Draft Initial Environmental Examination

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PAK: Proposed Loan for Additional Financing Islamic Republic of Pakistan: Trimmu and Panjnad Barrages Improvement Project

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PUNJAB IRRIGATION DEPARTMENT
GOVERNMENT OF PUNJAB

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INITIAL ENVIRONMENTAL EXIMINATION (IEE)
OF
REHBILITATION AND UPGRADNG OF ISLAM BARRAGE

August 2018

Project Management Office

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Rehabilitation and Upgrading of Islam Barrage

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LIST OF ABBREVIATION

AIDS	Acquired Immunodeficiency Syndrome
AOI	Area of Influence
BOD_5	Biochemical Oxygen Demand
BOQ	Bill of Quantities
COD	Chemical Oxygen Demand
CO_2	Carbon Dioxide
CO	Carbon Monoxide
COSHH	Control of Substances Hazardous to Health
CSCEnv	Construction Supervision Consultants Environmentalist
CEnv	Contractor's Environmentalist
cft	cubic feet
CSC	Construction Supervision Consultants
d/s	Downstream
DO	Dissolved Oxygen
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESU	Environmental and Social unit
EA	Environmental Assessment
FAO	Food and Agriculture Organization
ft	Feet
GIS	Geographical Information System
GHGs	Greenhouse Gases
GOP	Government of Punjab
GRC	Grievance Redress Committee
HSE	Health, Safety & Environment
HIV	Human Immunodeficiency Virus
kg	Kilogram
km	Kilometres
LARP	Land Acquisition and Resettlement Plan
LAA	Land Acquisition Act
IEE	Initial Environmental Examination
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
IWT	Indus Water Treaty
mg/l	Milligrams per liter
N_2O	Nitrous Oxide
mm	Millimeters
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NESPAK	National Engineering Services Pakistan
NO_x	Oxides of Nitrogen
NTU	Nephelometric Turbidity Unit
N_2O	Nitrous Oxide
NOC	No-Objection Certificate
NGOs	Non-government Organizations
O&M	Operation and Maintenance

PICs	Project Implementation Consultant
PM	Particulate Matter
ppm	parts per million
ppb	parts per billion
PEPA	Punjab Environmental Protection Act
PEPC	Pakistan Environmental Protections Council
PID	Punjab Irrigation Department
PMO	Project Management Office
PPC	Pakistan Penal Code
PPEs	Personal Protective Equipments
PHS	Public Health and Safety
RSC	Residual Sodium Carbonate
RE	Resident Engineer
SAR	Sodium Absorption Ratio
SO_x	Oxides of Sulphur
SCARP	Salinity Control and Reclamation Project
SFA	Social Framework Agreement
SSEMP	Site Specific Environmental Management Plan
SMO	SCARPS Monitoring Organization
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TBT	Tool Box Talk
u/s	Upstream
US-EPA	United States Environmental Protection Agency
µS/cm	Micro Siemens per centimeter
$\mu g/m^3$	Microgram per cubic meter
UNO	United Nation Organization
WAPDA	Water and Power Development Authority
XEN	Executive Engineer

UNITS AND CONVERSION FACTORS

Length

1 inch	=	25.4 millimeters				
1 meter	=	3.281 ft				
1 mile	=	1609 meters	=	1760 yards	=	5280 ft

Area

1 sq. m	=	10.76 sq. ft	=	1.196 sq. yd
1 hectares	=	2.47 Acres	=	10,000 sq. m
1 sq. km	=	100 hectares		

Volume

1 US wet gallon	=	0.833 imperial gallon	=	3.785 liters
1 US dry gallon	=	0.967 imperial gallon	=	4.404 liters
1 cu. meters	=	35.28 cu. ft		

EXECUTIVE SUMMARY

Introduction:

The Government of Pakistan (GOP) is implementing the barrages improvement program to address the increasing degradation of Pakistan's barrages. The Asian Development Bank (ADB) will support the GOP's program by financing a multi-phased Punjab Barrages Rehabilitation Project (PBRP). The development objective of the Project is the sustainable delivery of a productive and efficient barrages system contributing to lower the operation costs.

Islam head works is located on river Sutlej in southern Punjab about ten miles north-west of Hasilpur town in Bahawalpur District. The Barrage, designed for discharge capacity of 300,000 cusecs, was constructed during 1922-1927. Originally three canals were designed to take off from the barrage, two from the left bank (Bahawal Canal and Qaim Canal) and one from the right bank (Mailsi Canal).

The studies of the consultants conducted in 1998 revealed that Islam Barrage is an unsafe structure. Based on the recommendations of the Consultants, the Punjab Government had given due attention to Islam Barrage and included it in Phase-I Program of Rehabilitation of Barrages in Punjab. The Rehabilitation of Islam Barrage includes civil, mechanical and electrical works to improve the Barrage capacity, upgrading and modernization of the gates. Upstream and downstream floor of the Barrage will be inspected, and substrate and voids will be grouted under pressure.

An Initial Environmental Examination (IEE) report has been prepared for rehabilitation and upgrading of Islam Barrage. The report has been prepared to ensure compliance with the following objectives:

- ADB's Environment Safeguards Policy Statement, 2009;
- The applicable national environmental administrative and legal frame work;
- Environmental & social base line data within the project area of influence (AOI); and
- Assessment of potential environmental impacts and determining mitigation measures of expected adverse impacts.

A basic Environmental Management Plan (EMP) Framework (inclusive of all major environmental aspects and risk-based assessment plan) has been developed and the envisaged EMP implementation cost estimated. The EMP will be revised, upgraded and further details will be provided for each construction contract of the rehabilitation and upgrading of Islam Barrage.

The base line data was developed and analyzed to identify potential environmental impacts of the project. An Environmental Assessment Checklist methodology was adopted to identify the high-risk activities and suggest their mitigation measures. Where possible, eliminating

the risk by altering the scope or method of execution of work was preferred rather than minimizing the risk with control measures.

Legal and Administration Framework Policy:

Pakistan Environmental Protection Act 1997 is a primary legislation applied to environmental assessment studies in Pakistan. Under section 12 (with subsequent amendment) of the 1997 Act, a project falling under any category specified in Schedule I (SRO 339(1)/2000), requires the proponent to file an IEE with concerned environmental agency (Pak-EPA). Projects falling under any category specified in schedule II require the proponent to file an EIA with the environmental agency. As the estimated total cost of the project is well above 50 million Pak Rupee therefore the project falls under Schedule II and requires preparation of an EIA study. Lastly, all effluent and emissions should be in compliance with NEQS and should also establish monitoring and evaluation systems, as required under Pak-EPA.

The ADB's Environment Policy (2009) also requires that Environmental and Social Impact assessment to be conducted for the projects which could have adverse environmental impacts. Under ADB's Safeguard Policy Statement 2009, projects are to be categorized into the three environmental categories; A, B and C according to significance of the adverse environmental impacts. This Project has some adverse environmental impacts, but of lesser degree and significance. The Project is therefore categorized as 'B' as per ADB Safeguard Policy Statement 2009.

Description of Project:

The Project envisages detailed design of rehabilitation and up gradation works at Islam Barrage. The Project comprises of the following components:

i) Rehabilitation of main barrage and subsidiary weir, which includes:
    a. Grouting underneath the floors of barrage and subsidiary weir;
    b. Repair of cracks;
    c. Lowering of crest of subsidiary weir by 1 ft and overlay of concrete on upstream and downstream floor of the subsidiary weir. This will increase the barrage capacity from 311,000 cusecs to 332,000 cusecs corresponding to 100-year return period floods;
    d. Shortening length of existing divide walls to improve approach conditions;
    e. Provision of two new divide walls in Bays 10-11 & 21-22 to improve hydraulic conditions by separating main weir & depressed weir.
ii) Rehabilitation and up gradation of Gates and Hoisting System including provision of motors for electronic gate operation besides provision for manual operation of gates.
iii) Raising and Strengthening of Guide bunds;
iv) Provision of instrumentation and control system for uplift pressure monitoring; and
v) Rehabilitation of existing buildings on barrage and provision of staff quarters in canal colony.

Description of the Environment

In the past, the pond area of Islam barrage was classified as wildlife game reserve for the wildlife species. Now it has been de-notified by Irrigation Department and all the pond area land has been handed over to Irrigation Department. Baseline conditions of the area of influence (AOI) have been established considering the current and proposed development activities as well as the direct and indirect activities connected within the AOI. The information utilized for the preparation of IEE report was collected by using technical site surveys from proposed construction and rehabilitation sites and undertaking laboratory testing. Secondary data has been collected from the canals command area and published documents from other institutions i.e. land Reclamation Office, Scarps Monitoring Organization (SMO), Punjab Wildlife Office, Fishery Department etc.

Punjab Irrigation Department (PID) land is available at Head Islam Barrage, which would be utilized for Contractor's facilities (contractor camps, plant & equipment yard and work base areas etc). Surface water testing at barrage site indicates that the available water does not meet the WHO standards and is not fit for human consumption. However, the water meets the NEQS levels and FAQ standards for agriculture purposes and is fit for irrigation use. It has been concluded from groundwater testing that if the groundwater is to be used for the water supply in the labourer Camp, then it is the responsibility of the Principal Contractor to abstract water from sufficient depth after confirming that it meets the WHO drinking water quality standards. It was found from ambient air quality monitoring that air is reasonably clean at present as all the monitored parameters are within the limits as prescribed by NEQS. The measured noise levels are also meeting the NEQS and WHO guideline values at two monitoring locations. However, the monitored noise levels at the residential colony are exceeding the NEQS and WHO guidelines for this type of environment. The climate of the area is arid characterized by long hot summers and short mild winters**.** The summer extends from April to October. The mean temperature ranging between 39°C to 42°C in summer. May and June are the hottest months during which maximum temperature may rise up to 50°C. The average annual rainfall in the area is 150 to 180mm. nearly 60% of the Precipitation is received during July August whereas the rest is unevenly spread over the remaining months. The relative humidity is generally low except during monsoon period. Wind velocity remains low in winter but begins to intensify during summer and assumes the form of dust storm between May and September. The typical wind direction is south to north

The existing macro-habitats within the project area include the agricultural land, wetland (including the reservoir, canal system, and small water impoundments) of these, the agricultural land occupied most of the area. The wetland is an important ecological feature of the site and is a source to a number of bird's species. The dominant plant species are:

Dalbergia sisso (Shishmim), *Acacia nilotica* (Kiker), *Tamarix aphylla* (Farash) and *Prosopis juliflora* (Jangli kiker). The species of birds found in the area include pigeon, dove, egret, quail etc. Common wild mammals of the area include wild boar, jungle cat, mongoose, jackal, porcupine and fox etc. some species of reptiles and amphibians are found in the area e.g. Indian Cobra, Indian Monitor Lizard, Frogs and Toads etc. The population of the fish has been decreased due to the less discharge in river Sutlej. There are many fish shops on the left side of the barrage. It has been found that more than 45% of the people live around the barrage are connected with the fishing industry. The most common type of fish found at the barrage are Mali, Gulfam, Sangari, Rahu, Talapi, Mori and Soul.

The survey regarding socio-economic profile of the Affected Households (AHs) was carried out from April 02-07, 2018. This included the settlement pattern, demographic features, and occupation, income and living conditions of the AHs. The survey instruments used were questionnaire for socio-economic survey and focus group discussions. The population belongs to the project area is rural. Major castes in the area were Jhabail, Kallas, Thehim, Rajput etc. Average family size of the AHs computed to be 6.54 members per family. The proportion of male and female estimated 51.8% and 48.2% respectively**.** The main source of drinking water was hand pump but on RGB due to electric facility, AHs have also installed the electric motors along with hand pumps. The underground water quality was good. Total 23 hand pumps and 7 electric motors (water pumps) owned by the community were reported by the AHs.

Environmental Impacts and Mitigation Measures

The potential impacts associated with barrage rehabilitation works on environment and people are assessed in Chapter-7 of this report and appropriate mitigation measures proposed. The impacts have been identified through the use of standard checklist and expert's knowledge and experience. The impacts identified were assessed for their significance keeping in view their consequences, reversibility, likelihood, duration, location, timing etc. The evaluation of the environmental & social impacts has been summarized in Table 7.1 of IEE report.

Most direct and significant negative impacts of the project are caused by the loss of existing physical infrastructure present at left and right guide bunds. A total 25 households comprised of 170 family members will be affected by project. The households have their residential structures of different kinds (Pacca, Semi Pacca, Kacha, and straw sheds with and without boundary walls) in the project area, One AHs has a small grocery shop in his house and 02 No. of community structures (01 No. Masjid and 01 No. Bathak Hazrat Khizar) at LGB and RGB respectively. Detail of affected structures is given in the Resettlement Plan.

Other adverse impacts will be mainly of temporary nature during the construction phase of the project which will be mitigated through proper implementation of EMP. The overall positive impact of the project will be provision of employment to the local communities, and development of a recreational park

The nature and scope of the construction works and the environmental setting of the Project are such that no significant adverse environmental impacts are anticipated. No permanent adverse impacts are expected with respect to sensitive habitat, wild life or cultural heritage. On the other side, positive impacts associated with creation of safety structure of Islam barrage, increase efficiency of the irrigation system linked with Islam Barrage and flourish flora and fauna within the AOI are envisaged. During construction, the contactor's work force is expected to be largely available locally which will enhance economic opportunities for the local population of working age group. A public park will be developed at the barrage under this Project which will provide a recreation spot to the local community.

The Environmental Management Plan (EMP) has been developed in Chapter 8 of the Report. The EMP will need to be implemented and monitored at all stages of the Project by the concerned parties. A Grievance Redress Mechanism (GRM) to address community grievances and complaints during various project phases has also been developed. The same is provided in the EMP section of this report.

Conclusion:

The project will have net positive impact on the environment of the area. The barrage discharge capacity will be increased and therefore the risk of damaging crop, infrastructure, livestock etc due to uncontrolled breaching in case of flood will be minimized. Availability of jobs during construction phase shall employ and train number of unemployed local youth. Potential adverse environmental & social impacts of the project are associated with mainly the construction phase of the project and all of these impacts are temporary, localized and reversible in nature. These impacts can be mitigated through the proper implementation of the EMP. Therefore, it is concluded that this project is environmentally friendly, financially viable, economically sustainable, and pro-poverty alleviation.

1. INTRODUCTION

The Punjab province having only one fourth of the total area of Pakistan but its fertile land yield more than 50% of the total national agricultural produce. One of the reasons of its healthy agricultural production is efficiently managed irrigation network of dams, barrages, distribution systems and link canals systems on rivers of Punjab. The contribution of Punjab agriculture sector is 28% to the GDP (Government of the Punjab, Punjab Economic Report, 2007). Punjab irrigation network comprises of 24 canals fed by 14 Barrages and 9 major inter-river link canals, irrigating more than 27 million acres of land.

The Government of Pakistan (GOP) is implementing the barrages improvement program to address the increasing degradation of Pakistan's barrages. The Asian Development Bank will support the GOP's program by financing a multi-phased Punjab Barrages Rehabilitation Project (PBRP). The development objective of the Project is the sustainable delivery of a productive and efficient barrages system contributing to lower the operation costs.

Environmental Assessment (EA) for the Islam Barrage project was carried out according to Section 12 of the Punjab Environmental Protection Act 1997 (Amendment 2012) and Asian Development Bank Safeguard Policy Statement (SPS) 2009. The potential impacts of the proposed project activities on various environmental components were predicted during the environmental assessment process. An Environmental Assessment Checklist methodology was adopted to identify the high-risk activities and mitigation measures suggested. Where possible, eliminating the risk by altering the scope or method of execution of work has been preferred rather than minimizing the risk with control measures.

This document comprises the Initial Environmental Examination (IEE) study and complies with Punjab Environmental Protection Act 1997 (Amendment 2012) and Asian Development Bank Safeguard Policy Statement (SPS-2009). In case of change in design or site setup during construction phase of the project, the IEE will be revised; upgraded and further details will be incorporated accordingly.

Social Assessment (SA) has been conducted to evaluate the project's potential positive and adverse effects on the affected people and to examine project alternatives where adverse effects may be significant. The breadth, depth and type of analysis in the social assessment are proportional to the nature of the project and scale of the proposed project's potential effects on the affected people, weather such effects are positive or adverse. The Socio-Economic Survey was conducted by an experience and qualified sociologist.

The Contractor shall ensure that mitigation for the project is implemented fully and must be integrated into the project implementation. For any default, the damages so caused will be made good by the Contractor at his own cost and expenses. In case the Contractor fails to rectify the damage, the employer will do the needful at risk and cost of the Contractor. The amount will be determined by the Engineer which will be adjusted from amount due to the Contractor.

1.1 PROJECT LOCATION

The barrage is located in southern Punjab about ten miles north-west of Hasilpur town in Bahawalpur District at latitude of 29.8258° North and longitude 72.5508° East. The barrage location is indicated on Figure-1.1

It is connected to other parts of the country through roads and is distant about 5 h 18 m (305.7 km) via Depalpur Rd from the provincial capital Lahore and about 7 hr 13 m (552.9 km) via Lahore to Islamabad Motorway from Islamabad.

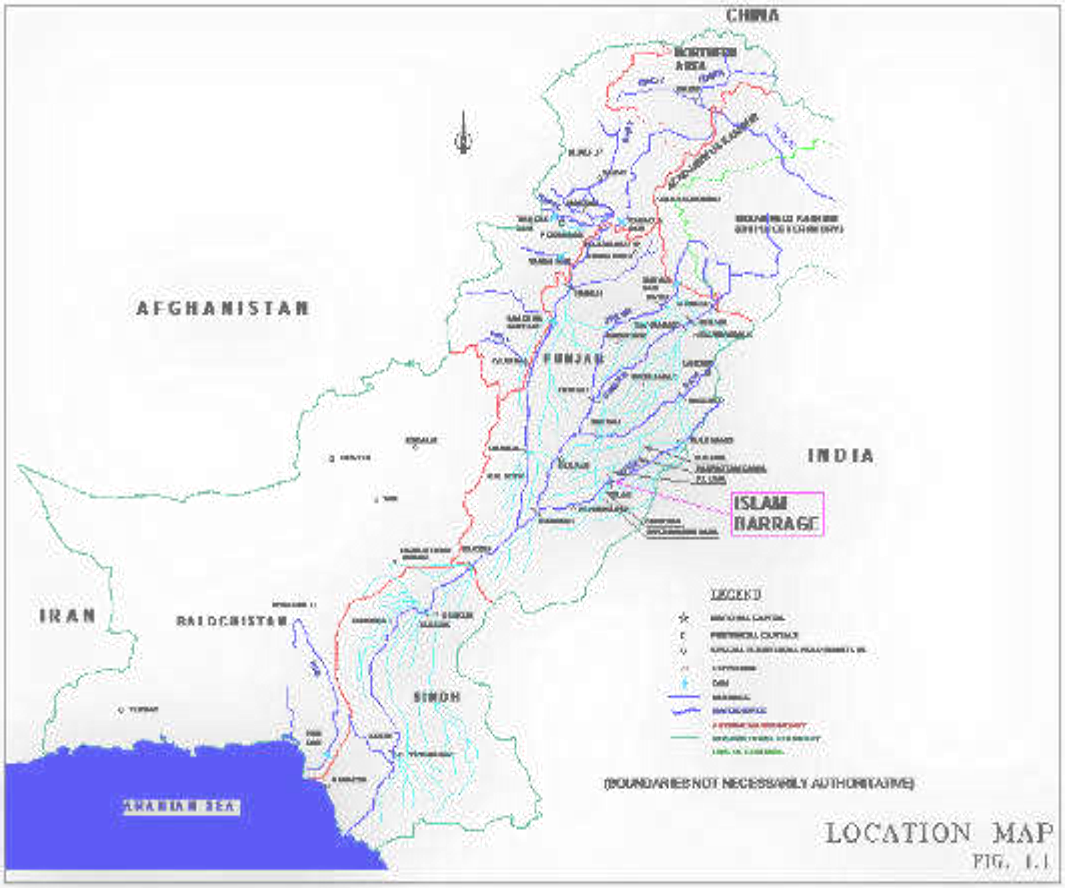

Figure- 1.1 Islam Barrage Location Map

1.2 PROJECT BACKGROUND

The Islam Barrage was designed for a discharge capacity of 300,000 cusecs. The barrage consists of main weir section and two under-sluice sections on both side of the main weir section. Originally, the main weir section comprised 16 bays each of 60 feet width. Three canals were developed to irrigate the Sutlej valley, two from left bank and one from right bank. Bahawal Canal (5,400cfs) and Qaim Canal (558cfs) off take from left bank and Mailsi Canal (5,400cfs) off take from right bank. Later Mailsi canal was closed due to shortage of water in Sutlej river and shifted on Sindnai Mailsi Branch (SMB) Link.

The barrage experienced heavy floods in August 1929 just after two years of its completion. Six central bays completely washed away and disappeared together with piers, superstructure gate and road bridge. These 6-central washed away bays were replaced by constructing 11 bays of shorter span i.e. 29 feet each along with other modification in 1929-30. In 1953, a subsidiary weir was constructed at a distance of about 400 feet downstream of the main barrage to check and control excessive retrogression experienced at the downstream floor.

Since the commissioning of Islam Barrage in 1927, an exceptionally highest flood of 4.926 recorded on October 11, 1955. Another high flood of 3.664 Lac cusecs discharge (including 0.6 Lac cusecs discharge through breaches) was recorded in 1988. Other high floods of 2.285, 2.727, 2.288, 2.852, 2.847 & 2.708 Lac cusecs were also recorded in 1929, lac cusecs (includes estimated 1.485 Lac cusecs discharge through breaches) was 1942, 1943,1947, 1948 & 1950 respectively, complete data from 1927 to 2016 is included in Annex 1. Schematic diagram of Sutlej river is shown in Figure 1.2.

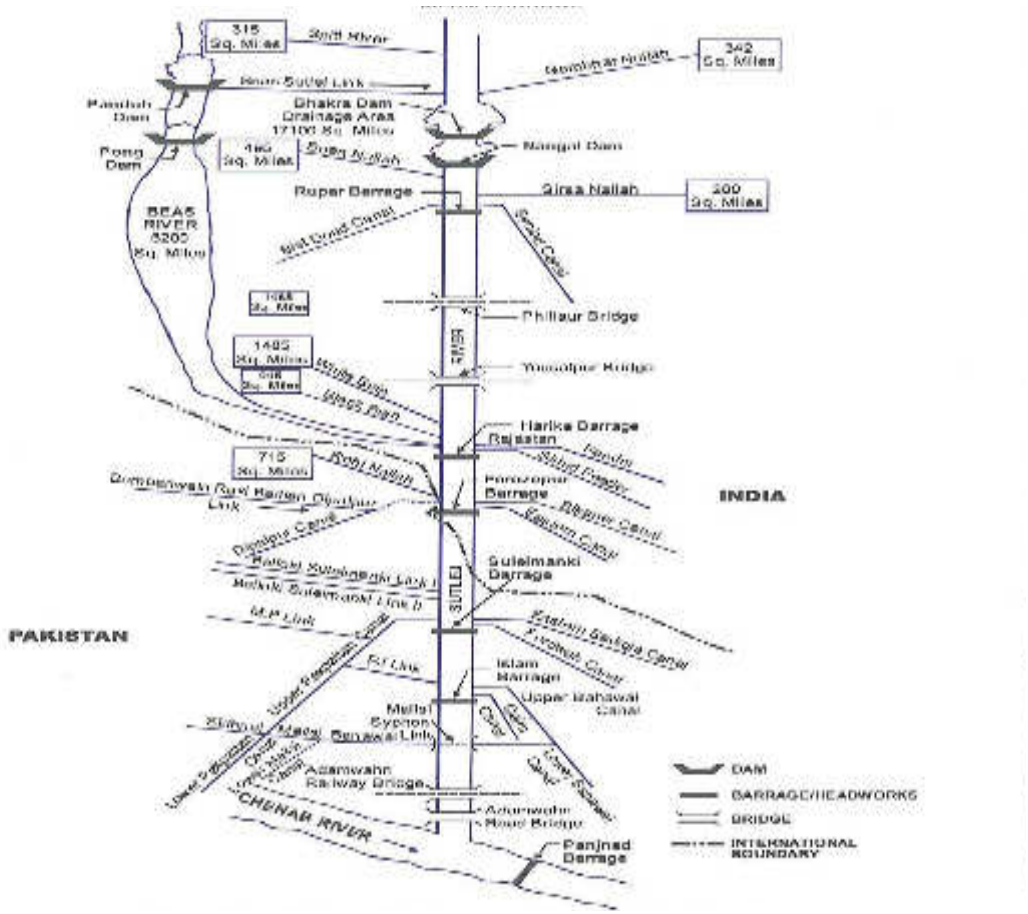

Figure 1.2 Schematic Diagram of River Sutlej Tributaries Above Islam Barrage.

1.3 INDUS WATER TREATY

In 1960, under the agreement of Indus Water Treaty, India was given the rights of the eastern rivers water, including Ravi, Sutlej and Beas. Consequent upon the construction of Bhakra/Nangal Dam on river Sutlej and Pandoh & Pong Dam on Beas; the discharge in Sutlej was reduced significantly. Ferozepur Barrage built in India on Sutlej river immediately before its entrance to Pakistan, stops almost all the water of the river and the river remains bone dry for about 10 months of the year. This entails a significant amount of work for transporting water from the other rivers through link canals to overcome the shortfall in river Sutlej. Pakpatan-Islam (P.I) Link Canal is off-taking from Pakpatan canal brings about 1,000 cfs of water to Islam Barrage. Mailsi Canal due to shortage of water at Islam Barrage was dislodged from Islam Barrage and shifted on SMB link.

Because of the very low flows or no flows during non-monsoon time (approximately 10 months of the year) the morphology of the river channel has drastically changed and there is general aggradation in the main creak due to sand drifts. The pond area of the barrage has also badly silted up especially in the right half where the high shoal has come very close to the divide wall.

The necessity and objective for the rehabilitation and up-grading are to propose remedial measures for:

a. Remodeling barrage and subsidiary weir for design discharge.
b. Repairing suspected damage of the downstream barrage floor and subsidiary weir structure.
c. Grouting substrata and concrete mass of the two structures to fill cavities and voids if any.

d. Restoring the existing Islam Barrage to perform its designated functions and ensure improved and reliable irrigation supplies.
e. Rehabilitation and upgrading the operational capability of the gates and hoisting mechanism at the barrage.
f. Providing instrumentation for pressure monitoring at the barrage floor.

Schematic diagram of Indus basin irrigation system has shown in Figure-1.3

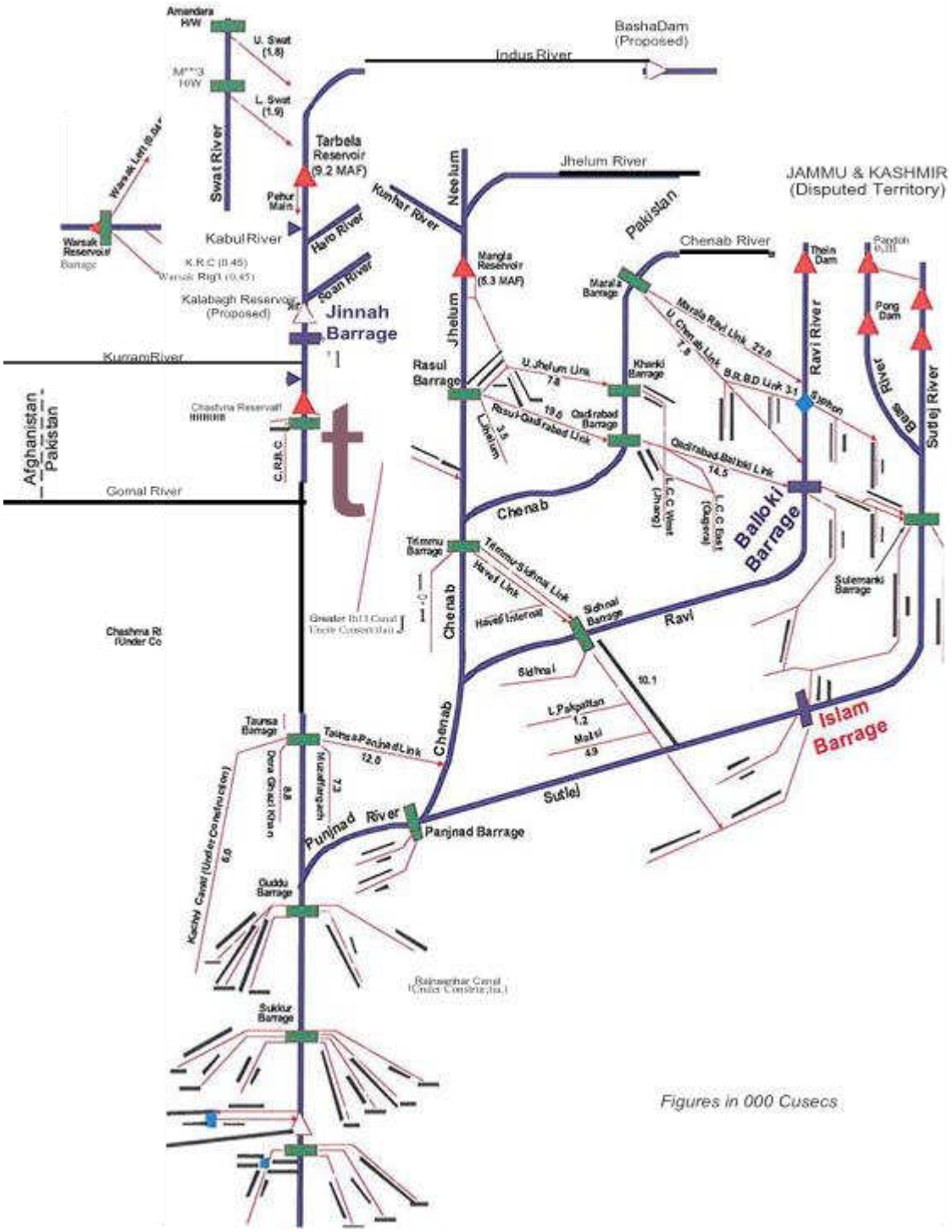

Figure 1.3: Schematic Diagram of Indus River

1.4 OBJECTIVES OF THE STUDY

The IEE study aims to achieve the following objectives:

- Develop baseline data of the physical, biological and social conditions of the project area.
- Assess potential environmental impacts and determine mitigation measures of expected adverse impacts.

1.5 PURPOSE OF THE REPORT

The purpose of this report is to present the findings of the IEE study. Possible adverse impacts of the project are identified and described in a systematic way as per the requirement of the ADB Safeguard Policy Statement (SPS 2009). Adequate mitigation measures and corresponding implementation mechanisms have been proposed so that these could be incorporated duly during the proposed project activity with due consideration. The report provides relevant information, as required under the ADB's approved format, to help the decision makers i.e. Asian Development Bank (ADB).

1.6 REVIEW OF PREVIOUS STUDIES

The preliminary Environmental and Social Impact Assessment (ESIA) study was previously conducted during preparation of Feasibility Report in July 2009. The potential positive and adverse environmental impacts on the area in result of the proposed project were briefly described in the report.

Since the Implementation of Indus Water Treaty in 1960 and subsequent construction of dams and barrages on rivers Sutlej by India, the river length in Pakistan has dried up except for the monsoon periods. This situation has upset the eco-system of the river plain and disturbed Flora & Fauna. More than 90% of the land within the immediate vicinity of the river plain is the agricultural land. The local farmers heavily depend on the river water and lack of availability of the water affects their agricultural production. Large number of groundwater extraction wells were installed to meet the water requirement and excessive pumping of ground water and river water have exhausted the fresh water zone and now brackish ground water has emerged over a large area and is being used as a last resort for existence.

Wildlife of the river plain has also been adversely affected and significant reduction in the migratory birds has been observed. Increasing water quantity in Sutlej river by remodeling of QB Link and BS Link canal systems up to Sulemanki headworks and passing down towards Islam and Punjnad headworks would check the biodiversity of the area besides recharging the groundwater aquifer.

The scope of work suggested in the Feasibility Report and considered in previous ESIA report includes construction of overflow spillway at Murphy Spur (between RD 3.5 to 4.05), closing of gap between Right Guide Bank and T-Head spur and providing an open channel (leading Channel) at breaching section in RRE at RD 6500 and 7500 leading the discharge up to old river channel. Moreover, a bridge was suggested at the junction of escape channel

and Ludden-Islam road. The scope of work was designed to cater the 100 years return flood discharge. In the Feasibility study the estimation of the probable flood discharges for the barrage at various return periods has been made using the following three methods considering the data from 1927 to 2003.

- Gumbel Extreme Value Type-I (EVI)
- Pearson Type-III
- Log Pearson Type-Ill

However, since the implementation of Indus Water Treaty and subsequent construction of dams and barrages by Indian government on Sutlej and Beas rivers, the pattern of water discharge in Sutlej river has significantly changed. The Feasibility Study consultants selected Gumbel-EVI distribution for the Islam Barrage as the best fitted distribution in all the three set of studies. The 100-years return period probable discharge with Gumble-EVI distribution for pre-construction of dams and post-construction of dams on rivers Sutlej and Beas are 396,000 cusecs and 323,500 cusecs respectively. Considering the highest recorded flood of 1988, the feasibility consultants have suggested the design flood discharge of 370,000 cusecs for Islam Barrage.

The Design Consultants have reviewed the available data and calculations carried out during the feasibility study and agree with the adopted procedures and use of Gumbel-EVI distribution. All the analysis carried out at the feasibility stage has been based on the historic data observed at barrage site. The design capacity of the Islam Barrage as computed by the feasibility consultants is estimated as 370,000 cusecs. The technical visits conducted at the Islam Barrage with PMO staff revealed that the discharge computation at the barrage have been overestimated. The detail design consultant developed a tailwater rating curves using observed estimated data, which is further used in the estimation of the barrage capacity. The barrage capacity is as 306,000 cusecs. The Review of Feasibility Report conducted by the design consultant concludes that the emergency spillway at the Islam Barrage is not needed and the existing breach mechanism can function as per departmental practice. However, breach size viz width & depth would be checked and controlled through adoption of suitable measures for this purpose.

1.7 APPROACHES ADOPTED FOR THE IEE STUDY

Environmental and Social data were collected and analyzed for the overall environmental study area. Primary data was collected during site visits. Secondary data for the overall study area was reclaimed from other institutions e.g. Wildlife department, Fishery, Irrigation, SMO and land reclamation etc.

The base line data was developed and analyzed to identify the potential environmental impacts of the Project. Risk based methodology adopted to identify the high-risk activities and suggest their mitigation measures. Where possible, eliminating the risk by altering the work scope or method of execution of work was preferred rather than minimizing the risk with control measures. Public consultation was also undertaken including gender study to take into account the public point of view about the project.

1.8 SCOPE OF WORK

Most of the 14 Punjab barrages are now more than 80 years old and are in distress owing to aging, design deficiencies, constructional defects, hydraulic and mechanical problems inadequate operation and maintenance, and drastic changes in river morphology as a result of implementation of Indus Water Treaty of 1960. During the recent past several serious damages have been reported. Serious damage to any of these barrages resulting in interruption of irrigation supplies can have disastrous implications on the country's economy and population of the area. The rehabilitation and modernization of these barrages has therefore been considered by the Government an urgent necessity and six of these barrages namely Jinnah, Taunsa, Khanki, Balloki, Suleimanki and Islam Barrages have been selected for rehabilitation in the first phase.

The requirement of higher water discharge in Bahawal and Qaim Canals has also been recognized and identified. The water quantity can be increased in river Sutlej during non--monsoon period by remodeling the link canals BS link and QB link. With the addition of new areas for Bahawal Canal systems on the brim of the Cholistan, the additional supplies required for Islam Barrage would be around 1750cfs. Thus, total release from Islam Barrage would be 3233 cusecs (2750 cfs for Bahawal +483 cfs for Qaim Canal). This option is more plausible and is suggested to be studied.

The Project envisages detailed design of rehabilitation and up gradation works at Islam Barrage includes the following components:

Scope of The Project

vi) Rehabilitation of Main Barrage and subsidiary weir, which includes
   a. Grouting underneath the floors of barrage and subsidiary weir.
   b. Repair of cracks.
   c. Lowering of crest of subsidiary weir by 1 ft and overlay of concrete on upstream and downstream floor of the subsidiary weir. This will increase the barrage capacity from 311,000 cusecs to 332,000 cusecs corresponding to 100-year return period floods.
   d. Shortening length of existing divide walls to improve approach conditions.
   e. Provision of two new divide walls in Bays 10-11 & 21-22 to improve hydraulic conditions by separating main weir & depressed weir.

vii) Rehabilitation and upgradation of Gates and Hoisting System including provision of motors for electronic gate operation besides provision for manual operation of gates.

viii) Raising and Strengthening of Guide bunds.

ix) Provision of instrumentation and control system for uplift pressure monitoring.

x) Rehabilitation of existing buildings on barrage and provision of staff quarters in canal colony

In addition to above, the project also includes preparatory works for rehabilitation of Islam Barrage, which include upgradition of SDO's office, XEN Office and regulation office/model room.

1.9 STRUCTURE OF THE REPORT

This report is divided into following chapters.

Chapter# 1. Introduction
Chapter# 2. Legal and Administrative framework policy.
Chapter# 3. Project Description
Chapter# 4. Environmental and Social Baseline condition.
Chapter# 5. Analysis of Alternatives.
Chapter# 6. Public Consultation and Information Disclosure.
Chapter# 7. Impact Assessment, Mitigation and Enhancement Measures.
Chapter# 8. Environmental Management Plan.
Chapter# 9 Recommendations and Conclusions

Pictorial View of the Islam Barrage

Plate 1.1: Approaching Islam Headworks from Ludden

Plate 1.2: Approaching Islam Headworks from Hasilpur

Plate 1.3: Road Bridge on Islam Barrage Main Weir

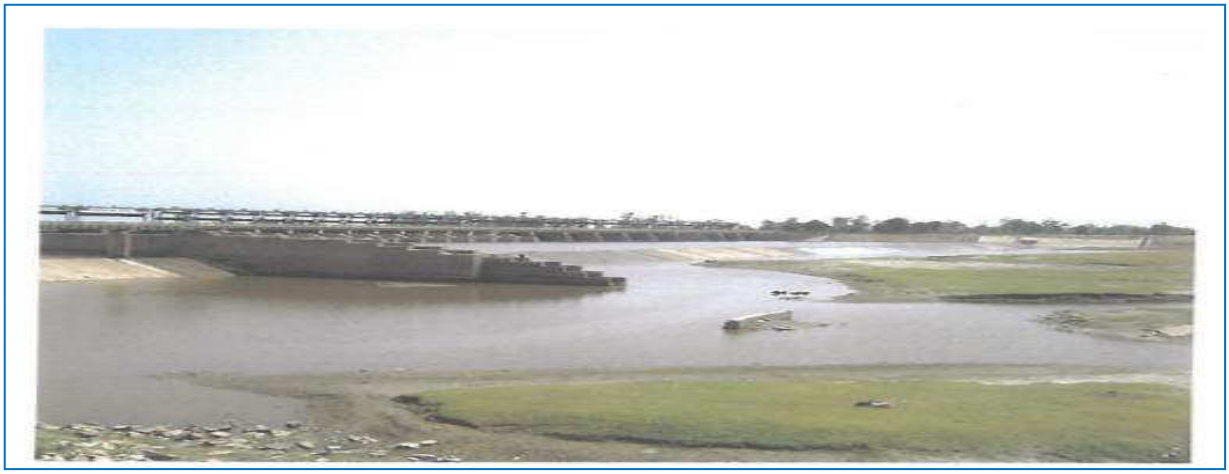

Plate 1.4: Islam Barrage Main Weir and Subsidiary Weir

Plate 1.5: Proposed location for Public Park

Plate 1.6: Irrigation Workshop at Islam Barrage

2. LEGAL AND ADMINISTRATIVE FRAMEWORK POLICY

2.1 GENERAL

This section provides an overview of the policy framework and national legislation that applies to the proposed Project. The Project is expected to comply with all national legislations besides Asian Development Bank Safeguard Policy relating to environment and social issues and to obtain all regulatory clearances required.

