PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

DASU HYDROPOWER PROJECT

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Volume 2: ENVIRONMENTAL IMPACT ASSESSMENT

ANNEXURES

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

June 2013

ANNEXES

List of Annexes

Annex – 1.1

NO OBJECTION CERTIFICATE (NOC) – ENVIRONMENTAL PROTECTION AGENCY – EPA

Environmental Protection Agency
Environment Department
Govt. of Khyber Pakhtunkhwa

Dy. No. 927 0-6
Date 24-11-2011

No. EPA/EIA/Dasu-Hydro-P/448
Date. 23-11-2011

CE (C) HP
DY. NO.....................
Date.........................

To

Haji M. Farooq Ahmad,
Project Director,
Dasu Hydropower Project, WAPDA,
D-Block, Sunny View, Lahore.

Subject: **SUBMISSION OF EIA REPORT OF DASU HYDROPOWER PROJECT FOR NOC**

I am directed to enclose herewith Legal Environmental Approval/ Decision Note on EIA report of "Dasu Hydro Power Project" at District Kohistan for your information and further implementation, please.

Pl. put-up to GM (H) P for information

Deputy Director (EIA)

DD(D)

24/11/2011

3rd Floor, SDU Building, Khyber Road, Peshawar Cantt
Telephone: 92 (91) 9210263, Fax: 92 (91) 9210280

SCHEDULE-VI

Decision on EIA

1.	**Name, address of proponent**:	*Haji Muhammad Farooq Ahmad* *Project Director Dasu HPP* WAPDA, D-Block, Sunny View Lahore Tel # 042-99202721-22 Fax # 042-99202722
2.	**Description of project.**	The Dasu Hydro Power is proposed to be located on river Indus about 07 km upstream of Dasu Town and 74 km downstream of Diamer Basha Dam. The project has installed capacity of 4320 MW and will generate 21334 GWh per annum. The project will require the resettlement of houses.
3.	**Location of project.**	The project is located in District Kohistan.
4.	**Date of filing of EIA.**	24/05/2011 (Ref: EPA Diary No.529)

5. After careful review, the Environmental Protection Agency, Govt. of Khyber Pakhtunkhwa has decided to accord approval of the Environmental Impact Assessment for Dasu Hydro Power Project (4320 MW) District Kohistan, for construction phase, in line with the guidelines issued by Pak. EPA and IEE/EIA Regulations, 2000, subject to the following terms & conditions:-

a) The proponent will adopt all precautionary and mitigation measures identified in EIA Report as well as any un-anticipated impacts during the construction and operation phase of project. The mitigation measures proposed in the EIA report are considered as "commitments" and institutional arrangement for its implementation shall be finalized before the start of construction so that proposed mechanism of environment protection should work in time.

b) Safety zone/adequate engineering measures should be provided to overcome fears of the residents regarding effect of pond to their houses.

c) Land and houses should be acquired through Revenue Department of Khyber Pakhtunkhwa as per land acquisition policy and the compensation should be made to the affectees as per government policy before starting the construction activities. Current land use such as barren or agriculture land should be taken into consideration.

d) All conflicting issues regarding compensation etc to be settled before executing or commencing of the project activities and a certificate in this regard should be submitted to this Agency.

e) Arrangements for compensation should be made through National Bank of Pakistan, District Govt. /Revenue Department.

f) Submergence of 40 km of Kara Kuram Highway should be reconstructed in another suitable place.

g) The exact number, type and ownership of trees be carried out and the same may be submitted to this Agency before the physical work started.

h) Afforestation programme should be planned and be submitted to this Agency.

i) Non-technical jobs should be provided to local community. Employment record for all positions shall be provided to EPA-Khyber Pakhtunkhwa and priority should also be given to locals in technical jobs.

j) Separate NOC/Legal Approval is required for batching/crushing plant and construction of Town/Colony under PEPA, 1997.

k) No extension would be permitted in the future in the existing hydropower project without prior approval of the EPA/Govt of Khyber Pakhtunkhwa.

l) The project management may consider the possibility of implementation of a social development programme in the area (health, education, communication etc) in consultation with local community.

m) The proponent shall provide the copy of this approval and EIA report to the contractor for information and compliance.

n) The proponent should ensure to avoid dumping of debris into down slope. A prior area should be identified for disposal of debris and be stabilized by proper plantation, bio engineering and engineering techniques. The same should be provided to this Agency.

o) In case, the blasting is inevitable, the controlled techniques, in accordance with Pakistan Explosive Act should be adopted in sliding and perspective sliding prone areas.

p) The proponent should ensure the strict and efficient health and safety measures for the protection of workers and passers-by backed by a comprehensive emergency response plan.

q) The proponent shall replace all public utilities, such as water supply pipes, power / phone lines and other infrastructures like masjids, schools, graveyards, hospitals etc to be lost by the execution of the project. If it is inevitable then alternative may be provided to the people of the area before construction with respective agencies under the intimation to Khyber Pakhtunkhwa-EPA.

6. The proponent shall be liable for correctness and validity of the information supplied by the environmental consultant.

7. The proponent shall be liable for compliance of Sections 13,14,17 and 18 of IEE/EIA Regulations, 2000, regarding approval, confirmation of compliance, entry, inspections and monitoring.

8. This approval is accorded only for the installation/ construction phase of the project. The proponent will obtain approval for operation of the hydro power project in accordance with the Section 13 (2) (b) and Section 18 of the IEE/EIA Regulations, 2000.

9. Any change in the approved project shall be communicated to EPA, Khyber Pakhtunkhwa and shall be commenced after obtaining the approval.
10. This approval shall be treated as null and void if all or any of the conditions mentioned above is/are not complied with.
11. This approval does not absolve the proponent of the duty to obtain any other approval or clearance that may be required under any law in force.
12. There is no legal case pending in the courts against the project.
13. In exercise of the power under Section 12 of the Pakistan Environmental Protection Act, 1997, the undersigned is pleased to approve the EIA Report for construction phase of the project with above mentioned terms and conditions.

Dated: Peshawar 23/11/2011
Tracking/File.No. EPA/EIA/Dasu-Hydro-P/ 448

DIRECTOR GENERAL
EPA, Khyber Pakhtunkhwa.
3rd Floor, SDU Building,
Khyber Road Peshawar Cantt.

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Annex – 2.1

NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS 2000, 2009 and 2010)

Table1: NEQS for Municipal and Liquid Industrial Effluents[1, 2]
(mg/l, unless otherwise defined)

No.	Parameter	Standards		
		Into Inland Waters	**Into Sewage Treatment[5]**	**Into Sea( )**
1.	Temperature increase[7]	=<3°C	=<3°C	=<3°C
2.	pH value	6 to 9	6 to 9	6 to 9
3.	Five-day bio-chemical oxygen demand $(BOD)_5$ at 20°C[1]	80	250	80[8]
4.	Chemical oxygen demand (COD)[1]	150	400	400
5.	Total suspended solids (TSS)	200	400	200
6.	Total dissolved solids (TDS)	3,500	3,500	3,500
7.	Grease and oil	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.3	0.3
9.	Chlorides (as Cl')	1,000	1,000	SC[9]
10.	Fluorides (as F')	10	10	10
11.	Cyanide total (as CN')	1.0	1.0	1.0
12.	Anionic detergents (as MBAS)[2]	20	20	20
13.	Sulfates (SO_4)	600	1,000	SC[9]
14.	Sulfides (s')	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40
16.	Pesticides[3]	0.15	0.15	0.15
17.	Cadmium[4]	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent)[4]	1.0	1.0	1.0
19.	Copper[4]	1.0	1.0	1.0
20.	Lead[4]	0.5	0.5	0.5
21.	Mercury[4]	0.01	0.01	0.01
22.	Selenium[4]	0.5	0.5	0.5
23.	Nickel[4]	1.0	1.0	1.0
24.	Silver[4]	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0
27.	Arsenic[4]	1.0	1.0	1.0
28.	Barium[4]	1.5	1.5	1.5
29.	Iron	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5
31.	Boron[4]	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.
2. Methylene Blue Active substances assuming surfactant as biodegradable
3. Pesticides include herbicides, fungicides, and insecticides
4. Subject to total toxic metals discharge should not exceed level given at S. No. 25
5. Applicable only when and where sewage treatment is operational and BOD = 80 mg/l is achieved by the sewage treatment system.
6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.
7. The effluent should not result in temperature increase of more than $3^{o}C$ at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not define, use 100 m from the point of discharge
8. ** The value for industry is 200 mg/l
9. *** Discharge concentration at or below sea concentration (SC)
10. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.
11. The concentration of pollutants in water being used will be subtracted from the effluent for calculating the NEQS limits.
12. Modified Benzene Alkyl Sulfate assuming surfacetant as biodegradable.

Table 2: NEQS for Gaseous Emissions

No.	Parameter	Source of Emission		Standards
1.	Smoke	Smoke opacity not to exceed		40% or 2 on Ringlemann Scale or equivalent smoke number
2.	Particulate matter[1]	(a)	Boilers and furnaces:	
		i)	Oil-fired	300
		ii)	Coal-fired	500
		iii)	Cement kilns	300
		(b)	Grinding, crushing, clinker coolers and related processes, metallurgical processes, converters, blast furnaces and cupolas	500
3.	Hydrogen chloride	Any		400
4.	Chlorine	Any		150
5.	Hydrogen fluoride	Any		150
6.	Hydrogen sulfide	Any		10
7.	Sulfur oxides[2, 3]	Sulfuric acid/sulfonic acid plants		5,000
		Other plants except power plants operating on oil and coal		1,700
8.	Carbon monoxide	Any		800
9.	Lead	Any		50
10.	Mercury	Any		10
11.	Cadmium	Any		20
12.	Arsenic	Any		20
13.	Copper	Any		50
14.	Antimony	Any		20
15.	Zinc	Any		200
16.	Oxides of nitrogen[3]	Nitric acid manufacturing unit		3,000
		Gas-fired		400
		Oil-fired		600
		Coal-fired		1,200

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1 per cent sulfur content in fuel oil. Higher content of sulfur will cause standards to be pro-rated.
3. In respect of emissions of sulfur dioxide and nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) special above, comply with the following standards.
4. Pakistan Standards for Sulfur Dioxide and Nitrogen Oxides for Power Plants Operating on Oil and Coal

Table 3: NEQS for Sulfur Dioxide

Sulfur Dioxide Background Levels (mg/m^3)			Standards	
			Criterion I	Criterion II
Background Air Quality (SO_2 basis)	**Annual Average**	**Maximum 24-Hour Interval**	**Max. SO_2 Emissions (TPD)**	**Max. Allowable 1-Year Average Ground Level Increment to Ambient (mg/m^3)**
Unpolluted	< 50	< 200	500	50
Moderately polluted[1]				
Low	50	200	500	50
High	100	400	100	10
Very polluted[2]	> 100	> 400	100	10

1. For intermediate values between 50 and 100 $\mu g/m^3$ linear interpretation should be used.
2. No project with sulfur dioxide emissions will be recommended.

Table 4: NEQS for Nitrogen Oxides

Annual arithmetic mean of ambient air concentrations of nitrogen oxides (expressed as NO_2) should not exceed		100 $\mu g/m^3$ (0.05 ppm)
Maximum emission levels for stationary source discharges, before mixing with the atmosphere: For fuel fired steam generators		
	Liquid fossil fuel	130 ng/J of heat input
	Solid fossil fuel	300 ng/J of heat input
	Lignite fossil fuel	260 ng/J of heat input

Table 5: NEQS for Noise

S No.	Category of Area/Zone	Effective from Ist July, 2010		Effective from Ist July, 2012	
		Limit in dB(A) Leq*			
		Day time	Night time	Day time	Night time
1.	Residential are (A)	65	50	55	45
2.	Commercial are (B)	70	60	65	55
3.	Industrial area (C)	80	75	75	65
4.	Silence zone (D)	55	45	50	45

Note:

1. Day time hours: 6 .00 am to 10.00 pm
2. Night Time hours: 10.00 pm to 6.00 am
3. Silence zone: Zones which are declared as such by the competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts and courts.
4. Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.
5. dB(A) Leq: time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

Table 6: NEQS for Ambient Air

Pollutants	Time-weighted Average	Concentration in Ambient Air		Method of Measurement
		Effective from 1st July 2010	Effective from 1st January 2013	
Sulfur Dioxide (SO_2)	Annual Average*	80 μg/m^3	80 μg/m^3	-Ultra Violet Fluorescence method
	24 hours**	120 μg/m^3	120 μg/m^3	
Oxide of Nitrogen as (NO)	Annual Average*	40 μg/m^3	40 μg/m^3	-Gas Phase Chemiluminescence
	24 hours**	40 μg/m^3	40 μg/m^3	
Oxide of Nitrogen as (NO_2)	Annual Average*	40 μg/m^3	40 μg/m^3	-Gas Phase Chemiluminescence
	24 hours**	40 μg/m^3	80 μg/m^3	
O_3	1 hour	180 μg/m^3	130 μg/m^3	-Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400 μg/m^3	360 μg/m^3	-High Volume Sampling, (Average flow rate not less than 1.1 m^3/min)
	24 hours**	550 μg/m^3	500 μg/m^3	
Respirable particulate Matter. PM $_{10}$	Annual Average*	200 μg/m^3	120 μg/m^3	-β Ray Absorption method
	24 hours**	250 μg/m^3	150 μg/m^3	
Respirable Particulate Matter. PM $_{2.5}$	Annual Average*	25 μg/m^3	15 μg/m^3	-β Ray Absorption method
	24 hours**	40 μg/m^3	35 μg/m^3	
	1 hour	25 μg/m^3	15 μg/m^3	
Lead (Pb)	Annual Average*	1.5 μg/m^3	1 μg/m^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2 μg/m^3	1.5 μg/m^3	
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	5 mg/m^3	Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m^3	10 mg/m^3	

* Annual arithmetic mean of minimum 104 instruments in a year taken twice a week 24 hourly at uniform interval

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

Table 7: NEQS for Drinking Water

Properties/ Parameters	Standard Values For Pakistan	Who Guidelines	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E.coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Most Asian countries also follow WHO standards
Physical			
Colour	≤15 TCU	≤15 TCU	
Taste	Non objectionable/Accept able	Non objectionable/Accept able	
Odour	Non objectionable/Accept able	Non objectionable/Accept able	
Turbidity	< 5 NTU	< 5 NTU	
Total hardness as CaCO3	< 500 mg/l	–	
TDS	< 1000	< 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	mg/Litre	mg/Litre	
Aluminium (Al) mg/1	<0.2	0.2	
Antimony (Sb)	<0.005 (P)	0.02	
Arsenic (As)	< 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	<250	250	
Chromium (Cr)	<0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	mg/Litre	mg/Litre	
Cyanide (CN)	<0.05	0.07	Standard for Pakistan similar to Asian developing countries

Properties/ Parameters	Standard Values For Pakistan	Who Guidelines	Remarks
Fluoride (F)*	<1.5	1.5	
Lead (Pb)	<0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	< 0.5	0.5	
Mercury (Hg)	<0.001	0.001	
Nickel (Ni)	<0.02	0.02	
Nitrate (NO3)*	<50	50	
Nitrite (NO2)*	<3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer end 0.5-1.5 at source	–	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries
* indicates priority health related inorganic constituents which need regular monitoring.			
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		< 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

Proviso:

1. The existing drinking water treatment infrastructure is not adequate to comply with WHO guidelines. The arsenic concentrations in South Punjab and in some parts of Sindh have been found high then Revised WHO guidelines. It will take some time to control arsenic through treatment process. Lead concentration in the proposed standards is higher than WHO Guidelines. As the piping system for supply of drinking water in urban centres are generally old and will take significant resources and time to get them replaced. In the recent past, lead was completely phased out from petroleum products to cut down lead entering into environment. These steps will enable to achieve WHO Guidelines for Arsenic, Lead, Cadmium and Zinc. However, for the bottled water, WHO limits for Arsenic, Lead, Cadmium and Zinc will be applicable and PSQCA Standards for all the remaining parameters.

Table 7: NEQS for Motor Vehicle Exhaust and Noise

Table 7.1: For in Use Vehicles

Sr. No	Parameter	Standards (maximum permissible limit)	Measuring method
1	Smoke	40 % or 2 on the ringlemann scale during engine acceleration mode	To be compared with ringlemann chart at a distance of 6 meters or more
2	Carbon Monoxide	6 %	Under idling conditions: Non dispersive infrared detection through gas analyzer
3	Noise	85 db (A)	Sound meter at 7.5 meters from the source

Table 7.2: For New Vehicles (Diesel)

(a) Emission Standards for Passenger Cars and Light Commercial Vehicles (g/Km)

Type of Vehicle	Category/Class	Tiers	CO	HC+ NOx	PM	Measuring Method
Passenger Cars	M1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg to meet NI category standards	Pak-II IDI	1.0	0.7	0.08	NEDC (ECE 15 + EUDCL)
		Pak-II DI	1.0	0.9	0.10	
Light Commercial Vehicles	N1-I (RW<1250 kg)	Pak-II IDI	1.0	0.70	0.08	
		Pak-II DI	1.0	0.90	0.10	
	N1-II (1250 kg<RW<1700 kg)	Pak-II IDI	1.25	1.0	0.12	
		Pak-II DI	1.25	1.3	0.14	
	N1-III (RW>1700 kg)	Pak-II IDI	1.50	1.2	0.17	
		Pak-II DI	1.50	1.6	0.20	

Parameter	Standards (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound-meter at 7.5 meters from the source

(b) Emission Standards for Heavy Duty Diesel Engines and Large Goods Vehicles (g/Kwh)

Type of Vehicle	Category/Class	Tiers	CO	HC+	NOx	PM	Measuring Method
Heavy Duty Diesel Engines	Trucks and Buses	Pak-II	4.0	1.1	7.0	0.15	ECE-R-49
Large Goods Vehicles	N2 (2000 and up)	Pak-II	4.0	7.0	1.10	0.15	EDC

Parameter	Standards (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound-meter at 7.5 meters from the source

Table 7.3: For New Vehicles (Petrol)

Emission Standards for Petrol Vehicles (g/km)

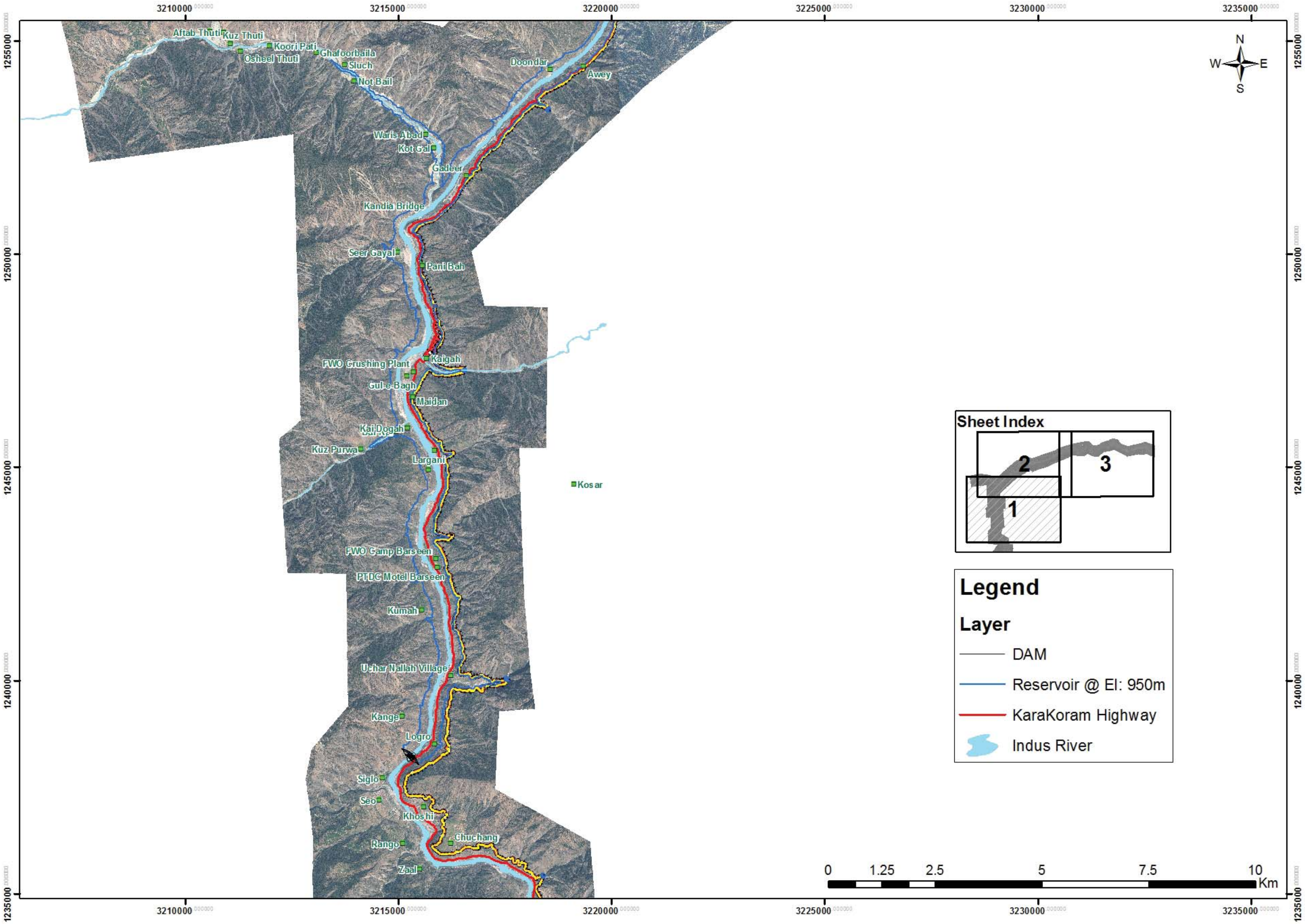
Type of Vehicle	Category/Class	Tiers	CO	HC+ Nox	Measuring Method
Passenger Cars	M1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg to meet N1 category standards	Pak-II IDI	2.20	0.5	NEDC (ECE 15 + EUDCL)
Light Commercial Vehicles	N1-I (RW<1250 kg)	Pak-II	2.20	0.5	
	N1-II (1250 kg<RW<1700 kg)	Pak-II	4.0	0.65	
	N1-III (RW>1700 kg)	Pak-II	5.0	0.08	
Motor Rickshaws and motor cycles	2,4 strokes<150cc	Pak-II	5.5	1.5	ECER 40
	2,4 strokes>150cc	Pak-II	5.5	1.3	

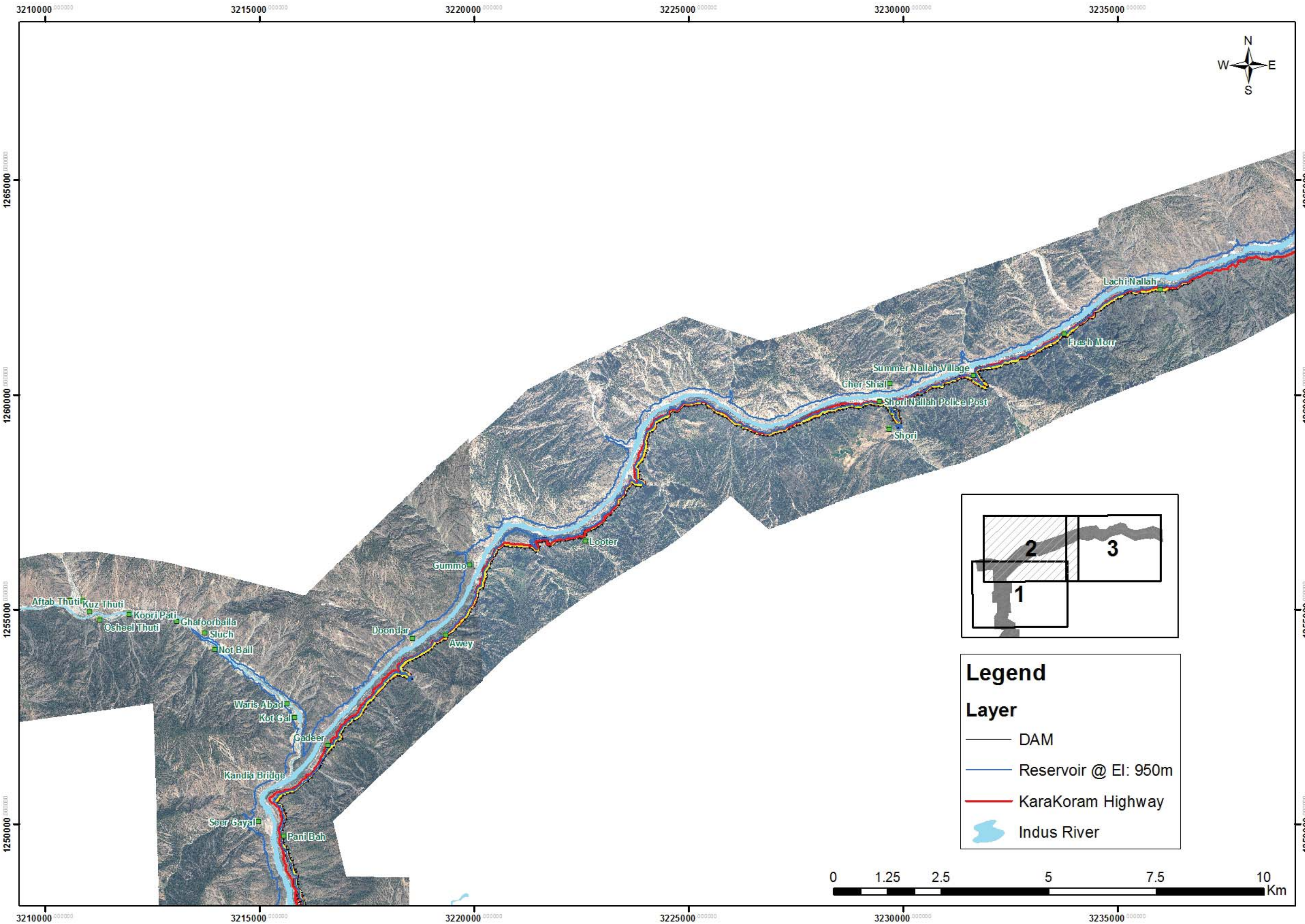
Parameter	Standards (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound-meter at 7.5 meters from the source

Explanation:
DI: Direct Injection
IDI: Indirect Injection
EUDCL: Extra urban driving cycle
NEDC: New European driving cycle
ECE: urban driving cycle
M: Vehicle designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
N: Motor vehicles with at least four wheels designed and constructed for the carriage of goods.
*: New models mean both model and engine type change

Annex – 3.1

RESERVOIR AREA MAP (AT FSL 950M)





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Osheel Thuti
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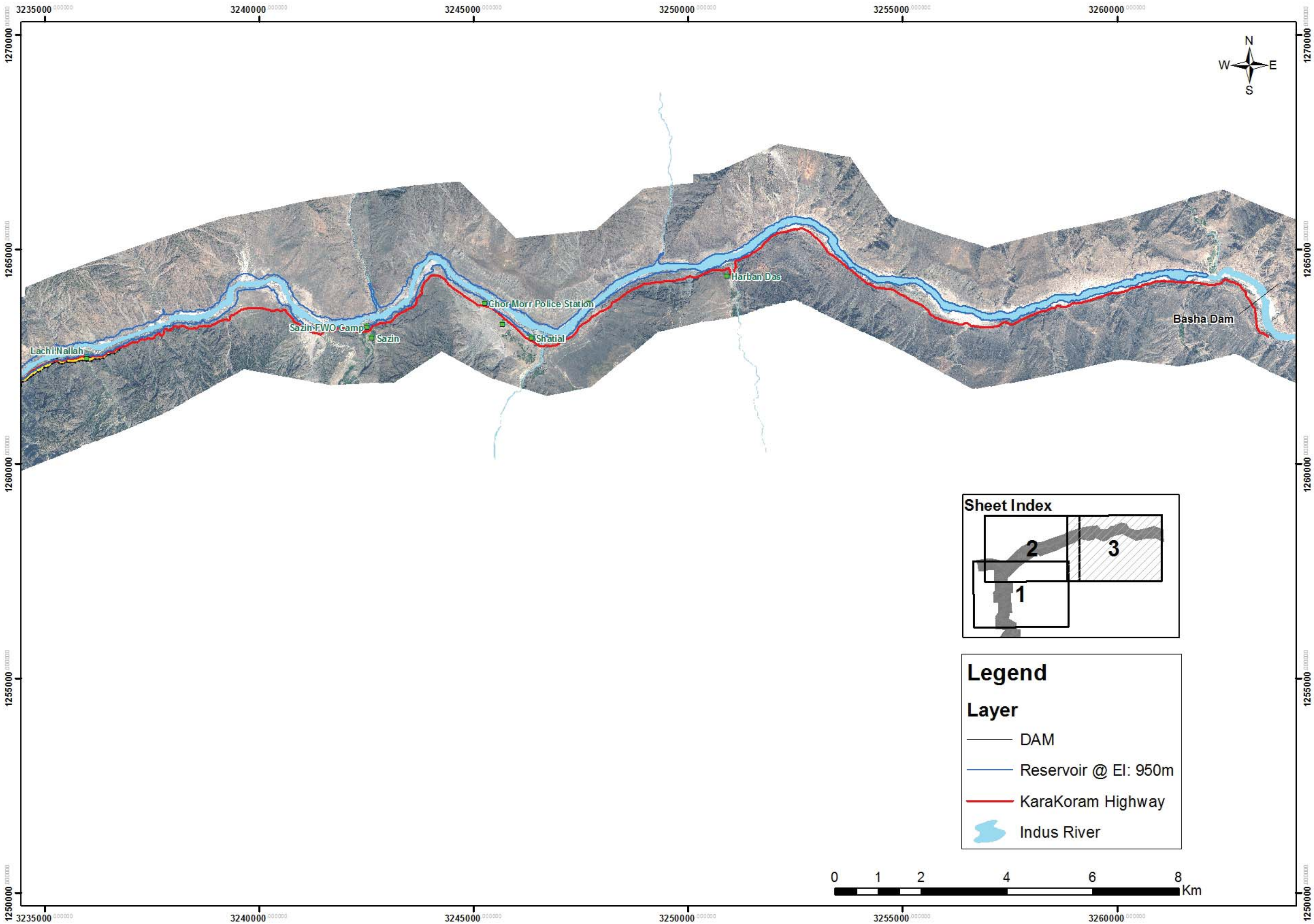
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Annex – 4.1

WATER QUALITY RESULTS DURING DETAIL DESIGN AND FEASIBILITY STUDIES

Table 4.1.1: Water Quality Results during July/August 2012

Sr. No.	PARAMETER	SAMPLING SITES (High Flow)							*STANDARDS (Surface Water)		Remarks
		Harban Das (River)	Darel River (Stream)	Tangir River (Stream)	Summer Nullah (Stream)	Churi Nullah (Stream)	Lutar Nullah (Stream)	Kandia River (Stream)	**Table 5 - Class C	***Table 6 - Class D	
1	Temperature (°C)	18	21	16.4	19	16.4	20.7	18	-	-	-
2	pH	7.03	7.38	7.42	7.12	7.42	7.82	7.75	6.5 - 8.5	6.5 - 8.4	Complied
3	Dissolved Oxygen (mg/l)	9.3	8.8	8.8	8.7	8.8	8.8	7.7	>5.0	>4.0	Complied
4	Conductivity (µS/cm)	201.3	121.3	30.1	50.9	29.1	78.6	87.9	1500	1500	Complied
5	Turbidity (NTU)	3	2.4	1.445	8.05	1.52	1	8.45	-	-	-
6	Total Hardness as $CaCO_3$ (mg/l)	8	10	13.8	12	13.8	23.4	10.01	-	-	-
7	BOD_5 (mg/l)	0.25	0.21	0.32	0.61	0.20	0.46	0.25	8.0	8.0	Complied
8	COD (mg/l)	0.60	1.01	1.40	1.80	0.70	1.64	1.22	-	-	-
9	Total Dissolved Solids (mg/l)	72.2	63	14	25.6	14	38.6	43.4	1000	1000	Complied
10	Total Suspended Solids (mg/l)	84	BDL	BDL	BDL	BDL	BDL	17	-	-	-
11	Chloride (mg/l)	10	8	4	6.4	5.5	2.5	4.5	-	100	Complied
12	Chlorine (mg/l)	BDL	0.015	0.055	0.05	0.195	0.045	0.1	-	-	-
13	Sodium (mg/l)	5.95	2.01	3.08	2.20	1.44	1.50	1.91	-	-	-
14	Fluoride (mg/l)	BDL	0.75	BDL	0.52	BDL	0.11	BDL	1.5	1.0	Complied
15	Iodine (mg/l)	BDL	0.1	0.39	0.15	0.75	0.21	0.75	-	-	-
16	Sulphate (mg/l)	BDL	BDL	0.5	BDL	0.5	1.5	1	-	-	-
17	Sulphide (mg/l)	1.18	BDL	0.09	0.39	0.09	0.25	0.32	-	-	-

Sr. No.	PARAMETER	SAMPLING SITES (High Flow)							*STANDARDS (Surface Water)		Remarks
		Harban Das	Darel River	Tangir River	Summer Nullah	Churi Nullah	Lutar Nullah	Kandia River	**Table 5 - Class C	***Table 6 - Class D	
		(River)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)			
18	Nitrogen Ammonia (mg/l)	0.92	BDL	BDL	BDL	BDL	BDL	BDL	1.0	-	Complied
19	Nitrate (mg/l)	3.5	0.3	0.09	0.6	0.09	2	2.9	-	-	-
20	Cyanide (mg/l)	0.008	0.003	0.025	0.03	0.02	0.045	0.035	0.005	1.0	Complied
21	Copper (mg/l)	0.0120	0.0015	0.0025	0.0024	0.0028	0.0032	0.0060	0.007	0.20	Complied
22	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.002	0.01	Complied
23	Chromium (mg/l)	0.01572	0.00640	0.02001	0.00896	0.00555	0.00639	0.00772	0.05	0.01	Complied
24	Lead (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	0.1	Complied
25	Silver (mg/l)	0.00037	BDL	0.0002	BDL	BDL	BDL	BDL	-	-	-
26	Zinc (mg/l)	0.014	0.003	0.010	0.062	0.002	0.002	0.006	0.086	2.0	Complied
27	Nickel (mg/l)	0.0215	0.0105	0.0179	0.0078	0.0062	0.0050	0.0113	0.05	0.20	Complied
28	Arsenic (mg/l)	0.0070	BDL	0.0014	0.0010	0.0013	BDL	0.0017	0.05	0.10	Complied
29	Selenium (mg/l)	0.00079	BDL	BDL	BDL	BDL	0.00091	BDL	0.005	0.02	Complied
30	Manganese (mg/l)	0.1206	0.0016	0.0119	0.0050	0.0018	0.0027	0.0118	0.10	0.20	Complied
31	Iron (mg/l)	0.230	0.093	0.203	0.289	0.071	0.132	0.264	0.3	5.0	Complied
32	Barium (mg/l)	0.0360	0.0120	0.0344	0.0344	0.0240	0.0275	0.0120	-	-	-
33	Boron (mg/l)	0.021	0.02	0.009	0.02	0.01	0.046	BDL	1.0	1.0	Complied
34	Mercury (mg/l)	0.0006	0.000462	0.00171	0.00036	BDL	BDL	0.002	0.000012	0.01	Complied
35	Magnesium (mg/l)	9.29	1.47	1.45	1.15	0.71	1.74	1.17	-	-	-
36	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	-	Complied

Sr. No.	PARAMETER	SAMPLING SITES (High Flow)								*STANDARDS (Surface Water)		Remarks
		Barseen Gah (Stream)	Uchar Nullah (Stream)	Dam Axis (River)	Segloo (River)	Dasu Nullah (Stream)	Komela JalKot (River)	D/s of Jalkot (River)	U/s of Pattan (River)	**Table 5 - Class C	***Table 6 - Class D	
1	Temperature (°C)	15.5	16.5	21	17	15.6	18.3	-	-	-	-	-
2	pH	7.64	7.62	8.07	8.1	7.65	7.5	8.11	8.09	6.5 - 8.5	6.5 - 8.4	Complied
3	Dissolved Oxygen (mg/l)	8.6	8.9	8.2	8.02	8.1	8.2	9.3	9.7	>5.0	>4.0	Complied
4	Conductivity (µS/cm)	92.8	29.8	211.1	182.6	124.9	234.4	171.2	152.6	1500	1500	Complied
5	Turbidity (NTU)	3	1	45	65	0.545	70.5	57.5	59.5	-	-	-
6	Total Hardness as CaCO3 (mg/l)	BDL	10.6	62.6	65	40.2	59.8	30	43	-	-	-
7	BOD5 (mg/l)	0.37	0.50	1.00	1.20	0.20	0.45	0.42	0.55	8.0	8.0	Complied
8	COD (mg/l)	2.47	2.07	4.27	3.87	1.00	1.56	1.40	2.00	-	-	-
9	Total Dissolved Solids (mg/l)	44	15	105	90.6	56	115.8	80	75.5	1000	1000	Complied
10	Total Suspended Solids (mg/l)	BDL	BDL	126.7	16	BDL	245	22	19	-	-	-
11	Chloride (mg/l)	3.5	BDL	9	7	1	BDL	11	12	-	100	Complied
12	Chlorine (mg/l)	0.045	0.08	0.375	0.005	0.025	0.145	0.09	0.1	-	-	-
13	Sodium (mg/l)	3.36	BDL	3.94	6.12	3.80	2.29	5.02	7.13	-	-	-
14	Fluoride (mg/l)	BDL	BDL	1.12	0.547	0.09	BDL	0.9	0.6	1.5	1.0	Complied
15	Iodine (mg/l)	0.27	0.25	0.9	0.14	0.16	0.33	0.22	0.23	-	-	-
16	Sulphate (mg/l)	2	4	37	35.5	0.18	30	4.5	3.9	-	-	-
17	Sulphide (mg/l)	0.45	BDL	0.54	0.64	0.23	0.05	0.52	0.45	-	-	-
18	Nitrogen Ammonia (mg/l)	0.01	1.02	2.525	0.73	0.845	2.525	1.47	1.445	1.0	-	Not Complied
19	Nitrate (mg/l)	1.8	0.2	1.9	1.7	0.6	0.02	2.1	2.3	-	-	-
20	Cyanide (mg/l)	0.015	0.02	0.045	0.02	0.005	0.035	0.035	0.03	0.005	1.0	Complied
21	Copper (mg/l)	0.0027	0.0024	0.0060	0.0292	0.0061	0.0083	0.0176	0.0114	0.007	0.20	Complied
22	Cadmium (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.002	0.01	Complied

Sr. No.	PARAMETER	SAMPLING SITES (High Flow)								*STANDARDS (Surface Water)		Remarks
		Barseen Gah	Uchar Nullah	Dam Axis	Segloo	Dasu Nullah	Komela JalKot	D/s of Jalkot	U/s of Pattan	**Table 5 - Class C	***Table 6 - Class D	
		(Stream)	(Stream)	(River)	(River)	(Stream)	(River)	(River)	(River)			
23	Chromium (mg/l)	0.01001	0.0067	0.01324	0.03342	0.00931	0.01106	0.0040	0.00500	0.05	0.01	Complied
24	Lead (mg/l)	BDL	BDL	BDL	BDL	0.0101	BDL	BDL	BDL	0.01	0.1	Complied
25	Silver (mg/l)	BDL	BDL	BDL	0.0004	BDL	0.0002	BDL	BDL	-	-	-
26	Zinc (mg/l)	0.063	0.010	0.004	0.065	0.062	0.052	0.013	0.018	0.086	2.0	Complied
27	Nickel (mg/l)	0.0091	0.0046	0.0164	0.0172	0.0098	0.0127	0.0200	0.0210	0.05	0.20	Complied
28	Arsenic (mg/l)	0.0029	BDL	0.0019	0.0107	0.0014	0.0047	0.0320	0.0200	0.05	0.10	Complied
29	Selenium (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.00093	0.005	0.02	Complied
30	Manganese (mg/l)	0.0057	0.0032	0.0444	0.0373	0.0054	0.0742	0.0720	0.0846	0.10	0.20	Complied
31	Iron (mg/l)	0.280	0.066	0.205	0.159	0.250	0.286	0.271	0.562	0.3	5.0	Complied
32	Barium (mg/l)	0.0172	BDL	BDL	0.2287	0.1203	0.0962	0.0180	0.0163	-	-	-
33	Boron (mg/l)	0.03	0.09	0.19	0.102	0.022	0.02	0.06	0.21	1.0	1.0	Complied
34	Mercury (mg/l)	BDL	0.0016	BDL	BDL	BDL	BDL	0.002	BDL	0.000012	0.01	Complied
35	Magnesium (mg/l)	2.51	1.17	3.73	10.40	3.42	3.50	1.20	1.80	-	-	-
36	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	-	Complied

Table 4.1.2: Water Quality Results during December 2012

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)							*STANDARDS (Surface Water)		Remarks
		Harban Das	Darel River	Tangir River	Summer Nullah	Churi Nullah	Lutar Nullah	Kandia River	**Table 5 - Class C	***Table 6 - Class D	
		(River)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)			
1	Temperature (°C)	6.7	8.2	9.5	9	9.5	12.6	13.9	-	-	-
2	pH	7.9	7.76	7.53	7.64	7.44	7.88	7.88	6.5 - 8.5	6.5 - 8.4	Complied
3	Dissolved Oxygen (mg/l)	7.6	9	7.3	7.45	7.06	6.5	7.2	>5.0	>4.0	Complied
4	Conductivity (µS/cm)	325	135	118	56	62	85	92	1500	1500	Complied
5	Turbidity (NTU)	22.1	32	0.97	1.1	0.34	0.8	1.7	-	-	-
6	Total Hardness as CaCO3 (mg/l)	125	65	52	28	25	38	52	-	-	-
7	BOD5 (mg/l)	1.0	1.0	1.30	1.0	0.71	0.80	0.95	8.0	8.0	Complied
8	COD (mg/l)	7.60	4.80	7.50	5.10	3.90	6.40	3.50	-	-	-
9	Total Dissolved Solids (mg/l)	108	68	57	27	30	42	46	1000	1000	Complied
10	Total Suspended Solids (mg/l)	25	BDL	BDL	BDL	4	BDL	BDL	-	-	-
11	Chloride (mg/l)	18.6	9.6	7.8	9.3	8.1	6.5	15.3	-	100	Complied
12	Chlorine (mg/l)	0.04	0.05	0.01	0.06	0.03	0.02	0.03	-	-	-
13	Sodium (mg/l)	6.89	3.8	4.25	3.46	3.52	3.2	4.98	-	-	-
14	Fluoride (mg/l)	0.43	0.11	0.02	0.05	0.08	0.06	0.09	1.5	1.0	-
15	Iodine (mg/l)	0.19	0.09	0.15	0.16	0.2	0.12	0.19	-	-	-
16	Sulphate (mg/l)	47	6	6	27	5	3	3.3	-	-	-
17	Sulphide (mg/l)	0.6	0.7	0.2	0.9	1	0.3	0.3	-	-	-
18	Nitrogen Ammonia (mg/l)	0.06	0.01	0.02	0.09	0.01	0.05	0.1	1.0	-	-
19	Nitrate (mg/l)	1.6	1.9	1.9	1.6	1.5	2.6	1.7	-	-	-
20	Cyanide (mg/l)	BDL	BDL	BDL	0.0008	BDL	0.0011	0.0012	0.005	1.0	Complied

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)							*STANDARDS (Surface Water)		Remarks
		Harban Das	Darel River	Tangir River	Summer Nullah	Churi Nullah	Lutar Nullah	Kandia River	**Table 5 - Class C	***Table 6 - Class D	
		(River)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)	(Stream)			
21	Copper (mg/l)	0.005	0.0049	0.0063	0.0065	0.005	0.0047	0.0038	0.007	0.20	Complied
22	Cadmium (mg/l)	0.0002	0.0003	0.0007	0.001	0.0007	0.0003	0.0003	0.002	0.01	Complied
23	Chromium (mg/l)	0.021	0.0106	0.0182	0.0136	0.008	0.00817	0.0062	0.05	0.01	Complied
24	Lead (mg/l)	0.009	0.006	0.007	0.009	0.006	0.005	0.009	0.01	0.1	Complied
25	Silver (mg/l)	BDL	BDL	0.002	0.0012	0.001	BDL	0.0006	-	-	-
26	Zinc (mg/l)	0.03	0.028	0.032	0.0514	0.02	0.025	0.019	0.086	2.0	Complied
27	Nickel (mg/l)	0.016	0.025	0.033	0.034	0.026	0.0257	0.019	0.05	0.20	Complied
28	Arsenic (mg/l)	0.007	BDL	0.012	0.007	0.01	0.001	0.0007	0.05	0.10	Complied
29	Selenium (mg/l)	0.000112	0.00037	0.00064	0.00057	0.0004	0.00022	0.00025	0.005	0.02	Complied
30	Manganese (mg/l)	0.0122	0.047	0.0145	0.059	0.046	0.017	0.016	0.10	0.20	Complied
31	Iron (mg/l)	0.04	0.025	0.047	0.034	0.02	0.018	0.014	0.3	5.0	Complied
32	Barium (mg/l)	0.12	0.119	0.083	0.0223	0.07	0.064	0.029	-	-	-
33	Boron (mg/l)	0.026	0.051	0.01	0.045	0.035	0.065	0.023	1.0	1.0	Complied
34	Mercury (mg/l)	0.00002	0.000005	0.000007	0.000009	BDL	BDL	0.000008	0.000012	0.01	Complied
35	Magnesium (mg/l)	8.58	2.51	2.33	1.76	1.59	2.53	1.53	-	-	-
36	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	-	Complied

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)							*STANDARDS (Surface Water)		Remarks
		Barseen Gah	Uchar Nullah	Dam Axis	Segloo	Dasu Nullah	Komela JalKot	D/s of Jalkot	**Table 5 - Class C	***Table 6 - Class D	
		(Stream)	(Stream)	(River)	(River)	(Stream)	(River)	(River)			
1	Temperature (°C)	11.2	11.1	8.7	11.7	15.5	10.1	10.1	-	-	-
2	pH	8.06	7.89	8.05	8.01	8.01	7.95	7.3	6.5 - 8.5	6.5 - 8.4	Complied
3	Dissolved Oxygen (mg/l)	6.9	7	7.75	7.4	7.1	7.81	7.92	>5.0	>4.0	Complied
4	Conductivity (µS/cm)	100	89	265	272	199	275	301	1500	1500	Complied
5	Turbidity (NTU)	0.96	0.3	20.6	17.5	0.92	20	12.9	-	-	-
6	Total Hardness as CaCO3 (mg/l)	45	35	128	125	90	118	115	-	-	-
7	BOD5 (mg/l)	0.82	0.75	0.9	1.20	1.0	3.0	4.0	8.0	8.0	Complied
8	COD (mg/l)	5.2	4.75	8.9	5.2	3.5	7.0	7.7	-	-	-
9	Total Dissolved Solids (mg/l)	48	44	132	135	90	137	142	1000	1000	Complied
10	Total Suspended Solids (mg/l)	8	BDL	19	8	3	8.9	1	-	-	-
11	Chloride (mg/l)	5.5	10.3	11	18.2	6.8	13.4	14.3	-	100	Complied
12	Chlorine (mg/l)	0.02	0.01	0.04	0.02	0.03	0.03	0.05	-	-	-
13	Sodium (mg/l)	4.83	3.12	6.44	7.53	3.99	8.66	4.3	-	-	-
14	Fluoride (mg/l)	0.02	0.11	0.22	0.05	0.01	0.34	0.26	1.5	1.0	Complied
15	Iodine (mg/l)	0.08	0.07	0.12	0.18	0.15	0.12	0.16	-	-	-
16	Sulphate (mg/l)	3	5	46	46.5	8	47	46	-	-	-
17	Sulphide (mg/l)	0.2	0.5	1.7	0.6	0.3	1.3	1.1	-	-	-
18	Nitrogen Ammonia (mg/l)	0.06	0.07	0.22	0.15	0.09	0.06	0.03	1.0	-	Complied
19	Nitrate (mg/l)	1.3	2.8	1.8	1.3	3.1	1.3	1.1	-	-	-
20	Cyanide (mg/l)	BDL	BDL	0.002	0.0011	BDL	0.0018	0.0012	0.005	1.0	Complied
21	Copper (mg/l)	0.005	BDL	0.0052	BDL	0.0065	0.0041	0.006	0.007	0.20	Complied
22	Cadmium (mg/l)	0.001	0.00002	0.0002	0.00004	0.0005	0.0002	0.0012	0.002	0.01	Complied

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)							*STANDARDS (Surface Water)		Remarks
		Barseen Gah	Uchar Nullah	Dam Axis	Segloo	Dasu Nullah	Komela JalKot	D/s of Jalkot	**Table 5 - Class C	***Table 6 - Class D	
		(Stream)	(Stream)	(River)	(River)	(Stream)	(River)	(River)			
23	Chromium (mg/l)	0.008	0.005	0.017	0.006	0.0184	0.0086	0.011	0.05	0.01	Complied
24	Lead (mg/l)	0.006	BDL	0.01	BDL	0.007	0.005	0.00839	0.01	0.1	Complied
25	Silver (mg/l)	BDL	BDL	BDL	BDL	0.0019	BDL	0.0002	-	-	-
26	Zinc (mg/l)	0.032	BDL	0.028	BDL	0.037	0.024	0.04	0.086	2.0	Complied
27	Nickel (mg/l)	0.017	BDL	0.027	BDL	0.031	0.012	0.02	0.05	0.20	Complied
28	Arsenic (mg/l)	0.009	0.0044	0.004	0.006	0.0127	BDL	0.013	0.05	0.10	Complied
29	Selenium (mg/l)	0.00098	BDL	0.00089	BDL	BDL	0.00057	0.00011	0.005	0.02	Complied
30	Manganese (mg/l)	0.056	BDL	0.097	BDL	0.0507	0.062	0.06	0.10	0.20	Complied
31	Iron (mg/l)	0.021	BDL	0.035	BDL	0.023	0.022	0.026	0.3	5.0	Complied
32	Barium (mg/l)	0.154	BDL	0.12	BDL	0.191	0.035	0.187	-	-	-
33	Boron (mg/l)	0.059	0.131	0.151	0.013	0.036	0.051	0.073	1.0	1.0	Complied
34	Mercury (mg/l)	BDL	0.000014	BDL	BDL	BDL	BDL	0.00003	0.000012	0.01	Complied
35	Magnesium (mg/l)	2.74	2.02	4.13	9.85	4.86	3.6	1.92	-	-	-
36	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.01	-	Complied

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)						*STANDARDS (Surface Water)		Remarks
		U/s of Pattan	Besham	Thakot	New Darband	Khalabat	Topi			
		(River)	(River)	(River)	(River)	(Reservoir of Tarbela)	(Reservoir of Tarbela)	**Table 5 - Class C	***Table 6 - Class D	
1	Temperature (°C)	12.7	13.4	11.4	16.9	15	13	-	-	-
2	pH	8.2	7.6	8.18	7.85	7.88	7.7	6.5 - 8.5	6.5 - 8.4	Complied
3	Dissolved Oxygen (mg/l)	8.09	7.53	7.59	6.78	6.35	6.9	>5.0	>4.0	Complied
4	Conductivity (µS/cm)	262	255	261	235	230	239	1500	1500	Complied
5	Turbidity (NTU)	15.3	17	7.75	26	26.6	29	-	-	-
6	Total Hardness as CaCO3 (mg/l)	132	129	135	98	125	130	-	-	-
7	BOD5 (mg/l)	3.5	4.0	4.2	4.1	4.5	4.7	8.0	8.0	Complied
8	COD (mg/l)	8.5	7.5	9.6	8.5	8.1	9.5	-	-	-
9	Total Dissolved Solids (mg/l)	130	127	148	125	114	116	1000	1000	Complied
10	Total Suspended Solids (mg/l)	18	15	23	19	35	33	-	-	-
11	Chloride (mg/l)	22.7	35	33	37.3	20.5	30.7	-	100	Complied
12	Chlorine (mg/l)	0.03	0.04	0.06	0.05	0.04	0.05	-	-	-
13	Sodium (mg/l)	8.69	9.25	9.66	8.32	10.11	11.3	-	-	-
14	Fluoride (mg/l)	0.19	0.06	0.03	0.05	BDL	0.03	1.5	1.0	Complied
15	Iodine (mg/l)	0.09	0.27	0.16	0.18	0.1	0.15	-	-	-
16	Sulphate (mg/l)	41	43	41	38	18	21	-	-	-
17	Sulphide (mg/l)	1.08	1.3	0.6	0.9	1.8	0.8	-	-	-
18	Nitrogen Ammonia (mg/l)	0.14	0.23	0.1	0.02	0.12	0.1	1.0	-	Complied
19	Nitrate (mg/l)	1.6	1.5	1.6	1.1	2.4	2	-	-	-
20	Cyanide (mg/l)	0.0012	0.0008	0.0011	0.0011	BDL	BDL	0.005	1.0	Complied
21	Copper (mg/l)	0.0073	0.0062	0.0065	0.004	0.0045	0.004	0.007	0.20	Complied
22	Cadmium (mg/l)	0.0005	0.0011	0.0007	0.0007	0.0005	0.0006	0.002	0.01	Complied

Sr. No.	PARAMETER	SAMPLING SITES (Low Flow)						*STANDARDS (Surface Water)		Remarks
		U/s of Pattan	Besham	Thakot	New Darband	Khalabat	Topi			
		(River)	(River)	(River)	(River)	(Reservoir of Tarbela)	(Reservoir of Tarbela)	**Table 5 - Class C	***Table 6 - Class D	
23	Chromium (mg/l)	0.0122	0.0201	0.0086	0.0116	0.0243	0.0184	0.05	0.01	Complied
24	Lead (mg/l)	0.0027	0.008	0.009	0.0039	0.0039	0.003	0.01	0.1	Complied
25	Silver (mg/l)	0.0001	0.0007	0.00005	0.002	0.0008	0.001	-	-	-
26	Zinc (mg/l)	0.037	0.042	0.038	0.023	0.028	0.031	0.086	2.0	Complied
27	Nickel (mg/l)	0.038	0.0385	0.041	0.02	0.023	0.025	0.05	0.20	Complied
28	Arsenic (mg/l)	0.003	0.027	0.002	0.009	0.011	0.02	0.05	0.10	Complied
29	Selenium (mg/l)	0.00087	0.00125	0.00092	0.00077	0.00061	0.00063	0.005	0.02	Complied
30	Manganese (mg/l)	0.09	0.0746	0.085	0.0748	0.0149	0.082	0.10	0.20	Complied
31	Iron (mg/l)	0.052	0.051	0.065	0.026	0.049	0.045	0.3	5.0	Complied
32	Barium (mg/l)	0.054	0.159	0.052	0.07	0.115	0.09	-	-	-
33	Boron (mg/l)	0.134	0.0395	0.045	0.076	0.051	0.019	1.0	1.0	Complied
34	Mercury (mg/l)	BDL	0.000001	0.00002	0.00004	0.0000128	0.00005	0.000012	0.01	Complied
35	Magnesium (mg/l)	2.95	7.56	6.94	7.22	8.12	8.05	-	-	-
36	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	0.01	-	Complied

Table 4.1.3: Water Quality Results during Feasibility Studies

Sampling Site : River Samples
Sample Collected on : September 27-28, 2007

Sr. No.	Parameter	Sampling Sites									
		Harban Bridge (SW-1)		Summer Nallah (SW-2)		At Dam Axis 5 (SW-3)		At 1 km d/s of Axis 5 (SW-4)		Downstream of Dasu (SW-5)	
		Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
1	Temperature (^oC)	14.5	7.5	14	6.8	16.5	7.9	16	7	18	8.2
2	Taste	No Taste	No Taste	No Taste	No Taste	No Taste	No Taste	No Taste	No Taste	No Taste	No Taste
3	Odour	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less	Odour Less
4	Ph	6.8	7.8	6.8	8.1	6.9	8	6.8	7.7	7.01	7.5
5	DO (mg/L)	8	8.2	8	8.3	7.8	8.2	7.8	7.9	7.4	7.8
6	Conductivity (µS/cm)	70.9	73.1	68.6	70.7	67.3	68.2	71.2	71.4	72.8	73.5
7	Turbidity (NTU)	45	48	70	71	75	78	70	72	80	81
8	Hardness as CaCO3 (mg/L)	160	164	108	140	140	143	144	142	132	144
9	BOD (mg/L)	1.9	2.0	2.1	2.1	2.2	2.4	2	2.1	2.6	2.6
10	COD (mg/L)	3.1	3.3	3.3	3.4	3.9	3.9	3.2	3.4	3.8	4.1
11	Total Dissolved Solids (mg/L)	42.6	45.3	41.5	45.5	41	46.2	42.8	45.2	44.1	49.3
12	Total Suspended Solids (mg/L)	118	126	134	155	145	158	137	160	83	160
13	Chloride (mg/L)	3.5	3.7	2.5	3.7	2.75	3.9	2.9	3.9	2.4	4.1
14	Chlorine Total (µg/L)	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	Sodium (mg/L)	2.27	2.30	1.62	2.30	1.75	2.35	1.88	2.38	1.56	2.45
16	Fluoride (µg/L)	ND	ND	ND	ND	ND	ND	50	65	ND	62
17	Iodine (mg/L)	0.33	0.50	0.21	0.60	0.88	0.98	0.2	0.98	1.34	1.59
18	Sulphate (mg/L)	42	48	40	50.4	39	53.2	40	53.5	38	56.1
19	Sulphide (µg/L)	148	153	155	159	180	184	176	181	201	212
20	Nitrogen Ammonia (mg/L)	0.47	0.13	0.98	0.07	0.95	0.01	0.89	0.1	0.65	0.09
21	Nitrate (mg/L)	ND	ND	ND	ND	ND	0.93	ND	1.10	ND	1.15
22	Cyanide (µg/L)	ND	ND	ND	ND	0.85	ND	0.92	ND	1.1	ND

Sr. No.	Parameter	Sampling Sites									
		Harban Bridge (SW-1)		Summer Nallah (SW-2)		At Dam Axis 5 (SW-3)		At 1 km d/s of Axis 5 (SW-4)		Downstream of Dasu (SW-5)	
		Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II	Phase I	Phase II
23	Coliforms (E.Coli) (Org/100m)	7	9	13	10	9	10	12	11	2	12
24	Coliforms (Fecal) (Org/100m)	15	17	21	17	46	20	24	22	5	22
25	Copper (Cu) (μg/L)	0.83	0.88	6.36	1.9	4.82	1.95	12.21	2.1	4.76	2.3
26	Cadmium (Cd) (μg/L)	2.8	2.8	2.71	2.5	3.71	2.9	2.92	2.9	1.61	2.7
27	Chromium (Cr) (μg/L)	4.2	3.8	3.1	3.9	4	3.9	4.5	4.2	4.8	4.2
28	Lead(Pb) (μg/L)	17.06	18	17.14	17.2	16.36	17.5	16.93	19	19.22	19.5
29	Silver (Ag) (μg/L)	0.03	0.01	0.04	0.08	0.02	0.1	0.03	0.02	0.06	0.05
30	Zinc (Zn) (μg/L)	0.82	0.85	0.85	0.88	0.79	0.89	2.01	0.93	0.8	1.08
31	Nickle (Ni) (μg/L)	12.7	5.8	9.8	5.8	3.8	6.2	8.7	6.25	6.8	7.1
32	Arsenic (As) (μg/L)	3.6	1.82	3.1	1.96	2.9	1.99	3.5	2.15	3.8	2.45
33	Selenium (Se) (μg/L)	0.05	0.01	0.03	0.08	0.04	0.095	0.09	0.06	0.12	0.098
34	Manganese (Mn) (μg/L)	62.38	68	70.5	91	84	86	65.48	105.2	72	101.2
35	Iron (Fe) (μg/L)	68	90.7	142	166.4	170	195.9	72	269.4	78	289.8
36	Berium (Ba) (μg/L)	27.89	15.2	31.34	15.8	35	14.6	29.99	17.2	27	17.7
37	Boron (B) (μg/L)	12.46	30.2	14.51	35.5	15	35.9	13.21	36.4	13	26.2
38	Mercury (Hg) (μg/L)	0.71	ND	0.72	ND	0.92	ND	0.75	ND	0.84	ND
39	Alpha BHC (pesticide) (μg/L)	ND	ND	0.33	0.28	0.35	0.49	0.44	0.54	0.51	0.59
40	Gamma BHC(pesticide) (μg/L)	ND	ND	0.38	0.16	0.42	0.25	0.47	0.28	0.62	0.26
41	4,4'-DDT (pesticide) (μg/L)	ND	ND	0.35	0.11	0.3	0.41	0.42	0.41	0.48	0.44
42	Phenolic Compounds (n-octylphenol)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

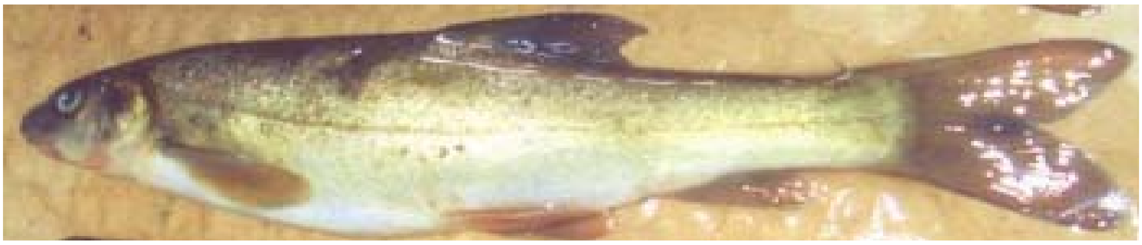
ND = Not Detected

Annex – 4.2

BIOLOGICAL INFORMATION OF INDIGENOUS FISH SPECIES

1. *Schizothorax plagiostomus*

Local Name:	Gahi in Northern Areas (Swati in KP)
Common Name:	Snow carp
Genus:	Schizothorax Heckal (1938) / Day (1889)
Sub-family:	Schizothoracinae
Family:	Cyprinidae
Order:	Cypriniformes



Distinct Features:

D2/9; P1/17-18; V1/10-9; A7; C19

A medium sized fish with both profiles arches. Its standard length is 78.9% of total length.

Colour:	Dorsally bluish grey with yellowish pink at ventral side
Head:	Large conical, flattened on ventral side.
Snout:	Painted and compressed at interior end, its length is 45.5% of head length.
Eyes:	Large, dorsal lateral in position and situated in anterior half of the head.
Mouth:	Inferior, horizontal and greatly arched, bounded by thick fleshy lips which are continuous at angles of the mouth. Interior part of lower lip is well depending horny pad. Nostrils present, nearer the interior margin of the eye.
Barbels:	Two pairs present, rostral and maxillary barbels almost equal in length.
Scales:	Small: covering the entire body except head. Lateral line complete and distinct.
Fins:	Either yellow or pink

Occurrence: Inhibited in different rivers, lakes and tributaries throughout Himalayan region.

Feeding habits: Feeds on phytoplankton (diatoms & algae), zooplankton (rotifer, cyclops) mostly at bottom region (Benthivorous) scarps algae from substratum rocks of stones.

Breeding: Become ripe after 2 & 3 years. Having size of 18-24cm length & 150-200gm weight. Spawn in clear flowing water (2-8m/sec) on gravelly /stony ground or on fine pebbles substratum in rising temperature (month of Mar/April). Mature adult undertake short-distance spawning migration to incoming stream where they breed amidst gravel and sandy beds.

Development: Fertilized eggs undergoes a series of development process. Morula stage is attained after 10-12 hrs of fertilization. Hatching takes place 110-112 hrs after fertilization. Hatchlings appears thin and yellow coloured yolksac bulbous in appearance. 2 days larva were more active but rests most of time at bottom. 3rd day larva still lays at bottom.

Distribution (in Pakistan): KPK, northern Punjab, northeastern Balochistan, Azad Kashmir. **(outside):** Afghanistan, Iran (sistan), India (Indus System only), China. **(in Project Area):** common in river Indus, Kaigah, Summer, Goshali, Pallas, Pattan, Sieglo, Kandia, Tingir, Darel stream/nullahs.

Source: 1. M.R. Mirza (1975) Freshwater Fishes & Zoogeography of Pakistan
2. M. Rafique (2001) Fish Fauna of Himalayans in Pakistan
3. S.N. Bahuguna (2006) & study of S. plagiostomus Project Report No. 4 (10) 2000/ASR-I/ 2003-2006

2. ***Racoma labiata*** **(Mirza 1990)**

Local Name:	Chun (very similar to Swati)
Common Name:	Snowcarp
Genus:	Racoma Mcelelland
	Schizothorax labiatus (Hora, 1934)
	Racoma labiatus (McClelland and Griffith, 1842)
Sub-family:	Schizothoracinae
Family:	Cyprinidae

Distinct Features:

Colour:	Greyish brown on dorsal side, yellowish below, dorsal and caudal fin grayish; other finds pinkish.
Head:	Large & snout arches, Head length 20% of the total body, Both lips are large and upper lip cover the mouth, lower lip lobed, surrounded by four barbels (2 rostral & two maxillary)

Feeding Habits: It feeds on different types of algae, scrap on rocks and also minor organisms. Its feeding habits are more similar with Swati (Schizothorax plagiostomus). Gut analysis endorses that Racoma labiata species depends mostly on phyto and minor zooplankton.

Breeding: Breeding season falls in the month of August. DBC's sampling could not reveal its ripeness. All fish caught were stout, strong and healthy. Their feeding conditions were quite promising.

Importance: Very important as food fish in Northern Areas.

3. ***Schizopyge esocinus*** **(Heckel, M.R. Mirza 1990)**

Local Name:	Asala
Common Name:	Snowcarp
Genus:	Schizopyge Heckel
Sub-family:	Schizothoracinae
Family:	Cyprinidae
Order:	Cypriniformes

Distinct Features:

Colour:	Silvery with black spots on the dorsal and lateral side (very similar to Brown Trout)
Body:	Stout and stronger
Head:	Large and about 22% of the body length, snout relatively conical, Mouth big but lips are thinner, surrounded by Four barbels.

Feeding Habits: It depends upon smaller organisms and predates smaller and minor fishes also.

Breeding: July 2006 samples showed developed sex organs but not of spent conditions. This showed that breeding was due in month of July 2006. Most of the mature samples were caught from upper reaches of Khanbari and Thak nullahs, which endorses its spawning grounds (upstream of Hydel Power Station). Its breeding takes place normally in the middle of July.

Importance This species is very precious source of protein in the area. Being wanted species as food anglers and commercial fishermen strive their best to catch Racoma labiate.

4. ***Glyptosternum reticulatum***

Local Name:	Jungli Chemo, (Chikar)
Genus:	Glyptosternum McClelland 1842
Sub-family:	
Family:	Sisoridae
Order:	Siluriformes

Distinct Features:

Colour:	Grayish at dorsal & yellowish at ventral with yellowish spots (similar to rocky spotting). Fins yellowish having distinct lines.
Head:	Head flattered and round. Mouth at dorsal surrounded by eight barbels lives attaches beneath rocks and pebbles.
Size:	Maximum size is 23cm.

Feed Habits: It depends on aquatic organism, insect, larva and minor organisms.

Breeding: It breeds in mouth of August, are differentiated easily.

Importance: Being predatory fish it balances the production of plankton. Even survives in the dry seasons.

5. ***Tor putitora* (Hamilton – 1822)**

Local Name:	Mahaseer
Genus:	Tor (Ahmad, 1943, Misra, 1959)
Sub-family:	Cyprininae
Family:	Cyprinidae
Order:	Cypriniformes
Subclass:	Teleostii
Class:	Teleostomi

Identifying Characters:	D1/8; P14-18; V9: A2/5 C2/19 L.I 22-27 Length range 16 – 26cm Weight upto 2Kg
Distribution:	Pakistan, Punjab, Balochistan, KPK, Bangladesh, India, East Punjab, U.P, West Bengal; Assam, Nepal.
Colour:	Greenish above with light pink sides and silver white abdomen; fins reddish yellow.
Habitat:	Clear shallow stream with gravel bed foothill mountain area (500m – 2000m) altitude.
Morphometry:	Body elongated & stout. Head larger 22% of body length, Eyes smaller & embedded in anterior part of Head, Eyes seem larger in smaller fishes. Mouth larger & have large lips at anterior end. Surrounded by four barbels (two rostal & two maxillary). Dorsal fin located between anal & pelvic fins; pectoral fins are smaller. Body covered with larger scales.
Feeding:	Feeds on plankton, may hunt smaller fishes; become omnivorous; doesn't feed below 16°C under captivity. Never competes with carps species.
Habitat:	Streams, rivers & nullahs of sub-mountain area.
Breeding:	Spawns in clear slow flowing water having rocky & gravel sandy bottom during April to September. Eggs are yellowish, heavy & demersal for hatching (sehgal – 1981) measuring 2.8 upto 3.2mm. It breeds also in confined ponds and response to stripping with hypo-physation or without pituitary gland extract. Artificial breeding very successful in India & Nepal.
Significance:	Good taste food fish and excellent game fish, source of recreation to anglers. In commercial fishery it occupies an important position for its quality. It attracts higher price in market.

