PEDO

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
GOVERNMENT OF KHYBER PAKHTUNKHWA PESHAWAR

No. 101 /GK/NEPRA/Gen License/ 2020
Dated Peshawar the: 13 /10/2020

To

The Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Tower
G-5/1, Islamabad

Subject: Application for Grant of Generation Licence to Pakhtunkhwa Energy Development Organization (PEDO) for the 88MW Gabral Kalam Hydropower Project, District Swat.

Dear Sir,

1. I, Engr. Riaz Ahmad Jan, Project Director Gabral Kalam Hydropower Project (88MW), being the duly authorised representative of PEDO by virtue of Authority Letter. No. GK/NEPRA/Gen License/2020/8716, dated October 05, 2020, hereby apply to the National Electric Power Regulatory Authority (NEPRA) for the grant of a Generation Licence to PEDO for 88MW Gabral Kalam Hydropower Project, pursuant to the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

2. I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999 and undertake to abide by the terms and provisions of the above said regulations. I further undertake and confirm that the information, provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

3. The Bank of Khyber (BOK) Sector B1 Phase-V Hayatabad Branch (0083) crossed cheque No. 38815096 dated: 13-10-2020, in the sum of Rs. 467,360/- (Rupees Four Hundred Sixty Seven Thousand Three Hundred & Sixty Only), being the non-refundable licence application fee, calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Enclosure: As Above

For information & ...
- DR-I/AR
- MF
copy to
ADG (Lic).

Chairman
- VC/M(T)
- M(A)
- M(Lic)
- M(M&E)

15/X/20

Project Director
Gabral Kalam HPP
PEDO, Peshawar

Copy for information to,

1. CEO PEDO, Peshawar
2. GM (Hydel) PEDO, Peshawar
3. CE (Dev)/Director (P&F), PEDO, Peshawar.

Alongwith 2x CDs

Recd. Assigned to Lic. Deptt. Alongwith cheque of Rs. 467,360/-. The same forwarded to Lic. Deptt. Alongwith cheque copy/scan in registrar deptt. retaining

GOVERNMENT OF KHYBER PAKHTUNKHWA
PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
(PEDO)

GENERATION LICENSE APPLICATION

FOR

88 MW GABRAL KALAM HYDROPOWER PROJECT
DISTRICT SWAT

October 2020

Original

105-PEDO House, 38/B-2 Phase-V Hayatabad, Peshawar, Pakistan.
Tel: +92-91-9217350, Fax: +92-91-9217340

GOVERNMENT OF KHYBER PAKHTUNKHWA
PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
(PEDO)

GENERATION LICENSE APPLICATION

FOR

88 MW GABRAL KALAM HYDROPOWER PROJECT DISTRICT SWAT

October 2020

105-PEDO House, 38/B-2 Phase-V Hayatabad, Peshawar, Pakistan.
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PEDO

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
GOVERNMENT OF KHYBER PAKHTUNKHWA PESHAWAR

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Enclosure: As Above

Project Director
Gabral Kalam HPP
PEDO, Peshawar

Copy for information to,

1. CEO PEDO, Peshawar
2. GM (Hydel) PEDO, Peshawar
3. CE (Dev)/Director (P&F), PEDO, Peshawar.

PLS A/C 01495009

Cheque No [redacted]

Payee's Account Only

THE BANK OF KHYBER

PHASE V HAYATABAD BRANCH (0083) SECTOR B1 PH-V

HAYATABAD PESHAWAR

Date 0 3 1 0 2 0 2 0

Pay [redacted] or bearer

Rupees Four Hundred Sixty Seven Thousand Three Hundred & Sixty only.

[redacted]

PK64 KHYB 0083 0000 0149 5009

PROJECT DIRECTOR PURCHASE OF LAND & PMO

Accountant
PMO World Bank Projects
PEDO Peshawar

Drawing & Disbursing Officer (DDO)
PMO World Bank Projects
PEDO Peshawar

Please do not write below this line.

⑈38815096⑈061008300830000001495009⑈000⑈

Check List for Examination of
New Generation Facility (Hydel) - License Application

Name of Company: Pakhtunkhwa Energy Development Organization (PEDO)
Capacity: 88MW
Prepared/Updated on: 13-10-2020

3(1)	Authorization from Board Resolution / Power of Attorney	Yes		Attached
3(3)	Application fee (including Indexation)	Yes		BOK Branch (0083) Crossed Cheque attached
3(4)	Three copies of Application	Yes		Provided
3(5)(a)(i)	Certificate of incorporation		No	PEDO is a public sector organization constituted under SHYDO Act 1993 and is Exempt under Section 24 of NEPRA Act and thus not required
3(5)(a)(ii)	Memorandum and articles of association	Yes		PEDO is a public sector organization constituted under SHYDO Act 1993. Energy & Power Notification No. SO(E)E&P/4-21/2014/Vol-II, Dated 17-04-2014 (Attached)
3(5)(a)(iii)	Annual Return statements or in lieu thereof		No	PEDO is a public sector organization constituted under SHYDO Act 1993 and therefore, not required to submit annual Return Statement.
3(5)(b)	Profile of experience of the applicant its management, staff and its members in power sector.	Yes		Attached (PD GBK HPP)
3(5)(c)	CVs of applicant's Senior Management and Technical professionals	Yes		A total of 7 nos. CVs provided
3(5)(d)(i)	Cash balance & bank certificates		No	PEDO is a public sector organization constituted under SHYDO Act 1993 and therefore, it is not required
3(5)(d)(ii)	Expression of interest to provide credit or financing along with sources and details thereof	Yes		Government of KP and World Bank will provide funds (loan) to the provincial government for the project development as segregated below: WB contribution (loan): (80%) Govt. of KP contribution: 20%
3(5)(d)(iii)	Latest financial statements		No	PEDO is a public sector organization constituted under SHYDO Act 1993 and therefore, not required to submit annual Return Statement
3(5)(d)(iv)	Employment records of Engineers & Technical Staff	Yes		CVs provided
3(5)(d)(v)	Profile of Sub-contractors		No	Works contract has not been awarded yet

3(5)(d)(vi)	Verified references w.r.t. experience of the Applicant and its sub-Contractors		No	Works contract has not been awarded yet.
3(5)(e)	Encumbrances on assets			N/A
3(5)(f)	Technical and financial proposal for Operation, maintenance, planning and development of the generation facility.			Project feasibility has been completed (report attached),Works contract will be awarded in 2021while Plant O&M will be done by PEDO through its own staff .
3(5)(g)(a)	Type of Technology	hydro power		Feasibility report provided
3(5)(h)	Feasibility Report	Yes		Provided
3(5)(i)	Prospectus	Yes		Provided

Cont'd....P/2.

Schedule III				
1.	Location (location maps, site maps) land	District Swat		Provided
2.	Plant: run of river, storage, weir	Run of the River		Provided
3.	Head: Minimum, maximum			Minimum Net Head-153m Maximum Net Head-159m
4.	Technology: Francis, Pelton, etc. Size, number of units.	Francis turbine		Three units / 2 x 37.5 MW and 1 x 13 MW each
5.	Tunnel (if proposed): length, diameter			Length: 4.7km Diameter 5.8m
6.	ESSA (Environmental and Social Soundness Assessment)	Yes		Provided
7.	Detailed feasibility report	Yes		Provided
8.	Resettlement issues			The potential resettlement issues have been taken care of in the project LARP
9.	Consents	Yes		Consent from NTDC has been sought vide letterNo. 02/PEDO/CE-WB/01, Dated: 04-09-2020 attached to the application.
10.	Infrastructure development	Yes		Included in the project feasibility report.
11.	Interconnection with National Grid Co. distance and name of nearest grid, voltage level (single line diagram)	Yes		The interconnection scheme for the power dispersal from Gabral Kalam Hydropower Plant would be through 2.6km long, 132 Kv transmission Line as Loop-in, Loop-out arrangement to the 132 kV transmission line of GorkinMatiltan HPP in Swat Area.
12.	Project cost, information regarding sources and amounts of equity and debt.	Yes		Project development cost is USD: 249.25 million.

13.	Project schedule, expected life			Project implementation period period:72 months, Project life 30 years, which can be extended to 50 years.
14.	Peaking/base load operation			No peaking
15.	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation			Generating Voltage -11 KV Frequency --50 Hz Power Factor - Leading 0.9& Lagging 0.85 Automatic Generation Control --No Ramping Rate -10 minutes Alternative Fuel -No Auxiliary Consumption 0.88 MW (1% of installed capacity) Time required to Synchronise -5 minutes
16.	System studies load flow, short circuit, stability	Yes		These will be conducted after obtaining consent for power evacuation from NTDC.(ref#9 above)
17.	Training and development	Yes		Project development include trainings and capacity building programs.

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GOVERNMENT OF KHYBER PAKHTUNKHWA
ENERGY & POWER DEPARTMENT

Dated Peshawar, the 17-04-2014

NOTIFICATION

/2090-98

No. SO(E)E&P/4-21/2014/Vol-II In pursuance of the amendments made in PHYDO ACT, 1993 and consequent renaming as Khyber Pakhtunkhwa Energy Development Organization (Amendment) Act, 2014 as notified vide Provincial Assembly Secretariat, Khyber Pakhtunkhwa, Notification No. PA/Khyber Pakhtunkhwa/Bills/2014/10625 dated April 2, 2014, "Pakhtunkhwa Hydel Development Organization (PHYDO)" being an attached Department of Energy & Power Department is hereby renamed as "***Pakhtunkhwa Energy Development Organization (PEDO)***",

Secretary to Govt: of Khyber Pakhtunkhwa
Energy & power Department

Endst. No. & Date as above

Copy forwarded to the:

1. All Administrative Secretaries to Government of Khyber Pakhtunkhwa.
2. The Secretary, Provincial Assembly Khyber Pakhtunkhwa.
3. The Chief Executive Officer, PEDO.
4. The General Manager, Hydel PEDO.
5. The General Manager, Admn/Finance, PEDO.
6. The President of Chamber of Commerce & Industry Khyber Pakhtunkhwa.
7. PSO to Chief Minster, Khyber Pakhtunkhwa.
8. PS to Chief Secretary Khyber Pakhtunkhwa.
9. PS to Additional Chief Secretary Khyber Pakhtunkhwa.

Section Officer (Establishment)

Dir (A/A).
Circulate to all concerned

21/4/14

MINUTES OF THE MEETING

SUBJECT: - MINUTES OF THE 50TH MEETING OF THE PEDO BOARD OF DIRECTORS HELD ON SEPTEMBER 3, 2020.

The 50th meeting of PEDO Board of Directors was held on September 03, 2020 under the Chairmanship of Mr. Nisar Muhammad Khan, Chairman PEDO Board of Directors. List of participants is at **Annex-I**.

2. The meeting started with the recitation of few verses from the Holy Quran. The Chairman welcomed the newly appointed member PEDO Board Mr. Haque Nawaz and expressed the hope that he will make useful contribution to the overall development of the Organization in view of his professional experience. CEO PEDO then presented the following agenda items for discussion in the meeting:

Agenda Item#	Subject
50-01	APPROVAL / CONFIRMATION OF MINUTES OF 49TH MEETING OF THE PEDO BOARD OF DIRECTORS
50-02	DISCUSSION ON THE AGE LIMIT OF PDs FOR PEDO PROJECTS
50-03	APPROVAL OF RECOMMENDATIONS FOR APPOINTMENT OF PROJECT DIRECTORS FOR VARIOUS PEDO PROJECTS
50-04	APPROVAL TO AUTHORIZE CEO PEDO TO SIGN AND SUBMIT THE TARIFF PETITIONS TO NEPRA FOR GABRAL-KALAM AND MADYAN HPPs
50-05	APPROVAL OF TECHNICAL EVALUATION REPORT FOR HIRING OF CONTRACTOR FOR THE PROJECT "ACCESS TO CLEAN ENERGY PROGRAM FOR CONSTRUCTION OF 672 MINI MICRO HYDRO POWER PROJECTS ON RIVER/TRIBUTRAIES AND CANAL" FINANCED BY ADB.
50-06	DISCUSSION ON THE LATEST IMPLEMENTATION STATUS OF MHPs PROJECT (COMPLETED, OPERATIVE, COST INVOLVED AND ISSUES, IF ANY).
50-07	APPROVAL FOR AMENDMENT NO.5 IN THE CONSULTANCY SERVICES AGREEMENT FOR 356 MHPs
50-08	APPROVAL FOR EXTENSION IN CONTRACT AGREEMENT OF CONTRACTOR FOR THE MINI MICRO HYDEL ON CANALS.

50-09	DISCUSSION ON THE INSPECTION REPORT OF PEDO INSPECTION TEAM REGARDING RANOLIA HPP
50-010	DISCUSSION ON THE IMPLEMENTATION STATUS OF THE DECISIONS TAKEN DURING 44TH & 45TH BOD MEETINGS REGARDING SOLARISATION PROJECTS OF MOSQUES AND SCHOOLS

AGENDA ITEM NO. 50-001

APPROVAL / CONFIRMATION OF MINUTES OF 49TH MEETING OF THE PEDO BOARD OF DIRECTORS

3. CEO PEDO informed the forum that the draft minutes of the 49th Board meeting were circulated amongst the Board members for their inputs. The inputs received from Mr. Abdul Siddique have been duly incorporated in the draft minutes. The draft minutes were presented to the forum for confirmation/approval.

DECISION:

4. The Board of Directors resolved to confirm and approve the minutes of the 49th PEDO Board meeting.

AGENDA ITEM NO. 50-002:

DISCUSSION ON THE AGE LIMIT OF PDs FOR PEDO PROJECTS

5. CEO PEDO informed the forum that during the 12th PEDO Board meeting held on 25th March, 2016 the age limit for Project Directors was approved as 65 years which was reduced to 63 years later on during the 37th Board meeting while finalizing advertisement for five (05) posts of PDs. However, in view of World Bank reservations regarding the upper age limit, the PEDO Board decided to re-advertise the positions of PDs by keeping the maximum age limit of 55 years. CEO PEDO informed the forum that in response a very limited number of applicants could be shortlisted for interview due to their less specific relevant experience of hydel projects which is possessed only by employees of WAPDA at Federal level and Irrigation Department at Provincial level. As a result the management could have a very thin pool of candidates available for final selection as compared to skilled professionals which could have been available in case the age limit was 63 years. CEO PEDO further highlighted that clause 9.6 (ii) of Chapter 9 of the Manual for Development Projects 2019 of Planning Commission and Guidelines for appointment

AGENDA ITEM NO. 50-004:

APPROVAL TO AUTHORIZE CEO PEDO TO SIGN AND SUBMIT THE TARIFF PETITIONS TO NEPRA FOR GABRAL-KALAM AND MADYAN HPPs.

24. CEO PEDO informed the forum that as part of the KP Hydropower & Renewable Development Program financed by Work Bank, PEDO has been undertaking construction of 88 MW Gabral Kalam and 157 MW Madyan HPPs. He stated that Consultants for the projects are in the hiring stage. After approval of the PC-I for the projects by PDWP, the same was submitted to CDWP for approval. During the Pre-CDWP meeting, the PC-I was returned with the direction that the sponsors will apply for feasibility stage tariff as per ECNEC decision for all subprojects of hydro power projects. In pursuance to the Pre-CDWP decision, an individual Consultant was hired as per the Word Bank guidelines for obtaining the feasibility stage tariffs for both the HPPs. The case was submitted to NEPRA by the authorized officer of PEDO. In response, NEPRA has directed to re-submit the case along with resolution of PEDO BoD for signatory of the subject tariff petitions.

25. CEO PEDO solicited approval of the Board to authorize him or his nominee for submission of the tariff petitions to NEPRA and to grant of Generation Licence for Gabral Kalam and Madyan HPPs.

26. Responding to the query raised by Engr. Arbab Khudadad Khan regarding selection of sites, CEO PEDO informed that detailed feasibility has been done afresh and there is no change in the sites conditions. Moreover the process of land acquisition will be initiated shortly. The forum was also informed that the feasibility stage tariffs for Gabral-Kalam and Madyan HPPs are 7.726 cents per KWH and 7.639 cent per KWH respectively.

DECISION:

27. After due deliberation, the forum unanimously resolved to authorize CEO PEDO or his nominee for submission of the tariff petitions to NEPRA and grant of Generation Licence for Gabral Kalam and Madyan HPPs. It was however decided that the Board may be kept informed about further development in this regard.

3.	Sahil Builders (Contractor) and ABKT (NGO)	**Package-1** LOT- 4 (Kohistan)	**Non-Responsive**	–
		Package-1 LOT- 5(Batagram)	**Non-Responsive**	–

30. Approval of the forum was solicited to the technical evaluation recommended by the MC and to allow PD MMHPPs opening of financial bids of the qualified bidders as per details contained in the table above.

31. While discussing the matter, the forum expressed its concern about delay in the bidding process and hiring of Management Consultant. PD MMHPPs responded that time was consumed in hiring of Management consultant, evaluation process of bids and addressing grievances of some of the firms. Secretary Energy & Power observed that the process of evaluation at the Committee level was completed in May, 2020 while it is being brought to the Board after three months. He stated that the issue should have been submitted to the Board earlier. CEO PEDO responded that it could not be placed before the Board earlier due to Covid-19 pandemic and other long list of important agenda items awaiting approval of the Board. Regarding delay in processing the case, CEO PEDO clarified that there will be no financial loss to the government and with no escalation charges as no such clause exist in the documents.

32. Mr. Abdul Siddique pointed out that as per the contract agreement; the consultant has to review the feasibility and preparation of the tendering documents. On the contrary, the pre-qualification was done before arrival of the consultants. He highlighted that two year has already been lapsed out the total contract period of 48 months. He further stated that the Consultant agreement is not clear whether payment shall be made on man-months basis or work done. CEO PEDO explained that for hydropower projects including MMHPPs, man-months system is being followed.

33. Project Director MMHPPs said that preparation of feasibility and design comes under the responsibilities of the contractors. He also clarified that pre-qualification was done by the PEDO PMU itself as it was feared that arrival of the consultants would take time.

34. The Board members also highlighted the following points:

i. Reasons of halting the pre-qualification process initiated in October, 2017;

Annex-I

1.	Mr. Nisar Muhammad Khan	In Chair
2.	Muhammad Zubair Secretary to Govt. of Khyber Pakhtunkhwa Energy & Power Department.	Member
3.	Engr. Muhammad Naeem Khan	CEO/ Secretary to PEDO Board
4.	Mr. Abdul Siddique	Member
5.	Engr. Arbab Khudadad Khan	Member
6.	Dr. Hassan Nasir	Member
7.	Engr. Bakht Zaman	Member
8.	Syed Mussawer Shah	Member
9.	Mr. Haque Nawaz	Member
10.	Engr. Maqsood Anwar Pervaiz, President Khyber Pakhtunkhwa Chamber of Commerce Industries, Peshawar	Member
11.	Mr. Nasrullah Additional Secretary Home & Tribal Affairs Department (Representative of Secretary Home)	Member
12.	Mr. Taj Muhammad Director Private Power	To assist CEO PEDO
13.	Dr. Shahid Ali Karim Dir (Finance & Admin), PEDO	For presenting relevant agenda
14.	Engr. Muhammad Luqman PD 356 Mini/Micro HPPs	For presenting relevant agenda

PEDO

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
GOVERNMENT OF KHYBER PAKHTUNKHWA PESHAWAR

No. /GK/NEPRA/Gen License/ 2020/8716
Dated Peshawar the:5/10/2020

To

The Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Tower
G-5/1, Islamabad.

Subject: **Authority Letter**

Mr. Riaz Ahmad Jan, Project Director Gabral Kalam Hydropower Project, bearing CNIC No. 17301-1230645-7,is hereby appointed as Authorized Representative of Pakhtunkhwa Energy Development Organization (PEDO), for the purpose of filing an application before NEPRA, for grant of Generation License and determination of Tariff for 88 MW Gabral Kalam Hydropower Project. He is also authorized to attend any meeting(s) and discussion(s) related to grant of Generation License and determination of Tariff, and to provide any information/document needed in this regard.

For and on behalf of
Pakhtunkhwa Energy Development
Organization (PEDO)

05/X/2020

(Engr. Muhammad Naeem)
Chief Executive Officer PEDO
Peshawar

Copy for information to,

1. PD Gabral Kalam HPP, PEDO, Peshawar.
2. GM Hydel, PEDO, Peshawar.
3. CE (Dev)/Director (P&F), PEDO, Peshawar.
4. CE/Head PMO, PEDO, Peshawar.

E823918

100
Rupees

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روپیہ

BEFORE THE NATIONAL ELECTRIC POWER REGULATRY AUTHORITY

AFFIDAVIT

I, Riaz Ahmad Jan, Project Director Gabral Kalam Hydropower Project (88MW), being duly Authorized Representative of PakhtunkhwaEnergy Development Organization (PEDO), hereby solemnly affirm and declare that the contents of the accompanying Generation License dated ,including all supporting documents are true and correct to the best of my knowledge and belief that nothing has been concealed.

I also affirm that all further documentation and information to be provided by me in connection with the accompanying petition shall be true to the best of my knowledge and behalf.

Deponent

GENERATION LICENSE FOR 88MW GABRALKALAM HYDROPOWER PROJECT DISTRICT SWAT

Article – 1

Definitions

(1) **In this Licence**:

a. "Act" means the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997);

b. "Authority" means the National Electric Power Regulatory Authority constituted under Section 3 of the Act.

c. "Licensee" means Pakhtunkhwa Energy Development Organization (PEDO) 88 MW GabralKalam Hydropower Project

d. "Rules" mean the National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000.

(2) Words and expressions used but not defined herein bear the meaning given thereto in the Act or in the Rules.

Article – 2

Application of Rules

This Licence is issued subject to the provisions of the Rules, as amended from time to time.

Article – 3

Generation Facilities

(1) The location, size, technology, interconnection arrangements technical limits, technical functional specifications and other details specific to the generation facilities of the licensee are set out in Schedule - I to this Licence.

(2) The net capacity of the generation facilities is set out in Schedule - II hereto.

(3) The Licensee shall provide the final arrangement, technical and financial specifications and other details specific to generation facilities before commissioning of the generation facilities.

Article – 4

Term

(1) The Licence is granted for a term of ***thirty (30) years*** after the commercial operation date.

(2) Unless revoked earlier, the licensee may, ***ninety (90) days*** prior to the expiry of the term of the licence, apply for renewal of the Licence under the Licensing (Application and Modification Procedure) Regulation, 1999.

Article – 5

Licence Fee

The Licensee shall pay to the Authority the Licence fee in the amount and manner and at the time specified in the National Electric Power Regulatory Authority (Fee) Rules, 2002.

Article – 6

Tariff

The Licensee shall charge from its consumers only such tariff which has been approved by the Authority.

Article – 7

Competitive Trading Arrangement

(1) The Licensee shall participate in such measures as may be directed by the Authority from time to time for development of the Competitive Trading Arrangement. The Licensee shall in good faith work towards implementation and operation of the aforesaid Competitive Trading Arrangement in the manner and time period specified by the Authority:

Provided that, any such participation shall be subject to any contract entered into between the Licensee and another party with the approval of the Authority.

(2) Any variation and modification in the above mentioned contracts for allowing the parties thereto to participate wholly or partially in the Competitive Trading Arrangement shall be subject to mutual agreement of the parties thereto and such terms and conditions as may be approved by the Authority.

Article – 8

Maintenance of Records

For the purpose of sub-rule (1) of Rule 19 of the Rules, copies of records and data shall be retained in standard and electronic form and all such records and data shall, subject to just claims of confidentiality, be accessible by the authorized officials of the Authority.

Article – 9

Compliance with Performance Standards

The Licensee shall conform to the relevant NEPRA rules on Performance Standards as may be prescribed by the Authority from time to time.

Article – 10

Compliance with Environmental Standards

The Licensee shall conform to the environmental standards as may be prescribed by the relevant competent authority from time to time.

Article – 11

Provision of information

(1) The obligation of the licensee to provide information to the Authority shall be in accordance with Section 44 of the Act.

(2) The licensee shall be subject to such penalties as may be specified in the relevant rules made by the Authority for failure to furnish such information as may be required from time to time by the Authority and which is or ought to be or have been in the control or possession of the licensee.

Schedule – 1

It contains the following information / drawings / sketches relating to the Power Plant Equipment and related System which are attached here with:

Plant Details

- General Information
- Plant Configuration
- Fuel Details
- Emission Values
- Installed Capacity
- Derated Capacity
- Expected Life
- Operation Record
- Cooling System
- Plant Characteristics
- Other details specific to the generation facility of the licensee such as:
    - Technical Limits of the Plant
    - Site Plan of Gabral Kalam Power Plant
    - General Layout of entire Gabral Kalam Power Plant
    - Interconnection Arrangements with National Grid

Plant Details

1. General Information

- Name of Applicant: Pakhtunkhwa Energy Development Organization (PEDO) ,Gabral Kalam Hydropower Project

- Address of the registered office: PEDO House,38-B2, Phase-5 Hayatabad Peshawar.
- Plant Location : Kalam, District Swat, Province of Khyber Pakhtunkhwa

- Type of Facility: Run of the River Hydropower Project

Plant Configuration

- Capacity of the Power Plant: (88MW)
- Type of Technology: High Head Hydropower
- Number of Units / Capacity -: Three units / 2 x 37.5 MW and 1 x 13 MW each

- Power Plant Make and Model –Francis turbine and Generators
- Commissioning Date November 2027

Fuel Details

- Type of Fuel: Hydropower Project
- Fuel (Imported / Indigenous): N/A
- Fuel Supplier: N/A

- **Emission values**

- SOx--- N/A
- NOx -- N/A
- CO --- N/A
- PM10 -- N/A

- Installed Capacity:88MW

2. Derated Capacity: No Derating as compared to ISO

3. Expected Life of the Facility ------------------------------------ 30 years

7. Operation Record :----------------New Plant to be commissioned by November 2027

4. **Plant Characteristics**

- Generating Voltage ---------------------------------- 11 KV
- Frequency -- 50 Hz
- Power Factor -- Leading 0.90 & Lagging 0.85
- Automatic Generation Control ---------------------No
- Ramping Rate --------------------------------------- 10 minutes
- Alternative Fuel ---------------------------------------No
- Auxiliary Consumption --------------------------------0.88 MW (1% of installed capacity)

Time required to Synchronise ----------------------- 5 minutes

SCHEDULE – II

The Net Capacity of the Licensee's Generation Facility

- Gross Installed Capacity of the Plant (ISO) ------------ 88 MW
- De-rated Capacity of the Plant ---------------------------- 88 MW
- Auxiliary Consumption of the Plant -------------------- 0.88 MW
- Net Capacity of the Plant --------------------------------- 87.12 MW
- Construction Period -- 48 months
- Expected date of Commercial Operation of the Plant – November 2027

Note: These are indicative figures provided by the Licensee.

The Net Capacity of the Plant available for dispatch to Power Purchaser will be determined through procedures contained in the Agreements or Grid Code

Interconnection Arrangement with National Grid for Power Dispersal of the Plant

The power evacuation from Gabral Kalam HPP is done through 220 kV Double Circuit Transmission Line as Loop-in and Loop-out arrangement to the nearest 220 kV Transmission Line coming from upstream Gorkin Matiltan HPP. The length of transmission line is approximately 2.6 km.

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION (PEDO)

1. INTRODUCTION

The Khyber Pakhtunkhwa (KP) province of Pakistan is blessed with huge hydropower potential. This potential remained focus of interest to private investors and international funding agencies. Most of the hydel projects of Pakistan including Tarbela and Warsak hydropower stations are located in KP.

Pakhtunkhwa Energy Development Organization (PEDO), since its inception in 1986, has been instrumental in identifying and exploiting hydel potential in Khyber Pakhtunkhwa. The organization is under the administrative control of Energy and Power Department of Provincial Government and is governed by the Board of Directors. PEDO has so far identified a number of promising hydel potential sites of more than 6000MW capacity, which can be developed in a systematic manner either through Public sector or Private sector.

i. Objectives of the Organization

- Prepare comprehensive plan for development of the power and energy resources of the province.
- Frame schemes related to Generation, Transmission and Distribution of power, construction, maintenance and operation of powerhouses.
- Advisory body for the Government of KP in power sector matters regarding hydropower development.
- Conducting feasibility studies, surveys ofhydel potential sites etc.
- Implementation of Provincial Hyde-l Power Policy to promote private sector investment in generation, transmission and distribution of power.

ii. Role of PEDO

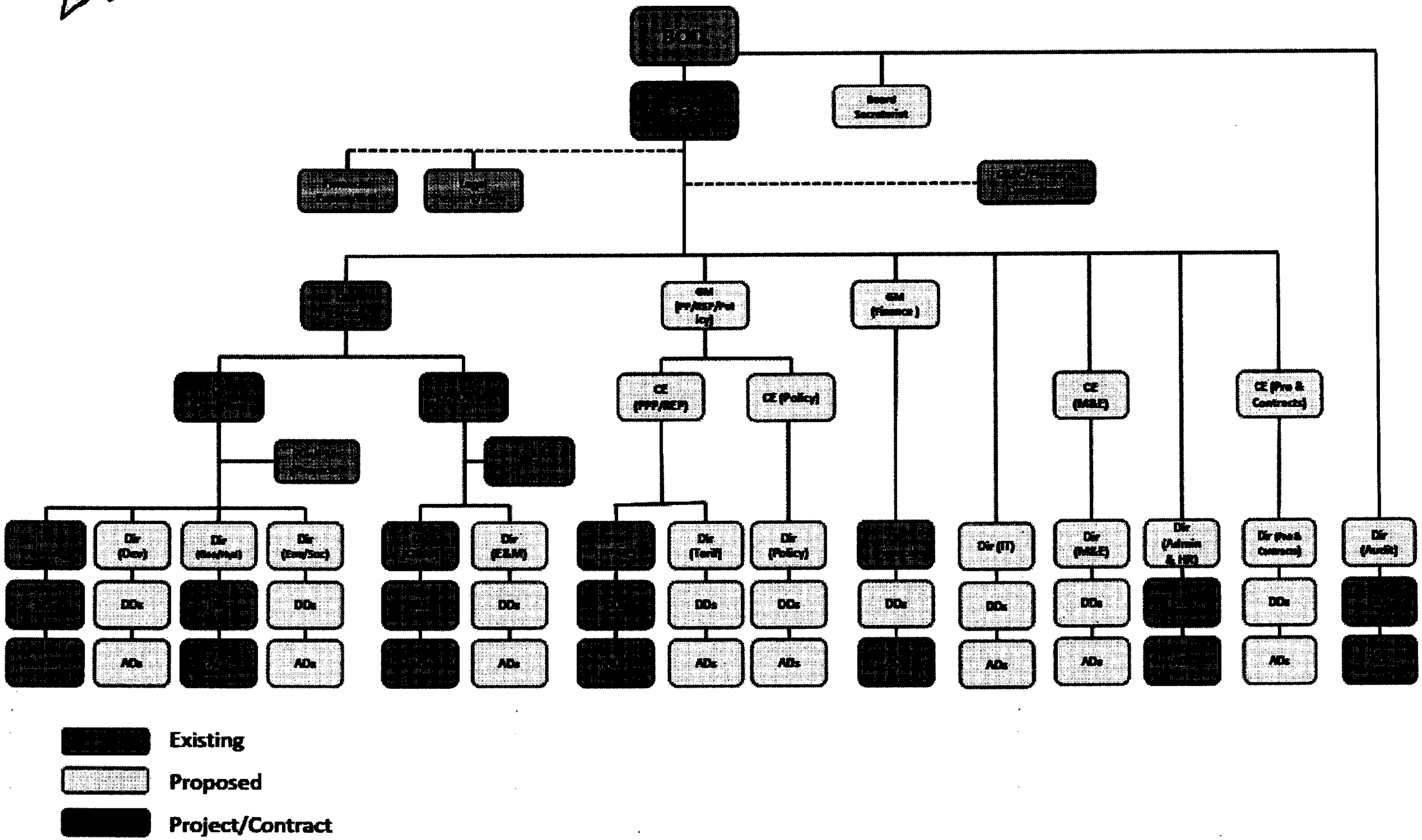
The Provincial Government has entrusted a dynamic role to PEDO, which mainly oriented towards private sponsors participation in power sector projects besides developing projects in public sector. PEDO has established a dedicated Directorate to provide one window facility to private sponsors.

iii. PEDO Organization

A Board of Directors comprising thirteen (13) members under the chairmanship governs affairs of PEDO. Following are the members of the PEDO Board of Directors as of to date followed by organizational structure of the PEDO on the next page.

1. Mr. Nisar Muhammad Khan, Chairman
2. Muhammad Zubair, Secretary to Govt of KP Energy & Power
3. Engr. Muhammad Naeem khan, CEO/Secretary to PEDO Board
4. Mr. Abdul Siddiqui, Advisor KPRA
5. Engr. Arbab Khudad Khan, EX GM WAPDA
6. Dr. Hasan Nasir, Project Management Specialist, CECOS University
7. Engr. Bakht Zaman, EX GM IESCO
8. Syed Mussawer Shah, EX GM (H), WAPDA
9. Mr. Haque Nawaz, EX DG Audit
10. Engr. Maqsood Anwar Pervaiz, President KP Chamber of Commerce Industries, Peshawar
11. Ikram Ullah , Additional Secretary , Home & Tribal Affairs Department
12. Atif Rehman, Secretary Finance Department
13. Muhammad Jabbar Khan, CEO, PESCO

PEDO ORGANOGRAM



iv. Achievements by PEDO

PEDO, with the assistance of GTZ (German Agency for Technical Cooperation), has compiled a Master Plan for rural electrification in the Northern mountainous areas of KP with particular emphasis on those areas which were not connected to the National Grid System. The Master Plan entails a total potential of more than 6000MW that has been identified for public and private sector development. The hydropower potential sites are mainly located in the Northern districts of K.P i.e. Chitral, Dir, Swat, Indus Kohistan and Mansehra.

2. PEDO PROJECTS

As tabulated, following are PEDO's projects at various stages.

Projects under Feasibility/Detail Design Studies

S/No	Name of Project	District	Capacity (MW)
1	Gabral Kalam HPP	Swat	88
2	Kari Muskhur HPP	Chitral	495
3	Torecamp- Goduber HPP	Chitral	409
4	356 MHPPs	All Districts of KPK	34.74
5	Access to Clean Energy Canal (10 MHPPs)	Charsadda / Mardan	81 KW

Projects with Completed Feasibility

S/No	Name of Project	District	Potential (MW)
1	Patrak-Shringal HPP	Dir	22.0
2	Nandihar HPP	Batagram	12.3
3	Arkari Gol HPP	Chitral	99.0
4	Istaro Boni HPP	Chitral	72.0
5	Mujigram-Shaghore HPP	Chitral	64.3
6	Naran Dam HPP	Mansehra	188.0
7	Balakot HPP	Mansehra	300.0
8	Sharmai HPP	Dir	150.0
9	Shushgai HPP	Chitral	144.0
10	Shogosin HPP	Chitral	132.0
11	Gahrait-Swir Lasht HPP	Chitral	377.0
12	Toren More Kari HPP	Chitral	350.0
13	Laspur Marigram HPP	Chitral	230.0

S/No	Name of Project	District	Potential (MW)
14	Barikot Patrak HPP	Dir	47.0
15	ShigoKach HPP	Dir	102.0
16	Ghor Band HPP	Shangla	20.8
17	Batakundi HPP	Mansehra	96.0
18	Jameshill More Lasht	Chitral	260.0

Under Construction Hydropower Projects

S/No	Name of Project	District	Capacity (MW)
1	Lawi HPP	Chitral	69
2	Kalkot- Barikot HPP	Swat	47
3	Patrak- Sheringal HPP	Dir	22
4	Koto HPP	Dir	40.8
5	Karora HPP	Shangla	11.8
6	Jabori HPP	Mansehra	10.2
7	Balakot HPP	Mansehra	300
8	Gorkin-Matilthan HPP	Swat	84

Solar and Other Under Construction Projects

S/No	Project Name	Capacity
1	Electrification of 100 Villages through Solar Alternate Energy, Phase-I	300 Watt each (2900 Solar Units)
2	Solarization of Chief Minister's Secretariat/Chief Minister's House	400 KWatt (Estimated)
3	Solarization of Civil Secretariat (Remaining Departments of Civil Secretariat)	400 KWatt (Estimated)
	Solarization Schools & Health Facilities	600 Watt per Class
5	Solar Electrification of 4000 Masajid in Khyber Pakhtunkhwa	2.6 KWatt (2000 Masajid)
		1.6 KWatt (2000 Masajid)
6	Solar Electrification of 440 in PK-10 & PK-11 in District Peshawar.	2.7 KWatt each (440 Masajid)
7	Electrification of Un-Electrified Villages through Solar/Alternate Energy, Phase-II (Additional 1000 SHS)	200 Watt each (1000 Solar Units)

S/No	Project Name	Capacity
8	Solarization of Administration Headquarters Offices in Charsadda (Feasibility)	N/A
9	356-Mini Micro HPP	34.74
10	Access to Clean Energy (Streams)	37.41
11	Access to Clean Energy (Canals)	15.72

Recently Completed Projects

S/No	Project Name	MW
1	Ranolia HPP Dubair District Kohistan	17
2	Daral Khwar Hydropower Project	36.6MW
3	Machai HPP	2.6
4	Electrification of Un-Electrified Villages through Solar/Alternate Energy, Phase-II.	200 Watt each (2750 Solar Units)

Engr. Muhammad Naeem Khan
Address: House # 4, Bilal Street, Academy Town Peshawar, KPK, Pakistan
Cell: +92 (0) 3009591743
qazinaeem@kpkep.gov.pk

Thirty threeyears of diversified experience in Water Sector management with remarkable leadership skills and over the top performance. Good organizational skills with forward thinking vision and optimism. Strong analytical, problem solving and project management skills, with a questioning mind and the ability to make well thought out decisions.Eager to learn new concepts, theories, and technologies with a very fast learning curve and implement successfully with proven technical, analytical and decision making skills. Trustworthy and ethical. Excellent interpersonal skills with proficient oral and written communication. Advocate for a positive change and team building, with belief in community driven and participatory approaches. Interested initializing my skills by seeking challenging executive level position.

EDUCATION

2005**UNIVERSITY OF ENGINEERING & TECHNOLOGYPESHAWAR, PAKISTAN**

- M.Sc.Water Resource Engineering

1983**UNIVERSITY OF ENGINEERING & TECHNOLOGYPESHAWAR, PAKISTAN**

- B.Sc. CivilEngineering (With Honor)

EXPERIENCE

Jan 2020- Till Date

Pakhtunkhwa Energy Development Organization (PEDO) Energy & Power Department KPK
(Chief Executive Officer)

Jan 2015 - Nov 2015 & Jan 2018 – June 2018

IRRIGATION DEPARTMENT KPK PESHAWAR, PAKISTAN
(Secretary Irrigation Department KPK)

After serving for about 30 years in the provincial irrigation department with a brilliant service record, I was posted as Administrative secretary of my parent department. During this period, I was also holding the additional charge as CEO of a public sector company (WSSP) which required lot of hard work as this new Company was tasked to provide all the civic services (including drinking water supply, solid waste management and waste water treatment) to the residents of Peshawar city. Following endeavourers were made;

- I concentrated on improving the technical strength of the Irrigation department by putting right man at the right job.
- An atmosphere of quality control and professionalism was created in all works, particularly the major projects like Bazai Irrigation project (Mardan), Warsak remodeling project (Peshawar) and small dams projects scattered in the province.
- Ensured and managed in-time funding for important projects which insured their timely completion.
- **Provided useful input as view point of the provincial government on the National Water Policy before its approval by CCI at federal government level.**
- Coordinated with ADB for funding of Pehure Extension project costing to Rs10 Billion which will not only irrigate 23000 acres of new land but may also generate 1MW of Electricity
- Ensured timely completion of 105 km long Bazai irrigation scheme meant for new command area of 25000 acres.
- **Coordinated and extended support to WAPDA designer on Mohmand/Momanddam project for its early completion.**
- **Coordinated with Federal Ministry of Water & Power for our mega project of Chashma First lift Canal for which finally MOU could be signed with 65% funding commitment by the Federal government side.**

- Federal as well as provincial funding for small dams projects initiated by me as DG small dams were arranged and projects completed successfully. Further new dams projects were initiated.
- Revenue collection system of the department was reviewed and strengthened.
- Contacts with national and international experts for innovative measures of water conservation were made.
- Ensured monthly progress review meetings regarding progress of ongoing projects.
- The programs of developmental projects was monitored and not only the allocated ADP funds were timely utilized but additional funds were consumed due to effective check on implementation with strong financial control at Secretariat level.
- With the support of top provincial government offices, the element of corruption was successfully checked and atmosphere of merit in all areas was developed.

Nov 2015- **ENERGY AND POWER DEPARTMENT KPK PESHAWAR, PAKISTAN**
Jan 2018 **(Secretary Energy and power department KPK)**

- The Energy & Power department is mandated to control all Energy and Oil & Gas related matters through its two attached Corporate Organizations namely Pakhtunkhwa Energy Development Organization (PEDO) and Khyber Pakhtunkhwa Oil and Gas Company (KPOGCL). Electric inspectorate is another attached setup which is dealing with Complaints and revenue matters related with PESCO.
- Managed to strengthen coordination with Federal Ministry of water and power, NEPRA,PPIB and AEDB which enabled the province to successfully get start on 20 number projects of renewable energy in the province.
- Under my supervision the department has developed a comprehensive and investor's friendly Hydro Energy Power Policy 2016 which has been approved by the provincial government.
- Energy and power department paved way for solution of decades old chronic problem of Net Hydel profit through a MOU signed between the Federal and Provincial government in the year 2016
- As a member of PESCOBoD, I have been successful to create conducive working relationship between PESCO& Provincial government which has developed an overall positive impact. Our close liaison with NTDC and PESCO has led towards good improvement in removal of constraints in our transmission and distribution system at provincial level.
- We have been successful in enhancing the oil and gas production in KPK with a tremendous pace through one window facility by Khyber PakhtunkhwaOil & Gas Company Limited (KPOGCL) working under the Energy & Power department.
- Developed conducive working relationship with Federal Ministry of petroleum, OGRA, DGPC, OGDC and other private sector forums which led us towards quick enhancement of oil from 30000 BPD to 55000 BPD during the last few years. Similar increase in gas from 300 MMCFD to 400 MMCFD has been achieved during this period.
- With an appreciable help of provincial government, we could not only ensure corruption free atmosphere in the attached departments but an environment of merit and justice has also been managed at all levels.
- Successfully managed and supervised the Energy and Power sector projects in 12 southern districts of KPK by Pakhtunkhuwa Energy Development Organization (PEDO).
- Strengthened and restructured PEDO on Corporate lines, which could work efficiently and against its total of 105 MW during the first 30 years. PEDO could now initiate its activities on series of hydro and other renewable energy projects with a total capacity of about 4000 MW in the province.

- Energy and Power department has succeeded in award of first ever 150 MW Shermai hydro power project to a very strong consortium of Sinohydro(China) and Sappire (Pakistan)
- Another six projects with a total capacity of 668 MW are in final stage of award to private sector firms on lowest tariff competition basis.
- Energy and Power department of KPK has initiated 11 number of projects under its public sector funding with a total capacity of 660 MW which is a history. All projects have been awarded on EPC contract basisfor completion within 4 to 5 years.
- Energy and Power Department is acting as focal office at KPK level which coordinate and extend all out help to WAPDA, Donor Agencies and private sector firms on mega power sector projects like Munda dam, Daso hydro power project, KuramThangi dam project, 800 MW SukkiKinarihydro power project (Private Sector) DiamirBasahaDam andGolengolehydro power project in Chitral.
- Energy and Power department under my supervision wasregularly giving its input in Reservoir Operation meetings being held at Federal Ministry of Water & Power where consensus of all stakeholders was developed based on the past experience.
- Developed a reliable team both at PEDO and KPOGCL level with the help of their Board of Directors.
- Ensure monthly progress review meetings to reviewprojects of attached departments.
- **Developed business plan and corresponding restructuring plan for PEDO with the help of its BoD.**
- **Coordinated and managed ABD and World Bank (WB) funding for five of energy sector projects with a capacity of 540 MW.**

Oct 2013 - May 2014

IRRIGATION DEPARTMENT KPK PESHAWAR, PAKISTAN
(DG Small Dams Directorate KPK)

- On my promotion as chief engineer (PBS-20), I was posted as DG small dams Directorate on the basis of my previous experience ofdam's projects in FATA.
- The ongoing office building for the directorate was completed within shortest possible time and office was established in our own premises for the first time.
- Proper system for the procurement the services of consultants and contractors, in line with PEC bidding process and KPRA rules was established.
- Chronic contractual controversies ofyears old dam projects were resolved and projects completed after a long halt.
- Proper business plan for dam projects was developed which was adhered to.
- Professional approach and quality control measures were ensured at all dam projects.
- Monthly progress review at DG office level caused a visible improvement in pace of progress.
- The issues with planning commission and ministry of water and power at federal level were amicably resolved and PSDP funded dam projects taken forward on fast track.
- A separate team was established for resolving the land acquisition disputesand social mobilization of affected people in dam area. This helped a lot in dispute resolution.
- The Directorate of small dams was given a boost and a total of 20 dam projects in KP were either completed or taken to final stage of completion.

May2014 - June 2016

WATER AND SANITATION SERVICES PESHAWAR (WSSP) COMPANY
(Chief Executive Officerof WSSP)

- Water and Sanitation Services Peshawar (WSSP) is a government owned Company established for water supply and sanitation services for Peshawar city. This is first of its kind in the world run on corporate basis where all civic services are provided by a single entity. I was the first CE of this Company where, with the help of USAID, World Bank and ADB, the setup was developed from scratch and taken to successful level, appreciated by all concerned.

- The establishment of this Company under SECP rules and its subsequent operation with thousands of existing staff of local government (with strong union) was an extremely difficult task which was achieved with blessing of ALLAH and hard work of my core team.
- Core management team for the company was hired on fast track on 100% merit basis.
- **This again was new and pleasant experience as a team leader, where merit base selection of management staff on market base salary could create an atmosphere with zero tolerance for corruption. This was the third test case as team leader in my career where I could see the results of corruption free setup when reasonably good salaries were paid and team was selected on basis of merit.**
- With hard work and good management, the WSSP was converted into a success story which was then reflected in other divisional head quarter of the province with lot of improvement in the level of civic services.
- The unprecedented success of WSSP project gave me national and international exposure resulting into increase in my confidence level that a water resource engineer can deliver in any water relevant field if he is a good manager and fair in handling his team.

Aug2010- May2013

FLOOD DAMAGES TERSTORATION DIRECTORATE (FDRD) IRRIGATION DEPARTMENT KPK
(Director General FDRD)

- In the aftermath of historic floods of 2010 FDRD was established as a dedicated setup for the restoration and rehabilitation of water sector infrastructure in KPK province.
- I was appointed as the Director General (DG) of the directorate where I established the office on emergency basis and selected my team on deputation basis.
- The restoration/rehabilitation plan, starting from assessment of damages, short-term, mid-term and long-term restoration activities, was presented and got approved from the government.
- As a first priority, the standing crops with cutoff supplies were saved by temporary restoring of irrigation water on about 113000 acres of land in the province. This emergent restoration task was almost completed during the first 30 days and maximum of the standing crops were saved.
- The mid-term and the long-term restoration works were awarded through opencompetitive bidding after fast track pre-qualification process for short-listing the contractors and consultants.
- The work comprising of about 200 packages of contracts of various sizes were awarded and completed under the supervision of consultants and project (FDRD) staff with in stipulated time.
- **The mega project like restoration of Munda Headwork and Amandara headwork were awarded as EPC contracts under USAID funding and the same were also successfully completed under my supervision as a team leader. The restoration works in the water sector by KPK were openly appreciated at national level as well as by the Donor Agencies.**
- The USAID grant was arranged with my personal interaction and coordination with USAID authorities.
- **The establishment of Directorate (FDRF), execution of about 200 contracts scatteredin all 25 districts of the province with a total cost of about Six Billion rupees was a success story with not a single complaint against the project works.**

- This again was my second experience as a team leader where the selection of competent and honest staff with a bit of financial incentive could lead to full scale success without any element of corruption.

Mar 2007- July 2011 **FATA DEVELOPMENT AUTHORITY (FATA-DA) PESHAWAR, PAKISTAN (GM Technical FATA-DA)**

- FATA DA was established as new entity during the year 2006 and I was appointed as head of Technical wing of the Authority on open merit basis.
- In the new setup and as head of the most important department of the FATADA, I established the department from very start, like formation of the team, office and other relevant arrangements.
- **As head of technical department, I had to look after the Small Dam section, Industrial development section, Skill Development section and village electrification programs with solar and other means.**
- During my tenure at FATADA two small dams projects could be completed in remote areas of South and North Waziristan Agencies while three other small dams were initiated which were completed later on. These projects were completed despite extreme tense law and order situation in FATA.
- Full scale planning and feasibility studies were managed in the entire FATA for water sector project particularly small dams.
- For the first time in history of FATA a properly designed industrial state was initiated in Mohmand Agency.
- A dedicated setup for skill development in FATA worked under my supervision which facilitated technical training to thousands of FATA youth which indirectly detached the young generation from militancy.
- The team formation and subsequent running of technical department with prominent success in all areas was a good experience.
- **The technical department being the major wing of FATADA was responsible to utilize about85% of the developmental allocation (ADP) of the Authority.**
- **Kept regular liaison with USAID office at Islamabad for their funded projects in various agencies of FATA.**

Nov 2006-**RRIGATION DEPARTMENT KPKPESHAWAR PAKISTAN**

Mar 2007**(Deputy Secretary Technical BPS-19)**

- Worked as technical advisor to secretary irrigation on all water sector issues of the province.
- Coordinated with Federal government, on the behalf of secretary irrigation, on technical matters.
- Manage technical review of feasibility studies, PC-Is and design documents at secretary office level.

Oct 2004- **IRRIGATION DEPARTMENT KPKPESHAWAR PAKISTAN**

Nov 2006**(Superintendent Engineer Small Irrigation Circle)**

- Managed supervision of departmental works in small irrigation schemes throughout the province where hundreds of small civil and government irrigation channels were rehabilitated and improved.
- **Worked as project in charge (PD) of a World Bank (WB) project meant for water conservation measures in 50 selected civil channels in the province which were executed on WB tender criteria.**

Nov 1985- **IRRIGATION DEPARTMENT KPK PESHAWAR PAKISTAN**

Oct 2004

After induction as Assistant Engineer in the Irrigation Department of Khyber Pakhtunkhwa in November 1985 till my up-gradation as Superintendent Engineer in the year 2004, I worked on various field and office positions as Sub-Divisional Officer, Design Engineer, Section Officer, Executive Engineer, Deputy Director with various tenures. **I got opportunity to supervise various local and foreign added projects with useful experience of working with World Bank and Asian Development Bank on large scale projects like Swabi SCARP project and Pehure high level canal project as Co-execution agency with WAPDA. Following is the breakup: -**

I. Assistant Engineer (BPS-17) from NOV 1985 to March 1994
II. Executive Engineer (BPS-18) March 1994 to October 2004

TRAININGS & PROFESSIONAL COURSES

Apr 28, 1986 **MANAGERIAL GRID TRAINING ARRANGED UNDER USAID PROGRAME** **PESHAWAR, PAKISTAN**

Aug 04, 1986 **COMPUTER ORIENTATION SEMINAR UNDER USAID PROGRAME** **PESHAWAR, PAKISTAN**

Feb 21, 1987 **OPERATION OF IRRIGATION SYSTEM UNDER UTAH STATE UNIVERSITY OF USA** **PESHAWAR, PAKISTAN**

Feb, 1988 **DESIGN STRATEGY MODULE COURSE UNDER USAID PROGRAM** **ABBOTABAD, PAKISTAN**

Jun 29, 1991 **OFFICER SECURITY (OSC_5/91) COURSE AT INTELLIGENCE BURU ACADMEY (IB) ISLAMABAD** **ISLAMABAD, PAKISTAN**

Jan 03, 1993 **APPLIED MICROCOMPUTER USE IN IRRIGATION AND DRAINAGE AT UTAH STATE UNIVERSITY USA** **UTAH STATE, USA**

Apr 15, 1998 **FOUR DAYS PRA TRAINING UNDER ADC SAWABI SCARP PROJECT** **ABBOTABAD, PAKISTAN**

Aug 06,1998 **ANALYZING ADP-SCHEMES WITH RESPECT TO PROGRESS, PLANNING & EVALUATION INFORMATIONGENERATED THROUGH SMES** **ISLAMABAD, PAKISTAN**

Sep13, 2001 **TRAINING ON FARMERS CONTROLLED FLEXIBLE IRRIGATION SUPPLY SYSTEM UNDER USAID UNDER MERRIAM IRRIGATION EDUCATIONAL FOUNDATION CALIFORNIA USA** **KARACHI, PAKISTAN**

May 13, 2002	**FUNDAMENTALS OF ELECTRONIC OFFICE COMPUTER COURSE AT BRAINS**	**PESHAWAR, PAKISTAN**
Sep 17, 2002	**PROJECT PROPOSAL DEVELOPMENT AT SZABIST KARACHI**	**KARACHI, PAKISTAN**
Dec 06, 2004	**PARTICIPATORY IRRIGATION MANAGEMENT COURSE (PIM) AT AGRO HYDRAULIC RESEARCH CENTRE MENEMEM IZMIR TURKEY**	**IZMIR, TURKEY**
Sep 29, 2004	**WORKSHOP ON DRAIN FRAME NDP KARACHI**	**KARACHI, PAKISTAN**
Feb 01, 2006	**FOUR DAYS COURSE ON DECISION MAKING AT NIPA LAHORE**	**LAHORE, PAKISTAN**
Aug 14, 2006	**COUNTRY FOCUSED TRAINING COURSE ON PLAN OF IRRIGATION BY JICA**	**TOKYO, JAPAN**
Sep 14, 2006	**ORIENTATION TRAINING PROGRAM BY (FIDA)**	**NATHIAGALI, PAKISTAN**
May 26,2008	**MONITORING AND EVALUATION PROGRAM FOR COMMISIONERS AT NUST LAHORE**	**LAHORE, PAKISTAN**
Apr 11, 2012	**ASIAN IRRIGATION FORUM ON OPTIMUM USE OF IRRIGATION RESOURSE AT ADB HEAD OFFCE MANILA**	**MANILA, PHILLIPINES**

PROFESSIONAL AFFILIATIONS

Dec, 2012	**PAKISTANENGINEERING COUNCIL (PEC)** (Member Governing Body (Civil) PEC)	**ISLAMABAD, PAKISTAN**
Dec, 2012	**PAKISTAN ENGINEERING COUNCIL (PEC)** (MemberThink PEC Tank Committee on Water)	**ISLAMABAD, PAKISTAN**
Dec, 2012	**PAKISTAN ENGINEERING COUNCIL (PEC)** (Member Accreditation Committee PEC)	**ISLAMABAD, PAKISTAN**
Dec, 2012	**PAKISTAN EMGINEERING COUNCIL (PEC)** (Member Think Tank Committee on Energy)	
Oct, 2012	**IRRIGATION OFFICERS WELFARE ASSOCIATION** (President Of The Association)	**PESHAWAR, PAKISTAN**
Oct, 2013	**INSTITUTE OF ENGINEERS PAKISTAN** (Member of Central Council)	**ISLAMABAD, PAKISTAN**
Nov, 2015	**KPOil &Gas Company Limited (KPOGCL)** (Member Board of Director)	**PESHAWAR, PAKISTAN**
Nov, 2015	**PAKHTUKHUWA ENERGY DEVELOPMENT ORGANIZATION (PEDO)** (Member Board of Director)	**PESHAWAR, PAKISTAN**

Dec 2016	**WATER SUPPLY & SANITATION SERVICES (WSSP)** (Member Board of Director)	**PESHAWAR, PAKISTAN**
Feb 2017	**PESHAWAR ELECTRIC SUPPLY COMPANY (PESCO)** (Member Board of Director)	**PESHAWAR, PAKISTAN**

SOCIAL AFFILIATIONS

Nov 2016	**DIR OFFICERS WELFARE ASSOCIATION** (President of the Association)	**PESHAWAR, PAKISTAN**
Oct 2016	**UJALA WELFARE ASSOCIATION** (President of the Association)	**PESHAWAR, PAKISTAN**

MISCELLANEOUS:

COMPUTER SKILLS Well versed with; Windows, MS Word, Power Point and Excel etc.

LANGUAGEEnglish (fluent), Urdu (fluent), Pashto (fluent)

DATE OF BIRTH June 03, 1958

CNIC NUMBER15302-1003629-1

CURRICULUM VITAE

Personal

Name	:	**ZAHID AKHTAR SABRI**
Fathers' Name	:	Abdul Aziz Sabri
Date of Birth	:	17th November 1960
Nationality	:	Pakistani
Domicile	:	Peshawar [Khyber Pakhtunkhwa]
Present Address	:	House No. 33, Street-3, Sector F-1, Phase-6 Hayatabad, Peshawar. Cell # 0300 88 55 333 Email: zasabri@hotmail.com

Academic Qualification

1986 BSc Electrical Engineering (with honors)
University of Engineering & Tech. Peshawar, Pakistan

1997 MBA (Project Management)
Preston University, Peshawar Campus

PEC Reg: Number : ELECT/5377

Employment & Experience

2018 – To date

Position Held:
Chief Engineer (Development & Operation) PEDO

Job description:

- Management & Regulation of all the in-operation powerhouses of PEDO.
- Financial management of revenue stream, indexation etc. of in operation powerhouses
- Construction supervision of ongoing hydropower projects.
- Monitoring of feasibility studies.
- Private Sector facilitation in awarding potential sites.

2007 - 2017	**Position Held:**

a) Director, Operation & Commercial, PEDO
b) Project Director Balakot Feasibility Study (300 MW)
c) Project Manager Machai HPP (2.6 MW)

Job description:

- Regulation of operation & maintenance of in-operation powerhouses.
- Controlling revenue collection from NTDC/CPPA, PESCO.
- Conducted feasibility study of 300 MW Balakot project.
- Completed Machai 2.6 MW project and connected to the PESCO system.

2001 - 2006 **Position Held:**

Deputy Director, Private Power Cell (SHYDO)

Job description:

- Preparation of First Provincial Hydropower Policy of NWFP 2001.
- Preparation of Request for Proposals, Bidding documents and contract agreements for soliciting bids and awarding hydel potential sites to private investors.
- Leasing of hydel power stations to private sector, planning for raw sites development.

1997-2000 **Position Held:**

Executive Engineer, Electrical Construction Division (SHYDO)

Job description:

- Construction supervision of 200 km 33 kV transmission & distribution lines for Reshun hydropower project, District Chitral.
- Preparation of tender and contract documents for soliciting bids for execution of works and supervision of construction works.
- Preparation of PC-Is for various construction projects, pre-qualification of contractors/consultants

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1994-1996 **Position Held:**

a) Executive Engineer (Planning), SHYDO
b) Project Director Feasibility Study of 36 MW Daral Khwar hydropower project

Job description:

- Appraisal of development projects including identification, planning, and preparation of proposals/ working papers in light of preliminary data.
- Pre-qualification of consultants, preparation of tender documents and evaluation of technical and financial proposals.
- Overall management of Daral Khwar project while conducting topo-survey, geo-physical & geo-technical investigations through contractors/consultants.

1993 - 1994 **Position Held:**

Executive Engineer (Electrical Design) SHYDO

Job description:

- Preparing design and layout of electrical transmission & distribution lines and grid station.
- Preparation of cost estimates for the schemes for obtaining clearance for inclusion of the scheme in the annual budget/ ADP/ PIP/ PSDP etc;
- Preparation of PC-IIs for feasibility studies of hydropower projects.
- Supervision of design section and computer training of junior engineers.

1987 - 1993 **Position Held:**

Assistant Engineer (Electrical Design) (SHYDO)

Job description:

- Coordination with GTZ (German Agency for Technical Assistance) in preparing Master Plan for rural electrification of remote mountainous areas of North West Frontier Province (NWFP).

- Reconnaissance study of hydropower potential sites in Northern areas of NWFP and updating the proposals/reports in light of the field survey/ site visits of the project area keeping in view broad technical parameters, economics and environmental / socio-cultural aspects.

1986 - 1987	**Assistant Engineer (Electrical)** **German Agency for Technical Assistance (GTZ)**

Job description:

- Conducted electricity demand forecast survey in Northern areas of NWFP comprising Chitral, Dir, Swat, Kohistan, Mansehra, Kaghan valleys.
- Analyzing the data on computer for determining the load centers in Northern districts of NWFP.
- Preliminary work for preparation of Master Plan of hydropower potential in NWFP.

Training / Tours / Visits

1989	Training/Study tour to UK, France, Switzerland, Austria, Germany visiting hydropower projects and manufacturers of hydropower machinery including SIEMENS & OSBERGER Germany, SULZER ESCHERWYSS & BELL Engineering Switzerland, WASSERKRAFT VOLK etc.
1994	Training in WASP and Power System Expansion Planning, conducted by GTZ and Montreal Engineering, Canada.
1995	Training/Study tour to Spain, Germany, Switzerland and to attend International Conference on hydropower and to acquire knowledge with emphasis on cascade hydropower system including visit to tunnel boring machine manufacturer in Germany.

Other Information

Computer Ability: MS Office, Auto CAD (Computer Aided Design)

Languages: English, Urdu

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MUHAMMAD IRFAN

Date of Birth	:	20th September 1964
Languages	:	Basic: Urdu Others: English (Full Working Knowledge)

Qualifications :

i) **Master in Hydropower Development.**
Norwegian University of Science & Technology
Year 2000.

ii) **B.Sc. CIVIL ENGINEERING (WITH HONOURS)**
NWFP University of Engineering & Technology
Year 1988.

iii) **Field Survey Training (WITH HONOURS)**
NWFP University of Engineering & Technology
Year 1987.

iv) **Computer Training.**
MS Office, MS Project
Auto-CAD

Experience:

31 years diverse experience in various activities of Hydropower development, starting from identification of Hydropower Sites to complete commissioning of the Power Houses.

- Current Job: (April-2020-till date)
  Chief Engineer (Development)
  Mentoring and Evaluation of Construction Activities of Development Projects.

- (March-2019- March-2020)
  General Manager (Solar)

- (Dec-2018- Feb-2019)
  Director Private Power PEDO

- (May-2018- Nov-2018)
  Director Finance & Administration PEDO

- (Nov-2017- April-2018)
  General Manager (Hydel)

- (May-2016- Nov-2017)
  Project Director 36.6 MW Daral Khwar HPP Swat.

- (2015- 2016)
  Director Private Power.

- (2013-2015)
  Dy. Director Private Power / Director (Civil) GMHPP
  Dealing with Development of Hydropower project in Private Sector.

- (2009-2013)
  Dy. Director Private Power / Project Director GMHPP.
  Dealing with Development of Hydropower project in Private Sector.

2003-2009
Project Manager Pehur Hydro Power Project
Management and Supervision of 18 MW Pehur Hydropower Project District Swabi.

2002-2003
Research Officer (Technical)
Irrigation & Power Department NWFP.
To assist Secretary Irrigation & Power in technical matters related to Civil Engineering.

2001-2002
Deputy Director Planning and Facilitation Sarhad Hydel Development Organization (SHYDO) Peshawar.
Worked on Facilitating Public and Private Sector in Development of Hydel Power Stations.
Worked on Master Plan for systematic harnessing of Hydel Power Potential in Northern area of N.W.F.P.

2000-2001
Executive Engineer Operation and Maintenance SHYDO Chitral.
Operation and Maintenance of Small Hydel Power Stations.
Distribution of Power supplies to remote and hilly areas of Chitral District.
Maintenance of consumer record, Provision of electric connections, Monthly billing, and Revenue collections.

1996-2000
Assistant Director Hydrology SHYDO Peshawar.
Worked on Establishment of Hydrological Gauging Stations in Northern area of NEWF. Collection and Analysis of Hydrological Data. Collection and Analysis of Sediment Data

1994-1996
Sub Divisional Officer Civil Maintenance SHYDO SWAT.
Maintenance of Civil Structures of Small Hydel Power Stations. Preparation of work estimates.

1992-1994

Sub Divisional Officer Civil Construction SHYDO SWAT.

Supervision of construction works of Ashuran and Thal Hydel Power Stations.

Preparation of PC-1 for new Hydel Power Schemes.

1989-1992

Assistant Engineer Civil SHYDO Chitral.

Supervision of construction of tunnel for Penstock for Reshun Hydel Power Project.

Dated: 10/05/2020

Muhammad Irfan
Chief Engineer (Development),
PEDO, Peshawar.

CURRICULAM VITAE

Name in Full	:	Maqsood Anwar Khan
Father Name	:	Sikandar Khan
Date of Birth	:	13th March 1968
Domicile	:	Peshawar
Marital	:	Married
Religion	:	Islam
Nationality	:	Pakistani
Postal Address	:	46-A Sector B-2 Phase 5 Hayatabad Peshawar.
Contact Nos.		
Office	:	+92-091-9219515
Mobile	:	+92-332-5446596
POSITION HELD	:	General Manager (Technical) BPS 20 FATA Development Authority Peshawar.
ACADEMIC QUALIFICATION	:	BSc Electrical Engineering

ACADEMIC RECORD:-

Examination Passed	Board /University	Year	Division
Bachelor of Science in Electrical Engineering (B Sc. Elect Engg)	M.L.Q.U Manila	1989/A	1st
Inter Science (F Sc. Pre- Engg)	B.I.S.E Peshawar	1984	2nd
Matriculation S S C	B.I.S.E Peshawar	1982/A	1st

Back Ground:-

Pakistan is currently experiencing one of the worst power crises in its history , whereas northern regions of the Khyber Pakhtunkhwa (KPK) , have been blessed with enormous un-tapped hydel potential (70% of overall hydel potential), which on development can bring relief to the people of KPK in particular and Pakistan in general in the form of reduce load shedding , less dependence on thermal power plants fuel imports, cheaper electricity, over all positive impact and improvement in socio economic parameter of the country. It is pertinent to mention here that most of the major hydropower projects (HPP), which are currently in operation, are lying in KPK Pakistan.

Sarhad Hydel Development Organization (SHYDO) Now called Pakhtunkhwa Energy Development Organization (PEDO) , established in 1986, is a provincial department of the Government of Khyber Pakhtunkhwa (KPK) in Pakistan . PEDO is created to identify, conduct and implement in private and public sector this vast available hydel potential of the KPK PEDO in collaboration with German Technical Agency, GTZ has conducted various studies and had identified various sites having a combine capacity of over 40000 MW in KPK of which 6000 MW capacity sites are indentified as feasible . These sites comprise small, medium and large hydropower projects.

PEDO has so far successfully completed the construction of a number of small to medium range HPPs in KPK which are in operation,. Further PEDO is currently constructed two more power projects in KPK, which includes an 81 MW Malakand – III HPP in Malakand Agency,18 MW Pehur HPP in district swabi and 2.0 MW shishi HPP in district Chitral.

In September 2007, PEDO has entered into a loan agreement "Renewable Energy Development Sector Investment Program – Project (REDSIP)" with the Asian Development Bank (ADB) , Under the REDSIP program ADB will provide loan to PEDO over the coming for Construction of three HPPs i.e. 36 MW Daral khwar 12 MW Ranolia Khwar and 2.0 MW Machai , Feasiblity studies of three sites (Koto,Karora and Jabori HPPs) and Capacity Building of PEDO . Out of these , PEDO has awarded the consultancy for 36 MW Daral Khwar HPP, feasibility studies of three sites and Construction of PEDO office building Feasibility Study of all above mentioned projects has been completed and construction is also in the final stages.

PROFESSIONAL EXPERIENCE

I am a professional Electrical Engineer , joined PEDO as Assistant Director / Junior Engineer in 1993 and since then I worked at various position in PEDO and now posses well over approximately twenty years of relevant experience in the field of Hydropower. I served at various positions in PEDO, which are briefly outlined in the following paragraphs.

1 Working as General Manager (Technical) BPS 20
In FATA Development Authority on deputation basis in own pay scale i.e BPS 19.

Main Responsibilities:

(i) Operation & Maintenance of Malakand –III HPP (81 MW)
(ii) Conducting Feasibility Studty of Mujigram HPP (60 MW)
(iii) Conducting Feasibility Study of Arkari Gol HPP (90MW)

(iv) Conducting Feasibility study of Istaro Booni HPP (70MW)
(v) Operation and maintenance of 4.2 MW Reshun Hydro power Project.
(vi) Transmission and Distribution of Power From 4.2 MW under feeder No.I,II&III
(vii) Up gradation of Reshun hydropower Project from 208 MW by successful installation of the third unit of 1.4 MW Capacity.
(viii) Rehabilitation of small hydropower projects under Earth Quake Rehabilitation Project and Augmentation of Jalkot Hydropower Project.
(ix) Preparation and Distribution of Consumers bills and collection of revenue from Hydropower Plants operated by PEDO
(x) Laisioning with District Governments and coordination and operate smoothly the power plants.

SHAH HUSSAIN SYED

CHIEF ENGINEER Pakhtunkhwa Energy Development Organization (PEDO):
(Head PMO / Chief Engineer PMO) / World Bank Projects:

I am responsible for World Bank assisted projects namely Gabral Kalam Hydropower Project (88MW) and Madyan Hydropower Project (157MW)
I am expert in regulatory compliance and statutory approval and international donor coordination and negotiation with GOP officials regarding Memorandum of Understanding (**MOUs**) and PILs (Project Implementation Letters). He is expert in procedures related to **Planning Commission** of Pakistan, **WAPDA**, Ministry of Housing Pakistan, Pak PWD, and provincial departments of C&W, Planning & Development (P&D), and Finance department, Home & Tribal Affairs, Peshawar Development Authority (PDA) and Pakhtunkhwa Highway Authority (PKHA).

Mr. Syed specializes in project management, budget planning, financial matters, land use planning and modeling, design, and construction of civil infrastructure projects. Mr. Syed is a certified Contract Officer Representative (**COR**) of the US government at State Department and thus directly involved in **global procurement of goods and service** through General Service Office (GSO) based in Germany. He has directly supervised INL funded projects of **UNDP, UNOPS** and FAO.
In addition to his technical skills, he also offers expertise in organizational performance and change management, labour relations, occupational health and safety, budgeting and, service operations management.

Mr. Syed has been leading the construction unit of INL as **Chief Engineer** (Head of the Construction Unit) for the **last 10 years** thus making him an excellent leader with proven record of managing both public & private sector organizations including hydro power projects, water supply and irrigation projects execution and management. Having 10 years of working experience at a senior management position, Mr. Syed headed many multi million dollars projects financed by multi-lateral agencies including INL, USAID, ADB, provincial and federal governments. He has exceptional experience in full cycle of project management from inception to completion (end-to-end) involving government of Pakistan, Government of United States, multiple consultants and contractors and the general public.

EDUCATION

- Master of Civil Engineering, University of Waterloo, **CANADA** - 2005
  Specialization: Project Management

- Diploma in Computer Programming, Seneca College Toronto, **CANADA** - 2002

Chief Engineer, United States Embassy (INL) Islamabad, Pakistan, Oct 2009-June 2019

General Responsibilities:

Responsibilities include supervising/managing the work of 14 senior civil engineers and numerous consultants, contractors and vendors. Providing guidance/assistance to Government of Pakistan (GOP) technical staff with whom the United States Government (USG) has an agreement or contractual relationship as per **FIDIC** rules regarding follow up of construction schedules compliance of work with regards to specifications and design. I am also responsible for developing the project proposals and obtaining approvals from the competent authorities. I am responsible for developing multi-year work plans and proper utilization of funds approved in accordance with the bilateral agreement between USG & GOP.

Counter Narcotics Hydro Power/Irrigation/Water Supply Projects (US$55M):

I was the lead hand on the functional planning and construction of counter narcotics Irrigation, Hydro Power and Drinking Water Supply and road projects in the province of Khyber Pakhtunkhwa and ex-FATA.
Since 2009, I have been directly involved in the construction of small hydro power projects in ex-FATA and Kala Dhaka and Kohistan districts of Khyber Pakhtunkhwa. Being the Chief Engineer and Head of the Construction Unit, I convinced the Government of Pakistan and US authorities to make maximum number of small hydropower stations in the far flung areas of ex-FATA and Kala Dhaka and Kohistan districts. I was the lead hand in making 3 years plans and 5 years plans and preparing **PC-1** for Kala Dhaka Area Development Project, Kohistan Area Development Project, Mohmand, Bajaur and Khyber Area Development Projects. I made micro hydro projects and drinking water supply projects as permanent feature of the Area Development Plans as the associated benefits of these projects are manifold.

INL completed more than **30 Micro Hydropower Units** providing electricity to about 30,000 people in the remote areas of ex-FATA and Kala Dhaka and Kohistan districts of KP Province.
Construction details of micro hydro units are site-specific. Sometimes an existing mill-pond or other artificial reservoir is available and can be adapted for power production. In general, micro hydro systems are made up of a number of components. The most important include the intake where water is diverted from the natural stream, river, or a waterfall from a natural water spring uphill. An intake structure such as a catch box is required to screen out floating debris and fish, using a screen or array of bars to keep out large objects. The intake may have a gate to allow the system to be dewatered for inspection and maintenance.

Irrigation Projects: The Irrigation Projects included the construction of 5 small dams and 150 new irrigation channels to provide irrigation water to the henceforth barren lands. Irrigation infrastructure included construction of siphons, aqueducts and lining of irrigation channels to ensure optimal use of irrigation water. Thousands of acres of new command area was included after completion of these projects. These lands were used for poppy growing and now capable of growing off season vegetables and traditional crops. Flood protection bunds were constructed across FATA to protect the agriculture lands from erosion.

Drinking Water Supply Projects: The water supply projects included the construction of overhead water tanks and associated distribution systems for various communities. The number of completed water-based projects exceeded 300 water supply projects during my 10 years of engagement. Water from natural springs was utilized to cater for the needs of various communities. In some cases tube wells were constructed for water supply to the overhead water tanks. In remote areas where no electricity was available, Solar Systems were installed to cater for water supply projects to the communities. Most of the Water Supply projects were completed in Khyber, Mohmand, Bajaur, Kala Dhaka and Kohistan districts of KP. Prior to INL interventions women used to travel large distance by foot to bring water in buckets. Now water is provided to these communities at their door steps.

Water Supply (SMALL DAMS) to 92 border outposts for Frontier Corp ($10.0M):

The water supply project to newly constructed 92 borders outposts was a unique project. The project was based on the idea of constructing small dams to store the water and then would be used as a source of water supply to various outposts at various far flung locations. The small dams were constructed in deep valleys basically blocking the way of spring water to provide clean water reservoir.

Roads Projects ($150M):
About 1200 Km of road projects were completed in ex-FATA poppy growing areas. I carried out feasibility studies of these roads and remained associated with these projects from inception through completion. Reviewed the construction documents and participated in the pre-bid meetings and responded to the queries of other government agencies, consultants and the public before the actual construction. Current Projects include: Crop Control Projects in Bajaur, Mohmand and Khyber Tribal Districts ($ 25.0 Million) through Directorate of Projects, KP

Ring Road Peshawar through Planning & Development KP :(US $45.0M):

Reviewed and approved the design and construction documents prepared by the consultants. **Three consulting firms carried out the design and 7 various contractors did the actual construction**. The road consisted of a number of flyover and underpasses and 14 bridges. The road was located in the urban area and currently used by heavy traffic therefore required a comprehensive traffic management plan and realistic construction schedule. The construction also involved detailed design and construction of drainage structures to discharge the storm water flows during rain events, installation and design of several traffic signals and construction of 2 roundabouts. The project was executed according to the **FIDIC** contract clauses and rules in letter and spirit. The project faced many challenges. The contract was awarded to international contractor called KARKON. But the contractor failed to complete the project in specified time and the contractor was restricted to only 30% of the project as per the **FIDIC** rules and the remaining work was put on fresh tendering dividing the work into 7 packages. The project was multi lateral financing by various donors including **INL** and **USAID** and provincial government. The stakeholders included **PDA, KPHA, P&D, INL and USAID along with multiple contractors and consultants**. This road was completed successfully in 2016.

Other Major Road Projects:

- Kanju to Maday Road - KP Highway Authority – 52Km (US $18M),

- Mattani Bypass Road- 29km - FATA secretariat (US $17.0M),
- Landikotal Bypass Road- 17km through FATA secretariat (US $7.0M),

Police Building Projects (US $50M)

- **Sind Police**: Construction of Women Barracks - $3M
- **Baluchistan Police:** Refurbishment of Police Training School Quetta ($ 10.7 Million)
- Construction of ANF Women Barracks ($ 5.0 Million)
- **KP Police:** Construction of Joint Police Training Center Phase-2($ 18.0 Million)

Construction of Joint Police Training Center Phase-2 ($18.0M):

Joint Police Training Center (JPTC) is still under construction in Nowshera. The project provides for accommodation for 1500 police persons. It consists of 7 barracks while each barrack allows for 200 persons to reside comfortably. The project consists of a residential area for instructors, support staff and administrative staff with families. A small park for the children is constructed. The project also consists of a 20 bed hospital/health unit. It has Quick Response Unit/Fire Brigade and a huge Firing Range. The project is divided into 3 areas namely: Training Area, Administrative Area and Residential Area. The total area of the compound is more than 1500 kanal. The Training Area consists of huge training sheds which would allow 500 persons to sit in one place. Huge Rappelling Tower of 65 meters height has been constructed for training the police personnel. The project components include: Academic Block, Administration Block, Auditorium, Hostels, Barracks, School, Mosque, Sports facilities, roads, external Water Supply System, Tube Wells and External Sewage System(Sanitation).

<u>Senior Engineer, Atkins Middle East, Abu Dhabi, UAE, Nov 2008-Oct-2009</u>

General Responsibilities:

General responsibilities include project management, roads and infrastructure designs, transportation planning, functional studies, preparation of contract documents, prequalification documents, terms of references and proposals. I was also responsible for client contact, liaison, and coordination and preparation of prequalification applications to be submitted to various organisations. My responsibilities further included the review and preparation of responses to quaries from developers and clients. I represented Transportation/Infrastructure team in the desin and master planning process and internal review committees.

United Arab Emirates (UAE) Nation Transport Plan. Client: National Transport Authority (NTA)
Project: Develop a National Transport Plan for the UAE and accompanying White Paper on transport policy
Key Services: Undertake a transport study of the whole of the UAE which sets out to:

- Review existing problems, opportunities and constraints relating to strategic transport demands within and between each of the emirates, as well as travel demands from areas outside the UAE;
- Develop a national transport model for passenger and freight transport;
- Examine and assess a range of short term, medium- and longer-term measures and policies to improve the current national transport system, based on international practice, as well as meet the travel demands expected from future growth across the region in line with the desired outcomes (objectives);
- Identify a preferred integrated transport strategy and investment program that best supports future aspirations for development and growth (National Transport Plan);
- Prepare an accompanying Transport White Paper, alongside the Plan, setting out the policy framework which will guide the direction for the UAE Federal Government and its partners at national, regional and local level in their activities; and provide advice and recommendations on an appropriate set of institutional roles and responsibilities for further development and delivery of the NTP between the Federal Government and its agencies and the transport authorities and others operating within each emirate, based on international practice.

ICAD IV, Abu Dhabi. Client: ZonesCorp
Project: Prepare a Conceptual Master plan for the ICAD IV project to create an industrial, commercial and social facility complex in Abu Dhabi
Key Services: Transportation planning and engineering

- To ensure the safety of the traffic on the proposed at grad rail intersection
- To assess the safety of the proposed Freight Rail access to the development and make suitable proposals for the rail crossing over the highway.
- Traffic impact, parking, pedestrian and public transport assessments
- Network modelling
- Integrated transport solutions
- Detailed transport plans
- Detailed highway, traffic signal and signing schemes

Other Projects:
I was working as a Project Manager on many other projects including Marriot Mixed Use Development Al Ain, Sheibat Al Watah Mixed Used Development Al Ain, Hard Rock Tower Dubai and Hellio Mixed Used Development Dubai.

Senior Engineer, Hyder Consulting Middle East, Bahrain, Jan 2008-Nov 2008

General Responsibilities:

General responsibilities included infrastructure and transportation planning, functional studies, preparation of contract documents, terms of references and proposals. Reviewed and prepared responses to land circulations, development circulations, and inquiries from the Ministry of Works, Ministry of Municipal Affairs, and the land development industry. Reviewed and coordinated

- To supervise the development and implementation of policies and procedures
- To participate in formulating the strategic goals, objectives and programs for the Highways Operations based on Alberta Transportation's overall Strategic Plan.
- To deliver through the consultative process and professional service agreements, planning studies/recommendations and Highway Vicinity Management Agreements that are technically sound, meet accepted departmental standards and policies and are supported by internal and external stakeholders.
- To facilitate the management review on traffic safety issues, performance, progress towards the achievement of targets and objectives.
- To assist in the developing of traffic safety annual plan. This was to be achieved by setting the numeric goals and key initiatives to achieve the goals, based on the current and expected performance.
- To actively participate in technical committees related to traffic safety. To supervise the implementation of major traffic engineering and safety programs, and the development of traffic engineering studies and traffic engineering and safety contracts and agreements.
- To advise and consult in formulating, reviewing and revising of the traffic safety systems, accident data base, the traffic laws and regulation, and the traffic enforcement issues.
- To implement the safety audit system and procedures and manage to conduct road safety audit on all proposed road designs and existing roads.
- To develop and implement a procedure to identify and to remedy traffic accidents black spots including sites visits.

As a project administrator for regional planning initiatives, prepared project Terms of Reference (TOR), selected engineering consultants, chaired Technical Review Committees (TRC) with municipal stakeholders, department representative and engineering consultants and ensured the delivery of completed planning studies. Reviewed draft reports and final reports provided by the consultants for technical accuracy and adherence to project Terms of Reference. I was able to clearly identify potentially contentious or politically sensitive issues for information and direction by department officials.

I provided contract administration of professional service agreements for planning studies to address network requirements for future highway upgrades with in the Region.

As Expenditure officer, monitored invoices and approved payments with approval limits and tracked expenditures for projects during all phases.

Conducted consultant performance appraisal with a goal to enhance future performance and increased consultant awareness of department policies, procedures and accepted practices. I worked with municipal stakeholders to achieve support and endorsement of Highway Vicinity Management Agreements (HVMA).

<u>Project Manager, Strathcona County, Alberta, Canada, Aug 2006-Jun 2007</u>

General Responsibilities:

Strathcona County is huge **municipality** at the outskirts of Edmonton headed by a Mayor and accompanied by 8 councillors. I was part of the core engineering team responsible for providing basic services including **water, sanitation, drainage, storm/flood water** management and transportation to the citizens at large.
General responsibilities included selecting consultants, supervising both consultants and contractors, transportation planning, functional studies, preparation of contract documents, terms of references and request for proposals. Reviewed and prepared responses to land circulations, development circulations, and inquiries from the administration, the land development industry, Council and the public. Reviewed and appr0ved requirements for new developments including Area Structure Plans, Outline Plans, and development/subdivision applications. The position by default was a point of contact for consultants, contractors, utility companies, stake holders and the citizens.

Involved in negotiating various contracts with the contractors and arranged pre-bid meetings of the consultants and contractors and stakeholders. Selected various consultants for a number of jobs. Supervised the work of consultants and contracts. Involved in evaulauting various subdivisional applications and made recommendations with respect to transportation requirements, made recommendations for appropriate access to the roadways as per Geometric Design Guideline of Alberta Infrastructure and TAC. Negotiated the Right of Entry Agreements, various Crossing Agreements with the utility companies and the private owners as per requirements.

My responsibilities also included checking and advising the community, safety plans prior to its execution at site including coordination with other major developers and stake holders, preparing Tender Documents for contractors to implement approved Traffic Safety Schemes.

<u>Petroleum Way and 17th Street Road Way Improvements Project. – Sherwood Park</u>: Project Manager for the Road Way and Intersection improvement project. The assignment involved preparation of the Consulting Agreement documentation, Contract documentation, coordination with Petro-Canada, ISL Engineering Consultants, Fortis, RGM signal contractor and Earthwise contracting Inc. and negotiations with other agencies involved. The construction was completed in typical urban environment and land restrictions. Two third of the finance was provided by Petro-Canada

<u>Josephburg Airport – County of Strathcona</u>: Project Manager for the construction of the Airport. The project included: coordination with Shell Canada, EBA Consulting Engineers, various sub consultants, Waiward Construction Inc., Alberta Infrastructure and Transportation and other agencies and stakeholders. I arranged pre-bid meeting and preconstruction meetings. I was involved in the land acquisition, making agreements with various agencies and utility companies. The project involved: geotechnical studies, preliminary and detailed designs, drawings and specifications, approvals and construction administration.

<u>Project Engineer, Morrison Hershfield, Calgary, Canada, Feb 2005-Aug 2006</u>

Truck Route Policy – City of Calgary: Project Manager: Provided input in developing a truck route policy for the City of Calgary. The project included extensive involvement of the stakeholders and required input from other Municipalities. In order to get a smooth feedback from other municipalities an interview questionnaire was developed and sent to them. Data collection and data analysis was also a major part of the project besides arranging a number of meetings with the stakeholders, City of Calgary, City police and staff.

16th Avenue extension project – Phase-2 – City of Calgary: Member of the design team for the 16th Avenue extension project. Provided input into the design and prepared contract document for the project. Estimated quantities and developed schedule of quantities for the contract document. I coordinated all activities with relevant utility companies, private properties and commercial businesses for smooth relocation and adjustments. Prepared and executed various agreements with stakeholders and arranged public meetings. I extensively used LDD and AutoCad in the Project. The construction of a state-of-the-art noise attenuation wall was one of the important aspects of the project. Convinced various residents along 16th Avenue and defined the limits of noise attenuation wall.

LRT Park and Ride Facility and Westwinds Drive – City of Calgary: Project Engineer for the geometric design of the LRT Park and Ride Facility. I carried out the functional planning of the LRT Park and Ride facility. Studied similar facilities and used ITE trip generation Manuel to establish the number of trips generated by the facility. I established the access requirements of the facility from Westwinds drive by using TAC guide line and Geometric Design Guide of Alberta Infrastructure. Carried out the Traffic Impact Assessment of Westwinds Drive and extensively used Excel for calculations and establishing trips. I used Synchro and micro simulation software SimTraffic for the purpose. Prepared Tender and Contract documents and project specifications and assisted in the tendering process. Reviewed shop drawings submitted by the designer.

Industrial Park – MD of Rocky View. Project Manager: Coordinated activities of the application process with various agencies for the proposed industrial park in the vicinity of MD of Rocky View. I carried out the functional planning for the facility. I established access requirements as per Alberta Infrastructure and Transportation standards. I studied various aspects of the project in the light of other adjacent commercial development and road way improvements like the Ring Road. I established the geometric design requirements of the project.

Project Engineer, Irrigation Department, Govt: of Pakistan, 1996-2001

Swabi SCARP Irrigation Project – Government of Pakistan / Asian Development Bank: It was a mega project of Pakistan aiming at improving the efficiency of the existing irrigation system and increasing command area. The objectives of the project were to increase the command area and increase irrigation water to the tail irrigators. Project Coordinator for preparation of US$880 million program for lining of 1200 water courses to improve agricultural water use efficiency and reduce water logging. The project included development of standard designs and specifications and extensive consultations with beneficiary farmers, various levels of governments, international donors and non-governmental organizations. The project included the construction of culverts, drains, subsurface tile drains and various hydraulic structures. The project also included the conversion of small water courses to minor canals thus increasing the command area manifolds. Design and construction of parabolic segments was also a big challenge. Pre-cast parabolic segments were introduced for the first time in Pakistan and were used for lining of minors and water courses thus making the construction very easy and time and cost effective. The construction of outlets was most challenging as it was the first participatory development project which required resolution of many conflicts and achieving a consensus among various farmers.

Subsurface drainage system was constructed across Mardan, Swabi and Charsadda districts. The clearance of the chocked up drains was included in the scope of the project. Flood water was blocked in many areas and illegal construction in the water ways had created hazards and endangered lives of the citizens. It was one of the project elements to clear the flood water ways to ensure smooth passage of flood water.

The project included development of standard designs and specifications and extensive consultations with beneficiary farmers, various levels of governments, international donors and non-governmental organizations. The project included the construction of canal petrol roads, culverts, drains, subsurface tile drains and various hydraulic structures. **The project was financed by World Bank and Asian Development Bank and the provincial government.**

Converting water courses into minor water ways for irrigation purposes and lining of main canals were the focus of the project. Sub surface drainage was achieved by providing sub surface tile drains.

Other Projects included: Narangi Irrigation Scheme and operational responsibilities of Indus Branch and Pehur Branch. I was responsible for diversion Maintenance of smooth flow of water at Main Machai Canal to facilitate **WAPDA** in construction and widening of Main Canal which off shoot from Dargai to Swabi district. Facilitated **WAPDA** engineers in construction of Pehur High Level Canal and providing the required data for design purposes.

