PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

DASU HYDROPOWER PROJECT

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Volume 1: EXECUTIVE SUMMARY

General Manager (Hydro) Planning, WAPDA, Sunny View, Lahore, Pakistan

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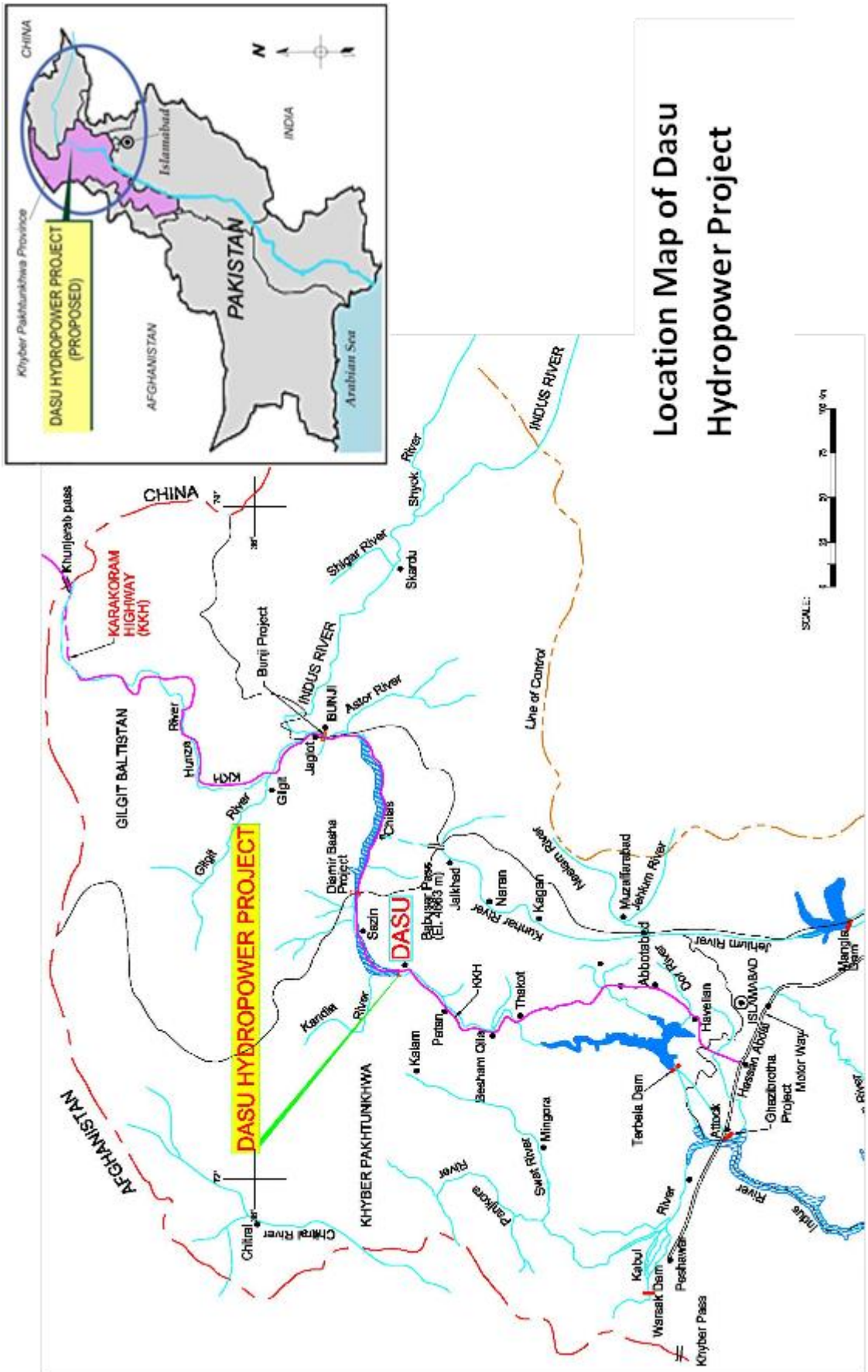
Location Map of Dasu
Hydropower Project
DASU HYDROPOWER PROJECT
(PROPOSED)
PAKISTAN
AFGHANISTAN
INDIA
CHINA
Islamabad
Khyber Pakhtunkhwa Province
Arabian Sea
DASU HYDROPOWER PROJECT
DASU
KARAKORAM HIGHWAY (KKH)
GILGIT BALTISTAN
KHYBER PAKHTUNKHWA
INDUS RIVER
Khunjerab pass
Skardu
Shigar River
Shyok River
Burji Project
BUNJI
Astor River
Hunza River
Gilgit River
Jaglot
Gilgit
Chilas
Diamir Basha Project
Sazin
Babusar Pass (El. 4694 m)
Jalkhad
Naran
Kaghan
Kunhar River
Neelum River
Muzaffarabad
Jehlum River
Mangla Dam
Abbottabad
Dor River
Havelian
ISLAMABAD
Hassan Abdal
Ghazikrotha Project
Motor Way
Thakot
Besham Qila
Patan
Kalam
Kandia River
Mingora
Swat River
Terbela Dam
Attock
Indus River
Kabul River
Peshawar
Warsak Dam
Khyber Pass
Chitral
Chitral River
Line of Control
SCALE:

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Vol 1: Executive Summary

Vol 2: Environmental Impact Assessment

Vol 3: Terrestrial Ecology

Vol 4: Aquatic Ecology

Vol 5: Physical Cultural Resources

Vol 6: Environmental Baseline Quality

Vol 7: Cumulative and Induced Impact Assessment

Vol 8: Environmental Management Plan

ABBREVIATIONS

ADB	Asian Development Bank
AHs	Affected Households
BCM	Billion cubic metre
BPs	Bank Procedures
CDM	Clean Development Mechanism
CEAP	Construction Environmental Action Plan'
CERs	Certified Emission Reduction
CIIA	Cumulative and Induced Impact Assessment
CITES	Convention on International Trade in Endangered Species
CSC	Construction Supervision Consultant
dBA	Decibel Adjusted
DHP	Dasu Hydropower Project
EA	Environmental Assessment
ECPs	Environmental Code of Practices
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMAP	Environmental Management Action Plan
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EU	Environment Unit
FSL	Full Supply Level
GB	Gilgit Baltistan
GCISC	Global Climate Change Impact Study Centre
GCMs	Global Circulation Models
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLOFs	Glacial Lake Outburst Flood
GOP	Government of Pakistan
GRC	Grievance Redress Committee
GWh	Giga Watt hour
HKH	Hindu Kush Himalayan
ICOLD	International Commission on Large Dams
IEE	Initial Environmental Examinations
IFC	International Finance Commission
ILRP	Income and Livelihood Restoration Program
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JICA	Japan international Cooperation Agency
KKH	Karakorum Highway
Km	Kilometer
KP	Khyber Pakhtunkhwa
kWh	Kilo Watt hour
LLO	Low Level Outlet
m	Metre

MCE	Maximum Credible Earthquake
MCM	Million Cubic Metre
mm	Milimetre
MOL	Minimum Operating Level
MW	Megawatt
NCS	National Conservation Strategy
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGOs	Non-Government Organizations
NHA	National Highway Authority
NOC	No Objection Certificate
NTDC	National Transmission and Dispatch Company
NTU	Nephelometric Turbidity Units
O&M	Operation and Maintenance
OBE	Operational Basis Earthquake
OHS	Occupational Health and Safety
OPs	Operational Policies
PATA	Provincially Administrated Tribal Area
PCR	Physical and Cultural Resources
PD	Project Director
PEPA	Pakistan Environmental Protection Act
PHAP	Public Health Action Plan
PM	Particulate Matter
PMU	Project Management Unit
PPM	Parts Per Million
R&D	Research and Development
RAP	Resettlement Action plan
RCC	Roller Compacted Concrete
ROR	Run of River
RWL	Reservoir Water Level
SA	Social Assessment
SRMP	Social and Resettlement Management Plan
STI	Sexually Transmitted Infection
UIB	Upper Indus Basin
UNFCCC	United Nation Framework Convention on Climate Change
USD	United States Dollar
WAPDA	Water and Power Development Authority
WB	World Bank
WCAP	Water Sector Capacity Building and Advisory Services Project
WEC	WAPDA Environment Cell
WWF	World Wide Fund for Nature

Volume 1
EXECUTIVE SUMMARY

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1. INTRODUCTION

1.1 DASU HYDROPOWER PROJECT

The Dasu Hydropower Project (DHP or the Project) is a 4320 MW hydroelectricity generation project proposed by the Government of Pakistan (GOP). The Project will inject about 18.44 million kWh (18,440 GWh) to the national grid and expand the energy sector of the country, while shifting from thermal generated electricity to low cost and high reward, clean generation of hydropower.

Pakistan is suffering from an acute power and energy crisis, which is primarily caused by insufficient energy supply and increasing demand. The total installed capacity of the country was 24,173 MW, yet only a peak demand of 19,924 MW could be served in 2011, indicating significant shortfall of 4249 MW. Power shortages resulted in long hours of load shedding, impacting households, industrial and commercial activities. Power shortages coupled with fuel shortages impacted export performance and economic growth. The impact of load shedding has been estimated at 3% to 4% of GDP, costing about US$ 10b a year. Further, Pakistan's energy sector is currently marked by high dependence on non-renewable fossil fuels much of which has to be imported, making energy production more expensive and affecting the national balance of payments. Other major problem is, despite huge hydropower potential in Pakistan in Indus Basin, hydropower share has declined from 64% during 1960s/80s to below 30% now.

In order to increase the hydropower generation capacity and irrigation system in the country, Pakistan Water and Power Development Authority (WAPDA) has prepared a "Vision 2025" program. The DHP is included in this program as one of the priority projects. A feasibility study for this project was carried out to identify the location of the project and to prepare preliminary engineering designs, cost estimates and a preliminary EIA. The detailed design is currently being prepared by an international consortium of consultants: the Dasu Hydropower Consultants (DHC). Financial assistance for study and design is given by World Bank under their Water sector Capacity building and Advisory services Project (WCAP).

DHP is a run-of-river project planned for development on the Indus River near 7 km upstream of Dasu town in Kohistan district of Khyber Pakhtunkhwa (KP) province. Location of the Project is shown in Figure 1.1. DHP is located about 350 km north of Islamabad.

DHP will be comprised of a 242 m high concrete dam and an underground powerhouse housing 12 turbines, each of which will produce 360 MW power, and a total maximum capacity to produce 4320 MW. WAPDA is the proponent and executing agency of the Project. World Bank is considering financing this Project for implementation.

The Project also includes construction of 62 km of Karakoram Highway (KKH) realignment due to inundation of part of the current road and about 300 km of two 500 kV transmission lines from Dasu damsite to Pathar Garh, near Hasan Abadal. The design of a transmission route is being carried out through a separate study by National Transmission and Dispatch Company (NTDC) and hence not covered in this study.

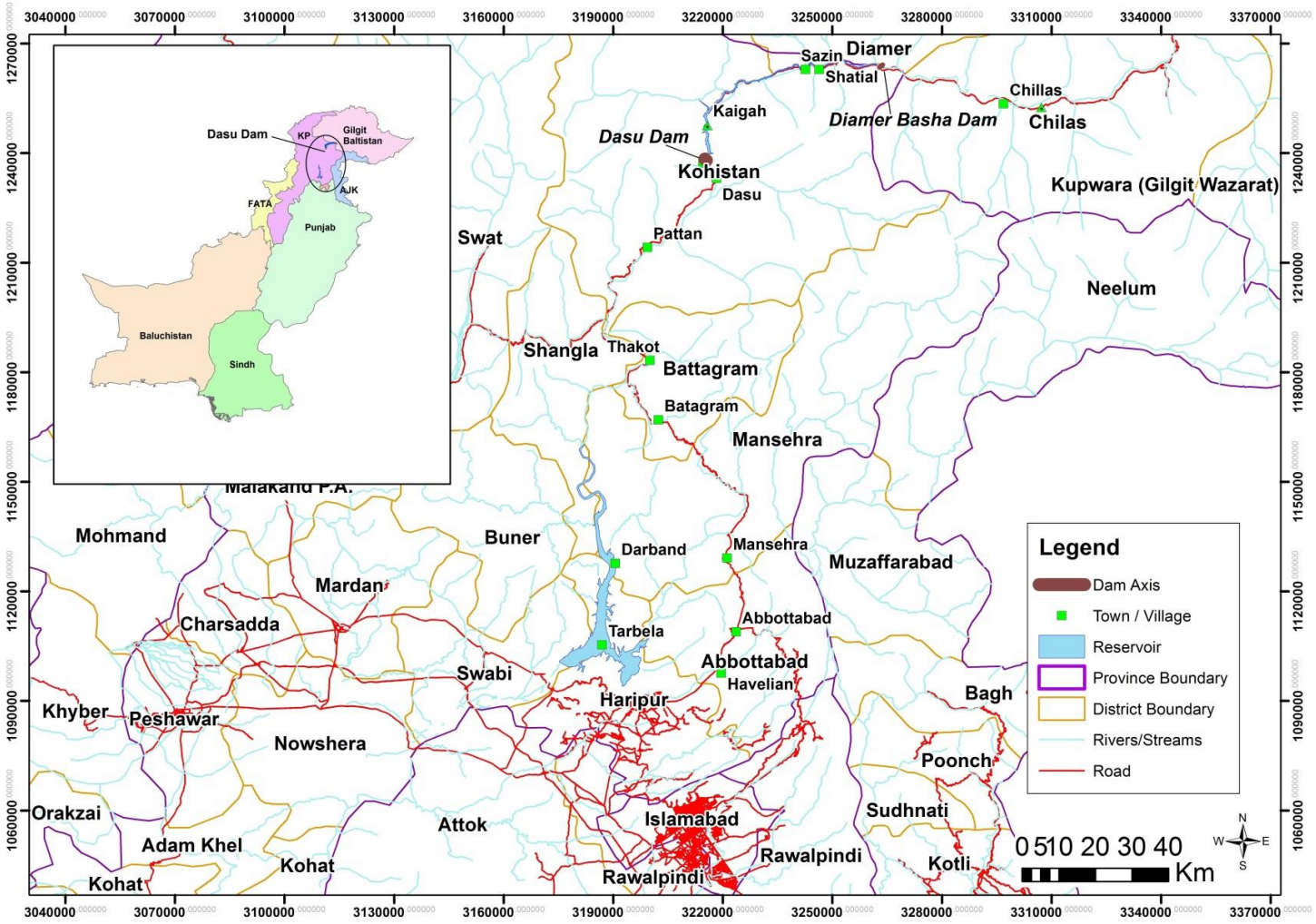


Figure 1.1: Location of DHP

1.2 ENVIRONMENTAL ASSESSMENT

An environmental assessment (EA) has been carried out as part of the detailed engineering design of the Project to evaluate the Project's potential environmental impacts and risks in compliance with GOP and World Bank guidelines. A set of 22 volumes have been prepared to address the full coverage of different environmental and social issues and impacts with possible mitigation measures to offset, reduce or compensate these impacts. These volumes are grouped into two categories: Environmental Management Action Plan (EMAP); and Social and Resettlement Management Plan (SRMP). Details of these documentations are given in Table 1.1.

Table 1.1: EA Documentation (EMAP and SRMP)

Volume	Title
A. Environmental Management Action Plan (EMAP)	
Vol.1	Executive Summary
Vol.2	Environmental Impact Assessment
Vol.3	Terrestrial Ecology
Vol.4	Aquatic Ecology
Vol.5	Physical Cultural Resources
Vol.6	Environmental Baseline Quality
Vol.7	Cumulative and Induced Impact Assessment
Vol.8	Environmental Management Plan
B. Social and Resettlement Management Plan (SRMP)	
Vol.1	Executive Summary
Vol.2	Socioeconomic Baseline and Impact Assessments
Vol. 3	Public Consultation and Participation Plan
Vol. 4	Resettlement Framework
Vol. 5	Resettlement Action Plan
Vol. 6	Gender Action Plan
Vol. 7	Public Health Action Plan
Vol. 8	Management Plan for Construction-related Impacts
Vol. 9	Grievances Redress Plan
Vol. 10	Communications Strategy
Vol. 11	Downstream Fishing Communities: Baseline and Impact Assessments
Vol. 12	Area Development and Community Support Programs
Vol. 13	Costs and Budgetary Plan
Vol. 14	Safeguards Implementation and Monitoring Plan.

1.3 COMPOSITION OF THE STUDY TEAM

The environmental and social assessment of the Project was undertaken by a team of national consultants with the support of international consultants.

Environment Team: The national team members include Zafar Iqbal Chaudry and Mudassar Hassan (Environment Specialists), Dr. William George and Prof. Tahir Omer (Fish Experts), Dr. Sajid Nadeem (Wildlife expert), Dr. Rehmatullah Qureshi (Vegetation Expert), Prof. Ihsan H. Nadiem and Irshad Ahmad Soomro (PCR Specialists), Dr. Allah Bakhsh Sufi (CIIA Specialist), and Noman Saeed (GIS Specialist). The international team members include Dr. Venkata Nukala (Lead Environmental Specialist), Malcolm Winsby (Aquatic Ecologist), Dr. Kashif Sheikh (Terrestrial Ecologist) and Dr. Masud Karim (Environmental Specialist – Climate Change).

Social Team: The national team members include Maqsood Ahmed, Dr. Ramzan Chaudhary, Awais Hassan Khan (Resettlement Specialists), Anwar Fazal Ahmed, Arslan Tariq (Sociologist), Saima Raoof and Ujala Saleem (Gender Specialists), Rana Muhammad Saleem (Consultation Specialist), Ahmed Saleem (Communications Specialist), Noorul Hadi (Livelihood Specialist), and Dr. Ilyas Quershi (Public Health Specialist). The international experts include Dr. Mohamad Zaman (Team Leader, Safeguards), Sunil Gonnetilleke and Dr. Haimin Wang (Resettlement Specialists), Dr. Iffat Idris (Social/Conflict Analyst), and Dr. Bernhard Eder (Public Health Specialist).

The social and environmental team was supported by WAPDA's Independent Consultants (Reiste Koopmans and Muhammad Omar Khalid) and International Panel of Experts (Prof. Gouqing Shi and Erik Helland-Hansen). World Bank Lead Safeguard Specialist Chaohua Zhang and Senior Environmental Specialist Javaid Afzal provided useful advice and guidance to the Team throughout the study period.

2. POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 KEY ENVIRONMENTAL LEGISLATIONS IN PAKISTAN

2.1.1 Pakistan Environmental Protection Act, 1997

Pakistan Environmental Protection Act (PEPA) establishes the general conditions, prohibitions, and enforcement for the prevention and control of pollution and the promotion of sustainable development in the Country. It also describes and delineates the powers and functions of the Pakistan Environmental Protection Council, Pakistan Environmental Protection Agency (Pakistan EPA), provincial Environmental Protection Agencies (EPAs), and Environmental Tribunals. In particular, the Act creates the authority for delegation of environmental management functions to the provincial EPAs. The requirement of conducting environmental assessment before commencing developmental projects stems from this Act. 18th Amendment Act in 2010 authorized the provinces to make their own laws and regulations regarding environmental. The powers of Pak-EPA have now become the powers of provincial EPAs. Government of KP although initiated to draft its own laws, to date no law has been enacted in KP and PEPA 1997 continue to be the province legal instrument for environmental protection.

2.1.2 Other Relevant Legislation in Pakistan

The other legislation and regulations relevant to the proposed project are listed below.

- Pakistan Penal Code (1860), deals with offences against public interests e.g. to control noise, toxic emissions and disposal of effluents;
- Pakistan Explosives Act (1894) provides regulations for handling, transportation and use of explosives used for quarrying and blasting of rock;
- Land Acquisition Act, 1894
- Factories Act (1934), provides regulations for safe handling and disposal of toxic and hazardous materials by contractors;
- The North-west Frontier Province Wild-life (protection, Preservation, Conservation And Management) Act, 1975
- Protection of Trees, Act (1949) prohibits cutting and logging of trees planted by the Forest Department along roads and canals;
- Pakistan Water and Power Development Authority Act (1958) authorizes WAPDA to develop water and power resources in the country through construction and operation of water storages and powerhouses and erecting electrical transmission lines;
- Antiquity Act (1975) protects antiquities and empowers the Government of Pakistan (GoP) to prohibit excavation and construction works in any area that may contain objects of archaeological or cultural historic value;
- Motor Vehicle Ordinance (1965) empowers licensing and other authorities to regulate traffic rules, speed and weight limits and vehicle use;
- Labor Laws: labor rights are provided in the Constitution of Pakistan; various acts and ordinances provide additional rules for working hours, minimum working age and conditions of employment;
- Highway Safety Ordinance (2000) includes provisions for licensing and registration of vehicles and construction equipment;
- Local Government Ordinance (2001) deals with enforcement of laws for land use, conservation of natural vegetation, air, water, disposal of solid waste and wastewater effluents, public health and safety.

2.1.3 Regulations and Guidelines

The regulations and guidelines relevant for the present ESA study are listed below.

- Pak-EPA IEE and EIA Regulations, 2000
- National Environmental Quality Standards (NEQS), 2000, 2009 and 2010
- Guidelines for the Preparation and Review of Environmental Reports, 1997
- Guidelines for Public Consultations, 1997
- Guidelines for Sensitive and Critical Areas, 1997
- Policy and procedures for filing, review and approval of Environmental Assessments, 2000

2.1.4 Relevant National Policies and Plans

The national policies relevant to the proposed project and its environmental and social assessment are briefly described below.

- National Conservation Strategy (NCS), 1992, was adopted as the guiding environmental policy for Pakistan and a Mid-Term Review was undertaken in 2000. The Mid-Term Review concluded that the achievements under the Strategy had been primarily awareness raising and institution building, and that future initiatives should emphasize improvements in implementation capacity.
- The National Environmental Policy (NEP) was adopted in 2005 and provides broad guidelines to the federal, provincial, and local governments in addressing environmental concerns and cross-sectoral issues such as poverty, health, trade, and local governance. To achieve its policy objectives, the NEP directs the Ministry of Environment (now Ministry of Climate Change), and provincial and local governments to develop plans for its implementation. The NEP provides an opportunity to strengthen relationships between Federal, provincial and local governments for environmental management, adopt innovative governance approaches, and incorporate performance measures in the implementation of agreed programs.
- The National Environmental Action Plan (NEAP) was adopted in 2001 with the stated objective of alleviating poverty through environmental projects. Starting at the federal level, a gradual integration of the programs at the provincial and local levels was envisioned. While some capacity has been built at the federal and provincial level, the NEAP has yet to fully realize its objectives.

2.1.5 International Treaties Signed by Pakistan

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

- Plant Protection Agreement for the Asia and Pacific Region and amendments, 1955
- Convention on Wetlands of International Importance especially as Waterfowl Habitat and associated protocols and amendments, 1971
- Convention concerning the Protection of the World Cultural and Natural Heritage, 1972
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
- Vienna Convention for the Protection of the Ozone Layer, 1985
- The Montreal Protocol on Substances that Deplete Ozone Layer and associated amendments, 1987
- Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal, 1989

- United Nations Framework Convention on Climate Change, 1992
- Convention on Biological Diversity, 1992
- Agreement for the Establishment of the Near East Plant Protection Organization, 1993
- International Plant Protection Convention (1997 Revised Text)
- Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997
- Memorandum of Understanding concerning Conservation Measures for the Siberian Crane, 1998
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000
- Stockholm Convention on Persistent Organic Pollutants, 2001.

2.1.6 Environmental Procedures

In accordance with the Pakistan Environmental Protection Act of 1997 (PEPA) and the Pak-EPA IEE and EIA Regulations, 2000, an EIA is required for hydroelectric power projects exceeding a generation capacity of 50 MW and with transmission lines with a capacity of more than 11 kV. The DHP will generate 4,320 MW, therefore an EIA for this project is mandatory.

The owner of the project, the (WAPDA) has already submitted the feasibility study EIA report and the formal approval of the EIA report by the KP EPA was received by WAPDA on November 23, 2011. This approval is valid for three years and is extendable for periods of three years. No further approval of revised EIA is required. However, the revised EIA will be submitted to KP EPA.

2.2 WORLD BANK SAFEGUARD POLICIES

OP/BP/GP 4.01– Environmental Assessment: The World Bank requires an Environmental Assessment (EA) for all projects proposed for Bank financing to ensure that these projects are environmentally sound and sustainable. For hydropower projects, this policy is triggered if modification of river flows lead to adverse environmental risks and impacts. The DHP project has been classified as Category A, because of the scope and size of the project involving large-scale construction activities and modification of river flows. An environmental assessment of the DHP has been carried out to mitigate or minimize all potential adverse environmental and social impacts. The environmental and social plans are documented in 23 volumes of EMAP and SRMP documents.

OP 4.04 – Natural Habitats: If changes in river flow have the potential to cause significant loss or degradation of natural habitats, borrowers must comply with this policy**.** The project has potential to cause significant conversion of aquatic habitat and impair associated ecological functions by: conversion of riverine habitat to lacustrine habitat through creation of a long reservoir (73 km); placement of a high dam (242m) on the river mainstem effectively creating a barrier to movement of biota and impairing ecological/longitudinal connectivity along the Indus River mainstem. These potential adverse impacts and possible mitigation measures are examined as part of the EIA. A standalone report on 'Aquatic Ecology is prepared. There are no protected areas, or critical habitats in or near to the project area.

