Government of Sindh, Pakistan
Irrigation Department

Sindh Barrages Improvement Project -
Sukkur Barrage Rehabilitation and Modernization

Environmental and Social Management Plan of Cofferdams
(An Addendum to 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
CEAP	Construction Environmental Action Plan
CSC	Construction Supervision Consultant
Cumec	Cubic meters per second (m^3/s)
Cusec	Cubic feet per second (cf/s)
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
GoS	Government of Sindh
IEE	Initial Environmental Examination
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
MEC	Monitoring and Evaluation Consultant
MCM	Million Cubic Meters
NEQS	National Environmental Quality Standards
OHS	Occupational Health and Safety Specialist
PAK EPA	Pakistan Environmental Protection Agency
PCMU	Project Coordination and Management Unit
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
SMF	Social Management Framework
WBG	World Bank Group
WWF	World Wide Fund for Nature

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 project of the Government of Sindh (GoS) to rehabilitate the 85-year-old Sukkur barrage to enhance its useful life to safeguard the reliable supply of irrigation water to about 3.34 million ha[1]. The Project is located near the towns of Sukkur and Rohri in Sindh province. The World Bank is funding this Project 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 in 2017**, which was approved and cleared by the World Bank[2] and Sindh Environmental Protection Agency.

The present report is an addendum to the ESA and an Environmental and Social Management Plan (ESMP) of the Cofferdams. The original scope of work does not envisage the construction of cofferdams, and hence this addendum is prepared to update the environmental and social assessment carried out for the original Project.

1.1 Background

Need for improvement of Sukkur barrage. After eight decades of its useful life, the Sukkur barrage in Sindh has developed major safety issues. The feasibility study of the 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 were needed, 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 0.9 million cusec (25,485 m^3/s).

Original Scope of the Project. Major interventions proposed in the original Project are: These works include:

a. 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).
b. 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)
c. Civil works to improve the strength of barrage structure (RCC arches, stone arches, stone piers, etc.) and raising of left and right divide walls
d. Gates and mechanical works for improved gate operations and increasing the gate height by 61 cm (2ft)
e. Electrical works for improved reliable operations

[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.

[2] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/356891516200660593/environmental-and-social-assessment

Updated Scope of the Project. The updated scope of works now involves the replacement of all barrage and canal head regulator gates instead of repair and rehabilitation as included under item d) Gates and mechanical Works, of the original scope of works. For replacement of all gates, working under dry condition has been considered necessary for timely completion of works, requiring temporary river diversion works through cofferdams. A detailed description of the proposed works is given in Chapter 2. Further, about 1.5 km long 11 kV power line will be built to supply power to the barrage from the nearest grid station.

Rationale for changes in the scope of work. The original scope of works and ESA were based on technical studies carried out prior to 2017. However, the incident of June 2018, involving a crack in the back flange of horizontal girder in Gate 39 followed by the December 2019 incident of a crack in hoisting assembly of gate hoisting system in Gate 33, highlighted the necessity for revisiting the rehabilitation works identified in the inspections carried out during 2012-13. These identified problems were repaired immediately, followed by strengthening through bolting of additional 11m long MS Plate in the full length of the back flange of Gate 39 during the Annual Closure of January 2019. SID has engaged several international and national consultants to conduct a detailed inspection of gates and their structural integrity. These studies have recommended the replacement of all barrage gates.

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 the 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.

1.2 The Environmental and Social Assessment

Environmental and Social Assessment of the Project. The SID prepared an ESA and Social Management Framework (SMF) for the Sukkur Barrage Rehabilitation. The ESA adequately assessed all potential impacts associated with the implementation of Sukkur rehabilitation and prepared an environmental and social management plan (ESMP). During the preparation of SBIP, no land acquisition or resettlement was anticipated for Sukkur Barrage rehabilitation. The SMF was prepared, including the Resettlement Policy Framework (RPF) to guide the preparation of resettlement action plans (RAP) for any unforeseen land acquisition, and a Communication Strategy to support continued consultations during project implementation. These documents were approved by the World Bank in December 2017.

Dolphin Management Plan. The Indus River between the Guddu and Sukkur barrages is the nationally designated Indus Dolphin Reserve for Indus River Dolphin and also a RAMSAR wetland of international importance. This part of the river contains a large population of dolphins. Impacts of construction activities on dolphins were assessed, and mitigation measures are proposed in ESA. A dolphin conservation and management plan is being implemented under SBIP to strengthen the ongoing conservation activities.

Scope of this Addendum. The addendum only covers the description of additional works, impacts and risks associated with these works, and environmental and social management plan. The regulatory framework, environmental and social baseline conditions in the project area, and impact assessment presented for the original scope of work in the ESA remains the same, hence not repeated in this document. Detailed stakeholder consultations were conducted during the preparation and disclosure of the original ESA. Additional consultations were carried out during the preparation of this addendum with the World Wildlife Fund and Sindh Wildlife Department.

Contents of the present document: Detailed description of proposed additional project activities and analysis of alternatives are given in Chapter 2. Potential adverse impacts of the proposed activities are described in Chapter 3. ESMP, including institutional arrangements and conditions to be included in the bidding documents, are described in Chapter 4.

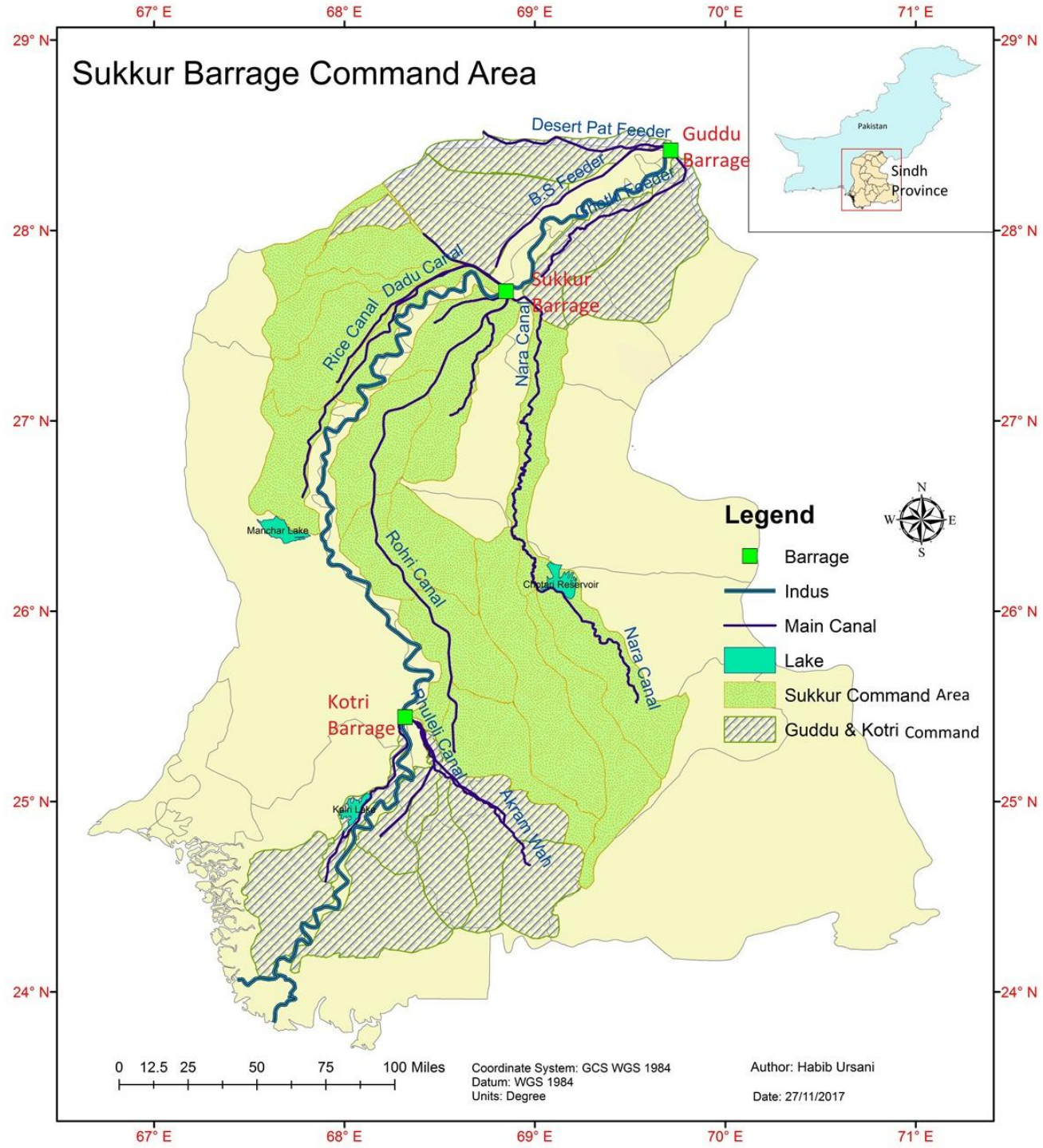

Figure 1.1: Location of Sukkur Barrage and its command area

2 Project Description

2.1 Background

Description of the barrage structure. The layout of the barrage is shown in **Figure 2.1**. 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. 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[3]. 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 the commissioning of the barrage in 1932, it was observed that the right bank canals were drawing excessive silt. This situation was investigated by 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.
- **Bay 3 – Spans 15 to 23**: **Tail Channel.** This is the section between the middle bank island and the outer bank wall. 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[4] in this bay were replaced during the refurbishment from 1980 to 1992. Span 23 is permanently closed by a masonry wall with a top-level of 200' (60.96m
- **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[5] , and the gates in this section were installed in 1986 to 1992.
- **Bay 8 – Spans 60 to 66**: **Left Pocket.** This is the section between the left abutment and the left bank wall. This section of the barrage controls flows from the left pocket. Each scouring sluice[6] 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.

[3] 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')

[4] 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

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

[6] 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)}.

