

WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA)

DETAILED ENGINEERING DESIGN, PREPARATION OF BIDDING DOCUMENTS AND PC-1 OF CHINIOT DAM, PROJECT



ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Main Report

(Volume - 1 of 2)

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DISCLAIMER

This EIA report has been prepared based on the available design information at the Detailed Design Report stage. Updating of this report in the future may be required subject to any changes in the detailed design report. As such the environment team of the Chiniot Dam Consultants has no control over the changes in the project final design.

Detailed Engineering Design, Preparation of Bidding Documents and PC-1 of Chiniot Dam Project

Environmental Impact Assessment (EIA) Report

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LIST OF ABBREVIATIONS

ADP	Annual Development Programme
AOI	Area/Area of Influence
BOD	Biochemical Oxygen Demand
CCP	Cultural Code of Practice
CO	Carbon monoxide
CO ₂	Carbon Dioxide
COD	Chemical Oxygen Demand
CDA	Canal and Drainage Act
CDCG	Chiniot Dam Consultants Group
CDM	Clean Development Mechanisms
DBE	Design Basis Earthquake
DC	Deputy Commissioner
DCR	District Census Report
EIA	Environmental Impact Assessment
EP&CCD	Environmental Protection and Climate Change Department
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
E&RT	Environment & Resettlement Team
ERP	Emergency Response Plan
FFA	Flood Frequency Analyses
GBV	Gender Base Violence
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GoP	Government of Pakistan
GWh	Gigawatt hour
HSE	Health Safety & Environment
IEE	Initial Environmental Examinations
JBC	Jhang Branch Canal
LAC	Land Acquisition Collector
LCC	Lower Chenab Canal
LOF	Level of Effort
LAA	Land Acquisition Act
MAF	Million Acre Feet
MCE	Maximum Credible Earthquake
MSDS	Material Safety Data Sheets
MW	Mega Watt
NCS	National Conservation Strategy
NDMA	National Disaster Management Authority
NDMA	National Disaster Management Authority
NGOs	Non-Government Organizations
NPO	No Project Option
NTDC	National Transmission and Power Dispatch Company
OBE	Operating Basis Earthquake
OHS	Occupational Health and Safety
OIC	Organization of the Islamic Conference
O&M	Operation and Maintenance

PAPs	Project Affected Persons
PDHS	Pakistan Demographic and Health Survey
PEPA	Punjab Environmental Protection Act
PEGO	Project Environmental Grievance Officer
PEQS	Punjab Environmental Quality Standards
POPs	Persistent Organic Pollutants
PMU	Project Management Unit
PGA	Peak ground acceleration
QB	Qadirabad-Balloki
RAP	Resettlement Action Plan
RNR	Renewable Natural Resources
PMF	Probable Maximum Flood
SC	Supervisory Consultants
SEA	Sexual Exploitation and Abuse
SEE	Safety Evaluation Earthquake
SO ₂	Sulphur dioxide
SOPs	Standard Operating Procedures
SNGPL	Sui Northern Gas Pipelines Limited
SRT	Salt Range Thrust
TORs	Terms of References
TMA	Tehsil Municipal Administration
UNO	United Nations Organization
UNCCD	UN Convention to Combat Desertification
WAPDA	Water and Power Development Authority
WEC	WAPDA Environmental Cell

EXECUTIVE SUMMARY

ES-1 INTRODUCTION

The Chiniot Dam Project is a part of WAPDA's Vision 2025 which aims to optimize water use by capturing surplus Chenab River flows near Chiniot City. The objectives of this project are ensuring year-round water supply, flood control, effective water usage, and groundwater recharge, enhancing the overall efficiency and sustainability of the Indus irrigation system.

The Project area mainly falls in the flood plain of Chenab River and majorly comprises the cultivated fields. The reservoir area of Chiniot Dam falls under the Jurisdiction of Chiniot, and Sargodha Districts of Punjab Province. At the dam site, Chenab River flows in two narrow gorges and existing flood embankment anchored to these hills, are creating a good topographic situation favourable to develop a low-level reservoir. Proposed storage capacity is 1.0 MAF flood water with 80 MW electricity generation capacity.

For physical, terrestrial ecology and socio-economic aspect, the Area of Influence (AOI) was finalized as the dam site, reservoir area, associated proposed infrastructure localities, 50 m buffer for surrounding situation, and the 5 km stretch above and below the reservoir area for upstream and downstream effects respectively. The AOI / Study Area is selected on the basis of the Project's direct and indirect potentially significant impacts on bio-physical and socio-economic features.

ES-2 LEGAL FRAMEWORK

The Government of Pakistan (GOP) has promulgated laws/acts, regulations and standards for the protection, conservation, rehabilitation and improvement of the environment. Considering the location of the proposed project, Punjab Environment Protection & Climate Change Department (Punjab-EP&CCD) is the concerned regulatory authority and Punjab Environmental Protection Act (PEPA), 1997 (as amended 2017) is the core legislation with respect to Environment. As per Punjab Environmental Protection (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations 2022, the subject Project falls under the Schedule II of category E, which is related to Water Management, Dams, Irrigation and Flood Protection with criteria that all medium and large dams and reservoirs require an EIA Study to initiate the process of Environmental Approval from the EP&CCD. Other laws, acts, ordinances and guidelines applicable are Land Acquisition Act, 1894 Including Later Amendments, Punjab Environmental Quality Standards (PEQS), 2016, Pakistan Penal Code, 1860, The Affected Persons Ordinance, 2001, The Forest Act, 1927, Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974, Punjab Plantation and Maintenance of Trees Act, 1974, Cutting of Trees (Prohibition) Act, 1975, Protection of Trees and Brushwood Act, 1949, Punjab Plantation and Maintenance of Trees Act, 1974, Cutting of Trees (Prohibition) Act, 1975, Protection of Trees and Brushwood Act, 1949, Provincial Local Government Ordinances, 2001, Punjab Antiquities Amendment Act, 2012, Explosives Act, 1884, Hazardous Substance Rules, 2018, Water Apportionment Accord, 1991, The Canal and Drainage Act, 1873, Punjab Mining Concession Rules, 2002, etc. Since Pakistan is a member of a number of international organizations, it

has to follow the international protocols and obligations related to the environmental perspective.

ES-3 Description of the Project

The proposed Chiniot Dam Site is located about 176 km downstream of Marala, 5 km from Chiniot city and about 100 m upstream of existing Railway Bridge on Chenab River. The proposed reservoir of Chiniot Dam which will have a length of 36 km will extend beyond the Motorway bridge of Pindi Bhatian.

The proposed Chiniot Dam is a floodwater storage dam and is being planned and designed to manage the floodwaters of the Chenab River. The Project will comprise a 21 m high Earth Fill Dam that will create a reservoir with a gross storage volume of about 1.0 MAF. Total area and length of reservoir proposed is 190 sq.km and 36 km, respectively. The main purpose of the dam is the flood attenuation and to regulate water for irrigation purposes.

Total manpower required for the proposed project will be estimated by the contractor at construction stage, whereas as per consultant's previous experience the workforce for proposed project has been estimated as 450 workers 150 skilled and 300 unskilled labour. The water consumption is estimated to be 18,000 liters /day¹ for 450 construction workers comprising skilled and unskilled labors for the proposed Project. The wastewater generation is estimated to be 14,400 liters/day for 450 construction workers comprising skilled and unskilled labour for the proposed Project. The solid waste generation is estimated to be 202.5 kg/day (as per 0.45 kg/capita/day waste generation)² for 450 construction workers comprising skilled and unskilled labors for the proposed Project.

ES-4 ALTERNATIVES OF THE PROJECT

Three alternative project layouts (Alternative - I, Alternative - II and Alternative - III) were considered for the reservoir and two options for powerhouse scheme.

Table ES-1: Comparison of Alternative Project Layouts

Sr. No.	Description	Alternate - I	Alternate - II	Alternate - III
TECHNICAL PARAMETERS				
Dam / Barrage				
1.	Embankment Length			
	Left	38 km (124,640 ft.)	55 km (180,445 ft.)	62 km (203,412 ft.)
	Right	39 km (127,920 ft.)	44 km (144,357 ft.)	48 km (157,480 ft.)
Reservoir				
2.	Reservoir Area	47,700 Acres	86,735 Acres	120,000 Acres
3.	Reservoir Length	35 km	35 km	35 km
4.	Reservoir Perimeter	88.3 km	94 km	109 km
5.	Gross Storage	1.0 MAF	1.44 MAF	1.82 MAF

1. Water requirements for 450 Work Force = (450) x (40) = 18,000 liters/day
Wastewater Generation = (18,000) x (80% of wastewater) = 14,400 liters/day

2. Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day

Sr. No.	Description	Alternate - I	Alternate - II	Alternate - III
6.	Live Storage	0.93 MAF	1.386 MAF	1.759 MAF
ENVIRONMENTAL PARAMETERS				
7.	Area Inundated	47,700 acres	86,735 acres	120,000 acres
8.	Population Affected	27,300	33,257	62,420
9.	Land to be Acquire / transfer from govt. departments	47,700 acres	86,735 acres	120,000 acres
10.	Agriculture Land	12,613 acres	50,735 acres	83,000 acres
11.	Houses (No.)	3,896	4,751	11,461
12.	Flora (No. of Trees)	50,599	315,000	507,000

Option 1 proposes a powerhouse on the left side of the right river gorge, using a gross head of 10 meters and an installed capacity of 80 MW. Equipped with six horizontal shaft bulb turbines, it will generate 227 GWh annually. Option 2, located on the left bank of the Chenab River in a narrower gorge, uses a rated net head of 12.4 meters with the same turbine setup and capacity. The powerhouse must be founded on sound geological strata to withstand the substantial vibrational and thrust loads generated by electro-mechanical equipment, and to prevent differential settlements. The alignment of a surface powerhouse is determined by topographical constraints and the inflow/outflow hydraulic profile.

Subsurface data reveals that at Site-II, rock strata are encountered at relatively shallow depths, whereas at Site-I, rock is present at considerably deeper levels. In terms of hydraulic head, Site-II offers a net head of 12.47 m, compared to 10.0 m at Site-I, providing additional energy potential.

After detailed analysis, Alternative I was chosen for detailed study due to its smaller reservoir area, lower costs, and fewer land acquisition, resettlement, and environmental issues. It offers the highest benefits and lowest costs compared to other options. Option 1 was excluded due to flood risks and unfavourable geological conditions. The powerhouse location in Option 2, on the left side of the left river gorge, was selected for its favourable geology and topography.

ES-5 BASELINE ENVIRONMENT

The baseline study aims to document the existing conditions of resources likely to be impacted, including physical, ecological, and socio-economic environments. A team of experts including: Environmental Scientist, Environmental Engineers, Ecologist and Sociologists was constituted to establish the baseline conditions of the Study Area/AOI. Based on the impact zones for the various predicted impacts, Study Area/AOI was developed and demarcated. In October 2023, the said team conducted field visits to the proposed dam site, reservoir area, and downstream command area to collect baseline data.

Baseline data was collected using checklists, satellite imagery (Google Earth), and General Topographic (GT) sheets. The Area of Influence (AOI) was demarcated through expert judgment, field visits, consultant experience, and consultation with relevant departments. Experts prepared checklists for key physical, ecological, and socio-economic parameters. Meetings and scoping sessions were held with project stakeholders to gather primary information, disclose project details, and address concerns. Government offices were visited to verify field data and obtain relevant documents

Following is the description of the baseline conditions of the Study Area/AOI.

Physical Environment

The topography of the area, south of Chiniot in the Indus Plain, is flat with Indian Basement rock ridges up to 250 meters high, separating the plains into upper and middle basins. The reservoir features fluvial plains with sand-rich river channels, fluvial terraces above the river, and paleo-alluvial fans with medium sand. The dam site is located where the river splits into two gorges between rock hills, suitable for accommodating the barrage.

The geology reflects the Himalayan formation, marked by intense deformation, complex folding, high-angle strike-slip faults, and crust thickening through thrust faults. In western Kirana Hills, the area features Indian Shield basement rocks, including metasedimentary layers and altered basic igneous rocks.

Building Code of Pakistan (2007) shows that the Project area (Chiniot) falls in Seismic Zone 2A of Pakistan (low to moderate damage).

The soil is predominantly silty clay and sand, with characteristics including silty sandy clay and silty sand in reservoir and barrage areas. The flood plain of the Chenab River features a mix of sandy silt and clayey silt, with varying densities observed in different project areas. The soils present in the reservoir area of the Chiniot dam are of alluvial nature of Quaternary age.

The climate in project area is semi-arid and hot subtropical. The winter and spring are pleasant whereas summer is hot with dust and heat waves. Monsoon rains occur in summer, while westerlies bring winter rainfall. Temperatures range from 6°C to 45°C, with a mean monthly precipitation of 23 mm. Average humidity is 33.5%, with wind speeds of 11-16 km/hr.

The main source of surface water is River Chenab. Apart for these, two drains Buchiana drain and Marh drain also exist in the project area.

The Tehsil Municipal Administration (TMA) Chiniot oversees solid waste management in Chiniot District, handling both primary and secondary waste collection. However, the city lacks a proper waste disposal system. An initial survey of the proposed project site revealed no waste management facilities, with waste being dumped in open heaps and nearby water bodies.

Environmental monitoring for ambient air quality and noise levels was conducted at (05) five locations in Chiniot: Chenab Nagar, Basti Pathan, Talibwala, Basti Mallah, and Langar Makhdoom. Surface water samples were collected from (05) five locations of River Chenab, while wastewater samples were taken from Hersa Shaik and Hast Khiwa stream. Drinking water was sampled from five hand pumps in Langar Makhdoom, Talibwala, Kot Muhammad Yar, and Muslim Colony.

All the test results were compared with PEQS 2016 standards. Drinking water results are within the acceptable limits of PEQS 2016, except for turbidity at Kot Muhammad Yar and Muslim Colony. Surface water was within acceptable limits, but wastewater exceeded standards for Ammonia, Sulfide, COD, and BOD. Ambient air quality showed PM_{2.5}, PM₁₀, and

SPM levels exceeding limits at all locations, while noise levels were also above standard at all five sites

The land use of the study area is a mix of Agricultural, barren land, nullahs, roads, settlements, orchards and trees. Environmentally sensitive receptors were identified during site visits. Sensitive receptors include Educational Institute (Schools), Mosque, Shrine and Monument.

Ecological Environment

The ecological environment of the area is complex, fragile, and sensitive, with diverse flora and fauna. Located in a semi-arid region of Pakistan, it experiences a dry climate year-round, with occasional seasonal rains occurring between July and September.

The Large area of the forest has been converted into agriculture land some of which lies in river basin and island type dry areas are prominent. Prominent aquatic and natural vegetation of the study area includes Lyngbye's sedge, Hydrilla, Water lily, Horned pond-weed, Reed, Indian lotus, Curly-leaf pondweed, Jand, Athel, Indian plum, Goose grass and Kansgrass etc.

The Chak Bahadur reserve forest, approximately 37.58 acres, intersects with the proposed project area. It is crucial to avoid this forest or adhere strictly to legal and environmental requirements if unavoidable. A NOC or de-notification is needed per the Punjab Forest Act. Although the area is currently submerged and lacks vegetation, restoring it is essential for the project's sustainability.

The major flora found in study area include Kikar, Bohar, Peepal, Shisham, Ber, Neem, Mulberry, Safeda and Bakain etc. Commonly found fauna are Jackal, Squirrel, Fox, Rats, Mongoose, Wild bear, Frog, Toad, Brown cobra and Indian krtai etc. House sparrow, Mynah, House crow and Pigeon are the common avifauna of the study area.

River Chenab have rich aquatic ecology which varies with seasonal fluctuation. Common aquatic biodiversity of study area includes macro and micro flora (macrophytes, cyanobacteria, algae, protozoa) and aquatic fauna (mosquitoes, mayflies, dragonflies, zooplanktons and fish fauna).

The study area primarily supports irrigated agriculture with reliance on tube wells and limited canal water. High-yield crops such as wheat, sugarcane, and various vegetables, including tomatoes, peppers, cucumbers, and potatoes are grown here.

Socio-economic Environment

The Chiniot Dam Project is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab. The reservoir area of Chiniot Dam falls under the Jurisdiction of Chiniot, and Sargodha Districts of Punjab Province.

In 2023, District Chiniot had a population of 1,563,024, with a 2.3% annual growth rate and a literacy rate of 50.05%. The majority (95.47%) are Muslims, while Ahmadiyya make up 4.37%. The 2017 census reported 1,368,659 residents, with 699,606 males and 668,914 females.

The district has a rural population of 946,429 and an urban population of 422,230. Punjabi is spoken by 94.62%, Urdu by 3.85%, and other languages by 1.16%. There are 220,396 households. Major tribes include Rajput, Dhudhi, and Syed. About 44.4% depend on agriculture, livestock, and fishing. Chiniot is renowned for its furniture and woodwork.

In 2023, District Sargodha has a population of 4,334,448 and 684,799 households, with a 2.08% growth rate. The 2017 census reported a literacy rate of 65.54%, with 74.12% for males and 56.88% for females. Urban residents total 1,144,535 (30.97%), and 25.11% are under 10 years old. Muslims constitute 98.08% of the population, while Christians make up 1.76%. Punjabi is spoken by 94.07%, Urdu by 4.31%, and Pashto by 1.23%. Major ethnic groups include Jat, Rajput, Arain, Gujar, and Awan. The economy relies heavily on construction (35.8%) and agriculture (31.0%). Sargodha is renowned for its citrus production.

Total 297 households were randomly selected from the project reservoir and its allied facility areas for questionnaire-based survey. The survey result reveals a male population of 52% compared to 48% females, with an average household size of 7.6 people. Age distribution shows 37% under 17 years, 20% between 18-25 years, 16% between 26-35 years, 10% between 36-45 years, and 17% over 45 years. Literacy rates indicate 21% illiterate, 55% literate, with primary education for 19%, middle for 9%, matriculated for 6%, and a few holding higher qualifications. Punjabi is the predominant language spoken by 100% of respondents. Ethnic groups include Galotar and Haral Jutt. About 27% rely on agriculture and livestock, while 77% are non-earning, with 33% being housewives. Income levels vary, with 2% earning up to 32,000 PKR monthly and 38% earning above 62,000 PKR. Expenditures align closely with incomes. Most live in joint families (51%) and own their homes (98%), with 14% in pacca houses, 64% in semi-pacca, and 22% in katcha houses. All households have electricity and access to drinking water, but face challenges like inadequate healthcare, transportation, and sanitation facilities. Women contribute significantly to household and economic activities but face issues including limited public transport, water scarcity, and lack of educational and skill development opportunities.

ES-6 Stakeholder Engagement and Public Consultations

The primary stakeholders include all the PAP's according to their loss of assets and living conditions, Provincial and District Level Government Departments of Punjab such as Environmental Protection and Climate Change Department (EP&CCD), Sui Northern Gas Pipelines Limited (SNGPL), Irrigation Department, Agriculture Department, Wildlife Department, Forest Department, etc. However, the secondary stakeholders include the public and private agencies involved in the implementation of the Project.

The consultations with various departments of both District Chiniot and Sargodha highlighted several common concerns and suggestions for the proposed project. Key issues include the need for comprehensive Environmental Management Plans (EMPs) to mitigate environmental impacts, such as tree loss and disruption to wildlife habitats. Many officials emphasized the importance of compensating agricultural losses and ensuring fair compensation for affected communities. Recommendations included developing a tree plantation plan, integrating fish hatcheries, and protecting protected forests. Additionally, concerns about the impact on silt mining and local livelihoods were noted, with suggestions for creating robust resettlement and

livelihood restoration plans. There was a consensus on minimizing impacts on agriculture and ensuring that the project's benefits, such as flood protection and recreational opportunities, outweigh the potential negative effects. Efforts to engage local communities, protect wildlife, and follow legal requirements were strongly advised.

Total 198 participants were present in individual and 29 group consultation sessions. They expressed significant concerns about the acquisition of fertile agricultural land for the dam project, suggesting a relocation of the project to preserve this vital resource. They emphasized the need for compensation at market rates, land-for-land exchanges, and proper resettlement plans for affected communities, including residential and commercial structures. The community also stressed the importance of addressing livelihood impacts for silt miners and ensuring timely compensation payments. Concerns about the relocation of mosques and graves, dust, noise, and potential waterlogging were noted. Suggestions included preparing comprehensive livelihood restoration plans, minimizing construction disruptions, and implementing effective drainage strategies.

ES-7 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The overall impacts of pre-construction, construction and operational phase of the proposed project were identified on the basis of literature review, site surveys and expert opinion on prevailing site conditions and sensitive receptors. Identified impacts were evaluated through Environmental and Social impact matrix.

Positive Impacts of the proposed project are protection against flood damages, irrigation benefits, provision of water storage, energy production, water management, habitat improvement for wildlife, aquatic life and migratory birds, infrastructure development, employment opportunities and socio-economic uplift.

Major environmental and Social impacts associated with the proposed project during pre-construction phase include Land Acquisition (permanent & lease), impact on infrastructure, damage during field investigations, impact on flora and fauna, fear of resettlement and loss of physical assets. Major impacts during construction phase include impacts on aesthetics, transportation, roads, soil erosion, contamination of ground and surface water, solid waste and wastewater generation, ambient air and noise pollution, drilling burrowing hazards, employment issues, loss of privacy and security and damage to flora and fauna etc. Major impacts during operation phase include sedimentation, salinity and waterlogging, loss of nutrients, impact on water quality, change in land use, dam safety and emergency, water seepage, impact on flora and fauna, water borne diseases and change in farming patterns.

Mitigation measures for the pre-construction phase include preparation of Resettlement Action Plan (RAP), minimizing land acquisition, carefully relocating infrastructure, and avoiding sensitive areas. Reduce air pollution through dust control, manage excavated material properly, and establish construction camps with minimal impact on vegetation. During construction, mitigation measures include efficient waste management, adherence to traffic rules, and proper excavation disposal to avoid drainage blockage. Maintain existing vegetation, manage soil erosion, and recycle excavated materials. Implement on-site sanitation, dust control, noise reduction, and health and safety protocols. Ensure local

consultation for construction timing and promote awareness of HIV/AIDS among workers. Mitigation measures during the operational phase of the Chiniot Dam include using four sluices to manage sedimentation and conducting drawdown sluicing during high discharge periods. Watershed management, such as tree planting and erosion control, will extend the reservoir's lifespan. Additional measures involve regular water quality monitoring, promoting aquatic macro-fauna, and adhering to safety standards to address dam failure risks and maintain environmental balance.

ES-8 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The EMMP has been prepared for all phases (e.g. pre-construction, construction and operation and maintenance) of the proposed project as part of the EIA report with following objectives:

- To ensure that all necessary corrective actions are carried out in time to counter any adverse environmental impact;
- To ensure the regular monitoring of those factors which may affect the safety of the environment under a systematic monitoring approach;
- Define the responsibilities of the project Proponent, Contractors, Supervision Consultants (SC) and environmental monitors;
- Provide a procedure for timely action in the face of unanticipated environmental situation;
- Identify training requirements at various levels including project proponent, Contractor and SC;
- Provide a monitoring mechanism in the form of an environmental monitoring program, which includes monitoring parameters, monitoring frequency to ensure that all the mitigation measures are completely and effectively implemented;
- Provides estimation of environmental cost for the implementation of EMMP; and
- Identify the resources required for the implementation of EMMP.

The EMMP also provides information regarding institutional requirements for the implementation of EMMP at proponent, supervisory consultant and contractor level, environmental mitigation plan, environmental monitoring plan. Various management plans including HSE management, tree plantation, emergency preparedness and response framework, restoration and rehabilitation, waste management, traffic management and change management have also been prepared as part of EMMP. The tentative cost of environmental and social mitigation measures, monitoring and training is about 1.90 billion PKR excluding land acquisition and resettlement cost.

ES-9 CONCLUSIONS

The implementation of the proposed project will have beneficial impacts on population of the project area. Construction of dam at Chenab River will provide protection against flood, irrigation benefits, provision of water storage, energy production and habitat improvement for flora and fauna. Apart from the beneficial impacts of the project, the proposed project has potential some adverse environmental and social impacts during the construction and operational phases. The major impacts such as land resettlement and loss of agriculture land will be permeant but to mitigate this Resettlement Action Plan will be implemented.

Proper implementation of EMMP, containing mitigation measures for anticipated potential impacts along with monitoring program, should be ensured during all three phases of the proposed project. All personnel staff, employees and contractor/s should undertake appropriate training prior to construction to ensure they are aware of the on-site responsibilities in respect of all environmental and social issues.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

The major sources of surface water available to Pakistan are perennial flows of river Indus, Chenab, Jhelum and its tributaries. As such the major surface water development in the country has been based on the use of waters of Indus and its tributaries. However, the flows of these rivers are characterized by a great variation, both annually and seasonally. About 84% of the flows occur during three summer months and a sizeable part of these flows is wasted due to non-availability of storage capacity. On the other hand, there is an urgent need to augment the quantum of useable water to sustain the irrigated agriculture which utilizes about 97% of available river flows. All the past development plans of the country in the Water and the related Hydropower Sector have therefore, recommended programmes for the creation of Surface Storage by building dams so that the surplus river flows could be conserved for utilization during periods of low river flows and the hydraulic head utilized for power generation.

After the independence of Pakistan, the first dam which was constructed was the Warsak dam on the Kabul River in 1960. This dam with a height 250 ft, created a small storage with an initial capacity of 0.04 MAF. The construction of this dam helped in extending irrigation through gravity and lifts canals and added 240 MW to the power generation capacity.

Following the Indus Water Treaty with India in 1960, the construction of large dams and as part of the Replacement Works under the Treaty, three storages were developed. Mangla Dam on the Jhelum River, with a live storage capacity of 5.34 / 4.82 MAF was made operational in 1967. This was followed with the Tarbela Dam on the Indus River with a live storage capacity of 9.7 MAF, which became functional in 1976. A smaller storage of 0.7 MAF was developed on the Indus River at the Chashma Barrage in 1971. These storages helped greatly in regulating the highly variable run-of-the-river flows and augmented the meager irrigation supplies for the rabi season. The hydropower generation from Mangla & Tarbela dams has increased to 4,478 MW representing a major component of the country's total power generating capacity.

For augmenting the capacity of the surface storages for beneficial uses and also for capturing the hydro-electric potential, the major Kalabagh dam was taken to the feasibility stage by the time Tarbela dam was completed. After the review of the feasibility, detailed investigation and design, over five years resulted in the completion of the Tender Documents in 1987. The construction of this major project with live storage capacity of 6.10 MAF and power generating capacity of 3,600 MW has however not been possible due to the opposition of some of the provincial governments.

With the heavy dependence of the country's economy on irrigated agriculture, for which the available water resources have been largely harnessed (by the diversion of the natural river flows) the country is faced with an uncertain future for meeting the growing demands for food and fibre. The required increases in future agricultural production have to come from greater agricultural productivity and larger irrigated areas and this implies a control on the irrigation supplies matched to the crop water requirements. With the inherent variability in the river flows,

the control on the supplies by the construction of dams has therefore, acquired a great urgency.

Realizing the gravity of the situation in the Water Sector of the country, WAPDA, conceived Vision 2025 and for its achievement developed a National Water Resources and Hydropower Development Programme. This Programme includes irrigation Extension Schemes, and Storages which can be integrated with the existing irrigation system and those which are outside. For the storages, which can be integrated with the Indus irrigation system, priority has been given to a dam on the Indus River and to off-channel storages fed by the Indus flows. The proposed Chiniot Dam Project is one of the off-channel storages to be fed with surplus flows of Chenab near Chiniot City, in the Vision 2025 Programme.

Since 1960, the Chiniot Dam Project has undergone several proposals aimed at optimizing water resource management along the Chenab River. In 2003, an Appraisal Study conducted by M/s BARQAAB Consulting Services evaluated surplus flows and storage potential along the Chenab River. Afterword, WAPDA prepared a feasibility report recommending a 17 m high dam. The reservoir, bounded by dykes, would have a storage capacity of 1,100 Mm³ (0.9 MAF) with minimal environmental impact. The proposed barrage would handle a peak discharge of about 34,000 cumecs (1,200,000 cusecs) at a conservation level of El. 190 m a.m.s.l. Additionally, a powerhouse on the left side of the right river gorge was proposed to generate 80 MW of electricity.

In addition to above, Contract for Consultancy Services regarding Detailed Design and Tender Document along with Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP) was awarded by WAPDA to the Chiniot Dam Consultants Group (CDCG) - Joint Venture of National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK), the lead firm, Pakistan Engineering Services (Pvt.) Ltd. (PES), BARQAAB Consulting Services (Pvt.) Ltd. and DOLSAR Engineering Inc. Co on June 10, 2022. Terms of References (TORs) are attached as **Annex-I**.

1.2 REQUIREMENT TO CONDUCT EIA

Punjab Environmental Protection and Climate Change Department (Punjab-EP&CCD) is the concerned regulatory authority and Punjab Environmental Protection Act (PEPA), 1997 (as amended 2017) has been considered for the Environmental Impact Assessment (EIA) study as it is the core legislation which deals with the protection of environment in the Province. As per Section 12 of PEPA, 1997 (as amended 2017); no proponent shall commence construction or operation unless he has obtained Environmental Approval from the concerned Environmental Protection Agency i.e. Punjab-EP&CCD.

Punjab EP&CCD, Review of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Regulations 2022 provide the basis for the screening of a Project as per project size and magnitude. The subject Project falls under the Schedule II of category E, which is related to Water Management, Dams, Irrigation and Flood Protection with criteria that all medium and large dams and reservoirs require an EIA Study to initiate the process of Environmental Approval from the Punjab EP&CCD.

1.3 OBJECTIVE OF EIA

The prime objective of the EIA study is to identify and assess the anticipated impacts of the proposed project and to recommend necessary mitigation measures to prevent/minimize the identified adverse impacts on surrounding environment and community by adequate environmental and social management during pre-construction, construction and implementation stages.

More specifically, other associated objectives of this EIA are to:

- Facilitate proponents and financiers of the project in ensuring environmental and social sustainability of the project;
- Establish a baseline of existing social and environmental conditions prior to project initiation by collecting secondary and primary data/information on physical, biological and socio-economic environment of the project area;
- Identify potentially significant environmental and social impacts (both positive and negative) during all stages of the project;
- Avoid, minimize, and suggest mitigation and compensation measures for significant adverse impacts;
- Conduct, record and report public consultation and participation with major stakeholders; and
- Provide Environmental Management and Monitoring Plan (EMMP) for all stages of the project as a tool for the implementation of the suggested measures, along with monitoring and evaluation mechanism with adequate resources including capacity building of implementing agencies.

1.4 PROJECT LOCATION, SIZE AND MAGNITUDE

The proposed Chiniot Dam Site is located about 100 km downstream of Qadirabad Bridge and 5 km from Chiniot city and about 100 m upstream of existing Railway Bridge on Chenab River. The proposed reservoir of Chiniot Dam which will have an approximate length of 36 km will extend upto Motorway bridge of Talib Wala. The area is formed of flood plain of Chenab River. The area comprises the cultivated fields. The reservoir area of Chiniot Dam falls under the Jurisdiction of Chiniot and Sargodha Districts of Punjab Province. At this site Chenab River flows in two narrow gorges and existing flood embankment anchored to these hills, creating a good topographic situation favorable to develop a low-level reservoir. Storage capacity is proposed 1.0 MAF flood water and generates cheap 80 MW electricity. The location map of the proposed project is shown in **Figure 1.1**.

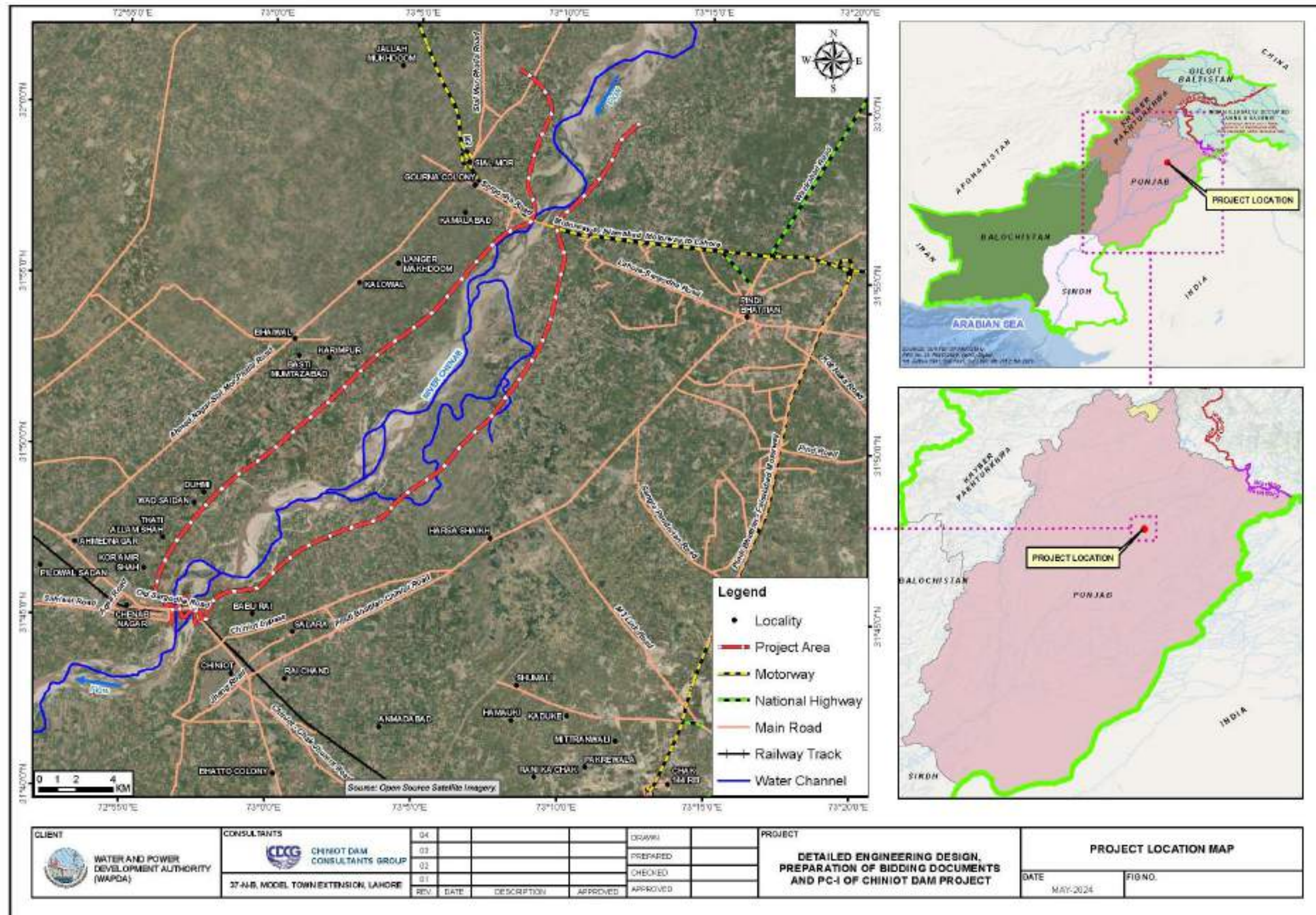


Figure 1.1: Location Map of Proposed project

1.5 PROJECT PROPONENT

The Proponent and executing agency of the proposed Project is Water and Power Development Authority (WAPDA) whereas CDCG is the consultant for the proposed Project. The contact address details are given as under:

a) Proponent Contact Address

Water and Power Development Authority,
Sunny View Estate, Lahore
[Tel: +042-9902717](tel:+042-9902717)

b) Consultant Contact Address

Chiniot Dam Consultant Group (CDCG)
Joint Venture of National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK), the lead firm, Pakistan Engineering Services (Pvt.) Ltd. (PES), BARQAAB Consulting Services (Pvt.) Ltd. and DOLSAR Engineering Inc. Co
House 37-B, Block – N, Model Town Extension, Lahore
Tel: +92-42-35194871

1.6 CONSULTANT EIA TEAM

The consultant's EIA team, comprising environmental engineers/scientists, sociologists and ecologist were involved in the preparation of this EIA report for the proposed Project. The team was involved in data collection, analysis of data, impact assessment and mitigation measures and report compilation. In addition, the EIA team worked in close coordination with the design team and several inputs were provided by the design specialists to the EIA team. Details of the EIA team are provided in **Table 1.1**.

Table 1.1: Team Composition for the EIA Study

Sr. No.	Name	Designation	Responsibilities
1.	Mr. M. Shariq Ahmed	Head ERSD/ Team Leader	Responsible for liaison with the Client and relevant stakeholders, reconnaissance survey of the project site, technical guidance and input for preparing the EIA report.
2.	Mr. Fahad Saleem	Senior Environmental Engineer	Responsible for site survey and collection of baseline data, evaluation of potential significant impacts of the project on the surrounding environment, proposal for mitigation measures for adverse impacts, and formulation of EMMP and finalization of EIA.
3.	Mr. Wasim Abbas	Senior Sociologist	Responsible for preparing social survey tool, collection of socio-economic data for baseline, meeting with local people and relevant stakeholders for noting their concerns and comments, identification of potential impacts on socio-economic environment, proposal for mitigation measures for adverse social impacts and preparation of EMMP.
4.	Mr. Noor Elahi	Aquatic Expert	Responsible for site survey and collection of baseline data for aquatic ecological parameters, evaluation of potential significant impacts of the project on aquatic flora and

Sr. No.	Name	Designation	Responsibilities
			fauna and proposal for mitigation measures for the same.
5.	Ms. Shehnila	Environmental Scientist / Gender Expert	Responsible for site survey and collection of baseline data, review of procedures, guidelines, legal and policy framework, gender consultation meetings with local women's and stakeholders for noting their concerns and comments, preparation of project description and perform analysis of alternatives.
6.	Mr. Shoaib Aziz	Sr. Engineer (Chemical)	Responsible for data digitization and management and compilation of EIA report.
7.	Mr. Ibadullah	Senior Ecologist	Responsible for site survey and collection of baseline data for biological parameters, evaluation of potential significant impacts of the project on ecological sources of the project area and proposal for mitigation measures for the same.
8.	Mr. Muhammad Abdul Basit	Environment, Health and Safety Expert	Responsible for site survey and collection of baseline data, review of procedures, guidelines, legal and policy framework, and preparation of EIA report.

1.7 APPROACH AND METHODOLOGY

The detailed approach and methodology used for the EIA study is provided below:

1.7.1 Literature Review

Prior to mobilization, the consultants conducted a desktop study through collection and review of guidelines, data and reports related to the project, that included (a) review of relevant Environmental Legislations; (b) Google Earth Satellite Imagery; (c) Relevant District Census Reports (DCR), 1998 and Socio-Economic Data of Census, 2017; (d) Design Data provided by the Client; and (e) Reference similar project EIA documents.

1.7.2 Review of Environmental Laws and Institutional Requirements

The Project needs to comply with all the applicable environmental policies, laws, guidelines, acts and legislations of the Government of Pakistan (GoP) and Punjab. Moreover; Environmental and Social Standards laws and regulations related to the proposed Project has also been discussed in detail in Chapter-2 of this EIA report.

1.7.3 Environmental Screening

After the desktop studies the first step in the environmental assessment process is the Project Screening. Screening defines the nature of the project and type of study required to integrate environment into the design.

Considering the prevailing conditions of the Project area and based on Punjab Environmental Protection Agency Review of IEE and EIA regulations 2022, the proposed Project falls under

category E “Water Management, Dams, Irrigation and Flood Protection” of Schedule-II which means that an EIA is required for the proposed Project.

1.7.4 Delineation of Study Area/AOI

Identification of Study Area/Area of Influence (AOI) is an important activity for environmental studies at this stage. AOI if not delineated properly can impact the overall objectives and conclusions of an environment study. Moreover, it also impacts the allocated resources including the level of effort (LOE) and time. AOI is the area over which the proposed Project activities can potentially impact directly or indirectly on the environment. In this report the word study area and AOI is used interchangeable.

The AOI is different for the physical, ecological and socio-economic Environment. For physical environment, the AOI refers to the geographical or spatial extent in which a particular physical factors exist or project has impacts on that component. The AOI of physical environment include main dam area, reservoir area, upstream area (where changes in the river's hydrological regime and sediment transport are likely to occur. The upstream area may include sections of the river valley, tributaries, and their associated ecosystems), downstream area (where changes in river flow, sediment transport, and water quality downstream can impact the physical environment) and surrounding landscape (such as the dam site and its immediate vicinity, will also be part of the AOI which includes the construction site, offices and colony area, access roads, and associated infrastructure, etc.).

Similar to AOI of physical environment, the AOI of socio-economic environment pertains to the spatial or social boundaries within which human activities, systems, and structures impact are foreseen. It includes the immediate project area, reservoir area (where impounding will occur), downstream area (where the effect of the proposed project construction will be foreseen). The AOI in the socio-economic context will be influenced by factors like political/district boundaries, demographic patterns, economic interdependencies, and cultural norms.

In contrast to above, the AOI of ecological environment refers to the spatial extent over which ecological interactions and processes occur. It encompasses the ecological relationships, dependencies, and dynamics among organisms, species, habitats, and ecosystems. The AOI in the ecological context can vary depending on factors such as nearby designated forest and wildlife areas, stretch of waterbody directly and indirectly affected by the proposed project activities.

For physical, terrestrial ecology and socio-economic aspect, the AOI will be the dam site, reservoir area, associated proposed infrastructure localities, 50m buffer for surrounding situation (refer **Figure 1.2**), and the 5km stretch above and below the reservoir area for upstream and downstream effects respectively. On other hand the stretch of river between Qadirabad and Trimmu Barrage will be considered as AOI for aquatic ecology at a greater extent however, the aquatic habitat of the Chenab River and its tributaries in the reach from Railway Bridge GT road Faisalabad to Talib wala pattan Islamabad Motorway will be the direct AOI for aquatic ecological study. The benthic margins of the River are also pertinent, given that there is a seasonal flow fluctuation in the river and some bank inundation occurs from time to time. The AOI / Study Area is selected on the basis of the Project's direct and indirect potentially significant impacts on bio-physical and socio-economic features.

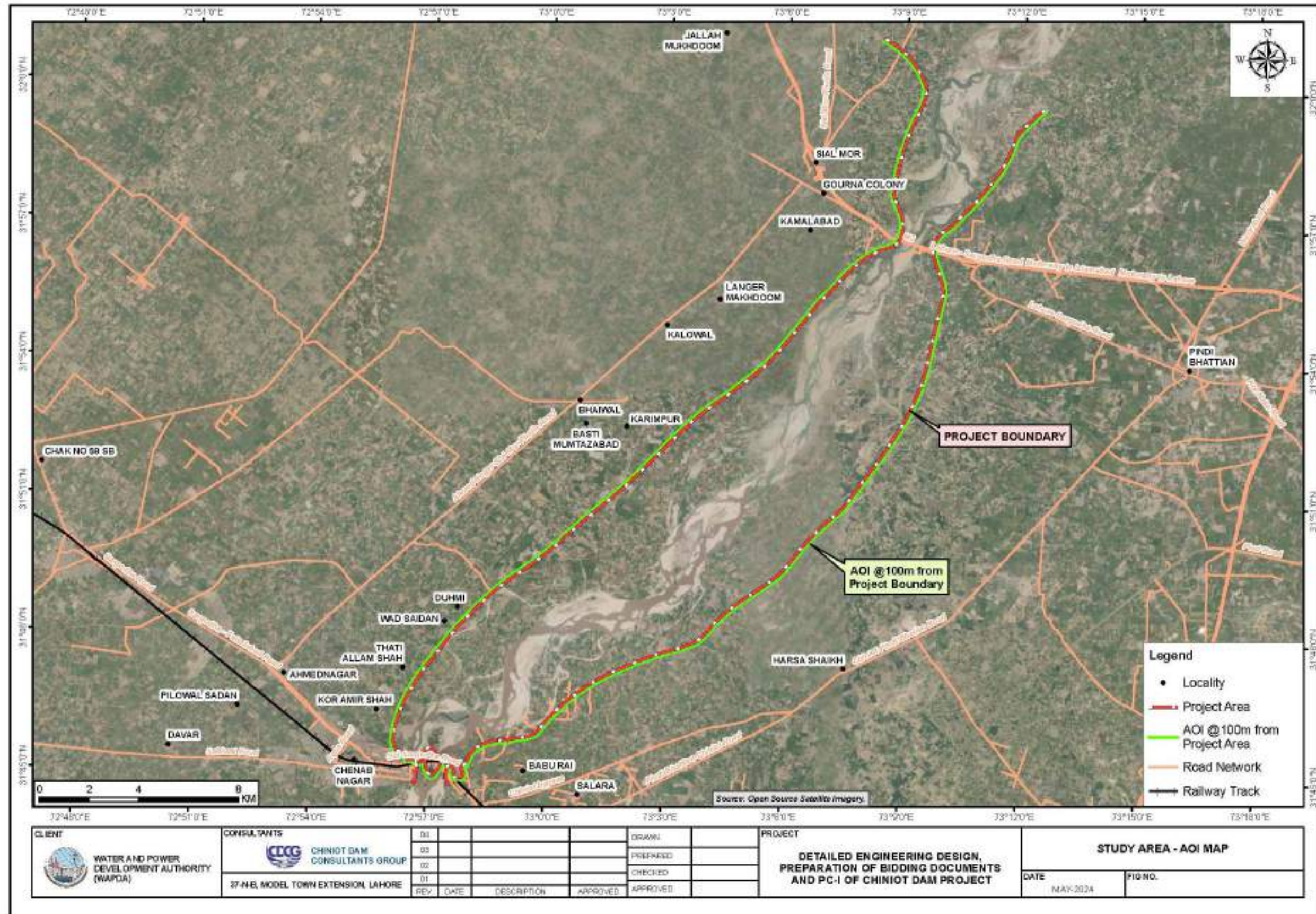


Figure 1.2: Study Area/ AOI map

1.7.5 Analysis of Alternatives

It is a mandatory requirement for EIA study to analyze each potential technical, location and layout alternative available that could have been developed to meet the objectives and recommend the most environmentally and economically feasible option.

To select the most viable option keeping in view the environmental, economic and social constraints, the analysis of different alternatives (technical, location and layout alternatives) was carried out. Moreover, the No Project Option (NPO) was also considered with reference to the increased water supply demand due to existing population. This exercise confirmed the justification for the need of the proposed Project.

1.7.6 Environmental Baseline Survey of the Project

After the selection of the most feasible alternative based on satellite images and the delineation of AoI, detailed environmental survey was carried out within the AoI. Detailed investigations/surveys were carried out for environmental parameters on which any adverse or positive impacts were envisaged by the implementation of the proposed project. Prior to the start of field activities, comprehensive checklists, proformas and maps were developed covering the following main parameters:

a) Physical Environment

The information acquired for the establishment of physical environment baseline included the following main parameters:

- Land resources (including land use pattern, soil composition, contamination of soil and soil erosion etc.);
- Water resources (including available surface and groundwater resources and natural streams, hydrology, spring water, water supply, water contamination etc.);
- Climate data (including temperature, rainfall, humidity, wind speed and direction etc.);
- Ambient air quality and noise level monitoring data; and
- Existing solid waste management and effluents disposal practices and storm water drainage.

b) Environmental Monitoring, Sampling and Testing

Environmental monitoring has the key role to assess the status of existing environment that changes spatially and temporally. However, the goals, sample collection strategies, and methods of analysis used in monitoring must be well defined in advance to obtain robust results. In the preparation of a sampling plan, goals, strategies, and methods must be considered in conjunction with an understanding of the target environment, including the physical, chemical, and biological variables and processes involved. Environmental monitoring has been conducted for following:

- Ambient air quality monitoring (8 - 24 hours);
- Noise measurement (24 hours); and
- Sampling and analysis of drinking water and wastewater.

c) Ecological Environment

The information collected through primary (field surveys) and secondary data sources for the establishment of ecological environment baseline included the following main parameters:

- Flora (trees, herbs, shrubs, grasses and overall vegetation including valuable or rare trees and their loss due to implementation of the Project etc.);
- Fauna / Wildlife (Mammals, reptiles, amphibians and avifauna);
- Aquatic ecology
- Agriculture and livestock;
- Protected areas, National Parks, Game reserves, Game sanctuaries any other ecologically important areas (if any);
- Migratory birds' corridors; and
- Endangered species (both flora and fauna).

d) Socio-Economic Environment

Surveys were carried out within the AoI in order to develop the socio-economic baseline information of the general settled population.

The sample size calculation was followed for the determination/establishment of the socioeconomic baseline. The intention was to develop the socioeconomic baseline on the basis of the representative sample size within the AoI. The size of a sample influences two statistical properties; (1) the precision of our estimates and (2) the power of the study to draw conclusions.

Based on the sampling methodology, a number of households, shops, and other entities were interviewed within the areas of the city located within the AoI and consulted for the collection of baseline socio-economic data. The Survey Tools are attached as **Annex-II**.

The following major aspects were covered in the socio-economic baseline survey of the sample population settled within the AoI:

- Demographic characteristics;
- Literacy status/ education;
- Nature of business/occupation;
- Livelihood/income;
- Living standard of the population;
- Social Infrastructure available;
- Gender issues;
- Pressing needs of the people;
- Community perception about the Project etc.;
- Labor Influx to Project area;

- Religious, cultural and heritage information (mosques, shrines, graveyards);
- Archaeological monuments;
- Buildings and infrastructure details, including residential, commercial, and animal shed for complete/partial relocation; and
- Other private/public infrastructures such as roads, telephone poles, hand pumps, tube wells, schools, universities, markets, hospitals, shops, libraries, mosques, etc.

1.7.7 Stakeholder Consultations

Stakeholder identification and consultation were conducted. The consultants identified Project stakeholders during inception/scoping stage and held meetings and digital communication with them during the field surveys to receive feedback on the anticipated environmental and social issues related to the Project impacts and suggested mitigation measures. Meetings were carried out with the project affectees, relevant departments including Forest, Wildlife, Archeology, Agriculture, Social Welfare, PEPA, Works and Services Department, Non-Government Organizations (NGOs) etc. to discuss the issues/constraints and get their views and feedback to mitigate the potential environmental and social impacts associated with the implementation and operation of the Project. Letters were also written to the concerned departments through Client for communication.

1.7.8 Impact Assessment and Mitigation Measure

A logical and systematic approach was adopted for impact identification and assessment. The process began during the screening and continued through scoping which identified the key issues and classified them into different categories. The tools, which were used for impact assessment, are:

- Checklists to identify the impacts during field investigations/surveys (refer **Annex-II**);
- Matrices for qualitative assessment of the identified impacts; and
- Overlays and GIS based assessment for the quantification of significant impacts based on Google imagery and filed verification.

Assessment of potential environmental and social impacts in terms of their nature, extent, location, timing, and duration were carried out. The severity of the assessed impact was determined by considering the magnitude and likelihood. The impacts were correlated to the Project location, design stage, construction as well as operation stage. Based on the impacts prediction and as a result of public/stakeholder consultations, EIA team screened the adverse environmental and social impacts for inclusion in the mitigation measures and EMP. Public consultations (which provided feedback of the impacts from the stakeholder's viewpoint) were used to screen out the insignificant impacts. Matrices and overlays were used for the evaluation of temporal and spatial impacts respectively.

The Consultants proposed practicable, economically feasible and socially acceptable mitigation measures for the significant adverse environmental and social impacts. These measures were based on exploring the ways to achieve the Project objectives causing least disturbance to the existing environment by alternative ways, proposing changes in the Project design, through improved monitoring and management practices (storage of construction

materials, labor camps, waste disposal, disposal of construction debris etc.) or through monetary compensation.

1.7.9 Grievance Redress Mechanism (GRM)

The GRM is important for any developmental project where ongoing risks or adverse impacts are anticipated. This mechanism serves as a way to meet requirements, prevent and address community concerns, reduce risks, and assist larger processes that create positive social change. The GRM for the proposed Project along with the committee composition has been suggested along with the procedures for handling environmental and social concerns of the Project stakeholders. This procedure includes a redress mechanism scaled to the Project's identified risks and adverse impacts, focusing on stakeholders.

1.7.10 Environmental Management and Monitoring Plan (EMMP)

An EMMP has been prepared to ensure the adequacy and effectiveness of the proposed protocol by clearly identifying the roles and responsibilities of the agencies responsible for implementation, monitoring and auditing of EMMP activities, existing and suggested framework, necessary approvals, training needs and the required further studies. The EMMP also includes organizational setup, a monitoring mechanism, monitoring plan, environmental and social parameters to be monitored with their frequency. Similarly, costs for environmental monitoring, ecological and social component/social mitigation measures were also included as part of the EMMP. Environmental monitoring, evaluation, auditing and reporting mechanism were also proposed in the EMMP.

1.8 ORGANIZATION OF REPORT

This report contains ten chapters. The contents of chapters are described as follows:

- **Chapter 1**– “Introduction” describes introduction, location of project, objective and purpose of the EIA report;
- **Chapter 2** – “Environment Legislative Requirement and Framework” elucidates the current legal framework including national and WB's ESF requirements which are applicable to the proposed Project in the context of environment and sustainable development;
- **Chapter 3** – “Description of Project” furnishes an overall description of the project, including its background, features and key components, timeframe and cost;
- **Chapter 4** – “Analysis of Alternatives” provides details on alternate routes and options considered for the proposed interventions, location and design;
- **Chapter 5** – “Existing Baseline Profile” comprises a detailed narrative of the existing (baseline) conditions of the Project area, with respect to its physical, biological and socio-economic environment;
- **Chapter 6** – “Stakeholder Consultation” provides summary of consultative sessions with the local community as well as with other stakeholders including local politicians, local government officials, policy makers and NGOs for their opinions and suggestions on the Project;

- **Chapter 7** – “Anticipated Environmental Impacts & Mitigation Measures” elaborates the likely impacts of the Project on the physical, biological and socio-economic environment during the construction and operation stages and lays down the proposed measures to mitigate the adverse impacts of the Project;
- **Chapter 8** – “Grievance Redress Mechanism” describes the need for establishing a GRM and define the grievance redress procedure;
- **Chapter 9** – “Environmental Management and Monitoring Plan” provides the mechanism to be adopted for the implementation of measures and monitoring the environment during all stages; and
- **Chapter 10** – “Conclusion” provides the major findings of the report.

2 ENVIRONMENT LEGISLATIVE REQUIREMENTS AND FRAMEWORK

2.1 GENERAL

This chapter provides an overview of the policy framework and legislation that applies to control the environmental consequences as a result of project implementation and operation. The project needs to comply with all the applicable environmental policies, laws, guidelines, acts and legislations of Government of Pakistan (GoP) and Government of Punjab (GoPb). Pakistan is signatory to various international conventions for pollution control and biodiversity, which are also discussed.

2.2 SUMMARY OF RELEVANT STRATEGIES, POLICIES, ACTS AND LEGISLATION

The summary of major relevant strategies, policies, acts and legislation from environmental perspective are briefly described in **Tables 2.1 & 2.2** below:

Table 2.1: Main Strategies/Policies Related to Environment and Relevance to the Proposed Project

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project
1.	National Conservation Strategy, 1992	Pakistan National Conservation Strategy (NCS), which was approved by the federal cabinet in March 1992, is the principal policy document on environmental issues in the Country. The NCS outlines the Country's primary approach towards encouraging sustainable development, conserving natural resources and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment.	The core areas that are relevant in the context of the proposed project are pollution prevention during construction, conserving biodiversity and supporting forestry and plantation.
2.	National Forest Policy, 2015 Punjab Forest Policy, 2019	The goal of these policies is to foster the sustainable development of Renewable Natural Resources (RNR) in Pakistan, through maintenance and rehabilitation of these essential resources and enhancement of sustainable livelihoods of rural masses, particularly women, children and other deserving groups. The various components of these policies include: a) Reducing poverty, powerlessness and unemployment; b) Population planning in critical ecosystems; c) Reducing the impact of socio-economic factors; d) Providing substitutes to firewood in the mountain-woods; e) Reducing political interferences in Forestry and Wildlife Departments;	The proposed project area also lies within Chaksarkar Reserved Forest. Therefore, these policies are directly applicable.

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project
		f) Renovating and invigorating the institutions of RNR; g) Supporting Local Governments in the sustainable development of their RNR; h) Policies for fragile ecosystems; i) Riverside forests; j) Irrigated plantations; k) Preservation of sensitive and unique forests; l) Wildlife conservation; m) Rangelands and desert ecosystems; and n) Planting trees and fodder on farmlands.	
3.	National Environmental Policy, 2005	In March 2005, Government of Pakistan (GoP) launched its National Environmental Policy, which provides a framework for addressing the environmental issues. Section 5 of the policy commits for integration of environment into development planning as instrument for achieving the objectives of National Environmental Policy. It also provides broad guidelines to the Federal Government, Provincial Governments, Federally Administered Territories and Local Governments to address their environmental concerns and to ensure effective management of their environmental resources.	Clause (b) of sub-section 5.1 states that IEE/EIA related provisions in Environmental Protection Act, 1997, will be diligently enforced for all developmental projects.
4.	Punjab Labor Policy, 2018	The main objective of the labor policy is the social and economic well-being of the labor of Pakistan. The labor policies have following 4 parts: • Legal Framework; • Advocacy: rights of workers and employers; • Skill development and employment; and • Manpower export.	The labor will be employed for construction of the proposed project. These policies will apply to all the labor employed.
5.	National Climate Change Policy, 2012 (Updated in 2021)	The National Climate Change Policy provides a framework for addressing the issues that Pakistan faces or will face in future due to the changing climate. In view of Pakistan's high vulnerability to the adverse impacts of climate change, in particular extreme events, adaptation effort is the focus of this policy document. The vulnerabilities of various sectors to climate change have been highlighted and appropriate adaptation measures spelled out. The policy covers measure to address issues in various sectors such as water, agriculture, forestry, coastal areas, biodiversity and other vulnerable ecosystems. Notwithstanding the fact that Pakistan's contribution to global Greenhouse Gas (GHG) emissions is very small, its role as a responsible member of the global community in combating climate change has been highlighted by giving due importance to	The proposed project involves the renewable energy resource development which will have positive impacts on the regional as well as global climate change issues.

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project
		mitigation efforts in sectors such as energy, forestry, agriculture and livestock. Furthermore, appropriate measures relating to disaster preparedness, capacity building, institutional strengthening; technology transfer; introduction of the climate change issue in higher education curricula; ensuring environmental compliance through Initial Environmental Examinations (IEE) and Environmental Impact Assessments (EIA) in the development process; addressing the issue of deforestation and illegal trade in timber; promoting Clean Development Mechanisms (CDM); and raising Pakistan's stance regarding climate change at various international forums, have also been incorporated as important components of the policy. The policy thus provides a comprehensive framework for the development of Action Plans for national efforts on adaptation and mitigation.	
6.	National Sustainable Development Strategy, 2012	The National Sustainable Development Strategy is an attempt to define sustainable development and the pathway to a "green economy" in Pakistan's context. It lays out an adaptive system and approach that can be continuously improved, through regular updates, to respond to evolving challenges. The focus has been on integrating not only across the three overall dimensions of economic, social and environment but also integrating the goals with the existing development paradigm with the aim of shifting it on to a more sustainable pathway.	This strategy is applicable as the proposed project involves the construction of Dam to protect the downstream settlements from flood and generate green energy.
7.	National Electricity Policy, 2021	The Ministry of Water and Power of the Government of Pakistan has developed an ambitious power policy to support the current and future energy needs of the country. This bold strategy will set Pakistan on a trajectory of rapid economic growth and social development. Simultaneously, it will address the key challenges of the power sector in order to provide much needed relief to the citizens of Pakistan. This document will frame the broad contours of the energy policy articulating the vision for the power sector, highlighting its key challenges, setting major goals, summarizing policy principles, and highlighting the strategy devised to achieve Pakistan's aspirations	The proposed project is a renewable energy production facility and it will reduce the gaps between energy availability and demand of Pakistan.
8.	Pakistan Policy for Power Generation 2002	The 2002 Power Generation Policy of the Government of Pakistan allows provinces of Pakistan and AJK to develop power generation projects of enough capacity in public and/or private sectors at the least cost to utilize the available natural resources for	This policy is relevant as the proposed project is aligned with this policy to increase power generation capacity of a province.

Sr. No.	Policy/Strategy	Brief Coverage	Relevance to Project
		power generation and to avoid capacity shortfall.	
9.	Policy for Development of Renewable Energy for Power Generation 2006	In 2003 the AEDB was established to act as a central agency for the development, promotion, and facilitation of renewable energy technologies; the formulation of plans and policies; and the development of a technological base for manufacturing of renewable energy equipment in Pakistan. In February 2006, the administrative control of the AEDB was shifted from the Cabinet Division to the Ministry of Water & Power. The AEDB has developed the National Policy for promoting renewable energy sources in the medium and long term, which is known as the Policy for Development of Renewable Energy for Power Generation, 2006 (Power Policy). AEDB is also responsible for procuring land leases from the Revenue department for solar and wind farm projects. The current Project is developed under provisions of the Policy for Development of Renewable Energy for Power Generation, 2006. The Renewable Energy Policy of Pakistan envisages mainstreaming of renewable energy in the development plans of the country.	This policy is relevant as the proposed project will produce the renewable energy through Hydropower production.
10.	National Disaster Risk Reduction Policy, 2013	National Disaster Management Authority (NDMA), being the lead focal agency for disaster preparedness and management, has therefore, embarked upon formulation of a comprehensive National Disaster Risk Reduction Policy through wider consultations with all stakeholders including all provinces, state of AJ&K and regions. This policy covers disasters risk reduction in a more holistic way and introduces a proactive and anticipatory approach by laying special emphasis on risk assessment and prevention.	This policy will be elicited if any unforeseen natural and manmade disaster occurs during construction and operation phase.
11.	National Action Plan for COVID-19 Pakistan	GoP has launched the “National Action Plan for COVID-19 Pakistan” to combat the challenge of prevailing virus, also available at: https://www.nih.org.pk/wpcontent/uploads/2020/03/COVID-19-NAP-V2-13-March-2020.pdf The GoP has launched the real-time data portal for COVID-19: http://covid.gov.pk/ These measures are mostly relating to the containment, awareness and capacity building. Besides this COVID-19 daily situation report is also available at: https://www.nih.org.pk/wpcontent/uploads/2020/04/COVID-19-DailyUpdated-SitRep-03-April-2020.pdf	This Action Plan for COVID-19 is applicable to the proposed project.

Table 2.2: Main Legislation/Acts Related to Environment and Their Relevance to the Proposed Project

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
1.	Punjab Environmental Protection Act, 1997 (As amended up to 2017)	The Punjab Environmental Protection Act, 1997 (As amended up to 2017) is comprehensive legislation and provides the legislative framework for protection, conservation, rehabilitation and improvement of 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 Punjab Environmental Protection Council (PEPC); • Prohibition of certain discharges or emissions; • Punjab Environmental Quality Standards (PEQS) for wastewater, air emissions and noise; and • Provincial Government can issue notices and enforce them to protect the environment. In the recent amendments, legislative powers related to environment and ecology are given to provincial governments from the Federal government. The provinces are required to enact their own legislation for environmental protection. Other amendments include increasing the penalties for violations. For the proposed Project, Environmental Protection Department (EPD)/Environmental Protection Agency (EPA), Government of Punjab (GoPb) is the concerned authority. The capability of regulatory institutions for environmental management is ultimately responsible for the success of environmental assessments and that development projects are environmentally sound and sustainable.	The provision of the act is applicable to the proposed project for conducting an IEE/EIA according to section 12 and to obtain environmental approval from the EPA. The section 11 of the act is applicable in term of compliance with Punjab Environmental Quality Standards (PEQS). Similarly, section 13 of the act prohibits the import of hazardous waste. The provisions of section 16 are also applicable to comply with the discharge or emission of any effluent, waste, air pollutant or noise or disposal of waste or handling of hazardous substance. Under section 17, penalties will apply if proposed project fails to comply with the provisions of section 11, 12, 13 and 16.
2.	Punjab Environmental Protection	These regulations set out: • Key policy and procedural requirements for filing an EIA;	The provisions of these regulations are applicable for environmental screening of the

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
	(Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2022	- The purpose of environmental assessment; - The goals of sustainable development; - The requirement that environmental assessment be integrated with feasibility studies; - The responsibilities of proponents; - Duties of responsible authorities; - Provides schedules of proposals that the project requires either IEE or an EIA; - The environmental screening process of the projects under schedule I, II and III; and - The procedure for the environmental approval for filing the case with the Punjab Environmental Protection Department (Punjab EP&CCD) for granting of the NOC.	project, which implies that an EIA is required for the proposed project as per the Schedule II Category E of the regulations.
3.	Punjab Environmental Quality Standards (PEQS), 2016	PEQS promulgated in 2016. Previously, National Environmental Quality Standards (NEQS) were used for compliance, which were promulgated in 1993 and amended in 1995 and 2000. Specified standards under PEQS are for: - Drinking Water; - Ambient Air; - Noise; - Industrial Gaseous Emissions; - Municipal and Liquid Industrial Effluents; - Motor vehicle exhaust and noise; and - Treatment of Liquid and Bio-Medical Waste.	All projects to be implemented in Punjab must conform to PEQS during all the phases i.e. construction and operation.
4.	Punjab Wildlife Act, 1974	The Punjab Wildlife Act (1974) is developed for the regulation of activities relating to protection, conservation and management of wildlife in Punjab.	The proposed project involves the cutting of trees which may result in loss of habitat; therefore, the provisions of this law are applicable.
5.	Land Acquisition Act (LAA), 1894 Including Later Amendments	The Land Acquisition Act, 1894, is a "law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be paid on account of such acquisition". The exercise of the power of acquisition has been limited to public purposes. The principles laid down for the determination of compensation, as clarified by judicial pronouncements made from time to time, reflect the anxiety of the lawgiver to compensate those who have been deprived of property, adequately. The land needed for the construction of development projects will be acquired under normal conditions based on prevailing market prices or negotiated prices between client and the owners of land. Section 17(4) of the LAA will not be used in the absence of an emergency. Instead, the land will be purchased under	The relevancy of this policy is anticipated as proposed project involves permanent acquisition of private land.

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
		willing-seller willing-buyer deal at agreed upon market rates and the seller will have the option not to sell the land, in case an acceptable deal for both the parties is not reached.	
6.	Punjab Plantation and Maintenance of Trees Act, 1974	The Punjab Plantation and Maintenance of Trees Act, (1974) regulates tree plantations and enforces measures for their protection.	The requirements of this act are applicable in terms of planting new trees and their maintenance by the occupier of the existing land who would have the physical possession. i.e. project proponent.
7.	Punjab Antiquities Amendment Act 2012	The Punjab Antiquities Amendment Act, 2012 is adopted from the Pakistan Antiquities Act of 1975 with a few minor changes. The Antiquities Act, 1975 (amended in 1990) states the following: • “Ancient” is any object that is at least 75 years old; • All accidental discoveries of artifacts must be reported to the Federal Department of Archaeology; • The Government is the owner of all buried antiquities discovered on any site, whether protected or otherwise; • All new construction within a distance of 200 feet from protected antiquities is forbidden; • No changes or repairs can be made to a protected monument, even if it is owned privately, without approval of the responsible authorities; and • The cultural heritage laws of Pakistan are uniformly applicable to all categories of sites regardless of their state of preservation and classification as monuments of national or world heritage.	The law is applicable to the project mainly due to its two provisions: ▪ According to the law, any construction activity within 61 m or 200 ft. of protected antiquities, are prohibited. ▪ The provisions of this act would also be applicable, if any accidental archaeological discoveries may occur during the excavation works for the construction of proposed project.
8.	Pakistan Penal Code, 1860	The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents.	The provisions of the Penal Code, 1860 are applicable to the project in terms of penalties for effecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.
9.	The Protection against Harassment of Women at the Workplace Act, 2010	The Protection Against Harassment of Women at the Workplace Act (2010) refers to sexual harassment at the workplace.	This Act may be applicable to the project if women are employed for the construction of the proposed project.
10.	Punjab Restriction of Employment of Children Act 2016 and Employment of	Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any construction, or any other hazardous employment.	The relevance of this act to the project is to prohibit child employment for construction of the proposed project.

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
	Children Act, 1991	In accordance with this Article, the Employment of Child Act 1991 prohibits child labor (a child is under 14 years old). Presently GoPb has drafted a new Act "Punjab Restriction of Employment of Children Act 2016" dealing with child labor in the commercial and industrial sectors of Punjab. The Act is expected to be promulgated by the Punjab Assembly shortly.	
11.	Labor Laws as part of Constitution of Pakistan 1973,	The Constitution of Pakistan contains a range of provisions with regards to labor rights, in particular: • Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor; • Article 17 provides a fundamental right to exercise the freedom of association and the right to form unions; • Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and • Article 37(e) makes provision for securing just and human conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment. Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. The labor laws are a comprehensive set of laws in Pakistan dealing with the following aspects: • Contract of Employment; • Termination of Contract; • Working Time and Rest Time; • Working hours; • Paid Leave; • Maternity Leave and Maternity Protection; • Other Leave Entitlements; • Minimum Age and Protection of Young Workers; • Equality • Pay Issues; • Workers' Representation in the Enterprise; • Trade Union and Employers Association Regulation; and • Other Laws.	The labor laws are relevant as it deals with employment of labor for the proposed project. Following are the major labor laws which are applicable to the project: • Bonded Labor System (Abolition) Act, 1992 • Employment of Child Act, 1991 • Minimum Wages Ordinance, 1961 • Industrial Relations Act, 2010 • West Pakistan Minimum Wages for Unskilled Workers' Ordinance, 1969
12.	Guideline for Solid Waste Management, 2005 (Draft)	Guidelines for Solid Waste Management (2005) are in draft form (Pak-EPA in cooperation with Japan International Corporate Agency and United Nations Development Programme).	The provision of these guidelines is applicable for waste generation during construction works of the proposed project.

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
13.	Electricity Act, 1910	The Act provides a legal basis for distribution of Power. It enables a licensee to conduct operations for supply of electricity and binds the license to payment of compensation in respect of any damages caused during the construction, Operation and Maintenance (O&M) of Power distribution facilities.	This act may be applicable if any damages occur during construction of the power facilities.
14.	Punjab Forest (Amendment) act 2016	The act empowers the provincial forest departments to declare any forest area as reserved or protected. It empowers the provincial forest departments to prohibit the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling, lopping and topping of trees, branches in reserved and protected forests.	This act will be triggered as Chaksarkar Reserved Forest is situated in and around the Project area.
15.	Cutting of Trees (Prohibition) Act, 1975	The Act was enforced in 1975 to place restrictions on cutting of trees in order to restrain unchecked trend of tree felling without replacement plantations.	This act will be applicable to the proposed project where the cutting of tree will be involved.
16.	National Disaster Management Act, 2010	National Disaster Management Act, 2010 was passed by Parliament of Pakistan in 2010. The Act applies to whole Pakistan including tribal areas of FATA. The Act was passed in backdrop of 2010 Floods in Pakistan and strengthens Disaster Management system.	This act will be applicable to the proposed project if any unforeseen natural and manmade disaster occurs during construction and operation phase. The proposed project will require special consideration of disaster and risk management strategies as per the Act.
17.	The Canal and Drainage Act, 1873	The Canal and Drainage Act 1873 (CDA) focuses on construction and maintenance of drainage channels and defines powers to prohibit obstruction or order their removal. It also covers issues related to canal navigation. It 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 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."	This act is applicable as the proposed project may cause impacts on drains in the project area.
18.	Punjab Environmental Protection (Motor Vehicles) Rules, 2013	Subject to the provisions of this act, and the rules and regulations, no person shall operate a motor vehicle from which air pollutants and noise are being emitted in an amount, concentration or level which is in excess of the Punjab Environmental Quality Standards, or where applicable the standards established under clause (g) of subsection (1) of section 6 of the act.	This act will be elicited during construction and operational phase due to use of motor vehicles that produces air pollutants and noise.

Sr. No.	Legislation/Acts	Brief Coverage	Relevance to Project
19.	The Punjab Emergency Service Act, 2006	It deals with the establishment of emergency service for a purpose of maintaining a state of preparedness to deal with emergencies, to provide timely response, rescue and emergency medical treatment to the affected persons and recommending measures to be taken by related organizations to avoid any emergency situation. It describes procedures to establish emergency service, emergency board, emergency fund, emergency ambulance and rescue vehicles, offence and punishment, etc.	This act is applicable to the proposed project to provide timely response, rescue and emergency medical treatment to the affected persons during construction and operation phase of project.
20.	Seismic Building Code of Pakistan 2007	This code stipulates the minimum requirements for seismic safety of building and structures and the provisions of the Building Code of Pakistan (Seismic Provisions-2007) shall apply for engineering design of buildings, like structures and related components. Construction of buildings shall be considered as violation of professional engineering work specified under clause (XXV) of section 2 of the Act.	This Code is applicable to the proposed project as it includes the formation of structures.
21.	The Punjab Occupational Safety and Health Act, 2019	This Act entails provision of occupational safety and health of the workers at workplace and to protect them against risks arising out of the occupational hazards; to promote safe and healthy working environment catering to the physiological and psychological needs of the employees at workplace.	The Act will trigger during construction and operational phase to ensure health and safety of workers at workplace associated with the project activities
22.	Punjab Hazardous Substance Rules, 2018	These rules describe the procedure of handling, transportation and disposal of hazardous substances and hazardous waste. Inter alia, general safety precautions for handling hazardous substances as well as safety precautions for workers, and notification requirements in the event of an accident are described in these rules. Requirements for project waste management plans are also defined. These include a requirement for updating the plan every three years, the need to provide for management of hazardous	These rules are applicable to the proposed project due to involvement of hazardous waste handling, use and disposal during the construction stage.

2.1 COMPLIANCE PROCEDURE FOR OBTAINING NOC FROM EPA

Punjab Environmental Protection (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations 2022 provides the necessary details on the preparation, submission, and review of the EIA/IEE reports. Categorization of projects for IEE and EIA is one of the main components of these regulations. Projects have been classified on the basis of expected degree of adverse environmental impact.

The proposed project falls under Schedule II (Category 'E' of "Water management, dams, irrigation and flood protection") and requires an EIA study for obtaining NOC/environmental

approval from Punjab EP&CCD. The EIA prepared for proposed project will be submitted to Punjab EP&CCD through project proponent to initiate the process of NOC.

The regulations stipulate that within ten (10) working days of the EIA report submission, Punjab EP&CCD will confirm that the document submitted is complete for the purpose of initiation of review process. During this time, should the agency require the proponent to submit additional information, it will return the EIA to the proponent for revision, clearly listing those aspects that need further discussion. Subsequently, Punjab EP&CCD would make every effort to complete an EIA review within forty-five (45) days of filing.

The prescribed procedure for review of EIA by the Punjab EP&CCD is described in Punjab Environmental Protection (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations 2022. Article 12(4) of PEPA, 1997 (as amended up to 2017) binds the agency to communicate its approval or otherwise within a period of four months from the date that the environmental impact assessment is filed complete in all respects in accordance with the regulations, failing which the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations.

2.2 PROCEDURE FOR THE ECOLOGICAL SENSITIVE AREAS

Prior to filing the case for Environmental approval/NOC being granted by the responsible authority (PEPA), the following steps related to ecological sensitive zones/areas should be undertaken:

- First of all, the proponent should identify whether the site for the proposed development is within the precincts of a protected ecosystem, cultural and archaeological sites. This list was last updated in April, 1997. If the proposed site is not located in a notified area and there are no apparent ecological or cultural values associated with the site, take no further action;
- If proponent or consultant identifies an ecological site that appears to be of importance, but the site is not listed, they should discuss the site with the relevant conservation authority;
- If the site falls within the boundaries of a protected ecosystem (reserve forest, protected forest or game sanctuary, the relevant conservation authority such as Forest Department and Wildlife Department in each Province should be contacted for advice about the extent to which the development may be allowed and with what conditions. Certain protected areas may have total prohibition of development while others may allow controlled development;
- The relevant conservation authority should inform the responsible authority of their assessment of the significance of the likely impacts of the proposed development early in the process in order for the responsible authority to determine the level of documentation required. The EP&CCD will then be in a position to review the level of reporting required in the light of the advice from the conservation authorities; and
- During the review of the environmental report, the responsible authority will liaise with the Conservation Authority to ensure that the impacts and mitigation measures

detailed in the environmental report are well based to frame environmental approval conditions, which protect the values of the listed area.

2.3 INTERNATIONAL PROTOCOL/CONVENTIONS

As Pakistan is a member of a number of international organizations such as United Nations Organization (UNO), Organization of the Islamic Conference (OIC), South Asian Association for Regional Cooperation (SAARC), Economic Cooperation Organization (ECO) etc., so it has to follow the international protocols and obligations related to the environment. The major protocols, ratification dates by Pakistan and obligations related to the proposed project are provided in the **Table 2.3** below.

Table 2.3: International Agreements/Conventions Relevant to the Project

Sr. No.	Agreement/Convention	Ratification	Description/Relevance
1.	UNESCO Convention on the Protection of the World's Cultural and Natural Heritage, 1972 Web Link: http://whc.unesco.org/en/%20convention%20text/	Pakistan ratified this convention on 23 July 1976.	Convention concerning the Protection of the World Cultural and Natural Heritage - 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. The proposed project design team must pay due attention to archaeological sites and local norms. Both of these factors will also be considered during project implementation.
2.	Convention on the International Trade of Endangered Species (CITES), 1975 Web Link: https://www.cites.org/	Pakistan signed the Convention in 1973 and ratified it in April 1976.	The convention entered in to force on 1 July 1975. The principal obligations of contracting parties to the CITES are to safeguard the trade in rare or endangered species and it established a permit system to control imports and exports of wild fauna and flora. According to this convention, species threatened with extinction whose movement between countries is prohibited except for conservation purposes such as captive breeding, species whose commercial trade is permitted but export permits are needed.
3.	Convention on Conservation of Migratory Species of Wild Animals, 1979 https://www.cms.int/	Pakistan signed this convention in 1981 and ratified it in December 1987.	Convention on the Conservation of Migratory Species deals with the conservation and protection of the migratory species. Species covered in the Convention should be given special attention during EA and monitoring and any impacts identified should be mitigated to acceptable levels.

Sr. No.	Agreement/Convention	Ratification	Description/Relevance
			The proposed project is relevant as Environmental measures will be taken to conserve wild animals present in the project area.
4.	The Rio Declaration, 1992 Web Link: http://www.unesco.org/education/pdf/RIO_E.PDF	Pakistan signed the treaty on 13Jun 1992 and ratified on 1 June 1994	The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the earth's ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption. The law is relevant as the proposed project has a focus on the conservation of natural environment.
5.	Kyoto Protocol, 1992 Web Link: https://unfccc.int/kyoto_protocol	Pakistan has ratified Kyoto Protocol in 2005	The Kyoto Protocol is a protocol to reduce Greenhouse gasses that cause climate change. It was agreed on 11th December, 1997 at the 3rd Conference of the countries to the treaty when they met in Kyoto, and entered into force on 16th February, 2005. As of November 2007, 175 countries have ratified the protocol. One hundred and thirty seven (137) developing countries have ratified the protocol, including Brazil, China, India and Pakistan but have no obligation beyond monitoring and reporting emissions. The proposed project is relevant as it involves the generation of green energy and construction of Dam which will protect the downstream settlements from flood by making them Climate Resilient.
6.	UN Convention to Combat Desertification (UNCCD), 1994 Web Link: https://www.unccd.int/	Pakistan signed the Convention on 15th October 1994 and ratified it on 24 February, 1997	The UNCCD is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements. The proposed project is relevant as it will provide water to the downstream settlements for agriculture purposes.
7.	Stockholm Convention on Persistent Organic Pollutants (POPs), 2004	The Stockholm Convention on Persistent Organic Pollutants was signed on 22 May 2001 and	Convention seeks to protect human health and the environment from POPs as set out in Article 1, which are chemicals that remain intact in the environment for long periods, become

Sr. No.	Agreement/Convention	Ratification	Description/Relevance
	Web Link: https://www.un.org/press/en/2004/unep204.doc.htm	entered in to force on 17 May, 2004. Pakistan signed the convention on December 6, 2001	widely distributed geographically and accumulate in the fatty tissue of humans and wildlife.

2.4 ADMINISTRATIVE FRAMEWORK

2.4.1 Water and Power Development Authority (WAPDA)

WAPDA is responsible for ensuring that the Project complies with the laws and regulations and mitigations measures suggested in EMMP of the proposed Project for controlling the environmental and social concerns arising during pre-construction / design and construction phase and that all preconstruction requisites, such as permits and clearances are met.

2.4.2 Environmental Protection Agency, Punjab

As the proposed Project falls in Chiniot and Sargodha Districts of Punjab therefore; Punjab-EP&CCD will be responsible for reviewing the report, issuing environmental approval and overall/broad based monitoring of the proposed Project activities.

3 DESCRIPTION OF THE PROJECT

3.1 GENERAL

This Chapter provides a brief description of the Chiniot Dam Project design including the description and details of the dam, project components, construction aspects and operation & maintenance activities.

3.2 OBJECTIVES OF THE PROJECT

The main objectives of Chiniot Dam Project are effective water usage, ensuring regulated supply of water throughout the year, flood control and recharge ground water.

The other associated objectives of the proposed Dam are enlisted below:

- Flood Protection;
- Live Water storage 1,147 Mm³ (0.93 MAF) to regulate existing downstream canal network;
- Power Generation of 80 MW / 227 GWh;
- Water Supply to nearby community;
- Recreation & Socio-Economic Uplift; and
- In addition, recharge of groundwater aquifer is also an indirect benefit associated with the proposed Dam.

