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Government of Sindh, Pakistan
Irrigation Department

Sindh Barrages Improvement Project -
Sukkur Barrage Rehabilitation and Modernization

ENVIRONMENTAL AND SOCIAL ASSESSMENT

Sindh Irrigation Department

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List of Acronyms

AF	Additional Financing
BCM	Billion Cubic Meter
BDL	Below Detectable Limit
BP	Bank Policy
CEAP	Construction Environmental Action Plan
CIA	Cumulative Impact Assessment
CCA	Canal Command Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CGRM	Community Grievance Redress Mechanism
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSD	Cutter Suction Dredger
CSC	Construction Supervision Consultant
Cumec	Cubic meters per second (m^3/s)
Cusec	Cubic feet per second (cf/s)
dB	Decibels
ECA	Employment of Child Act
ECP	Environmental code of Practice
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESA	Environmental and Social Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
g	Peak ground acceleration
GCA	Gross Command Area
GDP	Gross Domestic Product
GoS	Government of Sindh
IBIS	Indus Basin Irrigation System
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IRSA	Indus River System Authority
IUCN	International Union for Conservation of Nature
GD	Grab Dredger
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
Ha	Hectare
HH	Household
mg/l	Milligram per liter
mm	milli meter
NCS	National Conservation Strategy
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NH	National Highway
NOx	Nitrogen Oxides
NTU	Nephelometric Turbidity Unit
NW	North Western Canal
OFWMA	On Farm Water Management Project
OP	Operational Policies
OHS	Occupational Health and Safety Specialist
OSPAR	OSPAR Convention or Convention for the Protection of the Marine Environment of the North-East Atlantic
PAK EPA	Pakistan Environmental Protection Agency
PCMU	Project Coordination and Management Unit
PECP	Pakistan Environmental Protection Council
PET	Potential Evapotranspiration
PM	Particulate Matter
PMO	Project Management Office
POE	Panel of Experts
PPE	Personal Protective Equipment
RAMSAR	Convention on Wetlands Signed in Ramsar Iran
RAP	Resettlement Action Plan
RCC	Reinforced Cement Concrete
RPF	Resettlement Policy Framework
SAP	Social Action Plan
SBIP	Sindh Barrages Improvement Project
SEPA	Sindh Environmental Protection Act
Sindh-EPA	Sindh Environmental Protection Agency
SID	Sindh Irrigation Department
SIDA	Sindh Irrigation and Drainage Authority
SO2	Sulphur dioxide
SMF	Social Management Framework
SPM	Suspended Particulate Matter
SWMO	Sindh Water Management Ordinance
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TORs	Terms of reference
TSHD	Trailing Suction Hopper Dredger
USD	United States Dollar

KEF Canal	Khairpur East Feeder Canal	VEC	Valued Environmental Component
KWF Canal	Khairpur West Feeder Canal	WAA	Water Apportionment Accord
MAF	Million Acre Foot	WBG	World Bank Group
MEA	Multi Lateral Environmental Agencies	WSIP	Water Sector Improvement Project
MEC	Monitoring and Evaluation Consultant	WWF	World Wide Fund for Nature
MCM	Million Cubic Meters		

Conversions

British Units	Metric Units	Metric Units	British Units
1 ft	0.305 m	1 m	3.28 ft
1 mile	1.609 km	1 km	0.621 miles
1 cusec (cf/s)	0.283 cumec (m^3/s)	1 cumec (m^3/s)	35.315 cusec (cf/s)
1 ac	0.405 Ha	1 ha	2.47 ac
1 MAF	1.2335 BCM	1 BCM	0.8107 MAF

1 Introduction

The Sukkur Barrage Rehabilitation and Modernization Project (the Project) is a proposed project, by the Government of Sindh (GoS), for rehabilitation of the 85-year old Sukkur barrage to enhance its useful life to safeguard the reliable supply of irrigation water to about 3.33 million ha[1]. The project is located near the towns of Sukkur and Rohri in Sindh province. Major interventions proposed in the Project are: (a) civil works to improve the strength of the barrage structure to enhance the life of the barrage; (b) mechanical works for improvement of gate operations for improved flood protection; (c) electrical works and monitoring systems for improved reliable operations of the barrage; (d) removal of sediments from the upstream of the barrage to prevent conveyance of sedimentation to the canals and improved flood control; and (e) removal of sediments from the heavily silted up right bank canals for improved irrigation flows. The GoS has requested funding for this Project from World Bank through Additional Financing (AF) under the current Bank funded 'Sindh Barrages Improvement Project' (SBIP). Sindh Irrigation Department (SID) is the executing agency of the Project. A comprehensive Environmental and Social Assessment (ESA) has been carried out for the Project and presented in this report.

1.1 Background

Agriculture is the mainstay of Sindh economy. About 60 percent of 42 million Sindh population live in rural areas and mainly depend on agriculture and related activities for their livelihood. About 30-35 percent of Sindh's population lives below poverty line, and a majority of the poor are rural. Pakistan produces over 108 million tonnes of agricultural commodities worth over USD 13 billion annually. Sindh contributes about 23 percent to country's agriculture Gross Domestic Product (GDP). In recent decades, agriculture's contribution to Pakistan's GDP has declined; however, it still accounts for 21.6 percent of GDP. Agriculture GDP consists of 32.8 percent major crops, 11.1 percent minor crops, 53.2 percent livestock, 2.9 percent fisheries and forestry. Through its production, agriculture contributes 60 percent to the country's export earnings and 45 percent of the nation's labor force. Pakistan is among the top 20 global producers in over 48 different agricultural commodities and Sindh substantially contribute towards production of rice, sugarcane, wheat and cotton.

Irrigation is critical for agriculture in Sindh. Rain-fed agriculture is not possible in Sindh since it falls under 'hot desert climate' (Koeppan classification), where annual rainfall is very low (about 100 mm) compared to annual potential evapotranspiration (over 2200 mm). About 78 percent of groundwater in Sindh is generally saline (except along Indus) and not suitable for irrigation. Thus without canal irrigation, agriculture is not possible in Sindh. Even before construction of barrages, for centuries some areas in Sindh had depended on flood waters of Indus for agriculture through its old Inundation Canal Systems (artificial inundation canals that were linked to Indus and received water when there were high flows or floods). Inundation canals generally provided uncertain and precarious supplies during crucial sowing and maturity periods. Further, due to upstream construction of barrages, this region received only marginal supplies for inundation canals.

Indus Basin Irrigation System and barrages in Sindh. Pakistan's agricultural sector is almost wholly dependent on irrigation, particularly the Indus Basin Irrigation System (IBIS). IBIS accounts for approximately USD 300 billion of investment (at current rates), 22 percent of the country's GDP, 65 percent of its employment, and 70 percent of its export earnings. Sindh is the primary beneficiary of IBIS with three large barrages built on the Indus River. First barrage

[1] The potential command area of Sukkur barrage is about 3.34 million ha, but actual irrigation area is about 3.08 million ha. About 600,000 farming households are directly benefitted by the barrage.

Sukkur was commissioned in 1932 followed by Kotri and Guddu in 1955 and 1962, respectively (see Figure 1.1). These three barrages divert about 59 billion cubic meters (BCM) of water to a cultivable command area of about 5.1 million ha. Besides transforming desolate and barren lands of Sindh in to green fields and fertile depository of grain, these barrages were also instrumental for establishment of agro-based and agro-allied industry to open and provide new vistas of employment and job opportunities for the expanding population of Sindh.

Sukkur Barrage has the largest irrigation network in the country. Sukkur Barrage is one of the most important and strategic structures of the Indus Basin Irrigation System. About 80 percent of the agriculture land in Sindh depends on the Sukkur barrage. The barrage has seven canals, four on the left bank (Nara, Khairpur Feeder East, Rohri and Khairpur Feeder West) and three on the right bank (Dadu, Rice and North Western). The left bank canals serve 11 districts of Sindh (Sukkur, Khairpur, Noshehro Feroze, Nawabshah, Sanghar, Mirpurkhas, Umarkot, Badin, Hyderabad, Tando Allahyar and Tharparker); while the right bank canals serve four districts of Sindh (Shikarpur, Larkana, Shahdad Kot and Dadu) and one district of Baluchistan (Dear Allah Yar). A total of 1,805 villages comprising of 13,746 settlements are located in the command areas of the seven canals. The barrage is also used for river control and flood management, act as a source of water supply for all sectors of the economy, function as a bridge over Indus. Therefore, the condition and the safe and reliable operation of the Sukkur barrage have far-reaching implications for the livelihood and economic growth of all segments of society in Sindh.

Need for improvement of Sukkur barrage. After eight decades of its useful life, the Sukkur barrage in Sindh have developed major safety issues. The feasibility study of Sukkur barrage has identified many issues such as (i) insufficient flood evacuation capacity through the barrage arches under the gates, (ii) sedimentation of the left and right pockets in front of the intakes of the canals, (iii) silting up of right bank canals, (iv) scour at the left pocket, (v) outdated equipment and electrical system, and (vi) need for some local structural repairs on arches, piers and road deck. There is a risk to the barrage in case of large flood events, and any failure of the barrage during those events is likely to be catastrophic affecting water supplies to all the irrigated areas of the barrage and flooding the Sukkur town. The feasibility study concluded that substantial rehabilitation, maintenance and improvement works, including critical structural repairs, desilting, upgrading of the gate lift structure and electric wire system; the current barrage can increase the flood passage capacity to 1.2 million cusecs (33,980 m^3/s) from the current flood capacity of 1.9 million cusec (25,485 m^3/s).

1.2 Sindh Barrages Improvement Project (SBIP)

SBIP is an ongoing Bank funded project for rehabilitation of the fifty-year-old Guddu barrage to enhance its useful life to safeguard the reliable supply of irrigation water to about 1.05 million ha. Major works included in Guddu barrage rehabilitation are: (a) replacement of barrage gates and canal head regulators, and some structural repairs to enhance the life of the barrage; (b) strengthening and extension of river training works for modification of river flows and for Improved flood protection; and (c) construction of a new left pocket divide wall to prevent conveyance of sedimentation to the canals. SBIP became effective in November 2015.

Safeguard instruments of SBIP: The SID has prepared an ESA and Social Management Framework (SMF) for the Guddu Barrage Rehabilitation. The ESA has adequately prepared all the environmental and social management plans (ESMP) to address the impacts associated with implementation of Guddu rehabilitation. Indus River between the Guddu and Sukkur barrages is a designated game reserve for Indus River dolphin. The ESA has included a dolphin conservation and management plan to strengthen the ongoing conservation activities as well as cumulative impacts associated with the operation of all three barrages in Sindh. During the

preparation of SBIP, no land acquisition or resettlement was anticipated for Guddu Barrage rehabilitation. The SMF was prepared, including Resettlement Policy Framework (RPF) to guide preparation of resettlement action plans (RAP) for any unforeseen land acquisition, a Social Action Plan (SAP) to support local area development programs, and a Communication Strategy to support continued consultations during project implementation.

1.3 The Proposed Project for Additional Financing

The feasibility study cum detailed design of the Sukkur barrage rehabilitation, including Environmental and Social Impact Assessment (ESIA), has been prepared during 2012-2017 by an international consulting firm WS Atkins International Ltd. in joint venture with two Pakistani firms ACE and NDC. Financial assistance for the study was provided by the World Bank under the Sindh Water Sector Improvement Project (WSIP). Sindh Irrigation Department (SID) is the executing agency of the WSIP. The GoS has requested the World Bank to also include the rehabilitation of Sukkur barrage as a part of the ongoing SBIP through AF.

Location: Sukkur barrage is located at longitude 68° 51'E and latitude 27°41'N across the River Indus some 362 km from Karachi. The Sukkur city (population 0.523 million) is located on the left bank of the barrage and the Rohri town is located on the right bank of the barrage. The location map of Sukkur barrage and its command area is shown in Figure 1.1. The Barrage is located about 185 km downstream of Guddu Barrage and about 550 km upstream of Kotri Barrage.

Proposed rehabilitation and modernization of Sukkur Barrage: The physical works that are proposed for the rehabilitation scheme are as follows:

- Removal of about 1.5 million cubic meters (MCM) of sediments from both left and right pockets of the barrage and right bank tail channel through dredging (about 0.75 MCM) and excavation (about 0.75 MCM).
- Removal of about 4.24 MCM of sediments from the right bank canals (3.07 MCM from a 25 km length of Rice canal; 0.92 MCM from a 7 km length of North Western canal; and 0.25 MCM from a 7 km length of Dadu canal)
- Civil works to improve the strength of barrage structure (RCC arches, stone arches, stone piers, etc.) and raising of left and right divide walls
- Gates and mechanical works for improved gate operations and increasing the gate height by 61 cm (2ft)
- Electrical works for improved reliable operations

1.4 The Environmental and Social Assessment

Studies and basic data: This ESA is based on field studies and data collected between 2012 and 2017 by the consultant team charged with the design of the project and their reports on Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA), which are also disclosed on SID website along with the ESA reports. A team of independent consultants was retained by SID to validate design consultants reports and prepare independent ESA report as per guidelines of World Bank.

Independent consultants: The Project Management Office (PMO) of SBIP engaged a team of independent consultants – Dr. Venkata Nukala (team leader, environmental specialist, email: venkata@eiaPractitioner.com), Dr. Najam Khurshid (ecologist), Mr. Haider Bhugri (social specialist) and Mr. Nijaz Lukovac (engineer) – to assess the environmental and social impacts of the project, and to prepare this main ESA report and an Executive Summary. During the ESA process, the independent consultants regularly interacted with the design consultant, carried out

their own field visits, participated in consultations, and conducted their independent analysis and impact assessment. Terms of References for this study is given in Annex A.

Contents of the present document: After a description of the Sindh and Pakistani legal and administrative framework and the applicable World Bank policies in chapter 2, a project description is presented in chapter 3, followed by a discussion of project alternatives in chapter 4. A description of the physical, chemical, biological and socio-economic environment is given in chapter 5. Potential adverse effects of the project are described in chapter 6 and potential cumulative impacts and concerns associated with other barrages of Sindh are presented in chapter 7. Possible mitigating measures to offset, reduce or compensate potential negative impacts of the project are included in the Environmental and Social Management Plan (ESMP) that is summarized in chapter 8. Finally, chapter 9 provides an overview of all stakeholder consultations and activities for disclosure and access to the information.

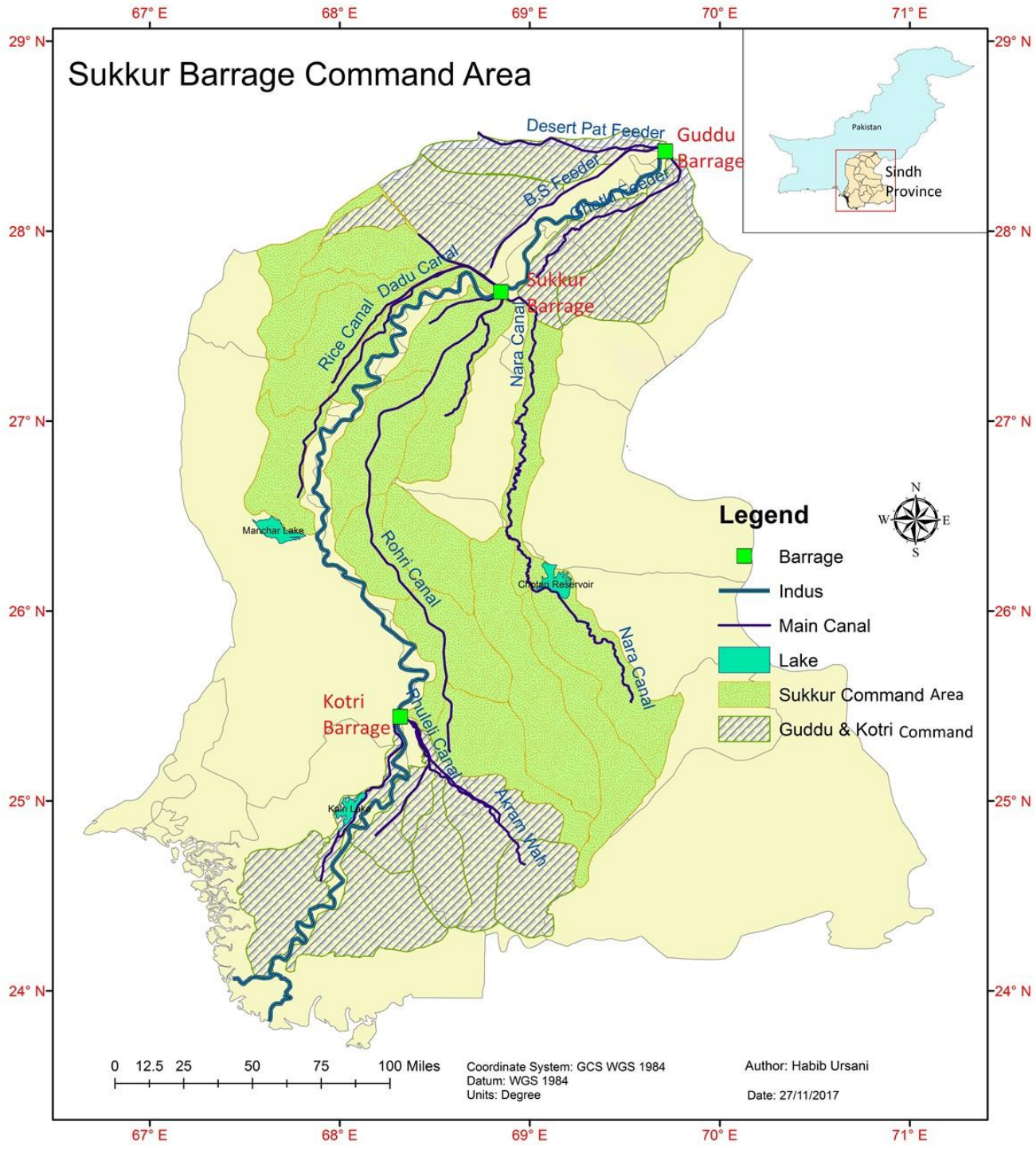


Figure 1.1: Location of Sukkur Barrage and its command area

2 Policy, Legal and Administrative Framework

2.1 General

This Chapter provides an overview of the legislative structure and environmental assessment process in the province of Sindh as well as a list of key environmental legislation applicable in Pakistan. It also provides an overview of World Bank and other relevant international requirements including identification of applicable World Bank Operational Policies and applicable World Bank Group Environmental, Health and Safety (EHS) Guidelines.

2.2 Applicable National Environmental Policies and Legislation

2.2.1 National Environmental Policies and Guidelines

National Conservation Strategy (1992)

The Pakistan National Conservation Strategy (NCS) is the principal policy document for environmental issues in the country which was developed and approved by the Government of Pakistan on 1st March 1992. The NCS works on a ten-year planning and implementation cycle. It deals with following core areas:

- Maintaining soils in cropland;
- Increasing irrigation efficiency;
- Protecting watersheds;
- Supporting forestry and plantations;
- Restoring rangelands and improving livestock;
- Protecting water bodies and sustaining fisheries;
- Conserving biodiversity;
- Increasing energy efficiency;
- Developing and deploying material and energy renewable;
- Preventing and abating pollution;
- Managing urban wastes;
- Supporting institutions for common resources;
- Integrating population and environmental programs;

The National Environmental Policy (2005)

The National Environmental Policy (NEP) describes integration of the environment into development planning through the implementation of the EIA process at the scheme level. The NEP is the overarching framework which aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development'.

The policy includes guidelines to Federal, Provincial and Local Governments under the following headings:

- Water supply and management
- Air quality and noise
- Waste management
- Forestry
- Biodiversity and protected areas
- Climate change and ozone depletion

- Energy efficiency and renewable
- Multilateral environmental agreements

National Environmental Quality Standards (2010)

The National Environmental Quality Standards (NEQS) were first promulgated in 1993 and have been subsequently amended including standards for liquid effluent and gaseous emissions. The latest standards for ambient air, drinking water quality and noise levels were published on November, 2010 and standards for motor vehicle exhaust, diesel vehicle and petrol vehicle were published in August, 2009. The following standards are specified therein:

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment facilities, and the sea
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources
- Maximum allowable concentration of pollutants (8 parameters) in ambient air quality
- Maximum allowable concentration of pollutants (3 parameters) in motor vehicle exhausts
- Drinking water standards
- Noise standards

Guidelines for Sensitive and Critical Areas (1997)

The Guidelines for Sensitive and Critical Areas, 1997, identify officially notified protected areas in Pakistan, including critical ecosystems, archaeological sites, etc., and present checklists for environmental assessment procedures to be carried out inside or near such sites. Environmentally sensitive areas include, among others, archaeological sites, biosphere reserves and natural parks, wildlife sanctuaries and game reserves. These guidelines are applicable as the project area is in the vicinity of wildlife sanctuary (also a Ramsar site) for the Indus Dolphin.

Guidelines for the Preparation and Review of Environmental Reports (1997)

These guidelines are a part of package of *Pakistan Environmental Protection Ordinance 1997* and National Environmental Quality Standards, regulations and other guidelines. The scope of this guideline is confined to those aspects of environmental report preparation and review which are of general nature. Sector specific provisions are not included, nor are the subject of public consultation, which is dealt with separately.

Guidelines for Public Consultation (1997)

The Pakistan Environmental Protection Ordinance 1997 requires public participation during the review of an EIA (section 12 (3)). The “policy and procedure for the filing, review and approval of environmental assessments” requires the proponents to consult with the affected community and relevant NGO’s during the preparation of an environmental report.

The Solid Waste Management Policy (2000)

This policy was promulgated which aims to facilitate control on waste by providing principles of good waste management and reducing waste at source. The Guidelines have been consulted during planning and designing the disposal of solid waste from the staff colony and construction camps.

National Legislation

Factories Act (1934)

The clauses of the Factories Act relevant to the project are those which concern health, safety and welfare of workers, disposal of solid wastes and effluents, and damage to private and public

property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. As construction activity is classified as 'industry', these regulations will be applicable to the Contractor(s) to be engaged for Sukkur Barrage Rehabilitation works.

Forest Act (1927)

Federal Forestry Act of 1927 authorises Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set fire in the forest, quarry stone, remove any forest produce or cause any damage to the forest by cutting trees or clearing up area for cultivation or any other purpose

Protection of Trees and Brushwood Act (1949)

The Protection of Trees and Brushwood Act prohibits illegal cutting or lopping of trees along roads and canals planted by the Forest Department. The matter of permission to remove any trees, their compensation, and plantation to replace the lost trees will be taken up with the Sindh Forest authorities.

Antiquity Act (1975)

The Antiquity Act ensures the protection of cultural resources in Pakistan. This act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in this act as "Ancient products of human activity, historical sites, sites of anthropological or cultural interest and national monuments etc.".

The act prohibits new construction in the proximity of a protected antiquity and empowers the government of Pakistan to prohibit excavation in any area that may contain articles of archaeological significance.

Under this act, the proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, and during the course of the project if an archaeological discovery is made, it should be reported to the Department of Archaeology accordingly.

No protected or unprotected antiquity has been identified in the project area that may be affected by the project interventions. However, a chance find procedure has been included in this ESIA in case of any, as yet, unidentified antiquity.

Wildlife Act (1975)

The Wildlife Act consolidates the laws approach to protection, preservation, conservation and management of wildlife in the country.

Local Government Ordinance (2001)

The Local Government Ordinance empowers the Government of Pakistan and provincial governments to enforce laws for land use; conservation of natural vegetation; air, water, and land pollution; disposal of solid waste and wastewater effluents; and public health and safety, including some provisions for environmental protection. Section 93 of this Ordinance pertains to environmental pollution, under which the local councils are authorised to restrict actions causing pollution to air, water or land.

The Local Councils of the project and surrounding area have been consulted for their views on the project interventions, and mitigations are proposed based on their views.

Motor Vehicle Ordinance (1995)

The Motor Vehicle ordinance deals with the powers of the Motor Vehicle Licensing Authorities and empowers other related agencies to regulate traffic rules, vehicle speed and weight limits, and vehicle use, to erect traffic signs, and to prescribe special duties of drivers in case of

accidents. It also prescribes powers of police officers to check and penalise traffic offenders. At the same time, the ordinance also empowers the regional transport authority to operate as a quasi-judicial body at district level to monitor road transport, licensing requirements, and compensations for deaths or injuries to passengers on public carriers.

Highway Safety Ordinance (2000)

The Highway Safety Ordinance includes provisions for licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control offences, penalties and procedures; and the establishment of a police force for motorways and national highways to regulate and control the traffic as well as keep the highways clear of encroachments.

Employment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labour in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth year of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act are carried out. The contractor will be bound by this Act to disallow any child labour at the project sites or camp sites.

2.3 Applicable Provincial Environmental Policies and Legislation

Sindh Environmental Protection Act (SEPA), 2014

The Sindh Environmental Protection Act (SEPA) was enacted on March 20, 2014. SEPA is the basic legislative tool empowering the Sindh government to frame regulations for the protection of the environment. The Act provides the framework for protection and conservation of species, wildlife habitats and biodiversity, conservation of renewable resources, establishment of standards for the quality of the ambient air, water and land, establishment of Environmental Tribunals, appointment of Environmental Magistrates, Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) approval. It also describes the powers and functions of the Sindh Environmental Protection Agency (Sindh EPA). The requirement to conduct environmental IEE or EIA before commencing developmental projects is a requirement under this Act.

The key features of the Act have a direct bearing on the proposed Sukkur Barrage Rehabilitation AF because the project requires an environmental and social assessment. As Sukkur Barrage is located in the district of Sukkur, it falls under the jurisdiction of the Sindh Environmental Protection Agency that will accord the approval of the ESIA pertaining to the project.

The following are the key features of the Act that have a direct bearing on the project area.

- **Section 11 (Prohibition of Certain Discharges or Emissions)** states that “Subject to the provisions of this Act and the rules and regulations made there under, no person shall discharge or emit, or allow the discharge or emission of, any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards (NEQS)”.
- **Section 13 (Handling of Hazardous Substances)** requires that “Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, or import any hazardous substance except (a) under a license issued by the Agency and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other Instrument to which Government is a party.” Enforcement of

this clause requires the SEPA to issue regulations regarding licensing procedures to define 'hazardous substance.'

- **Section 14-1 (Prohibition of Action Adversely Affecting Environment)** requires that "Subject to the provisions of this Act and the rules and regulations, no person shall cause any act, deed or any activity, including - (a) recycling or reuse of hospital waste and infectious waste; (b) disposal of solid and hazardous wastes at unauthorized places as prescribed; (c) dumping of wastes or hazardous substances into coastal waters and inland water bodes; (d) release of emissions or discharges from Industrial or commercial operations as prescribed; (e) recycling or reuse or recovery of hazardous wastes or industrial by-products in an unauthorized or non-prescribed manner or procedure, and (f) any activity which may cause adverse environmental effect due to trans boundary projects of Province of Sindh" which lead to Pollution or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment and natural resources.
- **Section 15 (Regulation of Motor Vehicles):** Subject to provision of this clause of the Act and the rules and regulations made there under, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the NEQS, or where the applicable standards established under clause (g) of subsection (1) of Section-6 of the Act.
- **Section 17-I (Initial Environmental Examination and Environmental Impact Assessment)** requires that "No proponent of a project shall commence construction or operation unless he has filed with the Agency an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from the Agency approval in respect thereof." The EIA has been prepared for the Sukkur Barrage Rehabilitation AF to comply with this Section of the Act.
- **Section 17-2b (Review of EIA):** The Agency shall review the Environmental Impact Assessment report and accord its approval subject to such conditions as it may deem fit to impose, or require that the EIA be re-submitted after such modifications as may be stipulated or rejected, the project as being contrary to environmental objectives.
- **Section 19-1 (Environmental Monitoring)** states that "the Agency shall carry out or arrange environmental monitoring of all projects in respect of which it has approved an initial environmental examination or environmental impact assessment to determine whether the actual environmental impact exceeds the level predicted in the assessment and whether the conditions of the approval are being complied with".
- **Section 20-1 (Environmental Audit and Review)** requires that "the Agency shall from time to time require the person in charge of a project to furnish, within such period as may be specified, an environmental audit or environmental review report or environmental management plan containing a comprehensive appraisal of the environmental aspects of the project".

Sindh Wildlife Protection Ordinance (2001)

The Sindh Wildlife Protection Ordinance of 1972, as amended in 2001, 2010 provides for the preservation, protection, and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the ordinance. The ordinance also specifies three broad classifications of the protected areas:

- National Parks: Hunting and breaking of land for mining are prohibited in national parks, as removing vegetation or polluting water flowing through the park
- Wildlife Sanctuaries: Wildlife sanctuaries are areas which are left as undisturbed breeding grounds for wildlife. Cultivation, grazing and residing is prohibited in the demarcated areas. Special permission is required for entrance of general public. However, in exceptional

circumstances, these restrictions are relaxed for scientific purpose or betterment of the respective area on the discretion of the authority.

- Game Reserves: Game reserves are designated as areas where hunting or shooting is not allowed except under special permits. The Indus between Guddu and Sukkur barrages is the Game Reserve.

Wild Birds and Animals Protection Act (1912)

The Wild Birds and Animals Protection Act of 1912 provides for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto.

Sindh Fisheries Ordinance (1980)

The Sindh Fisheries Ordinance of 1980 provides rules and regulations for marketing, handling, and transportation, storage of fish and shrimps for commercial purpose and sale of fish used for the provincial trade in the Province of Sindh. Contravention of this Ordinance leads to imprisonment up to 6 months or a fine of 10,000 rupees or both. A provision is made for total ban on use of destructive fishing gear fishing during June and July.

The Sindh Water Management Ordinance (2002)

The Government of Sindh has promulgated the Sindh Water Management Ordinance (SWMO 2002) on October 26, 2002. SWMO 2002 provided framework for institutional reforms in water sector by decentralizing the water resources management and irrigation and drainage services. Under the SWMO 2002, Sindh Irrigation and Drainage Authority (SIDA) has been established at the provincial level for overall water resources management with a broad involvement from stakeholders. Similarly, the Area Water Boards is established at the canal command level, and Farmer Organizations (FOs) at the distributary/minor canal level consisting of water users' associations at the watercourse level. SIDA would therefore be involved in addressing the social and environmental issues under the project and through monitoring arrangements ensure that they are implemented properly.

Sindh Strategy for Sustainable Development (2007)

The Sindh Strategy for Sustainable Development proposes a ten-year sustainable development agenda for the province of Sindh. Its purpose is to highlight the ecological, economic and social issues of the province and to provide recommendations and strategic actions to address them. The strategy promotes the sustainable use of natural resources to achieve the objectives of poverty alleviation and social development through the participation of the people of Sindh.

2.3.1 EIA Approval Procedure

The Pak-EPA prepared regulations in 2000 for the "Review of IEE and EIA". These regulations categorize development projects for IEE and EIA into Schedules I, II and III. Projects are classified on the basis of expected degree and magnitude of environmental impacts and are included in different schedules.

The projects listed in Schedule-I include those where the range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. Schedule-I projects require an IEE to be conducted, rather than a full-fledged EIA, provided that the project is not located in an environmentally sensitive area.

The projects listed in Schedule-II are generally major projects and have the potential to affect a large number of people in addition to significant adverse environmental impacts. The impacts of projects included in Schedule-II may be irreversible and could lead to significant changes in land use and the social, physical and biological environment. Sukkur Barrage Rehabilitation AF is categorized in Schedule II and requires a full EIA. Sindh Environmental Protection Act is

approved in March 2014. Figure 2.1 provides an outline of the EIA process in Sindh. Those projects not included in schedule-I and II don't require IEE or EIA.

Sindh Irrigation Department is responsible for compliance with environmental commitments and mitigation measures proposed in this environmental report and in the subsequent review and approval conditions.

No construction, preliminary or otherwise, relating to the project shall be undertaken until and unless the EIA approval has been issued by the Sindh EPA.

The Sindh Irrigation Department shall submit the Environmental Report on a prescribed application along with a processing fee of Rs. 30,000 to Sindh-EPA. After submission of the EIA report, a thirty (30) day period for public comment shall be provided. The assessment will be completed within a period of ninety days from receipt of the complete documents, and earlier than this wherever practicable. Following the completion of public hearing, if required, and the provision of any further data from the proponent, the decision shall be made and conveyed thirty days thereafter.

Policy and Procedures for the Filing, Review and Approval of Environmental Assessments

The Policy and Procedures for Filing, Review and Approval of Environmental Assessments, 2000, define the policy context and the administrative procedures that will govern the environmental assessment process, from the project pre-feasibility stage to the approval of the environmental report.

Guidelines for the Preparation and Review of Environmental Reports

The Guidelines for the Preparation and Review of Environmental Reports, address project proponents, and specify:

- The nature of the information to be included in environmental reports
- The minimum qualifications of the EIA consultant
- The need to incorporate suitable mitigation measures into every stage of project implementation
- The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves.
- The reports must contain baseline data on the project area, a detailed assessment thereof, and mitigation measures.

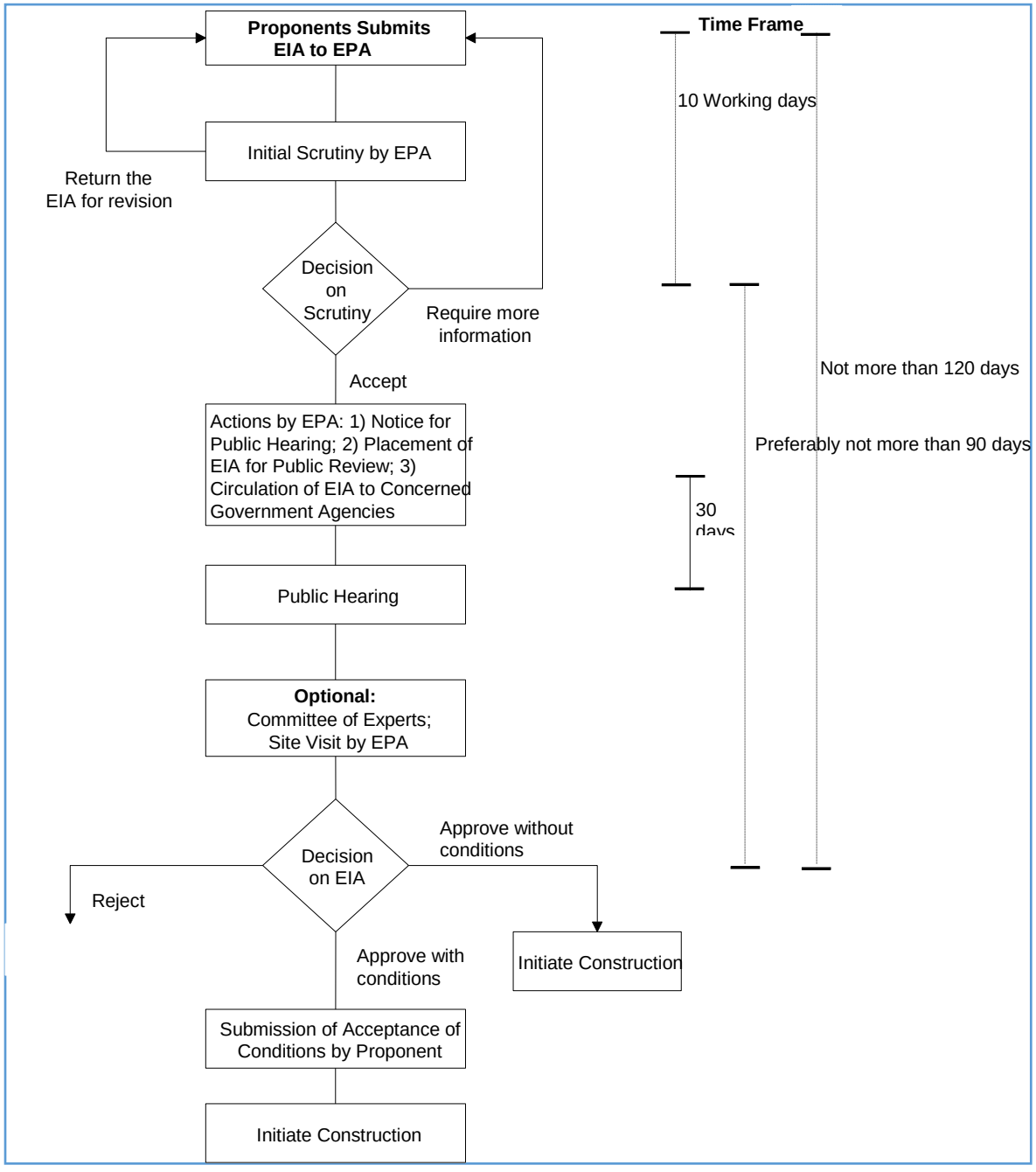


Figure 2.1: EIA Approval Process from Sindh EPA

2.4 Environmental Regulatory Authorities

The Pakistan Environmental Protection Ordinance, 1983 was the first legislation in Pakistan designed specifically for the protection of the environment. The promulgation of this Ordinance was followed in 1984 by the creation of Pakistan Environmental Protection Council (PEPC).

Pakistan Environmental Protection Council

The PEPC is the highest inter-ministerial statutory body in the country headed by the Prime Minister and is responsible for:

- Formulating national environmental policy;
- Enforcing PEPA 1997;
- Approval of the NEQS;
- Incorporation of environmental considerations into national development plans and policies; and
- Provision of guidelines for the protection and conservation of biodiversity in general as well as conservation of renewable and non-renewable resources.

Climate Change Division

The Climate Change Division, which falls directly under the Prime Minister Secretariat, is the focal point for National Policy, Legislation, Plans, Strategies and programs with regard to Disaster Management, Climate Change including Environmental Protection and preservation. The Division also deals with other countries, international agencies and forums for coordination, monitoring and implementation of environmental agreements.

Pakistan Environmental Protection Agency (PAK-EPA)

The PAK-EPA is headed by a Director General and has wide ranging functions as set out in PEPA 1997. These include preparation and co-ordination of national environmental policy for approval by PEPC, administering and implementing PEPA 1997 and preparation, revision or establishment of NEQS. The PAK-EPA has issued regulations regarding the environmental assessment procedures known as Review of Initial Environmental Examination (IEE) and EIA Regulations, 2000; these provide a firm legal status to the IEEs and EIAs. The jurisdiction of the EPA is applicable to the following projects:

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

Sindh Environmental Protection Agency

Sindh Environmental Protection Agency (Sindh EPA) is a counterpart of the PAK-EPA at the province level. The Sindh EPA is established by the respective provincial/regional governments. They are headed by a Director General. The IEE and EIA reports pertaining to projects falling within the boundary of Sindh are to be submitted to the Sindh EPA for approval.

2.5 International Treaties and Conventions

Pakistan is a signatory to a number of Multilateral Environmental Agreements (MEAs). These MEAs impose requirements and restrictions of varying degrees upon the member countries, in order to meet the objectives of these agreements. However, the implementation mechanism for most of these MEAs is weak in Pakistan and institutional setup mostly non-existent. The following are the relevant international treaties and conventions that have been ratified by Pakistan, where relevant, these will be discussed in further detail within relevant chapters:

- RAMSAR Convention on Wetlands of International Importance
- Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal
- Convention concerning the Protection of World Culture and Natural Heritage
- Convention on the International Trade in Endangered Species
- International plant protection convention
- International Covenant on Economic, Social and Cultural Rights
- International Labour Organization's (ILO) Core Labour Standards on

    - Freedom of association (convention 87)
    - Elimination of forced and compulsory labour (conventions 29 and 105)
    - Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
    - Abolition of child labour (conventions 138 and 182)
- Kyoto Protocol to the Convention United Nations Framework on Climate Change
- Stockholm Convention on Persistent Organic Pollutants
- United Nations Convention on Biological Diversity
- United Nations Convention on the Rights of the Child
- United Nations Framework Convention on Climate Change.

2.6 World Bank Safeguard Policies

The World Bank's environmental and social safeguard policies relevant to the project are summarized in Table 2.1 and include the following. The proposed AF does not trigger any new policy.

Environmental Assessment (OP 4.01): provides the framework for World Bank environmental safeguard policies and describes project screening and categorization to determine the level of environmental assessment required. The original operation is classified as Category A due to the major rehabilitation works on Guddu Barrage and potential impacts on the core habitat of endangered Indus River Dolphin located immediately downstream of Guddu Barrage. The classification remains the same for the proposed AF. The proposed AF activities involve civil and mechanical rehabilitation works of an existing barrage on Indus River with a potential to effect water quality and upstream dolphin habitat. The World Bank requires an environmental and social assessment for all "Category A" projects proposed for Bank financing, in order to ensure that these projects are environmentally and socially sound and sustainable. In accordance with the requirements of Operational Policy (OP) 4.01, environmental and social assessment has been carried out and ESMP prepared to mitigate or minimize all potential adverse environmental and social impacts.

Natural Habitat (OP 4.04): The policy recognizes the importance of natural habitat in sustaining biodiversity, and requires that projects strictly avoid their significant conversion or degradation (particularly for critical natural habitat), and minimize and mitigate impacts to them including, as appropriate, through creation of offsets and restoration measures. The Indus River between the Guddu and Sukkur barrages is the nationally designated game reserve for Indus River Dolphin and also a RAMSAR wetland of international importance. This part of the river contains large population of dolphins. Impacts of construction activities on dolphins were assessed and mitigation measures are proposed in ESMP. A dolphin conservation and management plan is being implemented under SBIP to strengthen the ongoing conservation activities.

Involuntary Resettlement (OP 4.12): sets out the World Bank requirement to avoid or mitigate adverse impacts resulting from project developments on cultural resources. No land acquisition is anticipated for the proposed AF. However, minor temporary or permanent land acquisition or resettlement might be required, depending on contractor's camp location or if a location study during the AF implementation indicates removal of an bank island and/or a shoal (or bela in the local language) on the right bank. A resettlement policy framework (RPF) has been prepared for the original project and updated for the proposed AF.

Safety of Dams (OP 4.37): This policy requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures through the project cycle. It recommends, where appropriate, that Bank staff discuss

with the borrowers any measures necessary to strengthen the institutional, legislative, and regulatory frameworks for dam safety programs in those countries. For large dams, the borrower must engage an independent Dam Safety Panel. Barrages are major hydraulic structures across rivers and are susceptible to failures due to earth quakes and floods. This policy is triggered and an action plan has been developed, including establishment of an independent panel of experts[2] to review the project design and review of emergency preparedness plan[3].

International Waterways (OP 7.50): Projects on International Waterways may affect the relations between the World Bank and its borrowers, and between riparian states. Therefore, the Bank attaches great importance to the riparian making appropriate agreements or arrangements for the entire waterway, or parts thereof, and stands ready to assist in this regard. A borrower must notify other riparian countries of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections. The project is located on the Indus River, which is an international waterway shared by Afghanistan, China, India and Pakistan. Therefore, OP 7.50 International Waterways is triggered but the AF falls within the exception to the notification requirement set forth in paragraph 7(a) of OP7.50 is applied because project investments primarily involve rehabilitation of existing barrage facilities and have no impact on water use or quantity of water flows of Indus River.

Access to Information: This policy sets out the Bank's requirements for disclosing and sharing information. The policy reaffirms the Bank's commitment to transparency and accountability in its activities for promoting development effectiveness and poverty reduction. This ESA report and Executive Summary along with SID's Social Management Framework have been disclosed at SID website and World Bank Info Shop in addition to sharing them with the stakeholders including the local community.

In addition, the following policies and guidelines have been taken into account in the project design:

Environmental Health and Safety Guidelines: The World Bank Group Environment, Health, and Safety (EHS) General Guidelines (2007) contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology.

Gender Policy (OP 4.20): The World Bank's Gender Policy aims to reduce gender disparities and enhance women's participation in the economic development of member countries. During the ESA, gender aspects have been considered and women's participation has been ensured as far as possible while carrying out the stakeholder consultations.

Pest Management (OP 4.09): No pesticides, herbicide or fungicides will be used in any of the project activities and hence this policy is not applicable. However, to address the increased use of pesticides in Sindh, a pesticide management plan has been implemented under the World Bank funded Sindh On Farm Water Management Project (OFWMP).

[2] The engineering designs have been reviewed by the panel of experts. In addition, the SID has also engaged international experts Mr. Barry Trembath and Dr. George Annandale to provide independent views on the project design. The Project designs are also reviewed by the World Bank's Lead Dam Specialist, Mr. Satoru Ueda.

[3] A standard emergency preparedness plan exists for all barrages in the Sindh, and it includes mechanisms to address various incidences such as scour, erosion, floods, seepage, gate failure, earth quakes, terrorism, etc. The plan includes standard protocols such as monitoring and surveillance; communications and notifications to relevant authorities and to the general public, and emergency actions for flood releases or immediate repairs.

Indigenous People (OP 4.10): This policy has defined Indigenous Peoples for policy application as well as the planning process to be followed if a Bank-funded project affects Indigenous Peoples. In Pakistan, the World Bank has concluded through its operational experiences that only Kalash people in Chitral district of Khyber Pakhtunkhwa province meet the definition of Indigenous Peoples as described in this policy. Since no Kalash people live in the project area, this policy is not applicable.

Physical Cultural Resources (OP 4.11): sets out the World Bank requirement to avoid or mitigate adverse impacts resulting from project developments on cultural resources. There are no known cultural or archaeological heritage sites within the project area. However, procedures dealing with "chance finds" are to be included in the bidding documents for the construction contracts.

Forestry (OP 4.36): The policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. No forests are located in the project area and hence this policy is not applicable.

Projects in Disputed Areas (OP 7.60): Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. This policy is not applicable, since the project is not located in or near any disputed territory.

Table 2.1: World Bank Policies Triggerd Under the Proposed AF

Directive	Policy	Triggered	Comments
Environmental Assessment	OP/BP 4.01	Yes	As the Project falls into Category A, a full ESA has to be carried out. It is the basis of this ESA document.
Natural Habitats	OP/BP 4.04	Yes	The Indus River between the Guddu and Sukkur barrages is the nationally designated game reserve for Indus River Dolphin and also a RAMSAR wetland of international importance. This part of the river contains large population of dolphins. Impacts of construction activities on dolphins were assessed and mitigation measures are proposed in ESMP. A dolphin conservation and management program is being implemented under SBIP.
Indigenous Peoples	OP 4.10	No	Not triggered since no Indigenous People are living in the area.
Physical Cultural Resources	OP 4.11	No	Not triggered since there are no known cultural or archaeological heritage sites within the project area. However, procedures dealing with "chance finds" are to be included in the bidding documents for the construction contracts.
Involuntary Resettlement	OP/BP 4.12	Yes	No land acquisition is anticipated for the proposed AF. A resettlement policy framework (RPF) prepared under SBIP has been updated to deal with any unexpected land acquisition required for the proposed AF. The updated RPF will guide the planning and implementation of compensatory measures in line with relevant Pakistani laws and OP 4.12.
Forests	OP/BP 4.36	No	Not triggered since no forests are located in the project area.
Pest Management	OP 4.09	No	Not triggered. No pesticides, herbicide or fungicides will be used in any of the project activities.
Safety of	OP/BP	Yes	The dam safety Policy is triggered and an action plan has

Directive	Policy	Triggered	Comments
Dams	4.37		been developed, including establishment of an independent panel of experts to review the project design and preparation of emergency preparedness plan.
Projects in International Waterways	OP/BP/ GP 7.50	Yes	This policy is triggered but an exception to notification is applied because project investments primarily involve rehabilitation of existing barrage facilities and will have not adversely change water use or quantity of water flows of Indus River.
Projects in Disputed Areas	OP/BP 7.60	No	Not triggered since the project area is not located in a disputed territory.
Access to information			The EIA reports of design consultants have been disclosed in SID's website in July 2017. This ESA and the executive summary (including its Sindhi and Urdu translation) along with the main ESA will be will be posted to SID's website; and will be sent to the World Bank's external website.

2.6.1 World Bank Environmental and Social Guidelines

The principal World Bank publications that contain environmental and social guidelines are listed below;

- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues;
- Involuntary Resettlement Sourcebook;
- Social Analysis Sourcebook;
- Physical Cultural Resources Sourcebook; and
- World Bank Group - Environmental Health and Safety Guidelines, such as
    - General[4];
    - Ports, Harbors and Terminals (relevant sections on dredging activities)[5];
    - Construction Materials Extraction[6]

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

[5] http://www.ifc.org/wps/wcm/connect/d2f2cf88-ce22-4a48-86fc-45ee3b8e9e45/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES

[6] http://www.ifc.org/wps/wcm/connect/d6bb0e80488551afa93cfb6a6515bb18/Final%2B-%2BConstruction%2BMaterials%2BExtraction.pdf?MOD=AJPERES&id=1323162191491

3 Project Description

3.1 Background

Salient Features of the Sukkur Barrage. Construction of Sukkur barrage was started in 1927 and was commissioned in 1932. Total width of the barrage between the two abutments is 1.4 km, comprising of 66 gated bays in the main weir, 5 gated bays in the right pocket (under sluices between the right divide wall and right abutment) and 6 gated bays in the left pocket (between the left divide wall and left abutment). The structure is mainly of stone masonry construction with reinforced concrete arches spanning 18.29m (60') openings for the two bridge decks; an upper deck used for operating the gates and a lower road deck. The canal head regulator structures on both the banks control flow in the three right-bank canals of Dadu, Rice and North Western canals; and four left-bank canals of Khairpur Feeder East, Rohri, Khairpur Feeder West and Nara Canals. The canal regulators are low level structures carrying a deck area for operating the gates and a road bridge. The river training works upstream of the main barrage comprise divide walls, a submerged weir and approach/tail channel with outer and middle banks within the river and an inner bank adjacent with the right guide bank. An island was also built between the middle bank and approach channel. Layout of the barrage is shown in Figure 3.1.

Barrage irrigation function. The primary purpose of the barrage is to raise the water level in the Indus in order to divert river water into seven irrigation canals (three on the right bank and four on the left). The canals irrigate 3.34 million ha (8 million acres) of cultivated land. Irrigation allowances are regulated by the 1991 Water Apportionment Accord, which allows an average volume of 2.17 BCM (1.76 million acre feet, MAF) per month (approximately equivalent to an average discharge of 838m^3/s or 29,600 cusecs) to be diverted from the Indus between October and April (the dry season crops, *Rabi*) and an average volume of 3.98 BCM (3.23 MAF) per month (approximately equivalent to an average discharge of 1538 m^3/s or 54,300 cusecs) to be diverted between May and September (the monsoon crops, *Kharif*). The canals are generally closed annually during January for about four weeks for maintenance works; and for about two weeks in April. However, Rice Canal will be closed for about 6 months during October to March.

Barrage flood discharge function. In 1932, the Sukkur Barrage and its protection works were constructed to safety pass a flood of 1.5 million cusecs (42,475m^3/s). However, the modifications done during 1940 in right side river training works (which included closure of 10 gates, construction of a submerged weir and an island in front of closed gates) reduced the flood capacity to 0.9 million cusecs (25,485 m^3/s). Almost since its inception, the Barrage has been facing hydraulic, functional and structural problems over its life of 85 years, during which about 11 super floods with discharges more than 0.9 million cusecs (25,485 m^3/s) have passed through Sukkur Barrage. Hydrological analysis conducted as part of the preparation of this project show the design flood (100-year return period) to be about 1.34 million cusecs (37,944 m^3/s).

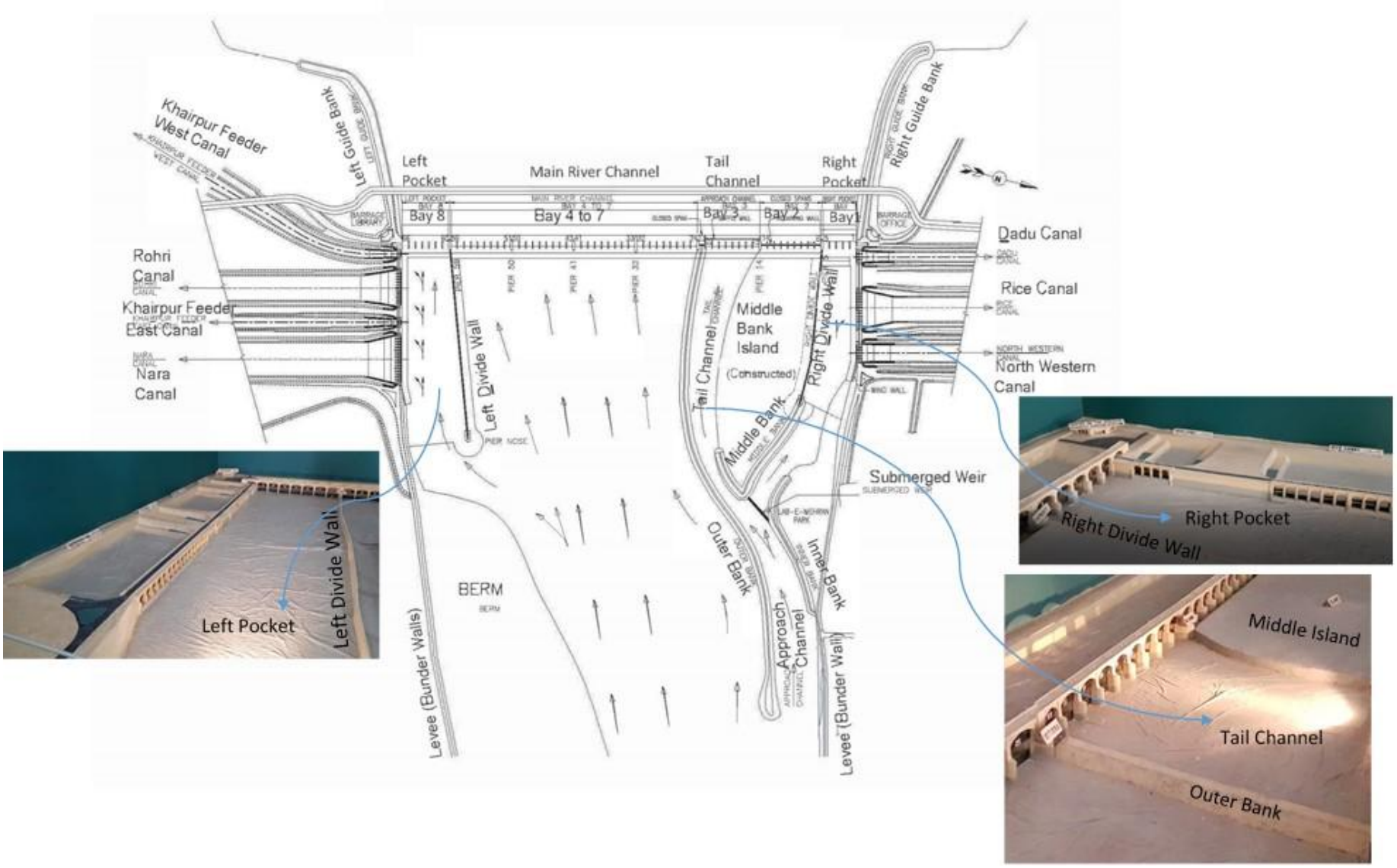


Figure 3.1: Existing Layout and sections of Sukkur barrage

3.2 Description of the Barrage Structure

The layout of the barrage is shown in Figure 3.1. The main barrage has eight distinct sections, referred to as bays, grouping a number of spans in each. Each span contains a vertical lift gate. The spans and the piers in the main barrage are numbered from right to left looking downstream. The eight bays are**:**

- **Bay 1 – Spans 1 to 5**: **Right Pocket**. This is the section between right bank abutment to right divide wall (Figure 3.1). This right pocket controls the flow to the right bank canals and hence the desiltation of the right pocket is very critical. This section also contains scouring sluices for facilitating flushing of deposited sediments[7]. Each scouring sluice span controls the flow with a 7.47m x 18.29m (24.5 ft x 60 ft) steel gate. The right divide wall was constructed at an angle of 95º to the axis of the barrage, for a distance of 359.66m (1,180 ft) widening the pocket from 106.68m (350 ft) at sluices to 143.26m (470 ft) at its mouth. The wall is then continued parallel to the guide bank; for a further distance of 140.21m (46 ft'). At the upstream end of the divide wall is a submerged weir with crest level, at 56.27m (184.6 ft) which separates the right pocket from the approach/tail channel and is intended to reduce the sediment intake into the right bank canals.
- **Bay 2 – Spans 6 to 14**: **Closed Spans and Middle Bank Island**. After commissioning of the barrage in 1932, it was observed that the right bank canals were drawing excessive silt. This situation was investigated through developing a physical model at Poona Laboratory in India during 1932. Based on the model recommendations, this section of the barrage with nine river sluices is permanently closed and new river training works were constructed. These are middle bank and an island between the barrage and outer bank (known as middle bank island) and outer bank. to stop the entering of silt in to canals. The approach/tail channel is a 1219m (4,000 ft) long curved channel which is formed by the outer bank and the right bank (approach channel), and the outer bank and the island (tail channel).
- **Bay 3 – Spans 15 to 23**: **Tail Channel.** This is section between middle bank island and outer bank wall (Figure 3.1). The purpose of the channel is to induce secondary currents at the location of the submerged weir to ensure that sediment laden flow is carried down the tail channel and water with lower sediment content discharges into the right pocket. The gates[8] in this bay were replaced during the refurbishment in 1980 to 1992. Span 23 is permanently closed by a masonry wall with a top level of 200' (60.96m). The outer bank, a river training bund, with a top level of 200.5' (61.11m) extends approximately 1524m (5000 ft) upstream from span 23. The top width of the bund is 1.22m (4 ft). There is a low height breach in the bund approximately 762m (2500') upstream of the barrage. This was reportedly created for access to the remedial works in the right pocket in 2005. The breach was repaired by placing loose rock placed in the breach in the hope that silt would deposit around the loose rock to form a barrier to the flow.
- **Bay 4 to 7 – Spans 24 to 59: Main River Channel.** This is the main section of the Barrage. The river sluices in this bay similarly have raised sill design[9] and the gates in this section were installed in 1986 to 1992.