Annex – 4.3

ECONOMIC USE OF PLANTS (ETHNOBOTANICAL INVENTORY)

Sr. No.	Plant Species	Family	Local name	Medicinal	Ethno -Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vege-table	Weeds	Others
1	*Abelmoschus esculentus* (L.) Moench.	Malvaceae	Bhindi	√	–	√	√	–	–	–	√	–	–
2	*Abies pindraw* Royle.	Pinaceae	Chur	–	–	–	√	√	√	–	–	–	√
3	*Achyranthes aspera* L.	Amaranthaceae	Malkuni	√	√	√	√	–	–	–	–	–	–
4	*Adiantum capillus-veneris* L.	Adiantaceae		√	–	–	–	–	–	–	–	–	√
5	*Adiantum venustum* D. Don	Adiantaceae	Jathoori	√	–	–	–	–	–	–	–	–	√
6	*Ailanthus altissima* (Mill.) Swingle	Simarubaceae	Darawa	–	–	√	√	–	√	–	–	–	√
7	*Ajuga bracteosa* Wall. ex Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
8	*Ajuga parviflora* Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
9	*Alnus nitida* Endl.	Betulaceae		–	–	√	√	–	–	–	–	–	√
10	*Alternanthera pachyacantha*	Aizoaceae		–	–	√	–	–	–	–	–	–	–
11	*Alternanthera pungens* Kunth.	Amaranthaceae		–	–	√	–	–	–	–	–	√	–
12	*Amaranthus caudatus* L.	Amaranthaceae	Ghanar	√	–	√	–	–	–	–	√	√	–
13	*Amaranthus graecizense* L.	Amaranthaceae		–	–	√	–	–	–	–	–	√	–
14	*Amaranthus oleraceus* L.	Amaranthaceae	Kas ghanar	–	–	√	–	–	–	–	–	√	–
15	*Amaranthus viridis* L.	Amaranthaceae	Ghanar	–	–	√	–	–	–	–	√	√	–
16	*Anagallis arvensis* L.	Primulaceae		–	–	√	–	–	–	–	–	√	–
17	*Arabidopsis himalaica* (Edgew.) O.E.S.	Brassicaceae		–	–	√	–	–	–	–	–	√	–
18	*Aristida cyanatha* Nees ex Steud.	Poaceae		–	–	√	–	–	–	–	–	–	–
19	*Artemesia maritima* L.	Asteraceae	Daroon	√	–	√	√	–	–	–	–	–	√

Sr. No.	Plant Species	Family	Local name	Medicinal	Ethno -Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vege-table	Weeds	Others
20	*Asparagus filicinus* Buch.-Ham. ex D. Don	Asparagaceae	Zao	√	–	–	√	–	–	–	–	–	√
21	*Astragalus candolleanus* Royle ex Benth.	Fabaceae	Chioo	–	–	√	√	–	–	–	–	–	–
22	*Atriplex lasiantha* Boiss.	Chenopodiaceae	Kiklohukbursa	–	–	√	–	–	–	–	–	–	–
23	*Barleria acanthoides* Vahl.	Acanthaceae		–	–	√	–	–	–	–	–	–	–
24	*Barleria cristata* L.	Acanthaceae		–	–	√	–	–	–	–	–	–	–
25	*Bauhinia variegata* L.	Caesalpiniaceae		√	–	√	√	–	√	–	√	–	√
26	*Bergenia ciliata* (Haw.) Sternb.	Saxifragaceae	Korat	√	–	√	–	–	–	–	–	–	√
27	*Bidens biternata* (Lour.) Merr. & Sherff.	Asteraceae	Surbul	–	–	√	–	–	–	–	–	√	–
28	*Boerhavia procumbens* Banks ex Roxb.	Nyctaginaceae		–	–	√	–	–	–	–	–	–	–
29	*Bothriochloa bladhii* (Retz.) S.T Blake	Poaceae	Lhash	–	–	√	–	–	–	–	–	–	–
30	*Bothriochloa ischaemum* (L.) Keng	Poaceae	Lhash	–	–	√	–	–	–	–	–	–	–
31	*Brachiaria distachya* (L.) Stapf	Poaceae		–	–	√	–	–	–	–	–	√	–
32	*Brachiaria reptans* (L.) Gard. & C.E. Hubb.	Poaceae		–	–	√	–	–	–	–	–	√	–
33	*Brousonetia papyrifera* (L.) Vent.	Moraceae	Jangal murt	–	–	√	√	–	√	–	–	–	√
34	*Calamintha umbrosa* (M. Bieb.) Fisch. & Mey.	Lamiaceae	Bheroo rang	–	–	√	–	–	–	–	–	√	–
35	*Calotropis procera* (Willd.) R. Br.	Asclepiadaceae		√	–	√	√	–	–	–	–	–	√
36	*Cannabis sativa* L.	Cannabinaceae		√	–	√	–	–	–	–	–	√	–
37	*Capparis spinosa* L.	Capparidaceae	Kurr	–	–	√	√	–	–	–	–	–	√
38	*Capsella bursa-pastoris* (L.) Medik	Brassicaceae		–	–	√	–	–	–	–	–	√	–
39	*Carex chitralensis* Nelmes Mag.	Cyperaceae	Zatch	–	–	√	√	–	–	–	–	–	√

Sr. No.	Plant Species	Family	Local name	Medicinal	Ethno -Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vege-table	Weeds	Others
40	*Carum carvi* L.	Apiaceae	Zeera	√	–	√	–	–	–	–	–	–	√
41	*Cedrus deodara* (Roxb. Ex Lamb.) G. Don	Pinaceae	Beesh	–	–	–	√	√	√	–	–	–	√
42	*Celtis australis* L.	Ulmaceae	Makosh	–	–	√	√	–	–	–	–	–	–
43	*Centella asiatica* (L.) Urban	Apiaceae	Tikroo	√	–	√	–	–	–	–	–	–	–
44	*Cheilanthus farinosa* (Forssk.) Kaulf.	Pteridaceae		–	–	√	–	–	–	–	–	–	√
45	*Chenopodium album* L.	Chenopodiaceae	Kanwan	√	–	√	–	–	–	–	√	√	–
46	*Chenopodium ambrosioides* L.	Chenopodiaceae	Tahoo	√	–	√	√	–	–	–	–	√	–
47	*Chenopodium botrys* L.	Chenopodiaceae	Kunwan	–	–	√	–	–	–	–	–	–	–
48	*Chenopodium* cf. *opulifolium* Schrad. ex Koch & Ziz.	Chenopodiaceae		–	–	√	–	–	–	–	–	–	–
49	*Chrozophora tinctoria* (L.)Juss.	Euphorbiaceae		–	–	√	–	–	–	–	–	–	–
50	*Chrysopogon aucheri* (Boiss.) Stapf	Poaceae		–	–	√	–	–	–	–	–	–	–
51	*Cirsium falconerii* (Hk.f.) Petrak	Asteraceae	Jocho	–	–	√	–	–	–	–	–	–	–
52	*Citrullus colocynthis* (L.) Schrad.	Cucurbitaceae		√	√	√	√	–	–	–	–	–	√
53	*Clematis montana* Buch.	Ranunculaceae		–	–	√	–	–	–	–	–	–	–
54	*Clematis nepalensis* Royle	Ranunculaceae		–	–	√	–	–	–	–	–	–	–
55	*Cleome viscosa* L.	Capparidaceae		–	–	√	–	–	–	–	–	√	–
56	*Commelina paludosa* Bl. Enum.	Commelineace		–	–	√	–	–	–	–	–	√	–
57	*Convolvulus arvensis* L.	Convolvulaceae	Halor	–	–	√	–	–	–	–	–	√	–
58	*Conyza aegyptica* Ait.	Asteraceae		–	–	√	–	–	–	–	–	√	–
59	*Conyza bonariensis* L.	Asteraceae	Phuljoo	–	–	√	–	–	–	–	–	√	–
60	*Conyza canadensis* L.	Asteraceae	Panar tahoor	–	–	√	–	–	–	–	–	√	–
61	*Coronopus didymus* (L.) Sm.	Brassicaceae	Marchaki	–	–	√	–	–	–	–	–	√	–

Sr. No.	Plant Species	Family	Local name	Medicinal	Ethno -Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vege-table	Weeds	Others
62	*Cotinus coggygria* Scop.	Anacardiaceae	Khakoh/Shini	–	–	√	√	–	√	√	–	–	–
63	*Cotoneaster affinins* var. *bacillaris* (Lindl.) Schneider	Rosaceae	Luni	–	–	√	√	–	–	√	–	–	–
64	*Cotoneaster microphylla* Wall. ex Lindl.	Rosaceae	Kiur	–	–	√	√	–	–	√	–	–	–
65	*Cotoneaster nummularia* Fisher & Meyer	Rosaceae	Dudul	–	–	√	√	–	–	–	–	–	–
66	*Cousinia thomsonii* Clarke	Asteraceae		–	–	√	–	–	–	–	–	–	–
67	*Cucumis melo* var. *agrestis* Naud.	Cucurbitaceae		–	–	√	–	–	–	√	–	√	√
68	*Cucurbita maxima* Duch. ex Lam.	Cucurbitaceae		–	–	√	√	–	–	–	√	–	–
69	*Cuscuta reflexa* Roxb.	Cuscutaceae	Zhoo	–	–	√	–	–	–	–	–	–	–
70	*Cymbopogon distans* (Nees) W. Wats.	Poaceae	Kattal	–	–	√	–	–	–	–	–	–	–
71	*Cynodon dactylon* (L.) Pers.	Poaceae	Kabal	–	–	√	–	–	–	–	–	√	–
72	*Cynoglossum lanceolatum* Forssk.	Boraginaceae	Chiroo	–	–	√	–	–	–	–	–	–	–
73	*Cyperus niveus* Retz.	Cyperaceae		–	–	√	–	–	–	–	–	–	–
74	*Cyperus rotundus* L.	Cyperaceae		–	–	√	–	–	–	–	–	√	–
75	*Dactyloctenium aegyptium* L.	Poaceae	Sarkhoo gha	–	–	√	–	–	–	–	–	√	–
76	*Dalbergia sissoo* Roxb.	Fabaceae		–	–	√	√	√	√	–	–	–	√
77	*Datura innoxia* Mill.	Solanaceae		√	–	–	√	–	–	–	–	–	–
78	*Datura stramonium* L.	Solanaceae		√	–	–	√	–	–	–	–	–	–
79	*Debregeasia salicifolia* (D. Don) Rendle	Urticaceae	Chiroo	–	–	√	–	–	√	–	–	–	√
80	*Dianthus crinitus* Sm.	Caryophyllaceae		–	–	√	–	–	–	–	–	–	–
81	*Dichanthium annulatum* (Forssk.) Stapf	Poaceae		–	–	√	–	–	–	–	–	√	–
82	*Dicliptera roxburghiana* Nees	Acanthaceae		–	–	√	–	–	–	–	–	–	–
83	*Digera muricata* (L.) Mart.	Amaranthaceae		–	–	√	–	–	–	–	√	√	–

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84	*Digitaria sanguinalis* (L.) Scop.	Poaceae		–	–	√	–	–	–	–	–	√	–
85	*Diospyros lotus* L.	Ebenaceae	Amlok	–	–	√	√	√	√	√	–	–	√
86	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shounth/Bajj	–	–	√	√	–	–	–	–	–	√
87	*Duchesnea indica* (Andr.) Focke	Rosaceae		–	–	√	–	–	–	√	–	–	–
88	*Echinochloa colona* (L.) Link	Poaceae		–	–	√	–	–	–	–	–	√	–
89	*Echinops cornigerus* DC.	Asteraceae	Kuro	–	–	√	–	–	–	–	–	–	√
90	*Eclipta prostrata* (L.) L.	Asteraceae		√	–	√	–	–	–	–	–	–	–
91	*Ephedra ciliata* Fisch. & Mey. ex C.A. Mey.	Ephederaceae	Ragaal	–	–	√	√	–	–	–	–	–	–
92	*Ephedra intermedia* Schrenk	Ephederaceae	Suo	–	–	√	√	–	–	–	–	–	√
93	*Eragrostis aterovirens* (Desf.) Trin. ex Nees	Poaceae		–	–	√	–	–	–	–	–	√	–
94	*Eragrostis cilianensis* (All.) Vig.	Poaceae		–	–	√	–	–	–	–	–	√	–
95	*Eragrostis minor* Host.	Poaceae		–	–	√	–	–	–	–	–	√	–
96	*Eucalyptus lanceolatus*	Myrtaceae		–	–	√	√	–	√	–	–	–	√
97	*Euonymus pendulus* Wall.	Celastraceae		–	–	√	√	–	–	–	–	–	–
98	*Euphorbia granulata* Forssk.	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
99	*Euphorbia hirta* L.	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
100	*Euphorbia indica* Lam.	Euphorbiaceae	Ispatre	–	–	√	–	–	–	–	–	√	–
101	*Euphorbia kanorica* Boiss.	Euphorbiaceae		–	–	√	–	–	–	–	–	–	–
102	*Euphorbia prostrata (*L.) Ait	Euphorbiaceae		–	–	√	–	–	–	–	–	√	–
103	*Euphrasia himalayica* Wettst.	Scrophulariaceae		–	–	√	–	–	–	–	–	–	–
104	*Ficus carica* L.	Moraceae	Pha	√	–	√	√	–	√	√	–	–	√
105	*Fumaria indica* (Hausskn.) H.N. Pugsley	Fumariaceae		√	–	√	–	–	–	–	–	√	–
106	*Gallium aparine* L.	Rubiaceae		–	–	√	–	–	–	–	–	√	–

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107	*Gentiana capitata* Ham. ex D. Don	Gentianaceae	Salaloo	–	–	√	–	–	–	–	–	–	–
108	*Geranium rotundifolium* L.	Geraniaceae		–	–	√	–	–	–	–	–	–	–
109	*Geranium willichianum* D. Don	Geraniaceae	Ratajot	–	–	√	–	–	–	–	–	–	–
110	*Heliotropium europaeum* L.	Boraginaceae		√	–	√	√	–	–	–	–	√	–
111	*Heliotropium* spp.	Boraginaceae	Dodosulo	–	–	√	–	–	–	–	–	–	–
112	*Heteropogon contortus* (L.) P. Beauv.	Poaceae		–	–	√	–	–	–	–	–	–	–
113	*Impatiens edgeworthii* Hook.f.	Scrophulariaceae		–	–	√	–	–	–	–	√	–	–
114	*Indigofera heterantha* Wall. Ex Brand	Fabaceae	Kachhi	–	√	√	√	–	–	–	–	–	–
115	*Juglans regia* L.	Juglandaceae	Achhoe	√	–	√	√	√	√	√	–	–	√
116	*Juncus* spp.	Juncaceae		–	–	√	√	–	–	–	–	–	–
117	*Kickxia ramosissima* (Wall.) Janchen	Scrophulariaceae		√	–	√	–	–	–	–	–	–	–
118	*Lactuca auriculata* (Wall. ex Dc.)	Asteraceae		–	–	√	–	–	–	–	–	√	–
119	*Lactuca dissecta* D. Don.	Asteraceae		–	–	√	–	–	–	–	–	√	–
120	*Lactuca serriola* L.	Asteraceae	Harool	–	–	√	–	–	–	–	–	√	–
121	*Lagenaria siceraria* (Molina) Standley	Cucurbitaceae		–	–	√	–	–	–	–	√	–	–
122	*Lepidium pinnitifidum* Ledeb.	Brassicaceae	Makoch	–	–	√	–	–	–	–	–	√	–
123	*Lespedeza elegans* Cambess.	Fabaceae		–	–	√	–	–	–	–	–	–	–
124	*Leucaena leucocephala* (Lam.) de-Wit	Mimosaceae		–	–	√	√	√	√	–	–	–	–
125	*Luffa cylindrica* (L.) Roem.	Cucurbitaceae		–	–	√	–	–	–	–	√	–	–
126	*Malva neglecta* Waller.	Malvaceae	Shani	–	–	√	–	–	–	–	√	√	–
127	*Malva parviflora* L.	Malvaceae	Zarooshal/Masha	–	–	√	–	–	–	–	√	√	–

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128	*Malvastrum coromendelianum* L.	Malvaceae		–	–	√	–	–	–	–	–	√	–
129	*Maytenus royleanus* (Wall. ex Lawson) Cufodontis	Celastraceae	Phaikar	–	–	√	–	–	–	–	–	–	–
130	*Medicago lupulina L.*	Fabaceae		–	–	√	–	–	–	–	–	√	–
131	*Melia azedarach* L.	Meliaceae		√	–	√	√	–	√	–	–	–	–
132	*Mentha longifolia* (L.) Huds.	Lamiaceae	Feeru	√	–	√	–	–	–	–	–	–	√
133	*Micromeria biflora* (Ham.) Bth.	Lamiaceae	Kaldajar	–	–	√	–	–	–	–	–	–	–
134	*Morus alba* L.	Moraceae	Marath	√	–	√	√	√	√	√	–	–	√
135	*Morus nigra* L.	Moraceae		√	–	√	√	√	√	√	–	–	√
136	*Myrtus communis* L.	Myrtaceae	Amboo/Lachi	√	–	√	√	–	–	√	–	–	√
137	*Nasturtium officinale* R. Br.	Brassicaceae	Zalzaal	√	–	√	–	–	–	–	√	–	√
138	*Nerium oleander* L.	Apocynaceae		–	–	–	√	–	–	–	–	–	√
139	*Olea ferruginea* Royle	Oleaceae		√	–	√	√	–	√	–	–	–	√
140	*Onopordum acanthium* L.	Asteraceae	Zehech	–	–	√	–	–	–	–	–	–	√
141	*Oxalis corniculata* L.	Oxalidaceae	Chukoo	–	–	√	–	–	–	–	–	√	–
142	*Parthenium hytserophorus* L.	Asteraceae		–	–	√	–	–	–	–	–	√	–
143	*Paspalidium flavidum* (Retz.) A. Camus	Poaceae		–	–	√	–	–	–	–	–	√	–
144	*Paspalum paspalodes* (Michx.) Scribner	Poaceae		–	–	√	–	–	–	–	–	√	–
145	*Pennesitum orientale* L.	Poaceae		–	–	√	–	–	–	–	–	–	–
146	*Periploca aphylla* Decne.	Asclepiadaceae	Sui	–	–	√	√	–	–	–	–	–	√
147	*Persicaria barbata* (L.) Hara	Polygonaceae	Danduni	–	√	√	–	–	–	–	–	–	√
148	*Phalaris minor* Retz.	Poaceae		–	–	√	–	–	–	–	–	√	–
149	*Phragmites australis* (Cav.) Trin.ex Steud.	Poaceae	Nai	–	–	√	√	–	–	–	–	–	√
150	*Phyla nodiflora* (L.) Greene	Verbenaceae		√	–	√	–	–	–	–	–	√	–

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151	*Physalis peruviana* L.	Solanaceae	Manakach	–	–	√	–	–	–	√	–	√	–
152	*Pinus gerardiana* Wall. non Lamb.	Pinaceae	Thulesh	√	–	–	√	√	√	√	–	–	√
153	*Pinus roxburghii* Sargent	Pinaceae	Chugi	–	–	–	√	–	–	–	–	–	√
154	*Pinus wallichiana* A.B. Jackson	Pinaceae	Chhar	–	–	√	√	√	√	–	–	–	√
155	*Pistacia chinensis* Bunge	Anacardiaceae	Kangar	√	–	√	√	–	√	–	–	–	√
156	*Plantago aitchisonii* Pilger	Plantginaceae	Shileet	–	–	√	–	–	–	–	–	–	–
157	*Plantago lanceolata* L.	Plantginaceae	Shileet	√	–	√	–	–	–	–	–	–	–
158	*Plantago ovata* Frossk.	Plantginaceae	Shileet	√	–	√	–	–	–	–	–	–	–
159	*Plectranthus rugosus* Wall. ex Bth.	Lamiaceae	Salal	–	–	√	–	–	–	–	–	–	√
160	*Poa annua* L.	Poaceae		–	–	√	–	–	–	–	–	√	–
161	*Polygonum affine* D. Don	Polygonaceae	Banke	–	–	√	–	–	–	–	–	√	–
162	*Polygonum effusum* Meirsn.	Polygonaceae	Banke	–	–	√	–	–	–	–	√	√	–
163	*Polygonum hydropiper* L.	Polygonaceae		–	–	√	–	–	–	–	–	–	–
164	*Polypogon fugax* Nees ex Steud.	Poaceae		–	–	√	–	–	–	–	–	√	–
165	*Polypogon monspeliensis* (L.) Desf.	Poaceae		–	–	√	–	–	–	–	–	√	–
166	*Populus deltoides* Bartram ex Marsh.	Salicaceae	Sufaida	–	–	√	√	√	√	–	–	–	√
167	*Portulaca oleracea* L.	Portulacaceae	Pishil	–	–	√	–	–	–	–	√	√	–
168	*Prunus amygdalus* Batsch	Rosaceae		√	–	√	√	–	√	√	–	–	√
169	*Prunus armeniaca* L.	Rosaceae	Ashae	√	–	√	√	–	√	√	–	–	√
170	*Prunus domestica* L.	Rosaceae	Aroo	√	–	√	√	–	√	√	–	–	√
171	*Pteridium aquilinum* (L.) Kuhn.	Pteridaceae		–	–	√	–	–	–	–	–	–	√
172	*Pteris crerica* L.	Pteridaceae	Kuenz	–	–	√	–	–	–	–	–	–	√
173	*Pteris vittata* L.	Pteridaceae	Kuenz	–	–	√	–	–	–	–	–	–	√
174	*Punica granatum* L.	Punicaceae	Dangoo	√	–	√	√	–	√	√	–	–	√

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175	*Pyrus communis* L.	Rosaceae	Taango	–	–	√	√	–	√	√	–	–	√
176	*Pyrus mallus* L.	Rosaceae	Bhaap	√	–	√	√	–	√	√	–	–	√
177	*Quercus baloot* Griffith	Fagaceae	Bani/Jaand	√	–	√	√	√	√	–	–	–	√
178	*Quercus dilatata* Lindl. ex Royle	Fagaceae	Kagani/Zharyun	–	–	√	√	√	√	–	–	–	√
179	*Rananculus scleratus* L.	Rananculaceae		√	–	√	–	–	–	–	–	–	–
180	*Rhus mysurensis* Heyne ex Wight & Arn.	Anacardiaceae	Kasudur	–	–	√	√	–	–	–	–	–	√
181	*Ribes alpestre* Dcne. ex Jacq.	Rosaceae	Shigay	√	–	√	√	–	–	–	–	–	√
182	*Ricinis communis* L.	Euphorbiaceae		√	–	–	√	–	–	–	–	–	√
183	*Robinia pseudoacacia* L.	Fabaceae		–	–	√	√	–	√	–	–	–	√
184	*Rubus ellipticus* Smith	Rubiaceae	Gorash	–	–	√	√	–	–	√	–	–	√
185	*Rumex dentatus* L.	Polygonaceae		–	–	√	–	–	–	–	–	√	–
186	*Rumex hastatus* D. Don	Polygonaceae		–	–	√	√	–	–	–	–	–	√
187	*Rumex nepalensis* Spreng	Polygonaceae	Hababil	√	√	√	√	–	–	–	–	–	–
188	*Saccharum ravennae* (L.) Murray	Poaceae	Swar phuroo	–	–	√	√	–	–	–	–	–	√
189	*Salix acmophylla* Boiss.	Salicaceae	Chhubi	–	–	√	√	–	–	–	–	–	√
190	*Salvia moorcroftiana* Wall. ex Bth.	Lamiaceae		√	–	√	–	–	–	–	–	–	–
191	*Saussurea albescens* (DC.) Schr. Bip.	Asteraceae		–	–	√	–	–	–	–	–	–	–
192	*Saussurea atkinsonii* Clarke	Asteraceae		–	–	√	–	–	–	–	–	–	–
193	*Saussurea heteromalla* DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
194	*Scorzonera virgata* DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
195	*Setaria glauca* (L.) P. Beauv	Poaceae		–	–	√	–	–	–	–	–	√	–
196	*Setaria viridis* (L.). P. Beauv.	Poaceae	Pashtili	–	–	√	–	–	–	–	–	√	–
197	*Silene conoidea* L.	Caryophyllaceae		–	–	√	–	–	–	–	–	√	–
198	*Solanum nigrum* L.	Solanaceae		√	–	√	–	–	–	–	–	√	–

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199	*Solanum surattense* Burm.f.	Solanaceae	Shuroo gae/mano gae	√	–	√	–	–	–	–	–	–	–
200	*Solanum villosum* (L.) Moench	Solanaceae		–	–	√	–	–	–	–	–	√	–
201	*Sonchus arvensis* f. brachyotus (DC.) Kirp.	Asteraceae		–	–	√	–	–	–	–	–	–	–
202	*Sonchus asper* (L.) Hill.	Asteraceae		–	–	√	–	–	–	–	–	√	–
203	*Sonchus oleraceus* L.	Asteraceae	Chuloor	–	–	√	–	–	–	–	–	√	–
204	*Sorghum halepense* (L.) Bern.	Poaceae		–	–	–	√	–	–	–	–	√	–
205	*Stellaria media* (L.) Cyr.	Caryophyllaceae		–	–	√	–	–	–	–	–	√	–
206	*Tagetes minuta* L.	Asteraceae		–	–	√	√	–	–	–	–	–	–
207	*Tamarix aphylla* (L.) Karst.	Tamaricaceae		–	–	–	√	–	–	–	–	–	√
208	*Taraxacum officinale* Weber.	Asteraceae	Palor	–	–	√	–	–	–	–	–	–	–
209	*Taraxcum wallichii* DC.	Asteraceae		–	–	√	–	–	–	–	–	–	–
210	*Themeda anathera* (Nees) Hack.	Poaceae	Furun	–	–	√	–	–	–	–	–	–	–
211	*Thymus serphyllum*	Lamiaceae	Isperki	–	–	√	–	–	–	–	–	–	√
212	*Tragus biflorus* Schult.	Poaceae		–	–	√	–	–	–	–	–	–	–
213	*Tribulus longipetalus* Viv.	Zygophyllaceae	Shiwo kuroo	–	–	√	–	–	–	–	–	–	–
214	*Tribulus* spp.	Zygophyllaceae	Shiwo kuroo	–	–	√	–	–	–	–	–	–	–
215	*Tribulus terrestris* L.	Zygophyllaceae	Shiwo kuroo	√	–	√	–	–	–	–	–	√	–
216	*Trifolium repens* L.	Fabaceae		–	–	√	–	–	–	–	–	–	–
217	*Urtica dioica* L.	Urticaceae	Jomi	–	–	–	–	–	–	–	√	–	–
218	*Valeriana stracheyi*	Valerianaceae	Koindaru	–	–	√	–	–	–	–	–	–	–
219	*Valeriana wallichii* DC.	Valerianaceae		–	–	√	–	–	–	–	–	–	–
220	*Verbascum thapsus* L.	Scrophulariacea e	Khardak/Kher os	√	–	√	√	–	–	–	–	–	–
221	*Verbena officinalis* L.	Verbenaceae	Chiroo	–	–	√	–	–	–	–	–	√	–
222	*Veronica beccabunga* L.	Scrophulariacea		–	–	√	–	–	–	–	–	–	–

Sr. No.	Plant Species	Family	Local name	Medicinal	Ethno -Vet.	Fodder	Fuel	Timber	Agri. Imp.	Fruit	Vege-table	Weeds	Others
		e											
223	*Vitex negundo* L.	Verbenaceae		√	–	√	√	–	–	–	–	–	√
224	*Vitis himalyana*	Vitaceae	Kuchar jachh	–	–	√	√	–	–	–	–	–	–
225	*Vitis jaquemontii* Parker	Vitaceae	Magrath	–	–	√	√	–	–	–	–	–	–
226	*Vitis vinifera* L.	Vitaceae	Jach	√	–	√	√	–	–	√	–	–	√
227	*Withania coagulens* Dunal	Solanaceae		√	–	–	√	–	–	–	–	–	–
228	*Xanthium strumarium* L.	Asteraceae	Kundi	–	–	–	√	–	–	–	–	√	–
229	*Zizyphus sativa* Gaertn	Rhamnaceae	Sizin/Sigiun	√	–	√	√	–	–	–	–	–	–
				57	**5**	**213**	**78**	**13**	**30**	**21**	**16**	**74**	**67**

Note: Out of 232, 229 species are subjected to some sort of use in the local area.

Annex – 4.4

DATA ON PASSERINE AND MIGRATORY BIRDS

Table 4.4.1: Non-passerines Birds Recorded from Dasu Project Area

S/No	Common Name	Scientific Name	Family	Status	Remarks
1.	Great or Eurasian Cormorant **	*Phalacrocorax carbo sinensis*	Phalacrocoracidae	A	Kandian river-shallow water
2.	Chukar *	*Alectoris chukar*	Phasianidae	C	8 observed Laachi Nallah on mountain slopes, reported from all the area from Dasu to Basha
3.	Grey Partridge/Francolin*	*Francolinus pondicerianus*	Phasianidae	C	Crossed the KKH near Kandian Suspended bridge; reported from Laachi nullah area
4.	Himalayan Monal*	*Lophophorus impejanus*	Phasianidae	R	Stuffed bird at Dasu town hunted from Kandian Valley few month ago; reported from Kaigah, Laachi, Sazin
5.	Western Tragopan*	*Tragopan melanocephalus*	Phasianidae	V	Reported from higher valleys of Kandian, Laachi, Sazin Kot, Kaigah
6.	Marsh harrier**	*Circus aeruginosus*	Accipitridae	C	Kandian Valley
7.	Black kite*	*Milvus migrans*	Accipitridae	A	Kandian valley, Shatial, Laachi
8.	Shikra *	*Accipiter badius*	Accipitridae	F	Laachi Nallah
9.	Common Kestrel*	*Falco tinnunculus*	Falconidae	C	Laachi, Kandian, Waliabad, Razika village, Down-stream near Zaid Khar Nullah
10.	Water rail**	*Rallus aquaticus*	Rallidae	F	Kandian Valley
11.	Red-wattled lapwing*	*Vanellus indicus*	Charadriidae	A	Couching Village
12.	Common sandpiper***	*Actitis hypoleucos*	Tringinae	C	Near Dasu on Right bank
13.	Blue rock pigeon*	*Columba livia*	Columbidae	A	Common from Kandian suspended bridge up to Basha
14.	Indian ring dove*	*Streptopelia decaocto*	Columbidae	A	Dasu, Kandian
15.	Oriental turtle dove*	*Streptopelia orientalis*	Columbidae	C	Kandian Valley
16.	Little brown dove*	*Streptopelia senegalensis*	Columbidae	A	Dasu, downstream before the Zaid Khar Nallah

S/No	Common Name	Scientific Name	Family	Status	Remarks
17.	Spotted dove***	*Streptopelia chinensis*	Columbidae	C	Dasu, Chochung
18.	Northern eagle owl*	*Bubo bubo*	Strigidae	F	Laachi Nallah area
19.	Common kingfisher*	*Alcedo atthis*	Apodidae	F	Kandian Valley
20.	Indian roller*	*Coracias benghalensis*	Meropidae	C	Chochung, Dasu
21.	Hoopoe*	*Upupa epops*	Upupidae	C	Waliabad, Chochung, Kandian valley
22.	Asian Koel***l	*Eudynamys scolopacea*	Cuculidae	C	Near Seo Village

*Resident; **Passage migrant; ***Summer breeder/wintering; A=Abundant; C=Common; F=Frequent; S=Scarce; V=Vulnerable; R=Rare (status described by Roberts, 1991, 1992)

Table 4.4.2: Passerines Birds Recorded from Kohistan area

S/No	Common Name	Scientific name	Family	Status	Remarks
1.	Crested lark*	*Galerida cristate*	Alaudidae	A	Waliabad, sandy and gravel area along left bank of Indus
2.	Yellow wagtail**	*Motacilla flava*	Motacillidae	C	Dasu
3.	Grey wagtail***	*Motacilla cinera*	Motacillidae	C	Melar
4.	White/pied wagtail***	*Motacilla alba*	Motacillidae	A	Summar Nallah, Kandian valley, Dasu, Laachi
5.	Large wagtail*	*Motacilla maderaspatensis*	Motacillidae	C	Kandian Valley, Dasu
6.	White-cheeked bulbul*	*Pycnonotus leucogenys*	Pycnonotidae	A	Melar, Panibagh, Chochung, Kandian Valley, Dasu
7.	Brown dipper*	*Cinclus pallasii*	Cinclidae	C	Kandian river –shallow river area
8.	Blue throat**/***	*Luscinia svecia*	Turdidae	F	Chochung, Kandian
9.	Indian blue robin**/***	*Luscinia brunnea*	Turdidae	C	Laachi nullah
10.	Blue-headed redstart***	*Phoenicurus caeruleocephalus*	Turdidae	C	Laachi nullah
11.	Black redstart***	*Phoenicurus ochruros*	Turdidae	C	Dasu, Kandian valley, Laachi

S/No	Common Name	Scientific name	Family	Status	Remarks
12.	White-bellied Redstart*	*Hodgsonius phoenicuroides*	Turdidae	S	Goshali Village-on left bank of supit nullah-downstream
13.	Plumbeous water Redstart***	*Rhyacornis fuliginosus*	Turdidae	C	Kandian river, Shallow water
14.	Common Stonechat**/***	*Saxicola torquate*	Turdidae	C	Laachi nullah
15.	Pied Bushchat*	*Saxicola caprata*	Turdidae	C	Kandian river's bank, Razika
16.	Rufous-tailed Rock Thrush**	*Monticola saxatilis*	Turdidae	R	Razika
17.	Blue whistling thrush***	*Myiophoneus cacruleus*	Turdidae	C	Dasu, Melar, Kandian valley, Barseen Nallah, Seo
18.	Eurasian blackbird*	*Turdus merula*	Turdidae	F	Near Pattan
19.	Grey-hooded flycatcher***	*Seicercus xanthoschistos*	Sylviidae	C	Melar, Chochung
20.	White-cheeked nuthatch*	*Sitta leucopsis*	Sittidae	C	Dasu, Shatial, Melar, Barseen Nallah, Chochung, Laachi, Kandian valley
21.	Eurasian nuthatch***	*Sitta europaea*	Sittidae	F	Sazin kot, Dasu
22.	Isabelline shrike ***	*Lanius isbellinus*	Laniidae	F	Dasu, Panibagh, Melar
23.	Bay-backed shrike*	*Lanius vittatus*	Laniidae	C	Dasu, Panibagh, Melar
24.	Jungle crow*	*Corvus macrorhynchos*	Corvidae	C	Common in all the area from Dasu to Basha
25.	House crow*	*Corvus splendens*	Corvidae	A	Around Dasu town
26.	Common Raven*	*Corvus corax*	Corvidae	F	Laachi, Kandian valley
27.	Lanceolated/Black-headed Jay*	*Garrulus lanceolatus*	Corvidae	F	Melar, Panibagh
28.	Yellow-billed Chough*	*Phyrhocorax phyrhocorax*	Corvidae	A	Razika village
29.	Common myna*	*Acridotheres tristis*	Sturnidae	A	Common in all the area from Dasu to Basha
30.	Jungle myna*	*Acridotheres fuscus*	Sturnidae	F	Choochang, Kandian, Laachi Nallah
31.	House sparrow *	*Passer domesticus*	Passeridae	A	Common in all the area from Dasu to Basha especially near human settlements

S/No	Common Name	Scientific name	Family	Status	Remarks
32.	Red-fronted serin*	*Serinus pusillus*	Carduelinae	A	Kandian valley, Razika village
33.	Rock bunting ***	*Emberiza cia*	Emberizinae	C	Chochung, Kandian, Laachi, Sazin
34.	Grey necked bunting***	*Emberiza buchanani*	Emberizinae	S	Kandian, Laachi
35.	Black Drongo*	*Dicrurus macrocercus*	Dicruridae	A	Dasu
36.	Great Tit*	*Parus major*	Paridae	C	Panibagh, Waliabad

*Resident; **Passage migrant; ***Summer breeder/wintering; A=Abundant; C=Common; F=Frequent; S=Scarce; V=Vulnerable; R=Rare (status described by Roberts, 1991, 1992)

Table 4.4.3: Aquatic/ Wetland Birds in Project Area[1]

Sr./No	Common Name	Scientific name	Family	Remarks
1.	Great or Eurasian Cormorant	*Phalacrocorax carbo sinensis*	Phalacrocora-cidae	Kandia river-shallow water
2.	Water rail	*Rallus aquaticus*	Rallidae	Kandia Valley
3.	Red-wattled lapwing	*Vanellus indicus*	Charadriidae	Choochang Village
4.	Common sandpiper	*Actitis hypoleucos*	Tringinae	Near Dasu on Right bank
5.	Common kingfisher	*Alcedo atthis*	Alcedinidae	Kandia Valley
6.	White-breasted kingfisher	*Halcyon smyrnesis*	Alcedinidae	Near Dasu on Right bank
7.	Marsh harrier	*Circus aeruginosus*	Accipitridae	Kandia Valley
8.	Yellow wagtail	*Motacilla flava*	Motacillidae	Dasu
9.	Grey wagtail	*Motacilla cinera*	Motacillidae	Malyar
10.	White/pied wagtail	*Motacilla alba*	Motacillidae	Summar Nullah, Kandia valley, Dasu, Laachi

[1] Note:
1-Species listed from 1-15 were recorded during field surveys conducted in July-September 2012
2-Analysis is completed for other potential wetland birds that are already reported to visiting/ staging/ migrating in this area and or they will likely be attracted to the large water body after the construction of the reservoir.
3- It is anticipated that this list will continue to grow as information and data becomes available.

Sr./No	Common Name	Scientific name	Family	Remarks
11.	Large wagtail	*Motacilla maderaspatensis*	Motacillidae	Kandia Valley, Dasu
12.	Brown dipper	*Cinclus pallasii*	Cinclidae	Kandia river –shallow river area
13.	Black redstart	*Phoenicurus ochruros*	Turdidae	Dasu, Kandia valley, Laachi
14.	White-bellied Redstart	*Hodgsonius phoenicuroides*	Turdidae	Goshali Village-on left bank of supit nullah-downstream
15.	Plumbeous water Redstart	*Rhyacornis fuliginosus*	Turdidae	Kandia river, Shallow water
16.	Grey Heron	*Ardea Cinerea*	Ardeidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
17.	Grelag Goose	*Anser anser*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
18.	Ruddy shelduck	*Tadorna ferruginea*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
19.	Wigeon	*Anas penelope*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
20.	Gadwall	*Anas strepera*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
21.	Common teal	*Anas crecca*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
22.	Mallard	*Anas platyrynchos*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
23.	Ferruginous duck	*Aythya nyroca*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
24.	Pintail	*Anas acuta*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
25.	Shoveler	*Anas clypeata*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
26.	Common Pochard	*Aythya ferina*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
27.	Tufted duck	*Aythya fuligula*	Anatidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence

Sr./No	Common Name	Scientific name	Family	Remarks
28.	Common crane	*Grus grus*	Gruidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
29.	Demoiselle crane	*Anthropoides virgo*	Gruidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
30.	Pheasant-tailed Jacana	*Hydrophasianus chirugus*	Jacanidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
31.	Curlew sandpiper	*Calidris ferruginea*	Scolopacidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
32.	Ruff	*Philomachus pugnax*	Scolopacidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
33.	Common snipe	*Gallinago gallinago*	Gallinagininae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
34.	Red shank	*Tringa tetanus*	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
35.	Green shank	*Tringa nebularia*	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
36.	Marsh sandpiper	*Tringa stagnatilis*	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
37.	Common sandpiper	*Actitia hypoleucos*	Tringinae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
38.	Caspian tern	*Sterna caspica*	Sternidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence
39.	Water pipit	*Anthua spinoletta*	Motacillidae	Reported in secondary data/ literature. Further field surveys during migratory season/ winter may confirm their distribution/ occurrence

ANNEX 4.5

TRAFFIC DATA ALONG KKG AND LOCAL ROADS

Table 4.5.1: Traffic Counts on Bridges on Indus (To and fro traffic from left bank to right bank)

Dates	Days	Location	Vehicle										
			Bicycle	Motor cycle	Car	Jeep	Loader/ Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
01-06-12	Friday	Largani	0	14	34	3	2	3	0	0	0	0	0
02-06-12	Saturday	Kandia	0	0	36	2	32	0	0	0	0	0	0
03-06-12	Sunday	Tangir	1	31	66	6	8	15	0	7	0	0	2
03-06-12	Sunday	Shatial	0	122	67	35	5	16	0	5	0	2	0

Dates	Days	Location	Pedestrian	Livestock					
				Cow	Buffalo	Goats / Sheep	Donkey / Mule	Horse	Other (Stray Animals)*
01-06-12	Friday	Largani	177	16	0	30	2	1	11
02-06-12	Saturday	Kandia	53	0	0	21	0	0	0
03-06-12	Sunday	Tangir	37	2	0	0	0	0	0
03-06-12	Sunday	Shatial	126	3	0	4	0	0	2

*Stray Dogs, Cats

Note: Traffic survey for suspension bridges was conducted only for 12 hrs.

Table 4.5.2: Traffic Count Survey in Pattan, Besham and Thakot on KKH

Dates	Days	Location	Vehicle											Total Vehicle
			Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles	
12-06-12	Tue	Pattan	0	54	122	46	64	65	5	64	30	1	0	451
12-06-12	Tue	Besham	1	9	84	28	43	9	22	20	6	0	20	242
13-06-12	Wed	Besham	8	207	1215	199	741	290	24	191	43	20	0	2938
(13-14)-06-2012	Wed - Thu	Thakot	15	214	413	191	282	180	103	363	126	113	103	2103

Note: Traffic count survey was done in Pattan for 6 hrs, Thakot for 24 hrs and in Besham it was done for 3 hrs in the night and 12 hrs in the day time.

Table 4.5.3: Traffic Count Survey of Jalkot Road, Dasu

Dates	Days	Vehicle										
		Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
08-06-12	Friday	6	58	272	50	59	46	0	0	0	4	0
09-06-12	Saturday	2	72	281	33	19	28	0	0	0	0	0
10-06-12	Sunday	0	54	267	25	30	10	0	0	0	0	0
	Total	8	184	820	108	108	84	0	0	0	4	0
	Average/Day	3	61	273	36	36	28	0	0	0	1	0

Dates	Days	Pedestrian	Livestock					
			Cow	Buffalo	Goats / Sheep	Donkey / Mule	Horse	Other (Stray Animals)*
08-06-12	Friday	4317	33	16	222	27	13	37
09-06-12	Saturday	4308	24	0	373	14	4	28
10-06-12	Sunday	3148	6	0	337	13	0	38
	Total	11773	63	16	932	54	17	103
	Average/Day	3924	21	5	311	18	6	34

Table 4.5.4: Traffic Count Survey of Komila Bazar Entrance on KKH

Dates	Days	Vehicle										
		Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
05-06-12	Tuesday	16	304	1082	410	500	489	127	295	50	11	15
06-06-12	Wednesday	16	298	997	223	479	381	167	338	63	67	44
07-06-12	Thursday	12	335	822	252	413	382	148	340	47	46	33
	Total	44	937	2901	885	1392	1252	442	973	160	124	92
	Average/Day	15	312	967	295	464	417	147	324	53	41	31

Dates	Days	Pedestrian	Livestock					
			Cow	Buffalo	Goats / Sheep	Donkey / Mule	Horse	Other (Stray Animals)*
05-06-12	Tuesday	3190	21	8	334	8	3	50
06-06-12	Wednesday	6025	6	2	195	5	3	47
07-06-12	Thursday	6290	16	18	328	17	4	50
	Total	15505	43	28	857	30	10	147
	Average/Day	5168	14	9	286	10	3	49

Table 4.5.5: Traffic Count Survey of Dasu near NATCO Hotel, 3km from Dasu Bridge

Dates	Days	Vehicle										
		Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
4/28/2012	Saturday	9	242	649	251	256	216	201	383	58	2	25
4/29/2012	Sunday	22	246	795	357	383	340	253	547	106	0	37
4/30/2012	Monday	1	225	661	257	266	253	177	399	58	9	5
08-5-2012	Tuesday	1	184	654	274	344	244	161	403	50	17	18

Dates	Days	Vehicle										
		Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
5/9/2012	Wednesday	4	206	623	265	315	262	192	433	74	4	48
5/10/2012	Thursday	0	204	620	285	280	260	218	411	57	2	37
5/11/2012	Friday	6	276	600	244	284	247	228	428	157	23	50
	Total	43	1583	4602	1933	2128	1822	1430	3004	560	57	220
	Average/day	6	226	657	276	304	260	204	429	80	8	31
	Percentage	0	9	26	11	12	10	8	17	3	0	1

Dates	Days	Pedestrian	Livestock					
			Cow	Buffalo	Goats / Sheep	Donkey/Mule	Horse	Other (Stray Animals)*
4/28/2012	Saturday	1218	52	0	60	55	3	70
4/29/2012	Sunday	1586	132	5	123	106	40	171
4/30/2012	Monday	1230	67	0	84	45	1	72
08-5-2012	Tuesday	1084	89	0	259	55	11	59
5/9/2012	Wednesday	1261	88	0	175	84	0	106
5/10/2012	Thursday	1187	70	2	186	80	12	111
5/11/2012	Friday	1426	133	0	401	134	2	148
	Total	8992	631	7	1288	559	69	737
	Average/day	1285	90	1	184	80	10	105
	Percentage	73	5	0	10	5	1	6

*Stray Dogs, Cats
Note: Figures are accumulative traffic count (i.e. To Gilgit & from Gilgit)

Table 4.5.6: Traffic Count Survey of Seo Road, Komila

Dates	Days	Vehicle										
		Bicycle	Motor cycle	Car	Jeep	Loader / Pick up	Van / Hiace	Coaster / Bus	Trucks	Heavy Loader	Tractor Trolley	Military Vehicles
05-06-12	Tuesday	10	176	490	148	259	180	0	0	0	10	2
06-06-12	Wednesday	0	158	434	143	218	175	0	0	0	10	0
07-06-12	Thursday	0	158	574	213	293	285	0	0	0	12	0
	Total	10	492	1498	504	770	640	0	0	0	32	2
	Average/Day	3	164	499	168	257	213	0	0	0	11	1

Dates	Days	Pedestrian	Livestock					
			Cow	Buffalo	Goats / Sheep	Donkey / Mule	Horse	Other (Stray Animals)*
05-06-12	Tuesday	2694	12	6	32	4	0	27
06-06-12	Wednesday	1313	12	13	43	6	2	19
07-06-12	Thursday	1530	4	12	14	2	0	21
	Total	5537	28	31	89	12	2	67
	Average/Day	1846	9	10	30	4	1	22

*Stray Dogs, Cats

Table 4.5.7: Traffic Count Statistics (Hourly Basis) – KKH Traffic Analysis

Date: 28 April to 11 May 2012

Hour	Vehicle (No) Average / Day	Pedestrian + Livestock (No) Average / Day
8:00-9:00	132	125
9:00-10:00	136	102
10:00-11:00	152	108
11:00-12:00	156	111
12:00-1300	144	90
1300-1400	136	101
1400-1500	133	97
1500-1600	129	118
1600-1700	161	116
1700-1800	126	104
1800-1900	122	126
1900-2000	87	71
2000-2100	82	62
2100-2200	70	52
2200-2300	82	26
2300-00:00	65	25
00:00-1:00	60	40
1:00-2:00	61	16
2:00-3:00	52	18
3:00-4:00	53	23
4:00-5:00	65	27
5:00-6:00	75	40
6:00-7:00	87	68
7:00-8:00	123	95

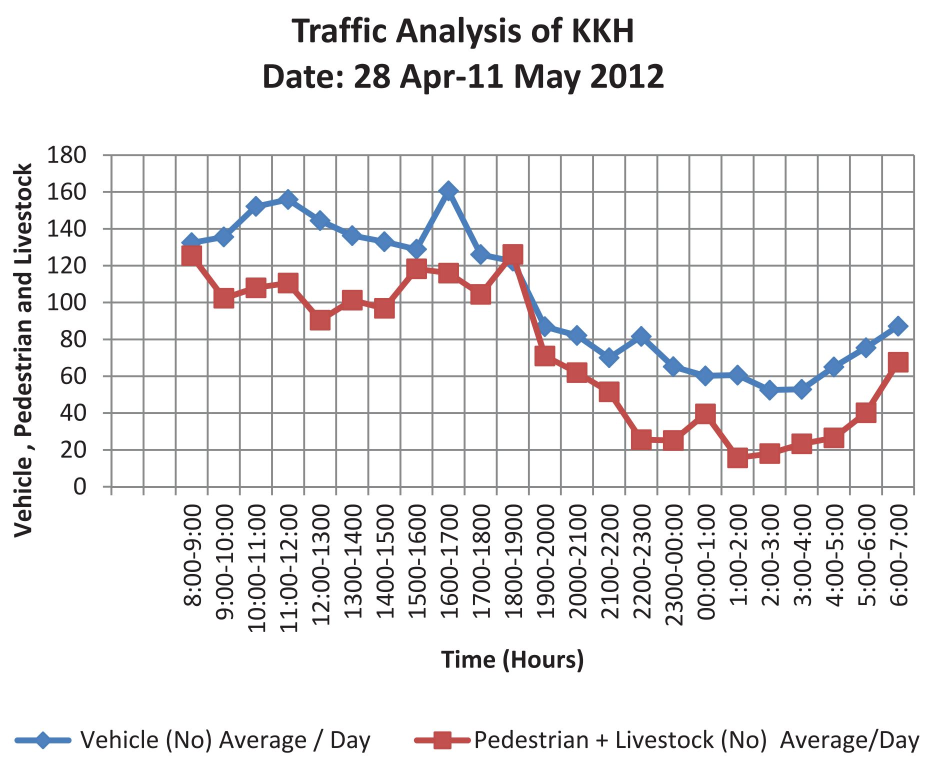


Table 4.5.8: Traffic Count Statistics (Hourly Basis) –Komila Bazar Entrance Traffic Analysis

Date: 5 to 7 June 2012

Hour	Vehicle (No) Average / Day	Pedestrian + Livestock (No) Average / Day
7:00-8:00	177	483
8:00-9:00	172	358
9:00-10:00	182	402
10:00-11:00	170	385
11:00-12:00	155	365
12:00-1300	204	412
1300-1400	203	248
1400-1500	194	367
1500-1600	164	328
1600-1700	259	499
1700-1800	223	347
1800-1900	183	482
1900-2000	160	183
2000-2100	95	69
2100-2200	68	43
2200-2300	49	18
2300-00:00	31	112
00:00-1:00	22	5
1:00-2:00	17	0
2:00-3:00	24	109
3:00-4:00	26	75
4:00-5:00	52	48
5:00-6:00	86	62
6:00-7:00	130	142

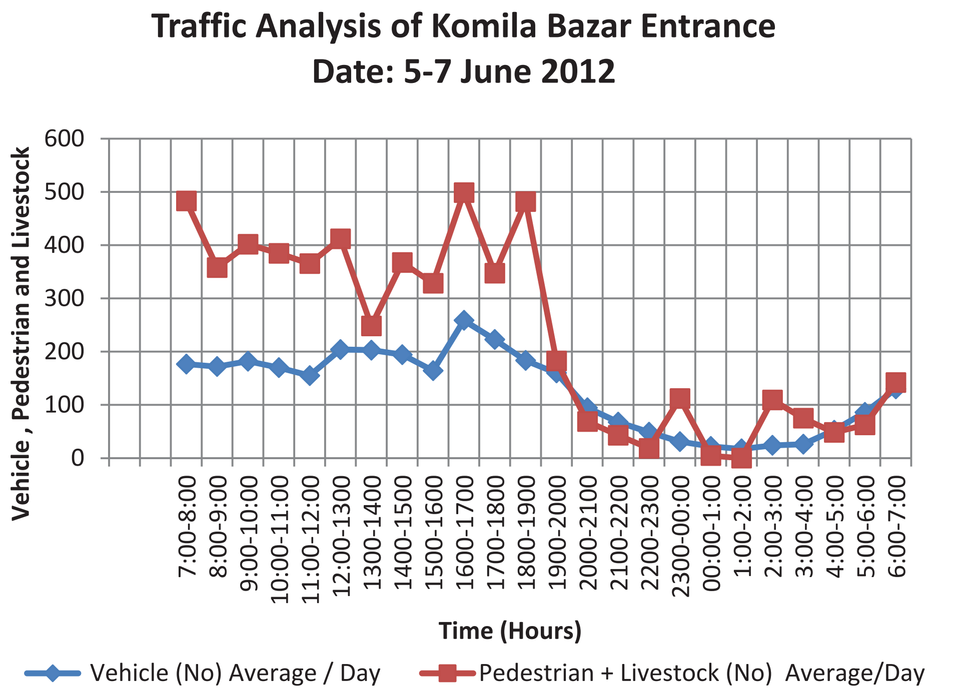


Table 4.5.9: Traffic Count Statistics (Hourly Basis) – Seo Road Traffic Analysis

Date: 5 to 7 June 2012

Hour	Vehicle (No) Average / Day	Pedestrian + Livestock (No) Average / Day
7:00-8:00	86	102
8:00-9:00	103	115
9:00-10:00	109	122
10:00-11:00	78	110
11:00-12:00	74	101
12:00-1300	69	101
1300-1400	93	173
1400-1500	81	153
1500-1600	111	143
1600-1700	96	118
1700-1800	134	195
1800-1900	75	194
1900-2000	47	99
2000-2100	35	40
2100-2200	25	28
2200-2300	9	21
2300-00:00	6	3
00:00-1:00	4	0
1:00-2:00	2	0
2:00-3:00	2	0
3:00-4:00	2	5
4:00-5:00	19	16
5:00-6:00	20	26
6:00-7:00	43	55

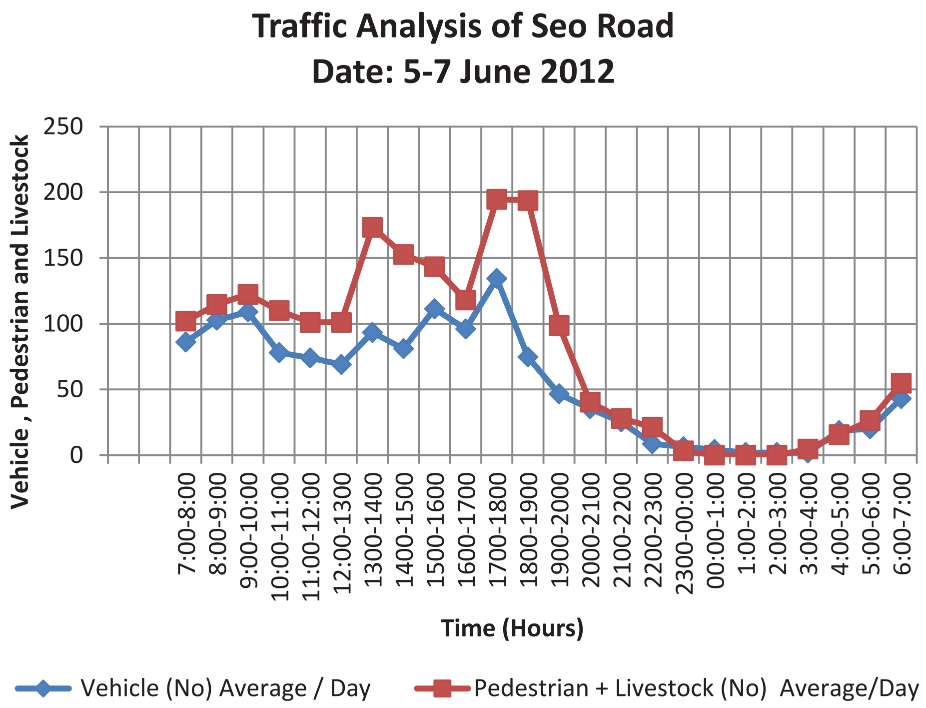


Table 4.5.10: Traffic Count Statistics (Hourly Basis) – Jalkot Road Traffic Analysis

Date: 8 to 10 June 2012

Hour	Vehicle (No) Average / Day	Pedestrian + Livestock (No) Average / Day
7:00-8:00	37	567
8:00-9:00	39	278
9:00-10:00	15	179
10:00-11:00	30	351
11:00-12:00	24	314
12:00-1300	27	265
1300-1400	23	180
1400-1500	19	196
1500-1600	27	246
1600-1700	21	288
1700-1800	30	416
1800-1900	23	385
1900-2000	32	231
2000-2100	21	37
2100-2200	11	18
2200-2300	4	12
2300-00:00	2	102
00:00-1:00	0	2
1:00-2:00	0	54
2:00-3:00	0	0
3:00-4:00	0	64
4:00-5:00	7	13
5:00-6:00	16	26
6:00-7:00	32	87

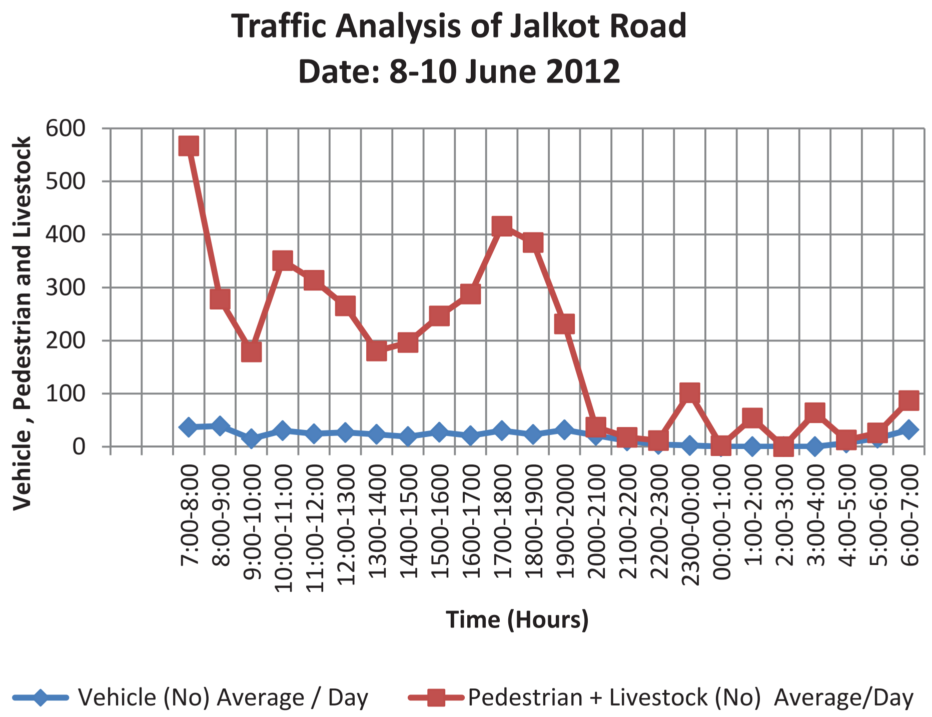
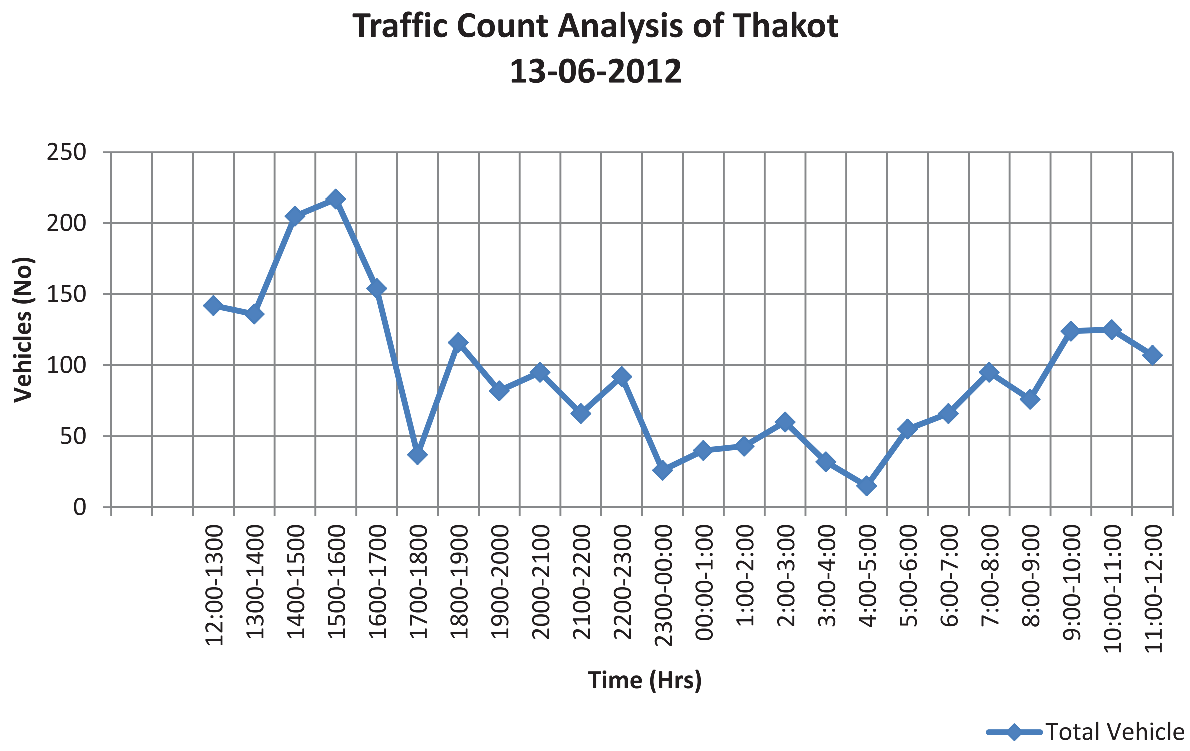


Table 4.5.11: Traffic Count Statistics (Hourly Basis) – Thakot Bridge Traffic Analysis

Date: 13 June 2012

Hour	Total Vehicles
12:00-1300	142
1300-1400	136
1400-1500	205
1500-1600	217
1600-1700	154
1700-1800	37
1800-1900	116
1900-2000	82
2000-2100	95
2100-2200	66
2200-2300	92
2300-00:00	26
00:00-1:00	40
1:00-2:00	43
2:00-3:00	60
3:00-4:00	32
4:00-5:00	15
5:00-6:00	55
6:00-7:00	66
7:00-8:00	95
8:00-9:00	76
9:00-10:00	124
10:00-11:00	125
11:00-12:00	107



Annex – 5.1

ANALYSIS OF ALTERNATIVES FOR WATERWAYS (INTAKE & TAILRACE TUNNELS)

Three alternatives were considered for waterways (intake and tail race tunnels) in Feasibility Study and an alternative that produces significantly greater energy than the other alternatives was recommended. However the feasibility study did not evaluate the impact of Khoshe fault on the location of the power house and its stability – though Khoshe fault which is crossing at the mid of the tailrace tunnel is not an active fault and would not be seriously weak nor fractured. During detailed design, the feasibility study alternative (Alternative 1) is further compared with 3 more possible alternatives. Plan and profile of all these 3 alternatives are presented in Figure 1 (Alternative 1, feasibility alignment), Figure 2 (Alternative 2); Figure 3 (Alternative 3) and Figure 4 (Alternative 4).

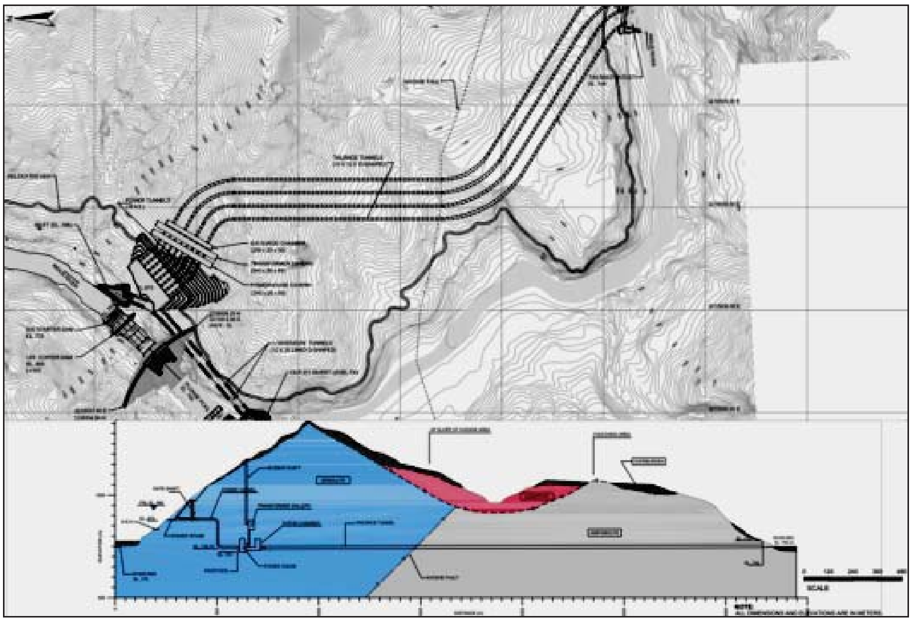


Figure 1: Waterway Plan and Profile of Alternative 1 (Feasibility Alignment)

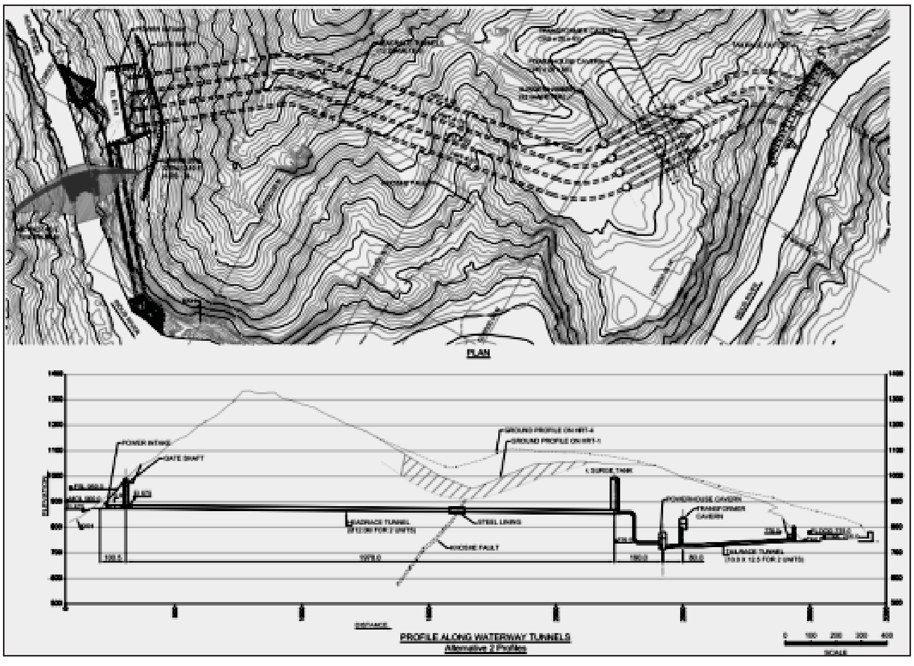


Figure 2 : Waterway Plan and Profile of Alternative 2

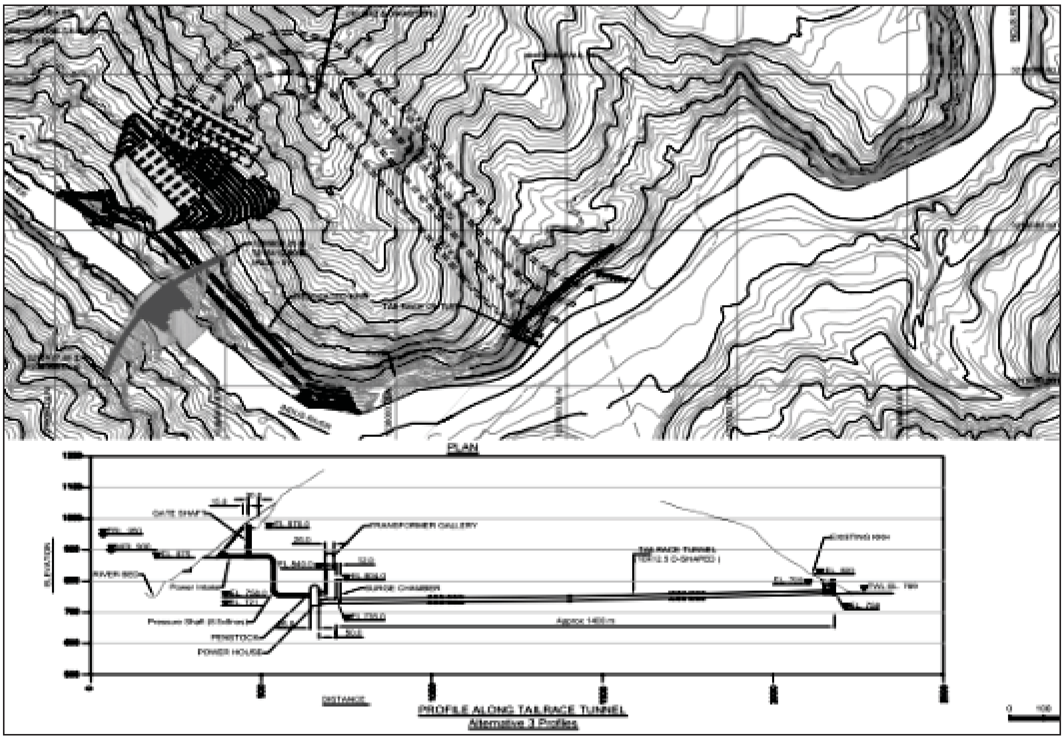


Figure 3: Waterway Plan and Profile of Alternative 3

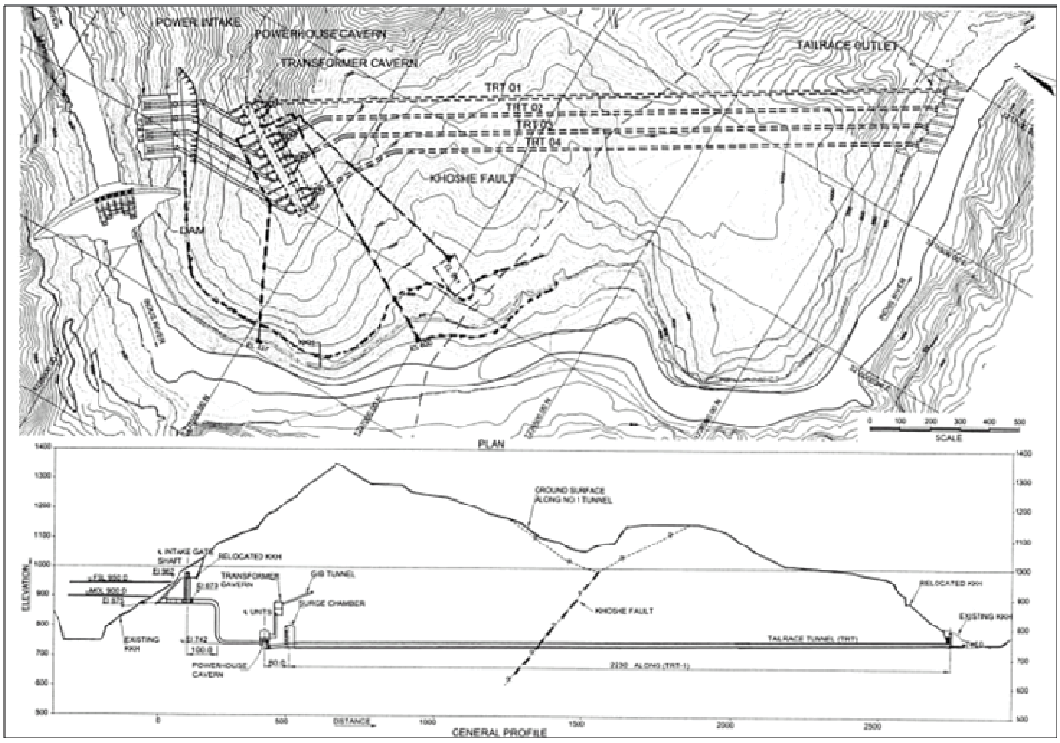


Figure 4: Waterway Plan and Profile of Alternative 4

The analysis of all four alternatives is presented in Table 1. Alternative 1 is a recommendation of feasibility study, in which power house is located .on the upstream side of the Khoshe fault and tail race tunnel crosses the fault. In Alternative 2, the power house is located on the downstream of the fault. Alternative 3 completely avoids crossing any facility through the fault. Alternative 4 is a slight modification of Alternative 1, in which the tail race tunnels are straight without any bend.

