Government of Sindh, Pakistan

Sindh Irrigation and Drainage Authority (SIDA)

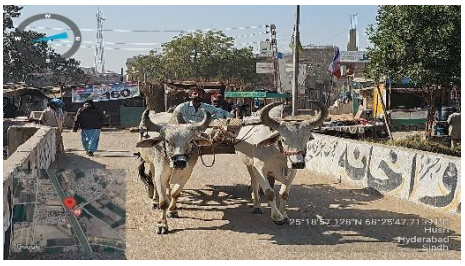
Sindh Water and Agriculture Transformation (SWAT) Project

Improvement & Rehabilitation of Akram Wah Canal









Environmental and Social Impact Assessment

Main Report

October 2025



The photograph on the cover page shows the poor condition of the current embankment of Akram Wah Canal.

DOCUMENT ISSUE AND REVISION RECORD

This document and its contents have been prepared and are intended solely for the information and use of Government of Sindh, Sindh Irrigation & Drainage Authority (SIDA) in relation to the **Design Review, Construction Supervision and Contract Management of Improvement and Rehabilitation Works of Akram Wah Canal.** The ACE & NESPAK (JV) assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

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ACRONYMS

AED	Anti-encroachment Drive
AWB	Area Water Board
BOQ	Bill of Quantity
CSC	Construction Supervision Consultant
C-ESMP	Contractor's Environnemental and Social Management Plan
C&W	Communication & Works
CoI	Corridor of Impact
DoA	Department of Archaeology
EA	Environmental Assessment
ECP	Environmental Code of Practice
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMU	Environmental Management Unit of SIDA
EPA	Environmental Protection Agency
EQS	Environmental quality standards
ESHGs	Environmental, health and safety guidelines
ESHS	Environmental, Social, Health & Safety
ESU	Environmental and Social Unit
FGD	Focus Group Discussion
E&S	Environmental and Social
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
GBV	Gender-Based Violence
GoP	Government of Pakistan
GoS	Government of Sindh
GRC	Grievance Redress Committee
IEE	Initial Environmental Examination
ILO	International Labor Organization
IUCN	International Union o for Conservation of Nature
LMP	Labour Management Procedures
M&EC	Monitoring and Evaluation Consultants
NEQS	National Environmental Quality Standards
NGO	Non-Government Organization
O&M	Operation and Maintenance
P&D	Planning and Development
OP	Operational Policy
OHS	Occupational Health and Safety
PAP	Project Affected Person
PC	Project Design Consultant
PCMU	Project Coordination and Monitoring Unit
PD	Project Director
PIC	Project Implementation Consultant
PIC	Prior Informed Consent
PM	Particulate Matter
PMO	Project Management Organization
MSIP	Management Strategies and Implementation Plans
RoW	Right of Way
RPF	Resettlement Policy Framework
SMRP	Social Management and Resettlement Plan
SEQS	Sindh Environmental Quality Standards
SWAT	Sindh Water & Agriculture Transformation
ToR	Terms of Reference
WHO	World Health Organization
WB	World Bank
WSIP	Water Sector Improvement Project

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

Units for Measurement of Canal Lengths

1 RD (Reduced Distance) = 1,000 feet

1 Canal Mile = 5 RDs or 5,000 feet or 1.524 km

1 Introduction

1.1 The Indus Basin Irrigation System

In order to fully utilize the river water resources of Pakistan, the Indus Basin Irrigation System (IBIS) has emerged as the largest contiguous irrigation system in the world. Irrigated agriculture within the IBIS provides food security to the country (supplying 90% of food production) and economic growth (accounting for over 25% of the country's Gross Domestic Product and 44% of employment in 2013[1]). The Indus River is, therefore, a critical resource for Pakistan.

The IBIS comprises three large dams, eighty-five small dams, nineteen barrages, twelve inter-river link canals, forty-five canal commands and 0.7 million tube wells. The IBIS irrigates 18.21 million hectares (45 million acres)[2] of farmland, producing wheat, rice, fruits, vegetables, sugarcane, maize and cotton for local use as well as for export.

Sindh province is the second biggest beneficiary of the IBIS (after Punjab), with three barrages and 14 canal commands. The irrigation system has a total length of 19,066 km (11,916 miles) of canals, which serve a gross command area (GCA) of 5.8 million ha (14,391 million acres). About 42,000 watercourses (tertiary channels) have an aggregate length of approximately 120,000 km (75,000 miles), which supply irrigation water directly to agricultural land. Approximately 59 billion cubic meters (48 million acre-feet) or of water is diverted annually to the canal commands. Yet, the province suffers from low water availability and land productivity.

According to the World Bank[3], approximately 37% of the rural population of Sindh lives below the poverty line, and 70% is landless. 56% of income to rural households is from agriculture, directly or indirectly, with poor households typically depending on wages earned through employment as agricultural labourers. Therefore, it is evident that stimulating rural growth, which raises agricultural wages, is fundamental for reducing poverty.

Studies undertaken under the Sindh on Farm Water Management Project identified a number of major issues in Pakistan's irrigation and drainage sector, with the majority of these stemming from underlying institutional weaknesses – primarily the exclusive control of the systems by public sector entities, characterized by inefficiencies, lack of corporate skills, poor user focus and a lack of accountability. Such institutional weaknesses have manifested in low irrigation water delivery, inequality in water distribution, wasteful use of on-farm water, poor operation and maintenance, low-cost recovery, and a constrained investment climate. These issues are exacerbated particularly in Sindh, where over 80% of the province is underlain by saline groundwater.

1.2 Sindh Water and Agriculture Transformation (SWAT) Project Background

Sindh Water and Agriculture Transformation (SWAT) Project (hereinafter referred to as the SWAT Project or the Project) is the proposed project by the Government of Sindh. The Project Coordination & Monitoring Unit (PCMU) of the Planning and Development (P&D) Department has been assigned coordination tasks for the preparation of the project in close consultation with the 'Agriculture, Supply and Prices Department' and 'Irrigation Department' supported by SIDA. The Government of Sindh has requested the World Bank (WB) to finance the SWAT Project. The overarching theme of the SWAT concept is the water and agricultural nexus to boost the rural economy and promote sound water resource management. The SWAT Project will support the Government of Sindh in agriculture and water management and facilitate a transformation along the three dimensions – agriculture, water resources and water service delivery.

[1] World DataBank, World Bank, http://databank.worldbank.org/data/home.aspx, [accessed 13/01/15]

[2] http://www.tbl.com.pk/indus-basin-irrigation-system-of-pakistan/

[3] Project Appraisal Document on a Proposed Credit to Pakistan for a Sindh Water Improvement Phase 1Project, World Bank, 2007

The Project will have the following components and a detailed description of these components is given in the Environmental and Social Management Framework (ESMF) of the SWAT:

- Component 1: Water Resources Management. The overall objective of this component is to help establish the institutional framework for integrated water resources management. This component will provide the foundation for integrated water resources management in Sindh by supporting policy and institutional reforms, improving planning, and establishing a hydro-agro informatics program that will benefit both the water and agriculture sectors. The PCMU will implement the component in coordination with the Irrigation Department.
- Component 2: Water Service Delivery. The overall objective of this component is to improve the delivery of canal water services to enhance agricultural water productivity and overall water resources management. This component will improve water delivery service (improved measurement and control of flows resulting in better predictability and reliability) for agricultural users. It will encompass the rehabilitation of three left bank canals, modernization of distributary and minor canals managed by Farmer's Organizations in the canal systems of the three existing Area Water Boards, and preparatory studies for the rehabilitation of right bank infrastructure.
- Component 3: This component will contribute to increasing agricultural water productivity by: i) investing in climate-smart agricultural investments and training at the WCA level; ii) adjusting the agricultural subsidy system to promote the transition to high-value, water-thrifty crops; ii) improving the knowledge and information base, with a focus on innovative approaches to dealing with water logging and soil salinity; iii) reducing value chain constraints to higher value, water-thrifty crops.
- Component 4: Project Coordination and Monitoring. The Component provides support to the PCMU under the P&D Development. The PCMU is expected to provide overall coordination of project activities to ensure synergy between the different project components.
- Component 5: Agricultural Flood Emergency Rehabilitation. This component will provide financial support to small farmers affected by the 2022 floods, reestablishing their agricultural production and emphasising the 2022-2023 Rabi crop.

The project will be implemented in the Ghotki, Nara and Left Bank Area Water Boards (AWBs). The location of the three AWBs included within SWAT is shown in Figure 1-1.

Rehabilitation of Akram Wah canal is one of the subprojects under Component 2 of the SWAT Project. A schematic view of the off-take branch and minor canals is shown in Figure 1-2, and the Akram Wah canal map is shown in Figure 1-3.

1.3 Subproject: Improvement and Rehabilitation of Akram Wah

1.3.1 Scope of Works

The scope of improvement and rehabilitation works includes:

- Removal and disposal of existing damaged canal lining (59 km; RD 0 to RD 193)
- Construction of impervious concrete lining with geomembrane and underdrainage system (59 km; RD 0 to RD 193)
- Embankment raising and strengthening (58 km; RD 193 to the tail end)
- Reinstatement of the Inspection Path (IP) and the Non-Inspection Path (NIP) for canal maintenance
- Replacement of 4 cross regulators, 13 head regulators and 1 escape structure
- Construction of water level control structures at RD 50 and RD 193
- Replacement of 5 syphon crossings under Akram Wah and repair of two syphons
- Replacement of existing sanctioned pump houses which need to be relocated during project implementation,
- Replacement of 12 road and 6 footbridges,
- Protection work to abutments, piers and deck slabs of existing pre-stressed concrete bridges and railway bridge
- Construction and Furnishing of Inspection Bungalow and office at Badin, and construction of staff quarters.

- Construction of Engineer's office and residence and staff accommodation at Tando Muhammad Khan
- Replacement or shifting of utility lines, where required.

Figure 1-1: SWAT Project – Location of Nara, Ghotki and Left Bank Canal AWBs

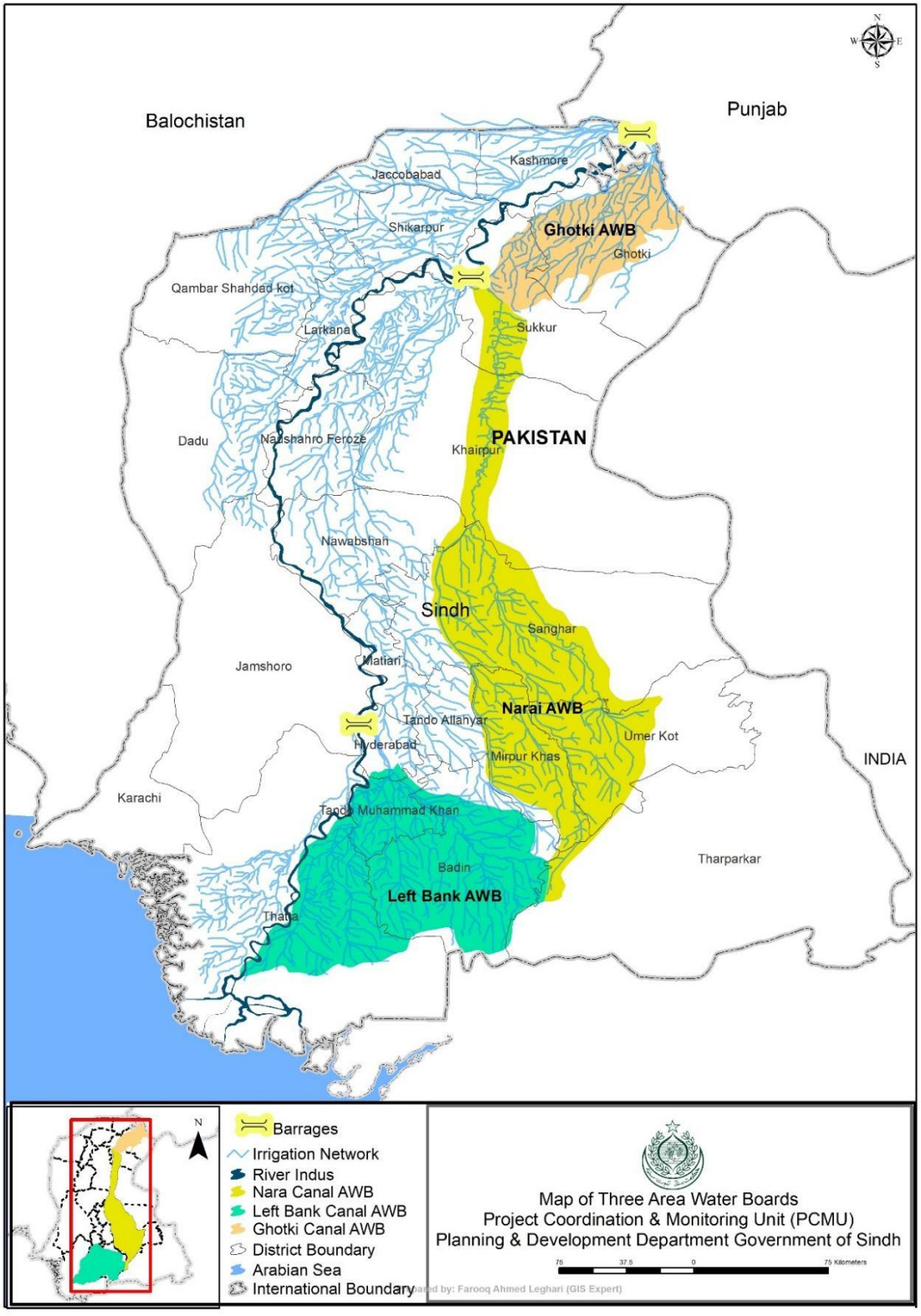
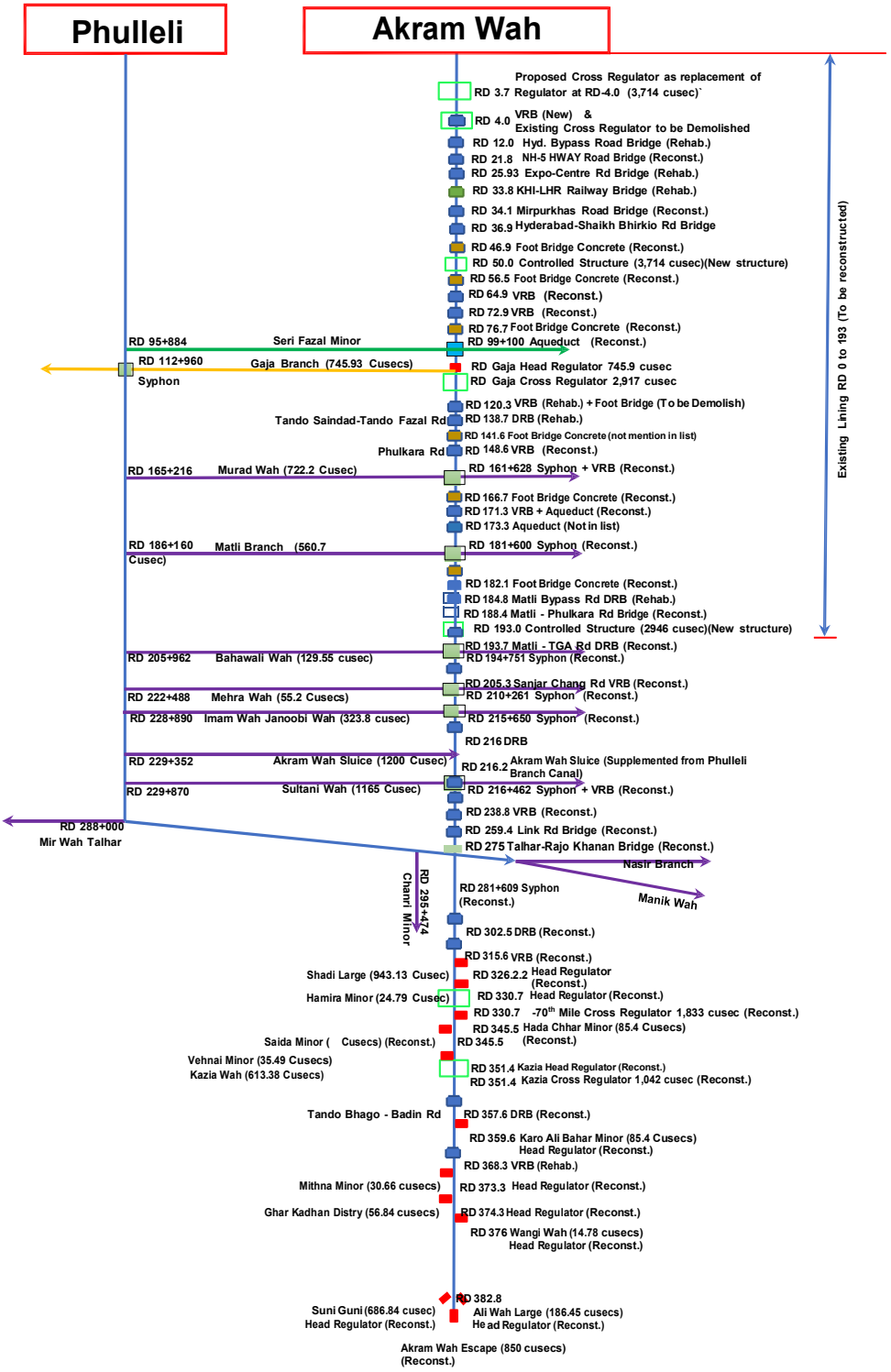


Figure 1-2: Index Plan of Akram Wah



1.3.2 Subproject Area

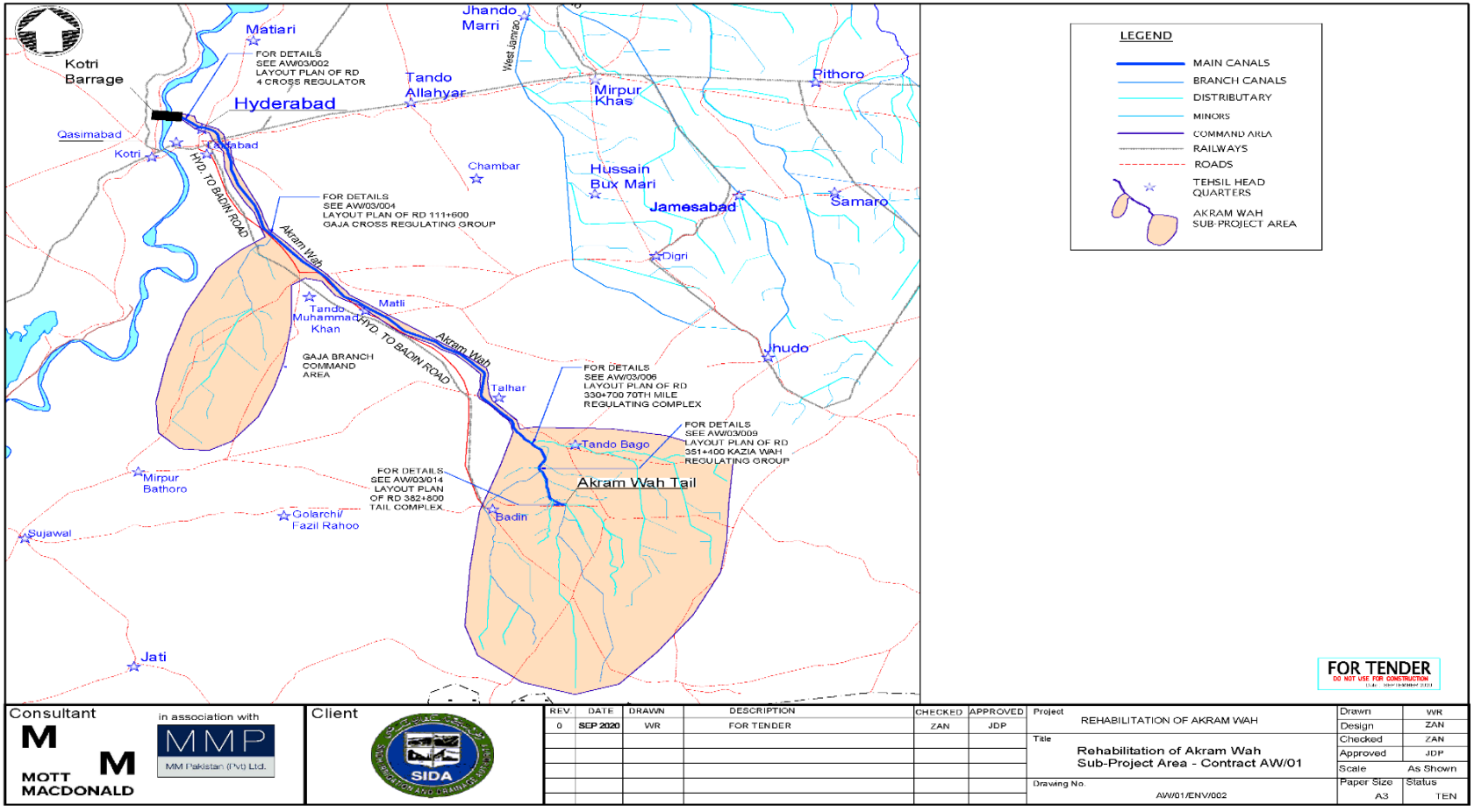
The project starts at the head regulator of Akram Wah at Kotri Barrage and ends at its tail regulator at RD[4] 382.8, about 14 kilometres to the east of Badin town on Badin-Khoski road. The area surrounding

[4] RD or Reduced Distance is a measurement of canal alignment/chinage. Distance between each RD is 1000 ft.

Akram Wah is dominated by agricultural lands, tree thickets, and orchards, but it also passes through three urban areas: Hyderabad, Matli (District Badin) and Tando Bago. About 55% of the land use is agricultural land, 24% is settlements, 13% is shrubs and 6% is barren land.

The area of the influence of the subproject is identified as the entire canal command area, as all the proposed activities will be located within this area, and the outcome of the proposed interventions will be felt through this command area. The area of the influence of the subproject is shown in Figure 1-3. Most of the construction operations will be along the inspection and non-inspection paths of Akram Wah. All the structures to be replaced and rehabilitated are located along the length of Akram Wah. However, the contractor will utilise the roads passing through these towns and cities to transport construction materials to work sites. The main Hyderabad-Badin road runs parallel to Akram Wah, which the contractor's plant will frequently use, and village roads leading to work sites.

Figure 1-3: Akram Wah subproject area



1.4 Environmental and Social Assessment of the Subproject

The subproject's environmental and social assessment has complied with the World Bank and Sindh EPA requirements. The main aims and objectives of this environmental assessment are to:

- Provide information for decision-making on the environmental consequences of proposed project interventions;
- Establish an environmental and socioeconomic baseline;
- Determine potential environmental and social impacts and assess these in terms of severity, magnitude and timescale;
- Devise mitigations to address the identified environmental and social impacts;
- Promote environmentally and socially sound and sustainable development through the identification of appropriate enhancement and mitigation measures and monitoring programs that will be required to ensure the development of the project without significant adverse impacts;
- Meet the provincial, national, international and WB standards;
- Public consultation and information disclosure, including amongst the local community and
- Preparation of ESIA (including ESMP)

The ESIA also serves the purpose of disclosure by documenting public consultation on the subproject's environmental and social impacts and by summarizing the rationale for appropriate levels of mitigation.

The rehabilitation works will be carried out within the canals' existing right of way (RoW). In early 2021, the Government of Sindh conducted an "anti-encroachment drive" (AED) on the right-of-ways of many canals in Sindh province including Akram Wah Canal, on the orders of the Sindh High Court. Approximately 1,246 households were affected, with more than 90% experiencing significant impacts. Most of the AED affected households were poor, informal settlers who were displaced from their homes. To address these legacy issues, SIDA prepared an Akram Wah Social Management and Resettlement Plan (SMRP) which will: i) provide an opportunity for AED affected households to improve their standard of living; and ii) pilot an approach to allowing AED affected households back on to the RoW in accordance with an Irrigation Department policy that was adopted in mid-2022.,

1.5 Study Methodology

The methodology for assessing and mitigating the social and environmental impacts of the Improvement & Rehabilitation Works of Akram Wah Canal can be summarised as follows:

- **Literature Review**. Following initial discussions with SIDA, a study was initiated to draft environmental baseline information on the project area. The study comprised a literature review and collection of updated authenticated published/printed data on the physical, ecological and social environment related to the focused area. The same was also used to delineate the scope of surveys, forming the basis of environmental assessment.
- **Stakeholder Consultations**. A series of consultations were conducted with communities surrounding the canal, affected people, Farmer's Organisations, and the Area Water Board. Further, two consultation workshops were conducted during the scoping and disclosure stages with all the relevant stakeholders, including Sindh Environmental Protection Agency and Wildlife Departments. Details of these consultations are discussed in Chapter 8 and **APPENDIX-C**. Ongoing consultations will also be conducted monthly or as or when required during the entire construction period.
- **Define the study area and engineering baseline**. The team preparing this ESIA has studied the full details of the engineering proposals and used them to define the study area. The engineering team has participated in field visits and decision-making to balance engineering needs with environmental and social impacts. Details of the engineering proposals are provided in Chapter 3.
- **Consideration of alternative subproject designs**. The environmental and social impact of alternative subproject interventions have been considered with reference to the project objectives, and reasons for their rejection are provided in Chapter 4.

- **Identify key resources, receptors and baseline conditions**. A detailed environmental baseline survey was conducted to collect primary data in the Project surroundings to help identify sensitive receptors. The primary data were examined and compared with secondary data from earlier environmental studies in the region. This data is presented in Chapter 6, and a summary of the different primary data collection tasks completed as part of this study is provided in this section. Baseline conditions have been established for air, noise, surface water and groundwater quality, climate, biodiversity, and socio-economic environment.
- **Assess potential impacts and risks**. Potential environmental and social impacts and risks during the implementation and operational stages of the project have been identified, and the magnitude of their impacts are assessed in terms of the scale of impact, duration of impact and spatial extent of the impact.
- **Develop a mitigation strategy and management plan**. Mitigation measures were proposed for various projects' activities to minimize the identified impacts during the project's life span. Such mitigations may be proposed at the construction or operation stage or may already have been applied during the design phase. The mitigations proposed for the construction and operation stage are incorporated into the Environmental and Social Management Plan (Chapter 7) and, where appropriate, within the Contract documents. Implementation and monitoring requirements and responsibilities are also defined. Measures to enhance beneficial impacts are also incorporated into the management plan. The mitigation strategy and management plan are well-versed in the lessons learnt from previous World Bank projects.

1.6 Study Team

This ESIA is based on field studies and data collected between 2020 and 2021 by the consultant team charged with the design of the subproject and their reports on Environmental Impact Assessment (EIA). The team includes Mohammed Ali Shishmahal and Aqeel Ahmed Magsi (environmental specialists), Muhammad Shayan (Environmental Engineer), Muhammad Rahim Junejo and Mujeeb-ur-Rahman (Sociologists), and Shagufta Shah and Shama Shah (Gender Specialists). The SIDA environmental and social team also participated in the field investigations, consultations and preparation of this ESIA.

The Sindh Irrigation Department retained a team of independent consultants to validate design consultants' reports and update ESIA reports per the World Bank guidelines. During the ESA process, the independent consultants conducted their field visits, participated in consultations, and conducted their independent analysis and impact assessment. The independent consultants team consists of Venkata Nukala (environmental specialist), Seema Khurram (social specialist), and Shaukat Ali Shahid (resettlement specialist).

1.7 Organization of the Report

The ESIA report has been structured as follows:

- Chapter 1 – Introduction: Provides an introduction and overview of the project
- Chapter 2 – Policy, Legal and Administrative Framework: Sets out the relevant laws, regulations and permits for the State Government of Sindh (GOS) and, more specifically, the SEPA. It provides key elements of underlying policy for both SEPA and World Bank, an overview of standards, regulations by other branches of government, and international commitments. Gives an overview of policy and legislation along with international guidelines relevant to the project
- Chapter 3 – Description of the Subproject: Describes the project in sufficient detail to highlight environmental aspects while describing technical features. Methods of construction and scheduling are addressed; environmental construction management will depend on the readiness of contractors to implement the Environmental Management Plan (EMP).
- Chapter 4 – Consideration of Alternatives: describes alternatives discussed during the detailed design period while reviewing the history of alignment selection. Other ‘selection’ issues that have environmental implications are described.

- Chapter 5 – Environment and Social Baseline: provides a general overview of perspectives on the baseline environment that support impact analysis. The level of detail for information is determined by what is available from secondary sources and primary data obtained by sampling and analysis, and is oriented to the problem of impact.
- Chapter 6 – Environment and Social Impact Assessment: Describes the proposed project's potential environmental and social impacts and their mitigation. General and project-specific guidelines were used to assess the potential environmental impacts at the various stages: designing, construction and operations of the project.
- Chapter 7 – Environmental Management Plan: Presents the Environmental Management Plan and Monitoring Program for the project
- Chapter 8 – Public Consultation and Information Discussion: Covers public consultation, disclosure and the grievance mechanism. The history of public consultation for the Project is reviewed, and descriptions of public consultation held during detailed design are provided, along with a summary of comments. Future public consultation is suggested.

2 Policy, Legal and Administrative Framework

2.1 National & Sindh Environmental Protection Laws & Policies

After the National Assembly of Pakistan passed the 18th amendment on April 8, 2010, the Pakistan Environmental Protection Agency (PEPA) disseminated its power to four provincial environmental agencies in Pakistan. The project has been assessed in compliance with the existing legal framework in Pakistan, including the Sindh Province, as well as relevant international policies and guidelines. The relevant policies, legislation and guidelines of Pakistan applicable to this subproject are summarised in this section.

2.1.1 Sindh Environmental Protection Act, 2014

The Sindh Environmental Protection Act, 2014) is a comprehensive legislation that provides the legislative framework for protecting, conserving, rehabilitating and improving the environment. The 'environment' has been defined in the Act as (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the interrelationships between any of the factors specified in sub-clauses 'a' to 'f'. The notable points of the law are:

- No proponent of a project shall commence construction or operation unless he has filed.
- an EIA with the Provincial Agency designated by the Provincial EPAs an EIA, and has obtained an approval;
- Establishment and formation of the Environmental Protection Council;
- Prohibition of certain discharges or emissions;
- Sindh Environmental Quality Standards (SEQS) for wastewater, air emissions and noise; and
- Provincial Government can issue notices and enforce them to protect the environment.

2.1.2 Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021

The Sindh Environmental Protection Agency (SEPA) IEE and EIA Regulations, 2021 define the categories. The proposed project is categorized based on the serving areas in Schedule III, section - F, sub-section-2 "Irrigation and drainage projects serving more than 15,000 hectares and above". The proposed project falls under Schedule "III", so it will require an EIA, and an application will be submitted to obtain a No Objection Certificate (NOC) from Sindh EPA to fulfil legal compliance.

2.1.3 Sindh Occupational Health & Safety Act, 2017

This Act provides for occupational safety and health conditions at all workplaces for the protection of persons at work against risk of injury arising out of the activities at workplaces and for the promotion of a safe, healthy and decent working environment adapted to the physical, physiological and psychological needs of all persons at work. Under the Act, the employer would be responsible for ensuring the health and safety of the workers at workplaces (construction sites are also considered workplaces under the act). The act mentions health and safety requirements that need to be complied with by the employer/site in charge and the workers. The Chief Inspector and the inspectors appointed under the act shall be responsible for enforcing health and safety requirements prescribed by the act. Penalties shall be imposed in case of non-compliance with the requirements.

2.1.4 Canal & Drainage Act, 1873

The Canal and Drainage Act 1873 (CDA) focuses on constructing and maintaining drainage channels and defines powers to prohibit obstruction or order their removal. It also briefly addresses issues relating to environmental pollution. Section 70(5) of the CDA clearly states that no one is allowed to "corrupt or foul the water of any canal so as to render it less fit for the purposes for which it is ordinarily used." In

addition, Section 73 of the CDA gives the power to arrest without warrant or to be taken before the magistrate a person who has willfully damaged or obstructed the canal or "rendered it less useful."

2.1.5 Sindh Resettlement & Rehabilitation Policy 2022

The Sindh Resettlement and Rehabilitation Policy 2022 covers all types of displacements in Sindh province - for instance, (a) development-induced displacement caused by project interventions; (ii) displacement caused by natural/climate related disasters; and (c) displacement caused by 'non-development project' related AEDs or eviction of informal settlers. For development projects in Sindh, this policy will cover both public and private sectors involving physical and/or economic displacement of people. Under this R&R Policy, any displacement or resettlement, irrespective of its causes (i.e., development project, non-development project/to free public land or natural/climate disasters), would be implemented as an adequately designed and coordinated 'project' that reduces vulnerability and enables environmental and social sustainability.

2.1.6 Sindh Public Property Removal (Removal of Encroachment) Act, 2010

The Provincial Assembly has passed the Act to avoid encroachment and provides measures for the removal of encroachment from public property. The law specifies powers to intervene, grievance redress and review mechanisms, eviction and recovery of cost of eviction in case of non-compliance, punishment for aiding and abetting the act of encroachment, rewards for outstanding performance in removal of encroachment, and setting up of grievance redress tribunals. The project proponents and other relevant line departments will provide continuous oversight and reinforcement to ensure that public spaces remain free from illegal encroachments as outlined in the Act.

2.1.7 Land Acquisition Act of 1894

The Land Acquisition Act 1894 provides for the acquisition of private properties for public purposes, including development projects in Pakistan. It comprises 55 sections dealing with area notifications, survey, acquisition, compensation, apportionment awards, dispute resolutions, penalties, and exemptions. The key clauses of the Act are summarized in Table 2-1. A detailed description of the Act is given in RPF. The land acquisition for the subprojects will be carried out in accordance with this act.

Table 2-1: Key Clauses of Land Acquisition Act

LAA Section	Description
Section 4	Publication of preliminary notification and power for conducting the survey.
Section 5	Formal notification of land needed for a public purpose. Section 5a covering the need for enquiry of the concerns or grievances of the affected people related to land prices.
Section 6	The Government makes a more formal declaration of intent to acquire land.
Section 7	The Land Commissioner shall direct the Land Acquisition Collector (LAC) to take order the acquisition of the land.
Section 8	The LAC has then to direct that the land acquired to be physically marked out, measured and planned.
Section 9	The LAC gives notice to all project-affected persons (PAPs) that the Government intends to take possession of the land and if they have any claims for compensation, then these claims are to be made to him at an appointed time.
Section 10	Delegates power to the LAC to record statements of the PAPs in the area of land to be acquired or any part thereof as co-proprietor, sub-proprietor, mortgage, and tenant or otherwise.
Section 11	Enables the Collector to make enquiries into the measurements, value, and claim and then to issue the final "award". The award includes the land's market area and the valuation of the compensation.
Section 11 A	Enables the Collector to acquire land through private negotiations upon request of Head of the acquiring department. Upon receipt of any such request, the collector is empowered to constitute/notify a committee for assessment of the market value of land and verification of title of ownership. On agreement by Head of Acquiring Department, with negotiated market value determined by the committee, the

LAA Section	Description
	collector shall then direct parties to execute sale deed in favor of acquiring department on stamp paper.
Section 11 B	Provides a time limit of six months to complete the land acquisition process from the date of notification under Section-4.
Section 16	When the LAC has made an award under Section 11, he will then take possession and the land shall thereupon vest absolutely in the Government, free from all encumbrances.
Section 18	In case of dissatisfaction with the award, PAPs may request the LAC to refer the case onward to the court for a decision. This does not affect the Government taking possession of the land.
Section 23	The award of compensation to the title holders for acquired land is determined at i) its market value of land, ii) loss of standing crops, trees and structures, iii) any damage sustained at the time of possession, iv) injurious affect to other property (moveable or immoveable) or his earnings, v) expenses incidental to compelled relocation of the residence or business and vi diminution of the profits between the time of publication of Section 6 and the time of taking possession plus 15% premium in view of the compulsory nature of the acquisition for public purposes.
Section 28	Relates to the determination of compensation values and interest premium for land acquisition.
Section 31	Section 31 provides that the LAC can, instead of awarding cash compensation in respect of any land, make any arrangement with a person having an interest in such land, including the grant of other lands in exchange.
Section 48A (LAA-1986)	If within a period of one year from the date of publication of declaration under section 6 in respect of any land, the Collector has not made an award under section 11 in respect to such land, the owner of the land shall, unless he has been to a material extent responsible for the delay be entitled to receive compensation for the damage suffered by him in consequence of the delay.

2.1.8 Other Relevant Environmental Legislation

An overview of other relevant legislation relevant to the environmental and social aspects of the Project is presented in Table 2-2.

Table 2-2: Other Relevant Social and Environmental Legislation

Legislation / Guidelines	Brief Description	Relevance to the Proposed Subprojects
Pakistan Labour Policy 2010	the policy recognizes that workers and employers must enjoy reasonable benefits that the economy can sustain without suffering setbacks.	Forced labour and child labour will not be allowed.
Factories Act, 1934 (as amended to 1997)	The clauses relevant to the project concern the health, safety, and welfare of workers, disposal of solid wastes and effluents, and damage to private and public property. The Factories Act also provides regulations for the handling and disposing toxic and hazardous materials.	Workers shall be protected from risks associated with wastewater discharges and emissions.
Sindh Bonded Labor System (Abolition) Act (2005)	The Bonded Labor System (Abolition) Acts seek to eradicate bonded labor practices prevailing in the respective provinces.	Bonded/forced labour will not be allowed.

Legislation / Guidelines	Brief Description	Relevance to the Proposed Subprojects
Sindh Minimum Wages Act 2015 for Unskilled Workers Ordinances (1969)	The ordinances state that every employer shall be responsible for the payment of minimum wages required to be paid under the ordinances to all unskilled workers employed, either directly or through a contractor, in his commercial or industrial establishment	Labour wages should be paid in accordance with this act
Sindh Environmental Quality Standards 2016	Sindh Environmental Quality Standards (SEQS) were notified in 2016. SEQS relevant to the Project include Municipal and liquid industrial effluents (32 parameters) • Industrial gaseous emissions (16 parameters) • Motor vehicle exhaust and noise (used and new vehicles) • Ambient air quality (9 parameters) • Drinking water quality (32 parameters categorized under biological, physical, chemical inorganic and organic, and radioactive parameters) • Noise (four zones during day and night).	The proposed project will comply with these standards.
Forest Act (1927) and Forest (Amendment) Act (2010)	The Forest Act of 1927 establishes the right of GoP to designate areas of reserved forest, village forest and protected forest. GoP can acquire such areas to prohibit or restrict the public use of such resources or other activities.	In consultation with the Forest Department, it has been confirmed that no such areas are present within the study area.
Protection of Trees and Brushwood Act (1949)	The Protection of Trees and Brushwood Act of 1949 prohibits the cutting or lopping of trees along roads and canals planted by the Forest Department unless the prior permission of the Forest Department is obtained.	ESIAs will be prepared in consistency with this Act.
Sindh Wildlife Protection Ordinance 1972	The ordinance requires the protection of wildlife species declared as protected and game animals. This ordinance restricts the hunting of protected and game animals. Game animals can be hunted under a permit from the wildlife department. It declares certain areas as national parks and game reserves where hunting and spoiling	No personnel or staff related to the project, including contractor staff, will be allowed to hunt or otherwise disturb wildlife.

Legislation / Guidelines	Brief Description	Relevance to the Proposed Subprojects
	of its natural landscape and environment is prohibited.	
Wildlife and Biodiversity (Protection, preservation and Conservation Management Act), 2015	The Act has been instated to consolidate the laws relating to the protection, preservation, conservation and management of wildlife in Sindh. It restricts hunting, possession and display of wildlife, trade and trafficking of wildlife or products, and protected areas. Wildlife offences and penalties for those offences are provided in the Act.	This act will apply to all the project workers.
Sindh Solid Waste Management Board Act, 2014	The government of Sindh has established the Sindh Solid Waste Management Board (SSWMB) under the Sindh Solid Waste Management Board Act 2014. SSWMB is responsible for collecting and disposing of solid and other wastes in the Province of Sindh.	The project will take the SSWMB on board wherever the project activities have the potential to generate solid waste.
Workers Compensation Act, 2013 Minimum Wages Act 2015	The Act provides for the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments. In the FY 2024-25 budget, the Sindh Government has set the minimum monthly wages in the province at Rs. 37,000/-[5].	The subprojects must ensure that all workers are paid at least minimum wages. If this is ensured, the Act will not affect the Project.
Sindh Transparency and Right to Information Act, 2016	The Act ensures transparency and access to information in Sindh.	Information on proposed projects will be shared on SID's website.
Motor Vehicle Ordinance (1965) and Rules (1969)	The ordinance deals with the licensing requirement for driving; powers of licensing authority, Regional Transport Authority and those of Court vis-à-vis disqualification for license and registration requirements to control road transport; compensations for the death of or injury to a passenger of public carrier; powers of Road Transport Corporation; traffic rules, power to limit speed, weight, use of vehicles; power to	The contractor will have to comply with these Rules.

[5] https://efp.org.pk/wp-content/uploads/2024/10/Sindh-Minimum-Wage-Notification-Un-Skilled-2024-25-1.pdf

Legislation / Guidelines	Brief Description	Relevance to the Proposed Subprojects
	erect traffic signs; specific duties of drivers in case of accident and powers of police officers to check and penalize traffic offenders.	
Highway Safety Ordinance (2000)	This Ordinance includes provisions for licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control offenses, penalties and procedures; and establishing a police force for motorways and national highways to regulate and control the traffic and keep the highways clear of encroachments.	The contractor will have to comply with this Ordinance.
Pakistan Penal Code (1860)	The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the environmental context, the Penal Code empowers local authorities to control noise, toxic emissions, and effluent disposal.	The contractor will have to comply with this Code.
Regulation of Mines and Oil Fields/ Mineral Development Act (1948)	This legislation provides regulatory procedures for quarrying and mining construction material on public and private lands.	The contractor will have to comply with this Act.
Pakistan Antiquity Act, 1975	All accidental discoveries must be reported to the federal Department of Archeology. It also makes the federal government the owner of all buried antiquities discovered from any site, whether protected or otherwise.	Chance-finds are to be reported to provincial archaeological departments.
Sindh Prohibition of Employment of Children Act, 2017	According to this Act, "child" means a person who has not completed his fourteenth year. The act specifies that no child shall be employed or permitted to work in any establishment.	Children aged below 18 will not be engaged in construction works.

2.1.9 Legislation Related to Gender-Based Violence

Legal and Policy Framework of Pakistan. Article 25 of the Constitution of the Islamic Republic of Pakistan, while guaranteeing gender equality, empowers the State to make special provisions for the protection of women. This includes protection of the right to life, liberty, economic empowerment, and education. The GBV is covered under the legal framework of GoS to protect women against harassment in the workplace. The Sindh Protection Against Harassment of Women in the Workplace Act, 2010 requires a number of actions to protect women against harassment in the workplace. As a result, the GoS

appointed a woman as the provincial Women's Ombudsperson for receiving and disposing of complaints of working women against harassment in their respective places of employment..

International Commitments Signed by Pakistan. The Government of Pakistan has ratified various international human rights instruments, committed to securing equal rights for women including, the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) and International Labor Organization (ILO) Conventions No. C-100 (Equal Remuneration Convention) and C-111 Discrimination (Employment and Occupation). CEDAW obliges member States, to eliminate all forms of discrimination against women and bring de-jure and de facto equality between men and women. It also obliges States to take all legislative, administrative and other measures to ensure women's participation in economic, political and national life. In addition to CEDAW, ILO Convention No. 100 and No. 111 provide for equality of opportunity and treatment in all employment-related matters including remuneration.

2.2 Environmental Regulatory Authorities

The relevant environmental regulatory authority is the Sindh Environmental Protection Agency (EPA). The provincial EPAs are responsible for environmental regulation and implementing GoP environmental policies in their respective provinces. As part of their roles, provincial EPAs are responsible for reviewing EIA documentation for compliance with provincial EIA requirements and procedures, using their district-based staff, and monitoring the implementation of EMPs.

The statutory functions of the provincial EPAs are to:

- Administer and implement the Environmental Protection Act, its rules and regulations
- Review IEE/EIA, preparation of procedures and guidelines
- Prepare, revise and enforce EQS (industries, municipalities, vehicular emission)
- Establish and maintain laboratories, certification of laboratories for conducting tests and analysis
- Assist local Councils, Authorities and/or Government Agencies in executing projects.
- Establish a system of surveys, monitoring, examination, and inspection to combat pollution.
- Conduct training for Government functionaries and industrial management
- Provide information and education to the public on environmental issues
- Publish the Annual State of the Environment report
- Undertake surveys and qualitative and quantitative analysis of data on air, soil and water quality, and industrial, municipal and traffic emissions
- Take measures to promote environment-related Research and Development (R&D) activities.

Other key relevant departments in the province and their roles are summarized below.

- **Forest**
  - Preparation and implementation of policies and programs in the forestry sector.
  - Implementation of Forestry Laws and rules.
  - Protection, conservation, development, and management of renewable natural resources, particularly forests and rangelands in the province.
  - Sustainable management of forest for production of timber, firewood and other non-timber produce and services.
  - Demarcation and protection of Forest land against encroachment.
  - Raising of nurseries and plantations.
  - Provide extension services for mass awareness and conduct research and training for capacity building.
  - The Forest Department will be involved in case of the need to fell any trees in the government forests.
- **Wildlife**
  - Protection, conservation, preservation, and management of wildlife.
  - Management of protected areas, wildlife parks, safaris, and zoos.
  - Public and private participation through trophy hunting, private breeding farms and hunting associations.

- As such no protected areas fall within or adjacent to the study area of the ESIA however contractor and its staff will have to comply with the relevant wildlife protection legislation.

- **Fisheries**
  - Extension services/fish farming/aquaculture development.
  - Conservation, management and development of natural resources.
  - Production of fish seed under controlled conditions.
  - Research and training activities.
  - Introduction of new technologies for enhancing fish production.
  - The Fisheries Department will be involved in case of any damage to any fish resources and fishponds caused by the project activities.
- **Revenue Department**
  - The revenue department is responsible for the acquisition of land (permanent or temporary) including assessment, valuation, disbursement of compensation, and mutation in favor of implementing agencies.
- **Agriculture Department**
  - In case of an impact on crops and fruit trees, the Agriculture Department is fully responsible for the assessment and valuation of losses.
- **Communication & Works (C&W) Department**
  - The C&W will be involved in the assessment and valuation of losses in case of project impact on structures/ buildings and roads.

2.3 World Bank Operational Policies

The World Bank Safeguard Policies applicable to the SWAT project and their relevance to the Akram Wah Subproject are given in Table 2-3.

Table 2-3: of World Bank OPs for the SWAT Project and Relevance to Akram Wah

Directive	Policy	Trigger Status		Relevance to Akram Wah
		Triggered	Not Triggered	
Environmental Assessment	OP/BP/GP 4.01	✓		The subproject can be classified as Category B as the proposed work will be to rehabilitate the existing canal and will be carried out within the existing RoW. ESIA has been carried out in compliance with this policy
Natural Habitats	OP/BP 4.04	✓		Ecological studies have been carried out in the project area.
Pest Management	OP 4.09		✓	This is irrelevant to Akram Wah, but integrated pest management measures are proposed in the ESMF.
Cultural Property	OP 11.03/OP 4.11	✓		The proposed project will impact no known areas of cultural heritage. Procedures will be in place to deal appropriately with any chance finds. Chance-find procedures are included.
Involuntary Resettlement	OP/BP 4.12	✓		Improvement and Rehabilitation of Akram Wah Canal will involve resettlement issues, including legacy issues related to people recently displaced by the GOS through an Anti-encroachment drive on Supreme Court orders. A Social Management and Resettlement Plan has been prepared to mitigate impacts on AED affectees along the Akram Wah Canal.
Indigenous Peoples	OP 4.20/OP 4.10		×	Not triggered, as no Indigenous People or ethnic minorities will be affected by the proposed project.

Directive	Policy	Trigger Status		Relevance to Akram Wah
		Triggered	Not Triggered	
Forests	OP/BP 4.36		×	There will be no disruption to forests associated with the proposed project works.
Projects in International Waterways	OP/BP/GP 7.50	✓		This policy was triggered since the project activities relied on water from the Indus River, an international waterway. Project activities will be limited to renovating existing irrigation facilities to improve agricultural water productivity, and the activities are not expected to increase water abstraction from the Indus River. Thus, (i) the project will not adversely impact the quantity or quality of water in the international waterway and (ii) the project investments will not be adversely affected by the other riparians' possible water use. Therefore, the project falls within the exception to the notification requirements as outlined in paragraphs 7(a) and 7(b) of OP 7.50. The South Asia Regional Vice President approved the exception to the notification requirement on Month XX, 2021.

2.4 World Bank EHSGs

The Environment, Health, and Safety Guidelines (EHSGs) contain the performance levels and measures generally considered achievable in new facilities or projects by existing technology at reasonable costs. In addition, there are also industry-specific EHS guidelines. The guidelines relevant to the project are as follows: General EHS Guidelines[6].

2.5 International Conventions

Pakistan is a signatory to a large number of International treaties and conventions, and those are related to the protection of the ozone layer, the protection of wetlands, the conservation and wise use of different biological resources, safe handling and storage of genetically modified organisms, protection of water bodies of international importance and attached biodiversity and to controlled transboundary movement of hazardous wastes and their disposal

Table 2-4: International Treaties and Conventions

Theme	Convention	Date of treaty	Entry into force in Pakistan
Trans boundary movement of hazardous waste and disposal	**Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal:** It deals with the controlled trans-boundary movement of hazardous waste and disposal. The Convention provides for three sets of measures with binding obligations. These are: Strict control of transboundary movement of hazardous waste, Environmentally sound management of hazardous waste, and Enforcement and implementation of the convention's provisions at international and national levels.	1989	1994
Organic pollutants	**Stockholm Convention on Persistent Organic Pollutants:** This convention protects human health and the environment from the harmful impacts of persistent organic pollutants, which remain intact in the	2001	2008

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

Theme	Convention	Date of treaty	Entry into force in Pakistan
	environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife.		
Cultural heritage	**Convention Concerning the Protection of the World Cultural and Natural Heritage:** It requires parties to adopt a general policy on the protection of the natural and cultural heritage, to set up services for such protection, to develop scientific and technical studies, to take appropriate legal, technical, scientific and administrative measures and to foster training and education for such protection.	1972	1976
International trade of hazardous chemicals	**Rotterdam Convention on Prior Informed Consent (PIC) for Certain Hazardous Chemicals and Pesticides in International Trade:** The Rotterdam Convention is an international treaty designed to facilitate informed decision-making by countries about trade in hazardous chemicals. It establishes a list of covered chemicals and requires parties seeking to export a chemical first to establish that the intended importing country has consented to the import. It also requires that a party seeking to export a chemical that is not listed under the Convention but that is subject to a ban or severe restriction in its territory must provide notice to the importing country of the proposed export	1998	1999
Desertification	**United Nations Convention to Combat Desertification (UNCCD):** This convention attempts to combat desertification and mitigate the effects of drought in countries experiencing serious/desertification. It is supported by international cooperation and takes an integrated approach to sustainable development in the affected areas.	1994	1997
Climate change and the ozone layer	**Montreal Protocol on Substances that Deplete the Ozone Layer:** The 1987 Montreal Protocol on substances that deplete the ozone layer under which parties have to take appropriate measures to protect human health and the environment from human activities which change or are likely to change the ozone layer, by reducing the emissions of certain substances that deplete or change the ozone layer	1987	1993
	Vienna Convention for the Protection of the Ozone Layer: It acts as a framework for international efforts to protect the ozone layer with the primary objective of protecting human health and the environment against adverse effects resulting from human activities that modify or are likely to modify the ozone layer.	1985	1993
	United Nations Framework Convention on Climate Change - the primary objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	1992	1994
	Kyoto Protocol to the United Nations Framework Convention on Climate Change - enabled by the above Convention on Climate Change. It has more powerful and legally binding measures. It sets binding targets for 37 industrialized countries and the European community to reduce greenhouse gas emissions.	1997	2005
	Paris Agreement - Its aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise below 2 degrees Celsius above pre-industrial levels this century and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.	2016	2016
Biodiversity and the protection of plants and animals	**Convention on Biological Diversity –** It covers ecosystems, species, genetic resources, and biotechnology. The objectives are to conserve biological diversity, sustain the use of its components, and promote the fair and equitable sharing of benefits arising from genetic resources.	1992	1994
	Cartagena Protocol on Biosafety to the Convention on Biological Diversity - addresses potential risks posed by living modified organisms resulting from modern biotechnology.	2000	2009
	Bonn Convention on the Conservation of Migratory Species of Wild Animals - aims to conserve terrestrial, marine and avian migratory species throughout their range. It is concerned with the conservation of wildlife and habitats on a global scale.	1979	1987

Theme	Convention	Date of treaty	Entry into force in Pakistan
	The Convention on Wetlands of International Importance, Ramsar 1971 - Principal obligations to promote designation and conservation of wetlands, and to train and encourage research	1971	1976
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) - Strict regulation (including penalization, confiscation of the specimen, etc.) regarding the trade of all species threatened with extinction or that may become so, in order not to endanger their survival.	1975	1976
ILO Labor Conventions	The Government of Pakistan has ratified 36 ILO Conventions, including 8 fundamental conventions, as of now. In the South Asian sub-region, Pakistan is the second country that has ratified all eight fundamental conventions as enshrined in the ILO Declaration on Fundamental Principles and Rights at Work. The ILO works in close collaboration with its tripartite constituents to achieve Pakistan's decent work objectives. The ILO Governing Body has identified eight "fundamental" Conventions, covering subjects that are considered to be fundamental principles and rights at work: freedom of association and the effective recognition of the right to collective bargaining; the elimination of all forms of forced or compulsory labor; the effective abolition of child labor; and the elimination of discrimination in respect of employment and occupation. 1. Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87) 2. Right to Organize and Collective Bargaining Convention, 1949 (No. 98) 3. Forced Labor Convention, 1930 (No. 29) (and its 2014 Protocol) 4. Abolition of Forced Labor Convention, 1957 (No. 105) 5. Minimum Age Convention, 1973 (No. 138) 6. Worst Forms of Child Labor Convention, 1999 (No. 182) 7. Equal Remuneration Convention, 1951 (No. 100) 8. Discrimination (Employment and Occupation) Convention, 1958 (No. 111)		

3 Description of the Subproject

3.1 General

This subproject includes the rehabilitation of the Akram Wah, which off takes from the left bank of the River Indus at Kotri Barrage, near Hyderabad city. Administratively, the project area lies within Hyderabad, Tando Muhammad Khan and Badin districts.

The Akram Wah is 87m (285ft) wide at its head, reducing to 18m (60ft) at the tail. The Sanctioned Discharge for Akram Wah is 3,714 cusecs at the head regulator. This sanctioned discharge is aligned with the Water Apportionment Accord and, therefore, cannot be changed. It is understood that during periods of peak flows in the River Indus, a higher Peak Discharge of 3,714 cusecs + 20% = 4,457 cusecs may be available. If sufficient water is available, the peak flow can either be provided from the Indus via the head regulator, or from Fulleli Canal to serve the Gaja Branch command area or via Akram Wah sluices at Ali Pur to serve the command area at the tail of Akram Wah.

The main purpose of the Akram Wah is for irrigational use; however, as Akram Wah passes through three urban areas – Hyderabad, Matli and Tando Mohammad Khan as such Akram Wah is operated as a perennial canal and part of the water supply for these cities is now withdrawn from the canal. It is treated before being delivered by a pipe network to the towns. In addition, numerous private pump stations are located along the canal, withdrawing water for all purposes – drinking, livestock use and irrigation. Individuals can be observed filling containers for home consumption, and others filling tanks carried by animal-drawn or motorcycle-drawn trailers. All these activities indicate the vital role played by Akram Wah not only in agricultural activities but also in supporting the existence of the towns and communities along its route.

Figure 3-1: Akram Wah passing through the urban area	**Figure 3-2: Akram Wah passing through the rural area**
	









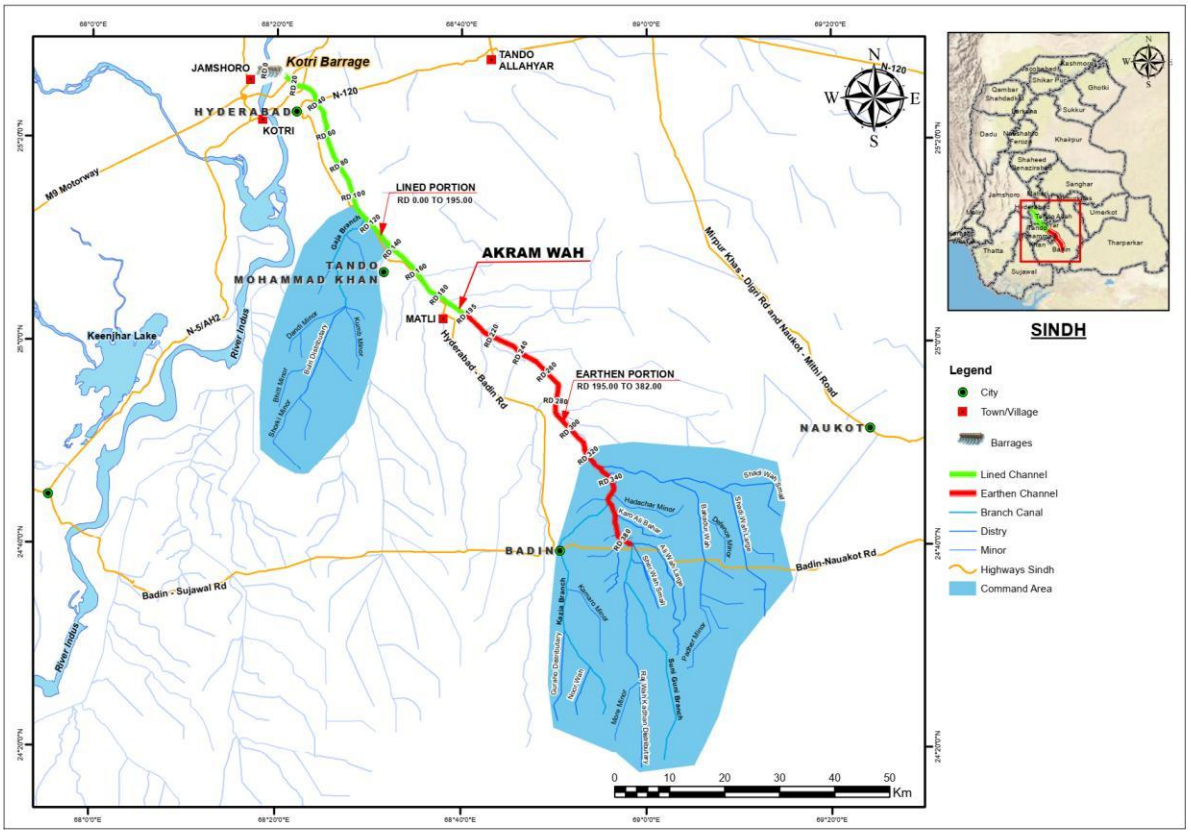
The demand for water supply from the canal has increased relative to the assumptions made in the original design. Where the canal flows through the urban areas, there is heavy encroachment up to and onto the embankments and, in extreme cases, into the canal where buildings have been constructed from the bank. Outside of urban areas, trees are common on both canal embankments, and agriculture is often practised up to the embankment toes.

3.2 Scope of Works

The project scope includes:

- Removal and disposal of existing damaged canal lining (59 km; RD 0 to RD 193)
- Construction of impervious concrete lining with geomembrane and underdrainage system (59 km; RD 0 to RD 193)
- Embankment raising and strengthening (58 km; RD 193 to the tail end)
- Reinstatement of the Inspection Path (IP) and the Non-Inspection Path (NIP) for canal maintenance
- Replacement of 4 cross regulators, 13 head regulators and 1 escape structure
- Construction of water level control structures at RD 50 and RD 193
- Replacement of 5 syphon crossings under Akram Wah and repair of two syphons
- Replacement of existing sanctioned pump houses which need to be relocated during project implementation
- Replacement of 11 road and 5 footbridges
- Protection work to abutments, piers and deck slabs of existing pre-stressed concrete bridges and railway bridge
- Construction and Furnishing of Inspection Bungalow and office at Badin, and construction of 4 staff quarters.
- Construction of Engineer's office and residence and staff accommodation at Tando Muhammad Khan
- Replacement or shifting of utility lines, where required.

Figure 3-3: Location Map as well as Depiction of Scope



3.3 Subproject Area

The subproject starts at the head regulator of Akram Wah at Kotri Barrage and ends at its tail regulator at RD 382.8, about 14 kilometres to the east of Badin town on Badin-Khoski road. The subproject area is shown in Figure 1-3.

The Corridor of Impact (CoI) will mostly fall within the government-owned Right of Way (RoW), which runs parallel to the canal. However, some works will be located beyond the RoW of the canal, such as:

- Disposal of material excavated from canal – The areas will fall within and outside the RoW,
- Establishment of borrow areas. These will be established within and outside the RoW;
- Realignment of canal reaches where head regulators and syphons are replaced at a different location – realignment will fall inside and outside the RoW;
- Realignment of roads to tie into replaced road bridges; and,
- Construction of a new AWB building at Badin falls outside the RoW of Akram Wah but will be constructed on land owned by the AWB.

The RoW lies beyond the outer toe of both canal embankments and runs parallel to the embankments for the entire canal length. RoW is taken as 315 ft wide strip through which the Akram Wah passes.

The area surrounding Akram Wah is dominated by agricultural lands, tree thickets, and orchards, but it also passes through three urban areas: Hyderabad, Matli (District Badin) and Tando Muhammad Khan.

Within urban areas, the RoW was heavily encroached upon by settlements (as shown in Figure 3-4 below). These encroachments have now been removed during AED and compensation was paid to all PAPs. Outside urban areas, agricultural land, managed orchards, and archaeological and cultural sites (mosques and graveyards) exist within the RoW. The area people follow agricultural practices, and they encroached upon government-owned land. Villages and smaller hamlets are present within the agricultural land, housing schemes, cattle farming, poultry farms, graveyards, shrines and houses/shops,

fish ponds, industrial, agricultural and commercial pumping stations, government dispensaries and police stations.