Highway Engineer, China Petroleum Engineering Construction Company, Pakistan, 1995-1996

National Highway Nowshera Chablat Project – Government of Pakistan: Project Engineer for 15 Km highway project. The project included: 6 bridges, 28 culverts and 30 hydraulic structures for storm water management and 1000 m drain along the highway. I was involved in the construction and coordination activities. I was also responsible for traffic management, traffic safety, and the traffic impact assessments of the diversions, and detours. We adopted the preferred option of detours with minimal detrimental traffic impacts. Responsibilities also included tracking of budgets, schedules and design coordination of project components and prepared specifications, tender and contract documents, and, maintained the smooth operation of traffic in spite of the heavy construction activities through effective project management and liaison with stakeholders. Administered construction contracts and inspected construction work onsite. I successfully completed environmental assessment studies of the various components of the project.

I was also responsible for land acquisition for the extended Right of Way (ROW). It included agreements on highway vicinity protection with the adjacent land owners and cost fixation with the government and the stakeholders.

Site Engineer Shahzaman Construction privet limited – 1993 - 1995

Responsibilities included construction supervision and oversight of the ongoing construction projects. Dealing with subcontractors and direct hire personals of the company and quality control and doing lab tests of the materials at site.

TRAININGS & PROFESSIONAL COURSES AND AWARDS:

1- LEADERSHIP TRAINING - **BANKGKOK**, THAILAND -
MARCH 2018

2- PROJECT MONITORING & EVALUATION **ISTANBUL**, TURKEY -

JUNE 2018

3-SUPERVISORY SKILLS **LAHORE**, PAKISTAN

AUG 2016

4-CONTRACTING OFFICER REPRESENTATIVE (COR) **WASHINGTON**, USA

SEPTEMBER 2016

5-PROJECT MANAGEMENT at Foreign Services Training Center -**WASHINGTON**, USA

APRIL 2015

6-EFFECTIVE OPERATIONAL MANAGEMENT at School of Professional Study- **WASHINGTON**

FEBURAY 2011

7-PRINCIPLES OF SUPERVISION AND LEADERSHIP - **EDMONTON, CANADA**

MARCH 2006

8- ROUNDABOUT DESIGN WORKSHOP at NORTHWESTERN UNIVERSITY CENTER FOR PUBLIC SAFETY

NOVEMBER 2006 - **EDMONTON**, CANADA

9 – CENTRE FOR TRANSPORTATION ENGINEERING & PLANNING- C-TEP

OCTOBER 2007 - **CALGARY, CANADA**

10- COPUTER SOFTWARE VISUME/VISSIM TRAINING

JULY 2007 - **VANCOUVER, BC, CANADA**

COMPUTER SKILLS

1- Microsoft Office
2- Word, Excel
3- Email Systems /Microsoft Out Look
4- Access Data Base Systems
5- Windows Infrastructure
6- Unix / Linux Operating Systems
7- MS Project
8- Primavera P6 / P3
9- Visual Basic Language/Programming
10- C++ Programming

AWARDS

1- HONOR AWARD BY UNITED STATES MISSION PAKISTAN – 2012
2- HONOR AWARD BY UNITED STATES MISSION PAKISTAN - 2013
3- MERITORIOUS AWARD BY UNITED STATES MISSION PAKISTAN- 2014
4- HONOR GROUP AWARDS – Multiple years

SOCIAL WELFARE ASSOCIATIONS / MEMBERSHIPS

Kohatian Foundation (Welfare Organization) –KF – Cadet College Kohat – Pakistan
Ujala Welfare Association – Welfare Organization for deserving kids

FARAZ AHMAD KHAN

Mobile no. 0092-300-8451096
E-mail : faraz96@hotmail.com, farazeapcl@yahoo.com
Mailing Address: House No. 20-E-2, Johar Town, Lahore

EXPERIENCE

March 2016 to date — **PakhtunKhwa Energy Development Organization**
Director Business Planning & Analysis

A senior leadership role in the top management team leading the provincial power sector, contribute in developing policies, strategic plans and setting direction for future growth.

Responsibilities

- Leading role in the World Bank assisted KPK Hydropower & Renewable Energy Development Program worth USD 786 Million, entailing construction of hydro power projects, installation of hybrid solar PV, investment planning and institutional strengthening components
- Focal person working with the International Finance Corporation (IFC) to bring investments to construct hydropower projects in Public Private Partnership (PPP) mode, with the first two target projects (of total 284 MW) having an estimated cost of USD 630 Million
- Providing key input in investment planning, capital budgeting and phasing of expenditures on projects financed through ADP, HDF, and MDFI's
- Evaluating and monitoring progress of ongoing projects for periodic stewardship by internal and external stake holders at various levels including the Chief Minister's Strategic Support Unit
- Assisting in formulating the company's future direction and support tactical initiatives
- Coordinating with NEPRA, CPPA-G, and NTDC
- Representing PEDO in the Sustainable Development Goal (SDG) unit and member of Technical Advisory Group (Energy) working to develop Sustainable Development Strategy for the province
- Secretary and member of the PEDO Management Committee

Contributions

- Key role in developing ADB funded programs; "KP Hydro Development Program" under an MFF (Muti- tranch Funding Facility) of worth USD650Million to construct 300 MW Balakot Hydro Power Project, and DLI based "Access to Clean Energy Program" for constructing 1000 micro hydel power plants, and Solarization of 8000 schools & BHUs
- Carried out successful evaluation of sponsors for six solicited Hydropower sites under KP Hydro power policy 2016 on the basis of International Competitive bidding on 'lowest levelised tariff', carried out first time in Pakistan, awarded two sites of total 201MW
- Represented PEDO in CPEC for promoting Hydro power projects portfolio of KPK from 2016-2019
- Successful negotiations with Asian Development Bank for a loan of US $ 330 million - Access to Clean Energy Program
- As the General Manager Solar (Nov 18 to March 19), oversaw portfolio of eight Solarization projects worth more than Rs 8 billion and removed bottlenecks to resume implementation
- Led project management for Tariff determination from NEPRA team to prepare tariff petition and defend in NEPRA for 37.7 MW Daral Khwar HPP
- Negotiated Energy / Power Purchase agreements with CPPA-G , intialled EPA for Pehur HPP
- Initiated the process for selection and implementation of an ERP and completed the "As is" review

and processes identification.

- Developed Reporting mechanism and templates for progress monitoring and evaluation
- Worked with ADB Consultants to develop 10 years roadmap for KP Power sector. The roadmap document used as effective tool to promote KP power sector
- Supervised Directorate of Planning & Facilitation responsible for preparation of Planning Commission documents at all steps of project conception to completion. Involved in preparing, reviewing PC-1 and II for hydro and solar projects and presenting to PDWP/ CDWP forums
- Represented PEDO in International Hydropower Congress 2019

Jan 2014 - March 2016 **Teaching and Consulting**

- August 2015 to March 2016: Adjunct faculty at School of Management Sciences, National University of Computer and Engineering Sciences (FAST), Lahore
- April 2015 to March 2016 : Worked as Consultant with a South African based global consulting firm Schuitema in Pakistan
- Jan 2014 to March 2015 : Adjunct faculty at Engineering University (UET) Lahore, Institute of Business & Management

Jan 2009 - Oct 2013 **Abbar and Zainy Group, Jeddah**
Corporate Resource Manager
DAIKIN – Ahmed Zainy Electrical and air-Conditioning Company

- Represented senior management team reporting to the shareholders, responsible for profitability, growth, business planning, strategy development, change management and restructuring
- Executive accountability for product import, distribution, pricing, and incentive systems
- Headed purchasing and logistics, credit control, and marketing departments
- Led business development activities to negotiate new agency contracts, and to prepare feasibility for starting own Chinese OEM brand
- Project Manager (Client side) for successful implementation of **"SAP"** ECC6.0 ERP modules namely; Finance, H R, Material Management, Controlling, Sales & Distribution, and Customer Service
- Overhauled the budgeting and forecasting process and procedures
- Restructured salesman incentives by separating schemes for dealer and project sales

June 2007 - Dec 2008 **Self Employed as Management Consultant**

- Worked in London with CEO Abbar & Zainy Group of Saudia to assist in managerial recruitment
- Worked with Stockwell Green Community Services (SGCS), London to prepare Management trainings for an EU funded project. Prepared a subsidiary of SGCS for "Investor in People (IIP)" certification
- Aug 2008 to Oct. 2008: Casamiastar Dubai: Developed investment & sales plan for real estate projects

Nov 2006 - May 2007 **Treasury Today, UK (**Leading independent publishing house, specializing in research and finance & treasury publications0
Senior Relationship Manager – Asia

- Led the business development team for Asia region focusing on China and India

- Developed relationships with Chinese banks including four large state-owned banks, and Central Bank of China. Negotiated deals with banks to generate sponsorship and advertising revenue

June 1999 - Sep 2006 **Engro Polymer & Chemicals Limited, Pakistan**
Regional Incharge Market Development (North)

- Led the Regional Market Development team to promote PVC products including pipes and fittings, geomembrane, profiles etc. The successful effort helped to take on a 50 percent capacity expansion in PVC production, and backward integration to manufacture raw material VCM
- Spearhead development of new markets for PVC resin and launched production and quality improvement initiatives at manufacturing facilities of customers. Trained them to improve marketing, and internal control systems. These manufacturers constituted 50% of the total customer portfolio
- Prepared project feasibilities and business plans to attract investment in PVC applications
- Negotiated with International Donor Agencies including DACCAR, UNICEF, and ADB to approve PVC pipes and fittings in water supply and sanitation projects in Pakistan and Afghanistan
- Worked extensively with top management of Water and Sanitation Authorities, Public Health Engineering Departments of Punjab & NWFP, EnC Pak Army, to promote usage of PVC products
- Honored with **"Corporate Excellence Award for Customer Focus"** in 2003 in recognition of efforts to successfully negotiate with Asian Development Bank (ADB), Government of Punjab and Suppliers a quality assurance system for a US$600million Water Supply and Sanitation project for Cholistan area
- Launched PVC Geomembrane in Irrigation, Agriculture, Fisheries and On Farm Water Management

  Jun 99 - Mar 01: Sales Officer North
- Launched PVC resins and managed a customer portfolio accounting for 40% of the total direct sales
- Developed and managed dealer network catering to 30% of indirect sales.

Dec 97 – Jun 99 **Caltex Oil Pakistan**
Zone Manager

- Led the team to launch Transformer Oil. Liaised with around 50 different businesses including power distribution companies, transformer manufacturers & importers, and IPP's
- Managed a portfolio of 15 industries, mainly in power generation, to sell Engine oil and Lubricants

Sep 96 – Sep 97 **Pakistan Credit Rating Agency**
Financial Analyst

- Conducted credit ratings of Non Banking Financial Institutions (NBFI), which involved assessing the financial performance, business risk management, asset quality and funding & liquidity in addition to appraising their future prospects with respect to other entities in the sector. The work entailed intensive report writing, research and inter personal skills.
- Carried out peer group and industry analysis to assess the relative standing of the particular companies and instruments being evaluated for credit rating

Jun 93 – Jul 94 **WAPDA, Pakistan**
Electrical Engineer

- Supervised the technical staff for operation and maintenance of 200 MWs Gas Turbine Power Station Faisalabad, and coordinated with the National Grid for load management and distribution among various local grids
- Received extensive training on hydro and thermal power generation, transmission and distribution

<u>Jun 92 – Jun 93</u> **NESPAK, Pakistan**
Electrical Engineer

- Supervised the construction activities of 500 KV Transmission Line on a span of 150km
- Carried out site planning and progress review activities with client WAPDA, and contractor China Shenyang Corporation

<u>Sept. 91 – May 92</u> **Rupali Polyester Ltd**
Trainee Electrical Engineer

- Undertook training on maintenance of Electrical control system of Polyester Staple Fiber section, and Diesel power generation setup

EDUCATION

1996 **LAHORE UNIVERSITY OF MANAGEMENT SCIENCES (LUMS), PAKISTAN**
Masters of Business Administration (MBA)

1991 **UNIVERSITY OF ENGINEERING & TECHNOLOGY, LAHORE, PAKISTAN.**
Bachelors of Electrical Engineering

1987 **UNIVERSITY OF THE PUNJAB, PAKISTAN.**
Bachelors of Arts - Majors in Journalism and Punjabi

ADDITIONAL INFORMATION

- Membership: Pakistan Engineering Council, Publications Society at LUMS
- Personal Interests include Poetry, Cricket, and social welfare activities
- Proficient in use of SAP, Microsoft Word, PPT, Excel, and Lotus 123, Word Pro, Freelance Graphics

PROFESSIONAL TRAININGS

Course Title	Institute
DEVELOPING AND OPERATING SMALL AND MEDIUM HYDROPOWER PLANTS	THE INTERNATIONAL CENTER ON SMALL HYDRO, CHINA
REVERSE POWER AUCTIONS, THAILAND	USAID, THAILAND
AC SOLUTION FOR HOTELS	DAIKIN LONDON
CREATING CUSTOMER LOYALTY	BRITISH COUNCIL MANAGEMENT DEVELOPMENT SERVICES
QUALITY MANAGEMENT TRAINING	AOTS JAPAN
NEGOTIATION AND SELLING SKILLS	CMD
CUSTOMER FOCUSED SUPPLY CHAIN MANAGEMENT	LUMS
MARKETING STRATEGIES FOR INDUSTRIAL COMPANIES	CENTER FOR PROMOTION OF IMPORTS FROM DEVELOPING COUNTRIES (CBI) OF NETHERLANDS

TEAM BUILDING	SENSEI
DECISION MAKING AND PROBLEM SOLVING	LUMS
LEADERSHIP – CARE AND GROWTH MODEL	SCHUITEMA PAKISTAN
ALTERNATE ENERGY IN PAKISTAN	WAPDA
UNIDO ENTREPRENEURSHIP DEVELOPMENT AND INVESTMENT PROGRAM	LCC&I
FINANCE FOR NON-FINANCIAL MANAGERS	ECPL, PAKISTAN
CHEMICAL ECONOMICS	ECPL, PAKISTAN

CURRICULUM VITAE

Name in full	:	Riaz Ahmad Jan
Father Name	:	Faqir Mohammad
Date of Birth	:	10th April, 1968
Domicile	:	Peshawar
Marital Status	:	Married
Postal Address	:	Project Director-RESDIP 105-PEDO House, 38/B-2 Phase-V, Hayatabad, Peshawar
E-mail address	:	janriaz@yahoo.co.uk
Contact No.	:	Office +92-91-9217350 Mobile +92-333-9266965
POSITION HELD	:	Project Director-F.Study Raw Sites Phase-II.
ACADEMIC QUALIFICATION	:	B.Sc Civil Engineering (with honors)
HIGHER QUALIFICATION	:	Master of Science "Hydropower Development"

ACADEMIC RECORD

Examination Passed	Board / Univ.	Year	Division	Marks obtained
Master in Hydropower Development	NTNU, Trondheim, NORWAY	1997	1st	
Bachelor of Science in Civil Engineering [B.Sc. Civil Engg]	NWFP,U.E.T Peshawar	1990/A	1st [With-Honour]	927/1250 74%
Inter Science [F.Sc. Pre-Engg:]	B.I.S.E. Peshawar	1985/A	1st	719/1100 (65%)
Matriculation [S.S.C]	B.I.S.E. Peshawar	1983/A	1st	*643)850* (76%)

WORK EXPERIENCE: As on 07.02.2020 closing date of application

- ***Over all Professional Work experience including Private Jobs: 30 Years-2 Months***
- ***Over all Professional Work experience Excluding Private Jobs: 28 Years- 8 Month***
- ***Over all Senior Management /Project Director Experience: 13 Years***
- ***Over all Senior Management / Project Director Experience (Individual Projects): 23Years-10 Month***

1. Project Director
F/Studies Raw Sites Phase-II (05.03.2014- 30-06-2020)

The job description for PD F/S Raw Sites phase-II was to hire Consultant for the F/Study and detailed design for 446 MW Kari Muskhure HPP (KMHPP) Chitral & 409 MW TorCamp Godubar HPP (TGHPP) Chitral. Consultants for the two projects have been awarded contracts under the Single Stage Two Envelope bidding method of procurement. Project activities upto Inception Report has been completed for both the projects. However due to Trans Basin Water Issue, contract for TGHPP has been terminated with the consultant M/S NESPAK & FITCHNER, while feasibility stage activities as per TORs for KMHPP are in progress. Feasibility stage activities are to be followed by detailed design, and preparation of the Pc-I.

2. Project Director
REDSIP (21.03.2016 to 05.04.2018).

PEDO has entered into a loan agreement for (i) three feasibility studies project namely Karora, Jabori and Koto (ii) Three construction projects namely 36.7MW Daral Khwar HPP, 17MW Ranolia HPP and 2.6MW Machai HPP and (iii) Capacity building of PEDO under the Renewable Energy Development Sector Investment Program (REDSIP) Asian Development Bank (ADB) Loan No. 2286 & 2287 PK. As PD REDSIP was co-signatory with Director Finance PEDO for the processing of funds request of Project Manager concerned to the ADB. Also processed the project related issues with the authorities concerned.

3. Project Director
Mini Micro HPP (24.03.2015 to 21.03.2016)
& D.D.O Mini Micro (21.03.2016 to 09.09.2016)

Has worked as Project Director for the Construction of 356 nos. mini micro Hydel power projects. The project was launched by the KP government to provide electricity and lively hood to the off grid communities in the twelve districts of the Kyhber Paktunkhwa province. As PD has managed the activities of the project Consultant along with construction Contract agreement of the Six different contractor. The project was unique in implementation as the land for the project was provided by the community in kind contribution whereas the cost of physical construction was borne by the KP government. Has also worked as drawing and disbursing officer for a period of six months.

4. Project Manager Machai HPP (Additional Charge)
(24.03.2015 to 03.09.2018)

2.6 MW Machai Hydropower project is located in Mardan district and was part of the ADB funded umbrella REDSIP PC-I. The project was implemented as EPC contract and Construction work had been awarded to M/S JV Alfajr International & Shaheen in March 2012. As Project Manager Machai HPP and as employer representative managed the Contracts for both the project consultant and Construction contractor. The project was successfully commissioned in November 2017 and handed over to the Director Operation and Commercial (O&C) PEDO.

5. Project Director
Koto Hydropower Project
(20.10.2010 to 22.06.2011) (Additional Charge)
(23.6.2011 to 24.10.2013)

Worked as Project Director Koto HPP district Dir lower. Performed duties on the project upto the finalization of the financial report for the selection of the Management Consultant for the project. Prepared and updated the original PC-I for the project submitted by the consultant during the feasibility of the project and pursued its approval at relevant approving forums such as PDWP/CDWP/ECNEC. Prepared responses to the pre PDWP/CDWP quarries till its final approval by ECNEC. Also prepared RFPs and bidding documents for selection of Management Consultant and carried out Technical, Financial Evaluation and prepared contract agreement.

6. Project Manager
Capacity Building (24.10.2007 to 30.6.2015)

(i) As Project Manager Construction of PEDO office building, prepared the original PC-I "Capacity Building" as part of the umbrella REDSIP PC-I and pursued its approval at relevant approving forums such as PDWP/CDWP/ECNEC. Prepared responses to the pre PDWP/CDWP quarries till its final approval by ECNEC. Prepared as per ADB guidelines (i) EOI for the Hiring of Management Consultants (MC) (i) Request for Proposal (RFP) for MC, (ii) Technical and Financial Bid Evaluation Reports (BER & FER), (iii) Review & approval of bidding documents for hiring of a Contractor for SHYDO HOUSE (PEDO HOUSE) Construction, (iv) management and processing of consultants and contractors billing etc.

The work for Construction of SHYDO Office Building was awarded to M/S Nasrullah Khan & Co. government contractor for initial contract price of Rs. 168 Million under the Single Stage Two Envelope bidding procedures. The construction of SHYDO Office building was completed by the contractor as per the original schedule. The building is operational since March 2012.

(ii) Has successfully implemented this component "Capacity Building of PEDO and Related Entities of the Energy & Power Department". Consultant was appointed under the ADB guidelines and Single Stage Two Envelope bidding procedures. Under the programme a total of 58 out of 89 proposed, officers/officials availed the training opportunities both inland and abroad as per the approved TORs. Both short and long term, seminars, workshops etc, in co-ordination with both local as well as international institutes / organisations/ water & power bodies etc., who specialises in the field of renewable energy development were provided to the course participants.

7. Assistant Director (Civil)
2.0 MW Shishi Hpp -Chitral
(-01. 2000 to -06. 2004) & (18.5.2006 to 23.10.2007)

(i) Assisted the Project Manager during the preconstruction stage of the project in preparation of (i) Engineer estimate for the project civil works components,(ii) Preparation and approval of the PC-I from PDWP (iii) Preparation of the PEC standard bidding documents and selection of contractors.

(ii) Assisted the Project Manager in the field during the construction stage of the project and remained at site of work. Efforts were made to ensure (i) completion of the project as per approved construction drawings, (ii) Follow quality control and assurance (iii) Contractor follow work plan and (iv) Complete the project within the original contract cost and minimum variation orders (v) Correct measurement of Contractor physical work for the interim payment certificates etc

8. Assistant Director (Civil)
(P&F) & Reshun Hpp Chitral.
(03.02.1992 to -12.2003)

As an Assistant Director performed duties on various assignment in PEDO (formerly SHYDO). The major works, experience and position that I have worked on are:

(i) Assisted the Project Manager 4.2 MW Reshun Hpp district Chitral in the field during the construction stage of the project and remained at site of work. Efforts were made to ensure (i) completion of the project as per approved construction drawings, (ii) Follow quality control and assurance (iii) Contractor follow work plan and (iv) Complete the project within the original contract cost and minimum variation orders (v) Correct measurement of Contractor physical work for the interim payment certificates etc.

(ii) Worked as Assistant Director Civil in Planning & Facilitation (P&F) directorate under the Director P&F. Was engaged in the processing of PC-Is & PC-IIs pertaining to various PEDO projects. Assisted the director P&F with the preparation and submission of the Annual Development Plan and Public Sector Development Plan reviews, and other important works related to Planning & facilitation directorate.

(iii)On behalf of PEDO, was a group member of the experts team from German Technical Cooperation team (GTZ), for the study named "Identification of Small and Medium Head Hydropower Potential in the Chitral". The study area covered both upper and lower chitral.

9. Assistant Engineer/ Site Engineer (Civil)

Ghulam Habib & Company (Pvt). Ltd.
(16-02-1991 to 02-02-1992).

Ghulam Habib & Company (Pvt). Ltd is a well-reputed high profile private construction company from Khyber Pakhtunkhwa and has constructed a number of important public buildings in KP. As a site engineer, worked on two major projects, (i) Construction of 20 nos Residential Secretariat Buildings at Peshawar. Communication and Works (C&W) Department, government of KP was the client for this project. (ii) Construction of Commercial Complex Building" at Phase-V Hayatabad Peshawar. Peshawar Development Authority (PDA) was the client for this project. I was responsible for quality control, bar bending schedule, billing and handling of other Engineering related problem at site of work for these projects.

10. Apprentice Engineer (Civil)
Peshawar Development Authority
Regional Office Hayatabad, Peshawar
(23-08-1990 to 15-02-1991).

Worked as Apprentice Engineer in Peshawar Development Authority (PDA) for a period of six months. There I worked on the Design, Surveying & Supervision of various projects in Roads & Buildings.

11. Trainings & Courses Achieved.

i. Attended workshop on ***"CAD/CAM-1 (6th Workshop)"***, held by Graduate School of Management and Computer Sciences 25th May 1995.

ii. Two Years course ***"Master in Hydropower Development"*** from the Norwegian University of Science & Technology (NTNU) Trondheim from 1995 to 1997.

iii. Course on ***"Hydropower Projects"*** conducted by WAPDA Engineering Academy Faisalabad from 8th November 1999 to 30th November 1999 followed by study tour from 1st December 1999 to 7th December 1999.

iv. Has attended Seminar on ***"Project Implementation and Administration"***, held in Islamabad Pakistan from 18 to 23 August 2008.

v. Has attended **"Loan Disbursement Seminar"** organized by Asian Development Bank and Ministry of Economic Affairs and Statistics Government of Pakistan, held in Marriot Hotel, Islamabad Pakistan from 21-22 May 2008.

vi. Has attended two days Training / Workshop on ***"The Khyber Pakhtunkhwa Public Procurement Regulatory Authority Act 2012 and The Khyber Pakhtunkhwa Procurement of Goods, Works and Services Rules-2014"*** at Pakhtunkhwa Energy Development Organization.

vii. Has attended the ***"13th Annual Power of Water Conference"***, by Ontario Water Association, Canada from 18th October 2013 to 24th October 2013.

viii. Has attended courses on ***"Contract & Construction Management"*** by Thomas Telford Courses-UK held in London from 9th to 22nd April 2014.

Government of Khyber Pakhtunkhwa
Pakhtunkhwa Energy Development Organization

Plot No. 38-B2, PEDO House, Phase-V, Hayatabad, Peshawar

Tele No. 091-9217350,

No.100/2020/PEDO/PD/GKHPP
Dated: 15/09/2020

To

Deputy Director (EIA),
EPA, KPK, Peshawar.

Subject: **ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT OF 88 MW GABRAL KALAM HYDROPOWER PROJECT FOR ENVIRONMENTAL APPROVAL**

Reference:
1. EPA letter No. EPA/EIA/PEDO/Gabral-HPP/88MW/Swat/20/615-616 dated 19.08.2020.
2. This office letter No. 48-51/PEDO/PD (GKHPP) dated 13-07-2020

As per EPA letter at ref#1 above, please find herewith necessary clarification/justification to the issues/observations raised by KP EPA. Also necessary attachments (Annex-01 & Annex-02) are enclosed where required.

S. #	EPA, KPK Comments	Reply/Response by the Proponent/PEDO
1.	Provide GIS Shape File/ Google Earth KMZ File/GIS Data of Tunnel, Powerhouse, Weir House, Dumping & Camping site and complete GIS data of HPPs on river Swat and other water bodies within KP.	The requisite data as requested has been uploaded on the Compact Disc (CD), which is enclosed with the letter please.
2.	Provide verified land acquisition and compensation documents. Details/ number of structures to be effected and compensation plan accordingly. Land demarcation (at least tentative) should be done before the public hearing.	The afore said documents has already been provided in Chapter 3 and 11 of the RAP report submitted to the KP EPA vide letter at ref#02 above (Annex-01). PEDO will ensure that tentative Land demarcation start prior to the commencement of the Public Hearing, which has been included in the TORs of the Project Management Support Consultant (PMS) for which hiring process has already been initiated.
3.	Provide a detailed study of cumulative effects of all HPPs on the morphology and ecology of river Swat.	Project Cumulative Impacts have been covered under Chapter 8 of the ESIA report as already submitted to KP EPA. (ref#02 above).
4.	The sampling/analysis (Air, Water &	Sampling/Analysis for (air, water &

S. #	EPA, KPK Comments	Reply/Response by the Proponent/PEDO
	Soil, etc.) shall be carried out through an EPA Certified Lab and latest detail of the same shall be submitted to this Agency.	soil, etc.) were carried out through EPA certified lab i.e. Pakistan Council of Scientific & Industrial Research Laboratories Complex (PCSIR), Peshawar. Hard copies of the results duly signed and stamped by the PCSIR enclosed as Annex-02.
5.	Provide clearance from Forest Department regarding cutting of 636 trees and plan for proposed Plantation.	Application for NOC to the Khyber Pakhtunkhwa Forest department will be submitted during the pre-construction phase activities of the project and will be shared with KP EPA accordingly. As expounded in the chapter-7 of the ESIA (ref#02 above), the proposed plantation plan include (i) upstream of weir catchment, at the upper elevations of the affected area (weir and powerhouse site), (ii) along the access roads and (iii) at the edges of the muck disposal sites etc.
6.	Provide clearance from Mines & Mineral Department (if any of the area is involved).	Application for NOC to the Khyber Pakhtunkhwa Mine and Mineral department will be submitted during the pre-construction phase of the project and will be shared with the KP EPA accordingly.
7.	Provide detail comments of Fisheries Department regarding suitability of Fish ladder or hatchery construction for effective survival of aquatic life.	A stakeholder consultation workshop was held on 21 October 2019 at PEDO House Peshawar, besides other stakeholders, fishery department also attended the workshop. The proposed fish ladder design considerations/parameters were also shared with the participants of the workshop and were appreciated by the concerned participants from fishery department; The comments recorded in ESIA report.
8.	Provide detail of Environmental flow study for the survival of lower riparian life.	For the detail E-Flow study, please refer to of chapter 7 & 8 of the ESIA report as already shared with KP EPA vide letter at ref#02 above.
9.	Provide total cost of the project, budget	The requested information are already

S #	EPA KPK Comments	Reply/Response by the Proponent/PEDO
	allocation with details of proposed activities for CSR, Environmental sector and Implementation of EMP.	given in the LARP & ESIA report as shared with KP EPA vide letter at ref#02 above. However, same has been extracted ease of facilitation as per following details. a. Project Total Cost: USD 238 million b. ESIA budget including EMP: USD 3.937 million c. Resettlement Action Plan (RAP) budget: USD 25.173 million
10.	Provide the detail of the number of Crush plants, batching plants and Asphalt Plants to be established for the proposed project. It is pertinent to mentioned here that as per IEE/EIA Regulations, 2000, separate approval shall be obtained from the Agency.	During construction phase of the project, one nos. Crush plant and one nos. batching plant will be installed at site to fulfill project concrete requirements. No asphalt plant is planned to be installed under the project. Separate NoCs will be applied accordingly during the preconstruction phase activities of the project.
11.	The dumping of muck material along the river side increase sedimentation load. To mitigate the same, a plantation plan for catchment area or block plantation in consultation with Forest Department and locals shall be prepared and submitted to this Agency.	Tree plantation will be implemented as per reply at para#05 above and will be submitted to KP EPA.
12.	Provide commencement, completion date and life span of the project.	Project commencement is expected in December 2020 with a total contract period of six years i.e. one year for pre-construction, four years for construction period and one year for defect liability period (DIP).

Encl: Annexure-01, Annexure-02.

Project Director
Gabral Kalam HPP
PEDO, Peshawar.

Copy to:

1. PS to CEO, PEDO, Peshawar.
2. PS to CE, PMO, PEDO, Peshawar.

Project Director
Gabral Kalam HPP
PEDO, Peshawar

No. 02 / PEDO / CE-WB / 01
Dated, Peshawar the: 04 / 09 / 2020

To,

Managing Director,
National Transmission & Dispatch Company Limited (NTDCL),
Lahore.

Subject: **ISSUANCE OF CONSENT FOR POWER EVACUATION FROM WORLD BANK PROJECTS OF 88MW GABRAL-KALAM HPP & 157MW MADYAN HPP – DISTRICT SWAT**

Dear Sir,

The Government of Khyber Pakhtunkhwa under the loan of World Bank is executing two (2) projects namely 88MW Gabral-Kalam HPP and 157MW Madyan HPP in District Swat to overcome the shortfall of electricity and promote cheap hydel electricity to reduce the burden of electricity charges on the people of Pakistan. The construction on both the projects will be starting soon.

PEDO has already filed feasibility stage tariff with NEPRA. NEPRA has observed that case for Generation License of both the above-mentioned projects be processed prior to approval of the Feasibility Stage Tariff.

Keeping in view the above, we intend to apply for Generation License for both the subject projects for which the issuance of Consent / N.O.C. for power evacuation from your good office is desired as the power evacuation voltage level is 220KV.

We further assure that PEDO will execute the following as part of the projects scope of work:

i. Preparation of detailed design for interconnection with the existing networks
ii. Load flow, short circuit and stability studies
iii. Submission of load flow studies to concerned quarters for approval
iv. Metering station at both the projects and telemetering with NPCC Islamabad as per NEPRA code
v. Signing of tariff agreement with CPPA-G according to the policy laid down by the Government of Pakistan

In light of the above and keeping in view the national importance of the subject projects, NTDC is requested to issue consent for Power Evacuation for both the projects as these projects have already been included in IGCEP 2047 so that the case for Generation License with NEPRA be taken up.

Syed Shah Hussain
Chief Engineer / Head PMO
World Bank Projects

CC:

1. Project Director – 157MW Madyan HPP, PEDO, Peshawar
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PROSPECTUS

1. INTRODUCTION

Gabral Kalam Hydropower Project (88MW) is run of the river scheme identified on the Gabral River in District Swat of Khyber Pakhtunkhwa. Upon development, project will dispatch 339 GWh annual energy to the National Grid. Major interventions designed under the project are (a) construction of diversion weir, sand trap, headrace tunnel, surge shaft, penstock, powerhouse, access roads, bridges, residential colony and other ancillary infrastructure; and (b) installation of turbines, generators along with allied electro-mechanical equipment and transmission line.

2. PROJECT LAYOUT AND MAJOR COMPONENTS

2.1 LAYOUT

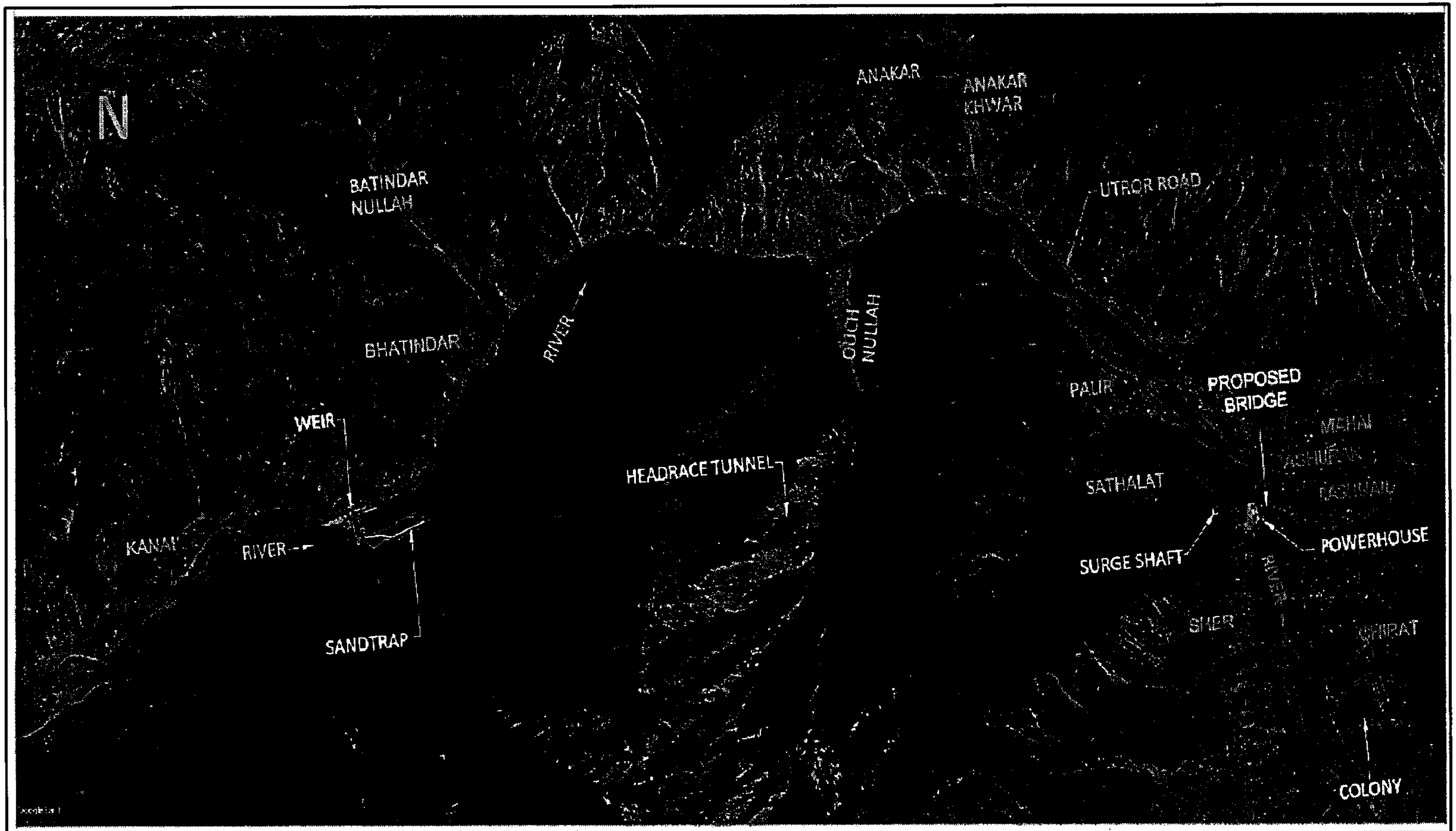
Gabral Kalam Hydropower Project (88MW) is located on the lower stretch of the Gabral River, between Kanai village and Kalam town of District Swat. The proposed weir site is identified at about 09km upstream of Kalam town whereas the powerhouse is located in front of the Ashuran village at the right bank of the Gabral River. Project area is accessible via Kalam Utror truck-able unpaved road which runs along the left bank of Gabral River.

Following are the coordinates of weir and powerhouse sites followed by Figure-1 showing project layout.

Table 1: Coordinates of Weir and Powerhouse

[illegible]	[illegible]	[illegible]
Weir	N 3931932.9282	E 274962.8185
Powerhouse	N 3931470.1919	E 280298.3343

Figure1: Project Layout



2.2 COMPONENTS

A. Civil Structures

The proposed concrete gravity weir of 149.5 meter length will retain river flows and will develop pond about 875m upstream with a maximum of 21m water depth. The crest level of the overflow spillway has been set at 2161 masl and that of the non-overflow section at 2168 masl. The weir has been designed to safely route 1,000 years flood from the under sluices.

To control floods in the reservoir, overflow spillway with five bays, each 12.0m long, are provided along with four under sluices (5.0m x 5.0m) in the weir body. In addition to flood routing, under sluices will be used for flushing sediments deposited in the pond so as to prevent chocking of the intake area by sediment deposition.

For diversion of flow from the reservoir for power generation, four gated intakes (4.5m x 5.0m) are provided. The entire waterway alignment is along the right bank of the Gabral River.

Furthermore, each of the four intake gates are connected to a 202m long connecting channel (5.2m x 5.0m) which conveys design discharge into the sand trap which has two chambers each of 14.75m wide and 165m long. Sand trap will trap sediments above the desired size i.e. 0.2mm, and will provide relatively clean water downstream into the conveyance system. The conveyance system, downstream of inlet pond, comprises 4.7km long headrace tunnel of 5.8m diameter modified horseshoe shaped, surge shaft of 12.6m, pressure shaft of 4.0m, pressure tunnel of 4.0m, penstock of 4.0m and manifold with branches of 2.3m and 1.54m diameter. The concrete lined headrace tunnel will convey design discharge of 65 m^3/s to the powerhouse. Pressure shaft and pressure tunnel will however be steel lined.

A conventional two stage cofferdam arrangement is proposed for construction works at the weir site to safely accommodate 10 years return period flood of 781 m^3/s. During the first stage, a channel will be excavated along the left bank of the river and cofferdams placed at the up and downstream reach (of the channel) to isolate the construction area. A temporary bridge will be provided at the downstream end for access to working area for construction work of the intake, under sluices and part of the overflow spillway.

The 44 by 16m surface powerhouse is a reinforced concrete frame structure building comprising of reinforced concrete walls, slabs and columns to accommodate three generation units comprising vertical Francis turbines, with tail water out flowing into Gabral River. It houses three units, equipment galleries, workshop, offices and amenities for the operating personnel. The building and associated outlet structures are located in metamorphic rocks having allowable bearing capacity of 45-135 t/m^2 whereas foundation springs have been based on 45 t/m^2.

Three span pre-stressed concrete girder bridge was designed for the powerhouse access and is located in front of the powerhouse on the Gabral River.

In accordance with the "Seismic Hazard Evaluation Report" the weir/dam has been categorized as moderate risk structure with a Safety Evaluation Earthquake (SEE) acceleration of 0.49g corresponding to a return period of 3000 years. For the Operating Basis Earthquake (OBE), an acceleration of 0.21g has been used corresponding to a return period of 145 years for the weir structure. For the design of all other appurtenant structures including tunnel and power house, a SEE acceleration of 0.30g has been used with a return period of 475 years.

B. HYDRO-MECHANICAL EQUIPMENT

For the design discharge of 65 cumecs, the optimum configuration has been worked out to be three generating units i.e. 2x37.5 MW and 13 MW vertical shaft Francis Turbines. The rated speed of the 37.5 MW unit is 375 RPM, whereas for 13MW unit, it is 600 RPM.

Digital, microprocessor type Proportional Integral Derivative (PID) governors are provided with each turbine. The governor regulator will have an independent hydraulic actuator of sufficient capacity to control the turbine under all operating conditions.

There will be three inlet valves at the manifolds, one for each turbine. The approximate diameter of 37.5 MW unit is 2m while for smaller unit it is 1.2m.

An overhead travelling crane has been provided in the powerhouse for installation and dismantling of the electro-mechanical equipment. The capacity of the crane has been sized tentatively at 120 tons, which is 20% higher than the maximum weight of the single heaviest component of the electromechanical equipment.

Other required major hydro mechanical equipment provided in the powerhouse are:

- Unit Cooling Water System
- Heating, Ventilation and Air Conditioning (HVAC) System
- Fire fighting system

C. HYDRAULIC STEEL STRUCTURES

i) INTAKE GATE FACILITIES

Intake structure comprises of intake fixed wheel gates, maintenance stop logs, trash racks, trash rack cleaning machine and gantry crane.

ii) SANDTRAP OUTLET GATE FACILITIES

Two chambers, each with one outlet gates, have been provided. Size of each gate is 5m wide x 4.5m high.

iii) SANDTRAP FLUSHING GATE FACILITIES

Each basin is equipped with two flushing channels provided at the bottom. Two vertical lift gates are provided at the end in each channel for evacuation of sediment deposits at the basin.

iv) UNDER SLUICE GATE FACILITIES

There are four gates 5m wide x 5m high each for low level outlet, provided within the main weir section. Primary function of these outlets is reservoir flushing, however, they can also be used for Mega flood handling purpose.

D. ELECTRICAL COMPONENTS AND TRANSMISSION LINE

Two 37.5M Wand one 13MW, 0.9 power factor, 50Hz, 11 kV vertical shaft, silent pole synchronous generators along with necessary auxiliary equipment, complete with control, monitoring, switchgear/protection systems have been proposed to produce 88 MW installed capacity.

In order to evacuate the generated power from the project to National Grid, three phase step-up power transformers, two with capacity of 45/55 MVA and one 15/20 MVA are proposed.

A 132 kV high voltage Gas Insulated Switchgears (GIS) equipment such as SF6 Circuit Breakers, Disconnecting Switches with and without Earthing Switches, Instrument Transformers and Control, Monitor and Protection of indoor equipment are proposed.

The power plant is proposed with state of the art Supervisory Control and Data Acquisition (SCADA) system. This will include programmable logic controllers (PLC's) Digital Governor, Automatic Voltage Regulator (AVR) for the complete control system of Turbine/Generator.

The power evacuation from Gabral Kalam HPP will be done through about 2.6 km long, 132 kV Double Circuit Transmission Line under Loop-in and Loop-out arrangement to the nearest 132 kV Transmission Line coming from upstream Gorkin Matiltan HPP(84MW).

3. PROJECT SOCIO-ENVIRONMENTAL ASPECT (ESIA AND RAP)

Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan(RAP) for GKHPP were prepared separately by Independent Consultant as part of the Feasibility Study and Detailed Design considering the World Bank (WB) requirements and guidelines.

ESIA report comply with the Schedule II of "Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 and World Bank OP 4.01 (Environmental Assessment) whereas RAP comply with Land Acquisition Act 1894 and World Bank OP 4.12 on Involuntary Resettlement. Other relevant WB policies applicable to the project include: Natural Habitats (OP 4.04), Physical Cultural Resources (OP 4.11), Involuntary Resettlement (OP/BP 4.12), Forests (OP/BP 4.36), Safety of Dams (OP/BP 4.37) and Projects on International Waterways (OP/BP 7.50).

The project area of influence comprises of about 11km long valley of the Gabral River and its mountain slopes, from Kanai village (one km upstream of the weir site to cover the reservoir area) to Kalam town (10km downstream), whereby it joins the Ushu River to form the Swat River.

Detailed environmental, ecological and socio-economic surveys were carried out in the project area through a review of secondary literature, field investigations for primary data collection, sampling and analysis of water, air and noise quality, questionnaire surveys, and community and stakeholder consultations.

Baseline and historical data shows that the winters in the project area are freezing with minimum temperatures ranging from -0.4 °C to -8.4 °C from November to March. The temperatures in spring (April and May) and in autumn (September and October) are usually warm in the day time (17°C to 20 °C) and cold on the night time (3 °C to 10 °C). The average annual precipitation is about 1076 mm, with nearly 58 percent of precipitation falls as snowfall during winter.

Water quality of the Gabral River, Bhan Khwar River, and spring at Kanai village was tested during January 2019, and the results suggest that water quality is generally good, with total dissolved solids ranging from 58 mg/l to 67 mg/l.

Air and noise quality was measured at three villages in the project area during August 2019. The ambient air and noise quality in the project area are generally good and well below the national environmental quality standards as the area has less exposure to vehicular traffic and industrial pollution. The particulate matter concentrations (PM_{10}) in the Kalam area varies from 30µg/m^3 to 35 µg/m^3 (the national standard is 150 µg/m^3). The average daytime noise levels in the Kalam area varies from 40 dBA to 50 dBA (the national standard is 65 dBA).

The important biodiversity areas near the project impact corridor are Bhan Khwar Valley Community Game Reserve, which is located on the Bhan Khwar catchment area (250 km^2), a tributary of the Gabral River. The alpine and subalpine habitats of the Bhan Khwar catchment area provide a rich habitat of 21 mammals, including threatened species of snow leopard and black bear.

Two fish species are recorded from the project area, an indigenous snow carp (Schizothoraxplagiostomus) and exotic brown trout. None of these species are listed in IUCN Red List. During spring, when flows start increasing in the rivers due to the melting of snow, the fish migrate upstream in April and May (within tributaries) due to high flows and turbidity at lower elevations. During autumn, when the temperatures start to drop at higher elevations, the fish migrate downstream in September and October.

A socio-economic survey of 169 randomly selected households was carried out in the project area. The total population of the surveyed households is 1365, in which 717 are male and 648 female.

There are six primary schools, one middle school for boys (in Ashuran village) and two higher secondary school (one each for boys and girls in Kalam). The level of illiteracy was to the extent of 42.5% for male and 84.8% for female.

The major source of livelihood for the project population is agriculture. They are: agriculture (31.5%),daily wage labour (12.5%), business (1.5%), service with both the government and private sector (3.6%), working abroad (3.5%), while the remaining 47.4% are the unemployed and students. Men in the project area are also engaged in seasonal employment in hotels at Kalam during summer.

The average annual household income was computed to be Rs. 68,998 per month. A major proportion (45.5%) of the surveyed households fall in the income category of Rs. 20,000 to Rs. 50,000, while 14.4% and 40.1% come under the income bracket of less than Rs. 20,000 and above Rs. 50,000 per month, respectively. The average per capita income was computed to be Rs. 98,333 per annum and Rs. 8,194 per month. In accordance with the poverty line (Rs. 25,475/ month per household), the level of poverty of the sample households is 14.4 %.

There is only one Basic Health Unit (BHU) in Kalam, which has five medical doctors, three nurses and lady health workers, and ten medical technicians. The nearest Rural Health Centre / hospital, which has beds and in-patient treatment facilities, is located in Mingora, about 80 km from Kalam.

Consultation being compulsory part of the study, a total of 58 consultation meetings with 439 participants (373 male and 66 female) were conducted. These include 48 local village meetings, one provincial-level workshop at Peshawar on October 21, 2019, one disclosure workshop at Kalam on November 7, 2019 to share the draft ESIA and RAP, in which the local communities, including affected communities, district level government agencies (including representatives of forest and wildlife departments, union councillors, and district administration).

Following are some of the project negative impacts.

- Permanent land acquisition of 157.44 acres (1259 kanals) owned by 89 households
- Loss of 684 trees including 48 owned by community and 636 by Forest Department.
- Inundation of 500 m existing road on the left bank and submergence of a footbridge and PVC water pipes.

- Impact on 11 acres of land due to construction for 2.6 km long transmission line (12 towers).
- Loss of livelihood due to the acquisition of 26 acres of agricultural land from 44 households.
- Depletion of water in Gabral River stretch between weir and powerhouse tailrace.
- Physical displacement of 8 households.
- There are 50 severely affected households as they will lose more than 10% or more of their land/productive resources and 49 are the vulnerable households.

Cash compensation will be made to the owners of the affected land and flora. Similarly, temporary land will be leased from the locals through cash compensation under lease agreements.

Also, 2.0 to 3.5 cumec water will be released in Gabral River to minimize the water depletion impact in the stretch between weir and tailrace.

In addition to the above, detail mitigation measures have been proposed in the project ESMP which shall be implemented during the project execution.

Also, hiring of the local community during construction works (about 300 workers on average regularly and 500 during peak construction daily for five years) will be another beneficial impact of the project.

4. SALIENT FEATURES OF THE PROJECT

Following are the brief salient features of the project.

Table 2: MAIN FEATURES OF THE PROJECT

S/No	DESCRIPTION	VALUE
1	**LOCATION**	
	Country	Islamic Republic of Pakistan
	Province	Khyber Pakhtunkhwa
	District	Swat
	Project Site	Kalam
2	**ORGANIZATIONS**	
	Client	Pakhtunkhwa Energy Development Organization (PEDO)
	Consultants	A Consortium of: • AGES Consultants Peshawar, Pakistan - Lead Firm. • Hydro Consult Engineering (Nepal) • DOLSAR Engineering Inc. Co.

S.No	DESCRIPTION	VALUE	
		Turkey. • Fida Hussain Chaudhry (FHC), Consulting Engineers Pakistan. • Technical Engineering and Management Consultants (TEAM), Pvt. Ltd. • Multitech Consulting Engineers (MCE), Pakistan	
3	**HYDROLOGY**		
	Catchment Area at Weir Site	957	Sq.km
	Catchment Area at Powerhouse Site	1212	Sq.km
	Design Flood ($Q_{1,000}$)	1793	m^3/sec
4	**RESERVOIR**		
	Normal Conservation Level	2161.0	masl
	Flood Surcharge Level	2165.3	masl
	Minimum Operating Level	2160.5	masl
	Depth of Reservoir at Weir Site	21	m
	Length of Reservoir	875	m
5	**WEIR**		
	Weir Type	Concrete Gravity	
	Weir Top Elevation	2168	masl
	Height of Weir above River Bed	28.0	m
	Maximum Height above Foundation	33.5	m
	Crest Length	149.5	m
	Crest Width	7.0	m
6	**OVERFLOW SPILLWAY**		
	Type	Overflow Ogee	
	Crest Level	2161.0	masl
	Length of Crest	67.5	m
	No. of Bays	5.0	m
7	**UNDER SLUICES**		
	Type	Orifice type with Ogee Crest	
	Crest Level	2142.5	masl
	Head on Crest at NCL	18.5	m
	No. and Type of Gates	4.0 No's	vertical lift
	Size of Stilling Basin (Combined)	105m x 30m	
8	**POWER INTAKE**		
	Type	Horizontal Intake	

S.NO	DESCRIPTION	VALUE	
	Total Width of Intake Structure	22.5	m
	Width of Waterway	18.0	m
9	**FISH LADDER / FISH PASS**		
	Type	Pool Pass Type	
	Design Discharge	0.26	m^3/sec
	Total Length of Fish Ladder	218.0	m
11	**CONNECTING CONDUIT / CONNECTING CHANNEL**		
	Type	Rectangular Box	
	Number of Conduits	2.0	No's
	Design Discharge	39.0 x 2	m^3/sec
	Size	5.2m x 5.0m, (W x D)	
	Average Length of Conduit	202.75	m
12	**SANDTRAP**		
	Type	Gravity Type	
	Length of Chamber	165	m
	Size of Sandtrap Chamber	14.75 x 13.5m	
	Trap Efficiency	79.0	Percent
13	**INLET POND**		
	Type	Concrete Lined Rectangular Section	
	Size of Inlet Pond	35.0m x 27.5m	
	Depth of Flow	14.0	m
14	**HEADRACE TUNNEL**		
	Type	Low Pressure Tunnel	
	Shape	Modified Horse Shoe	
	Average Flow Velocity	2.38	m
	Diameter of Tunnel	5.8	m
	Head Loss in Tunnel	3.67	m
15	**SURGE SHAFT**		
	Type	Simple Restricted Orifice	
	Geometry	Circular	
	Maximum Surge Level	2184.9	masl
	Diameter of Surge Shaft	12.6	m
	Top Level of Surge Shaft	2193.0	masl
	Height of Surge Shaft	60	m
16	**PRESSURE SHAFT / PRESSURE TUNNEL**		

S/No	DESCRIPTION	VALUE	
	Type	Pressurized Tunnel	
	Geometry	Circular Section	
	Diameter of Pressure Shaft and Tunnel	4.0	m
	Length of Pressure Shaft	145.0	m
	Length of Pressure Tunnel	130.0	m
	Steel Lining Thickness	23	mm
	Head Losses in Pressure Shaft / Tunnel	1.45	m
17	**PENSTOCK**		
	Length of Penstock	65.0	m
	Diameter of Penstock	4	m
	Thickness of Steel Lining	30.0	mm
	Velocity in Penstock at Design Discharge	5.17	m/sec
	Head Losses in Penstock	1.98	m
18	**MANIFOLD**		
	Type	Symmetrical Wye	
	Number of Branches	03 (three)	
	Thickness of Steel Lining	30	mm
19	**POWERHOUSE AND ACCESSORIES**		
	Type	Surface	
	Size of Powerhouse	44m x 16m	
	Turbine	Vertical Francis	
	Generation Units	03	No's
	Unit Discharge	2x 27.7 & 1 x 9.6	m^3/sec
	Generator Type	Vertical Synchronous Type	
	Power Transformers	Step up-11kV- 132 kV 3 Phase	
20	**TAILRACE**		
	Type	Concrete Lined	
	Length of Tailrace	15.48m	
23	**SWITCHYARD**		
	Size of Switchyard	44m x 16m (inside)	
	Switchgear	Gas Insulated System (GIS) 132 kV-3 Phase	
24	**TRANSMISSION LINE**		
	Transmission Line Length	2.6 km	

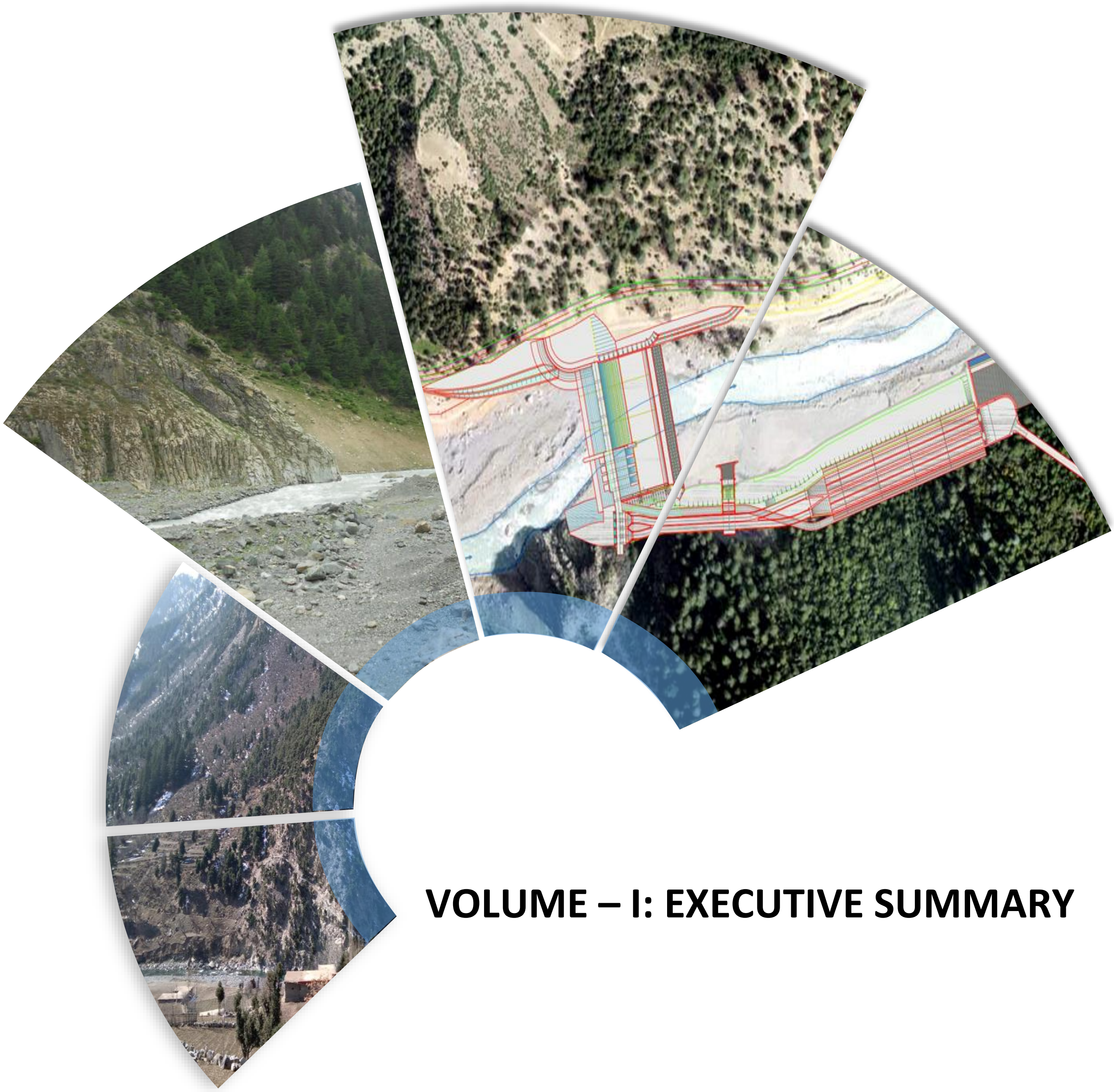
S/No	DESCRIPTION	VALUE	
	Type	Loop in loop out (Double circuit twin bundle)	
25	**HEAD AND DISCHARGE**		
	Gross Head	161.0	m
	Rated Net Head	153.0	m
	Head Loss at Design Discharge	8.0	m
	Design Discharge of Plant	65.0	m^3/sec
26	**CAPACITY AND OUTPUT**		
	Plant Capacity	88 MW	
	Capacity per Unit	2 x 37.5 MW & 1 x 13.0 MW	
	Plant Factor	44.7	
	Average Annual Energy	339 GWh	
29	**IMPLEMENTATION**		
	Pre-Construction	One Year	
	Construction Period	Four (4) Years	
	Defects Liability Period	One Year	
	Total Implementation Time	Six (6) Years	

Pakhtunkhwa Energy Development Organization PEDO

Energy & Power Department
Government of Khyber Pakhtunkhwa

FEASIBILITY STUDY REPORT OF GABRAL KALAM HYDROPOWER PROJECT (88 MW)

DISTRICT SWAT, KHYBER PAKHTUNKHWA



VOLUME – I: EXECUTIVE SUMMARY

JANUARY 2020

SUBMITTED BY: **A JOINT VENTURE OF:**

AGES (Pakistan), DOLSAR (Turkey), HEC (Nepal), TEAM (Pakistan) and FHC (Pakistan) Consultants

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FEASIBILITY STUDY OF
GABRAL KALAM HYDROPOWER PROJECT (88 MW)
DISTRICT SWAT, KHYBER PAKHTUNKHWA

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PART-D: CHAPTERS 14 TO 22

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PART-A: GENERAL, SURVEY AND LAND ACQUISITION DRAWINGS

PART-B: PLANNING AND DESIGN DRAWINGS

VOLUME-IV: **ANNEXURES TO MAIN REPORT**

Part A: TOPOGRAPHIC SURVEY AND HYDROLOGY & SEDIMENTATION DATA

Part B: HYDROLOGY & SEDIMENTATION DATA AND TRANSPORTATION & ROUTE SURVEY DATA

VOLUME-V: **GEOTECHNICAL INVESTIGATIONS REPORT**

PART-A: GEOTECHNICAL INVESTIGATIONS REPORT

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VOLUME-VI: **ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)**

VOLUME-VII: **RESETTLEMENT ACTION PLAN (RAP)**

FEASIBILITY STUDY OF
GABRAL KALAM HYDROPOWER PROJECT (88 MW)
DISTRICT SWAT, KHYBER PAKHTUNKHWA

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EXECUTIVE SUMMARY

1. INTRODUCTION

To explore and develop hydropower potential at provincial level, the Government of Khyber Pakhtunkhwa (GoKP) has already developed Reshun, Shishi, Malakand III, Pehur, Ranolia, Machai and Daral Khwar Hydropower projects through Pakhtunkhwa Energy Development Organisation (PEDO). Likewise, development of Gorkin-Matiltan, Lawi, Jabori, Karora and Koto Hydropower projects is in progress. In the same vein, the current feasibility study of Gabral Kalam Hydropower Project (GKHPP) is part of the PEDO programme to exploit and develop the hydropower potential in the province.

GKHPP was visualized as a run of the river scheme with storage for peaking during the study conducted for Swat valley (Region-4) under the Hydropower Development Master Plan for the Northern Areas of the erstwhile NWFP now KP. The study was jointly carried out by the erstwhile Sarhad Hydel Development Organization (SHYDO) in collaboration with German Agency for Technical Cooperation (GTZ) during 1990-1995.

PEDO assigned the consultancy services, for conducting the feasibility study, detailed engineering design and preparation of PC-1, to a joint venture of national and international firms led by AGES Consultants, Peshawar, Pakistan. The Consultancy agreement was signed on November 20, 2017 for two years' contract period, commencing December 11, 2017. The contract period was later on extended till the end of March, 2020 due to adverse weather conditions in the project area and enhancement of the scope of services to fulfil the World Bank's Guidelines.

1.1. LOCATION & ACCESSIBILITY

The project is located on lower stretch of Gabral River between village Kanai and Kalam town of Swat district. The proposed weir site is located about 09 km upstream of Kalam town and the powerhouse at about 1.5 km u/s of the main road bridge north of Kalam.

Table 1: Coordinates of Weir and Powerhouse

Project Site	Latitude	Longitude
Weir	N 3931932.9282	E 274962.8185
Powerhouse	N 3931470.1919	E 280298.3343

Kalam is at a distance of about 290 km from Peshawar and about 330 km from Islamabad, and accessible through Motorway (M-1), Swat Expressway / National Highway N-95 and further N-45. From Kalam, the project area is accessible via Kalam – Utror truckable unpaved road which runs along the left bank of Gabral River.

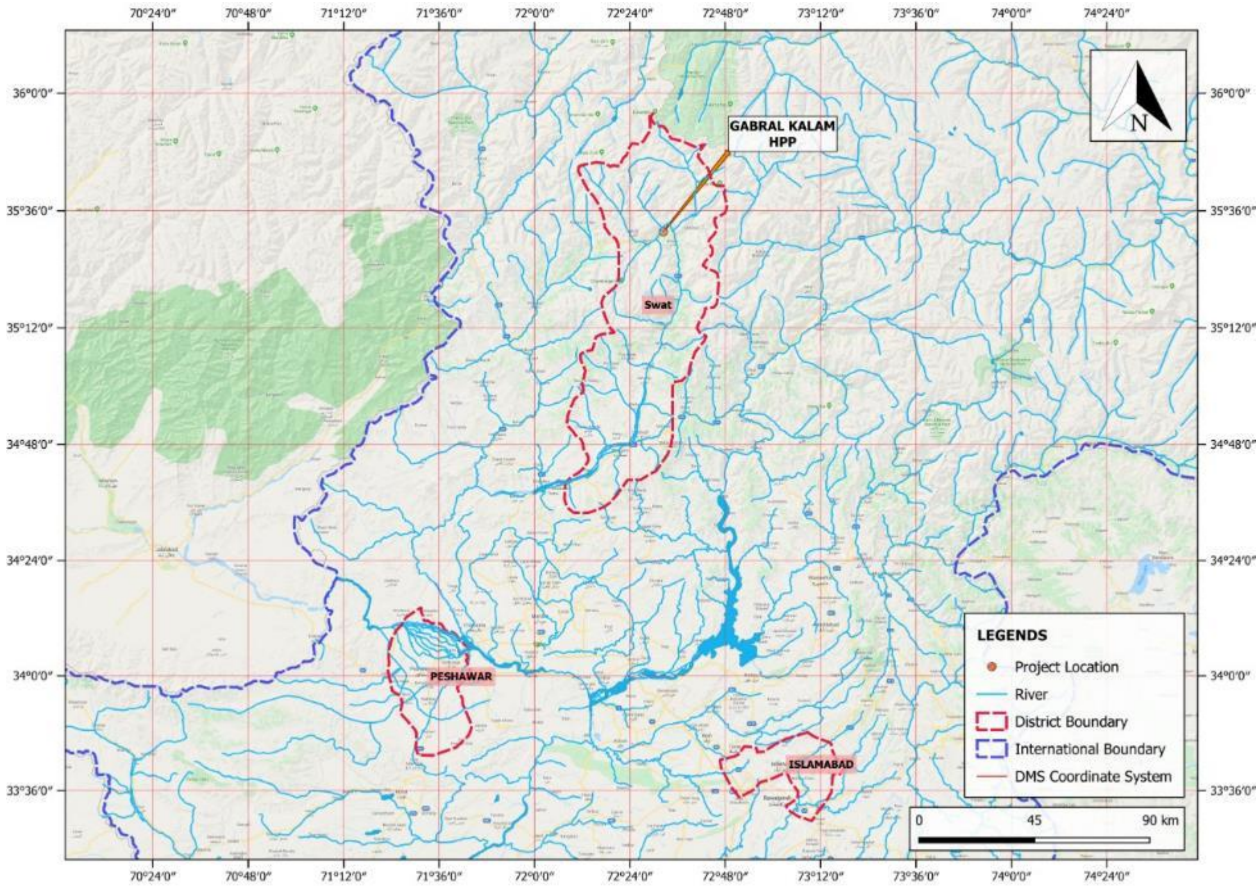

Figure 1: Project Location Map

2. SURVEY AND TOPOGRAPHY

For initial planning of the project, Survey of Pakistan topographic sheet, SRTM data and Google Earth Images were used. The nearest available and reliable Survey of Pakistan bench mark (SBM) is at Matiltan was used for establishment of the control network of GKHPP. A total of 11 control stations have been established in project area.

Important project components like weir & intake, sandtrap, inlet portal, surge shaft, pressure shaft, pressure tunnel, powerhouse area, switchyard and colony area were surveyed and mapped with Total Station as well as latest Photogrammetry technology.

In addition, river cross sections at weir site, powerhouse and intermediate stretch including bathymetric sections have been surveyed for numerical modelling of river.

3. HYDROLOGICAL AND SEDIMENTATION STUDIES

Hydrological studies have been carried out to gather basic data and analyse it as required for the design of hydropower plant which include the pattern and availability of flows, flood magnitude for design of structures, water level at structural sites and diversion arrangements. Study of the nature and quantity of the sediments in river flow has also been carried out.

The catchment of the Gabral River lies in the upper region of the Swat River basin and can be classified as a “high mountain catchment” with several glaciers. Glaciers are visible above altitude of 4,000 m asl. Runoff at a weir site is due to both snowmelts and rainfall events. The length of Gabral River up to the weir is about 35-40 km with an average bed slope ranging from 2 % to 3 %.

3.1. CLIMATE

The weather of the area can be characterised as very cold winter and pleasant summer. As per Koppen climate classification, the project area lies under stepped hot and fully humid (BSH) zone. The variation of temperature and rainfall is presented in the following figures based on the collected data for the Kalam Station.

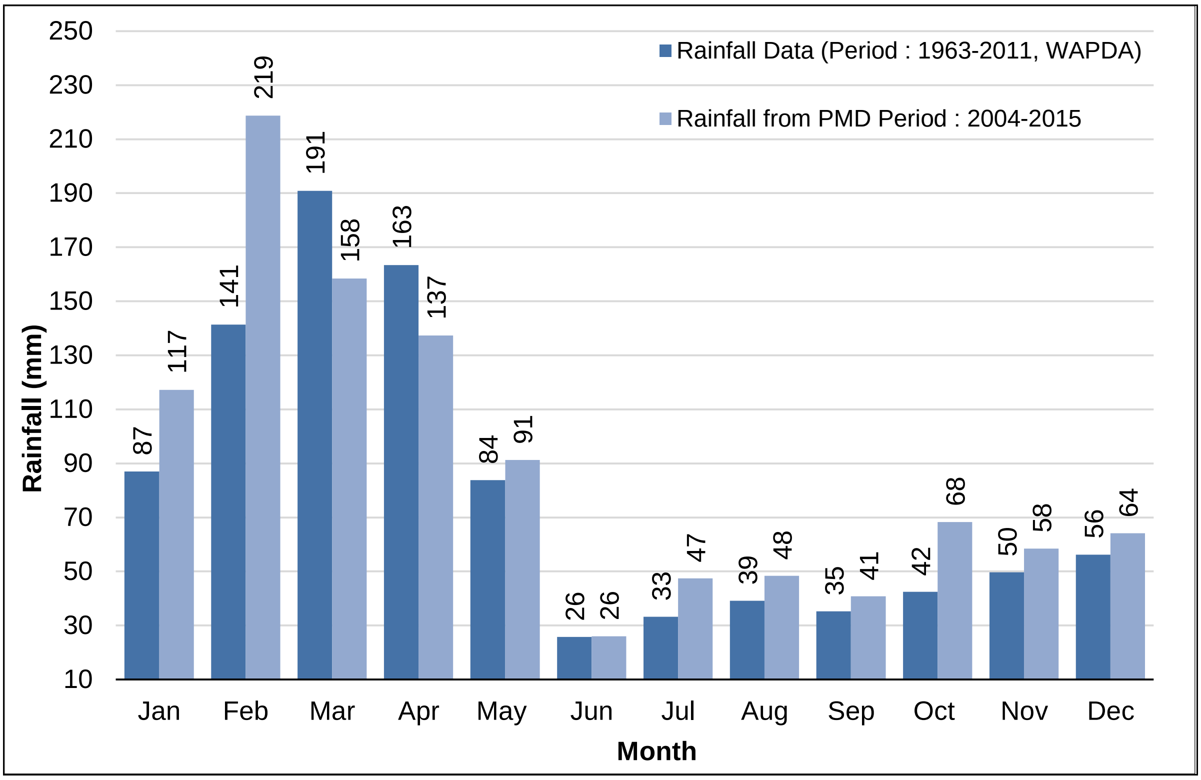

Figure 2: Mean Monthly Rainfall at Climate Station Kalam

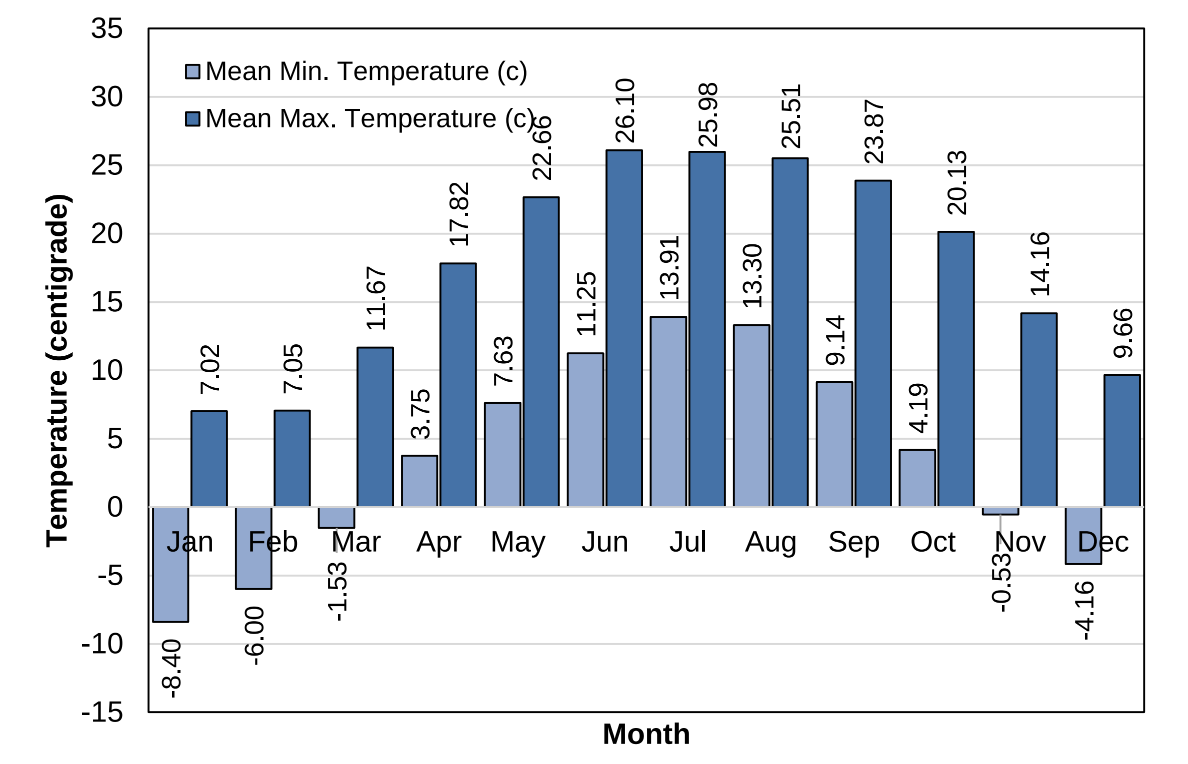

Figure 3: Mean Maximum and Minimum Temperature at Kalam (Source: PMD)

3.2. FLOW AVAILABILITY

Daily flow record of the following five (5) gauge stations was available around the project site, and which has been used for the hydrological estimation.

a) Daily flow record of Gabral River at Gulshanabad for the period of 1993-2015.

b) Batal Khwar at Utror for the period of 1993-2015.

c) Daily stream flow data of Swat River at Kalam from the year 1961 to 2010.

d) Daily flow data of Ushu River at Jildat for the period of 1993-2015.

e) Daily flow data of Ushu River at Matiltan for the period of 2011-2017.

In addition, a gauging station was also installed on Gabral River downstream of the weir site. Flow measurement has been carried out on weekly basis whereas the gauge was observed twice a day. Observed data is presented in detail in the respective chapter of the Main Report.

Figure 4: Gauging Station at Gabral River (Wuch Bridge)

The two gauging stations i.e. Gabral River at Gulshanabad and Batal Khwar at Utror, are about 2.5 km upstream of the proposed weir site. Downstream these stations, there is no significant contribution of flows from other sources. Hence, the water availability has been estimated by addition of these flows for the data recorded (1993 to 2015). For long-term series, Kalam Station data has been transposed at the weir site using regression analysis. Following is the flow series estimated at the weir site. Flow availability for 25%, 30%, 50% and 95% exceeding probabilities are estimated as 67 m^3/s, 56 m^3/s, 18.5 m^3/s and 6.3 m^3/s.

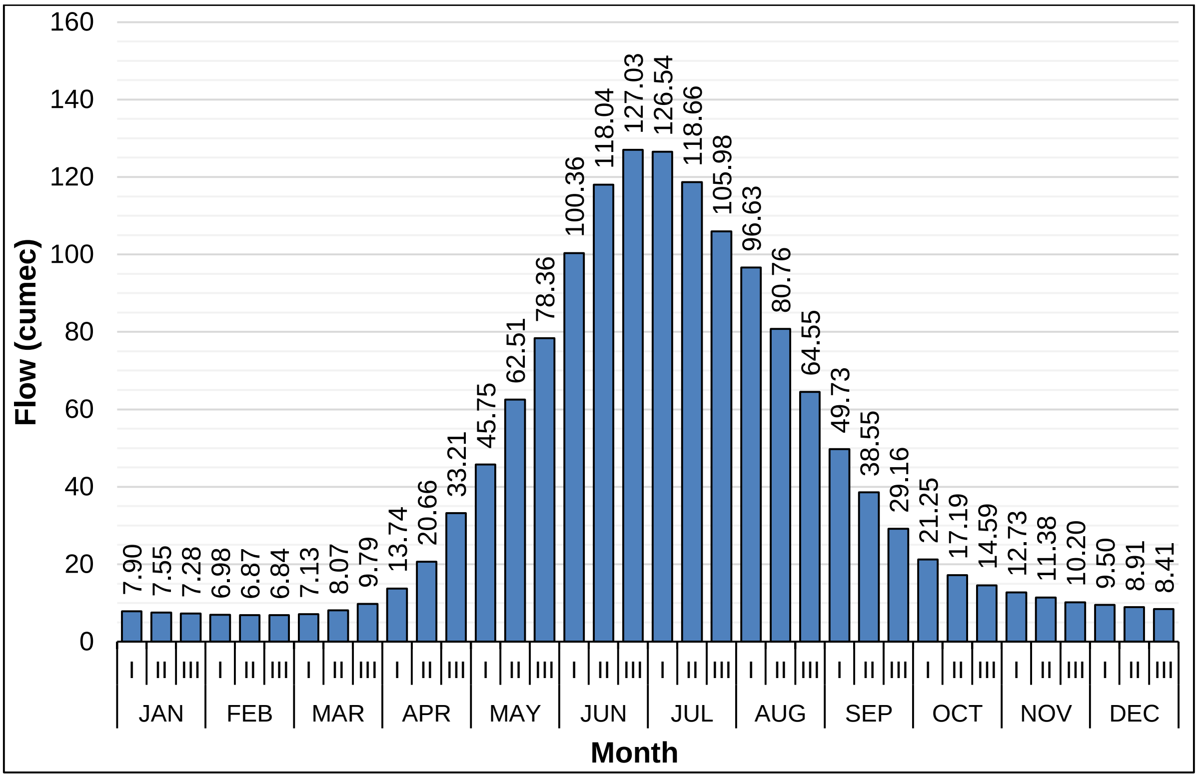

Figure 5: Mean 10-Daily Historic Flow for Gabral River at Weir (1961-2015)

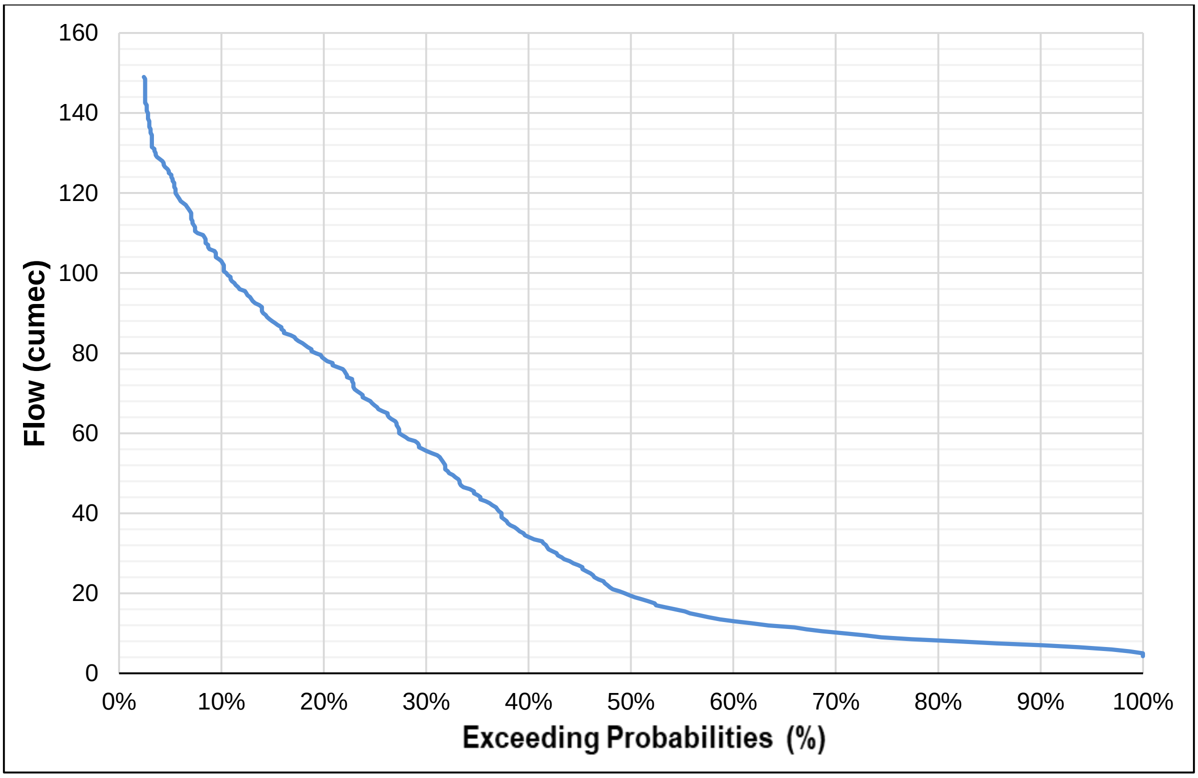

Figure 6: Flow Duration Curve of Gabral River at Weir Site - Historic (1961-2015)

Comparison of the observed flow based on the installed gauging station during feasibility study and estimated flow series of Gabral River indicated close similarities in high as well as in low flow season as presented hereunder.

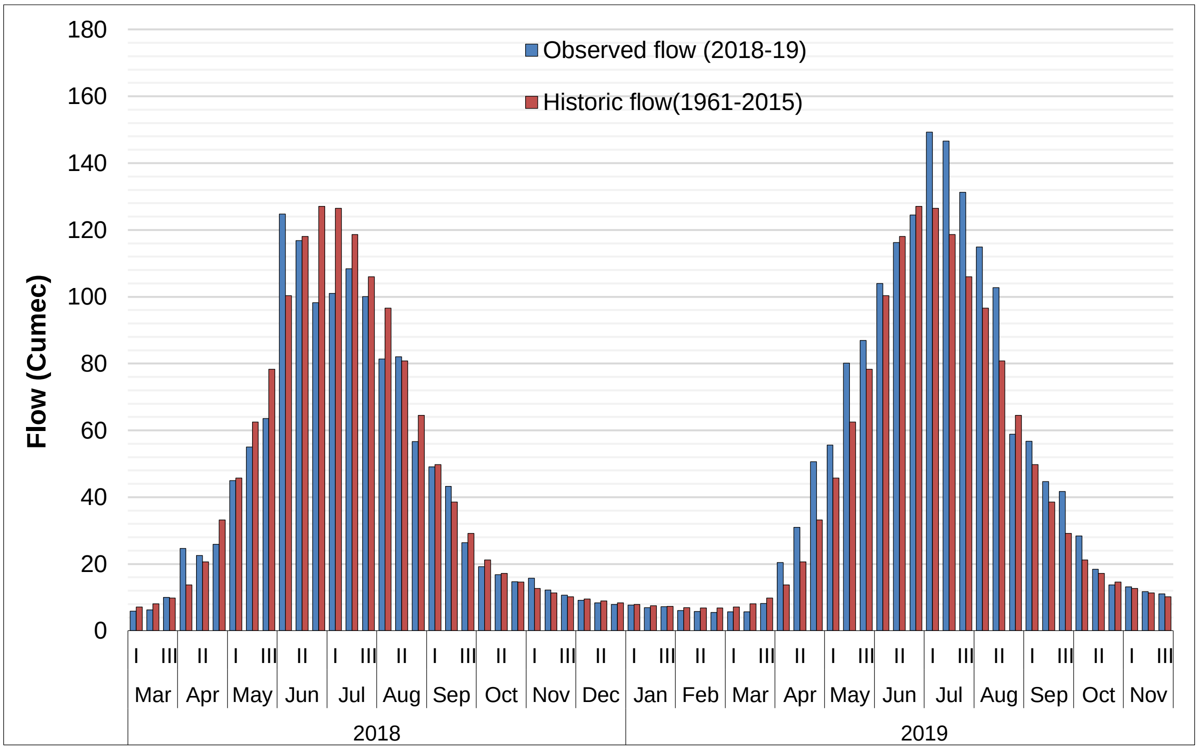

Figure 7: Mean10-Daily Generated and Observed Flow of Gabral River

3.3. DESIGN FLOOD STUDIES

Estimation of design flood was undertaken considering that floods in the northern areas of Pakistan are generated by two different processes i.e. snowmelt and precipitation. Recorded floods of Swat at Kalam are normally from snowmelt origin. When large and powerful events (Monsoon and Western disturbances) develop over the area, intense rainfall can originate extreme floods like the one occurred in July, 2010.

Design flood at the weir and powerhouse have been estimated from the following approaches:

a) Flood Frequency Analysis of Swat River at Kalam

b) Flood Frequency Analysis of Flood Data of Regional Rivers

c) Rainfall-Runoff Modelling

Estimated design flood on specific peak flood envelope curves of Regional River is recommended for design purpose as extreme event of July, 2010 is included in the analyzed record.

Table 2: Comparison of Design Flood (cumec) of Gabral River at Weir

Return Period (T Year)	Flood Frequency Analysis Swat River at Kalam	Regional River Specific Flood Envelope Curves	Regional River Average Specific Flood	Rainfall-Runoff Modelling
2	185	**364**	317	173
10	252	**778**	712	510
25	286	**974**	907	694
50	312	**1139**	1058	881
100	337	**1291**	1204	1068
1000	420	**1793**	1688	1745
10000	502	**2273**	2170	2458

3.4. ELEVATION-SURFACE AREA-CAPACITY

Surface area of the head pond was estimated from contour plan prepared at 1m contour interval. At normal operating level of 2161 m asl, surface area of head pond is 15 hectares and capacity is 1.08 Million cubic meter.

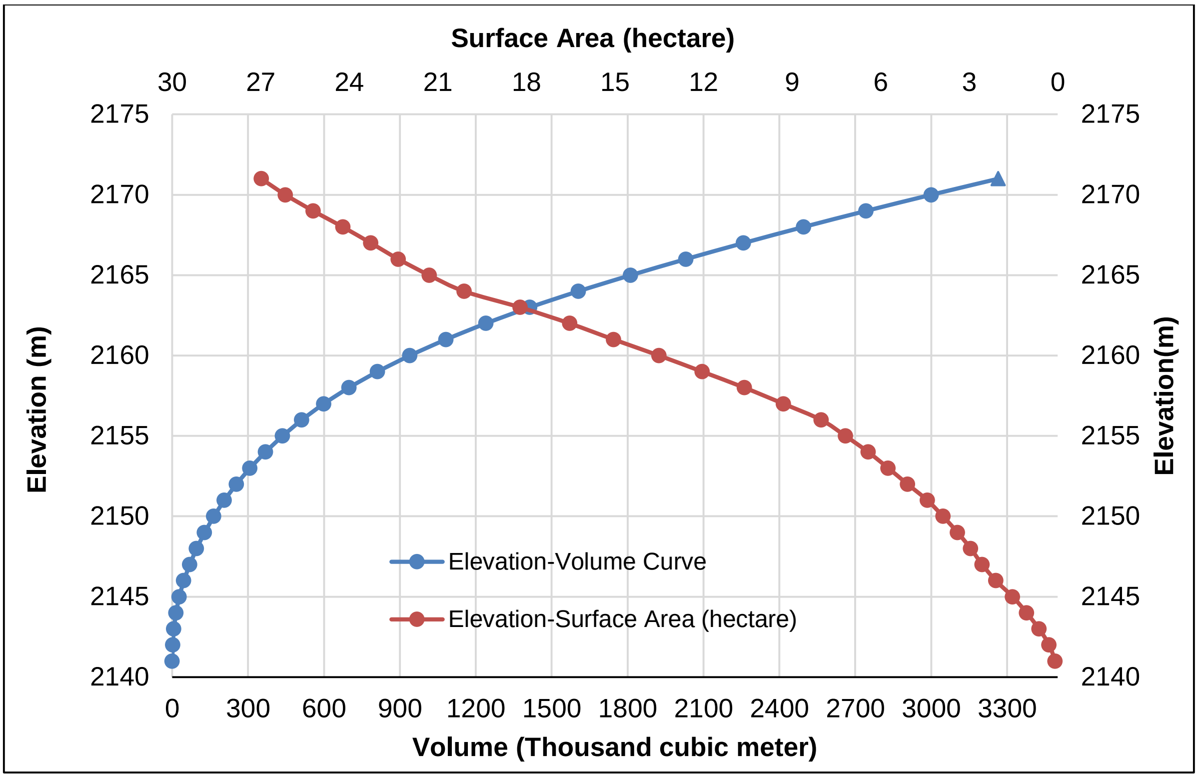

Figure 8: Elevation-Surface Area – Capacity Curves

3.5. DAM BREAK ANALYSIS

Dam break analysis was carried out through HECRAS model. The model results indicate almost no damages to the built-up areas located at higher terraces except the isolated buildings located in flood plain of Gabral River near Kalam.