2.2 REGULATORY REQUIREMENTS IN PAKISTAN

The 1973 Constitution of Pakistan had included the subject of Environment Pollution and Ecology in the concurrent legislative list. The parliament and provincial governments were empowered to formulate necessary laws under article 142. The federal environmental ministry was established for promulgation of the Environmental Protection Ordinance of Pakistan in 1983. It was the first comprehensive legislation prepared in the country. In March 1992 Pakistan prepared National Conservation Strategy (NCS), which provides a broad framework for addressing environmental concerns in the country. The Pakistan Environmental Protection Act was enacted on 6th December 1997, repealing the Pakistan Environmental Protection Ordinance 1983. The act stands at the apex of statutory law on environmental issues in Pakistan and takes precedence over all preceding federal and provincial legislations in setting nationwide environmental standards and in laying down policies and procedures under the Pakistan National Conservation Strategy.

In April 2010, National Assembly amended the Constitution of Islamic Republic of Pakistan 1973. Among the changes introduced by the Constitution (Eighteenth Amendment) Act 2010 is one having effect on environmental protection legislation of the country. Under the 18th amendment, the subject of environment and natural ecology is devolved to the provinces. Punjab law department has issued Gazette notification of the **Punjab Environmental Protection Act 1997 (Amendment) Act, 2012** in result of the 18th Amendment. Consequently, the responsibility to legislate upon and regulate the environment and natural ecology vests in the provinces. Punjab province has enacted the Punjab Environmental Protection (Amendment) Act, 2012, adopting the Pakistan Environment Protection Act, 1997, a Federal legislation, to the framework of the province. This has allowed the Provincial Government to constitute its own Environment Protection Tribunal and appoint its members.

Other Environmental Rules and Regulations

Other environmental rules & Regulations of Pakistan include:

- Environmental Tribunal Rules, 1999
- Review of IEE & EIA Regulation, 2000
- Certification of Environmental Laboratories Regulation, 2000
- Provincial Sustainable Development Fund Board (Procedure) Rules, 2001
- Environmental Samples Rules, 2001
- NEQS SMART Rules, 2001
- Pollution Charge Rules, 2001

- Environmental Tribunal Rules, 2012
- Punjab Environmental Protection Administrative Penalty Rules, 2013
- Punjab Hospital Waste Management Rules, 2014

Institutional Structure

The Pakistan Environmental Protection Council (PEPC) and Provincial Environmental Protection Agencies (EPAs) are the primary organizations responsible for administering the provisions of the Pakistan Environmental Protection Act.

Under the provision of the Act, provincial EPAs are responsible to manage the environmental concerns of their respective provinces. The provincial EPAs can frame environmental regulations tailored to the requirements of their provinces, provided these regulations meet or exceed the minimum standards set by EPA. They are also required to review and approve EIAs of all development projects undertaken in their respective provinces, including those projects implemented by federal agencies.

2.2.1 Regulations for Environmental Assessment

Under section 12 of Punjab Environmental Protection Act 1997 (Amendment 2012), a Project falling under any category specified in Schedule I (SRO 339, 10/2000), requires the proponent to file an IEE with concerned environmental agency. Projects falling under any category specified in Schedule II require the proponent to file an EIA with the command agency. Within ten working days of the IEE or EIA having been deposited the concerned EPA will confirm that the document submitted is complete for the purpose of review. Subsequently, the agency shall make every effort to complete IEE review within 45 days and an EIA within 90 days of filing.

Revised EIA Report is submitted to EPA Punjab and currently approval process is being carrying out.

2.2.2 National Environmental Quality Standards 2010

The National Environmental Quality Standards (NEQS) specify the following standards:

Effluent Discharges

The Standard prescribed for the maximum allowable concentration for 32 contaminants in municipal and liquid industrial effluents are provided in **Annex 2**. The parameters which will be relevant to the contractor's activity and discharges to surface water or surface water courses and their limits during the proposed project are listed in **Table 2.1**.

Parameter	Limit
Temperature	< 40 °C
pH	>6 and <10
Biological Oxygen Demand (BOD_5)	< 80 mg/l
Chemical Oxygen Demand (COD)	< 150 mg/l
Total Suspended Solids (TSS)	< 150 mg/l
Grease and Oil	< 10 mg/l
An-ionic detergents (as MBAS)	< 20 mg/l
Ammonia (NH_3)	< 40 mg/l
Chlorine	< 1.0 mg/l

Table 2.1: National Environmental Quality Standards for Effluent Discharge

There are no prescribed limits for the concentrations of microbiological determinants which will be required to be met by any wastewater discharge from the contractor's work camps.

Gaseous Emissions

NEQS for the emissions from vehicles is given in **Table 2.2.**

Table2.2: NEQS for Gaseous Emissions

Vehicle type	Maximum Emission Level	Conditions
Road vehicles	40% or 2 on the Ringelman scale	During acceleration

Ambient Air Quality

The ambient air quality standards recently announced by Pak-EPA are provided in **Table 2.3**.

Table 2. 1: NEQS for Ambient Air Quality

Pollutants	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Effective from 1st January 2009	Effective from 1st January 2012	
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m³	80 µg/m³	-Ultraviolet Fluorescence method
	24 hours**	120 µg/m³	120 µg/m³	
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m³	40 µg/m³	- Gas Phase Chemiluminescence
	24 hours**	40 µg/m³	40 µg/m³	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m³	40 µg/m³	- Gas Phase Chemiluminescence
	24 hours**	80 µg/m³	80 µg/m³	
O_3	1 hour	180 µg/m³	130µg/m³	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400µg/m³	360µg/m³	- High Volume Sampling, (Average flow rate not less than 1.1 m3/minute).
	24 hours**	550µg/m³	500µg/m³	
Respirable Particulate Matter. PM_{10}	Annual Average*	200µg/m³	120µg/m³	-β Ray absorption method
	24 hours**	250µg/m³	150µg/m³	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	25µg/m³	15µg/m³	-β Ray absorption method
	24 hours**	40µg/m³	35µg/m³	
	1 hour	25µg/m³	15µg/m³	
Lead (Pb)	Annual Average*	1.5µg/m³	1 µg/m³	- ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2 µg/m³	1.5µg/m³	
Carbon Monoxide (CO)	8 hours**	5 mg/m³	5 mg/m³	- Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m³	10 mg/m³	
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.				
** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.				

Noise Level

The standard prescribes maximum allowable noise level for road vehicles and construction machinery which is given in **Table 2.4**.

Table 2.2: NEQS for Vehicles Noise Level

	Maximum Noise Level	Conditions
Road vehicles	85 dB(A)	Measured at 7.5 m from vehicle

This standard will apply to the vehicles used by the contractor on public roads and to the construction equipment used on site. The contractor will need to ensure that all his sub-contractors also comply with these standards.

Pak-EPA has refined the noise level standards which are given in **Table 2.5**.

Table 2.5 Standards for Day and Nighttime Ambient Noise Levels

Category	Daytime L_{eqd} dB(A) (06:00 – 21:00)	Night-time L_{eqn} dB(A) (21:00-06:00)
Residential area	55	45
Commercial area	65	55
Industrial area	75	70
Silence zone	50	40
Daytime is defined as 06:00-21:00; nighttime is defined as 21:00-06:00 A silence zone will extend 100 m from any prescribed buildings.		

Drinking Water Quality Standards

NEQS for drinking water quality in the country will be applied. NEQS for drinking water quality is attached as **Annex-3.**

Guidelines for Environmental Assessment

The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the proposed project are discussed below:

Guidelines for Preparation and Review of Environmental Reports

The guidelines specify:

- The nature of the information to be included in environmental reports
- The minimum qualifications of the EIA consultant
- The need to incorporate suitable mitigation measures at every stage of project implementation
- The need to specify monitoring procedures.

The guidelines also require that the EIA/IEE report must contain baseline data relating to the project area, an interpretation of the data and proposed mitigation measures.

Guidelines for Public Consultation

These guidelines deal with the recommended approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.

2.2.3 Forest Act, 1927 (and Provincial Acts and Rules)

The Act deals with the matters related with protection and conservation of natural vegetation / habitats. The Act empowers the concerned agency to declare protected and reserved forest areas and maintain these forests. In spite of the fact that Act recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. Therefore, for cutting trees for the construction purposes or otherwise, prior permission is required from the Forest Department of the Punjab Province.

In subject project site, tree cutting is involved, so this act is applicable.

2.2.4 Forestry Notification

The Notification of the Government of Punjab, Forestry, Wildlife, Fisheries and Tourism Department No. FOFT (EXT) VIII. 17/96 of 1998 defines the approvals required for the falling of trees. If the number of trees to be cut for a project exceeds 100, or if the project falls within the jurisdiction of more than one district, a committee comprising the Commissioner of the division covering the districts, the Conservator of Forests, and the Superintending Engineer of PID must give their approval.

As the project falls within the jurisdiction of two district and number of trees to be uprooted for the project are about 20, so the project will be governed by the above-mentioned notification.

2.2.5 Provincial Wildlife (Protection, Reservation, Conservation and Management) Act, Ordinances and Rules

In addition to empowering the Provincial Wildlife Departments to establish game reserves, parks, and wildlife sanctuaries, these acts regulate the hunting and disturbance of wildlife. While reviewing an EIA, the Provincial EPD may consult the Provincial Wildlife Department in case the project has an impact on wildlife. EPD may require IPD to coordinate the implementation and monitoring of project impacts with the Provincial Wildlife Departments.

As there is no game reserve, parks and wildlife sanctuary in the project area so the project will not have governed by the above Act, ordinance and rules.

2.2.6 Antiquities Act, 1975

The Antiquities Act relates to the protection, preservation and conservation of archaeological/historical sites and monuments. It prohibits construction (or any other damaging) activity within 200 m of such sites unless prior permission is obtained from the Federal Department of Archaeology and Museums. The Antiquities Act also binds the project proponent to notify the department anything of archaeological value be excavated during project construction.

There is no archeological site identified within or near the project area.

2.2.7 Provincial Local Government Ordinances, 2001

This ordinance, issued mainly for the devolution process, also establishes regulations for land use, the conservation of natural vegetation, air, water, and land pollution, the disposal of solid waste and wastewater effluents, as well as matters related to public health and safety.

2.2.8 Regulation of Mines and Oil Fields and Mineral Development Act, 1948

This legislation provides regulatory procedures for the quarrying and mining of construction material on state-owned as well as private land.

The construction materials required for the project will be obtained from existing licensed quarries and sand pits. No new quarries or pits will be opened and therefore the project will not be governed by this Regulation. The quarries for the project will be identified by the Contractor in his formal proposal depending on the physical properties of the materials required and those of the material available in the source quarries. Final approval of sources will be given by the Engineer.

2.2.9 Factories Act, 1934

The Act addresses health, safety and welfare of workers, disposal of solid waste and effluent, and damage to private and public property. The Factories Act also provides regulations for handling and disposing of toxic and hazardous materials.

Construction activity is classified as an industry and therefore the regulations will be applicable to the Project Contractor. The procedures for the disposal of solid and liquid waste and of toxic and hazardous wastes will be prescribed later in this document.

2.2.10 Explosives Act, 1884

Under the Explosives Act, the project contractors are bound by regulations on handling, transportation and using explosives during quarrying, blasting, and other purposes.

No explosive is expected to be used during the construction of the Islam Barrage and therefore the requirements of the Act will not apply to the project.

2.2.11 National Resettlement Policy and Ordinance

Following a national consultative process, a National Resettlement Policy and a related ordinance were formulated. The policy and ordinance are presently being reviewed by the provinces and have yet to be approved and notified by the government. The salient applicable features of the Draft Resettlement Policy are given below:

- The Pak-EPA will be responsible for both environment-related as well as resettlement-related matters.

- The responsibilities for implementation at a provincial level are to be delegated to the concerned provincial EPAs with overall control of the Planning and Development Department.
- All categories of 'loss' arising from development projects that entail resettlement, need to be addressed: these include not only loss of land, built-up property, other infrastructure, and crops and trees, but also loss of income, job opportunities, and access to natural resources.
- Vulnerable groups whose issues need to be addressed in particular include: women, children, destitute persons, tribal communities, squatters, those with usufruct rights, and landless groups.
- There should be a particular emphasis on consultation with affected groups when preparing a LARP.

The provisions of the Draft Resettlement Policy are consistent with the requirements of the ADB Policy 2009.

2.2.12 Pakistan National Conservation Strategy

Pakistan National Conservation Strategy (NCS) was approved by federal cabinet in March 1992 and is the principal policy document on environment issues in the country. The Policy outlines the country's primary approach towards encouraging sustainable development, conserving natural resources and management of resources. NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed Project are pollution prevention and abatement, conserving biodiversity, protecting the wildlife game sanctuary and preservation of cultural heritage.

2.2.13 Environmental Standards

The environmental standards which will apply for the proposed project are discussed below.

Effluents

NEQS for industrial and municipal effluents define the maximum allowable concentration of pollutants in effluents released into different types of receiving bodies. US EPA standards will apply on biological contamination.

Ambient Air Quality

Ambient air quality standards including NEQS and WHO guidelines will define the maximum allowable concentration of pollutants in the ambient air. The stringent values among the two standards will be used while comparing the baseline as well as carrying out the impact assessment. The WHO guidelines for ambient air quality are provided in **Table 2.6**.

Table 2.6 WHO Guidelines for Ambient Air Quality

Pollutant	Averaging Period	Guideline value in µg/m^3
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM_{10}	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Source:
World Health Organization (WHO). Air Quality Guidelines Global Update, 2005

Notes:

PM 24-hour value is the 99th percentile.

Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

Drinking Water

In addition to NEQS that apply to effluents released from construction camps, the NEQS drinking water quality standards will be used as reference points for determining water quality during the project.

Noise

Again, stringent among the NEQS and WHO guidelines for noise levels will be followed while carrying out the baseline and impact assessment. WHO guidelines for noise are provided in **Table 2.7**.

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Table 2.7 WHO Guidelines for Noise

Receptor	Noise Level Guidelines LAeq,1hr (dBA)	
	Day time (07:00 - 22:00)	Night time (22:00 – 07:00)
Residential; educational institutional;	55	45
Industrial; commercial	70	70

2.3 INTERNATIONAL CONVENTIONS

Pakistan is signatory to a number of International Conventions, Protocols and Understandings relating to the environment. Those relevant to the project are described in the following paragraphs.

- **Convention on Biological Diversity**

The Convention of Biological Diversity was the outcome of the "Earth Summit" held in Rio-de-Janeiro in 1992. The Convention binds the signatories to respect, protect and conserve the earth environment and bio-diversity through sustainable use of natural resources. Another convention on Biological Diversity is International Inion for Conservation of nature (IUCN), which works across a wide range of themes related to conservation, environmental and ecological issues.

- **Bonn Convention**

The Convention on the conservation of migratory species of wild animals was held in Bonn in 1979. The Convention broadens the scope of RAMSAR to include migratory species other than waterfowl.

- **Kyoto Protocol**

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which sets binding obligations on its Parties to reduce emissions of greenhouse gases. Kyoto Protocol introduced the Clean Development Mechanism (CDM) to allow developed countries to work in cooperative projects with developing countries to reduce GHGs emissions. Pakistan deposited its instruments of accession to the Kyoto Protocol in January 2005. The activities at Islam Barrage are of temporary nature and will not have significant contribution in greenhouse gases emissions.

2.4 ASIAN DEVELOPMENT BANK REQUIREMENTS

The ADB's Safeguard Policy Statement (2009) requires that environmental considerations be incorporated into ADB operations to ensure that the project will have minimal environmental impact and be environmentally sound. The following guidelines shall be adopted:

Environmental Category

Projects are to be categorized in to the following environmental categories; A, B, or C as given in the table below. At any stage the category can be changed with the approval of the chief compliance officer if further studies and investigations reveal that the projects potential impacts are worse, minimal or negligible.

ADB Environmental Categories	Requirements
Category A: Projects with potential for significant adverse environmental impacts	-EIA (Environmental Impact Assessment) required. -Meaningful public consultation to be conducted as early as possible in the project cycle. -EIA report and Environmental management plan with budget to be prepared The EIA needs to be disclosed on ADB website 120 days prior the Board consideration
Category B: Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects	-IEE (Initial Environmental Examination) is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report. -Public consultation -IEE report to be prepared - IEE and EMP with environmental costs to be disclosed to public -IEE available to public on request if it is not normally to be attached as a core appendix circulated, the Summary of IEE is normally to be attached as a core appendix to the RRP

ADB Environmental Categories	Requirements
Category C: Projects unlikely to have adverse environmental impacts	-No IEE or EIA is required -Environmental implications to be summarized in the RRP

This project is categorized as 'B' as the project may leave some adverse impacts but of lesser degree e.g. resettlement and construction related impacts like air, water and noise pollution which are mitigable through preparation and implementation of resettlement Plan (RP) and EMP. It is anticipated that the project does not have significant adverse environmental impacts on the area and therefore falls in category B Project as per ADB SPS 2009 thus requiring preparation of an IEE study. The Rapid Environmental Assessment (REA) Checklist is given in annex-3.

Disclosure Requirements

PMO will disclose the Environmental Assessment Report on their respective websites. The summary of the report will be made available to the stakeholders at sites designated by Punjab-EPA in accordance with PEPA, 2012. In addition, executive summary of EA report will be translated into Urdu language by the project proponents and made available to local communities in the Project area and also made available on the official websites of the proponent (PMO Punjab Barrages). This will ensure that local communities are aware of the project's key impacts, mitigation measures and project implementation mechanism. The IEE Report will also be disclosed on the ADB Website.

3. PROJECT DESCRIPTION

3.1 GENERAL

The Islam Barrage, located about 10 miles north-west of Hasilpur town, was constructed on River Sutlej during 1922-1927 as a component of Sutlej Valley Project for feeding Bahawal Canal (5,400 cusecs) and Qaim Canal (483 cusecs) on the left bank and Mailsi Canal (4,883 cusecs) on the right. The barrage was designed for a discharge capacity of 300,000 cusecs. As a consequence of implementation of Indus Water Treaty, the Mailsi Canal from Islam Barrage was truncated and attached to new Sidhnai-Mailsi Link Canal in 1965. Similarly, the capacity of Bahawal Canal was reduced from 5400 cusecs to 1000 cusecs by shifting lower areas of the canal on to the new Mailsi-Bahawal link.

Barrage structure includes main weir, subsidiary weir and guide banks. The upstream ends of the guide banks are further joined with marginal banks extending up to 10 miles namely Left Retired Embankment (LRE) whereas Right Retired Embankment (RRE) is 13.4 miles long. There are three major spurs on right side called as Murphy Spur, T.Head Spur and new T. H. Spur and one on the left side called on G.H. Spur as shown in Figure 3.1and 3.2.

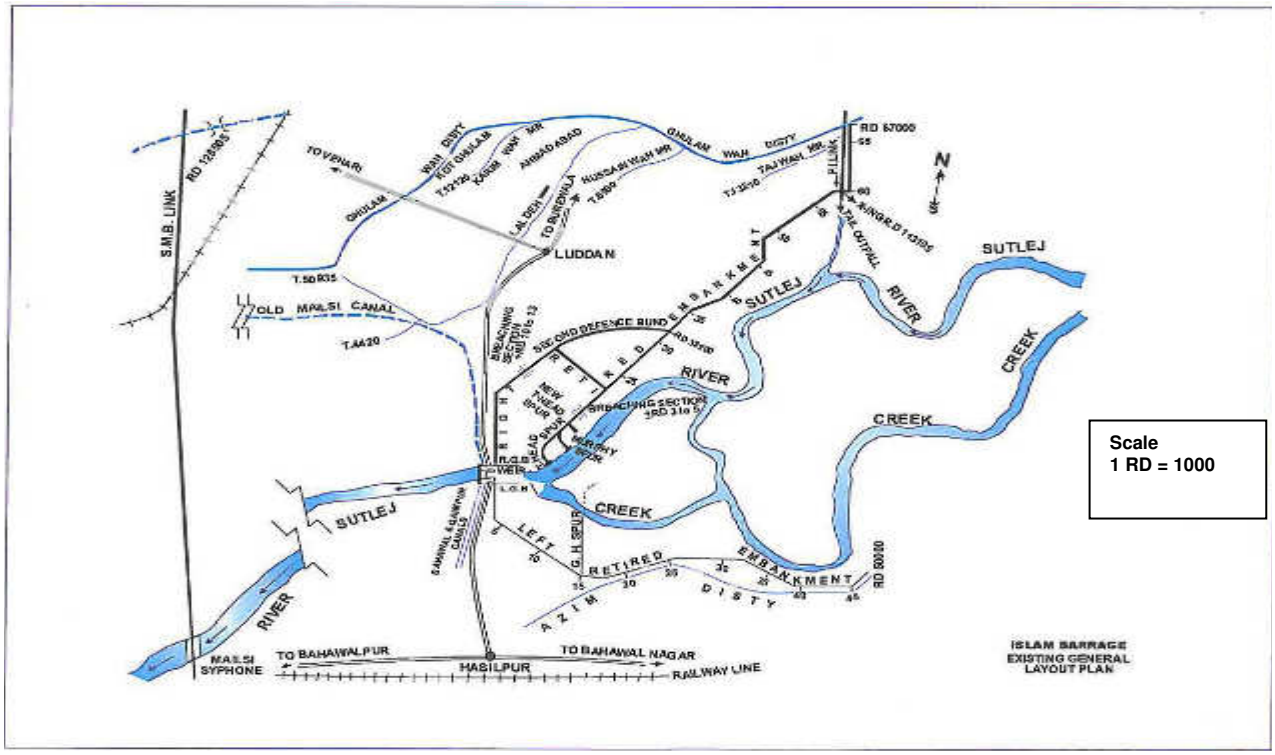

Figure 3.1: Islam Barrage Existing General Layout

Figure- 3.2 Islam Barrage General Layout (Google Image)

As stated earlier, this barrage is 90 years old, i.e. it was originally constructed during 1922-27. The barrage, the subsidiary weir and the gates operating mechanism have outlived and are presently in bad shape. The aging process along with inadequate/deferred maintenance has contributed to a general deterioration of different components/structures and heavy damages to the regulating gates and hoisting equipment. Any serious damage to this barrage can result in colossal losses in the form of total or partial disruption of irrigation supplies, non/less-production of agricultural crops, loss of government revenue, rehabilitation cost of emergency repairs, thus adversely affecting the national economy in additional to human sufferings beside multitude of social and environmental hazards.

Realizing the gravity of the situation of this barrage and other such barrages, the Punjab Irrigation and Power Department engaged Consultants for the evaluation of the safety of major irrigation installations/structure in the Province. The studies of the Consultants (June 1998) concluded that Islam Barrage is an unsafe structure. Based on the above recommendations, the Punjab Government has given due attention to Islam Barrage and has included it in the Phase-I program of rehabilitation of barrages in Punjab.

3.2 BARRAGE STRUCTURE

At the time of completion of Barrage structure in 1927 the barrage comprised of:

1. A low crested main weir consisting of 16 spans of 60ft each with crest level placed at the crest level of the two under sluice pockets.

2. Two divide walls separating the pockets, from the main weir and extending 650 ft upstream of the crest pile line under the weir.

3.Left and right guide banks designed on the bell's mouth system extending 3,380ft upstream and 830ft downstream of the weir crest.

4. Right and left retired or marginal embankments extending either side to about 10 miles upstream of the weir.

5. Head regulator of Mailsi canal on the right flank consisting of 7 spans of 20ft.

6. Head regulators of Bahawal and Qaimpur Canals on the left flank, the former consisting of 7 spans of 20ft and the later having 2 spans of 9ft each.

The barrage experienced heavy floods in August 1929 just after two years of its completion. Six central bays completely washed away and disappeared together with piers, superstructure gate and road bridge. These 6 central washed away bays were replaced by constructing 11 bays of shorter span i.e. 29 feet each with other modification were made in 1929-30. In 1953, a subsidiary weir was constructed at a distance of about 400 feet downstream of the main barrage to check and control excessive retrogression experienced at the downstream floor. The layout of the main weir is shown in figure 3.2.

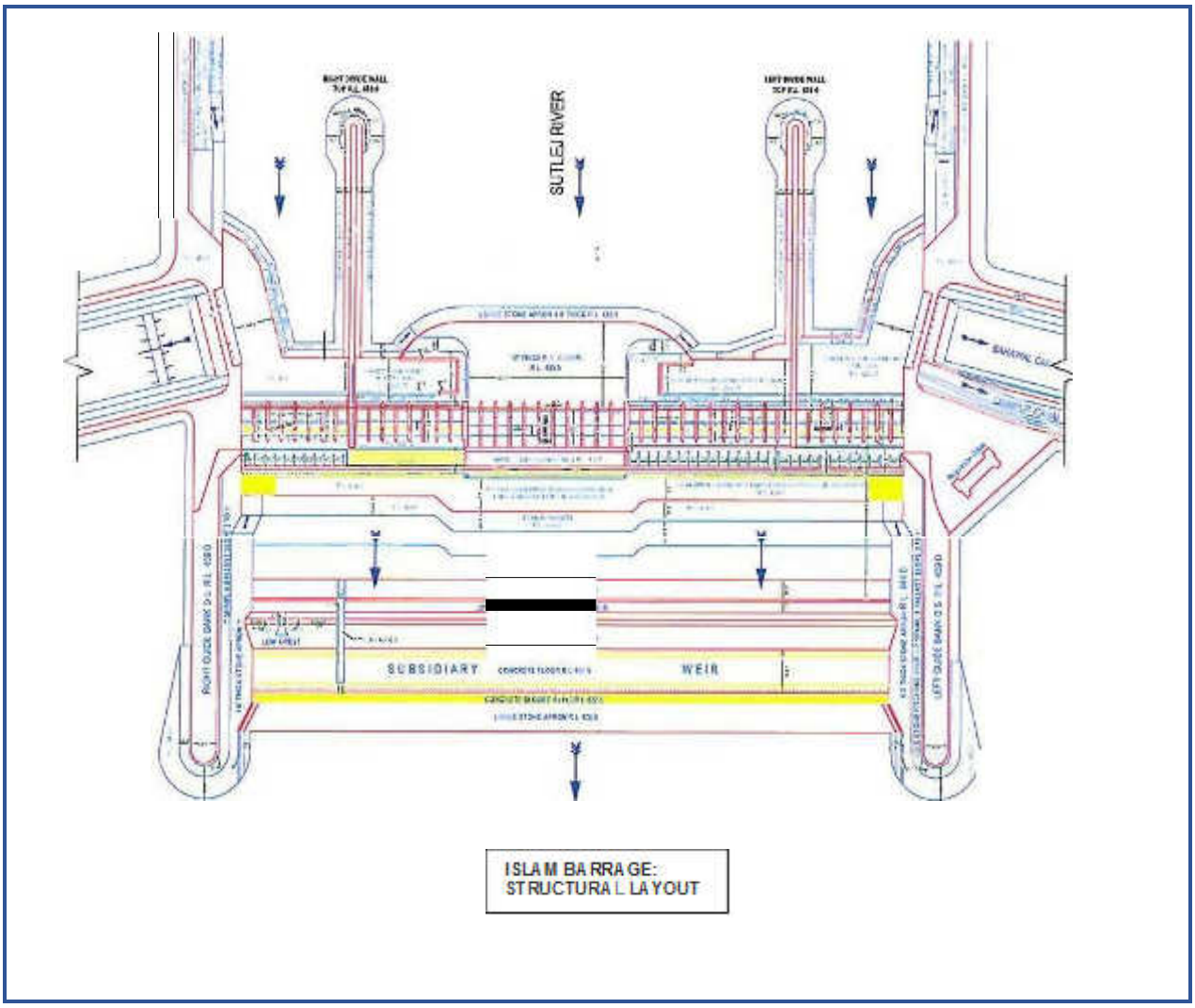

Figure 3.2: Existing Barrage Structure

3.3 PROJECT OBJECTIVES

- Remodeling barrage and subsidiary weir for the design discharge. It includes replacement/re-laying of damaged / defective concrete, concrete block aprons & stone aprons.
- Rehabilitation and modernization of the gates and hoisting mechanism. It includes automation of gate operation replacement/ repair of gates & its hoist system.
- Grouting substrata and concrete mass of the main barrage and subsidiary weir structures to fill cavities and voids.
- Facilitate remodeling/ rehabilitation works (Civil & Mechanical) ensuring safe & sustained supply to off taking system.
  Installation of stand pipe and electronic instruments for pressure monitoring under the barrage floor.

3.4 DESCRIPTION OF PROJECT

The works include both Civil and Mechanical/Electrical works. The details are as follows:

Civil Works

- Grouting the Cavities and Cracks
- Removal of the Deposited Silt from upstream pond area
- Remodeling of Subsidiary Weir Structure
- Develop a new Public Park

Mechanical/Electrical Works

- Rehabilitation/Replacement of Barrage Gates, Installing Hoisting System and Electric Motors.
- Installation of Pressure Monitoring Instruments.
- Installation of 11 KV Power Supply System.
- CCTV Surveillance System

3.5 CIVIL WORKS

3.5.1 Grouting the Cavities and Cracks in Structure

This will include the following components:

Main weir

The barrage structure itself is now under a controlled stress due to presence of subsidiary weir below. The downstream floor however has been experiencing repeated damages and various types of repair techniques were devised. Cement/sand grouting of floor mass and substrata underneath had been repeatedly done to fill suspected cavities, runnels and voids. The floor mass has been showing signs of cracks, which were touched up in various forms to ensure structural soundness and stability against expected pressures.

The geophysical/geotechnical investigations have revealed no serious weaknesses except some odd locations. Details are available in geophysical report (Vol-1), the age-old repair work done and floor mass of weaker concrete mix laid in thin investigations had not been

conducted feasibility studies consultants. With this objective in view, it may be necessary to thoroughly clean downstream floor area and repair the visible cracks, enlarged joints and other damages in the top layer of the reinforced concrete floor. The lean concrete mass below need to be grouted with appropriate material to plug the hidden cavities or the Consultant can introduce another reliable technique.

Subsidiary weir structure

The construction joints of this structure have widened up. The water pool on the upstream side with a high crest level leaks from these joints on the downstream side, which gives an impression of structural weakness. Though, the subsidiary weir is giving good performance without any structural problem. No removal of the overburden and dewatering to inspect the downstream floor is required. The top visible surface of the subsidiary weir and its upstream floor will be repaired and grouted, similarly, as that of the barrage floor to plug any inherent weakness of concrete mass and substrata, or another technique can be incorporated by the consultant/ engineer.

Grouting network can be devised for this process at 20 ft grid or whatever recommended by the Consultant. The surface of downstream glacis, weir crest and upstream glacis shall be milled/ scratched and subsequently covered with a thin layer of high strength concrete dully anchored with the lower layer of concrete mass.

3.5.2 Dredging the Deposited Silt Upstream

Since the implementation of the Indus Water Treaty, the morphology of the river has changed. Significant masking close to the barrage have occurred due to dwindling of river flows. The active creak of the river is located to the right side of the Barrage. Water drawn by Bahawal & Qaim canals routs towards the left pocket, by causing the flow to travel from right to left (flows parallel to the barrage). This is aggravating the flow conditions at the left and right divide wall noses. Considerable sizes of "Bela" have been developed within the upstream pond area and have reduced the barrage capacity. It is proposed to clear the clayey material from the "Bela" at upstream pond area and use it as a fill material in guide bank improvement work. Additional earthwork over and above the earthwork required for embankments for suitable clearance towards pockets would also be made.

Some overburden of deposited silt will also be removed from the downstream barrage loose stone protection area and settlements therein would be made good by filling stone.

3.5.3 Remodeling of Subsidiary Weir

Necessary geotechnical and geophysical investigations have been carried out for the main / subsidiary weir to examine its health. Please refer details in the Section 3.5.1. To check leakages through construction joints and give the present rough/pitted surface a smooth, set shape, treatment proposed by the feasibility consultants would be revisited and further refined.

Physical hydraulic model studies have been carried out for the project. Both comprehensive as well geometric sectional model studies have been carried out for the project. The results of the model studies show that the barrage capacity can be increased to 332,000 cusecs of 9401.2 cumecs (the design flood) by lowering the subsidiary weir without endangering the safety of the barrage. In addition, the approach to the barrage also needs to be improved in order to achieve the desire flood discharging capacity and in this regard the waterways between the guide banks need to be restored. Tests revealed that trimming the bela upstream to a more streamlined shape gives the desired results. This objective is to be achieved by construction of a cunnete as has been adopted for the project.

Mathematical modeling studies have been carried out for the project to establish design flood levels for the river training works. The design flood levels thus simulated for the design

discharge (100-year flood) have been determined and the required bank levels have been calculated by adding freeboard to the design flood level.

3.6. MECHANICAL/ELECTRICAL WORKS

3.6.1 Repair of Barrage Gates, Installing Hoisting System and Electric Motors

The gates and operating mechanism has been planned for repair and up gradation to meet the current demand. All the gates of standard bays (60 ft Span) has been planes to rehabilitate with rubber sealing and motorized hoisting machines. Gate in central depressed bays are in double leaf (lower gates and upper gates) and has been planned to replace with single leaf gates and motorized hoisting, similar is the case with Qaimpur Canal Gates. Bahawal canal gates are most problematic at site. It is planned to change the design of these gates from flap gates (Walton Type) to fixed wheel gates with new superstructure and motorized hoist machines. The cross sections of various type of gates are shown in annex-4 The gates operation of both the barrage and head regulators have been planned to be coupled with electric motors to reduce dependence on manual operation which needs deployment of large laborer force. A system of gates operation monitoring has been devised on site. New independent 11 KV feeder for whole Barrage Complex has been planned and a standby diesel generator of appropriate capacity has been planned for installation as an alternative in the event of power failure.

3.6.2 Installation of Pressure Monitoring Instruments

Due to defective and damaged pressure pipes, new piezometers both electrical & stand pipes are planned for installation under the structure (main weir and subsidiary weir). Certain number of the piezometers will be vibrating wire type so as to allow remote reading of the uplift pressures from the control room. The piezometers shall be installed at all the necessary points along the profile for pressure measurement and comparison with design values.

3.7. MATERIAL REQUIREMENTS

The main type of materials require for the execution of the work are:

3.7.1 Civil Works

- Concrete Work
- Cement
- Crush
- Sand
- Plasticizer
- Air Entraining Agent
- Steel Reinforcement
- Epoxy
- Grouting Material
- Earthwork

3.7.2 Mechanical/ Electrical Works

1- Gates

2- Hoisting System

3- Roller trains

4- Motors

5- Gear Box

6- A local Control Panel (LCP)

7- 11 KV Feeder

8- Low Voltage Cabling System

9- CCTV Surveillance System

10- Piezometer System

11- Sensors and other Electronic devices.

3.8 SOURCES OF MATERIAL

The common source of the material and quantity required for civil work are described in tables 3.1 & 3. 2. The tentative Bill of Quantities developed for the project has been included in PC-1 Performa of the scheme.

Sr.#	Raw Material Availability	Source
1	Earth Material	Available locally, borrowed from the lands temporarily acquired for the purpose.
2	Aggregate	Available at many sources, such as: - Quarries at Sakhi Sarwar (160 miles), Margalla Hills (420 miles) and Sikhanwali (220 miles), Sargodha (230 miles). - The choice will however will depend upon the quality and suitability of the rock material of the construction of the hydraulic structures.
3	Rip-rap material	Available from the three locations indicated above.
4	Sand	Though available locally, the construction grade would need to be acquired from Lawrencepur (435 miles) or another approved site.
5	Water for preparation of concrete	Ample fresh groundwater aquifer is available along the river. The contractor will install tube well in the area already held by IPD.
6	Cement	Portland cement is locally available from the two factories situated at Daud Khel (310 miles). However, the cement of other grades is available within the country for the factories at D.G.Khan (160 miles), Karachi (740 miles), Chakwal (140 miles), Islamabad (420 miles), Wah (425 miles), etc.
7	Reinforcement steel	Available from re-rolling mills at Lahore (220 miles).
8	Mechanical parts of the Gates	Could be manufactured at Factories at Lahore (220 miles) and Gujranwala (260 miles) and /or imported from abroad.

Table: 3.1 Source of raw materials

Material	Unit	Year-I	Year-II
A. Concrete	100 Cft	3200	2960
B. Fabrication of Steel	100 kg	4100	3775
C. Stone Work	100 Cft	10950	12340
D. Earthwork	100 Cft	60500	55845
E. Gates and Hoisting System	No	17	21

Table: 3.2 Quantity of materials

3.9 EQUIPMENT AND MACHINERY YARD

The requirement of following equipment and machinery were determined at feasibility level:

- Boats = 03 No.
- Crane 80 Ton capacity = 02 No.
- Crane 45 Ton capacity = 04 No.
- Excavator = 06 No.
- Grader 140 H. P = 03 No.
- Plain Vibratory Roller = 05 No.
- Sheep Footed Roller = 05 No.
- Hand Compactor = 05 No.
- Trucks 35 Ton Capacity = 10 No.
- Concrete Batching Plant = 01 No.
- Transit Mixture = 02 No.
- Rig Machine = 02 No.
- Pickups single Cab = 02 No.
- Water Boozers = 02 No.
- Water Sprinkler = 03 No.
- Mud Pumps = 10 No.
- Centrifugal Pumps = 10 No.
- Transport for Labores (Bus) = 02 No.
- Jack Hammer = = 10 No.

- Spares parts for the above machinery/equipment
- Other Equipment

The equipment will be kept in a yard to be located near the barrage. As referred earlier, the Irrigation Department owns enough land near the construction sites and also have their own workshop that can accommodate the yard. The existing workshop is open and away from habitations. So, the yard will not cause disruption to the population.

3.10 MATERIAL DEPOTS

The construction material would need to be staked within the area allocated for Batching Plant. As referred earlier, the PID has ample space near the barrage where along with Batching Plant and Equipment Yard the area would also be available for storage of the construction material, provided the change management process is followed as described in the EMP.

3.11 WORK BASES

The work base area proposed at the end of the right guide bank at the short distance from the Ludden road. The material will convey through the Ludden road and access roads to the

construction point. The Work base area and all the access roads are located within the PID's land therefore no any social problems are anticipated due to the establishing the work base area and access road. Modification and maintenance of the surface of the bunds and access roads to be done to ensure the dust free environment of the area.

3.12 APPROACHES TO WORK SITE

The Contractor's Camp, Laborer Camp, machinery yard, material depots, batching plant and RE's office will all be located in and around Ludden Road and easily accessible to the work site. All constitute within Irrigation Department land and no private land acquisition require. All the work activities will be within short journey of Laborer Camp, Contractor's & consultant's offices and RE's office. These approaches are not likely to cause any significant environmental and social problems for the construction program.

3.13 WATER FOR HUMAN CONSUMPTION AND CONSTRUCTION WORK

Groundwater quality along the river is suitable for human consumption and construction work activities. The contractor will make arrangements for the availability of drinking water at site. The contractor will arrange for the water required for construction works on his own. For this purpose, he will install hand pumps/tube wells accordingly. In case of saline groundwater zone, the water should be brought from outside the saline zone. However, the river water could be used for sprinkling and fire protection.