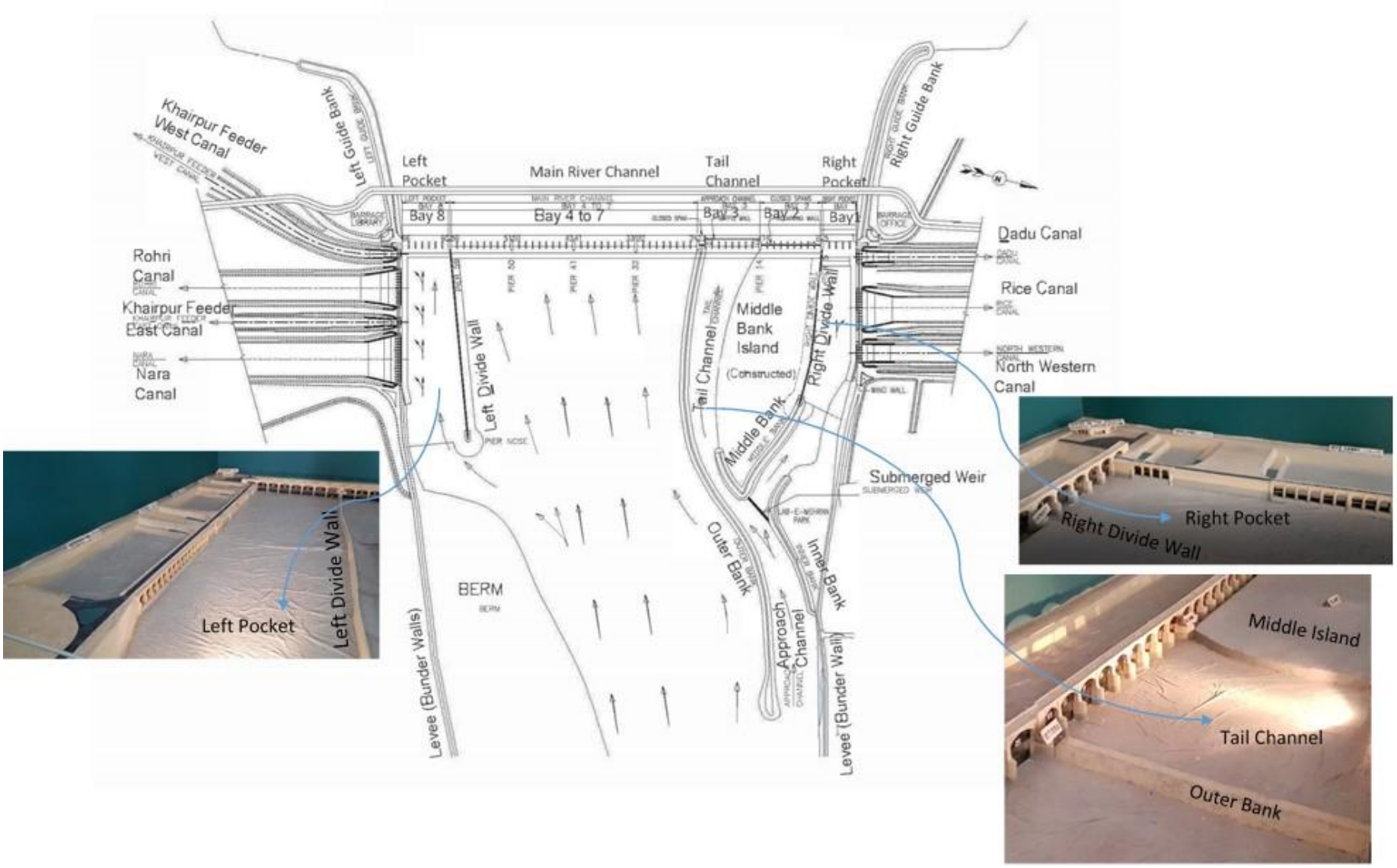

Figure 2.1: Existing Layout and sections of Sukkur barrage

2.2 Description of Proposed Works

The proposed works under the updated scope of work are given below, and these works require the construction of upstream and downstream cofferdams:

- Replacement of Tail Channel and Main River Channel Sluice Gates
- Barrage Foundation Inspection and Repairs.

2.2.1 Gate Replacement Scheme and Cofferdam Requirements

The gate replacement works will be carried out over a period of four years. The first year comprises of planning and procurement, whereas in the subsequent three years, the gate replacement works will be carried out during low flow season for about nine months each year. The works to be carried out each year are described below.

- **Year 1:** Procurement of material for cofferdams construction and finalization of implementation methodology by the Contractor
- **Year 2**: Replacement of 14 Main River Channel Sluice Gates in Barrage Spans 46 to 59 with foundation inspection/repairs.
- **Year 3**: Replacement of 8 Tail Channel Sluice Gates in Barrage Span 15 to Span 22 with foundation inspection/repairs in all the eight spans, and Replacement of 8 Main River Channel Sluice Gates in Barrage Span 24 to 32, excluding ongoing replacement work for gate in Span 31, with foundation inspection/repairs in all the 9 spans.
- **Year 4**: Replacement of 8 Main River Channel Sluice Gates in Barrage Span 33 to 45, excluding recently replaced gate in Span 35, 39 and 40 and ongoing works for replacement of gates 33 and 34, with foundation inspection/repairs in all 13 spans.

The year-wise cofferdam arrangement is shown in **Figures 2.2, 2.3 and 2.4**.