Table 1: Alternatives for Waterways

	Alternative 1 (FS Alternative)	**Alternative 2**	**Alternative 3**	**Alternative 4**
Location with respect to Khoshe fault	Recommended by Feasibility Study. Intake and powerhouse complex is located in the left abutment of dam and its tailrace tunnels are extended downstream by 2.7 km from the power cavern. The tail race tunnels cross the Khoshe fault some 1.2 km downstream of the underground powerhouse	Intake location is similar to Alternative 1, but the power house is located on the downstream of Khoshe fault. Headrace tunnels cross the fault	Location of intake and powerhouse complex is identical to the above Alternative I. However, the tailrace tunnels are shortened to the average length of 1.4 km in order to avoid the tunnels crossing through the Khoshe fault. Outlets of the tailrace tunnels are located immediate upstream of the Khoshe fault on the left bank.	Similar to Alternative 1 in terms of intake location, but the headrace tunnel is extended to 500. The tail race tunnels are straight and crosses Khoshe fault
Length of water ways	2..885 km (0.26 km headrace and 2.625 km tail race)	2.57 km (1.97 km headrace and 0.6 km tail race)	1.66 km (0.26 km headrace and 1.4 km tail race)	2.7 km (0.5km head race and 2.2 km of tail race0
Linearity of the Waterways	Have a 60^{o} horizontal bend aiming at avoiding sharp angle crossing with rock discontinuity planes.	Have a bend.	Curved	Straight, waterway for hydropower generation should be straight as much as possible to minimize head loss in the waterway, provided that rock conditions along the tunnels are good enough for tunneling
Power generation capacity (including gross head)	4320 MW 195m (FSL is 950 m and tunnel outlet level is 755m)	Similar to Alternative 1	4070 MW 181 (FSL is 950 m and tunnel outlet level is 769m)	Similar to Alternative 1
Protection against Khoshe fault	The tunnels cross the Khoshe fault but water leak to the surrounding fault zone will not occur because internal water pressure will be lower than	The tailrace tunnels receiving internal water pressure of 100 m head have to pass through Khoshe fault where minimum depth of ground	No protection is required since tunnels are not crossing the fault	Similar to Alternative 1. Based on the geological surveys conducted during detailed design, it was found that is

	Alternative 1 (FS Alternative)	Alternative 2	Alternative 3	Alternative 4
	surrounding ground water pressure which is at least greater than water column pressure measured below the nearby river water level.	cover over the tunnel is only 100 m. To prevent water leak to ground surface in the fault zone, the tunnels need to be steel-lined in a certain section (say 100 m).		a normal contact of rock types or an inactive fault with limited displacement. Hence Khoshe fault will not affect any alternatives
Surge shafts	No upstream surge shaft is required because of short tunnel between turbine and intake. Tailrace surge shafts or chambers are required to dampen surge waves as the tailrace tunnels are long.	Because of long pressure tunnel between turbines and intake, upstream surge shaft is required to mitigate water hammer pressure and dampen surge waves.	No upstream surge shaft is required. On the downstream side, Since tailrace tunnels are still not sufficiently short, surge chamber is required in tailrace but size of the chamber can be much smaller than Alt. I.	Similar to Alternative 1
Cost Total Base price of the Project (million dollars)	Less than Alternative 2 5204.6	Higher 5462.7 (5% higher than Alternative 1)	Lower 4988.8 (4.1% less than alternative 1) owing to shorter length of the water way	Less than Alternative 1 5051 (3% less than Alternative 1
Conclusion				Since Khoshe fault is not active, final alternative was chosen based on economic evaluation. Alternative 4 is preferable since it is more economical than alternative 1 with shorter and straight tunnels.

Annex – 6.1

METHODOLOGY FOR CALCULATIONS OF GHG EMISSIONS FROM DHP

GHG emissions are calculated in accordance with the revised 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories. These Guidelines contain a description of inventory methodologies and comprehensive emission factors for all major sources and interventions. The inventory is divided into following four main categories and each of these categories is further subdivided within the inventory.

- Energy
- Industrial Processes and Product Use
- Agriculture, Forestry and Other Land Use
- Waste

6.1.1 During Construction

The IPCC methodology breaks the calculation of emissions (e.g., for carbon dioxide) from fuel combustion into 6 steps:

***Step 1*:** Estimate Apparent Fuel Consumption in Original Units
***Step 2*:** Convert to a Common Energy Unit
***Step 3*:** Multiply by Emission Factors to Compute the Carbon Content
***Step 4*:** Compute Carbon Stored
***Step 5*:** Correct for Carbon Unoxidized
***Step 6*:** Convert Carbon Oxidized to CO_2 Emissions

A yearly inventory of the following direct and indirect GHGs is prepared up to 2019 when the dam construction will be completed and first stage of hydropower plant will start commissioning.

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Non Methane Volatile Organic Compounds (NMVOC).

The data used for the estimation of emissions has been collected from the following sources.

- Traffic counts data and traffic forecast
- Area of the asphalt pavement and the quantity of the bitumen
- Fuel consumption by type of vehicles
- Type, number and usage rate of construction vehicles and corresponding fuel consumption.

As standard emission factors (EF) are not established for Pakistan, emission factors for stationary and mobile combustion, fugitive emissions, in the inventory have been developed using the default values given in IPCC guidelines.

6.1.2 During Operation

GHG emissions during operation stage are also calculated using methodology proposed in ‘Agriculture, Forestry and other Land Use’ in IPCC 2006 Guidelines. In Agriculture, Forestry, and Other Land use category, there are two appendices, which cover, (a) Appendix 2: Possible Approach for Estimating CO_2 Emissions from Lands Converted to Permanently Flooded Lands: Basis for Future Methodological Development (updated in November 2008) and (b) Appendix 3: CH_4 Emissions from Flooded Land: Basis for Future Methodological Development.

IPCC basis for Future Methodological Development indicates that flooded land may emit CH_4 in significant quantities, depending on a variety of characteristic such as age and depth of reservoirs, land-use prior to flooding, climate, and management practices. In contrast with CO_2 emissions, CH_4 emissions are highly variable spatially and temporally. Current measurements of CH_4 fluxes from Flooded Land are not sufficiently comprehensive to support the development of accurate default emission factors (especially for bubbles emissions and degassing emissions), however, there are fairly good information for diffusive emissions.

IPCC basis for Post-flooded CH_4 emissions can occur via the following pathways:

- Diffusive emissions, due to molecular diffusion across the air-water interface;
- Bubble emissions, or gas emissions from the sediment through the water column via bubbles; this is a very important pathway for CH_4 emissions, especially in temperate and tropical regions;
- Degassing emissions, or emissions resulting from a sudden change in hydrostatic pressure, as well as the increased air/water exchange surface after reservoir waters flow through a turbine and/or a spillway; this is a very important pathway for CH_4 emissions from young tropical reservoirs.

Methane can be emitted from flooded lands through release of bubbles, by diffusion and by degassing. A decision tree is normally used through the processes of selecting an appropriate approach for CH_4 emissions from Flooded Land. Tier selection and the level of spatial and temporal disaggregation implemented by inventory compilers will depend upon the availability of activity data and emission factors, as well as the importance of reservoirs as contributors to national greenhouse gas emissions. Due to the lack of sufficient data and information Tier 1 default data is used in this study (which is also used for country-specific scientific evidence and data). In Tier 1 approach the following equation is used for estimating CH_4 emission:

$$CH_4Emission_{WWflood} = P * E(CH_4)_{diff} * A_{flooded\_total\_surface} * 10^{-6}$$

Where,

CH_4 emission$_{WWflood}$ = total CH_4 emissions from Flooded Land, Gg of CH_4/year
P = ice-free period, days/year (usually 365 for annual inventory estimates, or less in country with ice-cover period)
$E(CH4)_{diff}$ = averaged daily diffusive emissions, kg CH_4/ha/day
$A_{flooded\_total\ surface}$ = total flooded surface area, including flooded land, lakes and rivers, ha.

On the other hand IPCC basis for post-flooded carbon dioxide emissions from Land Converted to Flooded Land can occur via the following pathways:

- Diffusive Emissions, due to molecular diffusion across the air-water interface; this is the major pathway for CO_2 emissions;
- Bubble Emissions, or gas emissions from the sediment through the water column via bubbles; this is a very minor pathway for CO_2 emissions;
- Degassing Emissions, or emissions resulting from a sudden change in hydrostatic pressure, as well as the increased air/water exchange surface after reservoir waters flow through a turbine and/or a spillway.

Evidence suggests that CO_2 emissions for approximately the first ten years after flooding are the results of decay of some of the organic matter on the land prior to flooding. The easily degradable carbon and nutrients are made available to producer organisms upon flooding and metabolized. Beyond this time period, CO_2 emissions are sustained by the input of organic material transferred into the flooded area from the watershed. Three methods of increasing sophistication called Levels 1, 2 and 3 are used to estimate CO_2 emissions from flooded reservoir. In Levels 1 and 2 diffusive emissions are estimated only. A level 3 method, based on detailed measurements, includes all relevant fluxes of carbon dioxide emissions from flooded lands. Level 3 includes degassing emissions and considers the age, and the geographical location and the water temperature of the reservoir. When using Level 3, all relevant emissions from flooded lands should be estimated for the life-time of the reservoir. Due to the lack of data, Level 2 estimate is used in this study for the CO_2 emission from the flooded reservoir created by the construction of the dam in the project. Under Level 2, country-specific emission factors are used to estimate CO_2 diffusive emissions. In Level 2, CO_2 emissions can be estimated from reservoirs following the approach shown in the following Equation. The IPCC basis states that CO_2 emissions from Land Converted to Flooded Land should be estimated only for ten years after flooding when using Level 2 method unless country-specific research indicates otherwise.

$$CO_2\ Emission_{LWflood} = [\{P_f * E_f\ (CO_2)_{diff} + P_i * E_i\ (CO_2)_{diff}\} * (A_{flood.surface} * f_A * 10^{-6})]$$

Where:

$CO_2\ Emission_{LW\ flood}$ = total CO_2 emissions from Land Converted to Flooded Landed, Gg CO_2/yr

P_f = ice-free period, days/yr

P_i = period with ice cover, days/yr

$E_f(CO_2)_{diff}$ = averaged daily diffusive emission from air water-interface during the ice free period, kg CO_2/ha/day

$A_{flood.surface}$ = total reservoir surface area, including flooded land, lakes, and rivers, ha

f_A = fraction of the total area flooded within the last years

Annex – 7.1

EMISSION FACTORS FOR CONSTRUCTION EQUIPMENT

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NOX	SOX	PM	CO2	CH4	N2O
Concrete Mixer								
Concrete Static Mixer 0.25 M3	0.0075	0.0386	0.0475	0.0001	0.0023	6.3	0.0007	0.0003048
Concrete Static Mixer 0.191 M3	0.0293	0.0852	0.1548	0.0002	0.0091	18	0.0026	0.0011914
Concrete Vibrator	0.0075	0.0386	0.0475	0.0001	0.0023	6	0.0007	0.0003048
Concrete Batching Plant (Computerized)								
Concrete Batching Plant Capacity 30 M3	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Concrete Batching Plant Capacity 50 M3	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Batch/Mix RCC Plant 500 m3/hr	0.1525	0.5829	0.9172	0.0010	0.0851	83.1	0.0138	0.0061903
Asphalt Plant								
Capacity 20 Ton	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Capacity 80 Ton	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Aggregate Plant & Sand Plant								
Screening Plant 1500 ton/hr	0.1104	0.5320	0.7540	0.0009	0.0633	80.9	0.0100	0.0044826
Course Aggregate Crush/Screen Plant 650 ton/hr	0.2088	0.9654	1.6343	0.0019	0.0946	167	0.0188	0.0084765
Sand Plant 300 ton/hr	0.1525	0.5829	0.9172	0.0010	0.0851	83.1	0.0138	0.0061903
Coarse Precooling Plant 350 ton/Rfrg	0.0160	0.0544	0.1019	0.0002	0.0044	13.2	0.0014	0.0006508
Bull-Dozer								
CAT D-7	0.2545	0.7124	2.1985	0.0021	0.0942	183.5	0.0230	0.0103347
CAT D-8	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
CAT D-9	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
Komatsu D-155	0.2545	0.7124	2.1985	0.0021	0.0942	183.5	0.0230	0.0103347
Komatsu D-85	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
Bull-Dozer 90 HP	0.2209	0.8528	1.6304	0.0015	0.0945	129	0.0199	0.0089691
Bull-Dozer 120 HP	0.2209	0.8528	1.6304	0.0015	0.0945	129.5	0.0199	0.0089691
Bull-Dozer 200 HP	0.2545	0.7124	2.1985	0.0021	0.0942	183	0.0230	0.0103347
Front End Loader								

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NOX	SOX	PM	CO2	CH4	N2O
Front End Loader 1.5 M3	0.1045	0.4187	0.6404	0.0007	0.0576	58.9	0.0094	0.0042419
Front End Loader 2.5 M3	0.1312	0.6288	1.0135	0.0012	0.0583	106	0.0118	0.0053287
Front End Loader 3.00 M3	0.1330	0.3838	1.3129	0.0017	0.0462	149	0.0120	0.0054
Grader								
GAT G-140	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
GAT G-14	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
GAT G-120	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
Volvo	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
Komatsu GC 705	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
Komatsu GC 605	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
Motor Grader 140 HP	0.1348	0.5355	0.8223	0.0009	0.0740	75.0	0.0122	0.0054736
Motor Grader 165 HP	0.1554	0.7363	1.1931	0.0014	0.0688	124	0.0140	0.0063098
Welding Plant								
Welding Plant Unit	0.1071	0.2854	0.2637	0.0003	0.0260	26.0	0.0097	0.004348
Local Welding Plant	0.1071	0.2854	0.2637	0.0003	0.0260	26.0	0.0097	0.004348
Road Roller								
Tandem Roller (10 Ton to 12 Ton)	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Tandem Vibratory Roller 1.5 Ton	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Tandem Vibratory Roller 6 Ton	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Tandem Vibratory Roller 8 Ton	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Static Tandem Roller 8 Ton	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035	0.0015925
Static Tandem Roller 12 Ton	0.0553	0.6096	0.3030	0.0012	0.0156	108	0.0050	0.002245
Combination Roller 10-12 Ton	0.0553	0.6096	0.3030	0.0012	0.0156	108	0.0050	0.002245
Combination Roller 18 Ton	0.0553	0.6096	0.3030	0.0012	0.0156	108	0.0050	0.002245
Water Bouzers								
Truck mounted (Capacity 10,000 Ltrs)	0.0087	0.0299	0.0555	0.0001	0.0022	7.1	0.0008	0.0003549
Truck mounted (Capacity 12,000 Ltrs)	0.0087	0.0299	0.0555	0.0001	0.0022	7.1	0.0008	0.0003549
Truck mounted (Capacity 15,000 Ltrs)	0.0079	0.0810	0.0843	0.0002	0.0019	14.3	0.0007	0.0003197
Water Tank Toe Type (Capacity 4000 Ltrs)	0.0052	0.0301	0.0368	0.0001	0.0015	4.9	0.0005	0.0002126
Dumpers/Trucks								
Truck Mercedes 10W (500 ft³ (14.16 M³) Capacity)	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Truck Daewoo (500 ft³ (14.16 M³) Capacity)	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243

Equipment	Emission Factors (lb/hr)							
	ROG	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**	**N2O**
Truck Nissan (500 ft³ (14.16 M³) Capacity)	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Truck Hino (500 ft³ (14.16 M³) Capacity)	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Dumper 10 Ton Capacity	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Dumper 18 Ton Capacity	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Flat Body Truck 8 Ton Capacity	0.1533	0.7593	1.1072	0.0014	0.0666	125	0.0138	0.0062243
Excavator (Chain Excavator)								
Hitachi 220	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Hitachi 200	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Hitachi UH09/083	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Solar 120	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Komatsu DC 200	0.1288	0.6678	0.9613	0.0013	0.0569	112	0.0116	0.0052314
Excavator (Tire Excavator)								
Hitachi W-100	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Hitachi DW-100	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Hitachi EX120/130	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Excavator (Track Type) 100 HP	0.1183	0.5220	0.7300	0.0009	0.0657	73.6	0.0107	0.0048023
Aggregate Spreading Machine								
Aggregate Spreader Machine (4 M Wide)	0.1104	0.5320	0.7540	0.0009	0.0633	80.9	0.0100	0.0044826
Power Generators								
150 KVA	0.0157	0.0698	0.1063	0.0002	0.0061	10.2	0.0014	0.0006363
250 KVA	0.0276	0.0951	0.1632	0.0002	0.0096	17.6	0.0025	0.0011217
Lift Machine	0.0175	0.0517	0.0957	0.0001	0.0055	11.0	0.0016	0.0007095
Tractors								
Tractor 50 HP Capacity	0.1006	0.3305	0.3030	0.0004	0.0267	30.3	0.0091	0.004083
Tractor (Fiat-480) and Trolley with Jack Capacity 7 M³	0.0760	0.3557	0.4910	0.0006	0.0432	51.7	0.0069	0.0030875
Tractor (Fiat-480) and Trolley without Jack Capacity 7 M³	0.0760	0.3557	0.4910	0.0006	0.0432	51.7	0.0069	0.0030875
Tractor (Fiat 480) with rotator blade	0.0760	0.3557	0.4910	0.0006	0.0432	51.7	0.0069	0.0030875
Transit Mixers								
Capacity 6 M³	0.112	0.4448	1.3824	0.0016	0.0664	168.8184	0.0052	0.0048
Capacity 4 m³	0.112	0.4448	1.3824	0.0016	0.0664	168.8184	0.0052	0.0048
Daff (4 m³)	0.112	0.4448	1.3824	0.0016	0.0664	168.8184	0.0052	0.0048

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NOX	SOX	PM	CO2	CH4	N2O
Diesel Delivery Truck								
Diesel Delivery Truck with 100 mm (4 ") diameter Pump, 6000 Liters	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Diesel Delivery Truck with 100 mm (4") Diameter Pump, 10,000 Liters (Capacity)	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Bitumen Distributor Truck								
Capacity 2000 Ton	0.034	0.3304	0.0336	0.0004	0.0036	44.094	0.0032	0.002
Steel Bar Cutting and Bending Machine								
Steel Bar Cutting Machine	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Steel Bar Bending Machine	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Steel Plate Cutter	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Steel Moulding	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Grinder Machine								
Grinder Machine (7"- 9")	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Floor Grinding Machine (Chemical)	0.1927	0.5215	0.4545	0.0006	0.0462	44.0	0.0174	0.0078241
Paver								
2.5 M wide	0.1239	0.3124	0.2591	0.0003	0.0279	23.9	0.0112	0.0050299
4 M wide	0.1150	0.3997	0.6897	0.0006	0.0610	54.5	0.0104	0.0046677
Mobile Crane								
3 Ton	0.1101	0.2979	0.2478	0.0003	0.0258	23.2	0.0099	0.0044723
10 Ton	0.0982	0.3650	0.5844	0.0006	0.0533	50.1	0.0089	0.0039868
20 Ton	0.1089	0.4838	0.8259	0.0009	0.0479	80.3	0.0098	0.0044196
45 Ton	0.1103	0.3103	1.0712	0.0013	0.0388	112	0.0100	0.0044785
Stressing Equipment								
Stressing Equipment (Specs?)	0.1506	0.3950	0.3243	0.0004	0.0352	30.3	0.0136	0.0061143
Piling Rig								
Piling Rig (Up to 1.5m Ø)	0.0194	0.0658	0.1233	0.0002	0.0054	16.0	0.0017	0.0007872
Piling Rig (above 1.5m Ø	0.0351	0.2335	0.2768	0.0004	0.0149	31.0	0.0032	0.0014249
Percussion boring winch (Diesel) with boring Bailer 127 to 200 mm Ø	0.0351	0.2335	0.2768	0.0004	0.0149	31.0	0.0032	0.0014249
Percussion boring winch (Diesel) with boring bailer 450 mm Ø or above	0.0351	0.2335	0.2768	0.0004	0.0149	31.0	0.0032	0.0014249

Equipment	Emission Factors (lb/hr)							
	ROG	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**	**N2O**
Girder Launcher								
Model No. H2Q ,Lifting capacity 900 ton and maximum span range 30 M.	0.1008	0.5880	0.8599	0.0012	0.0467	107	0.0091	0.0040931
Concrete Pump								
Mobile 80 M³ / Hour	0.0386	0.1051	0.1803	0.0002	0.0117	19.5	0.0035	0.0015671
Static 45 M³ / Hour	0.1155	0.3229	0.3362	0.0004	0.0299	34.3	0.0104	0.0046884
Power Broom								
Power Broom 2.1 M wide	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Dewatering Pump								
Dewatering Pump with Delivery Pipe 4" Ø (Diesel)	0.0386	0.1051	0.1803	0.0002	0.0117	19.5	0.0035	0.0015671
Dewatering Pump with Delivery Pipe 6" Ø (Diesel)	0.1155	0.3229	0.3362	0.0004	0.0299	34.3	0.0104	0.0046884
Dewatering Pump with Delivery Pipe 4" Ø (Petrol)	0.0386	0.1051	0.1803	0.0002	0.0117	19.5	0.0035	0.0015671
Dewatering Pump with Delivery Pipe 6" Ø (Petrol)	0.1155	0.3229	0.3362	0.0004	0.0299	34.3	0.0104	0.0046884
Compressor								
Capacity 300 CFM	0.0286	0.0779	0.1337	0.0002	0.0087	14.4	0.0026	0.0011617
Pneumatic Tire Roller								
PTR 9 Wheeler 18 Ton Capacity	0.1320	0.6220	1.0725	0.0012	0.0591	108	0.0119	0.0053607
PTR 9 Wheeler 21 Ton Capacity	0.1347	0.4083	1.4103	0.0017	0.0498	153	0.0122	0.0054712
Asphalt Recycling & Cold Milling Machine								
Asphalt Recycling Machine	0.0185	0.0632	0.1170	0.0002	0.0045	15.3	0.0017	0.0007518
Cold Milling Machine 1M width	0.0066	0.0391	0.0466	0.0001	0.0018	6.4	0.0006	0.0002693
Road Marking Machine								
Model 15 DM	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Jack Hammer								
Jack Hammer HP-100 (Chain Type)	0.0160	0.0544	0.1019	0.0002	0.0044	13.2	0.0014	0.0006508
Jack Hammer HP-100 (Tyre Type)	0.0160	0.0544	0.1019	0.0002	0.0044	13.2	0.0014	0.0006508
Rock Driller								
Model DM 041 w, Type wet and weight 26 to 30 Kg.	0.0351	0.2335	0.2768	0.0004	0.0149	31.0	0.0032	0.0014249

Equipment	Emission Factors (lb/hr)							
	ROG	CO	NOX	SOX	PM	CO2	CH4	N2O
Misc. Equipment								
Plate Compactor	0.0153	0.0520	0.0974	0.0002	0.0042	12.6	0.0014	0.0006218
Saw / Wood Cutter Machine (Petrol) 45 cc	0.0199	0.0678	0.1261	0.0002	0.0050	16.5	0.0018	0.0008085
Pressing Machine for Door Shutter	0.0066	0.0391	0.0466	0.0001	0.0018	6.4	0.0006	0.0002693
Pump 4" delivery (Diesel)	0.0386	0.1051	0.1803	0.0002	0.0117	19.5	0.0035	0.0015671
Vibrator (Pocher 1.5")	0.0118	0.0617	0.0737	0.0002	0.0028	10.1	0.0011	0.0004777
Paint Spray Machine	0.0185	0.0632	0.1170	0.0002	0.0045	15.3	0.0017	0.0007518

Annex – 7.2

RESERVOIR LANDSLIDES

Potential locations of landslides are identified in the reservoir rim slopes are identified for their management. Total fifty potential landslides, 37 and 13 along the left and right reservoir slopes, respectively, were observed, as summarized in Table 7.2.1. Slope instability with levels I (High), II (Medium) and III (Low) in the following assessment criteria was only used to describe the degree of the possibility of future landslide activity at present condition-before the impoundment of dam reservoir.

Table 7.2.1: Summary of Identified Reservoir Potential Landslides

No.	Depth (m)	Length (m)	Width (m)	Volume (m^3)	Distance from Damaxis (m)		Elevation (m)		Present Stability	Effect of Impoundment	Hazard Level	Severity of Landslide-related Consequence	Risk Level
							Toe	Head					
R-01	80	730	350	20,440,000	DS	4,650	842	1,207	II	s	C(II-s)	b	L(C-b)
R-02	90	251	100	2,259,000	DS	5,200	785	950	III	s	C(III-s)	b	L(C-b)
R-03	70	245	110	1,886,500	DS	5,350	775	950	III	s	C(III-s)	b	L(C-b)
R-04	20	237	430	2,038,200	DS	5,600	795	950	III	s	C(III-s)	b	L(C-b)
R-05	20	275	220	1,210,000	US	2,250	771	1,002	II	l	B(II-l)	b	M(B-b)
R-06	12	147	106	186,984	US	8,250	811	915	II	l	B(II-l)	b	M(B-b)
R-07	70	330	350	8,085,000	US	10,450	721	922	III	l	B(II-l)	b	M(B-b)
R-08	30	283	120	1,018,800	US	12,300	845	1,045	III	l	B(II-l)	b	M(B-b)
R-09	30	247	110	815,100	US	16,750	861	1,085	II	l	B(II-l)	b	M(B-b)
R-10	40	292	200	2,336,000	US	19,700	854	1,097	II	l	B(II-l)	b	M(B-b)
R-11	55	241	54	715,770	US	44,150	994	1,079	II	s	C(II-s)	b	L(C-b)
R-12	52	466	125	3,029,000	US	47,050	968	1,308	III	s	C(II-s)	b	L(C-b)
R-13	80	199	80	1,273,600	US	49,550	1,059	1,185	II	s	C(II-s)	b	L(C-b)
L-01	53	145	50	384,250	US	5,700	820	930	II	s	C(II-s)	b	L(C-b)
L-02	53	239	46	582,682	US	5,300	775	890	III	s	C(III-s)	b	L(C-b)
L-03	40	443	173	3,065,560	US	5,850	812	1,142	II	l	B(II-l)	b	M(B-b)
L-04	200	800	350	56,000,000	US	6,800	827	1,777	II	m	B(II-m)	b	M(B-b)
L-05	20	243	120	583,200	US	6,700	1,055	1,205	III	s	C(II-s)	b	L(C-b)
L-06	55	313	115	1,979,725	US	8,250	920	1,100	II	m	B(II-m)	b	M(B-b)
L-07	15	120	80	144,000	US	11,350	865	945	III	l	C(II-l)	b	L(C-b)
L-08	125	565	307	21,681,875	US	16,150	873	1,298	II	m	B(II-m)	b	M(B-b)
L-09	70	828	380	22,024,800	US	16,670	950	1,570	III	s	C(II-s)	b	L(C-b)
L-10	115	615	270	19,095,750	US	17,000	940	1,270	III	s	C(II-s)	b	L(C-b)
L-11	40	381	300	4,572,000	US	17,300	1,112	1,442	III	s	C(II-s)	b	L(C-b)
L-12	30	417	110	1,376,100	US	17,950	836	1,156	III	l	C(II-l)	b	L(C-b)
L-13	30	254	150	1,143,000	US	18,850	896	1,136	III	m	C(II-m)	b	L(C-b)
L-14	20	461	190	1,751,800	US	20,000	837	1,387	III	m	C(II-m)	b	L(C-b)
L-15	20	842	310	5,220,400	US	20,350	820	1,510	III	m	C(II-m)	b	L(C-b)
L-16	15	132	75	148,500	US	21,000	941	1,061	II	s	C(II-s)	b	L(C-b)
L-17	20	339	280	1,898,400	US	21,200	880	1,120	II	m	B(II-m)	b	M(B-b)
L-18	20	203	70	284,200	US	22,300	1,038	1,198	II	s	C(II-s)	b	L(C-b)
L-19	15	180	90	243,000	US	22,200	1,075	1,200	II	s	C(II-s)	b	L(C-b)
L-20	21	115	27	65,205	US	27,600	1,140	1,228	II	s	C(II-s)	c	L(C-b)
L-21	60	465	175	4,882,500	US	27,850	949	1,249	II	s	C(II-s)	b	L(C-b)
L-22	63	244	115	1,767,780	US	32,150	950	1,115	II	s	C(II-s)	b	L(C-b)
L-23	10	127	60	76,200	US	33,000	961	1,051	II	m	B(II-m)	c	M(B-C)
L-24	71	385	115	3,143,525	US	33,250	900	1,175	II	m	B(II-m)	b	M(B-b)
L-25	85	340	142	4,103,800	US	33,950	915	1,170	II	m	B(II-m)	b	M(B-b)
L-26	30	318	550	5,247,000	US	35,650	845	1,070	II	l	B(II-l)	b	M(B-b)
L-27	15	574	210	1,808,100	US	36,850	878	1,318	II	m	B(II-m)	b	L(B-b)
L-28	60	298	46	822,480	US	37,850	975	1,192	II	s	C(II-s)	b	L(B-b)
L-29	30	105	38	119,700	US	40,300	919	1,058	II	m	B(II-m)	b	M(B-b)
L-30	38	105	73	291,270	US	42,700	945	1,018	III	m	C(II-m)	b	L(C-b)
L-31	20	322	60	386,400	US	44,150	1,016	1,201	II	s	C(II-s)	b	L(C-b)
L-32	25	260	100	650,000	US	45,150	961	1,161	II	s	C(II-s)	b	L(C-b)
L-33	34	280	100	952,000	US	47,350	940	1,150	II	m	B(II-m)	b	M(B-b)
L-34	57	290	65	1,074,450	US	47,550	940	1,140	II	m	B(II-m)	b	M(B-b)
L-35	76	247	96	1,802,112	US	48,550	1,000	1,200	II	s	C(II-s)	b	L(C-b)
L-36	100	375	200	7,500,000	US	51,350	1,018	1,331	III	s	C(II-s)	b	L(C-b)
L-37	45	250	150	1,687,500	US	51,550	1,094	1,220	II	s	C(II-s)	b	L(C-b)

Risk Assessment of Potential Landslides

Risk assessment of a potential landslide includes two steps, namely, 1) Hazard assessment associated with impoundment and 2) Estimation of landslide-related consequences.

Hazard level assessment of a landslide after impoundment or during reservoir operation was carried out on the basis of the above-mentioned two criteria, slope instability at present condition (Tables 7.2.2 and 7.2.3) and effect of impoundment on a landslide (Table 4). A hazard level was defined as A to C from high to low as a result of the hazard level assessment with impoundment, as shown in Table 7.2.4.

Table 7.2.2: Assessment criteria of slope instability at present conditions

Slope Instability at Present Condition		Criteria for Judgments
I	Highly Unstable	1) Over-steepened with surface movement, or 2) Recent, active landslides, or 3) Slope adjacent to recent, active landslide with similar characteristics, or 4) Pre-existing landslide areas with signs of recent activity
II	Questionable (or Unstable)	1) Over-steepened with no surface movement, or 2) Pre-existing landslide areas with no sign of recent instability
III	Stable	1) Land not qualifying as questionable or highly unstable

Table 7.2.3: Assessment Criteria of Impoundment Effect on Slope Stability

Criteria for Judgments		Criteria for Judgments
l	Large	One third of a landslide is below the designed full supply level (El. 950m).
m	Medium	Less one third of landslide is below the designed full supply level
s	Small	Toe of a landslide is above the designed full supply level

Table 7.2.4: Hazard level of a landslide with impoundment

Hazard Assessment		Slope Instability at Present Condition		
		I	II	III
Effect of Impoundment	l	A	B	C
	m	B	B	C
	s	C	C	C

Risk assessment was carried out in consideration of (i) landslide hazard level (Table 7.2.4) and (ii) landslide-related consequences (Table 7.2.5) and defined as H, high risk level to L, low risk level, as shown in Table 7.2.6.

Table 7.2.5: Assessment Criteria of Severity of Landslide-related Consequences

Severity of Landslide Related Consequences		Criteria for Judgments
a	Large	1) Directly damage to dam body and effect on stability of dam itself
b	Medium	1) Directly or indirectly damage to facilities, or 2) Complete blockage of the river channel by landslide material (more than 10^5 m^3 in volume) with a resulting flood, or 3) High overtopping of a dam crest by water wave probably with large damage to related facilities and downstream
c	Small	1) Partial blockage of the river channel by landslide material (less than 10^5 m^3 in volume), or 2) Reduction of reservoir capacity by sedimentation of landslide materials, or 3) Low overtopping of a dam crest by water wave probably with small damage to related facilities and downstream

Table 7.2.6: Risk Rating of Landslide Areas

Risk Assessment		Severity of Landslide-related Consequence		
		a	b	c
Hazard Level of a Landslide Area	A	H	M	L
	B	M	M	L
	C	L	L	L

The assessment results, as summarized in Table 7.2.6 above, show that eighteen landslides with moderate risk level would cause a considerable damage to the project and were selected for further geotechnical investigations and probably structural stabilization, as listed Table 7.2.7.

Table 7.2.7: Selected Landslides for Further Geotechnical Activity

No.	Landslide No.	Present Stability	Effect of Impoundment	Hazard Level	Severity of Landslide-related Consequence	Risk Level
1	R-05	II	l	B(II-l)	b	M(B-b)
2	R-06	II	l	B(II-l)	b	M(B-b)
3	R-07	III	l	B(II-l)	b	M(B-b)
4	R-08	III	l	B(II-l)	b	M(B-b)
5	R-09	II	l	B(II-l)	b	M(B-b)
6	R-10	II	l	B(II-l)	b	M(B-b)
7	L-03	II	l	B(II-l)	b	M(B-b)
8	L-04	II	m	B(II-m)	b	M(B-b)
9	L-06	II	m	B(II-m)	b	M(B-b)
10	L-08	II	m	B(II-m)	b	M(B-b)
11	L-17	II	m	B(II-m)	b	M(B-b)
12	L-23	II	m	B(II-m)	c	M(B-C)
13	L-24	II	m	B(II-m)	b	M(B-b)
14	L-25	II	m	B(II-m)	b	M(B-b)
15	L-26	II	l	B(II-l)	b	M(B-b)
16	L-29	II	m	B(II-m)	b	M(B-b)
17	L-33	II	m	B(II-m)	b	M(B-b)
18	L-34	II	m	B(II-m)	b	M(B-b)

8.1.1 Management of Landslides

Further evaluate the hazard and risk of these landslides and their activity during the reservoir operation, the following geological and geotechnical investigations for the selected landslides were suggested:

- Topographical survey (1:2,000 scale)
- Detailed surface mapping
- Borehole investigations
- Installation of monitoring system (displacement and rainfall)
- Monitoring of landslide movement (each 5 years before and after impoundment)

A detailed geological and geotechnical study will be studied on the basis of the above-listed data to develop a geotechnical recommendation on the management of these potential landslides, as listed below:

- Continuous monitoring of landslide movement, or
- Stabilization of landslides by structural measures such as removal of unstable area, and anchoring works, etc.
- Control of drawdown rate of reservoir water level during reservoir operation

It is proposed that the reservoir to be filled initially with a rate of 1 m/day and carefully monitor the slopes in in the landslide prone areas. During the sediment flushing, the fill rate of 4 m/day and emptying rate of 3 m/day is recommended to minimize the landslides. It is expected after few cycles of reservoir filling and releasing the slopes will be stabilized.

Annex – 7.3

SEISMIC HAZARD ASSESSMENT[1]

1. Introduction

The site of Dasu Project is located in the Kohistan Island Arc physiographic province and tectonically it is called an active region because it is “sandwiched” between the converging Indian and Eurasian tectonic plates. According to the grouping of the Geological Survey of Pakistan, the Project area belongs to the “Serious Seismic Danger Zone”.

Among the planned project facilities, the dam, which is 242 m high, is a critical component of the Project. Thus, the dam should be designed to be safe under strong earthquake action. In order to obtain the seismic design parameters, the following procedures have been undertaken for the seismic hazard assessment:

1) Estimate of peak ground acceleration (PGA) value by deterministic procedure;
2) Estimate of PGA value by probabilistic procedure;
3) Estimate of response spectra for design; and
4) Preparation of earthquake time histories.

In addition to the design parameters above, it is noted that reservoir-triggered earthquake should be considered as one of seismic hazard assessment. It is sure that the filling, drawdown, or the presence of the reservoir has caused earthquake(s) although there are a limited number of documented cases. According to the ICOLD guideline (Bulletin 72, 2010 Revision), the largest recorded magnitude was 6.3. DHC is trying to find some evidence or a sign that would suggest potential earthquake not only during the field investigation but also during construction. Careful attention should be made during impounding. Therefore, no specific description is given in this section.

2. Definition of Design Parameters by ICOLD (2010)

The ICOLD guidelines (Bulletin 72, 2010 Revision) provide the following definitions:

<u>Operating Basis Earthquake (OBE)</u> *represents the level of ground motion at the dam site for which only minor damage is acceptable. The dam, appurtenant structures and equipment should remain functional and damage should be easily repairable, from the occurrence of earthquake shaking not exceeding the OBE. In theory the OBE can be determined from an economic risk analysis but this is not always practical or feasible. In many cases, it will be appropriate to choose a minimum return period of 145 years (i.e., a 50% probability of not being exceeded in 100 years).*

<u>Safety Evaluation Earthquake (SEE)</u> *is the maximum level of ground motion for which the dam should be designed or analyzed. For dams whose failure would present a great social hazard the SEE will normally be characterized by a level of motion equal to that expected at the dam site from the occurrence of a deterministically-evaluated maximum credible earthquake or of the probabilistically-evaluated earthquake ground motion with a very long return period, for example, 10,000 years.*

<u>A Maximum Credible Earthquake (MCE)</u> *is the largest reasonably conceivable earthquake magnitude that is considered possible along a recognized fault or within a geographically defined tectonic province, under the presently known or presumed tectonic framework. The most severe ground motion affecting a dam site due to an MCE scenario is referred to as the MCE ground motion. Evaluation of the MCE ground motion is generally done using a deterministic approach, in which the MCE scenarios for each identified fault and tectonic province are taken into account.*

[1] Extract from Detailed Design Engineering Report of Dasu Hydropower Project, 2012

3. Major Faults and Lineaments

Major faults and lineaments assessed and reviewed in this study are summarized in **Table 7.3.1** and shown in **Figure 7.3.1** and **Figure 7.3.2**

Eleven faults and lineaments have been reviewed and seven out of 11 had been considered in the FS in 2009. The following four faults and lineaments are additionally listed because there is no clear evidence that these are not active faults:

- Spat Gah fault (East, West), interference type;
- Lineament No.14 delineated by Dr. Asif on LandSat imagery;
- Lineament No.18 delineated by Dr. Asif on LandSat imagery; and
- Lineament No. 9 delineated by Dr. Asif on LandSat imagery.

In the FS report, the Lineament No.14 is the branch of the Kamila strike slip fault and it is stated, "Dr. Asif also marked this point on the LandSat image with two branches at the northern terminus near the confluence of the Kandia River with the Indus River. This fault passes at the closest distance of 10 km west of the project site. This is a younger fault cutting the regional structure and should therefore be taken as active structure capable of releasing regional stress in the form of earthquakes."

As to Lineament No. 9 and No. 18, due to difficult access or covering by deep deposit, the said lineaments could not be judged as inactive.

Matsuda et al. (2000) stated that the groups of faults formed of same strike keeping an adjacent distance within 5 km should have characteristics common among associated faults. Therefore, Spat Gah Fault (east, west) is incorporated into this study.

Table 7.3.1: Major Faults and Lineaments and their Magnitude Assessed in this Study

	Tectonic Feature	Fault Length (Km)	Fault type	Closest distance (km)	Maximum Magnitude Potential (Mw)			Selected Magnitude (Mw) Maximum
					Wells & Coppersmith (1994)	Nowroozi (1985)[1]	Slemmons et al. (1982)[1), 2)]	
Feasibility Repot	Main Mantle Thtust (MMT)	200	reverse	45	7.8	7.9	8.1	8.1
Feasibility Repot	Kohistan Fault	150	reverse	30	7.7	7.7	7.9	7.9
Feasibility Repot	Spat Gah Fault (East)	16	strike-slip	8	6.5	6.5	6.3	6.5
Feasibility Repot	Spat Gah Fault (West)	19	strike-slip	10	6.6	6.6	6.6	6.6
Feasibility Repot	Chilas Complex Fault (Kamila Shear)	140	unknown	12	7.6	7.7	*7.7*	7.7
Feasibility Repot	Kamila Strike Slip Fault	55	strike-slip	10	7.1	7.2	7.0	7.2
Feasibility Repot	Fault No.13	12	unknown	8	6.3	6.4	*6.4*	6.4
This study	Spat Gah Fault (East+West)	35	strike-slip	8	6.9	6.9	6.7	6.9
This study	Fault No.14	16	unknown	5	6.5	6.5	*6.5*	6.5
This study	Fault No.18	100	unknown	16	7.4	7.5	*7.5*	7.5
This study	Fault No.9	7	Nomal	6	6.0	6.1	6.0	6.1

1) From Ms to Mw is applied in Scordilis(2006)
2) Italic means average value of Slemmons et al.(1982)
3) unknown fault type assumed as reverse fault

4. Examination of PGA

The magnitude was selected as the maximum value among the respective magnitudes proposed by three research groups.

A. Wells and Coppersmith (1994):

The relationship between the length of an active fault (L, km) and the moment magnitude (Mw) is as follows:

Reverse fault $Mw=5+1.22*\log(L)$

Strike-slip fault Mw=5.16+1.12*log(L)

Normal fault Mw=4.86+1.32*log(L)

All Mw=5.08+1.16*log(L)

B. Nowroozi (1985):

The relationship between the length of an active fault (L, km) and the surface wave magnitude (Ms) is as follows:

Average Ms=1.259+1.244logL

The conversion to the moment magnitude from the surface wave magnitude uses the formula of Scordilis (2006). It is as follows:

Mw=0.99*Ms+0.08 for 6.2< MS < 8.2

C. Slemmons et al. (1982)

The relationship between the length of an active fault (L, km) and the surface wave moment magnitude (Ms) is as follows:

Strike-slip fault Ms=1.404+1.169logL

Reverse fault Ms=2.021+1.142logL

Normal fault Ms=0.809+1.341logL

The conversion to the moment magnitude from the surface wave magnitude uses the formula of Scordilis (2006). It is as follows:

Mw=0.99*Ms+0.08 for 6.2< MS < 8.2

The magnitudes of the faults of which type are unknown are taken as the average values using the above three equations.

Furthermore, the information on the active faults around the Dasu Dam site for the past five years have been checked through several journals and their results. The list of journals is shown in **Table 7.3.2**. So far, new issues on the active faults have not been reported yet.

Table 7.3.2: List of Journals on Issue of Active Faults and Lineaments

1)	Tectonophysics
2)	Physics of Earth and Planetary Interiors
3)	Geophysical Journal International
4)	Geophysical Research Letters
5)	J. Geophys Res
6)	Pure and Applied Geophysics
7)	Geomorphology
8)	Remote Sensing of Environment
9)	Journal of Asian Earth Sciences
10)	Journal of Geodynamics
11)	Journal of Structural Geology
12)	Bulletin of the Seismological Society of America

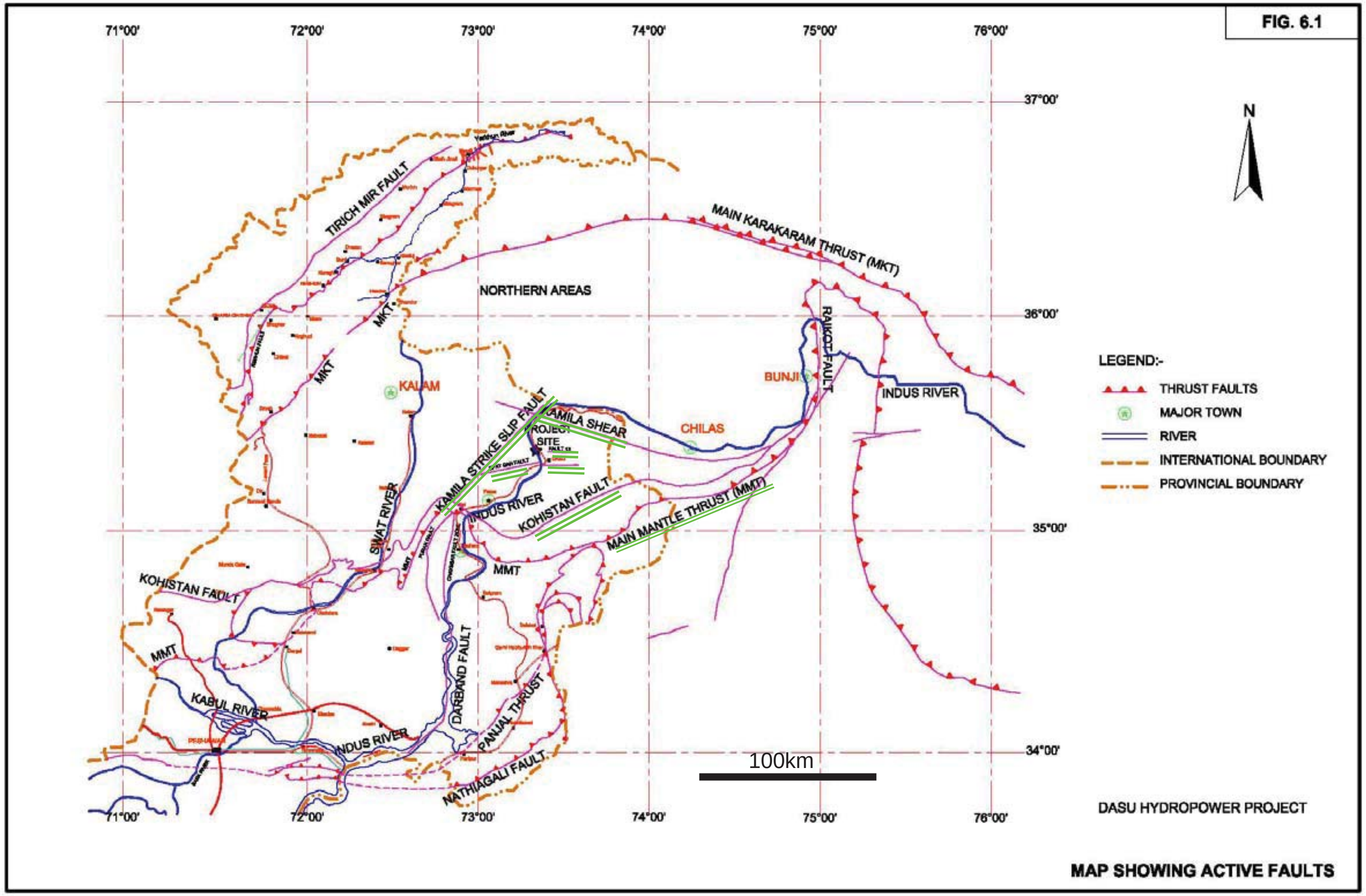


Figure 7.3.1: Major Active Faults around the Dasu Dam site

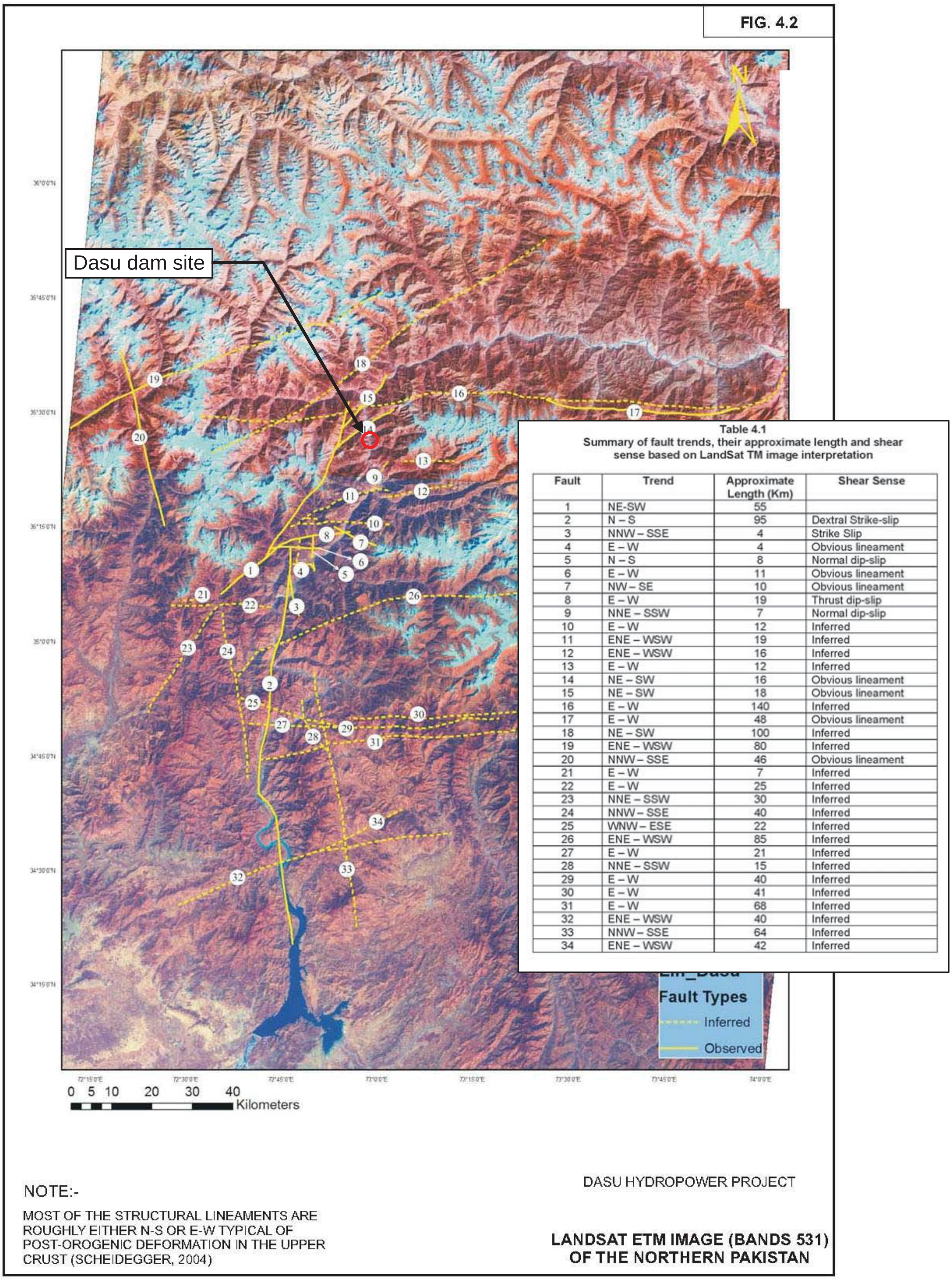


Table 4.1
Summary of fault trends, their approximate length and shear sense based on LandSat TM image interpretation

Fault	Trend	Approximate Length (Km)	Shear Sense
1	NE-SW	55	
2	N – S	95	Dextral Strike-slip
3	NNW – SSE	4	Strike Slip
4	E – W	4	Obvious lineament
5	N – S	8	Normal dip-slip
6	E – W	11	Obvious lineament
7	NW – SE	10	Obvious lineament
8	E – W	19	Thrust dip-slip
9	NNE – SSW	7	Normal dip-slip
10	E – W	12	Inferred
11	ENE – WSW	19	Inferred
12	ENE – WSW	16	Inferred
13	E – W	12	Inferred
14	NE – SW	16	Obvious lineament
15	NE – SW	18	Obvious lineament
16	E – W	140	Inferred
17	E – W	48	Obvious lineament
18	NE – SW	100	Inferred
19	ENE – WSW	80	Inferred
20	NNW – SSE	46	Obvious lineament
21	E – W	7	Inferred
22	E – W	25	Inferred
23	NNE – SSW	30	Inferred
24	NNW – SSE	40	Inferred
25	WNW – ESE	22	Inferred
26	ENE – WSW	85	Inferred
27	E – W	21	Inferred
28	NNE – SSW	15	Inferred
29	E – W	40	Inferred
30	E – W	41	Inferred
31	E – W	68	Inferred
32	ENE – WSW	40	Inferred
33	NNW – SSE	64	Inferred
34	ENE – WSW	42	Inferred

Figure 7.3.2: Major Lineaments around the Dasu Dam site

In this study, the following five attenuation models were considered:

- Abrahamson and Silva 2008 NGA Model (referred to as "AS08");
- Boore and Atkinson 2008 NGA Model (referred to as "BA08");
- Campbell and Bozorgnia 2008 NGA Model (referred to as "CB08");
- Chiou and Youngs 2008 NGA Model (referred to as "CY08"); and
- Idriss 2008 NGA Model (referred to as "I08").

Note: NGA means the Next Generation Attenuation Project of Pacific Engineering Research Center, University of California at Berkeley in the United States of America.

Table 7.3.3 shows the results of PGA calculation. **Figure 7.3.3** also shows the same results corresponding to each attenuation model. The results are summarized as follows:

1) The maximum PGA was estimated at Fault No. 14 in all faults and lineaments. The PGA (median plus one sigma) was 0.62 g as the maximum value of the five attenuation models.
2) The next greatest PGA was estimated at Kamila Shear. The PGA (median plus one sigma) was 0.52 g as the maximum value of the five attenuation models.
3) Abrahamson (2008) shows **Figure 7.3.4** and indicates that formulas I08 and CY08 were likely to be high values compared with other models. For some cases, the PGA values of I08 and CY08 were about 1.5 to 2 times more than other models if the distance from the fault is short.
4) The PGA values of models AS08, BA08 and CB08 were very similar and seem to be reliable.

As a result, the three models, AS08, BA08, and CB08, were used for the estimation of PGA of MCE. The maximum PGA resulting from the three formulas (AS08, BA08, and CB08) was estimated to be 0.54 g, which will occur along Fault No. 14.

Table 7.3.3: Estimated PGA Values for Major Faults and Lineaments around the Dasu Damsite (Unit: g)

	Tectonic Feature	Fault Length (Km)	Fault type	Closest distance (km)	Maximum Magnitude Potential (Mw)			Selected Magnitude (Mw)	AS08		BA08		CB08		CY08		I08	
					Wells & Coppersmith (1994)	Nowroozi (1985)[1]	Slemmons et al. (1982)[1), 2)]	Maximum	Median	Median +1σ	Median	Median +1σ	Median	Median +1σ	Median	Median +1σ	Median	Median +1σ
Feasibility Repot	Main Mantle Thtust (MMT)	200	reverse	45	7.8	7.9	8.1	8.1	0.099	0.172	0.124	0.219	0.092	0.155	0.137	0.234	0.127	0.206
Feasibility Repot	Kohistan Fault	150	reverse	30	7.7	7.7	7.9	7.9	0.113	0.197	0.150	0.263	0.116	0.196	0.170	0.289	0.163	0.268
Feasibility Repot	Spat Gah Fault (East)	16	strike-slip	8	6.5	6.5	6.3	6.5	0.160	0.294	0.176	0.309	0.245	0.415	0.227	0.403	0.227	0.419
Feasibility Repot	Spat Gah Fault (West)	19	strike-slip	10	6.6	6.6	6.6	6.6	0.141	0.256	0.167	0.293	0.211	0.357	0.202	0.355	0.207	0.377
Feasibility Repot	Chilas Complex Fault (Kamila Shear)	140	unknown	12	7.6	7.7	*7.7*	7.7	0.187	0.327	0.218	0.384	0.215	0.364	0.302	0.515	0.299	0.501
Feasibility Repot	Kamila Strike Slip Fault	55	strike-slip	10	7.1	7.2	7.0	7.2	0.179	0.313	0.206	0.362	0.227	0.385	0.257	0.438	0.257	0.447
Feasibility Repot	Fault No.13	12	unknown	8	6.3	6.4	*6.4*	6.4	0.152	0.282	0.165	0.289	0.237	0.401	0.241	0.431	0.243	0.450
This study	Spat Gah Fault (East+West)	35	strike-slip	8	6.9	6.9	6.7	6.9	0.190	0.336	0.210	0.369	0.255	0.431	0.265	0.455	0.272	0.484
This study	Fault No.14	16	unknown	5	6.5	6.5	*6.5*	6.5	0.221	0.406	0.218	0.384	0.320	0.542	0.332	0.588	0.334	0.616
This study	Fault No.18	100	unknown	16	7.4	7.5	*7.5*	7.5	0.143	0.250	0.180	0.317	0.170	0.287	0.230	0.393	0.229	0.390
This study	Fault No.9	7	Nomal	6	6.0	6.1	6.0	6.1	0.154	0.294	0.124	0.218	0.228	0.385	0.181	0.331	0.219	0.416

Notes: The values highlighted in green indicate the maximum value at mean plus one standard deviation (84-percentile), and the values highlighted in yellow indicate the maximum value at the median (50-percentile).

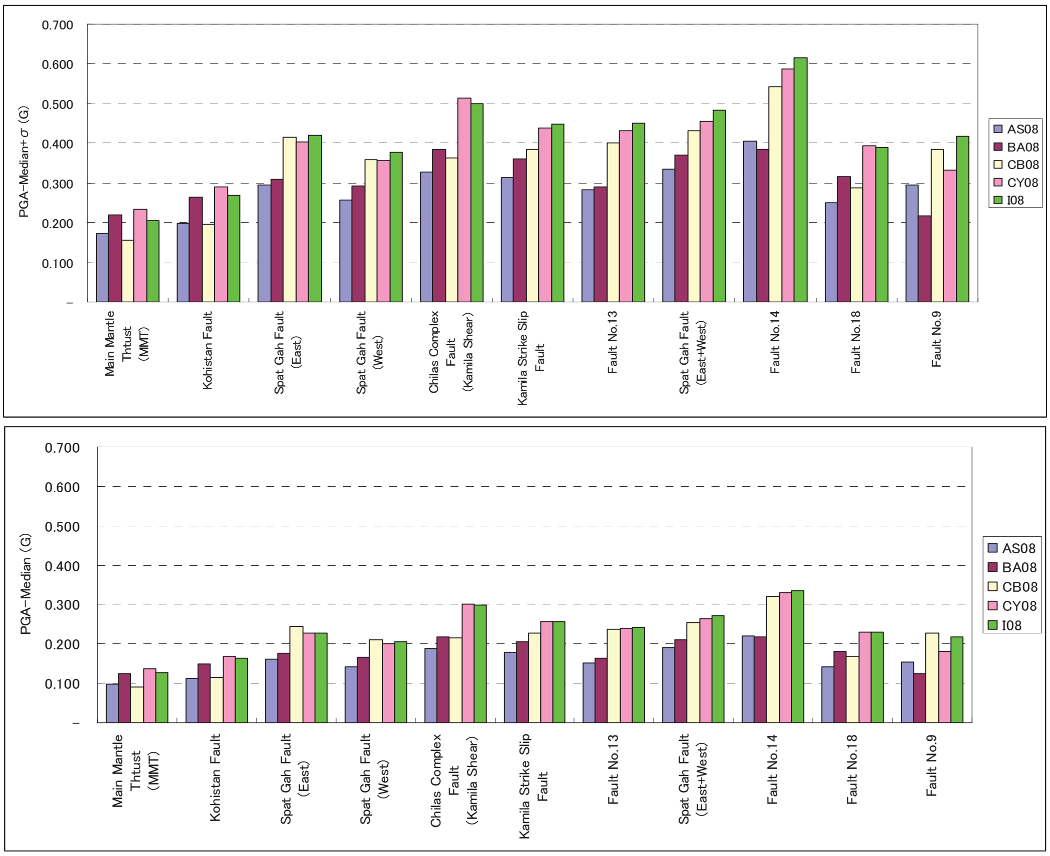
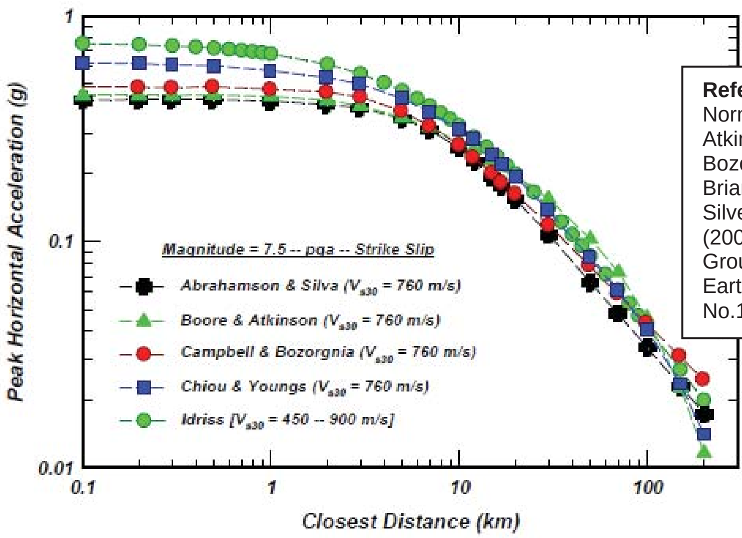


Figure 7.3.3: Estimated PGA Values for Major Faults and Lineaments around the Dasu Dam Site (Unit: g) (Top: Median+σ, and Bottom: Median)



Reference:
Norman Abrahamson, Gail Atkinson, David Boore, Yousef Bozorgnia, Kenneth Campbell, Brian Chiou, I.M. Idriss, Walter Silver, and Robert Youngs (2008), Comparisons of the NGA Ground-Motion Relations," Earthquake Spectra, Vol. 24, No.1, February, 2008, pp. 45-66.

Figure 29 Comparison of the median values of pga calculated using the NGA relationships – M = 7.5 and strike slip mechanism

Note: ● indicates PGA using I08, and ■ indicates PGA using CY08

Figure 7.3.4: Comparison of the Median Values of PGA as Calculated Using the NGA Relationships

5. Relation between Frequency of Exceeding and PGA

(1) Data used for analysis

The feasibility study collected data observed from 1828 to April 2008, while DHC collected data after April 2008 up to 2011 as supplement from the following three observing stations:

i) Earthquake data collected at Tarbela Dam and Mangla Dam;
ii) U.S. Geological Survey (USGS); and
iii) International Seismological Centre (ISC).

Seismicity of the Project region from 1828 to 2011 is shown in **Figure 7.3.5**. It shows that the southern area of the Dasu Dam site has high seismicity. M5 class earthquakes cluster in this area however, the Dasu Dam site is outside of this area. The epicenter of the earthquake which occurred on October 8, 2005 (Mw=7.6) is shown in this figure. The distance from the epicenter to the dam site is about 100 km.

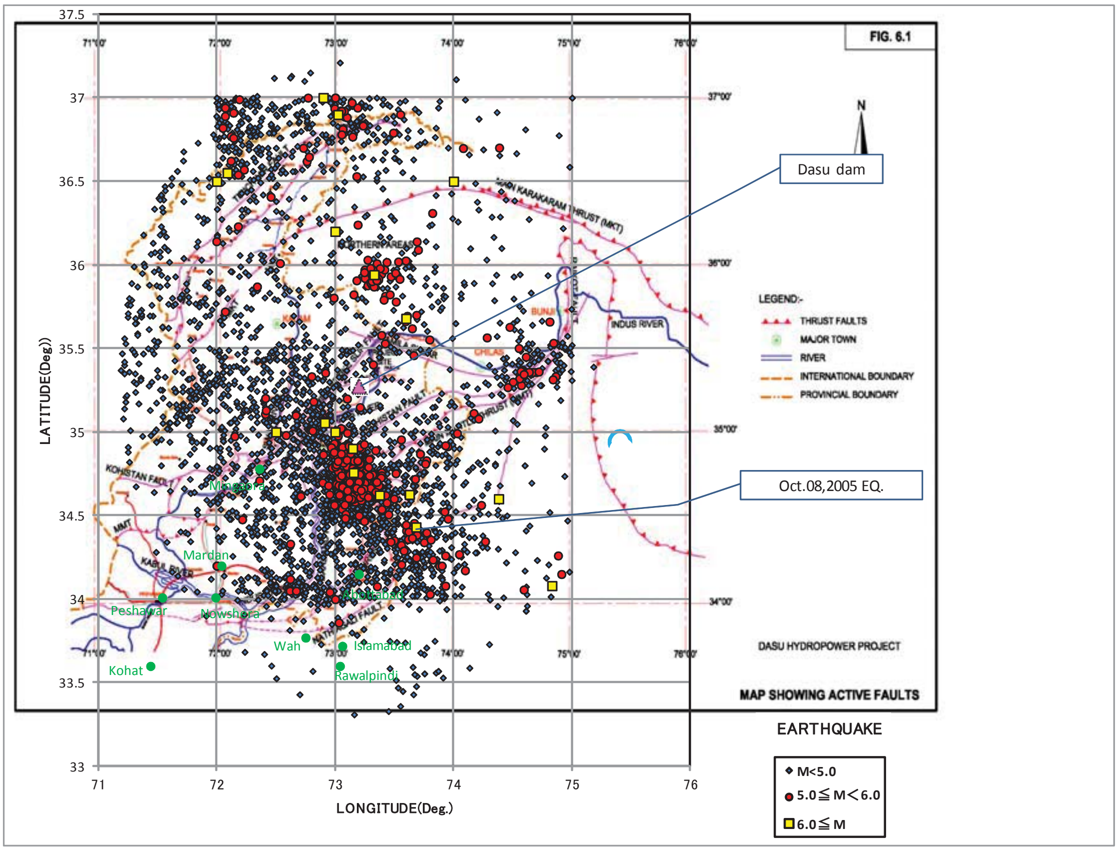


Figure 7.3.5: Seismicity of the Project Region and Active Faults

Figure 7.3.6 and **Figure 7.3.7** show the focal depth distribution of earthquakes (1828-2011), and that most earthquakes occurred within a depth of 50 km. This means the strong ground motion is likely to be expandable.

