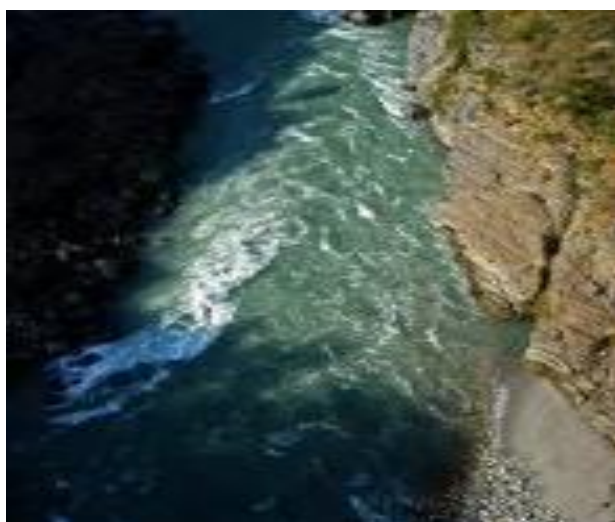


Chapter-1 Introduction

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 are discharged into various streams without treatment which ultimately reach the rivers. This has given rise to serious water pollution and human health problems. 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 the two 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 consumer's health. Certain heavy metals may also badly harm the aquatic life.

Although during high flow season the effect of pollution of municipal and industrial discharges in rivers is not pronounced, 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 quality is not being done in the province. Many

reasons to this effect included 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 severe 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 the Punjab decided to monitor the Quality of River Satluj under its ADP Project” **Monitoring of Surface water Bodies in Punjab**”. The river was decided to be monitored right from its entry point in Pakistan to its point of its joining with river Chenab at Punjnad and to suggest the various options for improvement of environment of River Satluj.

1.2 Objectives

The over all objective of the study are as followings:

- 1.2.1 To study pollution status of River Satluj from Ganda Singh joint Check post, Kasur, i.e its entry point in Pakistan, to before mixing into river Chenab at Mouza Sarwar Abad Tehsil Ahmed Pur Sharqi, District Bahawalpur.
- 1.2.2 To carry out the laboratory analysis regarding water quality of the river Satluj and various point sources adding pollution to the river 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 Satluj 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 activist 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 Satluj / 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 and various sewage out falls, nullahs and drains.
- 1.3.4 Assessment of the prevailing environmental pollution based on the sample analyses.
- 1.3.5 Impact studies of Satluj River 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 the all types of point sources of pollution of surface water as well as the water quality of the surface water body with object of 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

- ◆ TMAs/ Local Govts
- ◆ Irrigation and Power Department, Government of Punjab
- ◆ Directorate of land Reclamation Irrigation & Power Department

- ◆ Office of Executive Engineer, Drainage Section, I&P Department.
- ◆ Water and Sanitation Agency (WASA)
- ◆ Institute of Environmental Engineering and Research, University of Engineering & Technology, Lahore.

Data collected from various research reports on Satluj River water quality, 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 effect 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 review following sources of pollution were identified

a) Irrigation Canal

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

- i) B.S Link canal
- ii) P.I link Canal

b) Wastewater Drains

In addition to disposal points marked as pumping stations, wastewater carrying drains dispose off effluent into the river Satluj randomly but pandoki drain in Kasur district is the main continuous source of pollution for river satluj.

i) Pandoki drain

Pandoki drain comes from Raiwind and carries the municipal and industrial waste of Raiwind city. It also carries the industrial waste of kasur city and waste from treatment plant of Kasur tannery. This drain is responsible for adding organic load of 20.209 tons in the river.

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

- a) Sampling of point sources
- b) River Satluj sampling U/s of the point source
- c) River Satluj Sampling d/s of the point source after mixing

Based on the physical survey nineteen (19) sampling points were identified for sampling of river sutluj.

Table 2.1 indicates the locations of the various sampling pints fixed along the river length and on the point sources of the river Satluj.

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.



Nitric acid was used as preservative in sampling bottles for trace elements and nitrate determination . All samples were brought to the lab 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 Satluj and Sources of Pollution

