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ANNEXURES

ABBREVIATIONS AND ACRONYMS

BHU	Basic Health Unit
CBOs	Community Based Organizations
CCM	Community Consultation Meetings
CO	Carbon mono Oxide
dB-A	Decibels
EIA	Environmental Impact Assessment
El	Elevation
EPA	Environmental Protection Agency
EMU	Environmental Management Unit
EPD	Environmental Protection Department
FRL	Full Reservoir Level
ft	Feet
GIS	Gas Insulation System
GB	Gilgit Baltistan
GHG	Greenhouse Gas
GPS	Global Positioning System
GW	Gega Watt
HEPO	Hydro Electric Planning Organization
ha	hactare
HSEQ	Household and Socio-economic Questionnaire
HT	High Tension
IEE	Initial Environmental Examination
IFAD	International Fund for Agriculture Development
IUCN	International Union for Conservation of Nature
KKH	Karakoram Highway
km	kilometer
km/h	kilometre per hour
kv	kilo volt
KT	Karakouram Thrust
LAA	Land Acquisition Act
LAC	Land Acquisition Collector
LPG	Liquid Petroleum Gas
LT	Low Tension
LPP	Land Price Profile

LUP	Land Use Profile
m	meter
M/s	Messer
m^3/s	cubic meter per second
mb	body wave magnitude
MBT	Main Boundary Thrust
MCM	Million Cubic Meter
MDE	Maximum Design Earthquake
mg/m^3	milligram per cubic meter
mm	millimetre
MKT	Main Karakouram Thrust
MW	Mega Watt
NAPWD	Northern Area Power and Water Department
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NGO	Non Government Organization
NO	Nitrogen oxide
NA	Northern Area
^oC	degree Centigrade
PAP	Project Affected Population
PEPA	Pakistan Environmental Protection Agency
PHPP	Phandar Hydro Power Project
PM	Particulate Matter
POF	Pakistan Ordinance Factory
PPAF	Pakistan Poverty Alleviation Fund
PTCL	Pakistan Telecommunication Limited
RAP	Resettlement Action Plan
RB	Requiring Body
SO	Sulphur Oxide
VCSC	Valuation Compensation and Settlement Committee
VOC	Volatile Organic Compound
VPP	Village Population Profile
WAPDA	Water and Power Development Authority
WWF	World Wide Fund
WEC	Wapda Environmental Cell

EXECUTIVE SUMMARY

In the Northern Areas of Pakistan, the results of the hydrological surveys revealed that there are numerous small streams and waterfalls with strong and violent flow having sufficient potential for electricity generation through hydropower plants. Hydropower is very well known as source of energy in Pakistan and there is ever growing experience to develop the hydropower potential indigenously. The demand for electricity is growing rapidly whereas the present supply is insufficient to meet even the existing needs of the counrty. The principle forms of energy consumed in the Northern Areas are correctly identified as firewood, kerosene oil, LPG, diesel oil, and batteries. Generally firewood including sticks, bushes and grass etc, is used for cooking and heating, kerosene oil for lighting in household and electricity generated by diesel sets in commercial sector.

Keeping in view the aforementioned scenario, the Government of Pakistan has prioritised the development of the water resource projects in the country. In this connection, the Water and Power Development Authority (WAPDA), Pakistan has signed a consultancy contract in October, 2010 with a joint venture of M/s FHC Consulting Engineers, Lahore, M/s Techno Consult International, Karachi and M/s Electra Consultants, Peshawar in association with M/s Scott Wilson Limited of United Kingdom for the detailed engineering design. FHC Consulting Engineer is the lead firm of the joint venture.

Under the Pakistan Environmental Protection Act 1997 (PEPA-97), clause 12, it is required that the proponent of any development project will have to submit an IEE or EIA report to the concerned Environmental Protection Agency / Department to obtain approval prior to the start of construction or operation of the project. According to the PEPA (Review of IEE and EIA) Regulations 2000, the hydropower generation plants fall under category A of Schedule II, which require EIA for environmental approval prior to any construction. Further as per the PEPA regulations, if the hydropower generation is less than 50 MW, then IEE is required; otherwise, EIA should be submitted to the concerned authority.

The objective of the Environmental Impact Assessment (EIA) study is primarily to document the existing baseline environmental conditions of the project area, establish the potential impacts of the project construction and operation on the physical, ecological and human environment, and propose appropriate mitigation measures for the adverse impacts.

Phandar Hydropower Project was identified in the Ghizar valley in 1995 near Phandar Lake under the Comprehensive Planning of Hydropower Resources on tributaries of Indus River by Hydroelectric Planning Organization (HPO), (WAPDA) in collaboration with GTZ of Germany, to meet the growing regional power demand of Gilgit – Baltistan and ultimately of Pakistan.

The project key data is as follow;

Hydrology (Design flows)		
Design discharge	40.0	m^3/s
Mean annual flow	31.7	m^3/s
Catchment area of Ghizar River at weir	1442	km^2
Design flood (100 Year Return Period)	397	m^3/s
Reservoir		
Reservoir area	350,188	m^2
Max. reservoir operating level	2901.50	m asl
Min. reservoir operating level	2900.50	m asl
Reservoir capacity at 2901.50 m asl	0.660	MCM
Reservoir capacity at 2900.5 m asl	0.424	MCM
Live Storage	0.236	MCM
Weir Structure		
Weir height above riverbed	1.50	m
Weir crest level	2901.50	m asl
Length of overflow main weir	140	m
Length of left bank slab	234	m
Length of stilling Basin	9.0	m
Under sluices		
Number of outlets	4	Nos.
Gate type	Vertical lift gate	
Gate size (WxH)	2.0 x 2.0	m x m
Discharge capacity	32	m^3/s
Power Waterways		
Power Intake		
Type	Lateral intakes	
Number of gates	2	
Gate size (W x H)	3.5 x 4.5	m x m
Deck elevation	2905.0	m asl
Intake sill level	2892.5	m asl
Low Pressure Tunnel (Concrete Lined)		
Diameter	5.0	m
Length	300	m
Low Pressure Conduit (Fiber Glass)		
Diameter	4.0 to 3.70	m
Length	663.0	m
Penstocks (Steel pipes)		
No. of penstocks	2	
Diameter	2.3 to 2.1	m
Length of each penstocks	408	m
Anchor blocks	9	
Power Generation		
Gross head (HWL-Turbine centre line)	238.7	m

Max. net head	237.2	m
Min. net head	232.3	m
Rated. net head	235.7	m
Plant design discharge	40	m^3/s
Installed plant capacity	80	MW
Turbine type	Pelton (Vertical Axis)	
No. of Units	4	
Turbine centerline level	2662.8	m asl
Number of generators	4	
Average annual energy	374.9	GWh
Powerhouse type	Surface	
Size of powerhouse (L x W x H)	80 x 18.3 x 31.9	m x m x m
Substation	Indoor GIS	
Transmission line	132	kV
Tailrace Channel		
Size of channel (W x H)	20 x 5.5	m x m
Length of tailrace channel	52.0	m

The methodology adopted for conducting EIA study includes orientation session, development of the data acquisition plan, review of the existing data and previous studies, sources and tools of data collection, primary data collection surveys (reconnaissance survey, socioeconomic survey, land use, trees' survey, land price survey and ecological investigation survey), sources of secondary information (departmental surveys) and data analysis.

The study area of the Phandar Hydropower Project for the purpose of environmental assessment includes Phandar Lake and adjacent land, area to be used for construction camps, quarries areas, spoil disposal areas, and the area under the impact of weir, connecting channel, tunnel, low pressure conduit, penstocks, powerhouse, GIS building and other ancillary buildings. The project area is predominantly a cultivated area. The geology of the project area mainly consists of morainic material on the surface with bed rock of Greenstone / schist. It is fine texture / metamorphic rock of light greenish-grey color, medium hard, generally breaks along schistocity plane, highly fractured and jointed. Most of the project area covered with slope deposits, terraces, flood plain and morainic deposits.

According to seismic zoning map of Pakistan included in Pakistan Building Code seismic provision (2007), project area falls in Zone 3. The annual rainfall in the project area varies between 5.3 mm to 675.6 mm for the period of 1955 - 2010. In the project area, the maximum temperature rises to above 40ºC during June to August and minimum temperature remains below freezing point during October to March (-2.8^{0}C to -13.0^{0}C) according to temperature records for the period of 1955-2010.

In the project area, surface water bodies including Ghizar River and Chashi Gol Nullah are the main source of water for people living in the area for their own consumption, livestock use and irrigation purposes. The quality of drinking water is safe for drinking purposes. The noise levels vary at different locations at different timings but within the permissible limits.

Terrestrial fauna of the area comprised of domestic animals including dogs, sheep, goats, cows, donkeys and yaks. The wild life in Ghizar and its surrounding is famous for its faunal diversity (mammals, residents and migratory). Snow leopard, Brown bear and Himalayan ibex are reported as endangered or rare species.

In Ghizar District, some of the restricted range species like snow partridge and Himalayan monal pheasant are extremely rare. Water fowls in the project area are also reported by locals and WWF- Pakistan. Bird species available in the project area includes Peregrine falcon, Alpine chough, Jungle crow, House sparrow, Chukar partridge, Golden eagle, Hoopoe, Himalayan snow cock, Northern eagle, Brown dipper, Hill pigeon, Kestrel, Laughing thrush, Wood pecker, Black billed magpie, Whistling thrush, Wall crapper, Sparrow hawk, Bearded vulture, Snow partridge, Alpine swift, Common swift, Northern pintail, Marbled teal, Common teal.

The Ghizar River including 45 streams and 5 lakes from Shandure to Gakuch provides as ideal habitat for fish species. The fish species found in that area including Phandar Lake are Brown trout (*salmo trutta fario), schizothorax, plagiostomus, S.labiatus and S.esocinus.*

The flora of the Phandar valley comprised of three categories: weeds, desert type native plants and high alpine plants, which are mostly found near cultivated fields, cliffs and along the streams respectively.

There are two villages in the project area namely Phandar and Chhashi. The population of the area resides in the villages, of varying population sizes (800-1200) especially scattered residences in Phandar. In the project area, average household size comes out to be 8 - 9 persons per household. According to the sample based socio-economic survey, about 66 percent of the households live in nuclear family structures. The percentage of the younger population is found to be higher than those above 45 years and male-to-female ratio in the area is 54: 46. The education level is not good in the project area, about 34 percent of the household members have matric or above level of education, followed by middle and primary level education (about 21 percent). Leaving the categories of housework and education, which mainly pertain to house wives and children, the principle earning occupations include agriculture and government jobs, especially Pak Army. The income levels in the area are low when comparing with market prices of commodities available in local market, in which all the prices are almost double to the actual market price due to extra transportation charges.

All the houses are built using stones and planks for walls and roofing respectively. Majority of the residents lived in their respective areas since their birth or did not remember the exact period when their forefathers moved to the area. The main mode of transport among the local villagers is their own bicycle and motorcycles. About 90 percent walk on foot to nearby villages. Surface water is used for all domestic purposes and no proper sanitation system available in the area.

The major environmental impacts of the project will be due to the construction and operational activities. The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction. Such impacts are related to soils (erosion and slope stability), water quality, air quality, noise, disruption to the biological environment, public health, interruption of communications, at-risk population / safety, community stability, and cultural and religious values / properties.

The operational phase impacts are on flora, aquatic fauna, land, economic conditions and settlements. During the operational phase terrestrial fauna of area will be affected along with fish available in lake and river. Noise levels of the area will also be increased due to intake structure, powerhouse, and movement of vehicles. There will be loss of land and few houses for this project.

Socio-economic impacts of the project include political and power structure, settlement pattern, family structure, occupation, employment, workforce and public health.

The mitigation measures for the construction phase issues include disposal of domestic wastewater, domestic solid waste management, dust suppression, noise and vibration control, flora and aquatic fauna conservation. To mitigate impacts during the operational phase, the management should implement flora and aquatic fauna plantation and provide the structures (fish pass, ladder, nets) respectively. For the socio-economic impact mitigation management should ensure, the public consultation and participation, political hierarchy, transparency, documentation, village meeting, consultation workshops, compensation packages and area development plan, in the project execution.

In order for monitoring and evaluating mitigation measures implementation, the WAPDA Environmental Cell (WEC) shall establish a well-structured Environmental & Social Management Unit (E & SMU) within the project overall organisational arrangement. The expense of the E & SMU office including laboratory, staff, vehicles etc. will be borne by the project. The team of the E & SMU should be comprised of senior environmental expert, senior sociologist, junior environmentalist, junior sociologist and administrative & supporting staff. The E & SMU shall be responsible for ensuring implementation of the mitigation measures and compliance of the PEPA regulations for the construction phase impacts by the Contractor.

The E & SMU shall also be responsible for monitoring the reservoir and river sedimentation, ecology, water levels, wild life, public safety, fishing activities and liaison with agencies.

No single issue is more critical to the social acceptability of the project than the issue of valuation and compensation of the lands and properties, to be acquired for the project. This aspect becomes important because of the general public perception, that the government authorities generally do not adequately and earnestly address the compensation and resettlement issues in the planning and construction of major national projects. Another set of issues, greatly underrated and sometimes altogether disregarded, are the social, cultural and economic trauma and endeavors, through which the displaced people, especially poor, have to undergo, on account of the places and relations, left behind and in regard to the adjustment to the new places of their abiding.

The aforesaid considerations and complexities, which are sufficiently serious, render the land aquisition an integral and very important component of the project, rather than merely a mitigation measure to the impact of displacement.

To ensure that social issues of the affectees of the project are effectively handled, WAPDA must form a Grievance Resolution Committee (GRC) for the project. The GRC shall be headed by EMC and must include all relevant stakeholder departments, contractor, NGOs, local government and the community. The GRC will be responsible for providing a mechanism to the aggrieved persons on issues arising as a result of project activities and to ensure that the mechanism provides a solution of the grievances and to facilitate the recording and processing of the grievances.

The primary law for acquisition of land for public purposes in Pakistan is the “Land Acquisition Act, 1894” (hereinafter referred as the Act). The land acquired under the Act vests in the Province and it is only thereafter that the Province may transfer it to someone else. In addition to the provisions of the Act, regulations setting out the procedure for land acquisition have been provided in the “Punjab Land Acquisition Rules, 1983”, which are applicable in Punjab. There is another body of general regulations called the Standing Order No 28, which is being followed by the K.P.K as well as the Punjab. For the acquisition of land for the Project, the above-mentioned Act, rules and regulations shall be followed. The valuation of the land for compensation is governed by Section 23 and 24 of the Act.

- Under Section 23, the matters to be considered in determining compensation are as follows:

  - Market value of the land at the time of notification of Section 6
  - Damage sustained by the person interested by taking of any standing crops or trees

- Damage sustained by the person at the time of the Collector's taking possession of the land
- Damage sustained by the person at the time of acquisition of land injuriously affecting his other property, movable or immovable
- If compelled to change his residence or place of business, the reasonable expense incurred for such change
- Damage resulting from diminution of profits of land from declaration to actual taking possession by the Collector
- An additional sum of fifteen percent (15%) of the market value of the land is to be paid in consideration of the compulsory nature of the acquisition.

➢ Para 61 of the Standing Order 28 provides guidelines for determination of the market value, including consulting "respectable people who are disinterested".

➢ Section 24 of the Act lays down matters to be neglected in awarding compensation, which include the degree of urgency which led to the acquisition, any disinclination of the person interested in the land to part with it and any expected increase in value to the land from its future use.

Estimates of land acquisition costs for the project includes costs of compensation for the private as well as public lands, physical properties and infrastructure to be acquired and / or relocated for the project, which are estimated on the basis of the principles of valuation prevailing market prices. It is estimated that a total of 500.32 kanals of land will need to be acquired for the project and 617 trees need to be cut for the proposed project. Summary of the estimates of the aforementioned costs for the proposed Phandar Hydropower Project is as follow:

Item	Estimated Costs (Million Rupees)
Compensation for Land	240
Compensation for Trees	17
Environmental Mitigation Cost	283
Total	**540**

1 INTRODUCTION

1.1 BACKGROUND

Northern areas of Pakistan, including Gilgit Baltistan, are blessed with small streams, rivers and waterfalls with strong and violent flow having tremendous potential for the development of hydel power. The area is mainly hilly and mountainous with valleys and also stretches of plains.

According to Northern Area Strategy for Sustainable Development, less than 50% population of northern areas has access to the electricity. The demand for electricity is growing rapidly whereas the present supply is insufficient to meet even the existing needs of the area. In the absence of electric supply, population of Northern Areas uses various alternate energy resources to meet their needs.

Owing to the scarcity of indigenous fuel resources in Pakistan and a steep rise in fuel cost in the world market, the national strategy is to exploit hydropower potential to a maximum extent, taking into account all possibilities for short term peaking. The total installed capacity of the hydropower stations in the country is about 6595MW, out of which 94MW is in Northern Areas. However, an abundant hydel potential remains untapped which needs to be harnessed.

The power system in Northern areas is independent of national grid. It is not practically/economically feasible to construct long transmission lines for the isolated/scattered communities in the northern hilly parts of the country. The project area in the very near future is not likely to be connected to the national grid due to its remote location from the national grid. It is therefore essential to build hydropower schemes in these areas in order to resolve the power problems of an isolated system.

1.2 THE PROPOSED PROJECT

Phandar Hydropower Project is identified and planned by HEPO, WAPDA in collaboration with the German Agency for Technical Assistance (GTZ) from Germany. The project was identified under “Comprehensive Planning of Hydropower Resources on Tributaries of Indus River in Northern Area”. The project has been planned as peak power plant for optimum capacity 80MW consisting of four units utilizing gross head of 237 meters on Ghizar River with mean annual energy generation of 348 GWh.

Keeping in view of the present and future power demand for local areas, Government of Pakistan has prioritised the development of the water resource projects in the country. In this connection, the Water and Power Development Authority (WAPDA), Pakistan has signed a consultancy contract in October, 2010 with a joint venture of M/s FHC Consulting Engineers, Lahore, M/s Techno Consult International, Karachi and M/s Electra Consultants, Peshawar in association with M/s Scott Wilson Limited of United Kingdom for the detailed engineering design. FHC Consulting Engineer is the lead firm of the joint venture.

This report "Environmental Impact Assessment (EIA) and Land acquisition Plan (LAP)" is an integral part of the study.

1.3 PROJECT CATEGORIZATION

According to Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, Hydroelectric Projects with power generation capacity of over 50MW and power transmission lines with capacity more than 11Kv fall in Schedule-II and require EIA. Likewise, as per World Bank Guidelines, Phandar Hydropower Project with generating capacity of 80MW and 132kV transmission lines would fall within the category "A" Projects which require full scale EIA.

1.4 SCOPE OF THE STUDY

The scope of the study proposed by WAPDA in TOR includes EIA/LAP/Environmental Management & Monitoring Plan for the proposed project. Resettlement Action Plan and Environmental Management and Monitoring Plan are the part of EIA Report. Major activities carried out for the preparation of EIA report are following:

- Review of available data, previous reports and drawings;
- Review of applicable laws, policies, rules and regulation;
- Collection of baseline data concerning physical, biological and socioeconomic conditions of the project area;
- Identification and assessment of the potential environmental impacts of the proposed project in qualitative and quantitative form and suggestion of appropriate measures to mitigate the impacts;
- Environmental management and monitoring plan;
- Public consultations;
- Land Acquisition and Compensation Plan

1.4.1 Land Acquisition Plan

The proposed project does not involve any physical resettlement (Physical displacement) which is the main cause of delay in mega projects. However, agricultural land will be acquired on temporary and permanent basis for the construction of project structures and other facilities including power house, buildings and offices, extended weir structure, contractor camps and area for landscaping. Judicial compensation based on market value will be paid to the land affectees. The scope of the Land Acquisition Plan (LAP) includes the following:

- Review of applicable policy, legislative and administrative framework;
- Collection of the land acquisition-related baseline data, through field surveys, including quantum of public and private lands and other assets and data on prevailing market values of lands;
- Establishing entitlements and compensation provisions for the Project Affected People (PAP);
- Proposals on the project area development;
- Institutional arrangements for the implementation of the LAP;
- Monitoring and evaluation mechanism for the LAP; and
- Estimation of land costs to be acquired and other assets

1.5 LIMITATIONS OF THE STUDY

This EIA document has been prepared in conformity with the objective and scope of the study. The study has been conducted by the qualified team in a manner consistent with the acclaimed skills and professionalism required from the consultants. The consultants have tried to cover all important aspects and relevant impacts of the proposed project; however, the study is subject to following limitations.

- The documented baseline information shows the existing physical, biological and socioeconomic conditions of the area. The proposed project is currently at feasibility stage and will undergo the planning, detailed designing and tender document preparation stages. The completion of all these stages up to the implementation of the project will take a certain period of time. Environmental conditions of the site could change considerably if significant delays occur. On the safer side, we have assumed that the documented baseline conditions will be valid up two year.

- Cadastral records for the study area were not available in the Revenue Department Ghizar, Gilgit-Baltistan as the department had not carried out the detailed survey of the project site up till then. In the absence of such records, consultant used the satellite images for the estimation of quantum of land to be acquired for the implementation of proposed project.

1.5.1 Study Team

WAPDA has availed the consultancy services of a joint venture of four consultancy firms for detailed engineering design of the proposed project. EIA study is the part of design report. The baseline data collection, public consultation, stake holder meetings, environmental management plan, was carried out by a team from M/s FHC Consulting Engineers led by Mr. Azher Uddin Khan (Head Environment), Mr. Rashid Maqbool (Senior Environment Engineer) and Miss Nosheen Gardezi (Senior Sociologist/Ecologist).

1.6 ORGANIZATION OF THE REPORT

Chapter-1 "Introduction" presents the objectives and scope of the EIA and LAP studies.

Chapter-2 "Policy, Statutory and Administrative Framework" provides a broad outline of the policy, statutory and administrative framework, in local as well as international perspective, applicable to the environmental impact and resettlement process.

Chapter-3 "Project Description" furnishes an overall description of the Phandar Hydropower Project, including its background and key components.

Chapter-4 "Project Alternatives" lays down the various alternatives studied for the propose PHPP.

Chapter-5 "Methodology" lays down methodologies adopted for collection of primary as well as secondary data and information, required for carrying out the EIA and LAP study.

Chapter-6 "Baseline Environmental Profile of the Project Area" comprises a detailed documentation of the existing (baseline) conditions of the project area, in respect of its physical, ecological and socio-economic environment.

Chapter-7 "Environmental Impacts Mitigation Measures" documents the likely impacts of the project on the physical, ecological and socio-economic environment along with appropriate mitigation measures both for all the phases of the project.

Chapter-8 "Public Consultation" describes the consultation sessions held with the stakeholders of the project.

Chapter-9 "Environmental Management Plan" provides the proposals on mechanism to be adopted for effective implementation of proposed environmental measures.

Chapter-10 "Land Acquisition: Compensation and Valuation" presents the principles of valuation and compensation for the private as well as public lands, and physical properties to be acquired for the Project.

Chapter-11 "Land Acquisition: Miscellaneous Measures" includes categories of land to be acquired for the project implementation and disclosure of information to the public.

Chapter-12 "Estimates of Land Acquisition and Environmental Management Cost" presents estimates of environmental, land acquisition and compensation costs for the project.

2 POLICY, STATUTORY AND ADMINISTRATIVE FRAMEWORK

2.1 GENERAL

This chapter presents the environmental policy, legislative and administrative framework for the protection of environment, adopted and enforced in Pakistan. The requirements of these policies, legislations and guidelines have been duly considered in the preparation of the plan to mitigate environmental impacts of the proposed Phandar Hydro Power Project. It also provides the overview of applicable World Bank policies.

Governmental and non-governmental institutional set-ups for environmental protection and conservation in Pakistan have been described in order to facilitate the proponent of the Project to understand these organizations and their potential role in the Project. This section also describes the current legal responsibilities of the proponent of the Project in the context of environmental protection.

2.2 NATIONAL LAWS

Government of Pakistan has enacted a number of laws to deal with the environmental and social aspects related to the implementation of development projects in the country. In 1983, Pakistan Environmental Protection ordinance was issued which was then repealed by Pakistan Environmental Protection Act in 1997. Under the Act, environmental assessment of the development projects is mandatory prior to start the construction phase. In order to facilitate the proponents and implementing agencies, Pakistan Environmental Assessment Procedures were formulated in 1997.

This EIA Study has been carried out in accordance with the World Bank guidelines and applicable national laws and guidelines and procedures and practices formulated by the Federal Environmental Protection Agency (EPA) as prescribed in the Pakistan Environmental Assessment (EA) Procedures.

2.2.1 Pakistan Environmental Protection Act (PEPA)-1997

Pakistan Environmental Protection Act, 1997 (PEPA 1997) was enacted by repealing PEPO 1983. The PEPA 1997 provides the framework for the implementation of National Conservation Strategy, protection and conservation of species, wildlife habitats and biodiversity, conservation of renewable resources, establishment of standards for the quality of the ambient air, water and land, establishment of Environmental Tribunals, appointment of Environmental Magistrates, Initial Environmental

Examinations (IEE), Environmental Impact Assessments (EIA), promotion of public education and awareness of environmental issues through mass media. The PEPA, 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, soil, marine, and noise pollution, as well as to the handling of hazardous wastes. Penalties have been prescribed for those contravening the provisions of the Act.

The following are the key features of the law that have a direct bearing on the proposed project:

Section-11 (Prohibition of Certain Discharges or Emissions)

Subject to the provisions of this Act and the rules and regulations made there under 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 National Environmental Quality Standards (NEQS)

Section-12 (Initial Environmental Examination and Environmental Impact Assessment)

Section 12 (1) requires that "No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an initial environmental examination [IEE] or, where the project is likely to cause an adverse environmental effect, an environmental impact assessment [EIA], and has obtained from the Federal Agency approval in respect thereof."

Section 12(2)(b) states that the Federal Agency shall review the Environmental Impact Assessment report and accord its approval subject to such conditions as it may deem fit to impose, or require that the environmental impact assessment be re-submitted after such modifications as may be stipulated, or reject the project as being contrary to environmental objectives.

Section-14 (Handling of Hazardous Substances)

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 Federal Agency 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.

Section-15 (Regulation of Motor Vehicles)

Subject to the provisions of this 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 National Environmental Quality Standards, or where applicable the standards established under clause (g) of sub-section (1) of section 6.

Section-17 (Penalties)

(1) 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 and where 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.

(2) Whoever contravenes or fails to comply with the provisions of section 14 or 15 or any rule or regulation or conditions of any licence, any order or direction issued by the Council or by the Federal Agency or Provincial Agency shall be punishable with fine which may extend to one hundred thousand rupees, and in case of continuing contravention, or failure with an additional fine which extend to one thousand rupees for every day during which such contravention continues.

Copy of Pakistan Environmental Protection Act is attached as **Annexure - A.**

2.2.2 Review of IEE and EIA Regulations (2000)

The publication of the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations 2000 provides necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA). PEPA (Review of IEE and EIA) Regulations (2000) is attached as **Annexure - B.**

These regulations categorize the development project for environmental assessment in two schedules on the basis of the degree and magnitude of environmental impacts. Schedule-II projects require comprehensive environmental Impact Assessment study as these projects are likely to cause the significant adverse environmental impacts whilst environmental impacts of Schedule-I are less adverse than those of Schedule-I project therefore Initial environmental Examination (IEE) is required for Schedule-1 Projects.

According to the Pakistan Environmental Protection Act 1997 and Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations, 2000, an Environmental Impact Assessment mandatory for Hydroelectric Power Generation having generation capacity more than 50MW and with the transmission lines of 11kV and above.

Phandar Hydropower project will generate 80MW and 132 kV transmission line. Thus, an environmental Impact assessment (EIA) for this project is obligatory.

2.2.3 National Environmental Quality Standards

The NEQS were promulgated in 1993 and revised in 2000 and 2010. These standards specify the allowable concentrations of pollutants in municipal and liquid effluents discharged to inland waters, sewage treatment and sea, allowable gaseous emissions from motor vehicles, ambient air quality, drinking water quality and noise standards. The copy of the NEQS is annexed as **Annexure - C**.

Effluent discharged standards, ambient air quality standards, noise standards and drinking water quality standards are relevant to the environment aspects of Phandar Hydropower project.

2.2.4 Other Applicable Laws

The applicable laws for the environmental study of the proposed hydropower project are briefly described below:

a) Land Acquisition Act, 1894 (including later amendments)

Land Acquisition Act (LAA) 1894 governs the acquisition of private properties for public purposes including large development projects. The Act is applicable throughout the country including NA. The Act comprises 55 Sections dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions. Part II of this Act deals with the land acquisition procedures. The salient sections of LAA, 1984 are given here;

Section 4: Publication of preliminary notification and power for conducting survey.

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 the land to be marked out, measured and planned.

Section 9: The LAC gives notice to all project affected people (PAP) that the Govt. intends to take possession of the land and if they have any claims for compensation that should to be made to him at an appointed time.

Section 10: Delegates power to the LAC to record statements of PAP in the land or any part thereof as co-proprietor, sub-proprietor, mortgagee, and tenant or otherwise.

Section 11: Enables the Collector to make enquiry into measurements, value and claim and issue the final “award". Included is the land's marked area and valuation of compensation.

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 PAP may request the LAC to refer the case onward to the court for decision. This does not affect the taking possession of the land.

Section 23: The award of compensation for the owners for acquired land is determined at its market value plus 15% in view of compulsory nature of the acquisition for public purposes.

Section 28: Relates with determining compensation values and interest premium for land acquisition.

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.

For Phandar Hydropower Project, the compensation for acquisition of land will be carried out in accordance with the provisions of Land Acquisition Act and requirements of World Bank operational Guidelines. In the project area, land ownership belongs to the community. People living in the area have unwritten possession of land. Cadastral records are also not available in the Revenue Department.

b) Explosive Act, 1884

This act prohibits the manufacturing, possessions, use, sale, transport and export of explosive without the permission licence. The project contractor is bound for getting the licence and using the explosive during blasting and other purposes.

c) Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting trees without the prior permission of local authority.

d) Factories Act, 1934

The clauses relevant to the proposed project are those, which concern the health, safety and welfare of workers, disposal of solid waste and effluent, and damage to private and public properties. The Act also provides regulations for handling and disposing of toxic and hazardous materials.

e) The Antiquities Act, 1975

By this Act Government of Pakistan has been given the power to prohibit excavation in any area that may contain articles of archeological significance. Under the Act, the project proponents are obligated to ensure that no activity is undertaken within 200 ft of a protected antiquity, and to report to the department of Archeology, Govt. of Pakistan, any archeological discovery made during the course of the project.

If any antiquities are found during the construction phase of the project, the relevant department will be immediately informed and activities will be stopped until the clearance from the department.

f) Pakistan Water and Power Development Authority Act, 1958

This act provides for the unified and coordinated development of the water and power resources of Pakistan. Under the provisions of this act, WAPDA can place the poles, apparatus and appliances for the transmission of electricity.

g) Northern Areas Wildlife Preservation Act 1975

This Act provides for the establishment of national parks, wildlife reserves and wildlife sanctuaries and the issuing of hunting licenses and certificates of lawful possession. It regulates hunting, prohibits the use of inhumane methods and imposes certain other limitations, such as time of day, season and area in which hunting is permitted. The First Schedule to the Act contains a list of animals divided according to the categories of "small game" and "big game".

All activities at the project site will have to be carried out keeping in view the provisions of this act.

2.2.5 Environmental Policies and Assessment Procedures

All the applicable policies and guidelines are discussed in this section

a) National Environmental Policy, 2005

The National Environment Policy (NEP) is drafted to protect, conserve and restore country's environment which will help in improving the quality of life of the citizens.

This policy provides an overarching framework for addressing the environmental issues particularly pollution of water bodies, air pollution, lack of proper waste management, deforestation and loss of biodiversity. It also gives the directions for addressing the cross sectoral issues as well as underlying causes of environmental degradation and meeting national obligations.

b) National Conservation Strategy, 1992

The Pakistan National Conservation Strategy (NCS) is one of the principal policy documents for environmental issues in the country that was developed and approved by the Government of Pakistan on March 1, 1992. Following policy and mitigation measures have been proposed for hydropower in the NCS:

Policies

- Develop Pakistan's medium to long term large hydropower potential to meet electricity needs; and
- Take early account and full care of the impacts of hydel generation

Measures

- Subject site and process selection for hydro to environmental objectives, and assess and mitigate the residual adverse impacts with the same rigour as engineering design

Environmental Assessment procedures, 1997

Federal EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines, which are applicable to the proposed project, are listed below:

Policy and Procedures for Filing, Review and Approval of Environmental Assessments: These guidelines define the policy context and the administrative procedures that govern the environmental assessment process, from the project feasibility stage to the approval of the environmental report.

Guidelines for the Preparation and Review of Environmental Reports: The guidelines on the preparation and review of environmental reports specify the following for the project proponents:

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

Guidelines for Public Consultation: These guidelines define the tools and techniques for effectual public consultation.

Guidelines for Sensitive and Critical Areas: These guidelines identify the notified protected areas of Pakistan including ecosystems and "archaeological and cultural sites". These guidelines help the proponent in identifying the critical and sensitive areas of Pakistan. The proponent for the proposed development in a protected area will be required to contact the authority (Secretary Forestry and Wildlife Departments)

As, there is no protected area within or near the proposed project site therefore, these guidelines will not be applied.

Sectoral Guidelines for Sewerage Schemes: These guidelines identify and explain the issues that should be addressed for sewerage system proposal.

For Phandar hydropower project, these guidelines will be considered during the designing of construction camps, Buildings and offices.

2.2.6 Administrative Framework

The administrative framework operating in Pakistan relevant to environmental issues of the Phandar Hydropower Project, right from execution to monitoring, is briefly presented below:

Water and Power Development Authority (WAPDA)

Water and Power Development Authority (WAPDA), being the executing agency of the project, shall be responsible for submitting EIA to the Responsible Authority for approval; for the implementation of proposed measures for mitigation of adverse environmental impacts of the project; and for carrying out the requisite environmental monitoring and evaluation activities.

Pakistan Environmental Protection Agency

Federal jurisdiction is applicable to the projects as under:

- On federal land
- Military projects
- Involving trans-country impacts
- Bearing trans-province impacts

For all other cases, the concerned provincial responsible authority shall have jurisdiction.