3.14 LABORER CAMP

It is envisaged that the Project will attract about three hundred of skilled/unskilled laborer. It should be ensured that maximum laborer hired would be local who will return home in the evening. However, the majority of the skilled laborer working on site is likely to be from other part of the country. It is a contractor’s contractual obligation to provide a laborer camp and consultants and employer office on site. The location of the laborer camp should be at least 500 meters away from the nearby major human settlements. The camp size should be appropriate to accommodate the site laborer of about 200 people. Transportation facility from the camp to worksite will be provided by the Contractor. The camp should have solid waste management, drainage facilities, proper health facilities, adequate canteen, cooking and laundry facilities, mosque and play area. The suggested site for laborer camp is a state land.

3.15 CONSTRUCTION SCHEDULE AND IMPLEMENTATION ARRANGEMENTS

The construction planning for the project has been carried out based on the construction methods, plant and equipment required to perform economically the construction activities and within an appropriate time span. For this purpose, the project has been separated into the following five major components:

- Care and handling of water
- Barrage repair/rehabilitation
- Guide Banks
- Electrical / Mechanical works
- Rehabilitation of barrage colony

The Project has been envisaged to be executed under a single contract package. International Contract Bidding procedure will be followed for procurement of contractor as per Asian Development Bank guidelines. In addition, construction schedule has been developed for the project using computer software (primavera). Construction is scheduled to

take two years from the contract award date to the completion of works including commissioning of the gates operating system and instrumentation. Supervisory Consultants are proposed to be appointed for providing supervisory services for the project. The construction schedule is given in Annex -5.

4. ENVIRONMENTAL BASELINE

4.1 GENERAL

Data collected for the IEE study primarily pertain top infrastructure details, ecology of the area, flora and fauna, physical and socioeconomic. This chapter assesses the dimensions of the Area of Influence (AOI) and describes relevant physical, biological and socioeconomic conditions, including any changes anticipated prior to the project commencement. Primary data has been collected by technical site surveys from proposed construction and rehabilitation sites and undertaking laboratory testing. Secondary data has been collected from the canals command area and published documents from other institutions i.e. land Reclamation Office, Scarps Monitoring Organization (SMO), Punjab Wildlife Office, Fishery Department etc.

4.2 PROJECT AREA OF INFLUENCE

Project Area of Influence" (AOI) is the area likely to be affected by the project, including all its ancillary aspects such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and waste disposal areas and Laborer camp unplanned developments induced by the project and as well as canal command area.

Although the major construction activities remain restricted to the construction site, yet the situation in which construction related activities would extend beyond the construction site including:

- The Laborer camp site, batching plant, material storage depots, equipment and machinery yards and canal command area
- Borrowing & quarrying sites for soil materials
- Construction of haul tracks in order to transport construction material

The satellite image of the Project area and its surrounding is shown in figure 4.1

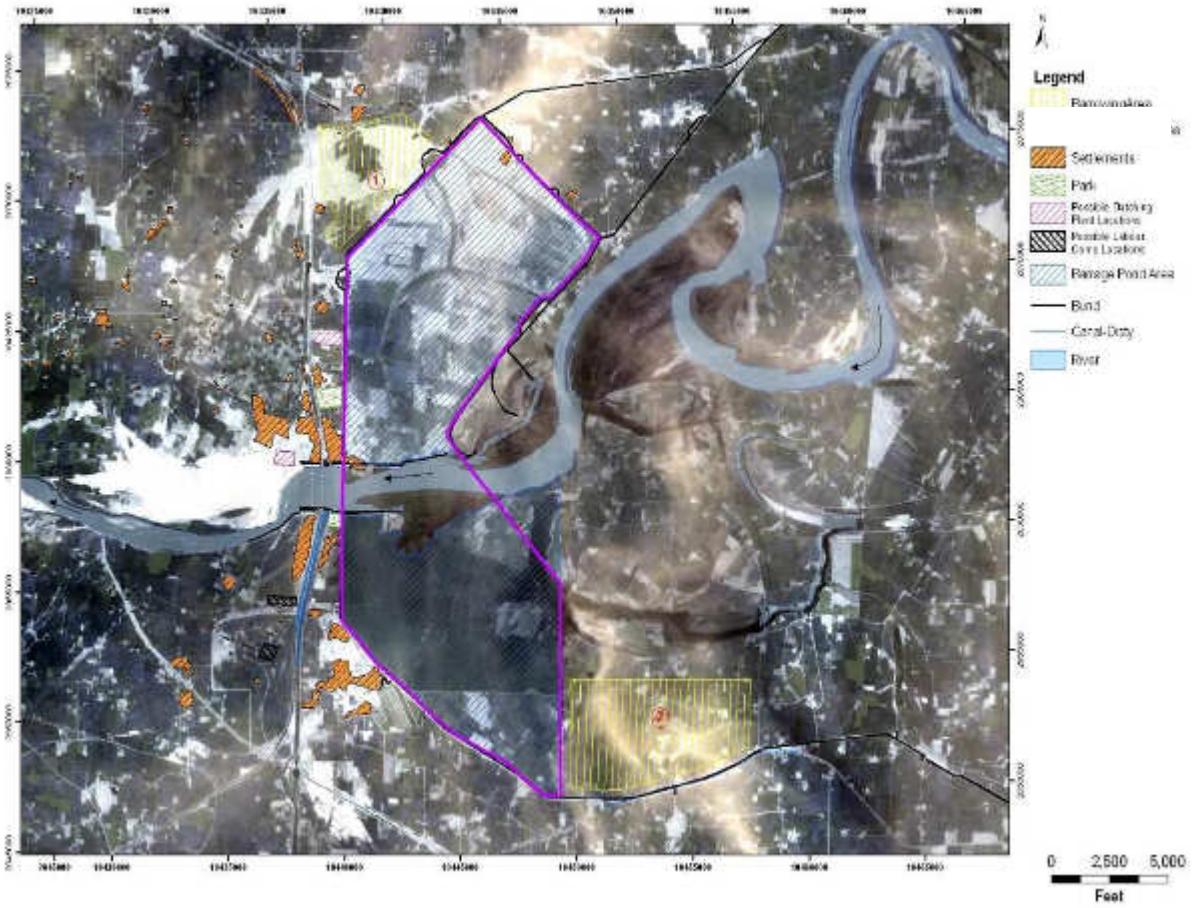

Figure 4.1: Satellite Image of Surrounding Area of the Project

The project area falls within the boundaries of Bahawalpur, Vehari and Bahawalnagar Districts. It lies between 28º-57' to 30º-57' latitudes north and 71º-20' to 73º-58' longitudes. The length of the Islam Barrage between abutments is 1,621 ft. Bahawal and Qaim canals off-takes from Islam Headworks. Upper Bahawal and Qaim canals irrigate about 107,000 acres in Bahawalpur district. The command area is bounded by river Sutlej in north, Abbasia canal command in west, Cholistan desert and Malsi Bahawal (Lower Bahawal) canal command in south west and Fordwah and Sadiqia canal command in the east. Khairpur Tame Walih is the main town falling in the canals command area. Figure 4.2 describes the canals command area. Survey during field visits suggested that apart from irrigation, water of the irrigation canals in the project area is not consumed for human drinking but is consumed by livestock. There will not be extended canal closure in the execution of the project activities as both the canals are non-perennial.

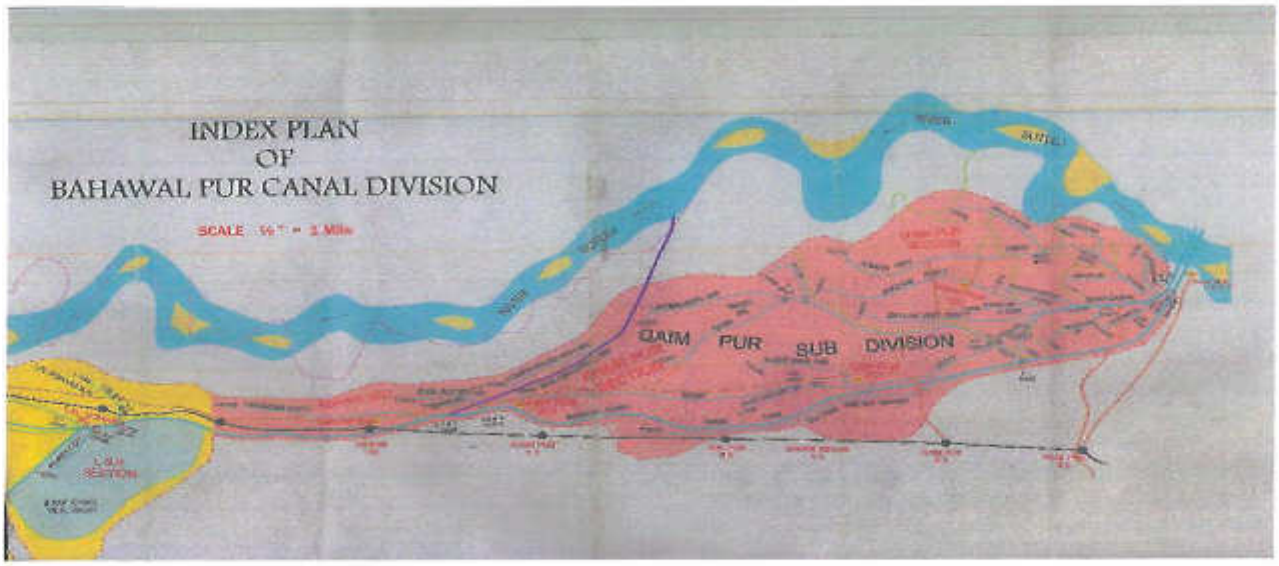

Figure 4.2: Canal Command Area (Source—Punjab Irrigation Department)

4.1 PHYSICAL ENVIRONMENT

It includes water quality (surface and groundwater), soil condition, ambient air quality and climate.

4.1.1 Physiography and Soil

Physiography mainly includes systematic identification, description and different land forms existing in the study area. In alluvial landscapes, like the Indus Basin, major land form units are: Active/Recent flood plains, sub recent flood plains and Piedmont Plains. These are further subdivided into: bars/levees, basins/channels infill and level to nearly level areas of numerous local topographical inequalities which are one of the major causes of soil salinization followed by sonication.

Active flood plains are narrow strips along the river and its tributaries. The plains are inundated almost every year, covered with rich alluvium and are suitable for agriculture. Sub recent flood plains also called alluvial terraces are depositional and are separated from the adjoining active flood plains by the river cut bluffs ranging in height from 2 to 10m. The sediments are called old alluvium and are composed of compact calcareous silty clay. Piedmont plains develop between the mountain and the river. The Piedmont plains of River Sutlej fall in Indian territory. The river rolling down the mountains become active only when rainfall takes place. It flows down the slopes swiftly. On reaching the foothills, it loses speed and drop part of the load within the streams, which split into a number of narrow channels. The gravel, sand and silt thus deposited, form the alluvial fans. The Piedmont plains, dominated by the alluvial fans, provide good soils and suitable topography for agriculture.

Soil Types

The proposed Project area forms a part of the vast Indus plain, which is a part of the Indo-Gangetic depression. This depression is of a synclinal nature. Synclinorium depression is a fore deep downward of the Himalayan foreland of variable depth, converted into flat plains by simple process of alleviation. The alluvial deposits are underlain by rocks of Precambrian age.

Borrowing Area

There is ample land of Irrigation Department near and around canal colony for use of borrow area, Laborer Camp and Batching Plant. The facilities are located within Irrigation Department's land. The soil will be sampled and tested by the contractor before start of the earth work to confirm the suitability of the use of the soil as fill material for construction of coffer dams etc.

Surface Salinity

Surface salinity has been appraised by visual assessment of amount of salts accumulated at the surface in the form of crust/salt puff, apparent adverse effects on existing crops/natural vegetation; determination of EC.

The study was undertaken by Scarp Monitoring Organization (SMO) department and summarized in their report, considered 636 surface (0-15 cm) soil samples. The samples were tested in the field for EC and pH whereas, 315 surface soil samples of the representative sites were analyzed in the laboratory for pH, Electric Conductivity (EC) and sodium Absorption Ratio (SAR) for confirmation of field appraisal.

Status of Surface Salinity

To study the distribution of salts and sodic conditions in the soil profiles, SMO arranged 636 auger holes at suitable sites up to 180 cm depth or to the sloughing material for the study within the canal command area. The acreage and percentages of saline area including Lower Bahawal Canal command area are summarized in Table 4.1 and distribution shown on Figure 4.3

Table 4.1: Surface Salinity Statistics

Class	Acreage	%age
Non-Saline (S_1)	1,019,287	94
Slightly Saline (S_2)	29,192	3
Moderately Saline (S_3)	7,358	1
Strongly Saline (S_4)	4,406	*
Miscellaneous Land Types	18,778	2
Total	1,079,021	100

* Less than 1%

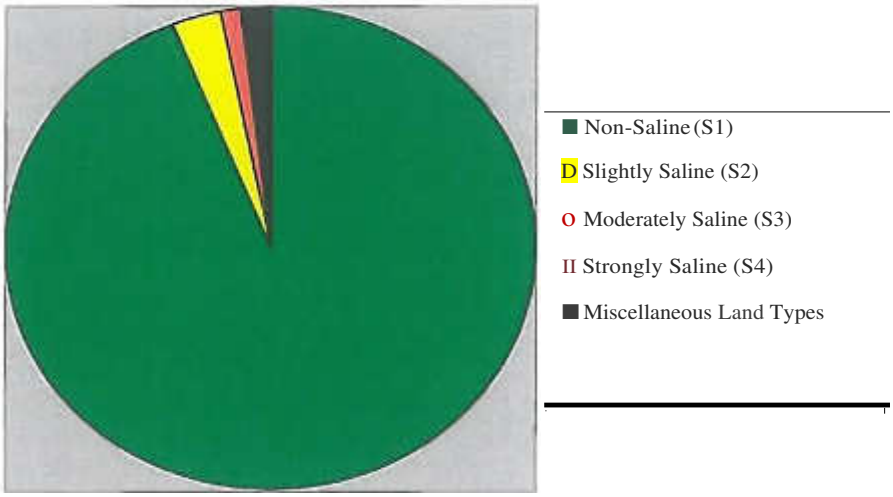

Figure 4.3: Saline Area in Canal Command area of Bahawal Canal & Qaim Canal

4.3.2 Water

Two main sources of water occur within the AOI i.e. surface water and groundwater.

4.3.2.1 Surface Water

Surface water resources of the project area include Sutlej River, Pakpattan-Islam (PI) Link Canal that has its outfall at the Sutlej River at about RD 60 of RRE and Bahawal and Qaim Canals off take from the left bank of the Barrage. Once perennial, the river has now become a non-perennial channel after utilization through diversion of its water by India under Indus Water Treaty of 1960. Presently, its flow mostly released from Pakpattan-Islam (PI) Link Canal and occasional releases from Suleimanki Barrage that mostly occur during high flow season. PI Link Canal is off-taking from Pakpattan Canal bring about 1,000cfs to Islam Barrage.

***Surface Water Testing*[1]**

Grab samples were taken from upstream and downstream at Islam Barrage, the location of sampling point was selected at about 50m from either side of the Barrage. The sampling

[1] The test results are based on sampling carried out as part of IEE report (2018). .

points were undertaken to establish the base line condition of surface water of the study area.

Sampling Procedure

Samples were collected and tested by an EPA authorized laboratory "Apex". The monitoring was carried out on 21 July 2018. Standard sampling procedures were followed at each site to ensure the integrity of the samples collected and validity of test results. Prior to sampling and laboratory testing, discussions were held with concerned staff and Apex representatives, regarding sampling, sample handling, and transfer procedures, identification, and transportation of samples. The sampling procedures followed throughout the field-testing are briefly outlined below:

- The water sampling and spot testing teams were given check list field data form, complete instructions on the importance and significance of correct sampling procedures. Polyethylene bottles were used to collect water samples. For E-Coli sampling, sterilized containers were used.
- Manual sampling procedures were adopted for the collection of water samples. In accordance with the standard manual sampling procedure, a surface sampler consisting of a plastic wide mouthed container tied to a rope was used for sampling. Samples from the river and canal were collected from the location where the water was well mixed, homogenized and flowing. Samples were collected from middle of the channels and natural stream where the velocity of the flow was average or higher than average and there were minimum chances of solid settling.
- As general rule, it is best to analyze the sample as soon as possible after collection. Samples were preserved in an icebox at or near 4°C immediately after collection.
- Nitric acid and Sulphuric acid were added to the sampling bottles in quantities sufficient to lower the pH of the samples to just about 2. To stabilize the concentration of total and dissolved metals for a maximum of 28 days.
- Standard sample transfer procedures were followed to avoid confusion in sample identification, including labeling, and safe transportation to the Apex laboratory at Lahore.
- Sample bottles were given identification numbers immediately after the samples were collected. A custody transfer record, containing the following information, was attached to the sampling bottle:
    1. Sampler name
    2. Sample identification number.

3. Sample origin
4. Sample date and time
5. Sample type (grab)
6. Sample conditions (source. site, temperature; pH)
7. Sample preservation (for dissolved metals)
8. Sample shipping time.
9. Sample integrity (sealed, leaks. tag Aed. iced)
10. Analysis required.

- All water samples collected after proper preservation were stored in an ice box and kept in the refrigerator. The samples were transported to Apex, Lahore by car maintaining proper conditions of refrigeration using an ice box.

Through these services, all samples were sent to Apex laboratories Lahore in time and in good condition.

Analysis of Results

The test results are summarized in table 4.3;

Table-4.2 (Sheet-1) Surface Water Base line Results (U/S of the Barrage).

Sr. No.	Parameter	Unit	Result	WHO	National Environment Quality Standards
1.	pH	--	7.3	6.5-9.5	6 - 9
2.	Color	TCU	7		<15
3.	Taste	--	OK		Non Objectionable
4.	Odor	--	OK		Non Objectionable
5.	COD	mg/l	43.0		150
6.	BOD	mg/l	18.4		80
7.	Oil and Grease	mg/l	0.6		10
8.	Chloride	mg/l	66.9		250
9.	Sulphates	mg/l	73.4	250	600
10.	Cadmium	mg/l	N.D.		0.1
11.	Chromium	mg/l	0.04		1.0
12.	Copper	mg/l	0.05	2.00	1.0
13.	Iron	mg/l	1.4	0.3	8.0
14.	Lead	mg/l	N.D.	0.01	0.5
15.	Zinc	mg/l	0.8	3.00	5.0
16.	Phenolic Compounds	mg/l	N.D.		0.1
17.	Ammonia	mg/l	2.1	1.50	40
18.	Fluorides	mg/l	0.5	1.50	20
19.	Sulphides	mg/l	N.D.		1.0
20.	Total Dissolved	mg/l	356	1000	3500

	Solids				
21.	Total Suspended Solids	mg/l	16		200
22.	Chlorine	mg/l	N.D.	250	1.0
23.	Mercury	mg/l	N.D.	0.001	0.01
24.	Selenium	mg/l	N.D.		0.5
25.	Silver	mg/l	N.D.		1.0
26.	Arsenic	mg/l	0.05		1.0
27.	Barium	mg/l	N.D.	0.7	1.5
28.	Manganese	mg/l	0.03	0.50	1.5
29.	Boron	mg/l	0.17		6.0
30.	Aluminum	mg/l	0.21		---
31.	TOC	mg/l	0.07		2.0
32.	Anionic detergents	mg/l	N.D.		20
33.	Cyanide	mg/l	N.D.		2.0
34.	Total Toxic Metals	mg/l	0.97		2.0
35.	Total Coliform	Number/ 100ml	N.D		0/100 ml
36.	E-Coli	Number/ 100ml	N.D		0/100 ml

N.D. = Not Detected

Table 4.2 (Sheet-2) Surface Water Base Line Results(D/S of the Barrage).

Sr. No.	Parameter	**Unit**	**Result**	**WHO**	**National Environment Quality Standards**
1.	pH	--	7.6	6.5-9.5	6 - 9
2.	Color	TCU	5		<15
3.	Taste	--	OK		Non Objectionable
4.	Odor	--	OK		Non Objectionable
5.	COD	mg/l	41.0		150
6.	BOD	mg/l	29.2		80
7.	Oil and Grease	mg/l	0.2		10
8.	Chloride	mg/l	67.1		250
9.	Sulphates	mg/l	109.4	250	600
10.	Cadmium	mg/l	N.D.		0.1
11.	Chromium	mg/l	0.04		1.0
12.	Copper	mg/l	0.06	2.00	1.0
13.	Iron	mg/l	1.4	0.3	8.0
14.	Lead	mg/l	N.D.	0.01	0.5
15.	Zinc	mg/l	0.9	3.00	5.0
16.	Phenolic Compounds	mg/l	N.D.		0.1

17.	Ammonia	mg/l	3.1	1.50	40
18.	Fluorides	mg/l	0.5	1.50	20
19.	Sulphides	mg/l	N.D.		1.0
20.	Total Dissolved Solids	mg/l	362	1000	3500
21.	Total Suspended Solids	mg/l	19	250	200
22.	Chlorine	mg/l	N.D.	0.001	1.0
23.	Mercury	mg/l	N.D.		0.01
24.	Selenium	mg/l	N.D.	0.02	0.5
25.	Nickle	mg/l	0.02		1.0
a	Silver	mg/l	N.D.		1.0
b	Arsenic	mg/l	0.05	0.7	1.0
c	Barium	mg/l	N.D.	0.50	1.5
d	Manganese	mg/l	0.03		1.5
e	Boron	mg/l	0.17		6.0
f)	Aluminum	mg/l	0.21		---
26.	TOC	mg/l	0.07		2.0
27.	Anionic detergents	mg/l	N.D.		20
28.	Cyanide	mg/l	N.D.		2.0
29.	Total Toxic Metals	mg/l	0.97		2.0
30.	Total Coliform	Number/100ml	N.D		0/100 ml
31.	E-Coli	Number/100ml	N.D		0/100 ml

N.D. = Not Detected

Results Discussion

The average salinity of upstream and downstream of the barrage are 335mg/l and 570mg/l respectively. Guideline in FAO paper 29 interpret 2000mg/l as the upper limit for no degree of restriction on use of water for irrigation. This indicates that there is no restriction of use of water of Islam Barrage for irrigation purpose from salinity point of view.

The Laboratory analysis results are compared with NEQS 2000 & WHO guidelines as shown in tables 4.2 .It has been found that most of the contaminants are within the limits as prescribed in NEQS 2000 and WHO guidelines .

Irrigation Standards

Guideline of FAO Paper 29, Hanson et al., 1999 and WAPDA, are used to interpret infiltration issues resulting from use of Islam Barrage waters for irrigation. FAO has defined infiltration as function of both Sodium Adsorption Ratio (SAR) and Electrical Conductivity (EC) whereas WAPDA Standards (described in table 4.4) define infiltration as function of SAR and or Residual Sodium Carbonate (RSC) only.

Table 4.4: Water Quality Parameters (WAPDA STANDARD)

Symbols	Usable	Marginal	Hazardous
EC x 10^6 µS/cm	0 – 1500	1500 - 3000	> 3000
RSC (meq/l)	0 – 2.5	2.5 – 5.0	> 5.0
SAR (mg/l)	0 – 10	10 - 18	> 18

Recreation Use

Environmental Protection Agency (EPA), 2003 define maximum limit of E-coil equal to 0 per 100ml for freshwater. The results of sampling during the study period indicate that water is fit for recreation use the results also meets the NEQS level.

4.3.2.2. Groundwater[2]

One grab sample of ground water was collected to monitor its quality. The sample was collected from the hand pump, located near the residential area.

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METHODS OF ANALYSIS

The following methods were used for the analysis of ground water.

- AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
- AMERICAN WATER WORKS ASSOCIATION AND
- WATER ENVIRONMENT FEDERATION, 18TH EDITION, 1992 &
- HACH WATER ANALYSIS SYSTEM

Test Results Analysis:

The suite of contaminants and test results are summarized in table 4.5 and 4.6. The test results indicate that the groundwater quality is fit for drinking and agricultural use. The Laboratory analysis results have compared with PEQS and WHO as shown in table 4.5. It has been found that all of the contaminants are within the limits of PEQS and WHO. The original results of water analysis are attached as Annex-5

Table 4.5: Groundwater Baseline Results (Hand Pump at Barrage)

[2] The test results are based on sampling carried out as part of IEE report (2018). .

Sr. No.	Parameter	Unit	Result	WHO	(PEQS)
1	pH	--	7.3	6.5-8.5	6.5-8.5
2	Color	TCU	4	15.0	<15
3	Taste	--	OK		Non Objectionable
4	Odor	--	OK	3(USEPA)	Non Objectionable
5	Turbidity	NTU	2	5.0	<5
6	Total Hardness as $CaCO_3$	mg/l	169		<500
7	Total Dissolved Solids (TDS)	mg/l	352	1000.0	<1000
8	Aluminium(Al)	mg/l	N.D		0.2
9	Arsenic(As)	mg/l	N.D	0.1	<0.05
10	Antimony(Sb)	mg/l	N.D		0.005
11	Barium(Ba)	mg/l	N.D	0.7	0.7
12	Boron(B)	mg/l	N.D		0.3
13	Cadmium(Cd)	mg/l	N.D	0.003	0.01
14	Chloride (Cl)	mg/l	84	250.0	250
15	Chromium(Cr)	mg/l	N.D	0.05	0.05
16	Copper(Cu)	mg/l	0.3		2
17	Cyanide(CN)	mg/l	N.D	0.7	0.05
18	Fluoride (F)	mg/l	0.09		<1.5
19	Lead(pb)	mg/l	N.D		0.05
20	Manganese(Mn)	mg/l	0.01		0.5
21	Mercury(Hg)	mg/l	N.D	0.001	0.001
22	Nickel(Ni)	mg/l	N.D		0.02
23	Nitrate (NO_3)	mg/l	12.7	50.0	<50
24	Nitrite (NO_2)	mg/l	0.6		3
25	Selenium (Se)	mg/l	N.D	0.01	0.01
26	Residual chlorine	mg/l	N.D		0.2-0.5
27	Sulphate as SO_4^{2-}	mg/l	225		400
28	Iron as Fe^{3+}	mg/l	0.04	0.3	0.3
29	Sodium	mg/l	61	200.0	200
30	Zinc (as Zn^{2+})	mg/l	0.5		5.0
31	Total Coliform	Number/ 100ml	N.D		0/100 ml
32	E-Coli	Number/ 100ml	N.D	0	0/100 ml

N.D. = Not Detected

Table 4.6: Groundwater Quality for Irrigation Purpose

Sr. No	Parameter	Unit	Results		WAPDA Standards (Marginal)
			GW1 (31/1/8)	GW2 (1/2/8)	
1	Electrical Conductivity (EC)	µS/cm	412	486	1500-3000
2	Sodium Absorption Ratio (SAR)	meq/l	1.48	1.89	2.5-5.0 (meq/l)
3	Residual Sodium Carbonate (RSC)	mg/l	6.19	4.05	10-18

Secondary Data

Groundwater Quality in Canals Command Area

The secondary data for groundwater quality has been collected from Directorate of Land Reclamation and SMO offices for canals command area. The ground waters were classified on the basis of laboratory analysis arranged by SMO for Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) during 2003-04. For ease in description, the ground waters have been expressed as usable, marginal and hazardous for irrigation as determined by the adverse value of any of the above mentioned three parameters. The classification criteria used is not intended to be hard and fast' in relation to the effects of irrigation waters on soil and crop growth which can be truly adjusted according to environmental factors such as climate, type of soil, crops grown and management practices.

SMO also carried out testing for pH and EC in the field by using digital pH and EC meters and sent all the water samples to the laboratory for detailed chemical analysis. The samples were analyzed for:

Limits of these parameters namely EC, SAR and RSC used for classification of water samples as usable, marginal and hazardous are given in table 4.4.

Using the above parameters, 437 water samples have been classified as usable, marginal and hazardous categories and presented in Table 4.7.

Table 4.7: Shallow Ground Water Quality

Source	No. of Water Samples	Shallow Water Quality					
		Usable		Marginal		Hazardous	
		No.	%	No	%	No	%
Handpumps	283	76	27	79	28	128	45
Tubewells	114	46	40	28	25	40	35
Pipes	40	23	57	13	32.5	4	10
Total	437	145	33.2	120	27.46	172	39.35

It appears that overall proportion of usable, marginal and hazardous quality water samples is 31, 27 and 42 respectively. Water quality of tube wells is relatively better than that of hand pumps.

The overall shallow ground water quality indicates that the usable category of present survey has decreased by 22% over 1977-79 survey, whereas marginal and hazardous water quality have increased by 13% and 9%, respectively. This might be due to heavy pumpage of private tubewells which were installed and operated by the farmers in the command area to meet with the crop water requirements of the area. The drought conditions prevailing in the

country since 1960, after Indus Treaty also played role in deterioration of shallow water quality as fresh water recharge comparatively remained less than pumpage.

Depth of Water Table

SCAPRs Monitoring Organization (SMO) is engaged in monitoring the water table depth in Indus Plain bi-annually i.e. during pre-monsoon and post- monsoon through a network of piezometers and tube wells.

The status of water table in Bahawalpur Area, in June 2015 is given in Table 4.8.

Table 4.8: Depth to Water Table (June – 2015)

Sr. #	Depth (cm)	Acreage	%age
1	0 – 90cm	2.71	0.06
2	90-150cm	6.178	0.14
3	150 – 300cm	145.047-	3.36
4	More than 300	4168.082	96.44
	Total:	4321.778	100

1 Hectare = 2.471

Source: SMO, WAPDA

It can be seen that 98% of the area has water table below 300 cm depth. The data reveals that 26% waterlogged area having water table between 0-300 cm depth during 1977-79 was eliminated during the subsequent years. Under the existing situation water-logging is not a problem within canal command area.

4.3.2 **Ambient Air Quality**[3]

Ambient gaseous monitoring was carried out at one point; Upstream of Barrage near start of Bridge on 21 July 2018. The monitoring was carried out against the parameters given in Punjab Environmental Quality Standards (PEQS) for Ambient Gases.

Particulate matter in ambient air was also monitored at the same location. The monitoring was carried out against the standards values set by Punjab Environmental Quality Standards (PEQS) for Ambient Particulate Matter.

MONITORING

Sampling Methodology

HAZ Scanner HIM 6000 was used for the sampling of ambient gases. The instrument was mounted on tripod on upstream side of the Barrage near Bridge. The system is based on the

[3] The test results are based on sampling carried out as part of IEE report (2018). .

electrochemistry and the system is designed as 'Plug and Play'. The HAZSCANNER logger is self-configuring and all relevant calibration data and other technical specifications are stored in battery-backed up memory. The HAZ-SCANNER system has an exclusive self-zeroing feature which cycles on every 60 minutes. This feature may be triggered more often with a change in temperature. The self-zeroing operation requires 6 to 8 minutes to complete. During these clean airs purge events the instrument sensors store the last valid readings.

The portable HAZ-SCANNER™ system is portable and easily deployable as an ambient air quality monitor to measure and document critical U.S. EPA criteria pollutants including nitrogen oxide, sulfur dioxide, ozone, carbon dioxide, particulates, VOCs, Nitrogen dioxide and more. The HAZSCANNER instrument provides direct readings in real-time with data logging capabilities.

Monitoring Points

The monitoring location was finalized based on the instruction of client. Upstream side of the Barrage was selected for monitoring. The equipment was placed near the starting point of the main Traffic Bridge on Barrage.

Monitoring of Particulate Matter (PM_{10})

Sampling Methodology

HAZ Scanner HIM 6000 was used for the sampling of ambient gases. The instrument was mounted on tripod on upstream side of the Barrage near Bridge. The system is based on the electrochemistry and the system is designed as 'Plug and Play'. The HAZSCANNER logger is self-configuring and all relevant calibration data and other technical specifications are stored in battery-backed up memory. The HAZ-SCANNER system has an exclusive self-zeroing feature which cycles on every 60 minutes. This feature may be triggered more often with a change in temperature. The self-zeroing operation requires 6 to 8 minutes to complete. During theseclean air purge events the instrument sensors store the last valid readings.

The portable HAZ-SCANNER™ system is portable and easily deployable as an ambient air quality monitor to measure and document critical U.S. EPA criteria pollutants including nitrogen oxide, sulfur dioxide, ozone, carbon dioxide, particulates, VOCs, Nitrogen dioxide and more. The HAZSCANNER instrument provides direct readings in real-time with data logging capabilities.

Results and Discussion

The monitored and processed data regarding the ambient Particulate Matter is presented in the ANNEXURE-III of this report. From monitored and processed data, it is evident that the average value of PM_{10} is 63.0 µg/m^3. The limiting value for PM_{10} as set by Punjab Environmental Quality Standards for Ambient Particulate Matter is 150 µg/m^3. It is also evident that the average value of SO_2 for 24 hours monitoring is 54.0 µg/m^3. The limiting value for SO_2 as set by Punjab Environmental Quality Standards for Ambient Air is 120 µg/m^3. The 24 hours average monitored value for NO_2 was 44.0 µg/m^3. The limiting value for NO_2 as set by Punjab Environmental Quality Standards for Ambient Air is 80 µg/m^3. The 8 hours average monitored value for CO was 0.01 mg/m^3. The limiting value for CO as set by Punjab Environmental Quality Standards for Ambient Air is 5.0 mg/m^3.
Maximum level of pollutant detected within 8 hours average of monitoring at hourly interval is summarized in table 4.9 and 4.10. Wind direction was from South to North.

Table. 4.9 Particulate matter Baseline Results

Reference Point	**(Particulate matter) PM_{10} (µg/m^3)**
Upstream of Barrage (Near Bridge) (8 hrs. average)	63.0
Punjab Ambient Air Quality Standards (PAAQS)	**150.0**

Table. 4.10 Other Pollutants Baseline Results

Reference Point	**SO_2 (µg/m^3)**	**NO_2 (µg/m^3)**	**CO* (mg/m^3)**
Upstream of Barrage (Near Bridge) (8 hrs average)	54.0	44.0	0.01
Punjab Ambient Air Quality Standards (PAAQS) (24 hrs. average)	**120.0**	**80.0**	**5.0***

*** =** CO Time weighted average PEQS value is taken for 8 hrs.

Comments: All tested parameters are in compliance with the Punjab Environment Quality Standards for ambient gases

The monitoring result shows that the monitored values are within the prescribed limiting value set by PEQS. Hence, it can be concluded that the ambient air is reasonably clean at present. Keeping in view the traffic level, present and expected, no significant change is anticipated in the air quality after the completion of the construction work. However, air quality could be deteriorated during the construction phase.

Noise Monitoring

Methodology

Noise level measurements were carried out in a way that each set of monitoring was completed in one go. Measurement of the noise levels was made on the "A Weighted Scale" in slow response mode in terms of decibel scale dB(A). It must be remembered that a fourfold decrease in energy (due to each doubling of distance from the reference point) results in a 6-dB(A) decrease in sound pressure level.

The noise level meter, during measurements, was held at a distance of about 5 feet above the ground level. In order to measure noise levels objectively, necessary precautions were taken to avoid interference from wind, external magnetic inductions, vibrations, high temperature and humidity. Since reflection of sound from the monitoring engineer is not negligible, hence during monitoring, engineer always stood with 30o angle to the direction of the sound source to which the engineer's arm was extending while holding the meter in his hand.

Five minutes measurements, at each point were taken while recording reading after every half a minute. A set of 10 readings was recorded at each point during every 5 minutes measurement.

Selection of Noise Level Monitoring Points

Monitoring of noise level was carried out at three points in study area. The monitored and processed data regarding noise levels monitoring is given in **ANNEXURE-5.**

Distribution of measuring points

Distribution of the noise level measuring points is as below:

1. REGULATION BUILDING OF BARRAGE
2. CONTROL BRIDGE
3. RESIDENTAL COLONY

Calculation Methods

Average and the Leq Values Calculation:

i) Average:

The following equation is used (Introduction to Environmental Engineering, II-Edition, by MACKENZIE L. DAVID A. CORP-NWELL) to find the ultimate average value at various monitored points:

$$\mathbf{Lp = 20Log\ 1/N \sum 10^{Lj/20}}$$

Where:
Lp = Average sound level pressure dB (A)
N = No. of measurements
Lj = jth sound pressure level in dB (A)
j = 1,2,3,……..,N

ii) log Equivalent (Leq):

Leq value is calculated by using the following formula (Introduction to Environmental Engineering, II-Edition, by MACKENZIE L. DAVID A. CORP-NWELL):

$$\mathbf{leq = 10\ log \sum 10^{Li/10}\ (ti)}$$

Where:
Leq = Equivalent continuous equal energy level
N = No. of samples (monitoring) taken
Li = The Noise level in dBA of the ith sample
ti = fraction of total sample time

e.g.
The data are collected for five minutes and ten readings have been taken with an interval of ½ minute as under:

dB (A)									
35	35	40	38	36	35	37	35	35	36

Total measurement time at each point = 5 minutes
Total measurements taken during 5 minutes at each point =10

Time interval between two consecutive readings at
a point during each measurement = 0.5 minutes
Time fraction (t_i) for each measurement = 0.5/5 = 0.1
putting this value in the above formula Leq is calculated as under:

$$\text{Leq} = 10 \log \sum [10^{35/10}(.1) + 10^{35/10}(.1) + 10^{40/10}(.1) + 10^{38/10}(.1) + 10^{36/10}(.1) + 10^{35/10}(.1) + 10^{37/10}(.1) + 10^{35/10}(.1) + 10^{35/10}(.1) + 10^{36/10}(.1)]$$

$$= 10\log\sum[316.23+316.23+1000+630.96+398.11+316.23+501.19+316.23+316.23+316.23+398.11]$$

Leq 5m = 10 log 4509.498
Leq 5m = 10* 3.65
Leq 5m = 36.5

LIMITING CRITERIA FOR NOISE

The limiting criteria considered for noise based on PEQS for commercial area is 65 dB (A). The same is 55 dB (A) for residential area. Moreover, the limiting criteria as per WHO guidelines is 70 dB(A) for commercial area and 55 dB(A) for residential area.

RESULTS AND DISCUSSION

The results indicate that the noise levels at two of the locations are within the criteria as set by PEQS and WHO for commercial areas. Leq values recorded at Regulation building and Control Bridge are 58.80 dB(A), and 62.80 dB(A) respectively. However, the noise result at the housing colony is exceeding the criteria as set by PEQS and WHO for residential areas. Leq value of 58.89 dB(A) was recorded at the residential colony.
The results of the noise levels are presented as ANNEXURE-5.

Photo Log

4.3.4. Climate

No meteorological station is located within the project area. The data and analysis provided is based on yearly record. The climate monitoring stations manage by Pakistan Metrological Department (PMD) near the project area include the stations at Sahiwal and Multan. The climate of the area is arid characterized by long hot summer and short mild winter. The summer extends from April to October.

Temperature

The mean temperature ranging between 39°C to 42°C in summer. May and June are the hottest months during which maximum temperature may rise up to 50°C. The winter lasts from December to February with minimum temperature ranging from between 2°C to 5°C. January is the coldest month and chill prevails during the winter when old wave from Quetta ranges, lashes the area.

Rainfall & Humidity

The average annual rainfall in the area is 150 to 180mm. Nearly 60% of the Precipitation is received during July August whereas the rest is unevenly spread over the remaining months. On the whole the rainfall is too scant and unreliable to be of any agricultural use. The general evapotranspiration is very high and the irrigation requirements are met through the well-organized (weir controlled) canal irrigation system. The relative humidity is generally low except during monsoon period.

Wind

Wind velocity remains low in winter but begins to intensify during summer and assumes the form of dust storm between May and September. The typical wind direction is south to north.

4.3.5 Climate Change

Climate Change is emerging threat to various parts of the world. There is complex relationship between variable climate and changing hydrology in the world. Due to Climate Change the temperature has raised globally. Meanwhile, the precipitation pattern has altered to greater extent in those regions which are vulnerable to climate change.