Sample No.	Description
1	River Sutluj, entry point into Pakistan from India at Picnic spot, Ganda Singh joint Check post, Kasur
2	River Sutluj, before mixing with Pandoki drain near Sheikh Hammad, District Kasur
3	Pandoki drain, before mixing with River Sutluj Near Moza Sheikh Hammad, District Kasur
4	River Sutluj after mixing with Pandoki drain, Near Moza Thathee Farid, District Kasur
5	River Satluj at village Attari, upstream B.S Link canal
6	B.S Link canal before Mixing into River Satluj, Okara
7	River Satluj, Downsteam B.S Link canal, Head Sulemanki Okara
8	River Satluj Entry point Into, District Pakpattan And Exit PointOf District Okara Pir Ghani road.
9	River Satluj at Malik rajar bridge, Minchanabad, Pakpattan raod, District Pakpattan
10	River Satluj at Rehmani Malkan, Lakhwera road, exit point, District Pakpattan
11	River Satluj at Mouza Musa Bot Arifwala Road, Bahawalnagar.
12	River Satluj at Sahu Pattan Entry Point Into District Vehari.
13	River Satluj Before Mixing With P.I Link Canal , At Mouza Noor Ludden, Vehari.
14	P.I link Canal Before Mixing Into River Satluj, District Vehari.
15	River Satluj after Mixing With P.I Link Canal At Mouza Noor Vehari.
16	River Satluj, Head Islam, Entry Point Into District Bahawalpur.
17	River Satluj At Mouza Hassan Shah, Exit Point, District Vehari.
18	River Satluj at Bonga Ramzan Pattan Lal Sohona Tehsil & District Bahawalpur.
19	River Satluj Before Mixing With River Chenab, At Mouza Sarwar Abad Tehsil Ahmed Pur Sharqi, District Bahawalpur.

2.3 Project Area Description and Sources of Pollution

2.3.1 Project Area Description

The Sutlej River is the longest of the five rivers that flow through the historic crossroad region of Punjab in northern India and Pakistan. It is located north of the Vindhya Range, south of the Hindu Kush segment of the Himalayas, and east of the Central Suleiman Range in Pakistan.



The Sutlej is sometimes known as the Red River. It is the easternmost

tributary of the Indus River. It flows generally west and southwest entering India through the Shipki La pass in Himachal Pradesh. In Pakistan, it waters the ancient and historical former Bahawalpur state. The region to its south and east is arid, and is known as Cholistan a part of Bahawalpur Division. The Sutlej joins with the Beas River in Hari-Ke-Patan, Amritsar, Punjab, India, and continues southwest into Pakistan to unite with the Chenab River, forming the Panjnad River near Bahawalpur. The Panjnad joins the Indus River at Mithankot. Indus then flows through a gorge near Sukkur, flows through the fertile plains region of Sindh, and terminates in the Arabian Sea near the port city of Karachi in Pakistan.

The waters of the Sutlej are allocated to India under the Indus Waters Treaty between India and Pakistan, and are mostly diverted to irrigation canals in India. A huge, multipurpose Bhakra-Nangal Dam has been built on the Sutlej by the Indian government. The largest modern industrial city along the Sutlej banks is Ludhiana in India.

2.4 Sources of Pollution of River Satluj

The pollution of the River Satluj and the groundwater in the project comprise of mainly municipal sewage and industrial effluents of kasur district.

2.4.1 Municipal Sewage

The disposal of untreated municipal wastewaters into the river is main cause of deterioration of river water quality. Sewage 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.

2.4.2 Wastewater Carrying Drains

Wastewater carrying drains are also responsible for the pollution of Rivers. There is only one drain which collects the sewage and industrial wastewater in the urban areas of Kasur and Raiwind city and falls into the River Satluj. 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 this drain is given as below:

i) Pandoki Drain

This drain has an average discharge of 86.95 cusecs and carries both type of wastewater i.e sewage and industrial effluent from Raiwind and Kasur city.

2.3.2 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 off in the river through its have potential to pose serious health problems. In addition, such discharges may result in adverse effects on downstream agriculture.

Chapter-3 Pollution of River Satluj

This chapter describes the results of the analysis of the samples collected during 2009 from the various sampling points along the river and its point sources of pollution. Details of the analysis of individual samples is given below whereas **Table 3.1** presents the summary of the results of analysis of sample collected along the river Satluj and its sources of pollution.

3.1 Water Quality of the River Satluj

Analysis reports of the individual samples indicates the following results

3.1.1 River Sutluj, entry point into Pakistan from India at Picnic spot, Ganda Singh joint Check post, Kasur

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 3.5 mg/l and 7.7 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.1

Table-3.1 Wastewater analysis report of River Sutluj, entry point into Pakistan from India at Picnic spot, Ganda Singh joint Check post, Kasur

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	21.0
2	Value of pH	6-9	7.7
3	Dissolved Oxygen	-	8.8
4	Biochemical Oxygen Demand	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	7.7
6	Total Dissolved Solids (TDS)	3500 mg/l	140
7	Total Suspended Solids (TSS)	200 mg/l	50
8	Chloride (Cl ⁻¹)	1000 mg/l	20
9	Sulphate (SO ₄) ⁻²	600 mg/l	22
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.161
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.080

14	Copper	1.0 mg/l	0.061
15	Cadmium	0.1 mg/l	0.07
16	Chromium	1.0 mg/l	0.003
17	Zinc	5.0 mg/l	0.031
18	Iron	8.0 mg/l	0.991
19	Nickel	1.0 mg/l	0.027
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	10
22	Calcium (Ca)	-	20
23	Potassium (K)	-	3.4

Remarks: The parameters analyzed are within the NEQS limits.