PEPA is headed by Director General and has administrative, technical and legal staff. PEPA is also allowed to establish advisory committees for various subjects and appoint as members thereof eminent representatives of the relevant sector, educational institutions, research institutes and non-government organization. PEPA can undertake inquiries or investigation into environmental issues either of its own accord or upon complaint from any person or organization and institute legal actions against persons found in violation of the PEPA-97.

Environmental Protection Department

Components of the project lie geographically in Gilgit – Baltistan province and therefore, GB-EPA have the jurisdiction over the respective components of the project. GB-EPA is headed by Director and supported by administrative, technical and legal staff. The major functions of GB-EPA is to issue, after reviewing, the approval of EIA for the projects; carry out environmental monitoring of the operations in the province; enforcement of environmental legislation; and to monitor the projects as per the recommendation of the EIA. GB-EPA can involve district and local administration for the enforcement of environmental legislation. GB-EPA is also responsible to monitor the implementation of the project as per the recommendations of the EIA.

Local Government Institutions

The proposed project lies in district Ghizar of Gilgit – Baltistan province. Under the existing local government system, one district government would be involved in one or other way in the project. Under the present government system, various departments, related to different project activities, like revenue, health, forestry, wildlife, fisheries and agriculture, are also the stack holders for the project.

International and National Non-Governmental Organizations

International environmental and conservation organizations, such as the International Union for the Conservation of Nature (IUCN) and the World Wide Fund for Nature (WWF) have been active in Pakistan. These organizations have worked closely with the Government and have played an advisory role with regard to the formulation of environmental and conservation policies. Since the Rio Summit, a number of national environmental non-governmental organizations (NGOs) have also been formed, and have been engaged in advocacy and, in some cases, research. The most prominent national environmental NGOs, such as the Sustainable Development Policy Institute (SDPI) and Shirkatgah, are members of the Pakistan National Committee of IUCN. The role of these organizations would be very important in the project perspective.

National NGO's such as Agha Khan Rural Support Program (AKRSP) and Pakistan Poverty Alleviation Fund (PPAF) are very active in Gilgit – Baltistan for the implementation of community development projects. These NGO's can also provide important input in the community mobilisation, advocacy for the project, implementation of area development plans, and land acquisition plans. These NGOs can also serve as an important institutional arm for the implementation of core values recommended by the World Commission on

Dams. Principle core values recommended by the Commission are: equity, efficiency, participatory decision-making, sustainability, and accountability.

2.3 WORLD BANK GUIDELINES

Almost all the international financing organizations have developed EIA guidelines and manuals. Following are the principle World Bank publications that contain environmental guidelines and are relevant to the project:

- The World Bank, Volume I: Policies, Procedures, and Cross-Sectoral Issues, Environmental Assessment Sourcebook, Washington D.C., 1991.
- The World Bank, Volume II: Sectoral Guidelines, Environmental Assessment Sourcebook, Washington D.C., 1991.
- The World Bank, Technical Paper 140, Environmental Assessment Sourcebook, Washington D.C., 1991.
- The World Bank, Operational Directive OD 4.00: Environmental Assessment, Environmental Assessment Sourcebook, Washington D.C., 1991.

The World Bank “Environmental Assessment Sourcebook" covers environmental issues relating to development in most sectors. It contains special sections on dams and reservoirs, and on irrigation and drainage. Apart from providing information on the Bank's policies and procedures, it gives general information on potential environmental impacts. The Sourcebook is particularly useful, if financial support is required from the World Bank. The World Bank Operational Directive (OD 4.00) on Environmental Assessment describes the Bank's policy and procedures in respect of EIA at regional, sectoral and project levels.

In addition to these documents, there are several other World Bank operational policies and directives that are relevant to the project.

2.3.1 Operational Policies of World Bank

Following WB operational policies have been reviewed for the proposed project activities.

- OP 4.01 (Environmental Assessment);
- OP 4.04 (Natural Habitats);
- OP 4.09 (Pest Management);
- OP 4.10 (Indigenous People)
- OP 4.11 (Physical Cultural Resources);

- OP 4.12 (Involuntary Resettlement)
- OP 4.36 (Forests);
- OP 4.37 (Safety of Dams);
- OP 7.50 (Projects on International Waterways); and
- OP 7.60 (Projects in Disputed Areas)

Table - 2.1: presents a summary of applicability status of World Bank (WB) operational policies to the proposed project.

Table - 2.1: Applicability status of WB Operational Policies

Policy	Applicability		Description
	Triggered	Not Triggered	
4.01 OP/BP (Environmental Assessment)	√		This operational policy (OP) requires the environmental assessment of World Bank financed projects to help ensure that they are environmentally sound and sustainable. The OP classifies the project in one of the four categories (A, B, C and FI) on the basis of the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. Annexure of this policy are following; **Annex A (**Definitions of terms that are frequently referred to in environmental assessment) **Annex B (**Contents of an EIA report for category "A" projects) **Annex C (**procedures and policies for the preparation of environmental management plan, including aspects like mitigation measures, monitoring requirements and institutional

			capacity development and training) *The proposed project falls under category "A". Therefore, Environmental assessment has been carried out for the proposed project.*
OP 4.04 (Natural Habitat)		√	The conservation of natural habitats is essential for long term sustainable development. World Bank supports the protection, maintenance and rehabilitation of natural habitats and their functions. *This policy will not trigger as all the activities of designing, construction and operational phases will not adversely impact the natural habitats. Moreover, there is no notified protected site in and near the project area.*
OP 4.09 (Pest Management)		√	Through this policy, WB supports a strategy that promotes use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. This policy encourages the use of Integrated Pest Management and safe use of agricultural pesticides. *There will be no use of pesticides, fertilizers or other chemicals inputs at any stage of the proposed project. Moreover, the proposed project will not increase the irrigation water supply or command area. Therefore, the project will not induce an increase in pesticide use.*

OP 4.10 (Indigenous People)		√	This policy requires that the development process should fully respect the dignity, human rights, economics and cultures of indigenous people. The policy states that Bank Financed projects should includes measures to (a) avoid potentially adverse effects on the Indigenous Peoples/ communities or (b) when avoidance is not feasible, minimize, mitigate, or compensate for such effects. *No indigenous people reside in the study area, as confirmed during the site survey. Thus, this operational policy is not triggered.*
OP 4.11 (Physical Cultural Resources)		√	This policy defines the WB requirement to mitigate the adverse impacts resulting from development activity on cultural resources including sites, structures, and remains of archaeological, historical, religious, cultural, or aesthetic value. *Thus operational policy will not trigger as there are no cultural resources in the vicinity of the study area; However, if any cultural property/notified area is discovered during implementation then relevant authority will be informed.*
OP 4.12 (Involuntary Resettlement)		√	This OP sets policies relating to involuntary resettlement of population displaced by the project. Priority of the Bank's policy is to avoid the resettlement of the population; however, if it is

			inevitable it should be kept to a minimal. The policy provides guidelines for conducting census surveys, preparing resettlement action plan and reporting procedures. *No involuntary resettlement will take place because of the proposed project components. Agricultural land will be acquired for the construction of project components and other facilities. Judicious compensation in accordance with the provisions of land acquisition act, 1894 will be paid to the land owners.*
OP 4.36 (Forests)		√	The objective of this Safeguard Policy is to assist the WB's borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests. *No forest area is likely to be affected due to the project activities therefore, this OP is not triggered.*
OP 4.37 (Safety of Dams)		√	The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB financed dam projects. *Dam structure is not involved in the project design. Gated weir will be*

			constructed to divert the Ghizar river flow into Phandar Lake.
OP 7.50 (Projects on International Waterways)		√	Projects on international waterways may affect the relationships between WB and its borrowers therefore; this policy requires that water rights issues should be assessed as early as possible during the project identification. Bank advises the state proposing the project on an international waterway (beneficiary state) that it should formally notify the other riparian of the proposed project by giving all available data. *The proposed project is not being constructed on any international waterway.*
OP 7.60 (Projects in Disputed Areas)		√	Projects in disputed areas may raise a number of problems affecting relations not only between the Bank and its member countries, but also between the countries in which the project is carried out or one or more neighboring countries. The Bank will finance the projects in disputed areas when there is no objection from other claimant to the disputed area or special circumstances of the project notwithstanding the objection. *Phandar Hydropower project is not located in or near any disputed area.*

International Treaties and Conventions

Pakistan is a signatory to a number of International Treaties and Conventions, which require conservation of environment, protection of wild life, environmental concerns of global scale and protection of workers against dangers arising from occupational exposure to harmful substances in the working environment. The implementation mechanism of these international treaties and conventions is week as institutional set up is not present. These conventions and treaties are reviewed to check their relevance to the proposed project. Owing to the low sensitive area with limited physical intervention of the project, no resettlement, no habitat of wildlife in the vicinity of the project area, no adverse impacts on natural vegetation and migratory birds who stay on Phandar Lake temporarily, no international treaty and convention is expected to be violated.

- Plant Protection Agreement for the South-East Asia and Pacific Region (as amended), Rome, 1956;
- International Plant Protection Convention, Rome, 1951;
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 and its amending Protocol, Paris, 1982;
- Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973;
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979;
- Convention on the Control of Trans-boundary Movements of Hazardous Waste and Their Disposal, Basel, 1989;
- Convention on Biological Diversity, Rio de Janeiro, 1992;
- United Nations Framework Convention on Climate Change, Rio de Janeiro, 1992, and
- Kyoto Protocol, 1997.

3 PROJECT DESCRIPTION

3.1 GENERAL

This chapter presents the location and need of hydropower project in the proposed area. Moreover, detailed description of each component of project scheme is also the part of this chapter.

3.2 NEED OF THE PROJECT IN THE AREA

The Northern areas of Pakistan are facing an acute shortage of energy, with a majority of the rural communities with no access to electricity. Presently, only half of the Northern Area's requirement for electricity is met through 79 mini and small Hydel power plants.

The region has rare alpine forest resources being consumed at unsustainable rates for domestic use, mainly cooking and heating. Also, there is a growing trend in rural households to consume diesel fuel for power generation.

Northern Areas offer tremendous potential to generate renewable energy. The perennial flow of water from snow melt in fast flowing streams, gives the area substantial potential to produce hydroelectricity through small, off-grid projects to serve the local area.

In the past, a number of small power stations were installed which are now insufficient to meet the growing demand of the big villages and towns. In order to resolve the power crises of isolated system, identification and ranking study for Hydropower schemes on the tributaries was carried out during 1992-97. The whole Northern Area was studied in 13 regions.

Phandar Hydropower Project is proposed on Ghizar River near Phandar Lake in Ghizar District, to meet the power demand of Gilgit – Baltistan.

3.3 LOCATION AND ACCESSIBILITY TO THE PROJECT SITE

The project area lies in Ghizar valley of Ghizar District which is located 165 km North West of Gilgit city on Gilgit-Chitral Road. The latitudes and longitudes of the project area are 36º 10' 06" and 72º 57' 30" respectively within the approximate elevations of 2590 – 2910 m asl.

The project area is accessible by newly constructed metalled road (Gilgit – Chitral) from Gilgit city. From down country to Gilgit, Karakoram Highway is the main road which which remains open throughout the year. The access to weir site from Gilgit-Chitral metalled road is near Phandar Lake. Location

Map of the project site is shown in **Figure - 3.1** whilst **Figure - 3.2** shows the satellite view of the proposed project location.

3.4 PROJECT LAYOUT AND SALIENT FEATURES

3.4.1 Project Layout

The proposed scheme will be located on the right bank of Ghizar River between Phandar Lake and Chhashi village. It is proposed that the flows of the Ghizar River will be diverted to Phandar Lake by constructing a low height weir. An intake structure will be built on the right end of the weir which will direct the Ghizar River flows to Phandar Lake through a connecting channel. The storage capacity of Phandar Lake is such that the project will operate as a peaking station to deliver approximately 40 MW during a 4 hours period every day during the winter season. In the summer season, the flows of the Ghizar River will support continuous 24 hour operation at a peak output power of 80 MW.

A power intake structure will be constructed on the south bank of Phandar Lake to deliver water from the lake to a tunnel and low pressure conduit. At the termination of the low pressure conduit a steel bifurcation will divide the water into twin steel penstocks which will run into a valve house, constructed to accommodate the maintenance and service valves.

The water will pass through the twin penstocks to the turbines in the powerhouse. After passing through the turbines and generating power, the water will then be discharged into the Chhashi Gol through tailrace channel.

3.4.2 Salient Features

Salient Features of the project are as detailed in **Table - 3.1.**

Table - 3.1: Salient Features of Phandar Hydropower Project

Hydrology (Design flows)	
Location	On Ghizar river (Gilgit Baltistan)
Type	Run of river
Design discharge	40.0 m^3/s
Mean annual flow	31.7 m^3/s
Catchment area of Ghizar River at weir	1442 km^2
Design flood (100 Year Return Period)	397 m^3/s

Reservoir	
Reservoir area	350,188 m^2
Max. reservoir operating level	2901.50 m asl
Min. reservoir operating level	2900.50 m asl
Reservoir capacity at 2901.50 m asl	0.660 MCM
Reservoir capacity at 2900.5 m asl	0.424 MCM
Live Storage	0.236 MCM
Weir Structure	
Weir height above riverbed	1.50 m
Weir crest level	2901.50 m asl
Length of overflow main weir	140 m
Length of left bank slab	234 m
Length of stilling Basin	9.0 m
Number of outlets	4 Nos.
Gate type	Vertical Lift Gate
Gate size (WxH)	2.0 x 2.0 m x m
Discharge capacity	32 m^3/s
Power Waterways	
Power Intake	
Type	Lateral intakes
Number of gates	2
Gate size (W x H)	3.5 x 4.5 m x m
Deck elevation	2905.0 m asl
Intake sill level	2892.5 m asl
Low Pressure Tunnel (Concrete Lined)	
Diameter	5.0 m
Length	300 m
Low Pressure Conduit (Fiber Glass)	
Diameter	4.0 to 3.70 m
Length	663.0 m
Penstocks (Steel pipes)	
No. of penstocks	2
Diameter	2.3 to 2.1 m

Length of each penstocks	408 m
Anchor blocks	9
Power Generation	
Gross head (HWL-Turbine centre line)	238.7 m
Max. net head	237.2 m
Min. net head	232.3 m
Rated net head	235.7 m
Plant design discharge	40 m^3/s
Installed plant capacity	80 MW
Turbine type	Pelton (Vertical Axis)
No. of Units	4
Turbine centerline level	2662.8 m asl
Number of generators	4
Average annual energy	374.9 GWh
Powerhouse type	Surface
Size of powerhouse (L x W x H)	80 x 18.3 x 31.9 m x m x m
Substation	Indoor GIS
Transmission line	132 kV
Tailrace Channel	
Size of channel (W x H)	20 x 5.5 m x m
Length of tailrace channel	52.0 m

3.5 PROJECT COMPONENTS

The project layout has been designed for optimum utilization of the power potential for electric power generation. The design discharge has been optimized as 40 m^3/s to produce 80MW using a gross head of 238.7m. The project components Include:

- Diversion weir
- Connecting channel
- Power intake and low pressure tunnel
- Low pressure conduit
- Penstocks
- Power House
- Transmission Lines
- Substation and Ancillary Buildings

3.5.1 Diversion Weir

Diversion weir is located on Ghizar River where intake for connecting channel is placed at right angle and nearest to Phandar Lake. The wide river section at weir axis reduces the surcharge over weir during flood period. 1.50 m high ungated weir has been designed to divert the design discharge of 40 m3/s. The normal reservoir level will be maintained at 2901.5 m asl with minimum operating level as 2900.5 m asl to have a live storage of 0.236 M.m3. The weir has been designed for a maximum discharge of 397 m^3/s that corresponds to a high flood with 100 years return period. The normal reservoir level is 2901.5 m asl and maximum flood level for 100 year return period is 2902.6 m asl.

Four under sluices 2 m x 2 m are proposed to flush the sediment in front of channel intake. Vertical lift gates are provided with stop logs on either side. The sill level for gate is 2898.70 m asl and deck level is 2904.0 m asl.

3.5.2 Connecting Channel

The channel intake is concrete structure with 26.5 m width. A small weir at the intake is designed to avoid sediment entry into connecting channel and Phandar Lake. The connecting channel will be 250 m long with bed slope of 1:2500. The trapezoidal channel is stone pitched with 12 m bed width. At normal reservoir level, water depth is 2.80 m. The bank level is fixed as 2904.0 m asl to accommodate flood. At intake, stop log at upstream of flushing gate have been provided to block water at both the ends during repair work of the gate.

3.5.3 Power Intake and Low Pressure Tunnel

The power intake at the southern end of Phandar Lake will be constructed with sill level at 2892.5 m asl. Intake has two bays, each equipped with gate 4.5 m wide and 3.5 m high. To avoid entry of fish into power conduit, a round steel mesh size 100 m x 4 m has been designed in front of power intake. After power intake, low pressure tunnel is to be constructed in the moraine. The concrete lined tunnel would be 300 m long with internal diameter of 5.0 m. Special geotechnical measures would be taken to excavate tunnel in the moraine.

3.5.4 Low Pressure Conduit

From tunnel, a low pressure conduit has been designed to convey the designed flows towards valve house and penstocks. Low pressure conduit would be fiber glass pipe with diameter 4.0 m at the start and 3.7 m near penstock. The length of pipe is 663 m to be laid at gentle slope of 4.5 %. The

pipe would be laid in a trench over concrete slab supported over filter material which would later be back filled with sand and natural alluvium to protect the pipe from freezing temperature during winter months.

3.5.5 Penstocks

Low pressure conduit will then be bifurcated into two steel penstocks in valve house. From the valve house to powerhouse, two steel penstock pipes have been designed supported over anchor blocks. At the upper and lower portion of penstock, rock outcrop is visible and in the middle portion alluvium upto 22 m has been assessed with seismic refraction survey. Nine (9) anchor blocks depending upon alternatives would be required to hold the penstock at each change of angle. For design discharge of 40.0 m3/s, two pipes of 2.30 m diameter with thickness varying from 10 to 15 mm have been proposed. The velocity in the pipe at design discharge will be 3.3 m/s.

3.5.6 Powerhouse

The powerhouse is located on the left bank of Chhashi Gol near Chhashi village. The building is a RCC frame structures of size 80 m x 18.3m x 31 m over RCC foundation. There will be provision of 4 Units of 20 MW each. The flood level of powerhouse will be 2660.9 m asl. Powerhouse structure will be founded on rock.

Some blasting will be required to create space for accommodating powerhouse up to foundation level of 2657 m asl. A bridge has to be constructed on Chhashi Gol to approach the powerhouse from valley road.

The outflow from powerhouse will be discharged into Chhashi River through a tailrace channel. The length of tailrace is 52.0 m. It has a rectangular section of 20.0 m wide and 5.5 m high. The whole length will be embedded in earth with excavated material. The channel will be sloppy and will drop into Chhashi Gol at elevation 2658 m asl.

Hydro Mechanical Equipment

The project is equipped with following auxiliary electrical and mechanical system / equipment for smooth operation and maintenance of powerhouse:

- cooling water system
- compressed air system
- water supply and drainage system
- oil handling and purification plant
- heating ventilation and air-conditioning system

- workshops
- cranes
- fire protection system

3.5.7 Transmission Line

To transmit 80 MW power generated from Phandar hydropower project to Gahkuch, a transmission network of about 165 km long transmission line of 132 kV would be constructed in Ghizar valley. The line routing will follow Ghizar River valley at newly constructed road level. Propose transmission line route along is attached as **Annexure D.**

3.5.8 Substation and Ancillary Buildings

GIS Substation:

An indoor GIS substation will be constructed adjacent to the main powerhouse building. All GIS switchgear will be housed inside the proposed building.

The standby diesel generator and associated fuel tanks will be placed in a separate building rather than in the power station where they will present a fire risk.

Permanent and Temporary Colonies and Infrastructure:

Following infrastructure will be required for the implementation of the proposed project:

- Residential colonies and labor camps;
- Aggregate crushing plants and concrete batching plants;
- Offices, Laboratories and Explosive storage;
- Access roads;
- Water supply, Water treatment, Sewerage system and power supply.

Location of all aforementioned infrastructures is shown in the maps attached as **Annexure - E.**

Residential Colony: Residential and non residential buildings are the essential requirements for the construction of PHPP in remote area of Gilgit. A small residential colony will be constructed for operation and maintenance (O&M) staff. Residential colony will be located near Gilgit - Chitral main road, about 2.4 km from powerhouse along the bank of Chhashi Gol and 1.5 km from power intake.

About 76 residences have been planned with other utility buildings like Control Office building and offices, dispensary, mosque, school, hostel, shopping centre, community centre and a 11 kV substation. Layout plan of residential colony is attached as **Annexure - F**.

Source of water supply to the permanent residential colony will be from tube wells to be bored near powerhouse on Chhashi Gol bank.

Alternative source of water supply will be from the cooling water tank in powerhouse from where water shall be pumped to Water Treatment Plant (WTP). The tailrace in the powerhouse shall be source of raw water.

Residential colony will be connected to sewerage treatment plant. Treated wastewater will be discharged into river.

Power Supply: Independent power supply up to 11 kV from existing 2MW Chhashi power station will be provided to the project area.

Access roads: The following permanent access roads will be constructed to the key project facilities.

- Access road to Powerhouse, Residential colony, offices, Contractor camps, etc.
- Access Road to weir and power intake
- Road along the low pressure conduit / penstock from intake to valve house.
- Two bridges and diversion of road along Chhashi nullah in the power house area.

Aggregate Crushing Plants: Three crushing plants with combined capacity of 200 to 300 tons/hour will be installed at three sites.

Concrete Batching Plants: Two concrete batching plant with mixing capacity of 30$m^{3/}$h will be installed. For maintaining the specified temperature of the fresh concrete and shotcrete mix, ice plant for cooling will be required during the summer season. Fine and coarse aggregate shall also be chilled in silos for maintaining the requisite temperature of 21 °C and ice shall be used instead of water depending on the environmental temperature for preparing cooled concrete. The cement storage silos and laboratories for testing of materials, concrete strength, etc. will also have to be established at site.

3.6 PROJECT IMPLEMENTATION

The proposed project implementation schedule spans over a period of 48 months. The source of financing may be arranged in parallel to tender process. It is expected that in addition to preparatory works, project construction can be completed in about 36 months.

The envisaged two phases of implementation of the project are given as under.

Phase - I: Pre Construction Activities

International Competitive Bidding Process:	12 months
Financial Close:	12 months

Phase - II: Construction Activities

36 months will be required for completion of all the components of the project works. A period of 04 months will be required for accomplishment of the requisite tests which has been included within 36 months.

4 PROJECT ALTERNATIVES

4.1 GENERAL

This chapter presents the project alternatives that have been studied for the proposed project.

4.2 NO PROJECT SCENARIO

Pakistan is facing a critical shortfall of electric energy since long, which has further aggravated during the last few years. It has been estimated that the annual power demand which was increasing at 4.8% for the last five years, is likely to increase by 8 to 10% by the end of this decade. Existing installed generation capacity of the country is about 19,762 MW (2007). Out of this WAPDA owns 9,884 MW, another 5,417 are owned by private, Independent Power Producers (IPPs), the Karachi Electric Supply Corporation (KESC) capacitates 1,756 MW while the rest is the installed capacity of nuclear and other co-generating industries. Thermal plants using oil, natural gas, and coal account for about 68% of this capacity, with hydroelectricity making up 29.4% and nuclear plants 2.6%. Hydroelectric generation, which is the second biggest contributor to the national power generation, is generally constrained somewhat due to priority of irrigation flow releases from our hydropower reservoirs and fluctuation of river inflows. Irrigation demands normally control the seasonal operation of reservoirs and the resulting quantum of energy production. The peak demand is 15,000 MW, but the production is only 9,000-10,000 MW, resulting in 10-12 hours load shedding. Currently WAPDA has been facing a shortfall of up to 6,000 MW (2012) during peak summer hours, which may further increase in the years to come if the current scenario prevails and no steps are taken to rectify the situation. To meet this growing demand, an increase in the installed capacity by 2'000 MW per year is required.

With this scenario, Pakistan is forced to exploit every source of power generation including hydro, oil, gas, coal, nuclear, wind, solar etc. Being aware of constraints in the public sector investment and to take up the task on a fast track, the Government of Pakistan framed a policy in 1994 to attract private investors for power generation from thermal resources. This policy was revised in 2002 to include hydropower in the private sector, which previously was under the exclusive jurisdiction of WAPDA.

As a result of the Power Policy of 1994, a number of thermal power projects have been installed in the country. These include Uch Power Plant (550 MW), Hubco Power Plant (1'300 MW), and Liberty Power Plant (235 MW) besides privatisation of WAPDA's Kot Addu Power Plant (1'500 MW).

Besides, during this period three power generation projects, namely Ghazi-Barotha Hydropower Project (1'450 MW), Chashma Hydropower Project (184 MW), Malakand Hydropower Station (81 MW) and Chashma Nuclear Power Plant (325 MW) were implemented in the public sector. Despite this enhancement in the power generation capacity, there is still a wide gap between power generation and demand of power supply.

To cater for this gap of power supply and also to meet the future power demand, Pakistan is in need of exploitation of all resources of power generation. Therefore, the option of "No Action" cannot be adopted. This option will not only affect the domestic sector but also hamper the development of industrial, commercial and agriculture sectors of Pakistan.

4.3 ALTERNATIVE SOURCES OF POWER GENERATION

The present available generation capacity is sufficient to meet the peak demand, provided the fuel is provided to the operating units, which isn't as simple as it looks. At present, over 50 percent of the current generation is dependent on furnace oil, the price of furnace oil has jumped from Rs. 2,000 per ton in the nineties to its current price of about Rs. 70,000 per ton. The cost of producing electricity from furnace oil is about Rs. 16 per kWh, however this is only the fuel price. The total cost for consumers for such electricity is about Rs. 22-25/kWh, which includes fixed cost and transmission/distribution losses.

The supply of furnace oil to generation companies is the responsibility of the government, however, considering the economic condition of the country, it is not viable for the government to purchase and provide oil to the generation companies at such high price. The generation companies are therefore, either shut or producing much below their capacity. The generation companies are thus unable to pay to the oil companies and as a result, a circular debt of Rs. 400 billion is created, at present. Unless this debt is cleared, there will be no immediate improvement in electricity supply. Therefore, the need of the hour is the search for an alternative fuel to furnace oil. The available resources of power generation in Pakistan are hydro, thermal (coal and natural gas), nuclear, wind in the coastal regions and solar.

The alternative fuel is coal that could have initially been imported and subsequently obtained by developing the huge deposit of Thar coal. The shift from furnace oil to coal has its demerits, too. Importing coal and modifying the existing power plants to use different boilers or establishing new power plants would take at-least three years. Then again only those power plants can be converted to coal can be converted to coal which are near the coast. Transportation of large quantities of coal would be a huge task. While there

is no denying the fact that country has huge potential to generate electric power, the circular debt of Rs. 400 billion is shying the investors away from Thar coal. The environmental issues related with the power generation from coal are also well known; hence the option of power generation via coal is not a favourable option.

The other alternative fuel again could be natural gas but that is not a long term fix. The reserves of natural gas in the country are not sufficient to replace furnace oil for a substantial amount of time. Natural gas resources of Pakistan are currently facing a shortfall. Therefore, its utilization for electric power generation will affect domestic and industrial use unless it is imported at high cost. The poor economy does not allow the import of fossil fuels, on a large scale.

As far as atomic/nuclear energy is concerned, Pakistan has currently total nuclear power generation capacity of 425 MW. Pakistan has established its first nuclear power reactor (125 MW) - KANUPP near Karachi in 1971 with help of Canada. The second nuclear plant (Chashma-1) was established in Punjab with help of China in 2000 with net generating capacity of 300 MW. Construction of another similar unit (Chashma-2) is currently under construction with help of China, which will add approximately 300 MW nuclear energy in national energy grid line upon its completion. Besides, Pakistan is going into negotiations with different countries including China for getting nuclear power plants, however, the process is very slow against the rapid growth in energy demands.

A large fraction of the population lives in remote areas and is still waiting to be connected to the national electricity grid. To help these remote communities in particular, and to overcome energy shortages in general, Pakistan needs to develop its indigenous energy resources like hydropower, solar and wind. The more than 1,000 km long coastline in the south and some places in the northern mountainous areas provide an excellent resource of wind energy. This alternative energy potential can be exploited to produce electricity on both community and wind farm scales but high cost and lack of investment are the detracting factors.

Recently, the very first wind energy project has been launched in Thatta District of Sindh with a generation capacity of about 50 MW to act as a pilot project. Still there is a long way to exploit the full wind resources of the coastal areas of Pakistan.

As far as the use of solar energy for electric power is concerned, Pakistan's share in this sector is almost negligible. This is because solar photovoltaic systems are prohibitively expensive in terms of installation costs. Also power

is available intermittently; only when energy from the sun is available, unless large scale storage batteries are also installed. This further escalates the installation cost.

Hydro resources of the country thus assume prime importance in the current scenario. This is not only due to the fact that hydropower is the cheapest power generation source but also because the country is endowed with ample hydro resources for power generation of up to 40,000 MW, out of which only about 7,000 MW is being exploited so far. In the overall energy mix of the country, the share of hydropower is less than 30% while the remaining about 70% is thermal from oil, gas, coal and nuclear in the descending order. Two decades back, the power generation capacity was almost in the reverse order, hydropower contributing up to 70% and thermal about 30%. As a result of this switch from hydro to thermal energy, the power generation cost has increased tremendously.

In the light of this, the only option left with Pakistan is the exploitation of vastly available renewable and cheap resource of hydro-energy. WAPDA has prepared a plan for exploitation of this energy source under “Vision 2025”. As a follow up, a number of projects have been undertaken both in public and private sectors. Some of these are at the implementation stage while others are in different stages of planning. The former category includes Khan Khwar (72 MW), Allai Khwar (121 MW), Duber Khwar (130 MW), Jinnah (96 MW) and Neelum-Jehlum (969 MW). The later projects include Basha-Diameer (4’500 MW), Dassu (3400 MW), Bunji (5’200 MW), Golen Gol (106 MW), Palas Valley/Spat Gah Cascade Complex (about 2’300 MW) and many more small hydel projects in the Northern areas of Pakistan, Azad-Jammu and Kashmir and NWFP.

4.4 ALTERNATIVE PROJECT LAYOUTS

4.4.1 Diversion Weir Structure

Alternative - 1

The feasibility study proposed a gated weir structure on the Ghizar River, about 700 m downstream of Phandar Lake. The proposed structure comprises four, 10 m wide radial gated bays with additional sediment sluice channel on the right abutment.

The function of the weir is to raise the water level in the Ghizar River such that flow can be transferred to Phandar Lake through a connecting channel between the operating levels of 2900.0 m asl to 2901.0 m asl. The depth of impounded water at the weir in Ghizar River is approximately 1.5 m. The structure is designed for a flood discharge of 375m^3/s.

It is noted from the feasibility study that at the proposed weir location, the left abutment comprises a major scree slope and the right abutment is a near vertical ridge of hard green schist. The orientation of the proposed weir structure in the feasibility study directs flood discharges at the left bank scree slope downstream.

The river would be guided towards weir through guide banks. The concrete portion of weir is about 66m and the remaining part of weir with abutments has been proposed as earth fill with compacted rocks. The stilling basin would accommodate the hydraulic jump and let the water to flow downstream through narrow portion with steep gradient. The water would flow through weir during the summer months when flow in river exceeds 40m^3/s or when powerhouse is working at capacity less than installed one.

Alternative - 2

The alternative layout will comprise an un-gated weir extending across the river further upstream, at the location of the connecting channel. At this location the river bed is wide and flat. The crest length of the weir will be approximately 200 m long with a crest level at 2901.5 m asl. The weir will extend along the sand bank on the left abutment to provide an erosion cut-off.

The back water effect on the agricultural land upstream under flood conditions has been considered and it is noted from the river rating curve that during flood, the water level in Ghizar River will not be significantly changed. The weir will become completely submerged during the flood and it will not raise the water levels. Water levels in the river upstream of the weir will only be raised during the low flow period. The resulting weir structure is low in height and will not create any particular foundation bearing pressure or energy dissipation difficulties.

The velocity of flow at the toe of the weir will be low enough to produce only a very weak hydraulic jump or undulation on the downstream side of the weir. It has not been considered necessary to provide a stilling basin design to accommodate this hydraulic jump or undulation.

A concrete apron of approximately 9.0 m in length will be provided downstream of the weir to carry the impact of the flow passing over the weir. Flexible stone aprons will also be provided upstream of the weir and downstream of the concrete apron to protect the alluvial river bed from erosion and undermining the weir section. The length of the concrete apron, including the vertical cut-off, has been selected by considering the seepage path to control undermining of the weir structure.

Bed load would progressively accumulate in the area upstream and pass over the weir in times of flood. The weir crest and apron will be protected against concrete abrasion due to movement of sediments over the rollway by applying a protective layer of high strength concrete.

To prevent overtopping and suspended sediment ingress into the lake in the times of flood, a low rock bund will be constructed along the top of the sand bar between the Ghizar River and Phandar Lake.

Advantages and Disadvantages of the Proposed Alternatives

Flood flows in the region are understood to have a short duration of concentration and rise and fall rapidly. A gated weir structure, proposed in alternative 1, used for such area of short duration floods may be difficult to operate and any lapses in operation may cause sedimentation upstream, blocking the intake to the lake. A very high degree of reliability for the gate opening would be required and provision for 24 hour staffing and backup power supplies would be essential. Consideration may also have to be given to the designing the structure to survive the failure of the gate opening without extensive damage. A review of the proposed gate sizes suggested that the structure has been conservatively designed and is suitable for the discharge of the 100 year flood with one gate out of operation.

The weir concept, proposed in Alternative - 2 is aimed at creating an arrangement that requires less operator intervention and reduces the risk of sediment accumulation in Phandar Lake and the connecting channel.