Figure 3-4:Typical photographs of settlements within the RoW



Government school situated within RoW



Government Dispensary within RoW

Tree shrubs, herbs, grasses and sedges are common species on the banks of Akram Wah. Vegetation and trees will be cleared in the vicinity of the planned structure. Common species present on the canal embankments and on structural sites include; *Phoenix dactlifera* (Khajoor), *Ficus religiosa* (Pipal), *F. bengalensis*, Eucalyptus sp. (sofaida), *Acaica nilotica* (Babur), *Melia indica* (Neem) trees etc.

Most of the construction operations will be completed within the canal prism and along the inspection and non-inspection paths of Akram Wah. However, the contractor will utilise the roads passing through these towns and cities to transport construction materials to work sites. The main Hyderabad-Badin road runs parallel to Akram Wah, which the contractor's plant will frequently use, and village roads leading to work sites.

The impact of improved irrigation reliability, equity and efficiency will be felt over Akram Wah's 644,949-acre command area. The command area of Akram Wah is split into the following areas:

- Gaja Branch off take (118,968 acres)
- Off takes downstream of 70th mile (475,672 acres)
- Areas from Sukkur Barrage command to Direct Outlets / Pumps from RD 4+000 to RD 381+000 (31,327 acres);
- Areas from Sukkur Barrage command to Shadi Wah Small (14,273 acres); and
- From Fulleli to Shadi Wah Small (4,709 acres).

3.4 Justification for Works

3.4.1 Condition Assessment

All regulating structures, including cross regulators and the head regulators for off-taking canals, were inspected along with the canal section (prism and embankments) and crossing structures such as pre-stressed concrete (PSC) bridges, village road bridges (VRBs), railway bridges, footbridges, water course aqueducts, syphons and pipeline crossings.

The Condition Assessment Report indicates that the overall condition of the structures is poor and most of the structures should be replaced. The condition survey for the hydro-mechanical equipment reached a similar conclusion regarding the need to replace most items. Typical photographs of damaged lining and structures are shown in Figure 3-5 to Figure 3-9.

Figure 3-5: Typical photographs of existing condition of Akram Wah infrastructure



Damaged concrete lining and Humps



Damaged brick lining



The poor condition of 70th Mile Cross regulator



Collapsed Footbridge









Figure 3-6: Condition Survey RD00+000 to 60+000

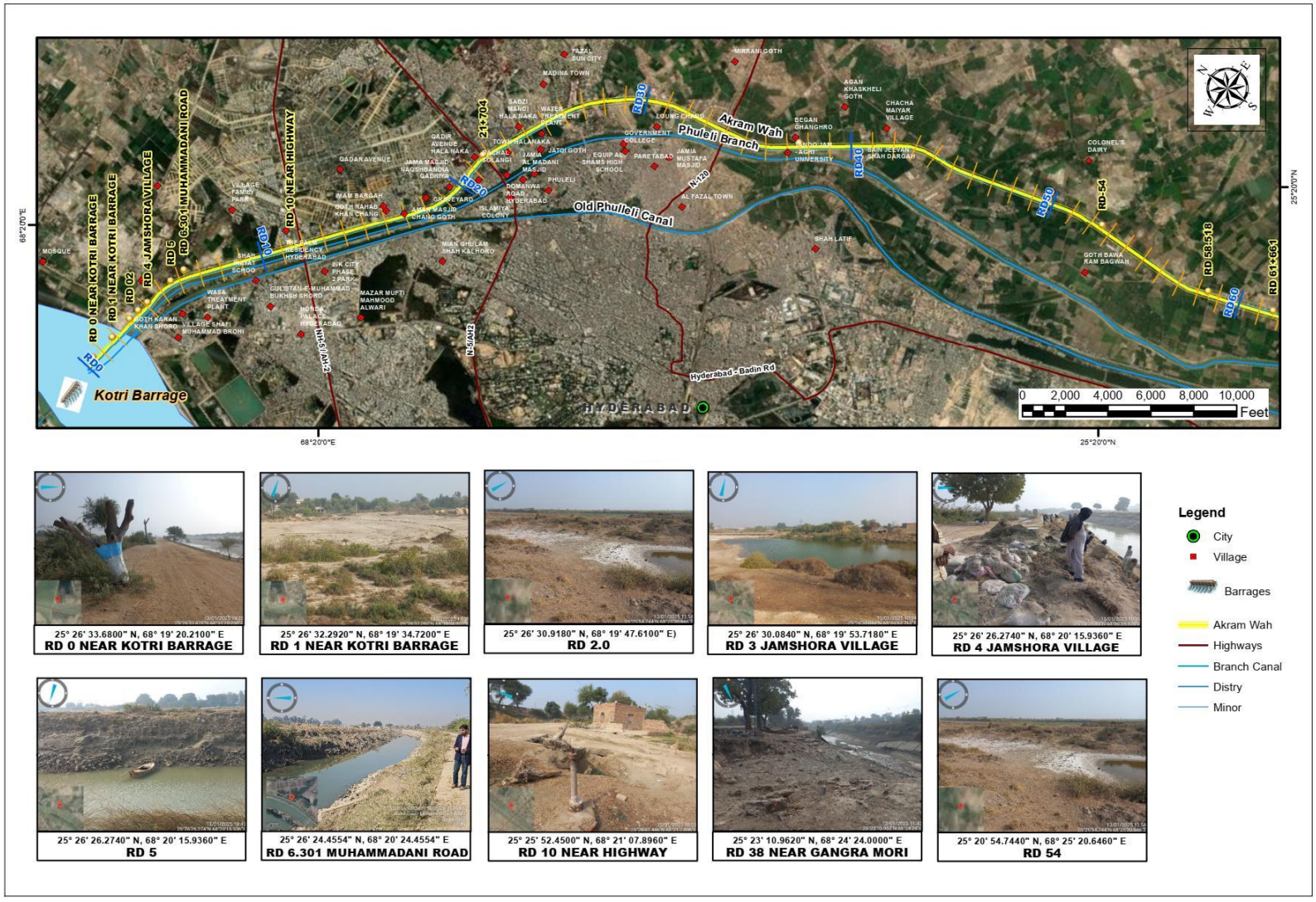


Figure 3-7: Condition Survey RD60+000 to 120+000

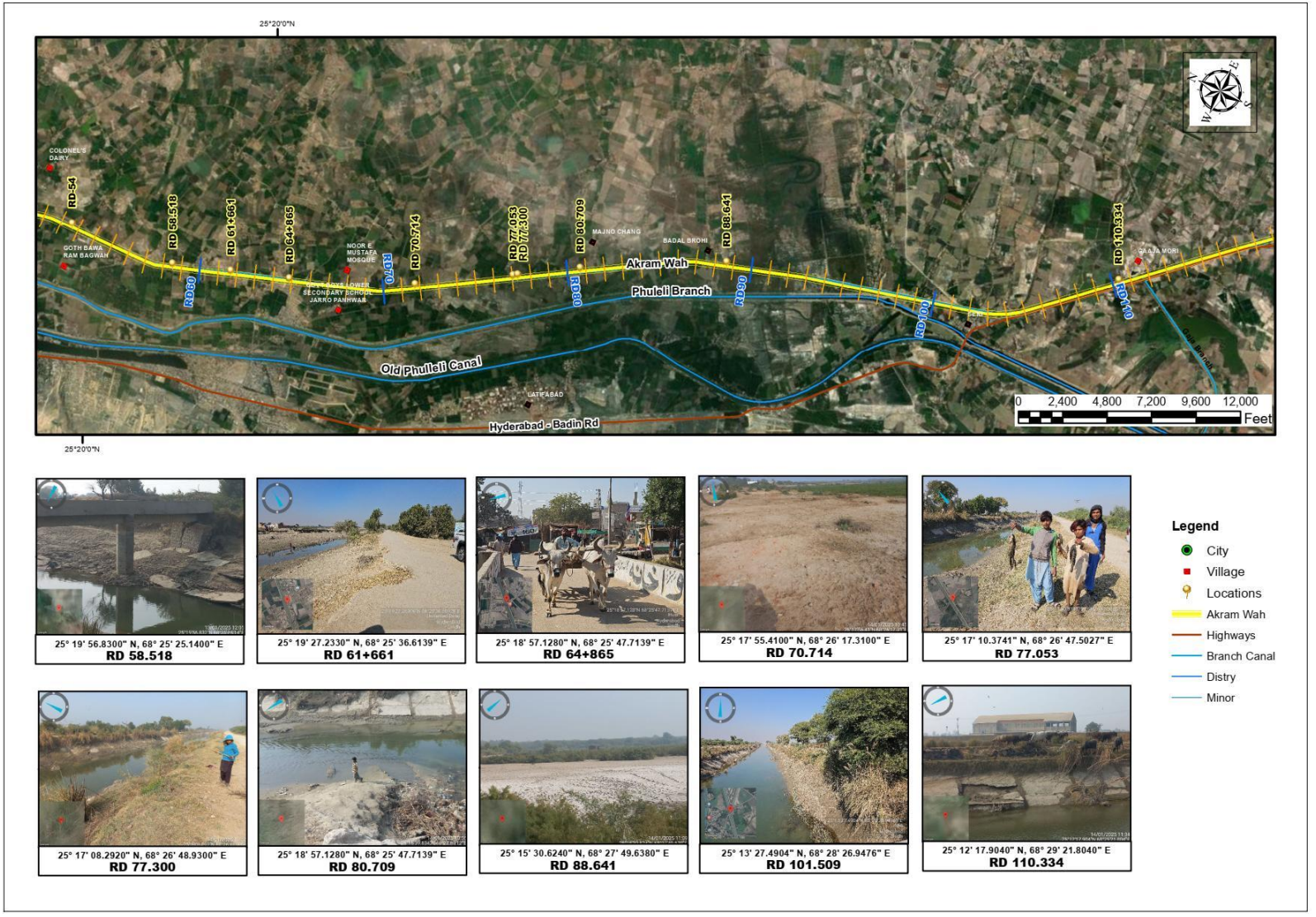


Figure 3-8: Condition Survey RD 120+000 to 180+000

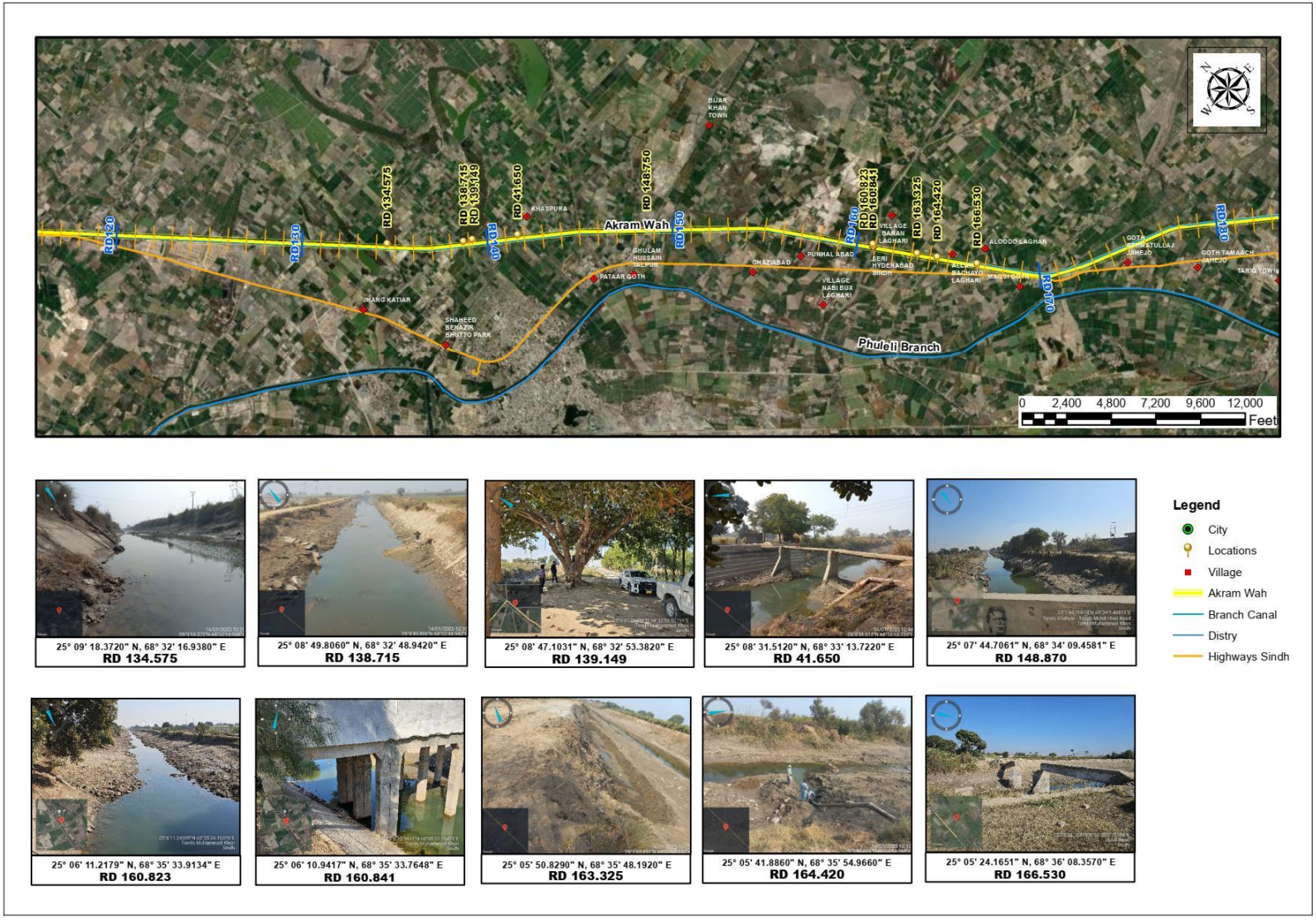
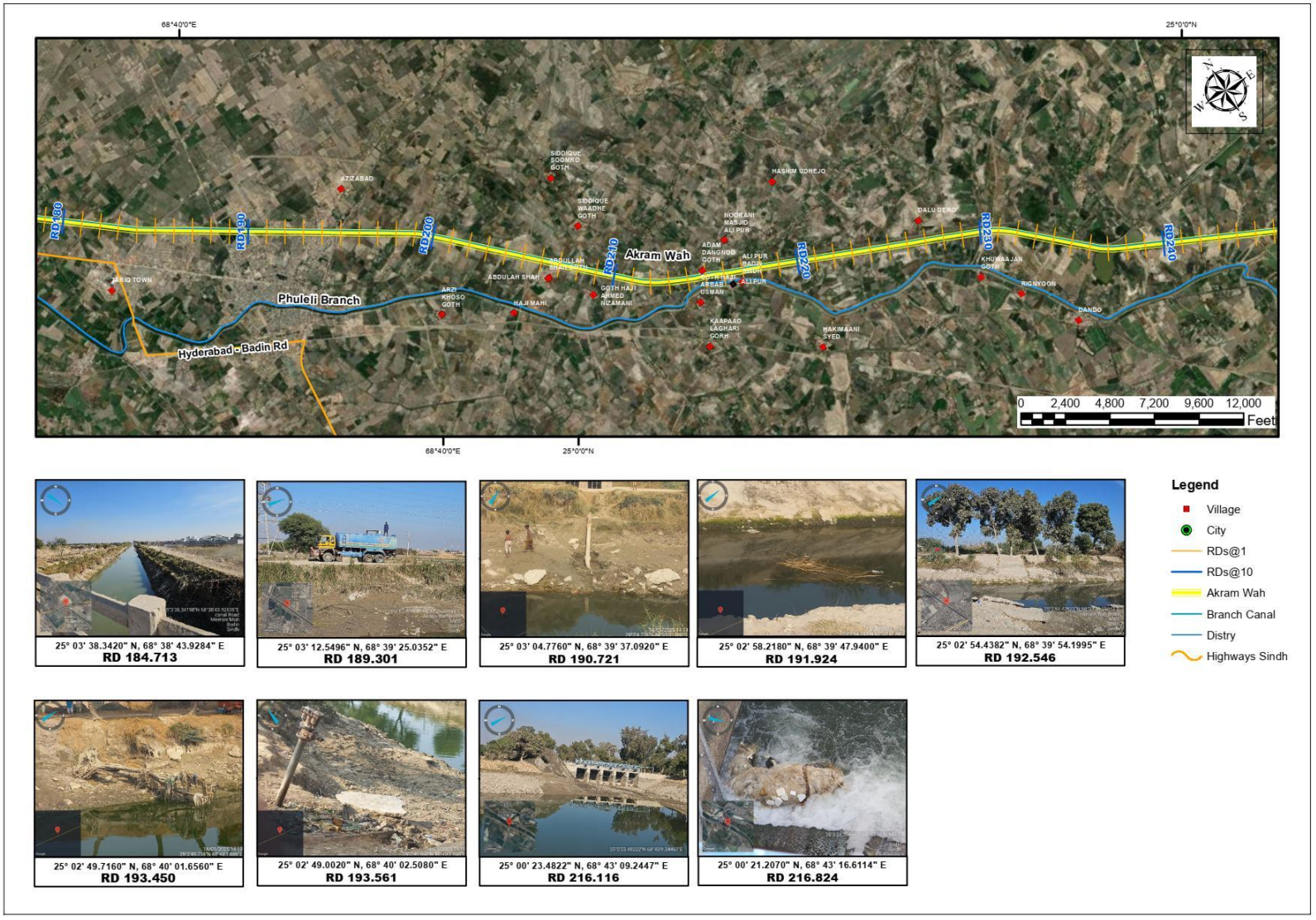


Figure 3-9: Condition Survey RD 180+000 to 194+000



3.4.2 Justification by Component

The proposed works have been agreed upon through consultation with SIDA and the AWB and based on the condition assessment and agreed design criteria. Justification for the major components of the works is provided in the following table.

Table 3-1: Justification for Proposed Works

Proposed Works	Justification
Reconstruction of Canal Lining from RD 0 to RD 193	The existing canal lining was in poor condition, reducing the conveyance capacity of the canal to 2,800 cusecs (compared to the sanctioned discharge of 3714 cusecs) and resulting in water shortages at the tail of the command. Given its present condition, repairing the existing lining is no longer economical. The relining will improve the hydraulic performance of the canal, control seepage and waterlogging and restore canal discharge capacity and provide canal protection particularly in urban reaches.
Embankment raising and strengthening from RD 193 to RD 383	Embankments are required to ensure that the peak discharge of 4,457 cusecs can be passed safely with adequate freeboard to reduce the risk of overtopping embankments, leading to interrupted irrigation supplies in the command area.
Replacement of regulating structures	Existing structures are generally in poor condition and require replacement – new structures will provide additional control and allow better water management, increasing efficiency and equity in supply distribution while minimising losses.
Replacement of syphons	Existing structures are generally in poor condition and require replacement to ensure continued supply to command areas served by the syphons.
Replacement of pump houses	Existing structures are generally in poor condition and require replacement.
Replacement of 18 bridges, including 6-foot bridges	Existing structures are being replaced where the existing freeboard to the proposed peak water levels is insufficient. This will allow peak flows to be conveyed along the canal, ensuring efficient use of peak supplies.
Construction of AWB outposts, offices and residence	Buildings required to ensure ongoing operation and maintenance of the irrigation system
Construction of Engineer's office, residence and staff accommodation	Buildings required for the implementation phase to facilitate the supervision of the works and ensure high-quality construction
Relocation of utilities, such as power lines, gas pipelines and water pipelines	Existing utilities will be relocated closely with the Sui Gas Agency and power authorities.

3.5 Pre-Construction Phase Activities

The following activities were completed during the design phase:

- Topographic survey
- Survey of vegetation and tree count for clearance
- Strip survey of Right of Way (RoW)
- Identification of diversion of services (water supply, electricity, telephone, gas pipelines, etc)
- Sediment analysis
- Hand pump and surface water analysis

3.6 Construction Phase Activities

The construction activity on the project will commence after getting the necessary clearance, including approval from the World Bank and SEPA. Standard & environmentally compatible construction materials

(Cement, Sand, Steel reinforcement, bricks, etc.) and techniques/construction practices will be employed besides adopting Standard Operation Procedures (SOPs) set out in the EMP.

The specific activities required for different phases of the rehabilitation works are given in detail below. The work shall be implemented by a contractor who has yet to be appointed. Overall responsibility for executing the construction works lies with SIDA, and operation and maintenance are with the Left Bank Canal AWB.

3.6.1 Site Clearance

All existing vegetation, trees, and any structures will be cleared from the following areas:

- Between the outer toes of the proposed embankments and any additional areas required for the contractor's working space from head to tail of Akram Wah;
- The footprint of proposed hydraulic structures and the realigned route of connecting reaches of the canal;
- The footprint of proposed bridges and the realigned route of connecting reaches of roads;
- Sites of Darogha landis (small resting rooms), AWB buildings at Badin and site for Engineer's facilities at Tando Mohammad Khan;
- Sites of contractor's camps; and,
- Any major haul routes – where new routes are to be established.

As part of the site clearance, existing utilities (see Table 3-4 for the details) will also need to be relocated.

A total of 4,865 trees (1,772 trees from RD 4+000 to 193+000 and 3093 Trees from 194+000 to 382+000) on the embankments are expected to be cut as a result of the site clearance activities. A compensatory tree plantation of 24,325 trees (at the ratio of 5 new trees per tree cut) will be developed along the embankments after the completion of the works. A detailed inventory of the affected trees and proposed compensatory tree plantation plan are described in APPENDIX-A and Section 6.8, respectively.

3.6.2 Ground Investigation

It is intended that during the initial implementation stage, the contractor will undertake ground investigations at the site of major structures to confirm ground conditions before construction commencing. Major structures will comprise those hydraulic structures incorporating steel sheet pile cut-offs and road bridges with reinforced concrete pile foundations. A typical ground investigation for each of these structures has been scoped including boreholes, trial pits, in-situ testing, sampling and laboratory testing.

For Akram Wah Canal, ground investigations will be carried out at the following sites;

- RD 4 Cross Regulator – RD 4.0
- Gaja Cross Regulator – RD 111.6
- 70th Mile Cross Regulator – RD 330.7
- Kazia Cross Regulator – RD 351.4
- Road bridges

3.6.3 Canal Remodelling Works

3.6.3.1 Removal and Disposal of Existing Canal Lining

As part of the canal rehabilitation works, the existing canal lining from RD 0 to 193, which is damaged, is to be removed. The condition of the existing lining is shown in Figure 3-5.

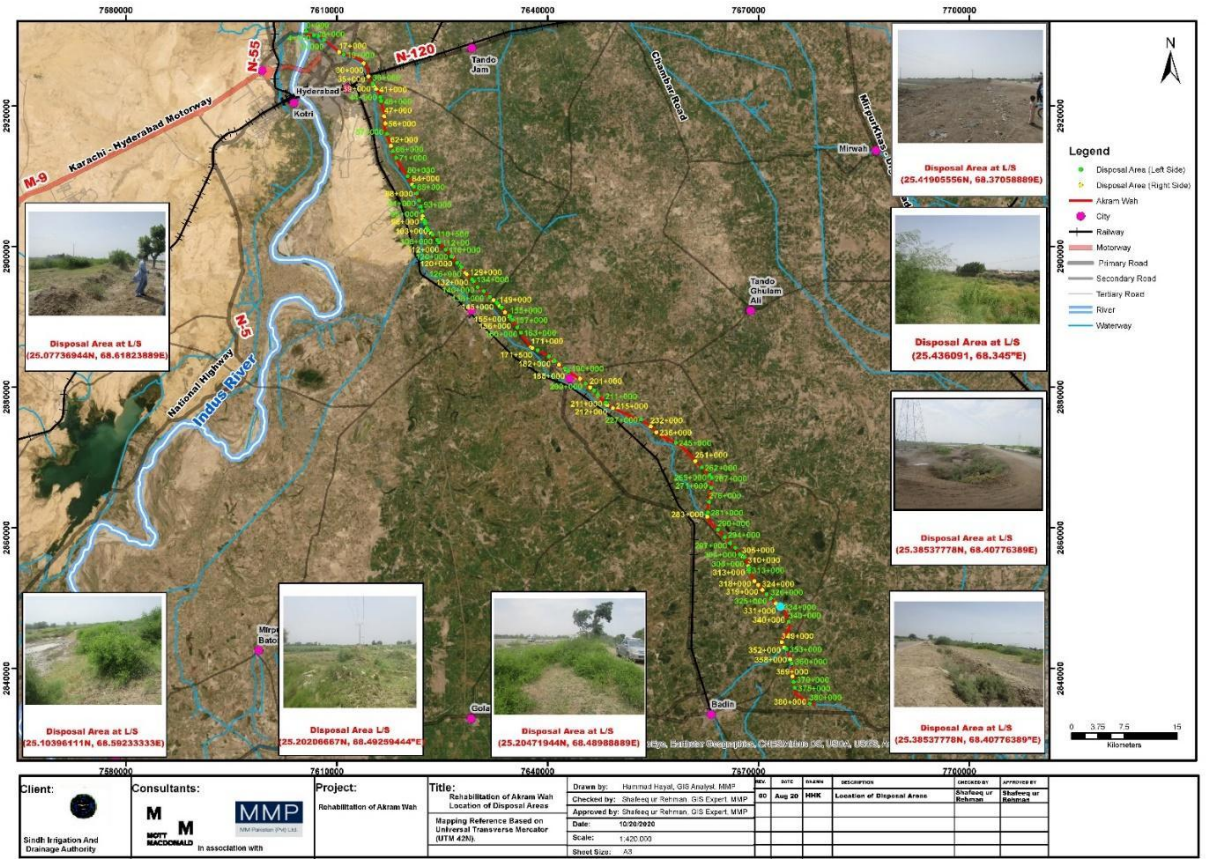
Approximately 10.5 million cubic feet[7] (cft) of canal lining will be removed and disposed of along with the spoils at designated disposal areas, as shown in Figure 3-11. These disposal areas are located within

[7] 1 m^3 = 35.314667 ft^3 or 1 ft^3 = 0.028317 m^3

the existing right of way, outside the canal embankments. Additional disposal sites will be identified by the Contractor if required.

Consideration will be given using lining debris in formation of IP aand NIP.

Figure 3-10: Location of Disposal Area



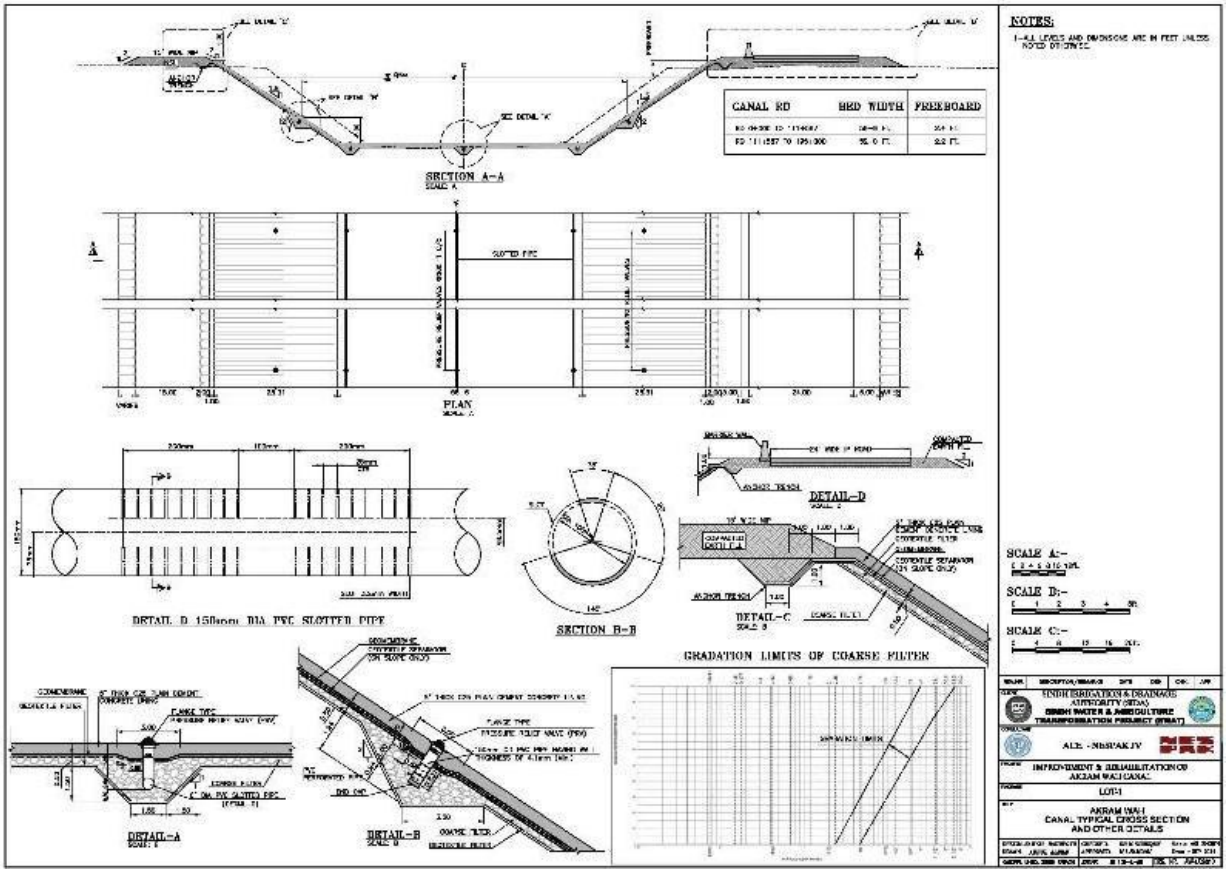
3.6.3.2 Construction of Canal Lining

In reach between RD 0 to RD 193 after necessary stripping of canal banks and bed construction of lining will be carried out as shown in Figure 3-11. The lining will include the following items of work constructed in the sequence below:

- Placement of geotextile fitter on canal bed and slopes (about 25.8 million sq.ft).
- Placement of slotted PVC drainage pipes in three rows with necessary connection for pressure relief valves (about 579,000 ft long)
- Placement of coarse fitter on bed and slopes (about 15 million cft).
- Placement of PVC geomembrane on bed and slopes (about 25.8 million sq.ft).
- Placement of separator geotextile on slopes (about 15 million sq.ft).
- Construction of concrete lining (about 10.8 million cft).
- Installation of pressure relief valves (PRVs), about 4,900 numbers.

The construction of concrete lining shall preferably be done by lining machines with slip forms.

Figure 3-11: Canal Lining Details



3.6.3.3 Excavation of Canal Banks and Disposal of Spoil

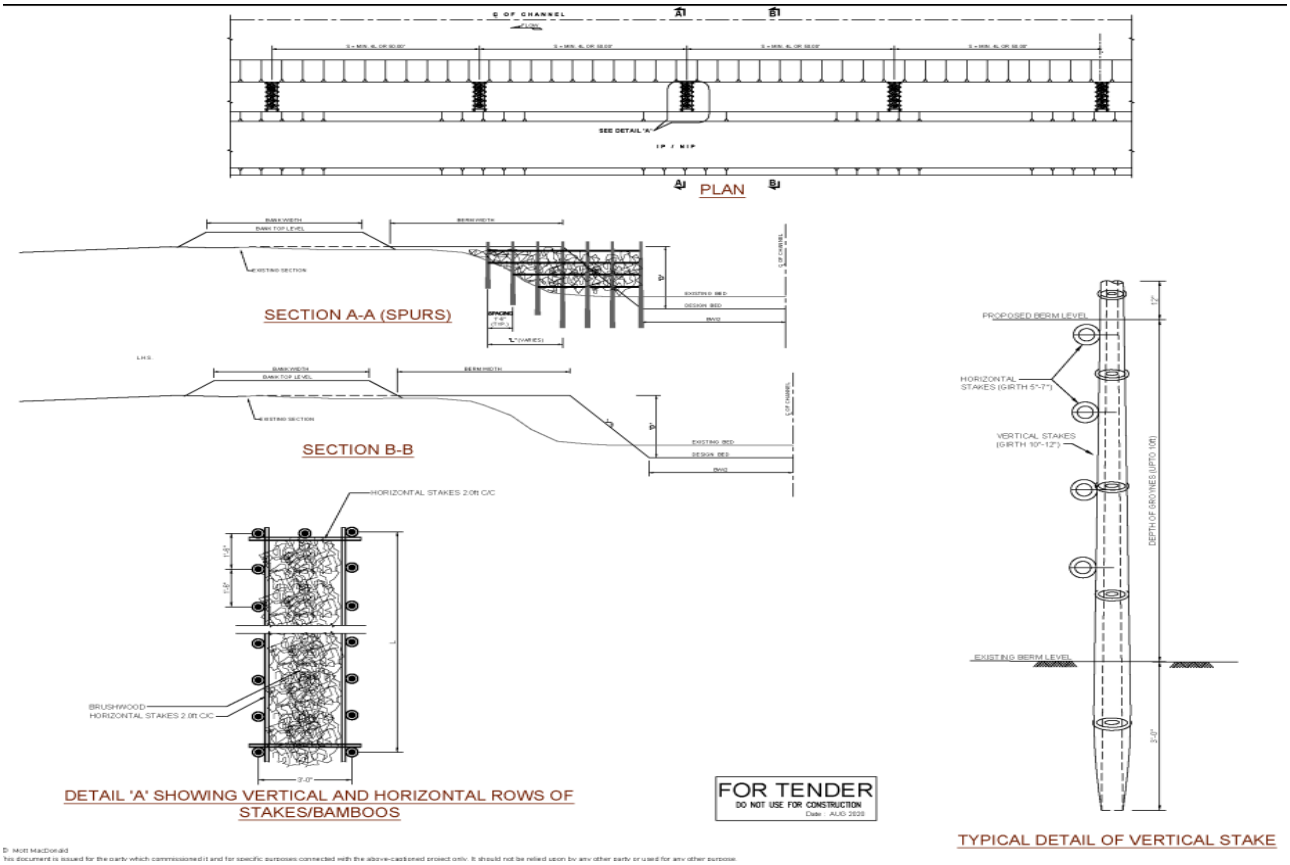
81 million cft of soil will be excavated from RD 0 to the tail. Most of this material will be used in earthfill works. A negligible amount will be disposed of outside the RoW.

Before excavation or de-silting activity commences, the spill disposal plan will be prepared and shared with the SIDA-EMU team. Finally, it will approved by the Project Director.

3.6.3.4 Berm Formation

Where the existing berm has been eroded, killa bushing will be installed to encourage natural berm formation. This is generally only required beyond RD 250. Killa bushing consists of stakes driven into the canal bed on either side of the canal. Strips of wood are woven between the stakes. These structures capture sediment in the flowing water, and encourage the formation of berms on the sides of the canal. A typical arrangement for the proposed killa bushing is shown in the following figure (Figure 3-12).

Figure 3-12: Typical Killa Bushing arrangement

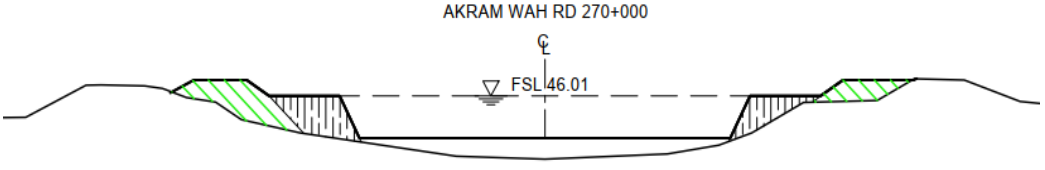


3.6.4 Raising and Strengthening Canal Embankments

Placement of earth fill for the raising and strengthening of the existing embankments will be undertaken to varying degrees from RD 0 to the tail of the canal. The majority of these works will be required from RD 193 to the tail, with only minimal fill to the embankments required from RD 0 to 193.

A cross-section showing the typical extent of embankment raising works required from RD 193 to tail is provided in the following figure (Figure 3-13). Note that the works are generally confined to within the footprint of the existing canal embankments, and as such, no major change in land use is expected as a result of these works.

Figure 3-13: Typical Embankment Raising Works from RD 193.8 to Tail



The stages of works required for embankment raising are as follows:

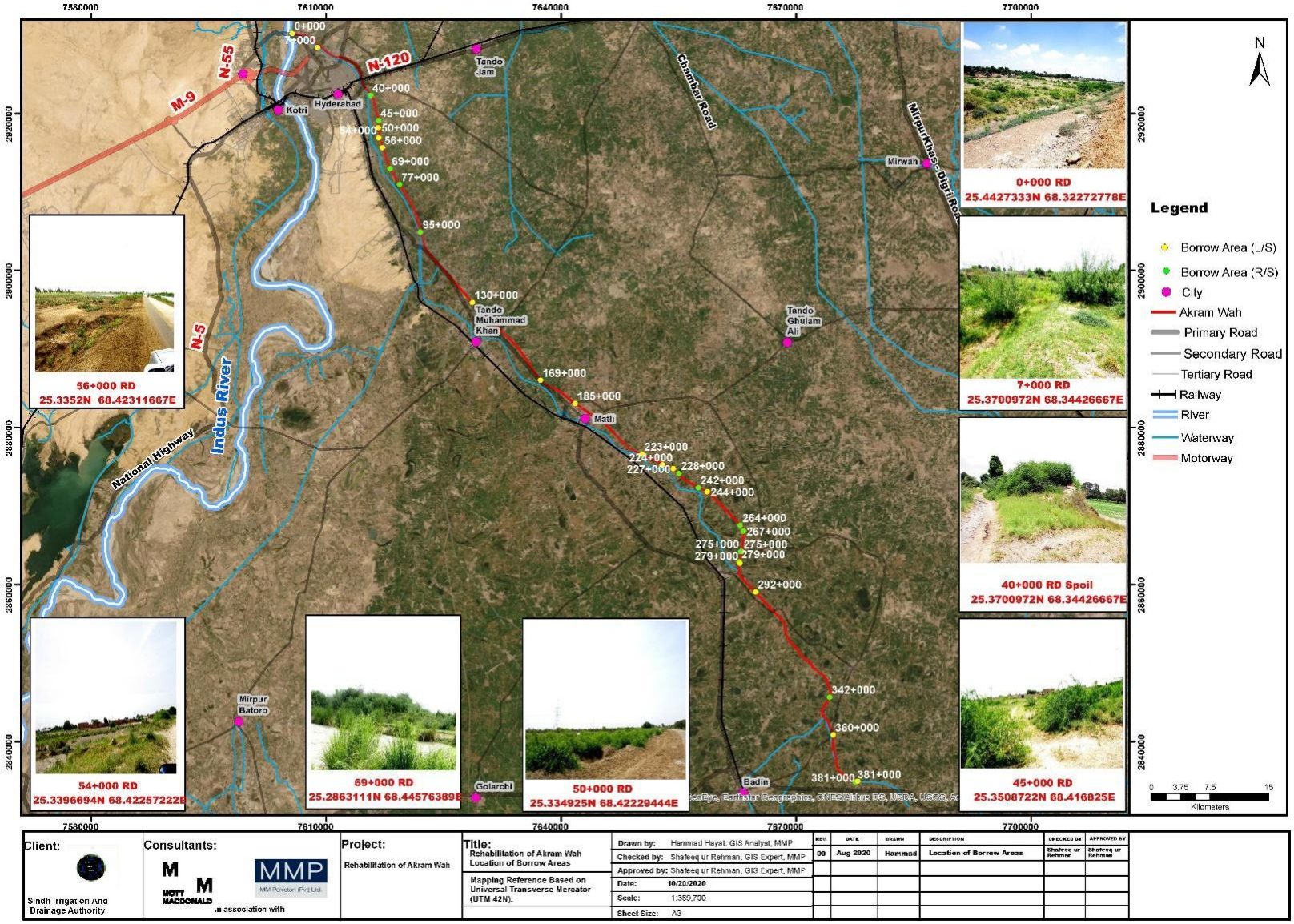
3.6.4.1 Scarification of Embankments

Before filling works for these embankments, the top 0.15m (six inches) of material shall be removed from the footprint of the embankments and disposed of. A total of 5.7 million cft of scarified material shall be removed from RD 193 to the tail. This will be disposed of within and beyond the RoW, including in the disposal areas detailed in the section 3.6.3.3.

3.6.4.2 Borrow Areas

A total net volume of 3 to 5 million cft will be required to form the embankments and will be excavated from borrow areas to be established within barren land to a depth of between 2 ft and 3ft. The topsoil of the borrow area will removed and stored separately, which will be reused for restoring the areas disturbed by the construction activities. It is preferable to establish borrow areas close to the canal to reduce haulage costs and the disturbance caused by haulage operations. However, this will not be possible where Akram Wah Canal passes through urban areas, and remote borrow areas will be required. Where remote borrow areas are required, the contractor will establish haulage routes from the borrow area to the canal. An overview of the location of the borrow areas currently identified is provided in Figure 3-11, providing 1.5 million cft of fill. Therefore, 1.5 to 3.5 million cft will need to be sourced outside the RoW. The baseline environmental conditions of the proposed borrow areas are given in Section 5.4.6.2. The additional borrow areas will be developed in barren government-owned lands and not for agricultural use. These areas also should not be located close to any environmentally sensitive areas. Before finalising the new borrow areas, the contractor will develop a borrow area management plan by identifying the proposed areas, which will be inspected in the field and approved by environmental and social specialists in the project implementation unit and construction supervision engineers.

Figure 3-14: Location of Borrow Area



3.6.4.3 Placement and Compaction of Earth Fill

The excavated material will be placed along the embankments to be raised in layers of approximately 1 ft. Each layer will be compacted, and water will be applied during this process to aid compaction. Following compaction, the next layer will be placed.

3.6.5 Works to Hydraulic Structures

3.6.5.1 General

As part of the Improvement and Rehabilitation of Akram Wah, a number of cross-regulators, head-regulators, and syphons are to be replaced. Two new cross regulators will also be constructed. An inventory of hydraulic structures to be replaced or constructed is provided in the following table (Table 3-2), and their location is shown in Figure 3-15.

Table 3-2: Inventory of Hydraulic Structures to be Replaced or Constructed on Akram Wah

RD	Structure Name	Cross-Regulator	Head Regulator	Syphon	Aqueduct
4	RD-04 C Regulator	√			
111.6	Gaja C Regulator	√			
50.0	Control Regulator (new structure)	√			
193.0	Control Regulator (new structure)	√			
330.7	70th Mile C Regulator	√			
351.4	Kazia C Regulator	√			
111.6	Gaja H Regulator		√		
330.7	Shadi Wah large H Regulator		√		
351.7	Kazia H Regulator		√		
382.8	Suni Guni Large H Regulator		√		
382.8	Ali Wah Large H Regulator		√		
382.8	Akram Wah Escape		√		
330.7	Hamir Minor H Regulator		√		
341.8	Hada Chhar Minor H Reg.		√		
345.0	Saida Minor Head Regulator		√		
351.4	Vehnai Minor Head Regulator		√		
359.8	Karo Ali bahar H Regulator		√		
373.4	Mithna Minor H Regulator		√		
374.4	Ghar Kadhan Minor H Reg.		√		
376.2	Vangi Wah H Regulator		√		
160.9	Murad Wah Syphon			Repairs only	
181.7	Matli Branch Syphon			Repairs only	
195	Bahawali Wah Syphon			√	
210.6	Mehra Wah Syphon			√	
215.5	Imam Wah Janubi Syphon			√	
216.5	Sultani Brahch Syphon			√	
281.7	Manik wah Syphon			√	
281.7	Nasir wah Syphon			√	
99.1	Seri fazal minor, aqueduct				√
171.3	Aqueduct				√

Details of the different activities required for the replacement of hydraulic structures are provided in the following sections.

3.6.5.2 Excavation of Diversion Channel

The new cross regulators are to be constructed within the existing alignment of the Akram Wah. A dry working area will be required to allow for the construction of the new cross-regulators. This shall be achieved by temporarily (up to two months at each site) diverting Akram Wah around the proposed cross-regulator site, thus ensuring continued irrigation supply to the downstream command area. This diversion will be completed with the RoW of Akram Wah. Earthen cofferdams will be constructed as part of the diversion works. As the temporary diversion is classed as temporary works, the final arrangement for aligning the temporary diversions shall be the contractor's responsibility (and the engineer's approval). The diversion works will be scheduled in the low-flow season to minimize the scale of civil works.

Under the proposed works, syphons will be replaced. In these cases, a temporary diversion of Akram Wah will be provided for the cross-regulators. See Figure 3-16

Most head regulators shall be constructed adjacent to the existing alignment of the off-taking canal. Therefore, it will be necessary to realign the head reach of these existing canals to connect them to the new head regulators. This shall require the permanent acquisition of privately owned land. The majority of this land is under cultivation. Further details of this permanent land acquisition are provided in the SMRP. In total, approximately 19.47 acres (7.88 Ha) of privately owned land shall be required to achieve the relocation of this regulating group and the realignment of canals at these locations.

3.6.5.3 Dewatering

The Contractor will establish a system of wells and submersible pipes to dewater the construction sites. Sump pits for the installation of pumps shall be excavated to a depth of approximately 1m (3ft) below the excavation surface at intervals of approximately 20m (65ft). The dewatered water will be pumped back into the canal. Dewatering operations are estimated to last between 20 and 30 days at each structure site.

3.6.5.4 Excavation

Once dewatering is complete, excavation to the foundation levels of each structure will begin using excavators. Steps and slopes will be maintained to ensure the excavation's stability. The excavated material will be stockpiled within the RoW. Most of it will be reused as backfill at the structure site or as fill to the surrounding embankments.

3.6.5.5 Sheet Pilling

Steel piles will be processed by cutting, welding and grinding to achieve the specified length for each structure and driven to the required depths using one of two piling rigs on site.

Figure 3-15: Location map of Structural site at Subproject Area

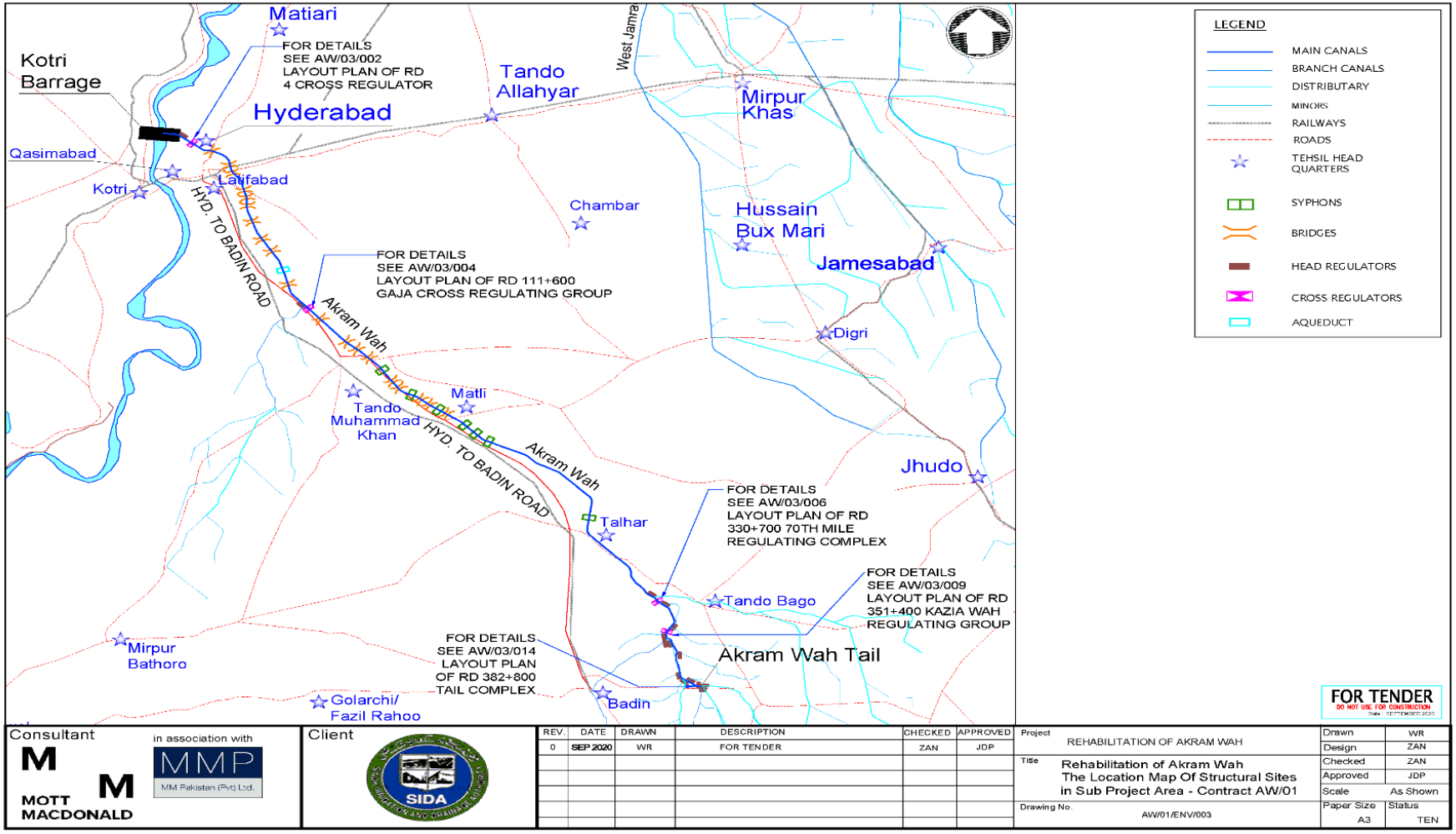
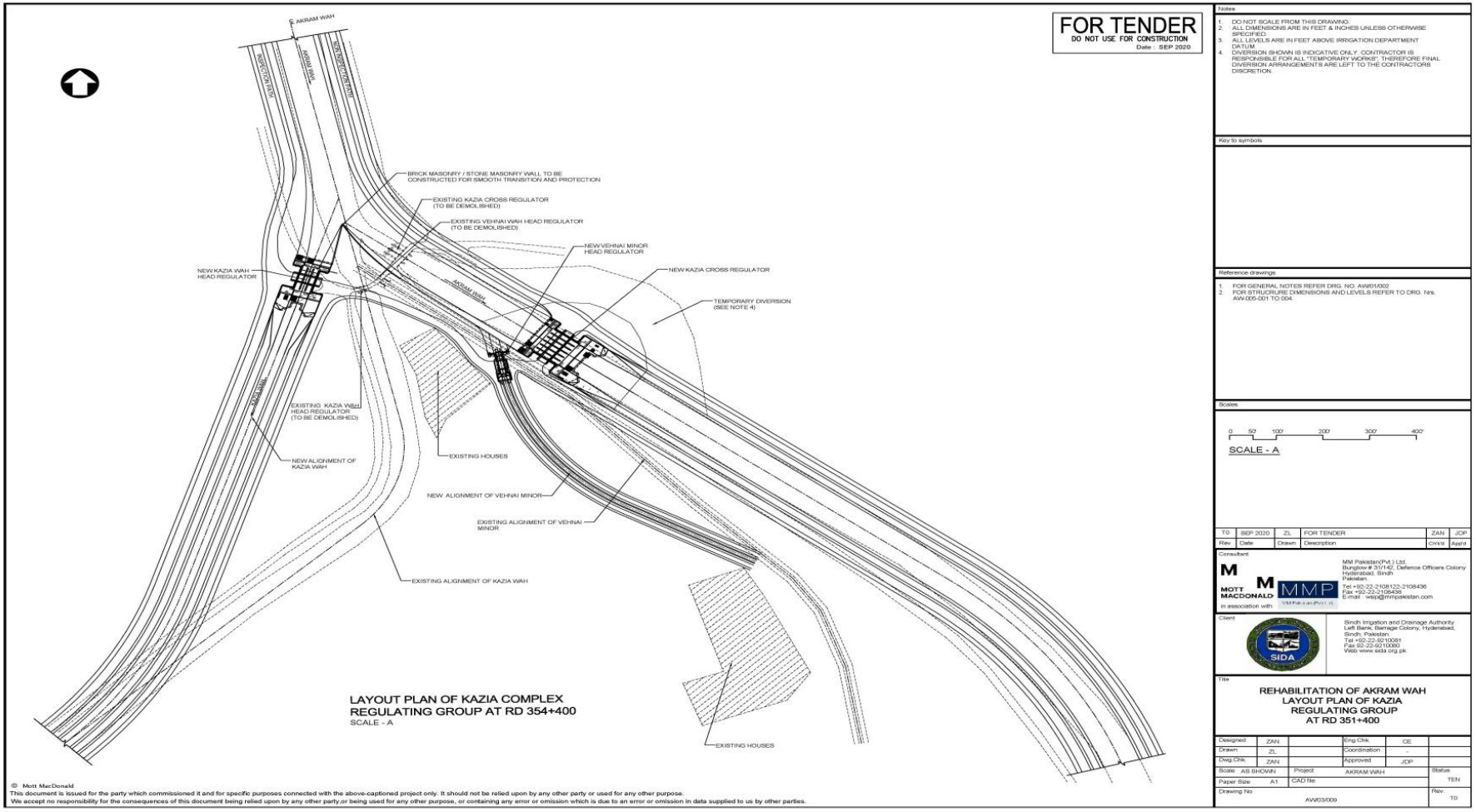


Figure 3-16: Example of a Typical Temporary Canal Diversion



3.6.5.6 Preparation and Placing of Concrete

The concrete will be placed from a hopper supported by a mobile crane, using formwork to achieve design levels and dimensions and placing reinforcement as per the designs. Concrete will be laid to the foundations and base slabs before proceeding to the abutments, piers, wing walls and approach road slabs. Finally, the superstructure (bridge decks and walkways) will be constructed.

3.6.5.7 Fill and Backfill

Backfill will be placed and compacted behind the abutments and wing walls. Fill will also be required around structures to tie into design levels. Material excavated at structure sites will be used for this purpose. In addition, approximately 1035,000 cft will be required from borrow areas.

3.6.5.8 Gates and Gantry (regulators only)

Radial gates will be used on all the cross-regulators and the head regulators to branch canals and vertical gates on the minor & distributary head regulators. Gates and stop log lifting gantries will be fabricated by the contractor. Embedded parts will be installed before installing each gate in the structure. Following this, lifting devices will be installed, and finally, the stop log lifting gantries with hoisting devices will be fitted.

3.6.5.9 Erosion Protection

Concrete block pitching and/or stone pitching will be laid on the canal bed and banks upstream and downstream of the structures to protect against scour.

3.6.5.10 Commissioning of Structures

In order to commission the cross-regulators at RD 04, RD 50 Control Regulator, RD 111+600 Gaja, RD 193 Control Regulator, RD 330+700 70th Mile, RD 351+400 Kazia and RD 382+800 Ali wah large head regulator, the temporary diversions will be closed off and the cofferdams removed. As the head regulators at RD 111+600 Gaja branch, RD 326+700 Shadi large, RD 331 Hamira minor, RD 346 Hadachhar minor, RD 349 Saida minor, RD 351 Vehnai minor, RD 351+400 Kazai branch, RD 360 Karo Ali bahar, RD 373 Mithna minor, RD 374 Ghar kadhan minor, RD 376 Vangi wah, RD 382+700 Sani guni and RD 382+800 Akram wah escape to be constructed in the dry, new canal alignments will be excavated to link the existing canals to the structures, and Inspection and Non-Inspection embankments will be formed. Once the new syphons are constructed, short reaches of the canals passing under Akram Wah Canal will be realigned to connect to the new structures.

3.6.5.11 Demolition of Existing Structures

Following the commissioning of the hydraulic structures, the existing structures shall be decommissioned, and where these present a hindrance to flow in the canal, they shall be demolished.

3.6.6 **Bridges**

The condition of existing bridges is described in the Condition Assessment Report. 18 bridges require replacement, of which 12 are road bridges and 6 are foot bridges. The road bridges are the responsibility of the highways department and will be replaced under this project where the freeboard is a constraint to the canal, the condition is poor or the canal's width has changed. Table 3-3 shows the bridges that will be replaced.

A minimum freeboard of 1.5 ft is ensured for the sanctioned discharge for replacement bridges. With the peak discharge of 4,457 cusec at the head of the canal, the freeboard to the bridges is reduced; bridges with freeboard less than 1.0 ft are selected to be replaced.

Table 3-3: Akram Wah Bridges to be Replaced/Repaired/Cancelled

Sr No	Structure	RD	Replace/Repair/ Cancelled
2	Hyderabad-Hala Road Bridge (2 bridges)	21.8	Y
5	Hyderabad-Mirpur Khas Road Bridge	34.1	Y
6	Ghanghra Road Bridge	36.9	C
7	Foot Bridge	46.9	Y
8	Foot Bridge	56.5	Y
10	Husri Village Road Bridge	64.9	Y
11	Village Road Bridge	72.9	Y
12	Foot Bridge	76.7	Y
13	Seri-Tando Fazal Road Bridge	101.6	Y
17	TMK-Phulkara Road Bridge	148.7	R
18	Aloodo Laghari Foot Bridge	166.7	Y
19	Mirani (Mori) Road Bridge	171.4	Y
21	Rehman Town Foot Bridge	182.8	Y
23	Matli-Phulkara Road Bridge	188.4	R
24	Matli-Tando Ghulam Ali Road Bridge	193.8	Y
27	Dando-Paro Khoso Road Bridge	238.8	Y
	Talhar Syphon Road Bridge	281	Y
30	Talhar-Tando Bago Road Bridge	302.5	Y
32	Tando Bago-Badin Road Bridge	357.7	Y

Y=Replacement, R=Repair, C=Cancelled

3.6.7 Construction of Operative Buildings and Offices

The Darogha landhis (operative buildings) will be constructed at the four regulating complexes at RD 111.6, RD 330.7, RD 351.4 and RD 382.8. In addition to this, Engineer's facilities buildings at Tando Mohammad Khan and LBC AWB buildings at Badin will be constructed.

3.6.8 Relocation of Utilities

Several utility lines cross the subproject area, including gas pipelines and electrical and water lines. The details of each utility line are presented in the table below (Table 3-4). The SIDA will closely coordinate with relevant authorities to relocate these utilities before the start of construction work. Further, 143 (44 on the right side and 99 on the left side of the canal) privately owned pump houses and lift machines will be temporarily relocated and installed again after completion of the works.

Table 3-4: Utility lines and locations

S #	Name of structure	Location
1	Three (3) Gas lines and 1 Water line	RD 4
2	Electrical line	RD 12+217
3	Gas line	RD 14+625
4	Mobile Tower (Ufone)	RD 21+000
5	Mobile Tower (Mobilink)	RD 21+700
6	Water pipeline	RD 21+900
7	One Gas line, four (4) water pipelines and three (3) electrical line	RD 22+000
8	Water pipeline	RD 23+600
9	Four (4) water pipelines	RD 34+100
10	Water pipeline	RD 34+300

S #	Name of structure	Location
11	One gas and water pipeline	RD 36+700
12	Gas and water pipeline	RD 64+000
13	Gas line	RD 99+700
14	Gas line	RD 111+600
15	Gas line	RD 111+800
16	Gas line	RD 114+100
17	Water pipeline	RD 138+800
18	Water pipeline	RD 148+700
19	Electrical line	RD 184+900
20	Gas pipeline	RD 188+400
21	One gas and one electrical line	RD 193+800
22	Gas line	RD 275+200
23	Wate pipeline	RD 281+700
24	Gas line	RD 330.7
25	Gas and electrical line	RD 357+700

3.6.9 Establish Construction Camps

3.6.9.1 Main Camp

Although the Contractor shall decide the final location of the main construction camp, an indication of the preferred location is given below. The main construction camp shall be located at RD 50 with sub camps at RD 160 and RD 350 of the Akram Wah, as shown in Figure 3-13. The Contractor shall be responsible for arranging the temporary use of privately owned or leased land where required for the completion of the Works. The Contractor shall enter into written, signed and witnessed agreements with the land owners, or lease holders, to use their land.