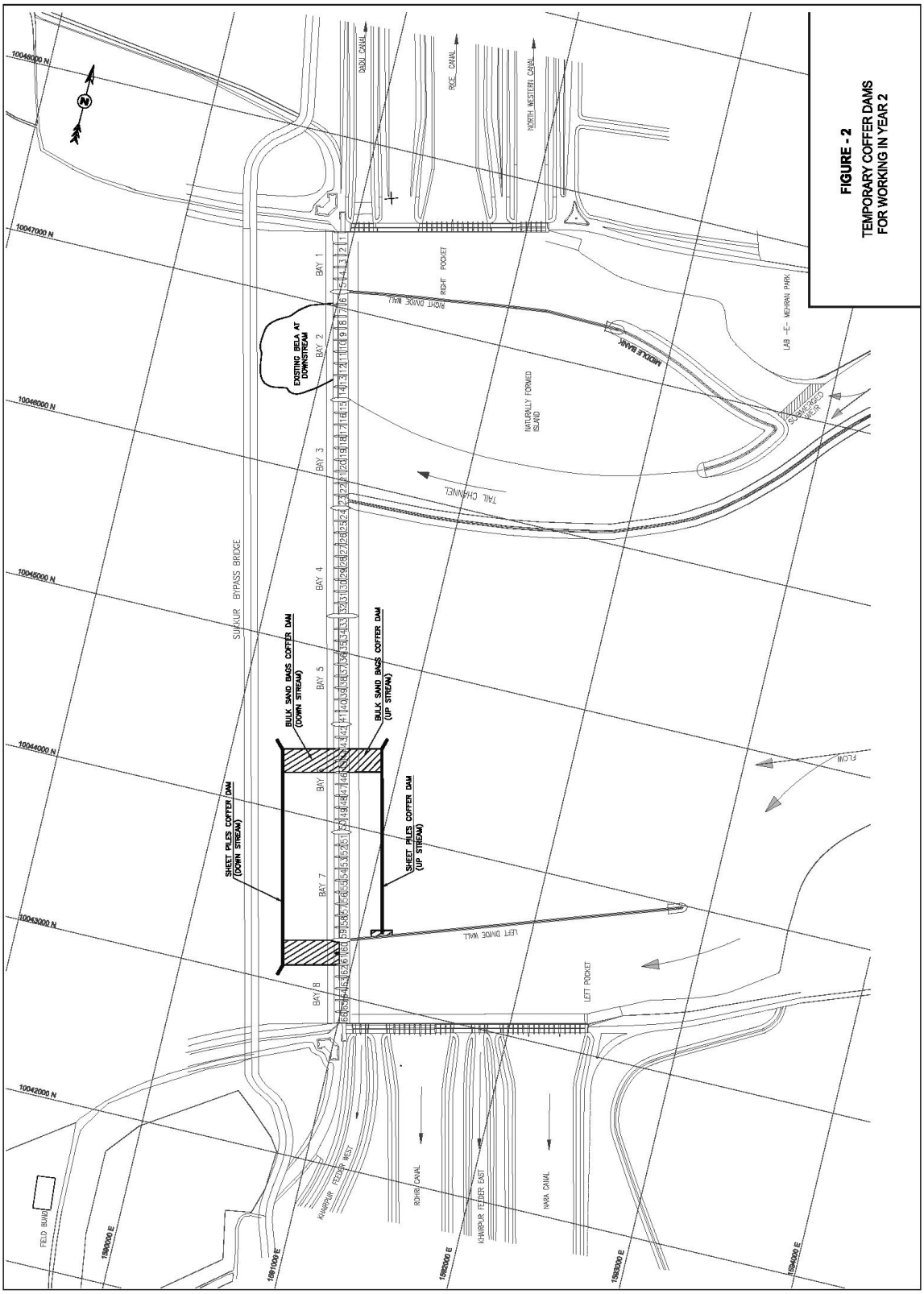

Figure 2.2: Cofferdam Arrangement for Year 2

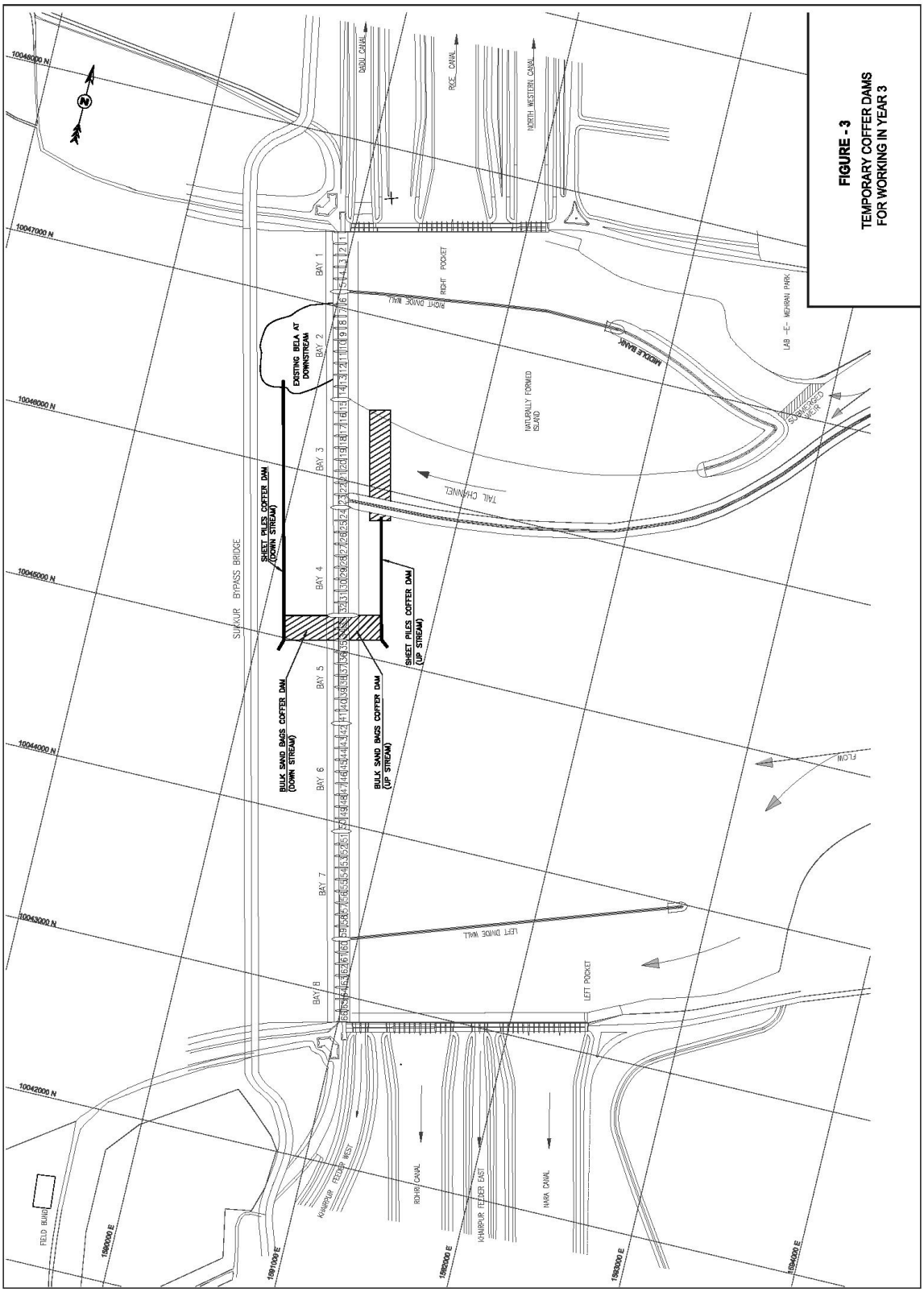

Figure 2.3: Cofferdam Arrangement for Year 3

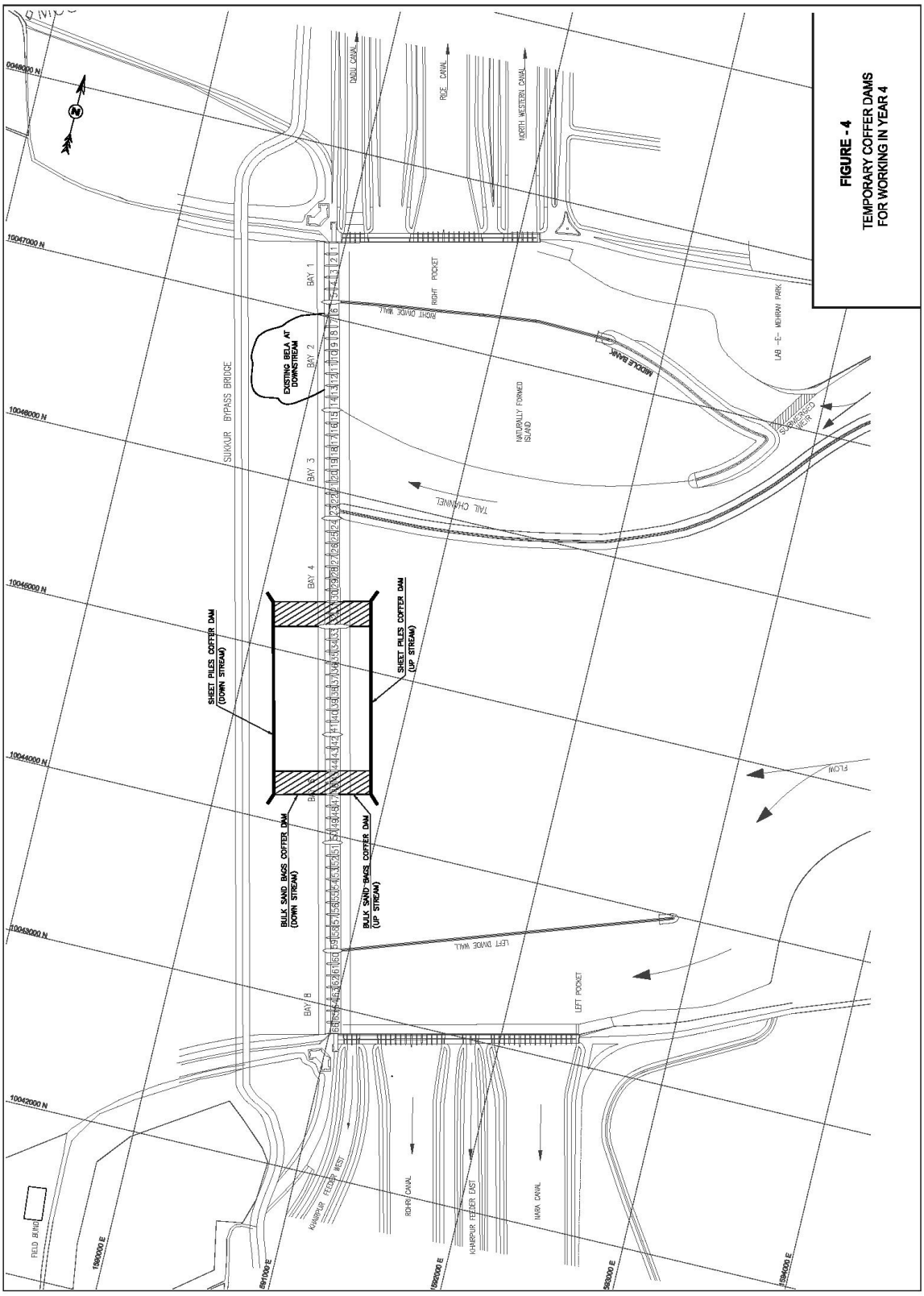

Figure 2.4: Cofferdam Arrangement for Year 4

2.2.2 Design Features of Cofferdams

The Sheet Pile Cofferdams have been selected for the length wherever possible. However, on top of stone masonry barrage foundation and upstream and downstream scour protection works, only the earthen cofferdams (embankments) were possible and proposed accordingly at these locations. This means that sheet pile cofferdams will be built on the upstream and downstream sides of the barrage. The upstream and downstream sheet piles will be connected on either side by earthen cofferdams.

The cofferdams have been designed with a freeboard of 4ft.

- Maximum Upstream Pond level 200.0ft
- Top of Upstream Cofferdam 204.0ft
- Maximum Downstream Water Level 191.0ft
- Top of Downstream Cofferdam 195.0ft

2.2.3 Sheet Pile Cofferdams

The upstream and downstream sheet pile cofferdams are made of twin lines of sheet piles with 6ft spacing in between. The river bed levels vary due to siltation, but the minimum bed level of 171.0 ft, same as the top of the River Sluice foundation, is used in the design of sheet pile for a total free-standing height of 33.0 ft with a total length of 70 ft for upstream sheet piles and free-standing height of 24.0ft with a total length of 50.0 ft for downstream sheet plies. The cross-section through upstream and downstream sheet piles cofferdam is shown in **Figure 2.5**. The twin Sheet Piles will be connected at the top through a structural connection and filled with silty sand material. This will enable extra strength for the required free-standing height as well as an improved seepage control.

The maximum length cofferdam with sheet pile will be required in Year 2 when 14 barrage spans will be isolated for gate replacement, requiring:

- 70ft high Upstream Twin Sheet Piles, for a length of 1,050ft and Single Sheet Piles for a length of 210ft, (1,150 number of 2ft wide sheet piles).
- 52 ft High Downstream Twin Sheet Piles on a length of 1,050ft and Single Sheet Piles on a length of 210ft (1,150 numbers of 2ft wide sheet piles).

Allowing for 90% reuse of sheet piles, stacking requirements will be for 1,200 sheet piles of 72ft and 52ft long, each.

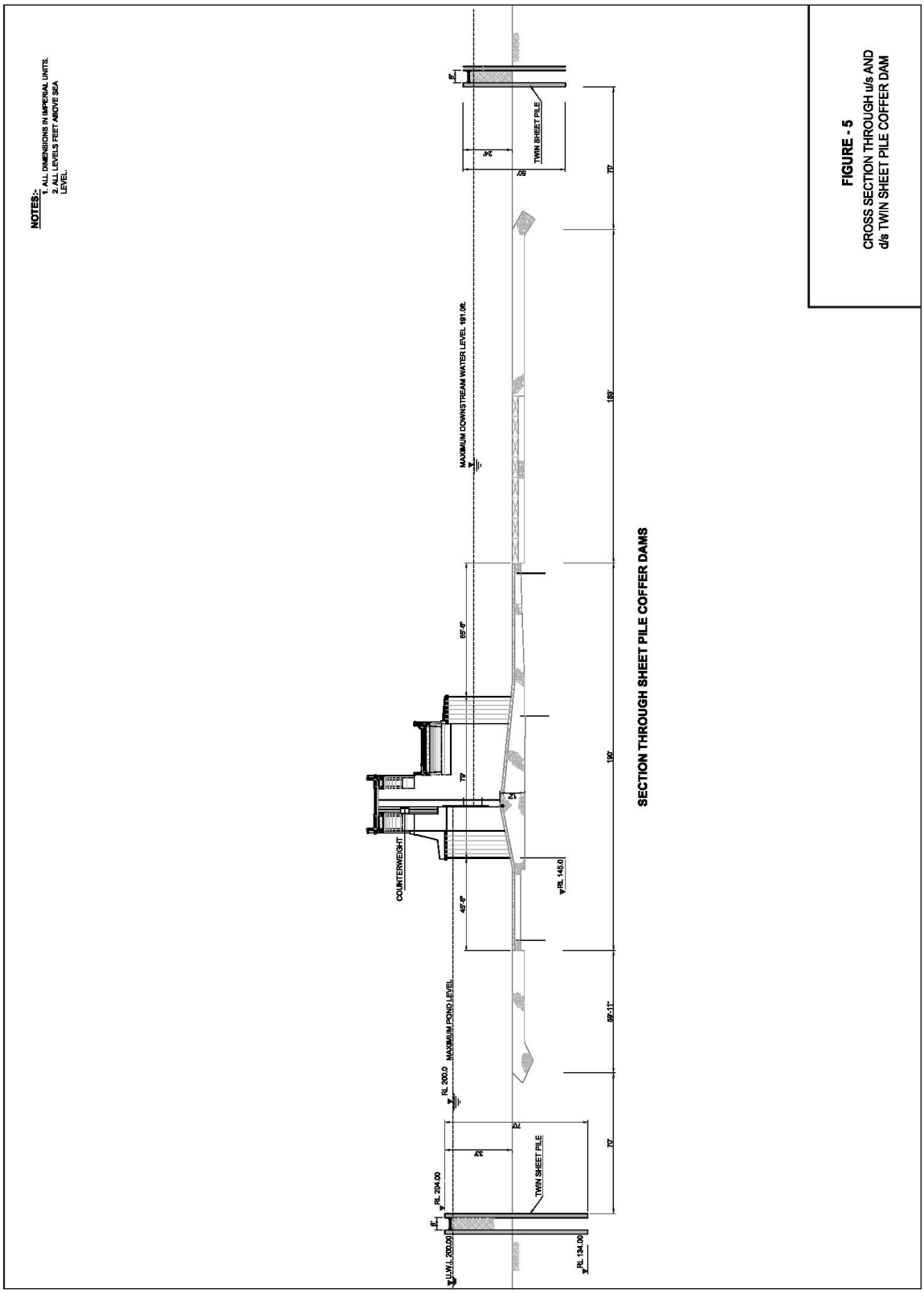

Figure 2.5: Cross-section of Sheet Pile Cofferdam

Pile Deriving Equipment

Barge Mounted Pile Drivers using Floating Pile Driving Frame will be used in the Project. The components of such a pile driving frame are shown in **Figure 2.6**.

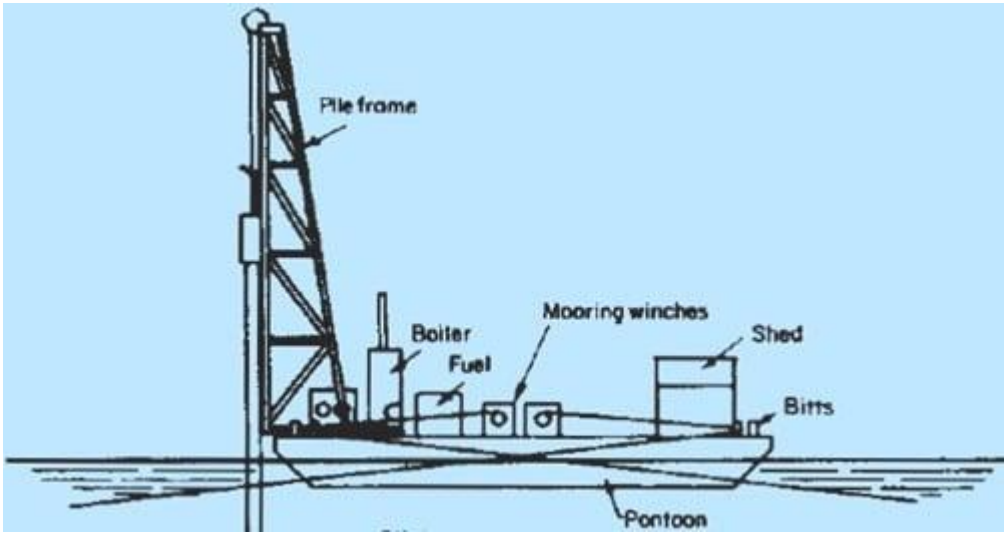

Figure 2.6: Floating Pile Driving Frame

The piles are transported to Floating Pile Driving Frame through Barges. **Figure 2.7** shows the working of Pile Driving Frame and Pile Transportation Barge.

Figure 2.7: Floating Pile Driving Frame through Barge

The requirements for 70m high piles in the Project will require a Floating Pile Driving Frame of about the following size:

Pile Driving Barge

- Length of Hull 16.2m x W 7.0m x H 1.8m
- Heavy plate steel hulls

Marine Crane

- 6-ton knuckle boom
- 15m reach @ 1 ton

Adjustable Tower

- 2 x hydraulic rams for rake of tower
- 1.65-ton drop hammer
- 16m H above the water line, 15.3m above deck
- Can be lowered for passage under bridges

Head Drill Unit

- Drill unit 7 cylinder (Staffa)
- 15m drill string
- All sizes of universal augers

Hydraulic Winch Package

- 1 x 7 ton lifting winch for tower
- 1 x 4 ton hammer winch
- 4 x 2 ton anchor winches

Piling Capabilities

- Installation by hammering, drilling, water jetting & screwing
- Pile diameters 200mm to 900mm
- Variety of pile materials including:
  — Turpentine & treated hardwood marine piles
  — Steel piles sleeved with HDPE plastic tube
  — Concrete marine piles
- Pile Wrapping

Transportable Barge

- Length of Hull 16.2m x W 7.0m x H 1.8m
- Can separate for transport into 2 components of LOA 16.2m x W 3.2m x H 1.8m

Figure 2.8 shows a Pile Driving Frame similar to the above specifications.