OP 4.11 – Physical Cultural Resources: The EIA study has shown that there are two beautifully decorated, 400 year old mosques in the project area. The feasibility study for the project showed that one of them could be saved by shifting the dam axis some distance. The second one is in the reservoir area and will have to be dismantled, transported and reconstructed at a higher altitude by the project. Shatial rock carvings, a nationally designated archeological site (belongs to first to 7th century AD), are located adjacent to the head of reservoir area of DHP. These rock art will not be inundated, but should be preserved and protected, since many more of them in

upstream areas will be inundated after the construction of the proposed Diamer-Basha dam. Since the narrow Indus valley has been the only connection between the Indian subcontinent and China since pre-historic times the possibility of unexpected "chance finds" is high. Therefore in the bidding documents for the construction contracts procedures dealing with "chance finds" are included, providing guidelines how to deal with unexpected situations when buried physical cultural property is found during the work.

OP/BP 4.12 - Involuntary Resettlement: For the development of project infrastructure, reservoir area and realignment of KKH an estimated 4,643 ha of land has to be acquired by WAPDA. This will include the relocation of 34 hamlets/small villages affecting 767 households or about 6,953 persons. A Resettlement Action Plan has been prepared to guide the planning and implementation of compensatory measures, resettlement and restoration of livelihood in line with relevant Pakistani laws and World Bank OP 4.12.

OP/BP 4.37 Safety of Dams: This policy is applicable for DHP. An International panel of experts is hired by WAPDA to review the engineering designs of the hydraulic structures. Dam safety monitoring equipment will be installed and regularly recorded. WAPDA's Dam Safety Organization will annually conduct investigations. An external organization will be hired to undertake an independent investigation on dam safety every three years.

OP/BP 7.50 Projects in International Waterways: The project is located on the Indus River which is an international waterway. However, according to Indus Basin Treaty signed between India and Pakistan in 1960, Indus River water (along with Jhelum and Chenab) is allocated to Pakistan. This treaty gives unrestrained used of the Indus River water to Pakistan.

Policy on Access to Information: Documents (safeguard assessments and plans related to environment, resettlement) prepared or commissioned by a member country/borrower are to be made available to the public as a condition for doing business with the Bank. The borrower provides such documents to the Bank with the understanding that the Bank will make them available to the public. The executive summary reports will be translated in to Urdu and will be made available through two Public Information Centres that will be established at the project site. The reports would be made available to public, and would be available on WAPDA website. EIA and its summary would be sent to WB Info Shop.

OP 4.36- Forests: The impact area is very rocky and scarcely vegetated with scrubs and stunted trees. An estimated 21,000 shrubs and predominantly stunted trees will be lost in the reservoir area. There are no forests in the lower part of the valley. However, there are community owned forests on higher elevation which could be indirectly affected by the project induced demand on fuel wood. Hence OP 4.36 is triggered.

OP 7.60- Projects in Disputed Areas: Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. OP 7.60 is not applicable to the Project since all the project facilities are located in the KP province.

Environmental Health and Safety Guidelines. The World Bank Group Environmental Health and Safety (EHS) Guidelines contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology.

2.3 COMPLIANCE STATUS WITH GOP AND WORLD BANK GUIDELINES

The present compliance status of the project with GOP legislation and World Bank safeguard policies is indicated in Table 2.1.

Table 2.1: Compliance of Project with GOP Legislation and WB Safeguard Policies

	Legislation/Policy	Actions Taken to Comply
Government of Pakistan (GOP)	Pakistan Environmental Protection Act, 1997	WAPDA got the No Objection Certificate (NOC) for EIA from KP EPA on 23-11-2011 based on the EIA prepared in the Feasibility Study. No further approval is required from KP EPA.
	Review of IEE and EIA regulations	EIA is prepared. The updated EIA will be again submitted to KP EPA for their review and extension of NOC.
	International treaties	Verification of protected sites has been done, Red List and protection of vulnerable habitats considered.
	Disclosure of projects	Public information centers will be established at Dasu on both banks. Executive Summary of EIA and RAP will be prepared in Urdu and will be placed in the information centers along with other project information. A public disclosure meeting will be held in Dasu by DHP with the affected community EIA report will be disclosed in WAPDA's website.
World Bank	Early screening and Scoping	Scoping sessions held through consultative workshops at Peshawar, Lahore, Karachi and Islamabad; and consultations at the affected villages.
	Participatory approach	Workshops, consultation meetings and focus group discussions have been held
	Integrate Environmental assessment (EA) and social assessment (SA)	Natural environment, human health, social aspects, physical cultural resources are integrated in planning documents.
	Climate Change and floods	Impact of increased snow-melt and climate change and effect on Indus floods studied. Regional and Strategic cumulative impacts determined
	Alternatives	Alternative sources of energy (thermal, wind power, small hydro, solar) including other large hydropower projects) are considered. Alternatives are considered for siting of the project facilities, dam and water ways; dam type; power generation equipment; construction material, WAPDA office, and construction phasing.
	Pollution	Baseline survey of environmental water, air quality, noise and soil carried out. Environmental standards applied and Environmental Code of Practices (ECPs) have been included in contract documents.
	Physical Cultural Resources	A comprehensive study was conducted on physical cultural resources in the project area. Chance find procedure included in contract

	Legislation/Policy	Actions Taken to Comply
		documents.
	Gender	A gender action plan report has been prepared.
	Public Health	A comprehensive study on public health aspects has been conducted and a Public Health Action Plan is prepared
	Consultation and Information Disclosure	Consultations have been conducted in all the affected villages and with the Jirgas. Stakeholder workshops were conducted in Peshawar, Lahore, Karachi and Islamabad. EIA will be disclosed to the affected community through a public disclosure meeting. The executive summary report of Independent Consultants EIA will be translated in to Urdu and will be made available through two Public Information Centers that will be established at the project site. The reports would be made available to public, and would be available on WAPDA website. EIA and its Summary would be sent to WB Info Shop

3. PROJECT DESCRIPTION

3.1 BACKGROUND OF THE PROJECT

WAPDA conducted a study in 1981[1] to identify potential hydropower and storage development projects in the Upper Indus Basin (UIB). The study recommended and ranked 25 major potential sites (9 on Indus and 16 on tributaries), each having an installed capacity of more than 100 MW. DHP was ranked second in this study following the Diamer Basha Dam Project[2] (Basha Project).

The river reach between Diamer Basha dam and Dasu dam is a narrow gorge of limited capacity, which would form a reservoir for Dasu dam without much storage. Water will be impounded in the reservoir by constructing a high dam to create a high head. Water will be released downstream of Dasu dam through turbines for generating hydropower, and as spill through the spillway.

A feasibility study was conducted for DHP during 2006 to 2008 to identify the location of the Project and prepare preliminary engineering designs and an EIA. The preliminary design was prepared with a concept that the Basha Project will be constructed prior to the DHP. Detailed design of the Project was started in September 2011 with funding from the World Bank.

3.2 DESCRIPTION OF PROJECT COMPONENTS

The Project involves construction of various civil, mechanical and electro-mechanical works, which include 242 m high RCC dam with appurtenant structures, underground power house with tunnels, office and colony, and temporary facilities such as access roads. Details of major works in the Project are given in Table 3.1. A layout map of the project facilities is shown in Figure 3.1.

Table 3.1: Main Civil, Mechanical and Electromechanical Works in DHP

No	Work	Quantity/Details
1	**River Diversion Works**	
1.1	Diversion Tunnel on Left Bank	
	- No. and Shape	2, D-shape shape
	- Size and Lining	17 m W x20m H, shotcrete lined
	- Length	1,261 m ~1,101m
1.2	Coffer Dams	
	- Length and Height of Upstream integrated Coffer Dam	Length 88m, height 95 m
	- Length and Height of Downstream Coffer Dam	Length 40m, height 19 m
2	**Main Dam and Associated Facilities**	
2.1	Dam	
	- Maximum Height above foundation	242m
	- Crest Length at El 957m	570m
2.2	Spillway	
	- Number of Bays	8
	- Type and Size of Gates	Radial, 16.5 m wide x 22.4m high
	- Plunge Pool	162.26 m from dam toe
2.3	Low Level Outlet	
	- Number and Size	9 no. (Circular, 6.4 m diameter,

[1] MONENCO 1981. Inventory and ranking study of the potential water storage and hydropower generation sites along the upper reaches of the Indus and its tributaries.

[2] At about 74 km upstream of DHP dam site, a site of Basha Project dam is located, which will be a storage dam for power generation as well as seasonal storage to supplement irrigation supplies downstream of Tarbela dam. Detailed design of Basha Project was completed in 2009 and was ready for implementation.

No	Work	Quantity/Details
		180.23m length)
	- Type and Size of Gates	
	Service gates:	fixed wheel,8.4mWx8.4mH
	Guard gates:	fixed wheel, 5.1 m W x 6.4m H
	Regulating gates:	Radial, 5.1m W x 6.4mH
2.4	Flushing Tunnels on Right Bank	
	-No and size	2 No 9.5 m dia (L= 820 m & 680 m)
	Type & Size of Gates	Stoplogs: 4.75mW x 9.5mH
		Guard/Regulating gates: Roller, 4.0mW x 9.5mH
3	**Power Intake**	
	- Number and Shape	4 no, D=12m, Flatbed type
	- Removal Trash rack	4 sets,
	- Intake service gates	4 no,9.5 m W x 12.5m H
	- Intake maintenance gates	2,9.5m W x 12.5m H
4	**Tunnels (Water Ways)**	
4.1	Power (Headrace) Tunnel	
	- Number and Shape	4 no, circular
	- Size and Lining	D=12.5~5.5m dia, concrete lined
	- Average Length	450m
4.2	Tailrace Tunnel	
	- Number and shape	4 no, D-shaped
	- Size and lining	10mW x12.5mH concrete lined
	- Average Length	2,152m in average
	- Surge Chamber	4 no, D=37m, H=56m
	- Surge Chamber Stoplogs	4, 6.2m W x 7.8m H gantry crane
	- Tailrace Outlet Gates	8 no, 9.0m W x 8 m high
5	**Power Generation**	
5.1	Generating Units	12 no, Francis turbines (360 MW), 166.7 rpm
5.2	Powerhouse	
	- Powerhouse Cavern L × W × H	424m × 31m × 62m
	- Transformer Cavern L × W × H	424m × 22m × 33.5m
	- Length and Location of Transmission Line	300 km, Dasu – Manshera - Gattito Pathar Garh Design of transmission line and its EIA is not covered by the present study
6	**KKH Realignment and Access Roads**	
6.1	KKH Realignment (to compensate loss of 46 km of existing KKH)	62 km
6.2	Access (Link) roads from realigned KKH to existing KKH	5.4 km (2.4 km to damsite and 3 km to Kandia
6.3	Access road along right bank from Komela to Damsite and then to Kandia	35 km (12 km from Komela to Damsite and 23 km from damsite to Kandia)
6.3	A suspension bridge on Indus, 8 km upstream of Kandia bridge (to compensate the submergence of Kandia and Larghani bridges)	290 m length bridge with 340 m access road on left bank and 85 m on right bank)
7	132 KV transmission line from Dubair Khwar to the Project Site	45 km

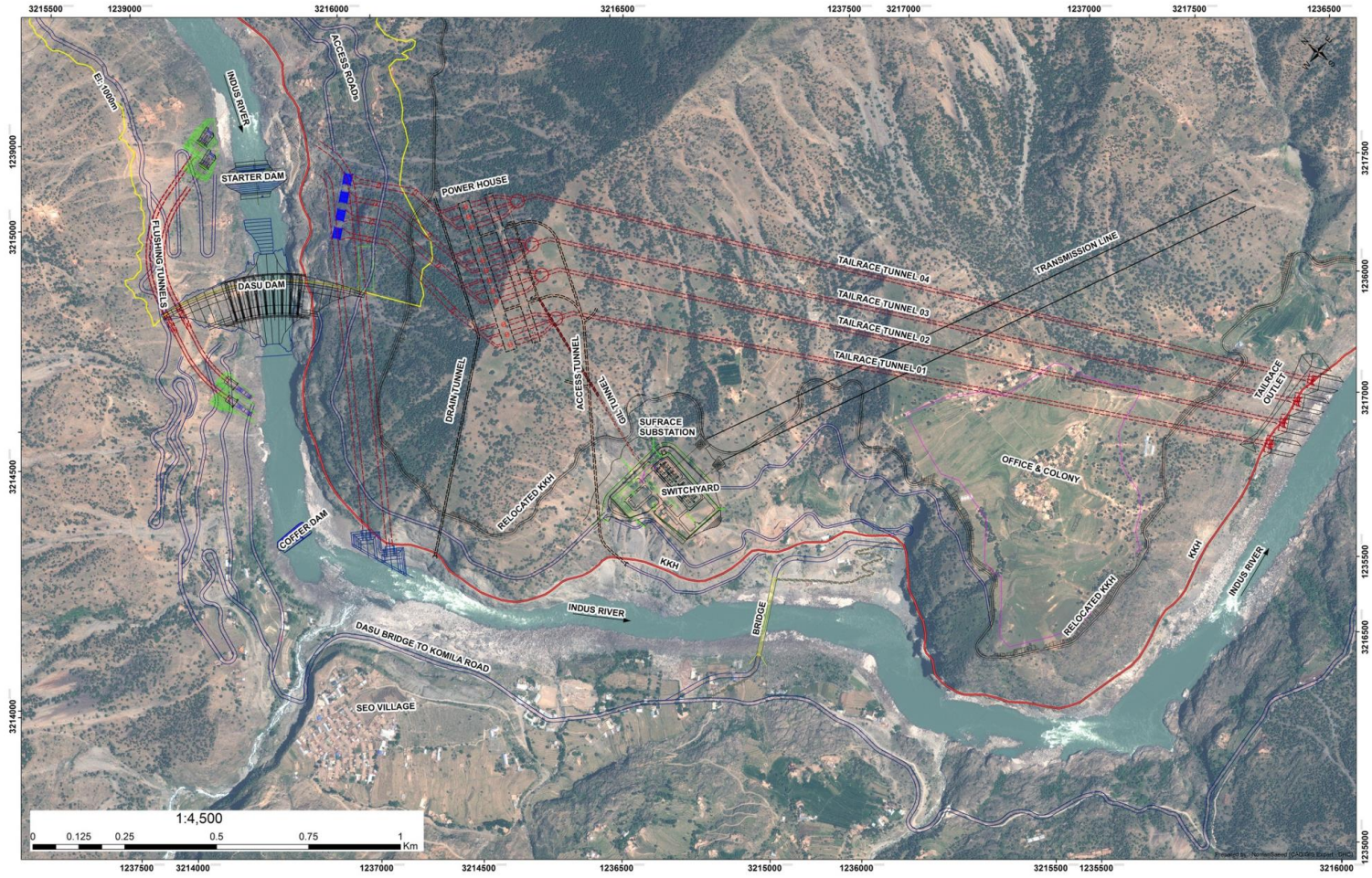


Figure 3.1: Layout of Dasu Hydropower Project

3.2.1 Main Hydraulic Structure

This component would primarily consist of the civil works required for main dam structure on the Indus River to raise the water level and thus create energy for running the power generating turbines and generators. The spillway structure would be designed to pass a probable maximum flood of about 52,000 m^3/s safely and with Low Level Outlets (LLO) and two flushing tunnels on the right Bank to flush the sediment coming from upstream and deposited in the reservoir. The main dam structure would be constructed with Roller Compacted Concrete (RCC). Maximum height of the structure would be about 242 meters above the foundation (crest level at 957 meters above sea level) and length at the crest would be about 570 meters.

3.2.2 Power Generation Facilities

Four power tunnels would divert water from the reservoir for power generation to the Power House constructed underground. Water passing through the turbines would be discharged from the power house to the river through four tailrace tunnels. Each power tunnel would supply water to three generation units of 360 MW each. A total of 12 units with a total installed capacity of 4,320 MW at full development. Similarly each tailrace tunnel would discharge water from three generating units.

3.2.3 Preparatory Works

These include the construction of new access road to damsite along right bank, coffer dams on both sides of the dam to provide dry workspace for construction of dams, diversion tunnels to divert river water around the damsite. Residences, office buildings and a WAPDA colony, housing staff and providing facilities, will be built near Choochang, 3 km downstream of damsite. Temporary facilities like construction yards, workshops, labor camps, crushing plants, etc. will also be constructed. About 30 MW of power supply is required for the construction site and the Colony. The required power will be supplied from Dubair Khwar hydropower project through a new transmission line to be constructed from Dubair towards Chuchang, near proposed colony site. From Chuchang grid station about 7 km of new distribution line will be constructed to the work areas.

3.2.4 Transmission Lines

Two 500 kV transmission lines have been planned from Dasu to Pathar Garh (near Hasan Abadal), where a new 500 kV grid station will be established. The alignment of the transmission line passes through the districts of Kohistan, Battagram, Mansehra, Abbotabad, Haripur and Attock districts. Length of the transmission line is approximately 250 km. The National Transmission and Dispatch Company (NTDC) will prepare detailed design, including a social and environmental assessment related to possible impacts of the construction of the transmission line. The impacts of transmission line are not covered in this report.

3.2.5 KKH Realignment

About 52 km of existing KKH will be submerged by the proposed reservoir of DHP. To compensate this loss, the Project will relocate the existing KKH to higher elevation above the reservoir high flood level, within the elevations between 960-1000 masl. In addition, to facilitate the smooth construction at the damsite and avoid obstruction to the regular traffic, a bypass will also be constructed along KKH to avoid the construction areas near the damsite. The relocated KKH will start from about 3 km north of Dasu town and end at about 11 km south of Shatial.

3.3 CONSTRUCTION PHASING

The DHP requires huge and committed investment. A staged development is the practical way to achieve earlier power generation with the minimum investment cost

(committed finance from the World Bank) and to deal with uncertainties in future investment. It was agreed with WAPDA and World Bank that a two staged approach will be followed for DHP with each stage divided into two phases. The stage 2 development is assumed to be implemented after Basha project construction, which has some implications on the sediment load to DHP and thereby operations of DHP.

During each phase additional power generating capacity of 1,080 MW (three turbines of 360 MW) will be installed. During Phase-1 (5 years, 2015-2020) the major hydraulic structures and related infrastructure will be constructed and one power tunnel including generating facilities for 1,080 MW of installed capacity. Another tunnel would be constructed during Phase-2, together with power generating facilities for another 1080 MW. Both phases of Stage 1 will be implemented simultaneously (2015 -2022). The Second Stage will include the construction of a third power tunnel and generating facilities for an additional 1,080 MW. Phase-3 and 4 would preferably be carried out after the development of Diamer-Basha dam.

3.4 PROJECT COSTS

Project costs are given in Table 3.2.

Table 3.2: Project Costs (in million USD)

	Description	Phase 1	Phase 2	Phase 3	Phase 4	Total
1	Dam and appurtenant structures	956.1	0	0	0	956.1
2	Underground powerhouse complex	401	171.7	229.5	159.7	961.9
3	Hydraulic steel structures - dam	264.8	0	0	0	264.8
4	Hydraulic steel structures – power house	31.4	20	19.5	19.5	90.4
5	Hydro mechanical and electrical equipment	264	226.9	251.7	199.4	942
6	500 kV transmission line	294	0	212	0	506
7	Social and environmental management cost	494.5	0	0	0	494.5
8	Administrative and consultancy costs	67.4	29.4	36.7	28.4	161.9
9	Physical contingency	166.9	19.5	36.8	17.9	241.1
10	Others (price escalation, interests, direct costs related to the project)	1,460.20	257.70	777.20	544.80	3039.9
	Total Cost	4400.3	725.2	1563.4	969.7	7658.6

Source: PC1 Estimates, Dasu Hydropower Project, October 2012

3.5 OPERATION OF DHP

3.5.1 Operational Concepts in Stage 1

The water level in the reservoir will always be maintained at 950m, and whatever additional water coming into the reservoir will be diverted through intake and to the power house. This means the reservoir and power house will be operated as a run of river (ROR) type power generation (base load plant).

During the high flow season (May to October) water will mainly enter the reservoir at a rate greater than water released through the powerhouse intakes and excess will pass over the spillway.

During Low Flow Season (November to April) water will also be maintained in the reservoir at 950m and additional water will be diverted through power house intake.

3.5.2 Operational Concepts in Stage 2 (after Commissioning of Basha Hydropower Project)

In Stage 2, after completion of Basha project, there is a potential that Dasu could be used as peaking plant due to guaranteed water releases from Basha reservoir. However, peaking operation produces about 1000 Gwh of less power annually compered to ROR (base load) operation. Hence in Stage 2 also it is recommended to use Dasu for base load operations. In the peaking plant operation, water will be stored and released on a daily cycle of approximately 18-20 hours storage followed by 4-6 hours release for power production (expected to take place approximately from 4 to 5pm to 8 to 11pm to meet the peak time requirement of grid).

Reservoir water level (RWL) in both ROR and peaking type is shown in Figure 3.2. As shown in this figure, the water level in the ROR type is completely kept at 950 m, while for reservoir storage type, the RWL shows the drawdown from FSL towards the MOL over 4 months from beginning of December up to beginning of April due to low flows. The reservoir water levels under the storage peaking type operation are controlled annually with the periods of 66.7% at FSL.950.00m, 8.4% at the transition between Full Supply Level (FSL) and Minimum Operating Level (MOL), and 24.9% at MOL.900.00m.

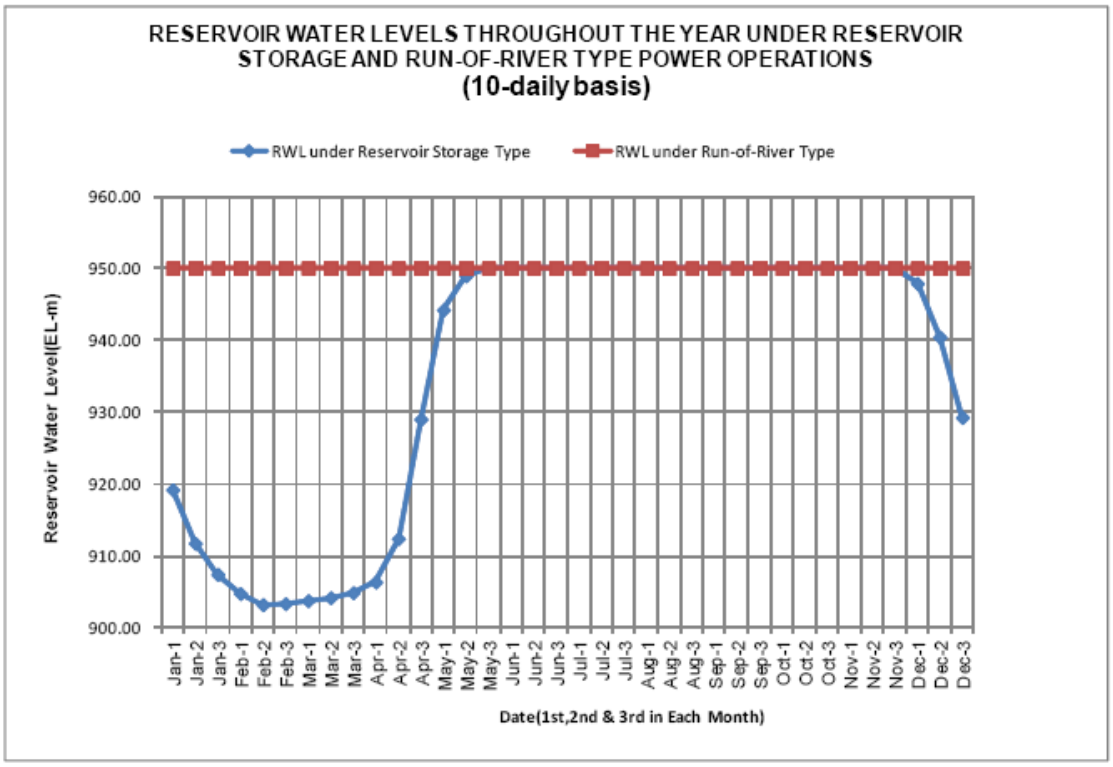


Figure 3.2: Reservoir Water Levels throughout the Year under Reservoir Storage Type and Run-of-River Type Power Generation Operations

3.5.3 Sediment Flushing

About 200 million tons of sediment passes every year at the dam site. Hence there will be reduction of reservoir storage over the years due to sedimentation and it is expected that the inlets for Low Level Outlets (LLO) and power intake will be filled within 20 to 25 years if there is no flushing of sediments.

The reservoir periodically will be flushed to remove accumulated sediment. The frequency of flushing is yet to be finalized. However, the current plans are to flush the reservoir once per year (after 15 years of operation if Basha is not constructed by that time or after 40 years if Basha is constructed within 15 years) for one month from 21st May to 20th June. Tentative lowering and rising program of the reservoir to undertake

drawdown flushing under free flow condition is shown in Figure 3.3 and specified below.