3.6. SEDIMENTATION STUDIES

Suspended sediment data of Gabral River at Gulshanabad for period of 2002 to 2015 was collected from SWHP, WAPDA. According to the available suspended sediment data, maximum observed ppm is less than 300 ppm, while average concentration is just 100 ppm. Similarly suspended sediment data of Swat River at Kalam is available for the period 1963-2009. The observed maximum and minimum concentration is 3,460 ppm and 3 ppm. The average sediment concentration is 0.01% (by weight) or 100 ppm and containing approximately 24% sand, 45% silt and 31% clay at high flow. Suspended sediment samples have also been collected with flow measurements during the feasibility study and analyzed in the University of Engineering and Technology (UET) Soil laboratory. As per samples test results, maximum and minimum concentration are 09 to 183 ppm. The estimated sediment load from regression analysis of suspended sediment and flow data of Gabral River is about 159 thousand tons including 25% bed load.

4. GEOLOGY

Swat valley is occupied by Kohistan Island Arc (KIA) comprising a sequence of post Eocene Age, consisting of granites, diorites, pyroxene granulites (norites), garnet granulites, slates, quartzites and green stones. Within a few km SE of Madyan, the Kohistan Island Arc is bounded by Main Mantle Thrust (MMT), which divides it from the Indian Plate consisting of granites, phyllite, slates and calcareous rocks, called Besham Group. The Gabral valley is passing through the stage of maturity.

The weir site and inlet structures are located in Utror Volcanics having various colours, fine to medium grained, pyroclastic, rhyolite, & andesite. The rocks are slightly to moderately weathered, moderately jointed. Volcanic rock comprises minerals such as Quartz, Orthoclase, and plagioclase with chert. Mega-porphyritic texture with fine grained groundmass. Phenocrysts are visible in hand specimen. Recrystallization is noted in the groundmass as well as in some phenocrysts. At right abutment, rocks are stable and massive forming steep slopes (65^o to 75^o). At left abutment, there is no exposure of rock and slopes exhibit talus material.

The headrace tunnel (4.7 km long) will be headed within Utror Volcanics and Barawal Banda slates & phyllites. The crucial part of this study was to identify the faulted contact between Utror Volcanics and Barawal Banda slates & phyllites. This task was accomplished by traversing across the proposed tunnel alignment

Initial 35% of tunnel will pass through Utror Volcanics. These Volcanics are light to dark grey fine to medium grained, hard, sparsely to moderately jointed. Mostly joints are open and filled with silty clay.

About 65% of the headrace tunnel shall be excavated through Barawal Banda slates & phyllites. These rocks are light grey to greenish grey, fine textured, thin bedded, and occasionally silty. Strike E-W direction and have northly dip, isoclinally folded.

For tunnel inlet portal, good quality rhyo-dacite belonging to Utror Volcanics face with moderate to steep stable slope is available on the right bank of the river. The rock is light to dark grey, fine to medium grained, hard to very hard, sparsely to moderately jointed. Mostly joints are open and filled with clayey silt. Generally, joint trends are N47E / 79NW and N30W / 65NE.

The powerhouse is located in rocks of Barawal Banda slates & phyllites comprising schists, phyllite, slates and quartzites of Dir Group. For GKHPP, both the ~~powerhouse~~ cavern~~s~~ as well as surface powerhouses were considered. These structures are sited in poor to fair quality rocks comprising slate, phyllite, schist and quartzite.

5. SEISMIC HAZARD ANALYSIS

As the project is located in the collision zone of the Indian and Eurasian plates, it may face a severe earthquake hazard potential. The Geological Survey of Pakistan has placed the Project area in the “Serious Seismic Danger Zone”. In Building Code of Pakistan, Seismic Provisions (2007), the Project area falls in Zone-3. Moreover, within the scenario of the October 08, 2005 earthquake of Pakistan, it becomes important to be very cautious regarding the seismic hazard assessment for such an important project.

The conclusions and recommendations regarding study of seismotectonic setting of GKHPP and the resulting seismic design parameters are as follows:

- The project is located in the Kohistan Island Arc which is sandwiched between Indian and the Eurasian tectonic plates and very active seismically.
- A number of moderate sized earthquakes have been recorded in Kohistan Island Arc during the last 100 years.
- A number of active faults are present around the project area.
- The main seismotectonic features considered critical for the seismic hazard for the project are as follows;
  - Main Karakoram Thrust (MKT),
  - Kohistan Fault,
  - Main Mantle Thrust (MMT), and
  - Shandur Fault
- Both probabilistic and deterministic seismic hazard evaluations were made to determine the expected ground motions at the project site.
  - The recommended horizontal Peak Ground Acceleration (PGA) associated with Operating Basis Earthquake (OBE) is 0.21g.
  - The recommended horizontal Peak Ground Acceleration (PGA) associated with Safety Evaluation Earthquake (SEE) is 0.49 g which is associated with ground motion having return period of 3,000 years.
  - All the appurtenant structures at the weir, tunnel and powerhouse areas are recommended to be designed for PGA of 0.30g, which is associated with ground motion having return period of 475 years.
- For safety monitoring purpose Strong Motion Accelerographs may be installed at the weir and powerhouse site.

6. GEOPHYSICAL INVESTIGATIONS

The purpose of geophysical investigations is to ascertain the type, nature, arrangement and thickness of various subsurface strata, including alluvial or moraine deposits and bedrock, together with their condition and the engineering characteristics of subsurface material as they exist to the depth. This is to be accomplished by means of seismic refraction survey using explosive as seismic energy source and electrical resistivity tomography (ERT) survey.

From the results of geophysical investigations carried out at the site of the proposed GKHPP, the following conclusions about subsurface conditions are drawn:

a. The subsurface material in the project area shows typically four layers having different seismic wave velocities.

   - The top layer having seismic wave velocity up to 1000 m/s is interpreted as loose overburden with relatively less compact material.

   - The second layer having seismic wave velocity ranging from 1001-2600 m/s is interpreted as dense overburden with boulders and relatively more compact material.

   - The layer having seismic wave velocity ranging from 2600 m/s to 3000 m/s is interpreted as highly fractured/weathered bedrock.

   - The layer having seismic wave velocity of more than 3000 m/s is interpreted as slightly to moderately jointed / fractured bedrock with different degree of jointing/fracturing. The greater the velocity of bedrock, the better will the rock mass condition.

b. The results of electrical resistivity tomography survey shows that overburden material in the project area have low to high resistivity while bedrock generally shows high to very high resistivity values.

c. At the weir site, two layers of overburden material are present represented by loose overburden and dense overburden. The thickness of loose overburden material varies widely from 3.8 meters to 30.2 meters. The bedrock was not encountered along seismic lines on the left side of the river, and it is inferred that the depth to bedrock on left side of river is generally more than 60 meters. The bedrock is interpreted to be present on the right side of the river at 6.3 to 13.9 meters' depth and quality of rock is slightly jointed/fractured with good rock mass characteristics.

d. At the proposed location of powerhouse near Kalam, the depth to bedrock below overburden varies from 4.6 meters near the river to as much as 33.6 meters on the upper terrace. The top layer of bedrock is highly weathered / fractured but good quality rock is present at depth.

7. GEOTECHNICAL INVESTIGATIONS

Geotechnical investigations were conducted at the project structural locations such as weir site, connecting channel, sand trap and inlet pond areas, along with headrace tunnel and outlet structures such as surge shaft, pressure shaft, pressure tunnel and powerhouse. The investigations included test pits and core drilling with water pressure (Lugeon) tests, groundwater conditions, and field & laboratory tests accordingly.

For the determination of engineering characteristics of rocks and foundation material, 16 boreholes collectively comprising more than 1200 m drilling were planned and executed.

Table 3: Geotechnical Investigation - Boreholes

S. No.	Location	Project Structure	BH. No.	Drilling in Overburden (m)	Drilling in Rock (m)	Total Drilling (m)
1	Weir Site	Weir right abutment	W - 1	-	50.00	50.00
2		Weir Axis (River right bank)	W - 2	27.00	15.00	42.00
3		Weir Axis (River left bank)	W - 3	57.00	8.00	65.00
4		Weir Axis (Valley left bank)	W - 4	60.00	-	60.00
5	Connecting Channel	Connecting Channel	C - 1	25.00	-	25.00
6	Sandtrap	Sand Trap	S - 1	20.00	10.00	30.00
7		Sand Trap	S - 2	2.00	48.00	50.00
8	Mulga Nullah	Tunnel Inlet Portal	T - 1	7.00	53.00	60.00
9	Ouch Nullah	Tunnel Alignment (Ouch Nullah)	T - 2	6.00	184.00	190.00
10	Powerhouse Area	Surge Shaft	SG - 1	3.50	139.50	143.00
11		Pressure Shaft	SG - 2	-	225.00	225.00
12		Surface Powerhouse	TR - 1	2.50	37.50	40.00
13		Surface Powerhouse	A - 1	2.30	47.70	50.00
14		Cavern Powerhouse	PH - 1	-	140.00	140.00
15	Opposite to Ashuran (River Right Bank)	Bridge Right Abutment	A - 2	11.30	18.70	30.00
16	Ashuran (River Left Bank)	Bridge Left Abutment	A - 3	3.00	17.00	20.00
				116.60	**990.40**	**1,217.00**

In addition, 20 test pits were excavated for assessment of construction materials and foundation conditions. Laboratory tests were performed on the samples obtained from the test pits and core samples from the boreholes drilled at locations of various project components.

Support classes required along various lengths of the 4.7 km headrace tunnel, surge shaft and pressure tunnel have been assessed based on geotechnical investigations using RMR, Q System and Phase2 by Rocscience.

Further, availability and locations for construction materials such as course and fine aggregate have been identified and their quality evaluated.

Table 4: Geotechnical Investigation – Test Pits

S. No	Location / Borrow Area	Coordinates		Test Pit #	Depth (m)
		Easting	Northing		
1	Weir Axis right bank side	274996	3931888	GWTP – 01	2.50
2		275021	3931886	GWTP – 02	2.50
3	Weir Axis left bank side	274979	3931973	GWTP – 03	3.00
4		274969	3931990	GWTP – 04	3.00
5	Weir Axis left abutment	274981	3932016	GWTP – 05	3.00
6		274975	3932024	GWTP – 06	2.00
7	Sand Trap	275134	3931919	STTP – 01	2.50
8		275181	3931923	STTP – 02	2.50
9		275218	3931926	STTP – 03	2.50
10	Colony Area	280824	3930578	GCTP – 01	3.00
11		280902	3930443	GCTP – 02	3.00
12		280845	3930412	GCTP – 03	3.00
13	Switchyard	280257	3931265	GSYTP - 01	2.50
14		280249	3931217	GSYTP – 02	2.50
15	Kanai village near Dhamaka Jheel Borrow Area – I	273615	3931521	GKTP – 01	2.00
16		274192	3931932	GKTP – 02	3.00
17		274229	3931931	GKTP – 03	3.00
18	Ashuran village, near SRSP powerhouse opposite to Palir Borrow Area – II	279606	3932387	GATP – 01	3.00
19		279682	3932368	GATP – 02	3.00
20		279716	3932315	GATP – 03	3.00
21	Kalam town Borrow Area - III	280780	3929593	GKSS - 01	Sand Sample
22	Kharkhari Jheel (Borrow Area – IV)	264833	3951476	KJSS - 01	Sand Sample

8. PROJECT LAYOUT PLANNING

Three locations for weir and two locations for powerhouse were identified within the project boundaries. These included the locations identified in the GTZ study. Pros and cons for all the alternatives were compared to select the best possible option with minimum topographical, hydrological, geological and social / environmental problems and maximum benefits. By combination of these identified locations, the following 9 number project alternatives were explored.

Table 5: Identified Alternative Layout

Option #	Option Name	Option Description
1	W1A – P1	Dam (50 meter) at TOR option and Powerhouse opposite Ashuran
2	W1B – P1	Diversion Weir (10 meter) at TOR location and Powerhouse opposite Ashuran
3	W1A – P2	Dam (50 meter) at TOR option and Powerhouse at right bank of Desan Khwar
4	W1B – P2	Weir (10 meter) at TOR location and Powerhouse at right bank of Desan Khwar
5	W2A – P1	Diversion Weir (10 meter) near Bhatindar and Powerhouse opposite Ashuran
6	W2B – P1	Diversion Weir (20 meter) near Bhatindar and Powerhouse opposite Ashuran
7	W2 – P2	Diversion Weir (10 meter) near Bhatindar and Powerhouse at right bank of Desan Khwar
8	W3 – PI	Diversion Weir (5 meter) at Dhamaka Jheel and Powerhouse opposite Ashuran
9	W3 – P2	Diversion Weir (5 meter) at Dhamaka Jheel and Powerhouse at right bank of Desan Khwar

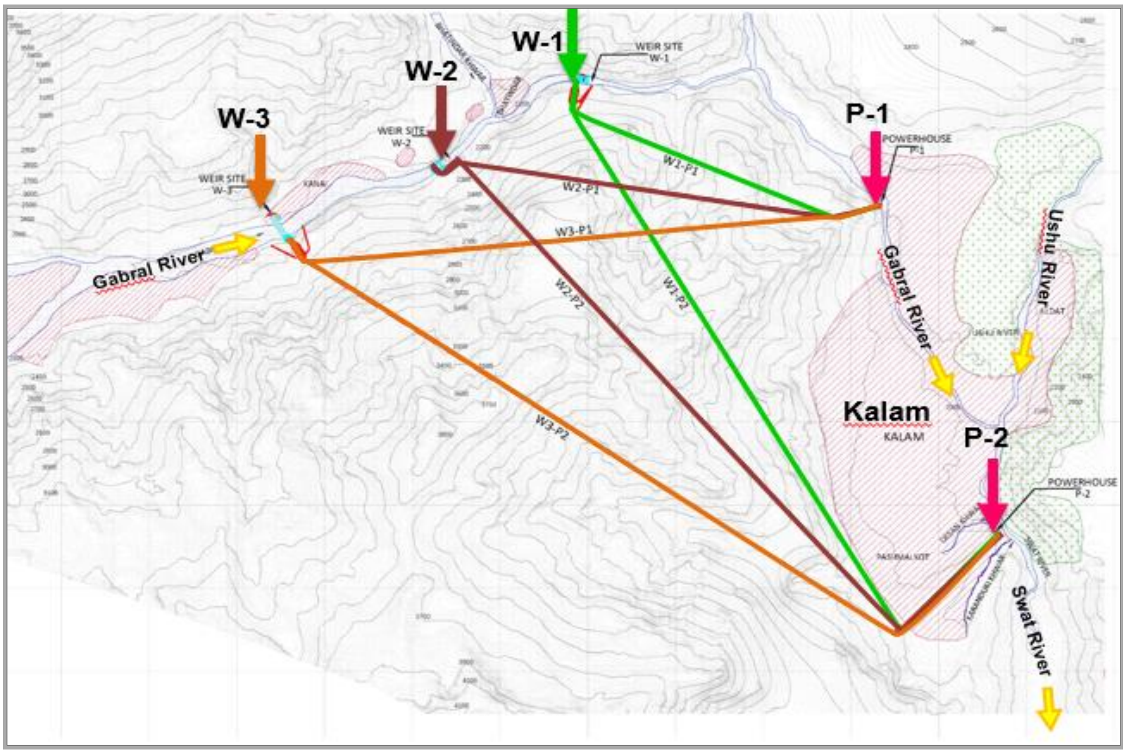

Figure 9: Plan of Identified Alternative Layout

It was given high consideration that in addition to the essential minimum environmental releases from the diversion weir (2 m^3/s to 3.5 m^3/s), substantial flow should be available in the river so that the natural beauty of Kalam, the main source of tourists attraction, does not get affected due to reduced flows in the river. Therefore, minimum environmental releases were estimated as presented hereunder.

Table 6: Estimated Environmental Flows

Month	Minimum Environmental Flow downstream of Weir Site (m^3/s)	Minimum Tourism Flow Requirement at Kalam (m^3/s)
January	2.0	6.0
February	2.0	6.0
March	2.5	6.0
April	3.5	8.0
May	3.5	12.0
June	3.5	12.0
July	3.5	12.0
August	3.5	12.0
September	3.5	8.0
October	3.5	6.0
November	3.5	4.0
December	2.0	4.0

Evaluation of the identified alternatives with due consideration for power potential, geology, environmental, social, and planning & design aspects was conducted and further ranking of the alternatives was carried out based on the generation cost as presented as in table 7.

W2 - P1 was ranked at top amongst the identified alternative and selected for further Feasibility Study. Layout plan of the selected option is presented as Drawing 1.

The proposed weir is 700 m downstream of Kanai Village and 1.2 km upstream of Bhatindar village. It is about 09 km upstream of Kalam and accessible via truckable road along the left bank of Gabral River. The road is almost at the river level and will require re-routing for construction and operation.

The selected alternative was fine-tuned based on the local conditions of topography, geology, construction ease, economics and environmental and social aspects. The weir axis was adjusted based on the limitations of upstream and downstream nullahs, rock exposure on right abutment, arrangement of conveyance system, extent of diversion weir and energy dissipation system. Layout plan of weir area is given in Drawing 2.

Table 7: Ranking of Alternative Layouts

Alternative Layout	Power (MW)	Total (M PKR)	Energy (GWh)	Cost Per MW (M USD)	Plant Factor (%)	Generation Cost (PKR / kWh)	Rank
W1A - P1	82	30,450	304.32	3.20	42.37%	9.12	6
W1B - P1	57	20,918	210.58	3.16	42.17%	9.06	5
W1A - P2	116	43,645	425.74	3.24	41.90%	9.35	7
W1B - P2	91	34,318	333.41	3.25	41.82%	9.38	8
W2A - P1	88	23,756	326.64	2.33	42.37%	6.63	1
W2B - P1	94	27,073	348.89	2.48	42.37%	7.07	1
W2 - P2	122	35,734	448.78	2.53	41.99%	7.26	4
W3 - P1	112	32,541	417.50	2.50	42.55%	7.11	2
W3 - P2	147	42,894	540.31	2.52	41.96%	7.24	3

Weir height / pond depth was selected based on the consideration not to significantly affect the upstream village (Kanai). With 21 m pond depth (normal conservation level at 2161 m asl), only lower terraces of Kanai village will be submerged that can be reclaimed by raising the area through muck disposal and protection bund. This rehabilitation activity will be carried out considering the flood level to ensure safety of the agricultural land and houses.

Two alternative alignments of headrace tunnels were considered from the point of view of ease and duration of construction, and rock cover, etc. Based on comparison, the alignment without intermediate access has been proposed.

The powerhouse site is on the right bank of the Gabral River opposite to Ashuran village. It is located at a distance of about 1.5 km upstream the bridge on the main road crossing Gabral river at Kalam. To access the powerhouse area, during construction and operation, a road and bridge across Gabral River will need to be constructed.

During the initial planning, both cavern and surface powerhouse were envisaged and cavern was preferred based on the topographical conditions. However, further detailing during the course of study, geotechnical investigations, operational implications and comparison of costs revealed that surface powerhouse was better option and thus adopted. Layout plan of the powerhouse area is presented as Drawing 3.

In addition to the main components of project, other related components like diversion arrangement, residential colony, construction camps, access roads, muck disposal sites etc. were also studied in sufficient details.

The diversion arrangement for construction in the weir area is possible through both bypass tunnel(s) and channel. Both the alternatives were evaluated and diversion was proposed through typical bypass channel within the river course.

Three alternative sites for the residential colony were selected and based on evaluation the area along the main Kalam Gabral road near the powerhouse proposed.

Aesthetics / tourism aspects were also studied in sufficient detail.

- Location of the powerhouse identified downstream of Kalam village at the inception stage was shifted upstream and so that the entire Gabral River water passes through Kalam round the year to keep the attraction for tourism. Similarly, weir W3 at Dhamaka Jheel near Kanai village was shifted to the W2 location from tourism and other perspectives.
- Artificial lake / pond with weir will be an attraction for tourists and an opportunity for the locals to develop commercial activities along the banks. The disposal area along the bank is proposed to be handed over after restoration to the original owners.
- Likewise, the spillway fall is also an attraction for tourists during high flows when surplus water gushes out of the spillway. The chute of spillway is provided with deflector blocks so that even with the small surplus water, the chute beauty is further improved for tourists' attraction.
- Left bank of the Gabral River at weir site is composed of overburden material where existing road will be re-routed up to the weir top level. For stability of the road, excavation of the bank slopes and cutting of trees will be required. The cut slopes of the road will, however, be stabilized with structural measures with plantation all along the bank. Toe of the slope along with the existing road will be restored to attract the tourist to stay and enjoy the chute spillway in operation.
- Upstream of the weir, the left bank will be stabilized by constructing a wall along the river side. Due to construction of this wall, additional space will become available wherefrom both the spillway chute and reservoir can be seen simultaneously. Thus, the space up to a distance of 150-200m will be converted into a scenic point for tourists.
- Protection wall along the right bank at weir site will be designed with the architectural measures to improve its scenic beauty.
- The road from powerhouse to the surge shaft is passing through a dense forest on the upstream side. Apart from the additional plantation, this road will be a very good track for the tourists interested in hiking. An open space near the surge shaft area will be developed for tourists to see the Kalam village along with the Ushu and Gabral Rivers in a single scene.

9. PROJECT OPTIMIZATION

Based on the Flow Duration Curve, 20% to 40% available discharge range (30 m^3/sec to 85 m^3/sec) with an interval of 5 m^3/s have been considered for capacity optimisation of the selected project layout. Optimisation was based on the financial analysis of the estimated benefits (energy) and cost for each discharge. Power and energy for the selected range were estimated as presented in the following table.

Table 8: Estimated Power and Energy

Design Discharge (m^3/s)	Tunnel Dia (m)	Number of Unit	Small Unit Discharge (m^3/s)	Installed Capacity (MW)	Annual Energy (GWh)	Plant Factor
30	4.4	3	7.5	40.9	211.1	58.85%
35	4.6	3	8.0	47.6	233.6	55.98%
40	4.9	3	8.0	54.5	256.3	53.69%
45	5.1	3	8.0	61.2	277.7	51.76%
50	5.3	3	8.5	68.0	295.0	49.51%
55	5.5	3	9.5	74.6	312.2	47.74%
60	5.7	3	9.5	81.5	329.2	46.14%
65	5.9	3	9.5	88.1	343.1	44.46%
70	6.0	4	9.0	94.6	359.9	43.45%
75	6.2	4	9.0	101.4	374.8	42.18%
80	6.3	4	9.0	107.9	385.5	40.78%
85	6.5	4	9.5	114.6	395.8	39.43%

Likewise, costs of the scheme for all the selected flows were estimated. Results of the financial analysis tabulated below indicate that the most attractive results are for the discharge of 65 m^3/s with minimum generation cost, highest NPV, highest B/C ratio and maximum IRR.

In addition to capacity optimisation, weir height and tunnel diameter were also optimised. The optimised weir height corresponds to normal conservation level of 2115 m asl (75 m pond depth). As this weir height would inundate the Kanai village and create many social problems, maximum possible pond depth of 21 m has been adopted. For the optimised discharge of 65 m^3/s, optimised tunnel diameter has been estimated as 5.9 m.

Table 9: Results of Optimisation Study

Design Discharge (m^3/s)	Power (MW)	Total Cost (M PKR)	Generation Cost (PKR / kWh)	Net Present Value (M PKR)	Benefit to Cost Ratio	Financial Internal Rate of Return
30	41.0	18,144.8	8.18	5,755.85	1.40	16.38%
35	47.7	19,301.5	7.87	6,965.07	1.45	16.96%
40	54.5	20,567.6	7.68	8,018.77	1.49	17.34%
45	61.3	21,716.8	7.51	9,070.43	1.52	17.70%
50	68.0	22,837.9	7.42	9,863.78	1.54	17.88%
55	74.6	23,913.1	7.33	10,705.11	1.56	18.08%
60	81.4	24,994.9	7.27	11,460.81	1.57	18.22%
65	88.0	26,055.9	7.23	12,100.48	1.58	18.30%
70	94.4	29,673.7	7.88	10,693.41	1.45	16.98%
75	101.3	30,869.6	7.88	11,143.50	1.45	16.99%
80	107.7	31,854.6	7.89	11,443.70	1.45	16.97%
85	114.3	33,000.5	7.44	13,248.90	1.54	17.86%

10. DESIGN OF PROJECT COMPONENTS

A concrete gravity weir has been proposed that will retain the river flows and develop a pond upstream to about 700 metres with a maximum of 21 m water depth. The crest level of the overflow spillway has been set at 2161 m asl and that of the non-overflow section at 2168 m asl. The weir has been designed to safely route 1,000 years flood from the undersluices. The overflow spillway alone can route a 50 years flood.

To control floods in the reservoir, overflow spillway with five bays, each 12.0 m long, are provided along with four undersluices (5.0 m x 5.0 m) in the weir body. In addition to flood routing, the undersluices will be used for flushing sediments deposited in the pond and to prevent chocking of the intake area by sediment deposition.

For diversion of flow from the reservoir for power generation, four gated intakes (4.5 m x 5.0 m) are provided. The entire waterway alignment is along the right bank of Gabral River.

Each of the four intake gates are connected to a 202 m long connecting channel (5.2 m x 5.0 m) which conveys the flows into the sandtrap. The sandtrap has two chambers each 14.75 m wide and 165 m long. The sandtrap will trap sediments above the desired size (0.2 mm) and will provide relatively clean water downstream into the conveyance system. The conveyance system downstream comprises a 4.7 km long headrace tunnel (5.8 m modified horseshoe shaped), surge shaft (12.6 m dia), pressure shaft (4 m dia), pressure tunnel (4 m dia), penstock (4 m dia) and manifold with branches (2.3 m and 1.54 m dia). The headrace tunnel is to be fully concrete lined to convey the design discharge of 65 m^3/s with head losses. The pressure shaft and pressure tunnel will be steel lined.

A surface powerhouse has been proposed which will accommodate three generation units comprising vertical Francis turbines, with tail water outflowing into Gabral River.

A conventional two stage cofferdam arrangement is proposed for construction works at the weir site. The river diversion design has considered safely accommodating 10 years return period flood of 781 m^3/s. During the first stage, a channel will be excavated along the left bank of the river and cofferdams placed at the up and downstream reach (of the channel) to isolate the construction area. A temporary bridge will be provided at the downstream end for access to working area for construction work of the intake, undersluices and part of the overflow spillway.

During the second stage, the diversion channel excavated (in the first stage) will be plugged at the up and downstream ends and a continuous cofferdam will be constructed connecting these two ends. The middle length of the cofferdam will be tied into the newly constructed undersluices. The flows can be routed through the undersluices, and the overflow and non-overflow sections of the weir at the left bank can be accessed for construction.

11. STRUCTURAL DESIGN OF PROJECT

Structural design of the weir and appurtenant structures is in accordance with relevant Design Manuals of US Army Corp of Engineers (USACE), American Concrete Institute (ACI), AASHTO LRFD Bridge Design Specification, Building Code of Pakistan SP 2007 and other relevant codes and standards.

The selected weir type is a concrete gravity structure consisting of overflow, non-overflow and undersluices sections. The weir is 29.5m high at non-overflow section and 24.0m high at overflow section The upstream face of the weir is at a slope of 0.8H:1V while downstream face is inclined at 1H:1V slope. The sloping face starts 8.0m below the weir crest. Base width of weir up to toe joint is 45.60m and stilling basin length is 30.0m. Concrete gravity dam has base slab, u/s and d/s faces (walls) in reinforced concrete. Between the u/s and d/s RC sections, lean/plum concrete has been used as infill material for adding weight to the structure. An RC apron slab has been provided on u/s side and made monolithic with the dam base slab. The u/s and d/s reinforced skin wall has been designed in high strength concrete for abrasion and erosion resistance.

Movement/contraction joints have been provided in the overflow spillway, undersluices section, stilling basin and intake structure at feasible locations. Fish ladder has been attached to the stilling basin wall located at the right side of the under-sluices section.

Stability analysis has been carried out for various sections of the dam body. All the sections have been investigated for stability against sliding, overturning, uplift and bearing for usual, unusual and extreme load cases. The loads include self-weight, normal water, silt, flood water, wave and seismic loads. Safety of structure in sliding, overturning, uplift and bearing has been verified against the recommended values provided in USACE EM 1110-2-2100 and EM 1110-2-2200.

Pseudo-static method of analysis is used for structural analysis based on static solution of the system subjected to inertia forces equal to the product of the mass of the system and the acceleration, acting in a selected direction. Earth pressures due to seismic actions are calculated taking into account active earth pressure or earth pressure at rest, as applicable.

In accordance with the "Seismic Hazard Evaluation Report" the weir / dam has been categorized as moderate risk structure with a Safety Evaluation Earthquake (SEE) acceleration of 0.49g corresponding to a return period of 3000 years. For the Operating Basis Earthquake (OBE), an acceleration of 0.21g has been used corresponding to a return period of 145 years for the weir structure. For the design of all other appurtenant structures including tunnel and power house, a SEE acceleration of 0.30g has been used with a return period of 475 years.

Analysis was carried out for various load combinations in accordance with referenced standards in a three-dimensional analysis software SAP2000 - based on finite element method of structural analysis. Boundary spring elements have been adopted for modelling sub soil supporting the structures in accordance with geotechnical recommendations.

The weir structure was sized to be safe against sliding, overturning, uplift and bearing pressure at various loads combinations set out in mentioned standards.

The powerhouse is a reinforced concrete frame structure building comprising of reinforced concrete walls, slabs and columns. It houses three units, equipment galleries, workshop, offices and amenities for the operating personnel. Length of the powerhouse is 44.0m and width is 16.0m internally. The building and associated outlet structures are located in metamorphic rocks having allowable bearing capacity of 45-135 t/m^2 and young's modulus is 3.82 Gpa. Foundation springs have been based on 45 t/m^2.

Sizing of structural members is based on the anticipated loads of electromechanical component and seismic effects of OBE and SEE. A monolithic concrete frame structure has been adopted keeping in view the seismic behaviour and ease of construction. The upstream and downstream RC walls of the powerhouse are 1200mm thick upto loading bay and 600mm thick between loading bay and roof slab. RC columns of 800 x 1600mm at maximum spacing of 8.20m. Corner columns are 1200 x 1600mm and the column under loading bay is 1200 x 2100mm. GIS floor slab is 300mm thick whereas loading bay slab is 600mm thick. Crane runway beam are 1400x 1700mm. Loading bay beams are 1200 x 2500mm and GIS floor beams are 1000 x 1500mm. Parabolic concrete roof has been proposed due to large span and snowbound area. Beams are provided under the transmission tower gantry located at roof slab.

All other structures including intake, power channel, spill channel, sand trap, inlet pond, headrace tunnel lining, surge shaft lining, pressure shaft lining and flood powerhouse flood protection wall are designed for the relevant loads and combinations in accordance with relevant standards and to be safe in usual, unusual and extreme events.

Three (03) span pre-stressed concrete girder bridge was designed for the powerhouse access and is located in front of the powerhouse on Gabral River. The bridge is designed in accordance with AASHTO LRFD Bridge Design Specification. In bridge design, loads due to heavy electromechanical components have also been considered.

12. HYDRO-MECHANICAL EQUIPMENT

Given the head and flow range for the project, the optimum configuration is three generating units 2x37.5 MW and 13 MW vertical shaft Francis Turbines. The rated speed of the 37.5 MW unit will be 375 RPM, whereas for 13 MW unit it will be 600 RPM.

Digital, microprocessor type Proportional Integral Derivative (PID) governors are recommended and each turbine will be provided with such an independent governor. The governor regulator will have an independent hydraulic actuator of sufficient capacity to control the turbine under all operating conditions.

There will be three inlet valves at the manifolds, one for each turbine. The design head will be 153 m which includes transient pressure. The approximate diameter of 37.5 MW will be 2 m and for smaller unit it will be 1.2 m.

An overhead travelling crane has been provided in the powerhouse for installation and dismantling of the electro-mechanical equipment. The capacity of the crane has been sized tentatively at 120 tons, which is 20% higher than the maximum weight of the single heaviest component of the electromechanical equipment i.e. rotor.

Other required major hydro mechanical equipment provided in the powerhouse are:

- Unit Cooling Water System
- Heating, Ventilation and Air Conditioning (HVAC) System
- Firefighting system

Adequate space has been provided for offices, workshop and control room in control building.

13. HYDRAULIC STEEL STRUCTURES

13.1. INTAKE GATE FACILITIES

Intake structure comprises of intake fixed wheel gates, maintenance stoplogs, trashracks, trashrack cleaning machine and gantry crane.

Power intake gate equipment

- Type of gates	Fixed wheel
- No. of gates and maintenance stoplogs	4 Nos & 2 Sets
- Size of service gate fixed wheel (W x H)	4.5 m x 5 m
- Size of maintenance stoplogs (W x H)	4.5 m x 2.6x2 m
- Type of trashrack	Fixed type
- No. of trashrack	4 Sets
- Size of trashrack (W x H)	4.6 m x 6.7 m
- No. of trashrack cleaner	1 Nos
- Type and No of crane	Gantry crane, 1 Nos

13.2. SANDTRAP OUTLET GATE FACILITIES

Two chambers, each with one outlet gates, have been provided. Size of each gate is 5 m wide x 4.5 m high.

Sandtrap outlet gate facilities

- No. of gates	2 Nos
- Gate Type	Fixed wheel
- Size of gate (W x H)	5 m x 4.5 m

13.3. SANDTRAP FLUSHING GATE FACILITIES

Each basin is equipped with two flushing channels provided at the bottom. Two vertical lift gates are provided at the end in each channel for evacuation of sediment deposits at the basin.

Sandtrap flushing gate facilities

- No. of gates	2 Nos
- Gate Type	Fixed wheel
- Size of gate (W x H)	0.9 m x 1 m

13.4. UNDERSLUICE GATE FACILITIES

There are four gates 5 m wide x 5 m high each for low level outlet, provided within the main weir section. Primary function of these outlets is reservoir flushing, however, they can also be used for Mega flood handling purpose.

Undersluice gate equipment

- No. of gates and maintenance stoplogs	4 Nos and 2 Sets
- Gate Type	Slide
- Size of gate (W x H)	5 m x 5 m
- Size of stoplog (W x H)	5 m x 3.1x2 m
- Type and no of crane	Gantry crane, 1 Nos

14. ELECTRICAL COMPONENTS AND TRANSMISSION LINE

Two 37.5 MW and one 13 MW, 0.9 power factor, 50Hz, 11 kV vertical shaft, silent pole synchronous generators along with necessary auxiliary equipment, complete with control, monitoring, switchgear/protection systems have been proposed to produce 88 MW installed capacity.

In order to evacuate the generated power from the project to national grid, three (3-phase) step-up power transformers, two with capacity of 45/55 MVA and one 15/20 MVA are proposed.

A 220 kV high voltage Gas Insulated Switchgears equipment such as SF6 Circuit Breakers, Disconnecting Switches with and without Earthing Switches, Instrument Transformers and Control, Monitor and Protection of indoor equipment are proposed.

One 4/5 MVA, 220/11 kV (3 phase) transformer with required protection and control switchgears is provided to cater for the power supply of the Powerhouse Station Service, Indoor Switchyard, Housing colony and the Weir site. Three 1000 KVA transformers are provided which will provide low voltage power supply to Power Plant and Indoor Switchyard. Four 200 KVA auxiliary transformers are provided to supply low voltage 400 V to housing colony. A 400 KW Emergency Diesel Generator is proposed for priority loads.

The power plant is proposed with a state of the art SCADA (supervisory control and data acquisition) system. This will include programmable logic controllers (PLC's) Digital Governor, Automatic Voltage Regulator (AVR) for the complete control system of Turbine/Generator. There will be a PC monitor and hard disc for data display and data acquisition system with graphic display screens to implement a vast array of control schemes.

The power evacuation from Gabral Kalam HPP is done through 220 kV Double Circuit Transmission Line as Loop-in and Loop-out arrangement to the nearest 220 kV Transmission Line coming from upstream Gorkin Matiltan HPP. The length of transmission line is approximately 2.6 km.

15. TRANSPORTATION AND ROUTE SURVEY

Heavy construction machinery is used in hydro-electric power generation projects. Similarly, heavy turbines, generators and transformers are used to generate and supply hundreds of megawatts of energy to the National Grid. The transportation of heavy construction machinery, electro-mechanical equipment and structural steel components for hydropower projects in northern areas is an uphill task that needs special planning and arrangements.

Objectives of the Route and Transportation study are:

i. Identification of practical and economically viable means and ways of transportation.

ii. Highlighting critical structures/portions of the route to be used for transportation of machinery/equipment to site.

Transportation of heavy equipment from Chakdara to the Project site will be a challenging task due to poor road condition, sharp bends and populated areas. The contractor shall give due attention to this part of the route. Customized trailer will be required for transportation of heavy equipment.

The bridges and culverts on the road on the route are designed for loading capacity of 70 tonnes with axle load of 11.3 tonnes. Due consideration shall be given to the axle load limits in customization of the troller. Tunnels on Swat Expressway may create some clearance issues, which need to be addressed prior to transportation of equipment.

The transportation of heavy and bulky equipment on broad gauge railway from Karachi to Nowshera will not cause any problem, however, clearances of various short tunnels on the railway track shall need to be confirmed prior to load movement.

Bahrain Kalam road is under construction and will be completed this year. With construction of new motorways, Swat Expressway and reconstruction of N-45 up to Khwazakhela and Bahrain Kalam road, transportation by road is not going to offer many problems. However, it is very important to resurvey all the possible routes and means of transportation prior to heavy load movement.

16. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for GKHPP were prepared separately by Independent Consultant as part of the Feasibility Study and Detailed Design considering the World Bank (WB) requirements and guidelines.

ESIA report has been prepared under the Schedule II of "Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000 and WB OP 4.01 (Environmental Assessment) whereas RAP comply with Land Acquisition Act 1894 and World Bank OP 4.12 on Involuntary Resettlement. Other relevant WB policies applicable to the project include: Natural Habitats (OP 4.04), Physical Cultural Resources (OP 4.11), Involuntary Resettlement (OP/BP 4.12), Forests (OP/BP 4.36), Safety of Dams (OP/BP 4.37) and Projects on International Waterways (OP/BP 7.50).

The project area of influence comprises of about 11 km long valley of the Gabral River and its mountain slopes, from Kanai village (one km upstream of the weir site to cover the reservoir area) to Kalam town (10 km downstream), where after it joins the Ushu River to form the Swat River.

Detailed environmental, ecological and socio-economic surveys were carried out in the project area through a review of secondary literature, field investigations for primary data collection, sampling and analysis of water, air and noise quality, questionnaire surveys, and community and stakeholder consultations.

Baseline and historical data shows that the winters in the project area are freezing with minimum temperatures ranging from -0.4 ^{o}C to -8.4 ^{o}C from November to March. The temperatures in spring (April and May) and in autumn (September and October) are usually warm in the day time (17 ^{o}C to 20 ^{o}C) and cold on the night time (3 ^{o}C to 10 ^{o}C). The average annual precipitation is about 1076 mm, with nearly 58 percent of precipitation falls as snowfall during winter.

Water quality of the Gabral River, Bhan Khwar River, and spring at Kanai village was tested during January 2019, and the results suggest that water quality is generally good, with total dissolved solids ranging from 58 mg/l to 67 mg/l.

Air and noise quality was measured at three villages in the project area during August 2019. The ambient air and noise quality in the project area are generally good and well below the national environmental quality standards as the area has less exposure to vehicular traffic and industrial pollution. The particulate matter concentrations (PM_{10}) in the Kalam area varies from 30 µg/m^3 to 35 µg/m^3 (the national standard is 150 µg/m^3). The average daytime noise levels in the Kalam area varies from 40 dBA to 50 dBA (the national standard is 65 dBA).

The important biodiversity areas near the project impact corridor are Bhan Khwar Valley Community Game Reserve, which is located on the Bhan Khwar catchment area

(250 km^2), a tributary of the Gabral River. The alpine and subalpine habitats of the Bhan Khwar catchment area provide a rich habitat of 21 mammals, including threatened species of snow leopard and black bear.

Two fish species are recorded from the project area, an indigenous snow carp (Schizothorax plagiostomus) and exotic brown trout. None of these species are listed in IUCN Red List. During spring, when flows start increasing in the rivers due to the melting of snow, the fish migrate upstream in April and May (within tributaries) due to high flows and turbidity at lower elevations. During autumn, when the temperatures start to drop at higher elevations, the fish migrate downstream in September and October.

A socio-economic survey of 169 randomly selected households was carried out in the project area. The total population of the surveyed households is 1365, in which 717 are male and 648 female.

There are six primary schools, one middle school for boys (in Ashuran village) and two higher secondary school (one each for boys and girls in Kalam). The level of illiteracy was to the extent of 42.5% for male and 84.8% for female.

The major source of livelihood for the project population is agriculture. They are: agriculture (31.5%), daily wage labour (12.5%), business (1.5%), service with both the government and private sector (3.6%), working abroad (3.5%), while the remaining 47.4% are the unemployed and students. Men in the project area are also engaged in seasonal employment in hotels at Kalam during summer.

The average annual household income was computed to be Rs. 68,998 per month. A major proportion (45.5%) of the surveyed households fall in the income category of Rs. 20,000 to Rs. 50,000, while 14.4% and 40.1% come under the income bracket of less than Rs. 20,000 and above Rs. 50,000 per month, respectively. The average per capita income was computed to be Rs. 98,333 per annum and Rs. 8,194 per month. In accordance with the poverty line (Rs. 25,475 / month per household), the level of poverty of the sample households is 14.4 %.

There is only one Basic Health Unit (BHU) in Kalam, which has five medical doctors, three nurses and lady health workers, and ten medical technicians. The nearest Rural Health Centre / hospital, which has beds and in-patient treatment facilities, is located in Mingora, about 80 km from Kalam.

Consultation being compulsory part of the study, a total of 58 consultation meetings with 439 participants (373 male and 66 female) were conducted. These include 48 local village meetings, one provincial-level workshop at Peshawar on October 21, 2019, one disclosure workshop at Kalam on November 7, 2019 to share the draft ESIA and RAP, in which the local communities, including affected communities, district level government agencies (including representatives of forest and wildlife departments, union councillors, and district administration).

Following are some of the project negative impacts.

- Permanent land acquisition of 157.44 acres (1259 kanals) owned by 89 households
- Loss of 684 trees including 48 owned by community and 636 by Forest Department.
- Inundation of 500 m existing road on the left bank and submergence of a footbridge and PVC water pipes.
- Impact on 11 acres of land due to construction for 2.6 km long transmission line (12 towers).
- Loss of livelihood due to the acquisition of 26 acres of agricultural land from 44 households.
- Depletion of water in Gabral River stretch between weir and powerhouse tailrace.
- Physical displacement of 8 households.
- There are 50 severely affected households as they will lose more than 10% or more of their land/productive resources and 49 are the vulnerable households.

Cash compensation will be made to the owners of the affected land and flora. Similarly, temporary land will be leased from the locals through cash compensation under lease agreements.

Also, 2.0 to 3.5 cumec water will be released in Gabral River to minimize the water depletion impact in the stretch between weir and tailrace.

In addition to the above, detail mitigation measures have been proposed in the project ESMP which shall be implemented during the project execution.

The overall positive impact of the project include generation of 339.2 GWh renewable electricity with minimal carbon emission. Also, hiring of the local community during construction works (about 300 workers on average regularly and 500 during peak construction daily for five years) will be another beneficial impact of the project.

The total cost of the ESMP implementation is estimated to be USD 3.94 million whereas the overall budget for the implementation of RAP is estimated USD 25.173 million.

17. COST ESTIMATE

Cost estimates comprise quantification of major items in the project components, unit cost determination, estimation of civil, electrical, mechanical and other components' costs and the associated cost including services, duties and taxes, interest during construction, environmental and social cost and unforeseen items.

There are several methods and guidelines for the determination of unit cost of hydropower projects depending on the nature and complexity as well the funding sources. However, it is not possible to use a single source due to the different nature of the items in hydropower projects. The unit rate should be realistic and according to the complexity of project and area. Therefore, combination of KP Market Rate System (MRS 2019), rates of hydropower projects under construction in Pakistan as well as budgetary estimates by manufacturers and standard guidelines have been used. The itemized cost estimate of the different components of the project is summarized in the table below.

Table 10: Summary of Project Cost Estimate

S. No.	Description	Amount			
		Local Component (Rs)	Foreign Component (USD)	Total (Rs)	Total (USD)
A. PRELIMINARY AND GENERAL					
1	PRELIMINARY AND GENERAL	571,285,419	238,905	608,793,577.67	3,877,666.10
Sub-total A		**571,285,419**	**238,905**	**608,793,578**	**3,877,666**
B. CIVIL WORKS					
1	RIVER DIVERSION DURING CONSTRUCTION				
1.1	First Stage Diversion	297,008,921	-	297,008,921	1,891,777
1.2	Second Stage Diversion	230,287,611	-	230,287,611	1,466,800
2	WEIR AND APPURTENANT STRUCTURES				
2.1	Foundation Treatment	863,853,910	-	863,853,910	5,502,254
2.2	Intake Structure	598,826,338	-	598,826,338	3,814,180
2.3	Undersluices Section and Fish Ladder	1,658,432,214	289,114	1,703,823,151	10,852,377
2.4	Spillway and Non Overflow Section	1,865,709,305	-	1,865,709,305	11,883,499
2.5	Protection Works	334,303,414	-	334,303,414	2,129,321
3	CONNECTING AND SPILL CHANNELS	411,917,822	-	411,917,822	2,623,680
4	SANDTRAP	3,099,394,106	-	3,099,394,106	19,741,364
5	INLET POND	294,835,910	-	294,835,910	1,877,936

S. No.	Description	Amount			
		Local Component (Rs)	Foreign Component (USD)	Total (Rs)	Total (USD)
6	HEADRACE TUNNEL	4,271,339,885	1,889,093	4,567,927,531	29,095,080
7	ACCESS TUNNELS	61,269,199	48,223	68,840,272	438,473
8	SURGE SHAFT	248,492,804	101,814	264,477,603	1,684,571
9	PRESSURE SHAFT	71,086,100	1,032,855	233,244,280	1,485,632
10	PRESSURE TUNNEL	48,600,745	887,294	187,905,945	1,196,853
11	PENSTOCK AND MANIFOLD	77,967,637	1,105,234	251,489,401	1,601,843
12	POWERHOUSE, SWITCHYARD AND ASSOCIATED WORKS	828,292,217	-	828,292,217	5,275,747
13	TAILRACE AND PROTECTION WALL	351,843,218	-	351,843,218	2,241,040
14	PERMANENT AND TEMPORARY BRIDGES	324,495,021	-	324,495,021	2,066,847
15	ROADS	985,680,128	-	985,680,128	6,278,217
16	EMPLOYER'S FACILITIES	438,702,559	-	438,702,559	2,794,284
17	AUXILIARY ITEMS	224,606,356	-	224,606,356	1,430,614
Sub-total B		**17,586,945,421**	**5,353,628**	**18,427,465,019**	**117,372,389**
C. ELECTRO-MECHANICAL WORKS					
1	HYDRO-MECHANICAL EQUIPMENT	-	12,316,119	1,933,630,714	12,316,119
2	HYDRAULIC STEEL STRUCTURES	99,349,683	630,435	198,327,975	1,263,236

S. No.	Description	Amount			
		Local Component (Rs)	Foreign Component (USD)	Total (Rs)	Total (USD)
3	ELECTRICAL EQUIPMENT	-	21,730,251	3,411,649,470	21,730,251
4	TRANSMISSION LINE AND INTERCONNECTION	15,181,416	905,582	157,357,832	1,002,279
Sub-total C		**114,531,100**	**35,582,388**	**5,700,965,992**	**36,311,885**
PROJECT CONSTRUCTION COST		**18,272,761,940**	**41,174,921**	**24,737,224,589**	**157,561,940**
D	CONSTRUCTION DESIGN, CONTRACT MANAGEMENT AND CONSTRUCTION SUPERVISION @ 5% OF CONSTRUCTION COST	913,638,096.98	2,058,746.07	1,236,861,229	7,878,097
E	CLIENT / PROJECT MANAGEMENT ORGANIZATION (PMO)	617,469,032.76	-	617,469,033	3,932,924
F	PEDO HEAD OFFICE CHARGES @ 1 % OF CONSTRUCTION COST	182,727,619.40	411,749.21	247,372,246	1,575,619
G	LAND ACQUISITION, RESETTLEMENT AND ENVIRONMENTAL MITIGATION	4,208,751,000	-	4,208,751,000.00	26,807,331
H	CONTINGENCIES @ 2% OF CONSTRUCTION COST	365,455,238.79	823,498.43	494,744,492	3,151,239
PROJECT BASE COST		**24,560,802,928**	**44,468,915**	**31,542,422,589**	**200,907,150**
I	DUTIES AND TAXES @ 5% OF FOREIGN COMPONENTS	349,080,983	-	349,080,983	2,223,446
J	PROVISIONAL SUM (Including price adjustment, variations, security, inauguration and other functions)	3,437,301,869.82	3,417,248.74	3,973,809,922	25,310,891
K	INTEREST DURING CONSTRUCTION (IDC)	2,577,425,204	4,397,806	3,267,880,771	20,814,527
TOTAL PROJECT COST		**30,924,610,985**	**52,283,970**	**39,133,194,264**	**249,256,014**

18. CONSTRUCTION PLANNING AND SCHEDULING

The construction schedule takes into account the sequence of activities required on the basis of local climate, culture, site access, topography and remoteness as well as the design complexity of the project. Significant concrete works will be required at the weir site to construct the diversion weir and the sandtrap. Such concrete work cannot be started during the winter months, especially at night when the ambient temperature reaches sub-zero levels. Similar is the case for coffer dams which need to be constructed in low flow season. On the other hand, it should be possible to continue with the excavation works inside the tunnel throughout the year.

In order to complete the project on time, it is important to prepare a realistic construction schedule and also monitor the progress of work carefully during the construction period. Identification of quarries for construction materials (aggregates), supply route of cement, reinforcements, diesels and other consumables (explosives), work force required, construction camps and facilities need to be arranged before starting the construction work.

After completion of the detailed design, tendering process and award of the Contract, the Contractor has to submit a performance guarantee to execute the construction work. Once the Client issue site access clearance letter, the Contractor will mobilize the team, equipment and construction materials at site. Contractor’s mobilization is scheduled within one month of the contract signing date.

The schedule of completion for the major works of temporary camps, access road, water supply, electricity and sanitation system are estimated separately in construction schedule. Similarly, construction of the residential colony and other necessary infrastructures will be continued as required and planned and provisioned in construction schedule.

Exploration of quarry sites, construction material availability at site, cement, steel bars, and stores for adequate stock will be planned and set up accordingly. Similarly, the schedule and plan for the required construction materials, human resources and equipment will be prepared and implemented, and monitored regularly for adequate human resources and construction materials’ stock at site for completion of the project within the stipulated schedule.

A laboratory will be set up at site for testing different construction materials and concrete. The contractor should submit such plan and trial mix reports to the Client / Engineer for the approval, regularly.

The main important and essential aspect in the project construction is efficient and smart project management at site with regular meetings, coordination and monitoring of the schedules with proper interface coordination within the different contractors and suppliers. Interface coordination planning has been worked out and addressed in planning and construction schedule preparation for the project. However, such interface coordination should be readjusted and monitored closely during construction.

The main civil construction work will start by the contractor after planning and proper setting of all the required facilities as described above.

The construction of the project work should start at several locations simultaneously. The work at weir, Inlet portal, Access Tunnel, Surge Tank, Pressure Tunnel and Powerhouse area can be carried out concurrently. The tunnel, weir and powerhouse are the major construction works and any of these components can be in the critical path during construction of the work. Turbines and generators also need to be timely supplied so that manufacturing of the equipment should take place on time. Total project construction duration is estimated to be 6 years comprising 1 year for preconstruction activities like tendering, award of contract, construction design etc., 4 years period for construction activities including mobilisation, and 1 year for defect liability period.

19. FINANCIAL AND ECONOMIC ANALYSIS

Evaluation of any large infrastructure project must be undertaken to determine its economic feasibility and financial viability before its implementation. The economic analysis is undertaken from the view point of economy as a whole from the country's perspective. Economic justification of investment in capital intensive projects depends on three factors; first whether there is a need for the project; second, where technological options are available whether the project presents the most economic choice; and third, does the investment produce an acceptable return to the national economy. This process involves assessment of the benefits and identification of project costs over the economic life of the project. The project costs comprises all costs incurred during implementation and, subsequently, operation of the project.

The estimated annual cost disbursal along with local and foreign cost components and other key parameters are shown in the following table.

Table 11: Estimate of Annual Cost Disbursal

Year	Local cost (Million Rs)	Foreign cost (Million Rs)	Total (Million Rs)	Total (Million US$)
1 – Pre-construction	4,729.5	143.7	4,873.2	31.04
2 – Construction	7,633.7	791.3	8,424.9	53.66
3 – Construction	6,261.0	361.2	6,622.2	42.18
4 – Construction	6,080.7	3,400.0	9,480.6	60.39
5 – Construction	2,984.7	2,533.5	5,518.3	35.15
6 – Defect Liability Period	3,235.1	978.8	4,213.9	26.84

Economic and financial analysis have been undertaken using the costs shown in the above table. The following assumptions have been made:

- Price Datum: June 2019
- Custom Duty: 5%
- Opportunity cost of capital: 12%
- Operation and maintenance cost: 1.5% of base cost per annum
- Interest rate: 6.62%
- Benefits are calculated based on:

Displacement of equivalent furnace oil plant at US$1982/kW together with fuel cost of PKR 8.15 per kWh.

Displacement of equivalent combined cycle gas turbine plant at US$1200/kW together with fuel cost of PKR 8.15 per kWh.

Based on the above assumptions, the results of the economic analysis are presented in the following table.

Table 12: Summary of Economic Analysis

Economic Indicators	CCG Turbine		Furnace Oil Plant	
	With CDM	Without CDM	With CDM	Without CDM
Present worth of benefits (Rs. million)	27,257.29	25,530.67	36,177.21	33,683.20
Present worth of costs (Rs. million)	21,145.05	21,145.05	21,145.05	21,145.05
Net Present Worth (Rs. million)	6,112.24	4,385.62	15,032.16	12,538.15
Benefit Cost Ratio (BCR)	1.29	1.21	1.71	1.59
EIRR %	17.75%	16.20%	31.72%	29.51%

The results of economic analysis above clearly demonstrate that the project is technically sound and economically viable. Compared to equivalent thermal combined cycle gas turbine, the project yields larger benefits.

Financial analysis of the project has been carried out. For the estimation of the benefits, the published average sale prices of PKR. 13.0 / kWh has been projected at 5% annually to the commissioning year which results in PKR 19.2/kWh. Summarized results of the financial analysis are shown the table below.

Table 13: Summary of Financial Analysis

Financial Analysis	
PW of benefits @ 12%; (Rs. million)	54,101.39
PW of costs @ 12%; (Rs. million)	29,341.80
Net Present Worth; (Rs. million)	24,759.59
Benefit Cost Ratio	1.84
FIRR	12.51%

The result of the financial analysis show FIRR higher than 6.62% (interest rate & 100% loan financing) which reveals that the revenue from the project will be able to serve the debts incurred in all cases.

20. CONCLUSION AND RECOMMENDATIONS

The Feasibility Study clearly demonstrate that GKHPP (88 MW) is technically feasible, financially viable and environmentally acceptable. Furthermore, the project will have positive impact on the national economy because it will significantly displace high cost thermal plants and to some extent curb the load shedding situation that the country currently faces. Therefore, the project implementation is justified if funds can be made available. As the project cost estimates along with the financial and economic analysis are based on 100% loan financing, any equity injection in the project will improve the financial and economic parameters.

The project is recommended for implementation with the following suggestions:

i. Long term discharge and sediment data from Kalam town has been used along with the measured data upstream of the weir site. It is recommended to continue with real time measurements of discharge and sediments at the proposed weir site till next stage of the project development as it will provide additional reliable data.

ii. A physical model study should be undertaken to verify the efficiency of undersluices proposed in the weir to flush sediments deposited in the reservoir.

iii. The implementation schedule provided in the study is based on “Item Rates / Unit Pricing Contract” rather than “Engineering Procurement and Construction (EPC) Contract”. Should there be any changes in the implementation mode of the project; the schedule may need adjustments.

iv. The cost estimates undertaken are based on price level of 2019 along with the current exchange rate of 1 USD = 157 PKR. Should the exchange rate change significantly and/or if there are long delays in project implementation, the cost estimates along with economic and financial analysis need to be revisited.

v. The tunnel and other underground structures are based on the limits of geotechnical and geophysical investigations including seismic surveys, test pits and exploratory boreholes as per the consultants TOR. Further geotechnical and geophysical investigations (especially additional boreholes) should be carried out at the weir site, tunnel alignment and the powerhouse site prior to start of the construction activities.

21. SALIENT FEATURES OF THE PROJECT

Salient features of the selected schemes are provided in the table below. The detail of each item has been presented in the respective section of the report.

MAIN FEATURES OF THE PROJECT

S. No	DESCRIPTION	VALUE	
1	**LOCATION**		
	Country	Islamic Republic of Pakistan	
	Province	Khyber Pakhtunkhwa	
	District	Swat	
	Project Site	About 09 km North East of Kalam	
2	**ORGANIZATIONS**		
	Client	Pakhtunkhwa Energy Development Organization (PEDO) Power and Energy Department, Government of Khyber Pakhtunkhwa	
	Consultants	A Consortium of: • AGES Consultants Peshawar, Pakistan - Lead Firm. • Hydro Consult Engineering (Nepal) • DOLSAR Engineering Inc. Co. Turkey. • Fida Hussain Chaudhry (FHC), Consulting Engineers Pakistan. • Technical Engineering and Management Consultants (TEAM), Pvt. Ltd. • Multitech Consulting Engineers (MCE), Pakistan	
3	**HYDROLOGY**		
	Catchment Area at Weir Site	957	Sq.km
	Catchment Area at Powerhouse Site	1212	Sq.km
	Design Flood ($Q_{1,000}$)	1793	m^3/sec
	Maximum Flood ($Q_{10,000}$)	2273	m^3/sec
4	**RESERVOIR**		

S. No	DESCRIPTION	VALUE	
	Normal Conservation Level	2161.0	m asl
	Flood Surcharge Level	2165.3	m asl
	Minimum Operating Level	2160.5	m asl
	Depth of Reservoir at Weir Site	21	m
	Length of Reservoir	875	m
	Reservoir Capacity at NCL	1.08	MCM
5	**WEIR**		
	Weir Type	Concrete Gravity	
	Weir Top Elevation	2168	m asl
	Freeboard above Maximum Surcharge	1.45	m
	Slope: Upstream Face	1 in 0.75 m	
	Slope: Downstream Face	1 in 1 m	
	Height of Weir above River Bed	28.0	m
	Maximum Height above Foundation	33.5	m
	Crest Length	149.5	m
	Crest Width	7.0	m
6	**OVERFLOW SPILLWAY**		
	Type	Overflow Ogee	
	Crest Level	2161.0	m asl
	Length of Crest	67.5	m
	No. of Bays	5.0	m
	Normal Design Flood (Q_{50})	1139	m^3/sec
	Safety Design Flood (Q_{100})	1291	m^3/sec
	Energy Dissipater	Hydraulic Jump, Stilling Basin	
	Size of Stilling Basin (Combined)	105 m x 30 m	
	Stilling Basin Level	2137.0	m asl
7	**UNDER SLUICES**		
	Type	Orifice type with Ogee Crest	
	Crest Level	2142.5	m asl
	Head on Crest at NCL	18.5	m
	No. and Type of Gates	4.0 No’s	vertical lift
	Gate Size	5 x 5	m
	Total Length of Waterway	26.0	m
	Maximum Capacity at NCL	1293	m^3/sec
	Crest Height above Foundation Level	6.5	m

S. No	DESCRIPTION	VALUE	
	Energy Dissipater	Hydraulic Jump, Stilling Basin	
	Size of Stilling Basin (Combined)	105 m x 30 m	
8	**POWER INTAKE**		
	Type	Horizontal Intake	
	Invert Level of Power Intake	2155.0	m asl
	Working Head on Intake Crest	6.0	m
	No. and Type of Gates	4.0 No's	Vertical Lift
	Size of Gates	5 x 4.5m (H x W)	
	Total Width of Intake Structure	22.5	m
	Width of Waterway	18.0	m
	Design Discharge	65.0	m^3/sec
	Discharge Capacity (Including Sediment Flushing Requirements)	78.0	m^3/sec
	Intake Crest Height above River Bed Level	15.0	m
9	**FISH LADDER / FISH PASS**		
	Type	Pool Pass Type	
	Design Discharge	0.26	m^3/sec
	No of Pools	109	No's
	Size of Pool	2.0m x 1.6m, (L x W)	
	Size of Orifice	0.35m x 0.35m	
	Minimum Water Depth	0.75	m
	Total Length of Fish Ladder	218.0	m
	Start Invert Level	2161.0	m asl
	End Invert Level	2139.0	m asl
10	**RIVER DIVERSION DURING CONSTRUCTION**		
	Coffer Dam		
	Type	Homogeneous Fill	
	Crest Elevation of u/s Coffer Dam	2155.0	
	Diversion Flood (Q_{10})	781	m^3/sec
	Embankments Upstream Slope	1 in 1.5	
	Embankments Downstream Slope	1 in 1.5	
	Diversion Channel	Concrete lined	
	Type	Trapezoidal	
	Lining Thickness	75+150	mm
	Size of Diversion Channel (W x D)	16.0m wide & 7.5m deep	

S. No	DESCRIPTION	VALUE	
	Length of Diversion Channel	620	m
	Depth of Flow in Diversion Channel at Design Flood 10 years	6.2	m
	Freeboard	1.3	m
	Maximum Flow Velocity	5.1 m/sec	
11	**CONNECTING CONDUIT / CONNECTING CHANNEL**		
	Type	Rectangular Box	
	Number of Conduits	2.0	No's
	Design Discharge	39.0 x 2	m^3/sec
	Size	5.2m x 5.0m, (W x D)	
	Average Length of Conduit	202.75	m
	Average Flow Velocity	1.60	m/sec
	Bed Level at Start	2155.5	m asl
	Bed Level at End	2155.44	m asl
12	**SANDTRAP**		
	Type	Gravity Type	
	Particle Size to be Removed	0.2	mm
	Average Velocity in Chambers	0.181	m/sec
	Length of Chamber	165	m
	Length of Upstream Transition	20.0	m
	Size of Sandtrap Chamber	14.75 x 13.5m	
	Invert Level of Sandtrap at Start	2155.44	m asl
	Roof Top Level of Sandtrap	2162.50	m asl
	Outflow Crest Elevation from Sandtrap	2156.5	m asl
	Nos. and Type of Outflow Control Gates	2.0 No's	Vertical Lift
	Outflow Control Gates Size	4.5m x 5.0m, (H x W)	
	Flushing Arrangement per Chamber	Gated Control Orifice Type	
	Flushing Discharge	13.0	m^3/sec
	Trap Efficiency	79.0	Percent
13	**INLET POND**		
	Type	Concrete Lined Rectangular Section	
	Invert Elevation at Start	2147.0	m asl
	Size of Inlet Pond	35.0m x 27.5m	
	Depth of Flow	14.0	m
	Submergence to Headrace Tunnel	10.4	m

S. No	DESCRIPTION	VALUE	
	Elevation of Inlet Pond Top	2162.5	m asl
	Velocity at Design Discharge	0.5	m/sec
14	**HEADRACE TUNNEL**		
	Type	Low Pressure Tunnel	
	Shape	Modified Horse Shoe	
	Invert Elevation of Tunnel	2147.5	m asl
	Flow Area	27.36	m^2
	Average Flow Velocity	2.38	m
	Diameter of Tunnel	5.8	m
	Length of Tunnel upto Surge Shaft	4710	m
	Invert Level of Tunnel at Surge Shaft	2123.35	m asl
	Head Loss in Tunnel	3.67	m
15	**SURGE SHAFT**		
	Type	Simple Restricted Orifice	
	Geometry	Circular	
	Maximum Surge Level	2184.9	m asl
	Minimum Surge Level	2137.86	m asl
	Diameter of Surge Shaft	12.6	m
	Diameter of the Throat	4.0	m
	Full Operational Water Level	2156.83	m asl
	Top Level of Surge Shaft	2193.0	m asl
	Height of Surge Shaft	60	m
16	**PRESSURE SHAFT / PRESSURE TUNNEL**		
	Type	Pressurized Tunnel	
	Geometry	Circular Section	
	Pressure Shaft Centreline at Start	2126.25	m asl
	Diameter of Pressure Shaft and Tunnel	4.0	m
	Flow Area	12.56	m^2
	Length of Pressure Shaft	145.0	m
	Length of Pressure Tunnel	130.0	m
	Average Flow Velocity	5.17	m/sec
	Steel Lining Thickness	23	mm
	Invert Level of Pressure Tunnel End	1990.1	m asl
	Head Losses in Pressure Shaft / Tunnel	1.45	m

S. No	DESCRIPTION	VALUE	
17	**PENSTOCK**		
	Invert Level of Penstock	1990.1	m asl
	Length of Penstock	65.0	m
	Diameter of Penstock	4	m
	Thickness of Steel Lining	30.0	mm
	Velocity in Penstock at Design Discharge	5.17	m/sec
	Net Head at Penstock	159.61	m
	Head Losses in Penstock	1.98	m
	Invert Level of Penstock at Powerhouse	1991.23	m asl
18	**MANIFOLD**		
	Type	Symmetrical Wye	
	Number of Branches	03 (three)	
	Diameter of Large Branch Pipes	2.3	m
	Diameter of Small Branch Pipe	1.54	m
	Velocity in Manifold at Design Discharge	5.21	m/sec
	Thickness of Steel Lining	30	mm
19	**POWERHOUSE AND ACCESSORIES**		
	Type	Surface	
	Size of Powerhouse	44 m x 16 m	
	Turbine	Vertical Francis	
	Generation Units	03	No’s
	Unit Discharge	2x 27.7 & 1 x 9.6	m^3/sec
	Generator Type	Vertical Synchronous Type	
	Power Transformers	Step up-11 kV- 220 kV 3 Phase	
20	**TAILRACE**		
	Type	Concrete Lined	
	Length of Tailrace	15.48m	
23	**SWITCHYARD**		
	Size of Switchyard	44m x 16m (inside)	
	Switchgear	Gas Insulated System (GIS) 220 kV-3 Phase	
24	**TRANSMISSION LINE**		
	Transmission Line Length	2.6 km	
	Type	Loop in loop out (Double circuit twin bundle)	

S. No	DESCRIPTION	VALUE	
25	**HEAD AND DISCHARGE**		
	Gross Head	161.0	m
	Rated Net Head	153.0	m
	Head Loss at Design Discharge	8.0	m
	Design Discharge of Plant	65.0	m^3/sec
26	**CAPACITY AND OUTPUT**		
	Plant Capacity	88 MW	
	Capacity per Unit	2 x 37.5 MW & 1 x 13.0 MW	
	Plant Factor	44.7	
	Average Annual Energy	339 GWh	
27	**PROJECT COST**		
	Project Construction Cost	24,737	M PKR
	Project Base Cost	31,542	M PKR
	Project Total Cost	39,133	M PKR
28	**ECONOMIC AND FINANCIAL INDICATORS**		
	Economic Parameters – CCGT		
	Net Present Value (NPV)	4,386	M PKR
	B/C Ratio	1.21	
	EIRR	16.2	%
	Financial Parameters		
	Net Present Value (NPV)	24,760	M PKR
	B/C Ratio	1.84	
	FIRR	12.51	%
29	**IMPLEMENTATION**		
	Pre-Construction	One Year	December 2020
	Construction Period	Four (4) Years	December 2024
	Defects Liability Period	One Year	December 2025
	Total Implementation Time	Six (6) Years	

Government of the Khyber Pakhtunkhwa, Pakistan

Khyber Pakhtunkhwa Hydropower and Renewable Energy Development Program

Gabral Kalam Hydropower Project

Environmental and Social Impact Assessment

Pakhtunkhwa Energy Development Organization (PEDO)

December 2019

The photograph on the cover page shows the proposed weir location and its upstream

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List of Acronyms

AD	Assistant Director
AIDS	Acquired Immunodeficiency Syndrome
AOI	Area of Influence
AP	Affected Person
BHU	Basic Health Unit
BOQs	Bills of Quantities
BP	Bank Policy
CASA	Central Asia-South Asia
CCGT	Combined Cycle Gas Turbines
CEDAW	Convention on The Elimination Of All Forms Of Discrimination Against Women
CEO	Chief Executive Officer
C-ESMP	Contractor's Environment and Social Management Plan
CIA	Cumulative Impact Assessment
COC	Code of Conduct
CSC	Construction Supervision Consultant
CV	Curriculum Vita
dBA	Decibel
DD	Deputy Director
EA	Environmental Assessment
ECPs	Environmental Codes of Practices
EHSGs	Environmental Health & Safety Guidelines
EMF	Electric and Magnetic Field
EN	Endangered
EPA	Environmental Protection Agency
EQS	Environmental Quality Standard
ESHS	Environmental, Social, And Health & Safety
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESU	Environmental and Social Unit
EU-CSC	Environmental Unit -Construction Supervision Consultant
FI	Financial Intermediary
FM	Frequency Modulation
LAA	Land Acquisition Act
LS	Lump-Sum
m	Meter
m/s	Meter Per Second
m^3/s	Meter Cube Per Second
masl	Meters Above Sea Level
MCM	Million Cubic Meter
MDF	Maximum Design Flood
mg/L	Milligram Per Liter
MSC	Management Support Consultants
MSDS	Material Safety Data Sheets
MSIP	Management Strategies and Implementation Plans
MW	Mega Watt
MWh	Megawatt Hour
NCL	Normal Conservation Level
NE	North East
NEQS	National Environmental Quality Standard
NGOs	Nongovernmental Organizations
NIC	National Identity Card
NOC	No Objection Certificate
NTDC	National Transmission & Dispatch Company
NTFPs	Non-Timber Forest Products
NW	North West
NWFP	North-West Frontier Province
O&M	Operation and Maintenance
O_2	Oxygen
OBE	Operating Basis Earthquake
^oC	Degree Celsius
OHC	Occupational Health Center
OHS	Occupational Health and Safety
OP	Operational Policy
PD	Project Director
PEDO	Pakhtunkhwa Energy Development Organization

FS	Feasibility Stage
g	Gram
GAP	Gender Action Plan
GBV	Gender Biased Violence
GCISC	Global Change Impact Studies Centre
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GKH	Gabral Kalam Hydropower Project
GoKP	Government of Khyber Pakhtunkhwa
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GTZ	Gesellschaft Für Technische Zusammenarbeit
Gwh	Gigawatt Hour
ha	Hectare
HHs	Households
HIV	Human Immunodeficiency Virus
HPP	Hydropower Project
IBAT	Integrated Biodiversity Assessment Tool
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labor Organization
IPCC	International Panel On Climate Change
IUCN	International Union For Conservation Of Nature
km	Kilometer
km^2	Kilometer Square
KP	Khyber Pakhtunkhwa
KPHREDP	Pakhtunkhwa Hydropower And Renewable Energy Development Program’
KV	Kilovolt
kV/m	Kilovolt Per Meter
LAC	Land Acquisition Collector
LPG	Liquified Petroleum Ga
PEPA	Pakistan Environmental Protection Agency
PGA	Peak Ground Acceleration
PIC	Project Implementation Consultant
PM	Particulate Matter
PMC	Project Management
PMO	Project Management Office
PPEs	Personal Protective Equipment
PV	Photovoltaic
PVC	Polyvinyl Chloride
RAP	Resettlement Action Plan
RHC	Rural Health Centre
RPF	Resettlement Policy Framework
SDP	Social Development Plan
SEA	Sexual Exploitation and Abuse
SEE	Safety Evaluation Earthquake
STD	Sexually Transmitted Diseases
STI	Sexually Transmitted Infections
TB	Tuberculosis
TL	Transmission Line
TOR	Term Of Refence
TPMA	Third-Party Monitoring Agency
UN	Union Council
UN	United Nations
US	United State
USD	United State Dollar
VECs	Valued Environmental Components
VU	Vulnerable
WAPDA	Water And Power Development Authority
WBG	World Bank Group
WHO	World Health Organization
$\mu g/m^3$	Microgram Per Meter Cube
µT	Microtesla

EXECUTIVE SUMMARY

The Government of Khyber Pakhtunkhwa (GoKP) through the Pakhtunkhwa Energy Development Organization (PEDO) is planning to implement the **Gabral Kalam Hydropower Project** (the Project or GKH), with financial assistance from the World Bank, under the 'Pakhtunkhwa Hydropower and Renewable Energy Development Program' (the Program). The Project will develop an 88 megawatt (MW) run-of-river hydropower project on the River Gabral (a tributary of the Swat River) to generate about 339-gigawatt hours (GWh) of electricity annually. The Project is located near the Kalam town in the Swat district of Khyber Pakhtunkhwa (KP) province. To address the environmental and social impacts of the Project, PEDO has prepared this Environmental and Social Impact Assessment (ESIA) in compliance with the national/provincial regulatory requirements and the World Bank's safeguard policies. A Resettlement Action Plan (RAP) for the Project has also been prepared and presented under a separate cover.

Project Description

The proposed project facilities include:

- 21 m high (above the riverbed) and 100 m wide weir with spillways, under sluices, fish ladder, outlet structures, and sand trap
- 4.7 km long underground tunnel from the weir site to the powerhouse
- Powerhouse (with two units of 37.5 MW and one unit of 13 MW) and a switchyard
- 2.7 km long 220 kV transmission line
- 6.6 km long roads, which includes the relocation of the existing road near the weir site and access road to the powerhouse site
- Project colony with a necessary water supply and sanitation facilities for 50 operations and maintenance (O&M) staff, including a primary school, a dispensary, and shops

In addition, the Project will develop the following temporary facilities:

- River diversion by building two cofferdams on both upstream and downstream of the weir site, and an open channel for diversion of water above the upstream cofferdam to below the downstream cofferdam
- Spoil (muck disposal sites) for storage of 0.8 to 1 million cubic meters of excess excavated material
- Quarrying and crushing activities to produce about 0.59 million cubic meters of aggregates
- A construction camp for about 200 workers along with water supply and sanitation facilities

Policy and Regulatory Framework

The Khyber Pakhtunkhwa (KP) Environmental Protection Act of 2014 is the primary legislative framework related to environmental protection in the Province. In accordance with this Act, the development of hydropower infrastructure will need to be approved by the KP Environmental Protection Agency (KP EPA) following the procedures given in the Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2010. These regulations classify the projects into two categories (Schedule I and Schedule II) for environmental clearances. The development of hydropower projects of more than 50 MW capacity will fall under Schedule II (which requires EIA), and less than 50 MW capacity will fall under Schedule I (which requires IEE). The Project falls under Schedule II, and this ESIA will be submitted to KP EPA for obtaining the Environmental Approval for the Project.

According to World Bank Operational Policy (OP) 4.01 (Environmental Assessment), the Project is classified as Category A. Other relevant World Bank policies applicable to the Project include Natural Habitats (OP 4.04), Physical Cultural Resources (OP 4.11), Involuntary Resettlement (OP/BP 4.12), Forests

(OP/BP 4.36), Safety of Dams (OP/BP 4.37) and Projects on International Waterways (OP/BP 7.50). The present ESIA has been prepared in compliance with these policies.

Environmental and Social Baseline

Study Area. The Project influence area (or the project area) comprises of about 11 km-long valley of the Gabral River and its mountain slopes, from Kanai village (one km upstream of the weir site to cover the reservoir area) to Kalam town (10 km downstream of the weir site, where it joins the Ushu River to form the Swat River). The influence area covers all those areas that will likely to be directly or indirectly affected by the Project construction and operational activities.

Baseline Surveys. Detailed environmental, ecological, and socio-economic surveys were carried out in the project area through a review of secondary literature, field investigations for primary data collection, sampling and analysis of water, air and noise quality, questionnaire surveys, and community and stakeholder consultations.

Physical Environment

Physical Setting and Land use: The physiography in the project area is dominated by mountainous terrain, narrow valleys of the Gabral river and its tributaries, eroded riverbanks, and agricultural lands along the riverbanks and forests on the hill slopes. The project area is located in a rural setting, and the major settlements in the project area are Kalam (a major tourist town with a population of about 12,300 people and 1351 households). The nearest settlement close to the primary construction site is Kanai village (which is located 0.9 km away from the weir site, on the upstream). A gravel road is located along the right bank of the river, which connects the project villages to the Kalam. Another important feature of the area is severe erosion on the left bank of the river by the 2010 flood, which engulfed the previously existing agricultural lands and filled them with the river sediments and huge boulders and made them not suitable for any cultivation.

Climate. The winters in the project area are freezing with minimum temperatures ranging from -0.4 ^{o}C to – 8.4 ^{o}C from November to March. The temperatures in spring (April and May) and in Autumn (September and October) are usually warm in the daytime (17 to 20 ^{o}C) and cold on the night time (3 to 10 ^{o}C). The average annual precipitation is about 1076 mm, with nearly 58 percent of precipitation falls as snowfall during winter.

Hydrology. The catchment of the Gabral River lies in the upper region of the Hindu Kush mountains of the Swat River basin. The mean 10-daily flows of the Gabral river at the weir site vary from 6.8 m^3/s to 127 m^3/s. The river flows are usually higher during the months of May to August due to the melting of snow and glaciers. During these months, the river carries higher flows than the 65 m^3/s (peak design discharge of the project). The river flows start to decrease from September, and the river flows are low (6.8 to 9.8 m^3/s) from December to March. Bhan Khwar is the perennial tributary of the Gabral River, located 4 km downstream of the proposed weir site (in the dewatered section, between weir and tailrace). The winter flows from the Bhan Khwar (1.5 to 3 m^3/s) contributes to additional environmental flows from the weir to be released from the Project.

Groundwater. The groundwater levels within the river bed are shallow, with depths ranging from 0.8 to 4.5m, due to the presence of overburden riverine deposits. Whilst, the groundwater was not encountered in any of the boreholes that were drilled away from the river due to the lack of fractures in the underground phyllite and schist formations. There is no extraction of groundwater in the project area for the drinking and irrigation uses. There are several springs located in the mountains on both sides of the river, which are being extensively used for drinking and irrigation purposes by the local communities.

Floods. The peak instantaneous discharges of the Gabral River during the floods vary from 77 m^3/s (in 2001) to about 1400 m^3/s (in 2013). The flood in 2010 (a flood of 300-year return period) is one of the worst in the region and caused severe damages to the infrastructure and the agricultural land in the valleys. A 1000-year (return period) flood of 1791 m^3/s is considered for the design of weir.

Seismicity. The project area is located in a tectonically active region affected by the continuing northward drifting of the Indian Plate and its subduction below the southern flank of the Eurasian Plate. A detailed seismic assessment has been carried out for the project, and a peak ground acceleration of 0.49 g, which is associated with ground motion having a return period of 3,000 years, is used for the design of the weir.

Water Quality. Water quality of the Gabral River, Bhan Khwar River, and spring at Kanai village is measured during January 2019, and the results suggest water quality is generally good, with total dissolved solids ranging from 58 to 67 mg/L.

Air and Noise Quality. Air and noise quality are measured at three villages in the project area during August 2019. The ambient air and noise quality in the project area are generally good and well below the national environmental quality standards as the area has less exposure to vehicular traffic and industrial pollution. The particulate matter concentrations (PM_{10}) in the Kalam area varies from 30 to 35 $\mu g/m^3$ (the national standard is 150 $\mu g/m^3$). The average daytime noise levels in the Kalam area varies from 40 to 50 dBA (the national standard is 65 dBA).

Biological Environment

Biodiversity. The overall biodiversity within the 50 km of the project area includes 245 species of plants, 20 species of fish, six species of amphibians, 18 species of reptiles, 283 species of birds and 70 species of mammals. The list of threatened species that can be found within region include four threatened mammalian species (Himalayan musk deer, Common Leopard, Snow leopard, and Black Bear), five endangered birds (Pallas's fish-eagle, Egyptian vulture, Greater spotted eagle, White-headed duck and Indian skimmer), and one endangered fish species (golden mahseer). The important biodiversity areas near the project area are Bhan Khwar Valley Community Game Reserve, which is located on the Bhan Khwar catchment area (250 km^2), which is a tributary of the Gabral River. The alpine and subalpine habitats of the Bhan Khwar catchment area provide a rich habitat of 21 mammals, including threatened species of snow leopard, and black bear.

Terrestrial Ecology. The project area and its surrounding areas can be classified into three ecological regions based on their altitudes (i) dry temperate ecoregion which covers the elevations up to 2700 masl, (ii) sub-alpine ecoregion, which covers elevations between 2700 to 3200 masl and (iii) alpine pasture ecoregion, which covers elevations between 3200 to 4700 masl.

Dry Temperate Ecoregion. All project facilities are located within this ecoregion, which mainly consists of coniferous forests that play a vital role in the economy of the area as a source of supply of timber, fuelwood, non-timber forest products, forage, and grazing. During field surveys, a total of 72 plant species are recorded in the project area. The forest vegetation mainly consists of Deodar, Blue pine, Chilgoza pine, and Spruce with pure and mixed occurrence. A total of 12 species of mammals, 14 species of herps (three amphibians and 11 reptiles) are recorded from the project area. Among these species, only Asiatic Black Bear (IUCN Status: Vulnerable) is a threatened species. Koklass, a wild pheasant (IUCN Category: Least Concern), is reported to occur near the project site.

Sub-alpine Ecoregion. The sub-alpine ecoregion represents a very fragile but ecologically significant ecosystem found at the elevations between 2700 to 3200 masl. This region also linked to forest resources. Key fauna associated with this habitat is; Musk Deer (*Moschus chrysogaster*), Snow Leopard (*Panthera uncia*), Markhor (*Capra falconeri*), Monal Pheasant (*Lophophorus impejanus*), Himalayan Snowcock

(*Tetraogallus himalayensis*) and Snow Partridge (*Lerwa lerwa*). These species are reported in the high mountains of Bhan Valley Community Game Reserve.

Alpine Pastures Ecoregion. The alpine pastures are located on the higher peaks of the mountains of northern areas of Pakistan between the elevations 3200 to 4700 masl. Alpine plants are adapted to harsh conditions, which include low temperature, dryness, ultraviolet radiation, and a short growing season. The area is rich with a wide diversity of flora and fauna. Wildlife species reported in this habitat included Snow leopard, Brown bear, Black bear, Markhor, Ibex, Musk deer, Monal pheasant, Himalayan Snowcock, and Snow partridge. These species are reported in the Bhan Valley Game Reserve. The mammalian species in the game reserve exists in the upper regions of alpines during summer and in the lower regions of alpine during winter.

Aquatic Ecology. The Gabral River and its tributaries are characterized by relatively steep gradients and substrate sizes, fast-flowing, and turbulent waters with high flows and more sediments during summer and low flows and low sediments during winter. Two fish species are recorded from the project area, snow carp (Schizothorax plagiostomus), an indigenous fish species of the Himalayan region, and exotic brown trout, which was introduced in the 1990s. None of these species are listed in IUCN Red List. Snow carps are short-distance migrants and mainly migrate within the tributaries. From April to September (spring and summer, high flows), they prefer upstream headwaters habitat at higher elevations. During September to April (low flows and winter), they prefer lower elevations. The triggers for migrations are high flows and low temperatures. During spring, when flows started increasing in the rivers due to the melting of snow, the fish migrate upstream from April and May (within tributaries) due to high flows and temperature at lower elevations. During autumn, when the temperatures start to drop at higher elevations, the fish migrate downstream from September and October.

Socioeconomic Environment

Demography. A socioeconomic survey of 169 randomly selected households was carried out in the project area. The total population of the surveyed households is 1365, in which males are 717 and females are 648.

Education. The educational facilities in the project area very limited and hence, literacy levels are also very low. There are six primary schools, one middle school for boys (in Ashuran village) and one higher secondary school (separately for boys and girls in Kalam). The level of illiteracy was to the extent of 42.5% for males and 84.8% for females.

Livelihood. The major source of livelihood for the project population is agriculture. The livelihood sources are agriculture (31.5%), 'daily wage labour (12.5%), business (1.5%), service with both the government and private sector (3.6%), and working abroad (3.5%). The remaining 47.4% were unemployed and students. Men in the project area are also engaged in seasonal employment in hotels at Kalam during summer.

Agriculture. Although agriculture is the main livelihood source for the majority of the households, the availability of the agricultural land is limited to the valleys along the riverbanks. The cropping season is between April to October, and there will be no agriculture during winter due to severe cold conditions and snowfall. Generally, two crops are grown, one is from April to July, and the second one is from July to October. Major crops grown are vegetables (tomatoes and potatoes), maize, pulses, and millets.

Household Income. The average household income was computed to be Rs. 68,998 per month. A major proportion (45.5%) of the surveyed households fall in the income category of Rs. 20,000 to Rs. 50,000, while 14.4% and 40.1% come under the income bracket of less than Rs. 20,000 and above Rs. 50,000 per month, respectively. The average per capita income was computed to be Rs. 98,333 per annum and Rs.

8,194 per month. In accordance with the poverty line (Rs. 25,475 per month per household), the level of poverty of the surveyed households is 14.4 percent.

Health. The health facilities in the project area are very limited. There is only one Basic Health Unit (BHU) in Kalam, which has five medical doctors, three nurses and lady health workers, and ten medical technicians. The nearest Rural Health Centre, which has beds and in-patient treatment facilities, is located in Mingora, about 80 km from Kalam.

Migration. Due to extremely cold weather and limited livelihood opportunities in winter, a number of locals migrate to plain areas, mainly the central districts of KP and Punjab provinces. People start to migrate in the month of November before the snow begins to fall and return in February/March. Schools also remained closed in winter and opened in spring. The migrated people work in cities and towns as agriculture labor, household helpers, and drivers and as shop keepers.

Cultural Sites. There are no archeological sites, historical sites, and sites of significant religious value located in the project area. There are six mosques and eight graveyards in the project villages. None of these mosques and graveyards will be affected by the proposed project activities.

Tourism. The landscape in the region is famous for tourism in summer due to its forest cover, mountains, mountain streams, springs, and pleasant weather. There are about 350 hotels in the Kalam town, and about 400,000 tourists visit the Kalam annually.

Analysis of Alternatives

Without Project Scenario. Presently, the electricity deficit between demand-supply is the range of 4,000 to 6,000 MW. Lack of access to electricity and power shortages result in long hours of load shedding, impacting households, industrial and commercial activities. About 64 percent of the total installed power capacity in the country originated from fossil power plants. The greater reliance on thermal sources also resulted in increasing dependency on imported fuel (oil, gas, and coal). The imports result in the high cost of power production and these high imports require USD 4 billion in foreign currency annually in fuel payment for power generation. The “without project” alternative is not realistic, because Pakistan will build additional hydropower plants to minimize power generation from imported fuels and to eliminate power shortages.

Alternatives in Project Planning. During the project conception and development stages, a number of alternatives were considered while taking into account the technical, social and environmental aspects at the fore. The proposed locations of the weir and powerhouse are finally selected to avoid submergence of upstream Kanai and Utror villages, and to release the water back into the river (from tailrace) before the Kalam town, to prevent any impacts on its tourism.

Environmental and Social Considerations in Project Design. Environmental and social aspects have been considered in the planning and design of the Project facilities. These include:

- The weir height and potential power generation from the project are optimized to avoid the inundation of upstream Kanai and Utror villages.
- Construction of embankment (flood protection wall) on the left bank at the weir site has reduced the land acquisition by 17 acres (that could be submerged under reservoir).
- Muck disposal sites are selected in the areas that were eroded in 2010 flood (before the flood, they were under agricultural use) and these sites will be reclaimed and can be used for agricultural purposes
- A fish ladder is designed based on the needs of snow carps and included in the weir
- The project will be operated as a ‘true run-of-river’ for baseload power generation without any peaking operation

- Tourist-attraction facilities are in-built in the project design (hiking ways, deflected spillway, and parks)

Potential Environmental Impacts and Risks

The Project will be a true run-of-river project (operated as a baseload plant) with a limited reservoir area (50 acres). The most direct and significant negative impacts of the project will be on aquatic ecology caused by the construction of a weir and diversion of the river flows, and land acquisition. The adverse impacts during the construction are temporary in nature and will mainly include waste generation, dust pollution, occupational health and safety risk, and community exposure to work hazards. The overall positive impact of the project, which is the generation of 339 GWh of renewable electricity with minimal carbon emission, will be experienced countrywide through the provision of enough energy to power the equivalent of about 116,000 homes per year in the country. The project's potential impacts are given in the following table, along with the key mitigation measures.