3.3 PROJECT ADMINISTRATIVE JURISDICTION

The proposed project falls under administrative jurisdiction of the District Chiniot, Punjab.

3.4 PROJECT LOCATION

The Chiniot Dam Project site is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage, 165 Km from the Lahore City, 5 km from the Chiniot City and about 100 meters upstream of existing Railway Bridge on Chenab River. The proposed reservoir dykes of Chiniot Dam, which will have an approximate length of 36 km and an area of 190 sq. km will extend upto Motorway bridge of Pindi Bhattian. Which is the flood plain of the Chenab River and comprises of the cultivated fields. The reservoir area of Chiniot Dam falls under the Jurisdiction of Chiniot and Sargodha Districts of Punjab Province. Gross Storage capacity is proposed 1.0 MAF flood water and generates 80 MW electricity. The location map of project is shown in Section 1. (**Figure 1.1.**)

3.5 PROJECT LAYOUT

The proposed Chiniot Dam is a floodwater storage dam and is being planned and designed to manage the floodwater of Chenab River. The Project will comprise a 21 m high Zoned Earthfill Dam that will create a reservoir with a gross storage volume of about 1.0 MAF. The main purpose of the dam is the flood attenuation and to regulate water for irrigation purposes. The layout plan of Chiniot Dam Project is shown in **Figure 3.1** and salient features are shown in **Table 3.1**.

Table 3.1: Salient Project Features

Concerned Authorities	
Sponsored By	Government of Pakistan
Execution	WAPDA
Operation and Maintenance	WAPDA
Concerned Federal Ministry	Ministry of Water and Power
A. Main Dam	
Type	Zoned Earthfill Embankment
Maximum Height	21 m
Crest Level	EL. 196.5 m amsl
Crest Width	10 m
Free Board	6.5 m from NPL
B. Reservoir	
Reservoir Length	36km
Reservoir Area	19,024 hectares (47,000 Acres)
C. Reservoir Dykes	
Type	Zoned Earthfill Embankment
Left Dyke Length	38 km
Right Dyke Length	39 km
Height	4.5 m -21 m
Crest Width	10 m
Crest Level	EL. 196.50 – 194.0 m amsl
D. Hydrology	
Average Annual Inflow	12,445 Mm ³ (10.09 MAF)
Gross Storage Capacity	1,233 Mm ³ (1.0 MAF)
Live Storage Capacity	1,147 Mm ³ (0.93 MAF)
Average Annual Sediment Inflow	46.14 MST
E. Hydropower	
Type	Surface Powerhouse
Total Installed Capacity	80 MW

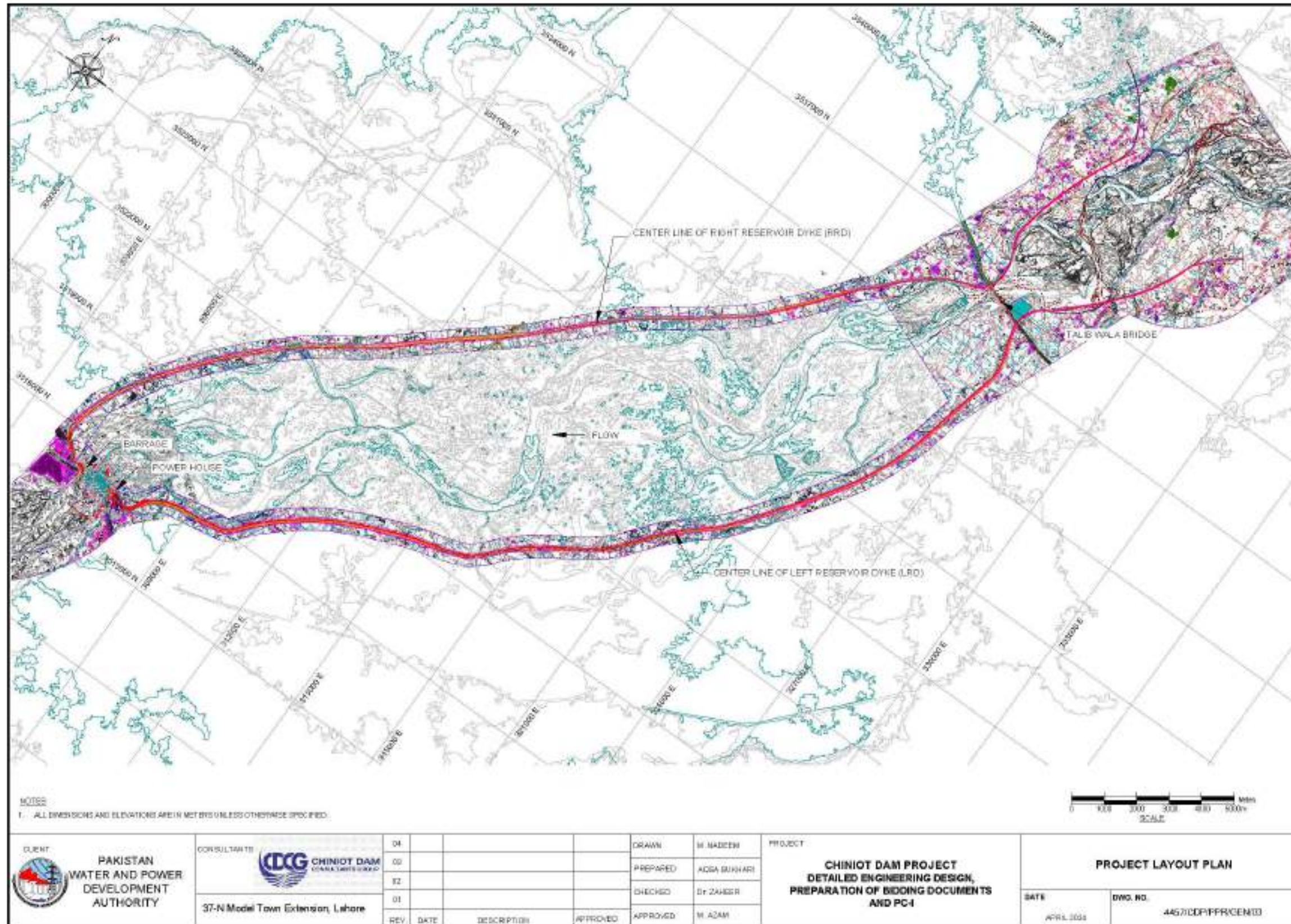


Figure 3.1: Layout Plan of Chiniot Dam Project

3.5.1 MAIN DAM

Main Dam has been proposed to be a Zoned Earthfill Embankment type with height of varies from 21 m to 4.5 m. Cutoff wall is constructed with impervious materials, which are compacted in the same manner as the impervious zone of the embankment. This keyway will minimize seepage under the embankment and increase the stability of the embankment. It will be taken down into impervious soil and rock and backfilled with the appropriate quality silty clay that is thoroughly compacted. Main Dam layout and cross section are shown in **Figure 3.2** and **Figure 3.3**.

3.5.2 RIGHT AND LEFT SIDE EMBANKMENTS / DYKES

Embankments / Dykes would be constructed on the right and the left side of the reservoir to develop a gross storage capacity of 1,233 Mm³ (1.0 MAF) at an elevation of 190 m.a.s.l. In Chiniot Dam Project, the cross section of the both embankments / dykes is of Zoned earthfill embankment nature. The layout plan of embankments / dyke is shown in **Figure 3.4**.

Main characteristics of Chiniot Dam Embankments are given in **Table 3.2**.

Table 3.2: Characteristics of Embankments/Dykes

Feature	Dykes
Length of Left Embankment	38 km
Length of Right Embankment	39 km
Crest Width	10 m
Embankment Height	4.5 m — 21 m
Free Board	6.5 m from NPL

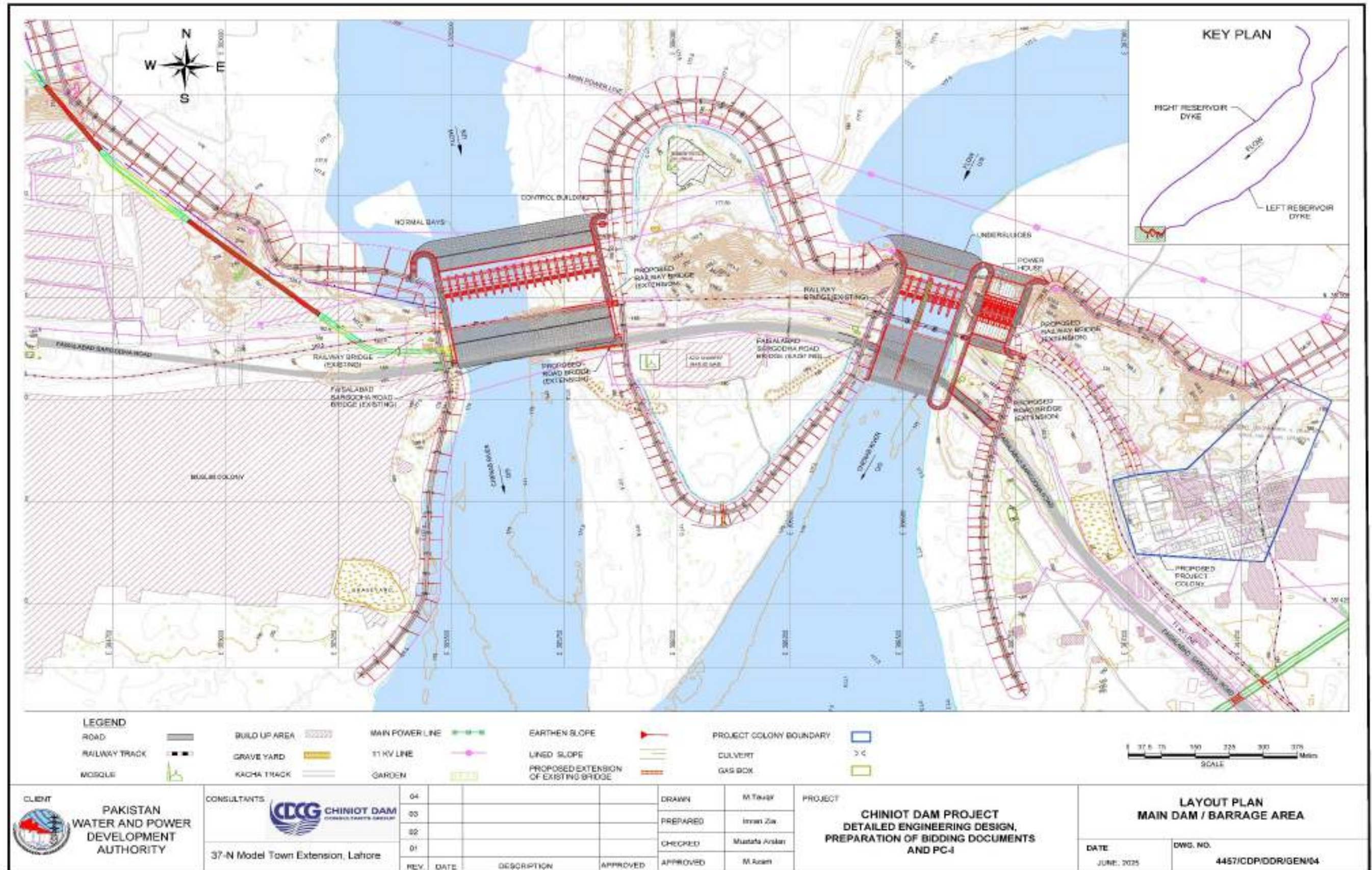


Figure 3.2: Layout Plan of Main Dam

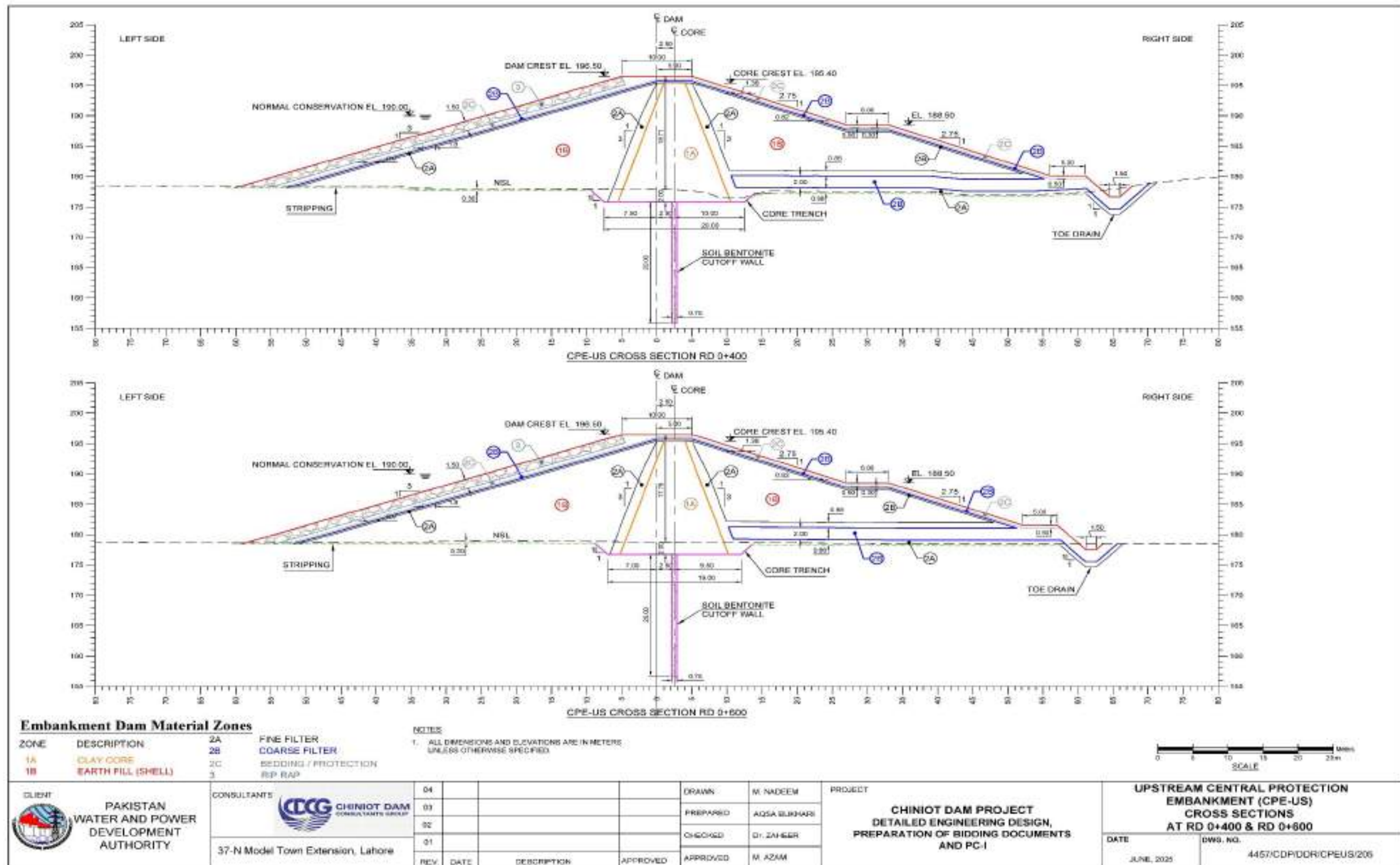


Figure 3.3: Cross Section of Upstream Central Protection Embankment

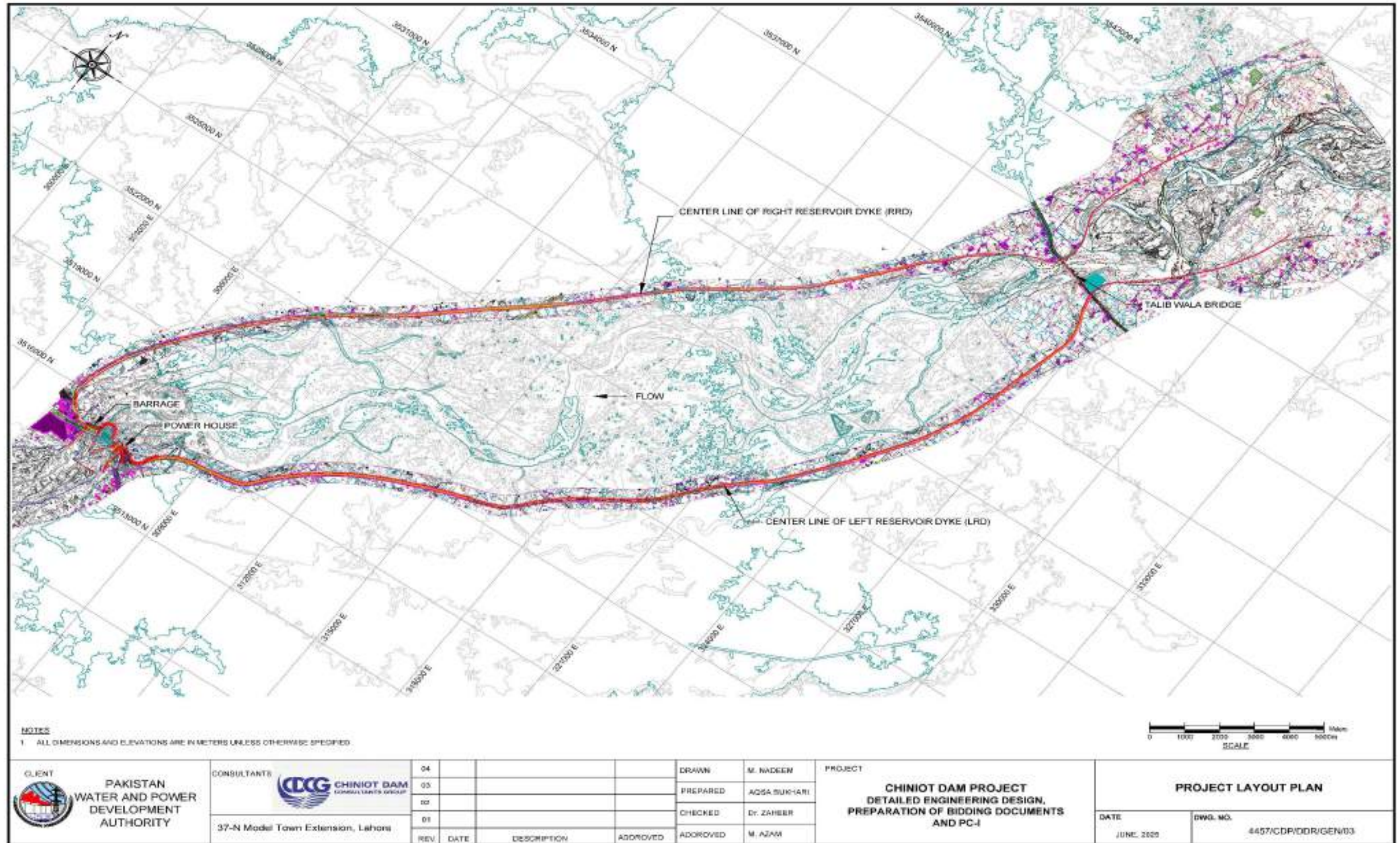


Figure 3.4: Right and Left Reservoir Dyke Plan

3.5.3 BARRAGE

At Project location, the river flow is divided into two channels and each channel flows through a gorge situated between the rock hills flanking the sides. The left side gorge is narrower than the right side one, spanning across the river. Each of the two segments of the barrage will span between the flanking hills, abutment to abutment. Barrage structures for dams are designed to safely pass the extreme flood flows without causing damage to constructed facilities as well as human life. Chiniot Dam Project is planned to store 1.0 MAF of surplus water of Chenab River with power potential of 80 MW. To release surplus water in flood season, two gated controlled barrages have been proposed at exiting right side and left side gorges. Barrages across the river would control the head pond level for power generation.

The design flood of 31,627 m³/sec against 100-years flood frequency is recommended for barrage of Chiniot Dam. It is proposed that a higher frequency flood of 200 to 500 years frequency may be considered for check flood. Therefore, the check flood is proposed as higher of the two values as 38,000 m³/s. The barrage design must ensure that check flood will pass through the barrage structure safely with pre-selected encroachment of the free board. Barrage / Spillway of the Chiniot Dam comprises of Twenty-two (26) radial gates, 07 in left gorge and 19 in the right one with the crest level of 178 m.a.s.l.

3.5.3.1 Right Side Barrage

The right-side barrage is proposed at right side gorge as flow regulation structure. It's a gated controlled structure to regulate flow in river and act as bearer to create ponding to store surplus water in high flood season and to release flood peaks in flood season. Total 19 No gates have been proposed in which 19 No. are normal bays. To counter for lateral soil pressure abutments are provided at outer side of barrage to retain soil pressure.

3.5.3.2 Left Side Barrage

Left side is planned to be provided at left side existing gorges as part of main barrage. The open width of existing left side gorge is shorter than right side gorge, so that the total length of left side barrage is smaller than right side barrage with total No of 7 bays, in which 3 No. are normal bays and 4 No are under sluice bays. A divide wall is proposed which separates normal bays from under sluices bays. Fish ladder for fish movement has been provided along divide wall Two side abutments have been provided to hold soil lateral pressure from outer side of barrage.

3.5.4 POWERHOUSE

The layout of the project is changed from the feasibility study. In the feasibility study the powerhouse was proposed on the alluvium i.e. on the left side of right gorge whereas now it is shifted on hard rock, i.e. powerhouse along with under sluices are shifted on the left side of the left gorge of Chenab River. The powerhouse comprises of 6 units, horizontal shaft bulb turbines with adjustable blades. The details of the turbine, i.e. setting of tailwater level, runner diameter and length of the draft tube, is given in the relevant section. The size of the

Powerhouse building is 81 x 54 x 56 meters. The powerhouse layout is shown in the below in **Figure 3.5**.

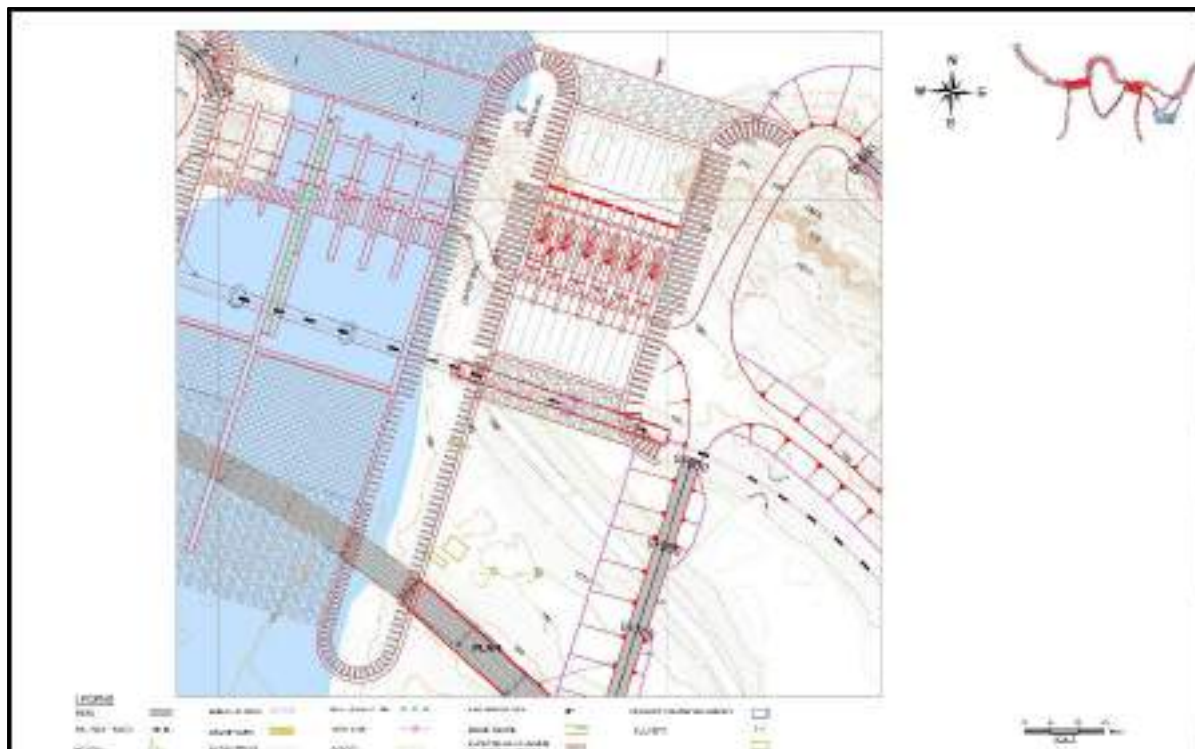


Figure 3.5: Powerhouse Layout

3.5.4.1 Headrace/Tailrace Channel

Headrace channels provided for controlling the flow through river to operate the powerhouse. The bed level of headrace channel is proposed as 178 m amsl. The approximate length of the headrace is about 55 m and width of the channel varies from 75.86 m to 178.0 m. The riprap is provided upto the 50 m in length to avoid scouring.

The Powerhouse of Chiniot Dam will discharge water into the river through draft tubes of all six turbines. It is important to keep the turbine's draft tubes submerged to minimize cavitation and for normal operation of the power plant. A tailrace channel will be provided to pass a combined discharge of 720 m³/s coming out from the powerhouse. Retaining walls will be provided on both sides of Tailrace Channel.

3.5.4.2 General Arrangement of Powerhouse Building

The powerhouse building is designed as a fully covered, indoor facility built of reinforced concrete. The powerhouse consists of six-unit bays, one erection bay, an unloading bay, equipment galleries, workshops and control rooms. Office and amenities for the operating personnel has been provided in the control building.

3.5.5 COFFER DAM

Construction works that can be carried out in dry conditions will be completed. These include the central protection embankment, the right and left bank dykes, the bridge strengthening at left river part and the 1st stage excavation of the powerhouse area, which will be used in 2nd stage of the diversion. After this, the coffer dams will be constructed in two stages. The purpose of proposed coffer dams is diversion of water for construction of main dam and appurtenant structures. Two coffer dams, one at upstream and one at downstream side of project have been designed to fulfill the diversion requirements for construction.

The construction of the coffer dam will be carried out in two stages after 1st stage. In Stage - 2, The upstream and downstream temporary cofferdams on the right bank will be constructed, and the river flow will be diverted to the left bank. During this stage, the bays on the right bank will be constructed, and the bridge strengthening at right river part and widening works will be completed. The upstream and downstream temporary cofferdams on the left bank will be constructed in Stage-3, and the river flow will be diverted to the already constructed bays on the right bank. In this stage, the bays on the left bank and the powerhouse construction will be completed. Salient features of Upstream and downstream coffer dams are given in **Table 3.3**.

Table 3.3: Main Features of Cofferdams

Feature	U/S Cofferdam	D/S Cofferdam
Max. Height at river section	14.0 m	5.0 m
Crest Width	5.0 m	5.0 m
Stage-2 : Cofferdams (Right Barrage) Crest Level	185.0 m	181.0 m
Stage-3: Cofferdams (Left Barrage) Crest Level	189.0 m	181.0 m

3.5.6 ROADWAY BRIDGES

Bridge is provided across the barrage to furnish a mean of access and movement of gantry crane for lowering and lifting stoplogs, access or support for the operating machinery for the crest gates. The bridge shall be designed for special loadings required for performing operation and maintenance functions and those that the bridge is subjected to during construction, including provisions for any heavy concentrated loads.

3.6 CONSTRUCTION ASPECTS

3.6.1 Land Acquisition

Approximately 48,300 acres of land is required for the proposed project interventions which will be acquired from government and private land owners.

3.6.2 Construction Materials

The materials used for construction purpose would include coarse aggregates (crush), fine aggregates (sand), steel, water, asphalt, reinforcement, cement etc. Availability of materials required for construction of the Earth fill type of embankment proposed for Chiniot dam project is explored at and in the vicinity of project area. Construction of Chiniot Dam involves an ample amount of construction materials comprising naturally available materials such as clay, sandy

gravel, fine and coarse sand, rocks fragments, etc. The details of the construction material for the proposed project are given as under:

3.6.2.1 Coarse Aggregate

Coarse aggregate are critical for producing high strength concrete use for Dam construction. The Sargodha, Mianwali, Margalla, and Khanpur quarries are well-established sources for coarse aggregates in the region and have been used in various mega projects. The aggregates from these quarries require thorough testing to ensure they meet the quality parameters at the construction phase. Therefore, it will be enough to cater for the aggregate needs. The appropriate sizes of aggregate processing and screening plants need to be installed for getting the required quality of stone aggregate.

3.6.2.2 Fine Aggregate (Sand)

High quality of large sand deposits is available in the vicinity of Chenab River for use in the Chiniot Dam Project. A number of sites have also been identified very close to the construction site.

3.6.2.3 Cementitious Materials

The following sources have been identified and given in **Table 3.4** for supply of the cementitious materials for the Chiniot Dam Project.

Table 3.4: Cement Manufacturers around Dam Site

Name of Factory	Location
Flying Cement Limited	Lilla
Bestway Cement Limited	Kalar Kahar & Chakwal
D.G. Khan Cement Limited	Chakwal
Dandot Cement Limited	Jhelum
Gharibwal Cement Limited	Jhelum

The cementitious material (both ordinary Portland cement and pozzolanic materials) will be supplied in 50 kg bags, and stored in weatherproof warehouses near the project site.

3.6.2.4 Reinforcing Steel

A large quantity of reinforcing steel is required for the proposed project. There are number of factories for producing reinforcing steel bars in the vicinity of the proposed site. The nearest location from where the reinforcing steel bars of the desired specification are available is Faisalabad. Reinforcing Steel will be deformed bars complying with ASTM A615 grade 40 and grade 60, in standard sizes. There are number of ISO certified steel re-rolling mills located in Lahore and Gujranwala who produce reinforcing steel according to required standards from which the requirements of the project can be easily met.

3.6.2.5 Steel Plates and Steel Formwork

About a million m² of steel formwork is required for project. Steel sheets of various thicknesses are produced in the Steel Mills of Karachi, which can be used to fabricate steel formwork. These can also be used for fabricating steel liners and other miscellaneous items required in connection with the construction activities. Alternatively, steel items can be imported from abroad.

The details of construction materials required for Major Civil Works is given in **Table 3.5**.

Table 3.5: Construction Materials for Civil Works

Materials	Estimated Quantity
Stripping	9,617,358 m ²
Soil Excavation	12,543,775 m ³
Rock Excavation	50,312 m ³
Core Filling	6,795,097 m ³
Concrete	525,089 m ³
Steel Enforcement	28,018,400 Kg
Earthwork	43,428,720 m ³

3.6.3 Colony and Camps

A large workforce along with the supervisory and support staff will be required for the project. The workforce will be originated from Punjab and other regions of Pakistan. Since local accommodation at site does not exist, therefore it will be necessary to build adequate temporary facilities including camps, workshops and ancillary facilities at convenient locations near the site.

The WAPDA colony once completed can be utilized for staffing of WAPDA senior site staff and expatriate staff till the project construction completes. After the completion of the project the colony will be utilized by Operation and Maintenance staff.

3.6.4 Construction Camps

Camp sites will be selected keeping in view the availability of adequate area for establishing camp sites, including parking areas for machinery, stores and workshops, access to communication and local markets, and an appropriate distance from sensitive areas in the vicinity. Keeping in view the following criteria guidelines, the Contractor has to identify the construction camp sites before start of the construction activities:

- There will be no resettlement issue for the location of the camps;
- Camp site will be away from the residential areas and sensitive receptors;
- Selection of sites for construction camps shall be near the project area having proper access to the nearby main/link road;
- The camps must be located in a place where the drainage from and through the camps will not threaten any domestic or public water supply;
- Camp site must be adequate in size to prevent overcrowding of necessary structures;

- The camp site will consider avoiding any damage of property, vegetation, irrigation, and drinking water supply systems;
- The camp site must not be subject to periodic flooding; and
- There will not be any ecological sensitive areas e.g. wildlife sanctuaries, game reserves, national parks, forest areas, etc. near to the construction camp site.

The tentative location of construction camps (02 in numbers) are shown in **Figure 3.6**.

3.6.5 Work Force

Man power demand estimation is an essential component to facilitate deployment of manpower. Total man power required for the proposed project will be estimated by the contractor at construction stage, whereas as per consultant's previous experience the workforce for proposed project has been estimated as 450 workers 150 skilled and 300 unskilled labour.

3.6.6 Water Requirement

The source of water during the construction phase will be from water bowser tanks and groundwater (if available) from local sources will be used. The water consumption is estimated to be 18,000 liters /day³ for 450 construction workers comprising skilled and unskilled labors for the proposed Project.

3.6.7 Wastewater Generation

The wastewater generation is estimated to be 14,400 liters/day for 450 construction workers comprising skilled and unskilled labour for the proposed Project.

3.6.8 Solid Waste Estimation

Due to construction activities waste will be generated at construction site and contractors camp. The contractor will provide the estimated quantity of excavation material during the construction phase. These wastes will be generated due to the construction activities and the up to the extent possible the excavated materials will be reused, where applicable, for construction purposed. Solid waste generated during construction and camp sites shall be safely disposed in demarcated waste disposal sites.

The solid waste generation is estimated to be 202.5 kg/day (as per 0.45 kg/capita/day waste generation)⁴ for 450 construction workers comprising skilled and unskilled labors for the proposed Project.

3.6.9 Power Requirement/ Power Source

The main source of electricity/electric power during construction phase will be diesel generators for construction camps and construction machinery and during the operational

3. Water requirements for 450 Work Force = (450) x (40) = 18,000 liters/day
Wastewater Generation = (18,000) x (80% of wastewater) =14,400 liters/day

4. Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day

phase it would be taken from main electric power grid, supplying power to the main city. The Contractor(s) will provide the details about capacity, type and number of generators to be utilized during construction phase.

3.7 PROJECT IMPLEMENTATION SCHEDULE

The proposed Project is expected to be completed within sixty (60) Months.

3.8 RESERVOIR OPERATION

The proposed Chiniot Dam would create an upstream reservoir at normal pond level of 190 m with gross storage capacity of 1.0 MAF. The dead storage level at 181m with storage capacity of 0.07 MAF. Thus, live storage capacity of 0.93 MAF would be available for Chiniot Dam Reservoir. The reservoir operation model is simulated by using continuous inflow series of 24 years from period range of (1990-91 to 2022-23) on 10-daily basis. The reservoir will be filled up to maximum conservation level at start of operation or during flood season. The reservoir operation would meet the irrigation demand considering evaporation and seepage losses with the addition of direct rainfall impact on reservoir storage. Keeping regular inflows with same flow regime by the mean of release through power house and spill through barrage, without storing water into reservoir. Rated discharge of powerhouse is 720 m³/sec which will increase to maximum of 800 m³/sec if needed for operational requirements. Thus there will be no impact on the regular flows at downstream including minimum environmental flows. However, during low flow, the reservoir water will augment the downstream water flow to ensure the minimum flow of 720 m³/sec.

3.9 WATER SUPPLY TO NEARBY COMMUNITY (FAISALABAD)

The drinking water supply option from Chiniot Dam to Faisalabad city has been incorporated on the basis of estimated planned annual water supply of 126 Million cubic meters. This supply would meet the daily water demand of around 1.0 million population or 158,479 households throughout the operational life of dam. The “willingness to pay” value for water supply services in Faisalabad has been estimated as Rs. 1059 per household per month by JICA master plan for WASA Faisalabad (2019).

3.10 COST OF THE PROJECT

The estimated cost of the construction works of proposed Project is PKR 277.885 Billion.

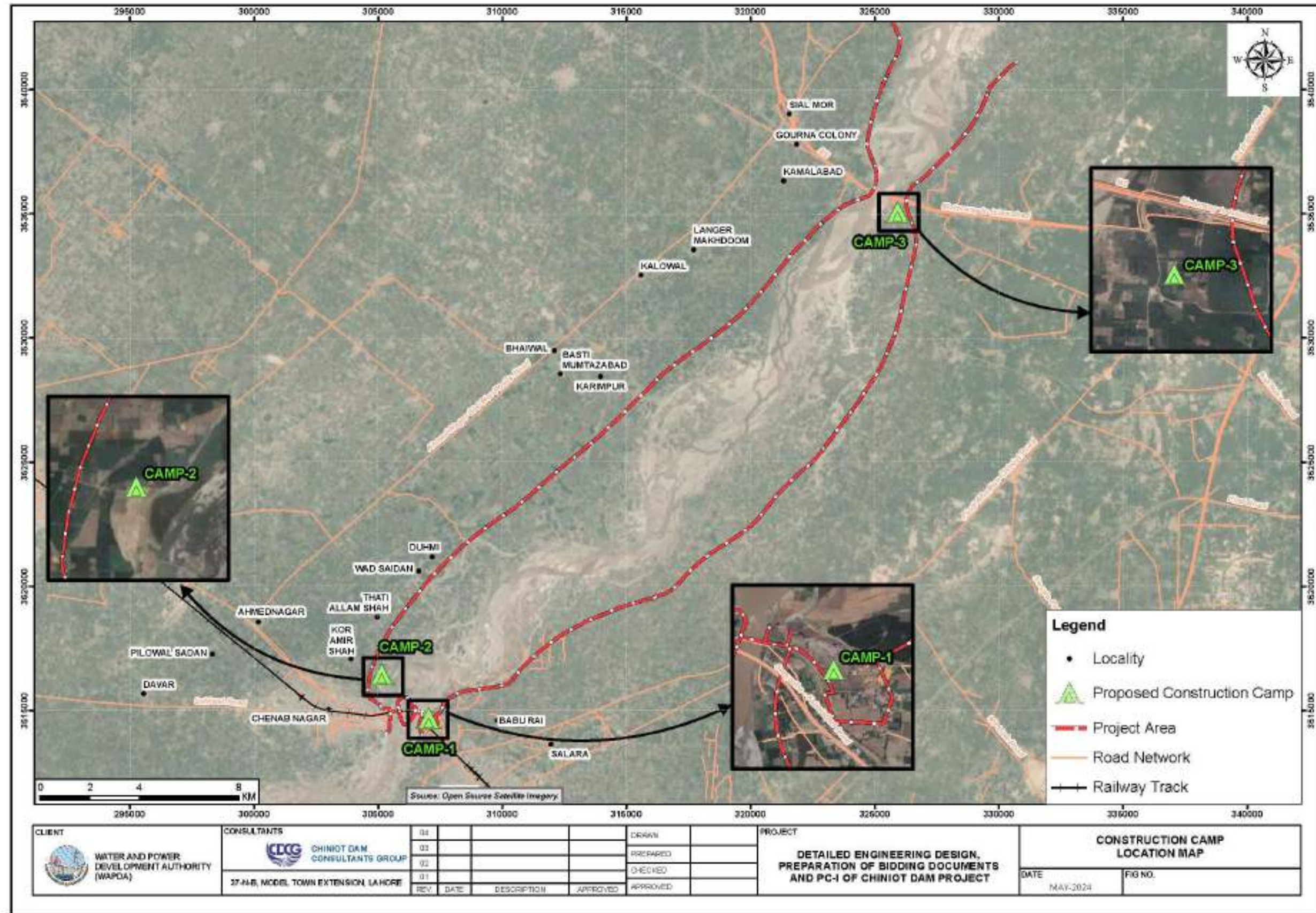


Figure 3.6: Tentative Construction Camp Locations for the CDP

4 ANALYSIS OF ALTERNATIVES

Analysis of alternatives is one of the core components of an Environmental Assessment. Analysis of alternatives ensures that all the available options and alternatives to the solution of a problem are being considered and compared. This comparison helps the proponent and the designers to adopt the most economical, technically viable and environmental and socially sound alternative for the implementation.

4.1 NO PROJECT OPTION

Water storage/ reservoirs not only provide water for irrigation (especially during the lean flow periods) but also provide a natural mitigation against flood damages which have devastating economic, social and environmental impacts on the affected population. Recently a Preliminary Damage and Needs Assessment subsequent to the 2010 floods (which created havoc in the many Districts throughout the country). A study was jointly undertaken by World Bank and Asian Development Bank. In magnitude those floods were considered the worst which Pakistan has experienced in its 70 years of its history. Punjab Province ranked second among the most severely damaged areas in the country. The Chenab River has also experienced devastating flood during 2014.

Historical evidence shows that when river levels are high, the flood water inundate a vast area at proposed dam site. Implementation of the Project will confine the flooding area (about 190 sq. km) and effectively pass the design flood downstream.

Chiniot Dam storage would benefit canals located it's downstream. The reservoir would store about 1.0 MAF of water to be released from storage by November, each year. Storage of surplus flood waters in this reservoir would permits diversions for beneficial use of flood water during the early summer thereby permitting the irrigation of some new area as well to supplement the existing irrigation system. The project will have affect for attenuating flood flows further downstream.

Based on the flood damages to infrastructure, canals, crops, livestock, livelihood and ecological imbalance; the construction of proposed dam is much important. Therefore, the no Project option means that no construction of flood protection dam, no reduction in flood damages and no improvement in irrigation and infrastructure system of area. This is not a feasible option as the attenuation high flow floods is the only option to assure the safety of infrastructure present in the Study Area/AOI.

4.2 ALTERNATIVE PROJECT LAYOUTS (RESERVOIR)

Different project layouts were studied to plan an optimized layout to achieve maximum storage and hydropower benefits. Flood mitigation is also a prime consideration in the selection of final project layout Different project layout options were developed on the basis of map study and field visits.

4.2.1 Alternate Project Layout – I

Alternate-I with proposed dam / barrage and dykes aligned with river banks will develop a surface area of 190 km². The reservoir will store about 1,233 Mm³ (1.0 MAF) of water to be released from storage by November, each year.

4.2.1.1 Area Submergence

The type of land being affected belongs to two main categories i.e., cultivated and river flood plain respectively. Rest of the area is covered by houses, cultivated fields, riverbed etc. Agricultural land is being used for raising farm crops like maize, wheat, fodder, sugarcane as seasonal crops and a very small number of fruit plants as perennial crop, which will be affected due to its submergence in water. Reservoir area in this option will inundate 47,000 acres of land which includes 33,337 acres' river plain and flooded area land and 12,613 acres of agriculture land. The reservoir length will be about 36 km and widths vary from 09 to 01 km.

4.2.1.2 Population Affected

In Alternate - I, total 16 villages, 8 each on both river banks will be affected due impounding of the reservoir. The reservoir will permanently submerge approximately 47,000 acres of land including 3,896 households. About 27,300 people will be displaced in this option.

4.2.1.3 Impact on Flora

Data has been developed on the basis of the satellite imageries and supplemented by field verification, based on the random sampling. In Alternate – I, there is about 50,599 clustered and scattered trees forest on both side of Chenab River. This includes 8,080 fruit trees which are estimated as 16% of the total trees.

Alternate – I layout salient features are given below.

Table 4.1: Alternative – I: Salient Features

Reservoir Surface Area	190 km ²
Reservoir Length (approx.)	36 km
Dyke Length	77 km
Gross Storage	1.0 MAF
Live Storage	0.93 MAF
Dead Storage	0.07 MAF
Installed Capacity	80 MW
Capacity per Unit	13.5 MW
No. of Units	06

4.2.2 Alternate Project Layout – II

In Alternate - II, the proposed layout identified along Chenab River banks with proposed dykes aligned along river banks will have a surface area of about 351 km². Proposed layout will leave storage of 1,776.22 Mm³ (1.44 MAF), this capacity will provide protection against high frequency flood.

4.2.2.1 Area Submergence

The type of land being affected belongs to two main categories i.e., cultivated and river flood plain respectively. Rest of the area is covered by houses, cultivated fields, riverbed etc. Reservoir area in this option will inundate 86,735 acres of land which include 33,337 acres' river plain and flooded area land and 50,735 acres of agriculture land. The reservoir length will be about 45 km and widths vary from 12 to 01 km.

4.2.2.2 Population Affected

Total 11 villages, 07 on right and 04 on left river bank will be affected due impounding of the reservoir in Alternate - II. The reservoir will permanently submerge approximately 86,735 acres of land including 4,751 households. About 33,257 people will be displaced in this option.

4.2.2.3 Impact on Flora

Alternate – II also have clustered and scattered forest. An estimated 0.315 million numbers of trees are located in this alternate with varying size. Impact of the reservoir is mainly on the forest trees / shrubs, whereas the fruit trees having the minimal impact.

Alternate – II layout salient features are given below.

Table 4.2: Alternative – II: Salient Features

Reservoir Surface Area	351 km ²
Reservoir Length	35 km
Dyke Length	100 km
Gross Storage	1.440
Live Storage	1.386 MAF
Dead Storage	0.054 MAF
Installed Capacity	80 MW
Capacity per Unit	13.5 MW
No. of Units	06

4.2.3 Alternate Project Layout – III

In Alternate – III, the existing dyke constructed by Punjab Irrigation Department was extended to achieve a gross water storage capacity of 2,245 Mm³ (1.82 MAF).

4.2.3.1 Area Submergence

The type of land being affected belongs to two main categories i.e., cultivated and river flood plain respectively. Rest of the area is covered by houses, cultivated fields, riverbed etc. Reservoir area in this option will inundate 120,000 acres of land which include 33,337 acres' river plain and flooded area land and 83,000 acres) of agriculture land. The reservoir length will be about 45 km and widths vary from 16 to 01 km.

4.2.3.2 Population Affected

Alternate - III, total 32 villages, 16 each on both river banks will be affected due impounding of the reservoir. The reservoir will permanently submerge approximately 120,000 acres of land including 11,461 households. About 62,420 people will be displaced in this option.

4.2.3.3 Impact on Flora

In this alternate, reservoir has clustered and scattered forest approximately 0.507 million trees of varying size. This data was developed on the basis of the satellite imageries and supplemented by field verification, based on the random sampling.

Alternate – III layout salient features are given below.

Table 4.3: Alternative – III: Salient Features

Reservoir Surface Area	485 km ²
Reservoir Length	35 km
Dyke Length	112 km
Gross Storage	1.820 MAF
Live Storage	1.759 MAF
Dead Storage	0.061 MAF
Installed Capacity	80 MW
Capacity per Unit	13.5 MW
No. of Units	06

4.2.4 Comparison of Alternative Project Layouts

Three alternative project layouts (Alternative - I, Alternative - II and Alternative - III) were considered for the reservoir. Field investigations at dam / barrage and reservoir area were carried out to select an optimal project layout. Comparison of three project alternatives is shown below:

Table 4.4: Comparison of Alternative Project Layouts

Sr. No.	Description	Alternate - I	Alternate - II	Alternate - III
TECHNICAL PARAMETERS				
Dam / Barrage				
1.	Type	Earth fill embankment		
2.	Height	21 m (68.89 ft.)		
3.	River Bed Level	175 m (574 ft.) a.s.l		
4.	Free Board	2 m (6.56 ft.)		
5.	Top Width	6 m (20 ft.)		
6.	Embankment Level	192 m (630 ft.) a.s.l		
7.	Embankment Length			
	Left	38 km (124,640 ft.)	55 km (180,445 ft.)	62 km (203,412 ft.)
	Right	39 km (127,920 ft.)	44 km (144,357 ft.)	48 km (157,480 ft.)
8.	Normal Conservation Level	190 m (623 ft.) a.s.l		
Reservoir				
9.	Reservoir Area	47.700 Acres	86.735 Acres	120.000 Acres

Sr. No.	Description	Alternate - I	Alternate - II	Alternate - III
10.	Reservoir Length	35 km	35 km	35 km
11.	Reservoir Perimeter	88.3 km	94 km	109 km
12.	Gross Storage	1.0 MAF	1.44 MAF	1.82 MAF
13.	Live Storage	0.93 MAF	1.386 MAF	1.759 MAF
ENVIRONMENTAL PARAMETERS				
14.	Area Inundated	47,700 acres	86,735 acres	120,000 acres
15.	Population Affected	27,300	33,257	62,420
16.	Land to be Acquire / transfer from govt. departments	47,700 acres	86,735 acres	120,000 acres
17.	Agriculture Land	12,613 acres	50,735 acres	83,000 acres
18.	Houses (No.)	3,896	4,751	11,461
19.	Flora (No. of Trees)	50,599	315,000	507,000

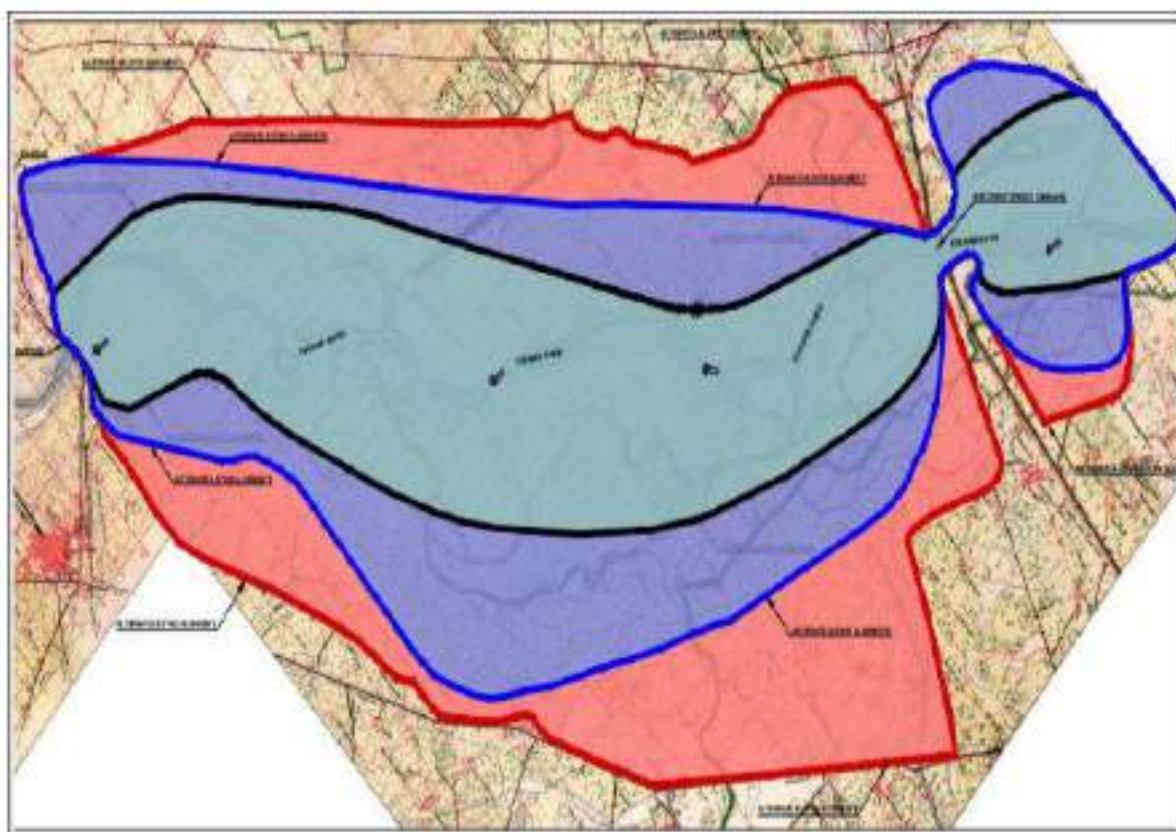


Figure 4.1: Alternate Project Reservoir Layout – I, II and III

Taking into consideration the smaller reservoir area, land acquisition, resettlement, environmental / social issues and lowest cost implications, Alternative-I Project Layout has the highest benefits and lowest costs in comparison with other options. Therefore, Alternate-I layout was selected for detailed studies.

4.3 ALTERNATIVE LAYOUTS OF RIVER SECTION STRUCTURES

For the main structures along the river cross section, different layout plans were prepared and studied according to the number of gates that could pass the design flow downstream and ensure the safety of the downstream bridges and Talib Wala Bridge on the upstream. Alternatives -1, 2, 3 & 4 (26 number of bays) with different arrangement of siting the bays of barrages and power house were prepared and compared.

4.3.1 Alternative-1

In Alternative-1, 7 barrage bays were located on the left bank, the power house, 4 sluiceway bays, fish passage and the remaining barrage bays were located on the right bank. **Figure 4.2** shows the arraignment of bays and power house.

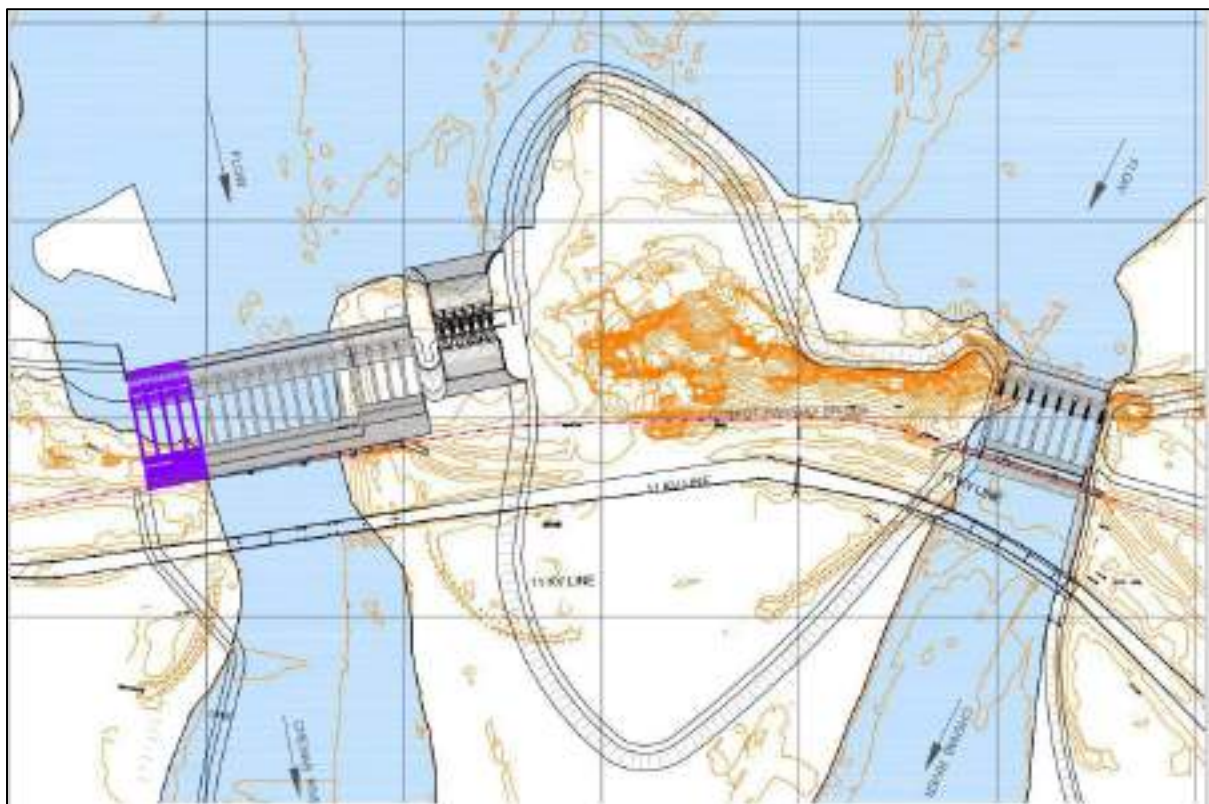


Figure 4.2: Alternative-1 Layout of Bays and Power House

4.3.2 Alternative-2

In Alternative-2, the power house, 4 sluiceway bays, fish passage and 12 normal bays were located on the right bank, the remaining barrage bays were located on the left bank. **Figure 4.3** shows the arraignment of bays and power house.



Figure 4.3: Alternative-2 Layout of Bays and Power House

4.3.3 Alternative-3

In Alternative-3, the power house, 4 sluiceway bays, fish passage and 3 barrage bays were located on the left bank, the remaining barrage bays were located on the right bank. **Figure 4.4** shows the arraignment of bays and power house.

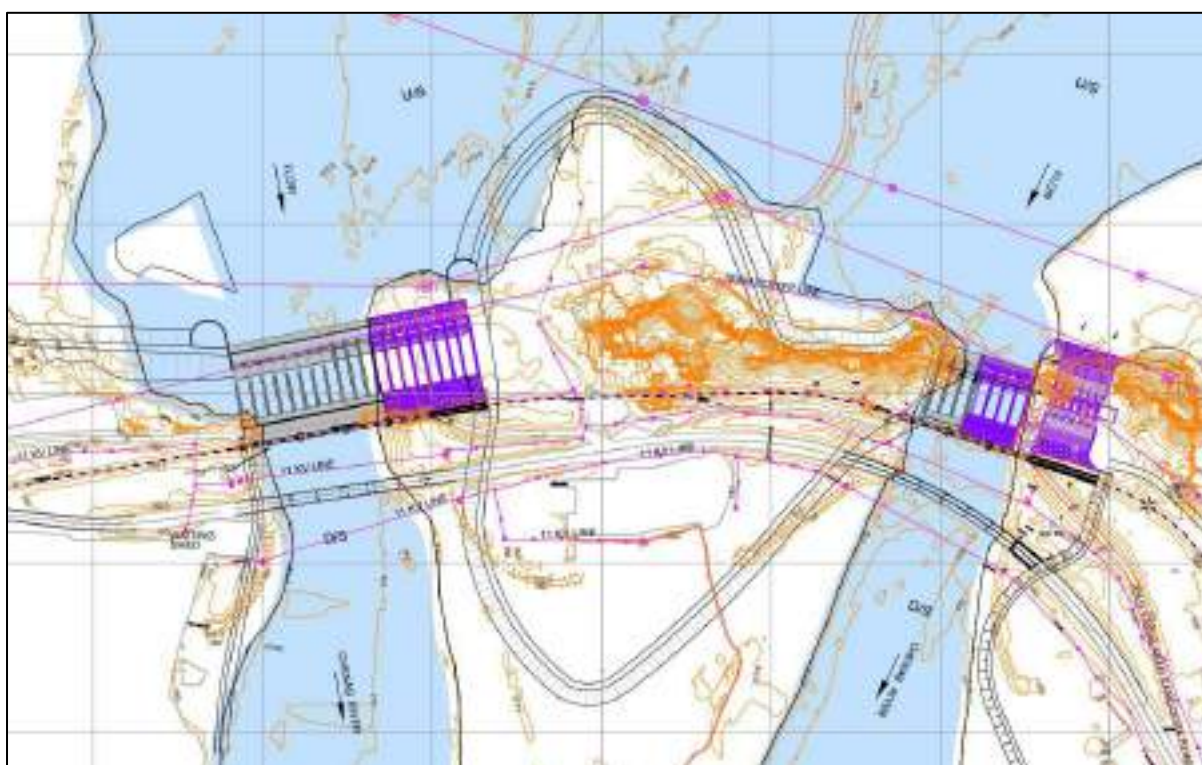


Figure 4.4: Alternative-3 Layout of Bays and Power House

4.3.4 Alternative-4

In Alternative-4, the power house, 4 sluiceway bays and fish passage were located on the left bank and all barrage normal bays were located on the right bank. **Figure 4.5** shows the arraignment of bays and power house.

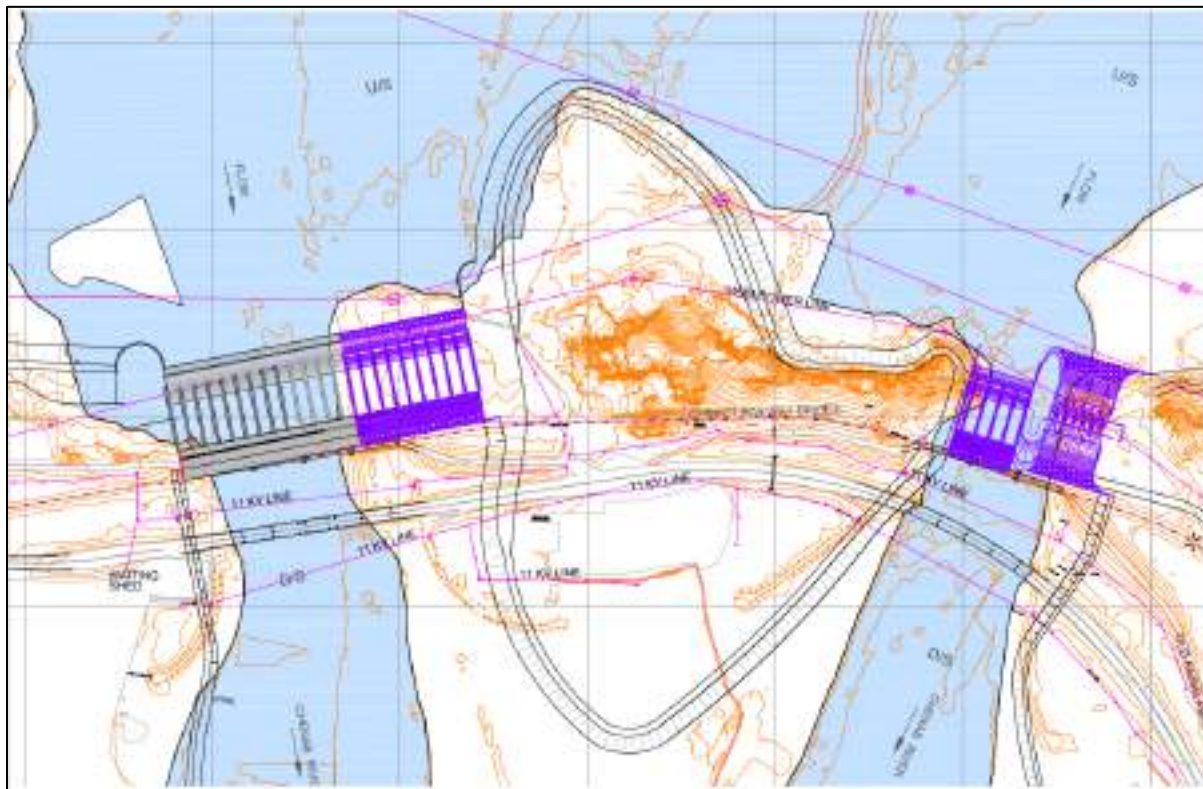


Figure 4.5: Alternative-4 Layout of Bays and Power House

4.3.5 Selection of the Most Suitable Alternative

The most suitable alternative was selected as Alternative-3. In Alternative-3, the powerhouse, 4 sluiceway bays, fish passage and 3 barrage bays are located on the left bank, the remaining barrage bays are located on the right bank as shown in **Figure 4.4**.

4.4 ALTERNATIVE PROJECT LAYOUTS (POWER PLANT COMPLEX)

Keeping in view the topography, geology and site conditions, two options of Power House locations were considered during the study. Details of these options are as follows.

4.4.1 Option - 1

In Option – 1, Powerhouse was proposed on left side of right river gorge. This option will utilize a gross head of 10 m and have an installed capacity of 80 MW. The powerhouse will be equipped with six horizontal shaft bulb type turbines with an installed capacity of 13.6 MW. It will generate 227 GWh of energy annually.

4.4.2 Option – 2

Powerhouse in Option - 2 was proposed on left bank of Chenab River. The left side gorge is narrower than the right side one. This option will utilize a rated net head of 12.4 m and have an installed capacity of 80 MW. The powerhouse will be equipped with six horizontal shaft bulb type turbines with an installed capacity of 13.6 MW.

The powerhouse must be founded on sound geological strata to withstand the substantial vibrational and thrust loads generated by electro-mechanical equipment, and to prevent differential settlements. The alignment of a surface powerhouse is determined by topographical constraints and the inflow/outflow hydraulic profile.

Subsurface data reveals that at Site-II, rock strata are encountered at relatively shallow depths, whereas at Site-I, rock is present at considerably deeper levels. In terms of hydraulic head, Site-II offers a net head of 12.47 m, compared to 10.0 m at Site-I, providing additional energy potential.

4.5 RECOMMENDATIONS

- Taking into consideration the smaller reservoir area, land acquisition & resettlement, environmental / social issues and lowest cost implications, Alternative- I Project Layout has the highest benefits and lowest costs in comparison with other options. Therefore, Alternate - I layout has been selected for detailed studies.
- The most suitable dam layout alternative was selected as Alternative-3. In Alternative-3, the powerhouse, 4 sluiceway bays, fish passage and 3 barrage bays are located on the left bank, the remaining barrage bays are located on the right bank.
- In case of Power House Location, Option – 2 i.e., surface power housed located on left side of left river gorge has been selected for detailed study based on favorable topography, geology, site conditions. However, Option - 1 was excluded for further study due to flood risk and unfavorable geological conditions.

4.6 BARRAGE OPTIONS CONSIDERED

Initially for a dam crest level of 196.5m amsl, different alternatives of the barrage were considered not only from technical and economic point of view but also for the social and environmental impacts as well.

- Gated (Chute barrage)
- Gated and Ungated Barrage combined barrage
- Totally ungated barrage
- A combination of Barrage and fuse plug/ flip bucket

The non-feasible alternatives in term of construction or excessive cost were omitted. The most suitable location and layout of *Gated Broad Crested Barrage* was adopted which delivers maximum net benefits.

5 EXISTING BASELINE PROFILE

5.1 GENERAL

This section provides the existing conditions of the proposed AOI. These conditions will also act as a benchmark for the assessment of impacts as well as during the compliance and effect monitoring during and after construction of the Project. This baseline will also provide the datum for assessing the impacts and suggesting the mitigation measures, which will be implemented effectively at various phases of the Project activities and description of baseline conditions of the Project as well as the AOI.

5.2 APPROACH ADOPTED

The consultant's team comprised of experienced experts including: Environmental Engineers, Environmental Scientist, Ecologist and Sociologists to establish the baseline conditions of the AOI/Study Area (**Figure 1.2**).

For the collection of baseline information checklists/proformas, Satellite Imagery (Google Earth), and General Topographic (GT) sheets were used. AOI was delineated based on expert judgment, field reconnaissance, Consultant's experience, study of available maps and data collected through secondary sources and results of the consultation with the relevant departments.

Each expert prepared a checklist/proforma for the collection of baseline data of the important parameters of physical, ecological and socio-economic environment (Refer **Annex-II**). Meetings and scoping sessions with all the concerned Project stakeholders were held for the collection of primary information, disclosure of Project interventions, provide information and to clear queries and misconceptions of the Project. Government offices were contacted and visited for the verification of baseline data collected during the field visit and to obtain relevant published documents.

5.3 PROJECT ACCESSIBILITY

The Chiniot Dam Project site is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage, 165 Km from the Lahore City, 5 km from the Chiniot City and about 100 meters upstream of existing Railway Bridge on Chenab River. The proposed Project site is accessible through following existing road networks such as:

- Chiniot Pindi Bhatian Road;
- Lahore Sargodha Road;
- Chiniot Bypass;
- Chiniot Jhang Road;
- Sangla Pandorian Road;
- Chiniot-Chak Jhumra Road;
- Ahmed Nagar Sial Mor-Phalia Road;
- Sargodha-Faisalabad Road;

- M-2 Motorway;
- Faisalabad Sangla Hills Road;
- West Canal Expressway;
- Jhang Road;
- Shaheenabad Bypass;
- Sahiwal Road; and
- Lalian Jhang Road

The project Area Accessibility Map is shown in **Figure 5.1**.

5.4 FIELD VISIT

A team of experts carried out the field visit from 25th to 30th of October 2023 to the proposed dam site in order to collect the baseline data of physical, ecological and socio-economic conditions.

Primary data was collected through direct field surveys while secondary data was collected from various authentic sources. The people living within the AOI were interviewed to have their views about the proposed project intervention and the perceived impacts on the natural environment within the AOI. This included information on land, surface water, groundwater, air, flora, fauna and socio-economic conditions. Stakeholder consultations were undertaken, details for stakeholder consultations are provided in Section 6 of this report.

Following is the description of baseline conditions of the AOI.

5.5 PHYSICAL RESOURCES

The following section provides an overview of the information on physical environment of the proposed Project Study Area / AOI collected from secondary sources. The major parameters covered include physiographic and topography, geology, soil, seismicity, climate and meteorology, Water Resources, Solid Waste, Land Use etc.

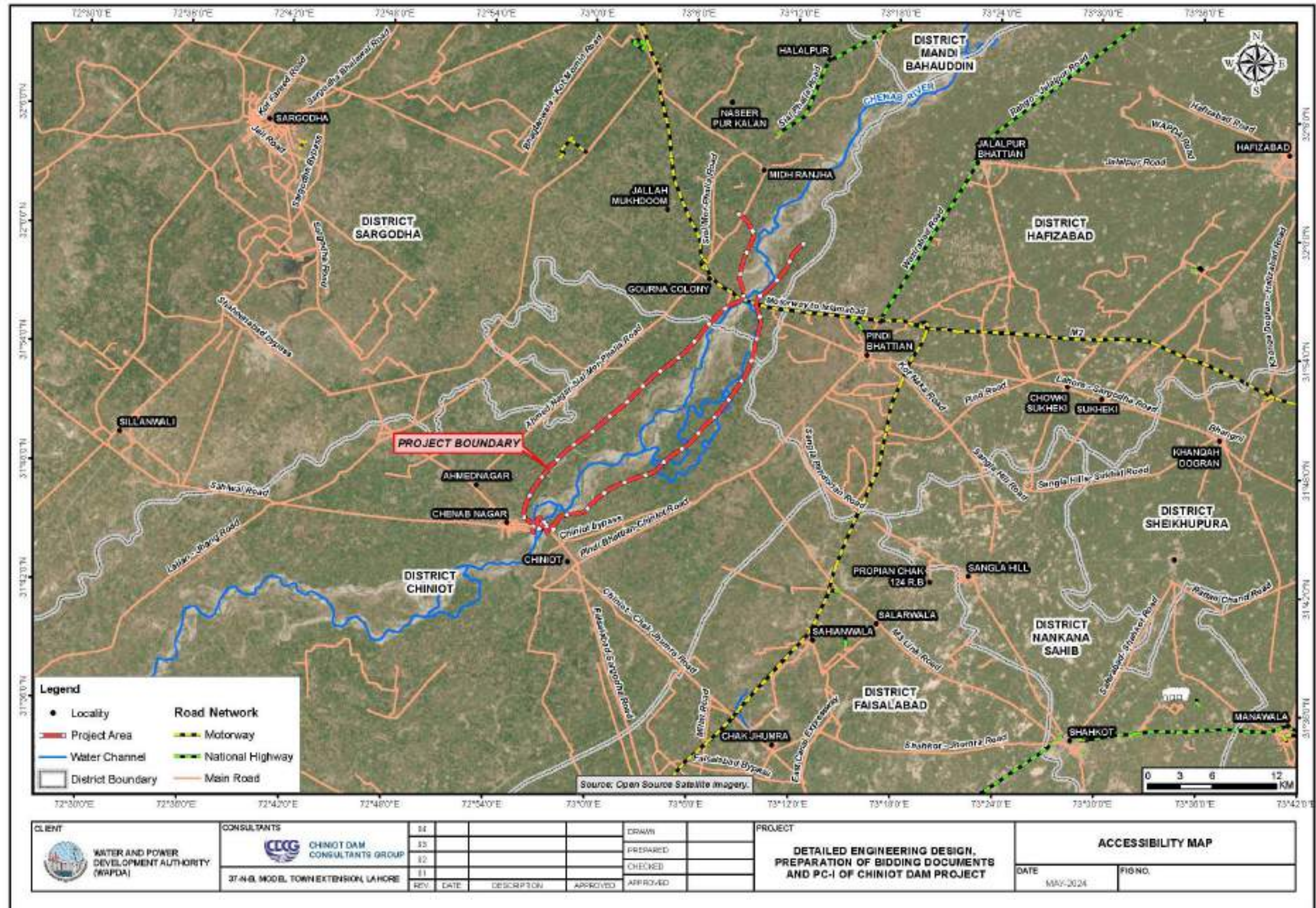


Figure 5.1: Project Area Accessibility Map

5.5.1 Topography

The dam site is proposed just upstream of century old Rail-cum-Road Bridge at Chiniot over River Chenab on Faisalabad-Sargodha Road. Whereas, the reservoir will spread over on River Chenab and surrounding areas from dam site to about 6 km upstream of Talibwala Bridge on Lahore-Islamabad Motorway (M-2)⁵.

The Project area is a part of the Indus Plain and lies just south of the Chiniot town with average elevation of 200 meters above Mean Sea Level. It is almost flat land interspersed with outcropping ridges of the Indian Basement rocks that reach up to 250 meters above sea level in the North and divide the Indus plains into upper and middle basin. Indian basement rocks are present on either side of the Chenab River, where Project appurtenant structures will be located. These hillocks are devoid of any soil cover and vegetation and separated by cultivated fertile land.

The reservoir area of the Chiniot dam divided into three geomorphic units i.e.:

- Fluvial plains, defines the sand rich main course of Chenab River and characterized by longitudinal and lateral bars;
- Fluvial terraces are the relative flat terrain above the water level of the main River channel and;
- Paleo-alluvial fans, comprised of unconsolidated medium sand accumulated at high topographic position along the proposed reservoir area.

At the location of dam, the river flow divides into two channels and each channel flows through a gorge situated between the rock hills flanking the sides. The left side gorge is narrower than the right side one, spanning across the river. Each of the two segments of the Barrage will span between the flanking hills, abutment to abutment. The combined width of the two gorges would be adequate to accommodate the Barrage.

The characteristics of the topography, including the elevation, geological formations, and the presence of the Chenab River, have direct implications for the environmental conditions and potential impacts of the proposed project. The topographic variation affects the distribution of soil cover, vegetation, and water flow patterns, which are crucial elements of the environmental baseline. Moreover, the presence of the rock formations in Project Area can affect the natural drainage patterns and can have implications for the stability of the proposed project structures. The topography map of the project area is shown in **Figure 5.2**.

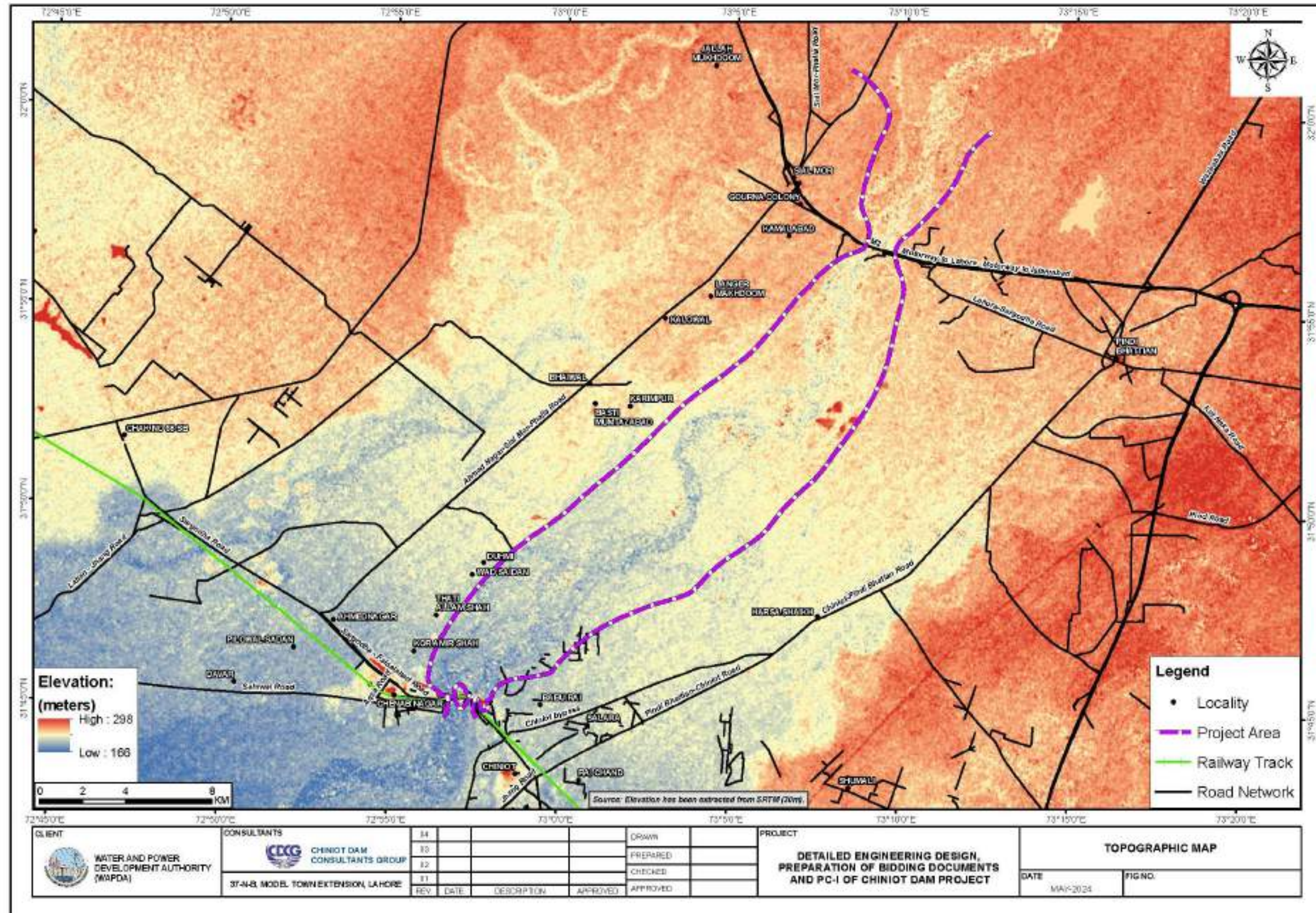


Figure 5.2: Topography Map

5.5.2 Geology

The prevailing geologic conditions in the region are directly tied to the formation process of Himalayan mountains characterized by intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The significant tectonic changes, which have had so much impact in the region, are feebly evident except the Indus Plain most noticeable relief features i.e. monadnocks called the Indian Shield basement rocks. These metasedimentary rocks inter-layered with andesite, rhyolites and tuff beds. Basic igneous rocks of diabasic composition intrude the sequence. The basic rocks are highly weathered and altered.

The site situated in western extension of Kirana Hills, exposed at Chiniot. These are the western extension of Aravalli Mountain ranges exposed in Pakistan at Sargodha, Chiniot, Sangla Hill, and Shahkot areas.

The Stratigraphic classification of exposed units in and around the vicinity of Kirana Hills has described and modified by Chaudhry et al, 1999. These groups according to stratigraphic classification of Chaudhry et al., (1999) are Hachi Volcanics and Machh Super Group. These two packages formed in two distinct petroTECTONIC assemblages (Ahmad et al., 2000).

The main rock units exposed in the Project area are:

- Arenaceous Slate;
- Cherty Quartzite;
- Quartz Wacke; and
- Dolerite.

These rocks are of sedimentary origin of Late Proterozoic age that later metamorphosed at low grade and cut by igneous intrusions (Chaudhry et al. 1999). Depending upon the basin configuration and material influx, the lithological variation is present in the Project area. The Chenab River distributed into two channels and cut these rock units. Many quarries had established near the Project area where rock is excavating for construction purposes.

5.5.3 Seismology

The Project area falls in the Punjab plain on north side of Indus basin, which is present south of the tectonically active collisional zone between the two tectonic plates. The nearest important tectonic features of the collisional zone north of the Project site are Salt Range Thrust in the north and Riasi Thrust in the Himalayan Range northeast of the Project site. On the north of the Project site, the closest trace of the Salt Range Thrust running east-west is passing at a closest distance of about 95 km. Towards northeast of the site, Riasi Thrust, running almost north-south, passes at a closest distance of about 190 km from the site.

Based on the evidences of Quaternary movement along these faults and association of observed seismicity, these tectonic features may be considered seismically active. The Project site itself is located in Indus basin in which rock outcrops are not present except the occasional

outcrops of basement rocks. Therefore, exposed tectonic features are not present near the Project site.

According to Building code of Pakistan, 2007, the Project area (Chiniot) falls in Seismic Zone 2A of Pakistan (low to moderate damage) and peak ground acceleration (PGA) from 0.08 to 0.16 g⁶. As the Project area falls in Indus basin which is located within the Indian plate south and southwest of the Himalayas and Salt Range and east of the predominantly northward trending mountain ranges of western part of Pakistan, the seismicity occurring within this zone is generally of low level. Although infrequent, some events have caused considerable damage. The activity within the Indus basin may be related to the bending of the lithosphere, active basement faults transverse to the fold and thrust belts, and/or development of a new frontal thrust. The seismology map of the project area is shown **Figure 5.3**.

The main seismogenic features, which may influence the seismic hazard for Chiniot Dam Project are:

- Salt Range Thrust (SRT);
- Riasi Thrust; and
- Basement Faults below Punjab Plain.

The maximum earthquake magnitude (in moment magnitude MW) of each of the fault was calculated using Wells & Coppersmith (1994) relationships between faults rupture length and magnitude. For the concealed Basement faults, maximum magnitude is adopted by adding 0.5 in the maximum recorded magnitude in Punjab plain. The adopted maximum magnitudes given in **Table 5.1**.