- Beginning date of lowering the reservoir water from FSL.950.00m: 15th of April
- End date of drawdown to RWL.842.55 m: 20th May
- Lowering rate:3m/day(120m in 40 days)
- Flushing period under free flow : 1 month from 21st of May up to 20th of June
- Beginning date of rising the reservoir water up to FSL.950.00m:21st of June
- End date recovered up to FSL.950.00m: 20th of July
- Rising rate: 4m/day (120m in 30 days)

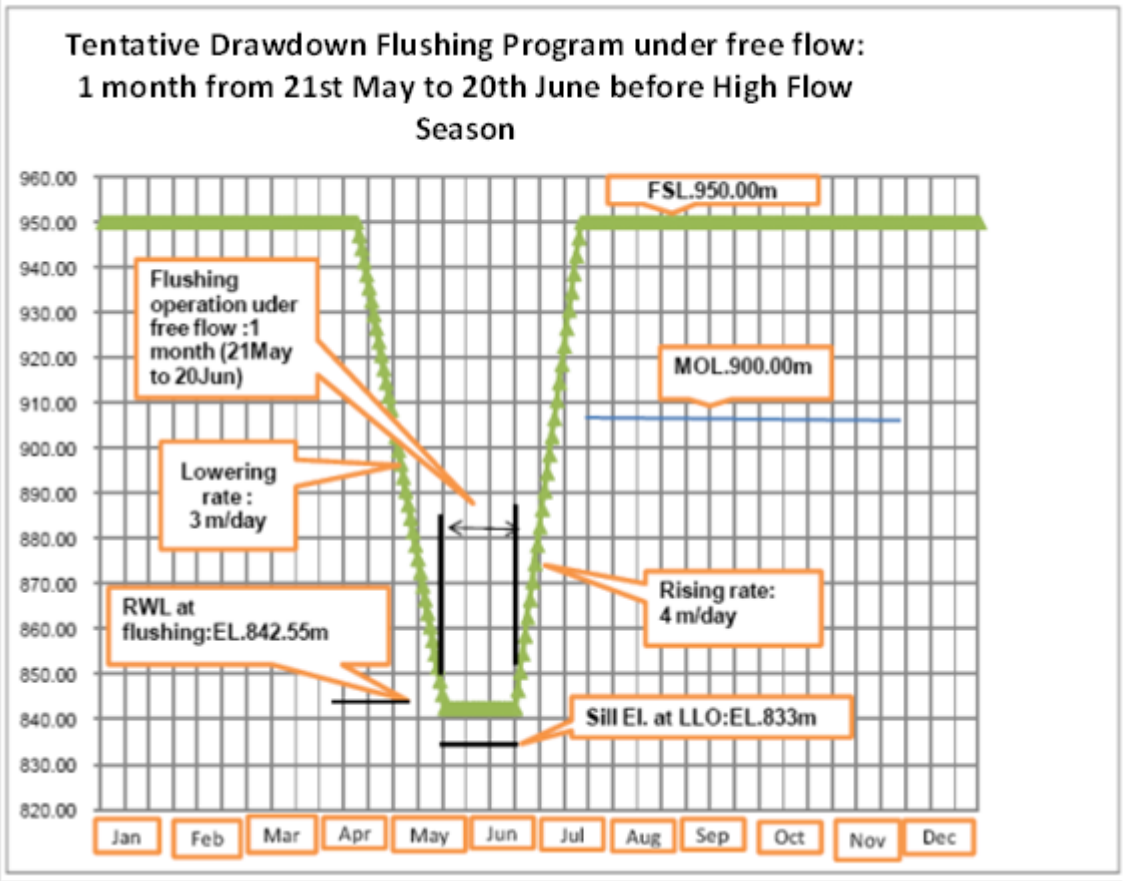


Figure 3.3: Tentative Reservoir Flushing Program

4. DESCRIPTION OF THE ENVIRONMENT

4.1 POTENTIAL IMPACT AREAS

The potential impact area of DHP includes all areas to be acquired for the reservoir and for construction works, housing areas, offices, access roads and realignment of KKH. On the upstream of damsite, the impact area of the project covers the left and right bank areas on both sides of the Indus from the riverbed up to reservoir full supply level of 950 masl. The impact area further extends to 1,000 m elevation to cover the realignment of KKH on the left bank and buffer area on the right bank. On the downstream of damsite, the impact area extends up to Dasu/Komila town, from where the access roads to the damsite will start. The impact area also includes (temporarily) KKH from Hasanabdal to Dasu, which will be extensively used by the Project vehicles. The study area of the project is much larger and covers the Indus valley between Basha and the Tarbela Reservoir.

4.2 PHYSICAL ENVIRONMENT

4.2.1 Topography

The Project area is located in the narrow Indus River valley of Hindu Kush –Himalayan mountain ranges. Lower Himalayas are located on the left bank and offshoots of Hindu Kush are located on the right bank of the Indus. These two mountain ranges join Karakoram Mountains near Gilgit. These three mountain ranges contain twelve of the thirty highest mountain peaks in the world, with heights greater than 8,500 m. The mountain peaks show typical glacial and pre-glacial geomorphic features, characterized by steep slopes, occasionally covered by sparse vegetation.

The river stretch between Basha dam and Dasu dam is a narrow gorge of limited capacity with a slope of 2.1m/km in average, which would form a reservoir without much storage. The river valley at dam axis, about 80 m wide, is generally symmetrical and deep V-shaped. The valley or abutment slopes at the both sides have an average slope of about 60 degrees at the lower part and of about 40 degrees at the upper part. The topography on each abutment is irregular with alternating scraps and natural benches.

4.2.2 Climate

The climate of Project area is generally influenced by the presence of high mountain system which creates rain shadows in some places and high precipitation in other. The climate in the project area can be classified as dry subtropical (below 1500 masl) to temperate (above 1500 masl) climate. In Dasu, the summers are generally hot with temperatures over 35 ^{o}C and winters are cold with temperatures up to 5 ^{o}C. Himalayas act as barrier to the monsoon movement and hence most part of the study area above Besham is located in monsoon shadow. The average annual rainfall in the monsoon shadow area is generally less than 300mm and in the monsoon influence area the rainfall is more than 1000mm. Rainfall in the northern part of the study area mainly occurs through westerly winds originating from Mediterranean Sea.

Within the gorges of the upstream study area, the climate varies between valleys and mountains. The valleys are dry with annual precipitation around 200mm, but totals can go up as high as 600 mm at elevations above 4000 masl. Glacial studies above 5000 masl suggest precipitation in the order of 2000 mm annually in the form of snow.

4.2.3 Geology and Seismicity

The Project area is underlain mainly by two types of rocks, granulite distributed in the upper reach and amphibolite in the lower reach with a contact zone, having 300 m wide at maximum, defined as Khoshe Contact. The bedrock of the dam site consists of

granulite or dioritic granulite which is covered in places by overburden. The granulite is generally grey, non-foliated, moderately to slightly weathered at outcrops but moderately to widely jointed or fractured. The rock mass is considered favourable for construction of dam foundation.

The Project area is prone to seismic movement and earthquakes and is classified as high earthquake zone by Geological Survey of Pakistan. The biggest earthquake of 2005, a magnitude of 7.5 on Richter scale, occurred in Azad Kashmir 100 km far from the Dasu. Following ICOLD guideline the seismic hazard assessment was carried out and for a 'Maximum Credible Earthquake' (MCE) of 0.54 g was considered for the project design.

4.2.4 Geomorphology and Landslides

The project area is characterized by steep and moderately steep slopes. The granulite and amphibolite rock slopes are susceptible to rock fall and block toppling along steeply inclined foliation, discontinuities and occasional wedge sliding along various combinations of inclined joints and shears. The stability of rock slopes depends largely on rock mass properties, structural discontinuities, moisture content and earthquakes. Frequent landslides are very common in the area. Huge moraine deposits occur on either side of Indus River are also responsible for frequent landslides during rainy season.

4.2.5 Hydrology

The Indus River originates at elevation of 5,500 m asl in the Tibetan Plateau to the north of Mansarovar Lake, and is fed by snow and glacier melt in the HKH mountain ranges. The length of the Indus up to the Dasu dam site is 1,024 km and the catchment of Indus River at the dam site is 158,800 km^2. Total annual flows at Dasu is 66.7 billion cubic meters (BCM) and 90% of these flows come from melting of snow and glaciers. Hence, summer months of June to September (known as high flow season) contain nearly 79% of total flows. October to May is known as low flow season due to lesser flows in the river. The mean annual runoff at the dam site is 2,116 m^3/s. Average monthly flows during high flow season are about 5000 m^3/s with highest flows of 6,600 m^3/s. Average monthly flows during flow season are about 500 m^3/s and the and the lowest flow is 291 m^3/s. The major tributaries (also known as nullahs) in the project area are Kandia, Darel, Tangir and Jalkot.

4.2.6 Flooding

A number of historic floods are known from the upper Indus catchment area. They occur because of the sudden blockage by one or more landslides of the Indus and the resulting overtopping and outburst of the river. Also heavy floods can occur when an ice barrier breaks or a glacial lake suddenly empties with an outburst flood creating havoc in downstream areas. Nearly 60 glacial lake outburst floods (GLOFs) were reported since 1830. Other causes of floods are heavy and prolonged storm runoff and intensive and extreme glacier and snow melting. Based on the flood frequency analysis at the dam site, the 1 in 10,000 year flood is 19,400 m^3/sec and the highest recorded flood due to GLOF was 24,360 m^3/sec. Probable maximum flood considered for the design of the dam is 51,957 m^3/sec.

4.2.7 Sedimentation

The Indus River carries a heavy sediment load due to the ruggedness of the catchment area and the strong erosional forces in the upper catchment area caused by deforestation and lack of protective vegetation cover. Another factor is the great variation between day and night temperatures. This may cause cracking and disintegration of rocks, erosion, and landslides on unstable slopes. Erosion materials in side valleys will be transported by melted snow towards the tributaries and will finally discharge as mud flows into the Indus. The river also derives sediments from vast

alluvial fields and moraine deposits formed along its banks more upstream. The sediments in the river water comprise suspended solid and moving bed load. The annual sediment load at Dasu is estimated at 200 million ton and 97 percent of it comes in the high flow season between June and September.

4.2.8 Groundwater

The groundwater table in the river valley is deep and limited to deeper aquifers. Groundwater is not even noticed in some of the test boreholes. Low precipitation, steep slopes, little over burden and vegetation, and low permeability of rocks are probably reasons for low groundwater. At the damsite, the groundwater depth on the right abutment ranges between 50 m to 68 m and on the left abutment between 48 m to 68 m. At the powerhouse and tail race area, the depth of groundwater level varies from 200 to 300m. This groundwater level is about 40 to 100m above the tail race and powerhouse caverns. Hence large scale groundwater dewatering is required for construction of tunnels. Permeability of the groundwater bearing strata along the tunnel alignment found to be 1 to 10^{-7}m/s. A few springs are also found to be distributed along and around the tailrace tunnels.

4.2.9 Surface Water Quality

The water quality of the Indus and its tributaries has been investigated during the high flow (Jul/Aug 2012) and low flow season (Nov/Dec 2012). Generally water quality is in compliance with the national drinking water standards (NEQS) and National Surface Water Quality Criteria of Pakistan (proposed by WWF in 2007). Water quality of Indus and its tributaries are characterized by: changes in physic-chemical conditions in high flow and low flow seasons; high water temperatures in high flow season (15 to 21 ^{o}C) and low temperatures in low flow season (6 to 15 ^{o}C); alkaline with pH above 7; high dissolved oxygen (above 6.5 mg/l; high turbidity up to 70 NTU in high flow season; and up to 32 NTU in low flow season; low total dissolved solids (less than 150 mg/l) and low conductivity (325 µS/cm); nitrate concentration range 0.6 to 3.5 mg/l; and nickel concentration is slightly exceeding the national drinking water standards (0.2 mg/l).

4.2.10 Air Quality

Generally air quality in the Project area is found to be within the ambient air quality standards (NEQS) except very fine particulate matter, $PM_{2.5}$(range: 20 to 180 µg/m^3) High concentrations of fine particulate matter are related to regional sources, not particularly any local source. The concentrations of particular matter are high in winter compared to summer, may be due to poor dispersion caused by either atmospheric inversion and calm winds or increased secondary pollutants' load. Concentrations of CO (range: 1 to 10 mg/m^3) have exceeded NEQS at Pattan and Besham, and concentrations of NO_2 have exceeded standards at Mansehra and Abbotabad in winter.

4.2.11 Noise Quality

Generally noise levels are high along the valley and in most cases exceeded the national standards. Average day time noise levels vary from 43 to 67 dBA and night time noise levels vary from 31 to 65 dBA. In Dasu and Komila, the day time noise levels vary from 56 to 58 dBA and night time noise levels vary from 44-52 dBA. With effective from July 2012, the NEQS for day time and night time noise levels in residential area are 55 and 45 dBA respectively.

4.3 AQUATIC ECOLOGY

4.3.1 Aquatic Ecosystem

Indus and its tributaries are characterized by relatively steep gradients and substrate sizes, fast-flowing, turbulent and turbid water. The river is mainly fed by melting of snow and glaciers; flow is high during summer and contribution from rainfall is very small. Quality of river water changes between the summer and winter seasons. During summer, river water is very turbid and carries a high sediment load. Several river tributaries (nullahs) join the river between Basha and Dasu. All tributaries pass along steep gradients through rocky areas of high mountains, exhibiting variable cascades, riffles and pools and, at confluences with the Indus River, gravel and sand where most spawning sites of snow carp and other species are believed to be located. Streambeds mainly are covered with boulders, cobbles and gravels. The banks of some streams have patches of vegetation such as herbs, shrubs and trees.

4.3.2 Fish Species

Fish diversity in the Indus River is low as compared to other major rivers of the region. The Indus River has 177 fish species including 12 exotic species, which is substantially lower than other major rivers in Asia like Ganges (350 species), Brahmaputra, Mekong (400) and Hwang Hu (320 species). Only four fish species are found in the project area (damsite and the proposed reservoir submergence area). These are: three species of indigenous snow carps (Schizothorax plagiostomus, Racoma labiata and Schizopyge esocinus) and one species of catfish (Glyptosternum reticulatum" belonging to family – Sisoridae). Fish sampling for Diamer Basha Project has also yielded only 13 species. The main reason for poor diversity is long torrential upper stream courses in the Himalayas, glacier fed water, high velocity, and high sediment load during summer or low mean discharge rate of water and low temperature during winter.

Plagiostomus is the dominant fish species in Dasu area representing more than 75% of total fish catch and other two species of snow carp represent about 15% of total fish catch. None of these species are listed in IUCN Red List. Mahaseer is other important cold water fish species of Indus (long distant migrant and endangered), but its habitat starts about 70 to 80 km downstream of the damsite.

Habitat of snow carp: In the project area fish found mainly in the tributaries, while in the mainstem they are found near the confluences during low flow season of winter. Tributaries with snow carp fish habitat on the upstream side of the dam site are Kandia, Tangir, Darel, Kaigah, Summar, and Goshali. While tributaries on the downstream side with snow carp fish habitat are Sieglo, and Jalkot. Snow carps thrive in the snow fed river habitat of clear, shallow water of stony substratum with an average depth from 0.5 to 3 meters, and river flows with low to high velocities (0.5 to 1.5 m/s). Average temperature requirements are 4 to 20 ^{o}C and dissolved oxygen requirements are 8 to 12 mg/l. Snow carps are bottom feeders and mainly feed on peryphyitic algae and diatoms.

Migration of snow carp: Snow carps are short distance migrants. In the project area, they migrate within the tributaries (head waters areas to lower elevations and to Indus confluence areas; and vice versa), not along the mainstem Indus. During April to September (spring and summer, high flows), they prefer upstream head waters habitat at higher elevations. During September to April (low flows and winter), they prefer lower elevations and confluence zone with Indus. The triggers for migrations are high flows, high sediment load and low temperatures. During spring, when flows started increasing in the rivers due to melting of snow, the fish migrate upstream from April and May (within tributaries) due to high flows and turbidity at lower elevations. During autumn, when the temperatures are starts to drop at higher elevations, the fish migrate downstream from September and October.

Spawning of snow carp: Female fishes spawn in two seasons, one in September-October and other in March - April. Sexually matured snow carp (when they reach 18-24 cm length, at the age of 2-3 years) spawn in tributaries in clear water (along stream banks, backwater pools and near confluences of other tributaries and Indus) on gravelly/stony ground or on fine pebbles at 10-30 cm depth. Low water currents of 0.5- 1.5 m/sec, pH 7.5, dissolved oxygen concentration of 8-12 mg/L and gravel sizes of 50-60 mm are the optimum conditions for spawning.

4.3.3 Fisheries

Fishing from Indus and its tributaries in the project area is limited. Local people fish as a part time activity, not as commercial fishermen. Very few persons sell their catches. No professional fishermen are found in the project area. Only Tarbela reservoir has proper organized commercial fishing.

A survey was conducted from 22 villages on the downstream of the dam from Dasu to upper part of Tarbela reservoir. About 12 percent of households are reported involved in fishing. 110 fishermen were interviewed, 75 percent of them primarily fish for domestic use and remaining 25 percent occasionally sell in the market.

4.4 TERRESTRIAL ECOLOGY

4.4.1 Terrestrial Ecosystem

The project area falls in montane dry sub-tropical scrub zone with rocky and barren terrain with scattered vegetation. The river beds are characterized by rocky outcrops with stony cliffs, large boulders and washed gravels. There is no littoral zone outside the tributaries (nullahs). There is soil erosion along steep slopes. Geographically, nearly 60 percent area is composed of barren hills with steep slopes. Vegetation cover is very low with scattered trees and shrubs. Vegetation cover increases with increase in elevations and mountain tops are generally covered with dense vegetation. There is some forest cover located beyond the direct project impact area on higher elevations, above 2,000 masl. There are certain permanent wet beds along the perennial nullahs that appear as narrow meadow strips and alluvial fans. These meadows and streams are main outlets for distribution of plant species. This kind of alluvial zone is also a preferable area for breeding/nesting of insects, birds, amphibians and reptiles. Some of the nullahs are perennial in nature and supply water during summer and snow melting period, while other remains dry during winter.

The mountain areas of northern Pakistan are home to unique wildlife and wilderness areas. Also the mountain reaches above the DHP area have a large biodiversity; but the Indus valley bottom (including the future reservoir area) is largely covered with scrub vegetation with its typical low biodiversity. Habitat of wild animals is confined to the mountain tops at higher altitudes (above 3,000 masl) outside the project impact area, and they rarely visit the valleys. From the wider study area, 232 species of plants, 199 species of avifauna, 31 mammals and 18 species of reptiles and amphibians are recorded.

4.4.2 Important Terrestrial Species

According to IUCN Red-List, none of the recorded 232 floral species are endangered, rare or vulnerable. A large number of these plant species are of economic or medicinal value for the inhabitants of the area. Most of the 199 recorded bird species reported are classified as “abundant and common”. The Western-horned Tragopan (*Tragopan melanocephalus*) is listed as “vulnerable”. The Monal Pheasant (*Lophophorus impejanus*) and the Rufous-tailed Rock Thrush (*Monticola saxatilis*) are classified as “rare”, and the Grey-necked Bunting (*Emberiza buchanani*) and White-bellied Redstart (*Hodgsonius phoenicuroides*) as “scarce”. According to IUCN’s Status and Red List of Pakistan Mammals, two mammalian species are reported Critically Endangered

(Common Leopard and Caracal Cat); three species are Endangered (Indian Wolf, Himalayan Musk Deer and Markhor); one Vulnerable (Asiatic Black Bear); three Near Threatened (Hill fox, Asiatic jackal, Rhesus macaque) and one Data deficient (Leopard cat). The Eurasian otter (*Lutra lutra*) was not seen in the project area during the terrestrial field surveys, but it is reported from the Diamer Basha area. Markhor is an important and endangered mammal commonly inhabits the area and is protected by local community through community conservation area for trophy hunting.

4.4.3 Community Game Reserve

There are no protected areas close to the project area. A private game reserve known as a Community Conservation Area (CCA) is located about 10 km upstream from the dam site near Kaigah. It is a community managed game reserve (not a protected area) for Markhor covering about 5000 ha. According to National Council for Conservation of Wildlife Population census in 2005, Kaigah CCA holds about 150 markhors. According to 'Conservation on International Trade in Endangered Species of Flora and Fauna' (CITES), the quota for Markhor hunting for Pakistan is 12. Out of hunting quota of 12 animals, four were allotted to KP, five to Baluchistan, and three to GB. Annually one hunting permit is issued for Kaigah conservancy. Each permit costs about USD 100,000 and 80% of this fee goes to the community. The money is kept in a conservation fund and is spent by the village conservation committee on conservation and community welfare programs. This program has brought a sense of ownership among the local communities and now they are expanding extending their full support and cooperation in the protection of wildlife.

4.4.4 Bird Migration

The migration of waterfowl occurs in north-south direction and vice versa. The birds breeding in central and northern Siberia migrate to the various destinations in Pakistan, crossing the Karakorum, Hindu Kush, and Suleiman ranges, and following the Indus valley and plains down to the Indus delta. The southward migration begins in November, and the northward migration starts in March. This flyway of waterfowl and migratory birds constitutes a famous corridor of international importance, the so-called "Indus Flyway" or "International Green Route No.7". The route offers plenty of food and a mild and hospitable climate to the birds. The Indus valley and more particularly the wetlands of southern Sindh are the major wintering grounds of migratory waterfowl. Key species using the flyway include cranes, teal, pintail, mallard, gadwall, white-headed duck, houbara bustard and Siberian crane.

4.4.5 Forests

Forests are located at altitudes more than 2,000 masl, well above the Project foot print area. These forests can be classified as 'Private Forests' owned by the local community, but managed by KP forest department, which is responsible for overseeing commercial timber extraction and timber sales. Previously local communities used to sell the timber on standing basis to logging contractors. KP Forest Department attempted to regulate volume extracted through the use of harvesting plans. Forests are quite a significant source of income for local communities as private owners, woodchoppers and timber cutting thereby selling through government leasing. The forest royalty ratio is 80:20 (80% share goes to community and 20% to the government treasury of KP). Selling of fuel wood is an important business in the Project area. People harvest Oak tree, Wild Olive and other fuel wood trees from hill sides and store in the form of wood toll on main KKH. Collection of mushroom and pine nut is also important seasonal business of the area. Various needs of local communities also place considerable pressure on natural forests. These include: timber for housing, agricultural implements, furniture; and firewood for cooking and space heating.

4.5 SOCIOECONOMIC ENVIRONMENT

4.5.1 Kohistan District

The word Kohistan literally means “land of mountains.” It is one of the most isolated and the most deprived district not only in KP but considered one of the least developed districts in the country. Swat is situated to its west, Chilas, Darial and Tangir on the northern side and Naran, Kaghan and Alai surround Kohistan from the southern and eastern sides. Dasu is the District headquarters, whereas Pattan, Palas, Kandia and Dasu are the four Tehsils (revenue unit) of Kohistan District. The River Indus flows through Kohistan and divides it socially and culturally.

4.5.2 Demographic Information

The Population of the Kohistan district is almost entirely Muslim (99.6%) most of the people belong to Hanafi Sunni Sect. The population of Kohistan in 2008 was 477,000, of which 55.43% are males and 44.57 % are females. Kohistan consists only of rural population with a population density as low as 63 per square kilometer. Male to female ratio is 100 to 124.

4.5.3 Education and Literacy

In Kohistan, the literacy rate in the people aged above ten is low (30%) compared to the national average of 57%. Low enrolment and non completion of primary grades are assumed to be the primary cause for low literacy. Gender disparity in educational attainment and in employment is a prominent feature of the socio-economic profile of Kohistan. Gender gaps in almost all social indicators that can be divided by gender are a common problem. This is reflected most obviously in education, with a sizable gender gap in literacy rates and enrollment rates as compared to national statistics.

4.5.4 Economy and Employment

The 1998 Census placed Kohistan at the bottom in terms of socioeconomic development indicators of the country. The proportion of the population that was working and employed was 26.4 percent, equivalent to 70.53 percent of the total labor force. Of the total employed population, 71.60 percent were self-employed, 10.68 percent worked as employees and 17.32 percent were unpaid family helpers. Compared to national-level statistics, poverty is endemic in the Kohistan not only numerically, but also conditioned by and evident with regard to access/transportation, education, health and employment.

Major sources of income are forest products (both timber and non timber), agriculture, business, employment and livestock. Given the mountainous terrain, flat cultivable land is very limited and there is a high degree of terrace agriculture.

4.5.5 Land Tenure

Traditionally, land was not permanently allotted to any individual or tribe – land was communally owned by the tribes in Kohistan. The tribes used to rotate their lands every five to ten years. However, after 1960, it was changed in favour of allotments on a permanent basis and most of the tribes distributed the land among individuals also. Thus, the lands are presently divided among the tribes and tribal members individually. Having said this, it must be pointed out that there is no formal or regular system of land tenure in the entire District of Kohistan. Likewise, there are no land titles or records due to lack of cadastral maps or surveys.

4.5.6 Agriculture

Despite scarcity of cultivable land in the district, people practice limited terrace agriculture where it is possible. Only kharif crops are grown in high altitude lateral valleys which remain very cold in winter. Both kharif and rabbi crops grow in the lower valleys and along the banks of the Indus where ever land is available. The major crops

grown in the district are maize and wheat along with red and white beans, potatoes, and all kinds of summer vegetables such as pumpkins, okra, wild spinach, carrot and radish. Agricultural products are solely for family consumption and nothing is produced for the local market. Irrigation is not systematic. The lands along the bank of streams, which can be commanded, are being irrigated through channels constructed by the people themselves through local irrigation system. In some areas land is also irrigated from springs.

4.5.7 Customs and Traditions

The tribal people of Kohistan consider themselves as substantially different from the majority of Pakistani population, especially, with regard to ancestry. Religious leaders have a large influence on the local populace and the social set-up of the area. There prevails a sense of suspicion that outsiders, particularly NGOs, have a hidden agenda of social change detrimental to their religious and cultural practices and traditions prevailing in the area. Information disseminated through imams of the mosques is considered more reliable and acceptable. Due to influence of the religious leaders and the distance from other parts of the country, dissemination of daily general information is very limited. Electronic media such as television is still not generally accepted and newspapers are not readily available in the villages. Further, due to the high illiteracy rate printed material is not used much.

Within the ambit of social structure, the basic residential/economic unit is the patrilocal joint family. Typically, this unit includes an elder's household and his married sons' families. Married sons generally live in their father's household with the latter or the eldest brother exercising authority over the extended family. The authoritative head of the household has the responsibility and authority to make decisions on behalf of the entire household members.