Table 1. Potential Impacts of the Project and Key Mitigation Measures

The impact of various Project activities	Key Mitigation and Enhancement Measures
Environmental impacts due to Project siting	
1. Generation of low carbon and environmentally friendly power generation. Supply of additional 88 MW (339 GWh) of electric power to the national grid of Pakistan	Implementation of the ESMP and RAP to mitigate impacts associated with the construction of the project
2. Loss of forest vegetation (48 trees owned by the community and 636 forest trees) due to the land clearing under project footprints	Compensation for the provincial forest department for replantation of trees and afforestation of degraded forest lands. Plantation of trees in the colony and around the reservoir area Supporting the provincial wildlife department for wildlife conservation in the project area and the Bhan game reserve. Detailed monitoring of impacts on flora and fauna during construction
3. Inundation of 500 m existing road on the left bank and submergence of a footbridge and PVC water pipes	Realignment and construction of a 1.4 km new road at a higher elevation and relocation of a footbridge and the utilities Provision of water supply to the communities through tankers during the relocation of PVC water pipes
4. Greenhouse gases emissions from the proposed land clearing, construction, material life cycle, and power generation and transmission (0.24 million tons of emissions over the lifetime of the project)	Net greenhouse gases emissions are minus 7.12 million tons when compared to other feasible options for power generation and transmission
Social impacts due to Project siting	
5. Acquisition of 157.44 acres (1259 kanals) of land permanently from 87 households	Adequate compensation for affected households as per the entitlement matrix in the RAP. Implementation of income and livelihood restoration plan Implementation of a social development plan.

The impact of various Project activities	Key Mitigation and Enhancement Measures
6. Impact on 11 acres of land due to construction for 2.75 km long transmission line (12 towers)	Adequate compensation for affected households as per the entitlement matrix in the RAP One-time compensation for the land under towers
7. Loss of livelihood due to the acquisition of 26 acres of agricultural land from 44 households	Adequate compensation as per RAP Implementation of income and livelihood restoration plan. Implementation of social development plan.
8. Relocation of 8 households	Adequate compensation for affected households as per the entitlement matrix in the RAP
Environmental impacts and risks during construction	
9. Generation of about 0.8 to 1 million cubic meters of spoils/muck (excess excavation) and their disposal	Transport and disposal of spoils and designated muck disposal sites identified and approved for land reclamation Proper dumping and adequate compaction to avoid dust and release back to the river Handing over the reclaimed sites to the landowners Landscaping of the areas after completion of works
10. Generation of construction waste including hazardous waste	Containers of adequate size and numbers in place for collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste
11. Generation of solid waste from campsites and offices (about 100 kg per day).	Implementation of the waste management plan Segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable), and garbage (non-recyclable). Placement of containers with adequate size and numbers. Organic waste will be treated through in-vessel composters Recyclable waste will be compressed through bailers and use services of the waste management contractor Disposal of the garbage at the designated disposal site
12. Wastewater discharges from the construction camps, sites, and batching plants	Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and at the worksites (sedimentation tanks for batching plants and discharges from tunnels; and site drainage) Monitoring of wastewater quality to ensure compliance with NEQS
13. The potential risk of soil and water pollution by construction works	Storage of fuels and chemical in contained facilities Availability of spill kits and trained personnel for immediate cleanup of any oil spills
14. Air and noise pollution from construction and traffic	Air and noise pollution control measures at the worksites and regular monitoring of ambient and noise quality to ensure compliance with NEQS Compliance with NEQS on vehicle and machinery emissions
15. Sourcing of aggregates (about 0.5 million cubic meters) for concrete works	Reuse of excavated material to the extent feasible Use of licensed quarry sites

The impact of various Project activities	Key Mitigation and Enhancement Measures
	Source the material from the boulders from the eroded riverbanks in the proposed reservoir area (which are found to be suitable for aggregates).
16. Impact on river habitat due to construction activities and drying of river section (about 590 m) between two cofferdams (for two years)	Control of wastewater and sediment releases to the river Monitoring and relocation of trapped fish into the downstream waters
17. Impacts from increased human activities on flora and fauna, including Bhan Community Game Reserve	Limit the siting of any temporary facilities within the boundaries of the worksites. Use of non-wood fuel for cooking and heating Code of conduct for workers and employee's protection of flora and fauna and a ban on tree cutting and hunting. Any violation of the code of conduct leads to strict punishment including termination of employment Awareness-raising to workers on the Bhan game reserve
Occupational Health and Safety Risks	
18. Occupational health and safety risks on workers due to hazards associated with the construction activities (instream, underground tunnels, mountain slopes, blasting and drilling, working on heights and trenches, cold weather, etc.)	Development and implement occupational health and safety plan in compliance with WB EHSGs. Regular site inspections and safety audits Regular training program for workers on occupational health safety (monthly training and daily toolbox talks) Incident investigation and reporting Conduct a 'job hazard analysis' at the new construction site to identify potential hazards and implement necessary control measures. Use of relevant personal protection equipment at all times Availability of firefighting fully equipped ambulance, first-aid and rescue facilities at the site Adequate water supply and mobile toilets at the worksites
19. Potential health risks due to inadequate facilities in the campsites (about 200 non-locals, including about 60 foreign workers live in construction camps)	A construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, recreation) for labor. Cleaning of the campsite on a daily basis. A medical clinic, with a medical doctor and attendants and preliminary staff, will be established at the camp The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan
20. Employment generation for the local community	The hiring of the local community during construction works (about 300 workers on average regularly and 500 during peak construction daily for four years) Implement a labor management plan Formal contracts to be signed with labor
21. Risk of child labor	No hiring of workers less than 18 years of age
Social Impacts and risks during construction	

The impact of various Project activities	Key Mitigation and Enhancement Measures
22. Safety hazards due to increased traffic on local roads especially for children and elderly people	Implement a traffic management plan (e.g., avoiding school hours, following sped limits, hiring licensed drivers, etc.) including awareness-raising and safety measures
23. Community exposure to work hazards	Barricade the work areas with hard fencing to prevent the entry of community in the construction areas. Placing adequate signboards and flagmen to divert the community away from the construction works. Community awareness programs on construction-related hazards, including awareness programs in schools
24. Dust from vehicular movement (20 to 30 trucks per day) on local roads and construction equipment	Frequent sprinkling of water as per weather requirements on the local roads and worksites to control dust emissions Dust control measures at the worksites
25. Risk of damage to houses by blasting activities (through fly rock and vibration)	Use of controlled blasting and placement of sandbags on the drill holes to prevent fly rock Adequate compensation for any affected structures
26. Impacts from labor influx and potential cultural conflicts between communities and workers	The contractor's code of conduct shall cover a program to promote awareness to the construction workers on respecting the local community. Construction camps will be built in the designated areas, located away from the local settlements The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community Inclusion of code of conduct obligations and the applicable legislation in the contracts of all employees and workers with the provision of sanctions and penalties in case of violations
27. Risk of gender-based violence, sexual exploitation and abuse, and sexual harassment	The contractor's code of conduct shall cover a program to promote awareness to the construction workers on avoiding gender-based violence, and the risk of spreading sexually transmitted diseases. The Contractor's monthly training program will cover topics related to Code of Conduct such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers
Environmental and Social impacts during Operational stage	
1. Barrier effect on fish migration	A fish ladder has already built into the design of the weir Sensors and underwater video cameras will be placed on the ladder and monitored to count the fish and to assess the effectiveness of the ladder
2. Reduced water flow between weir and tailrace during low flow season	Environmental flow requirements are assessed based on the requirements of snow carps. During extreme low flow season (December to February), when fish don't migrate and live in pools, an environmental flow of 2 m^3/s will be released. During the fish

The impact of various Project activities	Key Mitigation and Enhancement Measures
	migration season (March/April and September/October) and other seasons, the environmental flow of 2.5 to 3.5 m^3/s will be released. Downstream monitoring and adjustment of flows if required
3. Risk of bird electrocution from the transmission line	Insulation of exposed parts of the tower structure
4.Reduction of sediment load in the downstream water flows from the reservoir	Release of environmental flows and excess flows through sluices to release the sediments in the high flow season Regular flushing of sand traps during high flow season
5. Workers health and safety during routine operation and maintenance	Implementation of OHS plan
6. Waste generation from the plant and staff colony	Implement a waste management plan
7. Community health and safety	Complied with World Bank recognized standards on EMF through design considerations. Review of dam designs by an independent panel of experts
8 Improved livelihood opportunities from the development of tourist attractions and waste generation at tourist sites.	PEDO will provide preference to affected persons in establishing small businesses in designated tourist areas established at the project sites to improve their livelihood. PEDO establish and maintain waste and toilet facilities at the tourist sites near the project facilities

Cumulative Impacts

Valued Environmental Components. The potential cumulative impact of all existing and planned hydropower projects in the Swat River basin, in the context of the Gabral Kalam hydropower project, has been studied. The hydropower development in the basin for the next 20 years include 24 projects with a potential of 2072 MW. Of these four are existing (160 MW), two are under construction (884 MW), and 18 are proposed (1028 MW). All these projects are runoff river projects except Mohmand (Munda) Dam (the most downstream project in the Swat River), which involves storage (1600 million cubic meters) for power generation and irrigation. Four valued environmental components (VECs) have been studied, (i) river flows, (ii) terrestrial ecology, (iii) aquatic ecology, and (iv) socio-economic environment.

Cumulative impacts and contribution of the Project to the Cumulative Impacts. The development of hydropower projects in the Swat River basin will not have any cumulative impacts on the downstream irrigation schemes if all of them operate for baseload power generation, but if they are operated for peaking power generation (18 hours of storage and six hours of release), there will be a reduction of 34 to 57% of irrigation releases to the Upper Swat Canal. The potential cumulative impacts of hydropower development on terrestrial ecology include forest clearance, degradation of forest habitats, soil erosion and sedimentation, and impact on wildlife habitats. Cumulative impacts on the aquatic ecosystem include habitat degradation in both feeding and breeding grounds, barrier effect on snow carp's migration and fish entrapment. On socioeconomic environment, the potential cumulative impacts from the hydropower construction and associated infrastructure development (including community-led infrastructure to be built by PEDO at each project site) will be employment generation in rural areas, where most of the projects are located and significant improvement of socioeconomic conditions in the project areas due to improved access to towns and markets, electricity, and health and education facilities.

Actions to Address Cumulative Impacts. PEDO is planning to take several actions to address the cumulative impacts through implementation of various mitigation, compensation and enhancement measures, which include (i) detailed ecological studies as part of the ESIA studies of respective projects to develop adequate mitigation plans, (ii) construction of fish ladders to allow fish movement and migration both upstream and downstream of the weir, (iii) release of environmental flows, (iv) design and optimization of project facilities with minimum environmental impact, (v) tree plantation and promotion of wildlife conservation in each project area, (vi) implementing a social development plan for building community-led infrastructure projects in the project areas, (vii) operating all plants for baseload power generation, (viii) working closely with the fisheries department to augment their hatcheries for breeding of snow carps and releasing them on both and upstream of the weirs, (ix) implementing a comprehensive monitoring and adaptive management plan, and (x) carryout a detailed cumulative impact assessment of the Swat Basin under Component B of the parent Program.

Environmental and Social Management Plan

Institutional Arrangements. PEDO will establish a Project Management Organization (PMO) for the implementation of the Program. The Environmental and Social Unit of PMO will include a number of environmental and social specialists (two directors, three deputy directors, and six assistant directors). The staff of PMO will be responsible for the overall supervision of the implementation of the Program, including ESMP. The Construction Supervision Consultant (CSC) will be responsible for supervising the contractors for the implementation of ESMP. For this purpose, the CSC will appoint dedicated environmental, social, health and safety (ESHS) staff to ensure the implementation of environmental and social management plans during the project implementation. CSC staff will include an Environmental specialist, an Occupational Health and Safety Specialist, an Ecologist, Social Specialists, and ESHS site Inspectors. Contractors ESHS staff include an ESHS Manager, an Environmental Officer, an OHS Officer, a Social Officer, and ESHS Site Supervisors (one supervisor at each site).

Environmental Conditions in the Bidding Documents. In order to make the Contractors fully aware of the implications of the ESMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in ESIA as well as World Bank Group EHSGs. The Contractor will be made accountable through contract documents for the obligations of implementing the ESMP.

Mitigation and Monitoring Measures. A mitigation and monitoring plan is developed and presented in the ESIA. An Environmental Code of Practices (ECPs) has been prepared **(Annex 1)** to address generic impacts associated with hydropower construction. Prior to construction, the Contractor will prepare the Contractor's ESMP with site-specific management plans. The contractor will prepare and implement a code of conduct for his workers. Regular trainings will be conducted to contractor's workers on various ESHS aspects, including occupational health and safety, environmental protection, and awareness to the construction workers on avoiding gender-based violence.

Grievance Redress Mechanism. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected parties' concerns, complaints, and grievances about the environmental and social performance. A three-tier GRM has been designed to provide a time-bound, early, transparent and fair resolution for affected people. PEDO will follow the GRM to address any dissatisfaction and complaints by affected people and other stakeholder grievances. In addition, communities and individuals who believe that they are adversely affected by a World Bank-supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service . A GRM specific to deal with the workers' related grievances will also be established.

Budget. The total cost of the ESMP implementation is estimated to be USD 3.94 million. It covers the implementation of measures proposed for waste management, dust management, workers training, health and safety, health facilities at the campsite, wastewater treatment facilities, environmental monitoring, tree plantation and promotion of wildlife conservation, further studies and monitoring during construction, and capacity building of PMO staff.

Consultation and Disclosure

Extensive consultation and information dissemination (including with women) were carried out during ESIA preparation and disclosure. A total of 58 consultation meetings, with 439 participants (373 male and 66 female), were conducted. These include 48 local village meetings, one provincial-level workshop at Peshawar on October 21, 2019, one disclosure workshop at Kalam on November 7, 2019, to share the draft ESIA and RAP, in which the local communities, including affected communities, district-level government agencies (including representatives forest and wildlife departments, union councilors, and district administration). Feedback from the consultations was overall supportive of the Project by all stakeholders, but a request was made to enhance the benefits of the project to the local population through the provision of social services. The general concerns of the local community (also including women) are minimization of impacts on private land, payment of compensation based on the market rates, forms of payment, employment in the construction activities, and adequate mechanism for grievance redress.

The ESIA and Executive Summary of ESIA in Urdu will be disclosed on the PEDO website and will be sent to the World Bank for disclosure on its external website. Hard copies of these documents will be made available at local union council offices for public access.

1 Introduction

The Government of Khyber Pakhtunkhwa (GoKP), through the Pakhtunkhwa Energy Development Organization (PEDO), is planning to implement the Gabral-Kalam Hydropower Project (hereinafter referred to as '**the Project**' or **GKH**). The Project will construct an 88 megawatt (MW) run-of-river hydropower project on the Gabral River to generate about 339-gigawatt hours (GWh) of electricity annually. The Project is located near the Kalam town in the Swat district of Khyber Pakhtunkhwa (KP) province. Major interventions proposed in the Project are (a) construction of river diversion, weir, tunnel, powerhouse, access roads, project colony, offices, houses, and other ancillary infrastructure; and (b) installation of turbines, generators and electro-mechanical equipment, and transmission line. PEDO is the implementing agency of the Project and has prepared a comprehensive Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) for the Project. The ESIA is presented in this report, and the RAP is presented under a separate cover.

The GoKP has requested funding for this Project from World Bank through the proposed 'Pakhtunkhwa Hydropower and Renewable Energy Development Program' (hereinafter referred to as '**the Program'** or **KPHREDP**). The Program will support the GoKP for (i) development of three to four run-of-river hydropower projects in the Swat Basin (including the proposed GKH) and installation of solar panels on the hydropower assets in KP and (ii) strengthening of PEDO, the implementing agency of the Program. PEDO has also prepared an Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RPF) for the overall Program and presented under separate covers.

1.1 Background

Pakistan is suffering from an acute power and energy crisis, which is primarily caused by the increasing gap between the supply and the demand for electricity. The current (2017) generating capability of Pakistan is 19,020 MW in summer and 14,833 MW in winter, whereas the current demand is about 25,117 MW. Thus, the current shortfall is 6097 MW and 10,224 MW in the summer and winter seasons, respectively. Pakistan's power needs are increasing with a growth rate of 7 to 8 % (according to Pakistan Electric Power Company), the expected demand will be 96,000 MW by 2029-2030; whereas the generation additions are too slow to accompany the same pace, and there will be insufficient generation to meet the future demand in the coming years.

Per Capita Energy Generation and Consumption in Pakistan is among the lowest in the Word. The per capita energy generation of Pakistan in 2017 was 585-kilowatt hours (kWh), and per capita energy consumption in 2017 was 475 kWh. The per capita energy consumption in Pakistan is significantly lower than the average of middle-income countries (2355 kWh), and the neighboring countries of China (4475 kWh) and India (1122 kWh). According to the recent census of 2017, there are over 32 million households in Pakistan do not have access to electricity.

The Energy Generation of Pakistan is mainly from Fossil Fuels. The total installed generating capacity of Pakistan in 2017 was 28,172 MW in which 18,190 MW (64%) are from thermal sources, 7,115 MW (25%) from hydro, and the rest 2866 MW are from other renewable and nuclear sources. The major problem with the thermal is the high cost of electricity generation. These plants are not running up to their full capacity due to their dependence on imported fuel. With limited indigenous oil, Pakistan has to import over 70% of its requirements resulting in a debilitating drain on the country's balance of payments. Lack of foreign exchange to pay for fuel supplies has resulted in the production of electricity below the capacity of the existing plants. Although several gas-field plants have been commissioned during the last two decades, the reserves in these gas fields are dwindling. The energy sector is also the largest contributor to Pakistan's greenhouse gas (GHG) emissions at 46 percent of total emissions.

Lack of access to and poor reliability of electricity causing huge losses to Pakistan's economy. Lack of access to electricity and power shortages result in long hours of load shedding, impacting households, industrial and commercial activities. Lack of power affects people's quality of life, schools, colleges, clinics and hospitals; shops and businesses, reducing sales and revenues; and industry, reducing productivity. It also deters investment. This means, on a macro level, reduced economic growth, which translates into the loss of livelihoods, jobs, and income. The financial impact of load shedding has been estimated at 3 percent to 4 percent of GDP, costing about USD 10 billion a year. This situation is causing serious economic losses to the country and is responsible for increased unemployment and poverty. According to some estimates, Pakistani households spend about US$ 2.3 billion annually on alternative lighting products and services such as kerosene, gasoline, and battery-powered lighting.

Pakistan has Immense Hydropower Potential, most of which lies in Khyber Pakhtunkhwa Province. Pakistan is endowed with a hydropower potential of 40,000 MW, in which about 25,000 MW potential lies in KP. The total installed hydropower capacity in the country is 7,115 MW, in which about 4,000 MW is in KP. Pakistan Water and Power Development Authority (WAPDA) is a federal agency responsible for developing major to mega hydropower projects in the country, while the PEDO is the provincial agency responsible for developing small to major hydropower projects within the KP. PEDO, with the support of the German government, has identified several projects with an overall potential to generate 6,000 MW through the public sector, private sector, or public-private partnership. PEDO has approached the World Bank for funding of three priority hydropower projects identified in the above study, which included GKH.

World Bank Support in Hydropower Sector in KP. World Bank has been currently supporting the WAPDA on the implementation of two hydropower projects in KP, a 4500 MW Dasu Hydropower Project on Indus and 2820 MW Tarbela 4th and 5th Extension Hydropower Projects on Indus. Word Bank has also positively responded to the request of PEDO for financing its hydropower projects through the proposed Program.

1.2 Khyber Pakhtunkhwa Hydropower and Renewable Energy Development Program

The proposed 'Khyber Pakhtunkhwa Hydropower and Renewable Energy Development Program' (the Program) aims to help address the issues discussed in the previous section through the development of hydropower projects (HPP) and other renewable energy sources in KP. The Program will have the following components:

- **Component A:**
    - A1. Development of Gabral-Kalam Hydropower Project (GKH),
    - A2. Cascade development of the Swat River basin. Currently, two candidate projects are Kalkot-Barikot-Patrak HPP and Patrak-Shringal HPP, both on the Panjkora river in the Upper Dir District. However, other projects in particular of the Swat basin can also be considered for inclusion in the Program.
    - A3. Solar PV systems on hydropower assets.
- **Component B**: Institutional Strengthening and Energy Sector Development. This component will help prepare and implement a strategic roadmap and business plan for the development of KP energy systems and associated infrastructure to promote renewable energy, maximize investments and government revenue. It will also entail strengthening of institutional systems and processes so that the Energy Department GoKP and PEDO can efficiently and effectively manage their duties as a developer of renewable energy program as well as operations and maintenance of existing and future energy projects

- **Component C:** Environment and Social Management. The objective of this component is to improve the environment, local living and economic development in the project area for GKH and other hydropower projects under component A2 as well as solar sites under A3.
- **Component D:** Project Implementation Support and Technical Assistance. This component would cover the cost of the consulting and other services to implement the three hydropower projects starting with the GKH and solar PV project, as defined under Component A and fulfill training and capacity building needs of PEDO and PMO to implement project-related activities effectively.

1.3 The Proposed Gabral Kalam Hydropower Project

Location. The Project will construct an 88 MW run-of-river hydropower project on the Gabral River to generate about 339 GWh of electricity annually. The weir site of the Project is located at longitude 35.505501°N and latitude 72.518729°E across the Gabral River (the tributary of the Swat River, which in turn is a tributary of the River Kabul) in the Swat district of KP. The Kalam town (population 12,300), a major tourist destination in the region, is located about 10 km from the weir site. The Kalam is located approximately 239 km from Peshawar and 326 km from Islamabad. The location of the Project site is shown in **Figure 1.1**.

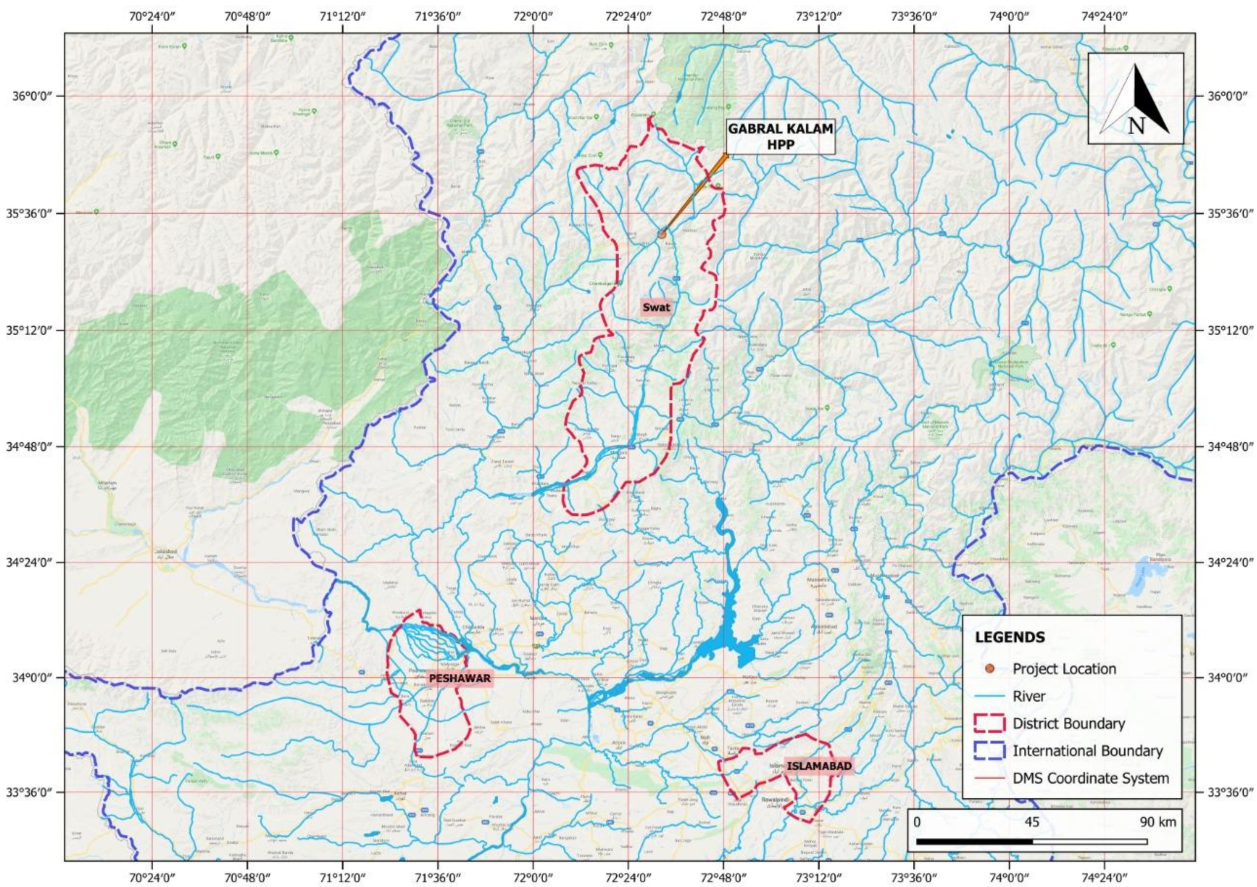


Figure 1.1: Location of the Project

Proposed Construction Works. A detailed description of the proposed facilities to be built is given in Chapter 3. A summary of the main physical works is given below:

- 21 m high (above the riverbed) and 100 m wide weir with spillways, under sluices, fish ladder and outlet structures
- 4.7 km long underground tunnel from the weir site to the powerhouse
- Powerhouse (with two units of 37.5 MW and one unit of 13 MW) and a switchyard
- 2.7 km long 220 kV transmission line from the switchyard to the interconnection point of an existing (under construction) transmission line from the Gorkin- Matiltan Hydropower Project
- Project colony with a necessary water supply and sanitation facilities for 50 O&M staff

1.4 The Environmental and Social Assessment of the Project

Studies and basic data: This ESIA is based on field studies and data collected during 2019 by the consultant team charged with the design of the project. A team of ecologists and environmental and social specialists of the design consultant have participated in the studies and collected data on the existing physical, biological and socio-economic environment of the project area. The team included Dr. Ashraf Bodla (biodiversity), Dr. Wasim Khan (wildlife), Prof. Ali Muhammad (fish), Ms. Hina Batool and Ms. Samina Parveen (environment), Mr. Umer Azeem (hydrology), and Mr. Shaukat Shahid and Mr. Zafar Bhatti (social). A team of independent consultants was retained by PEDO to guide the design consultants for necessary data collection and prepare an independent ESIA report as per the guidelines of the World Bank.

Independent consultants: PEDO has engaged two independent environmental and social consultants, Dr. Venkata Nukala and Ms. Samina Islam, to assess the environmental and social impacts of the project, provide input to the environmental and social aspects of the design, and to prepare this ESIA and RAP. During the ESIA preparation, the independent consultants regularly interacted with the design consultant, carried out their own field visits, participated in consultations, and conducted their independent analysis and impact assessment. While carrying out this assessment, the consultants also reviewed the environmental and social issues from other ongoing hydropower projects in KP, including World Bank-funded Tarbela 4th Extension and Dasu hydropower projects.

1.5 Content of the Report

Chapter 2 reviews the prevailing government regulatory requirements relevant to the environmental assessment and World Bank safeguard policies applicable to this Project, and actions taken by PEDO to comply with these requirements. **Chapter 3** presents a detailed description of the proposed project facilities and other salient information relevant to the environmental and social assessment. Possible design alternatives that have been considered and their influence on the environment and social situation are presented in **Chapter 4.** Description of the baseline environmental, biological and social conditions in the project area are presented in **Chapter 5**. Risks from climate change and earthquakes are described in **Chapter 6**. Potential environmental and social issues from the Project implementation, as well as the appropriate mitigation measures to address these negative impacts, have been discussed in **Chapter 7**. **Chapter 8** presents an assessment of the cumulative impacts resulting from the development of proposed and existing hydropower projects in the Swat basin. An Environmental and Social Management Plan (ESMP) is presented in **Chapter 9**, together with the proposed institutional arrangement, the management and monitoring requirements. Finally, **Chapter 10** describes the consultations that have been carried out with the stakeholders.

2 Legal, Regulatory and Administrative Framework

This chapter provides an overview of the national and provincial legislation and the World Bank safeguard policies that are relevant to the environmental and social assessment of the Project and actions that are taken (or to be taken) up by PEDO to meet these requirements.

2.1 Applicable Government Regulations

2.1.1 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997, is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, soil, marine, and noise pollution, as well as to the handling of hazardous wastes. As defined in the Act "environment" means: “(a) air, water, and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the inter-relationships between any of the factors in sub-clauses (a) to (f).

2.1.2 KP Environmental Protection Act

The KP Environmental Protection Act of 2014 is the provincial version of the Pakistan Environmental Protection Act, 1997 (PEPA) relevant to the Project. Responsibility for PEPA was transferred from the Ministry of Environment to the provincial governments by an amendment to the PEPA in 2012. The provincial versions continue to remain materially the same as the PEPA except where governmental bodies are referred.

The following are key features of the provincial Acts:

- Section 11 (Prohibition of Certain Discharges or Emissions) states that “Subject to the provisions of this Act and the rules and regulations made thereunder, no person shall discharge or emit, or allow the discharge or emission of, any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the Environmental Quality Standards.”
- Section 13-I (Initial Environmental Examination and Environmental Impact Assessment) requires that “No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from the Federal Agency approval in respect thereof.” This EIA will be submitted by PEDO for EPA approval.
- Section 13-2b (Review of IEE and EIA): The Environmental Protection Agency shall review the EIA report and accord its approval subject to such conditions as it may deem fit to impose, or require that the EIA be re-submitted after such modifications as may be stipulated or rejected, the project as being contrary to environmental objectives.
- Section 15 (Handling of Hazardous Substances) requires that “Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, or import any hazardous substance except (a) under a license issued by the EPA and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other Instrument to which Pakistan is a party.” Enforcement of this clause requires the EPA to issue regulations regarding licensing procedures and to define ‘hazardous substance.’

- Section 16 (Regulation of Motor Vehicles): Subject to provision of this clause of the Act and the rules and regulations made thereunder, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the EQS, or where the applicable standards established under clause (g) of subsection (1) of Section-6 of the Act.
- Section 18 (Penalties): Whoever contravenes or fails to comply with the provisions of section 11, 12, 13, or section 16 or any order issued thereunder shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues: Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only.
- Section 19 (Offences by Bodies Corporate): Where any contravention of this Act has been committed by a body corporate, and it is proved that such offense has been committed with the consent or connivance or, is attributed to any negligence on the part of, any director, partner, manager, secretary or other officers of the body corporate, such director, partner, manager, secretary or other officers of the body corporate, shall be deemed guilty of such contravention along with the body corporate and shall be punished accordingly.

Environmental approvals will be required under this act for the Project before starting the construction works and operation.

2.1.3 Pakistan Environmental Protection Agency (Review of IEE & EIA) Regulations, 2000

The IEE/EIA Regulations 2000 establish the framework for the preparation, submission, and review of the IEE and EIA. The regulations categorize development projects for IEE and EIA into two schedules (Schedules I and II). Schedule I include projects where the range of environmental issues is comparatively narrow, and the issues can be understood and managed through less extensive analysis. Schedule II covers major projects that have the potential to affect a large number of people in addition to generating potentially significant adverse environmental impacts. Preparation of a complete EIA is required for Schedule II projects. The following development projects fall under Schedule I:

- Hydroelectric power generation less than 50 MW
- Transmission lines less than 11 kV, and large distribution projects

The Project falls under Schedule II. Hence, an EIA will be required for those projects.

2.1.4 Land Acquisition Act of 1894

The Land Acquisition Act 1894 provides for the acquisition of private properties for public purposes, including development projects in Pakistan. It comprises 55 sections dealing with area notifications, survey, acquisition, compensation, apportionment awards, disputes resolutions, penalties, and exemptions. The key clauses of the Act are summarized in **Table 2.1**. The land acquisition for the Project will be carried out in accordance with this act.

Table 2.1: Key Clauses of Land Acquisition Act

LAA Section	Description
Section 4	Publication of preliminary notification and power for conducting the survey.

LAA Section	Description
Section 5	Formal notification of land needed for a public purpose. Section 5a covering the need for enquiry of the concerns or grievances of the affected people related to land prices.
Section 6	The Government makes a more formal declaration of intent to acquire land.
Section 7	The Land Commissioner shall direct the Land Acquisition Collector (LAC) to take order the acquisition of the land.
Section 8	The LAC has then to direct that the land acquired to be physically marked out, measured and planned.
Section 9	The LAC gives notice to all project-affected persons (PAPs) that the Government intends to take possession of the land and if they have any claims for compensation then these claims are to be made to him at an appointed time.
Section 10	Delegates power to the LAC to record statements of the PAPs in the area of land to be acquired or any part thereof as co-proprietor, sub-proprietor, mortgage, and tenant or otherwise.
Section 11	Enables the Collector to make enquiries into the measurements, value, and claim and then to issue the final "award". The award includes the land's market area and the valuation of the compensation.
Section 11 A	Enables the Collector to acquire land through private negotiations upon request of Head of the acquiring department. Upon receipt of any such request, the collector is empowered to constitute/notify a committee for assessment of the market value of land and verification of title of ownership. On agreement by Head of Acquiring Department, with negotiated market value determined by the committee, the collector shall then direct parties to execute sale deed in favor of acquiring department on stamp paper.
Section 11 B	Provides a time limit of six months to complete the land acquisition process from the date of notification under Section-4.
Section 16	When the LAC has made an award under Section 11, he will then take possession and the land shall thereupon vest absolutely in the Government, free from all encumbrances.
Section 18	In case of dissatisfaction with the award, PAPs may request the LAC to refer the case onward to the court for a decision. This does not affect the Government taking possession of the land.
Section 23	The award of compensation to the title holders for acquired land is determined at i) its market value of land, ii) loss of standing crops, trees and structures, iii) any damage sustained at the time of possession, iv) injurious affect to other property (moveable or immoveable) or his earnings, v) expenses incidental to compelled relocation of the residence or business and vi diminution of the profits between the time of publication of Section 6 and the time of taking possession plus 15% premium in view of the compulsory nature of the acquisition for public purposes.
Section 28	Relates to the determination of compensation values and interest premium for land acquisition.
Section 31	Section 31 provides that the LAC can, instead of awarding cash compensation in respect of any land, make any arrangement with a person having an interest in such land, including the grant of other lands in exchange.
Section 48A (LAA-1986)	If within a period of one year from the date of publication of declaration under section 6 in respect of any land, the Collector has not made an award under section 11 in respect to such land, the owner of the land shall, unless he has been to a material extent

LAA Section	Description
	responsible for the delay be entitled to receive compensation for the damage suffered by him in consequence of the delay.

2.1.5 Telegraph Act, 1885

The Telegraph Act (1885) was enacted to define the authority and responsibility of the Telegraph Authority. The law covers, among other activities, installation, and maintenance of telegraph lines and posts (poles). The Act defines the mechanism to determine and make payment of compensation associated with the installation of these lines and posts. Under this Act, the land required for the poles is not acquired (or purchased) from the owner, nor the title of the land transferred. Compensation is paid to the owner for any structure, crop or tree that exists on the land; the cost of the land is not paid to the owner. National Transmission & Despatch Company (NTDC) is the responsible agency for developing transmission line networks in the country and it has been following this act for building transmission line towers throughout the country.

2.1.6 Factories Act, 1934 (as amended to 1997)

The clauses relevant to the project are those which concern the health, safety, and welfare of workers, disposal of solid wastes and effluents, and damage to private and public property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. As construction activity is classified as 'industry', these regulations will be applicable to the construction contractors. Particular sections of the act applicable to the proposed Project are:

- Section 13(1): Every factory shall be kept clean and free from effluvia arising from any drain, privy or other nuisance.
- Section 14(1): Effective arrangements shall be made in every factory for the disposal of wastes and effluents due to the manufacturing process carried on therein.
- Section 16(1): In every factory in which, by reason of the manufacturing process carried on, there is given off any dust or fume or other impurities of such a nature and to such an extent as is likely to be injurious or offensive to the workers employed therein, effective measures shall be taken to prevent its accumulation in any work-room and its inhalation by workers and if any exhaust appliance is necessary for this purpose, it shall be applied as near as possible to the point of origin of the dust, fume or other impurities, and such point shall be enclosed so far as possible.
- Section 16(2): In any factory, no stationary internal combustion engine shall be operated unless the exhaust is conducted into open air and exhaust pipes are insulated to prevent scalding and radiation heat, and no internal combustion engine shall be operated in any room unless effective measures have been taken to prevent such accumulation of fumes therefrom as are likely to be injurious to the workers employed in the work-room.
- Section 20(1): In every factory effective arrangement shall be made to provide and maintain at suitable points conveniently situated for all workers employed therein a sufficient supply of drinking water.

2.1.7 Labor Laws

Labor laws in Pakistan are governed by many legislative tools. Principal labor rights are provided by the constitution of Pakistan. In addition to constitutional rights, acts and ordinances have been enforced from time to time for limiting working hours, minimum working age, and conditions of employment.

Of the 24 labor-related laws that existed in 2014 in Pakistan, those set out in **Table 2.2** relate directly to the International Labor Organization's (ILO's) core labor standards and will broadly be applicable to the proposed Project.

Table 2.2: Labor Laws of Pakistan

Legislation / Guidelines	**Brief Description**
KP Bonded Labor System (Abolition) Act (1995) and Punjab Bonded Labor System (Abolition) Act (2012)	The Bonded Labor System (Abolition) Acts seek to eradicate bonded labor practices prevailing in the respective provinces. The Acts define the `Bonded Labor System' as a system of forced or partly forced, labor under which a debtor enters or is presumed to have entered into an agreement with the creditor to the effect that: • In consideration of an advance obtained by him or by any of the members of his family (whether or not such advance is evidenced by any document) and in consideration of the interest, if any, due on such advance, or • In pursuance of any customary or social obligation, or • For any economic consideration received by him or by any member of his family.
KP/Punjab Minimum Wages for Unskilled Workers Ordinances (1969)	The ordinances state that every employer shall be responsible for the payment of minimum wages required to be paid under the ordinances to all unskilled workers employed, either directly or through a contractor, in his commercial or industrial establishment: • Provided that where an employer provides housing accommodation to a worker, he may deduct from the wages of such a worker, an amount not exceeding that in the ordinance; • Where the employer provides a worker with transport to and from the place of work, he may deduct from the wages of such a worker an amount not exceeding that specified in the ordinance.
KP/Punjab Industrial Relations Acts (2010)	These Acts seek to regulate the formation of trade unions, regulation, and improvement of relations between employers and workmen and the avoidance and settlement of any differences or disputes arising between them and ancillary matters.

Pakistan has ratified the ILO conventions for the core labor standards, including:

- Freedom of association and collective bargaining (conventions 87 and 98)
- Elimination of forced and compulsory labor (conventions 29 and 105)
- Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
- Abolition of child labor (conventions 138 and 182).
- Pakistan has also ratified the United Nations (UN) Convention on the Rights of the Child in 1990 but is not yet subscribed to the UN Convention of the Protection of the Rights of all Migrant Workers and Members of their Families.

The constitution of Pakistan contains a range of provisions with regard to labor rights found in Part II: Fundamental Rights and Principles of Policy:

- Article 11 of the constitution prohibits all forms of slavery, forced labor, and child labor.

- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions.
- Article 18 prescribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business.
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone.
- Article 37(e) makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment.

Pakistan's labor laws trace their origins to legislation inherited at the time of partition. The laws have evolved in response to socioeconomic conditions, shifts in governance, state of industrial development, population and labor force expansion, growth of trade unions, level of literacy, and the government's commitment to development and social welfare.

Under the constitution, labor is regarded as a 'concurrent subject,' which means that it is the responsibility of both the federal and provincial governments. However, for the sake of uniformity, laws are enacted by the federal government, stipulating that provincial governments may make rules and regulations of their own according to the conditions prevailing in or for the specific requirements of the provinces.
The labor laws are a comprehensive set of laws in Pakistan dealing with the following aspects:

- Contract of employment
- Termination of contract
- Working time and rest time (working hours, paid leaves, maternity protection and other leave entitlements).
- Minimum age and protection of young workers
- Equality
- Pay issues
- Workers' representation in the enterprise
- Trade union and employer's association regulation
- Other laws.

2.1.8 Pakistan Antiquity Act, 1975

The Pakistan Antiquity Act (1975) is applicable to the Khyber Pakhtunkhwa (KP). The current Antiquities Act 1975 (amended in 1990), redefined as 'ancient' any object that is at least 75 years old. It requires that all accidental discoveries are reported to the federal Department of Archeology. It also makes the federal government the owner of all buried antiquities discovered from any site, whether protected or otherwise. It bans all new construction within a distance of 200 feet from protected antiquities. The cultural heritage laws of Pakistan are uniformly applicable to all categories of sites regardless of their state of preservation and classification as monuments of national or world heritage. The Antiquities Act guarantees that no changes or repairs can be made to a protected monument even if it is owned privately without approval of the official agencies concerned with it.

2.1.9 Khyber Pakhtunkhwa Antiquities Act, 2016

KP has promulgated an act to protect, preserve, develop and maintain antiquities in the Province. The act defines "Antiquity" as any ancient product of human activity which has been in existence for a period of not less than one hundred years.

The act covers the establishment of different bodies; antiquities and related issues; development schemes; new construction and use of movable antiquities; excavation or exploration and related matters; and other miscellaneous provisions. It bans all new construction within a distance of 200 feet from protected antiquities except with the approval of the Directorate.

2.1.10 The Protection against Harassment of Women at the Workplace Act 2010

The act is applicable to Khyber Pakhtunkhwa (KP). The act protects women against sexual harassment at the workplace. The act is composed of 13 sections elaborating definitions, composition of the inquiry committee, procedure for holding inquiry, penalties (minor and major), powers of inquiry committee, role of the employer, the process for appeal against minor and major penalties, ombudsmen and powers of the ombudsmen.

2.1.11 The Khyber Pakhtunkhwa Prohibition of Employment of Children Act, 2015

According to this Act, "child" means a person who has not completed his fourteenth year of age. The act specifies that no child shall be employed or permitted to work in any establishment.

The act also states that a child not below the age of 12 years may be engaged in the light work, alongside his family member, for a maximum of two hours per day mainly for the purpose of acquiring skills, in a private undertaking or in any school established, assisted or recognized by Government for such purpose.

It is also specified that no adolescent shall be employed or permitted to work in any hazardous work included in the Schedule.

The act also stipulates the constitution of committee on child labor and covers the important aspects related to hours and period of work, weekly holidays, notice to inspector, disputes as to age, maintenance of register, and display of notice, abstract of sections and health and safety.

2.1.12 Guidelines for Public Consultation, 1997

These guidelines issued by the Pakistan Environmental Protection Agency address possible approaches to public consultation and techniques for designing an effective program of consultation that reaches all major stakeholders and ensures the incorporation of their concerns in any impact assessment study. The guidelines cover consultation, involvement and participation of stakeholders; effective public consultation (planning, stages of an Environmental Impact Assessment (EIA) where consultation is appropriate); and facilitation of involvement (including the poor, women, and NGOs).

2.1.13 Other Relevant Environmental Legislation

An overview of other relevant legislation relevant to the environmental and social aspects of the Project is presented in **Table 2.3**.

Table 2.3: Other Relevant Social and Environmental Legislation

Legislation / Guidelines	**Brief Description**	**Relevance to the Proposed Project**
National Environmental Quality Standards 2012	Powers for regulating Environmental Quality Standards (EQS) transferred from the national government to the provincial governments in 2012. The EQS are materially the same as the National EQS (NEQS) that were established in 1993 and were subject to amendment in 2000, 2009, and 2010. EQS relevant to the Project include:	The Project will comply with these standards.

Legislation / Guidelines	Brief Description	Relevance to the Proposed Project
	• Municipal and liquid industrial effluents (32 parameters) • Industrial gaseous emissions (18 parameters) • Motor vehicle exhaust and noise (used and new vehicles) • Ambient air quality (9 parameters) • Drinking water quality (32 parameters) • Noise (four zones during day and night).	
Forest Act (1927) and Forest (Amendment) Act (2010)	The Forest Act of 1927 establishes the right of GoP to designate areas of reserved forest, village forest and protected forest. GoP is enabled to acquire such areas in order to prohibit or restrict the public use of such resources or other activities within them.	It has been confirmed in consultation with the Forest Department that no such areas are present within the study area
Protection of Trees and Brushwood Act (1949)	The Protection of Trees and Brushwood Act of 1949 prohibits the cutting or lopping of trees along roads and canals planted by the Forest Department unless the prior permission of the Forest Department is obtained.	PEDO will take prior permission from the Forest Department for cutting of trees
Wildlife and Biodiversity (Protection, preservation and conservation management act), 2015	The Act has been instated to consolidate the laws relating to protection, preservation, conservation and management of wildlife in KP. It places restrictions on hunting, possession and display of wildlife, trade and trafficking of wildlife or wildlife products, and protected areas. Wildlife offences and penalties for those offences are provided in the Act.	This act will apply to all the project workers
Workers Compensation Act, 2013 Minimum Wages, Act 2013	The Act provides for the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments.	The Project will ensure that all workers are paid at least minimum wages.
Rivers Protection Ordinance 2002	The ordinance has been instated to provide for the protection of aquatic ecology, water quality, economic and environmental value of rivers and their tributaries in KP. The ordinance has been instated keeping in view the increasing developments along rivers in KP and the need to maintain the quality of the rivers for public use. The rules set out will be applicable to any length of a particular river or stream or any part of a river or its tributary that has been specified by the Government.	The rules laid out in the ordinance relate mainly to encroachment onto the river and pollution of the river. It is important that Project-related activities do not pollute the river and that all construction activities along the river banks be carried out within the area designated for them.
Right to Information Act, 2013	The Act provides for ensuring transparency and access to information in KP.	Information of the Project will be shared on PEDO's website
Motor Vehicle Ordinance (1965) and Rules (1969)	The ordinance deals with the licensing requirement for driving; powers of licensing authority, Regional Transport Authority and those of Court vis-à-vis disqualification for	The contractor will have to comply with these Rules.

Legislation / Guidelines	Brief Description	Relevance to the Proposed Project
	license and registration requirements to control road transport; compensations for the death of or injury to a passenger of public carrier; powers of Road Transport Corporation; traffic rules, power to limit speed, weight, use of vehicles; power to erect traffic signs; specific duties of drivers in case of accident and powers of police officers to check and penalize traffic offenders.	
Highway Safety Ordinance (2000)	This Ordinance includes provisions for licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control offenses, penalties and procedures; and the establishment of a police force for motorways and national highways to regulate and control the traffic as well as keep the highways clear of encroachments.	PEDO's contractors will comply with this Ordinance.
Pakistan Penal Code (1860)	The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of the environment, the Penal Code empowers local authorities to control noise, toxic emissions and disposal of effluents.	PEDO's contractors will comply with this Code.
Pakistan Explosives Act (1894)	The Pakistan Explosive Act of 1884 provides regulations for the handling, transportation and use of explosives during quarrying, blasting and other purposes. The quarrying of stone for rip rap or concrete aggregates may need blasting at the quarry site. In this event these regulations will be applicable for this project.	PEDO's contractors will comply with this Act.
Regulation of Mines and Oil Fields/ Mineral Development Act (1948)	This legislation provides regulatory procedures for the quarrying and mining of construction material on the public as well as private lands.	PEDO's contractors will comply with this Act.

2.1.14 Legislation Related to Gender-Based Violence

Legal and Policy Framework of GoP/KP. Article 25 of the Constitution of the GoP, while guaranteeing gender equality, empowers the State to make special provisions for the protection of women. This includes the protection of the right to life, liberty, economic empowerment, and education. The gender based violence (GBV) is covered under the legal framework of GoKP to protect women against harassment in the workplace. The Khyber Pakhtunkhwa Harassment of Women in the Workplace (Amendment) Act, 2017 requires a number of actions to protect women against harassment in the workplace. As a result, the GoKP appointed a woman as the provincial Women's Ombudsperson for receiving and disposing of complaints of working women against harassment in their respective places of employment. The Government of Khyber Pakhtunkhwa has also established a Commission on the Status of Women under the Khyber Pakhtunkhwa Commission on the Status of Women Act (2016). Moreover, a provincial Women's Empowerment Policy was launched in 2015 in pursuance of the province's commitment to gender equality. The Government of Khyber Pakhtunkhwa is committed to further improve the situation of women's rights and formulated a KP Human Rights Policy 2018, which also provides recommendations on violence against women and children. PEDO, being a part of GoKP, will comply with the Khyber Pakhtunkhwa Harassment of Women in the Workplace (Amendment) Act, 2017 of GoKP. The PEDO was instructed through a formal letter by Energy & Power Department dated 28-08-2017 on Implementation of "Protection Against Harassment of Women at Workplace Act 2010". The PEDO established requisite "Inquiry Committee" through Office Order No. 5958 dated 21/09/2017.

International Commitments Signed by Pakistan. The Government of Pakistan has ratified various international human rights instruments, committed to securing equal rights for women including, the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) and International Labor Organization (ILO) Conventions No. C-100 (Equal Remuneration Convention) and C-111 Discrimination (Employment and Occupation). CEDAW obliges member States, to eliminate all forms of discrimination against women and bring de-jure and de facto equality between men and women. It also obliges States to take all legislative, administrative and other measures to ensure women's participation in economic, political and national life. In addition to CEDAW, ILO Convention No. 100 and No. 111 provide for equality of opportunity and treatment in all employment-related matters including remuneration.

2.2 Environmental Approval Requirements of the Project

According to EIA/IEE regulations of 2010, the projects with hydroelectric power generation less than 50 MW and transmission lines less than 11 kV fall under Schedule 1, and require submission of IEE for environmental clearance from KP EPA. The projects more than these capacities will fall under Schedule II. The Project falls into Schedule II and PEDO will submit this ESIA for approval of KP EPA. The KP EIA approval process is illustrated in **Figure 2.1**. PEDO will submit this ESIA to KP-EPA after approval of the ESIA from the World Bank.

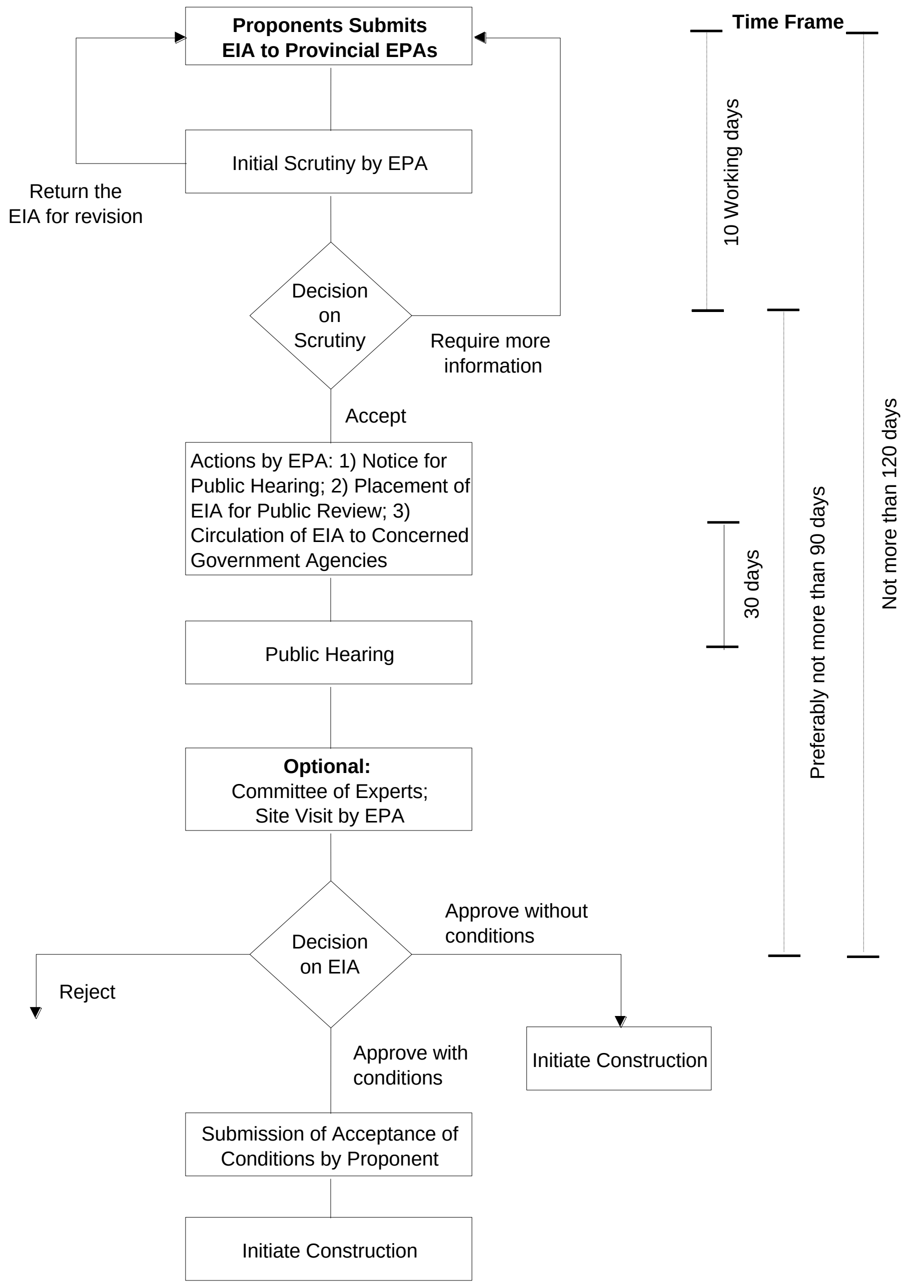


Figure 2.1: EIA Review and Approval Process

2.3 Environmental Regulatory Authorities

Since the project area falls in KP province, the KP Environmental Protection Agency (EPA) is the relevant environmental regulatory authority. The provincial EPAs are responsible for environmental regulation and implementing GoP environmental policies in their respective provinces. As part of their roles, provincial EPAs are responsible for reviewing EIA documentation for compliance with provincial EIA requirements and procedures and, using their district-based staff, also monitors the implementation of EMPs.

Statutory functions of the provincial EPAs are to:

- Administer and implement the Environmental Protection Act, its rules and regulations
- Review IEE/EIA, preparation of procedures and guidelines
- Prepare, revise and enforce EQS (industries, municipalities, vehicular emission)
- Establish and maintain laboratories, certification of laboratories for conducting tests and analysis
- Assist local Councils, Authorities and / or Government Agencies in the execution of projects
- Establish a system of surveys, monitoring, examination, and inspection to combat pollution
- Conduct training for Government functionaries and industrial management
- Provide information and education to the public on environmental issues
- Publish the Annual State of the Environment report
- Undertake surveys and qualitative and quantitative analysis of data on air, soil and water quality, and industrial, municipal and traffic emissions
- Take measures to promote environment-related Research and Development (R&D) activities.

Other key relevant departments in the province and their roles are summarized below.

- **Forest**
    - Preparation and implementation of policies and programs in the forestry sector.
    - Implementation of Forestry Laws and rules.
    - Protection, conservation, development, and management of renewable natural resources, particularly forests and rangelands in the province.
    - Sustainable management of forest for production of timber, firewood and other non-timber produce and services.
    - Demarcation and protection of Forest land against encroachment.
    - Raising of nurseries and plantations.
    - Provide extension services for mass awareness and conduct research and training for capacity building.
    - The Forest Department will be involved in case of the need to fell any trees in the government forests.
- **Wildlife**
    - Protection, conservation, preservation, and management of wildlife.
    - Management of protected areas, wildlife parks, safaris, and zoos.
    - Public and private participation through trophy hunting, private breeding farms and hunting associations.
    - As such no protected areas fall within or adjacent to the study area of the ESIA however contractor and its staff will have to comply with the relevant wildlife protection legislation.
- **Fisheries**
    - Extension services/fish farming/aquaculture development.
    - Conservation, management and development of natural resources.
    - Production of fish seed under controlled conditions.
    - Research and training activities.
    - Introduction of new technologies for enhancing fish production.
    - The Fisheries Department will be involved in case of any damage to any fish resources and fishponds caused by the project activities.
- **Revenue Department**

- The revenue department is responsible for the acquisition of land (permanent or temporary) including assessment, valuation, disbursement of compensation, and mutation in favor of PEDO.

- **Agriculture Department**
    - In case of an impact on crops and fruit trees, the Agriculture Department is fully responsible for the assessment and valuation of losses.
- **Communication & Works (C&W) Department**
    - The C&W will be involved in the assessment and valuation of losses in case of project impact on structures/ buildings and roads.

2.4 International Treaties Signed by Pakistan

Pakistan is a signatory to a number of international environment-related treaties, conventions, declarations, and protocols. The following are the relevant international treaties and conventions to which

- Convention on the Conservation of Migratory Species of Wild Animals
- Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal
- Convention concerning the Protection of World Culture and Natural Heritage
- Convention on the International Trade in Endangered Species
- International plant protection convention
- International Covenant on Economic, Social and Cultural Rights
- International Labor Organization's (ILO) Core Labor Standards on:
- Freedom of association (convention 87)
- Elimination of forced and compulsory labor (conventions 29 and 105)
- Elimination of discrimination in respect of employment and occupation (conventions 100 & 111)
- Abolition of child labor (conventions 138 and 182)
- Kyoto Protocol to the Convention United Nations Framework on Climate Change
- Stockholm Convention on Persistent Organic Pollutants
- United Nations Convention on Biological Diversity
- United Nations Convention on the Rights of the Child
- United Nations Framework Convention on Climate Change.

2.5 World Bank Safeguard Policies and Guidelines

The World Bank has developed a number of Safeguard Policies to ensure that all possible impacts are considered, and mitigation measures are spelled out prior to the implementation of any proposed project. These policies ensure that the quality of operations is uniform across different settings worldwide. If the decision is taken that a Safeguard Policy should be applied, mitigation measures and plans must be developed and in place before the implementation of a proposed project.

The Bank requires environmental screening and classification for all investment projects proposed for Bank financing, to help ensure that they are environmentally and socially sound and sustainable. Screening and classification take into account the natural environment (air, water, and land); human health and safety; social aspects (including especially involuntary resettlement and presence of Indigenous Peoples); cultural property; and trans-boundary and global environmental aspects.

The objectives of environmental screening and classification are to evaluate the environmental risks associated with a proposed operation; to determine the depth and breadth of Environmental Assessment (EA); and to recommend an appropriate choice of EA instrument(s) suitable for a given project. The Bank recognizes that environmental screening and classification is not absolute and involves professional judgment on a case by case basis. When screening, careful consideration needs to be given to potential environmental impacts and risks associated with the proposed project. Judgment is exercised with reference to the policy expectations and guidance; real impacts on the ground; and established regional and Bank-wide precedence and good practice.

2.5.1 Environmental Assessment (OP/BP 4.01)

EA requirement. The World Bank requires environmental assessment (EA) of projects proposed for Bank support to ensure that they are environmentally sound and sustainable, and thus to improve decision making. The Bank Policy OP/BP 4.01 considers that EA is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. EA takes into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples and physical cultural resources); and trans-boundary and global environmental aspects. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The present ESIA has been prepared in compliance with this OP/BP.

EA classification. The World Bank classifies the proposed project into one of the four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. These categories are defined below.

- Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.
- Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.
- Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.
- Category FI: A proposed project is classified as Category FI if it involves the investment of Bank funds through a financial intermediary (FI), in subprojects that may result in adverse environmental impacts.

2.5.2 Natural Habitats (OP 4.04)

The Policy highlights the importance of conservation of natural habitats, like other measures that protect and enhance the environment, for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank also supports and expects borrowers to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank- promotes and supports natural habitat conservation and improved land use by financing projects designed to integrate into national and regional development the conservation of natural habitats and the maintenance of ecological functions. Furthermore, the Bank promotes the rehabilitation of degraded natural habitats. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.

2.5.3 Physical Cultural Resources (OP 4.11)

This policy addresses physical cultural resources, which are defined as movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings and may be above or below ground, or underwater. Their cultural interest may be at the local, provincial or national level, or within the international community.

The Bank assists countries to avoid or mitigate adverse impacts on physical cultural resources from development projects that it finances. The impacts on physical cultural resources resulting from project activities, including mitigating measures, may not contravene either the borrower's national legislation or its obligations under relevant international environmental treaties and agreements.

2.5.4 Forests (OP/BP 4.36)

This Policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. The Bank believes that forests are very much essential for poverty reduction and sustainable development irrespective of their location in the world. The Bank assists borrowers with forest restoration activities that maintain or enhance biodiversity and ecosystem functionality. The Bank also assists borrowers with the establishment and sustainable management of environmentally appropriate, socially beneficial, and economically viable forest plantations to help meet growing demands for forest goods and services. The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical natural habitats. Furthermore, the Bank does not finance projects that contravene applicable international environmental agreements.

2.5.5 Projects on International Waterways (OP 7.50)

Projects on international waterways may affect the relations between the World Bank and its borrowers, and between riparian states. Therefore, the Bank attaches great importance to the riparian making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections.

2.5.6 Involuntary Resettlement (OP/BP 4.12)

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.

The overall objectives of the Policy are given below.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

2.5.7 Projects in Disputed Areas (OP 7.60)

Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B.

2.5.8 Safety of Dams (OP 4.37)

When the Bank finances a project that includes the construction of a new dam,3 it requires that the dam be designed, and its construction supervised by experienced and competent professionals. It also requires that the borrower4 adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works.

For large dams (dams of more than 15 m height), the Bank requires

a) reviews by an independent panel of experts (the Panel) of the investigation, design, and construction of the dam and the start of operations;

b) preparation and implementation of detailed plans: a plan for construction supervision and quality assurance, and instrumentation plan, an operation, and maintenance plan, and an emergency preparedness plan;

c) prequalification of bidders during procurement and bid tendering, and

d) periodic safety inspections of the dam after completion.

2.5.9 Environment, Health and Safety Guidelines

The Environment, Health, and Safety (EHS) Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities or projects by existing technology at reasonable costs. In addition, there are also industry-specific EHS guidelines. The guidelines that are relevant to the

Project are: General EHS Guidelines[1] and Good Practice Note on EHS Approaches for Hydropower Projects[2].

2.5.10 Public consultation and disclosure requirements by World Bank

The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. Accordingly, it is Bank's policy to be open about its activities and to welcome and seek out opportunities to explain its work to the widest possible audience. According to 'OP 4.01: Environmental Assessment' of the World Bank, the following conditions apply to the Project.

Consultations. For all Category A and B projects, the borrower should consult the project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and takes their views into account. The borrower should initiate such consultations as early as possible. For Category A projects, the borrower should consult these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) once a draft EA report is prepared. In addition, the borrower should consult with such groups throughout project implementation as necessary to address EA-related issues that affect them.

Disclosure. For a Category A project, the borrower should provide relevant information on project interventions in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The borrower should provide a summary of the proposed project's objectives, description, and potential impacts for the initial consultation. For consultation after the draft EA report is prepared, the borrower should provide a summary of the EA's conclusions. In addition, for a Category A project, the borrower makes the draft EA report available at a public place accessible to project-affected groups and local NGOs. The borrower also ensures that EA reports for Category A subprojects are made available in a public place accessible to affected groups and local NGOs. The document needs to be translated into Bengali. Public availability of the EA report for Category A project in the borrowing country and official receipt by the Bank are prerequisites to Bank appraisal of these projects.

2.5.11 Applicable World Bank Policies to the Project

The applicable World Bank policies for the proposed investments under the Project are given in **Table 2.4**.

Table 2.4: Applicable World Bank Policies for the Project

OP/BP	Triggered	Actions by PEDO
Environmental Assessment (OP4.01/BP4.01)	Yes	The Project is classified as Category A. PEDO has prepared this ESIA in compliance with the requirements of the policy.
Natural habitats (OP4.04/BP4.04)	Yes	The fish migration and river habitat will be obstructed due to the construction of the weir and diversion of water for power generation. PEDO has carried out studies to understand the fish habitat and biology in the project area and designed a fish ladder and environmental flows to ensure there will be no hindrance to the fish migration and degradation of aquatic ecology.
Pest Management (OP4.09)	No	Not relevant since the Project will not undertake any related activity such as purchase and or usage of agro-chemicals. Chemicals and pesticides are not

[1] https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES

[2] https://www.ifc.org/wps/wcm/connect/79ad4356-6f18-4955-bf35-adcd6d072897/GPN_EHSHydropower.pdf?MOD=AJPERES&CVID=mR5BwAV

OP/BP	Triggered	Actions by PEDO
		used by transmission line companies to clear vegetation under the transmission lines.
Physical Cultural Resources (OP4.11)	Yes	The Project will not affect any PCRs. PEDO will include chance-find procedures in the contract documents. The Project will develop facilities to promote tourism around the project sites.
Involuntary Settlement (OP4.12)	Yes	PEDO has prepared a RAP for the Project in accordance with this policy and carry out land acquisition in accordance with the approved RAPs.
Forests (OP4.36)	Yes	There will be a limited impact on two small forest patches located on the right bank near the weir site and powerhouse site. About 636 forest trees and 48 fruit and wood trees owned by communities will be cleared from these areas. PEDO will compensate these losses by providing compensation, provide financial support to the Forest Department in the plantation development, and develop plantation in the colony and around the project facilities.
Indigenous Peoples (OP 4.10)	No	No indigenous people, as defined in the Policy, are known to exist in the Program area.
Safety of Dams (OP 4.37)	Yes	PEDO will appoint an independent panel of experts to review the project designs. PEDO will monitor the dam safety during the operation.
Projects on International Waterways	Yes	The Project is located on the Gabral River, which a tributary of the Swat River. The Gabral river originates in Pakistan. The Swat River also originates and flows through Pakistan only and joins the Kabul River within Pakistan.
Consultations and Disclosure		PEDO has consulted with various stakeholders, including the affected communities during the preparation of the ESIA and RAP. PEDO has also shared the draft ESIA and RAP, during a public consultation meeting on November 7, 2019, and updated the draft reports based on this consultation. The ESIA and RAP (including translated versions of the executive summaries) will be disclosed on the PEDO website and will be sent to World Bank for the disclosure on its external website.

3 Project Description

This chapter presents a detailed description of the proposed facilities in the Gabral Kalam Hydropower Project.

3.1 Project Layout

The Project will construct an 88 MW run-of-river hydropower project on the Gabral River to generate about 339 GWh of electricity annually. The power generated from the Project will be evacuated through a 2.7 km long transmission line to be built from the switchyard to the proposed transmission of Gorkin – Matiltan.

The main facilities of the Project include arrangements for power generation (weir, intake channel, sand trap, headrace tunnel, surge shaft, penstock, powerhouse, and tailrace) and facilities for power evacuation (switchyard and transmission line). A schematic drawing of the proposed project facilities is given in **Figure 3.1**, and a layout map of the proposed Project facilities is shown in **Figure 3.2.**

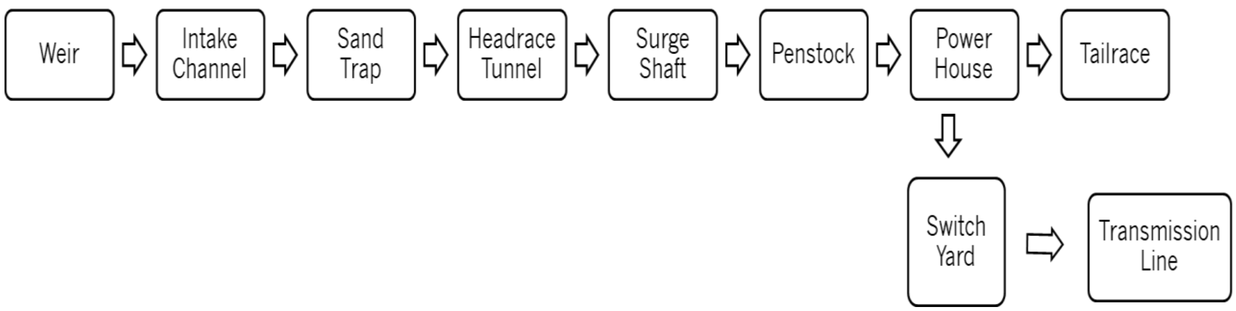


Figure 3.1: A schematic drawing of proposed project facilities

3.2 Key Project Facilities

Diversion Structure/ Weir

The proposed layout of the weir is given in **Figure 3.3** and cross-section of the weir is given in **Figure 3.4.** The weir site is accessible via motorable road / track along the left bank of the Gabral River. The height of the weir is 21 m above the riverbed (31 m including foundation) and the width of the river at this weir site is about 100 m. The water level observed at the weir site is about 2142 masl. The normal conservation (operational) level of the pond (reservoir) will be 2161 masl considering 21m pond depth. The weir will be a concrete gravity structure with overflow spillway and under sluices. Stilling basin has been made an integral part of the weir body.

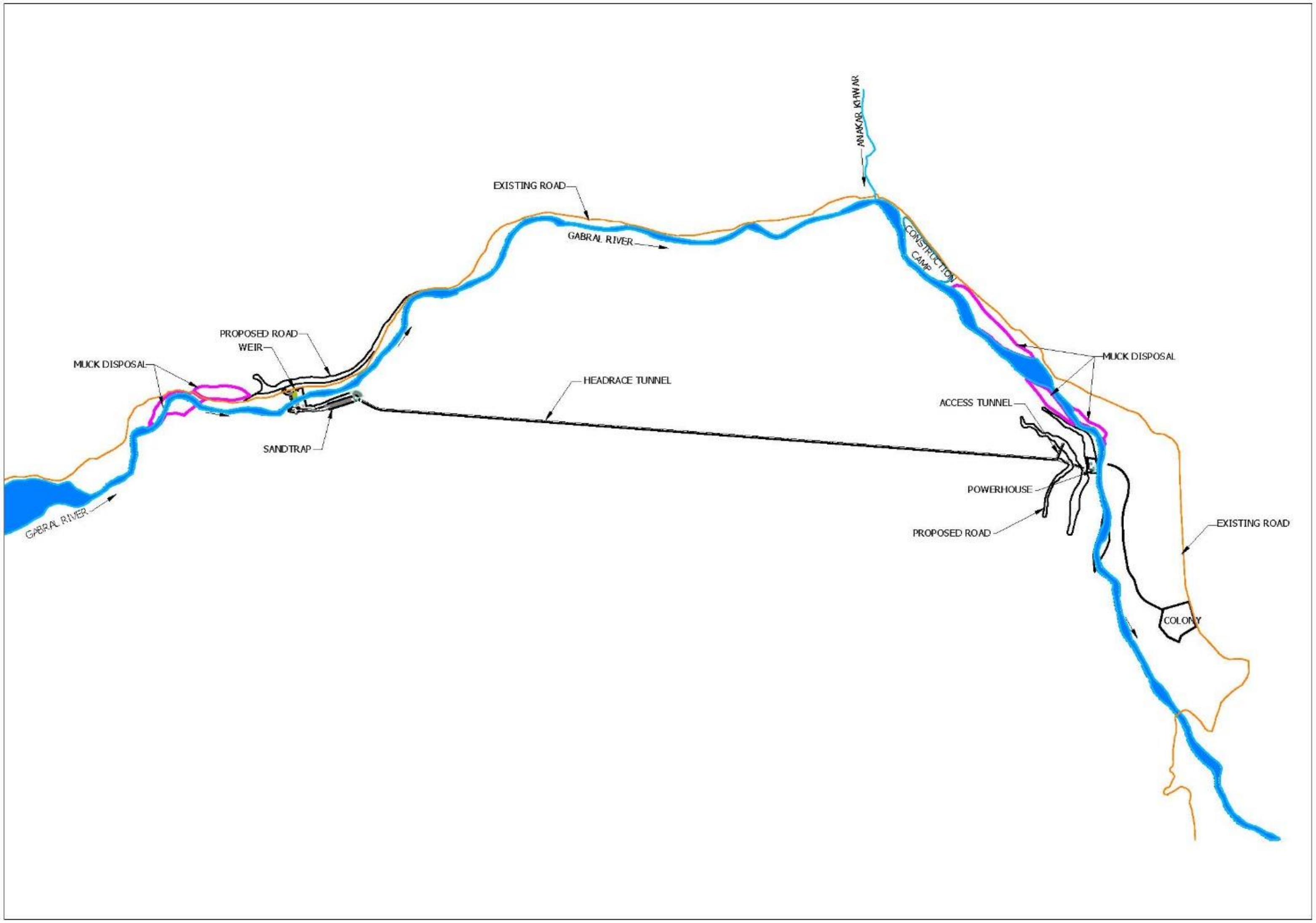


Figure 3.2: Project Layout

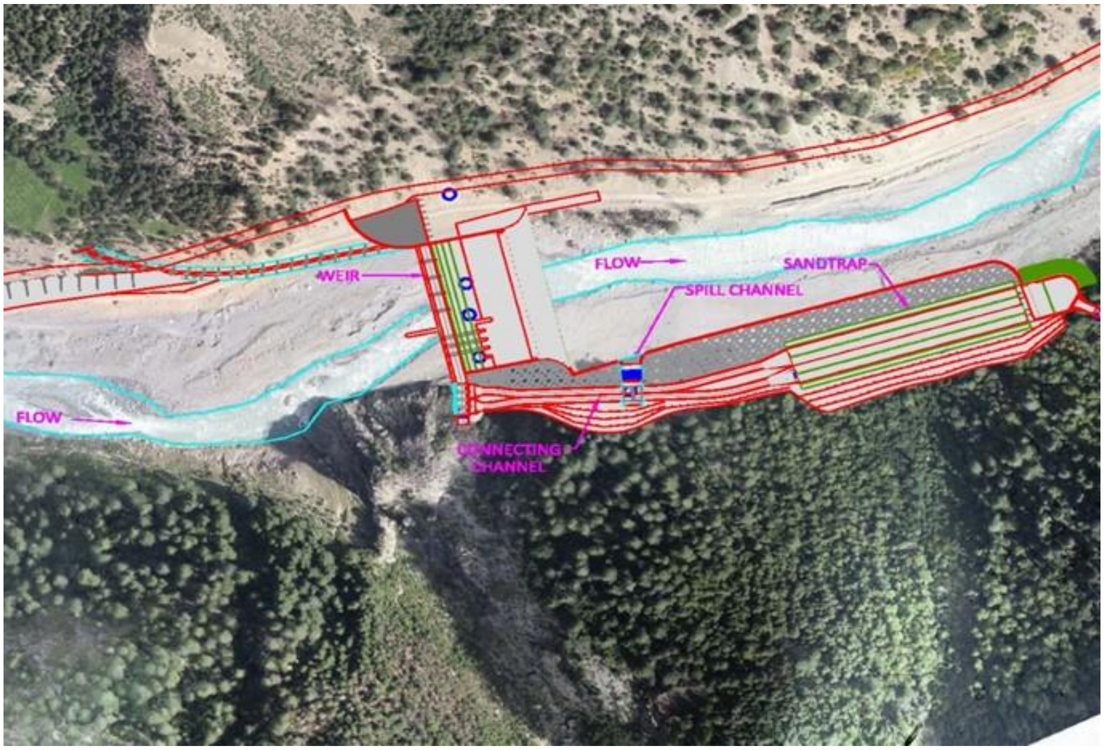


Figure 3.3: General layout of Weir, Intake Channel and Sand trap

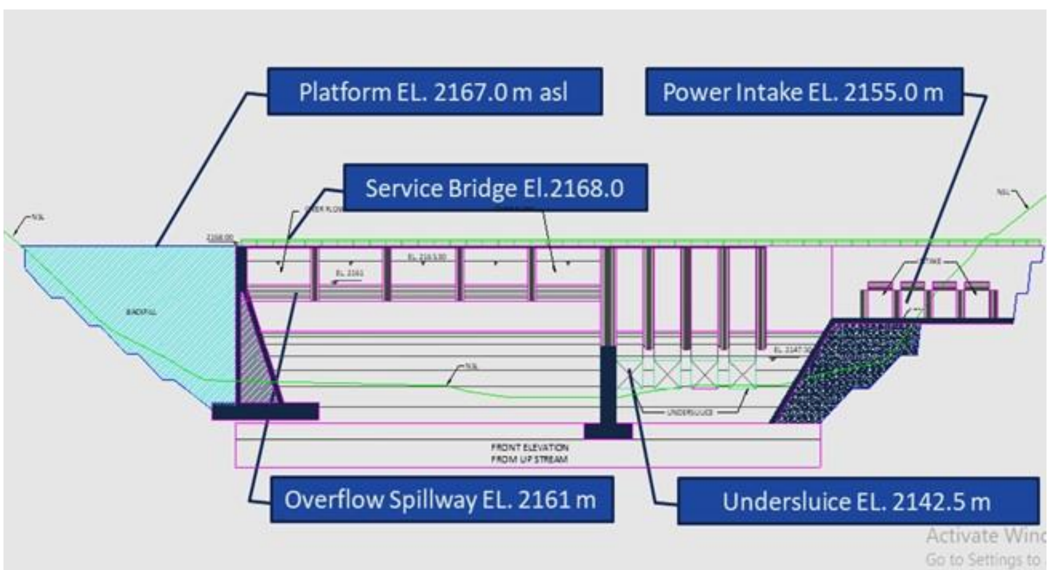


Figure 3.4: Cross-Section of Weir

Intake Channel and Sand trap

From the weir, the flow will be diverted through an intake channel to the sand trap. The intake channel will be a concrete-lined rectangular section with 35.0m x 27.5m dimensions. The depth of flow is 14 m and the design discharge speed is 0.5 m/sec. The invert level of the power intake is fixed below the normal reservoir level. The sand trap is of the gravity type and will remove particles up to 0.2 mm size and it is designed as a twin cell box structure. The dimensions of the sand trap are 14.75 x 13.5m and it will be of vertical lift type with 2 flushing gates. The layout of the intake channel and sand trap is shown in **Figure 3.2.**

Headrace tunnel

The envisaged headrace tunnel is about 4750 m in length up to surge shaft and the diameter of the tunnel is 5.8 m. It is designed as a low-pressure headrace with a modified Horseshoe type shape. From the headrace tunnel, water will be conveyed to the powerhouse by a combination of vertical pressure shaft and pressure tunnel. The entrance to the headrace tunnel is streamlined so as to reduce head losses and avoid cavitation. The area of the inlet is larger as compared to that of the headrace tunnel to ensure low entrance velocity. The entrance velocity at the inlet is kept as 0.61m/sec and the average flow velocity will be 2.38 m/sec. The layout map for the headrace tunnel is shown in **Figure 3.2.**

Surge Shaft and Penstock

From the headrace, tunnel water enters the surge shaft (used as pressure neutralizer in hydropower water conveyance system to resists excess pressure rise and pressure drop conditions). Relief valves are provided to relieve the detrimental effects of the water hammer produced because of a sudden load rejection / closure of the generating units. Surge shaft is of a simple restricted orifice type of circular shape with minimum and maximum surge levels of 2135.5 to 2189.5 masl. The height of the surge shaft is 65 m and the diameter is 12.9 m. From the surge shaft water enters the penstock, which comprises three branch pipes and the diameter of each pipe will be 4 m and the velocity of design discharge will be 5.17 m.

Powerhouse

At the end of the manifolds, water runs the turbines in the powerhouse area, located on the right bank of the Gabral River. The river level at the powerhouse location is about 1995 masl. Two turbines of 37.5 MW each and one turbine of 13 MW (Vertical-shaft Francis turbines) will be installed in the powerhouse. The layout of the powerhouse is given in **Figure 3.5.**

Switchyard

The switchyard will be a 220KV gas-insulated (GIS) *s*witchgear and related equipment such as Circuit Breakers, Disconnectors, Earthing Switches, and Lightning Arresters. The connection between each generator breaker and step-up transformers will be made with cables. The switchyard will have bays to accommodate cable feeders from the generator to the transformers. The overhead transmission line will be directly terminated in the switchyard. The control and protection system for the switchyard will be located inside the powerhouse building.

Transmission Line

A 2.7-km long 220 kV transmission line (TL) will be installed (12 towers with a footing of 10m x 10m, and right of way of 30m) from the switchyard to the proposed TL of Gorkin – Matiltan Hydropower Project (to be built in 2020-2021) for the evacuation of the power produced by the Project. The alignment of the proposed transmission line is shown in **Figure 3.6**.

The 2.7 km TL under the project connects into under construction transmission line for 84 MW Gorkin-Matiltan Hydropower project (GMHPP). The GMHPP transmission line is not an associated facility of the project because it will not be constructed contemporaneously with the Gabral Kalam Hydropower Project. The TL for GMHPP is expected to be completed by the end of 2021 and the construction of Gabral-Kalam is expected to start in early 2022. GMHPP TL would be constructed in any case to evacuate the power generation of GMHPP and would have been constructed even if the GKH was not constructed. Furthermore, it is not directly or significantly related to GKH.

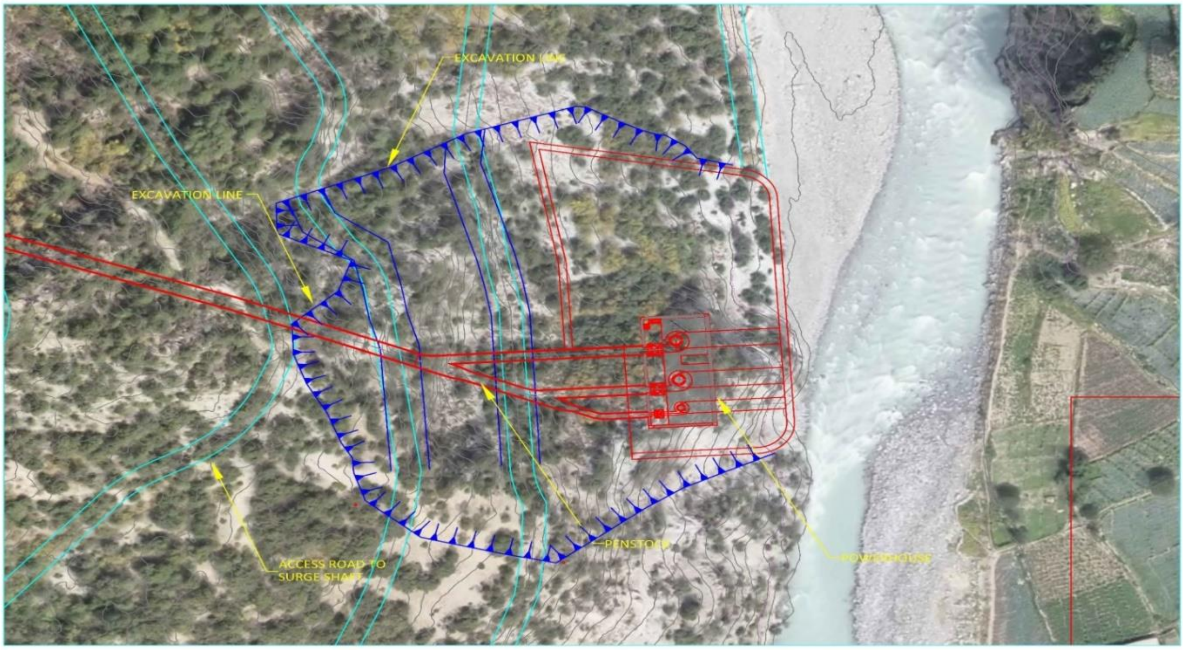


Figure 3.5: Layout of Powerhouse

Figure 3.6: Proposed Alignment of the Transmission Line

Fish Ladder

A fish ladder will be built in the weir to allow the movement/migration of fish on both upstream and downstream. The design of the fish ladder is based on the requirements of local fish species (depth of water, flow velocity, and slope). The drawing of the fish ladder is given in **Figure 3.7.**

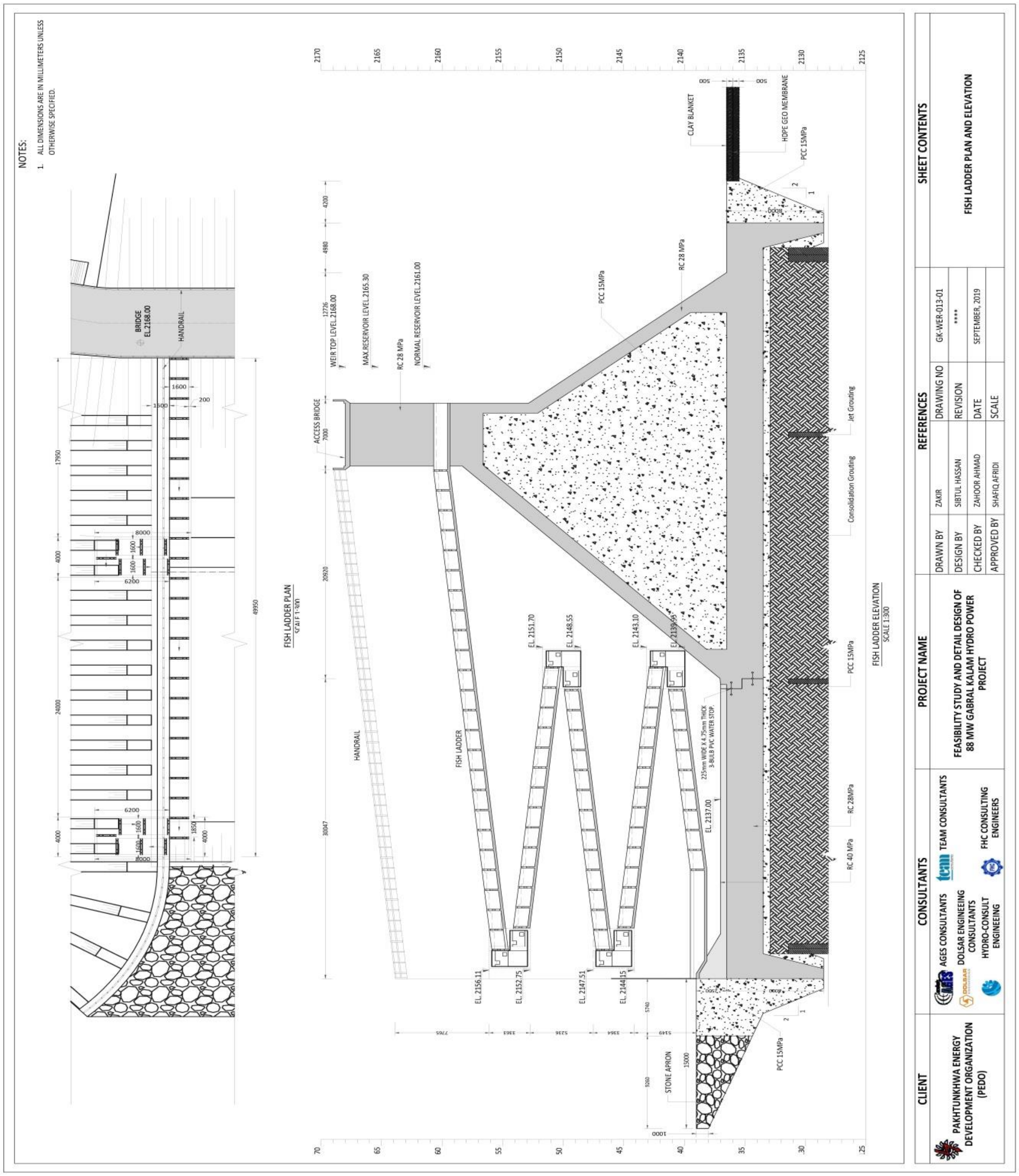


Figure 3.7: Design of Fish Ladder

3.3 Temporary Facilities

Diversion during Construction

Two cofferdams will be built on both upstream and downstream of the weir site to create a dry river bed for construction. The river flows from the upstream of the cofferdam will be diverted through an open channel below the downstream cofferdam. Cofferdams are earth-fill type embankments. The upstream cofferdam is 12 m high with 7 m wide crest. The downstream cofferdam is 7.5 m high with 7 m wide crest. The cofferdams will be used for the movement of vehicles during construction. Locations of the cofferdams are shown in **Figure 3.8.**

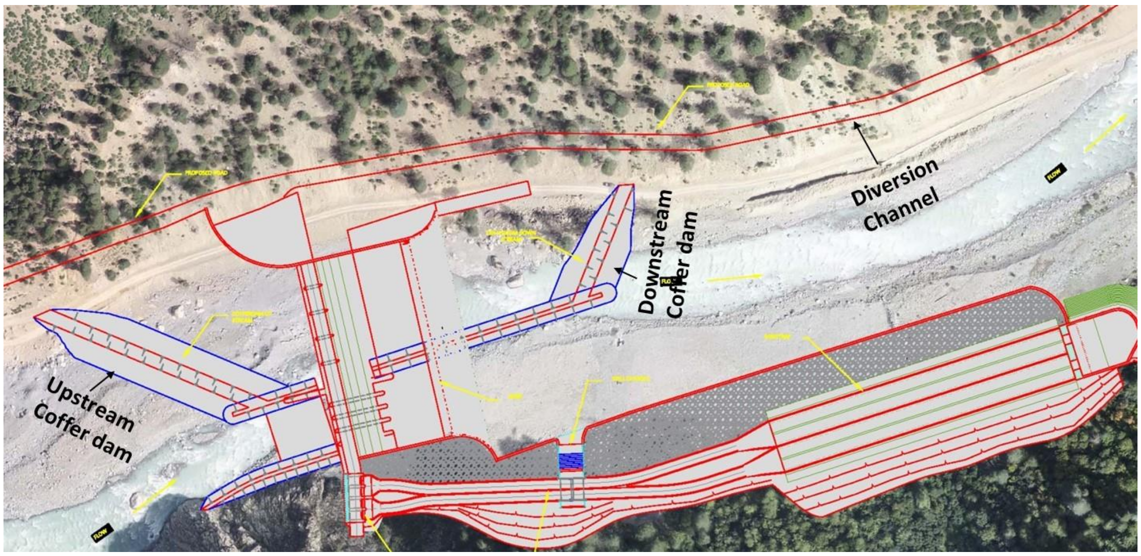


Figure 3.8: River Diversion Arrangement During Construction

Construction Camp

In principle, a construction camp should be located away from the main settlements as well as closer to the main construction components of the project. Keeping this in view, one construction camp will be established at a midpoint between Weir and Powerhouse.