Selected Alternative

In the selected alternative for diversion weir on Ghizar River, the intake for the connecting channel is placed at right angle to the weir and the site of the weir is selected so that it is nearest to the Phandar Lake. The wide river section at the weir axis reduces the surcharge over weir during flood period. The height of the designed weir is set at 1.50 m. The ungated weir has been designed to divert the design discharge of 40m^3/s. The normal reservoir level will be maintained at 2901.5 m asl with minimum operating level as 2900.5 m asl to have a live storage of 0.236M.m^3. The weir has been designed for a maximum discharge of 397m^3/s that corresponds to a high flood with 10 years return period. The normal reservoir level is 2901.5 m asl and maximum flood level for 100 year return period is 2902.6 m asl.

Four under sluices 2m × 2m are proposed to flush the sediment in front of channel intake. Vertical lift gates are proposed with stop logs on either side. The sill level for the gate is 2898.70 m asl and deck level is 2904.0 m asl.

4.4.2 Under Sluice Section

Alternative - 1

On the right side of the weir, an under sluice section is proposed to flush sediment down to river. The bottom of the flushing section varies between 2897 to 2895 m asl over a length of 15 m making a bed slope of 6%. 15 m long upstream reach of the flushing section has a rectangular shape having the clear width of 10 m. The proposed width of guide wall is 3 m. The proposed arrangement is intended to increase the efficiency of flushing section.

Alternative - 2

In the event of flood, heavy sediments will be transported by the river which could enter the intake of the connecting channel. Sluiceways will be provided for sediment flushing. Sluiceways will be constructed adjacent to the connecting channel intake on the right side of the weir. It is planned to provide four (04) sluiceways of size 2 m x 2 m. Access will be provided for the operation of the sluiceways by a bridge. Frequent operation of the sluiceways would keep the intake clear of sediments so that the intake could not be chocked due to the sediment accumulation which would cause the sediment ingress to the lake.

Selected Alternative

Four under sluices 2 m x 2 m are proposed to flush the sediment in front of channel intake. Vertical lift gates are provided with stop logs on either side. The sill level for gate is 2898.70 m asl and deck level is 2904.0 m asl.

4.4.3 Connecting Channel

Alternative - 1

A connecting channel is proposed in the feasibility study to transfer power generation flows from Ghizar River to Phandar Lake. The alignment of the proposed channel was such that it follows the left abutment of the sand bar that separates the lake from Ghizar River. A low weir is proposed at the entrance to the connecting channel to limit ingress of river bed load. The proposed design is to widen the already existing narrow channel which connects the Ghizar River with Phandar Lake to a bed width of 12 m. The channel will be excavated to a depth of 2898 m asl so that low flows during winter season can be diverted to the lake. The channel has a trapezoidal cross section with side slope 1:1 and energy slope of 1:2500. The proposed channel is a lined structure of stone masonry. The section is designed to convey the design discharge of 40m^3/s with 2.80m depth. The full supply level in the channel will be 2901 m with water depth of 3.0 m. A small weir of

3.0m is proposed at the inlet of the connecting channel to avoid siltation into the connecting channel.

Alternative - 2

The alternate arrangement for the inlet to the connecting channel comprises construction on the right bank of the river and river bed load ingress will be prevented by a deep set scour sluices passing at lower level from crest of connecting channel intake structure.

The intake to the connecting channel will be an integral part of the right abutment of the diversion weir so that bed load scouring would be undertaken to keep the intake clear. The connecting channel intake has been shaped as open profiled. The size of intake is kept larger than the channel in order to limit the intake velocity and head-loss. A central pier with stop-log slots will be constructed to facilitate the introduction of stop-logs. The pier will be designed to carry the load of the small bridge which will be provided over the intake for the access of operators and public use.

The stop-logs will be lowered down at the intake to close the channel for maintenance and inspection purposes. Trash rack screens will not be provided at the connecting channel intake.

The connecting channel will be constructed in the existing shallow erosion channel between the river and lake. The alignment of the connecting channel is selected for smooth flow and to keep the head loss as low as possible. This channel is designed to carry the power generation flow i.e. 40 m^3/s with the reservoir level at 2901.5 m asl from Ghizar River to Phandar Lake. The design of the channel has also been checked for winter flow conditions i.e. 11 m^3/s with the reservoir level at 2900.5 m asl. The channel will be lined with selected rock fill on a filter fabric. This type of lining construction will resist small movements and be more secure against pore pressures when the channel is de-watered.

The channel invert level has been selected to pass the design discharges of 40 m^3/s and 11 m^3/s with reservoir levels of 2901.5 m asl and 2900.5 m asl respectively. The bed slope of the channel will be 1:2000 with side slopes of 1:1. The section of the connecting channel has been selected such that the velocity in the channel will be around 1.0 m/sec i.e. a non silting velocity at full discharge capacity. The size of the rock-fill lining will be such that it remains stable at the maximum permissible velocity in the channel.

Advantages and Disadvantages of the Proposed Alternatives

Selected Alternative

In the selected alternative of the connecting channel, the channel intake is concrete structure with 26.5 m width. A low weir is proposed at the entrance to the connecting channel to limit ingress of river bed load. The connecting channel will be 250 m long with bed slope of 1:2500. The trapezoidal channel is stone pitched with 12 m bed width. At normal reservoir level, water depth is 2.80 m. The bank level is fixed as 2904.0 m asl to accommodate flood. At intake, stop log at upstream of flushing gate have been provided to block water at both the ends during repair work of the gate.

4.4.4 Phandar Lake

Alternative - 1

Phandar Lake is a natural feature formed by a barrier of glacial moraine across the Ghizar valley. The feasibility study suggests that the lake was formed when the river was blocked by a land slide. The river now flows to the north of the lake into a deep gorge and a wide sand bar separates the lake from Ghizar River. It is reported that the dividing sand bar has increased in size over past 10 to 15 years but the SOP topographic survey sheets dated 1986, show the lake and the river separated by approximately 200 m, effectively unchanged from the current situation. The material appears to be alluvial in origin. Normal river levels in summer months submerge the downstream sections of the sand bar. Phandar Lake is about 600 m long and 200 m wide. The depth of the lake varies between 5-8m. In the proposed alternative, Phandar Lake and some part of Ghizar River will be used as daily storage pond. The estimated natural storage at F.S.L of 2901 m asl is 150,000 m^3. The storage between 2900 to 2901 m asl will be used as live storage.

The seepage from the lake towards Chhashi village is high throughout the year. As the level in lake rises, the quantity of seepage also increases. This flow is used in the Chhashi village for drinking and irrigation purpose.

The natural side slopes of the reservoir are more than 30º. The embankments are consisting of morainic material. Around the reservoir, a drain with filter material will be constructed to collect water slopes. A fence of 2 m height all around the reservoir will be made for protection.

Alternative - 2

In the alternate arrangement the lake is required to serve two functions for the proposed power scheme:

Firstly the lake conveys the power generation discharge from the connecting channel to the power intake location.

Secondly the lake provides approximately 116,587 m^3 of storage in a 1.0 m operating range between El 2901.5 m asl and 2900.5 m asl. This storage is required to support a 4-hour period of peak generation during the winter months when river flows are low.

For both these reasons, it is important that further sediment deposition in the lake is minimized. The alternative weir arrangement has the potential to limit sediment ingress from the river into the lake by incorporation of the following features:

Overtopping of the sand bar under flood conditions will be prevented by the addition of a rock fill bund. This will prevent sediment laden flood waters connecting with the lake.

River bed load will be prevented from entering the connecting channel by the provision of a scour sluice at the connecting channel intake.

The ingress of suspended sediment into the lake via the connecting channel could be limited by operation of scour sluice gate. Seepage from the river through the moraine material results in springs in the valley downstream. These springs provide a useful source of water for the local community and their livestock. This is a natural condition which should remain. A minor adjustment to the lake water level will not significantly increase current seepage rates but the impact of diverting the river could be considerable.

Selected Alternative

The Alternate 2 in which the lake conveys the power generation discharge from the connecting channel to the power intake location is selected, the lake provides approximately 116,587 m^3 of storage in a 1.0 m operating range between El 2901.5 m asl and 2900.5 m asl in the proposed arrangement.

4.4.5 Intake for Power Channel

Alternative - 1

The proposed intake for the power channel/pressure pipe will be from southern end of Phandar Lake. The structure will be located at a location which has shortest possible tunnel section or deep cut channel for onward

power channel to forebay. The proposed design has the provision of minimizing the head losses at entrance and preventing the entry of bed load and other flushing debris in the intake. The other proposed components of the intake structure include trash rack and stop log gate. The velocity at the entrance of the intake will be 0.50 m/s at a design discharge of 40m^3/s towards headrace channel.

In the proposed design, the bars of the rack have a circular shape with a diameter of 0.4 cm and the distance between two bars is 1.0 cm. For maintenance and repair, the intake can be closed in front of the rack by stop logs.

Alternative - 2

In the alternate design, consideration has been given to re-locating the intake structure approximately 30 m to the north of the previously proposed location. Intake conditions are expected to be essentially unchanged but the revised location facilitates a tunnel route with less vertical cover.

The intake structure has been set sufficiently deep so that the full station discharge can be conveyed without adverse vortex formation. The existing lake bed will be excavated to an El. 2892.0 m asl and the invert level of the power intake will be set at El. 2892.5 m asl. The base of the structure is therefore below the existing lake bed level. The level of the power intake has also been checked against extreme freezing conditions at the site. During the winter the temperature will drop to approximately -10º C which will cause the formation of an ice layer. The maximum thickness of the ice layer will be approximately 0.14 m and will not affect the selected intake invert level.

The power intake has been designed to accelerate the flow uniformly by providing gradual contractions through the bell mouth from the trash rack to the control gate. The intake geometry has been designed in accordance with the guidance given in Design of Small Dams, USBR. The size of the intake has been designed so that the velocity through the trash rack will be approximately 1.0 m/s. A central pier will be provided to support an operating deck and to facilitate the operation of trash racks. A wheeled control gate will be provided with an upstream sealing and hydraulic hoist. The size of the control gate is 3.5 m x 4.5 m and stop-logs slots are provided immediately upstream of the control gate. The stop logs will be operated and maintained by mobile crane to provide access to the control gate or to the low pressure conduit downstream.

The operating deck at El. 2905.0 m asl will be used to remove and insert the trash rack screens by mobile crane, together with the operation and maintenance of the stop logs and to provide access to the shaft for operation of the control gate. Access to the power intake structure will be provided by road with direct access to the weir site.

To construct the tunnel portal and intake structure, it is envisaged that a rock spoil platform and coffer dam constructed in the lake at the location of the intake structure will provide the necessary working space. Water ingress into the working space can be controlled by dewatering. Upon completion of the structures and with the control gates installed, the working area could be re-flooded to match the lake level and the top of the rock spoil platform removed. The remaining lower section of the rock spoil platform would remain in place to protect the intake from ingress of bed load from the lake. The crest height will be reduced to El. 2898.0 m asl and a fish screen structure has been provided along the crest of the permanent coffer dam to prevent fish from reaching the power intake.

Selected Alternative

The power intake at the southern end of Phandar Lake will be constructed with sill level at 2892.5 m asl. Intake has two bays, each equipped with gate 4.5 m wide and 3.5 m high. To avoid entry of fish into power conduit, a round steel mesh size 100 m x 4 m has been designed in front of power intake. After power intake, low pressure tunnel is to be constructed in the moraine. The concrete lined tunnel would be 300 m long with internal diameter of 5.0 m. Special geotechnical measures would be taken to excavate tunnel in the moraine.

4.4.6 Tunnel, Power Channel & Forebay

Alternative - 1

The proposed design of the structure for carrying water the lake to power structure is either tunnel or deep cut channel. The bottom level at the start will be at 2897.0 m and its length will be 240. The proposed structure for tunnel has horseshoe shape having 6 m width and 5 m height. The capacity of tunnel is 40m^3/s and will act as free flow. The proposed tunnel will be concrete lined with bed slope of 1:1000.

Two alternates are proposed after the tunnel. Alternate-I consists of rectangular channel, which will lead to forebay, while alternate-II is composed of penstock pipe directly join with powerhouse.

The forebay for both alternatives is a major structure although the requirement for Alternative-II could be reduced given that it is located towards the upstream end of the power conduit system. A structure over 80 m long and 50 m wide is shown requiring an excavation some 30 m deep on the upslope side.

The spillway for Alternative-I would also be a substantial undertaking and is subject to the full generating head and discharge of the project. The feasibility study proposes that energy dissipation should be provided in the form of chute blocks. This is a prudent arrangement for small discharges and preferable to a high velocity chute with a terminal stilling basin. A central dividing wall is shown on the feasibility study drawing but the function of this provision is unclear. The spillway limits the space available on the terrace to accommodate the powerhouse.

Different penstock routes are proposed for the two alternatives. However in both cases the alignment runs slightly diagonal to the slope. This arrangement makes the penstock prone to impact by rock slides and may result is cross drainage requirements. It was noted that the slope above the powerhouse location is covered in places by scree material. This will require removal to provide a competent rock foundation along the selected route.

The proposed power channel is a rectangular channel that takes off from tunnel and travels at a slope of 1:1000 along the un-mattled road that leads to Chashi nullah. The channel has been designed for maximum capacity of 40m^3/s with 5.50 m width and 2.85 m water height. Free board of 0.5 m has been given all along the channel to avoid any over flow during operation. The walls are vertical having total height of 3.5 m including free board and wall thickness is 0.5 m. A 0.6 m cantilever has been proposed on either sides of the channel at bottom. The proposed thickness of base is 0.4 m. The bed slope of power channel is designed as 1:1000 over an entire length of 520 m length of power channel. The parameters of the design of the power channel have been adopted to maintain non-stilling and non-freezing velocity in the channel at design discharge as well as at minimum discharge.

Alternate - 2

In the alternate design arrangement, a fully pressurised system is adopted from the Phandar Lake power intake to the powerhouse. The arrangement will comprise a submerged tunnel, a single buried low pressure conduit and exposed twin penstocks down the powerhouse slope.

A preliminary analysis of the hydraulic transient behaviour for this layout has been undertaken. Pressure rise following load rejection can be limited to a nominal 10% of the gross head at the powerhouse by using the deflectors on the Pelton units, following a station trip or rapid shutdown.

Examination of the pressure drop following load acceptance has been undertaken with a 60 second interval between units with each unit loaded linearly over 15 seconds. The most critical location is at the transition between the low pressure conduit and the twin penstocks. A preliminary analysis indicates that this junction should be at an elevation not higher than 2,880 m asl.

A check on water column start time has also been carried out although this is unlikely to be a design limitation except when the station is required to operate in islanded mode.

Excavation of the tunnel through the moraine material is possible but will be a slow process. The tunnel is located approximately 30 m to the north of the feasibility study alignment, to avoid a minor spur in the moraine material on the downstream side. The tunnel will be circular in cross section with a fibre reinforced concrete lining and with a steel lattice arch and mesh reinforcement primary support. The final tunnel section will be 5.0 m in diameter. Access into the tunnel for inspection and maintenance will be provided via a small access shaft immediately downstream of the intake control gate.

Downstream of the tunnel section there will be a transition to a low pressure buried conduit. A single conduit will be considered in preference to the twin conduits proposed in the feasibility study to facilitate the single stage project development that has now been selected. This arrangement provides the lowest cost solution and the reduced width of the excavation and backfill will be easier to accommodate on sections of the alignment where there is a cross fall.

In this alternative, different forms of construction for the low pressure conduit have been examined including in-situ reinforced concrete, fibreglass reinforced polyester (FRP) pipe and steel conduits. From the analysis a fibreglass reinforced polyester conduit is the least expensive form of construction for the low pressure conduit.

The optimisation of the low pressure conduit has been carried out for a range of diameters of the FRP pipe. The selected diameter of the low pressure conduit will be 4.0 m for the upstream half and 3.7 m for the downstream

half. Two different diameters have been selected to permit conduit nesting to save transportation cost.

The low pressure conduit will follow a similar alignment as proposed for Alternative-II. The conduit has been aligned to result in the minimum possible cut and fill. The conduit will be placed in a cutting and backfilled with selected fine material. This arrangement will provide protection from mechanical damage and freezing in the winter months. It will also ensure that the conduit does not restrict access by the local community.

The FRP low pressure conduit of 3.7 m diameter will bifurcate into steel penstocks of 2.3 m diameter. A valve house will be constructed immediately after the bifurcation and will house four valves (maintenance and service valves) for the twin penstock branches. The invert level of the valve house is 2855.0 m asl and the clear height of the valve house will allow the valves to be removed for maintenance. The valve house will be constructed as a reinforced concrete structure in order to protect against rock slides from the surrounding slopes. Anti-vacuum/air relief valves will also be provided on the penstock branches to facilitate the emptying and filling and access manholes will be provided on each branch for inspection.

The penstock will reduce in diameter in three stages to ensure the penstocks are cost effective. The penstock diameter will reduce from 2.3 m to 2.2 m and then to 2.1 m and the change of diameter will be accommodated at the anchor block locations. Twin penstocks will follow the slope above the powerhouse and will bifurcate at the base of the slope behind the power station. The penstocks will bifurcate into 1.5 m diameter branches before entering the powerhouse. Twin penstocks with isolating control valves at the top of the slope will provide operational advantages and greater security of supply.

The penstock alignment has been revised to run at 900 to the slope contours to minimise the risk of impact from rock slides and to permit the powerhouse to be located at the upstream end of the terrace on the Chhashi Gol. This location will permit better flood protection of the power station, improve access arrangements and leave space for the substation.

At all changes of either vertical or horizontal alignment, reinforced concrete anchor blocks are required to carry the forces generated and these anchor blocks will need to be constructed on rock to provide the necessary stability.

Advantages and Disadvantage of the Alternatives

In the Alternative-2, a fully pressurized system, the large forebay and spillway structures will not be required, achieving a significant cost saving to the project. Operation and maintenance requirements will also be reduced.

Selected Alternative

From tunnel, a low pressure conduit has been designed to convey the designed flows towards valve house and penstocks. Low pressure conduit would be fiber glass pipe with diameter 4.0 m at the start and 3.7 m near penstock. The length of pipe is 663 m to be laid at gentle slope of 4.5 %. The pipe would be laid in a trench over concrete slab supported over filter material which would later be back filled with sand and natural alluvium to protect the pipe from freezing temperature during winter months.

Low pressure conduit will then be bifurcated into two steel penstocks in valve house. From the valve house to powerhouse, two steel penstock pipes have been designed supported over anchor blocks. At the upper and lower portion of penstock, rock outcrop is visible and in the middle portion alluvium upto 22 m has been assessed with seismic refraction survey. Nine (9) anchor blocks depending upon alternatives would be required to hold the penstock at each change of angle. For design discharge of 40.0m^3/s, two pipes of 2.30 m diameter with thickness varying from 10 to 15 mm have been proposed. The velocity in the pipe at design discharge will be 3.3 m/s.

4.4.7 Power House

Alternate - 1

The proposed arrangement for powerhouse comprise of a 4-units vertical axis Pelton station located on a convenient terrace on the left bank of the Chhashi Gol. The proposed arrangement comprises a heavy concrete sub-structure up to an elevation of 2668.8 m asl with a lighter reinforced concrete superstructure above. A main station crane traverses the entire length of the building and a loading bay area is proposed at the northern end. A large storage basement is proposed below the loading bay floor. A workshop area is also proposed adjacent to the loading bay with a control room and office accommodation above.

Three phase generator transformers are proposed for each unit on the downstream side of the station within the machine hall. The discharge from all 4 Pelton units is designed to be collected into a single transverse conduit with a single centrally placed outlet to the nullah.

The vertical configuration of the power station is based on placing the turbine runner at El. 2661.6 m asl, some 1.6 m above the 1,000 year flood level (2,660 m asl) in the Chhashi Gol. This is a generous arrangement and consideration might be given to adopting a lower flood return period at which generation is required to be shut down. The proposed level of the runner fixes the required levels for the turbine and generator, and the overall height of the building. The proposed roof of the powerhouse is flat.

Alternative - 2

In the alternate design arrangement, a number of revisions to the powerhouse layout have been considered. The preferred location of the powerhouse is at the upstream end of the terrace area on the left bank of the Chhashi Gol. This location leaves the maximum possible space for the other facilities that must be accommodated on the terrace and places the power station building behind a rocky spur which will provide some protection against extreme flood flows in the Chhashi Gol. The orientation of the powerhouse building has been adjusted such that the outflow from the machines is directed partially in a downstream direction. A common excavated tailrace channel has been adopted.

The generator and loading bay floor level is fixed at elevation 2,669.2 m asl. This arrangement will save structural concrete and rock excavation costs and place the generators above floor level. The chosen generator floor level will provide a more convenient access for inspection and maintenance of the generators. The final selected level of the generator and loading bay floor and the general external terrace level is above the extreme flood level in the Chhashi Gol. The extreme flood level for the 10,000 year flood is 2,661.0 m asl with the PMF at 2,665.0 m asl.

An additional potential benefit of the chosen configuration will be that an additional floor level can be accommodated above the control room. This additional floor would provide space for the additional office and staff facilities required in the power station building.

Separate outlet passages will be provided for each Pelton unit. The substructure will be extended on the downstream side of the power station to provide an external operating deck at El 2,669.0 m asl from which stop logs can be introduced to isolate each outlet passage from the nullah.

The foundation levels of the power station have been generally raised. Below the Pelton unit outlet passages, the foundation level has been raised by approximately 3 m and below the main inlet valves, the level can be raised by approximately 6 m.

The flat concrete roof proposed in the alternative has been replaced with a light-weight steel pitched roof comprising insulated steel profile sheeting supported on steel portal frames. This solution will result in a lower cost and permit a faster construction period.

Advantages and Disadvantages of Alternatives

The alternate arrangement proposed in Alternative 2 will save structural concrete and rock excavation costs and place the generators above floor level. The chosen generator floor level will provide a more convenient access for inspection and maintenance of the generators. An additional potential benefit of the chosen configuration will be that an additional floor level can be accommodated above the control room. This additional floor would provide space for the additional office and staff facilities required in the power station building. The flat concrete roof proposed in Alternative 2 will result in lower cost and permit a faster construction period.

Selected Alternative

The powerhouse is located on the left bank of Chhashi Gol near Chhashi village. The building is a RCC frame structures of size 80 m x 18.3 m x 31.9 m over RCC foundation. There will be provision of 4 Units of 20 MW each. The flood level of powerhouse will be 2,660.9 m asl. Powerhouse structure will be founded on rock.

Some blasting will be required to create space for accommodating powerhouse upto foundation level of 2657 m asl. A bridge has to be constructed on Chhashi Gol to approach the powerhouse from valley road.

The outflow from powerhouse will be discharged into Chhashi River through a tailrace channel. The length of tailrace is 52.0 m. It has a rectangular section of 20.0 m wide and 5.5 m high. The whole length will be embedded in earth with excavated material. The channel will be slopy and will drop into Chhashi Gol at elevation 2658 m asl.

5 APPROACH AND METHODOLOGY

5.1 GENERAL

This section presents the approach and methodology adopted for the collection of the requisite data, for the purposes of the EIA and Land Acquisition Plan for Phandar Hydropower Project.

5.2 DESK REVIEW OF PREVIOUS STUDIES

The environmental Impact Assessment study for Phandar Hydropower Project carried out in 2003 by HEPO was reviewed and gaps in the study were identified. In order to bridge these gaps, new work plan was devised to carry out field visits for preparation of comprehensive Environmental Impact Assessment report for the proposed project. Moreover, Feasibility study prepared by HEPO was also reviewed in order to gain an overall understanding of the project components and design. Other approved hydropower studies performed in the same region were collected from different authentic sources and reviewed to make the current study more comprehensive.

Following previous studies were reviewed to check their applicability in the existing conditions and the overall description of the proposed PHPP.

- "Phandar Hydropower Project" Feasibility Study, Vol I, II and III, December, 2003, Hydro Electric Planning Company (HEPO).
- "Phandar Hydropower Project" Inception Report, May 2011, Phandar Hydro Consultants.
- "Phandar Hydropower Project" Detailed Engineering Design Report, March 2012, Phandar Hydro Consultants.
- Other available details including maps, satellite images and survey reports.

5.3 PROJECT AREA

The environment team conducted the reconnaissance survey of the project area in December 2010. The objective of reconnaissance survey was to have an overview of the project area in order to develop comprehensive and effective field data collection methodology. In May 2011, detailed survey was conducted to collect both the primary and secondary data required for Environmental Impact Assessment study of the proposed PHPP.

5.4 SOURCES AND TOOLS FOR DATA COLLECTION

Table - 5.1 shows the sources and tools employed for the collection of requisite data of the project area:

Table - 5.1: Sources and Tools for Data Collection

Data Type	Tools	Sources/Data Collection Surveys
Primary Data	➢ Household Questionnaires ➢ Interviews with Locals/Project Affected People ➢ Field Reconnaissance Survey ➢ Field Measurements	➢ Socio-economic Survey, Focused Group Discussions ➢ Land Use Survey ➢ Trees Survey ➢ Land Prices Survey ➢ Ecological Investigation Survey ➢ Institutional Survey
Secondary Data	➢ Semi Structured Questionnaires and Interviews	➢ Project Office ➢ Public Departments and Agencies ➢ International Agencies ➢ Available Literature ➢ NGOs

All the data collected was reviewed, compared (where available from multiple sources), and verified to arrive at the final authentic numbers.

5.5 PRIMARY DATA COLLECTION SURVEYS

Socio-economic survey team conducted the field surveys in May, 2011. Details of each survey are given in this section.

5.5.1 Socio-economic Surveys by Household Questionnaire

The socioeconomic survey was conducted through structured questionnaires and interviews with the locals. The prime objective was to collect information about the project area and to document the feedback on the local and affected population of the project influence area. These surveys were carried out, on sample basis, through "Performa P-01-HSEQ: Household Socio-economic Questionnaire" as given in **Annexure - G**.

Sampling Design

Both the Phandar Village and Chashi Gol Village were included in sampling frame and assigned proportionate representation in sample size. The sample size was planned to be kept as 10 % of the total households of the project area. Random sampling technique was used to select the households to be interviewed. The detail of sample taken is given in **Table - 5.2.**

Table - 5.2: Sample Size

Village	Households	Sample (Nos.)
Phandar	140	13
Chashi Gol	90	10
Total	**230**	**23**

A total of 16 out of 140 and 12 out of 90 households were interviewed from Phandar and Chhashi village respectively. Therefore, the actual sample size thus worked out to be 12%.

Sampling Unit and Questionnaire

The primary sampling unit was the head of the household. The questionnaire covered the socioeconomic aspects including demography, education, employment and economic conditions, agriculture and livestock, housing condition, means of transport and feedback on proposed hydropower project.

5.5.2 Village Profile and Assets Survey

The village profile and assets survey was conducted to get information on the villages demographical and infrastructural characteristics. Data associated with the households, buildings and building plots and institutional facilities were collected through “Performa P-02-VPP: Village Population and Fixed Assets survey” as given in **Annexure - G)**.

5.5.3 Land Use Survey

The purpose of land use survey was to document the area for different categories of land uses (private as well as public). The land use data of the project area was primarily based upon the records of Land Revenue Department and satellite images. Data was collected in accordance with the “Performa P-03-LUP: Land Use and Trees Profile”, as given in the **Annexure - G**.

5.5.4 Trees’ Survey

Trees’ survey was carried out by the environment team, in the project area, in accordance with the “Performa P-03-LUP: Land Use and Tress Profile”, as given in **Annexure - G.** The purpose of the survey was to estimate the numbers of fruit and other valuable trees to be cut for the implementation of the proposed project.

The data was mostly collected as reported by the locals and verified by the team through field visits.

5.5.5 Land Prices Survey

Land prices survey of the project area was carried out by the environment team, in accordance with the "Performa P-04-LPP: Land Prices Profile", as provided in **Annexure - G**. The land prices were collected for different land categories from the following three sources:

- Reported by locals based on their information and/or perception
- Reported by local sellers/purchasers of land
- Land transaction prices, documented with Land Revenue Department

5.5.6 Ecological Investigation Survey

Information and data about the ecological and natural resources of the project area, was mostly obtained from the secondary sources, including government departments and published literature of the concerned international agencies. The environment team, however, during their surveys, collected some data on the terrestrial fauna and flora and aquatic fauna, in the project area, by interviewing the locals.

5.6 SOURCES OF SECONDARY INFORMATION

Certain baseline information and data, for the project area, was either solely collected from the secondary sources or, where collected by primary means, was corroborated with the available secondary data. Secondary sources were consulted for the collection of secondary information as presented in **Table - 5.3.**

Table - 5.3: Secondary Sources of Data Collection

Information Area	Secondary Source
Physical Environment	
Climate	Meteorological Department
Ecological Environment	
Protected Areas like Reserve Forest	Forest Department, Wildlife Department, WWF
Terrestrial and Aquatic Fauna Flora	Forest Department, Wildlife Department, WWF, Fisheries Department
Socio Economic Environment	
Demography	EIA of Phandar Hydropower Project by HEPO, 2003
Local Government and	District Government

Information Area	Secondary Source
Administration	
Agriculture	Agriculture Department
Livestock	Livestock Department
Roads	Highway Department
Mineral and Fossil Fuel Resources	EIA of Phandar Hydropower Project by HPO, WAPDA

5.6.1 Departmental Surveys

Departmental survey was carried out during the field visit in order to identify different public institutions, which may have a role in the implementation of the project. Relevant secondary data regarding aforementioned parameters were collected from the concerned departments through semi structured questionnaires and interviews. Further details regarding objectives of departmental survey and feedback on the project is given in **Chapter - 8**.

5.7 DATA ANALYSIS

After completing the surveys, filled questionnaire and interviews' Performas were edited and data was analyzed by using statistical technique of data analysis.

6 BASELINE ENVIRONMENTAL PROFILE OF THE PROJECT AREA

6.1 DELINEATION OF THE STUDY AREA

An environmental assessment study should encompass all the project aspects and expected impacts during different stages of the project execution in a delineated area, which is expected to be impacted by the project interventions. The study area of the Phandar Hydropower Project for the purpose of environmental assessment is Phandar Lake, adjacent land, area to be used for construction camps, quarries, spoil disposal area and the area under the impact of weir, connecting channel, tunnel, low pressure conduit, penstocks, powerhouse, GIS building and residential colony.

6.1.1 Purpose of the Baseline Study

An environmental baseline study is intended to identify and establish all the physical, ecological and socio-economic environmental conditions, prevailing before the execution of the project, in order to use this information as a reference datum to compare future changes and judge them if the condition has changed for better or worse. As such, it must include all resources that can reasonably be expected to be affected by a project. The baseline description is intended to accomplish two objectives:

- To provide the proponent of the project and stakeholders with sufficient knowledge about socio-economic set-up, agriculture, ecological features, built-up buildings and infrastructure of the project area, and
- To allow the planners to evaluate the potential efficacy of actions to mitigate adverse impacts and enhance benefits.

6.2 PHYSICAL ENVIRONMENT OF THE PROJECT AREA

Physical environment of the project area includes brief description of topography, geology and soil conditions, seismology, climate (Temperature, Humidity, Rainfall and Wind), surface and ground water resources.

6.2.1 Climate

The climate of the Northern Areas is greatly influenced by the presence of high mountain systems which create rain shadows in some places and high precipitation in others. The eastern part of the area is found a moist temperate zone of the western Himalayas but moving north-westward, the Karakorams and the Hindukush ranges present a much drier environment.

In the project area, the nearest climate station having long term records is located at Gupis. The climatic data regarding mean monthly and annual rainfall and temperature variation at Gupis was collected from Meteorological Department for the period of 1955-2008.

6.2.2 Temperature

In the project area, the minimum temperature remains below freezing during October to March (-2.8^{0}C to -13.0^{0}C). The maximum temperature rises to above 40 ºC during June to August. **Figure - 6.1** shows the temperature variation for the period of 1955 - 2008.

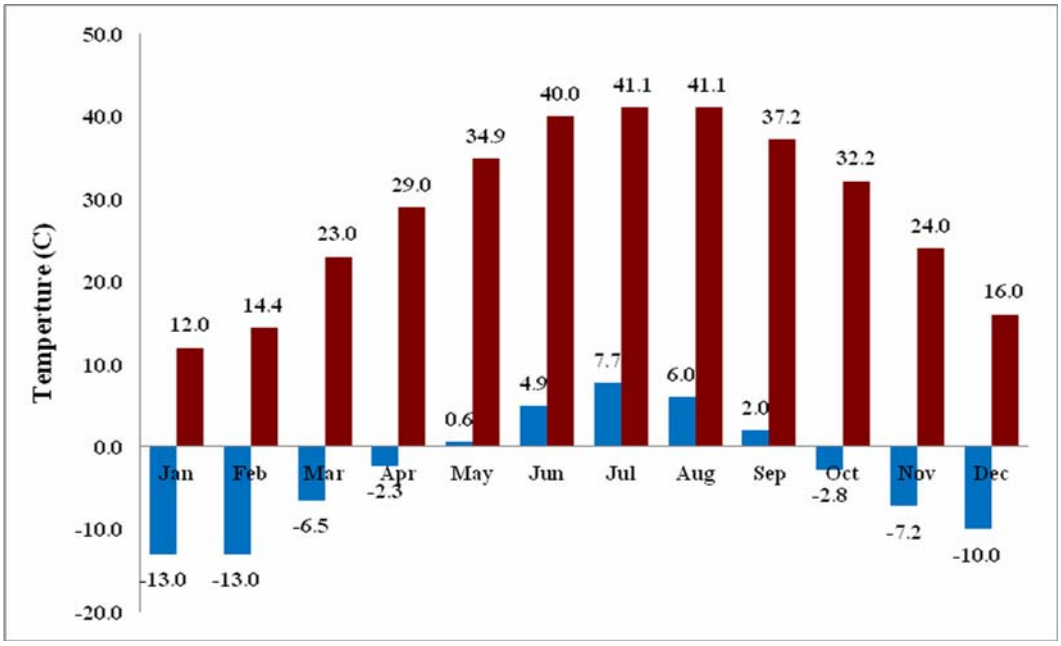


Figure - 6.1: Maximum and Minimum Daily Temperature

6.2.3 Precipitation

The project area receives precipitation in the form of rain in summer and in winter the snow is dominant when temperature is below zero. The annual rainfall varies between 5.3 mm to 675.6 mm for the period of 1955 - 2010. The maximum daily precipitation recorded during the historic period is 343.3mm in April 1999.