4.5.8 Seasonal Migration and Livelihood

The communities in the Project area are mainly transhumant agro-pastoralists. Seasonal migration is very common in project area and the people practice it due to a variety of reasons: climate, local psyche, culture, preferences and livelihood are the main among them. This seasonal migration is practiced to cater to the need of the time and local living style, and not only providing fodder for livestock but also for harvesting forest products from higher altitude. Usually people commence migrating to higher elevations in May and start moving back in mid-October. Most of the people have two houses at different elevations one is called the middle house and other is called higher elevation house. Some people who are shepherds also have a fourth house at the top and move to there to graze their livestock.

During summer when the ambient temperatures are high villagers prefer to move to higher elevations (1500masl to 2000masl) to beat the heat. In addition, most villagers have livestock and subsistence agriculture because the size of agricultural fields is of one to two acres in the middle and upper area of the valley and during summer their livelihood mainly depends upon these. Further, while at the lower elevation, villagers have to buy fuel wood but when they move to upper levels during summer they can gather fuel wood from own and communal forest areas where fodder is also available. Therefore, the seasonal trans-humane to upper elevations not only provide them with favourable living conditions and fodder for livestock, but also economic benefits. People, who remain living in the winter houses throughout the year are those engaged in government employment, other private sector jobs and also the tenants who have to care for others' agriculture fields. Migration pattern is explained in Figure 4.1.

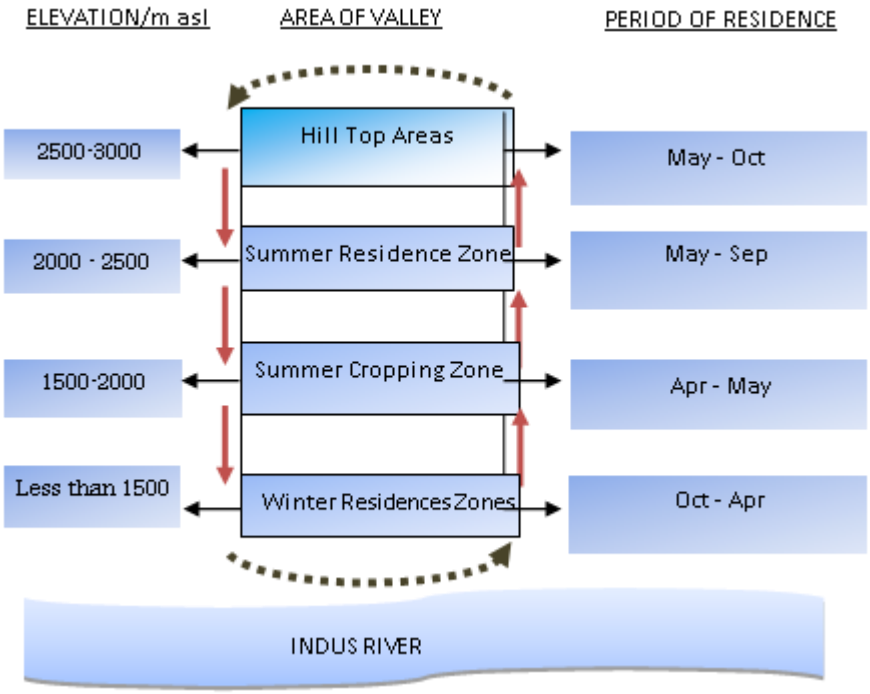


Figure 4.1: Seasonal Migration Patterns of Community

4.5.9 Role of Women

Kohistan has a highly patriarchal society in which women are absent from public life. Females have, if any, lack of opportunities to access education, they do not work outside the home, and they do not participate in politics and have no say in decision-making, even within the household. Purdah is very strictly observed – women are rarely seen outside the home. Even the entry of male first cousins into female areas of the home will often be forbidden. The role of women is as wives and mothers; they also carry out the majority of household and agricultural chores – cooking, washing, cleaning, collecting firewood, looking after livestock and working in the fields. The latter tasks are undertaken within the confines of *purdah*: areas of the forest, for example, are designated for women and no men will go there.

Polygamy is the norm in Kohistani society where the permission of previous wives is rarely sought before taking on new wives. Men still make every effort to prevent their women from being influenced by the outside world. Televisions and dish antennae have become more common in the district, but these tend to be kept in rooms where only males have access – in most households women are not allowed to watch television.

4.5.10 Tribal Systems and Leadership

Kohistan is divided by the Indus in to Right bank and Left bank or Swat Kohistan and Hazara Kohistan. Both parts of the Kohistan have their own history, culture and language. The Main tribes of Kohistan district are *Manzar, Money, Koka Kheil, Manik Kheil* and *Darram Kheil*. The two main tribes *Manzar* and *Money* occupy the Right bank of the Indus River known as Swat Kohistan while the main tribes on the Left bank of the Indus River, the Hazara Kohistan, are *Koka Kheil*, *Manke Khail* and *Darram Khel*.

Generally two to three villages comprise a sub tribe and, traditionally, these sub tribes are headed by a tribal head named malik. Malik is a title name which means the head man of the village. In every village or sub tribe there is at least one malik, but informally people use the term malik to more than one person in the village. Malik is a

person with money, power and respect from the villagers. The Malik takes decisions on behalf of his village community with involvement and consultation of the notables of the village and tribe. Issues beyond the level of the Malik are resolved through the jirgas process described below.

4.5.11 District Administration and Traditional Governance System

Kohistan District was under the Provincially Administrated Tribal Areas (PATA) in KP. Notwithstanding that Kohistan became a District under the federal administrative system in 1976, practises of the local traditional governance system is still accepted by the provincial government and district administration in conjunction with the law of the country. The district administration involves the maliks and conducts jirga system for local decision-making and resolution of disputes or for project administration.

Jirga is a committee of elders representing all parties to a problem or issue which deliberate and decide on village or inter-village or inter tribe problems and issues. Jirgas are constituted at different levels and is convened to resolve a particular issue. If the issue is within the family a jirga will be formed at the family level; if the matter is at village level a village level jirgas will be formed; if the matter is at tribal level the jirgas will be formed at tribal level; and if the issue is between different tribes the jirgas will be formed with the involvement of maliks from different tribes. In resolving issues which require legal interpretation Tehsil level and District level jirgas are convened which will include the Deputy Commissioner or his representatives.

4.6 PHYSICAL CULTURAL RESOURCES

The study area is a part of historical Silk Road and witnessed raise and fall of many cultures over a long span of millennia. Physical Cultural Resources (PCRs) identified in the study area are (i) Shatial rock carvings, (ii)400 year old century beautiful wooden mosques at Seo and Seer Gayal, (iii) graveyards and (iv) moveable artifacts.

Rock carvings site located near Shatial (located about 50 km upstream of Dasu) along the Indus is a designated archaeological site. It consists of 46 major rock boulders with carvings representing a wide variety of anthropomorphic (having human characteristics), zoomorphic (representing animal forms), and inanimate images. Anthropomorphic depictions range from simple line drawings of humans to an elaborate rendering of Buddhist tales with in a large triptych. These rock carvings belong to 1st to 7th century AD. These are of interest, in addition to the scholars, to local and foreign tourists particularly the Buddhists for their religious significance. Rock carvings at Shatial is a part of a large complex of over 30,000 petroglyphs and 5,000 inscriptions, spread over 30 sites stretching over 100 km from Shatial to the Raikot Bridge (located on the upstream side outside the study area).

The Seo mosque, the widely revered mosque in the region, is located in the Seo village, on the downstream of the proposed Dasu dam. According to the local tradition the mosque is approximately 400 years old. The mosque is constructed in dressed timber trunks placed one over the other. This religious building is currently in use for prayers and imparting Islamic religious education. Muslim visitors to Dasu visit this mosque in reverence while it also attracts common tourists for its ancient style of building and remarkable wood carvings.

The mosque at the village Seer Gayal is also said to be over 400 years old. The wooden mosque has the same articulately carved motifs, which suggest their origin in the same period as that of the Seo mosque. This mosque is also decorated with carving work on its wooden columns, door or other decorative elements like brackets.

5. ALTERNATIVE ANALYSIS

5.1 'DO NOTHING' OR 'WITHOUT PROJECT' ALTERNATIVE

Pakistan is suffering from an acute power and energy crisis which is primarily caused by (i) insufficient energy supply and increasing demand, (ii) heavy reliance on imported fossil fuels, and (iii) limited use (14%) of vastly available hydropower energy (40,000 MW). Power shortages resulted in long hours of load shedding, impacting households, industrial and commercial activities. The financial impact of load shedding has been estimated at 3% to 4% of GDP, costing about USD 10 billion a year. This situation is causing serious economic losses to the country and increased unemployment and poverty, and could also lead to social unrest.

Since 1971 the energy consumption per capita has increased by nearly 5 times from 91 kWh to 450 kWh per capita in 2009. From 2000 to 2011, the installed capacity increased from 14,444 MW to 24,173 MW (3.2 percent average annual rate from 2000 to 2011). On the other hand, peak demand of 12,344 MW in 2001 grew on average 7.6 percent annually to 25,648 MW (2011). This demand and supply will continue to increase and by 2029 the gap between available power and demand will be 17,364 MW. The great reliance upon thermal sources (oil, gas and coal) also results in increasing dependency on imported fuels resulting in high cost of power production, which negatively influences the national balance of payments. Hence, without-project scenario is not acceptable since this will seriously deteriorate the situation of power generation in the country.

5.2 ALTERNATIVE SOURCES OF ENERGY

Thermal generation: DHP is compared with various thermal alternatives such as combined cycle gas turbine (CCGT), natural Gas, fuel oil (high sulfur, HSFO) and coal in terms of their energy cost and CO_2 emissions. CO_2 emissions from thermal alternatives vary from 6.7 to 17.2 million tons per annum, while CO_2 emissions from Dasu reservoir are negligible (0.005 million tons per annum). Further thermal generation will emit large amounts of particulate matter (PM), sulfur dioxide (SO2), carbon monoxide (CO), nitrogen oxides (NOx) adversely damaging ambient environment and public health. The impacts of thermal alternatives are much more difficult (and costly) to mitigate than those that arise at hydropower projects. The health damage impacts of air pollution in terms of monetary costs is estimated to vary from 20 to 73 million USD per annum. Thermal alternatives are also expensive compared to DHP. Unit energy costs for thermal alternatives vary from 0.116 to 0.203 USD/kWh, while unit energy cost for DHP is 0.02 USD/kWh.

Other renewable energy sources: The main sources of alternative renewable energy available to Pakistan are small hydro and wind. Both are being actively developed. Per kWh delivered to the system, these sources both have the same beneficial impact of DHP in avoiding the environmental externalities of fossil generation, but are expensive than DHP. However, the scale and nature of these resources are such that neither can be viewed as a mutually exclusive substitute for DHP. Both of these options need to be developed to the extent technically and financially feasible: they are complements, not substitutes to DHP. Moreover, from the perspective of mobilising the necessary finance for the power sector, they do not compete for the same sources of finance: wind and small hydro can be 100% financed from local commercial banks, whose resources are simply not available to large hydro projects. DHP will not crowd out the ability to finance small renewables.

Other Hydropower Candidates in Pakistan: NTDC Least Cost Capacity Expansion Plan[3] study has compared the potential list of hydropower project candidates in Pakistan in terms of their unit energy cost and assessed DHP is among the least cost hydropower projects (4th rank) in Pakistan, which makes it an immediate candidate for development compared to other hydropower projects. Tarbela IV ranked 20th in this study and Diamer Basha ranked 26th in this study.

5.3 ALTERNATIVES FOR DAM SITES

Considering the development of cascade of hydropower projects in Indus, the area of interest locating a high dam which could develop the hydropower potential of river stretch between Basha and Dasu is 10 km segment of Indus River upstream of Dasu town. Dasu town represents the downstream limit of possible damsite in the stretch as the river valley of Indus on downstream of Dasu is significantly wider making the dam more expensive. On the other hand, the submergence and resettlement of entire Dasu town would never be accepted by the local community given the difficulty of finding adequate resettlement in the area. The feasibility study has identified six possible alternative locations for the siting of dam for preliminary analysis and finally considered 3 alternatives for detailed analysis. Alternative 2 (Axis 5) was finally selected after extensive consultations with the affected population. This alternative was technically and economically more feasible and had considerable lower social and environmental impacts, with lower needs of resettlement of people. Moreover the alternative made it possible to preserve an historic 400 year old mosque in the village of Seo. The selected site was also widely supported by the population of the area. During detailed design two other near-by sites (one 55m on upstream and other one 135 m on downstream) for the main structure were studied to define the exact location of the dam. The upstream alternative, is finally selected because of its environmental benefits such as 162,000 m^3 less excavation and 92,000 m^3 of less concrete requirement.

5.4 ALTERNATIVES FOR DAM TYPE

Three types of main structure were considered during the feasibility study, (i) a Roller Compacted Concrete structure, (ii) a Concrete Faced Rock fill structure and (iii) an Earth fill structure. The feasibility study recommended a Roller Compacted Concrete (RCC) structure on basis of lower cost, technical and environmental advantages. Environmentally, RCC structure is preferable due to availability of huge quantities of aggregates close to the damsite.

5.5 ALTERNATIVES FOR LAYOUT OF POWER AND TAILRACE TUNNELS

Three different types of waterways (intake and tail race tunnels) were considered during the feasibility study. However this study didn't evaluate the stability of the various types of rock and the possible impacts of the presence of the Khoshe fault, a geological dislocation near to the location of the underground power house. The Khoshe fault is not an active fault, with a weak or fractured rock structure. However its presence could possibly create water leakage from the pressurized tunnels and influence the design and construction cost of the tunnels. During detailed design four alternatives were studied. In alternative 1 the layout is followed selected during the feasibility study, in which the power house is located upstream of the Koshe fault. The tail race tunnels are all crossing the fault, with possible negative impacts. In alternative 2 the powerhouse is located downstream of the fault. In alternative 3 any crossing with the fault is avoided, but the tail race tunnels are curved, which is an disadvantage. Alternative 4 is a slight modification of Alternative 1, in which the tail race tunnels are

[3] NTDC 2011. National Power System Expansion Plan 2011-2030.

straight without any bend. This alternative is selected because of higher efficiency, since the head losses in a straight tunnel are always lower because of lower friction.

5.6 ALTERNATIVE CONSTRUCTION SCHEDULE

The DHP requires huge and committed investments. A staged development is the most practical way to achieve early power generation with relatively low investment cost (committed finance from World Bank). This approach could also facilitate in dealing with uncertainties in future investment. Both WAPDA and World Bank agreed on a two staged development of DHP, with each stage divided into two phases. The development of stage two is assumed to be implemented after completion of the Diamer-Basha project construction, which will largely reduce the sediment load into the Dasu reservoir and thereby prolonging the life of DHP.

5.7 ALTERNATIVES FOR CONSTRUCTION MATERIAL

Alternatives for Coarse Aggregates: About 9.2 million tons of coarse aggregate will be required for concrete works of the Project. The feasibility study has assessed five potential sites and found four sites are suitable. The recommended sites are located at Uchar Nullah, Barseen, Kaigah and Panibah. Though technically all these sites are suitable, location at Kaigah (10 km upstream of dam axis) is finally selected based on following environmental considerations: (i) the quarry area is located in future reservoir submergence area, thus avoiding additional land acquisition and resettlement, and (ii) enough space was already available for suitable arrangement of aggregate processing plant and storage of processed aggregates. No additional excavation of land is required for leveling.

Alternatives for Sand (Fine Aggregates): About 5 million ton of good quality sand will be required for the construction of the Project. Natural sand is the ideal material to be used as fine aggregates. During the feasibility study, no significant source of sand could be identified/ located close to the damsite. The river bed alluvium was eliminated as a potential source due to its fine nature and limited quantity. Finally the feasibility study recommended two sources: Maira and Chilas Sand deposits, located about 80km downstream and 120km upstream from Dasu respectively. During detailed design, manufacturing sand from Kaigah aggregates have been studied and recommended because of its environmental advantages compared to other two options of natural sand extraction proposed in feasibility study. The advantages are: (i) borrowing sand from Maira and Chilas will affect the aquatic ecology of Indus, (ii) traffic and transportation costs can be reduced, (iii) Kaigah is already selected for course aggregates, and same facilities can be used for fine aggregates (however, a new crusher to be installed), and (iv) In addition to Kaigah quarry, the raw materials for manufacturing sand will also be available from underground excavations such as or power house.

Alternatives for Pozzolan material: Three types of pozzolanic material (a naturally occurring fine material with certain chemical parameters) can be used for concrete production. They are (i) slag and fly ash; (ii) natural pozzolan; and (iii) manufactured or processed pozzolan. The feasibility study has recommended natural pozzolan at Gini, located 128 km upstream from dam axis. However, during detailed design, two more sites namely Kandia Valley (18km upstream) and Thorli Nullah (95km upstream) are further studied with a purpose to reduce the hauling distance. Detailed physical and chemical analysis of materials conducted during detailed design at these 3 sites concludes that moraine deposits of Gini area are more favourable, physically and chemically, for pozzolan. The pozzolan material could also be manufactured from the aggregates at the proposed quarry site, but this option requires further assessment.

5.8 ALTERNATIVES FOR RESETTLEMENT

It is common in major hydropower projects that resettlement townships will be developed to facilitate the relocation of affected communities. Given the nature of natural migration of the affected communities within the valley between higher and lower elevations; experiences learned from the past hydropower projects in Pakistan; and consultations with affected community, two options were discussed the affected community. A summary of these options are given below:

Option 1: Community-based relocation close to the current settlements, but at a higher location, with site and services to be developed by the project. This option includes the possibility of a self-managed relocation in Dasu Tehsil or in Kohistan District, with additional compensation and benefits prior to relocation. About 90 percent of the community preferred this option.

Option 2: Relocation to “down country” (outside Kohistan), with extra compensation and benefits prior to relocation. A minority of about 10 percent of the affected community preferred this option.

5.9 ALTERNATIVES FOR WAPDA OFFICE AND COLONY

A project colony will be established with offices, residential quarters, appurtenant facilities such as hostels, rest house, schools, mosques, hospital, market, etc. The Project colony should be located as near to the dam site as possible. However, the Project area is being a gorge; flat areas for large colony development near the damsite are not available. Tial Medhan (7 km downstream of damsite) was selected for project colony at feasibility study. One more alternative was studied during detailed design at Choochang (3 km downstream of damsite). This site in Choochang is found to be more suitable than Tial Medhan since it is very close to the damsite, adjacent to new KKH and no large scale excavation is required for development.

5.10 ALTERNATIVES FOR GENERATING EQUIPMENT

The feasibility study proposed to install eight turbines of 540 MW each for the generation of a total of 4,320 MW. These turbines are huge in size and difficult to transport. It appeared that the current condition of the KKH is an important limitation on the selection of suitable equipment. A comprehensive study was made to find out the maximum weight and width of generating equipment, which could safely pass the KKH. This was tested during trial transportations towards the Basha dam. Another factor which was considered was the possible influence of future changes in the flow regime of the Indus due to climate change. Three combination of generating equipment were evaluated: (a) 8 units of 540 MW, (b) 10 units of 432 MW, (c) 12 units of 360 MW. Option (c) was selected as the most feasible option on the basis of energy production and transportation requirements.

5.11 SEDIMENT MANAGEMENT AND FLUSHING FREQUENCY

About 200 million tons of sediments pass every year at the dam site and without any mechanism for release of sediments through flushing; the LLOs and power intake will be filled within 20-25 years. According to the feasibility study of DHP, the flushing of Dasu is not required until 50 years since Basha dam will be constructed first and flushing of Basha will begin after 40 years – and Dasu flushing is required ten years later.

But with Basha now likely to be completed after Dasu, the question is what flushing regime is required during the first few years of Dasu operation, before Basha is commissioned. After studying various options, the design team finally considered following three feasible options.

Option-1: no flushing up to 15 years and starts annual flushing under “Pre-Basha”

Option-2: Every year flushing after impounding under “Pre-Basha”

Option-3: No flushing under “Pre-Basha” and “Post-Basha”

Under worst case scenario, assuming there will be no Basha, the flushing regime of Option 1 (flushing from 15 years) is recommended. If Basha will be there, Option 3 will provide more power generation and the flushing may not be required for 50 years.

5.12 ALTERNATIVES FOR RIGHT BANK ACCESS ROAD

An access road of about 13 km is required along the right bank of Indus to the damsite from the existing KKH. Two options were considered for this alignment for first one km section of this road. one through Komilla village and other bypassing Komilla village. Both these alternatives follow the same alignment from second kilometer onwards. Access road bypassing through Komila village will be advantageous due to reduced resettlement and risk of traffic safety. But this option is technically not feasible due to very poor geotechnical conditions and landslide zone. Hence there is no other option than passing through the Komilla village. Pedestrian passes will be built and manual traffic control will be undertaken in this section to avoid traffic related accidents.

6. CLIMATE CHANGE IMPACTS AND RISKS

6.1 CLIMATE PROJECTIONS

6.1.1 Temperature Projection

Global Climate Change Impact Study Centre (GCISC) of GOP has been conducting climate change studies in Pakistan. In these studies, 13 IPCC AR4 Global Circulation Models (GCMs) for the A2 scenario and 17 GCMs for the A1B scenario, have been used. Based on the outcome of these studies, temperature projections for Pakistan in 2020s, 2050s and 2080s respectively by 1.31°C, 2.54°C and 4.38°C in A2 scenario and 1.45°C, 2.75°C and 3.87°C in A1B scenario. In northern Pakistan, where the project is located, the change in temperature in the year 2080 will be 4.67°C for A2 scenario and 4.12°C for A1B scenario, respectively.

6.1.2 Precipitation Projections

GCM ensemble based precipitation projections are much less certain than those for temperature due to the limitations of the current models for modeling precipitation. The precipitation projections indicate that precipitation is likely to increase in summer and decrease in winter in both Northern and Southern Pakistan, with no significant change in annual precipitation in either part.

6.1.3 Melting of Glaciers

Based on IPCC Fourth Assessment Report 2007 (AR4), the glacier melting in the Himalayas is expected to increase flooding of Indus and its tributaries for the next two to three decades which will be followed by decreased river flows as the glaciers recede. It is expected that the river flows will decrease after a few decades due to reduced glacier mass to a level that would be determined by the precipitation input at that time. According to the World Bank (2006) report: “Pakistan’s Water Economy: Running Dry”, the western Himalayan glaciers will retreat for next 50 years causing increase in Indus River flows and then the glacier reservoirs will be empty, resulting in decreases of 30% to 40% in river flows in the Indus Basin. A recent simulation modeling conducted by GCISC on Indus flows for a scenario, where the temperature will rise by 3^{o}C and the glaciers to shrink to half their present size, not only the overall annual flow would reduce by about 15%, the monthly flow pattern would also change considerably, with more water coming in spring and early summer and less water in the later part of summer.

6.1.4 Climate Change Adaptation

Based on the climate change analysis, it is recommended to consider the temperature increase of 3°C to accommodate future temperature rise in the design, and it is also recommended to consider a 15% increase in rainfall for design of hydraulic structures in the Project to accommodate rainfall changes due to climate change. It is recommended to consider a minimum 20% decrease in the low flows for the design of turbines to accommodate future decreased flows due to climate change. At the same time it is recommended to consider greater water flows over the next few decades.

Glaciers Monitoring Program: Most of the water resources of the Indus River are derived from glacial melt, and the Tarbela Dam is designed to withstand probable maximum floods that may be caused by glacial lake outbursts. Nevertheless, continued monitoring of glaciers is crucial for the water security of the country, and useful for developing the knowledge base for the operation of the dam and for planning future hydropower investments in the Indus Basin. This sub-component would support the Glacier Monitoring and Research Center (GMRC) under the WAPDA General Manager Planning for monitoring and research on the Upper Indus Basin (UIB) glaciers. This is intended to examine the characteristics and movements of

these glaciers, and provide early warning for glacial lake outbursts. The proposed GMRC would have four sections: (a) a field investigations section responsible for establishing and managing field stations. The office is proposed to be established in the upper catchment of the Indus; (b) a remote sensing and modeling section located in Lahore to carry out remote sensing and modeling studies; (c) a forecasting section; and (d) a data management section to maintain and upgrade data management systems and carry out data analysis and research activities. It would also link up with the high altitude meteorological network, surface water hydrology, and the WAPDA hydro-meteorological network. The sub-component would support works, equipment, consultancy, operations cost and technical assistance and training for establishment of the GMRC in the UIB during the Project period

Flood Telemetry Network: Flood volumes will increase due to climate change predictions on temperature increase and thereby melting of glaciers. Flood volumes are designed based on the historical record of flood levels in Indus, possible increase of flows due to climate change and recorded extreme events such as GLOFs. Recommendation is made to establish flood monitoring network in the upstream of Indus basin for early warning system and better management of floods at the DHP. A series of flood warning telemetry network is proposed in the Indus basin.

6.2 GREENHOUSE GASES (GHG) EMISSIONS

The net greenhouse gas (GHG) emission for DHP has been estimated using the Guidance Note of World Bank for Greenhouse accounting for Energy Investment Operations, ver. 1.0, June 2013. Total project emissions of DHP was estimated at 2.11 million ton CO2 equivalent (total emissions from reservoir: 0.073 million tons; emissions from land clearing and civil works: 0.103 million tons; life cycle emissions: 1.772 million tons; and emissions from energy use in construction: 0.158 million tons). The project emissions compare very favorable against the baseline emission of the nearest least-cost alternative (combined cycle gas turbine) estimated over 50 year, generating a total baseline emission of 225 million ton CO2 equivalent. The net emission of DHP is thus estimated at minus 223 million ton CO2 equivalent.t

7. POTENTIAL IMPACTS AND THEIR MITIGATION

7.1 SCOPING OF IMPACTS

Potential impacts of the Project have been identified based on the field investigations, review and analysis of primary and secondary data, review of feasibility and detailed engineering designs and documents, consultations with affected community and other stakeholders (through workshops at Peshawar, Lahore, Karachi and Islamabad), and mathematical models for prediction of air and noise pollution, and greenhouse gases emission.