An ideal location for the camp where almost all the contractor's facilities can be accommodated in the one on the left bank of the river just downstream of the confluence of Bhan Khwar (Anakar Khwar). The land available is about 10-12 acres along the main road. There are no settlements in the area, as this area was already eroded by the 2010 flood. The location of the proposed construction camp is shown on the map in **Figure 3.9.**

Spoil (Muck) Disposal Site

About 800,000 to 1,000,000 m^3 spoil (muck) material will be generated from the construction of weir, sand trap, tunnel, powerhouse, and other facilities. Most of these spoils will be generated from the weir site area, and hence a location close to the weir site is identified in a land that was eroded by the 2010 flood. The location of the spoil disposal site is shown in **Figure 3.10**. A spoil disposal site will also be developed near the powerhouse site.

Figure 3.9: Location of Construction Camp

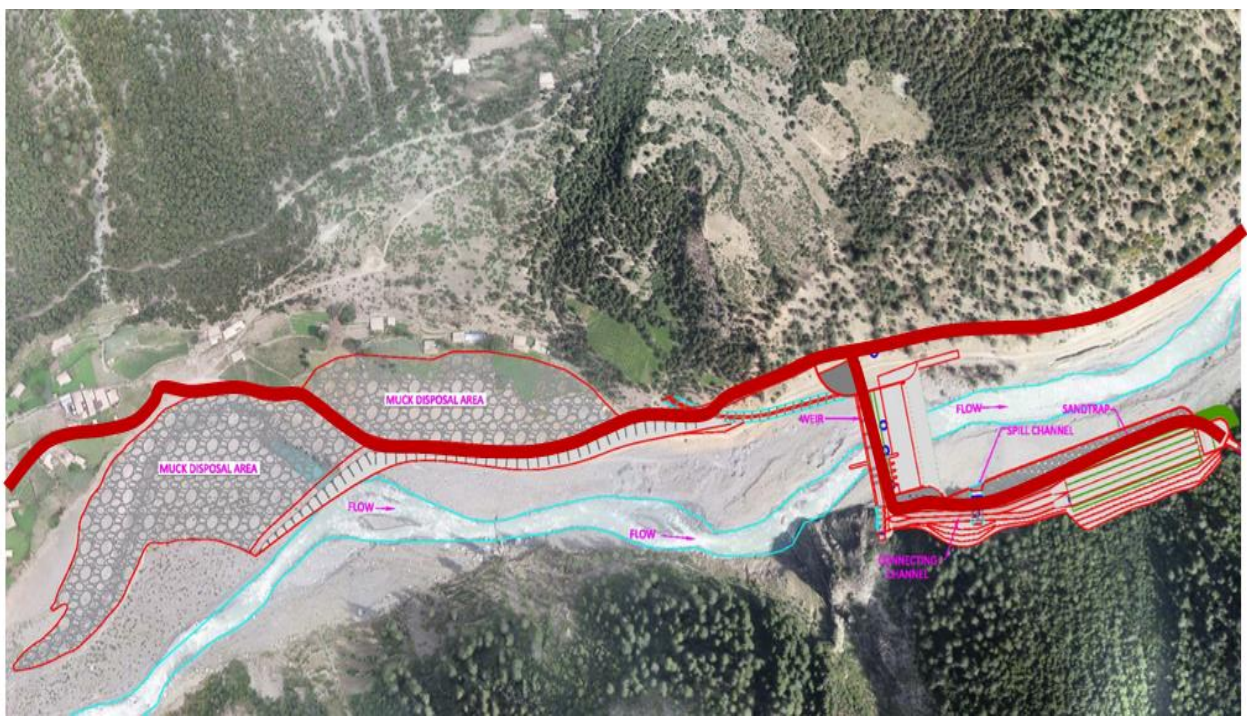


Figure 3.10: location of Muck Disposal sites and Access Roads (in dark red color)

3.4 Other Permanent Facilities

Access Roads

About 6.6 to 6.8 km of roads will be built to access the project facilities, and for the relocation of the existing road near the weir site. The proposed roads:

- Re-routing of the existing Kalam Gabral Road at weir site (1.4 km)
- The access road from the weir to tunnel inlet portal (300-400m)
- The access road to powerhouse (600-700m)
- The access road to surge shaft and headrace tunnel (4300m, including a 63.5 m long bridge)

The location of the proposed roads in the weir site is shown **in Figure 3.10,** and access roads to the powerhouse area are shown in **Figure 3.11.**

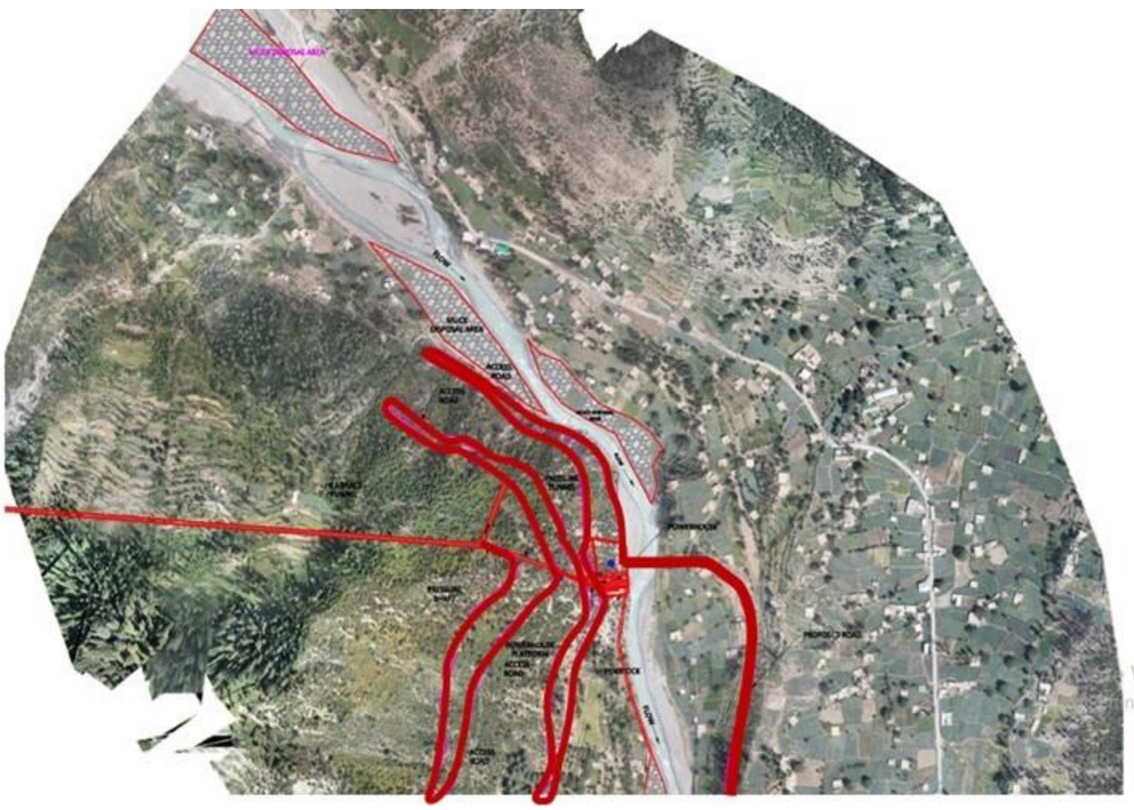


Figure 3.11: Location of proposed access roads in the Powerhouse area

Colony Area

A colony will be built for PEDO operation and maintenance (O&M) staff. The colony (in 9.3 acres) will include residences for 50 staff and facilities such as water supply and sanitation, roads, a primary school, a dispensary, a mosque, a park, a guest house, a community center, and shops. A layout of the colony is shown in **Figure 3.12.**

Figure 3.12: Colony for O&M Staff

3.5 Resource Requirements

Construction materials:

About 0.59 million cubic meters of aggregates (288,076 m^3 of fine and 303,651 m^3 of coarse) are required for the construction of the Project. Surface boulder deposits available on the riverbed and river embankment on the reservoir area of the weir will be used as aggregates. About 33,055 tonnes of steel and 170 million tonnes of cement will be required during construction.

Construction Equipment

The estimated requirement of construction equipment is given in **Table 3.1**. In addition, about 20 to 30 trucks per day will be used by the Contractor for the supply of material during construction.

Table 3.1: Estimated Construction Equipment

#	Type of Equipment	Quantity	#	Type of Equipment	Quantity
1	Excavators	12	13	Fuel Truck	1
2	Tractors	5	14	Crushing Plant	1
3	Pavers	5	15	Loader	7
4	Dumpers	25	16	Grader	1
5	Batching Plants	1 Unit	17	Compactors	5
6	Wheel Loaders	4	18	Concrete Trucks	3
7	Bulldozers	2	19	Concrete Cutting Machines	3
8	Rock Drill	10	20	Cranes	2
9	Compressor	4	21	Ambulance	1

#	Type of Equipment	Quantity
10	Diesel Generator	10
11	Water Sprinkler	2
12	Down-the-hole Drill	2

#	Type of Equipment	Quantity
22	Road Roller	2
23	Shotcrete Machines	2
24	Vibrators	4

Labor Requirements

About 500 workers, both skilled and unskilled, will be required throughout the construction period of five years. Out of which, about 200 will be outside workers (60 foreigners and another 140 will be from Pakistan but outside the project area), and 300 laborers are local, mostly un-skilled or semi-skilled labour. During the peak construction period, the requirement of local labour may increase up to 500 to 600.

3.6 Project Cost and Construction Schedule

The total cost of the Project is USD 224 million. The proposed construction period of 4 years and the detailed construction schedule is shown in **Figure 3.13**.

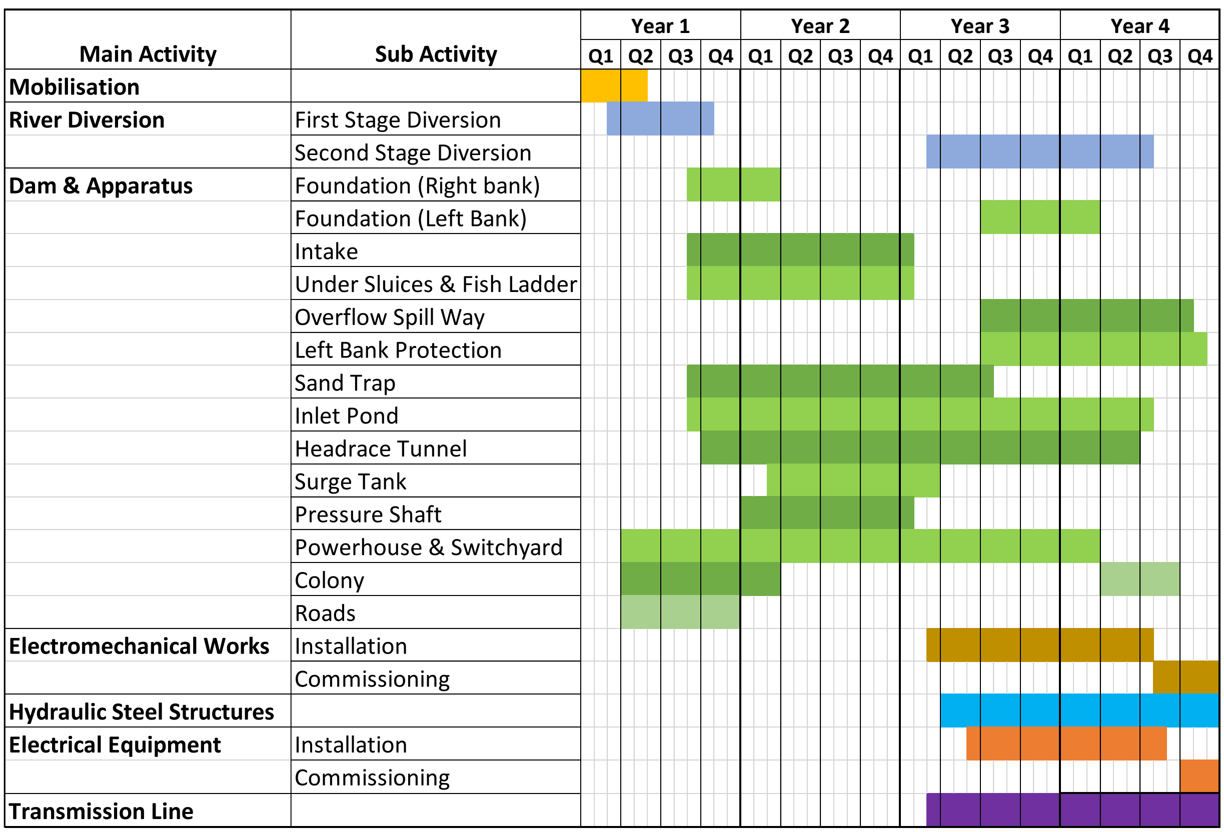


Figure 3.13: Construction Schedule of the Project

3.7 Operation Mechanism

The Project is a run-of-river scheme, and it does not involve any peaking operation so there will be no storage and peaking are involved. The length of the reservoir is 875 m with a capacity of 1.08 million m^3. When flows in the river are less than the design discharge (65 m^3/s), flows excluding environmental flows will be utilized for power generation. Whereas when the river is above design discharge, the design discharge will be utilized for power generation, and the rest of the water will be released in the river downstream of the weir in addition to environmental flows. The flows to be used for power generation and environmental flows are given in **Table 3.2**. Environmental flow estimates are calculated based on the requirement of water uses in the dewatered sections, including fish species, and details of these calculations are given in **Section 7.9.2**.

Table 3.2: Required Flows for Power Generation

River Flows			Environmental Releases	Flows Available for Power	Power Flows	Additional Spills in River
10 - Daily		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)
Jan	I	7.90	2.00	5.90	5.90	
	II	7.55	2.00	5.55	5.55	
	III	7.28	2.00	5.28	5.28	
Feb	I	6.98	2.00	4.98	4.98	
	II	6.87	2.00	4.87	4.87	
	III	6.84	2.00	4.84	4.84	
Mar	I	7.13	2.50	4.63	4.63	
	II	8.07	2.50	5.57	5.57	
	III	9.79	2.50	7.29	7.29	
Apr	I	13.74	3.50	10.24	9.60	0.64
	II	20.66	3.50	17.16	17.16	
	III	33.21	3.50	29.71	29.71	
May	I	45.75	3.50	42.25	42.25	
	II	62.51	3.50	59.01	59.01	
	III	78.36	3.50	74.86	65.00	9.86
Jun	I	100.36	3.50	96.86	65.00	31.86
	II	118.04	3.50	114.54	65.00	49.54
	III	127.03	3.50	123.53	65.00	58.53
Jul	I	126.54	3.50	123.04	65.00	58.04
	II	118.66	3.50	115.16	65.00	50.16
	III	105.98	3.50	102.48	65.00	37.48
Aug	I	96.63	3.50	93.13	65.00	28.13
	II	80.76	3.50	77.26	65.00	12.26
	III	64.55	3.50	61.05	61.05	
Sep	I	49.73	3.50	46.23	46.23	
	II	38.55	3.50	35.05	35.05	
	III	29.16	3.50	25.66	25.66	
Oct	I	21.25	3.50	17.75	17.75	
	II	17.19	3.50	13.69	13.69	
	III	14.59	3.50	11.09	11.09	

Nov	I	12.73	3.50	9.23	9.23	
	II	11.38	3.50	7.88	7.88	
	III	10.20	3.50	6.70	6.70	
Dec	I	9.50	2.00	7.50	7.50	
	II	8.91	2.00	6.91	6.91	
	III	8.41	2.00	6.41	6.41	

3.8 Salient Features of the Project

A summary of the salient features of the Project is given in **Table 3.3**.

Table 3.3: Salient Features of the Project

S. No	Description	Details	
1	**LOCATION**		
	Country	Islamic Republic of Pakistan	
	Province	Khyber Pakhtunkhwa	
	District	Swat	
2	**HYDROLOGY**		
	Catchment Area at Dam Site	957	Sq.km
	Catchment Area at Powerhouse Site	1212	Sq.km
	Design Flood (QD)	65	m3/sec
	Design Flood (Q100)	1731	m3/sec
	Maximum Design Flood (Q1,000)	1731	m3/sec
3	**RESERVOIR**		
	Normal Conservation Level	2161.0	masl
	Flood Surcharge Level (Worst Case)	2165.3	masl
	Minimum Operating Level	2160.5	masl
	Depth of Reservoir at Weir Site	21	m
	Length of Reservoir	875	m
	Reservoir Capacity at NCL	1.08	MCM
4	**WEIR**		
	Weir Type	Concrete Gravity	
	Crest Elevation	2168	masl
	Slope: Upstream Face	1 in 0.8m	
	Slope: Downstream Face	1 in 1m	
	Height of weir above River Bed	21.0	m
	Maximum Height above Foundation	26.5	m
	Crest Length	149.5	m
	Crest width	7.0	m
5	**OVERFLOW SPILLWAY**		
	Type	Overflow ogee	
	Crest Level	2161.0	masl
	Length of Crest	67.5	m
	No. of Bays	5.0	m

S. No	Description	Details	
	Design Flood (Q100)	1143	m3/sec
	Energy Dissipator	Hydraulic jump, Stilling basin	
	Size of Stilling Basin	105 x 30 m	
	Stilling Basin Level	2137.0	masl
6	**UNDERSLUICE**		
	Type	Orifice type with ogee crest	
	Crest Level	2142.5	masl
	Head on Crest at NCL	18.5	m
	No. and Type of Gates	4.0 No's	Vertical lift
	Gate Size	5 x 5	m
	Total Length of Waterway	26.0	m
	Maximum Capacity at NCL	1293	m3/sec
	Crest Height above Foundation Level	6.5	m
	Energy Dissipator	Hydraulic jump stilling basin	
	Size of Stilling Basin	105 x 30 m	
7	**POWER INTAKE**		
	Type	Horizontal intake	
	Invert Level of Power Intake	2155.0	masl
	Working Head on Intake Crest	6.0	m
	Submergence Provided	1.0	m
	No. and Type of Gates	4.0 No's	Vertical lift
	Size of Gates	5 x 4.5m (H x W)	
	Total Width of Intake Structure	22.5	m
	Width of Waterway	18.0	m
	Design Discharge	65.0	m3/sec
	Discharge Capacity (Including Sediment Flushing Requirements)	78.0	m3/sec
	Intake Crest Height above River Bed Level	15.0	m
8	**FISH LADDER**		
	Type	Pool Pass type	
	Design Discharge	0.26	m3/sec
	Step Pools	109	No's
	Size of Pool	2.0m x 1.6m, (L x W)	
	Size of orifice	0.35m x 0.35m	
	Min. water depth	0.75	m
	Total Length of Fish Ladder	218.0	m
	Start Invert Level	2161.0	masl
	End Invert Level	2139.0	masl
9	**RIVER DIVERSION DURING CONSTRUCTION**		
	Coffer Dam		
	Type	Homogeneous fill type	
	Crest Elevation of Coffer Dams	2154.0 U/S	
	Diversion Flood (Q25)	10 years	Peak 781 m3/sec

S. No	Description	Details	
	Embankments Upstream Slope	1 in 1.5	
	Embankments Downstream Slope	1 in 1.5	
	Diversion Channel	Concrete lined	
	Type		
	Lining Thickness		
	Size of Diversion Channel (WxD)	16.0m wide & 7.5m deep	
	Length of Diversion Channel	620m	
	Depth of Flow in Diversion Channel at design flood 10 years	6.2m	
	Freeboard	1.3m	
	Flow velocity	5.1 m/sec	
10	**CONNECTING CONDUIT**		
	Type	Rectangular Box type	
	Number of Conduits	2.0	No's
	Design Discharge	39.0	m3/sec
	Size	5.2m x 5.0m, (W x D)	
	Average Length of Conduit	202.75	m
	Average Flow Velocity	1.60	m/sec
	Bed Level at Start	2155.5	m asl
	Bed Level at End	2155.44	m asl
	Friction Losses in Connecting Conduit	0.06	m
11	**SANDTRAP**		
	Type	Gravity type	
	Particle Size to be Removed	0.2	mm
	Average Velocity in Chambers	0.181	m/sec
	Length of Chamber	165	m
	Length of Upstream Transition	20.0	m
	Size of Sandtrap Chamber	14.75 x 13.5m	
	Invert Level of Sandtrap at Start	2155.44	masl
	Outflow Crest Elevation from Sandtrap	2156.5	masl
	Nos. and Type of Outflow Control Gates	2.0 No's	Vertical lift
	Outflow Control Gates Size	4.5m x 5.0m, (H x W)	
	Flushing Arrangement per Chamber	Gated control Orifice type	
	Flushing Discharge	13.0	m3/sec
	Total head losses in the sandtrap	0.062	m
	Trap Efficiency	79.0	percent
12	**INLET POND**		
	Type	Concrete lined rectangular section	
	Invert Elevation at Start	2147.0	masl
	Invert Elevation at Tunnel Inlet	2147.5	masl
	Size of Inlet Pond	35.0m x 27.5m	
	Depth of Flow	14.0	m

S. No	Description	Details	
	Submergence to Headrace Tunnel	10.4	m
	Elevation of Inlet Pond Top	2162.5	masl
	Velocity at Design Discharge	0.5	m/sec
13	**HEAD RACE TUNNEL**		
	Type	Low-pressure headrace	
	Shape	Modified Horseshoe type	
	Invert Elevation of Tunnel	2147.5	masl
	Flow Area	27.36	m2
	Average Flow Velocity	2.38	m
	Diameter of Tunnel	5.8	m
	Length of Tunnel up to Surge Shaft	4710	m
	Invert Level of Tunnel at Surge Shaft	2123.35	masl
	Head Loss in Tunnel	3.67	m
14	**SURGE SHAFT**		
	Type	Simple restricted orifice	
	Geometry	Circular type	
	Maximum Surge Level	2184.9	masl
	Minimum Surge Level	2137.86	masl
	Diameter of Surge Shaft	12.9	m
	Diameter of the Throat	4.0	m
	Full Operational Water Level	2156.83	masl
	Top Level of Surge Shaft	2193.0	masl
	Height of Surge Shaft	60	m
15	**PRESSURE SHAFT / TUNNEL**		
	Type	Pressurized tunnel	
	Geometry	Circular section	
	Pressure Shaft centerline at start	2126.25	masl
	Diameter of Pressure Shaft and Tunnel	4.0	m
	Flow Area	12.56	m2
	Length of Pressure Shaft	145.0	m
	Length of Pressure Tunnel	130.0	m
	Average Flow Velocity	5.17	m/sec
	Steel Lining thickness	10 to 26	mm
	Invert Level of Pressure Tunnel End	1990.1	masl
16	**PENSTOCK**		
	Invert Level of Penstock	1990.1	masl
	Length of Penstock	65.0	m
	Diameter of Penstock	4	m
	Thickness of Steel Lining	35.0	mm
	Velocity in Penstock at Design Discharge	5.17	m/sec
	Net Head at Penstock	159.61	m
	Head Losses in Penstock	1.98	m

S. No	Description	Details	
	Invert Level of Penstock at Powerhouse	1991.23	masl
17	**MANIFOLD**		
	Type	Symmetrical wye	
	Number of Branches	three	
	Diameter of each Branch Pipe	2.3	m
	Velocity in Manifold at Design Discharge	5.21	m
	Thickness of Steel lining	26	mm
18	**POWERHOUSE AND ACCESSORIES**		
	Type	Surface/Open	
	Size of Powerhouse	44x16 Meter	
	Turbine	Vertical frames/ Francis	
	Generation Units	3	No's
	Unit Discharge	2x27.7 & 1x 9.6	m3/sec
	Generator Type	Vertical synchronous type	
	Power Transformers	Step up-11kv- 220kv 3phase	
19	**TAILRACE**		
	Type	Concrete lined channel	
	Length of Tail race	15.48 m	
20	**SWITCHYARD**		
	Size of switchyard area	44x16 inside	
	Switchgear	Gas Insulated System (GIS) 220kv-3 phase	
21	**TRANSMISSION LINE**		
	Transmission line Length	2.75 km approx.	
	Type	Loop in loop out (double circuit twin bundle)	
22	**HEAD AND DISCHARGE**		
	Gross Head	161.0	m
	Rated Net Head	153.0	m
	Head Loss at Design Discharge	8.0	m
	Design Discharge of Plant	65.0	m3/sec
23	**CAPACITY AND OUTPUT**		
	Plant Capacity	88 MW	
	Capacity per Unit	2 x 37.5 & 1 x 13.0 MW	
	Plant Factor	44.7	
	Average Annual Energy	339 Gwh	

4 Analysis of Alternatives

This chapter presents the analysis of various alternatives considered during the planning and design stages of the project and provides a comparative evaluation of their respective environmental and social benefits and impacts.

4.1 The Without Project Option

Pakistan is suffering from an acute power and energy crisis, which is primarily caused by the increasing gap between the supply and the demand for electricity. Between 2013 and 2017, the supply of electricity increased with an average of 6.84 percent per year from 14,600 MW to 19,020 MW. The demand for power meanwhile increased with 7.47 percent per year from 18,827 MW to 25,117 MW. This resulted in an escalating gap between supply and peak demand.

Due to a large gap between the demand and the supply, aggravated by the fact that existing thermal power plants do not produce at their full capacity due to their dependence on imported fuel, there is load shedding. Fuel for power plants is imported, and there is a shortage of fuel due to the lack of foreign currency. Presently, the current deficit between demand-supply is the range of 4,000 to 6,000 MW. Load shedding is 4 to 6 hours in urban areas and more in rural areas per day. Load shedding is applied throughout the year, which varies according to the consumption type, season, peak and off-peak hours.

Hydropower production as a percent of total energy production declined from about 64 percent in the period 1970- 1980 to about 27 percent in recent years, despite the huge hydropower potential in the country. Since the nineties, the power system in the country has steadily relied more and more upon thermal energy. In 2016-17, about 64 percent of the total installed power capacity originated from fossil power plants, about 25 percent from hydropower production, and the remaining from other renewable and nuclear sources. The greater reliance on thermal sources also resulted in increasing dependency on imported fuel (oil, gas, and coal). As much as 85 percent of oil and allied products are imported. The imports result in the high cost of power production and these high imports require USD 4 billion in foreign currency in fuel payment for power generation.

Case of "Without Project Alternative"

The “without project” alternative is not realistic, because Pakistan will build additional generating plants to eliminate power shortages. Given the increasingly prohibitive costs of fuel oil-based electricity generation, the development of Pakistan’s hydropower resources at a variety of scales represents the only reasonable prospect of eliminating these shortages. The above mentioned negative effects of short supply and high demand for electricity in the country confirm that 339 GWh to be produced by the Gabral Kalam Hydropower Project is genuinely needed and will be easily absorbed in the National Grid to help ease the load-shedding up to some extent.

4.2 Analysis of Alternatives in Project Planning and Design

During the project conception and planning stages, a number of alternatives were considered while taking into account the technical, social and environmental aspects at the fore. After the selection of the technically feasible, financially viable and socio-environmentally acceptable alternatives, the selected project layout and sub-structures were further fine-tuned to minimize the related impacts through alternative planning/design options. Various aspects of the alternatives and fine-tuning of the finally selected project layouts are described below.

4.2.1 Project Development Alternatives During Planning Stage

At the planning stage, various alternatives were considered in the river stretch between the Utror village (near the confluence of Gabral and Batal Khwar) and Kalam. Three possible locations for weir (W1, W2, and W3) and two possible locations for powerhouses (P1 & P2) were identified. Some of these locations were identified by previous studies of PEDO. From the available locations of weirs and powerhouses, eight (8) alternatives were developed and the best options were selected from the perspective of avoiding and minimizing social and environmental impacts, as shown in **Figure 4.1** and **Table 4.1**.

Table 4.1: Description of Alternative Layouts for Project development

S.No.	Alternative Name	Description	Power Potential (MW)
1	W1A – P1	Weir (50 meters) at GTZ location and Powerhouse opposite Ashuran	82
2	W1B – P1	Diversion Weir (10 meters) at GTZ location and Powerhouse opposite Ashuran	57
3	W1A – P2	Weir (50 meters) at GTZ location and Powerhouse at the right bank of Desan Khwar	116
4	W1B – P2	Weir (10 meters) at GTZ location and Powerhouse at the right bank of Desan Khwar	91
5	W2 – P1	Diversion Weir (20 meters) near Batindar and Powerhouse opposite Ashuran	88
6	W2 – P2	Diversion Weir (10 meters) near Batindar and Powerhouse at the right bank of Desan Khwar	122
7	W3 – PI	Diversion Weir (5 meters) at Dhamaka Jheel and Powerhouse opposite Ashuran	112
8	W3 – P2	Diversion Weir (5 meters) at Dhamaka Jheel and Powerhouse at the right bank of Desan Khwar	147

Amongst the alternatives, the ranking was done on the basis of power potential, geology, socio-environmental, and planning and design aspects. Each important component of the scheme, i.e. weir, sand trap, tunnel, powerhouse, accessories and access roads, etc. was given due weightage for ranking. Based on the ranking exercise, Alternative W2-P1 was selected for the feasibility study. Though with the increase in the height of weir, the power potential of the selected layout could be increased; however, due to social and environmental aspects, the project was optimized on 88 MW. All P2 options of powerhouse were downstream of the Kalam town. Gabral River is the lifeline of Kamal tourism in Swat valley, and significant depletion of water (due to water diversion) in the Gabral River could severally affect the tourism and local economy that could warrant associated socio-economic risks.

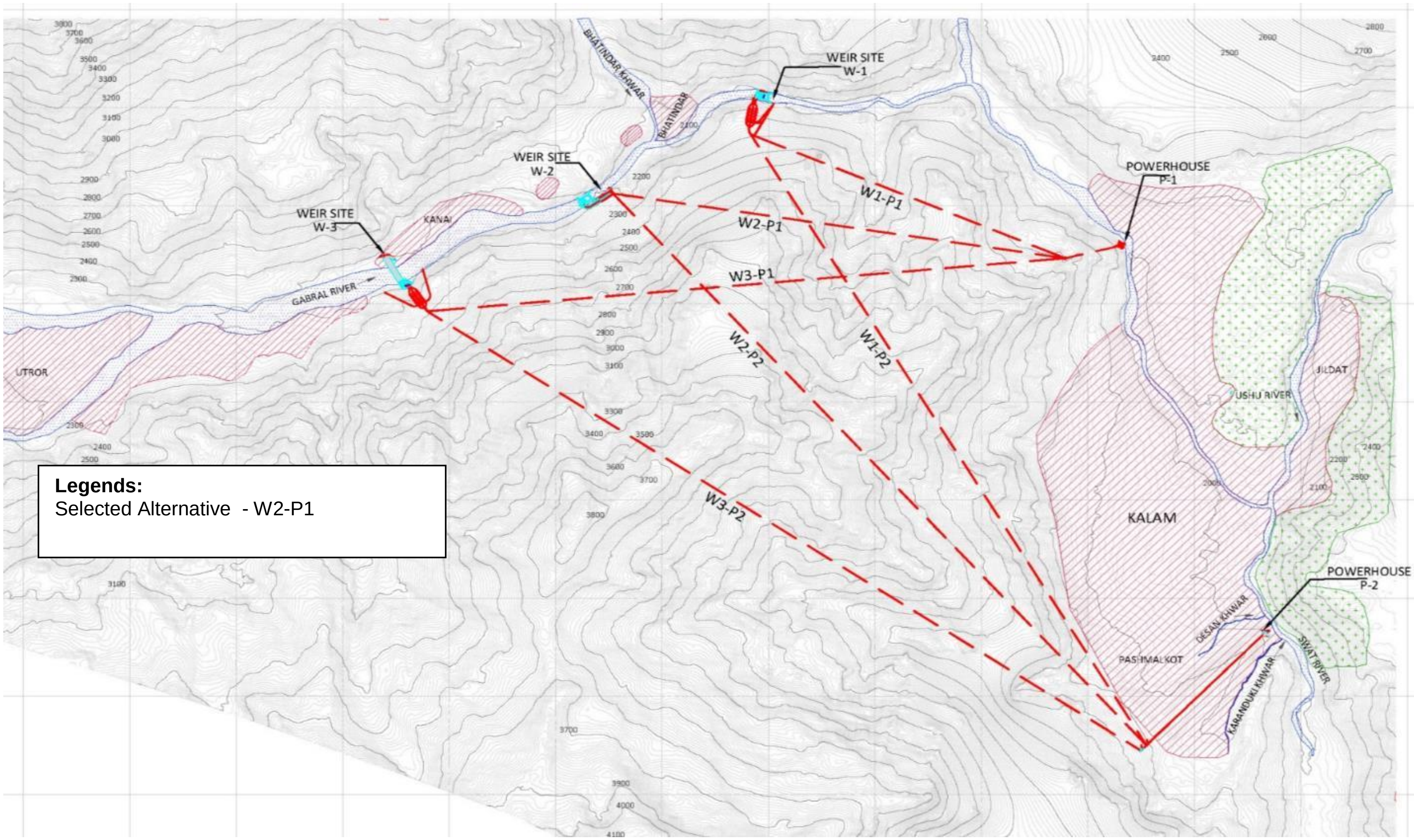


Figure 4.1: Alternative Layouts for Project development

4.3 Analysis of Alternatives in Project Design

During the design stage, several alternatives are considered to minimize the environmental and social impact for each sub-structure of the selected layout. They are briefly described below.

4.3.1 Reservoir Limitations and Weir Height

Theoretically, a dam of more than 70-100m height is possible at the selected location due to high abutment on both banks of the river, however, due to avoid inundation of Kanai and Utror villages, the height of weir is selected to keep at a level such that both the villages have no inundation and associated socio-economic and environmental impacts.

River level at the proposed weir site is 2140 masl. The corresponding level of the villages / terraces in Utror and Kanai villages are given in **Table 4.2** and shown in **Figure 4.2.**

Table 4.2: Level of Terraces and Settlements in Utror and Kanai Villages

Location	Terraces Level (masl)	Settlement Level (masl)
Lower Terraces of Utror Village	2195	2195
Upper Terraces of Kanai Village (Right of Kanai Nallah)	2190	2195
Upper Terraces of Kanai Village (Left of Kanai Nallah)	2170	2175
Lower Terraces of Kanai Village	2160	2165

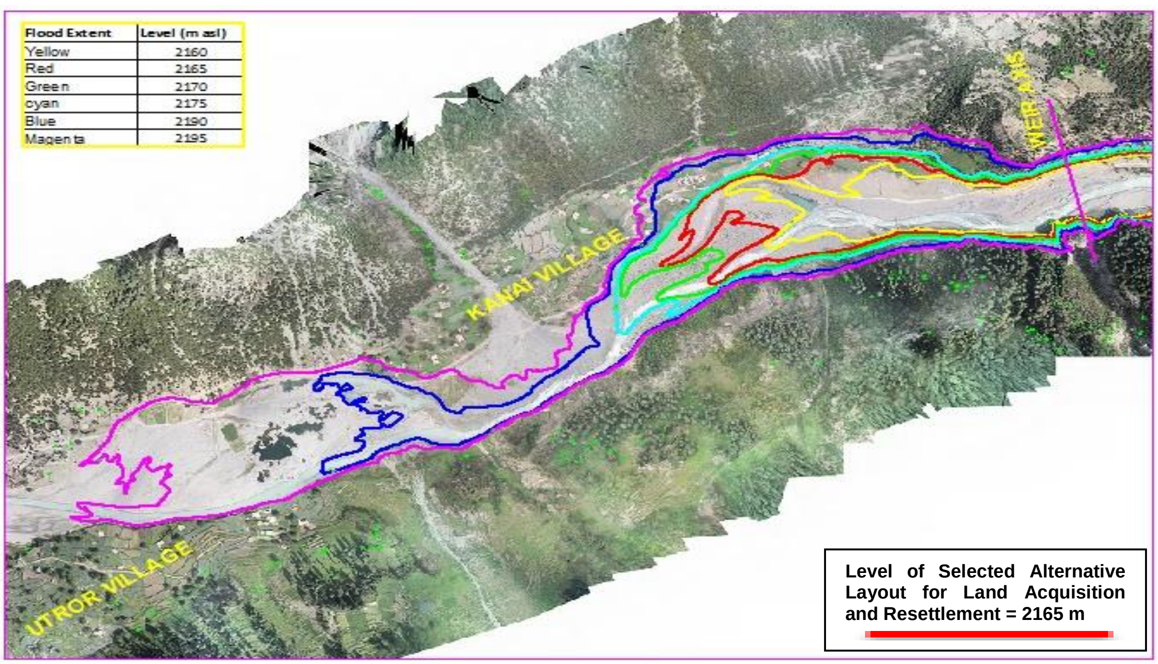


Figure 4.2: Possible Weir heights and associated inundation up to the Utror village

As evident from the above table, the most critical one is the level of the lower terraces of Kanai village. The main settlements of the Kanai village are along the left and right banks of the Kanai stream at lower terraces. There are few isolated houses in the lower terraces of Kanai village, whereas most of the irrigated land of lower terraces were eroded by the 2010 flood. The level of the five houses is about 2165 masl. Therefore, for socio-environmental considerations, a conservation level of about 2160 masl will be having no or nominal socio-environmental impacts. The level has been further tuned to 2161 masl during the course of study and recommended for the normal conservation (operational) level of the reservoir.

4.4 Social and Environmental Considerations in the Design

After the selection of the recommended project location, the sub-components were further studied to minimize the cost and socio-environmental impacts. Some of these considerations are described hereunder.

4.4.1 Type of Weir/Dam

Potential options for the type of weir include earth-fill dam, rockfill dam, and concrete gravity dam. Earth fill dams are the easier and simpler type for construction, but there is no adequate clayey material available in the region within the acceptable transportation limit so that the project may become attractive economically. Further, spillway cannot be constructed on the body of the earth-fill dam and thus, separate arrangements have to be made (requiring additional land acquisition). The location selected for the weir axis has no option for the separate spillway. In the case of a rockfill dam, though the rock is adequately available locally, the problem with the spillway will remain the same. A concrete gravity dam is selected since spillway and other outlets can be constructed within the dam body, availability of material locally, and other technical advantages.

4.4.2 Non-Peaking Reservoir

A peaking reservoir is recommended for the Project by the earlier study for economic reasons, wherein water would have stored in the reservoir for 18 to 20 hours and release in 4 to 6 hours for electricity generation. However, during the current study, it was identified that the Swat River flow is being utilized at Upper Swat and Lower Swat Canals for 24 hours of supply based irrigation. If the peaking system is used in the Project, the 100-year-old entire irrigation system would have disturbed in terms of water distribution timings and would have required additional infrastructure to re-regulate irrigation water distribution. Therefore, the peaking concept is dropped, and a non-peaking reservoir is selected.

4.4.3 Diversion During Construction

Diversion during construction was considered “with tunnel” and “without the tunnel (open channel).” Apart from the technical reasons, an important aspect of the selection of “Diversion in Channel” was the risk involved in the tunnel blockage due to logs in the floodwater, pose risks to the overflow of cofferdam which has serious social impacts terms of health and safety of construction workers, protection of equipment and material.

4.4.4 Headrace Tunnel Alignment

The headrace tunnel is passing deep in the intermediate valley to avoid the possibility of opening of the tunnel in the stream (daylighting), which would have required acquisition of additional private and forest land due to the construction of new access road.

4.4.5 Reservoir Levels and Freeboard

Weir is designed to pass the 1000 years flood in the basin safely. The normal conservation (operational) level of the reservoir is 2161.00 m. To pass the 1000 years flood, a surcharge of 3.90m is expected. Thus a level of 2164.90 m is the extreme flood level. A freeboard of 1.85m is kept above the flood level up to the soffit of the bridge. Whereas the bridge top on the weir is 2168m (7m above normal conservation level).

4.4.6 Employer's Facilities

Three different locations were considered for the project Employer's facility. An area that is safe from sloughing from hill slope and away from the riverbank is selected. This is also closer to the community so that the facilities like the school, hospital, shops, etc. provided in the colony are open for use by the locals as well. And the affected population demanded these facilities under the project.

4.4.7 Reclamation / Reuse of Area

Some parts of the lower irrigated terrace of Kanai village will be inundated in the reservoir. A flood protection bund is proposed along the existing road to protect land in the vicinity from inundation. However, due to the low level, the area may become waterlogged. To avoid this scenario, it is proposed to put the dump material in this area to raise it, which is also a strong demand by the local population. After rising off the area, a soil cover will be spread on the top to reuse the lands for agriculture purposes.

4.4.8 Spoil (Muck) Disposal Areas

Apart from the muck disposal areas at the weir site, a number of areas were identified at the powerhouse as well. These areas are basically the washed irrigated land due to the 2010 flood event. The areas will be acquired on a temporary basis for muck disposal, which will recover their lost agriculture lands. On the request of the local community, the land will be leveled to enable them to reuse these lands for agriculture after construction activities. These lands can also be used for commercial activities.

4.4.9 Aesthetics / Tourism Attractions

The Kalam town, near the project sites, is a tourism hub in the Swat valley. Due to the tourism potential in the project area, the project facilities can be converted to better aesthetics and tourist attraction places. The Project has taken the following measures :

- The most important aspects with respect to tourism and environment are the shifting of powerhouse upstream of the Kalam village and weir downstream of *Dhamaka Jheel* at the planning stage. A number of options with three weirs and two possible powerhouse sites were identified. The pros and cons of these alternative options were discussed at the planning stage and have briefly been described in Section 4.2. By shifting the powerhouse, the entire Gabral River water is allowed to flow in Kalam round the year to keep the attraction for tourism. Similarly, weir W3 at *Dhamaka Jheel* (a tourist site) near Kanai village was shifted to the W2 location based on various reasons, including tourism.
- An artificial lake is itself an attraction for tourists as well as the locals to develop commercial activities along the reservoir banks. The spoil disposal area along the reservoir can be handed over after restoration to the original owners, which can be used for livelihood activities such as the establishment of small eateries, kiosks, water sports during the operation phase of the Project.
- Although a spillway fall is an attraction for tourists during high flow months when surplus water can be released from the spillway, yet another attempt was made to keep the spillway further attractive. The chute of the spillway is provided with deflector blocks so that even with the small surplus water, the chute beauty can be improved for tourists' attraction. This will also help in dissipating the flow as well.
- The left bank of the Gabral River at the weir site is composed of overburden material where the existing road will be re-routed up to the weir top level. For the stability of the road, the slopes of

the bank will be excavated along with cutting off a number of trees. The cut slopes of the road will not only be stabilized with structural measures, but plantations will be made from the very first day after rerouting the road so that the trees become mature till the end of the project. Toe of the slope along with the existing road, will be restored to attract the tourist to stay and enjoy the chute spillway in operation.

- Upstream of the weir, the left bank will be stabilized by constructing a wall along the riverside. Due to the construction of this wall, a space of 15-20m, in addition to the proposed road, will be available as a raised platform. This is the location where both the spillway chute and reservoir can be seen simultaneously. Therefore, the space up to a distance of 150-200m will be converted into a scenic point for tourists.
- The protection wall along the right bank at the weir site will be designed with the architectural measures to improve its scenic beauty.
- The road at powerhouse location with a bridge will be an additional facility to the locals to cross the river through a short route instead of going far away to cross the river, and the two-third distance will be reduced.
- The road from powerhouse to the surge shaft is passing through dense vegetation on the upstream side however, there is less dense vegetation on the downstream side. A part of the additional plantation, this road, after the construction of the project, will be a very good track for the tourists for hiking. An open space near the surge shaft area will be developed for tourists to see the Kalam village along with the Ushu and Gabral Rivers.
- There is a very narrow gravel road used by the locals to reach the Kalam. The construction of roads will also cover a significant part of this track, which will improve the local mobility to Kalam easily.

5 Baseline Environment

This chapter defines the project influence area and presents a detailed overview of the physical, biological, and socio-economic environment within the project influence area, and results of the primary investigations carried out under the Project.

5.1 Definition of Project Influence Area

The Project influence area (or the project area) comprises of about 11 km-long valley of the Gabral River and its mountains, from Kanai village (one km upstream of the weir site to cover the reservoir area, and the Kanai village, which is affected by land acquisition) to Kalam town (10 km downstream of the weir site, where it joins the Ushu River to form the Swat River). The project activities are not likely to have any impact beyond one kilometer upstream of the weir site, and hence has been considered the upstream boundary of the project area. The rationale for defining the 10-km downstream boundary is that all project facilities, including the temporary facilities and access roads, will be located within this boundary. The project activities will have minimal impact on the downstream hydrology and aquatic ecology beyond 10-km downstream of the weir site due to the joining of another major river, Ushu to form the Swat River. The influence area covers all those areas that will likely to be directly (by the footprints of all the proposed project infrastructure, including land acquisition) or indirectly (by the temporary facilities such as construction camps and disposal areas, and access routes) affected by the proposed construction and operational activities.

Detailed environmental, ecological, and socio-economic surveys were carried out in the project area through a review of secondary literature, field investigations for primary data collection, sampling, and analysis of water, air and noise quality, questionnaire surveys, and community and stakeholder consultations. The map of the Project influence area is given in **Figure 5.1.**

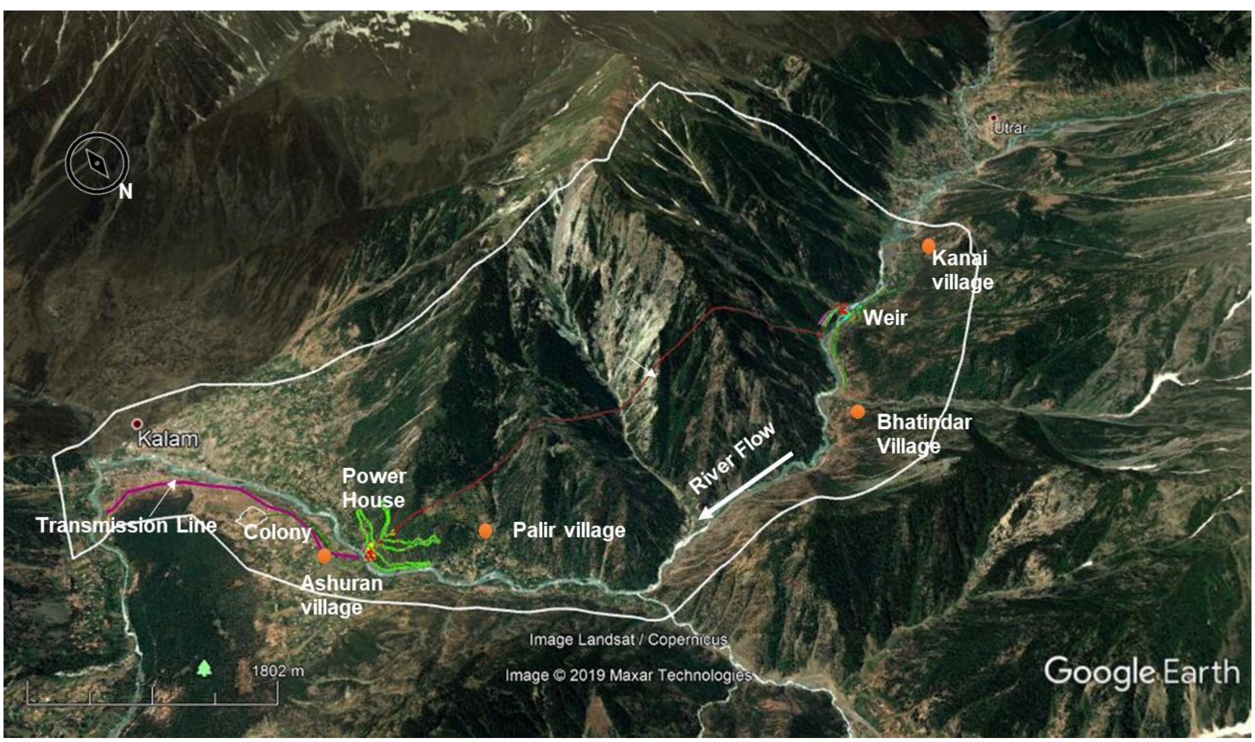


Figure 5.1: Location Map of Project Area of Influence

5.2 Physical Environment

5.2.1 Physiography

The physiography in the project area is dominated by mountainous terrain, narrow valleys of the Gabral river and its tributaries, eroded riverbanks, and agricultural lands in the valleys and forests on the hillslopes. The valley near the weir site is narrow (100m), but it gradually widens on both upstream and downstream (up to 500 m). The elevations along the Gabral River, in the project area, range from 1974 to 2180 meters above sea level (masl), while the elevations of the mountains range from 3700 to 4300 masl. The river carries high water flows during summer months due to the melting of snow and glaciers and very little flows during winter months. Riverbank erosion from the high sediment flows during floods is noticed on both banks of the river. A typical photograph of the project valley area is shown in **Figure 5.2.**

Figure 5.2: A View of the Project Area

Physical Setting and Land use: The project site is located in a rural setting with all lands in the valley along the river are extensively used for agricultural uses, and the hills are covered with the forest vegetation. The major settlements in the project area are Kalam (a major tourist town with a population of about 12,300 people and 1351 households). Ashuran is another major settlement in the project area with a population of 5100 (676 households) , which is further divided into sub-villages (including Paler, Mahai, Rashnail, Sher Kally, and Chirat, which are located close to the project facilities). The nearest settlement close to the major construction site is Kanai village (which is located 0.9 km away from the weir site, on the upstream). A gravel road is located along the right bank of the river, which connects the project villages to the Kalam. Other important feature of the area is severe erosion on the left bank of the river by the 2010 flood, which engulfed the previously existing agricultural lands and filled them with the river sediments and huge boulders and made them not suitable for any cultivation (these lands are referred as 'barren lands' in the social context). The land use map of the project area along the project facilities is shown in **Figure 5.3**.

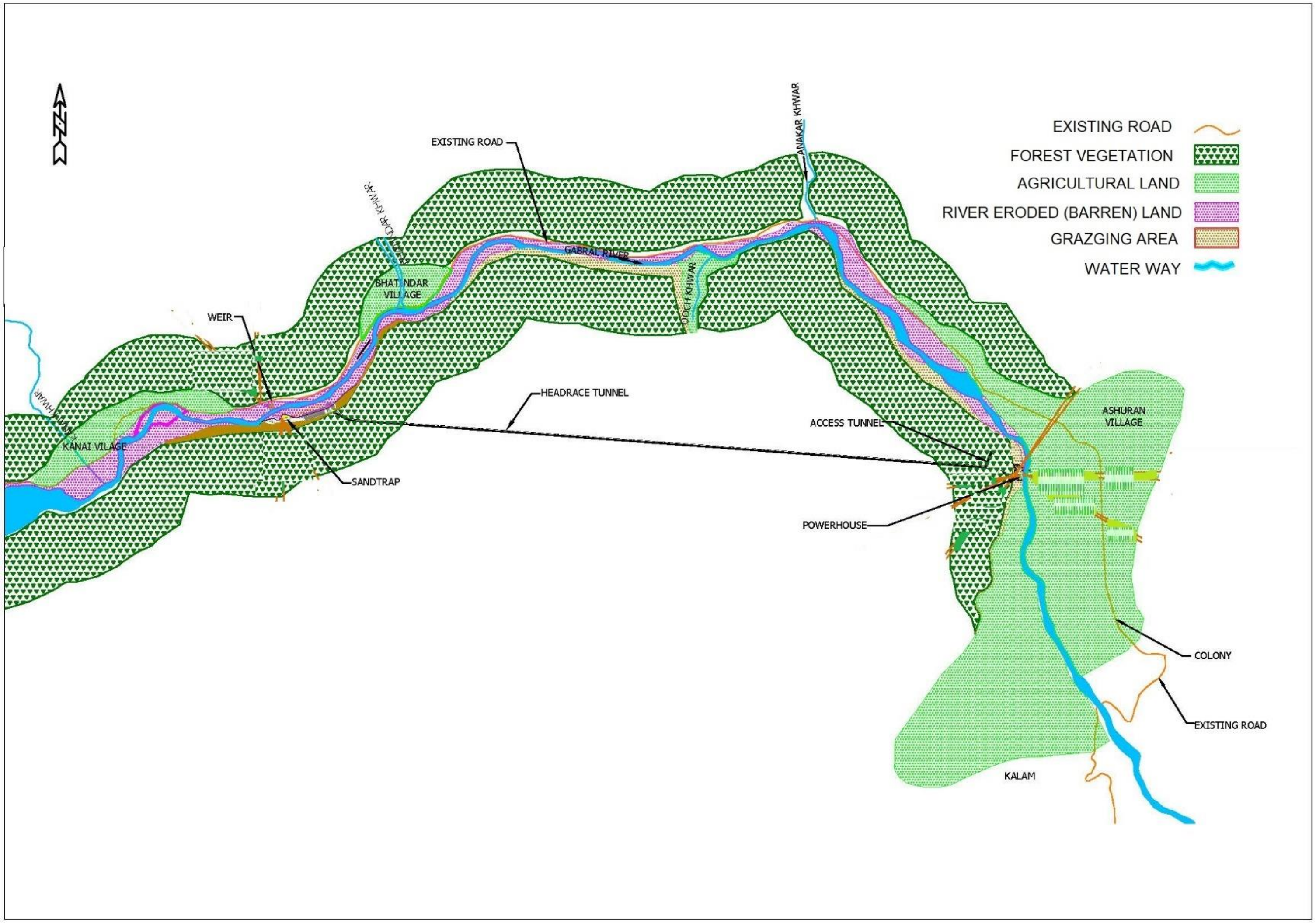


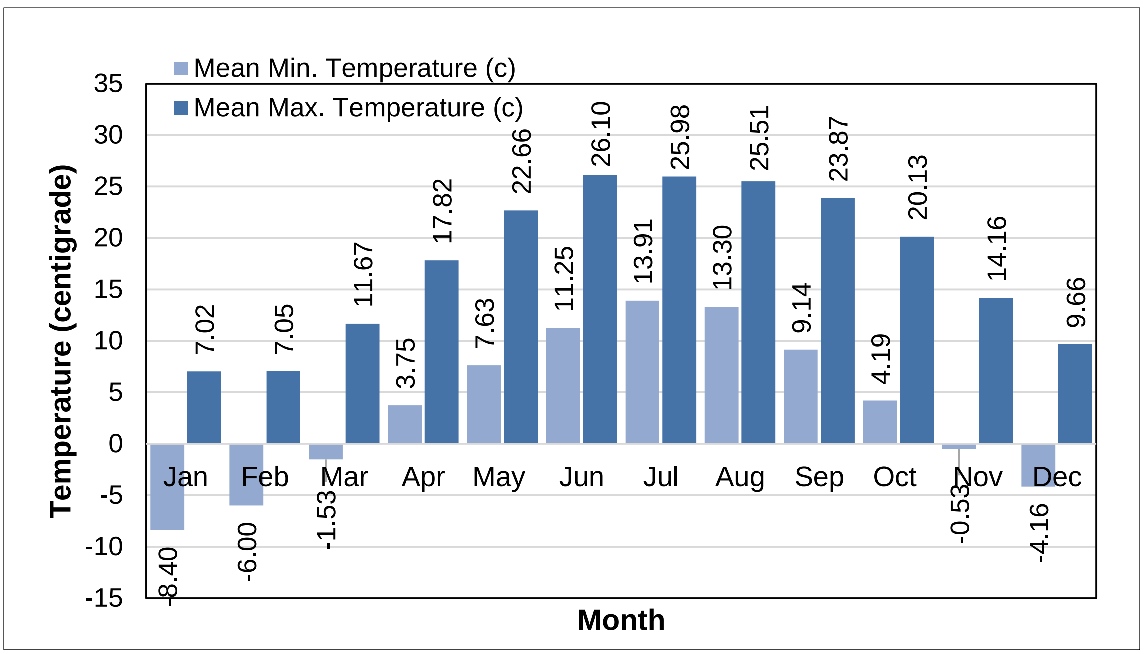
Figure 5.3: Land Use Map along with the project facilities in Project Area

5.2.2 Climate

According to Koeppen climate classification, the project area can be classified as 'humid subtropical climate,' characterized by warm and humid summers, and cold to mild winters. The winters in the project area are freezing with minimum temperatures ranging from -0.4 °C to – 8.4 °C from November to March. The temperatures in Spring (April and May) and in Autumn (September and October) are usually warm in the daytime (17 to 20 °C) and cold on the night time (3 to 10 °C). The mean monthly maximum temperature in the summer months (June to August) is around 26 °C. The summer (July to August) are hot with maximum average temperatures ranging from 25.5 °C to 26.1 °C.

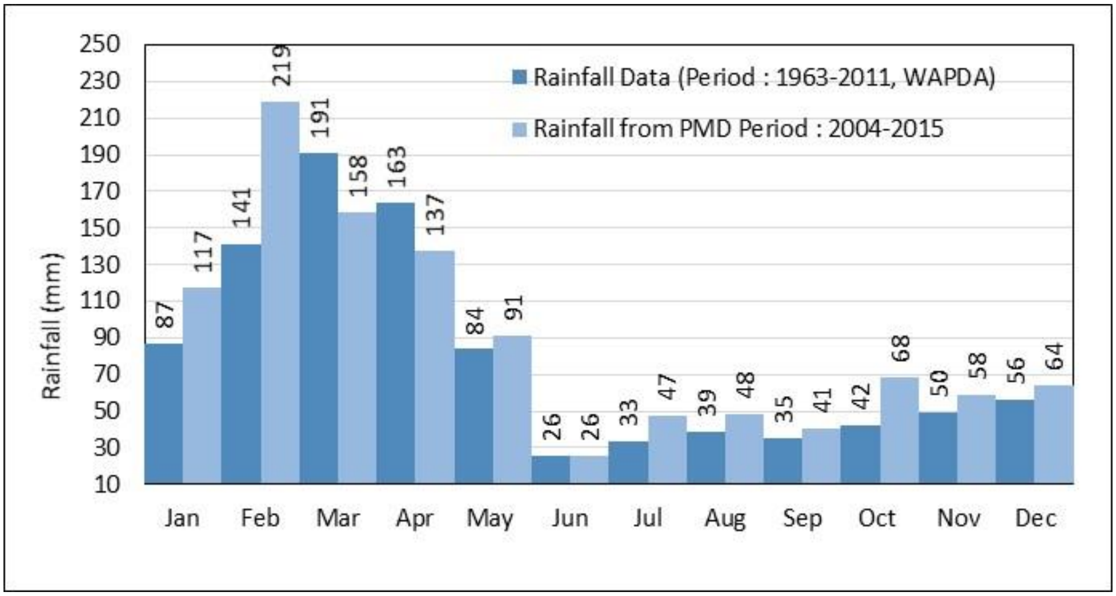
The average annual precipitation is about 1076 mm, with nearly 58 percent of precipitation falls as snowfall during winter. The minimum temperature recorded in Kalam was -11 °C in January, while the maximum temperature recorded was 32.4 °C in June. Monthly climate data at Kalam is given in **Figures 5.4 and 5.5**. The permanent snowline in the region starts above 4500 masl.

The average wind speed in the project area is 10.89 km/hr. The maximum wind speed is observed during the months of January to March (up to 13.8 km/hr), whereas the minimum wind speed is recorded in the months of September (8.1 km/hr).



(Source: Pakistan Meteorological Department PMD)

Figure 5.4: Mean Monthly Temperature Pattern at Kalam



(Source: Pakistan Meteorological Department PMD)

Figure 5.5: Mean Monthly Precipitation Pattern at Kalam

5.2.3 Hydrology

5.2.3.1 Hydrology of Gabral River

The catchment of the Gabral River lies in the upper region of the Hindu Kush mountains of the Swat River basin and can be classified as a "high mountain catchment." The highest mountain peak of the river reaches above 5500 masl. Snow and glacier melt during summer are the major sources of river flows. The length of the Gabral River up to the weir is about 35.40 km. The average river bed slope ranges from 0.02 to 0.03. The catchment area of the Gabral basin is shown in **Figure 5.6**. The major tributaries of the Gabral river are Shahi Bagh Nullah, Batal Khwar, and Bhan Khwar. The Bhan Khwar rivers join the Gabral on the downstream of the proposed weir. The catchment area of the Gabral up to the weir site is 951 km^2 and up to the confluence with the Ushu River is 1218 km^2.

The mean 10-daily flows of the Gabral river at the weir site are shown in **Figure 5.7** and they vary from 6.8 m^3/s to 127.0 m^3/s. The river flows are usually higher during the months of May to August due to the melting of snow. During these months, the river carries higher flows than the 65 m^3/s (peak design discharge of the project) and hence there will always be excess flows from the weir during these months. The river flows start to decrease from September, and the river flows are low (6.8 to 9.8 m^3/s) from December to March.

5.2.3.2 Sediment Concentrations of the Gabral River

The average sediment concentration of the Gabral River is 0.01% (by weight[3]) or 100 parts per million and containing approximately 24% sand, 45% silt, and 31% clay at high flow. The annual estimated suspended sediment load carried by the Gabral river is 126,492 tons, in which 86% of the load is carried during five months of high flow season (May to September). The monthly sediment load of the Gabral River is shown in **Figure 5.8**.

[3] Feasibility study of GKH Report, 2019

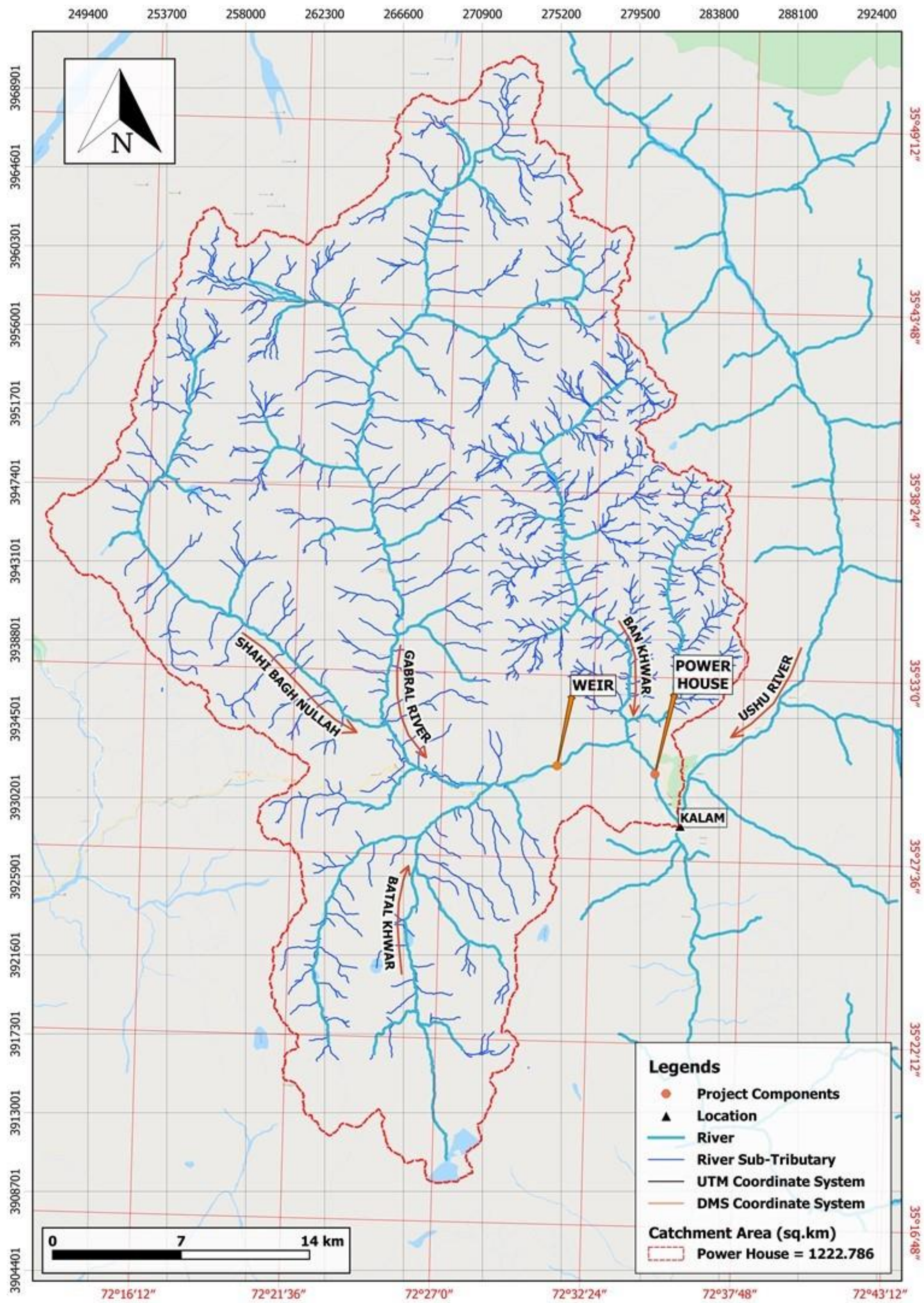
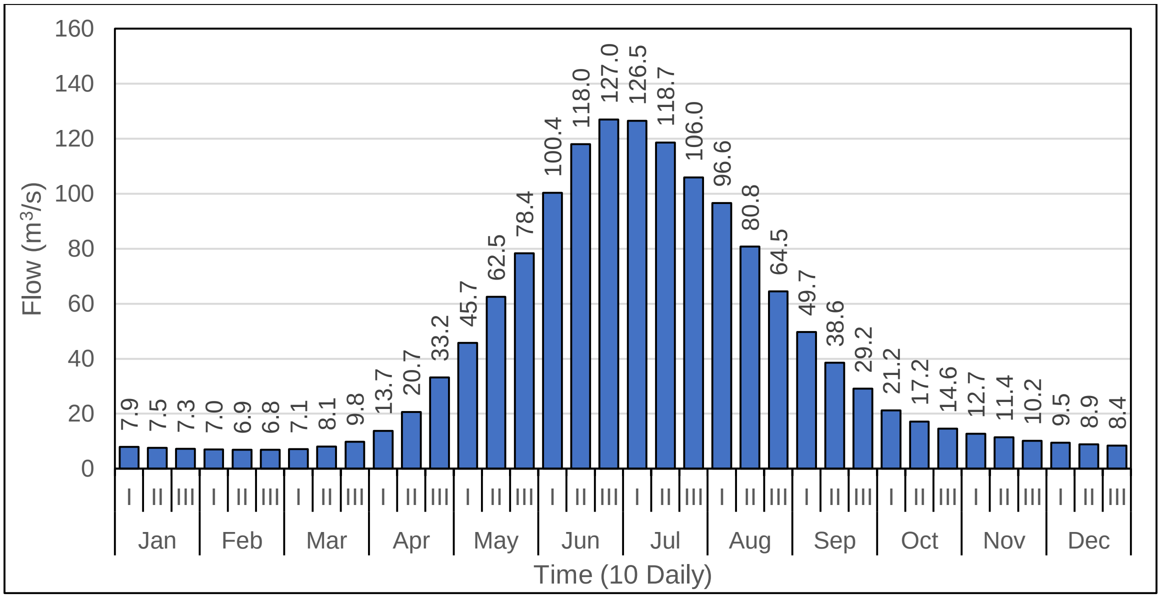


Figure 5.6: Catchment Area of the Gabral River



(Source: The Feasibility study report of GKH, 2019)

Figure 5.7: Mean 10-day Discharges of the Gabral River

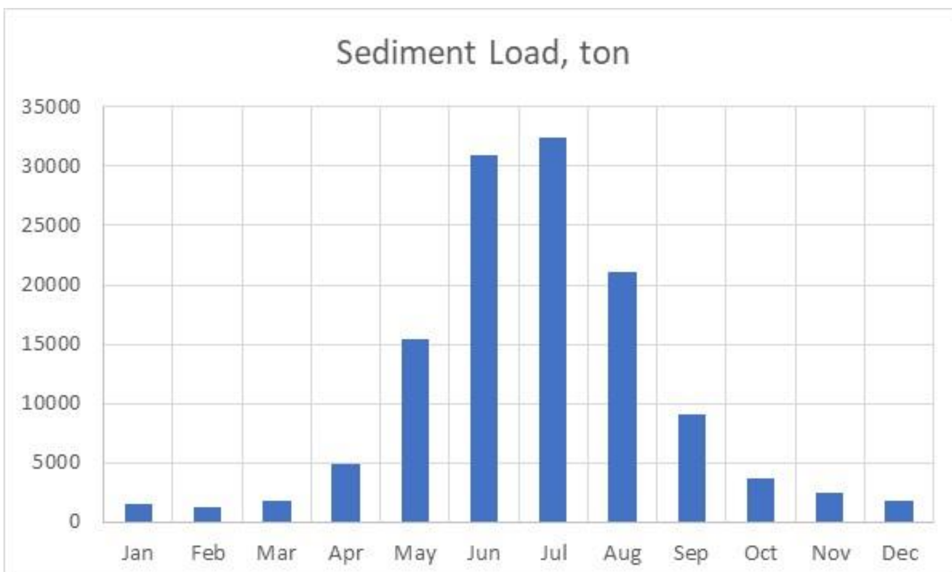


Figure 5.8: Monthly Sediment Loads of the Gabral River

5.2.3.3 Floods of the Gabral River[4]

The peak instantaneous discharges of the Gabral River during the floods vary from 77 m^3/s (in 2001) to about 1400 m^3/s (in 2013). The flood in 2010 (a flood of 300-year return period) is one of the worst in the region and caused severe damages to the infrastructure and the agricultural land abutting the river. A

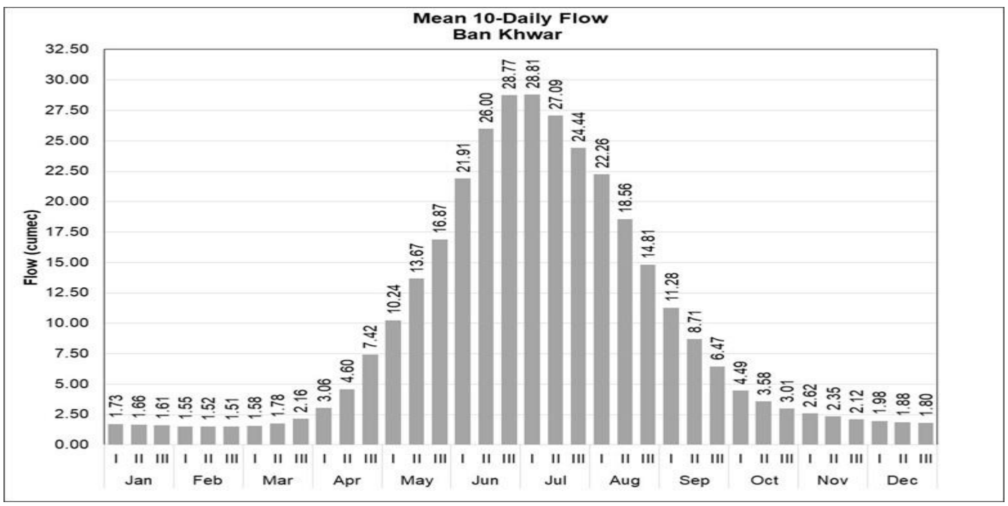
[4] Feasibility study Report of GKH, 2019.

detailed flood frequency analysis is carried out for the project and the following results are used for the design of the project facilities:

- Flood of 10-year return period: 781 m^3/s (used for temporary river diversion works during construction)
- Flood of 100-year return period (Design Flood): 1293 m^3/s
- Flood of 1000 year return period (Maximum Design Flood): 1791 m^3/s

5.2.3.4 Hydrology of the Bhan Khwar River

Bhan Khwar is the perennial tributary of the Gabral River, located 4 km downstream of the proposed weir site (in the dewatered section, between the weir and tailrace). The mean 10-day flow of Bhan Khwar is shown in **Figure 5.9**. The 10-day mean flows in the winter months vary from 1.5 to 3 m^3/s and in summer varies from 10 to 28 m^3/s. The winter flows from the Bhan Khwar river contributes to additional environmental flows from the weir to be released from the Project. A 1.2 MW hydropower site is located on the river, which supplies electricity to the local villages in the project area.



(Source: The Feasibility study report of GKH, 2019)

Figure 5.9: Mean 10-day Discharges of the Bhan Khwar River

5.2.3.5 Groundwater

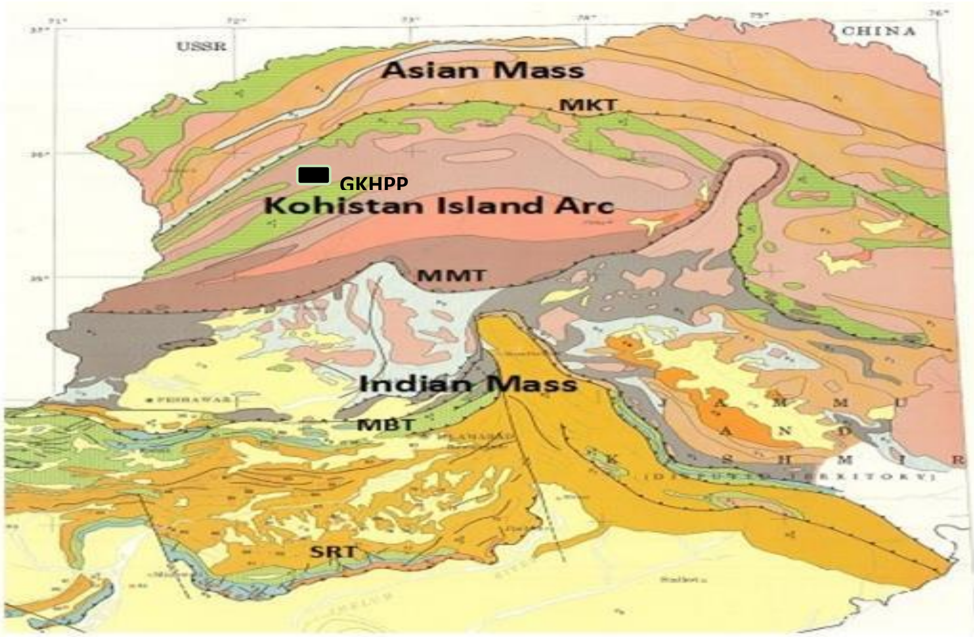
Groundwater in the project area is assessed by using the geotechnical investigations carried out during the feasibility study. The groundwater levels within the riverbed are shallow, with depths ranging from 0.8 to 4.5m, due to the presence of overburden riverine deposits. Whilst, the groundwater was not encountered in the boreholes that were drilled away from the riverbank due to the lack of fractures in the underground phyllite and schist formations. The boreholes drilled at the left abutment, tailrace, powerhouse and surge shaft did not show the presence of groundwater up to a depth of 200m. Hence it is not anticipated that groundwater is going to be a problem during the construction of foundations on the river banks, although there is a possibility of ingress of water through joint planes and discontinuities.

There is no extraction of groundwater in the area either through open wells or borewells for the drinking and irrigation uses. There are several springs located in the project area on both sides of the mountain, which are being extensively used for drinking and irrigation purposes by the local communities.

5.2.4 Seismicity

According to the Tectonic Map of Pakistan (**Figure 5.10**), the project area is located in a tectonically active region affected by the continuing northward drifting of the Indian plate and its subduction below the southern flank of the Eurasian plate. The collision of the two plates began about 50 million years ago, and the full contact between them was completed about 40 million years ago. Yet the Indian plate keeps on slowly drifting northward.

According to the building code of Pakistan Seismic Provisions (2007), the project area falls in zone 3 (corresponding to intensity VII and higher of the Modified Mercalli intensity scale) with recommended peak ground acceleration (PGA) of 0.24 to 0.32g. Risks of earthquakes are further discussed in **Section 6.4.**

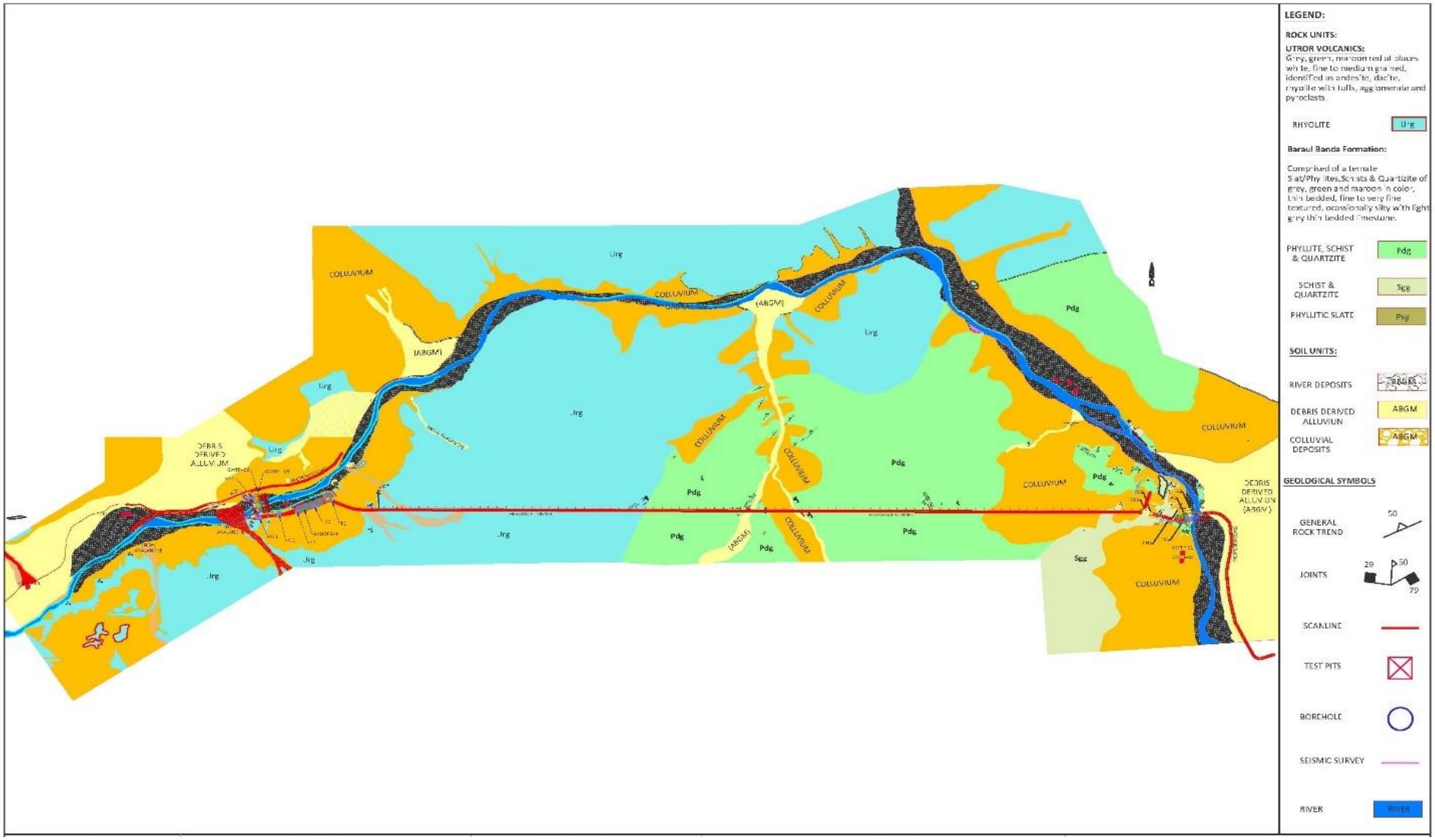


(Source: Feasibility study of GKH Report, 2019)

Figure 5.10: Tectonic Map of Northern Pakistan

5.2.5 Geology

The rock units of the project area belong to the Dir group. The Dir group includes dominantly pellitic rocks and associated Volcanics of Upper Swat and Dir. The group has been divided into two parts, Utror Volcanics, and Baraul Banda Slates. Exposures of these rock types are noticed in the project area. The Utror Volcanics comprises varicolored rhyolites, meta-andesite, dacite, tuffs, and agglomerates. The Baraul Banda Slates are light to greenish-grey, thin-bedded, fine-textured and occasionally silty. A geological map of the project area is shown in **Figure 5.11.** The soil units in the project area comprise alluvial, colluvial and glacial deposits. The alluvial deposits comprise young river deposits of rounded to sub-rounded boulders and gravel with sand and an appreciable amount of fines. The colluvial includes scree, talus, and landslide debris. The glacial (moraine) deposits are an accumulation of boulders, cobbles, and gravel into a silty and sandy matrix with the origin of outwash from glaciers. The left bank materials near the weir site consist of colluvial deposits, and hence an abutment will be constructed along the left bank of the weir site.



(Source: Feasibility study of GKHPP Report, 2019)

Figure 5.11: Geological Map of the Project Area

5.2.6 Water Quality

Water quality of the Gabral River, Bhan Khwar River, and spring at Kanai village is measured during January 2019, and the results are given in **Table 5.1**. The water quality is generally good, with total dissolved solids ranging from 58 to 67 mg/L. The existing sources of threats to the water quality are the disposal of solid waste into the river by the settlements located along the river, and mainly from the Kalam town. There are no industries and sand/gravel mining activities in the project area that are affecting groundwater quality.

Table 5.1: Water Quality of Rivers and Springs in the Project Area

Parameters	**Unit**	**Detection Limit**	**Gabral River (at Weir Site)**	**Bhan Khwar (at Ashuran village)**	**Spring (at Kanai)**
Temperature	^{0}C	-	5	4	4
pH	pH unit	0.01	6.89	6.82	7.02
Total Dissolved Solid	mg/l	1	61	58	67
Biological Oxygen Demand	mg/l	1	<1.0	<1.0	<1.0
Chemical Oxygen Demand	mg/l	1	<1.0	<1.0	<1.0
Total Suspended Solid	mg/l	1	<1.0	<1.0	<1.0
Chloride	mg/l	0.24	5.78	7.71	7.71
Fluoride	mg/l	0.01	<0.01	<0.01	<0.01
Sulphate	mg/l	0.41	26.34	23.04	28.4
Silver	mg/l	0.0032	<0.0032	<0.0032	<0.0032
Cadmium	mg/l	0.0028	<0.0028	<0.0028	<0.0028
Chromium	mg/l	0.0054	<0.0054	<0.0054	<0.0054
Copper	mg/l	0.0045	0.0088	0.0074	0.005
Lead	mg/l	0.013	<0.013	<0.013	<0.013
Mercury	mg/l	0.0008	<0.0008	<0.0008	<0.0008
Nickel	mg/l	0.008	<0.008	<0.008	<0.008
Arsenic	mg/l	0.01	<0.01	<0.01	<0.01

5.2.7 Air and Noise Quality

Air and noise quality is measured at three villages in the project area during August 2019. The ambient air and noise quality in the project area are generally good and well below the national standards (NEQS).

Table 5.2: Air and Noise Quality in the Project Area

Parameters	**Unit**	**Kanai Village (at weir site)**	**Ashuran Village (at colony site)**	**Ashuran Village (at powerhouse site)**	**Standard (NEQS)**
Sulphur dioxide	µg/m^3	14.96	16	15.13	120
Oxides of Nitrogen (NO_2)	µg/m^3	20.9	19.93	23.16	80
Carbon Monoxide	µg/m^3	0.27	0.3	0.32	5
Particulate Matter ($PM_{2.5}$)	µg/m^3	22.7	22.7	21.3	35
Particulate Matter (PM_{10})	µg/m^3	22.7	31.9	35.5	150

Night time Noise	dBA	43.3	50.1	39.2	55
Day time Noise	dBA	53.9	61.1	50.0	65

5.3 Biological Environment

Ecological surveys in the project area are carried out by a team of ecological experts, during September and October 2019, using various field survey methods such as line transects or strip census, pellet counts, howling records, mating calls and interviews with local residents and forests and wildlife departments. Detailed surveys will be further carried out during project implementation covering all seasons and to monitor the potential impacts of the project activities during construction. ToRs for further studies and monitoring are given in **Annex 4.**

5.3.1 Biodiversity of the Project Area

An ecological screening exercise is carried out to identify the key biodiversity of the project area using an Integrated Biodiversity Assessment Tool (IBAT) developed by the International Union for Conservation of Nature (IUCN) and published literature. The overall biodiversity within the 50 km of the project area includes 245 species of plants, 41 species of fish, six species of amphibians, 18 species of reptiles, 283 species of birds and 70 species of mammals. A detailed list of these species is given in **Annex 2.**

However, the overall species observed/recorded project area include 72 plant species, two fish species, three amphibians, 11 reptiles, 100 birds and 13 mammalian species (**Annex 3**). The biodiversity along the valleys in the lower elevations is comparatively low due to the tremendous increase in the human population (annual growth rate 3.32). The undisturbed patches of vegetation /habitats are restricted to the higher elevations (above 3200 masl), which are highly inaccessible due to the difficult nature of the terrain and geographic features. These habitats are in the alpine zone and can be found on the high mountains of the Bhan Khwar (tributary of the Gabral River) catchment area. The whole catchment area of the Bhan Khwar has been declared as the community game reserve in 2005.

The list of threatened species that can be found within the 50 km of the project area is presented in **Table 5.3**. Four threatened mammalian species (Himalayan musk deer, Common Leopard, Snow leopard, and Black Bear), five endangered birds (Pallas's fish-eagle, Egyptian vulture, Greater spotted eagle, White-headed duck and Indian skimmer), one endangered fish species (golden mahseer). In addition, one endangered plant species (Atlas daisy) is also reported from the area. The mammalian species are an inhabitant of higher altitudes where there is no human disturbance but are reported to come down sometime to the project area during the winter season.

5.3.2 Terrestrial Ecology

The project area and its surrounding areas can be classified into the following three ecological regions based on their elevations

(i) **Dry temperate ecoregion** which covers the elevations up to 2700 masl,
(ii) **Sub-alpine ecoregion**, which covers elevations between 2700 to 3200 masl and
(iii) **Alpine pasture ecoregion**, which covers elevations between 3200 to 4700 masl.

The ecological map of the project area is shown in **Figure 5.12**. Flora and fauna of these ecological regions are described in the following sections.

Table 5.3: Threatened Species within 50 Km of the Project area

	Species name	Common name	IUCN Category
A	**Mammals**		
1	*Moschus leucogaster*	Himalayan musk deer	EN
2	*Panthera pardus*	Common Leopard	VU
3	*Panthera uncial*	Snow leopard	VU
4	*Ursus thibetanus*	Asiatic black bear	VU
B	**Birds**		
5	*Haliaeetus leucoryphus*	Pallas's fish-eagle	EN
6	*Neophron percnopterus*	Egyptian vulture[5]	EN
7	*Clanga clanga*	Greater spotted eagle	VU
8	*Oxyura leucocephala*	White-headed duck	EN
9	*Rynchops albicollis*	Indian skimmer	VU
C	**Fish**		
10	*Tor putitora*	Mahseer	EN
D	**Plants**		
11	*Anacyclus pyrethrum*	Atlas daisy	VU

Note: EN (Endangered), VU (Vulnerable)

Source: Integrated Biodiversity Assessment Tool and Field Investigations

[5] Although this species is Endangered But it is found in the region only during summer season as summer breeder. Its breeding area comprises of whole western Boundary of Pakistan starting right from top in Gilgit Baltistan to KP and Balochistan.

