of analysis:

Results of the analysis show some common parameters that exceed NEQS i.e. BOD, COD, Sulfide, TSS, TDS, Chloride and Cyanide. Therefore it will be easy to choose some treatment technique taking these parameters under consideration. BOD, COD, TDS and TSS can be reduced by oxidation and sedimentation procedures. However removal of Sulfides, Chlorides and Cyanide need different treatments. As they are very toxic, they cannot be ignored and their presence makes this water unacceptable for irrigation purposes near the areas of their release. However, after mixing with other waters it becomes diluted to permissible limits for irrigation.

3.3 Sources of Pollution of River Jhelum

The pollution of the River Jhelum and the groundwater in the project comprise of municipal sewage, industrial effluents, sources related to agricultural activities and solid waste disposal

3.3.1 Municipal Sewage

The disposal of untreated municipal wastewaters into the river is main cause of deterioration of river water quality. Swage water impregnated with heavy organic load add greater fraction to deoxygenating of water. It carries with its huge organic loads to heavily tax the oxygen resources of the river. In addition municipal wastewaters contain pathogenic organisms and their disposal results in contamination of the river which is used as a source of drinking water supplies downstream.

3.3.2 Wastewater Carrying Drains

There are about many drains in Jhelum city which collects the sewage and industrial wastewater in the urban areas of the city. Numbers of drain join each other and carry all the collected sewage and industrial wastewater generated within the urban areas and dispose of in the river Jhelum through various pumping stations. Discharge in the drains is subjected to seasonal variation and mostly depends upon the weather conditions. In winter discharge is minimum and impregnated with heavy load due to less use of water.

Catchments areas and average flow of these drains is given as below:

i. Nullah Jaba

It carries storm water. It comes from Azad Kashmir.

ii. Dengi Pullee Drain

It has an average discharge of 1.9 cusecs and carries domestic waste of locality situated along Bela Restaurant.

iii. Piran Ghaib Drain

It has an average discharge of 2.9 cusecs and it carries domestic waste of Mohalla Piran Ghaib.

iv. Shamali Mohallah Drain

It has an average discharge of 2.1 cusecs and it carries domestic waste of Shamali Mohallah of Jhelum city.

v. Salman Paras Drain

It has an average discharge of 8.4 cusecs and it carries domestic waste of Mohallah Salman Paras of Jhelum city.

vi. Waste water Drain of Saraye Alam Gir City

It has an average discharge of 4.3 cusecs and it carries domestic waste of Saraye Alam Gir city.

vii. Mandi Bahau Din Drain

It has an average discharge of 6.7 cusecs. It comes from Mandi Bahau Din and carries domestic waste of Mandi Bahau Din. It also carries industrial waste water.

viii. Bhera Drain

It has an average discharge of 11.2 cusecs. It partially carries domestic waste and partially industrial waste water.

ix. Saim Nullah Bunsu

It has an average discharge of 2.5 cusecs. It partially carries domestic waste, storm water and saline water.

x. Ghag Drain

It has an average discharge of 2.0 cusecs. It carries partially domestic waste water storm water and saline water.

xi. Khushab Drain

It has an average discharge of 2.5 cusecs. It carries domestic waste water of Khushab city.

xii. Joharabad Drain

It has an average discharge of 10 cusecs. It carries industrial and partially domestic waste water of Joharabad and Khushab.

xiii. Dhup Sari Drain

It has an average discharge of 20 cusecs. It carries storm waste water.

xiv. Kaka Drain

It has an average discharge of 2.5 cusecs. It is Saim Nullah and carries domestic waste.

xv. Derkhan Wala Drain

It has an average discharge of 8.42 cusecs. It comes from Sargodha and falls into River Jhelum near Moza Qadir Pir. It contains domestic and industrial waste.

xvi. Rani Wah Drain

It has an average discharge of 95 cusecs. It comes from Bhalwal Sargodha and falls into River Jhelum near Moza Kiran Mazari. It contains domestic and industrial waste.

About 17 drains after joining to some major drains /trunk sewers ultimately dispose of the collected sewage/ wastewater into the river Jhelum.

3.3.3 Industrial Effluents

The industrial effluents contain pollutants including dissolved and suspended organic matter, heavy metals, and other toxic chemicals. With the exception of few,



industrial units discharge their untreated wastewaters on land, in rivers, or nullahs and drains to ultimately reach the river or groundwater.