The Significance of potential adverse effects was assessed using the following criteria:

Impact Magnitude. The potential impacts of the project have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria.

Sensitivity of Receptor. The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic.

Assigning Significance. Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown in Table 7.1.

Table 7.1: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High	High	Medium	Low / Negligible
Major	Critical	Major	Moderate	Negligible
Moderate	Major	Major	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

7.2 SUMMARY OF ASSESSED IMPACTS

The Project's potential impacts and their significance have been assessed using the above methodology. A summary of these impacts and their significance is presented in Table 7.2. While low significant impacts and general construction related impacts were not detailed here, they can be easily mitigated by (i) the contractors' good work practices, especially those related to the storage of construction materials and cleanliness of the work sites; (ii) cooperation by the local authorities and communities with the contractor in terms of traffic management and use of public space and utilities; (iii) project management's strict enforcement of the adequate construction practices and standards during construction; and (iv) the implementation of mitigation measures identified in the Environmental Code of Practices.

Table 7.2: Summary of Impacts of the Project and their Significance

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
Pre-Construction/Construction						
Physiography and Geology	Changes in natural topography at construction sites, quarry areas and spoil disposal sites will impair the natural landscape, causes the soil erosion and changes the drainage pattern	Major	High	Major	• Contractors' Management Plans on 'Sediment and Erosion Control' and 'Decommissioning and Landscaping' plans based on ○ ECP 6: Erosion and Sediment Control ○ ECP 8: Topography and Landscaping ○ ECP 9: Quarry Areas Development & Operation	Low
	Increased risk of landslides due to excavation of slopes	Moderate	High	Major	• Drainage management • Preventive measures in high risk areas • Emergency Preparedness Plan • Permanent monitoring in potential landslide areas	Negligible
	Increased risk of landslides during reconstruction of KKH	Moderate	High	Major	• Construction of retaining walls • Drainage management	Negligible
	Geological hazards of tunneling through Koshe contact	Minor	Low	Negligible	• Controlled blasting and excavation	Negligible
	Excessive groundwater dewatering will lead to significant delay in construction of tunnels and effect groundwater environment	Moderate	Medium	Moderate	• Groundwater control methods are included in the technical design and construction process	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Disposal of about 20 MCM of excavated rock as spoils	Major	High	Major	• Minimize generation of spoils by using excavated rock as aggregates for concrete and road fills • Contractors management plans on spoil management and landscaping of spoil disposal sites	Moderate
Water Quality	Increased turbidity in Indus and tributaries from discharges of construction activities	Moderate	High	Major	• Diversion of discharges from the construction areas to settling basins before releasing to Indus • Installation of silt fences and sediment traps • Contractors management plans based on ECP 3: Water Resources Management	Negligible
	Waste water from batching plants, construction yards, material storage sites, and other construction areas, and workers camps	Moderate	High	Major	• Drainage facilities for storage, collection and treatment of waste water • Sewage system for workers camps and colonies • Water quality monitoring and compliance with NEQS	Negligible
Air Pollution	Dust and air pollution from access roads of construction traffic	Moderate	Medium	Moderate	• Vehicle exhaust compliance with NEQS • Paving of access roads in construction areas	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Dust and air pollution from construction equipment and construction areas	Moderate	Medium	Moderate	• Contractors management plan on pollution control based on ECP 10: Air Quality Management • Air quality monitoring and compliance of NEQS • Maintain air quality in the tunnels in accordance with best international practices	Negligible
	emissions of greenhouse gases from construction equipment	Minor	Medium	Low	• Minimize greenhouse gases emissions accordance with EMP sub-plan 6: GHG Management Plan	Negligible
	Dust from quarry and crushing activities	Moderate	Medium	Moderate	• Water supply system for control of dust and fugitive emissions from quarry areas • Compliance with NEQS	Negligible
	Air pollution, traffic congestion and safety from use of 700 vehicle trips per day for transport of aggregates from Kaigah quarry to batching plant area (13 km)	Moderate	High	Major	• Conveyor belt for transportation of material • Dust suppression	Negligible
	Air pollution, traffic congestion and safety from use of 400 vehicles for transport of excavated rock to spoil disposal area	Moderate	High	Major	• Conveyor belt for transportation of material • Dust suppression	Negligible
Noise and Vibration	Noise along KKH and access roads from construction traffic	Moderate	Medium	Moderate	• Vehicle noise compliance with NEQS (85 dBA at 7.5 m form source) • Regular monitoring at sensitive receptors	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Noise from construction activities at dam site and relocation of KKH	Moderate	Medium	Moderate	• Contracts management plan for noise attenuation in accordance with ECP 11: Noise and vibration management • Noise monitoring at sensitive receptors and compliance with NEQS	Negligible
	Noise from quarry activities at Kaigah	Moderate	Medium	Moderate	• Excavation from southern end of Kaigah quarry and maintaining natural berm towards sensitive areas • Noise monitoring at Kaigah village and conservation area	Negligible
	Noise from quarry activities at Gini	Moderate	Medium	Moderate	• Excavation from eastern end of Gini quarry and maintaining natural berm towards settlements • Noise monitoring at Gini village	Negligible
	Vibration from blasting	Moderate	High	Major	• Chose optimum size of blasting per event to avoid any impacts on nearest receptors • Compliance with international standards • Notification in advance	Negligible
Waste	Pollution through solid waste and waste effluents	Moderate	Medium	Moderate	• Contractor waste management plan in accordance with ECP 1: Waste Management and ECP 2: Fuels and Hazardous Goods Management • Waste water collection and treatment; solid waste management	Negligible
	Spills from storage and handling of hazardous waste and fuels and site contamination	Moderate	High	Major	• Storage in designated sites • Proper design of site • Spill control procedure	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Risk of water pollution of reservoir area and site pollution due to improper decommissioning of contractors facilities and waste	Moderate	Medium	Moderate	• Contractors' management plans for decommissioning • Pre-fill reservoir cleaning and filling • Removal of potential sources of pollutants from reservoir area	Negligible
Flora	Loss of about 21,000 trees and shrubs from construction areas and reservoir submergence area	Minor	Medium	Low	• Planting of trees (5 new trees per each tree cut) near resettlement villages and reservoir buffer areas • Rejuvenation of forest at higher altitudes	Moderate (beneficial)
	Loss of 280 ha of grazing land	Minor	Medium	Low	• Livelihood restoration (SRMP Vol. 6: RAP)	Negligible
	Pressure on forest resources due to increased demand for forest products	Moderate	Medium	Moderate	• LPG market development • Non timber fuels for cooking and heating	Negligible
Fauna	Construction related impacts such as dust, noise and night lighting on fauna	Moderate	Medium	Moderate	• ECP 13: Protection of Fauna	Negligible
	Impact on birds due to high noise from drilling and blasting activities	Moderate	Medium	Moderate	• Noise attenuation measures to reduce noise levels • Deter the birds from construction areas	Negligible
	Noise and vibration impacts on animals at Kaigah community game reserve due to quarry/crushing activities and reconstruction of KKH at Kaigah	Moderate	Medium	Moderate	• Choosing of optimum blast size per event to ensure compliance with international standards • Noise monitoring at game reserve and compliance with NEQS	Negligible (adverse) Moderate (beneficial)

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Risk of poaching	Moderate	High	Major	• Access restriction to community game reserve • Training of staff on wildlife protection • Public awareness programs	Low
Aquatic Ecology	Impact on aquatic habitat due to construction activities in river and waste water releases to river	Moderate	Medium	Moderate	• Control of waste water and sediment releases to river • Water quality management protocols in ECPs	Negligible
	Impact on fish habitat due to construction of bridges in tributaries	Moderate	Medium	Moderate	• Design of single span bridges to avoid any construction of piers in the tributaries	Negligible
	Fish entrainment in the diversion tunnels due to upstream and downstream movement of fish	Minor	Medium	Low	• Fish deterrent devices or exclusion screens on both ends of diversion tunnels	Negligible
Physical Cultural Resources	Impact on Shatial rock carvings through vandalism	Minor	Medium	Low	• Protection of Shatial rock carvings through its procurement from private owners and development of site	Major (beneficial)
	Impact on historical Seo mosque due to dust and noise pollution from construction activities	Minor	Medium	Low	• Dust control and noise attenuation protocols in ECPs • Termite protection and provision of water and sanitation facilities	Moderate (beneficial)
	Inundation of 400 year old mosque in Seer Gayal	Major	High	Major	• Disassembling and rebuilding at new resettlement village • Termite protection and provision of water and sanitation facilities	Moderate (beneficial)
	Submergence of 17 graveyards	Major	High	Major	• Protection of graves with civil works to avoid collapse of graves	Negligible
	Chance find procedures	Moderate	Medium	Moderate	• Chance find procedures in the contract documents	Low

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
Land Acquisition and Resettlement	Acquisition of 4643 ha of land by WAPDA	Major	High	Major	• Compensation for lost assets of affected households and persons according to eligibility matrix of Resettlement Action Plan (RAP)	Low to Moderate
	Resettlement of 767 households, totaling 6,953 people	Major	High	Major	• Compensation, resettlement and livelihood restoration of affected households/persons according to Resettlement Action Plan	Low to Moderate
	Relocation of shops/commercial establishments	Moderate	Medium	Moderate	• Compensation for lost assets and commercial enterprises. • Assistance and livelihood restoration of affected persons according to Resettlement Action Plan	Low to Moderate
	Loss of civic amenities (7 schools, 2 basic health units, etc.)	Moderate	Medium	Moderate	• Rebuilding of civic amenities by project	Negligible
	Loss of 143 ha agricultural land	Moderate	High	Moderate	• Compensation for lost land, crops and fruit trees according to Resettlement Action Plan • Agricultural and Livestock Development Plan (Vol. 6: RAP)	Low to Moderate
Communi-cation Facilities	Inundation of 52 km of KKH	Major	Very High	Critical	• Realignment and construction of 68 km at higher level (including 6 km of bypass)	Negligible
	Loss of dolleys (manual cable cars connecting left and right banks of Indus) and hence loss of access to KKH and Komila market by the right bank community	Major	High	Major	• Right bank access roads along the reservoir from Komila	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Loss of Kandia and Larghani bridges connecting left and right bank	Major	High	Major	• Building of new bridge (7 km upstream of existing Kandia bridge) along with access roads (from Komila to Kandia through damsite) before dismantling the existing bridges	Negligible
Social and Cultural Issues	Social conflicts due to influx of about 4,000 in-migrant workers (in addition to about 3,000 construction workers)	Major	High	Major	• Management plan for in-migrant workers (SRMP Vol.8: Management Plan for Construction related Impacts) • Grievance mechanisms to address complaints	Negligible
	Lack of respect of local cultural norms and values	Moderate	Medium	Moderate	• Awareness campaign • Code of conduct for construction workers and employees • Grievance mechanism	Negligible
	Impacts from increased human activities	Minor	Medium	Low	• Code of conduct for workers and employees • Awareness raising	Low
	Increased load on local services and suppliers	Moderate	Medium	Moderate	• Local area development plan under SRMP • Contractor to procure camp supplies in a manner not affecting availability of essential commodities • Contractor to provide religious and cultural facilities for workers.	Negligible
	Employment generation	Moderate	Medium	Moderate (beneficial)	• Preference local workers and technicians • Vocational training	Moderate (beneficial)

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Increased economic activity	Moderate	Medium	Moderate (beneficial)	• Establishment of new businesses and commercial enterprises; • Local employment	Moderate (beneficial)
Health and Safety	Occupational health and safety issues and increased risk of accidents due to rough terrain and difficult work conditions	Moderate	High	Major	• Contractors OHS management plan in accordance with World Bank EHS guidelines and ECP 18: Workers Health and Safety • OHS staff with contractor, consultant and PMU • Contractors follows IFC Performance Standards • Safety training for workers	Low
	Health and safety at the construction camps	Moderate	High	Major	• ECP 16: Construction Camp Management	Negligible
	Reduced safety and health risks by interaction workforce with local residents	Moderate	Medium	Moderate	• Public Health and Safety Plan (SRMP Vol. 8) • Safeguards and awareness rising against communicable diseases.	Negligible
Traffic	Impact on KKH and its traffic due to additional 200-300 vehicles construction traffic	Moderate	High	Major	• Traffic management plan • Establishment of traffic management units along KKH • Upgrading of KKH by NHA	Low
	Safety hazards due to increased traffic for children and elderly people	Moderate	High	Major	• Traffic management plan addressing general access • Safety and security actions and procedures to protect local community	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
Operation and Management						
Hydrology	Loss of reservoir life and reduced power generation due to sedimentation	Major	Very High	Critical	• Studies on sedimentation control through integrated watershed management • Annual flushing of sediments after 15 years of first impounding	Moderate
	Changes in reservoir water quality	Minor	Medium	Low	• Temperature and dissolved oxygen measurements • Operational protocols for simultaneous release of water from LLOs and spillways	Negligible
	Reduced flows between damsite and tailrace during low flow season	Moderate	Medium	Moderate	• Release of environmental flows (tentatively recommended as 20 m^3/s from dam/LLOs and 222.5 m^3/s from tailrace)	Low
	Reduced flows on downstream of tailrace during low flow season of peaking operation	Moderate	Medium	Moderate	• Operation of at least one turbine during peaking operation	Low
	Tailrace flow surges due to stop and start of turbines	Moderate	Medium	Moderate	• Operational protocols for gradual starting of turbines • Warning through sirens and loudspeakers	Negligible
	Impacts of first filling of reservoir on safety of people and livestock and stability of slopes	Major	High	Major	• Awareness campaign and warning signs • Slow rate (2 m/day) of filling • Permanent monitoring of weak slopes	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Impact of first filling on the reservoir downstream irrigation requirement	Minor	Medium	Low	• Filling of reservoir in high flow season	Negligible
Aquatic Ecology	Effect on upstream fish habitat (river and tributaries) due to formation of reservoir	Moderate	Medium	Moderate	• Compensation hatchery with native cold water species in combination with open water stocking in the affected tributaries and reservoir • Maintenance of spawning areas • Further studies on aquatic biology during pre-construction and regular monitoring during operation	Negligible
	Fish migration across the dam	Minor	Low/ Medium	Negligible to low	• Study fish migration and establish baseline data • Develop fish hatchery and restock in upstream and downstream areas	Negligible
	Fish entrainment in the outlet structures due to downstream movement of fish during normal operation and flushing	Minor	Medium	Low	• Placing of screens or fish deterrent devices of outlet structures if required	Negligible
	Fish stranding and mortality during flushing	Minor	Medium	Low	• Development of site specific ramp down criteria • Flushing during high flow season (in early summer)	Negligible
	Impact of flushing and drawdown on reservoir fish production	Moderate	Medium	Moderate	• Fisheries Management Plan • Monitoring and study	Low

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	4.4 km length of river habitat between plunge pool and tailrace outlet will be lost or impaired during low flow season	Moderate	Medium	Moderate	• Studies on requirement of environmental flows to maintain fish habitat (tentatively recommended as 20 m^3/s from dam/LLOs and 222.5 m^3/s from tailrace)	Low
	River habitat impairment on downstream of tailrace during peaking operation	Minor	Medium to high	Low to Moderate	• Continuous operation of one turbine to release 222 m^3/s of water	Negligible
Fauna	Risk of bird collision and electrocution with transmission cables	Moderate	Medium	Moderate	• Maintaining 1.5 m spacing between energized components and grounded hardware; covering energized parts and hardware • Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters	Low
Risks	Reservoir Induced landslides	Major	High	Major	• Continuous monitoring of landslide prone areas • Stabilization of landslides • Control of drawdown and filling rates	Moderate
	Earth quake damage to dam	Major	High	Major	• Design of dam in compliance with ICOLD and WB OP 4.37 Safety of Dams • Review of designs by Panel of Experts • Seismic monitoring program	Negligible
	Reservoir induced earth quakes	Negligible	High	Negligible	• Seismic monitoring program	Negligible

Component	Impact	Magnitude	Sensitivity	Significance Prior to Mitigation and Enhancement	Mitigation and Enhancement Measure	Residual Significance
	Floods from GLOFs damage dam and human life	Major	High	Major	• Design of dam in compliance with international standards • Telemetry network for GLOF monitoring • Downstream warning system	Low

7.3 IMPACTS DURING PRE-CONSTRUCTION AND LAND ACQUISITION

7.3.1 Land Acquisition

A total of 4.643 ha of land have to be acquired for the project. This includes 4,006 ha for the reservoir (including buffer areas around the reservoir), 269 ha for physical project infrastructure and 199 ha for construction of roads (KKH and access roads). The census surveys have identified a total of 767 households, consisting of 6,953 persons from 34 villages, as being affected by the project interventions. The major impacts on the community have been identified as loss of structures including residential structures, land including agricultural land and income and livelihoods. 600 of these affected households (AHs) lose agriculture land and 753 AHs lose structures. 13 households of soniwals are affected due to their dependence on the river in the proposed reservoir area, for livelihood (soniwals extract gold from the river sand). The Project will affect 31 existing mosques, 7 schools, 2 basic health units, and 17 graveyards, next to facilitates for drinking water supply and irrigation, and latrines. A Resettlement Action Plan (RAP) has been prepared to address and mitigate the impacts on the affected households. The objective of the plan is to restore the income and livelihood conditions of the people to at least pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost, but also will be given additional assistance for relocation, re-employment and livelihood restoration. Most of the affected villages have direct access roads from KKH (left bank) or internal access roads (right bank). Rebuilding and provision of all these civic amenities in the new resettlement sites is essential as mitigation measure.

7.3.2 Resettlement

The footprint of the project will affect 34 hamlets and villages, each of them often consisting of not more than 25 to 30 houses. Seventeen villages are situated on the right bank and seventeen villages on the left bank. Consultations with the affected community revealed that most of them did not want to move away from the valley, and prefer to move to a self-selected and self-managed site together with their small community to a higher elevation in the same valley. Compensation and assistance in resettlement including provision of sites and services according to an agreed Resettlement Framework will be provided by the project.

7.3.3 Impact on Wage Earners

Apart from the direct impact on households, a total of 137 wage earners employed as laborers, helpers and masons will be affected by their relocation. Most of the PAPs employed as laborers (71 people) are engaged in the construction works in the area and transportation of timber from logging area to KKH. A smaller number is employed as Gujars looking after the livestock of maliks and in transportation of goods and groceries of villagers from KKH to higher elevation residences. Laborers employed as helpers (56 people) are unskilled workers engaged by small restaurants and shops and also offices in the area on a daily paid basis.

7.3.4 Impact on Vulnerable Groups

A total 68 of the affected households were identified as falling within the category of socially and economically vulnerable groups. Of the 68 vulnerable affected households 74% comprise those losing their agriculture land thereby making them vulnerable. Amongst the remaining vulnerable households, 23% comprise landless, followed by a female headed and a differently-abled headed household. Taking into account the socio-economic vulnerabilities of the affected households, specific provisions and special measures have been incorporated in the RAP to ensure that they are not marginalized in the process of project implementation.

7.3.5 Loss of Agriculture and Grazing Areas

The Project will affect 143 ha of agriculture land and 280 ha of grazing land in the lower valleys. Since the availability of agriculture and grazing areas are limited in the Project area, these losses will affect the livelihood of the affected community. In order to mitigate impacts associated with loss of agriculture and grazing areas, an adequate livelihood restoration program, including development of agriculture and grazing areas higher altitudes will be taken up.

7.3.6 Loss of Vegetation and Trees

About 21,000 trees will have to be cut for siting of project facilities and from reservoir submergence area before flooding in order to reduce anoxic conditions and greenhouse gases emissions. Generally these trees on the steep slopes of the Indus valley are not very well developed and often consist of stunted trees. They do not represent much natural, other than as a source of firewood for the local community. These trees also do not serve the purpose of primary habitat for wildlife species. The loss of trees will be compensated by successful plantation of the native species. The lost trees will be replaced at a ratio of 5:1 in the buffer area of the reservoir on the right bank, resettlement sites, DHP office and residential colony, and at higher elevations for forest regeneration with the support of local community.

7.3.7 Inundation of Communication Facilities

The Project will inundate two bridges on Indus (Kandia and Largani) and 14 cable trolleys connecting both the right and left banks. These are the only transportation facilities available for the right bank people to access KKH and then go to market in Komila and down the country. To compensate the loss of two bridges, the Project will construct one bridge at 8 km upstream of existing Kandia bridge along with access roads from new KKH on left bank and access road from Komila on right bank. Those who lost cable trolleys can use the new access road on the right bank to access to Komila market and then travel to other parts of the country. Further, wherever feasible, access roads will be built from the new KKH and right bank roads to the new resettlement villages. The Project will also inundate 46 km of KKH, which will be compensated by building a new KKH (62 km) on higher elevation above the reservoir level.

7.3.8 Impacts on Physical Cultural Resources

A 400 year old historic mosque in the village Seer Gayal will be flooded by the reservoir, together with the houses of the village. In consultation with the local community it was agreed that the wooden structures will be disassembled, transported and reassembled at a higher altitude at the new location of the village. Also 17 graveyards spread over the valley will be submerged by the reservoir. Local communities have requested the protection of graveyards from the collapse of graves under water and floating of human remains. A fatwa was also issued by local religious leaders on protection of the graves that will be submerged under the Project. The graves shall be protected with civil works (mud plastering) to withstand the impact of water. Other cultural resources that will not be submerged but shall be protected for adverse impacts of the project are the mosque in Seo, which is near to the access road and the cluster of rock carvings near Shatial, which is part of a much larger gallery of 30,000 rock carvings, most of which will be submerged under Diamer Basha dam site. KP Archeology Department requested the financial support of DHP to purchase the land (25 acres) for protection of Shatial rock carvings. The Project will support the KP Archeology Department in procurement of the land and protecting the land through fencing and tourism development.

7.4 IMPACTS DURING CONSTRUCTION STAGE

7.4.1 Change in Topography

Topography poses a challenging work environment for construction. There are very limited flat or mildly sloping areas where construction yards can be setup and equipment can be erected. As a result, large areas will have to be leveled in terrace form. Locations of all project facilities, including quarry areas and access roads, will be subjected to topographic changes through excavation and blasting. Changes in natural topography will impair the natural landscape and induce a series of impacts related to changes in slopes such as soil erosion, landslides and changes in drainage pattern. Soil erosion from the disturbed areas and excavated rock stock piles will increase the sediment load of surface water.

Land excavation and leveling shall be carried out only in the designated areas, and alternative excavation methods, such as controlled explosive use and cutting with excavator, will be used wherever possible. The topography of the final surface of the leveled lands shall be conductive to enhance the natural draining of rainwater and floodwater. The contractor shall prepare a landscaping and re-vegetation plans which shall include (i) restoration of cleared areas, quarries which are no longer in use, spoil areas, and any areas temporarily occupied during construction of works shall be undertaken using landscaping, provision of adequate drainage and revegetation; (ii) all areas disturbed by construction activity, including temporary access roads shall be landscaped to reflect natural contours, restore suitable drainage paths and encourage re-establishment of vegetation; and (iii) spoil heaps and excavated slopes shall be compacted and protected to prevent erosion.

7.4.2 Risk of Landslides

During construction there is an increased risk of landslides and collapse of slopes. Landslide is natural and common phenomena in the Project area in the mountain slopes along KKH. Natural landslide can occur due to lubrication of rock support structure by rainfall or by water seepage. The use of explosives to break the rock will have the capacity to generate the localized vibrations which can have potential of triggering a land slide. Landslide- prone areas in the project area have been identified and classified on basis of potential risks. Any blasting activities in these areas shall be controlled and contained within defined limits. Special attention shall be paid to the blasting areas, where rock mass conditions are poor (e.g. portal areas of flushing tunnel) due to presence of shear zones. Careless blasting could increase the requirement of slope stabilization measures in the area. Temporary drainage systems shall be installed to prevent water entering in to these areas with adequate maintenance and monitoring. Landslide areas will be monitored continuously for movement of displacement. If any new deformation is observed to be due to landslide movement, structural measures will be considered. Landslide prone areas along KKH reconstruction will be protected through retaining walls, cross drainage, toe protection, rock anchoring and other similar structures/measures.

7.4.3 Generation of Spoils

About 19 million cubic meters (MCM) of spoils (10.3 MCM from dam/tunnel works and 8.7 MCM from relocated KKH) will be generated from the excavation activities of the Project. Potential impacts from spoils and its disposal are (i) land acquisition for disposal of such huge quantities of spoils, (ii) conversion of those land areas in to a permanent dumping area, (iii) potential erosion from the spoil areas and moving of spoils in to the river, and (iv) aesthetic impacts. The Project will use the excavated rocks as concrete aggregate raw materials in addition to the quarried raw rock materials, if they meet the required quality and specifications. The excess excavation will be used in filling of embankment for KKH, and construction of retaining walls and bridges along KKH. The remaining spoils will be disposed in the designated disposal

area (68.85 ha area located at 3 km downstream of the damsite) on the right bank. The disposal area will be fenced on the riverside so that there will be no rock or sediment laden flows into the river. A dumping mechanism will be devised to dispose different grades of materials in different locations. Excavated material shall be placed in layers of about 1m depth and each layer is slightly compacted by earth moving machinery. Contractor will be responsible to prepare and implement spoil disposal plan for proper disposal of spoils, stabilization through compaction, protection of spoils from erosion and landscaping through plantation, bioengineering and engineering techniques. The spoil disposal area will be fenced on the riverside so that there will be no rock or sediment laden flows into the river. A belt conveyor system is also recommended for transport of spoils from the construction areas (temporary stockpiles on left and right bank of damsite) to disposal site to avoid usage of 400 vehicle trips per day for transportation of spoils.