In the event the contractor sets up temporary facilities, these must be established at least 500 m from any sensitive receptor residential area, schools, hospital

The camp shall cover an area of approximately 10,000m^2 (107,584ft^2) and approximately 100 people shall be resident in the main camp. The majority of this area shall provide a manufacturing and fabrication yard, and an office and dormitory shall also be provided here. The main campsite shall be powered by a 90 kW and 45 kW standby generators. This site will include the following facilities:

- Batching plant
- Material storage (including hazardous materials)
- Workshops
- Laboratory
- Site Offices
- Contractors accommodation
- Labour camp including welfare facilities such as kitchen & dining room
- Sanitation facilities
- Medical facilities
- Sewage disposal system
- Parking for vehicles and plant
- Generators
- Recreational Area

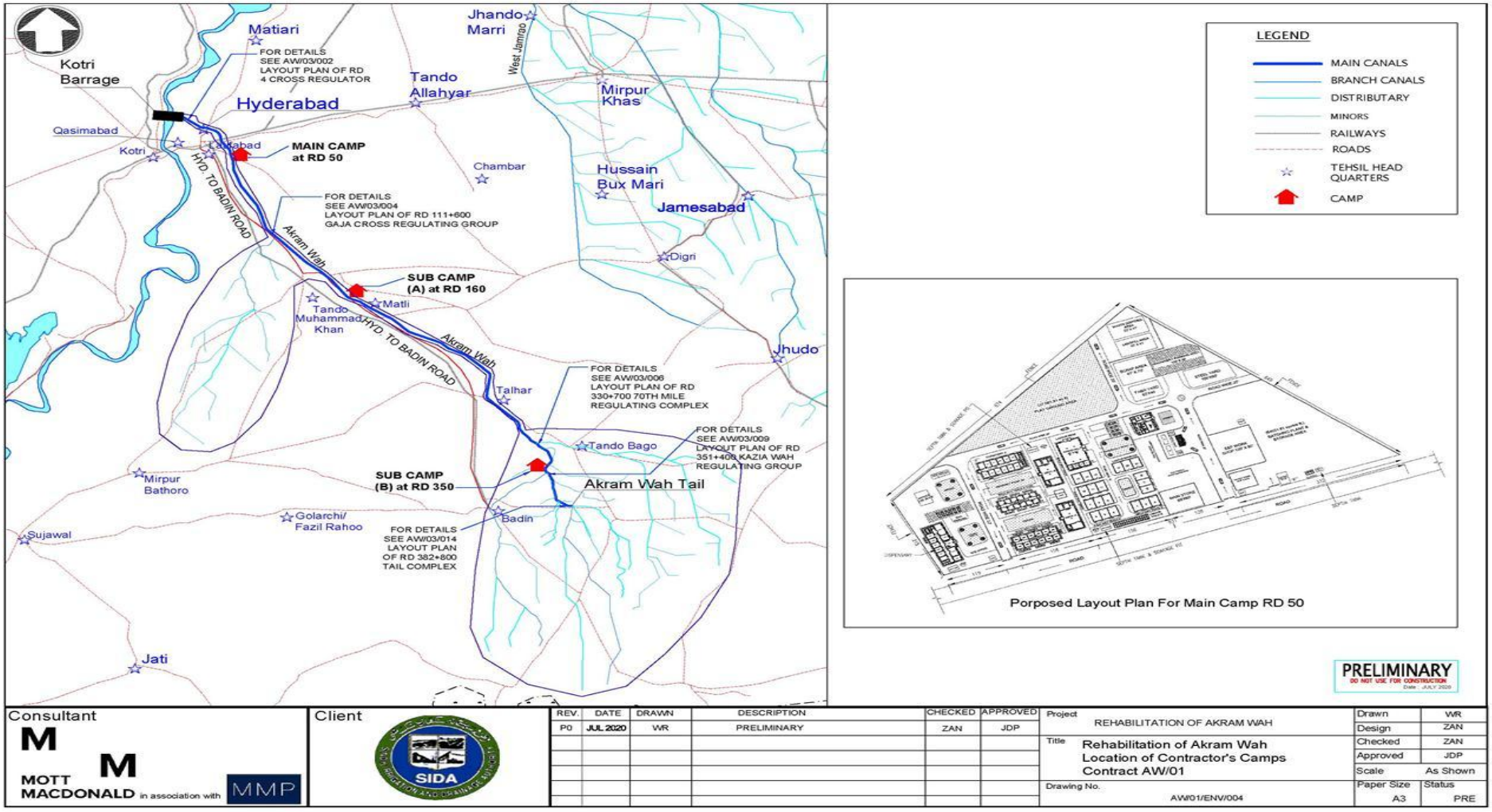
3.6.9.2 Sub Camps

The contractor shall provide subcamps as the different structure sites are distributed over a large subproject area. These camps shall be similar to the main camp but on a smaller scale. The sub-camps shall include the following facilities:

- Batching plant
- Material storage (including hazardous materials)
- Workshops
- Laboratory
- Site Offices
- Contractors accommodation
- Labour camp including welfare facilities such as kitchen & dining room
- Sanitation facilities
- Sewage disposal system
- Medical facilities
- Parking for vehicles and plant
- Generators
- Recreational Area

Each camp shall be constructed within the Government-owned RoW, or else the contractor shall be required to make arrangements to use the area with the landowner. While the contractor shall decide the final location of sub camps and shall be dependent upon his chosen methodology and programme, the following sub-camp locations are recommended as shown in Figure 3-17.

Figure 3-17: Location plan for Main Camp at RD 50 and Sub Camps at RD 160 and RD 350



3.6.10 Site Access

The Contractor will utilise the Inspection Path (IP) and the Non-Inspection Path (NIP) to access most of the site. The existing IPs and NIPs will be dislocated where head regulators of off-taking canals will be constructed through the IPs and NIPs. In these cases, temporary diversions of the IPs and NIPs shall be required.

All camps and work sites shall be accessible via the Hyderabad-Badin Road, as shown in the following figure, as well as via the IP and NIP of the canal.

3.6.11 Storage of Materials

Materials to be stored at construction sites will include cement, sand, steel, crush and other building material. All these materials shall be stored as per their nature in different stores to be constructed by the contractor at each camp. The storage locations shall be defined in the layout plans for camps and work sites, submitted by the contractor and approved by the engineer.

3.6.12 Waste Management & Disposal

The main types of waste expected to be generated and requiring disposal include:

- Waste generated during construction;
- Fuel, oils, and chemicals;
- Sewage;
- Campsite waste;
- Medical waste;
- Demolition waste;
- Packing waste; and,
- Excess construction material.

Domestic and construction waste will be the main types generated from camps and construction activities. Domestic waste contains a high percentage of readily degradable hydrocarbon, which smells bad when decomposed, especially in hot and humid environments. Construction waste classified as inert waste could be problematic to dispose of.

From the construction camps, it is estimated that up to 1,000 litres of sewage, 50 kg of domestic waste, and 1kg of medical waste will be generated daily during the peak of the Works.

An estimated total of 35,000 tonnes (35,000,000 kg) of demolition waste shall be generated from the Works. However, this shall be reduced by reusing demolition materials in construction. Excess construction material waste shall be minimised through careful planning by the Contractor.

3.6.13 Water Supply

Water will be required for construction activities and the workforce's consumption during construction. Water from the canals is not suitable for drinking, so the Contractor will make their arrangements to provide water. An estimated 18,000 litres of drinking water shall be used daily during peak work periods. It has to be ensured that all water used for drinking meets WHO or SEQS guidelines for drinking water quality.

3.6.14 Equipment and Materials

It is estimated that the equipment given in Table 3-5 shall be required to complete the Contract.

Table 3-5: Proposed Equipment for the execution of works

S No	Equipment	Qantity (tentative)
1	Excavator Long Boom	06
2	Excavator Short Boom	10
3	Jack Hammer	04
4	Concrete Transit Mixers	08
5	Batching Plants (0.5m)	02
6	Batching Plants (1.0m)	02
7	Canal Liner (6 m3)	02
8	Curing Equipment	04
9	Front End Loader	02
10	Motor Grader	02
11	Vibro Hammer	02
12	Excavator-Chain	04
13	Excavator-Tyre	06
14	Rotatory Piling Rig	02
15	Mobile Pump (45m)	02
16	Mobile Pump (22m)	02
17	Vibratory Roller	33
18	Mobile Crane (25 ton)	04
19	Dragline	08
20	Water Bowser	10
21	Graders	08
22	Dozer	08
23	Loader	06
24	Road Roller 15 ton	04
25	Road Roller 01 ton	02
26	Dumper	10
27	Concrete Pump	04
28	Trailer	02
29	Air Compressor	02
30	Mobile Workshop	02
31	Chiller Plant	02
32	Steel Cutting and Bending Machines.	04
33	Tractor Trolley	35
34	Front Blade Tractor	04
35	Back Blade Tractor	02
36	Asphalt plant	04
37	Welding plants	25
38	Wheel Barrow	100
39	Rotary Machines	02
40	Concrete Mixer	28
41	Diesel Engines	20
42	Tractor Back plate	10
43	Power Generator (100 to 200 kva)	20
	Total	**419**

Construction materials expected to be used in project works and nearest sources to the project area are displayed in the following table (Table 3-6).

Table 3-6: Proposed construction materials and potential sources

Material	Nearest Sources	Country
Cement –H	Lucky, Pakland, Thatta (O.P.C and S.R.C)	Pakistan
Admixture –H	SIKA, ULTRA, FOSPAK	Pakistan
Crushed Stone	Crusher Plants at Nooriabad	Pakistan
	Crusher Plants at Jamshoro	Pakistan
Fine Aggregates	Bholari near Kotri	Pakistan
Joint Sealer –H	SIKA, ULTRA, FOSPAK	Pakistan
Deformed Steel	Amreeli, Abbas , Razzak at Karachi	Pakistan
Water Stop	SIKA SERVICES	Pakistan
Stone Pitching	Jamshoro, and Thatta	Pakistan
PVC Pipe	Karachi	Pakistan
Pressure Relief Valves	Karachi, Dubai	Pakistan, UAE
Gates and Hoisting Devices	Karachi and Gujjranwala, Lahore	Pakistan
Pre-Stressed Cable Wire-H	Karachi and Lahore	Pakistan
Steel Sheet Pilling	Arecelor Mittal	to be imported
Geotextile Filter	DuPont Typar	To be imported
Geotextile Separator	Karachi, Lahore	Pakistan
PVC Geomembrane	Karachi, Lahore	Pakistan
Bitumen-H	ULTRA, and FOSPAK	Pakistan
Joint Filler Sheets	ULTRA and FOSPAK	Pakistan
Angle Iron -H	Karachi and Lahore	Pakistan
Elastomeric Bearing Pad	Karachi and Lahore	Pakistan
UPVC Pipe	Karachi and Lahore	Pakistan
Anchorage Cone, Sheeting, Helical Core	Karachi and Lahore	Pakistan

3.6.15 Personnel

The key personnel shall be from within the contractor's company, whereas skilled workers and labourers shall be locally employed. It is estimated that up to 500 personnel shall be employed on the contract at its peak. As many shall be employed locally, not all shall reside in the contractor's camps. It is estimated that about 100 personnel will be residents in the camps.

3.6.16 Works Schedule

A three-year contract completion period will provide three closures to the contractor.

3.6.17 Decommissioning of Contractor's Facilities

Following the works, the contractor shall dismantle and remove all temporary facilities associated with the works from the subproject area, including camps and batching plants. The Contractor should ensure that all project sites have been restored. Furthermore, all grievances have been addressed and closed during the defect liability period.

3.7 Operational Phase Activities

The Left Bank Canal AWB shall complete the following activities during the operational phase.

- Impacts monitoring
- Regular operation of gates on cross- and head regulators
- Regular maintenance includes painting gates, lubricating moving parts on hydraulic structures, replenishing stone pitching, and repairing embankments following floods.

4 Consideration of Alternatives

4.1 General Outline and Scope

As discussed in this report, the proposed works are the Improvement and Rehabilitation of Akram Wah, a subproject of the Sindh Water and Agricultural Transformation Project. The subproject is to be carried out within Left Bank Canal AWB. It includes removal and disposal of existing damaged canal lining, reconstruction of concrete lining with geomembrane and underdrainage system, reconstruction of major and minor hydraulic structures, embankment reinstatement and replacement and rehabilitation of bridges.

The alternative subproject activities considered and the reasons for their rejection are discussed under the following headings.

4.2 No Subproject

The main objective of the subproject is to improve the efficiency, effectiveness, reliability and equity of irrigation water distribution in the command area of Akram Wah and to ensure the canal can convey the full design discharge. Most of the hydraulic structures on Akram Wah are aged structures, and the canal itself is in poor condition (as described in section. 3.4.1), with the canal lining having already failed. Without work to replace and rehabilitate the infrastructure, the canal will continue to convey less than its design discharge, meaning farmers in the command area will continue to receive less than adequate support for agriculture. There is also a real risk of hydraulic structures failing, resulting in an entire loss of supply to the downstream command.

4.3 Institutional Reform Only

Although it has been established through WSIP that improved efficiency, effectiveness, reliability, and equity of irrigation water distribution can partially be achieved through deepening and broadening existing institutional reform and through participatory irrigation management, the long-running institutional weaknesses have resulted in inadequate maintenance of the irrigation structures throughout the subproject area. Institutional reform will do nothing to address the disrepair of the canal infrastructure. Without engineering intervention, adequate irrigation supplies required to support agriculture in the command area cannot be delivered.

4.4 Structure Rehabilitation versus Replacement

In order to reduce the environmental impact and capital cost of the project, it is preferable to rehabilitate structures where possible. A condition assessment of all the irrigation structures within the subproject area identified that they are aged with degraded structural and hydro-mechanical integrity and that rehabilitation of many of these structures would unlikely return them to a serviceable state. The condition assessments and discussions with users and operators of the system identified that the replacement of regulating structures of Akram Wah was required to ensure the successful and equitable delivery of irrigation water throughout the system.

4.5 Canal Remodelling Alternatives

The existing (failed) canal lining along Akram Wah is considered to be providing almost no benefit to reduction of seepage losses along the canal.

Rehabilitation of Akram Wah as an unlined channel is therefore feasible if the other constraints on conveyance (such as land acquisition) within the Hyderabad city reach can be overcome.

A number of options for the design of the canal remodelling were considered in order to achieve the conveyance requirements without significantly increasing the seepage losses. The list of options considered is presented in the following table, along with a commentary on the pros and cons of each solution.

Table 4-1: Canal Cross-Section Design – Options Considered

Option	Description	Pros	Cons	Outcome
1	Earthen canal, same size: removing the old lining and reshaping the canal to optimize efficiency – with option of vibratory compaction of the canal bed for seepage control where seepage appears to be a real issue.	Lowest-cost option.	The required conveyance capacity will not be achieved without increasing the cross-section.	Not progressed as conveyance capacity insufficient.
2	Earthen canal, widened (only possible outside of urbanized areas)	Lower cost than any lining option.	Permanent and temporary land acquisition may be required. Increased seepage due to larger wetted perimeter.	Considered further in Section 4.5.1.
3	Earthen canal with concrete slabs on upper part of side slopes	Partial increase in conveyance capacity. Minor reduction in seepage losses.	Likely to lead to early failure of the concrete due to wash-out of the substrate (a failure mechanism already occurred in the existing lining).	Not progressed due to concerns regarding robustness of the concrete liner.
4	Earthen canal with concrete slabs on side slopes, top to bottom (but no lining on the floor of the canal)	Partial increase in conveyance capacity. Minor reduction in seepage losses.	Likely to lead to early failure of the concrete due to wash-out of the substrate (a failure mechanism already occurred in the existing lining).	Not progressed due to concerns regarding robustness of the concrete liner.
5	Canal lining, trapezoidal section, with geomembrane and concrete protection, including uplift pressure relief system	Significant increase in conveyance capacity. Significant and long-lasting reductions in seepage losses.	Higher cost. Requires robust system to prevent failure due to uplift pressures along the underside of the liner.	Considered further in section 4.5.3
6	Earthen Canal with retaining walls on top part of side slopes	Partial increase in conveyance capacity. Minor reductions in seepage losses.	Higher cost.	Considered further in section 4.5.2
7	Earthen Canal with retaining/sheet pile walls on full height of both sides only	Partial increase in conveyance capacity. Minor reductions in seepage losses.	Higher cost.	Considered further in section 4.5.2
8	Full canal lining, rectangular section, with reinforced concrete	Significant increase in capacity. Significant reductions in seepage losses.	Highest cost option.	Not progressed due to very high cost. The additional benefit in terms of seepage reduction relative to Options 6 and 7 is not considered significant given the higher costs.

4.5.1 Option 2 – Earthen (Unlined) Canal

Where the canal passes through rural areas, a low-cost solution will be to provide an earthen (unlined) channel. This arrangement is already the case for the existing canal downstream of RD 193+800 to the tail at RD 382+800.

In the reaches upstream of RD 193+800, this will require removal and disposal of the existing (failed) lining material and excavation of the canal embankments and bed in order to widen and deepen the canal cross-section. Permanent land acquisition along one or both sides of the canal will be required in order to widen the canal, the implications of this are discussed further in PIC Report on Canal Lining (January 2025)

The abutment arrangement at the existing bridges will provide a constraint on canal widening. It is noted that some existing bridges have been identified for replacement under the project; in other locations, the canal can be conveyed under the bridges with some localized protection works.

The existing syphons that pass under the bed of the canal may need to be reconstructed to accommodate the new bed levels and this is discussed further in Volume I – Design Report.

Additional land acquisition is unlikely to be necessary for the rehabilitated canal downstream of RD 193+800. The works in these reaches would, therefore, generally comprise reprofiling of the existing canal section; it is not expected that significant widening or narrowing of the cross-section would be required as the sanctioned discharge has not changed. This option would therefore avoid the need to source significant volumes of fill material as would be required if the canal was being lined (with a narrower cross-section). Some fill material will still be required in order to raise both embankments such that the (higher) peak discharge water levels can be accommodated.

This arrangement is not considered appropriate for reaches where the canal passes through constrained urban areas due to the cost and considerable difficulty of acquiring the additional land that would be necessary.

The major drawback of providing an unlined channel is that the corresponding cross-section has a large wetted perimeter. The seepage flows will be higher than that of other lining materials. Seepage losses for the rehabilitated canal design are calculated in Volume I – Design Report.

4.5.2 Options 6 and 7 – Retaining or Sheet Pile Wall

Where the canal passes through urban areas (particularly the Hyderabad reach), it may be necessary to minimise the Corridor of Impact (CoI) by constructing retaining or sheet pile walls on the left and right embankments.

Alternatives for the retaining wall have been considered as follows:

- Concrete retaining wall;
- Brick masonry retaining wall;
- Stone masonry retaining wall;
- Steel sheet pile wall.

For each alternative, it was considered that the canal bed would either be unlined or comprise precast concrete blocks or brickwork to achieve the roughness/conveyance requirements.

For the seepage assessment, it was assumed that the losses through the retaining wall section would be comparable to those of an unlined canal. This is likely to be a conservative assumption given that the canal prims will be partially constructed of material with very low permeability (brick, stone or concrete).

This option is considered not feasible due to difficulties in wide excavations required for construction of retaining walls and very high cost involved in its construction.

4.5.3 Option 5 - Canal Lining with Geomembrane and Underdrainage System

Options for the provision of a new canal lining were presented in the Canal Lining Working Paper. (PC, 2020) and PIC Report on Canal Lining (January 2025).

As demonstrated by the historic performance of the existing Akram Wah lining and in the other literature reviewed, the effectiveness of providing a simple concrete-only lining in canals was considered to be limited. For Akram Wah it is therefore recommended that any new lining system should consist of a geomembrane under cast in-situ concrete lining for protection.

On the basis of discussions with the LBC AWB SIDA and World Bank Experts and results of investigations carried out in September to October and the considerations given above, the following option was considered for the extent of Akram Wah lining:

- Lining may be provided in the reach, from RD 0 to RD 193, where it was originally lined. The lining beyond RD193 will be costly because for lining, the canal section needs to be narrowed down. Also, in this reach the soils mostly silt/clay so no seepage reduction is required.
- The proposed arrangement for full Canal lining will be consisting of a geomembrane under cast in-situ concrete lining for protection with extensive underdrainage system with pressure relief valves.
- To additional cross regulators will be provided to control water levels in canal.

The lining will reduce seepage losses ensure hydraulic performance and efficiency of the canal and save area of construction. After necessary deliberation this option has been adopted for RD 0 to RD 193 and in the remaining length of canal from RD 193 to 383 strengthening of banks and section remodelling will be carried out.

5 Environment and Social Baseline

5.1 Background information

This chapter gives a detailed description of the study area's physical, environmental and socio-economic conditions. The data collection techniques combine primary and secondary means, i.e., by field verifications, observations, sampling and monitoring, which was supplemented by a review of published literature and previous EIA studies conducted in the surrounding areas of the proposed project. The baseline data defines and elaborates on the present physical environmental quality within the project's surroundings. This baseline was developed after conducting socio-environmental and ecological assessments (as well as engineering and topographical surveys conducted as part of the design process). PC has carried out a detailed topographic survey of Akram Wah during the closure period in January 2020. This included detailed surveys of the structures, including the Akram Wah head regulator, and cross-sections taken at 5RD spacing in accordance with the Terms of Reference (ToR) and. Environmental and social baseline surveys were conducted by PC consultant June 2020. A detailed description of the surveys is given below;

1. Physical Resources
2. Ecological Resources
3. Socioeconomic and Cultural Resources

5.2 Aims of Baseline

This chapter aims to describe the prevailing environmental condition of the project area and use this to determine the negative and positive impacts of the project. As such, the study covered the area's physical, biological, and socio-economic environments before the commencement of project activities. This categorization will assist in understanding the prevalent macro and microenvironment of the area. It would enable the assessment of possible environmental impacts that may arise from the activities associated with the Improvement and Rehabilitation of Akram Wah Canal. It would also help the study team suggest the mitigation measures required to minimise the negative impacts identified in this study, if not eliminated.

5.3 Physical Environment

5.3.1 Overview of the Subproject Area

The area surrounding the subproject area is dominated by agricultural lands, tree thickets and orchards, but it also passes through three urban areas: Hyderabad, Matli and Tando Muhammad Khan. The settlement of people along the Akram Wah banks is a very serious issue since it badly hampers the regulation and management of Akram Wah and creates challenges for the Irrigation Engineers and Staff. Although the Sindh Irrigation Act – of 1879 and government law do not allow people to encroach on the canal command premises, people have settled in these areas over time.

5.3.2 Topography

Hyderabad, Tando Muhammad Khan and Badin districts lie in that part of the lower Indus plain, a vast alluvial plain along the course of Indus. These districts are part of the Lower Indus Plain, formed by the alluvial deposits of the Indus River. Thus, its land is uniform, and hills do not diversify it. The Indus bifurcates district Dadu from Hyderabad, stretches from 110 km on the western flank of the district, and is surrounded by a riverine forest. The district has no mountains or hills except small hill rocks, an offshoot of the Khirthar limestone (middle Eocene) range known as Ganjo Takkar. They run parallel to the Indus River, about 22 km south of Hyderabad. The highest point in these is known as Gaho, which is about 75 meters above sea level. There are also two small hillocks north of Tando M. Khan. The hillocks are called Budhaka Takkar. The rest of the district is a fertile plain with an elevation of about 50 meters above sea level.

5.3.3 Land Use

5.3.3.1 Subproject area

The major land in the subproject area was agricultural land, settlements and orchards. However, a small portion of barren land, thickets and shrub/grass mix was available in the subproject area. The details of major land use types in the subproject area are below.

Table 5-1: Land use in the Subproject Area

Type of Land Use	Area In Ha	Area (%)
Agriculture Land	142.05	55.07
Orchard	0.37	0.14
Settlements	62.66	24.29
Tree Thickets	1.38	0.54
Shrub/Grass Mix	35.65	13.82
Barren Land	15.82	6.13
Total	**257.93**	**100**

5.3.3.2 Land Use within the Corridor of Impact

The land use within the footprint of the proposed works has been analysed and is summarized in the following table.

Table 5-2: Land Use within the Footprint of Proposed Works

Type of Land Use	Area In ha	Area (%)
Tree Thickets	0.3	1.00
Shrub/Grass Mix	10.29	34.23
Buildings	19.47	64.77
Total	**30.06**	**100**

5.3.4 Meteorological Conditions in the Subproject Area

5.3.4.1 Weather

According to Koeppen's climate classification, the Sindh area can be classified as a 'desert hot climate' because of its low annual rainfall compared to potential evapotranspiration and high temperatures. High daytime temperatures are generally followed by an abrupt fall in temperature during the night, accompanied by a pleasant breeze with an elevation of 13 meters (43 ft.). The area's summer season starts in April and ends in October, while the winter starts in November and ends in March. Tando Muhammad Khan is the nearest Hyderabad City, and it has a similar climate. The yearly climatic details are described below:

Table 5-3: Climatic Conditions of Hyderabad City[8]

Month	Temperature °C		Precipitation	Relative Humidity %
	Minimum	Maximum	Millimetres	
Jan	3.3	33.3	1.5	47
Feb	4.0	38.2	5.4	46
Mar	9.0	43.4	4.8	39
April	12.0	46.0	6.0	39
May	19.0	48.4	3.6	49
June	20.0	48.5	9.6	58

[8] Pakistan Meteorological Department

Month	Temperature °C		Precipitation	Relative Humidity %
	Minimum	Maximum	Millimetres	
July	21.4	45.5	53.0	65
Aug	22.8	43.9	62.3	68
Sep	20.6	45.0	19.4	62
Oct	15.6	44.0	4.2	47
Nov	6.0	41.0	1.9	43
Dec	3.0	36.0	2.5	47

Table 5-4: Climatic condition of Badin District

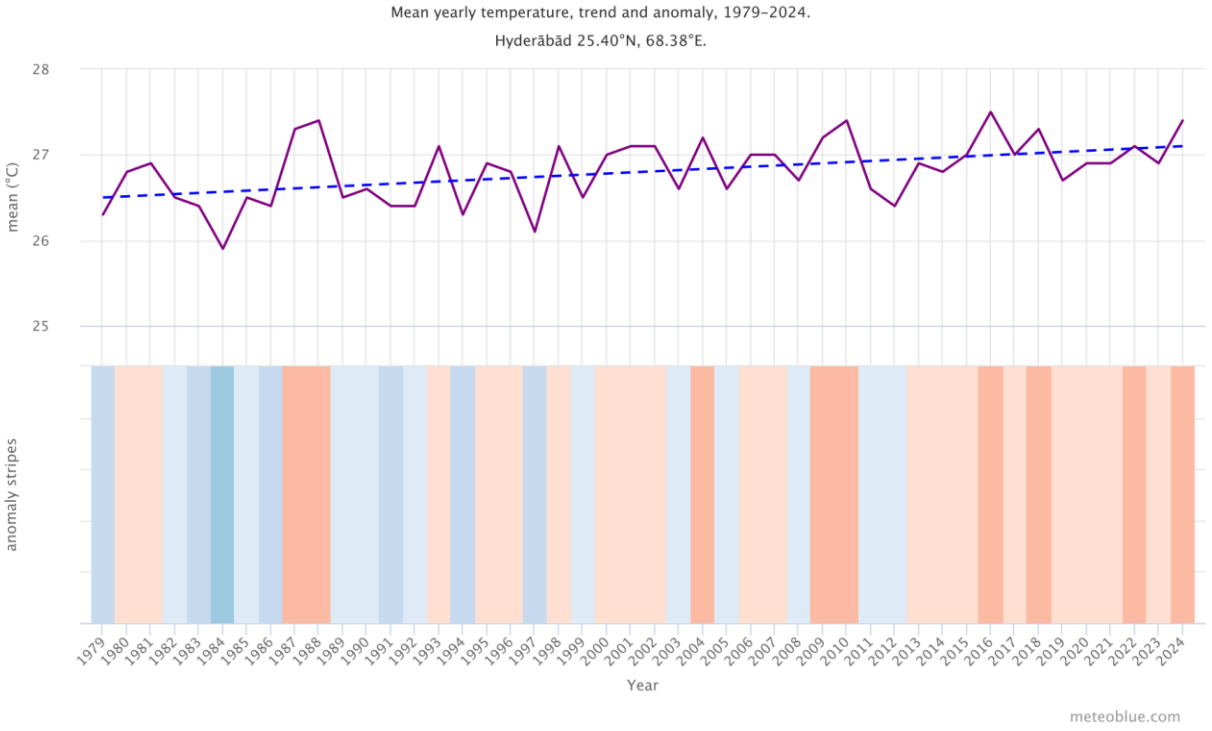
Month	Temperature °C		Precipitation	Relative Humidity %
	Minimum	Maximum	Millimetres	
Jan	8.73	25.87	0.96	50.38
Feb	11.60	28.59	3.60	48.81
Mar	16.80	34.02	2.30	48.36
April	21.80	38.40	2.49	48.97
May	25.47	39.85	0.69	53.10
June	27.46	38.02	10.76	60.70
July	27.04	35.1	70.49	69.61
Aug	26.06	33.61	89.88	72.55
Sep	24.87	34.36	34.43	69.78
Oct	21.70	35.80	3.72	59.15
Nov	15.86	31.87	1.67	53.88
Dec	10.10	26.68	1.11	52.46

5.3.4.2 Hyderabad Temperature

The overall weather of Hyderabad is hot and arid; the hot season lasts for 3.0 months, from April 8 to July 7, with an average daily high temperature above 40°C. The hottest month of the year is May, with an average high of 42°C and a low of 35°C. The cool season lasts 2 months, from December 5 to February 12, with an average daily high temperature below 27°C.

The below picture shows the maximum, minimum and average temperature of Hyderabad recorded in the last 45 years:

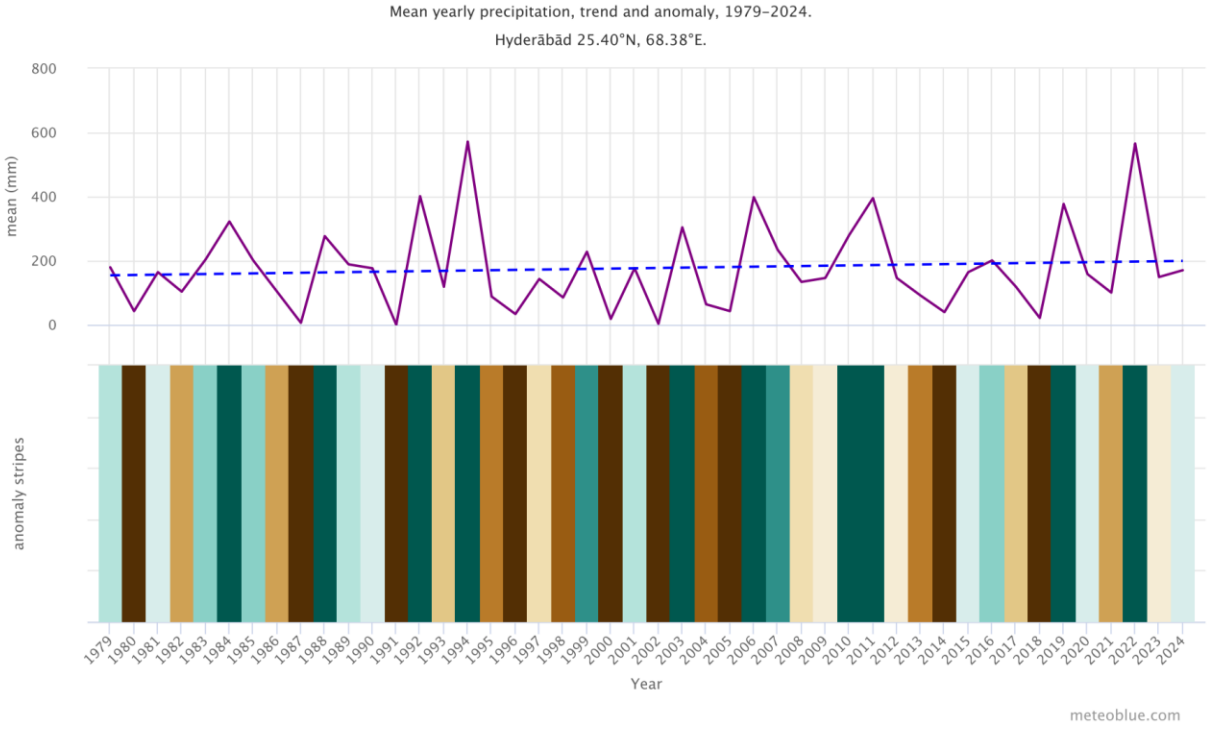
Figure 5-1: Temperature of the Hyderabad in the last 45 years



5.3.4.3 Hyderabad Rainfall

The region shows a low amount of rainfall for most of the year. The highest amount of rainfall is received during the monsoon season. The graph below shows the average yearly rainfall of 45 years; among the data, the highest rainfall with precipitation above 100mm was recorded in 2011.

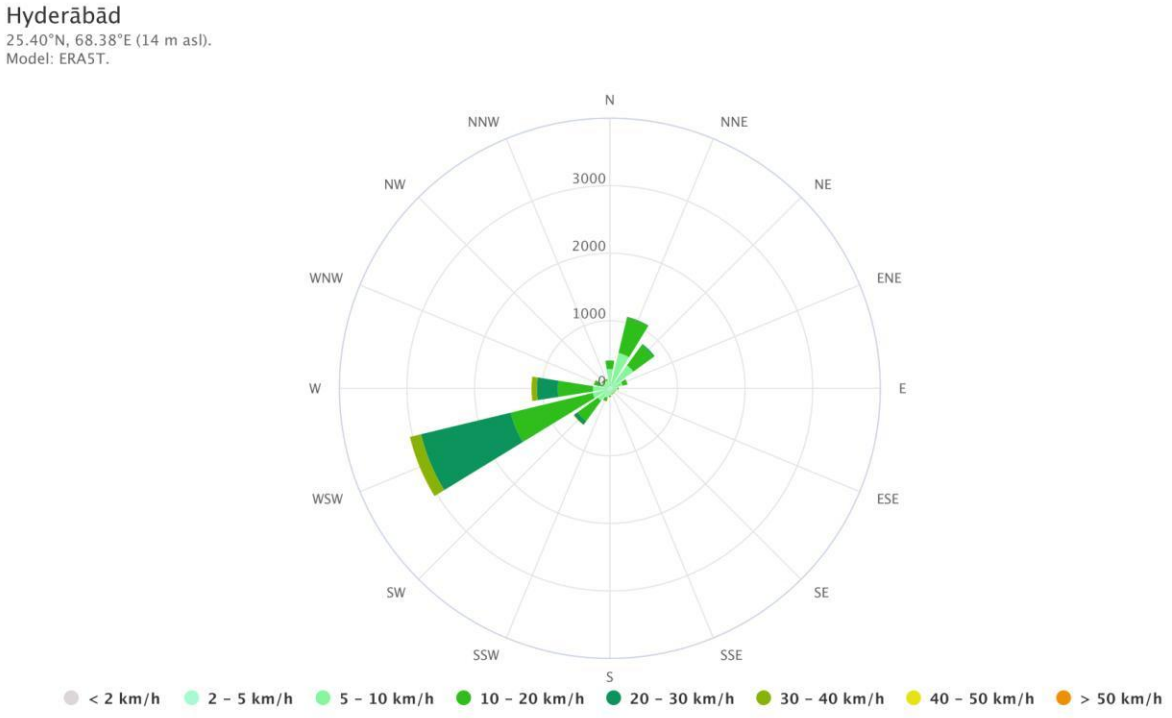
Figure 5-2: Rainfall data of Hyderabad last 45 years



5.3.4.4 Hyderabad Wind speed and Direction

The wind speed shows severe variation during the summer and winter seasons, with the highest speed recorded during the month of May, June and July. The data on wind speed are based on 30 years of weather model simulations, as shown in the figure below.

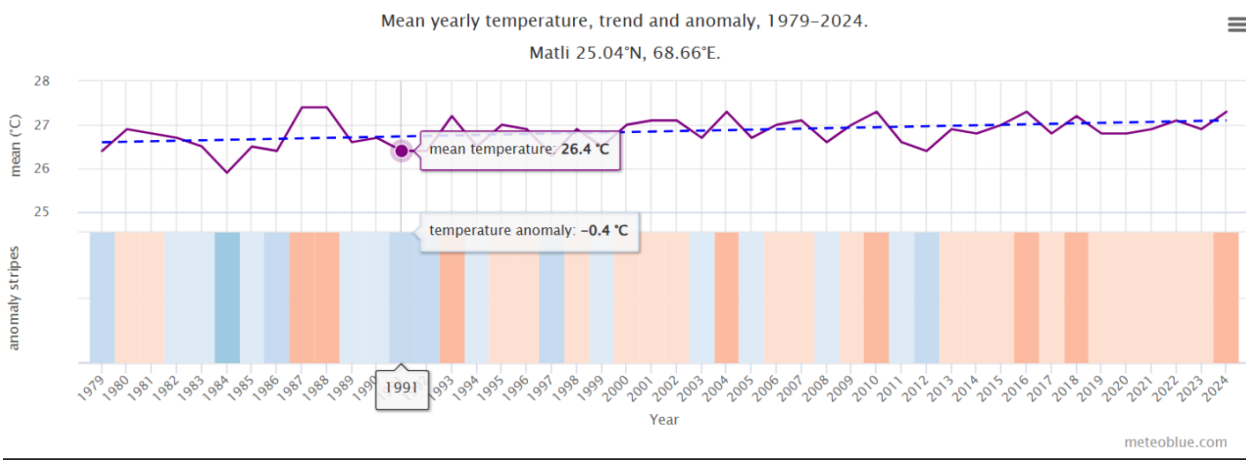
Figure 5-3: Wind Speed & Wind Direction of Hyderabad



5.3.4.5 Matli Temperature:

The overall weather of Matli is hot and arid; the hot season lasts from April to July, with an average daily high temperature above 40°C. The hottest month of the year is May, with an average high of 42°C and a low of 35°C. The cool season lasts 2 months, from December 5 to February 12, with an average daily high temperature below 27°C. The picture below shows the maximum, minimum and average temperatures of Matli recorded in the last 45 years.

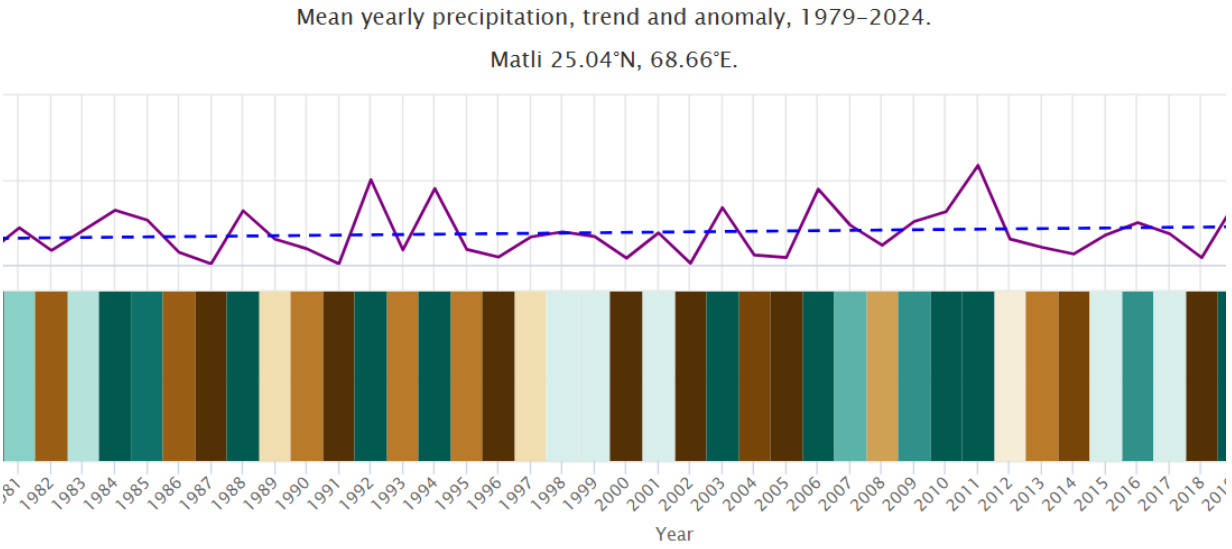
Figure 5-4: Temperature of Matli City



5.3.4.6 Rainfall

The region shows a low rainfall for most of the year, and the highest rainfall is received during the monsoon season. It is very erratic as it has been dry for some years, and there is no rain. The graph below shows the average yearly rainfall of 45 years; among the data, the highest rainfall with precipitation of above 100mm was recorded in 2011.

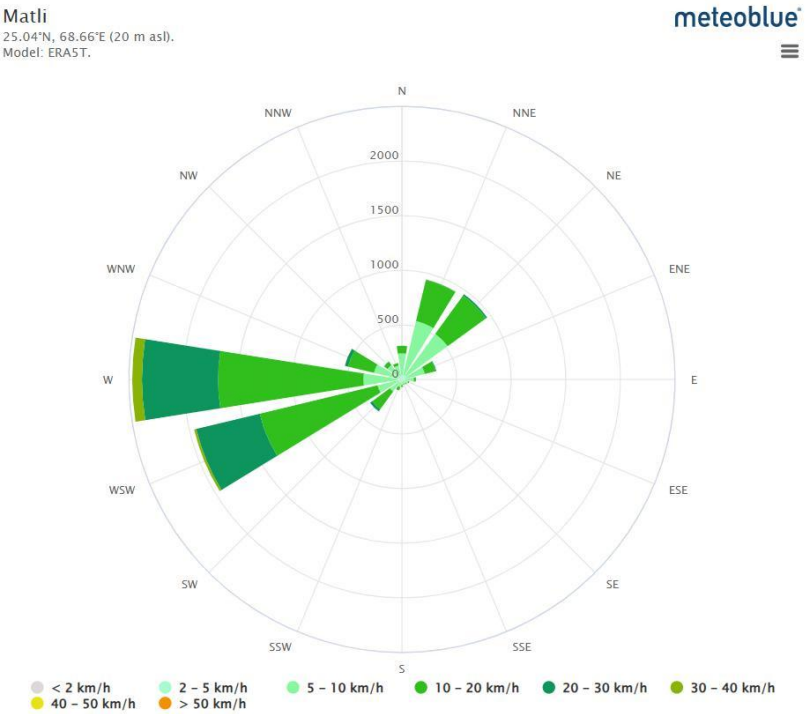
Figure 5-5: Rainfall Data of Matli City



5.3.4.7 Wind Speed and Direction

The wind speed shows severe variation during the summer and winter, with the highest speed recorded during May, June and July.

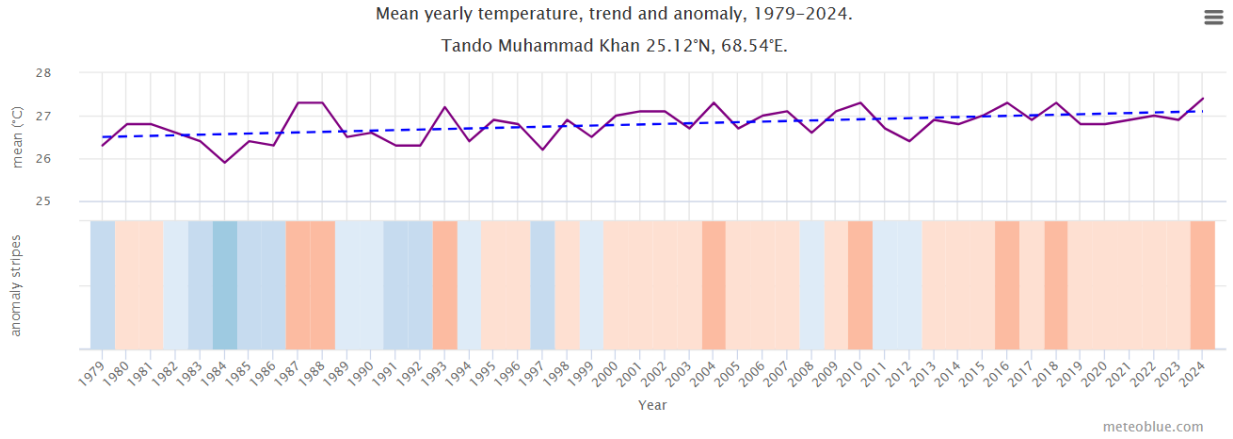
Figure 5-6: Wind Speed and Wind Direction of Matli City



5.3.4.8 Tando Muhammad Khan Temperature

The overall weather of Tando Muhammad Khan is hot and arid; the hot season lasts from April to July, with an average daily high temperature above 40°C. The hottest month of the year is May, with an average high of 42°C and a low of 35°C. The cool season lasts 2 months, from December 5 to February 12, with an average daily high temperature 27°C. The below picture shows the maximum, minimum and average temperature of Tando Muhammad Khan recorded in the last 45 years.

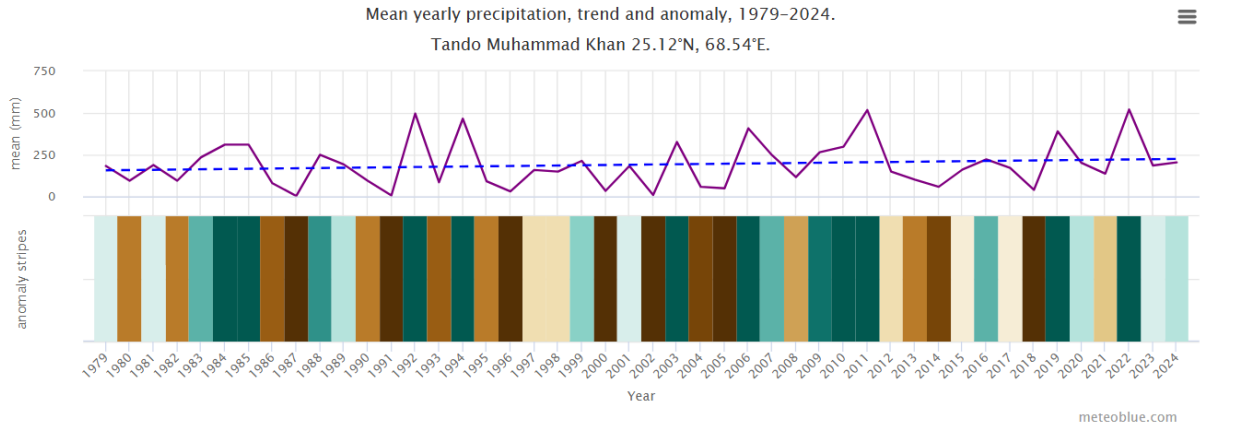
Figure 5-7: Temperature of Tando Muhammad Khan City



5.3.4.9 Tando Muhammad Khan Rainfall

The region shows low rainfall for most of the year, and the highest rainfall is received during the monsoon season. It is very erratic as it is dry for some years, and there is no rain. The graph below shows the average yearly rainfall of 45 years. Among the data, the highest rainfall with precipitation above 100mm was recorded in 2011.

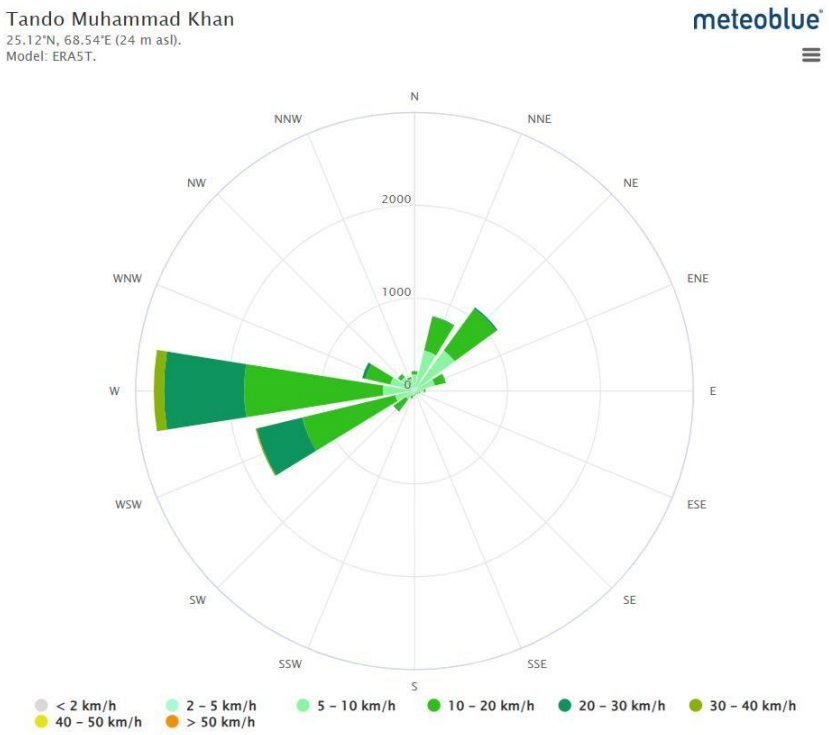
Figure 5-8: Rainfall Data of Tando Muhammad Khan City



5.3.4.10 Wind Speed and Direction

The wind speed shows severe variation during the summer and winter, with the highest speed recorded during May, June and July. The data on wind speed experienced in 2009-2020 is shown in the figure below.

Figure 5-9: Wind Speed & Wind Direction of Tando Muhammad Khan City



5.3.5 Ambient Air Quality

5.3.5.1 General

The Ambient Air Quality of the nearby canal area was measured by Pakistan Space and Upper Atmosphere Research Commission (SUPARCO), registered by the Sindh EPA for Air Quality Monitoring. As there were no industries near the construction sites of the subproject area and, only vehicular traffic on the dirt roads caused some dust emissions whose effect was fairly localized. The average levels of the ambient air pollutants such as NOx, SO_2, CO, O^3 and Particulate Matter (PM_{10}, $PM_{2.5}$, SPM) were observed within the SEQS. The measurements taken at Fulleli Canal are still valid for this project because of their proximity to the Akram Wah and little or no industrial development has occurred in the area. It should be noted that the bidding document will contractually bind the Contractor to undertake ambient air quality measurements before mobilization. The Engineer will have to ascertain whether the indicated mitigations are still valid or modifications are required.

All recorded pollutants' average and maximum values were high at Akram Wah RD 140 (Fulleli site 30th Mile Cross Regulator). The high level of these pollutants is due to the high traffic movement through this Cross Regulator bridge to Tando Mohammad Khan, the closest city to the subproject area.

Similarly, the second-highest recorded pollutant values were found at Akram Wah RD 170 (Fulleli site Immam Wah Cross Regulator). This is due to the crossing of traffic movement Tando Muhammad Khan district bypass road. In general, the air quality at Akram Wah RD 216.5 (Fulleli site Ali Pur Cross Regulator) structural site was found good. This is because these structure sites are not connected to any metaled roads, so there is very little vehicular traffic within the vicinity of this structure.

The three were selected for sampling and continuous (24 hrs.) monitoring of seven Air Quality parameters as per SEQS. The monitoring results collected from February 2015 are produced here in the following tables.

5.3.5.2 Nitrogen Oxides (NOx)

Nitrogen oxides (NOx), a mixture of Nitric oxide (NO) and Nitrogen dioxide (NO_2), are produced from natural sources, such as motor vehicles and other fuel combustion processes. NO is colourless and odourless and is oxidized in the atmosphere to form NO_2. NO_2 is an odorous, brown, acidic, highly corrosive gas that can affect our health and environment. NOx are critical components of photochemical smog, NO_2 produces the yellowish-brown colour of the smog.

The level of nitrogen oxides in ambient air was found to be far below the limit given in the SEQS. The details of these can be found in the following table.

Table 5-5: Level of Nitrogen Oxides (NOx) [9]

Sites	NO_x		
	Min (µ g/m^3)	Average (µ g/m^3)	Maximum (µ g/m^3)
Fulleli 30th Mile Cross Regulator	19.5	22.5	27.5
Fulleli Imam Wah Cross Regulator	14.2	16.4	19.4
Akram Wah/Fulleli Ali Pur Cross Regulator	11.3	12.3	14.2
SEQs Limit)-Average time 24 hrs.	80 (µ g/m^3)		

5.3.5.3 Sulphur Dioxide (SO2)

High concentrations of SO_2 cause a wide variety of health and environmental impacts because of the way it interacts with other substances in the air. Particularly sensitive groups include children, the elderly and people with heart or lung diseases, especially asthma sufferers. At all sites, the level of sulphur dioxide in ambient air was found to be far below the limit given in the SEQS.

Table 5-6: Levels of Sulphur Dioxide

Sites	SO_2		
	Min (µ g/m^3)	Average (µ g/m^3)	Maximum (µ g/m^3)
Fulleli 30th Mile Cross Regulator	10.1	12.6	16.4
Fulleli Imam Wah Cross Regulator	8.3	9.6	11.4 `
Akram Wah/Fulleli Ali Pur Cross Regulator	7.8	8.3	9.6
SEQS Limit -Average time 24 hrs.	120 (µ g/m^3)		

5.3.5.4 Carbon Monoxide (CO)

CO is a colourless, odourless and tasteless gas. It consists of one carbon atom covalently bonded to one oxygen atom. Carbon monoxide forms when oxygen is reduced during combustion; otherwise, carbon dioxide forms. Carbon monoxide has a significant fuel value, burning in air with a characteristic blue flame and producing carbon dioxide. Despite its serious toxicity, CO plays a highly useful role in modern technology, being a precursor to many products. The level of carbon monoxide in ambient air was found to be below the permissible limits.

Table 5-7: Levels of Carbon Monoxide (CO)

Site	CO		
	Min (µ g/m^3)	Average (µ g/m^3)	Maximum (µ g/m^3)
Fulleli 30th Mile Cross Regulator	1.1	1.4	1.8
Fulleli Imam Wah Cross Regulator	1.1	1.3	1.5
Akram Wah/Fulleli Ali Pur Cross Regulator	0.6	0.9	1.1
SEQs Limits)-Average time 08 hrs.	5 (µ g/m^3)		

[9] **^1NO_x= NO + NO_2**

5.3.5.5 Ozone (O_3)

Ozone in the air can be harmful to health, typically on hot, sunny days when ozone can reach unhealthy levels. Even relatively low levels of ozone can cause health effects. Children, people with lung disease, older adults, and people who are active outdoors, including outdoor workers, may be particularly sensitive to ozone.

Ozone is particularly likely to reach unhealthy levels in urban environments but can be transported long distances by wind. Therefore, even rural areas can be affected by high ozone levels. However, the level of ozone measured in the ambient air of the sub-subproject area was far below the SEQS, as shown in the following table.

Table 5-8: Levels of Ozone

Site	O_3		
	Min (µ g/m^3)	Average (µ g/m^3)	Maximum (µ g/m^3)
Fulleli 30th Mile Cross Regulator	7.0	12.0	18.0
Fulleli Imam Wah Cross Regulator	5.0	11.5	16.0
Akram Wah/Fulleli Ali Pur Cross Regulator	3.0	7.6	12.0
SEQs Limits)-Average time 1hr.	**130 (µ g/m^3**		

5.3.5.6 Particulate Matters

Particulate matter (PM) is a complex mixture of materials consisting of varying combinations of dry solid fragments, solid cores with liquid coatings and small droplets of liquid. These tiny particles vary greatly in shape, size and chemical composition and can be made up of different materials such as metals, soot, soil and dust. PM may also contain sulphate particles. PM is divided into many size fractions and measured in microns (a micron is one-millionth of a meter). Sindh EPA regulates three classes of particles – particles up to 10 microns (PM_{10}), particles up to 2.5 microns ($PM_{2.5}$) and Total Suspended Particulate (TSP). $PM_{2.5}$ particles are a subset of PM_{10}, and PM_{10} particles are a subset of TSP. The levels of Particulate Matter in ambient air were within the SEQS limit.

Table 5-9: Levels of Particulate Matters

Site	PM 10 (µ g/m^3) (µ g/m^3)		PM2.5 (µ g/m^3)		SPM (µ g/m^3
	Average	Min	Average	Max	Average
Fulleli 30th Mile Cross Regulator	121	20.0	23.4	28.0	193
Fulleli Imam Wah Cross Regulator	102	17.0	21.9	26.0	181
Akram Wah/Fulleli Ali Pur Cross Regulator	89	14.0	19.7	24.0	156
SEQS Limits-Average time 24 hrs.	150(µ g/m^3)		35 (µ g/m^3)		500 (µ g/m^3.

5.3.5.7 Lead

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major source of lead emissions in ambient air within the sub-subproject area is the fuel used in motor vehicles. The level of lead is shown in the following table.

Table 5-10: Lead in Ambient Air

Site	Lead in Ambient Air (µ g/m3)
Fulleli 30th Mile Cross Regulator	0.2
Fulleli Imam Wah Cross Regulator	0.1

Site	Lead in Ambient Air (µ g/m3)
Akram Wah/Fulleli Ali Pur Cross Regulator	--
SEQS Limits- Average time 24 hrs.	1.5 (µ g/m^3)

Baseline Ambient Air Monitoring Location is shown in the following Figure 5-10.

The baseline Ambient Air quality data was collected during a nearby Canal area study by Sindh EPA certified lab. The sampling was conducted on three points by means of stationary units; among three locations, one sampling point is nearer to Akram Wah, as depicted in the figure below.

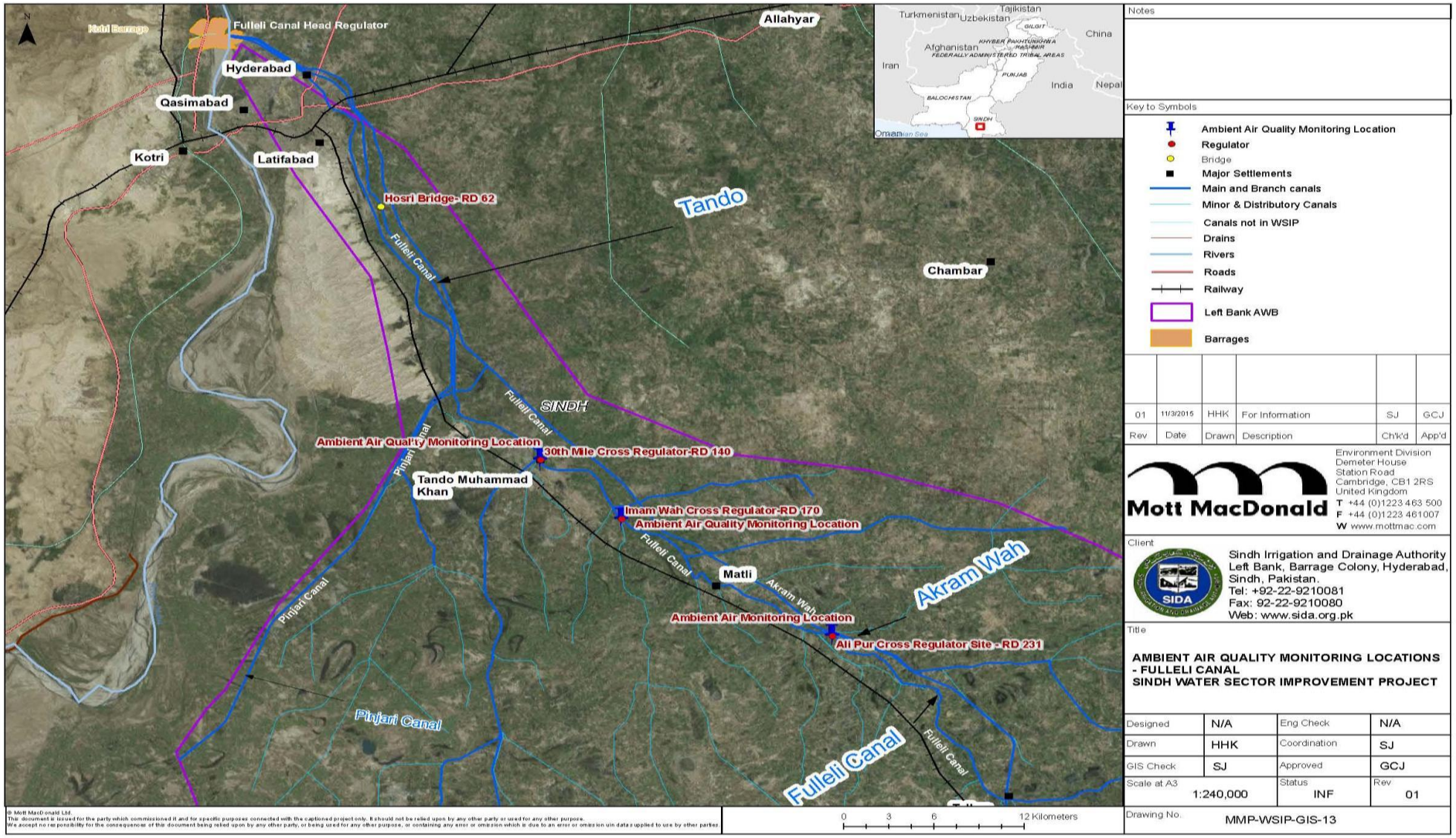
5.3.6 Noise Levels in the Subproject Area

SUPARCO also measured the noise at three regulating sites near the canal. This data is relevant and used in the Akram Wah project as there has been no significant change in demography. It should be noted that the bidding document will contractually bind the Contractor to undertake noise level measurements before mobilization. The Engineer will have to ascertain whether the indicated mitigations are still valid or modifications are required. The monitoring location is also near the Akram Wah project. The average noise level was near 60 (dBA), above the permissible limits of SEQS (55 dBA for the residential area). This, however, does not exceed the noise levels prescribed for industrial or commercial areas in SEQS and World Bank standards. The details of minimum, average and high noise are given below table;

Table 5-11: Noise Levels

Site	Noise Levels		
	Min (dBA)	Average (dBA)	Max (dBA)
30th Mile Cross Regulator	52	61	68
Imam Wah Cross Regulator	55	59	65
Ali Pur Cross Regulator	51	59	64
SEQS Limits	75 dBA- Industrial Are 65 dBA-Commercial Area 55 dBA-Residential Area		

Figure 5-10: Baseline Ambient Air Monitoring Locations



5.3.7 Water Resources

The people of the surrounding areas within the project corridor use surface and groundwater resources for domestic, livestock and irrigation purposes. The surface water is supplied to the people of nearby cities with the help of pump houses. However, where the pumping facilities are not available to supply surface water, groundwater resources (Hand pumps) are used daily.

In addition to drawing water from Akram Wah, some of the communities along its route also dispose of garbage into the canal, with clear evidence of all types of garbage from papers and plastics which accumulate at any of the control structures along the canal route, to more insidious materials including vegetable and animal waste and human excrement all being discharged into Akram Wah. Another use of this canal is by animal herders; bovines are often found there. The overall result is that, whereas the water which is supplied into Akram Wah at the head regulator is generally relatively good quality water, as the canal passes in its first 37 RDs through Hyderabad, it accumulates a heavy load of garbage, making the water generally unfit for consumption. However, since the local population in the area has no choice, they abstract and use the water, perhaps making some effort to purify it by boiling it.

It should be noted that the bidding document will contractually bind the Contractor to undertake water quality measurements before mobilization. The Engineer will have to ascertain whether the indicated mitigations are still valid or modifications are required.

5.3.8 Water Quality

5.3.8.1 Water Quality Tests during Detailed Design

The surface and groundwater, quality were tested during detailed design study to check the water quality of the Akram Wah Canal. As given in the table below, these results show that the canal water quality is unsuitable for human consumption.