April and May are the months of maximum rainfall while lowest rainfall occurs in the month of November. It indicates that Ghizar valley is not affected by monsoon winds. Mean monthly and average annual rainfall at Gupis are indicated in **Figure - 6.2** and **Figure - 6.3.**

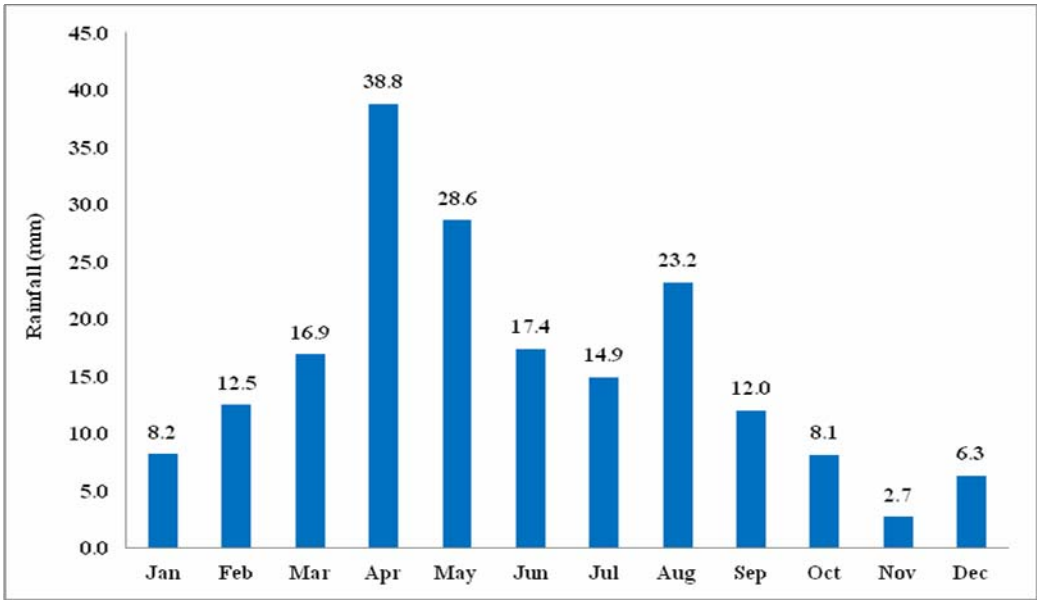


Figure - 6.2: Mean Monthly Rainfall (1955-2010)

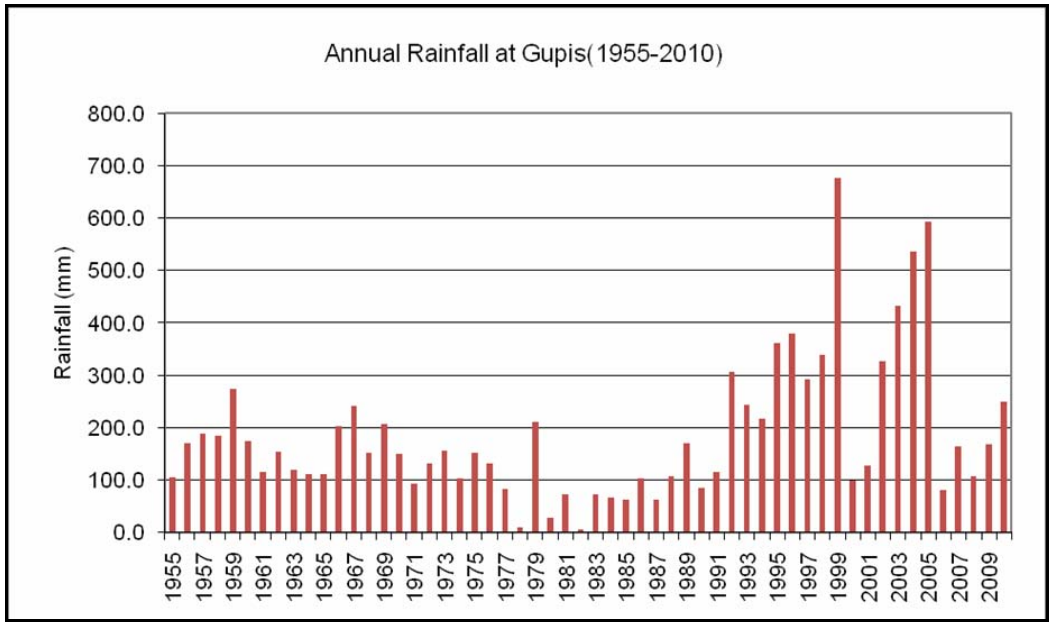


Figure - 6.3: Annual Rainfall (1955-2010)

6.2.4 Topography, Geology and Soil

Ghizar valley flows with mild river gradient of about 0.04 % from 5 km upstream to 0.7 km downstream of diversion weir axis. In downstream area of weir, the gradient becomes steep up to 6.6 % in the narrow gorge of about 4 km upto its confluence with Chhashi Gol and Bahastaro Gol.

Ghizar River has catchment area of 1442 km^2 and mean elevation of 4150 m asl upto weir site. The elevation in the project area varies from 2905 m asl to

2662 m asl. The terrain is mountainous, rugged with little vegetation, very large scree cones and boulder moraine. The region is characterized by pattern of high and steep hills, which are high towards north. The general elevation of the land gradually increases towards west of Phandar valley. The highest elevation is 5217 m asl and the lowest elevation is 2100 m asl. The peaks are mostly covered with snow. The terrain is mountainous, rugged with little vegetation, very large scree cones and boulder moraine.

Abundant glacial deposits overlie in the valley. Intense avalanches / weathering have taken place in the area, which has formed terraces. Avalanches in the area frequently occur. There are flat fields on the both sides of the river upstream of the Phandar Lake. The texture of the soil consists of silt, clay and sand.

Phandar valley was a long and wide valley but due to massive movement of avalanches formed a natural dam, which broke later on. Then bank of the Lake shows glacial deposits. The river along the lake has mild gradient and with rocks and boulder bed, which were brought down by glaciers and avalanches.

The geology of the project area mainly consists of morainic material on the surface with bed rock of Greenstone / schist. It is fine texture / metamorphic rock of light greenish-grey color, medium hard, generally breaks along schistocity plane, highly fractured and jointed. Most of the project area covered with slope deposits, terraces, flood plain and morainic deposits.

At the right bank of the river downstream of weir site, rock is exposed while the rock on the left side exposed away from river. The lower portions of the slopes are covered with scree material.

6.2.5 Seismology

According to feasibility study, major faults including Main Karakouram Thrust (MKT), Karakorum Thrust (KT), Reshun fault and some are located in the project area. The area has been the centre of number of major earthquakes of intensities 5 to 7(Ms). The seismic hazard analysis was carried out using the deterministic and probabilistic approach to determine Maximum Credible Earthquake (MCE) and Operating Basis Earthquake (OBE) respectively.

Results of MCE for representative faults in the form of Peak Ground Acceleration (PGA) and Peak Groung Velocity (PGV) are given in the **Table - 6.1**.

Table - 6.1: MCE for Representative Faults

Associated Source Generating MCE	Site Type	PGA (g)	PGV cm/sec	Remarks
MKT	Rock	0.506	113.45	Higher Estimates
MKT	Soil	0.506	157.56	
MKT	Rock	0.129	6.17	Lower Estimates
MKT	Soil	0.129	8.57	

Source: *Detailed Engineering Design report, Phandar Hydropower Project*

According to seismic zoning map of Pakistan included in Pakistan Building Code seismic provision (2007), the project area falls in Zone 3. Seismic Zoning map is attached as **Annexure - H**.

Consultants have to rely on seismic refraction survey results which show extremely fractured weathered rock at about 22 m depth which is believed to be maximum along the slope as anticipated by rock profiling with the help of geological mapping.

6.2.6 Surface Water Hydrology

There are two water bodies, Ghizar River and Chhashi Gol, in the project area. Ghizar River originates from as elevation 4300 m asl from large glaciers of Khakush Gol and Shuni Gol in Shandur area and flows eastward joining number of tributaries including Yasin, Iskhuman and Hunza River and ultimately joins the Indus River. The catchment area of Ghizar River near Phandar Lake is estimated about 1442 km^2.

Chhashi Gol originates at an El. 5292 m asl from Kheli Ann area and flows northward drains into Ghizar River. Chhashi Gol comprised of tributaries Shaghia Gol, Ano Gol and Kana Gol. Settlement located on the banks of Chashi Gol and Ghizar river use surface water for all the domestic purposes. During socioeconomic survey of the project area, none of the respondent reported the any water related disease.

The mean monthly and annual flows of Ghizar River at Phandar were estimated from 1995 up to 2010 as presented in the **Figure - 6.4** and **Figure - 6.5.**

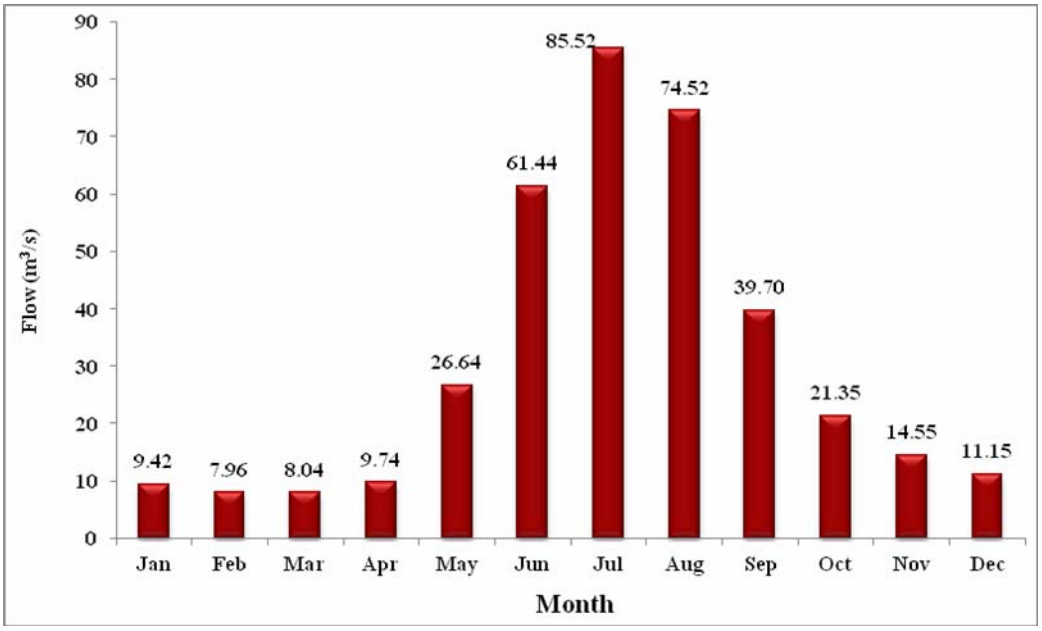


Figure - 6.4: Mean Monthly Flows – Ghizar River at Phandar

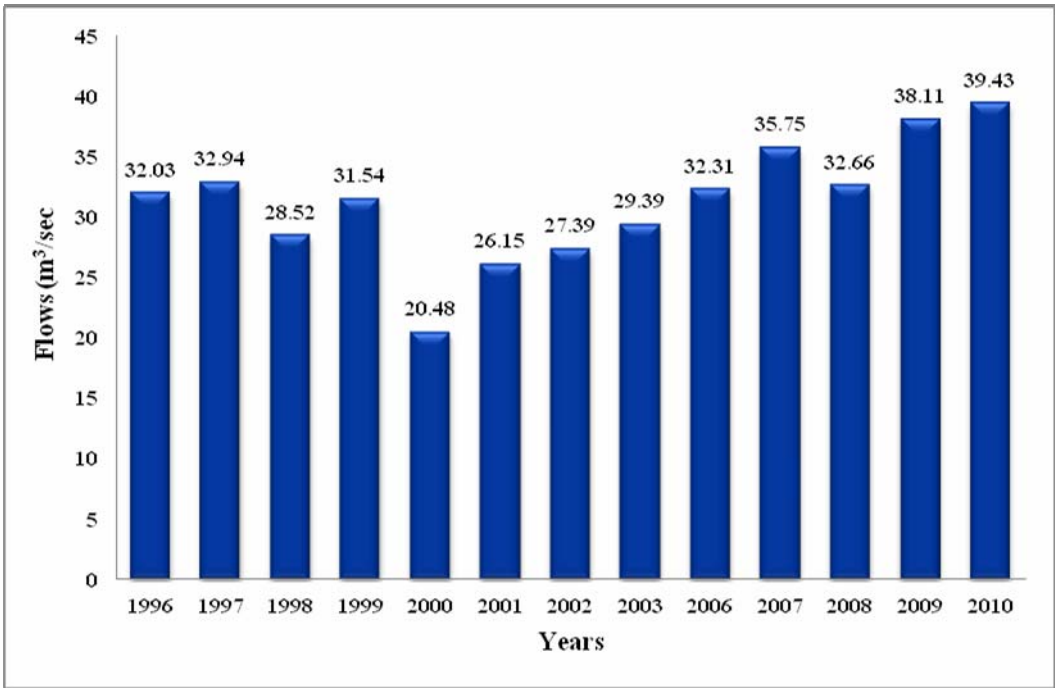


Figure - 6.5: Mean Annual Flows at Phandar (1996-2010)

6.2.7 Flooding

Floods in Northern areas arise from various generating mechanisms. These mechanisms include melting of snow and glaciers during prolonged hot period, and landslide resulting in blocking the river. Estimated peak discharges of Ghizar River at weir site as stated in detailed engineering design report are given in **Table - 6.2.**

Table - 6.2: Maximum Flood Values at Proposed Weir Site

Return Period (Years)	Flood (m^3/sec)
2	154.8
5	219.7
10	262.7
25	316.9
50	357.2
100	397.1
500	489.5
1000	529.2

Phandar Hydropower Project is not too much affected by the GLOF as it is located far away from GLOF affected areas compare to whole Gilgit River basin. Peak discharges from GLOF in Gilgit River varies between 231m^3/sec and 592 m^3/sec.100-year peak discharge (397 m^3/sec) estimated by flood frequency analysis is quite comparable with GLOF values and therefore recommended for the design of proposed weir.

6.2.8 Sedimentation

The sedimentation is a major problem in the weir area as the river has very mild slope at the weir and upstream stretch and owing to which sediments are deposited in this part of the river. The bed slope of Ghizar River abruptly changes after the proposed weir site.

The analysis of sediment concentration of upstream stretch of weir structure and Phandar Lake reveals the information about morphology of sediments, suspended load and bed material.

Suspended load measurements have been carried out at gauging station since 1997 by SWHP and are being taken in combination with discharge measurements. The data for the year 2010 was analyzed and the mean annual suspended sediment load from observed data comes out to be of the order of 0.25 MST. Taking 15% of suspended load as bedload, annual bedload comes to be 0.0375 MST. Therefore, total annual sediment at weir site is of the order of 0.288 MST.

The bed material of the Ghizar River consists of fines. At project site, Ghizar River consists of silt sand material with little gravels and boulders. The surface material of river bed of Ghizar River comprises of more coarser material while the subsurfave material is much finer.

For bed material, measurements at Nalter Gah had been taken to make estimation. The studies on the sediment loading of River Ghizar at weir site infer that the fine layer of armour material starts movement at 5,900 m^3/sec. The maximum discharge at the weir site is Ghizar River is 85.5m^3/sec. Hence the study concludes that the stability of river bed is much greater than expected and the initiation of coarser bed load movement is not anticipated.

6.2.9 Surface Water Conditions

In the project area, surface water bodies including Ghizar River and Chashi Gol Nullah are the main source of water for people living in the area for their own consumption, livestock use and irrigation purposes. Originally, the rain water and snowmelt water is clean and do not contain any impurities but when flow over land surface they capture the sediments and other impurities.

In order to ascertain the quality of surface water, three water samples, first from upstream of Ghizar river, second from downstream of Chhashi Gol and third from Water and Sanitation Extension Programme (WASEP) supply scheme were collected in May, 2011 and tested for both physico-chemical and microbiological parameters. The laboratory results of these samples summarized in **Table - 6.3** shows that all the tested parameters are within the permissible limits when compared with WHO Guidelines. Test reports are attached as **Annexure - I.**

Table - 6.3: Surface Water Quality

Parameter	Test Results		
Parameters	Upstream of Ghizar River (Phandar Settlement)	Chashi Gol Nullah (Seepage Water)	WASEP supply scheme
E. Coli	Negative	Negative	Negative
pH	7.6	8.0	7.8
Temperature (^{0}C)	20	20	20
Turbidity	<5NTU	<5NTU	<5NTU
Color	No Obj.	No Obj.	No Obj.

Parameter	Test Results		
Odor	No Obj.	No Obj.	No Obj.
Taste	No Obj.	No Obj.	No Obj.

Source: *Monitoring at the Site*

6.2.10 Ground Water

The entire project area consists of rocky mountainous terrain. Only small quantity of water can percolate and form ground water reserves.

In order to monitor the groundwater level in the project area, trenches, boreholes and test pits were excavated at or near the project structures location. Ground water in the form of thin layers has been found in some boreholes drilled near Chashi Gol Nullah and Ghizar River, accumulated through seepage from water bodies. Water table in the area varies between 1.40m to 10.50m from NSL.

The small ground water reserves is not being used by the local community therefore, samples were not collected for ground water quality testing.

6.2.11 Ambient Air Quality

The ambient air quality of the project area is good as no industrial activity and other sources of air pollution exist in the study area. The major source of fuel for cooking in the project area is wood. Burning of wood contributes to the concentration of particulate and nitrogen oxide but the emissions are not high as the project area is sparsely populated.

The project site is accessible through Gilgit to Chitral road and from Chitral via Shandur pass road. Presently, the number of vehicles moving in the project area through these roads is not high enough to cause a threat to air quality of the area.

6.2.12 Noise

There is no major noise producing activity in the project area. The only source of noise is vehicular traffic moving through Gilgit to Chitral road and Chitral via Shandur pass road but the traffic volume playing in the area is very low.

The noise levels were monitored at three locations within the project area, power house area, road near Chashi village and near phandar village. Noise levels were measured with the help of digital sound meter (MS-6700).

Monitoring results are shown in **Table - 6.4** while test reports are attached as **Annexure - I.**

Table - 6.4: Noise monitoring results

Sampling Point	Noise levels (dB)	NEQS(dB)
power house area	40-50	85
Road near Chhashi village	45-55	85
Phandar village	50-60	85

Source: *Monitoring at the Site*

The noise levels measured at aforementioned locations are below 85**(**dB). This is mainly because of low traffic volume and absence of industries.

6.3 BIOLOGICAL ENVIRONMENT

The Gilgit - Baltistan is rich in flora and fauna because of varied climatic conditions and ecosystems. In spite of unscientific management and ruthless hunting in the past, wildlife in the Gilgit - Baltistan still supports rare and endangered species of mammals and birds like Marco Polo sheep, blue sheep, markhor, black bear, brown bear, chakor, snow leopard and ram chakor. Due to the destruction of habitat wildlife population of Gilgit - Baltistan is decreasing rapidly and other valuable species are also decreasing. Until 1947, almost all the important valleys, most of them now included in protected areas, supported a high density of wild animals and hunting was allowed to only a few British and high ranking local officials, rulers and persons with high social status.

6.3.1 Terrestrial Fauna

Terrestrial fauna of the area comprised of domestic animals including dogs, sheep, goats, cows, donkeys and yaks. The wildlife in Ghizar and its surrounding is famous for its faunal diversity (mammals, residents and migratory). List of wild animals found in the area is given in **Table - 6.5.**

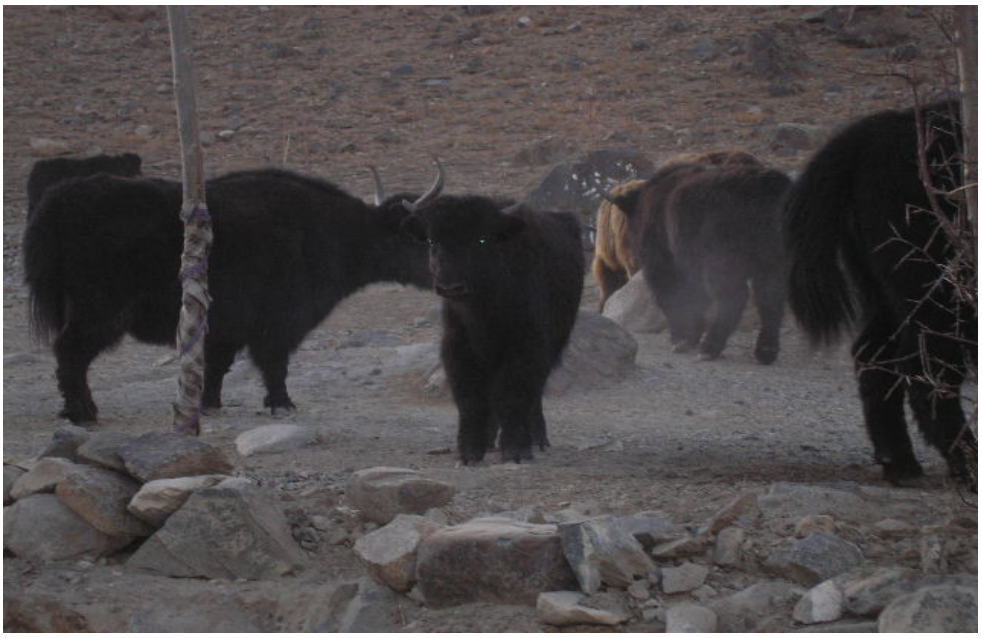
Table - 6.5: Wild Animals of the Project Area

Scientific Name	Common Name	Local Name
Capra ibex sibirica	Himalayan Ibex	Kill mayaroo
Vulpes vulpes montana	Red fox	Loee
Lepus capensis	Cape hare	Ushayoo

Scientific Name	Common Name	Local Name
Uncia uncia	Snow leapord	Dee
Felis lynx	Himalayan lynx	Bug bayaro
Canis lupus	Wolf	Shahaal
Ursus arctos	Brown bear	Ich

Source: *WWF Gilgit Baltistan*

Wild and Domestic animals of the area



6.3.2 Avifauna

Gilgit - Baltistan have one of the most diverse avifauna of the mountain region of the world. The Karakoram and Himalayan ranges separate the uplands of Central Asia from South Asia, forming a barrier between two large areas of Asia which are different climatologically. The geographic location of Gilgit - Baltistan makes it ideal for many bird species. The area is a staging, transitory, breeding, migratory and native ground for many species. In total, about 230 species of birds have been estimated for this region. These include passage migrants, vagrants, residents, breeding and irregular visitors. Many of these species breed in Northern Areas and are found over a large range.

There are some rare species which not only occur in the area but also breed here. These include lammergeyer and the golden eagle.

Particularly in Ghizar District, Some of the restricted range species like snow partridge and Himalayan monal pheasant are extremely rare. Water fowls in the project area are also reported by locals and WWF- Pakistan. Bird species available in the project area are presented in **Table - 6.6.**

Table - 6.6: Avifauna of the area

Common Name	Scientific Name
Peregrine falcon	*Falco peregrinus*
Alpine chough	*Pyrrhocorax graculus*
Jungle crow	*Corvus macrorhynchos*
House sparrow	*Passer domesticus*
Chukar partridge	*Alectoris chukar*
Golden eagle	*Aquila chrysaetos*
Hoopoe	*Upupa epops*
Himalayan snow cock	*Tetraogallus himalayensis*
Northern eagle	owl *Bubo bubo*
Brown dipper	*Cinclus pallasii*
Hill pigeon	*Columba rupestris*
Kestrel	*Falco tinnunculus*
Laughing thrush	*Garrulax lineatus*
Wood pecker	*Dendrocopos mahrattensis*
Black billed magpie	*Pica pica*
Whistling thrush	*Myiophoneus careuleus*

Common Name	Scientific Name
Wall crapper	*Tichodroma muraria*
Sparrow hawk	*Accipiter nisus*
Bearded vulture	*Gypactus barbatus*
Snow partridge	*Lerwa lerwa*
Alpine swift	*Apus melba*
Common swift	*Apus apus*
Northern pintail	*Anas acuta*
Marbled teal	*Marmaronetta angustirostris*
Common teal	*Anas crecca*

Source: *WWF Gilgit Baltistan*

6.3.3 Endangered, Threatened and Vulnerable Species of Fauna

The IUCN red list of Endangered, Threatened and Vulnerable Species in Northern areas is shown in **Table - 6.7.**

Table - 6.7: IUCN red list of Endangered, Threatened and Vulnerable Species in Northern areas

Category	Species	
	Scientific Name	**Common Name**
Endangered Species	*Capra flconeri*	Markhor
	Eupegaurus cinereus	Wolly flying squirrel
	Ovis vigneri	Ladakh urial
	Unica unical	Snow leopard
Vulnerable Species	*Ursus thibetanus*	Asiatic black bear
Threatened Species	*Naemorhedus goral*	Grey goral
	Moschus chrusogaster	Musk deer
	Matmota caudate	Long-tailed marmot
	Pseudois nayaur	Blue sheep

None of these threatened, vulnerable and endangered species have been reported in the project area.

List of the internationally threatened mammal, reptile and bird species of Pakistan are presented in the **Annexures - J, K, L** and **M**.

Annexure –J Internationally Threatened Mammals of Pakistan (IUCN 1990)

Annexure - K Nationally Threatened Mammal Species of Pakistan (Listed As Endangered by NCCW)

Annexure - L Internationally Threatened Reptile Species of Pakistan

Annexure - M Internationally Threatened Bird Species of Pakistan

6.3.4 Protected Areas of Pakistan

Protected areas include National Parks, Game Reserves and Wildlife Sanctuaries. Pakistan has a network of 225 Protected Areas comprising 14 National Parks, 99 Wildlife Sanctuaries, 96 Game Reserves, and 16 unclassified (private, proposed or recommended). No such location exists in the project area. List of protected areas of Pakistan is attached as **Annexure - N.**

6.3.5 Terrestrial Flora / Natural Vegetation

Ghizar District has very small forest area as compared to other districts. The project area falls in a dry temperate, sub alpine and alpine zones, where a variety of floral species are found. Mostly trees grown in the villages are fruit, shade, timber and fire wood. Due to the shortage of natural forest, the locals have planted Willow and Popular trees to fulfil their basic need of timber and firewood.

The project flora is comprised of three categories: weeds, desert type native plants and high alpine plants, which are mostly found near cultivated fields, cliffs and along the streams respectively. A list of trees, shrubs, herbs, medicinal plants and fruit trees of the area are listed in **Table - 6.8**.

Table - 6.8: Terrestrial Flora/Natural Vegetation

Common Name	Local Name	Botanical Name
Birch	Jogee	*Betula utilis*
Willow	Chitee beyu	*Salix tetrasperma*
Juniper	Chalee	*Juniperus macropoda*
Poplar	Falchoo	*Populus alba*

Common Name	Local Name	Botanical Name
Shrubs		
Pencil cedar	Matharee	*Juniperus communis*
Sea buckthorn	Buru	*Hippophae rhmnoides*
Berberry	Ishkeen	*Berberis lycium*
Tamarix	Hookaro	*Tamarix gallica*
Wild rose	Shingie	*Rosa webbiana*
Goose berry	Shumloo	*Rebis alpestris*
Herbs		
Trifolium	Shaftal	*Trifolium repens*
Dandelion	Ishkinache	*Taraxacum officinale*
Wild thyme	Tumoroo	*Thymus serphyllum*
Berginia	Suspur	*Berginia stracheyi*
Mullein	Jangli tamakoo	*Verbescum thapsus*
Wild strawberry	Jangle mawa	*Fragaria vesca*
Ephedra	Som	*Epherdra intermedia*
Cumin seed	Kamsal zeera	*Cumium cyminum*
Medicinal Plants		
Worm seed	Afsanteen	*Artemisia aritime*
Pencil cedar	Juniper	*Juniperus macropoda*
Dandelion	Dudal	*Traxacum officinale*
Astraglus	Hapochi	*Astraglus spp*
Stinging nettle	Bichu boti	*Urtica dioica*
Capper	Kabir	*Capparis spinosa*
Ephedra	Asmani buti	*Ephedra intermedia*
Coriander	Danya	*Coriandrum sativum*
Safflower	Zafran	*Carthamus tinctorious*
Wild rue	Ispand	*Peganum harmala*
Sea buckthorn	Sea buckthorn	*Hippophae rhamnoides*

Common Name	Local Name	Botanical Name
Curled sock	Khati buti/Dock	*Rumex hastatus*
Puncture wine	Gakhoro	*Triblus terristris*
Thorn apple	Datura	*Datura stramonium*
Horse mint	Jangli pudina	*Mentha sylvestris*
Barberry	Kashmal	*Berberis lycium*
Chicory	Kasni	*Cichorium intybus*

Source: *WWF Gilgit Baltistan*

Medicinal plants available in the area have great importance, but due to the unawareness of their use local do not use it frequently. Mostly, these plants are used for stomach pain, fever, gastric disorders, liver problems, skin infections and injuries heal up, etc.

Flora of the Area

Exhibit - I

Exhibit - II

Exhibit - III

Exhibit - IV

Exhibit - IV

Exhibit - VI

Exhibit-VII

Exhibit-VIII

6.3.6 Orchards

Gilgit - Baltistan is well suited particularly for the production of deciduous fruits. Fruit crops have been grown here for last several years and now posses the genetic basis for tolerance to extreme cold, heat, frost, disease and pests. They represent a unique resource for future horticulture development (IUCN/GoP). Fruit trees are located in valleys and on the lower slopes.

The apricot trees are abundantly found in Gilgit - Baltistan with more than 300 different varieties of the fruit carrying different taste. The people have their own orchard full of fruit trees. Apricot is the best source of income for the poor people. They also meet their fuel requirements from the trees during the cold and long winters.

During spring season, the apricot flowers not only add to the beauty of the region, but also fill the air with a sweet fragrance.

The locals of project area have reported that they have grown walnut, apricot, pears, mulberry and almonds on their land for their domestic and commercial purposes. **Table - 6.9** and **6.10** presents the area, production and use of fruits in subdivision of Yasin / Gupis respectively.

Table - 6.9: Area and Production of Fruits in Gupis / Yasin

Fruits	Fruit Bearing Trees	Non Fruit Bearing Trees	Area (ha)	Production (T)
Apricot	124232	50775	761	7870
Apple	36830	24020	265	1195
Grapes	12048	13725	112	267
Pears	1678	5261	30	86
Peaches	5719	2821	37	150
Pomegranate	3736	3126	30	68
Cherry	9455	9074	81	111
Mulberry	8159	3203	49	466
Walnut	12658	5126	77	116
Almond	25146	15264	176	212

Source: *Gilgit – Baltistan agriculture statistics 2009 survey report*

Table - 6.10: Fruits Production and Consumption in Gupis / Yasin

Fruits	Production (T)	Wastage (T)	% Losses	Consumed (T)		Marketed (T)	
				Fresh	Dry	Fresh	Dry
Apricot	7870	2996	38	300	105	187	216
Apple	1195	258	22	561	0	375	0
Grapes	267	23	9	28	0	35	0
Pears	86	23	27	28	0	35	0
Peaches	150	77	51	61	0	12	0
Pomegranate	68	14	20	24	0	31	0
Cherry	111	25	23	73	0	13	0
Mulberry	466	293	63	77	16	0	7
Walnut	116	0	0	0	74	0	52
Almond	212	0	0	0	108	0	104

Source: *Gilgit – Baltistan agriculture statistics 2009 survey report*

6.3.7 Pastures

The natural pastures are found at elevation about 3811 m asl, which is above the tree limit. Grazing land and pastures are scattered in patches where the area is relatively flat. Mostly, herbaceous plants are grown in the pastures and the density of ground cover depends upon the available moisture and soil depth.

The far grazing area and there higher elevations contributes in the damage of forest. It was observed during the survey that mostly animals in the project area usually graze in agriculture fields, but in winter season they do not have any location to graze as it get covered with snow or damaged by the frost. It is also observed that people wrap the trees stem with cloths or thorn to protect the plants from animal, which eats bark when they do not found any grazing area especially in winter season. Oak trees are lopped to feed the animals in winter season. The intensity of lopping is heavy and quit frequently and the oak branches looped for leaf fodder are utilized as a fuel wood.

View of grazing land in the project area

6.3.8 Fish and Fisheries

The Gilgit - Baltistan has many rivers, streams and alpine lakes fed by snowmelt and glacier waters. The freshwater resources contain several fish species which are an important component of the region's biodiversity.

The fish diversity in Gilgit - Baltistan is not yet described with greater detail despite its biological and evolutionary significance. However, some recent studies report that there are about 17 species of native fish and 3 of exotic

fish. Out of 17 native species, four are endemic to Gilgit - Baltistan, while several others have ranges confined to one or two localities.

The number of fish species found in high altitude streams and lakes is low. Deosai Lake, one of the highest lake in the world located at an elevation of 4,142m, have only three fish species namely *Triplophysa stoliczkai, Diptyichus maculatus*, and *Ptychobarbus conirostis.*

Among exotic species, brown trout was introduced in Gilgit agency during the early 1900s. This species is now well established and is found in most of the rivers and lakes of Gilgit and Ghizar districts. Particularly, upstream of the Ghizar River and its tributaries contain a large number of brown trout. Other exotic species include North American rainbow trout and Chinese carp, introduced for aquaculture. However, it is not clear that these exotics breed naturally, but their distribution is very limited and they are found only in those water bodies where they were stocked.

The Ghizar River including 45 streams and 5 lakes from Shandure to Gahkuch provides as ideal habitat for fish species. The fish species found in that area including Phandar Lake are Brown tout (*salmo trutta fario), schizothorax, plagiostomus, S.labiatus and S.esocinus.* Breeding season of trout fish starts from late October to February in which fishing is prohibited.

Being a carnivorous in nature, the trout take food from natural environment, which includes protozoan, coelenterates, rotifers, insects, crustaceans, mollusks and larvae of many insects. It has also been observed that trout fish eat local fishes, while the eggs of trout are being eaten up by local fishes.

There is no commercial fishing in the area. Fish caught by the locals are consumed at household level.