7.4.4 Risk of Water Pollution

Water quality and water flows will be affected by the construction activities in the river (coffer dams and main dam), discharges from the tunnels, quarry sites, batching plants, construction yards and construction camps. Any discharges to the surface waters will be properly treated (can be achievable mostly by sedimentation/settling tanks) before discharging. Quality of discharge waters shall comply with NEQS. Design drainage for the quarry and batching plant area to direct runoff into a sump/basin for inspection for pollutants prior to discharge. Silt fences, sediment barriers or other devices will be provided to prevent migration of silt during construction within streams and river. All fuel and oil storage sites will be surrounded by a catcher drain and oil water separators to capture the spills. Those potential sources of pollution shall be identified and removed during the construction period and prior to the first filling of the reservoir. The proposed submergence area under the reservoir contains some new structures and facilities (construction yards and camps) will be built by the DHP contractors during construction. All these structures will be decommissioned before filling the reservoir to avoid contamination of reservoir water.

7.4.5 Risk of Air Pollution

Main sources of air quality pollution are emissions from construction related traffic and equipment, tunnel construction, rock blasting and excavation, quarry areas, aggregate mixing plants and road construction. Dust from unpaved roads and construction areas will have impacts on crops, animals and houses. The construction activity will generate airborne dust and particulate matter. About 200-300 vehicles are expected to use KKH from Havelian side to the Project site. Greenhouse gas emissions from automobiles and construction equipment consist of the gaseous product of engine fuel combustion (exhaust emissions) and evaporation and leaks from vehicles (Fugitive emissions). To mitigate dust problems, all access roads in the construction area that will be used by the project will be paved. For example, access road along the right bank from damsite to Kandia where construction yards are located will be paved. The construction and road machinery used during the construction process shall comply with NEQS requirements with respect to emission and noise pollution. Maintaining the construction equipment and vehicles as per manufacturer's recommendation will reduce the emissions from the equipment and vehicles. All dust raising locations will be kept wet with water sprinkling. Material such as pozzolan and cement will be covered with tarpaulin during transportation. To mitigate the impacts associated with the use of daily 700 vehicles for transport of aggregates from quarry site to the batching plant, the Project will have a belt conveyor system and avoid use of vehicles for material transport. Dust controlling system will be extended to the conveyor belt system. A belt conveyor system is also recommended for transport of spoils from the construction areas (temporary stockpiles on left and right bank of damsite) to disposal site to avoid usage of 400 vehicle trips per day for transportation of spoils.

7.4.6 Noise and Vibration from Blasting and Construction Activities

Blasting (20,000 tons of explosives will be used in the Project) and drilling are the major sources of noise and vibration. Noise will also be generated from vehicular movement, excavation machinery, concrete mixing and crushing plants. Ground vibration and airblast levels will be generated from blasting activities. At low to medium levels, ground vibrations and air blasts can result in community annoyance. At higher levels this could lead even to structural damage on buildings. Contractors will to monitor the noise levels regularly at the construction sites and take necessary measures to comply with the national standards. It is recommended that the contractor shall carry out trail blasts with various charge amounts and record vibrations levels at the nearest receptors and finally chose the optimum amount of blasting per event. Acoustic enclosures and high efficiency mufflers are to be fitted to the noise generating equipment. The blasting schedule will be agreed with the local government and community. The Contractor will install and operate a siren of sufficient volume to be easily heard above the general site noise from all points within a radius of 1 km of surface blasts.

Excavation at the quarry sites shall be started from the non receptors side (southern end for Kaigah) and shall be progressed towards the receptors side. This will maintain natural berms and act as acoustic shields to avoid impacts on receptors. Noise, vibration and dust will be continuously monitored to ensure the compliance with NEQS, and if any excedances are noticed, additional noise attenuation and dust control measures shall be implemented. These include placing of material stockpiles and noise shields around the high noise generating equipment.

7.4.7 Pollution from Waste

Construction works are expected to generate excess material from construction sites (concrete, steel cuttings, discarded material), and wastes, including garbage, recyclable waste, food waste, and construction debris. In addition small quantities of hazardous waste will also be generated mainly from the vehicle maintenance activities (liquid fuels; lubricants, hydraulic oils; chemicals, such as anti-freeze; contaminated soil; spillage control materials used to absorb oil and chemical spillages; machine/engine filter cartridges; oily rags, spent filters, contaminated soil, etc.). The solid waste will be disposed at the landfill area developed for the Project and hazardous waste will be sold to the licensed vendors.

7.4.8 Increased Pressure on Forest Resources

Forests, though essentially located on high elevation well away from project construction areas, are the most important natural resource of the area and owned by the community. Community use forests for timber harvesting through government leasing. In addition the community uses the forest resources for selling of firewood and collection of pine nut, fruits and medicinal plants. The construction activities are expected attract about 7,000 in migrants (construction workers, their families and service providers). This will create a huge demand for firewood due to increased energy requirements for cooking and space heating during winter, and will finally increase the pressure on forest resources, which is already under heavy pressure from local communities for commercial harvesting, firewood and grazing. Contractor will provide non firewood fuels such as LPG, for the construction workers. The Project will support the local government to develop LPG market to reduce the pressure on firewood and timber.

7.4.9 Impact on Kaigah Community Game Reserve

This Private Game Reserve is bordering the old KKH. There will be infringement of the reservoir into the reserve (size 5,000 ha) and some 51 ha will permanently be affected by submergence. The construction of the new KKH will also affect some 31 ha of land

from the reservoir for road construction. Moreover during construction a large quarry will be developed at the border of the reserve (in future reservoir submergence area) where the old KKH is crossing the Kaigah nullah. Use of explosives and regular quarrying (duration estimated at 2.75 year) along with 5.5 km of KKH construction within the game reserve (duration estimated at 7-8 months) will produce noise and vibrations that may disturb wildlife in the area when they visit lower elevations (mainly during winter). The wildlife habitat in the reserve located about 3 to 12 km from the quarry area. During winter months of December to April, markhors come to lower altitude habitat, which is located about 3 km from the quarry site. Noise, air and ground vibration from blasting and aggregate crushing operations at Kaigah are the major sources of disturbances on the game reserve. At low to medium levels, ground vibrations and air-blasts result in annoyance, but at higher levels, it would be expected that wildlife may avoid lower altitude habitats during the construction period. The maximum instantaneous blasting at the quarry site is expected to be in the range of 100 to 250 kg. However, based on the preliminary assessment an instantaneous blasting up to 1,000 kg is not expected to create any impact on the Markhor habitat. It is recommended that the contractor shall carry out trail blasts with various charge amounts and record vibrations levels at the closest habitat and finally chose the optimum amount of blasting per event to avoid any impacts on wildlife. Similarly noise levels will also be monitored and if it exceeds the national standards, acoustic enclosures for noise attenuation will be placed around the crushing plant or its operation will be limited to day time. Strengthening of the game reserve will be taken up by the project in consultation with the management of the game reserve. The Project will also carry out studies to establish two community conservation areas in the project area.

7.4.10 Risk of Poaching

Construction of realigned KKH along left bank and access roads along the right bank (within 1,000 masl) will not interfere with any wildlife corridors. However, they may provide increased access to hunting and poaching. Poaching from construction workers can be affectively curtailed by conducting wildlife awareness programs. Temporary access roads will be decommissioned after completion of the Project. The Project can support the district wildlife authorities in conducting awareness programs on wildlife conservation.

7.4.11 Impact on Fish

At the damsite coffer dams will be placed upstream and downstream of the work areas to keep the river bed dry for about 980 m length to facilitate construction of the dam. Aquatic biological production will be eliminated from approximately 980m of stream length, part of which (the dam footprint) will be removed for the life of the dam. Pre-construction and construction activities have potential to adversely affect aquatic biota by release of high concentrations of sediment, fuels/oils and other toxic compounds, and solid waste and use of explosives. High sediment loads will be produced during placement of the coffer dams and again when water first passes through the work area after completion of dam and plunge pool construction. Sediment concentrations above natural levels can cause mortality of biota directly; for fish, damaged gills and sediment clogging of gill chambers eventually leads to death. Measures proposed to protect the water quality will mitigate potential effects on fish. The section of the river between both cofferdams created to construct the main structure will dry up entirely. Upstream fish movement will be blocked by relatively high and uniform water velocities in the diversion tunnels and the physical barrier created by the coffer dams. Strong laminar flows and absence of low-energy rest areas in the tunnels likely will prevent all fish passage upstream. Fish drawn into the upstream end of the diversion tunnel will be subject to high water velocity and possible abrasion. Fish exclusion screens or fish deterrent devices are recommended for diversion tunnels. The endangered golden

mahaseer (Tor putitora) reportedly do not ascend beyond approximately Thakot-Besham, 70-80 km downstream of the dam site. Hence there will be no impact on the Mahaseer due to construction of the Project.

7.4.12 Increased Traffic on KKH and Access Roads

KKH is the life line of northern areas and it is the only highway connecting the north of Pakistan with the rest of the country. About 2,590 vehicles per day including 15% heavy trucks are currently using the KKH for transportation of goods. During construction, it is estimated that about 200 to 300 construction trucks per day are expected to use KKH to supply cement, steel, fuel and other construction materials to the site. Additional project vehicles using the KKH and exceptional heavy transports of turbine sections may cause traffic congestions and safety hazards. The transport along the access roads through Komela bazar is also expected to create traffic nuisance and safety hazards. Further, there are no layby areas along the KKH between Thakot to Dasu, where drivers can stop the vehicles and take rest. This is one of the common causes for the traffic related accidents along KKH since the driver falling asleep at wheels. A traffic management plan is developed for the Project to streamline the traffic flow on KKH by establishing traffic control units and strengthening traffic facilities along KKH. The Project will also develop some layby areas along KKH.

The construction activities can potentially impact the residents of Dasu-Komila and along KKH, particularly the movement and safety of school children. In addition, due to increased use of trucks and other vehicles on the narrow roads in the project area and the access roads elderly people, women and children will be more exposed to dangerous situations, which may lead to traffic accidents. Contractors will prepare and implement their own traffic management plans with an aim at ensuring access to residential areas, preventing of unsafe situation, especially near schools, housing areas, construction areas, camps and offices.

7.4.13 Influx of in-Migrants and Related Social Issues

The influx of construction workers to the Project site may place considerable pressure on the traditional Kohistani socio-cultural system as well as resources. Although the volume and number of in-migrants is difficult to accurately determine at this time, a possible scenario suggests that for every job created by the Project, at least an additional job will be created as a snow-ball effect to support and sustain the growing population and businesses in the Project area. There will be 2 times more indirect in-migrants (family, followers, service providers etc.) than direct in-migrants as construction workers/staff for project construction. In addition to the in-migrants, there will be foreign workers (skilled and semi-skilled) employed in the project site. At the construction stage, Dasu will have over six-times more people than the current number of residents, putting considerable pressure on existing resources – for example, housing/shelter, land, water, power, food supplies, jobs, and transport/infrastructure – on households and communities, threatening their general well-being and welfare.

Unless properly managed this sudden influx of people could create negative aspects such as an increased crime rate, tensions and social conflicts between the various groups. In order to prevent such problems the project will develop a pro-active approach by working out a Migration Management Plan, even before arrival of the first in-migrants. In this plan detailed solutions for a number of key issues will be prepared including issues regarding housing and accommodation, food security, local infrastructure, community health, labor contracts, employment and business opportunities, security, integration and cultural understanding and community and area development. This Plan procedures and rules will be worked out by the PMU in close cooperation with the Contractor and local authorities. Responsibilities for the implementation of the plan rest with the local authorities, the line departments, WAPDA and the Contractor.

Workers coming from different parts of Pakistan may have different norms and values in social behavior and religion from the resident population. This situation will be addressed by an awareness campaign implemented in the beginning of the construction phase. The Contractor would be aware of the possibility and risks of miscommunications between local residents and workers, a situation which easily could lead to social unrest. This would be prevented by raising awareness and implementation of a Code of Conduct for the workers. Complaints from the local community will be addressed by the Grievance mechanism that will be developed.

7.4.14 Impact on Public Health

Construction sites are likely to have health and safety impacts. There will be potential for diseases to be transmitted, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted diseases such as HIV/AIDS. Camp sites for construction workers are locations that have significant impacts such as health and safety hazards on construction workers and nearby communities. The potential implications associated with housing of the immigrant workforce include generation of solid waste and sewage, public health impacts through the possible introduction of diseases not prevalent in the surrounding areas, and promotion of disease vector habitats within the temporary housing areas. A public health action plan will be implemented to reduce public health impacts, which will include awareness campaign on sexually transmitted diseases such as HIV/AIDS. Apart from awareness raising and prevention the medical health facilities in the Project area will be facilitated to deal with such incidences.

7.4.15 Workers Health and Safety

The rough terrain and difficult work conditions at the construction areas will create a number of occupational risks and hazards. The construction activities will involve blasting, large scale excavation, underground works, operations of heavy construction machinery and vehicular traffic. These activities may pose health and safety hazards to the workers at site during the use of explosives, use of hazardous substances, lifting and handling of heavy equipment, operating machinery and electrical equipment, working near water or at height and more. PMU, construction supervision consultant and contractors will have an OHS specialist in their respective teams to plan and execute OHS related issues and risks. Each contractor will establish a comprehensive OHS Plan aimed at preventing accidents, injuries and work-related diseases. This plan will be submitted to PMU and supervision consultant for review and approval before construction. Each contractor will also prepare an Emergency Response Plan defining procedures to be followed during any emergency. Personal protective equipment will be provided to all construction workers. The Contractor shall conduct ongoing training programs for all construction workers on basic health care issues and construction safety matters, and on the specific hazards of their work. The contractor shall follow closely the World Bank Group (IFC) Performance Standards on Labor and Working Conditions. Special attention should be focused on safety training for workers to prevent and restrict accidents and the knowledge how to deal with emergencies.

7.4.16 Employment Opportunities

The Project construction activities will provide about 2,700 job opportunities for both skilled unskilled laborers during first six years of construction. Local community will be given preference in employment of the construction works. Also there will be employment opportunities for office staff, administrative and logistic functions and in transportation. Important for sustainable livelihood restoration is that sufficient vocational training and skill development is provided. A pro-active program to this end is already started by WAPDA: local youths are receiving a six-month vocational training in various lines of work to prepare them for guaranteed jobs in the project construction work. The graduates may also obtain jobs elsewhere, if they choose to.

Establishment of vocational training centers for men and women will be part and parcel of the project resettlement plans. After the construction phase there will be other opportunities for more permanent functions within the project operation and maintenance. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population. This will be a major and significant positive impact of the project. The considerable influx of people during all phases of the project will considerably stimulate the local economy, by involving local businesses and village level enterprises. New opportunities for local businesses, suppliers, hotel owners, shopkeepers and the transportation sector will be created. All these developments will considerably stimulate the local economy in the district.

7.5 IMPACTS DURING O&M STAGE

7.5.1 Formation of Reservoir

The character of the river Indus and its valley bottom will change from a fast flowing uncontrolled sediment-laden river with steep rocky slopes into a narrow controlled water reservoir (average width 365m) and extending for about 73 km up stream at full supply level (FSL) of 950m. In lateral valleys of tributaries the reservoir penetrates several kilometers inland and is expected to develop new natural hot-spots at the confluence of snow-fed small streams with the main water body. The surface area of the reservoir is very small (23.8 km^2) and storage volume is 1.41 BCM. Maximum depth of the reservoir at the dam site is 185m and the minimum depth at the head of the reservoir is about 10m. .

Habitat conditions along the 73km length of the river at FSL will be characterized by a long transition along the former river gradient featuring river-like fast-moving water in the upstream end and deep slower moving water in the downstream end. Reservoir ecology will not be typical of a natural lake environment and will undergo rapid reduction in size caused by rapid sedimentation and changes associated with transition of reservoir operation from run-of-river to peaking (notably, drawdown during cycle of water storage and release for power generation). Relatively high water velocities and narrow width will maintain river-like features along much of the reservoir.

Water velocities along the length of the reservoir will generally be less than pre-reservoir river conditions. Although reservoir features will be lake-like, surface water velocities will be high compared to most lakes and storage reservoirs. The relatively high water velocities suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline.

7.5.2 Risk of Reservoir Induced Landslides

Inundation of the unstable hill slopes in reservoir will cause slope failures. The rocks in dry condition in stable equilibrium will be destabilized due to seepage of water triggering landslides. Potential locations of landslides are identified in the reservoir area and are classified into hazard levels 1 to 3 (1 being highest). These slopes will be carefully monitored during the first reservoir filling. It is recommended that the reservoir be filled with a slow rate of 2 m/day and carefully monitor the slopes in the landslide prone areas. This slow rate is maintained in order not to destabilize the slopes of the valley and to prevent landslides, which may occur when soil/rock is getting wet and slopes might collapse. Further detailed geological and geotechnical studies are recommended for management of potential landslides. These measures would include stabilization by structural and vegetation cover, drainage management and control of drawdown rate of reservoir water level during operation.

7.5.3 Impact of Sedimentation on the Reservoir and Power Generation

About 200 million tons of sediment passes every year at the dam site. Hence there will be reduction of reservoir storage over the years due to sedimentation and it is expected that the inlets for LLO and power intake will be filled within 20 to 25 years if there will be no flushing of sediments. Heavy bed load will settle near head reach and the finer material will settle in middle and lower reaches of the reservoir. Based on the engineering analysis carried out during detailed design, it was concluded that flushing of sediments will not be required until 15th year of operation. If Basha is constructed by that time, flushing operation is not required further 30 years since Basha dam with enough storage capacity would act as sediment trap. During flushing, the power generation will be stopped approximately for a period of one month during May and June, which will reduce the annual generation by 4,800 GWh when there will be flushing after 45 years or by 2,900 GWh if the flushing starts after 15 years.

Sedimentation control is critical to improve the life of reservoir and increase of power generation. Sedimentation inflow to the damsite comes from its overall catchment in Indus Basin. Sedimentation inflow within the DHP reservoir area is negligible compared to overall inflow to the damsite. Hence sedimentation control measures are to be targeted for overall UIB. Integrated watershed management of UIB can be an option. Detailed studies are recommended for planning, design and implementation of integrated watershed management for control of erosion and sedimentation in the UIB.

7.5.4 Changes in Reservoir Water Quality

Generally water quality in reservoirs will be deteriorated to thermal stratification and depletion of dissolved oxygen at deeper levels. Average water retention time (residence time) in the reservoir (volume/flow per unit time) is an important determinant of the extent of the change in water quality. Generally, long retention times in the reservoir will affect the reservoir water quality through changes in dissolved oxygen, eutrophication and thermal stratification. Average water retention time in Dasu reservoir found to be very short varying from 1 to 6 days during high flow season, and about 19 days during low flow season. The impacts on water quality are estimated to be minor due to these short retention times. However, if low oxygen conditions are evident during monitoring prior to flushing a lead-in period may be required whereby the lower-level outlets are used to draw out low oxygen-concentration lower-elevation water in combination with spillway releases to provide adequate oxygen concentrations in water downstream of the plunge pool.

7.5.5 Impairment of Upstream Fish Habitat and Spawning Area

About 570 ha of river and tributaries in the upstream of the dam will be subject of biotic and abiotic changes caused by the reservoir. Reservoir ecology will not be typical of a natural lake environment and will undergo rapid reduction in size caused by rapid sedimentation. Water velocities along the length of the reservoir will generally be lower than in pre-reservoir river conditions. Although reservoir features will be lake-like, surface water velocities will be high compared to most lakes and storage reservoirs. The relatively high water velocities suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline. Spawning areas in the in the tributaries will be submerged and it is expected that new natural hot-spots will be developed at the confluence of tributaries with the main water body. Maintenance of spawning areas and developing fish hatchery for production of native snow carps (snow carp hatcheries are already established in India and Nepal) and stocking of fish in the tributaries, reservoirs is recommended to compensate the loss of habitat and reservoir fishery production. Further studies are recommended during construction and operation stage to establish detailed baseline data on aquatic ecology to develop additional offset measures and research on hatchery development

7.5.6 Barrier Effect on Fish Migration

From the beginning of the construction activities, initially by coffer dams and finally by the dam, a barrier will be created in Indus, which will impair the ecological connectivity in the river, including the movement of biota and the migration of fish. Currently, fish production in the Indus River within the project area is low, as may be seen from the absence of full-time fishermen and the low yields from fisheries sampling. Some subsistence fishery is practiced in the tributaries during the low-flow period. Also fish diversity is low, the main reasons being the long torrential stream, the cold, glacier-fed water, the high sediment load, and the low trophic level of the water. No long distance migratory fishes are present in the project,- area that could be affected by the dam. Snow carp migration is within the tributaries and hence will not be affected by the dam. Further studies will be carried out (during pre-construction/construction) to strengthen the existing knowledge on fish biology and ecological baseline for the Indus corridor between Basha and Tarbela in order to better interpret and mitigate actual impacts of DHP and to be able to prepare adequate offsetting measures on fish and fisheries of other hydropower projects in the UIB such as the Diamer-Basha dam

7.5.7 Impact on Aquatic Ecology Between Dam and Tailrace

The 4.4 km section between the dam and tailrace will receive reduced water inflow during low flow season. This can potentially cause significant impacts on the aquatic fauna and overall ecology of the river in this reach. However due to a favorable profile of the riverbed, a section of 3.2 km length upstream of the tailrace could permanently receive water from backwater flow of the tailrace. Only 1.2 km of river below the main dam is critical for drying up during the low flow season. Sieglo stream joins in this section and brings about 0.5 m3/s flow during low flow season. Maintaining a minimum environmental flow downstream of the dam could mitigate potential impacts on aquatic habitat and fauna on this river section including confluence with Sieglo, especially in the period between December and April. Thus environmental flows are required to mitigate any adverse impacts. Two approaches were followed in designing environmental flows – one on the experience of Ghazi Barotha hydropower project located on Indus on the downstream of Tarbela and other on meeting requirement of aquatic habitat. Ghazi Barotha has a 54 km of dewater section between barrage and tailrace and it is being compensated by 28 m^3/s, which is found to be adequate through a 5 year monitoring program by WAPDA Environmental Cell. In DHP, an environmental flow of 20 m^3/sec from the dam and 222 m^3/sec from the tailrace is recommended. These environmental flows will maintain a depth of 0.5 m and velocity of 2 m/s at Seiglo confluence which is adequate to maintain winter habitat of snow carps. On average, the recommended environmental flows (242 m^3/s) in most of the dewatered section will represents 44% of average winter flows and 72 to 95% average winter wetted perimeter. A downstream environmental effects monitoring program will be put in place to enable assessment of changes in ecological components and adjust the environmental flows if required.

7.5.8 Impact on Aquatic Ecology on the Downstream of Tailrace During Peaking Operations

Flows and ecological conditions downstream of the tailrace outlet are not expected to be altered during run of river (Stage 1) operation. However, during peaking operation (Stage 2), in-stream ecological conditions potentially will be affected downstream of both the dam and tailrace outlet by daily flow reduction in winter during the storage cycle, with effects extending for longer distances; without mitigation, cessation of flow would have significant adverse effects on the downstream ecosystem. Environmental flows of and 222.5 m^3/s from tailrace (during low flow season of October to May) as environmental flow to maintain the aquatic habitat between the dam and tailrace. During Stage 2, an environmental flow of 222.5 m^3/s is recommended to be released from tail race, which could be done by always operating one turbine; and 20 m^3/s is

recommended to be released from dam. Thus a total of 242 m^3/s will be released as environmental flow from the downstream of tailrace, which will be equal to about 44% of average winter flows. These recommended environmental flows generally exceed the environmental flows recommended in other river basins of Western Himalayan region (Wildlife Institute of India has recommended an environmental flow of 20% of average monthly flows during winter for Alaknanda and Bhagirathi Basins, Uttarakhand, India). Further studies are recommended to understand the habitat requirements of downstream fishes. A downstream environmental effects monitoring program will be put in place to enable assessment of changes in ecological components.

The surges associated with peaking operation would likely cause rapid downstream displacement of fish and other biota (including fish-food organisms) holding in residual pools and channels during the 18 hour storage-period (when downstream flow would be negligible). Smaller fish sizes, notably fry, would be most susceptible to this effect. This effect would occur along the length of the Indus River that experiences the surge until a point is reached where the surge is attenuated to tolerable levels due to inflow from tributaries and groundwater and frictional effects of bottom substrate. It is recommended to operate at least one turbine and use additional water for peaking operation. This will ensure release of 222.5 m^3/s from tailrace. In addition, an operational protocol to be designed to soften the rapid water level and flow variations due to peaking and thereby reduce the downstream impact, a fixed start and stop procedure shall be implemented. This will include: (i) each turbine goes from zero to full level in two or three equal steps separated in time by a few minutes. When a second turbine is started, the same procedure will be followed for each turbine in order. The same procedure will be followed when reducing the load. The start and stop procedure can be further adjusted with the monitoring results.

High mortality of fish from stranding can occur during rapid ramp down of flows downstream from reservoirs. When DHP flows are reduced after the approximate 4-5 hour energy-generation window, there will be potential for fish to be stranded as the downstream shoreline water level recedes when flow is halted. The distance downstream that peaking flows would be detectable is not known; flows likely would be attenuated to negligible at some point before reaching the southern end of Tarbela Reservoir. Flow-reduction rates to protect aquatic biota from stranding and mortality downstream from hydropower facilities have been developed in a number of jurisdictions usually based on detailed background knowledge on the biology of target species and site-specific requirements. Such background information is not available for the species known to occur in the project area-of-influence. The period of greatest vulnerability is likely the winter period.