[7] The scouring sluices in this section have a level bed design u/s 53.64m (176'), weir sill level 53.64m (176') and d/s 53.34m (175')

[8] The river sluices in this bay have a lower bed and raised sill design {u/s apron level 52.12m (171ft), weir sill level 53.95m (17ft) and d/s apron level 52.12m (171ft)}. The opening of 21' (6.40m) high gates in these spans draws water past the submerged weir. A low level divide wall extends from pier 15 and pier 22 to 19.81m 65' (65') from the pier noses of these piers towards the downstream side of the barrage. A RCC baffle wall is located downstream of gates 15 to 22

[9] {u/s apron level 52.12m (171'), weir sill level 53.95m (177') and d/s apron level 52.12m (171')}

- **Bay 8 – Spans 60 to 66**: **Left Pocket.** This is section between left abutment and left bank wall (Figure 3.1). This section of the barrage controls flows from the left pocket. Each scouring sluice[10] span in this section controls the flow with a 7.47m (24.5') x 18.29m (60') steel gate. The old gates were replaced with new ones between 1986 and 1992. The left divide wall separates the left pocket from the main river. The wall extends from pier 59 approximately 601.07m (1972') upstream at an angle of 95° to the barrage axis, increasing the width of pocket channel from 149.96m (492') at the scouring sluices to 175.26m (575') at the mouth. The 8.23m (27') high left divide wall is built with a 6.10m (20') width at base, 1.52m (5') width at top and with a top level of 200.5' (61.11m). Scour protection works are provided at the upstream end of wall.

There are three different pier sizes incorporated in the barrage structure. The standard pier is 3.05m (10') wide and 21.34m (70') long, the abutment pier at the end of each bay (piers 5, 14, 23, 32, 41, 50 and 59) are 7.62m (25') wide and 36.58m (120') long with an extended cutwater. The central abutment pier 32, which is 7.85m (25'9") wide and 57.91m (190') long, extends u/s and d/s of the barrage over the entire foundation of the river sluices.

The abutments of the barrage are founded inside the river bed at about 121.92m (400') from the higher river banks on either side. The road bridge terminates at the abutment while the gate bridge continues for one span on either side of the barrage to connect with the abutment towers which are constructed over sound foundation.

The abutments are in line with the canal head regulators and are connected with the first head regulator on each side through a masonry wall with a thickness of 1.07m (3.5') at the top, retaining the earth fill on the landwards side. Similar connecting walls are also built for joining the abutments of consecutive canal head regulators in a straight line. The abutments terminate with wing walls on the downstream side of the barrage. A similar wing wall is provided on the upstream side at the most upstream canal head regulator abutment.

The barrage has a number of auxiliary structures such as:

- **Canal Head Regulators** – with sill level of all head regulators that is kept at least 1.83m (6') above the barrage floor. The higher level gate bridge of the regulators is supported on 7.62m (25') wide twin elliptical arches with a rise of 2.19m (7.17') at the crown and the lower level road bridge over a single 7.62m (25') wide elliptical arch, with a rise of 2.54m (8.33') at the crown.
- **Guide Banks** - The upstream guide banks are shaped to be more or less perpendicular to the barrage, and contain the river between them. The left guide bank is about 3962m (13000') long from the end of the upstream wing wall at the abutment of Nara Canal to the limestone outcrops. The guide bank was designed with a freeboard of 1.52m (5') to the highest recorded flood level of 60.36m (198.04') at the time of design. The top width was 9.14m (30') with a road, and the last 1219m (4000') was set back from the river bank, forming a berm. The bank has been raised many times since then and also has a wall with a top level now varying from 63.40m (208') near barrage to 64.62m (212') near Lansdowne Bridge. The right guide bank runs a distance of about 1372m (4500') from the end of upstream wing wall at the abutment of North Western Canal to the existing masonry bunder wall. The guide bank was constructed at a lower height to join with the existing road which could not be raised due to door levels of the already constructed houses close to the bunder wall. The wall was however raised to 61.78m (202.7'). The present levels of bunder walls are

[10] The scouring sluices in this section have a level bed design {u/s 53.64m (176'), weir sill level 176' (53.64m) and d/s 175' (53.34m)}.

from 63.40m (208') to 64.92m (213') near Lansdowne Bridge. The most downstream section of the guide bank is now no longer required due to the construction of the inner bank.

- **Bunder Walls (dykes, levees)** – The right bunder wall is a continuous wall from the barrage to Sukkur-Begari Bund, just upstream of Lansdowne Bridge. The left bunder wall is two lengths; from the barrage to the circular bund near the shrine hills of Satin-jo-Astan and after the hills, upstream of Lansdowne Bridge, joining Rohri-Nabishah Bund. Near Sukkur Gorge, the walls on both sides are founded on steep hills, with its height ranging from 1.52m (5') to as high as 6.07m (20'). The last raising of wall was done to maintain a 0.91m (3') freeboard from flood levels of 2010. The construction was completed recently by rising to the required height by plane cement concrete and providing a 7.6cm (3 inch) RCC sheet, hanging down from this concrete mass, on the river side for protection of stones from weathering and scouring actions

3.3 Assessment on Current Condition of Sukkur Barrage

The condition assessment carried out under the feasibility study indicates that there are serious operational difficulties and safety issues with the barrage. Most severe problems include (i) insufficient flood evacuation capacity through the barrage arches under the gates, (ii) sedimentation of the left and right pockets in front of the intakes of the canals, and in the right bank canals (iii) scour at the right pocket, (iv) outdated equipment and electrical system, and (v) need for some local structural repairs on arches, piers and road deck. There is a risk to the barrage in case of large flood events, and any failure of the barrage during those events is likely to be catastrophic affecting water supplies to all the irrigated areas of the barrage and flooding the Sukkur town. The feasibility study concluded that substantial rehabilitation, maintenance and improvement works, including critical structural repairs, silt removal, upgrading of the gate lift structure and electric wire system; the current barrage can increase the flood passage capacity to 33.980 m^3/s (1.2 million cusecs), representing the estimated 20-years flood. The assessment on the current conditions of the barrage and need for rehabilitation is further explained in detailed in Section 4.1 on 'without project alternative'.

3.4 Project Objective

The main development objective of Sukkur Barrage rehabilitation and modernization project is to safeguard the reliable supply of irrigation water to about 3.34 million ha thus benefitting directly about 0.6 million farm households and about 6 million population. This will be achieved through proposed rehabilitation and modernization measures and additional studies proposed under this Project.

3.5 Project Components for for the Proposed AF

3.5.1 Component A: Rehabilitation of Sukkur Barrage

This component will support all civil and mechanical works proposed for rehabilitation of the barrage and its associated structures. The proposed scope of investment under this component would include: (i) mechanical repairs and improvement (current gears and hoists manufactured in 1926), (ii) critical repairs to the structure, (iii) removal of silt from the barrage in both right and left pockets, and from the right bank canals, and (iv) control and measurement structure of the main canal gates. These activities are further elaborated in the following sections:

3.5.1.1 Mechanical improvements and Repairs

The works will include gate repair works to improve the regulation and the flow of the barrage. This includes increasing of Gates Height by 61 cm (2ft); increasing of freeboard for fully opened condition; replacement of Roller Trains, Bottom & Side Seals and other Components; removal of Counterweights and Installation of Required Powerful Lifting Motors; and remote gate operation

from Central Control Office and from Gate Deck as well as hand wind facility for manual operation. Detailed list of activities to be carried out under this component are:

- Barrage Gates:
  - Minor Repairs and Epoxy Coating
  - Increasing of Gates Height by 61 cm (2ft)
  - Increasing of Freeboard for Fully Opened Condition
  - Replacement of Roller Trains, Bottom & Side Seals and other Components.
  - Removal of Counterweights and Installation of Required Powerful Lifting Motors.
  - Remote Gate Operation from Central Control Office and from Gate Deck as well as hand wind facility for manual operation.
- Canal Head Regulator Gates:
  - Minor Repairs and Epoxy Coating
  - Replacement of moving parts
  - Pontoon Mounted Caisson Gates:
  - for Main Barrage (4 numbers)
  - For Canal Head Regulators (2 numbers)
- Complete replacement of electrical works

3.5.1.2 Repairs to Barrage Structure

The works included are repairs of (i) RCC arches of the barrage at about 200 locations; (ii) minor stone reconstruction of broken stone edges of head regulators, (iii) complete replacement of gate deck flooring, (iv) inspection of foundations and carrying out necessary repairs, and (v) improvement of storm water drainage. Details of works to be carried out under this component will include:

- Repair works to structure:
  - RCC Arches of Barrage (200 numbers)
  - Stone Arches of Head Regulators (165 numbers)
  - Stone Piers, Barrage (128 numbers) and Head Regulators (110 numbers)
  - Stone Filling above Arches of Barrage and Head Regulators
  - Complete Replacement of Gate Deck Flooring
  - RCC Jacketing of Canal Head Regulator Piers
  - Isolation of weir foundations for inspection and required repairs.
- Road works:
  - Replacement of Road Surface and Stormwater Drainage.
- Foundation and inspection repairs
  - Isolation of foundation for Inspection during low flow season
  - Repairs, as required.

3.5.1.3 Desilting of the Barrage

The works included are, desilting of:

- Right Pocket and approach channel
- Tail Channel
- Left Pocket and its approach

The locations of the areas where desilting will be carried out are shown in the Figure 3.2. The middle bank island and outerbank bela will remain intact, as desilting will be undertaken around the island.

Figure 3.2: Locations of the areas to be desilted in the barrage

3.5.1.4 Desilting of the Right Bank Canals

About 4.24 MCM of sediments will be removed from the right bank canals. The details of sediments to be removed from the right bank canals are given in Table 3.1 and locations are shown in Figure 3.3.

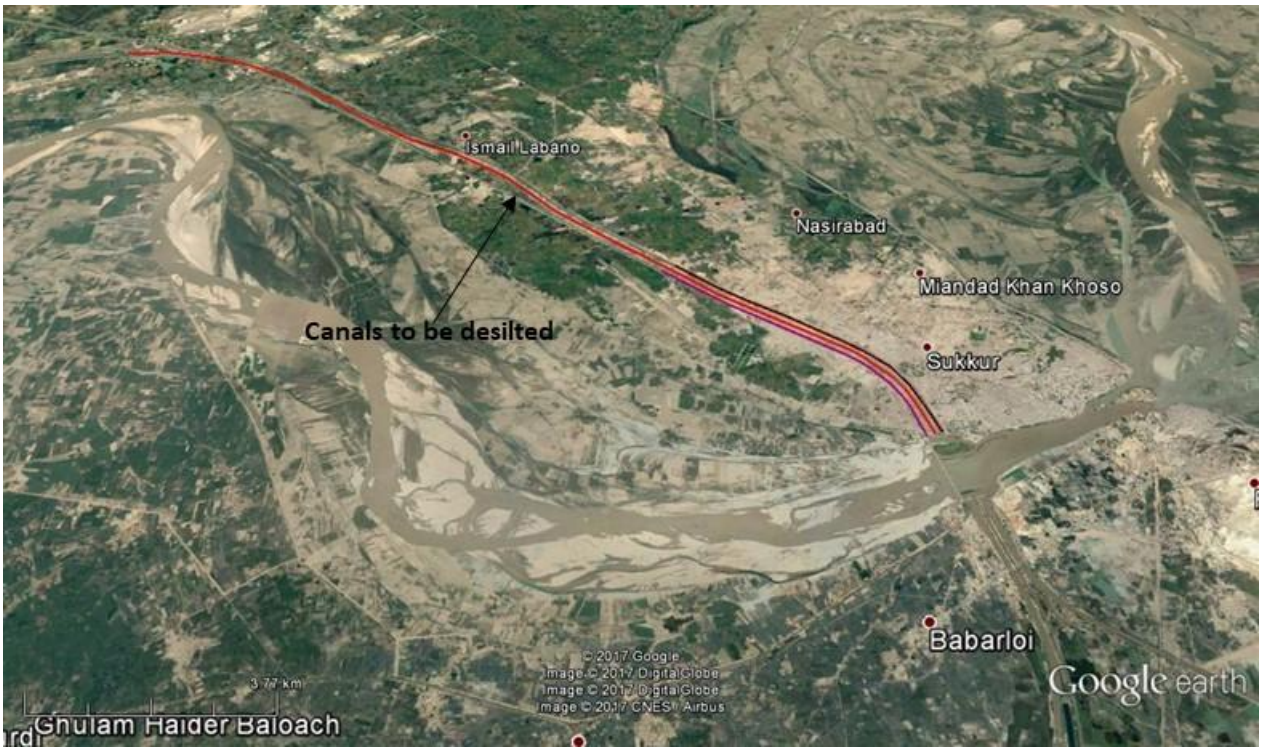


Figure 3.3: Locations of right bank canals to be desilted

Table 3.1: Details of silt removal from right bank canals

Name of the Canal	Length of the Canal to be desilted, km (from the Canal off take point)	Quantity of the material to be desilted, MCM
Rice	25.60	3.07
North Western	7.01	0.92
Dadu	7.01	0.25
Total		**4.24**

3.5.1.5 Other minor construction activities

The project will also support construction of some buildings for the workshops and offices within the existing barrage premises in the land owned by the Barrage.

3.5.2 Component B: Improved Barrage Operation, Improvement

This component will support modernization and improvements to the barrage operation and maintenance. This will include necessary upgrades to the instrument monitoring systems such as piezometers, gate positioning and gauging, training and capacity building for staff, replacement of surveillance and maintenance boats and procurement of hydrographic equipment. The project will provide new covered workshops and a stock of spare parts for maintenance activities. The instrument monitoring system for the barrage will be renovated and the operating staff will be equipped with an upgraded operation, maintenance, and surveillance manual. This component will lead to upgrading of the operating facilities with a higher level of control and improved operation & maintenance.

3.5.3 Component C: Project Management Coordination and Monitoring and Evaluation, and training

This component will support the coordination of all project-related activities as well as training and technical assistance in procurement, financial, social and environmental safeguards and communication. Activities will include the establishment of an independent Panel of Experts (POEs) to review, monitor, evaluate, and help guide the rehabilitation process with regard to the safety of the barrage.

3.5.4 Component D: Technical studies

This is anew component under the proposed AF. It would support: (a) a study for exploring suitable locations for a new Sukkur Barrage (detailed in Section 4.2), and (b) a detailed hydraulic study to determine the optimal design for the riverbank training and the needs for raising the height of the bund wall, and (c) preparation for a possible second phase rehabilitation with environmental and social safeguards documents.

3.5.5 Component E: Integrated Riverine Management.

This also is a new component under the prposed AF, which will upgrade the Social Action Plan (SAP) under the Social Management Framework (SMF) as a standalone component to focus on social development and environment management of the stretch of Indus River between Guddu and Sukkur Barrages. It would comprise activities supporting: (a) dolphin management and conservation, (b) community fisheries co-management, (c) sustainable agriculture, (d) technical studies (e.g., design for fish passage gates) and (e) water quality and pollutant studies. This component would be implemented in collaborations with the Sindh Environmental Protection Agency (SEPA), Wildlife Department, Forest Department and Agriculture Department, and

Fishery Department. World Wildlife Fund (WWF) would also participate in implementation of this component.

3.6 Construction Methodology

Most of the proposed project works, except dredging and excavation of sediments, will be carried above the water on the barrage. The chemical quality of sediments has been evaluated during this ESA study and they were found that non-contaminated. Considering the good quality of the river bed sediment materials, the following dredging and dredged material placement techniques have been adopted by the Project.

3.6.1 Dredging and Dredged Material Management

The dredging of sediments (estimated volume is 0.75 MCM) will be carried out through hydraulic cutter suction dredgers during high flow season of July and August and dredged material will be placed 'in-river' on the downstream of the barrage through hydraulic pipes. The rationale for selection of dredging methods and dredging season and dredged material placement in the river are further discussed in Chapter 4 and mitigation measures associated with the dredging are discussed in Chapter 6.

3.6.2 Excavation of Sediments and Excavated Sediments Management

Two sites have been identified, one on right bank and the other on left bank, for placement of material to be excavated from the right bank canals and from the barrage. Locations of these two placement sites are shown in Figure 3.4. This location has also been used for excavated material placement during previous dredging works. This location is not generally covered by the river water during normal flow season, except during very high floods; and during these high floods this material will be transported back to the river. There is no cultivation or residences in these areas, thus, no land acquisition or resettlement is required for these two sites.

Figure 3.4: Locations of excavated material placement area

Excavated material from the barrage site will be placed on the left bank placement area; while the excavated material from the first 7 km length of canals will be placed at the right bank placement area. The material excavated beyond the 7 km of the Rice canal, will be used to strengthen the existing embankment. The material excavated from the first 7 km of the canals cannot be used for strengthening of canal embankments since they are occupied by about 300 squatters' households and illegal constructions. Details on the sediments to be excavated from each construction site and how they will be managed are given in Table 3.2. The right bank placement area can hold a volume of 2.5 MCM, while the left bank placement area can hold 3 MCM of material.

Table 3.2: Details on Management of Excavated Materials form the Barrage and Canals

Name of Site/ Canal	Length to be de-silted, km	Quantity of material to be excavated, MCM	Material to be placed at Left Bank Placement Area, MCM	Material to be placed at Right Bank Placement Area, MCM	Material to be used for Canal Embankment Strengthening, MCM
Barrage Area		0.75	0.75		
Dadu Canal	7.01	0.25		0.25	
North Western Canal	7.01	0.9		0.9	
Rice Canal	First 7 km	1.09		1.09	
Rice Canal	From km 7 onwards to km 25.60				1.98
Total		**4.24**	**0.75**	**2.24**	**1.98**

3.6.3 Excavation Methods and Transportation Routes

The desilting of the Dadu and North Western canals is planned to be carried out over a period of two years, but only during the month of January, when the canals are closed annually for maintenance works. While, desilting of Rice Canal will be carried out over a period of 3 months (October to December) during its six month of canal closure period. Normal means of excavations using excavators and dumpers will be used for de-silting. The closure period with no flows in canals will allow movement of heavy machinery in the canal bed, avoiding the use of canal embankments which are heavy congested by squatters and illegal constructions in the first 7 km length of the canals. The entrance and exit of excavators and dumpers taking out the excavated silt from canal bed will be controlled near the canal bridge crossing at km 1.3 (RD 4) and km 5.1 (RD 17). The routes used by the dumpers for transport of excavated silt is shown in Figure 3.5.

The de-silted material will be transported through the existing highways to the right bank placement area and will have minimum interaction with local communities. About 80 trucks will be used daily during one month of excavation period for transport of de-silted material. Traffic management will be in place by the contractor with adequate placement of traffic signals and traffic control personnel, when the vehicles are passing through the local roads.

The excavated material from the barrage area to the left bank placement area will be transported through a 1.5 km river and canal embankments (local roads) and passes through settlements. About 20 dumpers will be used daily during low flow season of excavation in the barrage. Strict traffic management will be in place by the contractor with adequate traffic signals and traffic control personnel along this route.

Figure 3.5: Location of Vehicular Rotes for De-Silting of Canals

3.7 Construction Material and Sources

During the construction, a large amount of construction material will be required. This will include cement, sand, aggregates and steel. The aggregate will be obtained from an existing government approved quarry site located at Rohri, 10 km from the barrage site. There exist several quarry sites in Rohri. Due diligence will be carried about to ensure the quarry is being operated as per the provisions of the permits issued by the provincial Environmental Protection Agency (EPA). Before procurement of the material, the environmental specialists from the Project Management Office of SBIP will visit these areas to ensure the environmental safeguards are in place; and also consult with the EPA on the record of any compliances related to the quarry operator. The cement would be brought from cement factories located near Hyderabad while steel may be procured from Karachi. A summary of construction material requirements of the project is given below

- Stones for Bed Protection : 35,680 m^3 (1.26 million cft)
- Stones for Scour Protection : 43,000 m^3 (1.52 million cft)
- Course aggregate for Concrete : 4,530 m^3 (0.16 million cft)
- Fine aggregate for Concrete : 3,400 m^3 (0.12 million cft)

It is expected that about 50 trucks per day will be used for transport of quarry material over a period of one month. In addition, it is expected that about 20 to 30 trucks will be used within the construction areas for transport of concrete and other materials.

3.8 Contractors Facilities

Average labour requirement per day is 200 while peak time requirement estimated to be 350. Unskilled workers will be mainly hired locally. The number of skilled workers to be brought by the contractor from other parts of Pakistan or abroad will be around 70. A workers' camp will be established by the contractor near the barrage site. The contractor will provide adequate accommodation, transportation, and basic services including water, sanitation and medical care for the workers in compliance with the best industry practices such as "Workers' accommodation: processes and standards - A guidance note by IFC and the EBRD"[11]. The location of the camp area is shown in Figure 3.6. This area has been also used by earlier contractors for developing camp area during previous rehabilitation work. Hence, some facilities are already available in this area, which can be used by the contractor. In addition to the workers' camp, the contractor will also be built the following temporary facilities required for construction:

- concrete batching plant
- bulk construction materials storage
- general storage area
- workshop area
- plant maintenance and storage
- fuel storage
- temporary storage of waste materials
- wastewater treatment plant
- offices
- testing laboratory

11 http://www.ifc.org/wps/wcm/connect/9839db00488557d1bdfcff6a6515bb18/workers_accomodation.pdf?MOD=AJPERES&CACHEID=9839db00488557d1bdfcff6a6515bb18

Figure 3.6: Locations of proposed contractors camp

3.9 Construction Equipment

Table 3.3 outlines the approximate number of major machinery and vehicles that are envisaged to be required for the project construction works:

Table 3.3: Equipment Required for the Project

Equipment	Number
Dredger	1
Barge mounted crane	1
Air Compressor (10-30m3/min)	6
Batching Plant	2
Tug Boats	4
Boat – (passenger)	6
Breaker Excavator mounted hydraulic	12
Breaker, hand held 20-35 kg	20
Bus	5
Chipper, hand held, pneumatic	20
Concrete Mixer petrol	10
Concrete pump lorry mounted/stationary	4
Crane 35 ton	10
Crane 80 ton	3
Crane, mobile barge mounted	4
Generator standard silenced	10
Loader/Dumper wheeled/tracked	20
Drill Percussive, handheld, electric	6
Drill/Grinder handheld electric	8
Pick up	10
Dumper, regular use (more vehicles will be used during one-month period of canal de-silting)	20
Poker, vibratory, hand held	10
Saw/Groover concrete petrol	6

Water Bowser	6
Water Sprinkler Trucks	25

Source: Feasibility Study of Sukkur Barrage Project

3.10 Construction Schedule

The construction is planned to be completed in 3.5 to 4 years. The proposed construction schedule is shown in Figure 3.7. De-siltation works using dredging will be carried out during one high flow season; while the desiltation works using excavation will be carried out during one or two low flow seasons. Canal desilting will be carried out during canal closure period. It is expected that all desilting works will be carried out in one season, however if they could not be finished in one season, they will be carried out during next season. During this period, there will be additional studies will be carried out through physical models for design of additional river training works to achieve a design discharge of 1.5 million cusecs (42,475 m^3/s). If these studies recommend construction of additional river training structures, they will be constructed in a subsequent phase.

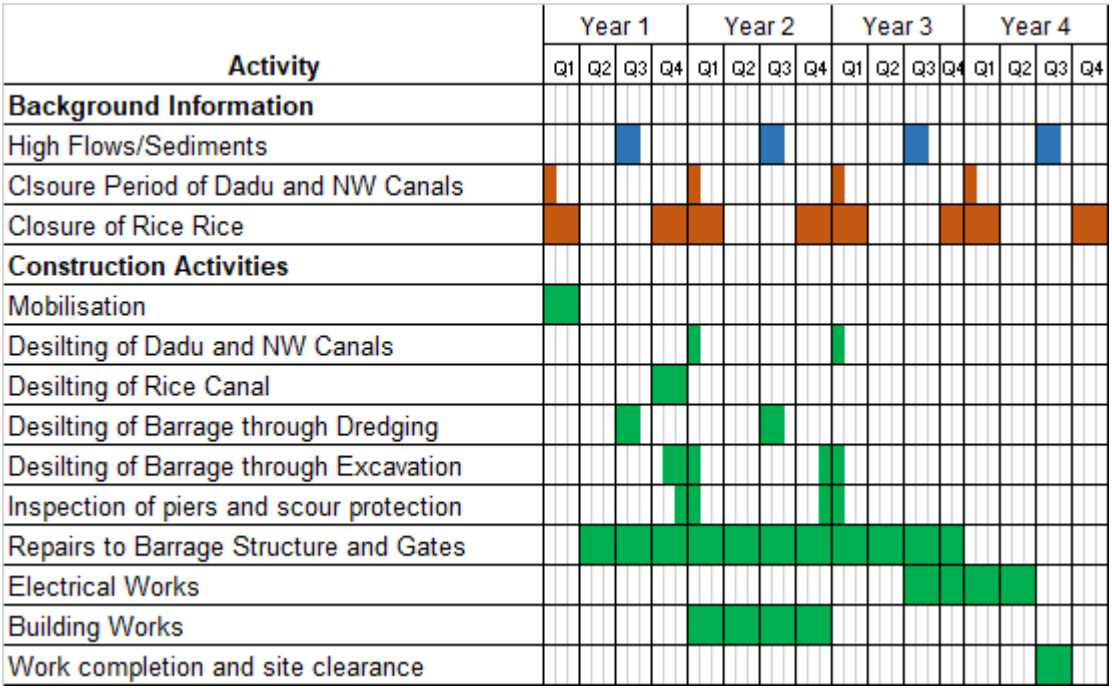


Figure 3.7: Proposed Construction Schedule

3.11 Project Cost

The estimated cost of Sukkur Barrage rehabilitation is shown in Table 3.4.

Table 3.4: Overall Estimate of Project Cost (US Dollars)

Project Components	Project cost, million USD
A. Rehabilitation and Modernization of Sukkur Barrage	81
B. Improved Barrage Operation, Improvement	4

C. Project Management Coordination, Construction Supervision, and Monitoring and Evaluation, and technical assistance and training	3
D. Feasibility Studies for new barrage, detail design and Environmental and Social Management Plans	6
E. Integrated riverine management, and implementation of environmental and social management plans	6
Total	**100**

4 Project Alternatives

During feasibility study and detailed design stages of the Project, various alternatives are considered based on the SID previous experiences in Kotri barrage and Guddu barrage rehabilitations. These alternatives were primarily derived based on numerical and physical modeling studies, with an intention to avoid any adverse environmental and social impacts associated with the irrigation releases, aquatic ecology and resettlement. This Chapter presents the analysis of various alternatives considered and their evaluation highlighting environmental and social aspects.

4.1 No Project alternative

Reduced Flood Capacity of the Sukkur Barrage. The record of flood discharges since 1901 indicates that before construction of the barrage a flood of 0.85 million cusecs (24,069 m^3/s) passed through Sukkur in 1914. From that year, the floods mostly remained below 0.7 million cusecs (19,821 m^3/s) with only a few of the floods above this value; maximum passing in 1917 at 0.77 million cusecs (20,954 m3/s). However, after extensive flood protection works and construction of flood embankments on both sides of River Indus, the spreading of river flows was prevented resulting in a marked increase in floods, starting with floods of 1 million cusecs (28,316 m^3/s) in 1958. Since then, this increasing tendency in combination with unpredictable nature of the hydrological condition/variation and behaviour of Indus River has resulted in 11 instances when river flow crossed 0.9 million cusecs (25,500 m^3/s). Flows above 0.9 million cusecs are termed as super floods. Out of these 11 floods, six were recorded to be above 1.1 million cusecs (31,148), with a maximum flood of 1.2 million cusecs (33,980 m^3/s) in 1976. The breaches at upstream of Sukkur Barrage, during this flood places the actual flood to be higher than 1.2 million cusecs (33,980 m^3/s). The recent flood of 2010 was similarly higher than recorded 1.13 million cusecs (31,998 m^3/s) at Sukkur Barrage, due to a number of flood embankment breaches at upstream of Sukkur Barrage.

Although all of these floods passed through Sukkur Barrage without any major damages but were found to be extremely strenuous to the barrage structure. Much of the downstream scour protection needed strengthening/replenishment after most of these floods. The observation recorded during flood of 2010 (Figure 4.1) shows that a major disaster was avoided by just a margin of 1 ft. when the freeboard below the bottom of fully opened barrage gates remained at this extremely unsafe value. Any rise in the flood level could have resulted in the blockage of free flood passage by these fully opened gates, transferring a pressure to the gates and then to the barrage, for which the structure is not designed for.

The water surface is close to underside of fully open gates, approximately 300mm clearance.

The underside of the masonry coping on the cutwater is 202.5. The flow water appears to be lapping up to this level.

Figure 4.1: Photos of Sukkur Barrage during 2010 Flood

Sedimentation issues of the Barrage. At present, the issue of sedimentation is just not limited to the problem of excessive entry of silt into the canals on right bank. After construction of river training works in 1939 the silting problem remained in check for quite a number of years. However, the increasing in canal discharges disturbed the balance created by the design of river training works and silting in the canals started to raise the bed level of the canals. The measure adopted to maintain the canal supplies in the silting canals was to increase the operating Pond Level. After an increase of 4.5 ft., through the years, the pond level is now at 199.0ft, changing from original Design Pond Level of 194.5ft. The low flows in the Indus River are also contributing greatly to silting as frequent flushing not becomes possible. At the time of construction of Sukkur Barrage, the project designers were even concerned for the impact of planned construction of Bhakra dam on River Sutlej. But with passage of time not only Bhakra but a number of other large dams, barrages and head works have been constructed on River Indus and its tributaries which have reduced the annual inflow reaching at Sukkur and is adding to problems to manage affective flushing operation. Consequently:

- This increasing in pond level in combination with reduced river flows has contributed to silting at upstream of the barrage, in the Left Pocket and its extremely oblique approach from main river, in the Tail Channel and in the Right Pocket. The reduced flows passing to downstream of the barrage are also resulting in heavy silting at downstream as well.
- The upstream silting in combination with silting at left berm, near the entrance to the left pocket, has resulted in constriction of approach to the Left Pocket. This is causing unfavourable flow conditions in that might result in excessive silt entry into the canals on left bank.
- With increased silting, the capacity of right pocket is now just enough to fillip; at least to half of its capacity in just one year, as observed after complete de-silting of right pocket during emergency repairs of 2006.

The photographs showing condition of silting in Right Pocket, Left Pocket, and Tail Channel, and at Upstream and Downstream of the Barrage and at downstream of Rice Canal Head Regulator is shown in Figures 4.2 to 4.5.

Water level 187 ft (closure 2013)

Water level 185 ft (closure 2014)

Figure 4.2: Photos of desiltation on the right pocket

Water level 186.5 ft (closure 2013)

Water level 184 ft (closure 2014)

Figure 4.3: Photos of desiltation on the left pocket

Water level 187 ft (closure 2013)

Water level 185 ft (closure 2014)

Figure 4.4: Photos of desiltation on the tail channel

Downstream of Barrage during Closure 2014

Downstream of Rice Canal Head Regulator during closure 2013

Figure 4.5: Photos of desiltation on the barrage downstream and Rice Canal Head Regulator

Consequences of not carrying out any rehabilitation and improvement works. The failure to carry out the proposed rehabilitation works will put the barrage at risk and its structural integrity, and any partial or full failure of the barrage would have severe consequences. Failure of the barrage due to severe floods will be catastrophic, affecting irrigation supply to the entire command area of 3.34 million ha. This in turn will affect livelihood of about 0.6 million farming households; and flooding of Sukkur town. Hence not carrying out any rehabilitation works will severely affect the economy of the region and the country at large.

4.2 Alternative to the Project

New construction to replace the Sukkur Barrage has been considered and rejected by both GoS and the Bank mainly due to the underlying soundness of the existing structure including foundations. With proper interventions, the existing structure can last for an indefinite period and can pass a flood of 1.2 million cusecs (33,980 m^3/s). The flood capacity of the barrage can be further increased with proper additional river training works. The difficulties of identifying a suitable location for the new barrage, technically, socially and environmentally, and the culture value of the current barrage also contributed to the decision. However, Sukkur Barrage is absolutely critical for Sindh's rural economy, and GoS is keen to carry out a pre-feasibility level analysis which would concentrate on identifying suitable locations for a new barrage which might have to be built in the medium to long term. This Project will support this study.

4.3 Alternatives to Flood Management

The feasibility study indicated that the current flood passing capacity of the barrage is 0.9 million cusecs (25,500 m^3/s), which is equivalent to 7 to 8 years of flood event), which needs to be increased to at least 20 years' occurrence floods - 1.2 million cusecs (33,980m^3/s). This increase can be achieved by increasing of freeboard below the fully opened gates, by raising the gates 6ft higher. In addition, extensive additional river training works will be needed in the future to improve the flood capacity of the barrage for 100-years occurrence floods (1.34 million cusec) and for the structure to last long. However, before taking up of any river training works extensive studies would be required through developing physical modes. Hence, the Project support both the alternatives, by taking up the first alternative of raising gates; and financing the studies for design of river training structures.

4.4 Options for Desilting of the Sediments from the Barrage Area

About 1.5 MCM of desilted material will be removed from the barrage. There are two options for desilting of the sediment deposits from the barrage. Generally, desiltation from the dry river beds will be carried out using excavation methods, and desiltation of sediments under water will be carried out using dredging methods.

For removal of silting from the dry river or canal beds or in the dry shoals (islands with silt deposits) that are located above water levels; excavators will be used for excavation of the sediments. The sediments will be then transported through trucks to the sediment placement area. The impacts associated with the excavation from dry river bed are minimal on the river since there will be no sediment dispersion. However, if the sediments contain some water, the sediment dispersion from excavation will be mitigated by placing sediment traps around the excavation activities.

The removal of siltation under the water will be carried out through dredging. Various types of dredging methods are discussed in the next section.

The project will use the both type of desiltation methods. Excavation will be used during low flow season when both the pockets are dry (in the months of December to February). The approximate volume of excavation is 0.75 MCM. The dredging will be carried in high flow season

(July to August) when the river water levels are generally high and the river carries high sediment load. The approximate volume of dredging will also be 0.75 million cubic meters.

4.5 Alternative Types of Dredging

General types of dredging suitable for the sediment removal from the Project are mechanical and hydraulic dredgers. General environmental issues associated with the various phases of dredging and how these impacts are significant with various types of dredgers are given in the following subsections.

4.5.1 Dredging Phases and Environmental Impacts

There are four phases of dredging: excavation, lifting, transportation and placement.

Excavation is the physical removal of the material from its in situ location on the bottom of a water body. It can be done by hydraulic forces and/or by mechanical forces of a cutter head, a draghead or the cutting edge of a bucket. The physical changes that can take place during excavation are the generation of suspended sediments (causing an increase in turbidity), mixing of soil layers, loss of excavated material (spill) and dilution (sediment mixing with water, especially in the case of hydraulic dredging).

Lifting is the vertical transportation of the excavated material from the bed. This is done mechanically in the case of a backhoe, dipper or bucket ladder dredger, or hydraulically in the case of a cutter suction, trailing suction hopper-, disc bottom-, auger- or sweep dredger. The physical changes that occur during lifting are the release of suspended sediments for example as overflow losses during loading, the creation of loose and mobile spill layers and a change in the density of the material.

Transportation is the process of transferring the excavated material to the location of placement. This can be done hydraulically through a pipeline, by hopper dredgers, barges, trucks or conveyor belts. The physical changes that can occur during transportation are dilution, spillage, noise, air pollution and safety in relation to other users of the transport route.

Placement of the excavated material can be at a designated site underwater or on land. The physical changes that may occur during placement are the space occupied by the material, especially the area it covers (on land or riverbed), and dispersion of the deposited material.

4.5.2 Dredger Types and Appropriate Use

The main types of dredgers used throughout the world are cutter suction dredgers (CSD), trailing suction hopper dredgers (TSHD) and mechanical dredgers[12]. CSDs are most commonly used for removing hard sediments in capital dredging projects, while TSHDs are used mostly for maintenance or capital dredging of unconsolidated sediments of lower to medium strength. Mechanical dredgers can be used for a wide range of soils and in many types of projects, but generally have much lower rates of production than suction dredgers.

4.5.2.1 Cutter Suction Dredger

CSDs typically consist of a pontoon equipped with a rotating cutter head and an adjacent suction pipe that collects a mixture of cuttings and water which is pumped through a discharge pipeline to its destination (Figure 4.6). The suction action inside the cutter means that most of the sediment removed by the cutter is captured. As high dredging efficiency and low turbidity at the cutter head are closely linked, it is uncommon for turbidity generated by the cutter head to cause

[12] The World Association for Waterborne Transport Infrastructure 2009. Dredging Management Practices for the Environment: A Structured Selection Approach

environmental concern[13]. The other advantage of CSDs is that the dredged material can be transported through pipelines for long distances.

Figure 4.6: Cutter Suction Dredger

4.5.2.2 Trailing Suction Hopper Dredger

A TSHD consists of a self-propelled ship with a hopper. The vessel is equipped with one or two suction pipes connected to draghead(s) (Figure 4.7). The dragheads are lowered to the seabed and a slurry of sediment and water is pumped through these into the hopper. Dredged material settles in the hopper and the water drains off through a controllable hopper overflow system. Settlement of material in the hopper is dependent primarily upon grain size. Loading times can vary markedly for different sediments. The dredger usually deposits the contents of the hopper on a placement ground through doors or valves in the bottom of the hopper. Split hulled vessels are com- mon for smaller dredgers of this type. Most modern TSHDs are also fitted with pump-ashore equipment and are able to discharge the hopper load through a floating pipeline connected to the dredger.

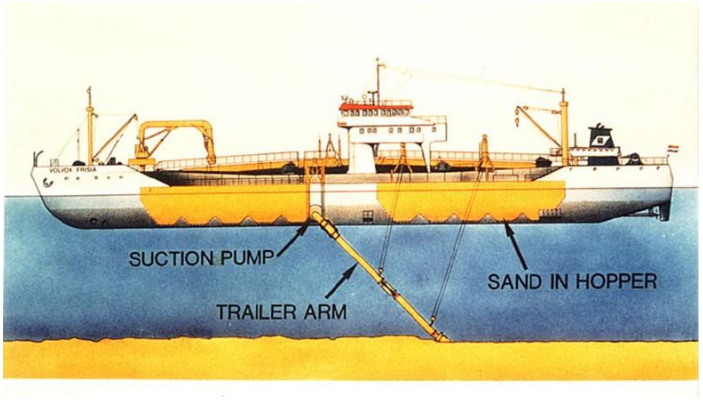


Figure 4.7: Trailing Suction Hopper Dredger

[13] John SA, Challinor SL, Simpson M, Burt TN and Spearman J (2000). Scoping the assessment of sediment plumes from dredging. CIRIA Report C547, London, 190 pages

4.5.2.3 Mechanical Dredgers

There is a wide variety of mechanical dredgers. The most familiar type is the grab dredger (GD) which consists of a crane mounted on a pontoon or self-propelled hopper that operates a wireline controlled grab (Figure 4.8). Other types of mechanical dredgers are the backhoe dredger which operates a bucket mounted on an arm that is hydraulically operated) or the bucket ladder dredger (BLD) which has a chain of buckets being rotated over a ladder.

Mechanical dredgers normally discharge into independent hopper barges. Grab dredgers may cause minimal disturbance and dilution of clays compared to hydraulic methods used by CSDs and TSHDs, but may cause high turbidity in loose silts where a significant fraction of the load may be washed out as the grab is hauled through the water. Mechanical equipment can reduce spillage and turbidity by limiting for example hoisting speed and by avoiding overloading of open barges and hoppers. These are measures, however, that may reduce the production (output) of the equipment[14].

Mechanical dredgers are better able to handle boulders, debris, ropes, chains, and so forth, than are dredgers which rely on pumps. They are well-suited to dredging in confined places such as alongside wharfs, and the grab dredger's depth of operation is limited only by its cable length. Their main disadvantage is that generally they have lower rates of production.

Figure 4.8: Grab Dredger

4.5.3 Dredger Selection

Since dredging and dredged material placement are site specific activities, choosing the ideal dredger is also site specific. Dredger selection depends on a number of variables including:

- availability and cost;
- physical characteristics of the sediment;
- amount to be dredged;
- dredging site and depth;
- distance to the placement site;
- depth of placement site;
- physical environment at dredging and placement sites;
- contamination level of sediments; and
- method of placement.

[14] Burt TN, Land JM, and Otten H (2007): Measure- ment of sediment release from a grab dredge in the River Tees, UK for the calibration of turbidity pre- diction software. Proc. World Dredging Congress (WODCON XVIII), Orlando, FL

When evaluating the environmental performance of specific dredgers, it is also necessary to consider the effect of the production rate on the project duration, the levels of turbidity and suspended sediment concentrations generated relative to background levels, the proportion of total sediment lost to the environment and the degree of contamination in the sediment.

In evaluating dredgers, all phases of the dredging operation (excavation, lifting, transportation and placement) should be considered as an integrated process. Typically, CSDs have the least effect on turbidity at the dredging site and TSHDs produce similarly low turbidity when used without overflow. Grab dredgers and TSHDs, when used with overflow, produce significantly higher turbidity throughout the water column near the dredging site than do CSDs.

At the placement site, the reverse may be true. Mechanical dredgers do not disturb the structure of the dredged materials as much as CSDs or TSHDs do, which may fluidise sediments by mixing them with water. Fluidisation of clays by CSDs and TSHDs may cause discharged material to cover an excessive area when unconfined, and fluidised sediments may take some time to consolidate thus providing a source of ongoing turbidity until consolidation has occurred. Consequently, suction dredgers may be preferred if the vicinity of the dredging site is particularly sensitive, while a mechanical dredger may be favoured if the vicinity of the placement site is sensitive.

Table 4.1 presents an overview of dredger types and their relative performance related to certain environmental aspects.

Table 4.1: Environmental aspects of standard dredging equipment[15]

	Safety	Accuracy	Turbidity	Mixing	Spill	Dilution	Noise
Suction Dredger	+	-	+	-	-	0	+
Cutter Suction Dredger	+	+	0/+	0/+	0	0	+
Trailer Suction Hopper Dredger	+/0	-	-/0	-	0	-	+
Bucket Ladder Dredger	-	+	-/0	0/+	+	+	-
Backhoe Dredger	-	+	-/0	+	+	+	+
Grab Dredger	-	-	-/0	0	+	+	+

'+' better than average;
'0' about average;
'-' below average; all qualifications seen as relative to other dredger types

4.5.4 Recommended Dredger

Based on the analysis presented in the above sections and Table 4.1, the cutter suction dredger will perform comparatively better than all other dredgers such as (i) low risk of sediment dispersal during excavation (most of the sediment excavated will be captured by the dredger to minimize sedimentation); (ii) low risk of sediment releases from lifting (most of the sediment captured should be lifted efficiently to minimize the re-suspension of sediments); and (iii) low risk of leakage from transportation. Hence, cutter suction dredgers will be used for the project.

4.5.5 Timing of Dredging Activities

The dredging activities will be carried out in high flow season (July and August) when the river naturally carries high sediment load. During these months, the river carries about 100 million tons of sediments load and any additional turbidity generated by the dredging caused by these

[15] The World Association for Waterborne Transport Infrastructure 2009. Dredging Management Practices for the Environment: A Structured Selection Approach

activities will have very minimal impact on the natural sediment load of the river. The amount of sediments to be removed will be less than 1 percent of total natural sediment load of the river.

If the dredging activities are carried during other periods when the river carries very less sediment load (less than 10 million tons per month) any additional turbidity generated by the dredging activities will be significant. The amount of sediment to be removed will be equal to 10 percent of the natural load of the river. Hence to minimize the turbidity from the dredging and dredge material placement activities, the dredging will be carried out only during high flow season.

4.6 Alternatives to Dredged Material Management

The options for dredged material management can generally be classified in to two categories: (i) placement on the land for beneficial uses and (ii) placement in the river. The beneficial uses for dredged material (if suitable, environmentally acceptable and there is a demand) for on land use is engineering fill (foundation basis for construction, earth fill); and construction (reclamation of new land, aggregate, roads, dikes and bunds). The placement of dredged material on the land has not been considered as the preferred option since all the land along the river are either densely populated or intensively cultivated. Placement of the material in the river, on the downstream of the barrage, is considered as a preferred option in this project since removal of sediment, by dredging, from its natural path or cycle, may have damaging environmental consequences (in the delta, the balance between erosion and accretion is disturbed by reduced water flows and sediments). Therefore, it can be beneficial to return the material into the originating system, rather than removing it to a separated site. This also supports the Indus delta and its ecosystem, which has been under threat due decreased sediment and river flows to the delta.

The impacts on turbidity and sediment dispersion associated with aquatic placement can be minimized by submerged discharge (placing the pipe line vertically one meter below the water column or just above the river bottom) which result in a decreased resuspension and spread of the lateral extent material. The bottom relief created by mounds of dredged material may also provide refuge habitat for some fish.

The Indus carries about 100 million tonnes of sediments at Sukkur during high flow season of July and August, and the water in this period is highly turbid (turbidity is generally more than 900 NTU and 1200 mg/L of suspended solids). If the dredging and dredge material placement in the river is carried out during these months, the additional sediment load and turbidity generated by cutter suction dredgers would be minimal. Hence, it is decided to carry out dredging during high flow season. Environmental monitoring would be in place during this process to ensure no impacts on the river morphology and sediment load, and on fisheries.

The excavation for sediment from the barrage (about 0.75 MCM) will be carried out during low flow season or dry periods, and the material will be placed in the dry river bed (Figure 3.4) along the left bank on the downstream of the barrage. The Indus flows through these areas only during super floods and hence the sediments placed at this location will be carried away by the river during next super floods (flows above 0.9 million cusec). The excavation of sediments from right bank canals (about 2.24 million cubic meters) during low flow season, will also be placed in the dry river bed along the right bank on the downstream of the barrage. These material will also be ultimately carried out by the river during next floods.

4.7 Options for Desilting of Sediments from Right Bank Canals

Desilting of canals can be carried out either by using dredgers during regular canal flow season or by excavators during canal closure period when the canal bed is dry. If the dredging is used, the desilted material need to be transported through the canal embankments to the right bank

placement areas through trucks. The canal embankments, which are of 10 to 12 m width, can generally be used for this purpose, and also these embankments are owned by the irrigation authorities. However, the canal embankments are fully occupied with the squatters and illegal construction of houses. Most of the canal desilting activities will need to be carried out in the first 7 km from the barrage; and embankments in these areas have very high density of squatters due to proximity to Sukkur town. Hundreds of families live on these embankments close to the barrage area. All these families have to be resettled during dredging operations, mainly for transport of the desilted material. The other option is to carry out the desilting activities in the canal closure period using excavators. The canal bed can be used for movement of excavators and transport of sediment through trucks, thus avoiding the use the canal embankments and also avoiding the need of any resettlement on the embankments. Hence, the Project will carry out desilting operations using normal excavators and dumpers during canal closure period.

5 Description of Environment

5.1 Physical Environment

5.1.1 Definition of the study area

The study area of the Project includes impact area of the project and its area of influence. The impact area of the Project includes all areas that are likely to be directly (footprints) or indirectly affected by the proposed desilting and construction activities. On the upstream of the barrage, the impact area extends up to 2 km to cover the desilting works and downstream up to 10 km to monitor changes associated with dredging and dredge material placement in the river. Along the banks, the impact area extends to one km away from the river to cover the areas that could be influenced by the impacts from construction works, and access routes to the work and silt deposit sites. The location of the study area is shown in Figure 5.1. The project influence area covered for impact assessment also broadly covers this impact area, but on the upstream it extends up to Guddu barrage to cover the dolphin game reserve. The impact area for the canal excavation will be limited to about 100 m either side of the both banks, and primarily restricted to the canals and its embankments since desiltation will be carried out during canal closure period and dry canal beds will be used mainly for movement of construction equipment and vehicles.

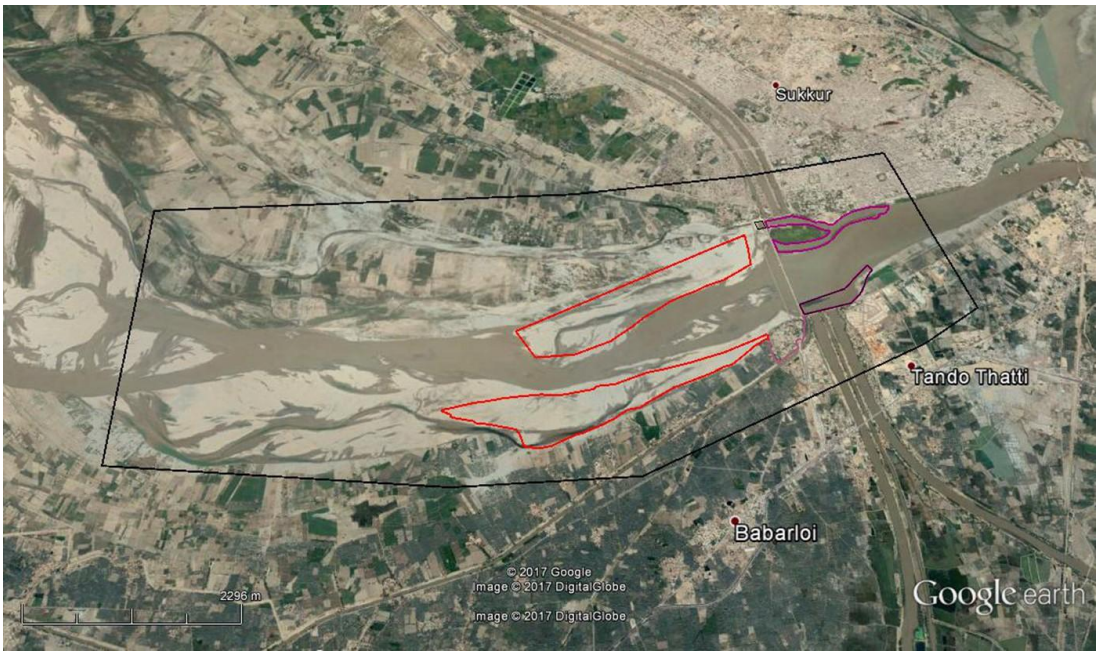


Figure 5.1: Project Impact Area

5.1.2 Physiography

The physiography in this area is dominated by characteristics of braided Indus river (meandering channels, temporary shoals and alluvial sand tracts), barrage pondage and floodplain agriculture. Indus downstream of Sukkur is extensively braided with a width of 10 to 15 km with constantly shifting channels. The river generally carries water through its entire width during high flow season of June to September, while the water will be limited to few channels during remaining months. Before construction of the Sukkur barrage, the area is a desolated terrain with some agriculture in the floodplains, but the barrage transformed these barren lands in to vast agricultural tracts. Flood embankments have been constructed all along Indus. The river

carries high sediment loads during months of July and August when the river flows are at maximum.

Physical Setting and Land use: The barrage is located in an urban setting with all areas around the barrage and Indus are urbanized by Rohri town on the right bank and Sukkur city on the left bank. Sukkur is the third largest city in Sindh province with a population of about 0.5 million. The barrage office and colony are located close to the barrage. The road (lower deck) on the barrage is extensively used by local traffic, mostly motorbikes and small cars; and heavy traffic is not allowed on the barrage. The average daily traffic on the barrage is about 8,000 vehicles. A national highway is located about 150 m away on the downstream of the barrage, and average daily traffic on this highway is about 24,000 vehicles (50 percent of which are heavy traffic).

5.1.3 Climate

According to Koeppen climate classification, the Sukkur area can be classified as 'desert hot climate' because of its low annual rainfall compared to potential evapotranspiration, and high temperatures. The average annual rainfall is about 120 mm with nearly 61 percent of rainfall falls in monsoon months of July and August. Average annual potential evapotranspiration is 2,216 mm. Between May to September, day time temperatures exceed 35 °C and during winter months the night time temperatures may drop up to 2 °C. Climate change is also expected to increase extreme precipitation events, and trigger both extremely high precipitations resulting in floods, and extremely low precipitation resulting in droughts. Monthly climate data at Sukkur is given in Figures 5.2 to 5.4.

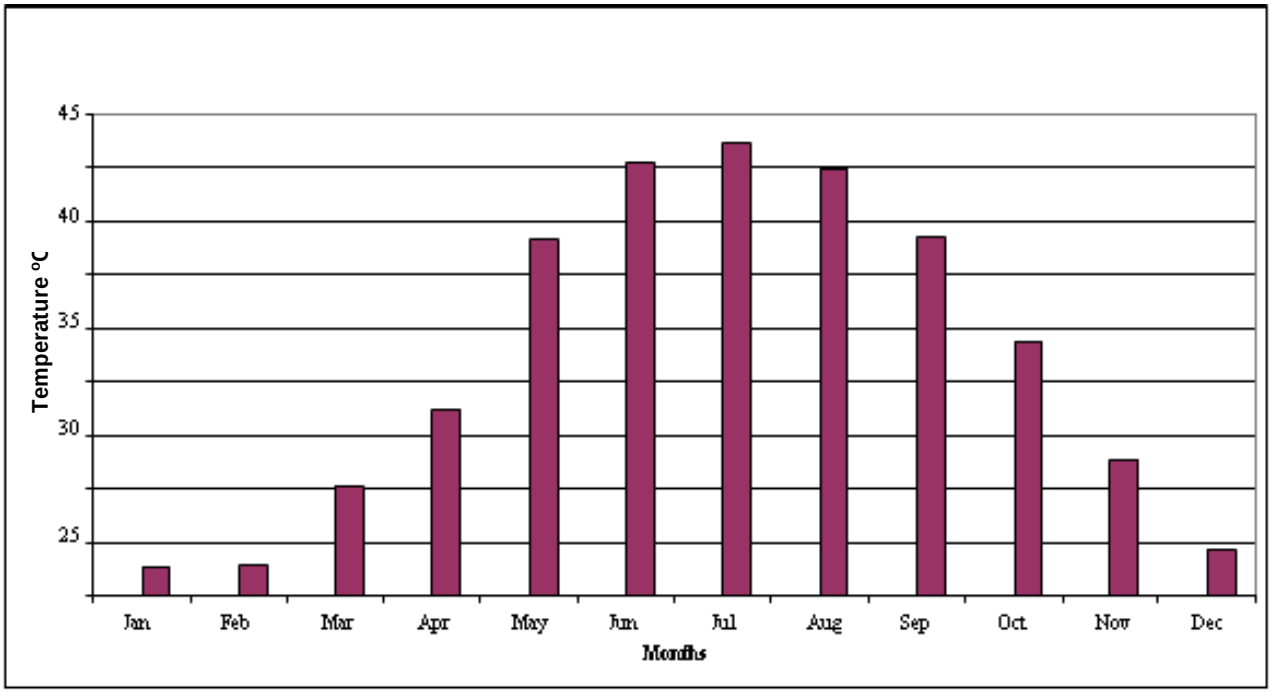


Figure 5.2: Average Monthly Temperature at Sukkur

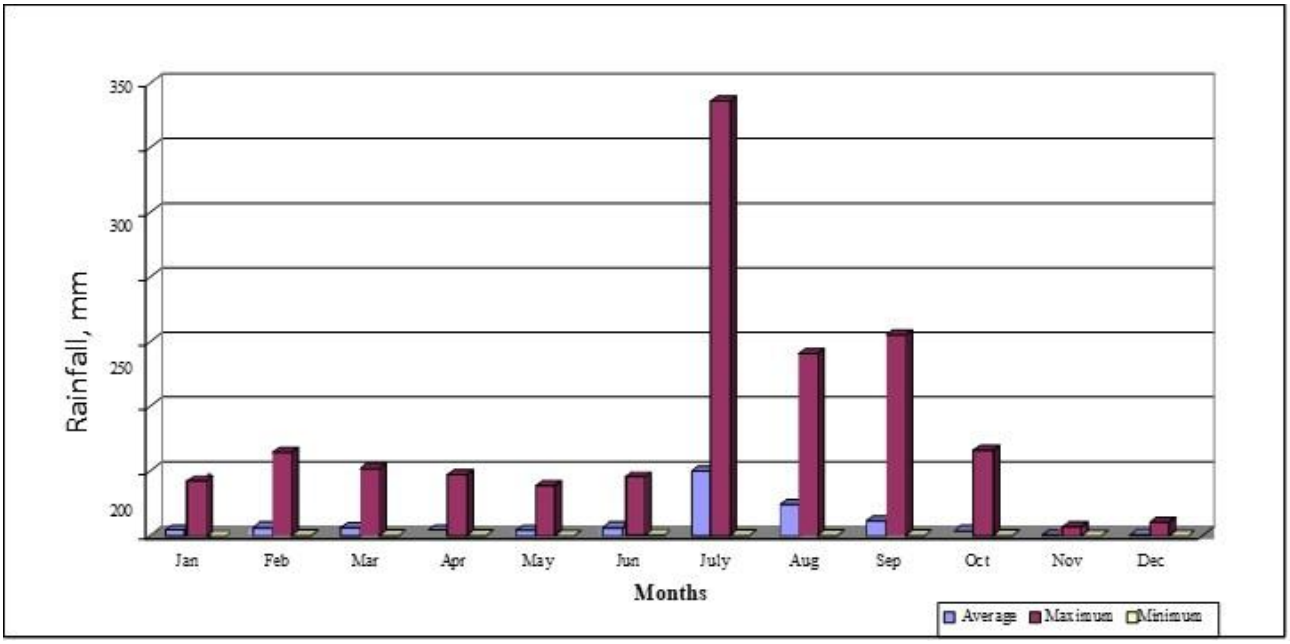


Figure 5.3: Average Monthly Rainfall at Sukkur (1975 to 2005)

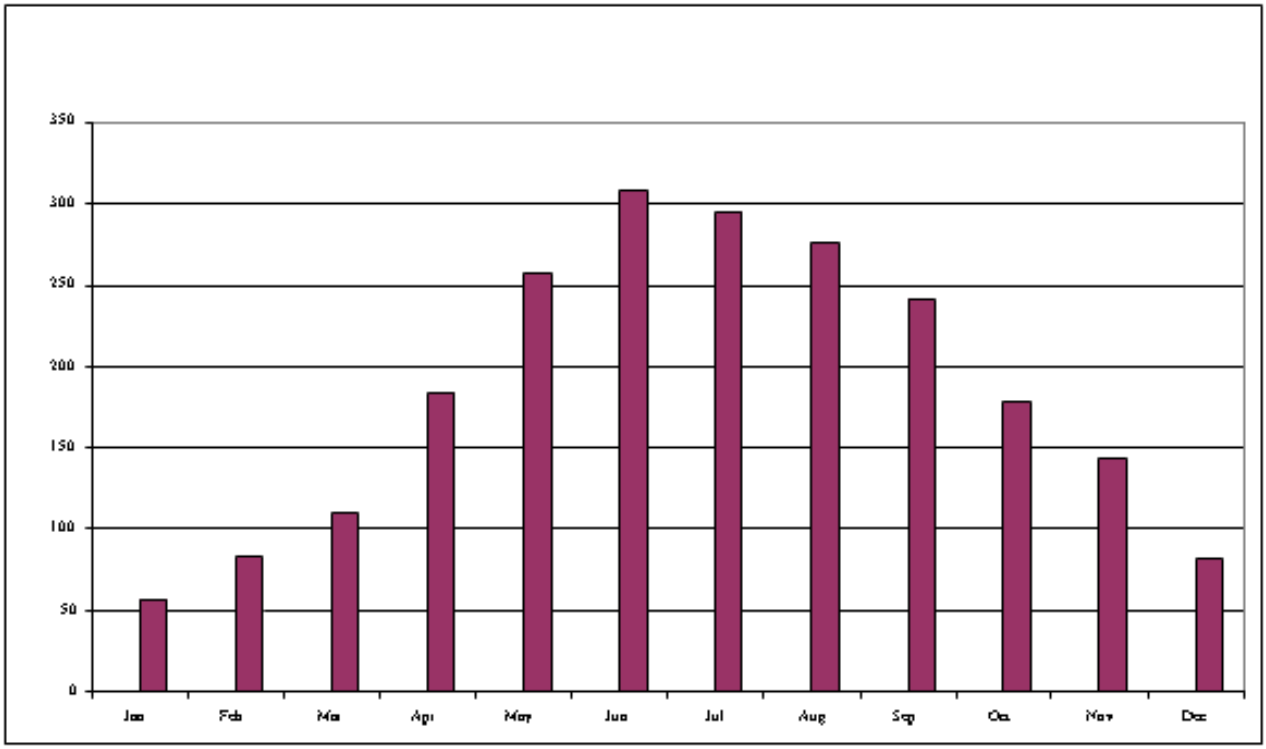


Figure 5.4: Average Monthly Evaporation (mm) at Sukkur (1975 to 2005)

5.1.3.1 Climate Change and Future Predictions

According to the Pakistan Meteorological Department, Pakistan is particularly vulnerable to climate change as it lies within a region where temperature increases are expected to exceed the global average and its arid and semi-arid land is dependent upon glaciers in the Tibetan

plateau to provide water to drive its heavily agricultural dependent economy. These glaciers are reported to be receding due to climate change.