Table 5-12: Water quality analysis results

S. NO	Reduced Distance (RD)	Parameters			
Canal water		pH (30.5°C)	TDS (mg/l)	Conductivity (micro-S/cm)	Microbial Contamination
	RD 3 +500 L/S	7.9	263	603	**Present**
	RD 90+740 L/S	7.9	228	625	**Present**
	RD 160+960 L/S	7.9	270	637	**Present**
	RD 184+850 R/S	7.9	292	636	Present
	RD 192+200 R/S	7.9	387	605	Present
	RD 259+350 R/S	7.10	387	602	Present
	RD 302+500 R/S	7.87	382	600	Present
	RD 382+800 L/S	7.99	396	619	Present
	357+700 R/S	7.58	440	688	Present
	SEQS	6.5 – 8.5	<1000	-	Must not be detectable in any 100 ml sample
	WHO	6.5 – 8.5	<1000	-	Must not be detectable in any 100 ml sample

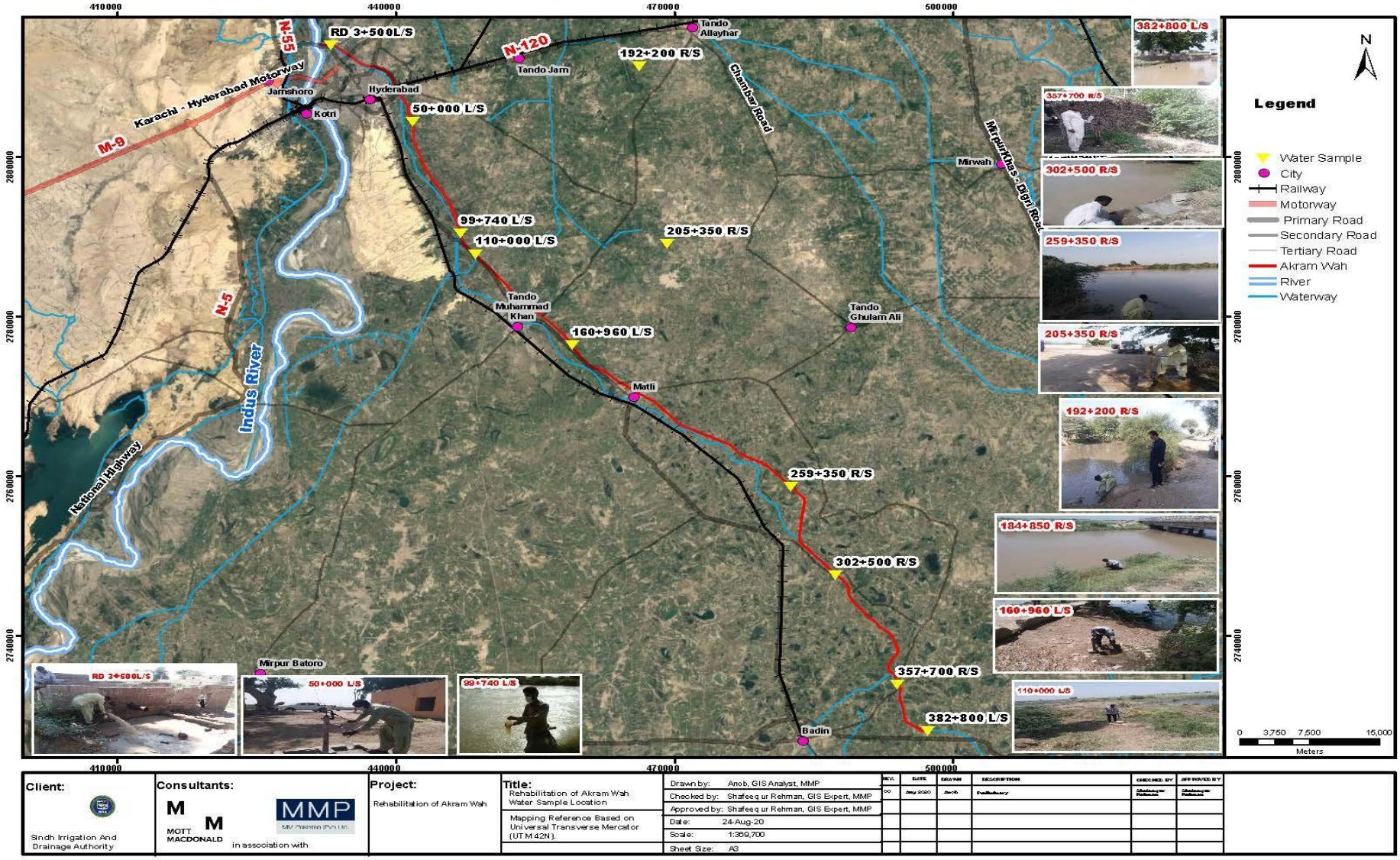
Table 5-13: Physical properties analysis results

S. NO	Reduced Distance (RD)	Parameters			
Canal water		Colour	Odor	Taste	Turbidity (NTU)
	RD 3 +500 L/S	Colourless	Unobjectionable	Unobjectionable	32.9
	RD 99+740 L/S	Colourless	Unobjectionable	Unobjectionable	58.9
	RD 160+960 L/S	Colourless	Unobjectionable	Unobjectionable	40
	RD 184+850 R/S	Colourless	Unobjectionable	Unobjectionable	45.8
	RD 192+200 R/S	Turbid	Unobjectionable	-	249
	RD 259+350 R/S	Turbid	Unobjectionable	-	303
	RD 302+500 R/S	Turbid	Unobjectionable	-	191
	RD 382+800 L/S	Turbid	Unobjectionable	-	193
	SEQS	□ 15 TCU	Non objectionable	Non objectionable	□ 5 NTU
	WHO	□ 15 TCU	Non objectionable	Non objectionable	□ 5 NTU

Table 5-14: Chemical parameters analysis results

S #	Reduced distance	Parameters													
Canal water		Sulphate (mg/l)	Nitrate (mg/l)	Chloride (mg/l)	Hardness as CaCO3 (mg/l)	Magnesium (mg/l)	Iron (mg/l)	Potassium (mg/l)	Sodium (mg/l)	Arsenic ppb	Fluoride (mg/l)	Alkalinity	Bi-Carbonate (mg/l)	Calcium (mg/l)	Carbonate (mg/l)
1	RD 3 +500 L/S	18	3.8	75	148	62	Nil	4.8	14	Nil	Nil	Nil	146	86	32
2	RD 90+740 L/S	15	2.9	70	170	80	Nil	2.9	13	Nil	Nil	Nil	138	90	33
3	RD 160+960 L/S	20	2.8	68	170	80	Nil	4	18	Nil	Nil	Nil	111	90	40
4	RD 184+850 R/S	18	3.4	85	176	84	Nil	3.7	14	Nil	Nil	Nil	137	92	30
5	RD 192+200 R/S	73	0.01	89	160	19.44	.05	3.1	62	Nil	0.10	2	100	32	Nil
6	RD 259+350 R/S	73	0.01	88	160	17	.05	3.0	61	Nil	0.02	2	100	36	Nil
7	RD 302+500 R/S	64	0.01	94	150	17.01	.04	2.9	65	Nil	0.03	2	100	32	Nil
8	RD 382+800 L/S	62	0.01	95	160	19.44	.04	3.0	65	Nil		2.2	110	32	Nil
	SEQS	-	≤ 0.50	< 250	< 500 mg/l	-	-	-	-	≤ 0.05	≤ 1.5	-	-	-	-
	WHO	-	50	250	-	-	-	-	50	0.01	1.5	-	-	-	-

Figure 5-11: Baseline Ambient Air Monitoring Locations



Overall, 8 samples were collected along the project area. In total, 22 drinking water parameters were tested. The Canal water is found to be high in turbidity, pH, Nitrate and biological contaminations at different RDs.

Figure 5-12: Disposal of sewage into Fulleli Canal



Figure 5-13: Garbage dumping in Akram Wah



Figure 5-14: Women using Soap and Washing powder for clothes washing (RD 61+000 R/S)



Figure 5-15: Buffaloes in Akram Wah



5.3.8.2 Water Quality Tests during Design Review (2024)

During design review stage 116 observation wells were installed on both sides of Akram Wah at 5 RDs intervals between RD 0 to RD 200 and at 10 RDs interval between RD 200 to RD 380.

To randomly check quality of groundwater along Akram Wah water samples were collected from recently installed observation wells at about 25 RDs intervals. At locations where the observation well was found damaged, water samples from the next nearby observation well were collected. The samples were tested for pH value, TDS and electrical conductivity (EC). The results are given in Table 5-15.

Table 5-15: Water Quality Test Results of Samples from Observation Wells

S. Nr	Sample Taken from Observation Well	PH	EC (S/cm)	TDS (ppm)
1	OW-RD-010 L	6.98	1,962	1,110
2	OW-RD-025 R	6.93	8,637	3,912

3	OW-RD-030 L	6.86	2,051	1,210
4	OW-RD-050 L	6.96	2,213	1,354
5	OW-RD-055 R	6.74	5,500	2,750
6	OW-RD-075 L	6.48	8,643	4,321
7	OW-RD-075R	7.09	3,397	1,698
8	OW-RD-100 L	6.28	10,000	9,826
9	OW-RD-105 R	6.48	4,588	2,357
10	OW-RD-125 L	5.58	6,217	3,108
11	OW-RD-125 R	6.87	10,000	10,000
12	OW-RD-150 L	7.22	6,402	3,201
13	OW-RD-150 R	6.56	4,089	2,044
14	OW-RD-180 L	6.46	10,000	8,371
15	OW-RD-175 R	6.66	1,048	585
16	OW-RD-200 L	6.65	2,611	1,473
17	OW-RD-195 R	5.77	1,864	1,125
	Maximum	**7.22**	**10000**	**10000**
	Minimum	**5.58**	**1048**	**585**
	Average	**6.62**	**5248.35**	**3437.94**

It is noted that the EC values indicate high to very high salinity values. Similarly, the TDS values are also categorized as high to very high, though the pH values are in optimal range. The groundwater is neither suitable for drinking nor agriculture.

5.3.9 Floods

The full effects of torrential rains in August 2020 are yet to be realized. Previous floods due to extreme rainfall in 2011 were the highest-ever monsoon rains in Sindh province, and they badly affected the Hyderabad and Tando Mohammad Khan districts. In Tando Muhammad Khan, all 17 Union Councils were severely affected due to 217 mm of rain from August 10th to 12th, 2011. The total affected population in this district was 585,411. 874 villages were affected, 12,607 households were destroyed, 12,369 houses were damaged and 83% of standing crops were destroyed. Most of the schools were closed and converted into relief camps.[10]

Hyderabad district was also badly affected by the rain. The inadequate drainage facility and sewage system resulted in flooding in those areas with lower elevations. In the 2011 monsoon floods, the affected population was 377,992 ,and there were 20,644 damaged houses in 24 UCs[11].

5.3.10 Geology and Soil

On a broader scale, the Indus basin is divided into Lower, Middle and Upper Indus, comprising southern Sindh and Northern Sindh. The alluvial sediment deposited by the River Indus in the lower Indus region, in

[10] *OCHA Report. Pakistan Floods 2010-Tando Muhammad Khan District Profile*

[11] *Source: OCHA Report. Pakistan Floods 2010-Hyderabad District Profile)*

general, and in the subproject area, in particular, consists mainly of fine to medium sands, silts and clays of Pleistocene and recent epochs over a basement of tertiary rocks. The nature of the soils varies considerably from place to place, and there are layers of sand belts (containing sand and sandy silt) and clay belts (containing clay and silt) spread throughout the area. These belts are of various thicknesses—the soils' depth varies from 9 to 91 meters (30 to 300ft). On the whole, sand belts are wider in extent than heavy soil belts. However, the clay belt predominates towards the south.

The soils of the Subproject area are of recent alluvial origin and are suitable for irrigated agriculture. Textures are closely related to depositional conditions and all mapping is based on geomorphic units. Although stratification is complex, most soils are within the range of fine sandy loam to silty clay loams, which are the most common. All soils contain calcium carbonate and most contain gypsum. Salinity is widespread but generally ephemeral. With adequate water and drainage, simple leaching can reclaim most soils.

5.4 Biological Environment

This section of the ESIA study describes the biological aspects of the environment in the Akram Wah subproject site in terms of vegetation, habitat and fauna.

The different types of habitat and land use present in the subproject area are categorized as follows:

- Wetland (Reeds, shrubs and grass mix)
- Orchards
- Trees thickets near canal embankment
- Agriculture Land
- Urban areas (Buildings)
- Scattered small ponds, including Fish pond
- Barren land, including borrowed area
- Spoils

5.4.1 Wetlands (Reeds, Shrubs, grass mix)

During the field surveys, numerous water ponds and different RDs were observed. They are mostly formed because of continuous water seepage from the canal. In some places, seasonally flooded areas were also observed; they result from rainfall, especially during the monsoon season.

The dominant species present in the wetland habitats are: *Phragmites karka* (Nar/naro) and *Typha elephantia* (Pann) *T. domingensis* (Pann), associated with *Cyperus arendrius*, (Moniah Gaah), *C. conglomerates* (Moniah Gaah), *C.rotundus* (kabah), *Saccharum spontaneum* (Booro munj), *S. bengalensis* (booro), *Paspalum dischicum, Cynodon dactylon* (Chhabar).

Figure 5-16: Wetland picture at RD 54	Figure 5-17: Wetland picture at RD 88
	

5.4.2 Orchards

Several orchards were found along the project area and within the Corridor of Impact (COI) of Akram Wah. An orchard of Mango, Jaman and Lemon trees existed on t5 feet of COI at RD 172+950 R/S. Another orchard of Mango and Jaman trees was surveyed within 10 to 30 feet of COI at RD 69+800 R/S. Several other orchards are located near Hyderabad and Tando Muhammad Khan districts, which supply fruit to these and other nearby cities. The prominent species in these orchards are *Mangifera indica* (Amb), *Cydonia oblonga Mill* (Zaitoon), *Genus Phoenix* (khaji), *and Syzygium cumini (Jamun) trees which support* the needs of nearby cities.

Figure 5-18: Orchard of Mango, Jaman & Lamon trees at RD 172+950 R/S	Figure 5-19: Orchard of Mango and Jaman trees at RD 69+800 R/S
	
N25°04.676' E068°36.944'	N25°18.385' E068°26.001'



5.4.3 Tree thicket near canal embankment

Tree, shrubs, herbs, grasses and sedges were the common species on the banks of Akram Wah. These species were found in the middle and at the outer and inner slopes of the embankments.

During the survey conducted in July-September 2020, 2022 and 2025, it was found that 4,865 trees are expected to be cut due to the lining of the canal (mostly the inner bank of the canal 1,772 trees from RD 0+000 to 194+000), the raising of embankments (inner and outer banks 3,048 Trees from RD 194+000 to 382+000) and construction of diversion channels. The inventory of existing trees and trees to be cut is shown in APPENDIX-A.

The species present on the canal embankments and on structural sites are; Melia Indica (Neem), Albezia lebbeck (Sarehan), Phoenix dactlifera (Khajoor), Acacia Nilotica (Babur), Eucalyptus (Safaido), Zizyphus (Bair), Pithecellobium dulce (Jalebi), Ficus religiosa (Pipal), *Pongamia pinnata (Sukhchain),* Ziziphus jujube (Ber), Delonix regia (Gul Moher), Psidium guajava (Amrood), Melia Indica (Neem), Tamarindus indica (Imli), Conocorpus and *Mangifera Indica (Amb)*.

Figure 5-20: Trees at RD 163+820 L/S	**Trees at RD 192+100 R/S**
	
N25°05.934' E068°35.762'	25° 02' 54.4382" N, 68° 39' 54.1995" E

5.4.4 Agriculture Lands

Settled agriculture is the most important land use and the chief driver of the economy of Sindh. Farming is the primary source of income for the local population in the Akram Wah command area. There are two main cropping seasons; "Kharif" and "Rabi". The Kharif season starts from April-May and ends in October-November, while the Rabi starts from November-December and ends in April-May.

Many of the growers are illegal occupants of the government-owned RoW, and they converted this to farmland at both the right and left banks of the canal. The wild flora of these lands is confined to the borders of the agricultural fields.

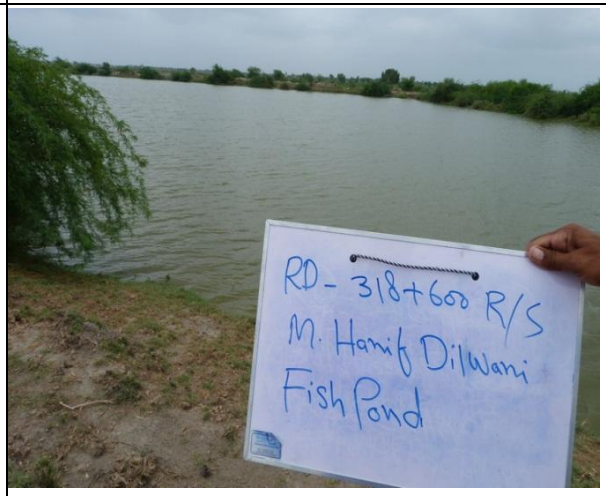
The main crops are wheat, cotton, rice and sugarcane. The dominant species at the borders of the agricultural land are grasses associated with herbs and tree cover.

The tree cover in the agricultural land includes Mengifera Indica (AMB), Citrus (Lemon), Ber (*Zizyphus jujube), and Jamun.* Most trees have a wide range of economic uses such as timber, fodder and for building and boat-making purposes. Important species include rosewood (*Dalbergia sisso),* babur l (Acacia *nilotica)* and Sufedo (*Populus euphratica).*

Figure 5-21:Agricultural area in the project area	**Figure 5-22: Agricultural area in the project area**
	
	

5.4.5 Fish Ponds

Several fish ponds surround the Akram Wah. Most of them are privately owned and belong to the people residing in the nearby area. These ponds are created by taking water from the canal and depend on the seasonal rainfall. The ponds are created by excavation and not excavation on an agricultural field called leeve pond.

Figure 5-23: Fish pond at RD 122+100 L/S	Figure 5-24: Fish pond at RD 318+600 R/S
	
N-25°10.853', E-068°30.794'	N-24°48.398', E-068°53.953'

5.4.6 Barren Land, including Borrow area

5.4.6.1 General

The land between and beyond open water ponds is barren in regularly flooded areas before the monsoon season, as shown in the following figures. Much of this barren land is at a lower ground level than the surrounding agricultural land. The groundwater level in these areas is also higher than that of the surrounding areas due to seepage from the Akram Wah. As a result, this land becomes flooded during the monsoon season, creating seasonal wetlands for up to six months from August to January. Approximately (15.82 ha) of barren land exists within the subproject area, accounting for 6.13% of the total land use in the subproject area.

Figure 5-25: Barren land on L/S of Akram Wah	Figure 5-26: Barren land on R/S on Akram Wah
	
(25°14’51.4”N, 68°28’03.3”E)	(24°42’51.9”N, 68°56’34”E)

5.4.6.2 Borrow Area

The PC Engineering and Environmental team and the representative from SIDA and Left Bank Canal Area Water Board (LBC-AWB) conducted a joint visit. The positions of the borrow areas shall be identified during construction by the Contractor following tests to confirm the suitability of the borrow material. The contractor shall make arrangements to use material from this land and rehabilitate the borrow areas to their original condition.

Each borrow area identified for the subproject exists on barren land/seasonally flooded areas, which are not cultivable and have no ecological importance. There are no trees in these borrow areas. However, some sparse bushes and shrubs can be found.

Figure 5-27: Borrow Area at 0+000 RD



(25°26'33.84"N 68°19'21.82"E)

Figure 5-28: Borrow Area at 56+000 RD



(25°20'6.72"N 68°25'23.22"E)

Table 5-16 depicts the location of each borrow area identified along with its coordinates.

Table 5-16: Proposed Borrow Area Location

S#	RD	Side	GPS Coordinates
1	0+000	L/S	25°26'33.84"N 68°19'21.82"E
2	7+000	L/S	25°26'12.35"N 68°20'39.36"E
3	40+000	R/S	25°22'43.25"N 68°24'45.29"E
4	45+000	R/S	25°22'3.14"N 68°25'0.57"E
5	50+000	L/S	25°21'5.73"N 68°25'20.26"E
6	54+000	L/S	25°20'22.81"N 68°25'21.26"E
7	56+000	L/S	25°20'6.72"N 68°25'23.22"E
8	69+000	R/S	25°18'10.39"N 68°26'4.98"E
9	77+000	R/S	25°17'10.78"N 68°26'44.75"E
10	95+000	R/S	25°14'13.73"N 68°28'11.71"E
11	130+000	L/S	25° 9'50.61"N 68°31'45.99"E
12	169+000	L/S	25° 3'35.16"N 68°38'50.10"E
13	185+000	L/S	25° 3'35.16"N 68°38'50.10"E
14	223+000	L/S	25° 0'13.78"N 68°44'40.58"E
15	224+000	L/S	24°59'56.15"N 68°44'36.37"E
16	227+000	L/S	24°59'31.68"N 68°45'35.24"E
17	228+000	R/S	24°59'39.82"N 68°45'6.57"E
18	242+000	R/S	24°58'20.31"N 68°47'19.30"E
19	244+000	L/S	24°58'19.50"N 68°47'29.74"E
20	264+000	R/S	24°55'59.83"N 68°50'12.05"E
21	267+000	R/S	24°55'38.09"N 68°50'24.50"E
22	275+000	R/S	24°54'21.67"N 68°50'13.67"E
23	275+000	L/S	24°54'21.41"N 68°50'17.35"E
24	279+000	R/S	24°53'43.19"N 68°50'8.02"E

S#	RD	Side	GPS Coordinates
25	279+000	L/S	24°53'37.57"N 68°50'11.20"E
26	292+000	L/S	24°51'51.18"N 68°51'15.05"E
27	342+000	R/S	24°45'17.40"N 68°56'20.94"E
28	360+000	L/S	24°42'55.82"N 68°56'35.62"E
29	381+000	R/S	24°39'59.88"N 68°58'6.59"E
30	381+000	L/S	24°40'2.35"N 68°58'16.95"E

5.4.7 Urban Areas and Buildings

The Akram Wah runs through the periphery of Hyderabad, Hosri, Tando Muhammad Khan and Matli cities and provides water for agricultural, industrial and domestic purposes in the project area. The settlement of people along the Akram Wah banks is a very serious issue since it badly hampers the regulation and management of Akram Wah and creates enormous problems for the Irrigation Engineers and Staff. Although the Sindh Irrigation Act – of 1879 and government law do not allow people to encroach on the canal command premises, people have settled in these areas over time.

The overall urban area within the government-owned right of way (RoW) in the vicinity of the structure sites is 21 ha (53 acres), covering both sides of the canal (based on 15.3 meter-50ft RoW). However, none of these areas fall directly within the footprint of the proposed works. The habitat in the surrounding area includes the following trees; A*caica nilotica* (Sindhi Babur) *Phoenix dactlifera* (Khajoor), *Ficus religiosa* (Pipal), *Dalbergia sissoo* (Tali), *Albezia lebbeck* (Sarhn), *Melia indica* (Neem). *Eucalyptus sp.* (Sufedo), *Ziziphus jujube* (Ber).

The other native species found in the *area; T. domingensis* (Pann), *C. rotundus* (kabah), (Booro munj), *S. bengalensis* (booro), *Paspalum dischicum, Saccharum spontaneum Cynodon dactylon* (Chhabar), *Typha elephantia* (Pann). *are C. conglomerates* (Moniah Gaah).

5.5 Fauna

5.5.1 Classification of Key Species

Key species within the subproject area have been identified based on the following criteria;

- Listed as Near Threatened, Vulnerable, Endangered or Critically Endangered on the IUCN Red List
- Convention on the Conservation of Migratory Species of Wild Animal (CMS)
- Listed as protected under the Sindh Wildlife Protection Ordinance (SWPO)

5.5.1.1 International Union for Conservation of Nature (IUCN) Red List

The IUCN evaluates species and categorises them in terms of their extinction risk under the following categories:

- Least Concern
- Near Threatened
- Vulnerable
- Endangered
- Critically Endangered
- Extinct in the Wild
- Extinct

5.5.1.2 The Convention on the Conservation of Migratory Species of Wild Animal

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979, requires countries to take action to avoid endangering migratory species. The term “migratory species” refers to the species of significant proportion whose members cyclically and predictably cross one or more national jurisdictional boundaries. The parties must also promote or cooperate with other countries in research on migratory species.

The Convention contains two appendices. Appendix I contains the list of endangered migratory species according to the best scientific evidence available. For these species, the member states of the Convention are required to endeavour to:

- Conserve and restore their habitats.
- Prohibit their hunting, fishing, capturing, harassing and deliberate killing.
- Remove obstacles and minimize activities that seriously hinder their migration.
- Control other factors that might endanger them, including control of introduced exotic species

Appendix II lists the migratory species, or groups of species, that have an unfavourable conservation status as well as those that would benefit significantly from the international cooperation that could be achieved through inter-governmental agreements.

Pakistan has been a party to this convention since 1987

5.5.1.3 Sindh Wildlife Protection Ordinance (SWPO), 1972

The Second Schedule of SWPO lists all species legally protected in Sindh.

5.5.2 Ecological Baseline

In order to capture the ecological baseline of the project area, a desktop study was initiated, supplemented by a survey conducted in September 2020-22. The details and photographs are attached in subsequent sections.

5.5.3 Mammals

A summary of the species recorded in surveys is provided in the following table.

Table 5-17: Summary of Mammal Survey Results

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Helogale parvula (Common dwarf mongoose)	Least concern	-	-
Sciurus carolinensis (tree squirrel)	Least concern	-	-
Pipistrellus kuhlii (bat or chamrro)	Least concern	-	-
Lepus nigricollis (Indian hare or khargosh)	Least concern	-	-
Felis chaus (Jungle cat or Jangli Billi).	Least concern	-	Yes
Tatera indica (Indian Gerbil)	Least concern	-	-
Suncus murinus (House Shrew)	Least concern	-	-

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Funambulus pennantii (Northern Palm Squirrel)	Least concern	-	-
Herpestes javanicus (Small Indian Mongoose)	Least concern	-	-
Herpestes edwardsii (Indian Grey Mongoose)	Least concern	-	-
Pteropus giganteus (Flying foxes)	Least concern	-	-
Lesser bendicoot rat (indian mole rat)	Least concern	-	-
Rattus rattus (House Rat)	Least concern	-	-
Sus scrofa (Indian wild boar)	Least concern	-	-
viverricula indica (Small indian civet)	Least concern	-	**Yes**
Lepus nigricollis (Indian hare)	Least concern	-	**Yes**

Details of the mammals identified to be present within the sub-subproject area are given in the following sections. Within these sections, the preferred habitats of the mammals have been assessed against habitats available in the subproject area, and further details have been added regarding their regional status[12].

5.5.3.1 Lepus nigricollis (Indian hare)

The Indian Hare can be found in various habitats, such as short grasslands, barren agricultural fields, crop fields, and forest roads. The species can be seen in forests of many types other than the mangroves and tall grassland habitats. However, one can see the species adjacent to forest areas in agricultural fields. Its diet consists primarily of grasses.

5.5.3.2 Lesser bandicoot rat (indian mole rat)

This species is mainly found in agricultural landscapes, such as rice paddies, and can occur in urban areas. Its broad range of natural habitat includes open swampy areas, subtropical and tropical dry deciduous forests and mangroves.

5.5.3.3 Rattus rattus (House Rat)

It is generally found in any area that can support its mainly vegetarian diet. Because it is an agile climber, it often lives in high places, such as top floors of buildings in populated areas or trees in forested areas.

5.5.3.4 Sus scrofa (Indian wild boar)

The Eurasian wild pig occupies various temperate and tropical habitats, from semi-desert to tropical rain forests, temperate woodlands, grasslands and reed jungles, often venturing onto agricultural land to forage. It is found in a variety of habitats.

[12] Secondary data regarding preferred habitats and threats has been taken from the IUCN Red List (http://www.iucnredlist.org/)

5.5.3.5 Viverricula indica (Small indian civet)

Small Indian Civets have been recorded in a wide range of habitats, particularly in degraded and fragmented landscapes and in less encroached areas, in deciduous forests, bushland, grassland, riverine habitats and marshes.

5.5.3.6 Helogale parvula (Dwarf Mongoose or Naur)

The dwarf mongoose is common throughout Sindh, sometimes occurring in high densities. It has no major reported threats. The species are commonly found in agricultural lands, especially in tree thickets which are supported in the subproject area.

5.5.3.7 *Sciurus sp.* (Tree Squirrel)

The tree squirrel is commonly reported in the subproject areas. There are no major known threats and no current indication of widespread population decline of this species. However, the squirrel prefers mature deciduous and dense tree thickets. They can also be found nesting in trees and near open water, as can be found in the subproject area.

5.5.3.8 Pipistrellus kuhlii (Bat or chamrro)

Kuhl's pipistrelleis a species of vesper bat that lives over large areas. This species roosts in large colonies on large trees in both rural and urban areas, close to agricultural fields, ponds, and roads. Colonies usually have a permanent roost with one or two temporary roosts that individuals shift to depending on season. The species is sensitive to habitat loss, due to tree cutting and also know to suffer from poisoning via the use of pesticides used to eradicate mosquitos within urban areas. This bat may be encountered within any large trees found within the subproject area.

5.5.3.9 Lepus nigricollis (Indian hare or khargosh)

The Indian hare is reported in various habitats within the subproject area, such as short in the edges of tree covers and agricultural fields. However, its preferred habitat is forest land. The main threat to the hare is converting forest areas to agricultural land, and hunting for meat.

5.5.3.10 Felis chaus (Jungle cat or Jangli Billi)

The jungle cat is common throughout Sindh and is especially associated with riverine swamps and reed beds. It is reportedly present within the sub-subproject area for the work Akram Wah. It is not strictly nocturnal and may sometimes be seen emerging to hunt in the late afternoon. If the jungle cat is seen within the canal sides and in agriculture fields, it will likely only pass through since, as with all the larger animals, these will comprise only a small part of its wide-ranging territory. Jungle cats are known to rest within dense cover during the day.

5.5.3.11 Tatera indica (Indian Gerbil)

The Indian gerbil is known to cause property damage and is commonly considered a pest in Pakistan. As a result, it is threatened by poisons within settlements. Despite this, it has a large and steady population. The gerbil is adaptable to many habitat types where there is an adequate food source, but frequently observed near agricultural land, and at the edges of the embankment sides that allow for extensive burrowing. The gerbil burrows to rest, store food, and sleep.

5.5.3.12 Suncus Murinus (House Shrew)

The house shrew is an abundant and stable species living around human settlements. As well as near settlements, the occurrence of the house shrew may be expected within agricultural land in the subproject area. There are no major reported threats to this species.

5.5.3.13 Funambulus Pennantii (Northern palm squirrel)

The northern palm squirrel is a very adaptable species and may be found in a range of habitats in the subproject area, but its pit refers to grasslands. There are no major reported threats to this species.

5.5.3.14 Heppestes Javanicus (Small Indian Mongoose)

The small Indian mongoose is known to occur in a variety of habitats but appears to prefer well-watered, naturally agricultural lands and vegetated areas, all of which are available within the subproject area. It is also known to thrive in human-altered habitats. The mongoose generally eats insects, but it is an opportunistic feeder and will eat frogs, spiders, snakes, small birds and bird eggs. The only major threat to the mongoose in the wild is that they are sold as pets. This practice is not uncommon in Sindh, or the subproject area, as the mongoose is known to kill snakes and prevent them from entering homes.

5.5.3.15 Heppestes Edwarsii (Common Grey Mongoose)

The common grey mongoose is common and abundant in the subproject area and is highly adaptable to human-dominated landscapes. These species have been observed in thickets, cultivated fields, and tree thickets, which are common in subproject areas. As with the small Indian mongoose, this species is occasionally kept as a pet to control snake populations within settlements. They are also captured by snake charmers who fight them with snakes as a source of income.

5.5.3.16 Pteropus giganteus (Flying fox)

These bats belong to the suborder Megachiroptera and are the largest bats in the world. They are commonly known as fruit bats or Indian flying foxes, among other colloquial names. The species is largely found in South Asia but also occurs in adjacent China and South East Asia. There are at least 60 extant species in this genus.

According to the IUCN, this species roosts in large colonies on large trees in rural and urban areas, close to agricultural fields, ponds, and roads. A single young is born between April to early June. Flying foxes may travel long distances, up to 150 km to and from their roost, at night in search of food. Colonies usually have a permanent roost with one or two temporary roosts that individuals shift to depending on the season.

Characteristically, all species of flying foxes only feed on nectar, blossom, pollen, and fruit, which explains their limited tropical distribution. Unlike microbats, which use echolocation to locate and catch prey, smell and eyesight are very well-developed in flying foxes. Feeding ranges can reach up to 40 miles.

According to the IUCN, the flying fox is classed as ‘least concern’ as there appear to be no major global threats, although local threats exist, such as cutting trees used as roosts and hunting for meat and medicinal purposes. In 1989, all species of *Pteropus* were placed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Muhammad Mahmood-ul-Hassan also revealed in his study that, “The diet of the Indian flying fox (Pteropus giganteus) in urban habitats of Pakistan” and describes that Pteropus giganteus is given no protection by Pakistani law[13].

[13] Muhammad Mahmood-ul-Hassan,at al, The diet of the indian flying fox (Pteropus giganteus) in urban habitats of Pakistan”,341-347,2010

Pteropus giganteus is included in the fourth schedule of the Punjab Wildlife (Protection, preservation, conservation and management) Act 1947 section 2 (v) lists the species that are given no legal protection and can be hunted.

Figure 5-29: Indian grey mongoose[14]



Figure 5-30: Indian Mole Rat[15]



5.5.3.17 Key Species

Of the mammal species identified to be present in the subproject area, the following are considered as key species within this ESIA:

- *Felis chaus* (Jungle cat)
  - Protected under Sindh Wildlife Management Ordinance
- Indian Wild boar
- Small Indian Civet
- Indian Hare

5.5.4 Reptiles and Amphibians

A summary of the species recorded within each survey is provided in the following table:

Table 5-18: Summary of Reptile and Amphibian Survey Results

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Enhydris pakistanica (Sindh river snake)	Least Concern	-	-
Chamaeleo zeylanicus (chameleon or Girgit)	Least Concern	-	-
Rana tigerina (Tiger Bull Frog)	Least Concern	-	-
Naja oxiana (Central Asian Cobra)	Not assessed	-	-

[14] https://www.inaturalist.org/

[15] https://www.inaturalist.org/

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Bungarus caeruleus (Indian krait)	Not assessed	-	-
Hemidactylus flaviviridis (House Gecko)	Least Concern	-	-
Varanus bengalensis (Bengal Monitor)	Least Concern	-	Yes
Bufo stomaticus (Indus Valley Toad)	Least Concern	-	-
Pangshura Tecta (Indian Roofed Turtle)	Least concern	-	-
Geoclemys hamiltonii (Spotted Pond Turtle)	Endangered	-	-
Ophisops jerdonii (Punjab-snake-eyed Lacerta)	Least Concern	-	-
Varanus bengalensis (Indian Monitor lizard)	Least Concern	-	-

Details of the reptiles and amphibians identified to be present within the sub-subproject area are given in the following sections. Within these sections, the preferred habitats of the reptiles and amphibians have been assessed against habitats available in the subproject area, and further details have been added regarding their regional status[16].

Geoclemys hamiltonii prefers shallow, densely vegetated standing water bodies but may also occur in rivers, ponds, reservoirs, and basks, preferentially in reed beds. This species feeds mostly on snails, taking dragonfly larvae and other insects, freshwater crustaceans, and various other vegetable and animal food items.

5.5.4.1 *Ophisops jerdonii*

This is a fossorial and diurnal species that inhabits rocky terrain and dry open forests, where it is common in leaf litter, as well as other moist environments, including shady places in gardens, forests, grasslands, and areas with dense ground cover.

5.5.4.2 *Varanus bengalensis*

This species is found in a variety of habitats, from desert areas to floodplains, scrubland to forests, at moderate elevations. It can also inhabit agricultural areas.

5.5.4.3 *Enhydris pakistanica* (Sindh river snake)

This species is considered to be relatively abundant in its limited range, and no known major threats have been identified. The Sindh river snake is not known to move away from water, and it is found in canal sides with emergent vegetation, such as those found adjacent to the Akram Wah in the subproject area.

5.5.4.4 *Chamaeleo zeylanicus* (Chameleon or Girgit)

This chameleon lives in various habitats, including agricultural land and tree thickets habitats found in this subproject area. All chameleons are primarily insectivores that feed by projecting their long tongues from their mouths to capture prey located some distance away. Their major threats include harvesting for medicinal purposes as well as the sale of pets.

[16] Secondary data regarding preferred habitats and threats has been taken from the IUCN Red List (http://www.iucnredlist.org/)

5.5.4.5 *Rana tigerina* (Tiger Bull Frog)

The tiger bullfrog is tolerant of a broad range of habitats. The species is considered locally common throughout much of its range, and it prefers seepage ponds near the canal side. However, populations are predicted to decline shortly because of habitat loss and water pollution. It is also commonly found in artificial wetlands, such as paddy fields.

5.5.4.6 *Naja Oxiana* (Central Asian Cobra)

This cobra has a high tolerance for a broad range of modified habitats and is reported in abundance. It prefers habitats associated with open water but can also be found in agricultural lands and tree thickets. Therefore, it may have a broad range throughout the subproject area.

5.5.4.7 *Bungarus caeruleus* (Indian krait)

The Indian krait's range comprises various habitats and may be found in agricultural fields and inhabited areas in the subproject area. It takes up residence in termite mounds, brick piles, and even inside houses.

5.5.4.8 *Hemidactylus flaviviridis* (House Gecko)

The common name for the Hemidactylus flaviviridis is the Yellow-bellied House Gecko, another lizard observed in the project area. It is observed near agriculture fields, houses, tree cover and supported vegetation.

5.5.4.9 *Varanus bengalensis* (Bengal Monitor)

The Common Indian Monitor has been observed within the project area. It is listed as the least concern on the 2014 IUCN Red List. Its favoured habitat is floodplains, scrublands, and forests, and it is also reported to inhabit agricultural areas (although this does not appear to be its favoured habitat). The lizard's main threat is harvest for the commercially valuable skin. Habitat loss is not seen as a major threat as it utilises a wide range of habitats.

5.5.4.10 *Bufo stomaticus* (Indus Valley Toad)

The *Bufo stomaticus* is commonly known as the Indian marbled toad, Assam toad, Indus Valley toad, or marbled toad. It is found in various habitats including agricultural lands and human habitations, all of which exist within the subproject area. The species is threatened by habitat loss due to infrastructure development, intensification of agriculture and pollution of wetlands.

5.5.4.11 *Pangshura Tecta* (Indian Roofed Turtle)

This species is also known as the Indian roofed turtle. This is a quiet-water turtle, occurring in canals and ponds and as such may be encountered in the northern extents of the subproject area. The diet includes small fish, small insects and small aquatic species.

Figure 5-31: Ophisops jerdonii [17]	Figure 5-32: Monitor lizard
	

5.5.4.12 Key Species

Of the reptile and amphibian species identified to be present in the subproject area, the following are considered as key species within this ESIA:

- Varanus bengalensis (Bengal Monitor)
- Protected under Sindh Wildlife Management Ordinance
- Indian Roofed Turtle
- Spotted Pond Turtle

5.5.5 Avi-Fauna

Details of the bird species identified during the stage 1 and stage 2 surveys are provided in the following table.

Table 5-19: Summary of Avi-Fauna Survey Results

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Phalacrocorax carbo (Great cormorant, Ari)	Least Concern	-	-
Ciconia ciconia (White stork, Bagla)	Least Concern	Yes	-
Halcyon smyrnensis (White-breasted kingfisher, Machi mar)	Least Concern	-	-
Passer domesticus (House sparrow, Jhirki or Chiriya)	Least Concern	-	-
Zenaida macroura (Mourning dove, Fakhta)	Least Concern	-	-
Falco cherrug (Saker Falcon, Saker Baaz)	Endangered	Yes	Yes

[17] https://eol.org/pages/1055727

Species	IUCN Classification	Listed in CMS Appendix I or II?	Protected under SWPO?
Vanellus indicus (Red-wattled lapwing, Titehar)	Least concern	-	-
Psittacula krameri (Rose-ringed parakeet, Tota)	Least concern	-	-
Bubulcus ibis (Cattle Egret, Baglow)	Least concern	-	-
Phoenicopterus ruber (American flamingo, kang)	Least concern	-	-
Anas poecilorhyncha (Spot-billed duck, Badk)	Least concern	-	Yes
Anas acuta (Pintail, Chit kabri Badk)	Least concern	-	-
Gyps bengalensis (White-rumped vulture, Kari Ghajh)	Critically endangered	-	-
Francolinus francolinus (Black francolin, Karo Titar),	Least concern	-	-
Coturnix coturnix (Common quail, Bateer),	Least concern	Yes	-
Gallinula chloropus (Common moorhen, Karari Aarri)	Least concern	-	-
Columba livia (Rock dove, Junglie Kabotar),	Least Concern	-	-
Ceryle rudis (Pied kingfisher, Kabbara Machhi Maar),	Least Concern	-	-
Upupa epops (Hoopoe, Kath Kutho	Least Concern	-	-
Anthus novaeseelandiae (Australasian pipit, Gangle Jhirki)	Least Concern	-	-
Limosa limosa (Black-tailed godwit, karo Bugh).	Near Threatened	-	-
Acridotheres tristis (Indian Myna, Myna, Shark)	Least Concern	-	-
Sturnus Roseus (Gulabi pate wari kabbar)	Least Concern	-	-
Milvus migrans (Black Kite)	Least Concern	-	-
Alcedo atthis (Common Kingfisher)	Least Concern	-	-
Egretta garzetta Little Egret	Least Concern	-	-
Spatula clypeata Northern Shoveler	Least Concern	-	-
Gymnoris xanthocollis Chestnut-shouldered Bush-sparrow	Least Concern	-	-
Gallinula chloropus Common Moorhen	Least Concern	-	-
Argya earlei Striated Babbler	Least Concern	-	-

Figure 5-33: House sparrow	Figure 5-34: Egretta garzetta[18]
	

5.5.5.1 Key Species

The key species reported in the subproject area of influence are summarized below.

Protected Species

The Saker Falcon (F*alco cherrug*) and *Anas poecilorhyncha* (Spot-billed duck, Badk) were protected under the Sindh Wildlife Protection Ordinance of 1972.

Endangered Species

The following species are listed in the IUCN Red Book :

- Saker Falcon (*Falco cherrug*) – Endangered
- Black-tailed Godwit (*Limosa limosa*) – Near threatened
- White rumped vulture (*Gyps bengalensis*)- Critically Endangered
- *Ciconia ciconia* (White stork, *Bagla*) – Least Concern
- *Coturnix coturnix* (Common quail, Bateer) – Least Concern

Table 5-20: Details of Key Avi-Fauna Species

S #	Species	Habitat				Threat
		Terrestrial	Fresh water	Resident	Migrant	
	Saker Falcon (F*alco cherrug*)	✓	✓	✓		Loss and degradation of steppes and dry grasslands through agricultural intensification
	Anas poecilorhyncha (Spot-billed duck, Badk)	✓	✓	✓		Killing by wild animals

[18] https://eol.org/pages/ 49933470

S #	Species	Habitat			Threat
	Black-tailed Godwit (Limosa limosa	✓	✓	✓	Loss grasslands and hunting and trapping
	White rumped vulture (Gyps bengalensis)-	✓		✓	The manufacturing of intiinflammatory veterinary drug diclofenac, which is used to treat domestic livestock, has been identified as the cause of Mortality. The manufacturing of anti-inflammatory veterinary drug diclofenac, which is used to treat domestic livestock, has been identified as the cause of mortality
	Ciconia ciconia (White stork, Bagla)	✓		✓	Species may also suffer as a result of the excessive use of pesticides
	Coturnix coturnix (Common quail, Bateer)	✓		✓	Loss of rough grass and uncultivated land and an increase in the use of herbicides and insecticides

5.5.5.2 Saker Falcon

The saker falcon is classed as endangered by the IUCN due to a rapid population decline. The falcon hunts close to the ground in open terrain (often grassland) and its diet consists of small rodents and birds. They are known to nest in cliffs and tree copes.

5.5.5.3 Black-tailed Godwit

The black-tailed godwit is classed as near threatened by the IUCN due to a rapid decline in parts of its range. The godwit is a migrant species. Its preferred habitat includes cattle pastures, lowland wet grasslands, grassy marshland, lake margins and damp grassy depressions. The species nests at ground level within its preferred habitat. Its diet consists mainly of insects and fish eggs. The preferred habitat of key species is given in the following table.

5.5.5.4 White-rumped Vulture

The white-rumped vulture is classed as critically endangered due to an extremely rapid population decline attributed to poisoning due to feeding on carcasses of animals treated with the veterinary drug diclofenac. It most commonly occurs in plains and nests in tall trees, often near human habitation. It feeds upon the decaying flesh of animals.

5.5.5.5 *Ciconia ciconia* (White stork, Bagla)

This species is classed as Least Concern in the IUCN Red List. The species inhabits open areas, generally avoiding regions with persistent cold, wet weather or large tracts of tall, dense vegetation such as reedbeds or forests.

5.5.5.6 *Coturnix coturnix* (Common quail, Bateer)

It is listed in CMS and is classed as Least Concern in the IUCN Red List. They are found in grassland and artificial/terrestrial land. Birds feed mainly on grasses, weeds, and grain seeds, but they also eat ground-dwelling invertebrates.

5.5.5.7 *Anas poecilorhyncha* (Spot-billed duck, Badk)

The spot-billed duck is protected under SWPO and is listed as the least concern of the IUCN Red List. However, the population trend is decreasing. The species is found in wetlands (inland), Marine Coastal/Supratidal, Artificial/Terrestrial, Artificial/Aquatic & Marine habitats.

5.5.6.8 Preferred Habitat of Key Fauna Species

The following table reviews the key species identified through the environmental assessment and the habitat types found in the subproject area, representing their preferred habitats.

Table 5-21: Key Fauna Species and Preferred Habitat

Species	Status	Barren land	Urban areas/ villages	Agricul. Land	Trees	Wetland	Fish pond	Orchards
Varanus bengalensis (Bengal Monitor)	Protected/ Least Concern	X		X		X		
Felis chaus (Jungle cat)	Protected	X	X	X	X	X		X
Saker Falcon	Endangered/ Protected			X	X (nest)			
Black-tailed Godwit (*Limosa limosa*)	Near threatened			X	X			
White rumped vulture (*Gyps bengalensis*)	Critically Endangered			X	X			
Indian Wild boar	Least Concern	X		X		X		X
Small Indian Civet	Least Concern			X	X	X		X
Indian Hare				X	X	X		X
Indian Roofed Turtle						X		
Spotted Pond Turtle						X		
Ciconia ciconia (White stork, Bagla)	Least Concern	X						
Coturnix coturnix (Common quail, Bateer)	Least Concern			X				
Anas poecilorhyncha (Spot-billed duck, Badk)	Least Concern					X		

5.6 Socio-economic Environment

The Resettlement Action Plan of Akram Wah contains full details of the socio-environment. However, a summary taken from this report is provided below.

5.6.1 Surveys

The Akram Wah canal passes through 142 villages/*goth* in 7 tehsils of the three districts of Hyderabad, Tando Muhammad Khan and Badin. The socioeconomic baseline of the project area is collected through a survey of 291 households (27% of project-affected households) in all 142 villages along the canal alignment and consultations with local communities. The sample size of the surveyed households is given in Table 5-22.

Table 5-22: Household socioeconomic survey by district

District	Talukas/ Subdistricts	Number of Goths/ Villages	Households surveyed (Nos.)
Hyderabad	Hyderabad, Qasimabad	60	166
Tando Muhammad Khan	Tando Muhammad Khan	18	11
Badin	Badin, Matli, Talhar and Tando Bhago	64	114
	Overall	142	291

5.6.2 Settlements along the Canal

The names of the villages/*goths* along the canal are given in Table 5-23. There are 60 goths/ villages in the Hyderabad district, 18 goths/ villages in the Tando Muhammad Khan district, and 64 goths/ villages in the Badin district.

Table 5-23: Goths/ Villages and Districts along Akram Wah Sub-project

District	Talukas	Goths/ Villages
Hyderabad	Hyderabad	Hala Naka, Ghumna Abad, Channal Mori, Bachar, Chal Goth, Mori, Gato, Ghafoor Shah Colony, Mirpur Naka, Ghanghra Mori, Dergha Jevan Shah Colony, Sabo Gato, Workio, Sainby Gopang, Sokpur, Abdul Ghafoor Khoso, Bagh Wah, Sattar Dino Shoro, Rahat Ullah Shoro, Achar Shoro, Busho Shoro, Kando Shoro, Jamal Kachi, Hameso Shoro, Lambo Patel, Phulan Baladi, Umar Solongi, Qadir Bakhsh Solongi Colony, Panhwar, Hosri Town, Viro Patel, Chownel, Dilber Burfat, Jaro Panhwar, Chang Juma, Manjoo Khan Chang, Pholshoro, Hyder Brohi, Ali Aghen, Seri, Qasim Qazim, Punhoo Qambrani, Surf Hajmar, Soof Khan, Najana, Hajno, Gas Stop, Gaja Mori, Obhayo Mallah, Sumer Khalifa, Bhidal Shoro, Meer Gahri, Ramzan Brohi, Umer Halapoto, Hamza Farm.
	Qasimabad	Loung Khaskheli, Ali Hassan Shahani, Ghulam Qadir Mallah, Ghulab Laghari, Noor Khan Chang
Tando Muhammad Khan	Tando Muhammad Khan	Tsine Dand, Ahsan Machi, Umer Hayat, Rajo Nizam Khan, Kasspura, Pir Sattar Jan Sarhandi, Qadir Pur, Shekh Mhor, Majeed Shah, Bachal Shah Farm, Bhai Khan, Bodogamb, Haji Ghulam Muhammad Gunjoo, Bajar Khan Talpur, Mori, Noor Muhammad Kalari, Bahram Mori, Baran Laghari
Badin	Badin	Allah Dino Junejo. M. Juman, Haji Talib, Wahani More, Mitho Khan Umrani, Qasim Umrani, Wanhai Shareef, M. Urs Mallah, Makhdoom Abdul Rehman, Syed Ali Bux Shah. Haji Lakha Dino, Alam Khan Khoso, Kolhi Village

District	Talukas	Goths/ Villages
	Matli	Boran Mori, Wali Muhammad Magsi, Chutto Magsi, Soomro Khan Laghari, Yaqoob Kumber, Rahmatullah Janejo, Meerani Mori, Tamachi Janejo, Qabool Janejo, M. Khan Notkani, Bypass Mori, Qadir Bakhsh, Mehrab Lund, Falkara Mori, Nazim Mori, Maryam Abad, Saleem Colony, Bashir Abad Colony, Gul Muhammad Colony, Ghareebabad, Haji Ramzan, Mori Stop Matli, Sheikh Colony, Mor Goth, Alipur, Sajan Sawai, Bhawansha, Juma Khan, Muharram Mallah, Yar M. Mallah
	Talhar	Gul M. Butt, Golari, Jameel Putho, Channel Mori, Allah Bachyo, Gul Muhammad Mughal, Allah Bakhsh, Yousif Katiyar, 70 Mori
	Tando Bhago	Mori, Fakhar Din, Bando Junejo, Alam Khan Khoso, Haji Saddique, Haji Abdul Chooro, Haji Umer Khokher, Babu Fakhar, Ghazi Baig, M. Raso Khokher, M. Saleh Khoso, Lal Muhammad Khokhar

Source: Socioeconomic survey of Akram Wah

5.6.3 Demographic Profile

As per the national census reports of 2017, the total population of sub-project districts is 4,680,977, in which around 51.9% (2,428,286) is male, and 48.1 % (2,252,691) is female.

The population is primarily rural along the project alignment, except near Hyderabad. About 90% of the surveyed households are rural, and 10% are urban or semi-urban.

The population of the surveyed households is 1999, in which 856 are male, and 1063 are female. The average family size of each household is about 7. The age-wise demographic statistics of the surveyed households are given in Table 5-24. About 43% of the surveyed population aged between 15 to 45 and are generally more economically productive.

Table 5-24: Gender Disaggregated Age Distribution

Sr. No.	Age Group	Gender Composition (%)		
		Both Sexes	Male	Female
1	1-15 Years	37.3	12.1	25.2
2	>15-25 Years	34.5	20.5	14.0
3	>25-35 Years	3.7	1.2	2.5
4	>35-45 Years	4.6	2.7	1.9
5	>45-55 Years	6.1	1.1	5.0
6	>55-65 Years	6.3	3.0	3.3
7	Above 65 Years	7.5	4.0	3.5

5.6.4 Ethnicity and Caste Groups

The social organization in all villages is firmly based on *Biradari* (tribal) system, where each caste has a caste leader. The main castes in the project area are *Laghari, Bheel, Chandio, Jamali, Kolhi, Junejo, Katiyar, Umrani, Siyal, Dalwani, Sama, Soomra, Shaikh, Shah, Rind, Solangi* and *Khaskheli*. These castes are not related to religion and are not immutable.

The Sindhi language is commonly spoken as the mother tongue of the majority of the communities in the project area. However, Urdu, Punjabi, Marwari and Saraiki languages are also spoken and understood in the area. Islam is the major religion in the project area, and other minor religions present in the area are Agha Khani, Christian, Hindu (*Kolhi, Oadd, Bagri, Shakari* and *Meghawar*).

5.6.5 Education

The literacy rate in the project area is very low compared to the national average. The level of illiteracy amongst men is 23.1% and 41.3% for women. Gender disaggregated education details have been summarized in Table 5-25. The main reasons for illiteracy are the non-availability of schools and madrasas (religious schools) in the nearby area of their goths/ villages. Students often must travel far from their houses to access education.

Table 5-25: Literacy Rate of the Sample Households

Educational Attainment/ Literacy	Household Members (%)		
	Male (n=856)	Female (n=1063)	Total (n=1919)
Tertiary/College	2.3	0.8	3.1
Secondary	6.5	2.7	9.2
Primary	12.6	10.6	23.2
Did not Attend School	23.1	41.3	64.5

Source: Census and socioeconomic survey of PAHs

About 8.3% of the surveyed population have access to boys' primary schools, 11.8% have access to girls' primary schools, 18.3% and 18.4% respectively have access to boys' and girls' middle schools, and 16.6% and 20.7% have access to boys' and girls' high schools. There are also several small madrassas where students receive religious education.

5.6.6 Healthcare

There are few facilities for general healthcare in most villages. Government hospitals are mainly located in urban areas ad generally far away from the project villages. According to the surveyed households, the quality of health care services is not adequate, and only a few villages have medical technicians and Lady Health Visitors. The commonly reported diseases are diarrhea, measles, hepatitis, tuberculosis, cough and cold, malaria, and in some cases, heart-related conditions.

5.6.7 Housing Conditions

About 6.2% of the surveyed households live in *pacca* houses (permanent structures made of brick and mortar). About 78% of households live in live semi-*pacca* houses (semi-permanent houses) made of cement, mud and bricks. Generally, families from lower-income households live in '*katcha'* houses made of mud, stones, wood, and or thatched shed.

5.6.8 Livelihoods and Household Economies

Most of the affected households' primary livelihood sources (78.6%) are the daily wage labour in the farming sector, farming and livestock. Other main sources of income are businesses such as grocery stores and small eateries (7.9%), employment in government and private companies (3.8%).

The surveyed households' average annual per capita income is PKR 24,634, whereas the average yearly household income is PKR 162,434. About 60 percent of this income is spent on food items (31 % of income)

and other household expenses (29% of income) such as fuel, education, health, clothing, shoes, cosmetics, utility charges, and other miscellaneous expenditures. The total average annual spending of the surveyed households on both food and non-food items is estimated at PKR 98,601.

5.6.9 Land Tenure and Agriculture

There is a formal or regular system of land tenure in the entire project area. Most local people own agricultural land and the land on which their houses are built. In cases of tenant farming, the tenant farmers take one-third of the total produce of the farm.

Land ownership and inheritance are paternalistic, with only male sons typically eligible to inherit land and daughters rarely getting a share. In some cases, the daughters are offered their share of agricultural land; however, they sometimes refuse to take it due to cultural reasons. Most of the land is allocated to individuals using informal methods of documentation of plots like placing stones/markers at the boundaries by community elders.

The major rabi (winter) crops are 23.5 % wheat, 2.9 % sunflower and Kharif (summer) crops are 67.4 % rice, 6.0 % cotton, 3.2 % chillies, 9.6 % sugarcane. The average yield per acre of rice is 8,676 kg, cotton is 2607 kg, sugarcane 152488 kg, and wheat is 8,814 kg.

Livestock is a significant source of livelihood for the households and includes milk production and animal sale and purchase. Approximately half of the households raise an average of 2.4 animals (buffaloes, cows, goats and sheep) per household. The average numbers of poultry birds per household are 3.2. The details are given in Table 5-26 and photographs of cattlesheds are shown in Figure 5-35.

Table 5-26: Livestock Inventory of Surveyed Households

Project	Type of Animal					
	Buffaloes	Cows	Donkey	Goat	Sheep	Poultry
% of household owning livestock	11.4	6.6	2.3	19.7	14.3	3.7
No. of PAHs, who kept animals	33	19	7	57	42	11
No. of total animals	69	45	18	140	105	35
Average No. of Animals/PAH	2.1	2.4	2.6	2.5	2.5	3.2

Figure 5-35: Livestock in the Project Area



5.6.10 Cultural and Religious Site

There are religious structures in the right of way, including 29 mosques, 11 mandirs and several Muslim community alams and prayer places in the right of way of the Akram Wah Canal. The government's anti-encroachment drive on the supreme court orders in early 2021 has demolished many of these structures. The proposed canal rehabilitation works will also affect some of these structures, and the project will rebuild the structures after completion of the works.

The important cultural sites located in the project districts, but outside the project area, are the Shrine of Syed Taj Muhammad Turail in Badin (a 200 years old shrine for the Khuwaja Community, which holds a large gathering of people from all parts of the county annually). The Taj Mahal of His Highness Mir Khuda Bux near Talhar and the shrine of Dodo Soomro and Chanesar Soomro are also located in the Badin district.

5.6.11 Non-Government Organization in the Project Corridor

During the field survey, it was observed that many NGOs are working in the study area. National Rural Support Programme (NRSP) is working in the health, education and water sector and provides rural loans for the purchase of crops and animals. Thar Deep Rural Development Programme (TRDP), Strengthening Participatory Organization (SPO), Marvi Stop Service (MSS), Babul-Ilm Foundation England, and the National Commission of Human Development are also active within the project area. These NGOs are

focused particularly on the fields of health, education, livestock, poultry, health and hygiene, infrastructure, micro-credit and environment. NGOs are working in the whole district, not specifically in the project area, but the population of the project area is also benefited.

5.6.12 Gender Assessment

Women face numerous gender inequalities in the social context and therefore, this has an impact on their participation in decision-making regarding education, health, marriage and family planning and community-level initiatives. In general, gender inequalities are deeply rooted in social and cultural norms and practices, which result in discrimination, which ultimately affects the quality of their lives. Most of the women's roles are limited to family and are excluded from main decision-making at the household and society level.

Women are involved in a range of household activities, childcare and social obligations primarily and income generation activities, including:

- Agricultural and farming activities such as harvesting, picking of vegetables.
- Livestock rearing, collection of fodder, grazing, washing buffaloes, processing the milk products.
- Poultry, cleaning cot, supervise hatching, feeding, health care and other domestic activities.
- Employment as private and government schoolteachers, Lady Health Visitor, Lady Health Worker and traditional birth attendant.
- Other household chores include washing clothes, fetching water and firewood, cooking, child caring, cleaning and repairs of household items, participation in social obligations/ marriages and gathering

5.6.12.1 Roles and Responsibilities of Women

Approximately 100% of women are responsible for childcare activities, about 52.9% are involved in farming activities, and about 51.2% are engaged in livestock rearing activities.

Men have better levels of educational attainment than women, and for that reason and traditional; attitudes, there are few occupational opportunities available for the women in the area. Very few women are employed due to social and cultural barriers. A few of them are teachers and nurses. Although traditionally some women are busy in agricultural activities alongside male family members, women mainly undertake household activities such as cooking, cleaning, fetching water and taking care of children and elderly family members, as shown in Table 5-27. Compared with men, women typically spend more of their income on household rather than personal expenditures.

Table 5-27: Women's Involvement in Household Activities

Roles and Responsibilities/ Activities	The extent of Response by Women (%)	Remarks
❑ Household Activities	100.0	Most of the household routine activities (cooking, washing clothes, child care etc.) are being carried out by the women.
❑ Farm/ crop activities	52.9	The agricultural activities are in the farm fields, where in general, the male members are working. However, women are helped in sowing, harvesting, and picking vegetables.
❑ Livestock	51.2	Outdoor activities of livestock management are carried by the male members, while the female members are involved in preparing fodder, feeding, cleaning, milking and watering animals at home.

Social Obligations	66.7	Most of the decisions (regarding education and women employment) within the household area are decided by the male members of the family
Decision Making	66.0	
Government Jobs	2.0	Employment as private and government schoolteachers, Lady Health Visitor, Lady Health Worker and traditional birth attendant.
❑ Private Jobs	9.0	
Source: Census and socioeconomic survey of PAHs		

5.6.12.2 Gender Segregated Roles and Responsibilities in Livestock Management

During the FGDs, most women responded that they were actively involved in livestock management activities with their men. Most of the women were involved in preparing fodder, feeding, cleaning, milking, and watering animals at their homes. Details are shown in Table 5-28.

Table 5-28: Gender Segregated Roles and Responsibilities in Livestock Management

Responsibilities/ Activities	Gender	
	Male Members (%)	Female Members (%)
Preparing fodder	16	84
Feeding to animals	21	79
Veterinary care	85	15
Cleaning	39	61
Milking	25	75
Watering to the animals	31	69

5.6.12.3 Gender Segregated Roles and Responsibilities in Agriculture

The men and women are both involved in agricultural activities such as preparing land, sowing and harvesting, picking vegetables and on-farm water management. Primarily women help in sowing, harvesting and picking vegetables. Details are shown in Table 5-29.