7.5.9 Impact of Flushing on the Reservoir Fisheries

The current plan is to use the reservoir for base load generation during the first stage of the project, estimated at 15 years. After this period the reservoir shall be flushed annually during one month (mid May-mid June) when discharges of the Indus are high. In this period it is expected that specific fisheries management is required to sustain the population of fish in the reduced reservoir area during flushing, possibly followed by re-stocking afterwards. There are considerable uncertainties with respect to expected losses of fish harvest during flushing and the appropriate mitigating measures. These issues have to be studied into more detail in the recommended feasibility studies on fishery development. Flow releases during reservoir flushing are not likely to have a sustained negative effect on the downstream ecosystem, as long as peak flows occur within the normal period of seasonal high flows.

7.5.10 Impact on downstream fish during flushing operation

The potential impacts on the downstream during flushing operations are turbulent habitat conditions, release of high sediment load and altered water quality from the reservoir. Flushing events should not occur earlier than the planned early summer period to prevent possible adverse effects outside the intended timing window especially during the winter low-flow period. Release flows during flushing should be within limits of historical flows for the season over which flows will be released (currently planned for mid-May to mid-June). As explained earlier, the impacts on water quality in the reservoir are estimated to be minor due to these short retention times. However, if low oxygen conditions are evident during monitoring prior to flushing a lead-in period may be required whereby the lower-level outlets are used to draw out low oxygen-concentration lower-elevation water in combination with spillway releases to provide adequate oxygen concentrations in water downstream of the plunge pool. Adequate ramp-down rates should be recommended (tentatively recommended as 5-10 cm/hr, measured at tailrace outlet) and can be refined using monitoring results. Upon completion of flushing during reservoir refill, downstream flows should be released through low level outlets.

7.6 CUMULATIVE IMPACTS

Cumulative impacts of DHP and other hydropower projects on UIB for the next 10 years have been assessed on i) water-hydrology, water use and quality; ii) vulnerability to flooding, flood management aspects; iii) forestry and bio-diversity; iv) agriculture and livelihood; v) social issues (i.e., involuntary resettlement, loss of income, ethnic minorities, cultural impacts considering religious and cultural values associated with Indus and health risks including risk of HIV/AIDS); vi) fisheries; transport; vii) water supply and irrigation; vii) urban development; viii) power transmission and industry; ix) institutional issues and capacity.

7.6.1 Cumulative Impacts on Hydrology

Total average annual flow at Tarbela is 78.92 BCM. About 19.77 BCM of water (25%) will be retained in the reservoirs of the proposed projects (including the existing Tarbela). Operation of reservoirs (storage and release of water from reservoirs, either for irrigational purposes at Basha or peaking operations at Dasu) will alter the natural flow pattern. Presently high flows in Indus occur in summer and low flows occur in winter season. Downstream of Tarbela, a considerable increase of 42 % can be seen in low flow season when storage capacity of Basha is released into the system. With Basha, flows between Dasu and Tarbela will not change considerably due to possible peaking operation and overall effect will be negligible. However, during peaking a few hours surge will occur. No flow change is anticipated between Basha and Tarbela during regular operation. Mitigation measures shall include comprehensive examination of downstream flow changes (including both minimum flows and surge flows) resulting from all projects and opportunities to coordinate operational releases to minimize potential combined effects of flow and water quality changes on in-stream and riparian resources and human activities.

7.6.2 Cumulative Impacts on Fisheries

Nearly 290 km of riverine ecosystems in UIB will be converted lake-like ecosystems; segments of the Indus River and tributaries downstream of each dam will be subject to altered flows and water quality. Existing and proposed hydropower projects have potential to adversely affect endemic fish species and fishing activity. Due to release of high water flows from reservoirs in winter, there will be a potential effect on the fish movement patterns between tributaries and the Indus. This will also affect the availability of fish for local consumption. Risks to fish habitat will increase as a result of project-induced increases on urban development, agriculture, transport, forestry and

industrial activity. Project-induced increases in human populations, especially during the construction stage will increase demand for fish and pressure on fish stocks.

WAPDA shall support development and implementation of an integrated basin-wide framework to assist assessment and management of wild-capture fisheries, including identification of long-term strategies to assist fisheries management institutions to address potential effects of multiple hydropower developments in their jurisdictions and engage community stakeholders. Define and support capacity-building in fisheries management institutions to strengthen capabilities related to both fisheries ecology and management. Support community/stakeholder-awareness programmes that highlight: interaction between hydropower facilities and fisheries resources; life cycle needs/habitat and protection requirements of fish species in the upper Indus River basin; good practices and opportunities for capture-fisheries in the basin area. Support broad-area inventory and analysis of ecological components and fishing activities based on a long-term perspective and, within the basin-wide framework, identification of high priority needs to enable assessment of planned hydropower development over the next 10 years and projects under consideration beyond 10 years.

7.6.3 Bird Collision and Electrocution

There are already two existing transmission lines (132 KV and 220 KV) along Indus valley on the downstream of Pattan. There will be two transmission lines of 500 KV for Dasu along Indus up to Pattar Garh, near Hasan Abadal. These transmission lines have potential for collision and electrocution of migratory birds. Design of transmission line should maintain 1.5 meter spacing between energized parts and hardware components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware and installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.

7.6.4 Cumulative Impacts on Rock Art Galleries of Northern Pakistan

The rock carvings at Shatial are part of the much larger rock art galleries in Northern Pakistan within a stretch of 100 km between Shatial and Raikot Bridge. There are about 30,000 rock drawings and more than 5,000 inscriptions represent a time span lasting from the late Stone Age (after 8^{th} millennium BC) to the Islamisation of the mountain region that took place in the 16^{th} century. The remarkable diversity of these engravings, also known as the “guest book of the Silk Route”, mirrors the history, the Cultural and social traditions and the religious ideas of local as well as immigrated ethnic groups. Most of these carvings will be submerged under Diamer Basha Project. A museum will be established at Chilas, by Diamer Basha Dam Project, to relocate the Rock carvings (if feasible) that will be submerged by Basha project. 3D replica models for all submerged carvings will also be placed in the museum. The development and security of the Shatial site is more important under DHP as it will be the only site portraying the original and authentic specimens of rock art.

8. ENVIRONMENTAL MANAGEMENT PLANS

8.1 ENVIRONMENTAL MANAGEMENT PLANS

The EMP is prepared as a series of sub-plans which as a whole have direct environmental management procedures and the implementation of prescribed mitigation measures during the construction and operational phases of the Project. All plans include list of potential impacts, mitigation measures, responsible agencies for implementation and monitoring, frequency and mode of monitoring, auditing, actions for potential concerns and reporting mechanism.

8.1.1 Construction Management Plan

This plan sets out criteria for shortlisting of contractors and requirements of contractors' staff. The plan also includes 18 numbers of Environmental Code of Practices to be followed by the contractors to mitigate all construction related impacts. The Contractor needs to prepare a 'Construction Environmental Action Plan' (CEAP) demonstrating the manner in which the Contractor will comply with the requirements of ECPs and the management plans proposed in EMAP. Training programs are recommended for the construction workers.

8.1.2 Operational Management Plan

The plan recommends a set of action plans to implement and monitor during O&M stage on Sediment movement and reservoir accumulation monitoring; environmental releases monitoring; seismic activity monitoring; landslide monitoring; fish monitoring; migratory bird monitoring; and surface water quality monitoring.

8.1.3 Physiography and Geology Plan

Objective of the plan is to reduce the potential for impacts resulting from topographical changes (soil erosion, landslides) and soil contamination during construction. The plan include stabilization of landslide prone areas which may be impacted by construction activities or reservoir formation, and monitor stability of landslide prone areas at 18 identified locations during construction and operational phases; and monitoring program of sediment movements in the reservoir.

8.1.4 Hydrology and Surface Water Management Plan

Objective of the plan is to reduce potential impacts of construction on the water quality of Indus and its tributaries and to reduce potential impacts on hydrology from the operation of the project with no net increase of the downstream flooding potential resulting from the Project. Design of waste water collection mechanism and settling basins are recommended for the construction yards and tunnel construction areas. A laboratory at Dasu with all necessary facilities at the site is recommended for chemical analysis of water for key parameters of NEQS 2000 and 2010; along with potable conductivity, pH and turbidity meters.

8.1.5 Air Quality Management Plan

Objective of the plan is to maintain ambient air quality at properties adjacent to worksites, quarry sites, stockpile locations and along KKH throughout the construction phase. Design of scrubbers and dust control measures are recommended in the crushing plants and stockpile areas. A laboratory at Dasu will be established with all necessary equipment to measure the air quality for all parameters of NEQS 2000.

8.1.6 GHG Emission Reductions and Climate Change Monitoring Plan

Objective of the plan is to minimize the release of GHG's from the Project during the construction and operation phases; and to establish a monitoring mechanism to understand climate change impacts. The plan recommends a flood telemetry network

in the catchment area for early warning system and management of extreme events such as floods. The telemetry network also records rainfall and temperature data to monitor and understand the climate change patterns for adaptive management. A hydro meteorological station is also recommended at Dam site to monitor meteorological parameters at the dam site.

8.1.7 Noise and Vibration Management Plan

Objective of the plan is to maintain a reasonable acoustic environment for living, in particular for sleeping, and use of properties adjacent to the area of construction influence during construction works, and protect the residential and other structures from the effects of construction vibration. The plan recommends test blasting exercise with various charges and monitor resultant noise and vibration levels at various distances and to define the sensitive areas that will be affected during the future blasting activities. Mufflers and acoustic enclosures are recommended in high noise generating equipment, and personal protection equipment such as ear plugs and vibration absorbent gloves are recommended in high noise and vibration work environment.

8.1.8 Waste Management Plan

Objective of the plan is to reduce the amount of waste generated by the Project through implementing the waste management hierarchy (avoidance, reuse, recycling, and waste disposal). The plan recommends setting up of appropriate hazardous, industrial and domestic waste disposal facilities. And a disposal mechanism for the excess spoil disposal in the designated area. Disposal site shall be fenced towards the river side to arrest washing into the river and local government and other small contractors working under the project will be provided free access to these materials for construction purposes.

8.1.9 Hazardous Substances Management Plan

Objective of the plan is to manage and mitigate any potential impacts of hazardous substances on soils, waterways and other components of the environment. The plan recommends developing controls and standard operating procedures for the use of fuels to prevent spills and establish firefighting system and fire safety (fire extinguishers) at the construction sites where fire is a hazard.

8.1.10 Terrestrial Ecology (Flora and Fauna) Management Plan

Objective of the plan is to minimise impacts on the wildlife, habitat and ecological values of the River Indus and its surroundings. The plan recommends a plantation development plan in the buffer areas of the reservoir on the right bank, in DHPs office and colony, and at the resettlement with a target to develop about 100,000 trees. A nursery will be established with the native species District forest and agricultural departments will be provided support to establish these nurseries and maintain each plant for a period of minimum 3 years with support of the local community.

8.1.11 Aquatic Ecology Management Plan

Objective of the plan is to minimize Impacts to the aquatic habitat and ecological values of the River Indus and its tributaries. The plan recommends further field studies to obtain movement patterns and seasonal habitat use of snow carp and catfish in Indus and its tributaries, to assess the need for fish passage and environmental flows. The plan also recommends further studies to assess the potential for reservoir fisheries development with native snow carps by developing a small R&D hatchery.

8.1.12 Traffic Management Plan

The objective of the plan is to minimize traffic jams and safety hazards on KKH and along access roads to the construction sites. The plan recommends a traffic unit at Dasu to control the construction related traffic inflow and outflow with sub offices

along KKH at Hassanabdal, Haripur, Abbottabad, Chatter plain, Thakot, Besham, Pattan, Komela, dam site, and quarry sites at Kaigah and Gini. These offices will be connected with telephone, fax, mobile phone and internet. The movement of construction traffic will be maintained by these traffic units. These units will be supported with emergency rescue equipment.

8.1.13 Physical Cultural Resources Management Plan

The objective of the plan is to protect the designated archeological site near Shatihal by supporting the KP archeological department to (i) procure 25 acres of land, in which rock carvings are located, from the private owners (ii) fence the area, (iii) provide fiberglass sheds; (iv) develop tourist facilities and (v) documenting the importance of rock carvings and their translations. The plan also recommends improvement measures for Seo mosque, the most revered mosque in the project area by providing toilet facilities and firefighting equipment.

8.1.14 Occupational Health and Safety Plan

Objective of the plan is to promote health and safety of construction workers in accordance with best international standards and to comply with national employment and labour laws. PMU, contractors and supervision consultants will have OHS specialists in their teams to manage OHS related issues during project implementation. Each contractor will establish a comprehensive OHS Plan aimed at preventing accidents, injuries and work-related diseases. This plan will be submitted to PMU and supervision consultant for review and approval before construction. Each contractor will also prepare an Emergency Response Plan defining procedures to be followed during any emergency. This plan will be submitted to PMU and supervision consultant for review and approval.

8.2 SOCIAL AND RESETTLEMENT MANAGEMENT PLANS

8.2.1 Resettlement Action Plan

Resettlement Action Plan (RAP) provides (i) entitlements for loss of physical property including houses, land and trees; and (ii) entitlements for loss of income. The compensation will include:

- assistance in cash amounting to the negotiated value which is the assessed and agreed value of land at the time of dispossession and would include cost of titling;
- replacement value of structures together with a moving allowance;
- market value of trees, crops and perennials;
- cash grants and resettlement assistance such as shifting and reconstruction allowance, compensation for loss of workdays/income due to dislocation
- additional cash assistance for relocation and house reconstruction for socio-economically vulnerable households such as female-headed households, households below poverty line, households headed by differently-abled and those losing more than 10% of their total income as a result of the Project.

8.2.2 Resettlement Villages

The affected communities are used to seasonal migration up and down along the valley slopes and such migration is tied to their livelihoods and cultures. The affected communities expressed their preferences to relocate to higher elevations within the same valley with all assistance from WAPDA, including site development with basic civic amenities. The project will develop resettlement sites with basic infrastructure such as roads, water supply, irrigation, drains, schools, basic health units, mosques, etc.

8.2.3 Income and Livelihood Restoration Program (ILRP)

Programs for income restoration are recommended to restore the income of affected communities to pre-project level or better. A two-phase approach has been adopted for the Project: short-term program (during construction of the dam and relocation phase) and long-term programs (during O&M starting at 2020 - onward). Short term programs will include (i) assistance to support lost income, (ii) assistance to re-establish business/enterprises, (iii) special assistance to vulnerable groups, (iv) employment in construction work, and (v) engagement in plantation development in the buffer areas of the reservoir. Long terms programs will be designed and implemented by DHP, and will include capacity development of PAPs and regional development programs with focus on resettlement areas. The RAP has provision for Social Development Fund in the budget for long-term livelihood development program.

8.2.4 Gender Action Plan

In order to sensitize the women for implementing gender based development plans, the Gender Action Plan has developed a cautious approach considering the sensitivity and constraints of approaching women directly. The recommended path is to raise awareness among men about the project benefits to the population in general and women and children in particular. Second, there is a need to raise awareness about women rights and gender sensitization among the religious leaders, tribal chiefs, and local influential and other relevant stakeholders such as project staff and local government officials. Third, to improve the situation of women, the project will work with men – the "gate-keeper" – and approach women through men as the primary channel due to absence of direct contact and participation. Another entry point to involve women is children and promotion of health and hygiene in the home. The Gender Action Plan also includes the mechanisms to raise the educational, health standards of women and children, and their process access to project benefits.

8.2.5 Public Health Action Plan

The Public Health Action Plan (PHAP) includes (i) preventive, promotive and curative health services; (ii) health messages with clear priorities (for instance, waste management, standing water, safe environment –particularly for women and children, domestic violence); (iii) focus on construction related health conditions and diseases like biological contaminants of drinking water, dust, combustion gases, emission to soil and water, noise and pollution; (iv) on-going HIV/AIDS and STI education campaign; and (v) secured housing for workers to stay with their families to reduce the likelihood of risky behaviour. WAPDA will establish a forum of dialogue and collaboration with the implementing partners providing health services, District Health Office, police/law enforcement, civil society members, representative of the target communities (village, tribes etc.) and construction management. The monitoring of the PHAP implementation forms an integrated part in this process.

8.2.6 Management Plan for In-Migrants and Construction Workers

The plan recommends various strategies to engage the local stakeholders in the processes and prepare Dasu for dealing with in-migrants socially and culturally, including access to housing and employment in the Project. The essence of the migration management plan is to recognize the in-migrants and construction workers as stakeholders in the Project construction. Key strategies include: (i) Awareness building about in-migration to meet the short-fall in the local labor market; (ii) In-migrants relocation and housing and access to housing in the local area; Improvements in the local social infrastructure – for example, road rehabilitation and access; provision for supply of piped water for drinking, (iii) Employment and business opportunities for all; and (iv) the Project will make all arrangements for labor and workforce security by the contractors at camp sites. Finally, the Project will undertake and work with local communities and administration to enhance inter-cultural

understanding between locals and in-migrant groups for mutual benefits and the need to share project benefits by all stakeholders.

8.2.7 Communication Plan

The communication plan will be used in the consultation and information dissemination processes in the implementation of all safeguard plans. The specific strategies include (i) Internal communication to increase knowledge, build support for the implementation of the Project, (ii) Provision of timely information on the project, its impacts, its timing, its progress, together with a mechanism to express their concerns and grievances; (iii) Public participation mechanisms to provide platform to engage with institutions opinion leaders, implementation partners, and the general public, (iv) A phased multi- media communication programme to increase knowledge on the project and to increase public support for DHP and such projects in future, (iv) Media advocacy to promote accurate and analytical coverage of the project; and (v) Communications capacity strengthening of DHP team and/or partners to implement the Communication Strategy.

8.2.8 Grievance Redress Plan

The Project will establish a four-tier grievance redress committee (GRC) system, including Project-level independent GRC, for resolution of grievances and disputes related to social and environmental resettlement safeguard plans. The GRCs are to ensure accessibility, fairness and independence of the procedures. The GRCs will be built on a “bottom up” system that would include: (i) Village-level GRC, (ii) UC Level GRC; (iii) District-level GRC, and (iv) Project-level GRC. First, GRC at the village level consisting of local representatives of the affected people and maliks or village elders, project staff, and local government representatives and will receive cases and resolve locally within a defined timeline. Cases which are not satisfactorily resolved or affected persons have still grievances will be forwarded to the next tier with full documentation and history of the case(s). Unresolved cases will move to the upper tier up to the Project-level GRC. Since GRC is a project-specific “extra-legal” system, the aggrieved party, after completing the processes, can eventually take resort to the court for resolution, if needed.

8.3 INSTITUTIONAL ASPECTS AND IMPLEMENTATION

8.3.1 Institutional Framework for Implementation of EMP

Institutions responsible for executing and monitoring the environmental aspects of this Project are:

- DHP and its Project Management Unit (PMU) will be responsible for overall implementation of the Project and hiring of contractors and consultants
- A ‘Safeguard Unit’ will be established in PMU, which will be responsible for all required administrative and financial decisions and actions for effective and timely implementation of the safeguards. The Safeguard Unit will consists of an Environmental Unit and a ‘Social and Resettlement Unit’
- The Environmental Unit in DHP (EU-DHP) will be responsible to undertake responsibility for routine and random monitoring of implementation of EMP.
- As several contractors will be working simultaneously for timely and speedy implementation of the project, it is important that Construction Supervision Consultant (CSC) has an environmental unit to effectively supervise and monitor the environmental activities being implemented in the field. Environmental Unit in CSC (EU-CSC) is responsible for supervision of implementation of EMP.
- Contractors will be responsible for implementation of EMP during construction and first year of operation of the project. They also have dedicated staff for EMP implementation.

- In some cases consultants and specialist organizations will be hired to implement specific plans in EMP such as conservation areas development, fish monitoring, etc.
- Internal auditing on implementation of EMP will be taken up EU-DHP and WAPDA's Environmental Cell (WEC)
- External auditing will be taken up by an independent agency

Organization chart of PMU of DHP and institutional framework for implementation of social and environmental safeguards is shown in Figure 8.1. An extract of the organization which demonstrates the organizational structure and how it relates to the implementation of the EMP is shown in Figure 8.2 .

Roles and responsibilities relating to environmental management for the key positions in the Project team are given below.

8.3.1.1 Project Director of DHP (PD)

The PD/GM-CEO of DHP is the executive head of the entire Dasu Hydropower Project operations. He is responsible for necessary policy, administrative and financial decisions and actions for effective and timely implementation of the project as per the approved framework and implementation schedules. The Deputy Project Director-Safeguards will assist the PD in the execution of EMAP.

8.3.1.2 Environmental Unit of DHP (EU-DHP)

A 'Safeguard Unit' will be established in PMU, which will be headed by a Deputy Project Director. The safeguard unit will consist of two units – one 'Environmental Unit' and one 'Social and Resettlement Unit'.

Environmental Unit in DHP will consist of three sub-units (Environment, Ecology, Occupational Health and Safety) with the following Staff

- Director - Environment
- Deputy Director - Environment
- Assistant Director - Environment (with two site engineers)
- Assistant Director - Ecology (with two support specialists - Fish expert 1, plantation expert 1)
- Assistant Director - Occupational Health and Safety (with one support specialist).

8.3.1.3 Environmental Unit of CSC (EU-CSC)

CSC will consist of an Environmental Unit headed by Team Leader (international environmental specialist). The unit will consists Environmental Specialists (1 international and 2 national specialists), Ecologist (1 international and 1 national), Occupational Health and Safety Specialist (1 international and 1 national), and Environmental Surveyors (4 national). The EU-CSU shall be responsible for the supervision of implementation of the EMP. It will liaise heavily with the construction team to ensure all environmental commitments are incorporated into the construction activities and work processes.

8.3.1.4 Contractor

Each contractor will be recommended to have suitably qualified and experienced persons acceptably fluent in the English language, to function as Environmental Specialist and Occupational Health and Safety Specialist, who will be working in close liaison with the environmental staff of DHP and CSC. The contractor's environmental team will also include a community relations representative and environmental technicians (both for lab and field investigations).