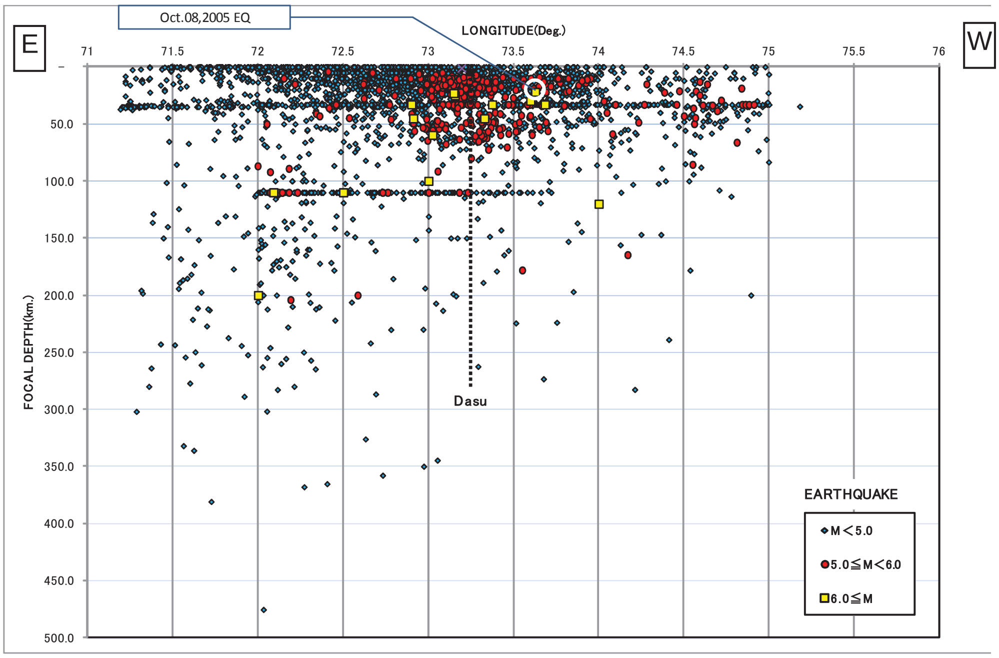


Figure 7.3.6: Focal Depth Distribution of Earthquakes (EW Section)

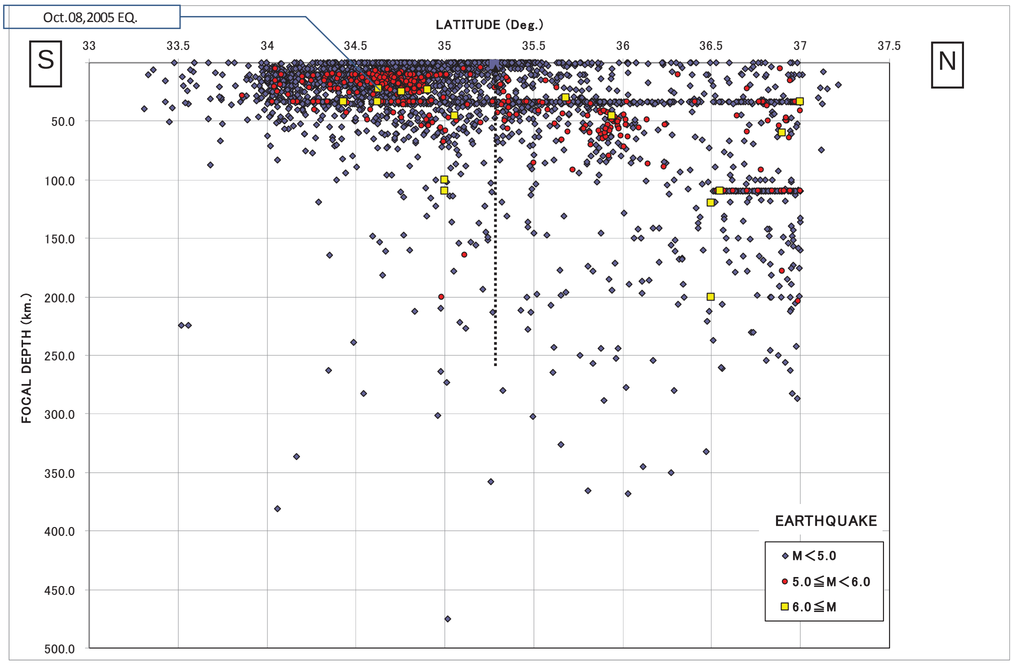


Figure 7.3.7: Focal Depth Distribution of Earthquakes (NS Section)

(2) Analytical method

In accordance with the reference titled, “An online graphic computer program (ERSA-G) and its application to seismic macro-zonation of Japan”, which has been developed at the Institute of Industrial Science, the University of Tokyo, the following procedures were applied:

i) Compute accumulative frequency distribution against the respective earthquake intensity “M” related to the earthquake recorded, and compute the annual earthquake intensity divided by the observation period.

ii) Plot the data, earthquake intensity in x-coordinates and accumulative frequency per year in y-coordinates on both logarithm graphs.

iii) Get the equation of log Y=A+B*log X, where, A and B are coefficients.

The online graphic system takes into account the following models:

- AS08: Abrahamson and Silva 2008 NGA Model;
- BA08: Boore and Atkinson 2008 NGA Model;
- CB08: Campbell and Bozorgnia 2008 NGA Model; and
- I08: Idriss 2008 NGA Model.

If Chiou and Youngs 2008 NGA Model (CY08) is used, the PGA values will likely be extremely high because this method is sensitive to earthquakes occurring at deep (focal depth is over 100 km). Thus, the CY08 model is not used for this analysis.

(3) Results

The results of PGA versus the epicenter distance (km) at the Dasu Dam site using the four models were plotted as shown in **Figure 7.3.8**.

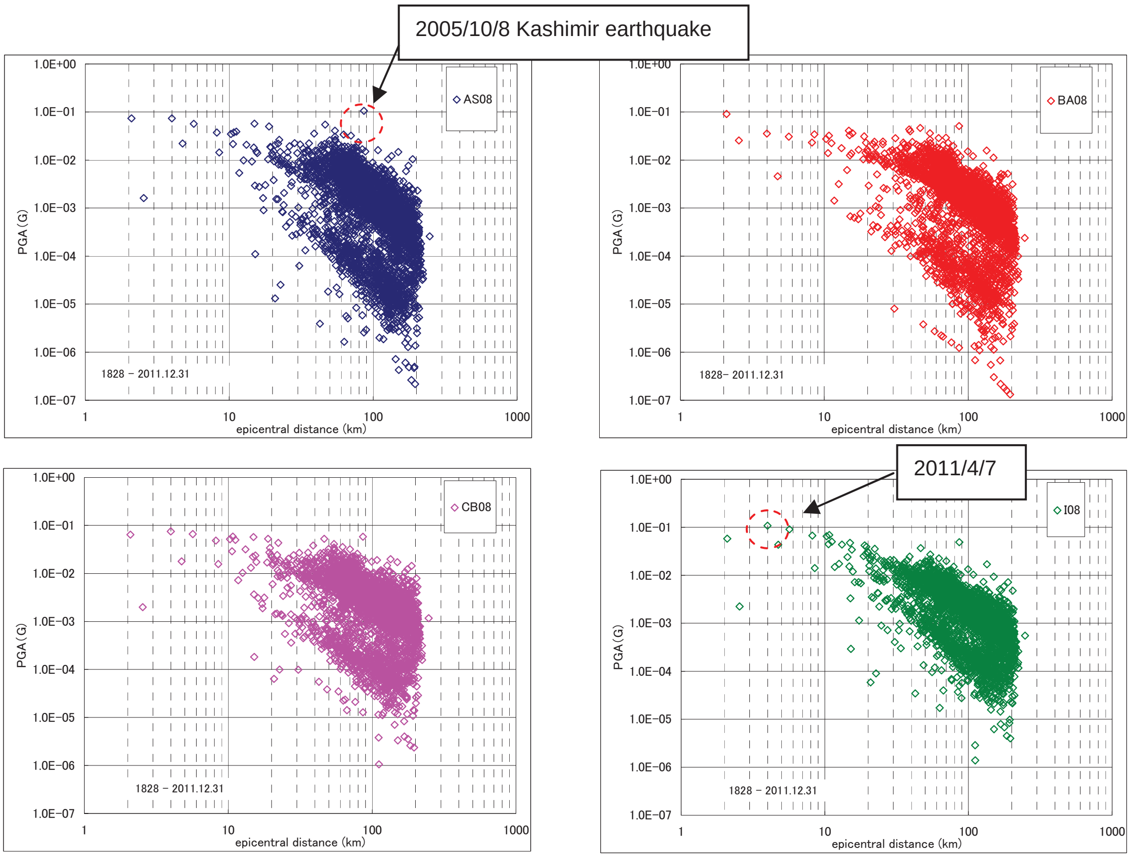


Figure 7.3.8: Distributions of Maximum PGA at the Dasu Dam Site using the Four Candidate Models (1828 to 2011)

As shown in **Figure 7.3.8**, it was confirmed that the relationship between the epicentral distance (km) and the PGA (g) among the four models is almost same.

The maximum PGA during the observation period was 0.108 g as assessed by I08. It was the earthquake which occurred on April 7, 2011 with the epicenter 4 km from the Dasu Dam site. Furthermore, the PGA of 0.106 g as assessed by AS08 was based on the Kashmir Earthquake which occurred on October 8, 2005.

The results of the seismic risk analysis by each attenuation model are shown below in **Figure 7.3.9** to **Figure 7.3.12**.

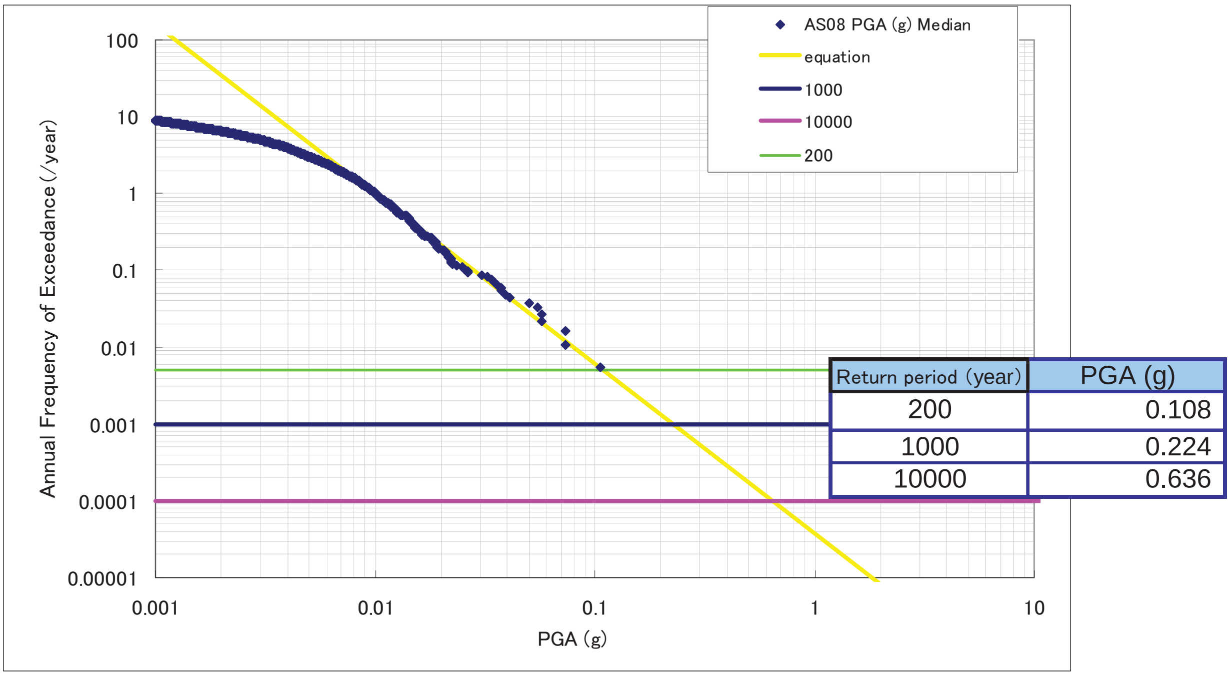
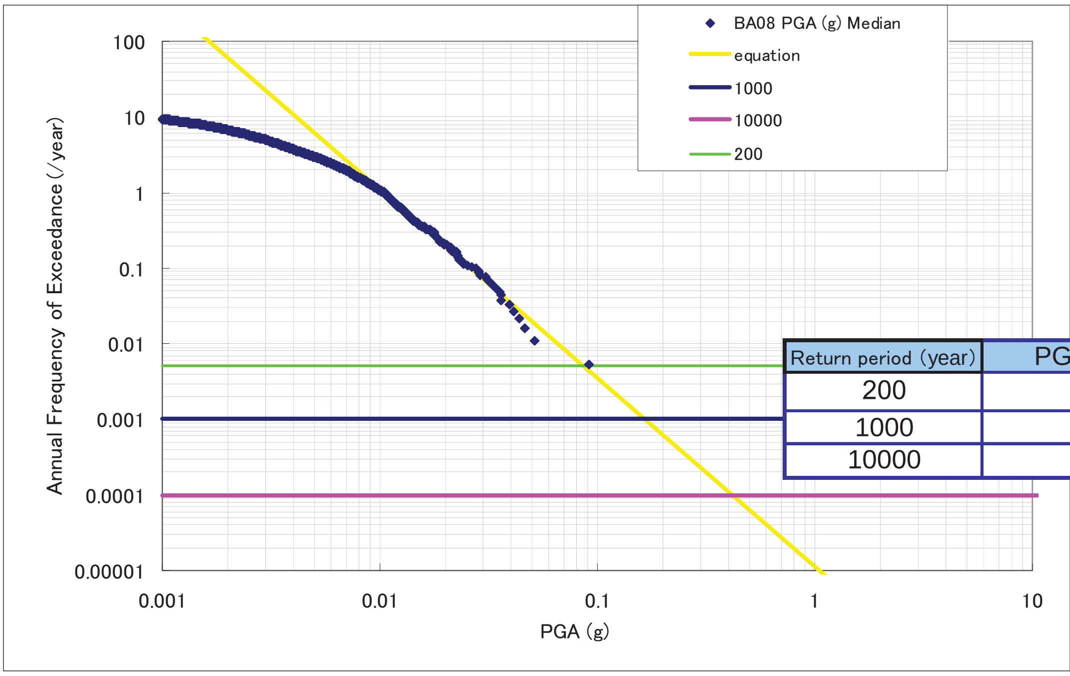


Figure 7.3.9: Relationship between Annual Frequency of Exceeding (/year) and PGA (g) (1828 to 2011) as Assessed by AS08

By plotting the annual frequency of exceeding (/year) and the PGA (g), the linear recurrence formula to fit the upper bound was obtained.

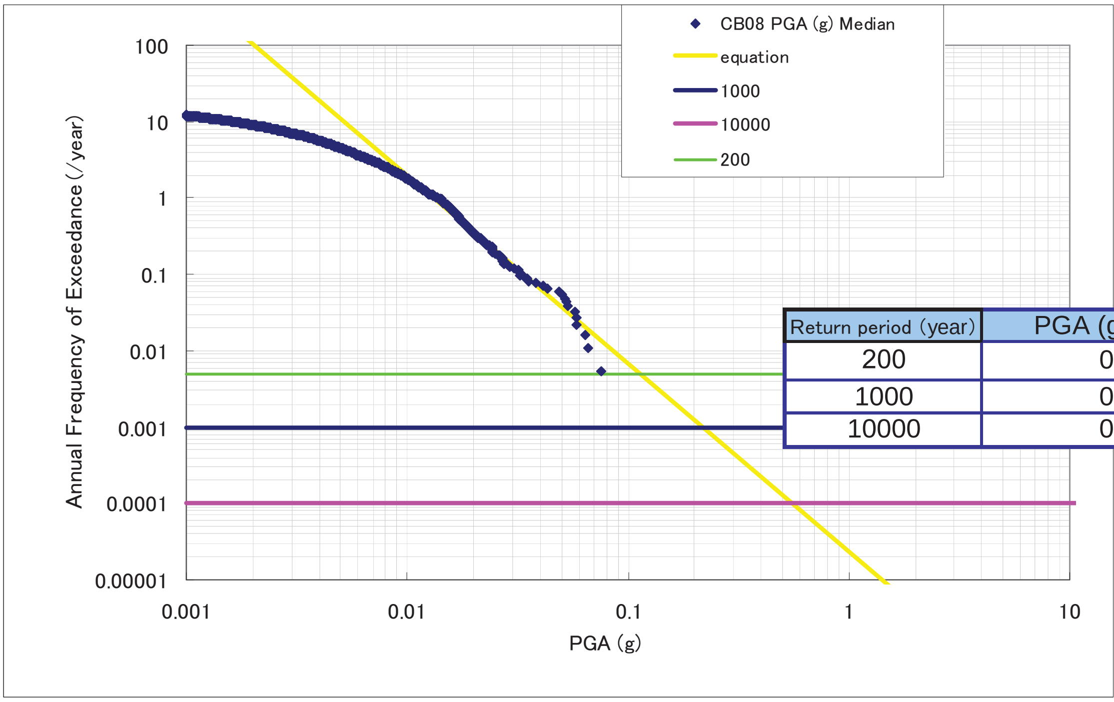
It was assumed that the PGA at 10,000 years recurrence interval with a probability of exceeding 1% in 100 years might correspond to MCE.

Figure 7.3.9 shows that the PGAs corresponding to 200-year, 1000-year, and 10,000-year recurrence intervals are 0.108 g, 0.224 g, and 0.636 g, respectively.



Return period (year)	PGA (g)
200	0.087
1000	0.166
10000	0.417

Figure 7.3.10: Relationship between Annual Frequency of Exceeding (/year) and PGA (g) (1828 to 2011) as Assessed by BA08



Return period (year)	PGA (g)
200	0.114
1000	0.219
10000	0.558

Figure 7.3.11: Relationship between Annual Frequency of Exceeding (/year) and PGA (g) (1828 to 2011) as Assessed by CB08

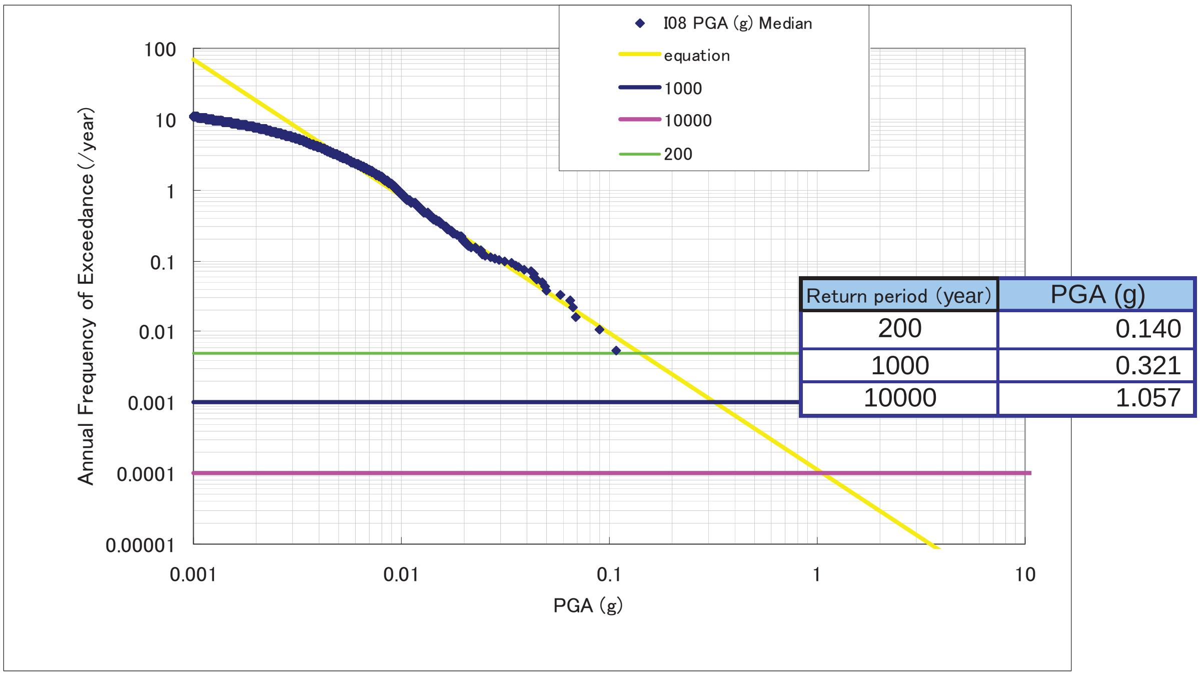


Figure 7.3.12: Relationship between Annual Frequency of Exceeding (/year) and PGA (g) (1828 to 2011) as Assessed by I08

The evaluation results with respect to PGA by using the four models are summarized in **Table 7.3.4** below.

Table 7.3.4: Results of Return Period versus PGA

Return period (year)	PGA (g) Median					FS
	AS08	BA08	CB08	I08	Max	
200	0.11	0.09	0.11	0.14	0.14	0.18
1000	0.22	0.17	0.22	0.32	0.32	0.29
10000	0.64	0.42	0.56	1.06	1.06	—

As indicated in Section 2.6.4, except for the PGA assessed by I08, the PGA for a return period of 10,000 years ranges within 0.4-0.6 g. It was confirmed that this figure well coincides with that of MCE, which is 0.54 g as assessed from associated faults and lineaments around the Dasu Dam site described in Section 2.6.4.

6. Examination of PGA for MCE and OBE

MCE:

In the deterministic approach using attenuation models, the maximum PGA of the three formulas (AS08, BA08, and CB08) was 0.54 g at Fault No. 14. This value is recommended as the PGA for MCE. In the probabilistic approach using the seismic risk analysis, the average PGA in a return period of 10,000 years using the above three models indicated 0.54 g.

Therefore, the value of 0.54 g is recommended as the PGA for MCE.

OBE:

Following the definition provided in the ICOLD guideline, the return period of 200 years was considered as OBE and that for 1000 years is attached for reference. Following the results shown in **Table 7.3.4**, the value of 0.14 g is recommended as the PGA for OBE.

Comparing with the values in the FS, MCE is greater while OBE is less. The main reasons which caused such differences include the increase in the number of data for analysis (from April 2008 to 2011) and the application of the latest probabilistic method with respect to software and acceleration attenuation relationships. The FS used the probabilistic analysis software EZ-FRISK (Risk Engineering Inc.), while in this study the program based on ERSA-G analytical method was used. In both the FS and this study, the acceleration attenuation relationships were used to adopt crustal earthquake in the world, however, the FS adopted Idriss (2004), Abrahamson and Silva (2004), Boore and Atkinson (2007), and Campbell and Bozorgnia (2008). On the other hand, this study adopted the four latest available NGA models, AS08, BA08, CB08, and I08.

7. Design of Acceleration Response Spectra for MCE and OBE

(1) Design of horizontal acceleration response spectra

The acceleration response spectrum (5% damped) of MCE was examined at Fault No. 14. The response spectrum was calculated by the following attenuation models:

- Abrahamson and Silva 2008 NGA Model (AS08);
- Boore and Atkinson 2008 NGA Model (BA08); and
- Campbell and Bozorgnia 2008 NGA Model (CB08).

The acceleration response spectra (both the median and median+1σ were written together) from the three attenuation models are shown in **Figure 7.3.13**. Moreover, the design response spectrum of MCE and OBE (return period 975 years) in the FS is also shown in this figure.

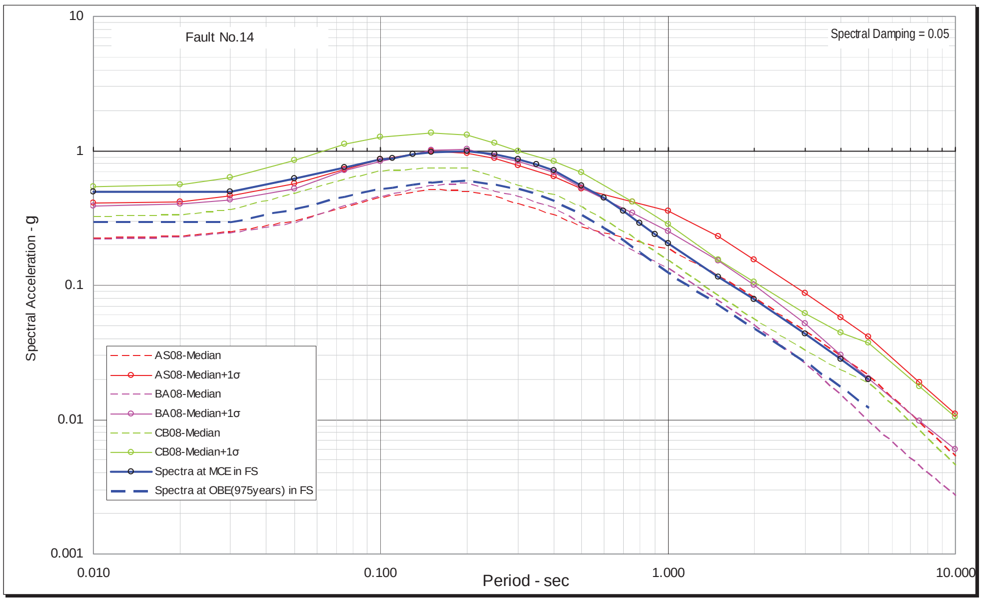


Figure 7.3.13: Response Spectra (5% Damped) Estimated at Fault No. 14

The acceleration response spectrum for MCE was set up by taking the maximum envelope curve of each response spectrum. **Figure 7.3.14** shows the designed horizontal acceleration response spectrum for MCE.

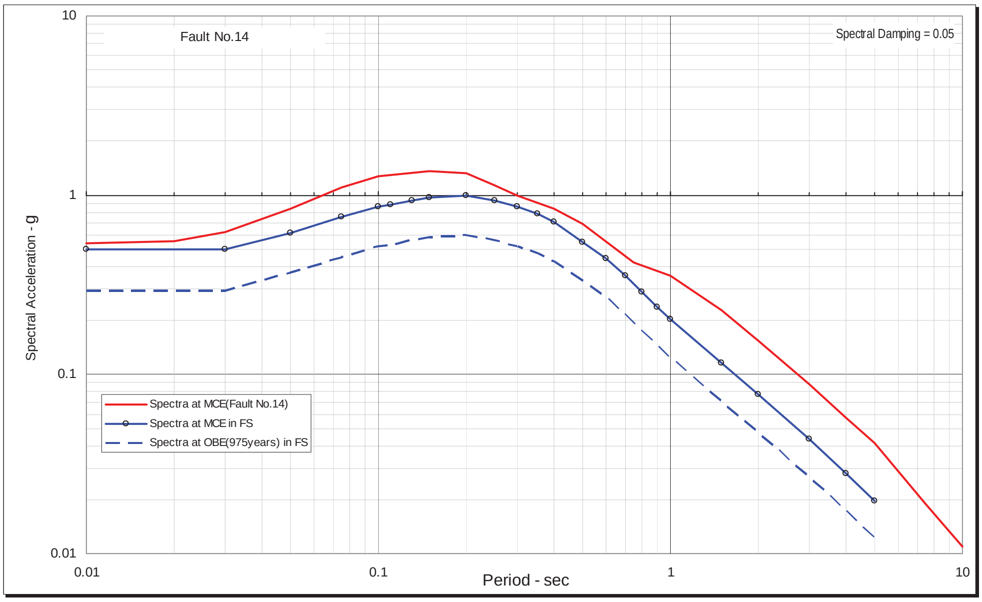


Figure 7.3.14: Designed Horizontal Acceleration Spectrum at Fault No. 14 for MCE (PGA is Equivalent to 0.54 g)

The OBE response spectra (Figure 7.1.15 and 7.1.16) adopted for the design was assessed through the following procedure:

i) Compute the response spectrum (median and mean plus one standard deviation) for 11 major faults and lineaments near the Dasu Dam site as summarized in **Table 7.3.1** and further computed the average.

ii) Adjust the average spectrum at 0.01 s by multiplying the constant to be consistent with the PGA for 200 years.

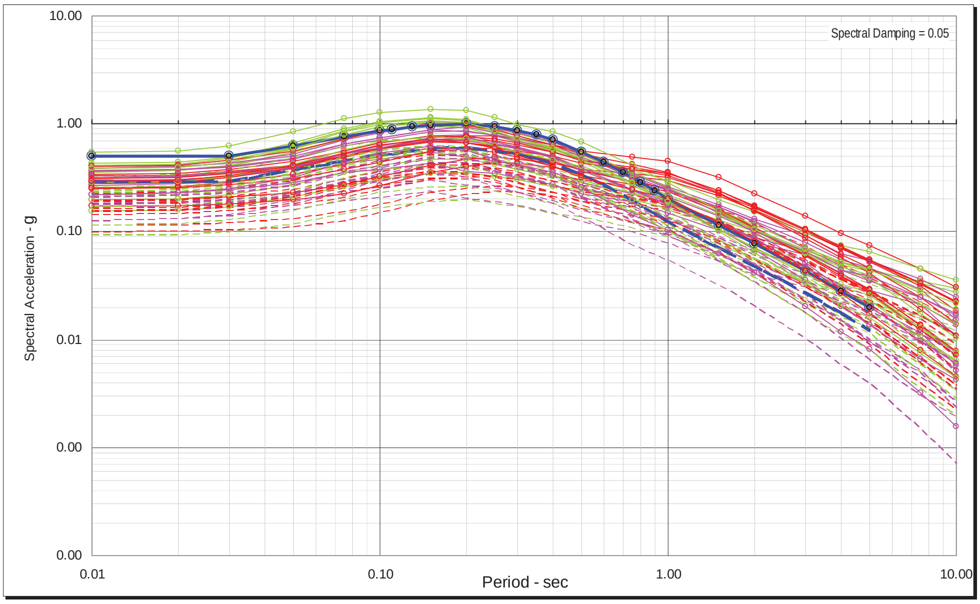


Figure 7.3.15: Response Spectrum Estimated for Major Faults and Lineaments around the Dasu Dam Site

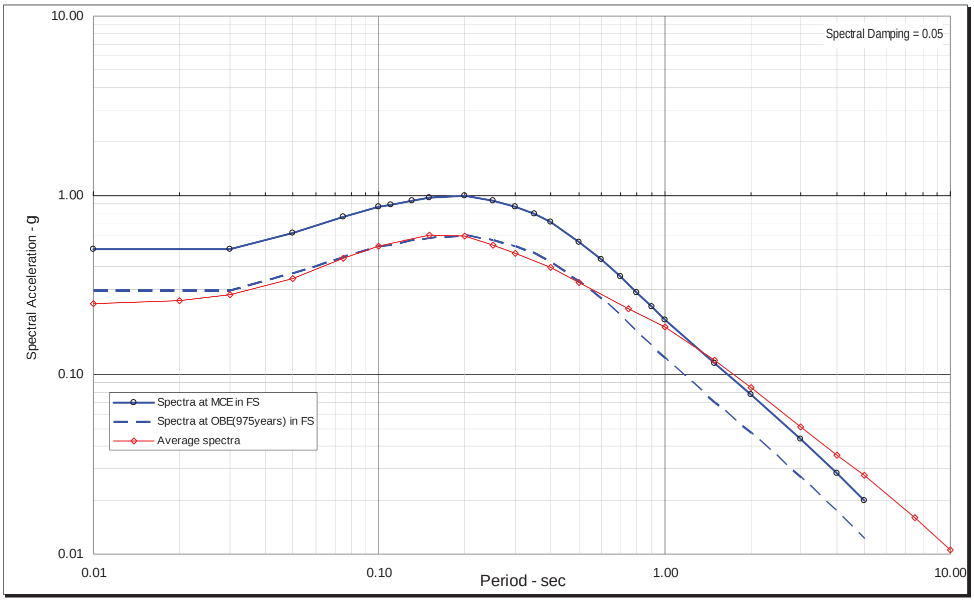


Figure 7.3.16: Average Acceleration Response Spectrum (PGA is Equivalent to 0.25 g) and Comparison with the Spectra in the FS (2009)

The horizontal response spectrum with a return period of 200 years is shown in **Figure 7.3.17**.

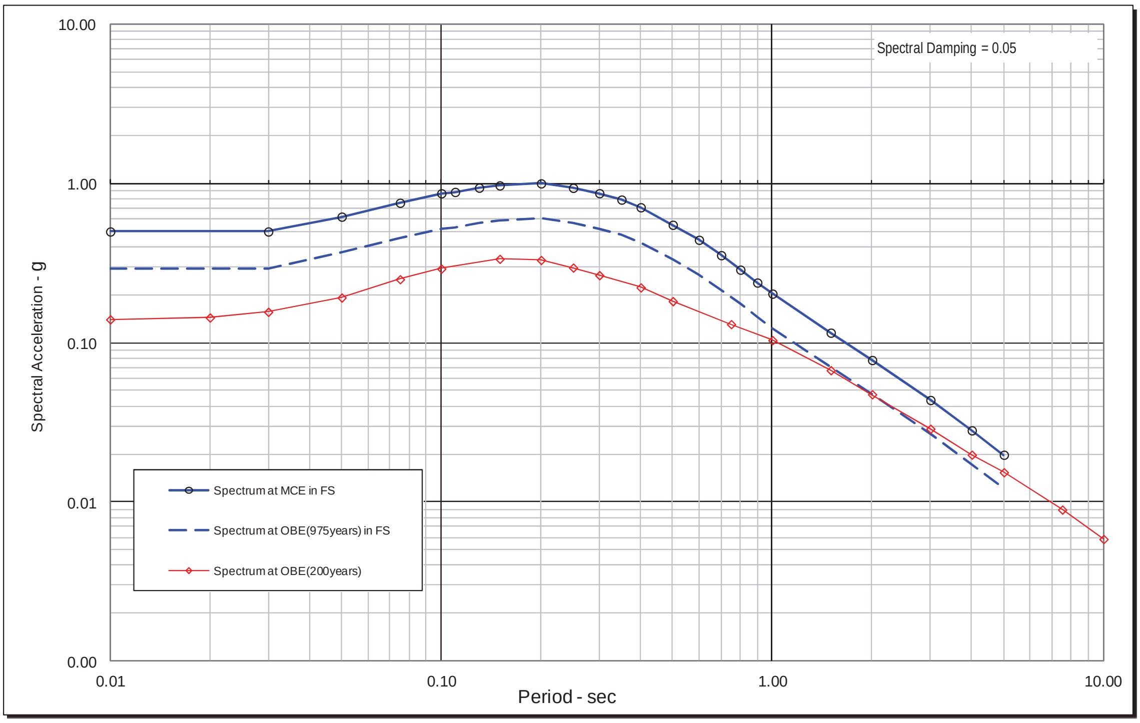


Figure 7.3.17: Design OBE Response Spectrum for Return Period of 200 Years Corresponding to PGA of 0.14 g

(2) Design of vertical acceleration response spectra for MCE and OBE

Generally, vertical ground motion prediction was established together with horizontal ground motion. Therefore, recent studies were reviewed by focusing on the ratio of vertical to horizontal response spectral acceleration (V/H ratio).

Each of the listed literature below mentioned a relationship between horizontal and vertical ground motion:

- According to the ICOLD guideline (1989), vertical PGA may be conservatively taken between two-thirds and one-half of horizontal PGA outside the near-field.
- According to Newmark and Hall (1978), it is recommendable that the design motions in the vertical direction are taken as two-thirds of the value in the horizontal direction across the entire frequency range in the design of nuclear power plants.
- Several recent studies have mentioned the vertical to horizontal spectral ratio (V/H ratio). The V/H ratio depends on the natural periods, hypocentral distance, earthquake magnitude, and so on. Several designed V/H ratios were proposed.
- Shown in **Figure 7.3.18** is the V/H ratio in Boomer et. al. (2011). This figure shows three V/H ratio models. The characteristics of the three models are as follows:
  - The V/H ratios for each model are less than 0.6 for period ranges longer than 0.1 s.
  - The V/H ratios are different for each model. They are 0.6-0.9 at period ranges shorter than 0.1 s. Also, the values peak (V/H ratio over 1) at period ranges around 0.05 s.

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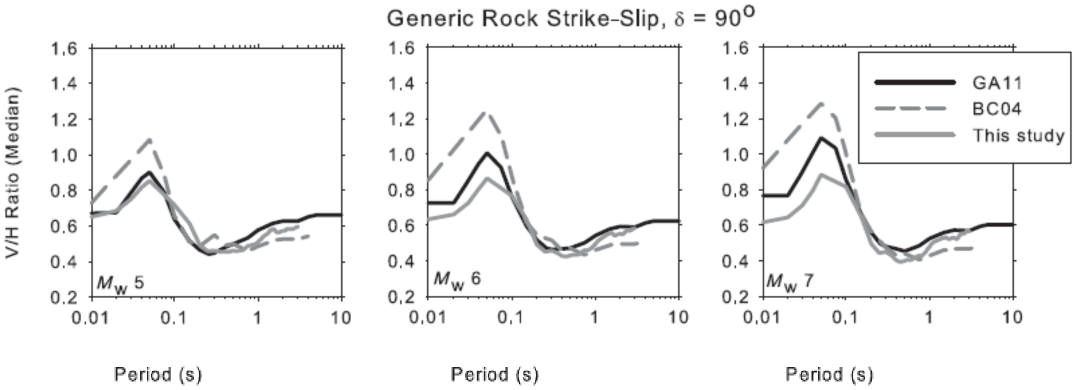


Figure 7.3.18: Comparisons of Selected V/H Ratios by Boomer et al. (2011)

- The U.S. Army Corps of Engineers (2007) also showed the methods for setting the V/H ratio. There is a peak period in the vertical spectrum which is shorter than the horizontal spectrum. The design vertical spectrum is taken as two-thirds of the horizontal spectrum at periods longer than T_{sv}. T_{sv} indicates the peak period in the vertical spectrum. At periods shorter than T_{sv}, the V/H ratio depends on the hypocentral distance. It is taken as 1 if the hypocentral distance is shorter than 10 km, and is 0.67 if the distance is longer than 40 km. Then, it is taken as 0.84 if the hypocentral distance is from 10 km to 40 km.

b. Construction of standard vertical spectrum.

(1) To determine the standard spectrum it is necessary to compute first the period defining the upper limit of the maximum vertical amplification plateau, given by

$$T_{SV} = \frac{0.67}{F_V} T_S \quad (9)$$

(2) The standard vertical spectrum is then defined as follows:

Source to Site Distance (R)	Conversion Factor
≤ 10 km	1.00
25 km	0.84
≥ 40 km	0.67

$$S_{AV}(T) = \begin{cases} F_V\, S_A(T) & \text{for } T < T_{SV} \\ 0.67 \dfrac{\overline{S_1}}{B_1 T} & \text{for } T_{SV} \le T \end{cases} \quad (10)$$

Figure 7.3.19: Construction of Vertical Spectrum by the U.S. Army Corps of Engineers (2007)

Bozorgnia and Campbell (2004) proposed a simplified V/H ratio. They proposed two models of rock sites at a hypocentral distance that is shorter than 20 km and 60 km. **Figure 7.3.20** shows the V/H ratio by Bozorgnia and Campbell (2004). In the case with a distance shorter than 20 km, the V/H ratio is about 0.9 for periods of 0.1-0.4 s, and 0.5 for periods longer than 0.3 s. Then in the case with a distance longer than 60 km, the V/H ratio is 0.67 for periods of 0.1-0.4 s, and 0.5 for periods longer than 0.3 s.

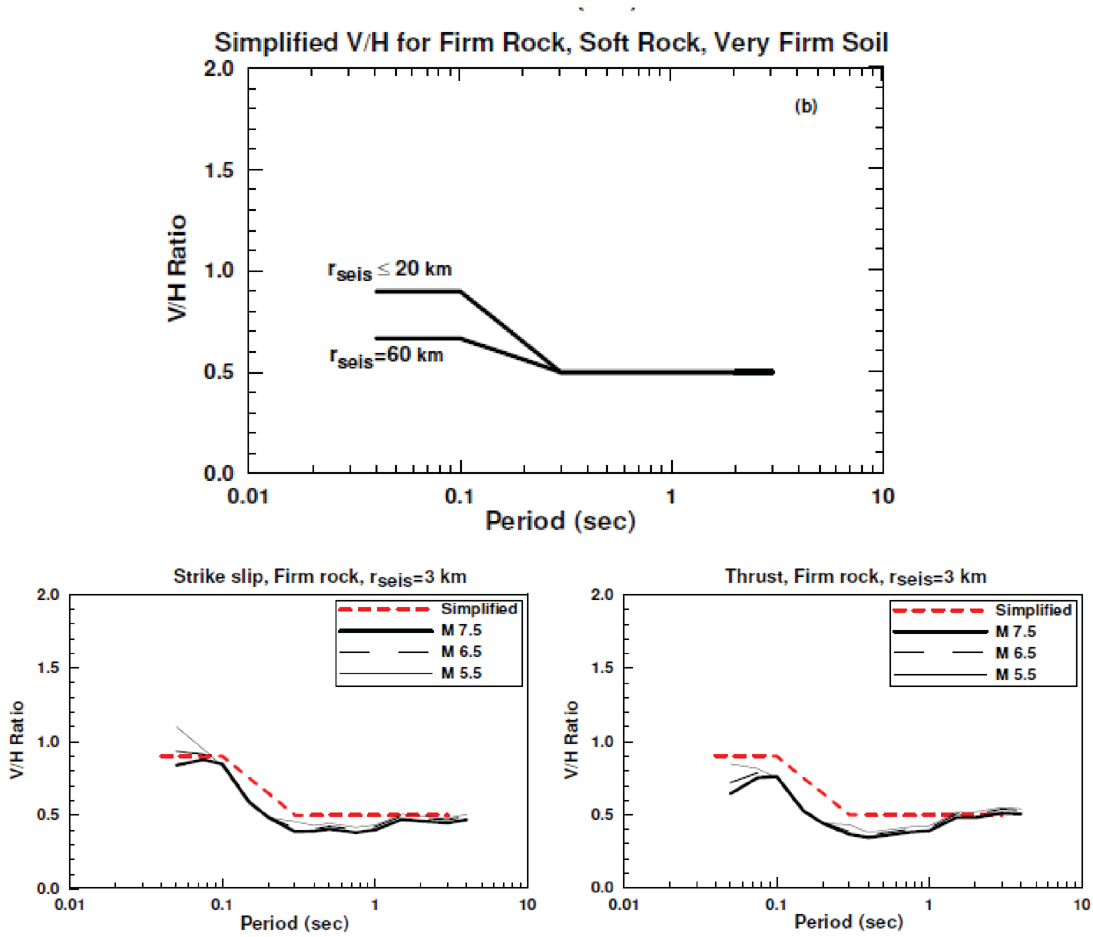
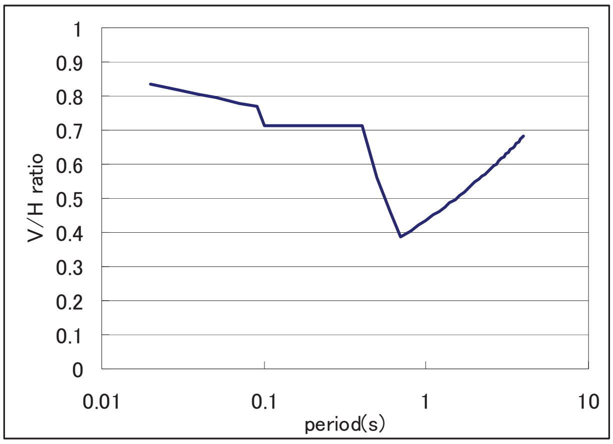


Figure 7.3.20: Simplified V/H Spectra by Y. Bozorgnia and K. W. Campbell (2004)

- In the Guidelines for Seismic Performance Evaluation of Dams during Large Earthquakes in Japan (2005), the lower limits of the horizontal and vertical acceleration response spectra were constructed. The average V/H ratio is about 0.7 (≒2/3) qualitatively.



Source: http://www.nilim.go.jp/lab/fdg/

Figure 7.3.21: Lower Limits of the Horizontal and Vertical Acceleration Response Spectra in Japan (Left: Horizontal, and Right: Vertical)

Based on literature review, the V/H ratio was set as follows:

1) Recent several studies were mentioned that the V/H ratio depends on the hypocentral distance, earthquake magnitude, and natural periods. The V/H ratio is high in case of a short hypocentral distance and a short period range.

2) According to the ICOLD guideline (1989), the vertical PGA may be conservatively taken between two-thirds and one-half of the horizontal PGA. According to the U.S. Army Corps of Engineers (2007), the V/H ratio is taken as two-thirds at 40 km of the hypocentral distance.

3) In the Guidelines for Seismic Performance Evaluation of Dams during Large Earthquakes in Japan (2005), the average V/H ratio is about 0.7 (≒2/3) qualitatively.

4) However, the V/H ratios are different in each study. Several V/H ratio models were proposed. Therefore, a uniform V/H ratio should be developed in the future.

Based on the review results above, the vertical PGA is taken as two-thirds of the horizontal PGA, and V/H ratio is taken as two-thirds of all the natural period range.

The horizontal and vertical PGA values for MCE and OBE are presented in **Table 7.3.5** and the corresponding response spectra are shown in **Figure 7.3.22** and **Figure 7.3.23**.

Table 7.3.5: Horizontal and Vertical PGA Values for MCE and OBE

Earthquake	PGA (Horizontal)	PGA (Vertical)
MCE	0.54	0.36
OBE (200 years)	0.14	0.09

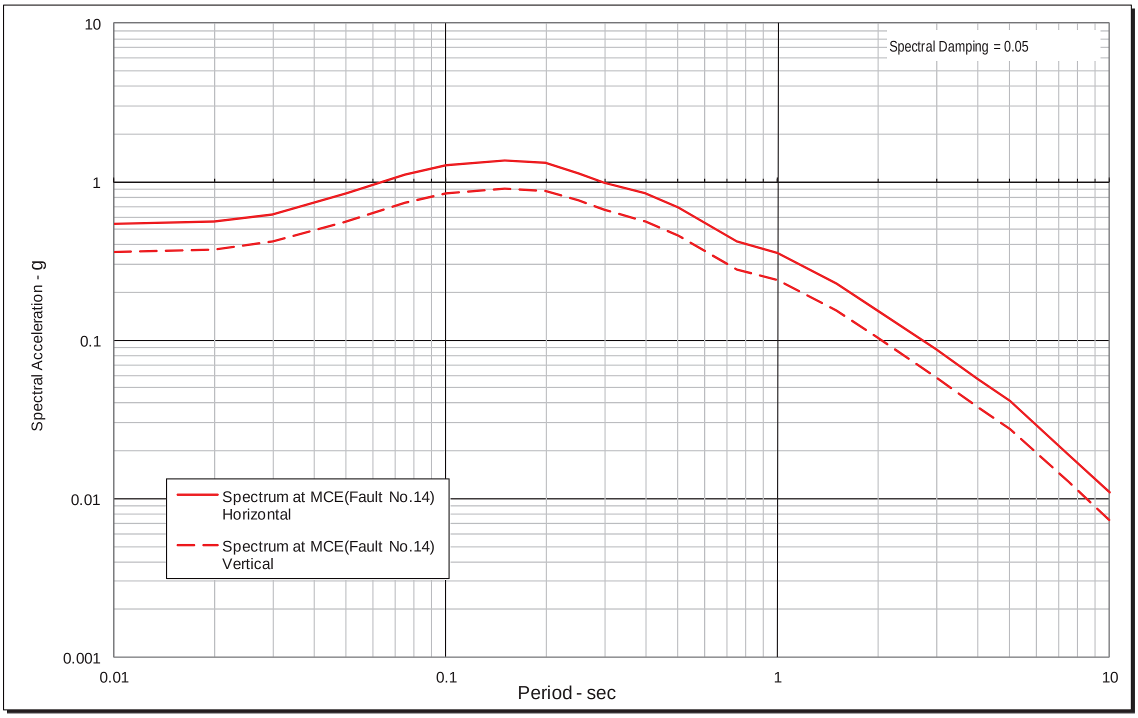


Figure 7.3.22: Horizontal and Vertical Response Spectra for MCE

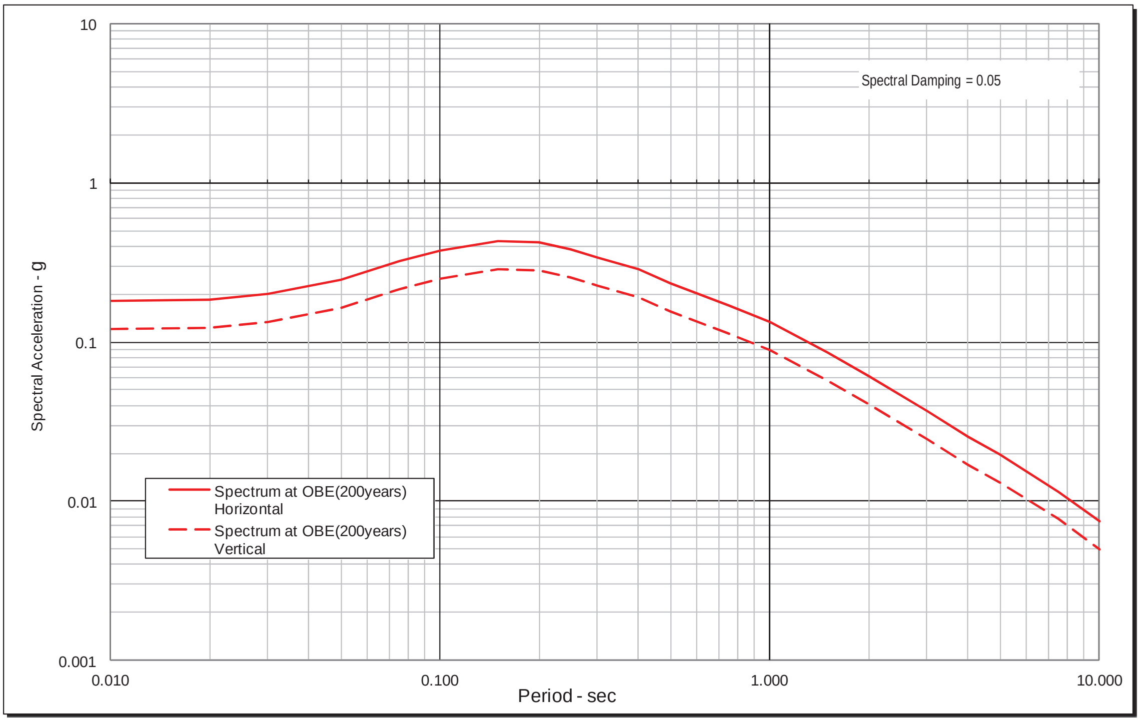
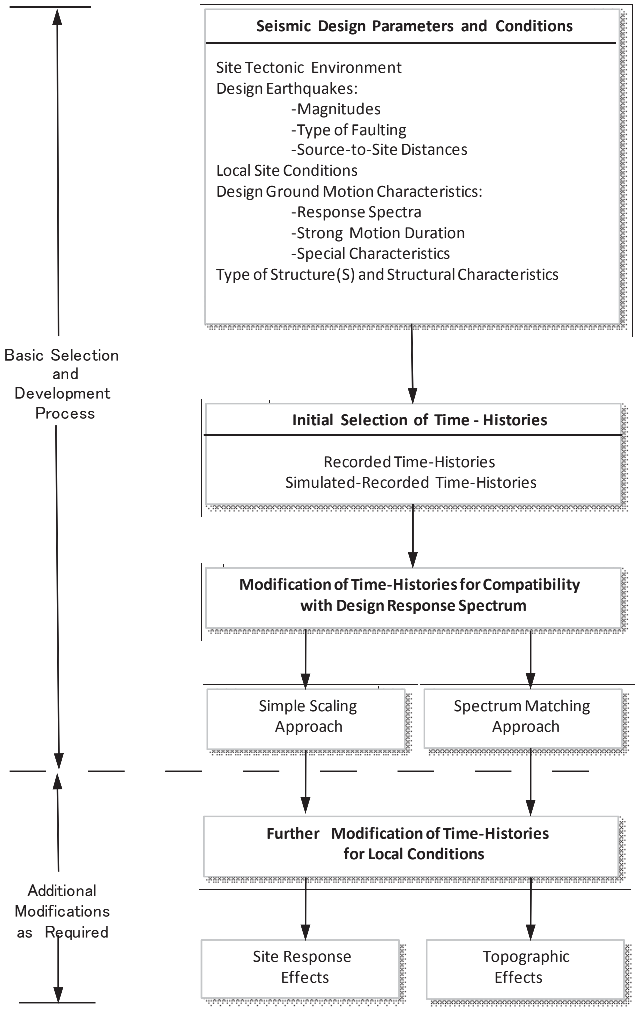


Figure 7.3.23: Horizontal and Vertical Response Spectra for OBE (200 Years)

8. Preparation of Earthquake Time Histories for MCE and OBE

In this section, the earthquake time histories for MCE and OBE for the dynamic response analysis of dam are prepared. Following the U.S. Army Corps of Engineers (2003), the procedure for developing time histories for seismic analysis is shown in **Figure 7.3.24**.



Source: U.S. Army Corps of Engineers(2003) Engineering and Design - Time History Dynamic Analysis of Concrete Hydraulic Structures [EM 1110-2-6051]

Figure 7.3.24: Procedure for Developing Time Histories for Seismic Analysis

(1) Selection of earthquakes

According to the U.S. Army Corps of Engineers (2003), it is important that the designed earthquake and conditions are similar to the selected ones with regards to the tectonic environment around the dam site, the earthquake magnitude, the hypocentral distance, the type of faulting, and local site conditions (e.g., rock or soil). Time histories that are similar to the design conditions should be selected from available strong ground motion databases.

The criteria for the selection of time histories for the Dasu Dam site are as follows:

- Large and active tectonic lines or faults are distributed near the dam site. The type of faulting is reverse or strike-slip. They are distributed within 50 km.
- The earthquake magnitude is assumed at about 6.0-8.0.

According to the U.S. Army Corps of Engineers (2003, 2007), the seismic analysis for concrete dam was shown using strong ground motion as observed from an earthquake with a magnitude greater than 6.5. **Table 7.3.6** shows the strong ground motions observed by the U.S. Army Corps of Engineers (2003, 2007).

Table 7.3.6: List of Strong Ground Motions Observed by the U.S. Army Corps of Engineers (2003, 2007)

Earthquake	Time	Region	Depth(km)	Mechanism	Mw	station	Closest distance to fault(km)	Site Geology
Parkfield	1966-06-28 04:26:14 UTC	California	10	Strike-slip	6.1	Parkfield, CA Cholame 8W	11.2	Thin Alluvium;Sandstone
San Fernando	1971-02-09 14:00:41 UTC	California	13	Reverse	6.6	Pacoima Dam, CA	3.5	Highly jointed Diorite Gneiss
Morgan Hill	1984-04-24 21:15:18 UTC	California	8.5	Strike-slip	6.1	Coyote Lake Dam, CA - San Martin; Station E	1.5	Fill over carbonate rock
Loma Prieta/Santa Cruz Mountains	1989-10-18 00:04:15 UTC	California	17.48	Reverse-Oblique	7	Gilroy Array Sta 1, CA - Gavilan College,	2.8	Rock
Northridge	1994-01-17 12:30:55 UTC	California	17.5	Reverse	6.7	Newhall, CA - Sun Oil Co - W Pico Canyon Blvd	9.4	Nonmarine Deposit
Northridge	1994-01-17 12:30:55 UTC	California	17.5	Reverse	6.7	Pacoima Dam, CA	11.7	Highly jointed Diorite Gneiss

The observed strong ground motions listed in **Table 7.3.6** have been caused by earthquakes with magnitude greater than 6.5, and the types of faulting are reverse or strike-slip. Moreover, the hypocentral distance is within 20 km. Therefore these site conditions are similar to the Dasu Dam site.

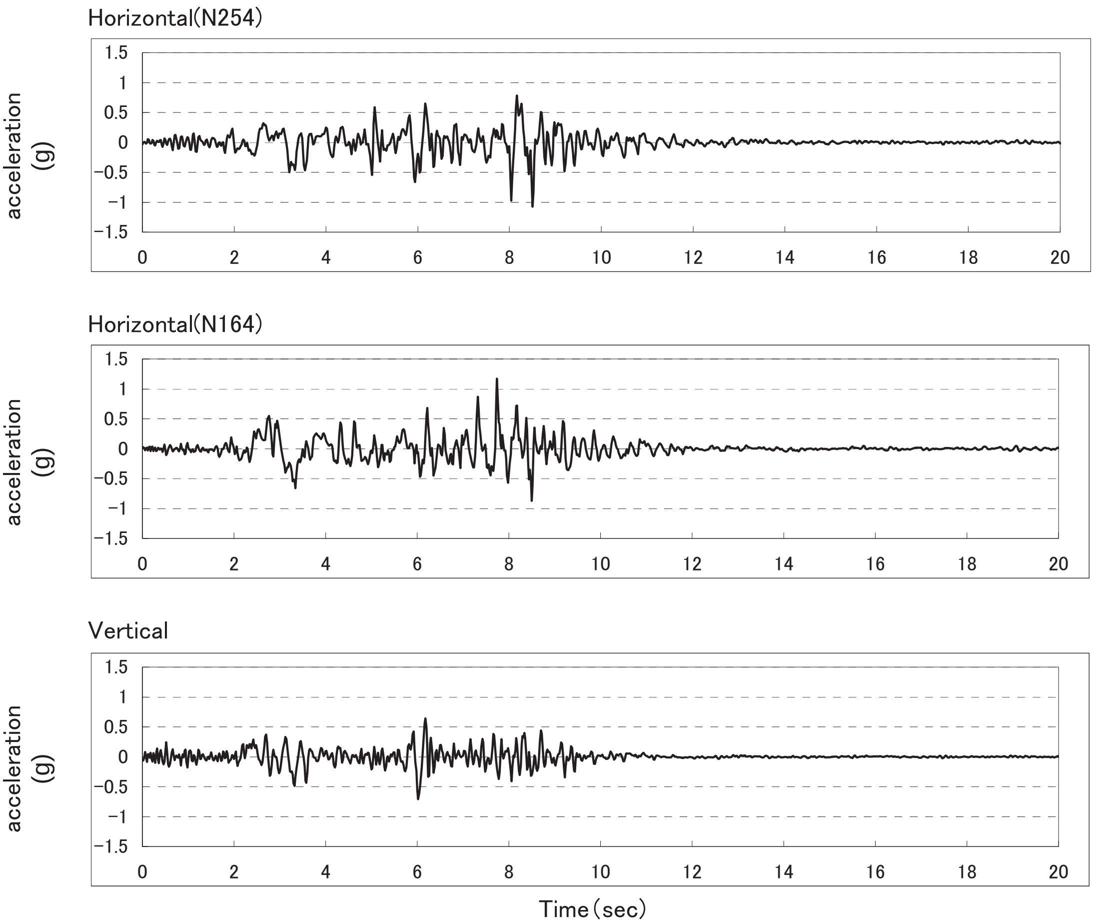
Three time histories, observed at Pacoima Dam during the San Fernando Earthquake, at Coyote Lake Dam during the Morgan Hill Earthquake, and at Gilroy Array Sta. 1 during the Loma Prieta Earthquake, were selected because their site geologies are of rock and their hypocentral distances are close. These time histories were collected from the website of the Consortium of Organizations for Strong-Motion Observation Systems (COSMOS).

Table 7.3.7 shows the parameters (e.g., PGA, PGV) of selected time histories. Time histories which observed the maximum PGA of two components were selected. Such are highlighted in gray in **Table 7.3.7**.

Table 7.3.7: List of Parameters of Selected Time Histories

Earthquake	Time	Region	Depth (km)	Mechanism	Mw	station	Closest distance to fault(km)	Site Geology	Component	PGA(gal)	PGA(g)
San Fernando	1971-02-09 14:00:41 UTC	California	13	Reverse	6.6	Pacoima Dam, CA	3.5	Highly jointed Diorite Gneiss	Horizontal(164)	1,148.1	1.17
									Horizontal(254)	1,055.0	1.08
									Vertical	696.0	0.71
Loma Prieta	1989-10-18 00:04:15 UTC	California	17.48	Reverse-Oblique	7	Gilroy Array Sta 1, CA - Gavilan College,	2.8	Rock	Horizontal(90)	433.6	0.44
									Horizontal(0)	426.6	0.44
									Vertical	206.4	0.21
Morgan Hill	1984-04-24 21:15:18 UTC	California	8.5	Strike-slip	6.1	Coyote Lake Dam, CA - San Martin; StationE	1.5	Fill over carbonate rock	Horizontal(N285)	1,137.8	1.16
									Horizontal(N195)	639.8	0.65
									Vertical	376.3	0.38

Figure 7.3.25 to **Figure 7.3.27** show the waveforms of the three time histories selected.



Note: The horizontal direction indicates the clockwise angle from the north at the seismometer. N164 indicates 164° from north to south.

Figure 7.3.25: Recorded Acceleration Time Histories at Pacoima Dam during the 1971 San Fernando Earthquake

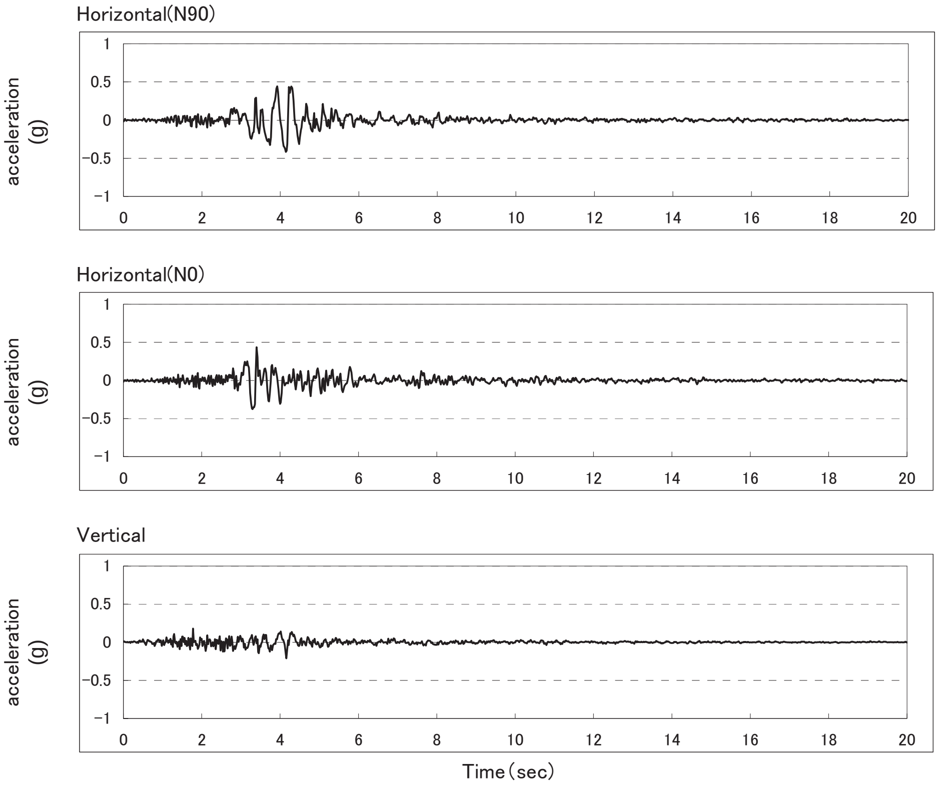


Figure 7.3.26: Recorded Acceleration Time Histories at Gilroy Array Sta. 1 during the 1989 Loma Prieta Earthquake

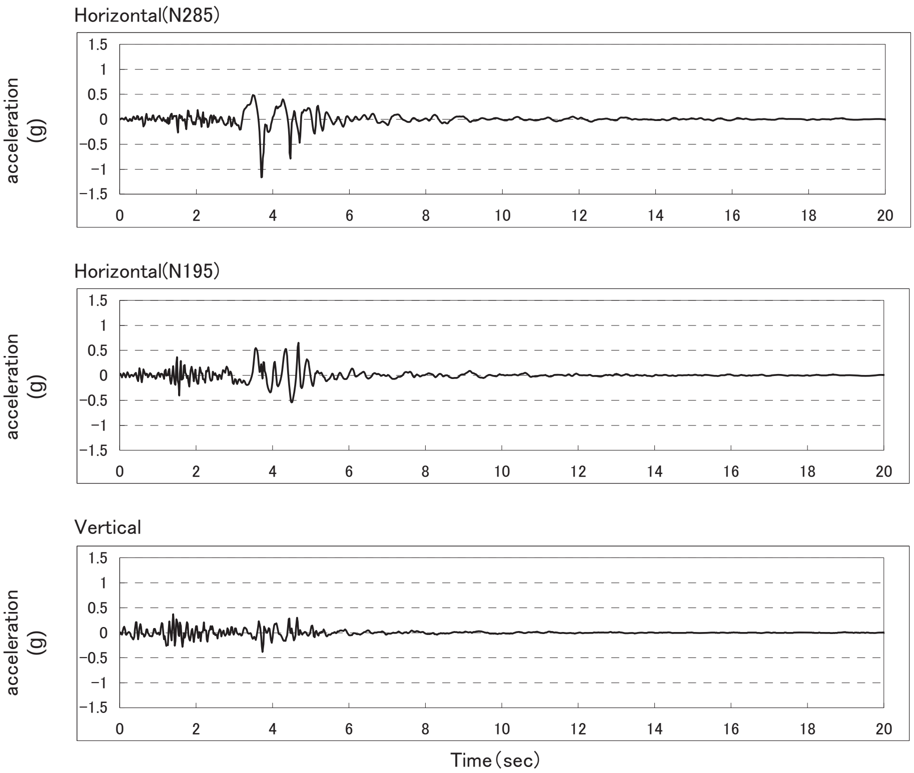


Figure 7.3.27: Recorded Acceleration Time Histories at Coyote Lake Dam during the 1984 Morgan Hill Earthquake

(2) Preparation of earthquake time histories for MCE and OBE

In preparing the time histories data, there are two approaches. The first is the spectrum matching approach, and the other is the simple scaling approach. In this study, the spectrum matching response spectra were selected because they are set by the attenuation relationship based on the many observed earthquake time histories.

The software ARTEQ for Windows was used for the spectrum matching for compatibility with the response spectra for design. A sample display of ARTEQ is shown in **Figure 7.3.28**.

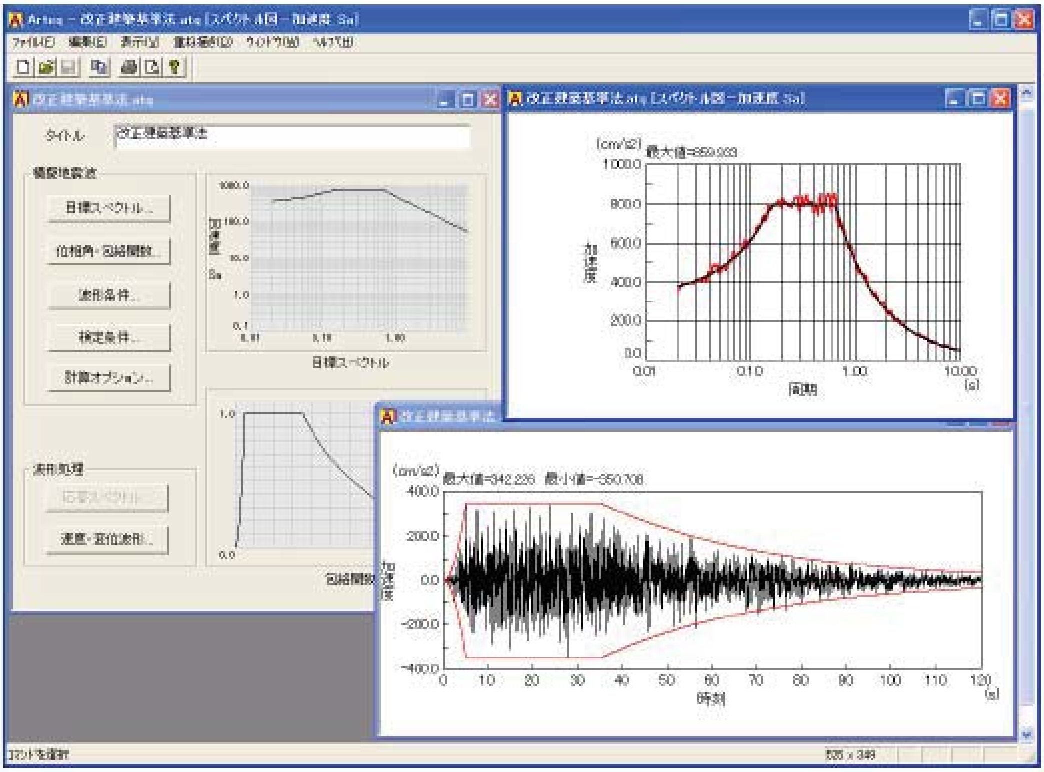


Figure 7.3.28: ARTEQ for Windows (KOZO KEIKAKU ENGINEERING Inc.)