The main effects of climate change predicted within Sindh are increased temperatures and increased frequency of extreme precipitation events, both extremely high precipitation resulting in floods, and extremely low resulting in droughts. Such trends are already evident from recorded data.

Figure 5.5 shows the current trend of increasing occurrence of heat waves (10 days above 40 degrees Celsius) as recorded in Sindh by the Pakistan Meteorological Department.

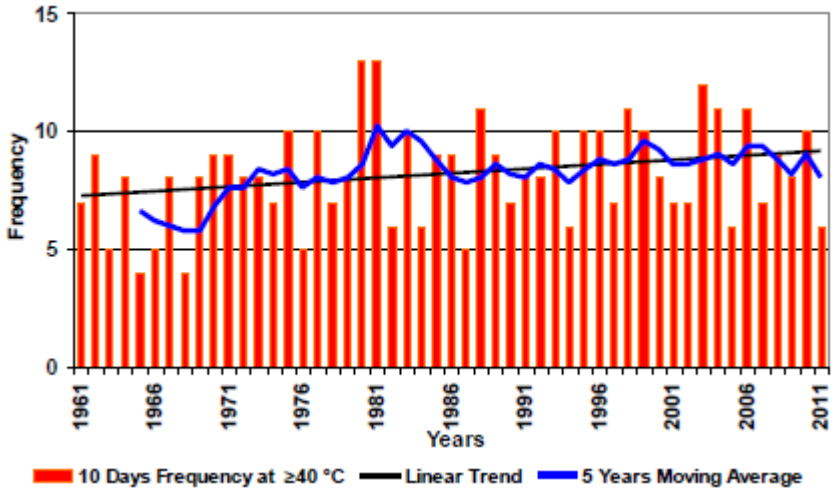


Figure 5.5: Recorded Increase in Heat Waves in Sindh since 1961

The predicted temperature increases in Pakistan, according the Pakistan Meteorological Department, shall be approximately 2 °C by 2050, and 4 degrees Celsius by the end of the century.

Figure 5.6 demonstrates how the frequency of extreme rainfall events has increased in the preceding 45 years.

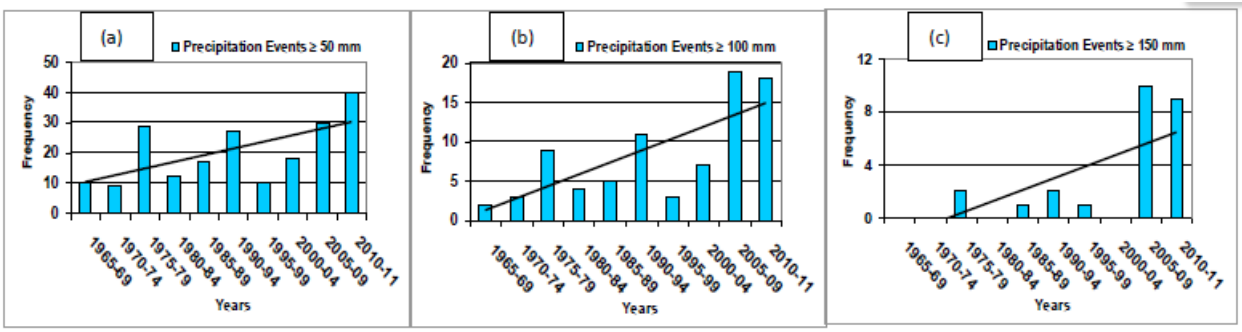


Figure 5.6: Recorded Changes in Extreme Prepetition Events in Sindh

Figure 5.7 compares the precipitation predicted from present day to 2050 to the current average rainfall in Sindh. The figure shows that Sindh is expected to receive heavier than normal rainfall during the monsoon season in the future, and that the monsoon season is expected to move towards the autumn.

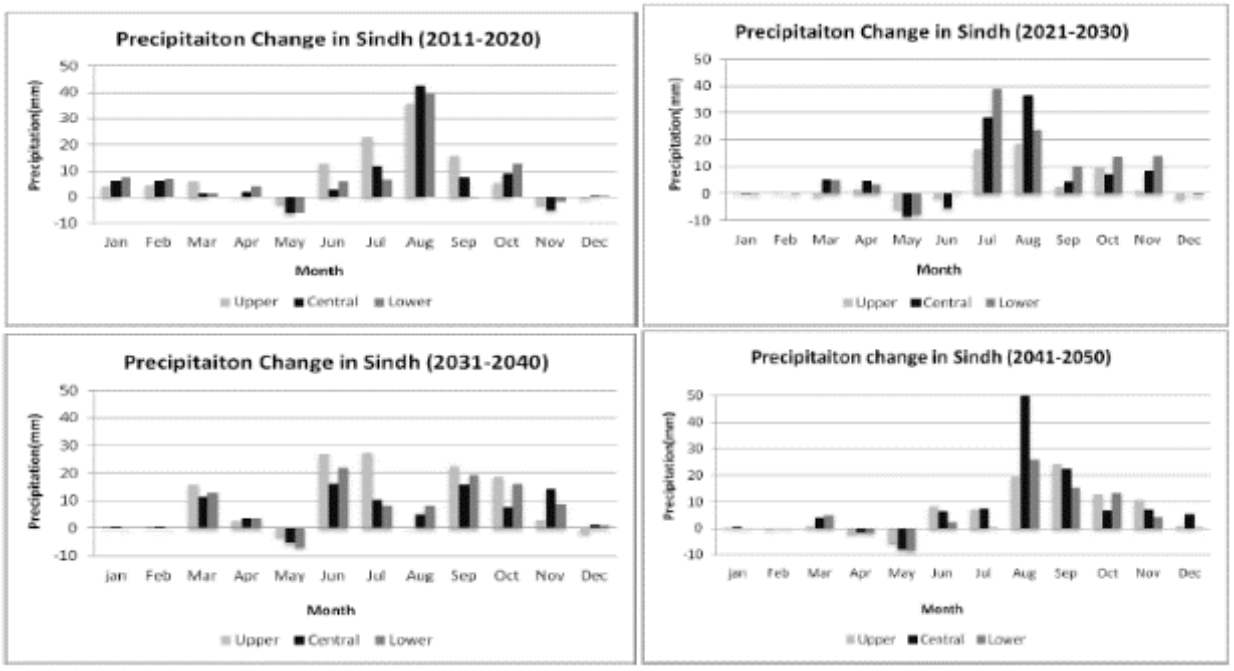


Figure 5.7: Predicted Future Changes in Precipitation in Sindh

5.1.4 Geology

The barrage site is surrounded by Kirthar range formations extending from southwest to the north and Thar Desert in the east. The barrage is constructed just 4.6km downstream of Brahui Limestone region which formed throughout the tertiary Cenozic period whereas remaining area comprises of recent alluvial deposits. At 7 km upstream of Sukkur, Indus river passes through a narrow gorge in Rohri Hills. These limestone formations are some 40km long and 16km wide extend in a north-south direction between the course of Indus and the cities of Sukkur and Rohri. The hills consist of fossiliferos limestone rocks. The thickness of the river alluvium varies along the river, minimum being at Bakhar gorge which increase to downstream.

5.1.5 Soils

The soils at the barrage site are alluvial in nature and are mainly silty clay, clay loam, and loam soils. At barrage location the thickness of river alluvium is about 30 to 50m.

5.1.6 Seismicity

The Sukkur Barrage is located in seismically inactive region with history of low to medium magnitude earthquakes in its near vicinity. According to building code of Pakistan Seismic Provisions (2007) the site is located in zone 2A with recommended peak ground acceleration of 0.08 to 0.16g. The Sukkur barrage has been originally designed on conservative side of 0.22 g.

5.1.7 Indus River Flows at Sukkur

The Indus drains an area of about 950,000 km^2 and generates a mean annual discharge of 6,682 m^3/s. The hydrograph of the river at Sukkur is strongly seasonal with a long low water season between October and May (low flow season) and a high water season between June and September (high flow season) – driven primarily by summer snowmelt in the upper catchment and monsoon rainfall. The river usually peaks in mid-August or early September. River flow upstream of Sukkur barrage varies from a monthly average flow of approximately 22.83 MAF (28.16 BCM) in August, to a monthly average flow of approximately 1.44 MAF (1.78

BCM) in January. The corresponding figures downstream of barrage are approximately 20.06 MAF (24.74 BCM) and 0.29 MAF (0.35 BCM) in August and December respectively.

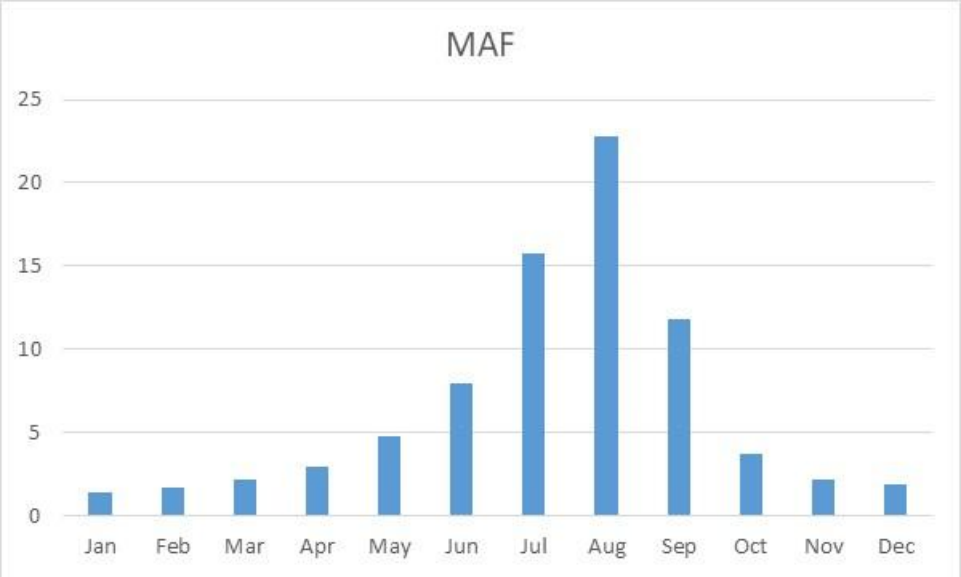


Figure 5.8: Average Monthly Discharges in River Indus at Sukkur Barrage (1961 to 2011)

The average diverted flows from the river for canals and downstream flows from the barrage are given in Table 5.1. During the months of May to September, the average flows diverted to the canals is 2.89 MAF (2001 to 2011) and the average flows diverted during October to April is 1.23 MAF.

Table 5.1: Canals withdrawals and flows to downstream of the barrage

Month	Period 1961-2011			Period 2001-2011		
	Average Diverted flows into the Canals (MAF)	Average Downstream flows (MAF)	Ratio of flows / Diverted Flows	Average Diverted flows into the Canals (MAF)	Average Downstream flows (MAF)	Ratio of flows / Diverted Flows
January	0.62	0.80	1.29	0.34	0.52	1.54
February	1.48	0.34	0.23	1.18	0.31	0.27
March	1.56	0.64	0.41	1.18	0.57	0.48
April	1.48	1.46	0.98	1.26	0.82	0.65
May	2.04	2.81	1.38	2.24	1.32	0.59
June	2.87	5.32	1.85	3.13	2.82	0.90
July	3.20	12.90	4.03	3.35	5.99	1.79
August	3.14	20.06	6.39	2.99	11.53	3.86
September	2.65	9.11	3.44	2.72	4.29	1.58
October	2.21	1.59	0.72	1.94	0.92	0.47
November	1.83	0.36	0.20	1.45	0.39	0.27
December	1.65	0.29	0.18	1.28	0.27	0.22

5.1.8 Floods

Floods in Indus generally occur due to heavy and prolonged storms and intensive/extreme glacier and snow melting. High discharges above 0.9 million cusec (25,485 m^3/s) are termed as super floods. A number of such floods have been recorded historically near Sukkur (1950, 1956, 1957, 1973, 1975, 1976, 1978, 1986, 1988, 1989, 1992, 1995, 2010 and 2011). The Sukkur barrage with a current flood capacity for 0.9 million cusec (25,485 m^3/s) has safely passed all the historical floods. Annual maximum flows of Indus at Guddu and Sukkur Barrage, from 1962 to 2010, are shown in Figure 5.9.

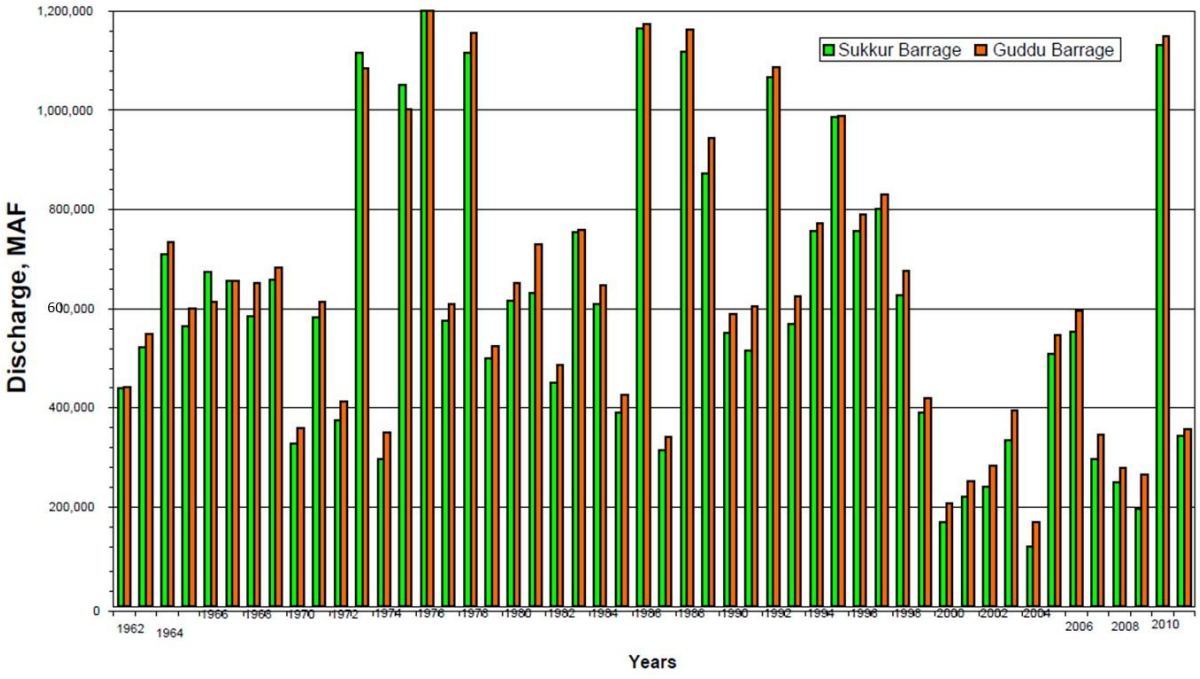


Figure 5.9: Annual Maximum Flow at Sukkur and Guddu Barrage from 1962- 2010

The flood severity levels and their occurrence during 1962 and 2010 are referred in Table 5.2 for the River Indus at Sukkur Barrage.

Table 5.2: Statistics of Historical Floods on the River Indus at Sukkur Barrage

Flood Severity	Threshold of Discharge (Cusecs)	No of Years of Occurrence	Average Frequency of Occurrence
Super Flood	Q >900,000	10	19%
Very High Flood	Q <700,000 ≤ 900,000	6	13%
High Flood	Q <500,000 ≤ 700,000	17	35%
Medium Flood	Q <350,000 ≤ 500,000	7	15%
Low Flood	Q <200,000 ≤ 350,000	9	19%
Normal Flood	Q≤200,000		

Source: Irrigation Department, Govt. of Sindh

5.1.9 Climate Change Impacts on Floods

The impact of climate change is likely to severely affect flows in the River Indus. Climate change may impact upon flows in two ways; Firstly, the source of the Indus is glaciers on the Tibetan Plateau where temperatures are rising, resulting in a retreat of these glaciers and although there is little certainty of the long term impacts of climate change on these glaciers, some scenarios

indicate that these glaciers could be lost, resulting in an overall decrease in river flows. Such a decrease could be significant. Secondly, more intense monsoon rainfalls (as observed in 2010) could become more common and result in an increase in peak flows in the Indus at Sukkur. Such an increase would negate any reduction in peak flow as a result of upstream regulation.

Based on IPCC Fourth Assessment Report 2007 (AR4), the glacier melting in the Himalayas is expected to increase flooding of Indus and its tributaries for the next two to three decades which will be followed by decreased river flows as the glaciers recede. It is expected that the river flows will decrease after a few decades due to reduced glacier mass to a level that would be determined by the precipitation input at that time. According to the World Bank (2006) report: "Pakistan's Water Economy: Running Dry", the western Himalayan glaciers will retreat for next 50 years causing increase in Indus River flows and then the glacier reservoirs will be empty, resulting in decreases of 30% to 40% in river flows in the Indus Basin. In long term, the monthly flow pattern would also change considerably, with more water coming in spring and early summer and less water in the later part of summer. The short term increases of floods due to glacier melting has been adapted, by the design engineering consultant, in estimating flood levels at Sukkur barrage.

5.1.10 Morphology

The Indus River is a dynamic River which changes significantly through time. However, at Sukkur the limestone outcrops upstream represent a stable section of the Indus in this area. Downstream of this the river widens towards the barrage. Upstream of the limestone outcrops the river can be characterized as a braided river, while the downstream part of the river can be characterized as a meandering river channel. The overall gradient of the Indus is relatively flat with a gradient of approximately 0.47'/mile (approx. 1 in 11,200) between Mithankot and the Sea. Figure 5.10 showing the morphological changes of the channel during the 20th century.

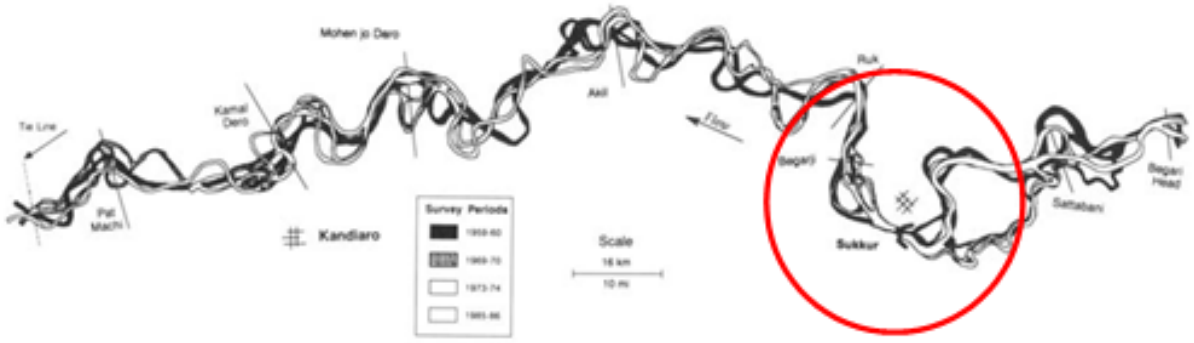


Figure 5.10: Morphological changes of Indus during 20th Century

5.1.11 Groundwater

In the floodplain areas, the groundwater occurs at shallow depths (5 to 10 m) and is also being used generally for domestic uses. Though 80 percent of Sindh is underlain by saline groundwater, the groundwater in the floodplains is generally good due to regular recharge from Indus.

5.2 Chemical Environment

Sampling and analysis: Sampling and analysis of Indus water and river bed sediments were carried out at four locations during high flow season of August 2017. Two samples have been collected on upstream side (one from each pocket) and two samples have been collected about

500 m downstream of the barrage area. The samples have been tested for physical and chemical parameters, organics, nutrients, pollutants and metals to establish baseline conditions. Detailed test results are given in Annex B and summary of these results are provided in the following sections

5.2.1.1 Sediment concentrations in Indus

The sediment concentrations of Indus at Sukkur is shown in Figure 5.11. During months of July and August, the river carries about 100 to 110 million tons of sediments, and during remaining months of the year, it carries about 40 million tons of sediment. During the months of November and January, when the river carries very low flows, the sediment load is very low.

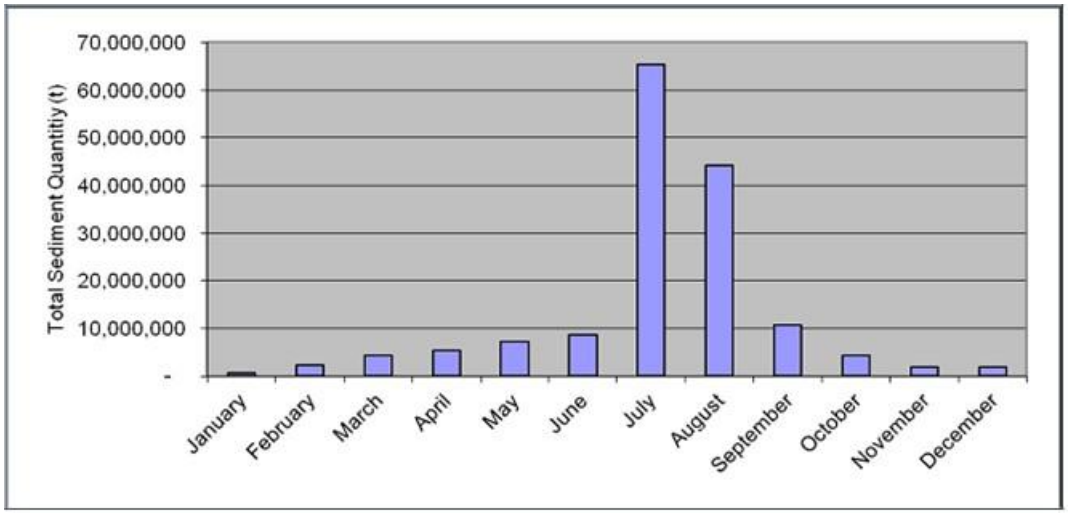


Figure 5.11: Sediment Concentrations at Sukkur Barrage

5.2.1.2 Indus Water Quality

The water quality of the Indus in high flow season is highly turbid ranging from 970 to 1220 NTU and with a total suspended solids of 1275 to 1860 mg/L. The electrical conductivity ranges from 515 to 577 µS/cm. The chloride level ranges from 11 to 18 mg/L. The water from irrigation canals is also being used for drinking purpose in Kotri and Rohri towns and in command area, where the groundwater is saline. The existing threats to Indus water quality are discharges of municipal and industrial waste waters. Water quality data of Indus is given in Table 5.3.

Table 5.3: Indus water quality near the barrage

	Parameter	Unit	NEQS	Detectable Limit	Right bank upstream	Right bank downstream	Left bank upstream	Left bank downstream
1	Conductivity, Electrical (EC)	µS/cm	_	0	515	557	519	535
2	Organic Carbon, Total (TOC)	mg/L		0.3	2.36	2.04	1.84	1.93
3	Turbidity	NTU		0.2	1260	1020	990	970
4	COD	mg/L	150	5	62.5	80	71	64
5	BOD	mg/L	80	2	18	24	22	19
6	Solids, Total Suspended (TSS)	mg/L		5	1860	1450	1275	1537.5

	Parameter	Unit	NEQS	Detectable Limit	Right bank upstream	Right bank downstream	Left bank upstream	Left bank downstream
7	Phosphate, Total	mg/L		0.1	3.55	1.08	1.01	0.89
8	Nitrogen, Total	mg/L		1	34.71	89.84	8.17	8.17
9	Calcium (Ca)	mg/L		0	60.76	61.35	57.06	57.2
10	Potassium (K)	mg/L		0.2	4.17	3.19	3.57	3.14
11	Magnesium (Mg)	mg/L	0.05	0	0.9	7.37	7.64	7.8
12	Sodium (Na)	mg/L		1	7.48	6.61	7.22	7.62
13	Alkalinity, Bicarbonate	mg/L		5	235.37	309.88	253.1	234.18
14	Alkalinity, Carbonate	mg/L		5	<05.00	<05.00	<05.00	<05.00
15	Chloride	mg/L	1000	5	17.64	11.48	12.35	10.81
16	Sulphate	mg/L	600	5	69.13	70.78	56.79	78.39

5.2.1.3 River Sediments Quality

Riverbed materials are compared with OSPAR guidelines (Oslo/Paris convention for the Protection of the Marine Environment of the North-East Atlantic) to assess the contamination levels. The test results have shown all four samples from the high flow season are within the acceptable limit of OSPAR guidelines. No pollutants such as PCBs, POPs and hydrocarbons were detected in the sediments. The arsenic concentration in the sediment are less than 0.5ppm (the standard is 30 to 80 ppm), cadmium concentration is less than 0.5 ppm (the standard is 1 to 2 ppm), and the chromium varies from 31 to 90 ppm (the standard is 150 to 200 ppm). The quality of river bed sediments is shown in Table 5.4.

Table 5.4: Quality of river bed sediments near the barrage

Sr,	Sediment Quality Parameters	Units	OSPAR Guideline	Detection limit	Right bank	Right bank	Left bank	Left bank
					Upstream Sediment	Downstream Sediment	Upstream Sediment	Downstream Sediment
1	Salinity	ppt		_	0.155	0.07	0.073	0.091
2	Arsenic (As)	mg/kg	30 to 80	0.5	<00.50	<00.50	<00.50	<00.50
3	Cadmium (Cd)	mg/kg	1 to 2.5	0.5	<00.50	<00.50	<00.50	<00.50
4	Chromium (Cr)	mg/kg	150 to 200	0.5	<00.50	<00.50	<00.50	<00.50
5	Mercury (Hg)	mg/kg	0.6 to 1	0.5	<00.50	<00.50	<00.50	<00.50
6	Nickel (Ni)	mg/kg	50 to 100	0.5	20.8	16.2	23.5	30
7	Lead (Pb)	mg/kg	100 to 120	0.5	<00.50	<00.50	<00.50	<00.50
8	Organic Carbon Total	%		_	0.09	0.019	0.051	0.097
9	Phosphate, Total	mg/kg		1	579.89	664.46	595.99	591.96
10	Total Nitrogen	mg/kg		1	837.01	581.28	1003.03	1158.41

Sr,	Sediment Quality Parameters	Units	OSPAR Guideline	Detection limit	Right bank	Right bank	Left bank	Left bank
					Upstream Sediment	Downstream Sediment	Upstream Sediment	Downstream Sediment
	(Organic Inorganic)							

5.2.1.4 Groundwater Quality

A survey was conducted by 'Pakistan Council of Research in Water Resources' in 2010 in the rural areas of Sukkur including Salehpat, Rohri, Sukkur and Pano Aqil. It has been observed that the total dissolved solids in the ground have exceeded the national standards in 35% of the samples. Other exceedances noticed are: sodium (in 27% of total samples), chloride (in 23% of total samples) and sulphate (in 10% of total samples).

5.2.2 Air Quality

The baseline ambient air quality (NOx, SO_2, CO, PM_{10}, and $PM_{2.5}$) at Sukkur Barrage was collected in June 2012 during the feasibility study of the Project and the results are shown in Table 5.5. Air quality near the barrage area was found to exceed national standards of ambient air quality for fine particulate matter ($PM_{2.5}$, PM_{10}) and Carbon Monoxide (CO). Concentrations of particulate matter $PM_{2.5}$ ranges from 80 to 240 µg/m^3 (the standard is 35 µg/m^3); PM_{10} ranges from 270 to 300 µg/m^3 (the standard is 120 µg/m^3) and CO ranges from zero to 10 µg/m^3 (the standard is 5 µg/m^3). Vehicular traffic and industries are the major sources air pollution. Air quality data will be further collected during pre-construction period in the project area to establish the baseline conditions.

Table 5.5: Air Quality at Sukkur Barrage

Parameter	**Unit**	**Site-I (at Sukkur barrage)**			**Site-II (Bride on NH on Downstream of the barrage)**			**NEQS**
		Min.	Max.	Average	Min.	Max.	Average	
Nitrogen oxides, NOx	µg/m^3	BDL	BDL	BDL	BDL	BDL	BDL	80
Sulphur di Oxide, SO_2	µg/m	BDL	BDL	BDL	BDL	BDL	BDL	120
Carbon monoxide, CO	µg/m	0	7	5	4	10	7	5
$PM_{2.5}$	µg/m	48	106	78	146	311	242	35
PM_{10}	µg/m	68	311	180	174	423	317	120
Suspended Particulate Matter (SPMO	µg/m	91	343	219	198	461	325	500
Noise (day)	dB	77	78	78	80	81	80	65
Noise (Night)	dB	66	78	72	75	79	77	55

5.2.3 Noise Quality

Noise levels near the barrage are generally high due to vehicular traffic and have also exceeded the national standards. The night time noise levels were found in the range of 60 to 70 dB, and day time noise levels were found in the rage of 74 to 80 dB.

5.2.4 Traffic on the barrage

A week long traffic count survey was conducted in October 2011 to record the number and type of traffic passing the barrage. The traffic data was also collected for the bridge on National Highway which is located about 150 m downstream of the barrage; and also on Lansdowne bridge which was located about 5 km upstream of the barrage. The traffic count, including daily averages, is shown in the Table 5.6. The average daily traffic on the barrage is 8,000 vehicles and only small vehicles are allowed on this road. The barrage is generally closed for public traffic in the month of January for routine maintenance works of the barrage. The traffic is very high on National Highway with an average daily traffic of 24,000 vehicles.

Table 5.6: Average Traffic Count at Sukkur

Type of Vehicle	**On the barrage**		**On Lansdowne bridge**		**Bridge on NH on downstream of barrage**	
	Total Vehicles weekly	**Average Vehicles daily**	**Total Vehicles weekly**	**Average Vehicles daily**	**Total Vehicles weekly**	**Average Vehicles daily**
Trailer 6 Wheeler	0	0	0	0	28,254	4,036
Truck 4 Wheeler	99	14	306	44	37,453	5,350
Bus 4 Wheeler 17	17	2	561	80	21,469	3,067
Pick Up + Wagon	18143	2,591	33,187	4,741	22,388	3,198
Cars	22,3237	3,319	28,484	4,069	24,696	3,528
Other Tractors	94	13	870	125	7,913	1,130
Motor Cycles	6,482	926	45,434	6,491	21,749	3,107
Horse Cart /Tanga + Donkey	8,707	1,243	4,471	640	4,258	608
Total Vehicles	**256,779**	**8,108**	**113,313**	**16,190**	**168,180**	**24,024**

5.3 Biological Environment[16]

5.3.1 Fauna of Indus River Plains

Indus is one of the largest rivers in the world, originates in the Tibetan mountains, flows west across northern India and south through Pakistan. The Indus River plain is a vast expanse of fertile land, covering about 200,000 square miles (518,000 square km), with a gentle slope from the Himalayan piedmont in the north to the Arabian Sea in the south. The average gradient of the slope is no more than 1 foot per mile (1 meter per 5 km). Except for the micro relief, the plain is featureless. It is divisible into two sections, the upper and lower Indus plains, on account of their differing physiographic features. The upper Indus plain is drained by the Indus together with its tributaries, the Jhelum, Chenab, Ravi, Beas, and Sutlej Rivers.

[16] References provided in this section are given in Annex C.

The lower Indus plain, the course of which goes through Sindh province, is flat, with a gradient as slight as 1 foot per 3 miles (1 meter per 10 km). The micro relief is quite similar to that of the upper Indus plain. The valley of the Indus and its banks have risen higher than the surrounding land as a result of the aggradation work of the river; and though the river is lined with flood-protecting bunds along its course, the alluvial sands and clays of the soil tend to give way before floods, leading the river to change course frequently. The level surface of the plain is disturbed at Sukkur and Hyderabad, where there are random outcroppings of limestone. These gradients and different composition of soil act together with influence of temperature and other physical factors create habit for different species and when they combine they form ecosystem.

The Indus River is the home to one of the few species of freshwater dolphin worldwide, the Indus river dolphin (Platanista gangetica minor) and numerous species of distinctive fishes, many of which live in or migrate through the waters of the Indus River. The river Indus is the main source of freshwater in supporting the freshwater biodiversity as well as the freshwater supply. The other most significant fish species are found in Indus Plains are Hilsa (*Tenualosa ilisha*) which is anadromous (migrates from sea to freshwater) and the Barramundi *(Lates calcaifer),* a catadromous fish (migrates from freshwater to sea); but movement of these species are restricted to below Kotri barrage.

The Indus is also home to a number of endemic fishes, including Indus baril (*Barilius modestus),* Indus garua (*Clupisoma naziri)* and rita catfish Rita. Several snakehead fishes also live here, including giant snakehead (*Channa marulius)*. The Riverine forest of Indus has highly valuable as wildlife habitats for mammals. Hog deer (*Axis porcinus),* Jungle cat *(Felis chaus), fishing cat (Felis viverrina,) mangoose (Herpestes edwardsi, H. auropunctatus,) porcupine (Hystrix indica), hedgehog* (Hemiechinus spp.), fox (*Vulpes bengalensis)* and Jackal (*Canis aureus).*

More than 150 species of birds were reported from the Indus River system, in which 4 are threatened namely Marbled Teal, Sociable Lapwing, Greater Spotted Eagle and Long-tailed grass warbler. Two of them Greater Spotted Eagle and Long-tailed grass warbler were recorded near the barrage area. Beside these 4 some others are near threatened. During survey we have observed total 86 species of birds from the river and its associated areas.

The freshwater turtles found in the Indus River can be categorized in to 3 groups; the Brown River turtle (*Kachuga smithi)*, The Indian Saw backed turtle (*K.tecta)* and Brahminy River turtle (*Hardella thurgi)*. Soft Shell Turtles including Indian Flapshaped turtle (*Lissemys punctate),* Spotted pond turtle (*Geochlemys hamiltoni),* True Soft Shell Turtle including narrow headed soft shell turtle (*Chitra indica)*, Indian soft shell turtle (*Trionyx gangeticus)*. Among snakes found in the Indus River and its surroundings are; Chequered keel back snake (*Natrix piscator)*, dark bellied marsh snake (*Xenochrophis cerasogaster)*, striped river snake (*Enhydris pakistanica)*, Indian python (*Python molurus*, Dhaman *Ptyas mucosus)*, striped keel back (*Amphiosma stolata)*, Indian cobra (*Naja naja)*, these are inhabitants of muddy banks of rivers and canals, where thick grasses with other natural vegetation like Typha, Tamarix and Prosopis are available. The Indian monitor lizard (*Varanus bengalensis)* not only share the same habitat but is also widely distributed in the surrounding areas.

Detailed list of fauna in the Indus river plains, located between Sukkur and Guddu barrages, are given in Annex C.

5.3.1.1 Fauna in the Project Area

Most of the threatened species as mentioned in the previous sections occur in the Indus River System and its associated wetlands but none of them is found near the project or its impact

area, except dolphins. This is confirmed during consultations with the district wildlife department, fisheries department, and WWF. The detailed information on dolphin and impacts of the project activities on the dolphin habitat are further discussed in later sections in this report. In addition to dolphin, two threatened species of birds are rarely seen in the project area are Greater Spotted Eagle and Long-tailed grass warbler. Both species have wide range of habitat which extends both in upstream and downstream of Sukkur barrage. Normally when any development activity starts, they move to the other safe part of the habitat for roosting and feeding. The construction activities are limited to the barrage area, which is very small area compared to their home or feeding range. Hence, the project activities will not create any negative impacts on these threatened bird species.

5.3.1.2 Mammals

5.3.1.3 Indus Dolphin Game Reserve

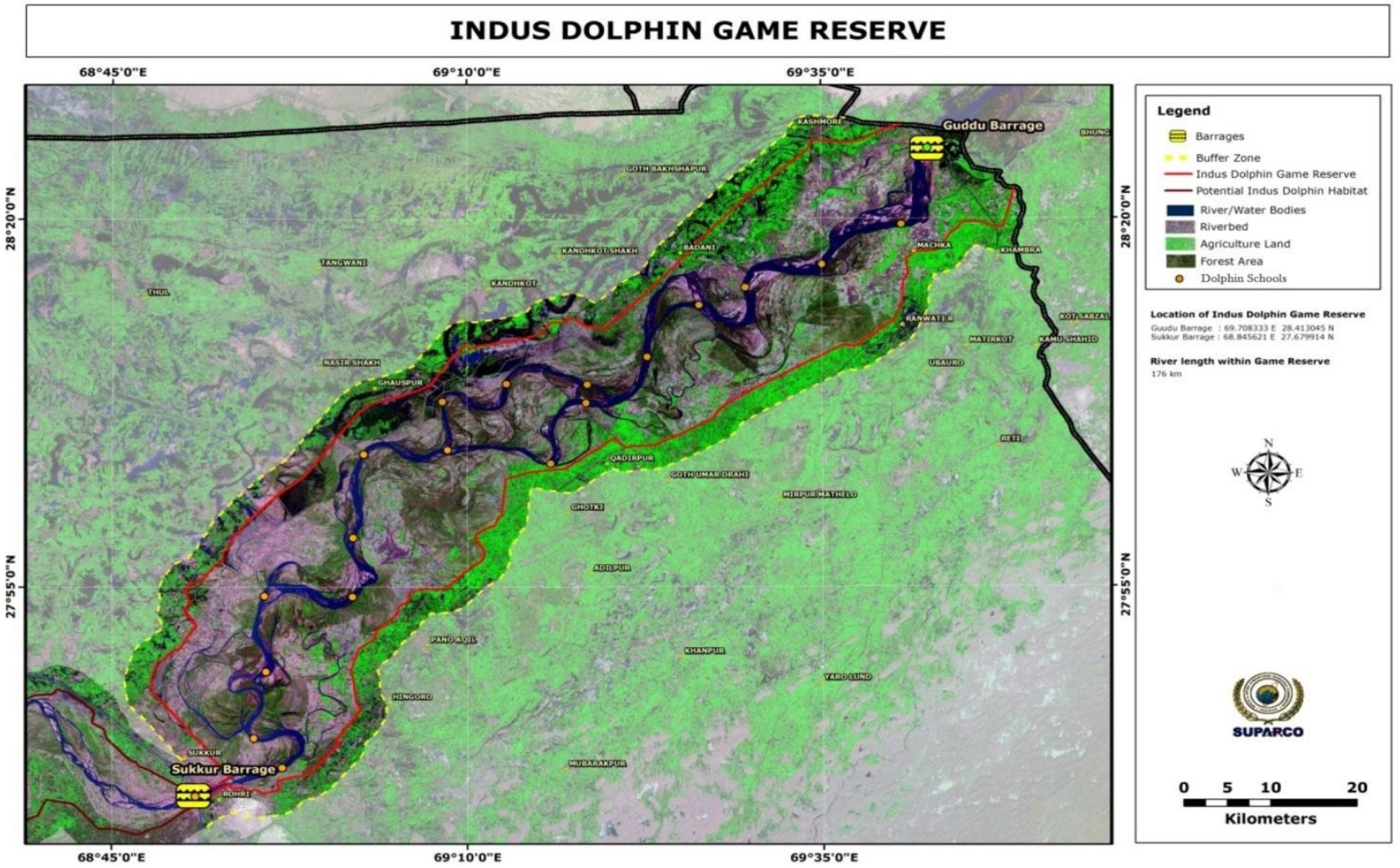
A 170 km stretch of the River Indus between two irrigation barrages Guddu and Sukkur is designated as national protected area for Indus dolphin, and is also known as Indus Dolphin Game Reserve[17]. The total area of the reserve is 125,000 ha and has a 3 km buffer zone on the floodplains. This dolphin game reserve was also declared as Ramsar wetland of International Importance in year 2000. According to recent estimates in 2011, the reserve holds a population of 918 dolphins. Whereas in 1975, only 150 dolphins were recorded from this reserve signifying the conservation efforts carried out so far. A photograph of Indus Dolphin is shown in Figure 5.12. Location of dolphin game reserve is shown in Figure 5.13.

Figure 5.12: Photograph of an Indus River Dolphin

[17] Government may declare any area to be a game reserve where hunting and shooting of wild animals shall not be allowed, except under a special permit, which may specify the maximum number of animals or birds that may be killed or captured and the area and duration for which such permits shall be valid.

5.3.1.4 Indus River Dolphin

The Indus river dolphin (*Platanista gangetica minor*) or Bulhan, as it is locally known is an endangered river cetacean that occurs in Pakistan and also it has been recently discovered that small population also exist in Punjab of India. Other river dolphin species occur in the Yangtze River in China, the Amazon and Orinoco in South America and the Ganges, Brahmaputra and Meghna River System in India, Bangladesh and Nepal.



Source: Sindh Wildlife Department

Figure 5.13: Indus Dolphin Game Reserve

The Indus River dolphin is a very unusual kind of cetacean. It is thought to have its origin in the ancient Tethys Sea, which dried up around fifty million years ago forcing the dolphin to adapt to its only remaining habitat - the rivers. Living in the turbid waters of the Indus for millions of years has meant that its sight has been replaced by a sophisticated sonar system known as echolocation, which it uses to steer and hunt underwater. This species represents a unique genome, an irreplaceable part of the biodiversity of life on earth.

Habitat Preference of Dolphins

Dolphins are abundant in the long stretches of deep water in association with shallow water meanderings, confluences and mid channel sand bars. The primary habitats preferred by the Indus River dolphins are characterised by an eddy-counter current system in the main river flow caused by a point bar formed from sediments and deposits, a convergent stream branch, or by an upstream meander. They are also found below sand bars and bridges where eddies are formed. Being a mammal, the dolphin can survive a wide range of temperature fluctuations. It can tolerate temperatures as low as 5 °C in the upper reaches of Indus in winter, and as high as 35 °C in the summer in the plains of Sindh. They have also been found in highly turbid water in monsoon and it is thus assumed that the water temperature and turbidity are not significant factors in determining the distribution of this species. Dolphin feeds mostly on fish (particularly on Wallago attu, singari Macrones aor and marakho Catlabuchanani) and invertebrates. It does much of its feeding at or near the bottom, using echolocation, swimming on one side, and probing the river bottom with its snout and flipper.

According to a recent survey conducted by the Sindh Wildlife Department in 2011, from Guddu to Sukkur Barrage, a total 918 Dolphin were seen in which 804 were mature 47 were the young and 67 were baby. There are more than 18 major schools of dolphin exist at different location between Guddu barrage to Sukkur barrage.

Life Cycle

Births of dolphins may take place throughout the year, but appear to peak in July to August. The gestation period for the dolphins is approximately 10 months and a single calf is born every two years. Juveniles are weaned at around one year of age, but do not reach sexual maturity until around 10 years of age. This species is thought to live at least 28-30 years in the wild.

Threats

Dolphin population in Indus is currently under threat of habitat fragmentation by the barrages, trapping in irrigation channels of Sukkur, reduced flows in the river in winter, sedimentation of the river beds, depletion of prey base, pollution from the agricultural return flows and municipal wastes, entanglement in fishing gears and poaching for its oil.

Measures taken in SBIP for Dolphin Conservation

A series of actions will be taken under the the parent project, SBIP to address the current threats on the dolphins and their conservations. These measures are described in Section 7.3.3. and Section 8.4.5.1. These include: i) detailed surveys on population status for two years covering both high flow and low flow season in each year, (ii) threat assessment surveys and develop mitigation plan, (iii) recommending no fishing zone in the river stretches that support breeding population, (iv) capacity building of the line government agencies and universities on dolphin research, conservation and management, (v) development of sustainable fishery management plan, (vi) involving local communities in dolphin conservation and management, (vii) supporting wildlife department in establishing rescue units to rescue dolphins stranded in canals, (viii) education and awareness programs, and (ix) conducting an international workshop in Karachi to learn and share dolphin conservation and management options. Implementation of these

actions are in progress.

Smooth-coated Otter (*Lutrogale perspicillata*)

Smooth-coated otter (*Lutrogale perspicillata*) is a semiaquatic species belonging to the Mustelidae family of order Carnivora and is one of the two species of otters found in Pakistan (Roberts, 2005). It is reported as Near Threatened (NT) according to IUCN Red List of Mammals of Pakistan (Sheikh & Molur, 2005). The species is distributed throughout the Indomalayan eco-zone and its distribution in Pakistan is along the Indus River and its tributaries. (Roberts, 1997).

Smooth coated otter prefers plain areas and is found near rivers, canals, lakes and fish ponds surrounded by thick vegetation especially Typha spp., Fragmites spp. and Saccharum spp. Otters are considered as an indicator species for the health of wetland ecosystems due to being sensitive to degradation, when considering the food chain (Roberts, 1997). Overall population of this species is on decline. Various threats to the species identified during the field surveys included hunting, habitat degradation due to pesticide use for fishing and cultivation along the river banks, water pollution and competition and conflicts between otters and fishermen. (Khan et al. 2008). It has been reported that this species is highly persecuted by the local fish farm owners as they consider it a big threat to their farms.

5.3.1.5 Reptiles and Amphibians

List of reptiles and amphibians commonly found in and around Indus between Guddu and Sukkur barrages are given in Annex C. These include four species of amphibians, three species of freshwater turtle, one species of agama (lizard), one species of monitor lizard and ten species of snakes. None of these species are listed in IUCN Redlist.

5.3.1.6 Avifauna

River Indus and its associated tributaries provide critical habitats for birds. Shallow and deep water habitat is the major attraction for waterbirds, both resident and migratory species. Vegetation on both sides of the river provide ample habitat to forest birds and associated agriculture areas are the source of food for many species. The migration of water birds occurs in north-south direction and vice versa. The birds breeding in central Asia migrate to various destinations in Pakistan, following the Indus valley and plains down to the Indus delta. This flyway of migratory birds is a corridor of international importance, the so-called “Central Asian – South Asian Flyway.” Large numbers of water birds and other birds like teal, pintail, mallard, gadwall and houbara bustard follow the Indus on their way towards the wetlands of southern Sindh, which are the most important major wintering grounds of migratory water birds in the region.

Ten wetlands of Sindh have been designated as Ramsar Sites to provide safe refuge to these migratory birds. Upstream and downstream of Sukkur Barrage and its pond areas also provide an ample opportunity for migratory birds to roost and use as staging ground in winter but due to its location within urban area very small number of migratory birds can be observed in these areas. The shallow ponds are the attraction for ducks and waders while deep water areas provide food for fish eating birds. A total of 41 migratory bird species were recorded in the Game Reserve area. Since the barrage is Located within the city limits and continuous traffic movement cause disturbance. Due to this disturbance it is not attractive to the migratory birds. Out of recorded species from the Indus Dolphin Game Reserve, 13 are abundant to the area, 23 are common, 2 are less common and 3 are rare. Two threatened bird species, Greater Spotted Eagle (IUCN vulnerable) and Long-tailed grass warbler (IUCN Pakistan vulnerable) were recorded in the game reserve.

5.3.1.7 Ichthyofauna

The fish fauna of River Indus is poor as compared to other rivers of the Asia viz. Brahmaputra, Ganges, Mekong, Salween, Hwang Ho and Yandtze. All are originated from same geographical location of Tibetan highland Plateau except River Ganges. The length, drainage area, mean water discharge, slope, water temperature and sediment load of each river is variable, hence directly influencing on the diversity of Riverine ecosystem. Human activities threaten the productivity, diversity and survival of fresh water resources.

The fish fauna recorded from the river between Sukkur and Guddu barrages is given in Annex C.they belong to family of carps (*catla catla, Aspidaoparia morar, chela cachius, cirrhinus reba, cirrhinus mirgala, L. calbasu, L. gonius and Labeo rohita*) *sanke heads* (Channa marulias), catfish (*mystus cavasius*), knifefishes (*Notoptreus. Chitala and N. chitala*), and prawns (*palaemon carcinus*). Most of the fish species are commercially important. None of these fish species are in the IUCN Redlist.

5.3.1.8 Invertebrates

Invertebrates are far more diverse and numerous in inland waters than plants. Apart from fishes, invertebrates form an important group. The important groups include sponges, flatworms, mollusks, polychaete worms, oligochaete worms, crustaceans, insects and numerous parasitic species in various groups. As on land, insects are the most diverse group of organisms in inland waters. Unlike terrestrial faunas, where beetles (Order Coleoptera) are the most diverse, flies (Order Diptera) appear to be by far, the most abundant group in inland waters. Invertebrate diversity of freshwater ecosystems of Pakistan is not properly documented.

5.3.2 Flora

There are around 6000 plant species in Pakistan of which 300 are endemic (5% of the total flora). Wetland plants are specially adapted to waterlogged soils and are an important resource for people living in wetland environs. Wetlands plants are highly productive in waterlogged conditions. Wetlands plants can be divided as emergent, submerged and floating leaves plants.

Riverine and associated shallow wetland habitat is a transitional habitat between deep water aquatic systems and terrestrial systems. The varied hydrological regimes are associated with diverse set of environmental conditions that require plants to tolerate different degrees of wetness. Some plants are characteristics of aquatic as they show their climatic conditions and habitat type. Hydrophytic vegetation is a major determinant of regulated wetlands. Aquatic habitat normally consists of two types of plants; hydrophytes (with submerged organs) and helophytes (on wet soil). Hence plants growing in water like ponds, lakes and rivers are unquestionably hydrophytes (Tiner, 1991). It is the hydrological regime of aquatic habitat with varying wet and drier periods that makes them different from terrestrial and deep aquatic ecosystems. Even slight changes in hydrology may result in significant alteration of wetland processes, species composition and ecological functions.

Most of these plants belong to Potamogetonaceae, Nymphaeaceae and Najadaceae families. Hydrila verticillata is the abundant species that prevailed in the stagnant area of the river as recorded by visual observations. The river Bella and marginal area is dominated by Phragmites kerka - Saccharum spontaneum that grew on moist soil with puddles of water and made it a reasonable habitat for many of wader bird species. These aquatic plants supported macroinvertibrates and birds of that habitat and diversity and are the habitats for most of macroinvertibrates.

5.3.2.1 Aquatic Flora

Aquatic plants play significant role in fresh water, brackish or marine aquatic ecosystems. They

help removing the nutrients and other pollutants from streams and provide a habitat for fish, shrimp and other aquatic species and provide forage for waterfowl. According to a broader definition, “all those plants that at least spend part of their life cycle in partially submerged conditions are regarded as aquatic species”. In our survey aquatic flora was found completely out of picture. However, plant scientists reported few aquatic species previously from the Indus River. Any catastrophe gravely affects the biotic and abiotic components of the ecosystem and consequently, results in the loss of aquatic flora, as the floating / partially sub-merged plant species are washed out by the floods. This is not only the matter of concern for flora but fauna do suffer by the unavailability of the hydrophytes, which they utilize primarily for their food purpose and secondarily for their breeding ground. After any disturbance it takes time to re-assemblage and colonized again to form an ecosystem.

5.3.2.2 Marginal Flora

The province of Sindh comprises of many wetlands, which are either connected with Indus River or other seasonal rivers and streams. Wetlands are more diverse and more productive than any other terrestrial ecosystems due to their diverse ecological services and useful living resources such as reducing silt load from incoming waters, reducing erosion by buffering wave action and harboring fish, medicinal and edible plants and maintaining healthy web of life.

In contrast to aquatic flora, marginal flora is found flourishing quite well. Noteworthy marginal plant species include Typha angustata (Pollens of Typha angustata are used in a traditional Korean medicine “Silsosangami.” Leaves are used for mating). Phragmites karka (Decoction of the root is orally given acts as diuretic and used in kidney, gall bladder’s stones and bleeding piles), Persicaria glabra, Tamarix indica, Tamarix dioica (the leaves form an ingredient of an effective herbal drug, “Icterine” used against jaundice). Both the species of Tamarix are locally referred as Lai. Polygonum effusum and Kohautia retrorsa.

Bukan Booti Phyla nodiflora is frequently observed creeping branched herb at the margins of the River Indus. It was found dominant not only to downstream but also to upstream region. Its leaves and young shoots are sometimes used in curing indigestion in children; its decoction is considered as cooling agent and used as a demulcent.

5.3.2.3 Indus Riverine Forests

In the central alluvial plains of Sindh province, forestry is the major land-user after agriculture. The Sindh forest department is the custodian of only 2.3 % forest resources which possesses 8% of its total land area . It spread over 0.6 M acres (0.24 M ha) and it receive inundation waters received during high flood season. During 1860 to 1960, earthen embankments were constructed on both sides of Indus River. These embankments are one of the significant parts of riverine belt and restricted the uncontrolled flooding/inundation of Indus River. Therefore, sustainability of forest ecosystem solely depends on the regular inundation supplies. The dominant tree species of Indus Riverine Forest are *Acacia nilotica* (babul), *Prosopis cineraria* (Kandi), *Tamarix aphylla* (Lawa), *Tamarix dioca* (Lai) and *Populus euphratica* (Bahan) restricted to well drain high silt containing stabilized Kacho areas (riverine belt).

Forests in Sindh can be categorized into two distinct types; one that are situated inside flood embankment along river Indus are called riverine forests and those which are situated outside embankment are called inland rorests. The Sindh province owns 0.272 m ha riverine forests, which is about 82% of total Riverine forest area in the country which clearly shows that the Sindh province is rich in riverine forests. Riverine forests are one of the important ecosystems of Sindh. These forests along river Indus get annual inundation during monsoon. The vegetation in riverine forests is much influenced by the frequent change in erosion and deposition due to changing course of the river Indus. Riverine forests of the project area have canopy of *Populus*

euphratica (Bahan), *Prosopis cineraria* (Kandi), *Acacia nilotica* (Babul), *Tamarix dioica, Tamarix indica* (Lai), *Salvadora persica* (Pilu), and *Salvadora oleoides* (Khabbar) etc. Bahan *Populus euphratica* is one of the pioneer indigenous tree species of Pakistan but over the past few years this tree species showed great decline. Shah Belo is the place where Bahan *Populus euphratica* was found dominant. Its wood is used for fuel in Sindh. Kandi *Prosopis cineraria* is a versatile species, providing fodder, fuel, food, timber, and shade, as well as enhancing the fertility of the soil and sand dune stabilization. The flowers are pounded and mixed with sugar, and eaten by women during pregnancy to safeguard them against miscarriage. The flowers are also valuable in honey production. Babul *Acacia nilotica* is a good soil binder and increases soil fertility through nitrogen fixation. Good quality Babul gum is used in calico-printing and dyeing, as a sizing material for silk and cotton, and in the manufacture of paper. Pods are reported to be effective in urinogenital disorders; the unripe pods are used to make ink, a decoction of the bark is used as a substitute for soaps.