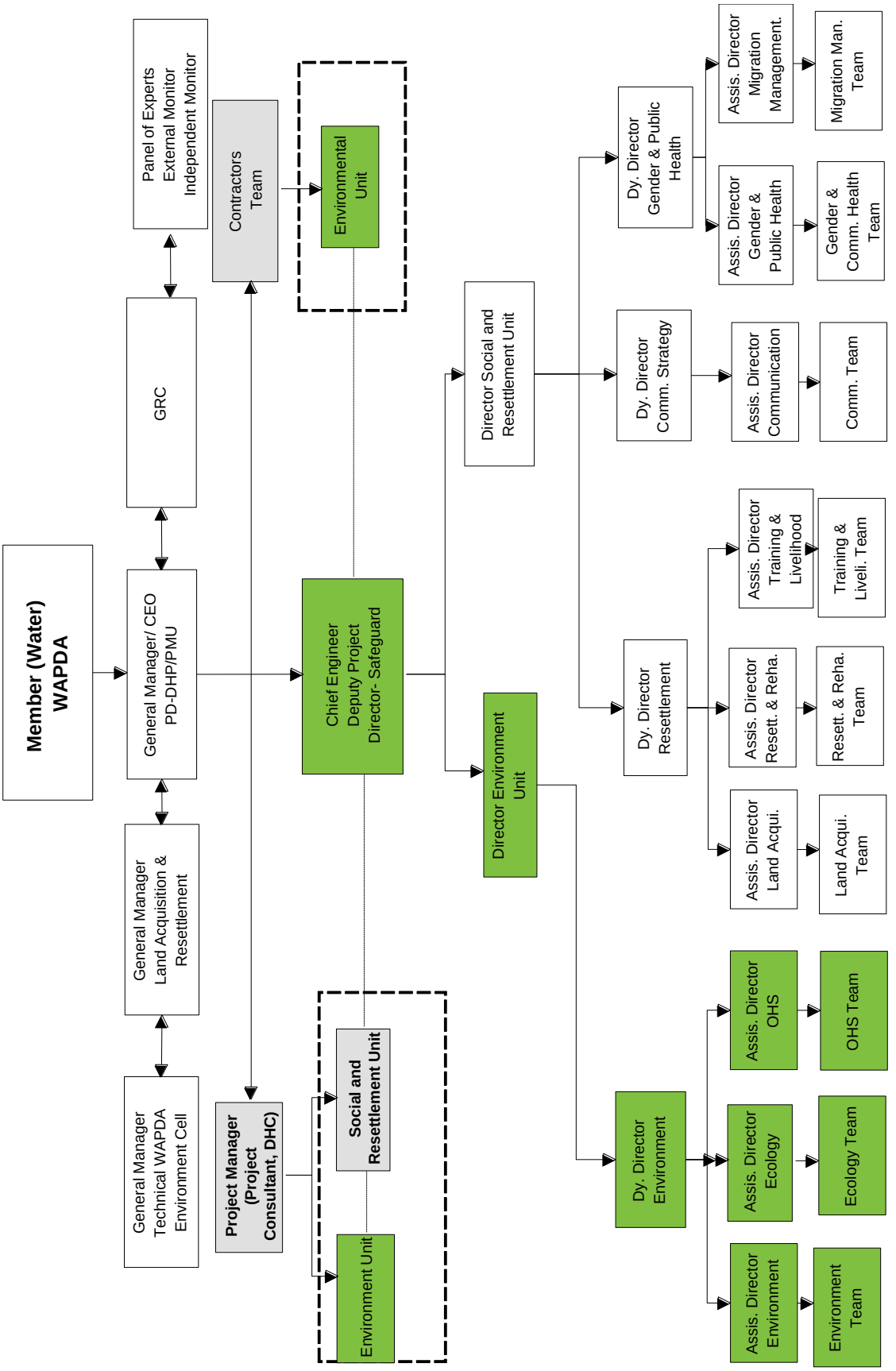
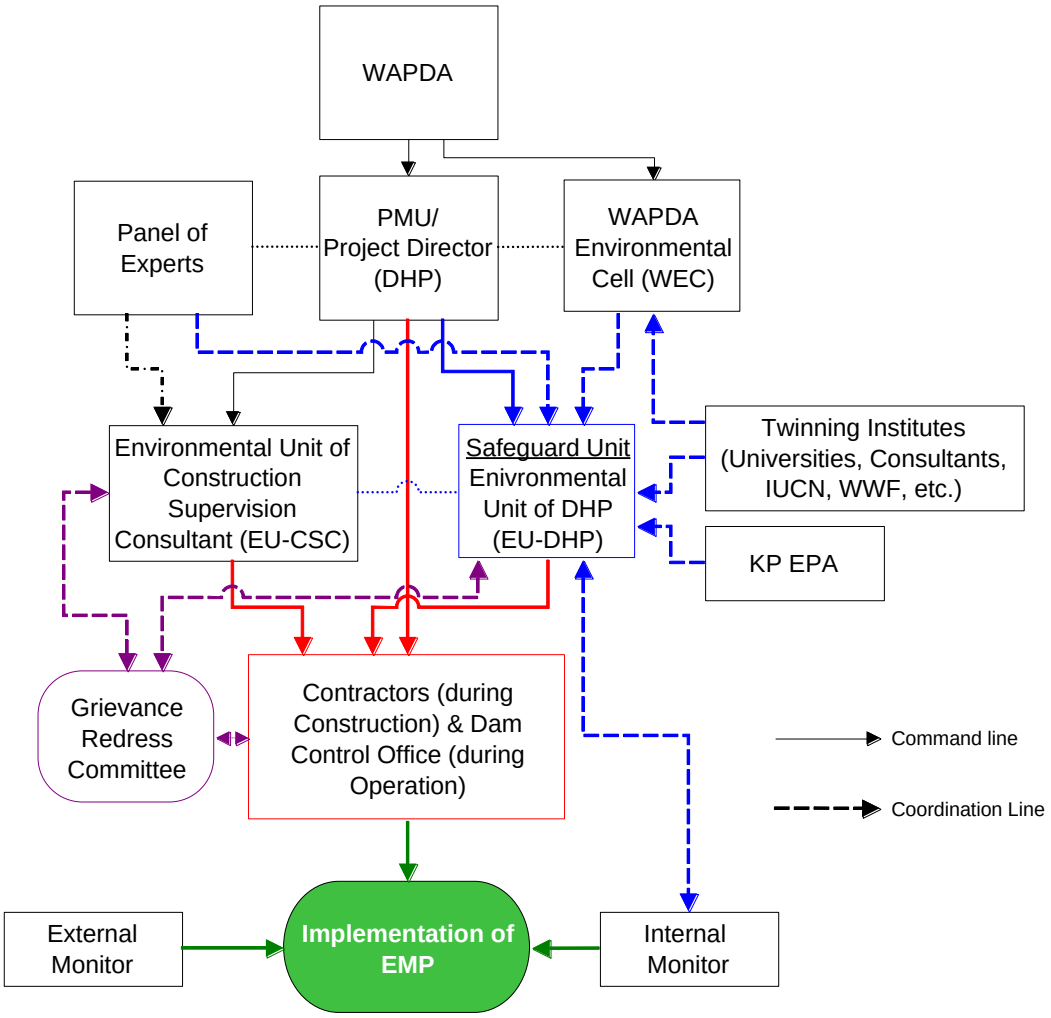


Figure 8.1: DHP Organization Chart



Note: Each box in the above figure represents an organization contributing to the 'Implementation of EMP'.

Figure 8.2: Organizational Framework for Implementation of EMP

8.3.1.5 Dam Control Office

Dam Control Office of DHP will be responsible for implementation of EMP during O&M stage, such as release of environmental flows during winter, sediment flushing, flood management, etc.

8.3.1.6 WAPDA Environmental Cell (WEC)

WAPDA Environmental Cell (WEC) is responsible for overseeing environmental issues associated with WAPDA's hydropower projects in the country. The unit is headed by a Director General with specialists in environment, ecology, geology, soil, economy, social and gender specialists. The WEC will also conduct periodic monitoring of EMP implementation activities and advise the EU-DHP on any action necessary to comply with the implementation requirements.

8.3.1.7 External Environmental Auditors

External Auditors or External Monitoring Agency will be engaged to conduct the external and independent monitoring of the implementation of the EMP. This external monitoring agency is to carry conduct six-monthly, annual and final evaluation of the EMP implementation and recommend changes if and when necessary to the EU-DHP.

8.3.1.8 Panel of Experts

WAPDA will engage an independent panel of environment and social experts to advise DHP Safeguard Unit and other project entities on all environmental and social matters including effective implementation of EMAP and SRMP, particularly on unanticipated situations, impacts, and their mitigation. The Panel will review on a regular basis the various reports and documents produced by Safeguard Unit, Supervision Consultants and contractors; periodically visit the site to have firsthand information on the environmental and social impacts and EMP/SRMP implementation; and provide report to WAPDA on the overall environmental and social performance of the project.

8.3.2 Monitoring Plan

Monitoring of environmental components and mitigation measures during construction and operation stages is a key component of the EMP to safeguard the protection of environment. The objectives of the monitoring are to (i) ensure that the mitigation measures included in the EMP are effectively and regularly implemented (compliance monitoring); and (ii) monitor changes in the environment during various stages of the project life cycle with respect to baseline conditions (effects monitoring).

Internal and external environmental audits will be undertaken throughout the construction process to ensure that the Project environmental requirements and the EMP are implemented appropriately.

The auditing process should be designed to identify any non-conformances, providing an opportunity to apply corrective and / or preventative action where appropriate. The auditing schedule will be

- Internal auditing every three months on implementation of the EMP
- Internal auditing every six months on review of EMP
- External (third party) auditing on the project environmental performance every six months.
- Internal auditing will be carried out by the EU-DHP quarterly.

External auditing (or third party monitoring) will be conducted by the external monitoring and evaluation consultants for auditing of existing practices against the requirements of EMP. The following aspects will be covered under the external audit:

- the EMP is being adequately implemented,
- mitigation measures are being implemented and their effectiveness,
- the compliance and effects monitoring are being conducted,
- environmental and social trainings are being conducted, and
- complete documentation is being maintained.

These audits would be used to re-examine the continued appropriateness of the EMP and to provide advice on any up-dates required. Attention would be given to lessons learnt in the light of experience. In particular, consideration would be given to the monitoring programs in place to determine whether their purpose has been served and they can therefore be terminated or reduced in frequency.

WAPDA Management would review the results of internal and external audits and provide commitment and resources to tackling outstanding issues. WAPDA Management would support the proposed EMU in mechanisms to manage financial payments to contractors based on performance against the items identified in the EMP.

8.3.3 Reporting and Feedback Mechanism

The following reports to be prepared by various parties during implementation of EMP:

- Daily reports by the Contractor to the EU-CSC
- Weekly reports by EU-CSC to the EU-DHP and EU-DHP

- Monthly reports by EU-DHP for internal circulation
- Monthly reports by Contractor to the EU-CSC and EU-DHP
- Quarterly reports by EU-DHP to the World Bank and KP-EPA
- Six reports by External Auditors

Daily reports by the contractor shall include compliance issues related to the daily construction activities. Before starting of construction works, the contractor will prepare a checklist and pro-forma for preparing daily reports which will be approved by EU-DHP.

EU-CSC will prepare weekly reports on the status of EMP implementation and environmental performance of the contractor. These reports shall be based on the contractor's reports and their supervision. EU-CSC shall assess how accurate is the factual information provided in the contractor's reports, fill any gaps identified in them, and evaluate adequacy of mitigation measures applied by contractor. CSC must highlight any cases of non-compliance with EMPs, inform on any acute issues brought up by contractor or revealed by supervisor himself, and propose corrective actions.

EU-DHP will prepare brief monthly reports for internal circulation with information on the main types of activities carried out within the reporting period,

EU-DHP shall report quarterly to the World Bank and KP-EPA on the status of environmental compliance of construction works. The quarterly reports will include environmental mitigation measures and monitoring activities undertaken, details of monitoring data collected, analysis of monitoring results, recommended mitigation measures, environmental training conducted, and environmental regulatory violations. EU-DHP shall inform the World Bank on any major environmental issues at any time, independently from the schedule of regular reporting.

8.3.4 Inclusion of EMP in Contract Documents

In order to make contractors fully aware and responsible of the implications of the EMP and to ensure its compliance, it will be ensured that environmental measures are treated appropriately and separately in the tender documentation and that payment milestones are linked to environmental performance, measured by execution of the prescribed environmental mitigation measures. Such a procedure would help ensure adequate assessments of project impacts are carried out during Project construction and operation phases, where a consistent approach will be expected on behalf of contractors that warrant data and information collected from monitoring programs are compared to baseline conditions.

The contractor would be made accountable through contract documents and/or other agreements of the obligations and importance of the environmental and social components of the Project. They would be prepared to co-operate with the executing agency, project management unit, supervising consultants and local population for the mitigation of adverse impacts. After the EMP's addition in the contract documents, the contractor will become bound to implement the EMP and to hire trained environmental management staff for implementation and effectiveness of the mitigation measures.

The contractor is to bid for executing the EMP, including the hiring of recommended staff, recommended mitigation measures and monitoring programs, as part of their Bill of Quantities.

8.3.4.1 Contractors Environmental Action Plan (CEAP)

The Contractors shall be required to prepare a 'Construction Environmental Action Plan' (CEAP) demonstrating the manner in which they will comply with the requirements of EMP Sub-Plans, ECPs and the World Bank Group EHS guidelines. before mobilization and obtain approval from the EU-DHP and EU-CSU. The Plans will include a series of management plans:

- Site specific sediment and erosion control plan for each construction site and quarry;
- Site specific camps management plan for each camp;
- Spoil management and disposal plan for each site;
- Waste management plan for each construction site and quarry;
- Site specific pollution control (water, air, noise) plan for each construction site and quarry;
- Site specific traffic management plan for each construction site and quarry;
- Site specific decommissioning and landscaping plans for quarry sites, spoil disposal sites, temporary roads and other disturbed areas;
- Occupational health and safety plan and training programs;
- Emergency Response Plan and Early Warning System ;
- HIV-AIDS Preventive Management Plan and training programs;
- Complaints logging system and response plan;
- Standard Operating Procedures for blasting operations;
- Standard Operating Procedures for pollution spills, and management of fuels and hazardous goods; and
- Demobilization plan after completion of works

8.3.4.2 Contractor's Management Plans as BOQs

Preparation and implementation of above mentioned management plans in CEAP will be included as a line item in BOQ with a lump sum provision. Thus the contractor has a contractual obligation to prepare and implement CEAP. The contractor shall submit a draft CEAP six months before commencement of the work for approval of PMU and CSC and final version two months before the commencement.

The CEAP will form the part of the contract documents and will be used as monitoring tool for compliance. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractors.

Payment to the contractor for all his works should be linked to the environmental performance and compliance with the EMP.

The Project Director should be entitled to stop the entire payment to the consultant if non-compliance issues are not addressed. For serious non-compliance issues such as pollution, erosion, reckless treatment of nature, hazardous working conditions, etc., the Deputy Project Director – Safeguards have authority to give stop-orders to the contractor and address .those issues immediately.

8.3.5 Budget Estimates

Cost estimates for implementation of various plans recommended in EMAP are estimated as 51 million USD (Table 8.1). The cost estimates include the budget for environmental monitoring, consultants for EMP implementation, institutional strengthening and capacity building and environmental enhancement/compensation measures.

Table 8.1: Summary of EMAP Budget

S.No	Description of the Plan	Budget in USD
A	**Contractors Bill of Quantities for Implementation of EMP**	
1.1	Contractors implementation of EMP	24,285,000
1.2	Environmental Staff of Contractors	
2	Water Quality Laboratory	540,000
3	Air, Noise, Vibration and Potable Water Quality Equipment	441,000
	Sub-Total A	*25,266,000*
B	**PMU Budget on Environmental Staff and Implementation of Mitigation and Monitoring Measures**	
1	Environmental Staff of EU-DHP	2,900,000
2	Environmental Staff of Construction Supervision Consultant	4,338,000
3	Panel of Experts – Social and Environment	425,000
4	External Monitoring Consultants	500,000
5	Internal Auditing	200,000
	Sub-Total B	*8,700,009*
C.	**Aquatic Ecology**	
1	Studies and monitoring of fish and habitat during pre – construction, construction and operation stages of the Project	968,000
2	Fish capture and stocking facilities	700,000
3	Installation of screens or fish deterrent devices to avoid injury to fish at various outlets.	400,000
4	Fish Hatchery and R&D facility	2,034,800
5	Fish habitat improvement of the tributaries	108,000
6	Capacity building of local Fisheries Departments	100,000
	Sub-Total C	*4,310,800*
D.	**Terrestrial Ecology**	
1	Tree Plantation	1,620,000
2	Enhancement of Community Game Reserve in Kaigah and studies for developing new community conservation areas	1,000,000
3	Afforestation programs for forest regeneration	3,000,000
	Sub-Total D	*5,620,000*
E.	**Physical Cultural Resources**	
1	Protection of Shatial Rock Carvings	1,539,435
2	Relocation of historical mosque at Seer Gayal	29,000
3	Protection of Graveyards that will be submerged in reservoir	6,240
4	Enhancement of Seo Mosque	25,880
5	Chance finds	48,000
	Sub-Total E	*1,648,555*
F.	**KKH Traffic Management**	389,200
G.	**Climate Change, GLOFs and Sedimentation in UIB**	
1	Early Flood Warning and Climate Monitoring	2,500,000
2	Glacier Monitoring Program	4,000,000
3	Integrated Watershed Development Studies	4,000,000
	Sub-Total G	*10,500,000*
H.	**Capacity Building**	600,000
I.	**Institutional Strengthening**	300,000
J	**Environmental Management of Resettlement Villages**	2,100,000
K	**Baseline Studies and Mitigations for Cumulative and**	10,000,000

S.No	Description of the Plan	Budget in USD
	Induced Impacts in Upper Indus Basin	
	Grand Total	**69,097,555**

9. PUBLIC CONSULTATIONS AND INFORMATION DISCLOSURE

9.1 COMMUNITY CONSULTATIONS

The process of public consultation and participation has been an integral part of project preparations since 2007. During the feasibility study a series of consultations were organized and these were stepped up during detailed design. During detailed design phase, village wise consultation meetings were conducted in 34 villages. 385 persons have attended these meetings. In addition to the consultation meetings, one on one consultation was held with 1,487 people during environmental and social surveys. These consultations were held as proposed in the Public Consultation and Participation Plan with formal and informal meetings, village level meetings and disclosures of project impacts to the affected households and communities. The views, needs and aspirations of the affected people as expressed during these consultations have been incorporated in the project design and the proposed mitigating measures with the objective to maximize benefits and minimize adverse social and environmental effects.

9.2 JIRGA MEETINGS

Three Jirga meetings were conducted during detailed design to inform the community leaders about the project, its details and potential impacts, and seek their participation in social and environmental assessment. The following charter of demands is submitted by Jirga. These charters of demands are the basis for discussion in all further Jirga meetings.

- Local roads in the affected villages should be constructed along with the general roads on both sides of the Indus River up till Basha Dam.
- For affectees of Dasu Hydropower project, the local area should be declared as tax free zone from where, precious stones, wood and wood byproducts etc. may have the liberty to market in rest of all areas of the country and for such business; interest free loans may also be provided.
- For affectees, technical vocational training institutes, schools, colleges and some similar centers should also be established.
- For Dasu Dam, all jobs should be for the affectees as being their right and; this may be accepted. For so, Dasu, Kandia and Pattan Tehsils should be prioritized at 1st, 2nd and 3rd and; any deputation/hiring or employment from outside these areas should be banned whereas; deployment of vehicles and machinery etc. may also be prioritized, likewise.
- In all colleges and the universities of country, a special quota of Kohistan should be for professional education. And by giving priority to the children of affectees, an allowance should be fixed by WAPDA
- Keeping in view the backwardness of District Kohistan, special quota for jobs should be fixed in both provincial and federal government departments including the Public Service Commissions and; an age relaxation may also be given.
- For the assets of the affected community which include houses, cultivated and barren lands, both fruiting and non-fruiting trees; special package should be announced according to the expectation of the affected community
- For affectees, government should develop plots according to the pattern and standards of a developed society in which, all facilities like schools, colleges, hospitals, electricity and water should be available and; their costs should not be on the part of affectees

- 20% royalty as being the right of affectees should be accepted and; electricity without any charges free of load shedding in all Kohistan should be provided
- In District Kohistan, hospitals should be built at tehsil levels and for the promotion of education, modern colleges and a university should be established
- In Tehsil Dasu, the establishment of a cadet college should immediately be announced in which, the children of affectees may get a special quota
- For employment outside the country, a special quota for District Kohistan should be fixed in which, priority should be given to the affectees
- After construction of Dasu dam, the right of fishing should be accepted for local people.
- By accepting the devotion, special honorary certificate should be awarded to the affectees

9.3 CONSULTATION WORKSHOPS

Considering the significance of DHP in the national context and its potential impacts on Indus basin, provincial level stakeholder consultation workshops were conducted in Peshawar, Karachi and Lahore in September 2012. These workshops were attended by the respective provincial EPAs, wildlife, fisheries, forest, archeology, and public health departments, universities, NGOs and civil societies. A national level workshop was held in Islamabad on October 2, 2012, which was participated by the provincial EPAs from Baluchistan and KP; development agencies such as ADB, JICA and World Bank; national government departments such as Planning Commission, Ministry of Climate Change, Federal Flood Commission, National Highway Authority, NGOs and universities. These consultation workshops were very successful and well accepted by all stakeholders and recognized as the first of its kind in Pakistan. Main concerns raised in these consultations are earth quakes, sedimentation, climate change, GLOFs and aquatic ecosystem.

9.4 DISCLOSURE

EMAP and SRMP documents will be disclosed in WAPDA's and World Bank's website. DHP will establish two Project Information Centres in Dasu and Komela for disclosure of these documents and project information to the affectees. Executive summary of Independent Consultant's EIA will be translated into Urdu and will be made available to the affected people by WAPDA. An information booklet will be designed for distribution among the affected persons as the primary tool for disclosure.

10. CONCLUSIONS

An environmental assessment of DHP has been carried out to describe the existing physical, biological and social environment; identify and evaluate potential environmental risks and impacts of the Project; examine project alternatives; identify measures required to prevent, minimize, mitigate or compensate for adverse impacts for inclusion into the environmental management plan; and conduct consultations with all relevant stakeholders. The assessment went a step beyond the general EIA process by conducting four national level workshops (at Peshawar, Lahore, Islamabad and Karachi), and incorporating an integrated approach to assess the cumulative and induced impacts due to developments in hydropower sector in UIB relation to DHP over next 10 years. Thus, the scope of the project impact assessments was comprehensive to cover all potential social and environmental aspects to comply with safeguard planning requirements of the World Bank and Government of Pakistan

A set of eight volumes has been prepared as a part of EA documentation in the form of Environmental Management Action Plan (EMAP). EMAP provides comprehensive coverage to the different environmental issues and project impacts, including mitigations and environmental management plan. Similarly a set of 15 volumes has been prepared to address the social and resettlement issues of the Project under Social and Resettlement Management Plan (SRMP).

Environmental issues are given due consideration throughout the Project planning and, wherever possible, environmental concerns are mainstreamed in the Project designs. These include:

- Environmental considerations were a significant factor in selection of the damsite. The chosen dam location reduced about 50% of resettlement; 7% of excavation and 1.8% of concrete volume compared to other alternatives.
- Quarry area to produce 14 million tons of aggregates is selected from reservoir submergence areas thus avoiding additional land acquisition and environmental impacts. Manufactured sand will be used (5 million tons) instead of river sand deposits recommended in the feasibility study to avoid impacts on aquatic ecology. Spoils from underground excavations (partly from surface excavations) will be used as aggregates.
- Transport of concrete, material and spoils (7 km for excavated rock and 13 km for aggregates) through belt conveyor system, thus avoiding about 1100 vehicles per day and related air pollution.
- Run of river operation of the project by always maintaining 950m of reservoir water level, thus always maintaining outflow at a rate equal to inflow to avoid any impacts due to reduced downstream water flows. Environmental flow (will be established by further studies and tentatively recommended 20 m^3/sec) will be released in low flow season to maintain the aquatic habitat between dam and tailrace.
- Impounding of reservoir will be done in high flow season to avoid reduction in flows in downstream. Similarly flushing will also be done in high flow season to reduce the impact of sediment load in downstream (97% of sediment load in Indus occurs in high flow season).
- Reduction of turbine size to suit the transportation capacity of KKH. The smaller unit capacity could also contribute to the energy production at low flow season, and could accommodate reduced river flows due to climate change. Further, the smaller units can be used to release continuous minimum flows if the DHP chose to operate as `storage or peaking` plant in Stage 2.
- Design of single span bridges on tributaries to avoid construction piers in rivers and disturb natural stream flows and aquatic habitat.

- Resettlement site selection and design in consultation with the affected community.
- Enhancement of environmental features in the Project area, though they were not impacted by the Project activities. For example, procurement and protection of historical rock carving site (1st to 7th Century AD) at Shatial (52 km upstream of DHP damsite and located adjacent to the reservoir), which is currently located in a private property and being subjected natural erosion and vandalism.
- Design of benefit sharing mechanism, with both monetary and non-monetary benefits, to share the project revenues with the affected communities and natural environment.
- Environmental criteria will be followed for shortlisting of contractors for major works under this Project. The environmental criteria include contractors compliance with ISO 14001, 2004 Environmental Management System (EMS), OHSAH 18000 (2007) related Occupational Health and Safety (OHS) and SA 8000 (Social Accountability); and experience in working with World Bank or other donor projects. Contractor team will include Environmental Specialist and Occupational Health and Safety (OHS) Specialist.
- Contractors bidding documents will include implementation of environmental management plans as paid items in the bills of quantity.
- Design of project implementation structure with strong emphasis on social and environmental staff. DHP will consist of a safeguard unit headed by a Deputy Project Director with social and environmental units. The environmental unit headed by Director with three sub units: environmental, ecology and OHS. Construction supervision consultant team also consists of an environmental unit with international and national specialists in environment, ecology and OHS.

The environmental impacts resulting from implementation of the DHP will be unusually limited in a number for a mega project of this size, due to the following environmental features and circumstances specific to the Project area, and engineering designs adopted for the Project to reduce the Project's environmental footprints:

- Limited inundation area under the reservoir (only 23.85 km^2 at full supply level) due to the dam's location in a narrow gorge and steep slope of the river bed. The power density of the Project (installed capacity per unit area) is 181 $W/m^{2,}$ which is the highest in the world among hydropower projects of such high capacity;
- The Project area is sparsely populated with a population density of 150 persons/km^2 (6,953 affected people from 4,643 ha of land acquisition). The affected people are mainly transhumant agro-pastoralists. They migrate vertically along the hill slopes with winters in lower valleys (from the river to 1500 masl) and summers in higher elevation (1,500 to 2,000 masl) with houses and agriculture lands on both lower and higher elevations. Thus the livelihood losses due to the Project are partial (only 5% of their total income will be lost) since acquisition is limited to elevation of 1,000 masl;
- Low biodiversity in the Project impact area (within 1,000 masl elevation) with 67 percent barren land rocks and limited vegetation. Significant biodiversity is located on the higher altitudes (forests above 2,000 masl and wildlife above 3,000masl), well away from project impact area. Forests are communally owned and hence illegal logging from outsiders is not possible;
- Limited fish diversity and quantity (3 indigenous snow carp species) in the Project impact area due to high sediment load, glacier melt and turbulent waters with very high discharge rates during summer; and low discharge rates during winter. Mahaseer, IUNC listed endangered fish species, habitat is located 70 to 80 km downstream of DHP dam site;

- Quarry sites for aggregates (14 million tons) required for construction of the Project are located within the future reservoir submergence area;
- Being run-of-river project, the operation of the dam will not affect the daily downstream flows and downstream ecosystem;
- The run-of-river and large volume of water inflow limit the residence time of inflowing water in the reservoir (1 to 6 days during high flow season, and about 19 days during low flow season). This reduced the impacts usually associated with large hydropower projects such as changes in water quality, GHG emissions and disruption of downstream flows.
- The Project has a power density of 181 W/m^2, which is 18 times higher than threshold limit of UNFCCC (10 W/m^2) for ignoring greenhouse gases emissions from a reservoir. The net emissions of DHP are estimated to be minus 233 million tons of CO_2 equivalent.

Potential impacts of the Project during various stages of implementation are assessed. Mitigation measures are recommended for all identified environmental issues. If all these mitigation measures are applied only a few environmental issues have low residual risks. These risks can be accommodated in the project of this size, however comprehensive and effective monitoring and control measures would need to be employed such that activities may be appropriately moderated as necessary.

The Project will have overall positive impacts and some negative impacts. Most of these negative impacts are mainly construction related and can be mitigated by the successful implementation of the EMP. There will be some residual impact for significant negative impacts, which will be compensated by environmental enhancement measures recommended in the EMP. Therefore, the completion of this environmental assessment fully meets the safeguard requirement of the World Bank and the Government of Pakistan.