The acceleration response spectra for design and the selected time histories are as follows:

■Acceleration response spectra for design
- MCE (Horizontal and vertical components)
- OBE (200 years) (Horizontal and vertical components)

■Selected time histories
- Records at Pacoima Dam during the 1971 San Fernando Earthquake (Horizontal N164°and vertical components)
- Records at Coyote Lake Dam during the 1984 Morgan Hill Earthquake (Horizontal N285°and vertical components)
- Records at Gilroy Array Sta. 1 during the 1989 Loma Prietra Earthquake (Horizontal N90°and vertical components)

For MCE:

Table 7.3.8 shows the results of spectral matched time histories for MCE. **Figure 7.3.29** shows the spectral matched time histories, the comparison with the design (target) response spectrum, and the matched spectrum using ARTEQ. In the spectrum's figure, the lower limit of the natural period range is 0.04 s (25 Hz frequency) at Nyquist frequency because the sampling period of each of the selected time histories is 0.02 s (50 Hz frequency).

Duration is defined as the time required to build up from 5% to 95% of the integral.

Table 7.3.8: Results of Spectral Matched Time Histories for MCE

Earthquake	Time	Region	Depth(km)	Mechanism	Mw	station	Closest distance to fault(km)	Site Geology	Component	MCE			
										PGA(gal)	PGA(g)	PGV(kine)	Duration(sec)
San Fernando	1971-02-09 14:00:41 UTC	California	13	Reverse	7	Pacoima Dam, CA	3.5	Highly jointed Diorite Gneiss	Horizontal	531.2	0.54	45.0	11.28
									Vertical	354.1	0.36	29.3	14.72
Loma Prieta	1989-10-18 00:04:15 UTC	California	17.48	Reverse-Oblique	7	Gilroy Array Sta 1, CA - Gavilan College,	2.8	Rock	Horizontal	531.0	0.54	41.8	10.88
									Vertical	353.3	0.36	20.0	11.74
Morgan Hill	1984-04-24 21:15:18 UTC	California	8.5	Strike-slip	6	Coyote Lake Dam, CA - San Martin; StationE	1.5	Fill over carbonate rock	Horizontal	530.6	0.54	37.0	6.08
									Vertical	354.0	0.36	19.5	7.94

The three time histories (Figures 7.1.29, 7.1.30 and 7.1.31) showed the same PGA value after being fit with the same acceleration spectrum. However, the PGV and the duration were different among the time histories due to the different phase characteristics (i.e., intervals between peaks and valleys of waveform). A high PGV produced high stress in the dam body, and a long duration affected structure stability. Therefore it is recommended that at least two time histories are used for the dynamic analysis. These are as follows:

1) 1971 San Fernando Earthquake
2) 1989 Loma Prietra Earthquake

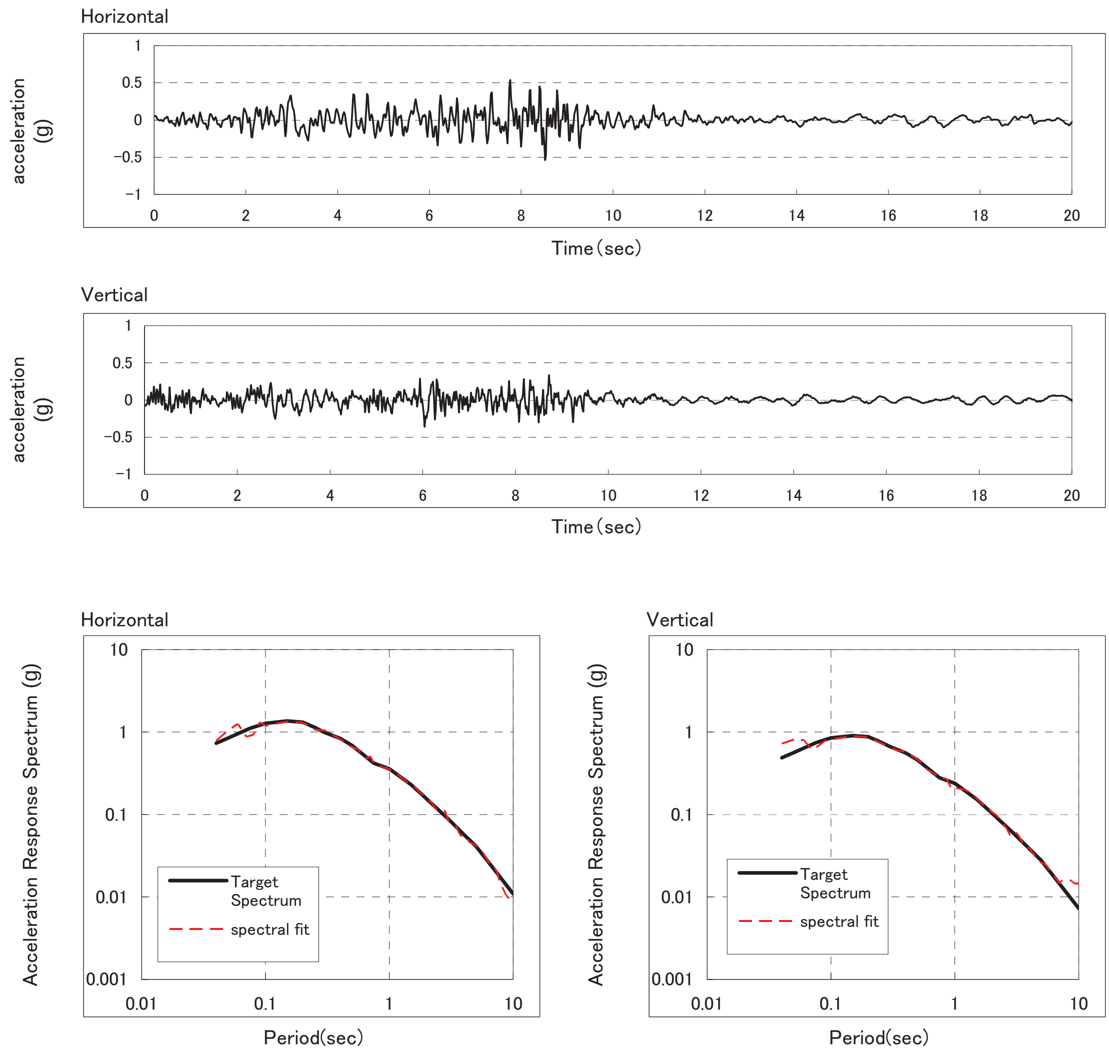


Figure 7.3.29: Time Histories and Response Spectra for MCE Using Records at Pacoima Dam during the 1971 San Fernando Earthquake (Horizontal N164° and Vertical Components)

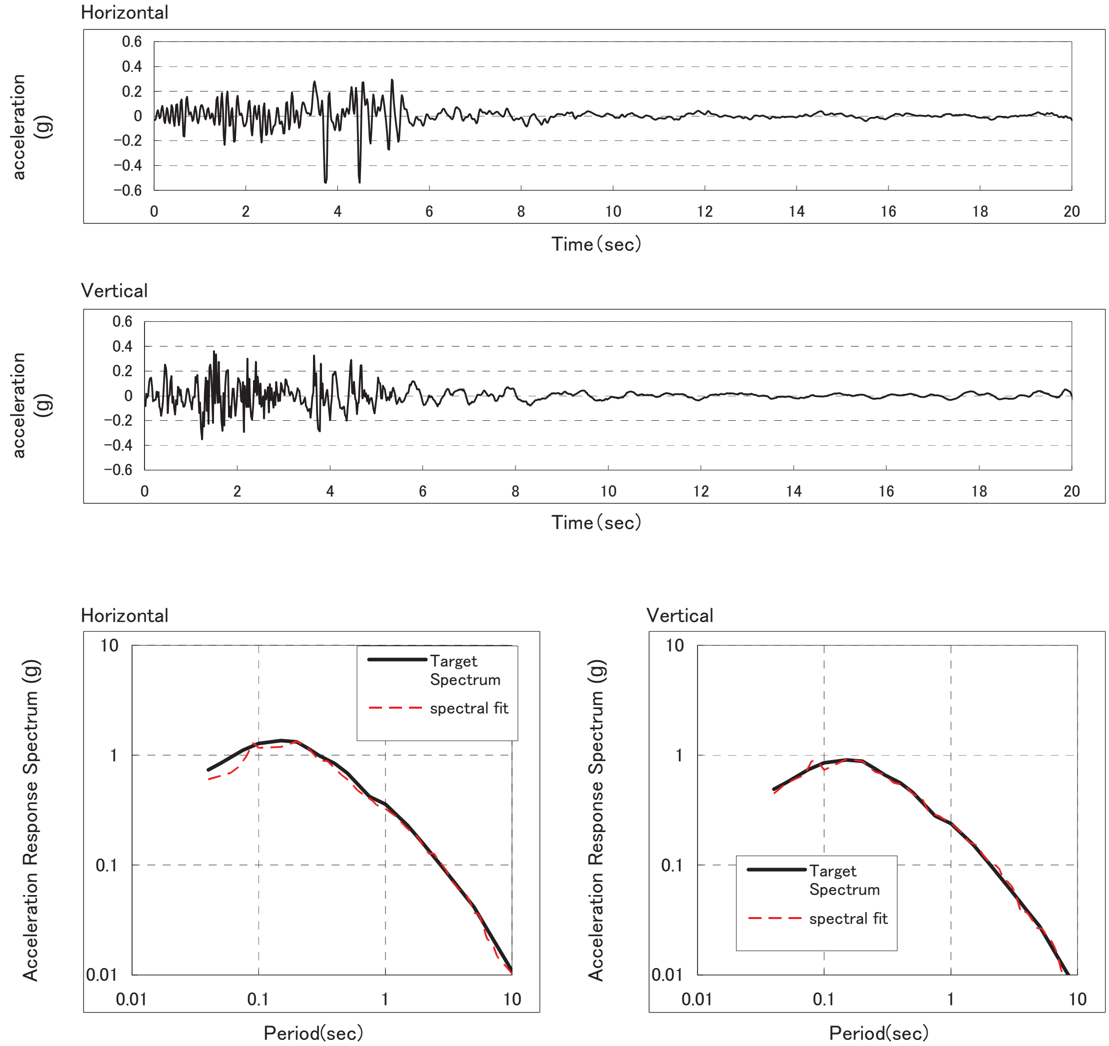


Figure 7.3.30: Time Histories and Response Spectra for MCE Using Records at Coyote Lake Dam during the 1984 Morgan Hill Earthquake (Horizontal N285° and Vertical Components)

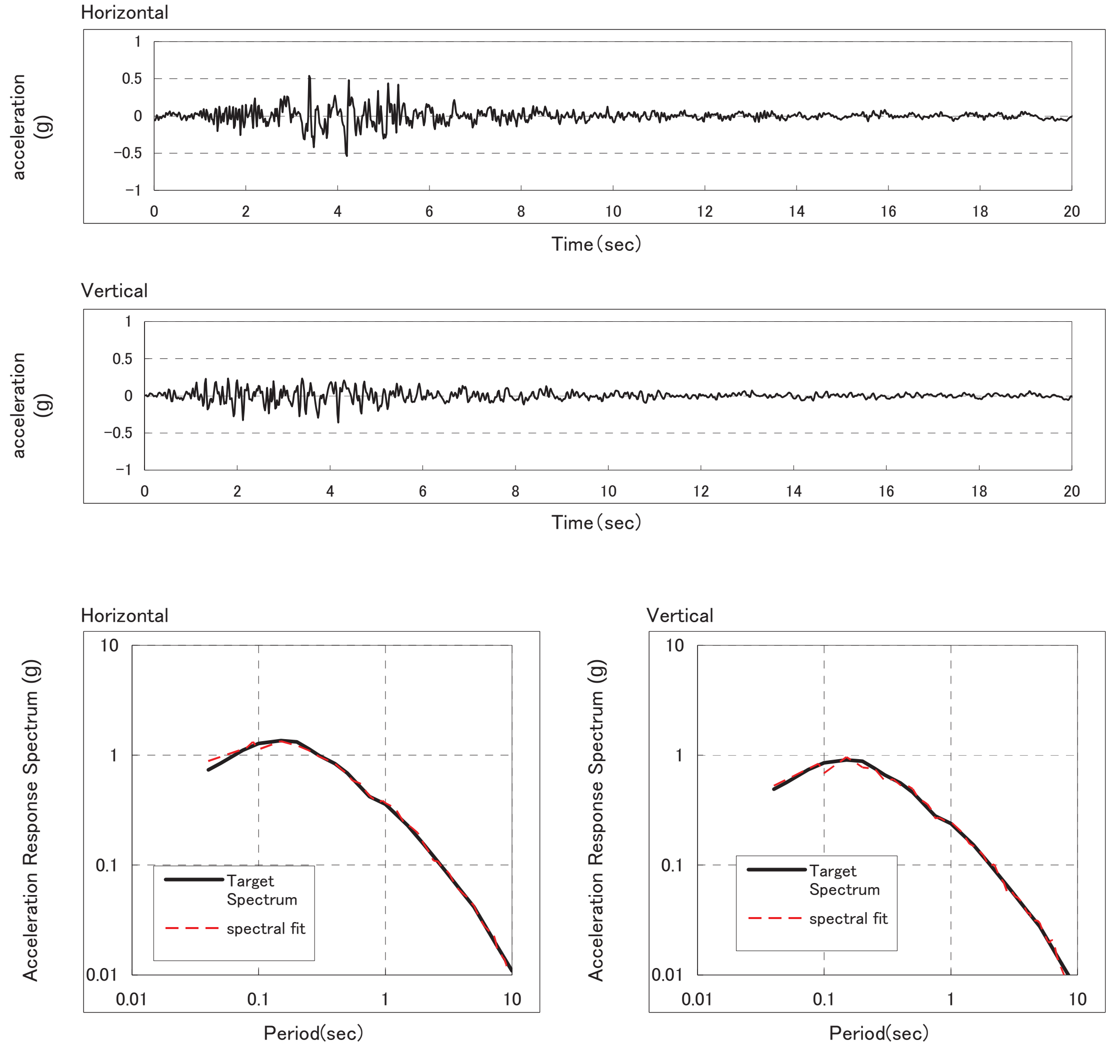


Figure 7.3.31: Time Histories and Response Spectra for MCE Using Records at Gilroy Array Sta. 1 during the 1989 Loma Prietra Earthquake (Horizontal N90° and Vertical Components)

For OBE (200 years):

Table 7.3.9 shows the results of spectral matched time histories for OBE (200 years). **Figure 7.3.32** to **Figure 7.3.34** show the spectral matched time histories, the comparison with the design (target) response spectrum and the matched spectrum using ARTEQ.

Table 7.3.9: Results of the Spectral Matched Time Histories for OBE (200 Years)

Earthquake	Time	Region	Depth(km)	Mechanism	Mw	station	Closest distance to fault(km)	Site Geology	Component	OBE 200years			
										PGA(gal)	PGA(g)	PGV(kine)	Duration(sec)
San Fernando	1971-02-09 14:00:41 UTC	California	13	Reverse	7	Pacoima Dam, CA	3.5	Highly jointed Diorite Gneiss	Horizontal	137.2	0.14	16.5	8.20
									Vertical	91.5	0.09	11.4	15.08
Loma Prieta	1989-10-18 00:04:15 UTC	California	17.48	Reverse-Oblique	7	Gilroy Array Sta 1, CA - Gavilan College,	2.8	Rock	Horizontal	137.2	0.14	13.9	9.16
									Vertical	91.5	0.09	6.9	10.00
Morgan Hill	1984-04-24 21:15:18 UTC	California	8.5	Strike-slip	6	Coyote Lake Dam, CA - San Martin; StationE	1.5	Fill over carbonate rock	Horizontal	137.2	0.14	8.1	7.04
									Vertical	91.6	0.09	5.7	13.86

The three time histories showed the same PGA value after being fit with the same acceleration spectrum. However, the PGV and the duration were different among the time histories due to the different phase characteristics (i.e., intervals between peaks and valleys of waveform). A high PGV produced high stress in the dam body, and a long duration affected the structure stability. Therefore, it is recommended that at least two time histories are used for the dynamic analysis. These are as follows:

1) 1971 San Fernando Earthquake
2) 1989 Loma Prietra Earthquake

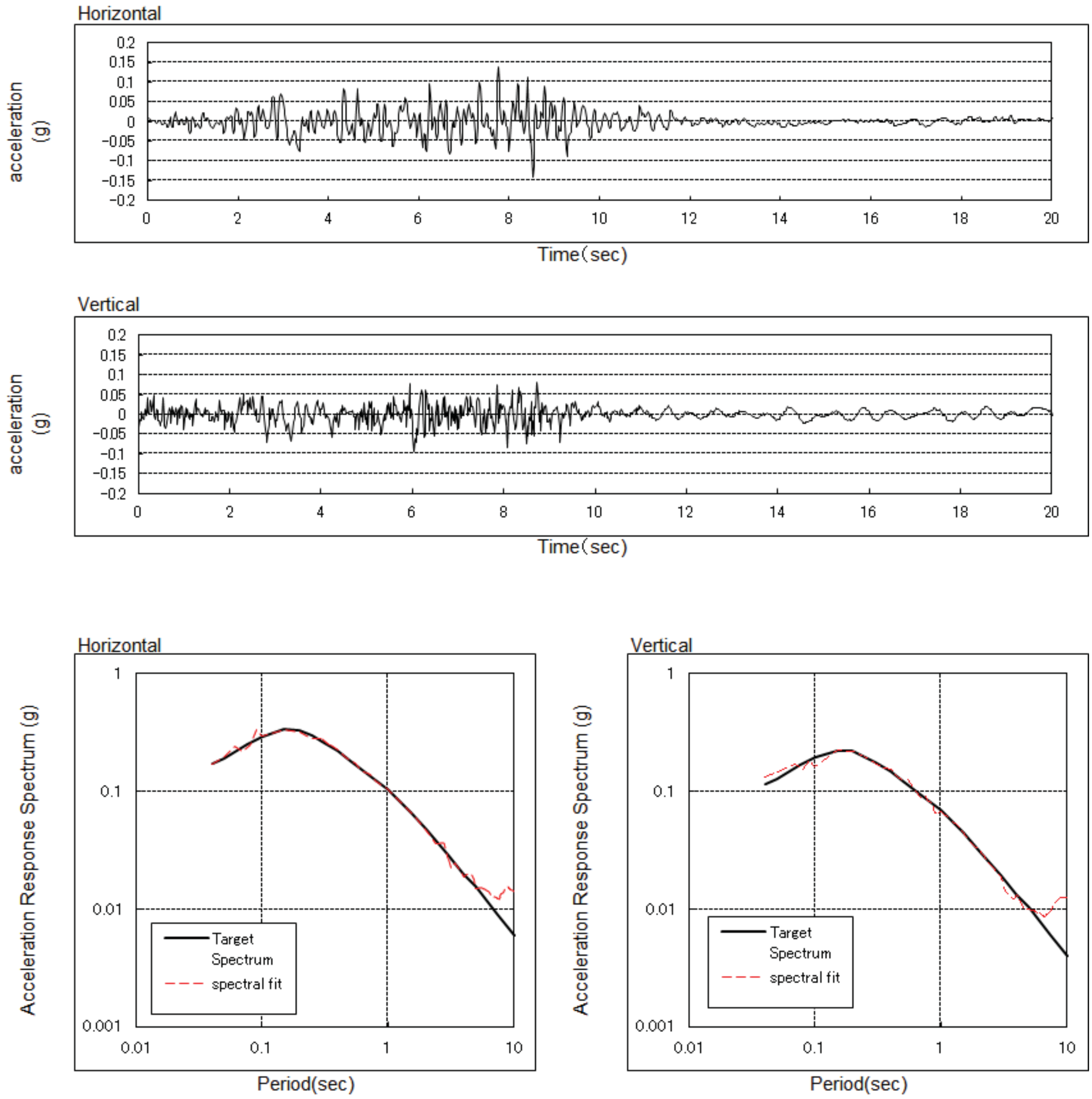


Figure 7.3.32: Time Histories and Response Spectra for OBE (200 Years) by Spectral Matching Approach Using Records at Pacoima Dam during the 1971 San Fernando Earthquake (Horizontal N164° and Vertical Components)

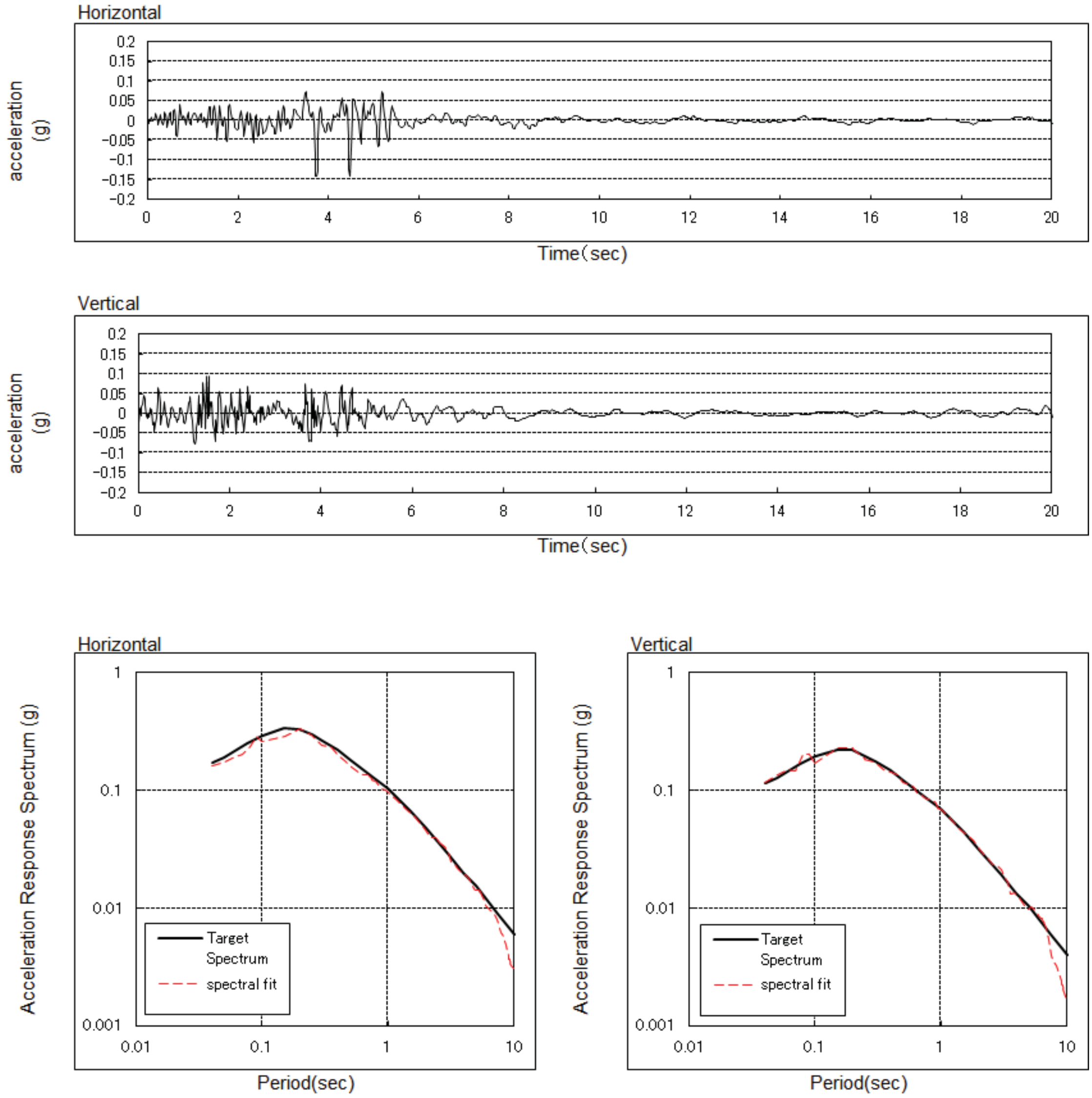


Figure 7.3.33: Time Histories and Response Spectra for OBE (200 Years) by Spectral Matching Approach Using Records at Coyote Lake Dam during the 1984 Morgan Hill Earthquake (Horizontal N285° and Vertical Components)

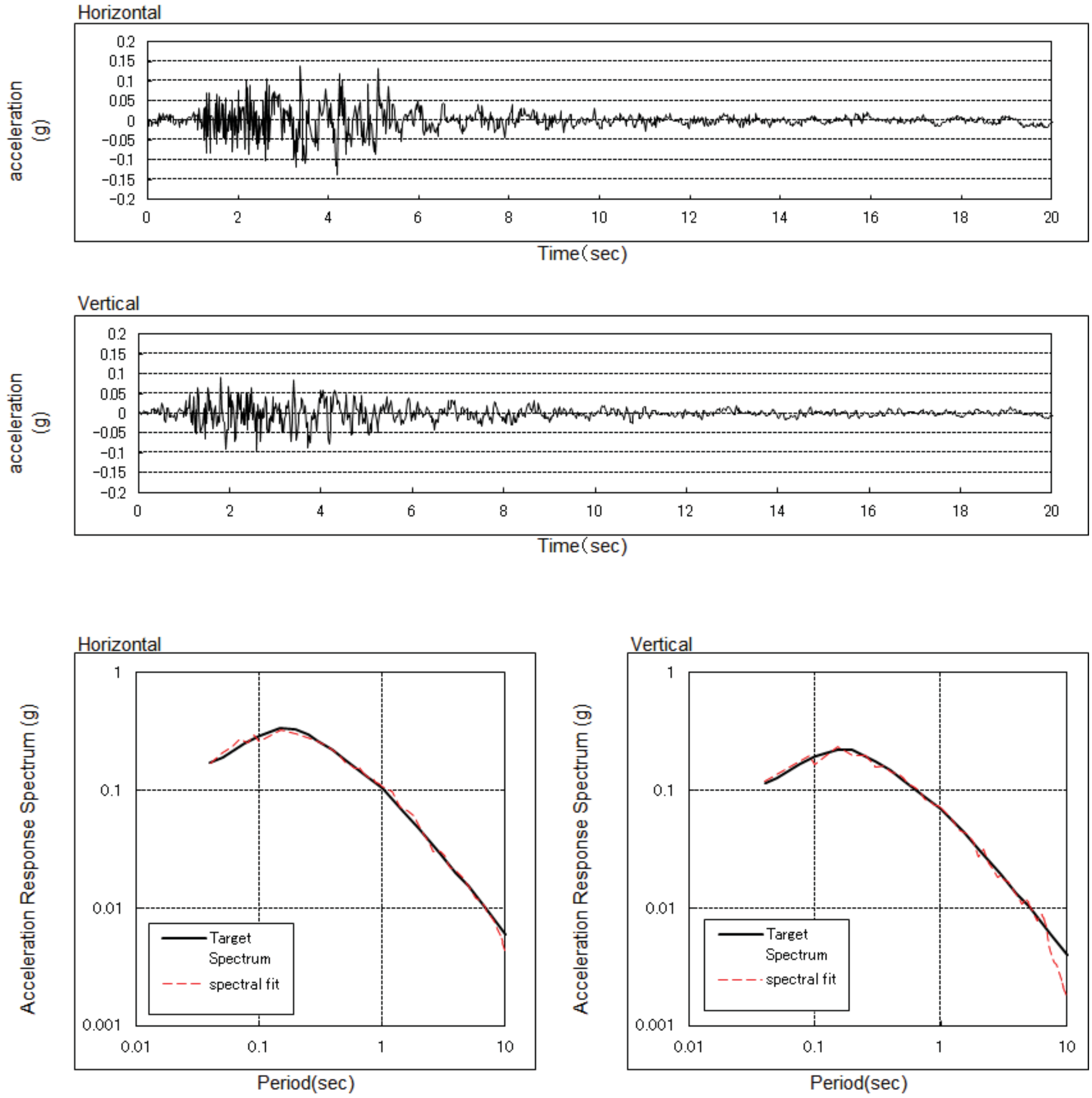


Figure 7.3.34: Time Histories and Response Spectra for OBE (200 Years) by Spectral Matching Approach Using Records at Gilroy Array Sta. 1 during the 1989 Loma Prietra Earthquake (Horizontal N90° and Vertical Components)

9. Conclusions and Recommendations

Referring to **Table 7.3.10**, which shows the comparison between the FS in 2009 and the results obtained in the detailed design (DD), the conclusions and recommendations are explained below.

Table 7.3.10: Summary of Seismic Hazard Assessment Results in the FS in 2009 and this Study

Descriptions	FS 2009		DD 2012	
	Results	Recommended	Results	Recommended
1) PGA by deterministic procedure	0.72 g in max	Order of 0.50 g	0.54 g (Fault No. 14)	0.54 g for Fault No. 14 fixed after identification as active tectonics
2) PGA by probabilistic procedure 200 years 10,000 years	 0.18 g -	 0.18 g -	 0.09-0.14 g 0.42-0.64 g	 0.14 g Order of 0.5 g
3) Response spectra 200 years 975 years MCE	 - 0.29 g 0.50 g	 - 0.29 g 0.50 g	 0.14 g - 0.54 g (Fault No. 14)	 0.54 g
4) Dynamic Analysis for Dam MCE PGA (Design) at rock surface OBE PGA (Design) at rock surface SEE PGA (Design) at rock surface	 0.50 g 0.18 g (200 year return period) -	 0.50 g 0.18 g (200 year return period) -	 0.54 g (Fault No. 14) 0.14 g (200 year return period) 0.42-0.64 g (10,000 year return period)	 0.54g for Fault No.14 fixed after identification as active tectonics 0.14 g Order of 0.5 g
5) Psedo-static analysis for Dam *3) MCE, Horiz. Vertical OBE, Horiz. Vertical		 0.33g (2/3PGA) *1) 0.22 g(2/3horiz.) 0.12g (2/3PGA) 0.08g'2/3horiz.)		 0.36g (2/3PGA) 0.24 g(2/3horiz.) 0.09g (2/3PGA) 0.06g (2/3horiz.)
6) Underground complex MCE, Horiz. Vertical OBE, Horiz. Vertical				 0.18g (1/2 of dam) *2) 0.12g(1/2 of dam) 0.045g (1/2 of dam 0.03g(1/2 of dam)
7) Ordinary Facilities; OBE, Horiz. (200-year period)		0.15g	0.14g	0.15g/0.3g

Note:
:*1) Refer to EM1110-2-6053, Page 7-2 (May2007)
*2) PGA in underground is a half of surface.
*3) Vertical earthquake component in pseudo-static analysis for a dam shall not be combined with horizontal earthquake (ref to Article 4.2 of EM1110-2200).

- As summarized in **Table 7.3.10**, it is concluded that the maximum PGA at the Dasu Dam site is 0.54 g, as estimated using deterministic procedures associated with the assumed active faults and lineaments.

- Through the probabilistic procedure, the PGA at the return period of 10,000 years corresponding to SEE was estimated to be in the order of 0.50 g. The PGA for MCE (0.54 g) is higher than that of SEE (0.50 g). Therefore, the peak bedrock acceleration to be applied for the dynamic analysis of the RCC main dam should be consistent with that of the PGA for MCE (0.54 g).
- It was noted that the PGA for the return period of 200 years under the probabilistic procedure is 0.14g. It is smaller than the 0.18 g obtained in the FS in 2009. This is due to the period of earthquake data and application of a different probabilistic method from that of the FS in 2009.
- The earthquake time histories for MCE and OBE for the dynamic analysis are summarized in **Table 7.3.11**.

Table 7.3.11: Earthquake Time Histories for MCE and OBE

Type	Recommended Spectral Matched Time Histories
MCE	1. 1971 San Fernando Earthquake 2. 1989 Loma Prietra Earthquake
OBE (200 years)	1. 1971 San Fernando Earthquake 2. 1989 Loma Prietra Earthquake

Three time histories were prepared for the stability analysis of the dam under both MCE and OBE. They showed the same PGA value after being fit with the same acceleration spectrum. The PGV and the duration were different among them due to their different phase characteristics. A high PGV produced high stress in the dam body, and a long duration affected the structure stability. The least two time histories shown in **Table 7.3.11** and having different phase characteristics are recommended to be used for the dynamic analysis.

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Annex – 7.4

DAM SAFETY AND ITS MONITORING

Dam Safety

Dam safety is given utmost importance in the Project design. The detail treatment of the subject is given in the design documents. A summary of safety parameters adopted in the project design and operation is given below:

- ***Safety against hydraulic pressure*** from fully supply level (FSL at EL.950m) and high flood level (SCF at EL.959.5m).
- ***Safety against combined pressure of water and soil (sediment)***; this is structural part of the design. This condition will not develop on initial filling, but may develop after years of reservoir operation if no sediment above flushing facilities is removed.
- ***Safety against overturning***: Each monolith layer is safe against overturning with respect to the downstream toe of the dam. The resultant force acting on the dam body falls within the middle-third of the foundation base for the normal operating conditions and during construction and its distance from the foundation edge falls within the base width under extreme loading conditions (SCF/ PMF or earthquake). Therefore there is no tension over the allowable stress in the concrete dam foundation under any construction or operational state.
- ***Safety against flood inflow***. Additional flood storage of 9.5m in height (EL.950.0m - EL.959.5m) has been provided in the design to accommodate the safety check flood (SCF/PMF).
- ***Safe against spill over due to extreme waves or flood events such as GLOFs.*** The safety check flood (SCF) of the dam is designed to considering a combined event of historical GLOFs and rainfall records ~~and natural dam failures~~. A flood surcharge of 9.5m in height has been provided to accommodate flood water from GLOF.
- ***Safety against waves generated by landslides in reservoir***. The chances of landslides fill during and after reservoir filling cannot be ruled out. The land slide wave may be absorbed by 9.5m provision in the dam design above FSL.
- ***Safety against hydrological surges from future upstream dams****:* According to the design reports of Bunji hydropower project, at the downstream of Bunji, for short-time, during peaking hours (4 hours daily from 18:00 to 22:00 in summer) a surge wave with a maximum height of 5 to 6m will travel from the tailrace channel along the river to Basha reservoir. This surge will not affect the Dasu dam directly. However, the 9.5m flood storage incorporated in Dasu project, will absorb any of such surges.
- ***Safety against scour in plunge pool scours depth***. The discharge from spillway will flip from the bucket into the air and fall in the pool of water below. The formation of eddies will dissipate the energy. The process will scour the river bed and depth of the water in the plunge pool will increase. This depth will attain equilibrium and reach no scour no deposit. The foundation of the dam is below the maximum scour depth is surety of the safety.
- ***Safety against Tilt or differential settlement***: The foundation of the dam is on firm fresh rock. There is no chance of differential settlement. The RCC dam body also has no settlement.
- ***Safety against leakages.*** The dam design has provided inspection galleries with drain holes. These will allow monitoring of the dam and allow releasing

uplifting after the fill. The high quality concrete will allow only very little transmissibility, especially GEVR at the upstream surface of dam. Should the inflow indicate an abnormal increase, the operator will have to investigate the reason and eliminate it.

- ***Safety against land sliding during reservoir filling and drawdown***. The filling of the dam for the first time, and subsequently for operation will result in increase of pore pressure. If the rock is poor, it may fail and result in landslide. The pore pressure developed during filling will create reverse hydraulic gradient. This can result in the failure of the slope and creating a landslide. The fill and emptying the reservoir must be kept at low rate for safety of dam. The first filling of the reservoir will be carried out at a rate of 1 m/day while monitoring slope failures. During flushing operations a filling rate of 3 m/day and drawdown rate of 4 m/day will be adopted in the first filling manual. However, it is expected the landslide prone areas will be stabilized after a few cycles of filling and drawdown.
- ***Safety during repeated drawdown cycles and fill cycles if used for peaking power***. It is important to keep surveillance during operation and keep studying the slope movement. For this purpose the slopes have been mapped and their movement recorded to forecast the landslides. This has to be part of operation manual.
- ***Safety against fire***: Fire protection system (comprising fire protection and fire monitoring system, and firefighting system) will be established in the underground powerhouse. Water distribution network with $50m^3$ storage tank will be established for firefighting system. Common fire extinguishers of type A (common combustion), B (flammable liquid and gas) and C (live electrical equipment) will also be installed.
- Preparation of annual dam and reservoir safety report for review by dam experts of WAPDA and World Bank. This has to be the part of operation manual.

Dam Safety Monitoring

Monitoring is an important tool to ensure dam safety. A large number of instrumentation sensors will be installed in the body and foundation of Dasu dam for the purpose of monitoring various important aspects of behaviour during construction, first filling and in operation. The total number of instruments installed makes an allowance for the expected situation that some will be lost and cease to function during construction and early operation. The instruments will include inclinometers, piezometers, pendulums, leakage weirs, seismometers and surface temperature.

WAPDA looks after safety of its dams through Dam Safety Organization (DSO). After completion of the construction, DSO will look after the safety of Dasu dam. The dam safety Programme consists of Three Tiers:

- “The First Tier monitoring is carried out by the operation and maintenance (O&M) staff of the project. This consists of observing the responses of the vast network of instruments embedded in the various structures. The data collected thus is compiled and analyzed to identify the areas of abnormal behavior and to devise measures for immediate action.
- The Second Tier monitoring is carried out by DSO. It is done by keeping a constant watch on the flow of instrument response data of the project structures through Tier One, analyzing it using the latest interpretation techniques, locating the areas of abnormal behavior and suggesting short term and long term solutions. DSO also undertakes annual inspections to see the physical condition of the works and to make on site appraisal of performance data. At the end of the inspection, a comprehensive report is issued

commenting upon the physical condition of the works, abnormalities observed, their likely causes and possible solutions. Its experts also visit projects, whenever any abnormal situation is reported, to study the phenomenon in situ and suggest corrective measures. In summary DSO's functions under Second Tier are as below:

  - Carrying out annual inspection and issuance of inspection report, identifying physical inadequacies, erratic performances, possible causes and the corrective measures.
  - Compilation, tabulation and interpretation of performance data of project structures and issue biannual safety evaluation reports.
  - Paying site visits to study, diagnose and prescribe problems of emergent natures.

- The Third Tier monitoring implies Periodic Inspections which are undertaken at an interval of 2 to 5 years, depending upon the hazard value and age of the dam. This is supposed to be carried out by an external team, who are not part of WAPDA, DSO and O&M staff of Dasu dam. The external team will prepare a comprehensive inspection reports reviewing the health of the structures, identifying the areas of concern and suggesting short term and long term corrective measures”.

Annex – 8.1

ELIGIBILITY AND ENTITLEMENT MATRIX

Loss Item 1: Loss of Agricultural Land Used in Terrace Cultivation			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Owner(s) of land identified by District Revenue Officer (DRO) through Land Acquisition Survey	1. Negotiated Value (NV) of agricultural land agreed between PAPs and the Government (project) 2. Cultivable Plot (1/2 kanal) close to the self-managed resettlement site; 3. Dislocation Allowance of PKR 500/- (Five hundred) per kanal but the total amount will not exceed PKR 20,000./- (Twenty thousand)	1. NV will be computed by the DRO based on the Unit Rates agreed upon at a Jirga comprising Village Committee (VC), District Revenue Officer (DRO), District Coordination Officer (DCO) and Project Resettlement Office (PRO); and also unit rates of Diamer-Basha Dam Project. 2. The Project through DRO will pay cash compensation through crossed cheque with assistance from PRO to confirm identity of owner.	Identified owners will be assisted by the PRO to prepare legal documents in support of their ownership.
Implementation Issues:			
1. Landowners will be informed of the details of the land acquisition and compensation process, resettlement package and payment procedure. 1. The VCs were established by the Assistant Coordination Officer (ACO) with recommendation of the village Malik in every affected village 2. The Unit Rates to be used in computing Negotiated Value (NV) for agricultural land will be determined at a Jirga including the Village Committee (VC), DRO or representative, DCO or representative, and PRO established under the Project Director PD-DHP (called the Price Evaluation Committee, duly formed and notified by PD-DHP). The valuation process will take into consideration the rates adopted by the Diamer-Basha Dam Project as this was a request of the community presented during the Grand Jirga held in April and September, 201. 3. The community in the project has derived the right to use homestead, agricultural and other land, by virtue of traditional land tenure under their traditional laws and customs. Therefore, formal land ownership documents as title deeds and cadastral maps have not been prepared for land in this area. Therefore, the Land acquisition survey is conducted by the DRO to establish land ownership and boundaries as these details are required to issue notice under Section 4 of LAA 1894.			
Loss Item 2: Loss of Homestead and Commercial Land			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Owner(s) identified by DRO through Land Acquisition Survey	1. Negotiated Value (NV) of land. 2. Dislocation Allowance @ PKR 750/- (Seven hundred and fifty) per kanal but the total amount will not exceed PKR 5,000/- (Five thousand). 3. Affected owners will be entitled to a free one Marla plot along the realignment of KKH for commercial land and free 1/2 kanal plots for	1. NV will be computed by the DRO based on the Unit Rates agreed upon at a Jirga comprising VC, DRO, DCO and PRO; and also unit rates of Diamer-Basha Dam Project; 2. Project through DRO will pay for the land. 3. Project will develop the resettlement sites with provision of basic amenities as electricity, potable water,	Identified owners will be assisted by the Project to prepare legal documents in support of their ownership.

	residential structures. 4. Provision of basic infrastructures at new resettlement area such as access road, drinking water supply, sanitation, schools, electricity, mosque, health facility and commercial area free of cost. 5. An additional allowance equal to the price of 1/2 kanal plot in project area for Affected PAPs who will not receive a plot and will be relocated by themselves.	roads 4. All the PAPs who will be relocated at the resettlement sites will receive a free plot however, others will receive average price of the plot (within the project area) computed by the DRO. 5. Those PAPs who will be relocated by themselves collectively out of relocation sites developed by the project but within the project district will also be eligible for the site development and basic amenities. however PAPs who relocate outside the district will not be eligible for site development and basic amenities	

Implementation Issues:

1. Consultations with Project Affected Persons (PAPs) revealed that most of them did not want to move away from the valley where their present abodes are located and preferred to relocate at a higher elevation within the same valley. This is mainly due to their seasonal migration to different elevations of the valley where they have houses at these different elevations as described under subheading 2.1.4 in Section 2. Therefore, the PAPs elected to move to a preferred self-managed site at a higher location in the same valley.
2. PAPs will be informed of the details of the compensation policy, resettlement package and payment procedure.
3. NV will be determined and approved for the project following the procedure as stated under Loss Item 1 above.
4. Land titling will be completed through the land acquisition survey conducted by the DRO before issuance of notice under section 4.

Loss Item 3: Loss of Communal Property and Resources

Unit of Entitlement	Entitlements	Application Guidelines	Additional Services
1. VC for communal property; 2. All villagers losing access to common land areas for pasture and fuel wood	1. Negotiated Value (NV) of land will be paid to the VC 2. A plot in the self-managed resettlement site for each communal property as schools, mosque, burial ground, health center, community center etc. 3. The project will construct the structures for common properties in the self-managed resettlement sites selected by the PAPs and the siting of the common properties will be decided by the VC. 4. Demarcated areas for pasture and fuel wood gathering	1. NV will be computed by the DRO based on the Unit Rates agreed upon at a Jirga comprising VC, DRO, DCO and PRO; 2. Project/DRO will pay for the land of common properties. 3. The Project will construct the common properties at each resettlement site with planning inputs and monitoring by VC of each resettlement site. 4. WAPDA/Project will make arrangements with DCO and Forest Department for the community in each resettlement site to use sustainably demarcated areas for pasture and fuel wood gathering	1. VC will be assisted by the PRO to organize legal documents in support of the compensation payments for the common properties. Social and Resettlement Unit with guidance from an experienced organization in this field will assist and guide the community in utilizing the common land area sustainably.

Implementation Issues:

1. NV will be determined and approved for the project following the procedure as stated under Loss Item 1.
2. The VC will be responsible for the relocation of community property sites.
3. Unallocated land which are not declared as, and not qualifying as, protected areas but suitable as pasture land, will be demarcated by the DCO (with guidance from the Forest Department)as communal land for the community resettled in the site. PMU through WAPDA will make necessary inter agency and legislative arrangements to facilitate the demarcation of the land before relocation.

Loss Item 4: Loss of Residential Structures

Unit of Entitlement	Entitlements	Application Guidelines	Additional Services
Owner(s) of the structures identified by DRO through Land Acquisition Survey	1. Replacement Value (RV) of residential structure. 2. Transfer/relocation Grant @ PKR 100/-(One hundred) per square meter of affected structure. 3. Reconstruction Grant @ PKR 250/-(Two hundred and fifty) per square meter of affected structure. 4. Special Assistance of one-time payment of PKR 5000/- (Five thousand) for each female, disabled, elderly headed and very poor households. 5. Owner will be allowed to take away all salvageable materials free of cost. 6. The households moving and settling outside the project district will be eligible of getting a special allowance for relocation @ Rs. 50,000/- in addition to their actual compensation and other allowances.	1. Applicable to all structures located within the acquisition areas. 2. DRO with expertise from Communication and Works Department will determine the RV based on the Unit Rate agreed at the Jirga will compute the RV. When necessary, PRO will be employed to verify structures eligible for RV and other assistance. 3. Project/PMU will pay for structures 4. The Project will provide other resettlement benefits directly with assistance from Social and Resettlement Unit	Assistance in relocation and reconstruction.

Implementation Issues:

1. Land Acquisition Survey conducted by DRO and Detailed Measurement Survey by Communication and Works Department (C&W) will assess and record details such as floor area and category of structure of to be demolished.
2. The Unit Rate for different types of residential structures will be computed by the Executive Engineer, C&W and approved at a Jirga comprising representatives from all affected villages, DRO or representative, DCO or representative, and PRO with expertise from C&W. The valuation process will take into consideration the rates adopted by the Diamer-Basha Dam Project.
3. Compensation must be paid before PAPs dismantles and removes the structures as per civil works requirement.
4. The date of service of notice under section 4 and/or Inventory Census will be the cut-off date for all structures to be removed.

<table>
<tr><td colspan="4">Loss Item 5: Loss of Commercial Structures</td></tr>
<tr><td>Unit of Entitlement</td><td>Entitlements</td><td>Application Guidelines</td><td>Additional Services</td></tr>
<tr><td>Owners of commercial structures identified by DRO through Land Acquisition Survey</td><td>1. RV of commercial structures.
2. Transfer Grant @ PKR 100/-(One hundred) per square meter of affected structure.
3. Reconstruction Grant @ PKR 500/-(Five hundred) per square meter of affected structure.
4. Owner will be allowed to take all salvageable materials back free of cost.</td><td>1. Applicable to all structures located within the land acquisition area at cut-off date.
2. Jirga of affected villagers and DRO with expertise from C&W will determine the RV.
3. When necessary, PRO will verify and record structures eligible for RV and other assistance.
4. DRO will pay for structure.
5. The Project will provide other resettlement benefits with assistance from SRU.</td><td>Assistance in relocation and re-construction.</td></tr>
<tr><td colspan="4">Implementation Issues:</td></tr>
<tr><td colspan="4">1. Land Acquisition Survey conducted by DRO and Detailed Measurement Survey by Communication and Works Department (C&W) will assess and record details such as floor area and category of structure of to be demolished.
2. Replacement value (RV) of structure will be determined and approved in the process as stated in Loss Item 4.
3. Compensation must be paid before dismantling and removing the structures as per civil works requirement.
4. The cut-off date for titled owners and socially recognized owners as stated in Loss Item 4.</td></tr>
<tr><td colspan="4">Loss Item 6: Loss of Physical Cultural Resources</td></tr>
<tr><td>Unit of Entitlement</td><td>Entitlements</td><td>Application Guidelines</td><td>Additional Services</td></tr>
<tr><td>Department of Archaeology and Museum (DOAM) of KPK, the Legal Custodian of the archaeological resources of the project affected area.</td><td>1. Cost of dismantling, moving and reconstruction of the 400 year Mosque at Seer Gayal.
2. Cost of land to relocate the Mosque
3. Cost of protecting the submerged graves with stone pitching.</td><td>1. Applicable to the structures identified in the PCR Plan
2. Project consultants (Dasu Hydropower Consultants) has identified and recorded structures for conservation.
3. The Project will support local community in performing religious ceremonies before covering the graveyards.</td><td>The Project will support the DOAM in procurement and protection of rock carvings at Shatial.</td></tr>
<tr><td colspan="4">Implementation Issues</td></tr>
<tr><td colspan="4">1. The project consultant team has identified and assessed the cost of PCR to be conserved/relocated.
2. Cost of conservation and/or relocation will be paid to the Department of Archaeology and Museum (DOAM) of KPK before dam construction and the DOAM is responsible for implementation before inundation.</td></tr>
<tr><td colspan="4">Loss Item 7: Loss of Timber and Fruit Bearing Trees</td></tr>
<tr><td>Unit of Entitlement</td><td>Entitlements</td><td>Application Guidelines</td><td>Additional Services</td></tr>
<tr><td>1. Owner(s) identified by DRO through Land Acquisition Survey
2. Socially recognized (by Malik/Mullah and VC) owners of</td><td>1. RV of Timber trees.
2. Fruit-bearing trees: if the tree is at or near fruit-bearing stage, the estimated current market values of</td><td>1. Applicable to all trees and plants located in acquisition area at cut-off dates.
2. DRO/Project will pay applicable compensation for trees/plants.</td><td>SRU to explain RAP policies regarding compensation for the trees of different categories and</td></tr>
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<tr><td>trees grown on public or other land, as identified by Census and verified by Land Acquisition Survey.</td><td>the fruit produce for 3 seasons.
3. Fruit-bearing trees with timber: RV for the timber and estimated current market value of fruit produce of the tree for 3 seasons.
4. Owners will be allowed to fell trees and take the timber, free of cost.</td><td>3. DRO with assistance from Department of Forestry and Department of Agriculture will recommend RV of trees and fruits.
4. Development of new nurseries facilities for fruit and non-fruit treesin new resettlement sites
5. Replantation of 5 trees per affected tree in the project area</td><td>size and make the Entitled Persons (EPs) aware that they could take the timber and fruits free of cost.</td></tr>
<tr><td colspan="4">Implementation Issues:</td></tr>
<tr><td colspan="4">1. Standard rates for trees of different species available with the Department of Forestry/Department of Agriculture will be considered by DRO in calculating the RV.
2. DRO will determine the market price of trees with assistance from district Department of Forest/Department of Agriculture and enhance it by 50% to fix compensation value.
3. The SRU will provide guidance in re-plantation and post-plantation care programs under Environmental Management Action Plan (EMAP).</td></tr>
<tr><td colspan="4">Loss Item 8: Loss of Standing Crops</td></tr>
<tr><td>Unit of Entitlement</td><td>Entitlements</td><td>Application Guidelines</td><td>Additional Services</td></tr>
<tr><td>Cultivators identified by DRO through Land Acquisition Survey</td><td>1. RV of standing crops.
2. Owners will be allowed to harvest of standing crops prior to inundation.</td><td>1. Applicable for all crops standing on land within the acquisition area at the time of dispossession.
2. DRO with assistance from PRO will pay for crops.
3. DRO with assistance from Department of Agriculture will recommend RV of crops at harvest.</td><td>SRU will assist EPs in the process of claiming compensation from DRO office for preparing necessary documents.</td></tr>
<tr><td colspan="4">Implementation Issues:</td></tr>
<tr><td colspan="4">RV of crops will be recommended by DRO/Department of Agriculture (based on data obtained from District Agriculture Extension Office, Dasu) for those identified through Land Acquisition Survey conducted by DRO.</td></tr>
<tr><td colspan="4">Loss Item 9: Loss of Leased/Mortgaged Land</td></tr>
<tr><td>Unit of Entitlement</td><td>Entitlements</td><td>Application Guidelines</td><td>Additional Services</td></tr>
<tr><td>1. Identified recognized lessee or sharecropper, with informal tenancy arrangements, including socially recognized verbal agreements.</td><td>1. RV of crops.
2. Outstanding lease money back to the lessee by the owner as per agreement.
3. Dislocation allowance @ PKR 1500/-per kanal for actual cultivator to cover the income loss from the land</td><td>1. With customary tenancy agreements, including socially-recognized verbal agreements, owner will receive compensation payment from DRO. The owner will pay the outstanding liabilities to the lessee/mortgagee under the conditions that: (i) all contractual liabilities are already paid up; (ii) if not, the legal owner will get the residual payment after all liabilities are paid up.</td><td>1. SRU will assist in ensuring that the lessee receives all eligible payments.
2. SRU will facilitate the refund of outstanding lease money by the owner to the lessees.</td></tr>
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		2. DRO will ensure the payment of RV of crops to the cultivator. 3. Dislocation Allowance will be paid to the actual cultivator of the acquired land by DRO/Project with assistance from SRU.	
Implementation Issues:			
1. Land Acquisition Survey conducted by DRO will identify each land owner and any persons who presently have interest in the acquired land from formal/informal agreement. 2. Any disputes over status of present interest in the land will be resolved through grievance redress procedure. Once resolved, SRU will assist in processing payments of all outstanding liabilities on the land to the appropriate persons. 3. RV of crops will be determined by DRO/Department of Agriculture (based on data obtained from District Agriculture Office, Dasu). 4. Dislocation Allowance to cover loss of income will be paid to the tenant as per project-specific policy provisions.			
Loss Item 10: Loss of Income from Displaced Commercial Premises			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Any proprietor or businessman or artisan operating in premises, at the time of issuance of Notice under section 4.	1. Grant for Loss of Business @ 10% of DRO's payment for the structure. 2. One time Moving Assistance of PKR 5000/-(Five thousand) for tenants. 3. Affected businesses to be relocated to the new market area to be established under Management Plan for In migration and Construction Workers	1. Business owners will be paid the entitlements after award of compensation by DRO to the owner of premises. 2. The Project will directly pay the entitlement to the eligible affected persons with assistance from SRU.	EPs will be brought under income generation program.
Implementation Issues:			
1. Primary eligibility to be based on businessmen identified by DHC Census and verified by Land Tenure Survey conducted by DRO. 2. All the business operators will be entitled for grant against loss of business and relocation to the new market area to be established under Management Plan for In migration and Construction Workers (Volume 10 of Social and Resettlement Management Plan 3. The income-generating program will be implemented by the SRU with assistance from an organization experienced in rehabilitation and livelihood generation activities of resettled persons in similar hydropower projects in the area.			
Loss Item 11: Temporary loss of income (wage earners in agriculture, commerce & small business and industry)			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Regular wage earners employed in agriculture, commerce & small business and industry in the affected area.	1. Grant to cover temporary loss of regular wage income @ PKR 200/-(Two hundred) X 90 days for farm labor; PKR 200/-(Two hundred)X 90 days for Gujjers employed to look after livestock; PKR 250/-	1. EP must have been an employee of landowner or business located in the acquired lands for at least twelve months, as identified by the Census conducted by the Consultants (DHC Census). 2. Special needs of vulnerable groups will be	1. EPs will be brought under income and livelihood restoration programs to be implemented under RAP, and training programs,

	(Two hundred and fifty) X 90 days for employees in timber transportation; 2. A one-time grant of PKR 150,000/= (one hundred and fifty thousand) for Soniwal households engaged in gold extraction in the project affected area identified by the DHC Census 3. Female-headed households, disabled, elderly and extremely poor to be paid a one-time grant of PKR 50,000/- (fifty thousand) as Special Assistance. 4. Income and livelihood restoration assistance from SRU Social Development Fund, to be created by the Project. 5. Rs.300 (Three hundred) X 90 days for wage workers at hotels/shops and restaurants	assessed further. 3. The resettlement benefits will be paid by Project with assistance from SRU.	including the current technical and vocational training programs sponsored by the Project. 2. Involvement of trained EPs in construction work. 3. Involvement of trained EPs in tree plantation and social afforestation programs under EMAP.
Implementation Issues:			
Primary eligibility to be based on wage earners identified by the DHC Census and further verified by PRO. Further claims and grievances, if any, will be settled by the grievance redress committee and PRO.			
Loss Item 12: Loss of Income from Rented-out and Access to rented-in residential/ commercial premises			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
1. Owner of the rented-out premises as identified by Census and verified by PRO. 2. Household/person rented-in any such structure as identified by Census and verified by PRO.	Dislocation Allowance of PKR 10,000./-(Ten thousand) for Renters and PKR 5000/-(Five thousand) for renter	Each renter of affected premises will be entitled for the dislocation allowance. The owners of rented out premises will be entitled for dislocation allowance for each unit of premises rented out to separate families or persons. Dislocation Allowance will be paid by Project with assistance from PRO/SRU.	1. EPs will be brought under income and livelihood restoration program to be implemented under RAP. 2. Involvement of trained EPs in project construction work. 3. Involvement of trained EPs in tree plantation and social afforestation programs.

Implementation Issues:

DHC Census and verification by PRO will establish the owner and renter of the residential and commercial premises.

Loss Item 13: Households losing more than 10% of their income (from agriculture or business) due to the project

Unit of Entitlement	Entitlements	Application Guidelines	Additional Services
Persons losing more than 10% of their income from all sources as identified by Census and verified by PRO.	1. One time Dislocation Allowance @ PKR 10,000/- (Ten thousand) per household.	1. The one time Dislocation Allowance will be paid by Project with assistance from PRO.	1. EPs will be brought under income and livelihood restoration program. 2. EPs will also be included in the current project sponsored vocational training program training EPs for employment in project construction activities. 3. Involvement of trained EPs in Project construction work. 4. Involvement of trained EPs in tree plantation and social forestations programs.

Implementation Issues:

1. Loss of income will be assessed as per actual loss of productive resources (land and businesses) to the project and the total income of the affected households from all sources through Census of all affected households.
2. PRO will verify the percentage of loss comparing the actual loss and the total income from all sources of the affected households.
3. Households becoming landless due to acquisition of agricultural land will be eligible for credit from the PRO Social Development Fund (SDF) for longer duration.

Loss Item 14: Loss of Livelihood (Non-cash Entitlement)

Unit of Entitlement	Entitlements	Application Guidelines	Additional Services
Households/persons affected by loss of livelihood	1. Free Vocational Training will be provided to the people of affected area. 2.Free horticulture training will be provided to the people of affected area. 3. Training in fish hatchery operations	A pro-active program to this end has already been started by WAPDA**:** local youths are receiving a six-month vocational training program in various lines of work to prepare them for guaranteed jobs in the project construction work. Priority will be given to affected households for working in project construction activities.	1. PAPs will also be included in the current project sponsored vocational training program training PAPs for employment in project construction activities.

	and sustainable fishery will be provided to the people of affected area. 4.Jobs in the project will be provided to the people of affected area 5. Inclusion in area development programs implemented with SDF and project benefit sharing mechanism		
Implementation Issues: Area development programs including sustainable income generation activities and training, micro credit and entrepreneurial training etc will be planned and implemented by Assistant Director, Training and Livelihood, in the long term, with funding from SDF and Benefit Sharing Mechanism			
Loss Item 15: Public Structures			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Concerned Department	Replacement of affected structures	WAPDA and concerned department with the help of DCO will be responsible for the replacement of the affected public structures with the financial assistance of the project at appropriate site.	After the construction of the affected public structure, the said structure will be handed over to the concerned department who will be responsible for the further maintenance and operation.
Implementation Issues:			
Loss Item 16: Unforeseen Adverse Impacts			
Unit of Entitlement	**Entitlements**	**Application Guidelines**	**Additional Services**
Households/persons affected by any unforeseen impact identified during RAP implementation	Entitlements will be determined as per the resettlement policy framework	The unforeseen impacts will be identified through special survey by the PRO/SRU. The entitlements will be approved by PMU/WAPDA and concurred by the World Bank	APs affected by unforeseen impacts as additional relocation due to blasting and dust, construction associated activities will be accommodated by this compensation by SRU with facilitation by PRO
Implementation Issues:			
The unforeseen impacts and affected persons will be identified with due care as per policy framework and proposed to WAPDA and World Bank for approval including details as quantity of losses, their owners and the entitlements.			

Annex – 8.2

LAND ACQUISITION AND RESETTLEMENT BUDGET

Sr. No.	COST ITEMS	Unit	Unit Rate (PKR)	Quantity	Total Cost (MPKR)	Total Cost (MUS$)
1 - COMPENSATION & ALLOWANCES						
1.1	**LAND**					
COMPENSATION						
1.1.1	Grazing/ Rakh	Kanal*	262,000	6,253	1,638.30	17.25
1.1.2	Barren (GhairMumkin Stone)	Kanal	100,000	47,582	4,758.16	50.09
	Barren (GhairMumkin)	Kanal	190,000	21,652	4,113.96	43.30
1.1.3	Agriculture	Kanal	760,000	3,138	2,385.11	25.11
1.1.4	Residential	Kanal	325,000	603.8	196.25	2.07
1.1.5	Commercial	Kanal	325,000	112.2	36.47	0.38
	Sub-total (Basic Compensation)				**13,128.23**	**138.19**
	Escalation of 2 Years at 6.5% for 2013 Rates				1,762.14	18.55
	Tax (@2%)				262.56	2.76
	Service Charges (@15%)				1,969.24	20.73
	Sub-total (1.1)				**17,122.17**	**180.23**
1.2	**STRUCTURES**					
1.2.1	Katcha	Sq. ft.	1,500	740,526	1,110.79	11.69
1.2.2	Pacca	Sq. ft.	2,500	87,659	219.15	2.31
1.2.3	Semi Pacca	Sq. ft.	2,000	481,413	962.83	10.14
1.2.4	Wood	Sq. ft.	1,500	11,326	16.99	0.18
	Sub-total (1.2)				**2,309.75**	**24.31**
1.3	**TREES**					
1.3.1	Non Fruit Tree	No.	20,000	18,317	366.34	3.86
1.3.2	Fruit Tree	No.	57,000	2,982	169.97	1.79
	Sub-total (1.3)				**536.31**	**5.65**
1.4	**CROPS**					
1.4.1	Maize	Per 40 kg	1,500	22,724	34.09	0.36
1.4.2	Wheat	Per 40 kg	1,600	18,592	29.75	0.31
	Sub-total (1.4)				**63.83**	**0.67**
1.5	**Relocation Cost (Based on Entitlement Matrix)**					
1.5.1	Dislocation Allowance against loss of agri. Land	Kanal	20,000	2,827	56.54	0.60
1.5.2	Reconstruction Grant for Residential Structure	m^2	250	127,906	31.98	0.34
	Sub-total (1.5)				**88.52**	**0.93**
1.6	**Rehabilitation Assistance**					
1.6.1	Special Assistance For Vulnerable HHs					
	Soniwals	No.	200,000	13	2.60	0.03
	Others	No.	150,000	42	6.30	0.07
1.6.2	Assistance against income loss by owners operated commercial setups for three months.	Person	30,000	76	2.28	0.02
1.6.3	Assistance for Affected wage earners	APs for 3 months	27,000	137	3.70	0.04
1.6.4	Transfer Grant for relocation of business structures	m^2	100	7113.8	0.71	0.01
	Sub-total (1.6)				**15.59**	**0.16**
	Sum of Sub-totals of 1				**20,136.18**	**211.96**
2 - RESETTLEMENT SITES DEVELOPMENT						
2.1	**Land**					

Sr. No.	COST ITEMS	Unit	Unit Rate (PKR)	Quantity	Total Cost (MPKR)	Total Cost (MUS$)
2.1.1	Land Leveling	Kanal	350,000	2070	724.50	7.63
	Sub-total (2.1)				**724.50**	**7.63**
2.2	**Resettlement sites Infrastructure development**					
2.2.1	Access Roads construction and land compensation	Km	10,000,000	51	510.00	5.37
2.2.2	Mosque	No.	7,360,000	4	29.44	0.31
2.2.3	Water supply Tank(30 Village)	Cu. ft.	2,850	57,120	162.79	1.71
2.2.4	Water Supply Channel(30 Village)	per km	695,000	100	69.50	0.73
2.2.5	School (Middle)	No.	12,720,000	2	25.44	0.27
	School(Primary)	No.	6,360,000	4	25.44	0.27
2.2.6	Boundary wall for Graveyard	per G. Yard	1,170,000	30	35.10	0.37
2.2.7	Dispensary(3 Structures)	per structure	920,000	3	2.76	0.03
	Sub-total (2.2)				**860.47**	**9.06**
	Sum of Sub-totals of 2				**1,210.47**	**12.74**
3 - LIVELIHOOD SUPPORT						
3.1	Skill Development for Affected Communities	per year	100,000,000	15	1,500.00	15.79
	Sub-total of 3				**1,500.00**	**15.79**
4 - LOCAL AREA DEVELOPMENT						
4.1	Infrastructure				1,235.00	13.00
4.2	Entrepreneur Support 10 Years				475.00	5.00
4.3	Capacity Building of Local Government				237.50	2.50
4.4	Training & extension support 10 Years (Services and facilities)	Years	47,500,000	10	475.00	5.00
4.5	Education Fund 10 Years (Literacy Promotion, Scholarship, etc.)				427.50	4.50
	Sub-total of 4				**2,850.00**	**30.00**
5 - INSTITUTION & MANAGEMENT						
5.1	Building	Sq. ft.	2,000	8,160	16.32	0.17
5.2	Fixtures and Furnishing	Lump sum			20.00	0.21
5.3	(a) PMU Staff Salaries	Years	36,100,000	10	361.00	3.80
	(b) PMU Costs during O&M	Years	45,600,000	5	228.00	2.40
5.4	Vehicles	No	4,200,000	10	42.00	0.44
5.5	R&M of vehicles	Years	10,000,000	15	150.00	1.58
5.6	Office Equipment	Lump Sum			10.00	0.11
5.7	Operation & Maintenance Cost	Years	250,000	15	3.75	0.04
	Sub-total of 5				**831.07**	**8.75**
6 - PLANNING AND DESIGNING						
6.1	Resettlement Implementation Design	Lump Sum			28.50	0.30
6.2	Resettlement Site Development Design	Lump Sum			28.50	0.30
6.3	Livelihood Support Design and Implementation	Year	28,500,000	15	427.50	4.50
	Sub-total of 6				**484.50**	**5.10**
7 - ADMINISTRATIVE OVERHEADS						
7.1	Administrative Overhead: Land Acquisition By DRO	Lump Sum			10.00	0.11
	Sub-total of 7				**10.00**	**0.11**
8 - MONITORING & EVALUATION						
8.1	Independent Monitor (2 times a year)	Year	30,000,000	8	240.00	2.53
8.2	Internal Monitoring	month	250,000	84	21.00	0.22
8.3	IPOE	Per visit	3,000,000	14	42.00	0.44

Sr. No.	COST ITEMS	Unit	Unit Rate (PKR)	Quantity	Total Cost (MPKR)	Total Cost (MUS$)
8.4	MIS Development	Lump Sum		One time cost	2.65	0.03
8.5	MIS Staff	Lump sum			24.78	0.26
Sub-total of 8					**330.43**	**3.48**
9 - TRAINING & CAPACITY BUILDING						
9.1	Consulting Service Cost (Sub Projects) / Outsourcing, (If any)	Lump sum			25.00	0.26
9.2	Research	Year	15,000,000	10	150.00	1.58
9.2.1	National	Year	2,500,000	7	17.50	0.18
9.2.2	International	Year	7,000,000	7	49.00	0.52
9.3	Trainings	Year	30,000,000	10	300.00	3.16
Sub-total of 9					**541.50**	**5.70**
Total (1+2+3+4+5+6+7+8+9)					**28,268.65**	**297.56**
10 - CONTINGENCY						
10.1	Physical Contingency (@25%)				**7,067.16**	**74.39**
10.2	Price Contingency (@9 %)				**2,544.18**	**26.78**
Sub-total of 10					**9,611.53**	**101.17**
GRAND TOTAL (Total of 1+2+3+4+5+6+7+8+9+10)					**37,880.74**	**398.74**

* 1 Kanal = 506m^2 or o.125 Acre or 0.05ha, 1$=95 PKR as per 2012 rates

Annex – 9.1

TERMS OF REFERENCE FOR THE DHP ENVIRONMENTAL UNIT STAFF

Note: All the following positions are based in Dasu in Kohistan District of KP.

TOR FOR DIRECTOR ENVIRONMENT

Designation:
Director Environment

Qualification:
At least Master degree in Environmental Engineering/Environmental sciences from the university recognized by PEC/HEC. Ph.D. is preferred.
Experience:

- 15 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system

Job Description:
Director of Environment heads the Environmental Unit of Dasu Hydropower Project. The unit consists of 3 sub-units: Environment, Ecology and Occupational Health and Safety. Each of the sub-units will be headed by Assistant Director. The position is based in WAPDA's Project Office at Dasu. The responsibilities of Director includes, but not limited to

- To ensure that environmental requirements of the project are implemented in the whole cycle of project implementation.
- To implement the environment management plan as per design of consultants.
- To ensure the implementation of mitigation measures as per design of consultants.
- To communicate specific problems/constraints faced by environment expert of contractor to implement good practices.
- To co-ordinate with provincial and district governments to obtain necessary clearances, such as tree cutting, land clearance, quarry operation etc.
- To co-ordinate with DOR in implementing environmental conditions attached to the environmental clearance.
- Traffic management and co-ordination meetings.
- To co-ordinate with World Bank missions, WEC and DG-EPA KP
- To identify any impact not forecasted in EIA report and find an acceptable mitigation.
- Monitoring environments (water, air, noise, vibration, health issues) and issue reports.
- Issue corrective action plan.
- To liaison with consultants.
- To prepare the monthly and quarterly progress report.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR DEPUTY DIRECTOR ENVIRONMENT

Designation:
Deputy Director Environment

Qualification:
Master degree in Environmental Engineering/Environmental sciences from the university recognized by PEC/HEC.