Irrigated Forests

The 81,200 ha of riverine forests exist on both sides of River Indus but now these forests has drastically reduced after the construction of earthen embankments (bunds) with the construction of three barrages on Indus River for providing river water for agriculture. The canal water also used for many inland forests for converting these into irrigated forests. Inland forests falling in the command of each barrage are as under: Guddu Barrage command area: 0.02 million ha (0.05 million acres), Sukkur Barrage command area: 0.04 million ha (0.09 million acres) and Kotri Barrage command area: 0.03 million ha (0.07 million acres) with of total 0.08 million ha (0.20 million acres). These irrigated forests were supported to supply firewood to railway, ships, fuel wood for cantonments. The idea of irrigated plantation was initiated during the British Rule in Sindh. The dominant tree species of irrigated plantation are *Dalbergia sissoo*, *Acacia nilotica*, *Salmalia malabaricum* and *Eucalyptus camaldulensis*.

Management of Riverine Forests during British Rule Period

There is no record available about the managerial system of these forests, as no administration reports exist for that period till 1860-61 before the period of Sindh conquest by British Empire. However, Local rulers and communities were looking after these woodlands for hunting purpose (Anon, 1986). The management also does not exist during 1860 – 1895 on any systematic plan of reproduction and harvesting. Local population had exploited the forest resources to meet their demand, Indus Flotilla Company – a British military Company and subsequently for the state railway when railway took the place of steam boat navigation (Anon, 1987). In the initial period, the disposal system adopted were shared and royalty methods, that were later substituted by departmental working. Departmental working continued up to 1901, when the system of selling coupes by tender or by auction was introduced (Aitken, 1907).

Current Management Practices of Riverine Forests

In order to generate/regenerate *Acacia nilotica*, the management objective of these forests was set, which is the most stable tree species with short rotation period and high economic value. *Acacia nilotica* takes a longer time to grow or regenerate in its natural succession as it follows a growth cycle which is preceded by *Tamarix, Saccharum* and *Populus euphratica* growth. *Acacia nilotica* regenerates when favourable conditions and new soil formation are created in the riverine tract (Panhwar, 2004). In order to speed up the process and grow Acacia in a shorter period, broadcast sowing is done in muddy waters during recession of floods each year (Amjad, 1984). Management practices have been simple and time tested. The forest areas on attaining rotation period are marked for clear felling in the form of 64 ha (one compartment) or smaller coupes for felling operations. Clear felled coupes/areas and newly stabilized kacha areas are regenerated as inundation recedes after the peak flood season (Anon, 1973).

Population Pressure on Riverine Forests

Sindh is the second most urbanized and populous province of Pakistan. 72 percent of the population in Sindh province is depended on agriculture which is mostly practiced in the central zone which is resulted in thickly populated irrigated tract and put direct pressure on riverine forests. Due to increasing population, the destruction of riverine forests has accelerated. However, all the biodiversity of riverine forests has been damaged particularly trees are badly affected due to population pressure. In order to meet the need of domestic fuel wood and livelihood, the indiscriminate tree cutting has exacerbated the condition of already fragile ecosystem. People have also encroached upon forestland for agriculture purposes. More than 40,000 ha of riverine forests of Sindh have been encroached (Anon, 1986).

Such practices have resulted in the total destruction of ecosystem biodiversity i.e. loss of wildlife habitat, soil degradation, disappearance of associated fauna and flora, decrease in gene pool and change of micro climate have changed over all environmental scenario of the area. This has ended in the decreasing the horizontal and vertical structures of riverine forests (Sirhindi and Keerio, 1987). The population living in Kacho area (Riverine Belt) and adjoining areas depend either directly or indirectly on the riverine forest resources. It is generally observed that the people living within riverine forests or its vicinity mostly depend on riverine forests for meeting their domestic needs. According to an estimate (IUCN, 1991), people living within 5 km of forests are dependent on riverine forests to the extent of 50 percent, whereas 30 percent needs of the people residing up to 10 km are met from riverine forests.

5.3.2.4 Agriculture

Traditional agriculture in the riverine area is based on Sailabi (Flooded) cultivation i.e., cultivation on preserved moisture for crops like wheat, oil seeds, winter vegetables, and melons, which all are winter crops. Kharif (summer) cultivation is mostly dependent on tube-well water is led from the main stream or Dhoros to low lying flat lands. Tube-well irrigation is limited mostly to sugarcane but some time cotton; sorghum (fodder), summer vegetables and summer oils are also raised. Use of tube-well water for raising mainly sugar cane shows the general trend in use of pumped water for value added crops. It is encouraging that the future trend would mainly be to grow value-added crops, rather than conventional cereal culture or fodders which are un-economical to grow on tube-wells or lift pumps from Dhoros and are marginal on canal water even in irrigated areas.

5.3.2.5 Natural Vegetation

The vegetation of alond game reserve was assessed a total of 105 plant species belonging to 81 genera and 36 families have been identified. Of them, 15 grass species (Poaceae family) have been identified, which include ground covers, annual to perennial herbs, succulent herbs, sub-shrubs to hardy shrubs to perennial grasses and the trees. This much number of plant species is reflective of the fact that this ecosystem is highly productive and the magnitude of alpha diversity of the Indus Dolphin Reserve is also high. The major plant families which contributed in the formation of vegetation in the area are Poaceae (Grass Family = 14.30%), followed by Asteraceae (7.88%), Fabaceae (6.75%), Mimosaceae (5.70%), Boraginaceae (4.80%), Chenopodiaceae (3.90%) and Amaranthaceae, Capparidaceae, Convolvulaceae, Malvaceae and Nyctaginaceae (2.88%) each.

In addition to Xerophytes, Salt tolerant plant species are also recorded from the outer margin area i.e., Halophytes which are equally important in contributing the manifold benefits not only to the environment but also to the masses. All the recorded plant species are very important as far as biodiversity is concern. There is no threatened plant species identified in the project area.

5.4 Social and Economic Environment

Socioeconomic surveys were carried out by the feasibility study and detailed engineering design consultant in the canal command areas; and the data presented in this section is mostly based on this survey. As part of these surveys, household and village profile surveys were carried out. The household surveys covered all the seven canal command areas and interviewed farmers at head, middle and tail end of the canals. Additionally, detailed interviews were carried out with the communities located close to the barrage sites on the shoals on the upstream of the barrage.

5.4.1 Overview of the Command Area of Sukkur Barrage

The Sukkur Barrage has the longest irrigation system in the world, with 61,000 km (38,000 miles) of irrigation canals and associated off take distributaries. The total gross commanded area (GCA) served by the seven off-taking canals from the Barrage is 3.33 million ha (8.24 million acres) on both banks of the Indus River in Middle and Lower Sindh. Out of this 3.06 million ha (7.55 million acres) are cultivable.

The beneficiaries of the project are considered to be those who are irrigating their fields from the seven canals getting water from the Sukkur Barrage, located on both the left and right sides of the Barrage. The socioeconomic survey was therefore conducted on a sample of the populations living in the command areas of the seven canals. This includes the command areas of Nara, Khairpur Feeder East (KFE), Rohri and Khairpur Feeder West (KFW) Canals on the left bank; and Dadu, Rice and North Western canals on the right bank of the Barrage. The canals on the right bank of the river are serving four districts of Sindh; Shikarpur, Larkana, Shahdad Kot and Dadu. The North Western Canal also irrigates some area at Dear Allah Yar of Balochistan. The canals on the left bank of the river are serving 11 districts; Sukkur, Khairpur, Noshehro Feroze, Nawabshah (Shaheed Benazirabad), Sanghar, Mirpurkhas, Umarkot, Badin, Hyderabad, Tando Allahyar and Tharparker. Details of the beneficiary districts and command areas of each canal are summarized in Table 5.7.

Table 5.7: Districts in Sukkur Barrage Command Area

	Name of Canal	Length (Miles)	Gross Command Area (million acres)	Cultivable command area (million acres)	Benefitted Administrative Districts
A	**Left Bank Canals**				
1	Khairpur East Feeder	58.6	0.53	0.37	Kahirpur; Sukkur
2	Khairpur Western Feeder	41.9	0.41	0.32	Kahirpur; Sukkur
3	Nara Canal	226.0	2.22	2.14	Kahirpur; Sanghar; Tando Allah Yar; Nawabsha; Mirpur Khas
4	Rohri Canal	208.0	2.90	2.61	Khairpur; Naushero Feroze; Nawabshah
B	**Right Bank Canals**				
5	Dadu Canal	131.5	0.60	0.55	Larkana; Shikarpur
6	North Western Canal	36.1	1.03	0.94	Jaccababad; Shikarpur
7	Rice Canal	82.0	0.55	0.52	Sukkur; Larkana; Upper Dadu
	Total	784	8.24	7.45	

The demographic profile of the districts benefiting from the canals of Sukkur Barrage is presented in Table 5.8. This includes population, health and education statistics for the entire districts.

Table 5.8: Socioeconomic Profile of Beneficiary Districts of Sukkur Barrage

No	Description	Sukkur	Khairpur	Sanghar	Nawabshah	Mirpur Khas	Naushehro Feroze	Larkana	Shikarpur	Jacobabad	Dadu	Ghotki
1	Area (sq: K.M)	5,165	15,910	10,728	4,239	7,332	2,946	7,423	2,688	5,287	19,070	6,083
2	Population Year 1998 (Nos)	908,373	1,546,587	1,452,956	1,135,131	1,569,020	1,087,571	1,927,066	880,438	1,425,572	1,688,811	970,549
3	Population estimated Year 2012 (No	1,351,754	2,248,809	2,121,321	1,738,111	2,247,458	1,360,091	2,970,820	1,177,766	1,891,365	2,435,602	1,520,783
3a	Male	483,251	810,448	762,212	599,275	820,840	568,574	993,576	456,589	744,014	887,061	511,363
3b	Female	425,122	736,139	690,744	535,856	748,180	518,997	933,490	423,849	681,558	801,750	459,186
4	Population Growth Rate (1981-98)	2.88	2.71	2.74	3.09	2.60	1.61	3.14	2.10	2.04	2.65	3.26
5	Density per sq k.m (Year 1998)	175.9	97.2	135.4	267.8	214.0	369.2	259.6	327.5	269.6	88.6	159.6
6	Density per sq k.m (Year 2012)	261.7	141.3	197.7	410.0	306.5	461.7	400.2	438.2	357.7	127.7	250.0
7	Literacy rate (male/female) %	59.8	35.5	30.9	34.1	30.4	39.1	35.0	33.9	23.2	30.4	44.2
8	No. of universities.	-	1.00	-	1.00	-	-	-	-	-	5.00	-
9	Primary and Middle Schools (No)	1,039	1,398	3,252	102	1,657	2,028	2,721	609	2,594	2,608	1,411
10	Secondary and Higher (No)	156	229	-	-	114	64	94	118	-	-	37
11	Rural Health Centers (No)	4	5	7	2	3	2	4	2	2	2	2
12	Basic Health Units (No)	24	60	35	31	64	40	53	33	27	59	27
13	Hakims and Homeopaths (No)	50	34	69	-	270	-	568	45	133	-	14
14	Registered Medical Practinors (RMP	74	93	241	117	405	214	598	100	265	370	27
15	Hospitals (No)	3	7	7	1	7	2	6	3	4	5	41,004
16	No. of Prominent NGOs	5	10	10	21	2	60	354	31	10	103	1
17	Average Family Size	5.0	-	7.0	5.8	7.0	5.5	6.0	8.0	na	5.5	5.0
18	Average Living Rooms per Household	2.0	6.0	na	6.0	5.8	5.8	6.0	4.0	5.6	5.5	53.0

5.4.2 Demography

5.4.2.1 Population

The Sukkur barrage command area covers 1,805 villages and 13,746 settlements. Village refers to mouza and deh, both commonly used terms in the command areas of the Barrage. In a village, there may be one or more settlements, also called abadis, bastis, dhokes. The number of villages and settlements is shown in Table 5.9.

Table 5.9: Number of Villages and Settlements in Command Areas of Sukkur Barrage

Name of Canal	Number of Villages	Total Settlements
Khairpur Feeder East	215	1,438
Khairpur Feeder West	226	1,389
Nara	359	3,539
Rohri	205	1,727
Dadu	292	2,020
North Western	314	2,343
Rice	194	1,290
Total	**1,805**	**13,746**

5.4.2.2 Ethnic Composition

Sindhi is the most common language spoken in the command area. The socioeconomic survey shows that 96% of the respondents speak Sindhi as their primary language. Urdu was spoken and understood by 89.1% of the respondents.

Sukkur district is majority Muslim, constituting 96% of the total population, of which about 80% belong to the Sunni sect and 16% belong to the Shia sect. The minorities include Hindus (3.28%) and Christians (about 0.51%). The Hindu population is mostly settled in urban areas and is engaged in the trade and services sectors.

Sindhis share the biggest segment of population in Sukkur and Rohri city areas (70.50%), followed by Muhajirs (15.50%), Pashtoon (2.50%), Seraiki (1%) and Balochi (1%). Baloch tribes include, Mirani Rind, Kalyar, Chandio, Gabol, Khoso and Leghari. Other tribes in Sukkur include Indhar, Ansaris, Mahars, Syed, Mughals, Soomro, Mangrio, Chijjan, Phulpoto, Palh and many more. There is also a presence of Sindhi and Saraiki Memons. Traditionally Memons were associated with trade and retail business but during last two decades, they have ascended as an active social and economic front. Soomro are Sindhi speaking, associated with law, trade, information technology, technical, medical, administration, generally in education and social fields; for their development they perform steps ahead day and night. Tertiary families are Saraiki speaking, and mostly are associated with profession of law, medical and education.

5.4.3 Livelihood Sources

According to socioeconomic surveys, agriculture is the main source of livelihood for about 77% of the households. Agriculture is the main source of livelihood for 77% of the households. Other sources of income are labour and daily wages, employment with the government, and remittances from the family members working in the cities. However, 58% households also have secondary sources of income from activities including labour, livestock, trading etc. However, 58% households also have secondary sources of income from activities including labour, livestock, trading etc..

Given that the primary source of income for people living in the barrage command area is agriculture, the majority of households do not have regular monthly income, but rather have seasonal income from crops. Only 6.5% households have employment within their home village or nearby villages and have regular monthly income. Table 5.10 presents statistics on the income from both primary and secondary sources.

Table 5.10: Sources of Income for Surveyed Households

Source	Households (both primary and secondary)
Agriculture	88%

Livestock	63%
Employment	6.5%
Remittance	8%
Labour	10%
Other – Occasional	11%

The socioeconomic survey of the project area indicates the minimum monthly income as Rs. 6,000/- (Rs. 200/- per day). The survey also reveals that 60% of the people of the project area live below the poverty line, the majority of whom live in rural areas. However, urban poverty is also significant.

5.4.4 Agriculture and Livestock

Wheat, rice, cotton, sugarcane, maize (grain and fodder), pulses, orchards and vegetables are grown in the majority of villages. Wheat is the dominant crop followed by cotton, rice and sugarcane in all the villages. The analysis also shows that 29% of villages have orchards, these include dates, mango and banana. A summary of the percentage of villages by cultivation of different crops is shown in Table 5.11.

Table 5.11: Percentage of Village in Canal Command Area Growing Crops

Name of Canal	Wheat	Rice	Cotton	Sugar cane	Maize	Pulses	Orchards	Vegetables
Khairpur Feeder East	97.15	38.84	88.07	51.80	6.88	4.12	39.03	17.88
Khairpur Feeder West	97.08	37.93	90.98	54.64	7.69	4.24	42.71	18.57
Nara Canal	97.97	10.24	97.86	85.81	45.46	12.99	62.08	55.95
Rohri Canal	92.16	61.76	80.03	88.41	35.27	18.02	41.35	44.28
Dadu Canal	82.01	64.23	25.01	12.92	17.57	1.58	4.73	9.63
North Western Canal	80.22	69.74	0.73	2.93	1.83	7.33	-	4.03
Rice Canal	88.00	81.68	14.19	8.39	7.35	7.74	9.81	11.48
Overall	**90.65**	**54.92**	**56.70**	**43.56**	**17.44**	**8.00**	**28.53**	**23.12**

Average crop yields have been collected from the Bureau of Statistics, Sindh as well as from annual statistics issued by Government of Pakistan. The data on crop yields indicated that the crop yields have shown mixed trends of growth over the last 10-years. Average crop yields, by canal commands, of the last three years have been used for analysis in the socioeconomic study. The data was verified with the response by the farmers recorded during household interviews. Average yield of major crops by canal command is summarized in Table 5.12:

Table 5.12: Average Yield Per Hectare (kg) by Canal Commands

Crop	NW Canal	Rice Canal	Dadu Canal	KFW Canal	Rohri Canal	KFE Canal	Nara Canal
Rice	3,232	3,308	3,176	2,839	1,653	2,417	2,300
Cotton	-	710	702	785	865	770	787
Wheat	3,844	3,242	3,148	3,794	3,838	3,791	3,588

Sugarcane	53,500	46,959	46,918	59,595	58,377	57,888	56,857
Mangoes	-	6,491	6,570	7,087	6,584	9,794	8,226
Banana	-	1866	1,732	4,060	3,899	4,281	4,744
Dates	9,594	8,957	5,250	8,094	9,333	7,825	10,708

Goats and poultry are usually owned by almost every farming household surveyed. Table 5.13 shows the percentage of households owning cattle, the average number of animals owned by each household, and the average monetary value of the cattle.

Table 5.13: Livestock Ownership by Surveyed Households

Type of Livestock	% of Households	Number of Livestock/HH	Average Value (Rs)
Goat	93.1	12.4	6,300
Sheep	25.9	8.9	4,700
Cow	31.4	6.0	41,000
Buffalo	60.5	10.1	59,000
Horse	12.2	0.1	39,000
Mule	3.1	0.1	40,500
Donkey	2.1	0.3	10,534
Ox	4.1	1.0	70,000
Poultry	96.2	12.1	240

5.4.5 Fisheries

Fish is an important natural resource in the Indus River. The fisheries department gives permits for the fishermen for fishing in Indus. However close to the barrage, fishing is banned by the government due to security issues. Fishing is also not allowed in high flow season.

The Fisheries Department no longer gives contracts for fishing in the Indus River. The now functional Benazir Fishing Card System provides permits to individual fishermen on a nominal registration fee. While this results in less exploitation of fishermen by contractors, the system has led to an excessive number of fishermen operating on the river. New fishermen (those not from traditional fishing communities) are also likely to not abide by the fishing rules and regulations. Electro fishing, use of under sized net, dynamiting and poisoning is wide spread. This has led to great pressure on the fish resources in the River Indus.

Fisher Folk is an international forum of fishermen which provides protection to the rights of fishermen and regulates their fishing activities for conservation. According to Fisher Folk, there are three traditional fishing villages of about 500 households in the 10 to 15km radius of Sukkur Barrage. However, because of overall reduction in fish population in Indus, a number of these households stopped fishing. Alternatively, they are working as laborers in agriculture or at commercial fish ponds. There still are around 30 to 35 fishing boats in these villages, and fishing households earn about Rs. 7,000 per month.

5.4.6 Social Infrastructure

5.4.6.1 Health Facilities

Health facilities in the districts that fall in the command area of the seven canals off-taking from

Sukkur Barrage are summarized in Table 5.14 below. In addition, there are private health facilities in the Sukkur city.

Table 5.14: Health Facilities in Command Area Districts

No	Description	Sukkur	Khairpur	Sanghar	Nawabshah	Mirpur Khas	Nausheh ro Feroze	Larkana	Shikarpur	Jacobabad	Dadu	Ghotki
1	Rural Health Centers (No)	4	5	7	2	3	2	4	2	2	2	2
2	Basic Health Units (No)	24	60	35	31	64	40	53	33	27	59	27
3	Hakims and Homeopat hs (No)	50	34	69	-	270	-	568	45	133	-	14
4	Registered Medical Practitione rs (RMP	74	93	241	117	405	214	598	100	265	370	27
5	Hospitals (No)	3	7	7	1	7	2	6	3	4	5	2

5.4.6.2 Education

Literacy rate is low in the villages surrounding the canal command areas as compared to the overall national level. The literacy ratio amongst male and female is 1.3:1. About 14% of school age children have never attended school. Among the illiterate, 11% could read (but not understand) the Holy Quran. 2.9% of the surveyed population is only able to write their names or read newspapers to some extent. Formal education level was achieved by 16.5% for primary education, 14.1% for matriculation, 3.1% for intermediate, 1% for graduation and 0.5% for post-graduation. Overall, the literacy level is only 36.3% as compared to 47% at Pakistan level. Table 5.15 shows the level of education among the surveyed male and female population of the project area. Table 5.16 shows the number of schools and universities in the districts falling in the command area of the project.

Table 5.15: Education Levels in Project Area

Sr #	Description	Male %	Female %	Overall %
1	Illiterate	14.1	26.3	20.6
2	Read Quran	11.1	13.7	11.1
3	Just literate	3.8	1.9	2.9
4	Trade Skill	0	0.3	0.1
5	Primary	18	9.3	16.5
6	Matric	16	4.6	14.1
7	Intermediate	5.4	0.6	3.1
8	Graduate	3.2	1.3	1.1
9	Masters	0.5	0.4	0.5
10	School age-not going	12.1	15.4	14
11	Below school age	15.8	26.2	16

Table 5.16: Educational Facilities in Command Area Districts

No	Description	Sukkur	Khairpur	Sanghar	Nawabshah	Mirpur Khas	Naushehro Feroze	Larkana	Shikarpur	Jacobabad	Dadu	Ghotki
1	No. of universities.	-	1.00	-	1	-	-	-	-	-	5	-
2	Primary and Middle Schools (No)	1,039	1,398	3,252	102	1,657	2,028	2,721	609	2,594	2,608	1,411
3	Secondary and Higher	156	229	-	-	114	64	94	118	-	-	37

5.4.6.3 Water Supply and Sanitation

About 76% villages, located in the command area of the Barrage, rely on hand pumps for drinking water. More than 28% of the villages also get drinking water from canals. The percentage of villages using various sources of drinking water in the command area of the canals is shown in Table 5.17.

Table 5.17: Sources of Drinking Water in Surveyed Villages (in percentage)

Name of Canal	Piped Supply	Tube well	Open Well	Hand Pump	Private Electric Pump	Canal/ River	Other
Khairpur Feeder East	4.49	5.99	2.20	89.14	17.83	10.72	4.35
Khairpur Feeder West	4.51	6.10	1.86	90.72	17.51	11.14	3.98
Nara Canal	6.09	1.75	2.20	41.85	5.43	80.69	10.43
Rohri Canal	5.60	5.55	6.38	71.51	13.83	46.13	4.38
Dadu Canal	6.99	12.20	16.92	64.13	4.01	15.59	15.48
North Western Canal	7.33	1.10	4.40	89.01	4.03	24.54	5.13
Rice Canal	5.16	6.97	13.42	83.87	5.03	8.39	7.23
Total	**5.74**	**5.67**	**6.77**	**75.75**	**9.67**	**28.17**	**7.28**

A large number of sampled households have fitted flush system within the housing unit. Others go to agricultural fields or behind the boundaries of the houses to urinate or defecate. About 86.7% have latrine facility with flush mechanism within their houses, of which 30% have the modern fittings of seat and tank fitted with their flush system in the latrine.

5.4.7 Gender Issues

The role of women in domestic activities and their involvement in decision making was explored by posing a series of questions to male respondents during the socioeconomic survey. Findings reveal that women are the most suppressed section of society. In rural areas, they are refused

the access to education, hospital or travel. In urban areas, however, the women have access to education, employment, travel and medical treatment. Women have high involvement in household activities and child rearing. The only economic activities with some of women is livestock rearing and farming. The findings of the socioeconomic survey are presented in Table 5.18.

Table 5.18: Participation of Women in Activities and Decision Making

Nature of Activities	***Participation by Women %***	
	In Activity	**In Decision Making**
Household Activities (washing, cooking, repairs)	88.1	66.3
Child Caring	98.1	60.8
Livestock Rearing	50.0	13.2
Farm/Crop Activities	64.7	3.4
Social Obligations (Marriage, Death events)	89.6	2.5
Sale & Purchase of Land/ Immovable Property	4.5	1.0
Any Other Issue in the family	3.4	-

5.4.8 Cultural resources

Sindh province is home to nearly 3,000 sites and monuments, of which 1600 are listed as protected under the provincial, Sindh Cultural Heritage (Protection) Act 1994 and also Pakistan Antiquities Act, 1975, while 1,200 remain unprotected. Sukkur area is rich with cultural monuments and historical sites. Figure 5.14 shows the locations of the historical sites located in Sukkur city and details of these sites are given in Table 5.19. All these sites are located more than 4 km from the barrage site and will not be impacted by the proposed project activities.

Figure 5.14: Locations of the cultural sites in Sukkur

Table 5.19: Cultural and Historic Sites near Sukkur

S#	Name of Cultural/Historical Site	Significance	Location	Distance from the barrage
1	Sadhu Bella	Hindu temple	On an island in Indus	4 km from on upstream
2	Mir Masum's Minar and tomb	tomb	Sukkur	More than 6 km
3	Satyan-jo-than	Buria site	Rohri	More than 6 km
4	Stone Tool Factory area	Historic site	Rohri	More than 6 km
5	Wood carved door on residential house owned by Evacuee Trust Property Board	Wood carving	Rohri	More than 6 km

5.4.9 Livelihoods on Middle Bank Island and Shoals

The barrage is located in an urban setting with all areas around the barrage and Indus are urbanized by Rohri town on the right bank and Sukkur town on the left bank. The road (lower deck) on the barrage is extensively used by local traffic. A national highway is located about 150 m away on the downstream of the barrage.

The barrages' s middle bank island and shoals (silt deposits, locally known as belas) on barrage's outer bank wall and along upstream river banks are being used by squatters for cultivation during low flow season when these lands are emerged above water levels. Locations of the middle bank island, outer bank bela and left bank bela is shown in Figure 3.2. Photograph showing the middle bank island and outer bank bela is shown in Figure 5.15. Most squatters, who are cultivating on belas and middle island live in the Sukkur town or nearby villages.

Figure 5.15: Locations of Middle Bank Island and Outer Bank Bela on Upstream of the Barrage

The Middle Bank Island consists of 45 acres and it is being used by 14 squatters. The squatters in the Middle Bank Island hails from Cahkar Rustam in Lakhi Shikarpur taluka and have

permanent residences in their native village. Among these 14 squatters, 5 squatters also have residential structures in the main bank island and live with their families. These squatters have some businesses in Sukkur town and some of the squatters are also the employees of the barrage, and work as *beladars* (responsible for routine maintenance). The squatters grow vegetables and wheat on the island. The women involved in quilt making and cattle rearing. They don't have any safe drinking water and sanitation facilities in the island, but have access to medical and school facilities in Sukkur town. They use boats to cross the river. The irrigation authorities have so far not taken any action to evacuate these squatters since they safeguard the security of the island. The proposed project activities will not have any impact on these squatters since the Middle Bank Island is part of the barrage structure and will not be disturbed by the proposed desilting activities.

The Outer Bank Bela consists of about 5 acres and is being used by 2 squatters for cultivation of crops during low flow season. These squatters live in Sukkur town and their primary income is business; and they cultivate these lands as a source of secondary income. There are no residential structures in this bela. The proposed project activities will not impact the outer bank bela.

The Left Bank Bela consists of about 120 acres and some part of this land is being used by 24 squatters for cultivation of crops when these lands emerge above water levels during low flow season for a few months in winter. The extent of bela varies every year due to erosion of the river or deposition of more silts by the river. These squatters live in Sukkur town and their primary income is business; and they cultivate these lands as a source of secondary income. There are no residential structures in this bela. The proposed project activities will remove a small portion of the bela (about 6 acres), which is non cultivable. The project activities will not have any impact on the squatters and on their cultivated land.

6 Potential Impacts and Mitigation Measures

6.1 General

Sukkur barrage has been in operation for about 85 years and the proposed rehabilitation works will not alter the current operational regime of the barrage and hence will not create any additional impacts. The proposed activities are limited to the existing footprints of the barrage and no additional land acquisition is required, hence most of the impacts from the proposed activities are temporary in nature and limited to construction period. There will be no impact on the canal releases. The negative impacts associated with the construction are mostly related to dredging and excavation activities for sediment removal. However, the extent of dredging to be carried out under the project (0.75 MCM of dredging during high flow season) is very limited compared to the annual sediment load of about 100 million tonnes carried out by the Indus during high flow season. Dolphin game reserve located immediately upstream of the barrage is the most significant receptor susceptible from impacts of the desilting and construction works. The overall positive impact of the project, which is the enhancement of the life of the barrage to safeguard the livelihoods of 0.6 million farming households in the command area through provision of irrigated water for 3.34 million ha, will be experienced countrywide.

6.2 Impact Assessment Methodology

Potential environmental and social impacts were identified on basis of review of feasibility study reports, field visits and stakeholder consultations. The significance of potential impacts was assessed using the criteria and methodology given below.

Impact Magnitude

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

The magnitude of potential impacts of the Project has generally been identified according to the categories outlined in Table 6.1.

Table 6.1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration of potential impact	Long term Beyond life span of the project	Medium Term Lifespan of the project	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact

Parameter	Major	Moderate	Minor	Minimal
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in Table 6.2.

Table 6.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown in Table 6.3.

Table 6.3: Significance of Impact Criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very High	**High**	**Medium**	**Low**
Major	Critical	Major	Moderate	Minimal
Moderate	Major	Major	Moderate	Minimal
Minor	Moderate	Moderate	Minor	Minimal
Minimal	Minimal	Minimal	Minimal	Minimal

6.3 Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in Section 6.2 above. A summary of these impacts and their significance is presented in Table 6.4.

Table 6.4: Potential impacts and their significance

Impact from various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Environmental impacts during construction stage:					
Impact of dredging on aquatic and benthic habitat	Very high	Moderate	Major adverse	• Dredging during high flow season (July and August) • Dredging through cutter suction dredger • Implementation of environmental code of practices (ECP) on dredging	Minimal
Sediment dispersion from dredging activities	Very high	Moderate	Major adverse	• Dredging during high flow season (July and August) • Dredging through cutter suction dredger • Ecological monitoring	Minimal
Impact of in-river placement of dredged material	Very high	Moderate	Major adverse	• Placement of material in active river channels in high flow season; placement in the scours if required • Submerged discharge of material	Minimal
Effluents and emissions from dredgers and associated vessels	Very high	Moderate	Major adverse	• Emergency preparedness plan by contractors (e.g. booms and skimmers in place for separation of oil spills from river) • Regular maintenance of water borne equipment • No disposal of bilge water from the boats/barges in to the river Maintenance of equipment	Minimal
Impact of underwater noise levels on dolphins' vocalization and behavior	Very high	Moderate	Major adverse	• Monitoring for dolphins within 500 m from dredging areas; and chase away dolphins from those areas using pingers. • 'soft start' (gradually ramping up sound levels) approach during dredging to chase away dolphins	Minimal
Risk of dolphin collision with construction vehicles	Very high	Minor	Moderate adverse	• Restrict the motor boat speeds to 15 km/hour • Restrict the boat movement within the construction area	Minimal
Impacts from excavation activities in the barrage	High	Minor	Moderate adverse	• Excavation will be carried out only in dry river beds • Pollution prevention and control measures • Traffic management along sediment transportation routes	Minimal
Impacts from excavation activities in the right bank canals	High	Minor	Moderate adverse	• Desilting only during canal closure period. • Use canal beds for construction equipment movement. • Scheduling the desilting activities of Rice canal without overlapping of desilting activities in Dadu and NW Canals • Traffic control measures through adequate traffic signs and traffic control personnel	Minimal
Risk of entrapment of dolphins, turtles, and other aquatic fauna in construction areas	Very High	Minimal	Minimal adverse	• Rescue of the animals and release them back in to the river • Availability of dolphin rescue facilities with the contractor	Minimal
Impact of excavated material placement on the dry river banks	Medium	Minimal	Minimal adverse	• Uniform distribution of the material in the placement areas • Limiting the height of material dumps to not more than 6 ft.	Minimal

Impact from various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Disposal of replaced mechanical and electrical parts	Medium	Major	Moderate adverse	• Waste material such as steel and gate wheels and hoists will be sold to steel industry through open auction and finally will be transported to Lahore or Karachi to steel industries • Rubber seals will be sold to rubber industry through open auction	Minimal
Potential risk of soil and water pollution by construction works	Medium	Moderate	Moderate adverse	• Management plans for pollution prevention • Implementation of ECPs by Contractor • Compliance with NEQS on waste water discharges	Minimal
Air and noise pollution from construction and traffic	High	Moderate	Major adverse	• No construction activities during night time near the villages • Dust and noise control measures as per ECPs • Compliance with NEQS on vehicle and machinery emissions	Minimal
Risk of pollution from solid waste and waste effluents	Medium	Moderate	Moderate adverse	• Waste management plan by the contractor • Use of available municipal waste disposal facilities in Sukkur • Use of approved facilities for hazardous waste disposal	Minimal
Impacts from borrow and quarry activities	Medium	Moderate	Moderate adverse	• Source material only from licensed operators • Due diligence to ensure the proposed licensed quarry is being operated in accordance with environmental permits	Minimal
Social Impacts during Construction:					
Land acquisition and resettlement	Very high	Minimal	Minimal	• Proposed activities do not anticipate land acquisition or resettlement.. If any land acquisition is required, RAP will be prepared and implemented according to RPF.	Minimal
Impact on irrigation releases from the barrage	Very high	Minimal	Minimal	• Works that require temporary canal closures will be carried out only during regular canal closure period.	Minimal
Impact on traffic on the barrage	Medium	Moderate	Moderate adverse	• Advance notification on traffic closure	Minimal
Generation of employment	Medium	Moderate	Moderate beneficial	• Notifying employment opportunities as per the communication strategy	Moderate beneficial
Increased economic activity	Medium	Moderate	Moderate beneficial	• Establishment of new businesses and commercial enterprises; local employment	Moderate beneficial
Safety hazards due to increased traffic especially for children and elderly	High	Moderate	Major adverse	• Traffic Management Plan addressing general access • Safety and security actions and procedures to protect local	Minimal

Impact from various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
people				community	
Impacts from the influx of labour from the outside areas	Low	Moderate	Minimal adverse	• About 70 non-locals will reside in a camp that will be set up on ID owned land Contractor follows IFC Performance Standards on Labor and Working Conditions; • ECPs on management of labour influx and worker's camps • Grievance redress mechanism	Minimal
Possible cultural conflicts between communities and workers and health impacts, including women's privacy and access	High	Moderate	Moderate adverse	• Awareness campaign; Code of conduct for workers • Grievance mechanism	Minimal
Workers health and safety	High	Moderate	Major adverse	• Occupational Health and Safety Plan to be implemented • Emergency Preparedness Plan; Safety training for workers • Adequate water supply and sanitation facilities, medical and first aid care facilities	Minimal

6.4 Environmental impacts during Construction Stage

6.4.1 Impact of Dredging on Aquatic and Benthic Habitat

About 0.75 million m^3 (MCM) of desiltation will be removed through dredging. Dredging activities may cause several negative impacts on the aquatic habitat and fauna due to generation of high sediment flows and disturbance of benthic habitat. Various stages of the dredging and potential impacts from each of these stages is summarized below.

- Excavation: Excavation is the process of physical removal of the material from its in situ location on the bed of a water body. This will be done either hydraulically or mechanically by dredger heads. The physical changes that can take place during excavation are the generation of suspended sediments (causing an increase in turbidity, destruction of benthic environment, and changes to river morphology), mixing of soil layers and noise and air pollution from the equipment.
- Lifting: Lifting is the vertical transportation of the excavated material from the bed. Similar to excavation, this will also be done either hydraulically or mechanically. The physical changes that occur during lifting are the release of suspended sediments for example as overflow losses during loading. Sediment re-suspended in the water column in high concentrations can directly lead to physical abrasion of, for example, filter-feeding organs or gill membranes of fish and shellfish. Increase in turbidity, due to sediment resuspension, also reduces light penetration in to the water thus resulting in to reduction in primary productivity for phytoplankton. If the sediments are rich in nutrients and metals; the resuspension of sediments may release nutrients, organic matter and/or toxic chemicals in to the water.
- Transportation: Transportation is the process of transferring the excavated material to the placement location. This will be typically done hydraulically through a pipeline. The potential impacts during transportation are spillage and safety in relation to other transport users of the river.

Mitigation

Mitigation measures to address impacts associated with dredging on aquatic and benthic habitats are:

- The dredging activities will be carried out during high flow season of July and August when the river naturally carries high sediment load; and any impact on benthic habitat will be quickly restored by the new sediment load. During this season, the river carries about 100 million tonnes of sediment load, while the material to be dislited (0.75 MCM) during this season will be equal to only 1% of this load.
- The Contractor will use Cutter Suction Dredger, which is known to have a low risk of sediment releases from lifting. Reduce the suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity to ensure that the cutter advancement rate is not greater than the ability of the suction pump to remove the material that has been cut.
- An ongoing ecological monitoring will be in place by the contractor to evaluate the impacts of the dredging and develop additional mitigation measures as required. The additional measures could include efficient use of cutting and lifting operations, reduce the volume of dredging rates to minimize adverse impacts on aquatic life from the resuspension of sediments.
- General mitigation measures for the dredging are given in ECP 19: Dredging Management. The Contractor shall comply with the mitigation measures proposed in ECP 19 (Annex D).

- To minimize the spillage from the transportation, the contractor shall regularly inspect and maintain equipment in order to prevent leaks.

With the above mitigation measures, the residual impacts of dredging have been assessed as minimal.

6.4.2 Sediment Dispersion from Dredging Activities

Sediment plumes will be generated from dredging activities increasing the turbidity and sediment load in the river. The plumes will generally extend up to a 100 meters from the dredging location. Increases in suspended sediments and turbidity levels from dredging and disposal operations may under certain conditions have adverse effects on animals and plants by reducing light penetration into the water column and by physical disturbance. Increased suspended sediments can affect filter feeding organisms.

Mitigation

Mitigation measures to minimize sediment dispersion from dredging activities are:

- To minimize these impacts, the dredging activities in the project will be carried out during high flow season of July and August when the natural sediment load in the river is very high (about 100 million tons), river water is highly turbid (more than 900 NTC) and river carries high suspended solids (more than 1200 mg/l). Hence, any additional sediment concentration generated by dredging activities would be very minimal compared to the baseline concentrations.
- The contractor will use Cutter Suction Dredger, which is known to have a low risk of sediment dispersal. The suction action inside the Cutter Suction Dredger means that most of the sediment removed by the cutter is captured. As high dredging efficiency and low turbidity at the cutter head are closely linked, it is uncommon for turbidity generated by the cutter head to cause environmental concern.
- An ongoing ecological monitoring will be in place by the contractor monitor the sediment load and, if necessary, the contractor shall modify the dredge operation to minimise fines, e.g. restrict the amount of material being dredged.
- Implement the mitigation measures proposed in ECP 19: Dredging Management (Annex D)
- Share the dredging activity schedule with the district wildlife department and fisheries department, who are interested to participate in monitoring activities

With the above mitigation measures, the residual impacts of sediment dispersion from dredging have been assessed as minimal.

6.4.3 Impact of In-River Placement of Dredge Material

The dredged material will be placed in the active river channels on the downstream of the barrage. The impacts from aquatic placement of dredged material will result in generation of high turbidity levels which may affect organisms that depend on light for their existence (photosynthesis) and fish. For fish, high concentrations clog the gills and affect the growth and survival of eggs and larvae, diet and reproduction (which in turn will influence the availability of dolphin's diet). Indirect effects include deterioration of spawning beds and loss of food-benthos. However, the release of desilted sediments back to the river will have significant positive impacts. The release of sediments from their natural cycle will affect the erosion/accression balance in Indus delta, and it will be always beneficial to return the material into the originating system; rather than removing it to a separate site.

Mitigation

- The impacts on turbidity and sediment dispersion associated with aquatic placement can be minimized by placing material in active river channels through submerged discharge (placing the pipe line vertically one meter below the water column or just above the river bottom) which result in a decreased resuspension and spread of the lateral extent material. The bottom relief created by mounds of dredged material may also provide refuge habitat for some fish.
- Dredging and dredged material placement shall be carried out in high flow season of July and August when the river naturally carries high sediment load. Since the dredging and dredge material placement will be carried out during high flow season, it is not anticipated any impacts on the river morphology and flows.
- An ongoing monitoring mechanism will be in place by the contractor to monitor changes in sediment load and river morphology at the dredged material placement location and its downstream for any adaptive management, if required.

With the above mitigation measures, the residual impacts of in-river placement of dredged material have been assessed as minimal.

6.4.4 Effluents and Emissions from Dredging Equipment and Associated Vessels

Solid and liquid waste effluents will be generated from the dredgers and associated vessels. The solid waste will be mainly from the vessel's kitchen and liquid waste is mainly bilge water. The solid waste and bilge water should be collected and properly disposed after adequate treatment. There is a risk of water pollution from these activities through accidental spillage of fuels, hazardous material and bilge water. Any such pollution events will seriously impact the dolphin and fish habitat.

Mitigation

- The contractor will take utmost care to prevent such risks and will prepare and implement an emergency preparedness plan to address these risks. The contractor will make booms (oil fence), absorbents and skimmers available on site along with trained personnel to recover spilled oils from water surface.
- Noise and air emissions will also be generated by the dredging equipment, which can be minimized regular maintenance of the equipment as per manufacturers specification.
- The contractor shall comply with the mitigation measures proposed in ECP 19: Dredging Management and ECP 20: Dolphins Management from Construction Impacts (Annex D).

With the above mitigation measures, the residual impacts from effluents and emissions from dredging equipment and associated vessels have been assessed as minimal.

6.4.5 Impact of underwater noise levels on dolphin's vocalization and behaviour

For dolphins, sound serves three main functions: (i) it provides information about their environment, (ii) it is used for communication and (iii) it enables the remote detection of prey. The sounds generated by dolphins often extend beyond the range audible to the human ear. Vocalizations of Dolphins will be in range of 125-173 (dB at 1m) for whistles and 218-228 (dB at 1m) for clicks. Underwater noise levels generated by the dredgers and associated vessels may impact the dolphin's vocalization and behavior.

Mitigation

Mitigation measures to reduce noise levels from dredging and to minimize the impacts on dolphins include:

- Monitoring an exclusion zone of about 500 m radius for at least 30 minute before the start of dredging. If dolphins are observed in the exclusion zone, dredging works will be delayed until they have left the area. If dolphins enter the exclusion zone after dredging has commenced, dredging works would cease until they have left;
- Dredging work will adopt a 'soft start'; using a low energy start to the dredging operations to give dolphins an opportunity to leave the area, gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling commences,
- Contractor will use pingers to chase away dolphins from the work sites,
- The contractor will hire a qualified ecologist for implementing the above mitigation measures and monitoring of impacts on dolphins
- Share the dredging activity schedule with the district wildlife department and fisheries department, who are interested to participate in monitoring activities

With the above mitigation measures, the residual impacts of underwater noise pollution on dolphin have been assessed as minimal.

6.4.6 Risk of dolphin collision from construction works

Most of the water borne construction activities, including dredging, will be taken up on the upstream side of the barrage; hence motor boat traffic will be higher on the upstream side of the barrage. There is a risk of collision between dolphins and motor boats.

Mitigation

Following mitigation measures will be adopted to avoid the risk of collisions

- The boat movement on the upstream of the barrage will be limited to only dredging sites and other instream construction sites
- Restrict motor boats speed within 15 km/h in accordance with best international practices followed in the North America
- Pingers will also be used to chase away dolphins from the construction areas.
- Use of boats will be limited to day time, and if they are needed to be used during night time, adequate night time lighting will be provided.
- Implement the mitigation measures proposed in ECP 20: Dolphins Management from Construction Impacts (Annex D)

With the above mitigation measures, the residual impacts with risk of dolphin collision have been assessed as minimal.

6.4.7 Impacts from Excavation Activities in the Barrage

About 0.75 MCM will be desilted from the barrage area through excavation from the dry river bed areas using excavators. Since the excavations will be carried out to remove dry sediments, there is no risk of sediment generation from the excavation activities. However, if the sediments are saturated with water content, there will be some risk of sediment dispersion. The impacts associated with the excavation activities will be mainly air and noise pollution from earth moving equipment and trucks. The excavated material from the barrage area will be transported to the left bank placement through a 1.5 km length of local roads. About 20 trucks will be used daily for transport of these material, and movement of these trucks along the local roads may cause safety hazards.

Mitigation

- Excavations will be carried out in dry river beds and to remove only dry sediments. These activities will be carried out mainly low flow season.
- If any sediment water released from the excavation activities, they will be contained by placing the silt fences, sediment traps around the excavation areas to prevent migration of silt in to the river.
- Strict traffic management will be in place by the contractor with adequate traffic signals and traffic control personnel along the routes used by the trucks for transport of excavated material to the left bank placement area.
- All local roads that are damaged by the construction activities will be repaired to their original state after completion of works.
- Implementation of mitigation measures given in ECP 15: Traffic Management (Annex D)

With the above mitigation measures, the residual impacts from excavation activities in the barrage have been assessed as minimal.

6.4.8 Impacts from Canal Desilting Activities

Desilting activities carried out along the first 7 km of the right bank canals will cause significant nuisances through dust and noise pollution on the communities living on the embankments. The canal embankments are generally used for accessing canal maintenance works and are the property of the Irrigation Department, but these embankments are occupied by the squatters. Hence movement of construction equipment along the canal embankments will be difficult to access the desilting sites in Canal.

The desilted material needs to be transported to the right bank placement area through the trucks. The desilting activities of Dadu and North Western canals will be carried out over a period of two years, but only during the month of January, when canals are closed for regular maintenance of the barrage (See Figure 3.6). About 36 trucks will be required daily for transport of desilted material from Dadu and another 42 trucks will be required daily for transport of desilted material from North Western Canal. Together, about 78 trucks will be used daily for transport of the material to the right bank placement area. These trucks will mainly use the existing National Highway (the average daily traffic on national highway is 24,000 vehicles) and a local road for a length of about 0.5 km near the placement area. The addition of daily 78 trucks (each truck will make about 20 trips per day) to the existing highway, will have negligible impact on the existing traffic; but on the local roads, it may cause traffic safety hazards.

The de-siltation of first 7 km of Rice Canal can be carried out for three months, during October to December, and about 50 trucks per day will be needed for transport of desilted material. Addition of these 50 trucks per day will have minimum impact on the existing highway, but may cause traffic safety hazards on the local roads.

Mitigation

- Desilting activities will be carried out only in canal closure periods.
- Canal beds will be used for movement of construction equipment and vehicles, instead of canal embankments
- The entrance and exit of excavators and dumpers taking out the excavated silt from canal bed will be controlled near the canal bridge crossing at km 1.3 (RD 4) and km 5.1 (RD 17). The routes used by the dumpers for transport of excavated silt is shown in Figure 3.5
- The desilted material will be carried out in covered trucks to control the dust emissions
- Desilting activities will be limited to day time hours to avoid nuisance to the local communities

- Strict traffic management will be in place by the contractor with adequate traffic signals and traffic control personnel along the routes used by the trucks for transport of excavated material to the left bank placement area.
- Implementation of mitigation measures in ECP 15: Traffic Management

With the above mitigation measures, the residual impacts associated with canal excavation have been assessed as minimal.

6.4.9 Risk of entrapment of Dolphins and other Aquatic Fauna in Construction Areas

There is a risk that dolphin is trapped during desilting activities in the barrage area. Sometimes dolphins are drifted into canals and are stranded there when canal flows decrease. Freshwater Turtles are an integral part of the aquatic ecosystem and have an important role of cleaning and balancing of habitat. These turtles are found in the pond areas, canals and river banks. These turtles are not directly threatened with the desilting activities in the main river but during de-siltation activities in the canal there are chances that freshwater turtles are found.

Mitigation

- A dolphin rescue unit will be established by the contractor in the site to rescue dolphins that are entrapped in the construction areas. The dolphin rescue will include an ambulance, a stretcher, water facility and a trained rescue staff.
- The parent project, SBIP, is also supporting the local wildlife departments for establishing dolphin rescue team under dolphin conservation and management plan.
- Before initiating the desilting activities, an observation survey will be conducted in surrounding areas for presence of dolphins and turtles. The turtles will be rescued and released safety in to other canals before carrying out desilting activities.
- Support of district wildlife department will be taken during rescue and release operations of any animal species found during the desilting activities.
- General mitigation measures to address flora and fauna are given in ECPs 12 and 13 (Annex D).

With the above mitigation measures, the residual impacts associated with entrapment of dolphins and turtles have been assessed as minimal.

6.4.10 Impacts of Excavated Sediments Placement on Dry River Banks

The excavated material from the barrage (0.75 MCM) and from the right bank canals (2.24 MCM) will be transported through trucks to the sediment placement area located on the on the downstream of the barrage. The material from the barrage will be placed in the left bank placement area (Figure 3.4), which has a capacity to hold 2.5 MCM. This placement has been used in earlier occasions by the Irrigation Department for placement of excavated material. The materials from right bank canal will be placed on the right bank placement area, which has a capacity to hold 3 MCM material. Since there are dry sediments, there is no risk of release of sediment laden runoff from the placement area. These parts of the river banks, used for proposed placement of desilted material, will only be submerged under water during super floods. Hence, the material will eventually go back to the river, when this section of river will be filled during super floods. While, some material from the right bank placement area may go back to the river in next high flow season. Since, the river already carries huge sediment loads during super floods (more than 200 million tonnes of sediments) during high flow season, the joining of 3 MCM (roughly equal to 4 million tonnes) of sediment from placement areas will have minimal impacts on the sediment concentrations and downstream river morphology. The release of desilted sediments back to the river, to its natural cycle, is expected to have significant positive impacts. The movement of trucks and dumping of material may cause dust and noise pollution.

Mitigation

The contractor shall take the following mitigation measures

- The placement area will be marked in to several plots for uniform placement and distribution of material, to avoid improper dumping of material
- The height of each material dump will be limited to 6 ft.
- The material will be carried out through covered trucks and material will be dumped at low height to minimize dust emissions.
- Dust control measures through water sprinklers
- Additional mitigation measures to address dust pollution are given in ECP 10: Air Quality Management (Annex D)
- Mitigation measures to address noise impacts are given in Section 6.4.13.

With the above mitigation measures, the residual impacts associated with the placement of excavated material on the dry river banks have been assessed as minimal.

6.4.11 Disposal of replaced mechanical and electrical parts

All scrap material will be sold to steel industries in Lahore and Karachi through an open auction. Similarly, rubber material will be sold to rubber industries through an auction. None of these waste materials will be disposed at the site.

6.4.12 Potential risk of soil and water pollution

During construction there is a high risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals that are used in construction areas, yards, batching plants, worker camps, and storage sites. These spills can pollute soils and contaminate surface and groundwater in the area. There is also a risk of water pollution from these activities through accidental spillage of fuels, hazardous material and bilge water.

Mitigation

Following mitigation measures will be carried out by the contractor to minimize soil and water pollution.

- The contractor will take utmost care to prevent such risks and will prepare an emergency preparedness plan to address these risks. The contractor will make booms (oil fence), absorbents and skimmers available on site along with trained personnel to recover spilled oils from water surface. The contractor shall include training in the use of this equipment within his training plan and carryout regular drills in the deployment of this equipment
- Greasing of the gates will be carried out in dry working area. Painting of gates will be done on the land and only after drying they will be fixed to the barrage.
- The contractor shall be prohibited from bailing or pumping this water into the river, but instead shall be required to collect the bilge water, treat it by separation and dispose of the separated oil and fuel as hazardous waste
- All waterborne plant shall be regularly serviced as per the manufacturer's guidelines and be inspected daily prior to operation.
- Refuelling of dredgers and boats will be properly carried out to avoid any spills. Refuelling of boats will be done on shore. Spill kits and other absorbent material will be made available at refuelling points on the barges.
- Additional mitigation measures are given in ECP 3: Fuels and Hazardous Goods Management, ECP 3: Water Resources Management, ECP 5: Soil Quality Management, and ECP 7: Erosion and Sediment Control.

With these mitigation measures, the residual impacts with risk of water pollution have been assessed as minimal.

6.4.13 Noise and air pollution from construction works and traffic

Air pollution may be caused by emissions from construction related traffic and machinery. A lot of noise and dust will be produced by earth works at river training works, other machinery, concrete mixing, and traffic from trucks and vehicles. Noise levels at nearby villages may exceed the national standards.

Mitigation

The following mitigation measures will be implemented:

- Construction equipment and vehicles will be regularly maintained according to the instructions provided by the manufacturers, so that emissions are minimal and comply with emission standards of NEQS.
- Dust generation from construction sites will be restricted as much as possible and water sprinkling will be carried out as appropriate, especially at those places where earthmoving, excavation will be carried out.
- Contractor will be required to implement the measures prescribed in the Environmental Code of Practices (ECP), which will be included in the contracts. Detailed ECPs are included in the Annex D. ECPs 10 and 11 cover Air Quality and Noise Management
- Construction activities near the settlements will be limited to day time only. High noise producing equipment will be provided with mufflers or acoustic enclosures.

With the implementation of above mitigation measures, the residual impact on noise and air pollution has been assessed as minimal.

6.4.14 Risk of Pollution from Solid Waste and Waste Effluents

Repairing of existing structures generates debris. Further construction works also generate large quantities of excess materials from construction sites (concrete, discarded material) and wastes from worker's camp and construction yards, including garbage, recyclable waste, food waste, and other debris. In addition, small quantities of hazardous waste will be generated from maintenance activities, including oil filters and other waste products.

Mitigation

The following mitigation measures will be implemented:

- Contractor will prepare and implement solid waste collection and disposal plan.
- Contractor to develop and undertake construction waste management strategy for both hazardous and non-hazardous wastes separately.
- The existing municipal waste facilities will be used for disposal of solid waste
- Protocols and measures prescribed in the ECPs 1 and 2 (Annex D) on the management of solid and hazardous waste will be implemented.
- Siting of any fuel and hazardous material storage sites, including refuelling facilities, batching plants and construction yards are to be located outside the flood embankments and at least 500 m away from any residential areas.
- Hazardous waste will be disposed of through Sindh EPA certified contractors.

With the implementation of above mitigation measures, the residual impact of various waste effluents has been assessed as minimal.

6.4.15 Impact from Borrow and Quarry Activities

About 0.80 million m^3 of stone and 0.08 million m^3 of aggregates will be required for construction activities. Improper siting and extraction of these construction materials will have significant impacts on physical and biological environment on the quarry and borrow areas.

Mitigation Measures

The following mitigation measures will be implemented:

- The contractor shall use the government approved quarry sites for procurement of stones and aggregates. The contractor shall not develop any new quarry sites.
- The environmental staff of Project Management Office (PMO) will visit the proposed quarry sites and carry out due diligence to ensure the quarry operators are complying with the EHS requirements for licensing the EPA; before procurement of the material. Best practices on quarry areas development and operation are given in ECP 9 (Annex D).
- World Bank Group EHS Guidelines for Construction Materials Extraction[18]
- PMO will consult with EPA on the record of non-compliances if any with the proposed quarry operator.

6.5 Social Impacts during Construction Stage

6.5.1 Land acquisition

The Project activities have been designed in such a way to avoid any land acquisition and resettlement. The project activities will be carried out within the barrage and canal beds. Hence, any land acquisition or resettlement is not anticipated for the proposed interventions. However, there could be some land requirement for any unforeseen works around the Barrage or works at the canal offtake points. There may also be temporary land acquisition, depending on camp site requirements. Should land acquisition be required, SID will prepare resettlement action plan (RAP), including compensation details, according to the updated RPF, which is available as part of SMF in a separate cover.

Desilting of the Barrage. Adjacent to the proposed desilting area and as shown in Figure 3.2 and Figure 5.14, there are two shoals (a) outer bank bela and (b) left bank bela. The left bank bela and outer bank bela is formed by silt deposits (Section 5.4.9). If any minor and unseen land acquisition is required, it will be mostly from these two areas. In addition, the middle bank island is also located close to the barrage site. All these three areas are cultivated by squatters and tenants, and 5 households reside on the middle bank island. Vegetables and fodder are cultivated throughout the year. Other cultivations include wheat in *rabi* and cotton in *kharif*. There are livestock (cattle) on the island, which are taken care of by women. Table 6.5 provides estimated areas of cultivation in the belas and middle bank island.

Table 6.5**: Estimated areas of cultivation near the barrage site**

Sr. No	Location	Estimated Area (Acres)
1	Left Bank Bela	120
2	Outer Bank Bela	5
3	Middle Bank Island	45
	Total:	**170**

[18] http://www.ifc.org/wps/wcm/connect/d6bb0e80488551afa93cfb6a6515bb18/Final%2B-%2BConstruction%2BMaterials%2BExtraction.pdf?MOD=AJPERES&id=1323162191491

Table 6.6 provides number of cultivating households.

Table 6.6: Number of households cultivating the belas and middle bank island

Sr. No.	Location	No.	Household Members (No.)
1	Left Bank Bela	24	256
	Squatters	24	256
	Tenants	0	0
2	Outer Bank Bela	2	21
	Squatters	1	5
	Tenants	1	16
3	Middle Bank Island	14	127
	Squatters	5	46
	Tenants	9	81
	Total	40	404
	Squatters	30	307
	Tenants	10	97

Currently, there is no on-going cultivation on the slice of left bank bela, which will be removed as a part of desilting. There will be no removal of the middle bank island and outer bank bela under the current design. In the middle bank island, consultations were undertaken with tenants, including resident women and men. Women, in particular, were interested in employment of their sons above 18 years old as unskilled laborers. The tenants are accessing the island or outer bank bela by boat from the river bank.

Mitigation

- If any locations on the outer bank bela and left bank canal or middle island need to be acquired due to outcome of design studies during AF implementation, an abbreviated RAP will be prepared according to the updated RPF.
- During desilting activities around the island, a dedicated access route will be provided to the tenants of middle bank island and outer bank bela (which will be marked through buoys), so that there will be no impact on their livelihoods.
- See the mitigation measures for noise in 6.4.13 and women's privacy in 6.5.8 (cultural conflicts).