The discharge of industrial effluents in the river results in depletion of oxygen resources. Harmful industrial chemicals disposed of in the river through its have potential to pose serious health problems. In addition, such discharges may result in adverse effects on downstream agriculture.

Industrial wastewater contains toxic chemicals. It is alarming that most industries have been started without proper planning and waste treatment plants. They just dispose of untreated toxic waste into nearby drains, canals or rivers. Automobile service stations are another major contributor to surface water pollution. Untreated oil, grease and dirt find its way into nearby canals and drains ultimately falling into Jhelum, where it critically damages the ecosystem.

3.3.4 Agricultural Runoff

Agriculture runoff is another source of pollution of Jhelum River. Extensive and indiscriminate use of pesticides and fertilizers to support agricultural activities in surrounding areas, results in leaching of such chemical during heavy rainfall.

No specific data are available on the quantities of pesticides and fertilizers being used in the surrounding areas of River Jhelum.

Since agriculture sector in Punjab is largest contributor to its GDP, there has been observed significant increase in use of fertilizers during the past few years. The excessive and indiscriminate use of pesticides results in its leaching to the ground water as well as to surface water through run off during rainy season.



3.3.5 Solid Wastes Disposal

Very small part of solid waste generated in Jhelum finds its way into the sewer system and a part of it appears in the outfall drains to ultimately reach the River Jhelum resulting in its unaesthetic appearance and degraded water quality.

3.4 Quality of the wastewater Carrying Drains

Individual results of the analysis of the waste water samples collected from the waste carrying drains have been given in the section 3.1. The summary of the analysis is given as below.

- 3.4.1 Near Jhelum, during low flow season, amongst wastewater carrying drains, Dengi Paullee Drain being is responsible for adding 0.0297 tons per day of organic load. Then comes Piran Ghaib Drain which contributing 0.638 Tons per day of organic load into the river Jhelum. Shamali Mohalla drain conveying wastewater having organic load of 0.637 Tons per day. Salman Paras drain is adding 3.82 tons per day of organic loads to River Jhelum. Waste water drain of Saraye Alam Gir city is adding organic load of 1.094 tons per day.
- 3.4.2 Near Khushab, during winter, saim Nulluh Bunsu is disposing 0.0128 tons per day of organic load whereas Ghag drain is adding 0.0073 tons per day of organic load into Jhelum. Khushab drain is responsible for adding 1.8655 tons per day of organic load. Joharabad drain and Dhup Sari drains are adding 0.225 & 0.088 tons of organic waste respectively into the River Jhelum. Kaka drain is disposing 0.0152 tons of organic load into Jhelum River.
- 3.4.3 During low flow season, near Jhang, Derkhan Wala drain is adding 5.356 tons and Rani Wah drain is adding 34.863 tons of organic loads on daily basis into River Jhelum.

Chapter-4 Conclusions and Recommendations

This chapter describes the conclusions of the monitoring of river Jhelum during low flow season. Conclusions and recommendations of the monitoring exercise are given as below:

4.1 Conclusions

- 4.1.1 The discharge of municipal and industrial wastewaters is causing the deterioration of the river water quality near Jehlum city.
- 4.1.2 The river water quality is acceptable for irrigation purpose.
- 4.1.3 The river water quality is good near Khushab district because of excessive amount of dissolved oxygen. The amount of dissolved oxygen from the starting point of sampling to the end point is founded almost same.
- 4.1.4 Rani Wah Drain Jhang, Derkhan Wala Drain Jhang, Dhup Sari Drain Khushab, Joharabad Drain Khushab, Ghag Drain Khushab, Saim Nullah Bunsu, of Saraye Alam Gir City Jhelum, Salman Paras Drain Jhelum, Shamali Mohallah Drain Jhelum, Piran Ghaib Drain Jhelum and Nullah Jaba Jhelum have higher values of BOD, COD, Sulfide, TSS, TDS, Chloride and Cyanide either all or some of them before mixing with River Jhelum but their concentrations reduce after dilution with River Water.

4.2 Recommendations

- 4.2.1 With the increase of population, water consumption is increasing that resulting in more sewage production at a notable rate. So the concerned District Governments (Jhelum, Gujrat, Khushab, Sargodha, Jhang) must plan for installation

of sewage treatment plants to keep it within the NEQS limits so that it can be used safely for irrigation.