Fish Species found in the project area

Brown Trout (Salmo Trutta fario)

Sternarchogiton labiatus

Schizothorax Plagiostomus

6.4 SOCIO-ECONOMIC ENVIRONMENT OF THE PROJECT AREA

The socio-economic profile of the area focuses on the sources of livelihood, income levels, and accessibility to social services like health, education, demographic, social structures and conditions. This information will also assist in planning and designing amicable solutions during the resettlement process.

The socio-economic data collection process is explained in chapter-5. This section covers the socio-economic profiles of the project area.

6.4.1 Political and Administration Units

Ghizar District has been ruled by various local Rajas and later divided between the Mehtar of Chitral and the Maharaja of Kashmir. After 1895, all of Ghizar was annexed to Gilgit Agency, which was directly ruled by the British Government. After independence, the areas become a part of NA's as a district. The major places are Punial, Sher Qila, Ishkuman, Yasin, Gupis, Chatorkhand, Imit and Utz, with Gahkuch as the capital. The project area (Phandar and Chhashi) is located in Tehsil Gupis, District Ghizar.

6.4.2 Historical Context

Before the independence of Pakistan in 1947, Maharaja Hari Singh extended his rule to Gilgit and Baltistan. After the partition, Jammu and Kashmir, in its entirety, remained an independent state. The Pakistani parts of Kashmir to the north and west of the cease-fire line established at the end of the Indo-Pakistani War of 1947, or the Line of Control as it later came to be called, were divided into the Northern Areas (72,971 km²) in the north and the Pakistani state of Azad Kashmir (13,297 km²) in the south. The name "Northern Areas" was first used by the United Nations to refer to the northern areas of Kashmir. A small part of the Northern Areas, the Shaksgam tract, was provisionally ceded by Pakistan to the People's Republic of China in 1963.

Gilgit – Baltistan, consists of seven districts, has a population approaching one million and shares borders with Pakistan, China, Afghanistan, and India. The people of this remote region were liberated from the Dogra regime of the former princely state of Jammu and Kashmir on 1 November 1947 with the help of the Pakistan army and then became citizens of a self-liberated and very short-lived independent state (17 days only). The new state asked the government of Pakistan to provide it with necessary assistance with which to conduct its affairs, as it did not have the necessary administrative infrastructure of its own. The government of Pakistan accepted the request and sent Sardar Muhammad Alam Khan, an extra assistant commissioner from the NWFP, to Gilgit. Sardar Muhammad Alam Khan then took control of the territory's administration as its first appointed political agent.

On 29 August 2009, the Gilgit - Baltistan Empowerment and Self-Governance Order, 2009, was passed by the Pakistani cabinet and later signed by the President of Pakistan. The order granted self-rule to the people

of the former Northern Areas, now renamed Gilgit - Baltistan, by creating, among other things, an elected legislative assembly.

6.4.3 Settlement Pattern

The proposed project is located in Ghizar District. There are two villages (Chashi Gol and Phandar Village) in the project area which are expected to be affected due to the project implementation. The population of these villages varies between 800 to 1200 people. Phandar settlement is located about 3km upstream from proposed weir site at Ghizar River whilst Chasi settlement is located downstream near power house area.

6.4.4 Demography

The study of population as well as its growth and distribution is highly important to forecast power demands of the areas. The increase in the population of Northern Areas has been more than double since the first population census in 1951, compared to second census in 1981 as it increased from 0.25 million to 0.57 million showing 124.4% increase. According to 1998 population census, the population of NA was 0.87 million as against 0.57 million in 1981 showing annual growth rate of 2.5 %.

The density of population increase from 8 persons/km^2 to 12 persons/km^2 in 1998. According to 1998 population census average size of the household of the NA comes to 7.9 persons as compared to 7.1 persons in 1981. In rural areas population concentration is mostly around rivers and streams.

6.4.5 Household Size

In the project area average household size comes out to be 8 - 9 persons per household. According to the sample based socio-economic survey, about 23 percent of the households have less than 6 members.

Male-to-female ratio, in the area is 54:46. The percentage of the younger population is found to be higher than those above 45 years. Percentages of unmarried and married are about 62 percent and 38 percent, respectively. Majority of the unmarried members are students or below 18 years of age.

6.4.6 Family System

According to the sample based socio-economic survey, about 66 percent households live in nuclear family structures, while the remaining 34 percent lives in joint families.

6.4.7 Educational Facilities

Education plays an important role in human capital formation. It raises the productive efficiency of individual and produce skilled manpower, capable of leading economy of the area to the path of sustainable development. Low literacy ratios, low enrolment rates, lack of trained teachers and poor physical infrastructures school / colleges indicated the poor performance in this aspect.

Apart from the efforts made by the government, Agha Khan Rural Support Programme (AKRSP) is also working in the project area through a number of schools network. There are total fourteen educational facilities in the project area. Details are given in **Table - 6.11.**

Table - 6.11: Educational facilities in the project area

Government /Non Formal/Private Schools							
Primary		Middle		High		College	
Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
8		3		2		1	

According to the sample based socio-economic survey, about 34 percent of the household members have matric or above level of education, followed by middle and primary level education (about 21 percent).

6.4.8 Occupations, Employment and Workforce

Based on the sample based socio-economic survey of the project area, **Figure - 6.6** presents distribution of household members by occupation.

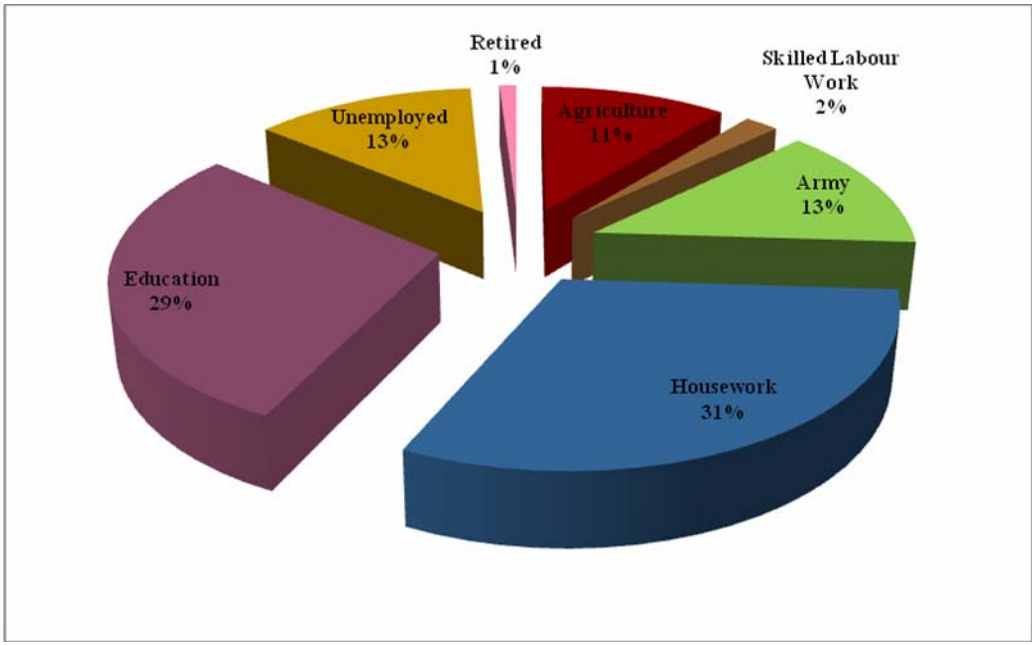


Figure - 6.6: Distribution of Household Members by Occupation

Leaving the categories of housework and education, which mainly pertain to house wives and children, the principle earning occupations include agriculture and Government Jobs, especially Pak Army. Figure shows that 13% households are dependent on government jobs while 11% are engaged with agricultural activities.

Female employment does not seem to be very common, as a large majority of them mentioned housework as occupation, but on the other hand they are also the helping hands of males in agricultural activities. The data further show that the younger age members are more gainfully employed as compared to older age groups of 50 and above years.

6.4.9 Agriculture

The agriculture sector in the Gilgit-Baltistan is showing positive growth but at slow rate due to inherent constraints of poor infrastructure and small holdings. Majority of population is engaged in this sector even then the area has deficit of food grains. A mix of different activities is followed in the farming system. There may be variation in farm size or in the status of minor crops in the overall cropping practices but the general combination of crops; livestock and other farm related activities are more or less the same. Approximately more than 90% of rural population is depending upon this occupation. Land use statistics shows that 85 thousand hectares of land is under cultivation, out of which 60 thousand hectares are under cereals and vegetables and 25 thousand hectares are under fruits in the entire Gilgit - Baltistan *(GB agriculture statistics 2009)*.

Agriculture Department is doing its utmost to increase crops and fruit production through various schemes of seed production and multiplication development of horticulture and plants protection operation schemes for land reclamation and construction of irrigation channels.

Table - 6.12 presents area and production of fruits, cereals and vegetables in Ghizar District.

Table - 6.12: Area and Production of Vegetables and Cereals in Ghizar District

Cereals/Vegetables	Area (ha)	Production (T)
Wheat	2226	4403
Maize	3348	9564
Barley	413	855
Buckwheat	72	152
Fodder	1140	5070
Potato	714	11024
Tomato	48	399
Peas	15	114
Cabbage	22	114
Chinese cabbage	12	62
Onion	27	632
Capsicum	1	3

Source: *Gilgit –Baltistan agriculture statistics 2009 survey report*

The people of the project area are dependent on agriculture activities. Major crops and vegetables grown in the project area and their production capacity are presented in **Table - 6.13**.

Table - 6.13: Area and Production of Vegetables and Cereal in Tehsil Yasin / Gupis

Cereals/Vegetables	Area (ha)	Production (T)
Wheat	1193	2168
Maize	1667	4649
Barley	367	773

Cereals/Vegetables	Area (ha)	Production (T)
Buckwheat	15	35
Fodder	669	3080
Potato	420	6412
Tomato	17	130
Peas	8	61
Cabbage	14	79
Chinese cabbage	4	27
Onion	18	339
Capsicum	0	0

Source: Gilgit –Baltistan agriculture statistics 2009 survey report

6.4.10 Agricultural Land Tenure

The socio-economic survey of the project area reveals that 100% households cultivate their own land. In some cases, the cultivable land was reported to be left waste without any utilization, for the reasons of irrigation problems and poor yield.

6.4.11 Principal Crops and Cropping Pattern

Cropping pattern and intensities are considered as measures of the level of agricultural development of an area. Generally, the cropping pattern options open to farmers depend upon the availability of irrigation water. In the project area, farmers tend to grow uni-seasonal crops due to severe weather conditions in winter and flooding season (July-August). Mostly, they grow wheat, maize, onion, tomato and potato. The agriculture land near the lake and upstream of the lake along the Ghizar River has heavy moisture conditions, which sometimes results into low crop yield while in Chhashi village, the same cropping system is adopted but the agriculture land is irrigated through seepage water.

6.4.12 Livestock

Livestock in the project area is not only a source of income but also serve dietary purposes. Large herds of yaks, cattle, sheep and goats are found in Gilgit-Baltistan. However, physical condition and general health of animals are not satisfactory, especially in winter due to shortage of fodder. Bullocks are the main source of farm power but they are hardly capable of drawing plough due to poor health. Animal's diseases are causing considerable losses to livestock. Productivity of cattle is generally low because of severe

weather conditions and lack of proper food. Meat, milk, butter and eggs are the main livestock products but most of these are consumed at household level. Keeping in view the demand of meat and milk, AKRSP and Animal Husbandry Department have introduced improved breed of livestock and poultry under the UNDP funded project.

Major livestock animals in the area are cows, goats, seeps, yaks and donkey. **Figure - 6.7** shows the number of different livestock animals and poultry owned by people in Ghizar District.

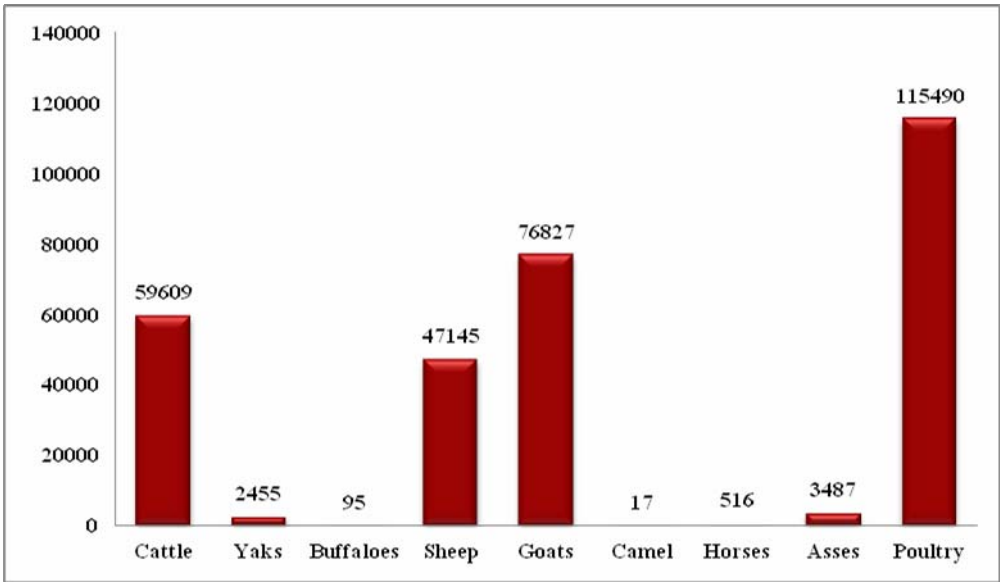


Figure - 6.7: Number of Animals in District Ghizar

Source: *Sample Based Socio-economic Survey, 2011*

6.4.13 Industrial Activities

No industrial activity is found in the project area.

6.4.14 Trading Activities

Agricultural and livestock mainly suffice to the needs of the people living in the project area. Very few people sell their harvest and livestock (including its products such as eggs, milk, ghee, butter) in the market for monetary gains.

6.4.15 Women Status and Cultural Approach

Women of the project area take the responsibilities of taking care of household activities, bringing up of children, live stock poultry and collection of wood for heating and cooking. Men participate in agricultural and outdoor activities.

6.4.16 Economic Conditions

6.4.16.1 Sources of Livelihood

In the project area, majority of households have farmlands within their village boundaries. Distribution of households owning agricultural land, with respect to their landholding size, is presented in **Figure - 6.8**.

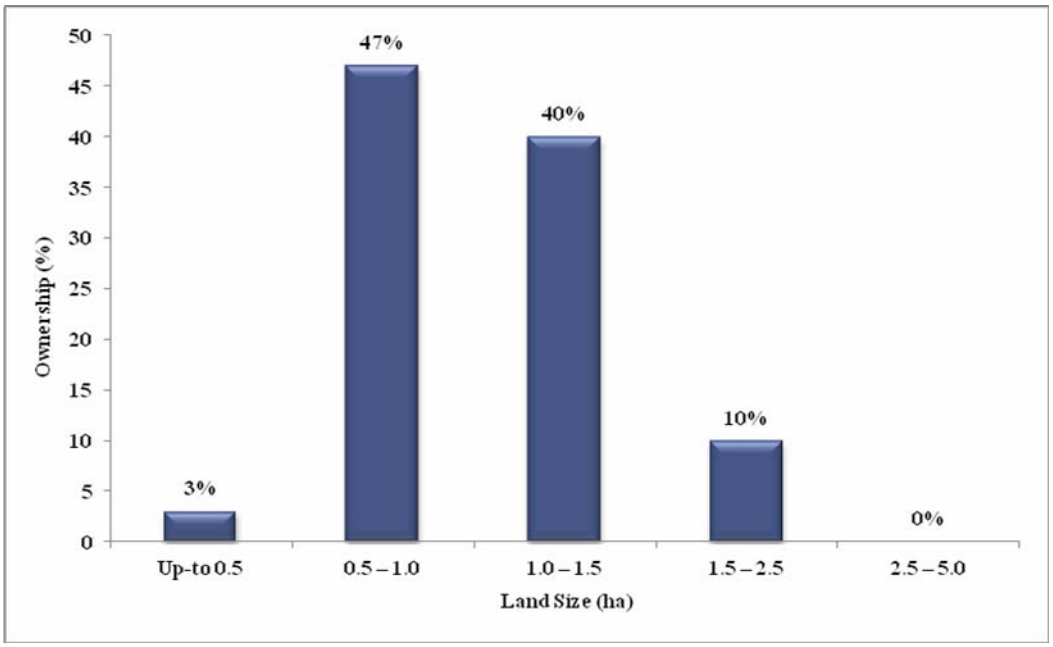


Figure - 6.8: Distribution of Households by Agricultural Land Size

Source: *Sample Based Socio-economic Survey, 2011*

Figure shows that most of the landholdings in the project area are quite small. None of the household has more than 15kanals of land.

The actual size of the land is not confirmed because land measuring system is not existed in the area. People have just marked the boundaries as done by their forefathers. Moreover, no cadastral records are available with Revenue Department.

6.4.16.2 Incomes Levels

Socioeconomic survey shows that government jobs and agriculture are the main source of income for the respondents. About 6% households have income below PKR 7,000, 30% between PKR 7001 to PKR 10,000 and 64% have income level more than 10,000 but less than 15,000. **Figure - 6.9** shows the distribution of Households by Average Monthly Household Income.

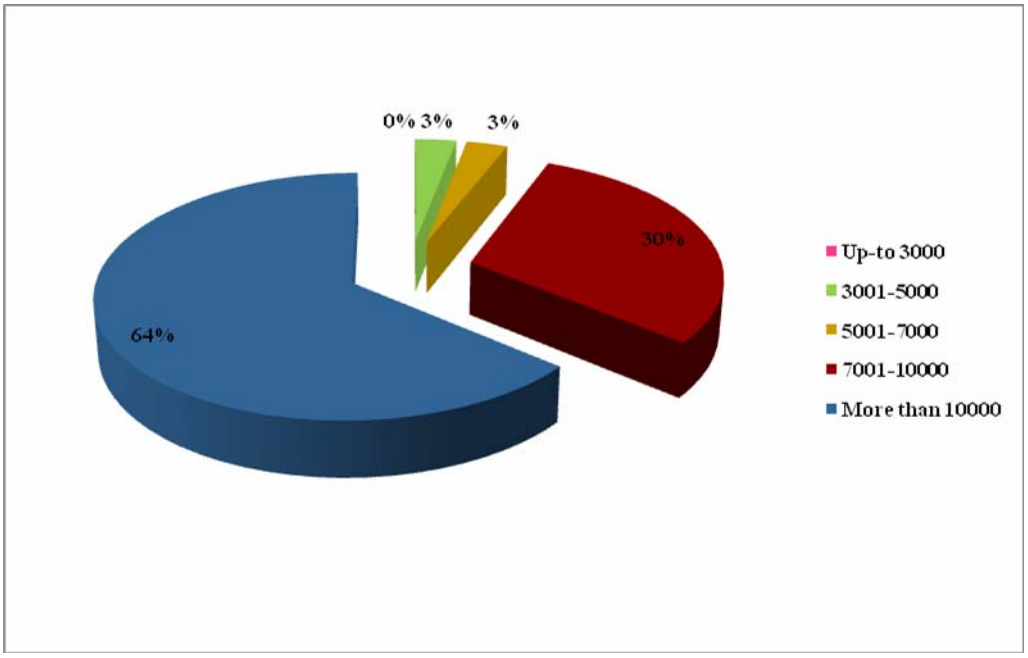


Figure - 6.9: Distribution of Households by Average Monthly Household Income

Source: *Sample Based Socio-economic Survey, 2011*

6.4.16.3 Language Spoken

Ghizar district has a remarkable cultural and ethnic diversity. According to the survey results, more than 95% people of the project area are Ismalis whilst others belong to Sunni Sect of Islam. Four languages, Shina, Khuwar, Burushaski and Wakhi are spoken in the area. Shina is the local language followed by Urdu.

6.4.16.4 Housing

Housing condition is an important indicator for determining the economic conditions of the population as it reflects the financial position and living standards of the inhabitants. **Figure - 6.10** shows that 80 percent houses in the project area have plot area of about 15 marla with 5 - 8 marla covered area. Remaining 20 % of the houses have plot area of 10 - 15 marla. It needs to be noted that these values are based upon the information as reported by the respondents.

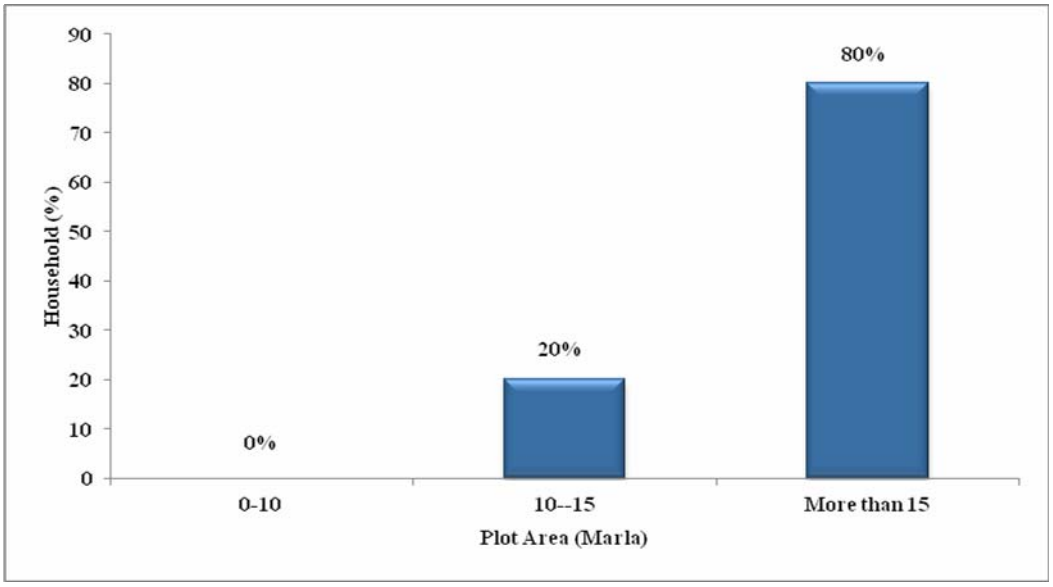


Figure - 6.10: Housing condition

Source: *Sample Based Socio-economic* Survey*, 2011*

Housing Condition

All the houses are built using stones and planks for walls and roofing respectively. Majority of the residents interviewed during the survey claimed to have lived in their respective areas since their birth or did not remember the exact period when their forefathers moved to the area. This is also reflected from the structures of their houses that are mostly permanent.

Number of Rooms

The surveyed houses have at least 3 to 4 rooms. The number of rooms depends upon the needs of the family. In larger families with marital extensions of sons, additional rooms are built to fulfil the additional space requirements.

6.4.16.5 Household Utilities and Appliances

Table - 6.14 provides a summary of the household utilities and appliances, for the households, located in the project area. These data are based on the census based physical and sample basis socio-economic surveys conducted by the environment team.

In the project area, river water and community water supply schemes are the major sources of water for the inhabitants of the area. The community water supply schemes are laid in both the surveyed villages by WASEP and Pakistan Poverty Alleviation Fund (PPAF).

More than 70% people are dependent on community water schemes and remaining on surface water resources. People showed their satisfaction on the availability, accessibility and quality of available water.

Sanitation facilities are also available in the area. About 90% households have sanitation facilities inside their homes while remaining used to defecate in open fields. More than 50% households of area use wood as cooking fuel. Cylinder gas and Kerosene Oil are also utilized but in nominal proportions as compared to wood either due to high cost or shortage of supply. A very small number of families own bigger assets like tractors, vehicles.

Table - 6.14: Household Utilities and Appliances

Utility/Appliance	Usage
Water Supply	(%)
Seepage of water from Lake	02
River water	05
Chhashi Gol water	06
Community water schemes	77
Sanitation	
Latrines inside house	90
Connection to drains/sewerage	0
Electricity	
Household connections	100
Fuel for Cooking and Heating	
Fuel-wood (by buying)	1
Fuel-wood (by collection)	66
Cow dung	0
Cylinder Gas	14
Kerosene	20
Household Appliances	
Television	43
Refrigerator	-
Washing Machines	10
Cart or a Tonga	6
Bicycle	16
Motor bike	-
Tractor	-
Source: *EIA-RAP Sample Socio-economic Survey, 2011*	

6.4.16.6 Transport and Travel Mode

Transportation and communication network is most important among the basic infrastructure. The development of the area is largely dependent of its efficiency. An efficient transport and communication system is not only pre-requisite for economic development but is also essential for economic cooperation among area, particularly trade and tourism.

Although the present network is not adequate even then Northern Areas Planning and Works Department NAPWD has been taken keen interest for the development of this sector. Mostly the valleys have been connected with jeepable tracks. Isolated villages have been connected with road head through bridges.

The main mode of transport among the local villagers is their own bicycle and motorcycles.

6.4.17 Street Condition

Both the setlement in the project area have unpaved streets with open side drains which serve as wastewater discharge channel.

6.4.18 Public Health and Health Facilities

The prevailing diseases that afflicted the residents of the surveyed settlement are skin and eye infections, asthma and bronchitis, probably caused due to extensive use of wood for heating and cooking. About 5% people are suffering from eyes and skin infections, asthma and pneumonia. Seasonal diseases like Cough, flu, fever etc are common. The children particularly are the more vulnerable to seasonal diseases.

No adequate health care facilities are available in the area. There are three (03) Basic Health Units (BHU) and 01 private clinic run by a medical. Serious patients are taken to the Gupis and Gahkuch for treatment.

6.4.19 Transport and Communications

The project area can be approached by travelling 165 km on metalled road from Gilgit towards Chitral. Northern Areas Transport Corporation NATCO is available from Gilgit to Gahkuch. This road will be used for the transportation of machinery, construction material and others for the project.

6.4.20 Power Supply

Both the settlements of the project area have been provided with power supply through 1 MW Hydel Power Plant at Shamaran village, 6 km downstream of the lake.

6.4.21 Telecommunications

According to the census based physical survey, there was no landline or other mobile networks available in the area except S. Com mobile service which is only used in Northern Areas.

6.4.22 Postal Services

Postal facilities in the project area are very poor. There is one post office in Phandar village which provides the services to the inhabitants of the project and adjoining areas.

6.4.23 Natural Mineral Resources and Archeology

No natural mineral resources and related mining activities are reported in the Ghizar District.

6.4.24 Cultural and Religious Resources

There is no archeologically and historically important site in and immediate surroundings of the project area. According to the census based physical survey, the project area has 4 mosques, 3 jamat khanas, 6 shrines and 2 graveyards. All of the mosques and jamat khanas do not have any historical or architectural value.

6.4.25 Tourism/Recreational Areas

Gilgit Baltistan is the most spectacular region of Pakistan in terms of its geography and scenic beauty. This area is well known because of its beautiful natural scenes showing snow covered peaks, multicoloured mountains, greenery in the form of different types of grass, shrubs and trees. Five out of the fourteen mountain peaks with height of over 8000 meters including the K-2 (world second highest peak) and some of the largest glaciers are located in Gilgit Baltistan.

A large number of tourist visits the area every year. The local communities get employment as tourist guides and transporters.

The project area (Phandar Lake) has great scenic value. It is approximately half way from Gilgit to Chitral. Tourists use to stay there while travelling to Chitral or Shandure. There are NAPWD rest houses and PTDC hotel in Teru and Phandar.

7 ENVIRONMENTAL & SOCIOECONOMIC IMPACTS AND MITIGATION MEASURES

This chapter presents the overall impacts and proposed mitigation measures for the proposed project during the construction and operational phase of the project on physical, biological and human environment of the project area.

7.1 ASSESSMENT PROCEDURES

The environmental assessment of the project is conducted, principally, within the framework of Pakistan Environmental Protection Act 1997, Pakistan Environmental Assessment Procedures (2000), World Bank Guidelines and Asian Development Bank Guidelines. For rating impact significance, the following criterion is developed by considering severity of risk on environment and human health, probability of occurrence, legal requirements and views of the interested / affected parties:

- NA – Not Applicable
- O – Insignificant (no or minimal impact);
- LA – Low Adverse (short term reversible or less damage)
- MA – Medium Adverse (long term reversible damage)
- HA – High Adverse (severe irreversible damage)
- LB – Low Beneficial (short term benefits or less beneficial)
- MB – Medium Beneficial (long term benefits)
- HB – High Beneficial (perpetual benefits)

7.2 SUMMARY OF IMPACTS

Checklist of environmental and social impacts is presented in **Table - 7.1.**

Table - 7.1: Summary of Impacts

Name	Presence of impacts		Nature of Impacts	
	Yes	No	Positive	Negative
Construction Phase				
Geology	√			√
Topography	√			√
Land sliding	√			√
Soil	√			√
Land and Land Use		√		
Flammable and Explosive Material	√			√

Name	Presence of impacts		Nature of Impacts	
	Yes	No	Positive	Negative
Borrow Areas/Excavated Material	√			√
Solid waste		√		
Surface Water	√			√
Air Quality		√		
Noise	√			√
Terrestrial Flora	√			√
Terrestrial Fauna	√			√
Aquatic Life		√		
Land Acquisition	√			√
Increased Traffic	√			√
Local Employment	√		√	
Cultural/Religious and Archeological Sites		√		
Local Economic Conditions	√		√	
Public Health & Safety	√			√
Local Social Order	√			√
Operational Phase				
Climate		√		
Surface Water Bodies		√		
Demolishing Material	√			√
Flooding		√		
Sedimentation		√		
Variation in Water Flows	√			√
Aquatic Life and Fish Species	√			√
Agriculture Land	√			√
Air Quality		√		
Civic Amenities	√		√	
Noise Pollution and Vibration	√			√
Women	√		√	
Local Public Health	√		√	

7.3 DESIGNING PHASE

This phase mainly comprises of comprehensive feasibility study of the proposed PHPP. There will be no any major physical interference during this phase except site inspection and other surveys for the completion of

feasibility study. Therefore, no significant environf73mental, socioeconomic and health impacts are envisaged at this stage.

Seismic Risk and Architectural Design

The project area is located at the edge of Eurasian and Indian Continental Plates. Thus, the area has been considered the centre of a number of major earthquakes of various intensities. In the past, the proposed project area has been severely affected by the tectonic activities.

October 08 2005 earthquake, which killed 80,000 people and many concrete building collapsed completely, was the strongest earthquake in the area during last 100 years. Earthquake risk in the area cannot be avoided as high seismic potential of the area can destroy the project activities both during the construction and operational phase. However, none of the project activities is likely to be powerful enough to influence the seismic hazard.

7.4 CONSTRUCTION PHASE

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction. Such impacts are related to soils (erosion and slope stability), water quality, air quality, noise, and disruption to the biological environment, public health, interruption of communications, at-risk population / safety, community stability, and cultural and religious values / properties.

7.4.1 Impacts on geology of the Area

The construction activities for the proposed project interventions involving cutting of rocks, large scale excavation, dumping of soil and blasting for tunnel formation and to create space for accommodating power house upto foundation level will disturb the stable geological formation of the area. As a result, features of the geological formation will be damaged at some places but the impacts will be in the category of low adverse.

Mitigation Measures

All the aforementioned activities cannot be avoided during the construction phase Therefore; following mitigation measures should be taken into account in order to minimize the adverse impacts:

- It is suggested that blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material.

- Increased number of blasts with low intensity explosive material should be preferred rather than high intensity single blast to avoid the noise impacts on the surroundings and excessive damage to the surrounding rocks.

7.4.2 Impacts on topography of the Area

Construction activities of Phandar Hydropower Project are not expected to impact the topography of the area significantly except for those areas where physical activities including digging and excavation areas, storing or dumping sites for excessive material, storing areas and movement of heavy construction machinery will be carried out. The area where excavated material is to be dumped will also be negatively impacted. However, impacts would be low adverse.

Mitigation Measures

A detailed development and operation plan for borrow areas must be prepared by the contractor at the pre-development stage (before the start of extraction of material from each borrow area). Contractor should strictly follow the provisions of approved plan in order to minimize any negative impact associated with the borrow areas. Likewise, excavated material should be dumped at suitable and approved disposal sites.

7.4.3 Impacts on land sliding

High seismic potential and unstable geological formations are two major causes of land sliding in the area. The formation at some places of the project area may become loose due to the blasting of rocks. This will increase the risk of land sliding in the surrounding of the construction sites. The impacts of land sliding will be in the category of medium adverse.

Mitigation Measures

Blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material.

7.4.4 Impacts on Soil

The soil related issues include soil erosion and slope instability, failure to rehabilitate the borrow areas and soil contamination by the spillage of chemicals like fuel, construction chemicals and concrete. This usually happens when these materials are carelessly handled or transported in open and loosely capped containers. The contamination of soil at campsites, workshop areas and storage areas may limit the future use of land.

The construction of power house and access roads to power house, weir site and power intake structure will require the removal of natural vegetation cover and large number of trees. Approximately, 617 trees will be removed for the construction of above mentioned structures. This activity may cause the slope destabilization owing to the erosion caused by the removal of vegetation cover. The impacts on soil due to large scale construction activities will be high adverse.

Mitigation Measures

Good engineering and biological practices will help to control the soil erosion in the project influence area. Soil erosion remedial measures should be based on the geotechnical and geomorphic conditions of the project area that vary from site to site.

As a biological solution, "Plantation plan" should be developed and implemented by the supervisor engineer. Plantation plan should include the identification of affected areas, unstable slopes and the type and number of trees to be planted. It is suggested that against cutting of 617 trees management should make a provision of compensatory plantation at the ratio of 1:2 (two trees should be planted for every tree to be cut). Plantation should comprise of fast growing native trees with deep root system for anchoring the soil material.

7.4.5 Impacts on Land and Land Use

Land use pattern of the project area have been studied through GIS maps. GIS maps have been prepared showing the quantification of the areas to be occupied for the proposed PHPP. These areas include agricultural land, construction camps site, residential area, access roads and office area. Extended weir site, site for power house and disposal and storage areas. No area will be submerged due to the proposed PHPP project. **Table - 7.1** below shows the existing use of land to be acquired for the proposed project.