3.1.2 River Sutluj, before mixing with Pandoki drain near Sheikh Hammad, District Kasur

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 3.3 mg/l and 7.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.2

Table-3.2 Wastewater analysis report of River Satluj before mixing With Pandoki drain near Sheikh Hammad, District Kasur.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	22.3
2	Value of pH	6-9	6.8
3	Dissolved Oxygen	-	8.2
4	Biochemical Oxygen Demand	80 mg/l	3.3
5	Chemical Oxygen Demand	150 mg/l	7.4
6	Total Dissolved Solids (TDS)	3500 mg/l	130
7	Total Suspended Solids (TSS)	200 mg/l	30
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	0.086
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.077
14	Copper	1.0 mg/l	0.052
15	Cadmium	0.1 mg/l	0.006

16	Chromium	1.0 mg/l	0.004
17	Zinc	5.0 mg/l	0.018
18	Iron	8.0 mg/l	0.930
19	Nickel	1.0 mg/l	0.01
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	12
22	Calcium (Ca)	-	20
23	Potassium (K)	-	4.6

Remarks: The parameters analyzed are within the NEQS limits.

3.1.3 Pandoki drain, before mixing with River Sutluj Near Moza Sheikh Hammad, District Kasur

The Dissolved Oxygen level at this sampling point was found as 0.39 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 95 mg/l and 220 mg/l respectively. This drain is responsible for adding 20.209 tons of organic loads to the river. The detailed analysis report of the sample collected from this point is given in Table-3.

Table-3.3 Wastewater analysis report of the Pandoki drain, before mixing with River Sutluj near Moza Sheikh Hammad, District Kasur

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	25.2
2	Value of pH	6-9	6.9
3	Dissolved Oxygen	-	0.39
4	Biochemical Oxygen Demand	80 mg/l	95
5	Chemical Oxygen Demand	150 mg/l	220
6	Total Dissolved Solids (TDS)	3500 mg/l	2000
7	Total Suspended Solids (TSS)	200 mg/l	940
8	Chloride (Cl ⁻¹)	1000 mg/l	210
9	Sulphate (SO ₄) ⁻²	600 mg/l	337
10	Sulfide	1.0 mg/l	28
11	Fluoride (As F')	10 mg/l	0.302
12	Cyanide (As CN')	2.0 mg/l	4.36
13	Manganese	1.5 mg/l	0.095
14	Copper	1.0 mg/l	0.05
15	Cadmium	0.1 mg/l	0.009

16	Chromium	1.0 mg/l	0.022
17	Zinc	5.0 mg/l	0.019
18	Iron	8.0 mg/l	0.88
19	Nickel	1.0 mg/l	0.012
20	Oil & Grease	10 mg/l	7.7
21	Sodium (Na)	-	600
22	Calcium (Ca)	-	72
23	Potassium (K)	-	4.3

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

3.1.4 River Sutluj after mixing with Pandoki drain, Near Moza Thathee Farid, District Kasur

The Dissolved Oxygen level at this sampling point was found as 4.1 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 18 mg/l and 48 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 River Sutluj after mixing with Pandoki drain, near Moza Thathee Farid, District Kasur

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	22.4
2	Value of pH	6-9	6.8
3	Dissolved Oxygen	-	4.1
4	Biochemical Oxygen Demand	80 mg/l	18.0
5	Chemical Oxygen Demand	150 mg/l	48
6	Total Dissolved Solids (TDS)	3500 mg/l	370
7	Total Suspended Solids (TSS)	200 mg/l	30
8	Chloride (Cl ⁻¹)	1000 mg/l	95
9	Sulphate (SO ₄) ⁻²	600 mg/l	88
10	Sulfide	1.0 mg/l	04
11	Fluoride (As F')	10 mg/l	0.216
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.079
14	Copper	1.0 mg/l	0.050
15	Cadmium	0.1 mg/l	0.008
16	Chromium	1.0 mg/l	0.015
17	Zinc	5.0 mg/l	0.017

18	Iron	8.0 mg/l	0.910
19	Nickel	1.0 mg/l	0.010
20	Oil & Grease	10 mg/l	0.9
21	Sodium (Na)	-	78
22	Calcium (Ca)	-	60
23	Potassium (K)	-	4.1

Remarks: The value of Sulfide exceeds the NEQS limits.

3.1.5 River Satluj at village Attari, upstream B.S Link canal

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 4.8 mg/l and 18 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.5

Table-3.5 Wastewater analysis report of the River Satluj at village Attari, upstream B.S Link canal

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	24.0
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	8.8
4	Biochemical Oxygen Demand	80 mg/l	4.8
5	Chemical Oxygen Demand	150 mg/l	18
6	Total Dissolved Solids (TDS)	3500 mg/l	190
7	Total Suspended Solids (TSS)	200 mg/l	10
8	Chloride (Cl ⁻¹)	1000 mg/l	70
9	Sulphate (SO ₄) ⁻²	600 mg/l	44
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.612
12	Cyanide (As CN')	2.0 mg/l	0.003
13	Manganese	1.5 mg/l	0.047
14	Copper	1.0 mg/l	0.033
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.017
18	Iron	8.0 mg/l	0.095
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0

21	Sodium (Na)	-	24
22	Calcium (Ca)	-	24
23	Potassium (K)	-	4.4

Remarks: The parameters analyzed are within the NEQS limits.