Table 5.1: Critical Faults and Their Maximum Earthquake Potential

Sr. No.	Tectonic Feature	Fault Length (km)	Fault Rupture Length (km)	Maximum Magnitude Potential (Mw)	Closest Distance from Fault (km)
1.	Salt Range Thrust	160	80	7.3	92
2.	Riasi Thrust	220	110	7.5	180
3.	Basement Faults below Punjab Plain	---	---	6.0	5

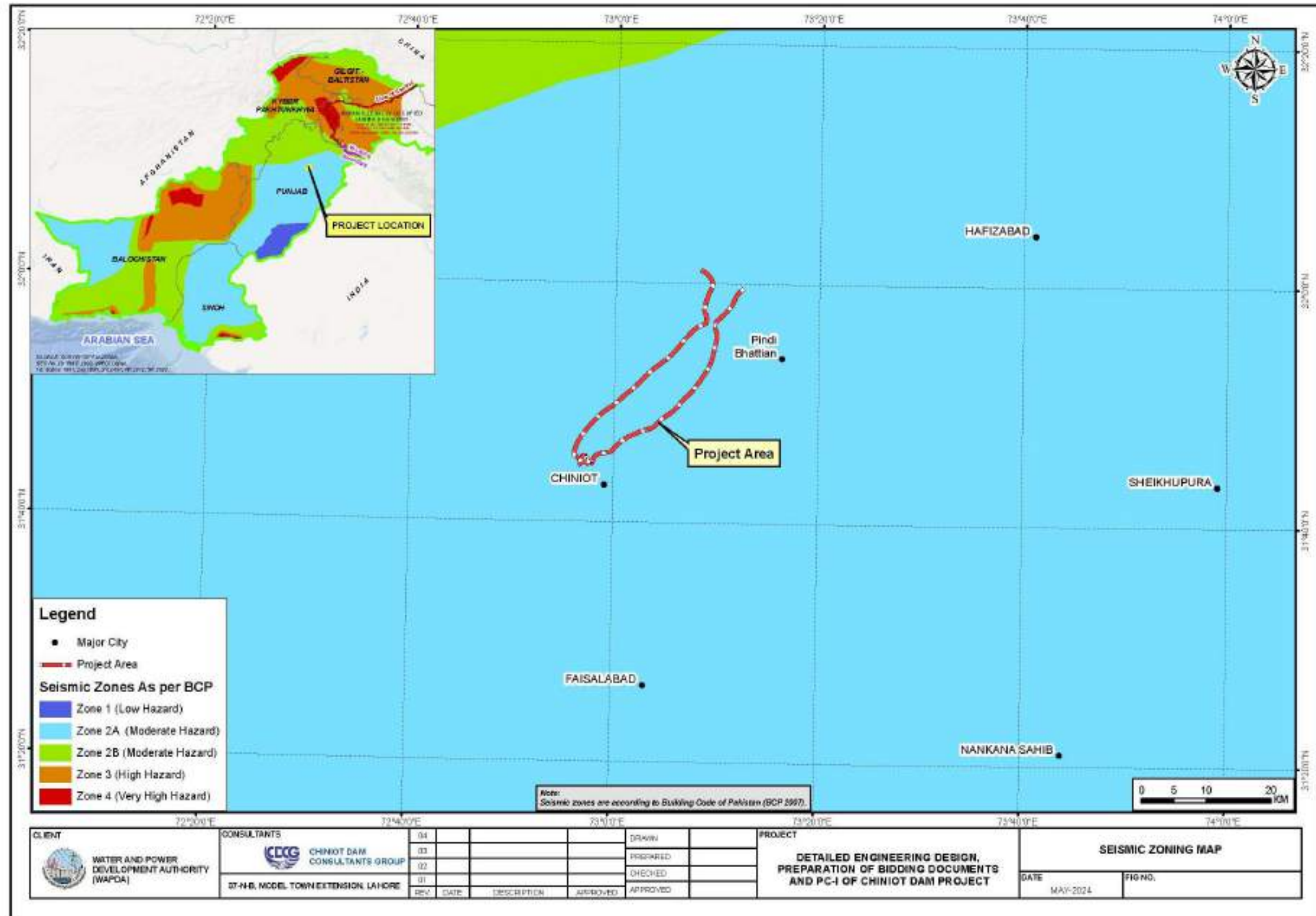


Figure 5.3: Seismic Zoning Map of Proposed Project Area

5.5.4 Soil

The soil of the Chiniot formed from the Quaternary alluvial deposits comprising silty clay and sand, accumulated by braided tributaries of Indus River system, originating from the north-west Himalayas⁷.

The Rechna Doab⁸ encompasses the Chiniot district therefore; soil of the district also classified into five series based on vertical and horizontal textural variations.

The Project area is located in the flood plain of Chenab River. Hence, recently deposited soil units are widely spread. It is present as thick alluvium while near the periphery of Paleo-high (Sargodha High) it covers the bedrocks. Terrace deposits mainly consists of mixture of sandy silt with subordinate clay⁹.

5.5.4.1 Reservoir Area

The soils present in the reservoir area of the Chiniot dam are of alluvial nature of Quaternary age. The presence of the alluvial deposits in the region are the result of the extensive inundation, deposition and erosion over a long period of time.

During the feasibility stage, a strip mapping survey was conducted along the proposed reservoir dykes to assess the surface geology and soil characteristics. The survey employed handheld GPS, tape measurements, and Brunton compass techniques to ensure accurate field data collection. A swath approximately 100 meters wide on either side of the central reservoir rim line was systematically traversed and documented. The survey area is predominantly under agricultural cultivation, and the surface cover primarily consists of alluvial soils, characterized by variable mixtures of silt, clay, and sand. As a result of the mapping efforts, five principal soil units were identified and delineated on the field mapping sheets. These units were distinguished based on textural composition, color, moisture content, and other observable field characteristics.

- Sandy Clayey Silt
- Clayey Sandy Silt
- Sandy Silt
- Silty Sand
- Sand

5.5.4.2 Barrage

Right Side Barrage

Six (06) bore holes with depths 45 m, to 60 m were drilled down to investigate the subsurface conditions prevailing in this area. The medium dense silty sand/sand encountered from zero (0) to 18 m and further up to 30 m, dense sand is present.

7 Commission on Engineering Geological Maps of the International Association of Engineering Geology - CEGM-IAEGC, No. 15, 1976.

8 The Rechna includes all the area between the Chenab and Ravi Rivers, all the way from the Jammu Division of Jammu and Kashmir in India till their confluence in Punjab, Pakistan.

9 Chiniot Dam DDR by WAPDA, June 2025

Left Side Barrage

Four (04) boreholes drilled at barrage-II site to investigate the subsurface rock conditions. At left side, boreholes BH-01 and BH-02 drilled up to 65 m to 42 m. Other boreholes drilled down to depth of 48 m in riverbed and up to 48 m at right abutment of the Chenab River respectively. Loose to medium dense silty sand is present up to 18 m and medium dense silty sand up to 23 m. However, in BH-02 gravelly soil encountered after 18 m.

5.5.4.3 Intake Area

The intake structure, positioned on the left side of the Left Side Barrage (LSB), is geologically underlain by a sequence of slates (designated AS-1 to AS-4). These rock units were identified through detailed geological mapping and corroborated by findings from subsurface investigations. In addition to the slate sequence, a fault zone has been interpreted within the subsurface profile, suggesting the presence of structural discontinuities that may influence the rock mass behavior, seepage characteristics, and foundation stability in the intake area.

5.5.4.4 Power House

The powerhouse area is located on the left side of the Left Side Barrage (LSB). As part of the current stage of investigations, two boreholes—BH-46(N) and BH-47(N) were drilled to a depth of 40 meters each to assess the subsurface conditions and geological profile of the site. Both boreholes encountered a fault zone at depth, overlain by a shallow colluvial cover. In BH-46(N), bedrock was encountered at 15 meters, beneath a sequence of fine-grained soils. In BH-47(N), bedrock was reached at a shallower depth of 4 meters, indicating lateral variability in the bedrock profile across the powerhouse footprint.

5.5.4.5 Tailrace

Two boreholes, BH-13 and BH-37(N), were drilled in the tailrace area to investigate the subsurface conditions. Both boreholes encountered a significant thickness of alluvial deposits. BH-13 penetrated through the alluvium and subsequently intersected underlying slate, indicating the transition from unconsolidated to consolidated strata within the depth range explored. BH-37(N) remained entirely within the alluvial layer, with no contact with bedrock observed within the drilled depth. These findings suggest variability in the depth to bedrock across the tailrace area and underscore the dominance of thick alluvial cover. The reported permeability values according to soil types given in **Table 5.2**.

Table 5.2: Permeability Values of the Soil Types

Sr. No.	Structure Type	Soil Type	Permeability (cm/s)
1.	Dam Body	Silty Clay, Silty Sand, Sand, Clayey Silt and Silty Sandy Clay	7.02×10^{-3}
2.	Left Bank Embankment	Silty Clay	7.69×10^{-2}
		Silty Sand	1.07×10^{-2}
3.	Right Bank Embankment	Sand	3.97×10^{-3}
		Silty Sand	2.31×10^{-2}
		Silty Sandy Clay	1.39×10^{-2}
		Silty Clay	9.23×10^{-2}

5.5.5 Climate

The seasonal climatic conditions must be considered for the design and execution of the developmental projects. The climate including air, temperature, precipitation, humidity and wind speed and wind direction are an influencing factor, affecting the construction of engineering structures. However, to determine the overall effect of the climatic stresses, daily and seasonal temperature changes, site altitude, direct solar radiation, and precipitation must be considered.

Climatic station Sargodha, is the nearest station to the Chiniot Dam Site, and is operated by Meteorological Department-Pakistan. Climatic Normals Data of Sargodha station for the period of (1991-2021) and rainfall data of Sargodha station for the period of (1981-2015) have been collected from Meteorological Department The detail of data is given in DDR.

The Project area has moderate to extreme climate conditions, with hot summers and cold winters. The summer starts from April and lasts till September while the winter seasons lasts from November to March. Mean monthly min temperature varies from 4.9°C to 27.2°C; mean monthly max varies from 18.6°C to 40.7°C, respectively with mean monthly temperature range from 11.75°C in January to 33.95°C in June, correspondingly. Mean monthly rainfall varies from 4.4mm in November to 94.1mm in August. Temperature, precipitation, relative humidity, wind speed and wind gust of the Study Area is discussed below.

5.5.5.1 Temperature

Table 5.3 shows that the distinct seasonal pattern, with the highest average maximum temperatures occurring in May and June, reaching up to 42.6°C, indicating peak summer heat. The coolest period is observed in January, where the mean minimum temperature drops to 4.9°C and the average monthly temperature is just 11.75°C. A gradual rise in temperatures begins in March, peaks mid-year, and then declines from September onwards, reflecting a typical subtropical climate cycle with hot summers and mild winters. **Figure 5.6** shows Mean Minimum and Maximum Temperature in the Study Area (1991-2021)

Table 5.3: Mean Maximum Temperature from 1991-2021¹⁰

Month	Mean Maximum Temp (°C)	Mean Minimum Temp (°C)	Mean Monthly Temp (°C)
Jan	18.6	4.9	11.75
Feb	22.4	8.2	15.3
Mar	27.8	13.7	20.75
Apr	34.1	19.4	26.75
May	40.8	24.6	32.65
Jun	42.6	27.5	35.05
Jul	37.7	27.2	32.45
Aug	31.9	25.7	28.8
Sep	35.7	24.8	30.25
Oct	32.2	18.6	25.4
Nov	26.9	11.5	19.2
Dec	21.8	6.2	13.9

¹⁰ Meteorological Data for Project Area (1991-2021)

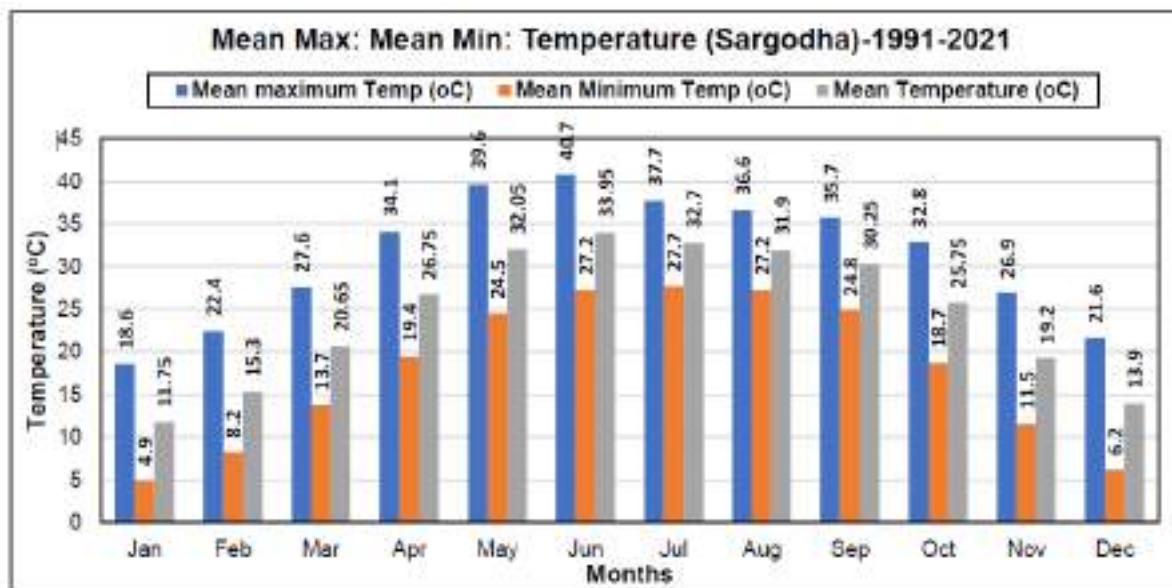


Figure 5.4: Mean Minimum and Maximum Temperature in the Study Area

5.5.5.2 Precipitation (Rainfall)

Table 5.4 shows the rainfall data with the highest precipitation occurring in July (191.6 mm) and August (167.2 mm), indicating the peak of the monsoon season. The driest months are November and December, with rainfall as low as 4.4 mm and 8.7 mm respectively. Rainfall begins to increase from March, peaks during mid-year, and tapers off after September, showing a clear seasonal trend dominated by summer monsoon rains. **Figure 5.7** shows the graphical presentation of mean monthly precipitation in the Study Area for the year 1981-2015.

Table 5.4: Mean Monthly Precipitation (1981-2015)¹¹

Month	Mean Monthly Rainfall (mm)
Jan	18.7
Feb	28.3
Mar	39.5
Apr	57.1
May	26.9
Jun	28.6
Jul	191.6
Aug	167.2
Sep	56.1
Oct	12.1
Nov	4.4
Dec	8.7

¹¹ Meteorological Data for Project Area (1981-2015)

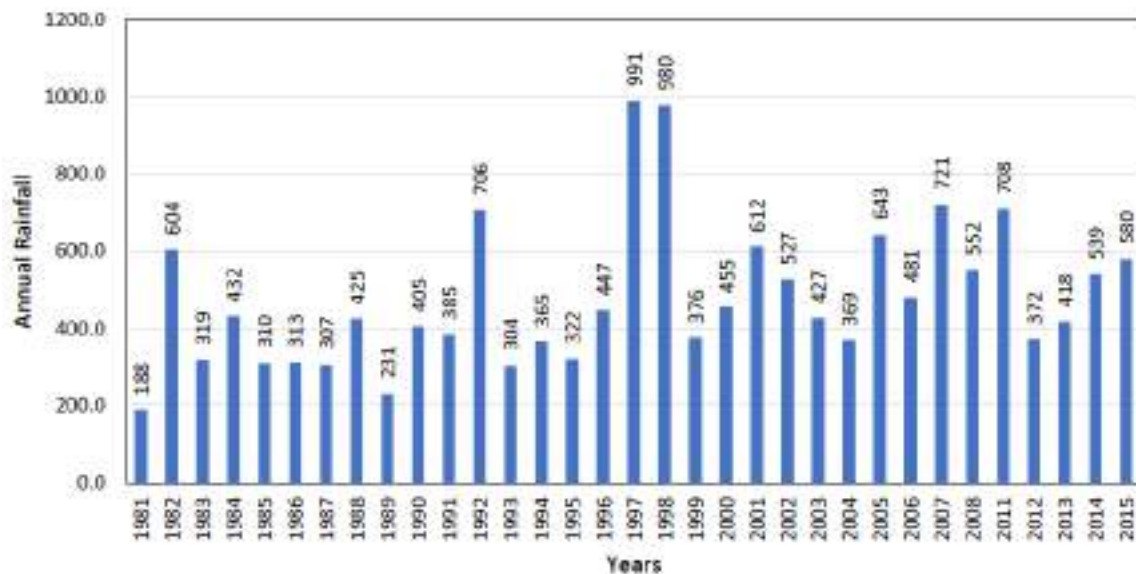


Figure 5.5: Average Precipitation in the Study Area

5.5.5.3 Relative Humidity

The chart displays the average monthly humidity percentages. Humidity is highest in February (47%) and January and March (44%), indicating more moisture in the air during winter months. It drops significantly during the dry summer months, reaching the lowest in May (20%) and June (23%). Humidity rises again during the monsoon season in July and August, peaking at 42% in August, and then gradually decreases toward the end of the year. This pattern reflects a typical subtropical climate with dry summers and more humid winters and monsoon months. **Figure 5.8** shows mean relative monthly humidity observed in the Study Area from 1991-2021.

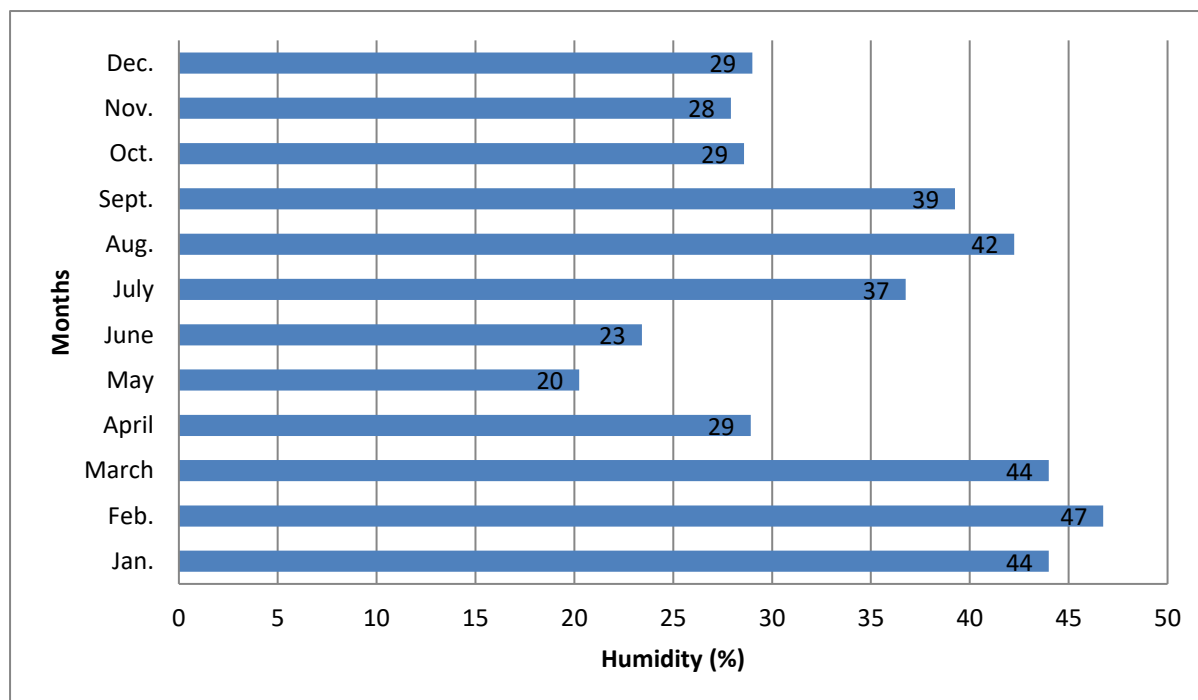


Figure 5.6: Relative Humidity in the Study Area (1991-2021)

5.5.5.4 Wind Speed and Wind Gust

The below graph shows the monthly variation of average wind speed and wind gust (in km/h). Wind speeds are generally moderate throughout the year, peaking in May at 10 km/h and dipping in October at 6 km/h. Wind gusts follow a similar trend, with the highest values of 16 km/h in March and April, and the lowest at 11 km/h in October. Both wind speed and gusts decrease after mid-year, indicating calmer wind conditions in the latter part of the year. **Figure 5.9** shows average wind speed and gust in the Study Area from 1991-2021.

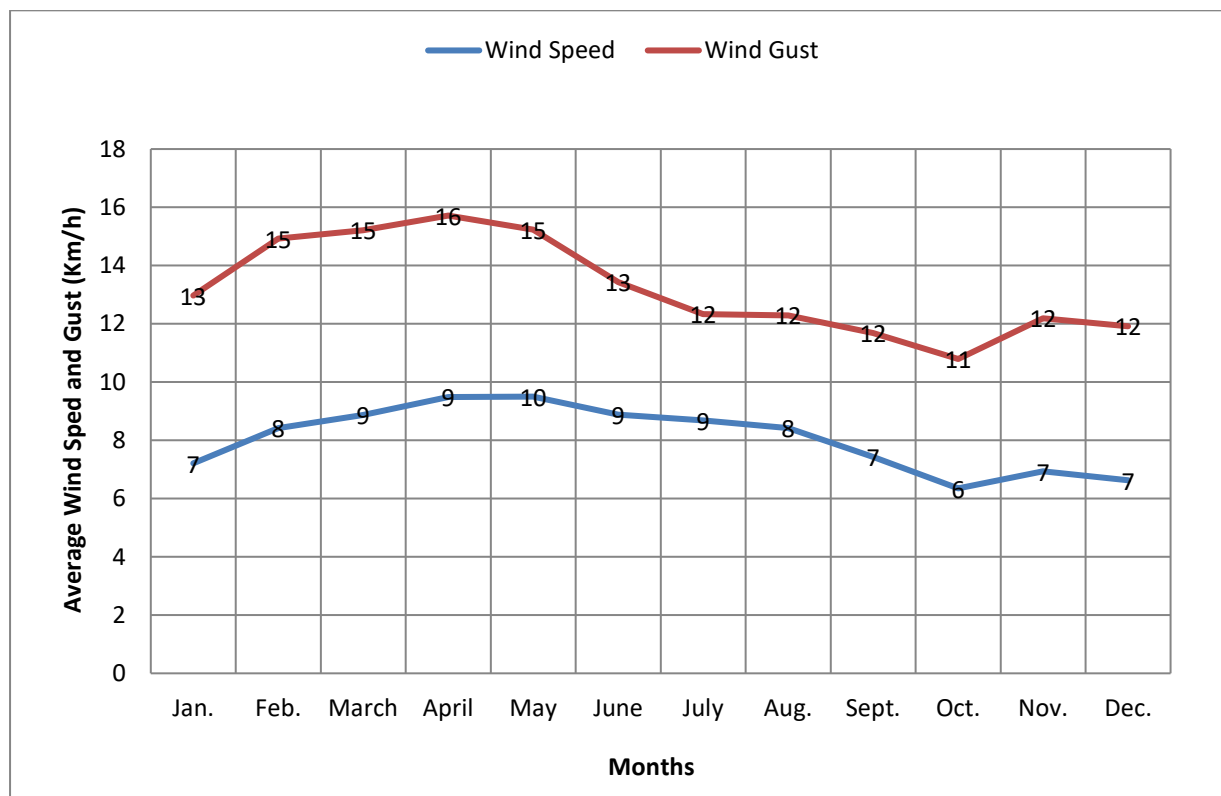


Figure 5.7: Average Wind Speed and Gust in the Study Area from 1991-2021

5.5.6 Surface Water

The primary surface water sources present in the Chiniot are the Jhelum and Chenab Rivers and Marh Chiniot Drain. However, the Chenab River, and the Jhang Branch Canal and Link Canal and distribution system from these two sources is the main source of irrigation system in the Chiniot.

5.5.6.1 Chenab River

The Chenab River originates from the upper Himalayas in India. The river flows from the north-east to the south-west direction of national borders between Pakistan and India, and then finally joins the River Indus. Chenab River flows almost 30 km away to the north of Faisalabad city¹². Discharge of the Chenab River is monitored upstream and downstream of the Khanki Head and the Qadirabad Barrage Works. The Qadirabad Barrage built about 100 km upstream

¹² https://punjab.gov.pk/faisalabad_geography

of Chiniot city, which is located along Chenab River (north of Faisalabad city). The Khanki Head Works installed about 30 km upstream of the Qadirabad Barrage.

Flooding in Chenab River

The Chenab River at proposed dam / barrage site bifurcate and pass through narrow gorges. During floods, these two narrow gorges obstruct the flow and creates a backwater effect. Historical evidence shows that when river levels are high, the floodwater inundate a vast area (about 485 sq. km) upstream of twin gorges / proposed dam site. Implementation of the Project will confine the flooding area (about 190 sq. km) and effectively pass the design flood downstream.

In addition to this, abundant flood water released by India in high Flood season and its tributaries enters the downstream areas of Chiniot District by submerging dwellings and cultivated land resulting in heavy financial as well as life damages. Further, these releases submerge downstream areas of Jhang district upto Trimmu Barrage Athara Hazari causing temporary displacement of number of households along with their cattles.

The flood protection bunds in District Chiniot are as follows:

- Kot Naja Bund: Situated on the right side of Chenab River. It falls from RD1, 0, 1000 to 1,32,000 in Tehsil Lalian;
- Chiniot Flood Bund: Total Length of this flood bund is 77500 feet situated in Tehsil Chiniot starting from ORD Kot Muhammad Yar River Chenab Bridge up to 77500-check post of district boundary, Chiniot Lahore road; and
- Mamola Guide Wall Spur: This spur constructed during 1997 under the supervision of Khairwala Drainage Division and transferred to Kirana Division for its maintenance for the protection of Mamola Village.

5.5.6.2 Jhang Branch Canal (JBC)

Jhang Branch Canal (JBC) is located about 20 km north-west of Faisalabad city. The JBC joins tail of Lower Chenab Canal (LCC) Feeder upstream of the canal, whereas LCC Feeder connects with Qadirabad-Balloki (QB) Link Canal that originates from upstream of Qadirabad Barrage. The Jhang Branch Upper Canal further divides into Jhang Branch Lower Canal and Bhowana Branch Canal downstream. As per the design of Jhang Branch Canal, the “authorized head discharge” (maximum daily discharge to be supplied from the upstream end of the canal) is 88.77 m³/sec and “authorized tail discharge” (actual discharge that flows out the canal at the downstream end) is 51.93 m³/sec¹³.

5.5.6.3 Jhelum River

Jhelum River is a river that flows in the Indian and Pakistani controlled portions of Kashmir, and Punjab in Pakistan. It is the westernmost of the five rivers of Punjab, and passes through Jhelum District. It is a tributary of the Chenab River and has a total length of about 725 kilometers.

¹³ Faisalabad Canal Division, Irrigation Department and Official Website of Irrigation Department

5.5.6.4 Drains

During the site visit of the right embankment of River Chenab, a Buchiana drain observed in the route, leading towards the selected alternate layout of the right embankment. This drain was mostly in dry condition with a little bit of flow at some locations of the drain. This drain is a part of inflows into the reservoir area. However, it is intimated by the locals during the visit, the flow of water in this drain is high during cloud outburst and monsoon seasons. On the left embankment, Ahmad Pur Nakka drain observed. Therefore, the provision of a drainage channel along the downstream toe of the right/left embankments endorsed.

The Marh drain (a man-made drain) originates from Marh village in Faisalabad and discharges into the Chenab River. The drain carries all the storm water runoff generated in the area during rainfall events. All the industrial effluent and village sewage is also discharged into this drain.

The hydrological map of the project area is shown in **Figure 5.10**.

5.5.6.5 Groundwater

The ground water is sweet in taste and recharged from river Chenab, which is flowing at western end of the city. The water supply system is based on ground water and tube wells, and depth of water table is determined at the range of about 20 m to 60 m¹⁴. The water supply network covers 60% of the town and serves 75% of the total population. The distribution system consists of two (02) overhead reservoirs of 50,000-gallon capacity each and two (02) hilltop reservoirs of 100,000-gallon capacity each. The total capacity is 300,000 gallons¹⁵.

Hand pumps are also used to obtain drinking water in the nearby villages as well. Irrigation water comes from a network of irrigation canals and/or tube wells. Locals informed the environmental team that canal water is not available throughout the year for agriculture; therefore, most of the farmers who have more than 0.8 hector of land have installed their own tube wells. Those unable to afford tube-well, take water from canals for irrigation at an additional cost of PKR. 400 to 500 per hour. Some small landholders collectively established tube-wells to meet the irrigation demands.

5.5.7 Sedimentation

Sediment measurements were not available at the dam site, but sediment was estimated from sediment measurements at d/s Qadirabad Barrage, 100 km u/s from Chiniot Dam Site. Total Sediment Load per annual at Chiniot Dam Site is estimated to be about (41.86 MTons or 46.14 MS Tons) and in volume (31,295 Ac. Ft). Sediment quantity which moves in almost continuous contact with the stream bed (i.e., within bed layer). Bedload transport is a specific mode of sediment transport, where the bed sediment particles are transported in rolling, sliding or in a series of tiny saltation within a layer of fluid, called bedload layer. Bed load for Chiniot Dam is assuming as 5% of suspended sediment load. The average annual Bed Load is estimated as

¹⁴ *Delineation of Groundwater Aquifers and Subsurface Geological Variations Using Electrical Resistivity Survey, Chenab Nagar, Chiniot, Pakistan, July 2017*

¹⁵ *Chiniot City Profile Service Delivery Baseline Data, Punjab Cities Improvement Investment Program, 2018 (Report by The Urban Unit)*

(1.99 MTons and in volume 1490 Ac. Ft).¹⁶. Based on the suspended sediment load and discharge, the total sediment load containing both suspended and bed load is about 46.14 MST with which reservoir life is estimated as 41 year. It is worth mentioning that the sediment load estimation is totally relying on water availability. In case water availability changes in future, annual sediment load will also be revised accordingly.

¹⁶ Hydrological and Sedimentation Studies of Chiniot Dam (2025)

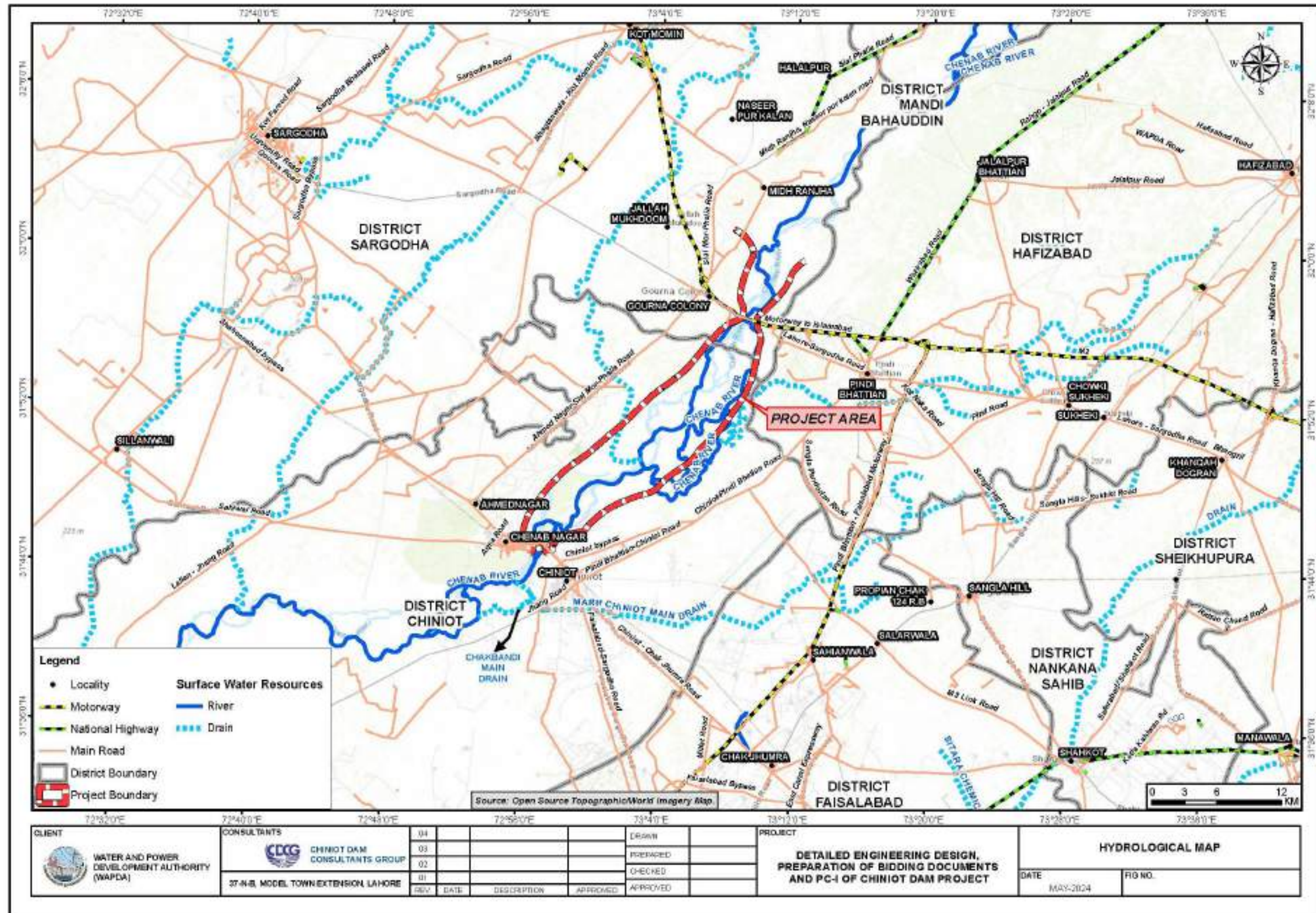


Figure 5.8: Hydrological Map of Project Area

5.5.8 Solid Waste and Wastewater Drainage

The Tehsil Municipal Administration (TMA) Chiniot is managing the existing solid waste management system of Chiniot District. The existing solid waste collection in general is divided into primary and secondary collection system. However, there is no proper solid waste disposal system in the city.

TMA Chiniot is responsible authority for the collection and management of municipal waste generated on the proposed Project site. However, from the initial field survey, it was observed that there is no facility of waste collection and management on the proposed site, as waste was seen dumped as open heaps at road sides, and in nearby water body by residents and road users.

5.5.9 Environmental Monitoring, Sampling and Testing for Proposed Project

In order to determine the existing ambient air, noise, water and wastewater quality of the area following locations were selected in the AoI. The sampling locations for the environmental monitoring of ambient air, noise and water for proposed project are shown in **Figure 5.11** respectively. These monitoring locations have been finalized considering the sensitive receptors along the corridor. The environmental parameters for ambient air, noise level, drinking water and surface water were monitored in December 15, 2023 to December 20, 2023 and these results were used for establishing the baseline profile of the Study Area.

5.5.9.1 Drinking Water Quality

Drinking water sample was collected from (05) five different locations shown below within the project area and were analyzed for physical, chemical and microbiological parameters. **Table 5.5** shows the results of drinking water analysis. The detailed results of drinking water quality have been compared with PEQS 2016 and attached in **Annex-III**.

Table 5.5: Results of Drinking Water Analysis

Sr. No.	Parameter	Limit Values (PEQS-2016)	Drinking Water from Hand Pump of Langar Makhdoom		Drinking Water from Hand Pump of Talibwala		Drinking Water from Hand Pump		Drinking Water from Hand Pump of Kot Muhammad Yar		Drinking Water from Hand Pump of Muslim Colony	
			Coordinates		Coordinates		Coordinates		Coordinates		Coordinates	
			31.746396°N	72.969912°E	31.943828°N	73.145539°E	31.849618°N	73.120799°E	31.89211°N	73.054876°E	31.750495°N	72.9436° E
1.	Total Coliforms	--	Detected		Detected		12CFU/100 ml		Detected		Detected	
2.	Faecal Coliforms Bacteria	Must not be detectable in any 100mL sample	ND		ND		ND		ND		ND	
3.	E. Coli	Must not be detectable in any 100mL sample	ND		ND		ND		ND		ND	
4.	Taste	Non Objectionable / Acceptable	Acceptable		Acceptable		Acceptable		Acceptable		Acceptable	
5.	Odor	Non Objectionable / Acceptable	Acceptable		Acceptable		Acceptable		Acceptable		Acceptable	
6.	pH*	6.5-8.5	7.2		7.3		7.3		7.5		8	
7.	Turbidity	<5 NTU	0.3 NTU		7.3 NTU		0.1 NTU		6 NTU		33.3 NTU	
8.	Color	≤15 TCU	ND		ND		ND		ND		ND	
9.	Total Dissolved Solids (TDS)*	<1000 mg/L	414 mg/L		341 mg/L		335 mg/L		536 mg/L		728 mg/L	
10.	Total Hardness as CaCO ₃ *	Total Hardness as CaCO ₃ *	280 mg/L		256 mg/L		260 mg/L		360 mg/L		290 mg/L	
11.	Residual Chlorine	0.2-0.5 mg/L	ND		ND		ND		ND		ND	
12.	Chloride (as Cl ⁻)*	<250 mg/L	15 mg/L		39 mg/L		12 mg/L		19 mg/L		178 mg/L	
13.	Fluoride (F ⁻)*	≤1.5 mg/L	0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L	
14.	Cyanide (CN ⁻)	≤0.05 mg/L	ND		ND		ND		ND		ND	
15.	Nitrate (NO ₃ ⁻)	≤50 mg/L	ND		0.3 mg/L		1 mg/L		8 mg/L		1 mg/L	
16.	Nitrite (NO ₂ ⁻)	≤3 mg/L	ND		ND		ND		ND		ND	
17.	Phenolic Compounds (as Phenols)	NGVS	ND		ND		ND		ND		ND	
18.	Aluminum (Al)	≤0.2 mg/L	ND		ND		ND		ND		ND	
19.	≤0.2 mg/L	≤0.005 mg/L	ND		ND		ND		ND		ND	
20.	Arsenic (As)	≤0.05 mg/L	ND		ND		ND		ND		ND	
21.	Barium (Ba)	0.7 mg/L	ND		ND		ND		ND		0.1 mg/L	
22.	Boron (B)	0.3 mg/L	ND		ND		ND		ND		ND	
23.	Cadmium (Cd)	0.01 mg/L	ND		ND		ND		ND		ND	
24.	Chromium (Cr)	≤0.05 mg/L	ND		ND		ND		ND		ND	
25.	Copper (Cu)	2.0 mg/L	ND		ND		ND		ND		ND	
26.	Lead (Pb)	≤0.05 mg/L	ND		ND		ND		ND		ND	
27.	Manganese (Mn)	≤0.5 mg/L	ND		ND		ND		ND		ND	
28.	Mercury (Hg)	≤0.001 mg/L	ND		ND		ND		ND		ND	
29.	Nickel (Ni)	≤0.02 mg/L	ND		ND		ND		ND		ND	
30.	Selenium (Se)	0.01 mg/L	ND		ND		ND		ND		ND	
31.	Zinc (Zn)	5.0 mg/L	0.5 mg/L		0.4 mg/L		0.4 mg/L		0.6 mg/L		0.8 mg/L	
32.	Pesticides	NGVS	ND		ND		ND		ND		ND	

mg/l: Milligram per Liter **ND:** Not Detectable **PEQS:** Punjab Environmental Quality Standards

The above **Table 5.5** illustrates that all parameters of drinking water samples are within the acceptable limits of PEQS 2016, except for turbidity, which exceeds the limit at Kot Muhammad Yar and Muslim Colony.

5.5.9.2 Surface Water Quality

The surface water quality sample was taken from Chenab River near Talibwala for monitoring. The water sample was analyzed for the parameters specified in PEQS, 2016. The detailed surface water results are given in **Table 5.6**.

Table 5.6: Results of Surface Water Analysis

Sr. No.	Parameter	Limit Values (DW-PEQS-2016)	Sampling Locations									
			Surface Water from River		Surface Water from River		Surface Water from River near Talibwala		Surface Water from River		Surface Water from River	
			Coordinates		Coordinates		Coordinates		Coordinates		Coordinates	
			31.768167°N	2.973063°E	31.936665°N	73.146742°E	31.944845°N	73.147034°E	31.895323°N	73.057683°E	31.849633°N	73.12083°E
1.	pH value (H ⁺)*	6-9	7.7		8.1		7.7		8.1		7.8	
2.	Total Suspended Solids (TSS)*	200 mg/L	28 mg/L		25 mg/L		13 mg/L		102 mg/L		20 mg/L	
3.	Total Dissolved Solids (TDS)*	3500 mg/L	240 mg/L		244 mg/L		249 mg/L		102 mg/L		234 mg/L	
4.	Chlorine (Cl)	1.0 mg/L	ND		ND		ND		ND		ND	
5.	Chloride (as Cl ⁻)*	1000 mg/L	12 mg/L		13 mg/L		13 mg/L		15 mg/L		14 mg/L	
6.	Fluoride (as F ⁻)*	10 mg/L	0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L	
7.	Cyanide (as CN ⁻)	1.0 mg/L	ND		ND		ND		ND		ND	
8.	Ammonia (NH ₃)	40 mg/L	ND		ND		ND		ND		ND	
9.	Sulfide (S ²⁻)	1.0 mg/L	ND		ND		ND		ND		ND	
10.	Sulfate (SO ₄ ²⁻)*	600 mg/L	42 mg/L		42 mg/L		49 mg/L		142 mg/L		73 mg/L	
11.	Chemical Oxygen Demand (COD)*	150 mg/L	5 mg/L		42 mg/L		< 3 mg/L		4 mg/L		5 mg/L	
12.	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	< 2 mg/L		< 2 mg/L		< 2 mg/L		< 2 mg/L		< 2 mg/L	
13.	Grease and Oil (as n-HEM)	10 mg/L	ND		ND		ND		ND		ND	
14.	Phenolic Compounds (as Phenol)	0.1 mg/L	ND		ND		ND		ND		ND	
15.	An-ionic detergents (as MBAS)	20 mg/L	0.4 mg/L		0.2 mg/L		0.4 mg/L		0.5 mg/L		0.5 mg/L	
16.	Arsenic (As)	1.0 mg/L	ND		ND		ND		ND		ND	
17.	Barium (Ba)	1.5 mg/L	0.1 mg/L		0.1 mg/L		0.1 mg/L		0.1 mg/L		0.1 mg/L	
18.	Boron (B)	6.0 mg/L	ND		ND		ND		ND		ND	
19.	Cadmium (Cd)	0.1 mg/L	ND		ND		ND		ND		ND	
20.	Chromium (Trivalent and Hexavalent)	1.0 mg/L	ND		ND		ND		0.1 mg/L		ND	
21.	Copper (Cu)	1.0 mg/L	ND		ND		ND		ND		ND	
22.	Iron (Fe)	8.0 mg/L	1.1 mg/L		1.1 mg/L		1.2 mg/L		1.2 mg/L		1.1 mg/L	
23.	Lead (Pb)	0.5 mg/L	ND		ND		ND		ND		ND	
24.	Manganese (Mn)	1.5 mg/L	ND		ND		ND		ND		ND	
25.	Mercury (Hg)	0.01 mg/L	ND		ND		ND		ND		ND	
26.	Nickel (Ni)	1.0 mg/L	ND		ND		ND		ND		ND	
27.	Pesticides	0.15 mg/L	ND		ND		ND		ND		ND	
28.	Selenium (Se)	0.5 mg/L	ND		ND		ND		ND		ND	
29.	Silver (Ag)	1.0 mg/L	ND		ND		ND		ND		ND	
30.	Zinc (Zn)	5.0 mg/L	0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L	
31.	Total Toxic Metals	2.0 mg/L	0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L		0.2 mg/L	
32.	Temperature	≤37 °C	14.0 °C		16.3 °C		15.6 °C		16.2 °C		15.0 °C	

mg/l: Milligram per Liter **ND:** Not Detectable **PEQS:** Punjab Environmental Quality Standards

The above results of the surface water samples in (05) five different locations indicate that all parameters are well within the permissible limits of Punjab Environmental Quality Standards (PEQS), 2016.

5.5.9.3 Wastewater

The wastewater quality was measured in the project area. The wastewater samples were taken from (02) two different locations as given below in **Table 5.7** and was analyzed for the parameters specified in PEQS 2016. **Table 5.7** below presents the wastewater monitoring results of the project area

Table 5.7: Results of Wastewater Analysis

Sr. No.	Parameter	Limit Values (DW-PEQS-2016)	Sampling Location			
			Wastewater from Stream		Wastewater from Stream of Hast Khiwa	
			Coordinates		Coordinates	
			31.849633°N	73.12083°E	31.849058°N	73.029098°E
1.	pH value (H ⁺)*	6-9	7.8		9.7	
2.	Total Suspended Solids (TSS)*	200 mg/L	13 mg/L		27 mg/L	
3.	Total Dissolved Solids (TDS)*	3500 mg/L	1448 mg/L		16100 mg/L	
4.	Chlorine (Cl)	1.0 mg/L	ND		ND	
5.	Chloride (as Cl ⁻)*	1000 mg/L	165 mg/L		2459 mg/L	
6.	Fluoride (as F ⁻)*	10 mg/L	0.5 mg/L		0.3 mg/L	
7.	Cyanide (as CN ⁻)	1.0 mg/L	0.1 mg/L		0.6 mg/L	
8.	Ammonia (NH ₃)	40 mg/L	87 mg/L		406 mg/L	
9.	Sulfide (S ²⁻)	1.0 mg/L	11 mg/L		86 mg/L	
10.	Sulfate (SO ₄ ²⁻)*	600 mg/L	443 mg/L		428 mg/L	
11.	Chemical Oxygen Demand (COD)*	150 mg/L	468 mg/L		7144 mg/L	
12.	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	248 mg/L		3786 mg/L	
13.	Grease and Oil (as n-HEM)	10 mg/L	18 mg/L		8 mg/L	
14.	Phenolic Compounds (as Phenol)	0.1 mg/L	ND		ND	
15.	An-ionic detergents (as MBAS)	20 mg/L	0.3 mg/L		0.2 mg/L	
16.	Arsenic (As)	1.0 mg/L	ND		ND	
17.	Barium (Ba)	1.5 mg/L	0.6 mg/L		0.7 mg/L	
18.	Boron (B)	6.0 mg/L	0.2 mg/L		0.2 mg/L	
19.	Cadmium (Cd)	0.1 mg/L	ND		ND	
20.	Chromium (Trivalent and Hexavalent)	1.0 mg/L	0.5 mg/L		0.6 mg/L	
21.	Copper (Cu)	1.0 mg/L	ND		ND	

Sr. No.	Parameter	Limit Values (DW-PEQS-2016)	Sampling Location			
			Wastewater from Stream		Wastewater from Stream of Hast Khiwa	
			Coordinates		Coordinates	
			31.849633°N	73.12083°E	31.849058°N	73.029098°E
22.	Iron (Fe)	8.0 mg/L	0.7 mg/L		0.6 mg/L	
23.	Lead (Pb)	0.5 mg/L	ND		ND	
24.	Manganese (Mn)	1.5 mg/L	ND		ND	
25.	Mercury (Hg)	0.01 mg/L	ND		ND	
26.	Nickel (Ni)	1.0 mg/L	ND		ND	
27.	Pesticides	0.15 mg/L	ND		ND	
28.	Selenium (Se)	0.5 mg/L	ND		ND	
29.	Silver (Ag)	1.0 mg/L	ND		ND	
30.	Zinc (Zn)	5.0 mg/L	1.2 mg/L		1.3 mg/L	
31.	Total Toxic Metals	2.0 mg/L	1.4 mg/L		1.6 mg/L	
32.	Temperature	≤37 °C	17.2 °C		17.8 °C	

mg/l: Milligram per Liter **ND:** Not Detectable **PEQS:** Punjab Environmental Quality Standards

The results for wastewater show that all parameters are within acceptable limits, except for Total Dissolved Solids, Chloride, Ammonia, Sulfide, Chemical Oxygen Demand, and Biological Oxygen Demand, which are high at Hast Khiwa wastewater stream.

Results of wastewater sampling from another location mentioned above in **Table 5.7** shows that all parameters are within acceptable limits, except for Ammonia, Sulfide, Chemical Oxygen Demand, Biological Oxygen Demand and Grease and Oil (as n-HEM).

5.5.9.4 Air Quality

The ambient air quality monitoring for Nitrogen Dioxide (NO₂), Nitrogen Oxide (NO), Sulfur Dioxide (SO₂), Carbon Monoxide (CO), Ozone (O₃), Particulate Matter (PM_{2.5}), Particulate Matter (PM₁₀) and Suspended Particulate Matter (SPM) was carried out in the Project Area. The sampling was conducted for 24 hours duration for NO₂, NO, SO₂, PM_{2.5}, PM₁₀ and SPM, 1 hour for O₃ and 8 hours for CO.

The average concentrations of ambient air pollutants are given in **Table 5.8** The detailed results of ambient air quality monitoring have been attached in **Annex-III**.

Table 5.8: Average Concentration of Ambient Air Pollutants

Parameter	Limits as Per PEQS, 2016	Location									
		Chenab Nagar, Chiniot		Basti Pathan, Chiniot		Talibwala, Chiniot		Basti Mallah, Chiniot		Langar Makhdoom, Chiniot	
		Coordinates		Coordinates		Coordinates		Coordinates		Coordinates	
		31.754051°N	72.93828°E	31.750185°N	72.965444°E	31.944349°N	73.146107°E	31.849522°N	72.120593°E	31.892546°N	73.056438°E
Carbon Monoxide (CO)	5 mg/m ³ for 8 Hours	0.9		1.1		0.9		0.7		0.7	
Sulfur Dioxide (SO ₂)	120 µg/m ³ for 24 Hours	10.2		9.9		10.5		10.9		11.0	
Ozone (O ₃)	130 µg/m ³ for 01 Hours	15.7		23.0		22.0		24.0		22.9	
Oxides of Nitrogen as NO	40 µg/m ³ for 24 Hours	13.0		13.2		12.3		12.3		13.0	
Oxides of Nitrogen as NO ₂	80 µg/m ³ for 24 Hours	23.0		23.6		23.5		23.3		23.4	
Particulate Matter PM _{2.5}	35 µg/m ³ for 24 Hours	190		181		208		156		283	
Particulate Matter PM ₁₀	150 µg/m ³ for 24 Hours	354		292		320		226		366	
Suspended Particulate Matter (SPM)	500 µg/m ³ for 24 Hours	642		744		662		541		1017	
Lead (Pb)	0.5 µg/m ³ for 24 Hours	0.3		0.5		0.6		0.4		0.8	

µg/m³: micrograms per cubic meter PEQS: Punjab Environmental Quality Standards

5.5.9.5 Noise Level

Noise level monitoring was carried out in the project area location in the study area. Major sources of noise observed at the site were vehicular traffic in and around the study area. The average concentrations of noise level are given in **Table 5.9**. The detailed results of noise monitoring have been attached in **Annex-III**.

Table 5.9: Average Concentration of Noise

Monitoring Point	Zone	Sampling Locations	Coordinates		PEQS 2016 Limits		Average Values Obtained	
			Latitude	Longitude	Day Time	Night Time	Day Time	Night Time
					6:00 am to 10:00 pm	10:00 pm to 6:00 am		
1	Industrial	Chenab Nagar, Chiniot	31.754051°N	72.93828°E	55 dB(A)	45 dB(A)	65	62
2	Residential	Basti Pathan, Chiniot	31.750185°N	72.965444°E	55 dB(A)	45 dB(A)	59 dB(A)	55 dB(A)
3	Residential	Talibwala, Chiniot	31.944349°N	73.146107°E	55 dB(A)	45 dB(A)	63 dB(A)	62 dB(A)
4	Residential	Basti Mallah, Chiniot	31.849522°N	72.120593°E	55 dB(A)	45 dB(A)	64 dB(A)	62 dB(A)
5	Residential	Langar Makhdoom, Chiniot	31.892546°N	73.056438°E	55 dB(A)	45 dB(A)	67 dB(A)	66 dB(A)

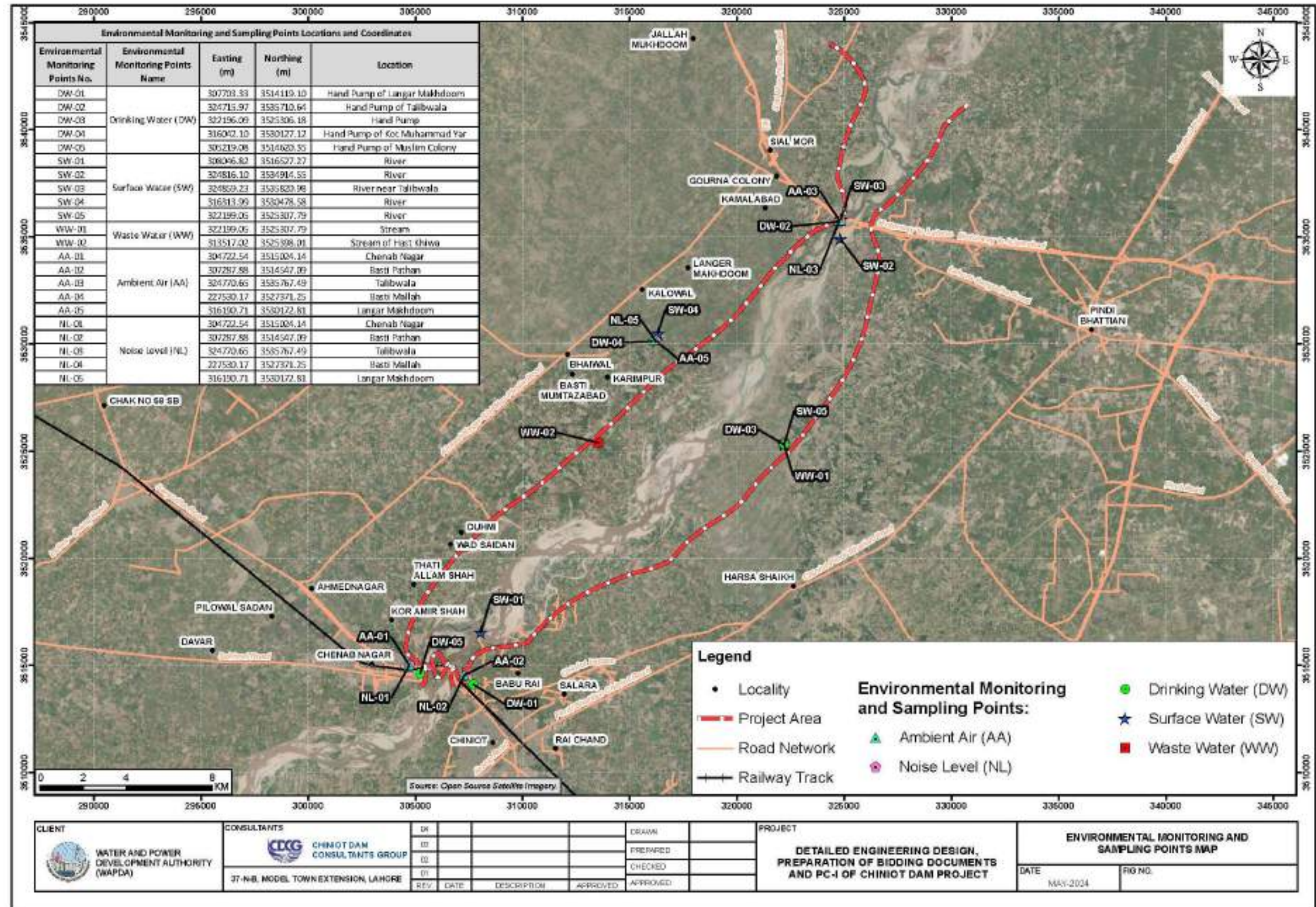


Figure 5.9: Environmental Monitoring Sampling and Testing Map

5.5.10 Land Use Pattern

The land use of the study area is a mix of Agricultural, barren land, nullahs, roads, settlements, orchards and trees. The land use map of the proposed Project area is shown in **Figure 5.12**. **Table 5.10** depicts land use cover of the study area.

Table 5.10: Land Use Cover of the Study Area in Reservoir

Sr. No.	Land Cost	%	Area In Reservoir (acres)
1	Barren / Open Area	2.5	1,785.50
2	Land Under Builtup Area	0.8	381.19
3	Cultivated Land in Flooded Area	42.2	20,165.73
4	Cultivated Land in Agriculture Land	26.4	12,613.41
5	Graveyard	0.01	3.77
6	Orchard	0.04	54.62
7	Railway	0.002	1.11
8	Road / Track / Bridge	0.17	82.01
9	Stream / Nullah	0.06	40.71
10	River Land	27.84	13,172.02
	Total	100	48,300.07

5.5.11 Major Settlements

The major settlements in and around the proposed Project area is as follows:

- Barina;
- Chenab Nagar;
- Talibwala;
- Rata Pur Rehan;
- Bhaikh;
- Behlolpur;
- Chuchak;
- Kalowal;
- Karim Pur;
- Basti Mumtazabad;
- Hammona;
- Dhumi;
- Wad Syedan;
- Thathi Alam Shah;
- Kot Ameer Shah; and
- Salara

The settlement map of the proposed project area is shown in **Figure 5.13**.

5.5.12 Sensitive Receptor

Sensitive receptors are mainly people or other organisms that may have a significantly increased sensitivity and exposure to the pollutants and social disturbance, due to the developmental projects. Thus, sensitive receptors are necessary to be identified, to evaluate the potential impacts of the proposed Project on public health and the surrounding environment.

The sensitive receptors identified within AOI of the proposed Project, based on GIS Mapping and during reconnaissance survey are:

- Government Primary School Basti Malah;
- Government Primary School Burj Umer;
- Boo Ali Qalandar Shrine;
- Monument Shuhada;
- Punj Peer Shrine;
- Girls School;
- Masjid Wadi Aziz; and
- Shareef Masjid.

These are the receptors where the occupants are more susceptible to the adverse effects i.e. exposure to toxic chemicals and other pollutants through air and noise emissions, through temporary edifice of construction camps and mobilization issues due to construction activities. The map of environmental sensitive receptors shown in **Figure 5.14**.

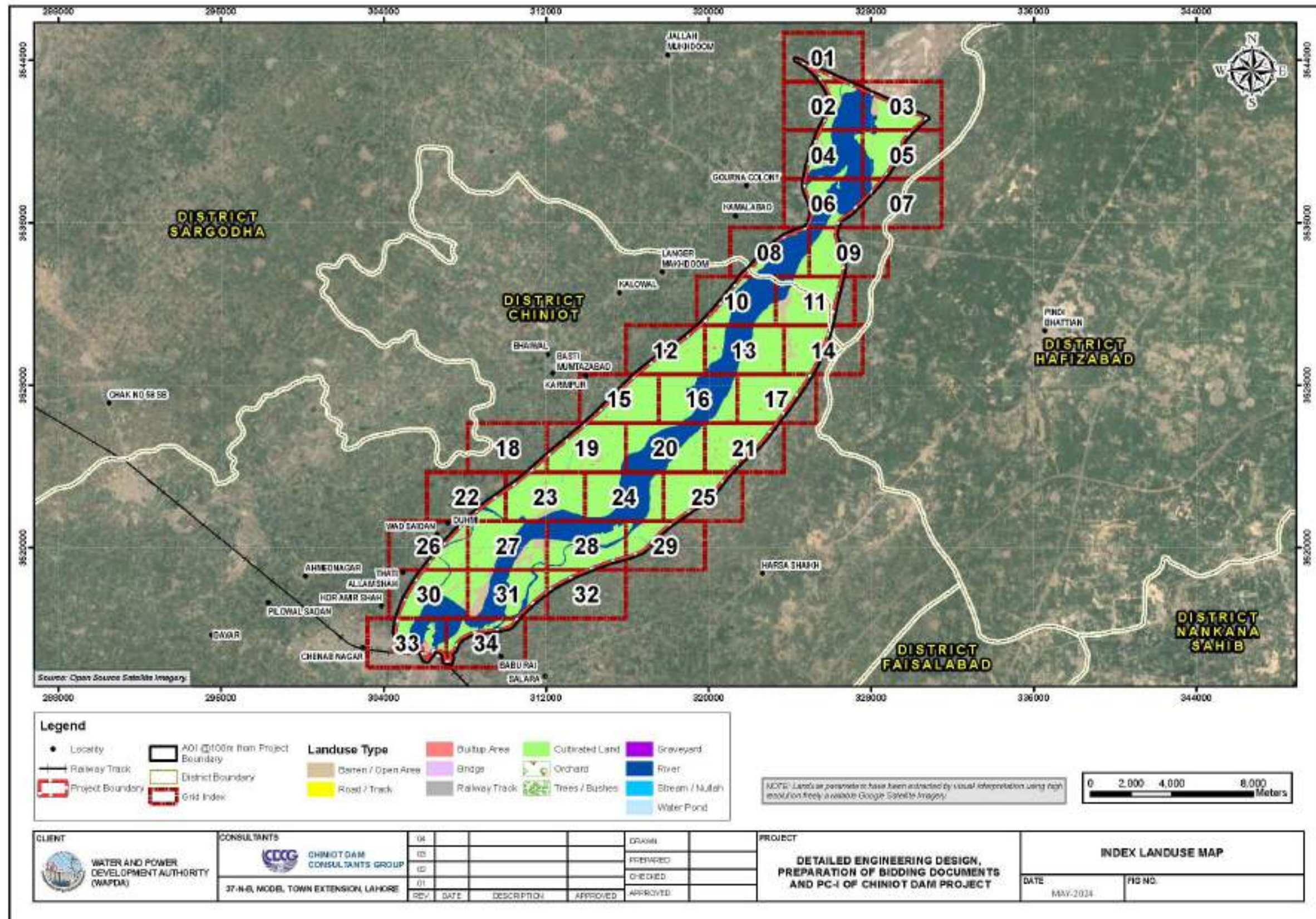


Figure 5.10: Land use Map of Project Area

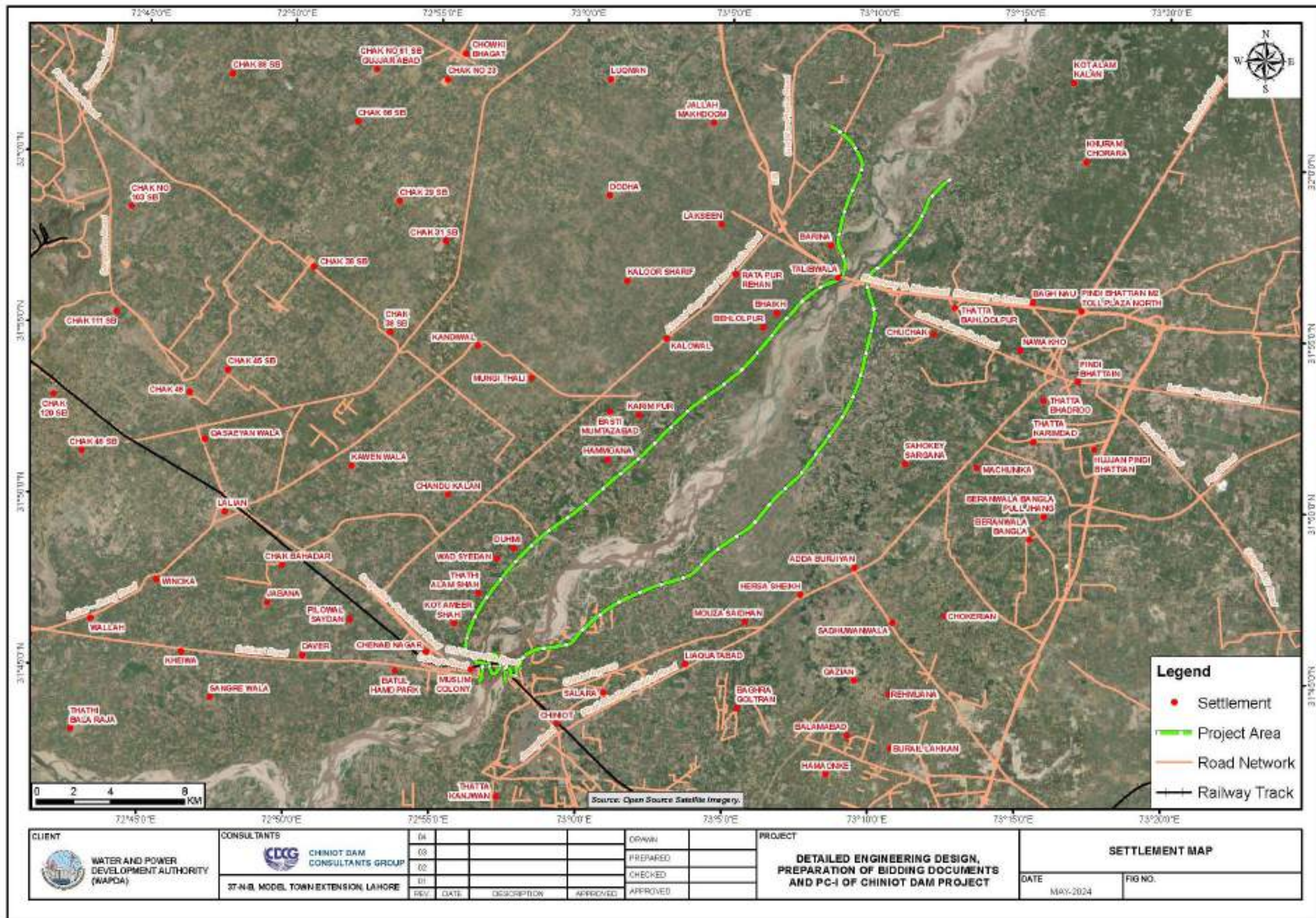


Figure 5.11: Settlement Map of Project area

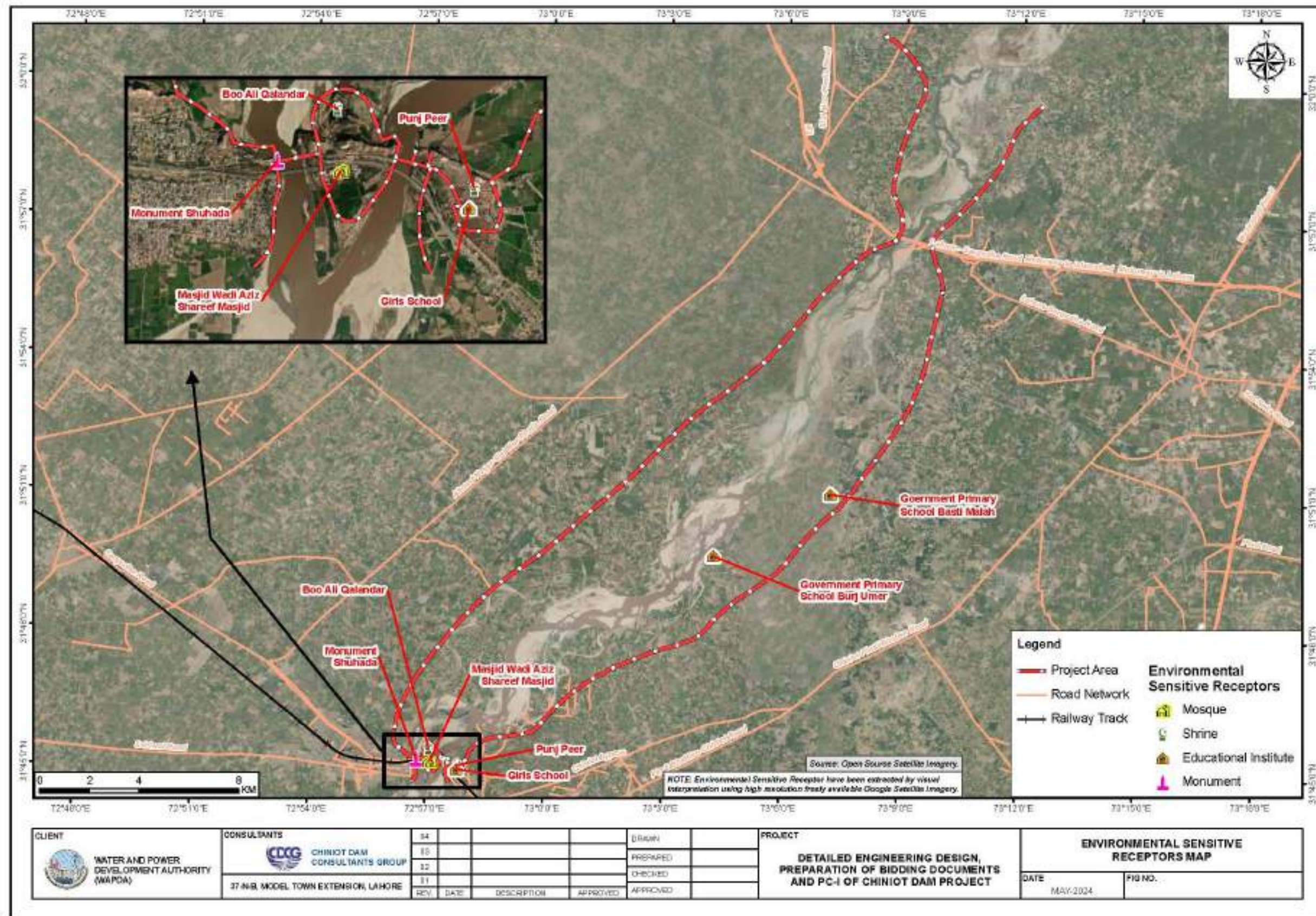


Figure 5.12: Sensitive Receptor Map of Project Area

5.6 BIOLOGICAL ENVIRONMENT

5.6.1 Ecological Context

Biodiversity conservation is crucial for sustainable development and making decisions regarding natural resources and its management. The study goal is to use ecological approaches to determine the species presence and diversity of wild flora and fauna and the ultimate impacts of project factors on local dynamics. The Study Area is situated in semi-arid region of Pakistan. The region is characterized by dry climate both in summer and winter season. The water precipitation is in the form of occasional seasonal rains, during rainy season (July– September). On the basis of climax vegetation, the whole Indus basin plain with the exception of parts of the districts of Sialkot, Gujrat and Jehlum, consists of tropical thorn forests.

It was observed during present survey that ecological equilibrium is subject to disturbances from developments and human interventions. With the passage of time water has decreased from the wetland areas and urbanization and crops cultivation is adversely affecting the healthy areas, as a result many mammalian species have left their natural habitat and/or forced to live near or around human populations. These findings are in line with the results of Southwick and Siddiqi (1994) Singh and Banyal (2012).

5.6.2 Methodology

All the available literature was thoroughly reviewed to better understand the project area and its surroundings including habitat, flora, and fauna. The route alignment was thoroughly examined based on the primary (field visits) and secondary data (Flora of Pakistan-MI-Sheikh, Birds of Pakistan-ZB-Mirza-Mammals of Pakistan-TJ Roberts, Previous EIAs of the proposed area, Manual of silviculture for Pakistan [1965] Champion, Sir H.G.; Pakistan Forest Inst., Peshawar eng; Seth, S.K. Khattak, G.M.). The stakeholder departments of Forest, Wildlife, Fisheries, EP&CCD and Agriculture were also consulted. This survey broadly covers ecosystem sensitivities (If any), vegetation, other flora, and fauna.

5.6.3 Terrestrial Flora and Fauna

5.6.3.1 Forests, Geography and Its Importance

The plant diversity is one of the most important component of terrestrial ecosystems, which plays a critical role in maintaining an area's stability. A diversified flora also helps in slopes stabilization, soil improvement, the buffering of weather extremes and the provision of habitat for wildlife. It becomes a major topic of concern in recent decades that how to conserve an environment on sustainable basis. Moreover, it is the legitimate source of fundamental needs including food, medicine, and other products, as well as a growing public awareness of its importance in ensuring human well-being. In case of species diversity, the best indication is species richness which is highlighted by various environmental factors such as temperature, annual rainfall and soil composition. Resultantly, it affects composition of plant communities and geographical distribution in an environment

The Indus plain consists of two features; the alluvial plain and sand-dunal deserts. The country is drained by five rivers; namely, Indus, Jhelum, Chenab, Ravi and Sutlej. Of these Indus arising in snow-covered northern mountain ranges flows towards south through the Punjab and Sindh plains into a wide delta before entering the Arabian sea. Other rivers join it on the way, together feeding one of the largest irrigation systems in the world. The great river system of Indus in Pakistan derives a part of their water supply from sources which lie in the highlands beyond the Himalayas and the western mountains, and part from countless valleys which lie hidden within the mountain folds. Much of the silt of the alluvial plain is from natural geological erosion of mountains in the north brought down by rivers. Thal desert lies between the rivers Indus and Jhelum, while Cholistan and Thar deserts occur on the south-east of the country.

5.6.3.2 Pressure and Threats to the Forests

Pakistan is a forest poor country where less than 6 per cent of total area is under forests. Since most of area falls in arid and semi-arid region, low precipitation naturally deters the growth of forests. Every year thousands of hectares of forest are destroyed, making way for various human activities. In areas where the forest remains, its richness and health is declining.

Population boom coupled with poverty and lack of awareness has led to illegal and unsustainable logging, overharvesting of wood for fuel and charcoal, and increased small-scale farming that continues to reduce the forest cover of Pakistan.

5.6.3.3 Grazing and Solid Waste Threats in the Area

Throughout the study period livestock grazing was observed in and around project area. The practice is a source of income for nearby communities and plays a role for general socio-economic development of the area but has adverse impacts on biodiversity. Non degradable products from hotels, shepherds, local people and tourists are adversely affecting the water quality of the river water and scenic beauty of the forest area. These non-degradable products are also a major hurdle in renewal of forest and obstruct afforestation thus directly depleting plant and indirectly, animal diversity. Nearby communities rely on the Riverine water for fishing and agriculture and forest area for hunting, livestock production and crop cultivation.

Forest fires, natural hazards along with pests and diseases further contribute to the declining rate. All this threatens the survival of countless species, fuels climate change, jeopardizes people's livelihoods and undermines the vital services that forests provide. (WWF)

The variation in plant species and community structure along with the altitude and latitude is a well-established phenomenon which affects climate. It induces apparent threats and even permanent loss triggered through various elements including climate change, strong demographical growth and various anthropological activities such as urbanization, industrialization, overgrazing and deforestation. Deforestation along obscured vegetation caused ecological disruption, change in soil structure due to physical weathering, and rock denudation, ultimately become reason in floods and disrupted the structure of entire natural flora. This threat is particularly predominant in places where significant population and density exists, consequently it derives an increase in resource demand, and eventually appears as

exploitation of available natural resources viz., overgrazing, deforestation and overexploitation.

5.6.3.4 Importance and Solution

Forest is a complex ecosystem, a biological system with distinct and myriad interrelationships with the living and non-living parts of the environment. Along with providing timber, fuelwood and fodder, it also provides ecosystem services, which are essentially goods and services that are vital to human health and livelihood. Many of these services like scenic landscape, soil conservation, carbon sequestration, watershed services, and wildlife habitat are viewed as public goods that provide free benefits to the society.

However, unsustainable utilization of these public goods and services causes loss of forests and environmental degradation. With better protection, management and planning we can continue to benefit from forests, without damaging the environment. We can even go further, by replanting and restoring forests that have been destroyed or degraded, which can help combat climate, extend and reconnect wildlife habitats, and reduce problems like flooding and erosion.

5.6.3.5 Forest Type of the Project Area

The Large area of the forest has been converted into agriculture land some of which lies in river basin and island type dry areas are prominent. Prominent aquatic vegetation of the study area includes lymbye's sedge (*Carex fedia*), hydrilla (*Hydrilla verticillata*), water lily (*Nymphaea lotus*), horned pond-weed (*Zannichellia palustris*), reed (*Phragmites karka*), Indian lotus (*Nelumbo nucifera*), curly-leaf pondweed (*Potamogeton crispus*), lesser Indian reed mace (*Typha angustata*), eel grass (*Vallisneria spiralis*) and muskgrass (*Chara* sp.). Important natural vegetation of the surrounding plains includes jand (*Prosopis cineraria*), athel (*Tamarix aphylla*), Indian plum (*Zizyphus mauritiana*), goose grass (*Eleusine compressa*), kangrass (*Saccharum spontaneum*), shisham (*Dalbergia sissoo*) and kikar or thorn-tree (*Acacia nilotica*) by Savage, 1968; Roberts, 1984; IUCN, 1987. Most common weed species of the study area include burra gokharu (*Tribulus terrestris* L.), common cockle-bur (*Xanthium strumarium*), Indian doab (*Cynodon dactylon*), devil's horsewhip (*Achyranthes aspera*), slender amaranth (*Amaranthus viridis*), white-top weed (*Parthenium hysterophorus*), prostrate spurge (*Euphorbia prostrata* L.) and marijuana (*Cannabis sativa*).

5.6.3.6 Tropical Thorn Forests

These are low, open and pronouncedly xerophytic forests in which thorny leguminous species predominate. This type occupies the whole of the Indus plain except the driest parts. The major tree species are *Prosopis cineraria* (Jhand), *Capparis decidua* (Karir, Karil), *Zizyphus mauritiana* (Ber), *Tamarix aphylla* (Farash) and *Salvadora oleoides* (Pilu, wan). Among them are a large number of shrubs of all sizes. The tree forest climax is very frequently degraded to a very open, low thorny scrub of *Euphorbia* (Thor), *Zizyphus* (Ber), etc. owing to the universally heavy incidence of grazing and other biotic factors. Edaphic variants, especially connected with degree of salinity, shallowness over rock, etc., often occur. A characteristic pioneer

vegetation is developed on inland sand dunes and the semi-deserts of the areas of least rainfall.

On the basis of climax vegetation, the whole Indus basin plain with the exception of parts of the districts of Sialkot, Gujrat and Jehlum, consists of tropical thorn forests. Prior to the development of irrigation, agriculture and urbanization, the area extended from the foothills of the Himalayas and low-hills in the south-west Punjab plains and Balochistan to the Arabian sea. The climax species of these forests are *Salvadora oleoides*, *Capparis decidua*, *Tamarix aphylla* and *Prosopis cineraria*, which grow on a wide range of soil textures, from flat deep alluvial soils to heavy clays, loams and sandy loams. The climate varies from semi-arid (250 to 750 mm rainfall) to arid (less than 250 mm rainfall). The summer temperature in this tract is as high as 50°C.

Earlier, these forests merged with riverine forests along the river banks and with scrub forests in the low hills in the north and north-western regions of Pakistan. Together these forests provided an ideal habitat to the wildlife of the area which seasonally migrated according to their needs; during cold winter from the lower hills towards the plains in search of food and shelter, from the flood plains towards the dry areas during floods and towards the rivers during the summer drought. This is no longer the situation. Riverine forests now grow in the forms of non-adjacent patches over an area of 173,000 ha. Irrigated agriculture is carried over 18.668 million ha. and irrigated tree plantations over an area of 103,000 ha in this tract.

5.6.3.7 Species Composition

These are the most common trees in the district: bohar (*Ficus Indica*), pipal (*Ficus religiosa*), bakain (*Melia azedarach*), barna or amaltas (*Cathaticarpus fistula*), phulai (*Acacia modesta*), jaamun (*Sizygium jambolnum*), bahn or ubhan (*Populus euphratica*), kikar (*Acacia Arabica*), Kabuli kikar (*Acacia cupressi formis* or cypress-formed), shisham (*Dalbergia sissoo*), ber (*Zizyphus jujube*), siris (*Acacia speciosa*), white siris (*Acacia elata*), sirin (*Albizia lebbek*), jand (*Acacia leucuphelea*), aak (*Calotropis procera*), and vann or jal (*Salvadora abeoides*) of 2 varieties kaura (sour) jal and mitha (sweet) jal are particularly popular with local people on account of their fruit called pilu. Sarkanda, Karir bush (*Capparis aphylla*) with its fruit used as pickles also thrive in various parts of the district. The Munikana is the characteristic plant of Chenab valley. Its leaves are used for thatching houses. In the cold weather, animals also feed on these leaves mixed with grain or oil-cakes called khal. Some major species other than above are listed in **Table 5.11**.

Table 5.11: Major Flora in the Study Area

Sr. No.	Common Name	Scientific Name
1.	Kikar	<i>Acacia nilotica</i>
2.	Shisham	<i>Dalbergia sissoo</i>
3.	Ber	<i>Zizyphus sp.</i>
4.	Sufeda	<i>Eucalyptus camaldulensis</i>
5.	Mulberry	<i>Morus alba</i>
6.	Neem	<i>Azadirachta indica</i>
7.	Sirris	<i>Albizia lebbek</i>
8.	Dherek	<i>Melia azedarach</i>
9.	Bakain	<i>Melia azadirachta</i>

5.6.3.8 Riverine Forests

Introduction

Riverine forests are known to be the mainstay of forestry in Sindh and some portion of Punjab as well. The importance of these forests are highlighted by their products and services such as timber, firewood, pit props for mines, forage for livestock which support biodiversity and game animals. The riverine forests, commonly known as the kacho or bela forests, grow in narrow belts along the banks of Rivers. The existence of these forests is mainly dependent on the flooding by rivers.

Major Species

The riverine forests being flooded by rivers have very rich and fertile alluvial soils, thus supporting growth of *Acacia nilotica* (Babul), *Populus euphratica* (Bahan), shisham and many various plants which grow in only flooded areas.

The Deforestation Crisis

Riverine forests in Pakistan have also been a victim of deforestation with a rate as high as 2300 ha per annum. Smooth flow of rivers during monsoon is the only lifeline for the survival and successful growth of these forests. However, Rivers in Pakistan have been put under environmental stress. Water is diverted for agricultural use and it is coupled with naturally occurring drought. For this reason, the riverine forests along many riverine belts in Punjab and Sindh have dried up.

Factors Responsible for Degradation

In the project area on last few decades, large-scale degradation of riverine forests has taken place due to a severe decrease in the flow of freshwater. Other than that, population pressure for meeting the needs of local people (domestic and industrial) and an increase in the high-lying areas due to low floods are the main factors responsible for the degradation of riverine forests.

The riverine forests and its associated biodiversity has been negatively affected due to insufficient water flow during forest's growing season which resulted in reduced function and productivity of forest ecosystem to a significant level. In addition, other socio-economic and managerial issues have worsened the condition of riverine forests ecosystem to such a degree that they are fading away from the land at an alarming rate. In recent years, as much as 50% of the original 0.238 million ha of riverine forests has deteriorated beyond the level of economic feasibility.