Table 5-29: Gender Segregated Roles and Responsibilities in Agriculture

Responsibilities/ Activities	Gender	
	Female Members (%)	Male Members (%)
Land preparation	3.0	97.0
Sowing	42.0	58.0
Harvesting	36.0	64.0
Picking of vegetables	69.0	31.0
On farm management	15.0	85.0
Other (weeding, hoeing etc.)	13.0	87.0

Figure 5-36: Women Engaged in Agriculture





5.6.12.4 Women Employment in Different Institutions

Employment of women in different government and private jobs in educational and health institutions is limited as they were employed in government and private institutions within the vicinity of the project area. The details regarding women's employment are shown in Table 5-30.

Table 5-30: Women Employment in Different Institutions

Institutions/ Employment	Involvement of Women		General
	Yes	No	Remarks
Education	-	-	Generally, women are not doing the government and private jobs within the vicinity of the project area. Only a few female members are employed as school teachers and nurses/LHV in BHU and dispensaries.
Government	✓	-	
Private	✓	-	
Health	-	-	
Government	✓	-	
Private	✓	-	
NGOs	-	✓	
Private Job	✓	-	
Own Business	-	✓	
Others	✓	-	

5.6.12.5 Access to Social Facilities for Women

There is no vocational training/skills development center in the project area for women. Some women are involved in embroidery, stitching and sewing clothes, but this is typical to supplement household incomes rather than recreation. Details are shown in Table 5-31.

Table 5-31: Access to Social Facilities for Women

Facilities		Remarks
Access to	Education	Local women have no access to education as well as vocational training/ skills development opportunities.
	Skills development	
Access to micro-finance		There is no access to micro-finance facilities.

Access to control over resources	In general, the women have no access to control over the resources in the project area.
Access to income-earning activities	The women have limited access to income generation activities in the villages as well as in the project area. However, under the project, employment opportunities may be explored and accordingly provided to the local women to supplement their household income and ultimately improve their well-being and livelihood.

5.6.12.6 Vulnerability Status of Women

During consultations, it was observed that the women in the project area face vulnerabilities in the social context, i.e. below the poverty line; women-headed HHs, elderly, widowed and disabled, and minorities/indigenous groups. During the FGDs in the villages, the local women responded that there is no such mechanism/ program, action plan for the social protection for the vulnerable women in the vicinity of the project area.

5.6.12.7 Other Concerns of Women

During the FGDs, women responded that they face domestic hardship in the form of physical and mental disturbance. However, these disturbances are generally settled/ resolved within the houses; and no complaints were registered. Moreover, they are interested in project-related benefits, including job opportunities and vocational training/ skills development for income generation activities.

Due to the lack of transport facilities, non-affordability of transport and social and cultural barriers, female's access to education is not prioritized. There is also a perception of some of the parents that women's education is not a worthwhile expenditure as they have to leave their parents' house after their marriage. In some areas, civil society organizations (CSO) and non-governmental organizations (NGOs) are involved in skill enhancement activities for young women, including candle making, decoration items, embroidery, and dressmaking.

Access to healthcare for women is also worse than it is for men. Few women receive treatment from ante-natal care centers or any form of post-natal care from skilled birth attendants. The majority of people consider it unnecessary and cost prohibitive. As with education, affordable transport and cultural barriers are also restrictive factors.

During the household survey, the community prioritized their development needs such as roads, electricity, water supply and health facilities. The respondents were asked to rank their needs as the highest priority. The responses of the sample respondents reflecting their priorities are given in Table 5-32. Some of the highest priorities were primary school and middle schools for girls, showing that attitudes are slowly changing and that people are increasingly seeing the importance of female education.

Table 5-32: Ranking of Development Needs of the Surveyed Households

% of Sample Respondents									
Health Care Facility (RHC)	Dispensary	Gas Facility	Road	Electricity	Primary school for girls	Middle school for boys	Hand Pump / Clean Drinking Water	Village Drainage	Irrigation Water
17.5	17.9	16.8	15.8	12.9	12.0	14.3	12.4	10.7	1.7
Source: Census and socioeconomic survey of PAHs									

6 Potential Environmental and Social Impacts and Their Mitigation

6.1 Overview of Impacts

The proposed Akram Wah canal rehabilitation works will be carried out within the existing right of way. The most direct and significant adverse impacts of the project will be on the natural landscape caused by the development of borrow areas to source about 11 million cubic feet (0.3 million m^3) for the strengthening of the canal embankment and disposal of about 20 million cubic feet (0.6 million m^3) spoils generated from the canal excavation, lining of canal, and acquisition of 23.67 acres (19.47 acres (7.88 Ha) will be permanently for the minor realignment of off-taking canals and 4.2 acres will be temporarily for construction of temporary diversion channel). The proposed works will affect 1586 residential structures owned by 788 squatter households and 258 commercial structures owned by 148 squatter households. The adverse impacts associated with the construction are temporary and will mainly include waste generation, dust pollution, occupational health and safety risks and community exposure to work hazards. The overall positive impact of the project, which is the improvement of canal flows from 2,600 cusecs to 3,714 cusecs, will safeguard the livelihoods of about 92,000 farming households in the command area through the provision of irrigated water for 0.462 million acres, will be experienced countrywide.

6.2 Impact Assessment Methodology

Potential environmental and social impacts were identified based on a review of the feasibility study report, field visits, stakeholder consultations, and experiences from constructing the previous canal rehabilitation projects under the World Bank-funded Sindh Water Sector Improvement Project. The significance of potential impacts was assessed using the criteria and methodology given below.

Impact Magnitude

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

The magnitude of the project's potential impacts has generally been identified according to the categories outlined in Table 6-1.

Table 6-1: Parameters for Determining Magnitude

Parameter	Major	Moderate	Minor	Minimal
Duration of the potential impact	Long term Beyond the lifespan of the project	Medium Term The lifespan of the project.	Limited to the construction period	Temporary with no detectable potential impact
The spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	A specific location within the project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	The potential impact is effectively permanent,	Baseline requires a year or so with some interventions	Baseline returns naturally or with limited intervention	Baseline remains constant

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

Sensitivity of Receptor

The sensitivity of a receptor has been determined based on a review of the population (including proximity/numbers/vulnerability) and the presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. The criteria for determining receptor sensitivity of the Project's potential impacts are outlined in Table 6-2.

Table 6-2: Criteria for Determining Sensitivity

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

Assigning Significance

Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor have been determined. The significance of each potential impact is established using the impact significance matrix shown in Table 6-3.

Table 6-3: Criteria for Determining Significance of Impacts

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

6.3 Summary of Assessed Impacts

The project's potential impacts and significance have been assessed using the methodology described in Section 7.2 above. A summary of these impacts and their significance are presented in Table 6-4**,** along with the key mitigation measures. A detailed assessment of impacts and proposed mitigation measures are given in the subsequent sections. Environmental Codes of Practice (ECPs) have been prepared to address all generic construction-related environmental and social risks and are presented in **APPENDIX-D**.

Table 6-4: Potential Impacts and Their Significance

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
Environmental and Social impacts due to Project siting					
1. Safeguarding the livelihoods of about 92,000 farming households in the Akram Wah canal command area by restoring irrigated water for 0.187 million hectares.	Very high	Major	Critical beneficial	Implementation of the ESMP, SMRP to mitigate impacts associated with the construction of the project	Critical beneficial
2. Loss of 4,865 trees developed by the AWB and squatters in the footprints of the proposed works. The trees are expected to be cut due to the lining of the canal (mostly the inner bank of the canal 1,772 trees from RD 0+000 to 194+000), the raising of embankments (inner and outer banks 3,093 Trees from RD 194+000 to 382+000) and construction of diversion channels.	Medium	Major	Moderate adverse	A compensatory tree plantation of 24,325 trees will be carried out within the right of way, adjacent to the canal embankments and inspection roads, at the rate of 5 new trees for each tree cut. Tee cutting should be avoided to the extent feasible. The Environmental Staff of the SIDA and construction supervision consultants (PIC) will review and approve each tree cutting by the Contractor. A pre-construction survey will be carried out by the Environmental Staff of SIDA and the PIC to ensure no fauna and ecological features are affected. The contractor will prepare the inventory of all cut trees and keep a record of each cut tree by filling out the chain of custody form. As per the required details of the chain of custody form, proper handling and taking over will be ensured by getting the signatures of concerned AWB officials to whom trees will be handed over. A compensatory tree plantation will be carried out within the right of way, adjacent to the canal embankments and embankment inspection roads, at the rate of 5 new trees for each tree cut.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
3. The early 2021 Anti-Encroachment Drive (AED) impacted approximately 1236 households. Permanent acquisition of 19.47 acres (7.88 Ha) of private land outside of the RoW for minor realignment of off-taking canals.	Very high	Major	Critical adverse	Adequate compensation for affected households as per the entitlement matrix in the SMRP. Implementation of the SMRP to compensate for lost assets, ensure stable and dignified housing, and support livelihood development.	Minimal adverse
4. Acquisition of 1.7 hectares of land temporarily to construct temporary canal diversion works prior to rehabilitation of canal cross regulators	Very high	Moderate	Major adverse	Adequate compensation for affected households as per the entitlement matrix in the SMRP. Restoration of the temporary diversions to the satisfaction of the landowners. This may include filling up the excavated channels with the borrow material or spoils generated by the canal excavation activities. If the landowner is willing to use the excavations to develop fish ponds, the banks should be stabilized to prevent erosion and maintain a 2:1 slope.	Minimal adverse
Environmental impacts and risks during construction					
5. A total of 81 million cubic feet or 2.3 million cubic meters of material will be excavated from RD 0 to the tail. Of this, most of the material will reused or be permanently disposed of within and close to the RoW. An additional 11 million cubic feet (0.3 million cubic meters) will need to be disposed of outside the RoW.	High	Major	Major adverse	Spoil disposal sites have been identified and presented in the ESIA. The Contractor can select the spoil disposal sites and submit the plan for the Engineer's approval. The spoil disposal sites should be located on barren lands or government-owned lands. Minimize the requirement of developing spoil sites by planning borrow and spoil disposal activities so that borrow sites will be used for spoil disposal. The contractor will sign the agreement with the land owners or lease holders for the use of their land for spoil disposal. Transport and disposal of spoils at the designated disposal sites approved by the Engineer Proper dumping and compaction are needed to avoid dust and release it back to the canal or nearby agricultural lands. The	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				spoil disposal sites will be landscaped with native plant and tree species. Implement additional measures provided in ECPs ECP 8 and ECP 9	
6. Borrowing 11 million cubic feet (0.3 million cubic meters) soil to construct the embankments.	High	Major	Major adverse	Reuse excavated material from the canal to the extent feasible to minimize the requirement of borrow material. About 30 borrow sites (covering an area of 55 acres) have been identified within the RoW and presented in the ESIA (Figure 3-11). These areas are mainly located in barren lands owned by the government and are not for agricultural use. The Contractor can select additional borrow sites and submit the plan for the Engineer's approval. The borrow sites should be located on barren lands or government-owned lands. The excavations at the borrow sites within the RoW should be limited to 2 ft to 3 ft to minimize water seepage from the canals. Fill up the borrow areas with the spoil generated from the canal excavations. The banks of the borrow areas should be stabilized to prevent erosion and maintain a 2:1 slope.	Minimal adverse
7. Impact on downstream water releases during the rehabilitation of 9 cross regulators	High	Major	Major adverse	The irrigation flows in the canal will be maintained by constructing and maintaining the temporary diversion channels around the hydraulic structures. The rehabilitation of hydraulic structures will be scheduled in the low flow season or canal closure period (January to February). Implement additional measures provided in ECP 9	Minimal adverse
8. Disruptions in the traffic due to the reconstruction of 12 road bridges and 6 footbridges and the relocation of water pipelines	High	Major	Major adverse	The contractor will prepare a traffic management plan by identifying alternate routes to divert the traffic got approval from the engineer. Construct or rehabilitate the temporary diversion routes if required.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				Relocation of utilities before the construction activities, mainly RDs (0+000 to 195+00), where the lining of the canal was proposed. Implement additional measures provided in ECP 15	
9. Generation of construction waste, including 10.5 million cubic feet (0.30 million cubic meters) of canal lining consisting of concrete and bricks	High	Moderate	Major adverse	Disposal of the construction waste in the designated spoil disposal areas or fill up the already developed borrow areas. Implement additional measures provided in ECPs ECP 1 and ECP 2	Minimal adverse
10. Generation of solid waste from campsites and offices (about 50 kg per day), including hazardous waste	Very High	Moderate	Major adverse	Implementation of the waste management plan Segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable) and garbage (non-recyclable). Placement of containers with adequate size and numbers. Organic waste will be treated on-site using in-vessel composters, bins, or pits. Recyclable waste will be compressed through bailers, and the services of the SEPA-approved waste management contractor will be used. Disposal of garbage at the nearby municipal disposal areas Containers of adequate size and numbers to collect hazardous wastes (used fuels, batteries, etc.) Procurement of services of a waste management contractor for transport and treatment of recyclable and hazardous waste Implement additional measures provided in ECP 1	Minimal adverse
11. Wastewater discharges (about 1,000 litres per day) from the construction camps, sites, and batching plants	Medium	Moderate	Moderate adverse	Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and the worksites (sedimentation tanks for batching plants and site drainage) Monitoring of wastewater quality to ensure compliance with SEQS 2016	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				Implement additional measures provided in **ECP 3**	
12. The potential risk of soil and water pollution by construction works	Medium	Moderate	Moderate adverse	Storage of fuels and chemicals in contained facilities Availability of spill kits and trained personnel for immediate cleanup of any oil spills Implement additional measures provided in ECP 2	Minimal adverse
13. Air and noise pollution from construction and traffic	Moderate	Medium	Moderate adverse	Air and noise pollution control measures at the worksites and regular ambient and noise quality monitoring to ensure compliance with SEQS 2016. Compliance with the SEQS on vehicle and machinery emissions Implement additional measures provided in ECPs ECP 10 and ECP 11	Minimal adverse
14. Impacts from increased human activities on flora and fauna	High	Minimal	Minimal adverse	Limit the siting of any temporary facilities within the boundaries of the worksites. Use of non-wood fuel for cooking and heating Code of conduct for workers and employees' protection of flora and fauna and a ban on tree cutting and hunting. Any code of conduct violation leads to strict punishment, including termination of employment. Implement additional measures provided in ECP ECP 12, ECP 13 and ECP 14.	Minimal adverse
Occupational Health and Safety Risks					
15. Workers' Occupational health and safety risks are due to hazards associated with construction activities (instream, drilling, working on heights and trenches, hot weather, etc.).	High	Moderate	Moderate adverse	Develop and implement an occupational health and safety plan in compliance with WB Environmental Health and Safety Guidelines. Regular site inspections and safety audits.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
				Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Incident investigation and reporting. Conduct a 'job hazard analysis' at the new construction site to identify potential hazards and implement necessary control measures. Use of relevant personal protection equipment at all times Availability of firefighting, shelter during hot weather, first-aid and rescue facilities at the site Adequate water supply and mobile toilets at the worksites Take insurance policy for workers against potential injuries, both temporary and permanent (e.g. amputation of body parts such as finger, hand, leg, foot, eye) and fatalities Implement additional measures provided in ECP 18 and LMP	
16. Potential health risks due to inadequate facilities in the campsites (about 100 non-locals live in construction camps) and the spread of communicable diseases.	High	Moderate	Moderate adverse	A construction camp will have adequate facilities (safe drinking water and sanitation, kitchen, rest areas, and recreation) for labour. Cleaning of all these facilities daily. A medical clinic with a medical doctor, attendants and preliminary staff will be established at the camp. Communicable disease protocols will be followed at the construction sites and camps. The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints using the approved GRM plan. Implement additional measures provided in ECP 20	Minimal adverse
Social Impacts and risks during construction					

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
17. Safety hazards due to increased traffic on local roads, especially for children and elderly people	High	Moderate	Major adverse	Implement a traffic management plan (e.g., avoiding school hours, following speed limits, hiring licensed drivers, etc.), including awareness-raising and safety measures. Implement additional measures provided in ECP 8	Minimal adverse
18. Community exposure to work hazards	Very high	Moderate	Major adverse	Barricade the work areas (near the settlements) with hard fencing to prevent community entry into the construction areas. Adequate signboards and flagmen should be placed to divert the community away from the construction sites. Community awareness programs on construction-related hazards, including awareness programs in schools. Implement additional measures provided in ECPs ECP 16, ECP 17 and ECP 18.	Minimal adverse
19. Employment generation for the local community	Very high	Moderate	Major beneficial	The hiring of the local community during construction works (about 500 workers daily for three years). Implement labour management procedures.	Major beneficial
20. Risk of child labor	Low	Moderate	Minimal adverse	Ensuring that children under 18 are not employed directly or indirectly on the project.	Minimal adverse
21. Impacts from labour influx and potential cultural conflicts between communities and workers	High	Moderate	Moderate adverse	The contractor's code of conduct shall cover a program to promote the construction workers' awareness of respecting the local community. Construction camps will be built in the designated areas away from the local settlements. The Contractor's monthly training program will cover respectful attitude while interacting with the local community. The code of conduct obligations and the applicable legislation should be included in the contracts of all employees and workers, with the provision of sanctions and penalties in case of violations.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
22. Risk of gender-based violence (GBV), sexual exploitation and abuse (SEA), sexual harassment (SH), child abuse and exploitation.	High	Minimal	Minimal adverse	The contractor's code of conduct (English, Urdu & Sindhi) shall cover clauses related to avoiding gender-based violence, sexual exploitation and abuse, and sexual harassment. The code of conduct will be translated into Sindhi and disseminated. The code of conduct will be included in the worker's contract agreement, and any violation of the code of conduct will lead to termination of employment. The contractor's code of conduct shall cover a program to promote awareness to the construction workers on avoiding GBV, SEA, SH and the risk of spreading sexually transmitted diseases. The Contractor's monthly training program will cover topics related to the Code of Conduct, such as sexual harassment, particularly towards women and children, and violence, including sexual and/or gender-based violence. Measures to protect the privacy of women and girls by the contractor, sub-contractors and service providers.	Minimal adverse
Environmental and Social impacts during Operational stage					
1. Workers health and safety during routine operation and maintenance	High	Moderate	Moderate adverse	Conduct a 'job hazard analysis' at the new construction site to identify potential hazards and implement necessary control measures. Use of relevant personal protection equipment at all times Availability of firefighting, shelter during hot weather, first-aid and rescue facilities at the site.	Minimal adverse
2. Community health and safety	Very high	Minor	Moderate adverse	Barricade the work areas (near the settlements) with hard fencing to prevent community entry into the construction areas. Adequate signboards and flagmen should be placed to divert the community from the construction works.	Minimal adverse

The impact of various activities	Sensitivity	Magnitude	Significance Prior to Mitigation	Key Mitigation and Enhancement Measure	Residual Significance
3. Requirement of borrow material for embankment strengthening and disposal of damaged canal lining.	High	Moderate	Moderate adverse	Reuse or widening of existing borrow areas if available. Identify new borrow areas in the barren lands or the government-owned lands. Use of spoils for strengthening the canal embankment and RoW. Use of existing spoil disposal sites if available.	Minimal adverse

6.4 Environmental and Social Impacts from Project Siting

6.4.1 Restoration of Irrigation Flows and Economic Improvement in the Command Area

The Project would increase the current irrigation flows of Akram Wah Canal from 2,600 cusec (74 cumecs) to 3,714 cusecs (105 cumecs). This will restore the irrigation flows in the 0.462 million acres (0.187 million hectares) of Akram Wah command area. With the last-mile improvement works and water-efficiency methods to be carried out under the SWAT, the irrigation flows will reach all the farmers in the command area. The irrigation water distribution, reliability, and equity of irrigation flows will be improved. Thus, the proposed rehabilitation works of Akram Wah will safeguard the livelihoods of about 92,000 farming households in the command area. These benefits will ultimately manifest in improved agricultural production and increased employment opportunities in rural Sindh, leading to improved lives of vulnerable people.

6.4.2 Loss of Vegetation

The vegetation (including trees) on the existing embankments shall be stripped where embankments are to be raised, and material filled over these embankments to raise and widen the embankments. For the RDs where canal lining has been proposed, only the inner two rows of embankment trees are anticipated to be removed. Vegetation and trees shall also be cleared from a strip adjacent to the existing outer toe of the embankments where widening of the existing embankments is proposed. Material shall then be filled over this area to construct the embankments. The AWB and squatters mainly develop the vegetation in the RoW.

It is estimated that 4,865 trees are expected to be cut due to the lining of the canal (mostly the inner bank of the canal 1,772 trees from RD 0+000 to 194+000), the raising of embankments (inner and outer banks 3,093 Trees from RD 194+000 to 382+000) and construction of diversion channels. The inventory of existing trees and trees to be cut is shown in APPENDIX-A. These trees mainly include wood and fruit trees.

Mitigation

SIDA will implement the following compensation and enhancement measures:

- Tee cutting should be avoided to the extent feasible. An inventory of trees cut by the contractor during the execution of the works shall be maintained during construction. The contractor shall minimize the number of trees to be cut, making careful and selective pruning where possible to reduce the need for removal. The felling of trees to establish the borrow areas or dispose of spoil shall not be allowed.
- The Environmental Staff of the SIDA and construction supervision consultants (PIC) will review and approve each tree cutting by the Contractor.
- A compensatory tree plantation will be carried out within the right of way, adjacent to the canal embankments and embankment inspection roads, at the rate of 5 new trees for each tree cut.

The contractor will implement the following mitigation measures.

- The contractor shall mark each tree required to be removed with a cross on all four sides using highly visible paint. The marking shall be located approximately 4.5 feet from the tree's base.
- The contractor shall prepare an inventory of all trees to be cut. The inventory shall include the following details for each tree: Reference number, Location, Species, Girth, Approximate height, Diameter at breast height and Geotag Photograph of the tree.
- The contractor shall submit the inventory to the Engineer, and no tree-cutting shall be permitted until written approval from the Engineer. If tree cutting is carried out without written permission, the contractor shall not be paid for this activity, and the Contractor has to pay adequate compensation to the owners.
- The Engineer shall only approve tree cutting where a complete tree inventory has been submitted to the Engineer detailing all trees included in the request and after consultation confirmation with the Engineer's environmental specialist. A joint visit between the environmental specialists of the

Engineer and the Contractor (or their representatives) shall be conducted to verify the inventory before approval.

- Once the contractor receives approval from the Engineer, they can cut the approved trees and store them in a designated, secure storage area. This plan would be circulated by the Resident Engineer and Environmental Specialist of supervision consultant (PIC) to all relevant authorities such as concerned AWB, SIDA & M&ECs. The contractor and PIC must ensure the presence of all the above-mentioned stakeholders during the cutting down trees.
- The Contractor shall mark each cut section of the tree with a unique reference number corresponding to a reference number on the tree inventory.
- The Contractor shall maintain the tree inventory to include the number of cut sections of each tree and storage details of each section removed from the site. The tree inventory shall always be kept up-to-date and available to the Engineer.
- The Contractor shall inform the Area Water Board via the Engineer when a batch of trees is ready for handover.
- The Area Water Board shall visit the tree storage area to review the inventory of trees to be handed over. The Area Water Board shall only assume responsibility for each batch of trees and arrange for their transportation from the storage area following the signing of the Chain of Custody Form and the agreed tree inventory.
- Concerned AWB would be responsible for auctioning all cut trees with identification of the name and species of each cut tree in favour of the Irrigation department/Sindh government.
- Compensatory tree plantation at the rate of 5 new mature trees for each tree cut in the areas identified by SIDA. A mature tree has a girth greater than 0.15 m (six inches) and a height of 5-7 feet. The contractor shall be responsible for identifying the plantation site, submitting a tree plantation plan to the Engineer, and the aftercare of these trees for one year, following which the AWB shall become responsible for the survival of the trees.
- All trees to be replanted shall be native species as they have the greatest chances for survival. The species should be determined based on the site suitability for the tree species. The list of recommended tree species for plantation (Table 6-5)and species which are strictly prohibited for plantation (Table 6-6) are provided in the following tables.

Table 6-5: Recommend Trees for Plantation

S.no	Scientific Name	Local Name
1	Dalbergia sissoo	Sheesham
2	Acacia nilotica	Sindhi Babur
3	Zizyphus jujube	Bair
4	Ficus religiosa	Peepal
5	Melia Indica	Nim
6	Phoeix Dectylifera	Khajoor
7	Mangifera indica	Amb

Table 6-6: Trees Prohibited for Plantation

Sr. no	Scientific Name	Local Name
1	Arjuna	Arjun
2	Eucalyptus camaldulensis	Sufeedo
3	Casuarina equisetifolia	English lawa

The residual impacts of vegetation clearance have been assessed as minimal with the above compensation and enhancement measures.

6.4.3 Land Acquisition and Resettlement

The proposed rehabilitation works will be mainly carried out within the existing right of the way (RoW) of the canal, except for some diversion works. Generally, the canal's right of way is about 220 ft, which includes 100 ft for the canal width and 110 ft on both sides for the canal protection, embankment, and inspection roads. Permanent acquisition of around 19.47 acres (7.88 Ha) of private land outside the RoW is required for minor realignment of off-taking canals. The temporary acquisition of around 1.7 hectares of land is required to construct temporary canal diversion works before rehabilitating canal cross regulators.

Mitigation

In early 2021, while preparation for SWAT was ongoing, the Sindh High Court mandated that the Irrigation Department undertake an AED for all its property throughout the province, including clearing the right-of-way (RoW) of the Akram Wah canal. Around 1,246 households were affected, with more than 90% experiencing significant impacts. Most of the AED-affected households were poor, informal settlers who were displaced from their homes. To address these legacy issues, SIDA prepared the SMRP, which will i) provide an opportunity for AED-affected households to improve their standard of living and ii) pilot an approach to allowing AED-affected households back onto the RoW in accordance with an Irrigation Department policy that was adopted in mid-2022.

The general provisions of the SMRP include compensation to AED-affected households for lost assets at full replacement cost, as well as transportation, resettlement, and vulnerability allowances. Commercial properties consist primarily of small mobile kiosks, and owners will be compensated for lost assets and temporary loss of income. There is no evidence of loss of livelihoods due to AED, as most households moved slightly outside the RoW and continued their normal wage labour or agricultural activities. The SMRP provides opportunities for livelihood enhancement through vocational training and potential employment in the Akram Wah construction works.

In accordance with overall Irrigation Department policy, SIDA will pilot an approach whereby AED-affected households are granted permission to move back into the RoW in a supervised manner. The households must self-construct houses meeting minimum standards; extremely poor and/or vulnerable households will also be provided additional cash and technical support as necessary. SIDA will ensure that no new encroachments occur on the RoW and that the households are protected from future AED activities. The SMRP also covers non-AED related resettlement issues such as minor land acquisition outside of the RoW, and removal of community structures and public infrastructure within the RoW. A Sindh Panel of Experts has endorsed the SMRP and will provide oversight throughout its implementation. An independent resettlement monitor has been contracted to provide supplemental reporting to the GoS and the Bank.

6.5 Environmental Impacts and Risks during Construction

6.5.1 Generation of spoils

The proposed excavation works for removing silt deposited in the canals and improving canal profiling will generate huge quantities of excavated spoils. The volume of sediments and materials excavated is estimated to be 81 million cubic feet or 2.3 million cubic meters. Most of the excavated material can be reused for raising/replenishing of inspection and non-inspection paths and strengthening canal embankments. A map showing an overview of the location of the disposal areas is shown in Figure 3-10. Disposal of remaining spoils (8 million cubic feet or 0.23 million cubic meters) requires designated land; otherwise, improper spoils disposal will impact the natural drainage and local landscape.

Mitigation

The contractor will implement the following mitigation measures:

- Minimize the generation of spoils by reusing the excavated material to the maximum extent possible by strengthening embankments or disposing of them in the RoW along the canal inspection roads.
- The height of the spoils in the RoW should be at least 3 ft below the embankment height and road height to ensure that wind erosion will not transport these materials to the canal. The spoils should be dumped appropriately and compacted adequately to avoid dust and released back to the canal or nearby agricultural lands.
- The Contractor can select the spoil disposal sites and submit the plan for the Engineer's approval. The spoil disposal sites should be located on barren lands or government-owned lands that are not environmentally sensitive. Minimize the requirement of developing spoil sites by planning borrow and spoil disposal activities so that borrow sites will be used for spoil disposal.
- Transport and disposal of spoils and designated spoil disposal sites.
- Proper dumping and compaction are needed to avoid dust and release it back to the canal or nearby agricultural lands.

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

6.5.2 Impacts from Borrow Activities

About 11 million cubic feet (0.3 million cubic meters) of soils will be required for construction activities. Improper siting and extraction of these construction materials will significantly impact the borrow areas' physical and biological environment. Of this, 1.5 million cubic feet will be sourced from 30 suitable borrow areas identified within or adjacent to the right of way (Figure 3-11). These areas have been identified within the existing barren or seasonally flooded lands not used for agriculture.

Mitigation Measures

The following mitigation measures will be implemented:

- Reuse of excavated material from the canal to the extent feasible to minimize the requirement of borrow material
- About 30 borrow sites (covering an area of 55 acres) have been identified within the RoW and presented in the ESIA (Figure 3-11). These areas are mainly located in the barren lands owned by the government and are not for agricultural use.
- The Contractor can select additional borrow sites and submit the plan for the Engineer's approval. The borrow sites should be located on barren lands or government-owned lands. The contractor will prepare a detailed Borrow Areas Plan containing appropriate mitigations/guidelines, especially when borrows will be beyond the RoW or in private barren lands. Agreements will be signed with a land owner or leaseholder in the presence of witness persons for the use of their land.
- Topsoil of each Borrow area will be stored at a particular place for restoration when it is required.
- The excavations at the borrow sites within the RoW should be limited to 2 ft to 3 ft to minimize water seepage from the canals.
- Fill up the borrow areas with the spoil generated from the canal excavations.
- The borrow sites will be restored by grading the banks' slopes with a 2:1 slope. The side slopes will be protected with vegetation to minimise erosion. Suitable surface slopes and drainage ditches and conduits – as needed – shall be constructed to prevent water from collecting at the site.

The residual impacts have been assessed as minimal with the above mitigation measures.

6.5.3 Impact on downstream irrigation Flows

The rehabilitation of canal hydraulic structures, such as cross regulators, requires dry working areas and the construction of cofferdams. During these works, if there is any temporary decline or disruption in the availability of downstream irrigation flows, the downstream communities will be severely affected

Mitigation Measures

The following mitigation measures will be implemented:

- Designs have been proposed, which include the construction of temporary diversions of the Akram Wah to ensure the continued supply of irrigation waters during the construction of new cross regulators.
- The irrigation flows in the canal will be maintained by constructing and maintaining the temporary diversion channels around the hydraulic structures.
- The new head regulators shall be built off-line to allow continued operation of the existing structures throughout the construction period
- The rehabilitation of hydraulic structures will be scheduled in the low flow season or canal closure period (January to February).
- The dewatered water between the two cofferdams, on both sides of the hydraulic structures, will be pumped to the diversion channel.

6.5.4 Generation of Construction and Hazardous Waste

Removal of canal linings will generate 10.5 million cubic feet (0.30 million cubic meters) of canal lining consisting of concrete and bricks. The construction works will also generate large quantities of excess materials from construction sites (concrete, discarded material, etc.) and wastes from camps and construction yards, including other debris. In addition, small quantities of hazardous waste will also be generated mainly from the vehicle maintenance activities (liquid fuels; lubricants, hydraulic oils; chemicals, such as anti-freeze; contaminated soil; spillage control materials used to absorb oil and chemical spillages; machine/engine filter cartridges; oily rags, spent filters, contaminated soil, etc.). It is imperative that such waste is responsibly disposed of to avoid adverse environmental and human health impacts.

Mitigation

The following mitigation measures will be implemented:

- Disposal of the construction waste generated from the removal of canal lining should be disposed of in the designated spoil disposal areas that will be identified by the contractor and approved by the PIU. The contractor will prepare disposal plan prior to mobilisation and take approval from the PIU.
- Guidelines for managing wastes, including solid and hazardous wastes, are given in ECPs (See ECP 1 on Waste Management and ECP 2 on Fuels and Hazardous Substances Management in **APPENDIX-D** for detailed mitigation measures). Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the Engineer and SIDA for their review and approval.
- The contractor will place containers of adequate size and numbers in place to collect various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites and transport these wastes regularly to a centralized facility.
- The contractor will procure the services of a waste management contractor for transport and treatment of hazardous waste and management of recyclable waste.
- For disposal of inorganic construction waste, the contractor will develop a waste disposal site or place them in the spoil disposal areas.

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

6.5.5 Generation of Solid Waste

Solid waste will be generated from the construction camps and offices, which include food waste, paper and plastic, and garbage. About 100 workers live in the construction camp, and the average solid waste generation per worker is 0.5kg per day. Thus, the total quantity of waste generated from the camps will be 150 kg per day. Most of these wastes will be food waste. If these wastes are not properly managed, they may harm the environment and the health of workers and nearby communities.

Mitigation

The following mitigation measures will be implemented by the contractor:

- Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the Engineer for their review and approval.
- Collection and segregation of solid waste into kitchen waste (organics), paper and plastic (recyclable) and garbage (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, rooms) for the segregation of the waste at the source.
- Organic waste will be treated on-site using in-vessel composters, composting bins or composting pits. The final compost can be given to the local communities to use in the agricultural lands or developing the plantations.
- Procure the services of waste management contractors for the collection and management of recyclable waste. Recyclable waste will be compressed through bailers to minimize the volume of waste to be stored and transported.
- Develop a waste disposal site for the disposal of garbage.

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

6.5.6 Wastewater Discharges from Construction Sites

The wastewater discharges from the workers' camps and the construction sites can pollute the canal water and local groundwater. The wastewater discharges from the batching plants contain high sediment loads and high pH values. The groundwater will be affected by the wastewater discharges. Other wastewater discharges from the construction sites include sanitary effluents vehicle and machinery washing facilities.

Mitigation

The following mitigation measures will be implemented:

- Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and site drainage). Open pits will be strictly forbidden for use of sanitary effluents, vehicle and machinery washing facilities by Contractor
- Sedimentation ponds of adequate size and capacity will be built to treat discharges from the batching plants to allow the sediments to settle. The settled sediments will be periodically removed and disposed of at the designated spoil disposal sites.
- The contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water
- Vehicles will be washed only in the designated areas that are concreted, and wastewater from the washing areas to be connected to the sedimentation ponds, consisting of oil-water separators.
- Quarterly monitoring of wastewater quality to ensure compliance with SEQS

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

6.5.7 Risk of Soil and Water Pollution from Construction Works

During construction, there is a high risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals used in construction areas, yards, batching plants, worker camps, and storage sites. Other potential sources of soil and surface water and groundwater pollution are improper

storage and handling of materials, including hazardous materials, discharges from the construction sites and material storages, lack of proper drainage facilities, spillage of fuels, erosion from material stockpiles, etc.

Mitigation

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

- Storage of fuels and chemicals in contained facilities and taking appropriate measures to avoid and contain any spillage.
- Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The containment area's volume should equal Fuels tanks will be checked daily and dip logs maintained for leaks, and all such leaks will be plugged immediately.
- Confine the contaminants immediately after such accidental spillage and clean up oil spills using spill kits.
- Collect contaminated soils, treat and dispose of them as a hazardous waste
- Temporary stockpiles to be protected from erosion.
- Additional mitigation measures are given in ECP 2: Fuels and Hazardous Goods Management, ECP 3: Water Resources Management, ECP 5: Soil Quality Management, and ECP 6: Erosion and Sediment Control.

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

6.5.8 Air and Noise Pollution from Construction

During construction, air and noise emissions from the construction activities will cause temporary nuisances to the residents of the nearby villages. Major air and noise pollution sources are excavations and embankment construction, development of borrow and spoil disposal sites, movement of vehicles on the earthen canal inspection roads, and emissions from construction-related traffic and equipment. The construction activities will also generate airborne dust and particulate matter. The dust raised from the above activities will have impacts on crops, animals and public health.

Mitigation

The following mitigation measures will be implemented;

- Construction equipment and vehicles will be well maintained so that emissions are minimal and comply with the emission standards of SEQS.
- Batching plants will be located a minimum of 500 m away from residential areas and will have appropriate dust/emission suppression mechanisms such as wet scrubbers.
- Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period. Water sprinkling should be focused on access routes in the vicinity of the villages.
- The contractor shall be required to submit a traffic management plan which identifies the proposed access and haulage routes and shall be prohibited from using any routes other than those specified in the traffic management plan.
- Existing tracks shall be favoured for material haulage.
- The earthwork equipment operators will be trained to reduce dust emissions while carrying earthworks.
- Construction activities near the settlements will be limited to daytime only.
- Implement the additional mitigation measures provided in ECPs to address air and noise quality impacts (see ECPs ECP 10 and ECP 11 in **APPENDIX-D** for air and noise quality management).
- A GRM will be put in place to receive complaints from the public on various aspects of environmental issues, including noise pollution. The contractor will address these grievances by adopting the necessary measures.
- Quarterly air and noise quality monitoring will be carried out in the project area to ensure compliance with SEQS on ambient air and noise quality.

The residual impacts have been assessed as minimal with the above mitigation measures.

6.5.9 Impact on Flora and Fauna

Wildlife, including mammals, reptiles, and birds, will likely be affected by construction through disturbance (presence of people, artificial lighting and noise), injury, or death owing to construction works (including striking by plants and trapping in deep excavations) and increased traffic.

Mitigation

The following mitigation measures will be implemented:

- The contractor's code of conduct for workers will include conditions on the protection of flora and fauna, the ban on cutting trees, and the ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions, including fines and termination of employment.
- Awareness-raising to workers on the protection of flora and fauna.
- Before and during vegetation clearance or tree felling, any animals found will be removed and released to a safe place. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place.
- Non-wood fuel is used for cooking and heating. The contractor should provide gas cylinders for cooking, provide training to local labour in the safe use of gas cylinders, and depute a camp manager responsible for overseeing the operation of camps, including refilling of gas cylinders. This will minimize workers cutting trees.
- Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats, and other wildlife.
- No organic waste will be disposed of in the open places

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

6.6 Occupational Health and Safety Risks During Construction

6.6.1 Occupational Safety Risks in Construction

Some of the Occupational Health and Safety risks which are likely to arise during the construction phase are typical to many large construction sites, which include exposure to physical hazards from the use of heavy equipment; working at height and electrical equipment, trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Key construction activities with potential OHS hazards in the project are working in the canal and earth works.

Mitigation

The following mitigation measures will be implemented:

- The contractor must prepare, approve, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSGs, and Sindh Occupational Safety and Health Bill (2017). If these guidelines cannot address any specific aspect of OHS, good international practices such as OSHA and ILO will be applied. OHS Plan should contain general guidance for all identified hazards under each work activity, and 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 are any changes in the construction methodologies.
- OHS Plan should contain general guidance for all identified hazards under each work activity, 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 Engineer and the World Bank will review and approve the OHS plan.

- Conduct a 'job hazard analysis' at the new construction site to identify potential hazards 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 before the start of construction to ensure that control measures are in place.
- 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 always present at the worksites, they will be trained by their OHS team on monitoring the safety aspects of the construction works.
- Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.
- Incident investigation and reporting will be maintained, including a complete record of accidents and near misses.
- In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, full-face eye shields, life-buoy jackets, boats with motors and ear protection. The contractor will also provide training to workers on how to use them, maintain them in a sanitary and reliable condition, and replace the damaged ones immediately with the new ones.
- Availability of firefighting, ambulance, medical and rescue facilities at the site for the implementation of an emergency response plan.
- The worksites have adequate water supply, mobile toilets, and medical and first aid care facilities.
- Contractors will have dedicated and qualified staff to ensure 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 maintained.
- First aid facilities will be made available at the worksites and in the camps. The contractors will engage qualified first aider(s).
- Implement the mitigation measures and emergency response plans given in ECP 18: Worker Health and Safety and ECP 19: Instream Construction Works.

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

6.6.2 Occupational Health Risks in Construction

Potential health issues for workers are associated with using temporary accommodation sites, including sanitation, disease, fire, cultural alienation, sleeping space, quality and quantity of food, personal safety and security, temperature control and recreation, and the spread of communicable diseases, amongst others.

Mitigation

The following mitigation measures will be implemented:

- Implement the communicable diseases protocols during construction, detailed in ECP 20. communicable diseases Health and Safety Plan (**APPENDIX-D**). The plan provides detailed measures for awareness materials, detection measures, physical distancing measures, respiratory measures, hand hygiene measures, cleaning and disinfection, and response measures if workers have communicable disease symptoms.
- The contractor will develop and implement a camp management plan
- The construction camp will have adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.), including entertainment facilities, so there will be minimal interaction between them and local communities. All these facilities should be cleaned daily.
- The Contractor will provide and implement a plan for suitable housing for workers living onsite. Housing should meet IFC specifications (Workers' Accommodation: Processes and Standards) in respect of the nature and standard of the accommodation and facilities to be made available.
- Labour camps should be built with easily cleanable flooring material, float finished plain concrete slab floor, brick or block walls, and cleaned regularly.

- Food provided to workers should contain an appropriate level of nutritional value.
- Overcrowding should be avoided inside the labors camps. The minimal floor space per resident should be 4 to 5.5 square meters.
- Cots should be provided equally to the number of labourers at each camp. There should be a minimum space between two cots of 1 meter.
- Ensure the availability of electricity with a sufficient quantity of ceiling or stand-by fans according to the number of labour living in the camp.
- Sources of water used for toilets and washrooms and ensure the availability of water in these sanitary facilities at all times.
- Sanitary and toilet facilities should be designed to provide workers with adequate privacy, including ceiling-to-floor partitions and lockable doors.
- Toilet facilities should be conveniently located and easily accessible. Standards range from 30 to 60 meters from labour camp.
- The contractor will provide adequate facilities for disinfecting and cleaning of cooking utensils.
- An adequate new bore of hand pumps should be installed at all the campsites. No stagnant water, foul mud and sanitary effluents around 10 meters of the hand pumps should not be observed. Otherwise, this could lead to the germination of microbiological contamination, the main factor of water-borne diseases in drinking water sources.
- A medical clinic with a medical doctor and attendants will be established at the campsite. Workers will carry out regular health checkups.
- The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan.

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

6.7 Social Impacts and Risks during Construction

6.7.1 Safety Hazards Due to Increased Traffic

The construction activities can potentially impact the residents of settlements along the Akram Wah Canal, particularly the movement and safety of children and elderly people. Due to the increased use of trucks and other vehicles on the local rural roads, pedestrians, particularly elderly people and children, will be more exposed to dangerous situations, leading to traffic accidents.

Mitigation

- The contractor will develop and implement a traffic management plan with adequate measures such as avoiding school hours, following speed limits, hiring licensed drivers, etc. The plan will be implemented to ensure access to residential areas and prevent unsafe situations, especially near schools, housing areas, and construction areas.
- Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic.
- Project drivers will be trained in defensive driving.
- Ensure that all construction vehicles observe speed limits on the construction sites and public roads.
- Provide adequate signage, barriers, and flag persons for traffic control.

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

6.7.2 Community Exposure to Work Hazards

Communities will be exposed to construction-related hazards due to excavation and heavy vehicular movements. These risks will be more at the construction works located close to the existing road and settlement (near the proposed colony and access roads)

Mitigation

The following mitigation measures will be implemented:

- Barricade the work areas with hard fencing to prevent community entry into the construction areas.
- Placing adequate signboards and flagmen to divert the community away from the construction works.
- Community awareness programs on construction-related hazards, including awareness programs in schools. Construction activities such as blasting and excavation may pose safety risks to the nearby population, particularly in the borrow areas.
- First aid medical facilities will be made available at the worksite.

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

6.7.3 Dust from Local Roads and Construction Activities

The construction activities, particularly earthworks and vehicular movement on earthen canal inspection roads, will generate airborne dust and particulate matter. In addition, vehicular movement along the local roads will also generate a lot of road dust. The dust raised from the above activities will impact crops, animals and public health. The generation of dust will be a major issue in the construction.

Mitigation

Following measures will be implemented

- Dust generation from construction sites will be restricted as much as possible, and water sprinkling will be carried out as appropriate, especially at those places where earthmoving excavation will be carried out.
- Frequent sprinkling of water on the local roads and worksites to control dust emissions. The contractor has to mobilize adequate water sprinkling trucks.
- A GRM will be put in place to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.

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

6.7.4 Employment Opportunities in Construction Activities

About 100 skilled and 400 unskilled workers will be required to work continuously during construction for about three years. The project offers good opportunities for local residents to apply for employment as unskilled and skilled construction workers. During the stakeholder consultations, the local communities showed great interest in working on construction activities. The contractor will be recommended to employ local workers and technicians to the extent possible. In other canal rehabilitation projects, it is also a common practice that the contractors hire local communities for all unskilled works. In addition to maintaining good relations with the local communities, maximizing local employment may also be cost-effective since engaging the workforce from other parts of the Country could be costlier. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population for a short time. This will have a significant positive impact on the project.

Mitigation

The contractors will be required to formulate a labour management policy to ensure the equitable availability of employment opportunities to all communities within the project area, particularly those affected.

The contractor will adopt the following Labor-Management Guidelines while preparing the labour management policy:

- encourage to engage local workers/laborers with the same terms and conditions of outside workers/laborers;
- integrating provisions to redress labour related grievances in the Grievance Redress Mechanism (GRM), which should be well known to the laborers/workers and accessible;
- prohibition of child labor and not hiring of workers less than 18 years of age;
- no engagement of forced and bonded labor;

- provision of a safe and healthy working environment to workers; and
- taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encourage for insurance facility for workers.

6.7.5 Impacts from Labour Influx

For the proposed project activities, the average labour requirement per day is 500. Unskilled workers will be mainly hired locally; however, the contractor will bring the skilled workers from other nearby areas. It is estimated that about 100 migrant workers work on this project. labor influx may lead to negative impacts on the host community. Pre-existing social issues in the host community can easily be exacerbated by the influx of labor. The potential risks associated with labour influx are social tension arising between the local community and the construction workers, which may be related to differences due to competition for local resources, increase the rate of crimes and/or a perception of insecurity by the local community, increased burden on and competition for public service provision, and influx of people may bring communicable diseases to the project area, including sexually transmitted diseases, or the incoming workers may be exposed to diseases to which they have low resistance.

Mitigation

The following mitigation measures will be implemented:

- This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which could easily lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on-site, in camps, and local communities.
- The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS.
- The contractor will prepare a labour influx management plan prior to construction works for the approval of the Engineer.
- The contractor's code of conduct shall cover the program to promote awareness among the construction workers on respecting the local community.
- Construction camps will be built in the designated areas away from the local settlements.
- The contractor will ensure local water usage will not be affected by the project's water usage or compete with the local community's water requirements.
- The Contractor's monthly training program will cover respectful attitude while interacting with the local community.
- Screening workers for communicable diseases and providing appropriate treatment to reduce exposure to the local population are also important.

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

6.7.6 Risk of Gender-Based Violence

The interaction between the Project construction labor force and the communities is expected to be limited, particularly with women due to the conservative culture in the region. The current level of Gender-Based Violence (GBV)/Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH) and Violence Against Children (VAC) risk is quite low in the Project, and the likelihood of GBV/SEA risk from the proposed project is also not expected significant due to the employment of local labour in construction works. Only skilled workers will be hired from outside. The risk assessment has been made based on the country and legal context, gender norms and beliefs, and national capacity to respond and experience from implementing previous canal rehabilitation projects in Sindh.

Proactive/Preventive Measures

Commensurate with this risk level and also to be proactive, the Project has proposed several proactive measures as below:

- The Contractor Code of Conduct is developed and incorporated into workers' contracts, and training and socialization on it are provided to workers.
- Mandatory and regular training for workers on required lawful conduct in the local community and legal consequences for failure to comply with laws;
- Commitment/policy to cooperate with law enforcement agencies investigating perpetrators of gender-based violence;
- Creation of partnership with local civil society organization to report workers' misconduct and complaints/reports on gender-based violence or harassment through the Grievance Mechanism;
- Provision of opportunities for workers to regularly return to their families;
- Provision of opportunities for workers to take advantage of entertainment opportunities away from local rural communities.
- The contractor's code of conduct shall cover a program to promote awareness to the construction workers on avoiding GBV, SEA, SH and the risk of spreading sexually transmitted diseases.
- The Contractor's monthly training program will cover topics related to Code of Conduct such as sexual harassment, particularly towards women and children, violence, including sexual and/or gender-based violence.

6.8 Environmental and Social impacts during Operational stage

6.8.1 Workers Health and Safety during O&M

The potential OHS risks associated with the O&M stage are related to the maintenance of canal structures, and these risks are similar to the construction stage works. These include exposure to physical hazards from use of heavy equipment; working at height and electrical equipment; trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery.

Mitigation

The following mitigation measures will be implemented:

- The O&M contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSGs, and Sindh Occupational Safety and Health Bill (2017). The plan will be reviewed and approved by SIDA.
- To protect all project personnel and visitors, the Contractor will provide workers with personal protective equipment (PPE), such as safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, full face eye shields life-buoy jackets, boats and ear protection. The contractor will also train workers on how to use them, maintain them in sanitary and reliable condition, and replace the damaged ones immediately with new ones.
- Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies.

6.8.2 Community Health and Safety during O&M

The community health and safety impacts during the maintenance of the canals are similar to the impacts of the construction works. The use of construction vehicles along the canals may create safety hazards for children and elderly people. Communities can be exposed to construction hazards and dust emissions.

Mitigation

The O&M Contractor will implement the following mitigation measures

- Ensure that all construction vehicles observe speed limits on the construction sites and public roads
- Provide adequate signage, barriers, and flag persons for traffic control.
- Barricade the work areas with hard fencing to prevent the entry of the community into the construction areas.
- Frequent sprinkling of water on the local roads and worksites to control dust emissions
- The contractor's code of conduct shall cover the program to promote the construction workers' awareness of respecting the local community.

6.8.3 Management of Borrow Material and Spoils

Minor amounts of borrowed material may be required to strengthen canal embankments during maintenance works. Desilting works in the canals may generate spoils. Improper sourcing of borrow material and disposal of spoils may impact the natural environment.

Mitigation

The following mitigation measures will be implemented by the O&M Contractor

- Reuse of existing borrow areas if available. Widening of the existing borrow sites in the RoW
- Identify new borrow areas in the barren lands or the government-owned lands.
- Use of spoils to strengthen the canal embankment and RoW. Use of existing spoil disposal sites if available.
- New borrow areas and spoil disposal sites should be identified in the barren lands devoid of any sensitive environmental features and the lands owned by the governments. SIDA will approve these sites prior to their development.

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7 Environmental and Social Management Plan

7.1 General

The Environmental and Social Management Plan (EMP) for Akram Wah Project has been prepared keeping in view the anticipated environmental impacts during pre-construction, construction and operational stages of the project, on the existing environmental conditions including air, soil, water and wildlife etc. of the project area and suggests appropriate measures to mitigate the potential adverse impacts and enhance the positive impacts. This chapter includes a review of issues encountered during the implementation of the ESMPs under previous major WSIP contracts and incorporates the lessons learnt from this experience into the ESMP for this subproject.

This chapter also details the roles and responsibilities of the subproject stakeholders, both generally and in detail, for each aspect of the works and operation of the project and includes monitoring responsibilities.

The methodology followed for preparing the ESMP consists of the following steps:

- Identifying responsibilities of various agencies involved in the Project for implementation and monitoring of mitigation measures,
- Estimating budget requirements for implementing mitigation and monitoring measures
- Deriving mitigation/protection measures for identified impacts,
- Recommend mitigation, compensation and enhancement measures for each identified impact and risk, and
- Developing a mechanism for monitoring the proposed mitigation measures.

7.2 Institutional Arrangements

7.2.1 The Sindh Irrigation and Drainage Authority (SIDA)

As the implementing agency, SIDA is overall responsible for ensuring the implementation of the EMP for this subproject. In order to ensure sufficient implementation of the EMP, SIDA shall delegate the responsibility of the implementation of the ESMP to a contractor during the construction stage, and day-to-day monitoring during construction shall be delegated to PIC, in their capacity as *Engineer* under the civil works contract.

During construction, SIDA shall maintain overall responsibility for monitoring the implementation of the ESMP, and this shall be achieved through the Environmental Management Unit (EMU) within SIDA. The monitoring provided by EMU shall be intermittent but continuous throughout the construction phase to provide oversight to the actions of the contractor and PIC.

During construction, the EMU shall review monitoring reports prepared by PIC and the contractor, and ensure any issues are brought to the attention of the Project Director or resolved directly through liaison with the environmental teams of the contractor and/or PIC. For any major issues referred to the Project Director, the Project Director shall ensure resolution of these with the contractor, through the civil works contract for the subproject, or with PIC for which the Project Director shall act as the *Employer* on both.

During the operational stage of the subproject, SIDA, through the EMU, shall continue to be responsible for the implementation of this ESMP, although a number of tasks may be delegated to AWB.

7.2.2 Project Coordination and Monitoring Unit (PCMU)

The Project Coordination and Monitoring Unit (PCMU) shall be responsible for the coordination of the implementation of this ESMP and independent monitoring of the implementation actions of all parties. The Project Coordinator of PCMU shall delegate these tasks to the Environmental Specialist of PCMU. The PCMU shall be assisted in monitoring by the Monitoring and Evaluation Consultants (M&EC), who PCMU shall engage as an independent body. Where serious matters cannot be resolved at the project level, PCMU may choose to elevate these matters to the Project Steering Committee.

7.2.3 Area Water Board

The AWB is responsible for the routine operation of the canal and manages the environmental and social issues during the operational stages.

It is noted that the AWB is responsible for several activities relating to implementing the Resettlement Action Plan for this subproject, which is to be implemented before the construction phase. These are detailed in the Resettlement Action Plan for Akram Wah. The AWB shall be involved in consultations and meetings during construction as their input may be required for the resolution of matters, especially where these relate to land acquisition (both permanent and temporary). The AWB shall be required to support the contractor during the construction period to resolve any issues arising from temporary land acquisition issues and minimize any delays in the construction progress and other community grievances.

7.2.4 Project Implementation Consultants (PIC) or Construction Supervision Consultants

The PIC will be responsible for the implementation of this EMP. PIC will act as Construction Supervision Consultants (CSC) during construction. The CSC will be responsible for supervising the contractors in implementing ESMP. For this purpose, the CSC will appoint dedicated environmental, social, health and safety (ESHS) staff to ensure the implementation of environmental and social management plans during the project. They will supervise the contractor for the ESMP implementation, particularly the mitigation measures. They will also be responsible for implementing the monitoring of the effects of these measures.

CSC will have the following environmental and social safeguard staff:

- Environmental Specialist
- Ecologist
- Occupational Health and Safety Specialist
- Sociologist/Resettlement Specialist
- Environmental, Social, and Health & Safety (ESHS) Inspectors

The ESHS staff of CSC will closely supervise the construction works to ensure that all environmental commitments are incorporated into the construction activities and work processes.

7.2.5 The Contractor

The contractor is also required to appoint the following environmental staff for the implementation of ESMP in the field, particularly the mitigation measures.

The contractor will develop various plans for health, safety, the environment and social issues (discussed in Table 7-3) and get them approved by the PIC, SIDA and the World Bank. The contractor will also be responsible for communicating with and training its staff in the ESHS aspects before the commencement of the on-site physical works. The contractor's ESHS team will include the following team members:

- ESHS Coordinator
- OHS Officer
- Community Liaison Officer
- Human Resource Officers
- ESHS Site Supervisors (one supervisor at each site).

- Medical Officer

7.2.6 Summary of Roles and Responsibilities

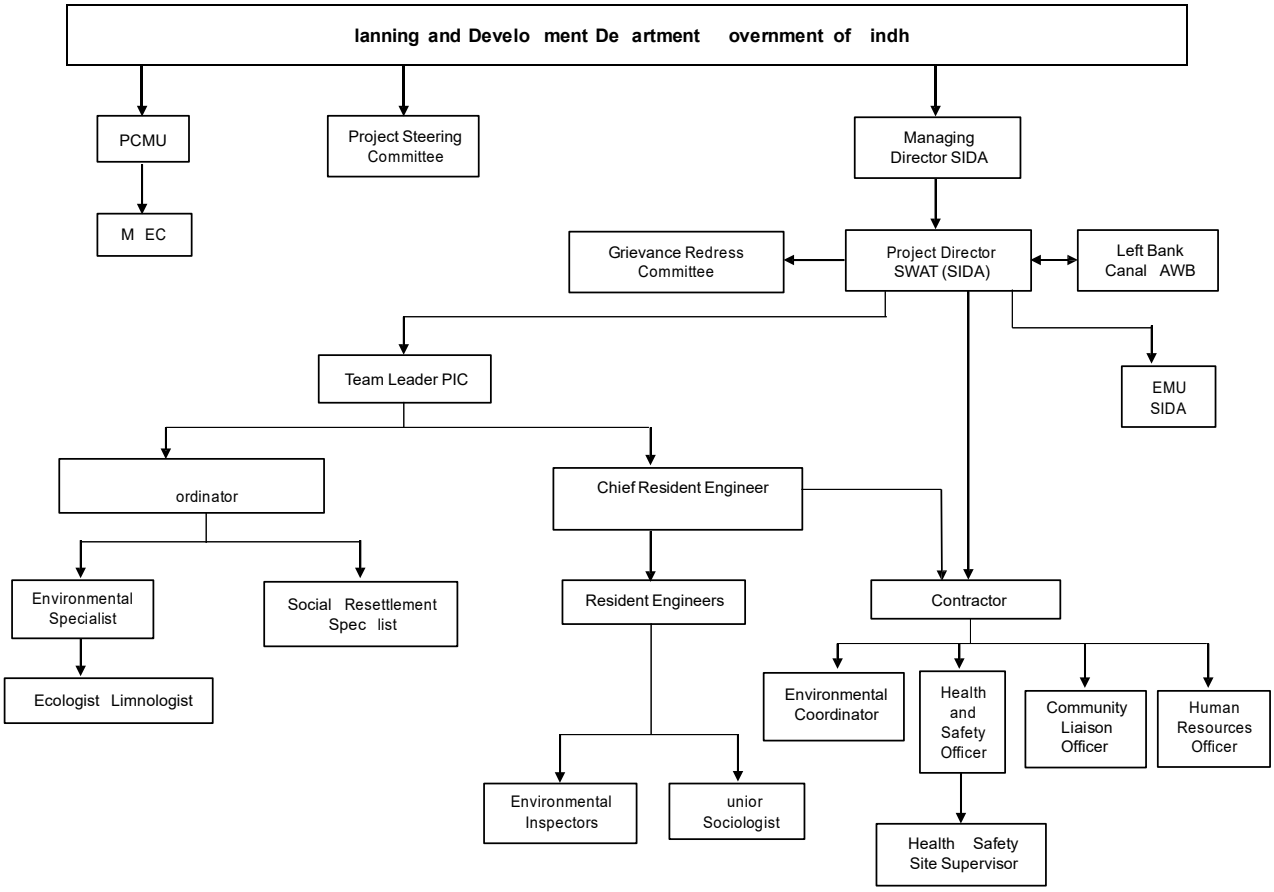
The roles and responsibilities of the project parties are summarised in the following table and the organogram is provided in Figure 7-1.

Table 7-1: Roles and Responsibilities under the ESMP

Project Entity	Responsibilities under EMP
PCMU	• Coordination to ensure all activities are carried out in compliance with ESMP and Contracts
SIDA	• supervising, facilitating and coordinating the implementation of environmental and social plans, including ESMP and SMRP; • inclusion of ESMP in the contract documents and, preparation of relevant specifications and conditions, and review of the bidding documents • ensuring that contractors follow EPA regulations, World Bank Safeguard Policies, and other requirements mentioned in the ESMP and SMRP; • identifying any issues of non-compliance and reporting them; • suggesting mechanisms to link contractor performance in relation to the ESMP to the timing of financial payments, incentives or penalties; • interacting with stakeholders for their concerns about the construction activities, (vii) development of local area development programs, and • prepare quarterly monitoring reports on ESMP implementation
AWB	• Implementation of SMRP • Support the contractor in temporary land acquisition • Addressing the grievances on resettlement issues • Responsible for the operation and maintenance of the canal, and tree plantation in the RoW
PIC/CSC	• Supervising and supporting contractors in achieving their responsibilities as outlined in the ESMP • Review and approve the Contractor's site-specific plans on ESMP and OHS implementation. • Regular safety audits at the worksites; • Issuing non-compliance notices to the contractors • Providing input, advice, and approval on activity-specific work plans relating to ESMP • Supervising the implementation of activity-specific work plans • Regularly reviewing and assessing ESHS risks throughout the construction phase; • Identifying and preparing environmental induction and training materials; • conducting ESHS trainings; • Assist SIDA in addressing and resolving ESHS complaints and grievances • Responding to environmental incidents as required; • Managing compliance reporting as it relates to the Project and preparing monthly ESMP compliance reports; and • Liaise with SIDA for effective environmental and social management at the site
Contractor	• Preparation of C-ESMP, including OHS Plan • Implementation of ESMP and E-ESMP • Preparation of monthly reports

The institutional arrangements as described above are presented in Figure 7-1.

Figure 7-1: Organogram for EMP Implementation



7.3 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 as per ESMP for interim payment.

SIDA 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 gender-based violence;
- 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 7-2.