3.1.6 B.S Link canal before Mixing into River Satluj, Okara

The Dissolved Oxygen level at this sampling point was found as 7.0 mg/l. Biochemical Oxygen Demand (BOD₅) and Chemical Oxygen Demand (COD) of the River were found to be 4.6 mg/l and 25 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 B.S Link canal before Mixing into River Satluj, Okara

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	24.1
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	7.0
4	Biochemical Oxygen Demand	80 mg/l	4.6
5	Chemical Oxygen Demand	150 mg/l	25
6	Total Dissolved Solids (TDS)	3500 mg/l	200
7	Total Suspended Solids (TSS)	200 mg/l	120
8	Chloride (Cl ⁻¹)	1000 mg/l	45
9	Sulphate (SO ₄) ⁻²	600 mg/l	48
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.773
12	Cyanide (As CN')	2.0 mg/l	0.003
13	Manganese	1.5 mg/l	0.054
14	Copper	1.0 mg/l	0.062
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.013
18	Iron	8.0 mg/l	0.099
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	20
22	Calcium (Ca)	-	24

23	Potassium (K)	-	1.5
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Remarks: The parameters analyzed are within the NEQS limits.

3.1.7 River Satluj, Downstream B.S Link canal, Head Sulemanki Okara

The Dissolved Oxygen level at this sampling point was found as 7.5 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 3.7 mg/l and 16.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.7

Table 3.7
Wastewater analysis Report of River Satluj, Downstream B.S Link canal, Head Sulemanki Okara

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	25.0
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	7.5
4	Biochemical Oxygen Demand	80 mg/l	3.7
5	Chemical Oxygen Demand	150 mg/l	16.4
6	Total Dissolved Solids (TDS)	3500 mg/l	290
7	Total Suspended Solids (TSS)	200 mg/l	140
8	Chloride (Cl ⁻¹)	1000 mg/l	55
9	Sulphate (SO ₄) ⁻²	600 mg/l	78
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.765
12	Cyanide (As CN')	2.0 mg/l	0.004
13	Manganese	1.5 mg/l	0.092
14	Copper	1.0 mg/l	0.082
15	Cadmium	0.1 mg/l	0.008
16	Chromium	1.0 mg/l	0.011
17	Zinc	5.0 mg/l	0.019
18	Iron	8.0 mg/l	0.920
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	34
22	Calcium (Ca)	-	24
23	Potassium (K)	-	5.6

Remarks: The parameters analyzed are within the NEQS limits.

3.1.8 River Satluj Entry point Into, District Pakpattan and Exit Point of District Okara Pir Ghani road.

The Dissolved Oxygen level at this sampling point was found as 7.8 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 4.0 mg/l and 20 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.8

Table-3.8 Wastewater analysis report of River Satluj Entry point into, District Pakpattan and exit point of District Okara Pir Ghani Road.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	25.0
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	7.8
4	Biochemical Oxygen Demand	80 mg/l	4.0
5	Chemical Oxygen Demand	150 mg/l	20
6	Total Dissolved Solids (TDS)	3500 mg/l	240
7	Total Suspended Solids (TSS)	200 mg/l	100
8	Chloride (Cl ⁻¹)	1000 mg/l	55
9	Sulphate (SO ₄) ⁻²	600 mg/l	44
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.284
12	Cyanide (As CN')	2.0 mg/l	0.004
13	Manganese	1.5 mg/l	0.045
14	Copper	1.0 mg/l	0.033
15	Cadmium	0.1 mg/l	0.005
16	Chromium	1.0 mg/l	0.008
17	Zinc	5.0 mg/l	0.015
18	Iron	8.0 mg/l	0.085
19	Nickel	1.0 mg/l	0.005
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	19
22	Calcium (Ca)	-	24
23	Potassium (K)	-	4.0

Remarks: The parameters analyzed are within the NEQS limits.

3.1.9 River Satluj at Malik rajar bridge, Minchanabad, Pakpattan raod, District Pakpattan

The Dissolved Oxygen level at this sampling point was found as 7.7 mg/l. Biochemical Oxygen Demand (BOD) 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-3.9

Table 3.9 Wastewater Analysis Report of River Satluj at Malik rajar bridge, Minchanabad, Pakpattan raod, District Pakpattan

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	26.0
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	7.7
4	Biochemical Oxygen Demand	80 mg/l	3.5
5	Chemical Oxygen Demand	150 mg/l	16
6	Total Dissolved Solids (TDS)	3500 mg/l	220
7	Total Suspended Solids (TSS)	200 mg/l	60
8	Chloride (Cl ⁻¹)	1000 mg/l	75
9	Sulphate (SO ₄) ⁻²	600 mg/l	38
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.193
12	Cyanide (As CN')	2.0 mg/l	0.005
13	Manganese	1.5 mg/l	0.042
14	Copper	1.0 mg/l	0.031
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.014
18	Iron	8.0 mg/l	0.082
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	24
22	Calcium (Ca)	-	22
23	Potassium (K)	-	2.6

Remarks: The parameters analyzed are within the NEQS limits.