Table - 7.1: Existing use of land of the project area

Sr. No.	Project component Location	Land use classification	Estimated Area (Kanal)	%age of total area
1	Left Bank of Weir	Agricultural	22.79	4.55
2	Right Bank Weir / Connecting Channel	Agricultural	6.82	1.36
3	Right Bank Bund Protection	Agricultural	64.04	12.80

Sr. No.	Project component Location	Land use classification	Estimated Area (Kanal)	%age of total area
4	Road to Weir	Mountainous	29.10	5.82
5	Power Intake	Mountainous	4.38	0.88
6	Low Pressure Conduit	Mountainous	81.61	16.31
7	Penstock	Mountainous	37.91	7.58
8	Powerhouse	Agricultural/Mountainous	37.33	7.46
9	Road to Powerhouse	Agricultural/Mountainous	118.58	23.70
10	Offices / Residences	Agricultural/Mountainous	49.62	9.92
11	Contractor's Camp (Weir / Power Intake)	Mountainous	8.25	1.65
12	Contractor's Camp (Powerhouse)	Agricultural/Mountainous	28.85	5.77
13	Stockpile / Storage	Agricultural/Mountainous	11.39	2.28
	Total (Approximate)		500.32	100

The total area likely to be acquired for the project components, colonies and other infrastructure is 500.32 kanals. The existing land use pattern will be changed due to the construction of project interventions in the area. However, the impact will be insignificant.

Mitigation Measures

It is suggested that local stakeholders are brought on-board early in the process to identify sensitive land uses, issues, and local plans and laws.

7.4.6 Impacts of Flammable and Explosive Materials

Explosive materials will be required for rock excavation during the tunnel formation, low pressure conduit and penstock installation. Other major flammable materials to be used during the construction activities include diesel, furnace oil, petrol, LPG, kerosene oil and machinery fuels.

These materials present little risk to the environment, if properly transported stored and used; otherwise they are potentially very dangerous. Improper storage and handling practices for these flammable and explosive materials can pose dangers of fire and blasts in the area. The impacts will be in the category of high adverse.

Mitigation Measures

Large amount of flammable materials and explosives will be used throughout the project construction. Safety procedures should be developed and followed by the contractor and labour strictly while using, handling and storage of these materials and explosives. Contractors should be provided written instructions about the methods and safe practices of using flammable materials and explosives.

For safety of construction labour and immediate communities, it is suggested that contractor's staff should be trained about the procedures of blasting, safe use, handling and storage of materials.

7.4.7 Impacts of Borrow Areas/Excavated Material

During the construction phase of the project, substantial quantity of excavated material including gravel, soil and sand will be generated from the excavation activities. As per detailed engineering design report, excavation is required for the following structures.

- 250m long trapezoidal channel to connect the weir site with Phandar lake;
- 300m long low pressure concrete lined channel with internal diameter of 5m;
- 663m long low pressure conduit to convey the designs flow will be laid in the trench up to the penstock; and
- 52m long and 20m wide tail race channel to discharge the outflow from power house into Chhashi River.

The extent of the negative impacts will depend upon their disposal practices. Unsafe disposal of excavated material may not only create the environmental degradation but also a nuisance for the surrounding community. Moreover, borrow areas, if left open, may prove hazardous to human beings, wildlife and livestock of the area. Impacts of borrow areas are envisaged in the category of medium adverse.

Mitigation Measures

The followings measures are proposed in order to reduce the negative impacts on the environment:

- Emphasis should be to decrease the volume of mucking material by reusing and then the disposal at the marked area in environment friendly way;
- In order to reduce the volume of disposal material, maximum part of the excavated material can be used in other activities like construction of coffer dam and filling of borrow areas and natural depressions in the project area.
- In order to increase the aesthetics of the area, native grass can be planted by dumping the surplus material in the proposed residential colony with suitable soil cover;
- As per "Detailed Engineering Design Report", surplus borrow material will be disposed at the "marked disposal site" to be constructed between Phandar Lake and Weir site. It is suggested that area should be properly levelled after filling so that it might bring into some other use.

7.4.8 Impacts of Domestic Solid Waste

The main sources of solid waste, associated with the construction of the project are domestic solid waste from Contractor's camps, office buildings and housing facilities. Indiscriminate disposal of solid waste may lead to generation of obnoxious smells/odour and adversely impact the aesthetic condition of the land besides land pollution. Impact of domestic solid waste will be in the category of insignificant.

Mitigation Measures

It is proposed that domestic solid waste from all the sources should be collected at a common point and then safely disposed off only in demarcated waste disposal sites.

7.4.9 Impacts on Surface Water

During the construction phase, the surface water bodies may get impacted from the following potential sources, if proper control measures are not exercised:

- Sewage effluent from Contractor's Camps and residential facilities;
- Construction site runoff and general construction activities

The turbidity level in downstream of weir site, lake and Chashi Gol near the power house will increase significantly due to settling of particulate matter to be emitted from project construction activities and movement of heavy construction machinery and equipments. However, the extent of surface water pollution will depend upon the implementation of pollution control measures.

The project activities will be completed in thirty six months. About 250 Nos, of workforce and 76 professional staff will be required for the project. Total water requirement for the staff will be approximately 73m^3/day. As per standards, 80% of water supplied will be generated as sewage. The sewage, if disposed without treatment may increase the pollution load of receiving body. Considerable quantity of water will also be used during the construction activities. Runoff from construction work area contains increased sediments load and suspended solids. Sediments laden runoff, if uncontrolled, may carry the pollutants into the water bodies. Impacts on surface water bodies will be in the category of low adverse.

Mitigation Measures

- As per Detailed Engineering Design report, the sewage will be discharged into a screening chamber/septic tank and sewerage treatment plant. Heavier and suspended solids will be removed periodically and sewerage wastewater will be allowed to flow into Chhashi Gol. According to the National Environmental Quality Standards, BOD of all the surface discharges from domestic wastes should not exceed 80 mg/l.
- Water should be sprinkled during the construction phase of the project in order to reduce the dust emissions from the construction activities especially during construction of roads and blasting activities.
- Settling ponds should be constructed to improve the quality of final draining effluent from construction areas.

7.4.10 Impacts on Air Quality

Presently, the air quality of the area is good but the construction activities at large scale will invariably result into pollution of the ambient air. The major sources of air pollution will be emissions from crushers and concrete batching and mixing plant, blasting operations, increased vehicular traffic, surplus material disposal and storage of construction material.

The operation of crushers during the construction phase will generate the fugitive emissions comprising mainly the particulate matter. Approximately 72,000 tonnes of aggregate of different sizes will be required for the construction proposed PHPP. In order to meet this requirement, three plants for crushing screening, sand milling and washing with the combined capacity of 200 to 300 tons/hour will have to be installed at different sites. Two concrete batching plants with the effective mixing capacity of 30m3/hour will be installed for preparing the concrete. Much of the fugitive dust generated by crushing activities consists of relatively large size particles, which are expected to settle within a short distance from their source.

Since, both the settlements Phandar and Chashi are located at a fair distance from the site therefore, no major impacts are anticipated. Dusty environment at the project site will cause adverse health impacts on the labours working near the crushing plant.

Exhausts of the construction machinery, equipment, and construction materials transport vehicles, mostly diesel based employed for the project, will emit the SO_2 to the environment. The short term increase of this pollutant will be quite low hence; no major impact is expected on this account on ambient air quality.

There will be increased vehicular movement for the transportation of construction material and equipments to the project area. Marginal increase of emissions including SO_2 and NO_2 is expected for a short duration. No major impacts are expected as these emissions are released at ground level which donot trevel for long distances.

Large quantities of construction material will be stored at the project site. Some of the stored material may get entertained into the surrounding environment due to the blowing of wind. However, the impacts will be insignificant and visible on around the storage site.

Table - 7.2 shows the impacts of air pollutants on Environment and Human Health, if they exceed the permissible limits.

Table - 7.2: Impacts of Air Pollutants on Environment and Human Health and Life

Parameter	Impact
Particulate Matter	➢ Damage to plants by restricting photosynthesis ➢ Impairment of atmospheric visibility ➢ Deterioration of aesthetic quality of atmosphere, land and water ➢ Increase in the frequency of respiratory infections such as bronchitis
Oxides of Sulfur	➢ Chlorosis in plants ➢ Serious lung damage, particularly in sulphate form ➢ Respiratory diseases like Chronic bronchitis
Oxides of Nitrogen	➢ Retardation of growth in plants ➢ Reduction in oxygen carrying capacity of blood ➢ Impairment of olfactory sense and night vision ➢ Dryness and roughness of the throat

Mitigation Measures

- Crusher and concrete batching plants should be installed at a fair distance from Chashi and Phandar village. Moreover, It is recommended that crushers should be equipped with dust suppression equipment comprising of scrubber and water sprays. This will significantly reduce the amount of dust released from the crushing plant.
- Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area;
- Personal protective equipments including, dust masks and ear plugs should be provided to the drivers and labours working in dusty environment.
- Minimize drop heights when loaders dump soil refuse into trucks and cover dump trucks before travelling on public roads; and
- Emissions from power generators and construction machinery are important point sources at the construction sites. Proper maintenance and repair should be undertaken to minimize the hazardous emissions.
- Maximum speed limit should be imposed on all internal access roads by use of speed bumps and appropriate road signage.

7.4.11 Impacts of Noise on Workers and Residents of the Area

Noise is a bye product of human activities and potentially a serious pollutant and threat to human health. Major sources of noise during construction phase of the project will be rock blasting activities by means of explosives, excavation machinery, operation of heavy construction machinery and equipment and stone crushing plants. With regards occupational exposure, construction labour are the most likely to be exposed to the potential impacts of high noise levels. Continuous exposure to high noise level above 90dB effects the hearing perception and thus, should be avoided. However, the residents of both the settlements will not be disturbed as these settlements are located at a fair distance from the project construction site. The impacts of noise on locals and construction workers will be in the category of insignificant and low adverse respectively.

Table - 7.3 below shows the maximum limit of noise exposure specified by OSHA.

Table - 7.3: Maximum Limit of Noise Exposure Specified by OSHA

Noise Levels dB(A)	Unprotected Exposure Period/Day (Hours)
90	8
95	4
100	2
105	1
110	1/2
115	1/4
120	No exposure permitted at or above this level

Blasting and heavy construction machinery will be the major source of vibration. Vibration level during blasting activities are expected to be low therefore, no negative impacts are anticipated.

Mitigation Measures

- Local community should be informed prior to starting the blasting activities;
- Low intensity explosive should be used in blasting activities instead of high intensity blasting material; and
- Ear plugs should be provided to the workers and drivers working in noisy environment.
- The noise levels should be kept under the permissible limit. otherwise these may cause the adverse impacts depending upon the intensity of noise

- Construction contractors should maintain heavy-duty machinery in good operating condition.
- Noise levels should be monitored near the sensitive points periodically. if levels exceeds the permissible limits then appropriate measures should be taken.

7.4.12 Impacts on Terrestrial Flora

The detailed description of the terrestrial flora of the project area has been discussed in chapter 6. The major flora of the project area comprised of trees and shrubs. Large number of trees and bushes will be uprooted for the construction of powerhouse, access road to weir site and powerhouse. Moreover, construction workers have the potential to increase the pressure on the resources of the project area if they are allowed to cut the trees for fuel consumption.

Uncontrolled movement of heavy machinery used for setting up the contractor camps, concrete mixing and batching plant, crusher plants might cause damage to the natural vegetation. Dust generated due to the vehicles movement will settle on the leaves of plants, thus reduction in the amount of sunlight falling on the leaves. This will reduce the photosynthetic process.

The level of severity of the impacts on flora of the project area depends upon the management practices and mitigatory measures adopted during the construction phase. Based on the previous experience, the impacts on the flora are anticipated to be low adverse.

Mitigation Measures

It is proposed that the potential damage should be mitigated right from the beginning of the construction activities.

- Site Engineer will develop and implement a tree plantation plan to compensate for the loss of trees. It is suggested that three trees should be planted for every tree to be cut.
- It should be part of the contract of the Contractor that they will ensure that vegetation of the area will be protected from the project construction activities as much as possible;
- The Contractor will arrange training for its team, on importance of vegetative cover, and how it can be protected;
- Briefings should be arranged for the drivers of the vehicles about the allowed routes for plying vehicles;

- Vegetation should only be cleared when absolutely necessary. If possible, vegetative cover should be left in place; and
- Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area. By controlling the dust emissions, the settling of the dust particles on the plants leaf can be avoided.

7.4.13 Impacts on Terrestrial Fauna

The presence of fauna in any area mainly depends upon type and nature of flora. It provides food, resting, hiding and breeding sites to all types of animals. Terrestrial fauna of the project area consists of common domestic nature animals and some wild animals and reptiles.

Domestic animals are represented by the animals of local importance including goats, sheep, cows and donkeys. These animals are dependent upon natural vegetation due to insufficient patches of grazing land in the area. Removal of vegetation cover at some sites during land clearing activities will negatively impact the fauna of the area.

During the construction period, movement of construction material and equipment carrying vehicles and workforce may interfere in the movement of fauna. Since, domestic animals are guided and controlled by the herder and therefore, any causality in terms of accident is not anticipated. Operation of various machinery and equipments will generate significant noise especially from crushing plant; blasting and excavation activities will have negative impact on the fauna of the area.

No endangered or threatened species were reported in the project area. Therefore, adverse impacts on endangered or threatened species are excluded. Some birds may leave the area due to the noise and blasting activities. There will be adverse impacts on the insects of the area. It is anticipated that large number of insects will be killed owing to construction activities and movement of vehicles. All the impacts on terrestrial fauna will be of temporary nature and will end with the completion of the project.

Mitigation Measures

- In order to reduce collisions of vehicles with fauna, speed limits should apply to all roads and vehicle using the site, a maximum of 40 km/h is recommended
- The collection, hunting or harvesting of any animals at the site should be strictly forbidden;

- Construction contractors should maintain heavy-duty machinery and vehicles in good working condition in order to stop or reduce any oil leakage or spillage from the machines; and

7.4.14 Impacts of Aquatic Life

During the construction phase, the flow pattern in the river will not be changed except at the coffer dam site (constructed at weir upstream for excavation on right bank). Therefore, the impacts on aquatic life will be insignificant.

7.4.15 Impacts of Land Acquisition

The total land required for the construction of proposed project is 500.32 kanal. Most of the land required for construction of proposed project components belongs to locals of project area. The impact of land acquisition would lead to loss of livelihood and agricultural land. Therefore, the impacts would be medium adverse.

Mitigation Measures

It is recommended that judicious compensation based on marker rates should be paid to the affected families.

7.4.16 Impacts of increased traffic

The project area is mainly accessible through Gilgit-Chitral road. At present, the traffic volume is not high on this road. However, when construction activities will start, traffic volume will increase due to the addition of heavy loaded construction material and equipment carrying vehicles. Movement of trucks and heavy transport of material may also cause the traffic congestion. This situation will continue during entire construction period. Traffic volume will further increase during the peak tourists season who will use this road to reach Shandoor. Additionally increase in the traffic load will make the road busy and risky for local people. The impacts due to increased traffic will be in the category of medium to high averse.

Mitigation measures

Construction contractor will prepare a Traffic Management Plan (TMP) in order to ensure safety to all road users. The plan will ensure the efficient operation of the road together with the construction activities. TMP will show the access roads for vehicles, speed limits, safety signs and lane restriction where applicable. The contractor will submit this plan to supervision consultant for review and approval.

7.4.17 Impacts on Local Employment

The construction phase of the proposed project will be completed within 36 months. About 250 Nos. of workforce together with supervisory staff will be required for the project construction. Most of the skilled manpower will be from Gilgit-Baltistan. Locals will get the limited job opportunities as unskilled or semi skilled labour. It has been observed in the mega projects like hydropower that the major work is contracted out who bring their own skilled labour. Job opportunities impact is considered as positive impact of the proposed PHPP.

7.4.18 Impacts on Cultural/Religious and Archeological Sites

No site of archeological, cultural and historic importance has been reported in and around the project area. Thus, no impacts on such structures/sites are envisaged.

7.4.19 Impacts on Local Economic Conditions

Apart from the direct construction related jobs for the locals, other indirect work opportunities will also be generated due to the proposed project which will provide impetus to the local economy of the area. Commercial activities including food stalls, tea stalls, shops and transportation activities will be increased. The locals will avail the opportunities due to the initiation of the proposed project in the area and increase their income levels. The impacts are envisaged in the category of medium beneficial.

7.4.20 Impacts on Public Health and Safety of the Local Population

Following are the key public health and safety concerns associated with the construction activities of the project:

- Increased air pollution levels in the atmosphere are the source of greatest concern from public health point of view; and
- Most of the public and workers safety hazards would be associated with the operation of construction machinery and equipment, transportation and blasting activities. The causes of safety hazards generally involve human errors, operational faults of machinery and unforeseen incidences.

The impacts on public health and safety are predicted as low adverse.

Mitigation Measures

- Project Environment Management Unit or contractor will employ a safety officer during the construction stage. The contractor should develop health and safety plans to prevent the accidents.
- Appropriate PPEs should be provided to the workers
- Training sessions should be arranged for the workers regarding complete understanding of operating procedures and risks associated with the construction activities

7.4.21 Impacts on Local Social Order

The influx of large work force including skilled, semi skilled and unskilled labour in the project area, during construction period, may disturb the local communities and create social and cultural problems. Most of the trained labour force will come from other parts of the country while some of the locals will also be hired. This manpower will stay in labour camps, residential colonies and contractor's camps to be constructed near or in the settlements. Adverse impacts are anticipated to be appeared due to the intermixing of labours with the local communities. Difference in cultural and social values among the locals and workforce may create tensions and conflicts and some serious law and order problems. The impacts on local social order will be in the category of medium adverse.

Mitigation Measures

- The control of such situations shall be exercised by including appropriate clauses in the construction contracts, which shall comprise the regulations on the workforce necessary to avoid any law and order situation; and
- Security guards and police constables should be appointed in the project area to cope up with any mishap and to control the law and order problems.

7.5 OPERATIONAL PHASE IMPACTS

7.5.1 Impacts on Climate

There will be no major hydrological change due to the implementation of the project that is expected to impact the local climate of the area. No reservoir will be constructed for water storage. Water lost into the atmosphere in the form of vapours will not affect the local climatic conditions of the project area as the lake and river are existed in the project area for several years. As the proposed project will not have any impact (positive or negative) on the climate of the area therefore, no mitigation measures are required.

7.5.2 Impacts on Surface Water Bodies

During operational phase, the source and causes of water pollution will be different from construction phase. The main sources of effluent will be residential colony for operational and maintenance staff, school and dispensary. As, all these sources will be connected with sewerage treatment plant and other facilities therefore, no adverse impact are anticipated on receiving water body as a result of disposal of treated effluent.

Mitigation Measures

It should be ensured that sewage from all sources be treated in sewage treatment plant so as to meet the national effluent standards.

7.5.3 Impacts of Demolishing Material

Prior to start the operational phase of the project, concrete batching and mixing plants, coffer dams, labour camps and other temporary structures will be demolished. The large quantity of debris produced will require environmentally safe disposal to avoid environmental degradation. The impacts will be in the category of low adverse.

7.5.4 Impacts of Flooding

There will be no back water effect on human settlement and agricultural land upstream both under flood condition and normal flow period. During high flow period, the water level in Ghizar river will not be significantly changed. A small rise in water level would spread the river over the alluvial terrace on the left bank of the river. The low height weir (1.50m) will become completely submerged and it will not raise the water level in Ghizar river.

7.5.5 Impacts of Sedimentation

The Ghizar river have the sediments in different concentrations which differ depending upon the discharge. The average annual discharge at weir site is calculated to be 31.7m^3/s. Total sediments expected to reach the weir site during the normal flow period is estimated to be 14,400 Tons/Year. In the case of extraordinary events, heavy sediment load of 28,800 Tons/Year will be transported by the river which could enter the intake of connecting channel.

Sediments will progressively accumulate in the area upstream and pass over the weir in times of flood. As, the sediments will be released with high velocity water therefore, the morphology of the river will not be changed below the weir and sediments will move far away from the weir site with high velocity water. The impacts due to sedimentation will be insignificant.

Mitigation Measures

The sediments clearing mechanism has been provided in "Detailed Engineering Design Report through sluiceways. Four under sluices 2m×2m will be constructed adjacent to the connecting channel intake on the right side of the weir.

7.5.6 Impacts of variation in Water Flows

The water flow pattern from downstream of weir site will change as significant volume of water will be diverted towards reservoir. The variation in flows will directly impact the operation of plant, downstream aquatic life and community. During summer operation, plenty of water is available in Ghizar river. Therefore, downstream flow variation is not expected to be significant. However, during winter season, the flow becomes low. The flow variation is expected to become more critical during winter months when plant will operate only during peak hours and maximum possible power output is required. This output depends upon the available flows in the river and storage capacity of reservoir.

There is minimum human population along the banks of river downstream the weir site using river water. Therefore, no negative impacts are anticipated on human population owing to the change in the hydrology. However, reduction in river flow will adversely impact the aquatic life specially fish population

Mitigation Measures

It should be obligatory for the project to release minimum water flow downstream the weir site throughout the year as environmental flow.

7.5.7 Impact on aquatic life and fish Species

Ghizar River and Phandar Lake are the principal natural habitat of aquatic fauna, mainly fish, in the project area. The movement of fish will be affected by the intake structure and weir in Ghizar River.

The construction of weir on Ghizar River will reduce the downstream flow in winter season. The change in flow pattern will affect the aquatic fauna and fish species present in the area between weir and Chhashi GoI confluence.

Following impacts on trout fish are associated with the PHPP :

- According to Director Fisheries GB, weir construction obstructs the free movement of fish along the course of water. There is no

seasonal migration in trout fish. Fish can move upstream and downstream in any season in search of food;

- The trout required shallow water spots in their breeding season (October – February). The water level is already quite low during abovementioned period. Moreover, construction of weir will not only further decrease the quantity of water in downstream but also obstruct the movement of trout to reach the spawning habitat of trout fish which could be upstream or downstream of the weir;
- After the construction, some of the original fish population would not be able to adapt to the new environment, though most of them are expected to survive;
- Fish migrating downstream and upstream may encounter altered ecosystems and barriers that impact their ability to survive; predation from other species also has an impact; and
- Construction of weir will also contribute in developing a new habitat for fish.

The impacts on fish species are foreseen in the category of low adverse.

Mitigation Measures

Following mitigation measures are proposed to minimize the impacts on aquatic fauna.

- While designing the project special attention should be given to ensure to plug off the leakages of oil and other chemicals dispersants from turbine and machine engines to avoid hazardous affect on aquatic life;
- Appropriate sized fish ladders should be provided to ensure the free movement of fish from downstream to upstream and vice versa. Ladder will also help to protect the fish spawning habitat during their breeding season (October – February). The gradient of the ladder should be almost same like the weir area. Normally trout fish requires 1.2 m/s velocity of water and 1-2 feet depth of water for their easy movement (Director Fisheries GB)
- Fish traps should be used to stop the fish movement to the intake structure, tunnel, etc;
- For management and conservation of fisheries, certain conservation and management staff should be recruited on recommendation of Fisheries Department, GB;

- Director fisheries have recommended that 0.5 m^3/s minimum flow should be released constantly to compensate the fish movement in winter season;
- Fish hunt should be prohibited with net, cages and by the use of dynamite;
- Fisheries Department must be consulted at all stages as it is the obligation of the department to manage all natural water resources in GB as per provision of existing Fisheries Act and Rules 1975.

7.5.8 Impacts on Agricultural land

As discussed in Chapter-6, people of Chashi Gol rely on seepage flow for irrigation and domestic purposes. After the construction of weir, the seepage may reduce which will ultimately affect the residents of Chhashi village and agricultural land. The impacts will be in the category of medium adverse.

Mitigation Measures

It is proposed that issue of water requirement for Chashi Gol residents should be incorporated in the overall design of the project. Moreover, if water supply through seepage flow is completely disconnected then alternate sources should be identified for irrigation and drinking water.

7.5.9 Impacts on Air Quality

Generally, the air quality of the area is good. During the operational phase, the air of the area will improve as compare to the construction phase of the project owing to the less movement of vehicles in the area.

7.5.10 Impact on Civic Amenities

The accessibility to the project area will be improved due to the construction of link roads and widening of Gilgit Chitral road. Schools, mosques, dispensary will be constructed for the project staff but after the completion of the project these facilities will also be available for the locals of the project area. The impacts will be in the category of high beneficial.

7.5.11 Noise Pollution and Vibration

The principal sources of noise and vibration during the operation phase include Intake Structure, Tunnel, Valve House and Powerhouse. The noise levels measured by at the project site were within the permissible limits of NEQS but during the operational phase the noise levels may increase.

As a reference, Terbela and Ghazi Barotha Hydropower Projects has 70-80 dB-A noise levels at 250 meter distance downstream from the Powerhouses *(EIA of Akhori Dam)*. There is chance of increase in noise level at Chhashi Gol where the existing noise levels are around 50-60 dB-A. Noise levels above the permissible limits result into various health impacts depending upon the intensity of noise. The impacts will be in the category of low to medium adverse.

Mitigation Measures

- Best practices should be employed in all noise generating activities. These include the proper maintenance of the pumping equipment and the proper muffling of operating equipment;
- Plantation of trees and other vegetation will also help to attenuate the attenuate the noise impacts to the surrounding area.

7.5.12 Impacts on Women

Women of the project area will also be capable to use the project facilities including schools and dispensary. Therefore, positive impacts are anticipated on the females of the area.

7.5.13 Impacts on Local Public Health

There area is lacking in health facilities. After the construction of this project, better health facilities will be available in the area which is a positive impact of the project.

8 PUBLIC CONSULTAION & INFORMATION DISCLOSURE

8.1 GENERAL

This section describes the outcome of public consultation sessions held with different stakeholders that may be affected from the implementation of Phandar Hydropower project at Ghizar River.

8.2 BACKGROUND

The Government of Pakistan and the funded agencies including the World Bank demand meaningful consultations with the project affected people of the area and other stakeholders for determining the environmental and social impacts related with the proposed project. Therefore, an attempt has been made to consult a full range of stakeholders including Government Departments, NGOs and project affected people[1] in accordance with the statutory requirements of Government of Pakistan and World Bank operational policies.

The public consultations, which have become a standard practice in mega development projects, are carried out to ensure that adequate and timely information is provided to project affected people and all other stakeholders and that they are given sufficient opportunity to voice their opinion and concerns. Involvement of stakeholders in true sense not only improves the social acceptance of the project but also ensures the participation of the stakeholders in the process of project development.

8.3 CONSULTATION OBJECTIVES

The objectives of public involvement were as follow:

- To inform the stakeholders and project area community about what is being proposed and provide them the key project information;
- To have interaction with the community of the area and other stakeholders for primary and secondary data collection;
- To identify the social and environmental issues related to the implementation of PHPP in order to avoid any subsequent conflict;
- To manage expectations and misconceptions regarding the proposed project and;
- To receive the feedback from primary as well as secondary stakeholders

[1] For Phandar Hydropower project, project affected people are those whose land will be acquired for the construction of project components. No resettlement is involved in PHPP.

8.4 STAGES OF CONSULTATION PROCESS

Public consultation process has been carried out in two stages at the planning and designing stage of the project. At the first stage, community residing in the project affected area has been consulted. Feedback from the community regarding location of ancillary facilities for the project was considered at the designing of the project for the selection of the sites in the area. Views of community regarding issues associated with the proposed project have been considered to identify the potential impacts from the PHPP and also to develop the mitigation strategy for minimization of those impacts. Project affected people and other stakeholder departments were consulted in the second stage. This consultation will continue during the operational and monitoring phase of the project.

8.5 METHODS USED FOR CONSULTATION PROCESS

Following tools of consultation were used for the proposed PHPP.

- Semi structured interviews
- Interviews with the land affected population
- Scoping sessions
- Meetings with the stakeholder Departments

a) Visit to the Stakeholder Government Departments and NGOs

All the relevant stakeholder government departments and NGOs having direct or indirect relation with PHPP were visited between May 19, 2011 to May 27, 2011. Meetings were held with the representatives of these departments in order to;

- Inform them about the hydropower project in the area, features of the proposed project and issues associated with the projects;
- Obtain their views on social acceptability of the project in the particular area
- Get information about compensation process for each type of land to be acquired for the construction of project components;
- Obtain information about endangered and threatened species in the area, any protected area and vulnerable groups in the vicinity;
- Increase the confidence of the people on the project by involving the people of the area from all walks of life.

Table - 8.1 provides the list of the departments visited and name of contacted persons in order to get the relevant information. **Table - 8.3** gives the summary of feedback.

Table - 8.1: List of Department Visited

Department/ Organization Visited	Date of Visit	Person Contacted	Designation
Environmental Protection Department, GB	May 19, 2011	Mr. Shehzad Hasan Shigri	Director
Gilgit Conversation & Information Centre (CIC) WWF	May 19, 2011	Mr. Farasat Ali	Conservation Officer
Tourism Department, GB	May 19, 2011	-	Director
Agriculture Department,GB	May 20, 2011	Mr. Azam	Director
Fisheries Department	May 20, 2011	Mr. Ghulam Abbas	Director
Livestock Department, GB	May 20, 2011	-	Director
Forest Department, GB	May 21, 2011	-	Director
Revenue Department District Ghizar	May 25, 2011	Mr. Mirza Ali	Patwari
Forest Department, District Ghizar	May 25, 2011	Mr. Raja Alamgir	DFO
National Highway Authority (NHA)	May 27, 2011	Engr. Abdullah Jan	General Manager (GM)

Exhibit - 1: Meeting with Director EPA Gilgit-Baltistan

Exhibit - 2: Meeting with Director Agriculture Gilgit-Baltistan

Exhibit - 3: Meeting with Director Fisheries

Exhibit - 4: Meeting with Director Forest Department, GB

Exhibit - 5: Meeting with Director Livestock-GB

Exhibit - 6: Meeting with Patwari, District Ghizar

b) Scoping

Scoping sessions in the project area were arranged in Phandar and Chashi Gol Village. Residents of these villages were informed in advance about the purpose of the meeting so that all the interested people could attend the sessions regardless of their gender, religion, ethnic and age.

Separate sessions were held in both the villages. The location selected for consultation was accessible to all who wanted to attend. The community of the area was briefed about the proposed PHPP in the area, overview of the nature of construction activities and details of the land to be acquired for the implementation of the project. In these sessions, discussions were held and community was provided an opportunity to ask any question regarding the proposed project.

To ensure that project affected people had equal opportunity to receive project information and raise their concerns following approaches were used:

- Sufficient time was given to the participants so that they could voice their concerns both in written form. After the consultation sessions, a resolution from the residents of project area regarding the proposed project was submitted to the consultant team which is attached as **Annexure - O.**

- Participants were allowed to raise their concerns on one to one basis
- Illiterate (People who were not able to read and write) participants were asked to listen to the project description and give their comments to the consulting team.

Table - 8.2 shows the number of participants in discussions

Table - 8.2: Number of participants in discussions

Sessions	Date	Venue	No. of Participants
PHANDAR VILLAGE			
1	May 22, 2011	Phandar Village	5-6
2	May 23, 2011	Phandar Village	120
CHASHI-GOL VILLAGE			
1	May 22, 2011	Chashi-Gol Village	4-5
2	May 23, 2011	Chashi-Gol Village	80-90

c) Interviews with the Community and Affected People of the Area

Two settlements namely Phandar and Chashi Gol fall within the project influence area. Population of these settlements varies between 800 to 1200. Appropriate sample size from the given households of the project area was selected for establishing the baseline condition of the area. The head of the household was interviewed through semi-structured questionnaire and feedback was recorded. Project affected people were interviewed separately. The main objectives of these questionnaires were to collect the information about socioeconomic conditions of the area, enable the respondents to raise their concerns on the perceived impacts associated with the PHPP and respond to any questions which was not covered during the scoping.

8.6 OUTCOMES OF PUBLIC CONSULTATIONS

During scoping sessions and public consultation and meetings with other stakeholders, the overall response was positive. People of the project area were well aware of the proposed project but not about its components. A summary of feedback received is given in **Table - 8.3.**

Table - 8.3: Summary of Feedback

Stakeholder Category	Feedback Received Through Public Consultation
Visit to Stakeholder Departments/Organizations (Government and Non Governemnt)	➢ Judicious compensation should be paid to the affected people; ➢ Tree plantation and management plan ➢ Appropriate health and safety measures ➢ WWF showed his reservation on the ecology of the area and suggested that Proponent should take appropriate measures in order to avoid the damage to flora and fauna of the area; ➢ EPD directed that proponent should follow all the related laws, rules and regulations in order to make the project environment friendly; ➢ Provision of electricity in the project area on subsides rates ➢ electricity to the poor, Safe transportation of construction related material ➢ Free mobility of females should be ensured ➢ Project area should get benefits from the proposed PHPP like availability of free of cost establishment of schools and health facilities.
Consultation with affected people	➢ Affected people apprehensions are related to the land to be acquired for the construction of the components of the proposed project. Authorities should pay them timely compensation on the basis of current market rate ➢ Compensation procedure should be less time consuming ➢ Job opportunities should be provided to the locals on priority basis
Scoping Sessions	➢ Area development schemes should be initiated

Stakeholder Category	Feedback Received Through Public Consultation
	➢ Safety signs should be available before the construction starts ➢ All the participants emphasized the need to ensure the selection of locals in non technical jobs during the construction phase whilst during operational phase employment to the locals should be provided on permanent basis. ➢ Construction work (construction of access roads) should not be carried out at night times ➢ Authorities should maintain a cooperative attitude towards community and pay attention to all the community concerns that may arise during the project implementation

Exhibit - 7: Scoping session in the Project Area

Exhibit - 8: Another View of Public Consultation in the Project Area

Exhibit - 9: Project Affectee Raising his Concern

Exhibit - 10: Project Briefing

9 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

9.1 GENERAL

The Environmental Management and Monitoring Plan (EMMP) is prepared to ensure the effective implementation of mitigation measures proposed for the environmental impacts during design, construction and the operation phases. Environmental Management plan contains two parts; First part covers the Mitigation Management Plan while second covers the Monitoring Plan. Management plan also covers the institutional measures to be taken during planning, implementation, construction and operation of the project.