Currently, climate change impact assessments are carried out for a number of reasons; such as to address abilities to meet changes in flow pattern and flood consequences, also to predict the possible changes in agriculture practices (Fowler et al. 2007; Kay et al. 2009). It is expected that in the near future that the world hydrological cycle will be disturbed due to global warming, which will alter the timing and intensity of extreme events (e.g. flood, droughts, cyclones etc).

Water is essential for the survival of all living beings including plants. However, water resources are unevenly distributed in time and space, which causes serious water shortage in many regions. Similarly, socio-economic development concomitant with population growth have tremendously increased water use worldwide during the last few decades. This uneven distribution of water has increased the competition over water resources among different regions and countries (trans-boundary water systems).

Pakistan is one of such regions that face severe impacts of climate change. Pakistan is declared 3rd water scarce country in the world. One of the trans-boundary basins in the Indus is Sutlej river basin which lies between Pakistan and India and is likely to be affected by climate change. The total basin of Sutlej River is 395,000 km2 approximately and 1,400-km long Sutlej is used extensively for irrigation. Sutlej river water was a source of dispute between India and Pakistan until 1960, when the countries concluded the Indus Waters Treaty, which allocated the water of the Sutlej to India in exchange for exclusive Pakistani rights to the Indus and its western tributaries. As a result, India, has constructed irrigation and hydro-power dams on Sutlej River. Of these Bhakra dam, Bilaspur constructed in 1963, Nathpa Jharki dam constructed in 2004, Karcha Wangtoo Hydro-electric power plant commissioned in 2011, and Koldam dam (18 km from Bilaspur) constructed in 2015. Therefore, flows in the downstream (Pakistan's territory) of these dams is not only to be affected by climate change but also due to water management through the mentioned reservoirs.

Flows at Islam head-works are controlled by upstream infrastructure in India as well as Sulemanki headworks as well as link canals in Pakistan. The hydrology of the Sutlej River (flows at Islam head-works) is mainly driven by summer snowmelt in the upstream (Himalayas) and South-Asian monsoon. The onset of the summer monsoon brings heavy rains that often produce extensive flooding in the low laying areas of Sutlej River Basin in Pakistan.

The maximum recorded flood occurred in 1955. The recorded flow was 342,581 ft3/sec. The second largest flood occurred in 1988 (306,425 ft3/sec). However, numbers of exceptionally high flood events have declined during 1927-2016. Various intensity flood events, flood intensity limits and number of occurrences are listed in Table 4. 10 and shown in Figure 4.4, at decadal scale during 1927-2016. During the last two decades, normal and low floods have been recorded at the Islam Head-works.

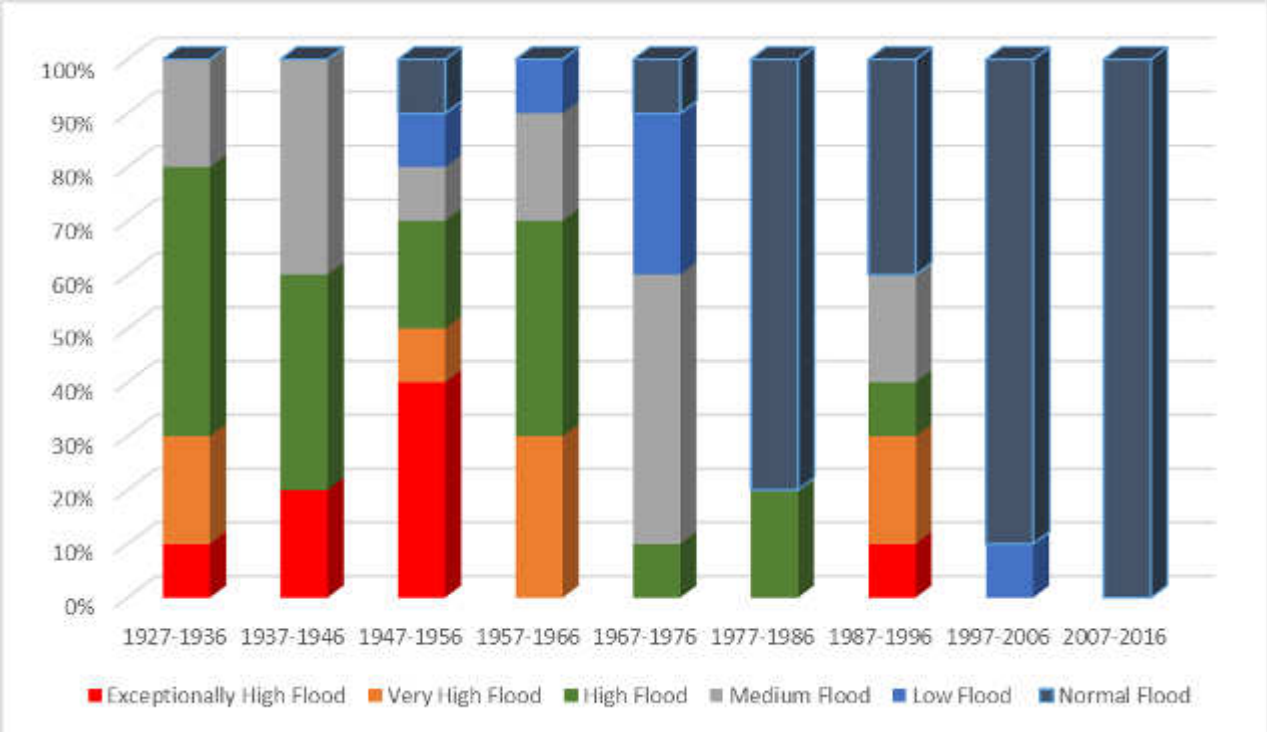
Table 4.10: Various intensity flood events recorded at Islam Head-works during 1927-2016

Flood Events	Flood Limits	1927 to	1937 to	1947 to	1957 to	1967 to	1977 to	1987 to	1997 to	2007 to

	(cusecs)	1936	1946	1956	1966	1976	1986	1996	2006	2016
Exceptionally High Flood	> 225000	1	2	4	0	0	0	1	0	0
Very High Flood	175000-225000	2	0	1	3	0	0	2	0	0
High Flood	120000-175000	5	4	2	4	1	2	1	0	0
Medium Flood	80000-120000	2	4	1	2	5	0	2	0	0
Low Flood	50000-80000	0	0	1	1	3	0	0	1	0
Normal Flood	< 50000	0	0	1	0	1	8	4	9	10

Source: Data obtained from PMO barrages

Figure 4.4: Number of various intensity flood events recorded at Islam Head-works during 1927-2016



Potential causes of this variation could be upstream infrastructure development (and their water management) together with climate change. Unfortunately, limited climate data is

available in the study area. For historic climate change assessment, the nearest available station at Bahawalnager data (1962-2006) maintained and operated by Pakistan Meteorological Department (PMD) has been used.

A total of 13 core climate indices have been estimated for the study area as shown in Table 4.11. Five indices are related to the temperature while eight indices are related to the precipitation. Indices are driven from daily maximum temperature, minimum temperature, and daily precipitation.

Table 4.11: Core climate indices calculated and analyzed

	INDEX	INDEX LONG NAME	INDEX DETAIL	UNITS
1	SU	Number of summer days	Annual count of days when TX (daily maximum temperature) > 25oC	Days
2	TN10p	Cool nights	Percentage of days when TN < 10th percentile	Days
3	TX10p	Cool days	Percentage of days when TX < 10th percentile	Days
4	TN90p	Warm nights	Percentage of days when TN > 90th percentile	Days
5	TX90p	Warm days	Percentage of days when TX > 90th percentile	Days
6	R10	Number of heavy precipitation days	Annual count of days when PRCP>=10mm	Days
7	R20	Number of very heavy precipitation days	Annual count of days when PRCP>=20mm	Days
8	R25	Number of very heavy precipitation days	Annual count of days when PRCP>=25mm	Days
9	CDD	Consecutive dry days	Maximum number of consecutive days with RR<1mm	Days
10	CWD	Consecutive wet days	Maximum number of consecutive days with RR>=1mm	Days
11	R95p	Very wet days	Annual total PRCP when RR>95th percentile	mm
12	R99p	Extremely wet days	Annual total PRCP when RR>99th percentile	mm
13	PRCP TOT	Annual total wet-day precipitation	Annual total PRCP in wet days (RR>=1mm)	mm

Indices derived from climate station data (1962-2006) show an increase in monthly maximum and minimum temperature 0.016°C/yr and 0.05°C/yr respectively (rise in maximum and minimum temperature during 45 years is 0.72°C and 2.25°C respectively). Annual summer days (maximum temperature > 25°C) have increased by 13 days during 1962-2006. Similarly, cool days and cool nights declined by 1 day and 20 days during 1962-2006. During the same period, warm days and warm nights raised by 11 days and 16 days respectively. Precipitation does not show any statistically significant rise/decline.

In addition to climate station data bias-corrected base-line data (1976-2005) of CMCC-CMS Global Climate Model (GCM) has been used for extreme events analysis. Indices derived from GCM 30 years data (1976-2005) show an increase in monthly maximum and minimum temperature 0.05°C/yr and 0.059°C/yr respectively (rise in maximum and minimum temperature during 30 years is 1.5°C and 1.77°C respectively). Annual summer days (maximum temperature > 25°C) have increased by about 22 days during 1976-2005. Similar to station data precipitation does not show any statistically significant increase/decrease.
Keeping in view the above results, climate change may induce following implications:

- Rise in snow-melt and glacier-melt, which may increase river flows initially but on long-term basis a river flow decline is expected;
- Rise in early snow-melt may result in changes in river flow patterns and peak flow occurrence;
- Rise in temperature may result in decline in snowfall and increase in rainfall, thus may result in rainfall-runoff increase;
- Increase in temperature may result in rise in losses, particularly evapo-transpiration;
- Increase in evapo-transpiration losses will rise stress on crop water demand;
- Increase in temperature may result in changes in cropping patterns;
- Changes in climate change may affect crops health; and
- Changes in climate may adversely affect irrigation practices and working environment in the field.

All above challenges can be mitigated through appropriate water management practices together with adequate climate change adaptation strategies.

4.4. **BIOLOGICAL ENVIRONMENT**

The existing macro-habitats within the project area include the agricultural land, wetland (including the reservoir, canal system, and small water impoundments) of these the agricultural land occupied most of the area. The wetland is an important ecological feature of the site and is a source to a number of bird's species.

Natural Vegetation

Vegetation of Bellas

The vegetation of shallow depths along the bellas was found dominated by *Typha angustata* (cattail) and *Phragmites communis* (reed). The other associated species include herbs and grasses such as *Arubdo donax*, *Oenanthe stonolifera*, *Ranunculus sceleratus*, *Veronica melissifolia*, *Marsilea minuta*, *Rumax dantatus*, *Bacopa monnieri*, *Polygonum barbatum*, and *Scirpus maritimus*.

The vegetation of bellas had shown a transition of aquatic vegetation towards terrestrial one. The margins of the bellas with middy soils had supported the Typha and Scirpus specis. As the level of the bella increased and moisture reduced, the typha community was replaced by *Sacharum spontaneun* associated with *Tamarix dioca* and *Arundo donax*. On upper levels with dry soils, *Ziziphus nummularis*, *Calotropis procera*, *Acacia nilotica* and *Dalbergia sisso* become associated.

Vegetation of Wastelands

The other habitat being used by a variety of birds is waste lands scattered in between the agriculture lands and along the roads. This habitat is supporting a various plant species ranging from trees to herbs and grasses. The dominant plant species are as follows:

Trees: *Salvadora oleoides* (Vann), *Prosopis juliflora* (Jangli kiker), *Tamarix aphylla* (Farash), *Dalbergia sisso* (Shishmim), *Acacia nilotica* (Kiker), *Albizzia lebbec* (Sars)

Shrubs*:* *Calotropis procera (*Ak*), Prosopis glandulosa (Jangli kiker), Zizyphus nummularia, Capparis aphylla (Karir),*

Herbs: *Boerhavia diffusa(*Itsit), *Fomaria indica (*Pitpapra), *Carthamus oxycantha* (Pohli), *Peganum hermala (*Hermal), *Alhagi maurorum* (Jawann).

Grasses: *Cynodom dacylon, (*Khabal), *Desmostachya bipinnata* (Dab), *Dicanthium annulatum* (chimber), *Sporobolus sp. Imperata cylindrica* (Seer).

Vegetation of Sandy Area.

The sandy areas are extending along the river and its abandoned creeks. The soil is predominately sandy loam/loamy sands and predominately has xerophytic vegetation dominated by species *Saccharum munja* (Sarkanda), *Calligonum polygonoides* (Phog), *Cymbopogan jwarancosa* (Khivi), *Aeura javanica* (Bui), *Alhagi maurorum* (Jawan), Carthamus oxycantha (Pohli).

Vegetation of Agricultural Fields.

The agricultural crops also provide a good shelter to many animals as well as to the birds, but on the other hand these areas also cause damage to the wildlife due to frequent land clearance, trapping/hunting and use of pesticides etc. The vegetation in this type of habitat is mainly composed of herbaceous and grass species such as *Cynodon dactylon* (Khabal), *Cenchrus ciliaris* (Dhaman), *Cyperus eleucinoides* (Dela), *Convolvulus arvensis* (Haran Khuri), *Amaranthus spinosus* (Chilai), *Asphodelus* sp. (Piazi), *Solanum nigrum* (Mako). On the periphery of the cultivated fields, some species such as *Achyrathus aspera* (Pothkanda), *Datura alba* (Datura), and *Xanthium strumarium* (Mohabat booti) were also observed in addition to planted trees and common grasses.

Plantations

The common species used for plantation in the area include *Dalbergia sisso* (Sheshum), *Acacia nilotica* (Babul)*, Melia azadiracta* (Neem), *Albizzia lebbec* (Sars), *Eucalyptus camaldulensis.* The fruit trees of the area are *Psidium guyava* (Amrud), *Mangifera indica* (Aam), *Eugenia jambolana (*Jaman*), Moris alba* (Toot) etc

Terrestrial Fauna

The rich Fauna of Sutlej River at Islam Barrage, upstream in the barrage head pond and downstream in the released waters, is as follows:

Mammals

Species	***Scientific Name***	***Status***
Jungle cat	*Felis chaus*	Common
Mongoose	*Herpestes edwardsi*	Common
Mongoose	*Herpestes anropunctatous*	Common
Porcupine	*Hystrise indica*	Common
Hedge Hog	*Hemiechinus spp.*	Common
Fox	*Valpes bengalensis*	Less Common
Jackal	*Canis aureus*	Common
Wild Boar	*Sus scrofa*	Common
House Rat	*Rattus rattus*	Common
Yellow House Bat	*Scotphilus*	Common
Hare	*Lepus nigricollis*	Common

Reptiles & Amphibian

Species	***Scientific Name***	***Status***
Frogs	Frogs	Common
Toads	Toads	Common
Marsh crocodiles	Crocodylus palustris	Now extinct
Sand Boa or Du-muhi	Erys Johnii	Common
Chequared keel back	Natrix piscator	Common

Species	***Scientific Name***	***Status***
Snake		
Dark-bellied marsh Snake	*Xenochrophis cerasogaster*	Common
Striped river Snake	*Enhydris pakistanica*	Rare
Gecko	*Hemidactylus*	Common
Dhaman	*Ptyas mucosus*	Rare
Striped Keel back	*Amphiosma estolata*	Rare
Indian Cobra	*Naja naja*	Common
Indian Monitor Lizard	*Veranus bengalensis*	Common
Variety of lizards, krait and viper		Common

Turtles – Hard shelled

Species	***Scientific Name***	***Status***
Common River Turtle	*Hardella Thurjii*	Rare
Brahminy River Turtle	*Hardella thurgi*	Common

Flap Shells

Species	***Scientific Name***	***Status***
Indian Flapshell Turtle	*Lissymes punctata*	Common
Brown River Turtle	*Kachuga Smithin*	Common

True Soft Shells

Species	***Scientific Name***	***Status***
Narrow Headed soft shell turtle	*Chitra indica*	Rare
Indian soft-shelled turtle (Sunworshippens)	*Trionysc gangeticus*	Rare
Common Tortois		Common

Birds

Species	***Scientific Name***	***Status***
White breasted kingfisher	*Halcyon smyrnensis*	Common
Pied kingfisher	*Ceryle rudis*	Common
Little egret	*Egretta garryetta*	Common
Cattle egret	*Bubulcus ibis*	Common
Pond heron	*Areleola grayii*	Common
Little bittern	*Ixobrychus minutus*	Common
Red-vented bulbul	*Pyenonotus cafer*	Common
Black drongo	*Dicrurus macrocercus*	Common
Rosy starling	*Sturnus vulgaris*	Common
Common myna	*Acridotheres tristis*	Common
Bank myna	*Acridotheres ginginianus*	Common
House crow	*Corvas splendens*	Common
Large pied wagtail	*Motacilla maderaspatensis*	Common
Ring dove	*Streptopelia decaocto*	Common
Little brown dove	*Streptopelia senegalensis*	Common
Indian roller	*Coracias benghalensis*	Common
Plain prinia	*Prinia inornata*	Common
Purple sunbird	*Nectarinia asiatica*	Common
Indian robin	*Saxicoloides fulicata*	Common

Species	***Scientific Name***	***Status***
Coppersmith barbest	*Megalaima rubricapilla*	Common
Rose-ringed parakeet	*Psittacula krameri*	Common
Black-crowned night heron	*Nycticorax nycticorax*	Common
Greater coucal	*Centropus sinensis*	Common
Asian koel	*Eudynamys scolopacea*	Common
Golden-back woodpecker	*Dinopium javanense*	Common
Yellow-crowned woodpecker	*Dendrocopos mahrattensis*	Common
Barn owl	*Tyto alba*	Common
Spotted owlet	*Athene brama*	Common
Blue-rock pigeon	*Columba livia*	Common
Yellow-throated sparrow	*Petronia xanthocollis*	Common
Sind sparrow	*Passer pyrrhonotus*	Common
River tern	*Sterna aurantia*	Common
White spoon bill	Platalea leucorodia	Rare
White tailed plover	Vanellus leucurus	Rare
Black Winged stilt	Himantopus himantopus	Common
Cattle egret	Bubulcus ibis	Common
Common coot	Fulica atra	Common
Common pochard	Aythya ferina	Common
Common sand piper	Actitis hypaleucus	Common
Black Headed goose	Anser indicus	Rare
Red crested pochard	Netta rufina	Rare
Tufted duck	Aythy fuligula	Rare
Pond heron	Ardeola Grayti	Common
River tern	Sterna aurantia	Common

Fish

The population of the fish has been decreased due to the less discharge in river Sutlej. The data included in this section is collected during the site meeting with the fishing contractors and visit at the local Fisheries Department. It has been reported that the fisheries Department lease out the fishery at the barrage pond in about 5 hundred thousand. Rupees per annum. There are lots of fish shops on the left side of the barrage as shown in the figure-4.4. Similarly, the Tahsil Councils of Hasilpur, Vehari and Chishtian separately lease out the backwater areas of the barrage pond. Mainly the fish is exported to big cities like Multan, Lahore, Karachi etc, however small quantity of fish is sold by the vendors along the road near the barrage as shown in the Fig 4.4. Fishing is not allowed within 500m of the barrage upstream and downstream. Specially designed and prepared net (Jal) by the fishermen are the common tool of catching fish. It has been found that more than 45% of the people live around the barrage are connected with the fishing industry. The most common type of fish found at the barrage are Mali, Gulfam, Sangari, Rahu, Talapi, Mori and Soul.

Table 9: The list of commonly found fish species from Head Islam Barrage

Local Name	Scientific Name	Status
Choota saul	*Channa striatus* (Bloch)	Common
Daula	*Channa marulius* (Ham)	Common
	Channa punctatus (Block)	Common
Dumbra, Dumbro, Rohu	*Labeo rohita* (Ham)	Common
Gulfam	*Cyprinus carpio*	Common
Grass carp	*Ctenopharyngodon idella*	Common
Kangee	*Ambassis nama* (Ham)	Common
	Colisa fasciata (Bloch and schn)	Common
Khagga	*Mystus bleekeri* (Day)	Common
Khagga	*Rita rita* (Ham)	Common
Mori	*Cirrhinus mrigala* (Ham)	Common
Mali	*Wallago attu* (Bloch And Schn)	Common
Rahu	*Labeo rohita* (Ham)	Common
Singhi	*Heteropneustes fosslis* (Bloch)	Common
Theil, Thaila, Theili	*Catla catla* (Ham)	Common
Talapi	*Oreochromis mossambica* (Peters)	Common
	Oreochromis niloticus (Peters)	Common
	Oreochromis aureus	Common

It can be concluded from the above data that as long as there is no drastic change in the general river habitat there can hardly any impact on Fish habitats. In anyway, the biological inter balance in the ecosystem is healthy that all minor changes do not cross the limits of ecological shock absorbers.

Photographs

Fig- 4.4 Fishery shops at Head Islam Barrage

4.5. SOCIO-ECONOMIC STUDIES

General

The survey regarding socio-economic profile of the Affected Households (AHs) was carried out from April 02-07, 2018. This included the settlement pattern, demographic features, and occupation, income and living conditions of the AHs. The survey instruments used were questionnaire for socio-economic survey and focus group discussions. The socio-economic data was collected by PMO-Punjab Barrages, Punjab Irrigation Department (PID).

Settlement Pattern and Ethnicity

The population belongs to the project area is rural. Major castes in the area were Jhabail, Kallas, Thehim, Rajput etc

Gender Composition and Literacy Status

Average family size of the AHs computed to be 6.54 members per family. The proportion of male and female estimated 51.8% and 48.2% respectively as shown in Table 4-. Table illustrates that overall 9.1 percent affected population (10 years & above) were literate. Out of them 8.21 percent male and 0.91 percent females were literate respectively.

Gender Composition and Literacy

Average Household Size (No.)	Gender Composition (%)		Literacy Rate (%)		
	Male	Female	Overall	Male	Female
6.54	51.8	48.2	9.1	8.2	0.9

Source—Resettlement Plan (RP) Islam Barrage

Main Occupations

In project area, AHs were involved in a number of occupations to meet their domestic needs and household expenses. Data given in the following table shows that out of the total AHs, 53.8% were engaged in unskilled labour, 27% were earning their livelihood by Agriculture/livestock, 15.4% were involved in small business activities like shops/stores, food kiosks, selling of fish etc. and only 3.8% were employed in government departments. Thus, it can be concluded that a major proportion of AHs was doing un-skilled labour due to lack of education and opportunities.

Main Occupations of the AHs

Description	Own Business	Agriculture/ Livestock	Government Service	Unskilled Labor	Total
Nos.	4	7	1	14	26
Percentage (%)	15.4	27	3.8	53.8	100

Source-Resettlement Plan (RP)Islam Barrage

Cropping Pattern

The major crops grown in the project area were Wheat, Fodder and seasonal vegetables.

Average Yield of Major Crops in the Project Area

Av. Yield / acre in (mds)		
Wheat	Fodder (Berseen)	Fodder (Jowar)
36.89	303.25	161.5

Source: Directorate of Agriculture, Crop Reporting Service Punjab, District Bahawalpur (2016-17).

Household Income of AHs

The income of a household includes; i) income from laborer/wages laborers, ii) income agriculture/livestock activities. In field survey, major sources of income include income from laborer/wages laborers, crops/livestock, small business. Survey results summarized in the following table shows monthly income of AHs.

Monthly Income of AHs

Monthly Income of AHs	Frequency	Percentage (%)
Less than 5000	03	12
5001 to 10000	8	32
10001 to 20000	12	48
More than 20000	2	8

Source of Fuel

Wood is most commonly used as a source of fuel, followed by animal dung cake, kerosene oil as well as gas cylinder in some houses as pointed by the Affected Persons (APs).

Gender Issues

Women were generally involved in most of activities in the project area like other rural areas. About one-half of total population, consists of women in the project area. Major activities, where women were involved in the project area are:

- Involved in farming activities, like harvesting of wheat & picking of cotton, fodder cutting, livestock look-after and sowing, hoeing & picking of vegetables at encroached land and others land for wage.
- Non-farming activities include ‘saf’ (mat) making, ropes making etc.
- Domestic work includes child rearing/ caring, cooking, cleaning, repair of households’ items.

- Other - participation in social obligations/ marriages and gathering etc.

Source of Drinking Water

The main source of drinking water was hand pump but on RGB due to electric facility AHs have also installed the electric motors along with hand pumps. The underground water quality was good. Total 23 hand pumps and 7 electric motors (water pumps) owned by the community were reported by the AHs.

Affected Households

Total 25 households comprised of 170 family members were affected by project. The households have their residential structures of different kinds (Pacca, Semi Pacca, Kacha, and straw sheds with and without boundary walls) in the project area, One AH has a small grocery shop in his house and 02 No. of community structures (01 No. Masjid and 01 No. Bathak Hazrat Khizar) at LGB and RGB respectively. Detail of affected structures is shown in the following Table.

No. of AHs by Category of Impacts

Sr. No	Entity	No.	Affected Households (AHs)	Severely Impacted HH
1	Land	5.5 Acres	8	8
2	Residential Structures	21 Houses + 4 Boundary Walls	25	20
3	Community Structures	2	0	0

Vulnerable AHs

The field survey shows that there were 16 vulnerable families. There was one widow head of family. Families were vulnerable because they were living under the poverty line (Government of Pakistan has officially declared the poverty line as if someone is earning less than Rs. 15000/month, he/she is living below the poverty line). These families will also be given vulnerability allowance along with their entitled compensation.

Indigenous Peoples (IPs)

There is no indigenous community fond in the project area during the field survey.

Impact on Historical, Cultural and Religious Structures

There was 01 No. Masjid and 01 No. religious place (Bathak Hazrat Khizar) was located at LGB and RGB respectively.

Severe Agriculture Land Impact Allowance

Most of the affected families were affected by their single structure, 08 AHs have to face severe agriculture land impact i.e. they have their residential structures on RGB and cultivating the river belt for agriculture inside the RGB. These families will affect severely due to dual impact of the project. Detail is presented in RP of Islam Barrage.

Unit Rates of Structures by type of Construction

The value of different structures affected under the project was computed based on the approved unit rates of structures obtained from the Building Department While a summary of unit rates is shown in Table below.

Unit Rates by type of Structures

Sr. No.	Description	Type of Construction	Unit Rate (Rs.)
i)	**Residential structures**		
		Pacca structure	840/ Sq. ft.
		Semi-pacca structures	600/ Sq. ft.
		Katcha structure	360/ Sq. ft.
		Thatched sheds/Straw Shed	120/ Sq. ft.
ii)	**Community structures**		
		Pacca structure	840/ Sq. ft.
		Semi-pacca structures	600/ Sq. ft
		Katcha structure/ sheds	360/ Sq.ft.
iii)	**Boundary wall**	Pacca structure	150/ Sq. ft
		Semi-pacca structures	120/ Sq. ft
		Katcha structure	80/ Sq. ft
iv)	**Other assets**	Hand pump	Rs. 8,000/ unit
		Electric Motor	Rs. 12,000/ unit
		Tandoor	Rs. 1000/ unit

4.6 Conclusion

The environment of Project area is reasonably clean and display rich flora & fauna. The unconfined aquifer can be found on site as shallow as 15m depth from the ground level. The stratum underneath of topsoil is loose to medium dense Sand therefore extra care will be required in under taking the work activities and storage of the material on site to avoid any accidental spill or spread of contaminants. The ambient air quality at the Barrage and along the guide bunds will be under risk of deterioration from plant emission and dust generated from the site traffic during construction phase.

The required unskilled and up to certain limit the skilled laborer is available from the surrounding area of the Project site. There is ample Irrigation Department land available on site for the setup of contractor's camp, material yard, batching plant etc. therefore no private land acquisition will require for these activities. Overall, the Project activities will emplace positive environmental and social impacts on the area.

From the above observation, it can be concluded that there are no serious environmental and social problems in the project area. The adverse impacts and their mitigation measures are discussed in detail in Chapter 7.

5. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

5.1 GENERAL

Stakeholder involvement is an essential element for an effective environmental assessment, as it is linked with project planning, appraisal and development in general. Public involvement during Initial Environmental Examination (IEE) have a tendency to improve project design environmental soundness and social acceptability. Considering more stakeholder involvement in EIA process resulted in improving the quality of the environmental assessment (EA).

5.2 LEGAL REQUIREMENT FOR PUBLIC CONSULTATION

According to the IEE and EIA Review Regulations 2000, public consultation is mandatory for IEE study. It is also mandatory for all the projects classified as category B project under the ADB Safeguard Policy Statement, 2009.

5.3 CONSULTATION METHODOLOGY

5.3.1 Stakeholder identification

They are grouped into the following main categories

i. Local Communities
ii. Government & Local Government Bodies
iii. Civil Societies
iv. Private Sector Bodies

The groups or institutions identified as stakeholder under each category are listed below

i. Local Communities
    a) Local laborer (landless)
    b) Farmers of all land holding categories
    c) Fishing communities
    d) Female-head household
    e) Small business owner

ii. Government
    There can be many departments who can be indirectly related to the project but those who have high relevance include;
    a) Punjab Irrigation Department (including both top and low ranked officers and staff)
    b) Punjab Forest Department, Wildlife, Fisheries Department
    c) EPA

iii. Civil Society Institution that may have relevance to the Project includes various NGO's working in the construction and social development
iv. Private sector bodies can be commercial e.g. plantation manager, fishing contractors etc

5.4 CONSULTATION PROCESS AND METHODOLOGY

Consultations with stakeholders were carried out by different members of the team at different stages of the study. Consultation process includes focus group discussion, village meetings and semi-structured interviews and one to one meeting or interviewed in the case

of government, private and civil society institutions. During the consultation process, the stakeholders were briefed about the project objectives and scope and their fears and suggestions were recorded.

All meetings and discussion were held during day time on working days to ensure the availability and participation of the group/individual being consultant. The consultations were sensitive to the local language and cultural needs and wherever expatriate staff was involved local interpreters were used, as the staff observed local norms. The list of people consulted during the project cycle by various experts is provided in table 5.1

District Wild Life Officer of Vehari and SDO Forest Vehari, were apprised about the rehabilitation project of Islam Barrage and status of the Game Reserve Area. When inquired about the status of the Game Reserve Area, District Wildlife Officer provided letter regarding de-notification of Game Reserve Area and also provided information about Fauna and Flora.

Table 5.1: List of Officials Contacted

Sr. #	Official Name	Date	Title	Phone #
1	Amjad Saeed	3/5/18	Head PMO	042-99250351 0322-4003849
2	Malik Parvez Arif	3/5/18	Director Environment PMO	042-99250359 0340-6170086
3	Nazim Hussain Shah	3/5/18	M&E (Expert)	042- 99250358 0301-8739287
4	Miss. Nila Jubeen	3/5/18	Deputy Director (Environment)	0334-1129996
5	Mr. Raza Abbasi	3/5/18	Deputy Project Director	0300-9670067
6	Zeeshan Ashraf	7/5/18	XEN. Islam Barrage	067-3691338
7	Mr. Irfan Bhatti	7/5/18	SDO Islam Barrage	0300-5532328
8	Uzma Altaf	7/5/18	Gender Specialist /ADB	
9	Muhammad Hussain Khan	24/4/18	District Wildlife Officer (Vehari)	
10	Mr. Amar Khan	11/5/18	Chief SPRU	03009691577
11	Raja Javaid Iqbal	24/4/18	SDO Forest Vehari	03004589942
12	Miss Sadia	17/4/18	Research Associate WWF	
15	Nasim-ur-Rehman Syed	17/4/18	EPA, Director (EIA)	042-9232228
16	Zulfaqar Baluch	24/4/18	Block Officer Forest	03007851336
17	Muhammad Javaid	24/4/18	Watcher Wildlife	03057001248
18	Abdul Razaque	24/4/18	Head Master Govt. High School, Head Islam)	0302-4430619

5.5 MEETINGS WITH PUBLIC MEMBERS

In second phase of public consultation, members of public and their representatives were consulted to introduce the Project formally to the local community and take on their opinion about the Project. Gender study was also carried out to include the women of the community in this survey.

Table 5.2: Member of Public Contacted

Sr. #	Name	Date	Occupation	Phone
7	Muhammad Nadeem	7/5/18	Fish Shop	03026903618
8	Manzoor Ahmaid	7/5/18	Fish Shop	03004188821
	Muhammad Dilshad	7/5/18	Fish Shop	0304-7034276
9	Muhammad Zafar	7/5/18	Driver	03089171637
10	Muhammad farooq	7/5/18	Laborer	03039067378
11	Muhammad Ashfaq	7/5/18	Fish Shop	0308-5667337
12	Muhammad Mukhtiar	7/5/18	Fish Shop	0307-7375093
13	Muhammad Munsha	7/5/18	Driver	0301 7924303
14	Muhammad Sultan	7/5/18	Laborer	0302 7733903
15	Muhammad Sohail	7/5/18	Shopkeeper	0308 6810787
16	Muhammad Sharif	7/5/18	Affected Person	
17	Muhammad Dilshad	7/5/18	Affected Person	
18	Allah Thida	7/5/18	Laborer	0307-5215687
19	Muhammad Jahangier Khan	7/5/18	Student	03009157204
20	Muhammad Sohail	7/5/18	Shopkeeper	0308-6810787
21	Muhammad Nawaz	7/5/18	Farmer	0301 7925814

Objectives achieved with the public consultation.

The following objectives were achieved: -

- Eliminate the fears that the large number of workers and laborer will be brought by the contractor from outside the project area and ensure them that an opportunity of employment generated by the project shall be availed by the people of the area.
- It was clarified that no access roads or public paths damage or alter because of laborer camp, material depot, machinery yard etc.

- It has been ensured to the local community that maximum employment will be offered to the local laborer/workers. They were given the following illustrative numbers of skilled and unskilled laborer that will be required for the project.

Employment opportunity at Islam Barrage Rehabilitation Work

	Approximate Total No.	Minimum Percentage of Local
Skilled Worker	50	As much as possible
Semi-Skilled Laborer	50	As much as possible
Unskilled Laborer	200	As much as possible

- Confirm that people in canal command area do not use the canal water for drinking purpose.
- Eliminate the scare that the canals will remain closed during the Kharif Crops season. It was clarified that due measures will be taken that canals would run as per usual program and canal closure will take place only under the notified canal closure program as follow.

Name of Canals:	Qaim Canal Bahawal Canal
Status of Canals:	Non-Perennial
Period when canals would run:	April 15 to October 15

- No change would ordinarily be made in existing capacity of canals during construction phase, so no impact is anticipated on the canal command area. It was explained that project aimed at rehabilitating the Islam Barrage and increase the capacity of the barrage by strengthening Barrage structure and dredging the silt within the pond area of the barrage.
- Resettlement Plan has been prepared to facilitate the shifting of illegal squatters.
- Eliminate the fears that the large number of workers and laborer will be brought by the contractor from outside the project area and ensure them that an opportunity of employment generated by the project shall be availed by the people of the area.

- Fishermen of the community believe that the construction activities would not put adverse effects on fishing industry as most of the Project activities schedule within half kilometer of upstream and downstream of the barrage structure which is a prohibited area for fishing. However, the strengthening of the embankments work will raise the noise level of the surrounding area and could effect the fishing activities next to the embankments.
- Question was passed by the community that presence of some 300 male members of laborer from general locality of project will not only restrict the chances of women employment, but also cause moral and social problems for the free movement of local women folk in the area. It was clarified that strict discipline would be exercised on the labour force by providing stringent clauses in the contract document. To cut out the possibility of any moral issues or Communicable diseases spread, a well organized campaign shall be run.
- Road and kacha paths within the project areas would expose to the heavy traffic due to Project activities. This could raise the road accident and deterioration rate of the

roads. It was clarified that due sinology and traffic management plan would be put into operation to minimize the impacts.

- With arrival of about 300 additional persons, the price of accommodation in project area and Islam Barrage markets would go up, and price index would go unfriendly for the local villagers. It was clarified that a Labour Camp will be constructed to accommodate for 250 workers. It was also explained to the local community by some trade-oriented people that instead of rise in price those would fall because larger market activities reduce the profit margin and price.

The following points came up in open acceptance of the project.

- Greater employment opportunity was most welcome.
- Greater economic activity will alleviate poverty.
- Islam barrage will be saved and given longer base of life and thus the dependent agriculture.
- Present level of services i.e. electricity, communication, schooling, water supply etc. is likely to improve.
- New Public Park will attract visitors and tourism in the area and put positive effects on the local economy.

5.6 INFORMATION DISCLOSURE

The national regulations and ADB safeguard policy (discussed in **Chapter 2** of the present document) require project proponents to carry out disclosure of the IEE report. Accordingly, the copies of IEE will be placed at the office of EPA Punjab, at the Project Site i.e., DO Environment office Vehari, Executive Engineer Irrigation Department Islam Barrage, and the Punjab Public Library Lahore so as to be accessible to project beneficiaries, local NGOs and general public. A copy of the IEE report will be sent to the ADB Info Shop before the Bank begins formal appraisal of the project.

5.7 EPA APPROVAL

The revised version of ESIA report duly reconciled with PMO has been submitted to EPA Punjab for obtaining No Objection Certificate (NOC). A cheque of Rs. 30,000.00 has already been deposited along with the report by the consultant to EPA through PMO. The approval from EPA (NOC-No Objection Certificate) for the Project is mandatory requirement before its commencement.

Pictorial View of Public Consultations

Director E/S PMO conducting meeting with Affected community at Islam Barrage

DD Social PMO conducting meeting with Affected Persons (AFs) RMB

Meeting with AFs (LMB).

Affected community at Islam Barrage

Meeting with affected woman

Meeting with DO Wildlife Department,

Meeting with SDO Forest Department, Vehari

6. STUDY OF PROJECT ALTERNATIVES

The analysis of alternatives for the project is a vital part of the environmental assessment process as it gives the opportunity to review and assess different ways of meeting the project objectives so that the environmental impact of the project is minimal. The following options/alternatives were analyzed for the assessment of strengths and weaknesses of the proposed project:

Following options/alternatives were analyzed for strength and weaknesses:

1. No project option (worst case scenario option)
2. Provision of Spillway at RRE
3. Provision of Spillway, Escape Channel and Road Bridge
4. Structural Repair Work,

5.1 NO PROJECT OPTION (WORST CASE SCENARIO OPTION)

Analysis

Strength and Opportunities

- No social conflict issue shall develop, due to acquiring land from private/illegal settlers and immigrating new settlers.
- No environmental issue will develop due to the construction activity.
- The recurring cost of the Project would be avoidable.
- The irrigation systems downstream of canals command area of Bahawal Canal and Qaim Canal shall not interrupt due to the project activities.
- The efforts and investments shall be saved and would be available for diversion to another project in case the Project is not taken up at all.
- Loss of the agriculture land through which the escape canal has to pass, shall be avoided.

Weakness and Threats

- The no project alternative is undesirable as it would mean continued economic, social and environmental losses.
- Loss of property and land at the events of flood as the flood retaining embankments are damaged and weak.
- The people of the area shall be denied employment during the project construction and later through escalated economic activities.
- The barrage, subsidiary weir and gates operating mechanism have outlived and are presently in bad shape.
- Any serious damage to this barrage can result in colossal losses in the form of total or partial disruption of irrigation supplies, non/less-production of agricultural crops, loss of government revenue, rehabilitation cost of emergency repairs, thus adversely affecting the national economy in addition to human sufferings beside multitude of social and environmental hazards.

Conclusion

The weakness and threats outweigh the strengths and opportunities for enhancing capacity of the Islam Barrage and is not therefore recommended.