Experience:

- 8 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system

Job Description:
The responsibilities of Deputy Director includes, but not limited to:

- To assist Director Environment in implementing the environment management plan as per design of consultants.
- To assist director environment in the implementation of mitigation measures as per design of consultants.
- To assist director environment in co-coordinating with provincial and district governments to obtain necessary clearances, such as tree cutting, land clearance, quarry operation etc
- To assist DOR in implementing environmental conditions attached to the environmental clearance.
- Traffic management and co-ordination meetings.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To co-ordinate with DG-EPA KP.
- To identify any impact not forecasted in EIA report and find an acceptable mitigation.
- Monitoring environments (water, air, noise, vibration, health issues) and issue reports.
- Issue corrective action plan.
- To liaison with consultants.
- To assist in preparation of monthly progress report.
- To assist in preparation of bi annual progress report.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR ASSISTANT DIRECTOR ENVIRONMENT

Designation:
Assistant Director Environment

Qualification:
B.Sc/Master degree in Environmental Engineering/Environmental sciences from the university recognized by PEC/HEC.

Experience:

- 5 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system

Job Description:
The responsibilities of Assistant Director includes, but not limited to

- To assist deputy director environment in implementing the environment management plan as per design of consultants.
- To assist deputy director environment in the implementation of mitigation measures as per design of consultants.
- To collect data regarding the environment from the field.
- To manage the record of the data collected from the field.
- Traffic management and co-ordination meetings.
- To co-ordinate with WEC.
- To identify any impact not forecasted in EIA report and find an acceptable mitigation.
- Monitoring environments (water, air, noise, vibration, health issues) and issue reports.
- To assist deputy director in Issuing corrective action plan.
- To liaison with consultants.
- To assist in preparation of monthly progress report.
- To assist in preparation of bi annual progress report.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR ASSISTANT DIRECTOR ECOLOGY

Designation:
Assistant Director Ecology

Qualification:
Master degree in Botany/Zoology from recognized university along with computer skills.

Experience:

- 5 years' experience in the field of botany/zoology in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system

Job Description:
The responsibilities of Assistant Director Ecology includes, but not limited to

- To conduct field surveys to collect information about the numbers and distribution of flora and fauna.
- To carry out survey to collect baseline ecological data
- To analyze and interpret the collected data,
- To liaison with and advising site managers, engineers, planners and others associated with a survey;
- To build relationships with stakeholders, including members of the public;
- Traffic management and co-ordination meetings.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To co-ordinate with DG-EPA KP.
- To identify any impact not forecasted in EIA report and find an acceptable mitigation.
- To monitor birds, wild life and aquatic life and issue reports.
- To liaison with consultants.
- To prepare monthly progress reports.
- To prepare bi annual progress reports.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR FISH EXPERT

Designation:
Fish Expert

Qualification:
M. Phil / Master Degree in Animal Sciences with specialization in fish/fishery biology from recognized university.

Experience:

- 5 years' experience in the field of aquatic biology/fishery research, management and teaching.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system
- Experience in preparation of project reports will be an asset.

Job Description:
The responsibilities of fish expert includes, but not limited to

- To conduct field surveys to collect information about the numbers and distribution of fishes.
- To carry out fishery baseline survey.
- To analyze and interpret the collected data,
- To liaison with the fishery department KP.
- To build relationships with stakeholders, including members of the public;
- Responsible for planning, execution/carrying out other related assignments.
- Plan for reservoir fishery and implement fishery landing facilities and marketing.
- Fish hatchery implementation.
- To propose and execute research on biological species of indigenous species in the project area.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To liaison with consultants
- To prepare monthly progress reports.
- To prepare bi annual progress reports.
- Responsible for planning, execution/carrying out other related assignments

TOR FOR ASSISTANT DIRECTOR OHS

Designation:
Assistant Director OHS

Qualification:
B.Sc/Master degree in Environmental Engineering/Environmental sciences with specialization in occupational health and safety from the university recognized by PEC/HEC.

Experience:

- 5 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system
- Experience in preparation of project reports will be an asset.

Job Description:
The responsibilities of Assistant Director OHS includes, but not limited to

- To conduct field surveys to collect information about the health and safety situation in the project area.
- To carry out health and nutritional survey to identify the health conditions of directly and indirectly affected villages of project area.
- To analyze and interpret the collected data,
- To liaison with the concerned department KP.
- To build relationships with stakeholders, including members of the public;
- To monitor clean environment of the offices and living areas.
- To implement the Environment management plan as described in the design report.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To liaison with consultants.
- To prepare monthly progress reports.
- To prepare bi annual progress reports.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR HEALTH AND SAFETY SPECIALIST

Designation:

Health and Safety Specialist

Qualification:

B.Sc./Master degree in Environmental Engineering/Environmental sciences with specialization in occupational health and safety from the university recognized by PEC/HEC.

Experience:

- 5 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system
- Experience in preparation of project reports will be an asset.

Job Description:

The responsibilities of health and safety specialist includes, but not limited to

- To conduct field surveys to collect information about the health and safety situation in the project area.
- To carry out health and nutritional survey to identify the health conditions of directly and indirectly affected villages of project area.
- To analyze and interpret the collected data,
- To liaison with the concerned department KP.
- To build relationships with stakeholders, including members of the public;
- To monitor clean environment of the offices and living areas.
- To implement the Environment management plan as described in the design report.
- To conduct awareness programs with the help of health department to educate people about their health.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To liaison with consultants.
- To prepare monthly progress reports.
- To prepare bi annual progress reports.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR SITE ENGINEER

Designation:

Site Engineer

Qualification:

B.Sc./Master degree in Environmental Engineering/Environmental sciences with specialization in the field of environment from the university recognized by PEC/HEC.

Experience:

- 3 years' experience in the field of environment in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system
- Experience in preparation of project reports will be an asset.

Job Description:

The responsibilities of site engineer includes, but not limited to

- To monitor the implementation of the environment management plan as per design of consultants.
- To implement mitigation measures as per design of consultants.
- To collect data regarding the environment from the field.
- To manage the record of the data collected from the field.
- Traffic management and co-ordination meetings.
- To co-ordinate with World Bank missions.
- To co-ordinate with WEC.
- To identify any impact not forecasted in EIA report and find an acceptable mitigation.
- Monitoring environments (water, air, noise, vibration, health issues) and issue reports.
- To conduct spot monitoring for air, water and noise quality.
- To liaison with consultants.
- To assist in preparation of monthly progress report.
- To assist in preparation of bi annual progress report.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR PLANTATION EXPERT

Designation:

Plantation Expert

Qualification:

B.Sc./Master degree in Horticulture/Agriculture sciences with specialization in the field of horticulture from the recognized university.

Experience:

- 3 years' experience in the field of horticulture in public/private sector including two years' experience in project coordination.
- Experience in working with water related mega projects specifically in implementation of EMP in hydropower projects. Experience in working with World Bank or other donor funded projects is preferable.
- Fluent in English Language
- Knowledge of computer operating system
- Experience in preparation of project reports will be an asset.

Job Description:

The responsibilities of plantation expert includes, but not limited to

- To monitor the implementation of the environment management plan as per design of consultants.
- To establish the sapling sites.
- To monitor the sapling sites.
- To implement the plantation plan.
- To monitor the plantation plan.
- To collect data regarding the Plants from the field.
- To manage the record of the data collected from the field.
- To co-ordinate with WEC.
- To build the capacity of implementing partners and other stakeholders on horticulture practices.
- To compile and collect information on local input suppliers.
- and techniques
- To liaison with consultants.
- To assist in preparation of monthly progress report.
- To assist in preparation of bi annual progress report.
- Responsible for planning, execution/carrying out other related assignments.

TOR FOR ARCHAEOLOGIST

Designation:
Archaeologist

Qualification:
At least master degree in Archaeology/Museology from recognized university along with computer skills.

Experience:
5 years' experience in the field of archaeology and museums. At least one research papers should be published about archaeology and museology in national/international journal or national/international seminars/symposiums.

Job Description:
General

- To conserve/preserve the cultural heritage and develop it to have healthy share in economic growth of Khyber Pakhtoonkhwah (KP) and Pakistan.
- To develop and promote tourism in Pakistan and attract tourists to historical and cultural heritage, provide entertainment and recreational facilities to people.
- The ultimate aim is to contribute to regional and national economic growth.

Project Specific

- To establish a museum at Shatial.
- To preserve rock carvings at Shatial.
- To look after the operation and maintenance of museum and tourist facilities.
- To preserve Seo Mosque at Seo.
- To look after the preserved mosque.
- To dismantle Seer Gayal Mosque, its transportation and supervision to new site.
- To re-establish Seer Gayal mosque at a new place.
- To maintain preservation of any new chance find in the area.
- To maintain the record of various visitor groups and individuals.
- To maintain the remarks of high level visitors (national and foreigners)
- To co-ordinate with Archaeology department KP.
- Responsible for planning, execution/carrying out other related assignments.

Annex – 9.2

EMP COST ESTIMATES

A. Contractors Bills of Quantities

Table A1- Environmental Staff of Contractors

S.No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Development and implementation of management plans (CEAP) in accordance with Project's EMP and WorldBank Group EHS guidelines	2014-2025		Lumpsum	1% of civil works (1780 million USD) and 0.5% of mechanical or electro-mechanical works (1297 million USD)	24,285,000
2	Environmental staff of contractors (Environmental Specialist, OHS specialist, and other necessary staff to carryout the above activites)					
	Total					**24,285,000**

Table A2- Water Quality Laboratory

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Water Quality Lab for testing of Key NEQS parameters for Water and Waste Water Quality	2015-2022	Lump sum	1	200,000	200,000
2	Chemicals and maintenance	2015-2022	Years	10	10,000	100,000
3	Technician	2015-2022	Months	120	2,000	240,000
	Total					**540,000**

Table A3 - Portable Air, Noise, Vibration and Water Quality Meters

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
I	**Air Quality Meters**	2015-2022				
1	PM		Numbers	10	2,500	25,000
2	SO_2		Numbers	10	2,500	25,000
3	Nox		Numbers	10	2,500	25,000
4	CO		Numbers	10	2,500	25,000
5	CO_2		Numbers	10	2,500	25,000
II	**Noise Quality Meters**					
1	Noise Meter		Numbers	10	1,000	10,000
2	Vibration Meter (air)		Numbers	10	2,500	25,000
3	Vibration Meter (Ground)		Numbers	10	1,000	10,000
III	**Water Quality Meters**					
1	Turbidity		Numbers	10	1,000	10,000
2	Conductivity		Numbers	10	500	5,000
3	pH		Numbers	10	500	5,000

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
4	Temperature		Numbers	10	100	1,000
5	DO		Numbers	10	1,000	10,000
IV	Technicians	2015-2022	Months	120	2,000	240,000
	Total					**441,000**

B. PMU Budget on Environmental Staff and Consultants

Table B1- Environmental Staff of EU-DHP (Project Management Unit of WAPDA at Dasu)

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Deputy Project Director	2014-2025	Month	120	600	72,000
2	Director	2014-2025	Month	120	2,400	288,000
3	Deputy Director	2014-2025	Month	120	2,000	240,000
4	Asst. Director - Environment	2014-2025	Month	120	1,700	204,000
5	Site Engineer 2	2014-2025	Month	240	1,500	720,000
6	Asst. Director Ecology	2014-2025	Month	120	1,700	204,000
7	Fish expert	2014-2025	Month	120	1,500	180,000
8	Plantation expert	2014-2019	Month	72	1,500	108,000
9	Assistant director OHS	2014-2025	Month	120	1,700	204,000
10	Health and safety specialist	2014-2025	Month	120	1,500	180,000
11	Equipment/ office facilities	2014-2015				250,000
12	Vehicles	2014-2015				250,000
	Total					**2,900,000**

Note: The remuneration rates are double the regular WAPDA wages

Table B2- Environmental Staff of EU-CSC (Construction Supervision Consultant)

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	International Environmental Specialist - Lead (intermittent for 3 years)	2015-2022	Month	36	30,000	1.080.000
2	International Environmental Specialist - OHS(intermittent)	2015-2022	Month	26	30,000	780,000
3	International Ecologist - Intermittent	2015-2022	Month	16	30,000	480,000
4	Environment Specialist (Nat) (2 persons for 7 years)	2015-2022	Month	204	4,000	816000
5	Ecologist (nat) (one person for 6 years)	2015-2022	Month	84	4,000	624,000
6	Occupational Health and Safety Specialist (Nat) (1 person for 7 years	2015-2022	Month	120	4,000	480,000
7	Surveyors (Nat) (2 persons for 5 years each)	2015-2022	Month	156	500	78,000

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
	Total					4,338,000

Table B3- Panel of Experts

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	POE - Environmental Specialist (2 weeks for every 6 months)	2014-2025	Month	10	25,000	250,000
2	POE - Social and Resettlement Specialist (2 weeks for every 6 months)	2014-2016	Month	3	25,000	75,000
3	Travel Expenses					100,000
	Total					**425,000**

Table B4- External Auditing (Third Party) Consultants

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Air Quality Monitoring	2014-2025	20 Sites/yr	10	15,000	150,000
2	Water Quality Monitoring	2014-2025	20 Sites/yr	10	15,000	150,000
3	Noise and Vibration Monitoring	2014-2025	20 Sites/yr	10	5,000	50,000
4	Auditing of Work Practices and EMP Compliance Issues	2014-2025	Months	10	15,000	150,000
	Total					**500,000**

Table B5 - Internal Auditing (by WEC)

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Travel and Field Expenses	2014-2025	Quarterly	40	5,000	200,000
	Total					**200,000**

C. Aquatic Ecology

Table C1: Fish Studies and Monitoring

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
I. Fish Biological Study					
Team Leader	2014-2015	Months	12	5000	60000
Sr Survey Officer	2014-2015	Months	12	3000	36000
Data Collector	2014-2015	Months	12	2000	24000
Technical Assistant 1	2014-2015	Months	12	1500	18000
Technical Assistant 2	2014-2015	Months	12	1500	18000
Field work (25 months)	2014-2015	days per month	10	100	12,000
Water Quality Testing (25 months)		Samples / month	50	100	60,000
Consultations and meetings					5,000
Sub Total					**233,000**
II- Seasonal Fish Habitat use					
Team Leader	2015-2019	month	20	5000	100,000
Sr Survey Officer	2015-2019	month	20	3000	60,000
Technical Assistant 1	2015-2019	month	20	1500	30,000
Technical Assistant 2	2015-2019	month	20	1500	30,000
Field work	2015-2019	days per month	10	200	40,000
Laboratory	2015-2019	Samples / month	50	75	75,000
Sub Total					**335,000**
III. Downstream Reservoir Fish Monitoring					
Team Leader	2020-2025	Month	25	5000	125000
Fish Expert 1	2020-2025	Month	25	4000	100000
Fish Expert 2	2020-2025	Month	25	3000	75000
Field work	2020-2025	days per month	10	150	37,500
Laboratory	2020-2025	Samples / month	50	50	62500
Sub Total					**400,000**
Grand Total					**968,000**

Table C2: Design and implementation of fish capture and stocking

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Capture and handling equipment	2015-2019				130,000
Fish containers					20,000
Oxygen cylinders					20,000
Vehicles					30,000
Operation cost of fish	2020-2030	Year	10	50,000	500,000
Total					**700,000**

Table C3: Installation of fish deterrent devices or exclusion screens.

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Installation of fish deterrent or exclusion screens.	2015-2019			400,000	400,000
Total					**400,000**

Table C4: Fish Hatchery and R&D facility

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Land cost	2018-2025	acres	10	60000	600,000
Civil works	2018-2025	Lump sum			300,000
laboratory	2018-2025	Lump sum			200,000
Operation costs	2018-2025	Year	5	147240	736,200
Fish landing facilities	2018-2025				198,600
Total					**2,034,800**

Supporting Table for Table C4: Operating cost of hatchery

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Asst. Director		year	5	1,700	102,000
Fisheries Asst. 2		year	5	1,400	168,000
Supervisor 1		year	5	270	16,200
Fishermen 4		year	5	250	60,000
Guard 6		year	5	250	90,000
Watchers 3		year	5	200	36,000
Sweeper 1		year	5	150	9,000
Electricity bill		year	5	1,500	90,000
Driver		year	5	200	12,000
Vehicle maintenance		year	5	500	30,000
lab operations		year	5	250	15,000
Fish feed		year	5	500	30,000
breeder fish		year	5	50	3,000
Miscellaneous		year	5	1,000	60,000
maintenance		year	5	250	15,000
Total					736,200

Supporting Table for Table C4: Construction of fish landing facilities

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Office		No	1		50,000
Store		No	1		50,000
Guards 2		No	2	150	3,600
Guard room		No	1		20,000
Gettie for boat anchoring		No	1		50,000
Maintenance					25,000
Total					**198,600**

Table C5: Enhancement measures for Fish Habitat Near the Tributaries

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
construction of pools/riffles in tributaries	2020-2025	No	6	15,000	90,000
staff for collection of brooders and leaving them in pools	2020-2025	No	6	150	10,800
Total					**100,800**

Table C6 : Capacity building of KP Fisheries Department

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Capacity building for assisting with field studies and biodiversity management	2020-2025			50,000	50,000
Capacity building for reservoir fisheries management	2020-2025			50,000	50,000
Total					**100,000**

D. Terrestrial Ecology

Table D1-Tree plantation and forest management plan

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Sapling	2014-2016	No	300,000	0.4	120,000
Tree plantation and maintenance for 3 years	2016-2020	No	100,000	15	1,500,000
Total					**1,620,000**

E. Physical Cultural Resources

Table E1: Physical Cultural Resources

	Item	Unit	Quantity	Rate. PKR	Amount, PKR	USD
I	**Procurement and Protection of Shatial Rock Carvings**					
1	Land Acquisition	Ha (Acres)	10(25)	According to agreement between Director Revenue office and DOAM KP	125,800,000	1,258,000
2	Fencing	meters	1250	100 (including charges)	125,000	1,250
3		Poles	417 (with poles for every 3m)	500	208,500	2,085

	Item	Unit	Quantity	Rate. PKR	Amount, PKR	USD
4	Gate	Number	1	Lump sum	50,000	500
5	Facilities for office and tourists (office, information centre, visitors' toilet, visitors pavilion, etc.)	Square meters	5,000	5,000	25,000,000	250,000
6	Cleaning of Carvings with chemicals and providing fibreglass facilities	Number	46	30,000	1,380,000	13,800
7	Training of 3 local persons for 6 months as guides at Tourism Dept., Shadman Lahore	Number	3	100,000 (including tuition fees, accommo-dation and stipend)	300,000	3,000
8	Salaries for 2 security staff for 3 years by WAPDA (later will be by KP DOAM)	Year	3	360,000 (15,000 per month / staff)	1,080,000	10,800
	Sub Total I				**153,943,500**	**1,539,435**
II	**Seo Mosque**					
1	Anti-termite chemicals for protection of timber (2640 square meters of timber and 1217 square meters of ground)	Litres	62	4,000	248,000	2,480
	Rental charges (12 days) for Tools for injection (injector machine and spray machine), their transport from Lahore and labour charges	Days	12	20,0000 (incl. daily rental charge for machine/day is 5,000)	240,000	2,400
2	Firefighting equipment (fire extinguishers)				100,000	1,000
3	Timber Precision/Polish	Lump sum			1,000,000	10,000
4	Water supply, sanitation facilities and ablution facilities	Lump sum			1,000,000	10,000
	Sub Total II				**2,588,000**	**25,880**
III	**Seer Gayal Mosque**					
1	Dismantling mosque structure and transporting to new site	Lump sum			400,000	4,000
2	Land acquisition of 505 square meter (1 canal) for relocation site of mosque	Lump sum			500,000	5,000

	Item	Unit	Quantity	Rate. PKR	Amount, PKR	USD
3	Foundation and reassembling and new material provision, water supply, sanitation, etc.	Lump sum			2,000,000	20,000
	Sub-Total III				**2,900,000**	**29,000**
IV	**Protection of Graveyards**					
1	Provision of mud, and mud pitching	Grave	320 graves in 16 graveyards	700	224,000	2,240
2	Religious ceremony at each graveyard (including food for 100 people and bringing of religious leaders for Quran recitation)	Graveyard	16	25,000	400,000	4,000
	Sub-Total IV				**624,000**	**6,240**
V	**Chance Finds**					
1	Services of an archaeological expert over a period of one year (spread over 6 year of constructions phase)	Month	12	400,000	4,800,000	48,000
	Grand Total				**164,855,500**	**1,648,555**

F. KKH Traffic Management

Table F1 – KKH Traffic Management

Sr. No.	Description	Year	Unit	Quantity	Rate. USD	Amount, USD
1	Traffic Manager	2015-2022	Month	72	600	43,200
2	Traffic Clerk	2015-2022	Month	72	300	21,600
3	Guards 2	2015-2022	Month	72	150	10,800
4	Sub Offices on rent Dasu, Pattan, Besham, Thakot, Abbotabad, Haripur. (6 years at 6 offices)	2015-2022	Monthly	432	400	172,800
5	Furniture	2015-2022	Set	6	1000	12,000
6	Utility Bills	2015-2022	Month	72	400	28,800
7	Stationary	2015-2022	Lump sum			100,000
	Total					**389,200**

G. Climate Change, GLOFs and Sedimentation in UIB

Table G1: Flood Telemetry Network

Description	Year	Unit	Quantity	Rate. USD	Amount, USD
Telemetric Equipment (Procurement of Radio Telemetric equipment complete including sensors, spares, towers, field testing and servicing equipment etc.)		Set	20	75,000	1,500,000
Training (Foreign Training of electronics staff for installation and maintenance of telemetric equipment.)		Number of Staff	4	25,000	100,000
Installation of 18 nos. telemetric stations.		Set	18	17,000	306,000
Vehicles (4x4 D/C P/U vehicles)		Number	2	50,000	100,000
Staff (Remuneration of staff and operation expenses for about 10 years)		Number	4	120,000	480,000
Weather Station (Rain Gauge, Snow Gauge, Evaporation Pan, Wind velocity and direction, sunshine, humidity and temperature recorder)		Set	1	25000	25,000
Staff (remuneration of Meteorologist and operational expenses for 10 years)		Number	1	120000	120,000
Total					**2,631,000**

J. Environmental Management and Enhancement of Resettlement Villages

Table J1. Environmental management and Enhancement of the Resettlement Villages

Description	Year	Unit	Quantity	Rate. USD	Amount, USD	Remarks
Operation and management of solid waste and liquid waste facilities in the village, and also at schools and BHU	10	Villages	14	6000	840,000	500 USD per month for the period of 10 years for 14 villages.
Water supply treatment and maintenance	10	Villages	14	1200	168,000	100 USD per month for the period of 10 years for 14 villages.
Environmental Officer at each village	10	Villages	14	3000	420,000	250 USD per month for the period of 10 years for 14 villages.
Water supply and sanitation operator at each village	10	Villages	14	2400	336,000	200 USD per month for the period of 10 years for 14 villages.
Sanitation and hygiene promotion activities	10	14 villages	1	1000	10,000	1000 USD per year for the period of 10 years for 14 villages.
Cleaner/Sweeper/Gardener	10	Villages	14	2400	336,000	200 USD per month for the period of 10 years for 14 villages.
Total					**2,110,000**	

Annex – 9.3

ENVIRONMENTAL CODE OF PRACTICES

Introduction

The objective of the Environmental Code of Practices (ECPs) is to address all potential and general construction related impacts during implementation of the Dasu Hydropower Project (the Project or DHP). The ECPs will provide guidelines for best operating practices and environmental management guidelines to be followed by the contractors for sustainable management of all environmental issues. These ECPs shall be annexed to the general conditions of all the contracts, including subcontracts, carried out under the Project.

The list of ECPs prepared for the DHP is given below:

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Quarry Areas Development & Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fisheries
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Workers Health and Safety

The ECPs will form the part of the contract documents and will be used as monitoring tool for compliance. It is mandatory for the main contractors procured directly by the project to include these ECPs in their subcontracts. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractors. Contractors and subcontractors are requested to refer the Environmental Management Plan given in the EIA report of the Project for further information on corrective actions, performance indicators, and monitoring, auditing and reporting protocols.

ECP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to supervision consultant for approval. • Organize disposal of all wastes generated during construction in the designated disposal sites approved by the Project. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal. • Potable water should be supplied in bulk containers to reduce the quantity of plastic waste (plastic bottles). Plastic bag use should be avoided.
Hazardous Waste	Health hazards and environmental impacts due to improper waste management practices	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills.

ECP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit the plan for supervision consultant approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Store and use fuels in accordance with material safety data sheets (MSDS). Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored; and ensure personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store and use fuels in accordance with material safety data sheets (MSDSs). • Store all liquid fuels in fully bunded storage containers, with appropriate volumes, a roof, a collection point and appropriate filling/decanting point. • Store hazardous materials above flood level considered for construction purposes • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials.

ECP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECPs 1 and 2. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.
Discharge from construction sites	Construction activities, sewerages from construction sites and work camps may affect the surface water quality. The construction works will modify groundcover and topography changing the surface water drainage patterns of the area. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, and effect habitat of fish and other aquatic biology.	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials. • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site. • Divert runoff from undisturbed areas around the construction site. • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to a approved waste disposal site or recycling depot. • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove dust and sediment. • Water the loose material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).
Construction activities in water bodies	Construction works in the water bodies will increase	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	directly off site. • Monitor the water quality in the runoff from the site or areas affected by dredge/excavation plumes, and improve work practices as necessary. • Protect water bodies from sediment loads by silt screen or other barriers. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems. • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and ecoli.	The Contractor Shall • Provide the drinking water that meets NEQS standards. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time.

ECP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	The Contractor shall • Prepare a program to prevent/avoid standing waters, which supervision consultant will verify in advance and confirm during implementation. • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line. • Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there. • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to NEQS, before it is being discharged into the recipient water bodies. • Ensure that there will be no water stagnation at the construction sites and camps. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		avoid drainage congestion. • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem.
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps. • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position.

ECP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP1 and storage of materials in ECP2. • Construct appropriate spill contaminant facilities for all fuel storage areas. • Establish and maintain a hazardous material register detailing the location and quantities of hazardous substances including the storage, and their disposals. • Train personnel and implement safe work practices for minimizing the risk of spillage. • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site. • Remediate the contaminated land using the most appropriate available method.
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds.

ECP 6: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, which affects the growth of vegetation and	The Contractor shall • Reinstate and protect cleared areas as soon as possible. • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turf/tree plantations.

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
	causes ecological imbalance.	
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, and (ii) destruction of aquatic environment by erosion and/or deposition of sediment damaging the spawning grounds of fish	The Contractor shall • Locate stockpiles away from drainage lines. • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds. • Remove debris from drainage paths and sediment control structures. • Cover the loose sediments of construction material and water them if required. • Divert natural runoff around construction areas prior to any site disturbance. • Install protective measures on site prior to construction, for example, sediment traps. • Install 'cut off drains' on large cut/fill batter slopes to control water runoff speed and hence erosion. • Observe the performance of drainage structures and erosion controls during rain and modify as required.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).

ECP 7: Top Soil Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone. • Plan construction access to make use, if possible, of the final road alignment.

ECP 8: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	The Contractor shall • Ensure the topography of the final surface of all raised lands (construction yards, approach roads and rails, access roads, etc.) are conducive to enhance natural draining of rainwater/flood water. • Keep the final or finished surface of all the raised lands free from any kind of depression that causes water logging. • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping. • Reinstate the natural landscape of the ancillary construction sites after completion of works.

ECP 9: Quarry Areas Development & Operation

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Development and operation of borrow areas	Borrow areas will have impacts on local topography, landscaping and natural drainage.	The Contractor shall • Use only approved quarry and borrow sites • Identify new borrow and quarry areas in consultation with Project Director, if required. • Reuse excavated or disposed material available in the project to the maximum extent possible. • Store top soil for reinstatement and landscaping.

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
		• Develop surface water collection and drainage systems, anti-erosion measures (berms, revegetation etc.) and retaining walls and gabions where required. Implement mitigation measures in ECP 3: Water Resources Management, ECP 6: Erosion and Sediment Control • The use of explosive should be used in as much minimum quantity as possible to reduce noise, vibration and dust. • Control dust and air quality deterioration by application of watering and implementing mitigation measures proposed in ECP 10: Air Quality Management • Noise and vibration control by ECP 11: Noise and Vibration Management.

ECP 10: Air Quality Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner. • Cover hauls vehicles carrying dusty materials moving outside the construction site. • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions. • Control the movement of construction traffic. • Water construction materials prior to loading and transport. • Service all vehicles regularly to minimize emissions. • Limit the idling time of vehicles not more than 2 minutes.
Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors. • Focus special attention on containing the emissions from generators. • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Service all equipment regularly to minimize emissions. • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations.
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard, and also can affect the local crops;	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted. • Minimize the extent and period of exposure of the bare surfaces. • Restore disturbed areas as soon as practicable by vegetation/grass-turfing. • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations. • Not water as dust suppression on potentially contaminated areas so that a liquid waste stream will be generated. • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems. • Not permit the burning of solid waste.

ECP 11: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures. • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site.
Construction	Noise and vibration	The Contractor shall

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
machinery	may have an impact on people, property, fauna, livestock and the natural environment.	• Appropriately site all noise generating activities to avoid noise pollution to local residents. • Use the quietest available plant and equipment. • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid the unnecessary use of alarms, horns and sirens.
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours. • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions. • Employ best available work practices on-site to minimize occupational noise levels. • Install temporary noise control barriers where appropriate. • Notify affected people if major noisy activities will be undertaken, e.g. blasting. • Plan activities on site and deliveries to and from site to minimize impact. • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas.

ECP 12: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has	The Contractor shall • Minimize disturbance to surrounding vegetation. • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetations. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	wide range of adverse environmental impacts.	• Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill a, etc. • Not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work camps to prevent fuel wood collection.

ECP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality,	The Contractor shall • Limit the construction works within the designated sites allocated to the contractors. • check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal.
	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds. • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and locate active nests. • If bird nests are located/ detected within the

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		ledges and roadside embankments then those areas should be avoided. • Petroleum products should not come in contact with the natural and sensitive ecosystems. Contractor must minimize the release of oil, oil wastes or any other substances harmful to migratory birds' habitats, to any waters, wetlands or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum numbers required. • Relocate hollows, where appropriate. • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Night time lighting	Lighting from construction sites and construction camps may affect the visibility of night time migratory birds that use the moon and stars for navigation during their migrations.	The Contractor shall • Use lower wattage flat lens fixtures that direct light down and reduce glare, thus reducing light pollution, • Avoid flood lights unless they are absolutely required. • Use motion sensitive lighting to minimize unneeded lighting. • Use, if possible, green lights that are considered as bird's friendly lighting instead of white or red colored lights. • Install light shades or plan the direction of lights to reduce light spilling outside the construction area.
Construction camps	Illegal poaching	The Contractor shall • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching. • Ensure that staff and Subcontractors are trained and empowered to identify, address and report potential environmental problems.

ECP 14: Protection of Fish

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine	The Contractor shall • Ensure the construction equipment used in the river are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
	transport and disposal of wastes into the river	accidental spillage from equipment; make an emergency oil spill containment plan to be supported with enough equipments, materials and human resources. • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river.
Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall • follow mitigation measures proposed in ECP 3 : Water Resources Management and EC4: Drainage Management.

ECP 15: Road Transport and Road Traffic Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Strictly follow the Project's 'Traffic Management Plan' and work with close coordination with the Traffic Management Unit. • Prepare and submit additional traffic plan, if any of his traffic routes are not covered in the Project's Traffic Management Plan, and requires traffic diversion and management. • Include in the traffic plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges temporary diversions, necessary barricades, warning signs / lights, road signs etc. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the Pakistan Traffic Regulations.
	Accidents and spillage of fuels and chemicals	The Contractor shall • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit.

ECP 16: Construction Camp Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Locate the construction camps with in the designed sites or at areas which are acceptable from environmental, cultural or social point of view; and approved by the supervision consultant. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the supervision consultant for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters.
Construction Camp Facilities	Lack of proper infrastructure facilities , such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers. • Safe and reliable water supply, which should meet NEQS. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time (WHO guideline). • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads. • Provide child crèches for women working construction site. The crèche should have facilities for dormitory, kitchen, indoor and outdoor play area. Schools should be attached to these crèches so that children are

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
		not deprived of education whose mothers are construction workers. • Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps. • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipments/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas. • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. • Provide HIV awareness programming, including STI (sexually transmitted infections)

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		and HIV information, education and communication for all workers on regular basis. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during rainy season in offices and construction camps and yards. • Not dispose food waste openly as that will attract rats and stray dogs. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices.
Safety	In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of fire fighting equipments suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. • Give prior notice to the laborers before demolishing their camps/units. • Maintain the noise levels within the national standards during demolition activities. • Different contractors should be hired to demolish different structures to promote recycling or reuse of demolished material.

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
		• Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

ECP 17: Cultural and Religious Issues

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural issues cause social disturbances.	The Contractor shall • Communicate to the public through community consultation regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Not block access to cultural and religious sites, wherever possible. • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) should there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious institution. • Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until approval to continue is given. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people. • Allow the workers to participate in praying during construction time. • Resolve cultural issues in consultation with local leaders and supervision consultants. • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters.

ECP 18: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc), (ii) risk factors resulting from human behavior (e.g. STD, HIV etc) and (iii) road accidents from construction traffic.	The Contractor shall • Implement suitable safety standards for all workers and site visitors which should not be less than those laid down on the international standards (e.g. International Labor Office guideline on 'Safety and Health in Construction; World Bank Group's 'Environmental Health and Safety Guidelines') and contractor's own national standards or statutory regulations, in addition to complying with Pakistan standards. • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job. • Appoint an environment, health and safety manager to look after the health and safety of the workers. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters.
	Child and pregnant labor	The Contractor shall • not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks.
Accidents	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	The Contractor shall • Ensure health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations should be easily accessible throughout the place of work. • Document and report occupational accidents, diseases, and incidents. • Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards, in a manner consistent with good international industry practice. • Identify potential hazards to workers,

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules. • Provide adequate lighting in the construction area, inside the tunnels, inside the powerhouse cavern and along the roads.
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECP 16 Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECP 2 • Solid waste collection and disposal system in accordance with ECP1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Water and sanitation facilities at the construction sites	Lack of Water sanitation facilities at construction sites cause inconvenience to the construction workers and affect their personal hygiene.	The contractor shall • Provide portable toilets at the construction sites, if about 25 people are working the whole day for a month. Location of portable facilities should be at least 6 m away from storm drain system and surface waters. These portable toilets should be cleaned once a day and all the sewerage should be pumped from the collection tank once a day and should be brought to the common septic tank for further treatment. • Provide safe drinking water facilities to the construction workers at all the construction sites.
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community • ECP 2: Fuels and Hazardous Goods Management • ECP 4: Drainage Management • ECP 10: Air Quality Management • ECP 11: Noise and Vibration Management • ECP 15: Road Transport and Road Traffic Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to potential diseases.	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS. • Train all construction workers in general health and safety matters, and on the specific hazards of their work. Training should consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Implement malaria, HIV/AIDS and STI education campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled occupations, at the time of recruitment and thereafter pursued throughout the construction phase on ongoing and regular basis. This should be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.

Annex – 10.1

MACHINERY USED IN CONSTRUCTION OF KKH

No	Description	Construction Machinery	Number (for KKH1)	Number (for KKH2)
1	Road way Excavation	Bull Dozer (200 Hp)	2	6
		Front End Loader	1	3
		Dump Truck	2	6
2	Formation of Embankment	Grader (165 Hp)	2	3
		Combination of Rollers	1	3
		Water Tanker	1	3
3	Base Course (WBM)	Power Broom	2	4
		Front End Loader	1	3
		Dumper	2	6
		Combination of Rollers	2	6
4	Asphaltic Base Course/Wearing Course Plant Mix	Power Broom	2	3
		Front End Loader	1	2
		Asphalt Plant	1	1
		Paver (4m wide)	1	3
		Dumper (10-18 t)	3	6
		P.T.R. (9 wheeler)	1	3
		Tandem Vibration Roller (10-12 T)	1	3
5	Bituminuous Prime Coat/Tack Coat	Power Broom	1	1
		Engine Opertaed Bitumen Pressure Distributor	1	1
6	Concrete Production	Concrete Batching Plant (30 cubic meter/H)	1	2
		Front End Loader	1	3
		Concrete Transit Mixeer	1	2
		Vibrator	1	2
7	Pre=stressed Concrete Structures	Pre-stressting Equipment	1	2
		Equipment for Launching Beams	1	1

Annex – 10.2

CONSTRUCTION OF KKH: POTENTIAL ENVIRONMENTAL IMPACTS, MITIGATION AND MONITORING MEASURES

Table 1: Impacts and Mitigation Measures of KKH Relocation

Activity/Issue/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines	Institutional Responsibilities	
			Implementation	Supervision
A. Pre-Construction				
Land acquisition and resettlement	Acquisition of 11 ha of land and relocation of 24 households (excluding the area acquired for reservoir)	Compensation in accordance with the Projects Resettlement Action Plan	Social Unit -DHP	CSC
Contractors Environmental Action Plan	Environmental impacts from the construction activities	Contractor will prepare the following plans and submit to EU-DHP for approval • Site specific sediment and erosion control plan for each construction site; • Site specific camps management plan for each camp • Site specific spoil management and disposal plan for each construction site • Site specific waste management plan for each construction site; • Site specific pollution control (air, noise) plan for each construction site; • Site specific traffic management plan for each construction site; • Site specific decommissioning and landscaping plans for spoil disposal sites, temporary roads and other disturbed areas; • Complaints logging system and response plan; • Standard Operating Procedures for blasting operations • Standard Operating Procedures for pollution spills	Contractor	EU-DHP/EU-CSC

Activity/Issue/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines	Institutional Responsibilities	
			Implementation	Supervision
		• Demobilization plan after completion of works		
B. Construction				
Landslides	Excavation activities may trigger potential landslides	• EMP Sub-Plan 3: Physiography and Geology • Monitor landslides areas for displacement • Surface water management for prevention of landslides by construction of temporary drainage systems. • Implement slope stabilization techniques to prevent erosion and further triggering of landslides •	Contractor	EU-DHP/EU-CSC
Spoils		• Minimize generation of the spoil by reusing the excavated rock as road fill and aggregates for cement • Contractors management plans on spoil management and disposal	Contractor	EU-DHP/EU-CSC
Soil	Soil erosion and soil pollution from the construction sites	• Implement ECPs 5, 6, and 7 on Soil Quality Management, Erosion and Sediment Control and Top Soil Management	Contractor	EU-DHP/EU-CSC
Topography /Landscape	Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	• Ensure the topography of the final surface of all raised lands are conducive to enhance natural draining of rainwater/flood water; • Reinstate the natural landscape of the ancillary construction sites after completion of works	Contractor	EU-DHP/EU-CSC
Borrow areas	Degradation of borrow areas	• Only approved borrow and quarry sites will be used by the contractors and produce copy of necessary government licenses to the DHP before procurement. • Implement mitigation measures in ECP 9: Quarry Area Development and Restoration	Contractor	EU-DHP/EU-CSC
Water Quality	Water pollution from discharges of construction sites, fuel and material storage sites, soil erosion, workers	• Implement mitigation measures proposed in the following ECPs: o ECP 2: Fuels and Hazardous Goods	Contractor	EU-DHP/EU-CSC

Activity/Issue/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines	Institutional Responsibilities	
			Implementation	Supervision
	camps, etc.	Management o ECP 3: Water Resources Management o ECP 4: Drainage Management o ECP 6: Erosion and Sediment Control • Any discharges to the river or streams should meet the NEQS		
Air Quality	Air quality can be adversely affected by vehicle/machinery exhaust emissions	• Vehicle exhaust emissions should comply with NEQS • Maintenance of vehicle/equipment in accordance with manufacturer's recommendation • Implement mitigation measures ECP10: Air Quality Management • Asphalt plant should be located minimum 1 km away from the settlement areas • Water the unpaved roads and material storage sites to control the dust	Contractor	EU-DHP/EU-CSC
Noise and Vibration	High noise and vibration levels due to construction traffic, equipment use and blasting activities	• Noise from vehicle exhausts should comply with NEQS • Implement noise control measures given in ECP11: Noise and vibration management • No construction activities during night time within 500 m from the settlement areas • Notify adjacent landholders prior any typical noise events such as blasting • Install temporary noise control barriers where appropriate	Contractor	EU-DHP/EU-CSC
Waste	Soil and water pollution from improper management of waste and excess material from the construction sites	• Implement mitigation measures proposed in ECP 1: Waste Management • Collect and transport waste to project's landfill site.	Contractor	EU-DHP/EU-CSC
Hazardous Substances	Potential spills from improper storage and handling of asphalt and fuels.	• Implement mitigation measures in ECP 2: Fuels and Hazardous Goods Management • Trained personal with appropriate spill control mechanism shall be available at the site	Contractor	EU-DHP/EU-CSC

<table>
<tr><th rowspan="2">Activity/Issue/ Impact Source</th><th rowspan="2">Environmental Impacts</th><th rowspan="2">Mitigation Measures/ Management Guidelines</th><th colspan="2">Institutional Responsibilities</th></tr>
<tr><th>Implementation</th><th>Supervision</th></tr>
<tr><td>Vegetation clearance</td><td>Cutting of about 700 trees and shrubs</td><td>• Implement mitigation measures proposed in ECP12: Protection of Flora
• Tree plantation to compensate the loss of trees with a target to develop about 5 trees for each tree cut.
• Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
<tr><td>Birds</td><td>Impact on migratory birds, its habitat and its active nests.
Noise impacts from construction activities</td><td>• Implement mitigation measures proposed in ECP13: Protection of Fauna
• Implementation of noise and dust control measures
• Training of workers in protection of wildlife</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
<tr><td>Wildlife</td><td>Noise and vibration impacts on the wildlife in Kaigah conservation area</td><td>• Noise and vibration measurements at Kaigah CCA should not exceed NEQS
• Training of workers in protection of wildlife
• Implement mitigation measures proposed in ECP13: Protection of Fauna</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
<tr><td>Fish</td><td>Pollution of water by concrete and discharges from construction areas will affect the fish and other aquatic species</td><td>• Implement mitigation measures provided in ECP 14: Protection of Fisheries.
• All necessary measures will be taken to prevent earthworks related to the road and bridges from impeding cross drainage at tributaries / streams
• Waste water discharges should meet NEQS</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
<tr><td>Traffic</td><td>Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users</td><td>• Contractor will prepare his traffic management plan for approval of DHP
• Work in coordination with the DHP’s Traffic Management Unit
• Implement the mitigation measures proposed in ECP 15: Road Transport and Road Traffic Management</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
<tr><td>Physical and Cultural Resources</td><td>Chance finds of archeological sites</td><td>• Chance find procedures are included in the contract documents
• Stop work immediately and notify the site manager if, during construction an archaeological site is discovered. DHP will communicate with KP DOAM.</td><td>Contractor</td><td>EU-DHP/EU-CSC</td></tr>
</table>

Activity/Issue/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines	Institutional Responsibilities	
			Implementation	Supervision
		Resume the work after instructions received from KP DOAM		
Workers Health and Safety	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths.	• Implement suitable safety standards for all workers and site visitors which should not be less than those laid down on the international standards, • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Implement mitigation measures in ECP 18: Workers Health and Safety • Provide adequate water supply and sanitation facilities at the construction sites and camps	Contractor	EU-DHP/EU-CSC
Construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	• The Contractor shall provide adequate housing for all workers with all necessary basic facilities such as water supply and sanitation facilities, sewage treatment, in-house entertainment facilities • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS). • Implement mitigation measures proposed in ECP 16: Construction Camp Management	Contractor	EU-DHP/EU-CSC
Demobilisation of Contractor	Pollution of construction sites with oil spills	• Clean up and restoration of temporary construction areas • Disposal of waste material at the construction site.	Contractor	EU-DHP/EU-CSC
C. Operation and Maintenance Phase				
Landslides	Construction of the road can trigger development of the landslides in the landslide prone areas	• Permanent monitoring using crack gauges, where applicable • Maintenance of surface water drainage systems,	NHA	EU-DHP

Activity/Issue/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines	Institutional Responsibilities	
			Implementation	Supervision
		and retaining walls installed for minimizing landslides • Employment of road gangs for immediate clearance of landslides		
Erosion	Erosion from hill slopes, road cuts and spoil disposal sites.	• Develop plans and designs such as mechanical means and landscaping for control of erosion	EU-DHP through a follow up study	PD - DHP

Table 2: Environmental Monitoring Plan during Construction and Operation

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implementation	Supervision
During Construction					
Landslide	Identified potential landslide areas	Visual inspection and displacement monitoring	Monthly	Contractor	EU-DHP/ EU-CSC
Erosion	Cut slopes, embankments and rock disposal sites	Visual inspection of erosion prevention measures and occurrence of erosion	Monthly	Contractor	EU-DHP/
Borrow areas	Borrow sites	Visual inspection	Monthly	Contractor	EU-CSC
Surface water quality	At all tributaries and sites near down stream	Sampling and analysis of surface water quality and waste water quality	Quarterly (during bridge construction)	Contractor	EU-DHP/
Air Quality (dust, smoke)	Construction sites	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place; asphalt plant is located more than 1 km from residential areas	Daily	Contractor	EU-CSC
Air Quality (PM, NO2, SO2, CO)	Near the sensitive sites and settlements (as directed by CSC)	Air quality monitoring	Quarterly	Contractor	EU-DHP/
Noise	Construction sites	Visual inspection to ensure good standard equipment are in use	Weekly	Contractor	EU-CSC
	Construction sites	Ensure work restriction between 21:00-06:00 close to the sensitive locations	Weekly	Contractor	EU-DHP/

Parameter	Location	Means of Monitoring	Frequency	Responsible Agency	
				Implementation	Supervision
	Nose measurement	Hourly, day and night time noise levels (dB) monitoring using noise meters	Quarterly	Contractor	EU-CSC
Waste Management	Construction camps and construction sites	Visual inspection that solid waste is disposed at designated site	Monthly	Contractor	EU-DHP/
Hydrocarbon and chemical storage	Construction camps	Visual Inspection of storage facilities	Monthly	Contractor	EU-CSC
Traffic Safety	Haul Roads	Visual inspection to see whether proper traffic signs are placed and flagmen for traffic management are engaged	Monthly	Contractor	EU-DHP/
Drinking water and sanitation	In construction sites and construction camps	Ensure the construction workers are provided with safe water and sanitation facilities in the site	Weekly	Contractor	EU-CSC
Cultural and archeological Sites	At al l work sties	Visual observation for chance finding	Daily	Contractor	EU-DHP/
Safety of workers	At work sites	Usage of Personal Protective equipment	Monthly	Contractor	EU-CSC
Contractors demobilization	Construction work areas, contractor yards and construction camps	Visual inspection to ensure removal of all buildings and equipment from the site. The site is clean and was restored to original condition	Before contractor's demobilization	Contractor	EU-DHP/
During Operation and Maintenance					
Landslides and landscapes	Along KKH alignment	Visual inspection of long-term degradation of natural landscape at land strips and slopes adjacent to road. Development of landslides, rock falls and other natural hazardous process. Visual Impacts. Change of drainage patterns, erosion and degradation of vegetation	Quarterly	DHP	External Monitor

Annex – 12.1

LIST OF PARTICIPANTS OF COMMUNITY CONSULTATION IN 34 VILLAGES

Village: Chuchang **Dated:** 26/6/2012

Sr. No.	Name of Participant
1.	Qari Aziz-ur-Rehman
2.	Sher Khan
3.	Javaid
4.	Zareen
5.	Hazb-ur-Rehman
6.	Badar Jamil
7.	Haroon
8.	Abdul Sattar
9.	Ajoon Khan
10.	Kimya
11.	Shabbir Khan
12.	Munir Ahmad

H.H

Chuchang village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	قاری عزیز الرحمن	
2	شبیر خان	
3	جاوید	
4	زرین	زرین
5	حزب الرحمن	
6	بدر جمیل	بدر جمیل
7	ھارون	ہارون
8	عبدالستار	Ab[illegible]
9	اجون خان	
10	کیمیا	
11	شبیر خان	
12	منیر احمد	

Dated: 26/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Khoshi **Dated:** 24/6/2012

Sr. No.	Name of Participant
1.	Hakim Khan
2.	Alaf Saeed
3.	Lal Saeed
4.	Sher Ghazi
5.	Faiz Malik
6.	Muhammad Ayaz
7.	Kareem Khan
8.	Maskeen
9.	Umar Yar
10.	Shalim
11.	Sala-ud-din
12.	Abdul Rehman
13.	Muhammad Ghani
14.	Ahsan-ul-Haq
15.	Fazal-ur-Rehman
16.	Habib-ur-Rehman
17.	Muhammad Ghani
18.	Hijab Khan
19.	Noor-ur-Rehman
20.	Sher Muhammad
21.	Gul Zareen
22.	Pir Wali Shah
23.	Moasum Khan
24.	Fazal Momin

Khashi
24/6/2012

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	حکیم خان	
2	الف سید	
3	لال سید	[illegible]
4	مشہر غازی	
5	قاسم ملک	[illegible]
6	محمد ایاز	
7	~~عبدالکریم~~ کریم خان	کریم خان
8	مسکین	
9	عمر یار	[illegible]
10	شالم	
11	صلاح الدین	
12	عبدالرحمن	عبدالرحمن
13		
14	محمد غنی	
15	~~احسان~~ احسان الحق	احسان الحق

Dated: 24/6/2012

4

Households ...
Attended 25 (7.50)

Khosni village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
16	فضل الرحمان	فضل الرحمان
17	حبیب الرحمان	حبیب الرحمان
18	محمد غنی	[illegible]
19	محبان خان	محبان خان
20	نور الرحمان	[illegible]
21	شیر محمد	شیر محمد
22	گل زرین	گل زرین
23	پیر ولی شاہ	
24	موسم خان	
25	فضل مومن	
11		
12		

Dated: 24/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Logro **Dated:** 23/6/2012

Sr. No.	Name of Participant
1.	Narang Shah
2.	Shamas-ud-Din
3.	Syed Wali Khan
4.	Gul Badshah
5.	Abdul Salam
6.	Gul Akbar
7.	Abdul Malak
8.	Gul Sher
9.	Shamas-ur-Rehman
10.	Noor Muhammad
11.	Khan Gheer
12.	Muhammad Ameen
13.	Ahmad Ali
14.	Sheraan
15.	Sarfraz Khan
16.	Rashmil Khan
17.	Masar Khan
18.	Mustafa
19.	Zaror
20.	Ameez Khan
21.	Wali-ur-Rehman
22.	Rehmat Wali
23.	Syed-ur-Rehman
24.	Hazrat Wali

16 HH
covered 27

Logro Village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	نارنگ شاہ	نارنگ شاہ
2	شمس الدین	شمس الدین
3	سید ولی خان	سید ولی خان
4	گل بادشاہ	گل بادشاہ
5	عبدالسلام	عبدالسلام
6	گل اکبر	گل اکبر
7	عبدالمالک	عبدالمالک
8	گل شیر	گل شیر
9	شمس الرحمان	شمس الرحمن
10	نور محمد	نور محمد
11	خان نگیر	خان نگیر
12	محمد امین	محمد امین

Dated: 23/6/2012

4

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
13	احمد علی	
~~2~~ 14	شادان	
~~3~~ 15	سرفراز خان	
~~4~~ 16	رشمل خان	
~~5~~ 17	مصر خان	
~~6~~ 18	[illegible]	
~~7~~ 19	زرور	
~~8~~ 20	اظہر خان	امین تاج
~~9~~ 21	ولی الرحمن	ولی الرحمان
~~10~~ 22	رحمت ولی	رحمت ولی
~~11~~ 23	سید الرحمن	سید الرحمن
~~12~~ 24	حضرت ولی	حضرت ولی

Dated: 23/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Kai Gah **Dated:**

Sr. No.	Name of Participant
1.	Haider Shah
2.	Qari Maaz Hussain
3.	Fazal Malak
4.	Malik Falqoos
5.	Hakeem Khan
6.	Kismat Shah
7.	Habib-ur-Rehman
8.	Abdul Rehman
9.	Fazal Wahab
10.	Abdul Rehman
11.	Sahibzada
12.	Ameerzada
13.	Shah Akbar
14.	Fazal-ur-Rehman
15.	Abdul Rauf

Rai Grah village

Sr No.	List of Participants	Signature /Thumb Impression
1	منور شاہ	[illegible]
2	قاری معاذ حسین	قاری معاذ حسین
3	فضل مالک	[illegible]
4	ملک تلقوس	Mr [illegible]
5	حلیم خان	دایم خان
6	قسمت شاہ	قسمت شاہ
7	حبیب الرحمان	[illegible]
8	عبدالرحمان	[illegible]

P.T.O

Signature:____________________ Signature:____________________

Name: ____________________ Name: ____________________

CNIC: ____________________ CNIC: ____________________

(Interviewer) (WAPDA Representative)

9-	فضل وہاب	فضل وہاب
10-	عبدالرحمان	A. Rehman
11-	صاحب زادہ	صاحبزادہ
12-	امیر زادہ	امیر زادہ
13-	شاہ اکبر	شاہ اکبر
14-	فضل الرحمان	فضل الرحمان
15-	عبدالرؤف	

Dasu Hydropower Project

(Consultation & Participation)

Village: Pani Bah **Dated:** 12/6/2012

Sr. No.	Name of Participant
1.	Molvi Abdul Kareem
2.	Bakhat Tajamul
3.	Noor Badshah
4.	Ali Haider
5.	Juma Syed
6.	Mir Subhan
7.	Haji Syed Imran
8.	Habib Noor
9.	Raj Gul
10.	Gul Nawaz
11.	Bradar
12.	Fazal Noor

Dasu Hydropower Project

Consultation & participation

Village Pani Bak

~~List of Participants~~

Sr No.	List of Participants	Signature /Thumb Impression
1	مولوی عبدالکریم	
2	بخت تجمل	
3	نور بادشاہ	نور بادشاہ
4	علی حیدر	علی حیدر
5	محمد زاہد	
6	محسن سبحان	
7	حاجی سید عمران	
8	حبیب نور	
9	راز گل	
10	گل نواز	
11	برادر	
12	فضل مولا	

Dated: 12-6-2012

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Dasu Hydropower Project

(Consultation & Participation)

Village: Gadeer **Dated:** 09/6/2012

Sr. No.	Name of Participant
1.	Fazal Shah
2.	Hidayat-ur-Rehman
3.	Haji Naamdad

Gadeer village

9-6-2012

دستخط	نام
[illegible]	۱۔ فضل شاہ
ہدایت الرحمن	۲۔ ہدایت الرحمن
[illegible]	3 ۔ حاجی نامدار

Dasu Hydropower Project

(Consultation & Participation)

Village: Kass Village **Dated:** 27/6/2012

Sr. No.	Name of Participant
1.	Muhammad Mukhtar
2.	Ghulam Muhammad
3.	Muhammad Iqbal
4.	Usbama Ghani
5.	Muhammad Saeed
6.	Said Khan
7.	Abdul Rasheed
8.	Abdul Majeed
9.	Fazal Kareem

(43)
Kass village.

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	محمد مختیار	
2	غلام محمد	
3	محمد اقبال	
4	مجتبیٰ غنی	
5	محمد سعید	
6	سید جان	
7	عبدالرشید	
8	عبدالمجید	
9	فضل الکریم	فضل کریم
10		
11		
12		

Dated: 27/6/2012

Dasu Hydropower Project

(Consultation & Participation)

Village: Kango **Dated:** 24/6/2012

Sr. No.	Name of Participant
1.	Gul Zareen
2.	Guldad
3.	Abdul Malak
4.	Sartaj
5.	Gul Rehman
6.	Gul Munir
7.	Sahibzada
8.	Abdul Ghafoor
9.	Muhammad Aslam
10.	Mehmood-ul-Hassan

Kango village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	گل زرین	گل زرین
2	گل داد	
3	عبدالمالک	
4	سرتاج	سرتاج
5	گل رحمان	
6	گل منیر	
7	صاحبزادہ	صاحبزادہ
8	عبدالغفور	عبدالغفور
9	محمد اسلم	
10	محمود الحسن	
11		
12		

Dated: 24/6/2012

Dasu Hydropower Project

(Consultation & Participation)

Village: Seo **Dated:** 24/6/2012

Sr. No.	Name of Participant
1.	Muhammad Akram Shah
2.	Ameez Khan
3.	Muhammad Tariq Shah
4.	Malik Tota Khan
5.	Rakho
6.	Shah Rehman
7.	Musharaf Khan
8.	Muhammad Yaseen
9.	Anees-ur-Rehman
10.	Muhammad Siraj
11.	Atta Ullah
12.	Roshan
13.	Abdul Rehman

Seo Village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	محمد اکرم شاہ	
2	افسر خان	افسر خان
3	محمد طارق شاہ	
4	ملک طوطا خان	طوطا خان
5	رحم	رحم
6	شاہ رحمان	ثناء الرحمن
7	مشرف خان	مشرف خان
8	محمد یاسین	محمد یاسین
9	انیس الرحمان	انیس الرحمان
10	محمد سراج	محمد سراج
11	عطا اللہ	
12	روشن	زر شت
13	عبدالرحمان	

Dated: 24/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Chalas **Dated:** 29/6/2012

Sr. No.	Name of Participant
1.	Fazal Elahi
2.	Ahmad Khan
3.	Syed Ahmad
4.	Saeed-ur-Rehman
5.	Saeed-u-Zaman
6.	Bashir
7.	Yaseer Khan
8.	Saleh Muhammad
9.	Bashir

Chalaas village,

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	فضل الٰہی	
2	احمد خان	احمد خان
3	سید احمد	سید احمد
4	سعید الرحمٰن	سعید الرحمٰن
5	سید الزمان	سید الزمان
6	بشیر	بشیر
7	یسیر خان	یسیر خان
8	صالح محمد	
9	بشیر	بشیر
10		
11		
12		

Dated: 29/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Lootar **Dated:** 21/6/2012

Sr. No.	Name of Participant
1.	Abdul Razaq
2.	Hakumat Khan
3.	Sher Muhammad
4.	Abdul Qayyum
5.	Imran Khan
6.	Kamran Akmal
7.	Ali Muhammad
8.	Abdul Rauf
9.	Sheraan
10.	Zer Mian
11.	Shahzada
12.	Haq Sher
13.	Nazar Khan
14.	Abdul Qadar

Looten village. 24#.

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	عبدالرزاق	IAB
2	حکومت خان	حکومت خان
3	شبیر محمد	
4	عبدالقیوم	شبیر الرحمن
5	عمران خان	عمران خان
6	کامران اکمل	
7	علی محمد	
8	عبدالرؤف	
9	شیران	شیران
10	زرمیاں	زرمیاں
11	شہزادہ	شہزادہ
12	حق شیر	

13 نذر خان

Dated: 21/6/2012

14 - عبدالقادر

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Shori Nalla **Dated:** 19/6/2012

Sr. No.	Name of Participant
1.	Abdul Wajid
2.	Abdul Sadiq
3.	Shakoor Khan
4.	Talawat Khan
5.	Gul Syed
6.	Wasal Khan
7.	Farid Khan
8.	Yaseen
9.	Hussain Wali
10.	Haji Alam
11.	Jahangir Khan
12.	Sanobar Khan
13.	Aurang Zeb
14.	Anayat Ullah
15.	Sher Khan

24 H.H
Shori Nalla

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	عبدالواحد	عبدالواحد
2	عبدالصادق	عبدالصادق
3	شکور خان	شکور خان
4	ثروت خان	ثروت خان
5	گل سید	گل سید
6	واصل خان	واصل خان
7	فرید خان	فرید خان
8	مالشن	مالشن
9	حسین ولی	حسین ولی
10	حاجی عالم	حاجی عالم
11	جہانگیر خان	
12	صنوبر خان	صنوبر خان
	اورنگ زیب	اورنگزیب

Dated: 19/6/2012

13 عنایت اللہ — عنایت اللہ

14 شبیر خان — شبیر خان

Dasu Hydropower Project
(Consultation & Participation)

Village: Summar Nallah **Dated:** 15/6/2012

Sr. No.	Name of Participant
1.	Wali Rehmat
2.	Liaqat Wali
3.	Saar Jamil
4.	Abdul Wahid
5.	Ghulam Muhammad
6.	Shaqar Khan
7.	Rehmat Ullah
8.	Sabir Wali
9.	Muhammad Younus
10.	Habib Khan
11.	Lal Sajjad
12.	Abdul Wazir
13.	Hussain Wali
14.	Muhammad Jamil

Dasu Hydropower Project

Summar Nallah **Consultation & participation**

~~List of Participants~~

Sr No.	List of Participants	Signature /Thumb Impression
1	Wali Rehmat	ولی رحمت
2	Liaqat Wali	لیاقت ولی
3	Saar Jamil	
4	Abdul Wahid	محمد عبدالواحد
5	Ghulam Muhammad	غلام محمد
6	Shagar Khan	
7	Rehmat allah	رحمت اللہ
8	Sabir wali	صابر ولی
9	Muhammad Younus	محمد یونس
10	Habib Khan	HABIB KHAN
11	Lal Sajjad	
12	Abdul wazir	

عبدالجبیر

14: Hussain wali حسین ولی

15: Muhammad Jamil محمد جمیل

Dated: 15/6/2012

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Dasu Hydropower Project

(Consultation & Participation)

Village: Lachi Nalla **Dated:** 18/6/2012

Sr. No.	Name of Participant
1.	Muhammad Yahya
2.	Alam Gireer
3.	Shah Alam
4.	Manzoor Ahmad
5.	Gul Faraz
6.	Shah Nawaz
7.	Haji Zaboor

Total Households 12
Lachi Nalla

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	Muhammad Yahya	[signature]
2	Alam Gireer	[signature]
3	Shah Alam	[signature]
4	Manzoor Ahmad	[signature]
5	Gul Faraz	[signature]
6	Shah Nawaz -	[signature]
7	Haji Zaboor	[signature]
8		
9		
10		
11		
12		

Dated: 18/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Shatial (Shaheen Kot) **Dated:** 20/6/2012

Sr. No.	Name of Participant
1.	Haji Jajil Khan
2.	Shamas Khan
3.	Abdul Wakeel
4.	Muhammad Zaman
5.	Jal Zer
6.	Barkat Khan
7.	Janbaz
8.	Farid Khan
9.	Baz Gul
10.	Gulzada
11.	Reham Dil
12.	Liaqat Wali
13.	Haji Naamdad
14.	Ashoor Mehmood
15.	Sahib Zer
16.	Khoma
17.	Haji Narna Khan
18.	Kareem Ullah
19.	Abdulllah
20.	Shabbir
21.	Rajab Khan
22.	Gul Zer
23.	Sher Ahmad
24.	Dil Muhammad
25.	Gulber

شتیال شاہین کوٹ

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	حاجی جمیل خان	جمیل خان
2	شمشی خان	شمشی خان
3	عبدالوکیل	عبدالوکیل
4	محمد زمان	محمد زمان
5	جمیل زر	[illegible]
6	برکت خان	[illegible]
7	جانباز	JANBAZ
8	فرید خان	[illegible]
9	باز گل	باز گل
10	گل زادہ	[illegible]
11	رحیم دل	رحیم دل
12	لیاقت ولی	لیاقت ولی

13 — حاجی لعل مراد [illegible]

Dated: 20/6/2012

14-

4

شتیال شاہین کوٹ

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
15	ارشد محمود	0998-503363 ارشد محمود
16	صاحب زر	صاحب زر
17	[illegible]	خوشا
18	ناصراللہ خان	حاجی نصر خان
19	کریم اللہ	کریم اللہ
20	عبداللہ	عبداللہ
21	شبیر	شبیر
22	رجب خان	رجب خان
23	گل زر	گل زر
24	بشیر احمد	بشیر احمد
25	دل محمد	دل محمد
26	گل بر	گل بر

Dated: 20/6/2012

Dasu Hydropower Project

(Consultation & Participation)

Village: Harpin Nallah **Dated:** 13/6/2012

Sr. No.	Name of Participant
1.	Fardoos
2.	Amam Ali
3.	Younas
4.	Shakeel
5.	Umar Farooq
6.	Sher Alam
7.	Mumtaz
8.	Naqeeb
9.	Rehman
10.	Abdul Bari
11.	Nadir
12.	Shah Alam

Dasu Hydropower Project

Consultation & participation

Harpin Nallah (Camp)

~~List of Participants~~

Sr No.	List of Participants	Signature /Thumb Impression
1	Fardoos	فردوس
2	Amam Ali	اماوئی
3	Younas	
4	Shakeel	
5	Umer Farooq	عمر فاروق
6	ShareAlam	شیر عالم
7	Mumtaz	
8	Naqeeb	نقیب
9	M. Rehman	
10	Abdul Bari ~~Amam Ali~~	عبد الباری
11	Nadir	
12	Shah Alam	شاہ عالم

Dated: 13/6/2012

S-15

Dasu Hydropower Project

(Consultation & Participation)

Village: Seglo **Dated:** 11/6/2012

Sr. No.	Name of Participant
1.	Muhammad Younas
2.	Shamas-ur-Rehman
3.	Muzamil
4.	Subdar
5.	Shah Nawaz
6.	Sana Ullah

Dasu Hydropower Project

Consultation & participation

List of Participants Seglo

Sr No.	List of Participants	Signature /Thumb Impression
1	Muhammad Yousaf	
2	Shamas ur-Rehman	
3	Muzamil	M.Jehani
4	Subdar	
5	Shah Nawaz	
6	Sana Ullah	Sanaullah
7		
8		
9		
10		
11		
12		

Dated: 11-6-2011

S-15

Dasu Hydropower Project

(Consultation & Participation)

Village: Sazeen Camp (left bank) **Dated:** 14/6/2012

Sr. No.	Name of Participant
1.	Sher Afzal
2.	Muhammad Mustaqeem
3.	Khan Afzal
4.	Muhammad Maskeen
5.	Shah Alam

Dasu Hydropower Project

Consultation & participation Dated 14/6/12

Sazeen Camp
~~List of Participants~~ Left Bank

Sr No.	List of Participants	Signature /Thumb Impression
1	Sher Afzal	
2	Muhammad Mushtaqeem	
3	Khan Afzal	
4	Muhammad Mushfeeq	
5	Shah Alam	
6		
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11		
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Dated: 14-6-2012

S-15

Dasu Hydropower Project

(Consultation & Participation)

Village: Melar **Dated:** 02/6/2012

Sr. No.	Name of Participant
1.	Badar Munir
2.	Gulab Khan
3.	Shah Zada
4.	Ameez Khan
5.	Umar Khan
6.	Qaiser
7.	Musharraf Khan
8.	Amir Khan
9.	Hanseer Khan
10.	Shamas-ur-Rehman
11.	Bashir Ahmed
12.	Fazal Haq

Dassu Hydropower Project

(Consultation & Participation) Melar

Sr. No.	Name of Participant	Signature /Thumb Impression
1	Badar Munir	
2	Gulab Khan	
3	Shah Zada	شاہزادہ
4	Ameer Khan	
5	Umer Khan	
6	Qaiser	قیصر
7	Musharraf Khan	
8	Amir Khan	
9	Hanseer Khan	
10	Shamsur Rehman	
11	Bashir Ahmed	مولوی بشیر احمد
12	Fazal Haq	

Dated: 2/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Kai Dogah **Dated:** 03/6/2012

Sr. No.	Name of Participant
1.	Jan Muhammad
2.	Muhammad Alam
3.	Muhammad Munir
4.	Muhammad Azam

Kai Dogah

Sr No.	List of Participants	Signature /Thumb Impression
1	Jan Muhammad	[signature]
2	M. Akram	محمد اکرم
3	M. Muneer	محمد منیر
4	M. Azam	محمد اعظم
5		
6		
7		
8		

Signature: [signature]
Name: Anwar Fazal
CNIC: ______
(Interviewer)

Signature: Ahsan
Name: Ahsan Tufail
CNIC: 34502-2468757
(WAPDA Representative)

Dated: 08-06-12

(* Note: Please attach necessary photograph)

Dasu Hydropower Project

(Consultation & Participation)

Village: Kuzkai **Dated:**

Sr. No.	Name of Participant
1.	Haji Fazal Rehman
2.	Gul Daat

Name of village : Kuz Kai Location of Meeting Dara : Fazal Rehman Date 8/

Name	Father's name	Signature
Haji Fazal Rehman :	Sham Toor	
Gul Dad :	Malik Hakim Khan	گل داد

Dasu Hydropower Project

(Consultation & Participation)

Village: Seer Gayal **Dated:** 04/6/2012

Sr. No.	Name of Participant
1.	Molvi Abdul Malak
2.	Abdul Quddus
3.	Muhammad Raheem
4.	Abdul Sattar
5.	Fazal Ahad
6.	Aneer Khan
7.	Syed Ahmad
8.	Molvi Hussain Ahmad

Seer Gayal

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	مولوی عبدالمالک	
2	عبدالقدوس	
3	محمد رحیم	M Rahim
4	عبدالستار	
5	فضل احمد	
6	منیر خان	
7	سید احمد	سید احمد
8	مولوی حسین احمد	
9		
10		
11		
12		

Dated: 4/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Kot Gul **Dated:** 05/6/2012

Sr. No.	Name of Participant
1.	Mir Subhan
2.	Ahmad Jan
3.	Rasheed
4.	Shair Ali
5.	Abdul Malik
6.	Alif Deen
7.	Gul Zaman
8.	Abdul Waheed
9.	Ashraf
10.	Haji Shafi
11.	Ghulab Khan

5-6-2012

Kot Gal.