9.2 OBJECTIVES OF EMP

The specific objectives of EMP are to:

- Facilitate the implementation of mitigation measures proposed in chapter-7;
- Assign the responsibilities to the project proponent, contractors and the project team for effective management of the proposed project;
- Minimize the potential impacts of the proposed project on environment and maximize the project benefits; and
- Define the monitoring mechanism and parameters to be monitored in order to ensure the effectiveness of mitigation measures.

9.3 MITIGATION MANAGEMENT PLAN

Mitigation Management Plan is developed to identify all the issues/potential impacts and appropriate mitigation measure identified in chapter-7 and outcomes of consultation with stakeholders. The Mitigation Plan clearly shows the responsibilities of each stakeholder and project team involved in project planning, construction and implementation.

Generally, some local contractors are not familiar with the project related environmental issues and don't implement the mitigation measures suggested in EIA report. It is suggested that project related environmental issues should be treated in tender documentation and payments to the contractor should be linked with the environmental performance. Moreover, contractor should be legally bound through the contract to perform all the activities in way which is safe for the environment as well as the health & safety of its employees and surrounding communities.

9.4 ENVIRONMENTAL MANAGEMENT AND ACTION PLANS (EMAPS)

The contractor should be required to prepare the Environmental Management and Action Plans (EMAPs) as per guidelines and mitigation measures given in chapter-7 prior to mobilization and obtain the approval of the management. **Table - 9.1** shows the guidelines to prepare environmental management and action plans (EMAPs).

Table - 9.1: Guidelines to Prepare Environmental Management and Action Plans (EMAPs).

1- Management / rehabilitation plan for quarry / borrow areas	
Objective: To manage the borrow worksite (quarry / borrow areas) to avoid the environmental damage	
Activity: Development and operation of quarry / borrow areas	
Management Guidelines	The contractor will develop a Borrow and Quarry area management plan prior to start the extraction of material from each borrow pit or quarry by using these guidelines. ➢ Site layout and boundaries with the following provisions: • Name, location and ownership of the borrow or quarry area; • Existing land use of the area • Estimates of the resources to be extracted; • Stockpiling location; • Dust and noise consideration; • Sequence of operation; • Site operating procedures • Pit wall suitability in case of quarry • Wild life interaction ➢ Avoid interference of borrow areas with the natural or designed drainage system ➢ Reuse the leftover excavated material e.g., construction of elevated resort to promote the tourism and backfilling the pits and queries. If this is not possible, then excavation slopes will be smoothed and depression will be filled in such a way that it looks more or less like the original ground surface.

	➢ Where the agricultural land is unavoidable, the top 30cm of the plough layer should be stock piled for redressing the land after the required borrow material has been removed ➢ Avoid soil erosion by planting indigenous grass in case of low embankments ➢ Protect high embankments i.e, over 2m by stone pitching or riprap across the embankment as appropriate ➢ Landscape the pits that cannot be fully rehabilitated in order to avoid creating hazards to the people and livestock ➢ Service the machinery and equipment on routine maintenance schedule to ensure proper operation and thus minimize the emission and noise
2- Waste Management	
Objective: To reduce the amount of waste by adopting waste management practices	
Activity: General Waste	
Management Guidelines	➢ Segregate the waste streams (construction debris, food waste, reusable waste) ➢ Develop waste management plan for each segregates stream ➢ Disposal of each stream in environmental friendly manner ➢ Adopt 3R approach to minimize the production of waste ➢ Conduct trainings of staff engaged in waste collection and disposal regarding waste management practices ➢ Maintain the temporary collection waste at the construction site ➢ Emphasize good house keeping ➢ Use refuse containers at each work site
Activity: Hazardous waste	
Management	➢ Collect the chemical wastes in labeled and sealed drums

Guidelines	➢ Ensure the availability of MSDS for hazardous chemicals on the site ➢ Retain the waste oils, lubricants, greasy and oily rags, or other materials subject to spontaneous combustion in labeled containers used for that purpose exclusively and dispose properly at frequent intervals.
3- Fuel and Hazardous material management	
Activity: hazardous material/fuel handling and storage	
Objective: To reduce/eliminate the adverse impacts of hazardous materials on surroundings	
Management Guidelines	➢ Store the hazardous material includes fuels, lubricants, chemicals and hazardous goods in approved fueling tanks. ➢ Store the fuel tanks in an area where it cannot be hit by vehicles or other equipment. The storage area should be located away from any water body. ➢ Mark the storage site with “HAZARDOUS MATERIAL STORAGE SITE” where drum and containers are put. ➢ Place the fire extinguishers near the fuel storage areas and be of a suitable type and size to permit the evacuation of workers during a fire. ➢ Don’t permit the smoking near storage area and post the "No Smoking" signs. ➢ Don’t permit the smoking during any fuelling operation. ➢ Store the hazardous material on concrete floor covered with plastic sheet. ➢ Floor should be sloped to safe collection area in case spill occurs. ➢ Containers must be closed except when adding or removing material ➢ Use auto shut down valves for fuel transfer pipes ➢ Designate the specific site for refueling.

	➢ Dispose the non recycled waste to EPA designated disposal site ➢ Ensure the provision and use of PPE while handling of hazardous materials ➢ Ensure that all containers and chemical filled drums are in good condition ➢ Regular check of any leakages to identify the problem prior to occur ➢ Conduct trainings of staff regarding proper storage and handling of chemicals and other hazardous goods.
4- Spill Management	
Activity:	Spill Control
	Spills of petroleum products and other hazardous materials cannot be entirely prevented; however, the impacts of spills can be minimized by establishing a predetermined line of response and action plan. Spill contingency plan should include the following; **1. Introduction:** project description, topography e.g. slope of land, scope of the plan, site name and location, type and amount of hazardous materials stored on-site, the storage capacity and the type and number of storage containers, all nearby surface water bodies etc. **2. Description of response:** identify response personnel, flowchart showing the communication lines and the response duties of each member of the response team. **3. Action plan:** potential impacts related to the spill and procedures to be taken in response to a spill. Following procedures should be in detail; • Procedures for initial action, • Spill reporting procedures. • Procedures for cleaning up the spill.

	• Procedures for transferring, storing, and managing spill-related wastes. • Procedures for restoring affected areas, **4. Resources inventory:** spill response equipment **5. Description of training programs** Plan should be updated monthly to reflect changes such as fuel storage locations, arrival of new hazardous materials on site and new personnel and contact information
5- Health, safety and working environment plan	
Objective: Promote health and safety of construction labor at the work place	
Activity: Construction Camps	
Management Guidelines	Ensure the provisions of following facilities: ➢ Safe drinking water supply ➢ Sufficient ventilation facilities ➢ Security fence ➢ Proper sanitary facilities ➢ Proper sewerage system ➢ Wastewater treatment facility ➢ Solid waste collection system ➢ First aid facilities ➢ Training of workers

Activity: Management Practices	
Management Guidelines	➢ Develop and implement safety standards for all the workers and at workplace and visitors which should not be less than those laid down on the international standards. ➢ Establish OHS plan and submit to E&SMU for approval. ➢ Periodic inspections and procedures for correction and control. This provides a method of identifying existing or potential hazards in the workplace, and eliminating or controlling them. ➢ Provision of personnel protection equipments to the workers ➢ Trainings of employees in safety and health, basic sanitation and specific hazards at the work place ➢ Development and implement driving safety rules
Activity: Occupational Accidents	
Management Guidelines	➢ Identify potential hazards to the workers ➢ Provision of first aid facility at site and ambulance facility during emergency to be transported to nearest hospital ➢ Document the accidents and diseases ➢ Health screening of workers to assess the physical fitness ➢ Provide sufficient light system at active construction areas
Activity: Water and Sanitation Facilities	
Management Guidelines	➢ Provide sanitary facilities at the construction site. Location should be at a fair distance from surface waters. ➢ Provide safe drinking water supply to the workers

6- Noise and Vibration Management	
Objective: To maintain the acceptable tranquil environment for living in and around the construction site	
Activity: Construction activities/Blasting/Construction Machinery noise	
Management Guidelines	➢ Use well maintained construction machinery ➢ Use buffers around generators and static noise generating machinery ➢ Avoid use of needless horns and alarms ➢ Use low intensity explosive material instead of high intensity explosive material ➢ Prefer incresed number of blasts with low intensity explosive material should rather than high intensity single blast to avoid the noise impacts ➢ Install temporary noise control barriers where appropriate. ➢ Monitor noise levels and analyze the results as required. ➢ Schedule the loading and unloading trucks ➢ Avoid to perform the noisiest activities at time near residential areas
7- Air Quality Management	
Objective: To maintain the ambient air quality as per standards	
Activity: Construction activities/Movement of construction Vehicles	
Management Guidelines	➢ Impose maximum speed limit on all internal access roads by use of speed bumps and appropriate road signage. ➢ Undertake maintenance and repairing of generators and construction machinery to avoid hazardous emissions ➢ Performed sprinkling of water wherever there is potential source for dust in the project area; ➢ Install crusher and concrete batching plants at a fair distance from Chashi and Phandar village. Equip the crushers

	with dust suppression equipment comprising of scrubber and water sprays to reduce the amount of dust released from the plant. ➢ Provide water supply system for controlling dust from the borrow area ➢ Conduct monitoring near sensitive points ➢ Use closed conveyer system to transport the material to batching plant ➢ Pave the access roads in the construction area ➢ Cover the stock piles in order to avoid the air born dust.

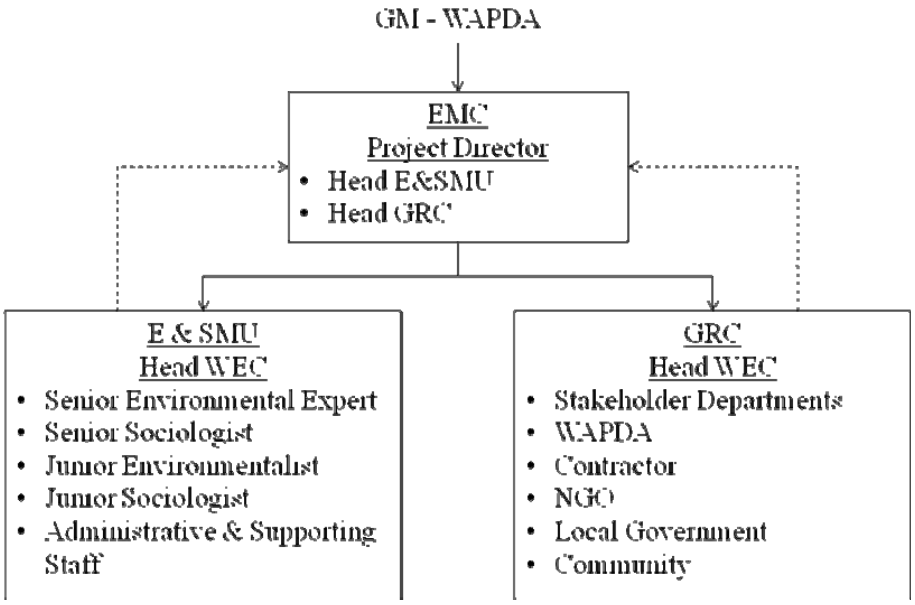
9.5 INSTITUTIONAL SET-UP

The WAPDA, being the project executing agency, shall take the responsibility of establishing the proposed institutional arrangement for the implementation of the mitigation measures, monitoring plan and land acquisition related measures of the project.

9.5.1 Establishment of Project Environmental Management Committee

WAPDA will establish an Environmental Management Committee (EMC) under the existing organizational framework. The committee will be headed by the Project Director. Supervisory consultant and head E&SMU will assist the project director in decision making process. EMC will be responsible for overall supervision and management of various aspects of the project including environmental issues. The committee will also take the decisions at project level. The composition of EMC is given in **Figure - 9.1.**

Figure - 9.1: Composition of EMC



Legend

EMC = Environmental Management Committee

E&SMU = Environmental & Social Management Unit

GRC = Grievance Resolution Committee

WEC = WAPDA Environmental Cell

Under EMC, a well-structured Environmental and Social Management Unit (E&SMU) exclusively for PHPP will be established to implement and monitor the measures to be taken during various phases of the project. Head WEC will be given the additional responsibility of managing the activities of E&SMU specifically for PHPP. The expense of the E&SMU office including laboratory, staff, vehicles etc. will be borne by the project. **Table - 9.1** shows the composition of E&SMU.

Table - 9.2: Composition of E&SMU

Sr. No.	Post	No.	Details
1	Senior Environment Expert	01	Environmental Scientist or engineer having 05 years of experience in dealing with environmental issues specifically hydropower project
2	Senior Sociologist	01	Social Sociologist having 05 years of experience in dealing with the social issues and land acquisition related issues specifically hydropower projects
3	Junior Environmentalist	01	Fresh Environmental Scientist/Engineer
4	Junior Sociologist	01	Fresh Sociologist
5	Administrative and Supporting staff	04	Computer Operator, Driver, Attendant, Peon

9.5.2 Responsibilities of E&SMU

The E&SMU will be responsible for ensuring the implementation of the mitigation measures and compliance with the PEPA regulations for the construction and operational phase impacts. Following is the list of actions to be performed by E&SMU.

- Secure technical and advisory services from EMC and financial support from WEC through EMC;
- Ensure the effective implementation of EMP both during construction and operational phase;
- Liaison with other agencies working on different aspects of the environment in the project area. The purpose of liaison with these agencies is to make coordinated effort for monitoring and managing the project activities at different stages. Following are the agencies to liaise with:
    i. Environmental Protection Department (EPA), Gilgit-Baltistan (PEPA-97 compliance, EIA implementation reporting)

ii. NGOs of the area (Compensation related activities)
iii. WAPDA (river flows, compensation flow, water quality monitoring and sediment sluicing)
iv. Public Health Department
v. Forestry Department (landscaping, replanting disturbed areas during construction, soil protection)
vi. Wildlife Department (protection of wildlife of the area)
vii. Fisheries Department (Protection of aquatic fauna)

- Ensuring all the Contractors to follow the PEPA regulations and other requirements stipulated in the construction contracts concerning dust suppression, solid waste disposal, wastewater disposal, air pollution, noise and vibration, biodiversity, traffic management, occupational health and safety, transport, storage and use of explosive materials.

9.5.3 Training and Awareness

Environmental and social trainings will help to ensure that requirements of Environmental management plan are understood by the project team. Training programmes will be finalized during detailed design stage. The E&SMU will mainly be responsible for providing and evaluating the training programmes for effective implementation of Environmental management plan.

Trainings will be provided to construction contractors, WAPDA staff, project supervisors, skilled and unskilled persons engaged with the project. These trainings will continue to be conducted during the operational and maintenance stage. **Table - 9.3** shows the scope of training programmes.

Table - 9.3: Scope of training programmes.

Sr. No.	Scope	Responsibility	Staff/Participants	Schedule
1	➢ General awareness about the project and project area; ➢ Environmental and social aspects of the project; ➢ Mitigation measures; ➢ Environmental management plan	E&SMU	WAPDA staff (Project Supervisors and management staff), contractors	At detailed design stage (Prior to start the project activities)
2	➢ General awareness about the project and project area; ➢ Environmental and social aspects of the project; ➢ Community issues	E&SMU	Project team	Prior to start the project activities
3	➢ Environmental Management Plan ➢ Implementation mechanism ➢ Liquid and solid waste disposal ➢ Cultural values ➢ PPE ➢ Health and safety issues	E&SMU /Contractors	Construction workers	Prior to start the project activities
4	➢ Road safety principles ➢ Speed limits ➢ Waste disposal practices	E&SMU/ Contractors	Drivers	Prior to start the project activities
5	➢ Good House keeping ➢ Waste Disposal ➢ Natural resource management	Contractors	Camp staff	Prior to start the project activities

9.5.4 Grievance Redressal Mechanism

The present study identifies the social and environmental issues regarding implementation of the proposed project and suggests the measures to mitigate these impacts. However, some of the affectee may be less satisfied with the measures adopted to address the adverse impacts of PHPP.

For the proposed hydropower project, 52 acre land will be acquired for the construction of project components. The grievances will mainly relate to the compensation matter like non judicious distribution of compensation amount among the owners of jointly owned land and delay in compensation. Prompt attendance to such grievances will be crucial for successful completion of the proposed project component within a stipulated timeframe. Affected people may also have some other objections such as type and number of trees to be removed, nuisance from noise and dust, health related issues and social issues.

The main functions of GRM will be as follows:

- Provide a mechanism to the aggrieved persons on issues arising as a result of project activities and to ensure that the mechanism provides a solution of the grievances; and
- Facilitate the recording and processing of the grievances;

Grievance Resolution Committee (GRC)

A "Grievance Resolution Committee (GRC)" is proposed to address the matters at grass root level. The committee will be headed by the director. **Table - 9.4** shows the proposed GRC.

Table - 9.4: Proposed GRC

Department	Representative	Position Assigned
WAPDA	Head of WEC	Director
Consultant	Field/Supervisory consultant	Assistant
Stakeholder Departments/Agencies	Representative from Revenue Department	Member
	Representative from Fisheries Department	Member
	Representative from Wildlife Department	Member
	Representative from EPA	Member
Contractor	RE	Member
NGO	Representative from one	Member

Department	Representative	Position Assigned
	functional NGO of the area	
Local Government	Nazim	Member
Community	Two influential person, one from Chashi Gol and other from Phandar village	Member

The cost of properties likely to be damaged will be assessed by E&SMU. The relevant revenue record will also be consulted to verify land ownership. All the compensation payment will be made in the presence of local representatives in order to avoid any subsequent issue.

Complaint Register

A complaint register will be maintained at the work site to document all the complaints received from affected persons/community. The information recorded in the register will include the followings:

i. Date of the complaint
ii. Description of grievance
iii. particulars of the complaint
iv. Actions to be taken and persons responsible to take the actions

On receipt of a complaint, the field consultant/supervisory consultant will register it and forward to GRC. The committee members will review the complaint keeping in view its nature and suggest remedial actions. The proposed actions will also be shared with the aggrieved person. In case of environmental issues, the decision of GRC will be considered as final decision but in case of any social issue and compensation related issue the decision of GRC will also be forwarded to the project director for his review and approval of the actions taken.

The complainant views on remedial actions and suggestions will also be documented in the complaint register. In case, the complainant is not satisfied with the decision taken to resolve the grievances, the affectee has the right to appeal to the higher level.

9.6 CONSTRUCTION AND OPERATIONAL STAGE EMP

The identified environmental and social impacts and mitigation measures both during construction and operational phases are provided in chapter-8.

The issues generally fall under the following categories:

a) Construction Stage:

- Air and water pollution
- Nuisance to the community
- Conflicts with the community
- Local employment
- Health and safety
- Flora and fauna
- Traffic Management
- Compensation issues
- Explosive materials

b) Operational Stage:

- Water Flows
- Demolishing material
- Flooding
- Sedimentation
- Civic amenities
- Local public health

Table - 9.5 and Table - 9.6 shows the issues identified, mitigations proposed, and proposed staff responsible for its implementation.

Table - 9.5: Environmental Management Plan for Construction Stage

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
Geology	The construction activities for the proposed project interventions involving cutting of rocks, large scale excavation, dumping of soil and blasting for tunnel formation and to create space for accommodating power house upto foundation level will disturb the stable geological formation of the area.	➢ Blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material. ➢ Greater number of blasts with low intensity explosive material should be preferred rather than high intensity single blast to avoid the noise impacts on the surroundings and excessive damage to the surrounding rocks.	E&SMU,C,GRC
Topography	Construction activities are not expected to impact the topography of the area significantly except for those areas where physical activities including digging and excavation areas, storing or dumping sites for excessive material, storing areas and movement of heavy construction machinery will be carried out. The area where excavated material is to be dumped will also be negatively impacted.	➢ A detailed development and operation plan for borrow areas must be prepared by the contractor at the pre-development stage (before the start of extraction of material from each borrow area). Contractor should strictly follow the provisions of approved plan in order to minimize any negative impact associated with the borrow areas. Likewise, excavated material should be dumped at suitable and approved disposal sites.	E&SMU,,C,GRC

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
Land sliding	High seismic potential and unstable geological formations are two major causes of land sliding in the area. The formation at some places of the project area may become loose due to the blasting of rocks. This will increase the risk of land sliding in the surrounding of the construction sites	➢ Blasting should be minimized where possible; if inevitable then low intensity explosive material should be used instead of high intensity explosive material.	C
Soil	The soil related issues include soil erosion and slope instability, failure to rehabilitate the borrow areas and soil contamination by the spillage of chemicals like fuel, construction chemicals and concrete	➢ Good engineering and biological practices will help to control the soil erosion in the project influence area. Soil erosion remedial measures should be based on the geotechnical and geomorphic conditions of the project area that vary from site to site. ➢ Plantation Plan	E&SMU,C
Land Use	The total area likely to be acquired for the project components, colonies and other infrastructure is approximately 500.32 kanals. The existing land use pattern will be changed due to the construction of project interventions in the area.	➢ local stakeholders are brought on-board early in the process to identify sensitive land uses, issues, and local plans and laws	PEMU,C,GRC

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
Flammable and Explosive Materials	Explosive materials will be required for rock excavation during the tunnel formation, low pressure conduit and penstock installation. Other major flammable materials to be used during the construction activities include diesel, furnace oil, petrol, LPG, kerosene oil and machinery fuels. These materials present little risk to the environment, if properly transported stored and used; otherwise they are potentially very dangerous. Improper storage and handling practices for these flammable and explosive materials can pose dangers of fire and blasts in the area	➢ Safety procedures should be developed and followed by the contractor and labour strictly while using, handling and storage of these materials and explosives. ➢ Contractors should be provided written instructions about the methods and safe practices of using flammable materials and explosives. ➢ For safety of construction labour and immediate communities, it is suggested that contractor's staff should be trained about the procedures of blasting, safe use, handling and storage of materials.	PEMU,C
Borrow Areas/Excavated Material	Unsafe disposal of excavated material may not only create the environmental degradation but also a nuisance for the surrounding community. Moreover, borrow areas, if left open, may prove hazardous to human beings, wildlife and livestock of the area	➢ Emphasis should be to decrease the volume of mucking material by reusing and then the disposal at the marked area in environment friendly way; ➢ In order to reduce the volume of disposal material, maximum part of the excavated material can be used in other activities like construction of coffer dam and filling of borrow areas and natural depressions in the project area. ➢ In order to increase the aesthetics of the area, native grass can be planted by dumping the surplus material in the proposed residential colony with suitable	PEMU,C

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
		soil cover; ➢ As per "Detailed Engineering Design Report", surplus borrow material will be disposed at the "marked disposal site" to be constructed between Phandar Lake and Weir site. It is suggested that area should be properly levelled after filling so that it might bring into some other use.	
Domestic Solid Waste	Indiscriminate disposal of solid waste may lead to generation of obnoxious smells / odour and adversely impact the aesthetic condition of the land besides land pollution	➢ Domestic solid waste from all the sources should be collected at a common point and then safely disposed off only in demarcated waste disposal sites	PEMU,C
Surface Water	During the construction phase, the surface water bodies may get impacted from the following potential sources, if proper control measures are not exercised: ➢ Sewage effluent from Contractor's Camps and residential facilities; ➢ Construction site runoff and general construction activities The turbidity level in downstream of weir site, lake and Chhashi Gol near the power house will increase significantly due to settling of particulate matter to be emitted from project construction activities and movement of heavy construction machinery	➢ As per Detailed Engineering Design report, the sewage will be discharged into a screening chamber/septic tank and sewerage treatment plant. Heavier and suspended solids will be removed periodically and sewerage wastewater will be allowed to flow into Chhashi Gol. According to the National Environmental Quality Standards, BOD of all the surface discharges from domestic wastes should not exceed 80 mg/l. ➢ Water should be sprinkled during the construction phase of the project in order to reduce the dust emissions from the	PEMU,C

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
	and equipments. However, the extent of surface water pollution will depend upon the implementation of pollution control measures.	construction activities especially during construction of roads and blasting activities. ➢ Settling ponds should be constructed to improve the quality of final draining effluent from construction areas.	
Air Quality	The major sources of air pollution will be emissions from crushers and concrete batching and mixing plant, blasting operations, increased vehicular traffic, surplus material disposal and storage of construction material. Dusty environment at the project site will cause adverse health impacts on the labours working near the crushing plant.	➢ Crusher and concrete batching plants should be installed at a fair distance from Chhashi and Phandar village. Moreover, It is recommended that crushers should be equipped with dust suppression equipment comprising of scrubber and water sprays. This will significantly reduce the amount of dust released from the crushing plant. ➢ Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area; ➢ Personal protective equipments including, dust masks and ear plugs should be provided to the drivers and labours working in dusty environment. ➢ Minimize drop heights when loaders dump soil refuse into trucks and cover dump trucks before travelling on public roads; and ➢ Emissions from power generators and construction machinery are important point sources at the construction sites. Proper	PEMU,C

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
		maintenance and repair should be undertaken to minimize the hazardous emissions. ➢ Maximum speed limit should be imposed on all internal access roads by use of speed bumps and appropriate road signage.	
Noise	Noise impacts depends upon the intensity and distance from the source. Continuous exposure to high noise level above 90dB effects the hearing perception.	➢ Local community should be informed prior to starting the blasting activities; ➢ Low intensity explosive should be used in blasting activities instead of high intensity blasting material; and ➢ Ear plugs should be provided to the workers and drivers working in noisy environment. ➢ The noise levels should be kept under the permissible limit. otherwise these may cause the adverse impacts depending upon the intensity of noise ➢ Construction contractors should maintain heavy-duty machinery in good operating condition. ➢ Noise levels should be monitored near the sensitive points periodically. if levels exceeds the permissible limits then appropriate measures should be taken.	PEMU,C
Flora	➢ Movement of heavy machinery used for setting up the contractor camps, concrete mixing and batching plant,	➢ Site Engineer will develop and implement a tree plantation plan to compensate for the loss of trees. It is suggested that two	PEMU,C

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
	crusher plants might cause damage to the natural vegetation ➢ Tree cutting for the construction of project components	trees should be planted for every tree to be cut. ➢ It should be part of the contract of the Contractor that they will ensure that vegetation of the area will be protected from the project construction activities as much as possible; ➢ The Contractor will arrange training for its team, on importance of vegetative cover, and how it can be protected; ➢ Briefings should be arranged for the drivers of the vehicles about the allowed routes for plying vehicles; ➢ Vegetation should only be cleared when absolutely necessary. If possible, vegetative cover should be left in place; and ➢ Sprinkling of water should be performed during the construction stage wherever there is potential source for dust in the project area. By controlling the dust emissions, the settling of the dust particles on the plants leaf can be avoided.	
Traffic	Chances of accidents due to the increase in traffic volume	Construction contractor will prepare a Traffic Management Plan (TMP) in order to ensure safety to all road users. The plan will ensure the efficient operation of the road together	PEMU,C

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
		with the construction activities. TMP will show the access roads for vehicles, speed limits, safety signs and lane restriction where applicable. The contractor will submit this plan to supervision consultant for review and approval.	
Public Health and Safety of the Local Population		➢ Project Environment Management Unit or contractor will employ a safety officer during the construction stage. ➢ The contractor should develop health and safety plans to prevent the accidents. ➢ Appropriate PPEs should be provided to the workers ➢ Training sessions should be arranged for the workers regarding complete understanding of operating procedures and risks associated with the construction activities	
Local Social Order	The influx of large work force including skilled, semi skilled and unskilled labour in the project area, during construction period, may disturb the local communities and create social and cultural problems. Most of the trained labour force will come from other parts of the country while some of the locals will also be hired. This manpower will stay in labour camps, residential colonies and contractor's camps to be constructed	➢ The control of such situations shall be exercised by including appropriate clauses in the construction contracts, which shall comprise the regulations on the workforce necessary to avoid any law and order situation; and Security guards and police constables should be appointed in the project area to cope up with any mishap and to control the law and order problems	PEMU

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
	near or in the settlements. Adverse impacts are anticipated to be appeared due to the intermixing of labours with the local communities. Difference in cultural and social values among the locals and workforce may create tensions and conflicts and some serious law and order problems.		

PEMU: Project Environment Management Unit,

C: Contractor

GRC: Grievance Resolution Committee

Table - 9.6: Environmental Management Plan for Operational Stage

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
Surface Water	Surface water pollution due to sewage disposal	It should be ensured that sewage from all sources be treated in sewage treatment plant so as to meet the national effluent standards	E&SMU
Demolishing Material	Environmental Degradation	Disposal at designated site	E&SMU
Sedimentation	Accumulation of sediment may disturb the efficiency of project components.	sediments clearing mechanism should be followed	E&SMU
Water Flows	The water flow pattern from downstream of weir site will change as significant volume of water will be diverted towards reservoir. The variation in flows will directly impact the operation of plant, downstream aquatic life and community	It should be obligatory for the project to release minimum water flow downstream the weir site throughout the year as environmental flow.	E&SMU
Aquatic life and fish Species	The construction of weir on Ghizar River will reduce the downstream flow in winter season. The change in flow pattern will affect the aquatic fauna and fish species present in the area between weir and Chhashi Gol confluence. Detail of impacts is given in chapter-8.	➢ While designing the project, special attention should be given to ensure to plug off the leakages of oil and other chemicals dispersants from turbine and machine engines to avoid hazardous affect on aquatic life; ➢ Appropriate sized fish ladders should be provided to ensure the free movement of	E&SMU

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
		fish from downstream to upstream and vice versa. Ladder will also help to protect the fish spawning habitat during their breeding season (October – February). The gradient of the ladder should be almost same like the weir area. Normally trout fish requires 1.2 m/s velocity of water and 1-2 feet depth of water for their easy movement (Director Fisheries GB) ➢ Fish traps should be used to stop the fish movement to the intake structure, tunnel, etc; ➢ For management and conservation of fisheries, certain conservation and management staff should be recruited on recommendation of Fisheries Department, GB; ➢ Director fisheries have recommended that 0.5 m^3/s minimum flow should be released constantly to compensate the fish movement in winter season; ➢ Fish hunt should be prohibited with net, cages and by the use of dynamite; ➢ Fisheries Department must be consulted at all stages as it is the obligation of the department to manage all natural water resources in GB as per provision of existing Fisheries Act and Rules 1975	

Project Components	Impacts	Proposed Mitigation Measures	Responsibility
Agricultural land	Impacted due to unavailability of water	Water requirement for Chashi GoI residents should be incorporated in the overall design of the project. Moreover, if water supply through seepage flow is completely disconnected then alternate sources should be identified for irrigation and drinking water.	E&SMU

E&SMU: Project Environment Management Unit,

C: Contractor

GRC: Grievance Redressal Committee

9.7 ENVIRONMENTAL MONITORING PLAN

It is a process of repeated observations and measurements of one or more environmental quality parameters to enable changes to be observed over a period of time. Only through a well planned and organized system of project mentoring and evaluation, the progress against given targets of various components of the development projects can be achieved.

The main objective of environmental monitoring plan is the conservation of the quality of various components of the environment. Specific objectives include the following:

- To ensure that the required mitigation measures are being implemented and on time;
- To identify the problems while implementing the measures to protect the environment and solution to resolve such problems;
- To check that all the applicable legal requirements are being followed;
- To record the inputs of various stakeholders in management process;

Monitoring plans will include the parameters to be monitored, frequency of monitoring and responsibility to monitor.

9.7.1 Monitoring Requirements at different Stages of the project

E&SMU and detailed design consultant will mainly be responsible for design stage monitoring. At planning and design stage, monitoring activities should focus on the following:

- Project Environmental & Social Management Unit (E&SMU,) is staffed and well equipped prior to start the construction activities;
- Checking that all necessary environmental and social requirements of the project have been included in the tender document;
- Guidelines regarding waste disposal, traffic management, occupational health and safety and emergency response are available in the tender document;
- All the mentioned management plans are in place prior to start the construction activities;
- Surveys of PAPs and relevant departments needed for the preparation of “land acquisition plan” have been completed;

Environmental monitoring plan for construction and operational phases are given in **Table - 9.7.**

Table - 9.7: Environmental Monitoring Plan

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
CONSTRUCTION PHASE						
Disposal of excavated Material/Borrow areas	Hazardous to human being and wild life, Aesthetic Nuisance	Dumping at designated sites, Reuse of excavated material in order to reduce the volume of dumping material	Checklist, Visual Observations, Documents Review	Areas identified for disposal	Weekly	E&SMU,C
Soil Erosion/contamination	Slope instability Limit the future use of land	Inspection of pre-identified sensitive points including borrow areas	Checklist, Visual observations	Construction sites, storage and workshop areas	Weekly	E&SMU,C
Landslides	Instability of geological formation	Inspection of sensitive points/Appearance of cracks	Visual observations	Construction sites	Quarterly	E&SMU,C
Surface water quality	Deterioration of water	Physico-chemical and biological	Samples collection,	Downstream of Ghizar	Quarterly	E&SMU

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
	quality	parameters	Laboratory analysis	river, Chashi Gol Nullah and Phandar Lake		
Explosive materials	Danger to fire and blast in the area	Presence of proper storage area, Emergency plan, Display of safety signs, Trainings of workers	Checklists, Visual observations	Storage areas	Bi-annually	E&SMU
Air Quality	Dust, Noise and Emissions	Conditions of running vehicles, speed limits in project area, Water sprinkling, Ambient air quality parameters	Visual observations and sampling	Active construction areas	Quarterly for quantitative and Monthly for qualitative	E&SMU, C
Occupational health and safety	Health and safety hazards to the workers	Display of safety signs, Provision of PPEs to the workers, Trainings	Checklist, visual observations	Construction and storage sites	During construction activities	E&SMU, C

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
		records,				
Land acquisition and compensation	Land acquiring from land owners, Compensation to PAPs	Value of land, fair compensation	Checklist	Location of assets	Compensation will be continuous activity while 100% acquisition prior to start the project activities	E&SMU, GRC
Flora	Damage to the visual quality and beauty of the area	Types and species to be uprooted, presence and implementation of tree plantation plan	Checklist	Project area	Tree cutting will be completed prior to start the construction activities while tree plantation will be continuous activity	E&SMU, C
Public grievance	Dissatisfaction of PAPs	No. of complaints Actions on public	Complaint register	Throughout construction	Daily	E&SMU

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
		complaints				
Employment	Job opportunities for locals	Compliance with agreed contract	Checklist	Project area	Continuous activity	E&SMU, C
OPERATIONAL PHASE						
Surface water quality	Deterioration of water quality	Physico-chemical and biological parameters	Sampling, Laboratory analysis	Downstream of weir site	Quarterly	E&SMU
Water Flows/Compensation flow	Effect on aquatic life	Water flows	Flow measurement	Downstream of weir site	Monthly	E&SMU
Solid waste	Aesthetic nuisance	Provision of dust bins, designated site for dumping	Visual observations	Residential colony	Weekly	E&SMU
Noise	Disturbance to the locals	Noise levels within the standards	Noise levels measurement	Near power house	Weekly	E&SMU
Public grievance	Dissatisfaction of PAPs	No. of complaints Actions on public complaints	Complaint register	Throughout the operation	Daily	E&SMU

Description of Components	Associated Impacts	Monitoring Tasks/ Parameters	Methodology	Monitoring Location	Frequency of Measurement	Responsibility
Employment	Limited Job opportunities for locals	Compliance with agreed contract	Checklist	Project area	Continuous activity	E&SMU
Women	Privacy	No. of complaints	Observations, complaint register	Project area	Continuous activity	E&SMU

9.7.2 Monitoring and Reporting

Internal and External Monitoring: Internal Monitoring will be carried out to check the implementation and effectiveness of Environmental Management Plan based on data collection and analysis. The frequency of reporting will depend upon the scope of the project activities. Results of internal monitoring (Table 9.5) of mentioned parameters will be documented in periodic reports to assess the progress.