6.2 PROVISION OF SPILLWAY AT RRE

Strength and Opportunities

- No breaching shall be required in case of the flood.
- About 1000 acres of land shall be recovered for agriculture purpose, which is currently classified as wet land.
- The recovered land shall be safe from flood at average 4 times in 5 years.
- Funds and resources will be saved compared to provision of Provision of Spillway, Escape Channel and Road Bridge

Weaknesses and Threats

- Adverse environmental impact on wet land.
- Construction of spillway structure would involve larger engineering works and river water diversions.
- Capacity of related infrastructure would need to be enhanced, which will be costly.
- Considerable funds will be required to construct the Spill Way.

Conclusion

The weakness and threats outweigh the strengths and opportunities for enhancing capacity of the Islam Barrage and is not therefore recommended.

6.3 PROVISION OF SPILLWAY, ESCAPE CHANNEL AND ROAD BRIDGE

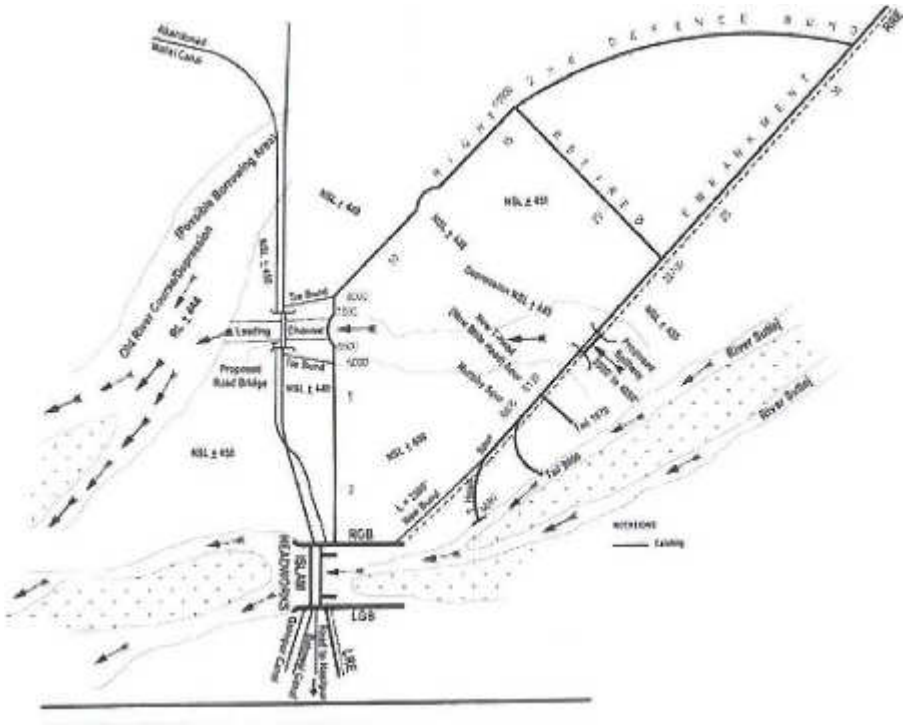


Figure 6.1: Provision of Spillway, Escape Channel and Road Bridge

Strength and Opportunities

- Thousands of acres of agricultural land will be saved at the event of flood.
- About a thousand acre of wet land will be reclaimed for agricultural purpose.
- Ludden Road will be saved from the flood damage.
- Better regulation and water availability by remodeling of link canals, Bahawal canal and Qaim canal.

Weaknesses and Threats

- Larger IPD and private land acquisition will be required.
- Cost of the project will be higher compare to provision of spillway at RRE.
- About 60 No. of houses will be required to relocate.
- Adverse social impacts due to the large number of people move into the area during the construction phase.
- Loosing of approximately 400 acre of agriculture land due to Construction of escape channel.

6.3.1 Consideration of Social Aspects

During the course of the social study, as described in chapter 4, it was concluded that provision of an Emergency Spillway is not warranted. In this scenario, the existing breach section will be kept intact so as to provide as a safety control measure in case of any emergency due to floods greater than 100-year flood (i.e., design flood) or due to capacity constraints due to progressive and abnormal bela formation in the River. Bridge site envisaged for passing the waters of originally proposed emergency spillway would be shifted to 4.1km from Islam Barrage on Hasilpur Ludden road. In such an eventuality this water (about 25,000 cusecs) would pass through old creak and may pass over the agricultural crops sown in the bed of the old creak. There will be no change in Social Impact of Flood due to operation of breach section as compared to existing situation. The area downstream of the Head Islam - Ludden Road will get flooded in case of any super flood (of the order of 100-year return period) occurring in the river, from downstream flows of the barrage due to back water, even without operating the breach section. The provision of road bridge itself will not adversely affect the flood situation in the downstream area, rather it would facilitate the evacuation of the flood waters from the upstream as soon as the flood levels downstream of the barrage fall. The selected work scheme includes the following activities, as shown in option 4

- Strengthening of Embankments (including build new tie bunds)
- Provision of Road Bridge and Structural Repair & Modernization Work

The study also recommends the following:

- Complete census of people affected and identifies all losses from land acquisition.

- Involve all stakeholders in a consultative process especially all affected person.

- Compensate all affected persons including encroachers/tenants to big losses at replacement rates.
- Where relocation of housing is required, develop relocation options in consultation with affected persons and host communities in order to restore living standards.
- Where people will lose income and livelihoods, establish appropriate income restoration programmes with objectives to improve, or at least restore, their productive base.
- Local NGO to be involve in the project activities for smoothly functioning of the project
- Local privacy/movements should not be disturbed during project construction stage.
- Prepare a time bound Resettlement Action Plan with appropriate provisions and source of funding.
- Involve sociologist and affectees in planning implementation and monitoring SAP/RAP.
- The project should be implemented in such a way that their houses crops, and lands shall not disturbed/damaged.

Conclusion

Weakness and threats outweigh strengths opportunities for this option and it therefore is not recommended.

6.4 STRUCTURAL REPAIR WORK (SELECTED OPTION FOR DETAIL DESIGN)

Strength & Opportunities

- Increase the capacity of pond area
- Minimum adverse Environmental and Social impacts on AOI as all the rehabilitation and repair work are within the river d/s of the barrage and no private land acquisition is involved
- Cost of the project is lower than other options

Weakness and Threats

- Breaching will be required in case of heavy flooding.
- No escape channel for the flood water to by pas the barrage.
- Agricultural land within the flood plain may be still under the risk of flood damage.

Conclusion

This option is most cost effective and emplaces less adverse environmental and socio-economic impacts. Therefore, this option is recommended for the detail studies.

5. POTENTIAL ENVIRONMENTAL & SOCIAL IMPACTS AND MITIGATION MEASURES

The potential impacts associated with barrage rehabilitation works on environment and people are assessed in this Chapter and appropriate mitigation measures proposed. The impacts have been identified through the use of standard checklist and expert's knowledge and experience. The impacts identified were assessed for their significance keeping in view their consequences, reversibility, likelihood, duration, location, timing etc. The evaluation of the environmental & social impacts has been summarized in Table 7.1

7.1 GENERAL

Most direct and significant negative impacts of the project are caused by the loss of existing physical infrastructure present at left and right guide bunds. Total 25 households comprised of 170 family members will be affected by project. The households have their residential structures of different kinds (Pacca, Semi Pacca, Kacha, and straw sheds with and without boundary walls) in the project area, One AHs has a small grocery shop in his house and 02 No. of community structures (01 No. Masjid and 01 No. Bathak Hazrat Khizar) at LGB and RGB respectively. Detail of affected structures is given in the Resettlement Plan.

Other adverse impacts will be mainly of temporary nature during the construction phase of the project which will be mitigated through proper implementation of EMP. The overall positive impact of the project, which is the provision of employments to the local communities, development of recreational park and sustainable supply of water to the command area.

7.2 POTENTIAL IMPACT SOURCES

Environmental impacts and social impacts attributed to the Project can be broadly classified into three main groups

- Impacts during design phase
- Impacts during construction phase
- Impacts during operational/post construction phase

Some of the impacts can be anticipated and avoided at design stage with appropriate adjustment in the Project Design, some can be mitigated by good implementation technique and other by following the operational manual.

5.3. IMPACTS AND MEASURES ASSOCIATED WITH THE IMPLEMENTATION OF THE PROJECT.

The following impacts are anticipated in case of the implementation of the Project

- The project will significant adverse impact on the existing residential area other than on a result of increase in noise and dust levels and movement of the additional machinery and traffic.
- There will be loss or damage to livelihood for which Resettlement Plan has been prepared to compensate their losses. The temporary employment to the local communities will be given. This will be the significant positive impact.
- The project area is free from the historical monument so there is no impact on such component.
- As far as tree cutting is concerned. The survey of the existing tree on site shows that more than 100 trees may be uprooted on site during construction activities. These trees belong to Irrigation Department
- There will be no impacts on the aquatic ecology of the river as seasonal flow regime of the river will be remain unchanged.
- To facilitate the works on the barrage the cofferdams will be built. The environmental impact of cofferdams will be localized and short term (during operation) which will be mitigable with good engineering practice.

Potential adverse environmental impacts of selected work scheme on physical, biological and socio-economic environment during design, construction and operational phase have been identified, measures to mitigate these impacts and their residual impact are discussed in this Chapter.

The relevant checklist of ADB's Rapid Environmental Assessment (REA) is included in Annexure-5. Potential impacts associated with the barrage rehabilitation project are summarized in Table 7.1. The impacts based upon physical, biological, and social have been discussed under pre-design phase, construction and operational phase. Each sub component has been assessed as slight, moderate or significant. The impacts have then been marked as avoidable, mitigable and irreversible.

Table 7.1 (sheet 1): Evaluation of Environmental & Social Impacts

Project Activity	Potential Impact	Impact Significance								
		Slight			Moderate			Significant		
		1*	2**	3***	1*	2**	3***	1*	2**	3***
1. Design Phase										
1.1 Design Adequacy of the Fish Ladder	Obstruction to fish migration in the river							/		
1.2 Impact of damaged friction blocks	Disturbance / Injury to aquatic life							/		
1.3 Obstruction to gate operations and leakage from the damaged gates	Disruption in feeding of canals.				/					
1.4 Impact of climate change	Implications on flood				/					
	Risk to infrastructure damage				/					
2. Construction Phase										
2.1 Establishment and operation of labor camps, material and equipment yards	Contamination of soil and water; soil erosion; resource consumption; change in land use and land form; additional load on local facilities/utilities such as schools, hospitals, electricity and water supply					/				
2.2 Waste Disposal Management	Soil and water contamination; obstruction in natural drainage; obstruction of community paths; aesthetic problems					/				
2.3 Borrow Materials from Earth Borrow Site	Soil erosion; Loss of fertile soil; obstruction in natural drainage and dust pollution					/				
2.4 Construction activities causing damage to paths, access roads and cross drains	Dust emission; blockage of natural drainage; Soil erosion; loss of natural vegetation; safety hazard for communities; damage to public infrastructure;					/				
2.5 Installation and operation of batching plant	Soil, air and water contamination; safety hazard for communities					/				
2.6 Construction Activity; Land Contamination due to Spill of Lubricants, Fuel, Chemicals and Other Waste Material.	Soil and water contamination; safety hazard; damage to crops; air contamination; noise pollution; damage to natural vegetation, damage to agricultural land or crop destruction habitat and wildlife		/							

* Avoidable through design
** Mitigation through contractor's obligation or by communities through social framework agreement (SAF)
*** Non-reversible, Permanent change (to be adopted)

Table 7.1 (sheet 2): Evaluation of Environmental & Social Impacts

Project Activity	Impact Assessment	Impact								
		Slight			Moderate			Significant		
		1*	2**	3***	1*	2**	3***	1*	2**	3***
2. Construction Phase										
2.7 Transportation of crushed material	Dust emission, safety hazards and traffic disruptions.					/				
2.8 Construction and dismantling of coffer dam	Contamination of surface water					/				
2.9 Earth work activities	Dust emission, emission from the machinery used for excavation and noise pollution.		/							
2.10 Various construction activities	Damage to biological resources / disturbance to wildlife / aquatic life					/				
2.11 Water consumption for construction and domestic activities	Water shortage for local community								/	
2.12 Construction activities causing social issues	Local conflicts; Privacy of women					/				
2.13 Construction activities causing public health and safety issues	Health hazard for local population and project staff								/	
2.14 Employment opportunities	Local disagreement associated with influx of workers from other parts of the country								/	
2.15 Restoration/ Rehabilitation works	Incomplete rehabilitation / restoration works could affect the aesthetic / scenic value of the area					/				
2.16 Various construction activities	Disturbance to cultural and archaeological sites.		/							
2.17 Water supply system & Waste water treatment impact	Changes in surface water / ground water conditions; Risk of disease transmission and pose a risk to health of consumers and workers		/							
2.18 HIV/AIDS and other communicable diseases	Public health, workers health resulting in social and economic impacts								/	
2,19 Impacts due to climate change	Impacts of establishing laborer camp						/			
	Impacts on concrete						/			

Project Activity	Impact Assessment	Impact								
		Slight			Moderate			Significant		
		1*	2**	3***	1*	2**	3***	1*	2**	3***
	Impacts on working hours and labor health						/			
3. Operation Phase										
3.1 Wrong implementation of the prescribed O&M plan	Mistakes at operational level or handling the operations by untrained staff can prove very risky and costly							/		
3.2 Regular Maintenance	Solid waste generation, disruption in water availability and blockage of traffic							/		
3.3 Impacts due to climate change	Flow patterns							/		
	Agriculture practices							/		
	Framers health and work environment							/		
	Crops health and cropping pattern							/		
	Capacity building of staff and awareness of farmers						/			

* Avoidable through design
** Mitigation through contractor's obligation or by communities through social framework agreement (SAF)
*** Non-reversible, Permanent change (to be adopted)

7.4 IMPACTS AND MITIGATION MEASURES DURING DESIGN PHASE

7.4.1 Design Adequacy of the Fish Ladder

Existing fish ladder design is appropriate, but obstructions were found in shape of vegetation and structural damage to stop smooth movement of fish across the ladder.

Adverse Environmental Impact

Minimum water discharge required to operate the fish ladder is 500 cusecs, which is not feasibly available during low flow season and, therefore, the fish ladder out of working in about 10 months of a year. This triggers the growth of vegetation inside the ladder and obstructs the water flow through the ladder during couple of months of high flow.

Mitigation Measures

Inspect the fish ladder on regular basis to make sure that the ladder is in working condition over the whole year and operate during high flow.

7.4.2 IMPACT OF DAMAGED FRICTION BLOCKS

Adverse Impact

Accompanied by pulsating Hydraulic jump, damage to friction blocks and upstream floor of the barrage can occur. The damaged portion of the friction blocks may have naked steel bar which can bring injury to the fish in the river during migration/ movement.

Mitigation Measures

Repair and grouting the damaged floor and friction blocks.

7.4.3 OBSTRUCTION TO GATE OPERATIONS AND LEAKAGE FROM THE DAMAGED GATES

Adverse Impact

Deterioration and damages to gates and hoisting system are also significant. Leakage of the order of 100 to 300 cusecs (2.8 to 8.4 cumecs) against an inflow of 1000 cusecs (28.3 cumecs) has been witnessed. This loss of valuable water has repercussions on water availability for the canal command areas and measures need to be taken to stop the stupendous and wasteful leakage. Frequent damages cause serious disruption in feeding of canals.

Mitigation Measures

- Rehabilitation of gate equipment, hoisting system and motorization of gates
- Replacement of existing hoisting machine with new electrically and manually driven hoist machines compatible with new design.

7.4.4 IMPACT OF CLIMATE CHANGE

Adverse Impact

Comprehensive climate change assessment has been carried out for the proposed project. The impact assessment comprises of analysis of data during 1976-2100. Base period has

been selected to be 1976-2005 (30 years), while future projections have been divided into four time periods; short term (2011-2040), medium term (2041-2070), long term (2071-2100), and entire time period (2011-2100). Two Representative Concentration Pathways (RCPs); RCP 4.5 and RCP 8.5 have been used for the current study.

A total of 13 core climate indices have been estimated for the study area as shown in Table 7.2, for all future time periods. Five indices are related to the temperature while eight indices are related to the precipitation. Indices are driven from daily maximum temperature, minimum temperature, and daily precipitation.

Table 7.2: Core climate indices calculated and analysed

1	SU	Number of summer days	Annual count of days when TX (daily maximum temperature) > 25oC	Days
2	TN10p	Cool nights	Percentage of days when TN < 10th percentile	Days
3	TX10p	Cool days	Percentage of days when TX < 10th percentile	Days
4	TN90p	Warm nights	Percentage of days when TN > 90th percentile	Days
5	TX90p	Warm days	Percentage of days when TX > 90th percentile	Days
6	R10	Number of heavy precipitation days	Annual count of days when PRCP>=10mm	Days
7	R20	Number of very heavy precipitation days	Annual count of days when PRCP>=20mm	Days
8	R25	Number of very heavy precipitation days	Annual count of days when PRCP>=25mm	Days
9	CDD	Consecutive dry days	Maximum number of consecutive days with RR<1mm	Days
10	CWD	Consecutive wet days	Maximum number of consecutive days with RR>=1mm	Days
11	R95p	Very wet days	Annual total PRCP when RR>95th percentile	mm
12	R99p	Extremely wet days	Annual total PRCP when RR>99th percentile	mm
13	PRCPTOT	Annual total wet-day precipitation	Annual total PRCP in wet days (RR>=1mm)	mm

Short term period (2011-2040)

Maximum and minimum temperatures are expected to rise, however the trends are not statistically significant. Single day maximum precipitation is likely to increase by 4.25mm/yr, while extremely wet day's precipitation may rise by 4.61mm/yr. Increase in precipitation may raise flood events in near future. All other trends are not statistically significant.

Mitigation Measures

- Rise in expected floods should be considered in design.

Medium term period (2041-2070)

Maximum and minimum temperatures are expected to rise by 0.04°C/yr and 0.039 °C/yr (rise in maximum and minimum temperature during 30 years is 1.2 °C and 1.17 °C respectively). Annual summer days (maximum temperature > 25°C) may increase by about 27 days during

2041-2070. During the same period, warm days and warm nights raised by 1.4 days and 1.7 days respectively. Precipitation does not show any statistically significant rise/decline.

Mitigation Measures

- Best construction practices (hot weather concreting and admixtures), best agriculture practices, best water management practices, farmers awareness schemes, capacity building of line department, cropping patterns and crops varieties should be proposed.

Long term period (2071-2100)

Maximum and minimum temperatures are expected to rise by 0.024°C/yr and 0.021 °C/yr (rise in maximum and minimum temperature during 30 years is 0.696 °C and 0.61 °C respectively). Annual summer days (maximum temperature > 25°C) may increase by about 18 days during 2071-2100. During the same period, warm days and warm nights raised by 1.5 days and 1.3 days respectively. Precipitation does not show any statistically significant rise/decline.

Mitigation Measures

- Best construction practices (hot weather concreting and admixtures), best agriculture practices, best water management practices, farmers awareness schemes, capacity building of line department, cropping patterns and crops varieties should be proposed.

Entire study period (2011-2100)

Maximum and minimum temperatures are expected to rise by 0.035°C/yr and 0.034 °C/yr (rise in maximum and minimum temperature during 100 years is 3.5 °C and 3.4 °C respectively). Annual summer days (maximum temperature > 25°C) may increase by about 64 days during 2011-2100. Similarly, cool days and cool nights may decline by 15 day and 19 days during 2011-2100. During the same period, warm days and warm nights may raise by 15 days and 14 days respectively. Precipitation does not show any statistically significant rise/decline.

Mitigation Measures

- Best construction practices (hot weather concreting and admixtures), best agriculture practices, best water management practices, farmers awareness schemes, well managed operation and maintenance, growing of more trees, capacity building of line department, cropping patterns and crops varieties should be proposed[4].

[4] Note: The above base-line results are based on a single climate station and a single GCM. Results from 13 additional GCMs and 3 RCMs will also be incorporated in final CRVA report

7.5 IMPACT AND MITIGATION MEASURES DURING CONSTRUCTION PHASE

7.5.1 Impacts of Location of Laborer Camp, and Material & Equipment Yard

Adverse Environmental Impact:

There is moderate adverse impact but mitigable through contractor obligation and SFA between the community.

Mitigations Measures:

- The contractor will, in consultation with residence engineer, resolve the exact location of all these facilities.
- Proposed locations for the camp and batching plant within the irrigation land is given in the IEE report. If the contractor prefers to acquire private land for these facilities then the contractor will arrange the additional payment to the land owner(s) and agreed the new proposed location with consultant's environmentalist and PMO.

7.5.2 Impacts of Waste Disposal site

Adverse Environmental Impacts:

There is sufficient IPD land available on site for Waste Disposal Site and no private land will require for this purpose. Inadequate disposal of waste could contaminate the land. The waste not handled properly could cause nuisance and diseases. Domestic waste contains high percentage of readily degradable hydrocarbon which on decomposition release bad smell, especially in hot and humid environment. Construction waste classified as inert waste which could be a problem to dispose of.

Mitigation Measures:

- Domestic waste generated at Labour Camp and site offices should be collected and temporarily store at the designated bonded area within the camp area before dispose off of site by the contractor.
- The temporary domestic waste storage area should be prepared, maintain and visually inspected on regular basis by the contractor & consultant to stop contaminating the adjacent land of waste disposal site.
- The location of construction waste disposal site should be such that no tree cutting, crop destruction or private land acquisition occurs.
- The waste will be disposed of according to the Waste Management Plan included in chapter 8.

- Construction waste should not be mixed with domestic waste as the construction waste could be reused as a fill material or dispose off separately.

Residual Adverse Impact:

- Waste storage area will attract animals and cause the foul smells in the surrounding area.

7.5.3 Impacts of Borrowing Site

Adverse Environmental Impact:

The additional soil require for the strengthening of the guide bunds will be excavated from the site selected by the contractor and approved by the Consultant. The sites are within the IPD land and most of it classify as waste land. If the contractor desires to excavate the soil from outside the nominated area than he has to get approval from the Consultant's Environmental Specialist and EU of PMO.
The excavating activities could place adverse environmental impacts including soil erosion, drainage problem, existing structure stability and health and safety of the workers and the local population.

Mitigation Measures:

- Earth required for revamping of guide bund and other works would be used out of the available government land. When earth is required to be lifted from private own land, then the owner(s) of the land would be duly compensated.
- The contractor will not leave the borrow pits in such a condition that they are unusable and could be filled with rain water and cause the problems for the community e.g. breeding place for mosquitoes etc.
- The contractor will ensure that selected borrow areas are clearly demarcated, including the allowable depth of the excavation, before starting any soil removing.
- The edges of the pits should be given flat slopes and area should be leveled as far as possible at the completion of the excavation.
- The barren or unfertile land will be preferred to use as borrowing area than the agricultural land.
- If the agricultural land need to be used as borrowing area then following additional measurements will be undertaken by the contractor
    - Excavate at least 50m away from the toe of the embankments

- Remove 6 inches of the topsoil and keep it separate on site for its re-spread back on the leveled borrow area
- Excavate up to maximum 3feet
- Level slops as far as possible
- Place the topsoil back on reasonably leveled area

- Land acquisition act 1894 should be followed for the any private land acquisitions.

Residual Adverse Impact:

- Uneven topography will be generated due to excavating land and will be restored through restoration of the borrow area. Contractor will restore the borrow area up to the desire of the consultant.

7.5.4 Damage to Paths, Access Roads and Cross Drains

Adverse Environmental Impact:

Infrastructure (road, drains etc) could be damaged through carelessness of the drivers/operators of heavy machinery. Such carelessness can cause considerable damage to paths, road and drains if the drivers/operators are not made aware, trained and bound to protect the infrastructure.

Mitigation Measures:

- An effective signology can reinforce the instructions to the drivers for example maximum load limit, type of vehicle allowed, speed limit etc.
- It is a Contractor's contractual obligations to impose strict control over operators and drivers of all types of vehicles.
- Should any damage take place, the contractor must be bound to carry out the repair immediately.
- Enforce the maximum speed limit for site traffic to 20 km/hour.

7.5.5 Impacts of Crushed Stone Transport

Adverse Environmental Impact:

Stones shall be brought from Sargodha District or Margalla hills. So, no quarrying has to be done locally. But the vehicles carrying the stones shall exert additional traffic load on the

roads leading to the project area. By keeping the road dust free and repaired even the slight impact shall stand mitigated.

Mitigation Measures:

- It is a Contractor's contractual obligation to use the roads and paths carefully and in case of any damage, repair the damaged roads and paths immediately.
- Undertake regular spraying of water on traffic routes and places porn to cause dust pollution.

7.5.6 Impacts of Finding Graveyard and Burials

No graveyard is identified within area of influence (AOI). However, if unrecorded graveyards and/or burials are found during the courses of construction activities, the supervising agency will contact and work with local religious authorities within the immediate Project area to allow for possible identification of the remains and where appropriate, properly undertake relocation and burial.

7.5.7 Contamination from Oil & Diesel and Other Spill from Construction Machinery

The dumping site for waste material or empty container can be damaged the land with allied physical, biological and social losses. This impact is mitigable through effective application of the maximum spill regulations, general criteria for oil and breakage at construction sites, as per standards set forth by Oil Spill Contingency Plan of PKP Exploration Ltd, Guidelines for Oil Spill Waste Minimization and Management issued by International Petroleum Industry Environmental Conservation Association and with mitigation measures described below.

(i) Minor Spills

Soil contaminated by minor spills/leakages (defined as leaks from vehicles, machinery, equipment or storage containers such that the area and depth of soil contaminated is less than one (1) sq.ft and three (3) inches respectively) is to be scraped and send to an incineration facility.

(ii) Moderate Spills

Moderate spills are defined as spills of volume less than or equal to 200 liters. These are to be contained and controlled using shovels, sands, absorbing mat and native soil. These equipments and materials are to be made available at camp sites during

the operation (Spill Kit). The contaminated soil will be excavated and send it to the treatment site such as bioremediation or solidification/stabilization (S/S). The excavated area will be lined with an impermeable base before fill with clean soil.

(iii) Major Spills

Major spills are defined as spills of volume much greater than 200 liters. This would require indication of Emergency Response Procedure and Oil Spill Contingency Plan to be prepared by the Contractor in consultation with the Engineer. These spills are to be handled and controlled by a specialize contractor to clean the site.

Mitigation Measures:

- All the oil-based material should be stored in the designated bunded area.
- Spill Kit should be available on site to handle the small spill on site.
- Good housekeeping will minimize the accidental spill.
- All loading and unloading of material should be supervised and carried out with appropriate plant.
- Empty drums of the fuel should be handled with care as some material may left over in the drums or container.
- All the liquid material or fuel should be stored well away from any control water body i.e. river, canal, wetland etc.

7.5.8 Water Supply System & Wastewater Treatment Impacts

Adverse Environmental Impact:

Pumping groundwater from the major aquifer for water supply for the laborer camp shall neither cause any significant change in the groundwater reservoir, nor in the river and canals which recharge it. The impact can be considered as slight and mitigable. The contractor should tap the underground reservoir and install hand pumps or tube wells with overhead water tank to supply drinking water to the laborer and workers at appropriate pressure. Groundwater test results indicate the shallow groundwater quality is not fit for human consumption because of elevated concentration of heavy metals.

It is envisaged that a considerable volume of wastewater will be generated from laborer camp. There are plenty of examples of successful systems of using wastewater for agriculture. Domestic wastewater is expected to be contaminated with pathogens. Many factors affect the degree to which the potential risk due to the presence of pathogen in

wastewater can become actual risk of disease transmission and pose a risk to health of consumers and workers (farmers). The following conditions need to be satisfied to adversely impact human.

1. Either an infective dose of an active pathogen reaches the field or pond or the pathogen multiplies in the field or pond to form an infective dose.
2. The infective dose reaches a human host.
3. The host becomes infected
4. The infection causes disease or further transmission.

The risk merely a potential if condition (4) is not met.

Mitigation Measures:

- It is the responsibility of contractor to test and confirm the suitability of the groundwater before its supply for domestic use.
- The depth of the extraction well should be increased until the quality of groundwater meets the WHO standards or the Filtering Unit can be installed by the contractor to achieve the WHO standards.
- It is the responsibility of the principal contractor to set up a suitable and appropriate wastewater collection and disposal system.
- If the waste water discharge into the control water body i.e. river or canal then it is a contractor's contractual obligation to confirm the effluent meets the NEQS level. Provision of underground septic tank is a preliminary treatment and reduce the total suspended solids (TSS) concentration to the acceptable level however it may not reduce the BOD level up to the required level. Therefore, it is suggested that, if require, an aeration treatment system should be emplaced to meet the BOD level before discharge of the effluent into the river. Aeration of wastewater can be achieved from number of treatment methods including mechanical aeration, providing steps in the open channel, aerobic stabilizing pond (maximum depth up to 4 feet) etc. the selection of treatment method depends on the availability of space and initial concentration of the BOD.
- The treated domestic sewage should be tested on regular basis before it is pumped into the river or used for agricultural purposes.

Residual Adverse Impact:

- It is envisaged that in the long run these could be some adverse effects on groundwater quality of the area in terms of drop in groundwater level due to the continuous pumping for the water supply to laborer camp.

- Stabilizing pond could cause the odor and nuisance problems of the surrounding area. The pond should therefore be at appropriate distance from the living area and direction of wind flow keep in view. Treatment with underground Septic Tank will not cause any odor except during the occasional cleaning of the chambers.

7.5.9 Contamination of Surface Water Due to Construction/Dismantling of Cofferdam

Contamination of the river water from soil material during construction and removal of the cofferdam consequently affecting the aquatic life, particularly downstream fisheries.

Mitigation Measure:

1 The material used for the construction of cofferdam should not contaminate the river water in terms of suspended solid, pH, oil etc.
2 The contractor will use good engineering practice to minimize the contaminating of the river water.

7.5.10 Impact on Air Quality of Earth Work Activities

Adverse Environmental Impacts

Excavating activities will generate dust and pollute the surrounding area. The emission from the plants use in earth work activities will also degrade the air quality of the site.

Mitigation Measures

- Regular spraying of water should be undertaken to minimize the dust pollution.
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition to minimize the exhaust emissions.

7.5.11 Impact on Biological Diversity.

Adverse Environmental Impacts

The natural habitat is vulnerable to the noise and dust generated from the movement of site traffic and work activities during the construction phase. The laborer camp and batching plant location should be carefully selected to minimize the tree cutting and disturbance to wildlife. Fish usually swim against the flow direction and weir may obstruct fish movement across the weir.

Mitigation Measures

- The purposed area for laborer camp and batching plant will not require any tree cutting. However, tree cutting is involved during strengthening of the both left and right guide bunds.
- The outside boundary of the camp should be fenced or walled to keep the camp activities inside the camp area.
- It is contractor obligation to ensure that unnecessary and out of bound activities/movements are not done outside the campus allotted to him for setting-up the laborer camp, material depots and machinery yard.
- No fire arms are carried by any of the worker.
- All forest, wildlife and fisheries laws are fully respected and abide by the Contractor and his work force.
- Necessary sign boards should be displayed to remind the obligation of laborer, visitors and members of public towards Biota.
- Inspections by wildlife, forest and fisheries officers are facilitated in camps to facilitate a proper implementation of relevant laws.
- 24 hours security should be provided by the contractor at Laborer Camp and Batching Plant.
- Every tree cut on site for execution of work should be replaced with the plantation of minimum five new trees.
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working conditions and properly tuned to minimize the adverse impact on waterfowl habitat by reducing noise, exhaust and land disturbance.
- Communities are given awareness and are involved in proper protection of the Biota inside and around the Project side.
- No unauthorized tree or bush cutting should be allowed. Should it be necessary, it must not be done without permission of the “The Engineer” and follow the change management process.
- If possible nests of bird, on trees need to be uprooted, be shifted to other nearby trees.

7.5.12 **Social Impacts**

Adverse Environmental Impacts

There is a risk of adversely affecting the social life of local population due to the arrival of large number of laborer from outside the area. Extra burden on the local infrastructure and services e.g. medical facility, shops, restaurants, mosque, public transport etc. is also anticipated.

Mitigation Measure

- The outside boundary of the camp should be fenced or walled for security reasons.
- Locating a laborer camp at least 500m or ideally 1km away from the villages (local settlement).
- Leisure facilities including play grounds, restaurant etc should be provided inside the laborer camp.
- All the unskilled laborer and where possible skilled laborer should be arranged locally.
- Pick and drop facilities should be arranged.
- The camp should be located within IPD land, such that there is no any private land acquisition required for this activity.

7.5.13 HIV/AIDS and other Communicable Diseases

The Laborer Camp, their interaction with truck drivers and alike personnel are potential places for spread of HIV/AIDS if the incidence exists. Majority of the people living in the surrounding of the Project, and potential Laborer are not aware of the source, mode of communication or consequences of HIV/AIDS. Although their religious and cultural value system, to a large extend exclude the outbreak or rapid communication of HIV/AIDS, yet its occurrence in such a situation cannot be precluded. It is necessary that along with other communicable diseases like Cholera, Typhide and Tuberculosis, awareness and preventive campaigns are run from time to time in the Laborer camps and the field offices of the Project on Communicable diseases.

Mitigating Measures:

The Contractor shall:

- Arrange to run a proper campaign, in the laborer camp, to make people aware of the cause, mode of transmission and consequences of HIV/AIDS.
- Strengthen the existing local health & medical services for the benefit of laborer as well as the surrounding villages.
- Ensure proper cleanliness and hygienic conditions at laborer camp by ensure a clean mess, proper drainage and suitable disposal of solid waste. Inoculation against Cholera will be arranged at intervals recommended by Health Department.
- Keep all the camps, offices, material depots, machinery yards and work site open for the inspection of health and safety measures, and related documents.

7.5.14 Restoration / Rehabilitation

Adverse Environmental Impacts

The construction activities could affect the aesthetic / scenic value of the area

Since the main settlement is located far from the project site, therefore it is unlikely to emplace any health & safety hazards for the local population due to the project activities.

Mitigating Measures:
The contractor will:

- Ensure that all borrow sites are remediated as per contract requirements.
- Ensure that Camp site is restored as per contract.
- Ensure that no potential conflicts arise with landowners during the restoration of the borrow areas.
- Ensure that all fencing and access gates relevant to construction activities are removed at the completion of construction phase of the project

7.5.15 Employment opportunities

Adverse Environmental Impacts

There are chances to have local disagreement associated with influx of workers from other parts of the country.

Mitigating Measures:

- Contractor will deploy maximum employment from the locals (unskilled). Skilled and semi-skilled will also be deployed provided the suitable competent persons with required qualifications/ experience are available.
- Contractor will maintain inter-tribal balance when giving employment to the local population. Preference to be given to the people directly affected by the project.

7.5.16 Public health and safety issues

Adverse Environmental Impacts
However, there will be safety and health hazards for the work force, particularly for the people working on the repair/ renovation of gates and hoists and installing electric equipments under the condition of full impoundment of the barrage.

Mitigating Measures:

- Ensure that no machinery is left unattended at work site.
- The Contractor should provide training to the workers on safety matters

- Ensure all entry points into the construction area are staffed 24 hours a day
- Ensure that safe driving practices are adopted, particularly while passing close to settlements. This includes a speed limit of 30km/h within built- up area (residential area) and 20km/h on site
- Greater awareness about Healthcare including HIV/AIDS and Hepatitis amongst the laborer and the local community shall be created.

7.5.17 Installation and operation of batching plant

Adverse Environmental Impact:

From previous work experience it has been observed that the emission or dust from the batch plant can be very harmful for the site workers and the local population. The dust emission could cause skin and respiratory disease e.g. skin rashes, lungs problem etc.

Mitigation Measures:

- Air quality should be monitored on regular basis near the plant
- The plant should be located at least 500m away from any living area. The plant should not be operated outside working hours
- Regular spraying of water should be carried out to minimize dust pollution
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working conditions to minimize exhaust emissions. The fitness certificate will be produced by the Contractor to avoid the unacceptable emissions. CO and smoke emission test will be carried out on quarterly basis and noise monitoring tests will be carried out three times a day
- Proper PPEs should be issued to the site workers and measures should be adopted to ensure that the workers will wear the PPEs properly when working on site
- If Contractor select any other site than the site suggested by the client and consultation than the site has to be agreed with the consultant's environmentalist and PMO. The following additional control measures need to be implemented in case the selected site is closer to the residential area
    - The plant has to be a **Zero Emission Plant** by installing new plant/ computerized and automatic plant. This will include using washed aggregated and enclosed cylose with automatic injection system of the material in to the mixing chamber.
    - The plant area should be constructed and maintained on an impermeable layer to prevent contamination of river water from surface run off
    - The access roads for the delivery Lorries pass through the living area. These roads/paths should be sprayed with water on regular basis to minimize dust pollution

Residual Impacts:

- Deterioration of air quality
- Although the recommended plant consists of an enclosed cylose, the plant activities will generate some dust especially in consistently dry weather

7.5.18 Water consumption

Adverse Environmental Impact:

Considerable amount of water will be required for the construction activity and due to this the shortage of water for the local communities may occur.

Mitigating Measure

- Contractor will maintain the water consumption record during the construction stage.
- Avoiding wastage of water through conservation techniques and selection of adequate water supply sources, ensuring no impact on local consumptions.

7.5.19 Climate Change Impact

Location of Labor Camp:

Maximum and minimum temperatures are expected to rise. Cool days and nights are expected to decline. Hot weather may produce discomfort in living of labor

Mitigations Measures:

- The contractor will, in consultation with residence engineer, select a location, where free air flow and tree canopies are nearby.

Impacts on Concrete

Rise in temperature may pose adverse impacts on hot weather concreting and water use.

Mitigation Measures:

- Adequate admixtures together with best practices should be adopted.
- Groundwater exploitation needs to be avoided.

Impacts on working hours and labor health

Rise in temperature may pose adverse impacts on labor health and working hours

Mitigation Measures:

- Availability of first aid should be ensured by the contractor
- Working hours should be relaxed or work timing should be changed according to situations
- Availability of cold water needs to be ensured at all site locations in case of hot weather
- Access to the nearest BHU/Hospital should be made available to all labors by providing dedicated site vehicles

7.6 IMPACT AND MITIGATION MEASURES DURING OPRATION PHASE

7.6.1 Impacts due to wrong implementation of the prescribed O&M plan

Adverse Environmental Impact

During regulation the gates will be stuck up and create problem to maintain the required pond level and subsequently effect the water supply to the command area.

Mitigating Measures

- Trained staff should be engaged for the implementation of Operational and Management Manual (O&M).
- Refresher Training Courses for operational staff.
- Continued public consultation and feedback on it
- Strict implementation of prescribed Environmental Management Plan (EMP).

7.6.2 Impacts of Regular Maintenance

Adverse Environmental Impact

Regular Maintenance of the barrage is carried out annually by the irrigation department staff at each barrage. During maintenance of the barrage, lot of solid waste is generated which can cause adverse environmental impact if not managed properly. Beside generation of solid waste, disruption in water availability to canal command area and blockage of traffic may also occur.

Mitigating Measures:

- Implementation of solid waste management plan.
- Proper awareness programs should be launched regarding canal closure during maintenance period.
- Maintenance / repairer work should be carried out during normal canal closure period.
- Traffic Management plan should be prepared and implemented during maintenance period of the barrage.

On the basis of the impact assessment the project will emplace positive environmental and social impacts of the area. There is not any permanent adverse environmental impact identified during construction phase. All the adverse impacts resulted from the construction activities are mitigable.

7.6.3 Climate Change Impact

Adverse impacts during the study period (2011-2100)

Maximum and minimum temperatures are expected to rise by 0.035°C/yr and 0.034 °C/yr (rise in maximum and minimum temperature during 100 years is 3.5 °C and 3.4 °C respectively). Annual summer days (maximum temperature > 25°C) may increase by about 64 days during 2011-2100. Similarly, cool days and cool nights may decline by 15 day and 19 days during 2011-2100. During the same period, warm days and warm nights may raise by 15 days and 14 days respectively. Precipitation does not show any statistically significant rise/decline.