Figure 2.8: Pile Driving Frame for Project Requirements

Additional Requirements of Pile Driving Frame for the Project

The noise from Pile Driving Frame is of considerable impact, with maximum noise from the impact of the hammer driving the pile into the soil and associated vibrations. The normal allowable limit for such noise is 90 dB continuously, allowing a maximum of 99dB for about 7 minutes. Special features available with this equipment will be adopted for use in the Project, and the equipment with confirmed maximum noise will not be allowed:

- Hydraulic Hammer with Low Headroom has no sound reduction provision and will not be used in the Project.
- Single Acting Diesel Stroke up Hammers make less noise and will be used in the Project.
- Wooden Cushion or Burlap Bags will be used on top of piles, greatly reducing noise from the impact of the hammer.
- The relatively softer strata of the river bed at the project site will also contribute to noise reduction as soon as the pile sinks few meters into the soil.
- Sound Shielding will be used with the hammer and other equipment.

2.2.4 Earthen Cofferdams

The connecting earthen cofferdams from Sheet piles to the barrage span over barrage foundation and scour protection work will be constructed using Bulk Sand Bags made of heavy polypropylene fiber. A large bag size of 40x40x24 inches will be used in construction, weighing about 1,100 kg after filling with silty sand, to provide stability and resist displacement in the flowing water.

The bags also allow the use of silty sand available at upstream left side bela and downstream silt deposits on right Bank. Reuse of sand bags will not be possible as these will be damaged/torn during embankment removal after completion of gate replacement work. However, the silty sand filled in the bulk sand bags can be reused.

The cross-section of upstream and downstream cofferdams is shown in **Figure 2.9**. The stacking of sandbags may not be that much regular as reflected in the figure, but lowering and dumping of these large sand bags will provide two embankments that will be filled with silty sand under still water conditions, providing required sealing in the two sand bag embankments.

After completion, the 35ft high upstream cofferdam will have a base width of 125ft to 148ft and top width of 75ft. The 28ft high downstream cofferdam will have the same base width and top width of 65ft. The quantities involved in the construction of these sand-filled bags and earthen cofferdams are:

	Upstream	**Downstream**
Bulk Sand Bags (numbers)	126,600	111,600
Silty Sand in Bags (cft)	2,813,000	2,480,500
Silty Sand b/w two Bag Embankments (cft)	1,460,500	1,781,000
Total Silty Sand in Bags (cft)	**4,273,500**	**4,261,500**

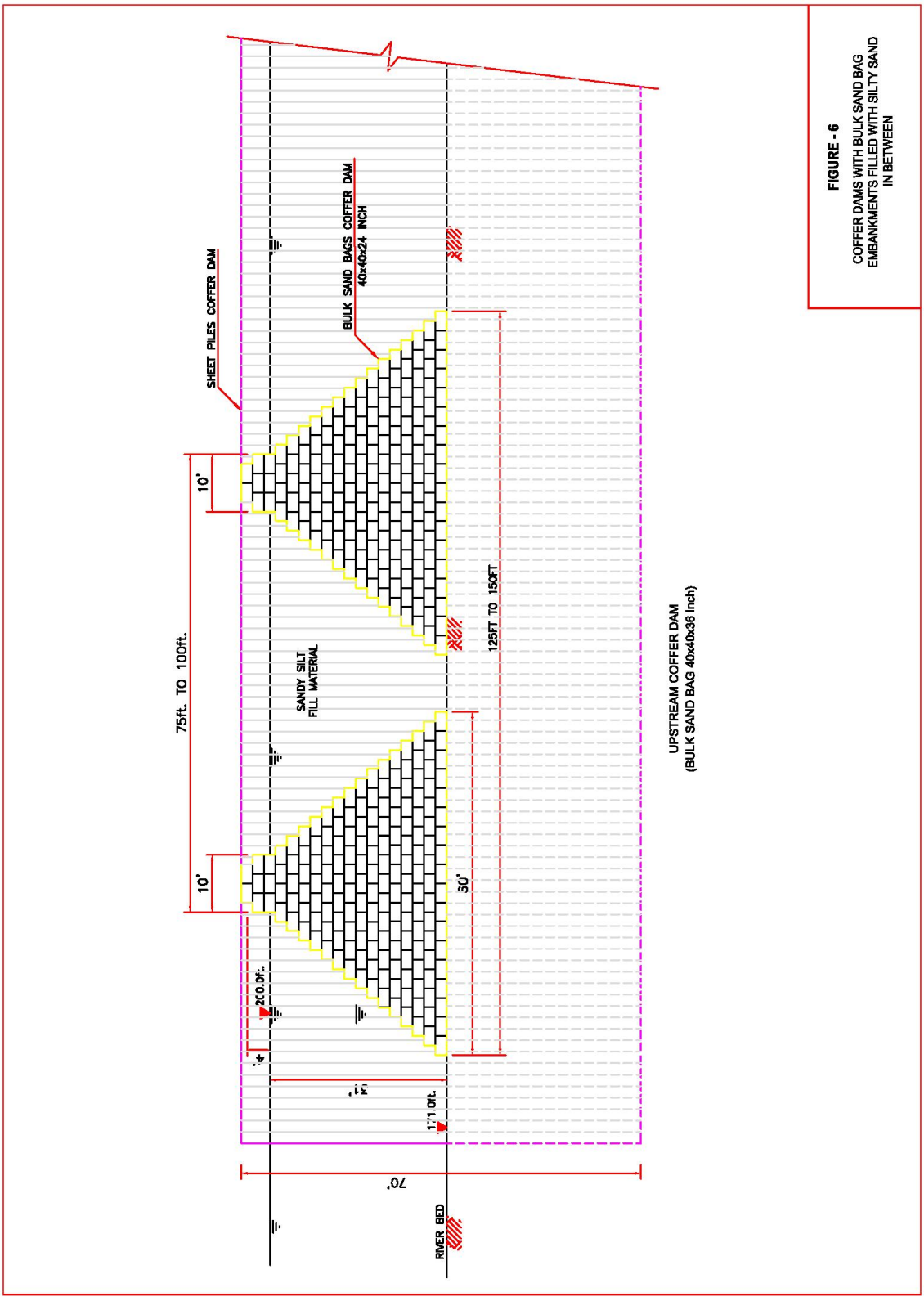

Figure 2.9: Cross section of Earthen Embankment

2.3 Methodology of Construction

2.3.1 Methodology of Sheet Pile Cofferdam

The sheet pile cofferdam will provide a strong and quickly constructed barrier in the flowing water. The two lines of sheet piles provide added strength and result in the efficient control of seepage water.

The sheet piles will be stored in a specially developed storage area in the left bank bela, upstream of the Caisson Platform's anchorage location. As the mentioned bela have no social use and ecological significance, therefore; no environmental and social impacts are associated with storage of sheet piles. This location will be used for anchorage of the required Pile Driving Barge/Vessel, during loading and unloading of sheet piles, for works at the upstream side. For cofferdam works at the downstream side, the sheet piles will be transported from their storage location downstream of the barrage for direct loading into a second Pile Driving Barge/Vessel downstream of Barrage.

Twenty-four hours of working will be done to complete the twin sheet piling in 30 days in a length of about 1,1000ft, both upstream and downstream of the barrage. The removal operation will be completed in about 15 days. The works for upstream and downstream sheet piling will be done simultaneously. The 100ft to 200ft extension of the single line of sheet pile will also be done to support the two Bulk Sand Bags embankment and ease in construction of these embankments.

2.3.2 Methodology of Sand Bag/Earthen Cofferdam

The construction of sand bags embankment will be started immediately after completion of about 200ft to 300ft of a single line of sheet pile, near the location of earthen embankments.

Three Barges will be used, each working 24 hours to construct these embankments upstream and downstream of the Barrage, simultaneously in 60 days. The sand bags will be filled through special sand bag filling machines after placing empty sand bags in the Barges. The filled sandbags will be lowered into the water through ropes and released near their intended locations, forming a desirable embankment shape for the two sand bags embankment.

After completion of the two parallel sand bags embankment, the space between the two will be filled by dumping silty sand in the available still water conditions.

After completion of gate replacement work, the sand-filled bags and sandy silt embankment will be removed through barge-mounted excavators, placing the excavated material in barges for their shifting back to the location from where the material was taken up. The dumped material will be sifted to remove all the torn pieces of sand bags for reuse in the construction of cofferdams for next year's requirements.

Borrow Material: The silt deposits in the River (**Figure 2.10**) will be used as the borrow material for earthen cofferdam construction. The material will be shifted to the cofferdam site through Barges after filling in large sand bags. During flooding of bela areas, low flow velocities through bela results in deposition of sediments. Any excavation in these areas will be replenish in few years' time through these annual silt deposition by the River, and hence there will be no environmental and social impacts associated with the borrow material.

Figure 2.10: Silty Sand Material Borrow Areas

2.4 Alternatives for Temporary Cofferdams

The Project has some peculiar requirements for the Construction of Temporary Cofferdams for gate replacement and foundation inspection works:

- Must be constructed under flowing water conditions.
- For each year of construction, the cofferdams should be of such minimum lengths that not more than 50% of the Main River Channel is blocked, allowing normal river flow and any unexpected larger flows through the barrages without problems.
- Must be of strong construction to withstand any unexpected larger flows during the non-flood period.
- Must be able to be constructed quickly after each flood season as well as are removable with ease before starting of the flood season, allowing maximum working time of about nine months for gate replacement and other activities to be completed under dry conditions in the isolated barrages spans.
- Allows a better seepage control through their body, minimizing the requirements for continuous dewatering from the isolated areas.
- Must have an environmental advantage with minimum requirements of quarrying for the required special construction material and allows the use of available sandy-slit material deposits upstream and downstream of the Barrage. Thus, avoiding large howling distances of heavy dumpers and other construction machinery from quarry sites, minimizing noise and environmental pollution associated with the movement of such large machinery.

2.4.1 Traditional Cofferdams under Flowing Water Conditions

The construction of traditional cofferdams under flowing water conditions is always a difficult task due to the involvement of large quantities of material like large size stones and impervious fill materials. Movement of such huge quantities through Barges, for construction of required

cofferdam in the middle of the River, in a short time is not considered practical. After completing works for that year, quick removal of such cofferdams will also be very difficult, if not impossible. The construction of such cofferdams also involves dumping/pushing material from one Bank of the River and using the constructed embankment to further advance the required dumping.

- For the use of these conventional cofferdams in the Project, such construction starting at some location on the Left Bank will be blocking the supplies to the canals on the Left Bank. If the canal flows are ensured by the construction of temporary bridge allowing required flows to the canals, the continuous embankment of the cofferdam will still be blocking the river flows to more than 50%, as the work will progress to the far side.
- The removal and reconstruction of this long embankment each year will be impossible to be achieved in a limited time of three months.
- The large dumping stones used in the embankments can be damaging to the working gates if these are displaced and are moved with flowing water to the location of the working gates.
- Environmental degradation will be associated at the quarries for such specialized material and during howling of material from quarry to the site of works.

2.4.2 Sheet Pile and Bulk Sand Bags Cofferdams

Sheet Pile cofferdams allow quick and fast construction under flowing water conditions and are proposed for construction in the river bed areas.