3.1.10 River Satluj at Rehmani Malkan, Lakhwera road, exit point, District Pakpattan

The Dissolved Oxygen level at this sampling point was found as 7.8 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 3.6 mg/l and 16 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table 3.10

Table-3.10 Wastewater analysis report of River Satluj at Rehmani Malkan, Lakhwera road, exit point, District Pakpattan

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	26.2
2	Value of pH	6-9	7.7
3	Dissolved Oxygen	-	7.8
4	Biochemical Oxygen Demand	80 mg/l	3.6
5	Chemical Oxygen Demand	150 mg/l	16
6	Total Dissolved Solids (TDS)	3500 mg/l	260
7	Total Suspended Solids (TSS)	200 mg/l	140
8	Chloride (Cl ⁻¹)	1000 mg/l	60
9	Sulphate (SO ₄) ⁻²	600 mg/l	44
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.237
12	Cyanide (As CN')	2.0 mg/l	0.004
13	Manganese	1.5 mg/l	0.040
14	Copper	1.0 mg/l	0.030
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.015
18	Iron	8.0 mg/l	0.081
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	24
22	Calcium (Ca)	-	28
23	Potassium (K)	-	3.1

Remarks: The parameters analyzed are within the NEQS limits.

3.1.11 River Satluj at Mouza Musa Bot Arifwala Road, Bahawalnagar.

The Dissolved Oxygen level at this sampling point was found as 9.3 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 4.8 mg/l and 24 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table 3.11

Table 3.11 Wastewater Analysis Report of River Satluj at Mouza Musa Bot Arifwala Road, Bahawalnagar.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	27.0
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	9.3
4	Biochemical Oxygen Demand	80 mg/l	4.8
5	Chemical Oxygen Demand	150 mg/l	24
6	Total Dissolved Solids (TDS)	3500 mg/l	100
7	Total Suspended Solids (TSS)	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	45
9	Sulphate (SO ₄) ⁻²	600 mg/l	22
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.103
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.045
14	Copper	1.0 mg/l	0.024
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.012
18	Iron	8.0 mg/l	0.092
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	25
22	Calcium (Ca)	-	20
23	Potassium (K)	-	3.8

Remarks: The parameters analyzed are within the NEQS limits.

3.1.12 River Satluj at Sahu Pattan Entry Point Into District Vehari.

The Dissolved Oxygen level at this sampling point was found as 8.0 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand

(COD) of the River were found to be 4.2 mg/l and 22 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table 3.12

Table 3.12 Wastewater Analysis Report of River Satluj at Sahu Pattan Entry Point into District Vehari.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	30.0
2	Value of pH	6-9	7.2
3	Dissolved Oxygen	-	8.0
4	Biochemical Oxygen Demand	80 mg/l	4.2
5	Chemical Oxygen Demand	150 mg/l	22
6	Total Dissolved Solids (TDS)	3500 mg/l	220
7	Total Suspended Solids (TSS)	200 mg/l	40
8	Chloride (Cl ⁻¹)	1000 mg/l	60
9	Sulphate (SO ₄) ⁻²	600 mg/l	48
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.038
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.048
14	Copper	1.0 mg/l	0.025
15	Cadmium	0.1 mg/l	0.04
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.014
18	Iron	8.0 mg/l	0.094
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	17
23	Potassium (K)	-	3.4

Remarks: The parameters analyzed are within the NEQS limits.

3.1.13 River Satluj Before Mixing With P.I Link Canal, At Mouza Noor Ludden, Vehari.

The Dissolved Oxygen level at this sampling point was found as 7.5 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 3.8 mg/l and 24.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table 3.13

Table-3.13 Wastewater analysis report of the River Satluj Before Mixing With P.I Link Canal , At Mouza Noor Ludden, Vehari.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	30.1
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	7.5
4	Biochemical Oxygen Demand	80 mg/l	3.8
5	Chemical Oxygen Demand	150 mg/l	24.4
6	Total Dissolved Solids (TDS)	3500 mg/l	180
7	Total Suspended Solids (TSS)	200 mg/l	70
8	Chloride (Cl ⁻¹)	1000 mg/l	55
9	Sulphate (SO ₄) ⁻²	600 mg/l	24
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.055
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.046
14	Copper	1.0 mg/l	0.024
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.005
17	Zinc	5.0 mg/l	0.015
18	Iron	8.0 mg/l	0.089
19	Nickel	1.0 mg/l	0.004
20	Oil & Grease	10 mg/l	0.00
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	18
23	Potassium (K)	-	4.3

Remarks: The parameters analyzed are within the NEQS limits.