Desilting of three right bank canals. The three right bank canals are encroached by approximately 300 households up to the first 7km from canal offtakes. No resettlement will be required, as civil works will take place within the canals during their regular closure period: The materials will be transported within canals up to ramps set up at canal offtakes and deposited at the placement area on right bank (see Figure 3.3). There is no cultivation or resident at the placement area. See the mitigation measures for noise in 6.4.13 and women's privacy in 6.5.8 (cultural conflicts). As mentioned earlier, Rice canal will be desilted up to 25km from its offtake. Beyond the first 7km from the offtake, there is no encroachment on the embankment. The materials will be used to strengthen the embankment.

6.5.2 Impact of canal closures on water needs of the command area

In addition to cultivation of crops, canal water is also being used for drinking purposes in some canal command area where groundwater is saline, industrial purposes and livestock. Most of the proposed project interventions will be carried above the water. Only dredging activities and scour protection works will be carried out under water. These activities do not require closure of any canal gates and hence there will be no impact on the irrigation releases from the barrage. Further, desiltation of the canals will also be carried out only during their regular annual canal closure period.

6.5.3 Impact of traffic on the Barrage

The barrage also acts as a road connecting the banks. The current traffic levels on the existing barrage is about 8,000 vehicles per day, most of which are small cars and motor cycles. The road access on the barrage is generally closed for one month in January for routine inspection and maintenance works. During these days, the traffic will either use national highways on the downstream (located 150 m away) or Lansdowne bridge on the upstream (located 6 km away). During proposed construction period, the traffic on the barrage may need to be closed for more time than the normal closure. This may cause inconvenience to the road users who are located close to the barrage site. The public will be informed in advance about the road closure periods through bill boards near the barrage site; and by placing adequate traffic diversion structures.

6.5.4 Generation of employment in the project area

About 200 skilled and non skilled workers will be required during construction on continuous basis for about 4 years. The project offers good opportunities for local residents to apply for employment as unskilled and skilled construction workers. Contractors are recommended to employ local workers and technicians to the extent possible. Employing local people will also generally diffuse the conflicts between migrant workers and local community. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population. This will be a major and significant positive impact of the project. Populations in project and command areas will be notified these opportunities, as described in the updated communication strategy in SMF.

6.5.5 Increased economic activity in the project area

The influx of migrant workforce will stimulate the local economy. There will be a higher demand for locally produced food, goods and services benefiting local farmers, and small businesses, such as hotels, shops, fruit sellers, tea cabins and poultry stalls.

6.5.6 Safety hazards for children and elderly people due to increased traffic

The construction activities can potentially impact the residents of Sukkur and Rohri, particularly the movement and safety of school children. The increased use of trucks and other vehicles on barrage and local roads may increase risk of traffic accidents on pedestrians, particularly elderly people and children.

Mitigation

The following mitigation measures will be implemented:

- Contractor will develop a traffic management plan in compliance with ECP 15 on traffic management (Annex D)
- The Traffic Management Plan will be implemented with aim at ensuring access to residential areas, and preventing unsafe situations, especially near schools, housing areas, construction areas, camps and office.

- Ensure that all construction vehicles observe speed limits on the construction sites and on public roads
- Provide adequate signage, barriers, and flag persons for traffic control.
- Fit audible warning devices in vehicles to alert during reversing

With the implementation of above mitigation measures, the residual impact on traffic safety has been assessed as minimal.

6.5.7 Impacts from Influx of Labour

For the proposed project activities, average labour requirement per day is 200. Unskilled workers will be mainly hired locally; however, the skilled works will be brought by the contractor from other parts of Pakistan or abroad. It is estimated that about 70 migrant workers work in this project. The influx of migrant labour generally have significant impacts on the local communities and environment. The project area is located in an urban setting, as Sukkur is the third largest city in Sindh after Karachi and Hyderabad. Socioeconomic survey did not find any local or tribal conflict. Hence general impacts associated with the labour influx are not expected to be significant.

Mitigation

- The Contractor shall ensure provision of adequate accommodation, transportation, and basic services including water, sanitation and medical care for all migrant works. The location of the camp will be located within the barrage area (Figure 3.6)
- The provisions for contractors work site will comply with the Guidance on Workers Accommodation developed by IFC and EBRD
- A grievance redress mechanism will be in place by the contractor to raise work place concerns. The project-level grievance redress mechanism will also be extended for the proposed AF.
- First aid facilities and adequate medicines will be made available at the camp site. The workers will undergo initial health screening and regular health check-ups.
- Complete details of the labour influx management are given in the ECP 16: Labour Influx Management and Contractors Camp Management (Annex D).

With the implementation of above mitigation measures, the residual impact has been assessed as minimal.

6.5.8 Possible cultural conflicts between communities and immigrant workforce and community health impacts

There could be potential conflicts between the local community and immigrant workforce. Workers coming from different parts of Pakistan or other countries may have norms and values in social behavior and religion that differ from those of the resident population. The influx and accommodation of a work force of about 70 non local workers could result in increased concerns for the health and safety of local population.

Mitigation

The following mitigation measures will be implemented:

- This situation will be addressed by an awareness campaign implemented in the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which easily could lead to conflicts. This will be prevented by raising awareness and implementing a Code of

Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps, and in local communities.

- The awareness campaign will include women's privacy and their access during civil works.
- The contractor shall employ a Community Liaison Officer who shall be responsible for the preparation and implementation of a Communication Strategy. This strategy shall detail stakeholders, their information, disclosure, and consultation and participation requirements and shall aim to ensure relevant stakeholders are pre-warned of any activities on site which may result in their disturbance.
- The project-level Community Grievance Redress Mechanism (CGRM) will be updated for the proposed AF. It defines a process for receiving, recording and responding to complaints and also monitoring of the success of any responsive action taken (detailed in 8.9).
- In addition, complaints register shall be set up at the Contractor's and Engineer's offices to record any complaints received during the implementation of the works. The contractor will implement ECP on cultural and religious issues (Annex D).
- The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction work force, including the spreading of sexually transmitted diseases such as HIV/AIDS

With the implementation of above mitigation measures, the residual impact has been assessed as minimal.

6.5.9 Workers health and safety

Construction activities from the dredgers, boats and barges need to be paid close attention due to the increased risk of accidents, unsafe working conditions and health risks. Construction workers from the dredgers and boats are particularly at risk if there are no proper safety protocols are in place. Construction activities also pose safety hazards for the site staff.

Mitigation

The following mitigation measures will be implemented:

- Occupational health and safety procedures will be enforced at site. Each contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the ECPs (Annex D) and World Bank Group's general and sector specific Environment, Health, and Safety (EHS) Guidelines[19].
- Water borne construction workers and divers will be adequately trained and provided with proper personal protection equipment (PPE) before putting them in to work. Frequent supervision will be carried out by supervision consultants to ensure they are wearing proper PPE at all times.
- Contractor OHS plan describe the tasks and methods to be used by workers associated with water borne construction and diving operation, and how to perform them safely and state how potential hazards are identified and handled. Contractor will ensure that the construction workers associated with these works are adequately informed about the OHS plan. Emergency response mechanism will be put in place to rescue workers from drowning and providing immediate treatment to the injured workers

[19] Download EHS Guidelines: http://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final+-+General+EHS+Guidelines.pdf?MOD=AJPERES

- Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge how to deal with emergencies.
- Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic.
- Liaison with traffic police will be maintained
- Project drivers will be trained on defensive driving.

With the implementation of above mitigation measures, the residual impact on workers' health and safety has been assessed as minimal.

7 Cumulative Impact Assessment

7.1 Objective

A cumulative impact assessment has already been carried out under SBIP covering rehabilitation of both Guddu and Sukkur barrage, and was presented in the ESA report of Guddu barrage. The objective of the current cumulative impact assessment is to review the assessment provided in SBIP and present a summary of this assessment, and describe actions taken so far by the PMO for management of cumulative impacts. The study has focused on two valued environmental components (VECs) related to barrages in Sindh, which are dolphin habitat and fish migration.

7.2 Background

Indus Basin Irrigation System (IBIS): The irrigation system on Indus comprises 19 barrages and head works, 12 link canals, 43 commands and some 107,000 water courses (Figure 7.1). A Water Apportionment Accord (WAA) was signed by the four provinces of Pakistan in 1991 to make an equitable distribution of Indus flows. The Indus River System Authority (IRSA) was created as the regulatory authority for monitoring and distribution of the water sources of the Indus River in accordance with the WAA. The WAA was based on the following parameters:

- Water entitlements were based on existing use of water that is actual average system uses for the period 1977 to 1982 where the ten daily uses would be adjusted pro-rata to correspond the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses.
- An automatic process for adjusting entitlements depending on availability was specified where the ten daily uses would be adjusted pro-rata to correspond the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses.
- Provinces were allowed to use their allocation in any way that they want where no restrictions would be placed on the provinces to undertake new projects within their agreed shares and the provinces will have the freedom within their allocations to modify system-wide and period-wise uses.
- The Accord implied that in major parts of the IBIS, there are, in fact, well-defined entitlements at all levels, from the international, through the interprovincial, down to canal commands, distributaries, outlets, and ultimately to each farmer on a water course.

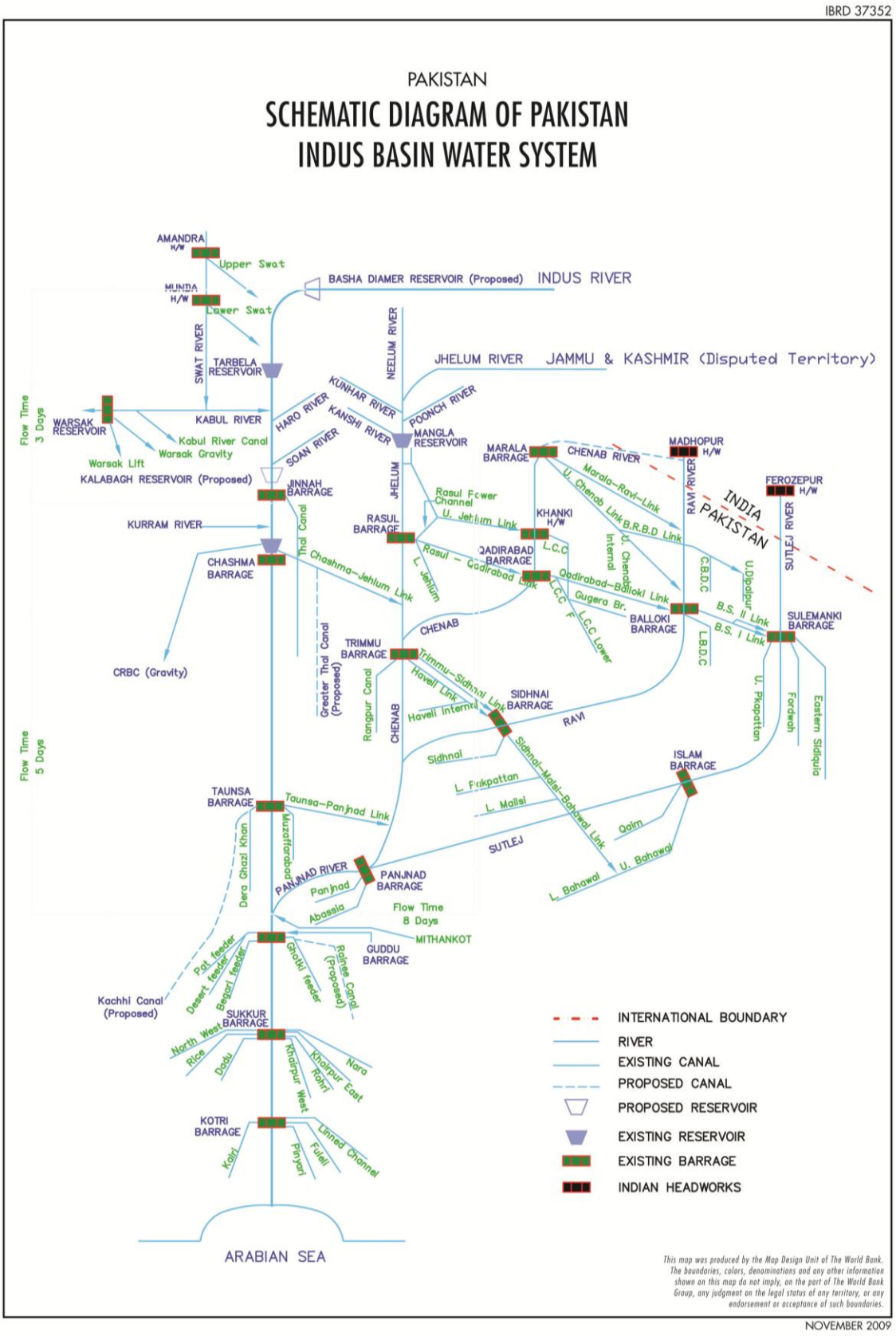


Figure 7.1: The Indus Basin Water System

7.3 Dolphin Habitat Fragmentation

7.3.1 Baseline Conditions and Trend

In 1870's, the Indus dolphin inhabited the lower Indus and its four major tributaries, Jhelum, Chenab, Ravi and Sutlej. By the early 1990's, Indus dolphins had undergone an 80% reduction in the original range, having been extirpated from four tributaries and also in upper parts of Indus. They are now confined to five contiguous 'river sections' on the Indus main stem in Pakistan, separated by barrages, and in the Beas River (tributary of Sutlej) in India. According to a survey in 2006, there were 1,406 dolphins in Indus and 90 percent of them are located in the dolphin game reserve, between Guddu and Sukkur barrages. Other major concentrations were noticed between Chashma to Taunsa barrages. While in 1975, only 150 dolphins were recorded from the game reserve. The most recent counts conducted by Sindh Wildlife Department in 2011 found 918 dolphins in the game reserve, and 29 between Sukkur and Kotri barrages.

7.3.2 Cumulative Effects

Construction of irrigation barrages between 1886 and 1971 has fragmented the dolphins' historical home range and confined them into a number of smaller river sections. Changes of river flows in these river sections, particularly low flow discharges in winter have further significantly reduced its habitat range, required water depths and velocities, and availability of fish prey. Studies on dolphin habitats in these river sections found, dolphins are still intact in those sections where the average monthly low flow discharges are 873 cumec (flow range is 205 to 1332 cumec) and dolphins were extirpated in the sections where average discharges are 227 cumec (range 0 to 1,076 cumec). Dolphin game reserve located between Guddu and Sukkur barrages is currently under threat from reduction of prey base; stranding and mortality in the irrigation canals of Sukkur; depletion of prey base due to use of small size mesh nets; poaching for their oil for use in traditional medicines; entanglement in fishing nets; and pollution from domestic, agricultural and industrial waters.

7.3.3 Recommendations made in ESA of Guddu Barrage

A dolphin management and conservation action plan is recommended to be carried out under SBIP to strengthen the conservation measures in dolphin game reserve. The Plan has included the following actions:

- **Action 1. Initiate population status survey**: There is no comprehensive data base available on Indus dolphins. Detailed surveys are required to develop an understanding and knowledge on the species and to develop a detailed management plan for conservation of dolphins. Surveys need to be conducted over a period of two consecutive years covering both low flow and high flow seasons in each year. This data will also be used to prepare Indus River dolphin population status reports.
- **Action 2. Threat assessment surveys**: Indus dolphin is facing many threats although it has been declared as protected species under the Sindh wildlife Protection Ordinance 1972. These threats include both anthropogenic and natural. The above proposed study will identify these threats and develop a mitigation strategy.
- **Action 3. Setting up of no fishing zones in the Game Reserve**: Based on the results of the above surveys on occurrences and identification of river stretches that support breeding and feeding grounds of dolphin, critical dolphin habitats will be identified that require protection from fishing. The study will recommend Sindh Government to declare the critical habitats as no fishing zones through necessary regulations. This will ensure an undisturbed breeding and feeding ground for the

dolphins. During the study national and international level consultation with experts and discussions with local communities especially with the fishermen will be required keeping in mind the needs of communities.

- **Action 4. Capacity building for dolphin conservation and management**: Universities and relevant government line departments in Sindh need to be supported to develop programmes to study dolphins and their habitat conditions. There is a need to establish research and training center along the Indus River especially where dolphin population exists. This center can conduct training programmes for government departments and universities on conservation and research methodologies. Doctoral researches in universities on dolphin should be promoted through appropriate funding mechanism.
- **Action 5. Community Involvement in river dolphin Conservation and Management**: The involvement or active participation of local stakeholders like traditional fishing community and other riverbank communities is essential for dolphin conservation. A 'Dolphin Watch' programmes can be developed especially in the easy accessible areas and encourage students to visit those areas with appropriate guidelines and environmental safeguards. Provincial tourism departments and private sector can also initiate these programmes.
- **Action 6. Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins**: The survival of the Indus River dolphin and a host of other aquatic wildlife are dependent on riverine ecology in general and the maintenance of an optimum water flow. Based on systematic and continued research and regular monitoring with the involvement of hydrologists and other multi-disciplinary professionals, critical water flow and minimum depths for river dolphin habitats should be determined, and management actions should be set in place to maintain such flow and depth.
- **Action 7. Dolphin rescue programme**: Sind Wildlife Department should be supported in establishing of permanent rescue programme of dolphins. This will include provision of transport vehicles to serve as dolphin ambulances and capacity building or hiring of staff for rescue program.
- **Action 8. Education and awareness**: Education and awareness programme to be conducted to increase the awareness level of all spectrums of the society about dolphin, its habitat requirements and its current threatened status. For example, declaring of dolphin as National Aquatic Animal will create lot of public awareness.
- **Action 9. International conference on dolphin conservation and management**: The project should support in conducting an international conference in Karachi to learn and share dolphin conservation and management options.

7.3.4 Actions taken by SBIP

The PMO of SBIP has started implementation of these recommendations. It has conducted an international conference on dolphin conservation and management. For implementation of other recommendations, SBIP is in the process of procurement of Sindh Wildlife Department. The wildlife department has already submitted a detailed proposal and budget for implementation of the plan and the PMO is currently reviewing their proposal. These activities will be expected to start from early 2018.

International Conference on 'Conservation and Management of Indus Dolphin in Indus River, Sindh, Pakistan'

PMO has conducted a one-day International Conference on 'Conservation and Management of Indus Dolphin in Indus River, Sindh, Pakistan' on 15 May 2017 at Karachi. The key objective of

the seminar is to learn and share dolphin conservation and management options between experts and the stakeholders. The findings from this conference will be used the implementation of the Dolphin Conservation and Management Plan.

Detailed objectives of the International Conference are as follows:

- Raise awareness of Project activities amongst stakeholders with interests in dolphin conservation and management
- Share experiences in methodologies for dolphin population surveys and population monitoring
- Discuss impacts and management options with respect to the following:
    - construction and operation of barrages;
    - dolphin mortality in irrigation canals;
    - depletion of prey base;
    - fishing;
    - pollution; and,
    - poaching
- Identify existing barriers to effective management and conservation of the Indus Dolphin
- Identify stakeholders with a role to play in the management and conservation of the Indus Dolphin

Participant Organisations

A total of 148 people from several organizations have participated in the International Conference: These include: Irrigation Department, Sindh Wildlife Department, Descon Eng ltd., IO/BM, PMO-SBIP Irrigation Department, National Institute of Oceanography (NIO), MMP-MMI, ICC, Project Implementation Consultant (Engineers), Sindh University Jamshro, SPMC, PCMU Planning Department, PMC/A WISP,TEKECELLANT, Sindh Fisheries Department, WWF-Pakistan, Mehran University and Engineering Technology Jamshoro, Sindh Irrigation and Drainage Authority, ITU/BISMIL, Revenue department, Sindh Abadgar Board, ALGP, Ecological Consultant, The News, Associate Eng-Consultant(ACE), Education, Eng-Consultant, SUPARCO, ORACAL, L&F Department, Food Security, IES, University of Karachi, Global Vision MET, KPMU, P&D , SAGP, SCA, SGS(Pvt), DR&C Tunisia , and World Bank. The list of participants are given in Annex E.

Summary of Conference

A summary of presentations made in the seminar are given in Annex E. Key recommendations of these presentations are summarized below; and these recommendations will be used while implementing the dolphin conservation program under the Project:

- Population Status Survey each year in the Game Reserve
- Threat Assessment Surveys in the Game Reserve
- Setting Up of No Fishing Zones in the Game Reserve
- Capacity Building for Dolphin Conservation and Management
- Community Involvement in Indus River Dolphin Conservation and Management
- Encourage academic institutions to participate in Dolphin Conservation and Management
- Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins

- Enhance Dolphin Rescue Programme
- Education and Awareness Programme
- Promotion of Tourism activities related to the Indus Dolphin
- Restocking of fish in the Game Reserve
- Setup of no fishing Zone within the Game Reserve
- Livelihood opportunities for affected Fisher folks
- Satellite tagging to determine actual home range size and movement across the barrages
- Genetics studies to assess in-breeding and population diversity
- Periodic check and monitoring of habitat quality
- Establish Indus Dolphin Conservation Fund
- International Conference on Dolphin Conservation and Management every 3 years
- Formulate Pesticide policy within the Game Reserve

7.4 Hilsa Migration

7.4.1 Baseline Conditions and Trend:

Hilsa, also called as 'palla' or 'shad' is an anadromous fish; migrate from sea to Indus for breeding, spawning and growth. Historically, early migration of hilsa in to the Indus was in between January and February and later migration was during summer and monsoon floods between April and July. Before the construction of barrages in Indus, hilsa was reported to travel a distance of 1,000 km up to Multan. After construction of Sukkur barrage in 1932, hilsa migration was limited to Sukkur barrage since it doesn't have any fish passes. Kotri and Guddu barrage, which were constructed in 1956 and 1962, have included fish passes to facilitate hilsa migration. Fish passes in Kotri barrage were not properly designed to facilitate migration of hilsa. Hence, after 1956 the migration of hilsa has been restricted up to Kotri barrage, 300 km from the sea. This obstruction has deprived hilsa of two-third of their previous spawning area. Hilsa fishery has been providing livelihood to a large number of fisherman in Sindh, some of them migrate to Kotri barrage area from Sukkur and Larkana districts.

7.4.2 Cumulative Impacts:

When hilsa migration starts in January, there is hardly any water available in delta for hilsa to migrate to upstream. Annual hilsa catch have been reduced considerably from last four decades from 11,800 tonnes in 1973 to 266 tonnes in 2012. The declines in hilsa catch are primarily due to reduction in flows below Kotri, loss of its original migration range, and advent of motorized fishing boats.

7.4.3 Recommendations made in ESA of Guddu Barrage

The overall situation of hilsa fishery is in severe stress and vulnerable to overexploitation. Serious attention is required to provide appropriate access for hilsa to the Indus River during migrations, and impose a ban on fishing during the upstream migration and the prevention of undersized catch. Fish ladders in Kotri and Guddu barrages must be rehabilitated to work effectively and new fish pass should be installed in Sukkur barrage. Design of rehabilitation of fish passes should be based on detailed understanding of hilsa swimming capabilities and its biological needs. Further studies are recommended to understand the biological requirements of hilsa, especially on its swimming capacity and attraction velocities to a fish way, breeding habitats, spawning grounds, migration route, and depth of water requirement for migration etc.

7.4.4 Actions taken by SBIP

Further studies will be taken under AF of SBIP to implement the above recommendations The Project Component E. Integrated Riverine Management will cover these aspects.

8 Environmental and Social Management Plan

8.1 Objectives of ESMP

The basic objective of the ESMP is to manage adverse impacts of project interventions in a way, which minimizes the adverse impact on the environment and people of the Project area. The specific objectives of the ESMP are to:

- Facilitate the implementation of the mitigation measures identified during the present ESA and discussed earlier in the document.
- Maximize potential project benefits and control negative impacts;
- Draw responsibilities for project proponent, contractors, consultants, and other members of the Project team for the environmental and social management of the Project;
- Define a monitoring mechanism and identify monitoring parameters in order to:
- Ensure the complete implementation of all mitigation measures,
- Ensure the effectiveness of the mitigation measures;
- Maintain essential ecological process, preserving biodiversity and where possible restoring degraded natural resources; and
- Assess environmental training requirements for different stakeholders at various levels.

The ESMP will be managed through a number of tasks and activities and site specific management plans. One purpose of the ESMP is to record the procedure and methodology for management of mitigation identified for each negative impacts of the Project. The management will clearly delineate the responsibility of various participants and stakeholders involved in planning, implementation and operation of the Project.

8.2 Inclusion of ESMP in contract documents

In order to make the Contractors fully aware of the implications of the ESMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in ESA as well as World Bank Group safeguard policies andEHS guidelines. The Contractor will be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

Construction of Environmental Action Plan

Contractors need to prepare site specific management plans to address various environmental issues, and to demonstrate the manner in which the Contractor will comply with the requirements of ECPs and ESMP. It will be reviewed and approved by supervision consultants, PMO and World Bank before implementation of construction works.

8.3 Institutional Arrangements

The existing organogram of SID and PMO for implementation of ESMP and SMF is shown in Figure 8.1.

8.3.1 Project Management Office (PMO)

Sindh Irrigation Department (SID) is the Project proponent. The PMO, which was already established under the secretary of the SID, will monitor and coordinate all project implementation activities. PMO would be responsible for all aspects of project implementation including technical, operational, financial management, and overseeing the implementation of ESMP. The PMO has included the following environmental and social staff

- Deputy Director Environment,
- Deputy Director Ecology
- Deputy Director Resettlement
- Deputy Director Social and
- Deputy Director Communications.

The responsibilities of the environmental and social staff are: (i) supervising, facilitating and coordinating implementation of environmental and social plans including ESMP and SMF; (ii) preparation of resettlement action plans (RAPs) for any land acquisition and resettlement activities, (iii) ensuring that contractors follow Sindh-EPA regulations, World Bank Safeguard Policies, and other requirements mentioned in the ESMP and SMF; (iv) identifying any issues of non-compliance and report these; (v) suggesting mechanisms to link contractor performance in relation to the ESMP to the timing of financial payments, incentives or penalties; (vi) interacting with stakeholders for their concerns about the construction activities, and (vii) prepare quarterly monitoring reports on ESMP implementation. PMO is located in Karachi and Sukkur (for both Guddu and Sukkur Barrage rehabilitation), and all environmental and social staff are located in Sukkur.

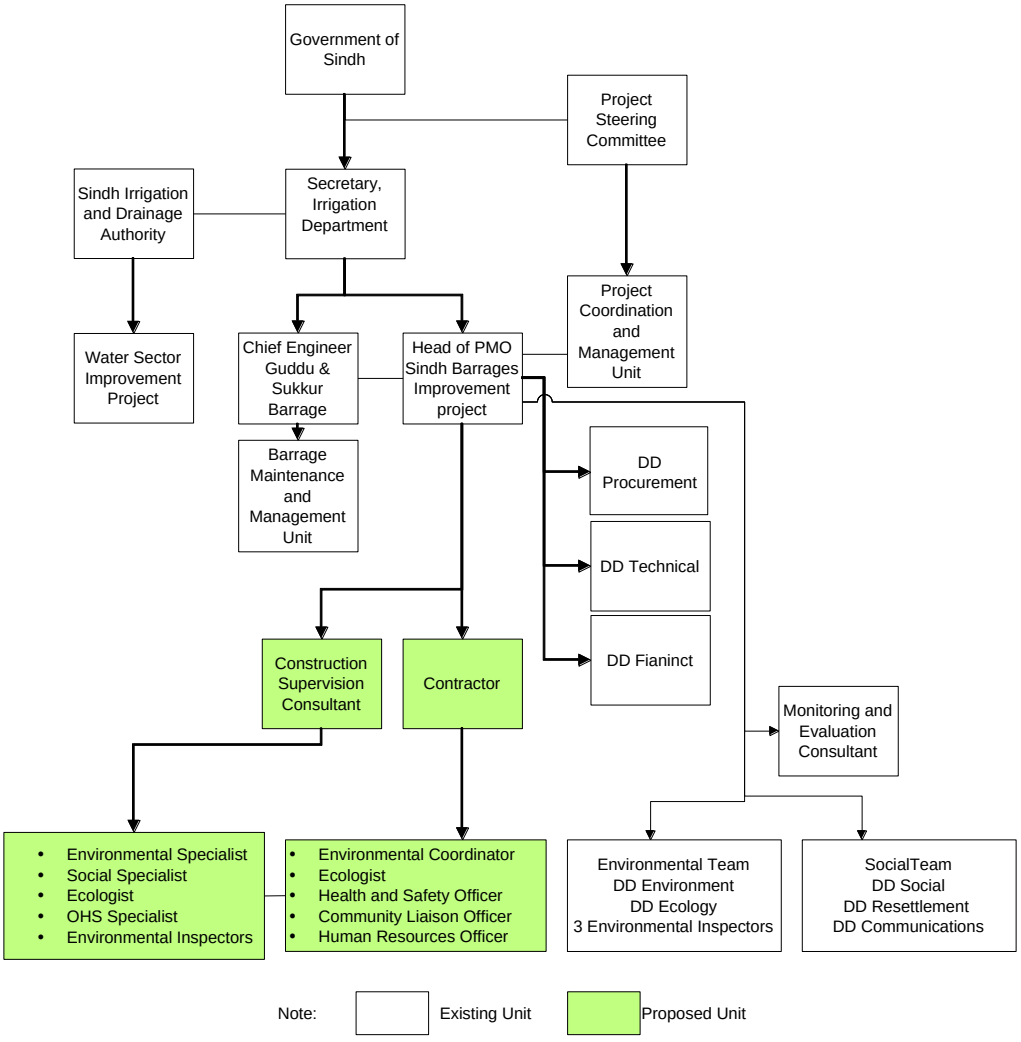


Figure 8.1: Proposed Institutional Structure for Implementation of ESMP

Project Coordination and Monitoring Unit (PCMU)

The Project Coordination and Management Unit (PCMU) is under the Planning and Development Department (PDD) of the Government of Sindh. PCMU supports project coordination and M&E, including monitoring environment and social safeguard compliances, and facilitates citizen engagement through grievance redress mechanism.

Construction Supervision Consultants (CSC).

The CSC will be responsible for supervising the contractors for the implementation of ESMP and SMF. For this purpose, the CSC will appoint dedicated environment and social staff to ensure the implementation of environmental and social management plans during the project. They will supervise the contractor for the ESMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of effects of these measures.

CSC will have the following environmental and social safeguard staff:

- Environmental specialist
- Social Specialist
- Ecologist
- Occupational Health and Safety Specialist
- EHS Inspectors

The safeguard staff of CSC will closely supervise the construction team to ensure that all environmental commitments are incorporated into the construction activities and work processes. Specific responsibilities include:

- Supervising and supporting contractors in achieving their responsibilities as outlined in the ESMP;
- Issuing non-compliance notices to the contractors;
- Providing input, advice, and approval on activity specific work plans relating to ESMP;
- Supervising the implementation of activity specific work plans;
- Regularly reviewing and assessing environmental risks throughout the construction phase;
- Identifying and preparing environmental induction and training materials;
- conducting environmental trainings;
- Assist PMO in addressing and resolving environment-related complaints and grievances
- Responding to environmental incidents as required;
- Supporting PMO in developing RAPs, as required;
- Managing compliance reporting as it relates to the Project, and preparing monthly ESMP compliance reports;
- Liaise with PMO for effective environmental and social management at site;
- Reviewing ESMP and revising it if required on six-monthly basis.

8.3.2 Monitoring and Evaluation Consultant (MEC)

MEC will be recruited by PMO to carry out independent monitoring of implementation of ESMP. The MEC will have environmental and social experts and shall carryout intermittent third party monitoring of the project. MEC will also carry out annual third party auditing of ESMP and make further modifications if required.

8.3.3 Contractors

Contractors are also required to appoint the following environmental staff for the implementation of ESMP in the field, particularly the mitigation measures.

The contractor will develop various plans directed towards health, safety, the environment and social issues (discussed in Section 8.4.3), and get them approved by the CSC, PMO and World Bank. These plans should also be cleared by the Bank. The contractor will also be responsible for communicating with and training of its staff in the environmental/social aspects before the commencement of the physical works on site. Appropriate numbers of the following personnel are required in the contractor's environmental team:

- Environmental coordinator
- Ecologist
- Health and Safety Officer
- Community Liaison Officer
- Human Resources Officer

8.3.4 Chief Engineer, Sukkur Barrage

Chief Engineer of Sukkur barrage is responsible for regular operation of the barrage and canal closures if required. Communications regarding canal closures, its impact and mitigation will be carried out with close coordination of Chief Engineer Sukkur Barrage. Any emergency i.e. unexpected flood due to heavy rainfall in monsoon or shortage of water due to drought would be communicated through Chief Engineer Sukkur.

8.3.5 Sindh Irrigation and Drainage Authority (SIDA)

SIDA is responsible in building capacity of farmer organizations (FOs) in the Bank-financed Water Sector Improvement Project. They will facilitate consultations with farmers in project and command areas, including women and vulnerable households.

8.4 Environmental and Social Management

8.4.1 Environmental Codes of Practice

A set of environmental codes of practice (ECPs) has been prepared for various environmental and social management aspects. The Contractors will be contractually obligated to comply with these ECPs, presented in Annex D. These are:

- 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 and Operation;
- ECP 10: Air Quality Management;
- ECP 11: Noise and Vibration Management;
- ECP 12: Protection of Flora;
- ECP 13: Protection of Fauna;
- ECP 14: Protection of Fish;
- ECP 15: Road Transport and Road Traffic Management;
- ECP 16: Labour Influx Management and Construction Camp Management;
- ECP 17: Cultural and Religious Issues;
- ECP 18: Workers Health and Safety;
- ECP 19: Dredging Management.
- CEP 20: Dolphins Management from Construction Impacts

8.4.2 Mitigation Plans

These mitigation plans have been prepared on the basis of the detailed impact assessment covered under Chapter 6. These plans (Table 8.1) are project-specific, and to the extent possible, site-specific, however contractors will be required to carry out further detailing of the key aspects, to prepare site-specific management plans discussed below.

8.4.3 Site-specific Management Plans

These plans are site-specific and where applicable, contract-specific and will be prepared by various contractors prior to the commencement of construction activities. The Plans to be prepared by the contractors for various aspects of the environmental management will mostly include the detailing of the measures included in the ECPs and Mitigation Plans respectively discussed in Sections 8.4.1 and 8.4.2, providing where applicable, location details, layouts and drawings, timelines, roles and responsibilities, methodologies and procedures, and key performance indicators. These plans will be reviewed and approved by the PMO and World Bank. A brief description of each of these plans is provided below:

Dredging Management plan will be prepared and implemented by the Contractor on the basis of the ECP 19, and the mitigation measures given in Chapter 6. The Plan will describe among others the methodology to be adopted for dredging and dredged material placement and disposal, and documentation to be maintained for the dredging activity. The Plan will be submitted to the PMO/CSC for their review and approval before initiating the desilting activity.

Dolphins Management Plan from Construction Impacts will be prepared and implemented by the Contractor on the basis of ECP 20 and the mitigation measures given in Chapter 6. The Plan will describe among others the methodology to be adopted by the contractor to manage construction related impacts on dolphins. The Plan will be submitted to the PMO/CSC for their review and approval before initiating the sand extraction activity.

Excavation Management plan for Desilting of Barrage and Canals will be prepared and implemented by the Contractor on the basis of all relevant ECPS including ECP 15, 19 and 20 and the mitigation measures given in Chapter 6. The Plan will describe among others the methodology to be adopted by the contractor to manage the desilting activities and transportation of material from excavation sites to placement sites. The Plan will be submitted to the PMO/CSC for their review and approval before initiating the excavation activity.

Erosion, sediment and drainage control plan will be prepared by the contractor on the basis of ECP 4, 6 and 8, and the mitigation measures given in ESA. The Plan will be submitted to the CSC/PMO for review and approval before contractor mobilization.

Pollution Prevention Plan will be prepared and implemented by the Contractor on the basis of ECPs 1, 2, 10, 11, and WBG EHS Guidelines (2007), as well as the mitigation plans given in ESA. The Plan will be submitted to the CSC/PMO for review and approval before contractor mobilization.

Waste Disposal and Effluent Management Plan will be prepared and implemented by the Contractor on the basis of ECPs 1, 2, 16 and WBG EHS Guidelines (2007), as well as the mitigation plans given in ESA a. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Traffic Management Plan will be prepared by the Contractor on the basis of ECP 15 and also the mitigation plans given in ESA, after discussion with SID and authorities responsible for roads and traffic. The Plan will be submitted to the CSC for their review and approval before contractor mobilization. CSC will facilitate the integration and coordination of the plans prepared by various contractors to prepare an overall Plan.

Occupational Health and Safety Plan will be prepared and implemented by the Contractor on the basis of the WBG EHS Guidelines (2007), ECP 18, and other relevant standards. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Drinking Water Supply and Sanitation Plan: Separate water supply and sanitation provisions will be needed for the temporary facilities, labor camp and workshops, in order not to cause shortages and/or contamination. A Plan will be prepared by the Contractor on basis of ECP 3. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Management Plan for protection of flora and fauna will be prepared by the Contractor on the basis of ECPs 12, 13 and 14 and mitigation measures proposed to address impacts on dolphins. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Labour Influx Management and Construction Camp Management Plan will be prepared by the Contractor on the basis of ECP 16 and also the mitigation plans given in ESA. The Plan will include the camp layout, details of various facilities including supplies, storage, and disposal. The Plan will be submitted to the CSC for review and approval before camp establishment.

Fuel and Hazardous Substances Management Plan will be prepared by the Contractor on the basis of ECP 2 as well as the mitigation plans given in ESA and in accordance with the standard operating procedures, relevant guidelines, and where applicable, material safety data sheets. The Plan will include the procedures for handling oils and chemical spills. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Instream Construction Works Management Plan will be prepared by the contractor to address the environmental concerns associated with use of motor boats and barge mounted equipments on the basis of the mitigation measures given in ESA. The plan will address risk of spills, collision with dolphins and safety of construction workers. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Emergency Preparedness Plan will be prepared by the Contractor after assessing potential risks and hazards that could be encountered during construction in the Indus and in the floods. The Plan will be submitted to the CSC for review and approval before contractor mobilization.

Communication Plan will be prepared by the contractor to demonstrate how they will communicate with local community leaders, provide details regarding employment opportunities at mobilization, and traffic management throughout the construction period. The contractor's

communication plan should define a process for receiving, recording and responding to complaints and also monitoring of the success of any responsive action taken to prevent the escalation of any conflicts.

8.4.4 Social Management Framework (SMF)

8.4.4.1 Resettlement Policy Framework (RPF)

The proposed AF doesn't anticipate land acquisition or resettlement. However, as a part of SMF, a RPF was prepared for the original project and has been updated for the proposed AF by SID in case of any unforeseen land acquisition is required for the project and also to guide temporary land acquisition by the contractors. The RPF presents (a) principles and legal framework applicable for mitigation of these losses; (b) eligibility and entitlement criteria, (c) valuation methods; and (d) process of preparation of resettlement action plan.

8.4.4.2 Social Action Plan (SAP)

SAP was developed under the original project to mitigate potential project social impacts (such as potential extended canal closure) and support local area development around Guddu Barrage. Under the proposed AF, SAP has been upgraded to a standalone component to support environment and social development of 170-km stretch of Indus between Guddu and Sukkur Barrages (Component E Integrated Riverine Management Plan). Activities would include support for fishing communities, such as alternative livelihood development, fishery co-management, and communication outreach (these activities will be designed during implementation of AF). SAP has, therefore, been removed from the updated SMF.

8.4.4.3 Communication Strategy

A formal communication strategy was prepared for the original project and has been updated for the proposed AF. The strategy lays out various communication needs and outreach tools and explains the responsibility of PMO to convey the awareness of the project impacts and its impacts to various stakeholders in the project and command areas of Guddu and Sukkur Barrages. A key aspect of this strategy shall be the communication of any project related impacts.

8.4.5 Plans to Address Cumulative Impacts

8.4.5.1 Dolphin Conservation and Management Plan

Dolphin game reserve located between Guddu and Sukkur barrages is currently under threat from sedimentation of river bed and depletion of river biota, including fish, reducing the prey base; stranding and mortality in the irrigation canals; depletion of prey base due to use of small size mesh nets; poaching for oil; entanglement in fishing nets; and pollution from domestic, agricultural and industrial waters. SID will engage in consultations with the federal government for better maintain flood flows and minimum flows to preserve the aquatic biodiversity. SID will carry out measures to prevent entry of dolphins in to canals during rehabilitation of Sukkur barrage. Further, a conservation and management plan will be carried out to address these issues and strengthen the conservation measures in dolphin game reserve. The plan will cover (i) detailed surveys on population status for two years covering both high flow and low flow season in each year, (ii) threat assessment surveys and develop mitigation plan, (iii) recommending no fishing zone in the river stretches that support breeding population, (iv) capacity building of the line government agencies and universities on dolphin research, conservation and management, (v) development of sustainable fishery management plan, (vi) involving local communities in dolphin conservation and management, (vii) supporting wildlife department in establishing rescue units to rescue dolphins stranded in canals, (viii) education and awareness programs, and (ix) conducting an international workshop in Karachi to learn and

share dolphin conservation and management options. Implementation of these actions are in progress. An international conference on dolphin conservation was held in Karachi in May 2017. For implementation of other actions, the PMO is engaging the Sindh Wildlife Department and these activities will be started from early 2018.

8.4.5.2 Hilsa Migration Management Plan

Hilsa migration is obstructed by all barrages in Sindh. Fish ladders in Kotri and Guddu barrage were originally designed to facilitate migration of hilsa. Though Kotri barrage has fish ladders, they were not being used by hilsa and hence hilsa migration is restricted to below Kotri barrage. Sukkur has no fish pass. There are no detailed studies available on hilsa migration, its bio-hydrological requirements for migration (e.g. water velocities, water depths, water quality, habitat conditions, etc.) for design of effective fish passes. A study is recommended under this project to study hilsa migration and design of new fish pass at Kotri and rehabilitation designs for existing fish passes at Kotri and Sukkur. Based on the outcome of this study, SID will rehabilitate fish ladders in Kotri and Guddu barrages and built a new fish pass in Sukkur. SID will coordinate with other line departments to restrict catching during upstream migration and undersized hilsa. Further studies will be carried out to implement these actions. The Component E: Integrated Riverine Management, will cover these activities.

8.5 Mitigation Plan

The mitigation plan given in Table 8.1 is organized around various issues associated with the project activities and includes various actions identified under the mitigation measures discussed in Chapter 6, define responsibilities for implementation as well as monitoring of each action, and also indicate the timing of these actions. Should any changes to the Project design or methods of construction and operation take place post this assessment stage, the impacts and monitoring/mitigation measures discussed may need to be revised to reflect such changes to allow the environmental and social implications of these changes to be addressed.

Table 8.1: Mitigation Plan

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
A. PRE-CONSTRUCTION STAGE				
A.1 Contractors' mobilisation and preparation of Contractors Environmental Action Plan (CEAP)	If contractors are not made responsible to comply with ESMP, there will be several constructions related impacts	In order to make the Contractors fully aware of the implications of the ESMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in ESA as well as WBG safeguard policies and EHS guidelines. The Contractor must be made accountable through contract documents for the obligations regarding the environmental and social components of the project. Contractor need to prepare the following site specific management plans to manage and mitigate/reverse potential adverse environmental impacts in compliance with ECPs and mitigation measures proposed in ESA. All these plans are to be reviewed and approved by CSC, PMO and World Bank • Dredging management plan • Dolphins Management Plan from Construction Impacts • Excavation Management Plan for Desilting • Erosion, sediment and drainage control plan • Pollution Prevention Plan • Waste Disposal and Effluent Management Plan • Traffic Management Plan • Occupational Health and Safety Plan • Drinking Water Supply and Sanitation Plan • Management Plan for Protection of Flora and Fauna • Labour Influx Management and Construction Camp Management Plan • Fuel and Hazardous Substances Management Plan • Instream Construction Works Management Plan • Emergency Preparedness Plan • Communication Plan	Contractor	CSC, PMO and World Bank
B. CONSTRUCTION PHASE: Environmental				
B.1. Impact of dredging on aquatic and benthic habitat	High sediment flows from dredging activities	• Carryout the dredging activities during high flow season of July and August when the river naturally carries high sediment load • Use the cutter suction dredger, which has low risk of sediment releases • Ongoing ecological monitoring to evaluate the impacts of dredging and develop additional mitigation measures if required.	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Comply with mitigation measures proposed in ECP 19: Dredging Management		
B.2 Sediment dispersion from dredging activities	High sediment concentrations from dredging activities	• Carryout the dredging activities during high flow season of July and August when the river naturally carries high sediment load • Use the cutter suction dredger, which has low risk of sediment dispersal • Ongoing ecological monitoring to evaluate the impacts of dredging and develop additional mitigation measures if required. • Comply with mitigation measures proposed in ECP 19: Dredging Management • Share the dredging activity schedule with the district wildlife department and fisheries department	Contractor	CSC, PMO
B. 3 Material Placement in the River	Sediment dispersal from hydraulic disposal of material	• submerged discharge (placing the pipe line vertically one meter below the water column or just above the river bottom) • Material placement in river (in active channels) during the months of July and August • Ongoing monitoring of sediment load and river morphology	Contractor	CSC, PMO
B.4. Effluents and emissions from dredging equipment and associated vessels	Waste generation and water pollution	• Prepare and implement an emergency preparedness plan • regular maintenance of the equipment as per manufacturers specification • Implement measures in ECP 19: Dredging Management	Contractor	CSC, PMO
B5. Impact of underwater noise levels on dolphin's vocalization and behaviour	Underwater noise levels generated by the dredgers and associated vessels may impact the dolphin's vocalization and behavior	• Monitoring an exclusion zone of about 500 m radius for at least 30 minute before the start of piling. If dolphins are observed in the exclusion zone, dredging works will be delayed until they have left the area. If dolphins enter the exclusion zone after dredging has commenced, dredging works would cease until they have left; • Dredging work will adopt a 'soft start'; using a low energy start to the dredging operations to give dolphins an opportunity to leave the area, gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling commences, • Contractor will use pingers upstream and downstream to chase away dolphins, • The contractor will hire a qualified ecologist for implementing the above mitigation measures and monitoring of impacts on dolphins • Share the dredging activity schedule with the district wildlife department and fisheries department, who are interested to participate in monitoring activities	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		• Implement measures in ECP 20: Dolphins Management from Construction Impacts		
B6. Risk of dolphin collision from construction works	risk of collision between dolphins and motor boats associated with construction works	• Restrict the boat movements within the construction areas • Restrict motor boats speed within 15 km/h in accordance with best international practices followed in the North America • Pingers will be used to chase away dolphins from the construction areas. • Use of boats will be limited to day time, and if they are needed to be used during night time, adequate night time lighting will be provided. • Implement measures in ECP 20: Dolphins Management from Construction Impacts	Contractor	CSC, PMO
B7. Impacts from Excavation Activities in the Barrage	Air and noise pollution from earth moving equipment and trucks	• Excavations will be carried out in dry river beds and to remove only dry sediments. These activities will be carried out mainly low flow season. • If any sediment water released from the excavation activities, they will be contained by placing the silt fences, sediment traps around the excavation areas to prevent migration of silt in to the river. • Strict traffic management will be in place by the contractor with adequate traffic signals and traffic control personnel along the routes used by the trucks for transport of excavated material to the left bank placement area. • Implement mitigation measures are given in ECP 15: Traffic Management	Contractor	CSC, PMO
B8. Impacts from Canal Desilting Activities	Nuisances through dust, noise and traffic disturbances.	• Desilting activities will be carried out only in canal closure periods. • Canal beds will be used for movement of construction equipment and vehicles, instead of canal embankments • The entrance and exit of excavators and dumpers taking out the excavated silt from canal bed will be controlled near the canal bridge crossing at km 1.3 (RD 4) and km 5.1 (RD 17). The routes used by the dumpers for transport of excavated silt is shown in Figure 3.5 • The desilted material will be carried out in covered trucks to control the dust emissions • Desilting activities will be limited to day time hours to avoid nuisance to the local communities • Strict traffic management will be in place by the contractor with adequate traffic signals and traffic control personnel along the routes used by the trucks for transport of excavated material to the left bank placement area. Additional mitigation measures are given in ECP 15:	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		Traffic Management • Repair all damaged local roads to their original state after works completion		
B.9. Risk of entrapment of Dolphins and other Aquatic Fauna in Construction Areas	Dolphins and turtles can be stranded in the canals	• A dolphin rescue team will be established by the contractor in the site to rescue dolphins that are entrapped in the construction areas. The dolphin rescue will include an ambulance, a stretcher, water facility and a trained rescue staff. • The parent project, SBIP, is also supporting the local wildlife departments for establishing dolphin rescue team under dolphin conservation and management plan. • Before initiating the desilting activities, an observation survey will be conducted in surrounding areas for presence of dolphins and turtles. The turtles will be rescued and released safety in to other canals before carrying out desilting activities. • Support of district wildlife department will be taken during rescue and release operations of any animal species found during the desilting activities. • Implement mitigation measures to address flora and fauna are given in ECPs 12, 13 and 20.	Contractor	CSC, PMO
B10. Impacts of Excavated Sediments Placement on the Dry River Banks	The movement of trucks and improper dumping of material may cause dust and noise pollution.	• The placement area will be marked in to several plots for uniform placement and distribution of material, to avoid improper dumping of material • The height of each material dump will be limited to 6 ft. • The material will be carried out through covered trucks and material will be dumped at low height to minimize dust emissions. • Implement mitigation measures to address dust pollution are given in ECP 10: Air Quality Management and ECP 11: Noise Quality Management	Contractor	CSC, PMO
B11. Disposal of replaced mechanical and electrical parts	Waste pollution	• All scrap material will be sold to steel industries in Lahore and Karachi through an open auction. Similarly, rubber material will be sold to rubber industries through an auction. • None of these waste materials will be disposed at the site	Contractor	CSC, PMO
B12. soil and water pollution	Pollution from fuel storage areas, construction areas	• The contractor will prepare and implement an emergency preparedness plan to address. • The contractor will make booms (oil fence), absorbents and skimmers available on site along with trained personnel to recover spilled oils from water surface. • The contractor shall include training in the use of this equipment	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		within his training plan and carryout regular drills in the deployment of this equipment • Greasing of the gates will be carried out in dry working area. Painting of gates will be done on the land and only after drying they will be fixed to the barrage. • The contractor shall be prohibited from bailing or pumping this water into the river, but instead shall be required to collect the bilge water, treat it by separation and dispose of the separated oil and fuel as hazardous waste • All waterborne plant shall be regularly serviced as per the manufacturer's guidelines and be inspected daily prior to operation. • Refueling of dredgers and boats will be properly carried out to avoid any spills. Refueling of boats will be done on shore. Spill kits and other absorbent material will be made available at refueling points on the barges. • Implement mitigation measures given in ECP 3: Fuels and Hazardous Goods Management, ECP 3: Water Resources Management, ECP 5: Soil Quality Management, and ECP 7: Erosion and Sediment Control.		
B. 13. Noise and air pollution	Air and noise pollution from construction equipment and traffic	• Construction equipment and vehicles will be regularly maintained according to the instructions provided by the manufacturers, so that emissions are minimal and comply with emission standards of NEQS. • Dust generation from construction sites will be restricted as much as possible and water sprinkling will be carried out as appropriate, especially at those places where earthmoving, excavation will be carried out. • Contractor will be required to implement the measures prescribed in the Environmental Code of Practices (ECP), which will be included in the contracts. ECPs 10 and 11 cover Air Quality and Noise Management • Construction activities near the settlements will be limited to day time only. High noise producing equipment will be provided with mufflers or acoustic enclosures.	Contractor	CSC, PMO
B14. Waste	Solid waste and hazardous waste from works	• Contractor will prepare and implement solid waste collection and disposal plan. • The existing municipal waste facilities will be used for disposal of solid • Protocols and measures prescribed in the ECPs 1 and 2 on the	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		management of solid and hazardous waste will be implemented. • Contractor to develop and undertake construction waste management strategy for both hazardous and non-hazardous wastes separately. • Siting of any fuel and hazardous material storage sites, including refueling facilities, batching plants and construction yards are to be located outside the flood embankments and at least 500 m away from any residential areas. • Hazardous waste will be disposed of through Sindh EPA certified contractors.		
B. 15. Quarry Activities	Impacts on physical and biological environment on the quarry and borrow areas	• The contractor shall use the government approved quarry sites for procurement of stones and aggregates. The contractor shall not develop any new quarry sites. • The PMO will visit the proposed quarry sites and carry out due diligence to ensure the quarry operators are complying with the EHS requirements for licensing the EPA; before procurement of the material. Best practices on quarry areas development and operation are given in ECP 9. • PMO will consult with EPA on the record of non-compliances if any with the proposed quarry operator. • To the extent feasible, the excavated material will be used for earth fill.	PMO	CSC
C. CONSTRUCTION PHASE: Social				
C1. Land acquisition	Land acquisition is not required as per the current design; but if land acquisition is required during project implementation, there will be impacts on livelihoods	• If any locations on the outer bank bela and left bank canal or middle island need to be acquired due to outcome of design studies during AF implementation, an abbreviated RAP will be prepared according to the updated RPF. • During desilting activities around the island, a dedicated access route will be provided to the tenants of middle bank island and outer bank bela (which will be marked through buoys), so that there will be no impact on their livelihoods.	Contractor	CSC, PMO
C2. Impact of canal closures on water needs of the command area	Impact on crop cultivation and drinking water supply.	• Carry out the instream construction activities in low flow season	Contractor	CSC, PMO
C3. Traffic on the barrage	Closure of the barrage for the local traffic	• The public will be informed in advance about the road closure periods through bill boards near the barrage site; and by placing adequate traffic diversion structures	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
C4. Generation of employment in the project area	Employment opportunities to the local communities	Populations in project and command areas will be notified these opportunities, as described in the updated communication strategy in SMF.		
C5. Traffic safety and hazards	Safety hazards for children and elderly people due to increased traffic	• Contractor will develop a traffic management plan in compliance with ECP on traffic management • The Traffic Management Plan will be implemented with aim at ensuring access to residential areas, and preventing unsafe situations, especially near schools, housing areas, construction areas, camps and office. • Ensure that all construction vehicles observe speed limits on the construction sites and on public roads • Provide adequate signage, barriers, and flag persons for traffic control. • Fit audible warning devices in vehicles to alert during reversing	Contractor	CSC, PMO
C6. Influx of Labour	The influx of migrant labour generally have significant impacts on the local communities and environment.	• The Contractor shall ensure provision of adequate accommodation, transportation, and basic services including water, sanitation and medical care for all migrant works. The location of the camp will be located within the barrage area (Figure 3.6) • The provisions for contractors work site will comply with the Guidance on Workers Accommodation developed by IFC and EBRD • A grievance redress mechanism will be in place by the contractor to raise work place concerns. • First aid facilities and adequate medicines will be made available at the camp site. The workers will undergo initial health screening and regular health checkups. • Implement the labour influx management are given in the ECP 16: Labour Influx Management and Contractors Camp Management	Contractor	CSC, PMO
C7. Community Health and Safety	Possible cultural conflicts between communities and immigrant workforce and community health impacts	• Raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on site, in camps, and in local communities. • The awareness campaign will include women's privacy and their access during civil works. • The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction work force, including the spreading of sexually transmitted diseases such as HIV/AIDS • The contractor shall employ a Community Liaison Officer who shall	Contractor	CSC, PMO

Environmental and Sustainability Issue	Issues/Impacts	Mitigation/Compensation Measures	Institutional Responsibilities	
			Implementation	Supervision
		be responsible for the preparation and implementation of a Communication Strategy. • The project-level Community Grievance Redress Mechanism (CGRM) will be updated for the proposed AF. It defines a process for receiving, recording and responding to complaints and also monitoring of the success of any responsive action taken (detailed in Section 8.9). • In addition, complaints register shall be set up at the Contractor's and Engineer's offices to record any complaints received during the implementation of the works. The contractor will implement ECP on cultural and religious issues	CSC	PMO
Workers health and safety	Exposure to physical hazards from use of heavy equipment, cranes; and electrical hazards from the use of tools and machinery	• Implement ECP 17: Workers Health and Safety, ECP 16: Labour Influx Management and Construction Camp Management • Appropriate PPE to the workers and training in use of these PPEs. Frequent supervision Contractor OHS plan describe the tasks and methods to be used by workers associated with water borne construction, and how to perform them safely and state how potential hazards are identified and handled.	Contractor	CSC, PMO

8.6 Monitoring Plan

Proposed monitoring plan to be carried during implementation of the project to ensure contractors compliance with the mitigation measures is given in Table 8.2 along with the monitoring indicators and frequency. CSC will be responsible for supervision of implementation of the plan. The total cost of monitoring has been estimated at USD 0.25 million.