The Bulk Sand Bag cofferdam provides an alternative to the heavy stones in the form of a soft impact bag weighing about 1,100 kg after filling with silty sand. The sand bags can be filled with sand through a sand filling machine after placing in the Barge and transported to the location for an assisted dumping, behind the constructed sheet pile embankment, over the hard foundation pavement and scour protection work. The benefits of these cofferdams will be:

Technical Benefits

i. **Construction under Flowing Water**: The proposed cofferdams can be constructed in flowing water without disrupting canal flows or blocking Main River flows by more than 50%. The overall environmental footprint is reduced by removing the dam from the site easily after completion of the works in the shortest time.

ii. **Fast and Low-Cost Construction**: In contrast to traditional earthen cofferdams requiring specialized and heavy-duty construction equipment, sheet pile and bulk sand bags cofferdams require only standard construction equipment that contributes to reduced construction time and cost.

iii. **Easy to Reconfigure, Modify and Dismantle**: One of the major environmental and economic impacts of conventional cofferdams is that they become nearly permanent structures that are difficult and costly to dismantle. For the selected cofferdams, the construction can be carried out rapidly and the completed structure can be suitably modified during construction and easily removed after completion of the required works.

Environmental Benefits

iv. **Use of Silty-Sand Materials Available within the Work Areas**: The filling of Bulk Sand Bags does not require any special filling material. The large Silty-Sand deposits near the Barrage can be used to fill these bags for the embankment construction.

v. **Recycling of Construction Materials:** The selected cofferdam with sheet piles allows reuse of the sheet piles, once removed after completion of the year work. Similarly, a large portion of silty-sand material used in filling the Bulk Sand Bags can also be recycled and reused as the cofferdam material in the next year's work. Thus, minimizing the borrow material requirements.

vi. **Reducing Footprint**: For the construction of the conventional cofferdams, a large footprint is required for stability, disrupting the aquatic environment as well as requiring huge quantities for the quarry material, resulting in adverse effects. In contrast, the sheet piles are just a line of piles, and the twin sheet piles proposed in the Project will have a footprint of only 8 to 10 ft, width in the required length, which results in reduced environmental impacts.

2.5 11kV Power Line

To augment the power supply at the Barrage, a 11 kV power line will be built from the nearest grid station to the existing transformers in the Sukkur barrage. There are four possible options to construct the power line (see Figure 2.11), from which two options are found to be feasible. They are (i) a 1.5 km long line from 132 SEPCO Grid Station to the right bank of the barrage and (ii) a 0.9 km long line from Hajna Shah Express Feeder to the left bank of the barrage. The proposed works involved in this activity are small-scale and mainly include the construction of poles/towers and the installation of power lines.

Figure 2.11: Options for 11 kV power line on right and left banks

A comparative analysis of all the available options for the 11 kV line is given in Table 2.1.

Table 2.1: Alternatives for 11 kV power line

Parameter	Right Bank Options		Left Bank Options	
	Option A	**Option B**	**Option C**	**Option D**
Available Power Sources (Grid Stations)	132kV Sukkur Township Grid Station	132 kV SEPCO GRID Station	132 kV Rohri GRID Station	11 kV Hajna Shah Express Feeder from Rohri Grid Station (supplies power to Sukkur Central Jail)
Length of proposed power line (distance to the above source from the barrage)	5 km	1.5 km	5.6 km	0.9 km
Land use along the proposed power line	The first 2 km passes through congested settlements and then crosses the national highway and NW Canal, following NW Canal Bank to the Barrage	The route crosses a road (Military Road) from the grid station and is then located on the embankment falling between NW and Rice Canals.	The alignment passes through the middle of populated Rohri City. The Grid Station is being utilized to its full capacity and for a recent new connection for Motorway.	The initial 0.3km route is located along Bunder Road. The route then crosses the four Left Bank Canals; Nara, KF East, Rohri and KF West canals.
Environmental and social aspects	Some mature trees, small businesses, and a police check post will be affected	This entire land belongs to the property of the Sindh Irrigation Department, and there are no settlements along the alignment	The alignment passes through Rohri city	The power line passes not far away from the Barrage, before it turns towards the Jail. No settlements are located along the alignment
Conclusion	Rejected due to longer length and potential impacts	Recommended due to shorter length and passes through government land.	Technically not feasible as no further expansion is possible within the grid station	Recommended due to shorter length and limited impacts. Another advantage of this option is that this is a dedicated line with minimal load shedding.

3 Potential Impacts and Mitigation Measures

3.1 Summary of Impacts for the original scope of the Project

Detailed analysis on potential impacts of the original scope of the Project is given in ESA. A summary of these impacts is given below:

Environmental impacts during construction stage:

- Impact of dredging on aquatic and benthic habitat
- Sediment dispersion from dredging activities
- Impact of in-river placement of dredged material
- Effluents and emissions from dredgers and associated vessels
- Impact of underwater noise levels on dolphins' vocalization and behavior
- Risk of dolphin collision with construction vehicles
- Impacts from excavation activities in the barrage
- Impacts from excavation activities in the right bank canals
- Risk of entrapment of dolphins, turtles, and other aquatic fauna in construction areas
- Impact of excavated material placement on the dry river banks
- Disposal of replaced mechanical and electrical parts
- Potential risk of soil and water pollution by construction works
- Air and noise pollution from construction and traffic
- Risk of pollution from solid waste and waste effluents
- Impacts from borrow and quarry activities

Social Impacts during Construction:

- Land acquisition and resettlement
- Impact on irrigation releases from the barrage
- Impact on traffic on the barrage
- Generation of employment
- Safety hazards due to increased traffic, especially for children and elderly people
- Impacts from the influx of labour from the outside areas
- Possible cultural conflicts between communities and workers and health impacts, including women's privacy and access
- Workers health and safety risks

3.2 Potential Impacts from Proposed Cofferdam works

The proposed additional 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 the construction period. The negative impacts associated with the construction are mostly related to piling and excavation activities for the construction of cofferdam. Indus Dolphin Reserve located immediately upstream of the barrage is the most significant receptor susceptible to impacts of the cofferdam construction works.

Most of the anticipated environmental and social impacts and risks of the proposed additional works are similar to the impacts and risks discussed in the above section and covered in detail

in the ESA. The additional impacts specific to the proposed cofferdam works are assessed in the addendum and discussed in the following sections. These impacts are:

- Sediment dispersion from cofferdam construction works
- Effluents and emissions from barges and associated vessels
- Impact of underwater noise levels on dolphins' vocalization and behavior
- Risk of dolphin collision with construction vehicles
- Impact on river morphology due to excavation of sediments for use in cofferdam construction
- Workers health and safety risks during cofferdam construction and working over water

The proposed works will not have any adverse impacts during the routine operational stages of the Sukkur barrage. The 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.

3.2.1 Sediment Dispersion from Cofferdam Construction Activities

The piling (up to 900 mm of diameter of drilling), installation of piles, and dumping of huge sandbags (each weigh about 1,100 kg) for cofferdam construction may cause a temporary increase in suspended sediment in the action area. The pile driving activities may generally produce total suspended sediment (TSS) concentrations of approximately 5.0 to 10.0 mg/l above background levels[7] within approximately 300 feet (91 meters) of the pile being driven[8]. Using a clamshell to extract piles allows sediment attached to the pile to move vertically through the water column until gravitational forces cause it to slough off under its own weight. The small resulting sediment plume is expected to settle out of the water column within a few hours. Increases in suspended sediments and turbidity levels 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. However, the TSS levels expected for pile driving or removal (5.0 to 10.0 mg/L) are below those shown to harm fish (typically up to 1,000.0 mg/l[9]) and benthic communities (390.0 mg/l)[10].

Mitigation

Mitigation measures to minimize sediment dispersion from cofferdam construction are:

- The piling activities for the initial few meters below the river bottom will be carried out with minimum hydraulic pressure to minimize the disturbance to bottom sediments.
- The sandbags at the river bottom will be placed carefully (not dumped from a height) to minimize the disturbance to the bottom sediments.

[7] The background TSS levels, as measured during the original ESA, ranges from 210 to 604 mg/l. TSS levels were measured at six locations - 1.River Water in Sukkur Barrage (Right Side of River): 471mg/l; 2. River Water (North Western Canal, Right Side) 535mg/l; 3. River Water (West KPFC, Left Side) 579mg/l; 4. River Water (River Barrage Sample, Left Side) 584mg/l; 5. River Water (Lansdowne Bridge, Left Side) 604mg/l; 6. River Water (Lansdowne Bridge, Right Side) 210mg/l;

[8] FHWA (Federal Highway Administration). 2012. Tappan Zee Hudson River Crossing Project. Final Environmental Impact Statement. August 2012. (Cross reference https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region)

[9] Wilber, D.H., and Clarke, D.G. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management 21(4):855-875.

[10] EPA (Environmental Protection Agency). 1986. Quality Criteria for Water. EPA 440/5-86-001.

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

3.2.2 Effluents and Emissions from Barges and Associated Vessels

Solid and liquid waste effluents will be generated from the barge 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 of 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 prepare and implement an emergency preparedness plan to address these risks. The contractor will make booms (oil fence), absorbents and skimmers available on-site and trained personnel to recover spilled oils from the water surface.
- The contractor will refuel barges and boats with proper care to avoid any spills. Make available spill kits and other absorbent material at refuelling points on the barges.
- The Contractor shall properly collect, treat and dispose of the bilge water from barges and boats.

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

3.2.3 Impact on Dolphins from Piling and other construction activities

A 170 km stretch of the River Indus between two irrigation barrages Guddu and Sukkur, is designated as a national protected area for Indus dolphins and is also known as Indus Dolphin Game Reserve[11]. The total area of the reserve is 125,000 ha and has a 3 km buffer zone on the floodplains. This Indus Dolphin reserve was also declared as Ramsar wetland of International Importance in the year 2000. According to recent estimates by Sindh Wildlife Department in 2019, the reserve holds a population of 1,419 dolphins[12]. Whereas in 1975, only 150 dolphins were recorded from this reserve, signifying the conservation efforts carried out so far. There are more than 18 major schools of dolphin exist at different locations between the Guddu barrage to Sukkur barrage.

Based on the assessment of the original ESA, the 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. A series of actions will be taken under the parent project, SBIP, to address the current threats to the dolphins and their conservations. These measures 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 a mitigation plan, (iii) recommending no fishing zone in the River stretches that support breeding population, (iv) capacity building of

[11] 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.

[12] https://tribune.com.pk/story/1950668/blind-dolphin-survey-reveals-55-increase-population

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.

The proposed construction activities may impact the dolphins in two ways, (i) risk of water pollution from construction may impact habitat quality of the dolphins (potential impacts and risks on water quality are discussed in the above section) and (ii) the underwater noise and vibration generated from the piling may have a significant impact dolphins vocalization and behavior. 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 the range of 125-173 (dB at 1m) for whistles and 218-228 (dB at 1m) for clicks. Underwater noise levels generated by the piling and associated vessels may impact the dolphin's vocalization and behavior.

Mitigation

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

- The contractor will use vibratory hammers or hydraulic hammers that produce less noise (Single Acting Diesel Stroke up Hammers) in the piling activities. Wooden Cushion or Burlap Bags will be used on top of piles to further reduce noise from the hammer's impact. The contractor will also use sound shielding with the hammer and other equipment.
- Monitoring an exclusion zone of about 500 m radius for at least 30 minutes before the start of piling. If dolphins are observed in the exclusion zone, piling works will be delayed until they have left the area. If dolphins enter the exclusion zone after dredging has commenced, piling works will cease until they have left.
- Piling work will adopt a 'soft start'; using a low energy start to the piling 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 regularly service all water borne plant as per the manufacturer's guidelines and be inspected daily prior to operation.
- 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. Support staff, including divers, will also be arranged by the Contractor for help of the ecologist.
- Share the piling activity schedule with the district wildlife department and fisheries department, who are interested in participating in monitoring activities.
- The contractor shall plan his operations to be completed based on a six-day working week from 9am to 5pm, in line with the national labour laws. However, the cofferdam construction will require additional working hours, or weekend working and for this requirement, the Contractor shall submit a request to the Engineer for permission to work extended hours, giving full reasons for the requests. Approval to such requests will not be granted for works on the colony site.