Restoring Their Potential

The prevailing condition of riverine forests necessitates sincere efforts by the country on government, community and individual level for the revival and maintenance of riverine forest ecosystems. This can only be achieved through concrete policy parameters, execution of well thought-out plans and scientific data analysis by the government and concerned authority. The sharp decline in river basin water table calls for reforms in water management techniques and change in engineered structures to enhance water flow towards the inundation plains. The authorities need to devise a formula to cope up with excessive cutting down of trees while simultaneously taking measures to increase the forest cover areas and control degradation of

forest foliage. If necessary actions to revive and maintain these forests are not taken immediately, the future generations of the country will face unbearable loss and an irreparable damage.

The productive potential of these areas can be restored by taking measures like developing artificial sources of irrigation like tube wells and lift pumps. Other than that these ruined areas should be developed by land levelling and by arranging the assured method of irrigation on high-lying areas. Lastly, suitable tree species should be planted which benefit the environment. In the proposed project of Dam provision of water for Chuk Sarkar reserve and other riverine forests in vicinities must be considered to restore these pristine habitats in the best interest of proposed project sustainability.

5.6.3.9 Fauna

Fauna found in the forests of the district include hyena, badger or *bijou*, jackal, fox, wild boar, and hare. The Study Area being agricultural land and is not very rich in wildlife. However, common fauna are Jackal (*Canis aureus*), Squirrel (*Funambulus*), Fox (*Vulpus vulpus*), Rats (*Mus musculus*) and Mongoose (*Herpestes auropunctatus*). Wild bear (*Sus scrofa*) is also reported in the area, but its number has been reduced to a bare minimum as a result of extensive hunting and shooting. Fauna and flora are an essential part of the environments and depend on each other in many ways and as the flora is not only plentiful, but also enriched with lush green crops. The fauna of the area comprises mammals, reptiles and birds etc. Included in game birds are tiliar, sand grouse, goose, duck, partridge, and quail. Wild goose (koonj) also migrates to the area during winter. Several venomous snakes were once commonly found, especially in the area between Chenab and Jhelum but their numbers are on the decline. The camels of the Bar are of a heavier built than those of the Thal, and hence, can carry heavier loads.

Table 5.12: Major Mammals in the Project Area

Sr. No.	Common Name	Scientific Name	IUCN Status
1.	Jackal	<i>Canis aureus</i>	LC
2.	Fox	<i>Vulpus bengalensis</i>	LC
3.	Porcupine	<i>Hystrix indica</i>	LC
4.	Squirrel	<i>Sciuridae</i>	LC
5.	Mouse	<i>Funambulus pennanti</i>	LC
6.	Mongoose	<i>Herpestes javanicus</i>	LC
7.	Wild Boar	<i>Sus scrofa</i>	LC

Reptiles and Amphibians

Amphibians and reptiles collectively called Herps, are very important animals among the vertebrates and important components of any living system. They may act as excellent biological indicators of any ecosystem. Their position in the ecological niche is so vulnerable that the survival and collapse of the whole energy cycle depends upon the presence and absence of the amphibians and reptiles. The main species found are brown cobra, indian krait, spiny and finger toad lizards.

Table 5.13: Major Reptiles in the Study Area

Sr. No.	Common Name	Scientific Name	IUCN Status
1.	Brown Cobra	<i>Naja oxiana</i>	NT
2.	Indian Krait	<i>Bungarus caeruleus</i>	LC
3.	Spiny tailed Lizard	<i>Uromastix hardwickii</i>	VU
4.	<i>Fringed toed Lizard</i>	<i>Acanthodactylus cantoris</i>	LC

Amphibians are represented in Pakistan by anurans i.e. frogs and toads and total 24 species of amphibians are reported in Pakistan. Amphibians found in the Study Area are given in **Table 5.14**.

Table 5.14: Major Amphibian Species in the Study Area

Sr. No.	Common Name	Scientific Name	IUCN Status
1.	Common Frog	<i>Rana tigrine</i>	LC
2.	<i>Common Toad</i>	<i>Bufo bufo</i>	LC

Avifauna

It is estimated that by 2050, majority of the global population will live in urban areas (Gatesire et al., 2014). Threats to biodiversity are particularly inherent to such rapid urbanization, which raises concerns over the future of the already reduced diversity in settings surrounding urban neighborhoods (Evans et al., 2011). In many developing countries, a large number of wildlife survives outside protected areas on farmlands, pasture lands, and in urban areas (Bolwig et al., 2006). Among all wildlife, birds are one of the most common wildlife in urban areas such as neighborhoods and cities (Loss et al., 2009). Bird populations have been declining as a result of landscape changes due to urban expansion (Strohbach et al., 2009).

At the local level, these major changes include high rates of land conversion into urban uses and increasing human pressure on biodiversity due to rapid population growth. Due to the important role that birds play in maintaining ecosystems and supporting biodiversity, many seek their protection to manage biological threats and efficiently protect the environment (Stevenson and Fanshawe, 2002). Birds fulfill many ecological functions in their habitats. For instance, they are bioindicators of healthy ecosystems (Mistry et al., 2008). In addition, insectivorous species and raptors regulate disease vectors, including mosquitoes and rodents. Scavenger birds, such as the pied crow (*Corvus albus*), contribute to biomass recycling and to some degree reduce levels of disposable wastes. Frugivorous birds play an important role in seed dispersal of fleshy fruit-producing plants (Stevenson and Fanshawe, 2002). Birds are also important in plant pollination as demonstrated by sunbirds, which participate in cross breeding of flowering plants, especially those with bird-pollination syndrome (Umar et al., 2018) and seed dispersal to pest and disease control i.e., vultures play a vital task of removing disease from the ecosystem through consumption of carrion (Whelan et al., 2008). The landscape of the Faisalabad Division in the Province of Punjab has been undergoing major changes due to rapid urbanization driven by a fast growing human population. Avian populations are changing rapidly as a result of extensive environmental change and these rates of change are expected to accelerate over the coming decades (Gregory et al., 2009). Human activities have some serious effects on avian diversity and bring changes which may lead to local and even worldwide extinction of avian fauna (Sumaila et al., 2020).

Anthropogenic activities are the main driver of these bird population declines, such activities are still ongoing despite international consensus that biodiversity loss must be arrested (Butchart et al., 2010). Understanding ecological factors such as vegetation that control the stability and persistence of bird populations is therefore crucial in establishing conservation as it is the key part of avian habitat (Mola et al., 2021). By increasing urban development, the avian population has been changed. In urban areas, not only the ecological factors but industrial agents and the behavior of human beings also affect the ecological processes (Altaf et al., 2012). Urbanization shows immediate effects and bring dramatic loss in biodiversity (Kondratyeva et al., 2020).

The importance of maintaining heterogeneous human-modified habitats is not only limited to favor species movements across landscapes, but also to provide suitable areas available for native species (Ewers and Didham, 2006; Fischer and Lindenmayer, 2007). Bird's diversity is very essential due to its clarity and attraction to natural environment. Pakistan is showing a huge variety of bird's fauna due to its ideal location in biological realms and its diversity (Grimmett et al., 1998)

House sparrow (*Passer domesticus*), House crow (*Corvus splendens*) and Mynah (*Acridotheres tristis*) are the most common in the area. In addition, some birds have also been observed in the area like Nightingale (*Pycnonotus cafer*), Parrot (*Psittacula krameri*), Pigeon (*Columba livia*) and Hoopoe (*Upupa epops*). Following are the avai fauna species reported and observed in the study area.

Table 5.15: Avifauna of Project Area

Sr. No.	Common Name	Scientific Name	IUCN Status
1	House sparrow	<i>Passer domesticus</i>	LC
2	Indian house crow	<i>Corvus splendens</i>	LC
3	Common myna	<i>Acridotheres tristis</i>	LC
4	Red vented bulbul	<i>Pycnonotus cafer</i>	LC
5	Cattle egret	<i>Bubulcus ibis</i>	LC
6	Green bee eater	<i>Merops orientalis</i>	LC
7	Pied bushchat	<i>Saxicola caprata</i>	LC
8	Red wattled lapwing	<i>Vanellus indicus</i>	LC
9	Black drongo	<i>Dicrurus macrocercus</i>	LC
10	The white wagtail	<i>Motacilla alba</i>	LC
11	Purple sunbird	<i>Cinnyris asiaticus</i>	LC
12	Bank myna	<i>Acridotheres ginginianus</i>	LC
13	Rofous tail lark	<i>Ammomanes phoenicurus</i>	LC
14	Baya weaver	<i>Ploceus philippinus</i>	LC
15	Laughing dove	<i>Spilopelia senegalensis</i>	LC
16	Striated babbler	<i>Turdoides earlei</i>	LC
17	White throated king fisher	<i>Halcyon smyrnensis</i>	LC
18	Jungle babbler	<i>Turdoides striata</i>	LC
19	Hudhud	<i>Upupidae</i>	LC
20	Little egret	<i>Egretta garzetta</i>	LC
21	Asian pied starling	<i>Gracupica contra</i>	LC
22	White breasted water hen	<i>Amaurornis phoenicurus</i>	LC
23	Long tail shrike	<i>Lanius schach</i>	LC
23	Black winged kite	<i>Elanus caeruleus</i>	LC
24	Indian roller	<i>Coracias benghalensis</i>	LC

Sr. No.	Common Name	Scientific Name	IUCN Status
25	Asian koel	<i>Eudynamys scolopaceus</i>	LC
26	Rufous treepie	<i>Eudynamys scolopaceus</i>	LC
27	Black rumped woodpecker	<i>Dinopium benghalense</i>	LC
28	Common gallinule	<i>Gallinula galeata</i>	LC
29	Indian pond heron	<i>Ardeola grayii</i>	LC
30	Little owl	<i>Athene noctua</i>	LC

5.6.4 Agriculture

Agriculture in the study area is predominantly irrigated agriculture. The project area depends upon a number of tube wells installed in the area for its irrigation, canal water is also available but for limited areas. As a result of ground water availability, lush green crops of wheat, sugarcane, fodder and vegetables give a substantial yield. Vegetables grown in the project area and the study area include, Tomato, sweet pepper, Brinjal, Cucumber, Okra, Bitter Gourd, Potato, Turmeric, Ginger, Cabbage, Carrot, Potato, Onion, Radish, Turnip, Peas, Spinach, etc.

5.6.5 Reserve Forests and Protected Areas

The reserved forest area approximately 37.58 acers (Needs re-verification during construction stage or at final/approved design stage) called Chak Bahadur is falling under the proposed project activities. The area was identified during a joint visit of CDCG Environment team, Punjab Forest Department and WAPDA surveyors team. It is recommended that forest area must be avoided up to maximum if not possible, then all legal and environmental requirements must be strictly considered prior to start any interventions to avoid inconvenience during project implementation. As per Punjab Forest Act, no activities are allowed in reserve forest areas without NOC/fulfilling legal formalities through concerned authorities.

The NOC/de-notification of reserve forest is required as per law of land/forest act prior to initiate any activities. The forest area is currently under river as shown in the map below so, no trees/vegetation was reported during site visits. Ecological Details and importance of riverine forests are already provided in above sections. Provision of adequate water for the restoration of subject forest is highly recommended to restore these degraded forests due non-availability of river's water. The restoration of above forests will definitely lead to sustainability of proposed project and best public and environmental interest overall. The formula for water provision may be finalised among WAPDA and Forest department Punjab.

Figure 5.15 shows the Reserved Forest in the project area

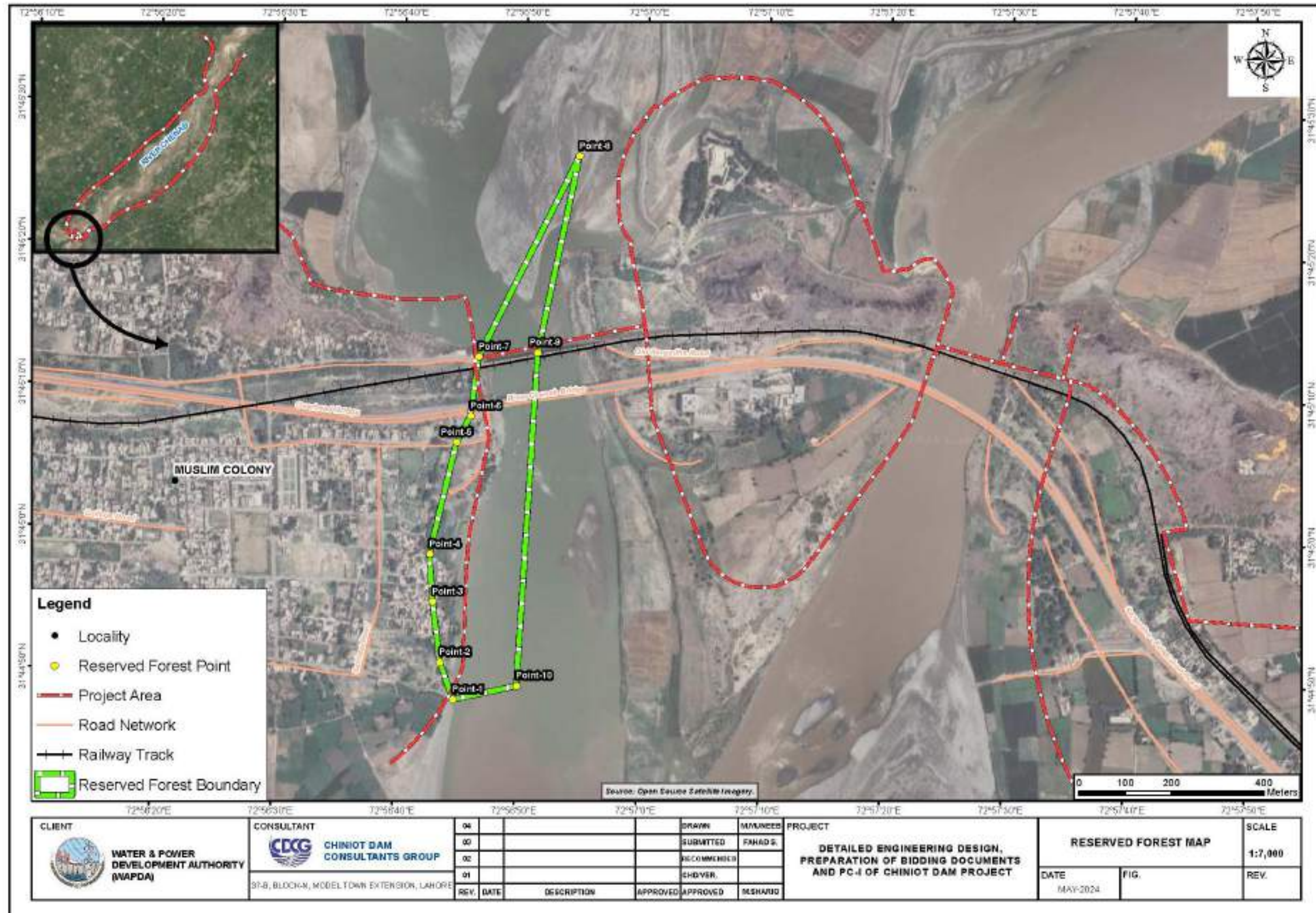


Figure 5.13: Reserved Forest in the Project Area

5.6.6 Endangered Species

There is no endangered terrestrial floral and faunal species reported in the project area.

5.6.7 Aquatic Ecology

Climate of an aquaculture and fisheries project is of prime importance for having maximum sustainable fish production from a water source. As far as climate of project area is concerned the climate of Chiniot district is hot and dry during summer and cold and dry in winter. The mean maximum and mean minimum temperatures during summer are about 40 C and 28 C respectively. The mean maximum and mean minimum temperatures during winters are about 27 C and 6 C respectively. The highest mean temperature (39 C) from 1961 to 1990 was recorded in the month of May. Likewise, the minimum mean temperature (8 C) was recorded in the month of January. The annual rainfall of the district is approx. 288.8 mm. Climatic conditions are conducive for fisheries and aquaculture point of view.

5.6.7.1 Study Area and Area of Concern for aquatic ecology

The Aquatic Ecology Study Area and AoC are essentially self-evident and comprises the aquatic margins of the Chenab River and its tributaries in the reach from Railway Bridge GT road Faisalabad to Talib wala pattan Islamabad Motorway. The benthic margins of the River are also pertinent, given that there is a seasonal flow fluctuation in the river and some bank inundation occurs from time to time.

Aquatic ecology is the study of the plants and animals that live in our rivers and streams and their interactions. These organisms are very sensitive to changes in water quality.

5.6.7.2 River Ecology

River Ecology is a system comprising of the river itself and the land alongside it. It's the zone where the non-living components of the river like water, rocks, sediment etc. are intrinsically connected to living organisms like fish, plants, microbes etc.

5.6.7.3 Types of Water Bodies in The Project Area

A river system has different types of water bodies during different seasons which have different types of ecology playing an important role in the river aquatic system. These water bodies may develop during flood / inundation of water temporarily like spawning areas, nursing areas, foraging areas & new recruitment areas. Some permanent water bodies develop in the river bed and riparian areas like pools, lakes, dhands, khoris etc. Which are linked with the main river only during high flow and play an important role in fish production & rivers eco system.

5.6.7.4 Aquatic Biodiversity

It includes all types of water plants and water animals living in the water and play their role in maintaining sustainable natural environment of a particular water area.

5.6.7.5 Aquatic Flora of the Project Area

It includes all types of plants (macro flora & micro flora) growing in the water, may be merged, submerged or floating in nature playing an important role in the aquatic ecosystem.

5.6.7.5.1 Macro Flora

These are the aquatic plants/ macrophytes that grow in or near water and are either emergent, submerging, or floating. In lakes and rivers. These provide cover for fish, substrate for aquatic invertebrates, produce oxygen, and act as food for some fish and wildlife.

5.6.7.5.2 Micro Flora

These include bacteria, cyanobacteria, protozoa, algae, and tiny animals such as rotifers. These can be important in the food chain that forms the basis of life in the water. For example, the microbes called cyanobacteria can convert the energy of the sun into the energy it needs to live.

5.6.7.6 Aquatic Fauna of the Project Area

An aquatic fauna is any animal, whether vertebrate or invertebrate, that lives in water for all or most of its lifetime. Many insects such as mosquitoes, mayflies, dragonflies and caddisflies have aquatic larvae, with winged adults, are included in aquatic fauna.

5.6.7.6.1 Zooplanktons

Zooplankton are the animal component of the planktonic community. Plankton are aquatic organisms that are unable to swim effectively against currents. Consequently, they drift or are carried along by currents in the ocean, or by currents in seas, lakes or rivers. Zooplankton are small, aquatic microorganisms in the water column that include crustaceans, rotifers, open water insect larvae and aquatic mites. The zooplankton community is composed of both primary consumers, which eat free-floating algae, and secondary consumers, which feed on other zooplankton.

5.6.7.6.2 Benthos / Micro Invertebrates

Organisms that live on or in the bottom of a body of water. Benthos refers to the bottom layer of water and all the organisms that live in it. There are different layers where organisms live in the benthos; in the sediment (hyperbenthos), on top of the sediment (epibenthos), and in the sediment (endobenthos). They are an excellent food source of bottom feeder fish and other aquatic animals.

5.6.7.6.3 Fish Fauna

Fish is the most important part of aquatic ecology being a best protein source for human beings. Fish study of the project area has not been done so far but there are some references of fish studies of Chenab. These studies are good bases for the project area. Fish sampling

was done on monthly basis from September 2015 to June 2016. The sampling was mainly done from upstream and downstream of Head Qadirabad (32° 0' 19" N, 73° 41' 36" E and elevation 210 M) (Maria et al, 2016). Previously fish fauna river Chenab was studied during 2013 – 2014 (National conference 2015). During 2013 the reported fish species were 34 only while during 2016 the number was 43. Reported fish species are given in the **Table 5.16**:

Table 5.16: List of fish species captured during study of Chenab during 2015 - 16

Sr.No.	Scientific name	Local name	IUCN Status
1	<i>Notopterus notopterus</i>	But Pari	LC
2	<i>Labeo rohita</i>	Rohu	LC
3	<i>Labeo boga</i>	Bhangan	LC
4	<i>Labeo calbasu</i>	Kalbans	LC
5	<i>Labeo dero</i>	Dero Machali	LC
6	<i>Cirrhinus mrigala</i>	Mori	LC
7	<i>Cirrhinus reba</i>	Reba Machali	LC
8	<i>Gibelion catla</i>	Thaila	LC
9	<i>Puntius sophore</i>	Sophore Popra	LC
10	<i>Puntius punjabensis</i>	Punjabi popra	LC
11	<i>Labeo rohita</i>	Rohu	LC
12	<i>Labeo boga</i>	Bhangan	LC
13	<i>Labeo calbasu</i>	Kalbans	LC
14	<i>Labeo dero</i>	Dero Machali	LC
15	<i>Cirrhinus mrigala</i>	Mori	LC
16	<i>Cirrhinus reba</i>	Reba Machali	LC
17	<i>Gibelion catla</i>	Thaila	LC
18	<i>Puntius sophore</i>	Sophore Popra	LC
19	<i>Puntius punjabensis</i>	Punjabi popra	LC
20	<i>Labeo rohita</i>	Rohu	LC
21	<i>Sperata sarwari</i>	Singhari	Not Found
22	<i>Rita rita</i>	Desi Khaga	LC
23	<i>Mystus cavasius</i>	Kanghar	LC
24	<i>Mystus bleekeri</i>	Kanghar	LC
25	<i>Wallago attu</i>	Malli	VU
26	<i>Ompok pabda</i>	Pafta Machali	NT
27	<i>Eutropichtys vacha</i>	Jhalli Machali	Not Found
28	<i>Clupisoma garua</i>	Bachwa	LC
29	<i>Bagarius bagarius</i>	Fauji Khaga	LC
30	<i>Gagata cenia</i>	Gagata cenia	LC
31	<i>Sisor raddophorus</i>	Kirla Machali	LC
32	<i>Heteropneustes fossilis</i>	Sanghi Machali	LC
33	<i>Xenentodon cancila</i>	Kaan Machali	LC
34	<i>Channa marulius</i>	Saul	LC
35	<i>Channa punctata</i>	Daula	LC
36	<i>Mastacembelus armatus</i>	Baam	LC
37	<i>Chanda nama</i>	Sheesha Machali	LC
38	<i>Parambassis ranga</i>	Ranga Sheesha	LC
39	<i>Glossogobius giuris</i>	Golu Machali	LC
40	<i>Colisa fasciata</i>	Bari Kanghi	Not Found
41	<i>Colisa lalia</i>	Choti Kanghi	Not Found
42	<i>Oreochromis niloticus*</i>	Chirra Machali	LC
43	<i>Oreochromis mossambicus*</i>	Chirra Machali	VU

5.7 SOCI-ECONOMIC BASELINE

5.7.1 Socio-economic aspects

The socio-economic aspects were studied with respect to human and economic development and quality of life values of the population in the Project Area. The human and economic development mainly focuses on population and communities, industrial development, infrastructure availability, institutions, transportation network, prevailing land use, power sources and agricultural pattern. Quality of life includes socio-cultural values, public health situation, recreational resources & development and archaeological/historical and cultural sites etc. Baseline information was gathered from literature, study reports, district census reports and through field surveys comprising interviews and meetings by the Consultants' social team, using survey tools. During the field survey interviews and meetings with the different categories of respondents were conducted and observations were also recorded after giving due consideration during survey.

The Chiniot Dam Project is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage & 5 km from the Chiniot city and about 100 meters upstream of existing Railway Bridge on Chenab River. The proposed reservoir of Chiniot Dam, which will have a length of 36 km and an area of 190 sq. km, will extend up to Motorway bridge of Pindi Bhatian. The area is formed of flood plan of Chenab River surrounded by the cultivated fields. The reservoir area of Chiniot Dam falls under the Jurisdiction of Chiniot, and Sargodha Districts of Punjab Province.

5.7.2 District Chiniot City at a Glance

5.7.2.1 Administrative and Political Settings

Chiniot comprises of three tehsils i.e. Chiniot, Lalian and Bhawana. Union Councils (UC) are the lowest tier of the local government and the fifth tier of government in Pakistan; in rural areas, UCs are often known as "village councils". The territory represented by a village council usually comprises a large village and surrounding areas, often including nearby small villages. The term "union council" may be used for localities that are part of cities. A village council is an elected local government body headed by a mayor and a deputy mayor.

Tehsil Council is the next tier of local government. About 4 to 5 UCs fall in the Tehsil Council (TC). Tehsil is a sub-unit of the district, which is the highest tier of the local government system, dealing with administrative matters at the district level. However, Deputy Commissioner (DC) is the highest ranked administrator of the district. For the collection of revenue and administration, the district is subdivided into Tehsils. Local governments also administer the area through Union Councils and Tehsils.

5.7.2.2 Demographic Characteristics of Chiniot District

The total area of the district is 2,643 square kilometers which give a population density of 517.84 persons per square kilometer. At the time of the 2017 census the district had a population of 1,368,659, of which 699,606 were males and 668,914 females. Rural population

is 946,429 while the urban population is 422,230. However, as per census of 2023, the population of the district has been increased to 1,563,024 with an annual population change of 2.3%. The literacy rate was 50.05%. Muslims were the predominant religious community with 95.47% of the population while Ahmadiya, officially counted as non-Muslims by the Pakistani state, were 4.37% of the population.

At the time of the 2017 census, 94.62% of the population spoke Punjabi, 3.85% Urdu and other 1.16% as their first language. **Table 5.17** gives Households, Population Increase, Sex Ratio, and Growth Rates of Chiniot District, for the year 2017.

Table 5.17: Demographic Characteristics of District Chiniot

Households	Population-2017				Population 2023	Sex Ratio 2017	2017-2023 Average Annual Growth Rate
	Male	Female	Transgender	All Sexes			
220,396	699,606	668,914	139	1,368,659	1,563,024	104.59	2.3

Source: Pakistan Bureau of Statistics (Census 2017)

5.7.2.3 Rural and Urban Distributions

According to Census of 2017, the district Chiniot falls in the urban and rural area with 220,396 number of households.

5.7.2.4 Ethnic Structure

Chiniot region was an agricultural region with forests during the Indus Valley Civilization. Chiniot is a district of multi-tribes nation. Tribes of Chiniot include Rajput Dhudhi Sahmal Sipra, Janjua, Dogar, Glotar, Syed, Sial, Mufti, Arain, Laali, Marath, Aheer, Awan, Makhdoom, Baloch, Bhatti, Bhutta, Butt, Bhowana, Chohan, Dhera, Durrani, Gujjar, Hanjra, Indra, Sipra, Walara, Haral, Tamimi, Hashmi, Jappa, Jatt, Koli, Kamoky, Kharal, Khokhar, Marral, Naul, Nakokara, Traggar Tragar, Nissowana, Puri, Pathan, Slara, Wassi, Dhawan, Wadhawan, Sehgal, and Kalyar

5.7.2.5 Economic Conditions

The important products of Chiniot includes cotton, wheat, sugar, rice, milk, pottery and wooden furniture etc. The city's agricultural economy is largely derived from "canal colonies" established during British rule when a vast network of canals were laid to irrigate Punjab. Chiniot is famous for its wooden furniture and developed as a Centre of woodworking given its close proximity to the Chenab River as timber from Kashmir would be floated down the river towards Chiniot District. Chiniot's artisans are renowned for their skill and were employed in the construction of both the Taj Mahal and Wazir Khan Mosque. The city's metal workers along with those of Lahore were considered the best in Punjab during the British period and Chinioti designs were considered superior to those of Hoshiarpur or Jalandhar. The major economic activities of the district Chiniot are depicted in the **Table 5.18**

Table 5.18: Major Economic Activities in the District:¹⁷

Major Economic Activities	Activities	Percentage
	Agriculture with its allied Livestock Breeding, Fishing	44.4
	Construction	33.5
	Community, Social & Personal Services	8.3
	Wholesale/ Retail, Hotel/ Restaurant	5.7
	Manufacturing	3.5
	Transport, Storage & Communication	2.0
	Others	2.6

5.7.2.6 Educational Facilities

There are numerous renowned educational institutions in the district Chiniot as following:

- Allama Iqbal Model School, Chiniot;
- Chenab College, Chiniot;
- Govt Al Islah High School, Chiniot;
- Govt High School Inayatpur, Chiniot;
- Govt High School Salara, Chiniot;
- Govt Islamia College, Chiniot;
- Govt Islamia High School, Chiniot;
- Govt Mudrassa-tul-Banat High School, Chiniot;
- Khatam e Nabuwat Institute of Modern Sciences (KIMS) College, Chiniot;
- Masoomen Foundation High School, Chiniot;
- Masoomen School and College, Chiniot;
- National University of Computer and Emerging Sciences (NUCES);
- Punjab College, Chiniot;
- Superior College, Chiniot;
- Tips College, Chiniot; and,
- Unified P/G Science College, Chiniot.

5.7.2.7 Health Facilities

Ample medical and health facilities are available in the Chiniot Metropolitan Corporation area and its suburbs. DHQ hospital is the latest addition to the medical care facilities in Chiniot. There are also other hospitals of voluntary organizations which provide health coverage at the Tehsils levels. Besides, a number of private hospitals and medical practitioners, Hakims, and homeopathic doctors are also practicing in the city. The health institutions that are working near the proposed project area are;

- Al Noor Laser Clinic. Al Noor Laser Clinic, Madrasatul Banat, road, Muhallah garrah, Chiniot;
- Islamia Hospital;
- Sardaran Siddique Hospital Chiniot;
- Rehman Medical Children Complex Hospital;
- PK Surgimed Hospital;

¹⁷ <https://pakistanalmanac.com/punjab-chiniot>

- Nabeel Ultrasound Clinic;
- Ali And Fatima Clinic; and
- M.D Executive Clinic.

5.7.2.8 Transportation

Four main intercity roads facilitate connectivity in Chiniot. Motorway M-2 is 33 km away from Chiniot, interlinked via Pindi Bhattian Road and M-4 is 20 km away from Chiniot, interlinked via Faisalabad Road. It is located at distance of 86 Km from Jhang and is connected by 60 ft wide metaled road. The town of Chiniot is also connected with major cities namely Lahore, Faisalabad and Sargodha by metaled road. Lahore is 140 Km, Faisalabad is 30 Km while Sargodha is 58 Km away.

The region is also connected through railroad network (Lalian and Chiniot). The Chiniot Railway Station was built during British rule before the independence of Pakistan. It was connected by the North-Western Railway to other cities in the Indian empire. Chiniot is on main line of Pakistan Railways and linked to main cities of the country.

5.7.2.9 Cultural and Sensitive Places

The project area is a rich in culture, it has many historical places that represent its culture like Omer Hayat Palace, Shahi Masjid, The Big Temple, Shrine of Ismail Shah Bukhari, Chiniot Bridge and Tomb of Shah Burhan are the famous cultural and historical places in the Chiniot.

5.7.3 District Sargodha at a Glance

5.7.3.1 Administrative and Political Settings

Sargodha Division is an *administrative division* of Punjab province, Pakistan. Sargodha city is the capital of the division. Sargodha comprises seven tehsils i.e. Sargodha, Kot Momin, Bhalwal, Shahpur, Silanwali, Bhera and Sahiwal. There are 186 union councils in district Sargodha.

5.7.3.2 Demographic Characteristics of Sargodha District

At the time of the 2017 census, Sargodha district had 592,044 households and a population of 3,696,212. Sargodha had a sex ratio of 979 females per 1000 males and a literacy rate of 65.54% - 74.12% for males and 56.88% for females. 1,144,535 (30.97%) lived in urban areas and 928,166 (25.11%) were under 10 years of age.

However, in 2023, the district have 684,799 households and a population of 4,334,448. The population growth rate was observed around 2.08 from 2017 to 2023. Sargodha District is among the world's best Citrus-producing region. Sargodha District is well known for its kinnow, a citrus variety. **Table 5.19** gives Households, Population Increase, Sex Ratio, and Growth Rates of Sargodha District, for the year 2017.

Table 5.19: Demographic Characteristics of District Sargodha

Households	Population-2017				Population 2023	Sex Ratio 2017	2.17-2023 Average Annual Growth Rate
	Male	Female	Transgender	All Sexes			
592,044	1,867,724	1,828,074	414	3,696,212	4,334,448	102.17	2.08

Source: Pakistan Bureau of Statistics (Census 2017)

5.7.3.3 Rural and Urban Distributions

According to census of 2017, the district Sargodha falls in the urban and rural area with per sq. Km. 631.18 number of households. As per the 2017 census Muslims were the predominant religious community with 98.08% of the population while Christians were 1.76% of the population. However, 94.07% of the population spoke Punjabi, 4.31% Urdu and 1.23% Pashto as their mother language.

5.7.3.4 Ethnic Structure

The major ethnic groups are the Jat, Rajput, Arain, Gujar, and Awan. The caste system is gradually becoming blurred as a result of increasing social mobility, intercaste marriages, and changing public opinion.

5.7.3.5 Economic Conditions

The majority of Sargodha's economy is based on agriculture. Wheat, rice, and sugarcane being its main crops. Sargodha is largest oranges, lemon and Kinnow-producing district of the world. Sargodha has likewise one material plant named as "Sultan Textile Mill". The major economic activities of the district Sargodha are depicted in the **Table 5.20**

Table 5.20: Major Economic Activities in the District:¹⁸

Major Economic Activities	Activities	Percentage
	Construction Industry	35.8
	Agriculture with its Allied Livestock Breeding & Fishing	31.0
	Community, Social & Personal Service	9.3
	Wholesale/ Retail, Hotel/ Restaurant	7.8
	Activities Not Adequately Defined	6.7
	Others	2.1

5.7.3.6 Educational Facilities

There are numerous renowned government and private educational institutions in the district Sargodha as following:

¹⁸ <https://pakistanalmanac.com/punjab-Sargodha>

- Beacon house School System;
- The City School;
- Lahore Grammar School;
- Dar-e-Arqam Schools;
- PAF Public School;
- Presentation Convent High School;
- Army Public School;
- Army Public College;
- Cornelius Law College;
- Sargodha Medical College;
- University of Sargodha;
- University College of Agriculture; and
- University of Lahore, Sargodha Campus.

5.7.3.7 Health Facilities

There are 155 public health facilities provided by the government, comprising on a DHQ hospital, T.B hospital, 7 THQ hospitals, 8 dispensaries, 14 RHCs, 117 BHUs and 7 MCH centers. Besides the government owned health facilities there are numerous private hospitals in the district Sargodha which are providing very good health facilities. The health institutions that are working in the District Sargodha are as following:

- Niazi Medical Complex;
- Mubarik Medical Complex;
- Bhatti Medical Complex;
- Faiz Memorial Hospital; and
- Ibrahim Hospital

5.7.3.8 Transportation

Sargodha lies about 45 km (28 mi) from the M-2 Motorway, which connects Lahore and Islamabad. The N-60 National Highway runs from Sargodha to Lahore through Pindi Bhattian and Sheikhpura. It is also connected to Faisalabad by a highway. Sargodha is also connected by the rest of the country through the rail. Sargodha Junction railway station is located on Shorkot-Lala Musa branch railway line. Hazara Express, Millat Express, Sandal Express and Sargodha Express provide daily transport to Rawalpindi, Lahore, Faisalabad, Multan, Karachi and other major cities.

5.7.3.9 Cultural and Sensitive Places

The project area is a rich in culture, it has many historical places that represent its culture and people visits these sites for recreational activities as well as religious attachments like Kirana Hills, Remount Depot Mona, Sher Shah Suri Mosque Bhera, and Sial Sharif Shrine.

5.7.4 Socio-Economic Characteristics of Project Area

5.7.4.1 Objectives of the Socio-Economic Baseline Survey

Socio-economic baseline survey presents an overview of the socio-economic conditions of project area in general, focusing on the key socio-economic development indicators such as demography, education and health facilities, income, expenditure trends and employment, to provide the context of the area. The main objective of the study was to analyze socioeconomic and cultural characteristics of the project beneficiaries in order to understand their interrelationships, dynamics, and qualities. The study also provides information to the project design in order to make the project interventions more effective, socially acceptable, culturally appropriate, gender sensitive and economically viable. Baseline surveys were carried out during October 25, 2023 to October 30, 2023.

One of the key objectives of the study was to plan more sustainable and equitable development through adequate social risk management by identifying and assessing negative and positive impacts caused by a project, to design and implement measures to prevent, reduce or compensate adverse impacts and enhance positive ones.

5.7.4.2 Information / Data Collection Methodology

The methodology adopted for the survey included a detailed desk review of project documents and relevant secondary information including official records and statistics, as well as academic and other subject matter reports. The secondary source information/data/reports include Detail Design drawings and latest Population Census Reports (2017) of district. Similarly, primary source includes community consultations, individual interviews and walk through the project area, which helped the survey team to physically observe the socio-economic conditions in the project area and data collection. Meetings were held with all stakeholders including the local community.

The sample size for the survey depends on the size of the affected persons in a project. A sample survey of 297 households was randomly undertaken for the socio-economic survey from the COI of the proposed project. Participants of Community consultations, Government departments are not the part of representative sample. Sample was taken from the different locations of the proposed project area which included local residents, shop keepers, farmers, drivers, government and private employees etc. The objective of using the random sampling technique was to get the data of the respondents of different categories along the proposed project area and covering the entire project area.

The key variables covered in the surveys and qualitative interviews include (i) identification and enumeration of the affected population; (ii) demography, (iii) social organization (iv) education and health facilities, (iv) occupational structures, (v) income and expenses level, (vi) access to social amenities, (vi) personal property, (vii) project's impacts on the local communities (viii) identification of gender impact including priorities and needs of the women. Questionnaire used for socio-economic baseline survey is attached as **Annexure-II**.

5.7.5 Demographic Structure of Households

This section provides information and data on the demographic structure of studied households.

5.7.5.1 Gender Composition of Household Population

According to the survey of sampled households, the male population was high as compared to the female population in the project area. On average the male population was 52% compared to the 48% female population among the sampled families. As per the survey, the household size was 7.6 persons per household. The detail of the population of sampled households is given in **Table 5.21** and depicted in **Figure 5.16** as well.

Table 5.21: Gender Composition of Household Population

Total Household	Population and Family Size				Total Population	Average Household Size
	Male	%	Female	%		
297	1177	52	1084	48	2261	7.6

Source: Socio-economic Survey

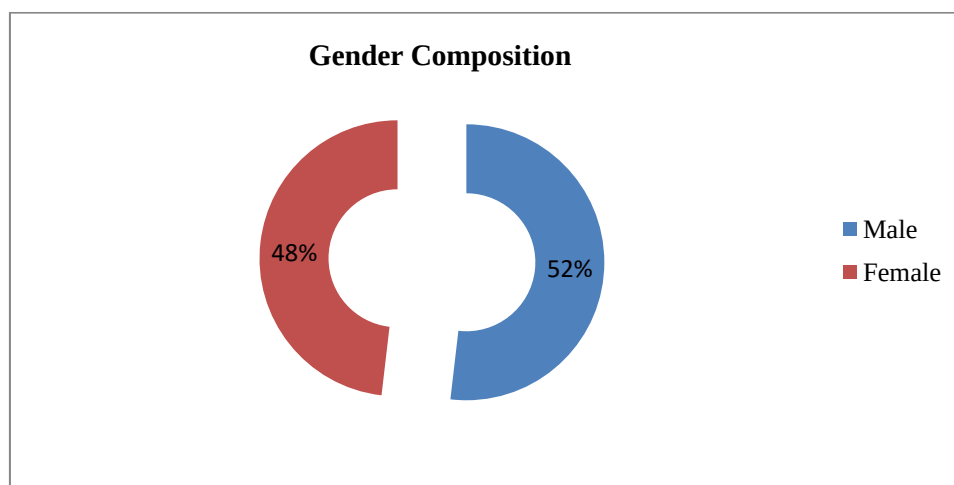


Figure 5.14: Gender Composition of Household Population

5.7.5.2 Age Group of the Household Members

Age is another important demographic characteristic that has a bearing on employment and mobility. A study of the distribution of members of households by age will throw some light on the type of strategies that may be helpful in raising their income and employment.

About 37% of the population is within the age range up to 17 years and 20% of the household were between 18 to 25 years of age, while 16% were between 26 to 35 years of age & 10 % of the HH members were between 36 to 45 years of age group and 17% were above 45 years of age group respectively. The data regarding the distribution of HH members of the respondents by age categories are presented in **Table 5.22** and **Figure 5.17**

Table 5.22: Age Group of Household Members

Sr. No.	Frequency Distribution	Number	Percentage
1	Up To 10 year	553	24
2	11-17	277	13
3	18-25	463	20
4	26-35	354	16
5	36-45	235	10
6	Above 45	379	17
Total		2261	100

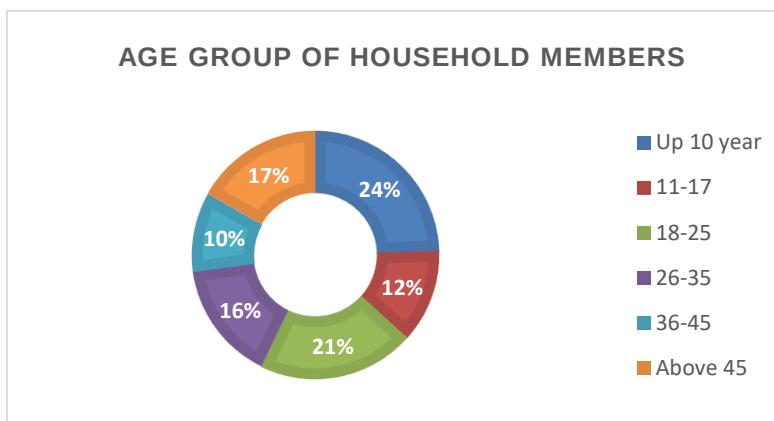


Figure 5.15: Age Group of Household

5.7.5.3 Educational Status of Household Members

Based on the sample survey (**Table 5.23**), 21% of the respondent population was illiterate and 55% were literate. In terms of education distribution, out of the literate population. 19% of the households got their education till primary level (five years of schooling), 9% of the households have the education up to middle level (8 years of schooling), and 6% & 2% of the households were matriculated and intermediate respectively. However, 1%, 1%, 0.09%, 0.04%, 24% and 15% of the households were graduates, post graduate, law, children up to 10 year, technical diploma and can read Quran holders respectively. The educational status of the respondents is depicted in **Figure 5.18**.

Table 5.23: Educational Status of the Household

Sr. No.	Educational Status	Number	Percentage
1	Up To 10 year	553	24
2	Illiterate	483	21
3	Primary	437	19
4	Middle	198	9
5	Metric	145	6
6	Intermediate	52	2
7	Graduation	27	1
8	Post Graduate	13	1
9	Law	2	0
10	Technical Diploma	1	0

11	Can Read Quran	350	15
Total		2261	100

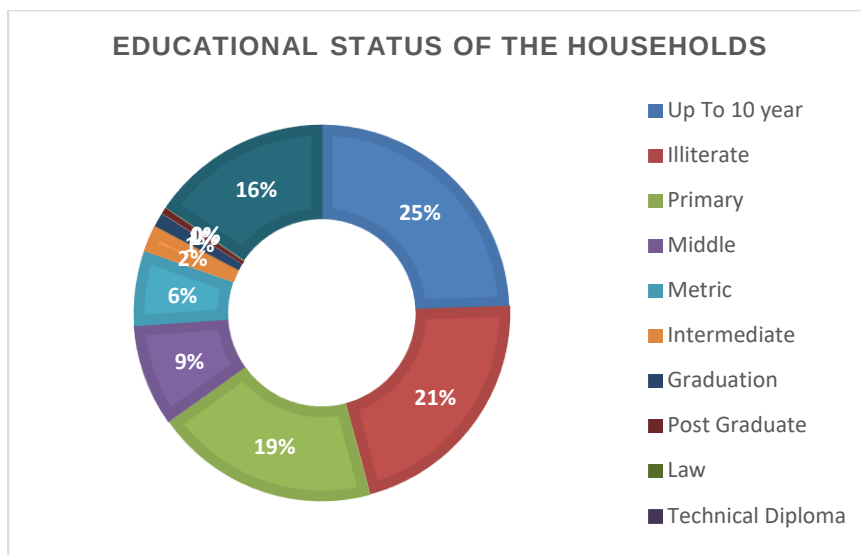


Figure 5.16: Educational Status of the Households

5.7.5.4 Mother Tongue of The Households

The term "mother tongue" refers to a **person's native language** that is, a language learned from birth. Also called a first language, dominant language, home language, and native tongue. The dominant language in the project area was Punjabi. Based on the sample survey, 100% of the respondents were Punjabi speaking, as shown in **Table 5.24** and depicted in **Figure 5.19** as well.

Table 5.24: Mother tongue of Households

Sr. No.	Mother Tongue	Number	Percentage
1	Punjabi	297	100
Total		297	100

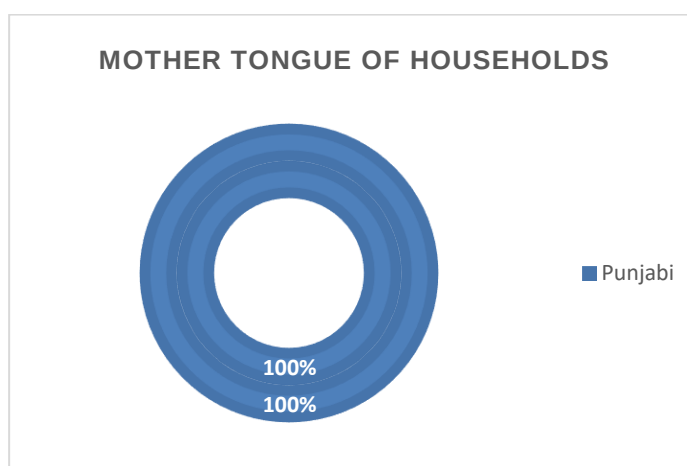


Figure 5.17: Mother Tongue of the Households

5.7.5.5 Ethnic Groups of Respondents

The survey findings revealed that Glotar (Jutt) and Haral (Jutt) were the major ethnic groups residing in the project area with a ratio of 35% and 25% respectively. While rest of the caste groups are depicted in **Table 5.25** and **Figure 5.20**.

Table 5.25: Ethnic Structure of Respondents

Sr. No.	Name of Caste	Number	Percentage
1	Glutar	104	35
2	Haral	73	25
3	Lali	30	10
4	Deaura	4	1
5	Baar	3	1
6	Sargana	10	3
7	Sipra	4	1
8	Malah	20	7
9	Pathan	23	8
10	Machi	5	2
11	Rehan	10	3
12	Syed	3	1
13	Noon	3	1
14	Rajpoot	5	2
Total		297	100

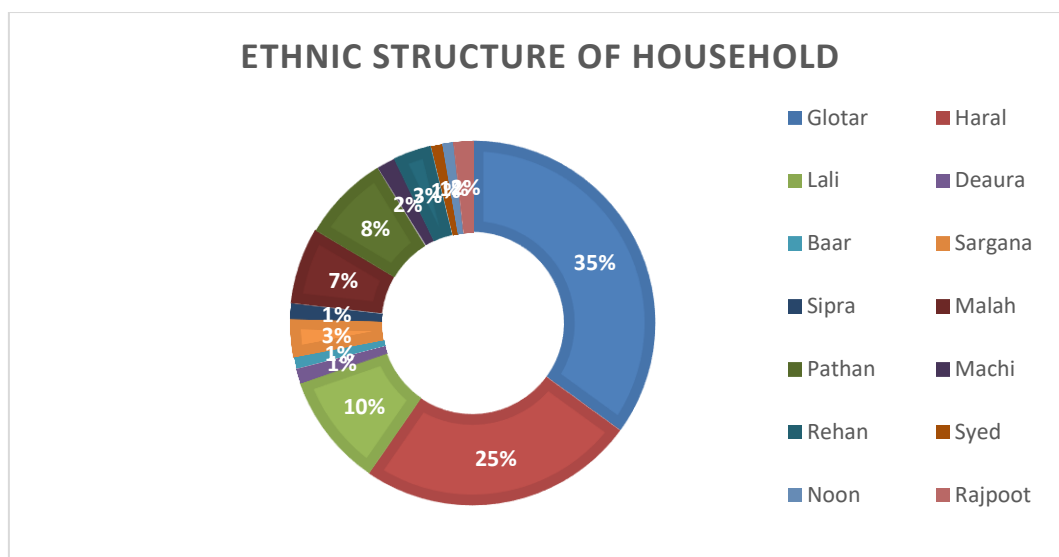


Figure 5.18: Ethnic Structure of the Respondents

5.7.5.6 Professional Status of Household Members

The occupations have been categorized based on the primary source of income. The sample survey revealed that the majority of the households. The survey revealed that out of total 297 HHs, about 27% depends on agriculture and livestock rearing. The survey has further revealed that the earning segment of the sample population works out about 6% of the households were associated with different private and government jobs and about 77% of the population was non-earning. Among non-earning segment, 02% are unemployed, 7% are students and

33% are household women with no outside economic activity. The remaining 24 % were children. The occupational status of the HH members is depicted in **Table 5.26** and **Figure 5.21**.

Table 5.26: Professional Status of the Household Members

Sr. No.	Professional Status	Number	Percentage
1	Up to 10 year	553	24
2	Agriculturist +Livestock	222	10
3	Agriculturist	337	15
4	Livestock	56	2
5	Shopkeeper	25	1
6	Labor	36	2
7	Student	166	7
8	Govt Job	14	1
9	Private job	48	2
10	House-Maid	275	12
11	Housewives	473	21
12	Gone Abroad	2	0
13	Retired	12	1
14	Un-employed	42	2
Total		2261	100

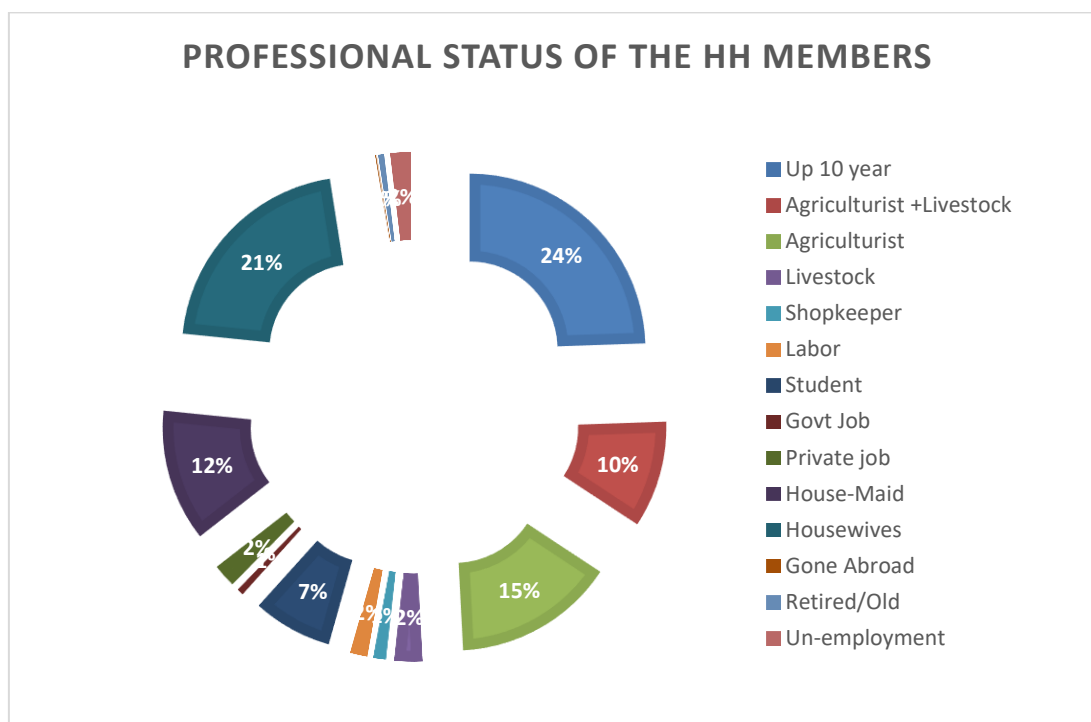


Figure 5.19: Professional Status of the Household Members

5.7.5.7 Average Monthly Household Income

During the socioeconomic survey of the households, it was observed that the household income of 2% of respondents was up to 32,000 per month, whereas 11% were earning between the ranges of 32,001 to 42,000 per month and 34% of household were earning between 42,001 to 52,000 per month. However, 14% and 38% of the respondents were

earning between 52,001 to 62,000 and above per month respectively. **Table 5.27** and **Figure 5.22** show the average monthly household income of the surveyed respondents.

Table 5.27: Average Monthly Household Income

Sr. No.	Distribution	Number	Percentage
1	Up to 32,000	7	2
2	32,001 to 42,000	34	11
3	42,001 to 52,000	101	34
4	52,001 to 62,000	43	14
5	Above 62,000	112	38
Total		297	100

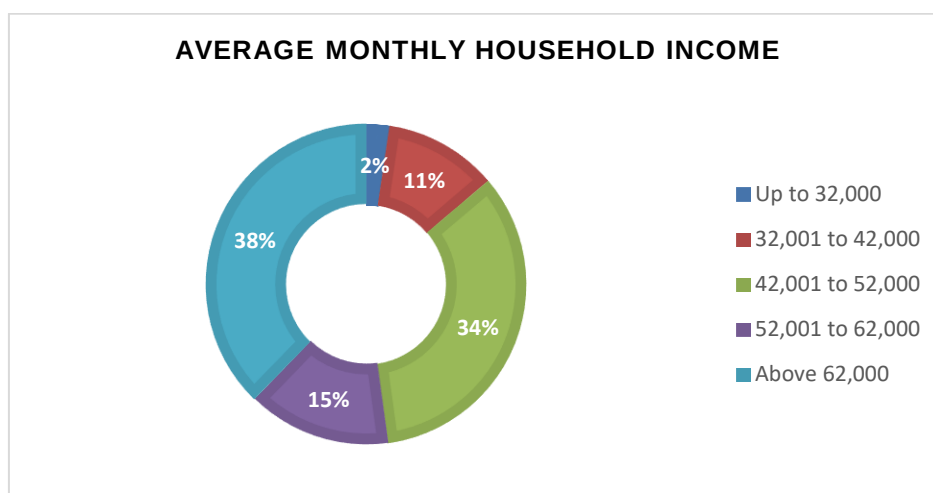


Figure 5.20: Average Household Monthly Income

5.7.5.8 Average Monthly Household Expenditures

Household expenditure depends on the earnings of the households. 8% of respondents reported their monthly household expenditure as up to 32,000 due to their low income. However, 23% of the respondents reported their expenses within the range of 32,001 to 42,000 per month. Whereas, 58% of respondents reported their monthly expenditures between the ranges of 42,001 to 52,000 in order to fulfill their family needs, while 8% of the respondents were expensing between 52,001 to 62,000, while 3% of the surveyed respondents spend above 62,000 in order to fulfill their monthly outlays. The information relating to the household expenditure in respect of the sample population is shown in **Table 5.28** and **Figure 5.23** shows the average monthly expenditures of the surveyed respondents.

Table 5.28: Average Monthly Household Expenditures

Sr. No.	Distribution	Number	Percentage
1	Up to 32,000	24	8
2	32,001 to 42,000	67	23
3	42,001 to 52,000	173	58
4	52,001 to 62,000	25	8
5	Above 62,000	8	3
Total		297	100

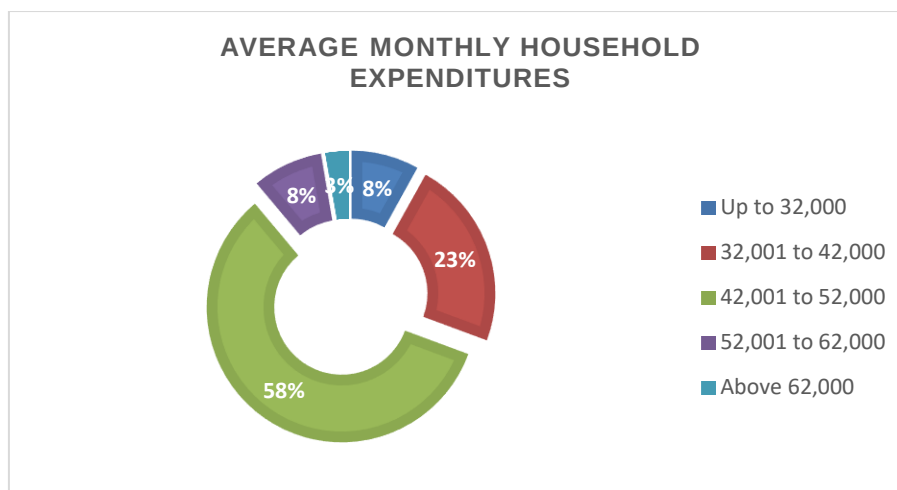


Figure 5.21: Average Monthly Household Expenditures

5.7.5.9 Family System of Respondents

During the socioeconomic survey of the respondents, it was observed that the majority of the respondent i.e.51% were living within a joint family system, while 49% of the household were living in a nuclear family system. The information relating to the family system in respect of the sample population is shown in **Table 5.29** and **Figure 5.24**.

Table 5.29: Family System of the Household

Sr. No.	Type	Number	Percentage
1	Joint	152	51
2	Nuclear	145	49
Total		297	100

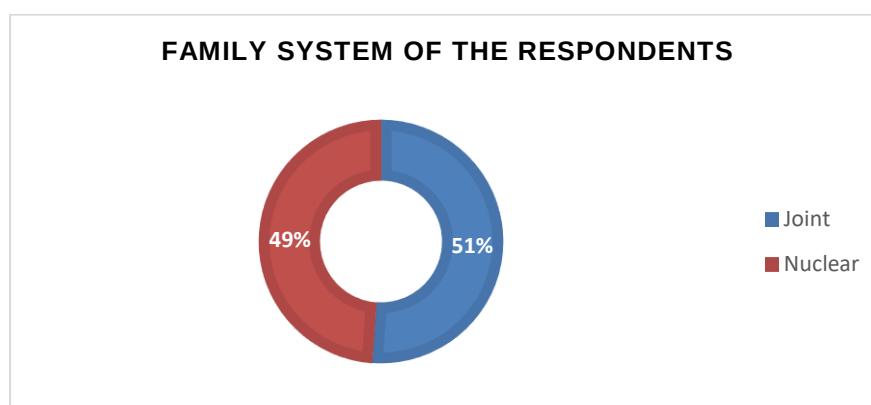


Figure 5.22: Family System of Respondents

5.7.5.10 Ownership Status of Houses

Housing is a major element of people's material living standards. It is essential to meet basic needs, such as shelter from harsh weather conditions, and to offer a sense of personal security, privacy, and personal space. Good housing conditions are also essential for people's

health and affect childhood development. Further, housing costs make up a large share of the household budget and constitute the main component of household wealth.

Regarding the ownership of the houses, findings of the study indicated that 98% of the surveyed respondents owned their houses, whereas 2% were living in rented houses. Detail of the ownership of the houses is given in **Table 5.30** and **Figure 5.25**.

Table 5.30: Ownership Status of Houses

Sr. No.	Status	Number	Percentage
1	Self-Owned	290	98
2	Rented	7	2
Total		297	100

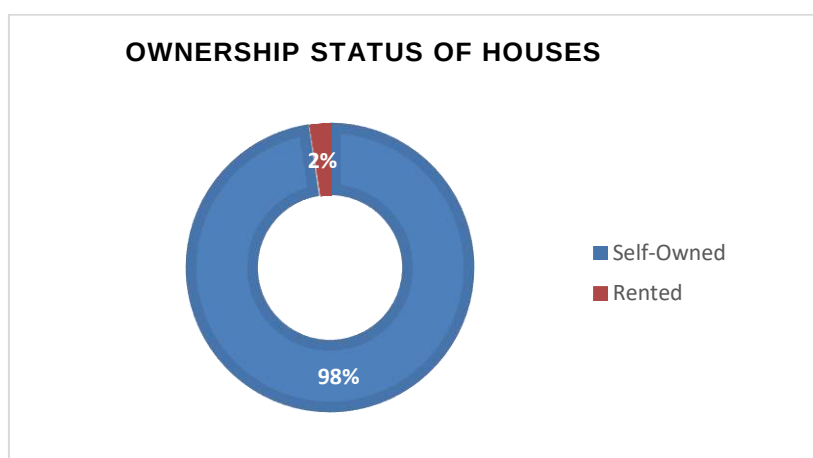


Figure 5.23: Ownership Status of Houses

5.7.5.11 Construction Type of the Houses

The Housing conditions of the respondents have been analyzed according to the construction type of houses in which they were residing. These are categorized as Pacca houses, Semi-Pacca houses, and Katcha houses. The house or building constructed with concrete and/or bricks falls in the pacca category. House or building constructed with burnt bricks and mud comes under the semi-pacca category, whereas houses constructed with un-burnt bricks and mud, or temporary wooden poles are categorized as the katcha category.

14% of the respondents were living in their Pacca houses, while 64% of the respondents were living in Semi – Pacca houses, and only 22% of the respondents were living in Katcha houses. Detail of housing condition is given in **Table 5.31** and **Figure 5.26**

Table 5.31: Construction Type of the Houses

Sr. No.	Type	Number	Percentage
1	Pacca	43	14
2	Semi-Pacca	190	64
3	Katcha	64	22
Total		297	100

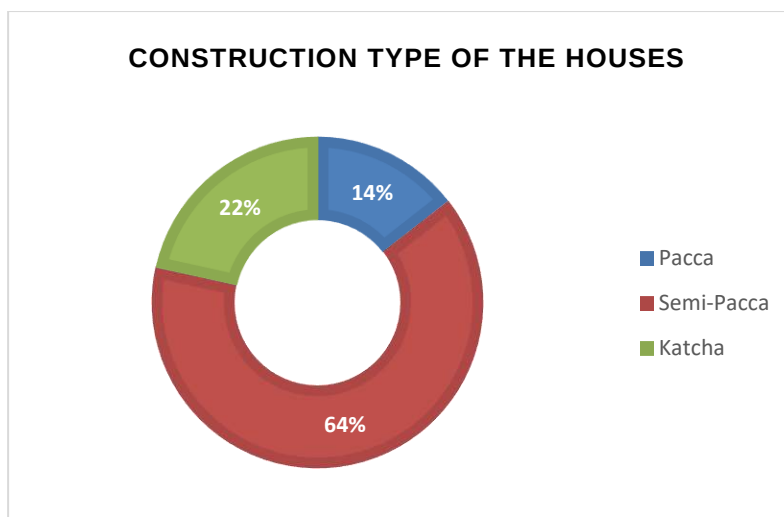


Figure 5.24: Construction Type of Houses

5.7.5.12 Access to Social Amenities

Social infrastructure and amenities are key to creating sustainable communities. This assessment sets the spaciousness of a household's dwelling, household amenities like availability of electricity and modern appliances, nature of access to water, fuel for cooking, and type of sanitation facilities available as primary indicators for assessing the standard of living.

The result of the survey revealed that 100% of the households had the facility of electricity and school. While the hospitals, Gas, sewerage and water supply was not available in the studied villages. People moves to other villages to avail health facilities. However, telephone/mobile was available to 99% of respondents. Rest of the available social amenities are given in **Table 5.32**.

Table 5.32: Access to Social Amenities

Sr. No.	Social Amenities	Number	Percentage
1	Electricity	273	92
2	School	273	92
3	Hospital	0	0
4	Gas	0	0
5	Water Supply	0	0
6	Sewerage	0	0
7	Telephone / Mobile	297	100
8	Water Filtration Plant	0	0
9	Road	77	26

5.7.5.13 Source of Drinking Water in the Project Area

Drinking water, also known as potable water, improved drinking water is water safe enough for drinking and food preparation. Access to a safe drinking water supply is not only a basic need and a precondition for a healthy life but is also a basic human right. The quality of water is directly linked to the quality of health. The amount of drinking water required to maintain

good health varies, and depends on physical activity level, age, health-related issues, and environmental conditions.

The findings of the survey indicated that 100% of the households had the facility of the drinking water inside their home in the shape of the household used hand pumps and electric water pumps. The detail of the facility of drinking water is given in **Table 5.33** and **Figure 5.27**.

Table 5.33: Source of Drinking Water in Project Area

Sr. No.	Source of Water	Number	Percentage
1	Hand Pumps/Electric Motor	297	100
Total		297	100

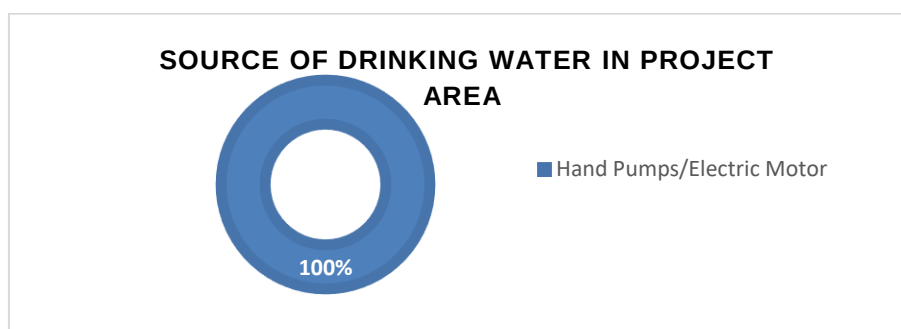


Figure 5.25: Source of Drinking Water in Project Area

5.7.5.14 Satisfaction Level With Quality of Drinking Water

The findings of the survey revealed that 93% of the respondents were satisfied with the drinking water quality, while 7% of the respondents were not satisfied with the water quality level. A detail of the satisfaction level of the respondents with the water quality is given in **Table 5.34** and **Figure 5.28**.

Table 5.34: Satisfaction Level with Water Quality

Sr. No.	Opinion	Number	Percentage
1	Yes	277	93
2	No	20	7
Total		297	100

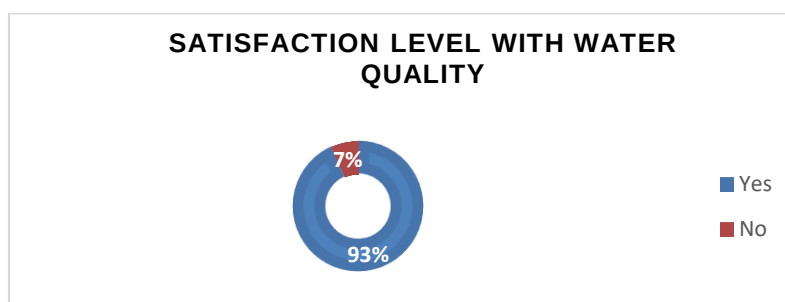


Figure 5.26: Satisfaction Level with Water Quality

6 STAKEHOLDER CONSULTATION

6.1 GENERAL

Timely and broad-based stakeholder involvement is an essential element for an effective environmental assessment, as it is linked with Project Planning, appraisal and development in general. Public involvement during Environmental Impact Assessment (EIA) has a tendency to improve project design environmental soundness and social acceptability.

This section describes the outcome of the stakeholders' consultation sessions held with different stakeholders that may be directly or indirectly affected by the proposed project. Public consultations are also mandatory for development projects. The adequacy of the public consultation and information disclosure is one of the basic criteria used to determine the project compliance with the national / international safeguard policies.

Under the proposed project, stakeholder consultations were carried out in the Study Area/AOI with the anticipated Project Affected Persons (PAPs), Government Departments and general public. These consultations were carried out from October 25th to October, 30th 2023. The Project management and implementation authorities are committed for undertaking public consultation at local levels as a part of Project planning/design for getting necessary environmental permissions.

This chapter presents the objectives, process, and outcome of the consultations carried out with the key stakeholders of the Project during the present EIA study. A consultation framework, describing the consultations to be carried out during the subsequent phases of the Project implementation ensuring ongoing and inclusive dialogues with key stakeholder is also provided in this chapter.

6.2 OBJECTIVES

The objectives of stakeholder consultation were to contribute to the openness, transparency and dialogue. Special efforts were made to ensure that the communication with the public should be efficient and well balanced. The concerned stakeholder groups were identified to participate in the assessment process. Specific tasks and purposes of consultations with stakeholders have been given in the **Table 6.1**.

Table 6.1: Tasks and Purposes of Consultations

Task	Purpose of Consultation with Stakeholders
Why consult with the stakeholders?	- To build trust to ensure sustained support for the proposed project and build resilience for times of crisis. - To learn about public concerns that need to be addressed and taken into account in designing of the Project concept and preparation of mitigation measures and programs. - To learn about the strengths, skills and organizations that the stakeholders can bring to support Project planning and implementation.
Modes and benefits of consultation	- Listening to and dialogue with stakeholders to keep the Project at tuned to public concerns early, to pre-empt breakdowns in public confidence. - Engaging the public and advocates for the Project construction and to support the implementation of social, resettlement, and environment programs.

Other objectives of public involvement include:

- Informing the stakeholders about the proposed Project;
- Providing an opportunity to those who remained unable to present their views and values, therefore allowing more sensitive consideration of mitigation measures and trade-offs;
- Providing those involved with planning the proposal with an opportunity to ensure that the benefits of the proposal are maximized and that no major impacts have been overlooked;
- Providing an opportunity for the public to influence the project design in a positive manner;
- Increasing public confidence in front of proponent, reviewers and decision makers;
- Providing better transparency and accountability in decision making;
- Reducing conflict through the early identification of contentious issues, and working through these to find acceptable solutions;
- Creating a sense of ownership of the proposal in the minds of the stakeholders; and
- Developing the Project which is truly sustainable.

More intangible benefits flow from the public involvement as the participants realize that their ideas can help to improve the Project. People gain confidence and self-esteem through taking part in the decision-making process and perceptions are expanded by meeting and exchanging views with people who have different values and ideas.

6.3 STAKEHOLDER IDENTIFICATION

The first step for the stakeholder consultation is the identification of the stakeholders. WAPDA is the Project Proponent for the proposed Project. As per definition, stakeholder is an entity which is concerned with the proposed Project in any way. Direct stakeholders are those entities which are directly concerned with the Project. The Project has both primary as well as secondary stakeholders.

The primary stakeholders include all the PAP's according to their loss of assets and living conditions, Provincial and District Level Government Departments such as Environmental Protection and Climate Change Department (EPCCD), Mines and Minerals Department, Irrigation Department, Agriculture Department, Wildlife Department, Sui Northern Gas Pipelines Limited (SNGPL) etc. However, the secondary stakeholders include the public and private agencies involved in the implementation of the Project.

Following is a list of major stakeholders consulted for the proposed Project:

6.3.1 Departmental Level Stakeholders

- Punjab EP&CCD;
- WAPDA;
- District Revenue Department of Chiniot and Sargodha;
- District Forest Department, Chiniot and Sargodha;

- Wildlife Department, Districts Chiniot and Sargodha;
- Fisheries Department, Districts Chiniot and Sargodha;
- Agriculture Department, Districts Chiniot and Sargodha;
- Social Welfare Department, Districts Chiniot and Sargodha;
- Mines and Minerals Department, Districts Chiniot and Sargodha;
- SNGPL Faisalabad Division;
- Punjab Irrigation Department, District Chiniot; and
- Local Government and Community Development Department.

Details regarding roles and responsibilities of the concerned agencies and departments are given in **Table 6.2**.

Table 6.2: Roles of Concerned Agencies/Departments

Sr. No.	Name	Roles
1.	Environmental Protection Agency	• EP&CCD is the regulatory authority and mainly responsible for the development and implementation of the environmental policies and strategies in order to integrate the environmental issues and sustainable development approaches into the legal and regulatory frameworks as per Punjab Environmental Protection Act; • EPAs are responsible for the issuance of Environmental Approval of the proposed Project; and • Punjab-EP&CCD is responsible for the compliance of EMMP and Environmental Approval provision during the construction and operation phases of the Project.
2.	WAPDA	• WAPDA is an autonomous and statutory body under the administrative control of the Federal Government and divided into three sectors Water, Power and Finance. • Water Wing of WAPDA is responsible for planning, designing and execution of Water Resources Development Projects in the sector of irrigation, drainage and hydropower. Inter-provincial major surface water Projects including large dams are also operated and maintained by Water Wing, WAPDA. • Roles of Power wing were redefined as Hydel Power Generation and O&M of power houses. • The Charter of Duties of WAPDA is to investigate, plan and execute schemes for the following fields: - o Generation, Transmission and Distribution of Power; - o Irrigation, Water Supply and Drainage; - o Prevention of Water logging and Reclamation of Waterlogged and Saline Lands; - o Flood Management; and - o Inland Navigation.
3.	Revenue Department	• Revenue Department is responsible for the land assessment, collection of land revenue and preparation of land records; and • The work relating to land acquisition, land lease, alienation of land etc. is also looked after by the Revenue & Estate Department. • Provide land ownership data of the project affected parties (PAPs) which include but not limited to the ownership record, land categorization and price details. • Responsible for implementation of all relevant Sections of LAA, 1894.
4.	Forest Department	• Protection, improvement and maintenance of existing forests; • Increase forests by planting new trees; and • Extension and advisory services to the general public about tree plantation.

Sr. No.	Name	Roles
5.	Wildlife Department	- Protection of Wildlife through enforcement of Punjab Wildlife Act 1974 amended upto 2007 and Rule amended upto 2010; - Captive breeding of endangered & indigenous / exotic wildlife species. Private sector participation in Wildlife Resources Management; - Management of Protected Areas; and, - Regulate sport hunting, Research & Surveys.
6.	Fisheries Department	- Responsible for the Conservation, Management and Development of Natural Fisheries resources through the enforcement of Punjab Fisheries Ordinance and Rules; - Promote aquaculture practices in private sector to bridge gap of protein deficiency in the diet of common man; and - Provide white meat to improve the health of people, utilize the untapped Fisheries resources to obtain maximum production, increase our share in the national economy.
7.	Agriculture Department	- Ensuring food security; - Enhancing productivity through better varieties and improved management practices; - Promoting high value crops, fruits and vegetables; - Promoting export of high value agricultural products; - Promoting efficient use of water and other inputs; - Improving soil health; - Development of culturable waste lands; and - Ensuring fair returns for the growers in marketing of their produce.
8.	Social Welfare Department	- Provide enabling environments and tangible opportunities through policies, programs and projects that would contribute in promotion of social progress and socio-economic uplift by addressing the needs of the marginalized and vulnerable segments of the society. - Social protection including institutional care; - Skill development and rehabilitation; - Registration, assessment, training, employment, and rehabilitation of disabled persons; and, - Eradication of social evils.
9.	Mines and Minerals Department	Mines & Minerals Department is responsible for grant, surveys, exploration and development of mineral resources in addition to collection of rents, royalties and fees from the mining concessionaires.
10.	SNGPL	- Enhancement of System Capacity; - Expansion of Transmission and Distribution Network; - Increase in Gas Sales; - Rehabilitation of Transmission and Distribution Network; - Reduction in Unaccounted for Gas Losses; - Improvement in Profitability; - Improvement in Consumer Services; - Adoption of Information Technology; - Human Resource Development; and, - Pursue Pipelines Construction and Advisory Business.
11.	Punjab Irrigation Department	- The Irrigation Department is committed to provide ensured and adequate water for irrigated agriculture for which it resorts to both development of new irrigation (flow/lift) schemes and conservation of flood water through small dams to meet province's requirements for food & fiber; and - Its ultimate aim is to provide year-round irrigation water/facilities and increase the irrigable area of the province through implementation of new schemes and improvement in the existing infrastructure for optimal utilization of available water resources.

Sr. No.	Name	Roles
12.	Local Government and Community Development Department	The department is responsible for the recruitments and administration of service personnel working in its attached departments. Moreover, other functions include: • Provide, manage, operate, maintain and improve the municipal infrastructure and services; • Manage properties and assets vested in local governments; • Enforcement of municipal laws and regulations; • Levy local taxes/fees to generate income; • Frame bye-laws to regulate municipal services; • Take cognizance of municipal offences and enforcement; • Exercise general powers and procedures as are enumerated in Eighth Schedule; and, • Perform functions within the provincial framework.

Prior letters were written to the concerned department for stakeholder consultation is attached as **Annex-IV** and Consultations with district level departments were carried out through meetings while consultations with local community members and project affected people etc. were undertaken during the baseline survey of the AOI. The consultation is an on-going process which should be continued during the project life cycle i.e. even after submission of EIA.

6.4 DEPARTMENTAL CONSULTATIONS

The stakeholder consultations were held with relevant departments. The details of the departmental officials contacted are given in **Table 6.3**.

Table 6.3: List of Government Officials Consulted

Sr. No.	Name & Designation	Name of Department/ Office
1.	Mr. Nawaz- Assistant Director 0345-4606733	District Office of Environment Chiniot
2.	Mr. Naveed Ahmad- Assistant Director- 0336-4815410 Ms. Saira Fatima- Inspector EPD 0340-1585247	District Office of Environment Sargodha
3.	Mr. Muhammad Jamshed 0310-4220652	Range Forest Office, RFO Chiniot (Jhang Forest Division)
4.	Mr. Muhammad Asif 0334-7414788	Divisional Forest Office, DFO Sargodha
5.	Mr. Mudassir Abbas 0301-7729014	District Wildlife Office, Sargodha
6.		District Office Fisheries, Chiniot
7.	MS. Shaista Bibi 0333-5064815	District Office Fisheries, DD Sargodha
8.	Rana Khalid	District Office Fisheries, DD Faisalabad Division
9.	Mr. Sheikh Maqbool 0322-6510620	District Office Fisheries, DD Fish Hatchery Faisalabad Division
10.	Mr. Asghar Salim 0334-6546268	District Office Fisheries, AD Fisheries District Chiniot
11.	Mr. Abdul Rauf 0307-4858127	District Office Fisheries, AD Fisheries District Sargodha

Sr. No.	Name & Designation	Name of Department/ Office
12.	Mr. Arsalan 0312-9509268	District Office Fisheries Assistant Warden Fisheries District Chiniot
13.	Muhhamd Shahbaz 0306-7672437	District Agriculture Department, DD Chiniot
14.	Mr. Zafar Abbas- District Officer- 0333-6713370	District Social Welfare Department, Chiniot
15.	Mr. Amjad Khan-Deputy Director	District Mines and Minerals Department, Chiniot
16.	Mr. Rizwan Saeed- Senior Clerk 0344-7578338 Mr. Muhammad Saeed- Surveys and Drawing Officer- 0312-7701656	District Mines and Minerals Department, Sargodha
17.	Mr. Dilnasheen- XEN Operations, SNGPL-Faisalabad Division 0333-6932866	SNGPL Regional Office Faisalabad
18.	Mr. Zulfiqar- SDO, Drainage Section, Irrigation Department Chiniot (Faisalabad Division) 0300-7632203	Irrigation Department Chiniot (Faisalabad Division)
19.	Mr. Yaseen Saleem- XEN, Drainage Section, Irrigation Department, Sargodha 0333-8899931	Irrigation Department, Sargodha
20.	Mr. Ghulam Shabir- Deputy Director 0333-4942605	District office Local Government and Community Development, Chiniot.

6.4.1 Views & Suggestions of the Officials of Departments

The responses of the government officials about the construction of the Dam were recorded during the discussions. Generally, the officials were of the view, that the construction of the proposed project will not have a positive impact on the economy of the area in term of loss of huge agriculture land. The **Table 6.4** indicates the detail of issues raised/discussed and suggestions given during the consultation:

Table 6.4: Detail of Issues/Points Raised/Discussed during Departmental Consultations

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
1.	Assistant Director -District Office of Environment Chiniot	- The consultant's team briefed the official about the project components and activities and discussed the need for the EIA study to comply with EP&CCD rules and regulations. - The official emphasized on the preparation of a comprehensive EMP and its subsequent implementation during the construction and operational phase of the project. - It is suggested that a tree plantation plan should be developed to compensate the loss of trees due to the project activities and local species should be planted to safeguard the environment. - It was also suggested to include the scope of fish hatchery /farm in the overall project.
2.	Assistant Director-District Office of Environment Sargodha	- The consultant's team briefed the official about the project components and activities and discussed the

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
		need for the EIA study to comply with EP&CCD rules and regulations. - It was highlighted by the officials that the area is rich in agriculture and due to area inundation the agriculture will be damaged. Therefore, the farmers should be compensated fairly for the loss of agriculture. Moreover, the client should work out and develop a strategy to develop the barren areas for agriculture to compensate the loss of agriculture productivity. - It was also suggested that legal formalities should be followed in terms of environmental approval.
3.	Divisional Forest Officer-DFO Jhang Forest Division, Range office Chiniot.	- The official was briefed regarding the project. - Data related to existing forests were acquired initially. In response, a joint visit was conducted to verify the Reserved Forest area. (details provided in Baseline of this report) - In case of any disturbance to the protected/reserved forest due to proposed intervention it may be avoided in case of non-avoidance the compensation/agreement will have paid as per law of land i.e. Punjab Forest Act. - Tree cutting should be avoided up to maximum level.
4.	Divisional Forest Officer-DFO Sargodha Forest Division.	- A detailed personation regarding the project was discussed among the DFO and CDCG environment team - The official proposed that Protected and reserve forests should be protected to ensure the environmental balance. - Minimize the impacts on green cover must be considered. - The impacted green cover in the area must be compensated with extensive plantation. He also suggested that the proposed project area is highly fertile in terms of agriculture and other green resources the Dam location may be changed to avoid direct impact on agriculture of the areas including fertile soils.
5.	District Wildlife Office, Chiniot	- The officials were briefed at DC Chiniot office and details were shared among the teams. - He recommended Avoidance of wildlife and to protect the habitats and it should be ensured during the project implantation and site selection. Firm mitigations should be ensured during construction to minimize the damage to wildlife and to protect habitat.
6.	District Wildlife Office, Sargodha	- CDCG team visited the subject office to brief the officials regarding the project and shared detailed. - They appreciated the proposed project - Recommendation by the concerned official was noted down, as below - The officer concerned made discourse on importance of the Biodiversity of areas falling in the proposed project area.