Table 7-2: Environmental, Social, Health and Safety Conditions in Bidding Documents

(**Note**: SIDA will include this Table in the Contract Specifications of 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	SIDA
1. Past performance of the Contractor on ESHS is one of the eligibility criteria for the shortlisting 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 gender-based violence (GBV) or health or safety requirements or safeguard in the past five years".	Bidder to make the Declaration	SIDA use this information to seek further information or clarifications in carrying out its due diligence
2. The contractor shall propose adequate ESHS Specialists in his team (Environmental Specialist, OHS specialist, Social specialist, site supervisors)	The Contractor's staff should include adequate ESHS specialists who are responsible for the implementation of all mitigation measures on ESHS risks and compliance with ESMP	The Bidder shall propose an Environmental, Social, Health and Safety (ESHS) Specialist as the Contractor's Key Personnel at the Site. The Bidder shall provide details of the proposed ESHS specialist, including academic qualifications and work experience. The ESHS Specialist should have a minimum bachelor's degree in engineering or a master's degree in sciences related to environmental management. The Specialist should have 5 years of experience monitoring and managing ESHS risks related to infrastructure projects.	The bidder is to submit the CV of the proposed ESHS Specialist	SIDA will review and approve
3. Contractor shall submit ESHS Performance Security for compliance with ESHS obligations	The Contractor should have financial implications if he does not comply with ESHS requirements. Hence, performance security will be collected from the contractor.	The Bidder shall submit the ESHS Performance Security as a "demand guarantee" of three percent (3%) of the Contract Amount.	The bidder will submit a Performance Security.	
4. Implement Mitigation Measures to Address Construction-Related Impacts given in ESMP	The mitigation measures to address potential ESHS risks and impacts should be included in the bidding documents. The contractor shall be made responsible for implementing the mitigation measures through the necessary conditions in the contract.	SIDA/PMU will ensure the ESMP in the General Specifications of the Bidding Document, and the reference to this document 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		SIDA will include this condition in the bidding document

Condition	The rationale for the inclusion of this Condition in the Contract	Specifications to be included in the Bidding Documents	Responsibility	
			Bidders	SIDA
		the ESIA of the Project, which is available on the PCMU 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 (APPENDIX-D**)		
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 for preparing and implementing C-ESMP (including OHS plans), including waste management, spoil site development, environmental monitoring, etc.	Bidder will quote for the ESHS Management.	
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 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 harassment, particularly towards women and children • Prohibit violence, including sexual and/ or gender-based violence • Respecting reasonable work instructions • Protection and Proposer use of the property	Bidder shall submit a code of Conduct with the bid documents	
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 the community from construction-related hazards inside the terminal • Pollution prevention (wastewater, air and noise emissions) and management • A waste management plan for proper collection and disposal of waste • Traffic management plan to ensure the safety of local	The bidder will submit MSIP along 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	SIDA
		communities from construction traffic • Hazardous material management plan safe storage and handling • Strategy to address labor influx impacts on the local communities • Gender-based violence and sexual exploitation and abuse prevention and response action plan • Emergency response plan and early warning system The Contractor shall be subsequently required to submit (before mobilization) the Contractor's Environment and Social Management Plan (C-ESMP) by the above strategies and Condition 4 of this Table.		

7.4 Environmental and Social Management during Construction

7.4.1 Environmental Code 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 their experiences in mega construction projects, including World Bank-funded projects in Pakistan, and also in conformity with the WBG EHSGs and Good International Industry Practice. The ECPs are presented in **APPENDIX-D** and will be included in the bidding documents (item 4 of Table 7-2) 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 Resource 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 Management Plan
- ECP 10: Air Quality Management
- ECP 11: Noise & 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: Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Worker Health and Safety
- ECP 19: Instream Construction Works (Diversion, and Hydraulic structures)
- ECP 20: Communicable Diseases Health and Safety Plan

7.4.2 Pre-construction Stage Mitigation Plans

Pre-construction stage will mainly include the mobilisation of the contractor and finalisation 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 mobilisation of ESHS Specialists

Each of the above conditions is elaborated in Table 7-3.

Table 7-3: 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 Management Plan (C-ESMP)	The Contractor shall submit site-specific management plans to address ESHS risks following the ESMP requirements and MSIP proposed in the bid documents.	The Contractor will submit for approval and implement their Environment and Social Management Plan (C-ESMP). The C-ESMP should be submitted prior to 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 • Community health and safety management plan • Borrow Area Management Plan • Spoil Management Plan • Camp management plan • Waste management plan • Wastewater discharge management plan • Air and noise emissions management plan • Hazardous material management and spill control plan • Water supply and sanitation management at the worksites and workers' accommodations Tree plantation plan • Management of labour influx • Labour recruitment procedures and labour management • Traffic management plan • Training plan for ESHS risks including HIV/AIDS, sexual exploitation and abuse, and gender-based violence • Emergency Response Plan • Grievance Redress Mechanism	Contractor	SIDA, PIC

Condition	The rationale for the inclusion of this Condition	Description of the Condition	Responsibility	
			Implementation	Supervision
		• Demobilization plan after completion of works		
2. Mobilisation of ESHS Specialists	The ESHS Specialists should be mobilised during pre-construction for the preparation of C-ESMP	The Contractor shall submit the CVs of the following ESHS Specialists for SIDA review and approval and mobilise them. • Environmental Officer • OHS Officer • Community Liaison Officer The ESHS Specialists should be present at the site throughout the construction period.	Contractor	SIDA, PIC
3. The hiring of Construction Labour	Labour Management 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 7-2) and will be terminated from employment if they do not comply with the code of conduct.	Contractor	PMO, CSO
4. Construction camp and storage facilities	The contractor will need areas for setting up camp and storage areas.	The contractor shall set up camp and storage facilities within sites approved by the SIDA with adequate facilities	Contractor	SIDA, PIC

7.4.3 Construction Stage Mitigation Plans

Detailed mitigation plans for construction stage impacts have been prepared on the basis of the detailed impact assessment covered under Chapter 6 and presented in Table 7-4. These plans are project-specific, and to the extent possible, site-specific, however, contractors will be required to carry out further detailing of the key aspects, to prepare site-specific management plans as part of C-ESMP for review and approval of SIDA.

Table 7-4: ESHS Impacts and Risks in Construction and Mitigation Measures

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

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Loss of 4,865 trees developed by the AWB and squatters in the footprints of the proposed works	• The contractor shall clearly mark each tree that is required to be removed. • The contractor shall prepare an inventory of all trees to be cut. The inventory shall include the following details for each tree: Reference number, Location, Species, Girth, Approximate height, Diameter at breast height and Photograph of the tree. • The contractor shall submit the inventory to the Engineer, and no tree-cutting shall be permitted until written approval from the Engineer. The contractor shall not be paid for this activity if tree cutting is carried out without written permission. • The Engineer shall only approve tree cutting where a complete tree inventory has been submitted to the Engineer detailing all trees included in the request and after consultation confirmation with by the environmental specialist of Engineer. A joint visit between the environmental specialists of the Engineer and the Contractor (or their representatives) shall be carried out to verify the inventory prior to approval. • Once the Contractor receives approval from the Engineer, they can cut the sanctioned trees and store them in a designated, secure storage area. • The Contractor shall mark each cut approved tree with a unique reference number corresponding to a reference number on the tree inventory. • The Contractor shall maintain the tree inventory to include the number of cut sections of each tree and storage details of each section removed from the site. The tree inventory shall be kept up-to-date and available to the Engineer at all times.		Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• The Contractor shall inform the Area Water Board via the Engineer when a batch of trees is ready for handover. • The Area Water Board shall visit the tree storage area to review the inventory of trees to be handed over. The Area Water Board shall only assume responsibility for each batch of trees and arrange for their transportation from the storage area following the signing of the Chain of Custody Form and the agreed tree inventory. • Concerned AWB would be responsible for auctioning all cut trees with identification of the name and species of each cut tree in favour of the Irrigation department/Sindh government. • Compensatory tree plantation at the rate of 5 new mature trees for each tree cut in the areas identified by SIDA. A mature tree is defined as a girth greater than 0.15 m (six inches) & 4-5 feet in height. The contractor shall be responsible for identifying the plantation site, submitting the tree plantation plan to the engineer, and aftercare of these trees for one year, after which the AWB shall become responsible for the survival of the trees. • All trees to be replanted shall be native species as they have the greatest chances for survival. The species should be determined based on the site suitability for the tree species. The list of recommended tree species for plantation and species which are strictly prohibited for plantation are provided in Tables Table 6-5 and Table 6-6 of ESIA.			
2. Temporary acquisition of land for canal diversions	• Restoration of the temporary diversions to the satisfaction of the landowners. This may include filling up the excavated channels with the borrow material or spoils generated by the canal excavation activities. If the landowner is willing to use the excavations to develop fish ponds, the banks should be stabilized to prevent erosion and maintain a 2:1 slope.		Contractor	SIDA PCI

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
3. Generation of spoils (excess excavation) and their disposal	• Minimize the generation of spoils by reusing the excavated material to the maximum extent possible by strengthening embankments or disposing them in the RoW along the canal inspection roads. • The height of the spoils in the RoW should be at least 3 ft below the embankment height and road height to ensure the wind erosion will not transport these materials to the canal. The spoils should be dumped appropriately and compacted adequately to avoid dust and released back to the canal or nearby agricultural lands. • The Contractor can select the spoil disposal sites and submit the disposal plan for the Engineer's approval. The spoil disposal sites should be located in barren lands or government-owned lands that are not environmentally sensitive. Minimize the requirement of developing spoil sites by planning borrow and spoil disposal activities so that borrow sites will be used for spoil disposal. • Transport and disposal of spoils and designated spoil disposal sites. • Proper dumping and adequate compaction are needed to avoid dust and release it back to the canal or nearby agricultural lands. Construction of retaining wall to protect the spoils from collapsing	Implement measures in the following ECPs: ECP 1 ECP 5 ECP 6 ECP 10	Contractor	SIDA PIC
4. Sourcing of borrow material for embankment works	• Reuse of excavated material from the canal to the extent feasible to minimize the requirement of borrow material • About 30 borrow sites (covering an area of 55 acres) have been identified within the RoW and presented in the ESIA (Figure 3-11). These areas are mainly located in the barren lands that are owned by the government and are not in agricultural use. • The Contractor can select additional borrow sites and submit the plan for the Engineer's approval. The borrow sites should be located on barren lands or government-owned lands. • The contractor will prepare a detailed Borrow Areas Plan containing appropriate mitigations/guidelines, especially	Implement measures in the following ECPs: ECP 9	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	when borrows will be beyond the RoW or in private barren lands. Agreements will be signed with a land owner or leaseholder in the presence of witness persons for the use of their land. • Top soil of each Borrow area will be stored at particular place for restoration when required. • The excavations at the borrow sites, located within the RoW, should be limited to 2 ft to 3 ft to minimize the seepage of water from the canals. • Fill up the borrow areas with the spoil generated from the canal excavations. The banks of the borrow areas should be stabilized to prevent erosion and maintain a 2:1 slope.			
5. Impact on downstream water releases during rehabilitation of 9 cross regulators	• Designs have been proposed, which include the construction of temporary diversions of the Akram Wah to ensure the continued supply of irrigation waters during the construction of new cross regulators. • The irrigation flows in the canal will be maintained by constructing and maintaining the temporary diversion channels around the hydraulic structures. • The new head regulators shall be built off-line to allow continued operation of the existing structures throughout the construction period. • The rehabilitation of hydraulic structures will be scheduled in the low flow season or canal closure period (January to February). • The dewatered water between the two cofferdams, on both sides of the hydraulic structures, will be pumped to the diversion channel			
6. Disruptions in the traffic due to reconstruction of 12 road bridges and 6 footbridges, and relocation of water pipelines	• Preparation of traffic management plan by identifying the alternate routes to divert the traffic. Construct or rehabilitate the temporary diversion routes if required. • Relocation of utilities before the start of the construction activities.			

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
7. Generation of construction waste including hazardous waste	• The construction waste generated from the removal of canal lining should be disposed of in the designated spoil disposal areas, which will be identified by the contractor and approved by the PIU. The contractor will prepare disposal plan prior to mobisliation and take approval from the PIU. • Guidelines for managing wastes, including solid and hazardous wastes, are given in ECPs (See ECP 1 on Waste Management and ECP 2 on Fuels and Hazardous Substances Management in **APPENDIX-D** for detailed mitigation measures). Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the Engineer and SIDA for their review and approval. • The contractor will place containers of adequate size and numbers in place for the collection of various types of wastes (metal, rubbers, used fuels, batteries, etc.) from the worksites and transport these wastes regularly to a centralized facility. • The contractor will procure the services of a waste management contractor to transport and treat hazardous waste and manage recyclable waste. • For disposal of inorganic construction waste, the contractor will develop a waste disposal site or place them in the spoil disposal areas.	Implement measures in the following ECPS: ECP 1 ECP 2	Contractor	SIDA PIC
8. Generation of solid waste from worker's campsites and offices	• Before commencing the construction activities, the contractor will be required to prepare a Waste Management Plan and submit it to the Engineer for their review and approval. • Solid waste is collected and segregated into kitchen waste (organics), paper and plastic (recyclable), and garbage (non-recyclable). Three kinds of waste bins (with different colours) with adequate numbers and capacities will be placed at the campsite (kitchen, offices, rooms) to segregate the waste at the source.	Implement measures in the following ECPs: ECP 1 ECP 16	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Organic waste will be treated on-site using in-vessel composters, bins, or pits. The final compost can be given to the local communities for use in the agricultural lands or developing plantations. • Procure the services of waste management contractors to collect and manage recyclable waste. Recyclable waste will be compressed through bailers to minimize the volume of waste to be stored and transported. • Develop a waste disposal site for garbage disposal.			
9. Wastewater discharges from the construction camps, sites, and batching plants	• Construction of wastewater treatment facilities at the campsite (e.g., septic tank and soak pit) and site drainage). Open pits will be strictly forbidden for use of sanitary effluents, vehicle and machinery washing facilities by Contractor. • Sedimentation ponds of adequate size and capacity will be built for the treatment of discharges from the batching plants to allow the sediments to settle. The settled sediments will be periodically removed and disposed of at the designated spoil disposal sites. • The contractor will be required to take appropriate measures to avoid and contain any spillage and pollution of the water. • Vehicles will be washed only in the designated concreted areas, and wastewater from the washing areas will be connected to the sedimentation ponds, consisting of oil-water separators. • Quarterly monitoring of wastewater quality to ensure compliance with SEQS	Implement measures in the following ECPs: ECP 3 ECP 4 ECP 16	Contractor	SIDA PIC
10. The risk of soil pollution by construction works	• Storage fuels and chemicals in contained facilities and take appropriate measures to avoid and contain any spillage. • Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The containment area's volume should equal 120% of the total volume of fuel stored. Fuel tanks will be	Implement measures in the following ECPs: ECP 5	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	checked daily, dip logs will be maintained for leaks, and all such leaks will be plugged immediately. • Confine the contaminants immediately after such accidental spillage and clean up oil spills using spill kits. • Collect contaminated soils, treat and dispose of them as a hazardous waste • Temporary stockpiles to be protected from erosion. • Additional mitigation measures are given in ECP 2: Fuels and Hazardous Goods Management, ECP 3: Water Resource Management, ECP 5: Soil Quality Management, and ECP 6: Erosion and Sediment Control.	ECP 6 ECP 7		
11. Air and noise pollution from construction	• Construction equipment and vehicles will be well maintained so that emissions are minimal and comply with emission standards of SEQS. • Batching plants will be located a minimum of 500 m away from residential areas and will have appropriate dust/emission suppression mechanisms such as wet scrubbers. • Dust generation from construction sites would be restricted as much as possible, and water sprinkling would be carried out throughout the construction period. Water sprinkling should be focused on access routes in the vicinity of the villages. • The contractor shall be required to submit a traffic management plan which identifies the proposed access and haulage routes and shall be prohibited from using any routes other than those specified in the traffic management plan. • Existing tracks shall be favoured for material haulage. • The earthwork equipment operators will be trained to reduce dust emissions while carrying earthworks. • Construction activities near the settlements will be limited to daytime only. • Implement the additional mitigation measures provided in ECPs to address air and noise quality impacts (see ECPs	Implement measures in the following ECPs: ECP 10 ECP 11	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	ECP 10 and ECP 11 in **APPENDIX-D** for air and noise quality management). • A GRM will be implemented to receive complaints from the public on various aspects of environmental issues, including noise pollution. The contractor will address these grievances by adopting the necessary measures. • Quarterly air and noise quality monitoring will be carried out in the project area to ensure compliance with SEQS on ambient air and noise quality.			
12. Impacts on flora and fauna from construction activities	• The contractor's code of conduct for workers will include conditions on the protection of flora and fauna, the ban on cutting trees, and the ban on hunting and poaching of wildlife. Employees found violating would be subject to strict actions, including fines and termination of employment. • Awareness-raising to workers on the protection of flora and fauna. • Before and during vegetation clearance or tree felling, any animals found will be removed and released to a safe place. There should be no burning of natural vegetation. The borrow animals, if found during excavation, shall also be transported to a safe place. • Use of non-wood fuel for cooking and heating. The contractor should provide gas cylinders for cooking, provide training to local labour in the safe use of gas cylinders, and depute a camp manager responsible for overseeing the operation of camps, including refilling of gas cylinders. This will minimize the cutting of trees by workers. • Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats, and other wildlife. • No organic waste will be disposed of in the open places	Implement measures in the following ECPs: ECP 12 ECP 13	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
13. Occupational Safety risks in construction	• The contractor will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan. These plans will be prepared in compliance with the World Bank Group's EHSGs, and Sindh Occupational Safety and Health Bill (2017). If these guidelines cannot address any specific aspect of OHS, good international practices such as OSHA and ILO will be applied. 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 are any changes in the construction methodologies. • OHS Plan should contain general guidance for all identified hazards under each work activity, 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 Engineer and the World Bank • Conduct a 'job hazard analysis' at the new construction site to identify potential hazards 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, 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. • Regular site inspections and safety audits by the construction supervision team, the OHS specialists and the site engineers. Since the site engineers will always present at the worksites, they will be trained by their OHS team on monitoring the safety aspects of the construction works.	Implement measures in the following ECPs: ECP 18 ECP 19 ECP 20	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Regular training program for workers on occupational health safety (monthly training and daily toolbox talks). Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge of how to deal with emergencies. • Incident investigation and reporting will be maintained, including a complete record of accidents and near misses. • In order to protect all project personnel and visitors, the Contractor will provide personal protective equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, body harnesses, protective clothing, goggles, full-face eye shields and ear protection. The contractor will also provide training to workers on how to use them, maintain them in a sanitary and reliable condition, and replace the damaged ones immediately with the new ones. • Availability of firefighting, ambulance, medical and rescue facilities at the site to implement an emergency response plan. • The worksites have adequate water supply, mobile toilets, and medical and first aid care facilities. • Contractors will have dedicated and qualified staff to ensure 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 maintained. • First aid facilities will be available at the worksites and camps. The contractors will engage qualified first aider(s). • Implement the mitigation measures and emergency response plans given in ECP 18: Worker Health and Safety and ECP 19: Instream Construction Works (Diversion, and Hydraulic structures).			

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
14. Occupational health risks in construction	• Implement the communicable diseases protocols during construction works, which are detailed in ECP 20. communicable diseases health and Safety Plan (**APPENDIX-D**). The plan provides detailed measures for awareness materials, detection measures, physical distancing measures, respiratory measures, hand hygiene measures, cleaning and disinfection, and response measures if workers are found with communicable diseases symptoms. • The contractor will develop and implement a camp management plan • The construction camp will be built with adequate facilities (safe drinking water and sanitation, kitchen, rest areas, etc.), including entertainment facilities, so there will be minimal interaction between them and local communities. All these facilities should be cleaned daily. • The Contractor will provide and implement a suitable housing plan for on-site workers. Housing should meet IFC specifications (Workers' Accommodation: Processes and Standards) in respect of the nature and standard of the accommodation and facilities to be made available. • Labour camps should be built with easily cleanable flooring material, float finished plain concrete slab floor, brick or block walls, and cleaned regularly. • Food provided to workers should contain an appropriate level of nutritional value. • Overcrowding should be avoided inside the labors camps. The minimal floor space per resident should be 4 to 5.5 square meters. • Cots should be provided equally to the number of labourers residing at each camp. There should be a minimum space between two cots of 1 meter. • Ensure the availability of electricity with a sufficient quantity of ceiling or stand-by fans according to the number of labour living in the camp.	Implement measures in the following ECPs: ECP 16 ECP 18 ECP 19 ECP 20	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Ensure the availability of water in these sanitary facilities at all times and they are cleaned frequently each day by appointing adequate janitors. • Sanitary and toilet facilities should be designed to provide workers with adequate privacy, including ceiling-to-floor partitions and lockable doors. • Toilet facilities should be conveniently located and easily accessible. Standards range from 30 to 60 meters from labour camp. • The contractor will provide adequate facilities for disinfecting, cleaning of cooking utensils. • The adequate new bore of hand pumps should be installed at all the campsites. No stagnant water, foul mud and sanitary effluents around 10 meters of the hand pumps should not be observed. Otherwise, this could lead to the germination of microbiological contamination, which are the main factors of water-borne diseases in drinking water sources. • A medical clinic with a medical doctor and attendants will be established at the campsite. Workers will carry out regular health checkups. • The Contractor shall establish a mechanism to collect the complaints from the workers and address those complaints by the approved GRM plan			
15. Safety hazards due to increased traffic, especially for children and elderly people	• Traffic Management Plan (with adequate measures such as avoiding school hours, following sped limits, hiring licensed drivers, etc.) will be implemented to ensure access to residential areas and prevent unsafe situations, especially near schools, housing areas, construction areas. • Road signage will be fixed at appropriate locations to reduce safety hazards associated with project-related vehicular traffic. • Project drivers will be trained in defensive driving. • Ensure that all construction vehicles observe speed limits on the construction sites and public roads	Implement measures in the following ECPs: ECP 15	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Provide adequate signage, barriers, and flag persons for traffic control.			
16. Community exposure to work hazards	• Barricade the work areas with hard fencing to prevent the entry of community in the construction areas. • Placing of adequate signboards and flagmen to divert the community away from the construction works. • Community awareness programs on construction-related hazards, including awareness programs at schools Construction activities such as blasting and excavation, particularly in the borrow areas, may pose safety risks to the nearby population. • First aid medical facilities will be made available at the worksite	Implement measures in the following ECPs: ECP 15 ECP 16 ECP 17	Contractor	SIDA PIC
17. Dust from vehicular movement on local roads and construction activities	• Dust generation from construction sites will be restricted as much as possible, and water sprinkling will be carried out as appropriate, especially at those places where earthmoving excavation will be carried out. • Frequent sprinkling of water on the local roads and worksites to control dust emissions. The contractor has to mobilize adequate water sprinkling trucks. • A GRM will be implemented to receive and address complaints from the public on various aspects of environmental issues, including dust pollution.	Implement measures in the following ECPs: ECP 10	Contractor	SIDA PIC
18. Employment opportunities in construction activities	• encourage to engage local workers/labourers with the same terms and conditions as outside workers/laborers; • integrating provisions to redress labour related grievances in the Grievance Redress Mechanism (GRM), which should be well known to the laborers/workers and accessible; • prohibition of child labor and not hiring of workers less than 18 years of age; • no engagement of forced and bonded labor; • provision of a safe and healthy working environment to workers; and	Implement measures in the following ECPs: ECP 16	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• taking steps to prevent accidents, injury, and disease and appropriate treatment for those suffering from occupational injuries/diseases; and encouraging insurance facilities for workers.			
Risk of child labor	• Ensuring that children under 18 years of age are not employed directly or indirectly on the project. • Local community provided with information on contractor's policies and Code of Conduct			
19. Impacts from the influx of labor from the outside areas	• This situation will be addressed by an awareness campaign implemented at the beginning of the construction phase. The Contractors will be aware of the possibility and risks of miscommunications between local residents and workers, which could easily lead to conflicts. This will be prevented by raising awareness and implementing a Code of Conduct for the workers. The Contractor shall develop a Worker Code of Conduct to govern the behaviour of workers on-site, in camps, and in local communities. • The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction workforce, including the spreading of sexually transmitted diseases such as HIV/AIDS. • The contractor will prepare a labour influx management plan prior to construction works for approval of the Engineer. • The contractor's code of conduct shall cover the program to promote the construction workers' awareness of respecting the local community. • Construction camps will be built in the designated areas, located away from the local settlements. • The contractor will ensure local water usage will not be affected by the project's water usage or compete with the local community's water requirements. • The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community.	Implement measures in the following ECPs: Implement measures in the following ECPs: ECP 16 ECP 17	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Screening worker influx for communicable diseases and providing appropriate treatment to reduce exposure to the local population. • The Contractor's monthly training program will cover topics related to respectful attitude while interacting with the local community			
20. Risk of gender-based violence GBV/Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH), child abuse and exploitation	• Contractor Code of Conduct is developed, incorporated into workers' contracts, and training and socialization on it provided to workers • The inclusion of a clause on GBV/SEA behavior obligations in the employment contracts of all employees and construction workers aimed at strengthening measures to address and prevent GBV/SEA in the workplace and construction areas. • Translation of code of conduct into Sindhi and dissemination of the principles laid out in CoC and the consequences (warnings, penalties, termination and legal actions) of its breach to all employees and workers • Mandatory and regular training for workers on required lawful conduct in the local community and legal consequences for failure to comply with laws; • Commitment/policy to cooperate with law enforcement agencies investigating perpetrators of gender-based violence • Posting of code of conduct in public spaces at contractor's work camps and living areas, and village information centers and public places of adjoining/neighboring communities in the Urdu language • Commitment/policy to cooperate with law enforcement agencies investigating perpetrators of gender-based violence; • Creation of partnership with local civil society organization to report workers' misconduct and complaints reports on gender-based violence or harassment through the Grievance Mechanism;	Implement measures in the following ECPs: ECP 16 ECP 17	Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	• Provision of opportunities for workers to regularly return to their families; • Provision of opportunities for workers to take advantage of entertainment opportunities away from local rural communities. • The contractor's code of conduct shall cover a program to promote awareness to the construction workers on avoiding GBV, SEA, SH and the risk of spreading sexually transmitted diseases • The Contractor's monthly training program will cover topics related to Code of Conduct such as sexual harassment, particularly towards women and children, violence, including sexual and/or gender-based violence			
21Chance finds during construction	The chance find procedures that will be used during this Project are as follows: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a nightguard shall be present until the responsible local authorities and relevant Department of Archaeology take over; • Notify the supervisory Engineer who in turn will notify the responsible local authorities and relevant Department of Archaeology immediately (within 24 hours or less); • Local authorities and the relevant Department of Archaeology would be responsible for protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archaeologists (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those		Contractor	SIDA PIC

Impact	Mitigation Measures	Generic Mitigation Measures	Responsibility	
			Implementation	Supervision
	include the aesthetic, historical, scientific or research, social and economic values; • The local authorities and the relevant Department of Archaeology shall take decisions on how to handle the finding. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance), conservation, preservation, restoration, and salvage; • Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the relevant Department of Archaeology; and • Construction work could resume only after permission is given from the local authorities and relevant Department of Archaeology concerning the safeguard of the heritage.			

7.5 Environmental Monitoring Plan

Monitoring of environmental components and mitigation measures during implementation and operation stages is a key component of the EMP to safeguard the protection of the environment. The objectives of the monitoring are to

- Monitor changes in the environment during various stages of the project life cycle with respect to baseline conditions; and
- Manage environmental issues arising from construction works by closely monitoring environmental compliance.

A monitoring mechanism is developed for each identified impact, and it includes:

- Location of the monitoring (near the Project activity, sensitive receptors or within the Project influence area)
- Means of monitoring, i.e. parameters of monitoring and methods of monitoring (visual inspection, consultations, interviews, surveys, field measurements, or sampling and analysis)
- Frequency of monitoring (daily, weekly, monthly, seasonally, annually or during the implementation of a particular activity)

The monitoring program will also include regular monitoring of construction and commissioning activities to ensure their compliance with the environmental requirements as per relevant standards, specifications, and EMP. The purpose of such monitoring is to assess the performance of the undertaken mitigation measures, formulate additional mitigation measures, and/or modify the existing ones aimed at meeting environmental compliance as appropriate during construction.

During construction, environmental monitoring will ensure the protection of air and noise pollution, community relations, and safety provisions.

Table 7-5: Environmental and Social Monitoring Plan During Construction

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

Parameter	Means of Monitoring	Location	Frequency	Responsibility Implementation
Irrigation Flows	Visual observations to ensure canal flows are not blocked	At cross-regulators	Monthly	Contractor
Erosion	Visual inspection of erosion prevention measures and the occurrence of erosion	All sites	Monthly	Contractor
Wastewater discharges from batching plants, and campsites	Spot measurement for pH Visual inspection to ensure clear water leaving the site	batching plant discharges	Weekly	Contractor
	Sampling and analysis of wastewater discharges for the parameters given in SEQS	3 sites (including batching, camp discharges)	Quarterly	Contractor
Surface water quality	Visual inspection of the presence of petroleum products.	All sites	Monthly	Contractor
Air Quality (dust)	Visual inspection is performed to ensure that good standard equipment is in use and that dust suppression measures (spraying of waters) are in place.	All sites	Daily	Contractor
	Visual inspection to ensure the dust suppression work plan is being implemented	All sites	Daily	Contractor
Ambient Air Quality	Air quality monitoring for 24 hours for the parameters specified in SEQS	At 3 sites	Quarterly	Contractor
Noise and vibration	24-hour noise monitoring (at/near construction sites, campsites, offices, colony, communities, quarry area, and transportation routes)	At 6 sites	Quarterly	Contractor

Parameter	Means of Monitoring	Location	Frequency	Responsibility Implementation
Emissions from plant and equipment	Visual Inspection	All vehicles	Monthly	Contractor
Waste Management	Visual inspection on spoil disposal	At disposal sites	Monthly	Contractor
	Availability of dust bins at worksites and camp	At camp and work sites	Monthly	Contractor
	Collection and treatment of organic waste	At campsite	Monthly	Contractor
	Collection and treatment of recyclable and hazardous waste by the waste management contractor	At camp and work sites	Monthly	Contractor
Operation of borrow sites	Visual inspection of borrow sites	At borrow sites	Monthly	Contractor
Spoil disposal sites	Visual inspection of spoil disposal sites	At spoil disposal sites	Monthly	Contractor
Tree plantation	Visual inspection to ensure plantations are growing well (5 trees to be planted for each tree uprooted)			
Spills from hydrocarbon and chemical storage	Fuels are stored in contained facilities Availability of spill kits at the site Visual Inspection for leaks and spills	At fuel storage sites	Monthly	Contractor
Traffic Safety	Placement of traffic signs and traffic control personnel	Near the construction sites	Monthly	Contractor
Local Roads	Visual inspection to ensure local roads are not damaged	Local roads	Monthly	Contractor
Cultural and Sites	Visual observation of cultural sites	Along the local roads	Monthly	Contractor
Drinking water and sanitation	Water quality analysis for drinking water parameters specified in SEQS	At the campsite	Quarterly	Contractor
Safety of workers	Usage of Personal Protective equipment. Safety audits	All worksites	Daily	Contractor

Parameter	Means of Monitoring	Location	Frequency	Responsibility Implementation
Labour engagement and GBV risks	Interaction with labours and review of GRM Record of training	All work sites	Monthly	Contractor
Workers Camps	Visual observation of the camp facilities and their maintenance	At campsite	Monthly	Contractor
Reinstatement of Work Sites	Visual Inspection	All worksites	After completion of all works	Contractor

7.6 Capacity Building and Training

The environmental and social trainings will help ensure that the EMP and CESMP requirements are clearly understood and followed by all project personnel. The primary responsibility of providing these trainings to all project personnel will be that of the contractor and Supervision Consultants.

The trainings will be provided to different professional groups, such as managers, skilled personnel, unskilled labourers, and camp staff. Members of the EMU responsible for supervision of environmental and social mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, participatory approach and social development. The contractor will also be required to provide environmental and social trainings to its staff, to ensure effective implementation of the EMP and CESMP. The training plan shall include a programme for the delivery of introductory training as shown in Table 7-6.

Table 7-6: Indicative Capacity Building Program for SIDA and other Project Staff

Program	Description	Participants	Form of training	Duration	Trainer/ agency
Introduction and sensitization to environment issues	Environmental impacts of proposed project Government and WB policies requirement for environmental issues	SIDA & AWB management, officials responsible for implementing project, and other PIU/PIC staff as interested	Workshop	One-day workshop preconstruction	PIC
EMP implementation	Implementation of EMP; impacts and mitigation; monitoring and reporting; public interactions and consultation	SIDA/AWB and Contractor staff responsible for implementation	Workshop	One day workshop	PIC

7.7 Contractor's Training Plan

The Contractor shall include a training plan within the CESMP that details the programme for the delivery of training. Demonstrating training shall be carried out initially at staff induction and repeated intermittently throughout the project to cover the subjects included in the following table.

Table 7-7: Training Subjects for Inclusion in Contractors Training Plan

Subject	Target Audience
Environment Code of Practice	All staff
Handling, use and disposal of hazardous material	Construction workers with authorised access to hazardous material storage areas and required to use hazardous material during their works
Waste Management	All staff (construction and camp staff)
Efficient & safe driving practices, including road & vehicle restrictions	Drivers & mobile plant operators
Actions to be taken in the event of major or minor pollution event on land	All construction staff
Use of flexible booms and surface skimmers in event of pollution event in water	All construction staff working on regulating structures or canal embankments
Pollution prevention: Best practice	All staff
Health & Safety: Safe way to work & hazard awareness	All construction staff
Health & Safety: Safe use of plant & equipment	Operators of plant & equipment
Health & Safety: Working at height	All construction staff
Health & Safety: Working near/on water	All construction staff
Health & Safety: Use of PPE	All construction staff
Emergency procedures and evacuation	All staff

Subject	Target Audience
Fire fighting	All staff
Site inductions, including requirements under the CESMP & details of environmentally sensitive areas of the site	All staff
Culturally sensitive awareness raising on HIV/AIDS and the spread of sexually transmitted diseases. Awareness raising on risks, prevention and available treatment of vector-borne diseases	All staff
Cultural sensitivities of the local population	On induction of all migrant staff
Identification of key species	All earthworks and vegetation clearance staff

7.8 Reports

The Contractor and Consultant's Environmental Social Teams will produce monthly monitoring reports. No change in the project design or scope can be introduced and no change in ESIA can be made unless approved by the competent authorities. The distribution list of reports is given in the following table.

Table 7-8: Distribution of Periodic Reports

Monthly	Non-Compliances observed on sites and actions required	Environmental/Social team of the Engineer (PIC)	SIDA AWB PCMU MEC Contractor
Monthly	• Actions taken on-site in response • to PIC Monthly report Project progress and works to be undertaken in the coming months • Details of training delivered • Details of accidents reported and actions taken • Result of environmental monitoring	Contractor	PIC SIDA AWB PCMU MEC
Quarterly, six monthly and yearly	Review of non-compliances reported and progress to resolve the issues Actions required at institutional level Result of environmental monitoring	SIDA-AWB	PIC PCMU SEPA World Bank

7.9 Cost associated with ESMP implementation

The budget for ESMP implementation is estimated at PKR 138 million (or USD 0.83 million). The detailed cost estimates are given in Table 7-9.

Table 7-9: Budget for Implementation of ESMP

Environmental & Social Implementation & Management Cost					
Summary of Cost					
1.	A - Contract Staffing Cost	28,800,000			
2.	B – ESMP Implementation Cost, including environmental Monitoring	44,667,000			
3.	C - Capacity Building & Training Costs during the project	2,100,000			
4.	D – Budget for SIDA field visits and monitoring	46,800,000			
5.	Sub Total	122,367,000			
	Total (Inclusive of all tax)	**138,274,710**			
A - Contract Staffing Cost					
S. No	**Description**	**Unit**	**Quantity**	**Unit Rate (PKR**	**Amount (PKR) (In Figures)**
1	Environmental Coordinator	Month	36.00	150,000	**5,400,000**
2	Health and Safety Officer	Month	36.00	150,000	**5,400,000**
3	HSE Site Supervisor	Month	36.00	100,000	**3,600,000**

4	Community Liaison Officer	Month	36.00	100,000	**3,600,000**	
5	Human Resource Officer	Month	36.00	100,000	**3,600,000**	
6	Pakistan Medical and Dental Council (PMDC) registered doctor	Month	36.00	200,000	**7,200,000**	
	Sub Total				**28,800,000**	

B-ESMP Implementation and ENVIRONMENTAL MONITORING COST

S. No	Parameter	Means of monitoring	Frequency	No of locations	Unit Cost	Quantity for 3 years	Sub Cost	Misc Lump sum costs*	Total Cost
1	Noise & Vibration	A-weighted noise levels –Leq one-hr over 24 hr period	Quarterly	6	6,000	12	432,000	50,000	482,000
2	Air Quality SPM, PM10, PM2.5, CO,SOx, NOx	Air quality monitoring for 24 hours specified in SEQS	Quarterly	3	25,000	12	900,000	1,800,000	2,700,000
3	Water use/drainage	Effluent parameters for any wastewater discharge (BOD, TDS TSS, pH, BOD, COD, oil and grease)	Quarterly	3	20,000	12	720,000	50,000	770,000
4	Drinking water	TDS, pH, Ecoli, Turbidity	Monthly	6	20,000	12	240,000	30,000	270,000
5		28 SEQS parameters and bacterial	Quarterly	10	20,000	12	2,400,000	50,000	2,450,000
6	Vehicle, machineries and equipment including Generator, batching, crushing plant and etc	Emission monitoring (batch-wise) as per SEQS	Quarterly	50	6,000	12	3,600,000	50,000	3,650,000
7	Tree Plantation & Aftercare	Total Trees to be planted	Lump sum		24,325	316	7,705,000		
8	Waste Disposal		Monthly		20,000	36	720,000		
9	Provision of Clean Water Supply		Monthly		50,000	36	1,800,000		
10	Traffic Management		Monthly		50,000	36	1,800,000		
11	Temporary Land Acquisition		Monthly		500,000	36	18,000,000		
13	Ambulance		Monthly		120,000	36	4,320,000		
	Sub Total						**44,667,000**		

C - Capacity Building & Training Costs during the project

1.	The approximate cost of training carried out by the contractor of his site staff	Monthly training as attached ESIA Report	1,500,000
2.	The approximate cost of training sessions to be carried out by the PIC	Two Trainings as specified in ESIA Report	600,000
	Sub Total		**2,100,000**

D. Budget for SIDA Field Visits and Monitoring Costs

S.No	**Parameter**	**Means of monitoring**	**Frequency**	**Location**	**Unit Cost**	**Total Nos for Annual**	**Total Cost**
1.	Site Visits by Authorities	Project Site	As When Required	Project Site	**100,000**	36	3,600,000
2.	EMU (SIDA) Staff Costs & Expenses	Project Site	As When Required	Project Site	**200,000**	36	7,200,000
3.	Environmental Unit of PIC Staff Costs & Expenses	Project Site	As When Required	Project Site	**500,000**	36	18,000,000
4.	Third-Party Audits	Project Site	As When Required	Project Site	**500,000**	36	18,000,000
	Sub Total						**46,800,000**

***Miscellaneous costs include** *Transportation charges, lodging/accommodation, fuel, generator, report writing etc*

8 Public Consultation and Information Disclosure

8.1 Introduction

Consultation with affected people and other stakeholders has become standard practice in the environmental assessment of development projects. The concept of public consultation is that the project proponent should share relevant information about the project interventions and their potential environmental impacts with all stakeholders. Consultation is a two-way process by which the knowledge and views of affected persons, NGOs, the private sector and other interested parties are taken into account in decision making. Information dissemination by the project proponent or his representative during public consultation is fundamental to meaningful consultation.

Both the Government of Sindh and the World Bank emphasise involving parties who could be affected by any development project to determine the social and environmental impacts associated with the project interventions and propose mitigation measures. Accordingly, necessary consultation and information disclosure sessions were organised with stakeholders to obtain their views on the subproject.

8.2 Specific Objectives of Consultations

The specific objectives of the consultation process were:

- Provide key project information to the stakeholders, and solicit their views on the project and its potential or perceived impacts,
- Information dissemination,
- Identification of problems and needs,
- Collaborative problem solving,
- Develop and maintain communication links between the project proponents and stakeholders,
- Reaction, comment and feedback on the proposed subproject; and
- Ensure that views and concerns of the stakeholders are incorporated into the subproject design and implementation to reduce or offset negative impacts and enhancing the benefits of the proposed subproject.

8.3 Methodology

The Project Consultants carried out public consultations at various locations in the proposed subproject area. The stakeholders' consultation during the work targeted the subproject area, administration, government officials, shopkeepers, and the local community in and around the subproject area. The consultation was carried out with both primary and secondary stakeholders. A scoping meeting was also conducted for NGOs and Institutional stakeholders. A summary of the meetings carried out are given in Table 8-1 and details are given in **APPENDIX-C**.

The following techniques and tools were used for public consultation:

- Focus Group Discussion with project-affected persons during preparation of ESIA, SMRP
- A scoping meeting was conducted, which was attended by different stakeholders at SIDA Office in Hyderabad on 13th August 2020
- A workshop to disclose the ESMF and Akram Wah ESIA to all the stakeholders at SIDA office in Hyderabad on 24th August 2021

Table 8-1: Details of Consultations

Stakeholders	Number of Meetings/FGDs	Number of Participants
Consultation with Government Officials (District Level Institutional Stakeholders Consultations)	18	35
Community Consultations & FGDs with men	80	661
Community Consultations & FGDs with women	39	359
ESIA Scoping Workshop	1	47
ESIA disclosure Workshop	1	15
Total	**139**	**1,107**

8.4 NGO and Institutional Consultations

In order to comply with World Bank and SEPA guidelines, the borrower must consult with project-affected groups and local nongovernmental organizations (NGOs) about the project's environmental aspects and take their views into account. Therefore, a Scoping meeting was conducted on 13th August 2020 at SIDA office. The purpose of the consultation was to:

- Inform the officials of the existence, nature of the project and the scope of work involved in the execution of the project.
- Provide a forum for the initial definition of critical environmental and social issues.
- Establish their interpretation of key sector development issues and linkages to the local and regional environment and social development as official stakeholders.
- Confirmation of the suitability of the initial list of communities selected for consultation.
- Facilitation of fieldwork.

The stakeholders consulted in this meeting are:

- SIDA
- Sindh EPA
- Area Water Board
- SSGCL
- Fisheries Department
- Non- Governmental Organizations (NGOs)
- Project effected persons
- Sindh wildlife department
- Agricultural department
- WWF
- Influential Community leaders
- Local community members like Imam Masjid and School teacher
- Universities

A presentation was made that reviewed the overview of the project, existing condition, proposed design and works, main anticipated impacts, EMP. Proposed works to hydraulic structures, bridge replacement and canal remodelling were shown in detail. The ESIA context was reviewed (policies and laws); the content of the EIA was summarized in terms of major headings, impacts and mitigation measures (general); Baseline data and use of construction ESMP explained. Social, Resettlement and gender issues were also discussed and the presentation was made to provide information on different consultations carried out with project affected persons at different location along the canal right of way. The presentation was followed by comments by the attendees and responses by the PC and SIDA team.

Further, a workshop was conducted on 24th August 20201 with all the above stakeholders to disclose the ESIA. A presentation was made to all the stakeholders on the potential environmental and social impacts of the project and the proposed mitigation measures to address these impacts.

Full details of the consultation, including attendees and the issues discussed, can be found in **APPENDIX-C**.

8.5 Grass Root Stakeholders Consultations

Consultations were also carried out with communities within the subproject area, as detailed in the following table.

8.6 Consultation with Local Women

39 consultation sessions with the local women were held and these meetings were participated by 359 women. The consultant's female interviewer conducted these consultations. The women of the area were keenly interested in the consultations and provided good information. The participants included housewives, students, and farm workers. A summary of these consultations are given in **APPENDIX-C**. The names and occupations of those attending the consultations are given in SMRP of Akram Wah.

As far as education is concerned, the majority of the women were illiterate. Most of them belonged to poor families living in small houses outside the CoI. They pointed out the following issues and concerns associated with this subproject:

- Most of the women demanded proper compensation, rehabilitation and assistance for lost assets.
- Risk of safety, security and privacy will be increased due to the working of outsiders during construction.
- During nine village survey all the participants male and female requested that groundwater in the area is severely saline and all the villagers are using the canal water for drinking and other house usage. Our request must be discussed with project proponent. Water supply schemes shall be provided through Akram Wah project. Drainage is another problem which could also be resolved through project works. These two are the basic needs of the project area. Some women complained of poor health facilities. Some women have also complaint that many Government and private parties NGOs use to come and ask about the facilities but never return back to resolve the problems of rural communities.
- All the cities use Akram Wah as drainage channel and drain the sewerage water in the canal they never realize that the downstream towns and villages are using the same water for drinking and other daily usages
- One man said that these organizations use the information to get money from other countries/NGOs and use it on their own.

8.7 Consultations with Project Affected Persons

As per Bank policy, PAPs and their representatives were consulted to introduce the subproject formally to the local community and to obtain their views on the subproject and discuss impacts to the PAPs as well as mitigation measures. The entitlements were discussed during these consultations, and the entitlement matrix) provided in SMRP of Akram Wah) reflects the agreed mitigations.

Group discussions were made with affected households. Various focus group meetings /discussions /scoping sessions were carried out with all expected subproject affected persons from 20th June 2020 to September 27, 2020. Full details of consultations with Project Affected Persons can be found in the SMRP for Akram Wah.

8.8 Meetings with Secondary Stakeholders

As per the participatory approach, staff of SIDA and Left Bank AWB were involved in the survey and consultations for the SMRP. A list of officials contacted is given in the SMRP of Akram Wah.

8.9 Summary of Consultations

The following table reviews the mains impacts that were discussed and mitigations that were agreed upon during the consultations.

Table 8-2: Impacts and Mitigations Discussed during Consultations

Impact	Discussion	Agreed Mitigation
Damage of the Canal	The canal lining is damaged at many places and need immediate reconstruction. Therefore, the project is welcomed by all stakeholders. However, they suggest that the proposed rehabilitation works should also consider the drainage issues. drainage is a major issues	The project will reconstruct the canal lining and embankments and will address the drainage issues.
Spoils from the proposed works	The damaged parts of the canals (soils and concrete) to be disposed of off away from the canals to ensure they won't fell into canals	Spoil disposal sites have been identified and all the spoils will be disposed of in the areas
Pollution of Akram Wah Canal	The canal water is being polluted with industrial and municipal wastewaters.	The proposed SWAT project will carry out a strategic study to understand the challenges in the water sector, including pollution from the industries
Tree cutting	Tree cutting should be minimized to the extent feasible. The trees that were cut from the embankment should be properly disposed of or should be handed over to the local communities.	Tree cutting would be avoided where feasible. The environmental specialists of SIDA and the Engineer will review and approve the plans for cutting each tree. AWB as the owner of the embankment will be responsible for selling the trees if they have any market value. Other trees will be given to the community.
Removal of privately-owned pump houses	PAPs shall either require compensation for new pumps or assistance to shift existing pumps to prevent any interruption in supplies from these pump houses. If PAPs are to rebuild the pump houses, when will they be able to rebuild them? There will be a delay between the demolition of the existing pumps and completion of the civil works before the PAPs can rebuild the pump houses. How will they supply water during this period?	The reconstruction of the pump houses and shifting of pumps shall be included within the civil works contract. The contractor shall be required to switch supplies within a single day to minimize disturbance of supply. The entitlement matrix has been updated accordingly. The affected households at Akram Wah in Left Bank Canals AWB subproject area requested that their pump houses should be reconstructed near the original location so that the water supply shall not be interrupted.
Removal of the mosque	This is a community structure. Who will receive compensation and how will we ensure it is rebuilt?	The affected structure will be rebuilt.
Removal of graveyard	This is a sacred structure visited by worshippers. Removal is sinful.	Removal of the graveyard shall be prevented through the construction of retaining walls around the grave.
Permanent land acquisition	The landowner shall be paid for his land, but a number of sharecroppers farm this land. Will they receive any of the compensation?	Sharecroppers to be identified and compensated as per the entitlement matrix. Compensation to be provided.
Migrant workforce entering the subproject area	How will the free mobility of women and children be maintained during implementation of the works?	The proposed construction camp is located away from any major settlement to minimise this impact. The Contractor shall be required to deliver training on cultural sensitivities of the local populations during the induction of all migrant staff.

8.10 Grievance Redressal Mechanism

The main objective of the grievance redress mechanism will be to arrive at mutually acceptable solutions to grievances through free and open discussions. It will also provide a forum to people who might have objections or concerns about their compensation to raise their objections and through conflict resolution address their issues adequately. The project will establish a grievance redress committee (GRC) at a sub-project level for the affected persons in line with the Social Impact Management Framework for WSIP, or any subsequent framework. The GRC shall meet at least quarterly to consider outstanding grievances.

Grievance redress arrangements should be disseminated to the PAPs with clear information on where and how grievances can be submitted, as well as the process for grievance redress, both at the subproject level and through the court system.

The committee is responsible for the facilitation of resolution of disputes and grievances which may arise during the implementation of this plan. The committee shall be formed of the following members given in **Table 8-3.**

Table 8-3: Grievance Redress Committee

Designation	Members
Project Director	Chairman
Director AWB	Member
Chairman AWB	Member
Sociologist/Participation Specialist, SIDA	Member (Secretary)
Local dignitary	Member
Land Acquisition Collector	Member
2 nr. Affected Person Representatives	Members
5 nr. Canal Assistant Akram Wah	Members

Any grievance which cannot be resolved at a project level (i.e. by the contractor, Supervision Consultant, SIDA or AWB) shall be referred to the GRC. If the affected person is not satisfied with the decision of GRC, he/she, as lost resort may submit the complaint to the court of Law. The committee will establish community complaints register at sub-project sites. Committee will register and file any grievance redress cases and would bring these into the notice of Project Director. Revenue department will be involved for land acquisition and crop compensation.

Grievances may be submitted to the GRC through any of the following means:

- By individual(s) through the complaints registrations system on the WSIP website (http://www.wsip.com.pk/Complaint/)
- These complaints are submitted directly to the Managing Director of SIDA and the PMC/A Team Leader and will be forwarded to the GRC Chairman
- By individual(s) in writing directly to the GRC Chairman
- By individual(s) in person at the Left Bank AWB office
- Director AWB shall forward grievances to the GRC chairman
- Referred to GRC chairman by the Contractor or PIC (for grievances submitted to the Contractor or PIC in the first instance but that cannot be not resolved by them)

The following standards shall underpin the proposed systems for handling any submitted grievances:

- All grievances received will be formally recorded by the GRC chairman in a Grievance Register to be maintained by the GRC
- A written acknowledgement shall be issued by the GRC chairman to the affected person within three working days of receipt.

- The GRC shall meet to discuss the Grievance within 5 working days of receipt. Attendees, minutes of the meeting and actions arising from the meeting shall be entered into the Grievance Register.
- If required, a second meeting of the GRC shall be held within 20 working days of receipt of the grievance, thus allowing 15 working days for deliberation by the GRC, receipt of legal advice and undertaking of investigations as may be necessary. Attendees, minutes of the meeting and actions arising from the meeting shall be entered into the Grievance Register.
- The final decision of the GRC (arising from the first or second meeting) shall be recorded in the Grievance Register, including any further actions to be taken and both shall be communicated to the affected person in writing within 30 days of receipt of the grievance.
- If a final decision cannot be reached by the GRC within 30 days, the findings of the GRC to date shall be communicated to the affected person in writing. The GRC shall agree upon a timeframe for resolution of the grievance which shall be recorded in the Grievance Register and shall also be communicated to the affected person in writing within 30 days of receipt of the grievance.
- Attendees, minutes and actions arising from any subsequent meetings shall continue to be entered into the Grievance Register, and the affected person shall be updated, in writing, on findings at 30-day intervals.
- If, at any time, the affected person is not satisfied with the decisions or findings of the GRC, they may register their complaint in a court of law.

All costs incurred by the GRC shall be borne by SIDA.

8.11 Documentation of GRC Cases

All records of GRC cases shall be properly maintained by the EMU Office, including minutes of meetings and decisions made by the GRC. The complaints received in writing or received verbally (or by phone) will be entered and properly recorded and documented. The meeting minutes at various GRCs will be recorded and decisions made will be as part of the input in the case record document and filed properly by respective GRCs.

The outcomes of GRC deliberations and decisions will be notified in written form by the Chair of the GRC within a week from the date of the meeting. The decisions taken are mandatory on the SIDA with regard to any additional awards or compensation to be paid to the disputants. The records of all GRC cases must be available for review and verification by SIDA/AWB, WB, Independent monitoring consultants and other interested stakeholders.

8.12 Disclosure

This ESIA will be disclosed in the SIDA website and will be sent to World Bank's external website. The ESIA summary will be translated in to Sindhi and will be uploaded in to the SIDAs website. The hard copies of the documents will be made available to the communities through the Farmers Organisations.

Appendices

APPENDIX-A. Tree Count Survey

This Appendix includes inventory of trees on the embankment which are expected to be cut. It was estimated that 4,865 trees are expected to be cut due to the lining of the canal

(mostly the inner bank of the canal 1,772 trees from RD 0+000 to 194+000), the raising of embankments (inner and outer banks 3,048 Trees from RD 194+000 to 382+000) and construction of diversion channels.

Tree Count Survey

This Appendix includes inventory of trees on the embankment which are expected to be cut. This Appendix contains following three tables

4+000 to 195+000

162+000 to 382+000

RD#	Name of Species Scientific Name	Common Name	Left Bank		Right Bank		unlining - Total Number of Trees to be cut
			Less than 24" & Greater than 6"	Greater than 24"	Less than 24" & Greater than 6"	Greater than 24"	
RD 04-05	Phoenix dactlifera	Khajoor			1		0
RD 05-06	Melia Indica	Neem			2		0
	Acacia Nilotica	Babur			1		0
	Melia Indica	Neem					0
	Albezia lebbeck	Sarehan					0
	Phoenix dactlifera	Khajoor			1		0
RD 06-07	Eucalyptus	Safaido					0
	Mangifera Indica	Amb					0
	Citrus Limon	Limo					0
	Melia Indica	Neem					0
	Albezia lebbeck	Sarehan					0
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur			2		2
RD 07-08	Eucalyptus	Safaido			2		2
	Conocorpus	Conocarpus			1		1
	Syzygium cumini	Jamun			8		4
	Melia Indica	Neem			6		2
RD 08-09	Conocorpus	Conocarpus			8		2
	Melia Indica	Neem			5	2	2
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur			4		0
	Eucalyptus	Safaido			3		0
RD 10-11	Mangifera Indica	Amb			2		0
	Conocorpus	Conocarpus			3		3
	Dalbergia sisso	Tali			4		0
	Zizyphus	Bair			2		2
	Melia Indica	Neem	3		3		0
	Albezia lebbeck	Sarehan	1			2	0
RD 12-13	Eucalyptus	Safaido	1				0
	Ficus religiosa	Pipal	1				0
	Melia Indica	Neem			5	3	3
	Albezia lebbeck	Sarehan	1		6	2	4
	Acacia Nilotica	Babur	2	2	5	1	2
	Eucalyptus	Safaido	2	3			0
RD 13-14	Conocorpus	Conocarpus		15			15
	Syzygium cumini	Jamun			1		0
	Ficus religiosa	Pipal			2		0
	Pithecellobium dulce	Jalebi			1		0
RD 15-16	Phoenix dactlifera	Khajoor				1	1

	Acacia Nilotica	Babur			5		2
	Melia Indica	Neem		2			0
RD 16-17	Albezia lebbeck	Sarehan					0
	Conocorpus	Conocarpus			15		15
	Dalbergia sisso	Tali			1		0
	Zizyphus	Bair			6		0
	Melia Indica	Neem			4		0
	Albezia lebbeck	Sarehan			1		0
RD 17-18	Acacia Nilotica	Babur					
	Eucalyptus	Safaido			23		15
	Syzygium cumini	Jamun			1		0
RD 18-19	Albezia lebbeck	Sarehan			4	2	4
	Melia Indica	Neem			4		2
	Albezia lebbeck	Sarehan	3		5	1	9
	Phoenix dactlifera	Khajoor	1		1		0
	Acacia Nilotica	Babur	1		6	2	5
RD 19-20	Eucalyptus	Safaido			4		
	Dalbergia sisso	Tali					
	Ficus religiosa	Pipal					
	Melia Indica	Neem			3		3
	Albezia lebbeck	Sarehan			4		4
	Phoenix dactlifera	Khajoor	1				1
RD 20-21	Acacia Nilotica	Babur			1		1
	Eucalyptus	Safaido			2		2
	Conocorpus	Conocarpus			1		1
	Melia Indica	Neem			2	3	5
	Albezia lebbeck	Sarehan	1	1	2		4
	Phoenix dactlifera	Khajoor			1		1
	Eucalyptus	Safaido			3	5	8
RD 21-22	Conocorpus	Conocarpus					
	Syzygium cumini	Jamun					
	Ficus religiosa	Pipal	1				1
	Melia Indica	Neem	2			6	3
	Phoenix dactlifera	Khajoor					
	Eucalyptus	Safaido	1				1
	Conocorpus	Conocarpus			20		15
RD 22-23	Dalbergia sisso	Tali			1		1
	Zizyphus	Bair		1			1
	Ficus religiosa	Pipal			2		2
	Melia Indica	Neem			4		4
	Albezia lebbeck	Sarehan			1		1
RD 23-24	Conocorpus	Conocarpus	8	1	3		12
	Zizyphus	Bair			2		2
	Melia Indica	Neem		4	1	8	6
	Albezia lebbeck	Sarehan			1		1
RD 24-25	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur					
	Conocorpus	Conocarpus	1		2	1	4
RD 26-27	Melia Indica	Neem	5				0
	Albezia lebbeck	Sarehan	3				0
	Acacia Nilotica	Babur	2				0

	Eucalyptus	Safaido	6				6
	Mangifera Indica	Amb	1				1
	Conocorpus	Conocarpus	15				15
RD 27-28	Dalbergia sisso	Tali	2				0
	Ficus religiosa	Pipal	2				0
	Melia Indica	Neem				8	2
RD 28-29	Melia Indica	Neem	4			10	5
	Albezia lebbeck	Sarehan				5	0
	Acacia Nilotica	Babur	1	6		4	5
	Mangifera Indica	Amb		8			3
RD 29-30	Conocorpus	Conocarpus	8				8
	Ficus religiosa	Pipal		1	1	2	0
	Melia Indica	Neem				4	0
	Albezia lebbeck	Sarehan				2	0
	Acacia Nilotica	Babur			1		0
	Melia Indica	Neem				8	0
RD 30-31	Albezia lebbeck	Sarehan	5		3		5
	Phoenix dactlifera	Khajoor	3				3
	Melia Indica	Neem	3	2	2	2	1
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	1				1
RD 31-32	Eucalyptus	Safaido		2	1		3
	Dalbergia sisso	Tali	1				1
	Pithecellobium dulce	Jalebi		1	1		0
	Melia Indica	Neem			3	4	0
	Albezia lebbeck	Sarehan	2				0
RD 32-33	Eucalyptus	Safaido	1				1
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi					0
	Melia Indica	Neem		2		4	0
	Albezia lebbeck	Sarehan	3			1	0
	Phoenix dactlifera	Khajoor			1		0
RD 33-34	Acacia Nilotica	Babur			2		2
	Ficus religiosa	Pipal	2		1	3	6
	Pongamia pinnata	Sukhchain	1				1
	Melia Indica	Neem		2	1	6	9
	Albezia lebbeck	Sarehan	1				1
	Phoenix dactlifera	Khajoor	1		3		2
RD 34-36	Acacia Nilotica	Babur	4		2		6
	Eucalyptus	Safaido		1	5		3
	Mangifera Indica	Amb		5	2	1	8
	Conocorpus	Conocarpus			8		5
	Ficus religiosa	Pipal		1			1
	Pithecellobium dulce	Jalebi		5			
	Pongamia pinnata	Sukhchain	1				1
	Ziziphus jujube	Ber		1			1
	Delonix regia	Gulmoher			1		0
	Melia Indica	Neem	2	2	5	3	5
	Albezia lebbeck	Sarehan	1		4	4	9
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	2		3	2	7

	Conocorpus	Conocarpus			5		5
	Syzygium cumini	Jamun			2		2
RD 36-37	Zizyphus	Bair			3		3
	Ficus religiosa	Pipal	2			2	4
	Pithecellobium dulce	jalebi			3		3
	Ziziphus jujube	Ber				3	3
	Psidium guajava	Amrood	1				1
	Melia Indica	Neem	2	5		8	15
	Phoenix dactlifera	Khajoor					0
	Acacia Nilotica	Babur	1			1	2
	Eucalyptus	Safaido				1	1
RD 37-38	Mangifera Indica	Amb					0
	Conocorpus	Conocarpus			6	3	9
	Syzygium cumini	Jamun					0
	Melia Indica	Neem				2	2
RD 38-39	Albezia lebbeck	Sarehan				4	4
	Phoenix dactlifera	Khajoor				2	2
	Melia Indica	Neem			2	3	0
	Phoenix dactlifera	Khajoor					0
	Acacia Nilotica	Babur			2	1	3
	Zizyphus	Bair			3		3
	Pithecellobium dulce	Jalebi			1		1
	Albezia lebbeck	Sarehan		2		1	3
	Acacia Nilotica	Babur			4		4
	Eucalyptus	Safaido				2	2
RD 39-40	Mangifera Indica	Amb					0
	Conocorpus	Conocarpus			5		2
	Syzygium cumini	Jamun					0
	Pithecellobium dulce	Jalebi	1		1	1	0
	Psidium guajava	Amrood			1		1
	Terminalia catappa	Badam			3	3	0
	Melia Indica	Neem			3	5	0
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur			4	3	5
	Eucalyptus	Safaido			9		5
RD 40-41	Conocorpus	Conocarpus			7		1
	Ficus religiosa	Pipal				1	1
	Pithecellobium dulce	Jalebi			1		1
	Albezia lebbeck	Sarehan				1	3
	Melia Indica	Neem				3	0
	Acacia Nilotica	Babur					1
	Mangifera Indica	Amb			1		0
RD 41-42	Conocorpus	Conocarpus					0
	Ziziphus jujube	Ber				1	0
	Syzygium cumini	Jamun			1		0
	Melia Indica	Neem			4	5	9
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur					
	Eucalyptus	Safaido					
RD 42-43	Conocorpus	Conocarpus					
	Ziziphus jujube	Ber				3	0