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

3.2.4 Risk of dolphin collision from barges and boats

The movement of barges and associated motor boat traffic for transport of piles, sand bags and workers may have a risk of collision with dolphins. These risks will be only on the upstream side of the barrage since no dolphins are located on the downstream side of the barrage.

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 cofferdam sites and other instream construction sites.
- Restrict motorboat speed within 15 km/h in accordance with best international practices followed in North America.
- Pingers will also be used to chase away dolphins from the construction areas.
- Use of boats will be limited to daytime, and if they are needed to be used during night time, adequate night time lighting will be provided.
  - A dolphin rescue unit has been proposed in the ESA for Sukkur Barrage Rehabilitation and Modernization. If a dolphin is entrapped in project machinery or equipment, the dolphin rescue unit will be immediately informed to take proper measures for rescuing the trapped dolphin. Availability of dolphin rescue facilities to the contractor will be ensured.

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

3.2.5 Impacts from Excavation of Riverbed Sediments

Construction of earthen cofferdams requires 8.54 million cubic feet (or 1.03 million cubic meters) of river bed sediments. These materials will be sourced through excavation from the dry river bed areas using excavators. Dry riverbeds downstream of the barrage and near the outer bank bela will be used to source the material (see Figure 2.10) and pack these materials into the sand bags. Since the excavations will be carried out to remove dry sediments, there is no risk of sediment generation from the excavation activities. The excavation of sediment deposits will not impact the morphology of the river and its natural cycle on erosion/accretion.. The river carries huge sediment loads (more than 200 million tonnes of sediments) during high flow season, the removal of 1.03 million cubic meters (roughly equal to 1.44 million tonnes) of sediment will have no impact on the sediment concentrations and downstream river morphology. Further, these silt deposits are annually replenished by the river, and hence there will be no adverse impacts associated with the borrow material.

Mitigation

- Excavations will be carried out in dry riverbeds and to remove only dry sediments. These activities will be carried out mainly during low flow season.
- If any sediment-water is 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 into the river.
- The cofferdams will be constructed over a period of 3 years, and hence the contractor will reuse the sediment-filled sandbags every year. Only additional quantities of sediments will be excavated if more sandbags are required.

The procedures dealing with “chance finds” will be followed by the construction contracts.With the above mitigation measures, the residual impacts from excavation activities have been assessed as minimal.

3.2.6 Borrow Sites- Impacts on Shoals (Belas and Island)

For upstream cofferdam, the material will be borrowed from the Left Bank Bela and shifted to the cofferdam site through Barges, after filling in Bulk Sand Bags or directly through Barges. A small amount of borrow material will be sourced near the middle island. All this transportation will be in the areas within Left Bunder Wall. For downstream cofferdam, the material will be borrowed from downstream silt deposits and shifted to the coffer dam site through Barges. All this transportation will be in the areas downstream of Right Side Embankment. The proposed areas for the borrow activities (Figure 2.10) are not under any community use (either for agricultural or residential purposes), and hence do not require any resettlement. As stated earlier, the proposed borrow activities will not affect the aquatic ecology of the river since the excavations will be carried out to remove dry sediments, and there is no risk of sediment generation from the excavation activities.

3.2.7 Disposal of replaced gates

The Project will generate a huge amount of scrap material due to the replacement of gates. The Sindh Irrigation Department has a Standard Operating Procedure in place for the auction and sale of scrap material generated from its barrage rehabilitation works. 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. The sand bags shall not be disposed of in the Indus River or its offtaking canals and shall be dumped in line with the contractor’s solid waste management plan. None of these waste materials will be disposed of at the site.

3.2.8 Workers Health and Safety

The Occupational Health and Safety risks associated with the construction of cofferdam or working inside a cofferdam include exposure to physical hazards from the use of heavy equipment, including cranes; working at height, working over water, failure of sheet piles and falling off, confined spaces, and electrical equipment; trip and fall hazards; exposure to noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

- The cofferdam construction activities and material storage will be on the riverside of the Left Bunder Wall. The community housing and areas exist across Bunder Road, parallel to this 5 ft high Bunder Wall. The Bunder Wall and the road completely separate the nearby communities with only controlled access inside this area. Therefore, there will be no impact on community health and safety due to coffer dam activities.
- The bunder wall will also dampen the normal construction noise and as the sheet piling work will be in the middle of river so there will be no impact of noise in these surrounding activities.
- In comparison to gate replacement works using Caisson Gate, the cofferdam construction will require a large work force and equipment for completion in a limited time period. The gate replacement and foundation inspection/repairs in the dry areas inside cofferdam will also involve a comparatively larger work force.

Mitigation

The following mitigation measures will be implemented:

- Contractor will prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. OHS Plan should contain general guidance for all identified hazards under each work activities, and site-specific OHS hazard and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there any changes in the construction methodologies.
- OHS Plan should contain general guidance for all identified hazards under each work activities and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor.
- The OHS plan will be reviewed and approved by the Construction Supervision Consultant and the World Bank
- Conduct a 'job hazard analysis' at the new cofferdam construction site to identify potential hazards that may arise from the proposed works or working conditions to the project workers and implement necessary control measures. The job hazard analysis should be part of the contractor's method statements, which will be reviewed and approved by the OHS Specialists of the supervision consultants. The specialists will also visit the construction sites prior to the start of construction to ensure the control measures are in place.
- The cofferdams should be built as designed and should have provision to access, light and, and adequate emergency exits.
- Water levels will be regularly monitored inside the cofferdam.
- Regular site inspections and safety audits by the construction supervision team, both by the OHS specialists and the site engineers. Since the site engineers will present at the worksites all the time, they will be trained by their OHS team on monitoring the safety aspects of the construction works.
- All workers should wear life vests when working near and over water.
- Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on the use of life vests, ring buoys, hazard awareness, and emergency response plan.
- Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained.
- Availability of firefighting, ambulance, medical and rescue facilities at the site for implementation of an emergency response plan
- Contractors will have dedicated and qualified staff for ensuring compliance with the OHS Plan.
- Awareness-raising material will be used, including posters, signage, booklets, and others at the worksites.
- First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).

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

3.2.9 Access to Cofferdam

The proposed coffer dam sites will be accessed through the road on the barrage and the road bridge (using ladders), and through the river (using barges). Besides access through ladders suspended from Road Bridge and Steel Cage suspended from Gantry Cranes at Gate Deck, additional access for light vehicles and for transport of small quantities of material in the isolated work areas inside the cofferdam, will also be made.

As the cofferdams are in the middle of river, Barges will be used for transportation of material, equipment, workers and light vehicles from the left bask on downstream of barrage to the cofferdam at downstream side. The access inside the isolated area will be made through any one side of the earthen or bulk sandbag embankment by the construction of earthen access ramp with 3% to 5% slope. This access ramp will be adjacent to the sheet piles. Only light vehicles will be allowed to use this ramp, passing through the river sluice foundation from downstream to upstream side. This access to upstream areas, through any of the barrage span isolated within this area with either existing gate removed, or newly installed gate raised up.

3.2.10 Impacts of Power line/ Electrical Works

No land acquisition and resettlement is anticipated with the proposed preferred option for power line. However, some operation stage health and safety risks that exist will be mitigated during the design and construction stage of the powerline. Normal safety practices observed in Pakistan and globally for power lines are considered for the power line as well. The aspects from public health and safety perspective standpoint to be considered during the detailed design stage of the power line are as [13]under:

A. System Safety

a) **System Safety Conductor for Tower Clearance**: For the safety of the system, it is imperative that any factor that may interrupt the power supply should be considered in the design. The clearance of the conductor from Tower legs and trusses is of prime importance. Therefore, in the design, a minimum clearance of 6.4 m is to be adopted by under extreme wind conditions of Sukkur. This is based on minimum requirements of National Electric Safety Code (NESC) (ANSI C2). With this clearance, there is 99% probability of withstanding switching surge of 3-sigma margin due to maximum over voltage under adverse climatic conditions.
b) **Earthing of the System**: Every Tower is connected to an earthing system. This is to keep Tower footings resistance at a level lower than 10 Ohms. For this purpose, it is suggested that two (02) earth electrodes of copper-clad steel rods needs to be sunk vertically into the ground to a minimum depth of 3 m and at the locations where the required resistance is not achieved crow footing to be done or any other feasible engineering solution needs to be adopted.
c) **Lightning Performance**: The Tower geometry, clearance and insulation of the system are designed to perform safely within the permitted lightning intensities. In this respect, consideration should be given to the Tower footing resistance and Isokeraunic level of the area. The accepted level is one trip out/ 100 km/ year due to lightning.

B. Public Safety

a) **Public Safety General Aspects**: In view of public safety, in the design, it needs to adopt a policy of keeping a 10 m wide corridor clear of all obstructions and tree plantation that exceeds a height of 2.5 m will not be allowed. As such, the existing trees with a height of not exceeding 2.5 m are allowed to remain under the lines. No residential or other public buildings, are permitted within the corridor. The height of the Towers can be increased in case of when the power line is crossing the Military road.
b) **Conductor to Ground Clearance**: The conductor to ground clearance is desirable to be worked out based on over voltage due to switching surge. In this consideration, safe clearance is required to be provided for moving objects under the line with a height of 6.0m, withstanding switching surge of 3-sigma margin with 99.7% probability under adverse atmospheric conditions. This should keep the maximum voltage

[13] Based on the previous experiences and globally recognized standards/practices.

gradient at ground level and maximum current induced in a person less than the internationally allowable values. As such, the total conductor to ground clearance shall in no way be less than 10.2 m in particular case when the power line is crossing Military road. The specific standard accepted is that of the National Electrical Safety Code (NESC), currently applicable in the United States.

Some other impacts/risks are (i) EMF which is a risk to human being health for the long term and also tends to interfere with inference is for not harmful and only for a short duration;(ii) unsafe erection of tower can result in injuries to the workers and residents in the area; and; (iii) Snapping of stringing blocks, unbalance load during stringing on tower leading to collapse, falling cables injuring workers, others etc. Stringing the wire loosely may result in cable touching the ground and other obstructions that could cause damage. Design stage mitigation measures will be devised to minimize the above risks.

The potential risks on workers' health and safety and community health and safety risks associated with the construction of 1.5 km power lines are similar to other construction works in the project, though their magnitude is limited. Appropriate personal protection equipment (PPE) will be given to the construction workers by the Contractor, and necessary training will be provided in occupational health and safety. Only trained workers will be used to deal with the live power lines or deactivating and properly grounding live power distribution lines before work is performed on, or in close proximity, to the lines. The community health and safety risks specific to the power lines may occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. These risks will be mitigated by securing the construction with appropriate barriers and signs to prevent the local communities from entering the construction areas.

4 Environmental and Social Management Plan

4.1 Objectives of ESMP

This ESMP will be an addendum to the ESMP of the original Project and will be used as a tool by the project management authorities to manage the impacts associated with the proposed project activities.

4.2 Institutional Arrangements

The existing organogram of SID and PMO for implementation of ESMP is shown in **Figure 4.1**.