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
		He also suggested avoiding negative impacts on local and migratory birds, if any.
7.	District Offices Fisheries, Chiniot and Faisalabad	- The NESAK environment team shared details of the project to the officials and following are the suggestion. - A fish hatchery with fingerlings facility must be on the site for replenishment of the stock to have maximum fish production from the project. - The fishing rights of the project area has been leased out for Rs.10, 23000/-during the year 2023 – 24. It is expected that same area will fetch much more income and fish production as well. - Although foraging, spawning & nursing grounds for fish will be destroyed in the project area but it will become the best area for maximum fish production, anglers and tourists. - They added regarding Drains, presently there is no fish, it receives industrial water from a Beverage factory near Sayyal Mor. It receives river water during flood. - The project will be more beneficial for fisheries point of view
8.	District Office Fisheries, Sargodha	- The official was briefed in detailed regarding the project. - The official suggested to also feed existing water bodies which support aquatic life. Dam design should support the fisheries and over all aquatics. - Avoid the direct and indirect impacts on water and habitats during construction and operational phases. - Fisheries department will provide inputs to aquatic development when Dam is constructed. Proposed project will definitely support the fisheries in the region and will be also leading to growth of local socioeconomic growth.
9.	District Agriculture Department, Chiniot	- The CDCG environment team presented the project to the official. - In response, the official shared information related to agriculture crops and crops pattern - The agriculture officer strongly supported the proposed project and its objectives. He also suggested about minimum loss of agriculture land.
10.	District Agriculture Department, Sargodha	- The official showed keen professional interest in the project, after sharing information by CDCG team. - He strongly recommends the project implantation soon, as these activates will contribute toward flood protect and agriculture development. He also suggested that after losses to agriculture land during construction and land acquisition alternate agriculture area of same of batter nature must be developed to avoid food security and inconvenience to farmers.

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
11.	District Officer-District Social Welfare Department, Chiniot	- The consultant's team briefed the official about the project components and activities and discussed the role of NGOs in the area for uplift of the marginalized communities. - The respective official described that a number of the NGOs are registered with the social welfare department in the proposed project area but on ground activities of these NGOs are not visible due to unavailability of funds and donors. - He explained that the local community is already marginalized and depends on agriculture for their livelihood. Therefore, due to huge acquisition of the agriculture land will disturb the economic thread of the local community. - He further explained that a huge economic and physical displacement is envisaged due to acquisition of the agriculture and residential land. - He was of the view that there is need to prepare the comprehensive Resettlement and Livelihood Restoration Plan to resettle the displaced community. - He briefed that their department with the help of local NGOs can provided assistance with respect to capacity building of the project affected persons in different walks of life. - He further added, that maximum skilled & unskilled labor should be hired from the local community during the Project construction activities. - Occupational health and safety should be taken care with respect during construction of the proposed Dam project. - Efforts should be made to reduce the physical disturbance at minimum level. - Livelihood disturbance should be minimized.
12.	Deputy Director-District Mines and Minerals Department, Chiniot	- The consultant team briefed in detail to the government official through project drawings and maps. - The respective official explained their jurisdiction regarding silt mining through maps and Kml files. - He explained that the proposed project will inundate a huge silt mining area which will have a negative impact on revenue generation. - He further added, that the livelihood of the hundreds of the local people as well as mining labor is associated with the silt mining which will be disturbed. - He was of the view that government should carry out cost benefit analysis and studies comprehensively before taking a final decision regarding construction of the project. - He was of the view that livelihood of the affected community should be restored before execution of the project.
13.	Surveys and Drawing Officer-District Mines and Minerals Department, Sargodha	- The consultant team briefed in detail to the respective officials through project drawings and maps.

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
		- The respective officials explained their jurisdiction regarding silt mining through maps in district Sargodha. - The respective officials were of the view that the project will have an impact at minimum area with compare to district Chiniot. - They were convinced that the project will disturb the livelihood of the local community as the single land owner receives PKR 450 per truck as a royalty for silt mining from his/her titled land. In this regard, local land owners earn a handsome amount per month. - The government officials suggested to chalk out the comprehensive and workable income and livelihood restoration plan for the affected communities. - The consultant team explained and briefed about the preparation of the environmental and social safeguard documents to provide proper compensation for the affected assets and to restore the livelihood of the affected households.
14.	XEN Operations-SNGPL Regional Office Faisalabad	- The consultant's team briefed the official about the project, its benefits and the scope of the study. - It was confirmed by the official that SNGPL pipelines and value control system in Chiniot near old Chiniot Bridge will be affected especially along the dykes. - It was told by the official that some arrangements will be made to safeguard the SNGPL pipeline and other facilities falling under the project components. - In this regard, it was suggested by the official to write a letter to the GM operations, Transmission and Distribution SNGPL Faisalabad for confirmation and to seek for the impact radius to save their facilities from the project activities.
15.	SDO, Drainage Section-Irrigation Department Chiniot (Faisalabad Division)	- The consultants briefed the official about the project scope, components and its benefits. - There are mainly three drains in Chiniot which outfalls in Chenab River which are Ahmed Pur Nakka Drain, Marh Chiniot Drain and Chak Bandi Main Drain. - It was told by the official that Ahmed Pur Nakka Drain outfalls in the Chenab River between the main dam and the tail of reservoir. - The other two drains are not falling in the project scope. - The discharge capacity of the drain is approximately 750 cusec. - The wastewater from these drains are directly discharged into the Chenab River without any treatment. - Prior to the start of the construction a formal letter should be written to proceed with the legal bindings under the Irrigation Department.
16.	XEN, Drainage Section-Irrigation Department, Sargodha	- The consultants briefed the official about the project scope, components and its benefits. - It was confirmed by the official that Lower Budhi Nullah Drain outfalls in the Project Reservoir area (Chenab River)

Sr. No	Agency / Department / Stakeholder	Apprehensions and Suggestions
		- The drain carries the load mainly from the Sargodha city and discharge in Chenab River without any treatment. - Prior to the start of the construction a formal letter should be written to proceed with the legal bindings under the Irrigation Department.
17.	Deputy Director-District office Local Government and Community Development, Chiniot.	- The consultants briefed the official about the project scope, components and its benefits. - The consultant team also explained its data requirements to the government official in order to carry out the socioeconomic surveys and to develop the socioeconomic baseline of the project area. - The government official appreciated the proposed project and expressed that the respective project will prove as a landmark for the local community of the district Chiniot especially. - He was of the view that beside making people secure from flood the reservoir of the dam can provide a lot recreational activities to the locals and the visitors. - While expressing his apprehensions, he added that local community should be compensated properly to restore their livelihood as the farming and agriculture is the prime source of the local communities living on river banks. - He added that there is already very less cultivable land in the project area and due to construction of the dam a large proportion of the cultivable land will be inundated and will not be available for the cultivation in the future. Resultantly, a huge population will become jobless and unable to earn their livelihood. Hence, there is need to develop a workable strategy to reduce the resettlement impacts on local people and to restore their lost livelihood. - Moreover, the respective official extended his complete cooperation for the project activities and ensured to provide any relevant data.

6.5 COMMUNITY CONSULTATIONS

For ascertaining the perceptions of different stakeholders about the project (during/ after construction) meetings were held with local communities and anticipated project PAPs within the project area. These meetings were held in an open atmosphere, in which participants expressed their views freely. Informal group discussions were also held as an additional tool for the assessment of the perceptions of the stakeholders about the project and potential impacts both positive and adverse likely to occur due to its implementation. The views of the local residents and general public were formally recorded and effort was made to make those beneficial for the Project.

6.6 APPROACH FOR THE CONSULTATION AND INFORMATION DISSEMINATION

A series of public consultations were required to get the feedback/concerns of the different category of stakeholders including local communities and other general public residing in and near about the project area.

Consultation process included meetings with specific proposed project area residents, community meetings/consultations and semi-structured interviews with the local community members. During the consultation process, the stakeholders were briefed about the project objectives and scope. Their fears and suggestions were recorded. These Consultations were conducted at following two levels:

- Community/Public Consultations
- Individual meetings with PAPs

Public Consultation was carried out in order to establish stakeholder's opinion regarding project implementation. The following methods were used for public consultation with project stakeholders:

- Scoping Sessions with the project affected persons;
- Formal Meetings with local community members and project affected members;
- Informal Meetings with locals at site;
- Individual Interviews of the local people and project affected persons.

6.6.1 Locations of the Public Consultations and Participation

The stakeholders were consulted during twenty-nine (29) consultative sessions at different locations in the proposed project area. Total numbers of participants in the consultations along with locations are mentioned in **Table 6.5** below, while event details including dates, venues, and specimen lists of the participants of Community Consultation are presented as **Annex-V**. The pictorial presentation of some consultation events is provided as Photolog.

Table 6.5: Consultation Locations and Number of Participants

Sr. No.	Settlement	Tehsil	District	Categories of Participants	No. of Participants
A	Consultations During Socio-economic Survey				
1.	Socio-economic Survey in the proposed project reservoir area.	Chiniot, Lalian and Kot Momin	Chiniot and Sargodha	Interviewed Project affected persons and local residents	297
B.	Formal Community Consultations and Scoping sessions				
1:-	Thatha Deura	Chiniot	Chiniot	Project PAPs and general Public	4
2:-	Thatha Mehmood Ka Mouza Qazian	Chiniot	Chiniot	Project PAPs and general Public	8
3:-	Thatha Chour Ka Mouza Channi Chour	Lalian	Chiniot	Project PAPs and general Public	6
4:-	Burj Umer	Chiniot	Chiniot	Project PAPs and general Public	8
5:-	Daira Noore K Machi Mouza Burj Umer	Chiniot	Chiniot	Project PAPs and general Public	5
6:-	Daira Dose Nahme Ka Mouza Jhangar Glotar	Chiniot	Chiniot	Project PAPs and general Public	5

Sr. No.	Settlement	Tehsil	District	Categories of Participants	No. of Participants
7:-	Daira Riaz Shair da Mouza Jhangar Ghotar	Chiniot	Chiniot	Project PAPs and general Public	6
8:-	Bone k Joghe Mouza Janghar Gilotar	Chiniot	Chiniot	Project PAPs and general Public	8
9:-	Lal da Burj Mouza Jhangar Gilotar	Chiniot	Chiniot	Project PAPs and general Public	5
10:-	Basti Malah Mouza Burj Mal	Chiniot	Chiniot	Project PAPs and general Public	5
11:-	Burj Zaida	Lalian	Chiniot	Project PAPs and general Public	9
12:-	Thatha Shah Balol	Lalian	Chiniot	Project PAPs and general Public	7
13:-	Burj Sargana	Lalian	Chiniot	Project PAPs and general Public	8
14:-	Daira Allah Yar Mouza Burj Bodha	Lalian	Chiniot	Project PAPs and general Public	7
15:-	Kheeva Channi	Lalian	Chiniot	Project PAPs and general Public	6
16:-	Dera Col. Aslam Mouza Bux Wala	Lalian	Chiniot	Project PAPs and general Public	8
17:-	Yakkewala	Lalian	Chiniot	Project PAPs and general Public	6
18:-	Bhindre Basti Mouza Behlol Pur	Lalian	Chiniot	Project PAPs and general Public	7
19:-	Daira Fateh Langar Makhdoom	Lalian	Chiniot	Project PAPs and general Public	8
20	Pehlwan Colony	Lalian	Chiniot	Project PAPs and general Public	8
21	Dera Longi Mouza Thati Alam Shah	Lalian	Chiniot	Project PAPs and general Public	6
22	Dera Haji Najabat Mouza Doum Syeda	Lalian	Chiniot	Project PAPs and general Public	5
23	Dera Sipra Mouza Hammoana	Lalian	Chiniot	Project PAPs and general Public	7
24	Jhala Sufi Mouza Hammoana	Lalian	Chiniot	Project PAPs and general Public	9
25	Basti Murad Mouza Yakkewala	Lalian	Chiniot	Project PAPs and general Public	8
26	Pacca Gorna	Kot Momin	Sargodha	Project PAPs and general Public	11
27	Khan Malah Mouza Bahar Wala	Kot Momin	Sargodha	Project PAPs and general Public	7
28	Baba Farid Colony Mouza Talib Wala	Kot Momin	Sargodha	Project PAPs and general Public	6
29	Kacha Gorna	Kot Momin	Sargodha	Project PAPs and general Public	5
Total Participants (A+B):					495

6.6.2 Findings of Community Consultations

Extensive consultations were conducted with the local communities and anticipated PAPs in the proposed project area to record their views and incorporating in the project planning. Beside the consultations with individuals during socioeconomic survey, Twenty Nine (29) consultative meetings were held with locals and anticipated project affected persons in the proposed project area. The major categories participated in these meetings were local

population, community groups, landowners, and particular project affected persons. All participants were briefed about the importance of the project and its impacts.

During the consultations, it was assessed that mostly people were aware about the project, its benefits and adverse impacts. During discussions, participants showed keen interest in discussion, raised their concerns, gave valuable suggestions and also raised various questions. The local people expressed their willingness and cooperation with the project staff during survey. The questions raised and responses given are provided in **Table 6.6**.

Table 6.6: Community Concerns and their Redress

Concerns	Redress	Remarks/ Action Taken
The participants were of the view that a huge agriculture land will be acquired by the government for construction of the dam which is not beneficial for the local community.	Participants requested to shift the location of the project to save the rich fertile land.	The consultant team briefed about the project components, its benefits and importance of current site selection. It was explained that the respective project has various important benefits besides its negative impacts on local community.
The participants requested to avoid the huge land acquisition as it is prime source of income for the local farmers.	Community suggested if land acquisition cannot be avoided then land for land compensation should be considered as compensation. Is this way they can ensure their sustainable livelihood.	It was explained to the participants that their suggestion will be forwarded to the decision makers as an option to review.
The participants of the consultation showed their concern upon rates of the land. They were of the view that Government may apply DC rates for our affected lands which will not be acceptable.	DC rates are very low, hence, market based rates should be applied for the affected lands. Farmers are already very poor and relies on cultivable lands for livelihood.	Government shall consider/ensure determination of land rates through proper formation of Price Assessment Committees at district level to provide market based rates for land compensation.
Participants showed their concerns regarding demolition of their residential structures falling in the proposed reservoir of the Dam.	Resettlement and proper compensation at replacement cost to affected households for loss of residential and other structures.	Executing authorities will ensure resettlement and proper compensation for affected residential structures through preparation and implementation of the RAP.
Loss of commercial, structures and income disturbance due to construction of the dam.	Resettlement and proper compensation at replacement cost to PAPs for loss of structures and livelihood.	Executing authorities will ensure resettlement and proper compensation for affected structures and impact on livelihood through preparation and implementation of the RAP.
Timely payment of compensation of the lost assets/ structures as well as crops & trees.	The payment of compensation for all affected structures/ assets should be paid prior to initiate civil works in accordance with the Entitlements agreed during preparation of the RAP documents.	PIU will ensure timely disbursement of compensation and confirmation of full payment of RAP through LAC/ EMA before allowing construction activities.
The structures which are affected due to the project should be fully compensated.	Only the structures or their parts located in ROW to be cleared for construction of the dam will be removed and compensated as per provisions and entitlement matrix outlined in the RAP. Moreover,	EA will monitor the actions and reflect in the internal monitoring report.

Concerns	Redress	Remarks/ Action Taken
	functional viability of the demolished structures will be assessed and accordingly compensation will be given for full or partially affected structures.	
The participants engaged with the silt mining raised their concern regarding loss of their livelihood.	Preparation of a comprehensive livelihood restoration plan.	A comprehensive and workable livelihood restoration plan should be prepared including provision of vocational trainings to build the capacity of the local labourers and to engage them in livelihood development activities.
Local skilled and unskilled labour should be employed in the project construction work as well as in office work.	Employment opportunities will be created during construction. The bidding documents will include provisions for engaging local labour and contractors will provide jobs to the locals on priority basis.	PIU of EA will monitor the actions and reflect in the internal monitoring report.
Avoid relocating / dismantling mosques and graves at the possible extent as mosques are located within the ROW.	The efforts have been ensured to avoid graveyards and minimize impacts on community structures i.e. mosques. However, the affected community structures will be relocated/ reconstructed at nearby place in consultation with the local community. Existing mosques will be kept intact at site until alternate mosques are ready for locals/ general public.	In consultation with the community by the PIU's LAR implementing team, a consensus will be made on the compensation and relocation options of affected community structures during RAP implementation. The agreed actions will be implemented, and compliance will be monitored and reported in internal and external monitoring reports.
In case of government land, the payment of compensation should be made to the encroachers whose structures are located within the ROW.	As per LAR provisions the PAPs facing loss of their assets encroached in the ROW will be eligible for compensation to the extent of structures or other assets except land to ensure that they can restore/reconstruct their assets out of ROW limits and are not worse-off due to project implementation.	PIU will monitor the actions and reflect in the internal monitoring report.
Site Camps of the Contractor	Provisions for camp and construction sites will be prepared, implemented and monitored.	The issues and incidents on non-compliance of SEMP provisions will be documented and reported in Environmental Monitoring reports.
Dust and noise during construction activities will disturb the local community.	All protective measures should be taken to manage the dust and noise during construction phase of the proposed project.	PIU will monitor the actions and reflect in the internal monitoring report.

6.7 STAKEHOLDER CONSULTATIONS FRAMEWORK FOR CONSTRUCTION AND OPERATION PHASE

Key stakeholders of the Project include provincial and district level government departments such as Punjab-EP&CCD, Agriculture Department, Forest Department, Wildlife Department, Fisheries Department, Project directly affected people, land owners and local people. The community members will be compensated by project proponent and they will be encouraged

to participate in project activities during construction and operation phases. The consultations are recommended to be made in future to facilitate the community at the local level.

The consultations should be carried out during the construction and operation phases of the Project. Efforts are recommended to maximize the consultations during the project implementation. The consultations will be carried out with the objectives to develop and maintain communication linkages between the project promoters and stakeholders, provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and ensure that views and concerns of the stakeholders are incorporated during the implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed Project. The framework for the future consultations is elaborated in **Table 6.7:**

Table 6.7: Future Consultations Framework

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
1	Provincial Government Departments	• Pre-Implementation • During the Project Implementation	• One round of consultation before start of implementation of project. • Monthly during construction phase and bi-annually during operation phase of the project.
2	District Level Government Officials	• Pre-Implementation • During Project Implementation	• One round of consultations before start of implementation of project. • Monthly during construction stage and bi-annually during operation phase of the project.
3	PAPs	• Pre-Implementation • During the Project Implementation	• One rounds of consultations before start of implementation. • Fortnightly during construction stage and bi-annually during operation phase of the project.
4	Surrounding Villages	• Pre-Implementation • During Project Implementation	• One round of consultation before start of implementation. • Quarterly during construction stage and bi-annually during operation phase of the project.
5	Local Elders	• Pre-Implementation • During Project Implementation	• One round of consultations before start of implementation of project. • Monthly during construction stage and bi-annually during operation phase of the project.
6	Women	• Pre-Implementation • During Project Implementation	• One rounds of consultations before start of implementation. • Fortnightly during construction stage and bi-annually during operation phase of the project.

7 ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

7.1 GENERAL

This chapter identifies the potentially significant beneficial as well as adverse environmental and social impacts of the pre-construction, construction and operational phases of the proposed Project on the physical, ecological and socio-economic domains of the environment. Moreover, appropriate, technically viable and economically feasible mitigation measures were suggested for each potentially adverse impact.

7.2 METHODOLOGY FOR IMPACT IDENTIFICATION

Selection of an appropriate and customized methodology for the impact assessment is critical for the whole outcome of an EIA study. The identification, categorization and evaluation of impacts were carried out by using various tools such as impact screening checklist, impact assessment matrices and overlay. Based on the notion of significance criteria each impact was classified. Based on the vast experience of the experts in the field of impact assessment, identification of the potentially significant and non-significant environmental and social impacts different tools has been utilized as detailed below:

7.2.1 Screening Checklist

Based on the findings of desk studies, processed satellite imageries, previous studies, screening checklist was prepared to screen out the potentially significant adverse environmental and social impacts during the construction and operation phases of the proposed Project. The objective of the impact screening is to assess the significance of the issues related to the atmosphere, climate, water resources, land resources, ecological environment, socio-economic environment, transport, infrastructure and communication, natural risks, hazards and external constraints of the Project for the proposed development. After the compilation of baseline information, processing of acquired satellite imagery, the screening checklist was filled to screen out the positive and adverse impacts of the proposed Project during the construction and operational phases.

7.2.2 Impact Matrices

Various EIA methodologies are available for identification of impacts including the checklist and project impact matrix. Among these methods, project impact matrix was used as impact identification methodology for the identification of temporal based impacts.

The Impact Evaluation Matrix was developed by placing project activities along one axis (i.e. Y-axis), and on the other axis (i.e. X-axis) the different environmental parameters likely to be affected by the proposed project actions grouped into categories i.e. physical, ecological and socio-economic environment. For the impact assessment, project impact evaluation matrix is used by dividing the project action into different phases (design/pre-construction, construction and operational phases).

7.2.3 Notion of Significance

The “notion of significance” was based on the following criteria:

- **Extent:** The scale of impact, i.e., limited to the immediate areas of development activity (the site); limited to within a distance reach of the development; affecting the region as a whole; or occurring at a national or international scale;
- **Duration and Frequency:** A prediction/forecasting of the lifetime of the impact: i.e., short-term; medium term; long term with the impact ceasing after the operational life of the development; or considered permanent and how many times the event will occur during that period;
- **Intensity:** A description of the intensity (magnitude/size) of the impact: i.e., high, medium, low, or negligible (no impact). The specialist studies must attempt to quantify the magnitude of impacts and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact;
- **Reversible/Irreversible:** Changes considered irreversible, for example, the loss of biodiversity within a river due to a change in water quality;
- **Probability:** The likelihood that the event will actually occur; and
- **Legal Restriction:** If the action is likely to affect, or be affected by a legal restriction.

Taking into account these criteria, potential significance was classified as either:

- **Low:** an impact for which no mitigation is necessary;
- **Medium:** an impact that requires effective mitigation; and
- **High:** an impact, which, if not mitigated, could stop the Project from proceeding.

The potentially significant impacts were then further investigated in detail to carry out a comprehensive assessment of the significant impacts.

Categorization of environmental impacts based on significance of notion is shown in **Table 7.1**.

Table 7.1: Categorization of Environmental Impacts

Sr. No.	Impact	Extent	Duration and Frequency	Intensity	Reversibility Category	Probability	Potential Significance
A	Pre-construction Phase						
	Physical Environment						
1.	Permanent Land Acquisition	Site-specific	Permanent	High	Irreversible	High Likely	High Significant
2.	Temporary Land Acquisition	Site-specific	Temporary	High	Reversible	High Likely	High Significant
3.	Affected Population	Site-specific	Permanent	High	Irreversible	High Likely	High Significant
4.	Impact on Infrastructure	Site-specific	Permanent	High	Irreversible	High Likely	High Significant
5.	Field Investigations	Site-specific	Temporary	Medium	Reversible	Likely	Medium Significant
	Ecological Environment						
1.	Flora and Fauna	Site-specific	Temporary	Low	Reversible	Likely	Low Significant
	Socio-economic Environment						
1.	Depriving the host community of any development activity	Site-specific	Temporary	High	Reversible	High Likely	High Significant
2.	Uncertainty and security of future activities	Site-specific	Permanent	Medium	Irreversible	Likely	Medium Significant
3.	Fear of displacement and resettlement	Site-specific	Permanent	High	Irreversible	High Likely	High Significant
4.	Imminent loss of physical assets	Site-specific	Permanent	High	Irreversible	High Likely	High Significant
5.	State of disturbance and stress prevalent among communities	Site-specific	Temporary	Medium	Irreversible	Likely	Medium Significant
6.	Fair compensation and delaying factor in making payment if any involved;	Site-specific	Temporary	High	Reversible	High Likely	Medium Significant
B	Construction Phase						
	Physical Environment						

Sr. No.	Impact	Extent	Duration and Frequency	Intensity	Reversibility Category	Probability	Potential Significance
1.	Aesthetics	Local	Long Term	High	Irreversible	Likely	Medium Significant
2.	Access Roads and Transportation	Local	Medium Term	High	Reversible	Likely	Highly Significant
3.	Natural Drainage	Site-specific	Medium Term	High	Reversible	Likely	Medium Significant
4.	Loss of Land in Disposal Area	Local	Medium Term	Medium	Reversible	Likely	Medium Significant
5.	Soil Contamination and Erosion	Local	Medium Term	High	Irreversible	Likely	Highly Significant
6.	Liquid and Solid Waste Generation	Site-specific	Medium Term	Medium	Reversible	High Likely	Medium Significant
7.	Surface Water Quality	Local	Medium Term	Medium	Irreversible	Likely	Medium Significant
8.	Quarrying/Borrow Pits Hazards	Site-specific	Medium Term	Medium	Reversible	High Likely	Medium Significant
9.	Hydrology	Local	Medium Term	Medium	Irreversible	Likely	Medium Significant
10.	Ambient Air Quality	Local	Medium Term	Medium	Reversible	Likely	Medium Significant
11.	Noise and Vibration	Local	Medium Term	Medium	Reversible	Likely	Medium Significant
Ecological Environment							
1.	Flora and Fauna	Local	Permanent	High	Irreversible	Likely	High Significant
Socio-economic Environment							
1.	Skilled and unskilled labor opportunities	Local	Medium Term	Medium	Reversible	Likely	Medium Significant
2.	Employment of locals and immigrants	Local	Medium Term	Medium	Reversible	Likely	Medium Significant
3.	Local economic development	Local/National	Long Term	High	Irreversible	Likely	Medium Significant
4.	Loss of privacy and security	Site-specific	Temporary	Medium	Reversible	Likely	Medium Significant
5.	Differences of cultural values	Local	Temporary	Medium	Reversible	Likely	Low

Sr. No.	Impact	Extent	Duration and Frequency	Intensity	Reversibility Category	Probability	Potential Significance
							Significant
6.	Disruption of utilities and load on physical infrastructure	Local	Temporary	Medium	Reversible	Likely	Low Significant
7.	Development of solid waste on dam site	Site-specific	Medium Term	Medium	Reversible	High Likely	Low Significant
8.	Gentrification	Local	Temporary	Medium	Reversible	Likely	Low Significant
C	Operation and Maintenance Phase						
	Physical Environment						
1.	Sedimentation	Local	Long Term	High	Irreversible	Likely	High Significant
2.	Loss of Nutrients	Local	Short term	Medium	Reversible	Likely	Medium Significant
3.	Landslides Hazard	Local	Long Term	Medium	Irreversible	Likely	Medium Significant
4.	Change in Land Use	Site-specific	Long Term	Medium	Irreversible	Likely	Medium Significant
5.	Water Logging and Salinity	Site-specific	Long Term	Low	Irreversible	Likely	Low Significant
6.	Water Seepage	Local	Long Term	Significant	Irreversible	Unlikely	Low Significant
7.	Water Quality	Local	Medium Term	Medium	Irreversible	Likely	Medium Significant
8.	Climate	Regional	Medium Term	Medium	Irreversible	Likely	Medium Significant
9.	Water Rights in Downstream Area	Local	Long Term	High	Irreversible	Likely	High Significant
10.	Dam Safety and Emergencies	Local	Long Term	High	Irreversible	Likely	High Significant
11.	Attenuation of Floods	Local	Long Term	High	Reversible	Likely	High Significant
12.	Air and Noise	Local	Short Term	Low	Reversible	Likely	Low Significant
	Ecological Environment						

Sr. No.	Impact	Extent	Duration and Frequency	Intensity	Reversibility Category	Probability	Potential Significance
1.	Flora and Fauna	Local	Long Term	Medium	Reversible	Likely	Medium Significant
Socio-economic Environment							
1.	Development of economic activities that boost the living standards of locals	Local/National	Long Term	High	Irreversible	Likely	Medium Significant
2.	Affected farming patterns due to change in downstream flow	Local	Medium Term	Medium	Reversible	Likely	Low Significant
3.	Increased agricultural productivity and price of land	Local/District	Long Term	High	Irreversible	Likely	Medium Significant
4.	Secured water rights	Local	Long Term	High	Irreversible	Likely	Medium Significant
5.	Regular water supply for irrigation	Local	Long Term	High	Irreversible	Likely	Medium Significant
6.	Promotion of recreational activity and fish farming	Local	Long Term	High	Irreversible	Likely	Medium Significant
7.	Water borne diseases as a result of large-scale water project	Local	Medium Term	Medium	Reversible	Likely	Low Significant

7.3 POSITIVE IMPACTS DURING CONSTRUCTION AND OPERATIONAL PHASES

The proposed Project have direct benefits called as Project main objective however, there are also associated benefits known as indirect benefits. Following are the associated positive benefits of the proposed Project:

7.3.1 Direct Benefits

7.3.1.1 Provision of Water Storage¹⁹

According to the International Commission on Large Dams, total dams and reservoirs in Pakistan over the height of 15 m (49 ft.) are known as large Dams. Tarbela Dam is the largest earth filled dam in the world and is second largest by the structural volume²⁰. Mirani Dam is the largest dam in the world in terms of volume for flood protection with a flood stock of 588,690 cubic hectometer while Sabakzai Dam is 7th largest with a flood stock of 23,638 cubic hectometer. Pakistan's water storage capacity is just for 30 days against the minimum requirement of 120 days while most of the developed countries have 1-2 years' water storage capability. The agriculture productivity in Pakistan in the wake of just 30 days' water storage capacity has alarmingly tumbled because of the water scarcity and its contribution towards gross domestic product has lowered by 21.8 per cent of GDP.

As the population of Pakistan is going to increase up to about 250 million by year 2030, the water availability which was around 5000 m³/capita/annum in 1951 (presently stands around 900 m³/capita/annum) is going to further reduce to around 700 m³/capita/annum by 2030, thus creating a water scarcity problem of acute nature unless adequate measures are taken to mitigate the above challenge.

The dwindling per capita availability of water in the country is shown in **Table 7.2**.

Table 7.2: Per Capita Water Availability in Pakistan

Year	Population (Million)	Per Capita Water Availability (m ³)
1951	34	5260
1961	46	3888
1972	65	2751
1981	84	2129
1991	115	1565
2002	139.5	1282
2010	173.51	1030
2015	191.71	932
2020	210.13	850
2025	227.35	786
2030	242.05	738

¹⁹Falkenmark Water Stress Indicator

Pakistan Strategic Country Environmental Assessment

<https://www.thenews.com.pk/archive/print/240583-population-explosion-a-threat-to-pak-progress#>

http://www.pbs.gov.pk/sites/default/files/other/pocket_book2006/2.pdf

<http://www.pakistaneconomist.com/pagesearch/Search-Engine2010/S.E634.php>

²⁰ Asianics Agro-Dev. International (Pvt) Ltd. (2000)

The construction of proposed dam will aid to store the flood water of Chenab River and overall increase the water storage of the Pakistan. The proposed Project will form an active storage reservoir of about 1,147 Mm³ capacities with the aim of providing assured and sustained supply of irrigation water for the downstream of the proposed dam and power supply need as a by-product. This would not only help to irrigate the new command areas downstream but would also augment the irrigation as well as power shortfall.

7.3.1.2 Energy Production

Proposed Chiniot Dam will generate an estimated annual energy production of about 227 GWh with the installed capacity of 80 MW. This will be produced as a by-product and help the National Power Policy achieve the goals of meeting Pakistan's energy needs in a sustainable manner and ensuring the generation of affordable electricity, while helping to close the existing energy supply gap.

Pakistan is facing acute shortage of Power due to increase in population and industrial development, which has created a huge gap between the demand and supply of electric Power. Its continued economic development is under threat unless the present shortages can be eliminated, increasing dependence on oil-fired electricity reversed and the country provided with affordable electricity at times of the day and the seasons when it is required. Currently being utilized Power generating sources are not sufficient to meet the electricity demand of today and obviously insufficient to meet the future ever increasing demand.

The current power load-shedding in the urban and rural areas, had become a routine matter, having a devastating impact on the national economy, industry and agriculture, putting millions of workers jobless. The rise in unemployment is having a direct adverse impact on the already deteriorated law & order situation in the country. Therefore, addition of this associated 80 MW of energy in the national grid will be a direct positive impact of the Chiniot Dam Project.

7.3.1.3 Groundwater Recharge

Chiniot dam will also play a significant role in groundwater recharge in the study area. The operation of Chiniot dam will regulate the water flow in downstream areas and ensure a steady supply throughout the year. By holding back water during rainy seasons and release it during drier periods, making it more suitable for groundwater recharge. This controlled release simulate natural flow patterns, allowing water to infiltrate the ground and recharge aquifers and prevent water scarcity.

7.3.1.4 Water Management

The anticipated storage capacity of the proposed reservoir is (1.0 MAF) at a full supply level of 190 m a.s.l. The design flood return period is 100 years which would produce a high flood level of 191.5 m a.s.l. Dam would be constructed on Chenab River with large storage for storage of flood surplus water and to regulate it. Chiniot dam project would also help to supply water on daily basis at downstream of the dam. It will mitigate impacts of existed drainage system and improve ground water situation at downstream of dam.

7.3.1.5 Local Vegetation and Livestock

The availability of the standing water of the Chiniot reservoir is likely to improve the microclimate of the area in what is currently not fit for flora and fauna. The fluctuations in the reservoir area created due to the operating conditions required by the generation of peak demand hydropower will promote the conditions for the growth of grassland and other vegetation at the periphery of the reservoir. This will provide valuable grazing for livestock, particularly in winter when grazing areas in the adjacent to reservoir. The improved vegetation condition around the reservoir will also provide improved habitats for birds, including waterfowl, and other wildlife which are likely to be attracted by the enriched ecosystem

7.3.1.6 Aquatic Life

The reservoir area of 190 sq. km will provide a significant volume of water that is likely to develop into an important aquatic ecological habitat. This should allow a significant development of fish and other aquatic plants on commercial basis. The scope for development of appropriate commercial managed fisheries is considerable, with widespread potential benefits in terms of employment for local people and also improvement in the levels of human nutrition for people living in the immediate and wide area.

7.3.1.7 Migratory Birds

During the winter season number of migratory birds reach in this area. The quantity of these birds going to reduce because water shortage in winter season. The reservoir provides abundance water through the year. The reservoir of Chiniot Dam creates save place for breeding and other activities.

7.3.1.8 Protection against Devastating Floods

Chiniot Dam project site has been planned for storage of water in flood season to cater for unprecedented releases from India in flood season and this stored water can be used for irrigation of lands in vicinity of Dam in low flow times.

Every year, sufficient flood water released by India in high Flood season and its tributaries enters the downstream areas of Chiniot District by submerging dwellings and cultivated land resulting in heavy financial as well as life damages. Further these releases submerge downstream areas of Jhang district upto Trimmu Barrage Athara Hazari causing temporary displacement of number of households along with their cattles. Chiniot dam project will not only provide shelter to downstream areas from flood damages during every flood season but will also recharge water table and irrigation of additional culturable lands of Chiniot and Jhang Districts. By creating reservoir after construction of Chiniot dam the stored water can be effectively used for water supply to Faisalabad and its surrounding areas as groundwater of Faisalabad district is not fit for drinking being saline in nature.

In connection to this Punjab Government spends Billions of Rupees every year for construction of protection bund as river training works along banks of Chenab River in order to stream line the flows of Chenab River without damaging of land and houses in vicinity of Chiniot and

Jhang Districts. Despite of all these arrangements flood water caused severe damages in these areas when unprecedented flood occurs due to high peaks released by India during every flood season without prior intimation to Pakistan. All these damages occur due to absence of a permanent structure at Chiniot Dam site.

7.3.1.9 Irrigation Benefits

Conservation of water at present is an alarming issue of Pakistan. Being an agriculture country Pakistan's economy based on agricultural products, so for growth of agriculture water is key factor. As the present landuse of the area is predominately agriculture and the promotion of agriculture depends to a large extent on the availability of irrigation water.

Construction of Chiniot Dam will conserve and regulate surplus flows of Chenab River for downstream use in the Indus Plain. Chiniot storage would benefit canals located it's downstream. The reservoir would store about 0.9 MAF of water to be released from storage by November, each year. Storage of surplus flood waters in this reservoir would permits diversions for beneficial use of flood water during the early summer thereby permitting the irrigation of some new area as well to supplement the existing irrigation system.

7.3.1.10 Infrastructure Development

Access and approach roads will be improved for the transportation of machinery of the Project, especially during construction activities of the dam for various components of the Project. Locals will be benefited by these roads and infrastructure during the construction and after the construction of the proposed Dam.

7.3.1.11 Employment Opportunities

Employment opportunities will be created for the unskilled and skilled local labor especially during construction and O&M phases of the proposed Project. The requirement of engineers, workers, labor, technicians, para-professionals etc. will help to generate employment opportunities from local communities preferably. Apart of this, opportunities of small businesses (for example, shop keepers etc.) will also be increased to have more income for local inhabitants. Locals will also have the opportunity to diversify their incomes by being employed during the construction period of the proposed Project. This will bring prosperity among locals and help in increasing the confidence of locals towards development Project. Transportation of the material, equipment, labor and other accessories the business of transport and cargo will also flourish in the area. This will also be a positive impact for the locals.

7.3.1.12 Recreation and Tourism Development

The construction of Chiniot dam will create a reservoir in an area where there are very few open water bodies and it is likely to enhance the landscape diversity of the area. There is already some limited tourism in the area. With the construction of the reservoir, it should be possible to provide a more diverse experience, including boating, sport fishing and also wildlife viewing, as the area is likely to provide a good habitat for water birds.

The dam itself will be a significant tourist attraction and a visitor's information center could be built explaining to the public the nature of the project. Adequate and well-planned tourist facilities, such as hotels and restaurants, along with boat and vehicle hire tours, would need to be put in place to capitalize on this opportunity

7.3.1.13 Water Supply to Nearby Community (Faisalabad)

The economic benefits of proposed future drinking water supply option from Chiniot Dam to Faisalabad city has been calculated on the basis of estimated planned annual water supply of 70 Million cubic meters. This supply would meet the daily water demand of around 1.0 million population or 158,479 households throughout the operational life of dam. The "willingness to pay" value for water supply services in Faisalabad has been estimated as Rs. 1059 per household per month by JICA master plan for WASA Faisalabad (2019). This value has been adopted here for estimating the water supply benefits. SCF has been used to convert this financial value to economic value of Rs. 1,906 per household per month. Thus annual water supply benefits have been estimated as Rs. 3,625 Million.

7.3.1.14 Socio-Economic Uplift

Development of small and local business, water for irrigation and job opportunities during the construction and O&M phases will cause socio-economic uplift of the area. The proposed Project will create new job opportunities for local residents preferably during the construction and O&M phases of the Project. This will uplift the socio-economic situation of the area. Non-quantifiable benefits include a significant improvement in general hygiene and living conditions of the rural area population with improved water quantity/quality as well as environment. It is also expected to increase in the land value and owners will have an opportunity to sell their land at increased prices and start new businesses.

7.3.2 Indirect Benefits

Other indirect benefits due to the construction of the Chiniot Dam could be listed as follows:

- Enhancement and improvement of the local economy due to enhanced irrigation facilities, and consequent benefits, which will create additional employment opportunities at the local level (for instance mechanics for modern machinery & equipment for irrigation);
- New roads / infrastructure in the form of access roads to the Dam area;
- New recreational facilities due to proposed reservoir; and
- The increased crop production will stimulate business and employment opportunities for the labor in form of handling, transportation, marketing, processing, etc. of agriculture produce.

7.4 EVALUATION OF ADVERSE IMPACTS DURING DESIGN/PRE-CONSTRUCTION PHASE

7.4.1 Physical Environment

7.4.1.1 Permanent Land Acquisition

a) Impact

Permanent land will be acquired for the Project components such as Powerhouse, Weir & Associated Structures, Access Roads and Project Colony. Overall, in the Project area 48,300.07 acres of land will be submerged which includes both private and government land. However, out of 48,300.07 acres, approximately 13,122.02 acres' land is river plain and 20,165.73 acres' are comprised of land prone to flood land 12,613.41 acres' are comprised of rich fertile agriculture land. The land title/ownership will be determined by the revenue department. However, the private land will be acquired on permanent basis under the provisions of Land Acquisition Act (LAA) 1894.

Moreover, the ownership record of affected land will be prepared by the Revenue Department according to separate categories of the land. Hence, this impact is Site-specific, Permanent, Irreversible, Possible, High Significant.

b) Mitigation Measures

Government owned land for the Project area will be acquired as per the policy of government of Punjab. While private land will be acquired as per provision of LAA, 1894. The process of land acquisition will start before the Project will enter into construction phase and section-4 of land acquisition act, 1894 will be notified by relevant agency.

The process of land acquisition and compensation should be followed in a transparent manner to minimize the impacts to provide judicious compensation to the displaced by providing sufficient budget in the project cost. According to Land Acquisition Act 1894, the following points are to be considered while determining compensation for the project affectees:

- The Land Acquisition Act (LAA) of 1894 is the main law regulating land acquisition for public purpose. This impact can be mitigated by ensuring compliance of Land Acquisition Act, 1894, addressing community grievances on priority basis and timely compensation to affectees;
- The process of acquisition for the land and land based assets and compensation should be followed in a transparent manner to minimize the impacts to provide judicious compensation to the displaced by providing sufficient budget in the Project cost.
- Due consideration should be given to minimum land acquisition in design phase by selecting alternate options and changing in engineering features if possible;
- Land that will be coming under project area should be acquired according to Land Acquisition Act (LAA), 1894.
- Compensation should be evaluated and provided as per market rates.
- In addition to land compensation, 15% compulsory land acquisition surcharge should be given to land affected persons.

- Other land based assets like orchards, crops and trees should also carefully enumerated and compensated according to agreed entitle matrix during preparation of RAP.

7.4.1.2 Temporary Acquisition (Land on Lease)

a) Impact

During the construction activities, contractor will establish contractor camps, storage areas for materials and equipment including vehicles, workshops, stockpile yard, etc. The tentative location of these construction camp areas is shown in (Refer **Figure 3.6**) which need to be finalized yet. Contractor need to lease the land for these areas in the vicinity of the construction sites. These areas will be acquired on temporary basis by direct negotiation and agreement with the owners or negotiated with or decided by the district administration office. Temporary acquisition will principally be the responsibility of the contractor. The total estimated land which will be occupied by the construction camps and associated facilities is about 1500 acres (for staff and labour camps and for material and equipment storage area). This impact is Site-specific, Medium Term, Reversible, Possible, High Significant.

b) Mitigation Measures

Land for above mentioned facilities will be directly rented from the private landowners by the contractor. The provisions of the Land Acquisition Act (LAA), 1894 will not be involved as the acquisition of the land will be temporary and will be covered by short-term lease agreements between the landowners and contractor. Temporary acquisition will principally be the responsibility of the contractor. Rental terms will be negotiated to the satisfaction of the concerned landowners and the agreement will be made in local language to make the process clear.

As mentioned the location of these areas are not finalized yet, therefore a criterion has been suggested which will be followed to avoid the adverse impact on the environment. The land for above mentioned facilities will be selected and leased prior to the start of construction phase.

Lease agreement will also govern the process of site restoration of the leased or rented land after the construction phase and will ensure through the terms of the construction contracts that landowners are compensated according to the terms of the lease agreements and the site restoration plans agreed upon by the contractors are duly carried out.

The following general site selection criteria have been suggested to be complied by the contractor:

- Minimize the resettlement, relocation of the existing infrastructure like roads, cultural and religious sites etc. and avoid the cutting of trees;
- It will be elevated to avoid floods and for other security reasons;
- Proximity to the major disaster and emergency management authorities;
- Avoid potentially security vulnerable areas;
- Minimize disturbance to the natural habitats of flora and fauna;

- Avoid densely populated areas/towns;
- Avoid indigenous or tribal settlements;
- Avoid wildlife sanctuaries, national parks and game reserves;
- Appropriate distance from the sensitive receptors (for instance, minimum 500m); and
- Avoid cultural, religious and historical buildings.

7.4.1.3 Impact of Structure Loss

a) Impact

The proposed project will affect the local residents and farmers at great extent. The public consultations and GIS based calculation of the affected structures revealed that more or less 3,896 miscellaneous structures will be affected due to creation of the reservoir area. These miscellaneous structures include residential, commercial, community and public structures including sensitive community structures like mosques and graveyards. The inventory of land, the detailed measurement of affected structures and the number of households to be affected by the acquisition of land will be completed during the preparation of the Resettlement Action Plan (RAP) with the help of the revenue and other concerned departments. The impact will be permanent and highly adverse in nature.

Due to adverse impact on the residential structures, human disturbance and displacement will occur which cause the social, gender, livelihood and cultural issues. This impact is Site-specific, Medium Term, Reversible, Possible, High Significant.

b) Mitigation Measures

- The efforts should be made to minimize the resettlement impacts on the local community by adopting engineering alternatives where possible;
- The effort should be made by making changes in design to avoid the sensitive and religious structures and to minimize the issues at possible extend. If demolishing is necessary, a mechanism will be developed for the restoration of these structures with the community consultation;
- A comprehensive resettlement and relocation plan must in place before displacement of affected communities at the large scale;
- Affected Persons should be compensated on full replacement cost of each category to construct a new structure of the same type;
- A comprehensive livelihood restoration plan should be prepared before displacement of the affected community; and,
- Proper consultations and coordination's with PAPs during and after resettlement process.

7.4.1.4 Impacts due to Field Investigations

a) Impact

Low level adverse impacts on the air quality, impact on surface water quality, soil contamination, soil erosion due to the pre-construction activities like geotechnical investigations including drilling, topographical surveys and seismic investigation will affect the existing settings. Activities like drilling, blasting, movement of machines and setup of contractor and consultant camps will also impact the soil, wildlife, noise levels etc. However, this impact is Site-specific, Temporary, Medium Term, Reversible, Likely, Low Significant.

b) Mitigation Measures

Good engineering practices and Standard Operating Procedures (SOPs) are required to be adopted by the contractors. This will mitigate or avoid this insignificant impact.

Measures such as sprinkling of water on the roads and dirt tracks, use of water to reduce air pollution during the stone crushing operation and tuning of vehicles and equipment will reduce the air pollution. The excavated material will be managed by ensuring proper storage areas located far away from the water bodies. The choice and design of these measures such as reduction of slope gradient and height, reduction in slope angle, removal of unstable material, use of reinforcement material etc. will be the responsibility of the contractor. The contractor will be required to train his workforce in the storage and handling of materials, like oil, diesel, petrol and chemicals, etc., which can potentially cause soil contamination. Special measures will be adopted to minimize the impacts on the nearby settlements such as avoiding noise generating activities during night time, etc.

7.4.1.5 Physical, Religious and Cultural Resources

a) Impact

According to the field survey, various local village mosques such as Masjid Wadi Aziz, Shareef Masjid and Boo Ali Qalandar Shrine are coming in the reservoir area. Other sensitive places are Government Primary School Basti Malah, Government Primary School Burj Umer and Monument Shuhada. These sensitive places are not directly affected due to proposed project however special considerations are required to eliminate the probability of impact.

b) Mitigation Measures

Due consideration shall be given to minimize the adverse impacts on the religious and community structures and places.

7.4.1.6 Interference with Other Utilities

a) Impact

The utility lines like gas pipes, electricity lines, local roads/tracks, etc. exist within study area of the proposed project. These utilities will be relocated before the start of construction activities. These utilities if not handled properly may cause difficulties to the people of the project area. The impact significance is medium adverse.

b) Mitigation Measures

- Proper compensation and restoration mechanism of public utilities will be adopted. The relevant department will provide the estimate for the relocation of the utilities and they will be provided compensation accordingly through PMU prior to implementation of the proposed project;
- Complete rehabilitation of affected public utilities will be ensured;
- All public utilities likely to be affected by the proposed project will be relocated well ahead of time before the actual commencement of the construction work;
- Close coordination with the concerned departments to curtail inconvenience to the residents of the project area; and
- Timely public notification of unexpected disruption of services will be ensured to avoid inconvenience to locals.

7.4.1.7 Water Logging Issues

a) Impact

Water logging can have significant impacts on nearby agricultural land, especially due to impoundment of reservoir. Water logging occurs when the soil becomes saturated with water, leading to poor aeration. The creation of a reservoir can lead to the inundation of fertile agricultural land, displacing crops and rendering the soil unsuitable for cultivation. This can result in the loss of valuable arable land, affecting local farmers and food production. Water logging can also contribute to soil salinization, especially in areas where the impounded water has a high salt content. As water accumulates in the soil, it can bring salts to the surface, making the land less fertile and inhibiting plant growth. The prolonged presence of water on agricultural land can lead to the significant yield losses and economic hardship for farmers. The impact significance is medium adverse.

b) Mitigation Measures

To mitigate the adverse effects of water logging on agricultural land, proper planning, and management strategies, such as implementing drainage systems, selecting appropriate crops, tube well arrangements in adjoining areas, and monitoring soil and water quality, are essential. Implementation of proper reservoir operation strategies will be ensured to control water levels and prevent prolonged inundation of agricultural land. Effective drainage systems including channels, ditches, and drains have been proposed along the dykes of the reservoirs and for surface and subsurface drainage, to remove excess water from the soil. Additionally, engaging

with local communities and stakeholders during the planning phase of reservoir projects can help identify and address potential challenges associated with water logging.

7.4.1.8 Impact on Downstream Low Riparian

a) Impact

As per definition, riparian zone or area is the interface between the land and a river or stream. Lower riparian area can be broadly defined as the area from the proposed dam up to the Trimu Barrage. There is a significant flooding Impact on the immediate downstream settlements (Muslim Colony, Darul Yaman, etc.) during the emergency flushing and high flow seasons. Apart from this, there are numbers of downstream water users which get benefits from the flooding water during high flow season. After attenuation of the flood, the downstream flow will be regulated and confined to the limited area which will not only save the local population from flood damages but on other hand cause serious livelihood and agriculture damages. The impact significance is medium adverse.

The minimum water release downstream of Chiniot dam may be sub divided into following major categories:

- Domestic unallocated water usage;
- Aquatic Water Usage;
- Groundwater Recharge;
- Recreational; and
- Losses and unaccounted water.

Water is being pumped by the locals or the lower riparian directly from the Chenab River for domestic purposes such as drinking, washing, washing of livestock etc. This water is also being used for the bathing and drinking of livestock apart from dumping of waste. This unaccounted-for water demand needs to be taken care during the establishment of minimum flows in the Chenab River. Apart from the above water usage, Chenab River water is also being used for the purpose of recreation such as boating and swimming. This use is identified based on the secondary information provided by the locals and later verified during the visit to the banks of Chenab River downstream of proposed project. Therefore, this use may also be considered for the establishment of minimum Flows.

Flood or rain fed agriculture water usages in the lower riparian area for irrigation purpose is also practiced during the floods by trapping flood water. Due to the construction of the dam, supply of water to the lower riparian area will be attenuated. Peaks will be flatter hence water might not reach the areas where the water reaches during flooding period. The impact significance is medium adverse.

b) Mitigation Measures

- Serious attention will be paid towards the issue of “Environmental Flow” which in many projects is fixed at an arbitrary level (normally 10% of the base flow) without taking into consideration the water uses / needs downstream of the proposed dam and mostly ignoring the rights of the lower riparians. In order to conserve the water rights of the

lower riparian, a provision of regulated flow will ensure during the dam operation. Therefore, lower riparian will not be devoid of their water requirements by volume instead due to the regulated flow, they will be better off as compared to the current scenario.

- Chenab River is being used for boating and swimming purposes at limited scale on various appropriate locations. Since this use is associated with summer as well as winter season. For summer season, due to the rainy season no minimum flows can be estimated as ample water is available. Therefore, an amount needs to be fixed for the flow month as a percentage of total flows (needs to be verified). It is suggested that 10% of the minimum flow currently occurred of the total flows available can be considered as for the recreational purpose. However, this needs to be verified through detailed flow assessment studies;
- Apart from above intended usage, groundwater recharge is another component which needs to be considered while calculating the minimum environmental flows for the Chenab River downstream of the proposed Dam. Based on current ground water study, a 5% of the minimum flow occurred of the total flow in the river can be considered as a limiting value. However, this needs to be verified through detailed downstream flow assessment studies; and
- Similar to the above, the flood or rain fed agriculture water usages demand of the lower riparian area for irrigation purpose will also require detailed flow assessment to allocate the minimum flow so that this impact can be minimized.

7.4.2 Ecological Environment

7.4.2.1 Flora

a) Impact

During the pre-construction phase, activities such as installation of construction camps, construction of temporary roads and mobility of construction staff may damage the local vegetation/trees. As the heavy machinery and camps will be moved and installed, which require significant space due to which available vegetation is expected to be removed. This impact is Site-specific, temporary, reversible, Possible, Medium Significant and needs to be encountered prior to the start of construction stage. Chak Sarkar Reserved forest (details provided in ecological baseline) may be falling under the project activities which will cause negative impacts on the local ecosystem. The impact significance is low adverse.

b) Mitigation Measures

- The camps, mobility of machinery and construction of temporary road should be proper planned and well designed to avoid any loss to local green cover.
- It is recommended to establish the construction camps where minimum or no vegetation exists.
- Similarly, the alternate routes for roads and points for camps are recommended where no loss of vegetation is expected.
- The location of construction camp will be selected so, as to have limited environmental effect during construction phase and to reduce the cost and land requirement.

- In the design phase all the reserved forest areas/ecologically sensitive areas must be avoided, or to minimise the negative impacts.

7.4.2.2 Fauna

a) Impact

As movement and installations of machinery and vehicles will take place so noise and habitat loss is expected. The routes of the available wildlife and other habitats may be affected due to camps set-up and machinery movements and installations. Temporary road may also affect the habitat of locally available fauna. Wildlife sensitive areas in consultations with relevant department must be avoided as disturbance to the wildlife may cause negative impacts. The impact significance is low adverse.

b) Mitigation Measures

- The standard measures must be adopted to minimize noise due to machinery movements and installations.
- Wildlife movements and routes must be considered during activities and should be avoided to their maximum level.
- The alternate routes and points are recommended to avoid any damage to locally available fauna.
- The camps shall be properly fenced and gated to check the entry of animals in search of eatable goods.
- Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them.
- In the design phase the Chak Sarkar reserved forest areas and other designated wildlife areas or ecologically sensitive areas, if any must be avoided, or to minimise the negative impacts.

7.4.3 Socio-economic Environment

a) Impacts

During the planning and design phase of the project, it is anticipated that there will not be any potentially significant adverse impact on the socio-economic environment. Locals may be temporarily disturbed due to the field investigations and drilling activities. This impact can be categorized as indirect, low, site-specific, short term, temporary, low probable and reversible.

b) Mitigation Measures

No mitigations measures are required except good engineering practices to avoid and reduce these low adverse impacts.

7.5 ADVERSE IMPACTS DURING CONSTRUCTION PHASE

Following impacts are anticipated during the construction activities on reservoir area, dam site, distribution weir site, gross command area and access roads:

7.5.1 Physical Environment

7.5.1.1 Visual Intrusion

a) Impact

Construction activities at dam axis, distribution weir and saddle axis will result in some visual impacts. The construction activities will involve the cutting of trees/vegetation, excavation, soil filling and cutting operation. This disturbs the natural scenic value of the environment. In addition to that the sitting of construction equipment and the lacks of resurfacing/replanting of exposed areas are also the leading factor to aesthetic reduction. This impact is Local, Long Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

The adverse environmental impacts related to the aesthetic could be effectively minimized at the construction phase. These will be mitigated by the control of clearing vegetation to the area in the construction limits and by plantation and quick re-vegetation during the construction phase. Good house-keeping, cleaning, efficient solid waste management system will be implemented to improve the aesthetics of the working environment.

7.5.1.2 Site Accessibility

a) Impact

The proposed Project Area falls within the territory of District Chiniot, please refer to the location map as Figure 1.1. The Project site can be accessed through Chiniot bypass, Pindi Bhattian – Chiniot Road and M-2 motorway.

Heavy vehicles will be utilized to transfer construction plants, equipment, construction materials, cement and fuel. These activities may have adverse impacts on the access roads. Apart from that it will increase the air and noise pollution. This impact is Local, Medium Term, Reversible, Likely, Highly Significant.

b) Mitigation Measures

The access roads to the dam site have to be pre-determined in consultation with the highway/traffic management officials. Access roads would have to be widened and/or improved to carry the anticipated load of traffic.

During the course of construction of proposed Chiniot Dam Project, contractor(s) will provide the signage and/or traffic control to the extent deemed necessary by the traffic utilizing or accessing the site roads. These signs will inform, control, warn, shift, or stop traffic on all site roads affected by the Project's heavy traffic. The following measures will be taken by the contractor(s) during the construction phase for the effective implementation of the traffic plan:

- Pakistan national and local traffic rules and regulations, instructions manual for motor vehicle and mobile machinery operation will be followed;
- No one will be allowed to drive motor vehicle or operate mobile machinery without a driving license;
- It will be prohibited to drive or operate vehicle in case of over fatigued or mental disease;
- Traffic speeds on unpaved roads will be limited to no more than allowable traffic speed;
- Traffic speed signs will be displayed prominently at all site entrances;
- A daily routine check-up of vehicles will be conducted not less than 05 minutes before its service;
- Use of appropriate signs, equipment, and traffic control measures that conform to the provisions in the traffic manual of city traffic police;
- Traffic inspection and security during transportation;
- Limit vehicular traffic designated access roads, construction laydown area, parking areas and the Project site;
- All damaged, destroyed or modified pavement legend, traffic control devices, signing and striping associated with the proposed development will be replaced as required prior to issuance of a certificate of occupancy; and
- Construction signs, lighting and barricading will be provided during construction as required.

The contractor(s) will also be responsible to prepare a comprehensive Traffic Management Plan and follow the conditions of contract for construction.

7.5.1.3 Natural Drainage

a) Impact

Construction activities such as excavation, filling and construction of the dam structure, distribution weir and saddle axis will affect the existing soil pattern in the Project Area, its surroundings and along the command area. In addition, this will lead to changes in the existing drainage pattern. The conditions will be more hazardous during the flood periods and can affect the construction activities. This impact is Site-specific, Medium Term, Reversible, Likely, Medium Significant.

b) Mitigation Measures

During the construction phase, excavated material will be properly disposed of ensuring that it will not block the natural drainage paths. Open drains for drainage of rain/flood water will be constructed, if considered necessary during construction period.

7.5.1.4 Potential Loss of Land in Disposal Areas

a) Impact

During the construction phase, huge quantities of rock will have to be excavated. Part of the excavated rock can be used as concrete aggregate provided the fragmented rock meets the quality standards needed for the work. In order to reduce the amount of rock to be disposed, excavated rock can be used in the Project for different types of infrastructural works. The remaining spoil will be disposed in designated and safe disposal areas. Based on the notion of significance, this impact is Local, Medium Term, Reversible, Likely, Medium Significant.

b) Mitigation Measures

The following mitigation measures will be implemented to reduce the impact significance:

- Minimize the generation of spoils by recycling the excavated rock to the maximum extent possible by using them as aggregate material in the concrete works;
- A restoration and re-use plan for the disposal areas will be prepared in advance;
- A spoil disposal plan will be prepared and implemented;
- Barren lands or natural depressions will be used for dumping the excavated spoil material ensuring that the local drainage will not be disturbed;
- The disposal area will be re-contoured to minimize changes in topography;
- Dispose excess rock material in the designated disposal site in an orderly manner (different spots to different size rocks); soil erosion control measures through bio-engineering techniques; and
- Potential risks of acid drainage will be assessed during construction by the contractor and necessary treatment measures will be adapted.

7.5.1.5 Resource Conservation

a) Impact

Resources involved in the construction of proposed Project would include water, fuel and construction materials.

Excessive water consumption by the construction staff may stress water resources in the Project Area and in certain cases may disturb the existing water supplies in the Project Area. Construction material to be used for construction includes coarse aggregates, fine aggregates, asphalt, cement, lining material, earthworks, reinforced and structural steel etc. Almost all the materials to be used in the construction of proposed Project are non-renewable and therefore their efficient use is necessary for the future use.

Fuel will be used to operate construction machinery. Efficient use of energy resources is important to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is important. The impact is minor negative. The impact significance is medium adverse.

b) Mitigation Measures

Following practices shall be adopted to conserve these natural resources:

- Use potable water bowsers for construction works and mineral water bottles/ ground water for drinking purpose;
- Plan for the provision/purchase of adequate insulation to reduce heat loss through batching plants;
- Reduction of wastage of water through training of workers involved in water use;
- Reuse of construction waste materials may be adopted wherever possible;
- Diesel and fuels with low sulphur content will be used to operate construction machinery and equipment;
- The efficient and well maintained equipment and machinery will be used;
- The equipment and machinery will be turned off when not in use;
- Ensure adequate insulation to reduce heat loss through batching plants;
- Regularly monitor CO and CO₂ content of the flue gases to verify that combustion systems are using practical excess air volumes; and
- A good camp design and an efficient worksite management plan can help the contractor to reduce the water demand, wastewater and solid waste volumes to the lowest levels.

7.5.1.6 Soil Contamination & Erosion

a) Impact

During the construction phase of the Chiniot Dam Project, large quantities of waste materials, chemicals, fuel and lubricants will be used apart from the generation of solid waste and liquid waste from the construction camps. Fuels and chemicals will be stored at the site for their immediate use, which will contaminate the soil if not handled properly.

Similarly, removal of vegetation and shrubs for the purpose of construction activities will lead to loosing of the soil, soil disturbances, and exposure of bare soil surface. This causes problems of soil erosion and siltation during rain. This impact is Local, Medium Term, Irreversible, Likely, Highly Significant.

b) Mitigation Measures

Good engineering practices will help in controlling soil erosion at construction sites. Following measures will be adopted according to site condition:

- Soil erosion impact on the area during the construction phase will be of a temporary nature. However, the contractor will be required to train his workforce regarding storage and handling of materials, like oil, diesel, petrol and chemicals, etc., which can potentially cause soil contamination;
- Retain as much existing vegetation possible;
- Use natural and artificial cover on disturbed areas;
- Divert runoff away from disturbed areas;
- Minimize runoff velocity and discharge;
- Proper solid waste management and housekeeping at construction camps will be practiced;

- The contractor will be required to prepare training manual and modules for all the construction related activities along with the schedule of training program and submit to the supervising consultants for approval;
- Soil contamination due to concrete transportation will be minimized by placing all containers in casings;
- The oil, fuel and chemical storage areas will be designed as per applicable standards i.e. Statutory Notifications (S.R.O), Government of Pakistan, Oil and Gas Regulatory Authority, Notification, Islamabad, 2nd July, 2009, etc.;
- Material Safety Data Sheets (MSDS) will be strictly followed during handling and storage of chemicals;
- Solid waste generated at the camp sites will be properly treated and safely disposed only in the demarcated waste disposal sites/areas; and
- Site restoration plan for the Project will be strictly followed.

7.5.1.7 Liquid and Solid Waste from Construction Camps

a) Impact

Development of construction camps in the Project Area will generate a significant quantity of liquid and solid waste. Residential accommodation is required for about large number of staff and workers of the contractor, the consultant and the employer on the Project. It is proposed to locate the necessary temporary and permanent colonies at or near the proposed Project site. Approximate proposed strength of the total staff for camps is about 450 at this phase of the Project. As a general rule the water consumption will be about 40 liters/capita/day and will subsequently generate about 70 to 80% of this water as sewage.

Disposal of wastewater without treatment will pollute the soil and surface water. Hence, water demand, on average, will be 18,000 liters/day for camps during the construction phase and estimated generated wastewater will range from 14,400 liters/day.

Camps will generate about 0.45 kg/person/day domestic solid waste comprising kitchen waste, garbage, putrescible waste, rubbish, and small portion of ashes and residues. Estimated quantity of solid waste will be about 202.5 kg/day. Improper waste management activities can increase disease transmission, contaminate ground and surface water and ultimate damage to the ecosystem. This impact is Site-specific, Medium Term, Reversible, Possible, and Medium Significant.

b) Mitigation Measures

To dispose the liquid and solid waste generated from the construction activities, the following steps will be taken by the contractor:

- Domestic and chemical effluents from the construction camp will be disposed by the development of on-site sanitation systems i.e. septic tank along with soakage pits, prior to discharge. Septic tank will be located adjacent to the construction camp. Proper monitoring to check the compliance of PEQS will be carried out;
- The domestic sewage will be treated with biological treatment technology and will be discharged as per PEQS. Proper monitoring to check the compliance of PEQS will be carried out;

- As per standard engineering practices after digestion of sludge for an extended period, the sludge will be dried and be used for the landfilling at proper location for final disposal;
- All the solid waste from the camps will be properly collected at source by placing containers and disposed of through proper solid waste management system. The contractor will coordinate with local representatives and concerned authorities, if any, for the disposal of solid waste;
- Toxic waste will be handled, stored, transported and disposed separately;
- The waste will be properly sealed in containers with proper labels indicating the nature of the waste;
- Solid waste will be segregated at source so that it can be re-used or recycled; and
- A waste management plan will be developed by the contractor and will be implemented with true spirit.

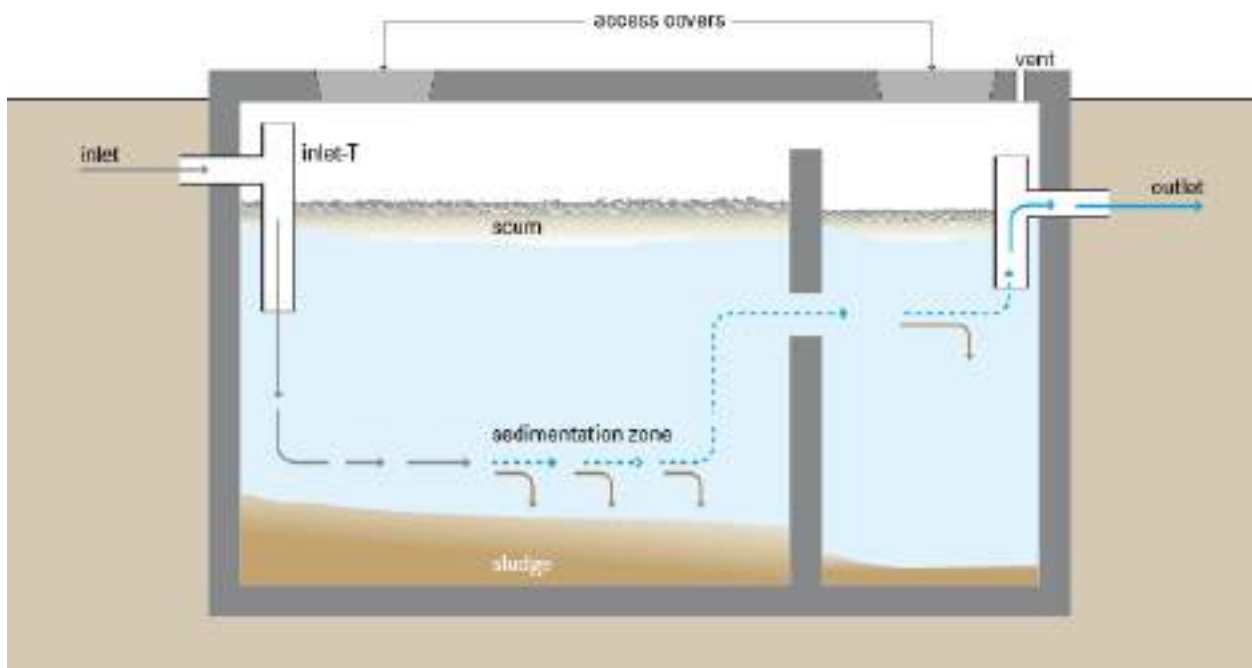


Figure 7.1: Schematic of Septic Tank

7.5.1.8 Surface Water Quality

a) Impact

Surface water quality of the Chenab River may get deteriorated due to the construction activities. During the construction phase of the proposed Project, materials like sand, gravel and stones will be required in large quantities. Extraction of the materials will also affect the surface water quality by increasing the sediment load. This water will be used during different construction activities. The movements of heavy vehicles on the unpaved tracks, excavation activities, cut and fill processes in the Project Area, fuel and chemical spills may deteriorate the quality of the surface water. These activities will also increase the sediments and turbidity of the water.

Waste streams can bleed toxic materials from items such as batteries, used computer equipment, leftover paints and pesticides and pathogenic organisms include specific strains of bacteria like E. coli into the leachate of dumps. Leachate from waste piles caused by exposure to precipitation and from residual liquids in the waste itself may contain organic matter, nutrients, metals, salts, pathogens, and hazardous chemicals. If allowed to migrate, leachate can contaminate surface water. The impact of waste transportation and disposal on surface water quality is considered to be Local, Medium Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

The excavated material will be managed by ensuring proper storage areas located far away from the water bodies. It will not cause the siltation of the Chenab River and other Nullahs/tributaries. All the solid waste from the camps will be properly collected at source by placing containers and disposed of through proper solid waste management system. To reduce the impact of sediment, load the contractor will make arrangements such as fine screens and drains to limit the siltation into the water bodies. A simplified sedimentation tank shall be built on the construction site for the primary treatment of the construction equipment wastewater, detergents and mud. Wastewater effluent from the contractors' workshops and equipment washing-yards will be passed through gravel/sand beds to remove oil/grease contaminants before discharging into the natural streams. This is the general guideline principle for the contractor.

According to the PEQS, the BOD concentration in sewage must be brought down to less or equal to 80 mg/l before being discharged into a natural stream having capacity to dilute the effluent. For wastewater, apart from BOD, COD of 150 mg/l will also be checked; and similarly, if the sewage after treatment is to be discharged on to the land it will meet the requirements of the PEQS for disposal of wastewater.

7.5.1.9 Quarrying/Borrow Area Hazards

a) Impact

Most of the construction material will be obtained from volume of rocks excavated in CDP for construction of powerhouse that is of good quality. Furthermore, to meet the required quantity of construction material for construction of the Earth fill type of embankment proposed for Chiniot dam project is explored at and in the vicinity of project area. Transportation of material from the quarry sites to the dam site will be a major task involving movement of heavy vehicles.

Development, excavation, loading and transportation of material from each site will create various adverse impacts on the existing environment. This would also affect the quality of surface water being utilized in the downstream area of dam axis due to high turbidity. Temporary storage of huge quantities of material in the shape of heaps may also affect the drainage pattern of the area. Hence based on the notion of significance, this impact is Site-specific, Medium Term, Reversible, Possible and Medium Significant.

b) Mitigation Measures

Proper Quarry Development and Management Plan for each identified quarry area will be made prior to the execution of work. The Plan will include all the infrastructural requirements of each site and implementation plan for the development of each quarry site in an environmental friendly manner. This plan will be submitted to the supervisory authority for approval. Guideline quarry management plan is attached as **Annex-VI**.

7.5.1.10 Ambient Air Quality

a) Impact

A large number of machinery and equipment will be deployed at site for the implementation of the Project. Different varieties of machinery/equipment will be required during the construction phase of the Project. The start of construction activities, working of equipment and vehicles will cause deterioration of the ambient air quality. Apart from the emissions of exhaust gases from the vehicles, generators, batching plants and machinery, fugitive dust emission will be the major air quality deterioration component. During the summer season, high winds will moderate the effect due to the dispersion, however, during the winter season, inversion will make the conditions worse. However, this impact will be of a temporary nature. The critical sources of air pollution during the construction phase are:

- Particulate matter from the excavation, movement of traffic and working equipment (stone crushing plants);
- Sulphur dioxide (SO₂) and lead in exhaust emissions of vehicles and machinery on site; and
- Carbon monoxide (CO), carbon dioxide (CO₂) and NO_x in the exhaust gases of vehicles.

This impact is Local, Long Term, Reversible, Likely, Highly Significant.

b) Mitigation Measures

These adverse impacts are likely to occur during the construction phase only. These will be effectively mitigated by adopting the following preventive measures:

- Constant sprinkling of water on the unpaved/dirt tracks to avoid the deterioration of air quality in reservoir area;
- Use of water to reduce air pollution during the stone crushing operation. This will also reduce the dust pollution during the hauling of the material due to the remaining moisture;
- Old plant, equipment and transport vehicles will not be used on the construction Project. Vehicles and plants older than 5 years will not be allowed;
- Haul-trucks carrying sand aggregate and other materials will be kept covered with tarpaulin to reduce the dust pollution;
- Planting rapidly growing trees, shrubs and grasses would help in reduction in air quality deterioration;
- Vehicle will be properly tuned; and
- PEQS provisions for ambient air quality, stack emission, noise levels and vehicular exhaust will be used for reference during the construction works.

7.5.1.11 Noise Pollution

a) Impact

The project activities which generate air pollution also generate noise. Hence during the construction phase, activities like movement of vehicles, operation of machinery, excavation, blasting, etc. will cause noise as well as vibrations. Existing environment of the area is free from noise pollution and the use of machines such as vehicles in the daily activities of the locals is almost negligible. Hence any noise generated during the night time will have a pronounced effect on the nearby receptors. Similarly, use of explosives during the excavation and construction will have a significant adverse impact on the safety of the workers.

The significant impact may be of high magnitude for the labor working in a place that is close to the area where explosives are in operation. This impact is Local, Long Term, Reversible, Likely, Highly Significant.

b) Mitigation Measures

To mitigate the above-mentioned impacts, following measures are recommended:

- Heavy duty machinery will be provided with mufflers in order to reduce the noise to within acceptable limits;
- Construction timing will be consulted with the residents of the nearby villages. This will minimize the disturbance to the local population;
- Provision of mufflers on machinery producing noise;
- Vehicle will be properly tuned;
- During the blasting activities for material quarries and borrow pits, labour will be provided with ear muffs to avoid hearing loss; and
- Construction timing will be coordinated with locals. Normally heavy noise generating activities are allowed only from 9 AM to 5 PM (during day time) to avoid disturbance to local public as well as fauna of the project area.

7.5.1.12 Greenhouse Gases and Climate Change

a) Impact

The main sources of GHG (CO₂, CH₄, NO_x etc.) during the construction activities of the proposed project will include both mobile and stationary sources. The mobile source will be the construction and transportation vehicles while the stationary source will be the batching and asphalt plants. Emission of GHG causes global warming and other climatic changes on regional and global scale. Cutting of trees will also reduce the carbon sequestering and overall increase the CO₂ content in atmosphere which is one of the major GHGs. This impact is Long Term, Likely, medium significant in nature.

b) Mitigation Measures

- Use construction machinery designed with suitable pollution abatement technology such as scrubbers;
- In order to control NO₂ emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO₂, PM10 and fuel consumption, and calibrate the engine in a lower area of fuel consumption;
- Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO₂;
- Used and old electrical equipment will be banned that can also help to reduce urban emissions;
- Environmentally friendly fuel such as Liquefied Petroleum Gas (LPG) can be used instead of diesel;
- Burning of waste will be strictly prohibited at site;
- Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and
- As appropriate use of solar panels at construction camp sites instead of diesel generators will also reduce the emissions.

7.5.1.13 Discovery of Heritage Sites and Structures during Excavation

a) Impact

During excavation, there is a chance of finding artifacts. In case of finding any artifact, the contractor shall immediately report through Supervision Consultant to Directorate General (DG) of Tourism, Sports, Culture, and Archaeology & Museums Department Government of Punjab to take further suitable action to preserve those antiques or sensitive remains.

According to the field survey, no notified archeological site was present in the Project Area. This impact is Long Term, Likely, low to medium significant in nature.

b) Mitigation Measures

- In case of finding archeological remains during excavation, the contractor shall immediately report through Supervision Consultant to Tourism, Sports, Culture, Archaeology & Museums Department Government of Punjab to take further suitable action to preserve those antiques or sensitive remains. Chance finds procedure is given in **Annex-VII**; and
- The contractor needs to obtain approval for excavation and submit the plan of rehabilitation of the site after excavation.

7.5.2 Ecological Environment

7.5.2.1 Flora

a) Impact

The project may involve cutting of vegetation cover on construction areas particularly along the proposed activities. It is initially/tentatively examined through GIS that approximately 50,599 mature and sub-mature trees may be affected which includes 16% Fruit trees and 84% timber trees (out of which 17% are low value trees). The provided number of trees is approximate and tentative which may be finalized prior to construction phase through relevant departments i.e. forest, agriculture and revenue departments.

The number of possibly impacted trees is provided by GIS mapping. Moreover, trees of small and medium sizes may be removed due the project for which compensation with 1:10 will be made to concerned parties (Local community, forest and other relevant departments. If any,) Exhaust of noxious gases from movement of heavy machinery and dust will pollute air which will adversely affect health and vigor of plants. During construction activities, the Contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements).

b) Mitigation Measures

- Incorporate technical design measures to minimize removal of trees.
- Cutting of trees and disturbance shall be avoided, as far as possible so, that negative effects on the process of natural regeneration of species are minimized and possible alternate route must be considered for proposed road, in which minimum ecological and environmental losses are expected.
- A tree plantation program/plan will be implemented (as provided in this report) with the recommendations and technical support of concerned Forest Department.
- As a principal, ten trees shall be planted in place/lieu of felling of one tree in consideration of mortality.
- The client shall implement the program with the help of Forest Department and with the consultation of concerned consultant ecologist.
- The Forest Department and agriculture department shall involve the communities for carrying out plantation.
- Plantation Plan implantation for compensatory planting for ten (10) trees against each fallen tree of similar floral function at the available spaces in/around the project area is highly desired to restore the ecosystem. Total 505,990 trees will be planted to compensate/in lieu of 50,599 trees. The competition ratio is 1:10.
- Open fires should be banned in the area to avoid hazards of fire in the area.
- Clearing of vegetation cannot be avoided at the areas specified for project structures, but damage to the natural vegetation may be minimized by establishing camp sites, workshops and batching plants on waste/barren land rather than on forested or agriculturally productive land.

- However, if such type of land is not available, it shall be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth.
- Construction vehicles, machinery and equipment will remain confined within their designated areas of movement.
- The Contractor's staff and labor shall be strictly directed not to damage any vegetation such as trees or bushes. They shall use the paths and roads for movement and shall not be allowed to trespass through farmlands or forested areas.

Contractor shall provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel shall not be allowed.

7.5.2.2 Fauna

a) Impact

During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, movement of machinery and vehicular traffic, movement of labor, camping, etc. The existing animals will leave the directly affected areas due to construction activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase. Birds as well will tend to move away from the construction areas and find shelter and food elsewhere due to the activities mentioned above for fear of being hunted / trapped.

Noise generated from machinery particularly during the night hours will even scare the wildlife residing in habitats located at some distance from the construction areas. Uncontrolled blasting may even disturb the wildlife of the Project Areas. Food and refuse at the Contractor's camps may attract animals that might in turn be hunted by the workers. This impact is Indirect, Site-specific, Temporary, Reversible, Possible and Medium Significant.

The planned construction activities will bring changes in land uses of the landscape. The planned activities include establishment of site camp and temporary residential baraks for encamped labour, burrowing sites, construction of kaccha service roads and pedestrian paths for efficient mobility of machinery and manpower.

Alterations in surface profile of landscape will impact the status of micro habitats that will result in subsequent dislocation of faunal species. Deep burrows area in the project site would result in emergence of water ponds. Similarly, the establishment of burrows areas in forest covered patches will cause impact on indigenous flora and wildlife habitat.

During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, movement of machinery and vehicular traffic, movement of labor, camping, etc.

The existing animals will leave the directly affected areas due to construction activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase.

However, the impact of project activities on the status of faunal species could be termed as medium to low. During construction phase of the proposed bund rehabilitation near Indus River, the impact sensitivity rating seems to be medium plus. Potential magnitude of impact to the habitat is long term issue that requires safeguard measures well in time. Direct impact on the temporarily dislocated species of fauna is not critical as the species are highly mobile and if their habitat after completion of the project is later restored, they are likely to return. No activities are planned in ecologically sensitive areas or Indus river so no major impact is anticipated in local fauna.

b) Mitigation Measures

- Care shall be taken during construction activities for avoiding purposely or chance killing of animals.
- If found any wild species and habitat during constructing that must be dealt carefully and local wildlife department officials should be called.
- Hunting, poaching and harassing of wild animals shall be strictly prohibited, and Contractor shall be required to instruct and supervise its labor force accordingly and clear orders should be given in this regard.
- The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this shall have to be controlled by the Wildlife Department.
- The working department must take NOC from the relevant department prior to construction phase;
- Provision of underpass/culvert/tunnel for the movement of different faunal species across the proposed road present in the project area and their locations in consultation with client and wildlife department.
- Special measures shall be adopted to minimize impacts on the wild birds, such as avoiding noise generating activities during the critical periods of breeding.
- Blasting and other noise generating activities shall not be carried out during the night by the work force, clear orders should be given.
- Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them.
- Noise produced by construction activities may be kept to acceptable level.