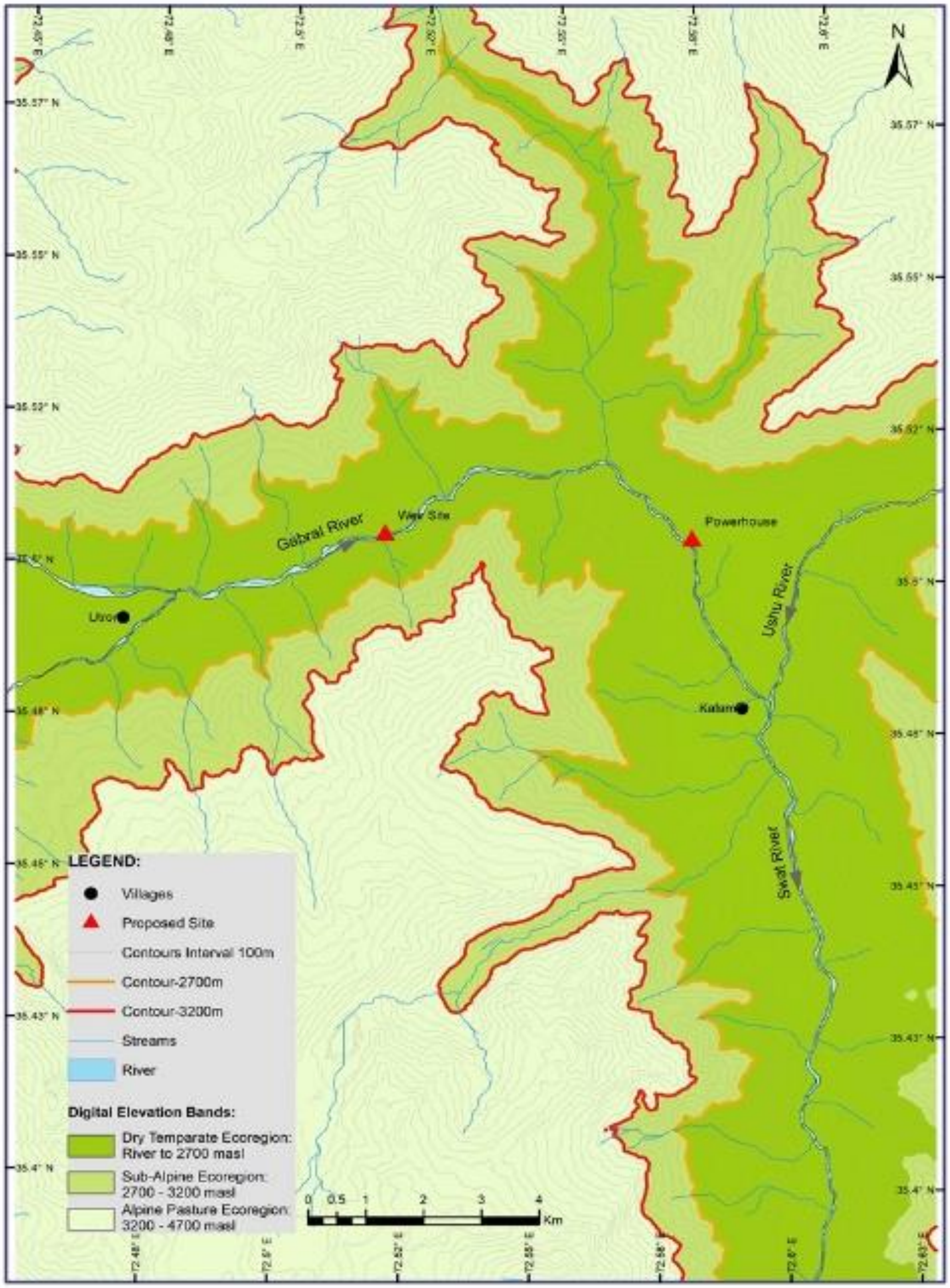


Figure 5.12: Ecological Regions of the Project Area and its Surroundings

5.3.2.1 Dry Temperate Ecoregion

The project facilities and its immediate surroundings up to 2700 masl are located in the dry temperate ecoregion, which mainly consists of coniferous forests that play a vital role in the economy of the area as a source of supply of timber, fuelwood, non-timber forest products (NTFPs), forage, and grazing. A few photographs from this region are shown in Figure 5.13.

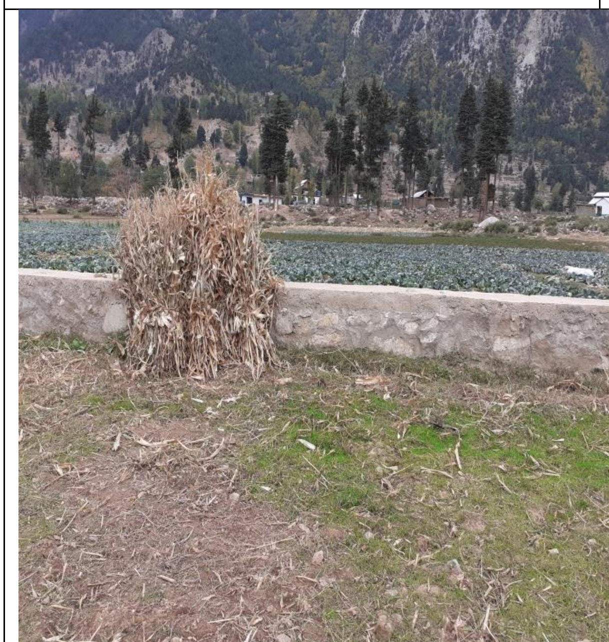
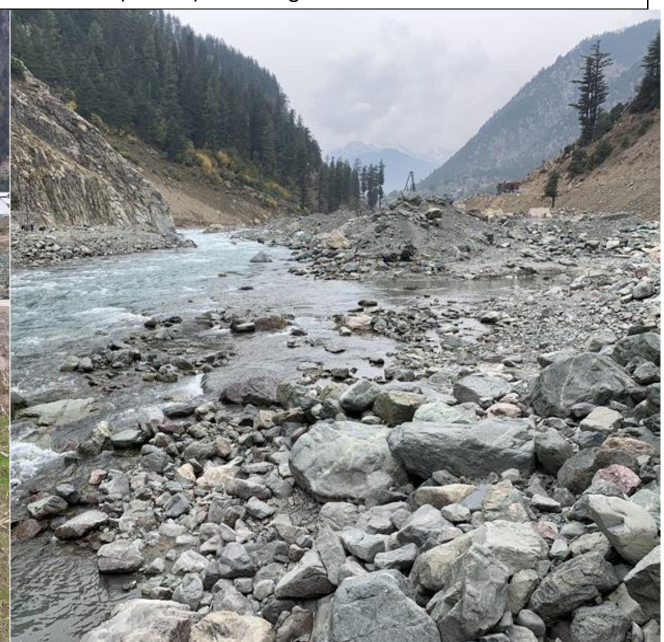
	
Dry Temperate Ecoregion: Pure stand of *Cedrus Deodara*	Vegetation (*Betula pepyrifera* (front) and *Cedrus deodara* (behind) on the right bank of the weir site
	
Cultivated Land (proposed colony site)	River Bed near the proposed weir site

Figure 5.13: Vegetation Types in the Project Area

5.3.2.1.1 Flora

A total of 72 plant species are recorded in the project area and detail of these species is given in **Annex 3**. The natural flora in this ecoregion mainly consists of Oak (*Quercus dilatata*), Deodar (*Cedrus deodara*), Blue pine (*Pinus wallichiana*), Wild Almond (*Purnus dulcis*), Birch (*Betula utilis*), Fir (*Abies pindrow*), Spruce (*Picea smithiana*), Willow (*Salix bablonica*), ajavayan (*Artemisia meritima)*, Sada Bahar (*Ephedra gerardiana*), Jangli Podina (*Indigofera heterantha*), Sumblo (*Berberis lyceum*) and Guch (*Viburnum nervosum)*. The fodder and forage species include Mauritian grass (*Apluda mutica)*, grass (*Cymbopogon stracheyi)*, khabal (*Cynodon dactylon*), Kotar Ghas (*Dicanthium annulatum*), Sirwala (*Galium aparine*, Prewatei (*Hedera nepalensis)*, Rewari kalan (*Lathyrus sp)*. and Maina (*Medicago polymorpha)*. None of these species are listed in the IUCN threatened category.

The forest trees are owned by the provincial government, but the land is owned by the community but with all types of rights of extraction of timber and firewood, grass cutting and grazing for local use unless specifically disallowed in certain areas. The forests are commercially logged, and in which 60% of the sale price is the community's share and the rest 40% is received by the provincial government.

The non-timber forest products from forests include medicinal plants, morals (black mushrooms), honey and several fruits such as walnuts, peaches, apples, wild persimmon, etc. These products will supplement the income of the local communities.

It was reported[6] that Kalam valley inhabits many important medicinal plants, majority of which are used in medicines (**Table 5.4**), but due to anthropogenic activities including unplanned tourism, deforestation, uprooting of medicinal plants and overgrazing, majority of these plant species are rapidly heading towards regional extinction in the near future.

Table 5.4: Medicinal Plants in the Kalam

Sr.No	Local Name	Botanical Name	Part being used
01	Zaharmora	*Aconitum violaceum*	Rhizome
02	Sakha Waja	*Acorus calamus*	Rhizome
03	Sumbal	*Adiantum venustum*	Leaves
04	Jawaz	*Aesculus indica*	Fruit, oil
05	Boti	*Ajuga bracteosa*	Whole plant
06	Terkha	*Artimisia brevifolia*	Shoots
07	Marjarey	*Arisaema Flavum*	Rhizome
08	Bargak	*Atropa acuminate*	Plant
09	Kowarey	*Berberis lyceum*	Plant
10	Gat Panra	*Bergenia ciliate*	Rhizome
11	Tarwa Panara	*Bistorta ampilexicaulis*	Rhizome
12	Makan Path	*Caltha alba*	Floral shoot
13	Mamera	*Corydalis stewartii*	Floral shoot
14	Kowanjey	*Dryopteris jaxtaposta*	Whole Frond
15	Kaga Velaney	*Feoniculum vulgare*	Fruit
16	Papra	*Fumaria indica*	Whole plant
17	Prewatei	*Hedera nepalensis*	Leaves
18	Spirkey	*Isodon rugosus*	Stem and leaves
19	Velaney	*Mentha longifolia*	Shoots
20	Podina	*Mentha spicata*	Leaves and stem
21	Mamekh	*Paeonia emodi*	Rhizome
22	Kakora	*Podophyllum emodii*	Rhizome
23	Noor-e-alam	*Polygonatum verticilatum*	Rhizome
24	Chotial	*Rheum austral*	Roots, Rhizome, leaves
25	Nazar Panra	*Skimmia laureola*	Leaves
26	Kamachoo	*Solanum nigrum*	Leaves and fruit
27	Banerya (Teen)	*Taxus buccata*	Bark

[6] Bakht N., Jan A., Haider A., Manzoor H., Mujtaba S., Siraj A., Abbas H.S., and Azhar M. 2018. Conservation Status Assessment of Native Vascular Flora of Kalam Valley, Swat District, Northern Pakistan. International Journal of Biodiversity and Conservation. Vol. 10(11), pp. 453-470.

Sr.No	Local Name	Botanical Name	Part being used
28	Mushk-e-Bala	*Valeriana jatamansi*	Rhizome
29	Banafsha	*Viola odorata*	Flower
30	Guch	*Viburnum nervosum*	Whole Plant
31	Persoshan	*Adiantum capillus*	Whole plant
32	Anjabar	*Polygonum amplexicule*	Roots
33	Unab	*Zizyphus vulgaris*	Fruits
34	Zakhmi-Hayat	*Bergenia ligulata*	Rhizome

(Source: Divisional Profile of Kalam Forest Division, 2014)

5.3.2.1.2 Mammalian Species

According to literature review, key mammalian species associated with this habitat are: Yellow-throated Marten (*Martes flavigula*), Kashmir Flying Squirrel (*Hylopetes fimbriatus*), Giant Red Flying Squirrel (*Petaurista petaurista*), Common Leopard (*Panthera pardus*), Rhesus Macaque (*Macaca mulatta*), Asiatic Black Bear (*Ursus thibetanus*), Porcupine (*Hystrix indica*),Murree Vole (*Hyperacrius wynnei*), Field Mouse (*Apodemus sylvaticus*), Turkistan Rat (*Rattus turkestanicus*), Whiskered Bat (*Myotis muricola*), and Long-eared Bat (*Pleclotus austriacus*). Among these species, Himalayan musk deer, Common Leopard, Snow leopard and Black Bear are listed as Vulnerable by IUCN.

During the field surveys, 12 species of mammals belonging to six orders, 10 families and 12 genera were recorded from the study area. The mammalian species observed from the project area along with their conservation status are listed in **Table 5.5.** According to the IUCN Red List of Threatened species, 10 species have Least Concern status, one species has not been evaluated while one species (Asiatic Black Bear) has Vulnerable status.

Table 5.5: List of the Species Recorded in the Project Area

Sr. No.	Recorded Mammals	Zoological Name	IUCN Red List (2019)	Population Trend (IUCN, 2019)
1	Western Himalayan White-toothed Shrew	Crocidura suaveolens	Least Concern	Stable
2	Greater Horse-shoe Bat	Rhinolophus ferrumequinum	Least Concern	Decreasing
3	Common Pipistrelle	Pipistrellus pipistrellus	Least Concern	Stable
4	Cape Hare	Lepus capensis	Least Concern	Decreasing
5	Giant Red Himalayan Flying Squirrel	Petaurista petaurista albiventer	Least Concern	Unknown
6	Himalayan Wood Mouse	Apodemus rusiges	Least Concern	Unknown
7	House Rat	Ratus ratus	Not Evaluated	Unknown
8	House Mouse	Mus musculus	Least Concern	Stable
9	Rhesus monkey	Macaca mulatta	Least Concern	Unknown
10	Indian Wolf	Canis lupus	Least Concern	Stable
11	Asiatic Jackal	Canis aureus	Least Concern	increasing
12	Asiatic Black Bear	Ursus thibetanus	Vulnerable	Decreasing

5.3.2.1.3 Herpetofauna

The common herpetofauna species in this ecoregion include Kashmir Rock Agama (*Laudakia tuberculata*), Skimm keelback (*Amphiesma sieboldii*), Himalayan keelback (*Amphiesma platyceps*), Blunt nosed pit viper (*Macrovipera lebetina obtusa*), Himalayan pit viper (*Gloydius himalayanus*)[7]

During field investigations, a total of 14 species of herps belonging to two orders, seven families and 11 genera were recorded from the study area, including three amphibians and 11 reptiles. The list of recorded species is given in **Table 5.7**. None of the other recorded species have a Threatened status according to IUCN. Among these species, the poisonous snake.

Table 5.6: List of recorded amphibians and reptiles from the study area

Sr. No.	Zoological Name	Common Name	Order	Family
1	Bufo stomaticus	Indus valley toad	Anura	Bufonidae
2	Bufo pseudoraddei pseudoraddei	Indus valley toad	Anura	Bufonidae
3	Euphlyctis cyanophlyctis microspinulata	Skittering frog	Anura	Ranidae
4	Laudakia himalayana	Himalayan Agama	Squamata	Agamidae
5	Laudakia pakistanica auffenbergi	North-Pakistan Agama	Squamata	Agamidae
6	Laudakia tuberculata	Blue Rock Agama	Squamata	Agamidae
7	Ophisops jerdonii Blyth	Rugose-spectacled lacerta	Squamata	Lacertidae
8	Ablepharus pannonicus	Snake-eyed skink	Squamata	Scincidae
9	Scincella himalayana Gunther	Himalayan skink	Squamata	Scincidae
10	Platyceps rhodorachis ladacensis	Ladakh Cliff racer	Squamata	Colubridae
11	Pseudocyclophis persicus	Dark-head Dwarf racer	Squamata	Colubridae
12	Ptyas mucosus mucosus	Rope-snake	Squamata	Colubridae
13	Spalerosophis diadema diadema	Blotched diadem snake	Squamata	Colubridae
14	Naja oxiana	Brown cobra	Squamata	Elapidae

5.3.2.2 Sub-Alpine Ecoregion

The sub-alpine ecoregion represents a very fragile but ecologically significant ecosystem found at the elevations between 2700 to 3200 masl. This zone is characterized by mild summer and a very short growing season in summer starting in June to August. The winter season is almost six months long with heavy snowfall and remains under snow for 3-4 months. The climatic conditions are very harsh and allow a very few tree species to establish themselves, except those equipped with specific adaptations and niche adjustments. The high mountains of the Gabral valley and Bhan Valley fall in this ecoregion.

[7] Khan, M.S., 2006. *Amphibians and reptiles of Pakistan.* Krieger Publishing Company, Malabar, Florida. pp.311.

5.3.2.2.1 Flora

The common flora of this ecoregion is *Betula utilis*, *Juniprus saquamata, Rhododendron arboretum, Euphorbia kanaorica, Salix himalayensis, Alopecurus pratensis, Saxifraga sibirica, Polygonum affine, Veronica alpine, Plantago lanceolate, Agrostis gigantean, Poa nemoralis, Poa pratensis, Primula macrophylla, Phleum himalaicum,* and *Aconitum heterophyllum*[8].

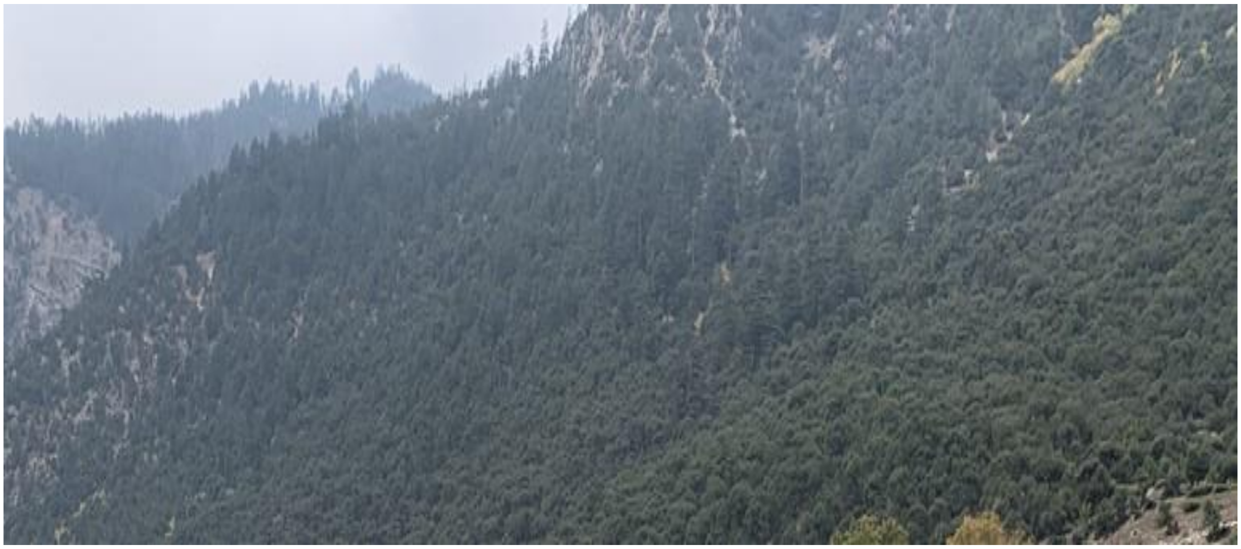


Figure 5.14: Sub- Alpine Region (Mixed forest)

This region also linked to the forest resource, which includes medicinal and aromatic plants, wild vegetables, wild fruits, Chilghoza nuts, and grasses. Medicinal plants found in this area include *Valeriana wallic shii, podo-phullum emodii, Saifraga spp Artemisia maritime, Viola serpens and Atropoa belladonna.*

5.3.2.2.2 Fauna

Key fauna associated with this habitat are; Royle's High Mountain Vole (*Alticola roylei*), True's Vole (*Hyperacrius affinis*). Chinese Birch Mouse (*Sicista concolor*), Musk Deer (*Moschus chrysogaster*), Snow Leopard (*Panthera uncia*), Markhor (*Capra falconeri*), Monal Pheasant (*Lophophorus impejanus*), Himalayan Snowcock (*Tetraogallus himalayensis*) and Snow Partridge (*Lerwa lerwa*)[9]. These species are found in the high mountains of Bhan Valley Game Reserve.

5.3.2.2.3 Herpetofauna

The common herpetofauna can be found in this ecoregion are: Swat Green Toad (*Bufotes pseudoraddei*), Indus Valley Toad (*Duttaphrynus stomaticus*), Asian common toad (*Duttaphrynus melanostictus*), Himalaya paa frog (*Nanorana vicina*), Himalayan ground Skink (*Asymblepharus himalayana*), Kashmir Rock Agama (*Laudakia tuberculata*), Himalayan pit viper (*Gloydius himalayanus*), Dice snake (*Xenochrophis tessellata*)[10].

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[8] Beg, A.R. 1975. Wildlife habitats of Pakistan. Bull, no. 5. Pak.Forest. Institute, Peshawer

[9] Roberts, T. J. 1997. The mammals of Pakistan. Oxford University Press, Karachi. 361 p.

[10] Khan, M.S., 2006. *Amphibians and reptiles of Pakistan.* Krieger Publishing Company, Malabar, Florida. pp.311.

5.3.2.3 Alpine Pastures Ecoregion

The alpine pastures are located on the higher peaks of the mountains between the elevations 3200 to 4700 masl. Alpine plants are adapted to the harsh conditions, which include low temperature, dryness, ultraviolet radiation and a short growing season. The area is rich with a wide diversity of flora and fauna.

5.3.2.3.1 Flora

The key flora in this habitat are; *Rhododendron arboretum, Juniprus saquamata, Saussurea lappa, Sedum trullipetalum, Aconitum heterophyllum, Saxifraga parnassifolia, Viola odrata, Bistorta affinis, Bistorta amplexicaulis, Alium himalynica, Colchicum luteum, Crataegus oxyacantha, Cynoglossum officinale, Festuca kashmiriana, Inula royleana, Poa alpine, Rheum austral, Trifolium repens, Thymus serpyllum, Potentilla fruticose, Primula macrophylla, Primula denticulate,* and *Diapensia purpurea*[11].

5.3.2.3.2 Mammals

Key mammalian species associated with this habitat include Snow leopard (*Panthera uncia*), Himalayan Ibex (*Capra ibex sibirica*), Red bear (*Ursus arctos*), Long-tailed Marmot (*Marmota caudata*), Lesser Shrew (*Sorex thibetanus*), Royle's High Mountain Vole (*Alticola roylei*), Ermine (*Mustela erminea*), and Chinese Birch Mouse (*Sicista concolor*)[12]. High mountains of Bhan khwar tributary has some of these species.

5.3.2.3.3 Herpetofauna

Alpine toad (*Scutiger occidentalis*), Himalayan toad (*Duttaphrynus himalayanus*), Baltistan toad (*Bufo latastii*) Himalaya paa frog (*Nanorana vicina*), Himalayan ground skink (*Asymblepharus himalayana*), Kashmir Rock Agama (*Laudakia tuberculata*), Himalayan agama (*Laudakia himalayana*), Badakhshan rock agama (*Laudakia badakhshana*), Toed gecko (*Altigekko yarkandensis*), Ladakh ground skink (*Scincella ladacensis*), Himalayan pit viper (*Gloydius himalayanus*)[13].

5.3.2.4 Avifauna

A total of 656 bird species belonging to 272 genera have been reported in Pakistan. Of these, 38% are winter migrants, 29% are Palearctic visiting species, 13% are regular winter visitors, and 20% breed on the subcontinent[14]. Pakistan is a wintering habitat for several migratory species of birds that use the Indus Flyway. The Indus Flyway is one of the world's major migration routes, running from Siberia to various destinations in Pakistan traversing the Karakorum, Hindu Kush, and the Suleiman mountain ranges.

A total of 283 bird species are noticed in the region and out of these 100 bird species have been observed/reported from the project area. The list of observed/reported species is given in **Annex 3.**

Forests and high mountain lakes are the preferred habitats of these species. The bird fauna includes pheasants such as Himalayan Snowcock, Chukar, Koklas Pheasant, Himalayan Monal Pheasant, and Snow Partridge.

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[11] Beg, A.R. 1975. Wildlife habitats of Pakistan. Bull, no. 5. Pak.Forest. Institute, Peshawer.

[12] Roberts, T. J., 1991. *Birds of Pakistan* Vol. I Oxford University Press, Karachi.

[13] Khan, M. S., 2000. *Amphibians and Reptiles of Pakistan*. (In Urdu) Urdu Science Board, 299 upper Mall, Lahore. 138 pp.

[14] Ali, S., Ripley, S. D., & Dick, J. H. (1987). Compact handbook of the birds of India and Pakistan.
Roberts, T. J., 1991. *Birds of Pakistan* Vol. I Oxford University Press, Karachi.
Mirza, Z. B., & Wasiq, H. (2007). A field guide to birds of Pakistan Bookland.
Grimmett, R., Roberts, T. and Inskipp, T. 2008. *Helm Field Guide Birds of Pakistan.* Christopher Helm. London.

Dubair is the nearest Important Bird Area (designated by Birdlife International) is located about 60 km from the project area and is located in the Upper Kohistan region, is an internationally important area due to the presence of Western Tragopan Phesant.

5.3.2.5 Bhan Valley Game Reserve

Bhan Khwar is the tributary of the Gabral River. The alpine and subalpine habitats of the Bhan Khwar catchment area provide a rich habitat of 21 mammals, including threatened species of snow leopard, and black bear. The entire 250 km^2 of the Bhan Khwar catchment area was notified as the Bhan Valley Community Game Reserve on June 25, 2005. Community-based conservation in this valley started during 2000-2007 under the Mountain Area Conservation Project by IUCN and the provincial Wildlife Department.

The objective of the community game reserve is to make the communities responsible for protecting the wildlife in those areas, and in turn, they will benefit from the fee collected for the hunting of game species such as Markhor and grey goral. Otherwise, these habitats and species are threatened by habitat degradation (due to grazing, fuelwood collection and timber exploitation) and illegal hunting. Markhor, National Animal of Pakistan, was until recently categorized as 'Endangered', but because of similar conservation measures in Northern Pakistan involving the community, especially trophy hunting, its status has been upgraded to 'Near Threatened'.

The location map of the Bhan Valley Game Reserve and the Project locations shown in **Figure 5.15**. About 0.08 Km^2 of the reserve is located in the project area. The alpine and subalpine habitats of the reserve are located about 10 to 20 km from the project facilities. The valley consists of 12 villages with a population of about 10,000. The rights of use of natural resources are divided among three major tribes of the valley, i.e., *Jalfor, Neelior* and *Dare Khail*. Wildlife Department and local community organization jointly take care of the reserve.

Figure 5.15: Location Map of the Bhan Valley Game Reserve

The key flora in this area is *Picea smithiana*, *Pinus willachiana*, *Cedrus deodara*, *Quercus balloot*, and *Taxus baccata*. Main medicinal plants in the valley are Kakora, Banafsha, Musk bala, Mamaikh, Kwarai, Mameera, Noor Aalam, Ziar Gulai, Somani, Kanaiz, Chatyal, Nazar Panra, Ratan jok and Zakhmi hayat. The species of agroforestry are Walnut (*Juglans regia*), Acorn (*Quercus balloot*), Horse Chestnut (*Aesculus* *indica*), Wild Rose (*Rosa webbiana*), Hippopi (*Hippopi rhamnoides*), Morel Mushroom (*Morchella conica*) and Ephedrine (*Ephedra sp*.).

The amphibians include Indus valley toad and skittering frog. Among reptiles are the Himalayan rock agama, Pakistan rock agama, some skinks and snakes like wolf snake, Himalayan pit viper and brown cobra. The valley is also rich in some of the endemic reptilian species like Pakistan Rock Agama (*Ludakia pakistanica*).

The key mammalian species in reserve include markhor, snow leopard, and black bear. According to surveys carried out by wildlife department in 2005, the mammals in the game reserve include markhors (10 to 15 numbers), ibex (up to 30 numbers), black bear (30 to 35 numbers), musk deer (10 to 13 numbers) and snow leopard (2 numbers). The mammalian species usually exists in the upper regions of alpines during summer and in the lower regions of alpine during winter.

More than 100 avian species are found in reserve including passerine and non-passerine birds, winter visitors, summer breeders, passage migrants, and resident birds. The avian fauna includes the Himalayan Snowcock, Chukar, Koklas Pheasant, Himalayan Monal Pheasant, Snow Partridge, and several seasonal migrants. These are considered common game species in the area.

5.3.3 Aquatic Ecology

Fish fauna diversity and abundance in northern Pakistan, including in the project area, are generally low due to high-altitude tributaries, low water temperature, high water velocity, and low benthic productivity. In comparison, much higher diversity and abundance of fishes are found on the lower reaches of the Swat River and the Kabul River. There are 41 fish species listed as inhabiting cold waters of Pakistan, and most of them belong to the indigenous species snow carp sub-family Schizothoricinae *(genera Schizothorax* and *Schizopyge*), and loaches of the genera Triplophysa, Schistura and Glyptothorax. None of these species are listed in IUCN Red List. All these taxa inhabit torrential and swift streams and rivers of the mountain region and have evolved morphometric features adapted to these habitat conditions[15]. In order to enhance the fish resource, two species of the family Salmonidae (brown trout and rainbow trout) were introduced in the Gabral River and adjoining streams in the early 1960s. Khyber Pakhtunkhwa Provincial Fisheries Department has established small hatcheries in the province where seeds of trout are produced and stocked in the Rivers of Northern Pakistan.

5.3.3.1.1 Aquatic Habitat

The Gabral River and its tributaries are characterized by relatively steep gradients and substrate sizes, fast-flowing, and turbulent waters. The river is mainly fed by melting of snow and glaciers; flow is high during summer and contribution from rainfall is very small. Quality of river water changes between the summer and winter seasons due to the sediment load, which is higher during summer. The nutrient contents of Gabral River were assessed at six different locations[16] and presented in **Table 5.7**. The tributaries of Gabral pass along steep gradients through rocky areas of high mountains, exhibiting variable cascades, riffles and pools and, at the confluence with the Gabral, gravel, and sand where most spawning sites of snow carp and other species are believed to be located. Streambed substrate mainly consists of

[15] Rafique, M. (2000). Fish diversity and distribution in Indus River and its drainage system. *Pakistan Journal of Zoology*, *32*(4), 321-332.

[16] Locations of sampling sites are : Kanai up Stream weir site (ID 1), downstream weir site (ID 2), downstream Bhan khwar (ID 3), weir site (ID 4), Ashuran power house area (ID 5) and colony area (ID 6)

boulders, cobbles, and gravels. The banks of some streams have patches of vegetation such as herbs, shrubs, and trees.

Table 5.7: Nutrient contents for Plankton

Parameters	Units	Results[17]						Expended Uncertainty (±)
		Sample ID 1	Sample ID 2	Sample ID 3	Sample ID 4	Sample ID 5	Sample ID 6	
Nitrate	mg/L	4.20	3.25	2.80	1.75	2.15	1.69	-
Potassium as K	mg/L	1.8	1.3	2.83	1.87	0.97	2.30	-
Phosphate as Po4	mg/L	7.8	7.8	7.4	6.9	7.45	7.53	-
Dissolve Oxygen (DO)	mg/L	9.8	9.65	9.92	9.7	9.89	9.68	-

Phytoplankton of river waters of Northern Pakistan consists of 6 families Cyanophyte, Chlorophyte, Chrysophyte, Bacillariophyta, Cryptophyte, and Euglenophyte. Zooplanktons were rare as few rotifers, some daphnia/moina were found. It was observed that due to torrential water planktons cannot stay in the main flow of the river or tributaries. Phytoplankton/periphyton is present inside waters, shallow water which is lentic type and warmer. Most of the algae especially filamentous algae is produced on the exposed surface of stones where sunlight effect directly. Zooplankton like daphnia/moina and paramecium were observed entangled in this type of algae.

Snow carp, the dominant fish species, is herbivorous and feeds on the algae on stones. It has a frontal mouth at the tip of the head to scrap algae, Phytoplanktons, Zooplankton and invertebrates present.

5.3.3.2 Fish

According to surveys carried out in the project area, two species of fish are noticed in the Gabral River. *Schizothorax plagiostomus* (snow carp or locally known as *Swati*), an indigenous species and *Salmo trutta (B*rown trout), an invasive fish species. The IUCN status of the snow carp species has not been assessed and it is widely distributed along the Himalayan Foothills of Pakistan, India, and Nepal. The population of native snow carp species is reported to be decreasing in the Gabral and Swat Rivers after the introduction of the brown trout. A brown trout hatchery is located in Madyan (located 50 km away from the project area), which annually releases thousands of fries into the River. A GoKP has also established a hatchery for snow carp for improving its population.

5.3.3.2.1 Snow Carp Habitat and Migration

Based on the review of available literature[18], the habitat, spawning and migration conditions of snow carps are presented below:

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[17] Locations of sampling sites are : Kanai up Stream weir site (ID 1), downstream weir site (ID 2), downstream Bhan khwar (ID 3), weir site (ID 4), Ashuran power house area (ID 5) and colony area (ID 6)

[18] (i) Petr, T.; Swar, D.B. (eds.), Cold water fisheries in the trans-Himalayan countries. FAO Fisheries Technical Paper. No. 431 Rome, FAO. 2002. p. 376. (ii) Shrestha, T. K., and S. S. Khanna. "Structure and histological changes in the ovary of the Nepalese snow trout Schizothorax plagiostomus (Heckel)." Matsya 5 (1979): 23-34, and (iii) Aquatic Ecology Report of Dasu Hydropower Project.

Habitat. Snow carps thrive in the snow-fed river habitat (altitude of 1200 to 3000 masl) of clear, shallow water of stony substratum with an average depth from 0.5 to 3 meters, and river flows with low to high velocities (0.5 to 1.5 m/s). The average temperature tolerance range is from 4 to 20 ^{o}C and dissolved oxygen requirements lie in the range of 8 to 12 mg/l. Snow carps are bottom feeders and mainly feeds on periphytic algae and diatoms.

Migration: Snow carps are short distant migrants, and they migrate mostly within the tributaries (headwaters areas to lower elevations and to confluence areas of the major rivers such as the Swat River; and vice versa). From April to September (spring and summer, high flow), they prefer upstream headwaters habitats at higher elevations. During September to April (low flow and winter), they prefer lower elevations. The triggers for migrations are high flow, high sediment load, and low temperatures. During spring, when the flow starts increasing in the rivers due to the melting of snow, the fish within tributaries migrate upstream from April to May due to high flows and turbidity at lower elevations. During autumn, when the temperatures start to drop at higher elevations, the fish migrate downstream from September to October.

Spawning: Female fish spawn in two seasons, one in September-October and the other in March - April. Sexually matured snow carps (when they reach 18-24 cm length, at the age of 2-3 years) spawn in tributaries in clear water (along stream banks, backwater pools and near confluences of other tributaries) on gravelly/stony ground or on fine pebbles at 10-30 cm depth. Low water currents of 0.5- 1.5 m/sec, pH 7.5, the dissolved oxygen concentration of 8-12 mg/L and gravel size of 50-60 mm are the optimum conditions for spawning. Mature fish typically change color during the breeding season. Mature males develop tubercles on either side of the head . Females are chased by males during the breeding season. The eggs laid remains attached to the substratum, while fry stays on sand and gravel bottom. A mature female can produce from 25000 to 39000 eggs/year.

5.3.3.2.2 Brown Trout Habitat and Migration

Habitat: The fish is found up to 3000 m high altitudes where the water temperature seldom rises 12 degrees Celsius. Such streams are highly oxygenated and clean water. The fish is carnivorous in nature and feeds on crustaceans, insects and their larvae and other smaller fish. The KP Fish department regularly stocks the river with thousands of fries.

Breeding: The fish becomes sexually mature within two years when the size is about 8 inches. The breeding season starts from November and December up to February. The female lays 300 to 1500 eggs in one episode, depending on the size of the female. Eggs are laid in slow running streams in nature by making a pit in the bottom gravel bed. Males fertilize the eggs with semen or milt and hide the eggs with gravel and sand. The fish has a short and stout body — eggs hatch in 40 to 70 days. Low water currents of 0.5- 1.5 m/sec, pH 7.5, the dissolved oxygen concentration of 8-12 ppm and gravel sizes of 50-60 mm are the optimum conditions for spawning. Brown trout share the same habitat for breeding with snow carp.

Migration: The fish is not migratory, and it generally moves between shallow pools to deep waters based on the availability of the flows.

5.4 Socioeconomic Environment

5.4.1 Overview Villages in the Project Area and Details of Surveys

The project influence area (or the project area) is located in a rural area and the settlements located in the project area between the reservoir area to Kalam are: Kanai (located about 900m away on upstream of the weir site; village population is 620 and households are 95), Bhatindar (along the access road, 1.2 km downstream of the weir; 665 people and 70 households), and Ashuran (along the access road to project facilities; 5100 people and 676 households). The locations of these villages are shown in **Figure 5.1**. The Ashuran is further divided into several sub-villages and six of these sub-villages are located near the project facilities, and they are Paler (710 people, 122 households), Mahai (650 people, 58 households), Rashnail (60 population, 13 households), Sher Kally (255 people, 30 households), and Chirat (550 people and 75 households). Administratively, the villages in the project fall into Ashuran Union council of Bahrain Tehsil in the Swat District.

The socioeconomic baseline of the project area is collected through questionnaire surveys, focus group discussions, consultations and review of secondary literature. Structured questionnaire surveys of 169 randomly selected households were carried out in the project villages (24 from Kanai – near the weir site, two from Chirat – near colony area, 66 from Ashuran – along the access road, 54 from Mahai, 23 from Sher Kally – near the powerhouse area). The key socio-economic aspects studied include the demography, housing patterns, nature of agriculture, availability of social infrastructure and amenities, livelihood opportunities, and economic well-being.

5.4.2 Demography of Surveyed Households

The total population of the surveyed households is 1365, in which males are 717 and females are 648. The proportion of male and female members is 52.5% and 47.4%, respectively, with a gender ratio of 1: 1.11.The gender-segregated statistics of household members are given in **Table 5.8**. The age of the family members has been distributed into the various age brackets to understand their level of contribution to the household income keeping in view the adult equivalent. About 28.13 percent and 23.07 percent of the male and female members respectively belong to the age-group of 10 to 60 years.

Table 5.8: Gender Segregated Age Distribution

Gender	Total HHs (number)	Household Members		
		Up to 10 years	Above 10 - 60 years	Above 60 years
Male	717	301	384	32
Female	648	310	315	23
Total	1365	611	699	55

Major cast groups in the project area are dirya khel, mirza khel, nalyoor khel, kalam khel, cheenal khel, knnai, gujar, malyer, bozae khel and mahai.

5.4.3 Education

The educational facilities in the project area are very limited and hence, literacy levels are also very low. There are six primary schools, one middle school for boys (in Ashuran village) and one higher secondary school (separately for boys and girls in Kalam). The level of illiteracy was to the extent of 42.5% for males and 84.8% for females. Gender segregated education details are summarized in **Table 5.9**.

Table 5.9: Average Literacy Rate of the Sample Households Members

Gender	Level of Education (%)						
	Illiterate	Primary	Middle	Metric	Inter-mediate	Bachelor	Masters
Male	42.5	23.0	11.8	13.5	4.3	2.8	2.1
Female	84.8	8.6	3.3	1.4	1.7	0.3	0.0
Overall	60.9	16.8	8.1	8.2	3.1	1.7	1.2

Access to primary school education for boys and girls found 34.5% and 12.6%,respectively. In the case of other levels of education for both boys and girls, access to Middle and High schools was quite limited (**Table 5.10**).

Table 5.10: Access to Educational Institutions

Access to Educational Facilities (in percent)					
Primary Schools		**Middle Schools**		**High School**	
Boys	Girls	Boys	Girls	Boys	Girls
34.5	12.6	13.2	1.7	5.2	0.6

5.4.4 Income and Livelihood Analysis

The major source of livelihood for the project population is agriculture. Other occupations and income-generating activities are being practiced in the project area include farming, employment in government and private sectors, daily wage labour, operating businesses such as running a grocery shop and working abroad. Details of livelihood sources of sampled households are given in **Table 5.11.**

Table 5.11: Livelihood Sources of Sampled Households (in percent)

Farming/ livestock	**Labor**	**Government Service**	**Private Service**	**Business**	**Employed Abroad**	**Others** (Unemployed/ students)
31.5	12.5	1.5	2.1	1.5	3.5	47.4

5.4.5 Livelihood Sources

Although agriculture is the main livelihood source for the majority of the households, the availability of the agricultural land is limited to the valley along the riverbanks. The average landholding of 73 % of the surveyed households is less than one acre. About 27% of the households have a land holding of 1 to 5 acres.

The cropping season is between April to October, and there will be no agriculture during winter due to severe cold conditions and snowfall. Generally, two crops are grown, one in from April to July and the second one is from July to October. Major crops grown are vegetables (tomatoes, potatoes, and cabbage); maize, pulses, and millets. The cropping pattern in the project area is given in **Table 5.12**.

Table 5.12: Cropping Pattern

S.No	Crops	Pattern	Percentage (%)
1	Vegetables (tomatoes, potatoes)	April to July	57
2	Pulses	April to July	23
3	Vegetables (cabbage, potatoes)	July to October	60
4	Maize	July to September	40
5	Millet	April to August	20

Income from livestock also contributes to the agriculture income through milk production and the sale and purchase of animals. About 57% of the surveyed households **(Table 5.13)** have livestock (mainly cows and goats), with an average number of 3.85 per household. The average number of poultry birds per household is 7.

Table 5.13: Livestock Inventory of Surveyed Households

Type of Animal	No. of HHs with Animals	No. of total Animals	Average No. of Animals/ HH
Buffaloes	3	3	1.00
Cows	98	379	3.86
Horse	9	20	2.22
Donkey	12	24	2.00
Sheep	24	153	6.37
Goat	90	329	3.65
Overall	**-**	**908**	**3.85**

5.4.6 Income and Poverty Levels

5.4.6.1 Income Levels

The assessment of annual household income is one of the important indicators to measure the well-being/livelihood of the household. The average household income was computed to be Rs. 68,998 per month. The survey results shown in **Table 5.14** reveal that a major proportion (45.5%) of the surveyed households fall in the income category of Rs. 20,000 to Rs. 50,000, while 14.4% and 40.1% come under the income bracket of less than Rs. 20,000 and above Rs. 50,000 per month, respectively. The average per capita income was computed to be Rs. 98,333 per annum and Rs. 8,194 per month. In accordance with the poverty line (Rs. 25,475/ month per household), the level of poverty of the sample households is 14.4 percent.

Table 5.14: Average Income of Surveyed Households

Income	Household Income Bracket			Total
	Upto Rs. 25,000	Above Rs. 25,000 – Rs. 50,000	Above Rs. 50,000	
Percent of HHs	14.4	45.5	40.1	100.0
Average HH Income	Average Annual Income			827,973
	Average Monthly Income			68,998
Average Per Capita	Rs./ Annum			98,333

	Rs./ Month	8,194
Level of Poverty (%)	Rs. 3,030/ person per month	14.4%

5.4.7 Household Expenditure

The average annual expenditure and pattern of expenditure provide an indication for assessing the standard of living. The expenditure on food items includes wheat or maize flour, cereals, pulses, sugar, cooking oil, and milk; while the non-food items include fuel, education, health, clothing, shoes, cosmetics, utility charges, and other miscellaneous expenditures.

The average household expenditure was estimated to be Rs. 787,973 per annum, out of which, the proportion of food and non-food expenditure was to the extent of 43.3% % and 56.7%, respectively.

5.4.8 Land Tenure, Land Use, and Natural Resources

Most of the land is allocated to individuals using informal methods of identification of plots like placing stones/markers at the boundaries and also accepted by the local community. There is no formal updated land record available with the Revenue Department in the entire project area. In general, the area is hilly/mountainous and there is a scarcity of flat and arable land. It is noted that on the whole, about more than 81% of the land is hilly/mountainous & barren. About 19% of the land is under cultivation in the form of terraces. The water streams are divided among communities or sub-tribes, and everyone knows who owns what piece of land.

5.4.9 Credit Levels of Households

5.4.9.1 Status of Credit Obtained by the Households

The aspects discussed in this section include the extent of sample households who obtained credit, amount of credit, major sources of credit and the purpose of credit. Generally, credit is obtained to supplement income to meet routine and some occasional expenditure of the household, including household purchasing, investment, social needs, construction and maintenance of the house, purchase of farm input/livestock and other expenditures. Credit is obtained from formal sources (banks/ institutions/ private money lender) and non-formal sources (like friends, relatives, and landowners). In the project area, it was observed that on the whole, 16.0% of the sample households obtained credit from non-formal sources, including money lenders, relatives/ friends. A major proportion of the households (81.5%) have obtained credit above Rs. 50,000, while the remaining 18.5% of households obtained credit up to Rs. 50,000. Details are given in **Table 5.15**.

Table 5.15: Average Amount of Credit Obtained by Sample Households

Amount of Credit Bracket	**Households Obtained Credit**	
	(Nos.)	**%**
< Rs. 20,000	2	7.4
Rs. 20,000 – Rs. 50,000	3	11.1
>Rs. 50,000	22	81.5
Total	27 (16.0%)	100.0

5.4.9.2 Source of Credit

The majority of the respondents had taken credit for investment purposes in some business activities and have taken a loan from their relatives. Among surveyed households (16.0%) who obtained credit, most of them have obtained it from non-formal sources. None of the sample households obtained credit from formal institutions due to the requirements of collaterals and payment of interest rates. The details regarding sources of credit are presented in **Table 5.16**.

Table 5.16: Sources of Credit

Sources of Credit	Households who Obtained Credit (Nos.)	Percentage (%)
Formal sources (banks)		
Informal sources	-	-
Private money lender	5	18.5
Relatives	19	70.4
Shopkeeper	-	-
Other	3	11.1
Total	27 (16% of the total sample HHs)	100.0

5.4.9.3 Purpose of Credit Obtained

The purpose of credit obtained is to supplement income to meet routine and some occasional expenditures of the household. Most of the sample households (about 50%) obtained credit for house matters (social obligations) and treatment for health-related issues. Details of purpose and amount of credit are summarized in **Table 5.17**.

Table 5.17: Purpose of Credit Obtained

Purpose of Credit Obtained	Households Obtained Credit (Nos.)	%	Amount (Rs.)
Purchase of house	2	6.7	1,015,000
Business	3	10.0	650,000
Farm inputs	3	10.0	70,000
Livestock (purchase of animals)	3	10.0	86,667
Household matters	9	30.0	362,222
Repair & maintenance of house	4	13.3	141,250
Others (health)	6	20.0	415,000
Total	30 (17.8%)	100.0	2,740,139

5.4.10 Housing Conditions

The ownership and housing condition are some of the key indicators for the assessment of the living standard and well-being of households. The main household structures consist of living rooms, animal shed/ room, and washroom. The details regarding the type of construction/ housing conditions of different structures/ sub-structures are presented in **Table 5.18.**

Table 5.18: Housing Conditions

Housing Condition	Percentage of Housing Conditions			
	Concrete	Semi-concrete	Mud	Wooden structures
Type of Room				
Living rooms	53.3	24.2	17.0	5.5
Animal shed/ room	26.5	18.4	41.8	13.3
Other sheds	23.3	36.7	25.0	15.0
Shelters	18.8	21.9	12.5	46.8
Bathroom	53.0	24.0	14.2	8.8

5.5 Public Health Facilities

The health facilities in the project area are very limited. There is only one Basic Health Unit (BHU) in Kalam, which has five medical doctors, three nurses and lady health workers, and ten medical technicians. The nearest Rural Health Centre (RHC), which has beds and in-patient treatment facilities, is located in Mingora, about 80 km from Kalam.

According to the information provided by the surveyed households, about 0.6% complained about the prevalence of stomach related diseases, especially in the summer season. Flu and Fever were reported as the most common disease by 14.2% and 5.3%, respectively. Diarrhea is a seasonal disease and reported by 0.6% of the respondents. Other diseases like Asthma, Chest Congestion, Eye infection, Heart-Related Diseases, Joint issues, Kidney Related Diseases, Paralysis, Shoulder pain, Human Immunodeficiency Virus (HIV), were rarely reported by the respondents. Tuberculosis (TB) was reported by 3.6 % of the respondents and Hypertension and Hepatitis patients were also reported. The main reasons for the prevalence of these diseases are unhygienic sanitation and indoor smoke from heating.

5.5.1.1 Access to social amenities

During the field survey, the availability of the social amenities/ basic infrastructure in the communities in the project area was determined. The results indicate that facilities such as drinking water, electricity, and roads are generally available in the villages. However, the availability of fuel (such as liquefied petroleum gas, LPG) and access to telecommunication facilities are quite limited.

Springs are the major sources of drinking water in the project area (85%) and water supply schemes contribute only a small proportion (15%).

5.6 Employment and Business Opportunities for the Locals

Men from better-off families are employed in public and private sectors or run their own businesses. The survey revealed that the majority of the middle-income group run their businesses whilst the poorer households work as daily wage laborers. Out of the total, 70 percent of the men from middle-income groups work in agriculture fields whilst a majority of the men from lower-income families work as daily wage laborers or as agriculture tenants. The females from both middle income and low-income groups work in agriculture fields to support the male members of their families. Almost 15 percent of the men from middle-income households run their own dry fruit and other small businesses and 15 percent work as government and private sector employees. Men and women are also involved in animal rearing and wood cutting and collecting.

5.6.1 Ownership Pattern of Land

Most of the surveyed households own the agriculture land and a few are also tenant farmers. All of them owned a piece of land on which their houses are built. In cases of tenant farming, the tenant farmers take one-third of the total produce of the farm. Until the head of the family is alive, only residential land is allotted to the sons, and once the patriarch's head passes away, the agriculture land is divided. A majority of the households only distribute land in between the sons, and daughters rarely get a share. In cases the daughters are offered their share of agriculture land, they refuse to take it due to cultural reasons.

5.6.2 Prevalence of Conflict and Cohesion

Peace and solidarity prevail in the Project area. The community is homogeneous, and members are known to each other. There are not many serious issues or tensions in the local communities except few individuals having feuds and rivalries. In case of any feud, the local *Jirga* resolves the issues then and there. The most common causes of tensions are land and forest disputes. There is a dispute between the Forest Department and the local population as the Forest Department wants people to inform the officials before the locals cut trees as the trees are legally owned by the Forest Department. However, the locals are of the opinion that the forest is owned by the locals and that they do not need to inform them before cutting trees. Tree cutting in the forest is illegal and the locals cut trees at night. Only the locals cut trees. The locals have demanded that they would stop cutting trees if the government was to provide them with free electricity to help them heat their houses and for cooking purposes.

5.6.3 Decision-Making Forums in the Local Communities

Jirga is a commonly acceptable decision-making forum in the project area for conflict resolution, as reported by the 83.9% sample respondents. A *jirga* is a traditional assembly of leaders that make decisions by consensus and according to the teachings of Pakhtunwali. The Pakhtunwali is a traditional lifestyle of the Pakhtuns and interpreted as "the way of the Pakhtuns" or "the code of honor."

5.6.4 Seasonal Migration Trends in The Project Area

Kalam is also a tourist destination during the summer season and therefore, the men in the area are engaged in seasonal employment. However, in winter, it is hard to find any tourists in Kalam and thus during winter, due to extremely cold weather, a number of locals migrate to plain areas, mainly the central districts of KP and Punjab provinces. Migration starts in the month of October and November before the snow starts to fall. Due to harsh weather conditions, schools remain closed and open in spring. The migrated people work in cities and towns as agriculture labor, household helpers, and drivers and as shop keepers. Families from better-off families of projects do not migrate during the winter season as they can afford to live in the harsh weather. Some of the well-off families in the area also own homes in the lower districts and move there. However, families from lower-income backgrounds who do choose to stay back, look after the homes, animals, and land of the families that migrate and are paid to do so by the owners.

5.6.5 Physical Cultural Resources

5.6.6 Cultural Sites

There are no archeological sites, historical sites, and sites of significant religious value are located in the project area. It is common that every village has a mosque and graveyards, and details of these cultural sites are given in **Table 5.19.** None of these sites will be affected by the proposed project activities.

Table 5.19: Cultural sites in the project area

S.NO	Village	Cultural sites	
		Mosque	Graveyard
1	Kanai	1	2
2	Paler	1	2
3	Mahai	1	1
4	Rashnail	1	1
5	Sher Kally	1	2
6	Chirat	1	1

5.6.7 Tourism

The region is famous for lush green hills, thick forests and bestowed with mesmeric streams, meadows, and waterfalls which are worth seen features of the landscape. Kalam is a famous tourist station in the region along with some other smaller hill stations such as Ushu (in the northeast of Kalam valley), Matiltan (location of large glaciers, thick forests, and lofty mountain peaks) and Utror (surrounded by snow-clad mountains). There are about 350 hotels in the Kalam town and about 400,000 tourists visit the Kalam annually. There is also a tourist location near the Kanai village (about 2 km upstream of weir site), known as *Dhamaka Jheel*, where the width of Gabral River is wide with a picturesque view. This tourist attraction is located outside the project influence area, and there will be no impact on this location from the proposed project activities.

5.7 Gender Assessment

5.7.1 Overall Context

Pakistani women face numerous gender inequalities in the social context and therefore, it impacts their participation in water resources related debates, policy, programs and community-level initiatives. As per Human Development Report 2018, Pakistan ranks 150 out of 189 on the Gender Development Index, with a value of 0.750 and on the Gender Inequality Index ranks at 150 out of 189 and has a value of 0.541. As per the Global Gender Gap Report 2018, Pakistan ranks at 148 and has a score of 0.550 points. The importance of empowering women across the board and mainstreaming women in the management and governance of water has been recognized at the global level since the 1980s, and Pakistan is a signatory to all the relevant water declarations and commitments. Gender inequalities are deeply rooted in the country's social and cultural norms and practices, resulting in discrimination with women and girls, which affect the quality of their life. Gender inequality in Pakistan in general and specifically in Khyber Pakhtunkhwa is characterized by the society and thereby, men on average are better positioned in social, economic, and political hierarchies.

Gender roles are constructed on the basis of the concepts of production and reproduction. The unequal gender roles are reinforced and maintained and influence male and female life circumstances. Women and girls experience differential access to food, education, medical care and access to resources and opportunities; their general and reproductive health is negatively affected due to restrictions on decision making and their mobility. Most of the women's roles are limited to family and are excluded from main decision making at household and society level. Lack of sufficient time, gender bias, social and cultural norms as well as family responsibilities are the most significant challenges women face to achieve balance in a patriarchal society. The gender analysis of AHs revealed that female' domestic roles, strict cultural values, and their early marriages are a great reason for the low enrolment of females in the schools and higher-level education. The sections below documented the outcome of gender assessment. As a result of gender assessment, a Gender Action Plan has been developed for gender mainstreaming in the Project, attached to ESIA of the project.

5.7.2 Family Composition

The households live as joint families, with the male patriarch as the head of the household. Single marriage system is in vogue, but in case a wife continually has 3 or 4 girls, then in the majority of the cases, the husband opts for a second marriage. The second wife lives in the same house with children. Joint family systems are prevalent in the project area wherein all family members deposit each of their earning in one exchequer and fulfill their needs from the same exchequer. The patriarchal family system persists in the project area; the elderly male member of the family is head of the family.

The respondents mentioned that commonly acceptable age for marriage for both boys and girls is 18 years, but the better-off income households prefer to marry their boys at the age of 25 and girls after 18 years of age. The better-off income households believe that the boys should first complete their education and then marry. In middle income and lower-income households, boys are married after they turn 18, and the girls are married between the age of 15-18 years.

5.7.3 Education Facilities

There are no social and cultural restrictions for the girls of the better-off income group to get an education from outside of Kalam. Middle income and lower-income families do not send their children outside of the locality for an education due to financial unaffordability, non-availability of educational facilities in the periphery, and due to social pressures to keep the girls at home. People of the area are aware of the importance of education, especially for girls. They are of the view that by getting a formal education, girls to become good wives, mothers, and daughters and thus become aware of their duties, rights, and responsibilities in society. On the other hand, non-formal education is a big source of socialization within society. They are also aware that education helps them improve their lifestyles and provide them with a ray of hope to get out of the darkness towards light.

The ratio of education is very low within the project area. The reasons for this are the non-availability of schools or madrasas (religious schools) in the nearby locality. Students have to go to faraway areas to get an education. The ratio of education in men is slightly higher than that of women. The majority of women are illiterate; however, they are aware of the importance of education for their new generation.

5.7.4 Constraints in Accessing Schools

Due to hilly terrain, hard weather, lack of transport facilities, non-affordability of transportation, and due to social and cultural barriers, the children are deprived of education. There are some small madrassas where students are getting religious education. There is a need for skill development in the project area, including that of making decoration items, embroidery, and dressmaking, etc.

5.7.5 Women Health

Information on the women's health issues has been gathered through discussions with the respondents as well as meetings with the health officials in the project area. According to the information gathered, very few women receive treatment from antenatal care centers; similarly, a very negligible number of women receive any form of post-natal care from skilled birth attendants. The majority of the respondents perceive it as unnecessary. Other reasons are the cost of treatment, a long distance from the health facilities, lack of roads and financial constraints, and social pressures.

5.7.6 Health Facilities/Issues for Women

The project area has limited health facilities (a BHU in Kalam). Even in case of delivery, traditional birth attendants are not available in the nearby localities. The most common illnesses among women are joint pain, anemia, seasonal fever, and depression. Women relayed that the bearing of children without any break is a cause of concern for their health and is also added a financial burden on the household. As the lifestyles of middle income and lower-income households are similar, the people have reported having similar diseases. There are no registered traditional Birth Attendants, Midwives available within the project area and people turn to local midwives and, in case of emergencies, either visit the Kalam BHU or the RHC in Mingora. The better-off families take their women to Private hospitals in Mingora. The women from middle income and lower-income groups give birth to their children at home with the help of elderly women.

5.7.7 Role of Women In Decision Making

The assessment reflects that the majority of the decisions within the households are made by the male members of the family, whilst the decision about children's marriages is made in consultation with elderly women. The decision about the sale and purchase of property and major expenditures is made by men across all income groups. Community-level decisions are always taken by the male members through the customary Jirga system. Women are not part of the Jirgas and no women-specific jirgas exist in the project area. Women related issues are mostly addressed by male Jirgas.

5.7.8 Mobility of Women

Women visit families, friends, and weddings and go out for shopping. However, as the markets are an average of 4.5 km away from the villages, and the women are accompanied by either an elderly woman or a male member of the family or a male child. Women travel for up to 30 minutes, 3-4 times a day to collect water from nearby streams and springs and use the water for drinking, cooking and cleaning and washing purposes. They also help the male members of their families in agriculture fields, which are generally next to their homes. However, women go in pairs and do not travel alone. Women always accompany the male members of the households to the BHU and to the hospital. Women rear animals and collect wood. It is pertinent to mention here that the women are allowed to visit their relatives and family friends on their own tribe within or outside of their villages. Women rarely go out for the purchase of grocery items and grocery shopping is mostly done by the male members of the family. The girls of better-off and middle-income households are allowed to go out to get an education while in lower-income households they are not allowed to go out without an accompanying male member of the household.

5.7.9 Women Social Protection

The women in consultation reported that none of the households have access to any social protection program such as the Benazir Income Support Program, Baitul Mall, or any other charity organization.

5.7.10 Availability of Skill Centers

There are no technical or vocational training centers for the women in the project area or in Kalam or in other nearby towns. The local artisans, both male, and female prepare many items from the local wood, including decoration pieces, beaded bracelets, and other such items. Some of the women are engaged in embroidery, but their products are taken to the market by men for selling. About 30 % of women of affected households are involved in stitching for women and children's clothing and earn up to PKR 200 per suit. On a monthly basis, a woman earns up to PKR 5000. About 25% of women from households' stitch clothes of female members of their families and children.

5.7.11 Concerns of Women about the Project

The local women know that the government intends to start a hydropower project in their area and their main concern was related to loss of land and physical displacement.

The women have an expectation that the project will elevate their low-lying barren lands and after leveling they will be able to grow crops on it. Local women identified the following problems in their area for the interventions through the Project:

- A middle and high school for girls in Kanai and Ashuran villages
- Vocational training center in Kanai and Ashuran villages
- Microfinance for women income-generating activities, including skill development as they want to improve their craft by designing handmade embroidery so they can compete in the market and get better rates for their products.
- Maternity home for women
- Microfinance institution that would help to develop and polish the skills of the local women as it would enable them to take loans, expand their work and be able to sell them to the locals and the tourists.
- The pavement of road from Kalam Town to Kanai village

5.7.12 Women's Participation in Income Generating Activities

Women are involved in several household and income generation activities, including:

- Employment as private and government school teachers, lady health visitors/ workers and traditional birth attendants.
- Poultry, cleaning cot, supervise hatching, feeding, and animal rearing.
- Other household chores include washing clothes, fetching water and firewood, cooking, child caring, cleaning and repairs of household items, participation in social obligations/ marriages and gathering.
- Agricultural and farming activities such as harvesting, picking of vegetables and drying fruits.
- Livestock rearing, collection of fodder, grazing, washing buffaloes, processing the milk products.
- Poultry, cleaning cot, supervise hatching, feeding and health care.
- Other households chores include washing clothes, fetching water and firewood, cooking, child caring, cleaning and repairs of household items, participation in social obligations/ marriages and gathering

5.7.13 Women Daily Activities

The women's participation in different activities was analyzed for a better understanding of the workload on women in various households, and according to the findings, all the local women responded that they are involved in household activities. These views were obtained from mix groups of women, including housewives. The women's daily activities, social obligations, business activities, employment and other activities given in **Table 5.20**.

Table 5.20: Women Participation in Household activities

Activities	No. of Households (Women Members)	%
The extent of women involvement		
Household activities	56	100.0
Child caring	54	96.4
Farming including vegetable growing & picking	23	41.1
Livestock rearing	17	30.4
Preparing fodder	44	78.6
Feeding animals	21	37.5
Veterinary care	14	25.0
Milking	32	57.1
Watering animals	29	51.8
Social obligations (marriage, and other functions)	41	73.2
Fetching of drinking water	32	57.1
Collecting fire/ fuel wood	8	14.3
Decisions are taken by women in your home		
Children issues	4	7.1
Education of children	6	10.7
Health issues	2	3.6
Marriages of children	5	8.9
Food and cooking	17	30.4

The women of the project area also contribute to income generation of their families through some woodwork and dressmaking. About 2% of women involved in wood carving and 6% of women are involved in dressmaking.

6 Climate Change and Other Risks

This chapter discusses the risks of climate change-related impacts, net greenhouse gas emissions from the Project and risk of earthquakes.

6.1 Climate Change Risks

During the last decade, substantial research is carried out to study the effects of long-term climate change on precipitation, air temperatures, and droughts in Pakistan. Some of the main conclusions of these studies (GCISC, 2009[19] , Planning Commission, 2009[20]) are:

- between 1980 and 2005 the frequency of heatwaves (T >40 °C) has been increased in north-western Pakistan. It is expected that there will be more frequent periods with extreme drought;
- based on predictions in scenarios of the International Panel on Climate Change (IPCC) estimates have been made by the Pakistan Meteorological Service of the increase in maximum daily temperatures, which ranges from 2.8 °C to 4.2 °C in the year 2080 for northern Pakistan;
- more heavy rainfall events during the monsoon season will occur over north-western Pakistan instead of over the north-east of the country. Some models calculate 25 percent more rainfall during monsoon. As a result, areas along the western rivers of the country (Indus and Kabul) will be more vulnerable to flood episodes similar to the one experienced during 2010;
- water availability might increase considerably (during monsoon or Kharif season) but not when it is required for agriculture (winter or rabi season); a shift has been observed in the rainfall pattern with monsoons starting 1-2 weeks earlier and winter rains confined towards February. The predictions of changes in precipitation, however, are much less certain than those in temperature. A general conclusion is that precipitation in the form of rainfall and snow is likely to increase in summer (2- 7 percent) and decrease (2-4 percent) in Northern Pakistan in the year 2080 (GCISC, 2009).

Other studies (World Bank[21], 2005, Rees and Collins, 2004[22]) have been concentrated on the effects of glacial melt, especially on the Hindu Kush-Karakorum or the Western part of the Himalaya. Major issues to be investigated are amongst others: the importance of the contribution of snow and glacial melt on the hydrology of the Indus; the observed changes in the extent of the glaciers; the effects of climate changes on the amount of melt-water.

From these studies, it has been concluded that glaciers in the Himalaya and Karakorum are receding faster than happens in any other part of the world. From digital terrain models and satellite observations, it might be concluded that the reduction of the thickness of ice in the Western Himalayan glaciers ranges between 0.50 to 0.90 m per year, although in some areas in the Karakorum an extension and increase of

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[19] GCISC (2009): Ali, G., S. Hasson, and A.M. Khan, Climate Change: Implications and Adaptation of Water Resources in Pakistan, Research Report No.GCISC-RR-13, Global Change Impact Studies Centre, Islamabad.

[20] Planning Commission 2009, Pakistan's Climate Change Policies and Actions, Task Force on Climate Change, Planning Commission, Planning and Development Division, Government of Pakistan.

[21] World Bank 2005.Pakistan's Water Economy Running Dry

[22] Rees, G. and D. N. Collins (2004), An assessment of the Potential Impacts of Deglaciation on the Water Resources of the Himalaya, Technical Report, DFID KAR Project No. R7890: Snow and Glacier Aspects of Water Resources Management in the Himalayas (SAGAR MATHA), Centre for Ecology and Hydrology, Oxfordshire, UK

glaciers has been reported. A recent study[23] suggests that 60 percent of the discharge in the Indus catchment is fed by the melting of glaciers and snow. This is a very high percentage as compared to other major rivers originating in the Himalayas, such as Brahmaputra, Ganges and Yellow River. In a likely scenario of global warming based on IPCC predictions, the reduction of the share of melt-water in the Indus discharge has been estimated at 8.4 percent. However, this could be (over) compensated by an expected increase of precipitation in the downstream areas (in the NW of the country), which are under the influence of the monsoon.

The relation between climate change and hydrology is extremely complex. This is especially the case, since the high variability in data on climate and hydrology, requiring long time series and proper monitoring. Moreover, regional circumstances might vary considerably, especially in high mountain areas. This often leads to conflicting data. More studies and more reliable data should be collected in the coming years.

6.2 Net Greenhouse Gases Emission from the Project – Power Generation Facilities

Net greenhouse gas (GHG) emissions from the implementation of the Project are estimated using the World Bank "Guidance Note: Greenhouse Gases Accounting for Energy Investment Operations, Version 2.0, January 2015 (hereinafter "Guidance Note") and IPCC 2006 guidelines. The emissions from the Project and baseline emission of the nearest least-cost alternative (CCGT) estimated for over 50 years.

6.2.1 GHG Emissions from the Generation Component

Three sources of emissions are considered for accounting GHG from the Project. The sources and the estimates are given below.

6.2.1.1 Reservoir Emissions

When a river is dammed, the flow dynamics are changed, riverine sediment and organic material are trapped, and terrestrial ecosystems are flooded. This alters the previous cycle and fluxes of CO_2 and other GHGs within the reservoir area. The main contributions to emissions are decomposable parts of flooded soil and vegetation in terrestrial zones and removed sinks from cleared biomass growth. GHG emissions from new aquatic systems will occur during the full lifetime of the reservoir but will exponentially decrease as the flooded organic material is decomposed and as biochemical conditions change.

The Project will create a limited reservoir (0.2 square kilometers) and will not contribute to any reservoir emissions, and hence reservoir emissions from the Project can be assumed to be zero.

6.2.1.2 Emissions from Land Clearing for Civil Works

Construction of project infrastructures such as weir, tailrace, switchyard, and some other project facilities such as spoil disposal require permanent land clearing. Emissions from land clearing can be calculated as a one-time emission of CO_2 based on the available dry biomass carbon for the total cleared areas for construction. According to IPCC guidelines, a dry temperate climate has 100 tons/ha of dry biomass, of which average carbon content is 47 percent. Total land clearing emissions for 2 km^2 are 0.034 million tCO_2e.

6.2.1.3 Embodied (Life Cycle) emissions in construction materials

The construction of the Project requires a huge amount of concrete, steel, metals, and other electromechanical equipment. All of these materials have embodied emissions as a result of the energy used to produce them, meaning that the implementation of the Project creates some upstream emissions

[23] Immerzeel, W. W., L. P.vanBeek, and M. F.Bierkens (2010), Climate change will affect the Asian water towers, Science, 328, 1382– 1385.

in the manufacture of the materials used. The Guidance Note recommended a mean value of 2.9 kg CO_2e/MWh per hydropower as a default factor if no other information is available. Total Embodied (Life Cycle) Emissions are 0.056 million tCO_2e.

6.2.2 Baseline Emissions

Two sources of emissions are considered for estimations of baseline emissions.

6.2.2.1 Baseline Generation Emissions.

These are GHG emissions resulting from the same amount of electricity generation using other alternate feasible energy sources. This feasible alternative should be realistic in terms of economic, technical, financial, legal, and regulatory aspects. The economic and least-cost analysis of the Project described CCGT is the most feasible alternative to the Project. Emission Factor for CCGT in Pakistan is 367.56 g CO_2/kWh. Total Baseline Generation Emissions for 50 years is 7.19 million tCO_2e.

6.2.2.2 Baseline Construction Emissions.

According to the 'Guidance Note', the default value for one-off emissions for thermal gas power is 503 kgCO2e/kW of installed capacity. The corresponding plant factor is 85 percent. For the installed capacity to produce 391GWh/year requires 50 MW of thermal gas power. Total baseline construction emissions are 0.03 million tCO2e. Therefore, the total baseline emissions from the above two sources are 7.21 million tCO2e.

6.2.3 Net Emissions

The net emissions (Project Emissions - Baseline Emissions from CCGT) of the Project are minus 7.12 million tons of CO_2 equivalent. A summary of the calculations is given in **Table 6.1**.

Table 6.1: Net GHG Emissions (tCO2) from T5HP – Power Generation Component

	Emission Type	Generation	Baseline (CCGT)	Net
1	Reservoir emissions	0		0
2	Generation Emission		7,185,798	-7,185,798
3	Land clearing	34,467		34,467
4	Embodied Emissions	56,695		56,695
5	Energy emissions in Construction (optional)	0	26,413	-26,413
	Total Emissions	91,162	7,212,211	-7,121,049

6.3 Net Greenhouse Gases Emission from Power Evacuation Facilities

Three sources of emissions are considered for accounting GHG from the power evacuation facilities. The sources and the estimates are given below, and emission calculations are given in **Table 6.2**.

6.3.1 GHG Emissions from Transmission Line

The losses in the transmission are estimated at 2%. The direct generation emissions associated with these losses (emission factor 0.6545 tCO_2/MWh) is estimated to be 0.15 million tCO_2e.

6.3.2 GHG Emissions from Land Clearing

Land clearing will be required at the tower locations (approximately tower will be required for every 300 m, and a clearance required for each tower is 10m X 10m), and emissions associated with the clearing are estimated to be 69 tCO_2e.

6.3.2.1 Sulfur hexafluoride fugitive emissions

Sulfur hexafluoride (SF6) is used in gas-insulated switchgear, gas circuit breakers, and (less frequently) in high-voltage, gas-insulated lines. SF6 may escape as fugitive emissions during the manufacturing, installation, use, maintenance, and disposal of this equipment. Sealed distribution equipment may not emit any SF6 during use, but transmission equipment often requires periodic refilling and hence has higher rates of fugitive emissions during use. The amount of SF6 emitted during operation, and decommissioning is related to the number and type of equipment used, as well as the maintenance and recycling procedures. SF6 emissions could occur in all transmission and distribution projects, depending on the type of equipment installed, refurbished, or maintained. Countries report SF6 emissions from the power sector in their national emissions inventories, and emissions factors from these inventories provide one way to estimate their magnitude (emission factor for Pakistan is 0.119 gSF6/MWh). SF6 emissions are estimated as 0.033 million tCO_2e.

6.3.2.2 Total Emissions from Power Evacuation

Embodied emissions and construction emissions have not been calculated since the information will be known only at the construction stage. The overall Project emissions from the above sources are estimated to be 0.154 million tCO_2e.

6.3.3 Baseline Emissions

The baseline (or alternative to the project intervention) is usually a project that provides the same level of service (for example, the same transmission capacity or reliability level) provided by the project being pursued. Since this will be a new transmission line, the other feasible alternatives are different routings. So, the emissions of this alternative would likely be very similar to those of the project.

6.3.4 Net Emissions

The net GHG emissions (Project Emissions - Baseline Emissions) of power evacuation are zero since this will be a new transmission line, and emissions from the project and baseline (alternative) will be the same.

Table 6.2: Net GHG Emissions (tCO2) from Power Evacuation Component

	Emission Type	Evacuation	Baseline	Net
1	Generation Emissions from losses in the project	153,546	153,546	0
2	Emissions from Land Clearing	69	69	0
3	SF6 Emissions	33,361	33,361	0
4	Embodied Emission (Optional)	0	0	0
5	Energy Emissions in Construction (Optional)	0	0	0
	Total Emissions	153,615	153,615	0

6.4 Risk of Earthquakes

The Project area is located in a part of Pakistan where earthquakes frequently occur, though usually, these are not of an exceptional magnitude. The project area is located in a tectonically active region affected by the continuing northward drifting of the Indian plate and its subduction below the southern flank of the Eurasian plate. The collision of the two plates began about 50 million years ago, and the full contact between them was completed about 40 million years ago. Yet the Indian plate keeps on slowly drifting northward.

The major regional faults related to the intercontinental collision and considered to be active and capable of generating earthquakes are Main Karakorum Fault (located 50 m away from the weir site), Main Mantle Thrust (located 50 km away from the weir site), and Kohistan Fault (located about 45 km from the weir site).

The most recent major earthquake in the area occurred on 8 October 2005, whose epicenter was near Ghori about 19 Km NE of Muzaffarabad (about 200 km from the weir site). The minimum moment magnitude (Mw) of the earthquake measured at this site was 7.6, and the hypocenter was located at a depth of 26 Km below the ground surface. The earthquake caused severe destruction in large areas of northern Pakistan and to a lesser degree, in northern Afghanistan and northern India. More than 73,000 people were killed through this earthquake and 450,000 people made homeless. The epicenter was located at a distance of about 200 km northeast from Tarbela.

The seismicity of the region was studied as part of the detailed design. The seismic accelerations used in the design of the Project are:

- The recommended horizontal Peak Ground Acceleration (PGA) associated with Operating Basis Earthquake (OBE) is 0.21g, which is associated with ground motion having a return period of 145 years.
- The recommended horizontal Peak Ground Acceleration (PGA) associated with Safety Evaluation Earthquake (SEE) is 0.49 g, which is associated with ground motion having a return period of 3,000 years. This PGA is used for the design of the weir.
- All the appurtenant structures at the weir, tunnel and powerhouse areas are recommended to be designed for PGA of 0.30g, which is associated with ground motion having a return period of 475 years.

A committee of an international panel of experts recruited by PEDO will review and approve the Project design. This will be done in accordance with the World Bank Policy OP 4.37 Safety of Dams. A network of instrumentation will be installed at the weir for continuous monitoring.

7 Potential Impacts and Risks and Their Mitigation

7.1 Overview of Impacts

The Project will be a true run-of-river project (operated as a baseload plant) with a limited reservoir area (50acres). The most direct and significant negative impacts of the project will be on aquatic ecology caused by the construction of a 21 m high (above river bed) weir and diversion of river for about 5.75 km for power generation, and acquisition of 200.14 acres/1601.49 kanals (157.44acres/63.716 hectares will be permanently and 42.7 acres/17.3 hectares will be temporarily). Out of total land needed for the project, 76.587 acres/189.255 hectares of permanent loss of private land owned 89 households, including 8 households who will be physically displaced. The adverse impacts during the construction are temporary in nature and will mainly include waste generation, dust pollution, occupational health, and safety risks and community exposure to work hazards. The overall positive impact of the project, which is the generation of 339 GWh renewable electricity with minimal carbon emission, will be experienced countrywide through the provision of enough energy to power the equivalent of about 116,000 homes per year in the country[24].

7.2 Impact Assessment Methodology

Potential environmental and social impacts were identified on the basis of a review of feasibility study reports, field visits, stakeholder consultations, and experiences from the construction of Dasu and Tarbela 4th Extension Hydropower Projects (World Bank funded hydropower projects in Pakistan). The significance of potential impacts was assessed using the criteria and methodology given below.

Impact Magnitude

The potential impacts of the project have been categorized as major, moderate, minor or minimal based on consideration of the parameters such as: i) duration of the impact; ii) the spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria.

The magnitude of the potential impacts of the project has generally been identified according to the categories outlined in **Table 7.1**.

Table 7.1: Parameters for Determining Magnitude

Parameter	**Major**	**Moderate**	**Minor**	**Minimal**
Duration of the potential impact	Long term Beyond the life span of the project	Medium Term The lifespan of the project	Limited to the construction period	Temporary with no detectable potential impact
The spatial extent of the potential impact	Widespread far beyond project influence area	Beyond immediate project components, project influence area	Within project influence area	A specific location within project influence area with no detectable potential impact

[24] The estimates are based on current per capita energy consumption 450 kwh per year, and the average household size in Pakistan (6.45 persons per household).

Parameter	Major	Moderate	Minor	Minimal
Reversibility of potential impacts	The potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst-case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on a review of the population (including proximity / numbers / vulnerability) and the presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. The criteria for determining receptor sensitivity of the Project's potential impacts are outlined in **Table 7.2**.

Table 7.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	The vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	The vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	The vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation

Sensitivity Determination	Definition
Low	The vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor have been determined and the significance of each potential impact established using the impact significance matrix shown in **Table 7.3**.

Table 7.3: Criteria for Determining Significance of Impacts

Magnitude of Impact	**Sensitivity of Receptors**			
	Very High	**High**	**Medium**	**Low**
Major	Critical	Major	Moderate	Minimal
Moderate	Major	Major	Moderate	Minimal
Minor	Moderate	Moderate	Minimal	Minimal
Minimal	Minimal	Minimal	Minimal	Minimal

7.3 Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in Section 7.2 above. A summary of these impacts and their significance are presented in **Table 7.4** along with the key mitigation measures. A detailed assessment of impacts and proposed mitigation measures are given in the subsequent sections. Environmental Code of Practices (ECPs) have been prepared to address all generic construction-related environmental and social risks and presented in **Annex 1**.

Table 7.4: Potential Impacts and their Significance

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
Environmental and Social Considerations in the Project Design					
1. Reduction of the reservoir area by building the left embankment	Very High	Major	Critical beneficial	About 17.25 acres of agricultural land and two houses are saved from the submergence by building an embankment on the left bank of the reservoir.	Critical beneficial
2. Impact on fish migration and aquatic ecology	Very High	Major	Critical adverse	A fish ladder is designed considering the requirements of snow carp, the indigenous fish species in the project area. Environmental flows are designed based on the requirement of snow carp and to maintain ecological connectivity.	Minimal adverse
3. Restoring the 2010 flood eroded areas and land reclamation through placing muck disposal	Very High	Major	Critical beneficial	Muck disposal areas are identified in the flood eroded areas. The restored lands will be handed over to the original owners	Critical beneficial
4. Development of tourism attractive facilities in the project area	High	Moderate	Major beneficial	Tourist-attraction facilities are in-built in the project design (parks near the reservoir area and deflected spillway) to provide additional recreation facilities to the tourists of Kalam hill station.	Major beneficial
Environmental impacts due to Project siting					
1. Generation of low carbon and environmentally friendly power generation. Supply of additional 88 MW (339 GWh) of electric power to the national grid of Pakistan	Very high	Major	Critical beneficial	Implementation of the ESMP and RAP to mitigate impacts associated with the construction of the project	Critical beneficial
2. Loss of natural vegetation (48 trees owned by the community and 636 forest trees) due to the land clearing under project footprints. Possible disturbance to Koklass and black bear pheasants.	Medium	Major	Moderate adverse	Compensation for the provincial forest department for replantation of trees in the same areas (at higher elevations, at a ratio of 10 new trees per each tree cut), and afforestation of degraded forest lands (in an area equal to the land affected by the project activities). Plantation of trees in the colony and around the reservoir area	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				Supporting the provincial wildlife department for wildlife conservation in the project area and the Bhan game reserve. Detailed monitoring of impacts on flora and fauna during construction	
3. Inundation of 500 m existing road on the left bank and submergence of a footbridge and PVC water pipes	Very high	Major	Critical adverse	Realignment and construction of a 1.4 km new road at a higher elevation and relocation of a footbridge and the utilities Provision of water supply to the communities through tankers during the relocation of PVC water pipes	Minimal adverse
4. Greenhouse gases emissions from the proposed land clearing, construction, material life cycle, and power generation and transmission (0.24 million tons of emissions over the lifetime of the project)	Medium	Minor	Minimal adverse	Net greenhouse gases emissions are minus 7.12 million tons when compared to other feasible options for power generation and transmission	Moderate beneficial
Social impacts due to Project siting					
5. Acquisition of 157.44acres (1259 kanals) of land permanently from 87 households	Very high	Major	Critical adverse	Adequate compensation for affected households as per the entitlement matrix in the RAP. Implementation of income and livelihood restoration plan Implementation of a social development plan.	Minimal adverse
6. Impact on 11 acres of land due to construction for 2.75 km long transmission line (12 towers)	Medium	Moderate	Moderate adverse	Adequate compensation for affected households as per the entitlement matrix in the RAP One time compensation for the land under towers	Minimal adverse
7. Loss of livelihood due to the acquisition of 26 acres of agricultural land from 44 households	Very high	Major	Critical adverse	Adequate compensation as per RAP Implementation of income and livelihood restoration plan. Implementation of social development plan.	Minimal adverse
8. Relocation of 8 households	Very high	Moderate	Major adverse	Adequate compensation for affected households as per the entitlement matrix in the RAP	Minimal adverse
Environmental impacts and risks during construction					

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
9. Generation of about 0.8 to 1 million cubic meters of spoils/muck (excess excavation) and their disposal	Medium	Moderate	Moderate adverse	Transport and disposal of spoils and designated muck disposal sites identified and approved for land reclamation Proper dumping and adequate compaction to avoid dust and release back to the river Handing over the reclaimed sites to the landowners Landscaping of the areas after completion of works	Major beneficial
10. Generation of construction waste including hazardous waste	High	Moderate	Major adverse	Containers of adequate size and numbers in place for collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste	Minimal adverse
11. Generation of solid waste from campsites and offices (about 100 kg per day).	Very High	Moderate	Major adverse	Implementation of the waste management plan Segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable) and garbage (non-recyclable). Placement of containers with adequate size and numbers. Organic waste will be treated through in-vessel composters Recyclable waste will be compressed through bailers and use services of the waste management contractor Disposal of the garbage at the designated disposal site	Minimal adverse
12. Wastewater discharges from the construction camps, sites, and batching plants	Medium	Moderate	Moderate adverse	Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and at the worksites (sedimentation tanks for batching plants and discharges from tunnels; and site drainage) Monitoring of wastewater quality to ensure compliance with NEQS	Minimal adverse
13. The potential risk of soil and water pollution by construction works	Medium	Moderate	Moderate adverse	Storage of fuels and chemical in contained facilities Availability of spill kits and trained personnel for immediate cleanup of any oil spills	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
14. Air and noise pollution from construction and traffic	Moderate	Medium	Moderate adverse	Air and noise pollution control measures at the worksites and regular monitoring of ambient and noise quality to ensure compliance with NEQS Compliance with NEQS on vehicle and machinery emissions	Minimal adverse
15. Sourcing of aggregates (about 0.59 million cubic meters) for concrete works	Medium	Moderate	Moderate adverse	Reuse of excavated material to the extent feasible Use of licensed quarry sites Source the material from the boulders from the eroded riverbanks in the proposed reservoir area (which are found to be suitable for aggregates).	Minimal
16. Impact on river habitat due to construction activities and drying of river section (about 590 m) between two cofferdams (for two years)	Medium	Moderate	Moderate adverse	Control of wastewater and sediment releases to the river Monitoring and relocation of trapped fish into the downstream waters	Minimal
17. Impacts from increased human activities on flora and fauna, including Bhan Community Game Reserve	High	Minimal	Minimal adverse	Limit the siting of any temporary facilities within the boundaries of the worksites. Use of non-wood fuel for cooking and heating Code of conduct for workers and employee’s protection of flora and fauna and a ban on tree cutting and hunting. Any violation to code of conduct leads to strict punishment including termination of employment Awareness-raising to workers on the Bhan game reserve	Minimal adverse
Occupational Health and Safety Risks					
18. Occupational health and safety risks on workers due to hazards associated with the construction activities (instream, underground tunnels, mountain slopes, blasting and drilling, working on heights and trenches, cold weather, etc.)	High	Moderate	Moderate adverse	Development and implement occupational health and safety plan Regular site inspections and safety audits (OSHA) Regular training program for workers on occupational health safety (monthly training and daily toolbox talks) Incident investigation and reporting Conduct a ‘job hazard analysis’ at the new construction site to identify potential hazards and implement necessary control measures.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				Use of relevant personal protection equipment at all times Availability of firefighting, fully equipped ambulance, first-aid and rescue facilities at the site Adequate water supply and mobile toilets at the worksites	
19. Potential health risks due to inadequate facilities in the campsites (about 200 non-locals, including about 60 foreign workers live in construction camps)	High	Moderate	Moderate adverse	A construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, recreation) for labor. Cleaning of the campsite on a daily basis. A medical clinic, with a medical doctor and attendants and preliminary staff, will be established at the camp The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan	Minimal adverse
20. Employment generation for the local community	Very high	Moderate	Major beneficial	The hiring of the local community during construction works (about 300 workers on average regularly and about 500 during peak construction for five years) Implement a labor management plan Formal contracts to be signed with labor.	Major beneficial
21. Risk of child labor	Low	Moderate	Minimal adverse	No hiring of workers less than 18 years of age	Minimal adverse
Social Impacts and risks during construction					
22. Safety hazards due to increased traffic on local roads especially for children and elderly people	High	Moderate	Major adverse	Implement a traffic management plan (e.g., avoiding school hours, following sped limits, hiring licensed drivers, etc.) including awareness-raising and safety measures	Minimal adverse
23. Community exposure to work hazards	Very high	Moderate	Major adverse	Barricade the work areas (near the settlements) with hard fencing to prevent the entry of community in the construction areas. Placing adequate signboards and flagmen to divert the community away from the construction works. Community awareness programs on construction-related hazards, including awareness programs in schools	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
24. Dust from vehicular movement (20 to 30 trucks per day) on local roads and construction equipment	Very high	Moderate	Major adverse	Frequent sprinkling as per weather requirements of water on the local roads and worksites to control dust emissions Dust control measures at the worksites	Minimal adverse
25. Risk of damage to houses by blasting activities (through fly rock and vibration)	Moderate	Medium	Moderate adverse	Use of controlled blasting and placement of sandbags on the drill holes to prevent fly rock Minimum use of explosive blast instead of one single blast Adequate compensation for any affected structures	Minimal adverse
26. Impacts from labour influx and potential cultural conflicts between communities and workers	High	Moderate	Moderate adverse	The contractor's code of conduct shall cover a program to promote awareness to the construction workers on respecting the local community. Construction camps will be built in the designated areas, located away from the local settlements The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community	Minimal adverse
27. Risk of gender-based violence (GBV), sexual exploitation and abuse (SEA), and sexual harassment (SH)	High	Minimal	Minimal adverse	The contractor's code of conduct shall cover clauses related to avoiding gender-based violence, sexual exploitation and abuse, and sexual harassment. The code of conduct will be translated into Urdu and disseminated. The code of conduct will be included in the worker's contract agreement, and any violation of the code of conduct will lead to termination of employment. The contractor's code of conduct shall cover a program to promote awareness to the construction workers on avoiding GBV, SEA, SH and the risk of spreading sexually transmitted diseases The Contractor's monthly training program will cover topics related to Code of Conduct such as sexual harassment particularly towards women and children, violence, including sexual and/or gender-based violence. The awareness activities will cover posting of CoC standards in public spaces in Urdu language; trainings and	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				sensitization sessions, providing information on GRM, awareness on suspicious situations and signs of GBV and other related aspects. Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers	
Environmental and Social impacts during Operational stage					
1. Barrier effect on fish migration	High	Minimal	Minimal adverse	A fish ladder has already built into the design of the weir Sensors will be placed on the ladder and monitored to count the fish and to assess the effectiveness of the ladder	Minimal adverse
2. Reduced water flow between the weir and the tailrace during low flow season	Very High	Major	Critical adverse	Environmental flow requirements are assessed based on the requirements of snow carps. During extreme low flow season (December to February), when fish don't migrate and live in pools, an environmental flow of 2 m^3/s will be released. During the fish migration season (March/April and September/October) and other seasons, an environmental flow of 2.5 to 3.5 m^3/s will be released. Downstream monitoring and adjustment of flows if required	Minimal adverse
3. Risk of bird collision and electrocution from the transmission line	Medium	Minor	Minimal adverse	Insulation of exposed parts of the tower structure	Minimal adverse
4. Reduction of sediment load in the downstream water flows from the reservoir	Medium	Minor	Minimal adverse	Release of environmental flows and excess flows through sluices to release the sediments in the high flow season Regular flushing of sand traps during high flow season	Minimal adverse
5. Workers health and safety during routine operation and maintenance	High	Moderate	Moderate adverse	Implementation of OHS plan	Minimal adverse
6. Waste generation from the plant and staff colony	High	Moderate	Moderate adverse	Implement a waste management plan	Minimal adverse
7. Community health and safety	Very high	Minor	Moderate adverse	Complied with World Bank recognized standards on EMF through design considerations. Review of dam designs by an independent panel of experts	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
8. Improved livelihood opportunities from the development of tourist attractions and waste generation at tourist sites.	High	Moderate	Major beneficial	PEDO will provide preference to affected persons in establishing small businesses in designated tourist areas established at the project sites to improve their livelihood. PEDO establish and maintain waste and sanitation facilities at the tourist facilities at the project sites	Minimal adverse

7.4 Environmental Issues Mainstreamed in the Project Design

Environmental and social aspects have been considered in the planning and design of the Project facilities. These include:

- The weir height and potential power generation from the project are optimized to avoid the inundation of upstream Kanai and Utror villages.
- Construction of embankment (flood protection wall) on the left bank at the weir site has reduced the land acquisition by 17 acres (that could be submerged under reservoir).
- Muck disposal sites are selected in the areas that were eroded by the 2010 flood (before the flood, they were under agricultural use) and these sites will be reclaimed and can be used for agricultural purposes
- A fish ladder is designed based on the requirements of snow carps and included in the weir
- The project will be operated as a 'true run-of-river' for baseload power generation without any peaking operation
- Tourist-attraction facilities are in-built in the project design (hiking ways, deflected spillway, and parks)

7.5 Impacts from Project Siting

7.5.1 Environmental Impacts from project siting

7.5.1.1 Low Carbon Power generation and Economic Improvement in the Region

The Project would supply about 339 GWh of electric power annually to the national grid. This additional electric power supply would address the current energy crisis in the country by eliminating the load shedding and power cuts and would lead to economic growth and increased employment. The Project generates clean energy enough to power the equivalent of about 116,000 homes per year in the country[25]. The estimated greenhouse gases from the Project are minus 7.12 million tons.