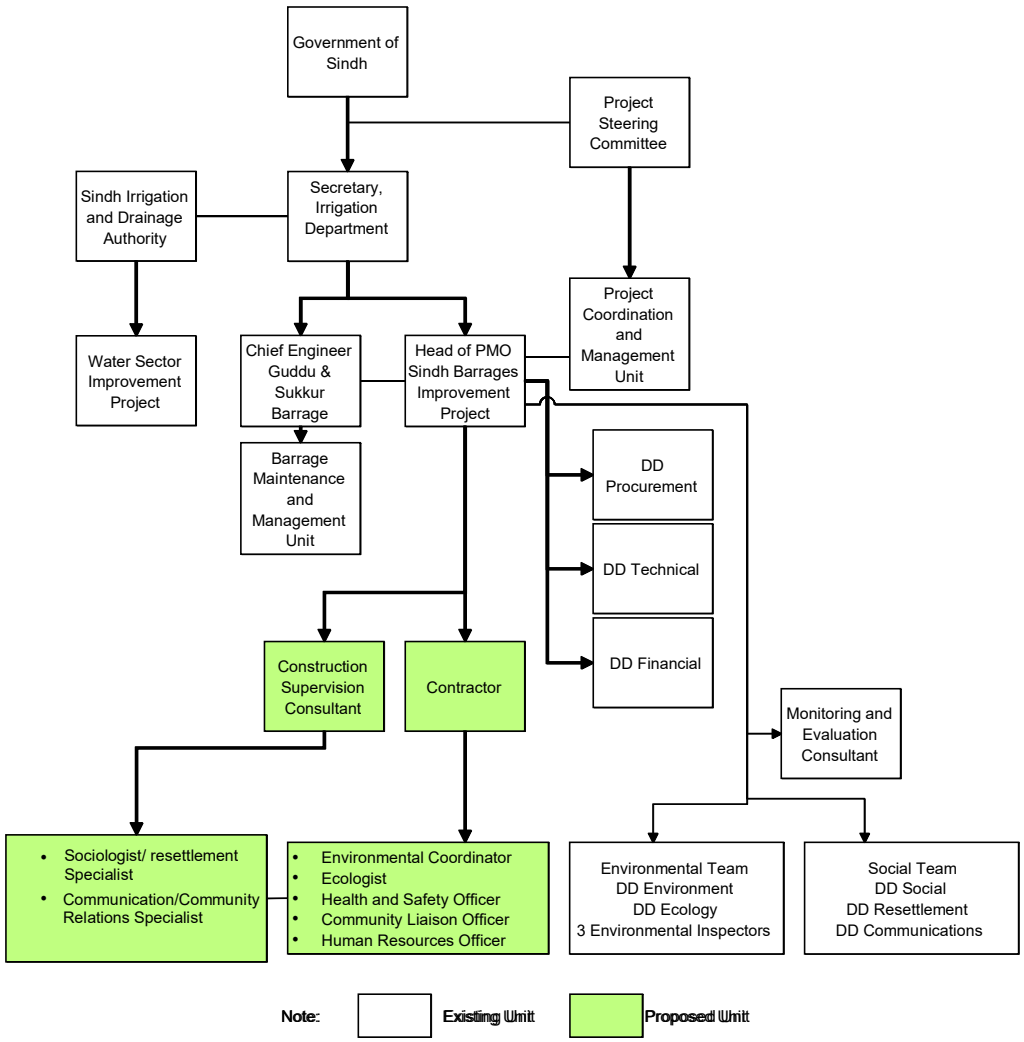

Figure 4.1: Proposed Institutional Structure for Implementation of ESMP

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.

4.2.1 Contractors

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

The contractor will develop various plans directed towards health, safety, the environment and social issues and get them reviewed and approved by the CSC and PMO. These plans will also be reviewed by the Bank for any advice. The contractor will also be responsible for communicating with and training its staff in the environmental/social aspects before starting 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

4.3 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 ESMP. The Contractor will be made accountable through contract documents for the obligations regarding the environmental and social components of the Project.

PMO will include the following Environmental, Social, Health and Safety (ESHS) Conditions in the bidding documents:

- ESHS Policies
- Past performance of the Contractor on ESHS aspects including sexual exploitation and abuse and sexual harassment.
- ESHS Staff with the Contractor.
- Performance Security.
- Mitigation measures to address construction impacts.
- Payments for implementation of ESHS measures.
- Code of Conduct of Contractor's Personnel.
- Management Strategies and Implementation Plans (MSIP) to manage the ESHS Risks.
- Withholding an interim payment where there has been a failure to perform an ESHS obligation

Each of the above conditions is elaborated in **Table 4.1**.

Table 4.1: ESHS Conditions in the Bidding Documents

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
1. Past performance of the Contractor on ESHS is one of the eligibility criteria for the Pre-qualification process	The contractor's past performance on compliance with ESHS is an indicator of the contractor's commitment and capability for implementation of the ESMP	The Bidder shall "declare any civil work contracts that have been suspended or terminated and/or performance security called by an employer for reasons related to the non-compliance of any environmental, or social (including sexual exploitation and abuse (SEA) and sexual harassment (SH) or health or safety requirements or safeguard in the past five years."	Bidder to make the Declaration	PMO use this information to seek further information or clarifications in carrying out its due diligence
2. Contractor shall propose adequate ESHS staff in his team	The Contractor's staff should include an ESHS Manager who is responsible for the implementation of all mitigation measures on ESHS risks and compliance with ESMP with the following support staff (i) Environmental Officer, (ii) Ecologist, (iii) Indus Dolphin Monitoring Staff (iv) OHS Officer, (v) Social Officer, and (vi) adequate ESHS Site Supervisors	The Bidder shall propose adequate ESHS staff, which shall include at a minimum an ESHS Manager, an Environmental Officer, an OHS Officer, and a Social Officer with adequate ESHS Site Supervisors (one supervisor at each site) The Bidder shall provide details of the proposed ESHS Manager, including academic qualifications and work experience. The ESHS Manager should have a minimum bachelor's degree in engineering or a master's degree in sciences related to environmental management. The Specialist should have 10 years of experience working on monitoring and managing ESHS risks related to hydropower projects.	The Bidder to submit the CV of the proposed ESHS Manager	PMO will review and approve
3. Contractor shall submit ESHS Performance Security for compliance with ESHS obligations	The Contractor should have a financial implication if he could not comply with ESHS requirements. Hence performance security will be collected from the contractor	The Bidder shall submit the ESHS Performance Security in the form of a "demand guarantee" in the amount of one percent (3%) of the Contract Amount.	The Bidder will submit a Performance Security	
4. Implement Mitigation	The mitigation measures to	PMO will include **Table 4.2** (measures during pre-construction),		PMO will include this condition in

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
Measures to Address Construction-Related Impacts given in ESMP	address potential ESHS risks and impacts should be included in the bidding documents. The contractor shall be made responsible for the implementation of the mitigation measures through the necessary conditions in the contract.	**Table 4.3** (measures during construction), **Table 4.4** (monitoring measures during construction) and ECPs (**Annex D of the original ESA**) of the ESMP in the General Specifications of the Bidding Document, and the reference to these tables will be provided in the Conditions of the Contract as follows: • The Contractor shall implement the mitigation and monitoring measures given in the ESMP to address ESHS risks associated with the construction works. The Consultant shall refer to the ESA of the Project, which is available on the SIDA website, for further guidance. • The Contractor shall comply with the World Bank Group's General Environmental Health and Safety Guidelines and Environmental Code of Practices		the bidding document
5. Payments for implementation of ESHS Mitigation and Monitoring Measures	BOQs on ESHS implementation are included in the Bidding Documents	The budget will be allotted to prepare and implement C-ESMP (including OHS plans) and monitoring plans.	Bidder will quote for the ESHS Management	PMO will include this in the general specifications of the bid document
6. Code of Conduct for Contractor's Personnel	All workers hired by the Contractor should sign a code of Conduct to ensure compliance with ESHS obligations of the Contract	The Bidder shall submit the Code of Conduct that will apply to the Contractor's employees and subcontractors. The Code of Conduct will state that the workers will comply with the following ESHS requirements: • Wearing of Personal Protective Equipment (PPE's) in the workplace at all times • Non-discrimination in dealing with the local community by race, ethnicity, gender, religion, disability, sexual orientation, gender identity, social, or health status. • Respectful attitude while interacting with the local community. • Prohibit sexual exploitation and abuse and sexual harassment..	Bidder shall submit code of Conduct with the bid documents	

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	PMO
		• Prohibit violence, including sexual and/ or gender-based violence. • Protection and Proposer use of the property • Awareness raising, communication and dissemination of information campaigns for employees, workers and communities residing around the construction sites on SEA, SH and GRM.		
7. Contractor's Management Strategies and Implementation Plans (MSIP) to manage the ESHS Risk	The Contractor proposal should include his understanding of the ESHS requirements of the Project and the proposed strategies to manage the ESHS risks	The Bidder shall submit Management Strategies and Implementation Plans (MSIP) to manage the following key ESHS risks: • Strategy for the protection of workers and community from the construction-related hazards • Pollution prevention (wastewater, air and noise emissions) and management • A waste management plan for proper collection and disposal of waste • Hazardous material management plan safe storage and handling • Strategy to address labor influx impacts on the local communities. • Sexual exploitation and abuse/sexual harassment prevention and response action plan • Emergency response plan and early warning system The Contractor shall be subsequently required to submit (before mobilization) Contractor's Environment and Social Management Plan (C-ESMP) by the above strategies and Condition 4 of this Table.	The Bidder will submit MSIP along with the Bid Documents	
8. Withholding an interim payment	Withholding an interim payment where there has been a failure to perform an ESHS obligation	To ensure the performance and commitment of the contractor/bidder, withholding of payment in case the contractor failed to perform/implement ESHS obligations.		PMO will include this in the general specifications

4.4 Environmental and Social Management During Construction

4.4.1 Environmental Codes of Practices

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 have been prepared based on the experiences in the construction of hydropower projects, including World Bank-funded hydropower projects in Pakistan and also in conformity with the WBG EHSGs and Good International Industry Practice. The ECPs are presented in **Annex D of the ESA** and will be included in the bidding documents (**item 4 of Table 4.1**) to ensure their implementation.

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.
- CEP 20: Dolphins Management from Construction Impacts

4.4.2 Pre-construction Stage Mitigation Plans

Pre-construction stage will mainly include the mobilization of the contractor and finalization of the following conditions/documentation by the Contractor:

- Contractor's Environmental and Social Management Plan (C-ESMP) with site-specific management plans;
- Labour Management Procedures to be followed for hiring and management of labour;
- The mobilization of ESHS Specialists

Each of the above conditions is elaborated in **Table 4.2**.

Table 4.2: ESHS Conditions in the Pre-Construction Stage

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
1. Preparation of Contractor's Environmental and Social	The Contractor shall submit site-specific management	The Contractor to submit for approval and subsequently implement their Environment and Social Management Plan (C-ESMP).	Contractor	PMO, CSC

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
Management Plan (C-ESMP)	plans to address ESHS risks following the ESMP requirements and MSIP proposed in the bid documents.	The C-ESMP should be submitted before the commencement of construction works, and no construction activities will be carried out under the Project until approval of the C-ESMP. The C-ESMP will include the following site-specific management plans: • Occupational health and safety management plan • Waste management plan • Wastewater discharges management plan • Hazardous material management and spill control plan • Training plan for ESHS risks including HIV/AIDS, sexual exploitation and abuse, and gender-based violence. • Emergency Response Plan • Grievance Redress Mechanism • Demobilization plan after completion of works		
2. Mobilization of ESHS Specialists	The ESHS Specialists should be mobilized during pre-construction for preparation of C-ESMP	The Contractor shall submit the CVs of the following ESHS Specialists for PMO review and approval and mobilize them. • Environmental Officer • OHS Officer • Ecologist • Social Officer The ESHS Specialists should be present at the site throughout the construction period.	Contractor	PMO, CSC
3. The hiring of Construction Labour	Hiring procedure for construction workers including the signing of code of Conduct	The procedures will include terms and conditions of employment, including hours of work, wages, overtime, compensation and benefits, holidays, leaves, and so on. The procedures will set out measures to prevent and address harassment, intimidation and/or exploitation. All workers shall sign the code of Conduct (see Item 6 of Table 4.1).	Contractor	PMO, CSO
4. Construction	The contractor	Contractor shall set up camp and	Contractor	PMO

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
camp and storage facilities	will need areas for setting up camp and storage areas.	storage facilities within sites approved by the PMO with the adequate facilities		

1.1.1 Construction Stage Mitigation Plans

Detailed mitigation plans for construction stage impacts have been prepared based on the detailed impact assessment covered under Chapter 3 and presented in **Table 4.3**. These plans are project-specific, and to the extent possible, site-specific; however, contractors will be required to prepare site-specific management plans as part of C-ESMP for review and approval of PMO.