Table 8.2: Effects Monitoring Plan

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
Ecological monitoring (dolphins, turtles, fish)	Field investigations for observations on dolphin or turtle entrapment or their presence to close to construction areas	During desilting of barrage and canals (daily)	Contractor	CSC, PMO
River morphology at the dredged material placement location	Sediment load and morphological conditions	During dredging and placement (monthly)	Contractor	CSC, PMO
Surface water quality	Sampling and analysis of river water quality and waste water discharges for the parameters given in NEQS 2000	Quarterly	Contractor	CSC, PMO
		Annually	External Monitor (PMO through a nationally recognized laboratory)	CSC, PMO
	Spot measurements of pH, conductivity, turbidity; visual inspection of presence of petroleum products	Monthly	CSC	CSC, PMO
Groundwater quality	Sampling and analysis groundwater quality for drinking water	Quarterly	Contractor	CSC, PMO
		Annually	External Monitor (PMO through a nationally recognized laboratory)	CSC, PMO
Air Quality (dust, smoke)	Visual inspection to ensure good standard equipment is in use and dust suppression measures (sprinkling) are in place	Daily	Contractor	CSC, PMO
	Visual inspection to ensure dust suppression work plan is being implemented	Daily	Contractor	CSC, PMO
Air Quality (PM_{10}, NO_2, SO2, CO_2, CO)	Air quality monitoring for 24 hours for the parameters specified in NEQS 2000	Prior to Construction	Contractor	CSC, PMO
		Quarterly	Contractor	CSC, PMO
		Annually	External Monitor (PMO through a nationally recognized laboratory)	CSC, PMO
Emissions from plant and equipment	Visual inspection	Monthly	Contractor	CSC, PMO
Noise and vibration	24 hour noise monitoring	Quarterly	Contractor	CSC, PMO
	24 hour noise monitoring	Annually	External Monitor (through a nationally recognized laboratory)	CSC, PMO
	Spot measurements	Monthly	CSC	CSC, PMO
Waste Management	Visual inspection that solid waste is disposed of at designated sites	Monthly	Contractor	CSC, PMO
Spills from hydrocarbon and chemical storage	Visual inspection for leaks and spills	Monthly	Contractor	CSC, PMO
Operation of borrow	Visual inspection of quarry sites	Monthly	Contractor	CSC, PMO

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
sites				
Traffic safety	Visual inspection to ensure Traffic Management Plan is implemented	Monthly	Contractor	CSC, PMO
Local roads	Visual inspection to ensure local roads are not damaged	Monthly	Contractor	CSC, PMO
Community relations	Consultations with community members	Monthly for the first year, then quarterly	Contractor	CSC, PMO
Laborers	Number and percentage of skilled and unskilled laborers hired locally.	Quarterly	Contractor	CSC, PMO
Drinking water and sanitation	Ensuring construction workers are provided with safe water and sanitation facilities on site	Weekly	Contractor	CSC, PMO
Safety of workers	Usage of personal protective equipment	Monthly	Contractor	CSC, PMO
Erosion	Visual inspection in all areas where run-off leaves bare and at important drainage features (ditches, gullies, etc.) after major rainfall events	Weekly	Contractor	CSC, PMO
Reinstatement of work sites	Visual Inspection	After completion of all works	Contractor	CSC, PMO

8.7 Capacity Building and Training

The environmental and social trainings will help to ensure that the requirements of the ESMP are clearly understood and followed by all project personnel. The primary responsibility of providing these trainings to all project personnel will be that of the contractor and CSC. The trainings will be provided to different professional groups separately such as managers, skilled personnel, unskilled labors, and camp staff. Capacity building will be aimed at strengthening the PMO and Sukkur operational staff in the field of environmental management and social development. Safeguard staff of PMO responsible for supervision of environmental and social mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, labor and working conditions, and social development. The contractor will also be required to provide environmental and social trainings to its staff, to ensure effective implementation of the ESMP. A budget of USD 0.25 million has been earmarked for capacity building. The training plan shall include a programme for the delivery of intermittent training, to cover the subjects included in Table 8.3. Training should be carried out initially at induction of staff and repeated throughout the project.

Table 8.3: Training Subjects for Inclusion in Contractors Training Plan

Training Subject	Target Audience
Environmental Code of Practices	All staff
Handling, use & disposal of hazardous material	Construction workers with authorised access to hazardous material storage areas and required to use hazardous material during their works
Waste Management	All staff (construction and camp staff)
Efficient& safe driving practices, including road & vehicle restrictions	Drivers & mobile plant operators
Actions to be taken in the event of major or minor pollution event on land	All construction staff
Use of flexible booms and surface skimmers in	All construction staff working on dredging and

Training Subject	Target Audience
event of pollution event in water	barges
Pollution prevention: Best practice	All staff
Refuelling of water borne plant – pollution prevention	Operators of water borne plant & vehicles
Health & Safety: Safe way to work & hazard awareness	All construction staff and O&M Staff
Health & Safety: Safe use of plant & equipment	Operators of plant & equipment
Health & Safety: Working at height	Staff colony, barrage & regulator construction staff
Health & Safety: Working near/on water	All construction staff working on barrage and in water
Health & Safety: Working near/on water	All construction staff working on barges
Health & Safety: Use of PPE	All construction staff
Occupational Health and Safety	To all persons entering the construction site
Emergency procedures and evacuation	All staff
Spill clean-up training	Contractor's spill management staff
Fire fighting	All staff
Site inductions, including requirements under the Environmental Management Plan & details of environmentally sensitive areas of the site	All staff
Culturally sensitive awareness rising on HIV/AIDS and the spread of sexually transmitted diseases. Awareness raising on risks, prevention and available treatment of vector-borne diseases	All staff
Grievance redress mechanism	All staff
Cultural sensitivities of the local population	On induction of all non local staff

8.8 Audits and Annual Review of ESMP

Internal environmental audits will be held with an objective to review the effectiveness of environmental and social management of the project. CSC under the supervision of PMO will carry out annual review of the appropriateness and adequacy ESMP and SMF in the light of its own monitoring and supervision as well as on the basis of the third party monitoring and audits discussed earlier. CSC will revise the ESMP and SMF in case substantial gaps and shortcomings are identified in these plans.

External third party environmental audits will be held with an objective to review the effectiveness of environmental and social management of the project. It is proposed that MEC carry out these audits on yearly basis. These audits would be used to re-examine the continued appropriateness of the ESMP and to provide advice on any updates required.

8.9 Grievances[20]

Grievances are actual or perceived problems that might give grounds for complaints. As a general policy, PMO will work proactively towards preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. For the original project, a project level grievance redress mechanism (GRM) has been established and the same will be used for Sukkur Project also. Community grievance redress mechanism (CGRM) addresses complaints related to both Guddu and Sukkur's ESMP/SMF as well as the project implementation, while procurement grievance redress mechanism (PGRM) specifically addresses procurement related

[20] Detailed GRM is given in Updated SMF of SBIP, which is presented in a separate cover.

issues. For CGRM, a complaint cell has been set up at PMO in Sukkur, chaired by Deputy Project Director. If a complaint is not resolved locally, it could be escalated to a grievance redress committee set up in Karachi. CGRM will also cover the proposed AF. The Grievance Redress Mechanism is shown in Figure 8.2 and the members of the complaint cell are shown in Table 8.4. SBIP grievance redress mechanism is detailed in SMF.

Table 8.4: PMO Complaint Cell

S No.	Designation	Position
1	Deputy Project Director, PMO-SBIP	Chairman
2	Executive Engineer (Guddu Barrage) or Executive Engineer (Sukkur Barrage)	Member
3	Deputy Director (Environment) PMO	Member
4	Representative of PIC	Member
5	Representative of Contractor	Member
6	Technical Officer PMO	Member
7	Deputy Director (Resettlement) PMO	Secretary

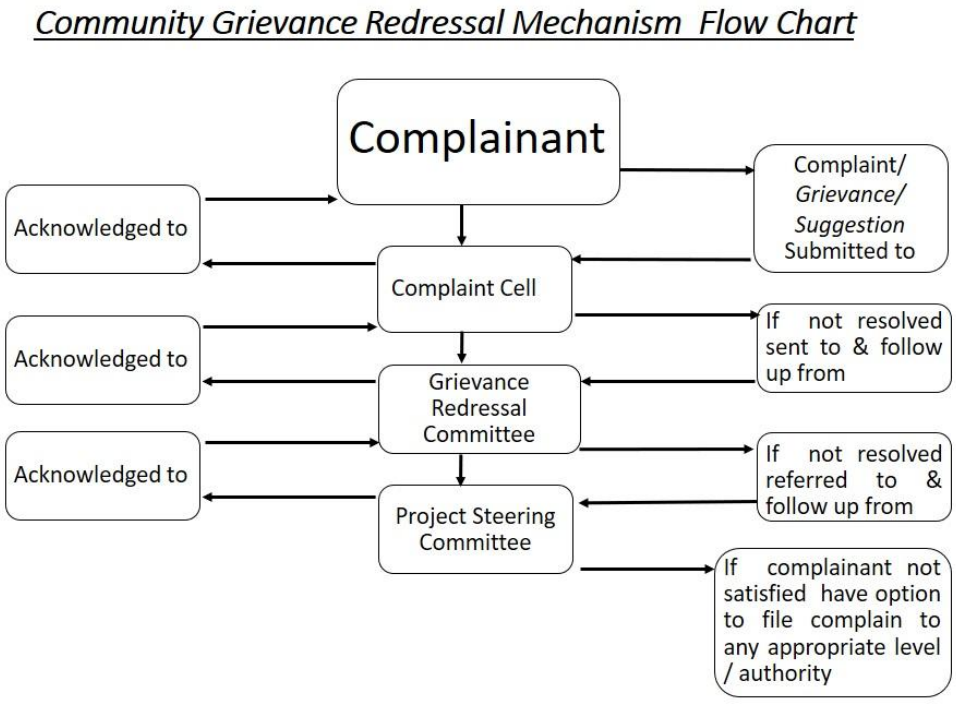


Figure 8.2: Grievance Redress Mechanism

8.10 Reporting

Proper arrangements are necessary for recording, disseminating and responding to information that emerges from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management systems “auditable.” The CSC will prepare monthly reports covering various aspects of the ESMP implementation including

compliance and effects monitoring, capacity building, and grievance redressal. List of reports to be prepared during implementation are given in Table 8.5.

Table 8.5: Reporting during implementation

Report	Contents	Prepared by	Distribution
Monthly	Non-Compliances observed on sites and actions required	Environmental/Social team of the Engineer (CSC)	PMO; MEC; SID, Contractor
Monthly	Actions taken on site in response to CSC Monthly report Project progress and works to be undertaken in the coming three months Details of training delivered Details of accidents reported and actions taken	Contractor	CSC PMO; MEC
Quarterly	Quarterly review on implementation of ESMP including compliance and effects monitoring, capacity building, and grievance redressal	PMO	PMO Sindh EPA; SID, SIDA, World Bank, CSC, Contractor
Semi-Annual	Semi-annual reporting for OHS, including workhours, number of lost-time accidents/incidents, serious injuries and fatalities, amount of lost time, root cause investigations, etc. There should also be some incident reporting requirements, such as for major spills, fatalities, local unrest, etc.	PMO	PMO Sindh EPA; SID, SIDA, World Bank, CSC, Contractor
Annual	Results of effects monitoring Independent review of environmental and social performance on site Recommended actions required by all parties	MEC	PMO, Sindh EPA SID, SIDA World Bank, CSC, Contractor

8.11 Cost of ESMP and SMF

The Component E of the Project 'Integrated Riverine Management' will cover 'The Social Action Plan, and water-related environmental and social issues in the 170-kilometer stretch of the Indus between Sukkur and Guddu Barrages. In particular, this component would comprise activities supporting: (a) dolphin management and conservation, (b) community fisheries co-management, (c) sustainable agriculture, (d) technical studies (e.g., design for dolphin passage gates) and (e) water quality and pollutant studies. This component would be implemented in collaborations with the Sindh Environmental Protection Agency (SEPA), Wildlife Department, and Agriculture Department, and Fishery Department. World Wildlife Fund (WWF) would also participate in

implementation of this component. The proposed budget for implementation of the component is USD 6 million.

Tentative of cost estimates for the updated SMF and ESMP implementation are given in Table 8.6.

Table 8.6: Cost Estimates for ESMP and SMF implementation

Sl. No.	Description of Item	Unit	Quantity	Unite Rate (USD)	Item Total (million USD)
1	Contractors cost for preparation and implementation of site specific environmental management plans, including implementation of mitigation measures given in the EMP and ECPs. Hiring of Environmental Health and Safety (EHS) Officer throughout construction period of the subproject	LS		About 1% of the Construction (Civil Works) Cost of the Project (USD 100 million)	Included in the civil works budget (Component A)
2	Environmental Specialist and Social Specialist in the Construction Supervision Consultant				Included in Component C
3	Environmental Monitoring during construction (sediment quality, water quality, air and noise quality)	LS		0.25	0.25
4	Capaicty building of PMO safeguard staff				0.25
5	Social Management Framework for Sukkur and Guddu Barrages (RFP and communication strategy)[21]	LS			1.5
	Total				**2.25**

[21] The original SMF is costed at US$5 million, including US$3.5 million for SAP. The SAP cost has been reallocated to Component E.

9 Stakeholder Consultations and Disclosure

9.1 Overview

Extensive consultations were carried out throughout the project preparation. Initial consultations were held at the early stages of the project preparation (2012-2013) and also during 2015 with the farming communities in the canal command areas to share the project objectives and terms of references of the proposed environmental assessment study. Consultations involved multiple methods – for example, household level interviews, village wise meetings, focus group discussions and workshops. Second round of consultations were carried out in 2017 to share the findings of the draft ESA. Details of stakeholders consulted are given in Table 9.1 and summary on consultation meetings are given in Table 9.2.

Table 9.1: Details of Stakeholders Consulted

General population in Project Area	• Head of households, Female • Farmers (tenant and owners), Laborers • Squatters in middle bank island, outer bank bela, and left bank bela
Command Area	• Farmers, Livestock Owners, Fishermen • Community and Religious Leaders
Local and Provincial Governments	• District administration of Sukkur • Sindh EPA, Forestry department, Agricultural department, Fisheries department, Rural development department, and Sindh wildlife department • Universities
NGOs/CBOs	• WWF and IUCN • Farmers Associations

Table 9.2: Summary on Details of Consultation Meetings

	Activities	No. of participants
A.	**First Round of Consultations (2012-2015)**	
1.	Village wise meetings in the left bank command area (35 villages)	432
2.	Meetings in the right bank command area (23 villages)	235
3.	Community consultations near the barrage site, including squatters	94
4.	Government stakeholders	24
B.	**International Seminar on Dolphin Conservation (2017)**	
1.	A one-day international seminar in Karachi on dolphin conservation and management	148
C	**Second Round of Consultations (in 2017)**	
4.	Public Consultation at Sukkur	30
5	Consultation workshop with downstream stakeholders at Jamshoro	59
6	Consultation workshop with provincial stakeholders	14
Total		**1,036**

9.2 First Round of Consultations

Initial round of consultations was held with the farmers in the command areas, local communities, and local government stakeholders during 2012-2015. The objective of these consultations are to share the details of the proposed project activities and scope of environmental and social assessment; and to obtain their feedback and comments.

9.2.1 Consultations with the Farmers in the Command Area

Consultations were carried out with the 55 farming communities (35 villages on the left bank and 23 villages on the right bank) located in the command area of the Sukkur barrage during 2015. The consultations covered all seven canals under Sukkur Barrage. Details of villages consulted are given in Table 9.3. A total of 667 people was consulted through these meetings. Detailed list of people participated in these meetings are given in Annex F. A summary of main issues raised during these consultations and how these issues are addressed and incorporated are shown in Table 9.5.

Table 9.3: List of Villages Consulted in the Command Area

Sr. No.	Barrage Side (Left/Right)	Canal Name	Distributary/Minor	Village Name	Participants (No.)
1	Left	Nara	Lukhurko Minor	Qadir Dad	9
2	Left	Nara	Malook Minor	Kathoor Town	7
3	Left	Nara	Kariri Minor	Pahlwan Shahar	12
4	Left	Nara	Laiwari Minor	Laiwari Minor Head	20
5	Left	Nara	Mumtaz Minor	Mumtaz Channel Head	9
6	Left	Nara	Nauabad Minor	Nauabad	7
7	Left	Nara	RD 203 Minor	Phyrhayaro Channel(H)	8
8	Left	Nara	RD 214 Minor	Akhtar Hussain Talpur	4
9	Left	Nara	Pir Bux Ghaho Minor	Pir Bux Gahoo	4
10	Left	Nara	RD 116 Minor	Panjal khan Bahmbhro	14
11	Left	Nara	RD 145 Minor	Samoo Khan Bahmbh	20
12	Left	Nara	RD 146 Minor	Chudhry Asghar Ali	13
13	Left	Nara	RD 205 Minor	Ayaz Abad	10
14	Left	Nara	RD 118	Kot Saraiko	11
15	Left	Nara	Dingri Minor	Atta Muhammad Ara Din	16
Sub Total:					164
16	Left	Khairpur East	Bhango Minor	H Raza Muhammad Shar	9
17	Left	Khairpur East	Faz Ganj Wah	H Muhammad Soomro	24
18	Left	Khairpur East	Khan Wah	Gul Hasan Kubar	13
19	Left	Khairpur East	Machi Minor	Nazar Faqeer Jamro	13
20	Left	Khairpur East	Sanhro Disty.	Bhutta Goth	9
Sub Total:					68
21	Left	Khairpur West	Chandia Minor	Garibo Khan Chandio	15
22	Left	Khairpur West	Machhar Minor	Machhar Chawk	6
23	Left	Khairpur West	Mangi Minor	Lal Bux Mangi	18
24	Left	Khairpur West	RD 106 R Minor	Haji Ali Dad	6
25	Left	Khairpur West	Mehtani Minor	Badal Khoro	13
26	Left	Khairpur West	Olad Jamsher Minor	Waris Faqeer Mangrejo	12

Sr. No.	Barrage Side (Left/Right)	Canal Name	Distributary/Minor	Village Name	Participants (No.)
27	Left	Khairpur West	Rangal Minor	Babarloo	8
	Sub Total:				78
28	Left	Rohri	Godho Disty.	Moley Dino Rajpar	14
29	Left	Rohri	Hingorja Minor	Hingorja Stop	8
30	Left	Rohri	Lakhi Sar Minor	Juman Khibar	9
31	Left	Rohri	Manharo Minor	Muhammad Ramzan Jamali	26
32	Left	Rohri	Mehrab Pur Branch	Ali Bux Sumrah	19
33	Left	Rohri	Rein Disty.	Noor Bhoora	23
34	Left	Rohri	Sarfraz Branch	Jamal Khan Kaloi	5
35	Left	Rohri	Mangi Minor	Lal Bux Mangi	18
Sub Total:					122
Total Left Bank:					432
1	Right	Dadu	Wadah Rabi Minor	Mehrab Khan Lakher	10
2	Right	Dadu	Gillispy Disty.	Zangi Jatoi	11
3	Right	Dadu	Hassan Wahan Minor	Channa Pul	10
4	Right	Dadu	Johi Branch	Mitho Khan Mastoi	13
5	Right	Dadu	Mahotta Minor	Agani	7
6	Right	Dadu	Nusrat Minor	Bhobhant Abro	10
7	Right	Dadu	Phakka Disty	Phakka	5
8	Right	Dadu	Vakro Minor	Sonahri	9
Sub Total:					75
9	Right	North West	Baho Minor	Qalandar Bux Bhati	15
10	Right	North West	Chandia Minor	Imdad Hussain Buledi	8
11	Right	North West	Fateh Pur Minor	Ali Abad Thahem	10
12	Right	North West	Gaheja Disty	Gaheja	8
13	Right	North West	Kalhora Minor	Filhiri	10
14	Right	North West	Kur Khairo Minor	DAim Khan Buledi	9
15	Right	North West	Masti Khan Minor	Molvi Muhammad Rafiq Jakhro	15
16	Right	North West	Mohammad Pur Minor	Bahadar Ali Chachar	15
17	Right	North West	Sajjawal Disty.	Allah Wadayo Abro	12
18	Right	North West	Wasand Disty.	Agham No. 2	8
Sub Total:					110
19	Right	Rice	Dhamrano Branch	Nazir Ahmad Jatoi	12
20	Right	Rice	Dodai Minor	Gul Muhammad Khoso	8
21	Right	Rice	Hira Wah Disty.	Haji Moti Ayo Jatoi	12
22	Right	Rice	Mondar Branch	Nasir Abad Citty	9
23	Right	Rice	Shah Nawaz Minor	Dargah Mashori Sharif	9
Sub Total:					50
Total Right Bank:					235
Total Left & Right Banks:					667

9.2.2 Consultations with the communities near the Barrage

Consultations with the communities located in the barrage area have been started from the early stages of the feasibility study. A total of 94 people (Table 9.4) has been consulted in these meetings. A summary of main issues raised during these consultations and how these issues are addressed and incorporated are shown in Table 9.5.

Table 9.4: List of Communities Consulted Near the Barrage Area

Sr. No.	Date	Venue	Participants (No.)
1	17-09-12	Middle Bank Island	14
2	20-09-12	Otaq of Mr Khuda Bux Bhutto	13
3	21-09-12	Otaq Mr Khuda Bux Bhutto	11
4	29-09-12	Sation Bundar (Zabardast Khan Mahar)	44
5	03-11-12	Middle Bank Island	12
		Total	**94**

9.2.3 District Level Stakeholder Consultations

Consultations were held during 2013 and 2014, with the district government agencies such as Wildlife Department, Forest Department, Fisheries Department, district administration and barrage authorities. A total of 24 persons were consulted and list of these people are given in Annex F. A summary of main issues raised during these consultations and how these issues are addressed and incorporated are shown in Table 9.5.

9.2.4 Feedback from First Round of Consultations

A summary of main issues raised during first round of consultations with the farmers in the command area, communities near the barrage and district government agencies; and how these issues are addressed and incorporated are shown in Table 9.5.

Table 9.5: Feedback from First Round of Consultations

	Comments and Suggestions	Action Point
A	**Farmers of Command Area**	
1	Farmers are very happy about the proposed rehabilitation and modernization works and said that it will improve their livelihoods, and will also benefit the whole province.	The Project will enhance the life of Sukkur barrage and thus safeguards the livelihoods of 0.6 million farming households.
2	Project activities should be designed in a such way that irrigation releases to the canals will not be stopped, particularly during summer months for the *Kharif* crops like cotton, which will not survive more than 6 to 7 days without the water. In some areas, where the soils are sandy, the soil quality will also be affected if the irrigation releases are stopped during summer months. In some villages, where the groundwater is saline, the canal water is being used for drinking purposes.	The proposed project activities will not require stoppage of any canals or will not interference with the irrigation releases to canals.
3	Regular canal closure periods should be maintained during proposed constructing works, and if the canals need to be closed other than regular periods, the irrigation department should share this information	Regular canal closure periods will be maintained. Desilting of canals will be carried out only during their annual canal closure periods.

	well in advance so that farmers will skip the cultivation during that season.	
B	**Communities near the Barrage**	
4	Communities are using the belas (silt deposits) along the banks for cultivation whenever it is possible as a secondary source of income, and any project activities in these areas will affect their livelihood.	The proposed desilting activities will not affect any farm lands in the belas.
5	The proposed construction activities should be limited to the existing barrage areas. If the Project require any land acquisition, the compensation for all losses should be paid at market rates.	The proposed project activities will not require any land acquisition. If any land acquisition would be needed during implementation stages, a resettlement action plan will be developed in accordance with Resettlement Policy Framework of SBIP.
6	Employment opportunities during construction period be provided to the communities living close to the barrage area	Preference will be given to local communities for unskilled labour work with the contractor.
C	**District Level Stakeholders**	
7	Dolphin is the only threated species in the barrage area and no other threated fauna or flora species were reported or sighted.	Dolphin is the only threatened species recorded in the project area.
8	Dolphins should be given special attention while executing the project activities and developing mitigation plans for the construction impacts. However, dolphin have a large home range between Sukkur and Guddu barrages, and it will temporarily move away from the construction areas.	Mitigation plans have been prepared to address construction related impacts on dolphins
9	Wildlife department would like to associate with the construction monitoring activities as they have experience in monitoring related to impacts on dolphin.	A dolphin conservation and management program will be implemented under the SBIP by the Sindh Wildlife Department

9.3 International Conference on Dolphin Conservation and Management

PMO has conducted a one-day International Conference on 'Conservation and Management of Indus Dolphin in Indus River, Sindh, Pakistan' to learn and share dolphin conservation and management options between experts and the stakeholders. The meeting was held on 15 May 2017 at Karachi. The proposed project activities under Guddu and Sukkur barrages also have been shared in a presentation by PMO.

A total 148 people from several organizations have participated in the International Conference. The participated organizations include: Irrigation Department, Sindh Wildlife Department, Descon Eng ltd., IO/BM, PMO-SBIP Irrigation Department, National Institute of Oceanography (NIO), MMP-MMI, ICC, Project Implementation Consultant (Engineers), Sindh University Jamshro, SPMC, PCMU Planning Department, PMC/A WISP,TEKECELLANT, Sindh Fisheries Department, WWF-Pakistan, Mehran University and Engineering Technology Jamshoro, Sindh Irrigation and Drainage Authority, ITU/BISMIL, Revenue department, Sindh Abadgar Board, ALGP, Ecological Consultant, The News, Associate Eng-Consultant (ACE), Education, Eng-Consultant, SUPARCO, ORACAL, L&F Department, Food Security, IES, University of Karachi, Global Vision MET, KPMU, P&D , SAGP, SCA, SGS(Pvt), DR&C Tunisia , and World Bank.

Detailed objectives and outcome of this international conference is presented in Section 7.3.4. Detailed list of participants is given in Annex E.

9.4 Second Round of Consultations

Second round of consultations were carried out during August to November 2017 by the independent ESA consultants.

9.4.1 Public Consultations at Sukkur

Public consultations were conducted on 7th August 2017 at PMO office in Sukkur. Prior notices are given through newspaper advertisements (in English and Sindhi dailies on 29th July 2017) and invitation letters. Copies of newspaper notifications are given in Annex G. The EIA and SIA documents prepared by the design consultants have been disclosed on the website of SID prior to the newspaper advertisements. About 30 people from Sindh Wildlife Department, Sindh Fisheries Department, Sindh EPA, Sindh Irrigation Department, WWF-Pakistan and some local NGOs have participated in the meeting. Detailed list of participants is given in Annex H.

The scope of the proposed project activities and its impacts and mitigation plans, dredging and dredge material management plans have been discussed in these consultations. Participants have fully supported all the proposed mitigation plans including dredging and dredge material placement in the river. They have shown interest in participating the monitoring of dredging activities to ensure dolphins are not affected by these activities. A summary of main issues raised with various stakeholders and how these issues are addressed and incorporated are shown in Table 9.6.

9.4.2 Consultations with Downstream Stakeholders at Jamshoro

A consultation meeting was held with the downstream stakeholders near Kotri barrage. The meeting was held on 29th November 2017 at US-Pakistan Centre for Advanced Studies for Water, Mehran University of Engineering and Technology, Jamshoro. A total of 59 people from various organizations have participated in these meetings. These organizations include: Sindh Abadgar Board (a farmers' advocacy organization), Teachers and researchers of the Mehran University and the US-Pakistan Centre for Advance Studies, and Irrigation Department of Kotri barrage. Detailed list of participants is given in Annex H. The participants have fully supported the proposed project activities and management plans, and did not raise any concerns on downstream impacts. A summary feedback from these consultations are given in Table 9.6.

9.4.3 Consultations with Provincial Level Stakeholders

A consultation meeting was held with the provincial stakeholders in Karachi. The meeting was held on 30th November 2017 at Project Coordination and Monitoring Unit, Karachi. A total of 14 people from various organizations have participated in these meetings. These organizations include: National Institute of Oceanography, Environmental Protection Agency, WWF, Sindh Development Study Centre, Irrigation Department and World Bank. Detailed list of participants is given in Annex H. The participants have fully supported the proposed project activities and environmental management plans. A summary feedback from these consultations are given in Table 9.6.

9.4.4 Feedback from Second Round of Consultations

A summary of main issues raised with various stakeholders and how these issues are addressed and incorporated are shown in Table 9.6. Detailed list of participants in these consultations are given in Annex G.

Table 9.6: Feedback from Second Round of Consultations

	Comments and Suggestions	Action Point
1	The area between the Sukkur and Guddu barrage area is dolphin game reserve. Sindh Wildlife Department is interested to participate in the monitoring of dredging and dredge material placement activities to ensure these activities will not affect the dolphin and fish. WWF has suggested that they have dolphin rescue team, and would be interested to provide their services if required. WWF has also recommended measures to ensure dolphins not present in the construction areas.	The SID is already in the process of engaging the Sindh Wildlife Department for carrying of dolphin conservation activities under SBIP. Schedules of dredging activities will be shared in advance with the wildlife life departments for participation in the monitoring activities. Mitigation measures proposed by WWF to ensure dolphins not to present in the construction area have already been included in the ESMP.
2	High flow season of Indus is the breeding season of many fish species. Measures should be taken during dredging to minimize the generation of sediment plumes. Sindh Fisheries Department would like participate in the monitoring activities along with the wildlife department.	Dredging and dredged material placement activities will be carried out during high flow season when the natural sediment load in the river is very high. The proposed dredging and placement methods considered in the project will have minimal impacts on the fish. Schedules of dredging activities will be shared in advance with the fisheries department for their participation in the monitoring activities.
3	Canals of Sukkur barrage have been silted up. The silting of canals, particularly the Rice canal, should be included in the scope of the Project to reap full benefits of the barrage retaliation.	Dredging of intake of the right bank canals have been included in the scope of the project
4	The common concern of all stakeholders is that extended closure of canals will seriously affect socio-economy of the command area. Regular scheduled canal closure period is about 3 to 4 weeks during month of April; and about 2 weeks during January. If the closure period is extended, it will seriously affect their crop and livestock production. If any canal closure is required for construction, the farmers should be informed one season in advance.	Canals will not be closed during the barrage rehabilitation period. Any works that require canal closure will be carried out during routine canal closure periods. Canal desilting will also be carried during canal closure period.
5	Local community should be given preference in employment in the construction activities.	The PMO will pursue with the contractor to hire all unskilled labour from local community and also skilled labour if available.
6	Construction works during night time should be avoided.	Construction related impacts such as noise and dust pollution are addressed in the ESMP and ECPs. No construction activities will be carried out during night time close to the communities.
7	Indus delta has been under threat of retreating due to reduced sediment and river flows from the upstream barrage.	The management plan on desilted material, from the barrage and canal, proposed for the project will release all the sediment material back to the river.
8	The barrage authorities should carry out adequate maintenance works regularly to avoid desiltation problems in future	The project will support developing necessary facilities required for adequate maintenance works of the barrage.
9	Resilience of the barrage structure for earth	Barrage site is located in a seismically inactive

	quakes.	region. Barrage is strong enough to withstand earth quakes. The barrage has been originally designed to withstand higher earth quake intensity than the required
10	WWF was involved in dolphin rescue operations in Sukkur area and would provide support to the project.	Dolphin rescue team will be established by the Project under the dolphin conservation program, and the contractor will also maintain a dolphin rescue team.

9.5 Disclosure

The draft EIA reports prepared by design consultants have been disclosed in SID website in July 2017. This ESA and Executive Summary of ESA will be disclosed in the SID website and will be sent to World Bank's external website. The ESA summary will be translated in to Urdu and Sindhi and will be uploaded in to the SIDs website. The hard copies of the documents will be made available to the communities through the library of the Sukkur barrage.

ANNEXES

Annex A: Terms of References for ESA Study

Terms of Reference and Scope of the services For Individual Team of Consultants to Validated and Update the Social and Environment Safeguard Documents as per Guidelines (OP 4.01) of World Bank Prepared By the Sukkur Barrage Rehabilitation Design Consultants

1. BACKGROUND

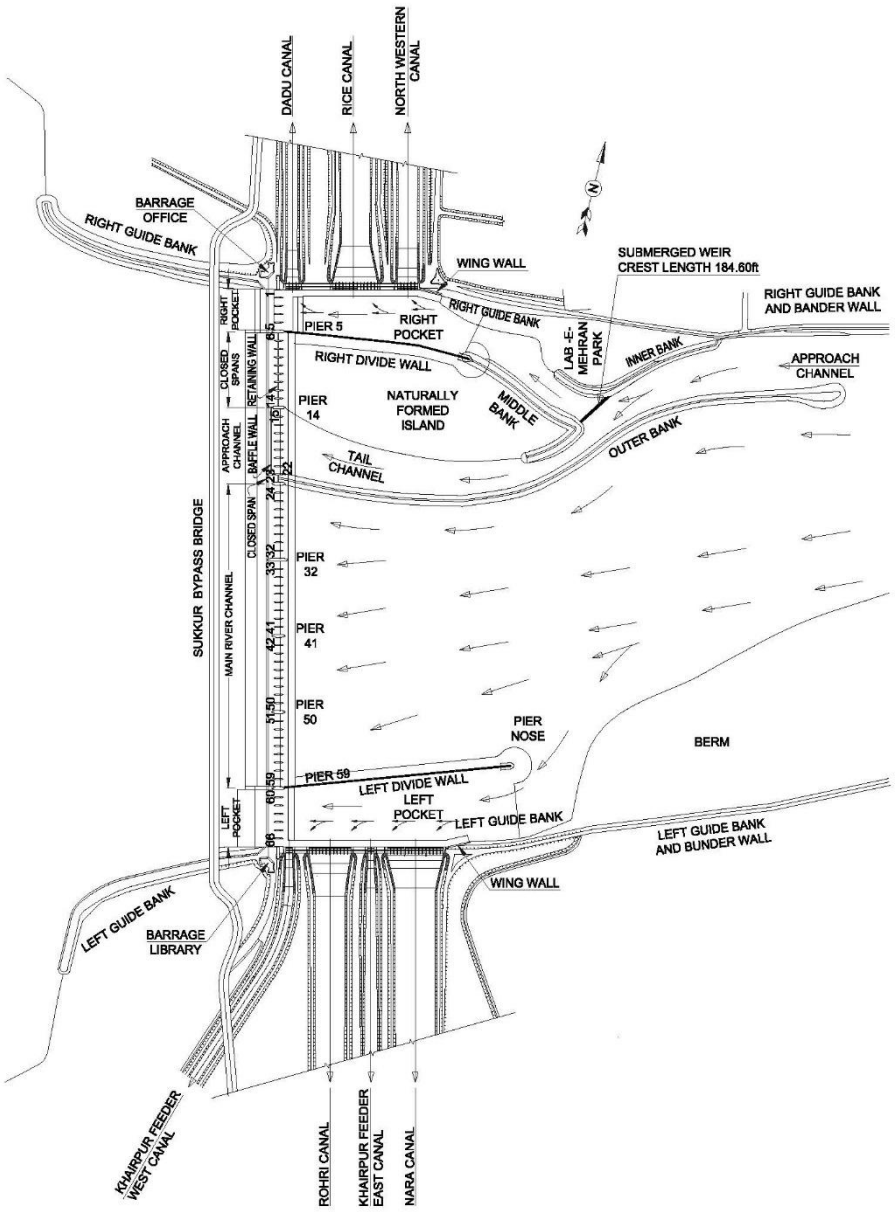
General:

1. The Indus River offers vast livelihood and ecological values for Sindh Province. The three barrages (Kotri, Sukkur, and Guddu) and the associated canal distribution systems cover 5.8 million hectares for irrigation, directly supporting about 6 million households, more than 50 percent of the total population in the province (see Annexure-I for the map). Further, the Indus River also supports invaluable ecological value; 170 kilometer stretch between Guddu and Sukkur Barrages, which provide some endangered species such Indus blind dolphin (*platanista gangetica minor*) with critical habitats, has been designated as a Ramsar site. In the area downstream to Kotri Barrage, there are mangrove forests covering about 600,000 hectares, which constitute an important ecosystem in the Indus Delta. Indus Delta mangroves are reportedly unique in being the largest arid climate mangroves in the world. They are almost entirely dependent upon freshwater discharges from the River Indus.

2. The three barrages, Kotri, Sukkur, and Guddu were constructed in 1958, 1932, and 1963 respectively. As these barrage are getting deteriorated, major rehabilitation works are underway. Kotri Barrage has undergone the major rehabilitation works in 2000, and similar comprehensive rehabilitation works are underway for Guddu Barrage under the World Bank financed Sindh Barrage Improvement Project (SBIP). As for Sukkur barrage, after a few minor rehabilitation works carried out during the last 20 years, the Government of Sindh (GoS) has decided to embark on a similar comprehensive rehabilitation and requested the World Bank for financing through the additional financing to SBIP.

3. Sukkur Barrage is located about 225 miles north east of Karachi (68^o 33'E, 27^o 41'N) in the Sindh Province of Pakistan. It is located about 3 miles downstream of Lansdowne Railway Bridge and the twin cities of Sukkur and Rohri are located on the right and left banks of the river, respectively. The Barrage is situated 100 miles downstream of Guddu Barrage and about 300 miles upstream of Kotri Barrage. Sukkur Barrage was the first barrage constructed on the Indus River. The Sukkur Barrage and Canals Project were sanctioned in June 1923 and work on the construction started in July 1923. The project was completed in 1932 and is the World's largest single unified irrigation network. Total gross commanded area (GCA) served by the seven off-taking canals is 8.24 million acres are on both banks of the Indus River in Middle and Lower Sindh. Out of this 7.55 million acres are cultivable. The maximum abstraction by all the canals is 64,728 cusecs at present compared to the total designed capacity of 47,530 cusecs. The original maximum design flood for the barrage was 1.5 million cusecs. The location of Sukkur Barrage is attached as Annex A to this TORs.

Figure.1: location of Sukkur barrage



4. Sukkur Barrage comprises 66 bays each of 60ft clear span and is divided into three sections: (a) the right under sluices, (b) the main weir and (c) the left under sluices. The right and left under sluices have 5 and 7 bays, respectively, and are separated from the main weir by right and left divide walls on the upstream side. The main weir is divided into six sections of 9 spans each. The sections are separated from one another and from the under sluices by 25ft wide abutment piers. The piers between the spans are 10ft wide. After commissioning of the barrage in 1932, it was observed that the right bank canals were drawing excessive silt. This situation was investigated in model studies at Poona Laboratory in India during 1938. The recommendations based on the model tests included closing of ten barrage bays, development of an island upstream of the closed bays and introduction of river training works. After implementation of the recommendations, the maximum discharge capacity of the barrage was

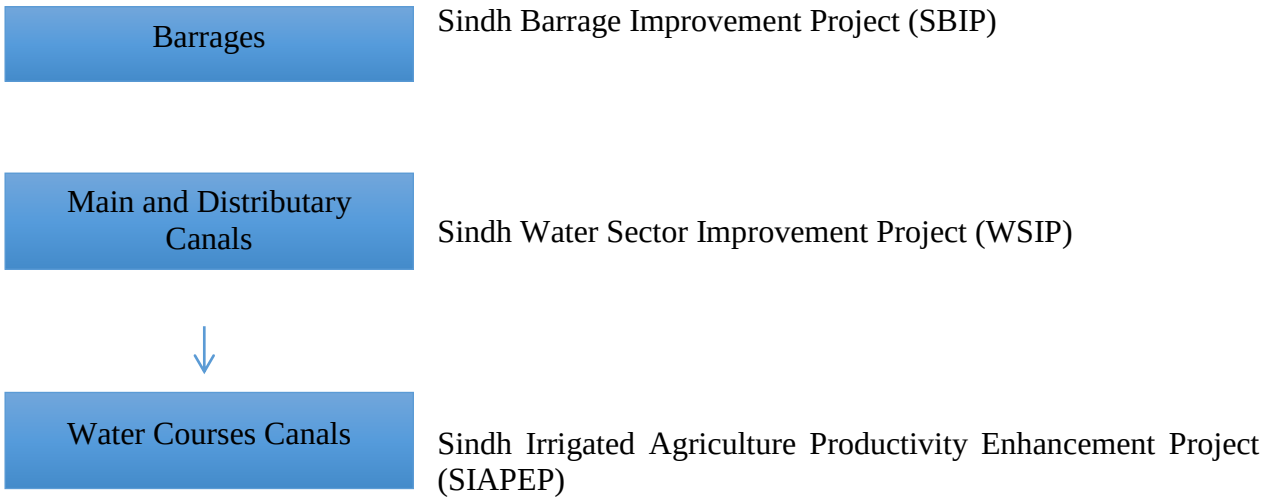
curtailed to 0.9 million cusecs. However, discharge over 1.0 million cusecs have been observed thereafter on several occasions. The maximum flood discharge observed was 1.2 million cusecs and passed the barrage in 1976. After operation for three quarters of century, the barrage faced a number of problems, partly due to a deficiency in the original design, partly due to ageing effects and partly due to its frequency of operation, which limits the time to carry out repairs and rehabilitation works in timely manner.

5. The problems have not only placed restrictions on its full utilization but even threatened its very existence. Major problems were experienced in the years 1947, 1985 and year 2004. In 2004 a large scour hole developed downstream of the first pile line in the first three spans of the right under sluices resulting in collapse and damage of the first pile line and the concrete slab in its vicinity. Cavities formed underneath the slab of the under sluices in front of the head regulator of Dadu Canal. Urgent emergency repairs were carried out by the Army Engineers to save this prominent and important structure from catastrophic failure.

6. Since its inception, the Barrage has been facing hydraulic, functional and structural problems over its life of 80 years. After 1973, a series of high floods exceeding 0.9 million cusecs (25,500 cumecs) up to a maximum of 1.2 million cusecs (34,000 cumecs) occurred causing serious threats to its stability and safety. Various measures were taken at different times to manage the performance of the barrage and to manage the flow in the seven canals off-taking from the Barrage.

7. The Government of Sindh has been closely working with the World Bank to systematically update and modernize the water distribution systems at main and distributary canals and water courses. The Figure 1 summarizes the support from on-going projects:

Figure 2. Bank Support for Sindh Water Distribution Systems



8. The Sindh Water Sector Improvement Project (WSIP-Phase.1) supported feasibility studies to rehabilitate Guddu and Sukkur Barrages. To improve efficiency and effectiveness of irrigation water distribution in rural Sindh, the rehabilitation of Guddu Barrage started under the Sindh Barrage Improvement Project (SBIP). An additional financing to SBIP is under preparation to support rehabilitation of Sukkur Barrage. WSIP and SBIP are implemented by Irrigation Department (ID), while SIAPEP is implemented by Agriculture Department.

Project interventions/ activities proposed for Additional Financing:

9. As the result of feasibility study and detailed design, the following interventions for Sukkur Barrage have been proposed as additional financing to the on-going SBIP:

- Repair and strengthening of the following Main Barrage Structure:
  - RCC Arches
  - Stone Masonry Works
  - Gate Desk Slab
  - Barrage Road
- Repair and Strengthening of structures of Canal Head Regulators:
  - The works includes repair on portions above normal pond level, including arches and piers. The works on downstream of the regulator will involve repair in the foundation and piers which would be done only during annual closure periods of one month.
- Gates and Mechanical Works
  - Rehabilitation of all operational gates with replacement of gearing, cables, seals, rust removal and corrosion protection.
- Electrical Works
  - Design, supply and installation of new electrical system.
- Instrumentation
  - Supply and installation instruments such as automatic water level recorders, replacement of 48 number existing vibrating wire piezometers.
- Monitoring and Control provision
  - Provide, Supply and Install equipment such as Acoustic Doppler Current Profile (ADCP), remote operating and monitoring system for all barrage and head regulator gates and vibration measurement and warning instruments for barrage.
- Dredging Works
  - In right and left pockets and upstream and downstream of barrage
- Strengthening of Existing Scour Protection Works
- Buildings Works
  - Barrage office compound works (offices, mechanical and electrical workshop, officers Resident and Rest hours etc)
  - Renovation of Existing Office
  - Construction of infrastructure facilities

- Any change in scope of intervention will be incorporated after consultations with the World Bank Experts and Consultants will consider the same accordingly.

10. For the original SBIP, Environmental Social Assessment (ESA) and Social Management Framework (comprised of Resettlement Policy Framework (RPF), Social Action Plan, and Communication Strategy) have been prepared for the Guddu Barrage rehabilitation works. Project Management Office established at the ID for SBIP will also execute the Additional Financing. The Chief Engineers Sukkur and Guddu Barrages will be the main stakeholders for Sukkur and Guddu Barrages respectively. To prepare for the Sukkur additional financing, the following safeguard related reports have been prepared by the Design Consultants of the Sukkur Barrage project as the part of Feasibility Study:

- An EIA report
- A Social Impact Assessment report
- A Resettlement Action Plan report

11. The SBIP is a Category A project for the World Bank's environmental and social safeguards policy, and major upgrading of the existing EIA, SIA and RAP by the independent experts shall be needed in order to meet the Bank's Safeguard Policy standards, notably OP.4.01.[22] Therefore, a team of independent consultants will be hired as to review the existing EIA, SIA and RAP reports and prepare the full ESIA and RAP as well as the executive summary for the project. The task will be divided among the team of independent environmental/social consultants.

12. Furthermore, the joint visit conducted by the Government of Sindh and the World Bank in October 2016 revealed that the current water resources in the Sindh Province, which is located most downstream of the Indus River, is experiencing water pollution and shortage, which in turn induce serious negative ecological, social and environmental implications. In this context, it has been agreed that the Additional Financing shall also provide the Government of Sindh to carry out the following two activities to start addressing the broader water resources and riverine environmental management in the Indus River within the Sindh Province.

- **Sindh Water Resources Status Assessment and Actions.** This assessment shall mainly focus on the current water use in the agriculture and identify the trade-off between the agriculture (economic) and ecology. In addition the assessment shall also review the current situation on water security and pollution, identify hotspots, develop future scenarios incorporating external factors (upstream development, climate change) and internal factors (industrialization, urbanization, agriculture development, environmental flow and competition among the different sectors), set out priority actions infrastructure investments, institutional re-organization, operational improvement) as well as key benchmarks for future monitoring.

- **Support for integrated riverine habitat management in the 170 kilometer Indus Stretch between Sukkur and Guddu Barrages**. Given the fact that there are the conflicts between Indus River Dolphin habitat conservation and fishing practice in the river stretch between Sukkur and Guddu Barrages, this aims at helping fishing communities in exploring alternative livelihood and better fisheries management, promotion of Indus River Dolphin conservation and strengthening the Department of Fisheries and Department of Wildlife Department in monitoring and managing the critical natural habitats, particularly those for Indus blind dolphin.

13. It has, therefore, been agreed that the following documents will be prepared for the appraisal of the Additional Financing;

1) The revised ESIA for Sukkur Barrage, including impacts on fisheries (and associated livelihood) and dolphin habitats, and cumulative impacts of Guddu and Sukkur Barrages during construction period and immediate operation;
2) A site specific Environmental and Social Management Plan, including Environmental Codes of Practice (ECOP), dredged material disposal plan, and monitoring plan on community fisheries and dolphin habitats;
3) The updated RAP for the Sukkur Barrage rehabilitation.

[22] OP. 4.01 states that Environmental Assessment, which states "The borrower is responsible for carrying out the EA. For Category A projects, the borrower retains independent EA experts not affiliated with the project to carry out the ESIA."

Other Documents

4) TORs for Sindh Water Resources Status Assessment and Actions.
5) An Implementation Plan for Support for integrated riverine habitat management in the 170 kilometer Indus Stretch between Sukkur and Guddu Barrages including: (a) proposed components and activities, (b) tentative target areas, (c) institutional arrangement, and (d) key indicators for output monitoring.

14. In order to prepare the above-mentioned documents, the following four independent consultants will be recruited.

a. Environmental Specialist (experience in water resource projects)/ Team Leader
b. Environmental Ecologist (vast experience in River Dolphin surveys)
c. Environmental Engineer (experience in water resources projects)
d. Social Scientist (experience in social assessment and fisheries community co-management)

2. Objective and Scope of Work

Objective of the Assignment:

15. The objective of the assignment is to prepare a set of safeguards documents as set out in para. 13 with a quality satisfactory to the World Bank to appraise the SBIP AF. The team of independent consultants will review and make use of all the existing information available and in particular data, tools and models used in preparing the safeguard documents. This will include, reports, maps, surveys conducted so far, Environmental and Social including the important ecological and species surveys and habitat management and mitigation measures and analysis, etc.

Scope of Works:

16. The scope of the works for each document is summarized as below:

1) ESIA. Review the ESIA report prepared by the design consultants, identify gaps with World Bank Safeguard Policies and fill the identified gaps regarding the following aspects:

- Baseline data (both environmental and social aspects): collect additional data including water quality and sediment quality around Sukkur Barrage, status of Indus River Dolphin upstream and downstream of Sukkur Barrage.
- The project description including Information on associated facilities, and requirement of resources.
- The methodology adopted by the Design consultant for scoping and screening of issues and will fill in the gaps in procedures as per WB Safeguard Policies and EHS guidelines and update the analysis; locations of quarry sites, and volume of earth works.
- Major impacts resulting from the project. Assess their seriousness, and develop key mitigation measures to be carried out the project.
- All applicable international and national environmental laws and regulatory frameworks, and national and international standards. Develop measures for full compliance with all applicable laws and regulations.
- Analysis of alternatives: assess the coverage, typology, environmental and social aspects for each of the alternative considered including that of without project option and

present analysis on project design, rehabilitation and dredging methodologies with the environmental and social criteria and recommend any changes if required.

- The impact of construction activities including dredging on the fish and dolphin habitats and their activities including foraging, resting and spawning/breeding, and strengthening of mitigation and compensation measures. Review and analyze the impact on sensitive riparian habitat due to construction of bunds and details of restoration measures needed.
- The impacts of the project activities during operation on aquatic ecosystem and species activities in general particularly on Indus River Dolphin. Suggest measures to minimize the negative impacts on aquatic ecosystem and particularly on Indus River Dolphin by the project activities.
- The Impacts on fishery, downstream irrigation and drinking uses during rehabilitation
- Social impacts around seven distributary canals of Sukkur Barrage and between Sukkur and Guddu Barrages, including impacts on vulnerable groups, such as fishery communities, tail-end farmers, and women.
- Local unskilled and skilled labor availability for the rehabilitation work, and assess potential impact, risks, and mitigation of potential influx of labor.
- Limited Cumulative Impact Assessment (CIA): review CIA sections for Guddu Barrage EIA and preliminary Sukkur Barrage EIA, focusing on the construction and initial operation period of Guddu and Sukkur Barrage.
- Dredged material management plan (to be part of the ECOP. See below), specifying the disposal methods and designated sites.
- A rescue plan for the potential trapping of dolphins during the construction activities along with clear listing of responsibilities for the implementation of rescue plan
- Potential emergency situation, potential damage and emergency action plan. Corporation would be necessary with the design consultant
- The inundation maps for determining the extent of flooding in relation to the people at risk, properties and access routes.
- The adequate environmental and social safeguard implementation arrangements of the project in the relevant safeguard documents

Two sets of consultation meetings, once in initial stage of the work and another upon completion of the draft, need to be organized with the relevant departments and stakeholders to document their concerns appropriately and proposed measures to address these concerns. Properly record these consultations according to the World Bank's safeguards policy and GoSindh regulation after assessing the adequacy and coverage of stakeholder consultation in the preliminary ESIA reports. Share the draft reports with the relevant stakeholders and obtain feedbacks for finalization. The recorded concerns and proposed measures need to be reflected in the final ESIA.

2) Site specific Environmental and Social Management Plan (ESMP). This should present clear actions (corrective and enhanced measures), implementation costs, and responsibility. Monitoring framework including monitoring parameters, frequency, and responsibility needs to be proposed. The plan should also lay out the protocols for documentation and reporting, change management, and grievance redress mechanism. ESMP should include ECOP, dredged material disposal plan, and monitoring plan on community fisheries and dolphin habitats.

3) RAP. Review and revise the preliminary RAP prepared for the Sukkur rehabilitation works and update the RAP in accordance with requirements of OP/BP4.12, to include the followings but not limited to cut-off date, entitlement matrix and valuation of and compensation for losses using the RPF prepared for Guddu Barrage rehabilitation (SBIP RPF). Hold

consultation meetings with the project affected persons (PAPs) and relevant stakeholders. Identify positive and negative impacts, record stakeholders concerns, and propose measures to address the issues. The elements to be covered in the RAP are detailed in the SBIP RPF.

Other Documents

4) **TOR for Sindh Water Resources Status Assessment and Actions.** Prepare a set of TORs for Sindh Water Resources Assessment and Actions to be undertaken during implementation of the project, which will show the status of water flow and quality of the Indus River, particularly agriculture, record critical aquatic habitats for endangered species (flora and fauna) (refer para. 11)

5) **Implementation Plan for an integrated riverine management.** Prepare a plan, including: (a) proposed components and activities, (b) tentative target areas, (c) institutional arrangement, and (d) key indicators for output monitoring.

3. Implementation Arrangements

17. The Consultants will work closely with PMO of SBIP (Irrigation Department Sindh) to whom they will be reporting on a day to day basis and coordinate with Project Coordination and Monitoring Unit (PCMU) WSIP/SBIP Project.

18. The Head of Project Management Office (PMO)/ Project Director, Sindh Barrages Improvement Project, Irrigation Department, will be representative of the client to coordinate all interfaces with the Consultants while PCMU team will support. The lead consultants' will be the principal contact.

19. The Consultants shall be responsible for all aspects of performance of services as set forth in the preceding sections of this TORs. ID (Sindh Irrigation Department), in coordination with other departments of the GoSindh, will be responsible for providing the existing data and information including all reports prepared so far for the project. Stakeholders would also include, but not limited to, Sindh Department of Wildlife Conservation, Department of Livestock and Fisheries, WWF, Sindh Irrigation and Drainage Authority (SIDA), Area Water Board (AWB), Farmer Organizations (FOs), fishery organizations, and local communities.

20. *Selection Procedure and Form of Contract*. The team of individual experts will be selected on merit based on qualification and experience of the consultants in relevancy to the assignments and following the World Bank's Procurement Guidelines. At this moment, the province is inclined to recruit the same experts engaged in preparation for the safeguards documents for Guddu Barrage for the sake of maintaining continuity and consistency.

21. *Duration of the Assignment.* Duration of the contract will be for four months after the mobilization of the independent experts.

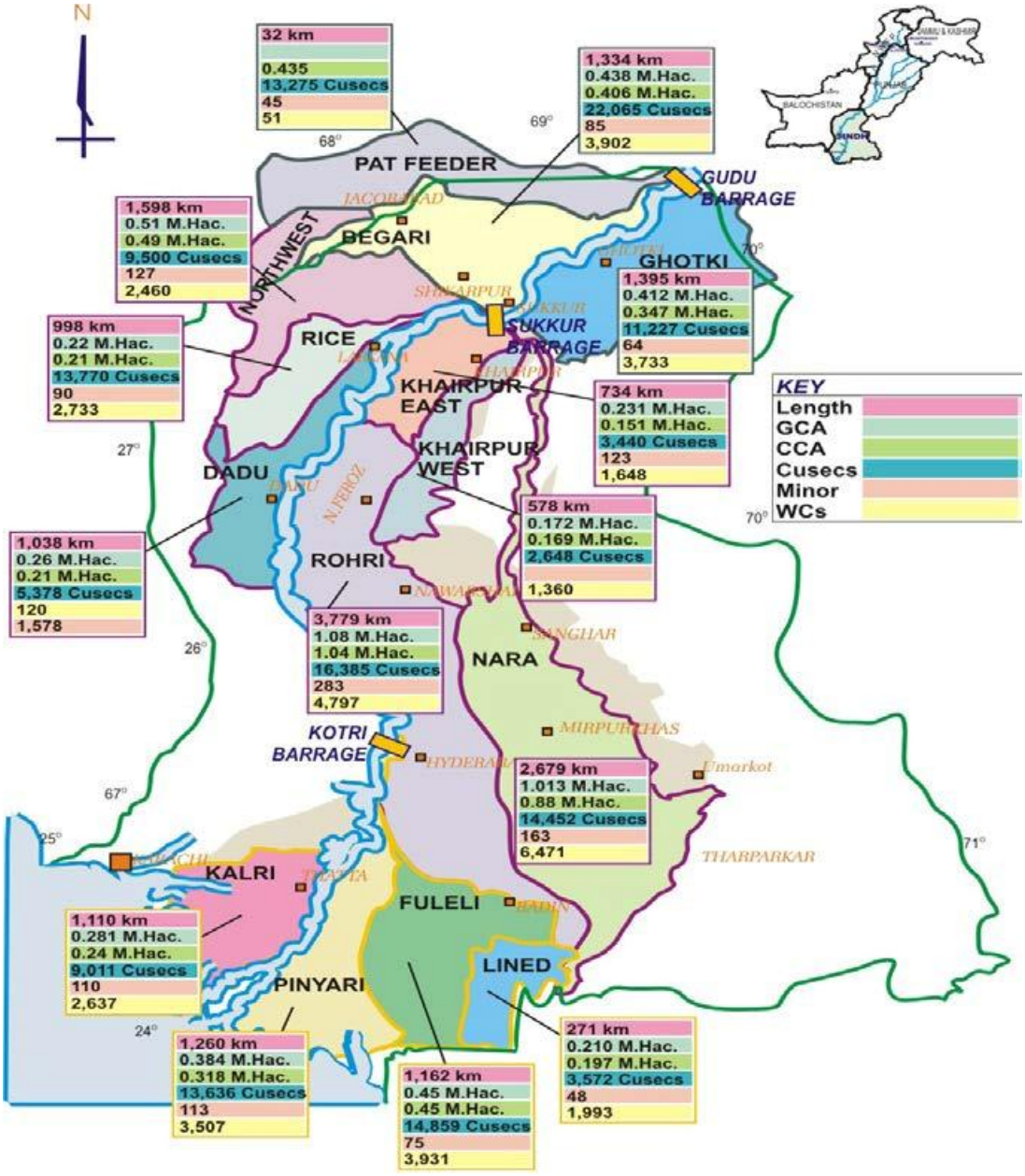
22. *Deliverable:* The team leader will compile the outputs from other experts and will prepare the draft documents specified in para.13, in English and detailed Executive Summary of the ESIA report. He will submit five copies of each report to the ID, which will forward the reports to the World Bank along with soft copies for review. Final documents specified in para. 13, in English and the final Executive Summary of the ESIA report should be prepared after incorporating client and stakeholder feedback after disclosure. After acceptance of the documents, the ID will arrange the translation of the documents into Urdu and Sindhi.