The information will be collected directly from field through periodic surveys and submitted to the project director for his feedback and actions. Monthly reports will be summarized in "quarterly monitoring reports" for onward submission to the GB-EPA and donors. Internal monitoring will be carried out internally by E&SMU.

Besides internal monitoring, it will be equally important to carry out external monitoring. The objective of external monitoring is to verify that all the mitigation measures are implemented and compensation has been paid to the affectees. For external monitoring, the project would hire the services of independent consultant or consulting firm. The responsibilities of external monitor will be fixed by in keeping in view the following objectives:

- Overall compliance with EMP
- Accuracy of data collection method and results
- Compensation process
- Effectiveness of GRM
- Level of satisfaction of PAPs

After the completion of the project, the external monitoring team will carryout a "post implementation audit" to assess that whether the objectives of EIA and LAP have been achieved or not.

TOR for External Monitoring Services Provider:

Activities that will be undertaken by the external monitor will include, but not limited to the following:

- Review of internal monitoring reports to determine whether these are in compliance with EMP or not;
- Identification of gaps in Internal monitoring reports;
- Review grievance records to assess the performance of GRC;
- Meeting with relevant stakeholders involved in EMP implementation and Land acquisition and compensation process to review the

progress;

- Status of the project in relation to the objectives of EIA and project specific;
- Review of approach and methodology for data collection to assess their effectiveness;
- Adequacy of manpower and financial resources allocated for the implementation of EMP and LAP.

10 LAND ACQUISITION: COMPENSATION & VALUATION

10.1 GENERAL

This chapter presents the principles of valuation and compensation for the private as well as public lands, and physical properties to be acquired for the Project in the light of the local and international policy, legal and institutional frameworks.

No single issue is more critical to the social acceptability of the Project than the issue of valuation and compensation of the lands and properties, to be acquired for the Project. This aspect becomes all the more important because of the general public perception, that the government authorities generally do not adequately and earnestly address the compensation issues in the planning and construction of major national projects. The legal framework given in this chapter is only allied to the land acquisition as according to the detailed engineering design and surveys only land will be acquired for the project no resettlement is involved in the project.

10.2 POLICY AND LEGAL FRAMEWORK

10.2.1 Legal Framework: Rights, Responsibilities and Procedures

This section presents applicable legal and regulatory provisions governing acquisition of privately owned lands, for the Project. The primary law for acquisition of land for public purposes in Pakistan is the “Land Acquisition Act, 1894” (hereinafter referred as the Act). The land acquired under the Act vests in the Province and it is only thereafter that the Province may transfer it to someone else. In addition to the provisions of the Act, regulations setting out the procedure for land acquisition have been provided in the “Punjab Land Acquisition Rules, 1983”, which are applicable in Punjab. There is another body of general regulations called the Standing Order No 28, which is being followed by the K.P.K as well as the Punjab. For the acquisition of land for the Project, the above-mentioned Act, rules and regulations shall be followed.

Land acquisition requires interaction between the Requiring Body (RB), which is normally a government agency that requires the land for certain national development project, and the Acquiring Body (AB), which is normally the Provincial Revenue Board, since land is a provincial subject according to the Constitution. The division of responsibility between the Requiring Body and the Acquiring Body in broad terms is that the Requiring Body provides the technical input and the Acquiring Body the legal input in the land acquisition process. It is the Requiring Body which must ensure that the project, for which the acquisition of land is required, is approved by the

authorities and that funds are available. The Requiring Body must also justify the need for land and other property on the basis of field surveys including detailed engineering design and prepare all necessary documents required for decision making.

In case of this Project the Requiring Bodies would be WAPDA and Provincial Revenue Boards of the GB, for the respective lands falling within their respective jurisdictions.

In accordance with the Act, the legal process is initiated by an application from the Requiring Body (RB) for acquisition of the required lands. In response to such application, the Provincial Government shall proceed as follows:

- Under Section 4, it causes the publication of a preliminary notification notifying that the land is needed for a public purpose. This permits entry, survey and investigation of the land in question by an authorized Government servant. He shall pay compensation for any damage caused by such entry. The purpose of a notification under Section 4 is to enable the authorities to carry out a preliminary investigation for deciding whether the land, intended to be acquired, is suitable for the purpose for which it is needed. The process of acquisition must start with a notification under Section 4. It is a condition precedent to the exercise of any further powers under the Act.
- Under Section 5, a formal notification is issued that the particular land is needed for a public purpose. This notification is published in the official Gazette and the Collector (authorized official of the Provincial Government) is required to cause public notice to be given of the substance of the notification. Issuance of notification under Section 5 has to take place not later than one year after notification of Section 4.
- Under Section 5-A, any person interested in any land, which has been notified under Section 5 may, within thirty days after the issue of the notification, object to the acquisition of the land. The Collector shall hear the objection, make necessary enquiries and submit a report within 90 days to the appropriate Government Authority. This Authority must announce its decision which shall be final, within 90 days; otherwise the objection shall be deemed to have been admitted and the acquisition proceedings will come to an end.

- Under Section 6, when the Provincial Government is satisfied, after considering the report, if any, made under section 5-A, that any particular land is required for a public purpose, a declaration to that effect shall be made by an authorized officer of the Provincial Government. This should follow within six months of the publications of the notification of Section 5.
- Under Section 7, after the declaration under Section 6, the Provincial Government shall “direct the Collector to take order for the acquisition of the land”.
- Under Section 8, the Collector has then to cause the land to be marked out, measured and planned, if this has not been done earlier.
- Under Section 9, the Collector gives notice to all interested people that the Government intends to take possession of the land and if they have any claims for compensation that they be made to him at an appointed time.
- Section 10 delegates powers to the Collector to record statements of persons possessing any interest in the land or any part thereof as co-proprietor, sub-proprietor, mortgagee, and tenant or otherwise.
- Section 11 enables the Collector to make enquiry into measurements, value and claims and issue the final award. Included in the award is the land's true area, his view of what compensation is warranted, and the apportionment of that compensation to all interested people.
- Sections 23 and 24 pertain to the criteria for compensation, to be followed by the Collector in making final award.
- When the Collector has made an award under Section 11, he will then take possession under Section 16 and the land shall thereupon vest absolutely, in the Government, free from all encumbrances.
- In cases of emergency, where the Board of Revenue considers it expedient to take possession of any land at any time before an award under Section 11 has been made, it shall notify this fact in writing to the Collector intimating in addition the date, by which the land is required by it. Under Section 17, the Collector can, after causing a notice to this effect to be served on the person or persons interested in the land, take possession of the land subject to the liability to pay any amount which may be incurred on account of acquisition.

The use of this Section of the Act shall be avoided in the land acquisition process for the Project.

- Under Section 18, the person dissatisfied with the final award by the Collector, may request the Collector to refer the case to the court for determination and decision. This however does not affect the taking possession of the land.

10.2.2 Persons Entitled to Compensation on account of Land Acquisition

The Act provides under Section 11 that the award shall state the compensation for "persons known or believed to be interested in the land". Section 31 of the Act states that on making an award under Section 11, the Collector shall tender payment of the compensation to "persons interested" entitled thereto according to the award. The persons interested include all persons claiming an interest in compensation to be made on account of acquisition of land. The provision is clarified in Para 62 of the Standing Orders No 28, which states:

"It should be noticed, however, that under the present Act no person can claim compensation unless some land has been taken in which he claims an interest, or over which he has an easement. He cannot claim compensation on general grounds that his land is injuriously affected by the acquisition if no part of it is taken under the Act".

The Act thus provides for payment of compensation only to affectees who have a legal interest in the land.

10.2.3 Valuation of Land Compensation

The valuation of the land for compensation is governed by Section 23 and 24 of the Act.

- Under Section 23, the matters to be considered in determining compensation are as follows:
  - Market value of the land at the time of notification of Section 6
  - Damage sustained by the person interested by taking of any standing crops or trees
  - Damage sustained by the person at the time of the Collector's taking possession of the land
  - Damage sustained by the person at the time of acquisition of land injuriously affecting his other property, movable or immovable

- If compelled to change his residence or place of business, the reasonable expense incurred for such change
- Damage resulting from diminution of profits of land from declaration to actual taking possession by the Collector
- An additional sum of fifteen percent (15%) of the market value of the land is to be paid in consideration of the compulsory nature of the acquisition.

➢ Para 61 of the Standing Order 28 provides guidelines for determination of the market value, including consulting "respectable people who are disinterested".

➢ Section 24 of the Act lays down matters to be neglected in awarding compensation, which include the degree of urgency which led to the acquisition, any disinclination of the person interested in the land to part with it and any expected increase in value to the land from its future use.

10.2.4 Land for Land Compensation

Under the Act, the person whose land is being acquired cannot be compelled against his wishes to accept compensation in any form other than cash. However, Section 31 of the Act provides that the Collector 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.

10.2.5 Time Frame for Payment of Compensation

The Act provides for the following time frames for the payment of compensation:

- When the Collector has made an award under Section 11, the Collector shall, before taking possession of the land, tender payment of the full amount of compensation awarded by him to the persons entitled thereto under the award. Thus the compensation shall be paid to the affectees prior to possession of the land being taken by WAPDA.
- If the persons entitled to compensation under the award shall not consent to receive it, or if there be any dispute as to the title to receive the compensation or as to the apportionment, the Collector shall deposit the amount of compensation in the Court to which a reference under Section 18 would be submitted.

- Where Section 17 is used for acquisition of land on emergency basis, payment will be made to the persons entitled thereto within 3 months of taking possession.

10.3 ENTITLEMENTS

This section lays down the entitlement policy proposed for the Project, developed in the light of the policy objectives and identifies the specific entitlement packages designed for those affected by the Project.

The Project shall be committed to provide entitlements to the persons who lose their land as well as to those whose livelihood is directly affected by the acquisition of land. The landless affected people include agricultural labourers, tenant farmers, skilled workers and others.

Following are the Entitlements proposed for the Project Affected People (PAP):

- Compensation on account of acquisition of private lands
- Compensation on account of fruit trees, crops & water channel etc.
- Work opportunities on priority basis
- Credit facilities
- Training opportunities

These combined Project efforts are intended to meet the land acquisition objectives of rendering the affected people with a standard of living equal to if not better than that which they had before the Project.

Table - 11.1 reflects the various categories of affected persons, which are in majority farmers as land owners and farmers as tenants.

Table - 11.1: Entitlement Matrix

Affected Persons	**Entitlements for following damages and losses**			**Preferred type of compensation**
	Land	**Structure**	**Income**	
Farmer as owner of land	Cultivated and/or rangeland	Structures of cultivated land terraces including water channels	Lost income for time when harvest from a)crops on cultivated land b) fruit trees is disabled due to	Adequate monetary compensation for cultivated land and other categories of

Affected Persons	Entitlements for following damages and losses			Preferred type of compensation
	Land	**Structure**	**Income**	
			project reasons	land, Improve the productivity of land
Tenant as occupant occupying cultivated land since >50 years	Half of value for occupied cultivated land (other half of values goes to the owner)	Any type of structure or structures of cultivated land terraces including water channels	Lost income for time when harvest from a)crops on cultivated land b) fruit trees is disabled due to project reasons	Adequate monetary compensation for cultivated land and other categories of land,
Water miller	If owner of land where water channel/mill is established	Water channels/water mill	---	Cash compensation for established water channel to be impacted by the project component
Car/Taxi owner	---	---	The taxi driver shall divert their business to other routes	Improved road shall enhance the business of taxi drivers/owners

10.3.1 Compensation on Account of Acquisition of Lands

The compensation, on account of the acquisition of private lands and other properties, shall be paid to those affected persons, who have a legal entitlement or easement on the acquired lands and properties, in accordance with the legal provisions presented in Section 9.2.2 and the provisions proposed as follows:

a) Acquisition of Private Lands

As required by the law, the cash compensation shall be based on the market value of land plus an additional 15% as compensation for compulsory acquisition of the land.

In order to minimize the period during which affectees will be deprived of agricultural income, they shall be permitted to farm the land, even after WAPDA has taken possession, until the land is actually required for construction.

b) Acquisition of Private Fixed Assets

This part of the Land Acquisition Act is describes the compensation for acquired private fixed assets and properties, attached to the land, including buildings, structures, tubewells and wells. There is no fixed asset present on the lands which is going to be acquired in the project area.

c) Loss of Crops, Orchards and Other Trees

All affected persons losing crops, orchards and other trees shall be entitled to cash compensation, on this account.

Where permitted by the construction schedule, farmers will be permitted to harvest crops. Where this is not possible, cash compensation will be based on the market value of the crop.

For fruit trees, the valuation will be based on their net annual income, capitalized for 20 years. For other trees, the valuation will be based on the market value, taking into account the species and the size of the tree.

Salvage rights of so acquired trees shall be given to affectee owners.

d) Acquisition of Common Public Land and Buildings

Compensation on account of acquisition of the common public lands and buildings, not owned by individuals or by Government, including Shamilat-e-Deh, graveyards, mosques and shrines, shall be paid to the affected households, on equal share basis.

According to the survey no Shamilat-e-Deh, graveyards, mosques and shrines were observed at the project sites where the project facilities or components are going to be construct or the land which is required for the project so no compensation on account of acquisition of the common public lands and buildings will be required.

e) Loss of Tenancy Rights

Any tenant with legally-valid tenancy shall be entitled to a part of the cash compensation payable for the land and to compensation for any land improvements they have made, in accordance with the provisions of the Law and the terms of the tenancy.

Informal tenants will be entitled to compensation for any land improvements they have made and will be provided green work permits and priority access to credit and training.

f) Loss of Rental Rights (Ijaradari)

Ijaradars will be entitled to a part of the cash compensation payable for the land and to compensation for any land improvements they have made, in accordance with the provisions of the Law. The annual net profit from the land will be capitalized for the remaining part of the lease.

g) Fragmentation of Landholding

An affected person who is losing a part of a contiguous landholding, and the residual fragment is smaller than 0.2 ha, shall be entitled to have the residual fragment also acquired.

h) Severance of Landholding

An affected person who is losing a part of his landholding, and the residual landholding is adversely affected by the severance, shall be compensated in accordance with the provisions of the Law.

i) Temporary Occupation Of Land

Temporary occupation of waste or arable land procedure when difference as to compensation exists:

- Subject to the provision of Part VII of this Act, whenever it appears to the Provincial Government that the temporary occupation and use of any waste or arable land needed for any public purpose, or for a Company, the Provincial Government may direct the Collector to procure the occupation and use of the same for such term as it shall think fit, not exceeding three years from the commencement of such occupation.
- The Collector shall thereupon give notice in writing to the persons interested in such land of the purpose for which the same is needed, and shall, for the occupation and use thereof for such term as aforesaid, and for the materials (if any) to be taken there from, pay to them such compensation either in a gross sum of money, or

by monthly or other periodical payments as shall be agreed upon in writing between him and such persons respectively.

- In case the Collector and the persons interested differ as to the sufficiency of the compensation or apportionment thereof, the Collector shall refer such difference to the decision of the Court.

10.3.2 Compensation on Account of Displacement

The Land Acquisition Act provides for compensation on account of the involuntary or compelled change in the residence or place of business, to those affectees, who have a legal interest in the land acquired by the Government for a public project.

As it is discussed before according to the detailed engineering design and surveys there is no resettlement is required or involved in the project, hence no displacement will be possible during or after the implementation of the project.

10.4 COMPENSATION FOR GOVERNMENT OWNED LANDS

10.4.1 Land and Buildings

The government, including semi-government bodies, own lands in following different forms, in the Project area:

- Cultivated, cultivable and uncultivable lands
- Land under streams and ponds
- Reserved forest
- Land under roads and public ways (*Rasta*)

The following is proposed regarding compensation of government owned lands:

- Government owned lands under streams, ponds, forests and vacant lands shall be transferred to the Project, without any financial transaction.
- Lands under any government owned public infrastructure like roads shall be paid for to the relevant departments, not on the basis of the area acquired, but on the basis of land requirements for the relocated and replaced infrastructure.

10.4.2 Relocation and Replacement of Public Infrastructure Facilities

The Project shall provide for realigning, relocation and replacement of the public infrastructure including roads and power lines. All the disconnected surrounding communities and settlements shall be restored.

10.5 WEST PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY ACT, 1958

This Act authorizes WAPDA to construct and operate electrical transmission lines with powers and obligations of a licensee under the Telegraph Act of 1910. This Act also establishes policy for land acquisition and compensation, as well as the degree of liability of WAPDA for damages sustained by landowners or others.

11 LAND ACQUISITION: MISCELLANEOUS MEASURES

11.1 PRINCIPLES

All the land, with which the implementation of the Phandar Hydropower Project will be either permanently or temporarily be used, needs to be acquired by the project developer (WAPDA) prior to the commencement of construction of the various facilities. Socioeconomic investigations in the project area revealed that owner of land prefer to sell the land to WAPDA instead of giving on lease basis.

Land acquisition legal procedures have already been explained in section 11 of this report. The procedures require compliance with the following principles:

- Land require for construction works needs prior acquisition
- Cadastral survey according to the Pakistan legislation has to be announced in public
- Inventory results for the land to be acquired has to be published in the villages
- Land compensation is to be based upon award to be announced by the revenue department; the revenue department Ghizar is proposing to consider the latest awards as the basis for fixing the price of land in Phandar and Chhashi Gol. The revenue department takes into consideration escalation at the rate of 15% per annum to update the prices of land awarded in earlier years.
- Special charge at 4% is to be added as fee of the revenue department
- Grievance procedures have to be fully implemented.

11.1.1 Land Categories

There are two types of structures which will be constructed in the project area for the Phandar Hydropower Project (PHPP):

- Permanent structure
- Temporary structure in construction site
- ***Permanent Structure:*** For the construction of the permanent structure of Phandar Hydropower Project, the land has to be acquired and awarded in advance. The land has to be acquired in permanent basis from the owner of the land for the permanent structures of the project.

- ***Temporary Structures in Construction Sites:*** For those construction works, land is needed for limited periods. This land later will be returned to the owner. To theses temporary structures may belong facility like labourer camps, contractors' site installations such as batching plants, stockpiling areas and construction of temporary access roads. This land also needs acquisition prior to the start of construction. Legal conditions for the temporary use have to be prepared by the Project Developer and to be contracted prior to the occupation of the land.

11.2 LIVELIHOOD DEVELOPMENT

11.2.1 Employment Opportunities for Affected People

The work opportunities, provided to the adult project affected persons, shall consist of priority in project employment with Contractors and the WAPDA through the issuance of work permits, having priority over non-permit holders. We recommended that the executive Engineer of WAPDA will draw a merit list of prospective employees from the list of affected persons in consultation with the Jirga. The contractor will employ and retain workers on the basis of skills, suitability and performance.

11.2.2 Vocational Training

Local residents as project affected people should be employed in construction works by the contractor with priority. This requires providing training on the job in order to raise the skills of local residents.

11.2.3 Reforestation

The project developer will make the contractor responsible to carry out the reforestation in the PHP project area. WAPDA shall be responsible for reforestation in the project area. Forest nurseries shall be established by the contractor for forest trees, fruit trees and ornamental plants.

11.2.4 Support to Economic Activities

The present economic situation beyond the self-supply agriculture is not very good. Timber is available in the project area in abundance and thus should play a large role in the economic activities of local population. For this e.g. assistance and vocational training is recommended to develop business in the area. Vocational training shall be supported by WAPDA. Funds to start carpentry, shops and small scale business shall be arranged by individuals from their saving or loans from banks. Training measures are recommended to be carried out to educate selected local persons for these occupations.

11.2.5 Communal Improvement

The Project Developer (WAPDA) will support the Jirga's and other community representatives in all regards for better community self organization.

11.3 PUBLIC INFORMATION AND PARTICIPATION

11.3.1 Goals and Objectives

Public information and participation are of paramount importance for the effective implementation of the project. The public comprises local community (including male and female members, community representatives, CBOs), local politicians, NGOs, businessmen, and government officials. Following are objectives of the public involvement:

- To create awareness about the project by furnishing sufficient information.
- To solicit collective viewpoints and concerns about the project.
- To develop consensus on the mitigation measures for the project impacts in order to avoid any chaotic situation during implementation.
- To ensure full participation at the planning, implementation and regional development stages of the project.
- To establish close coordination with the WAPDA, project Consultants, project NGO, and Contractors in order to resolve their issues.

11.3.2 Disclosure of Information

Absence of formal process to disseminate information about the project; in general, and the land acquisition and compensation issue; in particular, can give rise to fears, suspicions, and anxieties among the Project Affected People (PAP). It may hinder smooth flow of the project operations in the form of social disruptions, unnecessary delays in achieving deadlines and increase in costs. In order to avoid this unpleasant situation, proper means, such as scoping and consultation sessions and involvement of the PAP in planning and implementation of the project, should be adopted. They should also be enabled to articulate their views and concerns about the project and communicate them freely to the authorised people of the project.

11.3.3 Village Scoping and Consultation Sessions

Other than the two village meetings and one public hearing mentioned in the **Chapter - 8**, the project should organise small scoping meetings at village

level with the aim to disseminate comprehensive information about the project to the PAP. Information sharing is vital for their participation. The scoping sessions will comprise interviews with individuals (including male and female members), focussed group discussions (including poor, minority people, and women) and establishment of village committees to participate in the entire process of land acquisition and compensation. The participation of PAP will play pivotal role in decision making of their lives.

The consultative sessions should be arranged with the local community as well as with other stakeholders including local politicians, local government officials, policy makers and NGOs on all the important and critical issues whenever they are anticipated or occur. These consultations facilitate the refinement of already proposed mitigation measures and development of new specific mitigations measures for reducing the environmental impacts of the project during construction and operational stages. In these consultations, the information about land acquisition and compensation policies payment schedules, and implementation institutions should also be shared.

11.3.4 Women's Participation

In a rural setting, women are considered to play their roles as housewives looking after family members, doing household chores, taking part in agricultural activities, fetching water, rearing animals etc. They are not encouraged to voice their concerns in community development activities. As a matter of fact, women can play paramount role in earning livelihoods, decision-making and managing community affairs. The role of women shall not be overlooked at planning and implementation stages of the project. They shall be given equal opportunity to take part in village scoping and consultation sessions. Their needs and priorities shall also be taken into consideration while designing land acquisition and compensation packages.

11.3.5 Role of Non-Government Organizations

It is obligatory on the part of the WAPDA to involve Non-Government Organizations (NGO) – local and international; at planning, designing, implementation and regional development stages. They can make significant contribution to the project by facilitating village scoping and consultation sessions by ensuring maximum participation of the PAP, assisting the PAP for shifting to new locations, mobilising host communities to welcome new entrants, enhancing skills development of the PAP through training programs (e.g. vocational training), mobilising the PAP to take part in the development process, ensuring timely payment of awards, providing technical assistance

for grievance redress, taking part in monitoring and evaluation, and archiving records of the land acquisition related activities.

11.3.6 Public Information Centre

The purpose of this centre will be to facilitate all interested parties of the project. It will impart information about the project to the public and keep record of complaints of the PAP. All the reports of the project will be available at this centre. A senior official equivalent to the post of Director will head this centre. Periodic meetings will be held with the PAP, NGOs and other stakeholders to resolve issues of the PAP. Women will be encouraged to actively participate in these meetings. The proceedings of these meetings will be transcribed for analysis purposes.

12 ESTIMATES OF LAND ACQUISITION AND ENVIRONMENTAL MANAGEMENT COST

12.1 GENERAL

This section of the report presents estimates of environmental, land acquisition and compensation costs for the project. The costs of compensation involved private as well as public lands and trees to be acquired for the project. These are estimated on the basis of the principles of valuation, as established in the Section-11 & 12, and the prevailing market prices.

12.2 COMPENSATION COST FOR LANDS

12.2.1 Areas to be acquired

The area/land that would be acquired for the project components is totally depends upon the topographic survey and detailed engineering designs. The details of acquired land for the proposed project are given in **Table - 12.1**.

Table - 12.1: Detail of Land to be Acquired for the Project

Sr. No.	Project Component Location	Land use classification		Estimated Area (Kanal)	Estimated Area (hectares)
		Cultivated	Uncultivated		
1	Left Bank of Weir	Cultivated		22.79	1.132
2	Right Bank Weir / Connecting Channel	Cultivated		6.82	0.311
3	Right Bank Bund Protection	Cultivated		64.04	3.181
4	Road to Weir	Uncultivated		29.10	1.445
5	Power Intake	Uncultivated		4.38	0.217
6	Low Pressure Conduit	Uncultivated		81.61	4.054
7	Penstock	Uncultivated		37.91	1.883
8	Powerhouse	Cultivated / Uncultivated		37.33	1.854
9	Road to Powerhouse	Cultivated / Uncultivated		118.58	5.890
10	Offices / Residences	Cultivated / Uncultivated		49.62	2.464

Sr. No.	Project Component Location	Land use classification		Estimated Area (Kanal)	Estimated Area (hectares)
		Cultivated	Uncultivated		
11	Contractor's Camp (Weir / Power Intake)	Uncultivated		8.25	0.409
12	Contractor's Camp (Powerhouse)	Cultivated / Uncultivated		28.85	1.433
13	Stockpile / Storage	Cultivated / Uncultivated		11.39	0.565
Total (Approximate)				**500.32**	**24.85**

12.2.2 Land Category

There are two type of lands present in the project area cultivated (rain-fed) or uncultivated. **Table - 12.2** given below present the category and area of the land acquired for the proposed project.

Table - 12.2: Category and Area of the Land Acquired for the proposed Project

Land Category	Area (ha)
Cultivated	10.81
Uncultivated	14.11
Total (Approximate)	**24.92**

12.3 BASIS OF LAND COMPENSATION COSTS

According to the Land Acquisition Act, the compensation of land shall be based upon the Market Value of the land at the time of notification of Section - 6, with an additional sum of fifteen percent (15%) of the market value, on account of the compulsory nature of the acquisition. Further, the market valuation of the acquired land is the sole function of the Collector, who is authorised official of the Provincial Government.

The estimation of the market values of lands, for the project, is based upon the following two sources:

- Field surveys carried out by environment team in the project area
- Revenue Department, Gupis

The **Table - 12.3** presents land market values, as reported by the locals, sellers and purchasers of land in the area and land values in accordance with the cadastral revenue records, for the lands of different categories lying in the project area, based on the environment team filed survey.

Table 12.3: Land Market Values

Land Category	Price in Millions/ Hectare (Seller / Purchaser)	Price in Millions / Hectare (Revenue Record)
	Rupees	Rupees
Cultivated	6.0	1.4
Uncultivated	4.2	0.7

Table - 12.4 presents summary of the above established market values of different categories of lands for the project. Compensation values (Revenue Record) are computed by adding a sum of fifteen percent (15 %) of the market value, on account of the compulsory nature of the acquisition, social disturbance linked to resettlement of new land and cost of one year loss of crop. Government taxes, if any, are excluded from the analysis.

Table - 12.4: Estimated Compensation Value

Land Category	Estimated Market Value	Estimated Compensation Value
	(Rupees in Million / ha)	(Rupees in Million / ha)
Cultivated	6.0	11.90
Uncultivated	4.2	7.83

12.4 LAND COMPENSATION COSTS

Based upon the lands to be acquired for the project, as given in the **Table - 12.1 - 12.2** and the estimated land compensation values, as established in **Table - 12.4**, total compensation cost on account of land acquisition computed and presented in **Table - 12.5**.

Table - 12.5: Estimated Compensation Cost for Land

Land Category	Compensation Value (Rupees in Millions/ha)	Land to be Acquired (ha)	Compensation Cost (Million Rupees)
Cultivated	11.90	10.81	128.64
Uncultivated	7.83	14.11	110.48
Total (Approximate)		**24.92**	**239.12**
		Say	**240.00**

12.5 COMPENSATION COST FOR TREES

The approximate numbers of trees which are supposed to be removed during the construction phase for the aforementioned structures are given in **Table - 12.6**. The trees numbers assessment is completely dependent on the blowups maps (satellite images).

Table - 12.6: Approximate Number of Trees to be removed

Sr. No.	Project component Location	No. of trees to be cut
1	Powerhouse +-	142
2	Road to Powerhouse	190
3	Offices / Residences	249
4	Contractor's Camp (Powerhouse)	29
5	Stockpile / Storage	7
Total (Approximate)		**617**

Table - 12.7 presents the number of tress, their average unit compensation rates (based on blowups maps and field survey carried out by environment team) accounting for full replacement and total cost of compensation.

Compensation rate for fruit trees is Rs. 40,000 per unit and for other trees it is Rs. 26,500 per unit.

Table - 12.7: Compensation Cost for Trees

Category	Numbers	Compensation Rate (Rupees / unit)	Compensation Cost (Million Rupees)
Fruit Trees	50	40,000	2.0
Others	567	26,500	15.0
		Total	**17.0**

12.6 PROJECT AREA DEVELOPMENT

A provisional sum of 98 million Rupees is made for the miscellaneous development works in the project area.

Table - 12.8: Area Development

Category	Million PKR
Vocational Trainings	1.0
Economic Activities	10
Reforestation	02
School	15
Dispensary	10
Rehabilitation of Irrigation Channel	20
Development of Tourism Resort	40
Total	**98**

12.7 CONTRACTORS EMP IMPLEMENTATION

A provisional sum of 29 million Rupees is allocated for contractors EMP Implementation.

12.8 WEC BUDGET FOR E&SMU STAFF

Environmental and social management unit is proposed under WEC for effective implementation of mitigation measures. 118 million rupees are allocated for E&SMU Staff. This also includes the cost of Environmental Laboratory and capacity building and trainings.

12.9 TERRESTRIAL AND AQUATIC ECOLOGY

A provisional sum of 06 million Rupees is made for implementation of mitigation measures related to terrestrial and aquatic ecology.

12.10 SUMMARY OF ENVIRONMENTAL & LAND ACQUISITION COSTS

Table - 12.9 presents summary of the estimates of the environmental and land acquisition costs for the proposed Phandar Hydropower Project.

Table-12.9 Summary of Estimates of Environmental and Land Acquisition Costs

Sr. No.	Item	Unit	Quantity	Estimated Costs (Million PKR)	Remarks
Cost Estimation for Contractor's EMP Implementation					
1.	Contractors Implementation of EMP	Year	-	04	Contractor will develop and implement the site specific management plans as described in chapter-9. Existing air quality monitoring to establish the benchmark.
2.	Environment Staff of Contractor	Year	02	25	One senior Environmentalist , One OHS Expert
WEC Budget for E&SMU Staff					
1.	Salaries of professional staff of E&SMU	Year	06	50	Project Director, One Senior Environmental Expert, One Senior Sociologist, One Junior Environmentalist
2.	Salaries of administrative staff of E&SMU	Year	04	10	One computer operator, One Driver, One attendant and one peon.
3.	Vehicle (Double Cabin)	Number	01	05	-
4.	Vehicle maintenance	Year	-	01	-
5.	Travelling of staff	Year	-	02	-
6.	Internal Audits	Monthly	48	15	Internal monitoring and auditing by WAPDA
7.	External monitoring consultant	Year	04	15	Check the performance of GRC, compliance

Sr. No.	Item	Unit	Quantity	Estimated Costs (Million PKR)	Remarks
					of EMP and water, and air quality monitoring.
Environmental Laboratory					
1.	Laboratory (including chemicals and staff)	-	01	16	Laboratory will be established with required equipments and chemicals to test the air and water samples.
2.	Environmental Monitoring	Year	384	04	Check the compliance of NEQS
Land Compensation					
1.	Cultivated land	ha	10.81	128.64	-
2.	Uncultivated land	ha	14.11	110.48	-
Terrestrial Ecology					
1.	Compensation for fruit trees	Number	50	2.0	-
2.	Compensation for other trees	Number	567	15.0	-
3.	Tree Plantation	Number	2500	1.0	Nursery will be established for 2000 saplings (Four saplings for one tree to be cut)
Aquatic Ecology					
1.	Native fish study	-	-	05	Study will be conducted at pre construction and the operational phase of the project to understand the upstream and downstream movement of fish, fish behavior and seasonal habitat.
2.	Fish ladder installation	Cost is included in civil and mechanical work.			
Area Development					
1	Vocational trainings	-	-	1.0	To raise the skills of local labor
2.	Economic activities in the area	-	-	10	

Sr. No.	Item	Unit	Quantity	Estimated Costs (Million PKR)	Remarks
	Reforestation			02	Establishment of forest nurseries for forest, fruit and ornamental plants
3.	School	-	01	15	-
4.	Dispensary	-	01	10	-
5.	Irrigation channel rehabilitation	-	01	20	-
6.	Development of tourism resort	-	01	40	-
7.	Slope stabilization/Soil erosion control	Cost is included in civil and mechanical work.			
	Capacity building				
1	Trainings for contractor, contractor's staff and WEC staff	-	-	02	-
2.	Contingencies at 10%	-	-	30	-
			Total	**300**	