Table 4.3: ESHS Impacts and Risks in Construction and Mitigation Measures

(**Note**: PMO will include this Table in the Contract Specifications of the Bidding Documents)

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Sediment dispersion from cofferdam construction	• The piling activities for the initial few meters below the river bottom will be carried out with minimum hydraulic pressure to minimize the disturbance to bottom sediments. • The sandbags at the river bottom will be placed carefully (not dumped from a height) to minimize the disturbance to the bottom sediments.	Implement measures in the following ECPs ECP 19 ECP 20	Contractor	PMO CSC
2. Effluents and emissions from barges and associated vessels	• The contractor will take utmost care to prevent such risks and 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 surfaces. • The contractor will refuel barges and boats with proper care to avoid any spills. Make available spill kits and other absorbent material at refuelling points on the barges. • The Contractor shall properly collect, treat, and dispose of the bilge water from barges and boats.	Implement measures in the following ECPs: ECP 3 ECP 4 ECP 16 ECP 19 ECP 20	Contractor	PMO CSC
3. Impact on dolphins from piling and other construction activities	• The contractor will use vibratory hammers or hydraulic hammers that produce less noise (Single Acting Diesel Stroke up Hammers) in the piling activities. Wooden Cushion or Burlap Bags will be used on top of piles to further reduce noise from the hammer's impact. The contractor will also use sound shielding with the hammer and other equipment. • Monitoring an exclusion zone of about 500 m radius for at least 30 minutes before the start of piling. If dolphins are observed in the exclusion zone, piling works will be	ECP 20	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	delayed until they have left the area. If dolphins enter the exclusion zone after dredging has commenced, piling works will cease until they have left. • Piling work will adopt a 'soft start'; using a low energy start to the piling operations to allow dolphins to leave the area, gradually ramp up the sound levels to scare the dolphins and other cetaceans away before piling commences, • Contractor will regularly service all water borne plant as per the manufacturer's guidelines and be inspected daily prior to operation. • 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 piling activity schedule with the district wildlife department and fisheries department, who are interested in participating in monitoring activities			
4. Risk of dolphin collision from barges and boats	• The boat movement on the upstream of the barrage will be limited to only cofferdam sites and other instream construction sites • Restrict motorboat speed within 15 km/h in accordance with best international practices followed in North America • Pingers will also be used to chase away dolphins from the construction areas. • Use of boats will be limited to daytime, and if they are needed to be used during nighttime, adequate nighttime lighting will be provided	Implement measures in the following ECPs: ECP 20	Contractor	PMO CSC
5. Impacts from the excavation of riverbed sediments	• Excavations will be carried out in dry riverbeds and to remove only dry sediments. These activities will be carried out mainly during low flow season. • If any sediment water released from the excavation activities,	Implement measures in the following ECPs:	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	they will be contained by placing the silt fences, sediment traps around the excavation areas to prevent migration of silt into the river. • The cofferdams will be constructed over a period of 3 years, and hence the contractor will reuse the sediment-filled sandbags every year. Only additional quantities of sediments will be excavated if more sand bags are required.	ECP 3 ECP 4 ECP 6		
6. Impacts on Bela and Island due to location of Borrow Sites.	• Borrow material will be extracted from the dry river beds and small quantities from the belas if required. • The sites proposed for the borrowing by the contractor will be reviewed and approved by the environmental and social staff of the Engineer and PMO.	Contractor	PMO CSC	Contractor
7. Disposal of replaced gates	• 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 of at the site.	Implement measures in the following ECPs: ECP 1 ECP 2	Contractor	PMO CSC
8. Workers Safety risks	• Contractor will prepare, obtain approval, and implement an occupational health and safety (OHS) plan. OHS Plan should contain general guidance for all identified hazards under each work activity, site-specific OHS hazards and risks during construction, and control and preventive Measures proposed by the Contractor. The Plan shall be reviewed and updated if there any changes in the construction methodologies. • OHS Plan should contain general guidance for all identified hazards under each work activities and they should be presented in three discrete headings, (a) Contractor's Standards on the identified hazard management, (b) Expected Site-specific OHS hazard and risks during construction, and (c) Control and Preventive Measures proposed by the Contractor. • The OHS plan will be reviewed and approved by the	Implement measures in the following ECPs: ECP 16 ECP 18	Contractor	PMO CSC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	Construction Supervision Consultant and PMO. These will also be reviewed by the World Bank for any advice. • Conduct a 'job hazard analysis' at the new cofferdam construction site to identify potential hazards that may arise from the proposed works or working conditions to the project workers and implement necessary control measures. The job hazard analysis should be part of the contractor's method statements, which will be reviewed and approved by the OHS Specialists of the supervision consultants. The specialists will also visit the construction sites prior to the start of construction, to ensure the control measures are in place. • The cofferdams should be built as designed and should have provision to access, light and adequate emergency exits. • Water levels will be regularly monitored inside the cofferdam • Regular site inspections and safety audits by the construction supervision team, both by the OHS specialists and the site engineers. Since the site engineers will present at the worksites all the time, they will be trained by their OHS team on monitoring the safety aspects of the construction works. • All workers should wear life vests when working near and over water. • Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on the use of life vests, ring buoys, hazard awareness, and emergency response plan. • Incident investigation and reporting, including a complete record of accidents and near misses, will be maintained. • Availability of firefighting, ambulance, medical and rescue facilities at the site for implementation of an emergency response plan • Contractors will have dedicated and qualified staff for ensuring compliance with the OHS Plan • Awareness-raising material will be used, including posters, signage, booklets, and others at the worksites • A complete record of accidents and near misses will be			

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	maintained. • First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).			
9. Impacts from power lines; Community health and safety risks, and OHS risks	• Public will be barred from construction sites through access control • Establishing adequate facilities at the construction camp (mosque and entertainment) to minimize interaction between construction workers and local community • Appropriate PPE to the workers and training in the use of these PPES • Trained workers will be involved when working with live wires • Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). • Other measures in Item 9 of this table.	ECP 18	Contractor	PMO CSC

4.5 Monitoring Plan

Proposed monitoring plan to be carried during the implementation of the Project to ensure the contractor's compliance with the mitigation measures is given in Table 4.4, along with the monitoring indicators and frequency. CSC will be responsible for the supervision of the implementation of the plan.

Table 4.4: Effects Monitoring Plan

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
Ecological monitoring (dolphins)	Field investigations for observations on dolphin or turtle entrapment or their presence to close to construction areas	During cofferdam construction (daily)	Contractor	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
Emissions from plant and equipment	Visual inspection	Monthly	Contractor	CSC, PMO
Noise and vibration	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
Labor management	Records on terms and conditions of employment, including hours of work, wages, overtime, compensation and benefits, holidays, leaves, CoCs and other requirements.	Monthly	Contractor	CSC, PMO
Safety of workers	Usage of personal protective equipment Availability of rescue equipment for drowning	Monthly	Contractor	CSC, PMO

4.6 Reporting on ESMP Compliance

PMO and its Contractors will prepare periodic monitoring reports on the status of implementation of ESMP and will be submitted to World Bank for their review and feedback. Details of these reports and their content are given in **Table 4.5**.

Table 4.5: ESMP Monitoring and Compliance Reports

#	Title of the Report	Contents of the Report	Frequency of Report Preparation	Report to be prepared by
1	ESHS Monitoring Report	The compliance status of the Project with environmental and social mitigation and monitoring measures. Besides, the report also covers: • environmental incidents; • health and safety incidents, • health and safety supervision:	Monthly	Contractor

#	Title of the Report	Contents of the Report	Frequency of Report Preparation	Report to be prepared by
		• Major compliance issues • Labour management and worker accommodations • Training conducted and workers participated • Worker's grievances • Community grievances • Chance find (if any)		
2	ESMP Monitoring Report	The compliance status of overall Project with ESMP requirements	Quarterly	PMO
3	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event	Initial investigation report within 24 hours Detailed Investigation Report within ten days	Contractor

4.7 Capacity Building and Training

The environmental and social training will help to ensure that the requirements of the ESMP are clearly understood and followed by all project personnel. A capacity-building program is included in the original ESA, and USD 0.25 million has been earmarked for capacity building. The additional training programs to be covered under the addendum are given in Table 4.6. Environmental and OHS specialists of the CSC and Contractor are responsible for delivering these programs.

Table 4.6: Environmental and Social Training Programs

Contents	Participants	Trainer	Schedule
Environmental and social impacts of the Project and ESMP requirements of the Contractor; World Bank Group Environmental Health and Safety Guidelines. The contents for the second and subsequent training programs will cover topics related to the issues associated with ongoing construction activities.	All the technical Staff of PMO, ESU, and relevant technical staff of SIDA. Site Engineers of the PMC/Engineer.	ESHS staff of the CSC	During the initial stages of the Project implementation. The training will be repeated every six months.
Environmental and Social issues associated with the ongoing construction works; Workers' health and safety	Site Engineers of the Contractor, PMO, and the CSC	E&S staff of the CSC, PMO	On a monthly basis
Code of Conduct	Construction crew	Contractors	Prior to the start of

Contents	Participants	Trainer	Schedule
Occupational Health and Safety		ESHS Staff	the construction activities and during the construction activities (To be repeated as needed.)
Training on Indus River Dolphin Rescue/Protection	Construction crew	PIC with the support of WWF Indus River Dolphin Recue Team	Prior to start of the construction activities and during construction period.

4.8 Grievances[14]

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 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 4.2 and the members of the complaint cell are shown in **Table 4.7**. SBIP grievance redress mechanism is detailed in SMF.

Table 4.7: 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

[14] Detailed GRM is given in Updated SMF of SBIP.

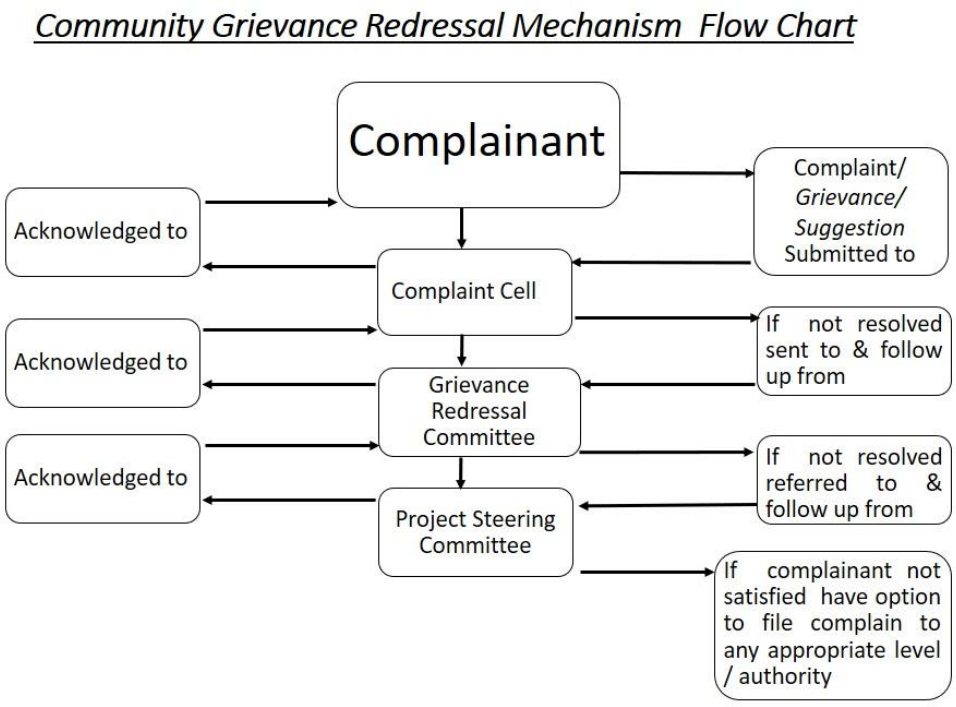

Figure 4.2: Grievance Redress Mechanism