23**.** **Key qualifications:** A multidisciplinary team will be required to complete this study. The core team is expected to include the following key individuals, who should be supported by additional staff as required. The core competencies for all key individuals include: self-starting; independent and responsible personality; ability to take initiative and work in teams; track record on following through with commitments and meeting deadlines; and strong written and oral

language skills in English. The core team should include at minimum the following specific areas of expertise:

a. *Environmental Specialist/Team leader* with at least 15 years of relevant experience in environmental and social assessment and management in the water sector, and a minimum of a Master's Degree in Biology, Environmental sciences, Environmental engineering and/or Management, or a related field (a PhD would be an advantage). Experience in Pakistan, and familiarity with both GoP and World Bank policies and regulations related to environmental and social assessment and management, wildlife conservation, resettlement are required.
b. *Environmental Ecologist* with at least 15 years of experience (including international experience) on biodiversity management aspects of water projects, including on good practices in biodiversity friendly barrage/dam engineering and design, as well as on minimizing concerns related to habitat fragmentation in rivers. Prior experience with World Bank safeguard policies, in particular Operational Policy (OP) 4.04 (Natural Habitats) and OP 4.01 (Environmental Assessment) is required. Experience with Cumulative Impact Assessment, preferably in the water sector, is also required. Specific knowledge of barrage/dam design measures to minimize impacts on the key species including river dolphins relevant to this assessment – e.g. dolphins, turtles, birds etc.– is a strong plus.
c. *Environmental Engineer (Water Resources Expert)* with Master's in Environmental Engineering, Environment Science or related field. PhD preferred. 10 years of minimum experience as Civil/Environment Engineer, Environmental Scientist, or related field, and at least 5 years of experience as Environmental Specialist in conducting environmental assessments of water sector of similar nature and complexity. Experience must include at least one World Bank/ADB or other development partner funded project, and must also include one or more projects with major dam/barrage component including hydrological analysis for dam/barrage development, environmental management for dredging and emergency preparedness.
d. *Senior Social scientist* with at least ten years of relevant experience. Familiar with national laws as well as World Bank policies and standards on land acquisition and stakeholder consultation. Experienced in carrying out field based social assessments. S/he should also have experiences in fishery community development.

Annexure –I Map of Barrages in Sindh Province



CANAL COMMAND MAP OF LOWER INDUS BASIN IRRIGATION SYSTEM, SINDH PROVINCE, PAKISTAN

Annex B: Chemical Quality of River Bed Sediments and River Water

SGS

Test Report No.927584
Our Ref: EHS Q-957(R1)/17
16 October, 2017
Page 01 of 03

CHEMICAL & ENVIRONMENTAL LABORATORY (KHI.)

TEST REPORT

Sample not Drawn by SGS Pakistan (Pvt.) Ltd.

Job No : EHS-Lab- 7167 /2017

Client Name & Address : ASSOCIATED CONSULTING ENGINEERS/ Bungalow no.B-25/25, Maqbooldad Cooperative Housing society, Block 7 & 8 Karachi.

Description Of Sample : Sediment Samples

Marking (If Any) : Given below No. Of Samples : 04

Sample Condition Upon Receipt: Satisfactory & Unsealed Date : 03-10-2017

Sr. #	Parameters	Method	Unit	Ldl	Test Results			
					Right Up Stream Sediment	Right Down Stream Sediment	Left Bank Up Stream Sediment	Left Down Stream Sediment
01	Salinity	Based on APHA-2510 B	ppt	-	0.155	0.070	0.075	0.091
02	Arsenic (As)	Based on USEPA 3050B	mg/kg	00.30	<00.30	<00.30	<00.30	<00.30
03	Cadmium (Cd)	Based on USEPA 3050B	mg/kg	00.50	<00.30	<00.50	<00.30	<00.30
04	Chromium (Cr)	Based on USEPA 3050B	mg/kg	00.30	31.00	35.40	65.00	89.60
05	Mercury (Hg)	Based on USEPA 7471B	mg/kg	0.030	<0.030	<0.030	<0.030	<0.030
06	Nickel (Ni)	Based on USEPA 3050B	mg/kg	00.30	30.80	16.20	20.30	30.00
07	Lead (Pb)	Based on USEPA 3050B	mg/kg	00.30	<00.50	<00.30	<00.50	<00.30
08	Organic Carbon, Total (TOC)	Calculated	%, ug/kg	-	0.090	0.019	0.051	0.097
09	Phosphate, Total	Based on USEPA 3050 B	mg/kg	01.00	579.89	664.46	591.99	591.96
10	Total Nitrogen (Organic Inorganic)	In House Titrimetric	mg/kg	01.00	837.01	991.28	1003.03	1195.41

Remarks: Ldl Means... Lowest Detection Limit < Means... Less Than.

- This report is not valid for any negotiation.
- This report pertains only to the sample (s) supplied and is issued without prejudice.
- The remaining portion of the sample (s) will be disposed off after one week unless otherwise instructed (Conditions Apply).
- The sample(s) to which the findings recorded herein (the "Findings") relate was (were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.
- All transactions are rendered by the Company under the General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

For and on behalf of,

SGS PAKISTAN (PVT) LTD.

DM (QA)

DM

CHEMICAL & ENVIRONMENTAL LABORATORY (KHI.)

TEST REPORT

Sample not Drawn by SGS Pakistan (Pvt.) Ltd.

Job No :	EHS-Lab-7187 /2017		
Client Name & Address :	ASSOCIATED CONSULTING ENGINEERS(Banglow no.B-25/25, Maqboolabad Cooperative Housing society, Block 7 & 8 Karachi.		
Description Of Sample :	Sediment Samples		
Marking (If Any) :	Given below	**No. Of Samples :**	04
Sample Condition Upon Receipt:	Satisfactory & Unsealed	**Date :**	03-10-2017

Sr. #	Parameters	Method	Unit	Ldl	Test Results			
	Poly Chlorinated Biphenyl				Right Up stream Sediment	Right Down stream Sediment	Left Bank Up Stream Sediment	Left Down Stream Sediment
01	2-Chlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
02	2,3-Dichlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
03	2,2',5-Trichlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
04	2,4',5-Trichlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
05	2,2',3,5'-Tetrachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
06	2,2',5,5'-Tetrachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
07	2,2',4,4'-Tetrachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
08	2,2',3,4,5'-Pentachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
09	2,2',4,5,5'-Pentachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
10	2,3,3',4',6-Pentachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
11	2,2',3,4,4',5'-Hexachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
12	2,2',3,4,5,5'-Hexachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
13	2,2',3,5,5',6-Hexachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
14	2,2',4,4',5,5'-Hexachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
15	2,2',3,3',4,4',5-Heptachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
16	2,2',3,4,4',5,5'-Heptachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
17	2,2',3,4,4',5',6-Heptachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
18	2,2',3,4',5,5',6-Heptachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025
19	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	USEPA 8082	ppm	0.025	<0.025	<0.025	<0.025	<0.025

Remarks: Ldl Means... Lowest Detection Limit < Means... Less Than.

- This report is not valid for any negotiation.
- This report pertains only to the sample (s) supplied and is issued without prejudice.
- The remaining portion of the sample (s) will be disposed off after one week unless otherwise instructed (Conditions Apply).
- The sample(s) to which the findings recorded herein (the "Findings") relate was (were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.
- All transactions are rendered by the Company under the General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, Indemnification and Jurisdiction issues defined therein.

For and on behalf of,

SGS PAKISTAN (PVT) LTD.

DM (QA) DM

CHEMICAL & ENVIRONMENTAL LABORATORY (KHI.)

TEST REPORT

Sample not Drawn by SGS Pakistan (Pvt.) Ltd.

Job No : EHS-Lab-7167 /2017

Client Name & Address : ASSOCIATED CONSULTING ENGINEERS/ Banglow no.B-25/25, Maqboolabad Cooperative Housing society, Block 7 & 8 Karachi

Description Of Sample : Sediment Samples

Marking (If Any) : Given below — No. Of Samples : 04

Sample Condition Upon Receipt: Satisfactory & Unsealed — Date : 03-10-2017

Sr. #	Parameters	Method	Unit	Ldl	Test Results			
	POP				Right Up stream Sediment	Right Down stream Sediment	Left Bank Up Stream Sediment	Left Down Stream Sediment
01	Endosulfan I	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
02	Endosulfan II	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
03	Endosulfan sulphate	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
04	4,4'-DDT	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
05	a-Chlordane	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
06	g- Chlordane	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
07	Hexachlorocyclohexane	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
08	a-BHC	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
09	b-BHC	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
10	d-BHC	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
11	g-BHC (lindane)	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
12	Dieldrin	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
13	Endrin	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
14	Endrin aldehyde	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
15	Heptachlor	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
16	Heptachlor epoxide (isomer B)	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
17	Aldrin	USEPA 8081	ppm	0.025	<0.025	<0.025	<0.025	<0.025
Other Organics								
1	Hexachlorobenzene (HCB)	USEPA 8270	ppm	0.025	<0.025	<0.025	<0.025	<0.025
2	Pentachlorobenzene	USEPA 8270	ppm	0.025	<0.025	<0.025	<0.025	<0.025
3	Hexachlorobutadiene	USEPA 8270	ppm	0.025	<0.025	<0.025	<0.025	<0.025

Remarks: Ldl Means... Lowest Detection Limit < Means... Less Than.

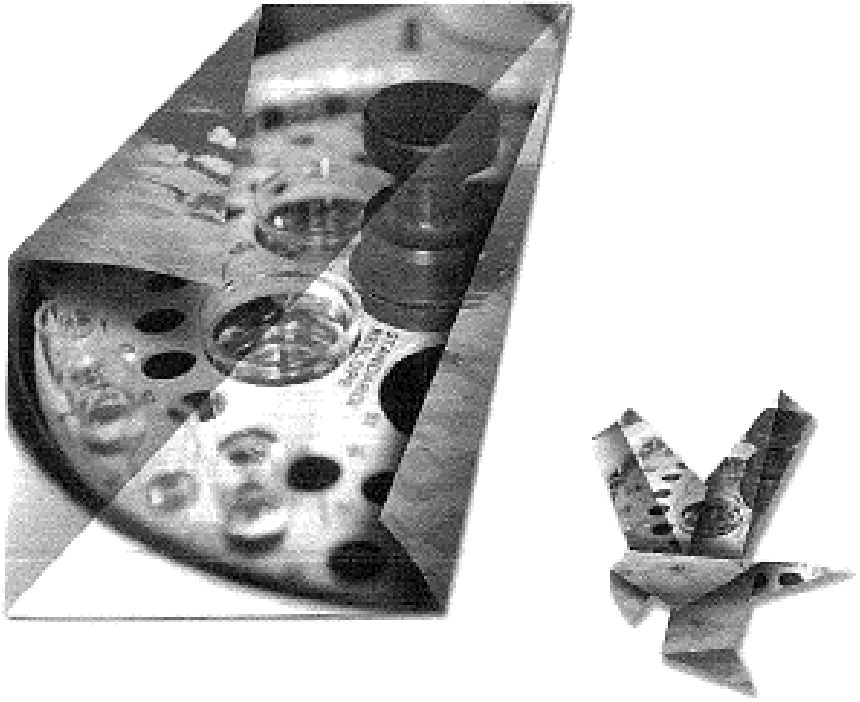
- This report is not valid for any negotiation.
- The report pertains only to the sample (s) supplied and is issued without prejudice.
- The remaining portion of the sample (s) will be disposed off after one week unless otherwise instructed (Conditions Apply)
- The sample(s) to which the findings recorded herein (the "Findings") relate was (were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

For and on behalf of,

SGS PAKISTAN (PVT) LTD.

DM (QA) DM

SGS



ANALYTICAL REPORT

WATER ANALYSIS

MULTIPLE PARAMETER ANALYSIS /EHS-Q-957(R1)/2017

PREPARED FOR:

ASSOCIATED CONSULTING ENGINEERS

SGS

ANALYTICAL REPORT

Test Report

CLIENT DETAILS

Client:	ASSOCIATED CONSULTING ENGINEERS.	Manager:	Iqbal Ashraf
Address:	Bungalow no.G-2/2/2E, Majboolabad Cooperative Housing society, Block 7 & 8 Karachi	Laboratory:	Chemical & Environmental Laboratory
Contact:	Mr. Imtiazuddin Hasan	Address:	H-30, Sector- 5, Korangi Industrial Area Karachi. 74900
Phone:	+92 21 3453 1171-3	Telephone:	+92-21-35121368-67
Email:	[redacted]	Fax:	+92-21-35121338
Project:	Analysis of Water	Email:	iqbal_ashraf@sgs.com , Karachi.environment@sgs.com
Order Number:	EHS-Q467(E1)2017	SGS Reference:	EHS-Lab-7167/2017
Samples:	Water Samples made	Sample Received:	03-October-2017
		Report Number:	927584
		Date Reported:	16-October-2017

COMMENTS

This report is not valid for any negotiation.
Samples are consumed during analysis.
Samples not drawn by SGS.

SIGNATORIES

Syed Zeeshan Ali
Assistant Manager Laboratory

Adnan Siddiqui
Deputy Manager QA/QC

Nº 927584

SGS

ANALYTICAL REPORT Report No.927584

Sample No.						
Client ID			Gate # 5 Upstream	Gate # 3 Downstream	Right Pocket Up stream	Right Pocket Down stream
Sample Matrix			Water	Water	Water	Water
Sample Date						
Sample Receipt Date			03-10-2017	03-10-2017	03-10-2017	03-10-2017
Sampled By			As supplied	As supplied	As supplied	As supplied
Parameter	Units	LOD	Result	Result	Result	Result
Temperature						
Temperature Difference	°C	-	-	-	-	-
Conductivity, Electrical APHA 2510 B 22nd Edition						
Conductivity, Electrical	µS/cm	60.01	914.00	977.00	519.00	535.00
Organic Carbon, Total (TOC) HACH Method 10129						
Organic Carbon, Total (TOC)	mg/L	60.30	03.36	02.94	01.84	01.93
Turbidity APHA 2130 B 22nd Edition						
Turbidity	NTU	00.20	1260.00	1430.00	686.00	970.00
Chemical Oxygen Demand (COD) APHA 5220 D 22nd Edition						
*COD	mg/L	08.00	82.00	868.00	71.00	84.00
Biochemical Oxygen Demand (BOD) APHA 5210 B 22nd Edition						
*BOD_5	mg/L	02.00	18.00	24.00	22.00	19.00
Total Suspended Solid APHA 2540 D 22nd Edition						
*Solids, Total Suspended(TSS)	mg/L	60.00	1662.00	1450.00	1275.00	1527.00
Phosphate, Total Based on APHA 4500-P 22nd Edition						
Phosphate, Total	mg/L	0.08	05.60	01.38	31.01	30.88
Nitrogen, Total by Kjeldahl Titration						
Nitrogen, Total	mg/L	01.00	34.71	09.84	08.17	08.17
Metals by AAS APHA 3111 B						
Calcium (Ca)	mg/L	00.02	80.78	01.28	97.08	97.23
Potassium (K)	mg/L	00.03	04.17	03.19	03.07	03.14
Magnesium (Mg)	mg/L	00.02	38.96	07.37	07.64	07.80
Sodium (Na)	mg/L	01.00	37.48	06.01	07.23	07.42
Alkalinity, Bicarbonate APHA 2320 B 22nd Edition						
*Alkalinity, Bicarbonate	mg/L	05.00	220.37	209.68	203.13	234.19
Alkalinity, Carbonate APHA 2320 B 22nd Edition						
*Alkalinity, Carbonate	mg/L	06.00	<06.00	<06.00	<06.00	<06.00
Chloride APHA 4500Cl- B 22nd Edition						
*Chloride	mg/L	05.00	17.64	11.40	12.85	10.61
Sulfate APHA 4500-SO_4^{2-} E 22nd Edition						
*Sulfate (SO_4^{2-})	mg/L	04.00	68.12	70.78	66.79	76.26
Fecal coliform (Fecal) Membrane Filtration Technique APHA 9222D 22nd Edition						
*Fecal coliform (E coli)	CFU/100ml	10	<10	<10	<10	<10

End of Report

FOOTNOTE

IS	Insufficient sample for analysis.
LOR	Limits of Reporting
TCC	Total Colony Count
P/A	Present / Absent
MPN	Most Probable Number
TPC	Total Plate Count
HPC	Heterotrophic Plate count
APC	Aerobic Plate Count
TVA	Total Viable Count & Total Bacteria
FDA	Food & Drug Administration of USA
BAM	Bacteriological Analytical Manual
LNR	Sample Listed, but not received
#	Results will follow soon.
*	This analysis is covered by the scope of accreditation.
	Uncertainty of the test can be provided upon request
^	Performed by the outside laboratory
<	Values less than reporting limit
NEQS	National Environmental Quality Standard

Sample analyzed as received

Annex C: Baseline Data of Biological Environment

List of Mammals of Indus Dolphin Game Reserve

S.No	Common name	Scientific name	IUCN Redlist	CITES Appendix
1.	Indus Dolphin	*Platanista gangetica minor*	Endangered	I
2.	Smooth-coated Otter	*Lutrogale perspicillata*	Vulnerable	II
3.	Hog Deer	*Axis porcinus*	Endangered	III
4.	Golden Jackal	*Canis aureus*	Least Concern	III
5.	Jungle Cat	*Felis chaus*	Least Concern	II
6.	Wild Boar	*Suss crofa cristatus*		
7.	Indian Hare	*Lepus nigricollis*	Least Concern	II
8.	Fishing Cat	*Felis viverrina*	Endangered	II
9.	Small Indian mangoose	*Herpestes Javanicus*		III
10.	Indian Porcupine	*Hystrix indica*		
11.	Hedgehog	*Hemiechinus spp.*		
12.	Fox	*Vulpes bengalensis*		
13.	Asiatic Jackal	*Canis aureus.*		III
14.	Desert Cat	*Felis silverstris*		III
15.	Five stripped palm squirrel	*Funambulus*		
16.	Indian grey mangose	*Herpestes edvars*		III

List of Amphibian and Reptile species of Indus Dolphin Game Reserve

Common name	Scientific name	Status	IUCN Redlist	CITES Appendix
Skittering frog	*Rana cyanophlyetic*	Common		
Tiger frog	*Rana tigrina*	Less Common		II
Indus toad	*Bufo andersoni*	Common		
Green toad	*Bufo viridis*	Less common		
Checkered keelback	*Xenochrophis piscotor*	Less common		
Marsh snake	*X. cerasogaster*	Less common		
Cat snake	*Boiga trigonata*	Less common		
Dhaman	*Ptyas mucosus*	Less common		II
Royal snake	*Sphalerosophis atriceps*	Less common		
Sand snake	*Psammophis condanarus*	Less common		
Indian krait	*Bungarus caeruleus*	Less common		
Cobra	*Naja naja*	Less common		II
Russell.s viper	*Viper russelii*	Rare		
Saw-scaled viper	*Echis carinatus*	Common		
Monitor lizard	*Varanus bengalensis*	Less Common		I
Spinytailed lizard	*Uromastic hardwicki*	Common		II
Indian softshell turtle	*Trionyx gangeticus*	Less common		I
Indian flapshell turtle	*Lissemys punetata*	Common		
Brown river turtle	*Kachuga amithi*	Common		

List of Avifauna in Indus Dolphin Game Reserve

S.No	Common name	Scientific name	Status	IUCN Redlist	CITES Appendix
1.	Avocet	*Recurvirostra avosetta*	Less common	Least Concern	
2.	Bank myna	*Acridotheres ginginianus*	Less common	Least Concern	
3.	Bay backed shrike	*Lanius vittatus*	Less common	Least Concern	
4.	Black bellied tern	*Sterna acuticauda*	Less common	Endangered	
5.	Black partridge	*Melanoperdix niger*	Rare	Vulnerable	
6.	Black shouldered kite	*Elanus caeruleus*	Less common	Least Concern	II
7.	Black winged stilt	*Himantopus himantopus*	Common	Least Concern	
8.	Black-headed gull	*Chroicocephalus ridibundus*	Common		
9.	Blue rock pigeon	*Columba livia*	Common	Least Concern	
10.	Bonellis eagle	*Aquila fasciata*	Rare	Least Concern	II
11.	Brahminy kite	*Haliastur indus*	Common	Least Concern	II
12.	Collard dove	*Streptopelia decaocto*	Common	Least Concern	
13.	Common Babbler	*Turdoides caudata*	Common	Least Concern	
14.	Common buzzard	*Buteo buteo*	Less common	Least Concern	II
15.	Common Indian myna	*Acridotheres tristis*	Common	Least Concern	
16.	Common sandpiper	*Actitis hypoleucos*	Common	Least Concern	
17.	Common wood shrike	*Tephrodornis pondicerianus*	Rare	Least Concern	
18.	Coot	*Fulica atra*	Common	Least Concern	
19.	Coucal	*Centropus*	Less common		
20.	Crested lark	*Galerida cristata*	Common	Least Concern	
21.	Great horned owl	*Bubo virginianus*	Less common	Least Concern	II
22.	Greater spotted eagle	*Aquila clanga*	Less common	Vulnerable	II
23.	Green sandpiper	*Tringa ochropus*	Less common	Least Concern	
24.	Green shank	*Tringa nebularia*	Less common	Least Concern	
25.	Grey heron	*Ardea cinerea*	Less common	Least Concern	
26.	Grey partridge	*Perdix perdix*	Less common	Least Concern	
27.	Herring gull	*Larus argentatus*	Common	Least Concern	
28.	House bunting	*Emberiza sahari*	Less common	Least Concern	
29.	House crow	*Corvus splendens*	Common	Least Concern	
30.	Indian black kite	*Milvus migrans*	Common	Least Concern	II
31.	Indian house sparrow	*Passer domesticus*	Common	Least Concern	
32.	Indian house swift	*Apus affinis*	Less common	Least Concern	
33.	Indian river tern	*Sterna aurantia*	Less common	Near Threatened	

34.	Indian robin	*Saxicoloides fulicatus*	Less common	Least Concern	
35.	Indian roller	*Coracias benghalensis*	Less common	Least Concern	
36.	Indian sand lark	*Calandrella raytal*	Less common	Least Concern	
37.	Indian sand martin	Riparia riparia	Less common	Least Concern	
38.	Indian scopes owl	*Otus bakkamoena*	Less common	Least Concern	II
39.	Indian tree pie	*Dendrocitta vagabunda*	Less common	Least Concern	
40.	Jungle babbler	*Turdoides striata*	Less common	Least Concern	
41.	Kentish plover	*Charadrius alexandrinus*	Common	Least Concern	
42.	Black drongo	*Dicrurus macrocercus*	Common	Least Concern	
43.	Koel	*Eudynamys scalopica*	Less common	Least Concern	
44.	Lesser sand plover	*Charadrius mongolus*	Common	Least Concern	
45.	Little cormorant	*Microcarbo niger*	Common	Least Concern	
46.	Little egret	*Egretta garzetta*	Common	Least Concern	
47.	Little grebe	*Tachybaptus ruficollis*	Common	Least Concern	
48.	Little green bee-eater	*Merops orientalis*	Common	Least Concern	
49.	Little ringed plover	*Charadrius dubius*	Common	Least Concern	
50.	Little stint	*Calidris minutus*	Common	Least Concern	
51.	Little tern	*Sterna albifrons*	Common	Least Concern	
52.	Long tailed grass warbler	*Schoenicola platyurus*	Less common	Vulnerable	
53.	Marsh harrier	*Circus aeruginosus*	Less common	Least Concern	II
54.	Night heron	*Nycticorax nycticorax*	Common	Least Concern	
55.	Osprey	*Pandion haliaetus*	Less common	Least Concern	II
56.	Pied bush chat	*Saxicola caprata*	Less common	Least Concern	
57.	Pied kingfisher	*Ceryle rudis*	Common	Least Concern	
58.	Plain prinia	*Prinia inornata*	Less common	Least Concern	
59.	Pond heron	*Ardeola grayii*	Common	Least Concern	
60.	Purple Moonrhen	*Porphyrio porphyrio*	Less common	Least Concern	
61.	Purple sunbird	*Cinnyris asiaticus*	Common		
62.	Red shank	*Tringa totanus*	Less common	Least Concern	
63.	Red vented bulbul	*Pycnonotus caffer*	Less common	Least Concern	
64.	Red watlled lapwing	*Vanellus vanellus*	Common	Least Concern	
65.	Rose ringed parakeet	*Psittacula krameri*	Less common	Least Concern	
66.	Rufous backed shrike	*Lanius schach*	Less common	Least Concern	
67.	Short toed eagle	*Circaetus gallicus*	Less common	Least Concern	II
68.	Sindh jungle sparrow	*Passer pyrrhonotus*	Less common	Least Concern	
69.	Sindh night jar	*Caprimulgus mahrattensis*	Less common	Least Concern	

70.	Sindh starling	*Sturnus roseus*	Less common	Least Concern	
71.	Slender billed gull	*Chroicocephalus genei*	Common		
72.	Small blue kingfisher	*Alcedo coerulescens*	Less common	Least Concern	
73.	Small Indian pranticole	*Glareola lactea*	Less common	Least Concern	
74.	Small sky lark	*Alauda gulgula*	Less common	Least Concern	
75.	Sparrow hawk	*Accipiter virgatus*	Less common	Least Concern	II
76.	Spotted owlet	*Athene brama*	Less common	Least Concern	II
77.	Steaked weaver	*Ploceus manyar*	Less common	Least Concern	
78.	Striated babbler	*Turdoides earlei*	Less common	Least Concern	
79.	Whiskered tern	*Chlidonias hybridus*	Less common	Least Concern	
80.	White breasted kingfisher	*Halcyon smyrnensis*	Less common	Least Concern	
81.	White breasted waterhen	*Amaurornis phoenicurus*	Less common	Least Concern	
82.	White cheeked bulbul	*Pycnonotus leucotis*	Common	Least Concern	
83.	White throated munia	*Euodice malabarica*	Less common	Least Concern	
84.	White-eyed buzzard	*Butastur teesa*	Less common	Least Concern	II
85.	Wire tailed swallow	*Hirundo smithii*	Less common	Least Concern	
86.	Yellow eyed babbler	*Chrysomma sinense*	Less common	Least Concern	

List of common Fish Species of Indus Dolphin Reserve

No.	**Species**	**Family**	**Common Name**	**IUCN Redlist**
1	*Aortichthys aor*	Bagridae	*Singhari*	Least Concern
2	*Aspidoparia morar*	Cyprinidae (carp)	*Ray Finned*	Least Concern
3	*Catla catla*	Cyprinidae (carp)	*Theli*	Least Concern
4	*Channa marulias*	Channidae	*Soll*	Least Concern
5	*Chela cachius*	Cyprinidae (carp)	*Chela*	Least Concern
6	*Cirrhinus reba*	Cyprinidae (carp)	*Suhni*	Least Concern
7	*Cirrihinus mirgala*	Cyprinidae (carp)	*Morakha/Morie*	Least Concern
8	*Gudsuia*	Clupeidae	*Pali*	Least Concern
9	*L . calbasu*	Cyprinidae (carp)	*Kalbans*	Least Concern
10	*L. gonius*	Cyprinidae (carp)	*Seereha*	Least Concern
11	*Labeo rohita*	Cyprinidae (carp)	*Rahu*	Least Concern
12	*Macrobrachium malcomsoni (Prawn)*	Palaemonidae	*Samll Jhenga*	Least Concern
13	*Mastacembelus armatus*	Mastacembelidae	*Baam*	Least Concern
14	*Mystus cavasius*	Bagridae (catfish)	*Tengara*	Least Concern
15	*N. chitala*	Notopteridae	*Cheetal*	Least Concern
16	*Notoptreus notoptreus*	Notopteridae	*Butpri*	Least Concern
17	*Palaemon carcinus (Prawn)*	Palamonidae	*Large Jhenga*	Least Concern
18	*Puntius sophore*	Cyprinidae	*Sophor*	Least Concern

19	*Rita rita*	Bagridae	*Khaga*	Least Concern
20	*Salmastoma bacaila*	Cyprinidae	*Small chall*	Least Concern
21	*Wallgo attu*	Siluridae	*Mully/Jarkha*	Least Concern

List of Crustaceans and Water Insects of Indus dolphin Reserve.

Common name	Scientific name	Status
Large jhenga	*Palaemon carcinus*	Less common
Small jhenga	*Macrobrachium malcomsoni*	Less common
Water bug	*Coraixa promontoria*	Common
Water bug	*C. substriata*	Common
Water-scorpion	*Laecotrephes rubri*	Less common

Floral diversity on both banks of Indus Dolphin Game Reserve

S#	Family	Plant Species	Life Form	Habit
1	Acanthaceae	*Blepharis sindica*	Therophyte	Herb
2	Aizoaceae	*Trianthema portulacastrum*	Therophyte	Herb
3	Aizoaceae	*Zaleya pentandra*	Chamaephyte	Herb
4	Amaranthaceae	*Amaranthus graecizans*	Therophyte	Herb
5	Amaranthaceae	*Amaranthus viridis*	Therophyte	Herb
6	Asteraceae	*Echinops echinatus*	Therophyte	Tall Herb
7	Asteraceae	*Eclipta prostrata*	Chamaephyte	Herb
8	Asteraceae	*Grangea maderaspatana*	Therophyte	Herb
9	Asteraceae	*Launaea procumbens*	Chamaephyte	Herb
10	Asteraceae	*Launaea resedifolia*	Therophyte	Herb
11	Boraginaceae	*Coldenia procumbens*	Chamaephyte	Herb
12	Capparidaceae	*Cleome brachycarpa*	Chamaephyte	Herb
13	Convolvulaceae	*Convolvulus prostratus*	Chamaephyte	Herb
14	Convolvulaceae	*Cressa cretica*	Therophyte	Herb
15	Cucurbitaceae	*Citrullus colocynthis*	Chamaephyte	Herb
16	Euphorbiaceae	*Euphorbia hirta*	Therophyte	Herb
17	Fabaceae	*Melilotus alba*	Chamaephyte	Herb
18	Fabaceae	*Melilotus indica*	Chamaephyte	Herb
19	Gentianaceae	*Enicostemma hyssopifolium*	Hemi-cryptophyte	Herb
20	Nyctaginaceae	*Boerhavia diffusa*	Chamaephyte	Herb
21	Nyctaginaceae	*Boerhavia procumbens*	Cryptophyte	Herb
22	Nyctaginaceae	*Commicarpus boissieri*	Phanerophyte	Herb
23	Polygalaceae	*Polygala erioptera*	Chamaephyte	Herb
24	Polygalaceae	*Polygala irregularis*	Chamaephyte	Herb
25	Polygonaceae	*Persicaria glabra*	Chamaephyte	Herb
26	Polygonaceae	*Polygonum effusum*	Chamaephyte	Herb
27	Portulacaceae	*Portulaca oleracea*	Therophyte	Herb
28	Primulaceae	*Anagallis arvensis*	Therophyte	Herb
29	Scrophulariaceae	*Bacopa monnieri*	Chamaephyte	Herb
30	Scrophulariacea	*Schweinfurthia papilionacea*	Chamaephyte	Herb
31	Solanaceae	*Solanum albicaule*	Chamaephyte	Herb
32	Solanaceae	*Solanum nigrum*	Therophyte	Herb
33	Solanaceae	*Solanum surattense*	Chamaephyte	Herb
34	Tiliaceae	*Corchorus depressus*	Chamaephyte	Herb
35	Verbenaceae	*Phyla nodiflora*	Chamaephyte	Herb
36	Zygophyllaceae	*Tribulus terrestris*	Therophyte	Herb

37	Zygophyllaceae	*Zygophyllum simplex*	Therophyte	Herb
38	Amaranthaceae	*Aerva javanica*	Phanerophyte	Shrub
39	Asclepiadaceae	*Calotropis procera*	Phanerophyte	Shrub
40	Asclepiadaceae	*Leptadenia pyrotechnica*	Phanerophyte	Shrub
41	Asteraceae	*Iphiona grantioides*	Chamaephyte	Subshrub
42	Asteraceae	*Pluchea lanceolata*	Phanerophyte	Shrub
43	Asteraceae	*Vernonia cinerascens*	Phanerophyte	Shrub
44	Boraginaceae	*Heliotropium curassavicum*	Chamaephyte	Subshrub
45	Boraginaceae	*Heliotropium ophioglossum*	Chamaephyte	Subshrub
46	Boraginaceae	*Trichodesma indicum*	Chamaephyte	Subshrub
47	Burseraceae	*Commiphora stocksiana*	Phanerophyte	Shrub
48	Burseraceae	*Commiphora wightii*	Phanerophyte	Shrub
49	Caesalpiniaceae	*Senna holosericea*	Chamaephyte	Subshrub
50	Capparidaceae	*Cadaba fruticosa*	Phanerophyte	Shrub
51	Capparidaceae	*Capparis decidua*	Phanerophyte	Large Shrub
52	Chenopodiaceae	*Atriplex stocksii*	Chamaephyte	Subshrub
53	Chenopodiaceae	*Haloxylon stocksii*	Phanerophyte	Shrub
54	Chenopodiaceae	*Salsola imbricata*	Phanerophyte	Shrub
55	Chenopodiaceae	*Suaeda fruticosa*	Phanerophyte	Shrub
56	Euphorbiaceae	*Euphorbia caducifolia*	Phanerophyte	Large Shrub
57	Fabaceae	*Alhagi maurorum*	Phanerophyte	Subshrub
58	Fabaceae	*Crotalaria burhia*	Phanerophyte	Shrub
59	Fabaceae	*Indigofera oblongifolia*	Phanerophyte	Shrub
60	Fabaceae	*Tephrosia purpurea*	Chamaephyte	Subshrub
61	Malvaceae	*Abutilon fruticosum*	Phanerophyte	Subshrub
62	Malvaceae	*Abutilon indicum*	Phanerophyte	Subshrub
63	Malvaceae	*Sida ovata*	Phanerophyte	Subshrub
64	Mimosaceae	*Acacia jacquemontii*	Phanerophyte	Shrub
65	Mimosaceae	*Prosopis glandulosa*	Phanerophyte	Large Shrub
66	Mimosaceae	*Prosopis juliflora*	Phanerophyte	Large Shrub
67	Resedaceae	*Ochradenus baccatus*	Phanerophyte	Shrub
68	Rhamnaceae	*Ziziphus nummularia*	Phanerophyte	Shrub
69	Rubiaceae	*Kohautia retrorsa*	Phanerophyte	Subshrub
70	Solanaceae	*Datura fastuosa*	Phanerophyte	Shrub
71	Solanaceae	*Lycium edgeworthii*	Phanerophyte	Shrub
72	Solanaceae	*Solanum cordatum*	Chamaephyte	Subshrub
73	Solanaceae	*Withania somnifera*	Phanerophyte	Shrub
74	Tamaricaceae	*Tamarix indica*	Phanerophyte	Shrub
75	Tiliaceae	*Grewia tenax*	Phanerophyte	Shrub
76	Zygophyllaceae	*Fagonia indica*	Chamaephyte	Subshrub
77	Mimosaceae	*Acacia nilotica*	Phanerophyte	Tree
78	Mimosaceae	*Acacia senegal*	Phanerophyte	Tree
79	Mimosaceae	*Prosopis cineraria*	Phanerophyte	Tree
80	Salicaceae	*Populus euphratica*	Phanerophyte	Tree
81	Salvadoraceae	*Salvadora oleoides*	Phanerophyte	Tree
82	Salvadoraceae	*Salvadora persica*	Phanerophyte	Tree
83	Tamaricaceae	*Tamarix aphylla*	Phanerophyte	Tree
84	Tamaricaceae	*Tamarix dioica*	Phanerophyte	Tree
85	Poaceae	*Aeluropus lagopoides*	Cryptophyte	Grass
86	Poaceae	*Cenchrus ciliaris*	Hemi-cryptophyte	Grass
87	Poaceae	*Cenchrus pennisetiformis*	Hemi-cryptophyte	Grass
89	Poaceae	*Chloris barbata*	Hemi-cryptophyte	Grass
90	Poaceae	*Chrysopogon aucheri*	Hemi-cryptophyte	Grass
91	Poaceae	*Cynodon dactylon*	Hemi-cryptophyte	Grass

92	Poaceae	*Dactyloctenium aegyptium*	Therophyte	Grass
93	Poaceae	*Dactyloctenium aristatum*	Therophyte	Grass
94	Poaceae	*Desmostachya bipinnata*	Cryptophyte	Grass
95	Poaceae	*Dichanthium annulatum*	Hemi-cryptophyte	Grass
96	Poaceae	*Panicum antidotale*	Hemi-cryptophyte	Grass
97	Poaceae	*Phragmites karka*	Cryptophyte	Tall Grass
98	Poaceae	*Saccharum benghalense*	Hemi-cryptophyte	Tall Grass
99	Poaceae	*Saccharum spontaneum*	Hemi-cryptophyte	Tall Grass
100	Poaceae	*Sporobolus nervosus*	Hemi-cryptophyte	Grass
101	Convolvulaceae	*Convolvulus glomeratus*	Chamaephyte	Climber
102	Fabaceae	*Rhyncosia minima*	Chamaephyte	Climber
103	Cyperaceae	*Cyperus bulbosus*	Cryptophyte	Sedge
104	Cyperaceae	*Cyperus pygmaeus*	Hemi-cryptophyte	Sedge
105	Typhaceae	*Typha angustata*	Cryptophyte	Reed

Khurshid N. (et.al) 2012, Baseline Study of Indus dolphin From Guddu to Sukkur Barrage and from Sukkur to kotri Barrage, Study Conducted by the Sindh Wildlife Department and Global Environmental Management Services (pp-182)

Phytoplankton of Indus River in Dolphin Game Reserve

NO.	TAXA
	CHLOROPHYTA
1	*Pediastrum*
2	*Spirogyra*
3	*Cladophora*
4	*Staurastrum*
	CYANOPHYTA
5	*Aphanocapsa*
6	*Oscillatoria*
	BACILLARIOPHYTA
7	*Melosira*

Zooplankton of Indus River in Dolphin Game Reserve

NO.	NAME OF SPECIES
	DINOFLAGELLATES
1	*Ceratium hirundinella*
	ROTIFERA
1	*Asplanchna priodonta*
2	*Anuropsis fissa*
3	*Brachionus amphiceros*
4	*Branchious angularis*
5	*Brachionus budapestinensis*
6	*Brachionus dorcas*
7	*Brachionus falcatus*
8	*Brachionus forficula*
9	*Brachionus plicatilis*
10	*B. quadritentus* f.*brevispinus*
11	*Brachionus quadridentatus*
12	*Brachionus rubens*
13	*B. calyciflorus*
14	*Conochiloides* sp.

NO.	NAME OF SPECIES
	COPEPODA
1	*Diaptomus* sp.
2	*Thermocyclops hyalinus*
3	*Mesocyclops leukarti*
4	*Harpacticoid* sp.
1	*Ceratium hirundinella*
	ROTIFERA
1	*Asplanchna priodonta*
2	*Anuropsis fissa*
3	*Brachionus amphiceros*
4	*Branchious angularis*
5	*Brachionus budapestinensis*
6	*Brachionus dorcas*
7	*Brachionus falcatus*
8	*Brachionus forficula*
9	*Brachionus plicatilis*
10	*B. quadritentus f.brevispinus*

15	*Filina longiseta*
16	*Keratella asymmetrica*
17	*Keratella cochlearis*
18	*Keratella cochlearis tecta*
19	*Keratella hispida*
20	*Keratella irregularis*
21	*Keratella javana*
22	*Keratella quadrata*
23	*Keratella squamula*
24	*Keratella testudo*
25	*Keratella tropica*
26	*Keratella valga*
27	*Lecane styrus*
28	*Notholca striata*
29	*Pompholyx complanta*
30	*Polyarthra vuglaris longiremis*
31	*Polyarthra dissimilaris*
32	*Polyarthra mira*
33	*Polyarthra remata*
34	*Schyzocerca sp.*
35	*Synchyta sp.*
36	*Trichocerca sp.*
	CLADOCERA
1	*Alona guttata*
2	*Bosmina longirostris*
3	*Bosminopsis deitersi*
4	*Ceriodaphnia cornuta*
5	*Chydorus ovalis*
6	*Ceriodaphnia reticulata*
7	*Daphnia lumholtzi*
8	*Diaphanosoma brachyurum*
9	*Diaphnosoma sarsi*
10	*Daphnia* sp.
11	*Moina micrura*

11	*Brachionus quadridentatus*
12	*Brachionus rubens*
13	*B. calyciflorus*
14	*Conochiloides* sp.
15	*Filina longiseta*
16	*Keratella asymmetrica*
17	*Keratella cochlearis*
18	*Keratella cochlearis tecta*
19	*Keratella hispida*
20	*Keratella irregularis*
21	*Keratella javana*
22	*Keratella quadrata*
23	*Keratella squamula*
24	*Keratella testudo*
25	*Keratella tropica*
26	*Keratella valga*
27	*Lecane styrus*
28	*Notholca striata*
29	*Pompholyx complanta*
30	*Polyarthra vuglaris longiremis*
31	*Polyarthra dissimilaris*
32	*Polyarthra mira*
33	*Polyarthra remata*
34	*schyzocerca sp.*
35	*Synchyta sp.*
36	*Trichocerca sp.*

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Annex D: 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 Project. 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 Project is given below.

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Quarry Areas Development and Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fish
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Labour Influx Management and Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Workers Health and Safety
- ECP 19: Dredging Management
- ECP 20: Dolphins Management from Construction Impacts

Contractors will prepare site specific management plans, namely Construction Environmental Management Plan (CEMP), in compliance with World Bank safeguard policies and EHS Guidelines, and Government of Sindh guidelines and based on the guidance given in the ECPs. The CEMP 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.

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 site specific 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.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• 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 them 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 is 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump 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 drainage management procedures and submit them for supervision consultant approval. • 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 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 causes ecological imbalance.	The Contractor shall • Prepare site specific erosion and sediment control measures and submit them for supervision consultant approval. • Reinstate and protect cleared areas as soon as possible. • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turf/tree plantations.
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	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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	sediment damaging the spawning grounds of fish	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-chemical and biological activity of the soil. The

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 • Prepare landscaping and plantation plan and submit the plan for supervision consultant approval. • 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 and 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 • Prepare quarry area management plan and submit the plan for supervision consultant approval. • 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. • 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 • Prepare air quality management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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. • 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 • Prepare a noise and vibration management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • 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 machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 wide range of adverse environmental impacts.	The Contractor shall • Prepare a plan for protection of flora and submit the plan for supervision consultant approval. • 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. • 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 • Prepare a plan for protection of fauna and submit the plan for supervision consultant approval. • 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 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.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
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 transport and disposal of wastes into the river	The Contractor shall • Prepare procedures for protection of fish and submit them for supervision consultant approval. • Ensure the construction equipment used in the river are well maintained and do not have oil leakage to contaminate river water.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Contain oil immediately on river in case of accidental spillage from equipment; make an emergency oil spill containment plan (under the Fuels and Hazardous Substances Management 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 • Prepare a traffic management plan and submit the plan for supervision consultant approval. • 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.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit.

ECP 16: Labour Influx Management and 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 • Prepare a management plan for construction of workers camp in accordance with IFC Guidance on Workers Accommodation and submit the plan for supervision consultant's approval. • Locate the construction camps within 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 accommodation, transportation, and basic services including water, sanitation, and medical care for the workers working on that project 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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		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 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.
Workers Accommodation	All workers in the camp should have adequate accommodation facilities	The Contractor shall provide the following: • The labour will be provided with accommodation on twin sharing basis made of insulated material and locally available building material, etc.; • The migrant workers with families shall be provided with individual accommodation comprising bedroom, sanitary and cooking facilities; • The units will be supported by common latrines and bathing facilities duly segregated for male and female labour; • Adequate number of toilets shall be provided in the accommodation facilities. A minimum of 1 unit to 15 males and 1 unit for 10 females shall be provided; • The contractor shall provide a kitchen facility for the construction workers and the food will be of appropriate nutritional value and will consider religious/cultural backgrounds; • All doors and windows shall be lockable and mobile partitions/curtains shall be provided for privacy; • Facilities for the storage of personal belongings

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		for workers shall be provided within the campsite only; • Dustbins shall be provided for collection of garbage and will be removed on a daily basis; • It is also required to provide first aid box in adequate numbers; and • Ventilation should be appropriate for the climatic conditions and provide workers with a comfortable and healthy environment to rest and spend their spare time.
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	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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	infections and HIV/AIDS.	emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas; and regular health checkups for every six months • Inspect the camp facilities regularly to ensure o Daily sweeping of rooms and houses shall be undertaken; o Regular cleaning of sanitary facilities shall be undertaken; o The kitchen and canteen premises shall be established under good hygiene conditions; o Daily meal times shall be fixed for the labour; o Smoking and alcohol consumption shall be prohibited in the workplace; o Water logging shall be prevented at areas near the accommodation facilities and adequate drainage is to be provided; and o Checklists pertaining to the daily housekeeping schedule shall be maintained and displayed at houses, toilets and kitchen. • 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) 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.
Cooking arrangement	The construction phase will involve engagement of large number of migrant people in the project area for a limited time.	Contractor shall ensure provision of following cooking facilities (kitchen) as listed below: • Places for food preparation are designed to permit good hygiene practices, including protection against contamination between and

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		during food preparation; • Adequate personal hygiene including designated areas for cleaning hands and cleaning of utensils; and • All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas are built using durable, non-absorbent, easily cleanable, non-toxic materials; • Food preparation area to be durable, easily cleanable, non-corrosive surface made of non-toxic materials. • To ensure that the fuel need of labourers in the project area does not interfere with the local requirements, necessary arrangements for supply of cooking fuel to the labourers shall be done by the contractor.
Safety	In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide appropriate and adequate 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. • Provide adequate, day-time night-time lighting shall be provided; • Provide training to the security personnel to respect the community traditions and in dealing with, use of force etc.; and
GRM	A Grievance Redress Mechanism (GRM) shall be formulated for the construction labourers (local and migrant) comprising of a review committee including representatives elected by labour and management	The Contractor shall develop and implement a GRM that should have the following elements: • Proper system for lodging grievances; • Provision for raising anonymous complaints; • Appropriate level of management for addressing concerns;

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	representatives. Project can extend the grievance mechanism developed for the project to the contractor also.	• Workers and members of the surrounding communities have specific means to raise concerns about security arrangement and staff; • Provision for timely action and feedback; • Monitoring and review of grievances raised and action taken; and • Scope for continual improvement of the system.
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. • 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.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• 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	The Contractor shall • Prepare an Occupational Health and Safety plan and submit the plan for supervision consultant's approval. • Implement suitable safety standards for all

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	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.	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.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Identify potential hazards to workers, 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
Health facilities	Effective health management is necessary for preventing spread of communicable diseases among labour and within the adjoining community.	The contractor shall provide the following medical facilities for the construction workers: • A first aid centre shall be provided for the labour within the construction site equipped with medicines and other basic facilities; • Adequate first aid kits shall be provided in the campsite in accessible place. The kit shall contain all type of medicines and dressing material; • Contractor shall identify and train an adequate number of workers to provide first aid during medical emergencies; • Regular health check-ups shall be carried out for the construction labourers every six month and health records shall be maintained; • Labours should have easy access to medical facilities and first aid; where possible, nurses should be available for female workers;

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• First aid kits are adequately stocked. • Information and awareness of communicable diseases, AIDS etc. shall be provided to workers. • Basic collective social/rest spaces are provided to workers.
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
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

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		well as to voluntary counseling and testing.

ECP 19: Dredging Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Dredging - Excavation	Increased turbidity, loss of transparency and increased suspended sediment concentrations. Impact on benthic habitats.	The Contractor shall • Select dredging equipment (e.g. Cutter Suction Dredger) which are known to have a low risk of sediment dispersal. The suction action inside the Cutter Suction Dredger means that most of the sediment removed by the cutter is captured. As high dredging efficiency and low turbidity at the cutter head are closely linked, it is uncommon for turbidity generated by the cutter head to cause environmental concern. • Monitor the dredging operation and, if necessary, change the dredge location to minimise fines or modify operations, e.g. restrict the amount of material being dredged (or the number of dredgers allowed to operate) at any one time. • Maintain record of all sand or sediment extraction (quantities, location shown on map, timing, any sighting of key species)
Dredging: Lifting	The release of suspended sediments during lifting can cause mortality to fish. The re-suspension of sediments can also release toxic chemicals or nutrients such as phosphates and nitrates, which may increase the eutrophic status of the system. Release of anaerobic sediment and organic matter in high concentrations may in some cases deplete the dissolved oxygen.	The Contractor shall • Select dredging equipment (e.g. Cutter Suction Dredger) which are known to have a low risk of sediment releases from lifting. • Reduce the suspended material released into the water column by adjusting the ratio of cutter revolutions to pump velocity to ensure that the cutter advancement rate is not greater than the ability of the suction pump to remove the material that has been cut. • Monitor the lifting operations and if required use techniques (e.g. silt curtains) to minimize adverse impacts on aquatic life from the resuspension of sediments.
Dredging: Transportation	Leakages and spillage from the hydraulic pipeline	The Contractor shall • Regularly inspect and maintain equipment in order to prevent leaks. • Develop and implement a spill prevention plan to prevent and contain accidental spills
River Traffic	The presence of barges and	The Contractor shall

	associated vessels and discharge pipelines will pose a risk to local river traffic. There is also risk of collision of construction boats with dolphins.	• Provide proper navigational lighting for the barges and associated vessels • Provide appropriate lighting to all floating pipelines and buoys • Check all navigational lights routinely to ensure that they are working properly. • Limit the motor boat speed to 15 km/h in accordance with best international practices and to avoid any collision with dolphins. . Pingers will be used to chase away dolphins form the construction areas thus minimizing the chances of any collision
Noise from dredging activities	Noise and vibration under water: Disruption to fish migration and disturbance to dolphins Noise and vibration above water: Nuisance to local community, disturbance to birds	The Contractor shall • Reduce the dredger noise at source by isolation of exhaust systems, by keeping engine room doors shut and by additional measures such as shielding. • Limit the noisy dredging to daylight hours, where possible, rather than at sunrise or sunset (significant for wildlife) or during night time hours. Where unavoidable, the contractor should ramp up the levels of engines or other noise producing sources, so that the noise slowly increases. This will encourage riverine and terrestrial fauna to move away from the source area prior to significant noise emissions • Inspect and maintain equipment in good working condition
Exhaust emissions	Air pollution and release of greenhouse gases from construction equipment	The Contractor shall • Inspect and maintain equipment in good working condition. Proper maintenance of engines ensures full combustion with low soot emissions. • Select and operate equipment and manage operations to reduce engine emissions. • Use low-Sulphur heavy fuels to reduce noxious emissions. • Provide Exhaust filtering.
Oil spills	Oil spills	The Contractor shall • Refuel of barges and boats with a proper care to avoid any spills. • Make available spill kits and other absorbent material at refueling points on the barges
Bilge water	Waste water disposal from the barges and associated vessels	The Contractor shall • Properly collect, treat and dispose the bilge water from of barges, and boats. • Empty barge or hopper from rest load by washing or mechanical cleaning before moving between different dredging areas to prevent distribution of contaminated material through residual loads.

ECP 20: Dolphins Management from Construction Impacts

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Underwater noise from dredging activities	Underwater noise levels generated by the dredgers and associated vessels may impact the dolphin's vocalization and behavior	The contractor shall • Monitor an exclusion zone of about 500 m radius for at least 30 minute before the start of piling. If dolphins are observed in the exclusion zone, dredging works will be delayed until they have left the area. If dolphins enter the exclusion zone after dredging has commenced, dredging works would cease until they have left; • Adopt a 'soft start'; using a low energy start to the dredging operations to give dolphins an opportunity to leave the area, gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling commences, • use pingers upstream and downstream to chase away dolphins, • have a qualified ecologist in his team for implementing these mitigation measures and monitoring of impacts on dolphins • Share the dredging activity schedule with the project authorities and district wildlife department.
Motor boat traffic associated with dredging and other instream construction activities	risk of collision between dolphins and motor boats	The contractor shall • Limit the movement of the boats to the construction areas and dredging sites. • Restrict motor boats speed within 15 km/h in accordance with best international practices followed in the North America • Use the pingers to chase away dolphins from the construction areas. • Limit the use of boats to day time, and if they are needed to be used during night time, provide adequate night time lighting
Stranding of dolphins in the desilting areas of barrage and canals	Risk of entrapment of dolphins in construction areas	The contractor shall • Establish a dolphin rescue unit in the site to rescue dolphins that are entrapped in the construction areas. The dolphin rescue unit will include an ambulance, a stretcher, water facility and a trained rescue staff. • Carry out, an observation survey, before initiating the desilting activities, in surrounding areas for presence of dolphins. The dolphins will be rescued and released safety in to other canals before carrying out desilting activities. • Take the support of district wildlife department during rescue and release operations of dolphins or any animal species found during the desilting activities.
Pollution from dredgers and boats	There is a risk of water pollution through accidental	The contractor shall • take utmost care to prevent such risks and will

	spillage of fuels, hazardous material and bilge water. Any such pollution events will seriously impact the downstream dolphin and fish habitat	prepare and implement an emergency preparedness plan to address these risks. The contractor will make booms (oil fence), absorbents and skimmers available on site along with trained personnel to recover spilled oils from water surface • •regularly service all water borne plant as per the manufacturer's guidelines and be inspected daily prior to operation. • •properly carry out refueling of dredgers and boats to avoid any spills. Refueling of boats will be done on shore. Spill kits and other absorbent material will be made available at refueling points.