7.5.1.2 Loss of Forest Vegetation

The proposed project facilities are located mainly within the river corridor; however some facilities on the right bank near the weir site for connecting channel, sand trap and tunnel inlet (13.86 acres) and powerhouse site (for powerhouse, surge shaft, access tunnel portal, access road from powerhouse to surge shaft) (48.5 acres) require cutting of some forest vegetation. It has been counted that about 636 wood trees would need to be cleared. The two forest patches affected by Project do not constitute natural habitats as they already under anthropogenic use for development settlements and grazing of their animals. All the affected trees are Cedar deodara (IUCN Status: Least Concern), which is a common and popular wood tree used for construction. In addition, the Project will also require cutting of 10 eucalyptus and 19 fruit trees (15 apples, 2 apricots, 1 peach, and 1 walnut) from the private properties.

Koklass pheasant (*Pucrasia macrolopha*; IUCN Status: Least Concern) is reported in the forests near the powerhouse site. This pheasant has a wide range of habitat and usually lives away from human settlements, and the proposed clearing of the forest will not have any impact since there are ample alternate and adjacent habitats to accommodate these pheasants. The only important species from the conservation point of view, known to occur near the project sites, is the Asiatic Black Bear (IUCN Category:

[25] The estimates are based on current per capita energy consumption 450 kwh per year, and the average household size in Pakistan (6.45 persons per household).

Vulnerable). The major activities under the proposed project that could affect the mammals are the construction works. However, the proposed construction activities will not affect the Black Bear population as the animal prefers to live in higher habitats away from human settlements. As the Bear is persecuted by humans due to damages to poultry, this animal avoids such a situation and keeps itself away from human settlements. Therefore, the project activities will not have any impact on the vastly distributed population of Black Bear around the project site. The project will not have any impact on the Bhan Valley Community Game Reserve since no project activities will be carried out in this valley, and the animal habitats are located about 15 to 20 km away deep inside the valley on the mountain tops. Hence, the significance of the vegetation clearance has been estimated as moderate.

Mitigation

PEDO will implement the following compensation and enhancement measures:

- The loss of natural vegetation from forests will be compensated through cash compensation to the Forest Department for the loss of trees and replantation of trees (a mandatory requirement of planting 10 new trees of indigenous species per each tree cut); and also support the forest department for afforestation of about 60 acres degraded forest land (in an area equal to the land affected by the project activities) in the similar ecological terrain.
- The project will also support the Wildlife Department in its efforts to promote wildlife conservation measures in the project area, including conservation measures in the Bhan Game Reserve.
- A budget of USD 600,000 has been allocated in the project budget for the above measures. Details of activities to be implemented under this budget will be worked out during the project implementation by the ESU staff of the PEDO in consultation with the forest and wildlife departments, and the final list of activities will be shared with the World Bank prior to their implementation.
- A tree plantation program will also be carried out in the proposed colony site.

With the above compensation and enhancement measures, the residual impacts of vegetation clearance have been assessed as minimal.

7.5.1.3 Formation of reservoir

The GKH reservoir would cover about 50 acres of the area (875 m long and 200-300 m width), which includes permanent flooding of about 18 acres of adjacent lands. Most of the lands to be submerged are covered with lands eroded by riverine floods and filled with boulders. About 300 m long local road on the left bank (from Kalam to Gabral) will be submerged under the reservoir and another 100 m long existing road will be affected by the footprints of the weir. A footbridge will be submerged in the proposed reservoir. The bridge was built by the local community and about 15 families are using this footbridge for collecting wood and access the grazing areas along with their livestock. A few PVC water pipes are also located on the riverbed of the proposed submergence area that are used to carry spring water from the right bank to the left bank for drinking purposes of a few households in Kanai village.

Mitigation

PEDO will implement the following mitigation measures:

- A new road of 1.4 km will be built to reroute the existing road adjacent to the weir and reservoir area

- The road built on the weir will be used for access to the right bank. The communities agreed to use the access road to be constructed over the weir, which will be ready before this bridge is submerged in the reservoir
- Relocate the affected PVC water pipes and re-instate the affected water supply facilities. The Contractor will manage to provide clean water to the affected households during the relocation of PVC water pipes through tankers at the accessible location to all affected communities, being within 30 minutes total round trip travel time as per United Nations definition of access to water.

With the above mitigation measures, the residual impacts of reservoir formation have been assessed as minimal.

7.5.2 Social Impacts from Project siting

7.5.2.1 Land acquisition and Resettlement

The development of project facilities will require the permanent acquisition of 157.44 acres/63.716 hectares (1259.57 kanals) of land, including 25.3 acres of agricultural land, 10 wood trees, 19 fruit trees, and 8 residential structures. The total households affected (AHs) by the permanent acquisition of land are 89 and the total affected people (APs) in these households are 743. Besides, the project will temporarily acquire 42.6 acres (347.58 kanals) of land, including 16 acres (37.89 kanals) of agricultural land, and the households affected by this acquisition are 82 and total affected population is 664. The proposed construction of a 2.75 km-long transmission line will also require the temporary land acquisition of 20 acres/8.1 hectare (160 kanals) for construction of 12 towers and right-of-way (30m). The total project-affected households are 171. The land acquisition will have a significant impact on the landowners and their livelihoods. A summary of the proposed impacts on land acquisition is given in **Table 7.5**.

Table 7.5: Summary of Resettlement Impacts

Sr. No.	**Category of Impacts**	**Affected Land**		**AHs (Nos.)**	**APs (Nos.)**	**Remarks**
		(Kanals)	**(Hectares)**			
A. Permanent Land Acquisition						
i)	Cultivated/Arable land	206.63	10.453	44	366	Permanent land acquisition
ii)	Barren (Un-cultivated land)	927.223	46.904	42	349	
iii)	Hilly (Un-cultivated land)	57.38	2.902	1	6	
v)	Cultivated/Arable land having residential structures	2.217	0.112	8	22	
vi)	Riverbed	66.11	3.344			
	Total	1,259.57	63.715	89	743	
Temporary Land Acquisition						
i)	Cultivated/Arable land	37.894	1.917	6	64	Land on a lease, which will be restored and returned to the landowners in its original condition.
ii)	Barren (non-cultivated land)	282.685	14.299	76	600	
iii)	Hilly (non-cultivated land)	-	-	-		
iv)	Residential land	-	-	-		
v)	Riverbed	21	1.062	-		
	Total	341.579	17.278	82	664	
Affected Cropped Area						

i)	Permanent impact	206.640	10.453	44	366	Affected cropped area
ii)	Temporary impact	126.852	6.411	16	64	Affected cropped area
	Total	333.492	16.864	60	-	
Affected Structures						
i)	Residential structures (Nos.)	8	-	8	22	Loss of residential structures
Affected Trees (Private)						
i)	Affected wood/ timber trees (Nos.)	10	-	4	32	
ii)	Affected fruit trees (Nos.)	19	-	4	32	

Mitigation

A Resettlement Action Plan (RAP) has been prepared to address and mitigate the impacts on the affected households. The objective of the plan is to improve or at least restore the income and livelihood conditions of the people to at least the pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost but also additional assistance will be given for relocation and livelihood restoration. The RAP also includes programs to improve the general quality of life of people in the project area through a Social Development Plan involving social, community, health, and educational infrastructure development activities with a budget of USD 5 million. Overall, the RAP presents (a) socio-economic profile of the affected settlements; (b) type and extent of loss of assets; including land, structures, and trees; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) institutional framework for the implementation of the plan, including monitoring and evaluation. The total cost of resettlement, including implementation, is estimated at USD 25.173 million.

7.5.2.2 Livelihood impacts

The land acquisition will have an impact on the livelihood of the affected households, especially on 44 households who lose their agricultural land permanently (25.83 acres or 206.64 kanals) and on 19 households who lose their agricultural lands temporarily (15.857 acres or 126.85 kanals). In the project area, the suitable agricultural lands are available mainly along the river banks, and hence the loss of agricultural land will also affect their livelihoods. In total, 49 households (out of total 171 households) will have significant impact due to loss of residential structures (8 households), loss of more than 10% of their land-based income (33 households), loss of both productive land and house (one household), and tenants who lose more than 10 percent of their income (8 households). These vulnerable households also include households that fall below the poverty line[26].

Mitigation

- Compensation will be paid to the affected households for lost land, crops and fruit trees in accordance with RAP. Additional cash compensation will be paid to vulnerable households.
- Livelihood restoration measures will also be implemented in accordance with the RAP
- Provision of temporary employment in the construction works

With the above mitigation measures, the residual impacts on livelihood have been assessed as minimal.

[26] The income at the poverty line is Rs. 25,475/ month per household

7.5.2.3 Relocation of Eight Households

Eight (8) residential structures consisting of 68 sub-structures (i.e., living rooms, kitchens, animal sheds, washrooms, etc.) will be affected due to the construction of the powerhouse and associated components. These structures owned by eight households located in Chirat, Sher Kalay, and Rashnail. All of these households have built structures on their own lands. This will cause physical relocation of these eight (8) households.

Mitigation

Compensation will be paid to affected households in accordance with the RAP. It was confirmed that all of these households have a nearby place to relocate their structures after getting compensation for land and structures as per the entitlement matrix.

7.6 Environmental Impacts and Risks during Construction

7.6.1 Generation of spoils

Excavations for weir, sand trap, tunnels, powerhouse, and switchyard facilities generate huge quantities of excavated rock. It is estimated that the quantity of rock to be excavated will be 0.8 to 1.0 million m^3. Part of the excavated rock can be used as aggregate provided the fragmented rock meets the quality standards needed for the work. Disposal of remaining spoils requires designated land; otherwise, improper disposal of spoils will have an impact on the river environment.

Mitigation

The contractor will implement the following mitigation measures:

- Minimize the generation of spoils by recycling the excavated rock to the maximum extent possible by using them as the aggregate material in the concrete works, and filling of embankments and road works
- Transport and disposal of spoils and designated muck disposal sites
- Proper dumping and adequate compaction of soil/muck to avoid dust and release back to the river
- Some disposal sites have been identified on the eroded riverbanks, which were originally agricultural lands. These lands can be reclaimed through the placement of spoils and providing soil layer at the top. These sites will be handed over to the landowners. During consultations, local communities have also offered to use their lands for disposal of spoils, if additional land is required.
- Landscaping of the spoil sites, that were in the permanently acquired lands, after completion of works

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.2 Generation of Construction and Hazardous Waste

The construction works generate large quantities of excess materials from construction sites (concrete, discarded material, etc.) and wastes from field camps and construction yards, including other debris. In addition, small quantities of hazardous waste will also be generated mainly from the vehicle maintenance activities (liquid fuels; lubricants, hydraulic oils; chemicals, such as anti-freeze; contaminated soil; spillage control materials used to absorb oil and chemical spillages; machine/engine filter cartridges; oily rags, spent filters, contaminated soil, etc.). It is imperative that such waste is responsibly disposed to avoid adverse environmental and human health impacts.

Mitigation

The following mitigation measures will be implemented:

- Guidelines for the management of wastes, including solid and hazardous wastes, are given in ECPs (See ECP1 on Waste Management and ECP 2 on Fuels and Hazardous Substances Management in **Annex 1** for detailed mitigation measures). Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the PMO for their review and approval.
- The contractor will place containers of adequate size and numbers in place for the collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites, and transport these wastes regularly to a centralized facility.
- The contractor will procure the services of a waste management contractor for transport and treatment of hazardous waste, and management of recyclable waste.
- For disposal of inorganic construction waste, the contractor will develop a waste disposal site or place them in the spoil disposal areas.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.3 Generation of Solid Waste

Solid waste will be generated from the construction camps and offices, which include food waste, paper and plastic, and garbage. About 200 workers live in the construction camp and the average solid waste generation per worker is 0.5kg per day. Thus, the total quantity of waste generated from the camps will be 100 kg per day. Most of these wastes will be food waste. There are no municipal waste disposal sites in the project area. If these wastes are not properly managed, they may harm the environment and health of workers and nearby communities.

Mitigation

The following mitigation measures will be implemented by the contractor:

- Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the PMO for their review and approval.
- Collection and segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable) and garbage (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, rooms) for the segregation of the waste at source.
- Organic waste will be treated through in-vessel composters and the final compost will be given to the local communities to use in the agricultural lands.
- Procure the services of waste management contractors for the collection and management of recyclable waste. Recyclable waste will be compressed through bailers to minimize the volume of waste to be stored and transported.
- Develop a waste disposal site for disposal of garbage.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.4 Wastewater Discharges from Construction Sites

The wastewater discharges from the batching plants contain high sediment loads and high pH value. Although the groundwater is not encountered in the test boreholes drilled along the tunnel alignment, there is a possibility groundwater may ingress through joint planes and discontinuities, creating dripping and moist conditions in some stretches of the tunnel. The discharges from the tunnel may contain high in suspended sediments and can have pH significantly different from receiving surface water bodies. These discharges will impact the aquatic environment if they are discharged without any prior treatment. The groundwater located within the river bed would be affected by the wastewater discharges. Other wastewater discharges from the construction sites include sanitary effluents from workers camp, and vehicle and machinery washing facilities.

Mitigation

The following mitigation measures will be implemented:

- Sedimentation ponds, of adequate size and capacity, will be built for the treatment of discharges from the batching plants and the tunnels to allow the sediments to settle. Final discharges from the sedimentation ponds shall comply with NEQS for wastewater discharges into the rivers. Frequently monitor the pH values and If the pH values high, add online buffering solutions to settlement ponds for control of pH. The settled sediments will be periodically removed and will be disposed of at the designated spoil disposal sites.
- Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and site drainage)
- The contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water
- Quarterly monitoring of wastewater quality to ensure compliance with NEQS

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.5 Risk of Soil and water pollution from Construction Works

During construction, there is a high risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals that are used in construction areas, yards, batching plants, worker camps, and storage sites. Earthworks for site preparation and foundation during rainy periods may carry the sediment load to the river. Other potential sources of soil and, surface water and groundwater pollution are improper storage and handling of materials, including hazardous materials, discharges from the construction sites and material storages, lack of proper drainage facilities, spillage of fuels, erosion from material stockpiles, etc.

Mitigation

The following mitigation measures will be carried out by the contractor to minimize soil and water pollution.

- Storage of fuels and chemicals in contained facilities and take appropriate measures to avoid and contain any spillage
- confine the contaminants immediately after such accidental spillage and cleanup of oil spills using spill kits.
- Collect contaminated soils, treat and dispose of them as a hazardous waste
- Topsoil from cultivated lands in the construction areas to be stripped and stockpiled where practical for later use for restoration of spoil disposal sites.
- Temporary stockpiles to be protected from erosion.
- Additional mitigation measures are given in ECP 3: Fuels and Hazardous Goods Management, ECP 3: Water Resources Management, ECP 5: Soil Quality Management, and ECP 7: Erosion and Sediment Control.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.6 Air and Noise Pollution from Construction

During construction, air and noise emissions from the construction activities will cause temporary nuisances to the residents of the nearby villages. The nearest residences are located about 900 from the weir site, where most of the construction works will be carried out. Major sources of air and noise pollution are drilling and blasting activities, excavations, emissions from construction-related traffic and equipment. The construction activities will also generate airborne dust and particulate matter. The dust raised from the above activities will have impacts on crops, animals and public health.

Mitigation

The following mitigation measures will be implemented;

- Construction equipment and vehicles will be well maintained so that emissions are minimal and comply with emission standards of NEQS.
- Crushing and batching and asphalt plants will be located a minimum 500 m away from residential areas and will have appropriate dust/emission suppression mechanisms such as wet scrubbers
- Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period.
- Construction activities near the settlements will be limited to daytime only
- High noise-producing equipment will be provided with mufflers or acoustic enclosures.
- Blasting methods should be selected to minimize dust and fly rock emissions.
- Implement the additional mitigation measures provided in ECPs to address air and noise quality impacts (see ECPs 10 and 11 in **Annex 1** for air and noise quality management).
-
- A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the contractor by adopting the necessary measures.
- Quarterly air and noise quality monitoring will be carried out in the project area to ensure compliance with NEQS on ambient air and noise quality.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.7 Impacts from Quarry and Borrow Activities

About 0.59 million m^3 of aggregates (0.29 million m^3 fine aggregates and 0.3 million m^3 coarse aggregates) will be required for construction activities. Improper siting and extraction of these construction materials will have significant impacts on the physical and biological environment on the quarry and borrow areas.

Mitigation Measures

The following mitigation measures will be implemented:

- The contractor shall use the designated quarry sites recommended by the PEDO or government-approved quarry sites for the procurement of aggregates.
- Reuse of excavated material from the construction sites to the extent feasible
- Source the material from the surface boulders from the eroded riverbanks in the proposed reservoir area (which are found to be suitable for aggregates).
- Although the material is widely available, the quarrying/mining activities will be limited to fewer areas to reduce the area of extent affected by quarrying activities. If any mining activities are to be carried outside the project area, they should be not be located in any sensitive areas.

- Maintain setbacks (which could include placement of berms) between sediment extraction areas and the low flow channels in order to reduce the low flow season impacts. These would include that excavations are set back at least 5 m from the main low flow channel and minimizing the activities that release fine sediment to the river.
- Maintain a buffer zone of 5 to 10m between the low flow channel and the mining operations to minimise the downstream impacts and limit the excavation activities to the low flow season.
- In addition, Implement the generic measures and best practices on quarry areas development and operation that are given in ECP 9 (**Annex 1**) and World Bank Group EHS Guidelines for Construction Materials Extraction

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.8 Impact on River Habitat due to Instream Construction Activities

At the weir site, cofferdams will be placed on upstream and downstream of the work areas to keep the riverbed dry for about 590 m length (for about two years) to facilitate the construction of the weir. Aquatic biological production will be eliminated from approximately 590 m of stream length, part of which (the weir footprint) will be removed for the life of the weir. Pre-construction and construction activities have the potential to adversely affect aquatic biota by the release of high concentrations of sediment during the construction of cofferdams, use of explosives and accidental spillage of fuels. Sediment concentrations above natural levels can cause mortality of biota directly; for fish, damaged gills and sediment clogging of gill chambers eventually lead to death. A surface channel will be built to divert the river water from upstream of the cofferdam to downstream of the cofferdam, and hence no impacts on fish movement are anticipated.

Mitigation

The following mitigation measures will be implemented:

- The open diversion channel shall be inspected regularly to ensure the safe passage of fish.
- If any fish is stranded in the dry river bed, it shall be relocated to the downstream
- Control of wastewater and sediment releases to river particularly in the section between cofferdams
- Prevent the release of silt, sediment, sediment-laden water, raw concrete, concrete leachate, or any other deleterious substances into the River.
- Ensure equipment and machinery are in good operating condition (power washed), free of leaks, excess oil and lubricants, and grease.
- Machinery leaking fuel, lubricants, hydraulic fluids, or solvents shall not work within the river.
- Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use.
- Regular monitoring of the aquatic habitat and fish species during the construction activities

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.6.9 Impact on Flora and Fauna

Wildlife, including mammals, reptiles, and birds, are likely to be affected by construction through disturbance (presence of people, artificial lighting and noise), injury, or death owing to construction works (including trapping in deep excavations) and increased traffic. The significance of the impact has been assessed as Medium. Project construction activities will have no impact on the Bhan Game Reserve.

Mitigation

The following mitigation measures will be implemented:

- The contractor's code of conduct for workers will include conditions on the protection of flora and fauna and ban on cutting of trees and ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions including fines and termination of employment.
- Awareness-raising to workers on the protection of flora and fauna, including the awareness on the conservation value of the Bhan Valley Community Game Reserve
- The dense vegetation will only be cleared once it has been established that any individuals present have fled. Before and during vegetation clearance or tree felling, any animals found will be removed and released to a safe place. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place.
- Use of non-wood fuel for cooking and heating
- Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats, and other wildlife.
- No organic waste will be disposed of in the open places
- PEDO will commission a study for the additional baseline data collection on flora and fauna and regular monitoring of the construction impacts on flora and fauna.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.7 Occupational Health and Safety Risks during Construction

7.7.1 Occupational Safety Risks in Construction

Some of the Occupational Health and Safety risks which are likely to arise during the construction phase are typical to many large construction sites, which include: exposure to physical hazards from use of heavy equipment including cranes; working at height and electrical equipment; trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Key construction activities with potential OHS hazards in the project are working in the river, underground tunnels, and on mountain slopes. The major risks associated with instream construction and work on slopes include the risk of drowning in the river and the risk of fall from slopes. The major risks associated with tunneling works are depletion of oxygen from poor ventilation and exposure to excessive heat and fumes, which can lead to acute or long-term health problems, the release of toxic gases, fumes and vapors, and release of dust and silica from drilling and blasting activities.

Mitigation

The following mitigation measures will be implemented:

- Each contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSGs, International Tunnel Association, ECPs in Annex 1, GoKP regulations on Factory Act 2013, Industrial Relations Act 2013, and Workers Compensation Act 2013. If these guidelines cannot address any specific aspect of OHS, international good practices such as OSHA and ILO will be applied. OHS Plan should contain general guidance for all identified hazards under each work activities, and site-specific OHS hazard and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there any changes in the construction methodologies.
- OHS Plan should contain general guidance for all identified hazards under each work activities and they should be presented in three discrete headings, (a) Contractor's Standards on the identified

hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor.

- The OHS plan will be reviewed and approved the Construction Supervision Consultant and the World Bank
- Conduct a 'job hazard analysis' at the new construction site to identify potential hazards that may arise from the proposed works or working conditions to the project workers and implement necessary control measures. The job hazard analysis should be part of the contractor's method statements, which will be reviewed and approved by the OHS Specialists of the supervision consultants. The specialists will also visit the construction sites, prior to the start of construction, to ensure the control measures are in place.
- Regular site inspections and safety audits by the construction supervision team, both by the OHS specialists and the site engineers. Since the site engineers will present at the worksites all the time, they will be trained by their OHS team on monitoring safety aspects of the construction works.
- Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.
- Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained.
- In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, body harness, protective clothing, goggles, fully face eye shields and ear protection. The contractor will also provide training to workers on how to use them and maintain in a sanitary and reliable condition and replace the damaged ones immediately with the new one.
- Availability of firefighting, ambulance, medical and rescue facilities at the site for implementation of an emergency response plan
- Adequate water supply and mobile toilets, medical and first aid care facilities at the worksites
- Contractors will have dedicated and qualified staff for ensuring compliance with the OHS Plan
- Awareness-raising material will be used including posters, signage, booklets, and others at the worksites
- A complete record of accidents and near misses will be maintained.
- First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).
- Implement the mitigation measures and emergency response plans given in ECP 18: Worker Health and Safety, ECP 19: Tunneling and Underground Construction Works, and ECP 20: Instream Construction Works.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.7.2 Occupational Health Risks in Construction

Potential health issues on workers are associated with the use of temporary accommodation sites include those relating to sanitation, disease, fire, cultural alienation, sleeping space, quality and quantity of food, personal safety and security, temperature control and recreation, amongst others.

Mitigation

The following mitigation measures will be implemented:

- The contractor will develop and implement a camp management plan

- The construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.) including entertainment facilities so that there will be minimal interaction between them and local communities
- A medical clinic, with a medical doctor and attendants, will be established at the campsite. Regular health checkups of the workers will be carried out.
- The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8 Social Impacts and Risks during Construction

7.8.1 Safety Hazards due to Increased Traffic

The construction activities can potentially impact the residents of settlements along Kalam-Gabral Road, particularly the movement and safety of school children at Ashuran. About 20 to 30 construction vehicles travel on this road on a daily basis for the transport of material such as steel and cement. Due to increased use of trucks and other vehicles on the narrow roads in the project area, pedestrians, particularly elderly people and children will be more exposed to dangerous situations, which may lead to traffic accidents.

Mitigation

- The contractor will develop and implement a traffic management plan with adequate measures such as avoiding school hours, following speed limits, hiring licensed drivers, etc.). The plan will be implemented with the aim of ensuring access to residential areas and preventing unsafe situations, especially near schools, housing areas, construction areas
- Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic.
- Liaison with traffic police will be maintained
- Project drivers will be trained in defensive driving.
- Ensure that all construction vehicles observe speed limits on the construction sites and on public roads
- Provide adequate signage, barriers, and flag persons for traffic control.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8.2 Community Exposure to Work Hazards

Communities will be exposed to construction-related hazards due to excavation, heavy vehicular movements, and blasting activities. These risks will be more at the construction works located close to the existing road and settlement (near the proposed colony and access roads)

Mitigation

The following mitigation measures will be implemented:

- Barricade the work areas with hard fencing to prevent the entry of community in the construction areas.
- Placing of adequate signboards and flagmen to divert the community away from the construction works.
- Implementation of traffic management plan near the blasting sites

- Community awareness programs on construction-related hazards, including awareness programs in schools Construction activities such as blasting and excavation, particularly at the borrow areas, may pose safety risks to the nearby population.
- Ambulance and first aid medical facilities will be made available at the worksite.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8.3 Dust from Local Roads and Construction Activities

The construction activities, particularly earthworks and blasting activities, will generate airborne dust and particulate matter. In addition, vehicular movement along the local gravel road will also generate a lot of road dust. The dust raised from the above activities will have impacts on crops, animals and public health. The generation of dust will be a major issue in the construction.

Mitigation

Following measures will be implemented

- Dust generation from construction sites will be restricted as much as possible and water sprinkling will be carried out as appropriate, especially at those places where earthmoving, excavation will be carried out.
- Frequent sprinkling of water on the local roads and worksites to control dust emissions. The contractor has to mobilise adequate water sprinkling trucks.
- A GRM will be put in place to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8.4 Risk of Damages from Blasting Activities

The construction of the Project has the potential to generate significant noise and vibrations from blasting and drilling activities. Vibration from blasting is a major source of concern if any structures and trees are located within close proximity to the blasting locations. The vibrations may cause damages to the structures and trees.

Mitigation

Following measures will be implemented

- Use of controlled blasting and placement of sandbags on the boreholes to prevent fly rock
- Adequate compensation for any affected structures. Prior to the start of the construction works, particularly near the blasting sites, all nearby residential structures will be photographed.
- A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the contractor by adopting the necessary pollution control measures. Continued consultations with the affected communities will be carried out during the construction phase.

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8.5 Employment Opportunities in Construction Activities

About 200 skilled and 300 unskilled workers will be required during construction on a continuous basis for about five years. During the peak construction period, the requirement of unskilled labour will be about 500 to 600. The project offers good opportunities for local residents to apply for employment as unskilled and skilled construction workers. The local communities during the stakeholder consultations have shown great interest to work in the construction activities. The contractor will be recommended to employ local workers and technicians to the extent possible. It is also a common practice in other hydropower projects in KP that the contractors hire local communities for all unskilled works. In addition to maintaining good relations with the local communities, maximizing local employment may also be cost-effective since engaging the workforce from other parts of the Country could be costlier. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population for a short time. This will be a major and significant positive impact of the project.

Mitigation

The contractors will be required to formulate a labour management policy to ensure equitable availability of employment opportunities to all communities within the project area, particularly the project affected persons.

The contractor will adopt the following Labor-Management Guidelines while preparing the labour management policy:

- encourage to engage local workers/laborers with the same terms and condition of outside workers/laborers;
- integrating provisions to redress labour related grievances in the Grievance Redress Mechanism (GRM) which should be well known to the laborers/workers and accessible;
- prohibition of child labor;
- no engagement of forced and bonded labor;
- provision of a safe and healthy working environment to workers; and
- taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage for insurance facility for workers.

7.8.6 Impacts from Labour Influx

For the proposed project activities, the average labour requirement per day is 500. Unskilled workers will be mainly hired locally; however, the skilled works will be brought by the contractor from other parts of Pakistan or abroad. It is estimated that about 200 migrant workers work in this project. labor influx may lead to negative impacts on the host community. Pre-existing social issues in the host community can easily be exacerbated by the influx of labor. The potential risks associated with labour influx are social tension arise between the local community and the construction workers, which may be related to differences due to competition for local resources, increase the rate of crimes and/or a perception of insecurity by the local community, increased burden on and competition for public service provision, and influx of people may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), or the incoming workers may be exposed to diseases to which they have low resistance.

Mitigation

The following mitigation measures will be implemented:

- This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which easily could lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behavior of workers on-site, in camps, and in local communities.

- The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS.
- The contractor will prepare a labour influx management plan prior to construction works for approval of PEDO.
- The contractor's code of conduct shall cover the program to promote awareness to the construction workers on respecting the local community.
- Construction camps will be built in the designated areas, located away from the local settlements
- The contractor will ensure local water usage will not be affected by the project water usage by the project or compete with water requirements of the local community
- The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.8.7 Risk of Gender-Based Violence

During consultations with the women on Gender-Based Violence (GBV)/Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH), the women reported that domestic violence is not common in the project area except for a few exceptional cases, but no one reports it as for them this is a not socially acceptable matter. No rape cases have been reported in the past years. Women visit relatives and family friends of their own tribe within or outside of their villages. Women also go out for shopping. However, as the markets are on an average of 4.5 km away from the villages, the women are accompanied by either an elderly woman or a male member of the family or a male child. Some women travel for up to 30 minutes, 3-4 times a day to collect water from nearby springs for drinking, cooking and cleaning and washing purposes. They also help the male members of their families in agriculture fields, which are generally next to their homes. However, women go in pairs and do not travel alone. Women always accompany the male members of the households to the hospitals located in Kalam town and Mingora city. Women rarely go out for the purchase of grocery items and grocery shopping is mostly done by the male members of the family. The girls of better-off and middle-income households are allowed to go out to get an education while in lower-income households they are not allowed to go out without a male member of the household accompanying them.

The interaction between the Project construction labor force and the communities is expected to be limited, particularly with women due to the conservative culture in the region. The current level of GBV/SEA risk is quite low in the Project, and the likelihood of GBV/SEA risk from the proposed project is also not expected significant due to the employment of local labour in construction works and a only skilled workers will be hired from outside. The risk assessment has been made based on the country and legal context, gender norms and beliefs, and national capacity to respond. In addition, several project-specific factors including project location, type of infrastructure to be constructed, accessibility of women for consultations, poverty levels, accessibility for the supervision of project and others were also considered for determining the risk levels.

Proactive/Preventive Measures

Commensurate with this risk level and also to be proactive, the Project has proposed several proactive measures as below:

- Inclusion of clause on GBV/SEA/SH behavior obligations in the employment contracts of all employees and construction workers aimed at strengthening measures to address and prevent GBV/SEA/SH in the workplace and construction areas.

- Translation of code of conduct (CO) into Urdu and dissemination of the principles laid out in CoC and the consequences (warnings, penalties, termination and legal actions) of its breach to all employees and workers.
- Awareness training of PEDO, CSC, contractor, sub-contractor and service providers staff to sensitize them about GBV, SEA, and SH, and their responsibilities to prevent
- Posting of CoC standards in public spaces at contractor's work camps and living areas, and village information centers and public places of adjoining/neighboring communities in the Urdu language
- Raising awareness that GBV is prohibited
- Awareness to explain suspicious situations and the signs of GBV/SEA/SH;
- Provide information on the use of GRM to report cases of GBV/SEA/SH, Code of Conduct breaches and assist victims of SEA, if signs of SEA are identified/a victim approaches them to complain about SEA;
- Awareness to communities, particularly women, and male and female children to understand risks of SEA and SH and the roles and responsibilities of parties involved in project implementation on SEA and SH prevention, processes for reporting incidents of project-related SEA/SH, and the corresponding accountability structures.
- Strengthen the Contractors' obligations and capacity to public health and safety risks and ensure contractor supervision capacity to monitor the mitigation of these risks.
- Preparing code of conduct for PEDO, PMO, Contractors, Sub-contractors and service providers (such as security agencies, catering, transport, or any other services) on GBV/SEA prevention and by integrating these measures/clauses in bidding documents.
- Proactive GBV/SEA prevention measures will be put in place, such as GBV/SEA related training to sensitize workers and local population along the project implementation area and ensuring that GRM for the project will also take care of GBV related issues if any.
- There will be adequate mechanisms in place to protect the local vulnerable population, especially women and minors from risks associated with the influx of workers (harassment, underage sex). This mechanism will ensure the sensitization and enforcement of code-of-conduct by the Contractor employees and workers and all other parties that are involved in the project implementation.
- Additionally, the Contractor will employ their skilled staff and apply unskilled construction labor from the local population as far as possible to minimize an influx of outsiders into the communities.
- The PMO will ensure compliance with the GoKP Act and policy and WB requirements related to GBV/SEA.
- The third-party monitoring agency of the project will also cover the monitoring of GBV/SEA prevention measures.
- Measures for receiving, reviewing and acting as appropriate on GBV/SEA concerns at the project management level.
- Documentation and reporting of prevention and response in the progress reports of the project.

7.9 Environmental and Social impacts during Operational stage

7.9.1 Barrier Effect on Fish Migration

By constructing the weir in the Gabral River, a barrier in the river will be created, which will impair the ecological connectivity in the river, including the migration of snow carps. The snow carp production in the Gabral River within the project area is low, the main reasons being the introduction of brown trout.

No other long-distance migratory fishes are present in the project that could be affected by the dam. There is also a risk that fish may pass through the tunnels and injured by the turbines.

Mitigation

The following mitigation and compensation measures will be implemented:

- A Fish ladder has already built into the design of the dam. The fish ladder is designed based on the requirements of snow carps and details of the fish ladder are given in Section 3.3.
- Water will be released continuously through the fish ladder at all times
- Sensors and underwater video cameras will be placed on the ladder and monitored to count the fish and to assess the effectiveness of the ladder
- Installation of trash rack at the intake to prevent the fish from entering water intakes and protect the fish against entrapment
- Regular removal of deposited sediments from the ladder
- Monitor the effectiveness of the fish ladder and take adaptive measures to improve the performance of the fish ladder
- Supporting the fisheries department for upgrading their snow carp hatchery at Nagoha Shamozai, and annually releasing the fish on both upstream and downstream of the weir
- A budget of USD 200,000 has been allocated in the project budget for the above measures. Details of activities to be implemented under this budget will be worked out during the project implementation by the ESU staff of the PEDO in consultation with the fisheries departments, and the final list of activities will be shared with the World Bank prior to their implementation

With the above mitigation measures, the residual impacts have been assessed as minimal.

7.9.2 Reduced Water Flow Between Weir and the Tailrace

The river-reach between the weir-axis to the tailrace discharge point (dewatered section) is about 5.75 km long (**Figure 7.2**). From last week of May to mid-August, when the average river flow is higher than 65 m3/s (the flow required to run all turbines), the excess water will be discharged through the under sluices/spillways thus maintaining about 47 m^3/s of flow in June, 56 m^3/s of flow in July and 20 m^3/s of flow in August in dewater section. However, from September to May, when the average flow is less than 65m^3/s, and during this period, if all water will be diverted to the powerhouse, there will be no release water to the downstream of the weir. A tributary Bhan Khwar river joins the Gabral in this reach (about 4.5 km downstream of the weir). The average discharges of Bhan Khwar during low flow season varies from 1.5 to 8 m^3/s during low flow season, which indicates that there will be minimal impact on the flows downstream of the Bhan Khwar. The reduced water inflow in this river section between weir and confluence with Bhan Khwar (4.5 km length) can potentially cause significant impacts on the aquatic fauna and overall ecology of the river in this reach during September to May if all flows are directed to the powerhouse. Due to the low reservoir capacity (1.08 million m^3), there will be no changes in the water quality of the reservoir. The reduced river flows may also contribute to the degradation of downstream fish habitats due to its reduced capacity of flushing of sediments deposited on the spawning areas.

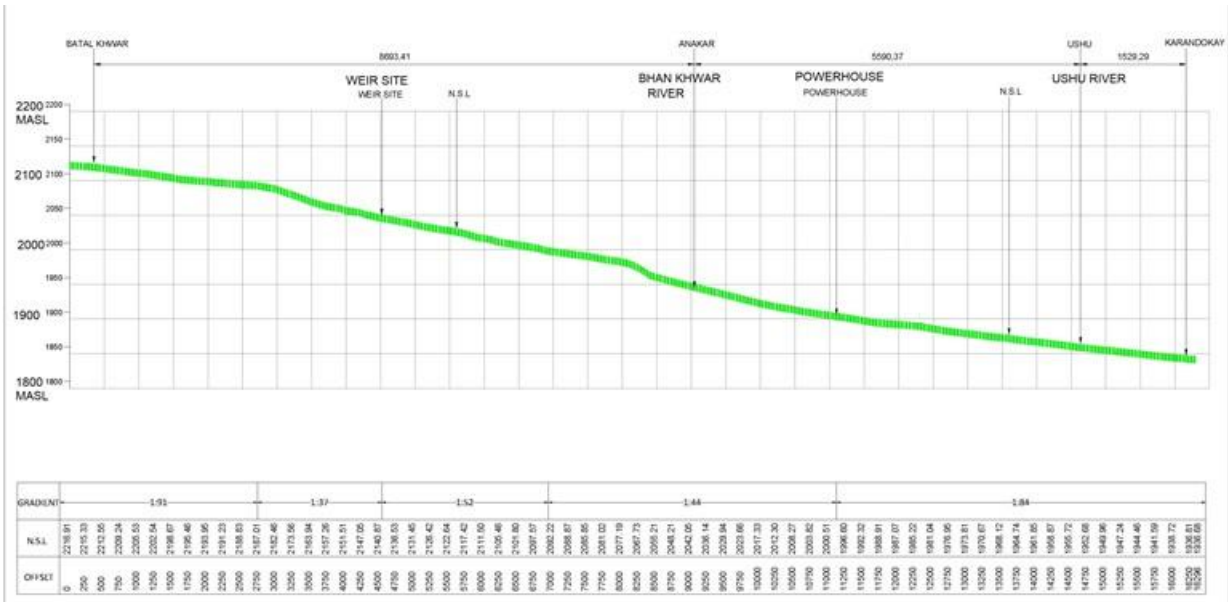

Figure 7.1: River Profile and Water Levels on the Downstream of the weir site

Need for Environmental Flow: Environmental flows are the water that is released into the river, for the specific purpose of managing the condition of that ecosystem. Generally, requirements of environmental flows are assessed based on the impact of specific ecosystem components such as aquatic animals, flood plains, river sand, estuaries, groundwater aquifers, recreational and cultural features, irrigation and drinking, etc. There is no human use of water (e.g., drinking, irrigation, cultural use, etc.) in the river section between dam and tailrace. All the villages in the project area depend on springs for drinking water and irrigation requirements. The only ecosystem that is likely to be affected in this river section due to reduced flows is the migration of snow carps and its habitat. Maintaining an environmental flow downstream of the weir could mitigate potential impacts on this habitat of snow carps. A comprehensive monitoring program will be in place during the O&M to regularly monitor the release of environmental flows and downstream impacts, and the environmental flows will be increased to mitigate any additional impacts are noticed.

Mitigation

A hydraulic modeling study was conducted to assess adequate flows to meet the requirements of snow carps (depth, flow, and velocities) in the downstream of the weir. A typical cross-section of the river on the downstream of the weir and the results of the modeling are given in **Figure 7.2**. A flow of 2.33 to 3.06 m^3/s will maintain the adequate depths (0.4 to 0.5) and velocities (1 to 1.1 m/s) to support the winter habitat of snow carps (see Section 5.3.3 for snow carp habitat requirements). An environmental flow of 2.5 to 3.5 m^3/s from weir is considered in the design during the migratory season of snow carp (March and April, and September and October), and a flow of 2 m^3/s is considered during extreme low flow season November to February when the snow carps do not migrate and live in pools.

With the above mitigation measures and compensatory measures described in the above section, the residual impacts have been assessed as minimal.

Area of Flow (m^2)	Depth of Flow (m)	Slope (m/m)	Wetted Perimeter (m)	Hydrulic Radius (m)	Manning Coefficient - n	Velocity (m/s)	Flow (m^3/s)
8.51	1.00	0.0167	13.09	0.650	0.05	1.94	16.49
5.47	0.75	0.0167	11.59	0.472	0.05	1.57	8.56
2.79	0.50	0.0167	10.09	0.277	0.05	1.10	3.06
2.30	0.45	0.0167	9.38	0.245	0.05	1.01	2.33
1.85	0.40	0.0167	8.64	0.214	0.05	0.92	1.71
0.74	0.25	0.0167	5.97	0.124	0.05	0.64	0.47

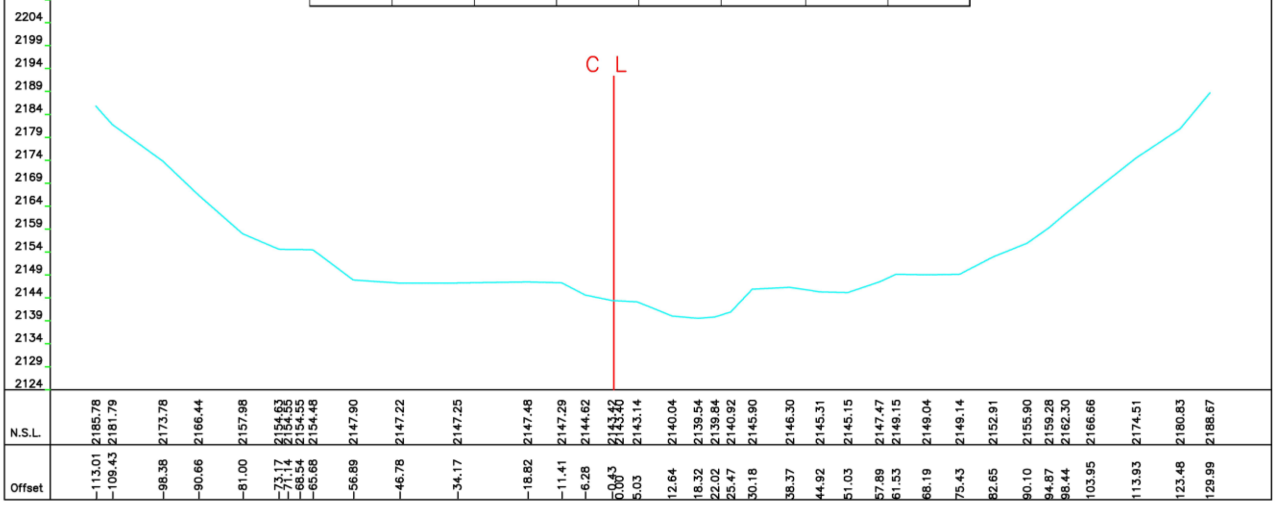

Figure 7.2: River Cross Section at the Downstream of the Weir and Results of Hydraulic Modeling

7.9.3 Risk of Bird Collision and Electrocution

The length of the proposed 220 kV transmission line in the project is 2.75 km. There are no staging areas for the migratory birds in the project, and birds continue to fly over the River without descending down, and hence there no bird collision is also expected. There also will be no electrocution risk for the large birds due to wider space between two vertical conductors (about 6m) since the maximum wingspan of the birds is generally within 3m. However, closely spaced exposed equipment, such as jumper wires on transformers, poses an electrocution risk to small birds.

Mitigation

The exposed coverings and parts of the transmission line towers will be insulated to avoid any electrocution of birds.

7.9.4 Impact on Downstream Sediment Load

The Gabral River carries about 126,4932 tons of sediment load annually, in which about 86% of the load is carried during five months of high flow season (May to September), and only 14% of the load is carried during seven months of the low flow season (October to April). After the construction of the weir, the sediment will be trapped behind the weir if there will be no flushing of the sediments from the reservoir. Even with the regular sediment flushing, the life of the reservoir is estimated at about 40 years. Hence the reservoir operations are designed with regular flushing of sediments through under sluices and from the sandtrap during high flow season. Hence the sediment concentrations in the downstream waters of the weir will be maintained during high flow season. However, during the low flow season, the sediment concentrations will be reduced due to the lack of flushing operations. The impacts associated with low sediment concentrations in the low flow season is minimal since the river generally carries the low sediment load during low flow season, and there is no existing mining industry for the extraction of river sediment material on the downstream of the weir.

Mitigation

PEDO will routinely carry out the following activities during O&M for sediment management:

- Sediments will be flushed from the reservoir through under sluices during high flow season
- Sediments from sandtraps will be flushed regularly during high flow season
- Environmental flows will be released through under sluices to allow some sediment flows during low flow season as well

7.9.5 Workers Health and Safety during O&M

The potential OHS risks associated with the O&M stage of hydropower plants are (i) exposure to higher levels electric and magnetic fields (EMF) than the general public because of working in proximity to electric power generators, equipment, and connecting high-voltage transmission lines, and (ii) exposure to high noise levels from the turbines and generators. The noise pollution will not be significant since the turbines and generators will be located in enclosed building structures for protection against the elements, thus significantly attenuating noise pollution. Workers of the transmission line may be exposed to occupational hazards from contact with live power lines during maintenance and operation activities.

Mitigation

The following mitigation measures will be implemented

Occupational EMF exposure will be prevented or minimized by preparing and implementing an EMF safety program that includes the following components:

- Identify potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities.
- Train workers in the identification of occupational EMF levels and hazards
- Establish and identify safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure and limiting access to properly trained workers.
- Implement action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The recommended EMF exposure levels by ICNIRP (also referred in WB EHSGs) are 10 kV/m for electrical field and 1000 µT for magnetic field
- Personal exposure monitoring equipment will be set to warn of exposure levels that are below occupational exposure reference levels (for example, 50 percent).
- Implement actions to minimize occupational exposure, which include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or using shielding materials
- Workers always use personal noise protective gear when working in high noise areas (typically areas with noise levels greater than 85 dBA).

- Transmission line workers will be provided with adequate PPEs and training on the safe use of equipment

7.9.6 Waste Management

The potential sources of waste during operation are domestic solid waste from the staff colony and offices, and hazardous wastes such as turbine and transformer oil, and maintenance materials or chemicals (such as paints, solvents). Nonhazardous wastes may include office waste, packing materials, and domestic waste from workers and work camps.

Mitigation

PEDO will implement a waste management plan for collection and disposal of organic waste, recyclables, garbage and hazardous waste following the principles give in ECPs 1 and 2 on waste management and hazardous waste management

7.9.7 Community Health and safety during O&M

The potential risks to the community will be the exposure to electrical and magnetic fields (EMF) from the transmission line. The recommended limits (by ICNIRP, which are endorsed by the World Bank) of community exposure to EMF are 5 kV/m for the electrical field and 200 µT for the magnetic field.

Other major community risks associated with hydropower projects during operation are dam failures due to different reasons ranging from seepage, piping (internal erosion), insufficient freeboard, liquefication due to earthquakes, etc.

Mitigation

Exposure to EMF levels from the proposed transmission will be well below the recommended levels by ICNIRP. The EMF exposure levels within 10 m from the center of the transmission line alignment are estimated as 2.72 kV/m for the electrical field (standard is 5 kV/m) and 8.9 µT for the magnetic field (the standard is 200). Beyond the 10m from the center of the transmission lines, the EMF levels will start to decrease.

To address the potential risks associated with the dam failure, the PEDO will appoint a team of the international and independent panel of experts to review the proposed designs. The panel includes experts in the dam, tunnel and geology, and hydrology, hydraulic structures, and sediment management. PEDO will install an instrumentation network to monitor the behavior of the weir, its foundations, and its abutments. In addition, PEDO will carry out a dam break analysis and prepare an emergency response plan for approval of the World Bank.

7.9.8 Impacts from the Tourist Facilities around the Project Facilities

The Project site is located near the Kalam town, which is a major tourism hub in the region. Due to the tourism potential in the project area, tourist facilities will be provided near the project sites. These include the development of parks and viewpoints near the weir site and walking tracks near the powerhouse. These facilities will act as an added attraction to the tourists and may attract more tourists to the Kalam. The overall impacts of the proposed tourist attractions around the weir sites are expected to be positive due to its contribution to the livelihood of the local communities and tourism industry in the region. There would be increased employment and business opportunities for the local communities. The adverse impacts associated with the tourist facilities may include the generation of solid waste, poor maintenance of public toilets, and inadequate housekeeping. Although tourism is not new to this area, there could be some adverse potential social impacts associated with tourists visiting the project sites such as social-cultural conflicts with local communities and the privacy of local women.

Mitigation

PEDO will provide preference to affected persons in establishing small businesses in designated eco-tourism spots. It will help affected households to formalize their small businesses and benefit from the promotion of local tourism.

PEDO will make concerted efforts in collaboration with the Department of Culture, Sports, Tourism and Youth Affairs (DoT) to promote responsible/eco-tourism to be socially, economically and environmentally responsible for avoiding impacts on the local socio-cultural situation and environment of the area around the weir.

The information communication material will be displayed at the tourist spots to promote responsible tourism.

The tourist facilities include waste collection bins and public toilets (separately for men and women), which will be maintained regularly by PEDO. The solid waste management system adopted for the PEDO colony and offices will be used for the collection, storage, transportation and disposal of solid waste from the tourist facilities.

8 Cumulative Impact Assessment

The potential cumulative impacts of all planned hydropower projects in the Swat River basin, in the context of the Gabral Kalam hydropower project, are discussed in this chapter.

8.1 Hydropower Development in the Swat River Basin

8.1.1 Overview of the Swat River

The Swat River is a perennial river in the northern region of KP, and its source is in the Hindukush Mountains and fed by the glacial waters. The river commences in the Kalam Valley of Swat Kohistan with the confluence of two main tributaries Ushu and Gabral and runs through mountainous terrain and narrow gorge up to Baghdheri. The average width in this reach is around 30-40 meters. Then the river enters in plain areas of Swat Valley; its average width is 400 meters in the extreme south of the valley, and it is a meandering river and receives the drainage of the entire Swat Valley. The river flows southwards and then westwards; once again, it enters a narrow gorge and joins by the Panjkora River at Qalangi. The river then flows southwestward into the Peshawar Plains and joins the Kabul River at Charsadda after a 320-kilometer course. Kabul river then joins Indus River at Attock (Punjab) below the Tarbela reservoir. The Swat River basin comprises all the areas drained by Swat River and its tributaries, and the total catchment area is 14,000 km^2.

8.1.2 The Proposed Hydropower Projects

The Hydropower potential of the Swat River Basin was studied under the "Hydropower development Master plan for Northern Areas of Khyber Pakhtunkhwa," which was carried out during 1990-1995 by PEDO and German Agency Technical Corporation. The hydropower projects identified by the study are given in **Table 8.1**.

Table 8.1: A Summary Hydropower Development in the Swat River Basin

Main River	Proposed HPPs on Main Rivers	Proposed HPPs on Tributaries	Existing HPPs on Canals
Gabral	• Chota Jabbar – 90 MW • Gabral Utrol – 50 MW • Gabral Kalam – 88 MW (Total : 183 MW)	• Swati – 8 MW • Batal Khwar – 8 MW • Bhan Khwar – 25 MW (Total: 41 MW)	
Ushu	• Javaid – 45 MW • Artistic – 55 MW • Gorkin Matiltan – 84 MW (*in construction)* • Ushu II – 20 MW (Total : 204 MW)	Kalam – 3 MW (Total: 3 MW)	
Kalam	• Kalam Asrit – 197 MW • Asrit Kedam – 215 MW • Madyan – 157 MW • Munda – 800 MW (*in construction*) (Total: 1369 MW)	• Choken Khwar – 12 MW • Kedam Khwar – 17 MW • Barel Dare – 9 MW • Daral – 36 MW (*existing*) • Kalkot-Barikot-Patrak – 47 MW • Patrak – Shringal – 22 MW (Total: 143 MW)	• Jaban – 22 MW • Dargal – 20 MW • Malakand III – 81 MW
Total	**1,756 MW**	**193 MW**	**123 MW**

A total of 24 hydropower projects are planned in the Swat Basin, with a total estimated hydropower potential of 2072 MW. Of these, 11 are located on the Swat, Gabral, and Ushu Rivers (total capacity 1,756 MW), and 9 are located on the tributaries (total capacity 193 MW).

In general, each project located on the main rivers (Swat, Gabral, and Ushu) has a capacity of more than 45 MW (except one project), and each project located on the tributaries has a capacity of less than 25 MW (except two projects). All these projects are runoff river projects except Munda (Mohmand) Dam Hydropower (the most downstream project in the Swat River), which involves storage (1600 million cubic meters) for power generation and irrigation.

8.1.3 Locations of Hydropower Projects

Locations of the hydropower projects in the Swat River Basin are given in **Figure 8.1**, and the current status of each of these hydropower projects is given in **Table 8.2**. Of the planned 24 projects, four are existing (160 MW), two are under construction (884 MW), and 18 are proposed (1028 MW). As seen in this table, out of the proposed 18 projects, feasibility studies are completed for only 3 projects and details of the other 15 projects are not available. Hence, a quantitative assessment of cumulative impacts could not be carried out in this study.

Among the four existing projects, three are located on the Upper Swat Canal, an irrigation offtake from the Swat River, and one is located on the tributary, Daral Khwar.

Among the two projects under construction, one is located on the Ushu (Gorkin-Matiltan) and the other one on the Swat (Munda).

Table 8.2: List of the Hydropower Projects in the Swat River Basin

Sr. No	Project	MW	Location	District	Tributary	Status	Client
1	Daral	36.6	35 12` 10.13” N 72 32` 35.78”E	Swat	Daral Khwar	Completed	PEDO
2	Gorkin Matiltan	84	35 31` 1.61” N 72 37` 35.78”E	Swat	Ushu	Under Construction	PEDO
3	Gabral Kalam	88	35 30` 21.83” N 72 31` 22.47”E	Swat	Gabral	Under the Feasibility stage (FS)	PEDO
4	Kalam Asrit	197	35 21` 44.67” N 72 36` 10.97”E	Swat	Swat	Under FS Stage	PEDO
5	Asrit Kedam	215	35 15.9`N 72 35.9`E	Swat	Swat	Under FS stage	PEDO/Private
6	Madyan	157	35 9` 0.26”N 72 32`0.65”E	Swat	Swat	FS completed	PEDO/Private
7	Kedam Khwar	17.1	35 13` 36.79”N 72 34`12.31E	Swat	Kedam Khwar	Identified	PEDO/Private
8	Chokel Khwar	12	35 9` 47.37”N 72 7` 5.37”E	Swat	Chokel Khwar	Identified	PEDO/Private
9	Batal Khwar HPP	8	35 29` 32.62” N 72 27`26.96”E	Swat	Batal Khwar	Identified	PEDO
10	Baral Derra	9	35 14`25.16”N 72 34` 50.28”E	Swat	Garnai Khwar	Under FS stage	PEDO/Private
11	Ban Khwar	25	35 31`20.37”N 72 33`35.75”E	Swat	Ban Khwar	Under FS stage	PEDO/Private
12	Gabral Utror	50	35 29`48.79”N	Swat	Gabral	Under FS stage	PEDO/Private

Sr. No	Project	MW	Location	District	Tributary	Status	Client
			72 29`5.72"E				
13	Artistic 2	55	35 34`34.36"N 72 40`35.73"E	Swat	Ushu	Under FS stage	PEDO/Private
14	Chota Jabba	50	35 32`8.41"N 72 24`49.05"E	Swat	Gabral	Identified	PEDO/Private
15	Javaid Power	45	35 38` 57.63"N 72 40`46.37" E	Swat	Ushu	Identified	PEDO/Private
16	Ushu II	20	35 28`46.87"N 72 35` 39.56' E	Swat	Ushu	Identified	PEDO/Private
17	Swati	8	35 31`32.79"N 72 24` 43.92"E	Swat	Tributary of Gabral	Identified	PEDO/Private
18	Kalam	3	35 29` 59.63" N 72 36` 12.92"E	Swat	Tributary of Ushu	Identified	PEDO/Private
19	Patrak Shringal	22	35 19'16.81"N 72 2'37.32" E	Dir	Panjkora River	FS completed	PEDO
20	Kalkot-Barikot-Patrak HPP	47	35^{o}24'7.52"N 72^{o} 10'25.69"E	Dir	Panjkora River	FS completed	PEDO
21	Malakand III	81	34°30'29.42"N 71°54'37.32"E	Malakand	Upper Swat canal	Completed	PEDO
22	Jaban	22	34°33'26.80"N 71°55'54.14"E	Malakand	Upper Swat canal	Completed	WAPDA
23	Dargai	20	34° 31' 7.77" N 71° 55' 8.11" E	Malakand	Upper Swat canal	Completed	WAPDA
24	Mohmand/ Munda	800	34°21'11.49"N 71°31' 58.72" E	Mohmand	Swat	Under construction	WAPDA
Potential of Swat River Basin		2071.7					

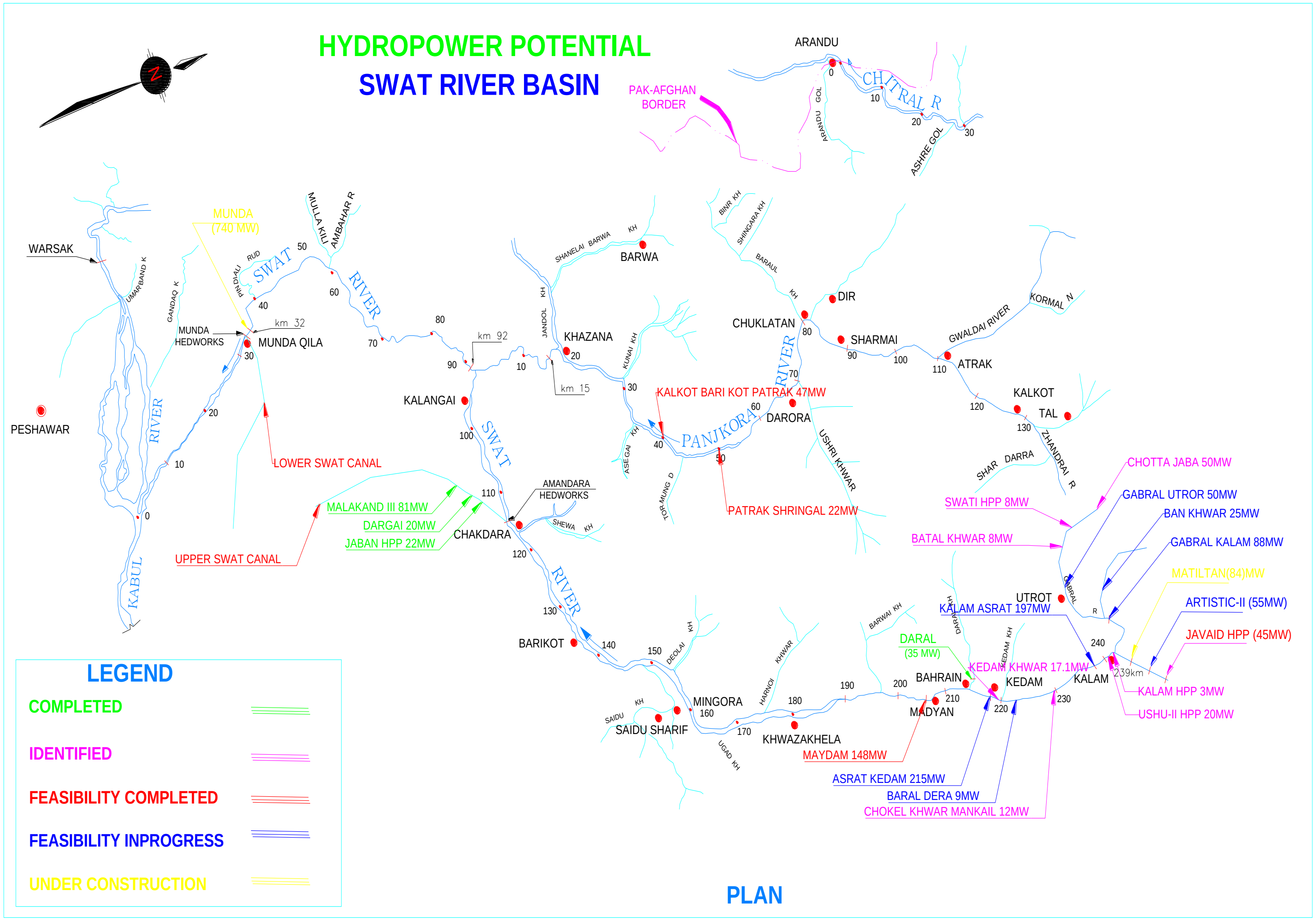

Figure 8.1: Locations of the Potential Hydropower Projects in the Swat Basin

8.1.4 Schematic View of Hydropower Development in the Swat River Basin

A schematic drawing (without scale) showing the locations of the existing, under construction and proposed hydropower projects are also shown in **Figure 8.2** for an easy reference for the discussion given in this chapter.

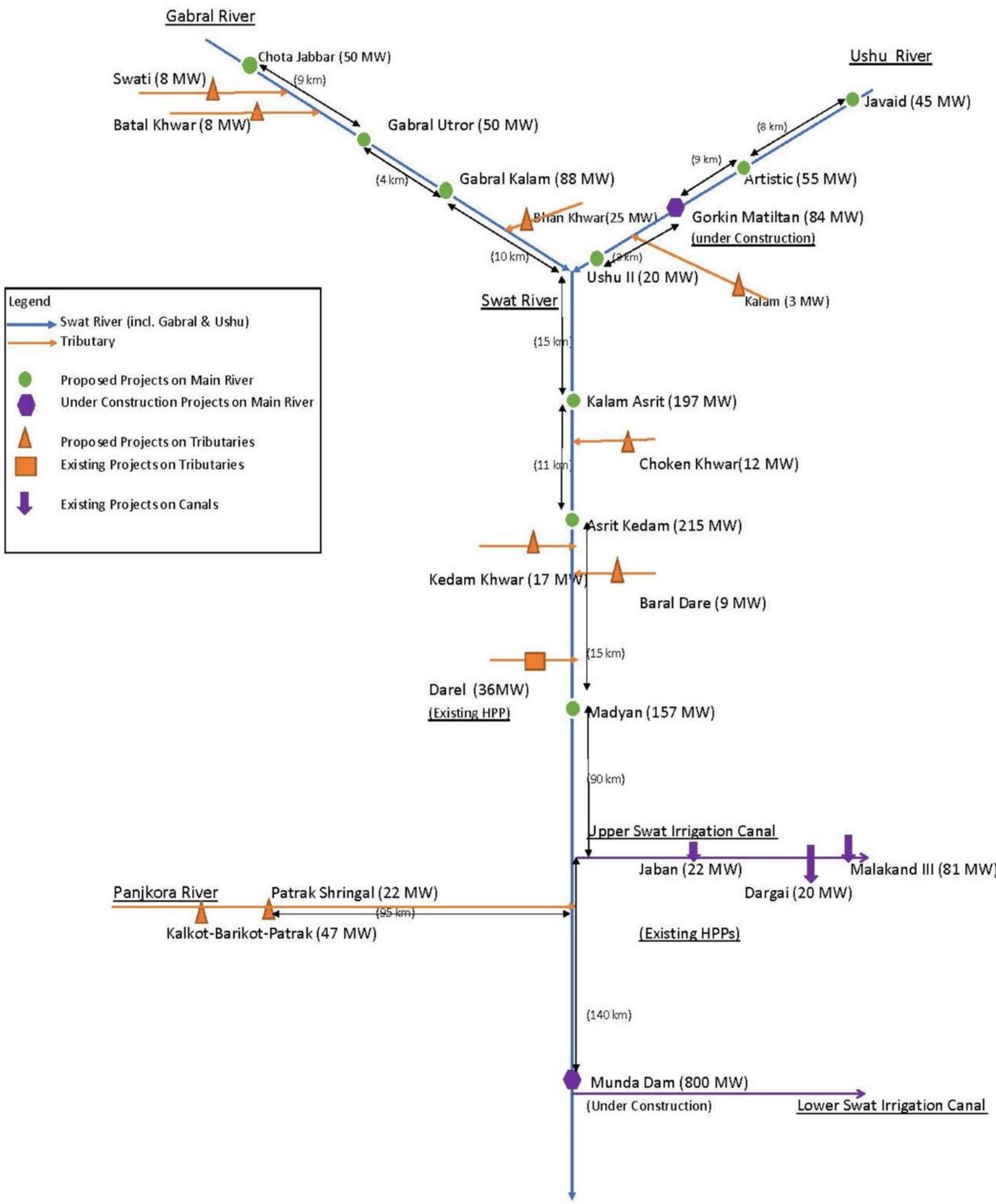

Figure 8.2: A Schematic View of Hydropower Development in the Swat River Basin

8.2 Study Boundaries and VECs

The spatial boundary considered for this cumulative impact assessment (CIA) is the whole Swat River Basin, and the temporal boundary has been taken up till the next 20 years as proposed projects will be expected to be completed by 2040. Four valued environmental components (VECs) have been studied for the CIA study and they are (i) river flows, (ii) terrestrial ecology, (iii) aquatic ecology and (iv) socioeconomic environment.

8.2.1 VEC 1: River Flows

8.2.1.1 Baseline

The main source of water flows in the Swat basin is the melting of snow and glaciers, and to some extent, by summer rains and monsoons. Annual precipitation over the entire basin is between 375 mm to 1250 mm. The river flows of the Swat at Kalam (upper reaches) and Chakdara (in the middle reaches where irrigation releases start from the river) are given in **Table 8.3**. At Kalam gauging station, the catchment area is 2020 km^2, and at Chakdara, the catchment area is 5770 km^2.

Table 8.3: River Flow data of Swat River at Kalam and Chakdara gauging stations

Month	**Swat River at Kalam m^3/s, (1961-2010)** (10 km downstream of GKH Weir Site)	**Swat River at Chakdara m^3/s, (1999-2007)** (140 km downstream of GKH Weir Site)
January	14.93	59.23
February	13.696	76.23
March	16.876	141.83
April	47.973	231.40
May	128.61	348.98
June	242.3	420.47
July	251.44	408.85
August	165.85	287
September	78.656	161.50
October	35.033	92.82
November	22.49	74.31
December	17.43	61.29

Irrigation Releases

The Swat River flows through mountainous terrain up to Madyan, and hence there are no irrigation requirements from the river. Once the river reaches the plain areas near Chakdara, there is extensive use of agriculture requiring irrigation releases from the Swat.

The most direct use of river flows of the Swat is from its two irrigation projects, the Upper Swat Canal and the Lower Swat Canal. The Amanda headworks near Chakdara releases water to the Upper Swat Canal, and the headworks near the Munda releases water to the Lower Swat Canal.

The Upper Swat Canal was completed in the year 1918, and it irrigates about 121,400 ha of lands of Charsadda, Swabi and Mardan areas in KP. A section of the canal carries water to the foot of Malakand hills, where a 3.5 km long Benton tunnel pierces the Malakand hills and releases water into the Daragai nullah. A cascade of three dams, Jaban, Dargai and Malakand III, are constructed on the canal.

The Lower Swat Canal flows in the Mardan district of the Peshawar Valley. It was commissioned in 1885 and was built as a typical British run-off-the river system, taking its waters from the Swat River.

The volume of water diverted to the Upper Swat and Lower Swat Canals from the Swat River is given in **Table 8.4.**

Table 8.4: Mean Monthly Water uptakes through Canals from Swat Rive

Months	Upper Swat Canal (1999-2007), m^3/s	Lower Swat Canal (1999-2007), m^3/s
January	19.29	1.81
February	28.94	3.81
March	43.54	26.29
April	66.22	39.43
May	69.97	44.40
June	74.36	45.85
July	70.26	40.70
August	60.45	38.13
September	61.41	41.29
October	51.78	33.31
November	42.07	25.85
December	35.74	21.89

8.2.1.2 Cumulative Impacts

Among the existing and proposed hydropower projects, Munda (Mohmand) dam is a storage project and located below the two irrigation canals and this dam will have no impact on the upstream irrigation system. All others are run-of-river projects. If these projects run on peaking operations due to storage of water for about 18 to 20 hours and then release the water for 4 to 6 hours for peaking operations, there will be a significant cumulative impact on the downstream irrigation projects. However, if they run on baseload operation, there will not be any impact on downstream irrigation projects.

The potential cumulative impacts associated with both baseload and peaking operations of all hydropower projects are explained in **Table 8.5**. The potential reductions in water flow at the Chakdara and irrigation flow to the Upper Swat Canal are given in this table if all hydropower projects store water for 18 hours and release it in 6 hours for peaking operations. The potential cumulative impacts are summarized below:

- If all the projects operated for baseload power generation, the river flows at Chakdara will remain the same as a baseline, and there will be no reduction in the irrigation releases to the Upper Swat Canal (see columns iii and iv of Table 8.5), and also there will be no reduction in the Lower Swat Canal.
- If all the projects store water for 18 hours for peaking operation, there will be a reduction of 75% of river flows at Chakdara during the 18-hour storage period (see column v of Table 8.5). This will, in turn, reduce the available irrigation flows to the Upper Swat Canal mainly from September to April and hence will significantly affect agriculture in Rabi season. The reduction of flows in the Upper Swat Canal is estimated to be about 34 to 57% from September to December (see the last column of Table 8.5). Although all the water from the projects will be released in the 6-hour window, it will not meet the requirement of all farmers. Presently, there is a well-established

warbandi[27] system under the Upper Swat Canal which operate on the basis of proportional flow distribution. In this system, each and every landowner has a fixed time during the day for his turn of irrigation water whereas the turn of one farmer is normally repeated after 7 days. Storing of water behind the dams for 18 hours means that the farmers having their turn during this 18-hour period will be suffered by 34 to 57% shortage of water, whereas the others will get additional water in 6 hours. This is a sensitive issue and any holding of water in the reservoirs for peaking operations will cause conflict among the farmers. The impacts will be similar for the Lower Swat Canal irrigation releases also.

- The incremental contribution of GKH to the overall cumulative impacts (If water is stored for 18 hours for peaking operations) will be a reduction of 15-25% of flows in Swat River at Chakdara from September to December, which in turn will reduce the irrigation releases to the Upper Swat Canal. However, GKH will not contribute to any reductions to the Lower Swat Canal due to the joining of the Panjkora river at 15 km downstream of the Chakdara and the river flows of Panjkora could meet the requirements of the Lower Swat Canal.

Table 8.5: Cumulative Impacts of Peaking Operations on River Flows and Irrigation Releases

Month	Baseline Flows at Chakdara (1997-2007)		Baseload operations - Cumulative Impacts on River Flows at Chakdara (Recommended Option)		Peaking Operation - Cumulative Impacts on River Flows at Chakdara during storage for 18 hours		
	Available River Flows (m3/s) (i)	Irrigation Releases to Upper Swat Canal (m^3/s) (ii)	Available River Flows (m^3/s) (iii)	Reduction in Irrigation Releases to Upper Swat Canal (m^3/s) (iv)	Available Swat River Flows (m^3/s) (v)	Reduction in Irrigation Releases to Upper Swat Canal (m^3/s) (vi)	Percentage Reduction in Irrigation Flows (vii)
January	59.23	19.29	59.23	0	14.81	4.48	23.24
February	76.23	28.94	76.23	0	19.06	9.88	34.15
March	141.83	43.54	141.83	0	35.46	8.08	18.56
April	231.4	66.22	231.4	0	57.85	8.37	12.64
May	348.98	69.97	348.98	0	87.25	0.00	0.00
June	420.47	74.36	420.47	0	105.12	0.00	0.00
July	408.85	70.26	408.85	0	102.21	0.00	0.00
August	287	60.45	287	0	71.75	0.00	0.00
September	161.5	61.41	161.5	0	40.38	21.04	34.25
October	92.82	51.78	92.82	0	23.21	28.58	55.19
November	74.31	42.07	74.31	0	18.58	23.49	55.84
December	61.29	35.74	61.29	0	15.32	20.42	57.13

Individually each hydropower project will also have localized impacts on its dewatered sections between the weir and tailrace. If there are any water uses (irrigation, drinking, etc.) during these stretches, they will be affected if all the water is diverted for power generation without releasing any environmental

[27] Warabandi system of water distribution is followed for canal irrigation system. The term Warabandi is originated from two vernacular words 'Wara' and 'bandi'. The meaning of wara is 'turn' and bandi means 'fixation'. Taken together, the term Warabandi means rotation of water supply according to a fixed schedule. "Warabandi is a system of equitable water distribution by turns according to a predetermined schedule specifying the day, time and duration of supply to each irrigation in proportion to holdings in the outlet
command".

flows. Since most of the projects are located on a hilly terrain, there is not much irrigation demand from the rivers due to presence of limited agricultural areas around the project sites, and the irrigation requirements are generally met from the springs (in GKH project area, the springs are used for irrigation, and there is no direct use of river water either for irrigation and drinking). Among all proposed projects, only Madyan has agricultural lands in its dewatered section (about 12 km section between the weir and tailrace), which could be affected if there are no environmental flow releases to meet the requirements of irrigation.

8.2.1.3 Actions to Address Cumulative Impacts

PEDO will take the following actions to avoid any impacts on the river flows and irrigation releases:

- All hydropower projects in the Swat River basin will be operated for baseload power generation since the peaking operations will affect the irrigation system downstream.
- All water uses (irrigation, drinking, and other uses) in the dewatered sections of each hydropower project will be assessed, and environmental flows will be released to meet these requirements
- Regularly monitor whether the released environmental flows meet the requirements the water uses and adjust the environmental flows if needed.

8.2.2 VEC 2: Terrestrial Ecology

8.2.2.1 Baseline Terrestrial Ecology

The Swat River basin can be divided into eight ecological zones considering the climatic variability along with the biodiversity and the land-use patterns. These zones are as follows:

- **The sub-tropical humid zone**: this zone is predominantly the lowlands of the valley with characteristic short winters and extended summers. The indicator species are *Bauhinia variegate, Phoenix spp., Reptonia buxifolia,* and *Nannorrhops ritchiana.*
- **The sub-tropical dry zone**: this zone covers most of the Swat Valley with the altitudinal range of 600 to 1000 m. The indicator species of this zone are *Acacia modesta* and *Olea ferruginea.*
- **The humid-temperate zone**: the altitudinal range of this zone is from 1000 to 1500 m with hot and humid summer, especially in June and July. The native tree species of this zone are *Pinus roxburghii* and *Quercus incana.*
- **The dry temperate zone**: the altitudinal range of this zone is from 1500 to 2000 m with extended cold winter and petite summer. The common indicator species of the zone are *Pinus wallichiana* and *Quercus dilatate.*
- **The dry (cool) temperate zone (Coniferous habitat)**: this is the most densely forested zone of the valley, ranging from 2000 to 2700 m altitudinally with Abies pindrow and Picea smithiana as the common indicator species.
- **The subalpine zone**: this zone is normally covered by snow for practically half of the year with an altitudinal range of 2700 to 3200 m. The indicator species of this zone are Betula utilis and Quercus semecarpifolia.
- **The alpine zone**: The altitudinal range of this zone is from 3200 to 4700 m with characteristic species, including mosses and ferns. This zone also has meadows and grassy slopes.
- **The cold deserts**: these are the highest points of the valley with an altitudinal range of 4700 to 6000 m above sea level. This zone is permanently covered with snow and lacks obvious macro-flora.

It is obvious that these dissimilar ecological zones deliver micro-climates and habitats to a wide variety of flora and fauna. They key biodiversity of the Swat basin is briefly described below:

Mammals. Pakistan hosts more than 190 species of mammals. The diverse habitats of the basin are home to a variety of wild animals, including snow leopard, Markhor, musk deer, Himalayan black bear, and Himalayan ibex. Other animals include Himalayan lynx, brown bear, grey wolf, striped hyena. According to the secondary data, 70 species have been reported from the Swat region with four Threatened species. The Threatened species include Common leopard (*Panthera pardus*), Snow leopard (*Uncia uncia*), Asiatic black bear (*Ursus thibetanus*) and Markhor (*Capra falconeri*).

Herpetofauna. Amphibians are represented in the Swat valley by anurans, i.e., frogs and toads whereas; reptiles are represented by *lacertilians* (lizards) and *serpents* (snakes). Amphibians and reptiles are very important animals of the Swat basin ecosystem system since they act as biological indicators.

Pheasants. Pheasants are usually considered as game birds. Four species are reported, including Chukar Partridge *(Alectoris chukar*), Black francolin *(Francolinus francolinus*), Koklass Pheasant (*Pucrasia macrolopha*) and Himalayan Monal pheasant (*Lophophorus impejanus*) in the region. None of these species is "Threatened" according to IUCN Red List of Threatened Species yet these are the most favored species among hunters as well as bird lovers. These species occupy vast habitats in northern areas in KP, Gilgit Baltistan and Azad Jammu Kashmir and some plane areas in Punjab and even being hunted in thousands each year their populations are stable. Therefore, the hydropower projects in the Swat region would not have any significant impact on pheasants.

Waterfowl. A number of waterfowl visit the Swat region each year during southward migration in September and spend the winter season in warm waters in the south. Some of the waterfowls during migration land in the region but only for one or two days using the wetlands as a staging area. If they find some food, they stay otherwise fly away. Swat falls into a colder region and most of the wetlands in Swat during the winter season have no attraction for the birds looking for warm waters in the south. Therefore, there will not be any kind of negative impact of hydropower projects in the Swat region.

Forests. The Swat basin is rich in forest resources and forestry products. The forest vegetation mainly includes Deodar, Blue pine, Chilgoza Pine and Spruce.

Protected Areas. There are some protected areas exist in the Swat valley, and all of them are game reserves (none of them are in the IUCN protected area category). The community game reserves close to the project sites are Bhan Valley Community Game Reserve (near the Bhan Khwar Project) and Mankial Community Game Reserve (near the Chokel Khwar project). The nearest key biodiversity area (located outside the basin) is Duber Valley, an Important Bird Area.

Current Threats. The existing threats on flora and fauna in the basin are mainly due to over-exploitation, mismanagement, and loss of natural habitats because of anthropogenic activities. Rapid human population growth is increasing the pressure on the basin's natural resources. Increased poverty has forced rural people to exploit biodiversity at unsustainable rates. Factors like deforestation, overgrazing, soil erosion, are posing major threats to the remaining biodiversity. With the current trends, the continuing loss of forest habitat, with its associated fauna and flora, will have severe impacts on the natural ecosystems.

8.2.2.2 Cumulative Impacts

The potential cumulative impacts of all hydropower projects include loss of forests, natural habitats and habitat degradation by the footprints of proposed facilities associated with hydropower projects. The terrestrial ecology of each hydropower project and potential cumulative impacts are given in **Table 8.6**.

Table 8.6: Terrestrial Ecological Conditions of Hydropower Projects and Cumulative Impacts

Ecoregion	Projects on Main River	Projects on Tributaries	Forest Cover near the project sites	Community Game Reserves near the projects	Cumulative Impacts on Terrestrial Ecology
Dry/cold temperate (2000 to 2700 masl)	All projects on Gabral and Ushu: • Chota Jabbar • Gabral Utror • Gabral Kalam • Javaid • Artistic • Gorkin-Matiltan • Ushu II	All tributaries of Gabral and Ushu: • Swati • Batal Khwar • Bhan Khwar • Kalam	The most upstream projects (Chota Jabbar on Gabral and Javaid on Ushu) have little forest cover and other project sites have medium to high forest cover	Bhan Valley Community Game Reserve (25,000 ha). Bhan Khwar project is located in this game reserve)	• Cutting of forest trees • Degradation of forest habitats • Soil erosion and increased sedimentation • Improved access to remote high mountain areas • Impact on wildlife habitats
Dry temperate (1500 to 2000 masl)	On the Swat River • Kalam – Asrit • Asrit - Kedam	• Chokel Khwar • Kedam Khwar • Baral Dare • Kalkot Barikot Patrak • Patrak Shringal	The forest cover is medium to high near these sites	Manikal Community Game Reserve (13063 ha) is located near Choke Khwar	• Cutting of forest trees • Degradation of forest habitats • Soil erosion and increased sedimentation • Improved access to remote high mountain areas • Impact on wildlife habitats
Humid temperate (1000 to 1500 masl)	• Madyan	• Daral	The forest cover is very limited near these sites	No game reserves near these sites	• Cutting of forest trees
Subtropical humid zone (less than 600 masl)	• Munda (Mohammad)	Projects on Upper Swat Canal: • Jaban • Dargai • Malakand III	No forest cover. The land use is mainly agriculture		• Clearing of natural vegetation

A summary of the key ecological features of the project sites and potential cumulative impacts are discussed below:

- All hydropower projects on the Gabral and Ushu and their tributaries (7 on main rivers and 4 on tributaries) are located in the dry/cold temperate zone with elevations ranging from 2000 to 2700 masl. These mountain slopes near the project sites are covered with medium to high forest cover (except two most upstream projects – Chota Jabbar on Gabral and Javaid on Ushu, which have little forest cover). The development of these projects require forest cutting and hence may impact the wildlife habitats. The clearing of forest areas will lead to indirect impacts such as soil erosion and increased sediment flows to the river from the stormwater runoff.
- Two hydropower projects on the Swat and five hydropower projects on its tributaries are located in the dry temperate zone with elevations ranging from 1500 to 2000 masl. The mountain slopes near these project sites are also covered with medium to high forest cover. The development of these projects also requires tree cutting which leads to similar impacts described above, but the impacts on wildlife habitats are expected to be lower than the upstream projects on the Gabral and Ushu rivers.
- According to a study based on satellite image processing[28], the dense forest cover in the Swat district reduced from 178,933 ha in 1992 to 108,054 ha in 2011, which amounts to about 3,730 ha annually over the 19 years. The areas covered by settlements, barren soils and rocky areas have shown a significant increase during this period. Though exact forest land to be affected by the above proposed 18 projects (between the elevations 1500 to 2700 masl), it is roughly estimated that about 900 ha of forest land will be affected by all the projects, and this equals to about one percent of the total forest cover in the district.
- The impacts on wildlife due to the forest clearance will be mostly felt on amphibians and reptiles due to their very restricted home range. The impacts on the mammals and birds are unknown at this stage due to the losses associated with habitat loss. The mammals and birds generally have a very vast home range, and there is a chance that when there is some disturbance in their habitat, they move to adjacent similar habitats, and when the disturbance is over, they retreat back in their native habitats.
- Two of the proposed projects are located close to the community game reserves. The Bhan Khwar project site is located in the Bhan Valley Game Reserve, and Chokel Khwar is located near the Manikal Community Game Reserve.
- Bhan Khwar is the tributary of the Gabral River. The alpine and subalpine habitats of the Bhan Khwar catchment area provide a rich habitat of 21 mammals, including threatened species of snow leopard, and black bear. The entire 25,000 of the Bhan Khwar catchment area was declared as Bhan Valley Community Game Reserve on June 25, 2005. The proposed hydropower project is located in the lower reaches of the Bhan Valley Game Reserve, and the project activities may impact the ongoing conservation activities due to the improved access into the valley through the project roads. Manikal Community Game Reserve (13,063 ha) could also be affected by improved access.
- The incremental impacts of the GKH to the cumulative impacts are mainly due to the clearing of forest trees, while the positive impacts would be significant due to its support to the forest department for afforestation and wildlife department for wildlife conservation with a proposed budget of USD 0.6 million.

[28] Sajid Ali, Wajid Ali, Salman Khan, Abdullah Khan, Zia Ur Rahman and Arshad Iqbal. Forest cover change and carbon stock assessment in Swat valley using remote sensing and geographical information systems. Pure and Applied Biology. http://dx.doi.org/10.19045/bspab.2017.60089

8.2.2.3 Actions to Address Cumulative Impacts

PEDO will take the following actions to minimize and compensate for the impacts on terrestrial ecology:

- Environmental assessments will be carried out for all proposed projects in accordance with the World Bank safeguard policies and guidelines, in addition to the national and provincial regulatory requirements. In accordance with KP EPA requirements, the hydropower projects less than 50 MW require an Initial Environmental Examination (a limited ESIA), but PEDO will conduct a detailed ESIA for these projects also in accordance with the World Bank guidelines.
- Detailed ecological baseline studies will be carried out as part of the ESIA studies and develop adequate mitigation plans to address all potential impacts on the ecological environment.
- While designing the Bhan Khwar and Chokel Khwar hydropower projects, the Impacts on the game reserve will be minimized by avoiding the sensitive wildlife habitats and optimizing the design of the project facilities with minimum footprints.
- Compensation and enhancement measures to address impacts associated with forest clearance and habitat degradation by tree plantation, afforestation of degraded forest habitats and wildlife conservation programs will be taken up in all the project sites by supporting the forest and wildlife departments.
- The Environmental and Social Unit of the PEDO will closely work with relevant stakeholders (forest and wildlife departments) and staff of proposed hydropower projects to ensure the impacts associated with each hydropower project are minimized.

8.2.3 VEC 3: Aquatic Ecology

8.2.3.1 Baseline Aquatic Ecology

The aquatic ecosystem in the Swat basin can be classified as (i) cold water ecosystem and (ii) semi cold-water ecosystem. The fish diversity of the rivers in the basin depends on the respective ecosystem.

Cold Water Ecosystem. Upper part of River swat from Baghdheri and upward have water temperature seldom raising above 12°C; therefore cold water fish species like *Salmo trutta fario* (Brown trout), *Onchorhynchus mykiss* (Rainbow trout), *Schixothorax plagiostomus* (Snow carp), *Schizothorax esocinus* (Chunr), *Schizothorax labiatus* (Bota), *Racoma labiat, Glyptothorax* species are found. None of these species listed in the IUCN red-listed category. All hydropower projects in the Swat River basin (except the Munda and the projects on the Upper Swat Canal) are located in the cold-water ecosystem and the *Schixothorax plagiostomus* (snow carp) is the most common species. The snow carp is an indigenous fish species of the Himalayan region and widely distributed in the cold waters of Pakistan, Nepal, and India.

Semi Cold-Water Ecosystem. The lower reaches of the Swat River, starting from the downstream of the confluence with the Panjkora river, exhibits this ecosystem. Munda Dam and hydropower projects in the Upper Swat Canal are located in this ecosystem. The Swat River before the confluence with the Kabul represents an ideal habitat for aquatic fauna, especially the fish due to plenty of food availability like macroinvertebrates, freshwater mussels, algae, and several other species of aquatic flora. During floods, both the Rivers bring down a variety of organic matter acting as fertilizer increasing phytoplanktons and zooplanktons population hence providing a rich baseline for a rich food Chain in the River. This results in a wide variety of fish populations downstream. Micro-invertebrate species recorded in these waters include Planaria, Leech, Caddis fly, Mayfly, Stonefly, Dragonfly, Dames fly, Water strider, Chironomous, Water beetles and Water scorpions. These macro-invertebrates contribute a lot to the food chain and hence an integral part of the ecosystem. About 38 fish species reported in this ecosystem belonging to six orders, nine families and 24 genera. Cyprinidae was recorded to be the richest family represented by 20 species, Nemachilidae by four, Sisoridae by six, Chanidae and Schilbidae by two species each and

Mastacembilidae, Schilidae, Belonidae and Chandidae by single species each. Mahseer (tor putitora) is an endangered and commercially important fish species in this ecosystem.

Currents threats to Aquatic Ecosystems. The riverine ecosystem in the Swat basin, particularly near the towns (e.g., Mingora. Saidu Sharif, Madyan, etc.), is affected by the release of untreated municipal sewerage along with disposal of solid waste into the river. The waste from all the settlements located along the river, particularly near the tourist areas (e.g., Kalam and Bahrain) is also being thrown directly into the river. Other major impacts on the aquatic ecosystem are the mining activities in the adjoining hills, particularly marble production in Mingora, Barikot and Batkhela areas, which releases high sediment loads and heavy metals into the river. It is observed that the populations of *Schizothorax plagiostomus, Cyprinus carpio,* and *Tor putitora* have decreased during the last two decades due to several factors including pollution and over-exploitation.