3.1.14 P.I link Canal before Mixing Into River Satluj, District Vehari.

The Dissolved Oxygen level at this sampling point was found as 7.7 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 3.4 mg/l and 18 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table 3.14

Table-3.14 Wastewater analysis report of P.I link Canal before Mixing into River Satluj, District Vehari.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	28.0
2	Value of pH	6-9	7.3
3	Dissolved Oxygen	-	7.7
4	Biochemical Oxygen Demand	80 mg/l	3.4
5	Chemical Oxygen Demand	150 mg/l	18
6	Total Dissolved Solids (TDS)	3500 mg/l	200
7	Total Suspended Solids (TSS)	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	40
9	Sulphate (SO ₄) ⁻²	600 mg/l	52
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.055
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.037
14	Copper	1.0 mg/l	0.017
15	Cadmium	0.1 mg/l	0.001
16	Chromium	1.0 mg/l	0.0
17	Zinc	5.0 mg/l	0.008
18	Iron	8.0 mg/l	0.085
19	Nickel	1.0 mg/l	0.001
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	13
22	Calcium (Ca)	-	16
23	Potassium (K)	-	4.2

Remarks: The parameters analyzed are within the NEQS limits.

3.1.15 River Satluj after Mixing with P.I Link Canal At Mouza Noor Vehari.

The Dissolved Oxygen level at this sampling point was found as 7.8 mg/l. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the River were found to be 3.6mg/l and 14.4 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 River Satluj after Mixing with P.I Link Canal at Mouza Noor Vehari.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	27.5
2	Value of pH	6-9	6.8
3	Dissolved Oxygen	-	7.8
4	Biochemical Oxygen Demand	80 mg/l	3.6
5	Chemical Oxygen Demand	150 mg/l	14.4
6	Total Dissolved Solids (TDS)	3500 mg/l	180
7	Total Suspended Solids (TSS)	200 mg/l	40
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	0.039
12	Cyanide (As CN')	1.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.044
14	Copper	1.0 mg/l	0.023
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.004
17	Zinc	5.0 mg/l	0.012
18	Iron	8.0 mg/l	0.085
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	12
22	Calcium (Ca)	-	26
23	Potassium (K)	-	4.6

Remarks: The parameters analyzed are within the NEQS limits.

3.1.16 River Satluj, Head Islam, Entry Point into District Bahawalpur.

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 4.4 mg/l and 35 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.16

Table-3.16 Wastewater analysis report of River Satluj, Head Islam, Entry Point into District Bahawalpur.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	28.0
2	Value of pH	6-9	7.7
3	Dissolved Oxygen	-	7.3
4	Biochemical Oxygen Demand	80 mg/l	4.4
5	Chemical Oxygen Demand	150 mg/l	35
6	Total Dissolved Solids (TDS)	3500 mg/l	220
7	Total Suspended Solids (TSS)	200 mg/l	250
8	Chloride (Cl ⁻¹)	1000 mg/l	55
9	Sulphate (SO ₄) ⁻²	600 mg/l	32
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.323
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.045
14	Copper	1.0 mg/l	0.023
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.004
17	Zinc	5.0 mg/l	0.009
18	Iron	8.0 mg/l	0.081
19	Nickel	1.0 mg/l	0.003
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	20
23	Potassium (K)	-	4.6

Remarks: The value of TSS exceeds the NEQS limits.

3.1.17 River Satluj At Mouza Hassan Shah, Exit Point, District Vehari.

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 4.2 mg/l and 28 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 River Satluj At Mouza Hassan Shah, Exit Point, District Vehari.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	$\leq 3^{\circ} \text{C}$	27.6
2	Value of pH	6-9	7.5
3	Dissolved Oxygen	-	8.5
4	Biochemical Oxygen Demand	80 mg/l	4.2
5	Chemical Oxygen Demand	150 mg/l	28
6	Total Dissolved Solids (TDS)	3500 mg/l	200
7	Total Suspended Solids (TSS)	200 mg/l	20
8	Chloride (Cl^{-1})	1000 mg/l	60
9	Sulphate (SO_4^{-2})	600 mg/l	54
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.0
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.045
14	Copper	1.0 mg/l	0.023
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.004
17	Zinc	5.0 mg/l	0.013
18	Iron	8.0 mg/l	0.088
19	Nickel	1.0 mg/l	0.002
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	16
23	Potassium (K)	-	4.1

Remarks: The parameters analyzed are within the NEQS limits.