- 4.2.2 The concerned District Governments must take measures to control/ reduce upstream pollution due to Dengi Pullee drain, Piran Ghaib drain, Shamali Mohalla drain, Salman Paras drain, waste water drain of Sarye Alam Gir City, Mandi Bahau Din drain, Bhera drain, Saim Nulluh Bunsu, Ghag drain, Derkhan Wala drain, Rani Wah drain, Kaka drain, Dhup Sari drain, Johrabad drain, by installation of sewage treatment plants.
- 4.2.3 District Jhelum is now entering in a new transit from agriculture to industrialization. So Government of concerned Districts (Jhelum, Gujrat, Khushab, Sargodha, and Jhang) should be provided with proper arrangements to dispose off industrial effluent. Industries should also be restricted to have EIA examination, so that none of the parameters of industries could exceed NEQS levels.
- 4.2.4 Similarly District Governments Jhelum and Jhamg should take measures especially to control/ reduce the high level of Cyanide discharged by some drains as Shumali Muhallah drain is carrying 11.6 mg/l, Darkhan wala drain is carrying 21.1 mg/l and Salman paras drain is carraying 44.7 mg/l of cyanid which exceeds the NEQS level.
- 4.2.5 Dumping of the solid waste along the banks of river Jhelum must be avoided.

Table 4.1
Summary of Issues of River Jhelum, proposed Measures
and Roles and Responsibilities

Issue		Measures	
1.	Pollution of River Jhelum due to industrial effluent carrying drains like Mandi Bahau Din drain, Saim Nullah Bunsu, Ghag drain Rani Wah drain	Industrial Pollution Control	Responsible Organizations
		<ul style="list-style-type: none"> Wastewater Reduction through cleaner production practices 	<ul style="list-style-type: none"> Industrial establishments in catchments areas of drains Chamber of Commerce and Industries EPD, Punjab (as Regulatory body)
		<ul style="list-style-type: none"> Conservative use of industrial water 	<ul style="list-style-type: none"> Industrial establishments I&P Department
		<ul style="list-style-type: none"> Installation of in-house Wastewater Treatment 	<ul style="list-style-type: none"> Individual industrial establishments
		<ul style="list-style-type: none"> Installation of common industrial effluent treatment plant 	<ul style="list-style-type: none"> Industrial organization Industries Department GOP Chamber of Commerce and Industries EPD, Punjab (as Regulatory body)
		<ul style="list-style-type: none"> Shifting of most polluting industrial units of same kind to designated areas equipped with common effluent treatment plants 	<ul style="list-style-type: none"> Industrial organization Industries Department GOP Chamber of Commerce and Industries EPD, Punjab (as Regulatory body)

	Issue	Measures	Responsible Organizations
2.	Pollution of River Jhelum due to Domestic sewage of Jhelum, Gujrat, Khushab, Sargodha, Jhang	Pollution Control caused by untreated sewage <ul style="list-style-type: none"> • Public awareness for conservative use of domestic water 	<ul style="list-style-type: none"> • TMAs (Town Municipal Administration) • EPD, Punjab
		<ul style="list-style-type: none"> • In house preliminary treatment 	<ul style="list-style-type: none"> • Mandatory provision of three compartment septic tanks in new housing schemes and where possible in existing scheme • Concerned Development Authority (IES) • EPD, Punjab
		<ul style="list-style-type: none"> • Installation of common sewage treatment plants 	<ul style="list-style-type: none"> • Private Housing Schemes • Development Authorities • EPD, Punjab

Issue	Measures	Responsible Organizations
3. Pollution of River Jhelum due to Improper Management of Domestic Solid Waste	Control of Pollution caused by Solid wastes <ul style="list-style-type: none"> • Public Awareness for Waste Minimization at sources • Introduce the benefits of Recycling, Reuse, Recover, Refuse and Repaired • Conversion of domestic solid waste into compost • Installation of Waste Disposal facilities i.e Landfill facilities and RDF facilities etc 	<ul style="list-style-type: none"> • TMAs • EPD • TMAs • EPD • TMAs • EPD • CDG (City District Government) Jhelum and Jhang • TMAs • EPD
4. Pollution of River Jhelum due Agriculture Run Off	Control of Agriculture Run Off <ul style="list-style-type: none"> • Environment Friendly use of pesticides and fertilizers 	<ul style="list-style-type: none"> • Agriculture Department • EPD, Punjab