Keeping in view the above results climate change may induce following implications:

- Rise in snow-melt and glacier-melt, which may increase river flows initially but on long-term basis a river flow decline is expected;
- Rise in early snow-melt may result in changes in river flow patterns and peak flow occurrence;
- Rise in temperature may result in decline in snowfall and increase in rainfall, thus may result in rainfall-runoff increase;
- Increase in temperature may result in rise in losses, particularly evapo-transpiration;
- Increase in evapo-transpiration losses will rise stress on crop water demand;
- Increase in temperature may result in changes in cropping patterns;
- Changes in climate change may affect crops health; and
- Changes in climate may adversely affect irrigation practices and working environment in the field.

Mitigation Measures

- Best agriculture practices, best water management practices, farmers awareness schemes, capacity building of line department, well managed operation and maintenance, growing of more trees, cropping patterns and crops varieties should be proposed.

8. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The Environmental Management Plan (EMP) presented here provides the mechanism to implement the mitigation measures and assistance in infrastructure development identified during the environmental assessment. The EMP proposes an effective plan of action that will indicate responsibilities and required measures to minimize the negative environmental & social impacts at various stages of the project It is the responsibility of the Contractor to develop Site Specific Environmental Management Plan (SSEMP) and get approval from Construction Supervision Consultant (CSC) before the commencement of physical works on site.

8.1 PURPOSE AND OBJECTIVES OF EMP

Environmental Management Plan (EMP) provides a mechanism to address the adverse environmental impact of a project during its construction, to accelerate project benefits, and to introduce standards of good practice to be adopted for all project works.
The objectives of the EMP are to:

- Define the responsibilities of the project proponents, contractors and construction supervision consultants;
- Facilitate the implementation of the mitigation measures identified in the EIA;
- Define a monitoring mechanism and identify monitoring parameters;
- Provide a procedure for timely action in the face of unanticipated environmental situation; and
- Identify training, requirements at various levels.

8.2 COMPONENTS OF THE EMP

The EMP has the following components:

- Organizational structure; roles and responsibilities;
- Mitigation Measures and Implementation Plan;
- Environmental Monitoring Plan;
- Communication and Documentation;
- Environmental Training;
- Waste Disposal Plan;
- Traffic Management Plan;
- Emergency Response and Contingency Plan;
- Health, Safety and Environment Plan;
- Tree Plantation Plan;
- Borrow Areas Restoration;
- Risk Management Plan and
- Environmental Management Cost

The components, as per requirement will be incorporated into various contract document and agreement needed for the implementation of the project. The components include brief description of the environmental aspects of the project activities, listing of mitigation measures, reporting on types of non-compliances with respect to EA or Environmental Management Plan (EMP) and EPA conditions of approval expected during implementation of the project, checklists for identification of non-compliances and format for environmental issues tracking report.

8.3 ORGANIZATIONAL STRUCTURE ROLES AND RESPONSIABILITY

This section provides institutional arrangements for environmental management during the proposed activity and defines the roles and responsibility of the various organizations/ departments. The roles and responsibilities of various project entities for the environmental and social management are discussed below. Overall organization structure is shown in figure 1.

8.3.1 Project Management Office (PMO)

The overall responsibility for the implementation of Environmental Management/Monitoring Plans rests with the Project Management Office (PMO), with the assistance of Environment and Social Unit (ESU) of PMO. The ESU consists of Director (Environment and Social Safeguards), Deputy Director (Environment), Deputy Director (Social) Deputy Director (Resettlement). Construction Supervision Consultant (CSC) will assist and advise PMO in implementation of EMP.

PMO will assume overall responsibility for ensuring:

- That while executing the contract and undertaking the construction all environmental norms, regulations and requirements promulgated by Pakistan Environmental Protection Council (PEPC), Punjab Environmental Protection Act (PEPA) 1997 (Amendment 2012), Environmental Protection Agency (EPA) Punjab and particularly Asian Development Bank environmental safeguard policy, with respect to the work site and adjacent areas are fully respected and implemented
- That Contractor and Construction Supervision Consultant (CSC) appoint a dedicated environmentalist and allied staff. PMO will also ensure that all environmental personnel are authorized to implement the socio- environmental policies and requirements of the EMP
- Coordination with relevant government departments and stakeholders on concerned socio-environmental issues
- Inspection and monitoring of residual impacts of the rehabilitation and upgrading work and ensuring documentation of the impacts during the construction phase
- Inspection of the significant impacts in case of unanticipated change in the project.

8.3.2 Environmental Social Unit (ESU)

ESU will monitor the environmental and social performance of the project, and in particular, adequate implementation of EMP. ESU will function in coordination with the Construction Supervision Consultants and will receive reports from them on behalf of PMO.

ESU will submit periodical progress and monitoring reports to all stakeholders as per their schedules. In this task they will seek assistance/ guidance from Construction Supervision Consultants as and when required.

ESU will closely liaise with Construction Supervision Consultant Environmentalist (CSCEnv.) and Contractor Environmentalist (CEnv.) of the supervision consultants and contractor, respectively.

8.3.3 Contractor

The contractor will be responsible for the implementation of EMP in the field. The contractor will ensure that EMP is implemented fully and is integrated into the project implementation. In case the contractor fails to implement any part of EMP, PMO will reserve the right to get it done at the cost of the contractor. The cost of any such work will be determined by the Construction Supervision Consultants and will be adjusted from amount due to the contractor. The contractor will also be responsible for communicating with and training of project staff in the environmental and social aspects and implementation of the EMP. The contractor will develop the Health, Safety, and Environment (HSE) Plan and SSEMP; submit to the Construction Supervision Consultants for their review and approval, before the commencement of the physical works at the site.

As described earlier as well, the contractor will appoint a dedicated Environmental Officer at the site, who will ensure EMP implementation at the site, and will liaise with Construction Supervision Consultant and ESU for this purpose.

8.3.4 Construction Supervision Consultants

The construction supervision consultants will supervise the contractor and will be responsible to ensure quality of work and fulfillment of contractual obligations of the contractor. The construction supervision consultants will also ensure that the contractor fulfills all the EMP requirements and implements all its components adequately. For this purpose, the supervision consultant will appoint a full time dedicated Environmentalist at the site, who will supervise the EMP implementation at the site, and liaise with office based Environmental Specialist (Consultant), and Environmental Officer (Contractor) and ESU for this purpose.

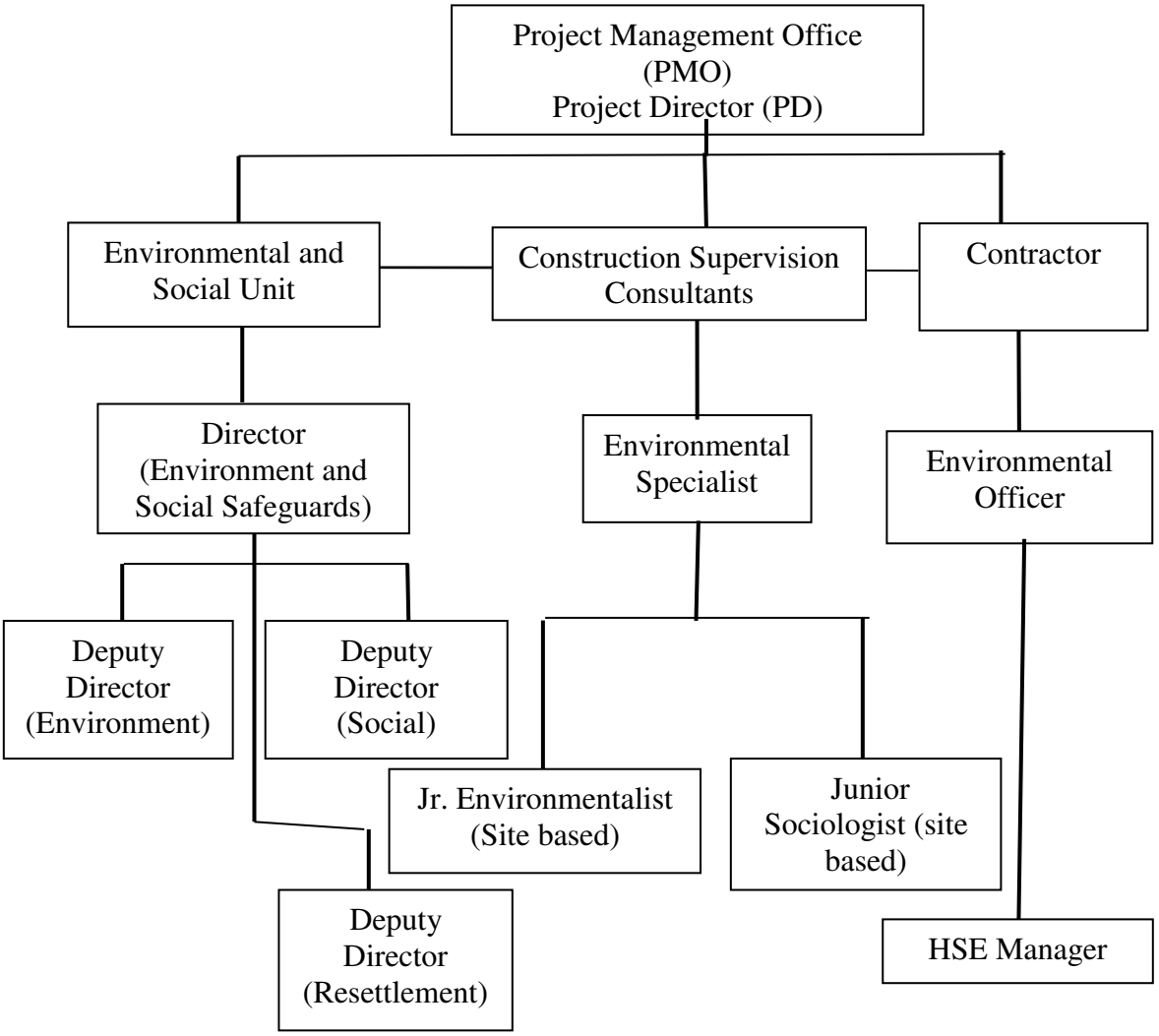


Figure 8.1: Organization Chart for Environment Management / Monitoring Implementation

8.4 MITIGATION MEASURES AND IMPLEMENTATION PLAN

The mitigation plan is a main component of EMP. The mitigation plan includes measures to mitigate potential negative impacts and enhance its positive impacts of the project. This section outlines the potential impacts of the proposed project on the physical, biological and socioeconomic environment and their associated mitigation measures. It also assigns the responsibilities for implementing these measures and frequency as well.

The Mitigation Plan for the activities likely to have a direct impact on the environment and community is presented in Table 8.1 & 8.2.

Table 8.1: Environmental Impacts Mitigation Plan

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
1	**Borrow Materials from Earth Borrow Site**	Soil erosion; Loss of fertile soil; obstruction in natural drainage and dust pollution	1.1 Preferably no private land will be used for borrow area. Contractor will excavate the material from the specified and demarcated borrow area and restricted to specified depth	CEnv	CSCEnv PMO-ESU	Records of clear boundary marker demarked in place	Once before start of excavation
			1.2 Contractor will maintain photographic record of the site before and after the restoration of the borrow site and also contractor will get approval from the land owner prior to start excavation.	CEnv	CSCEnv PMO-ESU	Photographs records and SFA signed by the land owner	At the start of the work then after restoration.
			1.3 Contractor will ensure that the surface drainage is provided to control the surface run off	CEnv	CSCEnv PMO-ESU	Compliances with Specification	Check once a week on typical working day
			1.4 Contractor will ensure that the movement of earth moving machinery is limited to the work area	CEnv	CSCEnv PMO-ESU	Compliance Site inspections	Daily Once a month
			1.5 Contractor will ensure that erosion protection measures are taken, such as retaining wall (if required), avoidance of steep cut	CEnv	CSCEnv PMO-ESU	Visible signs of any soil erosion	Monthly basis Once after rain
			1.6 Barren and infertile land should be preferred for use as borrow area. If agricultural land is to be used as borrow area then following measures should be taken by the contractor: • Remove first 15cm top soil and keep it on site to re-spread after completion of the excavation • Excavation of the earth fill be limited to an approximate depth of 100 cm as compared to adjacent elevated field • Stabilize the slopes during excavation	CEnv	CSCEnv PMO-ESU	A detailed protocol in checklist	Daily At completion of excavation When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			1.7 Contractor will level the borrow and the edges of the pits be given flat slopes as far as possible and as per the satisfaction of the land owner and top soil restored after the completion of the excavation activity	CEnv	CSCEnv PMO-ESU	Photographs record	During restoration When required
			1.8 Contractor will maintain the complete documentation for the borrow areas i.e. volume excavated, date of excavation, leveling date after completion of excavation	CEnv	CSCEnv PMO-ESU	Records	At the start of the excavation; During excavation.
			1.9 Contractor will carry out regular water sprinkling during executing of excavation to mitigate the dust pollution	CEnv	CSCEnv PMO-ESU	Compliance	Daily When required
			1.10. Contractor will ensure that the movement of excavating machinery and vehicles is limited to the work area.	CEnv	CSCEnv PMO-ESU	Compliance	daily
			1.11. The Contractor will prepare Borrow Area Restoration Plan.	CEnv	CSCEnv PMO-ESU	Records	Before restoration When required
3	**Installation and operation of batching plant**	Soil, air and water contamination; safety hazard for communities	3.1 Preferably no private land is used to establish the batching plant. Contractor needs to get approval from CSCEnv and PMO-ESU if he uses any private land for this purpose. Contractor will pay for the use of private land	CEnv	CSCEnv PMO-ESU	photographs; a statement signed by ESU that no private land is used, otherwise, contractor will be responsible for land use payments.	Once at the time of installation of batching plant
			3.2 The location of the batching plant	CEnv	CSCEnv	Compliance;	Once before

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			need to be at least 500 m from the villages (main settlement) and out of phase with the prevailing wind direction. If the selected location is less than 500m from the residential area then it has to be emission-controlled plant i.e. equipped with wet scrubber.		PMO-ESU	community complaints.	installation of batching plant
			3.3 Contractor will ensure that land contamination from the batching plant, during transportation and dumping of the waste fresh concrete is controlled through careful working of the Contractor's crews to avoid spillage of concrete and dumping of waste concrete on private land. Carry fresh concrete in mobile concrete drums only	CEnv	CSCEnv PMO-ESU	System in place	Daily When required
			3.4 If the selected location is next to the control water body i.e. River Sutlej then the area for batching plant should be bunded with an impermeable layer to prevent contamination of the river from surface run off in case of rain or by any other means of water flow. The area will be maintained on regular basis by the Contractor	CEnv	CSCEnv PMO-ESU	Design and prepare the Batching Plant area by a competent person. Photographs record	At the stage of establishing batching plant Weekly inspection When required
			3.5 Contractor will maintain leak / spill record for each incident of spill or damaged vehicles. Damaged / defective vehicles will not be operated unless repaired	CEnv	CSCEnv PMO-ESU	Compliance	Daily When required
			3.6 Contractor will ensure that the material is stock piled at the designated area only.	CEnv	CSCEnv PMO-ESU	Compliance; photographs	At the time of establishment of batching plant. Randomly
			3.7 Contractor will ensure that surface drainage is not blocked due to the piling	CEnv	CSCEnv PMO-ESU	Compliance' Photograph.	Daily Once a month

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			of the raw material				after each rain
			3.8 Contractor will store material on site with care and suggestions provided in EA/EIA in order to minimize the risk of spill or leakage into the river or control water body	CEnv	CSCEnv PMO-ESU	System in place	Daily
4	**Establishment and operation of laborer camps, material and equipment yards and approach roads.**	Contamination of soil and water; soil erosion; resource consumption; Change in land use and land form; additional load on local facilities/utilities such as schools, hospitals, electricity and water supply	4.1 Contractor will ensure that the baseline conditions are recorded before establishing camps and other site facilities.	CEnv	CSCEnv PMO-ESU	Availability of baseline description; photographs	Once at the Time of camp establishment
			4.2 Contractor will establish the laborer camp at a distance of at least 500m from major local settlement.	CEnv	CSCEnv PMO-ESU	Measured distance	Once before the establishment of the camp
			4.3 Contractor will obtain approval for sites for camps and other site facilities from the supervision consultants/PMO, and no private land is used for this purpose. If contractor goes for private land then he will be responsible for the payment to land owner and develop baseline condition of the area at his own cost.	CEnv	CSCEnv PMO-ESU	Written approval.	Once before the establishment of the camp
			4.4 Contractor will maintain photographic record of area adjacent to the camp site and other features are taken prior to commencement of any work activity which should be used as a reference during site restoration	CEnv	CSCEnv PMO-ESU	Photograph records	: Once before construction activity
			4.5 Contractor will ensure that camp size and room size(s) are as per standard specifications	CEnv	CSCEnv PMO-ESU	Compliance per specification	During camp construction
			4.6 Contractor will make an arrangement that domestic washing areas are demarcated and water from washing areas and kitchen is released in filter	CEnv	CSCEnv PMO-ESU	System in places	Once before start of the work Daily When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			bed soaking pits				
			4.7 Contractor will ensure that septic tank of appropriate design (approved from the supervision consultant) is used for sewage treatment and outlets released into soaking pits with filter bed	CEnv	CSCEnv PMO-ESU	Approved drawings; System in places	Once before start of work When required
			4.8 Contractor will ensure that latrines, septic tanks, and soaking pits or sumps are built at a safe distance from water body (tube wells or hand pumps), stream, or dry streambed and the bottom of the sump or soaking pits are above the ground water level	CEnv	CSCEnv PMO-ESU	Approved layout; physical verification	During design phase of camp set up and waste treatment system
			4.9 Ensure that sumps are located: • In absorbent soil • Down-slope and away from the camp • Downstream from the camp water source and above the high watermark of any nearby water body (if any).	CEnv	CSCEnv PMO-ESU	Approved layout; physical verification.	Once at the Time of camp establishment
			4.10 Contractor will ensure that effective drainage system is in place at site in order to avoid rain or wastewater ponding in the area	CEnv	CSCEnv PMO-ESU	System in place; photographs	Once at the start of work
			4.11 Supervision Consultant will ensure that existing wastewater disposal system is not overstressed, if used	CSCEnv	PMO-ESU	Compliance; complaints from relevant department or local communities	Monthly basis
			4.12 Contractor makes assessment and carries out renovation / expansion works of existing facilities in consultation with Supervision Consultant / PMO	CEnv	CSCEnv PMO-ESU	System in place	When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			4.13 For solid wastes disposal, the waste disposal plan will be followed by the Contractor. No waste will be left in the open.	CEnv	CSCEnv	Implementation of Waste Disposal Plan	Once before establishing Contractor's Camp
			4.14 To avoid the chemical and oil spills such materials will be properly stored away from the control water body and maintain good housekeeping by the Contractor.	CEnv	CSCEnv PMO-ESU	System in place; photographs	Daily during Construction Phase When required
5	**Access Tracks**	Dust emission; blockage of natural drainage; Soil erosion; loss of natural vegetation; safety hazard for communities; damage to public infrastructure**;**	5.1. The Contractor will prepare and implement Traffic Management Plan and gets its approval from The Engineer for implementation at site	CEnv	CSCEnv PMO-ESU	Compliance with map Site inspections	Daily Once a month
			5.2 After completion of construction work all the local roads under the use of the contractor will be restored by the contractor, as per contractor's contractual obligations	CEnv	CSCEnv PMO-ESU	Compliance; photographs	After completion of works and before processing of the final bill.
			5.3 All sections of the access tracks that are prone to dust emission and where sensitive receptors are located within 500 m should be identified and marked on the revised map of the project area (part of SSEMP) and water sprinkled regularly by the Contractor	CEnv	CSCEnv PMO-ESU	compliance; photographs	Once at the start of work On monthly basis
			5.4 Contractor will ensure that construction corridors along the access road are marked on site	CEnv	CSCEnv PMO-ESU	Compliance	Daily Monthly basis
			5.5 Contractor will ensure that the access roads do not block the natural drainage and culverts	CEnv	CSCEnv PMO-ESU	Compliance; photographs	Once at the start of work
			5.6 Contractor will ensure adherence to the speed limit of 20 km/hr at the access	CEnv	CSCEnv PMO-ESU	Compliance evidence of	When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			roads			training provided to drivers.	
			5.7 Construction corridor is monitored and repaired when required by the Contractor	CEnv	CSCEnv PMO-ESU	System in Place	Daily When required
			5.8 Contractor will ensure that vegetation clearing will be minimized and no tree will be uprooted without prior consent of the Supervision Consultant.	CEnv	CSCEnv PMO-ESU	Compliance with EA/EIA/EMP	When required Once a month
			5.9 Contractor will ensure that the disposal of cleared vegetation is not in a manner that may affect the blockage of natural drainage or public paths	CEnv	CSCEnv PMO-ESU	Site Inspections Implementation of Waste Disposal Plan	Daily Once a month
6	Waste Disposal Management	Soil and water contamination; obstruction in natural drainage; obstruction of community paths; aesthetic problem	6.1 The demolition waste and excavated material's disposal site will be agreed with the Supervision Consultant and Contractor and marked on site before starting the work	CEnv	CSCEnv PMO-ESU	Photographs; demarcation on maps and in the field	Before staring the work When required
			6.2 Contractor will maintain the Photographic record of the area of the nominated waste disposal site in order to restore the site at the completion of the construction phase	CEnv	CSCEnv PMO-ESU	Photographs record	Once at the start of work When required Once a month
			6.3 Contractor will ensure that all the waste generated from different locations must be disposed off according to the Waste Disposal Plan	CEnv	CSCEnv PMO-ESU	Photographs; demarcation on maps and in the field	As and When required
			6.4 Contractor will ensure that all trucks used for the transportation of waste construction material must be covered and water resist	CEnv	CSCEnv PMO-ESU	System in Place	When required
			6.5 It is the contractor's contractual obligation to complete and follow the SFA in case any private land is damaged / contaminated due to disposal of waste	CEnv	CSCEnv PMO-ESU	SFA Environmental Audit	Once a week When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			generated from the construction activities				
			6.6 Contractor will ensure that the movement of lifting machinery and vehicles is limited to the work area	CEnv	CSCEnv PMO-ESU	Compliance	Daily When required
			6.7 Contractor will ensure that waste soil is properly disposed off in a manner that does not affect the natural drainage	CEnv	CSCEnv PMO-ESU	Site Inspections	As and When required
			6.8 Ensure that factious medical waste is disposed of after proper autoclaving or incineration.	CEnv	CSCEnv PMO-ESU	Compliance	DC Weekly
7	Construction Activity; Land Contamination due to Spill of Lubricants, Fuel, Chemicals and Other Waste Material. Deterioration of ambient air quality from dust, vehicle emission and noise pollution	Soil and water contamination; safety hazard; damage to crops; air contamination; noise emissions; damage to natural vegetation, habitat and wildlife	7.1 Contractor will ensure that the maintenance of vehicle (LTV and HTV) and other plant takes place only in designated areas underlined with concrete slabs and a system to catch surface runoff. The contractor will construct lined wash area for vehicle washing	CEnv	CSCEnv PMO-ESU	Compliance System in place	Daily As and When required
			7.2 Contractor will ensure effluents from plant washing and other potentially contaminated effluents are released into soaking pit	CEnv	CSCEnv PMO-ESU	System in place	When required
			7.3 Contractor will store and handle fuels, oils, and other hazardous substances according to standard safety practices such as secondary containment bunded area. Fuel tanks will be labeled accordingly by the Contractor	CEnv	CSCEnv PMO-ESU	Approved HSES plan; compliance; photographs	Once in week When required
			7.4 Contractor will ensure that fuels, oils, and chemical are stored in areas lined by an impermeable base and containing dykes. The Material Safety Data Sheets	CEnv	CSCEnv PMO-ESU	System in place	Once every 15-days Once a month

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			(MSDS) or Control of Substances Hazardous to Health (COSHH) sheets will be available at material storage area				
			7.5 Contractor will ensure spills are avoided during fuel and oil transfer operations. Appropriate arrangements to minimize carrying around at site should be made. If required, carry in proper container(s) and vehicles	CEnv	CSCEnv PMO-ESU	System in place Arrangements in place	Daily When required
			7.6 Keep spill kit including shovels, plastic bags, absorbent materials and sand bags on site near fuel and oil storage areas	CEnv	CSCEnv PMO-ESU	System in place	Daily Once a month
			7.7 Contractor will plan refueling of vehicles on daily basis to minimize travel and chances of spill	CEnv	CSCEnv PMO-ESU	Work Planning	Daily
			7.8 Contractor will carry out vehicles fuel, oil, or battery fluid leakage check regularly	CEnv	CSCEnv PMO-ESU	Compliance	Daily When required
			7.9 Contractor will record of leak / spill incidents and maintain record for each vehicle and repairs affected vehicles at the earliest opportunity. Leaking vehicles will not be operated unless repaired	CEnv	CSCEnv PMO-ESU	System in place Maintain Record	Daily When required
			7.10 Soil contaminated by minor spill (covering an area up to 1 m^2 and 7.5 mm deep) will be collected and disposed off at burn pit by the Contractor	CEnv	CSCEnv PMO-ESU	Compliance	When required
			7.11 Contractor will ensure that soil contaminated by moderate spills or leaks (up to 200 liters) is contained using shovels, sand and soil. The contaminated soil will be removed from the site and sent to landfill site or burn pit as required. Major spills of volume exceeding 200 liters will be handled and	CEnv	CSCEnv PMO-ESU	Compliance	When required Once a month

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			controlled by a specialized contractor as suggested in Waste Disposal Plan				
			7.12 Planning, designing and execution of the project will be carried out through adopting proper mitigation measures to conserve aquatic life. Ensure that no oil/lubricant or other toxic materials are released into the river by the Contractor.	CEnv	CSCEnv PMO-ESU	Compliance; photographs of any damage; any complaints from communities.	Randomly.
			7.13 In case if the agriculture land/crops are damaged by the construction activities, proper compensation will be paid to the owner by the Contractor. After completion of construction phase the vegetation of the area will be restored through plantation of the indigenous species by the Contractor.	CEnv	CSCEnv PMO-ESU	Compliance	Weekly/as required.
			7.14 If during the construction activities, any archeological or religious sites (such as graves) are found, these will be protected, in consultation with Supervision Consultant / PMO, the relevant communities and the concerned Departments	CEnv	CSCEnv PMO-ESU	Compliance; photographs of any archeological or religious sites found during construction.	When require
			7.15. Contractor will ensure that firearms are not allowed to carry at site.	CEnv	CSCEnv PMO-ESU	Compliance; evidence of trainings provided to staff.	Randomly.

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			7.16. Contractor will ensure that there is no open defecating in the vicinity of camps or construction site.	CEnv	CSCEnv PMO-ESU	Compliance; evidence of any violations	Daily.
			7.17. Contractor will ensure that safe driving practices are observed so that the accidental killing of reptiles or small animals crossing the roads could be avoided.	CEnv	CSCEnv PMO-ESU	Compliance; evidence of trainings provided to staff.	Randomly.
			7.18 Use appropriate machinery in good working condition by the Contractor and keeping noise levels within NEQS.	CEnv	CSCEnv PMO-ESU	Compliance; complaints from communities	daily Weekly.
			7.19 Contractor will ensure that all equipment, generators and vehicles used during the construction are properly tuned and maintained in good working condition in order to minimize the emissions.	CEnv	CSCEnv PMO-ESU	Compliance; Daily Checklists completed by the contractor	Daily.
			7.20 Ensure that dust emissions at the construction sites are minimized by carrying out regular water sprinkling by the Contractor.	CEnv	CSCEnv PMO-ESU	Compliance; photographs; complaints from communities	Daily.
			7.21. Ear plugs and other protective devices will be provided to the workers working at noise prone area by the Contractor.	CEnv	CSCEnv PMO-ESU	Compliance; availability of PPE.	Randomly
			7.22 Use appropriate machinery in good working condition in order to keeping noise levels within NEQS.	CEnv	CSCEnv PMO-ESU	Compliance; environmental monitoring record	Daily

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
8.	Transportation of Crushed stone	Dust emission, traffic load, safety hazards	8.1It is a Contractor's contractual obligation to use the roads and paths carefully and in case of any damage, repair the damaged roads and paths immediately. 8.2Undertake regular spraying of water on traffic routes and places porn to cause dust pollution.	CEnv	CSCEnv PMO-ES	System in place	DC When required
9.	Construction and dismantling of coffer dam	Contamination of river water and damage to aquatic life.	9.1The material used for the construction of cofferdam should not contaminate the river water in terms of suspended solid, pH, oil etc. 9.2The contractor will use good engineering practice to minimize the contaminating of the river water. 9.3 Contractor to get the approval from CSCENV before start of the construction and dismantling of the coffer dams	CEnv	CSCEnv PMO-ESU	Compliance	DC Once at the time of Construction and dismantling of Coffer Dam
10	Earth Work Activity	Dust emission, emission from the machinery used for excavation and noise pollution	10.1Regular spraying of water should be undertaken to minimize the dust pollution. 10.2All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition to minimize the exhaust emissions.	CEnv	CSCEnv PMO-ESU	System in place	DC When required

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
11	***Biological Diversity***	The labour camp and batching plant location should be carefully selected to minimize tree cutting and wildlife habitat disturbance. The natural habitat is vulnerable to noise and dust generated from the movement of site traffic and work activities	8.1 When aligning the access tracks ensure that the chosen route requires minimum vegetation loss and no tree cutting. Every tree cut on site for the execution of work will be replaced with the plantation of a minimum of five new trees	CEnv	CSCEnv PMO-ESU	Compliance Site inspection	BC/DC
			8.2 Contractor will ensure that no fire arms are carried out by any of the employees or laborer, except designated security staff if required	CEnv	CSCEnv PMO-ESU	Compliance Site inspection	DC Daily When required
			8.3 Ensure that no-hunting, trapping and/ or harassing wildlife takes place at site. The wildlife protection laws should be strictly implemented	CEnv	CSCEnv PMO-ESU	Compliance with wildlife protection rules & regulation	BC/DC Daily When required
			8.4 Ensure that the camping sites should be located away from the hot spots i.e. the belas in the river which are ideal habitat for a variety of the wildlife.	CEnv	CSCEnv PMO-ESU	Compliance with drawing	BC
			8.5 Ensure that the general awareness of the crew is enhanced regarding the wildlife, through environmental training and notice boards provided by the contractor	CEnv	CSCEnv PMO-ESU	Compliance with Environmental and Wildlife Protection laws	DC Daily When required
			8.6 Contractor will provide clean source of energy at laborer camp and ensure wood and shrubs are not used as fuel during construction phase.	CEnv	CSCEnv PMO-ESU	Compliance with EIA/EMP	DC Daily Once a month
			8.7. Ensure camp waste/food waste is disposed off in such a way that animals are not attracted	CEnv	CSCEnv PMO-ESU	Compliance with Solid Waste Plan	Once a Week
			8.8 Ensure that fishing in the river by the project staff is avoided	CEnv	CSCEnv	Compliance with Wildlife Act	DC Routine

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
					PMO-ESU	Compliance with EIA	monitoring Once a month
			8.9 Contractor will monitor the noise level near the noise producing activities and use silencer or cordon off the work area with the noise absorbing panels to make sure the noise level within the is acceptable.	CEnv	CSCEnv PMO-ESU	Compliance with EIA/EMP	Daily
			8.10 Ensure that safe driving practices is observed so that accidental killing of human being and animals crossing the road could be avoided.	CEnv	CSCEnv PMO-ESU	Compliance with EIA/EMMP	DC Routing monitoring
			8.11 Vehicles and other equipment should only be serviced or repaired inside of the designated areas, away from the protected areas.	CEnv	CSCEnv PMO-ESU	System in place	DC Routing monitoring
			8.12 The soil loss due to unsustainable land use practices and developments in the game reserve area must be minimized.	CEnv	CSCEnv PMO-ESU	Compliance	DC weekly

Table 8.2: Social Impact Mitigation Plan

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
1	**Contractor's Facilities Development**	loss of private land, assets and income opportunities; damage to crops	1.1 All sites required for construction activities, camps, offices and workshops are owned by IPD, and no private land acquisition is envisaged. If contractor required private land on temporary basis for contractor's facilities then SFA will be completed and dually signed by the Contractor and land owner.	CEnv	CSCEnv PMO-ESU	Photographs; a statement signed by PMO that no private land is involved.	Before start of works.
2	Water consumption	Water shortage for the local communities	2.1 Avoiding wastage of water through conservation techniques and selection of adequate water supply sources, ensuring no impact on local consumptions.	CEnv	CSCEnv PMO-ESU	System in place; evidence of community consent if community source is used.	Before start of works, then randomly.
			2.2. Contractor will maintain the water consumption record during the construction stage.	CEnv	CSCEnv PMO-ESU	Record Sheets	During Construction Randomly
3	Social issues	Local conflicts; privacy of women	3.1. Contractor will ensure that conflicts with tribal leaders and local communities are avoided.	CEnv	CSCEnv PMO-ESU	Any sign of conflicts; community complaints	Randomly
			3.2 Contractor will inform the presence of foreigners (if any) in their area to women through traditional means of communication	CEnv	CSCEnv PMO-ESU	Community complaints. Evidence of information provided;	Randomly.
			3.3Ensure that individuals holding titles to private property used in the project (if any) are compensated in accordance with the market rates and all payments	CEnv	CSCEnv PMO-ESU	Community complaints. Availability of records;	Randomly

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			are recorded.				
			3.4. Contractor will ensure that project staff interaction with local community is minimized	CEnv	CSCEnv PMO-ESU	Compliance; community complaints	Randomly.
			3.5 Ensure regular inspection of relevant PMO and Environmental specialist of supervision consultant and gather complaints from Social / Environment Complaints Management Register and provide feedback to the concerned on the compliance status.	CSCEnv PMO-ESU CEnv	CSCEnv PMO-ESU	Evidence/records of visits; community complaints	Randomly.
4.	**Public health and safety issues**	health hazard for local population and project staff	4, 1 Health, Safety and Environment (HSE) plan will be developed and implemented by the contractor.	CEnv	CSCEnv PMO-ESU	Plan in place and operational	Once at the start of works, then randomly.
			4.2 The contractor will ensure that medical staff headed by qualified medical doctor, first aid equipment and stores, sick bay and suitable ambulance service are available at the camps all time.	CEnv	CSCEnv PMO-ESU	System and staff in place; community complaints	Once at the start of works, then randomly.
			4.3 A proper screening of laborer should be done at the time of recruitment. Ensure that periodic awareness campaigns for HIV/AIDS are undertaken for the project staff.	CEnv	CSCEnv PMO-ESU	Availability of record; evidence of training provided to staff.	Once at the start of works, then randomly.
			4.4 Contractor will ensure that a risk assessment of the spread of HIV/AIDS is undertaken in the project area on the basis of data from the Punjab HIV/AIDS program.	CEnv	CSCEnv PMO-ESU	Availability of record;	Daily When required
			4.5 Contractor will provide potable water and also shadow area to the workers at work place area for short breaks	CEnv	CSCEnv PMO-ESU	System in place.	Once at the start of works, then randomly.

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			4.6 The Contractor will depute guards at all entry points into construction sites 24 hours a day.	CEnv	CSCEnv PMO-ESU	Compliance.	Randomly
			4, 7 The Contractor will provide PPEs to all workers working at site for their safety.	CEnv	CSCEnv PMO-ESU	HSES plan in place; availability of PPE.	Once at the start of works, then randomly.
			4.8 Contractor will ensure no machinery is left unattended in the project area.	CEnv	CSCEnv PMO-ESU	Compliance.	Randomly
			4.9 The medical staff ensure periodical checks of the cooking staff and cooking practice particularly for symptoms of hepatitis A	CEnv	CSCEnv PMO-ESU	Medical Record	Randomly
			4.10 Contractor will ensure that use of horns is prohibited, except when necessary	CEnv	CSCEnv PMO-ESU	Compliance.	Randomly
5	Employment opportunities	Local disagreement associated with influx of workers from other parts of the country	5.1 Contractor will deploy maximum employment from the locals (unskilled). Skilled and semi-skilled will also be deployed provided the suitable competent persons with required qualifications/ experience are available	CEnv	CSCEnv PMO-ESU	Availability of record; community complaints.	Randomly.
			5.2 Ensure that inter tribal balance is maintained when giving employment to the local population. Preference to be given to the people directly affected by the project.	CEnv	CSCEnv PMO-ESU	Availability of record; community complaints.	Randomly.
6.	Restoration/ Rehabilitation	The construction activities could affect the aesthetic / scenic value of the area	6.1 Ensure that all borrow sites are remediated as per contract requirements by the contractor	CEnv	CSCEnv PMO-ESU	Compliance Photograph record	After completion of excavating work
			6.2 Camp site is restored as per contract.	CEnv	CSCEnv PMO-ESU	Compliance	After completion of work
			6.3 All extra products / materials, solid and liquid will be disposed off in accordance with the requirement of the EA/EIA and contract document by the	CEnv	CSCEnv PMO-ESU	Compliance with Waste Disposal-Plan	After completion of work

Sr. No.	Project Components	Impacts	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency
				Executor	Monitor		
			contractor				
			6.4 All fencing and access gates relevant to construction activities will be removed at the completion of construction phase of the project	CEnv	CSCEnv PMO-ESU	Compliance with restoration guidelines	After completion of work
			6.5 All pits (including sumps and depression) will be backfilled unless agreed with the CSCEnv at the completion of the project	CEnv	CSCEnv PMO-ESU	Compliance	At completion of work
			6.6 The portion of the access track likely to be of no use for other activities will be restored by removing culverts and gravel topping at the completion of construction phase	CEnv	CSCEnv PMO-ESU	Compliance	After completion of work
			6.7 While abandoning sumps the extra cap of soil will be placed over them to allow for compaction by the contractor	CEnv	CSCEnv PMO-ESU	Compliance with restoration guidelines	After completion of work
			6.8 contractor will ensure that no potential conflicts arise with landowners during the restoration of the borrow areas	CEnv	CSCEnv PMO-ESU	Compliance with SFA	After completion of work

CENV -Contractor's Environmentalist ESU- Environmental Social Unit CSCENV- Construction Supervision Consultant Environmentalist

8.5 ENVIRONMENTAL AND SOCIAL MONITORING

8.5.1 Compliance Monitoring

The contractor through his Environmental Officer will carry out internal monitoring to ensure that all the environmental and social requirements detailed in Tables 1 and 2 are adequately implemented. The consultant's Environmentalist and ESU of PMO will monitor the implementation of the environmental and social mitigation measures. Proper checklists will be developed for this purpose (see Annex 2).

The main objectives of the compliance monitoring will be to:

- Confirm that the activities undertaken are in compliance with the EMP and other conditions identified by PMO and the Supervision Consultants.
- Thoroughly observe the civil and mechanical works conducted by, and the site facilities established by, the Contractor
- Document and communicate the observations to the concerned persons of project's parties so that the corrective action, if required, can be taken timely.
- Maintain a record of all incidents of the environmental and social significance, related actions and corrective measures.
- Prepare periodic reports of the environmental and social performance of the project.
- Develop an environmental issue tracking system for an effective monitoring and ensuring that all environmental and social concerns are identified and addressed in a timely manner.

8.5.2 Effects Monitoring

The effects monitoring will be carried out to determine the adequacy and effectiveness of the mitigation measures provided in the Mitigation Plans. The Effects Monitoring Plan is provided in Table 3. The effects monitoring has the following objectives:

- To verify that the impacts of the proposed project are within acceptable limits (as anticipated in EA/EIA Report), thus establishing credibility.
- To minimize the magnitude of effects, control the timing, location and level of the project activities/mitigation measures.
- To notify PMO and other regulatory agencies in case of adverse impacts or sudden changes in the anticipated impacts so that the corrective measures can be taken such as modification of mitigation measures and/or inclusion of additional mitigations.
- To facilitate research and development by documenting the effects of the proposed project that can be used to validate impact- predication techniques and provide a basis for more accurate impact prediction related to future projects.