3.1.18 River Satluj at Bonga Ramzan Pattan Lal Sohana Tehsil & District Bahawalpur.

The Dissolved Oxygen level at this sampling point was found as 7.5 mg/l. Biochemical Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD) of the River were found to be 3.4 mg/l and 22 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.18

Table-3.18 Wastewater analysis report of River Satluj at Bonga Ramzan Pattan Lal Sohana Tehsil & District Bahawalpur.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	$\leq 3^{\circ} \text{C}$	31.1
2	Value of pH	6-9	7.4
3	Dissolved Oxygen	-	7.5
4	Biochemical Oxygen Demand	80 mg/l	3.4
5	Chemical Oxygen Demand	150 mg/l	22
6	Total Dissolved Solids (TDS)	3500 mg/l	200
7	Total Suspended Solids (TSS)	200 mg/l	50
8	Chloride (Cl^{-1})	1000 mg/l	40
9	Sulphate (SO_4^{-2})	600 mg/l	32
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.449
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.043
14	Copper	1.0 mg/l	0.022
15	Cadmium	0.1 mg/l	0.003
16	Chromium	1.0 mg/l	0.004
17	Zinc	5.0 mg/l	0.011
18	Iron	8.0 mg/l	0.081
19	Nickel	1.0 mg/l	0.002
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	18
23	Potassium (K)	-	4.2

Remarks: The parameters analyzed are within the NEQS limits.

3.1.19 River Satluj before Mixing With River Chenab, At Mouza Sarwar Abad Tehsil Ahmed Pur Sharqi, District6 Bahawalpur.

The Dissolved Oxygen level at this sampling point was found as 8.1 mg/l. Biochemical Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD) of the River were found to be 5 mg/l and 24.4 mg/l respectively. The detailed analysis report of the sample collected from this point is given in Table-3.19

Table 3.19 Analysis report of River Satluj before Mixing with River Chenab, At Mouza Sarwar Abad Tehsil Ahmed Pur Sharqi, District6 Bahawalpur.

S#	PARAMETERS	N.E.Q.S.	RESULTS
1	Temperature	=<3° C	27.0
2	Value of pH	6-9	7.0
3	Dissolved Oxygen	-	8.1
4	Biochemical Oxygen Demand	80 mg/l	5
5	Chemical Oxygen Demand	150 mg/l	24.4
6	Total Dissolved Solids (TDS)	3500 mg/l	180
7	Total Suspended Solids (TSS)	200 mg/l	80
8	Chloride (Cl ⁻¹)	1000 mg/l	25
9	Sulphate (SO ₄) ⁻²	600 mg/l	28
10	Sulfide	1.0 mg/l	0.0
11	Fluoride (As F')	10 mg/l	0.719
12	Cyanide (As CN')	2.0 mg/l	0.0
13	Manganese	1.5 mg/l	0.040
14	Copper	1.0 mg/l	0.025
15	Cadmium	0.1 mg/l	0.002
16	Chromium	1.0 mg/l	0.003
17	Zinc	5.0 mg/l	0.009
18	Iron	8.0 mg/l	0.075
19	Nickel	1.0 mg/l	0.002
20	Oil & Grease	10 mg/l	0.0
21	Sodium (Na)	-	15
22	Calcium (Ca)	-	22
23	Potassium (K)	-	4.2

Remarks: The parameters analyzed are within the NEQS limits.

3.2 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.

3.2.1 District Kasur

There is only one drain, Pandoki drain that carries all the collected sewage and industrial wastewater generated within the urban areas

and dispose of in the river Sutluj. Discharge in the drain is subjected to seasonal variation and mostly depends upon the weather conditions. In winter discharge is usually minimum and impregnated with heavy load due to less use of water.

Chapter-4 Conclusions and Recommendations

This chapter describes the conclusions of the monitoring of river Sutluj 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 of tanneries of Kasur district has caused deterioration of the river water quality,
- 4.1.2 The river water quality is acceptable from irrigation point
- 4.1.3 The river water quality is good near Bahawalnagar District because of excessive amount of dissolved oxygen. The lowest level of DO is founded near District Kasur due to the existence of Pandoki drain adding industrial effluents of tanneries as well as the municipal waste. The average amount of dissolved oxygen from the starting point of sampling to the end point ranged in 7-8.

4.2 Recommendations

- 4.2.1 The population of concerned Districts (Kasur, Pakpattan, Bahawalnagar, Okara, Bhawalpur, Vehari) is increasing day by day due to which water consumption is also increasing resulting in causing more sewage production. So the concerned District Governments must plan for installation of sewage treatment plants so it may be properly disposed off.
- 4.2.2 Government of Districts Kasur must take measures to control/ reduce upstream pollution control measures for Pandoki drain by installation of sewage treatment plants.
- 4.2.3 Irrigation Department of concerned districts may be requested to direct the industries to dispose off their effluents after proper treatment.

Industries should also be restricted to have EIA examination. So that all the parameters of industries should lie within the NEQS levels.