In pursuit for conserving biodiversity of the project site along with sustained ecological health of micro and macro habitat, it is understood that a balanced ecofriendly approach during implementation stage of the project is advisable. Migratory birds must be protected and strictly avoid to disturb its habitats. Following mitigation measures are proposed. Options for minimum alterations in existing landscape shall be adopted with due respect for ecological integrity including micro habitats. Indicators of terrestrial fauna and ecosystem prevailing in tropical thorn and riverine zone/forests shall be protected;

Space utilizing plan for the land of project site and placement of human activities zones shall be given preference on barren and unproductive patches of land. Protection of land patches stuffed with indigenous flora must be protected;

- Encamped labour shall not be permitted to cut trees and other flora species in and around the site for uses as fuel wood and making of shelters/sun sheds for the labours and earth work machinery/vehicles. Local flora serves as bio resource for nesting, feeding, breeding and resting areas for terrestrial fauna and merit protection;
- Cut and fill of land soil shall be carried out with calculated precision in line with due regards for biological resources stuffed in natural landscape;
- The budget for the proposed project will include provision for payment of compensation to farmers for the loss of any standing crops, or crops already sowed. Will be applicable for all crops standing on land within the acquisition area at the time of dispossession;
- In order to reduce the loss of agricultural land during the construction stage, existing haul routes will be preferred by the contractor, and the width of any new haul route shall be limited to the bare minimum required and approved by the engineer;
- Removal of all contractors' facilities from the project area shall be a contractual requirement, and as such the land used for the construction camps can be restored to facilitate agriculture and the land used for the construction camp shall become cultivatable.
- Compensation for the loss of crops and orchards to the land owners and cultivators as the case may be will be paid, in accordance with the prevailing market prices and uniformity in rates will be ensured within the local areas;
- As far as possible, land within the AOI (which will be acquired) or otherwise barren land without any crop outside the AOI will be selected for the camp sites and disturbance to the crops and natural vegetation will be avoided as much as possible.
- Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them; and
- Noise produced by the construction activities may be kept to acceptable level as per PEQS.

7.5.3 Socio Economic Environment

7.5.3.1 Social Issues/Community Disturbance, Health and Safety

a) Impact

The construction activities can potentially impact the residents of area, particularly the movement and safety of locals. In addition, due to increased use of trucks and other vehicles on the narrow roads in the Project Area and the access roads pedestrians, particularly elderly people and children will be more exposed to dangerous situations, which may lead to traffic accidents. Construction activities also pose safety hazards for the site staff.

The rough terrain and difficult work conditions in some parts of the area will need extra attention from contractors and Project management for the increased risk of accidents, unsafe working conditions and health risks. This is especially true for underground work in tunnels

and caverns, but also during excavation and construction work. This impact is Site Specific, Long Term, Irreversible, Likely, High Significant.

b) Mitigation Measures

The following mitigation measures will be implemented:

- Occupational health and safety procedures will be enforced at site. Each contractor(s) will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan;
- Contractor shall have a system to ensure that Risk, Emergency Preparedness, Environmental and Working Environment, analysis are carried out as integrated part of the design and engineering process;
- Contractor shall have implemented an Environmental Management System corresponding to the ISO 14001 or EMAS standards;
- A Traffic Management Plan will be implemented that will aim at ensuring access to residential areas, and preventing of unsafe situations, especially near schools, housing areas, construction areas, camps and offices;
- Construction activities such as blasting and excavation particularly at the borrow areas may pose safety risks to the nearby population;
- Appropriate procedures will be maintained for such activities, including cordoning off the area, prior information to nearby population and liaison with the community;
- There will be appropriate medical services and a facility with the capacity to treat emergency cases and trauma patients;
- Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge how to deal with emergencies;
- Road signage will be fixed at appropriate locations to reduce safety hazard associated with Project-related vehicular traffic;
- Liaison with traffic police will be maintained;
- Project drivers will be trained on defensive driving; and
- Vehicle speeds near / within the communities will be kept low, to avoid safety hazards

7.5.3.2 Conflict between Labours and Communities

a) Impact

The Project construction will bring significant changes in the lives and livelihoods, including new opportunities for employment and income for the local people. The development also attracts thousands of new in-migrants to the Project Area. Through the influx of workers and business people the population of area will increase within a few years. Unless properly managed this sudden influx of people could create adverse aspects such as an increased crime rate, tensions and social conflicts between the various groups. This impact is Local, Medium Term, Reversible, Likely, Medium Significant.

b) Mitigation Measures

The following mitigation measures will be implemented:

- Project has developed a pro-active approach by working out for a number of key issues which have been proposed including issues regarding housing and accommodation, food security, local infrastructure, community health, labor contracts, employment and business opportunities, security, integration and cultural understanding and community and area development. In accordance with this Plan procedures and rules will be worked out by the PMU in close cooperation with the contractors and local authorities; and
- Responsibilities for the implementation of these suggestions will rest with the local authorities, the line departments, WAPDA and the contractors.

7.5.3.3 Communicable Diseases

a) Impact

The labour in the Contractor Camp, truck drivers and like personnel who interact with each other have the potential for the spread of COVID-19 and HIV/AIDS if the incidence exists. Majority of the people living in the surrounding of the Project, and potential Labor are not aware of the source, mode of communication or consequences of HIV/AIDS. Although their religious and cultural value system, to a large extent excludes the outbreak or rapid communication of COVID-19 and HIV/AIDS, yet its occurrence in such a situation cannot be precluded. It is necessary that awareness and preventive campaigns are run from time to time in the Labor campus and the field offices of the Project to prevent the communicable diseases like Cholera, Typhoid and Tuberculosis.

There is a chance of spreading of an epidemic of Coronavirus disease (COVID-19) due to close interaction of the **labor** force during construction not only among the workers but also in the area. This impact can be categorized as direct, medium, site-specific, short term, temporary, high probability and reversible.

b) Mitigation Measures

The Contractor shall:

- Arrange to run an active campaign, in the labour camp, to make people aware of the cause, mode of transmission and consequences of HIV/AIDS;
- SOPs related to the construction industry advised by National Action Plan for COVID-19 Pakistan to control spreading of COVID-19, shall be implemented by the contractor and will be strictly monitored;
- Strengthen the existing local health & medical services for the benefit of labour as well as the surrounding villages;
- Ensure cleanliness and hygienic conditions at the labour camp by ensuring proper drainage

and suitable disposal of solid waste. Inoculation against Cholera will be arranged at intervals recommended by the Health Department;

- Locating a labour camp at least away from the villages (local settlement), and
- Keep all the camps, offices, material depots, machinery yards and work sites open for the inspection of health and safety measures and related documents.

7.5.3.4 Child Labour

a) Impact

There are two basic conventions on child labour adopted by the ILO, and one adopted by the United Nations. The ILO Minimum Age Convention, 1973 (No. 138) and its accompanying Recommendation (No. 146) set the goal of elimination of child labour, and the basic minimum age for employment or work (in developing countries at 14 years of age or the end of compulsory schooling, whichever is higher; and 15 or the end of compulsory schooling for developed countries). The Convention sets a minimum age of 2 years younger for “light work,” i.e., 12 and 13 years, respectively; and a higher minimum age for dangerous or hazardous work (basically 18 years of age, but 16 in certain circumstances). The Convention also has various other flexibility clauses.

Inhabitants of the Project Area have mix economic background and different sources of income. Children of low-income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Employment of Children Act, 1991 prohibits the employment of child and restrict the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 14 years) to work in an establishment shall be liable to punishment with imprisonment.

The child labour impact might arise during construction stage, as large number of skilled and unskilled labour will be required by the contractor for the construction activities of the proposed Project. This impact is medium negative in nature during construction stage.

b) Mitigation Measures

- Awareness will be created among the local communities about the adverse impacts of child labor. For the public awareness, meetings will be held in the Project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society;
- Contractor through contractual agreement will be bound to follow the labor standards, rules and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency;
- Client and Supervision consultant will ensure that contractor shall have its employment policy in accordance with relevant act and labor policies in Pakistan;
- Contractor will ensure the presence of all persons at site are adults and have their proper identity cards with them;

- Penalize contractors/employees using the child labor and penalize adults who violate children's rights and who force children to enter child labor.

7.5.3.5 Conflicts due to Culture

a) Impact

Workers coming from different parts of Pakistan may have norms and values in social behavior and religion that differ from those of the resident population. This can potentially cause tension and conflicts between outside workers and local community. This impact is Local, Medium Term, Reversible, Likely, Medium Significant.

b) Mitigation Measures

The following mitigation measures will be implemented:

- Maximum local Labour will be preferred for skilled and unskilled activities;
- This situation will be addressed by an awareness campaign;
- The contractors would be aware of the possibility and risks of miscommunications between local residents and workers, a situation which easily could lead to social unrest. This would be prevented by raising awareness and implementation of a Code of Conduct for the workers;
- Complaints from the local community will be addressed by the grievance redress mechanism; and
- The Contractor will be required to maintain close liaison with the local elders and religious scholars of nearby local community to ensure that any potential conflicts related to common resource utilization for the Project are resolved easily.

7.5.3.6 Impacts on Local Communities

a) Impact

The community belonging to the reservoir and Project Areas will be affected during the construction phase as follows:

- During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered;
- Unmonitored construction activities, e.g. blasting may create an accidental risk for the local residents particularly the women and children;
- Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor;
- Community will have to face the noise and dust problems during the construction activities;
- Induction of outside workers in the Contractor labor may cause cultural issues with the local community; and
- Theft problems to the community by the Contractor's workers and vice versa.

This impact is Site Specific, Medium Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

- During the construction phase, mobility of the workers in the nearby areas will be strictly restricted by the Contractor to avoid any inconvenience to the local communities;
- Proper arrangements in the form of alternative routes will be made to ensure that the mobility of locals will not be disturbed;
- Before starting the construction activities, Contractor will inform residents of the Project Area about the scheme of work, likely disturbances, and their duration as to whom they will address their complaints.
- The Contractor will select specific timings for stringing so as to cause least disturbance to the local population considering their peak movement hours;
- The Contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource utilization are resolved quickly;
- Contractor will take care of the concerns of the local community and the sensitivity towards the local customs. Contractor also needs a proper security to avoid any theft issue by the community;
- Use of good engineering practices such as water sprinkling, encasement and provision of silencer and mini stacks of generators etc. will be adopted to avoid inconvenience to the locals due to noise, smoke and fugitive dust; and
- The Contractor will warn the workers not to indulge in any theft activities and if anyone gets involved in such activities, he will have to pay heavy penalty and would be handed over to the police. Similarly, at the time of employing, the Contractor has to take care that the workers will be of good repute. The Contractor camp will be fenced properly and main gate.

7.5.3.7 Loss of Income

a) Impact

During the construction activities, people will suffer loss in their annual income due to the loss of crops, trees etc. This impact can be categorized as indirect, moderate, local, medium term, permanent, medium to highly probable and irreversible.

b) Mitigation Measures

- Fair, prompt and negotiated compensation for the crops and trees on private land will be provided to the affectees along with the land value; and
- Affectees will be involved in the valuation process of the Project.

7.5.3.8 Gender Based Violence (GBV)

a) Impact

In the society, female plays important role in managing household as well as in income earning activities, but they face various challenges to get access to educational institutions and employment opportunities due to cultural bindings, economic vulnerability and lack of facilities .

According to Pakistan Demographic and Health Survey (PDHS), 2017-18, 28 percent of women of Pakistan age 15 to 49 have experienced physical violence, six percent have experienced sexual violence, and seven percent experienced violence during pregnancy. Three in ten women who have ever experienced physical or sexual violence sought help to stop the violence, yet 56 percent never sought help nor told anyone.

During survey, consultations with females were conducted at individual and at group levels to get their apprehension regarding the project activities and suggestions to mitigate the relevant impacts. It was observed that except in a few cases (restriction on movements), there was no GBV prevailed among the consulted women. However; during construction phase GBV might arise due to discrimination made against women by unequal work distribution and unequal pay structure among others. SH against women might occur as a consequence of mixing of men and women at the construction site, and moving on the roads, bus stops and markets. Educational institutions near the project alignment are also sensitive regarding gender issues. This impact is Local, Medium Term, Reversible, Likely, medium Significant.

b) Mitigation Measures

- Trainings will be given to construction workers, alongside the implementation of strict measures and punishments in case of any sexual assaults, or GBV.
- During the timing of educational institutions workers will not be allowed to crowd in the surroundings;
- Alternative routes for pedestrian will be provided to avoid mixing of women with workers;
- Gender protection act will strictly be enforced during the construction activities in the project area, and monitor the implementation through field staff and district level structure;
- Awareness will be raised among the communities of the potential risks of GBV, and establish response services in the communities that can respond to instances of GBV (particularly those related to issues of labor influx);
- The Contractor will make sure that no discrimination is made on the basis of gender while hiring of workers. Complete standard operating procedures (SOPs) will be prepared and implemented by the contractor regarding working women at site. Implementation on these SOPs will be monitored by the SCs;
- Provisions of gender disaggregate bathing, changing, and sanitation facilities; and
- Contractor will take proper measures to address and resolve issues relating to harassment, intimidation, and exploitation, especially in relation to women.
- Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labor influx.

- Project staff will receive training on the prevention of SEA/SH. Engagement of skilled trainers to raise awareness among project workers of the risks, expected behaviors, and consequences of violations, communicated through training, and publicized codes of conduct. It may also be important to raise awareness of the risks among community members and local health authorities and inform them about available grievance mechanisms.
- Arrange and support local organizations and/or government initiatives on community STDs education, prevention, and treatment programs.
- Extensive training will be provided for awareness raising strategy which describes how workers and local communities will be sensitized to Sexual Exploitation and Abuse (SEA) and SH risks, and the worker's responsibilities under the CoC
- The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes will be identified for the communities, if required, especially along routes frequented by women folk, such as route to the local well or water source.
- Construction crew will avoid entering villages and settlements.
- Communities will be informed and consulted before commencing works inside or near the communities.
- Provision related to SEA/SH will be incorporated in the bidding document, and
- A Gender Action Plan will be prepared and implemented by contractor for the proposed project to reduce the significant of this impact.

7.5.3.9 Indigenous People

a) Impact

During the social field survey of the Project, no indigenous group of people was identified, which **comes** under the definition of the "Indigenous People". So, no impact on the indigenous people is envisaged due to the implementation of the Project. Thus no impact is foreseen on indigenous people.

b) Mitigation

No mitigation required.

7.5.3.10 Other Social Issues

a) Impact

The community belonging to the reservoir and Project Area will be affected during the construction phase as follows:

- During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered;
- Unmonitored construction activities, e.g. blasting may create an accidental risk for the local residents particularly the women and children;

- Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor;
- Community will have to face the noise and dust problems during the construction activities;
- Induction of outside workers in the contractor labor may cause cultural issues with the local community; and
- Theft problems to the community by the contractor's workers and vice versa.

This impact is Site Specific, Medium Term, Irreversible, Likely, Medium Significant.

b) Mitigation

- During the construction phase, mobility of the workers in the nearby areas should be strictly restricted by the Contractor to avoid any inconvenience to the local communities;
- Proper arrangements in the form of alternative routes should be made to ensure that the mobility of locals should not be disturbed;
- Before starting the construction activities, Contractor should inform residents of the Project Area about the scheme of work, likely disturbances, and their duration as to whom they should address their complaints.
- The contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource utilization are resolved quickly;
- Contractor will take care of the concerns of the local community and the sensitivity towards the local customs. Contractor also needs a proper security to avoid any theft issue by the community;
- Use of good engineering practices such as water sprinkling, encasement and provision of silencer and mini stacks of generators etc. should be adopted to avoid inconvenience to the locals due to noise, smoke and fugitive dust; and
- The Contractor will warn the workers not to indulge in any theft activities and if anyone gets involved in such activities, he will have to pay heavy penalty and would be handed over to the police. Similarly, at the time of employing, the Contractor has to take care that the workers should be of good repute. The Contractor camp should be fenced properly and main gate.

7.6 ADVERSE IMPACTS DURING THE OPERATION AND MAINTENANCE PHASE

7.6.1 Physical Environment

7.6.1.1 Sedimentation

a) Impact

The site is situated in western extension of Kirana Hills, exposed at Chiniot. The geology of project area is mainly classified as meta-sedimentary rocks which consist of Cherty Quartzite, Arenaceous Slate, Quartz Wacke and Dolerite. Angular boulders, gravel with sand and appreciable number of fines (ABGM) are present at the foot hills, while Silty Sand with some Clay intercalations are present along the river banks and in terrace deposits.

After the construction of Chiniot dam, the major part of the sediment load d/s of Qadirabad Barrage on Chenab River would be trapped by the Chiniot dam and only fine suspended sediment (clay and fine silt) will be released with outflows.

Construction of dam at western extension of Hills will disturb the sediment flow and sediments will start depositing in reservoir of dam resulting decrease in water storage capacity. Based on the suspended sediment load and discharge, the total sediment load containing both suspended and bed load is about 46 MST with which reservoir life is estimated as 41 years. Furthermore, reduction in storage will eventually alters the capacity for flow regulation, water supply and flood control benefits. The impact can be categorized as Local, Long Term, Irreversible, Likely, Highly Significant.

b) Mitigation

Due to high sedimentation load, four (04) No. under sluices on the left side of right gorge are proposed in Chiniot Dam, which will serve to flush sediment because its predicted life under normal reservoir operation is 41 years for average annual load of about 46.14 MST. For a sustainable use of Chiniot reservoir, it will be necessary to regulate the flows and effective sediment management will be carried out during operation of the Project.

Sediment will be passed through the reservoir by sluicing, which involves drawing down the water level during periods of high discharge and sediment load, thereby increasing flow velocity while reducing both residence time and sediment trapping. Aggressive drawdown, reducing the reservoir level to create riverine flow along the impounded reach during a flood, may also scour and release a portion of the previously deposited sediment. Drawdown sluicing will likely be performed during the monsoon to preserve peaking capacity.

7.6.1.2 Loss of Nutrients via Sediment Deposits

a) Impact

As discussed earlier, about total annual sediment load in Chiniot reservoir is about 46 MST. After construction of Chiniot Dam, the major part of the sediment load d/s of Qadirabad

Barrage on Chenab River would be trapped by the dam and only fine suspended sediment (clay and fine silt) may be released with outflows. Therefore, loss of sediments will deplete the nutrient content of the water to be distributed through distribution weir which may impact agricultural production in downstream areas. This impact is Local, Short Term, Reversible, Likely, Medium Significant.

b) Mitigation

This is residual impact. However, shortage of nutrients in irrigation water (due to the development of reservoir) in downstream area can be overcome by use of fertilizers and manures. Urea (Nitrogenous Fertilizers) and Phosphates fertilizers are very popular with Agriculturists in catchment and downstream area.

7.6.1.3 Seismic Hazards

a) Impact

The project is located in the northern part of the Indian plate, south of the boundary between the Indian plate and Kohistan Island arc which is sandwiched between the Indian and Eurasian tectonic plates. As the project region is located near the collisional zone of the plate boundaries, it is seismically active. A number of low to moderate sized earthquakes have been recorded in the project region during the last 100 years. The main tectonic features around the project site which could be controlling the maximum earthquake hazard are as follows:

- Salt Range Thrust
- Riasi Thrust, and
- Basement Faults below Punjab Plain

In terms of safety of a dam, seismic hazard i.e. earthquake in and around the project area will directly damage the civil structures, dam-break flooding and reduction of reservoir capacity. This impact is Local, Long Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

The following mitigation measures will be implemented:

- Pro-active measures will be implemented to stabilize and protect slopes. Early warning systems will be introduced that will indicate when cracks appear and allow any widening to be monitored;
- As per ICOLD Guidelines for selecting seismic design parameters for large dams (2016), Chiniot Dam falls in High Risk class, therefore the recommended ground motion for SEE is 0.35g (Dam Site/Powerhouse area) and 0.53g (dykes) for rock & soil foundation conditions respectively (corresponding to a return period of 10,000 year).;
- The recommended horizontal Peak Ground Acceleration (PGA) associated with OBE is 0.07g (Dam site/Powerhouse area) & 0.13g (embankments) for rock and soil foundation conditions respectively.

- The recommended horizontal Peak Ground Acceleration (PGA) associated with DBE is 0.12g (Dam site/Powerhouse area) & 0.21g (embankments) for rock and soil foundation conditions respectively;
- An Emergency Response Plan (ERP) for earthquakes and manmade disasters should be developed and implemented in close consultation with the NDMA and other concerned departments.

7.6.1.4 Change in Land Use

a) Impact

During the operational phase the land use pattern of the area will be changed to some extent due to the formation of approx. 190 km² Lake. The commercial and recreational activities will also be increased due to lake formation which may affect ecosystem of the area and bring economic boom in the area. This impact is Site-specific, Long Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

The tree plantation will be carried out in and nearby the Study Area and will have positive impact on the eco system of the area.

7.6.1.5 Water Logging

a) Impact

It is anticipated that due to the impounding of reservoir, some areas in the immediate vicinity of the reservoir may be prone to water logging and salinity. However, the extent of this impact will not be much. This impact is Site-specific, Long Term, Irreversible, Likely, medium Significant.

b) Mitigation Measures

Areas in the close vicinity of the reservoir will be prone to water logging. To mitigate this impact tube wells along with drainage channels both on right and left side have been provided in the design which will control the issue of water logging in proximity of the reservoir. Since it is a residual impact, therefore, mitigation of this impact requires planned operation of wells and monitoring mechanism which has been provided in the design.

Groundwater monitoring network shall be established on the priority basis to monitor the water table behavior along both sides of the reservoir and after the reservoir operations to be monitored on monthly basis. Dewatering tubewells, solar operated, for addressing the negative impact of dam seepage are proposed in the surrounding areas. The tentative depth of these wells shall be within 150 feet (46m) to 170 feet (52 meter) and 2.0 cusec (0.057 cumecs) capacity with fiber glass strainers.

7.6.1.6 Water Quality

a) Impact

Water stored in a dam or reservoir is subject to undergo certain physical, chemical and biological transformations. These phenomena are induced by natural forces mainly at the bottom anaerobic digestion of the biomass, climatic conditions (heat exchanges, aeration, etc.), chemical exchanges from geological formations, aquatic chemical reactions and material degradations among others as well as biological reactions associated with the organic materials decaying (biomass and humic matter decomposition from the flora and fauna i.e. submerged after first filling of reservoir). Variations in weather conditions and exposure to atmospheric conditions are among other conditions with potential effect to water quality.

Among the anticipated water quality aspects of interest for the dam would include:

- Turbidity and suspended matter from the entering flows, surface runoff discharges and organic reactions among other sources might lead to limited light penetration that has got direct linkage to biological quality of the water;
- Biomass accumulation in the dam area could render high humic (organic concentration) levels in the dam water. It also has a potential to increase the nutrients and other minerals associated with plant decaying matter;
- Limited water mixing, aeration and light penetration reduces available oxygen resulting into anoxic conditions at the lower layers of the water. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, hydrogen sulphide and create low pH scenarios. Due to the lowered pH, the geologically held iron and manganese and other heavy metals are likely to be released into the water effectively changing the water quality; and
- Implications on water quality would be felt by the water consumers in the immediate location of the dam as well as social and ecological dependents.

This impact is Local, Medium Term, Irreversible, Likely, Medium Significant.

b) Mitigation Measures

These can be mitigated by the following:

- Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water, treated water and water downstream of the dam location;
- Clearing and removal of all vegetation materials (live and dead) at the dam site before the area is excavated and inundated, maintain appropriate records on water quality as required by the law;
- Proliferation of aquatic macro-fauna could be encouraged along the periphery of the dam to ensure natural aeration of the water; and
- Effective reservoir maintenance manual would have to be developed to deal with the deteriorating water quality.

7.6.1.7 Greenhouse Gases Emission and Climate Change

a) Impact

Reservoir impounding (after few years of operation) will have a small impact on the local climate. It is expected that the humidity in nearby areas will increase and temperatures in nearby settlements are likely to decrease in the summer time as compared to without Project situation.

Release of Green House Gases (GHG) may also bring some changes in the climate. World Commission on Dams declared that dam reservoirs are observed to be the emitters of GHG such as CO, methane (CH₄), and Carbon Dioxide (CO₂) with large variations with situations. A range of factors directly influence the GHG emissions from reservoirs such as: storage depth, size, climate, age of reservoir, etc. Release of these gases may have low potential adverse impact on climate in the Study Area. This impact is Regional, Medium Term, Irreversible, Likely, Medium Significant.

It has been assumed that the avoided CO₂ emission in case of hydropower production from Chiniot Dam would be 488g/kWh. Given the average annual energy generation attributable to Chiniot Dam (GWh), annual estimated CO₂ emission reduction/avoidance of 100,162 Tons has been calculated. It has been estimated that the development of hydropower due to Chiniot Dam would result in reduction of total 5.01 Million tons of CO₂ (or CO₂ equivalent) over the 50 years' period.

The CO₂ emission reduction due to the proposed project would enable it to trade Certified Emission Reductions (CER) under Clean Development Mechanism. The annual emission reduction in CO₂ tons (0.100162 million Tons) have been multiplied with the estimated future market price of carbon, US\$ 1.5 per CER, to reach an annual CDM benefits of US\$ 0.154 Million or Rs. 42.97 Million. Apart from this, the proposed tree plantation and additional measures will further increase the CERs

b) Mitigation Measures

A separate study regarding GHG emissions will be conducted during O&M phase of the Project to estimate the overall CERs of the proposed project considering complete life cycle of the Chiniot dam. Furthermore, following measure will mitigate the impact of climate change and GHG emission during O&M phase.

- Use O&M machinery designed with suitable pollution abatement technology such as scrubbers;
- Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO₂;
- Used and old electrical equipment will be banned that can also help to reduce urban emissions;
- Environmentally friendly fuel can be used instead of diesel;
- Burning of waste will be strictly prohibited at site;
- Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and

- As appropriate use of solar panels or floating photovoltaic concept will be considered to further increase the CERs.

7.6.1.8 Dam Safety and Emergencies

a) Impact

In the event of a dam safety incident or failure which results in uncontrolled release of volume of the water stored behind Chiniot Dam, this release is capable of causing loss of life and significant property damages. The dam may fail for one or a combination of the following reasons:

- Overtopping caused by unusual precipitation event or flood;
- Differential deformation leading to cracking and displacement;
- Excessive settlement of the top of dam/crest;
- Foundation or abutment erosion;
- Abutment slope failure;
- A major slide in the reservoir close to the dam;
- Operational errors; and
- Deliberate man-made actions.

Failure of the dam resulting in uncontrolled release of the reservoir as well as high floods would result in inundation of downstream areas, consequences of which could be loss of life (reduction of loss of life is the top priority of emergency planning), property damage in flood plain, damage to infrastructure and irrigation water supply from the dam. The damages inflicted by flooding in the Project Area can generally be categorized as follows:

- Loss of land due to erosion;
- Loss of standing crops due to inundation;
- Damages to public and private properties due to submergence;
- Damages to infrastructure;
- Breaches of canal systems and suspension of irrigation supplies, major threat to Kachhi Canal being the front-line canal; and
- Loss of human lives and livestock.

This impact is Local, Long Term, Irreversible, Likely, High Significant.

b) Mitigation Measures

Impacts resulting from dam failure can be mitigated by ensuring strict adherence to standards in design and construction as well as regular dam inspection coupled with the preparation of emergency planned access control. It will be a highly potential significant adverse impact on the environment. Rim stability and dam safety studies are also recommended to be conducted during detail design phase of the Project.

7.6.1.9 Attenuation of Floods

a) Impact

Flood studies were carried out for the planning and design of barrage and other outlet structures as well as checking the safety of the proposed Chiniot Dam. These studies are the basis to evaluate the impact of the dam on the attenuation of floods in the downstream areas. The 100 years' frequency flood is estimated as 28,100; 30,500 and 38,300 m³/sec by using three Distributions (Gumbel, Pearson type3 and Lognormal), respectively with average flood values as 32,300 m³/sec; that value is close to flood estimated by (Pearson type 3) distribution. It has been observed that Pearson type 3 distribution is assumed to be adopted as design flood against 100-year flood frequency with value of 30,500 m³/sec.

On other hand, the available maximum value of peak instantaneous floods at Qadirabad Barrage for the period of 1922-2022, is (31,627 m³/sec) occurred in the year of 1957 and that flood value of (31,627 m³/sec) is higher than estimated above design flood against 100-year flood frequency with value of 30,500 m³/sec. This impact is Local, Long Term, Irreversible, Likely, High Significant.

b) Mitigation Measures

Finally, design flood of 31,627 m³/sec against 100-years flood frequency is recommended for barrage of Chiniot Dam. Furthermore, It is implicitly accepted that climatic changes in the region can have profound effect on the flood peaks. For this the peak flood may be enhanced by 10 to 25%. In technical memorandum flood peak flow was enhanced by 25%, for which client has shown reservations. The flood peak is now enhanced by 20%, which yields peak flow rate of $3627 \times 1.20 = 37,952$ m³/s.

It is proposed that a higher frequency flood of 200 to 500 years' frequency may be considered for check flood. Therefore, the check flood is proposed as higher of the two values as 38,000 m³/s. The barrage design must ensure that check flood will pass through the barrage structure safely with pre-selected encroachment of the free board.

Based on the flood studies, the observed recorded 200 to 500 year return period flood at proposed dam site of Chiniot Dam can be attenuated due to the construction of proposed Dam.

7.6.1.10 Air Quality and Noise

a) Impact

Commissioning and operation of the dam may affect the air quality in the area due to the increase in traffic volume and frequency due to recreation activities after formation of lake behind the dam. The traffic movement will induce some dust and noise problems in the area. There would be a marked difference of values between 'with' and 'without' Project situation. However, as the Project components are mostly civil works, these surely will not pollute the

air to a serious extent. As compared to construction stage, air quality and noise pollution will improve.

Noise levels are expected to rise during the operation phase of the proposed Project due to the increased traffic volumes and population flow into the Project Area as compared to baseline conditions. However, noise levels will be lesser than the construction phase of the Project. The main contributor to noise level will be the engine sounds and horns. These noise levels will be much less as compared to the level during the construction phase but are expected to have Local, Short Term, Reversible, Likely, Low Significant.

b) Mitigation Measures

To enhance the air quality of the Study Area, a tree plantation program will be initiated by Irrigation Department in consultation with Forest Department on priority basis. As noise levels, will not be a significant problem, no specific measures for noise levels are suggested.

7.6.2 Ecological Environment

7.6.2.1 Flora

a) Impact

During operational stage of the Project, there will be minimal effect on flora or release of any significant pressure detrimental to flora. Low level impact is expected at operational phase on Flora due to the operation and maintenance activities. This impact is Site-specific, Temporary, Short-term, Irreversible, Unlikely and Low Significant.

b) Mitigation Measures

- The implementation of plantation plan recommends compensation for cutting of trees and work will be started during operational phase to ensure the ecological balance and to avoid any impact on local environment;
- Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of tree groves, and linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation;
- Proper check and balance for above activities is highly recommended. Plantations so raised must be maintained according to the Silvicultural practices which includes proper irrigation, cleaning, pruning, thinning at prescribed intensity, silt clearance and trench-opening, etc.;
- Maintenance and security of the plantation will be done for at-least four to five years (in consultation with the Forest department). Measures such as fencing, watch guards and fire protection will be considered; and
- All activities must be done under the technical supervision of Punjab, Forest and Wildlife departments.

7.6.2.2 Fauna

a) Impact

There is no wildlife, game reserve, wildlife game sanctuary or national park in the project area so, no major impact on wildlife in the area is expected through noise, vibration and any type of normal activity in the project area. This impact is Insignificant.

b) Mitigation Measures

- Strict control must be exercised for stoppage of killing/poaching of available wildlife species (if any) by enhancing protection practices; and
- The precautionary measures described (mentioned above) for future shall also be applicable during operation phase as relevant for the conservation of wildlife species in the Study Area.
- The water storage in reservoir will attract different type of birds and animals as water is core part of ecosystem.
- The fisheries department will also be involved to start the activities regarding fisheries development in the reservoir waters.
- After all the environmental friendly planning, implementation and maintenance the project will have overall positive impact on local biodiversity and commons as well.

7.6.2.3 Impact on Aquatic Habitat due to Reservoir

a) Impact

Water velocities in the reservoir will be lower than in pre-reservoir river conditions while anticipated water temperature will be higher. This suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline. Spawning areas in the tributaries will be submerged and it is expected that new natural. This impact is site specific and medium significant in nature.

b) Mitigation Measures

- Maintenance of spawning areas and developing of new spawning areas; and
- The new fish hatcheries will be the alternate of the submerged spawning grounds which can produce the seed as per requirement.
- In this regard a separate study is recommended for the development fisheries development and management plan by the concerned departments.

7.6.2.4 Aquatic Life

a) Impact

Decomposition of vegetation in lake will release harmful nutrients and gases polluting surface air and poisoning fish in lake as well as in downstream area. Decomposition depletes oxygen in water, and such deoxygenated water can be lethal for fish.

Due to the storage of water, average temperature of the reservoir will increase as compared to the water flowing Chenab River. Due to this rise in water temperature of reservoir, there will be highly significant potential adverse impact on aquatic life including fish. These changed aquatic conditions may change the aquatic fauna and flora. Rise in water temperature may increase population of aquatic plants, which will need salvation and cleaning of lake at proper time periods (years). This impact is site specific and medium significant in nature.

b) Mitigation Measures

Lake/ Reservoir created by reservoir can be beneficially harnessed for protein rich fish for which adequate technical know-how and infrastructure is available with the Directorate of Fisheries. Experiences gained in Aquaculture/Pisci-culture from major dams can be utilized and augmentation of the current and proposed fisheries development projects especially in the area between Qadarabad and Trimu Barrage will further enhance the aquatic benefits of the propose project.

7.6.3 Socio-Economic Environment

7.6.3.1 Safety during Reservoir Operation

a) Impact

During operational stage of the Project, due to the impounding of the reservoir, the safety issues will arise. Main reservoir area is the major threat for accidents. Locals and workers can drown. This impact is site specific and high significant in nature.

b) Mitigation Measures

During operational stage of the Project, a security plan should be prepared for the reservoir area to prohibit youths from using reservoir for bathing, swimming and other recreational activities. Boating should not be allowed without the provision of life saving jackets and presence of a lifeguard.

7.6.3.2 Occupational Health and Safety

a) Impact

During the operation phase, health and safety issues related to workers and communities may arise. Operation and maintenance activities may cause health and safety risks such as

movement of machinery, poor handling and storage of hazardous substances, injuries due to electric shocks, falling of objects, slips or trips, dust, noise, accidents, transmittable diseases etc.

The flow of electric current in the conductors will also have an impact on the safety of the workers and locals (staff colony). The burning of the transformer or other electrical equipment due to short circuiting can create a fire which can spread. This will become a safety hazard for the workers. This impact is Site Specific, Long Term, Irreversible, Likely, High Significant.

b) Mitigation Measures

During the operational phase of the Project, a security plan will be employed to ensure the safety of the employees working at the Powerhouse, Switchyard and other electrical equipment. An effective communication system must be established so that the proper authorities are notified in case there is a fire in the Powerhouse, Switchyard and other electrical equipment.

Separated fire alarm systems shall be provided for station general area (comprising control building, administration building, machine Hall, workshop etc.), the generators and the transformers. The fire alarm system will be based on optical smoke detectors, manual call points, alarm sounders and auxiliary devices.

Fire water tank capacity has been worked out considering NFPA 851 requirements of two hours' worst fire scenario and fire hose stream requirements. Portable and trolley fire extinguishers will be provided at all entrances to the power stations. Clean Agent Gas System will be provided for Control room, Computer room and other electrical equipment rooms.

The protection equipment will be complete with all relay panels, instruments, meters, interposing and auxiliary relays, control switches, interposing current and voltage transformers, transducers and all auxiliary equipment. All protections, as far as possible, will be connected to separate current transformers and will have separately protected voltage circuit. Backup protection will be 100 % redundant of the main protection.

The main earthing system for the Powerhouse will be a separate distributed grid of conductors, properly designed to carry electrical fault currents without overheating. The earthing system will be designed according to IEEE-80 "Guide for Safety in AC Substation Grounding" and IEEE 665-1995 "Guide for Generating Station Grounding".

The overall control and monitoring of the entire powerhouse will be carried out from a central control room. Unit Control Level will deal with the control of individual units, which include the generating units, electrical distribution and other auxiliary systems. Local Control Level will comprise hardwired instrumentation and control through the local control panels e.g. local panels of circuit breakers, generators etc. Monitoring at all levels will be done simultaneously

7.6.3.3 Employment Opportunities

After completion of the construction works, employment opportunities will suddenly seize and unemployment for local residents may increase. However, with the experience gained from the proposed Project, the local people will have potential opportunities in future projects in other parts of country. WAPDA could develop a preferential system for local workers with good qualifications and experience at the end of construction of proposed Project. Construction workers could also qualify for positions in operation and maintenance activities.

7.6.3.4 Impact on Civic Amenities

The accessibility to the project area will be improved due to the construction of link roads and widening of existing road. Schools, mosques, dispensary will be constructed for the project staff but after the completion of the project these facilities will also be available for the locals of the project area. The impacts will be in the category of high beneficial.

7.6.3.5 Impacts on Local Public Health

The project area is lacking in health facilities. After the construction of this project, better health facilities will be available in the area which is a positive impact of the project.

8 GRIEVANCE REDRESS MECHANISM

Grievance redress mechanism (GRM) is important for developmental projects where ongoing risks or adverse impacts are anticipated. This mechanism serves as a way to meet requirements, prevent and address community concerns, reduce risks, and assist larger processes that create positive social change. The major objective of GRM is to implement and maintain a procedure for handling environmental and social concerns of the project stakeholders. This procedure will include a redress mechanism scaled to the project's identified risks and adverse impacts, focusing on stakeholders.

WAPDA will establish a Grievance Redress Committee (GRC) to facilitate resolution of complaints by Project Affected People (PAPs) and grievances about the project's environmental performance. The GRC will be coordinated by the Chief Resident Engineer and Environment Head. The GRC will address affected people concerns and complaints promptly, using an understandable and transparent process.

8.1 COMPOSITION OF GRC

The GRC will work directly under the supervision of Chief Resident Engineer. The following members are recommended to form a GRC to look into the environmental matters.

- WAPDA Environment Cell;
- Environment and Social Head of E&ST;
- Representative from PAPs;
- Environmental Engineer of Supervision Consultant; and
- Environmental Engineer of Construction Contractor

Environment and Social Head of E&ST will nominate one member of GRC and shall act as Project Environmental Grievance Officer (PEGO). He will review the case on merit and address the problem in accordance with prevailing rules/ procedures applicable to such grievances as per EMMP. The PEGO will then refer the case to GRC for final decision, whether to update and make necessary amendments in EMMP. The GRC will deliver its decision within thirty (30) days of registration of the case. If the affected person does not receive a response from GRC within thirty (30) days of the registry of the complaint, he/she can appeal to Environment and Social Head of E&ST, who will act on the compliant/ grievance within two weeks of day of its filing. If the affected person is not satisfied with the decision of Environment and Social Head of E&ST, then it can be referred to higher authorities / relevant govt. departments for its resolution. As a last resort, he/she may submit the complaint to Punjab-EP&CCD.

8.2 RESPONSIBILITIES OF GRC

The responsibilities of GRC will include the following:

- The GRC shall review, consider and resolve grievances related to environmental issues during implementation received by the PD office – Chiniot Dam WAPDA.

- Environmental Specialist of SC is responsible for conducting investigations on these grievances.

Any grievances presented to the GRC will ideally be resolved on the first day of hearing or within a period of one week, in case of complicated issues requiring additional investigations. GRC is empowered to take decision which is binding on WAPDA and considered final. GRC meeting will be held in the Chiniot Dam WAPDA, PD office or other locations agreed by the committee. If needed GRC members will conduct field visits to verify and review the issues at dispute.

8.3 PROCEDURES FOR FILING THE COMPLAINTS

Any affected person can register his complaint through application at PD office. The PD will direct the Environment and Social Head of E&ST to address the complainant at the same day. The Environment and Social Head of E&ST will have maximum one week to resolve the complaint. If complaint is not addressed within a week time, then the complainant can raise a grievance with the GRC. There are several ways one can report a grievance:

- Contact the PEGO of GRC over the phone. The contact details will be provided in the PD office; and
- Send an email to the address provided in the PD-office.

The grievance will be reviewed and will be decided by the GRC. In case the grievance is not connected to the project related activity or in case the project authority finds that they are working within the applicable Punjab EP&CCD standards, the grievance will not be further processed. In these cases, this will be explained in writing to the grievant.

In all the other cases the GRC will investigate whether they have failed to work to the intended standard and if they have identified measures which might be taken to protect against the incident occurring again.

The grievance mechanism will be made public through the public consultations and information leaflets during implementation.

8.4 TYPE OF GRIEVANCE

The following are some of the environmental issues could be subject for grievance from the affected people, concerned public and NGOs.

- Dust, noise and air pollution from construction activities
- Nuisance
- Intensive schedule of construction activities
- Inappropriate timing of construction vehicle flow
- Traffic Movement
- Water Pollution
- Waste disposal
- Disturbances to flora and fauna
- Health and safety

- Criminal activities
- Failure to comply with standards or legal obligations
- Illegal cutting of trees and disturbance to fisheries
- Non-Compliance of EMMP
- Land Acquisition issues
- Compensation issues (non-compliance with RAP document)
- Social and Cultural Issues.

8.4.1 GRIEVANCE REDRESS MECHANISM

The major objective of GRM is to implement and maintain a procedure for handling the environmental and social concerns of the project stakeholders. This procedure will include a redressal mechanism scaled to the project's identified risks and adverse impacts, focusing on stakeholders.

- The Grievance Redressal Cell (GRC-1) will be constituted as first tier of GRM at Project site to settle day to day issues of affectees, local communities and PAPs of project area related to the Contractor of the Project under RAP. The GRC-1 will be constituted & notified by the PMU for its implementation. The GRC-1 will settle the issues of RAP within 7 days.
- GRC-2 will be constituted and notified by the PMU as second tier of GRM for the Project. The objective of GRC-2 is to settle / tackle all type of issues related to RAP within 30 days. If RAP issues are not settled by the GRC-2 within 30 days, the case may be submitted to the GRC-3.
- GRC-3 will be constituted and notified by the Client. The objective of GRC-3 is to settle and make decision about the pending / unsettled issues of GRC-2. If the issue is yet not settle by GRC-3 within 60 days as a last resort, the complainant may submit the complaint to the Court of Law.

9 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

9.1 GENERAL

Environmental Management and Monitoring Plan (EMMP) is a tool for the implementation of the all the suggested measures to make the project environmentally sustainable. It provides an overall approach for managing and monitoring the environmental, ecological and socio-economic issues of the proposed Project, and describes the institutional framework and reporting mechanism to implement EMMP for the Project.

9.2 EMMP COMPONENTS

The EMMP comprises following main components:

- 1) EMMP Objectives;
- 2) Scope of the EMMP;
- 3) Environmental Policy, Legislation and Framework;
- 4) Institutional Requirements;
- 5) Environmental Audits;
- 6) Training and Capacity Building;
- 7) Communication & Documentation;
- 8) Environmental Mitigation and Management Plan;
- 9) Environmental Monitoring Plan;
- 10) Management Plans;
- 11) Code of Practices and Contractor Obligations; and
- 12) Environmental Management and Monitoring Cost.

9.3 OBJECTIVES OF EMMP

The basic objective of the EMMP is to manage potentially significant adverse environmental and social impacts of the Project. The specific objectives of the EMMP are to:

- Provide the details of the Project impacts along with the proposed mitigation measures, and the corresponding implementation activities;
- To ensure that all necessary corrective actions are carried out and monitored in time to counter any adverse environmental impact under a systematic monitoring approach;
- Provide a procedure for timely action in the face of unanticipated environmental situation;
- Define the role and responsibilities of the Project Proponent (WAPDA), Contractor(s), Supervisory Consultant(s) and other key players in order to effectively communicate environmental and social issues among them;
- Define a monitoring mechanism, reporting frequency and identify monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented;
- Design the training and capacity building plan for enhancing the capacities of the Project Proponent (WAPDA), Contractor(s), Supervisory Consultant(s) on environmental and social management;
- Identify the resources required to implement the EMMP and outline the corresponding financing arrangements; and

- Define the requirements necessary for documenting compliance with EMMP and communicating it to all the concerned regulatory agencies.

9.4 SCOPE OF THE EMMP

The scope of the EMMP includes the following phases of the proposed Chiniot Dam:

- Pre-construction Phase;
- Construction Phase; and
- Operation and Maintenance Phase.

All the activities performed during these phases will be controlled and monitored according to this EMMP.

9.5 ENVIRONMENTAL POLICY, LEGISLATION AND FRAMEWORK

The PEPA, 1997 (amended 2017) is a fairly comprehensive legislation which provides legislative framework for protection, conservation, rehabilitation and improvement of the environment. It contains provisions for the prevention of pollution and promotes sustainable development. 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 salient features of the law are:

- No proponent of a project shall commence construction or operation unless they have filed an EIA with the Provincial Agency (Punjab-EP&CCD), and has obtained an approval;
- Establishment and formation of the Punjab Environmental Protection Council;
- Prohibition of certain discharges or emissions;
- PEQS for wastewater, air emissions and noise; and
- Law also empowers Provincial Government to issue notices and to enforce them for the protection of the environment.

The PEPA, 1997 was amended in 2017 under the 18th amendment which gives legislatures power related to environment and ecology to the Provincial government from the Federal government. The provinces are required to enact their own legislation for environmental protection. Other minor amendments including increasing the penalty cost for violations.

The capability of regulatory institutions for environmental management largely ensures the success of environmental assessment for ensuring that the development projects are environmentally sound and sustainable.

Other project related national environmental laws, regulations, policies and guidelines are as follows:

- National Conservation Strategy (NCS), 1992;
- National Environment Policy, 2005;
- Pakistan Labor Policy, 2010;
- PEPA, 1997 (Amended 2017);
- Punjab-EP&CCD (Review of IEE and EIA Regulations, 2000);
- Pakistan EIA Procedures;
- Punjab Environmental Quality Standards (PEQS), 2016;
- Land Acquisition Act (LAA), 1894;
- Punjab Katchi Abadis Act, 1992;
- Cutting of Trees (Prohibition) Act, 1975;
- Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974;
- Punjab Plantation and Maintenance of Trees Act, 1974;
- Antiquities Act, 1975;
- Pakistan Penal Code, 1860;
- Canal and Drainage Act, 1873;
- Punjab Irrigation and Drainage Authority (PIDA) Act, 1997;
- Punjab Occupational Health and Safety Act, 2019;
- Pakistan Clean Air Program (PCAP); and
- Guidelines for Public Consultation.

9.6 INSTITUTIONAL SETUP FOR IMPLEMENTATION AND MANAGEMENT OF EMMP

9.6.1 Project Proponent - WAPDA

To implement and monitor the mitigation measures, the following institutions will be involved:

- WAPDA is the Proponent of the proposed Project and all the responsibility related to the protection of the environment lies with him;
- Project Contractor, as the executors of the EMMP during the construction phase of the project;
- Punjab-EP&CCD as observer and top monitoring agency during the construction and operation phases; and
- WAPDA Environmental Cell (WEC) and PIU/PMU of Chiniot Dam Project.

WAPDA was established through an Act of Parliament in 1958. It is an autonomous and statutory body under the administrative control of the Federal Government. The Authority consists of a Chairman and three Members (Water, Power and Finance). WAPDA was unbundled in the year 2007 whereby the functions of its Power wing were redefined as Hydel Power Generation and O&M of power houses. Following unbundling of its power wing, WAPDA's mandate is now development of water and hydropower resources in an efficient manner.

The current setup of WAPDA comprises a Chairman and three (3) Members working through a Secretary. The two main departments of WAPDA are Power Wing and Water Wing. Finance Department deals with financial matters of WAPDA. All wings are headed by their respective Members as mentioned above.

WAPDA Power Wing

WAPDA Power Wing currently headed by Member (Power). Power wing of WAPDA comprising Generation, Transmission and Distribution has been restructured into fourteen (14) public limited companies, in which four (4) Thermal Generation Companies (GENCOs), one (1) National Transmission and Power Dispatch Company (NTDC) and nine (9) Distribution companies (DISCOs).

WAPDA Water Wing

WAPDA Water Wing functions under Member (Water). For effective control, the entire country is divided into north, south, central and west zones generally covering all Provinces, for execution of surface water development Projects. Chief Engineers and Project Directors implement Projects falling under regions within the various zones. The Water Wing as a Chief Engineer (Coordination and Monitoring) for construction and operation of dams and all other Projects under Water Wing technical services and two separate General Managers for Ghazi Barotha Hydropower and National Drainage Project. The Planning Division of Water Wing headed by a General Manager, looks after all the planning activities on the water side. The activities of water resources and hydropower development and Vision-2025 are handled by three General Managers i.e. Technical, South, North, General Manager (Planning and Development) and General Manager Hydro Planning Development (directly involved for the proposed Project).

WAPDA Environmental Cell (WEC)

WAPDA Environmental Cell (WEC) works under General Manager (Technical Services) WAPDA and is headed by Director General (WEC). Current staff strength of WEC is about 15. Technical staff consists of environmental engineers, geologists, ecologists and civil engineers. EMMP execution and monitoring is be carried out by the Project based Environment and Social Unit (ESMU) headed by the Project director along with Supervisory Consultant and representatives of Contractor. WEC based at Lahore will carry out periodic monitoring, top supervision and internal auditing during Project construction phase.

The organizational structure of WAPDA is shown in **Figure 9.1**.

is highly recommended to be on-board within the existing setup of proponent. The department will primarily be responsible for tackling all the Health Safety and Environment (HSE) issues throughout the project cycle. The proposed staff is listed below:

a) E&RT:

- Senior Environmental Engineer/Scientist (Masters in Environmental Engineering/Sciences or related Field)–with 5 years' experience in Dam and Irrigation Projects; and
- Senior Sociologist (Master in Social Work/Sociology or related Field) with 5 years' experience in resettlement sector.

b) HSE Section:

- Senior Safety Engineer (Masters in Environmental Engineering and Safety Certification) will 5 years' experience in Dams and Irrigation Projects; and
- HSE Engineer Masters in Environment Engineering and NEBOSH Certified with 5 years' experience in Dams and Irrigation Projects.

Contractor must have an HSE Section having qualified professional staff. Proponent must consider this matter while selecting the Contractor.

Punjab-EP&CCD is the regulatory authority for issuance of NOC for this proposed project. As part of its mandate, protection of environment (water, air and noise) is their responsibility. Therefore, the agency will undertake an audit (as and when required) of the activities of the project (both phases) with respect to the protocols as defined in EMMP.

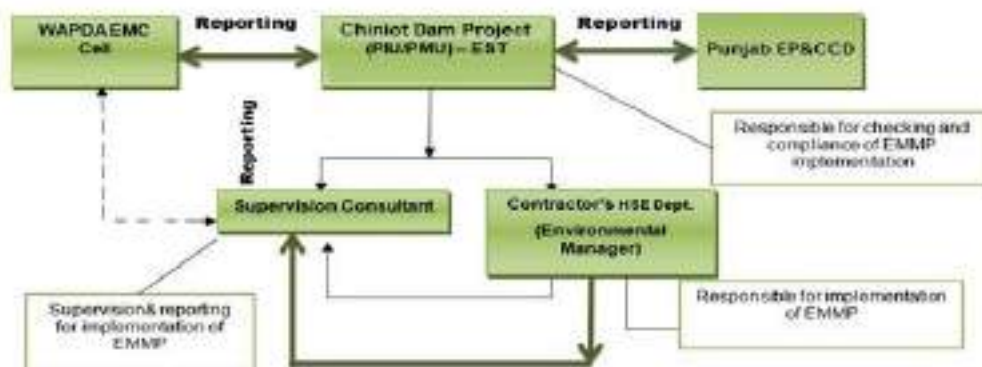


Figure 9.2: Organizational Structure during the Construction Phase

9.6.3 Roles and Responsibilities

The foremost responsibilities of proponent, EMC (E&RT/HSE Section) and Contractor are given in **Table 9.1** below.

Contractor is the main force behind meeting the project goals. Contractor is essentially deemed as the commercial leader of the project, in close coordination with the proponent, he has to manage and ensure some of the most important elements of the project including safety

of the project workers, equipment handling, HSE compliance, budget control, time allocation and remaining costs of the project.

Table 9.1: Roles and Responsibilities

Organization	Designation	Responsibilities
Proponent	Site Manager	- Overall in-charge and supervision of EMC's activities. - To ensure the project's compliance with the PEPA 1997 (Amended, 2017) and other national environmental regulations and stakeholder participations in the project construction and operation phases. - Liaison with Contractor.
EMC (E&RT)- Construction Phase	E&RT	- Monitor the and check the proper implementation of all mitigation measures for physical, ecological and social sectors. - Liaison with HSE department of Contractor. - Ensure compliance and implementation of national and provincial rules and regulations enforced by Punjab - EP&CCD especially regarding social and environmental aspects. - To assist Contractor for obtaining necessary approvals from the concerned departments. - To document the social complaints and prepare the social complaint register. - Monitoring and evaluation of environmental & social related matters of the project. - Carry out consultation with the locals with regards to any social issue that needs to be settled down. - Supervise the Contractor activities and make sure that all the contractual obligations related to the environmental and social compliance are met. - Prepare periodic Environmental Reports and distribute according to the requirement of EMMP.
Proponent (HSE Section) Operational Phase	HSE	- Oversee all the HSE activities being carried out. - Implement the HSE activities as provided in HSE plan. - Conduct site visits to ensure compliance with HSE protocols. HSE department will also ensure the compliance of all safety and health protocols during the operation phase.
Contractor	HSE Team	- Compliance of all the monitoring programs as given in EMMP (MMP, emergency plan, plantation plan, waste management plan etc.). - Ensure health & safety of site workers. - Liaison with EMC Section Proponent. - Training of workers. - Strict compliance of social mitigation measures. - Effective liaison with locals and heads of the villages.
Punjab-EP&CCD	Monitoring Team	- Audit of the activities being undertaken by Contractor and all other organizations as given in the proposed institutional plan. - Liaison with the Proponent and HSE Section to check compliance of measures as given in the EMMP during operation phase.

9.6.4 Supervisory Consultant

A Supervisory Consultant for the Project will be appointed by WAPDA, who will be designated as the “SC”. He will be responsible for the supervision of environmental mitigation measures as well as for the environmental monitoring of the Project activities. The role of SC will only be during the construction stage of the Project. The Consultant will be responsible for:

- Supervising the Project's Contractor(s) activities and ensuring that all the contractual obligations related to the design and construction, as well as environmental and social compliance are met.
- Ensuring that day-to-day construction activities are carried out in an environmentally sound and sustainable manner.
- Monitoring of the environmental aspects of the Project during construction to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMMP are implemented.
- Developing guidelines and a code of good practice describing the low-cost environmental measures that can be implemented during the construction and maintenance programs.
- Developing and conducting environmental training activities for Contractors and the Supervisory Consultant staff.
- Ensuring that the construction camps and other facilities are properly sited and installed in accordance with the contract.
- The identification of the exact locations and timing of baseline and periodic air, noise and water quality monitoring in accordance with the contract provisions.
- Undertaking critically important routine visual monitoring of the construction activities, waste disposal and overall environmental management practices by the Contractor(s). Effective environmental management during the construction will require frequent site visits and observation skills.
- Devising solutions to the environmental issues as they arise.
- Assisting the WEC in coordination with the EP&CCD, Punjab and provincial departments (where applicable), district administration, NGOs and other public/private sector organizations.
- SC will also impart training to Environmental Management/ Monitoring Cell (EMMC) appointed by the Project Proponent i.e. WAPDA.

9.7 PARTICIPATORY CONSULTATION FRAMEWORK

This aspect has been discussed in detail in the Chapter 6.

9.8 PLANNING FOR EMMP IMPLEMENTATION

For the effective implementation of EMMP during construction and O&M phase, the NOCs as well as necessary approvals from concerned departments and stakeholder coordination is a mandatory requirement at planning stage or before mobilization. Based on the outcomes of this EIA report, following but not limited to, the requisite NOCs/approvals and communication/coordination with relevant stakeholders are required.

9.8.1 NOC and Other Approvals

9.8.1.1 EP&CCD Approval Process

The EIA report duly reconciled with WAPDA is to be submitted to respective Punjab EP&CCD obtaining NOC. A demand draft of required EIA review fee has to be deposited along with the report by the Proponent to respective Punjab EP&CCD for initiating the review and EIA approval process. The approval from Punjab EP&CCD is the mandatory requirement before commencement of the proposed Project activities.

9.8.1.2 Provincial Departments of Wildlife, Forest and Archaeology

At the feasibility stage of the Project as per the requirement of EP&CCD guidelines for the Sensitive and Critical Areas, concerned provincial departments are informed through letters for the proposed project.

During the construction stage, if the implementation of the proposed Project involves the clearing of vegetation and trees which belongs to the forest or wildlife department, the Project Contractor will be responsible for acquiring a No Objection Certificate (NOC) from the provincial forest department. The application for an NOC will need to be endorsed by WAPDA. Similarly, if any Archaeological monument or site is crossed by or near to the proposed Project concerned provincial department needs to be contacted for NOC.

Where construction is to be carried out in the close proximity of the any archaeology sites (if identified during construction stage), the WAPDA is required to coordinate with the concerned departments to ensure that the impacts are minimized. The Contractor is also required to contact with concerned department before the start of the construction work.

9.8.1.3 Provincial Revenue Departments

Under the national law, matters relating to the land-use and ownership are the provincial subjects and the revenue department of the concerned province is empowered to carry out the acquisition of private land or built-up property for public purposes, including on behalf of other provinces. For this purpose, the concerned department must lodge an application with the concerned provincial government to depute a Land Acquisition Collector (LAC) and other revenue staff, who will be responsible for handling the matters related to the acquisition and disbursement of compensation.

9.8.2 Stakeholder Coordination

Notwithstanding the efforts so far put in for public participation, this activity will have to be pursued through the forthcoming implementation phases of the Project. In particular, the focus will be on the improvement and modification of the proposed intervention designs.

Participation mechanisms facilitate the consultative process and include information sharing and dissemination, disclosure, and participation of affected people and other stakeholders in the proposed Project related activities. In the peculiar social set-up of the Project Area, it is also important to involve the religious leaders as representatives of the public as well as part of effective communication process. They can provide a very effective medium to bring

information to the affected male population through Friday prayers. Local business community, especially the affected one, will also be brought into the process of awareness and participation.

The related institutional arrangements will also be in place for continuous consultation throughout the process of planning and implementation. During construction, WAPDA will have to implement EMMP.

The construction schedule will be established/updated before the commencement of construction work considering the activities specifically suggested in EMMP for its implementation.

9.9 ENVIRONMENTAL AUDITS

The environmental audit of the proposed project will be carried out both internally by WEC and externally by the external auditor e.g. Punjab-EP&CCD will check the various parameters with reference to the guidelines provided by PEPA, 1997 (amended 2017) and the standards specified by PEQS. The primary aim of the auditing is to assess the compliance and effectiveness of the EMMP as well as to assess the effectiveness of the previous corrective actions. Audit will also suggest remedial measures to overcome the environmental and social problems. External audit will be conducted on annual basis and at the time of completion of the Project.

Following are the main objectives of the audit.

- To evaluate whether the monitoring done is in compliance with the targets as set in EIA/EMMP;
- To determine the conformity of the environmental and social management plans with the specified requirements and identify non-conformity in environmental and social parameters as per EIA/EMMP; and
- Meet regulatory requirements and commitments.

9.10 TRAINING AND CAPACITY BUILDING

To enhance the capacity of the Proponent as well as the Contractor, training will be imparted related to the environmental and social issues of the proposed Project, implementation of mitigation measures and the monitoring protocols and reporting mechanism will also be carried out.

In-house training for the project staff including contractor, consultant and the supervisory staff of the Proponent will be ensured through the provision of one-day basic training and one-day advanced training, covering environmental and social aspects of the development projects in general, and implementation requirements with emphasis on the roles and responsibilities of the proponent and the contractor staff while executing the environmental management and monitoring plan in particular. The training protocols will include the following aspects:

- Procedures for monitoring the air quality parameters and measures to be adopted for avoiding or minimizing air pollution, particularly from the concrete batching plant, haul-trucks, etc.;

- Procedures for monitoring water quality parameters and measures to be adopted for avoiding or minimizing water pollution, particularly from the wastewater effluent generated from the workshops, machinery washing yards, and other obnoxious chemicals;
- Safe waste management and disposal practices;
- Safe noise levels from the construction machinery etc.;
- General housekeeping and cleanliness;
- Communicable diseases;
- Safety measures against hazards for workforce and the local communities arising from the construction activities; and
- Use of safety gadgets by the workforce.

A comprehensive training manual will be developed and implemented by the Contractor with prior consent of SC environmental staff.

9.10.1 Training Program

The detailed training program is given in **Table 9.2**. A training log will be maintained by the Consultant. The training log will include:

- Topic;
- Date, time and location;
- Trainer; and
- Participants.

Table 9.2: Training Program

Sr. No.	Staff	Trainers	Contents	Timing/Frequency
1.	Project Director, Construction, Chief Resident Engineer Resident Engineers, staff of the Environmental Management/ Monitoring Cell.	Supervisory Consultants (SC)	Introduction to Punjab Environmental Protection Act, 1997 as amended 2017. Introduction to the applicable national environmental laws and regulations. Roles and responsibilities of various stakeholders especially the Construction Contractors/ staff and Consultants. Introduction to EMMP and its contents and provisions/ limitations. Introduction to the Environmental Monitoring Plan. Documentation mechanism	<i>To be initiated soon after the start-up of the Project construction phase.</i>

Sr. No.	Staff	Trainers	Contents	Timing/Frequency
			* Use of laboratory equipment for testing and monitoring water and air quality parameters ect.	
2.	Construction Manager of the Contractor/ Contractor's staff.	SC	Mitigation measures included in the EMMP Good construction practices Wildlife and vegetation issues in the Study Area EMMP communication, documentation and monitoring requirements Workers/labour Health and Safety measures Community participation and consultations	<i>To be initiated at the start of the construction phase of the Project.</i>
3.	Operational / Managerial Staff of WAPDA	SC	Introduction to EMMP Related mitigation measures given in EMMP Safe handling, use and disposal of pesticides (fungicides, insecticides) fertilizers and hazardous wastes etc. Introduction to the Environmental Monitoring Plan and its relevant clauses.	<i>Prior to the start of operation and at least one training session during the first year of operation</i>
4.	Camp Staff/ Support Staff (Drivers, in-charge of workers/ labour, workshop force, kitchen staff etc.)	SC/ Contractor EMMP Staff	Road safety and restrictions Proper Vehicle maintenance Defensive driving Waste disposal Emergency handling Fire fighting Sanitation Camp(s) operation Housekeeping	<i>Prior to the start of any construction activity and one training session during the operation stage.</i>
5.	Contractor's Restoration and Clean-up team for borrow materials and camp areas	SC	Site Restoration & Restoration requirements	<i>Prior to the start of restoration activity (one training session)</i>

Sr. No.	Staff	Trainers	Contents	Timing/Frequency
6.	Community	SC/ Contractor EMMP Staff	Introduction to the Project features and operations Interaction mechanism with the Project owner and Project's key staff Introduction of any negative impacts on wildlife, vegetation, water etc. due to Project interventions & mitigation measures adopted. Benefits to the community by the Project/Positive outcomes Mechanism of community participation in the Project activities Complaints/ Grievance handling procedures	<i>To be initiated before the start-up of the Construction Activities under the Project.</i>
7.	<i>Contractor's Staff/ Support Staff (Drivers, in-charge of workers/ labour, workshop force, kitchen staff etc.)</i>	SC	An "alleviation programme" with respect to HIV/AIDS, COVID -19 and other infectious diseases. Compulsory HIV/AIDS awareness and other infectious diseases prevention training. Educational campaigns to be conducted in the Project Area.	<i>To be started immediately after the start of the construction activities.</i>

9.11 COMMUNICATION AND DOCUMENTATION

Communication and documentation is an essential feature of the EMMP. The key features of such mechanism are provided below:

- Meetings and Reporting;
- Photographic Record and Data Base; and
- Non-compliances(s) of EMMP.

9.12 MEETINGS AND REPORTING

Monthly meetings will be held at site during the construction phase. The purpose of these meetings will be to discuss the routine activities, non-compliances and their remedial measures. Various reports will also be produced at periodic time intervals, as provided in **Table 9.3** along with information regarding persons responsible for report preparation and review process. Additionally, minutes of meeting will also be submitted as part of routine environmental reports.

Table 9.3: Periodic Reporting Mechanism

Report Category	Prepared by	Reviewed by
Monthly	Contractors' environmental staff	Proponent and SC
Quarterly	Contractors' environmental staff	Proponent and SC
Annual Report	Contractors' environmental staff	Proponent and SC
Completion Report	Contractors' environmental staff	Proponent and SC

9.12.1 Photographic Record and Data Base

The Contractor will maintain photographic records of all activities during the implementation of the project. As a minimum, the photographic record will include the photographs of the sites, quarry sites, access tracks/roads, construction camps, and monitoring of different categories, etc. Data base of persons involved in monitoring, compliance and effects, HSE database, trainings, meetings, site restoration, tree plantation, compliance and non-compliance record according to HSE Plan will also be maintained.

Photographic record will also include shot number, photograph name, date, time, etc. to identify key locations by using digital camera. The activity will be performed before start and after end of activities.

9.12.2 Non-Compliance(s) of EMMP

The implementation of the proposed EMMP involves inputs from various functionaries. The Contractor will be primarily responsible for ensuring implementation and reporting of the mitigation measures proposed in the EMMP, which will be part of the contract documents. The provision of the EMMP cost will be made in the total cost of Project, for which Contractor will be paid on the basis of monthly compliance reports. However, if the Contractor fails to comply with the implementation of EMMP and submission of the monthly compliance reports, deductions will be made from the payments to the Contractor claimed under the heads of environmental components. Additionally, all non-compliances will be communicated to Contractor via non-compliance memos, emails, letters, etc. and will also be recorded in all environmental reports.

9.13 ENVIRONMENTAL MITIGATION PLAN

Environmental mitigation plan is considered as one of the main elements of EMMP. It will be used as the management tool for the implementation of mitigation measures. The plan includes following:

- The envisaged impacts as identified in EIA and their recommended mitigation measures; and
- The person/organization directly responsible for adhering to or executing the required mitigation measures.

It is highlighted that although the responsibilities for executing and monitoring the mitigation measures have been delegated to different organizations, PIU/PMU will hold the primary responsibility for ensuring the full implementation of EMMP. **Table 9.4** provides information about all impacts to be raised due to project activities during different phases of the Project i.e. pre-construction, construction and operation.

Table 9.4: Mitigation Management Matrix

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
Pre-Construction / Design Phase				
1.	Permanent Land Acquisition Permanent land will be acquired for the Project components such as Powerhouse, Weir & Associated Structures, Access Roads and Project Colony. Overall, in the Project area 48,300.07 acres of land will be submerged which includes both private and government land. However, out of 48,300.07 acres, approximately 13,122.02 acres' land is river plain and 20,165.73 acres' are comprised of land prone to flood land 12,613.41 acres' are comprised of rich fertile agriculture land. The land title/ownership will be determined by the revenue department. However, the private land will be acquired on permanent basis under the provisions of Land Acquisition Act (LAA) 1894.	Government owned land for the Project area will be acquired as per the policy of government of Punjab. While private land will be acquired as per provision of LAA, 1894. The process of land acquisition will start before the Project will enter into construction phase and section-4 of land acquisition act, 1894 will be notified by relevant agency. The process of land acquisition and compensation should be followed in a transparent manner to minimize the impacts to provide judicious compensation to the displaced by providing sufficient budget in the project cost. According to Land Acquisition Act 1894, the following points are to be considered while determining compensation for the project affectees: • The Land Acquisition Act (LAA) of 1894 is the main law regulating land acquisition for public purpose. This impact can be mitigated by ensuring compliance of Land Acquisition Act, 1894, addressing community grievances on priority basis and timely compensation to affectees; • The process of acquisition for the land and land based assets and compensation should be followed in a transparent manner to minimize the impacts to provide judicious compensation to the displaced by providing sufficient budget in the Project cost. • Due consideration should be given to minimum land acquisition in design phase by selecting alternate options and changing in engineering features if possible; • Land that will be coming under project area should be acquired according to Land Acquisition Act (LAA), 1894. • Compensation should be evaluated and provided as per market rates. • In addition to land compensation, 15% compulsory land acquisition surcharge should be given to land affected persons. • Other land based assets like orchards, crops and trees should also carefully have enumerated and compensated according to agreed entitle matrix during preparation of RAP.	District Government, Proponent	
2.	Temporary Acquisition (Land on Lease) During the construction activities.	Land for above mentioned facilities will be directly rented from the private landowners by the contractor. The provisions of the Land Acquisition Act	District Government, Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	contractor will establish contractor camps, storage areas for materials and equipment including vehicles, workshops, stockpile yard, etc. The tentative location of these construction camp areas is shown in chapter 7 which need to be finalized yet. Contractor need to lease the land for these areas in the vicinity of the construction sites. These areas will be acquired on temporary basis by direct negotiation and agreement with the owners or negotiated with or decided by the district administration office. Temporary acquisition will principally be the responsibility of the contractor. The total estimated land which will be occupied by the construction camps and associated facilities is about 1500 acres (for staff and labour camps and for material and equipment storage area).	(LAA), 1894 will not be involved as the acquisition of the land will be temporary and will be covered by short-term lease agreements between the landowners and contractor. Temporary acquisition will principally be the responsibility of the contractor. Rental terms will be negotiated to the satisfaction of the concerned landowners and the agreement will be made in local language to make the process clear. As mentioned the location of these areas are not finalized yet, therefore a criterion has been suggested which will be followed to avoid the adverse impact on the environment. The land for above mentioned facilities will be selected and leased prior to the start of construction phase. Lease agreement will also govern the process of site restoration of the leased or rented land after the construction phase and will ensure through the terms of the construction contracts that landowners are compensated according to the terms of the lease agreements and the site restoration plans agreed upon by the contractors are duly carried out. The following general site selection criteria have been suggested to be complied by the contractor: • Minimize the resettlement, relocation of the existing infrastructure like roads, cultural and religious sites etc. and avoid the cutting of trees; • It will be elevated to avoid floods and for other security reasons; • Proximity to the major disaster and emergency management authorities; • Avoid potentially security vulnerable areas; • Minimize disturbance to the natural habitats of flora and fauna; • Avoid densely populated areas/towns; • Avoid indigenous or tribal settlements; • Avoid wildlife sanctuaries, national parks and game reserves; • Appropriate distance from the sensitive receptors (for instance, minimum 500m); and • Avoid cultural, religious and historical buildings.		
3.	Structure Loss The proposed project will affect the local residents and farmers at great extent. The	• The efforts should be made to minimize the resettlement impacts on the local community by adopting engineering alternatives where possible;	District Government, Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	public consultations and GIS based calculation of the affected structures revealed that more or less 3,896 miscellaneous structures will be affected due to creation of the reservoir area. These miscellaneous structures include residential, commercial, community and public structures including sensitive community structures like mosques and graveyards. The inventory of land, the detailed measurement of affected structures and the number of households to be affected by the acquisition of land will be completed during the preparation of the Resettlement Action Plan (RAP) with the help of the revenue and other concerned departments. The impact will be permanent and highly adverse in nature. Due to adverse impact on the residential structures, human disturbance and displacement will occur which cause the social, gender, livelihood and cultural issues	- The effort should be made by making changes in design to avoid the sensitive and religious structures and to minimize the issues at possible extend. If demolishing is necessary, a mechanism will be developed for the restoration of these structures with the community consultation; - A comprehensive resettlement and relocation plan must in place before displacement of affected communities at the large scale; - Affected Persons should be compensated on full replacement cost of each category to construct a new structure of the same type; - A comprehensive livelihood restoration plan should be prepared before displacement of the affected community; and, - Proper consultations and coordination's with PAPs during and after resettlement process.		
4.	Impacts due to Field Investigations Low level adverse impacts on the air quality, impact on surface water quality, soil contamination, soil erosion due to the pre-construction activities like geotechnical investigations including drilling, topographical surveys and seismic investigation will affect the existing settings. Activities like drilling, blasting, movement of machines and setup of contractor and consultant camps will also impact the soil, wildlife, noise levels etc.	Good engineering practices and Standard Operating Procedures (SOPs) are required to be adopted by the contractors. This will mitigate or avoid this insignificant impact. Measures such as sprinkling of water on the roads and dirt tracks, use of water to reduce air pollution during the stone crushing operation and tuning of vehicles and equipment will reduce the air pollution. The excavated material will be managed by ensuring proper storage areas located far away from the water bodies. The choice and design of these measures such as reduction of slope gradient and height, reduction in slope angle, removal of unstable material, use of reinforcement material etc. will be the responsibility of the contractor. The contractor will be required to train his workforce in the storage	Design Consultant	Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
		and handling of materials, like oil, diesel, petrol and chemicals, etc., which can potentially cause soil contamination. Special measures will be adopted to minimize the impacts on the nearby settlements such as avoiding noise generating activities during night time, etc.		
5.	Physical, Religious and Cultural Resources According to the field survey, various local village mosques such as Masjid Wadi Aziz, Shareef Masjid and Boo Ali Qalandar Shrine are coming in the reservoir area. Other sensitives places are Government Primary School Basti Malah, Government Primary School Burj Umer and Monument Shuhada. These sensitive places are not directly affected due to proposed project however special considerations are required to eliminate the probability of impact.	Due consideration shall be given to minimize the adverse impacts on the religious and community structures and places.	Design Consultant	Proponent
6.	Interference with Other Utilities The utility lines like gas pipes, electricity lines, local roads/tracks, etc. exist within study area of the proposed project. These utilities will be relocated before the start of construction activities. These utilities if not handled properly may cause difficulties to the people of the project area.	• Proper compensation and restoration mechanism of public utilities will be adopted. The relevant department will provide the estimate for the relocation of the utilities and they will be provided compensation accordingly through PMU prior to implementation of the proposed project; • Complete rehabilitation of affected public utilities will be ensured; • All public utilities likely to be affected by the proposed project will be relocated well ahead of time before the actual commencement of the construction work; • Close coordination with the concerned departments to curtail inconvenience to the residents of the project area; and • Timely public notification of unexpected disruption of services will be ensured to avoid inconvenience to locals.	Design Consultant	Proponent
7.	Water Logging Issues Water logging can have significant impacts on nearby agricultural land, especially due to impoundment of reservoir. Water logging occurs when the soil becomes saturated with water, leading to poor aeration. The	To mitigate the adverse effects of water logging on agricultural land, proper planning, and management strategies, such as implementing drainage systems, selecting appropriate crops, tube well arrangements in adjoining areas, and monitoring soil and water quality, are essential. Implementation of proper reservoir operation strategies will be ensured to control water levels and prevent prolonged inundation of agricultural land. Effective drainage systems	Design Consultant	Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	creation of a reservoir can lead to the inundation of fertile agricultural land, displacing crops and rendering the soil unsuitable for cultivation. This can result in the loss of valuable arable land, affecting local farmers and food production. Water logging can also contribute to soil salinization, especially in areas where the impounded water has a high salt content. As water accumulates in the soil, it can bring salts to the surface, making the land less fertile and inhibiting plant growth. The prolonged presence of water on agricultural land can lead to the significant yield losses and economic hardship for farmers.	including channels, ditches, and drains have been proposed along the dykes of the reservoirs and for surface and subsurface drainage, to remove excess water from the soil. Additionally, engaging with local communities and stakeholders during the planning phase of reservoir projects can help identify and address potential challenges associated with water logging.		
8.	Impact on Downstream Low Riparian As per definition, riparian zone or area is the interface between the land and a river or stream. Lower riparian area can be broadly defined as the area from the proposed dam up to the Trimu Barrage. There is a significant flooding impact on the immediate downstream settlements (Muslim Colony, Darul Yaman, etc.) during the emergency flushing and high flow seasons. Apart from this, there are numbers of downstream water users which get benefits from the flooding water during high flow season. After attenuation of the flood, the downstream flow will be regulated and confined to the limited area which will not only safe the local population from flood damages but on other hand cause serious livelihood and agriculture damages. The impact significance is medium adverse.	Serious attention will be paid towards the issue of "Environmental Flow" which in many projects is fixed at an arbitrary level (normally 10% of the base flow) without taking into consideration the water uses / needs downstream of the proposed dam and mostly ignoring the rights of the lower riparians. In order to conserve the water rights of the lower riparian, a provision of regulated flow will ensure during the dam operation. Therefore, lower riparian will not be devoid of their water requirements by volume instead due to the regulated flow, they will be better off as compared to the current scenario. - Chenab River is being used for boating and swimming purposes at limited scale on various appropriate locations. Since this use is associated with summer as well as winter season. For summer season, due to the rainy season no minimum flows can be estimated as ample water is available. Therefore, an amount needs to be fixed for the flow month as a percentage of total flows (needs to be verified). It is suggested that 10% of the minimum flow currently occurred of the total flows available can be considered as for the recreational purpose. However, this needs to be verified through detailed flow assessment studies; - Apart from above intended usage, groundwater recharge is another component which needs to be considered while calculating the minimum environmental flows for the Chenab River downstream of the proposed	Design Consultant	Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	The minimum water release downstream of Chiniot dam may be sub divided into following major categories - Domestic unallocated water usage; - Aquatic Water Usage; - Groundwater Recharge; - Recreational; and - Losses and unaccounted water. Water is being pumped by the locals or the lower riparian directly from the Chenab River for domestic purposes such as drinking, washing, washing of livestock etc. This water is also being used for the bathing and drinking of livestock apart from dumping of waste. This unaccounted-for water demand needs to be taken care during the establishment of minimum flows in the Chenab River. Apart from the above water usage, Chenab River water is also being used for the purpose of recreation such as boating and swimming. This use is identified based on the secondary information provided by the locals and later verified during the visit to the banks of Chenab River downstream of proposed project. Therefore, this use may also be considered for the establishment of minimum Flows. Flood or rain fed agriculture water usages in the lower riparian area for irrigation purpose is also practiced during the floods by trapping flood water. Due to the construction of the dam, supply of water to the lower riparian area will be attenuated.	Dam. Based on current ground water study, a 5%of the minimum flow occurred of the total flow in the river can be considered as a limiting value. However, this needs to be verified through detailed downstream flow assessment studies; and Similar to the above, the flood or rain fed agriculture water usages demand of the lower riparian area for irrigation purpose will also require detailed flow assessment to allocate the minimum flow so that this impact can be minimized.		