8.5.3 Post-Project Monitoring

The objective of this monitoring will be to determine the level of residual impact of the project on physical, biological and socio-economic receptors of the project area. This monitoring

may be carried out within one month of the end of project activities. Post –project monitoring is included in effects monitoring, discussed above.

After the construction work a detail inspection by consultant, ESU and PMO will be conducted to verify that proper restoration work has been done and photographic evidence of the restoration work has been taken. Surrounding area of the proposed lake will be monitored to ensure there is no unexpected water logging or reduction in land productivity.

8.5.4 Third Party Monitoring

The Contractor will engage an approved laboratory from EPA Punjab for quarterly environmental monitoring as suggested in table 3 during construction phase of the project.

Table 8.3: Environmental Monitoring During Construction Phase

No.	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement
1	Ambient air quality	Construction site and batching plant site.	Laboratory based testing of NOx, SOx, CO and Particulate matter (PM10).	Quarterly
2	Quantity and quality of ground water used for domestic purposes.	Camp site and 1 km away from the camp site.	Water table depth, discharge capacity, laboratory-based testing of physical-chemical parameters, biological contamination, heavy metals and toxic organic compounds.	Quarterly
3	River Water Quality	At upstream and downstream of the construction site i.e. proposed weir site	Laboratory based testing of complete suite of contaminants as mentioned in the EA/EIA Report	Quarterly
3	Emission of dust, smoke and potential air pollutants from the construction machinery.	Construction sites, campsite, access roads, borrow areas	Dust, smoke, gases	Throughout construction phase
4	Visual check for exhaust emissions from the vehicles.	Construction sites, campsite, access roads, borrow areas.	Visible emissions.	During routine monitoring.
5	Visual check for vegetation loss	Construction site, campsite, access roads, borrow area	Type and number of tree species uprooted	At the beginning of construction activities.
6	Noise	Construction site, camp site, access roads, communities within 500m of construction site	Noise measurement	Once a week throughout the construction phase. Or as per requirement
7	Resource utilization	Project site.	Quantity of material used to include water and fuel	Daily during construction phase
8	Solid Waste Generation	On camp site and Construction site	Any sign of soil or water contamination; Any un-authorized waste dumping	Daily during whole construction phase.
9	Wastewater disposal	Camp sites, offices and construction site	Waste water generation rate, integrity and maintenance of the septic tanks and soaking pits, any sign of soil or water contamination	To be determined through water management techniques.
10	Oil wastes /spills	Oil storage area, vehicle washing lines; any other spill area.	Facilities to control the accidental oil spill as per oil spill contingency plan; any sign of soil or water contamination	Daily during construction phase
11	Socioeconomic issues	At project locations; settlements	Local people recruited for all manual laborer and other jobs for which local skill are available; grievances of and conflicts with communities;	During construction phase

8.6 COMMUNICATION AND DOCUMENTATION

Communication and documentation is the essential part of the EMP. The key features of such mechanism are:

8.6.1 Data Recording and Maintenance

All Forms to be used for recording information during the environmental monitoring. A standard format will be followed to correspond all the gathered data. Check boxes will be used as much as possible to facilitate data entry. Tracking system will be developed for each form.

8.6.2 Storage of Information

The database to be maintained may include the following information

- Training programs;
- Staff deployment;
- Non-compliances;
- Corrective actions
- Environmental data listed below:
  - Soil and land pollution
  - Disposal of excavated silt and earth
  - Disposal of waste
- Water resource
  - Quality
  - Quantity
- Fuel oil and chemical spills
- Vegetation/ tree record
- Record of wildlife
- Noise pollution
- Air and dust pollution
- Socio-economic data
- Site accidents
- Animals mortality

8.6.3 Meetings

The following environmental meetings during the project will be arranged

- Primary meeting for setting out the regular meetings framework
- Scheduled meetings between Contractor and Supervising Consultant
- Environmental Progress Review Meeting (EPRM) among ESU of PMO, Environmental Specialist of the Supervision Consultant and Environmental Officer of the Contractor

The purpose of meetings will be to discuss the conduct of the operation, non - compliances noted by the consultant's environmental team and measures for their remedy. The meeting will be recorded in the form of a daily/monthly environmental report.

8.6.4 Reports

The Environmental Specialist of the Supervision Consultant shall produce periodic reports as well as inspection notes based upon the visits to the Project site. This information shall make a basis for ESU for their further reporting or visiting the site. All reports shall be location and activity specific. The reports shall especially identify areas of contractor's non-compliances with the EMP and provide guiding remarks on actions to be taken. The significance of the non-compliances shall also be noted. Copies of these reports shall be sent to the Resident Engineer (RE) who shall forward them to the Team Leader, Head PMO, Punjab Irrigation Department and the Contractor for their action(s).

The RE will include in his routine reports a summary status of activities relating to the EMP. Supplemental reports on issues should also be prepared as and when required. The reports will be prepared, reviewed and distributed according to reporting mechanism provided in Table-8.4.

Table-8.4 Periodic Reports

Report	***To be Prepared by***	***To be Reviewed by***	***Distribution***
Daily	-Contractor's HSE officers	-Contractor environmental officer -Consultant's Environmental Specialists	-Resident Engineer
Monthly	-Environmental officer of the Contractor	-Consultant's Environmental Specialists	- Resident Engineer -PMO
Quarterly	-Environmental team of the Construction Supervision Consultants	-ESU of PMO	-Resident Engineer -PMO -PID -ADB - EPA Punjab
Bi-Annual Environmental Monitoring Report	Environmental team of the Construction Supervision Consultants	ESU of PMO	Resident Engineer -PMO -PID -ADB - EPA Punjab
Final	-Environmental team of the Construction Supervision Consultants	-ESU of PMO	-Resident Engineer -PMO -PID -EPA Punjab -ADB

8.6.5 Photographic Record of the Project Area

Key locations shall be identified for taking Photographs of the project area by using digital camera before the construction starts and the following information shall be recorded for each shot on a prescribed form

- Shot number
- Name of Photograph
- Date
- Time
- Featured Photograph
- Other observations

Photographs shall be retaken for the key location after completion of all activities.

8.6.6 Social Complaints Register

The stakeholders or affected people's concerns, complaints and grievances about the project environmental performance will be received, recorded and replied in a systematic way using an understandable and transparent process that is gender responsive, culturally appropriate and readily accessible to all segments of the affected people at no cost and without retribution.

The Contractor will maintain a social complaint register at camp site office to document all complaints received from the local communities. The register will also record the measures taken to mitigate these concerns. The final report will be communicated to Environmental & Social section of PMO. The Project Monitoring team shall carry out the monitoring of the implementation of social and environmental mitigation measures as per ADB Safeguard Policies.

8.6.7 Training Module

The environmental and social training will help to ensure that the requirement of the EMP are clearly understood and followed by all project personnel. The primary responsibility of providing these training to all project personnel will be that of the Contractor and Supervision Consultants. Contractor will arrange and implementation of the training plan. The training will be given to the different professional groups separately such as manager level group, work supervisors, skilled/unskilled labour etc. Tentative training plan of 10 sessions which will be finalized before the commencement of the project by the supervision consultant is given in Table 8.5

Table8.5 Training Plan

Trainee	Trainer	Contents	Schedule
Selected field staff of PMO and Supervision Consultant	ESU Specialists; Environmentalist of Supervision Consultant	Environmental and social aspects, particularly sensitivities of the project; Key finding of the EA; Social and cultural values of the area;	Before construction activities
All site personnel • Contractor: Managerial staff, Engineers, Environment, Social, Health and Safety staff • Consultants: Managerial staff and Engineers	ESU & Environmentalist of Supervision Consultant	Environmental and social aspects, key finding of the EA; Mitigation measures; Contingency plan; Community issues; Social and cultural values of the area	Before and during construction stage
Construction crew	Environmentalist of Supervision Consultant and Environmental Manager of Contractor	EMP; Waste disposal plan; HSE plan	Before and during construction stage
Drivers	Environmental Manager of Contractor; Environmentalist of Supervision Consultant	HSE plan; Road safety; Road restrictions; Vehicle restrictions; Defensive driving; Waste disposal; Social and cultural values of the area.	Before and during the construction
Camp staff	Environmental Manager of Contractor	HSE plan; Camp operation; Waste disposal; Natural resource conservation; Housekeeping	Before and during the construction
Restoration team	Environmentalist of Supervision Consultant	Waste disposal; Site restoration; Levelling and restoration of borrow area	Before the start of the restoration activity

8.7 GRIEVANCE REDRESS MECHANISM

This section describes mechanism to receive and facilitate the resolution of affected persons' concerns and grievances. It explains how the procedures are accessible to aggrieved party (AP) including women. A grievance mechanism will be available to allow an AP appealing any disagreeable decision, practice or activity arising from land or other assets compensation. APs will be fully informed of their rights and of the procedures for addressing complaints whether verbally or in writing during consultation, survey, and time of compensation. It is preferred that APs/local community should submit their complaints/ concerns and issues formally and accordingly the project staff will enter the complaint on Community Complaint Register (CCR) comprising of a minimum information such as the name and address of complainer, description of complaint, action taken, status of resolution of complaints and other necessary information/ record and reasons; in case the issue is not resolved. Proper consideration will be given to avoid the grievances rather than going through a redress process.

A Grievance Redress Committee (GRC) will be established at both project and field level. GRC at project level will include the Project director, representative of PMO/ PID, Social Safeguards staff of ESU, representatives of APs/ or local community and representatives of concerned FO (if any).

The GRC at project level will include the following members:

i). PD (PMO)
ii). Representative (PMO)
iii). Representative of AP / FO

This GRC will work both at the project and field level. The PMO field staff will inform the aggrieved party about GRC and mechanism by registering their concerns at concerned office. The complaints will be registered by maintaining community complaints register (CCR), where the name & address of complainer, date, description of complaint and action taken will be entered.

The GRC at field (District) level will include:

i). Executive Engineer / Sub-Engineer
ii). Social Mobilizer
iii). Patwari (land record keeper)
iv). Representative of AP/ FO

Table 8.6: Community Complaints/ Grievance Redress Process

Land Compensation Issues	Other Items Compensation Issues
• First, complaint resolution will be attempted at site (field level) through the	• First, complaints resolution will be attempted at site (field level) through the

Land Compensation Issues	Other Items Compensation Issues
involvement of the PMO/ informal committee/ and or concerned FO (if any).	involvement of the PMO/ informal committee/ and or concerned FO (if any).
• If unsettled, a grievance can then be lodged to the DO (Revenue)/ LAC who has 14 days to decide on the case.	• If no solution is reached, a grievance can be lodged to GRC. The GRC will provide the decision within 3 weeks of registering the complaint.
• If no solution is reached, a grievance can be lodged to GRC. The GRC will provide the decision within 3 weeks of registering the complaint.	• If the grievance redress system does not satisfy the DPs, they can pursue further by submitting their case to the appropriate court of law.
• In case, the grievance redressal system does not satisfy the DFs/ DPs, then they can pursue further by submitting their case to the appropriate court of law as per the process set out in Section 18 to 22 of the LAA 1894.	

GRC will meet atleast once a month and the decision of GRC would be the final. In general the functions of the GRC will be to:

- Provide support to DPs on problems arising out of their land / property acquisition
- Record the gievance of the DPs, categorize and priorities the grievances that need to be resolved by either committee; and
- Report to the aggrieved parties about the development regarding their grievances and the decsion of the project authorities.

All expense incurred in arranging grievance negotiations and meetins of GRC as well as logistics, shall be arranged by the project executing agency / implementation agency.

8.8 SOLID WASTE DISPOSAL PLAN

This component describes the waste disposal plan that will be employed during the construction and restoration period. A detailed Solid Waste Management Plan will be prepared as part of the SSEMP by the contractor. The main types of waste to be disposed off include:

- Waste generated during construction;
- Fuel, oils, and chemicals;
- Sewage;
- Camp site waste (Domestic waste);
- Packing waste;
- Excess construction material and
- Medical waste

Domestic waste and construction waste will be the main type of waste generated from Labour Camp and construction activities. Domestic waste contains high percentage of readily degradable hydrocarbon which gives bad smell on decomposition, especially in hot and humid environment. Construction waste classified as inert waste and need to be dispose off at nominated site only in order to avoid any drainage issue. It is recommended to collect the domestic waste and construction waste separately. The Contractor will adopt 3 Rs (reduce, reuse and recycle) technique for proper disposal of solid waste.

8.7.1 Domestic Waste

- All the waste generated at Labour Camp should be collected and temporarily stored at the designated bunded area within the labour camp before collected by the local authority or send to the approved disposal site.
- The area should be prepared, maintained and visually inspected and recorded on regular basis by the Environment Officer of the contractor.
- The waste storage area should be fenced to stop animal's direct contact with the waste. The site must be decontaminated to keep the building free from foul smells, spreading of diseases and healthy working environment on regular basis.
- It is the responsibility of Contractor to arrange the waste collection from the Labour Camp with local authority on regular basis, preferably twice a week or minimum once every week.
- Waste Chute should be provided within the Labour Camp. Chute will enable the collection of thrown solid in the covered storage site.
- Biodegradable bags should be provided to the occupants and residents of the labour camp for collecting their waste.
- Implement resource conservation and recover recyclable waste e.g. paper, steel cans, glass bottles etc. from the collected waste and divert the filtered waste to the waste disposal pit.

8.7.2. Construction Waste

- Construction waste could be reused as a fill material or construction material. However, the detail testing should be undertaken to confirm the suitability of the waste, if it is used as a construction material.
- If the construction waste is disposed off in construction waste disposal site then once the hole filled with the waste the top of the fill should be capped with clayed material and compacted to minimize water infiltration.
- The waste disposal site shall be selected with the collaboration of Supervision Consultant ensuring the site away from settlement, water body and preferably waste land.

8.7.3 Special Waste

Collection and disposal of special waste e.g. medical waste or used oil from equipment and machinery yard shall be arranged with specialized disposal contractor. Medical waste can also be sent to the local Tehsil or district hospital to dispose of with other hospital waste.

8.8 TRAFFIC MANAGEMENT PLAN

In order to manage the site traffic movement and enforcement of speed limit at site, the Contractor will be responsible for preparation and seeking approval of the Traffic Management Plan before commencing construction work from the construction supervision consultant.

The existing traffic facilities for public transportation will not be disturbed from the project activities. Any damage to local roads due to project activities will be restored by the contractor, as per contractor's contractual obligations. The temporary access tracks for labour camp and batching plant should be designed and constructed considering the load limit and vehicle types.

The following steps are suggested for proper management of traffic on routes by the Contractor:

i. The Contractor will display sign boards and banners about traffic diversion or alteration in road layout at places on detour routes.
ii. He will ensure the presence of, at appropriate places particularly near settlements, a traffic man to control traffic.
iii. Provision of speed breakers at appropriate places in consultation with/approval of the Engineer and relevant authorities which should also be removed after completion of the project.
iv. Obey speed limits as prescribed in Environmental Management Plan.
v. The Contractor will provide copies of his day to day traffic management strategy to the Engineer.
vi. The Contractor will arrange a rescue team and first-aid facility in case of any accident.
vii. The Contractor will keep the smoke emission of the vehicles within NEQS.
viii. Water will be sprinkled on earthen routes to control dust emissions.
ix. No private property without permission of the owner will be used for transportation.
x. Restriction on playing radio/tapes at high volumes.
xi. Restriction on use of noise producing machinery during night near settlements.
xii. The detailed traffic management plan will be prepared by contractor prior to construction works

8.9 EMERGENCY RESPONSE AND CONTINGENCY PLAN

If any of the results of the environmental monitoring/sampling exceeds specified trigger levels of the monitored parameters, the appropriate actions will be undertaken to prevent hazard to human life, property and minimize any immediate risks of pollution of the environment, ensure the immediate initiation of necessary investigation and management

actions to identify, mitigate and remedy the cause of the accident. Initiate training and periodic testing/checking when necessary.

The probabilities of accident such as oil spills, accidental habitat destruction, water or air pollution and encountering of high flow are low. However, such accidents may occur and overall environmental emergency response method may be used;

- Obtain an early warning of the emergency conditions so as to avoid adverse impacts on the environment
- Safeguard personnel to prevent injuries or loss of life
- Minimize the impact of such event on the environment by mitigating the potential for escalation and containing of the hazards
- Site In-charge should have permanent mode of contact (e.g. mobile phone or walkie talkie) with the HSE officer.
- Contact name and number of HSE officer should be available in site office and displayed on site office notice board.

In the event of any emergency the In-charge Site HSE/Environment Manager or a member of the HSE team shall take the following actions:

- Shall attend site of incident; assess the situation and issue directions to the concerned parties and to the Fire Fighting Team in case of fire
- Ensure that message about the incident have been communicated to Site Manager / Environment Manager of the Contractor
- Evaluate the scale of the incident and decide whether additional resources are required to deal with it adequately
- Liaise with site supervision staff for withdrawing any working permits
- Liaise with site supervision staff for the mobilization of any plants and equipment necessary for dealing with the emergency
- Limit access to the area with barriers, or other means to prevent unauthorized access
- Co-ordinate the re-instatement measures following stabilization of incident
- Maintain the records of the incident/ accident and prepare a full report of the event
- Take prompt and appropriate actions for defined events such as serious illness/injury, fatality, and snake bite etc.

It is the responsibility of the Contractor to provide at least one First Aider during working hours on site to handle emergency conditions and accidents. The Contractor will ensure the availability of MBBS doctor, paramedic staff and an Ambulance on full time basis at the Contractor's camp. The Contractor will also get a hospital on panel for critically injured persons. The First Aid provider at working area will perform the following duties.

i. Keep all necessary first aid medicines and bandages in the first aid box at every time
ii. Replace the medicines before their expiry dates

iii. Provide first aid to the injured in the event of accident

iv. Report any accident / incident to the environmental manager immediately for necessary action

v. Call ambulance in case of any serious emergency

Emergency siren should be installed at the project site and at camp site to inform the site worker about any emergency situation. The operation of the siren will be controlled by the HSE officer or his nominated person. The designated assembly area should also be marked and informed to site worker.

8.10 HEALTH, SAFETY AND ENVIRONMENT (HSE) PLAN

It is the Contractor's obligations to provide and implement the Health, Safety and Environment (HSE) Plan. The purpose of this HSE Plan is to identify the potential impacts and to develop a mechanism for a better management of health, safety and environment (HSE) issues relating to the project. A detailed HSE Plan will be submitted by the Contractor to The Engineer and PMO for approval.

Objectives: The HSE objectives include but are not limited to the following:

- Avoidance of all possible injuries during the execution of the project.
- Ensuring that all personnel employed on the Project are competent to carry out their designated safety tasks
- Developing positive health, safety and environmental protection attitude and perceptions at all levels of the project organization and creating safety and environmental awareness in general
- Implementing training programmes that support the achievement of the Contractor's staff and personnel's competency in relation to health, safety and environment
- Completing the project without incurring any significant property damage to the adjacent permanent structures or temporary facilities
- Completing the project without causing unnecessary risks and damage to the surrounding environment
- Implementing a hierarchy of communication forums that ensure that HSE concerns are raised and addressed at all levels of the organization
- Introducing methodology of motivating "good" safety and environmental performance
- Continuous monitoring and improve HSE performance

Site HSE Rules: The following HSE rules must be strictly followed:

- HSE orientation sessions before starting work
- Wearing of personal protective equipments
- Follow the message and instructions displayed on HSE notice boards at site
- Be aware of emergency assembly points and escape routes
- Promptly report all accidents to the concerned authority
- Maintain appropriate barricades as required
- Never temper with electrical cables and appliances
- The construction site should be designated as "NO SMOKING" area

- Vehicles must be driven at designated routes and drivers must have driving license for the class of vehicle they are operating
- Vehicles shall only be parked in designated parking areas

Health, Safety and Hygiene: The measures should include:

- Initial medical examination of all employees of the Contractor to verify their fitness for work
- Provide a group insurance cover to the workers and labour on site or in the camp, against accidents, mishaps or loss of life on duty
- Monthly talks on occupational health
- Provision of qualified medical personnel and adequate medical facilities to the staff
- First Aid trainings
- Provision of hygienic food to the employees
- Provision of drainage, sewerage and septic tanks in office buildings and camp areas
- Good housekeeping practices should be ensured at camp sites, construction sites and batching plant site

Security: Security measures should include:

- Provision of Identity Card to the employees
- Regular attendance and a controlled time keeping of all employees
- Proper checking of visitors
- Restriction of un-authorized persons to the residential and work areas
- Restriction of carrying weapons and control hunting by employees
- Provision of boundary walls / fences with proper exits to office and residential area.

8.10 TREE PLANTATION PLAN

The cutting/uprooting of trees will not require for the project implementation. However, in case any tree damaged due to project activities the contractor will pay the cost of tree (in case it is a privately-owned tree) to the tree owner and plant minimum 5 more trees in the area. In addition, contractor will plant minimum 10,000 local species of woody trees on the available state land in the project vicinity in order to fulfill the requirement of Environment Protection Agency (EPA) Punjab. The detailed Tree Plantation Plan will be prepared and implemented by the Contractor and verified by the Engineer during construction phase of the project.

8.11 BORROW AREAS RESTORATION

Borrow material may be required for the construction activities and establishing contractor's facilities. Contractor will prepare the Borrow Area Management Plan and get its approved from the Supervision Consultant. Photographic record will be kept before and after the land use of borrow area.

Depressions and pits should not be left unfilled/open such that these are unusable and can be filled with rain water and providing breeding place for mosquitoes or cause any health and safety issues.

Agriculture land should be restored such that it can be used for the agricultural purpose. The restoration of agricultural land includes but not limited to the following steps:

- Remove 6 inches of the topsoil and store it separately separate on site for its re-spread back on the levelled borrow area
- Excavate up to a maximum depth of 3 feet
- Level slopes as far as possible
- Restore the site to its original state or as per the satisfaction of the land owner

8.12 RISK MANAGEMENT PLAN

The outline of the Risk Management Plan is provided in this section. The detailed and more precise plan should be prepared and implemented on site by the contractor. The Plan identifies the possible hazards associated with the project activities, consequences of the occurrence, probability of the occurrence and action to reduce the risk to acceptable level i.e. low to medium.

Table 8.7 Risk Management Plan

Hazards	Consequences of Occurrence (Severity-L,M,H)	Probability of Occurrence (L, M, H)	Risk (L, M, H)	Action to Manage the Risk	Residual Risk
Oil, Chemical Spills	Contaminate land and control water bodies (H)	H	H	-Select the location of material storage yard away from the water bodies -Store material on bunded area with impermeable layer -Good housekeeping -Loading and unloading of material should be managed by a competent person -Spill kit should be available to deal with small spills	M
Adverse Environmental Impacts on River Ecology due to Construction Activities	Deteriorate natural habitat of River Ecology area (L)	H	M	-Implementation of the control measures to mitigate impact on biological resources -Select appropriate plant and equipment and enforce the speed limit for site traffic to minimize the noise and dust pollution	L
Failure in Plant and Equipment e.g. lifting gears etc.	Fatality or serious injury (H)	M	H	-Inspect all the equipment including lifting chains and ropes at the start of the work -A competent person should manage the work on site -Use appropriate PPEs	L
Batching Plant	Deteriorate ambient air quality (M)	H	H	-Select batching plant location away from the living area or provide wet scrubbers to the plant -Should not operate outside working hours i.e. night time or early morning -All the workers working at the plant should wear proper PPEs (breathing masks, gloves, eye protection etc.)	L
Smoke from Burning	Cause suffocation and diseases of respiratory tract (H)	M	H	-Provide smoke free fuel at labour camp -Cutting and burning of trees shall be prohibited -Waste burning at site shall be prohibited	L

Hazards	Consequences of Occurrence (Severity-L,M,H)	Probability of Occurrence (L, M, H)	Risk (L, M, H)	Action to Manage the Risk	Residual Risk
Road Accidents due to Construction Work Activities	Casualty, serious injury, damage to infrastructure (H)	M	H	-Prepare and implement Traffic Management Plan and implement on site with the collaboration of relevant authorities	L
Adverse Social Impacts due to Migrating Labour from Other Parts of the Country	Extra burden on existing welfare facilities. Presence of large number of outsiders may trigger communicable diseases (H)	M	H	-Improve and increase the capacity of available existing services to cope with the requirement of additional users -Run a campaign within the labour camp and local community to make people aware of the cause, mode of transmission and consequences of communicable diseases e.g. HIV/AIDS, tuberculosis, typhoid, cholera etc. -give maximum jobs to local community and avoid migration of people from other part of the country.	L

8.14 ENVIRONMENTAL MANAGEMENT COST

- **Environmental Monitoring Cost**

River water should be tested on quarterly basis at the barrage during barrage structure repair, motorization for gate operating system. Samples should be collected from upstream and downstream of the barrage during the construction phase. The samples should be tested for all parameters of NEQS (inland waters) and FAO guidelines (for irrigation, livestock and poultry). The approximate cost of monitoring of river water quality, assuming 2 years of construction phase is Rs. 600,000. Dissolved Oxygen, pH and Electrical Conductivity (EC) of the river water should be monitored on monthly basis during construction phase.

Groundwater should be tested on quarterly basis. Testing is also required at the start of the project before using the groundwater as a source of water supply. The samples should be collected from all the sources of groundwater use by the Contractor onsite i.e. hand pumps, tubewell etc. The parameters need to be tested include NEQS for drinking water quality and FAO guidelines (for irrigation, livestock and poultry). The cost of monitoring the groundwater is Rs. 400,000.

Laboratory based air quality monitoring (NO_x, SO_x, CO, PM_{10} and $PM_{2.5}$) should be monitored quarterly basis and visual monitoring of dust pollution should be conducted on daily basis during the project activities which are likely to produce dust. The approximate cost of Ambient Air Monitoring over 2 years of construction phase is Rs. 5.50,000 Noise should be monitored once a week throughout the construction phase and 3 times on each working day for every noise producing activity. The approximate cost of the Noise monitoring is Rs. 150,000.

Ecological environment of the area shall be monitored by the contractor's environmental team on regular basis during construction phase of the project. Any losses in flora & fauna due to project implementation shall be recorded and documented in the periodic environmental reports.

The approximate total cost of the Environmental monitoring during construction phase is Rs.1.65 million.

The required environmental monitoring is summarized below.

Table 8.8 Environmental Monitoring Plan for the Construction Phase

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
i. Construction Phase					
A. **Physical Monitoring**					
1.	Ambient air quality	Barrage, batching plant site and labor camp site	NOx, SOx, CO and particulate matter ($PM_{2.5}$, PM_{10})	Quarterly	Contractor
2.	Quantity and quality of groundwater used for domestic purposes	Camp site and 1 km away from the camp site	Water table depth, discharge, physical-chemical parameters, biological contamination, heavy metals and toxic organic compounds	Bi-annually	Contractor
3.	Quality of surface water used for construction activities	At source of surface water used	DO, EC, pH and TDS	Monthly	Contractor
			Full suite of contaminants given in main report of EIA (in ch. 4)	Bi-annually	Contractor
4.	Dust emission from the construction activities	Construction sites, camp site, access roads and borrow areas	Visual observations for dust	Throughout construction phase	Contractor
5.	Visual check for exhaust emissions from the vehicles	Construction sites, camp site, access roads, borrow areas	Visible emissions	During routine monitoring	Contractor
6.	Noise	Construction site, camp site, Game reserve boundary, access roads, communities within 500 m of construction site	Noise measurement	Once a week throughout the construction phase. Daily at each work place area.	Contractor
7.	Soil erosion	Construction site, camp site, access roads, borrow area	Visual observations for sheet or rill/gully erosion	During routine monitoring of entire project activities especially after rains	Contractor

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
8.	Resource utilization	Project site	Quantity of material used to include water and fuel	Daily during construction phase	Contractor
9.	Solid waste generation	On camp site and Construction site	Any sign of soil or water contamination; any un-disposed waste	Daily during whole construction phase	Contractor
10.	Wastewater generation	Camp site, offices, colony and construction site	Wastewater generation rate, integrity and maintenance of the septic tanks and soaking pits, any sign of soil or water contamination	To be determined through water management techniques	Contractor
11.	Oil wastes /spills	Oil storage area, vehicle washing lines; any other spill area	Facilities to control the accidental oil spill as per oil spill contingency plan; any sign of soil or water contamination	Daily during construction phase	Contractor
12.	Monitoring of water flows in the Rivers and Canals	Trimmu Barrage and various location in the Canals	Water flows. Also vigilance on any water thefts in particular during low flow periods	Throughout the construction period	Contractor
B. **Biological Monitoring**					
13.	Visual check for vegetation/tree loss	Construction site, camp site, access roads, borrow area, River bella	Type and number of tree species uprooted	At the beginning of construction activities and as and when required basis	Contractor
14.	Visual check for fauna loss	Construction site, camp site, access roads, borrow area, River bela, fish ladder	Mammals, Reptiles and Amphibians, Fish, Birds Illegal hunting, poaching, killing of mammals and reptiles (river) and water birds	At the beginning of construction activities and as and when required basis	Contractor

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
C. **Socio-Economic Monitoring**					
15.	Socioeconomic issues	At project locations; settlements	Local people recruited for all manual labor and other jobs for which local skill are available; grievances of and conflicts with communities	During construction phase	Contractor
16.	Safety measures for local population particularly women, children and elderly people	Haulage routes Entire project area	Accident risks, particularly for local population especially women, children and elderly people	Construction period	Contractor
17.	Vulnerability to accidents, human/animal accident risks	Entire project area	Accident and health risks	Construction period	Contractor
18.	Cultural invasion	Entire project area	Community resistance to Contractor's attitude, outside labor Cultural clashes with outside labor (not observing sanctity of the Holy month of Ramdan, prayer timings and local customs and traditions etc.)	Construction period	Contractor
19.	Dispute between outside and local labor force for job hunting	Entire project area	Social disturbance because of dissatisfaction with employing outsiders	Construction period	Contractor

- **Environmental Audit Cost**

Environmental Audit should be carried out on annual basis and at the completion of the project by an independent consultant. The approximate cost of this item is Rs. 600,000.

- **Training Cost**

Training is considered to be an important part of environment awareness and all site management and work supervisors should undertake periodic training.

The Contractor will arrange to run a proper campaign among the workers to make people aware of the causes, mode of transmission and consequences of communicable diseases e.g. HIV/AIDS, tuberculosis, typhoid, cholera etc.

Contractor will arrange briefing given to all workers regarding the biological resources and wetland area. It should be cleared to the worker that unnecessary and out of bound activities / movements are strictly prohibited in the barrage pond area. All labor, forest and fisheries laws should be explained to the workers.

The approximate cost of training the site staff is Rs. 600,000.

- **Tree cutting Replenishment Cost/ New Plantation Cost**

The total estimated cost of the plantation/environmental improvement is Rs. 1 million.

- **Cost of Implementation of Emergency Plan**

The emergency plan will be prepared and presented in the final EIA report. The plan will be prepared to address any emergency conditions occur due to encounter unexpected flood, breach in cofferdam or accidental spill of oil or chemical. The approximate cost of dealing with unforeseen circumstances during construction phase is Rs. 600,000.

- **Special Waste Disposal Cost**

The cost for disposal of domestic waste for 2 years of construction phase including the preparation and maintenance of the temporary storage area is included in the Contractor's contractual obligations.

Specialized Contractor should be hired to dispose off the special waste i.e. clinical waste, electric batteries, waste oil etc. The approximate cost of the disposal of special waste is Rs. 600,000.

- **Water Supply and Wastewater Treatment Cost.**

It will be one of Contractor's contractual obligations to arrange the supply of running drinking water at appropriate pressure to the site workers. The access of the drinking water should be available to every site worker. The cost of this item is included in the Contractor's contractual obligations. Water sample from each water source should be collected and tested on quarterly basis to confirm its suitability for drinking purpose. The approximate cost of this item is Rs. 500,000.

It is proposed to treat the domestic wastewater generated from the labour camp, which should be collected with provision of underground sewer system before discharge to control water body. The cost of this item is included in the Contractor's contractual obligations.

A groundwater sample from the nearest source of groundwater from soaking pit i.e. tube well, hand pump, open well etc. will be collected and tested on quarterly basis by the Contractor in order to ensure that the wastewater disposal does not adversely affect the groundwater quality. The sample should be collected from the downstream of soaking pit in the envisaged flow direction of groundwater. The allocated cost for this testing is Rs. 500,000. The approximate total cost of the above-mentioned item is 1 million Rs.

- **Site Visits by Regulatory Authorities**

Inspections by stakeholder and concerned bodies for example WWF, Wildlife, Forest or Fishery Officers etc. should be facilitated in camps to facilitate a proper implementation of relevant laws. The approximate cost of this item is Rs. 600,000.

- **Traffic Management Cost**

The Traffic Management Plan will be prepared by the Contractor to manage the site traffic and public traffic during construction phase of the project to minimize the interruption in the flow of traffic and its adverse impacts on the environment of area. The approximate cost allocated for this item is 1.1 million rupees. The cost includes the provision of temporary traffic signals, controlling dust pollution, provision of barricading fence, safety sign boards speed breakers etc.

- **Restoration Cost**

The area being under the use of Contractor during construction phase should be restored at the completion of the project to the original level without any additional cost by the Contractor.

: **ENVIRONMENTAL MANAGEMENT COST OF ISLAM Barrage**

Sr. #	Activity	Cost (million PKR)
1	Environmental Monitoring Cost	1.65
2	Water Supply and Wastewater Treatment Cost	1.0
3	Environmental Audit Cost	0.6
4	Training Cost	0.6
5	Emergency Plan	0.6
6	Special Waste Disposal Cost	0.6
7	Site Visits by Regulatory Authorities	0.6
8	Traffic Impact Management Cost	1.1
9	Tree cutting Replenishment Cost/ New Plantation Cost	1.0
10	Extended Canal Closure Cost	1.0
	Total	**8.75**

9. FINDINGS AND CONCLUSIONS

This chapter presents the key findings and conclusions drawn from the Environmental and Social assessment carried out as part of present study.

9.1 FINDINGS

- The proposed project will result in an increase in the barrage discharge capacity and therefore the risk of damaging crop, infrastructure, livestock etc. due to uncontrolled breaching in case of flood will be minimized.
- There are no sensitive ecosystems / habitats in the project affected area.
- The construction work could offer employment opportunities to hundreds of local semi-skilled and skilled workers.
- The adverse environmental impacts will be site specific occurring mostly during the construction phase;
- There are no known archaeological or historic sites or monuments in the area which could be affected by the project activities.
- No indigenous or vulnerable group of people was identified in the project area, which could be affected by the project.
- Displacement of people involved in the project execution, therefore RP will be prepared to compensate their assets/losses of the affected families (AF).
- No land acquisition is involved during the project execution.

9.2 CONCLUSIONS

The potential impacts of the project are associated with loss of existing physical infrastructure present at left and right guide bunds and the construction activities. All construction activities impacts are temporary and localized in nature. These impacts will be adequately addressed through implementing the appropriate mitigation measures, which have been included in EMP. Impacts associated with displacement of Affected Families (AFs) will be mitigated through development and implementation of Resettlement Plan (RP). Hence there will not be any lasting impacts of the project on the environment and communities of the area, provided that the mitigation measures included in EMP & RP are adequately implemented. On the other hand, project will likely stability of the existing structures against floods, erosion, and sedimentation; (i) increasing the flood passage capacities of the Islam barrage from 7,560 m3/s to 9,401 m3/s (24% increase); and (ii) capacity development of the communities in the vicinity of the Islam barrage, through upgrading of a girls' schools, construction of a family park, and the provision of livelihood training of 150 community members (50% women). Therefore, it is concluded that this project is environmentally friendly, financially viable, economically sustainable, generally neutral and pro-poverty alleviation.

ANNEXES

Annex-1- Annual Peak Discharges of River Sutlej at Islam Barrage (1927- 2016)

Year	Discharge Through		Total Annual Peak Discharge	Remarks
	Barrage	Breaches/Canals (Estimated)		
1927	114,328		114,328	
1928	87,797		87,797	
1929	228,500		228,500	
1930	211,485		211,485	
1931	142,028		142,028	
1932	179,243		179,243	
1933	149,867		149,867	
1934	136,853		136,853	
1935	135,518		135,518	
1936	130,025		130,025	
1937	171,046		171,046	
1938	152,167		152,167	
1939	80,101		80,101	
1940	96,831		96,831	
1941	115,636		115,636	
1942	272,752		272,752	
1943	228,882		228,882	
1944	110,136		110,136	
1945	122,403		122,403	
1946	135,825		135,825	
1947	285,254		285,254	
1948	284,742		284,742	
1949	99,404		99,404	
1950	270,800		270,800	
1951	59,911		59,911	
1952	142,002		142,002	
1953	147,098		147,098	
1954	176,189		176,189	
1955	342,581	150,000	492581	Breaches and cuts in Left and Right Retired Embankments (Maximum Recorded Discharge)
1956	160,477		160,477	
1957	180,232		180,232	
1958	212,702		212,702	
1959	147,494		147,494	
1960	130,035		130,035	
1961	212,702		212,702	

1962	158,365		158,365	
1963	113,285		113,285	
1964	134,213		134,213	
1965	58,136		58,136	
1966	107,565		107,565	
1967	128,721		128,721	
1968	67,639		67,639	
1969	105,438		105,438	
1970	83,568		83,568	
1971	167,880		167,880	
1972	55,393		55,393	
1973	166,453		166,453	
1974	8,080		8,080	
1975	4,995		4,995	
1976	111,476		111,476	
1977	36,796		36,796	
1978	135,033		135,033	
1979	120,220		120,220	
1980	39,616		39,616	
1981	14,300		14,300	
1982	14,381		14,381	
1983	37,271		37,271	
1984	25,941		25,941	
1985	27,528		27,528	
1986	17,528		17,528	
1987	8,879		8,879	
1988	306,425		306,425	
1989	10,383		10,383	
1990	122,117		122,117	
1991	14,281		14,281	
1992	182,637		182,637	
1993	89,155		89,155	
1994	91,880		91,880	
1995	183,902		183,902	
1996	46,190		46,190	
1997	39,758		39,758	
1998	66,320		66,320	
1999	12,244		12,244	
2000	13,763		13,763	
2001	3,482		3,482	
2002	2,849		2,849	
2003	1,720		1,720	
2004	11,751		11,751	
2005	14,422		16,272	
2006	16,973		16,973	
2007	10,785		10,785	
2008	35,081		35,081	
2009	6,396		6,396	
2010	31,454		31,454	
2011	49,706		49,706	

2012	13,938		13,938	
2013	70,932		70,932	
2014	19,832		19,832	
2015	43,943		43,943	
2016	15,301		15,301	
2017	14,221		14,221	

Annex-2

1290 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

(1) for Annex, I the following shall be substituted, namely:_____

Annex-I

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Existing Standards	Revised Standards Into Inland Waters	Into Sewage Treatment [5]	Into Sea [ ]
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C [1]	80	80	250	80**
4.	Chemical Oxygen Demand (COD) [1]	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) [2]	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides [3]	0.15	0.15	0.15	0.15

1	2	3	4	5	6
17.	Cadmium [4]	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent [4].. ..	1.0	1.0	1.0	1.0
19.	Cooper [4]	1.0	1.0	1.0	1.0
20.	Lead [4]	0.5	0.5	0.5	0.5
21.	Mercury [4]	0.01	0.01	0.01	0.01
22.	Selenium [4]	0.5	0.5	0.5	0.5
23.	Nickel [4].. ..	1.0	1.0	1.0	1.0
24.	Silver [4]	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic [4].. ..	1.0	1.0	1.0	1.0
28.	Barium [4]	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron [4]	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/I is achieved by the sewage treatment system.