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

Issue	Measures	Responsible Organizations
Pollution of River Sutluj due to industrial effluent carrying drain Pandoki	<p>Industrial Pollution Control</p> <ul style="list-style-type: none"> • Wastewater Reduction through cleaner production practices • Conservative use of industrial water • Installation of in-house wastewater treatment • Installation of common industrial effluent treatment plant • Shifting of most polluted industrial sector to designated areas equipped with common effluent treatment plants 	<ul style="list-style-type: none"> • Industrial establishments in catchments areas of drains • Chamber of Commerce and Industries • Industrial establishment • I&P Department • Individual industrial establishments • Industrial organization • Industries Department GOP • Chamber of Commerce and Industries • EPD, Punjab • Industrial organization • Industries Department GOP • Chamber of Commerce and Industries • EPD, Punjab
Pollution of River Satluj due to Domestic sewage kasur, raiwind city	Pollution Control caused by untreated sewage	

Issue	Measures	Responsible Organizations
	<ul style="list-style-type: none"> • Public awareness for conservative use of domestic water • In house preliminary treatment • Installation of common sewage treatment plants 	<ul style="list-style-type: none"> • TMAs, City District Governments • Mandatory provision of three compartment septic tanks in new housing schemes and where possible in existing scheme. • Concerned Development Authority • City District Governments • Private Housing Schemes • Development Authorities
Pollution of River Satluj due to 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

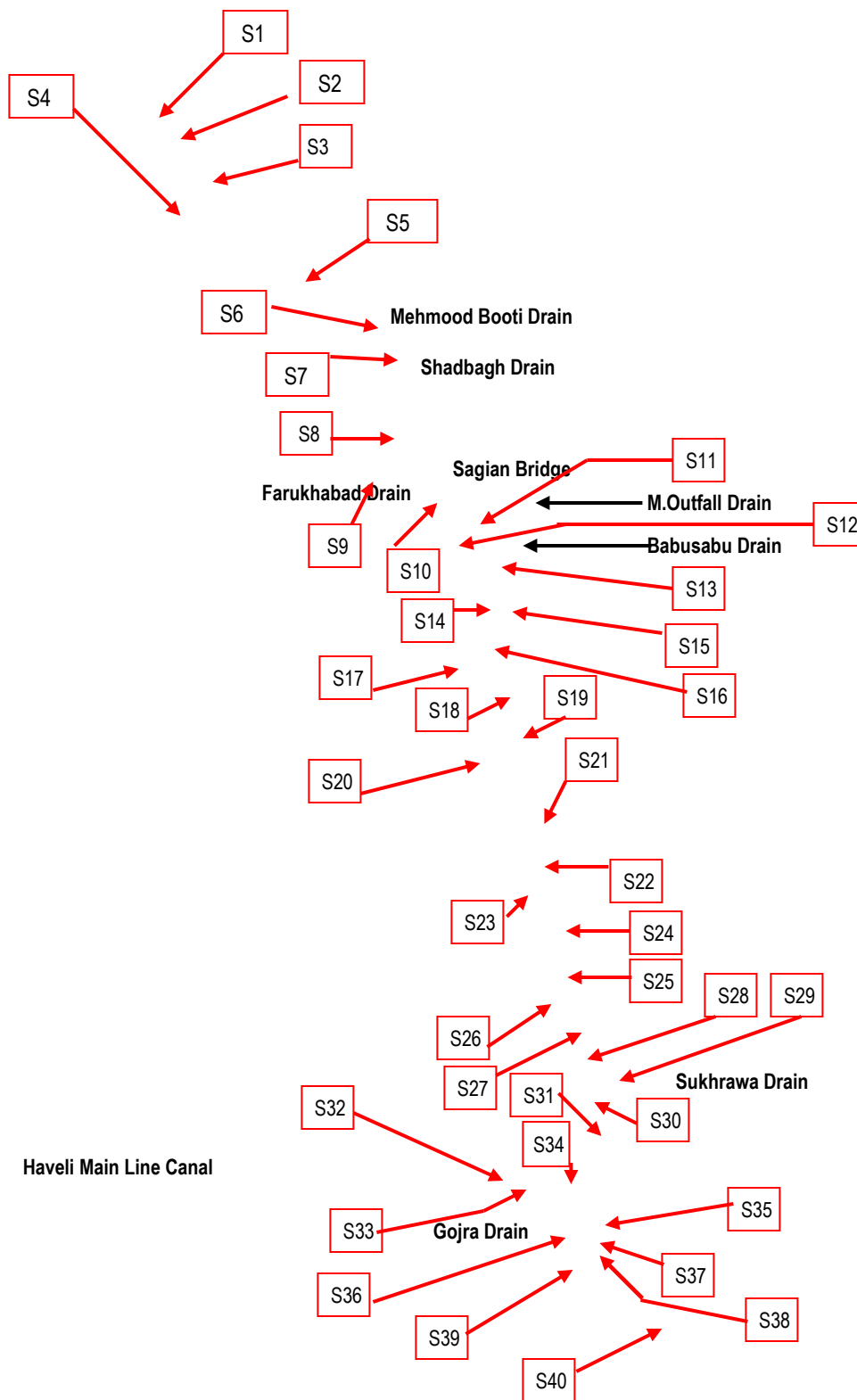


Figure 2.1 Location of Sampling Points along the River Ravi and Point Sources of Pollution