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	Peaks will be flatter hence water might not reach the areas where the water reaches during flooding period.			
9.	Flora During the pre-construction phase, activities such as installation of construction camps, construction of temporary roads and mobility of construction staff may damage the local vegetation/trees. As the heavy machinery and camps will be moved and installed, which require significant space due to which available vegetation is expected to be removed. This impact is Site-specific, temporary, reversible, Possible, Medium Significant and needs to be encountered prior to the start of construction stage. Chak Sarkar Reserved forest (details provided in ecological baseline) may be falling under the project activities which will cause negative impacts on the local ecosystem.	- The camps, mobility of machinery and construction of temporary road should be proper planned and well designed to avoid any loss to local green cover. - It is recommended to establish the construction camps where minimum or no vegetation exists. - Similarly, the alternate routes for roads and points for camps are recommended where no loss of vegetation is expected. - The location of construction camp will be selected so, as to have limited environmental effect during construction phase and to reduce the cost and land requirement. - In the design phase all the reserved forest areas/ecologically sensitive areas must be avoided, or to minimise the negative impacts.	Design Consultant	Proponent
10.	Fauna As movement and installations of machinery and vehicles will take place so noise and habitat loss is expected. The routes of the available wildlife and other habitats may be affected due to camps set-up and machinery movements and installations. Temporary road may also affect the habitat of locally available fauna. Wildlife sensitive areas in consultations with relevant department must be avoided as disturbance to the wildlife may cause negative impacts on the local ecosystem.	- The standard measures must be considered to avoid noise. - Wildlife movements and routes must be considered during pre-construction activities and should be avoided to their maximum level. - The camps shall be properly located and fenced to check the entry of animals in search of eatable goods. - Appropriate wastes of disposal facility will be proposed in camp layout to avoid the impacts on fauna. - In the design phase the Chak Sarkar reserved forest areas and other designated wildlife areas or ecologically sensitive areas, if any must be avoided, or to minimise the negative impacts.	Design Consultant	Proponent
11.	Socio-economic Environment	No mitigations measures are required except good engineering practices to avoid and reduce these low adverse impacts.	Design Consultant	Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	During the planning and design phase of the project, it is anticipated that there will not be any potentially significant adverse impact on the socio-economic environment. Locals may be temporarily disturbed due to the field investigations and drilling activities.			
Construction Phase				
1.	Visual Intrusion Construction activities at dam axis, distribution weir and saddle axis will result in some visual impacts. The construction activities will involve the cutting of trees/vegetation, excavation, soil filling and cutting operation. This disturbs the natural scenic value of the environment. In addition to that the sitting of construction equipment and the lacks of resurfacing/replanting of exposed areas are also the leading factor to aesthetic reduction.	The adverse environmental impacts related to the aesthetic could be effectively minimized at the construction phase. These will be mitigated by the control of clearing vegetation to the area in the construction limits and by plantation and quick re-vegetation during the construction phase. Material stockpiles will be removed as soon as work is completed and the area re-landscaped. Good house-keeping, cleaning, efficient solid waste management system will be implemented to improve the aesthetics of the working environment.	CC	SC - Proponent
2.	Site Accessibility The proposed Project Area falls within the territory of District Chiniot, please refer to the location map as Figure 1.1 . The Project site can be accessed through Chiniot bypass, Pindi Bhattian – Chiniot Road and M-2 motorway. Heavy vehicles will be utilized to transfer construction plants, equipment, construction materials, cement and fuel. These activities may have adverse impacts on the access roads. Apart from that it will increase the air and noise pollution.	The access roads to the dam site have to be pre-determined in consultation with the highway/traffic management officials. Access roads would have to be widened and/or improved to carry the anticipated load of traffic. During the course of construction of proposed Chiniot Dam Project, contractor(s) will provide the signage and/or traffic control to the extent deemed necessary by the traffic utilizing or accessing the site roads. These signs will inform, control, warn, shift, or stop traffic on all site roads affected by the Project's heavy traffic. The following measures will be taken by the contractor(s) during the construction phase for the effective implementation of the traffic plan:	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
		• Pakistan national and local traffic rules and regulations, instructions manual for motor vehicle and mobile machinery operation will be followed; • No one will be allowed to drive motor vehicle or operate mobile machinery without a driving license; • It will be prohibited to drive or operate vehicle in case of over fatigued or mental disease; • Traffic speeds on unpaved roads will be limited to no more than allowable traffic speed; • Traffic speed signs will be displayed prominently at all site entrances; • A daily routine check-up of vehicles will be conducted not less than five minutes before its service; • Use of appropriate signs, equipment, and traffic control measures that conform to the provisions in the traffic manual of city traffic police; • Traffic inspection and security during transportation; • Limit vehicular traffic designated access roads, construction laydown area, parking areas and the Project site; • All damaged, destroyed or modified pavement legend, traffic control devices, signing and striping associated with the proposed development will be replaced as required prior to issuance of a certificate of occupancy; and • Construction signs, lighting and barricading will be provided during construction as required. The contractor(s) will also be responsible to prepare a comprehensive Traffic Management Plan and follow the conditions of contract for construction.		
3.	Natural Drainage Construction activities such as excavation, filling and construction of the dam structure, distribution weir and saddle axis will affect the existing soil pattern in the Project Area, its surroundings and along the command area. In addition, this will lead to changes in the existing drainage pattern. The conditions will be more hazardous during the flood periods and can affect the construction activities.	During the construction phase, excavated material will be properly disposed of ensuring that it will not block the natural drainage paths. Open drains for drainage of rain/flood water will be constructed, if considered necessary during construction period.	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
4.	Potential Loss of Land in Disposal Areas During the construction phase, huge quantities of rock will have to be excavated. Part of the excavated rock can be used as concrete aggregate provided the fragmented rock meets the quality standards needed for the work. In order to reduce the amount of rock to be disposed, excavated rock can be used in the Project for different types of infrastructural works. The remaining spoil will be disposed in designated and safe disposal areas.	The following mitigation measures will be implemented to reduce the impact significance: - Minimize the generation of spoils by recycling the excavated rock to the maximum extent possible by using them as aggregate material in the concrete works; - A restoration and re-use plan for the disposal areas will be prepared in advance; - A spoil disposal plan will be prepared and implemented; - Barren lands or natural depressions will be used for dumping the excavated spoil material ensuring that the local drainage will not be disturbed; - The disposal area will be re-contoured to minimize changes in topography; - Dispose excess rock material in the designated disposal site in an orderly manner (different spots to different size rocks); soil erosion control measures through bio-engineering techniques; and - Potential risks of acid drainage will be assessed during construction by the contractor and necessary treatment measures will be adapted.	CC	SC - Proponent
5.	Resource Conservation Resources involved in the construction of proposed Project would include water, fuel and construction materials. Excessive water consumption by the construction staff may stress water resources in the Project Area and in certain cases may disturb the existing water supplies in the Project Area. Construction material to be used for construction includes coarse aggregates, fine aggregates, asphalt, cement, lining material, earthworks, reinforced and structural steel etc. Almost all the materials to be used in the construction of proposed Project are non-renewable and therefore their efficient use is necessary for the future	- Use potable water bowsers for construction works and mineral water bottles/ ground water for drinking purpose; - Plan for the provision/purchase of adequate insulation to reduce heat loss through batching plants; - Reduction of wastage of water through training of workers involved in water use; - Reuse of construction waste materials may be adopted wherever possible; - Diesel and fuels with low sulphur content will be used to operate construction machinery and equipment; - The efficient and well maintained equipment and machinery will be used; - The equipment and machinery will be turned off when not in use; - Ensure adequate insulation to reduce heat loss through batching plants; - Regularly monitor CO and CO₂ content of the flue gases to verify that combustion systems are using practical excess air volumes; and - A good camp design and an efficient worksite management plan can help the contractor to reduce the water demand, wastewater and solid waste volumes to the lowest levels	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	use. Fuel will be used to operate construction machinery. Efficient use of energy resources is important to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is important. The impact is minor negative.			
6.	Soil Contamination & Erosion During the construction phase of the Chiniot Dam Project, large quantities of waste materials, chemicals, fuel and lubricants will be used apart from the generation of solid waste and liquid waste from the construction camps. Fuels and chemicals will be stored at the site for their immediate use, which will contaminate the soil if not handled properly. Similarly, removal of vegetation and shrubs for the purpose of construction activities will lead to loosing of the soil, soil disturbances, and exposure of bare soil surface. This causes problems of soil erosion and siltation during rain.	Good engineering practices will help in controlling soil erosion at construction sites. Following measures will be adopted according to site condition: • Soil erosion impact on the area during the construction phase will be of a temporary nature. However, the contractor will be required to train his workforce regarding storage and handling of materials, like oil, diesel, petrol and chemicals, etc., which can potentially cause soil contamination; • Retain as much existing vegetation possible; • Use natural and artificial cover on disturbed areas; • Divert runoff away from disturbed areas; • Minimize runoff velocity and discharge; • Proper solid waste management and housekeeping at construction camps will be practiced; • The contractor will be required to prepare training manual and modules for all the construction related activities along with the schedule of training program and submit to the supervising consultants for approval; • Soil contamination due to concrete transportation will be minimized by placing all containers in casings; • The oil, fuel and chemical storage areas will be designed as per applicable standards i.e. Statutory Notifications (S.R.O), Government of Pakistan, Oil and Gas Regulatory Authority, Notification, Islamabad, 2nd July, 2009, etc.; • Material Safety Data Sheets (MSDS) will be strictly followed during handling and storage of chemicals; • Solid waste generated at the camp sites will be properly treated and safely disposed only in the demarcated waste disposal sites/areas; and • Site restoration plan for the Project will be strictly followed.	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
7.	Liquid and Solid Waste from Construction Camps Development of construction camps in the Project Area will generate a significant quantity of liquid and solid waste. Residential accommodation is required for about large number of staff and workers of the contractor, the consultant and the employer on the Project. It is proposed to locate the necessary temporary and permanent colonies at or near the proposed Project site. Approximate proposed strength of the total staff for camps is about 450 at this phase of the Project. As a general rule the water consumption will be about 40 liters/capita/day and will subsequently generate about 70 to 80% of this water as sewage. Disposal of wastewater without treatment will pollute the soil and surface water. Hence, water demand, on average, will be 18,000 liters/day for camps during the construction phase and estimated generated wastewater will range from 14,400 liters/day. Camps will generate about 0.45 kg/person/day domestic solid waste comprising kitchen waste, garbage, putrescible waste, rubbish, and small portion of ashes and residues. Estimated quantity of solid waste will be about 202.5 kg/day. Improper waste management	To dispose the liquid and solid waste generated from the construction activities, the following steps will be taken by the contractor: - Domestic and chemical effluents from the construction camp will be disposed by the development of on-site sanitation systems i.e. septic tank along with soakage pits, prior to discharge. Septic tank will be located adjacent to the construction camp. Proper monitoring to check the compliance of PEQS will be carried out; - The domestic sewage will be treated with biological treatment technology and will be discharged as per PEQS. Proper monitoring to check the compliance of PEQS will be carried out; - As per standard engineering practices after digestion of sludge for an extended period, the sludge will be dried and be used for the landfilling at proper location for final disposal; - All the solid waste from the camps will be properly collected at source by placing containers and disposed of through proper solid waste management system. The contractor will coordinate with local representatives and concerned authorities, if any, for the disposal of solid waste; - Toxic waste will be handled, stored, transported and disposed separately; - The waste will be properly sealed in containers with proper labels indicating the nature of the waste; - Solid waste will be segregated at source so that it can be re-used or recycled; and - A waste management plan will be developed by the contractor and will be implemented with true spirit.	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	activities can increase disease transmission, contaminate ground and surface water and ultimate damage to the ecosystem.			
8.	Surface Water Quality Surface water quality of the Chenab River may get deteriorated due to the construction activities. During the construction phase of the proposed Project, materials like sand, gravel and stones will be required in large quantities. Extraction of the materials will also affect the surface water quality by increasing the sediment load. This water will be used during different construction activities. The movements of heavy vehicles on the unpaved tracks, excavation activities, cut and fill processes in the Project Area, fuel and chemical spills may deteriorate the quality of the surface water. These activities will also increase the sediments and turbidity of the water. Waste streams can bleed toxic materials from items such as batteries, used computer equipment, leftover paints and pesticides and pathogenic organisms include specific strains of bacteria like E. coli into the leachate of dumps. Leachate from waste piles caused by exposure to precipitation and from residual liquids in the waste itself may contain organic matter, nutrients, metals, salts, pathogens, and hazardous chemicals. If allowed to migrate, leachate can contaminate surface water.	The excavated material will be managed by ensuring proper storage areas located far away from the water bodies. It will not cause the siltation of the Chenab River and other Nullahs/tributaries. All the solid waste from the camps will be properly collected at source by placing containers and disposed of through proper solid waste management system. To reduce the impact of sediment, load the contractor will make arrangements such as fine screens and drains to limit the siltation into the water bodies. A simplified sedimentation tank shall be built on the construction site for the primary treatment of the construction equipment wastewater, detergents and mud. Wastewater effluent from the contractors' workshops and equipment washing-yards will be passed through gravel/sand beds to remove oil/grease contaminants before discharging into the natural streams. This is the general guideline principle for the contractor. According to the PEQS, the BOD concentration in sewage must be brought down to less or equal to 80 mg/l before being discharged into a natural stream having capacity to dilute the effluent. For wastewater, apart from BOD, COD of 150 mg/l will also be checked; and similarly, if the sewage after treatment is to be discharged on to the land it will meet the requirements of the PEQS for disposal of wastewater.	CC	SC - Proponent

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
9.	Quarrying/Borrow Area Hazards Most of the construction material will be obtained from volume of rocks excavated in CDP for construction of powerhouse that is of good quality. Furthermore, to meet the required quantity of construction material for construction of the Earth fill type of embankment proposed for Chiniot dam project is explored at and in the vicinity of project area. Transportation of material from the quarry sites to the dam site will be a major task involving movement of heavy vehicles. Development, excavation, loading and transportation of material from each site will create various adverse impacts on the existing environment. This would also affect the quality of surface water being utilized in the downstream area of dam axis due to high turbidity. Temporary storage of huge quantities of material in the shape of heaps may also affect the drainage pattern of the area.	Proper Quarry Development and Management Plan for each identified quarry area will be made prior to the execution of work. The Plan will include all the infrastructural requirements of each site and implementation plan for the development of each quarry site in an environmental friendly manner. This plan will be submitted to the supervisory authority for approval. Guideline quarry management plan is attached with EIA report.	CC	SC - Proponent
10.	Ambient Air Quality A large number of machinery and equipment will be deployed at site for the implementation of the Project. Different varieties of machinery/equipment will be required during the construction phase of the Project. The start of construction activities, working of equipment and vehicles will cause deterioration of the ambient air quality. Apart from the emissions of exhaust gases from the vehicles, generators, batching plants and	These adverse impacts are likely to occur during the construction phase only. These will be effectively mitigated by adopting the following preventive measures: - Constant sprinkling of water on the unpaved/dirt tracks to avoid the deterioration of air quality in reservoir area; - Use of water to reduce air pollution during the stone crushing operation. This will also reduce the dust pollution during the hauling of the material due to the remaining moisture; - Old plant, equipment and transport vehicles will not be used on the construction Project. Vehicles and plants older than 5 years will not be allowed;	CC	SC - Proponent

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	machinery, fugitive dust emission will be the major air quality deterioration component. During the summer season, high winds will moderate the effect due to the dispersion, however, during the winter season, inversion will make the conditions worse. However, this impact will be of a temporary nature. The critical sources of air pollution during the construction phase are: • Particulate matter from the excavation, movement of traffic and working equipment (stone crushing plants); • Sulphur dioxide (SO₂) and lead in exhaust emissions of vehicles and machinery on site; and • Carbon monoxide (CO), carbon dioxide (CO₂) and NO_x in the exhaust gases of vehicles	• Haul-trucks carrying sand aggregate and other materials will be kept covered with tarpaulin to reduce the dust pollution; • Planting rapidly growing trees, shrubs and grasses would help in reduction in air quality deterioration; • Vehicle will be properly tuned; and • PEQS provisions for ambient air quality, stack emission, noise levels and vehicular exhaust will be used for reference during the construction works.		
11.	Noise Pollution The project activities which generate air pollution also generate noise. Hence during the construction phase, activities like movement of vehicles, operation of machinery, excavation, blasting, etc. will cause noise as well as vibrations. Existing environment of the area is free from noise pollution and the use of machines such as vehicles in the daily activities of the locals is almost negligible. Hence any noise generated during the night time will have a pronounced effect on the nearby receptors. Similarly, use of explosives during the excavation and construction will have a significant adverse impact on the safety of the workers.	All mitigation measures mentioned below will be taken in order to minimize the impacts of noise in the project area. Use of quieter equipment, scheduling of work activity, maintenance of noisy equipment and application of noise barrier will be ensured to minimize the adverse impacts of noise on sensitive receptors identified in the project area by ensuring the implementation of below mentioned mitigation measures. To mitigate the above-mentioned impacts, following measures are recommended: • Heavy duty machinery will be provided with mufflers in order to reduce the noise to within acceptable limits; • Construction timing will be consulted with the residents of the nearby villages. This will minimize the disturbance to the local population; • Provision of mufflers on machinery producing noise; • Vehicle will be properly tuned; • During the blasting activities for material quarries and borrow pits, labour will be provided with ear muffs to avoid hearing loss; and	CC	SC - Proponent

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	The significant impact may be of high magnitude for the labor working in a place that is close to the area where explosives are in operation	Construction timing will be coordinated with locals. Normally heavy noise generating activities are allowed only from 9 AM to 5 PM (during day time) to avoid disturbance to local public as well as fauna of the project area.		
12.	Greenhouse Gases and Climate Change The main sources of GHG (CO ₂ , CH ₄ , NO _x etc.) during the construction activities of the proposed project will include both mobile and stationary sources. The mobile source will be the construction and transportation vehicles while the stationary source will be the batching and asphalt plants. Emission of GHG causes global warming and other climatic changes on regional and global scale. Cutting of trees will also reduce the carbon sequestering and overall increase the CO ₂ content in atmosphere which is one of the major GHGs.	- Use construction machinery designed with suitable pollution abatement technology such as scrubbers; - In order to control NO₂ emission at site, diesel engine equipment and machinery will be installed with catalytic converter, as it allows diesel engine to take advantage of the trade-off between NO₂, PM10 and fuel consumption, and calibrate the engine in a lower area of fuel consumption; - Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO₂; - Used and old electrical equipment will be banned that can also help to reduce urban emissions; - Environmentally friendly fuel such as Liquefied Petroleum Gas (LPG) can be used instead of diesel; - Burning of waste will be strictly prohibited at site; - Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and - As appropriate use of solar panels at construction camp sites instead of diesel generators will also reduce the emissions.	CC	SC - Proponent
13.	Discovery of Heritage Sites and Structures during Excavation During excavation, there is a chance of finding artifacts. In case of finding any artifact, the contractor shall immediately report through Supervision Consultant to Directorate General (DG) of Tourism, Sports, Culture, and Archaeology & Museums Department Government of Punjab to take further suitable action to preserve those antiques or sensitive remains.	- In case of finding archeological remains during excavation, the contractor shall immediately report through Supervision Consultant to Tourism, Sports, Culture, Archaeology & Museums Department Government of Punjab to take further suitable action to preserve those antiques or sensitive remains. Chance finds procedure is provided in EIA report; and - The contractor needs to obtain approval for excavation and submit the plan of rehabilitation of the site after excavation.	CC	SC - Proponent

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	According to the field survey, no notified archeological site was present in the Project Area.			
14.	Flora The project may involve destruction of vegetation cover on construction areas particularly along proposed construction. It is initially/tentatively examined through GIS that approximately Around 50,599 mature and sub-mature trees will be affected which includes 16% Fruit trees and 84% timber trees (out of which 17% are non-value trees). The provided number of trees is approximate and tentative which may be finalized prior to construction phase through relevant departments i.e. forest, agriculture and revenue departments. The number of possibly impacted trees is provided by GIS mapping. Moreover, trees of small and medium sizes may be removed due the project for which compensation with 1:10 will be made to concerned parties (Local community, forest and other relevant departments. If any,) Exhaust of noxious gases from movement of heavy machinery and dust will pollute air which will adversely affect health and vigor of plants. During construction activities the Contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements).	• Incorporate technical design measures to minimize removal of trees. • Cutting of trees and disturbance shall be avoided, as far as possible so, that negative effects on the process of natural regeneration of species are minimized and possible alternate route must be considered for proposed road, in which minimum ecological and environmental losses are expected. • A tree plantation program/plan will be implemented (as provided in this report) with the recommendations and technical support of concerned Forest Department. • As a principal, ten trees shall be planted in place/lieu of felling of one tree in consideration of mortality. • The client shall implement the program with the help of Forest Department and with the consultation of concerned consultant ecologist. • The Forest Department and agriculture department shall involve the communities for carrying out plantation. • Plantation Plan implantation for compensatory planting for ten (10) trees against each fallen tree of similar floral function at the available spaces in/around the project area is highly desired to restore the ecosystem. Total 505,990 trees will be planted to compensate/in lieu of 50,599 trees. The competition ratio is 1:10. • Open fires should be banned in the area to avoid hazards of fire in the area. • Clearing of vegetation cannot be avoided at the areas specified for project structures, but damage to the natural vegetation may be minimized by establishing camp sites, workshops and batching plants on waste/barren land rather than on forested or agriculturally productive land. • However, if such type of land is not available, it shall be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth. • Construction vehicles, machinery and equipment will remain confined within their designated areas of movement.	CC	SC - Proponent

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		The Contractor's staff and labor shall be strictly directed not to damage any vegetation such as trees or bushes. They shall use the paths and roads for movement and shall not be allowed to trespass through farmlands or forested areas. Contractor shall provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel shall not be allowed.		
15.	Fauna During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, movement of machinery and vehicular traffic, movement of labor, camping, etc. The existing animals will leave the directly affected areas due to construction activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase. Birds as well will tend to move away from the construction areas and find shelter and food elsewhere due to the activities mentioned above for fear of being hunted / trapped. Noise generated from machinery particularly during the night hours will even scare the wildlife residing in habitats located at some distance from the construction areas. Uncontrolled blasting may even disturb the wildlife of the Project Areas. Food and refuse at the Contractor's	- Care shall be taken during construction activities for avoiding purposely or chance killing of animals. - If found any wild species and habitat during constructing that must be dealt carefully and local wildlife department officials should be called. - Hunting, poaching and harassing of wild animals shall be strictly prohibited, and Contractor shall be required to instruct and supervise its labor force accordingly and clear orders should be given in this regard. - The Contractor must be held responsible for instructing his work force accordingly and for enforcing this restriction. In addition, this shall have to be controlled by the Wildlife Department. - The working department must take NOC from the relevant department prior to construction phase; - Provision of underpass/culvert/tunnel for the movement of different faunal species across the proposed road present in the project area and their locations in consultation with client and wildlife department. - Special measures shall be adopted to minimize impacts on the wild birds, such as avoiding noise generating activities during the critical periods of breeding. - Blasting and other noise generating activities shall not be carried out during the night by the work force, clear orders should be given. - Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them. - Noise produced by construction activities may be kept to acceptable level. In pursuit for conserving biodiversity of the project site along with sustained ecological health of micro and macro habitat, it is understood that a balanced ecofriendly approach during implementation stage of the project is advisable. Migratory birds must be protected and strictly avoid to disturb its habitats.	CC	SC - Proponent

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	camps may attract animals that might in turn be hunted by the workers. This impact is Indirect, Site-specific, Temporary, Reversible, Possible and Medium Significant. The planned construction activities will bring changes in land uses of the landscape. The planned activities include establishment of site camp and temporary residential baraks for encamped labour, burrowing sites, construction of kaccha service roads and pedestrian paths for efficient mobility of machinery and manpower. Alterations in surface profile of landscape will impact the status of micro habitats that will result in subsequent dislocation of faunal species. Deep burrows area in the project site would result in emergence of water ponds. Similarly, the establishment of burrows areas in forest covered patches will cause impact on indigenous flora and wildlife habitat. During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, movement of machinery and vehicular traffic, movement of labor, camping, etc. The existing animals will leave the directly affected areas due to construction	Following mitigation measures are proposed. Options for minimum alterations in existing landscape shall be adopted with due respect for ecological integrity including micro habitats. Indicators of terrestrial fauna and ecosystem prevailing in tropical thorn and riverine zone/forests shall be protected; Space utilizing plan for the land of project site and placement of human activities zones shall be given preference on barren and unproductive patches of land. Protection of land patches stuffed with indigenous flora must be protected; • Encamped labour shall not be permitted to cut trees and other flora species in and around the site for uses as fuel wood and making of shelters/sun sheds for the labours and earth work machinery/vehicles. Local flora serves as bio resource for nesting, feeding, breeding and resting areas for terrestrial fauna and merit protection; • Cut and fill of land soil shall be carried out with calculated precision in line with due regards for biological resources stuffed in natural landscape; • The budget for the proposed project will include provision for payment of compensation to farmers for the loss of any standing crops, or crops already sowed. Will be applicable for all crops standing on land within the acquisition area at the time of dispossession; • In order to reduce the loss of agricultural land during the construction stage, existing haul routes will be preferred by the contractor, and the width of any new haul route shall be limited to the bare minimum required and approved by the engineer; • Removal of all contractors' facilities from the project area shall be a contractual requirement, and as such the land used for the construction camps can be restored to facilitate agriculture and the land used for the construction camp shall become cultivatable. • Compensation for the loss of crops and orchards to the land owners and cultivators as the case may be will be paid, in accordance with the prevailing market prices and uniformity in rates will be ensured within the local areas; • As far as possible, land within the RoW (which will be acquired) or otherwise barren land without any crop outside the RoW will be selected		

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	activities and human intervention. Some animals particularly reptiles may get killed during the earthworks operations. Moreover, the movements of the mammals and reptiles will be restricted during the construction phase. However, the impact of project activities on the status of faunal species could be termed as medium to low. During construction phase of the proposed bund rehabilitation near Indus River, the impact sensitivity rating seems to be medium plus. Potential magnitude of impact to the habitat is long term issue that requires safeguard measures well in time. Direct impact on the temporarily dislocated species of fauna is not critical as the species are highly mobile and if their habitat after completion of the project is later restored, they are likely to return. No activities are planned in ecologically sensitive areas or Indus river so no major impact is anticipated in local fauna.	for the camp sites and disturbance to the crops and natural vegetation will be avoided as much as possible. - Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them; and - Noise produced by the construction activities may be kept to acceptable level as per PEQS.		
16.	Social Issues/Community Disturbance, Health and Safety The construction activities can potentially impact the residents of area, particularly the movement and safety of locals. In addition, due to increased use of trucks and other vehicles on the narrow roads in the Project Area and the access roads pedestrians, particularly elderly people and children will be more exposed to dangerous situations, which may lead to traffic	The following mitigation measures will be implemented: - Occupational health and safety procedures will be enforced at site. Each contractor(s) will be required to prepare, obtain approval of, and implement an occupational health and safety (OHS) plan; - Contractor shall have a system to ensure that Risk, Emergency Preparedness, Environmental and Working Environment, analysis are carried out as integrated part of the design and engineering process; - Contractor shall have implemented an Environmental Management System corresponding to the ISO 14001 or EMAS standards;	CC	SC - Proponent

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	accidents. Construction activities also pose safety hazards for the site staff. The rough terrain and difficult work conditions in some parts of the area will need extra attention from contactors and Project management for the increased risk of accidents, unsafe working conditions and health risks. This is especially true for underground work in tunnels and caverns, but also during excavation and construction work	• A Traffic Management Plan will be implemented that will aim at ensuring access to residential areas, and preventing of unsafe situations, especially near schools, housing areas, construction areas, camps and offices; • Construction activities such as blasting and excavation particularly at the borrow areas may pose safety risks to the nearby population; • Appropriate procedures will be maintained for such activities, including cordoning off the area, prior information to nearby population and liaison with the community; • There will be appropriate medical services and a facility with the capacity to treat emergency cases and trauma patients; • Special attention will be focused on safety training for workers to prevent and restrict accidents and on the knowledge how to deal with emergencies; • Road signage will be fixed at appropriate locations to reduce safety hazard associated with Project-related vehicular traffic; • Liaison with traffic police will be maintained; • Project drivers will be trained on defensive driving; and • Vehicle speeds near / within the communities will be kept low, to avoid safety hazards		
17.	Conflict between Labour and Communities The Project construction will bring significant changes in the lives and livelihoods, including new opportunities for employment and income for the local people. The development also attracts thousands of new in-migrants to the Project Area. Through the influx of workers and business people the population of area will increase within a few years. Unless properly managed this sudden influx of people could create adverse aspects such as an increased crime rate, tensions and social conflicts between the various groups.	The following mitigation measures will be implemented: • Project has developed a pro-active approach by working out for a number of key issues which have been proposed including issues regarding housing and accommodation, food security, local infrastructure, community health, labor contracts, employment and business opportunities, security, integration and cultural understanding and community and area development. In accordance with this Plan procedures and rules will be worked out by the PMU in close cooperation with the contractors and local authorities; and • Responsibilities for the implementation of these suggestions will rest with the local authorities, the line departments, WAPDA and the contractors.	CC	LAC-Proponent

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18.	Communicable Diseases The labour in the Contractor Camp, truck drivers and like personnel who interact with each other have the potential for the spread of COVID-19 and HIV/AIDS if the incidence exists. Majority of the people living in the surrounding of the Project, and potential Labor are not aware of the source, mode of communication or consequences of HIV/AIDS. Although their religious and cultural value system, to a large extent excludes the outbreak or rapid communication of COVID-19 and HIV/AIDS, yet its occurrence in such a situation cannot be precluded. It is necessary that awareness and preventive campaigns are run from time to time in the Labor campus and the field offices of the Project to prevent the communicable diseases like Cholera, Typhoid and Tuberculosis. There is a chance of spreading of an epidemic of Coronavirus disease (COVID-19) due to close interaction of the labor force during construction not only among the workers but also in the area.	- Arrange to run an active campaign, in the labour camp, to make people aware of the cause, mode of transmission and consequences of HIV/AIDS; - SOPs related to the construction industry advised by National Action Plan for COVID-19 Pakistan to control spreading of COVID-19, shall be implemented by the contractor and will be strictly monitored; - Strengthen the existing local health & medical services for the benefit of labour as well as the surrounding villages; - Ensure cleanliness and hygienic conditions at the labour camp by ensuring proper drainage and suitable disposal of solid waste. Inoculation against Cholera will be arranged at intervals recommended by the Health Department; - Locating a labour camp at least away from the villages (local settlement), and - Keep all the camps, offices, material depots, machinery yards and work sites open for the inspection of health and safety measures and related documents.	CC	SC - Proponent
19.	Child Labour There are two basic conventions on child labour adopted by the ILO, and one adopted by the United Nations. The ILO Minimum Age Convention, 1973 (No. 138) and its accompanying Recommendation (No. 146) set the goal of elimination of child labour, and the basic minimum age for employment or work (in developing countries at 14 years of age or the end of	- Awareness will be created among the local communities about the adverse impacts of child labor. For the public awareness, meetings will be held in the Project area, and announcements will be made using the available local platforms with the involvement of all sectors of the society; - Contractor through contractual agreement will be bound to follow the labor standards, rules and regulations during hiring the labor force and all activities will be monitored by the social and environmental staff of the implementing agency;	CC	SC - Proponent

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	compulsory schooling, whichever is higher; and 15 or the end of compulsory schooling for developed countries). The Convention sets a minimum age of 2 years younger for “light work,” i.e., 12 and 13 years, respectively; and a higher minimum age for dangerous or hazardous work (basically 18 years of age, but 16 in certain circumstances). The Convention also has various other flexibility clauses. Inhabitants of the Project Area have mix economic background and different sources of income. Children of low-income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Employment of Children Act, 1991 prohibits the employment of child and restrict the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 14 years) to work in an establishment shall be liable to punishment with imprisonment. The child labour impact might arise during construction stage, as large number of skilled and unskilled labour will be required by the contractor for the construction activities of the proposed Project	- Client and Supervision consultant will ensure that contractor shall have its employment policy in accordance with relevant act and labor policies in Pakistan; - Contractor will ensure the presence of all persons at site are adults and have their proper identity cards with them; - Penalize contractors/employees using the child labor and penalize adults who violate children’s rights and who force children to enter child labor.		
20.	Conflicts due to Culture	- Maximum local Labour will be preferred for skilled and unskilled activates; - This situation will be addressed by an awareness campaign;	CC	SC - Proponent

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	Workers coming from different parts of Pakistan may have norms and values in social behavior and religion that differ from those of the resident population. This can potentially cause tension and conflicts between outside workers and local community.	- The contractors would be aware of the possibility and risks of miscommunications between local residents and workers, a situation which easily could lead to social unrest. This would be prevented by raising awareness and implementation of a Code of Conduct for the workers; - Complaints from the local community will be addressed by the grievance redress mechanism; and - The Contractor will be required to maintain close liaison with the local elders and religious scholars of nearby local community to ensure that any potential conflicts related to common resource utilization for the Project are resolved easily.		
21.	Impacts on Local Communities The community belonging to the reservoir and Project Areas will be affected during the construction phase as follows: - During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered; - Unmonitored construction activities, e.g. blasting may create an accidental risk for the local residents particularly the women and children; - Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor; - Community will have to face the noise and dust problems during the construction activities; - Induction of outside workers in the Contractor labor may cause cultural issues with the local community; and	- During the construction phase, mobility of the workers in the nearby areas will be strictly restricted by the Contractor to avoid any inconvenience to the local communities; - Proper arrangements in the form of alternative routes will be made to ensure that the mobility of locals will not be disturbed; - Before starting the construction activities, Contractor will inform residents of the Project Area about the scheme of work, likely disturbances, and their duration as to whom they will address their complaints. - The Contractor will select specific timings for stringing so as to cause least disturbance to the local population considering their peak movement hours; - The Contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource utilization are resolved quickly; - Contractor will take care of the concerns of the local community and the sensitivity towards the local customs. Contractor also needs a proper security to avoid any theft issue by the community; - Use of good engineering practices such as water sprinkling, encasement and provision of silencer and mini stacks of generators etc. will be adopted to avoid inconvenience to the locals due to noise, smoke and fugitive dust; and - The Contractor will warn the workers not to indulge in any theft activities and if anyone gets involved in such activities, he will have to pay heavy penalty and would be handed over to the police. Similarly, at the time of employing, the Contractor has to take care that the workers will be of good repute. The Contractor camp will be fenced properly and main gate.	CC	SC - Proponent

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	Theft problems to the community by the Contractor's workers and vice versa.			
22.	Loss of Income During the construction activities, people will suffer loss in their annual income due to the loss of crops, trees etc. The livelihood of large number of households is associated with the business of sand mining. Due to creation of the reservoir, the respective business will be affected which needs to be compensated.	- Compensation for the PAPs associated with sand mining business will be estimated and reported in RAP report in consultation with Mines and Mineral Department of Punjab. - Fair, prompt and negotiated compensation for the loss of crops and trees on private land will be provided to the affectees along with the land value; and - Affectees will be involved in the valuation process of the Project.	CC	SC - Proponent
23.	Gender Based Violence (GBV) In the society, female plays important role in managing household as well as in income earning activities, but they face various challenges to get access to educational institutions and employment opportunities due to cultural bindings, economic vulnerability and lack of facilities . According to Pakistan Demographic and Health Survey (PDHS), 2017-18, 28 percent of women of Pakistan age 15 to 49 have experienced physical violence, six percent have experienced sexual violence, and seven percent experienced violence during pregnancy. Three in ten women who have ever experienced physical or sexual violence sought help to stop the violence, yet 56 percent never sought help nor told anyone. During survey, consultations with females were conducted at individual and at group levels to get their apprehension regarding	- Trainings will be given to construction workers, alongside the implementation of strict measures and punishments in case of any sexual assaults, or GBV. - During the timing of educational institutions workers will not be allowed to crowd in the surroundings; - Alternative routes for pedestrian will be provided to avoid mixing of women with workers; - Gender protection act will strictly be enforced during the construction activities in the project area, and monitor the implementation through field staff and district level structure; - Awareness will be raised among the communities of the potential risks of GBV, and establish response services in the communities that can respond to instances of GBV (particularly those related to issues of labor influx); - The Contractor will make sure that no discrimination is made on the basis of gender while hiring of workers. Complete standard operating procedures (SOPs) will be prepared and implemented by the contractor regarding working women at site. Implementation on these SOPs will be monitored by the SCs; - Provisions of gender disaggregate bathing, changing, and sanitation facilities; and - Contractor will take proper measures to address and resolve issues relating to harassment, intimidation, and exploitation, especially in relation to women.	CC	SC - Proponent

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	the project activities and suggestions to mitigate the relevant impacts. It was observed that except in a few cases (restriction on movements), there was no GBV prevailed among the consulted women. However; during construction phase GBV might arise due to discrimination made against women by unequal work distribution and unequal pay structure among others. SH against women might occur as a consequence of mixing of men and women at the construction site, and moving on the roads, bus stops and markets. Educational institutions near the project alignment are also sensitive regarding gender issues	- Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labor influx. - Project staff will receive training on the prevention of SEA/SH. Engagement of skilled trainers to raise awareness among project workers of the risks, expected behaviors, and consequences of violations, communicated through training, and publicized codes of conduct. It may also be important to raise awareness of the risks among community members and local health authorities and inform them about available grievance mechanisms. - Arrange and support local organizations and/or government initiatives on community STDs education, prevention, and treatment programs. - Extensive training will be provided for awareness raising strategy which describes how workers and local communities will be sensitized to Sexual Exploitation and Abuse (SEA) and SH risks, and the worker's responsibilities under the CoC - The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes will be identified for the communities, if required, especially along routes frequented by women folk, such as route to the local well or water source. - Construction crew will avoid entering villages and settlements. - Communities will be informed and consulted before commencing works inside or near the communities. - Provision related to SEA/SH will be incorporated in the bidding document, and - A Gender Action Plan will be prepared and implemented by the contractor for the proposed project to reduce the significant of this impact.		
24.	Other Social Issues The community belonging to the reservoir and Project Area will be affected during the construction phase as follows: During the construction phase, the general mobility of the local residents and their livestock in and around the Study Area is likely to be hindered;	- During the construction phase, mobility of the workers in the nearby areas should be strictly restricted by the Contractor to avoid any inconvenience to the local communities; - Proper arrangements in the form of alternative routes should be made to ensure that the mobility of locals should not be disturbed; - Before starting the construction activities, Contractor should inform residents of the Project Area about the scheme of work, likely	CC	SC - Proponent

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	- Unmonitored construction activities, e.g. blasting may create an accidental risk for the local residents particularly the women and children; - Usage of community common resources like potable water, fuel wood etc. by Contractor workforce may create conflicts between the community and the Contractor; - Community will have to face the noise and dust problems during the construction activities; - Induction of outside workers in the contractor labor may cause cultural issues with the local community; and - Theft problems to the community by the contractor's workers and vice versa.	disturbances, and their duration as to whom they should addressed their complaints. - The contractors will be required to maintain close liaison with the local communities to ensure that any potential conflicts relating to the common resource utilization are resolved quickly; - Contractor will take care of the concerns of the local community and the sensitivity towards the local customs. Contractor also needs a proper security to avoid any theft issue by the community; - Use of good engineering practices such as water sprinkling, encasement and provision of silencer and mini stacks of generators etc. should be adopted to avoid inconvenience to the locals due to noise, smoke and fugitive dust; and - The Contractor will warn the workers not to indulge in any theft activities and if anyone gets involved in such activities, he will have to pay heavy penalty and would be handed over to the police. Similarly, at the time of employing, the Contractor has to take care that the workers should be of good repute. The Contractor camp should be fenced properly and main gate.		
Operation and Maintenance Phase				
1.	Sedimentation The site is situated in western extension of Kirana Hills, exposed at Chiniot. The geology of project area is mainly classified as meta-sedimentary rocks which consist of Cherty Quartzite, Arenaceous Slate, Quartz Wacke and Dolerite. Angular boulders, gravel with sand and appreciable number of fines (ABGM) are present at the foot hills, while Silty Sand with some Clay intercalations are present along the river banks and in terrace deposits. After the construction of Chiniot dam, the major part of the sediment load d/s of Qadirabad Barrage on Chenab River would be trapped by the Chiniot dam and only fine	Due to high sedimentation load, four (04) No. under sluices on the left side of right gorge are proposed in Chiniot Dam, which will serve to flush sediment because its predicted life under normal operation is 41 years for average annual load of about 46.14 MST. For a sustainable use of Chiniot reservoir, it will be necessary to regulate the flows and effective sediment management will be carried out during operation of the Project. Sediment will be passed through the reservoir by sluicing, which involves drawing down the water level during periods of high discharge and sediment load, thereby increasing flow velocity while reducing both residence time and sediment trapping. Aggressive drawdown, reducing the reservoir level to create riverine flow along the impounded reach during a flood, may also scour and release a portion of the previously deposited sediment. Drawdown sluicing will likely be performed during the monsoon to preserve peaking capacity.	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	suspended sediment (clay and fine silt) will be released with outflows. Construction of dam at western extension of Hills will disturb the sediment flow and sediments will start depositing in reservoir of dam resulting decrease in water storage capacity. Based on the suspended sediment load and discharge, the total sediment load containing both suspended and bed load is about 46.14 MST with which reservoir life is estimated as 41 years. Furthermore, reduction in storage will eventually alters the capacity for flow regulation, water supply and flood control benefits.			
2.	Loss of Nutrients via Sediment Deposits As discussed earlier, about total annual sediment load in Chiniot reservoir is 46.14 MST. After construction of Chiniot Dam, the major part of the sediment load d/s of Qadirabad Barrage on Chenab River would be trapped by the dam and only fine suspended sediment (clay and fine silt) may be released with outflows. Therefore, loss of sediments will deplete the nutrient content of the water to be distributed through distribution weir which may impact agricultural production in downstream areas.	This is residual impact. However, shortage of nutrients in irrigation water (due to the development of reservoir) in downstream area can be overcome by use of fertilizers and manures. Urea (Nitrogenous Fertilizers) and Phosphates fertilizers are very popular with Agriculturists in catchment and downstream area.	Proponent	
3.	Seismic Hazards The project is located in the northern part of the Indian plate, south of the boundary between the Indian plate and Kohistan	- Pro-active measures will be implemented to stabilize and protect slopes. Early warning systems will be introduced that will indicate when cracks appear and allow any widening to be monitored; - As per ICOLD Guidelines for selecting seismic design parameters for large dams (2016), Chiniot Dam falls in High Risk class. therefore	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	Island arc which is sandwiched between the Indian and Eurasian tectonic plates. As the project region is located near the collisional zone of the plate boundaries, it is seismically active. A number of low to moderate sized earthquakes have been recorded in the project region during the last 100 years. The main tectonic features around the project site which could be controlling the maximum earthquake hazard are as follows: • Salt Range Thrust • Riasi Thrust, and • Basement Faults below Punjab Plain In terms of safety of a dam, seismic hazard i.e. earthquake in and around the project area will directly damage the civil structures, dam-break flooding and reduction of reservoir capacity	the recommended ground motion for SEE is 0.35g (Dam Site/Powerhouse area) and 0.53g (dykes) for rock & soil foundation conditions respectively (corresponding to a return period of 10,000 year).; • The recommended horizontal Peak Ground Acceleration (PGA) associated with OBE is 0.07g (Dam site/Powerhouse area) & 0.13g (embankments) for rock and soil foundation conditions respectively. • The recommended horizontal Peak Ground Acceleration (PGA) associated with DBE is 0.12g (Dam site/Powerhouse area) & 0.21g (embankments) for rock and soil foundation conditions respectively; and • An Emergency Response Plan (ERP) for earthquakes and manmade disasters should be developed and implemented in close consultation with the NDMA and other concerned departments.		
4.	Change in Land Use During the operational phase the land use pattern of the area will be changed to some extent due to the formation of 190 km² Lake. The commercial and recreational activities will also be increased due to lake formation which may affect ecosystem of the area and bring economic boom in the area.	Important mitigation measures here include the establishment of local or regional development plans as well as resource management and monitoring programs (also to avoid or reduce land use conflicts) emergency preparedness and warning procedures on sudden flow variations, establishment of alternative areas for agriculture and fisheries for local people, clean water supply, irrigation, planning to minimize farm, forest and other resources loss, maximizing recovery of valuable resources prior to inundation, etc. The tree plantation will be carried out in and nearby the Study Area and will have positive impact on the eco system of the area.	Proponent	
5.	Water Logging It is anticipated that due to the impounding of reservoir, some areas in the immediate vicinity of the reservoir may be prone to	Areas in the close vicinity of the reservoir will be prone to water logging. To mitigate this impact Right and Left Side Drainage Channels has been proposed which will control the issue of water logging in nearby area of reservoir. Since it is a residual impact, therefore, this impact cannot be mitigated completely.		

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	water logging and salinity. However, the extent of this impact will not be much.	However, Groundwater monitoring network should be established on the priority basis to monitor the water table behavior along both sides of the reservoir and after the reservoir operations to be monitored on monthly basis. Dewatering tubewells, solar operated, for addressing the negative impact of dam seepage are proposed in the surrounding areas. The tentative depth of these wells should be within 150 feet (46m) to 170 feet (52 meter) and 2.0 cusec (0.057 cumecs) capacity with fiber glass strainers.		
6.	Water Quality Water stored in a dam or reservoir is subject to undergo certain physical, chemical and biological transformations. These phenomena are induced by natural forces mainly at the bottom anaerobic digestion of the biomass, climatic conditions (heat exchanges, aeration, etc.), chemical exchanges from geological formations, aquatic chemical reactions and material degradations among others as well as biological reactions associated with the organic materials decaying (biomass and humic matter decomposition from the flora and fauna i.e. submerged after first filling of reservoir). Variations in weather conditions and exposure to atmospheric conditions are among other conditions with potential effect to water quality. Among the anticipated water quality aspects of interest for the dam would include: Turbidity and suspended matter from the entering flows, surface runoff discharges and organic reactions among other sources might lead to limited light penetration that has got direct linkage to biological quality of the water;	- Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water, treated water and water downstream of the dam location; - Clearing and removal of all vegetation materials (live and dead) at the dam site before the area is excavated and inundated, maintain appropriate records on water quality as required by the law; - Proliferation of aquatic macro-fauna could be encouraged along the periphery of the dam to ensure natural aeration of the water; and - Effective reservoir maintenance manual would have to be developed to deal with the deteriorating water quality.	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	- Biomass accumulation in the dam area could render high humic (organic concentration) levels in the dam water. It also has a potential to increase the nutrients and other minerals associated with plant decaying matter; - Limited water mixing, aeration and light penetration reduces available oxygen resulting into anoxic conditions at the lower layers of the water. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, hydrogen sulphide and create low pH scenarios. Due to the lowered pH, the geologically held iron and manganese and other heavy metals are likely to be released into the water effectively changing the water quality; and - Implications on water quality would be felt by the water consumers in the immediate location of the dam as well as social and ecological dependents of Chenab River.			
7.	Greenhouse Gases Emission and Climate Change Reservoir impounding (after few years of operation) will have a small impact on the local climate. It is expected that the humidity in nearby areas will increase and temperatures in nearby settlements are likely to decrease in the summer time as compared to without Project situation. Release of Green House Gases (GHG) may also bring some changes in the	A separate study regarding GHG emissions will be conducted during O&M phase of the Project to estimate the overall CERs of the proposed project considering complete life cycle of the Chiniot dam. Furthermore, following measure will mitigate the impact of climate change and GHG emission during O&M phase. - Use O&M machinery designed with suitable pollution abatement technology such as scrubbers; - Plantation development as per the tree plantation/reforestation sub-plan is highly recommended for the sequestration of CO₂; - Used and old electrical equipment will be banned that can also help to reduce urban emissions; - Environmentally friendly fuel can be used instead of diesel;	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	climate. World Commission on Dams declared that dam reservoirs are observed to be the emitters of GHG such as CO, methane (CH₄), and Carbon Dioxide (CO₂) with large variations with situations. A range of factors directly influence the GHG emissions from reservoirs such as: storage depth, size, climate, age of reservoir, etc. Release of these gases may have low potential adverse impact on climate in the Study Area. This impact is Regional, Medium Term, Irreversible, Likely, Medium Significant. It has been assumed that the avoided CO₂ emission in case of hydropower production from Chiniot Dam would be 488g/kWh. Given the average annual energy generation attributable to Chiniot Dam (GWh), annual estimated CO₂ emission reduction/avoidance of 100,162 Tons has been calculated. It has been estimated that the development of hydropower due to Chiniot Dam would result in reduction of total 5.01 Million tons of CO₂ (or CO₂ equivalent) over the 50 years' period. The CO₂ emission reduction due to the proposed project would enable it to trade Certified Emission Reductions (CER) under Clean Development Mechanism. The annual emission reduction in CO₂ tons (0.100162 million Tons) have been multiplied with the estimated future market price of carbon, US\$ 1.5 per CER, to reach an annual CDM benefits of US\$ 0.154	- Burning of waste will be strictly prohibited at site; - Awareness programs of causes and effects of climate change will be conducted for mitigating GHG emissions; and - As appropriate use of solar panels or floating photovoltaic concept will be considered to further increase the CERs.		

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	Million or Rs. 42.97 Million. Apart from this, the proposed tree plantation and additional measures will further increase the CERs			
8.	Dam Safety and Emergencies In the event of a dam safety incident or failure which results in uncontrolled release of volume of the water stored behind Chiniot Dam, this release is capable of causing loss of life and significant property damages. The dam may fail for one or a combination of the following reasons: • Overtopping caused by unusual precipitation event or flood; • Differential deformation leading to cracking and displacement; • Excessive settlement of the top of dam/crest; • Foundation or abutment erosion; • Abutment slope failure; • A major slide in the reservoir close to the dam; • Operational errors; and • Deliberate man-made actions. Failure of the dam resulting in uncontrolled release of the reservoir as well as high floods would result in inundation of downstream areas, consequences of which could be loss of life (reduction of loss of life is the top priority of emergency planning), property damage in flood plain, damage to infrastructure and irrigation water supply from the dam. The damages inflicted by flooding in the Project Area can generally be categorized as follows:	Impacts resulting from dam failure can be mitigated by ensuring strict adherence to standards in design and construction as well as regular dam inspection coupled with the preparation of emergency planned access control. It will be a highly potential significant adverse impact on the environment. Rim stability and dam safety studies are also recommended to be conducted during detail design phase of the Project.	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	- Loss of land due to erosion; - Loss of standing crops due to inundation; - Damages to public and private properties due to submergence; - Damages to infrastructure; and - Loss of human lives and livestock.			
9.	Attenuation of Floods Flood studies were carried out for the planning and design of barrage and other outlet structures as well as checking the safety of the proposed Chiniot Dam. These studies are the basis to evaluate the impact of the dam on the attenuation of floods in the downstream areas. The 100 years' frequency flood is estimated as 28,100; 30,500 and 38,300 m³/sec by using three Distributions (Gumbel, Pearson type3 and Lognormal), respectively with average flood values as 32,300 m³/sec; that value is close to flood estimated by (Pearson type 3) distribution. It has been observed that Pearson type 3 distribution is assumed to be adopted as design flood against 100-year flood frequency with value of 30,500 m³/sec. On other hand, the available maximum value of peak instantaneous floods at Qadirabad Barrage for the period of 1922-2022, is (31,627 m³/sec) occurred in the year of 1957 and that flood value of (31,627 m³/sec) is higher than estimated above	Finally, design flood of 31,627 m³/sec against 100-years flood frequency is recommended for barrage of Chiniot Dam. Furthermore, It is implicitly accepted that climatic changes in the region can have profound effect on the flood peaks. For this the peak flood may be enhanced by 10 to 25%. In technical memorandum flood peak flow was enhanced by 25%, for which client has shown reservations. The flood peak is now enhanced by 20%, which yields peak flow rate of $3627 \times 1.20 = 37,952$ m³/s. It is proposed that a higher frequency flood of 200 to 500 years' frequency may be considered for check flood. Therefore, the check flood is proposed as higher of the two values as 38,000 m³/s. The barrage design must ensure that check flood will pass through the barrage structure safely with pre-selected encroachment of the free board. Based on the flood studies, the observed recorded 200 to 500 year return period flood at proposed dam site of Chiniot Dam can be attenuated due to the construction of proposed Dam.	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	design flood against 100-year flood frequency with value of 30,500 m ³ /sec.			
10.	Air Quality and Noise Commissioning and operation of the dam may affect the air quality in the area due to the increase in traffic volume and frequency due to recreation activities after formation of lake behind the dam. The traffic movement will induce some dust and noise problems in the area. There would be a marked difference of values between 'with' and 'without' Project situation. However, as the Project components are mostly civil works, these surely will not pollute the air to a serious extent. As compared to construction stage, air quality and noise pollution will improve. Noise levels are expected to rise during the operation phase of the proposed Project due to the increased traffic volumes and population flow into the Project Area as compared to baseline conditions. However, noise levels will be lesser than the construction phase of the Project. The main contributor to noise level will be the engine sounds and horns.	To enhance the air quality of the Study Area, a tree plantation program will be initiated by WAPDA in consultation with Forest Department on priority basis. As noise levels, will not be a significant problem, no specific measures for noise levels are suggested.	Proponent	
11.	Flora During operational stage of the Project, there will be minimal effect on flora or release of any significant pressure detrimental to flora. Low level impact is expected at operational phase on Flora due to the operation and maintenance activities.	- The implementation of plantation plan recommends compensation for cutting of trees and work will be started during operational phase to ensure the ecological balance and to avoid any impact on local environment; - Large scale planting with suitable indigenous trees, shrubs and ornamental plants in the form of tree groves, and linear plantation will be carried out in accordance with the Tree Plantation Plan to improve aesthetic value and offset the effect of removal of vegetation; - Proper check and balance for above activities is highly recommended. Plantations so raised must be maintained according to the Silvicultural	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
		practices which includes proper irrigation, cleaning, pruning, thinning at prescribed intensity, silt clearance and trench-opening, etc.; - Maintenance and security of the plantation will be done for at-least four to five years (in consultation with the Forest department). Measures such as fencing, watch guards and fire protection will be considered; and - All activities must be done under the technical supervision of Punjab, Forest and Wildlife departments.		
12.	Fauna There is no protected area, game reserve, game sanctuary or national park in the project area so, no major impact on wildlife in the area is expected through noise, vibration and any type of normal activity in the project area.	- Strict control must be exercised for stoppage of killing/poaching of available wildlife species (if any) by enhancing protection practices; and - The precautionary measures described (mentioned above) for future shall also be applicable during operation phase as relevant for the conservation of wildlife species in the Study Area. - The water storage in reservoir will attract different type of birds and animals as water is core part of ecosystem. - The fisheries department will also be involved to start the activities regarding fisheries development in the reservoir waters. - After all the environmental friendly planning, implementation and maintenance the project will have overall positive impact on local biodiversity and commons as well.	Proponent	
13.	Impact on Aquatic Habitat due to Reservoir Water velocities in the reservoir will be lower than in pre-reservoir river conditions while anticipated water temperature will be higher. This suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline. Spawning areas in the tributaries will be submerged and it is expected that new natural	- Maintenance of spawning areas and developing of new spawning areas; and - The new fish hatcheries will be the alternate of the submerged spawning grounds which can produce the seed as per requirement. - In this regard a separate study is recommended for the development fisheries development and management plan by the concerned departments.	Proponent	
14.	Aquatic Life Decomposition of vegetation in lake will release harmful nutrients and gases polluting surface air and poisoning fish in lake as well as in downstream area.	Lake/ Reservoir created by reservoir can be beneficially harnessed for protein rich fish for which adequate technical know-how and infrastructure is available with the Directorate of Fisheries. Experiences gained in Aquaculture/Pisciculture from major dams can be utilized and augmentation of	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	Decomposition depletes oxygen in water, and such deoxygenated water can be lethal for fish. Due to the storage of water, average temperature of the reservoir will increase as compared to the water flowing Chenab River. Due to this rise in water temperature of reservoir, there will be highly significant potential adverse impact on aquatic life including fish. These changed aquatic conditions may change the aquatic fauna and flora. Rise in water temperature may increase population of aquatic plants, which will need salvation and cleaning of lake at proper time periods (years).	the current and proposed fisheries development projects especially in the area between Qadarabad and Trimu Barrage will further enhance the aquatic benefits of the propose project.		
15.	Safety during Reservoir Operation During operational stage of the Project, due to the impounding of the reservoir, the safety issues will arise. Main reservoir area is the major threat for accidents. Locals and workers can drown.	During operational stage of the Project, a security plan should be prepared for the reservoir area to prohibit youths from using reservoir for bathing, swimming and other recreational activities. Boating should not be allowed without the provision of life saving jackets and presence of a lifeguard.	Proponent	
16.	Occupational Health and Safety During the operation phase, health and safety issues related to workers and communities may arise. Operation and maintenance activities may cause health and safety risks such as movement of machinery, poor handling and storage of hazardous substances, injuries due to electric shocks, falling of objects, slips or trips, dust, noise, accidents, transmittable diseases etc. The flow of electric current in the conductors will also have an impact on the	During the operational phase of the Project, a security plan will be employed to ensure the safety of the employees working at the Powerhouse, Switchyard and other electrical equipment. An effective communication system must be established so that the proper authorities are notified in case there is a fire in the Powerhouse, Switchyard and other electrical equipment. Separated fire alarm systems shall be provided for station general area (comprising control building, administration building, machine Hall, workshop etc.), the generators and the transformers. The fire alarm system will be based on optical smoke detectors, manual call points, alarm sounders and auxiliary devices. Fire water tank capacity has been worked out considering NFPA 851 requirements of two hours' worst fire scenario and fire hose stream	Proponent	

Sr. No.	Impacts	Mitigation Measure	Responsibility	
			Implementation	Monitoring
	safety of the workers and locals (staff colony). The burning of the transformer or other electrical equipment due to short circuiting can create a fire which can spread. This will become a safety hazard for the worke	requirements. Portable and trolley fire extinguishers will be provided at all entrances to the power stations. Clean Agent Gas System will be provided for Control room, Computer room and other electrical equipment rooms. The protection equipment will be complete with all relay panels, instruments, meters, interposing and auxiliary relays, control switches, interposing current and voltage transformers, transducers and all auxiliary equipment. All protections, as far as possible, will be connected to separate current transformers and will have separately protected voltage circuit. Backup protection will be 100 % redundant of the main protection. The main earthling system for the Powerhouse will be a separate distributed grid of conductors, properly designed to carry electrical fault currents without overheating. The earthling system will be designed according to IEEE-80 "Guide for Safety in AC Substation Grounding" and IEEE 665-1995 "Guide for Generating Station Grounding". The overall control and monitoring of the entire powerhouse will be carried out from a central control room. Unit Control Level will deal with the control of individual units, which include the generating units, electrical distribution and other auxiliary systems. Local Control Level will comprise hardwired instrumentation and control through the local control panels e.g. local panels of circuit breakers, generators etc. Monitoring at all levels will be done simultaneously		

9.14 ENVIRONMENTAL MONITORING

Environmental Monitoring provides timely and useful information to the project management and implementation agencies. Conceptually, “monitoring” means to check and balance, on a regular basis, the status of the project activities and realization of various developmental targets during construction, operation and maintenance. It helps in timely identification/analysis and removal of the bottlenecks and expedites actions. Certain environmental parameters (physical, chemical and ecological) are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the EMMP and its implementation are effective for the mitigation of impacts or not.

The main objectives of the construction phase monitoring plan will be to:

- Monitor the actual impact of the works on the project site physical, biological and socio-economic receptors;
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds the anticipated impact;
- Ensure compliance with legal obligations including safety on construction site; and
- Monitor the rehabilitation of borrow areas and the restoration of construction campsites as described in the EMMP; and
- Ensure the safe disposal of excess construction materials.

The Construction Contractor (CC) will be responsible for environmental monitoring and reporting throughout the construction phase under the supervision of Environmental Engineer of Supervision Consultant (SC); in coordination with Project Director, WAPDA. During construction phase, environmental testing reports will be prepared on quarterly basis and one comprehensive report will be prepared at the end of the construction phase and will be submitted to each of the following authorities and institutions: (i) WAPDA and (ii) Punjab-EP&CCD.

During project operation phase, WAPDA will be responsible to conduct environmental testing and monitoring along with its cost through a third party contractor and Punjab-EP&CCD certified lab. The reports will be prepared biannually and one comprehensive report will be prepared annually and submitted to the Punjab-EP&CCD. Contents of the final report will include results of environmental monitoring in comparison to the standards for the various parameters, location and sampling time along with recommendations for the future environmental testing and monitoring.

9.14.1 Monitoring Parameters and Frequency

The major negative impacts of the Project activities are related to ambient air & noise, and water resources, which will directly or indirectly effect the environment and will cause health problems to the receptors residing in the surrounding. In order to counteract these problems an environmental monitoring protocol has been proposed (**Table 9.5**). The proposed protocol contains the following monitoring parameters:

a) **Physical Environment**

For physical environment, following parameters will be monitored:

- Ambient air quality;
- Smoke, dust;
- Noise levels;
- Water (Ground and surface); and
- Wastewater.

b) **Ecological Environment**

During construction activities, it will be required to check whether plantation of trees was carried out or not and Contractor staff is advised not to cut the existing trees in the Study Area. During operation phase, monitoring team will be required to observe the growth of new plantation to be carried out by the HSE staff.

c) **Socio-economic Environment**

Effects on the socio-economic environment during construction phase will be monitored by EMC, considering parameters like hiring of local employment, community health and safety, mobility of local women, cultural compliance due to presence of foreign Contractor. Similarly, the above parameters will be monitored by HSE Section of proponent during operation phase. EMC at construction phase and HSE Manager at operation phase will maintain a Social Complaint Register.

9.14.2 Monitoring Strategy

Under the proposed monitoring strategy, it is recommended that WAPDA shall be responsible for all the monitoring activities. Client will engage a competent consultant to conduct environmental monitoring on a periodic basis. The overall objective of the environmental monitoring is to ensure that the key environmental parameters in the project area remain within the acceptable limits specified by the PEQS and other relevant benchmarks throughout the project execution. For this purpose, the Independent Environmental Monitor (IEM) will carry out the periodic sampling, monitoring, and analysis of the key environmental parameters specified in the EMMP and provide their results to the Client. All the findings and results in the form of monitoring report will be finally shared with respective EP&CCD by the Client.

The monitoring program has been designed carefully considering the identified impacts mentioned in Chapter-7 and some additions or deletions probably in frequency may be taken up in this program after learning lessons from one-year operation of the Project through Change Record Register. **Table 9.5** provides environmental monitoring schedule for construction and operations stages of the Proposed Project.

Table 9.5: Monitoring Plan for all Phases of the Project

Sr. No.	Parameter	Location	Monitoring Mechanism/Parameters	Frequency
A. PRE-CONSTRUCTION PHASE				
1.	Land acquisition	Project Area	Confirm that all acquisition has been completed and compensation paid to affectees as per RAP	As per RAP Document
2.	Tree cutting	Project Area	Comply with the Project Area tree plantation plan as and when required	Monthly
3.	Drinking Water	Water being used for drinking purposes by workers and nearby communities	Discrete grab sampling and laboratory testing of groundwater / drinking water according to PEQS	Once (Six samples of drinking water from nearby villages)
4.	Wastewater	Workers' camp and nearby discharging body	Effluent discharges from workers' camp to be tested for all parameters mentioned in PEQS	Once (Two samples of wastewater from nearby discharging bodies)
5.	Noise Levels	Nearby selected site (sensitive receptors) within or around project area	Noise level monitoring (Day and Night) according to PEQS	Once (Six locations prior to the start of construction)
6.	Ambient Air	Nearby selected site (sensitive receptors) within or around project area	Visual checks and monitoring of SO ₂ , NO, NO ₂ , CO, Ozone, Lead, Suspended Particulate Matter, PM ₁₀ , PM _{2.5} according to PEQS	Once (Six locations prior to the start of construction)
B. CONSTRUCTION PHASE				
1.	Drinking Water	Water being used for drinking purposes by workers and nearby communities	Discrete grab sampling and laboratory testing of groundwater according to PEQS	Quarterly (Six samples of drinking water from the workers' camps and nearby villages)
2.	Wastewater	Workers' camp and nearby discharging body	Effluent discharges from workers' camp to be tested for all 32 parameters mentioned in PEQS	Quarterly (Two samples of wastewater from camps and nearby discharging bodies)
3.	Noise Levels	Nearby selected site (sensitive receptors) near active construction sites and workers' camp(s)	Noise level monitoring (Day and Night) according to PEQS	Regular weekly noise monitoring through portable meter at active site. Quarterly (Six locations Nearby selected site (sensitive receptors) near active construction sites and workers' camp(s))
4.	Ambient Air	Nearby selected site (sensitive	Visual checks and monitoring of SO ₂ , NO,	Quarterly (Six locations

Sr. No.	Parameter	Location	Monitoring Mechanism/Parameters	Frequency
		receptors) near active construction sites and workers' camp(s)	NO ₂ , CO, Lead, Ozone, Suspended Particulate Matter, PM ₁₀ , PM _{2.5} according to PEQS	Nearby selected site (sensitive receptors) near active construction sites and workers' camp(s)
5.	Solid Waste	Workers' camps and active construction sites	Visual Checks for assessment of condition of waste generation, segregation, storage, collection and disposal.	Weekly
6.	Health and Safety	Workers' camps, batching plant, and active construction sites	All HSE related activities to be monitored including Tool Box Talks, safety signage, PPEs, first aid boxes, dispensary, medical check-ups, etc.	Daily
7.	Communicable Diseases	Labor camp / project colony	Medical check-ups and routine safety check-ups of the communicable diseases and accidents	Quarterly
8.	Terrestrial and Aquatic Ecological aspects	At and around project site or in the whole Study Area	Illegal hunting of fauna / avifauna. Tree Plantation Checks. Aquatic ecology	Weekly
9.	Environmental Audit	Whole Project Area	Auditor's checklists & performs	Biannual
C. OPERATION AND MAINTENANCE PHASE				
1.	Reservoir Water Quality	Comprehensive water sampling plan has to be devised to assess reservoir water quality w.r.t. irrigation, fisheries (as it is recommended to breed some compatible fish species during O&M phase)	Reservoir water sampling as specified by PEQS	Bi-annually
2.	Noise Levels	Near project site, colony, offices and settlements	Noise level monitoring (Day and Night) according to PEQS	Quarterly
3.	Ambient Air	Near project site, colony, offices and settlements	Visual checks and monitoring of SO ₂ , NO, NO ₂ , CO, Suspended Particulate Matter, PM ₁₀ , PM _{2.5} according to PEQS	Bi-annually
4.	Environmental Audit	Whole Project Area	Auditor's checklists & performs	Biannual

9.15 MANAGEMENT PLANS

Various site-specific management plans will be prepared by Contractor as a part of EMMP for the better management and implementation of EMMP during all phases of the proposed Project. However, approval of these site-specific plans from WAPDA will be sought before start of construction activities. These site-specific plans are listed below but not limited to these:

- Tree Plantation / Reforestation Plan;
- Health, Safety and Environment (HSE) Management Plan;
- Emergency Preparedness and Response Plan;
- Site Restoration and Rehabilitation Plan;
- Waste Management Plan;
- Disaster Management Plan;
- Drinking Water Supply and Sanitation Plan
- Traffic Management Plan;
- Change Management Plan
- Quarry Management Plan; and
- Resource Conservation Plan.

9.15.1 Tree Plantation / Reforestation Plan

The basic purpose of reforestation/afforestation/plantation of suitable species in the project area is to reduce the risk been made due to cutting of trees for the proposed project and to enhance green cover and improve the overall environment of the area. Reforestation will not only reduce the risk been made but will also increase the carrying capacity of the area regarding many positive aspects.

Afforestation will be done in those areas in which there is low forest cover or in areas which have been clearly felled and leave barren. Afforestation is highly important to maintain the biodiversity and ecological balances. It is also important to prevent global warming, soil erosion and pollution. Afforestation purifies the environment and helps in reducing the carbon dioxide level. Along with the importance of proposed Project to the local communities, the afforestation activity will further help in enhancing the socio-economic condition of the local communities. The spacing of the plantings will be wide enough to prevent competition for soil moisture, or when part of management, to accommodate machinery used for irrigation.

Based on the estimation, total cost of approximately 505,990 numbers of trees/plants will be 977.57 million PKR. The details are attached as **Annex-VIII**.

9.15.2 HSE Management Plan

Health risks and work safety problems may result at the workplace if the working conditions provide unsafe and/or unfavorable working environment due to storage, handling and transport of hazardous construction material. Workers will be provided with safe and healthy working environment taking into account risks inherent to the particular sector and specific

classes of hazards in Project Area. During construction phase, Contractor will be responsible for all HSE related issues and to comply with national laws and international standards for occupational health and safety. Guideline for contractor's Occupational Health and Safety Plan is attached as **Annex-IX**. The ultimate goal of the plan is to eliminate any injury to human and damage to facilities, materials and the environment.

The following measures are identified for health, safety, and environment protection during all activities of the proposed Project to minimize risk of accidents, which could endanger the life of personnel, cause damage to properties and environment:

- All contractor staff shall be well informed and trained on the HSE policies and guidelines;
- Contractor shall provide adequate health services as well as site first aid services for its workforce;
- The main priority of the contractor shall be to prevent accidents during mobilization, construction phase of the proposed Project. Prevention of workplace accidents during the construction activities will be achieved using approved work plan/instructions by the supervisors;
- Work safety measures and good workmanship practices shall be followed by the contractor to ensure no health risks for workers;
- Provision of adequate sanitation, washing, cooking and dormitory facilities;
- Proper maintenance of facilities for workers shall be monitored;
- Provision of protective clothing for labour handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles, etc. and contractor will ensure strict use of wearing these protective clothing during work activities;
- Elaboration of a contingency planning by the contractor at work site in case of major accidents shall be carried out. A comprehensive emergency preparedness and response plan will be developed and implemented at site;
- A site-specific fire-fighting plan also needs to be developed and implemented by Contractor during construction phase;
- Accidents shall be reported to and investigated by the Contractor. All personnel shall be encouraged to report all accidents/incidents and to cooperate in the investigation of such occurrence. A comprehensive accident/incident report will be produced for its review and necessary action;
- Adequate signage, lightning devices, barriers, and persons with flags during construction to manage traffic at haulage and access roads shall be conducted;
- The communicable disease of most concern during construction phase, like sexually-transmitted diseases such as HIV/AIDS, will be prevented by successful initiative typically involving health awareness, education initiatives, training health workers in disease treatment, immunization program and providing health service;
- Trainings, awareness and campaigns will be conducted for workers and surrounding communities on awareness and prevention of COVID-19. Guidelines to combat with COVID-19 are attached as **Annex-X**;
- Reducing the impacts of vector borne diseases on long-term health effect of workers will be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease;
- All construction activities shall be properly managed through careful planning and the applicable and relevant HSE policies; and
- Prior approval from proponent's environment team (E&ST) will be sought before starting any construction related activity.

9.15.3 Emergency Preparedness and Response Plan

Emergency Preparedness and Response Plan provides an overview of the procedures to mitigate and control the impacts on community, on occupational health and safety, on the environment and on the Project in the event of emergency situations and to respond in life threatening situations usually occurring suddenly and unexpectedly during the construction and operational phases of the proposed project. The contractor will be responsible for the preparation of plan and implemented at site after prior review and approval from the supervisory consultant and proponent. Guideline for contractor's EPRP is attached as **Annex-XI**.

9.15.4 Restoration and Rehabilitation Plan

The implementation of the proposed Project would involve construction workers' camp for staff and labor, establishment of fences around construction site, over usage of access roads for movement of heavy machinery/motor vehicles linking to various components of project, offices, borrow/quarry areas, etc. During construction, these activities could also result in accumulation of large amount of unused or spoil material at various sites such as at access roads, muck dumping sites, quarry sites, colonies, offices, etc. which will change the existing land cover in the project area. After completion of the construction work, it is required to restore the disturbed area to its original conditions wherever it is possible that is the sole responsibility of the Contractor. Various engineering and biological measures have been suggested for the restoration of these areas:

- Top soil will be stored at designated areas before performing excavation activities at quarry sites (if these are agriculture land) and after the completion of all the construction activities, quarry sites (if applicable) and construction sites will be covered with the top soil to support the growth of plant species;
- The area will be planted with indigenous vegetation that would require the initial establishment of fast growing grasses along with annuals and perennials, nitrogen fixing herbaceous legumes and non-legume shrubs to increase the soil conditioning and to stabilize the project site;
- Material stockpiles shall be removed as soon as the construction work will be completed;
- All the construction, toxic and hazardous chemicals/materials shall be completely removed from the site;
- All fencing and gates shall be removed and pits shall be backfilled;
- The reconstruction of interrupted drainage channels and pipes shall be carried out;
- Rehabilitation of affected roads will be carried out to avoid any inconvenience to the road commuters; and
- A clearance certificate from the proponent has to be taken by the Contractor in this regard.

Guideline Resource Conservation Plan is attached as **Annex-XII**.

9.15.5 Waste Management Plan

Management of solid and hazardous waste is one of the most important issues during construction phase of the Project. It is estimated that around 60 workers will be accommodated at construction camps (total of about 02 camp sites) during construction phase. As a general rule the water consumption will be about 40 liter/capita/day and will subsequently generate about 80% of this water as sewerage. Based on this water consumption, around 18,000 liter/day of water will be utilized for washing, cooking and bathing purposes at each camp site which will generate approximately 14,400 liter/day sewage at each the construction camp sites. In addition to that each construction camp site will generate about 202.5 kg/day of solid waste at site @ 0.45 kg/capita/day.

The major components of the workers' camp waste are garbage, putrescible waste, rubbish and small portion of ashes and residues, wastewater from camps toilets and washing yards, etc. The construction waste will include wastewater, oil spillage from machinery and solid waste (damaged or spoiled materials, temporary and expendable construction materials, etc.). Insecure and unhygienic disposal of the wastes may cause degradation of soil, land and water resources. However, a criterion has been developed for the solid and hazardous waste management at site. The criterion for plan is as follows:

- All the anticipated solid wastes will be collected through a properly designed solid waste management system. Enough number of containers will be placed inside the camps and within the construction area for the collection of various types of waste;
- These containers will help the component separation of various types of waste at source. Classification will be based on organic waste, recyclable waste, reusable waste (for resource and recovery) and waste for disposal site. Based on the conditions of the region, organic waste will be frequently collected to avoid odor problems;
- Recyclable, reusable and waste for disposal site will be collected twice a week and on alternate days and will be transferred to a properly designed disposal site;
- The special strategy for safe handling, storage and use of hazardous substances/material will be developed and ensured at site;
- The sewage system for camps shall be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewaters;
- Lined wash areas shall be constructed within the camp site or at site, for the receipt of wash waters from construction machinery;
- Medical waste and construction waste will be handled with care;
- The pesticide use shall not be allowed at site for clearance;
- Construction waste i.e. waste concrete, bricks, cement, etc. will be disposed of at the designated areas; and
- Construction workers and supervisory staff will be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste for disposal.

Based on the above guidelines, Contractor(s) will be responsible for the preparation of Waste Management Plan before the commencement of construction activities and its implementation at site after the prior review and approval from SC and proponent. Guideline Waste Management Plan is attached as **Annex-XIII**.

9.15.6 Disaster Management Plan

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Disasters are of two types i.e., Natural and Manmade.

The flooding, earthquake, wind storms are the major disastrous phenomena in the region. The mountainous terrain makes the community as well as worker more vulnerable to disasters. The development of poor infrastructural measures, poses greater vulnerability risk in relation to the onset of potential disasters. In such cases, even a moderate disaster could bring devastating effects on communities.

The Provincial Disaster Management Authority (PDMA) of Government of Punjab are mandated for planning, implementing and coordinating all activities in case of the onset of a disaster. Therefore, there is a specific requirement for developing a plan that effectively responds to any Monsoon induced emergency. PDMA specialize in mitigation, preparedness and an organized response to a disaster. The most important role of PDMA lie in providing a platform to come together and strategize management and response to disasters and calamities.

9.15.7 Drinking Water Supply and Sanitation Plan

Separate water supply and sanitation provisions will be needed for the temporary facilities including offices, labour camps and workshops in order not to cause shortages and/or contamination. A Plan will be prepared by the Contractor on basis of the mitigation plans. The Plan will be submitted to the CSC for their review and approval before contractor mobilization. Guideline Sanitation Plan is attached as **Annex-XIV**.

9.15.8 Traffic Management Plan

A comprehensive Traffic Management Plan (TMP) will be developed by Contractor mentioning routes to be followed for transportation of construction machinery and materials e.g. cement, steel, gravels, sand, etc. A guideline accessibility map is shown in Chapter 3 of this EIA report. Traffic Management Plan will comprise following contents necessarily:

- Goals and objectives of plan;
- Purpose & Scope;
- Project specific traffic;
- Roles & responsibilities of contractors' environmental personnel;
- Routes to be followed along with necessary maps;
- Transportation timing; and
- Mechanism to address road accidents (if occurs).

Guideline for contractor's TMP is attached as **Annex-XV**.

9.15.9 Change Management Plan

The present EIA has been carried out on the basis of the Project information available at this stage. It is however possible that the changes are made in some components of the Project during the design and construction phases. In order to address the environmental and social implications of these changes, a simple framework has been devised, which is described in this section. The change management framework recognizes the three broad categories (A, B & C) of the changes in the Project as detailed below:

Category ‘A’ Change: The ‘Category A’ change is one that will lead to a significant departure from the Project described in the EIA and consequently requires a reassessment of the environmental and socioeconomic impacts associated with the change. In such an instance, proponent will be required to conduct a fresh EIA of the changed aspect of the Project design and send the updated report to the relevant agencies for approval.

Category ‘B’ Change: The Category ‘B’ change is one that will entail Project activities not significantly different from those described in the EIA, which may result in the Project effects with overall magnitude to be similar to the assessment made in this report. In case of such changes, the EIA will be required to reassess the environmental and socio-economic impacts of the activity, specify additional mitigation measures, if necessary and report the changes to the relevant agencies (Contractors, PEPA).

Category ‘C’ Change: A Category ‘C’ change is one that is of little consequence to the EIA findings. This type of change does not result in effects beyond those already assessed in the EIA; rather it may be made onsite to minimize the impact of an activity, such as re-aligning a particular section to avoid cutting a tree, or relocating construction campsites to minimize clearing vegetation. The only actions required for such changes are informing all the key personnel and document the change.

9.15.10 Reservoir Fisheries Management Plan

Presently, due to unfavorable environmental conditions, fishery activities in the project are nominal. However, after creation of a very large water body through construction of Chiniot Dam, a tremendous boost could be provided to the fishery activities. To harness this potential, it will be necessary to develop a ‘Reservoir Fisheries Management Plan’. Its two basic areas of focus will be: fish stocks management; and reservoir fishery management.

Major impact on fish stocks will occur after reservoir impounding with significantly changed hydrological conditions of Chenab River. Particularly, the spawning areas in upstream and downstream of the dam will be changed with adverse impacts on fish stocks.

With the experience at Mangla, Chashma, Hub and Tarbela, WAPDA could develop Chiniot Dam reservoir as a sizeable fishery resource. Fishery would also become a very relevant factor of employment, which presently is not the case. In addition, the fish would significantly improve food basis of this distant area of Pakistan, where the nutritional level for most of the population is very poor.

A dam and its ancillary activities have various negative as well as positive impacts on the land, water, air, socio-economic and biological environments. The most adverse impacts are foreseen on the biotic communities of the water environment, in which fish are highly vulnerable. Construction of a dam/barrage triggers habitat alteration or modification in the upstream as well as downstream stretches of the river. It hampers the spawning movement of fish and its downstream impacts lead to habitat fragmentation and modification of the water stream characteristics. The livelihood of the fishermen community, if any, may also be affected adversely. An Aquatic Ecology and Fisheries Management Plan (AEFMP) would require the knowledge of area-specific impacts of the project on the fish, fish composition in the river and its tributaries, spawning grounds and fishing activities in the area.

All the activities such as collection of existing baseline data and its review, collection of baseline data of aquatic biota from selected points of Main River and its riparian areas.

- Meetings / discussions with focus groups, fishing community and departments,
- Laboratory tests at Lahore.
- Study of literature to interpret the data, literature review for report writing.
- Preparation of Atlas on the basis of data collected from field.
- Consultation workshops, preparation of final report, and submission of final report will be completed as per the schedule given by the client.

The Aquatic Ecology Fisheries Management Plan for the Chiniot Hydropower project will aim to:

- Minimize the adverse impacts to the aquatic habitat and ecological values of the River Chinab and its tributaries in the project area and the influence area as well,
- Rehabilitate disturbed areas, and
- Reduce potential construction impacts on fish.

Baseline data acquisition is a key pre-requisite to estimate the loss of spawning habitats by implementation of the project so that the planning may be done to compensate fish recruitment loss. Decreases in spawning habitat will cause decreases in new fish recruitment. This will reduce production of fish in the area causing disturbance in biodiversity which will in turn affect the livelihood of the fishermen community of the area.

The AEFMP will suggest the activities to be done pre-construction, during construction and post construction of the dam to achieve the aims of the plan, as stated in the above paragraph. Implementation of this plan will maintain biodiversity and sustainable production of fish in the area. It will comprise of the measures for fish stock management pre-construction by designing the construction work and framing of the rules for contractors. During construction, the fish stock will be managed by:

- Enabling migration of fish stocks across the dam site during construction
- Avoiding damage of fish stocks due to water pollution

9.15.11 Chance Find Procedure

The purpose of these guidelines is to address the possibility of archaeological deposits, finds and features becoming exposed during earth removing and ground altering activities associated with the construction and to provide procedures to follow in the event of a chance

archaeological find. The chance find procedure of archaeological deposits is attached as **Annex-VII**.

9.16 CODES OF PRACTICE

The Contractor will seek to develop codes of practice for its staff and employees in order to ensure that the intrusion of workers in the Project Area does not result in any social and environmental and social issues between the workers and locals which can harm the Project by causing unnecessary delays.

These codes will be based on the principles of environmental protection, occupational health and safety, good engineering practices, respect, integrity and sound ethical values. Each code will include, at minimum, the purpose and objectives, a policy statement from the in-charge explaining the importance of this code for the success of the Project, and examples of such conduct. Guidelines for the code of practices are discussed below.

9.16.1 General

General code of conduct will be developed for the Project and will include, at minimum, the following practices:

- Rules and guidelines will be given to the workers regarding the use of common resources such as wood, plants, water sources etc. to ensure their sustainable use.
- The code will also include provisions of the solid waste management plan to address solid waste collection and disposal in order to prevent unhygienic conditions and contamination of soil and water.
- The Contractor will be made arrangements to avoid accidental risks such as traffic signs board and speed control measures for the safety of locals.
- In construction camps, amenities of life including clean food, water and sanitation facilities must be provided to these camps, and the workers will be provided with guidelines on how to dispose of their waste and maintain a sense of hygiene.
- The training of workers in the construction safety procedures, equipping all construction workers with Personnel Protective Equipment (PPEs) i.e. safety boots, helmets, gloves, ear plugs, and protective masks also and monitoring their proper and sustained usage.
- Prior to blasting thorough inspection will be conducted and standard SOP will be developed and followed.
- Safety lookouts will be built to prevent people and vehicles from passing at the time of blasting.
- The Contractor will ensure that the construction labor is trained in safety procedures for all relevant aspects of construction.
- Formal emergency procedures will be developed for construction site in case of an accident. First Aid Kits and other necessary equipment will be kept available at site along with the list of emergency phone numbers at the construction site to be contacted in case of any accident.

- The safety of the public at all stages of the construction and operation will be ensured by appropriate public education and safety measures such as use of sign boards, barriers and flags and use of proper illumination at night.

9.16.2 Good Engineering Practices

Good engineering practices will be developed for the Project and will include, at minimum, the following practices:

- Standard Operating Procedures (SOP) for handling, storage and transportation of oil leakages, chemicals and other toxic materials will be strictly followed.
- Workers must be familiar with the Material Safety Data Sheets (MSDS) of each chemical used at site. MSDS are provided with each chemical drum. Chemicals will be stored as per their MSDS. Utmost care will be taken during the handling of these chemicals.
- Precautions will be taken to prevent spills and all workers will be trained in proper handling, storage and disposal of hazardous or toxic materials.
- Proper disposal plans of excavated material.

9.16.3 Cultural Norms

Cultural Code of Practice (CCP) will be developed for the Project and will include, at minimum, the following practices:

- Self-respect and sensitivity to insult is an important trait of the locals. The poorest among them has his own sense of dignity and honor and he vehemently refuses to submit to any insult. In fact, every local resident considers himself equal if not better than his fellow tribesmen and an insult is, therefore, taken as scurrilous reflection on his character. So the contractor will be careful to avoid any unceremonious interaction with the locals and inform their staff to be humble and polite.
- The Contractor will also take care of the norms of local community and their sensitivity towards local customs and traditions;
- The Contractor will brief the staff about local culture and norms;
- As per local culture wearing of pant shirt, half shirts, and short trouser are considered inappropriate attire, therefore the contractor inform the staff to avoid wearing short trousers and short shirt;
- Contractor will strictly warn the staff not to involve in any unethical activities and to obey the local norms and cultural restrictions particularly with reference to women;
- The Contractor will be required to maintain close liaison with the local elders and religious scholars of nearby local community to ensure that any potential conflicts related to common resource utilization for the Project are resolved easily;
- Privacy of women is a major cause of concern for the communities of the Project Area. Due to the Project activities, local women may not be able to perform their daily outdoor chores. Women in the Project are participate in other outdoor activities such as livestock rearing, bringing of potable water, collection of fire wood etc. that may be affected by the Project activities;

- The Contractor will have to select the specific timings for the construction activities so as to cause least disturbance to the local population particularly women considering their peak movement hours; and
- The Contractor will warn the staff strictly not to indulge in any un-ethical activities and to obey the local norms and cultural restrictions particularly with reference to women.
- If privacy of the nearby households is to be affected, the Contractor will inform the house owner in advance to make some alternative arrangements. Similarly, the Contractor will have to take great care that the construction activities will not affect the privacy particularly with reference to women.

