Government of the Khyber Pakhtunkhwa, Pakistan

Khyber Pakhtunkhwa Hydropower and Renewable Energy Development Program

Gabral Kalam Hydropower Project

Environmental and Social Impact Assessment
Executive Summary

Pakhtunkhwa Energy Development Organization (PEDO)

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

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/Project). 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.

GKH 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 associated with 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 have been disclosed on the PEDO website and the World Bank external website. Hard copies of these documents will be made available at local union council offices for public access.