1- Mir Subhan s/o Haji Safi میر سبحان ←
2- Ahmad Jan S/o Haji Jafar
3- Rasheed s/o Gulab Khan رشید خان ←
4- Shair Ali s/o Gul Dad
5- Abdul Malik s/o Gul Dad عبدالمالک
6- Alif Deen s/o Jamdar الف دین
7- Gul Zaman s/o Gulab Khan گل زمان
8- Abdul Waheed s/o Gulab Khan عبدالوحید
9 M. Ashraf S/o Umar Khan
10 Haji Shafi s/o Karim Khan
11 Ghulab Khan S/o Rajam

Dasu Hydropower Project

(Consultation & Participation)

Village: Nut Bel, Kandia **Dated:** 06/6/2012

Sr. No.	Name of Participant
1.	Abdul Waris
2.	Haji Khan Bahadar
3.	Abdul Sattar
4.	Javaid Iqbal
5.	Qalandar
6.	Ihsan-ul-Haq
7.	Hukamdad
8.	Inayat Ullah
9.	Haq Nawaz
10.	Muhammad Taj
11.	Mazhar Shah
12.	Sher Muhammad
13.	Raj Muhammad

Nut Bel, Kandia Valley, Tehsil, Dasu

Sr No.	List of Participants	Signature /Thumb Impression
1	Abdul Waris	
2	Haji Khan Behadar	بہادر
3	Abdul Sattar	
4	Javid Iqbal	
5	Qalandar	
6	Ihsan-ul-Haq	احسان الحق
7	Hukamdad	حکم داد
8	Inayat-ullah	

9 Haq Nawaz

10 - Muhammad Taj

11 - Mazhar Shah مظہر شاہ

Dated: 6-6-2012

Signature:______________________ Signature:______________________

Name: ______________________ Name: ______________________

CNIC: ______________________ CNIC: ______________________

(Interviewer) (WAPDA Representative)

Dated: 06.06. 2012

(* Note: Please attach necessary photograph)

12. Sher Muhammad

13. Raj Muhammad

S-15

Dasu Hydropower Project

(Consultation & Participation)

Village: Saleech **Dated:** 06/6/2012

Sr. No.	Name of Participant
1.	Qadir Khan
2.	Faridoon
3.	Haji peer Dad
4.	Mir Zeeshan
5.	Abdul Gafoor Malook
6.	Saeed Gul
7.	Azeem
8.	Waqar
9.	Shamsher
10.	Sattar
11.	Chapu
12.	Saeed Jan

Saleech village, Initial Consultation 6/6/12

Name	Signature
1) Qadir Khan	
2) Faridoon	
3) Haji peer Dad	
4) Mir Zeeshan	
5) Abdul Gafoor Malook	
6) Saeed Gul	
7) Azeem	
8) waqeel	
9) Shamsher	
10) Sattan	
11) Chapu	
12) Saeed Jan	جان

Dasu Hydropower Project

(Consultation & Participation)

Village: Thothi **Dated:**

Sr. No.	Name of Participant
1.	Abdul Majeed
2.	Sabeel
3.	Ayub Khan
4.	Farid Khan
5.	Zaid Khan
6.	Ghofran Khan
7.	Abdul Rasheed
8.	Syed Baz
9.	Lal Muhammad
10.	Gul Malook
11.	Muhammad Nazir
12.	Jahangir
13.	Yar Khan
14.	Dedar Shah
15.	Mushtahir
16.	Amal Dar

Thoti

دستخط	نام	نمبر شمار
عبدالمجید خان	عبدالمجید	1
سبیل	سبیل	2
ایوب خان	ایوب خان	3
فرید خان	فرید خان	4
زید خان	زید خان	5
غفران	غفران خان	6
عبدالرشید	عبدالرشید	7
	سیر باز	8
 لال محمد	لال محمد	9
	گل مسکوک	10

Thothi.

Sr No.	List of Participants	Signature /Thumb Impression
1	M. Nazir	نذیر
2	Jahangeer	[illegible]
3	Yar Khan	یار خان
4	Dedar Shah	[illegible]
5	Mashtahir	[illegible]
6	Amal Dar	عمل دار
7		
8		

Signature: [illegible]
Name: Anwar Fazal
CNIC:
(Interviewer)

Signature: Asad
Name: Asad-ur-Rehman
CNIC: 38404-5907918-1
(WAPDA Representative)

Dated:

(* Note: Please attach necessary photograph)

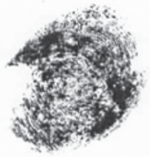
Dasu Hydropower Project

(Consultation & Participation)

Village: Warisabad **Dated:** 08/6/2012

Sr. No.	Name of Participant
1.	Haji Naji
2.	Muhammad Ayaz
3.	Khan Bahadur
4.	Hukam Dad
5.	Mulana Anayat Ullah
6.	Abdul Waris
7.	Abdul Sattar
8.	Ahsan-ul-Haq

Date: 8/6/2012 Wouusallah [illegible]

نام	دستخط
۱۔ حاجی یحیٰ	یحیٰ
2۔ محمد ایاز	
3۔ خان بہادر	خان بہادر
4۔ حکم داد	حکم داد
5۔ مولانا عنایت اللہ	[illegible]
6۔ عبدالوارث	[illegible]
7۔ عبدالستار	
8۔ احسان الحق	احسان الحق

Dasu Hydropower Project

(Consultation & Participation)

Village: Doondar **Dated:** 25/6/2012

Sr. No.	Name of Participant
1.	Roshan Khan
2.	Abdul Razzaq
3.	Jamal Khan
4.	Ghaffar Khan
5.	Ibrahim
6.	Qayyum
7.	Dedar Shah
8.	Nagir Shah
9.	Nabi Haq
10.	Abdul Haq
11.	Sahiba Haq
12.	Gul Bani

Doondar village

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	روشن خان	
2	عبدالرازق	
3	جمال خان	
4	غفار خان	
5	ابراہیم	
6	قیوم	
7	دیدار شاہ	
8	لنگر شاہ	
9	نبی حق	
10	عبدالحق	
11	صاحب حق	
12	گل نبی	

Dated: 25/6/2012

4

Dasu Hydropower Project

(Consultation & Participation)

Village: Gummo **Dated:** 17/6/2012

Sr. No.	Name of Participant
1.	Jamu Gul
2.	Muhammad Rafiq
3.	Abdul Rasheed
4.	Umer Farooq
5.	Said Jabar
6.	Said Rehman
7.	Fazal-ur-Rehman
8.	Abdul Sattar
9.	Muhammad Ayub

Dasu Hydropower Project

Consultation & participation

Gummo

~~List of Participants~~

Sr No.	List of Participants	Signature /Thumb Impression
1	Jamu Gul	
2	M. Rafiq	Rfiq
3	Abdal Rasheed	
4	Umer Farooq	Amr
5	Said Jabar	
6	Said Rehman	
7	Fazal-ur-Rahman	
8	Abdul Sattar	
9	Muhammad Ayub	محمد ایوب
10		
11		
12		

Dated: 19-6-2012

S-15

Dasu Hydropower Project

(Consultation & Participation)

Village: Seer Shayal **Dated:** 09/7/2011

Sr. No.	Name of Participant
1.	Fazal-ur-Rehman
2.	Alam Sher
3.	Aslam Khan
4.	Abdul Aziz
5.	Muhammad Sher
6.	Sher Mulah
7.	Ateel Khan
8.	Khoshal
9.	Sohail Nasir
10.	Badeem Khan
11.	Azeem Khan
12.	Gul Muhammad

بکر مشیال

Dassu Hydropower Project

(Consultation & Participation)

Sr. No.	Name of Participant	Signature /Thumb Impression
1	فضل الرحمان	
2	عالم شیر	عالم شیر
3	اسلم خان	محمد اسلم
4	عبدالعزیز	
5	محمد شیر	
6	شیر ملہ	
7	اتیل خان	
8	خوشحال	
9	سہیل ناصر	
10	ندیم خان	ندیم خان
11	عظیم خان	عظیم خان
12	گل محمد	Ahmad

Dated: 9/7/2011

Dasu Hydropower Project

(Consultation & Participation)

Village: Khaliqabad Darel Pull **Dated:** 12/6/2012

Sr. No.	Name of Participant
1.	Abdul Wajad
2.	Ubaid-ur-Rehman
3.	Fazal-ur-Rehman
4.	Soon Mian
5.	Nazeer
6.	Roozimand
7.	Hijab

Dasu Hydropower Project

Consultation & participation

Khaligabad Darel Pull

List of Participants

Sr No.	List of Participants	Signature /Thumb Impression
1	Abdal wajad	[signature]
2	Ubaid-ur-Rehman	[signature]
3	Fazal ul Rehman	[signature]
4	Soon Mian	سون میان
5	Nazeer	[signature]
6	Roozi mand	Rozim
7	Hijab	حجاب
8		
9		
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Dated: 12-6-2012

S-15

Annex – 12.2

NOTABLE MEMBERS OF THE COMMITTEE

Dated 19/03/2012.

Received Dassu 30-3-2012

To

The Executive Engineer,
WAPDA, Dassu Hydropower Project,
At Dassu.

Subject: **LIST OF NOTABLES OF THE GRAND JIRGA IN RESPECT FOR DASSU HYDROPOWER PROJECT IN RESPECT OF TEHSIL DASSU AND KANDIA.**

Memo:

The following committee of Tehsil Dassu and Kanida comprising of the following notables is hereby constituted for Grand Jirga regarding WAPDA (Dassu Hydropower Project) issues:-

S.No.	Name & Father	R/O
1.	MNA, NA-23 Kohistan.	
2.	MPA, PF-63	
3.	Malik Sumandar.	Jalkot.
4.	Haji Anwar.	Jalkot.
5.	Muhammad Hassan s/o Safa	Jalkot.
6.	Malik Charagh.	Dassu.
7.	Malik Sakhi.	Dassu.
8.	Haji Yarmanon s/o Chano	Teyal.
9.	Malik Mukhtar s/o Malik Shahdad.	Seo.
10.	Manawar Shah. (Sikandar Khel).	Dassu
11	Molve Abdul Hakeem S/O Afsar Khan	Uchar Dassu
12	Molve Roshan S/O Lala	Koshi Dassu
13	Haji Manan Shah	Kaigha Dassu
14	Filqoos S/O Qalander	Kaigha Dassu
15	Sirajuddin S/O Hussan Wali	Gadeer (Awai) Dassu
16	Zarbeland Khan Ex- Nazim Kun Jalkot	Rajkot Dassu
17	Qari mUhammad Saeed Ciost of Both Khel	Dassu
18	Narang Shah	Dassu
19	Fareed S/O Ayub	Summer Nallha
20	Raja Muhd: Arif s/o Sadar Khan	Sazain
21.	Moulvie Abdul Ghafoor.	Khatib Jamia Majid Shatial.
22.	Moulvi Saeed ur Rehman	Khatib Zilla Kohistan.
23.	Moulvie Noor Nabi.	Jalkot.
24.	Muhammad Ajmal s/o Hafiz Jamil	Jalkot.
25.	Malik Umar Khan Ex-MPA.	Seo.
26.	Malik Aman Ullah s/o Malik Ayub.	Gogyshy.
27.	Abdul Haleem	Seglo.
28.	Khan Bahadar s/o Bolia.	Kuma.
29.	Abdul Rehman s/o Fazal Ahmad.	Kama.
30.	Malik Gulab s/o Yousaf	Seo Milar.
31.	Umar Khan s/o Abdullah Khan.	Seo Milar.
32.	Malik Qadam Khan s/o Nawab.	Kuz Purwa.
33.	Haji Fazal ur Rehman s/o Shamto	Kai Kuz Purwa.
34.	Bakht Beland s/o Malik Hakeem Khan	Ex-U/C Nazim Seo.
35.	Abdul Malik s/o Moulvie Ghulam Essa.	Seri Gayal.
36.	Syed Rshid s/o Said Faqeer	Seri Gayal.
37.	Moulvi Bahadar Shah s/o Moulvie Jandar.	Thoti.
38.	Malak Samdar s/o Haji Aftab.	Kandia.
39.	Haji Afrin s/o Abdul Shakoor.	Thoti.
40.	Mir Hazar s/o Jafar	Kot Gal
41.	Haji Bara Khan	Kandia.
42.	Moulvi Abdul Waris.	Kandia.

The following notables have political influence in the tehsils.

i. Malik Syed Ameer of Dassu.
ii. Malik Noor Wali Shah of Dassu.
iii. Malik Siraj of Seo.
iv. Malik Manwar Shah of Jalkot.
v. Malik Haider of Kandia.
vi. Malik Rahim Din Kandia.
vii. Ghulam Said Ex-U/C Nazim.

Assistant Coordination Officer
Kohistan.

Annex – 12.3

EXECUTIVE COMMITTEE OF AFFECTEES OF DASU

No.	Name	No.	Name
1	Haji Umar Khan Seo	15	Maulvoi Abdul Hakeem
2	Malik Mukhtar	16	Maulvi Iqbal Shah
3	Malik Qadam Khan	17	Raheem Ullah
4	Malik Umar Khan	18	Filqoos Khan
5	Gulab Khan	19	Haji Ghulam Saed
6	Haji Fazal-ur-Rehman	20	Qadir Khan
7	Muhammad Raheem	21	Malik Manan shah
8	Gul Mar Khan	22	Saed Jameel
9	Aman Ullah	23	Maulvi Shamsher Ali
10	Haji Sammundar	24	Adbul Jabbar Khan
11	Haji Afreen	25	Halal Khan
12	Mir Hazaar Bajarani	26	Bajal Khan
13	Bakhaa Malik	27	Saoon Mian
14	Umar Khan Kot Gal	The names in Urdu are attached below	

List of Committee Members in Urdu

	حاجی عمر خان سمو	03135583388	[illegible]
2	ملک سر مختیار		[illegible]
3	ملک قدم خان (Ex-MPA)		[illegible]
4	ملک عمر خان (Ex-MPA)		[illegible]
5	گلاب خان	03459581110	[illegible]
6	حاجی فضل الرحمان		فضل الرحمان
7	محمد رحیم	03005644703	M. Rahim
8	گل مرخان		[illegible]
9	امان اللہ		امان اللہ
10	حاجی سندر		حاجی سندر
11	حاجی افرین		آفرین
12	میر ہزار بجارانی		[illegible]
13	بخار ملک		Bakht
14	عمر خان کوٹ گل		[illegible]
15	مولوی عبدالحکیم		مولوی عبدالحکیم
16	مولوی اقبال شاہ		مولوی اقبال شاہ
17	رحیم اللہ		Rahim
18	فلقوس خان		[illegible]
19	حاجی غلام سید		غلام سید
20	قادر خان		قادر خان
21	ملک منان شاہ		[illegible]
22	سعید جمیل		سعید جمیل
23	مولوی شمشیر علی		مولوی شمشیر
24	عبدالجبار خان	0302-5637202	[illegible]
25	ہلال خان		Helalkhan
26	بجل خان		بجل خان
27	سون میاں		سون میاں

Annex – 12.4

PARTICIPANTS OF JIRGA IN MARCH 2012 AND IN SEPTEMBER 2012

List of Participants of Jirga (2nd March)

Officials and Consultants at Jirga held on 2nd March 2012

Sr. No.	Name	Designation	Department / Organization
1.	Qazi Abdul Rahman	ACO	District Management
2.	Haji Muhammad Farooq	PD	WAPDA
3.	Muhammad Akram	Xen	WAPDA
4.	Dr. Sultan	Chief Environment Expert	DHC
5.	Shahid Goheer	Social and Resettlement Expert	DHC
6.	Zafar Ch.	Environment Expert	DHC
7.	Dr. Ramzan Ch.	Resettlement Expert	DHC
8.	Anwar Fazal Ahmad	Sociologist	DHC
9.	Muhammad Noman	GIS Expert	DHC

List of Participants at Jirga held on 2nd March 2012

Sr. No.	Name	Village	Sr. No.	Name	Village
1.	Ashraf Ali	Seo	2.	Kaftan	Kaigah
3.	Ahmad Khan	Doga Largani	4.	Fazal	Kaigah
5.	Soan Mian	Barseen	6.	Gul Meer Khan	Gial Sari
7.	Fazal ul Rahman	Doga	8.	Ismail	Dasu
9.	Bilal Khan	Doga Largani	10.	Abdullah Khan	Jal Kot
11.	Amiz Khan	Logro	12.	Muhammad Hassan	Jal Kot
13.	Gul Mian	Uchar Nallah	14.	Ghulam Said	Dasu
15.	Noor Wali	Uchar Nallah	16.	Abdul Sallam	Chochang
17.	Rat Mian	Doga Largani	18.	M. Umar Hanif	Dasu
19.	Shair Zada	Doga Largani	20.	Abdul Rahman	Lotar
21.	Ghulam Haider	Doga Largani	22.	Ahsam u Deen	Barseen
23.	Gahan Zaib	Seo	24.	Umat Rasool	Dogah
25.	Zaid Muhammad	Seo	26.	Muhammad Nabi	Mliar Dogah
27.	Rahmat Wali	Logro	28.	Ghulab Shah	Dasu
29.	Zahoor ul Haq	Uchar Nallah	30.	Afsar Khan	Khoshi
31.	Fazal ul Allah	Dasu	32.	Gahangeer	Logro
33.	Narang Shah	Logro	34.	Gulab Khan	Bar Parwa Dogah
35.	Wali Ullah	Dasu	36.	Khanger	Logro
37.	Shair Zaman	Logro	38.	Mer Hazar Khan	Kot gul
39.	Muhammad Zahir Shah	Logro	40.	Mer Subhan	Kot gul
41.	Abdul Qadir	Dasu	42.	Saider Khan	Looter

Sr. No.	Name	Village	Sr. No.	Name	Village
43.	Shahzada	Dasu	44.	Zar Bayan	Looter
45.	Abdul Aziz	Dasu	46.	Gul Akbar	Looter
47.	Gul Phurr	Lotar	48.	Iskander	Looter
49.	Abdul Raoof	Lotar	50.	Waliyat	Pani Bah
51.	Sheran	Lotar	52.	Mir Subhan	Pani Bah
53.	Gul Mian	Lotar	54.	Niaz Khan	Khushi Lugro
55.	Dadan Khan	Lotar	56.	Sabr Khan	Khushi Lugro
57.	Sultan	Lotar	58.	Sher Ghazi	Khushi
59.	Abdul Sitar	Kaigah	60.	Umer Yaar	Khushi
61.	Mohammad Anwar	Pani Bah	62.	Afsar Khan	Khushi
63.	Sher Mohammad	Looter Nullah	64.	Miskeen	Khushi
65.	Malik Umer Khan	Seo	66.	Mansoor	Khushi
67.	Maulvi Bahadur Shah	Seo	68.	Abdurehman	Khushi
69.	Sar baz	Seo	70.	Kareem Khan	Khushi
71.	Shahjahan	Seo	72.	Sher Rehman	Seo
73.	Manzil Shah	Seo	74.	Khursheed	Khushi
75.	Summer Khan	Khushi	76.	Mumtaz Khan	Khushi
77.	Hukam Khan	Looter	78.	Malik Sakhee	Dasu
79.	Haq Sher	Looter	80.	Lal Mian	Choochang
81.	Mohammad Jaan	Seo	82.	Bahadur Khan	GAyal Ser
83.	Fazal-e-Haq	Jalkot	84.	Mohammad Iqbal Shah	Kai gah segal
85.	M. Raheem	Gayal Ser	86.	Fazul Rehman	Dogah
87.	Mohammad Wali	Gayal Ser	88.	Ser Khan	Looter Nullah
89.	Sayed Rasheed	Gayal Ser	90.	Bajal Khan	Pani Bah
91.	Maulvi M. Nazir	Dogah	92.	Ahmad shah	Choochang
93.	Taj ud din	Gayal Ser	94.	Sher Dad	Seo
95.	Abdul Qadoos	Gayal Ser	96.	Ashraf Ali	Seo
97.	Anar Khan	Pattan	98.	Abdul Waqeel	Dogah Seo
99.	Malik Falqoos	Kaigah	100.	Noor ul Haq	Kot Gul Kandia
101.	Fazal e Raheem	Kaigah	102.	Zakir Shah	Kaigah
103.	Sagheer Khan	Lugro	104.	Jameel Khan	Kaigah
105.	Sabr	Pani Bah	106.	Abdur Razaaq	Looter

List of Participants of Jirga (27th September)

Officials and Consultants at Jirga held on 27th September 2012

Sr. No.	Name	Designation	Department / Organization
1.	Haji Muhammad Farooq	Project Director	WAPDA
2.	Muhammad Akram	Xen	WAPDA
3.	Abdul Rauf	MFO	DHC
4.	Anwar Fazal Ahmad	Sr. Sociologist	DHC
5.	Rana Saleem	Resettlement Expert	DHC

List of Participants at Jirga held on 27th September 2012

Sr. No.	Name	Village	Sr. No.	Name	Village
1.	Malik Mukhtiar	Siglo	2.	Malik Samundar	Kandian
3.	Malik Qadam khan	Dogah	4.	Abdul Wadood	Kandian
5.	Malik Umer Khan	Siglo	6.	Haji Bakha	Kandian
7.	Gulab Khan	Melar	8.	Molvi Meer Hazar	Kandian
9.	Haji Abdullah	Dogah	10.	Molvi Haris	Kandian
11.	Bakht Buland	Seo	12.	Molvi Hiqmat Shah	Kandian
13.	Shah Jahan	Siglo	14.	Alam Zaib	Kandian
15.	Aqal khan	Jalkot	16.	Abdul Wadh	Kandian
17.	Hazarat Noman	Jalkot	18.	Fazal Ur Rahman	Kandian
19.	Abdul Jabar	Jalkot	20.	Malik Haider	Kandian
21.	Muhammad Iqbal	Kandian	22.	Malik Umer Khan	Siglo
23.	Mehboob Khan	Kandian	24.	Muhammad Shah	Seo
25.	Shahzada	Seo	26.	Muhammad Raheem	Gayal
27.	Haji M. Ashraf	Siglo	28.	Rakhyal	Seo
29.	Umer Khan	Siglo	30.	Raja	Kandian
31.	Karim Dad	Kandian	32.	Molvi Noor Nabi	Jalkot
33.	Raja	Kandian	34.	Malik Falqoos	Kaigah
35.	Wali dad	Seo	36.	Hibab Shah	Jalkot
37.	Khan Bahadur	Seo	38.	Molvi Shamshair Shah	Jalkot
39.	Abdul Rahman	Seo	40.	Gul Mian	Jalkot
41.	Muhammad Hussain		42.	Saeed Jameel	Jalkot
43.	Abdul Salam		44.	Molvi Abdul Haleem	
45.	Isham u Deen		46.	Muhammad Ali	
47.	Abdul Waqeel		48.	Abdul Jabar Khan	
49.	Hanan Shah		50.	Soan Mian	
51.	Abdullah Khan		52.	Molvi Iqbal Shah	Gul e Bagh
53.	Bakht Khan		54.	Abdul Sitar	Barseen
55.	Muhammad Ayub		56.	Hilal Khan	Jalkot
57.	Hazrat Ali		58.	Zia Ul Haq	
59.	Ghulam Saeed		60.	Ghulam Saeed	
61.	Mahboob	Thuti	62.	Saif Ur Rahman	Kandian
63.	Liaqat	Jalkot	64.	Zahoor	Uchar Nallah
65.	Fazal ur Rahman	Jalkot	66.	Orangzaib	Tangeer
67.	Iqbal	Thuti	68.	Taj Muhammad	Tangeer

Annex – 12.5

ATTENDANCE LIST OF PESHAWAR

Registration and attendance

Location: PC Hotel, Peshawar
Date: September 10, 2012

Sr. No.	Name	Designation and Organization	Phone No.	Email
1	Engg. Zia-ur-Rehman	Jr. Engineer, Saalik Foundation	0332 5024235	salik.zrehman@gmail.com
2	Junaid Akhtar	S.D.F, Saalik Foundation Engg	0346 9365394	salik.junaid@gmail.com
3	Arshad pervaiz	Director - Civil GM North (WAPDA)	0333 9404001	
4	Murad ali shah	C.R.G. Caravan (NGO)	0345 9053719	
5	Zahid akhtar	Director Energy & Power Dept., Government of KP	0333 9141644	murada_151@hotmail.com
6	Dr. Idrees Masud	Chief Energy & Power Dept., Government of KP	03005897356	idreesmasood@yahoo.com
7	Abdul Qayyum	DD, DHP, WAPDA	03224010564	aqwbads@yahoo.com
8	Tabassum Khurshid	DD, DHP, WAPDA	0300 4116568	tabassumkh@yahoo.com
9	Hasnain Afzal	GM Hydro Planning, WAPDA, Lahore	0300 8411244	hasnainafzal@hotmail.com
10	Haji Muhammad Farooq	PD, DHP, WAPDA, Lahore	0300 4305595	
11	Dr. Amjad	DD - EIA, Environmental Protection Agency, Government of KP	9210148	
12	Muhammad Niaz	Deputy Conservator of Wildlife, Govt of KP.	03005926652	Niazkhanro@yahoo.com
13	Usman Yaqoob	Additional Secretary P&D (Energy & Power), Govt. of KP		
14	Dr. M. Bashir	DG EPA, Govt. of KP	9210263	drmb63@yahoo.com
15	Mr. Attia Dastgir	D.D, WEC, WAPDA, Lahore	042 99202429	dgwec@gmail.com
16	Mr. Ishtiaq Ahmad Kokab	Director, WEC, WAPDA, Lahore	042 99202429	
17	Dr. Roohullah Jan	DD, Health Department, Govt. of KP	091 9213120	
18	Muhammad Tariq	DD, SHYDO, Govt of KP		
19	Dr. Rehmatullah Qureshi	DHC/Arid Agriculture University, Rawalpindi	0300 6730496	rahmatullahq@yahoo.com
20	Dr. Sajid nadeem	DHC/ Arid Agriculture University, Rawalpindi	03008539455	sajidnm@uaav.edu.pk
21	Venkata Nukala	Environmental Specialist, DHC, Lahore	0345 8454861	venkata@eng-consult.com
22	Zafar Iqbal Ch.	DTL – Environment Specialist, DHC, Lahore	0300 9460132	zic42@msn.com
23	Prof (R) Tahir Omer	Aquatic Ecologist, DHC, Lahore	0321 4077053	talhaomer167@gmail.com

Sr. No.	Name	Designation and Organization	Phone No.	Email
24	Mudassar Hassan	Junior Environmentalist, DHC, Lahore	0333 9949488	enggmudassar@gmail.com
25	Irshad Ahmad Soomro	PCR Specialist, DHC, Lahore	0333 4366988	princesoomro1@yahoo.com
26	M Kamran	Office Manager, DHC, Lahore	0301 8434466	
27	Dr. Inayat Ali Shah	Professor, Univ. of Peshawar	9216754	driashahjeham@yahoo.com
28	Maqsood Ahmad	DD Civil GM Project (North), WAPDA, Peshawar		
29	Sajad Ahmad Khan	Director (Coordination), GM Planning North, WAPDA, Peshawar		
30	Qasir Jang khan	SE Civil WAPDA, Mardan		
31	Mohsin Ali Khan	DD(Civil) to GM (P) North Peshawar		
32	Zaigham Hasan	Asst. Prof. Dept. of Zoology Univ. Peshawar	0333 9387787	zaighamhasam68@yahoo.com
33	Sultan Rome	Executive Engineer. T&M Dir. WAPDA, Peshawar	0346 9317874	
34	M Tariq	SNO T&M WAPDA Peshawar	0344 9599044	
35	Habib ulluh Bangash	Addl. S.E WAPDA, Peshawar	0333 9278863	
36	Col (R) Ayaz Khan	Chief Security officer, Peshawar	0344 9084585	
37	Mohd. Youns Khan	Deputy Chief Conservator Forest, Govt. of KP, Peshawar	0314 7575108	
38	Naveed Iqbal	DD, Head Quarters, Pakhtoonkhwa Highway Authority, Peshawar	0332 9471021	
39	Dr. Shah Khan	Director, Dept. of Archeology, Govt. of KP, Peshawar	0343 9069317	
40	Fawad Khalil	Assistant Director, Dept of Fisheries, Govt. of KP, Peshwar	0345 9036623	
41	Idrees Khattak	Personal Secretory MD SHYDO, Govt. of KP, Peshawar.		

DASU HYDROPOWER PROJECT

Stakeholders Consultations Workshop on Environmental Assessment

Registration and Attendance

Location: PC Hotel, Peshawar
Date: September 10, 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
01	Engg. Zia ul- Rehman	Jr. Engg SAALIK Foundation	0332-5024123	salik.zrehman@gmail.com	
02	Junaid Akhtar	S.D.F SAALIK Foundation Engineer	0346-9365384	Salik.Junaid@gmail.com	
03	Arshad Perwaiz	Director Civil GM North (WAPDA) office	0333-9404001	-	
04	Murad Ali Shah	C.R.G Caravan (NGO)	0345-9053719	muradA_151@hotmail.Com	
05	Zahid Akhtar	Director. Energy & Power Deptt.	0333-9141644	Zasabki@hotmail.Com	
06	Dr. Idrees Masud	Chief Energy & Power P&D Deptt.	0300-5897356	Idreesmasood@Yahoo.Com	
07	Abdul Qayyum	DD WAPDA	03224010564	aqabad1@yahoo.com	

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
8	Tabassum Khurshid Ahmad	DD WAPDA	0300-4116568	tabassumkh@yahoo.com	[illegible]
9	Hasnain Afzal	GM Hydro	0300 8411244	hasnainafzal@hotmail.com	Hasnain
10	Haji Muhammad Farooq	PD Dasu Project	0300-4305595		[illegible]
11	Dr. Amjad	DD, EIA, EPA	9210148	—	[illegible]
12	Muhammad Niaz	Deputy Conservator wildlife	0300 5926652	niazkhan80@yahoo.com	[illegible]
13	Usman Yaqoob	A.Secretary P&D (Energy & Power)	-	—	[illegible]
14	Dr. M. Bashir	DG EPA	9210263	drmb63@yahoo.com	[illegible]
15	Mr. Attia Dastgir	D.D WEC WAPDA	042 99202429	dgwec@gmail.com	[illegible]
16	Mr. Istiaq Ahmad Kokab	Director - WEC WAPDA	042 99202429	"	[illegible]
17	Dr. Roohullah Jan	Health department	091 9213120	—	[illegible]

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
18	Muhammad Tariq	SHYDO			
19	Dr. Rehmatullah Qureshi	DHC/Arid Agri. University	0300-6730496	rahmatullahq@yahoo.com	
20	Dr. Sajid Nadeem	DHC/Arid Agri. University	03008539415	sajidnm@uaar.edu.pk	
21	Dr. Venkata Nukala	Environment Specialist DHC		Venkata@egs-consult.com	
22	Zafar Iqbal Ch	Environment Specialist DHC	0300-9460132	zic42@msn.com	
23	Prof Tahir Omer	Aquatic Ecologist DHC	0321-4077053	talhaomer@yahoo.com	
24	Mudassar Hassan	Environment Specialist DHC	0333-8949488	engrmudassar@gmail.com	Mudassar Hassan
25	Irshad Ahmad Soomroo	Archaelogist DHC			
26	M. Kamran	Office Manager DHC	0300-8434466		
27	DR. Inayat Ali Shah	Professor.	9216754	Driashahjehan@yahoo.com.	

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
28	Maqsood Ahmed	DD Civil GM Project (North).			
29	Sajjad Ahmed Khan	Dir(Coord) ✓ O/o GMP North Pesh			
30	Qaisir Jang Khan	SE Civil wapda Mardan	✓		
31	Mohsin Ali Khan Dy. Dir (Civil) wapda pesh	Dy. Dir (Civil) O/o GM(P) North Pesh.	✓	✓	
32	Zaigham Hasan	Asst. Prof. Dept. of Zoology Univ. of Pesh.	0333-9387 787	Zaighamhasan68 @yahoo.com	
33	SULTAN ROME	Xen T&M Div. wapda, Pesh.	0346-9317874		
34	M. Tariq	SDO T&M wapda Pesh	0344 8593 044		
35	Habibullah Bangash	Addl. S.E WAPDA	0332-9278863	—	
36	Col. Wali Ayaz Khan	Chief Security Officer wapda	0344-9084585	✓	
37	Mohd Younus Khan	Deputy Chief Conservator of Forests KP Pesh.	0314-7575108	-	10/9/12

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
38	Naveed Iqbal	D.D (W/O) PKHA	0332-9471021		
39	Dr Shah N Khan	Director Arch	03439069317	Shahnagar Yad	
40	Fawad Khalil	behalf of Director Fisheries Assistant Director	03369303637	fawad_wp@yahoo	
41	IDrees Khattak	Personal Secretary MD Shydo.	03459036623		

Annex – 12.6

ATTENDANCE LIST OF LAHORE

Registration and Attendance

Location: PC Hotel, Lahore
Date: September 17, 2012

Sr. No.	Name	Designation and Organization	Phone #	Email
1.	Muhammad Shabbir	Director Hydro Planning WAPDA	0300 8191948	Shabbierkmboh@hotmail.com
2.	Nazakat Hussain	Dy. Director Hydroplaning	0344 9507180	Nazakat5@yahoo.com
3.	Mujahid Tanveer Ahmad	Dy. Director Civil	0300 8866470	Tmujahid01@hotmail.com
4.	Muzammil Hashmat	Dy. Director civil, Hydroplaning	0300 3557693	Muzammil_hashmat@yahoo.com
5.	Abdul Qayyum	Dy. Director WEC. WAPDA	0322 4010564	aqusbadh@yahoo.com
6.	Tabbasum khurshid Ahmad	Dy. director WAPDA		
7.	Prof (R) Tahir Omer	Aquatic Ecologist	0321 4077053	talhaomer167@gmail.com
8.	Muhammad Azam	Dy. Director DHPP WAPDA	0333 6102315	
9.	Haji Muhammad Farooq	PD DHPP	0300 4305595	
10.	Mudassar Hassan	Junior Environmentalist	0333 9949488	enggmudassar@gmail.com
11.	Awais Hassan	Junior Sociologist	0333 6563675	awais_sblc@yahoo.com
12.	Dr. William George	Fisheries Expert	0345 4071422	williamgeorge@fccollege.edu.pk
13.	Irshad Ahmad Soomro	PCR Specialist	0333 4366988	princesoomro1@yahoo.com
14.	M Talha Javaid	AD ENU. WAPDA	0313 4414416	Siddiqw.tj@gmail.com
15.	M Abaid Sheikh	HEPO WAPDA	0333 4309767	
16.	Hafiz M Mukhtar	HEPO WAPDA	0323 4810449	Muk797@yahoo.com
17.	Sheraz khalid	Dy. Director HIPO, WAPDA	0321 6318492	Sheraz_engr@hotmail.com
18.	Dr. M. Tusif Bhutti	Assistant Prof.	0321 4327978	Tousifbhatti@yahoo.com
19.	M Shahid Amin	Assit. Dir. WLECT, DHPP	0333 4144711	shahidaminsahi@gmail.com
20.	Hasnain Afzal	GM Hydro planning		
21.	Iijma Motohico, PM	Project Manager	0304 4569583	dhp@dasu-dhc.com
22.	Dr. M. Zaman	Social & Environment Team Leader	03064081056	drmzaman@yahoo.com
23.	Zafar Iqbal Ch.	DTL Environment	0300 9460132	zic42@msn.com
24.	Dr. Ghulam Haider	M Partner DMC	0333 4211575	
25.	Sunil Goonetilleke	Resettlement Specialist	0345 8454863	Preethi_goonetilleke@yahoo.com
26.	Malcolm Winsby	Aquatic Ecologist	0305 4589718	mwinsby@gmail.com
27.	Venkata Nukala	Environmentalist Specialist	0345 8454861	venkata@eng-consult.com
28.	Mrs. Farida Javaid	PEC	0333 5134069	Engr.faridajavid@gmail.com
29.	Adil Hassan	AD WAPDA	0345 4022161	9022161@gmail.com
30.	Shah Mulk	Director WAPDA	0301 4798039	
31.	M Anwar	WAPDA	0321 4178803	

Sr. No.	Name	Designation and Organization	Phone #	Email
32.	M Mughees Arif	AD WAPDA	0334 4691464	mugheesarif@yahoo.com
33.	Ahmad Faisal	AD WAPDA	0300 4235240	ahmadfaysal@gmai.com
34.	Zia-ul-Hassan, DPM	Deputy Project Manager	0333 4691464	dhp@dasu-dhc.com
35.	Abdul Wahab	HEPO	0333 4135251	
36.	Hassan Hashim	WAPDA	0300 6345815	
37.	M Zeeshan	WAPDA	0300 8010702	
38.	Syed Ijaz Hassan	DD Elee. WAPDA	0313 4354912	
39.	Zai-ur-Rehman	WAPDA	0321 4612199	
40.	Waqas Mukhtar	AD WAPDA	0321 8846942	
41.	Faheem Shahzad	WAPDA	0300 7722787	
42.	Azhar	WAPDA	0333 4716606	
43.	Aqeel Ahmad Bashir	WAPDA	0344 5560461	
44.	Saleem Munawar	AD WAPDA	0345 4791104	
45.	Syed Ahmed Masood	ADE WAPDA	0300 8814217	
46.	Faisal Shahid	ADE (ELECT) WAPDA	0345 8737370	
47.	M Junaid Ghauri	ADE (Civil) WAPDA	0331 4561982	
48.	Falah-ud-Din	Director WAPDA	0300 5255467	
49.	Ch. M. Munir	Managing Partner DMC	0333 4210932	
50.	Dr. Farzawd	HOD Archaeology PLI	0321 4535383	
51.	Akbar Ali	LAER WAPDA	0321 4562745	
52.	Ishteqaq Ahmad Kaukab	Director (WEB)	0301 5710104	
53.	Mr. Attia Dastgir	Ass. Dy. dir. (WETC)	042 99202429	
54.	Ahmad Ameen	JE (Civil)	042 99202429	
55.	Dr. Mubrik Ali	CE, PARB	0322 4490772	
56.	Dr. Arifa Lodhi	GM. SUPARCO	0300 9273555	Arifa_lodhi@yahoo.com
57.	Danyal Hashmi	WAPDA	0300 4344584	
58.	Riaz-ud-Din	Director Hydro Planning	042 99202727	
59.	Sajjad Hussain	Dy. Director (Geo) Hydro Planning	-Do-	Sajjad.balghri@gmail.com
60.	Imran Ali	Jr Geologist	-Do-	
61.	M Nauman Nazir	Jr Geologist	-Do-	
62.	Ijaz Ahmad Khan	Director NDC	0300 8473540	
63.	Ijaz Ahmad Ijaz	Hydro Planning WAPDA	0300 4219844	
64.	Ejaz Ahmad Khan	Dy. Director (GEOL) Hydro Planning WAPDA	0300 4347529	
65.	Naseer Ahmad	Jr. Geologist Hydro Planning	0333 4310249	
66.	M Khalid Awais	Secretory Energy		
67.	Ihsan Qadir	AD WAPDA	0300 4448416	
68.	Aroos Munir	AD WAPDA	0333 4478483	
69.	Munhammad Rafique	Director (Keyal)	0302 3953103	
70.	Ashfaq	Dy. Director WAPDA	0333 4899902	
71.	Dr. Eng. Abdullah yasir	Assistant Prof. SDSC GC University	0300 4293718	
72.	Muhammad Bashir	Chief (W-P)	042 99210365	
73.	Ahsan-ud-Din	Dy. Director Fisheries	0333 4452587	
74.	Fatima Taseer	ADF Asst. Design ENG	0331 8441207	
75.	Rabia Farooq	WAPDA		
76.	Khalid Abu-Bakar	Dy. Director Behalf of GM(C&M) WAPDA	0323 4603167	
77.	Maseem Zehra	Chief Executive Aurat Foundation	0300 4815122	
78.	Dr. Raheel	GM (LAOR)	03007807070	

Sr. No.	Name	Designation and Organization	Phone #	Email
79.	Dr. Ali Hussan	Assist. Livestock specialist	0322 2066029	
80.	Maqsood H Bungish	Social Specialist	0346 9051018	
81.	Farhana Mazhar	WAPDA Gender Sp.	0303 4377776	
82.	Raheel Mustafa	WAPDA Asst. Agronomist	0300 5315110	
83.	Ahsan Ali	WAPDA Asst. M&E Specialist	0321 9621432	
84.	Harris Basharat	Asst. Community Development Specialist	0321 8426969	
85.	Azam Saeed	WAPDA Chief Arch. DHC	0324 6110273	
86.	Sohail Ali Naqvi	Coordinator WWF	0301 6056514	
87.	Dr. Khalid Mehmood	Assistant Prof. Veterinary University	0300 4664375	
88.	Maqsood Ahmad	DG EPA		

Registration and Attendance (Scanned)

DASU HYDROPOWER PROJECT

Stakeholders Consultations Workshop on Environmental Assessment

Registration and Attendance

Location: PC Hotel, Lahore
Date: September 17, 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
01	Muhammad Shabbir	Director Hydro Planning (WAPDA)	0300-8191948	Shabbir_kmboh@hotmail.com	
02	Nazakat Hussain	Dy. Director Hydro Planning	0344-950 7180	nazakat5@yahoo.com	
03	MUJAHID TANVEER AHMAD	DY. Director (CIVIL)	0300-8866470	tmujahid01@hotmail.com	
04	MUZAMMIL HASHMAT	DEPUTY DIRECTOR (CIVIL), HYDROPLANNING WAPDA	0300-3557693	muzammil_hashmat@yahoo.com	
05	Abdul Qayyum	Dy. Director WEC, WAPDA	0322-4010564	aqwbndh@yahoo.com	
06	Tabbasum Khurshid Ahmad	Dy. Director WAPDA	0300-4116568	tabassumkh@yahoo.com	
07	Tahir Omer	DHC	0321-4077053	tahiromer@yahoo.com	

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
08	Muhammad Azam	Dy. Dir. Dasu HPP WAPDA	03336102315		[signature]
09	Haji Muhammad Farooq	PD. DHP	0300-4305595		[signature]
10	MUDASSAR HASSAN	DHC	0333-9949488	enggmudassar@gmail.com	Mudassar Hassan
11	Awais Hassan Khan	DHC	0333 6563675	awais.sblc@gmail.com	[signature]
12	Prof. Dr. William Geechye	Fisheries Expert DHC			[signature]
13	Arshad Ahmad Soomroo	Archaeologist DHC	0333-4366988		[signature]
14	M. Talha Javaid	AD Env. WAPDA	0313-4414416	siddiqui.tj@gmail.com	[signature]
15	M. Abid Sheikh	HEPO WAPDA	0333-4309767	mabidsheikh@gmail.com	[signature]
16	Hafiz M. Mukhtar	HEPO WAPDA	0323-4810449	muk797@yahoo.com	[signature]
17	Sheraz Khalid	Dy. Director, HPO WAPDA	0321-6318492	sheraz_engr@hotmail.com	[signature]

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
18	Dr Muhammad Tousif Bhatti	Assistant Prof.	0321-4327978	tousifbhatti@yahoo.com	
19	M. SHAHID AMIN	Ass't. Dir. ELECT. DASU HPP Wapda	0333-4144711	shahidaminsahi@gmail	
20	Hasnain Afzal	GM Hydro Planning			
21	Motohiko IIJIMA	PM. DHP			
22	DR. M. Zaman	Team Leader Env/Social DHC		mqzaman.hc@gmail.com	
23	Zafar Iqbal Ch	Environment Specialist DHP	0300-9460132	zic42@msn.com	
24	DR. Ghulam Haider	M. Partner DMC	0333-4211575	?	
25	Sunil Gunnetilleke	Resettlement Specialist	0305-4608342		
26	Malcolm Winsby	Aquatic Ecology Expert DHP			
27	Dr. Venkata Nukala	Env. Specialist			

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
28	Mrs. Farida Javaid	PEC	0333-5134069	Engr.faridajaved@gmail.com	[signature]
29	Adil Hassan	AD WAPDA	0345-4022161	4022161@gmail.com	[signature]
30	Shah Mulk	Director WAPDA	0301-4798039		[signature]
31	M. Anwar	WAPDA	0321-4171803		[signature]
32	M. Mughees Arif	AD WAPDA	0334-4029506	mugheesarif@yahoo.com	[signature]
33	Ahmad Faisal	AD WAPDA	0300-4235240	ahmadfaysal@gmail.com	[signature]
34	Zia-ul Hassan	DPM DHP	0333-4691464		[signature]
35	Abdul Wahab	HEPO	0333-4135251		[signature]
36	Hassan Hashmi	WAPDA	0300-6345815		[signature]
37	M. Zeeshan	WAPDA	0300-8010702		[signature]

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
38	Syed Ijaz Hussain	DD Elec WAPDA	0313-4354912		[signature]
39	Zia-ur-Rehman	WAPDA	0301 4612199		[signature]
40	Waqas Mukhtar	AD WAPDA	0321-8846942		[signature]
41	Faheem Shahzad	WAPDA	0300 7722787		[signature]
42	Ashar Mirza	WAPDA	0333 4716606	@hotmail	[signature]
43	Aqeel Ahmad Bashir	WAPDA	0344-5560461		[signature]
44	Saleem Munawar	A.D wapda	0345-4791109		[signature]
45	Syed Ahmed Masood	ADE (Mech) WAPDA	0300-8814217		[signature]
46	Faisal Shahid	ADE (Elect). WAPDA	0345-8737370		[signature]
47	M. Junaid Ghauri	ADE (Civil) WAPDA	0331-4561982		[signature]

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
48	Falah ud-Din	Director WAPDA	0300 5255467		
49	Ch. M. Munir	Managing Partner DMC	0333-4210932		
50	Dr Farzand	HOD Archaeology PU	0321-4535383		
51	Akbar Ali	C&R WAPDA	0321-4562745		
52	ISHTERAQ AHMAD KAUKAB	DIRECTOR(WEC)	0301-571010		
53	Mr. ATTIA DASTGIR	Add. Dy. Dir (WEC)	042-99202429		
54	Ahmad Ameen	JE (Civil)	042-99202429		
55	Dr. Mubarik Ali	CP, PARB	03224490772		
56	Dr. Arifa Lodhi	GM. SUPARCO	03009273535	arifa_lodhi@yahoo.com	
57	Danyal Hashmi	WAPDA	03004344584		

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
58	Riaz ud-Din	Director Hydro Planning	042-992027 27		
59	Sajjad Hussain	Dy. Director (Geo) Hydro Planning	do—	Sajjad.balghari @gmail.com	
60	Imran Ali	Sr. Geologist	do		
61	M. Nauman Najm	"	"		
62	IJAZ AHMAD KHAN	Director NDC	0300 8473574		
63	Ijaz Ahmad Naz	Hydro Planning WAPDA	0300-4219844		
64	Ejaz Ahmad Khan Dy. Dir (Geol)	Hydroplanning WAPDA	0300-434-7529		
65	Naseer Ahmad	Jr. Geologist Hydroplanning	0333-4310248		
66	M. Khalid Awais Ranjha	Secretary Energy			
67	Ihsan Qadir	AD WAPDA	0300-4448416		

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
68	Aroos Munir	AD EPA	0333-4478483		[signature]
69	Muhammad Rafiq	Director (Keyal)	0302-3953103		[signature]
70	Ashfaq Sohail	(WAPDA) Dy: Director	03334899902		[signature]
71	Dr. Eng. Abdullah Yasar	Assistant Prof SDSC GC University	03004293718		[signature]
72	Muhammad Bashir	Chief (W-P) P-D Deptt	03249421085		[signature]
73	Ahsan ud-Din	Dy. Director Fisheries	0333-4452587		[signature]
74	Fatima Taseer	ADF. Asst. Design Engr	0331-8441201		[signature]
75	Rabia Farooq	WAPDA			[signature]
76	Khalid Abu Bakar Dy. Dir	On behalf of GM (C&M) WAPDA	0323-4603167		[signature]
77	Naseem Zehra	Chief Executive Aurat Foundation	03004815122		[signature]

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
78	DR Rahid -	GM-(LAOR)	0300 7602070	jmkrp@gmail.com	
79	Dr Ali Hassan Gad	Assist. livestock Specialist GEAEC	0322-20 66029	alihassangad@yahoo.com	
80	Mazhar H. Bangash	Social Dev. Specialist	0346 9057018	jalquars@yahoo.com	
81	Farhan Mazhar	WAPDA Geneleo SP	0303 4377776	farhanmazhar@gmail.com	
82	Raheel Mustafa	WAPDA Asstt: Agronomist	0300-5315114	rmustafa2003@yahoo.com	
83	Ahsan Ali	WAPDA Asst. M&E Specialist	0321-9621432	ahsan101@yahoo.com	
84	Harris Basharat	Asst Community Development Specialist	0321-8426969	harrisbasharat@gmail.com	
85	AZM SAEED	WAPDA. Chief Eng. DHC	0324-6110273		
86	SOHAIL ALI NAQVI	Coordinator, WWF	0301-6056514	engr_naqvi534@yahoo.com	
87	Dr. Khalid Mehmood	Assistant Professor veterinary university	0300-4664375	raeiankhalid@gmail.com	

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
88	Maqbood Ahmad	DG EPA			

Annex – 12.7

ATTENDANCE LIST OF KARACHI

Registration and Attendance

Location: Avari Towers, Karachi
Date: September 24, 2012

Sr. No.	Name	Designation and Organization	Phone No.	Email
1.	Haji Muhammad Farooq	PD, Dasu HPP WAPDA		
2.	Tabbassum Khurshid Ahmad	DD, Dasu HPP WAPDA	03004116568	tabassumkh@yahoo.com
3.	Abdul Qayyum	DD, Environment Dasu HPP, WAPDA	03224310564	aqwbadb@yahoo.com
4.	Dr. Venkata Nukala	Consultant DHP		Venkata@engconsult.com
5.	Zafar Iqbal Ch.	Consultant DHP		
6.	Irshad Ahmad Soomro	Archaeologist DHP	03334366988	Princesoomro1@yahoo.com
7.	Mudassar Hassan	Consultant DHP	03339949488	enggmudassar@gmail.com
8.	M. Kamran Khan	DHP	03018434466	
9.	Farhana Mazher	Land Acquisition and Resettlement WAPDA		
10.	Ali Hassan	LA&R WAPDA	03222066029	alihassangood@yahoo.com
11.	Dr. Asadullah Kaz.	Chancellor	022-2030177	asadkz@isra.edu.pk
12.	Dr. khan Mohammad	Dir. Mehran University	03003048281	kbrohi@hotmail.com
13.	Akbar Ali Khaliyar	Environment Specialist LA&R Wapda	03214562745	
14.	Dr. Imdad Siddiqui	Prof. University of Sindh	03332622429	siddiqui57@gmail.com
15.	Mrs. Imdad Siddiqui	Prof. University of Sindh	03003033557	
16.	Dr. Atif Mustafa	NED University	99261261 ext 2624	atifm@nednet.eud.pk
17.	Ghulam Abbas	Dy. Secretary Livestock & Fisheries	021-99203393	
18.	Rahat Najam	PCMU, P&D Environment Specialist	021-99205862	rahat@wsip.gov.pk
19.	Dr. Raheel Siddiqui	GM (LA&R) Wapda		
20.	Javed Iqbal	Engg. Review Magazine	0300-2292166	j.iqbal25@yahoo.com
21.	Jawed Akhter	WISP P&D Wapda	0321-3021307	
22.	Haider Saeed	Gal + WAF	03456159967	hildersaeed@gmail.com
23.	Zeeshan Soomro	PTCL Asstt. Manager	03218203020	Zeeshanhsoomro@yahoo.com
24.	Wilson Sabir	PTCL S. Officer	03333237275	wilsonathwai@yahoo.com
25.	Rafi-ud-Din	DG, EPA	021-35065946	
26.	Iqbal Ahmad Soomro	Add. Secretary Socio Welfare Deptt.	0300-8999124	iasumro@yahoo.com
27.	Akhter Hidayat Khan	PD Vinder Dam	03448275877	Akhter.hidayat@yahoo.com
28.	Riazudin	Cure	03413402969	
29.	Abdul Shamin Sheikh	Hydropower	03003587056	
30.	Dr. Fahmida Fardous	Sindh Wild Life Deptt.	03072258925	
31.	Riaz	Engg. Review	03223250717	
32.	Muhammad Afzal	Dy. Secretary Culture	03012196874	Afzal_channa@hotmail.co

Sr. No.	Name	Designation and Organization	Phone No.	Email
		Deptt.		m
33.	Saleem Qureshi	CLRK WAPDA chief engineer		
34.	Ziaul Haq	Dir Protocol Wapda		
35.	Mr. K.M. Brohi	Land Lord		
36.	Mubashir Ahmad	Mehran University	03452790559	
37.	Waseen Ali Bhutto	DM state life	03009226173	waseemalib@aol.com

Registration and Attendance (Scanned)

DASU HYDROPOWER PROJECT
Stakeholders Consultations Workshop on
Environmental Assessment & Cumulative and Induced Impacts

Registration and Attendance

Location: Avari Towers, Karachi
Date: September 24, 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
1	Haji Muhammad Farooq	PD, Dasu HPP WAPDA			
2	Tabbassum Khurshid Ahmad	DD, Dasu HPP WAPDA	03004116568	tabassumkh@yahoo.com	
3	Abdul Qayyum	DD, ~~WEC~~ Environment Dam HPP WAPDA	03224310564	aqwbadl@yahoo.com	
4	Dr Venkata Nukala	Consultant DHP		Venkat@ceg-canada.com	
5	Zafar Iqbal Ch	Consultant DHP			
6	Irshad Ahmad Soomroo	Archaeologist DHP	0333-4366988	Rirwsoomro1@yahoo.com	

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S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
7	MUDASSAR HASSAN	Consultant DHP	0333-9949488	engrmudassar@gmail.com	Mudassar Hassan
8	M. Kamran Khan	DHP	0301-8434466		[illegible]
9	Farhana Mazhar	Land Acquisition and Resettlement Wapda			[illegible]
10	Ali Hassan	Land Acquisition and Resettlement Wapda	0322-2066029	alihassanguad@yahoo	[illegible]
11	Dr. Abdullah Kazi	Chancellor	022-2030177	asadkazi@isra.edu.pk	[illegible]
12.	Dr. KHAN MOHAMMAD	Dir Mehran University	03003048281	kbrohi@hotmail.com	[illegible] 24/9
13.	Ali Sarwar Ali [illegible]	Env. Sp. LA&R Wapda	0321-4562741		[illegible]
14.	Dr. Imdad Siddiqui	Professor University of Sindh	03332622429	siddiqui57@gmail.com	[illegible]
15	Mrs. [illegible] Siddiqui	Prof. Library Sciences University of Sindh	03003032257		[illegible]
16.	Dr. Asif Mustafa	Ned University	99261261 ext 2624	asifm@neduet.edu.pk	[illegible]

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S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
17	Ghulam Abbass	Depy. Secretary. Livestock & Fisheries	021-99203-293	abbas_shaikh@hotmail.com	
18	Rahat Najam	PCMU, P&D. Environmental Specialist	02199205887	rahat@wsip.gov.pk	
19	Dr. Raheel Siddiqui	GM (LA&R) Wapda			
20	Jawed Iqbal	Engg. Review Magazine	0300-2292166	j.iqbal...	
21	Jawed Akhtar	WISP P&D Wapda	0321-3021307		
22	Hilda Saeed	Shirkat Gah + WAF	0345-6159967	hildasaeed@gmail.com	
23	Zeeshan Soomro	PTCL Asst Manager	0321-8203060	ZeeshanHSoomro@yahoo.com.	
24	Wilson. SABIR	PTCL S-officer	0333-3237275	WilsonTHWAI@YAHoo.com	
25	Rafi ud-Din DG, EPA	DG, EPA	021-35065946		
26	Iqbal Ahmed Soomro	Additional Secretary Social Welfare Deptt	0300-8999124	iasoomro@yahoo.com	24/9.

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S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
27	Akhtar Hidayat Khan	P.D. Winder Dam	0344-8275877	Akhter.Hidayat@Yahoo.Com	
28	Riazuddin	Cure Tuber / S/a	03413402969	–	
29	Abdul Shamim Sheikh.	Hydro Power -	0300-3587xx		
30	Dr. Fahmida Firdous.	SINDH WILD LIFE DEPT	0307-2258925		
31	RIAZ	ENGINEERING REVIEW	0322-3250717		ریاض اکبر
32.	MUHAMMAD AFZAL	DEPY. SECRETARY CULTURE DEPTT.	0301-2196874	afzal_channa@hotmail.Com	
33.	Saleem Qureshi	CCRK WAPDA Chief Engineer.			
34.	Ziaul Haq	Dir Protocol Wapda.			
35	Mr. K.M. Brohi	Land Lord			
36	Mubashir Ahmed	Mehran uni Student.	0340-2790xx9		

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Karachi, 24 September 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
37.	Waseem Ali Bhutto.	D.M. State Life	0300 9226173	waseemali5@ aol.com	

Annex – 12.8

ATTENDANCE LIST OF ISLAMABAD

Registration and Attendance

Location: Serena Hotel, Islamabad
Date: October 2, 2012

S.No.	Name	Designation and Organization	Phone No.	Email
1.	Chaouha Zhang	Social Expert World Bank	0301-8502527	czhang7@worldbank.org
2.	Rana Attia Dastgir	Add. Dy. Director WEC	042-35842653	
3.	Ishteqaq A. Kaukab	Director (WEC) WAPDA	0301-5710104	dgwec@gmail.com
4.	Engr. Muhammad Khan	Dy. Director (Tech) EPA, Balochistan	0333-7803543	uthmankhail@yahoo.com
5.	Mazhar Ali Shah	Chairman IRSA	0300-3016620	mzhar107@yahoo.com
6.	M. Ibrahim A. Rind	Retd. Chief Engineer, Irrigation Deptt, Balochistan	0300-3701183	
7.	Dr. Rubina Kausar	Asst. Director (Environment)	9032515	rbnksr@yahoo.com
8.	Dr. Abdul Rahim	Director PSP PMU	9252090	rajpar55@yahoo.com
9.	Muhammad Shaifq Awan	District Officer Rawalpindi Social Welfare	0333-8101665 4474010	sdo.rwp@yahoo.com
10.	M. Omar Khalid	Environment Specialist, World Bank	0333-5170767	mohalid@comsats.net.pk
11.	Abdul Rauf Shaikh	Registrar, Pakistan Engineering Council	0300-9567590	
12.	Engr. Muhammad Sohail	Pakistan Engineering Council	0345-9384064	
13.	Omar Javed	Regional Coordinator, Sungi	0345-8590551	omar.javed@sungi.org
14.	Ahmad Saleem	Consultant	0333-5113391	kasuris@gmail.com
15.	Javaid Afzal	Sr. Environmental Specialist World Bank	051-9090150	
16.	Awais Saleem	P&C Specialist PMPIU / WCAP	051-9244550	awaissaleem74@gmail.com
17.	Dr. Amjad Nabi	PMPIU / WCAP	0300-6441212 051-9244669	nabiamjad@yahoo.com
18.	Dr. Sajid Nadeem	DHC	0300-8539451	sajidnm@uaar.edu.pk
19.	Dr. Rehmat ullah	DHC	0300-6730496	rehmatullah@yahoo.com
20.	Dr. Mazhar Qayyum	Zoology / AAUR	0301-5153788 9290015	mazhardr@yahoo.com
21.	Sarfraz Ahmad	Chief (Water) P&D Division		
22.	Bareerah Fatima	RO Water P&D		
23.	Safia Shafiq	Env. Specialist ADB	0333-2154462	sshaiqsultant@adb.org
24.	Ozaki Yoshihiro	JICA	0334-5131843	ozaki.yoshihiro@jica.go.jp
25.	Imran Ahmed	JICA	0334-5169727	imranahmed.pt@jica.go.jp
26.	Mir. M. Muazzam	Dy. Manager PPIB	0300-4258607	mir872@hotmail.com
27.	Hamid Marwat	Chief Env. P&PD	0300-5248605	marwat67@yahoo.com
28.	Farhana Mazher	Gender Specialist LA&R WAPDA	0302-4375176	farhanmazher@gmail.com

S.No.	Name	Designation and Organization	Phone No.	Email
29.	Dr. M. Bashir Khan	DG EPA KPK	9210263	drmbk63@yahoo.com
30.	Ahsan Ali Shah	Asst. M&E Specialist	0321-9621432	ahsanlarp@gmail.com
31.	Raheel Mustafa	Asst. Agronomist	0300-5315110	rmustafa2003@yahoo.com
32.	Akbar Ali Khaatian	Env. Specialist LA&R WAPDA	0321-4562745	khatyan90@hotmail.com
33.	Muhammad Waseen	Provincial Coordinator Irrigation Balochistan	0333-7808780	waseem.qtes@gmail.com
34.	Fovad Khan	Env. Specialist World Bank	051-9090188	fkhan8@worldbank.org
35.	Bilal Ali Qureshi	VPO/ UNDP	0321-5177774	bilal.qureshi@undp.org
36.	Imran Durani	PD 100 Dams	0301-8386600	pd100dams@gmail.com
37.	Munir Ahmed	Asst. Project Engineer	0333-7801100	pd100dams@gmail.com
38.	Ather Hameed	CE (DSC)	0321-5136262	awanather@hotmail.com
39.	Dr. Qazi Tallat M. Siddiqui	DEA (C) CEA/CFFC	0333-5254670	qazitms@yahoo.com
40.	Himayat ullah Khan	Sp. Secretary	0300-8111953	
41.	Dr. Nadeem Amjad	Member (NRD) PARC	0300-5199466	pare.nadeem@gmail.com
42.	Dr. Rahem Z.A. Siddiqui	GM LA&R Wapda		gmlarp@gmail.com
43.	Nasir Majeed	DPD 100 Dams, Balochistan	0301-3772602	nasirdpd@gmail.com
44.	Nargis Sekandari		0343-5049644	nash_behsudi@hotmail.com
45.	Um-e-Kulsoom Dua Zubair	Director Duaa Foundation	0321-2005309	duaazubair@gmail.com
46.	Naeem Ashraf Raja	Director Biodiversity	0333-5201689	naeemashrafraja@yahoo.com
47.	Dr. Shahzad Jehangir	M/o Climate change	9245586	jehangir2000@hotmail.com
48.	Zulfiqar H. Shah	XEN SWHP WAPDA Rawalpindi	051-4414623	sayyed474@gmail.com
49.	Irshad Ahmad Soomro	Archaeologist DHA	0333-4366988	princesoomro1@yahoo.com
50.	Dr. Fazal Dad Kakar	DG Archaeology	051-9252516	
51.	Tahir Saeed	Asst. Director Archaeology	051-9252516	
52.	Haji M. Farooq	PD Dasu HPP		
53.	Mr. Hasnain Afzal	GM Dasu HPP		
54.	Tabbassum Khurshid Ahmad	Dy. Director WAPDA		tabassumkh@yahoo.com
55.	Talha	Asst. Director WAPDA		siddiqui.tj@gmail.com
56.	Motohiko Iljima	PM Dasu HPP		
57.	Zia-ul-Hassan	DPM Dasu HPP		
58.	Dr. M. Zaman	Team Leader Social & Env. DHC		
59.	Dr. Venkata Nukala	DHP		venkata@engconsult.com
60.	Malcolm Winsby	DHP		mwinsby@gmail.com
61.	Dr. William George	DHP		
62.	Dr. Allah Baksh	DHP	0306-4688853	

S.No.	Name	Designation and Organization	Phone No.	Email
	Sufi			
63.	Zafar Iqbal Ch.	DHP	0300-9460132	zic42@msn.com
64.	Maqsood Ahmad	DHP	0300/0321-8424754	amaksood67@yahoo.com
65.	Mudassar Hassan	Jr. Env. DHP	0333-9949488	enggmudassar@gmail.com
66.	Samia Rauf	DHP	0321-5257080	samia.raof@hotmail.com
67.	Iffat Idrees	DHP	0300-5308652	
68.	Dr. Kashif Sheikh	Terrestrial Ecologist (Int.) DHP	0300-8454860	
69.	Fawad Gillani	EPA Quetta	0336-5301160	
70.	Maria Khan Ch.	RA CIIT	0332-5109705	mdrr@udma.gov.pk
71.	Ahmed Kamal	Member (Planning & DRR), NDMA	9215412 0300-5278987	ifaengineer@gmail.com
72.	Ahua Qaranami	Dep. Of Archaeology	0300-5011483	
73.	Saifullah Awan	Dy. Dir. Pak-EPA Islamabad	0333-5523987	

Attendance and Registration (Scanned)

DASU HYDROPOWER PROJECT

Stakeholders Consultations Workshop on

Environmental Assessment & Cumulative and Induced Impact Assessment

Registration and Attendance

Location: Serena Hotel, Islamabad
Date: October 2, 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
01	Chaohua Zhang	Social Expert World Bank	03018502527	czhang2@worldbank.org	
02	Rana Attiq Dastgir	Add. Dy. Dir WEC	042-35842653	–	
03	Ishteqaq A. Kaukab	Director (WEC)	0301-5710104	dgwec@gmail.com	
04	Engr. Muhammad Khan	EPA, Balochistan Dy. Dir (Tech)	0333-7803543	uthmankhail@yahoo	
05	Mazhar Ali Shah	Chairman IRSA.	03008016626	mzhr1070@yahoo	
06	M. Ibrahim Baid	Rtd Chief Engineer Irrigation Deptt. Balochistan	0300-3801183		

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
07	DR. Rubina Kausar	AD(Env)	9032515	[illegible]	[signature]
08	Dr Abdul Rahim	Director. PSP PMKI	9252098	[illegible]@yahoo	[signature]
09	Muhammad Shafiq Awan	Distt Officer RWP Social Welfare	4474010 03338101665	[illegible]@yahoo com	[signature]
10	M. Omar Khalid	Env. Specialist	03335170767	[illegible]@comsats.net.pk	[signature]
11	Abdul Rauf Shaikh	Registrar Pakistan Engineering Council	0300-9567590		[signature]
12	Engr. Mahmood Sohail.	PEC	03459384164		[signature]
13	Omar Javed	Regional coordinator Sungi	0345-859[illegible]	omar.javed@sungi.org	[signature]
14	Ahmad Saleem	Consultant	0333-511-3391	kazmi@gmail.com	[signature]
15	Javaid Afzal	Sr Envt. Sp. WB	051-9090150		[signature]
16	Awais Saleem	PMPIU / WCAP PEC. / SP.	051-9244550	awaissaleem74@gmail.com	[signature]

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
17	Dr. Amjad Nabi	PMDIU/WCAP	051-9244664 03006441212	nabiamjad@yahoo.ca	[signature]
18	Dr. Sajid Nadeem	DHC	03208539457	sajidnmf@uaar.edu.pk	[signature]
19	Dr. Rahmatullah	DHC	0300-6730496	rahmatullah@yahoo.com	[signature]
20	Dr. Mazhar Qayyum	Zoology/UAAR	03015153788 9290015	mazhar.dr@yahoo.com	[signature]
21	Sarfaraz Ahmed	Chief (Envi) P&D Dept.			[signature]
22	Bareerah Fatima	RO water PWD			[signature]
23	Safia Shafiq	Env. Specialist ADB	0333-2154462	sshafiq.consultant@adb.org	[signature]
24	Ozaki Yoshihiro	JICA	0334-573-1893	ozaki.yoshihiro@jica.go.jp	[signature]
25	Imran Ahmed	JICA	0334-5169727	imranahmad.PT@jica.go.jp	[signature]
26	Mir. M. Muazzam	PPIB, Dy. Manager	03004258697	mir187@hotmail.com	[signature]

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
27	Hamid Marwat	Chief Env PEDO	0300-5248855	marwat67@ yahoo.com	[signature]
28	Farhana Mughal	Grade SP LA & R WAPDA	0333 4377726	farhanamughal@gmail.com	[signature]
29	Dr M. Bashir Khan	DG EPA KPK	9210263	drmbk63@ yahoo	[signature]
30	Ahsan Ali Shah	Asst: M&E Specialist	0321 8621432	ahsanlarp@ gmail.com	[signature]
31	Raheel Mustafa	Asstt: Agronomist	0300-5315110	rmustafa2003 @yahoo.com	[signature]
32	Akbar Ali Khalil	LA&R-WAPDA Env. Specialist	0321-4862745	kcalliyanpo@ hotmail.com	[signature]
33	Muhammad Waseem	Prov. Coordinator Gov: Balochistan	03337 7808780	waseem.qleo@ gmail.com	[signature]
34	Faiad Khan	Env. Specialist	0519090188	fkhan8@ worldbank.org	[signature]
35	Bilal Ali Qureshi	VPO/UNDP	0321-5177774	bilal.qureshi@undp	[signature]
36	Imran Durrani	PD. Iro Dams	030183866 70	PD.Iro Dams Gmail.Com	[signature]