	Dalbergia sisso	Tali					
	Melia Indica	Neem			1		0
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur			3	3	6
RD 43-45	Eucalyptus	Safaido			1		1
	Conocorpus	Conocarpus					
	Ficus religiosa	Pipal					
	Melia Indica	Neem			5		
	Albezia lebbeck	Sarehan				2	2
	Conocorpus	Conocarpus					
RD 46-47	Dalbergia sisso	Tali					
	Ficus religiosa	Pipal					
	Ziziphus jujube	Ber				3	3
	Melia Indica	Neem					
	Acacia Nilotica	Babur					
RD 47-48	Eucalyptus	Safaido			1		0
	Citrus Limon	limo					
	Conocorpus	Conocarpus			5		2
RD 48-49	Melia Indica	Neem	4				
RD 49-50	Albezia lebbeck	Sarehan	2				
	Conocorpus	Conocarpus		2			
	Melia Indica	Neem			6	2	5
RD 50-54	Acacia Nilotica	Babur			6	1	2
	Eucalyptus	Safaido					
	Conocorpus	Conocarpus		2	5		5
	Prosopis cineraria	Kandi					
	Cordia myxa	Lessori			1		1
	Melia Indica	Neem		2	3	3	4
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	1		8	2	7
	Eucalyptus	Safaido			1		1
RD 54-55	Pongamia pinnata	Sukhchain			1		1
	Conocorpus	Conocarpus			3		0
	Ficus religiosa	Pipal		4			0
	Syzygium cumini	Jamun		2			0
	Melia Indica	Neem		3	2	3	0
	Albezia lebbeck	Sarehan			2		0
	Acacia Nilotica	Babur		1		1	0
	Mangifera Indica	Amb				3	0
	Citrus Limon	Limo				1	1
RD 55-56	Syzygium cumini	Jamun				2	2
	Zizyphus	Bair	1				
	Ficus religiosa	Pipal			1	1	2
	Psidium guajava	Amrood			2		2
	Melia Indica	Neem		1			0
	Acacia Nilotica	Babur	1				1
RD 56-57	Conocorpus	Conocarpus			2	3	0
	Zizyphus	Bair			1		0
	Melia Indica	Neem		1	1	4	0
RD 57-58	Acacia Nilotica	Babur	2		3		0
	Conocorpus	Conocarpus			25		10

	Melia Indica	Neem			1		1
	Acacia Nilotica	Babur		2	3	2	2
RD 58-59	Pongamia pinnata	Sukhchain		1			0
	Conocorpus	Conocarpus			3		3
	Albezia lebbeck	Sarehan		1			0
RD 59-60	Acacia Nilotica	Babur					0
	Eucalyptus	Safaido		2			0
	Conocorpus	Conocarpus	10				5
	Acacia Nilotica	Babur	2				0
RD 60-61	Eucalyptus	Safaido	5				0
	Conocorpus	Conocarpus	2				0
	Acacia Nilotica	Babur	1	1	1	1	0
RD 61-62	Conocorpus	Conocarpus			3		3
	Melia Indica	Neem			2	4	6
RD 62-63	Albezia lebbeck	Sarehan				1	1
	Acacia Nilotica	Babur				2	2
RD 63-64	Conocorpus	Conocarpus			35		10
	Ficus religiosa	Pipal				1	0
	Ziziphus jujube	Ber		1			0
	Melia Indica	Neem			1	3	0
	Albezia lebbeck	Sarehan				1	0
	Acacia Nilotica	Babur			3	5	0
	Eucalyptus	Safaido			1		0
	Conocorpus	Conocarpus					0
	Pithecellobium dulce	Jalebi					0
	Melia Indica	Neem	1		3	9	5
	Albezia lebbeck	Sarehan			1	2	0
	Phoenix dactlifera	Khajoor					0
	Acacia Nilotica	Babur		2	2	2	0
	Eucalyptus	Safaido		3			0
	Conocorpus	Conocarpus	2		2		0
RD 64-65	Syzygium cumini	Jamun	1				0
	Dalbergia sisso	Tali		1			0
	Pithecellobium dulce	Jalebi			3		0
	Ziziphus jujube	Ber			1		0
	Melia Indica	Neem	1		3	4	0
	Albezia lebbeck	Sarehan				1	0
	Phoenix dactlifera	Khajoor		1		1	0
	Acacia Nilotica	Babur			2	2	4
RD 65-66	Eucalyptus	Safaido				1	1
	Conocorpus	Conocarpus		1	6	1	5
	Zizyphus	Bair	1				0
	Pithecellobium dulce	Jalebi			2		2
	Melia Indica	Neem		1	3	5	2
	Albezia lebbeck	Sarehan			1		1
	Acacia Nilotica	Babur	2		2	2	6
RD 66-67	Conocorpus	Conocarpus			2	1	3
	Pithecellobium dulce	Jalebi	2				0
	Tamarindus indica	Imli			2		0
	Melia Indica	Neem				7	5
	Phoenix dactlifera	Khajoor		2			0

	Acacia Nilotica	Babur			2	2	4
	Conocorpus	Conocarpus			3	1	2
RD 67-68	Syzygium cumini	Jamun		2			0
	Pithecellobium dulce	Jalebi			2		2
	Cordia myxa	Lessori			2		2
	Melia Indica	Neem			7	4	0
	Albezia lebbeck	Sarehan				3	0
RD 68-70	Phoenix dactlifera	Khajoor			1	1	2
	Acacia Nilotica	Babur			4	4	0
	Eucalyptus	Safaido		1	5	2	0
	Conocorpus	Conocarpus			5		0
	Syzygium cumini	Jamun			2	2	4
	Dalbergia sisso	Tali				4	0
	Zizyphus	Bair			1		0
	Pithecellobium dulce	Jalebi			3		3
	Ziziphus jujube	Ber				3	0
	Cordia myxa	Lessori			1		0
	Acacia Nilotica	Babur			1		1
RD 70-71	Eucalyptus	Safaido	1				0
	Syzygium cumini	Jamun			1		0
	Dalbergia sisso	Tali			2		0
	Phoenix dactlifera	Khajoor			1		0
	Acacia Nilotica	Babur			2		0
	Conocorpus	Conocarpus			8		4
RD 71-73	Dalbergia sisso	Tali			4		0
	Ziziphus jujube	Ber	1				0
	Prosopis cineraria	Kandi		2			0
RD 73-74	Melia Indica	Neem		5			0
	Phoenix dactlifera	Khajoor		4		1	0
RD 74-75	Acacia Nilotica	Babur	1	1			0
	Ziziphus jujube	Ber			1		0
	Melia Indica	Neem				2	0
	Acacia Nilotica	Babur		5			0
RD 75-76	Eucalyptus	Safaido		2			0
	Conocorpus	Conocarpus			2		0
	Zizyphus	Bair			1		1
	Melia Indica	Neem				1	0
	Phoenix dactlifera	Khajoor		1	1	1	0
	Acacia Nilotica	Babur		2			0
RD 76-77	Phoenix dactlifera	Khajoor				1	0
	Acacia Nilotica	Babur			1	1	0
	Eucalyptus	Safaido			1		1
RD 77-78	Conocorpus	Conocarpus	1				1
	Syzygium cumini	Jamun	1				0
	Cordia myxa	Lessori	1				0
	Melia Indica	Neem		3	1		0
RD 78-79	Albezia lebbeck	Sarehan	1				0
	Acacia Nilotica	Babur		2			0
	Phoenix dactlifera	Khajoor		1			0
	Acacia Nilotica	Babur		2		1	0
RD 79-80	Eucalyptus	Safaido	1				0

	Mangifera Indica	Amb	4				0
	Conocorpus	Conocarpus	6				0
	Syzygium cumini	Jamun		2			0
RD 80-81	Acacia Nilotica	Babur		4			0
	Eucalyptus	Safaido		2			0
	Zizyphus	Bair		2			0
	Phoenix dactlifera	Khajoor	1				0
RD 81-82	Acacia Nilotica	Babur		1			0
	Eucalyptus	Safaido		2			0
	Melia Indica	Neem			1	3	4
	Albezia lebbeck	Sarehan			1		0
	Acacia Nilotica	Babur	1	1	2		0
RD 82-83	Conocorpus	Conocarpus			2	2	2
	Albezia lebbeck	Sarehan				1	0
	Phoenix dactlifera	Khajoor	1				0
	Acacia Nilotica	Babur		1	3	4	0
RD 83-84	Eucalyptus	Safaido			1		0
	Conocorpus	Conocarpus			1		0
	Eucalyptus	Safaido		1	3		0
	Mangifera Indica	Amb		1			0
RD 84-85	Conocorpus	Conocarpus		2			0
	Dalbergia sisso	Tali	1				1
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi	1				1
RD 85-86	Melia Indica	Neem	4				0
	Acacia Nilotica	Babur	1		1		2
	Conocorpus	Conocarpus	2				0
	Melia Indica	Neem			1		0
RD 86-87	Phoenix dactlifera	Khajoor	1				0
	Acacia Nilotica	Babur	1				0
	Melia Indica	Neem		1			0
	Albezia lebbeck	Sarehan		1			0
RD 87-88	Acacia Nilotica	Babur		4			0
	Eucalyptus	Safaido		5			0
	Conocorpus	Conocarpus		6			3
	Acacia Nilotica	Babur	1				0
RD 88-89	Eucalyptus	Safaido	3				3
RD 89-90	Acacia Nilotica	Babur	3				3
	Phoenix dactlifera	Khajoor			1		1
RD 90-91	Acacia Nilotica	Babur	2				2
RD 91-92	Acacia Nilotica	Babur	1		1		2
RD 92-93	Acacia Nilotica	Babur		4	3		3
RD 93-94	Acacia Nilotica	Babur		2			2
RD 94-95	Melia Indica	Neem			4		0
	Albezia lebbeck	Sarehan			3		0
	Melia Indica	Neem			2		1
	Acacia Nilotica	Babur	1				1
RD 95-96	Eucalyptus	Safaido		4			0
	Syzygium cumini	Jamun		2			0
	Melia Indica	Neem				2	2
	Albezia lebbeck	Sarehan			5		0

RD 97-98	Phoenix dactlifera	Khajoor					0
	Acacia Nilotica	Babur	3			2	2
	Melia Indica	Neem				4	0
	Albezia lebbeck	Sarehan				2	0
	Phoenix dactlifera	Khajoor			1	2	0
	Acacia Nilotica	Babur				5	0
RD 98-100	Conocorpus	Conocarpus			2	1	0
	Zizyphus	Bair			1		0
	Ficus religiosa	Pipal			1		0
	Pithecellobium dulce	Jalebi			1		1
	Melia Indica	Neem			1		1
	Acacia Nilotica	Babur				4	0
	Eucalyptus	Safaido			2		0
RD 100-101	Conocorpus	Conocarpus			4		2
	Syzygium cumini	Jamun			3		0
	Pithecellobium dulce	Jalebi	1				1
	Melia Indica	Neem	6		4	1	5
	Albezia lebbeck	Sarehan	4				3
RD 101-102	Acacia Nilotica	Babur	5	1	3	1	5
	Conocorpus	Conocarpus	3		3		0
	Melia Indica	Neem	2		2	1	0
	Albezia lebbeck	Sarehan		1			0
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur		4	2	1	0
	Eucalyptus	Safaido			1		1
	Conocorpus	Conocarpus	1		3	2	0
	Syzygium cumini	Jamun	2				0
	Dalbergia sisso	Tali			3	1	0
RD 102-103	Cordia myxa	Lessori	1				1
	Melia Indica	Neem	1		1	7	0
	Albezia lebbeck	Sarehan				1	1
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur		7	3		6
	Eucalyptus	Safaido			2		0
RD 103-105	Mangifera Indica	Amb	1				0
	Pongamia pinnata	Sukhchain					0
	Conocorpus	Conocarpus			15		10
	Cordia myxa	Lessori		1			1
RD 105-106	Acacia Nilotica	Babur	1	15			5
	Melia Indica	Neem				2	2
RD 106-107	Acacia Nilotica	Babur		6			2
RD 107-108	Acacia Nilotica	Babur		3			1
	Melia Indica	Neem	1	1			1
	Albezia lebbeck	Sarehan	1				0
	Phoenix dactlifera	Khajoor	1				0
RD 108-109	Acacia Nilotica	Babur	1	3			0
	Eucalyptus	Safaido		2			2
	Pithecellobium dulce	Jalebi	1				0
	Acacia Nilotica	Babur		1			0
RD 109-110	Conocorpus	Conocarpus	1				0
	Melia Indica	Neem			1		0

RD 110-111	Phoenix dactlifera	Khajoor	1		1		0
	Acacia Nilotica	Babur		8	2		4
	Conocorpus	Conocarpus			4		0
	Syzygium cumini	Jamun				2	2
	Melia Indica	Neem	3				0
	Albezia lebbeck	Sarehan		1		2	0
	Phoenix dactlifera	Khajoor	1		3		0
RD 111-114	Acacia Nilotica	Babur	5		2	3	5
	Syzygium cumini	Jamun		1			1
	Zizyphus	Bair	1				0
	Phoenix dactlifera	Khajoor					0
RD 114-115	Acacia Nilotica	Babur	3		2	15	0
	Ficus religiosa	Pipal			1		1
	Melia Indica	Neem	2				0
	Acacia Nilotica	Babur	5		3		0
RD 115-116	Conocorpus	Conocarpus		1			1
	Dalbergia sisso	Tali	2				2
	Phoenix dactlifera	Khajoor		1			1
RD 116-117	Acacia Nilotica	Babur		2			2
	Zizyphus	Bair	1				1
	Melia Indica	Neem	2	8	1		0
	Albezia lebbeck	Sarehan		2	3		5
	Acacia Nilotica	Babur	3		6		5
RD 117-118	Eucalyptus	Safaido			7		0
	Dalbergia sisso	Tali			2		2
	Zizyphus	Bair		1			1
	Melia Indica	Neem		3	2		0
	Albezia lebbeck	Sarehan			1		0
	Phoenix dactlifera	Khajoor	1				1
RD 118-119	Acacia Nilotica	Babur				2	2
	Eucalyptus	Safaido			2		0
	Conocorpus	Conocarpus			1		1
	Albezia lebbeck	Sarehan				1	1
RD 119-120	Phoenix dactlifera	Khajoor			3		0
	Acacia Nilotica	Babur	1				1
	Melia Indica	Neem	20		5	3	10
	Albezia lebbeck	Sarehan	1		2	1	0
	Phoenix dactlifera	Khajoor	1	1	7		0
	Acacia Nilotica	Babur	5		8	2	0
	Eucalyptus	Safaido	7			2	0
	Conocorpus	Conocarpus	10	6	6		10
RD 120-121	Syzygium cumini	Jamun	5				0
	Dalbergia sisso	Tali	2				2
	Pithecellobium dulce	Jalebi	1		3		4
	Ziziphus jujube	Ber		1		2	3
	Cordia myxa	Lessori	1				0
RD 121-122	Melia Indica	Neem		1	5		0
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur			10		0
	Conocorpus	Conocarpus	2				2
	Dalbergia sisso	Tali		2			2

	Pithecellobium dulce	Jalebi			1		0
	Tamarindus indica	Gidamri			1		1
	Melia Indica	Neem		1		1	2
	Albezia lebbeck	Sarehan			1		1
	Phoenix dactlifera	Khajoor			4		0
	Acacia Nilotica	Babur	3		6		0
RD 122-123	Eucalyptus	Safaido	10	15		4	10
	Conocorpus	Conocarpus	10	9			8
	Syzygium cumini	Jamun				1	1
	Melia Indica	Neem		2			2
	Albezia lebbeck	Sarehan			4		0
	Phoenix dactlifera	Khajoor			5		0
	Acacia Nilotica	Babur	8		3	1	5
	Eucalyptus	Safaido	5				0
RD 123-124	Conocorpus	Conocarpus	8				0
	Syzygium cumini	Jamun		10			0
	Pithecellobium dulce	Jalebi	1				1
	Cordia myxa	Lessori		2			2
	Acacia Nilotica	Babur	4			4	0
RD 124-125	Eucalyptus	Safaido	6				0
	Phoenix dactlifera	Khajoor		2			2
	Acacia Nilotica	Babur		10		6	4
RD 125-126	Conocorpus	Conocarpus	12	10			0
	Dalbergia sisso	Tali		4			0
	Zizyphus	Bair		3			0
	Melia Indica	Neem		1			0
	Albezia lebbeck	Sarehan	4	6			0
	Phoenix dactlifera	Khajoor	1	1			2
	Acacia Nilotica	Babur	15	2	4		0
	Eucalyptus	Safaido	7	4			0
RD 126-127	Conocorpus	Conocarpus				4	4
	Syzygium cumini	Jamun				2	2
	Dalbergia sisso	Tali		3			3
		Sumbul	13	14			12
	Melia Indica	Neem		1	4		3
	Albezia lebbeck	Sarehan			5		5
	Phoenix dactlifera	Khajoor	1		3		4
RD 127-128	Acacia Nilotica	Babur			7		2
	Eucalyptus	Safaido			15		0
	Conocorpus	Conocarpus			20		10
RD 128-129	Dalbergia sisso	Tali			5		0
	Ficus religiosa	Pipal			5		0
	Terminalia catappa	Badam	2				2
	Cordia myxa	Lessori			1		1
	Albezia lebbeck	Sarehan			5		5
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	3		2	1	5
	Eucalyptus	Safaido				3	3
	Dalbergia sisso	Tali	8		5		10
	Dalbergia sisso	Tali				1	1
	Pithecellobium dulce	Jalebi				1	1

	Albezia lebbeck	Sarehan	3				3
	Phoenix dactlifera	Khajoor		1			1
RD 130-131	Acacia Nilotica	Babur	3	4			2
	Dalbergia sisso	Tali	7				2
	Pithecellobium dulce	Jalebi				1	1
	Melia Indica	Neem		1			1
RD 131-132	Mangifera Indica	Amb	2				0
	Terminalia catappa	Badam			2		0
	Acacia Nilotica	Babur	2				0
	Conocorpus	Conocarpus		1			1
RD 132-133	Dalbergia sisso	Tali	2				2
	Ziziphus jujube	Ber	1				1
	Melia Indica	Neem		1			1
	Acacia Nilotica	Babur	1	2	1		0
	Mangifera Indica	Amb		1			1
	Conocorpus	Conocarpus				2	2
RD 133-134	Dalbergia sisso	Tali				1	1
	Psidium guajava	Amrood			1		0
	Terminalia catappa	Badam	2				2
	Cordia myxa	Lessori	1				1
	Phoenix dactlifera	Khajoor				1	1
RD 135-136	Conocorpus	Conocarpus			1		1
	Cordia myxa	Lessori	1				1
	Melia Indica	Neem				1	1
	Conocorpus	Conocarpus			2		0
RD 137-138	Syzygium cumini	Jamun				5	0
	Pithecellobium dulce	Jalebi				1	0
	Cordia myxa	Lessori	1				0
RD 138-139	Melia Indica	Neem		1			1
	Albezia lebbeck	Sarehan		2			2
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur		3		1	0
	Eucalyptus	Safaido		2			0
	Syzygium cumini	Jamun			1		0
	Dalbergia sisso	Tali		1			1
	Ficus religiosa	Pipal		1			0
	Ziziphus jujube	Ber		1			0
	Terminalia catappa	Badam	2				0
	Melia Indica	Neem				2	0
	Albezia lebbeck	Sarehan		2			0
	Acacia Nilotica	Babur	15		2	1	4
	Eucalyptus	Safaido			2		0
RD 139-140	Conocorpus	Conocarpus	10		1		0
	Dalbergia sisso	Tali	5				0
	Pithecellobium dulce	Jalebi	2		2		0
	Melia Indica	Neem		1		3	0
	Albezia lebbeck	Sarehan			1		0
	Phoenix dactlifera	Khajoor			2		0
	Acacia Nilotica	Babur		2	5		3
	Eucalyptus	Safaido			1		1
	Syzygium cumini	Jamun	2				0

RD 140-141	Dalbergia sisso	Tali			2		2
	Pithecellobium dulce	Jalebi			4		4
	Ziziphus jujube	Ber				1	1
	Terminalia catappa	Badam		2			0
	Cordia myxa	Lessori				1	1
	Melia Indica	Neem		1		4	5
	Albezia lebbeck	Sarehan		4	2		6
	Phoenix dactlifera	Khajoor			2	2	4
RD 141-142	Dalbergia sisso	Tali		1			1
	Ziziphus jujube	Ber			1	1	2
	Cordia myxa	Lessori		1	1		2
	Melia Indica	Neem			5		3
	Albezia lebbeck	Sarehan			2		0
	Acacia Nilotica	Babur			3		0
	Eucalyptus	Safaido			2		2
RD 142-143	Conocarpus	Conocarpus			2		2
	Syzygium cumini	Jamun			5		0
	Pithecellobium dulce	Jalebi			1		0
	Melia Indica	Neem	5	9	1		10
	Phoenix dactlifera	Khajoor	2				2
RD 143-144	Acacia Nilotica	Babur	7	15	4	2	10
	Conocorpus	Conocarpus	8	2		1	11
	Pithecellobium dulce	Jalebi	4				4
RD 144-145	Ziziphus jujube	Ber				1	1
	Melia Indica	Neem	2	18	4		10
	Albezia lebbeck	Sarehan	6				6
	Phoenix dactlifera	Khajoor	5				5
	Acacia Nilotica	Babur	22	8	6	2	15
	Eucalyptus	Safaido			4		0
	Mangifera Indica	Amb		4			0
	Conocarpus	Conocarpus	4	12			10
	Syzygium cumini	Jamun	1	9			5
	Dalbergia sisso	Tali		1	2	6	4
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi			1		1
	Psidium guajava	Amrood	1				1
	Ziziphus jujube	Ber		1			0
	Melia Indica	Neem	2	1			0
	Albezia lebbeck	Sarehan	2	5	1	1	0
	Phoenix dactlifera	Khajoor	2				0
	Acacia Nilotica	Babur	22		3	12	20
	Eucalyptus	Safaido				1	1
	Conocarpus	Conocarpus	1	6	1		3
RD 145-146	Syzygium cumini	Jamun		1			1
	Debergia sisso	Tali			12	2	10
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi	2	1			3
	Melia Indica	Neem	1	1			2
	Albezia lebbeck	Sarehan	3				3
	Acacia Nilotica	Babur	10			20	10
	Eucalyptus	Safaido	1				1

	Conocorpus	Conocarpus	3	4			7
RD 146-147	Syzygium cumini	Jamun		1			1
	Ficus religiosa	Pipal	3				3
	Pithecellobium dulce	Jalebi	3				3
	Ziziphus jujube	Ber	1				1
	Melia Indica	Neem	1	1			2
	Phoenix dactlifera	Khajoor	1			1	2
	Acacia Nilotica	Babur	8	6	10	20	10
	Eucalyptus	Safaido	2	1			3
	Conocorpus	Conocarpus	10				10
	Syzygium cumini	Jamun					0
RD 147-148	Dalbergia sisso	Tali	2			2	2
	Zizyphus	Bair	1				1
	Ficus religiosa	Pipal	1				1
	Pithecellobium dulce	Jalebi	2				2
	Ziziphus jujube	Ber	1				1
RD 148-149	Melia Indica	Neem		6		1	7
	Albezia lebbeck	Sarehan	2			1	3
	Phoenix dactlifera	Khajoor			10		10
	Acacia Nilotica	Babur	6		2	5	5
	Eucalyptus	Safaido	8				0
	Mangifera Indica	Amb	2				0
	Syzygium cumini	Jamun	1				0
	Dalbergia sisso	Tali	5	2			0
	Zizyphus	Bair			4		2
	Pithecellobium dulce	Jalebi	3				3
	Albezia lebbeck	Sarehan				6	5
	Phoenix dactlifera	Khajoor	2				2
RD 149-150	Acacia Nilotica	Babur			11	7	10
	Conocorpus	Conocarpus	5	1	3		4
	Dalbergia sisso	Tali			3		2
	Melia Indica	Neem	1	1		1	0
	Phoenix dactlifera	Khajoor				1	1
	Acacia Nilotica	Babur	2		2		0
	Conocorpus	Conocarpus		3		1	4
RD 150-151	Syzygium cumini	Jamun	1				1
	Dalbergia sisso	Tali		1	4		2
	Pithecellobium dulce	Jalebi			1		1
	Acacia Nilotica	Babur			1		1
RD 151-152	Dalbergia sisso	Tali			4		2
	Acacia Nilotica	Babur	1		3		4
RD 152-153	Dalbergia sisso	Tali			7		2
	Melia Indica	Neem		3			3
RD 153-154	Acacia Nilotica	Babur	3		5		8
	Dalbergia sisso	Tali			3		3
	Melia Indica	Neem		1			1
	Acacia Nilotica	Babur	5	6	4		5
RD 154-155	Syzygium cumini	Jamun		1			1
	Dalbergia sisso	Tali	2				2
	Melia Indica	Neem	2	5			7
	Acacia Nilotica	Babur			5	2	7

	Syzygium cumini	Jamun		2			2
RD 155-156	Dalbergia sisso	Tali			3		3
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi		1			1
RD 156-157	Acacia Nilotica	Babur			1		1
	Melia Indica	Neem	1				1
	Acacia Nilotica	Babur			2		2
RD 157-158	Eucalyptus	Safaido			4		4
	Dalbergia sisso	Tali	5				5
RD 158-159	Melia Indica	Neem		1			1
RD 159-160	Albezia lebbeck	Sarehan	4				0
	Acacia Nilotica	Babur	1		4		5
	Eucalyptus	Safaido			2		2
	Conocorpus	Conocarpus			2		2
	Pithecellobium dulce	Jalebi			2		2
	Acacia Nilotica	Babur	3		2		0
	Dalbergia sisso	Tali			2		0
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi		1			1
	Melia Indica	Neem		3	1		4
	Albezia lebbeck	Sarehan		1			1
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	3	4	2		2
RD 160-161	Conocorpus	Conocarpus	1				1
	Dalbergia sisso	Tali		1	1	1	3
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi		1	2		3
	Melia Indica	Neem		4		2	2
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur		3	2		0
RD 161-162	Conocorpus	Conocarpus			1		1
	Syzygium cumini	Jamun				1	1
	Pithecellobium dulce	Jalebi			3		3
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur			3		3
RD 162-163	Mangifera Indica	Amb	2				2
	Dalbergia sisso	Tali			1		1
	Pithecellobium dulce	Jalebi	1				1
	Melia Indica	Neem	1			1	2
	Acacia Nilotica	Babur			1	2	3
	Eucalyptus	Safaido			2		0
	Mangifera Indica	Amb			2		2
RD 163-164	Syzygium cumini	Jamun			4	2	4
	Pithecellobium dulce	Jalebi			2		0
	Psidium guajava	Amrood				1	1
	Melia Indica	Neem			1		1
	Albezia lebbeck	Sarehan			3	1	4
	Phoenix dactlifera	Khajoor				2	2
	Acacia Nilotica	Babur			2		2
	Eucalyptus	Safaido	2				2
	Mangifera Indica	Amb				2	2

	Citrus Limon	Sukhchain			2		2
	Conocorpus	Conocarpus			1	2	3
	Syzygium cumini	Jamun		1		1	2
	Dalbergia sisso	Tali			2		2
RD 164-165	Pithecellobium dulce	Jalebi	1		2		3
	Psidium guajava	Amrood			2		0
	Ziziphus jujube	Ber	2				0
	Cordia myxa	Lessori			2		0
	Albezia lebbeck	Sarehan	2				2
RD 165-166	Dalbergia sisso	Tali			2		2
RD 166-167	Phoenix dactlifera	Khajoor		1			1
	Melia Indica	Neem	2	5		3	10
	Albezia lebbeck	Sarehan	2				2
	Phoenix dactlifera	Khajoor	1		1		2
	Acacia Nilotica	Babur	4	2		3	9
	Eucalyptus	Safaido	15				10
	Mangifera Indica	Amb	4	1			5
	Conocorpus	Conocarpus	4	2			6
RD 167-168	Syzygium cumini	Jamun	1				1
	Dalbergia sisso	Tali			2	4	6
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi		3			3
	Melia Indica	Neem		2	3	1	6
	Albezia lebbeck	Sarehan			1		1
	Phoenix dactlifera	Khajoor	3				3
	Acacia Nilotica	Babur				2	2
	Eucalyptus	Safaido	2				2
	Mangifera Indica	Amb	2				2
RD 168-169	Conocorpus	Conocarpus			2		2
	Syzygium cumini	Jamun	7		1		8
	Melia Indica	Neem		1			1
	Albezia lebbeck	Sarehan		3			3
	Syzygium cumini	Jamun	1				1
	Pithecellobium dulce	Jalebi	1				1
RD 169-170	Melia Indica	Neem		1		1	2
	Albezia lebbeck	Sarehan	1				1
	Acacia Nilotica	Babur		3	1		4
	Mangifera Indica	Amb		1			1
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi		2			2
RD 170-171	Melia Indica	Neem		6	3	2	11
	Albezia lebbeck	Sarehan		3			3
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	2	3	1	1	7
	Mangifera Indica	Amb	1				1
	Syzygium cumini	Jamun		2			2
	Dalbergia sisso	Tali	2	1	3		6
RD 171-172	Pithecellobium dulce	Jalebi		2			2
	Cordia myxa	Lessori	1	1			2
	Melia Indica	Neem	4	7	4	5	15
	Phoenix dactlifera	Khajoor	2		2		0

	Acacia Nilotica	Babur			3	2	5
	Eucalyptus	Safaido		1			1
	Mangifera Indica	Amb			3	3	6
	Syzygium cumini	Jamun	1		4		5
	Dalbergia sisso	Tali	1				1
RD 172-173	Ficus religiosa	Pipal				2	0
	Pithecellobium dulce	Jalebi		1	3	2	6
	Psidium guajava	Amrood			1		1
	Ziziphus jujube	Ber	2			2	0
	Citrus limon	limu				2	0
	Melia Indica	Neem		2	4	3	9
	Albezia lebbeck	Sarehan	1			2	3
	Acacia Nilotica	Babur	3	1	2	3	4
	Eucalyptus	Safaido			2		0
	Mangifera Indica	Amb	1		1	2	4
	Dalbergia sisso	Tali	4	5		1	5
RD 173-174	Ficus religiosa	Pipal			1		1
	Pithecellobium dulce	Jalebi	1				1
	Terminalia catappa	Badam				3	3
	Ziziphus jujube	Ber			1		1
	Cordia myxa	Lessori				1	1
	Melia Indica	Neem		1		1	2
	Acacia Nilotica	Babur	2	4		3	9
	Mangifera Indica	Amb	3				3
RD 174-175	Syzygium cumini	Jamun		2			2
	Dalbergia sisso	Tali	1				1
	Prosopis cineraria	Kandi		1			1
	Melia Indica	Neem	2	2		3	5
	Albezia lebbeck	Sarehan	1	1			2
	Acacia Nilotica	Babur		5	1		0
	Mangifera Indica	Amb		1	1		2
	Conocorpus	Conocarpus			5		2
RD 175-176	Syzygium cumini	Jamun			1		1
	Dalbergia sisso	Tali	5				5
	Pithecellobium dulce	Jalebi	3				3
	Citrus limun	limu				5	0
	Melia Indica	Neem			4		4
	Albezia lebbeck	Sarehan			2	2	4
	Acacia Nilotica	Babur				2	0
	Mangifera Indica	Amb			1		1
RD 176-177	Syzygium cumini	Jamun			2		2
	Dalbergia sisso	Tali	2		3	1	6
	Pithecellobium dulce	Jalebi				1	1
	Terminalia catappa	Badam				2	2
	Ziziphus jujube	Ber				2	0
	Melia Indica	Neem	2	2	2	3	5
	Albezia lebbeck	Sarehan		2		1	3
	Acacia Nilotica	Babur			4		4
	Eucalyptus	Safaido				2	2
	Mangifera Indica	Amb				4	0
	Conocorpus	Conocarpus			5		5

RD 177-178	Syzygium cumini	Jamun				2	0
	Pithecellobium dulce	Jalebi	1		1	1	3
	Psidium guajava	Amrood			1		1
	Terminalia catappa	Badam			3	3	4
	Melia Indica	Neem	1	1		1	3
	Acacia Nilotica	Babur	1		4	2	7
	Eucalyptus	Safaido			1		1
	Mangifera Indica	Amb		2			2
RD 178-179	Conocorpus	Conocarpus			1		1
	Syzygium cumini	Jamun		3			2
	Pithecellobium dulce	Jalebi	1				1
	Acacia Nilotica	Babur	2	3			2
RD 179-180	Conocorpus	Conocarpus	2				2
	Syzygium cumini	Jamun		1			1
	Albezia lebbeck	Sarehan			2		0
	Acacia Nilotica	Babur	2	2	1		5
RD 180-181	Conocorpus	Conocarpus	1		1		2
	Dalbergia sisso	Tali		1			1
	Ziziphus jujube	Ber			1	1	2
RD 181-182	Acacia Nilotica	Babur	3		2	1	6
	Ficus religiosa	Pipal				1	1
	Melia Indica	Neem			2		0
RD 182-183	Acacia Nilotica	Babur	3	1			4
	Zizyphus	Bair		1			1
	Albezia lebbeck	Sarehan				2	2
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	2		4	3	9
RD 183-184	Mangifera Indica	Amb			4		0
	Dalbergia sisso	Tali			4		0
	Prosopis juliflora	Devi				2	2
	Acacia Nilotica	Babur		2		2	4
RD 185-186	Syzygium cumini	Jamun	3				0
	Melia Indica	Neem		1		1	2
	Albezia lebbeck	Sarehan				3	3
RD 186-187	Acacia Nilotica	Babur	5				5
	Conocorpus	Conocarpus		1	2		3
	Syzygium cumini	Jamun	2	1			3
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi			2		0
RD 187-188	Melia Indica	Neem		2			2
	Albezia lebbeck	Sarehan			5		0
RD 188-189	Dalbergia sisso	Tali			2		0
	Melia Indica	Neem	1			2	3
	Albezia lebbeck	Sarehan				1	1
RD 189-190	Conocorpus	Conocarpus	2				2
	Syzygium cumini	Jamun	1				1
	Albezia lebbeck	Sarehan			1		1
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	1				1
	Eucalyptus	Safaido	1				1
RD 190-191	Syzygium cumini	Jamun	1				1

	Zizyphus	Bair			1		1
	Pithecellobium dulce	Jalebi	1				1
	Ziziphus jujube	Ber			2		0
	Melia Indica	Neem		3			3
	Phoenix dactlifera	Khajoor		2			2
	Acacia Nilotica	Babur		1			1
RD 191-192	Eucalyptus	Safaido	1				1
	Conocorpus	Conocarpus	5				0
	Syzygium cumini	Jamun		1			1
	Melia Indica	Neem		5			0
	Albezia lebbeck	Sarehan	2	3			5
	Acacia Nilotica	Babur		5	2	2	5
	Eucalyptus	Safaido			1	1	2
	Conocorpus	Conocarpus			2		0
	Syzygium cumini	Jamun	1	3			4
RD 192-193	Dalbergia sisso	Tali				1	1
	Zizyphus	Bair		1			1
	Ficus religiosa	Pipal				1	1
	Pithecellobium dulce	Jalebi	2	1		1	4
	Manilkara zapota	cheeku			2		0
	Melia Indica	Neem		7	2		5
	Albezia lebbeck	Sarehan	2	7	1		5
	Phoenix dactlifera	Khajoor		2		1	3
	Acacia Nilotica	Babur	3	4	4	2	5
	Eucalyptus	Safaido	2			2	4
	Mangifera Indica	Amb	1				1
RD 193-194	Conocorpus	Conocarpus		3		1	4
	Zizyphus	Bair					
	Ficus religiosa	Pipal		1			1
	Pithecellobium dulce	Jalebi	1	1		1	3
	Prosopis juliflora	Devi				1	1
	Cordia myxa	Lessori		1			1
	Melia Indica	Neem	3	4	3		5
	Albezia lebbeck	Sarehan		2			2
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	4	5	4	2	10
	Eucalyptus	Safaido			2	1	3
	Mangifera Indica	Amb	1		1	1	3
	Conocorpus	Conocarpus				2	2
	Syzygium cumini	Jamun		2			2
RD 194-195	Dalbergia sisso	Tali		1			1
	Zizyphus	Bair			1		1
	Ficus religiosa	Pipal			1		1
	Pithecellobium dulce	Jalebi			3	2	5
	Psidium guajava	Amrood			1		1
	Cordia myxa	Lessori			1		1
RD 195-196	Melia Indica	Neem	2	5	1		8
	Albezia lebbeck	Sarehan		2	2		4
	Phoenix dactlifera	Khajoor		2	3		5
	Acacia Nilotica	Babur		2	2	1	5
	Eucalyptus	Safaido				3	3

	Mangifera Indica	Amb	1			1	2
	Conocorpus	Conocarpus			2		2
	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali		1	1		2
	Ficus religiosa	Pipal			1		1
	Pithecellobium dulce	Jalebi	1		4		5
	Cordia myxa	Lessori					
	Melia Indica	Neem	3	4	2	1	10
	Albezia lebbeck	Sarehan		2	2		4
	Phoenix dactlifera	Khajoor			3		3
	Acacia Nilotica	Babur	4	3	2	2	11
	Eucalyptus	Safaido	1			1	2
	Mangifera Indica	Amb					
	Conocorpus	Conocarpus		1	1		2
	Syzygium cumini	Jamun				2	2
	Dalbergia sisso	Tali			1		1
	Zizyphus	Bair	2			1	3
	Ficus religiosa	Pipal		1	1		2
	Pithecellobium dulce	Jalebi			3		3
RD 196-197	Melia Indica	Neem		1	2	3	6
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	5	3	4		12
	Eucalyptus	Safaido				3	3
	Mangifera Indica	Amb					
	Conocorpus	Conocarpus			3		3
	Syzygium cumini	Jamun				1	1
	Dalbergia sisso	Tali			2		2
	Zizyphus	Bair			1		1
	Ficus religiosa	Pipal					
	Pithecellobium dulce	Jalebi					
RD 197-198	Cordia myxa	Lessori				1	1
	Melia Indica	Neem	2	2			4
	Albezia lebbeck	Sarehan		1			1
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	3	8	2	2	15
	Eucalyptus	Safaido			5	6	11
RD 198-199	Conocorpus	Conocarpus			10		10
	Zizyphus	Bair	1				1
	Pithecellobium dulce	Jalebi	1				1
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	2		1		3
RD 199-200	Eucalyptus	Safaido		2	2		4
	Pithecellobium dulce	Jalebi	1				1
	Melia Indica	Neem	3	2			5
	Albezia lebbeck	Sarehan		3			3
	Acacia Nilotica	Babur	2	1			3
	Citrus Limon	Limo					
RD 200-201	Dalbergia sisso	Tali	1				1
	Melia Indica	Neem	4	4			8
	Albezia lebbeck	Sarehan	1				1

	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	3	2			5
RD 201-202	Eucalyptus	Safaido					
	Syzygium cumini	Jamun		2			2
	Dalbergia sisso	Tali					
	Pithecellobium dulce	Jalebi		1			1
	Acacia Nilotica	Babur			2		2
RD 202-203	Acacia Nilotica	Babur	3	4			7
	Zizyphus	Bair	1				1
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	2	1	1		4
RD 205-206	Eucalyptus	Safaido				2	2
	Citrus Limon	Sukhchain				2	2
	Melia Indica	Neem		1			1
	Albezia lebbeck	Sarehan		1			1
	Acacia Nilotica	Babur	8	6			14
	Mangifera Indica	Amb	1				1
RD 206-207	Syzygium cumini	Jamun					
	Zizyphus	Bair					
	Pithecellobium dulce	Jalebi		1			1
	Acacia Nilotica	Babur		5	2		7
	Melia Indica	Neem	5	2			7
RD 207-208	Mangifera Indica	Amb		2			2
	Syzygium cumini	Jamun	2				2
	Zizyphus	Bair		1			1
	Melia Indica	Neem	1	1	2		4
	Albezia lebbeck	Sarehan	1		1		2
	Phoenix dactlifera	Khajoor		1		1	2
	Acacia Nilotica	Babur	6	15		3	24
RD 208-209	Mangifera Indica	Amb		2			2
	Syzygium cumini	Jamun		1			1
	Dalbergia sisso	Tali		3		1	4
RD 209-210	Zizyphus	Bair	4				4
	Melia Indica	Neem	2	4	1		7
	Albezia lebbeck	Sarehan	1	2		1	4
	Phoenix dactlifera	Khajoor		2			2
	Acacia Nilotica	Babur	6	12	4	3	25
	Mangifera Indica	Amb	3				3
	Conocorpus	Conocarpus		4			4
	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali					
	Melia Indica	Neem	1	2			3
	Albezia lebbeck	Sarehan				1	1
	Phoenix dactlifera	Khajoor			2		2
RD 210-211	Acacia Nilotica	Babur	5	4	8		17
	Mangifera Indica	Amb	1				1
	Dalbergia sisso	Tali				3	3
	Albezia lebbeck	Sarehan		1			1
RD 211-212	Phoenix dactlifera	Khajoor		1		5	6
	Acacia Nilotica	Babur				5	5
	Melia Indica	Neem		2			2

	Albezia lebbeck	Sarehan	1	3			4
	Phoenix dactlifera	Khajoor			1		1
RD 212-213	Acacia Nilotica	Babur	3	4			7
	Syzygium cumini	Jamun		1	2		1
	Mangifera Indica	Amb		2			2
	Melia Indica	Neem	3				3
	Albezia lebbeck	Sarehan		2			2
	Phoenix dactlifera	Khajoor		1	1		2
RD 213-214	Acacia Nilotica	Babur	5	6	1		12
	Eucalyptus	Safaido	1			1	2
	Syzygium cumini	Jamun	3				
	Phoenix dactlifera	Khajoor				4	4
RD 214-215	Acacia Nilotica	Babur		2	3		5
	Eucalyptus	Safaido	3	2		6	11
	Melia Indica	Neem	3			4	7
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur		3	3		6
	Eucalyptus	Safaido		5	1	4	10
	Mangifera Indica	Amb		1			1
	Conocorpus	Conocarpus	1	2			3
RD 215-216	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali					
	Zizyphus	Bair					
	Ficus religiosa	Pipal			1		1
	Pithecellobium dulce	Jalebi			1		1
RD 216-217	Cordia myxa	Lessori	2				2
	Melia Indica	Neem				1	1
	Albezia lebbeck	Sarehan				2	2
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur		7	4	8	19
	Acacia Nilotica	Babur	1			5	6
RD 217-218	Dalbergia sisso	Tali				1	1
	Melia Indica	Neem					
	Albezia lebbeck	Sarehan				2	2
RD 218-219	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur			2	1	3
RD 221-222	Acacia Nilotica	Babur	3	1			4
	Cordia myxa	Lessori					
	Melia Indica	Neem	2				2
	Acacia Nilotica	Babur	2				2
	Conocorpus	Conocarpus	1				1
RD 222-223	Pithecellobium dulce	Jalebi	1				1
	Prosopis juliflora	Devi	1				1
	Zizyphus	Bair	1				1
	Acacia Nilotica	Babur				4	4
RD 224-225	Conocorpus	Conocarpus				2	2
	Dalbergia sisso	Tali				1	1
RD 225-226	Dalbergia sisso	Tali				2	2
RD 226-227	Acacia Nilotica	Babur				7	7
RD 227-228	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur			2	6	8

RD 228-229	Acacia Nilotica	Babur			3	9	12
RD 229-231	Acacia Nilotica	Babur			1		1
RD 231-232	Melia Indica	Neem	8				8
	Phoenix dactlifera	Khajoor		5			5
	Acacia Nilotica	Babur	1			2	3
	Mangifera Indica	Amb		2			2
	Melia Indica	Neem	3				3
RD 232-233	Phoenix dactlifera	Khajoor					
	Albezia lebbeck	Sarehan		1			1
RD 233-234	Dalbergia sisso	Tali				4	4
	Acacia Nilotica	Babur					
RD 234-235	Dalbergia sisso	Tali		1		8	9
	Albezia lebbeck	Sarehan				1	1
	Phoenix dactlifera	Khajoor			1		1
RD 235-236	Acacia Nilotica	Babur			1		1
	Dalbergia sisso	Tali				2	2
	Acacia Nilotica	Babur			3		3
	Mangifera Indica	Amb	1				1
	Conocorpus	Conocarpus	25				25
RD 236-237	Dalbergia sisso	Tali				5	5
	Albezia lebbeck	Sarehan				1	1
	Phoenix dactlifera	Khajoor			1		1
RD 237-238	Acacia Nilotica	Babur				1	1
	Conocorpus	Conocarpus	1				1
	Dalbergia sisso	Tali				2	2
	Acacia Nilotica	Babur		4	1		5
RD 238-239	Dalbergia sisso	Tali			3	3	6
	Phoenix dactlifera	Khajoor			3		3
RD 239-240	Acacia Nilotica	Babur	1		12	6	19
	Dalbergia sisso	Tali				2	2
RD 240-241	Acacia Nilotica	Babur	3	2	6	10	21
RD 241-242	Acacia Nilotica	Babur	2		1		3
	Melia Indica	Neem				1	1
	Albezia lebbeck	Sarehan		1			1
RD 242-243	Phoenix dactlifera	Khajoor		2			2
	Acacia Nilotica	Babur	2			7	9
	Eucalyptus	Safaido		1			1
	Melia Indica	Neem		4	7		11
	Albezia lebbeck	Sarehan	2	1			3
	Acacia Nilotica	Babur	1	2	1	4	8
RD 243-244	Eucalyptus	Safaido		3			3
	Syzygium cumini	Jamun					
	Zizyphus	Bair					
	Melia Indica	Neem			2	2	4
RD 244-245	Acacia Nilotica	Babur			2		2
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur		2		4	6
	Conocorpus	Conocarpus	1	2			3
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	1		10	12	23

	Eucalyptus	Safaido					
RD 245-246	Prosopis juliflora	Devi		4			4
	Prosopis cineraria	Kandi			1		1
	Prosopis juliflora	Devi		5			5
	Cordia myxa	Lessori		1			1
	Prosopis juliflora	Devi		2			2
RD 246-247	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur	1	2	10	16	29
	Eucalyptus	Safaido		1			1
RD 247-248	Acacia Nilotica	Babur	1	1		2	4
RD 248-249	Albezia lebbeck	Sarehan				1	1
	Acacia Nilotica	Babur		3		2	5
	Conocorpus	Conocarpus		1			1
	Prosopis juliflora	Devi		3			3
	Psidium guajava	Amrood					
RD 249-250	Acacia Nilotica	Babur			5	3	8
	Dalbergia sisso	Tali					
	Melia Indica	Neem		1			1
RD 250-251	Acacia Nilotica	Babur				4	4
	Phoenix dactlifera	Khajoor					
RD 251-252	Acacia Nilotica	Babur	2	2	3	4	11
	Dalbergia sisso	Tali				2	2
	Melia Indica	Neem					
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor				2	2
	Acacia Nilotica	Babur		1	4	4	9
RD 252-253	Eucalyptus	Safaido	4				4
	Mangifera Indica	Amb	3	4			7
	Dalbergia sisso	Tali				3	3
	Melia Indica	Neem					
	Albezia lebbeck	Sarehan	3				3
	Acacia Nilotica	Babur		2		3	5
	Eucalyptus	Safaido		3		4	7
	Mangifera Indica	Amb	3				3
	Conocorpus	Conocarpus	2	2	5		9
RD 253-254	Syzygium cumini	Jamun		2			2
	Dalbergia sisso	Tali				2	2
	Zizyphus	Bair		1			1
	Psidium guajava	Amrood	2				2
	Cordia myxa	Lessori					
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur		2	2		4
	Conocorpus	Conocarpus			1		1
RD 254-255	Syzygium cumini	Jamun					
	Tamarindus indica	Imli					
	Cordia myxa	Lessori					
	Phoenix dactlifera	Khajoor		1			1
RD 255-256	Acacia Nilotica	Babur	2	4	4		10
	Eucalyptus	Safaido				2	2
	Acacia Nilotica	Babur	3	4			7

RD 256-257	Dalbergia sisso	Tali		1			1
	Albezia lebbeck	Sarehan		1			1
RD 257-258	Acacia Nilotica	Babur		4	2		6
	Dalbergia sisso	Tali	1				1
RD 259-260	Albezia lebbeck	Sarehan				3	3
	Acacia Nilotica	Babur	1			5	6
	Acacia Nilotica	Babur			6	3	9
RD 260-261	Dalbergia sisso	Tali					
	Acacia Nilotica	Babur	1	1	8	10	20
	Eucalyptus	Safaido		1			1
RD 261-262	Mangifera Indica	Amb					
	Dalbergia sisso	Tali					
	Cordia myxa	Lessori		1			1
	Melia Indica	Neem	1				1
	Acacia Nilotica	Babur		3	5	8	16
	Eucalyptus	Safaido					
RD 262-263	Conocorpus	Conocarpus	2				2
	Syzygium cumini	Jamun					
	Pithecellobium dulce	Jalebi					
	Acacia Nilotica	Babur		2	6	15	23
	Eucalyptus	Safaido	1				1
	Mangifera Indica	Amb					
	Dalbergia sisso	Tali					
RD 263-264	Pithecellobium dulce	Jalebi					
	Prosopis juliflora	Devi		6			6
	Cordia myxa	Lessori					
RD 264-265	Acacia Nilotica	Babur			3	16	19
	Melia Indica	Neem				2	2
RD 265-266	Acacia Nilotica	Babur	2			18	20
	Eucalyptus	Safaido				2	2
RD 266-267	Acacia Nilotica	Babur	4			14	18
	Acacia Nilotica	Babur	2	2		21	25
RD 267-268	Prosopis juliflora	Devi				3	3
	Melia Indica	Neem					
	Acacia Nilotica	Babur	2	7			9
RD 268-269	Eucalyptus	Safaido			4		4
	Zizyphus	Bair					
	Albezia lebbeck	Sarehan					
RD 269-270	Acacia Nilotica	Babur		4		20	24
	Dalbergia sisso	Tali				2	2
	Melia Indica	Neem		1			1
	Acacia Nilotica	Babur		5		27	32
	Eucalyptus	Safaido	1				1
RD 270-271	Mangifera Indica	Amb	1				1
	Prosopis juliflora	Devi	1				1
	Cordia myxa	Lessori		1			1
RD 271-272	Melia Indica	Neem		4			4
	Albezia lebbeck	Sarehan				1	1
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur		5		19	24

	Eucalyptus	Safaido	3		6		9
	Conocorpus	Conocarpus		1			1
	Syzygium cumini	Jamun		1			1
	Prosopis juliflora	Devi		1			1
	Acacia Nilotica	Babur		3		12	15
RD 272-274	Eucalyptus	Safaido			6		6
RD 274-275	Acacia Nilotica	Babur		4		8	12
	Prosopis juliflora	Devi	1				1
	Acacia Nilotica	Babur	8	20			28
	Eucalyptus	Safaido	8	1			9
RD 276-277	Dalbergia sisso	Tali					
	Pithecellobium dulce	Jalebi					
	Acacia Nilotica	Babur	3	15			18
	Eucalyptus	Safaido	3	4			7
RD 277-278	Conocarpus	Conocarpus	1		1		1
	Pithecellobium dulce	Jalebi			1		1
RD 278-279	Acacia Nilotica	Babur			5		5
	Acacia Nilotica	Babur			6		6
	Eucalyptus	Safaido			4		4
RD 279-280	Conocarpus	Conocarpus		1			1
	Pithecellobium dulce	Jalebi					
	Melia Indica	Neem		1	1		2
	Albezia lebbeck	Sarehan		2			2
	Phoenix dactlifera	Khajoor				2	2
	Acacia Nilotica	Babur	3	4		2	9
	Eucalyptus	Safaido			3		3
	Mangifera Indica	Amb					
	Conocorpus	Conocarpus		1			1
	Syzygium cumini	Jamun					
RD 280-281	Cassia fistula	Alamdas					
	Pithecellobium dulce	Jalebi		1	1		2
	Prosopis juliflora	Devi		3		2	5
	Psidium guajava	Amrood					
	Ziziphus jujube	Ber		1	1		2
	Melia Indica	Neem	1			4	5
	Albezia lebbeck	Sarehan				3	3
	Phoenix dactlifera	Khajoor			1	2	3
	Acacia Nilotica	Babur		3	2	8	13
RD 281-282	Eucalyptus	Safaido			1	3	4
	Conocorpus	Conocarpus				15	15
	Ficus religiosa	Pipal					
RD 282-283	Melia Indica	Neem		1			1
RD 283-284	Acacia Nilotica	Babur		3		16	19
	Zizyphus	Bair		1			1
	Prosopis juliflora	Devi		3			3
	Acacia Nilotica	Babur	4		2	4	10
	Conocorpus	Conocarpus			2	4	6
	Acacia Nilotica	Babur		5	8		13
	Zizyphus	Bair	1				1
	Psidium guajava	Amrood		2			2
	Acacia Nilotica	Babur		5	4	4	13

RD 284-286	Zizyphus	Bair		1			1
	Melia Indica	Neem			1		1
	Acacia Nilotica	Babur		1		9	10
RD 286-287	Eucalyptus	Safaido	1				1
	Dalbergia sisso	Tali					
	Melia Indica	Neem		2			2
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur	1	2		11	14
	Eucalyptus	Safaido		2			2
RD 287-288	Mangifera Indica	Amb	1				1
	Conocorpus	Conocarpus	3				3
	Syzygium cumini	Jamun					
	Zizyphus	Bair	1				1
	Phoenix dactlifera	Khajoor			1		1
RD 288-289	Acacia Nilotica	Babur	2			3	5
	Melia Indica	Neem					
RD 289-290	Albezia lebbeck	Sarehan				1	1
	Acacia Nilotica	Babur			1	2	3
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor				1	1
	Acacia Nilotica	Babur		3			3
RD 290-291	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali		1			1
	Cordia myxa	Lessori					
	Melia Indica	Neem	1	1			2
	Albezia lebbeck	Sarehan					
RD 291-292	Phoenix dactlifera	Khajoor	2				2
	Acacia Nilotica	Babur	1			1	2
RD 292-293	Melia Indica	Neem		1			1
	Acacia Nilotica	Babur		2		2	4
	Melia Indica	Neem	1				1
	Albezia lebbeck	Sarehan				1	1
RD 294-295	Acacia Nilotica	Babur	3				3
	Conocorpus	Conocarpus		1			1
	Zizyphus	Bair					
RD 295-296	Acacia Nilotica	Babur		5		5	10
	Acacia Nilotica	Babur	1	8			9
RD 296-297	Prosopis juliflora	Devi		5			5
	Albezia lebbeck	Sarehan				1	1
RD 297-298	Acacia Nilotica	Babur	9	3		3	15
	Albezia lebbeck	Sarehan					
RD 298-299	Acacia Nilotica	Babur	5	8			13
	Albezia lebbeck	Sarehan				2	2
RD 299-302	Phoenix dactlifera	Khajoor		3			3
	Acacia Nilotica	Babur	2		5	5	12
	Melia Indica	Neem		1			1
	Phoenix dactlifera	Khajoor		2	2	2	6
RD 302-303	Acacia Nilotica	Babur					
	Conocorpus	Conocarpus				1	1
		Devi		3			3

	Melia Indica	Neem				1	1
RD 303-304	Acacia Nilotica	Babur		2	2	18	22
	Albezia lebbeck	Sarehan				2	2
RD 304-305	Phoenix dactlifera	Khajoor				1	1
	Acacia Nilotica	Babur		7	2	11	20
	Phoenix dactlifera	Khajoor			1		1
RD 305-306	Acacia Nilotica	Babur		10	41		51
	Psidium guajava	Amrood					
	Albezia lebbeck	Sarehan	6				6
	Acacia Nilotica	Babur		2	5	27	34
RD 306-30	Psidium guajava	Amrood	1				1
	Cordia myxa	Lessori		1			1
RD 307-308	Acacia Nilotica	Babur				17	17
	Melia Indica	Neem					
RD 308-309	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur			1	8	9
RD 309-310	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	3		32		35
	Acacia Nilotica	Babur		7	8		15
RD 310-311	Pithecellobium dulce	Jalebi			1		1
RD 311-312	Acacia Nilotica	Babur	4	5			9
RD 312-313	Melia Indica	Neem					
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur	6	4		4	14
	Albezia lebbeck	Sarehan				1	1
RD 313-314	Acacia Nilotica	Babur			2		2
	Mangifera Indica	Amb					
	Albezia lebbeck	Sarehan				1	1
RD 315-316	Acacia Nilotica	Babur		6			6
RD 316-317	Ficus religiosa	Pipal	1				1
	Acacia Nilotica	Babur	1			1	2
	Melia Indica	Neem		2			2
	Albezia lebbeck	Sarehan	1			1	2
RD 317-318	Phoenix dactlifera	Khajoor				1	1
	Acacia Nilotica	Babur	2	3			5
	Eucalyptus	Safaido	3				3
	Melia Indica	Neem		1			1
	Albezia lebbeck	Sarehan		1			1
RD 318-319	Phoenix dactlifera	Khajoor				2	2
	Acacia Nilotica	Babur	2	4		5	11
	Cordia myxa	Lessori					
	Melia Indica	Neem					
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor		1			1
RD 319-320	Acacia Nilotica	Babur	4	2		7	13
	Eucalyptus	Safaido	5				5
	Dalbergia sisso	Tali	1				1
	Melia Indica	Neem		3			3
	Albezia lebbeck	Sarehan	1	8			9
	Acacia Nilotica	Babur	5		18		23
	Eucalyptus	Safaido		4			4

	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali	1				1
	Ficus religiosa	Pipal		1			1
	Cordia myxa	Lessori					
	Melia Indica	Neem	2	3	2		7
RD 320-321	Albezia lebbeck	Sarehan		4			4
	Phoenix dactlifera	Khajoor	1				1
	Acacia Nilotica	Babur		1		2	3
	Eucalyptus	Safaido		4			4
	Mangifera Indica	Amb					
	Zizyphus	Bair	1				1
	Citrus Limon	Limo					
	Pithecellobium dulce	Jalebi		1			1
	Prosopis juliflora	Devi		3			3
RD 321-322	Psidium guajava	Amrood		2			2
	Cordia myxa	Lessori		1			1
	Melia Indica	Neem	1		2		3
	Albezia lebbeck	Sarehan	1				1
	Acacia Nilotica	Babur	2		3		5
RD 322-323	Eucalyptus	Safaido		30			30
	Melia Indica	Neem					
RD 323-324	Acacia Nilotica	Babur		2			2
RD 324-325	Melia Indica	Neem				6	6
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur					
	Melia Indica	Neem	2		2		4
RD 325-326	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur	1				1
	Eucalyptus	Safaido					
	Melia Indica	Neem	1	3	1	3	8
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur	3	1			4
	Eucalyptus	Safaido	6				6
	Conocorpus	Conocarpus		4			4
	Melia Indica	Neem		2		2	4
RD 326-327	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur	4	5			9
	Eucalyptus	Safaido	5	4		3	12
	Mangifera Indica	Amb					
	Syzygium cumini	Jamun			1		1
	Dalbergia sisso	Tali		1			1
	Zizyphus	Bair		1			1
	Pithecellobium dulce	Jalebi				2	2
	Psidium guajava	Amrood					
RD 327-328	Cordia myxa	Lessori	1	3			4
	Melia Indica	Neem	4	1	1	1	7
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur			3		3
RD 328-329	Eucalyptus	Safaido				2	2
	Conocorpus	Conocarpus				1	1

	Dalbergia sisso	Tali	2				2
	Pithecellobium dulce	Jalebi					
	Melia Indica	Neem		2		2	4
	Albezia lebbeck	Sarehan			2		2
	Phoenix dactlifera	Khajoor			1	2	3
	Acacia Nilotica	Babur		2		3	5
RD 329-330	Eucalyptus	Safaido	4		3		7
	Conocorpus	Conocarpus		1			1
	Syzygium cumini	Jamun			1		1
	Cordia myxa	Lessori					
	Phoenix dactlifera	Khajoor				2	2
RD 331-332	Acacia Nilotica	Babur	3		3		6
RD 332-333	Melia Indica	Neem				2	2
	Acacia Nilotica	Babur	1		7		8
	Melia Indica	Neem				1	1
RD 333-334	Acacia Nilotica	Babur			2		2
	Prosopis juliflora	Devi				4	4
RD 336-337	Ziziphus jujube	Ber					
	Acacia Nilotica	Babur			5		5
	Melia Indica	Neem	1		5		6
	Albezia lebbeck	Sarehan			8		8
RD 337-338	Acacia Nilotica	Babur			11		11
	Eucalyptus	Safaido				6	6
	Mangifera Indica	Amb					
	Melia Indica	Neem		1	2		3
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur		2		4	6
	Mangifera Indica	Amb					
RD 339-340	Conocorpus	Conocarpus			5		5
	Pithecellobium dulce	Jalebi			2	1	3
	Ziziphus jujube	Ber			1		1
	Cordia myxa	Lessori				1	1
	Melia Indica	Neem	1				1
	Albezia lebbeck	Sarehan	4				4
	Phoenix dactlifera	Khajoor				2	2
RD 340-341	Acacia Nilotica	Babur		1	7	4	12
	Syzygium cumini	Jamun				1	1
	Pithecellobium dulce	Jalebi		2			2
	Phoenix dactlifera	Khajoor					
RD 341-342	Acacia Nilotica	Babur		2	2		4
	Melia Indica	Neem				1	1
	Phoenix dactlifera	Khajoor					
RD 342-343	Acacia Nilotica	Babur	4		2		6
	Dalbergia sisso	Tali	1				1
	Melia Indica	Neem		2		2	4
	Albezia lebbeck	Sarehan			5		5
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	1		8	4	13
	Eucalyptus	Safaido					
	Mangifera Indica	Amb					

RD 343-344	Conocorpus	Conocarpus			1		1
	Syzygium cumini	Jamun					
	Dalbergia sisso	Tali	4		8	4	16
	Pithecellobium dulce	Jalebi				3	3
	Cordia myxa	Lessori				1	1
	Melia Indica	Neem				4	4
	Albezia lebbeck	Sarehan				2	2
	Phoenix dactlifera	Khajoor		1			1
RD 344-346	Acacia Nilotica	Babur				19	19
	Eucalyptus	Safaido					
	Mangifera Indica	Amb				1	1
RD 346-347	Pithecellobium dulce	Jalebi				4	4
	Melia Indica	Neem				2	2
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur				15	15
	Eucalyptus	Safaido				3	3
	Mangifera Indica	Amb		1			1
RD 347-348	Acacia Nilotica	Babur	3		4	2	9
	Melia Indica	Neem			1		1
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor			1		1
	Acacia Nilotica	Babur	3	1		13	17
RD 348-349	Eucalyptus	Safaido					
	Conocorpus	Conocarpus			4		4
	Dalbergia sisso	Tali					
	Albezia lebbeck	Sarehan	4	5			9
	Phoenix dactlifera	Khajoor		1			1
RD 349-350	Acacia Nilotica	Babur		4	3		7
	Eucalyptus	Safaido		6			6
	Albezia lebbeck	Sarehan				2	2
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	6	5	8		19
	Eucalyptus	Safaido		5			5
	Conocorpus	Conocarpus		4			4
	Syzygium cumini	Jamun					
RD 350-351	Dalbergia sisso	Tali		2			2
	Zizyphus	Bair					
	Prosopis juliflora	Devi		1			1
	Cordia myxa	Lessori					
	Melia Indica	Neem			1		1
	Albezia lebbeck	Sarehan		1	2		3
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur				4	4
RD 352-353	Eucalyptus	Safaido		3	1		4
	Dalbergia sisso	Tali		1			1
	Prosopis juliflora	Devi	2	14			16
	Melia Indica	Neem		4			4
	Albezia lebbeck	Sarehan	1				1
RD 353-354	Acacia Nilotica	Babur		1	6	8	15
	Mangifera Indica	Amb					

	Melia Indica	Neem		8			8
	Albezia lebbeck	Sarehan	4				4
RD 354-355	Phoenix dactlifera	Khajoor		1		1	2
	Acacia Nilotica	Babur	1		12	18	31
	Eucalyptus	Safaido		1			1
RD 355-356	Mangifera Indica	Amb					
	Conocorpus	Conocarpus				14	14
	Syzygium	Jamun					
	Dalbergia sisso	Tali	3				3
	Ficus religiosa	Pipal		1			1
	Prosopis juliflora	Devi		6			6
	Melia Indica	Neem	15				15
	Albezia lebbeck	Sarehan		3			3
	Phoenix dactlifera	Khajoor	2				2
	Acacia Nilotica	Babur		4	3	7	14
	Eucalyptus	Safaido				4	4
	Mangifera Indica	Amb					
	Syzygium	Jamun					
	Dalbergia sisso	Tali					
	Zizyphus	Bair					
	Pithecellobium dulce	Jalebi					
	Prosopis juliflora	Devi		3		1	4
	Citrus Limon	Limo					
	Cordia myxa	Lessori		1			1
	Melia Indica	Neem		3			3
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor					
RD 356-357	Acacia Nilotica	Babur				5	5
	Syzygium	Jamun					
	Prosopis juliflora	Devi		3			3
	Melia Indica	Neem	1		2	4	7
	Albezia lebbeck	Sarehan	4		8	7	19
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur		2	3		5
	Eucalyptus	Safaido				1	1
	Mangifera Indica	Amb					
RD 357-358	Conocorpus	Conocarpus		2		1	3
	Pithecellobium dulce	Jalebi					
	Prosopis juliflora	Devi		7			7
	Tamarindus indica	Gidamri					
	Cordia myxa	Lessori					
	Melia Indica	Neem		5			5
	Albezia lebbeck	Sarehan	4				4
	Phoenix dactlifera	Khajoor					
RD 358-359	Acacia Nilotica	Babur			4		4
	Dalbergia sisso	Tali	2	4			6
	Pithecellobium dulce	Jalebi		2			2
	Phoenix dactlifera	Khajoor				5	5
RD 359-360	Acacia Nilotica	Babur		3		2	5
	Dalbergia sisso	Tali			1		1
RD 360-361	Acacia Nilotica	Babur		1	8		9

	Melia Indica	Neem		5			5
	Albezia lebbeck	Sarehan	6				6
	Acacia Nilotica	Babur	8	8		5	21
	Eucalyptus	Safaido					
	Mangifera Indica	Amb					
RD 361-362	Conocorpus	Conocarpus		3			3
	Syzygium cumini	Jamun		2			2
	Zizyphus	Bair					
	Pithecellobium dulce	Jalebi		1			1
	Melia Indica	Neem	3	4			7
	Albezia lebbeck	Sarehan		6			6
	Acacia Nilotica	Babur	4	7	12		23
	Eucalyptus	Safaido					
RD 362-363	Syzygium cumini	Jamun		1			1
	Ficus religiosa	Pipal				1	1
	Pithecellobium dulce	Jalebi	1				1
	Melia Indica	Neem	1				1
RD 363-364	Acacia Nilotica	Babur	3			35	38
	Eucalyptus	Safaido		2			2
	Melia Indica	Neem		5			5
	Albezia lebbeck	Sarehan					
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	1	5	10		16
	Eucalyptus	Safaido		1			1
	Conocorpus	Conocarpus					
RD 364-365	Syzygium cumini	Jamun		1			1
	Dalbergia sisso	Tali					
	Pithecellobium dulce	Jalebi		1			1
	Prosopis juliflora	Devi				2	2
	Tamarindus indica	Gidamri					
	Melia Indica	Neem			2	1	3
	Acacia Nilotica	Babur	8				8
	Eucalyptus	Safaido			1		1
RD 365-366	Conocorpus	Conocarpus			2	3	5
	Syzygium cumini	Jamun					
	Prosopis cineraria	Kandi	1				1
	Albezia lebbeck	Sarehan				4	4
RD 366-367	Acacia Nilotica	Babur			3	2	5
	Eucalyptus	Safaido					
RD 367-368	Conocorpus	Conocarpus			9		9
	Melia Indica	Neem				6	6
	Albezia lebbeck	Sarehan			3		3
RD 368-369	Acacia Nilotica	Babur	5			2	7
	Eucalyptus	Safaido					
RD 369-370	Conocorpus	Conocarpus					
	Pithecellobium dulce	Jalebi					
	Ziziphus jujube	Ber				1	1
	Albezia lebbeck	Sarehan		2			2
	Phoenix dactlifera	Khajoor					
	Acacia Nilotica	Babur	4		3	4	11
	Eucalyptus	Safaido		1			1

	Conocorpus	Conocarpus		1			1
	Dalbergia sisso	Tali		1			1
	Zizyphus	Bair		2			2
	Ficus religiosa	Pipal		1			1
	Cordia myxa	Lessori		1			1
	Melia Indica	Neem	3		1		4
	Albezia lebbeck	Sarehan				1	1
RD 370-371	Acacia Nilotica	Babur	5			4	9
	Eucalyptus	Safaido	2	3			5
	Melia Indica	Neem	1	1	5	1	8
	Albezia lebbeck	Sarehan					
	Acacia Nilotica	Babur	13				13
RD 371-372	Eucalyptus	Safaido				3	3
	Pithecellobium dulce	Jalebi			1		1
	Cordia myxa	Lessori			1		1
	Melia Indica	Neem				4	4
	Albezia lebbeck	Sarehan		1		3	4
	Acacia Nilotica	Babur		1	3		4
	Eucalyptus	Safaido					
RD 372-373	Mangifera Indica	Amb	1	1			2
	Dalbergia sisso	Tali					
	Pithecellobium dulce	Jalebi			1		1
	Melia Indica	Neem					
	Albezia lebbeck	Sarehan	6	4		1	11
	Acacia Nilotica	Babur		1	2		3
	Mangifera Indica	Amb				3	3
RD 373-374	Conocorpus	Conocarpus		5			5
	Syzygium cumini	Jamun					
	Pithecellobium dulce	Jalebi					
	Cordia myxa	Lessori					
	Melia Indica	Neem	1	5			6
	Albezia lebbeck	Sarehan		4	1		5
	Phoenix dactlifera	Khajoor		1			1
	Acacia Nilotica	Babur		4		3	7
RD 374-375	Dalbergia sisso	Tali		3			3
	Ficus religiosa	Pipal		2		1	3
	Pithecellobium dulce	Jalebi					
RD 375-376	Melia Indica	Neem					
RD 376-377	Acacia Nilotica	Babur			2		2
	Acacia Nilotica	Babur			6		6
RD 377-378	Acacia Nilotica	Babur					
	Melia Indica	Neem	4	4	2	1	11
	Phoenix dactlifera	Khajoor		3			3
	Acacia Nilotica	Babur	3	5		2	10
RD 378-380	Syzygium cumini	Jamun		2			2
	Pithecellobium dulce	Jalebi		1			1
	Cordia myxa	Lessori	7				7
RD 380-381	Acacia Nilotica	Babur	5				5
	Melia Indica	Neem				1	1
RD 381-382	Albezia lebbeck	Sarehan			1		1
	Acacia Nilotica	Babur				1	1

APPENDIX-B. Archaeological "Chance Find rocedure"

Background

The purpose of this document is to address the possibility of archaeological deposits becoming exposed during ground altering activities within the project area and to provide protocols to follow in the case of a chance archaeological find to ensure that archaeological sites are documented and protected as required.