Annex-3 Rapid Environmental Assessment report

ADB's Environment Policy

Rapid Environmental Assessment (REA) Checklist

IRRIGATION

Country/Project Title: **Pakistan / Islam Barrage Rehabilitation and Upgrading**

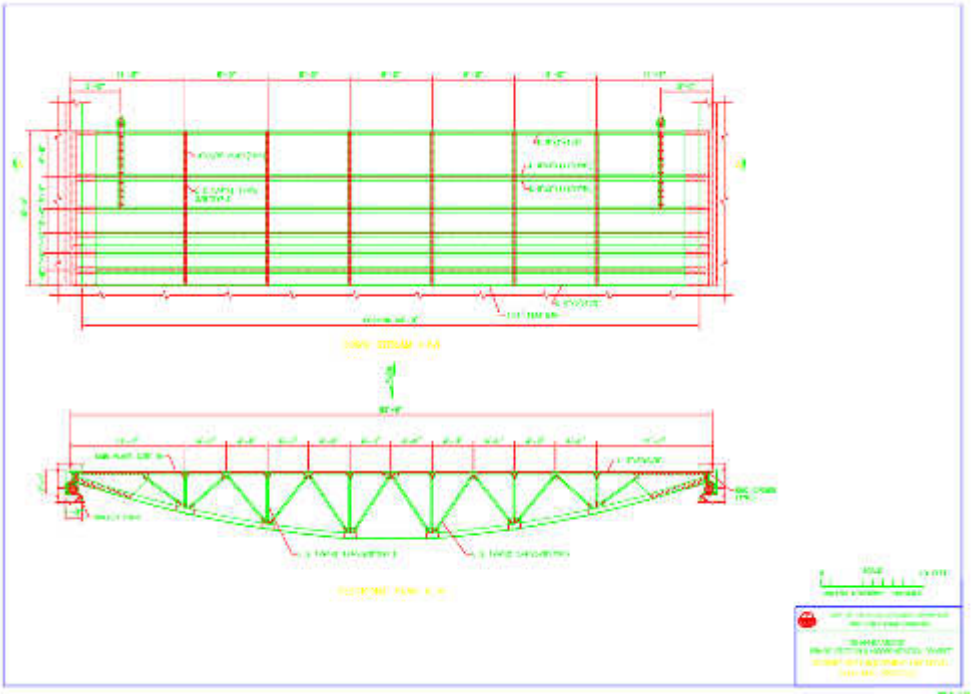
Prepared by: **Water Resources Division NESPAK (Project Consultant)**

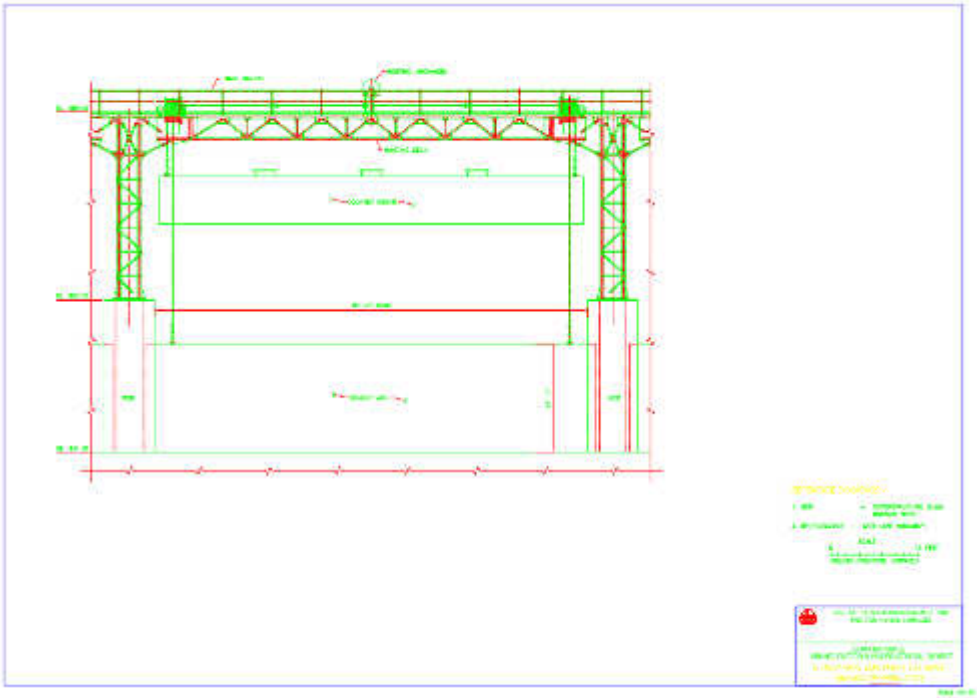
SCREENING QUESTIONS	YES	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
• Protected Area		✓	
• Wetland	Barrage Pond Area may consider as wetland but it is not a classified wetland		There will be no change in the level of pond only the existing capacity of the barrage will be restored. The pond area will be extended in both options (IEE/EIA Report- Chapter 5: Study of Project Alternatives) due to increasing the barrage width and excavating bela. Therefore, wetland area will be increase in these options
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	
• Special area for protecting biodiversity		✓	
No permanent adverse environmental impact is anticipated from the Project Siting. All the impacts will be of temporary nature and mitigable.			
B. Potential Environmental Impacts Will the Project cause...			
• Loss of precious ecological values (e.g. result of encroachment into forests/swamp lands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		✓	
• Conflicts in water supply rights and related social conflicts?		✓	No conflicts in water supply rights are anticipated as there will be no change in water courses
• Impediments to movements of people and animals?	✓		Temporary impediments during construction will be minimized through careful selection of Labour camp locations and provision of alternative routes and access paths if closed or used by the Contractor

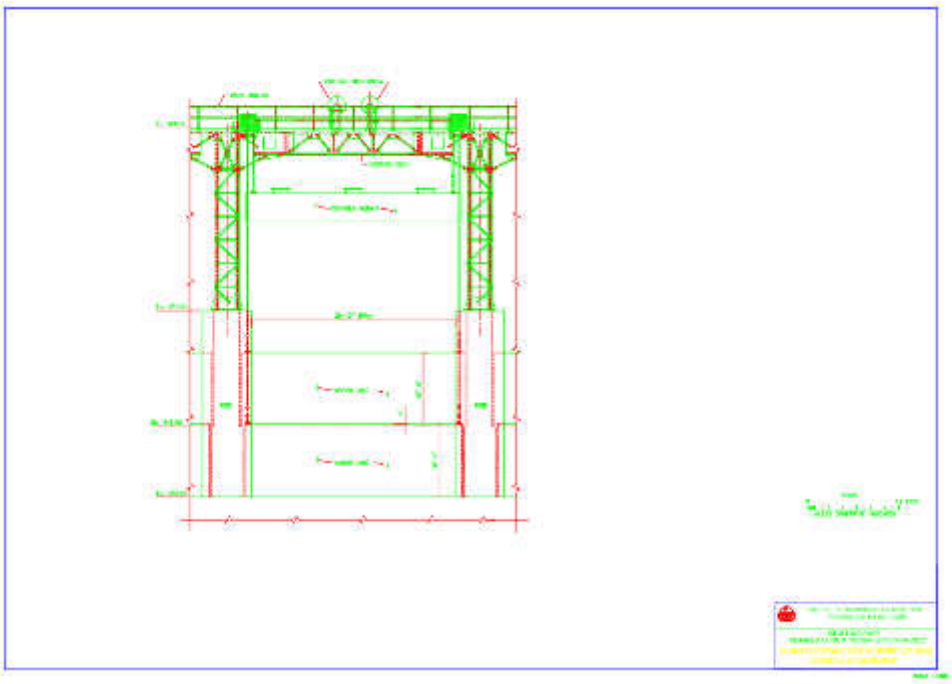
SCREENING QUESTIONS	YES	No	REMARKS
• Potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		✓	
• Insufficient drainage leading to salinity intrusion?		✓	
• Over pumping of groundwater, leading to salinization and ground subsidence?		✓	Over pumping of groundwater is not anticipated. Groundwater pumping for the water supply to the labour camp and batching plant is negligible compare to the available ample source of groundwater. The aquifer would be recovered/recharged easily and will not be affected adversely
• Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		✓	
• Dislocation or involuntary resettlement of people?	Houses / infrastructure will be required to relocate for both options (IEE/EIA Report-Chapter 5: Study of Project Alternatives)		A Resettlement Plan (RP) will be prepared and applied before start of construction of the project
• Potential social conflicts arising from land tenure and land use issues?		✓	
• Soil erosion before compaction and lining of canals?		✓	Canal lining are not included in the scope of work
• Noise from construction equipment?		✓	It will be further ensured that suitable Plant & Equipment use on site, regular noise monitoring during construction phase will minimize noise. The construction area is away from the populated areas
• Dust?	✓		Mitigation through sprinkling water when required. Instrumental dust monitoring at quarterly basis and visual inspection on 24 hours basis is recommended in Environment Monitoring Plan
• Labour-related social problems especially if workers from different areas are hired?		✓	Sufficient local source of labour is available. Outside labour will be employed only for those fields for which local skilled labour is not available. Regular awareness courses will be arranged on communicable disease and HIV/AIDS during construction for project labour
• Water logging and soil salinization due to inadequate drainage and farm management?		✓	No water logging and salinization impact is anticipated from the project implementation
• Leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?		✓	
• Reduction of downstream water supply during peak seasons?		✓	Work will be managed during routine canal closure and design

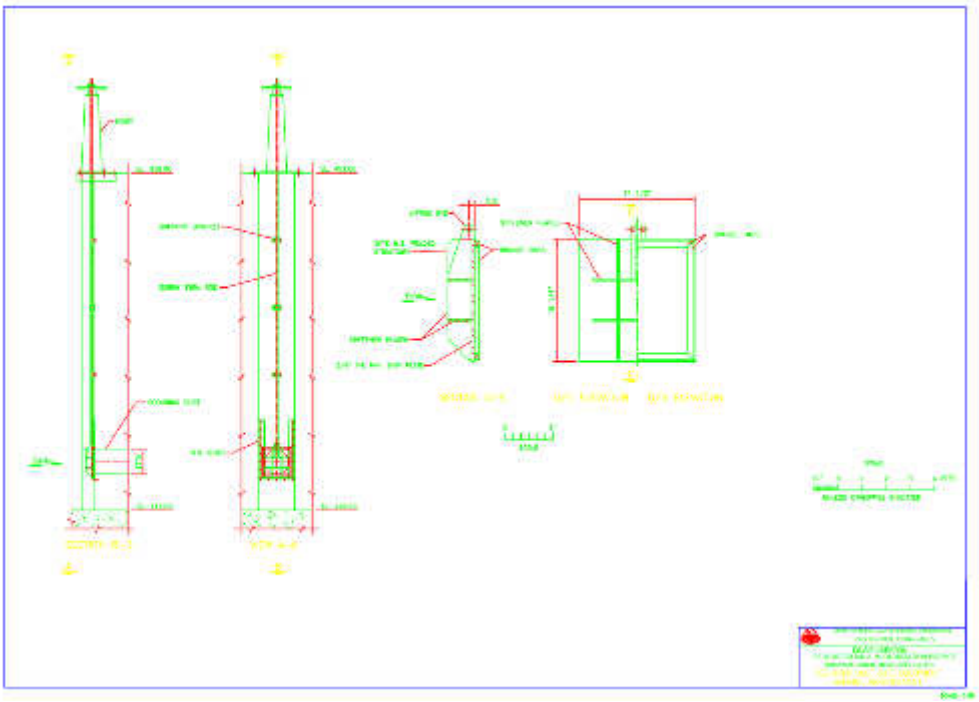
SCREENING QUESTIONS	YES	No	REMARKS
			provides cofferdams & temporary structure at necessary points
• Soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?		✓	
• Soil erosion (furrow, surface)?		✓	
• Scouring of canals?		✓	
• Logging of canals by sediments?		✓	
• Clogging of canals by weeds?		✓	
• Seawater intrusion into downstream freshwater systems?		✓	
• Introduction of increase in incidence of waterborne or water related diseases?		✓	No change in quality of water is anticipated from the project activities

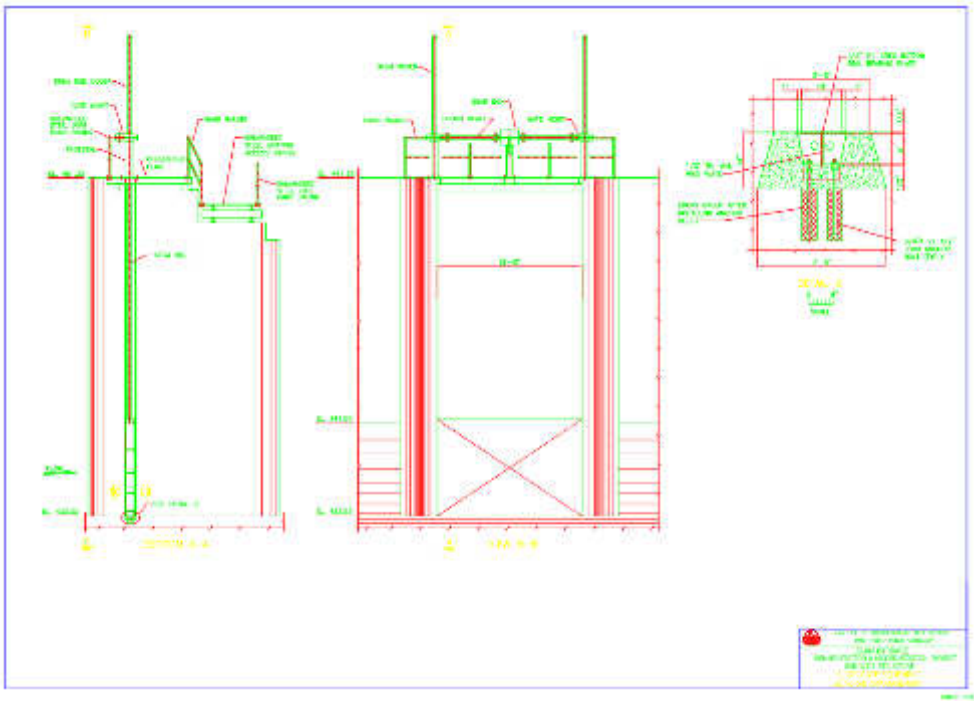
Annex-4 Cross-section of the various gates installed at Islam Barrage











Annex-5 Environmental Test Results

Apex Environment Laboratory

LABORATORY TEST REPORT

Reference:	442-18/AEL/IHW
Project Name:	**Islam Head Works**
Date of issue of report:	**26-07-2018**
Date of sampling:	**July 21, 2018**
Nature/source of sample(s):	Ambient Particulate Matter
Testing specifications:	**HAZ-Scanner HIM-6000**

Reference Point	**(Particulate matter) PM_{10} ($\mu g/m^3$)**
Upstream of Barrage (Near Bridge) (8 hrs average)	63.0
Punjab Ambient Air Quality Standards (PAAQS)	**150.0**

Comments: All tested parameters are in compliance with the Punjab Environment Quality Standards of Pakistan for Particulate Matter

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-The left over sample/s (if so available) shall be retained for fifteen days after the issuance of the report unless otherwise negotiated between the client and the laboratory.

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A sister concern of ECTECH Environment Consultants
The Laboratory is accredited as Environment laboratory by the Environmental Protection Agency, Government of the Punjab, Lahore

Apex Environment Laboratory

LABORATORY TEST REPORT

Reference: 442-18/AEL/IHW
Project Name: Islam Head Works
Date of issue of report: 26-07-2018
Date of sampling: July 21, 2018
Nature/source of sample(s): Ambient Gases
Testing specifications: HAZ-Scanner HIM-6000

Reference Point	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	CO* (mg/m^3)
Upstream of Barrage (Near Bridge) (8 hrs average)	54.0	44.0	0.01
Punjab Ambient Air Quality Standards (PAAQS) (24 hrs. average)	**120.0**	**80.0**	**5.0***

* = CO Time weighted average PEQS value is taken for 8 hrs.

Comments: All tested parameters are in compliance with the Punjab Environment Quality Standards for ambient gases

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Apex Environment Laboratory

LABORATORY TEST REPORT

Reference: 442-18/AEL/IHW
Project Name: **Islam Head Works**
Date of issue of report: **26-07-2018**
Date of sampling: **July 21, 2018**
Nature/source of sample(s): Baseline Noise Levels Monitoring
Testing specifications: Noise Level Meter, Model OS-11

Reference point # 1: Regulation Building

Date	Time	dB(A)									Leq
21-07-18	Day	69.0	54.1	54.6	53.9	61.6	57.2	53.3	67.8	63.0	53.5	58.80

Reference point # 2: Control Bridge

Date	Time	dB(A)									Leq
21-07-18	Day	68.8	62.7	60.9	58.9	67.5	60.0	68.4	59.7	59.8	61.3	62.8

Reference point # 3: Residential Colony

Date	Time	dB(A)									Leq
21-07-18	Day	60.0	58.7	56.6	59.0	57.5	62.1	63.0	65.1	58.7	58.2	58.89

Comments: All tested parameters are in compliance with the Punjab Environment Quality Standards for Ambient Nosie Levels.

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Apex Environment Laboratory

Environmental Monitored Data

Reference: 442-18/AEL/IHW
Project Name: Islam Head Works
Date of issue of report: 26-07-2018
Date of sampling: July 21, 2018
Nature/source of sample(s): Ground Water Sample
Testing specifications: APHA-USA

Sr. No.	Parameter	Unit	Result	Punjab Environment Quality Standards
1	pH	--	7.3	6.5-8.5
2	Color	TCU	4	<15
3	Taste	--	OK	Non Objectionable
4	Odor	--	OK	Non Objectionable
5	Turbidity	NTU	2	<5
6	Total Hardness as $CaCO_3$	mg/l	169	<500
7	Total Dissolved Solids (TDS)	mg/l	352	<1000
8	Aluminium(Al)	mg/l	N.D	0.2
9	Arsenic(As)	mg/l	N.D	<0.05
10	Antimony(Sb)	mg/l	N.D	0.005
11	Barium(Ba)	mg/l	N.D	0.7
12	Boron(B)	mg/l	N.D	0.3
13	Cadmium(Cd)	mg/l	N.D	0.01
14	Chloride (Cl)	mg/l	84	250
15	Chromium(Cr)	mg/l	N.D	0.05
16	Copper(Cu)	mg/l	0.3	2
17	Cyanide(CN)	mg/l	N.D	0.05
18	Fluoride (F)	mg/l	0.09	<1.5
19	Lead(pb)	mg/l	N.D	0.05
20	Manganese(Mn)	mg/l	0.01	0.5
21	Mercury(Hg)	mg/l	N.D	0.001
22	Nickel(Ni)	mg/l	N.D	0.02
23	Nitrate (NO_3)	mg/l	12.7	<50
24	Nitrite (NO_2)	mg/l	0.6	3
25	Selenium (Se)	mg/l	N.D	0.01
26	Residual chlorine	mg/l	N.D	0.2-0.5
27	Sulphate as SO_4^{2-}	mg/l	225	400
28	Iron as Fe^{2+}	mg/l	0.04	0.3
29	Sodium	mg/l	61	200
30	Zinc (as Zn^{2+})	mg/l	0.5	5.0
31	Total Coliform	Number/100ml	N.D	0/100 ml
32	E-Coli	Number/100ml	N.D	0/100 ml

N.D. = Not Detected

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apex
Environment Laboratory

Results and Discussion:
All the tested parameters are in compliance with the Punjab Environmental Quality Standards (PEQS) values for drinking water.

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Manager (Laboratory)

Laboratory Analyst

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Environment Laboratory

Environmental Monitored Data

Reference: 442-18/AEL/IHW
Project Name: Islam Head Works
Date of issue of report: 26-07-2018
Date of sampling: July 21, 2018
Nature/source of sample(s): Surface water - Upstream of Barrage
Testing specifications: APHA-USA

Sr. No.	Parameter	Unit	Result	National Environment Quality Standards
1.	pH	--	7.3	6 - 9
2.	Color	TCU	7	<15
3.	Taste	--	OK	Non Objectionable
4.	Odor	--	OK	Non Objectionable
5.	COD	mg/l	43.0	150
6.	BOD	mg/l	18.4	80
7.	Oil and Grease	mg/l	0.6	10
8.	Chloride	mg/l	66.9	250
9.	Sulphates	mg/l	73.4	600
10.	Cadmium	mg/l	N.D.	0.1
11.	Chromium	mg/l	0.04	1.0
12.	Copper	mg/l	0.05	1.0
13.	Iron	mg/l	1.4	8.0
14.	Lead	mg/l	N.D.	0.5
15.	Zinc	mg/l	0.8	5.0
16.	Phenolic Compounds	mg/l	N.D.	0.1
17.	Ammonia	mg/l	2.1	40
18.	Fluorides	mg/l	0.5	20
19.	Sulphides	mg/l	N.D.	1.0
20.	Total Dissolved Solids	mg/l	356	3500
21.	Total Suspended Solids	mg/l	16	200
22.	Chlorine	mg/l	N.D.	1.0
23.	Mercury	mg/l	N.D.	0.01
24.	Selenium	mg/l	N.D.	0.5
25.	Nickle	mg/l	0.02	1.0
26.	Silver	mg/l	N.D.	1.0
27.	Arsenic	mg/l	0.05	1.0
28.	Barium	mg/l	N.D.	1.5
29.	Manganese	mg/l	0.03	1.5
30.	Boron	mg/l	0.17	6.0
31.	Aluminum	mg/l	0.21	---
32.	TOC	mg/l	0.07	2.0
33.	Anionic detergents	mg/l	N.D.	20
34.	Cyanide	mg/l	N.D.	2.0

APEX ENVIRONMENT LABORATORY Suite # 4, IInd Floor Model Link Road LAHORE

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35.	Total Toxic Metals	mg/l	0.97	2.0
36.	Total Coliform	Number/100ml	N.D	0/100 ml
37.	E-Coli	Number/100ml	N.D	0/100 ml

N.D. = Not Detected

Results and Discussion:
All the tested parameters are in compliance with the Punjab Environmental Quality Standards (PEQS) values for drinking water.

Terms & Conditions

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-This report should be reproduced as a whole and not in parts.
-In case sampling is done by the client then the laboratory does not hold itself responsible as to the sample/s being representative of any batch or process or the entire production lot or lot.
-The responsibility of the ethical use of the results reported in this report lies with the client. Consequently, the laboratory is absolved of its responsibility for any claims that may result through the use by the client or others, of the results appearing in this report.
-The left over sample/s (if so available) shall be retained for fifteen days after the issuance of the report unless otherwise agreed between the client and the laboratory.

Manager (Laboratory)

Laboratory Analyst

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Apex Environment Laboratory

Environmental Monitored Data

Reference: 442-18/AEL/IHW
Project Name: Islam Head Works
Date of issue of report: 26-07-2018
Date of sampling: July 21, 2018
Nature/source of sample(s): Surface Water - Downstream of Barrage
Testing specifications: APHA-USA

Sr. No.	Parameter	Unit	Result	National Environment Quality Standards
1.	pH	--	7.6	6 - 9
2.	Color	TCU	5	<15
3.	Taste	--	OK	Non Objectionable
4.	Odor	--	OK	Non Objectionable
5.	COD	mg/l	41.0	150
6.	BOD	mg/l	29.2	80
7.	Oil and Grease	mg/l	0.2	10
8.	Chloride	mg/l	67.1	250
9.	Sulphates	mg/l	109.4	600
10.	Cadmium	mg/l	N.D.	0.1
11.	Chromium	mg/l	0.04	1.0
12.	Copper	mg/l	0.06	1.0
13.	Iron	mg/l	1.4	8.0
14.	Lead	mg/l	N.D.	0.5
15.	Zinc	mg/l	0.9	5.0
16.	Phenolic Compounds	mg/l	N.D.	0.1
17.	Ammonia	mg/l	3.1	40
18.	Fluorides	mg/l	0.5	20
19.	Sulphides	mg/l	N.D.	1.0
20.	Total Dissolved Solids	mg/l	362	3500
21.	Total Suspended Solids	mg/l	19	200
22.	Chlorine	mg/l	N.D.	1.0
23.	Mercury	mg/l	N.D.	0.01
24.	Selenium	mg/l	N.D.	0.5
25.	Nickle	mg/l	0.02	1.0
26.	Silver	mg/l	N.D.	1.0
27.	Arsenic	mg/l	0.05	1.0
28.	Barium	mg/l	N.D.	1.5
29.	Manganese	mg/l	0.03	1.5
30.	Boron	mg/l	0.17	6.0
31.	Aluminum	mg/l	0.21	---
32.	TOC	mg/l	0.07	2.0
33.	Anionic detergents	mg/l	N.D.	20
34.	Cyanide	mg/l	N.D.	2.0
35.	Total Toxic Metals	mg/l	0.97	2.0

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Environment Laboratory

36.	Total Coliform	Number/100ml	N.D	0/100 ml
37.	E-Coli	Number/100ml	N.D	0/100 ml

N.D. = Not Detected

Results and Discussion:
All the tested parameters are in compliance with the Punjab Environmental Quality Standards (PEQS) values for drinking water.

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Manager (Laboratory)

Laboratory Assistant

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Annex-6: Social Framework Agreement

Social Framework Agreement

1. This is a Draft Social Framework Agreement between an official representing the Punjab Irrigation Department (PID), Government of Punjab and the villagers' Committee, whose names have been inscribed below in their presence and full consent.

Sr. No. of Village	Village	Name (Two from each Village)	Father's Name
1.			1.
			2.
2.			1.
			2.
3.			1.
			2.
4.			1.
			2.
5.			1.
			2.
6.			1.
			2.
7.			1.
			2.
8.			1.
			2.
9.			1.
			2.

2. We the committee of village leaders/elders has agreed unanimously to nominate _____ S/O _____ as our Chairman and authorize him to enter into an SFA with PID on our behalf. We understand and pledge that this SFA will be a binding on us and PID throughout the currency of the construction work as well as the operational phase.

Signatures or Thumb Impression (TI) of the Chairman and the Members of the Villagers Committee

Sr. No.	Name	Signatures/TI
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

3. By mutual consent it is agreed that Punjab Irrigation Department

i. Shall not occupy any agriculture land or acquire any other land during the construction of the project

ii. Shall not cause any damage or reduction in the water supply in the canals during the construction period of the project, except in case of force majeure e.g. high floods, strong storms or any other act of God

iii. Shall not cause any disturbance to the wildlife, wetland, archeological heritage or a place of worship

iv. Shall not interfere in the social political or tribal balance of the area

v. Shall wherever possible, facilitate better services and supplies to the area e.g. schooling, health, awareness on epidemic and communicable diseases, electricity and road/rail communication

4. Also, by mutual consent it is agreed that all the villagers residing in the area influencing project (name of the villages listed in para 1 above), collectively and severally:

i) Shall not interfere in the location of labour camps, material depots, equipment yards and all the approach roads to be used during project construction phase, all of which will be located on the lands of PID

ii) Shall not interfere if the Punjab Irrigation Department decides to shift the construction of works elsewhere on a more suitable site as long as the activity remains on PID's own land

iii) Shall not receive any discharge of water slurry or oil spills to any graveyard or archaeological site

iv) Shall not cause any damage to wildlife or forest resources of any wildlife reserve and no villagers will be involved in killing, poaching or illegal hunting

v) Shall not allow reduction or official interference in our existing services and facilities e.g. education, health, electricity, water supply, religious and social congregations

vi) Agree that in case the Contractor wishes to obtain some material from the private lands or wishes to make use of any piece of land outside the Punjab Irrigation Department land that would invoke a new agreement between the villagers and the Contractor and PID or Govt. of the Punjab shall not be involved in that in any way

vii) Agree to respect and observe the cautions on the sign boards displayed by project authorities and shall not remove or cause to be removed any signboards or installations put up by PID or their representatives

(Add more conditions if required as per the prevailing circumstances)

This SFA has been signed this _____ day of _____, at _____

Signatures Resident Engineer (Full name and address)	Signatures Chairman Villagers' Committee (Name and Address)

Counter signed

Signature
Designated Official of Punjab Irrigation Department
(Full name and address)

Annex 7: Checklists and Environmental Issues Tracking Report

Checklists for Camp Site

Description	*Status*	*Notes*
Is the camp layout according to the design documents?	Yes ☐ No ☐	
Has the camp site been selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre-camping conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the camp site?	Yes ☐ No ☐	
Has the camp been established in the existing clearings / designated area?	Yes ☐ No ☐	
Was hunting, fishing, capturing wildlife, or poaching avoided?	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Have any trees been felled?	Yes ☐ No ☐	
Have the trees or bushes been burnt?	Yes ☐ No ☐	
Have bushes been disposed off in a water body or dry streambed?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	
Has the septic tank been built for sewerage? Has the soaking pits or sump been built for wastewater disposal?	Yes ☐ No ☐ Yes ☐ No ☐	

Description	***Status***	***Notes***
Has the sump been built in absorbent soil?	Yes ☐ No ☐	
Has the sump been built down-slope from the camp?	Yes ☐ No ☐	
Is the sump covered, in order to reduce access of insects and animals?	Yes ☐ No ☐	
Do the fuel storage facilities have adequate secondary containments arrangements in case of leakage or spilling?	Yes ☐ No ☐	
Has the concrete pad been constructed for fuel, oils and other chemical liquid transfer?	Yes ☐ No ☐	
Is the updated firefighting equipment available near fuel storage area?	Yes ☐ No ☐	
Is the fuel storage downwind and down slope of the camp?	Yes ☐ No ☐	
Is there any other combustible or flammable material in the fuel storage area?	Yes ☐ No ☐	
Are the fuel tanks properly marked with their contents and precautions?	Yes ☐ No ☐	

Note:

Signature Date

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Borrow Areas

Description	***Status***	***Notes***
Is the borrow area marked according to the design documents?	Yes ☐ No ☐	
Has the borrow area been selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre camping conditions?	Yes ☐ No ☐	
Has the access roads been established in the existing clearings / designated area?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Have any trees been felled?	Yes ☐ No ☐	
Have the trees or bushes been burnt?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	
Has the borrow area been fenced to avoid animal access and human safety?	Yes ☐ No ☐	
Is there proper mechanism to control dust pollution?	Yes ☐ No ☐	
Does the borrowed earth used for filling meet the specifications?	Yes ☐ No ☐	

Note:

Signature Date

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Access Roads

Description	***Status***	***Notes***
Have the access roads selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre-construction conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the construction?	Yes ☐ No ☐	
Have the access roads been established in the existing clearings or designated site?	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided in establishment of access roads?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Have any trees been felled?	Yes ☐ No ☐	
Has the compacted gravel topping been provided to access roads?	Yes ☐ No ☐	
Has the excavated earth / silt disposed off properly?	Yes ☐ No ☐	
Do the access roads have sufficient width?	Yes ☐ No ☐	
Have the diversion signs and required sign boards been placed on the access roads?	Yes ☐ No ☐	

Note:

Signature Date

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Construction Work Site

Description	***Status***	***Notes***
Is the construction site layout according to the design documents?	Yes ☐ No ☐	
Has the construction site been selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre-construction conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the construction?	Yes ☐ No ☐	
Has the construction site been established in the existing clearings or designated site?	Yes ☐ No ☐	
Does the temporary diversion channel built per specifications?	Yes ☐ No ☐	
Was hunting, fishing, capturing wildlife, or poaching avoided?	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided?	Yes ☐ No ☐	
Was the disposal of waste material in the protected area avoided?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Have any trees been felled?	Yes ☐ No ☐	
Has the excavated earth / silt been disposed off properly?	Yes ☐ No ☐	
Does the borrowed earth used for filling meet the specifications?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	

Description	***Status***	***Notes***
Has the septic tank been built for wastewater disposal?	Yes ☐ No ☐	
Is the soaking pits or sump covered, in order to reduce access of insects and animals?	Yes ☐ No ☐	
Do the fuel storage facilities have adequate secondary containments arrangements in case of leakage or spilling?	Yes ☐ No ☐	
Has the concrete pad been constructed for fuel, oils and other chemical liquid transfer?	Yes ☐ No ☐	
Is the firefighting equipment available near fuel storage area?	Yes ☐ No ☐	
Is the fuel storage downwind and down slope of the camp?	Yes ☐ No ☐	
Is there any other combustible or flammable material in the fuel storage area?	Yes ☐ No ☐	
Are the fuel tanks properly marked with their contents?	Yes ☐ No ☐	

Note:

Signature Date

Consultants' Environmentalist

Contractor's Environmentalist

MONITORING CHECK LISTS

A-Daily Monitoring Checklist

Description	Status	Additional Comments
A-Physical Conditions		
1-Ambient air quality		
Are dust emissions being regulated through sprinkling water on the routes being used by the Contractor?	☐Yes ☐No	
Are vehicle speeds being monitored to avoid excessive dust emissions at dust prone areas?	☐Yes ☐No	
2. Noise Control		
In case excessive noise levels are detected have appropriate mitigation measures been taken?	☐Yes ☐No	
Is restriction on playing tape records and blowing pressure horns etc. being observed?	☐Yes ☐No	
Are heavily traveled routes watered (where required) on a daily basis to minimize dust?	☐Yes ☐No	
2-Waste Material		
Has any natural drainage been disturbed or altered?	☐Yes ☐No	
Are the waste bins emptied regularly in the burn pit?	☐Yes ☐No	
Is food waste disposed in the open?	☐Yes ☐No	
Is the combustible waste burnt regularly in the burn pit?	☐Yes ☐No	
Is medical waste being stored separately at the camp site?	☐Yes ☐No	
3-Fuel/Lubricant		
Are the fuel tanks properly marked with their contents?	☐Yes ☐No	
Are the fuels and oils handled in a safe manner, ensuring no leakage or spillage?	☐Yes ☐No	
4-Traffic management		
Is vehicle speed limit being followed?	☐Yes ☐No	
Is the movement of all project vehicles and personnel been restricted to within the work areas?	☐Yes ☐No	
Do all vehicles and generators have muffles to reduce noise levels whilst working close to communities?	☐Yes ☐No	

B-Biological Conditions	
1-Flora	
Have trees and branches from canal plantation been used as fuel wood?	☐Yes ☐No
Has vegetation clearing been minimized?	☐Yes ☐No
2-Fauna	
Are the drivers careful and watchful about wild and domestic animals?	☐Yes ☐No
Any damage to animals?	☐Yes ☐No
C-Socio-economic	
1-Community	
During construction have good management practices been adopted by avoiding disturbance to areas adjacent to work area?	☐Yes ☐No
Are complaints from local communities being registered and responded to?	☐Yes ☐No
Have the local communities been formally notified about methods for registering complaints?	☐Yes ☐No

Name _____ Signature _____

Additional Comments: -

B-Weekly Monitoring Checklist

Description	Status	Additional Comments
A-Physical Conditions		
1-Soil Conditions		
Is any soil erosion observed?	☐Yes ☐No	
Has the movement of construction equipment been restricted to work areas to avoid unnecessary disturbance to different soil types in the project area?	☐Yes ☐No	
Have the areas along the access road been visually monitored and show any signs of soil erosion?	☐Yes ☐No	
2-Fuel/Lubricants		
Is regular inspection carried out to check leaks and spills?	☐Yes ☐No	
Is there any other combustible or flammable material in the fuel storage area?	☐Yes ☐No	
Are the fuels and oils handled in a safe manner, ensuring no leakage or spillage?	☐Yes ☐No	
Have the entire oil and fuel storage areas provided with impervious floor underneath to prevent soil contamination from leaks or spills?	☐Yes ☐No	
Are the spilled oil or fuel and used clean-up material being disposed properly?	☐Yes ☐No	
Are the spills and leaks thoroughly cleaned?	☐Yes ☐No	
Is the fuel transfer operation being supervised?	☐Yes ☐No	
3-Waste Material		
Is waste being stored temporarily onsite within a designated area?	☐Yes ☐No	
Is any type of solid waste being disposed off in the field?	☐Yes ☐No	
Are the fuel transfer arrangements protected against spills?	☐Yes ☐No	
Do the vehicles carry adequate containers/trash bags for litter/garbage and are they emptied at the campsite or other designed location regularly?	☐Yes ☐No	
4-Traffic Management		
Are the existing routes being used to access the project area?	☐Yes ☐No	
Is the number of routes kept to a minimum?		
Are short cuts being used?	☐Yes ☐No	

Are all vehicles and construction machinery properly maintained and tuned regularly to conform to NEQS?	☐Yes ☐No
Are pressure horns being used?	☐Yes ☐No
5-Borrow Areas	
Has necessary approval for the borrow areas been obtained from the Engineer?	☐Yes ☐No
Is the topsoil of the borrow pits removed and conserved for rehabilitation of the borrow area?	☐Yes ☐No
Are the conditions of approval for excavation of the borrow pits being complied with?	☐Yes ☐No
Is the drainage profile of the area being maintained to avoid impoundment of the agricultural runoff or storm water in the borrow areas?	☐Yes ☐No
6-Camp site	
Are generators in the construction camp properly maintained?	☐Yes ☐No
Is the emergency response plan available on site?	☐Yes ☐No

Name _____ Signature _____

Additional Comments:-

C-Monthly Monitoring Checklist

Description	Status	Additional Comments
A-Physical Conditions		
1-Waste Material		
Do the fuel storage facilities have adequate secondary containment up to 120% capacity in case of leakage or spillage?	☐Yes ☐No	
Does the Camp site have a septic system comprising of septic tank and soak pit?	☐Yes ☐No	
In case the soak pits got filled during the operation, has the grey water been sprinkled?	☐Yes ☐No	
Have the soak pits for laundry, kitchen and showers been built?	☐Yes ☐No	
Have the soak pits been built in absorbent soil?	☐Yes ☐No	
Have the soak pits been designed to accommodate waste water generated during the total duration of the operation?	☐Yes ☐No	
2-Quantity and Quality of Water		
Are prudent water conservation measures being taken on site?	☐Yes ☐No	
Has the quantity of water being used during construction kept to the minimum required level?	☐Yes ☐No	
Is the water well being used for project activities being checked/monitored for signs of water depletion on a regular basis?	☐Yes ☐No	
Can Surface water enter the soak pits?	☐Yes ☐No	
C-Socio-economic		
1-Community		
Is the burn pit located away from the nearest community?	☐Yes ☐No	
Are employment opportunities been provided to local people?	☐Yes ☐No	
Are all community related mitigation measures being adhered to?	☐Yes ☐No	
Do local men accompany the project personnel before entering into or close to communities?	☐Yes ☐No	

going

Name _____ Signature _____

Additional Comments

D-Quatterly Monitoring Checklist

Description	Status	Additional Comments
A-Physical Conditions		
Has any erosion been noticed and controlled in the project area?	☐Yes ☐No	
Has air quality remained under permissible limits?	☐Yes ☐No	
Has water quality remained under desired standards?	☐Yes ☐No	
Are the recyclable wastes including glass, tins, and metal scrap being sent for recycling?	☐Yes ☐No	
Has traffic flow remained satisfactory?	☐Yes ☐No	
Has the construction waste being disposed of properly?	☐Yes ☐No	
Has the camp been maintained properly in terms of safety and hygiene?	☐Yes ☐No	
B. Biological Conditions		
Is vegetation clearance according to the approved schedule?	☐Yes ☐No	
C-Socio-economic		
Have the grievances of the community addressed properly?	☐Yes ☐No	
	☐Yes ☐No	

Name _____ Signature _____

Additional Comments

Environmental Issues Tracking Report

Tracking No.	Log Date	Source	Location	Issue	Action Required	Responsibility	Target date	Completion Status