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
37	Munir Ahmed	Assistant Project Engineer	03337801100	PD.100 Dam Gmail	
38	Ather Hameed	CE(DSC)	0321 5136212	awanather@hotmail.com	
39	DR. QAZI TALLAT M. SIDDIQUI	DEA(C)	0333-5254670	qazitms@yahoo	
40	Himayat ullah Khan	Sp. Secretary	0300 9119533		
41	Dr. Nadeem Amjad	Member (NRD) PARC	0300.5199466	parc.nadeem @Gmail.com	
42	DR RAHEEL A. SIDDIQUI	GM-LAVR WAPDA		gmlavr@gmail.com	
43	Nasir Majeed.	DPD 100 Dams.	0301-3772602	nasirdpd@gmail.	
44	Nargis Sekandari		03435049644	Nash_behsudi @hotmail.com	
45	Umm-E-Kulsoom Dua Zubair	Director Duaa foundation	03212005309	duaazubair@ gmail.com	
46	Naeem Ashraf Raja	Director Biodiversity	0333-5201839	naeemashrafr.j4 @yahoo.com	

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
47	Dr. Shahzad Jehangir	M/o Climate Change	9245586	jehangir2000@hotmail	[signature]
48	Zulfiqar H. Shah	XEN - SWHP WAPDA R/Pindi	051-4414623	Sayyed474 @Gmail.com	[signature]
49	IRSHAD AHMAD SOOMRO	Archaeologist DHC	0333-4366988	Prince_soomro1 @yahoo.com	[signature]
50	Dr. Fazal Dad Kakar	D.G Archaeology	051/9252516		[signature]
51	Tahir Saeed	A/D	- do -		[signature]
52	Haji M. Farooq	PD Dasu HP			[signature]
53	Mr. Hasnain Afzal	GM Dasu HP			[signature]
54	Tabbassum Khurshid Ahmad	Dy. Director WAPDA		tabassumkh@yahoo.com	[signature]
55	Talha	Asst. Director WAPDA		siddiqui.tj @gmail.com	[signature]
56	Motohiko IIJima	PM DHP			[signature]

Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

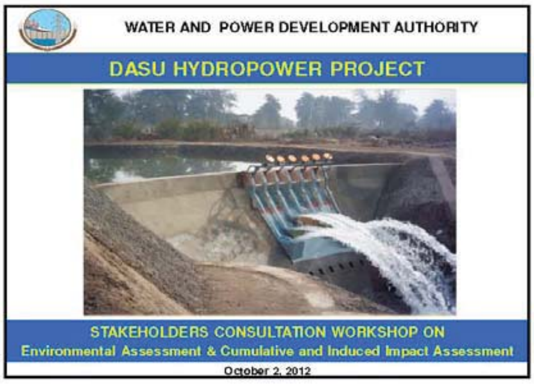
S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
57	Zia-ul-Hassan	DPM DHP			[signature]
58	Dr. M. Zaman	Team Leader Social & Envr.			[signature]
59	Dr. Venkata Nukala	DHP		venkata@ [illegible]	[signature]
60	Malcolm Winsby	DHP		mwinsby@gmail.com	[signature]
61	Dr. William George	DHP			[signature]
62	Dr. Allah Bakhsh Sufi	DHP	0306[illegible]		[signature]
63	Zafar Iqbal Ch	DHP	0300-9460132	zic42@msn.com	[signature]
64	Maqsood Ahmad	DHP	0300/0321 8424754	amaksood[illegible]@yahoo.com	[signature]
65	Mudassar Hassan	Jr. Envr. DHP	0333-9965488	engrmudassar@gmail.com	Mudassar Hassan
66	Samia Raouf	DHP	0321525 7080	samia.raouf@hotmail.com	[signature]

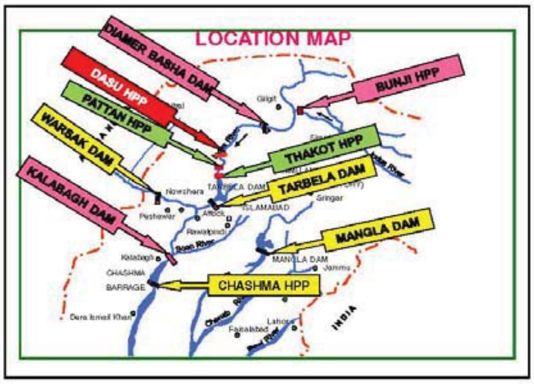
Stakeholder Consultations on Environmental Assessment & Cumulative and Induced Impacts of DHP Islamabad, 2 October 2012

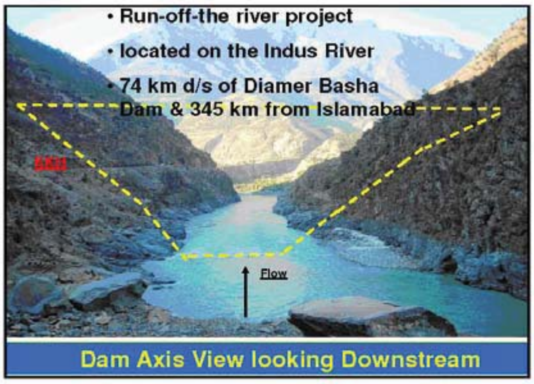
S.No.	Name	Designation and Organisation	Phone No.	Email	Signature
67	Iffat Idrees	DHP	0300-5308652		[signature]
68	Dr. Kashif Sheikh	Terrestrial Ecologist (Int) DHC	0300 8454860		[signature]
69	Fawad Gillani	EPA Quetta	0336 5301160		[signature]
70	Maria Khan Ch.	RA CIIT	0332 5109705		[signature]
71	Ahmed Kamal	Member (Planning & DRR), NDMA	9215412 0300-5278987	mdrr@ndma.gov.pk ifuengineer@gmail.com	[signature]
72	Ahsan Qamarani	Dep. Ag. Arch	0300 5011483		[signature]
73	Saifullah Awan	Dy. Dir Pak-EPA Islamabad	0333-5523987	saifullah@hotmail.com	[signature]

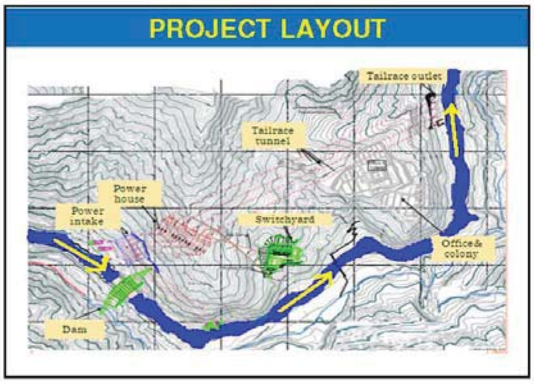
Annex – 12.9

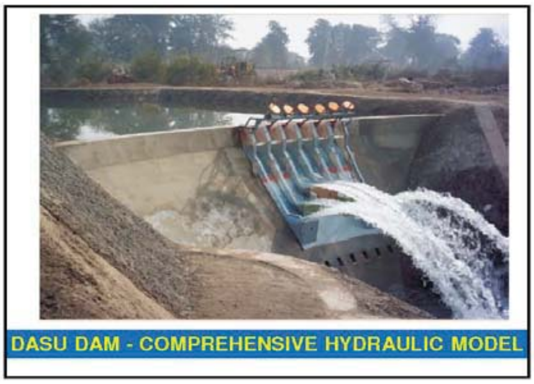
COPIES OF POWER POINTS AND DISCUSSION POINT

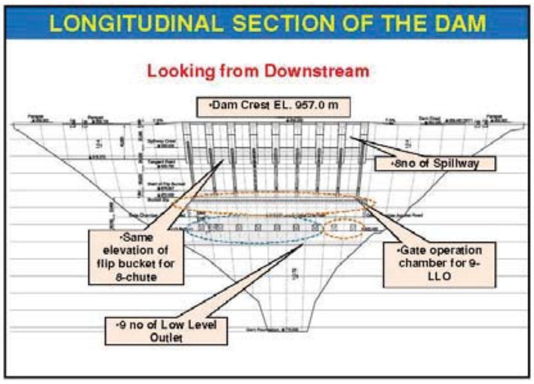




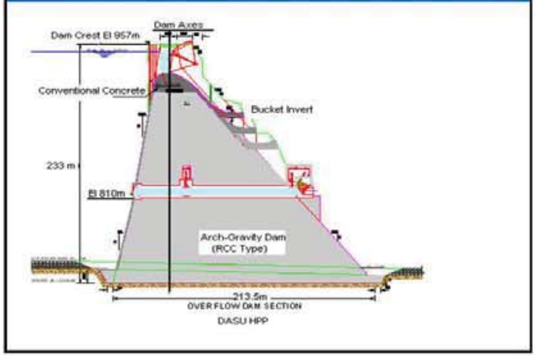




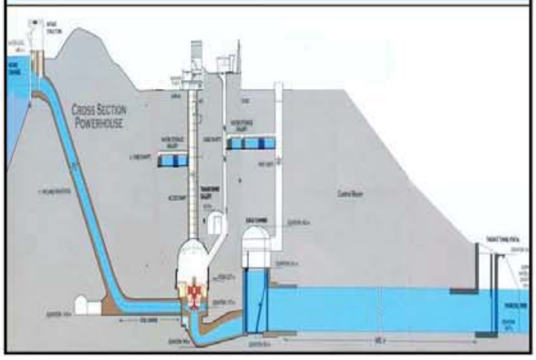




CROSS SECTION OF MAIN DAM



SECTION ALONG WATER WAYS & POWERHOUSE



STAGED DEVELOPMENT

	Stage I (Pre-Basha)		Stage II (Post-Basha)	
	Phase-I	Phase-II	Phase-III	Phase-IV
Works	Full dam & Three Turbines	Three Turbines	Three Turbines	Three Turbines
Cumulative Installed Capacity MW	1,080	2,160	3,240	4,320
Generation GWh under each Phase	7,500	4,000	3,500	3,000
Dasu Hydropower Cost (US$ million)	3,000	1,000	900	700
Transmission Line Cost (US$ million)	350		250	
Total Cost (US$ million)	3,350	1,000	1,150	700

SALIENT FEATURES (FULL PROJECT)

Reservoir	
Useable Storage Capacity	0.67 MAF
Main Dam	
Type	Roller Compacted Concrete (Gravity)
Max. Height	242 m
Crest Length (curved)	570 m
Spillway	
Type	Frontal, overflow, gated
Max. Design Capacity	36,800 m^3/s
Low Level Outlets	
Nos.	9 Nos.
Discharge Capacity	10,800 m^3/s
Power Generation	
Installed Capacity	4320 MW
Generating units	12, Francis turbines
Generating Unit Capacity	360 MW
Powerhouse location	Underground, left bank of Indus River
Annual Energy Post-Basha	21,300GWh
Annual Energy Pre-Basha	18,440GWh
Design Discharge	2600 m3/s
Design Head	183.8 m

DASU HYDROPOWER CONSULTANTS

The Joint Venture consists of the Following Firms;

- Nippon Koei Co., Ltd. (NK Japan) (Lead Firm)
- Dolsar Engineering Ltd. (Dolsar, Turkey)

In Association With:

- DMC, Pakistan
- NDC, Pakistan
- PES, Pakistan

SCOPE OF CONSULTANCY SERVICES

I. **Assignment – A:** Preparation of Detailed Engineering Design of Complete Project and Tender Documents and Tendering & Contracting for Stage-I

II. **Assignment – B1:** Construction Design, Contract Management & Construction Supervision for Stage-I, Tender Document and Tendering & Contracting for Stage-II

III. **Assignment – B2:** Construction Design, Contract Management & Construction Supervision for Stage-II, Tender Document and Tendering & Contracting for Stage-III

FINANCING OF CONSULTANCY CONTRACT

I. Assignment – A: World Bank Water Sector Capacity Building and Advisory Services Project (WCAP)

II. Assignment – B1 & B2: Yet to be decided

CONTRACTRUAL SUMMARY

- Consultancy Services Contract Agreement has been initialed on August 18, 2011
- Final Consultancy Services Agreement has been signed on September 19, 2011
- Commencement and Effective Date of Contract is September 19, 2011
- Completion Date of Assignment – A is February 18, 2014
- Completion Date of Assignment – BI is February 18, 2019
- Completion Date of Assignment – B2 is February 18, 2022

DELIVERABLE TARGETS ASSIGNMENT-A

- Review of Feasibility Study and Optimized Stage Development (Inception Report) on November 18, 2011
- Social & Resettlement Management Plan and Environmental Management Action Plan November 30, 2012
- Detailed Engineering Design and Tender Documents March 18, 2013
- Tendering and Contracting February 18, 2014

DELIVERABLE TARGETS ASSIGNMENT-B1&2

- Commercial Operation of Phase - 1 on February 2019
- Commercial Operation of Phase - 2 on February 2022
- Operation and Maintenance Manual Phase-1 February, 2019
- Operation and Maintenance Manual Phase-1 February, 2022

THANKS

Dasu Hydropower Project
Stakeholders Consultation Workshop
Environmental Assessment &
Cumulative and Induced Impact Assessment

Islamabad
October 2, 2012

Dasu Hydropower Consultants (DHC)

1

Overview of the Presentation

1. Environmental Assessment – WB and GOP Requirements
2. Project Study Area
3. Baseline Environment
4. Impact Assessment and Potential Impacts
5. Cumulative and Induced Impacts
6. Principles of developing Environmental Management Plan
7. Public and Stakeholder Consultations
8. Analysis of Alternatives
9. Institutional Strengthening and Capacity Building
10. Deliverables and Team Members
11. Brainstorming Session

2

Environmental Assessment

- The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable.
- According to the Bank, Environmental Assessment
  - evaluates a project's potential environmental risks and impacts in its area of influence;
  - examines project alternatives;
  - identifies ways of
    - improving project selection, siting, planning, design, and
    - implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and
    - enhancing positive impacts; and
  - includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

3

WB Policies Applicable to Dasu Project

Operational Policy/Bank Procedures		Triggered	Remarks
OP/BP 4.01	Environmental Assessment	Yes	Category A
OP/BP 4.04	Natural Habitats	Yes	Reservoir; Barrier Effect by Dam
OP 4.11	Physical Cultural Resources	Yes	Rock Carvings
OP/BP 4.12	Involuntary Resettlement	Yes	Land acquisition and Resettlement
OP 4.10	Indigenous People	No	
OP/BP 4.36	Forests	No	21,000 trees
OP/BP 4.37	Safety of Dams	Yes	
OP/BP 7.50	Projects in International Waterways	Yes	Indus Water Treaty
OP/BP 7.60	Projects in Disputed Areas	No	

4

GOP Policies & International Best Practices

- PAK-EPA, IEE and EIA Regulations, 2000
  - Dasu will be a Schedule II Project
- Environmental Protection Act, 1997
- National Environmental Quality Standards (NEQS), 2000
- Guidelines for Public Consultation, 1997
- International agreements [CBD (Convention on Biological Diversity); CITES, CMS, WHC and Ramsar (wetlands)]
- World Commission on Dams
- WB Group EHS Guidelines
- Hydropower Sustainability Assessment Protocol

5

Study Area/Project Impact Area

Permanent
- Project footprints (dam and other project facilities)
- Reservoir/inundated area/tributaries
- Both sides of the reservoir up to summits of immediate mountains(covering summit, slopes and valley).
- Relocated villages of the affected community
- Relocated portion of KKH along reservoir
- Indus downstream up to Tarbela

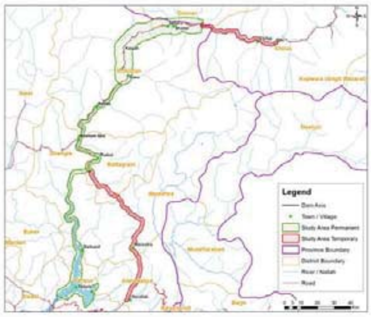
6

Study Area/Project Impact Area

- Temporary
  - KKH from Havelian to Gini and access roads to construction sites
  - construction material borrow and disposal areas
  - construction camp and areas
  - Indus from Gini to Basha

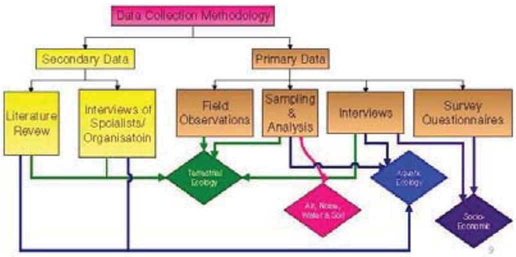
7

Project Study Area



Baseline Environment

- Establish baseline conditions and to monitor impacts during construction and operation



9

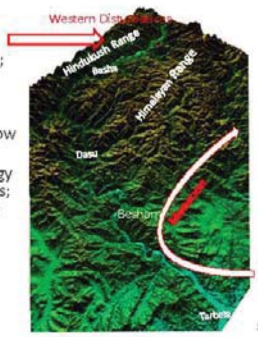
Baseline Environment

10

Baseline Environment

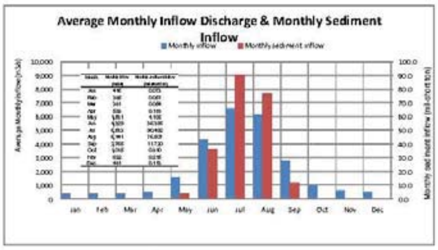
Physical Environment

- Topography: narrow gorges; steep slopes
- Climate (Warm Summers: 40°C, Cold Winters: -2 °C ; Monsoon Shadow Area; Snow Cover in winter
- Geology and Geomorphology (Relatively young mountains; seismically active; unstable geomorphology)
- Water Resources (mostly snow/glacier melt; risk of floods through intense rainfalls, landslides and GLOFs)



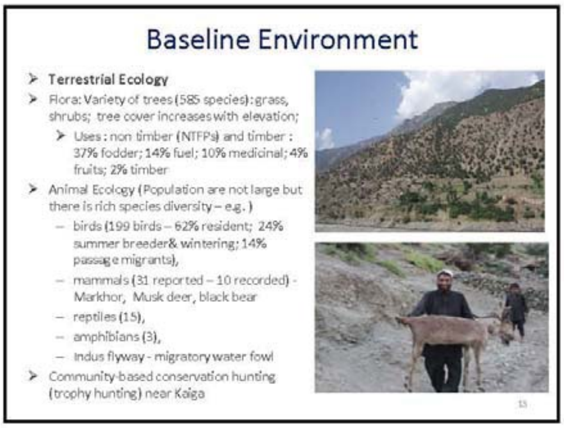
11

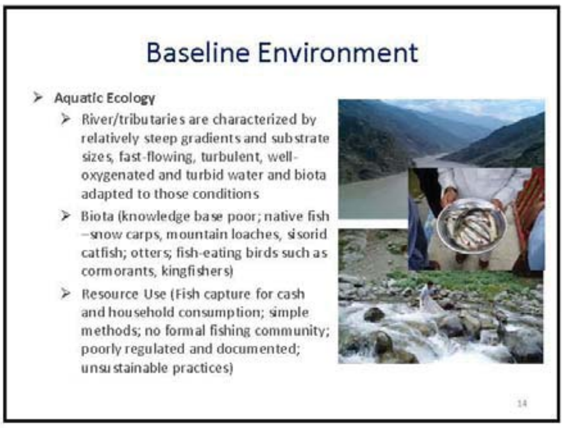
Baseline Environment

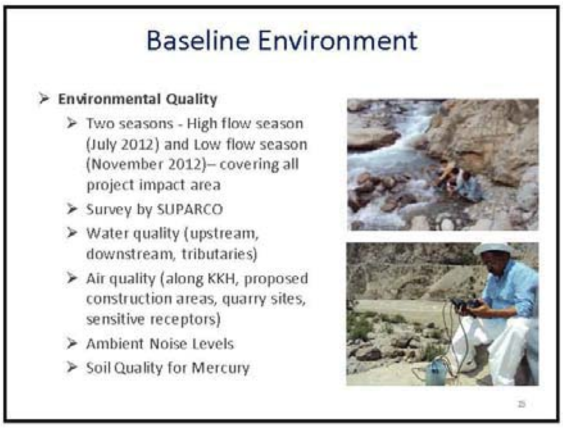


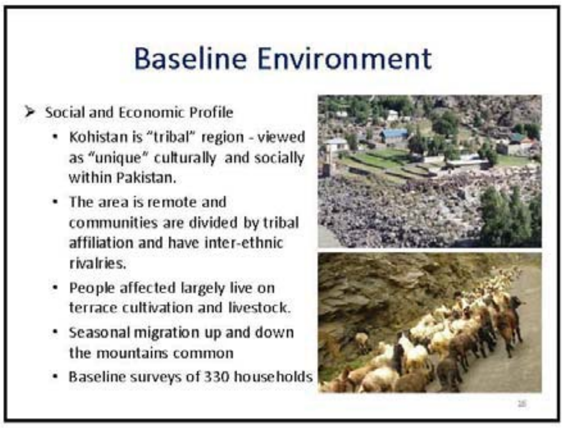
- Annual runoff, 66.7BCM, (78.6% from Jun to Sep)
- Annual sediment,200mil-ton (97.5% from Jun to Sep)

12

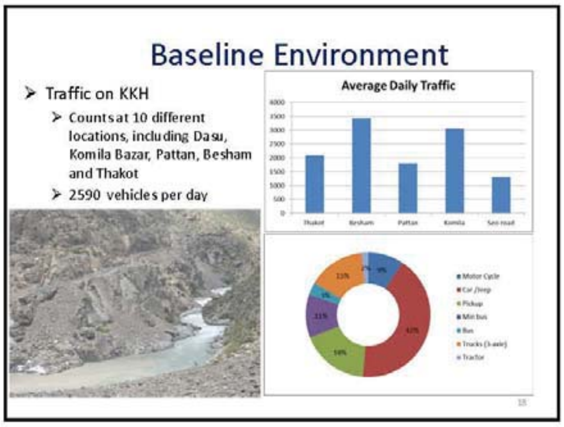

Baseline Environment
Terrestrial Ecology
Flora: Variety of trees (585 species): grass, shrubs; tree cover increases with elevation;
Uses: non timber (NTFPs) and timber: 37% fodder; 14% fuel; 10% medicinal; 4% fruits; 2% timber
Animal Ecology (Population are not large but there is rich species diversity – e.g.)
– birds (199 birds – 62% resident; 24% summer breeder& wintering; 14% passage migrants),
– mammals (31 reported – 10 recorded) - Markhor, Musk deer, black bear
– reptiles (15),
– amphibians (3),
– Indus flyway - migratory water fowl
Community-based conservation hunting (trophy hunting) near Kaiga

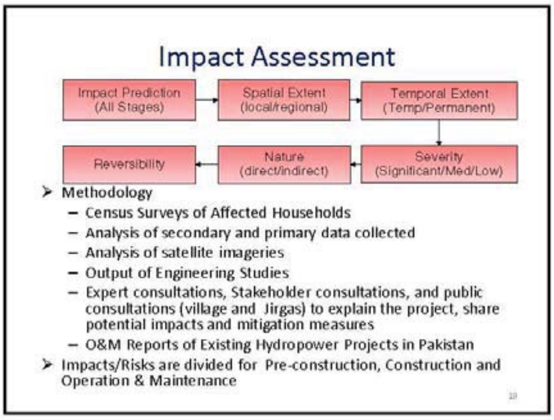

Baseline Environment
Aquatic Ecology
River/tributaries are characterized by relatively steep gradients and substrate sizes, fast-flowing, turbulent, well-oxygenated and turbid water and biota adapted to those conditions
Biota (knowledge base poor; native fish – snow carps, mountain loaches, sisorid catfish; otters; fish-eating birds such as cormorants, kingfishers)
Resource Use (Fish capture for cash and household consumption; simple methods; no formal fishing community; poorly regulated and documented; unsustainable practices)

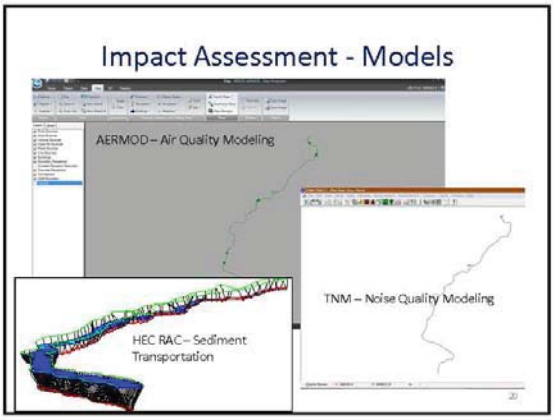

Baseline Environment
Environmental Quality
Two seasons - High flow season (July 2012) and Low flow season (November 2012)– covering all project impact area
Survey by SUPARCO
Water quality (upstream, downstream, tributaries)
Air quality (along KKH, proposed construction areas, quarry sites, sensitive receptors)
Ambient Noise Levels
Soil Quality for Mercury

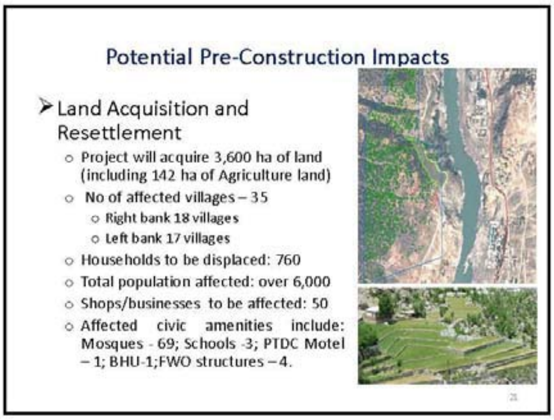

Baseline Environment
Social and Economic Profile
Kohistan is "tribal" region - viewed as "unique" culturally and socially within Pakistan.
The area is remote and communities are divided by tribal affiliation and have inter-ethnic rivalries.
People affected largely live on terrace cultivation and livestock.
Seasonal migration up and down the mountains common
Baseline surveys of 330 households

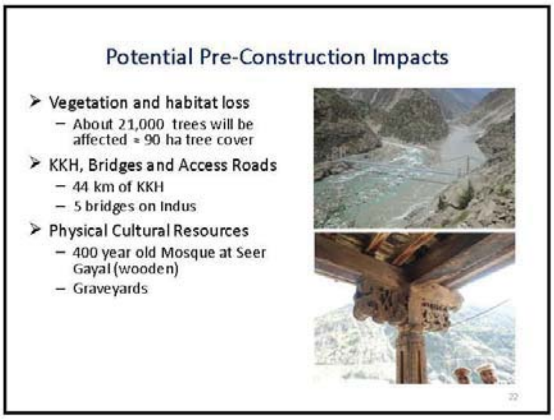

Baseline Environment
Cultural Resources
400 year old mosques with wooden structures at Seo and Seer Gayal
Rock Carvings at Shatial (1st Century AD to 8th Century AD)
Inscribed with Buddhist religious motifs, animals, hunting scenes
Pilgrims, traders and missionaries – left their records in the shape of inscriptions and carvings
Privately owned, not protected, subjected to vandalism


Baseline Environment
Traffic on KKH
Counts at 10 different locations, including Dasu, Komila Bazar, Pattan, Besham and Thakot
2590 vehicles per day
Average Daily Traffic


Impact Assessment
Impact Prediction (All Stages)
Spatial Extent (local/regional)
Temporal Extent (Temp/Permanent)
Reversibility
Nature (direct/indirect)
Severity (Significant/Med/Low)
➢ Methodology
– Census Surveys of Affected Households
– Analysis of secondary and primary data collected
– Analysis of satellite imageries
– Output of Engineering Studies
– Expert consultations, Stakeholder consultations, and public consultations (village and Jirgas) to explain the project, share potential impacts and mitigation measures
– O&M Reports of Existing Hydropower Projects in Pakistan
➢ Impacts/Risks are divided for Pre-construction, Construction and Operation & Maintenance
19


Impact Assessment - Models
AERMOD – Air Quality Modeling
TNM – Noise Quality Modeling
HEC RAC – Sediment Transportation
20

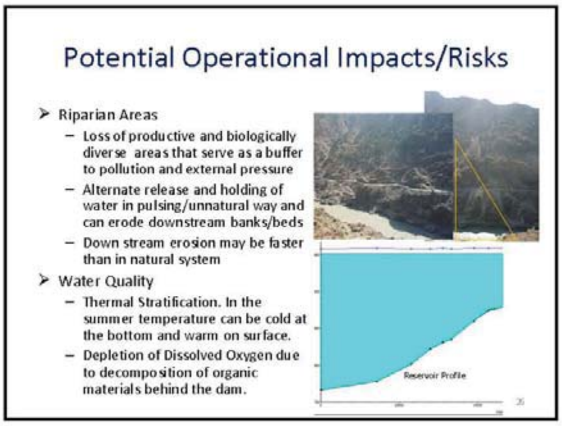

Potential Pre-Construction Impacts
➢ Land Acquisition and Resettlement
○ Project will acquire 3,600 ha of land (including 142 ha of Agriculture land)
○ No of affected villages – 35
○ Right bank 18 villages
○ Left bank 17 villages
○ Households to be displaced: 760
○ Total population affected: over 6,000
○ Shops/businesses to be affected: 50
○ Affected civic amenities include: Mosques - 69; Schools -3; PTDC Motel – 1; BHU-1;FWO structures – 4.
21

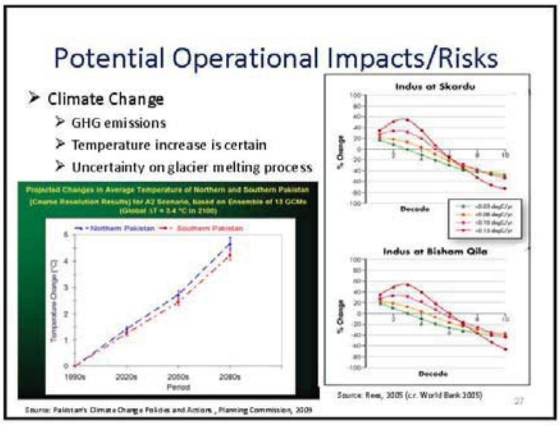

Potential Pre-Construction Impacts
➢ Vegetation and habitat loss
– About 21,000 trees will be affected ≈ 90 ha tree cover
➢ KKH, Bridges and Access Roads
– 44 km of KKH
– 5 bridges on Indus
➢ Physical Cultural Resources
– 400 year old Mosque at Seer Gayal (wooden)
– Graveyards
22


Potential Construction Impacts/Risks
➢ Construction traffic along KKH
– 200 to 300 construction vehicles/day on KKH
– Traffic congestion and safety
– Air and noise pollution
– No rest/layover areas along KKH
➢ Construction Areas
– Limited Workspace
– Access Roads
– Spoils
– Loss of top soil
– Soil, water and air pollution
– Noise and vibration
– River and terrestrial ecosystem
– Workers health and safety
23

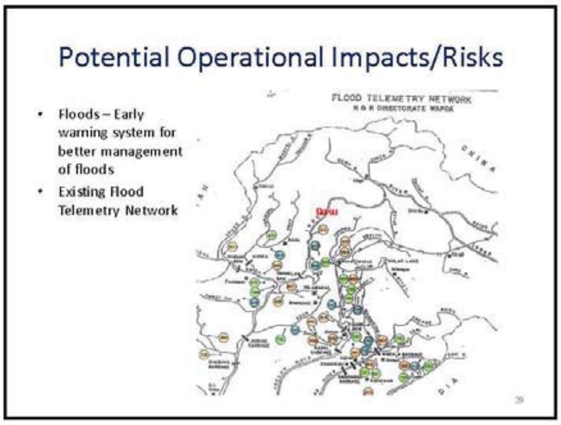

Potential Construction Impacts/Risks
➢ Immigrant Construction Workers
– 2,700 workers
– Induced migration
– Boomtown
– Community impacts
– Public health
– Exploitation of natural resources - poaching (hunting/fishing)
➢ Quarry Areas
– Air, Dust, noise and water pollution
– Aquatic ecosystem
➢ Physical Cultural Resources
– Chance finds
– Shatial rock carvings
➢ Decommissioning
– Contractors facilities after completion of construction (batching plants, oil storage facilities, waste,....)
24

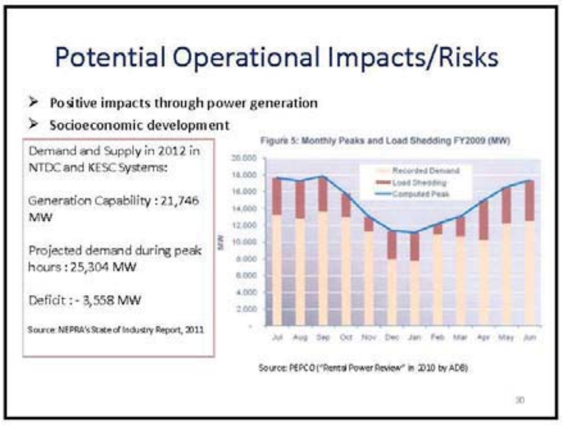

Potential Operational Impacts/Risks
Natural River Flows
– Changes to natural flow system and aquatic ecosystem (fish movement pattern – u/s and d/s)
– Reduced flow between dam and tailrace
– Altered downstream daily flow regime during low-flow season
– Aquatic habitat; human use of aquatic resources
Sediment and Debris
– No debris or sediment transport to d/s – Lack of submerged gravel beds – altered aquatic ecosystem habitat
– Scoured river bed below the dam
– Silting of reservoirs
– Excessively high sediment concentrations during/if infrequent flushing
25


Potential Operational Impacts/Risks
Riparian Areas
– Loss of productive and biologically diverse areas that serve as a buffer to pollution and external pressure
– Alternate release and holding of water in pulsing/unnatural way and can erode downstream banks/beds
– Down stream erosion may be faster than in natural system
Water Quality
– Thermal Stratification. In the summer temperature can be cold at the bottom and warm on surface.
– Depletion of Dissolved Oxygen due to decomposition of organic materials behind the dam.
Reservoir Profile
26

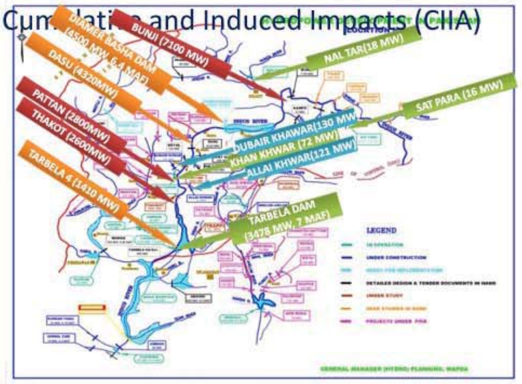

Potential Operational Impacts/Risks
Climate Change
GHG emissions
Temperature increase is certain
Uncertainty on glacier melting process
Indus at Skardu
Indus at Bisham Qila
% Change
Decade
Northern Pakistan
Southern Pakistan
Temperature Change (°C)
1990s
2020s
2050s
2080s
Period
Source: Rees, 2005 (c.r. World Bank 2005)
Source: Pakistan's Climate Change Policies and Actions, Planning Commission, 2009
27


Potential Operational Impacts/Risks
Impact of Climate Change and Glacier retreat on Indus Flows
Assumed Climate Change Scenario (CCS):
Δ Temp: +3°C, Δ Glacier Area: - 50%
Base Run off represents Mean Monthly Flows for the Period 1995-2004
Discharge (Cumecs)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Base Runoff
CCS Runoff
Base Glacier melt
CCS Glacier melt
Main Results: 1. Annual flows reduced by 15%
2. Intra-Annual flow pattern considerably changed
Source: Global Change Impact Studies Centre, 2009
28


Potential Operational Impacts/Risks
• Floods – Early warning system for better management of floods
• Existing Flood Telemetry Network
FLOOD TELEMETRY NETWORK
Dasu
CHINA
29


Potential Operational Impacts/Risks
Positive impacts through power generation
Socioeconomic development
Demand and Supply in 2012 in NTDC and KESC Systems:
Generation Capability : 21,746 MW
Projected demand during peak hours : 25,304 MW
Deficit : - 3,558 MW
Source: NEPRA's State of Industry Report, 2011
Figure 5: Monthly Peaks and Load Shedding FY2009 (MW)
Recorded Demand
Load Shedding
Computed Peak
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Source: PEPCO ("Rental Power Review" in 2010 by ADB)
30

Cumulative and Induced Impacts (CIIA)



Scope of the Cumulative and Induced Impact Assessment (CIIA)

- To characterize and understand the potential cumulative impacts arising from the construction and operation of all (in sequence and in total) the current and proposed projects on the Indus river over the next 10 years
- Assess the incremental environmental/ecological impacts of hydropower and storage development projects in Indus on
  - Aquatic fauna and flora
  - Biodiversity of the riverine ecosystem
  - Water availability for agriculture and other uses
  - Population displacement, social/resettlement aspects
- Provide guidance on integrated planning and development for addressing cumulative impacts

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Scope & Methodology of CIIA

- Spatial coverage:
  - Tarbela Catchment within Pakistan (Upper Indus Basin)
- Temporal coverage (Until 2022)
  - Existing: 3584 MW & 7 MAF
  - Under Construction: 251 MW
  - In Next 10 Years: 8070 MW & 8 MAF
- Methodology
  - Secondary data (feasibility studies, detailed engineering reports, evaluation reports)
  - Stakeholder consultations
- Two scenarios
  - 'Business as usual' development pattern
  - 'Best Practices' with a policy that supports environmentally sensitive development)

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CIIA - Key Issues and Questions

1. River Hydrology, Water Use and Quality
   - Changes in flow patterns: High flows in winter and low flows in summer
   - 22% storage of annual flow
   - Degradation of downstream due to release of sediment free water
   - Changes in water quality (suspended solids, temperature, dissolved oxygen)
2. Power Transmission and Industry
   - 2 existing transmission lines (132 KV and 220 KV) along Indus valley on d/s of Pattan
   - 500 KV transmission line for Dasu along Indus
   - 765 KV transmission line for Basha probably along Indus

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CIIA - Key Issues and Questions

3. Fisheries
   - Conversion of 58% (290 km of 502 km) of riverine ecosystem to lacustrine ecosystem.
   - Potential effect on aquatic habitat due to submergence on u/s and altered water quality d/s
   - Potential effect on fish movement patterns between tributaries and the River due to high flows in winter. This will also affect the availability of fish for local consumption.
   - Potential effect on reservoir fisheries of Tarbela due daily storage-release cycle Dasu during low flow season
   - Additional reservoir fisheries development
4. Forestry and Biodiversity
   - Erosion of riparian areas
   - Intrusion in to natural habitat and exploitation of flora and fauna
   - Bird collisions and electrocution
   - Artificial staging grounds for migratory birds

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CIIA - Key Issues and Questions

5. Social Issues
   - 135,000 peoples relocation (96,000 were from Tarbela)
   - 45,000 ha of land acquisition (27,000 was from Tarbela)
   - 10,000 immigrant construction workers per day
6. Agriculture and Livelihood
   - Loss of 1200 ha of agriculture land due Basha and Dasu
   - Life of Tarbela will be increased by 50 years
7. Transport
   - 4 fold increase in heavy vehicle traffic on KKH
8. Vulnerability to Flooding, Flood Management Aspects
   - Flood Attenuation
   - Requirement of Early warning system

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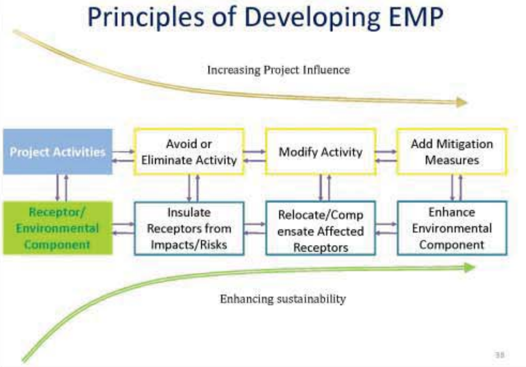
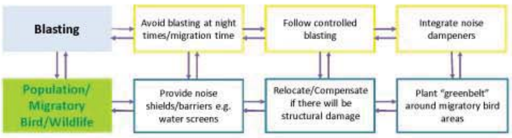
CIIA - Key Issues and Questions

9. Urban Development
   - Land use Changes
   - Accelerated and unplanned urban development
10. Water Supply and Irrigation
   - Water supply and irrigation is mostly from tributaries
11. Institutional Issues and Capacity of WAPDA
   - No corporate policy on socially and environmentally responsible development
   - Lack of manpower and capacity

Principles of Developing EMP

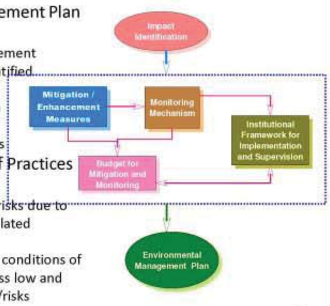


Example: EMP for Blasting



Structure of the EMP and ECPs

- Environmental Management Plan (EMP)
  - Mitigation and enhancement measures for each identified significant impact/risk
  - Monitoring mechanism
  - Budget
  - Responsible institutions
- Environmental Code of Practices (ECPs)
  - for managing impacts/risks due to general construction related activities.
  - annexed in the general conditions of the contract and address low and medium rated impacts/risks



Environmental Code of Practices

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Development, Operation and Restoration
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fisheries
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Workers Health and Safety
- ECP 19 – Decommissioning of contractors and Restoration of Construction Areas

Some Mitigation Measures – Adaptation in Project Planning and Design

- Finalisation of Dam site location to minimize social and environmental impacts
- Relocation of KKH/bridges to higher elevations
- Design for extreme seismic events (ICOLD, 2010)
- Basic Design Flood for extreme flood events.
- Landslide protection in the reservoir area
- Climate change adaptation
- Seismic and Flood Monitoring
- Operation as true run off river
- Environmental Flows
- Contractors with ISO 14001 EMS; SA 8000; OHSAS 18000 & WB/ADB experience.

Some Mitigation Measures – Pre Construction Impacts

- Land Acquisition and Resettlement
  - Infrastructure at the resettlement areas
  - Training of locals for future employment in project
- Vegetation Loss
  - Development of Greenbelts and Conservancies
- Physical Cultural Resources
  - Disassembling/dismantling and Reassembling/re-erection of 400 year old mosque
  - Protection of Graveyards through mud plastering
  - Procurement and protection of Shatihal rock carvings

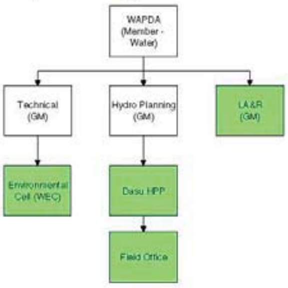
Some Mitigation Measures – Construction Impacts

- Traffic along KKH
  - Traffic units along KKH and Controlled traffic flow
  - Supporting local traffic infrastructure/authorities
- Construction Related Impacts
  - Strict implementation of EMP and ECPs
  - Environmental and Health & Safety Specialists in team
  - A Social and Environmental Unit in PD/PMU at the Project
  - Internal and External Auditing
  - Grievances Redress Mechanism
  - Awareness and education on environmental protection
  - Restoration of Construction Areas

Institutional Strengthening and Capacity Building

✓ Institutional Assessment of WAPDA for Social and Environmental Management

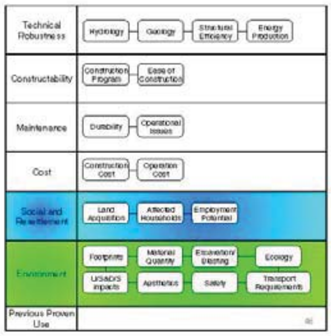
✓ Capacity Assessment for EMP implementation



Alternative Analysis

➢ Study various alternatives in project location and design, and

➢ Ensure that social and environmental issues are considered in the decision making
- site selection; design of facilities; construction program; and operation



Community/Stakeholder Consultations

- WB OP4.01 requires 2 rounds of consultations.
- 3 Jirga meetings and 34 village level consultation meetings

Consultation workshops are being conducted at
- Peshawar
- Lahore
- Karachi
- Islamabad

Community/Stakeholder Consultations

Summary of Community Consultations

- Better rates for land and structures
- Employment in project activities – Equal opportunity for both banks
- Self managed resettlement by communities – similar facilities in the new areas
- Protection of Graves with mud plastering
- 15 point charter of demands
  - Development of Kohistan District (roads, electricity, schools, hospital, colleges)

Community/Stakeholder Consultations

Peshawar Consultations (Sep 10, 2012) – 41 participants

- Development of agricultural terraces
- Documentation and Protection of Physical Cultural Resources
- Adequacy of health facilities to cope with demand
- Protection of aquatic and terrestrial flora and fauna – requirement of environmental flows
- Traffic on KKH
- Impacts during demobilisation
- Environmental Unit at Project Site for implementation of EMPs

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Community/Stakeholder Consultations

Lahore Consultations (Sep 17, 2012) – 88 participants

- Impacts on Rabi crops due to storage of water
- Low flow season and its impact on aquatic life
- Planning for Geohazards – land slides and earth quakes.
- Early warning system for floods
- Security issues in the project area
- Protection of heritage sites
- Impact on the community and their livelihood due to relocation

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Community/Stakeholder Consultations

Lahore Consultations (Sep 17, 2012) – 88 participants

- Support and augment local community based conservancies
- Traffic on KKH – Simultaneous construction of Basha and Bunji
- Health and Safety of workers and host community
- Impact of Transmission Lines along Indus valley on birds migration and public health due to EM waves

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Community/Stakeholder Consultations

Karachi Consultations (Sep 24, 2012) – 37 participants

- Monitoring of impacts on Lower Indus Basin
- Impact on migratory birds and international bird areas (IBA)
- Protection of Indus river ecology
- Geological hazards: seismic activity and faults
- Climate change impacts: GLOFs, erosion and sedimentation
- Habitat management plan for endangered species

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Deliverables - EMAP

Environmental Management Action Plan (Nov/Dec – 2012)

- Vol. 1 Executive Summary (Summaries of Vol 1 to Vol 8)
- Vol. 2 Environmental Impact Assessment
- Vol. 3 Terrestrial Ecology
- Vol. 4 Aquatic Ecology
- Vol. 5 Physical and Cultural Resources
- Vol. 6 Environmental Baseline Quality
- Vol. 7 Cumulative Impact Assessment
- Vol. 8 Implementation Management Plan and Cost Estimates

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Deliverables - SRMP

Social and Resettlement Management Plan (Nov 2012)

- Vol. 1 Executive Summary (of all SRMP documents)
- Vol. 2 Socioeconomic Analysis and Profiles of the Project Area
- Vol. 3 Public Engagement and Mobilization Plan
- Vol. 4 Resettlement Framework
- Vol. 5 Resettlement Action Plan
- Vol. 6 Grievances Redress Plan
- Vol. 7 Gender Action Plan
- Vol. 8 Public Health Action plan
- Vol. 9 Communications Plan
- Vol. 10 Management Plan for In-Migrants and Construction Workers
- Vol. 11 Costs and Budgetary Plan
- Vol. 12 SRMP Implementation Management Plan

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Overview of Deliverables – EIA

- Comprehensive Report covering all aspects of Environmental Assessment. The Contents of EIA report are
  1. Introduction
  2. Legal and administrative framework
  3. Description of Project
  4. Description of Baseline Environment
  5. Project Alternatives
  6. Relevant Issues (Climate Change, Risk of Flooding)
  7. Public Consultations and Information Disclosure
  8. Potential Environmental Impacts and their mitigation
  9. Potential Social Impacts and their mitigation
  10. Cumulative and Induced Impacts
  11. Environmental Management Plan
  12. Conclusions and Recommendations

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Team Members (International)

No.	Name	Position	Nationality
1	Dr. Mohammad Zaman	Team Leader (Social and Environment)	Canadian
2	Dr. Venkata Nukala	Environment Specialist	Canadian
3	Malcolm Winsby	Aquatic Ecologist & CIIA Team Leader	Canadian
4	Dr. Kashif Sheik	Terrestrial Ecologist	Canadian
5	Dr. Masud Karim	Environmental Specialist	Canadian
6	Dr. Haimin Wang	Resettlement Specialist	Chinese
7	Sunil Goonetilleke	Social Specialist	Australian
8	Bernahard Eder	Public Health Specialist	Austrian
9	Dr. Iffat Idris	Social Analyst	British

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Team Members (National)

No.	Name	Position
1	Zafar Iqbal Chaudry	Environment Specialist
2	Dr. William George	Fisheries Expert
3	Prof. Tahir Omer	Aquatic Ecologist
4	Dr. Sajid Nadeem	Terrestrial Ecologist
5	Dr. Rehmatulla Qureshi	Vegetation Expert
6	Prof. Ihsan H. Nadiem	PCR Specialist (Reviewer)
7	Mohd. Saleem	Consultation & Participation Specialist
8	Samia Raoof	Gender Specialist
9	Mudassar Hassan	Environmental Specialist
10	Irshad Ahmed Soomro	PCR Specialist
11	Dr. Alla Bakshsh Sufi	CIIA Specialist

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Panel of Experts (Social and Environment) and Independent Reviewers

No.	Name	Position
1	Prof. Shi Gouqing	Panel of Expert
2	Dr. Eric Jensen	Panel of Expert
3	Mr. R. Koopmans	Independent Reviewer
4	Mr. Omar Khalid	Independent Reviewer

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Brain Storming Session

- Objective: To involve the stakeholders in
  - identifying potential Cumulative and Induced Environmental impacts, mitigation measures, and
  - project planning and design
- Participants will be divided into groups
- 2 topics will be given to each group for discussion
- Group wise discussion for 15 to 20 minutes
- Presentation from each group (5 minutes for each group)

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Brain Storming Session

Discussion Point 1

Review the potential issues that could result from **cumulative and induced impacts** from the existing and future hydropower and storage projects in Tarbela Catchment as described in the presentation. Please discuss to

- Identify potential impacts and concerns of the cumulative development on the key issues presented;
- identify areas where planning and development interventions are required to deal with identified cumulative impacts
- Provide guidance on integrated planning and development for addressing cumulative impacts
- recommendations to the consultant team to incorporate in project planning and design

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Brain Storming Session

❖ **Discussion Point 2**

Please review the potential issues/impacts that could arise from the ***pre-construction***, ***construction*** and ***O&M*** activities described in the presentation. Please discuss

i. if other potential impacts should be addressed;
ii. possible mitigation and enhancement measures for all these impacts;
iii. adequacy of the boundaries of the project impact area;
iv. adequacy of proposed methodology for impact assessment; and
v. recommendations to the consultant team to incorporate in project planning and design.

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Thank You

- For comments and suggestions:

Mr. Haji Muhammad Farooq Ahmad
Project Director,
Dasu Hydropower Project
WAPDA
Sunny View, Lahore.
Phone: 042 99202676
Fax: 042 99202667
Email: dasuhpp@yahoo.com

Dr. Venkata Nukala, P.Geo.
Environmental Specialist
Dasu Hydropower Consultants
70-B/1, Gulberg III, Lahore
Phone: 042 3587 3659
Fax: 042 3571 3026
Email:
venkata@eng-consult.com

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DASU HYDROPOWER PROJECT
Stakeholders Consultations Workshop on
Environmental Assessment & Cumulative and Induced Impact Assessment

Discussion Point 1

Review the potential issues that could result from **cumulative and induced impacts** from the existing and future hydropower and storage projects in Indus River as described in the presentation (also summarized below).

Please discuss and provide recommendations on the following

Topic	Comments/Output
1. Additional potential impacts/concerns of cumulative development	
2. Key topics/areas where planning/development interventions are required to deal with identified cumulative impacts	
3. Guidance on integrated planning/development for addressing cumulative impacts	
4. Guidance to consultant team and WAPDA to incorporate in Hydropower project planning and design	
5. Key sector documents: planning/development/strategic; environmental assessments (strategic, sector, project)	

Key issues for cumulative and induced impact assessment

1. River Hydrology
2. Power Transmission & Industry
3. Fisheries
4. Forestry And Bio-Diversity
5. Social Issues
6. Agriculture And Livelihood
7. Transport
8. Floods
9. Urban Development
10. Water Supply And Irrigation
11. Institutional Issues and Capacity of WAPDA

Discussion Point 2

Review the potential issues/impacts that could arise from the **pre-construction, Construction and O&M activities** described in the presentation (Pages 11-15). Please discuss and provide recommendations on

Topic	**Comments/Output**
1. Other potential impacts should be addressed;	
2. Possible mitigation and enhancement measures for all these impacts;	
3. Adequacy of the boundaries of the project impact area;	
4. Adequacy of proposed methodology for impact assessment; and	
5. Recommendations to the consultant team to incorporate in project planning and design	

Annex – 13.1

HYDROPOWER SUSTAINABILITY ASSESSMENT PROTOCOLS – THE CASE OF DHP

Hydropower Sustainability Assessment Protocols[1] have been used to evaluate the social and environmental assessment carried out in the Dasu Hydropower Project. The results of the self-assessment tests of all 12 social and environmental protocols conducted by the Social and Environment Team are presented in Figure 1 in the form of sustainability profile and mapping. The scoring level ranges from 1 to 5 (5 being highest), while 3 is basic good practice, 4 is excellent and 5 is proven best practice with no room for improvement. Of the 12 protocols tested, 10 scored 4 (i.e., excellent) while 2 protocols received 3, which meets basic good practices. The rationale for the scoring for each protocol is given in the following tables (Table 1 to Table 12). The results of the test thus reflect high quality project preparatory works against global benchmark. The Dasu Hydropower safeguard "packages" are, therefore, not only comprehensive but also demonstrate international "good practices." The Project safeguard measures have enhanced national standards and shall hopefully remain as an example and "model" to draw on by future projects in Pakistan and globally.

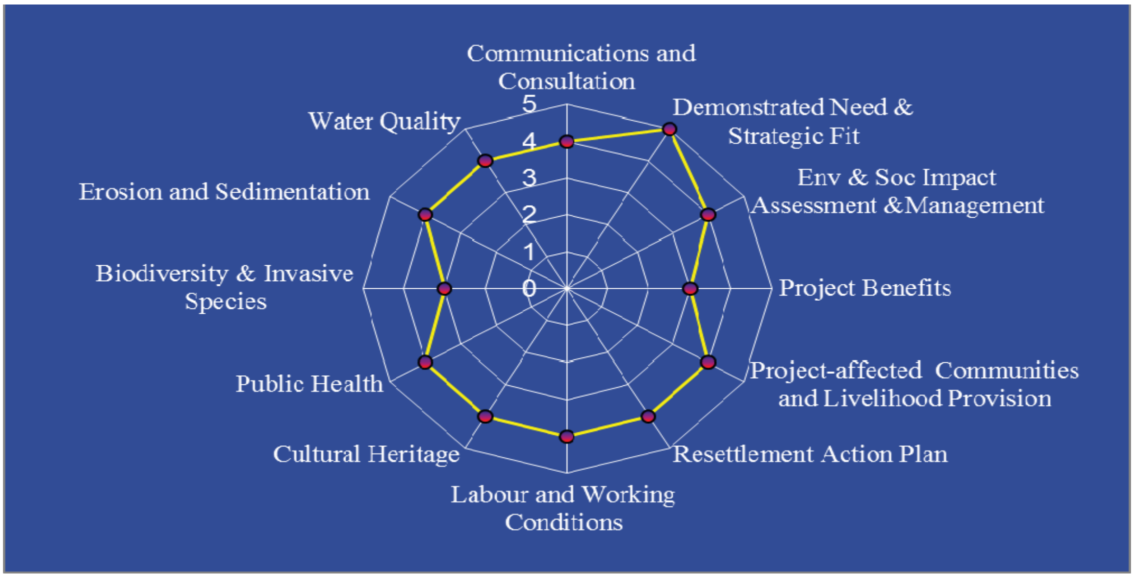

Figure 1: Hydropower Sustainability Assessment of DHP

[1] International Hydropower Association, 2010. Hydropower Sustainability Assessment Protocol

Table 1: Protocol 1: Communications and consultation

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-1	**Communications and consultation**	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	Two volumes of SRMP (Vol. 3 PCPP, and Vol. 11:- CP deal with consultations, communications and disclosures Demonstrated evidence of community engagement and extensive consultation with stakeholders and communication strategies and plans at implementation Broad-based community support to the Project .Good practices such as community participation in many committees (i.e., VC, GRC, Leading Group) for local decision-making, development and local capacity building Full compliance with WB and international "good practices"	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 2: Protocol 3: Demonstrated Need & Strategic Fit

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-3	**Demonstrated Need & Strategic Fit**	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	**Assessment** Analysis of Alternatives' have been carried out as part of EIA demonstrating the need for energy services Compared various feasible options for energy development (thermal and renewable) in terms of environmental and economic implications It was demonstrated in the analysis, DHP is low cost and clean energy source with limited social and environmental impacts due to high power density (power generation per unit area). **Stakeholder Engagement** WAPDA's strategy on Vision 2025 on hydropower development was widely publicised and disclosed. Need for justification was disclosed to the various stockholders at the four national workshops conducted at Peshawar **Out comes** In addition to EIA, a report on justification of DHP was prepared by the Project by WAPDA' A stand along section on EIA was presented to confirm that the DHP is one of the priority options to address demonstrated needs.	5
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 3: Protocol 5: Environnemental & Social Impact Asses ment & Management

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-5	Environnemental & Social Impact Asses ment & Management	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	**Assessment** A baseline has been established for all social and environmental features for the pre-project condition against which post-project changes can be compared. The social safeguard issues particularly focused on negotiated land compensation approved by the local *jirga*, communications and disclosures, community participation in local decision-making, livelihood restoration programs, gender and community health, up and down impacts of the dam project, and management and monitoring of in-migrants and construction workers moving into the Project site. The environmental issues focused on identification of impacts on fish movement, habitat, riparian areas, seismicity, sedimentation, GLOFs, and climate change through extensive field studies and consultations, and mainstreaming the impacts in the project planning, design, implementation and operation to avoid any residual impacts **Management** Environmental and social issues management plans and processes have been developed for project implementation and operation with no significant gaps; in addition to key social and environmental issues relating to the hydropower project, plans address construction related waste, noise, air quality, land disturbance and rehabilitation; the environmental and social impact assessment and key associated management plans will be publicly disclosed **Stakeholder Engagement** Conducted community level consultations meetings and *jirgas* (tribal assembly of elders) to discuss potential project impacts and possible mitigation measures. The feedback received were later incorporated in developing policy matters related to environmental mitigation and entitled matrix for compensation, relocation, livelihoods, gender and health issues. • Four national workshops are conducted at Peshawar, Lahore, Karachi and Islamabad	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

				Out comes • A set of eight twenty three (23) volumes have been prepared the packaging of the documentation demonstrates the full coverage of impacts in the form of Environmental Management Action Plan (EMAP, 8 volumes) and Social and Resettlement Management Plan (SRMP, 15 volumes). **Compliance** The social and environmental deliverables are prepared in compliance with GOP and World Bank polices and guidelines	

Table 4: Protocol 10: Project Benefits

Protocol	Title	Assessment		DHP - Evidence and Justification	Score
		Scores	Criteria		
P-10	Project Benefits	5	Plans to anticipate and respond to emerging risks and opportunities, and provision for sustained benefits	**Assessments and Opportunities** Project wide overview of the impacts, opportunities and benefit sharing analysis within hydropower context Project benefits in terms of good compensation, allowances and other financial support, new resettlement sites with all basic amenities, better public facilities, and livelihood programs Long-term training and skill development program for employment Non-monetary benefit sharing programs in the form of local area development with social , and economic infrastructures at project costs Monetary benefit sharing – for example, electricity at reduced rate, royalty sharing with local governments planned **Management** Livelihood and social management plan s have been drawn without any gaps Local area development plan already incorporated as project cost Royalty sharing with the local government requires further policy, legal and institutional arrangements Plans proposed for benefit sharing with natural environment **Stakeholder Engagement** Community level *jirga* meetings demanded better compensation policies, including a 15-Point Charter of Demands for project benefit sharing with the affected communities **Outcomes** SRMP Vol. 6 RAP for good compensation, better facilities in resettlement sites, better livelihoods and income; Vol. 13 Benefit Sharing Approaches and Plan for monetary and non-monetary benefit sharing); Environmental Enhancement Fund (EEF) in EMAP Vol. 8 EMP. Enhanced opportunities for affected households and communities for access to new and/or improved public amenities and potential revenue sharing arrangements.	3
		4	All basic good practice elements, but one or more cases exceeded, but a gap in proven best practice		
		3	Assessment of opportunities, project benefit plans, engagement of stakeholders, and plans to deliver benefits		
		2	Most relevant elements of basic good practice have been undertaken, (Level 3), but there is one significant gap		
		1	There are significant gaps relative to basic good practice (level 3)		

Table 5: Protocol 13: Project-affected Communities and Livelihoods

Protocol	Title	Assessment: Scores	Assessment: Criteria	DHP – Evidence and Justification	Score
P-13	Project-affected Communities and Livelihoods	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	Socioeconomic baseline (SRMP Vol. 2) and comprehensive impacts (SRMP Vol. 6 RAP) identified and documented Impacts on livelihoods identified thru Income and Livelihood survey In addition to cash assistance, multiple options for livelihood restoration – short and long-term Provisions for skill development, training and capacity building Livelihood program implementation –roles and responsibilities identified; provisions for financing established Good practices include long-term Social Development Program and Local Area Development Benefit Sharing Programs (SRMP Vol. 13) Monetary and non-monetary programs Full compliance with WB safeguards and international standards	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 6: Protocol 14: Resettlement Plan

Protocol	Title	Assessment: Scores	Assessment: Criteria	DHP – Evidence and Justification	Score
P-14	Resettlement Plan	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	Enhanced new policy measures to address and cover all impacts and mitigation, including compensation at current market prices Entitlement matrix cover all losses for all categories of affected persons Multiple options for relocation, including development of community-preferred sites in higher elevation with all basic amenities and provision for livelihoods New social, economic , educational infrastructures as additional investments for social development Gender action plan and attention to vulnerable groups Community-wide support for the project and community involvement in implementation activities Pre-construction activities for social preparedness and readiness Meet all compliance issues, including setting new standards	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 7: Protocol 16: Labor and Working Conditions

Protocol	Title	Assessment Scores	Assessment Criteria	DHP - Evidence and Justification	Score
P-16	Labor and Working Conditions	5	Suitable, adequate, and meet all international labor practices and rights	**Assessment of Human Resources Needs** Full assessment of human resources and labor management requirements – annually and over time during project construction Analysis of labor requirements and influx of in-migrants and construction workers to project sites Socio-cultural implications of in-migration , health and safety issues and labor rights **Management Plans** Management plans at project level as well as contractors and consultants, based on laws, guidelines and frameworks Management Plan for safeguarding rights of migrant workers. Good practices include occupational health and safety, training, equal opportunity, and grievances redress mechanisms Environmental Code of Practices and Social Code of Conduct for laborers and contractors **Stakeholder Engagement** An Occupational Health and Safety (OHS) unit will be established as part of environmental unit of PMU. The OHS Specialist/s will be part of contractor, supervision consultant and PMU staff. Proactive approaches to deal with in-migrants management Recognition of in-migrants and construction workers as a "stakeholder" group in project construction Provisions for community level workshop for awareness for inter-cultural understanding Campaign for awareness about HIV/AIDS and other health issues, and awareness against human trafficking including women and children **Out comes** Integrated Labor management plans for safeguarding labor rights and standards in and outside labor camps, and equal access to work and opportunities (EMAP Vol. 8 Environmental Management Plan, and SRMP Vol. 9 Management Plan for Construction-related Impacts, and Vol. 3 of Bidding Documents) **Compliance with Local and Internal Labor Rights** Full compliance with national and international labor rights and practices.	4
		4	All relevant basic good practice undertaken, but one significant gap remains		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	Most relevant elements of basic good practice (Level 3) with one significant gap		
		1	There are significant gaps relative to basic good practice (Level 3)		

Table 8: Protocol 17: Cultural Heritage

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-17	Cultural Heritage	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	**Assessment** Physical cultural resources in the project area are identified along with their significance Protecting cultural heritage is one of the key criteria for selecting the current dam site location Impacts and risk of the project development on the PCRS are assessed. Assessment also includes opportunities for enhancement of PCRs and potential for tourism development. **Stakeholder Engagement** Directly affected stakeholders are involved in identification of the PCRs Plans for protection of graveyards and relocation of Seer Gayal mosque are prepared in consultation with stakeholders Grievance Redress mechanism will be in place for stakeholders to raise issues and get feedback **Stakeholder Support** Current location of the dam site is selected with stakeholder support to avoid submergence of impact cultural heritage (Seo mosque) in the Project area. **Out comes** A Physical Cultural Resources report is prepared with plans to avoid, minimise, mitigate, and compensate negative impacts on cultural heritage arising from project activities. In addition enhancement plans are proposed Shatial rock carvings and Seo mosque, which will be not effected by the project.	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 9: Protocol 18: Public Health

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-18	**Public Health**	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	Three project documents (SRMP Vol. 6 GAP, Vol. 7 PHAP, and Vol. 8 Management Plan for Construction-related Impacts) cover issues related to public health issues. Integrated approach to public health to (i) minimize adverse impacts on health risks (including HIV/AIDS), IEC; and (ii) improved health delivery system in the project area, including in-migrants and host populations. Enhancement, including establishment of health clinics, including capacity building of the existing facilities Financing, implementation and monitoring arrangements established	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 10: Protocol 19: Biodiversity & Invasive Species

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-19	Biodiversity & Invasive Species	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	**Assessment** An assessment of terrestrial biodiversity; aquatic biodiversity including passage of aquatic species and loss of connectivity to significant habitat; and risks of invasive species has been undertaken Gaps are identified in the present assessment and recommended additional studies during project implementation **Management** Plans and processes to address identified biodiversity issues have been developed for project implementation and operation Ecological experts will be in place from the construction supervision consultant and project management unit respond to emerging risks and opportunities during project implementation **Outcomes** Two reports – Terrestrial Ecology and Aquatic Ecology are prepared with planning to avoid, minimise, mitigate, and compensate negative biodiversity impacts arising from project activities Plans for reservoir fishery development and enhancement for community conservation at Kaigah is proposed	3
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 11: Protocol -20: Erosion and Sedimentation

Protocol	Title	Assessment		DHP – Evidence and Justification	Score
		Scores	Criteria		
P-20	**Erosion and Sedimentation**	5	Suitable, adequate, and effective assessment with no significant opportunities for improvement	**Assessment** Erosion and sedimentation are key issues for the Project and have been thoroughly analysed with the state of art technology to assess their impact on the project and to understand the sediment load and dynamics Potential landslide prone areas are identified and their impacts are assessed Further studies are recommended for evaluation of geotechnical issues related with identified landslides and catchment management for reduction of erosion and sedimentation. **Management** Sediment flushing is designed to optimise the power generation LLOs and flushing tunnels are designed to manage the sediment load Potential landslides along KKH are considered in the engineering designs and retaining walls are recommended Reservoir landslide monitoring plan is prepared **Outcomes** A standalone report on Reservoir Operation and Sediment Management is prepared A reservoir landslide management plan is prepared	4
		4	Suitable, adequate and effective assessment with only a few minor gaps		
		3	Suitable, adequate and effective assessment with no significant gaps		
		2	A significant gap in assessment processes relative to basic good practice (Level 3)		
		1	Significant gaps in assessment processes relative to basic good practice (level 3)		

Table 12: Protocol 21: Water Quality

<table>
<tr><th rowspan="2">Protocol</th><th rowspan="2">Title</th><th colspan="2">Assessment</th><th rowspan="2">DHP – Evidence and Justification</th><th rowspan="2">Score</th></tr>
<tr><th>Scores</th><th>Criteria</th></tr>
<tr><td rowspan="5">P-21</td><td rowspan="5">Water Quality</td><td>5</td><td>Suitable, adequate, and effective assessment with no significant opportunities for improvement</td><td rowspan="5">Assessment
Assessment on water quality during project construction and operation is carried out
Assessment of water quality impacts on aquatic ecology have been carried out
Water quality during high flow and low flow season in Indus and its tributaries from Basha dam site to Tarbela dam site is established to monitor the future impacts
Management
Water quality management Plans and processes to address identified water quality issues have been developed for project implementation and operation
Opportunities for improvement of water quality, such as waste water treatment facilities for Dasu town are considered.
Outcomes
A series of following EMP sub-plans are recommended for protection of water quality
• EMP Sub-Plan 1: Construction Management
• EMP Sub-Plan 2: Operational Management
• EMP Sub-Plan 3: Physiography and Geology
• EMP Sub-Plan 4: Hydrology & Surface Water Management
• EMP Sub-Plan 7: Noise and Vibration Management
• EMP Sub-Plan 8: Waste Management
EMP Sub-Plan 9: Hazardous Substances Management
• EMP Sub-Plan 11: Aquatic Ecology Management</td><td rowspan="5">4</td></tr>
<tr><td>4</td><td>Suitable, adequate and effective assessment with only a few minor gaps</td></tr>
<tr><td>3</td><td>Suitable, adequate and effective assessment with no significant gaps</td></tr>
<tr><td>2</td><td>A significant gap in assessment processes relative to basic good practice (Level 3)</td></tr>
<tr><td>1</td><td>Significant gaps in assessment processes relative to basic good practice (level 3)</td></tr>
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