The Pakistan Antiquities act 1975, and the Sindh Cultural Heritage Preservation Act 1994, protects archaeological sites, whether on Provincial Government owned or private land. They are non-renewable, very susceptible to disturbance and are finite in number. Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents. The objectives of this 'Archaeological Chance Find Procedure' are to promote preservation of archaeological data while minimizing disruption of construction scheduling. It is recommended that due to the moderate to high archaeological potential of some locations within the project area, all on site personnel and contractors be informed of the Archaeological Chance Find Procedure and have access to a copy while on site.

Potential Impacts to Archaeological Sites

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as land clearing and excavation are all examples of activities that may adversely affect archaeological deposits.

Relevant Legislation

It ensures the protection, preservation, development and maintenance of antiquities in the province of Sindh. The Act defines "antiquities" as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GOS to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the subproject proponents are obligated to ensure that no activity is undertaken in the proximity of a protected antiquity, report to the Department of Antiquities, Government of Sindh, any archaeological discovery made during the course of the project.

Remedies and Penalties

The Sindh Antiquities Act provides for heritage inspection or investigation orders, temporary protection orders, civil remedies and penalties to limit contraventions. These powers provide:

''A contravention of any provision of this Act or the rules shall, where no punishment has been specifically provided be punishable with rigorous imprisonment for a term which may extend to two years, or with fine up to rupees ten hundred thousand, or with both. ''

Archaeological 'Chance Find' Procedure

If you believe that you may have encountered any archaeological materials, stop work in the area and follow the procedure below:

The following 'chance-find' principles will be implemented by the contractor throughout the construction works to account for any undiscovered items identified during construction works:

i. Workers will be trained in the location of heritage zones within the construction area and in the identification of potential items of heritage significance.
ii. Should any potential items be located, the site supervisor will be immediately contacted and work will be temporarily stopped in that area.
iii. If the site supervisor determines that the item is of potential significance, an officer from the department of Archaeology (DoA), GoSindh will be invited to inspect the site and work will be stopped until DoA has responded to this invitation.
iv. Work will not re-commence in this location until agreement has been reached between DoA and PDA as to any required mitigation measures, which may include excavation and recovery of the item.
v. A precautionary approach will be adopted in the application of these procedures.

Detailed Procedural Steps

- If the Director, department of Archaeology receives any information or otherwise has the knowledge of the discovery or existence of an antiquity of which there is no owner, he shall, after satisfying himself as to the correctness of the information or knowledge, take such steps with the approval of the Government, as he may consider necessary for the custody, preservation and protection of the antiquity.
- Whoever discovers, or finds accidentally, any movable antiquity shall inform forth with the Directorate within seven days of its being discovered or found.
- If, within seven days of his being informed, the Director decides to take over the antiquity for purposes of custody, preservation and protection, the person discovering or finding it shall hand it over to the Director or a person authorized by him in writing.
- Where the Director decides to take over an antiquity, he may pay to the person by whom it is handed over to him such cash reward as may be decided in consultation with the Advisory Committee.
- If any person, who discovers or finds any movable antiquity contravenes the provisions of the Act, he shall be punishable with imprisonment for a term which may extend to five (05) years, or with fine not less than fifteen hundred thousand rupees or with both and the Court convicting such person shall direct that the antiquity in respect of which such contravention has taken place shall stand forfeited to Government.
- The Director or any officer authorized by him with police assistance may, after giving reasonable notice, enter into, inspect and examine any premises, place or area which or the sub-soil of which he may have reason to believe to be, or to contain an antiquity and may cause any site, building, object or any antiquity or the remains of any antiquity in such premises, place or area to be photographed, copied or reproduced by any process suitable for the purpose.
- The owner or occupier of the premises, place or area shall afford all reasonable opportunity and assistance to the Director.
- No photograph, copy of reproduction taken or made shall be sold or offered for sale except by or with the consent of the owner of the object of which the photograph, copy or the reproduction has been taken or made. Where substantial damage is caused to any property as a result of the inspection, the Director shall pay to the owner thereof reasonable compensation for the damage in consultation with the Advisory Committee.

If the Director after conducting an inquiry, has reasonable grounds to believe that any land contains any antiquity, he may approach the Government to direct the Revenue Department to acquire such land or any part thereof and the Revenue Department shall thereupon acquire such land or part under the Land Acquisition Act, 1894 (I of 1894), as for a public purpose.

APPENDIX-C. Consultation Meetings – List of Participants and Photographs

C1. First Round of Consultations

A Scoping meeting was conducted on 13th August 2020 at SIDA office and the following organisations have participated in this meeting

- SIDA
- Sindh EPA
- Area Water Board
- SSGCL
- Fisheries Department
- Non- Governmental Organizations (NGOs)
- Project effected persons
- Sindh wildlife department
- Agricultural department
- WWF
- Influential Community leaders
- Local leaders
- Local community members like Imam Masjid and School teacher

List of participants attending the Scoping meeting are as follows.

S. NO	Name	Designation	Company
1	Ahsan Laghari	GM Research & Development	SIDA
2	Kabool M. Khatian	Chariman AWB	SIDA
3	Syed Mohsin Nazar	Director Finance	WASA-Hyderabad
4	Zulfiqar Ali	GM AWB	SIDA
5	Fahad Bhurgari	Manager HRD	SIDA
6	Aftab Hussain	Project Manager	RDF
7	Zubair Ahmed Channar	Divisional Forest Officer	Sindh Forest Dept.
8	A Rauf	Deputy Director	SEPA
9	Hafiz Hussain	Supervisor	Fisheries Dept.
10	Sharmila laghari	Sociologist	SIDA
11	Syed Muhammad Shah	Deputy Director	OFWM/SIAPEP
12	Mir Aslam	Local people/Zameedar	
13	Mir Moizaam	Local people/Zameedar	
14	Latif Mallah	Local people/Farmer	

S. NO	Name	Designation	Company
15	Masroor A. Shahwani	Institutional Specialist	SIDA
16	Tariq Baladhi	Manager AWB	SIDA
17	A Khalique Nizamani	Chairman	SIDA
18	Ab Ghafoor	Agriculturist	SPO
19	Yameen Memon	Chief Executive	MDC
20	Shahzeb Memon	Environmental Specialist	MDC
21	Ali Khamnaee	Assistant	SIDA
22	Asma Shahid	Divisional Forest Officer	Sindh Forest
23	Raza	Chairman	FO-Gaja Minnor
24	Amber Sanam Laghani	A.D	SIDA
25	Ghulam Mustafa	ESDS	SIAPEP
26	M. Ghous	I.S	SIDA
27	Sana Khanzada	SGS	SIAPEP
28	Muhammad Amin	Ecologist	SIDA
29	Tahir Ali Memon	D. Manger HSE	SSGCL
30	Uzma Imran	Assist. Professor	MUET
31	Parvez	AMT	SIDA
32	M. Siddique	Inspector	SIDA
33	Major Omar Farooq	Member AWB	SIDA
34	M. Ali Shishmahal	Sr. Environmentalist	MMP
35	Aqeel Ahmed Magsi	Environmentalist	MMP
36	Muhammad Shayan Ansari	Environmental Engineer	MMP
37	Nazir Ahmed	Senior Engineer	MMP
38	Mujeeb ur Rehman	Sociologist	MMP
39	Muhammad Rahim	Principal Sociologist	MMP
40	Abdul Moiz	Environmentalist	MMP
41	Muhammad Waqar	CAD Operator	MMP

The record of questions, comments and suggestions by attendees is shown in the following table.

S. No.	Name, designation & Department	Queries	PC/SIDA Responses
1	**Qabool Mohammad Khatyan** **Chairman left bank Area Water Board SIDA**	Akram Wah provide water to majority of areas in Badin district, for domestic and agricultural purpose and as the water quality is already contaminated, therefore sewage lines that are contaminating the canal water must be identified and stopped.	It is agreed that the disposal of sewage into Akram Wah should be stopped since the water is being used for drinking and agricultural purposes. This requires the municipal authorities in the urban centers of Hyderabad, Tando Muhammad Khan and Matli to implement sanitation improvement projects. Such interventions would need to be implemented by the relevant authorities in advance or in parallel with the rehabilitation of the canal which SIDA is planning to implement.
		He stated that in the urban areas of Hyderabad, Tando Muhammad Khan and Matli many buffaloes are sitting in the canal due to that not only the canal banks are damaged but also obstruction to the flow of water is created which results in overtopping of banks at few places. As such, the entrance of buffaloes in the canal shall be restricted by providing fencing or walls of suitable height above the top of retaining walls.	Retaining walls are proposed in the head reaches of the canal through Hyderabad city area and a wall or Rcc railing or Fencing is under consideration to control entry of animals into the canal. Retaining walls in Tando M Khan and Matli urban areas are also under consideration. (The idea of construction of retaining walls has now been dropped during design review.)
		He further said that while disposing the debris of collapsed concrete the contractor shall not be allowed to dump it on canal banks, which will again come back into the canal.	Suitable disposal areas for the existing failed lining are being identified with the assistance of Left Bank Canals AWB. It shall not be permitted to dispose of this debris on the canal banks.
		He proposed that Akram Wah shall be designed to carry its full designed discharge without dependence on Fulleli canal.	Once rehabilitated Akram Wah will be able to convey its full sanctioned discharge.
		He also informed that the removal of encroachments from RoW was halted following a stay order by the court of law. The court had allowed a period of one year to the encroachers to voluntarily vacate the canal RoW. The stay period is going to expire after one month after that the encroachments shall be removed forcibly, if not vacated.	It is advised that any resettlement activities associated with the project should follow the World Bank procedures.
		He again expressed his concern about the performance of Sultani Branch head regulator and said that new arrangement shall be properly designed and vetted by expert engineers to resolve this issue	SIDA has requested the design staff of the Project Consultants to re-visit Sultani Branch to ensure these issues are adequately addressed as part of the rehabilitation works.
		He also advised that under the institutional reforms training of lower staff (Daroghas and Beldars) shall be done to so that they should understand their duties and responsibilities.	The proposed Sindh Water and Agriculture Transformation project will also include components for institutional development and training.

S. No.	Name, designation & Department	Queries	PC/SIDA Responses
2	Major Omar Farooq Member Area Water Board	Emergency release of 200 to 250 cusec from Kazia to lowari drain must be provided, Design about 400 cusecs from shadi large to LBOD and 200 cusecs from Bulri to Dhandi drain. He also said that there is only one escape provided at the tail of Akram wah. He suggested that one or two escapes between head regulator and tail shall be provided to meet an emergency caused by heavy rainfall or breach in the canal.	It was requested that LBC AWB formalize their requirements for additional escapes to SIDA in writing for incorporation into the designs.
3	Abdul Raud Deputy Director Environmental Protection Agency, Hyderabad	What is the estimate time duration required to complete this project? What is the total cost of project?	It is expected that the project may take around 3 years to implement once the required approvals are in place, funding is secured, and procurement activities have been completed. It is expected that the cost of the project may be around US$ 75 million.
4	Yemeen Memon Chief Executive MDC	It has been observed that Contractors do not follow the tenets mentioned in Environmental Management Plan, so it is important that Project Implementation Consultant must ensure that guidelines mentioned in EMP are followed and implemented on site	There would be a Supervision Consultant appointed to monitor the Contractor's compliance with the EMP and to ensure any non-compliances are rectified.
5	Ghulam Mustufa SIAPEP project	Did the consultant considers the mud land in corridor of impact? The study should also focus to provide mitigation measures of drainage in Akram Wah.	The drainage of these areas was included in the Left Bank Master Plan that was prepared under WSIP. This master plan needs to be implemented.
6	Uzma Imran Assistant Professor MUET	What is the estimate time duration required to complete this project? It must be ensured that tail end user of canal is receiving the required amount of water for usage during project implementation. A few values of air quality data is already at SEQS permissible limits, therefore, during construction it must be ensured that pollutants/gases do not exceed the prescribed limits.	It is expected that the project may take around 3 years to implement once the required approvals are in place, funding is secured, and procurement activities have been completed. Temporary diversion channels will be constructed to ensure uninterrupted supply of water to tail enders. The air quality shall be monitored during construction.

S. No.	Name, designation & Department	Queries	PC/SIDA Responses
7	Shakila Laghari Sociologist SIDA	In order to protect the health & safety of workers an insurance policy for labor shall be included in ESMP	The Contractor shall be required to provide suitable insurance policies for their work force as was done in WSIP contracts.
8	Ehsan Laghari GM R & D SIDA	Sewage water is entering from 200 to 250 spots along the canal, these spots must be studied and proper mitigation measures must be provided to off-set its impact. Drainage pattern must be studied, considering the experience of 2011 super flooding, which reaches till Ahmedabad (India)	The municipal authorities need to be consulted on these issues by LBC AWB since the required mitigation (i.e., provision of adequate sanitation measures) is likely out with the scope of a canal rehabilitation project. The drainage of these areas was included in the Left Bank Master Plan that was prepared under WSIP. This master plan needs to be implemented.
9	Masroor A. Shahwani Institutional specialist	CPEC routes, if crossing the Akram Wah must be identified and should also be considered for stakeholder consultation in order to avoid any issue/concern	Noted, the same issue occurred under the WSIP project in Ghotki area and will be considered by SIDA accordingly.
10	Asma Shahid Divisional forest officer, Sindh Forest	Sindh forest department must be taken on board while cutting out trees of Akram Wah	Noted, and SIDA will act accordingly.

Attendance Sheets

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REHABILITATION OF AKRAM WAH

ATTENDANCE LIST

SIDA | THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

Dated: 13th August, 2020

S. No	Name	Designation	Organization	Cell	E-mail	Signature
01	M. Shayan	Environmental Eng	MMP (PIC)	1349-3284100	shayan.ansari@mmpakistan.com	
02	K. H. Soofi	DTL	MMP	0324-2931857	khadim.soofi@mmpakistan.com	
03	Nazir Ahmad Lashari	Senior Engineer	MMP	0300-3009411	nazir.lashari@mmpakistan.com	
04	Mujeeb-ur-Rehman	Sociologist	MMP	0300-3137077	mujeeb.rehman@mmpakistan.com	
05	Muhammad Rahim	Principal Sociologist	MMP.	0301-3624542	mr.jungio@hotmail.com	M. Rahim
06	Abdul Moiz	Environmentalist	MMP	0332-6779526	abdulmoiz@mmpakistan.com	
07	M. Waqar	COO operator	MMP	0333-2723928	waqarrajput86@hotmail.com	
08	TAHIR ALI MEMON	DY. Manager HSE	HSE SIDA SSGC	0323 2682770	–	

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REHABILITATION OF AKRAM WAH

ATTENDANCE LIST

SIDA | THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

Dated: 13th August, 2020

S. No	Name	Designation	Organization	Cell	E-mail	Signature
	Jameel Memon	Chief Executive	MDC	0300-9137695	yameenmemon@yahoo.com	
	Shahzeb Memon	Environmental Specialist	M/s ECS-MDC	0301-3981000	engineer.shahzeb@yahoo.com	
	Ali Khamisani	Assistant	SIDA	030-231654	khamisani.ali@yahoo.com	
	Asma Shahid	Divisional Forest Officer	Sindh Forest	0333-0033670	asma_a_shahid@yahoo.com	
	Razaq Mallah	Chairman	Fo-Gaja Mitro	03032634062	F.o	
	Amber Sanam Laghari	A.D.	SIDA	–	amber.laghari@yahoo.com	
	G. Murtaza Rijavi	ESDS-	SIAPEP	0333-2960384		
	M. Ghous Laghari	I.S'	SIDA	03133091158	ghous.laghari@yahoo.com	
	Sana Ichazada	SGS	SIAPEP	0333-7093639	–	
	Muhammad Anwar	SIDA	Ecologist	03322027536	mamin.khudri@gmail.com	

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ATTENDANCE LIST

SIDA | THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

Dated: 13th August, 2020

S. No	Name	Designation	Organization	Cell	E-mail	Signature
01	UZMA IMRAN	Asstt. Professor	USPCASW, MOET	0333-1993018	engrujma220@gmail.com	
02	Mohammed A. Shishmahal	Sr Environmentalist	MMP	0333-227-0796	M. A. Shishmahal@mmpakistan.com	
03	Aqeel Ahmed	Environmentalist	MMP	0300-8901705		
04	Parvez A Babkhan.	ANT	SIDA	0300-9314638		
05	Muhammad Rabi	Principal Socialogist	MMP	0301-3624542		
06	Mujeeb-ur-Rehman	Sociologist	MMP	0300-3137077	mujeeb.rehman@mmpakistan.com	
07	Nazir Ahmed Lashri	Senior Engineer	MMP	0300-3009411		
08	M. Siddique	Insp. Work	SIDA	0333-2856164		
10	Major (Retd) Zulfiqar Ahmed	Member	LBCA WH	0302-3		

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Dated: 13th August, 2020

S. No	Name	Designation	Organization	Cell	E-mail	Signature
1	Syed Muhammad Shah	Deputy Director	OFWM/SIAPEP	0333-2941377	dasalim70@gmail.com	
	Shah Alam	Zamindar		0343-6036571		
	Shah Faisal Zaman	Zamindar		03003401378		
	Coty Malik	Farmer	Mari Gujjo Nagar	0300 41 77882	Cotymalik@gmail.com	
	Masroor A. Shahwani	Inst. specialist		0331-3547862	Shahwani.masroor@	
	Tariq Bhatti	Manager CR.	LBC-NMB	0300-8213787	tariqbhatti@yahoo.com	
	KABOOL M. KHATIAN	CHAIRMAN AREA Water board	SIDA.	03002532840	Kabul Khatian@hotmail	
	A. Khaliq Nizamani	Chairman F.O Shahwah	Sida	03443662996		
	Pirbhu Satyani	Regional Head	SPO	0333-7512544	pls atyani@spopk.org	
	Ab. Ghafoor	Agriculturist	SPO	0333-3236179	aghafoor@spopk.org	

MMP M MM Pakistan (Pvt) Ltd. MOTT MACDONALD M

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Dated: 13th August, 2020

S. No	Name	Designation	Organization	Cell	E-mail	Signature
	SYED MOHSIN NAZAR	Director Finance	NASA - Hyderabad	0333-2602015	dfc.nasa@gmail.com	
	Zulfiqar Ali B	GM	UBL AWB	03332600908	zzali(fiqar@yahoo.com	
	FAHAD BHURGARI	MANAGER HRD - SIDA	SIDA	0314-2833377	mhrd@sida.org.pk	
	Aftab Hussain	President	K-D-F	0345 3788463	aftabhussain@kd-foundation.org.pk	
	Zubair Ahmed channar	Divisional Forest officer SF Tando Mukh khan.	Sindh Forest department	03322619628.	dfo.zubair@gmail.com	
	A. Rauf	D.D	SEPA	0315-2409618	abdul.raufgujarati176@gmail.com	
	Hafiz Hakamat	Supervisor	Fisheries Deptt	03003041183		
	Shakeela Bapary	Sociologist	SIDA	03062633007		
	Student / EVS /			03113811961	Rashidbalo1993@gmail.com	

Photographs of meeting








C2. Second Round of Consultations

The second round of consultations were conducted by arranging a workshop on 24th August 2021 at SIDA office with all relevant stakeholders. The ESIA was disclosed in the workshop along with the ESMF of the SWAT Project.

Attendance Sheet

ATTENDANCE SHEET OF PARTICIPANTS OF FARMERS ORGANIZATION for 2nd ROUND OF CONSULTATIVE MEETING WITH FOCAL GROUP OF SWAT PROJECT.

Sr: No	Names of Farmers	Names of FO	Contact No	Signature
01	Rabdin Jamil	Qaziyarah OLd	0309 3231330	12/8/24
02	Abdul Ghafoor	Shah wah	0344-3662996	
03	Muhammad Nasir Lodhi	Dariya Wali	03460225823	
04	Noor Muhamad	Jarki	03453013701	
05	Ali Buzr	2J	03053465126	
1	Babu	22-A	03013509[illegible]	
2	G. Qadir	Jassi		
3	Alishah	Panjtar		
9	Alamzoor	21 L	0300-3[illegible]	
10	Asghar	27 P	0301-1[illegible]	
11	Rajab Shah	F.O[illegible]	0345 3666798	
12	Faheem Khan	Khanot	0345 36546	
13	Ayaz Ali	LBC-AWB	0333 2828448	
14	[illegible]	LBC-AWB	0300 3095851	
15	Zaibunisa			
16	Shakeela	SIDA/EMU	0306 2053007	
17	Muhammad Aman	SIDA (R&D)	0332-2027536	
18	Maaz Afridi	SIDA (R&D)	0343-3307 260	

Photographs of the Event





Consultation during SMRP Preparation

Table 1. Consultations with Government Officials

PC No.	Date	Location/ Venue	No of Participants
1	May 20, 2021	Office of the Deputy Director Agriculture Extension Department, District Hyderabad	1
2	May 20, 2021	Office of the Agriculture Extension Department, District Hyderabad	1
3	May 20, 2021	Office of the On-Farm Water Management (OFWM) Department , District Hyderabad	4
4	May 21, 2021	General Manager (GM) SIDA, Focal Person & Consultants	5
5	May 24, 2021	Sindh Irrigation and Drainage Authority (SIDA) Focal Person & Other Officials	6
6	May 27, 2021	Managing Director (MG) SIDA & Officials	6
7	May 27, 2021	Office of the Irrigation Department, District Hyderabad	1
8	August 02, 2021	Office of Director, Left Bank Canals, Area Water Board, District Badin	1
9	August 03, 2021	Office of Directorate General, On-Farm Water Management, District Hyderabad	1
10	August 04, 2021	Office of the Canal Assistant, District Tando Muhammad Khan	1
11	August 05, 2021	Office of the Executive Engineer, Area Water Bank (AWB), Akram Wah	1
12	August 06, 2021	Office of the Divisional Forest Officer, District Hyderabad	1
13	August 06, 2021	Office of the Canal Assistant, Matli, District Badin	1
14	August 06, 2021	Office of the Canal Assistant, Tando Bago Sub-Division Talhar, District Badin	1
15	August 06, 2021	Office of the Canal Assistant, Kadhan Sub-Division, Dadhan, District Badin	1
16	August 07, 2021	Office of the Canal Assistant, Dhubi Sub-Divisional Water Board, Shahi Fazallah, District Badin	1
17	August 07, 2021	Office of the Canal Assistant, Shadi Sub-Division, Tando Bago, District Badin	1
18	August 07, 2021	Office of the Assistant Director, Left Bank Canal Area Water Board, District Hyderabad	1
	Total		**35**

Table 2. Consultations with the PAPs/ Local Communities

A. Consultations with PAPs/ Local Community (Male members)

PC. No.	Date	Location/ Venue	No of Participants
1	July 7, 2021	Ghulam Khan Chang, Union Council Sehnwar, Tehsil Latifabad (R) ,District Hyderabad	10
2	July 7, 2021	Gulab Laghari Union Council 03, Tehsil Qasimabad, District Hyderabad	4
3	July 7, 2021	Gulab Laghari Union Council 03, Tehsil Qasimabad, District Hyderabad	10
4	July 7, 2021	Gulab Laghari Union Council 05, Tehsil Qasimabad,District Hyderabad	10
5	July 7, 2021	Gulab Laghari Union Council 03, Tehsil Qasimabad, District Hyderabad	10
6	July 7, 2021	Gulab Laghari Union Council 03, Tehsil Qasimabad, District Hyderabad	10
7	July 7, 2021	Gulab Laghari Union Council 03, Tehsil Qasimabad, District	10

PC. No.	Date	Location/ Venue	No of Participants
		Hyderaba	
8	July 8, 2021	Husri, Union Council Sehri, Tehsil & District Hyderabad	10
9	July 8, 2021	Phulan Khan Baladi, Union Council Sehri, Tehsil & District Hyderabad	10
10	July 8, 2021	Chang, Union Council Sehri, Tehsil & District Tando Muhammad Khan	10
11	July 9, 2021	Gulab Laghari, Union Council 5, Tehsil Qasimabad, Distric Hyderabad	3
12	July 9, 2021	Gulab Laghari, Union Council 5, Tehsil Qasimabad, Distric Hyderabad	4
13	July 9, 2021	Gulab Laghari, Union Council 5, Tehsil Qasimabad, Distric Hyderabad	3
14	July 10, 2021	Dada Shah, Union Council Pahar Mari, Tehsil Tando Bago, District Badin	10
15	July 10, 2021	Muhammad Bachal Khokhar, Union Council Pahar Maree, Tehsil Tando Bago, District Badin	4
16	July 10, 2021	Qasim Umerani, Union Council Jando Shah, Tehsil & District Badin	7
17	July 10, 2021	Dada Shah, Union Council Pahar Mari,Tehsil Tando Bago, District Badin	7
18	July 10, 2021	Lal Muhammad Khokhar, Tehsil & Distric Badin	5
19	July 10, 2021	Haji Lakhano Khoso Union Council M. Khan Bhurgari, Tehsil & District Badin	5
20	July 10, 2021	Haji Talib Junejo, Union Council Pahar Mari, Tehsil Tando Bago, District Badin	6
21	July 10, 2021	Stop Wehrai Sharif, Union Council Pahar Mari, Tehsil Tando Bago, District Badin	10
22	July 10, 2021	Wahari Shareef, Union Council Pahar Mari, Tehsil Tando Bago, District Badin	10
23	July 11, 2021	New Baran Laghari, Union Council Ghulam Muhammad, Tehsil Matli, District Badin	6
24	July 11, 2021	Wali Muhammad Magsi, Union Council Ghulam Muhammad, Tehsil & District Thando Muhammad Khan	5
25	July 11, 2021	Soomro Khan Laghari, Union Council Ghulam Muhammad, Tehsil Matli, District Badin	3
26	July 11, 2021	Heero Thakhar Colony, Union Council 01, Tehsil & District Thando Muhammad Khan	6
27	July 11, 2021	New Baran, Union Council Ghulam Muhammad, Tehsil Matli, District Badin	8
28	July 11, 2021	Wali Muhammad Magsi, Union Council Ghulam Muhammad, Tehsil Matli, District Badin	8
29	July 11, 2021	New Baran Laghari, Union Council Ghulam Muhammad, Tehsil & District Thando Muhammad Khan	7
30	July 11, 2021	Ayooub Magsi, Union Council Ghulam Muhammad, Tehsil Matli, District Badin	6
31	July 12, 2021	Bashir Colony, Union Council 55, Tehsil Matli, District Badin	2
32	July 12, 2021	Mehar Lound, Union Council Ghulam Hyder,Tehsil Matli, District Badin	6
33	July 12, 2021	Mariyamabad (Kolhi Paro), Union Council Ghulam Muhammad, Tehsil Matli, District Badin	6
34	July 12, 2021	Haroon Machi, Union Council & Tehsil Matli, District Badin	10
35	July 12, 2021	Haroon Machi, Union Council Matli, Tehsil Matli, District Badin	10
36	July 12, 2021	Mariyamabad (Bheel Paro), Union Council Ghulam Muhammad, Tehsil Matli, District Badin	7
37	July 12, 2021	Muhammad Khan Natkumi, Union Council Pevakon, Tehsil Matli, District Badin	8

PC. No.	Date	Location/ Venue	No of Participants
38	July 12, 2021	Peer Waah, Union Council 03, Tehsil Matli, District Badin	4
39	July 13, 2021	Haji Khuda Bux Khoso, Union Council Tando Ghulam Hyder, Tehsil Matli, District Badin	2
40	July 13, 2021	Imam Bux Mala, Union Council Qasim Bux 04, Tehsil & District Hyderabad	11
41	July 13, 2021	Haji Talib Junejo, Union Council Paher Mari, Tehsil Tando Bago, District Badin	3
42	July 14, 2021	Gulab Laghari, Union Council Mirza Pur, Tehsil Qasimabad, District Hyderabad	14
43	July 15, 2021	Ghafoor Shah Colony, Union Council Ghafoor Shah, Tehsil Hyderabad City, District Hyderabad	9
44	July 15, 2021	Gopang Para, Union Council Ghafoor Shah, Tehsil Hyderabad City, District Hyderabad	11
45	July 15, 2021	Ghafoor Shah Colony, Union Council Ghafor Shah, Tehsil & District Hyderabad	10
46	July 16, 2021	Punhoon Qambrani, Union Council Seri, Tehsil & District Hyderabad	11
47	July 16, 2021	Punhoon Qambrani, Union Council Seri, Tehsil & District Hyderabad	10
48	July 16, 2021	Ghafoor Shah Colony, Union Council Pinyari, Tehsil & District Hyderabad	11
49	July 16, 2021	Abdul Ghafoor Khoso, Union Council Husri, Tehsil & District Hyderabad	7
50	July 17, 2021	Loung Patel, Union Council Husri, Tehsil & District Hyderabad	9
51	July 17, 2021	Channel Mori, Union Council Husri, Tehsil & District Hyderabad	10
52	July 17, 2021	Bharam Khan Shoro, Union Council Husri, Tehsil & District Hyderabad	10
53	July 17, 2021	Phulan Khan Balandi, Union Council Husri, Tehsil & District Hyderabad	7
54	July 17, 2021	Ab Ghafoor Khoso, Union Council Husri, Tehsil Sukhpur & District Hyderabad	10
55	July 17, 2021	Sain Bux Gopang, Union Council Husri, Tehsil & District Hyderabad	10
56	July 17, 2021	Phulan Khan Balandi, Union Council Husri, Tehsil & District Hyderabad	10
57	July 17, 2021	Khan Muhammad, Union Council Bhoki, Tehsil & District Hyderabad	9
58	July 17, 2021	Jewan Shah Colony, Union Council Gangra, Tehsil & District Hyderabad	9
59	July 17, 2021	Khamiso Shoro, Union Council Hoseri Boki, Tehsil & District Hyderabad	15
60	July 17, 2021	Wadero Jamal, Union Council Husri, Tehsil & District Hyderabad	12
61	July 18, 2021	Chutto Khan Magsi, Union Council Ghulam Muhammad Halepoto, Tehsil Matli, District Badin	14
62	July 18, 2021	Qadir Bux Solangi, Union Council Panwari, Tehsil & District Hyderabad, Province Sindh	7
63	July 18, 2021	Lumbo Patel, Tehsil & District Hyderabad, Province Sindh	12
64	July 18, 2021	Goth Vero Patail, Union Council Husri, Teshil & District Hyderabad	11
65	July 18, 2021	Phull Shoro, Union Council Husri, Teshil & District Hyderabad	6
66	July 18, 2021	Punhoon Qambrani, Union Council Seri, Tehsil & District Hyderabad	10
67	July 28, 2021	Soomar Khalifo Gaja Mori, Union Council Halepoto, Tehsil & District Hyderabad	10
68	July 28, 2021	Wali Muhammad Magsi, Union Council Palkera, Tehsil Matli,	11

PC. No.	Date	Location/ Venue	No of Participants
		District Badin	
69	July 29, 2021	Bachal Shah Farm, Union Council Pataar, Tehsil & District Tando Muhammad Khan	6
70	July 29, 2021	Baran Laghari, UnionCouncil Palkera, Tehsil Matli, District Badin	10
71	July 29, 2021	Haji Ghous Muhammad, Union Council Tando Saindad, Tehsil & District Tando Muhammad Khan	9
72	July 29, 2021	Qadir Pur, Union Council T.M.K, Tehsil & District Tando Muhammad Khan	8
73	July 30, 2021	Saleem Colony, Union Council Gul Muhammad Colony, Tehsil Matli, District Badin	7
74	July 30, 2021	Rehmat Ullah Jayjo, Union Council Palkera, Tehsil Matli, District Badin	11
75	July 30, 2021	Saleem Colony, Union Council Matli, Tehsil Matli, District Badin	9
76	July 31, 2021	Mor Goth, Tehsil Matli, District Badin, Province Sindh	10
77	July 30, 2021	Yaquib Khumhar, Union Council Pulkara, Tehsil Matli, District Badin	10
78	August 1, 2021	Syed Murad Ali Shah, Union Council Khnat, Tehsil Talhar, District Badin	4
79	August 1, 2021	Ali Pur, Union Council Ali Pur, Tehsil Matli, District Badin	8
80	August 2, 2021	Yousif Katheare, Union Council Chanari, Tehsil Talhar, District Badin	8
	Total		**661**

B. Consultations with PAPs/ Local Community (Female members)

PC. No.	Date	Location/ Venue	No of Participants
1	July 13, 2021	Muhammad Ramzan Brohi, Union Council 04, Tehsil Qasimabad, & District Hyderabad	8
2	July 13, 2021	Muhammad Ramzan Brohi, Union Council 04, Tehsil Qasimabad, & District Hyderabad	7
3	July 13, 2021	Ghulam Qadir Malha, Union Council 04, Tehsil Qasimabad, & District Hyderabad	9
4	July 14, 2021	Gulab Laghari Union Council & Tehsil Qasimabad, District Hyderabad	10
5	July 14, 2021	Gulab Laghari Union Council & Tehsil Qasimabad, District Hyderabadh	6
6	July 14, 2021	Gulab Laghari Union Council & Tehsil Qasimabad, District Hyderabad	10
7	July 15, 2021	Long Goth, Union Council Ghafoor Shah Colony, Tehsil & District Hyderabad	7
8	July 15, 2021	Ghafoor Shah Colony Union Council Ghafoor Shah Colony, Tehsil & District Hyderabad	10
9	July 15, 2021	Ghafoor Shah Colony Union Council Ghafoor Shah Colony, Tehsil & District Hyderabad	8
10	July 15, 2021	Ghafoor Shah Colony Union Council Ghafoor Shah Colony, Tehsil & District Hyderabad	10
11	July 16, 2021	Panu Gambrani Union Council Sehri, Tehsil & District Hyderabad	10
12	July 16, 2021	Panu Gambrani Union Council Sehri, Tehsil & District Hyderabad	9
13	July 16, 2021	Panu Gambrani Union Council Sehri, Tehsil & District Hyderabad	10
14	July 16, 2021	Long Goth Union Council Ghafoor Shah Colony, Tehsil & District Hyderabad	10
15	July 16, 2021	Panu Gambrani Union Council Sehri, Tehsil & District Hyderabad	10

PC. No.	Date	Location/ Venue	No of Participants
16	July 17, 2021	Abdul Gafoor Baloch, Tehsil Hosri & District Hyderabad	10
17	July 17, 2021	Loving Patel, Tehsil & District Hyderabad, Province Sindh	10
18	July 17, 2021	Abdul Gafoor Baloch, Tehsil Latifabad & District Hyderabad, Province Sindh	10
19	July 17, 2021	Jamal Wadero Kachi, Union council Hoosri ,Tehsil Latiqabad & District Hyderabad	10
20	July 17, 2021	Jamal Wadero Kachi, Union council Hoosri ,Tehsil Latiqabad & District Hyderabad	11
21	July 18, 2021	Hari Chand Mohaka Maghnar , Tehsil Matli & District Badin	9
22	July 18, 2021	Chutho Khan Magsi , Tehsil Matli & District Badin, Province Sindh	10
23	July 17, 2021	Noor Muhammad Kalhari ,Tehsil Matli & District Badin, Province Sindh	8
24	July 18, 2021	Chutho Khan Magsi , Tehsil Matli & District Badin, Province Sindh	10
25	July 27, 2021	Ghahi Khan Changh, Tehsil Hosrii, District Hyderabad, Province Sindh	8
26	July 27, 2021	Haji Jumo Burro, Tehsil Hosrii, District Hyderabad, Province Sindh	9
27	July 27, 2021	Phool Shoro, Tehsil Hosrii, District Hyderabad, Province Sindh	6
28	July 28, 2021	Ubhayo Mallah, Tehsil & District Hyderabad, Province Sindh	18
29	July 28, 2021	Suf Khan Hajaro, Tehsil & District Hyderabad, Province Sindh	10
30	July 28, 2021	Hira Thaukur Colony, Union Council T.M.Khan, Tehsil Patar, District T.M.Khan	10
31	July 29, 2021	Karnala Nazamiri, Tehsil Badin, District Matli, Province Sindh	5
32	July 29, 2021	Bashir Colony, Union Council Ghulam Ali, Tehsil Matli, District Badin	9
33	July 29, 2021	Hussainabad, Tehsil Matli, District Badin, Province Sindh	10
34	July 30, 2021	Adam Nagro, Union Council Mallar, Tehisl Matli, District Badin	8
35	July 30, 2021	Muhammad Hashim Solangi, Tehsil Talhar, District Badin, Province Sindh	7
36	July 30, 2021	Haji Mahi Khaskheli, Union Council Nazarpur, Tehsil Tando Ghulam Hyder, District Tando Muhammad Khan	9
37	July 31, 2021	Makhdoom Abdul Rehman, Union Council Kadhar, Tehsil & District Badin,	9
38	July 31, 2021	Yousaf Katiyar, Union Council Peeru, Tehsil Talhar, District Badin	10
39	July 31, 2021	Watho, Union Council Morli De, Tehsil & District Badin, Province Sindh	9
	Total		**359**

APPENDIX-D. Environmental Code of Practice

The table contains the project activities that will have environmental impacts and their mitigation measures.

ECP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop site specific waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to supervision consultant for approval. • Organize disposal of all wastes generated during construction in the designated disposal sites approved by the Project. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal. • Potable water should be supplied in bulk containers to reduce the quantity of plastic waste (plastic bottles). Plastic bag use should be avoided.

Hazardous Waste	Health hazards and environmental impacts due to improper waste management practices	The Contractor shall • Collect chemical wastes in 200 litre drums (or similar sealed container), appropriately labelled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDSs) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills.

ECP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit them for supervision consultant approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on top of a sealed plastic sheet away from watercourses. • Refuelling shall occur only within bunded areas. • Store and use fuels in accordance with MSDSs. Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored; and ensure personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labelled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store and use fuels in accordance with MSDSs.

		• Store all liquid fuels in fully bunded storage containers, with appropriate volumes, a roof, a collection point and appropriate filling/decanting point. • Store hazardous materials above flood level considered for construction purposes • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials.

ECP 3: Water Resource Management

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

Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove dust and sediment. • Water the loose material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and Ecoli.	The Contractor Shall • Provide the drinking water that meets SEQS standards. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time.

ECP 4: Drainage Management

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

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

ECP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP 1 and storage of materials in ECP 2. • Construct appropriate spill contaminant facilities for all fuel storage areas. • Establish and maintain a hazardous material register detailing the location and quantities of hazardous substances including the storage, and their disposals. • Train personnel and implement safe work practices for minimizing the risk of spillage. • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site. • Remediate the contaminated land using the most appropriate available method.
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds.

ECP 6: Erosion and Sediment Control

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

ECP 7: Top soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physic-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside Project area or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone. • Plan construction access to make use, if possible, of the final road alignment.

ECP 8: Topography and Landscaping

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

ECP 9: Quarry Areas Development and Management Plan

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Development and operation of borrow areas	Borrow areas will have impacts on local topography, landscaping and natural drainage.	The Contractor shall • Prepare quarry area management plan and submit the plan for supervision consultant approval. • Use only approved quarry and borrow sites • Identify new borrow and quarry areas in consultation with Project Director, if required. • Reuse excavated or disposed material available in the project to the maximum extent possible. • Store top soil for reinstatement and landscaping. • Develop surface water collection and drainage systems, anti-erosion measures (berms, revegetation etc.) and retaining walls and gabions where required. Implement mitigation measures in ECP 3: Water Resource Management, ECP 6: Erosion and Sediment Control • The use of explosive should be used in as much minimum quantity as possible to reduce noise, vibration and dust.

		• Control dust and air quality deterioration by application of watering and implementing mitigation measures proposed in ECP 10: Air Quality Management • Noise and vibration control by ECP 11: Noise & Vibration Management

ECP 10: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Prepare air quality management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner. • Cover hauls vehicles carrying dusty materials moving outside the construction site. • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions. • Control the movement of construction traffic. • Water construction materials prior to loading and transport. • Service all vehicles regularly to minimize emissions. • Limit the idling time of vehicles not more than 2 minutes.

Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors. • Focus special attention on containing the emissions from generators. • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites. • Service all equipment regularly to minimize emissions. • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations.
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard, and also can affect the local crops;	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted. • Minimize the extent and period of exposure of the bare surfaces. • Restore disturbed areas as soon as practicable by vegetation/grass-turfing. • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations. • Not water as dust suppression on potentially contaminated areas so that a liquid waste stream will be generated. • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems. • Not permit the burning of solid waste.

ECP 11: Noise & Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Prepare a noise and vibration management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures. • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site.
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents. • Use the quietest available plant and equipment. • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid the unnecessary use of alarms, horns and sirens.

Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours. • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions. • Employ best available work practices on-site to minimize occupational noise levels. • Install temporary noise control barriers where appropriate. • Notify affected people if major noisy activities will be undertaken, e.g. blasting. • Plan activities on site and deliveries to and from site to minimize impact. • Monitor and analyse noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas.

ECP 12: Protection of Flora

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Prepare a plan for protection of flora and submit the plan for supervision consultant approval. • Minimize disturbance to surrounding vegetation. • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetation. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill a, etc. • Not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or

		landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work camps to prevent fuel wood collection.

ECP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality	The Contractor shall • Prepare a plan for protection of fauna and submit the plan for supervision consultant approval. • Limit the construction works within the designated sites allocated to the contractors. • check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal.
Vegetation clearance	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds. • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and locate active nests. • If bird nests are located detected within the ledges and roadside embankments then those areas should be avoided. • Petroleum products should not come in contact with the natural and sensitive ecosystems. Contractor must minimize the release of oil, oil wastes or any other substances harmful to migratory birds' habitats, to any waters, wetlands or any areas frequented by migratory birds.

	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum numbers required. • Relocate hollows, where appropriate. • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Night time lighting	Lighting from construction sites and construction camps may affect the visibility of night time migratory birds that use the moon and stars for navigation during their migrations.	The Contractor shall • Use lower wattage flat lens fixtures that direct light down and reduce glare, thus reducing light pollution, • Avoid flood lights unless they are absolutely required. • Use motion sensitive lighting to minimize unneeded lighting. • Use, if possible, green lights that are considered as bird's friendly lighting instead of white or red colour lights. • Install light shades or plan the direction of lights to reduce light spilling outside the construction area.
Construction camps	Illegal poaching	The Contractor shall • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching. • Ensure that staff and Subcontractors are trained and empowered to identify, address and report potential environmental problems.

ECP 14: Protection of Fish

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine transport and disposal of wastes into the river	The Contractor shall • Prepare procedures for protection of fish and submit them for supervision consultant approval. • Ensure the construction equipment used in the river are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of accidental spillage from equipment; make an emergency oil spill containment plan (under the Fuels and Hazardous Substances Management Plan) to be supported with enough equipment's, materials and human resources. • Do not dump wastes, be it hazardous or nonhazardous into the nearby water bodies or in the river.

Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall follow mitigation measures proposed in ECP 3: Water Resource Management and ECP 4: Drainage Management

ECP 15: Road Transport and Road Traffic Management

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

ECP 16: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Prepare a construction camp management plan and submit the plan for supervision consultant's approval. • Locate the construction camps within the designed sites or at areas which are acceptable from

		environmental, cultural or social point of view; and approved by the supervision consultant. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the supervision consultant for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters.
Construction Camp Facilities	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers. • Safe and reliable water supply, which should meet NEQS. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time (World Health Organization -WHO guideline). • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads. • Provide child crèches for women working construction site. The crèche should have facilities for dormitory, kitchen, indoor and outdoor play area. Schools should be attached to these crèches so that children are not deprived of education whose mothers are construction workers. • Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.

Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps. • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the Project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections (STIs) and Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS). In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the labourers during emergency to be transported to nearest hospitals. • Initial health screening of the labourers coming from outside areas. • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. • Provide HIV awareness programming, including STIs and HIV information, education and communication for all workers on regular basis. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form.

		Regular mosquito repellent sprays during rainy season in offices and construction camps and yards. • Not dispose food waste openly as that will attract rats and stray dogs. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices. The Contractor shall • Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Encourage use of flameproof material for the construction of labour housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of fire fighting equipment suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of labourers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. • Give prior notice to the labourers before demolishing their camps/units. • Maintain the noise levels within the national standards during demolition activities. • Different contractors should be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so.

		• Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

ECP 17: Cultural and Religious Issues

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

ECP 18: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Good International Industry practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc.), (ii) risk factors resulting from human behaviour (e.g. STD, HIV etc.) and (iii) road accidents from construction traffic.	The Contractor shall • Prepare an OHS plan and submit the plan for supervision consultant's approval. • Implement suitable safety standards for all workers and site visitors which should not be less than those laid down on the international standards (e.g. International Labour Office guideline on 'Safety and Health in Construction; WBG's 'Environmental Health and Safety Guidelines') and contractor's own national standards or statutory regulations, in addition to complying with Pakistan standards. • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas. • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information, training and protective clothing to workers involved in hazardous operations and proper performance of their job. • Appoint an EHS manager to look after the health and safety of the workers. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters.
Child labour	Risk of child labour	The minimum age of labour for construction is 18 years
labour accident	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	The Contractor shall • Ensure health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations should be easily accessible throughout the place of work. • Document and report occupational accidents, diseases, and incidents. • Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards, in a manner consistent with good international industry practice.

		• Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules. • Provide adequate lighting in the construction area, inside the tunnels, inside the powerhouse cavern and along the roads.
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECP 16: Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. • Hygienic sanitary facilities and sewerage system. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECP 2 • Solid waste collection and disposal system in accordance with ECP 1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community • ECP 2: Fuels and Hazardous Goods Management • ECP 4: Drainage Management • ECP 10: Air Quality Management • ECP 11: Noise & Vibration Management • ECP 15: Road Transport and Road Traffic Management

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

ECP 19: Instream Construction Works (Diversion, and Hydraulic structures)

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Construction Works	River/Canal water quality and aquatic habitat due to risk of release of deleterious substances into the river	The Contractor shall • Prevent the release of silt, sediment, sediment-laden water, raw concrete, concrete leachate, or any other deleterious substances into the River. • Ensure equipment and machinery are in good operating condition (power washed), free of leaks, excess oil and lubricants, and grease. • Machinery leaking fuel, lubricants, hydraulic fluids or solvents shall not work within the river. • Keep a spill containment kit readily accessible onsite in the event of a release of a deleterious substance to the environment. Train onsite staff in its use.
	Stranding of fish in the dewatered area	The Contractor shall • Complete fish salvage before the start of works from the dewatered portion of the river using appropriate techniques.
	Risk of safety relative to river work	The Contractor shall • Devise an evacuation plan, including installation of warning signals and emergency exits, to safely evacuate employees and equipment from the work area. • Ensure risk management procedures are in place on all work sites to minimise the potential for damage arising from inclement weather and/or/elevated river levels during the course of work.
Excavation Works	.	The Contractor shall • Remove excavated material and dispose of it into the designated disposal areas, not dumping these materials into the river. Use

		mitigating measures to protect excavated material from being eroded and reintroduced into the river
Concrete Works	Concrete leachate is alkaline and highly toxic to fish and other aquatic life.	The Contractor shall • Provide appropriate devices and measures against the discharge of toxic materials and fluids originated from concreting work into the rivers, • Ensure that any materials or liquids produced by works involving the use of concrete, cement and cementitious materials shall not be deposited at non-designated places, and not be discharged into or about any watercourse without treatment. • Provide containment facilities for the wash-down water from concrete delivery trucks, concrete pumping equipment, and other tools and equipment.

ECP 20: Communicable Diseases Health and Safety Plan

Item	Good Practices/ Management Guidelines (to be implemented by Contractor/Promoter)
Awareness materials	• Preparation of awareness materials on communicable diseases , e.g., signs, posters • Installation of awareness signs at work sites for visibility to workers and the general public
Detection Measures	• Control and document the entry/exit to the work site for both workers and other parties. • Prevent sick workers from entering the site by checking the temperatures of workers and other people entering the site. Require self-reporting prior to entering the site. • All workers to self-monitor their health, possibly with the use of questionnaires, and take their body temperature regularly. • Thermal screening at the workplace to be considered only in the context of a combination of measures for prevention and control of communicable diseases at the workplace and along with risk communication.
Physical Distancing measures	• Keep a distance of at least 1 meter between workers and minimize physical contact, ensure strict control over external access and queue management (marking on the floor, barriers). • Reduce the density of people in the building (no more than 1 person per every 10 square metres), physical spacing at least 1 meter apart for work stations and common spaces, such as entrances/exits, lifts, pantries/canteens, stairs, where congregation or queuing of employees or visitors/clients might occur. • Avoid crowding by staggering working hours to reduce the congregation of employees at common spaces such as entrances or exits. • Implement or enhance shift or split-team arrangements or teleworking. • Minimise the movement of local workers in and out of the site (e.g., avoid workers returning home to affected areas or returning to site from affected areas). • Minimise the workers' contact with the local community.
Respiratory measures	• All workers should wear a face mask. • If a worker is sick, they should not come to work if a member of staff or a worker feels unwell while at work, provide a medical mask so that they may get home safely. • Where masks are used, whether in line with government policy or by personal choice, it is very important to ensure safe and proper use, care and disposal
Hand Hygiene measures:	• Regular and thorough handwashing with soap and water or hand hygiene with alcohol-based hand-rub (a) before starting work, before eating, frequently during the work shift, especially after contact with co-workers or customers, (b) after going to the bathroom, after contact with secretions, excretions and body fluids, after contact with potentially contaminated objects (gloves, clothing, masks, used tissues, waste), and immediately after removing gloves and other protective equipment but before touching eyes, nose, or mouth.

	• Hand hygiene stations, such as hand washing and hand rub dispensers, should be put in prominent places around the workplace and be made accessible to all staff, contractors, clients or customers, and visitors, along with communication materials to promote hand hygiene
Cleaning and Disinfection	• Cleaning and Disinfection off all site facilities, including offices, accommodation, canteens and common spaces: • Cleaning (soap, water, and mechanical action) to remove dirt, debris, and other materials from surfaces. Disinfection of dirty surfaces and objects only after cleaning. • Most common disinfectants – sodium hypochlorite (bleach) of surface at concentration 0.1% or alcohol at least 70% concentration for surfaces which can be damaged by sodium hypochlorite. • Priority disinfection of high-touch surfaces - commonly used areas, door and window handles, light switches, kitchen and food preparation areas, bathroom surfaces, toilets and taps, touchscreen personal devices, personal computer keyboards, and work surfaces. • Disinfectant solutions must always be prepared and used according to the manufacturer's instructions, including instructions to protect the safety and health of disinfection workers, use of personal protective equipment, and avoiding mixing different chemical disinfectants. • Provide appropriate PPEs to the cleaners. • Manage the waste as medical waste, and dispose of it in accordance with local regulations.
Response measures if workers found with communicable diseases symptoms	• Workers who are unwell or who develop symptoms consistent with communicable diseases to stay at home, self-isolate, and contact a medical professional or the local communicable diseases information line for advice on testing and referral (consider telemedicine and flexible sick leave policy). • Standard operating procedures to be prepared to manage a person who becomes sick at the workplace and is suspected of having communicable diseases , including isolation, contact tracing and disinfection. • People who were in close contact at the workplace with persons with laboratory-confirmed communicable disease's should be quarantined for 14 days from the last time of the contact in accordance with WHO recommendations. • Set out differentiated procedures for the treatment of sick persons based on the case severity. Pay workers throughout periods of illness, isolation or quarantine. • Set aside a part of worker accommodation for precautionary self-quarantine. • Establish communications with local medical services and refer sick workers to there.
Adjusting Work Practices and Manage Work Related Travels	• Consider changes to work processes and timings to minimize contact between workers (e.g., decreasing the size of work team, changing to a 24-hour work rotation). • Cancel or postpone non-essential travel to areas with community transmission of communicable diseases . • Provide hand sanitizer to workers who must travel, advise workers to comply with instructions from local authorities where they are travelling, as well as information on whom to contact if they feel ill while travelling. • Workers returning from an area where communicable diseases transmission is occurring should monitor themselves for symptoms for 14 days and take their temperature twice a day; if they are feeling unwell, they should stay at home, self-isolate, and contact a medical professional.
Communication and Contact With the Community	• Carefully manage the relations with the community with clear and regular communication. • Made aware of the procedures put in place at the site to address issues related to communicable diseases . • Practice social distancing with the local community.
Risk communication, training, and education	• Provide posters, videos, and electronic message boards to increase awareness of communicable diseases among workers and promote safe individual practices at the workplace, engage workers in providing feedback on the preventive measures and their effectiveness. • Provide regular information about the risk of communicable diseases using official sources, such as government agencies and WHO, and emphasize the effectiveness of adopting protective measures and counteracting rumors and misinformation.

	• Special attention should be given to reaching out to and engaging vulnerable and marginalized groups of workers, such as those in the informal economy and migrant workers, domestic workers, subcontracted and self-employed workers, and those working under digital labour platforms. • Train the workers on procedures in place by the project, and their own responsibilities in implementing them.

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