8.2.3.2 Cumulative Impacts

General impacts of hydropower dams on the aquatic environment, and their relevance to the hydropower development in the Swat River basin, and overall cumulative impacts are given in **Table 8.7**. The potential cumulative impacts are summarized below:

- **Habitat destruction**. Construction of dams causes habitat destruction in both feeding and breeding grounds, which leads to biodiversity loss. Dams block the natural flow of water, reducing water discharge in the downstream. Flowing water is vital as it cleans interstitial spaces of pebbles, gravel, and boulders and prepares spawning substrate for fish. In the absence of water flow after diversion, the spawning ground is covered by sediment that limits fish recruitment. Snow carps are reported to be affected by the destruction of their spawning beds[29]. These impacts are significant in the dewatered sections (between the dam and tailrace) of the hydropower projects. About 20% of the main stem of the Swat River (including Gabral and Ushu) will only have environmental flows that will be released from all hydropower projects.
- **Obstacles in Fish Migration**. The snow carps migrate upstream and downstream in response to water temperature (See Section 5.3.3.2). The proposed hydropower development will construct a series of physical barriers and such structures prevent fish species from reaching their traditional areas of spawning and feeding, leading to changes in the composition of upstream and downstream species. The Munda dam will have the most significant impacts since it will be a reservoir project with a 215 m high dam and completely stops the fish migration between the Swat River and the Kabul River, including the migration of mahseer.
- **Fish Injury**. Mortality resulting from fish passage through hydraulic turbines or over spillways during downstream migration is unavoidable. Bottom feeders such as snow carp and mahseer. maybe pulled in the intake and killed by the hydropower turbines. Even riverine fish adapted to fast current may be affected.

[29] T.K. Shrestha (2019). Conservation and Management of Fishes in the Large Himalayan Rivers of Nepal (https://www.researchgate.net/publication/266862560_Conservation_and_Management_of_Fishes_in_the_Large_Himalayan_Rivers_of_Nepal.)

Table 8.7: Overall Impacts of the Swat Hydropower Development on Aquatic Environment

Direct Impact	Indirect Impact	Secondary Impact	Cumulative	Relevance to the Swat Basin Development
Conversion of a lotic into a lentic pond ecosystem	Habitat destruction (in both feeding and breeding grounds due to reduction of water discharges on the downstream of the dams)	• Eutrophication of reservoir • Effect of exotic and invasive fish species • Emission of methane from the reservoir • Effect on food chain • Effect on fish health	Loss of movement path, blockage in inter-connected pathways of migratory fish in the rivers, extinction of fish species	The height of proposed hydropower projects is generally less than 25 m (above riverbed) with limited reservoir area, and hence impacts associated with water quality changes are not expected to be significant.
The downstream riverine environment from the dam will be converted into a dry stretch	• Low flow • Habitat destruction • Destruction of spawning bed impacts on fish breeding • Obstruction of fish migration	• River aggradation • Increase inshore erosion • Change in water quality		The aquatic environment of about 20% of the main Swat River (including Gabral and Ushu) will be affected by dewatered sections between dam and tailrace and will have environmental flows that will be released from all hydropower projects. About 10% of the Panjkora River will be affected by dewatered sections and will have environmental flows that will be released from all hydropower projects.
Fish migration will be obstructed	Impact on fish breeding	Decrease in fish population		Snow carp's migration and its population will be affected. Mahseer migration is affected by the Munda dam

Source: see footnote[30] for the source of first four columns

A recent study of the Asian Development Bank[31] has assessed potential impacts of the dams on the snow carp and mahseer species in Nepal rivers, and made the following recommendations based on the review of successful mitigation measures adopted in the Southeast Asia and South Asia regions:

[30] D.E. McAllister, J.F. Craig, N. David Source: D.E. McAllister, J.F. Craig, N. Davidson, S. Delany, and M. Seddon. 2001. Biodiversity Impact of Large Dams, Background Paper No. 1, Prepared for IUCN/UNEP/WCD

[31] Asian Development Bank, 2018. Impact of Dams on Fish in the Rivers of Nepal

- Projects can take various mitigation measures to facilitate fish movement across dams (such as providing fish ladder, fish passage, natural fish bypass channel, etc.) or
- Compensatory measures to maintain fish population such as (i) breeding fish in hatcheries and annually releasing them upstream and downstream of the dam to maintain their populations, (ii) improvement of spawning grounds, and (iii) catch and haul arrangement.

The study also assessed the effectiveness of environmental mitigation measures adopted in the operation of eight dam projects in Nepal. Despite the implementation of many mitigation measures, the fish population is found to be reduced in Kali Gandaki and Babar irrigation project. The main reasons are found to be lack of adequate monitoring and compliance on the environmental flow releases, limited budget for the operation of hatcheries, and non-maintenance of the fish ladders (removal of silt deposits).

The potential cumulative impacts all hydropower projects on the aquatic environment of Swat River will be minimized and compensated by the construction of fish ladders, the release of environmental flows to meet the requirement of fish habitats in the dewatered sections, and the release of native fish species into the rivers through fish hatcheries. Some hatcheries along the banks of River Swat have already been established by the KP Fisheries Department, one for Mahseer at Chakdara, one for Snow carps at Nagoha Shamozai, and one for brown trout at Madyan. All these hatcheries are functional, but these facilities are needed to be upgraded to be more efficient and productive.

8.2.3.3 Actions to Address Cumulative Impacts

PEDO will take the following actions to minimize and compensate for the impacts on aquatic ecology:

- Fish ladders will be built into the design of weirs to facilitate the movement and migration of fish on both upstream and downstream of the reservoir.
- Ensure year-round functionality of the fish ladder by always releasing the water and removing the sediment deposits in the ladder
- Fish movement and migration through the fish ladders will be monitored regularly to assess their adequacy (using sensors and underwater video cameras) and modify the designs if needed.
- Documentation of effectiveness fish ladder operation in the GKH to improve the fish ladder designs for other future hydropower projects
- Installation of appropriate screen devices at the intake to divert the fish from entering water intakes and protect the fish against entrapment.
- Ecological flows will be assessed based on the requirements of all water users (fish, riparian habitats, drinking, irrigation, tourism, cultural, etc.) in the dewatered sections (river-reach between the weir and tailrace) of the projects. The power generation of the projects will be optimized based on the requirements of environmental flows.
- Monitor the quality of the water from the reservoir and flows from under sluices
- The Environmental and Social Unit of the PEDO will closely work with the fisheries department to foster a mechanism to augment their fish hatcheries for the breeding of snow carp and mahseer and annually releasing them upstream and downstream of the weirs to maintain their population.

8.2.4 Socio-economic Environment

8.2.4.1 Baseline Condition

Most of the population in the Swat basin live in rural areas, which are located extremely in remote terrain with no development intervention except in a few towns. The national-level labor force level in KP is low and was reported to be 35.42% in (2017-18). The most recent Labor Force Survey indicates a notable unemployment rate of 7.16% for KP when compared with the national level of 5.79%. Health care facilities are very limited in KP with 277 hospitals, 911 dispensaries, 132 maternity and childcare facilities, and 22,154 beds in all hospitals and dispensaries. There are very limited paved roads connecting the villages. In some villages, local access is usually through walking trails in the mountain range.

8.2.4.2 Cumulative Impacts

The cumulative impacts of the proposed construction of hydropower projects on the socio-economic environment will be employment generation and infrastructure development in rural areas, where most of the projects are located. The proposed infrastructure developments, including the development of electrification, water supply, and educational and health facilities by each project, are expected to lead to significant improvement of the socio-economic conditions in the project area. The local communities will be directly benefitted by the employment opportunities in both construction and operational activities, and also will be indirectly benefitted by the employment and business opportunities due to improved access to the nearby towns and markets. The potential employment opportunities at the project sites will also attract skilled workers from other areas of Pakistan. The influx of outside workers may have some impact on the local population. Potential cumulative impacts associated with employment generation and labor influx, and induced impacts from infrastructure development are further discussed below.

Employment. During the construction period, each proposed project will employ about 500 skilled and unskilled persons continuously for about four to five years. The employment opportunities will be increased during the peak construction period. In the near term, the demand for local goods such as construction materials and supply of food and other services for the project and workforce will temporarily increase. Hence, there will be a significant positive impact on local employment and the economy during the construction period. During operation, after the project is completed, each hydropower project will employ about 50 people, and some of these opportunities will go to the local communities.

Labor Influx. The overall labor requirement of proposed hydropower development projects will be about 10000[32], which provides employment opportunities for skilled and unskilled labor, and will attract an influx of migrant labor from inside and outside of Pakistan as the local market has limited capacity in terms of the skilled labor force. Out of the expected labor requirements, 25% (2500) will be migrant labors (of which 50% will be foreigners and 50% Pakistanis but outside of the Project area). About 75% of the labor (7500) will be local labor. The influx of labor into the project site area for a period of four to five years may increase the risk of social tensions between the local community and the construction workers. Construction workers are predominantly younger males. Those who are away from home on the construction job are typically separated from their family and act outside their normal sphere of social control. This can lead to inappropriate and behavior, such as sexual harassment of women and girls, exploitative sexual relations, and illicit relations with the local community.

The incremental impacts of the Gabral Kalam hydropower project to the overall cumulative impacts are expected to be significant on local employment, but not on labor influx due to the inclusion of adequate measures to address risks with labor influx. In addition, a social development plan (with a provision of USD 5 million) is included project budget to implement community-based social infrastructure projects such as water supply and sanitation schemes, education, and health facilities and access roads.

[32] Approximate labour requirement for each project will be 500, and for total 20 projects would be 10000. About 25% of the labour will be skilled and consists of mostly outsiders and foreigners and remaining 75% would be locals. During peak Construction period, the requirement of local labor may increase upto 10,000 to 12,000.

8.2.4.3 Induced Impacts

The proposed infrastructure for hydropower development including electrification in the project areas may trigger induced developments such as urbanization, communication, business, tourism, industrialization, etc. These induced developments will have both positive and negative impacts. The positive impacts are improved socio-economic conditions in the region through employment generation and poverty reduction. The adverse impacts are air and noise pollution due to construction activities and increase in traffic levels, generation of more solid waste due to improved living standards, consequent health impacts due to pollution, clearance of forest resources and loss of biodiversity, and land acquisition and resettlement for the induced developments.

Most of the adverse impacts associated with induced development can be minimized by interventions of local government and regulatory agencies such as revenue and planning departments, environmental protection agencies, and forest department and wildlife departments in approval of planning of these developments and overseeing of their implementation.

8.2.4.4 Actions to Address Cumulative Impacts

PEDO will take the following actions to address the impacts on the socio-economic environment:

- Preference will be given to the local population in construction activities. The local communities will be hired to the maximum extent for skilled, semi-skilled and unskilled labor. The contractors will be required to implement a skill development program for the local population prior to their employment.
- A Social Development Plan will be implemented at all projects' areas, similar to the plan proposed for GKH. Various community-led infrastructure projects such as electrification, water supply and sanitation, education and health facilities, and access roads will be implemented under each project.
- The impacts on labor influx will be mitigated by maximizing the use of the local communities in employment and implementing a code of conduct and labor influx management plan.

8.3 A Summary of All Actions to Address Cumulative Impacts

A summary of all actions, to address the overall cumulative impacts of the proposed hydropower development in the Swat basin, are given below.

- Environmental assessments will be carried out for all proposed projects in accordance with the World Bank safeguard policies and guidelines, in addition to the national and provincial regulatory requirements.
- Detailed ecological baseline studies will be carried out as part of the ESIA studies and develop adequate mitigation plans to address all potential impacts on the ecological environment.
- Fish ladders will be built into the design of weirs to facilitate the movement and migration of fish on both upstream and downstream of the reservoir. Fish movement and migration through the fish ladders will be monitored to assess their adequacy and modify the designs if needed. Installation of appropriate screen devices at the intake to divert the fish from entering water intakes and protect the fish against entrapment.
- Ecological flows will be assessed based on the requirements of all water users (fish, riparian habitats, drinking, irrigation, tourism, cultural, etc.) in the dewatered sections (river-reach between the weir and tailrace) of the projects. The power generation of the projects will be optimized based on the requirements of environmental flows. Regularly monitor whether the

released environmental flows meet the requirements the water uses and adjust the environmental flows if needed.

- Impacts on the community game reserves and natural habitats will be minimized by avoiding the sensitive wildlife habitats and optimizing the design of the project facilities with minimum footprints.
- Tree plantation and wildlife conservation programs will be taken up in all the project sites by supporting the forest and wildlife departments.
- All hydropower projects in the Swat River basin will be operated for baseload power generation since the peaking operations will affect the irrigation system downstream.
- Maximizing the use of local skilled, semi-skilled and unskilled labor from the local communities for all project-related employment and implementing a code of conduct and labor influx management plan for the outside workers.
- A Social Development Plan will be implemented at all projects' areas, similar to the plan proposed for GKH. Various community-led infrastructure projects such as electrification, water supply and sanitation, education and health facilities, and access roads will be implemented under each project.
- The Environmental and Social Unit of the PEDO will closely work with relevant stakeholders (forest, wildlife, and fisheries departments of the province) and staff of proposed hydropower projects to ensure the impacts associated with each hydropower project are minimized. PEDO will also work closely with the fisheries department to foster a mechanism to augment their fish hatcheries for the breeding of snow carp and mahseer and annually releasing them upstream and downstream of the weirs to maintain their population.
- Importantly, the PEDO will conduct a comprehensive cumulative impact assessment study to better understand the environmental and social impacts and opportunities for hydropower development in the Swat River basin, consistent with the principles of sustainability. The study will be carried out in conjunction with Component B of the parent Program (KPHREDP). The component involves the preparation of a long-term integrated plan for the development of renewable energy and hydropower resources in the province, and sequencing of the investment program over 10 years, 20 years and 30 years periods considering priorities. The terms of reference (ToR) for the proposed cumulative impact assessment study is given in **Annex 5**.

9 Environmental and Social Management Plan

This chapter describes the proposed institutional mechanism, mitigation and monitoring plans for management of environmental, social, safety and health issues of the Project, and inclusion of mitigation and monitoring measures in contractors bidding documents

9.1 Objectives of ESMP

The basic objective of the ESMP is to manage the adverse impacts of project interventions in a way, which minimizes the adverse impact on the environment and people of the project area. The specific objectives of the ESMP are to:

- Facilitate the implementation of the mitigation measures identified during the present ESIA and discussed earlier in the document;
- Draw responsibilities for PEDO, contractors, consultants, and other members of the Project Team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters in order to:
    - Ensure the complete implementation of all mitigation measures,
    - Ensure the effectiveness of the mitigation measures;
- Implement environmental training programs for the implementation staff.

9.2 Institutional Arrangements for ESMP Implementation

The Institutional arrangements for the implementation of ESMP are given in **Figure 9.1**.

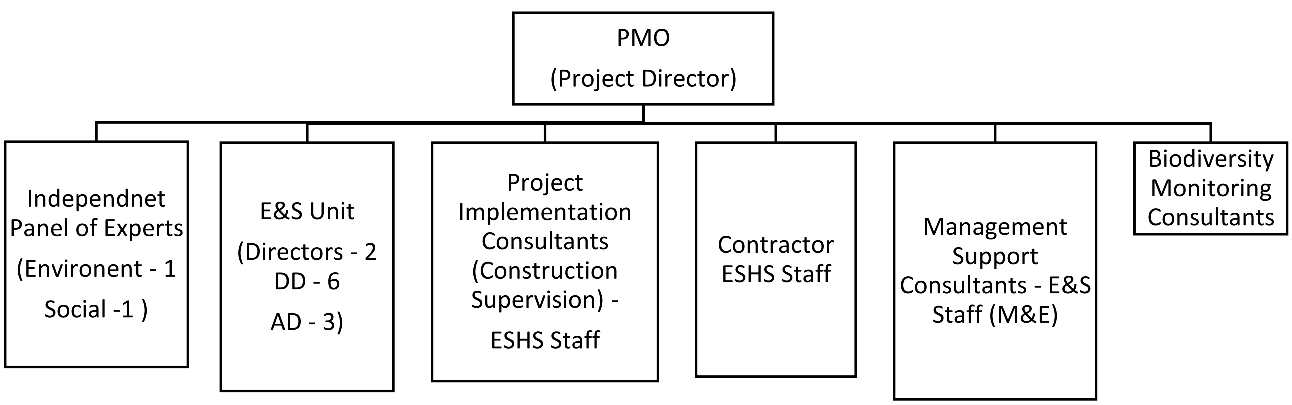

Figure 9.1: Organogram for Environmental and Social Management of the Project

9.2.1 Project Management Office

Pakhtunkhwa Energy Development Organisation (PEDO) is the implementing agency of the Project. PEDO will establish a Project Management Office (PMO) to monitor and coordinate all project implementation activities. PMO would be responsible for all aspects of project implementation, including technical, operational, financial management, and overseeing the implementation of ESMP.

PEDO has an existing 'Environmental and Social Unit (ESU),' for the management of environmental and social impacts of the Program. PEDO will depute these specialists to PMO to ensure the effective implementation of ESMP.

Details of environmental and social staff associated with various consultants and contractors to be engaged under the Program are summarized below:

- **Environmental and Social Staff in the PEDO/PMO.** The Environmental and Social Unit (ESU) of PMO includes the following staff:
    - Two Directors (one for the environment and one for social)
    - Three Deputy Directors (one each for the environment, OHS, Social Development)
    - Six Assistant Directors (two per each Deputy Director)

The PMO is headed by the Project Director. The responsibilities of the environmental and social staff of ESU are:

(i) supervising, facilitating and coordinating the implementation of environmental and social plans including ESMP and RAP;
(ii) inclusion of ESMP in the contract documents and preparation of relevant specifications and conditions, and review the bidding documents
(iii) ensuring that contractors follow KP EPA regulations, World Bank Safeguard Policies, and other requirements mentioned in the ESMP and RAP;
(iv) identifying any issues of non-compliance and report them;
(v) suggesting mechanisms to link contractor performance in relation to the ESMP to the timing of financial payments, incentives or penalties;
(vi) interacting with stakeholders for their concerns about the construction activities, (vii) development of local area development programs, and
(vii) prepare quarterly monitoring reports on ESMP implementation.

9.2.2 Project Implementation Consultant or Construction Supervision Consultants (CSC).

The Project Implementation Consultants (PIC) will act as Construction Supervision Consultants (CSC). The CSC will be responsible for supervising the contractors for the implementation of ESMP. For this purpose, the CSC will appoint dedicated environmental, social, health and safety (ESHS) staff to ensure the implementation of environmental and social management plans during the project. They will supervise the contractor for the ESMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of the effects of these measures.

CSC will have the following environmental and social safeguard staff:

- Environmental specialist
- Occupational Health and Safety Specialist
- Ecologist
- Social Specialists
- Environmental, Social, and Health & Safety (ESHS) Inspectors (six staff)

The ESHS staff of CSC will closely supervise the construction works to ensure that all environmental commitments are incorporated into the construction activities and work processes. Specific responsibilities of these staff include:

- Supervising and supporting contractors in achieving their responsibilities as outlined in the ESMP

- Review and approve the Contractor’s site-specific plans on ESMP and OHS implementation
- Regular safety audits at the worksites;
- Issuing non-compliance notices to the contractors
- Providing input, advice, and approval on activity-specific work plans relating to ESMP
- Supervising the implementation of activity-specific work plans
- Regularly reviewing and assessing ESHS risks throughout the construction phase;
- Identifying and preparing environmental induction and training materials;
- conducting ESHS trainings;
- Assist PMO in addressing and resolving ESHS complaints and grievances
- Responding to environmental incidents as required;
- Managing compliance reporting as it relates to the Project, and preparing monthly ESMP compliance reports; and
- Liaise with PMO for effective environmental and social management at the site;

9.2.3 Management Support Consultant (MSC)

The Management Support Consultants (MSC) support in project management and carrying out day to day activities of PEDO. Support various departments of PEDO in operation of various functions; Oversee Budgetary and financial Management; Prepare and assist in implementing Quality Control and Quality Assurance Plan; Contractual advice, variation orders, and settlement of disputes claims; Support in Implementation of the safeguard plans. MSC will also carry out independent monitoring of the implementation of ESMP. The MSC will have environmental and social experts and shall carry out intermittent third-party monitoring of the project. MSC will also carry out annual third-party auditing of ESMP and make further modifications if required.

9.2.4 Planning Consultant

The Planning Consultant will work for the overall Program (not for the GKH) to develop a Comprehensive Plan for Hydropower and Energy Systems in KP through (i) Assessment and Appraisal of potential hydropower and alternative renewable energy sites in KP, and preparation of a long-term integrated plan for development of renewable energy and hydropower resources in the province, and (ii) Sequencing of the investment program over 10 years, 20 years and 30 years periods considering priorities, objective agreed criteria, demands and implementation constraints, etc. and electricity price for the generators and consumers. The Consultant will also carry out feasibility studies for some priority subprojects.

9.2.5 Contractor

The contractor is also required to appoint the following environmental staff for the implementation of ESMP in the field, particularly the mitigation measures.

The contractor will develop various plans directed towards health, safety, the environment and social issues (discussed in Section 9.5.2) and get them approved by the CSC,PMO and the World Bank. The contractor will also be responsible for communicating with and training of its staff in the ESHS aspects before the commencement of the physical works on site. The contractor’s ESHS team will include the following team members:

- ESHS Manager
- Environmental Officer
- OHS Officer
- Social Officer

- ESHS Site Supervisors (one supervisor at each site)

9.3 Environmental Approvals and Permits Required for Project Implementation

Environmental clearances and permits required during the implementation of the Project are given in **Table 9.1**. PEDO and its Contractor will obtain these approvals from the relevant government departments during implementations.

Table 9.1: Environmental Approvals and Permits Required during Implementation of the Project

#	Details of Approval and Permits	Issuing Authority	Requirements	Responsible Agency	Timing
1	**Environmental Approval** for the overall construction of the Project	KP EPA	Submission of this ESIA	PEDO	Prior to Construction of the Project
2	**Environmental Approval** for establishing crusher plants	KP EPA	Submission of IEE Application	Contractor	During the construction phase
		Forest Department	Submission of Request	Contractor	During the construction phase
		Industries Department	Submission of Request with layout and location maps	Contractor	During the construction phase
		Mines and Mineral Department	Submission of Request	Contractor	During the construction phase
3	**Permit** for storage of blasting material	Deputy Commissioner of District	Submission of a request with the location map of the explosive store	Contractor	During the construction phase
4	**Permit** for the transport of blasting material	Chief Inspector of Explosives	Submission of a request along with a recommendation letter from the Employer	Contractor	During the construction phase
5	**Permit** for cutting of forest trees	Forest Department	Submission of a request	PEDO	During the construction phase
6	**Permit** for the use of quarry and excavated material	Mines and Mineral Department	Submission of a request with the location map of the quarry area	PEDO will sign the lease agreement and handover it to the contractor	During the construction phase
7	Batching Plant	KP-EPA	NOC is not required for establishing a batching plant, but the project has to inform EPA about the facility with a surety that all mitigation measures to control pollution will be adopted.	Contractor	During the construction phase
8	**Environmental Approval** for the operation of the Project	KP EPA	Submission of a compliance report on the implementation of conditions and recommendations given	PEDO	After completion of the Construction and prior to operation

#	Details of Approval and Permits	Issuing Authority	Requirements	Responsible Agency	Timing
			in the Environmental Approval for construction.		

9.4 Inclusion of ESMP in contract documents

In order to make the Contractors fully aware of the implications of the ESMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in ESMP. The Contractor will be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

PMO will include the following Environmental, Social, Health and Safety (ESHS) Conditions in the bidding documents:

- Past performance of the Contractor on ESHS aspects including sexual exploitation and abuse and gender-based violence;
- ESHS Staff with the Contractor;
- Performance Security;
- Mitigation measures to address construction impacts;
- Payments for implementation of ESHS measures;
- Code of conduct of Contractor's Personnel;
- Management Strategies and Implementation Plans (MSIP) to manage the ESHS Risks.

Each of the above conditions is elaborated in **Table 9.2**.

Table 9.2: ESHS Conditions in the Bidding Documents

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
1. Past performance of the Contractor on ESHS is one of the eligibility criteria for the shortlisting process	The contractor's past performance on compliance with ESHS is an indicator of the contractor's commitment and capability for implementation of the ESMP	The Bidder shall "declare any civil work contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the non-compliance of any environmental, or social (including sexual exploitation and abuse (SEA) and gender-based violence (GBV) or health or safety requirements or safeguard in the past five years."	Bidder to make the Declaration	PMO use this information to seek further information or clarifications in carrying out its due diligence
2. Contractor shall propose adequate ESHS staff in his team	The Contractor's staff should include an ESHS Manager who is responsible for the implementation of all mitigation measures on ESHS risks and compliance with ESMP with the following support staff (i)	The bidder shall propose adequate ESHS staff, which shall include at a minimum an ESHS Manager, an Environmental Officer, an OHS Officer, and a Social Officer with adequate ESHS Site Supervisors (one supervisor at each site) The Bidder shall provide details of the proposed ESHS Manager, including academic qualifications and work experience.	The bidder to submit the CV of the proposed ESHS Manager	PMO will review and approve

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	**PMO**
	Environmental Officer, (ii) OHS Officer, (III) Social Officer, and (iv) adequate ESHS Site Supervisors	The ESHS Manager should have a minimum bachelor's degree in engineering or a master's degree in sciences related to environmental management. The Specialist should have 10 years of experience working on monitoring and managing ESHS risks related to hydropower projects.		
3. Contractor shall submit ESHS Performance Security for compliance with ESHS obligations	The Contractor should have a financial implication if he could not comply with ESHS requirements. Hence performance security will be collected from the contractor	The Bidder shall submit the ESHS Performance Security in the form of a "demand guarantee" in the amount of one percent (3%) of the Contract Amount.	The bidder will submit a Performance Security	
4. Implement Mitigation Measures to Address Construction-Related Impacts given in ESMP	The mitigation measures to address potential ESHS risks and impacts should be included in the bidding documents. The contractor shall be made responsible for the implementation of the mitigation measures through the necessary conditions in the contract.	PMO will include **Table 9.1** (on environmental permits), **Table 9.3** (measures during pre-construction), **Table 9.4** (measures during construction), **Table 9.5** (monitoring measures during construction) and ECPs (**Annex 1**) of the ESMP in the General Specifications of the Bidding Document, and the reference to these tables will be provided in the Conditions of the Contract as follows: • The Contractor shall implement the mitigation and monitoring measures given in the ESMP to address ESHS risks associated with the construction works. The Consultant shall refer to the ESIA of the Project, which is available on the PEDO website for further guidance. • The Contractor shall comply with the World Bank Group's General Environmental Health and Safety Guidelines and Environmental Code of Practices (**Annex 1**)		PMO will include this condition in the bidding document
5. Payments for implementation of ESHS Mitigation and Monitoring Measures	BOQs on ESHS implementation are included in the Bidding Documents	The budget will be allotted for the preparation and implementation of C-ESMP (including OHS plans), and monitoring plans. The items given in the ESMP budget will be included in the BOQ, and the bidder shall quote the amount against these items.	Bidder will quote for the ESHS Management	PMO will include this in the general specifications of the bid document

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
6. Code of Conduct for Contractor's Personnel	All workers hired by the Contractor should sign a code of conduct to ensure compliance with ESHS obligations of the Contract	The Bidder shall submit the Code of Conduct that will apply to the Contractor's employees and subcontractors. The Code of Conduct will state that the workers will comply with the following ESHS requirements: • Wearing of Personal Protective Equipment (PPE's) in the workplace at all times • Non-discrimination in dealing with the local community by race, ethnicity, gender, religion, disability, sexual orientation, gender identity, social, or health status • Respectful attitude while interacting with the local community • Prohibit sexual harassment particularly towards women and children • Prohibit violence, including sexual and/ or gender-based violence • Respecting the reasonable work instructions • Protection and Proposer use of the property • Awareness raising, communication and dissemination of information campaigns for employees, workers and communities residing in AOI on SEA, SH and GRM.	Bidder shall submit code of Conduct with the bid documents	
7. Contractor's Management Strategies and Implementation Plans (MSIP) to manage the ESHS Risk	The Contractor proposal should include his understanding of the ESHS requirements of the project and the proposed strategies to manage the ESHS risks	The Bidder shall submit Management Strategies and Implementation Plans (MSIP) to manage the following key ESHS risks: • Strategy for the protection of workers and community from the construction-related hazards inside the terminal • Pollution prevention (wastewater, air and noise emissions) and management • A waste management plan for proper collection and disposal of waste • Traffic management plan to ensure the safety of local communities from construction traffic	The bidder will submit MSIP along with the Bid Documents	

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
		• Hazardous material management plan safe storage and handling • Strategy to address labor influx impacts on the local communities • Gender-based violence and sexual exploitation and abuse prevention and response action plan • Emergency response plan and early warning system The Contractor shall be subsequently required to submit (before mobilisation) Contractor's Environment and Social Management Plan (C-ESMP) by the above strategies and Condition 4 of this Table.		

9.5 Environmental and Social Management During Construction

9.5.1 Environmental Codes of Practices

The ECPs will provide guidelines for best-operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. These ECPs have been prepared based on the experiences in the construction of hydropower projects, including World Bank-funded hydropower projects in Pakistan and also in conformity with the WBG EHSGs and Good International Industry Practice. The ECPs are presented in **Annex 1** and will be included in the bidding documents (**item 4 of Table 9.1**) to ensure their implementation.

The list of ECPs prepared for the Project is given below.

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Topsoil Management
- ECP 8: Topography and Landscaping
- ECP 9: Quarry Areas Development and Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fish
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Labour Influx Management and Construction Camp Management
- ECP 17: Cultural and Religious Issues

- ECP 18: Workers Health and Safety
- ECP 19: Tunneling and Underground Construction Works
- ECP 20: Instream Construction Works (Diversion, Coffer Dam and Dam Construction)

9.5.2 Pre-construction Stage Mitigation Plans

Pre-construction stage will mainly include the mobilisation of the contractor and finalisation of the following conditions/documentation by the Contractor:

- Contractor's Environmental and Social Management Plan (C-ESMP) with site-specific management plans;
- Labour Management Procedures to be followed for hiring and management of labour;
- The mobilisation of ESHS Specialists

Each of the above conditions is elaborated in **Table 9.3**.

Table 9.3: ESHS Conditions in the Pre-Construction Stage

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
1. Preparation of Contractor's Environmental and Social Management Plan (C-ESMP)	The Contractor shall submit site-specific management plans to address ESHS risks following the ESMP requirements and MSIP proposed in the bid documents.	The Contractor to submit for approval and subsequently implement their Environment and Social Management Plan (C-ESMP). The C-ESMP should be submitted prior to the commencement of construction works, and no construction activities will be carried out under the project until approval of the C-ESMP. The C-ESMP will include the following site-specific management plans on: • Occupational health and safety management plan • Community health and safety management plan • Camp management plan • Waste management plan • Wastewater discharges management plan • Air and noise emissions management plan • Hazardous material management and spill control plan • Water supply and sanitation management at the worksites and workers' accommodations • Management of labour influx and facilities for the foreign workers • Labour recruitment procedures and labour management	Contractor	PMO, CSC

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
		• Traffic management plan • Training plan for ESHS risks including HIV/AIDS, sexual exploitation and abuse, and gender-based violence • Emergency Response Plan • Grievance Redress Mechanism • Demobilization plan after completion of works		
2. Mobilisation of ESHS Specialists	The ESHS Specialists should be mobilised during pre-construction for preparation of C-ESMP	The Contractor shall submit the CVs of following ESHS Specialists for PMO review and approval, and mobilise them • ESHS Manager • Environmental Officer • OHS Officer • Social Officer The ESHS Specialists should be present at the site throughout the construction period.	Contractor	PMO, CSC
3. Environmental approvals and permits during constructions	Government permits are required for carrying out some activities (see **Table 9.1**)	Contractor shall obtain the necessary approvals and permits for establishing crushing and batching plants, and storage and transport of blasting material	Contractor	PMO, CSC
4. The hiring of Construction Labour	Hiring procedure for construction workers including the signing of code of conduct	The procedures will include terms and conditions of employment, including hours of work, wages, overtime, compensation and benefits, holidays, leaves, and so on. The procedures will set out measures to prevent and address harassment, intimidation and/or exploitation. All workers shall sign the code of conduct (see Item 6 of Table 9.2) and they will be terminated from employment if not complied with the code of conduct.	Contractor	PMO, CSO
5. Construction camp and storage facilities	The contractor will need areas for setting up camp and storage areas.	Contractor shall set up camp and storage facilities within sites approved by the PMO with the adequate facilities	Contractor	PMO

9.5.3 Construction Stage Mitigation Plans

Detailed mitigation plans for construction stage impacts have been prepared on the basis of the detailed impact assessment covered under Chapter 7 and presented in **Table 9.4**. These plans are project-specific, and to the extent possible, site-specific, however, contractors will be required to carry out further detailing of the key aspects, to prepare site-specific management plans as part of C-ESMP for review and approval of PMO.

Table 9.4: ESHS Impacts and Risks in Construction and Mitigation Measures

(**Note**: PMO will include this Table in the Contract Specifications of the Bidding Documents)

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Generation of spoils (excess excavation) and their disposal	• Minimize the generation of spoils by reusing the excavated rock to the maximum extent possible by using them as the aggregate material in the concrete works, and filling of embankments and road works • Transport and disposal of spoils and designated muck disposal sites • Proper dumping and adequate compaction to avoid dust and release back to the river • Some disposal sites have been identified on the eroded riverbanks, which were originally agricultural lands. These lands can be reclaimed through the placement of spoils and providing soil layer at the top. These sites will be handed over to the landowners. During consultations, local communities have also offered to use their lands for disposal of spoils, if additional land is required. • Landscaping of the spoil sites, that were in the permanently acquired lands, after completion of works	Implement measures in the following ECPs: ECP 1 ECP 5 ECP 6 ECP 10	Contractor	PMO CSC
2. Generation of construction waste including hazardous waste	• Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the PMO for their review and approval. • The contractor will place containers of adequate size and numbers in place for the collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites, and transport these wastes regularly to a centralized facility. • The contractor will procure the services of a waste management contractor for transport and treatment of hazardous waste, and management of recyclable waste. • For disposal of inorganic construction waste, the contractor will develop a waste management site or place them in the spoil disposal areas.	Implement measures in the following ECPS: ECP1 ECP 2	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
3. Generation of solid waste from worker's campsites and offices	• Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the PMO for their review and approval. • Collection and segregation of solid waste into kitchen waste (organics), paper, and plastic (recyclable) and garbage (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, rooms) for the segregation of the waste at source. • Organic waste will be treated through in-vessel composters and the compost will be given to the local communities to use in the agricultural lands. • Procure the services of waste management contractors for the collection and management of recyclable waste. Recyclable waste will be compressed through bailers to minimize the volume of waste to be stored and transported. • Develop a waste disposal site for disposal of garbage.	Implement measures in the following ECPs: ECP 1 ECP 16	Contractor	PMO CSC
4. Wastewater discharges from the construction camps, sites, and batching plants	• Sedimentation ponds, of adequate size and capacity, will be built for the treatment of discharges from the batching plants and the tunnels to allow the sediments to settle. Final discharges from the sedimentation ponds shall comply with NEQS for wastewater discharges into the rivers. Frequently monitor the pH values and If the pH values high, add online buffering solutions to settlement ponds for control of pH. The settled sediments will be periodically removed and will be disposed of at the designated spoil disposal sites. • Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and site drainage • The contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water • The contractor will prepare and implement a Pollution Prevention Plan prior to the start of the work. • Quarterly monitoring of wastewater quality to ensure compliance with NEQS	Implement measures in the following ECPs: ECP 3 ECP 4 ECP 16	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
5. The risk of soil pollution by construction works	• Storage of fuels and chemicals in contained facilities and take appropriate measures to avoid and contain any spillage • confine the contaminants immediately after such accidental spillage and cleanup of oil spills using spill kits. • Collect contaminated soils, treat and dispose of them as a hazardous waste • Topsoil from cultivated lands in the construction areas to be stripped and stockpiled where practical for later use for restoration of spoil disposal sites. • Temporary stockpiles to be protected from erosion.	Implement measures in the following ECPs: ECP 5 ECP 6 ECP 7	Contractor	PMO CSC
6. Air and noise pollution from construction	• Construction equipment and vehicles will be well maintained so that emissions are minimal and comply with emission standards of NEQS. • Crushing and batching and asphalt plants will be located a minimum 500 m away from residential areas and will have appropriate dust/emission suppression mechanisms such as wet scrubbers • Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out through the construction period. • Construction activities near the settlements will be limited to daytime only • High noise-producing equipment will be provided with mufflers or acoustic enclosures. • Blasting methods should be selected to minimize dust and fly rock emissions. • Regular monitoring of air and noise quality to ensure compliance with NEQS on ambient air and noise quality • A quarterly air and noise quality monitoring will be carried out in the project area • A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the contractor by adopting the necessary measures	Implement measures in the following ECPs: ECP 10 ECP 11	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
7. Sourcing of aggregates for concrete works	• The contractor shall use the designated quarry sites recommended by the PEDO or government-approved quarry sites for the procurement of aggregates. • Reuse of excavated material from the construction sites to the extent feasible • Source the material from the surface boulders from the eroded riverbanks in the proposed reservoir area (which are found to be suitable for aggregates) • Although the material is widely available, the quarrying/mining activities shall be limited to fewer areas to reduce the area of extent affected by quarrying activities. If any mining activities are to be carried outside the project area, they should be not be located in any sensitive areas. • Maintain setbacks (which could include placement of berms) between sediment extraction areas and the low flow channels in order to reduce the low flow season impacts. These would include that excavations are set back at least 5 m from the main low flow channel and minimizing the activities that release fine sediment to the river. • Maintain a buffer zone of 5 to 10m between the low flow channel and the mining operations to minimise the downstream impacts, and limit the excavation activities to the low flow season. • Implement the generic measures and best practices on quarry areas development and operation that are given in World Bank Group EHS Guidelines for Construction Materials Extraction	Implement measures in the following ECPs: ECP 9	Contractor	PMO CSC
8. Impact on river habitat due to construction activities and drying of river section between two cofferdams	• The open diversion channel shall be inspected regularly to ensure the safe passage of fish. • If any fish is stranded in the dry riverbed, it shall be relocated to the downstream • Control of wastewater and sediment releases to river particularly in the section between cofferdams • Prevent the release of silt, sediment, sediment-laden water, raw concrete, concrete leachate, or any other deleterious substances into the River.	Implement measures in the following ECPs: ECP 3 ECP 4 ECP 14	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Ensure equipment and machinery are in good operating condition (power washed), free of leaks, excess oil and lubricants, and grease. • Machinery leaking fuel, lubricants, hydraulic fluids, or solvents shall not work within the river. • Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use. • Regular monitoring of the aquatic habitat and fish species during the construction activities			
9. Impacts on flora and fauna from construction activities	• The contractor's code of conduct for workers will include conditions on the protection of flora and fauna and ban on cutting of trees and ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions including fines and termination of employment. • Awareness-raising to workers on the protection of flora and fauna, including the awareness on the conservation value of the Bhan Valley Community Game Reserve • The dense vegetation will only be cleared once it has been established that any individuals present have fled. Before and during vegetation clearance or tree felling, any animals found will be removed and released to a safe place. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place. • Use of non-wood fuel for cooking and heating • Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats, and other wildlife. • No organic waste will be disposed of in the open places	Implement measures in the following ECPs: ECP 12 ECP 13	Contractor	PMO CSC
10. Workers Safety risks	• The contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSGs, International Tunnel Association, ECPs in Annex 1, GoKP regulations on Factory Act 2013, Industrial Relations Act 2013, and Workers Compensation Act 2013. If these guidelines cannot address	Implement measures in the following ECPs: ECP 18	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	any specific aspect of OHS, international good practices such as OSHA and ILO will be applied. OHS Plan should contain general guidance for all identified hazards under each work activities, and site-specific OHS hazard and risks during construction, and control and preventive Measures proposed by the Contractor. • OHS Plan should contain general guidance for all identified hazards under each work activities and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor. • The OHS plan will be reviewed and approved the Construction Supervision Consultant and the World Bank • Conduct a 'job hazard analysis' at the new construction site to identify potential hazards that may arise from the proposed works or working conditions to the project workers and implement necessary control measures. The job hazard analysis should be part of the contractor's method statements, which will be reviewed and approved by the OHS Specialists of the supervision consultants. The specialists will also visit the construction sites, prior to the start of construction, to ensure the control measures are in place. • Regular site inspections and safety audits by the construction supervision team, both by the OHS specialists and the site engineers. Since the site engineers will present at the worksites all the time, they will be trained by their OHS team on monitoring safety aspects of the construction works. • Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies. • Incident investigation and reporting, including A complete record of accidents and near misses, will be maintained. • In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such	ECP 19 ECP 20		

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	as safety boots, helmets, masks, gloves, protective clothing, goggles, fully face eye shields and ear protection. The contractor will also provide training to workers on how to use them and maintain in a sanitary and reliable condition and replace the damaged ones immediately with the new one. • Availability of firefighting, ambulance, medical and rescue facilities at the site for implementation of an emergency response plan • Adequate water supply and mobile toilets, medical and first aid care facilities at the worksites • Contractors will have dedicated and qualified staff for ensuring compliance with the OHS Plan • Awareness-raising material will be used including posters, signage, booklets, and others at the worksites • A complete record of accidents and near misses will be maintained. • First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).			
11. Occupational health risks in construction	• The contractor will develop and implement a camp management plan • The construction camp will be built with all adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.) including entertainment facilities so that there will be minimal interaction between them and local communities • A medical clinic, with a medical doctor and attendants, will be established at the campsite. Regular health checkups of the workers will be carried out. • The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan	Implement measures in the following ECPs: ECP 16 ECP 18 ECP 19 ECP 20	Contractor	PMO CSC
12. Safety hazards due to increased traffic especially for children and elderly people	• Traffic Management Plan (with adequate measures such as avoiding school hours, following sped limits, hiring licensed drivers, etc.) will be implemented with the aim of ensuring access to residential areas, and preventing unsafe situations, especially near schools, housing areas, construction areas	Implement measures in the following ECPs: ECP 15	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic. • Liaison with traffic police will be maintained • Project drivers will be trained in defensive driving. • Ensure that all construction vehicles observe speed limits on the construction sites and on public roads • Provide adequate signage, barriers, and flag persons for traffic control.			
13. Community exposure to work hazards	• Barricade the work areas with hard fencing to prevent the entry of community in the construction areas located near the settlements. • Placing of adequate signboards and flagmen to divert the community away from the construction sites. • Implementation of traffic management plan near the blasting sites • Community awareness programs on construction-related hazards, including awareness programs in schools Construction activities such as blasting and excavation, particularly at the borrow areas, may pose safety risks to the nearby population. • Ambulance and first aid medical facilities will be made available at the worksite.	Implement measures in the following ECPs: ECP 15 ECP 16 ECP 17	Contractor	PMO CSC
14. Dust from vehicular movement on local roads and construction activities	• Dust generation from construction sites will be restricted as much as possible, and water sprinkling will be carried out as appropriate, especially at those places where earthmoving, excavation will be carried out. • Mobilisation of adequate water sprinkling trucks and a frequent sprinkling of water on the local roads and worksites to control dust emissions • A GRM will be put in place to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.	Implement measures in the following ECPs: ECP 10	Contractor	PMO CSC
15. Risk of damage to houses by blasting activities (through fly rock and vibration)	• Use of controlled blasting and placement of sandbags on the boreholes to prevent fly rock	Implement measures in the following ECPs:	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Adequate compensation for any affected structures. Prior to the start of the construction works, particularly near the blasting sites, all nearby residential structures will be photographed. • A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. These grievances will be addressed by the contractor by adopting the necessary pollution control measures. Continued consultations with the affected communities will be carried out during the construction phase.	ECP 11		
16. Employment opportunities in construction activities	• Encourage to engage local workers/laborers with the same terms and condition of outside workers/laborers • Children under 18 will not be employed in dangerous work. • No forced labor, which includes non-voluntary work extracted under threat of force or penalty. This covers indentured and bonded labor. • provision of a safe and healthy working environment to workers; • taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage for insurance facility for workers. • Working relationship: Working conditions and terms of employment will be clearly documented and communicated to employees and contracted workers. • Worker's Organizations: Ensure the provision of worker's rights to associate and bargain collectively. The contractor will comply with the KP laws and regulations. • Non-Discrimination and Equal Opportunity: The employment relationship will be based on the principle of equal opportunity and fair treatment, and will not discriminate in the contexts of hiring, compensation, working conditions, and terms of employment, access to training, promotion, termination, retirement, and discipline. • Local employment: Maintain inventory of the entire workforce (including names/national identify card numbers/ addresses etc.) and employment contracts and share with PIC and regularly update of the inventory;	Implement measures in the following ECPs: ECP 16	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Retrenchment: Develop a plan to mitigate the adverse impacts of retrenchment, if layoffs are expected to be significant. • Grievances: A grievance mechanism for workers. The mechanism will be transparent and well understood and should address concerns promptly at an appropriate level of management. The mechanism should not delay or impede other remedies available under law or in the context of existing arbitration procedures.			
17. Impacts from the influx of labor from the outside areas	• This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which easily could lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behavior of workers on-site, in camps, and in local communities. • The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS. • The contractor will prepare a labour influx management plan prior to construction works for approval of PEDO. • The contractor's code of conduct shall cover the program to promote awareness to the construction workers on respecting the local community. • Construction camps will be built in the designated areas, located away from the local settlements • The contractor will ensure local water usage will not be affected by the project water usage by the project or compete with water requirements of the local community • The Contractor will manage to provide clean water to the affected households during the relocation of PVC water pipes through tankers at the accessible location to all affected communities, being within 30 minutes total round trip travel time as per United Nations definition of access to water.	Implement measures in the following ECPs: Implement measures in the following ECPs: ECP 16 ECP 17	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community			
18. Risk of gender-based violence GBV/Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH)	• Inclusion of clause on GBV/SEA behavior obligations in the employment contracts of all employees and construction workers aimed at strengthening measures to address and prevent GBV/SEA in the workplace and construction areas. • Translation of code of conduct into Urdu and dissemination of the principles laid out in CoC and the consequences (warnings, penalties, termination and legal actions) of its breach to all employees and workers • Awareness training to workers sub-contractor and service providers staff to sensitize them about GBV, SEA and SH, and their responsibilities to prevent • Posting of code of conduct in public spaces at contractor's work camps and living areas, and village information centers and public places of adjoining/neighboring communities in the Urdu language • Raising awareness that GBV is prohibited • Awareness to explain suspicious situations and the signs of GBV/SEA/SH; • Provide information on the use of GRM to report cases of GBV/SEA/SH, Code of Conduct breaches and assist victims of SEA, if signs of SEA are identified/a victim approaches them to complain about SEA; • Awareness to communities particularly women, and male and female children to understand risks of SEA and SH and the roles and responsibilities of parties involved in project implementation on SEA and SH prevention, processes for reporting incidents of project-related SEA/SH, and the corresponding accountability structures. • Strengthen the Contractors' obligations and capacity to public health and safety risks and ensure contractor supervision capacity to monitor the mitigation of these risks. • Preparing code of conduct for PEDO, PMO, Contractors, Sub-contractors and service providers (such as security agencies,	Implement measures in the following ECPs: ECP 16 ECP 17	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	catering, transport or any other services) on GBV/SEA prevention, and by integrating these measures/clauses in bidding documents. • Proactive GBV/SEA prevention measures will be put in place, such as GBV/SEA related training to sensitize workers and local population along the project implementation area and ensuring that GRM for the project will also take care of GBV related issues if any. • There will be adequate mechanisms in place to protect the local vulnerable population, especially women and minors from risks associated with the influx of workers (harassment, underage sex). This mechanism will ensure the sensitization and enforcement of code-of-conduct by the Contractor employees and workers and all other parties that are involved in the project implementation. • Additionally, the Contractor will employ their skilled staff and apply unskilled construction labor from the local population as far as possible to minimize an influx of outsiders into the communities. • The third-party monitoring agency of the project will also cover the monitoring of GBV/SEA prevention measures. • Measures for receiving, reviewing and acting as appropriate on GBV/SEA concerns at the project management level. • PEDO will maintain an updated list of service providers as a part of the mapping exercise to assist potential victims (if any) for timely, safe and confidential support immediately after receiving a complaint from a victim including money for transportation, documentation fee and lodging if needed. • The identification information on the victim will not be stored in GRM. • Documentation and reporting of prevention and response in the progress reports of the project			
19 Chance finds during construction	Chance find procedures which will be used during this Project are as follows: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a nightguard		Contractor	PMO and CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	shall be present until the responsible local authorities and relevant Department of Archaeology take over; • Notify the supervisory Engineer who in turn will notify the responsible local authorities and relevant Department of Archaeology immediately (within 24 hours or less); • Responsible local authorities and relevant Department of Archaeology would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historical, scientific or research, social and economic values; • Decisions on how to handle the finding shall be taken by the local authorities and the relevant Department of Archaeology. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration, and salvage; • Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the relevant Department of Archaeology; and • Construction work could resume only after permission is given from the local authorities and relevant Department of Archaeology concerning the safeguard of the heritage.			

9.5.4 Construction Stage Monitoring Plans

The proposed monitoring plan to be carried out during the construction stage of the Project to ensure contractors are complying with the mitigation measures is given in **Table 9.5,** along with the monitoring indicators and frequency. CSC will be responsible for the supervision of the implementation of the plan. The total cost of monitoring has been estimated at USD 0.15 million.

Table 9.5: Effects Monitoring Plan During Construction

(**Note**: PMO will include this Table in the Contract Specifications of the Bidding Documents)

Parameter	Means of Monitoring	Location	Frequency	Responsibility	
				Implementation	Supervision
Topsoil storage	Visual inspection on stripping, storage and reuse of topsoil	Excavations	Monthly	Contractor	CSC, PMO
Erosion	Visual inspection of erosion prevention measures and the occurrence of erosion	All sites	Monthly	Contractor	CSC, PMO
Wastewater discharges from tunnels and batching plants, and campsites	Spot measurement for pH Visual inspection to ensure clear water leaving the site	Tunnel and batching plant discharges	Weekly	Contractor	CSC, PMO
	Sampling and analysis of wastewater discharges for the parameters given in NEQS	5 sites (including tunnel, batching, camp discharges)	Quarterly	Contractor	CSC, PMO
Surface water quality	Sampling and analysis of river water quality s for the parameters given in NEQS	5 sites in the river	Quarterly	Contractor	CSC, PMO
	Visual inspection of the presence of petroleum products.	All sites	Monthly	Contractor	CSC, PMO
Air Quality (dust)	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	All sites	Daily	Contractor	CSC, PMO
	Visual inspection to ensure dust suppression work plan is being implemented	All sites	Daily	Contractor	CSC, PMO
Air Quality in tunnels	Spot measurements for CO, O2, PM2.5, and hazardous gases, levels in the tunnels	In the tunnel	Daily	EU-CSC	PMO

Parameter	Means of Monitoring	Location	Frequency	Responsibility	
				Implementation	Supervision
Ambient Air Quality	Air quality monitoring for 24 hours for the parameters specified in NEQS	At 5 sites	Quarterly	Contractor	CSC, PMO
Noise and vibration	24-hour noise monitoring (at/near construction sites, campsites, offices, colony, communities, quarry area, transportation routes)	At 5 sites	Quarterly	Contractor	CSC, PMO
Emissions from plant and equipment	Visual Inspection	All vehicles	Monthly	Contractor	CSC, PMO
Waste Management	Visual inspection on spoil disposal	At disposal sites	Monthly	Contractor	CSC, PMO
	Availability of dust bins at worksites and camp	At camp and work sites	Monthly	Contractor	CSC, PMO
	Collection and treatment of organic waste	At campsite	Monthly	Contractor	CSC, PMO
	Collection and treatment of recyclable and hazardous waste by the waste management contractor	At camp and work sites	Monthly	Contractor	CSC, PMO
Operation of quarry sites	Visual inspection of quarry sites	At quarry sites	Monthly	Contractor	CSC, PMO
Spills from hydrocarbon and chemical storage	Fuels are stored in contained facilities Availability of spill kits at the site Visual Inspection for leaks and spills	At fuel storage sites	Monthly	Contractor	CSC, PMO
Traffic Safety	Placement of traffic signs and traffic control personnel	Near the construction sites	Monthly	Contractor	CSC, PMO,
Local Roads	Visual inspection to ensure local roads are not damaged	Kalam-Gabral road	Monthly	Contractor	CSC, PMO,
Cultural and Sites	Visual observation for cultural sites	Along the local roads	Monthly	Contractor	CSC, PMO,
Drinking water and sanitation	Water quality analysis for drinking water parameters specified in NEQS	At the campsite	Quarterly	Contractor	CSC, PMO,
Safety of workers	Usage of Personal Protective equipment	All worksites	Daily	Contractor	CSC, PMO,
Labour engagement and GBV risks	Interaction with labours and review of GRM	All work sites	Monthly	Contractor	CSC, PMO

Parameter	Means of Monitoring	Location	Frequency	Responsibility	
				Implementation	Supervision
Reinstatement of Work Sites	Visual Inspection	All worksites	After completion of all works	Contractor	CSC, PMO,

9.5.5 Reporting on ESMP Compliance

PMO and its Contractors will prepare periodic monitoring reports on the status of implementation of ESMP and will be submitted to World Bank for their review and feedback. Details of these reports and their content are given in **Table 9.6**.

Table 9.6: ESMP Monitoring and Compliance Reports

#	Title of the Report	Contents of the Report	Frequency of Report Preparation	Report to be prepared by
1	ESHS Monitoring Report	The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers: • environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPEs by workers • worker accommodations • Training conducted and workers participated • Workers grievances • Community grievances • Chance find (if any)	Monthly	Contractor
2	ESMP Monitoring Report	The compliance status of overall Project with ESMP requirements	Quarterly	PMO
3	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within ten days	Contractor

9.6 Environmental and Social Management During Operation

9.6.1 O&M Stage Mitigation Plans

Detailed mitigation plans for operation and maintenance (O&M) stage impacts have been prepared on the basis of the detailed impact assessment covered under Chapter 7 and presented in **Table 9.7**. PMO's ESU staff will be responsible for implementing these measures.

Table 9.7: ESHS Impacts and Risks in O&M and Mitigation Measures

Impact	Mitigation Measures	Responsibility for implementation
1. Barrier effect on fish migration	• Sensors and underwater video cameras will be placed on the ladder and monitored to count the fish and to assess the effectiveness of the ladder. • Year-round release of water from fish ladders • Regular removal of sediments deposited on fish ladders • Compile the monthly data to share with the ESU • Installation of trash rack at the intake to prevent the fish from entering to the water conveyance system and tunnel • Monitor the effectiveness of fish ladder and take adaptive measures to improve the performance of the fish ladder • Supporting the fisheries department for upgrading of snow carp hatchery at Nagoha Shamozai and annually releasing the fish on both upstream and downstream of the weir.	PEDO O&M Staff PEDO ESU staff
2. Reduced water flow between weir and tailrace during low flow season	• Release of 2 m^3/s during extreme low flow season of December to February and 2.5 to 3.5 m^3/s during other seasons (including migratory fish season of March/April and September/October) of environmental flows.	PEDO O&M Staff
3. Impact on downstream sediment load	• Sediments will be flushed from the reservoir through under sluices during high flow season • Sediments from sandtraps will be flushed regularly during high flow season • Environmental flows will be released through under sluices to allow some sediment flows during low flow season as well	PEDO O&M Staff
4. workers health and safety due to noise and EMF exposure	• Prepare and implement an EMF safety program with the following components • Identify potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities. • Train workers in the identification of occupational EMF levels and hazards. • Establish and identify safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure and limiting access to properly trained workers.	PEDO O&M Staff

Impact	Mitigation Measures	Responsibility for implementation
	• Implement action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The recommended EMF exposure levels by ICNIRP are 10 kV/m for electrical field and 1000 µT for magnetic field • Personal exposure monitoring equipment will be set to warn of exposure levels that are below occupational exposure reference levels (for example, 50 percent). • Implement actions to minimize occupational exposure, which include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or using shielding materials • Workers always use personal noise protective gear when working in high noise areas (typically areas with noise levels greater than 85 dBA). • Transmission line workers will be provided with adequate PPEs and training on the safe use of equipment	
5. waste from the plant and colony including hazardous wastes	• implement a waste management plan for collection and disposal of organic waste, recyclables, garbage and hazardous waste following the principles give in ECPs 1 and 2 on waste management and hazardous waste management	PEDO O&M Staff
6. Community health and safety from exposure to EMF of transmission lines and risk of dam failure	• Measure EMF levels near the transmission line to comply with ICNIRP standards. • Dam design will be reviewed by the Independent Panel of Experts in the dam, tunnel and geology, and hydrology, hydraulic structures, and dam management • Install instrumentation network to monitor the behavior of weir, its foundation, and abutment. • Prepare an emergency response plan for dam -breaks prior to the operation of the project.	PEDO O&M Staff
7. Impacts from the tourist facilities	• PEDO will provide preference to affected persons in establishing small businesses in designated eco-tourism spots. It will help affected households to formalize their small businesses and benefit from the promotion of local tourism. • PEDO will make concerted efforts in collaboration with Department of Culture, Sports, Tourism and Youth Affairs (DoT) to promote responsible/eco-tourism to be socially, economically and environmentally responsible to avoid impacts on the local socio-cultural situation and environment of the area around the weir. • The information communication material will be displayed at the tourist spots to promote responsible tourism. • The tourist facilities include waste collection bins and public toilets, which will be maintained regularly by	PEDO O&M Staff TCKP

Impact	Mitigation Measures	Responsibility for implementation
	PEDO. The solid waste management system adopted for the PEDO colony and offices will be used for the collection, storage transportation and disposal of solid waste from the tourist facilities.	

9.6.2 O&M Stage Monitoring Plans

The proposed monitoring plan to be carried during the O&M stages of the Project is given in **Table 9.8** along with the monitoring indicators and frequency. PMO's ESU staff will be responsible for the implementation of the plan.

Table 9.8: Effects Monitoring Plan During O&M

Parameter	Means of Monitoring	Frequency	Responsibility	
			Implementation	Supervision
Downstream river flows	Measurements of discharges to the downstream	Monthly	PEDO O&M Staff	ESU
Fish counts	Data collection from sensors and monthly compilation of data	Monthly	PEDO O&M Staff	ESU
Fish catch surveys	Fish catch surveys to assess the use of ladder by the snow carps and brown trout	Monthly	PEDO O&M Staff	ESU
Waste	Collection and disposal of waste including hazardous waste	Monthly	PEDO O&M Staff	ESU
Dam Safety	Monitoring of data from dam safety equipment	Quarterly	PEDO O&M Staff	PEDO
EMF Exposure	Monitor EMF Levels in the powerhouse and switchyard	Continuous monitoring	PEDO O&M Staff	ESU
Water quality	Monitor water quality from the reservoir and on the fish ladders	Six-monthly	PEDO O&M Staff	ESU
Waste Management	Visual inspections to ensure the availability of waste collection bins at the tourist sites and regular waste collection and management	Continuous monitoring	PEDO O&M Staff	ESU

9.7 Capacity Building and Training

The environmental and social training will help to ensure that the requirements of the ESMP are clearly understood and followed by all project personnel. The competencies of the Consultant to be selected for capacity building training will include a thorough knowledge and experience of WB Environmental and Social Framework (ESF) and ESHGS guidelines. The trainings will be provided to different professional groups separately, such as managers, skilled personnel, unskilled labors, and camp staff. Capacity building will be aimed at strengthening the PMO staff in the field of environmental management and social development. Safeguard staff of PMO responsible for the supervision of environmental and social mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, labor and working conditions, and social development. The contractor will also be required to provide environmental and social trainings to its staff to ensure the effective implementation of the ESMP. A budget of USD 0.1 million has been earmarked for capacity building. The training plan shall include a program for the delivery of intermittent training to cover the subjects included in **Table 9.9**. Training should be carried out initially at the induction of staff and repeated throughout the project.

Table 9.9: Environmental and Social Training Programs

Contents	Participants	Trainer	Schedule
Environmental and social impacts of the Project and ESMP requirements of the Contractor; World Bank Group Environmental Health and Safety Guidelines. The contents for the second and subsequent training programs will cover topics related to the issues associated with on-going construction activities.	All the technical Staff of PMO, ESU, and relevant technical staff of PEDO who are involved in the management of environmental and social issues associated with routine operation and maintenance of the airport. Site Engineers of the PMC/Engineer.	ESHS staff of the CSC; and an external training agency who has a thorough knowledge of the WB safeguard policies and guidelines	During the initial stages of the Project implementation. The training will be repeated every six months.
Environmental and Social issues associated with the ongoing construction works; Workers' health and safety	Site Engineers of the Contractor, PMO, and the CSC	E&S staff of the CSC, PMO	On a monthly basis
Code of Conduct Occupational Health and Safety	Construction crew	Contractors ESHS Staff	Prior to the start of the construction activities and during the construction activities (To be repeated as needed.)

9.8 Audits and Annual Review of ESMP

Internal environmental safety audits will be held on a monthly basis with an objective to review the effectiveness of environmental and social management of the project. CSC, under the supervision of PMO, will carry out an annual review of the appropriateness and adequacy ESMP in the light of its own monitoring and supervision as well as on the basis of the third-party monitoring and audits discussed earlier. CSC will revise the ESMP in case substantial gaps and shortcomings are identified in these plans.

External third-party environmental audits will be held with an objective to review the effectiveness of environmental and social management of the project. It is proposed that MSC carry out these audits on a yearly basis. These audits would be used to re-examine the continued appropriateness of the ESMP and to provide advice on any updates required.

9.9 Gender Action Plan

The gender assessment of the project area is given in Section 5.5. The Gender Action Plan (GAP) for the Project is given in **Table 9.10**[33]. The internal monitoring of GAP implementation will be carried out by the social and gender staff of the CSC. A third party monitoring agency (TPMA) hired under RAP/ESIA implementation will be responsible for the external monitoring of the GAP.

Table 9.10: Gender Action Plan of the Project

#	Activities	Targets	Responsibility
1	Conduct public awareness campaigns on project benefits and encourage women to equally access development opportunities provided under the Project.	1.1 Project brochure in Urdu disseminated in villages of the project area of influence and within one month of the start of the Project and orientation to women in face-to-face meetings. 1.2 A documentary on the Project mitigation measures and benefits prepared in Pashto and Kohistani and shown to affected and beneficiary population in meetings and electronic media, among them 30% should be women. 1.3 Dissemination campaign to introduce project via local FM radio and local print media, minimum weekly basis for one month of the Project start.	PEDO, PMO - CSC and Third Party Monitoring Agency (TP MA)for monitoring
2	Socially and gender-inclusive consultations	2.1 Two broad-based socially and gender-inclusive participatory consultation workshops for relevant stakeholders on GAP objectives, one for male and one for female. 2.2 At least 25% of participants of stakeholder consultation activities are women. 2.3 Representation of women in consultation, participation and decision-making forums such as women-specific Affected Person Committee and Social Development Implementation Committee to voice their opinions, needs and preferences at a location and time that increases the possibility of women's participation, 20% of participants are women's representatives.	PMO, Project Director (PD), Social and Gender Staff of PMO (CSC and TPMA for monitoring)
3	Gender equality in compensation	3.1 compensation is paid to the one who owns the assets, if jointly owned by men and women, the amount is paid to both parties including resettlement and rehabilitation assistance. 3.2 Women having ownership of land and other fixed/affected assets receive compensation directly including resettlement and rehabilitation assistance. 3.3 Awareness raising in women about above provisions to ensure equality in gender rights in distribution of compensation and resettlement and rehabilitation assistance.	PMO, Project Director (PD), Social and Gender Staff of PMO (CSC and TPMA for monitoring)
4	Women and men benefit equitably from the	4.1 Minimum 80% vulnerable AHs provided training in improving existing skills or developing new income-generating skills either in on-farm or off-farm income-	PEDO, PMO, Project Director (PD), Social and

[33] After development of implementation plan of Social Development Plan and detailed Livelihood Restoration and Improvement Plan, this Gender Action Plan will be updated within 6 months of start of project implementation

#	Activities	Targets	Responsibility
	Livelihood Restoration Plan.	generating activities, among them 30% women trained in formal/informal skills (sewing, art and craft, veterinary, agri-processing, etc. as relevant) with microenterprise development training and financial support including marketing.	Gender Staff of PMO (CSC and TPMA for monitoring)
5	Social and gender-inclusive Social Development Plan (SDP)	5.1 Social Development Plan developed based on target population needs and priorities. 5.2 Installed water points/rehabilitation of existing water systems in all villages in the project area of influence, within 30 minutes round-trip travel time[34], will release women and children burden of fetching water, save time and improve their health; 5.3 At least one safe water connection at visible and accessible locations in community facilities, e.g. mosques, market area; 5.4 Safe and accessible water facilities for all girls' and boys' schools. 5.5 Conducted literacy campaigns to increase awareness of women and men to enrol the boys and girls in newly built schools under SDP. 5.6 Appoint at least one woman for Grievance Redress Mechanism (GRM) at the project site to address 100% women related complaints. 5.7 Monitor and evaluate the results of the implementation of the SDP by documenting successes, challenges, and lessons learned. 5.8 Recorded gender-disaggregated data by ethnicity, income, marginalized and vulnerable group against a set of socially inclusive and gender-sensitive indicators, monitored against baseline conditions and reported annually, focusing on improvements to the quality of life parameters.	PEDO, PMO, Project Director, Social and Gender Staff of PMO (CSC and TPMA for monitoring)
6	Women and girls visit the weir site with their families for recreation	6.1 Recreational area developed for families with sitting arrangement, water sports, and eateries; 6.2 Separate restrooms for women and men with a minimum of 6 toilets for women with clean running water and other personal hygiene facilities.	PMO, Project Director, Social and Gender Staff of PMO (CSC and TPMA for monitoring)
Institutional Strengthening, Project Management, and Monitoring and Evaluation			
7	Enhance the capacity of PEDO and PMO to include a gender perspective into program/project operations	7.1 Evidence that equal employment opportunity policy and practices are implemented, at least 10% of female staff in PMO with equal salaries by following GoKP fixed minimum quota for women employment; 7.2 Evidence of the type of incentives designed to recruit women, increase their capacity, and provide career development;	PMO, Project Director, Social and Gender Staff of PMO (CSC and TPMA for monitoring)

[34] The United Nations definition of access to an improved water source being within 30 minutes total round-trip travel time

#	Activities	Targets	Responsibility
		7.3 Social and Gender Specialist and female staff deployed in PMO and PIC to assist in GAP implementation and monitoring; 7.4 PMO and PEDO staff trained in job-related skills of which 10% are women; 7.5 Gender awareness and social inclusion training provided to 100% PMO and 50% management staff of PEDO for clarity in gender mainstreaming and social inclusion concepts, orientation on GAP targets, roles, and responsibilities, better planning, communication, coordination, implementation, documentation, monitoring and evaluation;	
8	Monitor satisfaction level of target beneficiaries	8.1 Conduct yearly satisfaction surveys of men and women project affected persons and beneficiaries of SDP including accessibility, quality, quantity, reliability, affordability, operations and maintenance; and share results;	PEDO, PMO, Project Director, Social and Gender Staff of PMO (CSC and TPMA for monitoring)
9	Include gender-disaggregated data in monitoring and evaluation and project progress reports.	9.1 Developed a set of quantitative and qualitative sub-indicators of key indicators, and develop a system to consistently collect, retrieve and analyze the gender-disaggregated data of level of participation, immediate results of activities, benefits, and outcomes, of the project on women, men, boys, and girls (disaggregated by gender, income, marginalized and vulnerable groups)	PEDO, PMO, Project Director, Social and Gender Staff of PMO (CSC and TPMA for monitoring)
10	Assess impacts of services on women, men, girls and boys	10.1 Conduct an impact assessment survey as a part of project evaluation to collect gender-disaggregated data to identify differential impacts on women and men, boys and girls due to implementation of RAP, Livelihood Restoration and Improvement Plan and Social Development Plan.	PEDO, PMO, PIC and TPMA

9.10 Social Development Plan (Draft)

A Social Development Plan (SDP) has been prepared beyond compensation and resettlement to enable project-affected populations to reap the project benefits as a form of development strategy to increase investment effectiveness. SDP for the project can be defined as a systematic mechanism to sustainably benefit local communities affected by the project's investment. The strategy substantiates the comprehensive compensation and resettlement policy of the project. Under this plan, community-based projects such as water supply and sanitation schemes, educational facilities, health clinics, access roads, etc. will be taken up. A budget of PKR 780 million (USD 5 million) has been allocated for SDP in the Project's RAP. A detailed description of the plan is given in the **RAP**.

9.11 Grievance Redress Mechanism

9.11.1 PEDO's Existing GRM

PEDO has a provision for receiving written complaints manually and their redressal but does not have standard operating procedures to receive and redress complaints and there is no practice of redressing anonymous complaints. Currently, PEDO has been receiving and redressing complaints under the "Pakistan Citizen Portal," a government-owned Mobile Application established by Prime Minister's Performance Delivery Unit and is being used as a tool to promote citizen-centric and participatory governance. It is an integrated citizens grievance redressal system connecting all government organizations both at federal and provincial levels.

9.11.2 Proposed GRM for the Project

A Project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected parties' concerns, complaints, and grievances about the environmental and social performance of the Project.

A three-tier GRM has been designed to provide a time-bound, early, transparent and fair resolution for APs and other stakeholder grievances regarding E&S management of each project. All complaints received verbally or in writing will be properly documented and recorded in the Complaint Management Register(s). In addition, an easy-to-access web-based GRM will be developed. All possible efforts will be made to redress complaints through project specific GRM and the complainants will also be encouraged to seek redressal of their complaints through this mechanism. Despite all efforts, if the complainant will not be satisfied with the resolution, s/he will have a right to lodge his/her complaint at the higher government administration or at the related court. If the complaint cannot be resolved at these three tiers, the complaint will have a choice to lodge his/her complaint at the related court of law. The GRM for the Program is outlined below and consists of three levels with time-bound schedules for addressing grievances and a detail description of the GRM plan is given in the **RAP**.

First Tier of GRM. The PMO's project site office will be the first tier of GRM, which will offer the fastest and most accessible mechanism for the resolution of grievances at the local level. A local level GRC will be formed for this purpose headed by the Project Director with the membership of Director-ESU, Land Acquisition Collector and other relevant staff of Revenue Department, contractors' representatives, consultants' representatives, representatives of other relevant departments, and two members from each affected persons (Aps) Committee. At this tier, the designated E&S staff of the PMO site office will make an attempt to resolve the complaints within two to 10 working days, depending on the nature of the grievance. The PD will convene the meetings of local GRC and conduct proceedings informally to reach an amicable settlement between the parties within 10 days of receiving a complaint (verbally or in writing) from an affected person or their representative. The report of the GRM meetings will be recorded in writing, and copies will be provided to the parties involved. Grievances will be documented with personal details (name, address, date of the complaint, nature of the complaint, etc.) unless anonymity is requested. A tracking number shall be assigned to each complaint/grievance. Should the grievance remain unresolved or the AP not satisfied with the decision, the grievance can be lodged with the Program level grievance redress committee, led by the head of PMO.

Second Tier of GRM. The E&S staff in PMO will refer to the unresolved issues or grievances (with written documentation) to the second tier of GRM, the PMO central level Grievance Redress Committee (GRC). The central level GRC shall be established by PEDO and will consist of the following persons: (i) a PEDO representative from senior management; (ii) the head of PMO will act as secretary of the GRC; (iii) Project Director of respective project; (iv) representative of DC office; (v) representative of PIC; (vi) Chief Resident

Engineer of the Consultants (on-call); (vii) representative of relevant government offices (on-call); (viii) two to three representative of respective project-affected people (on-call). A hearing can be called with the GRC, if necessary, where the AP(s) can present details of his/her/their concern/grievance. The GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 working days, depending on the nature of the grievance. All possible efforts will be made to redress complaints through project specific GRM and the complainants will also be encouraged to seek redressal of their complaints through this mechanism. Despite all efforts of complaint redressal, if the complainant is unsatisfied with the decision, the existence of the GRC shall not impede the complainant's access to the government's administrative or judicial remedies.

Third Tier of GRM: In the event that a grievance cannot be resolved directly by the second tier GRC or If complainant is dissatisfied with the decision of GRC, the affected people can seek alternative redress through the CEO or Board of Directors of PEDO, district administration, the Secretary Energy and Power Department or higher-level administrative authorities, the Pakistan Citizen Portal or the court of law, as appropriate.

Grievance Redressal Committee: The central level Grievance Redress Committee (GRC) will be formed by PEDO and as a continuing and functional structure, engaging personnel of PMO and other parties. The PEDO will specify that representatives of local/community authorities, elders, auditors, displaced persons and any other persons or entities can be included in the Committee as members. The details of central GRC and field-level/project site level GRC are provided in the RAP of GKH including their composition and functions.

Monitoring and reporting. The monitoring reports of RAP and ESMP implementation will include the following aspects pertaining to progress on grievances: (i) number of cases registered, level of jurisdiction (first, second, third tiers), number of hearings held, decisions made, status of pending cases; and (ii) lists of cases in process and already decided upon, may be prepared with details such as name with copy of NIC, complaint number, date of application, date of hearing, decisions, remarks, actions taken to resolve issue(s), and status of grievance (i.e., open, pending, closed).

9.11.3 Proposed GRM for Construction Workers

The GRM, with its present scope, addresses the grievances/complaints lodged by the project affected persons and other local stakeholders. But according to the lessons learned in various project contexts, there is also a need to establish a separate GRM to deal exclusively with those complaints that involve workers employed by the Contractors for construction activities. Such grievances may involve wage rates and unpaid overtime works, irregular and partial payments, lack/inadequacy of living accommodations, lack of clean drinking water and sanitation facilities, and lack of medical care.

The GRCs dealing with labor grievances will have members who are directly and indirectly associated with the construction works. The GRC will include a PMO official who is in charge at the worksite as the convener, resident engineer of the CSC, a worker's representative, and the contractor's representative. The convener will designate an official to receive the complaints and ensure the complainant does not lose his job and is not intimidated into withdrawing the complaint before the formal hearing.

To ensure impartiality and transparency, hearings on complaints will be held in a non-threatening environment and will remain open to all other workers on the site. The GRCs will record the (i) details of the complaints; (ii) reasons that led to acceptance or rejection of the individual cases, as well as the number of accepted and rejected cases; and (iii) decisions agreed with the complainants. PMO will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by the World Bank and other interested entities/persons.

9.12 Budget for Implementation of ESIA

The total cost of the ESMP implementation is estimated to be USD 3.94 million (**Table 9.11**). These costs will be covered under the Component C: Environmental and Social Management of the Program.

Table 9.11: Cost Estimates for ESMP Implementation

Sr. No.	Description of Item	Unit	Item Total (million USD)	Covered under the Component of the Program
A	**Contractors Budget**			
1.	Contractors preparation of C-ESMP including OHC Plans		Included in construction cost	Component A 1
2	Contractors ESHS Staff		Included in construction cost	Component A 1
3.	Waste Management (procurement and operation of composters, bailers, and waste management contractors)	LS	500,000	Component C
4	Dust Management (procurement and operation of sprinklers)	LS	200,000	Component C
5	Site/OHS facilities for workers (PPE)	LS	250,000	Component C
6	Training of Workers on Code of Conduct (incl. GBV/SH/AIDs)	LS	50,000	Component C
7	Health facilities at the camp including a fully equipped ambulance, doctor and nurses	LS	400,000	Component C
8	Wastewater treatment facilities (incl. mobile toilets at worksites)	LS	100,000	Component C
9	Spot monitoring for dust and hazardous gases in tunnels	LS	50,000	Component C
10	Environmental Monitoring during construction by a third party (wastewater quality, air, and noise quality) - every 3 months (4 years) at 5 locations	LS	100,000	Component C
B.	**Consultants Budget**			
1	ESHS Staff for the Construction Supervision Consultant	LS	Included in project management cost	Component D
2	Biodiversity Consultants (for additional data collection and monitoring)	LS	200,000	Component C
3.	Cumulative impact assessment of the Program (KPHRED)	LS	400,000	Component C
C.	**PEDO's Budget**			Component C
1.	Tree Plantation and Promotion of Conservation Efforts in Bhan Game Reserve	LS	600,000	Component C
2	Monitoring and management of impacts on fish	LS	200,000	Component C
2	Capacity building of PMO safeguard staff	LS	100,000	Component C
D.	**Contingency**			Component C
	Contingency (25% of A+B+C)		787,500	Component C
	Total		**3,937,500**	

10 Stakeholder Consultations and Disclosure

Details of stakeholder consultations and feedback received from the stakeholders and actions taken or to be taken up by PEDO to address their concerns are described in this chapter.

10.1 Consultation Meetings

Extensive consultations were carried out with the various stakeholders of the Project. Consultations involved multiple methods such as household-level interviews, wise village meetings, focus group discussions, individual meetings with government departments, and workshops. Details of stakeholders consulted are given in **Table 10.1**.

Table 10.1: Details of Stakeholders Consulted

Type of stakeholders	Stakeholders Consulted
The general population in Project Area	Local community including affected people, Female, local community leaders
Local and district governments and NGOs	District Administration, Revenue Department, Communication and Works, Forestry Department, Wildlife Department Agricultural department, Fisheries department, Kalam Development Foundation, Sarhad Rural Support Program
Provincial government	Environmental Protection Agency, Forest Department, Forestry Department, National Highway Authority, Sports, Tourism, Archaeology, and Youth Affairs

A total of 58 consultation meetings with 439 participants (373 male and 66 female) were conducted. These include 48 local village meetings, one provincial-level workshop at Peshawar on October 21, 2019, one disclosure workshop at Kalam on November 7, 2019, to share the draft ESIA and RAP, in which the local communities, including affected communities, district-level government agencies (including representatives forest of wildlife departments, union councilors, and district administration have participated. A summary of the details of these meetings and the list of participants are given in **Table 10.2.** A full list of participants is given in **Annex 6,** and some photographs from the meetings are given in **Annex 7**. Two local non-profit organizations, Sarhad Rural Support Program and Kalam Development Foundation, who advocate for the sustainable management of environment, provision of social services and community infrastructure development, and conserving of the natural resources, were also consulted.

10.2 Approach followed for Consultations with Women and Vulnerable Groups

In general, the women of the project area of influence have a restricted cultural environment. Due to the limitations of women to participate in public meetings, women-specific consultations were conducted to get women's concerns, perspectives, aspirations, needs and priorities. The consultations were conducted at locations that were socially acceptable for women and in their own language by female field staff only. A total of 66 women participated in consultations. The qualitative tools were used to conduct the consultations such as focus group discussions and in depth and key informant interviews. These included perception analysis of women on:

- Poverty

- Nature and extent of positive and adverse impacts and risks of the project on women and children that can enhance or reduce their wellbeing and vulnerability
- Coping strategies to recover from economic shocks such as loss of land, properties and income and livelihoods
- The mitigation measures to avoid or mitigate impacts on their daily and seasonal activities, mobility and privacy due to their roles of water and wood collection, work on their family farms, livestock rearing, socialization within communities and tribes
- All resettlement aspects especially eligibility, entitlements and compensation, resettlement and rehabilitation assistance
- Strategies for rebuilding capacities of women and their household members to enable them to bear shocks of displacement and social and economic losses; and the time period for revival.

Similarly, vulnerable groups (the affected families below the poverty line and those without formal titles) who required special assistance during the relocation and resettlement process were identified and consulted through focus groups discussions and in-depth interviews.

10.3 Feedback from Consultations

Feedback from the consultations was overall supportive of the project from both local communities and the government agencies, but a request was made to enhance the benefits of the project to the local population through the provision of social services, in addition to compensation, resettlement and rehabilitation assistance. Participants appreciated PEDO’s efforts in bringing them together from a variety of stakeholders and representatives of affected people for formal consultations in the workshops. All participants unanimously agreed that the draft safeguard reports were very comprehensive and extensively covered all environmental social aspects including the entitlement for resettlement and rehabilitation assistance. However, they have raised some concerns, which have been summarized in **Tables 10.3 and 10.4**.

Table 10.2: Details of Public Consultation Meetings

Type of Meetings conducted	Number of Meetings	Dates	Male Participants	Female Participants	Total Participants
1st Round Consultation Meetings at the community level	46	August 31 to September 2019	249	36	285
2nd Round Consultation Meetings at the community level	2	October 17, 2019	23	4	27
Meetings with government officials	7	October and November 2019	12	-	12
Workshop at Peshawar	1	21 October 2019	21	3	24

Type of Meetings conducted	Number of Meetings	Dates	Male Participants	Female Participants	Total Participants
Public Consultation and disclosure at Kalam in Hotel Golden Star	1	7 November 2019	68	2	70
Consultation with women at Kanai and Ashuran	2	14 November 2019	-	21	21
Total	**58**		**373**	**66**	**439**

The main concerns raised during consultations include:

- All local stakeholders strongly demanded to change the name of the project from Gabral-Kalam Hydropower Project to Kalam Hydropower Project (since there a village named Gabral, located away from the project area and it will get undue credit)
- impacts on private land and properties should be minimized, and if minimization is not possible then impacts should be mitigated completely and sufficiently;
- provisions should be made under the project for compensatory tree plantation and preservation of the natural environment;
- provision of employment during construction and operation phase to affected households;
- infrastructure development under the community development program;
- adequate measures should be taken to mitigate impacts on human health, water quality, and emissions, and other environmental issues.

Table 10.3: Feedback from Affected Communities

Key Concerns	Response/Actions
Minimize land acquisition to the extent feasible since the availability of suitable agricultural land is scarce in the project area.	While carrying out the feasibility studies for the Project, PEDO ensured the minimum acquisition of private land.
Adequate compensation for the loss of land. Payments to be made only to the legitimate owners at the prevailing market rates.	The principles and procedures for the valuation of assets at market rate have been laid down in RPF and RAP, in detail.
Compensation for land and structures to be paid prior to the construction.	Construction activities will start only after the payment of compensation to the affected communities of their lost land and other assets, including resettlement and rehabilitation assistance.

Key Concerns	Response/Actions
Development schemes such as schools, health centers, mother and child health care centers, vocational training centers separately for men and women should be implemented in the affected villages. And the access road from Kalam to Utror should be rehabilitated.	A Social Development Plan will be implemented as a part of the Project. The plan will include several interventions to address the priority needs of the local communities particularly the affected population. In addition, a livelihood restoration and improvement plan will be implemented to support the improvement of existing means of livelihoods and alternative off-farm income-earning opportunities including women-specific interventions.
During construction of the tunnel, water discharges from the tunnel may pollute the river water. River water pollution should be avoided from construction activities	Wastewater discharges from tunnels and project facilities will be released to the river after adequate treatment. ESMP includes measures for the treatment of wastewater discharges including water releases from the tunnel.
What would be the mechanism for noise control during the construction phase due to the operation of heavy machinery?	Noise emissions from vehicles and machinery will comply with national standards, and high noise generating equipment will be provided with mufflers. Noise generating activities will not be carried out during night time near the residential areas.
Fish ladders should be constructed.	A Fish ladder will be constructed.
Employment opportunities should be provided to local skilled and unskilled labor in the project to improve the livelihood of the locals. At least one-third of the local community, especially PAPs, should be engaged in the project-related jobs.	Contractors will give preference to the local skilled and unskilled labor. Preference will also be given to the PAPs.
Compensation for land acquisition should be paid before the commencement of work.	Compensation for loss of land, crops, trees, and structures, will be paid in accordance with the entitlement matrix presented in this RAP including compensation based on the market rate as well as replacement cost. Vulnerable affected people have been identified and assistance will be provided to them in addition to entitled compensation.
Compensation should be fair and should be delivered before the start of work. Payment of compensation for project-affected person especially vulnerable PAPs should be ensured.	Compensation for any loss to crops, trees, and structures will be paid in accordance with the rates given in the present RAP. These rates have been established based upon the official rates. Compensation is fair and paid in a timely manner.

Key Concerns	Response/Actions
While selecting the place for weir and powerhouse, impacts on the structures should be avoided and relocation of settlements should be minimized by changing the design, where possible.	The project design is already optimized to minimize land acquisition and resettlement requirements.
Transport for the relocation of assets and timely compensation to all the affectees should be provided.	Transition/ shifting assistance will be provided to the eligible/ entitled persons in addition to the compensation for the lost assets.
Damaged lands should be rehabilitated/ restored after the construction work is completed.	The contractor will rehabilitate/ restore the lands damaged by the construction activities.
Local norms should be honored, and construction work should be completed in time	Liaison with the community will be maintained during construction activities. The construction staff will be provided trainings regarding local norms. The construction staff will comply with the code of conduct. Construction activities will be carried out over a period of five years.
Compensation for the affected cropped area, houses and other private assets should be in harmony with existing market rates/ replacement cost	Compensation against losses of crops, trees, structures, and other assets will be paid to the PAPs in accordance with the present RAP. The compensation rates have been recognized based upon the official rates.
Women's participation in the activities outside the home is limited. However, in case of loss of any property/ assets, crops/ trees, compensation should be provided.	Compensation will be provided to the eligible and entitled PAPs including women and vulnerable people in accordance with the entitlement matrix of compensation given in the present RAP/ entitlement matrix covering the current market rates and replacement cost.
In some cases, local women are working in agricultural fields, so their routine activities should not be disturbed due to the construction activities.	Liaison with the community will be maintained during construction activities. The construction staff will be provided trainings regarding local norms. The construction staff will comply with the code of conduct. A GRM will also be established to address community complaints.
Women were inquisitive about the development of the area through the project.	A Social Development will be implemented under the Project, which will include community-based projects such as water supply and sanitation

Key Concerns	Response/Actions
	schemes, educational and health facilities, access roads, etc.
The access roads to the villages may be disturbed during the construction phase and there may be road safety concerns due to increased traffic volume.	A traffic management plan will be prepared and implemented.

Table 10.4: Feedback from Institutional Stakeholders

Key Concerns	Response/Actions
The reservoir will be silted up if there are no desilting will be done, and the life of the reservoir will reduce	There will be regular desilting of the reservoir during high flow season through under sluices
Blasting activities may impact the wildlife	Controlled blasting will be carried out, and no nighttime blasting will be carried out
There is a risk of hunting and poaching of animals by the workers	Workers' code of conduct will include a ban on illegal cutting of trees and hunting and poaching of wildlife. The contractor will carry out regular awareness programs to the workers on the protection of flora and fauna
The dam should have been constructed earlier. Rate/Compensations of the trees should be done at the market rate, and in the case of the Deodar tree, the community has 60 % concession and rights. If the project is being executed by the Provincial government, the forest department will not charge for the loss of trees. However, the community would charge against their share. (from forest department)	Forest department support for the project is appreciated and the compensation will be paid according to the market rates. In addition, the project will also support its afforestation activities and compensatory planting for the loss of trees. A budget of USD 0.8 million is proposed in the ESMP for the plantation and wildlife conservation activities.
People should be sensitized and mobilized for environmental protection and growing more trees.	The Project will support the on-going conservation programs of the forest department and wildlife department.
Fishways and fish ladders should be included in the the weir and district fisheries department would support the project activities	A Fish ladders will be built in the weir.
EPA's concern is mainly on the environmental releases from the weir to the downstream during winter and fair compensation to the affected households.	Environmental flows will be released from the weir during low flow season, and the requirement of flows are estimated based on the water uses in the downstream areas

10.4 Stakeholder Engagement Plan

A stakeholder engagement plan (SEP) is given in **Annex 8,** which is prepared following WB OPs and international best practices. The SEP will act as a guideline to enable PEDO, and other involved parties, to systematically carry out socially and gender-inclusive consultations with the primary and secondary stakeholders, to record their views and concerns and implement mitigation measures. The plan is aimed at enabling active and meaningful engagement of the stakeholder groups, especially the APs and venerable groups amongst them, and assures disclosure of information in a timely manner. The effective implementation of the SEP will mitigate the risks of poor stakeholder relations, particularly with APs throughout the Project lifecycle. The key features of the SEP are (i) identification and analysis of primary and other key stakeholders of the GKH; (ii) principles and key considerations for stakeholder engagement; (iii) stakeholder engagement approach; (iv) detail of GRM in the legal framework of Government of Khyber Pakhtunkhwa and program/projects specific GRM; (v) SEP implementation methodology; (vi) a plan for stakeholder engagement activities throughout the program/projects lifecycle; (vii) SEP monitoring, reviews and reporting, and (viii) key issues identified through stakeholder engagement activities. The SEP is a "living" document which will be regularly updated to include and enable documentation of all consultation activities undertaken and adaptation of stakeholder engagement approach and methodology in the light of results of monitoring and reviews to ensure appropriateness and effectiveness approach and methods used in engaging stakeholders (evaluation).

10.5 Access to Information

This ESIA and Executive Summary of ESIA will be disclosed on the PEDO website and will be sent to the World Bank for disclosure on its external website. The ESIA summary in Urdu will also be uploaded into the PEDO's website, and hard copies of these documents will be made available at local union council offices for public access.