Annex E: Summary of International Conference on Dolphins Management

Summary of Presentations made in the International Conference on Conservation and Management of Indus Dolphin in Indus River, Sindh, Pakistan'

Venue: KARACHI MARRIOT HOTEL

Dated: 15TH MAY 2017

SNo.	Name of Presenter	Title of Presentation	Topics Covered (Summary of Presentation)
1	**Dr Gill Braulik**	**Indus River dolphins –Why they are special, What we know, what we don't know.**	Dolphins appear to be concentrated into sections of river with pools of high volume during the dry season. This may be because depleted dry-season flow causes dolphins to concentrate in the limited habitat remaining with sufficient volume. Conservation efforts can be focused in these relatively small areas of favorable habitat. If river discharge declines further, dolphins may become trapped in deep pools. **Abundance**, Direct Counts, Counts corrected for missed animals that incorporate uncertainty tandem vessel mark-recapture, Standardized methods are needed to detect trends over time. **What we don't know** **Mortality** - What kills Indus dolphins? How many dolphins succumb to different causes of death in each area? **Movements** - Do dolphins move through barrages? In which direction? In which circumstances? How many? **Water Flow** – How much water is enough to sustain the dolphin population? **Food** – is there enough, when will there be not enough? **Pollution** – what are the impacts on the dolphins?
2	**Mr. Chris Hall**	**Indus Blind River Dolphin**	This presentation was imparted on Implementation of Contractor's Environmental and Social Management Plan (CESMP) as per the Contract Specification of Guddu SBIP/G2. The Contractor's Environmental and Social Management Plan (CESMP) must demonstrate compliance with this specification as well as the Environmental Code of Practices and Environmental and Social Management Plan as defined in the 'Sindh Barrages Improvement Project – Guddu Barrage Rehabilitation, Environmental and Social Assessment Report by Independent Environmental Consultants' dated December 2014

			Safeguard of Wildlife • Use of Waterborne Plant • Exclusion Zone • Limited Noise • Soft Start Procedure'
3	Mr. Ibrahim Samoo (ACE)	**SUKKUR BARRAGE** **Rehabilitation and Modernization**	The major activities of Rehabilitation of Sukkur barrage have been described such as Repair of Civil works (Main barrage and Canals 'structures),Change Electro-mach Equipments and Dredging. Potential impact and concern has been described regarding dredging material. **Increased sediment load due to dredging** Gate operation to open barrage gates near dredging location to quickly transport the increased sediments to downstream of the barrage. **Striking of Dolphins by construction vehicles** Limiting the speed of all the waterborne plants and speed boats to 15km/hour **Disturbance due to Noise and Vibrations** Equipment which makes a lot of noise, not to operate during breeding season (July to August). **Increased river pollution due construction waste.** Contractor to manage spill kits, absorbent materials and surface skimmers
4	**Dr. Ghulam Sarwar Gachal**	**Indus River Dolphin**	**<u>Conservation of the Dolphin depends on:</u>** Reducing pollution by natural filtration through lateral wetlands. Capture of animals trapped in canals for release in the Indus. Enforcement of legal protection. Educating local people about Dolphins. Better understanding their ecology and environment needs. More "Dolphin friendly" barrage designs. **<u>Analysis:</u>** Seasonal Change in water Quality. Pollution load of river water. Pollution load of river fish. Pollution load of sediments from various sites between Guddu & Sukkur Barrages may be analysed. Dolphin genetic study

			may be carried out through DNA.
5	Musud Karim, Ph.D., P. Eng., PMP	**Cumulative Impact Assessment for Sindh Barrages**	Dolphin management and conservation action plan, including following: Action 1. Initiate population status survey, Action 2. Threat assessment surveys Action 3. Setting up of no fishing zones in the Game Reserve, Action 4. Capacity building for dolphin conservation and management, Action 5. Community Involvement in river dolphin Conservation and Management, Action 6. Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins, Action 7. Dolphin rescue programme Action 8. Education and awareness, Action 9. International conference on dolphin conservation and management, Main purpose of barrage rehabilitation is to continue sustained supply through canals for irrigation in Sindh. Water should be used effectively by farmers without wasting it. Reduced wastage of irrigation water will allow more water to be discharged in to the downstream. The following initiatives were recommended: • Continue to provide support to small and medium size farmers in more productive use of waters. • Continue to provide trainings in efficient use of water, soil, crop management, alternate use of saved water etc. • The role of Watercourse Associations (WCAs) should be enhanced beyond routine water course improvement.
6	**Dr. Wazir Ali Baloch** **Dr. Anila Naz Soomro** **University Of Sindh**	**Fish Biodiversity of Indus River**	The main Causes affecting the Fish Biodiversity. Habitat destruction and defragmentation Water abstraction, industries and private use, Exotic species introduction. Pollution, Global climate change impacts. Biological diversity is the variety of living forms, the ecological role they perform and genetic from intense human intervention resulting in habitat loss and degradation and as a consequence, many fish species **Fish Biodiversity:** During the present study 40 fish species were recorded. This is higher number of fish species than recorded earlier. These belong to 14 families and 8 orders. Among them 26

			species were commercially important while 14 species were non commercial. All these fish species belong to Cyprinidae (Eleven species), Bagridae (Five species), Channidae (Three species) Siluridae (7 species), Notopteridae and Schilbeidae (Two species), Clupeidae, Mastacembelidae, Belontidae, Heteropneustidae, Chanidae, Cichlidae, Gobiidae, Belonidae and Cobitidae (One species).
7	**Saeed Akhtar Baloch** **Conservator, Sindh Wildlife Department.**	**Protection & Conservation of Indus River Dolphin.**	**Development initiatives:** A project in collaboration with WWF-Pakistan is also running for assessing the Agro-based activities which have an impact on the Indus Dolphin. Use of pesticides and other chemicals in Agriculture fields in and around the Dolphin Reserve is assessed through different metrics and farmers are being educated and trained for minimizing the use of deadly pesticides and chemicals in their agriculture fields. Sindh Wildlife Department is founder and pioneer of rescue conductor of Indus River Dolphin initiated since 1992. 125 rescue operations have been conducted so far. A total of 99 Dolphins have been successfully rescued between 1992 to 2017
8	**M. Y. Khuhawar and** **University of Sindh, Jamshoro**	**Water Quality Assessment of the Indus River and Major Sources of Pollution**	The results of analysis of the water samples collected between Guddu to Sukkur barrage most of the parameters are within the permissible limits of world health organization (WHO). It indicates that there is no threat at the present to Indus Dolphin from environmental factors however there is the need to examine the water quality at low flows to evaluate the extreme values.
9	**Dr. Muhammad Ashraf Bodla** **Chief Environmentalist MM-Pakistan**	**GUDDU BARRAGE REHABILITATION PROJECT** **AND** **DOLPHIN MANAGEMENT**	There are following Dolphin Management and Conservation Actions: Action 1. Initiate Population Status Survey, Action 2. Threat Assessment Surveys, Action 3. Setting Up of No Fishing Zones in the Reserve Action 4. Capacity Building for Dolphin Conservation and Management, Action 5. Community Involvement in Indus River Dolphin Conservation and Management, Action 6. Ensuring Critical Levels of Water Flow in Riverine Habitats of Dolphins, Action 7. Dolphin Rescue Programme, Action 8. Education and Awareness,

			Action 9. International Conference on Dolphin Conservation and Management. HUMBLE REQUEST: *Respect Dolphin as we respect our family because dolphin may also be a mother, father or a baby. Help dolphin because they are blind as we do for our blinds Care dolphin because they are innocent and friends of our children Protect them as they are endangered PERHAPS LEGENDARY THEY MAY RESCUE YOU ONE DAY FROM DROWNING*
10	**Rashid Ghufran** **Head QHSE** **Infrastructure Division Descon Engineering Limited**	**Environmental Issues for Rehabilitation of Barrages**	**Dolphin Rescue Guidelines/Plan** In case a Dolphin is seen stranded / injured near the work site, the work will be immediately suspended until advised to resume by authorized person. Report to the site HSE personnel and Dolphin Squad Coordinate with the concerned department (WWF or Sindh Wild life department) and pass on the required information. **Joint Actions with Sindh Wildlife Department and WWF Pakistan** Descon may work as a Facilitator with Sindh Wildlife and WWF Pakistan, to conserve Indus river Blind Dolphin at Guddu Project site. The Local Authorities will be pursued through Employer (PMO), Sindh Wildlife and WWF Pakistan to establish no fishing zone within Guddu Project site.
11	**Hamera Aisha**	**Indus River Dolphin Conservation**	**Indus river dolphin boat safari:** A myriad of environmental awareness activity, to gain support from general public, Alternate livelihood opportunities for the fishers , Average annual tourist turn-out 700 **Capacity building of stakeholders** Regular capacity building events for the government departments on; Indus Dolphin rescue Population assessments Postmortem/sample preservation techniques **Some of the knowledge gaps** • Dolphin translocation feasibility studies • Satellite tagging to determine actual home range size and

			movement across the barrages • Comprehensive population assessment • Habitat quality and carrying capacity assessments of Indus River Dolphin Game Reserve • Experiment by catch mitigation technologies • Genetics studies to assess in-breeding and population diversity
12	**Dr. Uzma Khan**	**The Indus River Dolphin Management**	What can be done to sustain? Indus Dolphin Conservation Fund Industries along with Indus River Dolphin Game Reserve, Green Pakistan Programme (Launched earlier this year) Environmental flows, Pesticide policy What can be done to sustain? Sindh Wildlife Board Inter departmental Indus dolphin conservation committee (Irrigation, EPA, Wildlife, Fisheries, WWF, IUCN) More protected areas for the Indus River Dolphin
	Suleman Mazhar Director BiSMiL Lab, Computer Science Dept., Information Technology University of the Punjab Ferozepur Road, Arfa Software Technology Park, Lahore	**Passive Acoustic techniques for Indus river dolphin survey and conservation**	**Passive Acoustic Monitoring Systems** Underwater Acoustics • a key sensory modality • long range underwater signal channel • large scale monitoring of marine life • Human-induced noise pollution • Passive Acoustics is better than active SONAR, tagging or visual based surveys

List of Participants in the International Conference on Conservation and Management of Indus Dolphin in Indus River, Sindh, Pakistan'

Venue: KARACHI MARRIOT HOTEL

Dated: 15TH MAY 2017

S.No	Name	Organization
1	Mr. Mir Aijaz Talpur	Sindh WildLife Dpt
2	Mr. Mir Akhtar Talpur	Sindh WildLife Dpt
3	Mr. Ameer Hussain Jagerani	Sindh WildLife Dpt
4	Mr. Saif-ur-Rehman	Descon ENGG ltd
5	Mr. Malik M.Yar	Descon ENGG ltd
6	Mr. Shabana M	IO/BM
7	Mr. Mushtaq Ahmed	Descon ENGG ltd
8	Mr. Asad faiz khoso	PMO.SBIP
9	Dr. Samina Kidwa	National Institute of Oceanoghrphay NIO
10	Mr. Rashid Chohan	Descon ENGG ltd
11	Mr. M.Saad Sattar	Descon ENGG ltd
12	Mr. Shahzad Hussain	PMO.SBIP
13	Mr. Habib Ursani	Irrrigation Department
14	Mr. Tanveer Ishrat	MMP
15	Mr. Murad Mahar	Irrigation Department
16	Mr. M.Ibrahim	ICC
17	Mr. Agha Habib	PMO.SBIP
18	Mr. Muhmmad Rafiq	Irrigation Department
19	Mr. Daniyal Ahmed	PIC Consultant MMP
20	Miss Fareeha Mahar	PMO.SBIP
21	Mr. Zahid Rehman	No
22	Mr. Imran Aziz Tunio	PMO.SBIP
23	Mr. Abdull Ghaffar Soomro	PMO.SBIP
24	Mr. A.Razzaque Memon	PMO.SBIP
25	Mr. Abdul Fatah	Irrigation Dpt
26	Dr. Anila Naz	Sindh University
27	Mr. Samiullhah	SPMC
28	Mr.Nazir Hussain Mughal	PCMU
29	Mr. Nusrat Hussain	Descon ENGG ltd
30	Mr. Atif Ali	Sindh University
31	Dr:Ghulam Sarwar Gachal	Sindh Uni
32	Mr. Syed Amjad Ali	PMO.SBIP
33	Mr. Wahid Bukhsh Soomro	PMO.SBIP
34	Mr. Waseem Ahmed	SPMC

S.No	Name	Organization
35	Mr. Ghulam Hyder	PMC/A WISP
36	Mr. Amna Bano	TEKECELLANT
37	Mr. Ali nazwaz	TEKECELLANT
38	Mr. Rehan M Iqbal	Sindh Fishres
39	Mr. Ghulam Qadir	Sind Fisheries Department
40	Mr. Syed Aftab Alam	
41	Mr. Aqeel Ahmed	PIC Consultant MMP
42	Mr. Rasheed Ahmed	Sindh Wildlife Department
43	Mr. Beena Ricer	Env. Engineer
44	Mr. Khair Muhmmad	Irrigation Dpt
45	Mr. Humera Aisha	WWF-P
46	Dr. Uzama Khan	WWF-P
47	Dr. M Ashraf Bodla	MMP
48	Dr. Sheraz Memon	MUET jamshoro
49	Mr. Abdul Wahid Khnadhar	Irrigation Department
50	Mr. Abdul Basit Khan	PCMU)WISP
51	Mr. Taj Muhhmad Skhaikh	Sindh wildlife Department
52	Mr. Mumtaz	Sindh wildlife Department
53	Mr.Syed Akbar Alam	SIDA
54	Dr. Suleman Mazhar	ITU/BISMIL
55	Mr. Ishtiaq Ahmed	Irrigation Department
56	Mr. Noor Ahmed	REVENUE
57	Mr. Saeed Akhtar Baloch	Sindh Wildlif Department
58	Mr. Marium Minhas	PCMU
59	Mr. Mehfooz Ursani	Sindh Abadgar Board
60	Mr. Nadeem Shahzad Khan	Descon ENGG ltd
61	Mrs Noor us Salah	MMP
62	Mr. Ghulam Sarwar	Sindh Wildlife Department
63	Mr. Shahzad Ali	PMO.SBIP
64	Mr. Ajaz Ahmed	MMP
65	Mr. Sajida Khalid	TAKECELLENT PVT LTD
66	Miss Oniza Zaim	TAKECELLENT PVT LTD
67	Mr. M Amin	ALGP
68	Mr. M sajid Memon	ALGP
69	Dr. Ali Muhmmad Memon	Sindh Fisheries Department
70	Mr.Huzoor Bux Khoso	Sindh Fisheries Department
71	Dr Ejaz Ahmed	Ecological Consultant
72	Mr. M Waqar Bhatti	The News
73	Miss.Nida Shahzad	PCMU WISP
74	Mr. Sajjad Anwar	MMP

S.No	Name	Organization
75	Mr. Habib Ahmedani	PCMU WISP
76	Mr. Amanullah Qureshi	PIC Consultant MMP
77	Mr. Masud Khan	Eng-Consultant
78	Mr. M.Sadiq Memon	Education
79	Mr. Rehman Bux	Education
80	Prof Dr.A R Abbasi	Sindh University
81	Prof. Doctor Baradi	Sindh University
82	Dr. Fateh Mari	PCMU
83	Mr. Ibrahim Samoon	ACE Consultant
84	Mr. Sayed Sanaullah Shah	SUPARCO
85	Mr. Kamran Arif	PIC Consultant MMP
86	Prof Dr. Ali Murad	Sindh University
87	Dr. Wazir Ali Baloch	Sindh University
88	Mr. Farman Shaikh	PMO
89	Mr. Sajid Hussain	PMO
90	Mr. Ashfaque Memon	Irrigation Department
91	Mr. Ikram Hussain	Fisheries Department
92	Mr. Shaikh Abdullah	SUPARCO
93	Mr. Imran Shaikh	Irrigation Department
94	Mr. khursheed Ahmed	Irrigation Department
95	Dr. Abdul Latif	Fisheries Department
96	Mr. Ghulam Muhammad Mahar	Fisheries Department
97	Dr. Punhal	Sindh University
98	Dr. Moushab	ORACAL
99	Mr.Naeemullah	Sindh wildlife Department
100	Mr. Ashiq Ali Lakhan	Irrigation Department
101	Mr. Engr. Naimatullah	NIO
102	Dr. Allah dad	Fisheries Department
103	Mr. Zulfiqar Ali Larik	Fisheries Department
104	Dr. Amanullah Mahar	Sindh University
105	Dr. M Mangi	SUPARCO
106	Mr. Khawar P Awan	L & F Department
107	Mr. Jawed	Food Security
108	Dr. Muhammad Younis Leghari	Sindh University
109	Mr. Humaira Kanwal	IES, UoK
110	Mr. Hamza Islam	Sindh University
111	Mr.Jamil Kazmi	Karachi University (KU)
112	Mr. Saima Shaikh	Karachi University (KU)
113	Miss S. Maha Zaidi	Karachi University (KU)

S.No	Name	Organization
114	Mr. Qamaruddin	PCMU
115	Dr. Abdul Jabbar	Fisheries Department
116	Mr. M. Mohsin Memon	PCMU
117	Miss Huma Kamran	PCMU
118	Mr. Muhammad Ayoub	PMCA-FAO
119	Dr. Habibullah Abbasi	Sindh University
120	Mr. Naveed Akhtar	PMO
121	Mr. M.Ahmed Farouqi	PMO
122	Mr. Noor Shaikh	XEN
123	Mr. Munir	Sindh wildlife Department
124	Mr. Irshad Ruk	Sindh wildlife Department
125	Mr. Manzoor Ruk	Sindh wildlife Department
126	Mr. Love Kumar	WWF
127	Mr.Jawed HakimMemon	Irrigation Department
128	Mr. Asim Sidiqui	MMP
129	Mr. M Safdar	Global Vision MET
130	Mr. Barkat Ali	Global Vision MET
131	Mr. Nouman Hussain	KPMU
132	Mr. Mudasir Ansari	P & D , SAGP
133	Mr. Tanzel Nazir	SCA
134	Mr. Umair Ali	SCA
135	Mr. Asif Mangi	SCA
136	Mr. Sayed Hasam Ali	MMP
137	Mr. Salman Mairaj	MMP
138	Mr. Imran Zameer	MMP
139	Mr. M. Ali Sheeshmahal	MMP
140	Mr. M. Zohaib	SGS(Pvt)
141	Mr. Adil Qureshi	ACE
142	Miss. Manahil	ACE
143	Mr. M. Asghar	DESCON
144	Mr. Ghaffar	A.A Association
145	Mr. G. Muhidin	SUPARCO
146	Dr. Ali Asghar Mahessar	PMO SBIP Irrigation Department
147	Dr. Gill Braulik	DR&C
148	Mr. Takeaki Sato	World Bank

Annex F: Details of First Round of Consultations

1. Villages consulted in the Canal Command Areas

Name of the Village or FO___:Qader Dad
Name of Offtaking Canal___:Narra Canal from RD:378 Left Side
Name of Minor/Distry :Lukturko Minor

Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
Ali Gowher Sahto	Laoung	FO Chairman	0321-3129676
Ali Nawaz	Qadir Dad	W/C Chairman	0321-3141055
Abid Pitafi	Jabbar Ptafi	Land Owner	0320-3537905
Din Mohammad	Ali Gauhar	Land Owner	0324-3955483
Bahram	Wazir Sahto	Land Owner	Nil
Saddar Din	Mohammad Umar	Land Owner	0300-3381584
Photo Faqeer	Loaung sahto	Land Owner	0324-3955493
Imam Bux	Laoung Sahto	Land Owner	0324-3955487
Mohammad Ali	Photo Khan	Land Owner	0322-3180091

Name of the Village or FO___:Kathoor Town
Name of Offtaking Canal____:Narra Canal from RD:324 Righ Side Name of Minor/Distry :Malook Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Ali Bux Shar	Thado Khan Shar	FO Chairman	0300-3100296
2	Atta Hussain	Thado Khan	W/C Chairman	0321-3186368
3	Haji Nawaz Ali	Sabhago Khan	Land Owner	Nil
4	Haji Rab Nawaz	Haji Nawaz Ali	Land Owner	0300-3945106
5	Mohammad Khan	Ali Bux	W/C Chairman	0322-32939622
6	Mohammad Ali	Shah Mir	Land Owner	Nil
7	Naseer	Mohammad Yousuf	Land Owner	Nil

Name of the Village or FO___:Pahlwan Shar
Name of Offtaking Canal____:Narra Canal from RD:384 Left Side
Name of Minor/Distry :Kirriri Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mohammad Rahim Shar	Pahlwan	FO Chairman	0321-3503139
2	Imam Bux	Saeed Ullah	Land Owner	0322-3261076
3	Irshad Ali	Mohammad Rahim	FO member	Nil
4	Ghulam Haider	Jan Mohammad	Land Owner	0303-3486711
5	Ghulam Ali	Mohammad Umar	Land Owner	0303-2425811
6	Zahid Ali	Attar Shar	Land Owner	0306-3379693
7	Ghulam Shabbir	Nizam Uddin	Land Owner	0322-3619018
8	Jindo Khan	Mohammad Somar	Land Owner	0321-3233-216
9	Mumtaz Ali	Shahbaz Dino	Land Owner	0321-3083039
10	Ghulam Akbar	Mohmmad Jiyal	Land Owner	0304-3462816
11	Ghulam Qadir	Haji Jabir	W/C chairman	Nil
12	Abdul Hakim	Mohamad Rahim	Land Owner	Nil

Name of the Village or FO___:Laiwari Minor Head
Name of Offtaking Canal_____:Narra Canal from RD:311 Left Bank Name of Minor/Distry :Laiwari Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Habib Ullah Shar	Banu Khan	FO Vice Chairman	0300-3168654
2	Haji Mohammad Mithal	Sono Khan	Land Owner	0322-3170788
3	Ghulam Mustafa	Haji Mohammad Saleh	W/C Secretary	0308-8390772

4	Sher Mohammad	Abdul Wahab	Lift Pump Operator	Nil
5	Abdul Karim	Mohammad Panjal	W/C Chairman	0321-3114807
6	Shahbaz Dino	Mohammad Saleh	Land Owner	0308-3663585
7	Mumtaz Ali	Bagh Ali	Land Owner	0321-3415567
8	Haji Sakhi Bux	Jahan Khan	WC Chairman	0300-5035535
9	Ghulam Rasool Chandio	Ali Bux	W/C Chairman	0301-3860391
10	Bashir Ahmad	Haji Sakhi Bux	Land Owner	0322-3618909
11	Imam Ali	Hamal Khan	Land Owner	0322-3162480
12	Haji Mohammad Hayat	Faqeer Mohammad	FO General Secy	0300-3169357
13	Mohammd Ismail	Noor Mohammad	Land Owner	0321-3186372
14	Abdul Ghaffar	Mohammad Hayat	Land Owner	0321-3420535
15	Bagh Ali	Dil Wash	Land Owner	Nil
16	Hakim Ali	Punhal	Land Owner	0321-3186121
17	Ghulam Shabbir	Mohammad Hayat	Land Owner	0300-2459711
18	Ghulam Hussain	Qamar Din	Land Owner	0321-396076
19	Meher Ali	Ubaid Ullah	Tenant	0321-3156227
20	Ali Raaz	Dattar Dino	Land Owner	O323-3612068

Name of the Village or FO___:Mumtaz Channel Head
Name of Offtaking Canal____:Narra Canal from RD:300 Right Side Name of Minor/Distry :Mumtaz Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Imdad Hussain	Bano Khan	Land Owner	03000215535
2	Jeal Khan	Sharaf Din	FO Chairman	0300-7711784
3	Mohammad Nawaz	Bahar Ridd	Land Owner	Nil
4	Ghulam Ahdi	Soreh	Land Owner	Nil
5	Anayat Ali	Banio Khan	Land Owner	0321-3630254
6	Ali Mohammad	Rasool Bux	FO G.Secretary	0303-3713422
7	Mohammad Illyas	Mohammad Ibad	Land Owner	Nil
8	Sada Hussain	Khadim Hussain	Land Owner	0321-3144151
9	Gulam Mustafa	Khuda Bux	Land Owner	0320-2763110

Name of the Village or FO___:Nauabad
Name of Offtaking Canal____:Narra Canal from RD:282 Left Side Name of Minor/Distry :Nauabad Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Allah Warrayo	Haji Mohammad Ibrahim	Land Owner	0300-3102939
2	Aijaz Ali	Haji Mohammad Ibrahim	Land Owner	0300-3123084
3	Shaukat Ali	Khan Mohammad	Land Owner	0306-0353540
4	Malhar Faqeer	Khameso Bhambhro	Land Owner	0321-3125107
5	Mian Dad Faqeer	Pir Bux Bhambhro	Land Owner	Nil
6	Mubarak Bhambhro	Tharo Faqeer	Land Owner	0322-3175735
7	Sain Dad	Pir Bux	Land Owner	0300-2707698

Name of the Village or FO:___Pharhyaro Channel Head
Name of Offtaking Canal:____Narra Canal from RD:220 Right Bank Name of Minor/Distry:_RD 203 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Khaliq Dino	Noor Mohammad	FO Chairman	0322-3936624
2	Shah Mohammad	Qadir Bx	Land Owner	0322-3613913
3	Khadim Hussain	Allah Dad	FO Vice Chairman	0321-3130937
4	Ashiq Hussain	Said Khan	FO Genera; Secy	0301-5193992
5	Altaf Hussain	Khadim Hussain	FO Treasurer	0321-3380981
6	Shahzado	Gul Sher	Lift Pump operator	0322-3619402
10	Sana Ullah	Baddar Din	Pesh Imam	0306-9018383

11	Liaqat Ali	Shah Mir Khan	Land Owner	Nil

Name of the Village or FO____:Pharhyaro Channel Head
Name of Offtaking Canal____:Narra Canal from RD:220 Right Bank Name of Minor/Distry :RD 203 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Khaliq Dino	Noor Mohammad	FO Chairman	0322-3936624
2	Shah Mohammad	Qadir Bux	Land Owner	0322-3613913
3	Khadim Hussain	Allah Dad	FO Vice Chairman	0321-3130937
4	Ashiq Hussain	Said Khan	FO Genera; Secy	0301-5193992
5	Altaf Hussain	Khadim Hussain	FO Treasurer	0321-3380981
6	Shahzado	Gul Sher	Lift Pump operator	0322-3619402
7	Sana Ullah	Baddar Din	Pesh Imam	0306-9018383
8	Liaqat Ali	Shah Mir Khan	Land Owner	Nil

Name of the Village or FO____:Mir Akhtar Hussain Talpur
Name of Offtaking Canal____:Narra Canal from RD:214 Left Bank Name of Minor/Distry :RD 214 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mir Akhtar Hussain Talpur	Mir Ashiq Hussain Tapur	FO Chairman	0300-3140544
2	Mohammad Rafique Dogar	Ashiq Dogar	Munshi of Mir	0305-2520798
3	Imdad Ali	Mattal	Land Owner	0304-6042343
4	Allad Dad	Sain Dad	Tenant	0304-3421843

Name of the Village or FO____:Pir Bux Gaho
Name of Offtaking Canal____:Narra Canal from RD:450 Left Side Name of Minor/Distry :Pir Bux Gaho Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mohammad Hassan Gaho	Abro Faqeer	FO Chairman	0321-3631786
2	Abro Faqeer	Hazoor Bux	Land Owner	0322-3786455
3	Mohammad Qasim	Soomro	Tenant	Nil
4	Mohammad Amin	Hadi Bux	Tenant	0322-3690811

Name of the Village or FO____:Panjal Khan Bamhbro
Name of Offtaking Canal____:Narra Canal from RD:116 Left Bank Name of Minor/Distry :RD:116 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Hassan Bux	Hadi Bux	Land Owner	0300-3185519
2	Noor Mohammad	Badal	Land Owner	Nil
3	Kamal	Imam Bux	Land Owner	0307-3412512
4	Ali Nawaz	Latif Dino	Land Owner	0303-2717585
5	Zameer Ali	Mohammad Panjal	FO Chairman	0300-3147660
6	Lal Bux	Mohammad Ramzan	FO Vice Chairman	0303-2817047
7	Hadi Bux	Habib Ullah	Land owner	Nil
8	Khuda Bux	Hadi Bux	Land Owner	0303-3470485
9	Karam Ali	Chibhar Khan	FO General Secy	0300-3191281
10	Bashir Ali	Mohammad Panjal	Land Owner	030-7342897
11	Ghulam Raza	Ghulam Akbar	Land Owner	0300-3544622
12	Qalandar Bux	Mohammad Soomer	Tenant	0304-1360720
13	Azhar Ali	Ghulam Qasim	Land Owner	0306-5820077
14	Imran Ali	Ghulam Qasim	Land Owner	0300-3921639

Name of the Village or FO____:Samoo Khan Bamhbro
Name of Offtaking Canal____:Narra Canal from RD:145 Left Bank Name of Minor/Distry :RD:145 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Khuda Bux	Mohammad Bux	Land owner	0305-2647605

2	Rahim Dino	Nawab Ali	Land Owner	0344-3380374
3	Ibrahim	Sain Dino	Land Owner	Nil
4	Bangul	Qaim	Land Owner	Nil
5	Shafi Mohammad	Badal	Land Ower	0306-2639527
6	Ashiq Hussain	Samo Khan	W/C Chairman	0302-3104300
7	Gulan	Jamshir	Land Owner	0340-7342140
8	Baqir Ali	Mohammad Ibrahim	Land Owner	0303-5562215
9	Abdul Razaq	Mohammad Punhal	Land Owner	0305-3223751
10	Ali Nawaz	Gul Sher	Land Owner	0303-2570575
11	Sodo	Imam Bux	Land Owner	0305-3458687
12	Imtiaz Ali	Qaim Khan	Land Owner	0305-3277593
13	Mohammad Hassan	Ali Murad	FO Chairman	0302-3619934
14	Jinsar Ali	Raho Khan	Land Owner	0303-2274404
15	Ghulam Hussain	Mehar	Land Owner	0307-3765830
16	Rab nawaz	Roshan Ali	Land Owner	0344-3700549
17	Sher Mohmmad	Hussain Bux	Land Owner	Nil
18	Bachal Khan	Aman Khan	Land Owner	0305-3514425
19	Ali Dino	Badal Khan	W/C Chairman	0303-2468766
20	Qurbam Ali	Khan Mohammad	Tenant	0303-2906976

Name of the Village or FO____:Chaudhry Asghar Ali
Name of Offtaking Canal____:Narra Canal from RD:196 Left Bank Name of Minor/Distry :RD:196 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Ch Asghar Ali	Nil	FO Chairman	0321-8661109
2	Ch: Zul Qarnain	Ch Asghar Ali	Landlord	0323-6057676
3	Ali Ganj	Mir Mohammad	Employee of Ch	0311-3188434
4	Abdul Ghafoor	Mehr Din	Tenant	Nil
5	Hakim	Seetal	Tenant	0303-3702090
6	Mohammad sachal	Sobharo Khan	FO Treasurer	0306-2901061
7	Ghulam Raza	Dadan	Land Owner	0307-2839155
8	Jabbal	Haji Samo	Tenant	Nil
9	Hatim	Qadir Bux	Land Owner	Nil
10	Mir Hassan	Mojan	Land Owner	0304-1421202

Name of the Village or FO____:Ayaz Abad
Name of Offtaking Canal____:Narra Canal from RD:205 Right Bank Name of Minor/Distry :RD:205 Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Sohrab Khan	Sudheer Khan	FO Chairman	0300-3106453
2	Nisar Ahmad	Ch Abdul Aziz	W/C Chairman	0300-8212391
3	Imdad Ali	Gulam Mohammad	W/C Chirman	0300-3123364
4	Ghulam Madni	Hassan Bux	Land Owner	0321-3159029
5	Yr Mohammad	Khabbar Khan	FO Vice Chairman	0322-3643127
6	Allah Bachayo	Haji Bahwal Khan	FO Treasurer	0300-2979301
7	Riaz Hussain	Shah Beg	W/C Chairman	0300-3101472
8	Mohammad Sharif	Memo	W/C Chairman	0302-2215081
9	Ghulam Shabir	Sudheer Khan	Land Owner	0322-3629639
10	Haji Ghulam Akbar	Rasool Dino	Land Owner	Nil

Name of the Village or FO____:Kot Saraiko Name of Offtaking Canal:_____:RD:118 Left Bank Name of Minor/Distry :RD:118_

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Talib Hussain	Khadim Hussain	Tenanat	0303-2468540
2	Taj Mohammad	Dhani Bux	Land owner	0305-3961902
3	Ghulam Qadir	Wali Mohammad	Tenant	Nil
4	All Jurio	Bagh Ali	Land Owner	0306-8951214
5	Mohammad Panjal	Ghulam Shabir	FO General Secy	0303-8702117

6	Skindar Ali	Rahim Dad	Tenant	0308-3651321
7	Amir Ali	Ghulam Mohammad	Land Owner	0305-3624038
8	Madad Ali	Dhani Bux	Ex-FO Chairman	0303-3296405
9	Latif Dino	Ghulam Bahar	Tenant	0307-7710241
10	Mir Hassan	Talib Hussain	Tenant	Nil
11	Riaz Hussain	Shahbaz Dino	FO Chairman	0303=3710235

Name of the Village or FO____:Atta Mohammad Ara Din
Name of Offtaking Canal____:Narra Canal from RD:414 Left Side
Name of Minor/Distry :Dingri Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mushtaq Ali	Atta Muhammad	FO Chairman	0322-3744835
2	Ghulam Mustafa	Mohammad Ramzan Ara Din	Land Owner	0322-3616027
3	Ali Hassan Ara Din	Ali Nawaz	Land Owner	Nil
4	Arbelo	Ali Mardah	W/C Chairman	0303-9125271
5	Mohammad Murad	Mano Khan	Land owner	0321-3603597
6	Atta Mohammad	Mohammad Tagial Ara Din	Land Owner	Nil
7	Sait Ali	Mohammad Azam	Land Owner	Nil
8	Muhammad Malook	Shah Muhammad	Land Owner	0321-3123370
9	Mohammad Waris	Ghulam Akbar	Land Owner	Nil
10	Mitho	Jaro	Land Owner	0320-3133283
11	Soomer Khan	Mohammad Murad	W/C Chairman	Nil
12	Raib Ali	Mohammad Urs	Land Owner	Nil
13	Irshad	Samd Khan	Land Owner	0321-313-8664
14	Qurban	Atta Mohammad	Land Owner	0321-35158014
15	Sajan	Ellahi Bux	Land Owner	Nil
16	Inayat Ali	Mumtaz Ali	Tenant	Nil

Name of the Village_____:Haji Raza Mohammad Shar Name of Canal_____:Khairpur East Canal
Name of Offtaking Canal:Ali Nawaz Wah Name of Minor/Distry :Bhango Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mohammad Sachal Shar	Mohammad Bachal	Land Owner	0300-0370999
2	Zulfiqar Ali	Ghulam Murtaza	Land Owner	0305-3155347
3	Mohammad Shahid	Abdul Kareem Shar	Land Owner	0300-3131166
4	Mohammad Arshad	Abdul Kareem Shar	Land Owner	0300-8210533
5	Abdul Ghani	Ghulam Rasool	Land Owner	0300-3123682
6	Maqbool Hussain Abupoto	-	Land Owner	0344-3778881
7	Qaim Din	Haji Ghulam Asghar	Land Owner	0331-2734930
8	Mohammad Sarwar	Gulam Bahar	Land Owner	0300-4166411
9	Mohammad Ibraheem	Abdul Wahab	Land Owner	0333-1247424

Name of the Village or FO___:Haji Mohammad Soomar Halipoto
Name of Offtaking Canal____:Khairpur East Canal from RD:293.6 Right Side Name of Minor/Distry :Faiz Ganj Wah

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Habib Ullah	Abdullah	Lander Owner	0301-3674308
2	Haji Mohammad Somar	Baloch Khan	Lander Owner	3033-3998749
3	Altaf Hussain	Mohd Ramzan	Lander Owner	0300-3186818
4	Jamal Din	Nizam Uddin Shar	Lander Owner	0300-3136672

5	Haji Ghulam Rasool	Haji Abdul Rhman	Lander Owner	0301-2932502
6	Hassan Ali	Nizam Uddin	Darago	0301-2931399
7	Ghulam Mustafa	Arz Mohd	Lander Owner	0300-3295603
8	Mohd Ali	Lemo Khan	Lander Owner	0307-3728938
9	Rustam Ali	Abdul Rehman	Lander Owner	0300-8080487
10	Anwar Ali	Kirrir Khan	Lander Owner	0302-3613785
11	Moula Bux	Nawab Khan	Lander Owner	0306-3075381
12	Hakim Ali	Miral Khan	Lander Owner	0300-3493946
13	Wahid Bux	Mohd Ali	Lander Owner	0304-8741880
14	Mumtaz Ali	Mazari Khan	Lander Owner	0306-2836387
15	Ghulam Haider	Ghulam Nabi	Lander Owner	0300-2824032
16	Ali Hassan	Fazal Mohd	Lander Owner	0300-3107185
17	Abdul Sattar	Khabar Khan	Lander Owner	0302-7555825
18	Abdul Raheem	Mohd Somar	Lander Owner	0304-3888939
19	Mohammad Chuttal	Mohd Somar	Lander Owner	0300-3255802
20	Rais Gul Mohammad	Habib Ullah	Lander Owner	0306-2609242
21	Mehrab Ali	Abdul Salam	Lander Owner	0307-3699213
22	Qurban Ali Memon	Lutu Ali Memon	SDO Irrigation	0300-3117544
23	Ghulam Mustafa	Ali Sher Abro	Sub Eng Irrigation	0301-3424964
24	Rehmat Ullah	Din Mohd	Sub Eng Irrigation	0300-3553549

Name of the Village_____:Gul Hassan Kubar Name of Offtaking Canal:Khairpur East Canal
Name of Minor/Distry :Khan Wah

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Wahid Ali	Ali Sher	Land Owner	0340-1384184
2	Atta Hassan	Mubarak	Land Owner	Nil
3	Ameer Ali	Ahmed Khan	Land Owner	0344-0009876
4	Ali Jan	Ali Murdah	Land Owner	0347-1606719
5	Abdul Razaq	Kodd Khan	Land Owner	Nil
6	Zeeb Kubar	Ali Khan	Land Owner	Nil
7	Anwar Kubar	Atta Mohammad	Land Owner	Nil
8	Ali Bux	Mohammad Waryam	Land Owner	Nil
9	Sajid Ali	Ali Mardad	Land Owner	0344-3781629
10	Asim Ali	Abdul Raqaq	Land Owner	Nil
11	Hazoor Bux	Mohammad Sadiq	Land Owner	0345-0179369
12	Mohammad Umer	Abdul Hameed	Land Owner	Nil
13	Farooq Ahmed	Safer Khan	Land Owner	0347-0308290

Name of the Village or FO____:Nazar Faqeer Jamro
Name of Offtaking Canal_____:Khairpur East Canal from Ali Baher WahLeft Side Name of Minor/Distry :Machi Minor

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Naseer Ahamd	Mohd Ramzan	Land Owner	0301-3506342
2	Raz Ali	Sabhao Faqeer	Land Owner	0347-3211178
3	Vird Ali	Mohd Suleman	Land Owner	0305-3479599
4	Saeed Ahmad	Mohd Ramzan	Land Owner	0344-2450748

5	Zahid	Mohd Panjal	Land Owner	0305-3209651
6	Gadda Hussain	Mohd Parrial	Land Owner	0343-3754881
7	Muhtiar Ali	Raz Ali	Land Owner	0347-3108701
8	Ghulam Akbar	Nabi Bux	Land Owner	0304-0529772
9	Ghulam Mohammad	Allah Dino	Land Owner	0305-3291693
10	Nasrullah	Gulam Ahdi	Land Owner	0306-3647779
11	Jameel Ahaad	Ghualm Ahdi	Land Owner	0300-2739023
12	Ghulam Musta	Mohd Yaqoob	Land Owner	0301-3684927
13	Mohd Rafique	Jamal Din	Land Owner	Nil

Name of the Village or FO____:Bhutta Goth
Name of Offtaking Canal____:Khairpur East Canal from RD:78.500 Right Side Name of Minor/Distry :Sanhro Distry

S#	Name of the Participant	Father's/Husband Name	Type of Farmer	Contact No
1	Mukhtiar Bhutoo	Mureed	Land Owner	0304-9536703
2	Sahib Dina	Abdul Hamid	Land Owner	0303-9719282
3	Sajad Hussain	Haji Feroz Khan	Land Owner	0301-3971199
4	Sahib Hussain	Mohammad Pathan	Land Owner	0301-3652704
5	Babar Hussain	Ejaz Hussain	Land Owner	0300-3363183
6	Baqir Hussain	Rasool Bux	Land Owner	0303-2445864
7	Hamad Ullah	Ghous Bux	Land Owner	0308-3600230
8	Jawed Ali	Ghulam Raza	Darogo Irrigation	0305-2334982
9	Kamal	Ali Murad	Dargo Irrigation	0301-3852005

Name of the Village_____:Garibo Khan Chandio Name of Canal_____:Khair Pur West Feeder Name of Offtaking Canal_____:Mahesar RD 04 Left Side
Name of Minor/Distry: : Chandia Minor

S#	Name of the Participant	Father Name	Type of Farmer	Contact No
1	Adam Khan	Mohammad Tagial	Land Owner	0307-3941384
2	Allah Wadhaio	Gulab Chandio	Land Owner	Nil
3	Rab Dino Chandio	Manik Khan	Land Owner	0303-3211567
4	Ghulam Mustafa	Ali Sher	Land Owner	0308-3619611
5	Gul Mohammad	Manik Khan	Land Owner	Nil
6	Ali Murad	Peeran	Land Owner	Nil
7	Haji Khaskheli	Sain Dino	Land Owner	Nil
8	Javeed Ahmad	Ali Murad	Land Owner	0307-3677455
9	Mustafa Khaskheli	Mohammad Mithal	Land Owner	Nil
10	Haji Khadim	Mohammad Tagial	Land Owner	Nil
11	Bux Ali	Sain Dino Khaskheli	Land Owner	Nil
12	Ali Mohammad	Mohammad Sadik	Land Owner	Nil
13	Mujahid	Gul Mohammad	Land Owner	0302-2680905
14	Naeem Ullah	Adam Khan	Land Owner	0304-8018766
15	Haji Mohammad	Manik Khan	Land Owner	0308-3643491

Name of the Village_____:Machhar Chouk Name of Canal_____:Khair Pur West Feeder
Name of Offtaking Canal____:Mehrab Minor RD 40 Right Side Name of Minor/Distry :Machhar Minor

S#	Name of the Participant	Father Name	Type of Farmer	Contact No

1	Mohammad Panjal	Ghulam Sarwar	Land Owner	Nil
2	Lal Dino	Dhani Bux	Land Owner	0300-3183708
3	Ejaz	Mohammad Bux	Land Owner	0308-3633161
4	Mohammd Suleman	Moula Bux	Land Owner	Nil
5	Mohammad Iqbal	Mohammad Achar	Land Owner	0304-4518002
6	Taj Mohammad	Mohammad Ramzan	Land Owner	0344-3142361

Name of the Village_____:Lal Bux Mangi Name of Canal_____:Khairpur West Canal
Name of Offtaking Canal_:Faiz Wah from RD 75 R/S Name of Minor/Distry :Mangi Minor

S#	Name of the Participant	Father Name	Type of Farmer	Contact No
1	Mukhtiar Hussain	Saiendad	Land Owner	0301-3973375
2	Mohammad Ali Kandro	Sultan Ahmed	Land Owner	Nil
3	Wadero Eidal	Wader Loang	Land Owner	Nil
4	Mohammad Ishq Malah	Arbab Ali	Land Owner	0302-3647779
5	Wazir Ali Kandro	Shahdad	Land Owner	Nil
6	Mujahid Ali	Imam Bux	Land Owner	0307-3627303
7	Juneed Ali Mangi	Faiz Mohammad	Land Owner	0300-8084579
8	Mohammad Fateh	Yousif	Land Owner	Nil
9	Deedar Ali	Niaz Ali	Land Owner	Nil
10	Javeed	Shahnawaz	Land Owner	Nil
11	Saifal	Mohammad Bux	Land Owner	Nil
12	Fayaz Hussain	Gulshan	Land Owner	0306-0969774
13	Abdul Latif	Ghazi Khan	Land Owner	Nil
14	Ali Hassan Mari	Gul Hassan	Land Owner	0302-3252170
15	Mohammad Urs Mallah	Kooral khan	Land Owner	Nil
16	Mukhtiar kandro	Loang Khan	Land Owner	Nil
17	Khalid Hussain	Arz Mohammad	Land Owner	Nil
18	Sakha Hussain	Wali Mohammad	Land Owner	0307-3670274

Name of the Village_____:Haji Ali Dad
Name of Canal_____:Khair Pur West Feeder
Name of Offtaking Canal____:Khairpur West Feeder RD 106 Right Side Name of Minor/Distry :Mehrab Wah

S#	Name of the Participant	Father Name	Type of Farmer	Contact No
1	Taj Mohammad	Imdad Ali	Land Ower	0336-8244461
2	Liaqat Ali	Khair Mohammad	Land Ower	0302-8911907
3	Mohammad Maroof	Mohammad Wahiayal	Land Ower	Nil
4	Ejaz Ali	Qadir Bux	Land Ower	0300-3156347
5	Imam Din	Abdul Kareem	Land Ower	Nil
6	Bashir Ahmad	Rab Naawaz	Land Ower	0301-2176867

Name of the Village_____:Badal Khoro
Name of Canal_____:Khair Pur West Feeder
Name of Offtaking Canal____:Faiz Nahar RD 165 Right Side Name of Minor/Distry :Mehtani Minor

S#	Name of the Participant	Father Name	Type of Farmer	Contact No
1	Liaqat Ali Khoro	Karim Bux	Land Owner	0302-3695177

2	Ali Gohar	QalandarBux	Land Owner	Nil
3	Abdul Waheed	Abdul Hameed	Land Owner	0301-2214136
4	Sharf Din	Ahmad Din	Land Owner	Nil
5	Amir Ahmad	Atta Ullah	Land Owner	0300-7012797
6	Rashid Ali	Abdul Sami	Land Owner	0300-8971685
7	Nizam Din	Mohammad Yaqoob	Land Owner	0307-3596915
8	Ghulam Mustafa	Abdul Karim	Land Owner	0302-5825759
9	Sanaullah	Mohammad Arif	Land Owner	Nil
10	Tahir	Mohkam Din	Land Owner	0341-3566647
11	Amanat Ali	Liaqat Ali	Land Owner	0304-5481424
12	Khadim Hussain	Nawab	Darogo Irrigation	0301-3864295
13	Abdul Rasheed	Malik DIno	Darogo Irrigation	0306-2765185

Name of the Village_____:Waris Faqeer Mangrejo Name of Canal_____:Khair Pur West Feeder Name of Offtaking Canal_____:Khairpur West Canal RD 62
Name of Minor/Distry: :Old Jamsher Minor

S#	Name of the Participant	Father Name	Type of Farmer	Contact No
1	Abid Ali	Hafeez Ullah	Land Owner	0300-3692497
2	Waqar Ali Solangi	Ali NAwaz	Land Owner	0301-3428782
3	Mohammad Rafiq Mangrejo	Rasool Bux	Land Owner	Nil
4	Rafiq Mumtaz	Khuda Bux	Land Owner	Nil
5	Abdul rasheed	Mohammad Hashim	Land Owner	Nil
6	Mehmood Hussain	Hafeez Ullah	Land Owner	0306-3158278
7	Munir Ahmad	Mohammad Umar	Land Owner	Nil
8	Zahid Hussain	Sanaullah	Land Owner	Nil
9	Bashir Ahmad	Mohammad Hashim	Land Owner	Nil
10	Abdul Rehman	Hafeez Ullah	Land Owner	Nil
11	Abdul Jabbar	Niamat Ullah	Land Owner	Nil
12	Ghualm Qadir	Khair Mohammad	Darogo Irrigation	0302-3671375

2. District Level Government Stakeholders

Sr. No.	Designation	Department
1	Mr. Ghulam Rasool Channa, Conservator (Retd.)	Sindh Wildlife Department
2	Mr. Saeed Baloch, Conservator	Sindh Wildlife Department
3	Mr. Taj Muhammad Sheikh, Deputy Conservator, Sukkur	Sindh Wildlife Department
4	Mr. Akhtar Hussain Talpur, In charge	Dolphin Conservation Centre, Sindh Wildlife Department
5	Mr. Rahim Bux Awan, Chief Conservator (Retd.)	Sindh Forest Department
6	Mr. Zulfiqar Memon, Conservator, Sukkur	Sindh Forest Department
7	Mr. Iftikhar Ahmad Arain, Divisional Forest Officer, Sukkur	Sindh Forest Department
8	Mr. Kashif Khan Durrani, Divisional Forest Officer Parks, Sukkur	Sindh Forest Department
9	Mr. Ziadullah Laghari Divisional Forest Officer, Khairpur	Sindh Forest Department
10	Mr. Ghulam Mustafa Gopang, Deputy Director	Sindh Fisheries Department
11	Mr. Kamran, Senior Project Management Officer	Indus Dolphin project, WWF Pakistan
12	Ms. Uzma Noorin, Conservation Officer	WWF Pakistan
13	Mr. Shakeel Ahmad, Botanist	Shah Abdul Lateef University, Mirpur Khas
14	Prof. Dr. G. Raza Bhatti, Founder Director	Biodiversity Conservation Centre, Shah Abdul Lateef University, Mirpur Khas
15	Mr. Ali Sher, Representative	Fisher Folk, Sukkur

Annex G: News Paper Advertisments on Public Consultations

Date: 29 July 2017

Notice of Public Consultation

Environmental and Social Assessment of Sukkur Barrage Rehabilitation Project

The study

Sindh Irrigation Department (SID) is undertaking environmental and social assessment for the Sukkur Barrage Rehabilitation Project under the financial assistance from the World Bank. The proposed project aims to repair and strengthening of the main barrage structure, canal head regulators, and gates.

Public Consultation:

A team of environmental and social consultants are preparing EIA, SIA and RAP for this Project. These draft reports are available on SID website for public review (http://www.sbip.org.pk/). As part of these studies and in accordance with the World Bank Operational Policy 4.01 and Environmental Protection Acts of Government of Sindh, public consultations and a public consultation meeting will be conducted at Sukkur at the following date and location:

Date: Monday, 7August 2017 (from 9.00 am to 1.00 pm)
Location: Office SBIP, B # A-106 Sindhi Cooperative Housing Society, Sukkur

In this consultation meeting, the public can meet with the study team, discuss the study objectives, environmental and social issues and mitigation measures for all environmental and social impacts and can participate in the project planning process. All the concerned and interested people are invited to attend these meetings.

Comments:

We are interested in hearing any comments that you may have about the study. With the exception of personal information, all comments will be part of the public record. In addition, there will be a comment sheet available, please drop the completed complete sheet in the box provided at the venue or mail it to the address below:

Project Director
Sindh Barrages Improvement Project
F/77/1 Kehkshan Clifton Karachi
Telephone No. 022-9201654
Email: shafqat-63@gmail.com

News Paper: Awami Awaz

Date: 29 July 2017

عوامي حقن جي ترجمان، ڪمپيوٽر تي بهترين مڪمل اخبار

ABC CERTIFIED

ڪراچي، حيدرآباد ۽ سکر مان هڪ ئي وقت شايع ٿيندڙ

Daily AWAMI AWAZ

روزاني عوامي آواز

Daily AWAMI AWAZ Karachi

سال 28 ـ شمارو 209 | ڇنڇر 29 جولاءِ 2017ع ـ 5 ذوالقعد 1438هه | صفحا 12 ـ قيمت 15 رپيا

اسٽيڪ هولڊرز گڏجاڻي ۽ عوام سان مشاورت جو نوٽيس

سکر بيراج جي بحالي ۽ جديد ڪرڻ جي ڪم دوران ماحولياتي ۽ سماجي اپاءَ

عالمي بئنڪ جي سهڪار سان سنڌ ايريگيشن ڊپارٽمينٽ سکر بيراج جي بحالي جو ڪم ڪرائڻ چاهي ٿي جنهن لاءِ ماحولياتي ۽ سماجي سکر بيراج جو اپاءَ تي رهيو آهي. هن تجويز ڪيل منصوبي جو مقصد آهي بيراج ۽ [illegible] جي [illegible] ۽ دروازن جي مرمت ۽ مضبوطي ڪري سگهجي.

عوامي مشاورت

ماحولياتي ۽ سماجي ماهرن جي هڪ ٽيم هن تجويز ڪيل منصوبي جي لاءِ ماحولياتي رد عمل جي تشخيص (اي آءِ اي)، (ايس آءِ اي) ۽ (آر اي پي) تيار ڪري رهيا آهن جي ماحولياتي ۽ سماجي [illegible]. عوام جي معلومات ۽ [illegible] لاءِ [illegible] جي ويب سائيٽ (www.sbip.org.pk) تي موجود آهن. عالمي بئنڪ جي آپريشنل پاليسي 4.01 ۽ صوبي سنڌ جي ماحولياتي تحفظ جي [illegible] جي لاءِ ماڻهن جي صلاح مشورو ۽ اسٽيڪ هولڊرز جي گڏجاڻي سکر ۾ هيٺ ڏنل تاريخ ۽ جڳهه تي منعقد ڪئي ويندي.

تاريخ: 07 آگسٽ 2017ع سومر ڏينهن

ٽائيم: صبح 9 وڳي کان منجهند 1 وڳي تائين

جڳهه: سڳڻ ٽيس، ايس بي آءِ پي آفيس آئي ـ 106 سنڌي هائوسنگ ڪوآپريٽو سوسائٽي سکر

هن ڪنسلٽيشن (مشاورتي) گڏجاڻي ۾ ماڻهو ماحولياتي ۽ سماجي تحقيقاتي ٽيم سان ملي سگهندا. انهن تمام ماحولياتي ۽ سماجي اثرات جي مطالعي، متعلق ۽ ماحولياتي سماجي مسئلن جي بابت ڳالهه ٻولهه ڪري سگهندا. انهن لاءِ [illegible] دلچسپي رکندڙ ماڻهن کي هن ڪنسلٽيشن (مشاورتي) گڏجاڻي ۾ اچڻ جي دعوت ڏجي ٿي.

تبصرو ۽ تجويز

اسان هن مطالعي جي بابت ۽ توهان جا تاثرات ۽ خيالات ٻڌڻ ۾ دلچسپي رکون ٿا. ۽ توهانجي ڏاتي معلومات کان علاوه تمام تبصره ۽ تجويز [illegible] جو حصو ٿيندا ۽ خاص طور تي ڪنسلٽنٽ موجود هوندي جنهن کي مڪمل طور تي لکي يا ٻئي موجوده [illegible] ۾ [illegible] هيٺ ڏنل پتي تي موڪليندا.

پراجيڪٽ ڊائريڪٽر

سنڌ بيراجز امپروومينٽ پراجيڪٽ

F 77/1 ڪهڪشان ڪلفٽن ڪراچي

ٽيليفون نمبر 0229201654

اي ميل Sbiiqm_463@gmail.com

Annex H: Details of Second Round of Consultations

1. Public Consultation in Sukkur

Date: August 7, 2017
Venue: PMO Office, Sukkur

1. Haider Bhurgri, Consultant, PMO
2. Habib Ursani, DD (Tech), PMO, SBIP
3. Shahid Goheer, Resettlemetn Expert, ACE (Pvt.) Ltd.
4. Dr. Ali Asgher Mahesar, DD(Env), PMO, SBIP, ID, Sukkur
5. Abdul Fattah Memon, AXEN, SBIP Sukkur
6. Zahid Hussain Mughal, AXEN, Regulation SI Division
7. Asim, AXEN, Sukkur
8. Ali Hassan Mangi, AXEN, Irrigation
9. Khursheed Ahmed, XEN Sukkur Barrage, Irrigation
10. Sardar Kakar, Env. Specialist SBRMP, ACE
11. M. Imran, SPO, WWF-Pak
12. Mir Akhtar Hussain, Park Ranger, SWLD
13. Munir Ahmed, MBD, SYWO
14. Amir Hussain Jagrani, ACW, SWLD
15. Abdul Ghaffar Soomro, Resettlement Specialist, PMO SBIP
16. Shafiullah, Asst. Director (Tech), SEPA
17. Mansoor Zafar, Deputy Director Fish Sukkur, Sindh Fisheries Dept
18. Rana M. Iqbal Khan, Deputy Director Fisheries Ghotki, Sindh Fisheries Dept
19. Manzoor Ahmed Soomro, Assistant Director Fisheries, Sindh Fisheries Dept
20. Venkata Nukala, Env. Consultant, PMO
21. Imran Aziz Tunio, Technical Officer, PMO SBIP
22. Taj Muhammad, DCW, SWD
23. Anwar Ali, Game Officer, SWL
24. Najma Chandio, Communication Specialist, PMO SBIP
25. Mujtaba Hassan, Assistant Manager (Admin), PMO SBIP
26. Abdul Majeed Chachar, Director Fisheries Sukkur, Livestock and Fisheries Dept.
27. Riaz Ahmed Lakh, Asst. Warden Fisheries Sukkur, Livestock and Fisheries Dept.
28. Satia Parkash, AXEN Right Bank Region, Irrigation Dept. Right Bank Region
29. Shafqat Hussain Wadho, PD SBIP, Irrigation Department
30. Najam Khurshid, Consultant, SBIP

2. Consultation at Jamshoro

Date: November 29, 2017
Venue: University of Mehran, Jamshoro

1. Mahfooz Ursani, Add. General Secretary, SAB
2. Nadeem Shah, V.P Sindh Abadgar Board
3. Azam Rind, SABTSec, SAB
4. Mushtaq Ahmed Nizamani, SAB MCEC, SAB
5. Mashooque Ali, Sindh Abadgar Board
6. Imran Aziz Tunio, Technical Officer, PMO SBIP
7. Dr. Ali Asgher Mahesar, DD(E) PMO SBIP
8. Noor-ul-Arfeen Baloch, DD (Mech) SBIP PMO
9. Dr. Munir Babar, Professor, MUET, USPCAW
10. Ashfaque Ahmed Memon, XEN (Technical Officer), Development Region-I Irrigation Dept
11. Abdullah Bhurgri, Superintending Engineer, Irrigation Departmetn
12. Muhammad Aslam Qureshi, AXEN, Irrigation Dept
13. Sajid Ali Bhutto, SE Dadu, Irrigation Dept
14. Abdul Wahid, AXEN, Irrigation Dept
15. Shoaib Ahmed Sugrio, Executive Engineer, Irrigation Dept
16. Iqbal Ahmed Palijo, XEN SRP, Irrigation Dept
17. Ghulam Ali Jarik, Director, Sindh Development Studies Centre
18. Zareen Khan Rind, Asst. Professor, SDSC
19. Hizbullah Magnio, Communication Specialist, SIDA
20. Feroz Ahmed
21. Sajaad Ali Soomro, Deputy Director Engineering, SIDA
22. Muhammad Amin, Ecologist, SIDA
23. Tariq Asad Ursani, AXEN, Irrigation Dept
24. Javed Hakeem Memon, XEN Kotri Barrage, Irrigation Dept
25. Muhammad Anjum, Sub. Engineer, Irrigation
26. Dr. R. B. Mahar, DD USPCAW
27. M. Ibrahim Samoon, TL, Atkins-ACE-NDC
28. Habib Ursani, DD (Tech), Irrigation Dept, PMO
29. Shafqat Hussain PD SBIP, Sindh Irrigation PMO
30. Bakhshal Lashari, PD USPCASW MUET
31. Muhammad Azam, Student, USPCASW
32. Vipin Kumar OAd, MS Student, USPCASW
33. Shan Ali, Student
34. Amjad Ali, Abadgar
35. A. Razaque, DDT, SBIP
36. Syed Saqib Shah, Progress Farmer
37. Nadeem Waraich, Sub Engineer,
38. Ghulam Shabir Solangi, PhD Student, USPCASW
39. Asim Ali, PhD Student, USPCASW
40. Aneela Memon, PhD Scholar, USPCASW

41. Abdul Ghani Soomro, PhD Scholar, USPCASW
42. Muhammad Aslam Baloch, Sub Engineer, Kotri Barrage Jamshoro
43. Karam Illahi, Sub Engineer, Kotri Barrage Jamshoro
44. Ziauddin Abro, PhD Scholar, USPCASW
45. Abdul Basit Khan, DD (Env.), PCMU-SBIP
46. Dr. Najam Khurshid, Consultant, SBIP
47. Muneer A. Memon, Soil Scientist, USPCASW
48. Shahzad Hussain, Abadgar
49. Nabeel Ali Khan, Student MS-UNRM, USPCASW
50. Asad Faiz Khoso, Abadgar
51. Ghulam Mujtaba Unar, Dist: G.S, Sindh Chamber of Agriculture
52. Nisar Ahmed Khatian, Distt: President, Sindh Chamber of Agriculture
53. Mureed Abbas, Office Secretary, Sindh Chamber of Agriculture
54. Azizullah Channa, Lecturer, IEEM, MUET
55. Farman Ullah Shaikh, Abadgar
56. Tufail Ahmed, Regional Head MEC, P&D Dept
57. Inam Rehman, Asst. Director, Education Dept
58. Nadir Ali Nizamani, Student USPCASW
59. Aqeel Ahmed, Student, USPCASW

3. Consultation at Karachi

Date: November 30, 2017
Venue:PCMU Office, Karachi

1. Naimatullah Sohoo, Senior Coastal Engineer, National Institute of Oceanography
2. Taj Muhammmad Sheikh, CWL, SWD
3. Ibrahim Samoon, TL, Atkins-ACE-NDC
4. Shafqat Hussain Wadho, PD SBIP, Irrigation Department
5. Dr. Najam Khurshid, Consultant, SBIP
6. G. Murtaza Abro, Assistant Chief (W&D) Section P&D Dept
7. Hamera Aisha, Manager Wildlife, WWF-Pak
8. Altaaf Shaikh, Manager Conservation, WWF-Pakistan
9. Fateh Marri, PC, PCMU
10. Konishi Toru, TTL, WB
11. M. Azhar Khan, DD (Tech) EPA-Sindh
12. Abdul Basit Khan, DD(Env), PCMU
13. Farooq Ahmed Laghari, GIS Specialist, PCMU
14. Imtiazuddin Hisam, Deputy Team Leader, Atkins-ACE-NDC