9.17 PUBLIC DISCLOSURE

WAPDA will disclose this EIA to all the stakeholders prior to the start of the construction. This report will be made available to the stakeholders at places as designated by the Punjab-EP&CCD. In addition, executive summary of the Report will be translated into Urdu language and made available to the affected communities and locals. The copies will also be kept at construction site for ease in accessibility of the locals. This will ensure the locals to be aware of the Project impacts, its mitigation, responsible staff and mode of implementation. In addition, the executive summary will also be published on WAPDA website.

9.18 CONTRACTUAL OBLIGATIONS

In order to make contractors fully aware and responsible of the implementation of the EMMP and to ensure compliance, it is recommended that environmental and social management measures are included in the tender documentation. The various contractors must be made accountable to implement the plans and mitigation measures which pertain to them through contract documents and/or other agreements of the obligations and importance of the environmental and social components of the Project.

Payments to contractors would be linked to environmental performance, measured by completion of the prescribed environmental and social mitigation measures. Contractors would be trained how to join forces with the executing agency, Project management unit, supervising consultants and local population for the mitigation of adverse impacts of the Project. For effective implementation of the proposed mitigation and monitoring measures they would attract trained and experienced environmental management staff.

9.19 EMMP COST

The contractor will be responsible for implementation of mitigation measures and environmental Monitoring during construction phase, whereas WAPDA will be responsible for implementation of mitigation measures and environmental Monitoring during operation phase. For an effective implementation of environmental mitigation measures during construction and operational phase, it is very important to provide sufficient funds for the implementation of environmental and social mitigation measures, monitoring and training. The tentative cost of environmental and social mitigation measures, monitoring and training is about **1.9 Billion PKR** excluding land acquisition and resettlement cost as given in the **Table 9.6**.

Table 9.6: Tentative Annual Environmental Monitoring and Management Cost

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
A	PRE- CONSTRUCTION PHASE						
A-1	Environmental Monitoring Cost						
1	Water Resources/ Surface Water Quality	Discrete grab sampling and laboratory testing of water samples by Punjab EP&CCD approved Laboratory for monitoring.	Once	30,000	4	120,000	One-time monitoring shall be carried out before the mobilization of Contractor.
2	Drinking Water Quality	Discrete grab sampling and laboratory testing of water samples by EP&CCD approved Laboratory for monitoring.	Once	30,000	6	180,000	
3	Wastewater	Discrete grab sampling and laboratory testing of wastewater samples by EP&CCD approved Laboratory for monitoring.	Once	30,000	2	60,000	
4	Noise Levels	dBA Leq. as per PEQS 2016	Once	5,000	6	30,000	
5	Ambient Air	Monitoring of CO, CO ₂ , SO _x , NO _x , HC, Ozone, Lead, and PM _{2.5} PM ₁₀ by EP&CCD approved Laboratory	Once	40,000	6	240,000	
	Monitoring						
	Sub-Total (A-1)					630,000	
A-2	Compensation and Resettlement Cost						

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost (PKRs)	Remarks
1	Land Acquisition and structure compensation cost	Land cost to the owner, standing crop, structure and tree compensation to affectees and tenant, and other Resettlement and Relocation Allowances	Once based on market value	Lump sum tentative cost as per RAP		60,981,741,708	Acquisition and compensation cost shall be paid based on the actual loss measured as per final RAP prior construction stage by the Contractor and verified by PMU/PIU.
	Sub-Total (A-2)					60,981,741,708	
A-3	Tree Plantation Cost						
1	Tree Plantation Cost	The cost and maintenance of one hectare of afforestation and estimated including cost of layout, digging, planting, carriage and watch and ward and its maintenance for five years	Lump Sum for 505,990 plantation as per the tree plantation plan (10% Linear Plantation and 90% Cluster Plantation at suitable sites identified after consultation with Forest Department)			977,572,680	The plantation cost is for the restoration of ecosystem and ensure the implementation of national legislations.
	Sub-Total (A-3)					977,572,680	
	Sub-Total A ((A-1)+(A-3))					978,202,680	Excluding land acquisition, resettlement and compensation cost
B	CONSTRUCTION PHASE						
B-1	Environmental Monitoring Cost						
1	Water Resources/ Surface Water Quality	Discrete grab sampling and laboratory testing of water samples by Punjab EP&CCD approved Laboratory for monitoring.	Quarterly	30,000	4	480,000	Quarterly monitoring cost for the one-year construction period and will be updated each year based on latest rates

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
2	Drinking Water Quality	Discrete grab sampling and laboratory testing of water samples by EP&CCD approved Laboratory for monitoring.	Quarterly	30,000	6	720,000	during construction timeline of the proposed Project.
3	Wastewater	Discrete grab sampling and laboratory testing of wastewater samples by EP&CCD approved Laboratory for monitoring.	Quarterly	30,000	2	240,000	
4	Noise Levels	dBA Leq. as per PEQS 2016	Quarterly	5,000	6	120,000	
5	Ambient Air Monitoring	Monitoring of CO, CO ₂ , SO _x , NO _x , HC, Ozone, Lead, and PM _{2.5} PM ₁₀ by EP&CCD approved Laboratory	Quarterly	40,000	6	960,000	
Sub-Total (B-1)						2,520,000	
B-2	Environmental and Social Management Cost						
1	HSE	Environment Personnel will monitor / conduct all HSE related activities e.g. TBTs, PPEs, housekeeping, safety signage, emergency preparedness, etc.	Monthly	300,000		3,600,000	<i>This is the tentative monthly cost for one-year period for one senior and two junior HSE experts along with their monthly logistics.</i>
			Lump sum			2,000,000	<i>Cost for PPEs, extinguishers, emergency lights, housekeeping equipment, safety signage and barricade, emergency preparedness kit, first aid kit, etc.</i>

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
2	Ecological and Biodiversity Monitoring & Management	Monitoring of disturbance of habitats through encroachment, noise and other construction activities.	Monthly	200,000		2,400,000	<i>This is the tentative monthly cost for one-year period for one senior expert along with their monthly logistics.</i>
3	Solid Waste Management	Collection, segregation, transportation, disposal and management of domestic, commercial, construction wastes	Monthly	200,000		2,400,000	<i>This is the tentative monthly cost for one-year period for one senior expert along with their monthly logistics.</i>
			Lump sum			1,500,000	<i>Cost for Collection, segregation, transportation, disposal and management of domestic, commercial, construction wastes</i>
4	Social Welfare and Development Cost	Based on the regular consultations with stakeholders including affectees and nearby community, through basic need assessment by the contractor and verified by PMU/PIU coordinating the district social welfare department.	Lump sum			5,000,000	<i>Different social welfare and development Projects i.e. easy loans for affectees, rehabilitation of schools, roads, tracks, BHUs etc.</i>
5	Training Cost	Literature preparation, printed material such as posters & pamphlets trainer(s), and venue, etc.	Monthly	200,000		2,400,000	<i>This is the tentative monthly cost for one-year period for one trainer along with logistics at site.</i>

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
6	Audit	Auditor's checklists & proformas	Bi-annual	500,000		1,000,000	<i>This is the tentative biannual cost for one-year period for at least two auditors along with logistics, travels and accommodation charges.</i>
7	Reservoir Fisheries Development and Management	Development of Hatchery complex/building and associated facilities	Lump Sum			62,000,000	<i>Tentative yearly cost for the Fisheries Management.</i>
8	Communicable Diseases	Tests will be performed by approved laboratory	Biannually	600,000		1,200,000	<i>This is the tentative cost for one-year period for medical tests of kitchen staff at each camp site.</i>
Sub-Total (B-2)						83,500,000	
Sub-Total B ((B-1)+(B-2))						86,020,000	<i>Tentative for One (01) year construction period.</i>
Sub-Total B ((B-1)+(B-2))						516,120,000	<i>Tentative for 72 months (6 Years) construction period. The cost shall be updated based on the current market prices during next years of construction phase.</i>
C	Defect Liability Period (One Year Cost)						
C-1	Environmental Monitoring Cost						
1	Water Resources/ Water Quality	Discrete grab sampling and laboratory testing of water samples by EP&CCD	Biannually	30,000	4	240,000	<i>Biannually monitoring cost for the one year this Phase and will be</i>

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
		approved Laboratory for monitoring.					reproduced for next years of on updated rates if required.
2	Drinking Water Quality	Discrete grab sampling and laboratory testing of water samples by EP&CCD approved Laboratory for monitoring.	Biannually	30,000	4	240,000	
3	Wastewater	Discrete grab sampling and laboratory testing of wastewater samples by EP&CCD approved Laboratory for monitoring.	Biannually	30,000	2	120,000	
3	Noise Levels	dBA Leq. as per PEQS 2016	Biannually	5,000	3	30,000	
4	Ambient Air	Monitoring of CO, CO ₂ , SO _x , NO _x , HC, Ozone, Lead and PM _{2.5} PM ₁₀ by EP&CCD approved Laboratory	Biannually	40,000	3	240,000	
	Monitoring						
Sub-Total (C)						870,000	
D	Environmental and Social Management Consultant Cost						
1	Team Leader EMMP	Cost for hiring of Supervision Consultant along with its Direct Expenses	Monthly	900,000		10,800,000	Lumpsum cost for one year
2	Environmental Expert		Monthly	500,000		6,000,000	
3	Social Expert		Monthly	500,000		6,000,000	
4	OHS Expert		Monthly	500,000		6,000,000	
5	Direct Expenses		Lumpsum	10,000,000		10,000,000	
	Sub-Total (D)					38,800,000	
	Sub-Total (D)					232,800,000	Overall Cost for 6 year Construction Period

Sr. No.	Parameter	Mechanism	Frequency	Unit Rate (PKR)	Quantity	Cost	Remarks
						(PKRs)	
	Grand Total (A+B+C+D)					1,727,992,680	Excluding land acquisition, resettlement and compensation cost
	Contingency Charges		10% of Grand Total			172,799,268	
	Grand Total with Contingencies					1,900,791,948	Excluding land acquisition, resettlement and compensation cost
						(Say 1.90 Billion)	

10 CONCLUSION

The proposed location for Chiniot Dam is the main site to store water and to protect the surrounding areas as well as downstream from flood on the Chenab River in Pakistan after the flood water enters from India. At this site, river flows in two narrow gorges which would create a good topographic situation favorable to develop a low-level reservoir. The proposed dam will also provide the storage to overcome the less water availability in downstream area during the low flow season and provide water supply to Faisalabad city.

As per the environmental and social studies, the proposed project will cause some adverse environmental, social and resettlement impacts including land acquisition, resettlement, tree cutting, loss of agriculture land, huge material requirement for embankment that are sensitive and irreversible. However, the implementation of suggested mitigation measures in true spirit will reduce the significance of these impacts. Moreover, the positive impacts during O&M stage will offset the effect of the construction stage impacts.

10.1 CONCLUSION

The implementation of the proposed project will have beneficial impacts on population of the project area. The key beneficial impacts of the proposed project are:

- The dam will help control river flow and prevent excessive flooding downstream, thereby reducing property damage and enhancing safety for communities.
- The dam will provide a consistent and reliable water source for irrigation, which will support agricultural productivity and allow for the cultivation of previously dry or less productive land.
- The construction of the dam will create a reservoir that stores water for use during dry periods, ensuring a steady supply for various needs including agriculture, industry, and municipal use.
- The dam will facilitate the generation of hydroelectric power, offering a renewable energy source that reduces reliance on fossil fuels and contributes to a stable electricity supply.
- The reservoir created by the dam will establish new aquatic habitats, benefiting local flora and fauna, supporting biodiversity, and providing protected environments for wildlife.

Apart from the beneficial impacts of the project, the proposed project has potential adverse environmental and social impacts during the construction and operational phases. These potential impacts can be avoided or mitigated by adopting suitable mitigation or remedial measures as mentioned in this EIA Report. Following are the conclusions based on the findings of EIA study;

- Major environmental and Social impacts associated with the proposed project during pre-construction phase include Land Acquisition (permanent & lease), impact on infrastructure, damage during field investigations, impact on flora and fauna, fear of resettlement and loss of physical assets.

- Major impacts during construction phase include impacts on aesthetics, transportation, roads, soil erosion, contamination of ground and surface water, solid waste and wastewater generation, ambient air and noise pollution, drilling burrowing hazards, employment issues, loss of privacy and security and damage to flora and fauna etc.
- Major impacts during operation phase include sedimentation, salinity and waterlogging, loss of nutrients, impact on water quality, change in land use, dam safety and emergency, water seepage, impact on flora and fauna, water borne diseases and change in farming patterns.

10.2 RECOMMENDATIONS

Following recommendations will be implemented during respective phases of the proposed Project:

- The proposed project will have both positive and negative impacts during the construction and operational phases, for which proper mitigation measures are necessary and proposed in the report. Proposed project may contaminate surface or drinking water to make them unfit for irrigation or drinking; or pollute the ambient air in dust and fugitive emissions;
- Construction activities may also contaminate soil due to the discarded construction materials and obstruction in natural drainage due to un-attended excavated material. Generation of solid waste will be an important soil contaminating source and may yield temporary adverse impact but its mitigation will be possible through implementation of waste management plan recommended in EMMP. Furthermore, oil spills and other lubrication materials may also contaminate soil which requires to be mitigated as per recommendations provided in report;
- Similarly, impact on water and air resources will also be of temporary nature during construction period. The water requirements for the project can be divided into two main uses i.e. water required for labor camp utilization and for construction purposes. If the generated sewage is not properly treated or disposed of this may contaminate the surface water and may affect the groundwater resources apart from soil contamination. It is recommended that wastewater effluent from contractors' camp will be treated at least primary level;
- Machinery in operation and other equipment's may yield temporary adverse impacts on the air resources. Most of these use diesel engines that generate noise and exhaust emissions. Generally, they will generate PM_{2.5}, PM₁₀, smoke, dust, CO and NO_x in the ambient air, which will deteriorate the air quality and resulting in temporary adverse impacts on the human health, fauna and flora. Similarly, fugitive dust due to the construction activities may also affect the local air quality. Good engineering, however, along with complying with EMMP and HSE plan will help to solve number of problems as mentioned here;
- A total of 505,990 trees will be raised in surrounding areas in lieu of 50,599 trees, which are liable to be removed during the construction of the propose Project. Thus, the number of plants to be raised is 10 times of plants to be removed. These all activates must be assigned, planned and implemented by Forest Department for successful plantation results and implementations on time. During the operation phase, there will be positive impact on the flora due to the extensive plantation;
- Impact on the fauna will be of minor and of temporary nature, and the project is not expected to have any significant adverse impact on them. With the improved flora of the track, due to extensive plantation, general fauna and especially the avifauna will be attracted to the area;

- As sedimentation is envisaged as an adverse impact during operation and maintenance phase of the proposed Project which emphasis on better watershed management & proper treatment of the catchment area/watershed is important;
- During operation and maintenance phase, some water rights issues may arise in downstream area (lower riparian) which needs to be addressed amicably as per mitigations provided in the report;
- The proposed Project is an environmentally green project and will promote and strengthen the environmental profile of the area instead of any serious damage subject to EMMP implementation therefore, EMMP needs to be implemented with letter and spirit along with mentioned roles and responsibilities and mitigation measures;
- Need to consult with the locals and religious scholars to protect the religious structures and graves situated near dam axis;
- Conducting the meaningful consultation with all the stakeholders including the local population on regular basis;
- A grievance redress mechanism (GRM) for the Project shall be established by PIU/PMU as part of the overall project management system in order to address community concerns and complaints. Through this mechanism, queries, problems, and complaints about the social and environmental will be answered, resolved effectively, and addressed expeditiously;
- Job will be provided to local people on priority basis and clause must be added, so that the contractor will be legally bound to provide the job to local people;
- For the utilization of stored water efficient mechanism will be developed that all the farmers will be benefitted;
- Further enhancement in drinking water facilities will be considered in the scope of work of the proposed project;
- There may be some temporary adverse impacts of the presence of labor camp or project colony near the settlements in terms of the chances of fatal accidents and undesirable social mixing. Both of these impacts can be mitigated through safe traffic management plan and strict application of rules and regulations by the contractor.
- The EMMP and all its requirements should be added to the Contractor's Contract, thereby making implementation of the EMMP a legal requirement according to the Contract. Therefore, Contractor will prepare its Site-Specific Management Plans which will be approved and monitored by the Supervision Consultant. The Supervision Consultant shall note any non-conformance with the Site-Specific Management Plans and the conditions of environmental approval by Punjab EP&CCD, Contractor should be held liable for breach of the contractual obligations of the EMMP. In order ensure compliance with the Site-Specific Management Plans, the Contractor will employ an Environmental Manager (or expert specified in EMMP) to monitor and report project activities throughout the project construction phase.
- The tentative cost estimate to implement EMMP is estimated as **PKR. 1.9 Billion**. This tentative cost will be included in the overall project cost. This cost will be reviewed and firmed up periodically to ensure realism. The Contractor however shall be paid against the actual execution with evidential proof of EMMP activity.



WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA)

DETAILED ENGINEERING DESIGN, PREPARATION OF BIDDING DOCUMENTS AND PC-1 OF CHINIOT DAM, PROJECT



ENVIRONMENTAL IMPACT ASSESSMENT REPORT

(Volume - 2 of 2) – Annexes

July 2025



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**Detailed Engineering Design, Preparation of Bidding Documents and PC-1 of
Chiniot Dam, Project**

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT (Volume 02 of 02)

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1 Introduction

- 1.1 Chiniot dam site is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage, 05 km from the Chiniot city and about 100 m upstream of existing road Railway Bridges on Chenab River. Coordinates at dam site are Latitude 31° 45' 15" N, Longitude 72° 57' 00" E. Location Map attached as **Figure - 1**.
- 1.2 Chiniot Dam Project is planned to store surplus flows of Chenab River by the construction of 17 m high dam. The stored water will be released to meet the irrigation water requirements of the downstream cultivable area and the power generation will be a by-product. The Project Layout Plan is shown in **Figure - 2**.
- 1.3 The Chenab River enters Pakistan territory in Sialkot district near village Diawara. Two more tributaries viz; Jammu Tawi at its left and Munawar Tawi at the right join the main river, just upstream (about 01 km) of Marala Barrage.

2 Mode of Implementation / Organization of Study

- 2.1 To conduct the overall study and other related multi-disciplinary activities, WAPDA will engage consultants.
- 2.2 Consultants will review the previous data / studies / investigations and propose additionally required investigations. Based on the overall data, available studies, additional Survey and Investigations, Consultants will complete their assigned task as detailed in scope of work of proposed study.
- 2.3 General Manager (Hydro) Planning, WAPDA will be the overall In-charge of the study envisaged over a period of Eighteen (18) months.
- 2.4 In conducting the studies, Chief Engineer-I (Hydro) Planning, WAPDA will provide to Consultants, the available documentation / data / studies / reports / surveys, assistance in collecting additional data / reports for field investigations and studies. Cost of additional Survey and Investigation including Physical Model Studies will be borne by WAPDA and is not included in the financial proposals.
- 2.5 WAPDA will periodically review and advise on specific issues / activities of Consultants. WAPDA will review the drafts of various reports / memoranda of Consultants before finalization. WAPDA will review the design and overall project plan by appointing a credible panel of independent Experts.
- 2.6 Guidelines for Consultants are given as under:
 - a. Consultants will carry out data collection and studies. However, additional topographic survey and surface / sub-surface geological investigations required in completing the assignment will be advised by Consultants and carried out by Chief Engineer-I, (Hydro) Planning Organization and other WAPDA formations under Consultant's technical supervision. Consultants shall provide appropriate schedule for timely completion of investigations. In-house capabilities of WAPDA formations will be utilized to the maximum extent for such survey and investigations. All other data collection, field survey and studies will be carried out by Consultants.

- b. Consultants shall make their own arrangements for office and residential accommodation in connection with the assignment including furnishing as per consultancy cost estimate as reimbursement items.
- c. Consultants shall make their own arrangements for transport on rental basis and provision will be made available under non-salary cost items in consultancy services agreement.
- d. For conducting topographic survey and its digitization, the Consultants shall suggest necessary arrangements and will provide all assistance for processing/ digitization of topographic maps. The cost of digitization shall be borne by the WAPDA and will not be included in the financial proposals.
- e. For social and environmental studies, the Consultant shall suggest resettlement works, Integrated Area Development (IAD) Plan and Confidence Building Measures (CBMs).
- f. In case of any deficiency, Consultants will advise WAPDA for necessary additional arrangements.
- g. Monthly progress review meeting will be held in which Consultant's sectional head will present progress, constraints and bottlenecks in the way of the working.
- h. Periodic presentation will be made by Consultants as and when desired by WAPDA for briefing, decision making and reviewing progress.

3 Background Information

3.1 Feasibility of Chiniot Report on Chenab River - First and Second Hill Plan (1960)

The first proposal was made by Mr. S.S. Kirmani, first Chief Engineer, Indus Basin Projects; WAPDA, on river channel storage of 1,233 Mm³ (1.0 MAF) by constructing a barrage on Chenab River at Chiniot.

The second proposal known as "First Hill Plan" was made by M/s Leeds, Hill and Jewett Inc. Consulting Engineers of USA, in 1960. The on-channel storage was envisaged as 1,603 Mm³ (1.3 MAF) with a barrage at Chiniot.

The third proposal by Mr. F.F. Haigh, envisaged as capacity of 1,603 Mm³ (1.3 MAF) of the on channel reservoir, with some modifications to the "First Hill Plan".

The fourth proposal again by M/s Leeds, Hill and Jewett also known as "Second Hill Plan", consists of an "off-Channel" storage of 1,727 Mm³ (1.4 MAF) in an abandoned river channel on left side of Chiniot City. A barrage at Chiniot Hills, to pond up water, an intake structure of a Link Canal to fill to off-channel storage and an Outlet Structure to release water from reservoir to Chenab River were the main components of the proposal.

3.2 Chiniot Dam Project Appraisal Study Report (2003)

WAPDA conducted an appraisal study in 2003 to assess the surplus flows and storage potential on the Chenab River reach between Marala and Chiniot.

Appraisal study concluded that the "off-channel storage" project would submerge major settlements like Chiniot satellite town, Faisalabad Water Supply System,

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Ramzan Sugar Mill and many other important commercial and non-commercial concerns.

An alternate study was carried out which proposed a channel reservoir, at level 190 m a.m.s.l with a storage of 1,110 Mm³ (0.9 MAF). The environmental aspects although involve some major settlements, but would be manageable, the reservoir being within the existing flood embankments with raised height.

3.3 Feasibility Study of Chiniot Dam Project (2018)

WAPDA prepared a Feasibility Report by utilizing in-house technical expertise. The study recommended a 17 m high dam at about 05 km from the Chiniot city and about 100 meters upstream of existing Railway Bridge on Chenab River. The reservoir will be bound by the left and right sides dykes/embankments to create a storage capacity of 1,110 Mm³ (0.9 MAF) with minimum environmental issues.

The proposed barrage will cater the peak discharge of about 34,000 cumecs (1,200,000 cusecs) at conservation level of El. 190 m a.m.s.l. Twenty-two (22) radial type gates are proposed in the dam / barrage, 07 in left gorge and 15 in the right one. The power house located on left side of right river gorge will generate 80 MW electricity and 275 GWh energy.

3.4 Salient Features of Proposed Chiniot Dam Project

Salient features of Chiniot Dam Project are listed in the following table. These features will be firmed up / modified / optimized during the proposed study:

Sr. No.	PARAMETER	S.I	F.P.S
A	Hydrology		
1	Catchment Area	740 sq. km	285.71 sq. miles
2	Average Annual Inflow	15,110 Mm ³	12.25 MAF
3	Avg. annual Sediment inflow	36 million Ton (0.043 MAF)	
4	Reservoir Area	18,500 hectares	45,700 acres
5	Gross Storage Capacity	1,110 Mm ³	0.9 MAF
6	Live Storage Capacity	1,048.46 Mm ³	0.85 MAF
7	Dead Storage Capacity	61.67 Mm ³	0.05 MAF
8	Reservoir estimated life	50 Years	
B	Barrage/ Main Dam		
1.	Main Dam Type	Zoned Earthfill Embankment	
2.	Barrage Type	Gated ogee spillway	
3.	Height	17 m	55.78 ft
4.	Crest Width	10 m	32.81 ft
5.	Crest level	El. 192 m amsl	El. 629.95 ft amsl
6.	Spillway Crest Length (R)	208.20 m	684.10 ft
7.	Spillway Crest Length (L)	85 m	278.89 ft
8.	Slope: u/s & d/s face	3H:1V	
9.	Spillway Crest Level	El. 178 m amsl	El. 584.02 ft amsl
10.	Free Board	01 m	3.28 ft
11.	River Bed Level	El. 175 m amsl	El. 574.18 ft amsl
12.	Normal Conservation Level	El. 190 m amsl	El. 623.39 ft amsl

Sr. No.	PARAMETER	S.I	F.P.S
13.	Spillway Design Discharge	34,000 cumecs	1,200,000 cusecs
14.	Spillway Gates	22 (07 on L/S and 15 on R/S)	
15.	Spillway Gate Size (W x H)	15 m x 13 m	49.22 ft x 42.65 ft
C	Under sluices		
16.	No. of Under sluices	04	
17.	Under sluice length	85 m	278.89 ft
18.	Crest Level	El. 176 m amsl	El. 577.46 ft amsl
19.	Gate Size (W x H)	15 m x 15 m	49.22 ft x 45.22 ft
D	Power House		
20.	Type	Surface Powerhouse	
21.	Discharge Capacity	720 cumecs	25,427 cusecs
22.	Rated Net Head	12.4 m	40.68 ft
23.	No. of Units	06, each 13.34 MW	
24.	Turbine Type	Horizontal Shaft Bulb Type turbines	
25.	Powerhouse size (L x W x H)	49.21 x 78.70 x 41.55 m ³	161.45 x 258.21 x 136.33 ft ³
26.	Installed Capacity	80 MW	
27.	Mean Annual Energy	275 GWh	
28.	Plant Factor	39.2 %	
E	Dyke / Embankment		
29.	Type	Homogenous Earthfill Embankment	
30.	Left Dyke Length	43 km	26.71 miles
31.	Right Dyke Length	40 km	24.84 miles
32.	Height	4 m - 15 m	13.12 ft - 49.22 ft
33.	Crest Width	10 m	32.81 ft
34.	Crest Level	El. 192 m amsl	El. 629.95 ft amsl
F	Upstream Coffor Dam		
35.	Max. Height at river section	6.5 m	21.33 ft.
36.	Crest Width, m.	5.0 m	16.41ft.
37.	Dam crest level, m.	El. 184.5 m. amsl	El. 605.34 ft amsl
G	Upstream Coffor Dam		
1.	Max. Height at river section	4.0 m	13.12 ft.
2.	Crest Width, m.	5.0 m	16.41 ft.
3.	Dam crest level, m.	El. 181.0 m. amsl	El. 593.86 ft amsl
H	Environment and Resettlement		
1.	Land to be acquire	11,100 hectares	27,400 acres
2.	Houses Affected	1,056	
3.	Population Affected	8,300	
4.	Flora (No. of Trees)	222,000	
I	Economic and Financial Analysis		
1.	EIRR	15.86%	
2.	B/C Ratio	1.65:1	
3.	FIRR	13.07%	
4.	Cost per KWh Rs.	6.91	
5.	Cost per KWh US Cents.	6.01	

4 Objectives and Standards of the Consultancy Services

- 4.1 The objective of the Consultancy services is to review the previous feasibility study, and prepare the project planning report, detailed engineering design, Preparation of Bidding drawings / documents and PC-I Proforma etc. of the Project.
- 4.2 The Consultancy services will be of such a quality as to allow WAPDA and Government of Pakistan for implementation of the Project.
- 4.3 Overall level of study and the degree of details on each aspect shall be sufficient to meet acceptability criteria of international donors that can be approached for funding of the Project for construction.

5 Scope of Work of Proposed Studies

The assignment will be accomplished in three tasks as given below;

TASK-I	Inception Report	(3 rd Month)
TASK-II	Project Planning Report	(12 th Month)
TASK-III	Detailed Engineering Design Report, preparation of Bidding Drawings / Documents and PC-I	(18 th Month)

5.1 Task-I: Inception Report (3rd month):

Task-I will cover review of all existing survey / field investigations, feasibility reports and documents available with WAPDA. The Consultants will also review preliminary design of various components given in the reports and various studies, evaluate project benefits and cost considering the time of implementation. The Consultants will prepare a comprehensive review of previous feasibility study and based on the findings of the review of previous feasibility study and additional work done by Consultants, the Inception Report will be prepared discussing alternate project layouts, water availability / requirement, power potential including infrastructure for implementation and operation of Chiniot Dam Project. The report will also include: the detail of field investigations / survey / studies and identification of data gaps in existing survey / barrage orientation required for accomplishing the assignment, social and environmental impact assessment, staffing status, detailed work programme for the study and any other findings / recommendations for review and concurrence by the Client, giving particular attention to water benefits in terms of power flood alleviation, irrigation supplies supplement in downstream areas and hydropower potential while preparing the Inception Report.

5.2 Task-II: Project Planning Report (12th month):

The following services to be performed on the basis of Task-I shall be covered under the Task - II.

- In order to support the conclusions under Task-I, additional field survey / investigations will be conducted under the supervision of Consultants.
- Project layout, for different barrage and dam/ dyke orientation, locations of embankments/ structures, intake structures etc. shall be developed to the degree of detail necessary to provide a fair comparison between the alternates.
- Review of previous feasibility study & available data and produce comprehensive studies, which may comprise but not limited to the following:

- Geological and Geotechnical investigations;
 - Hydrological investigations
 - Survey and mapping
 - Seismic Risk Analysis;
 - Layout Plan and optimization of Project Components / features;
 - Design of Barrage / Main Dam and Appurtenant Structures;
 - Sedimentation studies in reservoir;
 - Socio-Economic Studies;
 - Environmental Impact Assessment with Environmental Management Plan & Social Impact Assessment with preparation of Resettlement Action Plan;
 - Estimation of construction material and its availability;
 - Construction Planning & Contract Packaging;
 - Financial and Economic Analysis; and
 - Comprehensive Hydraulic Model Studies (Numerical and Physical).
- d. Seismic risk evaluation to determine seismic design parameters for various project components. Disaster Risk during the Project implementation will be evaluated and mitigation measures be proposed as presented in "Checklist for Disaster Risk Reduction".
- e. The population resettlement and the environmental aspects of the project will be assessed and quantified. The costs and benefits of resettlement and environmental aspects shall be taken into consideration in assessing the economic and financial viability of the Project. For the economic feasibility, all costs and benefits shall be valued in economic terms, while for the financial feasibility, shall be expressed in financial terms.
- f. The Consultants shall present their conclusions and recommendations to the above effects, in the shape of **Project Planning Report**, for review and concurrence by the Client.

Guidelines

- a. Consultants will follow the given design standards:
- For Hydraulic Structure Design USBR, USACE
 - For Materials testing ASTM
 - For Structures AASHTO, ACI & AISC, ASC Manual of RCC, Conferences on R.C.C. Dam
ACI / AASHTO code with latest Seismic Zoning Map for Pakistan
ICOLD Guidelines
 - For Seismic design
- b. Consultants shall proceed with the work, to determine and firm up the technical, economic and financial feasibility of the selected layout of the Project.
- c. Activities to follow this will include:
- i. Preparation of project layout covering all the components of the Project including the layout of infrastructure facilities required for implementation and operation stage of the Project.
 - ii. Preparation of Project Planning level designs of all structures for the selected alternate, and the components of the Project, layout of each

- major structure; and sufficient cross-sections to establish the magnitude and characteristics of the work and their construction costs, excluding infrastructure facilities.
- iii. For purpose of estimating project cost, all unit prices for major quantities of work shall be established by the latest methods. These methods will simulate each construction activity in such a way as to fit it into the available time span in the proposed construction schedule. Construction equipment, crews, materials and other resources would be adjusted to accomplish the work within the required time-span. The computations of unit prices shall be supported by detailed sets of financial prices with source.
 - iv. Indirect cost of construction for all major items into which the construction work is subdivided for cost estimating purposes, should be established separately. Total cost of each construction item shall then be obtained by multiplying the direct cost of construction, by a bid factor representing the influence of indirect costs.
 - v. Preparation of cost estimates of the Project broken down into local and foreign components. These shall include:
 - Major items like electro-mechanical and civil works including power house, main dam, dyke, spillway, intake & outfall structures etc. Price of major civil works and permanent equipment shall be estimated on the basis of ICB.
 - Environmental Impact Assessment with Environmental Management Plan & Social Impact Assessment with Resettlement Action Plan with cost estimation including Clean Development Mechanism (CDM).
 - Project Engineering and Management expenses, the owner's overhead expenses, and an adequate allowance for physical contingencies.
 - Import duties, taxes and interest during construction (to be assessed separately and not be included in the base cost estimates).
 - vi. Price escalation provisions shall be computed on the basis of the construction schedule for Local and Foreign Currency Components on the criteria followed by the Planning Commission, Government of Pakistan. These price escalation provisions shall not be included in the economic cost estimates and shall be used only for financial forecast and financial requirement purposes.
 - vii. Possibility of prospective project financing and implementation through different modes i.e., Private Sector / Public-Private Partnership (PPP) etc.
 - viii. Preparation of a construction schedule using CPM/ Primavera, MS Project/ PERT analysis and schedules for annual construction expenditures, both for Local & Foreign Currency Components, throughout the Construction period, as well as a schedule of annual expenditures for the Environmental Impact Assessment/ Resettlement Action Plan and other items which generally extend beyond the project commissioning.

- ix. For the purpose of economic analysis, power and irrigation benefits of the Project shall be based on realistic assumptions as to their value and on alternate scenarios for use of water in the existing or new irrigated areas. Based on the Project benefits, Economic Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit Cost Ratio (BCR) will be worked out to indicate the economic justification of the proposed project.
- x. The financial analysis will cover the envisaged power and irrigation benefits available from the Project. The analysis will be carried out to identify and quantify benefits and costs expressed in financial terms using indicators i.e. Financial Internal Rate of Return (FIRR), Net Present Value (NPV) and Benefit Cost Ratio (BCR) in both scenarios i.e., with or without CDM benefits.
- xi. Consultant will analyze Risk and Sensitivity of the Project output. They will propose an appropriate model after recalculating project outcomes (NPV, EIRR) for different values of major variables and combinations of variables.
- xii. Consultants will submit a Draft Project Planning Reports to be discussed in WAPDA for their views / comments. After clearance, the final Project Planning Report will be issued.

Pre-design work

• Layout Plan	Layout Plan and Optimization of Project Components / features;
• Confirmation of key design parameters	Confirm / update key design parameters, such as inflow design flood (s), probable maximum flood, maximum credible earthquake, geotechnical characteristics of dam body materials and subsurface, and other related design parameters
• Study of reservoir area	Analyze and identify potential risks of, seepage and other hazards in the reservoir area, and propose appropriate risk mitigation measures. Anticipate technical challenges of the project due to impact of upstream barrages.
• Water balance model downstream the dam	Analyze the general supply and consumption (diversions and environmental requirements) downstream the dam.
• Sedimentation study	Confirm / update design sediment load and expected economic life of the dam and the storage curves.
• Environmental impact assessment	Confirm / update possible adverse environmental impacts in and around the reservoir / Project area and downstream along with impact of water-logging & seepage through dykes in the Project area.






Water resources management plan

- Simulation of reservoir operations
Based on reservoir profiles, storage curves, available hydrological data and the given design dam height determine dependable live storages over the dam life.
- Climate change impact assessment
Synthesize hydrological data based on reliable climate change scenarios, and identify possible impacts on reservoir operations over the project.

Verification/ validation of economic benefits

- Estimation of irrigation benefits
Confirm / estimate the realistic economic benefits that will accrue from the design storage allocation for irrigation.
- Estimation of hydro-electric power benefits
Confirm / update the likely economic benefits from hydro-electric power generation based on the design allocation for hydropower.

Consultation with beneficiaries and affected people

- Stakeholder consultation
Identify the relevant stakeholders, develop an appropriate framework for stakeholder consultation, and carry out consultation as an integral part of the planning and design process.
- Gender development plan
In consultation with community leaders and women representatives, plan and design gender development component. Design required facilities, prepare drawings and cost estimates, and the implementation/ management arrangements for the facilities.
- Integrated Community development plan
Formulate Integrated Community Development Plan that draws together a diverse range of institutions to achieve sustainable development outcomes by enhancing the inherent capabilities of local communities. Such as creation of employment/ business opportunities, provision of health and education facilities, etc.

Detailed Engineering Design

- Hydraulic analysis (flood routing) and design of spillway
Based on reservoir profile developed under the sedimentation study, carry out flood routing analysis, and determine available surcharge, and the design spillway that will safely pass through



- **Model Studies**
the probable maximum flood in the inflow design flood(s). Examine the need for a model study, and if deemed necessary, develop the appropriate terms of reference, and supervise the model study. Prepare drawings and bill of quantity.
Perform Hydraulic model studies to ascertain the hydraulic behavior of important structures, flow pattern, sedimentation behavior, impact of flushing through under-slucies on alluvium downstream the spillway structures. Numerical modeling will be done and further physical model study will be made at Irrigation Research Institute on the recommendation of the Consultants.
Prepare a stream diversion plan during construction and design diversion structures. Prepare drawings and bill of quantity.
 - **Design of diversion**
Design of dam body, including determination of appropriate freeboard, and stress and stability analysis during and at completion of construction, sudden drawdown, and during credible maximum earthquake, using a reliable and verified computer model.
Design hydropower plants. Prepare drawings and bill of quantity.
 - **Design of main dam**
Design all other appurtenant structures. Prepare drawings and bill of quantity.
 - **Design of hydro-electric power plants, switchyard and transmission lines**
 - **Design of other appurtenant structures**
- **Construction plan**
Develop a construction plan.
Develop a detailed plan for disposing excavation spoils and other materials.
 - **Construction plan**
 - **Disposal plan**
- **Social and environmental safeguard**
Based on the flood routing analysis and other design parameters, prepare a social impact assessment report in project area, land acquisition and resettlement action plan discussing commercial and noncommercial settlements etc.
Develop an environmental management plan to alleviate / minimize the possible adverse environmental impacts in and
 - **Land acquisition and resettlement plan**
 - **Environmental management plan**

around the reservoir/ project area and downstream.

Dam safety and disaster risk management plan

- Instrumentation design
Design instrumentation to monitor the dam safety during and after construction, including dam's horizontal and vertical movement, alignment and tilt, stress and strains in the membrane and rock fill, pore pressure, phreatic surfaces, and seepage clarity and quantity.
- Disaster risk assessment and management plan
Comprehensive Dam Break study will be carried out.
Analyze the disaster risks associated with flood, and in consultation with the local authorities and the stakeholders, prepare a robust and sustainable disaster risk management plan. Disaster Risk during the Project implementation will be evaluated and mitigation measures be proposed as presented in "Checklist for Disaster Risk Reduction".

Preparation of procurement documents

- Project management plan
Propose appropriate project management plan, project implementation arrangements, and project management / construction supervision consultants and other support services, including detailed terms of reference and cost estimates.
- Procurement arrangements and packaging
Propose most procurement packaging and arrangements most suitable to the project and the project area.
- Invitation to bid, bidding documents
Prepare the relevant procurement documents.

Project readiness activities

- Project appraisal document and project administration manual
Prepare a draft PC-I, appraisal report, project administration manual and other relevant documents required for investment decisions by the government and the international financing agency(ies).
- Support for stakeholder consultation and participation
Support the establishment and initial takeoff of a stakeholder consultation / participation mechanism that should allow the stakeholders' concerns in the project design, construction, and post-construction operation.

- Support for safeguard due diligence implementation
 - Support for agencies/ beneficiary capacity development
- Support WAPDA and the provincial agencies in implementing the required safeguard due diligence works in a timely and fair manner, including support for the third-party monitoring agencies.
- Support pre-project capacity development of the project beneficiaries to facilitate modernization of farming and water management practices in the project irrigation command areas.

5.3 TASK - III DETAILED ENGINEERING DESIGN, BIDDING DOCUMENTS & PC-I (18th month):

- a. Preparation of Detailed Engineering Design of all structures of the selected alternate including the components of the Project as at Part-II above. Environmental & Social Impact Assessment with Environmental Management Plan, Land Acquisition and Resettlement Action Plan, cost estimation will also be prepared under Task - III.
- b. Detailed Engineering Design must include, but not limited to, the following outputs:
 - Output -1: Integrated water resources management plan based on the reservoir simulation to simulate the sedimentation in the reservoir, over the project life to determine the allocation of water for power. This would also include updated economic analysis.
 - Output -2: Detailed design of dam/ spillways, main dam, powerhouses, and other appurtenant structures.
 - Output -3: Integrated community development plan including land acquisition and resettlement plan, sustainable employment creation plan, gender development, etc.
- c. Preparation of detailed drawings of each structure and BOQ.
- d. Preparation of Bidding drawings with sufficient details in respect of the above for International Competitive Bidding.
- e. Preparation of bidding documents in line with FIDIC, PEC, World Bank, WAPDA guidelines and standard practice for donor funded projects. The bidding documents shall cover the Civil / Electro-Mechanical works of the Project and its components.
- f. Consultant shall ensure the following aspects of the bidding documents:
 - Completeness of documents in all aspects.
 - Documents are clear, concise and in an unambiguous language.
 - All provisions, clauses, definitions and terms are consistent throughout the document.
 - The documents clearly define the scope of work.

- The documents have clear Dispute Resolution Mechanism.
 - The documents meet with requisite International Standards.
- g. Based on the Project Planning Report, Detailed Engineering Design, Bidding Documents and PC-I will be framed as per the guidelines of Planning Commission of Pakistan. Bidding documents for each contract package shall consist of the following volumes;
- Volume - I:** Invitation to Bids, Instructions to Bidder, General Conditions and Special Conditions
- Volume - II:** Technical Specifications
- Volume - III:** Forms of Bid, BOQs, schedule of forms of Bank Guarantee for Bid Security, Performance Security and advance mobilization loan
- Volume - IV:** Contract Drawings
- h. Consultants will submit a Draft Detailed Engineering Design, ESIA, EMP, LA & RAP Reports, Bidding Documents and PC-I to be discussed with WAPDA for their views / comments. After clearance, the final Reports will be issued.

5.3.1 Additional Investigations

Additional geotechnical investigations may be required at the proposed site for detailed design. These investigations may include drilling, geophysical surveys, seismo-tectonic studies, field and laboratory tests.

Drilling: It is envisaged that in this drilling program special attention will be paid to the head regulator, intake structures, pumping station and other structure locations. Additional geotechnical investigations may also be required for main canal, distributaries and minors, cross-drainage structures, roads and utility crossings to be provided on the irrigation water distribution system. The type, depth and location of drilling will be provided by the Consultants.

Field Tests: Field tests may be carried out to determine the in-situ properties of rocks and soils. Suitable techniques will also be employed to determine the in-situ state of stress in the rock mass or any other tests deemed necessary by the Consultants.

5.3.2 Water and Power benefits

Because of the importance of irrigated agriculture for the Project area, the Consultants shall consider that storage reservoir to operate by optimizing the supply of water for irrigation and by-product power generation. The Consultants shall review the previous studies. This review will take into consideration any new aspect developed during the design stage of the studies.

Rating of generating units shall be examined to confirm the size selected in desk studies stage. In particular, system operational aspects should be analysed as well as constructional considerations. WAPDA shall decide on the final arrangement of project structures to be designed on proposal of consultants.

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5.3.3 Optimization of Project Layout

The Project layout in the previous reports includes the following important structures:

- Barrages and Silting Basin
- Under Sluices Bays
- Zoned / Embankment Dam
- Right and Left Side Dykes / Embankments
- Drainage Channel
- Power Generation & Powerhouse
- River Diversion and Outlets

The Consultants will review and optimize the Project layout given in previous reports. The review shall take into consideration how the overall quantum of work and cost of the Project can be reduced. To confirm the hydraulic aspects of project layout, the consultant shall propose appropriate physical **Hydraulic Model Studies** to be carried at Irrigation Research Institute (IRI), Nandipur.

5.3.4 Detailed Design of the Main Components

On the basis of available information and additional field investigations, the optimized irrigation and energy parameters, the hydraulic, geotechnical, structural, mechanical and electrical design criteria normally used for this type of work; the Consultants shall review and update the design of various project components i.e., dam/ barrage, reservoir rim, spillway alongwith energy dissipating structures & stilling basin, power house, trashracks, gates penstock, relieve valves, etc. The design produced shall be adequate for preparation of drawings and specifications for bid documents including BOQ. Main Components of the Project are:

a) Barrage & Main Dam

Zoned earthfill embankment with central impervious core will be constructed from right & left side spillway up to the start of the dykes. Main dam height is 15 m with a crest width of 10 m.

At proposed dam site, the river flow is divided into two channels and each channel flows through a gorge situated between the rock hills flanking the sides. The left side gorge is narrower than the right side one, spanning across the river. Each of the two segments of the spillway will span between the flanking hills, abutment to abutment. Design flood of 34,000 cumecs (1,200,000 cusecs) will be evacuated through spillways accommodated in two river gorges. The concrete gated spillway in left and right river gorges will consists of 07 and 15 bays respectively with hydraulic operated radial gates.

b) River Diversion Works

The Consultants shall perform the hydraulic and structural designs of the river / nullah diversion structures and other outlets, as well as the closure elements needed to control the

reservoir level. The Consultants shall analyse the risks involved for each configuration and river flood frequency.

The Consultants shall design the coffer dams, if required. Special attention shall be paid to the foundation treatment i.e., cut-off design. The safety of the coffer dams will be checked for the various combinations of load, as per international design practices. The construction method & construction planning of these will also be deliberated upon.

c) Under Sluices Bays

Under sluices will be provided to flush the sediment load. Four (04) bays will be located on extreme left of right river gorge spillway. The under sluice will be equipped with hydraulically operated gate, similar to main spillways for flushing sediments. A divide wall will separate the main dam portion from the under-sluice portion. The crest of under sluice portion will be kept at a lower level i.e., El. 177 m a.m.s.l than the crest of the normal portion of the dam i.e., El. 179.50 m a.m.s.l.

d) Silting Basin

The energy will be dissipated through a stilling basin. The downstream sloping apron extending from the crest level to the horizontal floor in spillway and under sluices will be laid at an inclination of 3H:1V and 5H:1V respectively and the structure will be designed to ensure that any hydraulic jump formation may take place only on the sloping apron to dissipate energy.

e) Right and Left Side Dykes / Embankments

Three Alternative dykes / embankment layouts were considered in detail at feasibility level to maximize the positive impacts i.e., storage capacity, power potential and minimize the negative impacts i.e., flood area, population / infrastructure affected etc. Taking into consideration the smaller reservoir area, land acquisition, resettlement, environmental / social issues and lowest cost implications, Alternative- I will yield highest benefits. Alternatives Project Layout Plan is shown in **Figure - 3** and comparison is given below:

Description	Alternative - I	Alternative - II	Alternative - III
Reservoir Area (km ²)	185	351	485
Dyke Length (km)	80	100	112
Gross Storage (MAF)	0.90	1.440	1.820
Live Storage (MAF)	0.85	1.386	1.759
People Effected (No.)	8,300	17,200	62,420
Land Acquisition (acres)	27,400	67,000	102,500
Houses Effected (No.)	1,056	2,341	11,461

Homogeneous earthen embankments will be constructed in the flood plains of Chenab River. The aim of providing these embankments is to confine the river flood water and maintain pond level within the area available between the embankments. The reservoir would be surrounded for about 90 percent of its parameter by earth dykes. Embankments / Dykes would be constructed on the right and the left side of the reservoir to develop a storage capacity of 1,110 Mm³ (0.9 MAF) at a crest elevation of 192.0 m a.m.s.l.

The left and right-side dyke / embankment length will be about 43 and 40 km respectively, to maintain a reservoir level of 190.0 m a.m.s.l. Dyke / Embankment height varies from 04 - 15 m.

f) Drainage Channel

Unlined drainage channel will be provided along the outer periphery of the dyke/embankment. The drainage channel will intercept the seepage water from embankment / dyke and drains/nullahs discharging into Chenab River. The proposed drainage channel will safely dispose-off the collected water downstream of the dam into the Chenab River. Discharge capacity of drainage channel varies from 5 -10 m³/s.

g) Power Generation

The powerhouse will be located on left bank of right river gorge. The surface powerhouse would be accessible from existing railway and Sargodha-Faisalabad Road bridges. The surface power house will consist of six generating units each having capacity of 13.34 MW. All six units would be Horizontal Shaft Bulb Type Turbines with a combined output of 80 MW at design discharge of 720.0 m³/s. Dam & Reservoir Map is attached as **Figure - 4**.

h) Quality Assurance and Quality Control Program

The Consultant shall prepare a Quality Assurance and Quality Control Program for the materials and workmanship to be provided for fulfilling the requirements of construction according to specifications. Under this programme the contractors will establish a "Quality Control Department" in their design set-up. Consultants shall setup procedures for quality assurance of their own work as per international standards.

i) Contractor Camp, Temporary Access Roads, Workshop Facilities, Material Storage, Batching Plant, Power Facilities etc.

The Consultant shall identify the contractor camp location, temporary access road alignment, quarry location. The Consultant shall carry out the required surveys and investigation to carry out the work. The works shall be carried out with minimum resettlement issues. The Consultant shall design, carry out and perform the construction of the Works, and subject to the approval of the Engineer, will be permitted to construct temporary road ways, camps, buildings and temporary works which he may require for the construction of the Works. If the Consultant wishes to use any land other than as allowed for construction of camps or for any other Contract purposes, the Consultant shall make all necessary arrangements with the owner thereof and shall bear all rentals or other costs connected therewith.

j) Project Accommodation

The Consultants shall design the temporary project accommodation to house the personnel that will be employed in the construction of the Project. The design shall cover all necessary facilities & amenities required during the implementation phase of the Project, including water supply, sewerage disposal, power supply, garbage disposal, street lighting, hospital, office buildings & other support facilities. In addition, the Consultants shall design the permanent project colony for the operating personnel with due attention to the climate conditions at the Project site.

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5.3.5 Environmental Impact Assessment Study and Preparation of Resettlement Action Plan (RAP)

The Consultants shall carry out Environmental Impact Assessment (EIA) at design stage and obtain its clearance from concerned Environmental Protection Agency. The physical conditions of the Project area will be firmed up during the detailed engineering design stage. The aspects of EIA activities but not limited to the following will be considered:

- Aquatic life study
- Fauna and Flora
- Impacts of Water Logging and Salinity in areas adjacent to reservoir
- Water quality study and effects on downstream river channel
- Cadastral survey of the Project affected area
- Institutional framework development for Resettlement Action Plan including development of compensation package based on cadastral survey and community consultation
- Women emancipation from poverty
- Minimum river flows required to maintain ecology of the area
- Evaluation of risks at construction phase measures for disaster risk reduction will be assessed.
- Total cost estimate covering mitigation action, compensation and resettlement cost

The Consultants will advise WAPDA and WAPDA will implement Resettlement Action Plan (RAP).

5.3.6 Costs Estimate, Disbursements Schedule, & Construction Planning

- a) The Consultants shall review and update detailed project costs estimate. Pay items shall be grouped by contracts & shall be broken down into local & foreign cost components. Resources costs shall be thoroughly reviewed & checked against costs for similar type of works or supplies.
- b) Construction & installation program for each contract shall be developed on the basis of a detailed simulation study of all activities involved & of the construction techniques planned. These programs shall take into consideration interference from other construction or erection activities, access availability, materials, balances, normal construction efficiencies, meteorology & river regime.
- c) Construction & installation program developed for each contract shall then be integrated into a general CPM grid, which shall incorporate all contracting activities, supplies, civil works & equipment erection in such a way as to maintain an appropriate order of precedence. The program should count for the regional seismicity and security situation of the area.
- d) The Consultants shall work out the most appropriate construction facilities arrangement, including material flow analysis & shall design the necessary access roads.

- e) The Consultants shall review and update PC-I Proforma for implementation of the Project.
- f) Detailed Project Implementation Plan (DPIP) and Detailed Cost Estimation may be proposed using latest methods / tools such as MS Project, Primavera etc.

5.3.7 Bidding Documents

Specifications of the components of the Project will be reviewed and updated including civil works, electrical and mechanical equipment. After the detailed engineering design & preparation of specification of works, the Bidding documents shall be undertaken by the Consultants at the level of International Competitive Bidding (ICB). The contract packages for bidding purposes shall be agreed beforehand between WAPDA and the Consultants. The works can be grouped in suitable number of packages. For all these packages the following will be prepared:

- General Conditions of Contract
- Particular Conditions of Contract
- Technical Specification
- Special Provisions
- Bill of Quantities
- Drawings etc.

Consultant shall ensure the following aspects of the bidding documents:

- Completeness of documents in all aspects.
- Documents are clear, concise and in an unambiguous language.
- All provisions, clauses, definitions and terms are consistent throughout the document.
- The documents clearly define the scope of work.
- The documents have clear Dispute Resolution Mechanism.
- The documents meet with requisite International Standards.

6 Staff Inputs (Consultants)

6.1 Qualification Requirements for the Key Experts

Consultants will assign adequately qualified key personnel's to carry out the study as described in TOR. Key experts should possess the qualifications and experience as mentioned below:

6.1.1 Project Manager / Team Leader: He/ She should have Master's Degree in Civil Engineering from a recognized university. Ph.D. qualification in related engineering discipline shall be given additional weightage. The incumbent should have specific experience of working in senior techno-managerial position with at least 5 years as team leader on dams & hydropower Projects. The incumbent should have minimum experience of 25 years with at least 15 years in design of barrage / dams & hydropower projects. The incumbent should be able to lead the team of Consultants and assist WAPDA in timely completion of the services with a quality output.

6.1.2 Expert (Geotechnical): He/ She should have Master's Degree in Geotechnical Engineering from a recognized university. Ph.D. qualification in related disciplines will

be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in geotechnical design of barrage / dams & hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Geotechnical).

- 6.1.3 Expert (Hydraulic Design):** He/ She should have Master's Degree in Hydraulic / Water Resource Engineering with civil engineering as basic graduation degree from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in hydraulic structure design of barrage / spillway & hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Hydraulic Design).
- 6.1.4 Expert (Dam / Dyke Design):** He/ She should have Master's Degree in Civil Engineering with civil engineering as basic graduation degree from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in design of embankment dams. The incumbent should have at least 5 years of working experience as Expert (Dam / Dyke Design).
- 6.1.5 Expert (Hydrology & Sedimentation):** He/ She should have Master's Degree in Hydrology or Water Resources Engineering from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in dams & hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Hydrology & Sedimentation).
- 6.1.6 Expert (Structural Design):** He/ She should have Master's Degree in Structural Engineering discipline from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in design of dam & hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Structure Design).
- 6.1.7 Expert (Hydropower):** He/ She should have Master's Degree in Hydropower / Water Resource Engineering from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years in design of hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Hydropower).
- 6.1.8 Expert (Electrical):** He/ She should be a graduate in Electrical Engineering from a recognized university. Higher qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years' experience in design of dam/hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Electrical).
- 6.1.9 Expert (Mechanical):** He/ She should have Master's Degree in Mechanical Engineering from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years on the in design of barrage gates / mechanical

plant equipment/ hydraulic steel works of dams/ hydropower projects. The incumbent should have at least 5 years of working experience as Expert (Mechanical).

6.1.10 Expert (Environment): He/ She should have Master's Degree in Environmental Engineering or related engineering discipline from a recognized university. Ph.D. qualification in related disciplines will be given additional weightage. The incumbent should have at least overall experience of 20 years with 15 years working on similar assignments. The incumbent should have at least 5 years of working experience as Expert (Environment).

6.1.11 Expert (Contracts): He/ She should be a graduate in civil engineering. Higher qualification in construction/ contracts management or other related discipline will be given additional weightage. The incumbent should have at least 20 years overall experience with minimum of 15 years handling of contracts / claims of related assignments. The incumbent should have at least 5 years of working experience as Expert (Contracts) of handling contracts/claims.

7 Man Months Required

Estimated Key Experts' time-input: **112 Man-months**

Estimated Non Key Experts time-input: **388 Man-months**

Total Estimated Key Experts & Non Key Experts time-input: **500 Man-Months**

Consultants should include **10 Man-Months** input of Foreign experts as per given in TOR and point system for the evaluation.

8 Additional Services

8.1 Regarding any services additional to those specified above, Consultants, if specifically requested by WAPDA, shall;

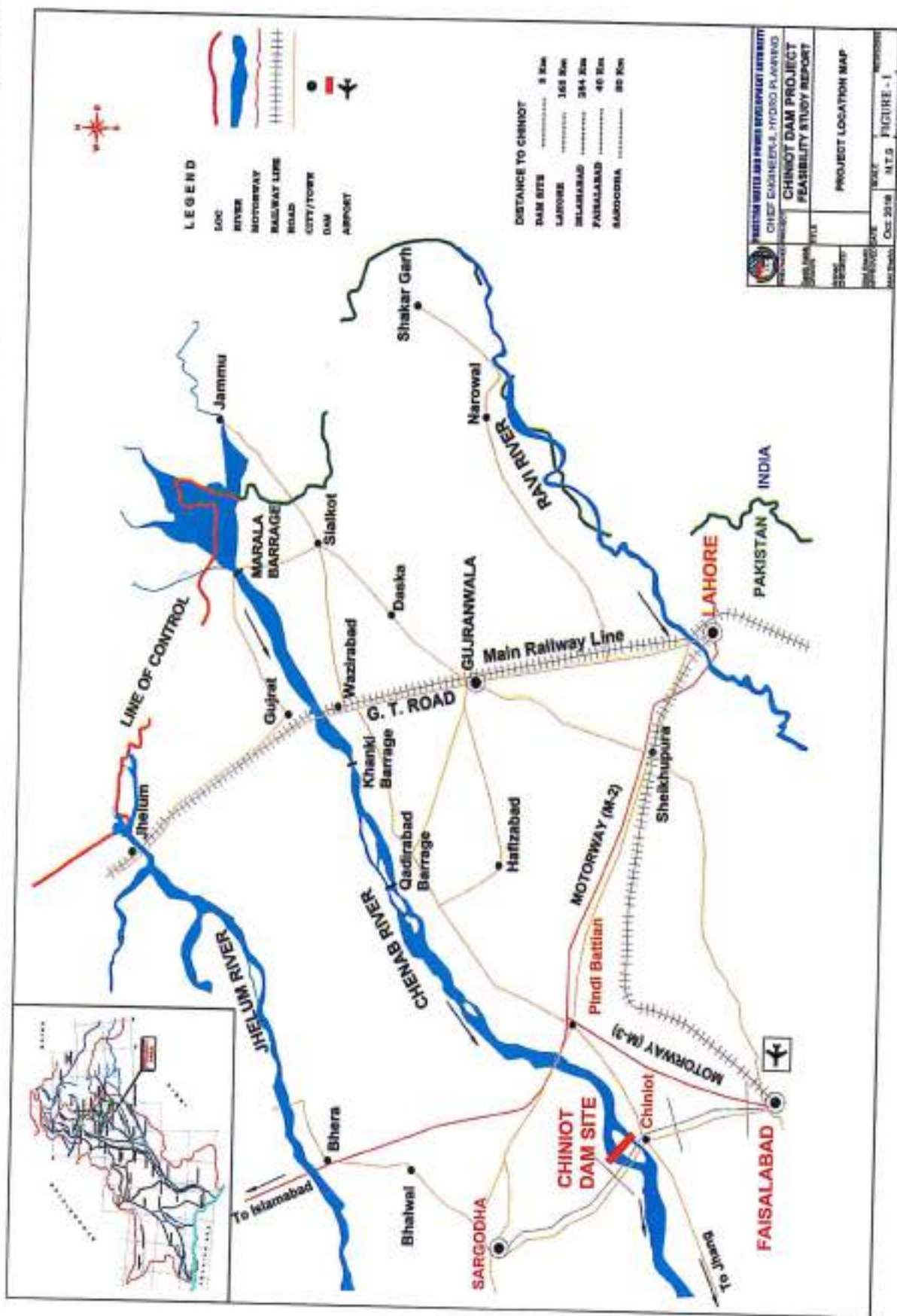
Provide special technical advice on aspects of the project that are not normally required / provided during the studies. However, any services which are not specifically mentioned in the TOR above but are allied and essential for the effective implementation and completion of the Project will also be provided by Consultants and will be deemed to have been part of this TOR.

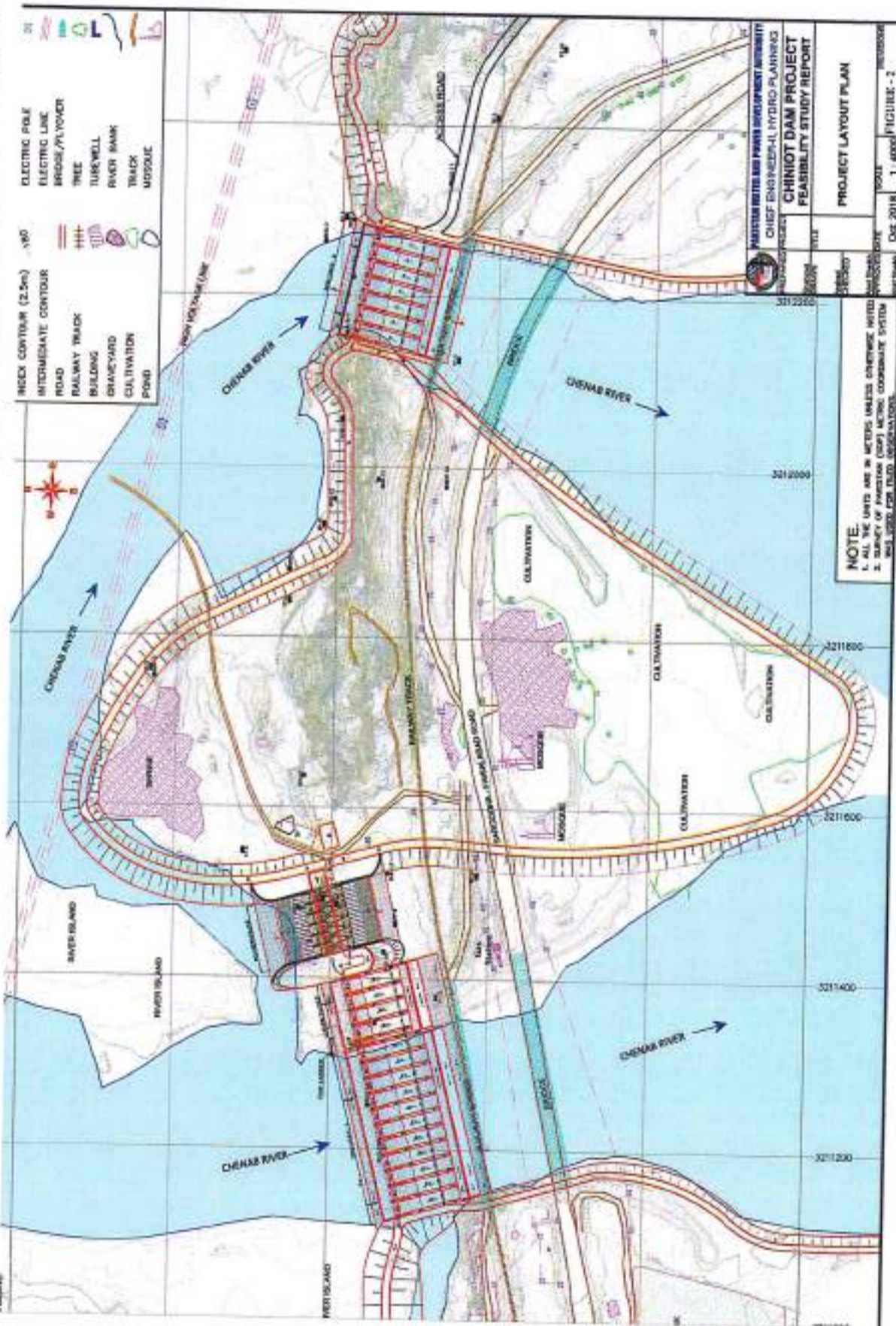
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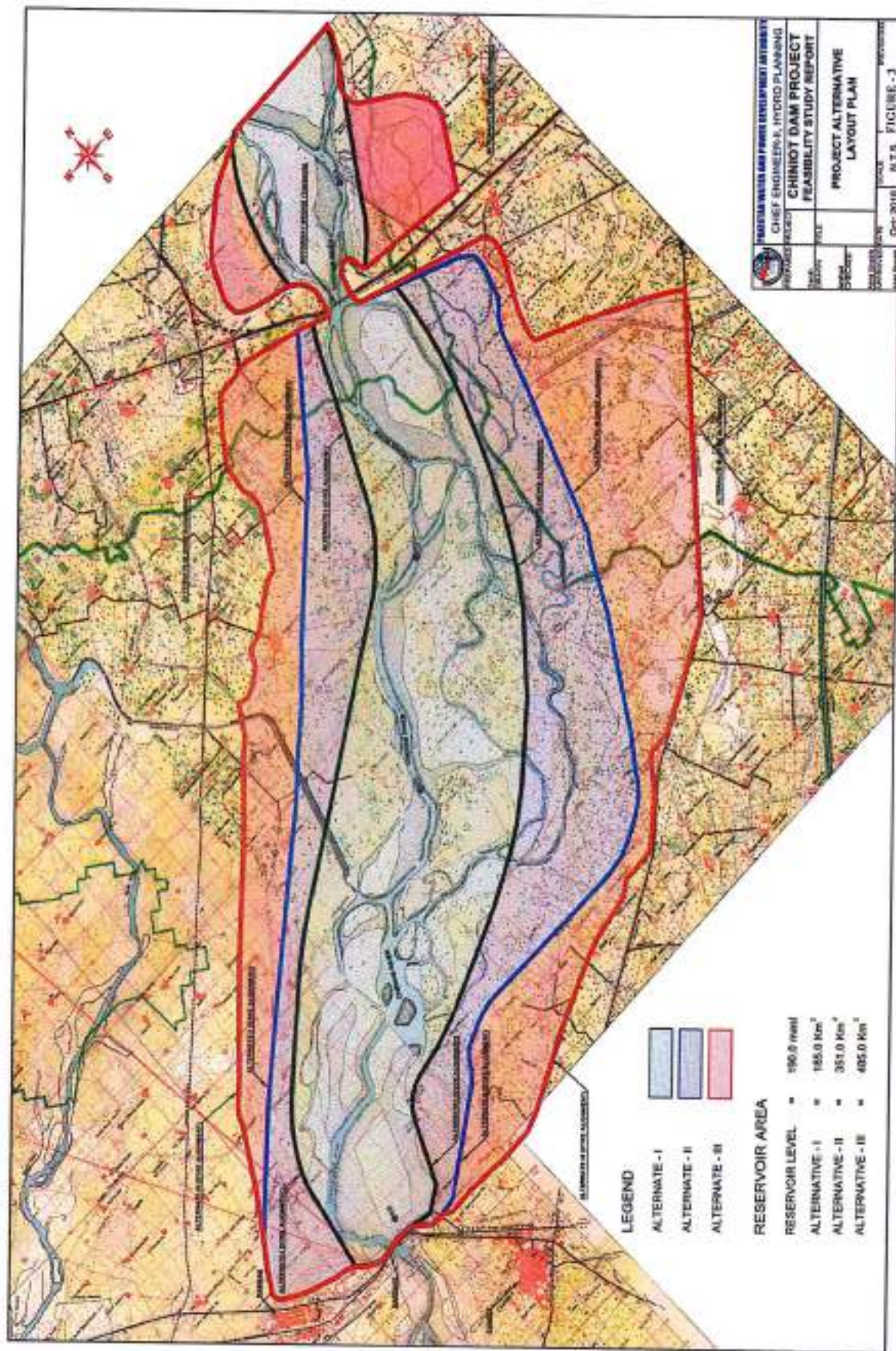
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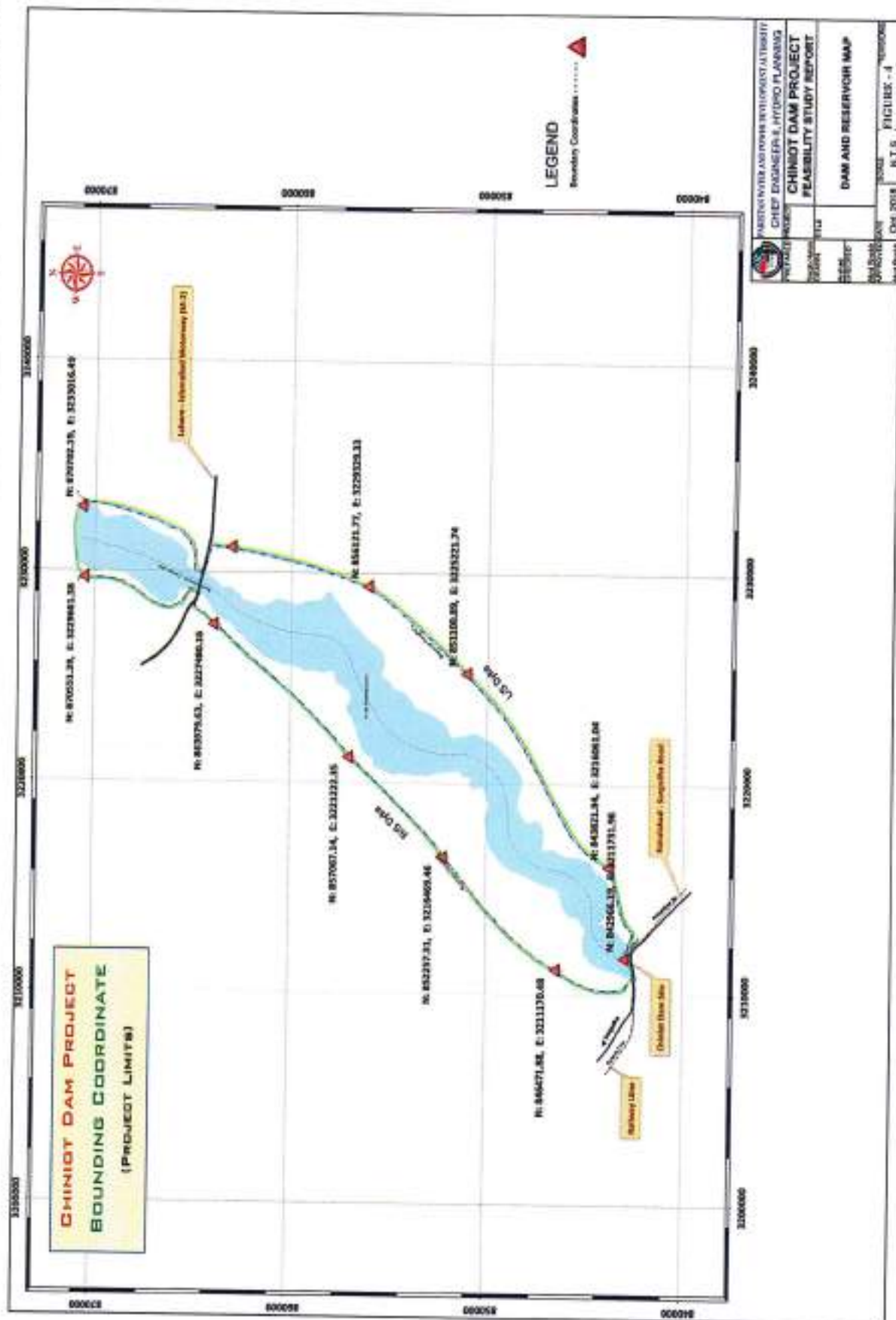
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ANNEX-II: CHECKLIST AND PROFORMA

CHECKLIST FOR PHYSICAL BASELINE CONDITIONS**PHYSICAL ENVIRONMENT****a. Type of area**

- Mountainous
- Arid
- Semi-arid
- Forest
- Dense forest
- Populated
- Densely populated

Any other _____specify)

b. Landuse of area

- Agriculture
- Barren
- Built-up
- Desert
- Access road
- Wetland

Any other _____(specify)

c. Geological conditions

- is the geology of the area rocky _____
- is the origin of rocks sedimentary/igneous/metamorphic
- any other _____ (specify)

d. Seismology

- is there any record of earthquakes in the past 50 years
- presence of faults/fractures
- any other details _____ (specify)

e. Topography & soils

- are the soils mixtures of sand /silt/clay/gravel/rock/clayey silt _____
- any other _____ (specify)

Proposed site	Soil description

Other features

- Drains
- Hills
- Plain Areas
- Any other _____ (specify)

f. Climate historical data from nearest weather station ()

Temperature	Wind	Relative humidity	precipitation	Evapotranspiration

g. Surface and Ground water**Source of surface water**

- Rivers
- Hill Torrents
- Surface Ponds
- Any other _____ (Specify)
- Surface water quality visual? _____

Sources of ground water

- Wells
- Hand Pumps
- Tube wells
- Any other _____ (Specify)
- Quality and Approx. depth _____

g. Air Quality

- Is the area visually pollution free _____
- Identification of point sources (Industries Refineries, power plants) or any other _____ (specify)
- Identification of non- point sources (cars, trucks, tractors) or any other _____ (specify)

h. Liquid effluents

- liquid effluents sources (industries/household/commercial)
- if any other _____ (specify)
- Identification of any disposal source for waste water from plant _____

Describe Details**i. Solid Waste**

- Types of waste (Municipal, commercial, institutional, agriculture industrial, biomedical) any other _____ (Specify)
- Waste Disposal facility (Landfill, dumping stations)
- Approx. waste generated (tons/day) _____
- Responsible solid waste management authority? _____
- Waste management (Good or Poor) _____ if poor, specify the reasons (lack of awareness among people, authority is not responsible enough)

j. Noise

- Sources of noise (traffic/industry or other _____)(Specify)
- Areas under high noise pollution? _____

k. Natural Hazards

- Does the project area has any previous records of flooding _____
- Are there any records of drought _____
- Any other _____(Specify)

l. Nearby Infrastructures in Study Area

Sr. No.	Infrastructure	Details
1.	Transmission Line Crossing	
2.	Surface Water Body	
3.	Water Supply Line	
4.	Roads	
5.	Quarry Area	
6.	Developmental Project	
7.	Sensitive Receptor	
8.	Other (Specify)	

Sr. No.	Significant Impacts	Details

ECOLOGICAL CHECKLIST FOR EIA

	Data Sheet No.		Date	/ /	Expert Name			
	Location/Village				District		RD/KMs.	
	BIODIVERSITY FEATURES							
(i)	Vegetation Description							
	Forests (Trees, Herbs, Shrubs)	Yes/No	Ecological Zone/Forest Type			Legal Status		
	Species Composition	ROW			No of Trees (Possibly Affected)			
	Diameter Class	0-15 cm	16-30 cm	31-45 cm	46-50 cm	51-65 cm	66-80 cm	81-95cm Above 95 cm
	Rangeland	Yes/No	Agricultural Land	Yes/No		Crop Type		
(ii)	Wildlife/ Fauna Description							
	Wildlife Protected Areas (Notified or Sensitive)							
	Mammals	Yes/No						
	Reptiles	Yes/No						
	Amphibians	Yes/No						
	Aquatic Habitat	Yes/No						
	Avifauna/Birds	Yes/No						
	Natural Wetland	Yes/No						
	Endangered Species	Yes/No						
	Other Biodiversity Features							
	Remarks/Comments:							

QUESTIONNAIRE FOR SOCIOECONOMIC BASELINE SURVEY

Date. -----

Photo No. -----

ID No. -----

1. IDENTIFICATION

1.1 Name of Respondent _____

1.2 Father's Name _____ 1.3 Cell. No: _____

1.3 Permanent Address of the Respondent:

Village: _____ Town _____ Tehsil _____ District: _____

1.5 Located _____ Caste _____

1.6 Demographic Profile of Respondent (Children up to 10 yrs (#): M _____, F _____ T _____)

Sr. No.	(a) Relationship with Respondent (See codes)	(b) Sex (See Codes)	Age (Yrs.)	(c) Education (See Codes)	(d) Name of Business/ Occupation (See Codes)		Income from Business/ Occupation (Rs. / Annum)		(e) Health Condition
					Main	Secondary	Main	Secondary	
1	Self								
2									
3									
4									
5									
6									
7									
8									
9									
10									

Demographic Codes:

a) Relationship: 1=Self, 2=Wife, 3=Son, 4=Daughter, 5=Father, 6=Mother, 7=Brother, 8=Sister, 9=Grand Father, 10=Grand Mother, 11=Sister in Law, 12=Nephew, 13=Father-in-Law, 14=Mother-in-Law, 15=Niece, 16=Uncle, 17=Aunty, 18= Son-in-law, 19= Daughter, 20= S. in Law, 21=D. in Law, 22= Other _____

b). Sex: 1=Male, 2=Female, 3= Transgender

c). Education: 1= Primary 2= Middle 3= Metric, 4= Intermediate, 5= Graduate, 6= Post Graduate, 7=Law, 8=Engineer, 9=MBBS, 10=Technical Diploma, 11=Dars-e-Nizami, 12=Can Read Quran, 13= Can Insert Signatures, 14= Illiterate

d). Occupations: 1=Agriculturist, 2=Shopkeeper, 3=Hotel, 4=Mechanic, 5=Barber, 6=Butcher, 7=Cobbler, 8= Business, 9= Govt. Servant, 10=Private Servant, 11=Labor, 12=Student, 13=House-Maid, 14=Housewife, 15=Advocate, 16=Livestock/Dairy, 17=Fishing, 18=Driver, 19=Health Related, 20=Teaching, 21=Entertainer, 22=Gone Abroad, 23=Retired/Old, 24=Other _____

e). Health: 1= Good, 2= Average, 3= Poor

1.8) Language Spoken _____ Religion _____

1.9) Type of family system: 1.Joint: _____ 2.Nuclear _____

2. AVERAGE MONTHLY EXPENDITURE ON FOOD AND NON- FOOD ITEMS (Rs.)

Items	Expenses
Food	
Non-food	
Utilities	
Health	
Education Care	
Other	

3. HOUSING CONDITIONS

3.1 Personal _____ Rented _____ Other _____

3.2 Type of Structure

(i) Katcha _____ (ii) Semi Pacca _____ (iii) Pacca _____

4. ACCESS TO SOCIAL AMENITIES (TICK)

Social Amenities	Available (Yes-No)	Satisfactory (Yes-No)	Reasons for Not Satisfaction
Electricity			
Gas			
Water Supply			
Water Filtration plant			
Telephone			
Sewerage/Drainage			
Hospital			
School (Boys-Girls)			
College (Boys-Girls)			
University (Boys-Girls)			
Religious Institution			
Road			
Source of Cooking if Sui Gas is not available			

5. CREDIT UTILIZATION

5.1 Have you obtained credit during last year? Yes ___ No ___ if yes, source of credit:

a) Formal b) Informal

5.2 Please write the name of relevant source

Formal source (s) _____

Informal source (s) _____

Purpose of Loan _____

6. WOMEN'S PARTICIPATION AND ROLE IN DIFFERENT HOUSEHOLD ACTIVITIES**6.1 Participation and Decision Making (Tick)**

Activities	Participation Extent (%)	Decision Making Extent (%)
Household activities		
Child caring		
Farm/Crop activities		
Livestock rearing		
Sale & Purchase of properties		
Social obligations (marriage, birthday & other functions)		
Local representation (councilor/political gathering)		

7. SOURCE OF DRINKING WATER:

1. Public Water Supply 2. Hand Pumps 3. Borehole 4. Any other ____

7.1 Quality of water: Good _____ Poor: _____

If Poor (Reason) _____

8. DOES ANY NGO EXIST IN YOUR AREA?

Yes _____ No _____

If yes, Name of NGO -: _____

8.1 Are you member of NGO? yes----- No----- if yes,

Role in NGO-: _____

9. PERCEPTION OF RESPONDENTS FOR ACTION ASSOCIATED WITH THE PROJECT:

Possible impacts/effects of the Project	Increase	Decrease
Employment opportunities		
Industrial Development Opportunities		
Living standard		
Unemployment		
Income generating activities		
Improvement in transport		
Mobility (Access to Resources)		
Physical Displacement		
Other specify		

10. ANY OTHER HISTORICAL / ARCHEOLOGICAL MONUMENT IN OR NEARBY THE PROPOSED PROJECT AREA?

1. Yes _____ 2. No _____ If yes, please specify

Name _____ Type _____ Distance from the proposed project _____

11. MAJOR DISEASES COMMON IN THE PROPOSED PROJECT AREA

12. IN YOUR OPINION, WHAT ARE SOME PRESSING NEEDS OF THIS AREA?

13. GENERAL REMARKS OF THE RESPONDENT

14. GENERAL OBSERVATIONS OF INTERVIEWER

Name of Interviewer: _____ **Date:** _____

**ANNEX-III: ENVIRONMENTAL MONITORING, SAMPLING
AND TESTING REPORTS**



ENVIRONMENTAL MONITORING REPORT DECEMBER- 2023

Water and Power Development Authority (WAPDA)

Project Name: Feasibility Study of Chiniot
Dam Project

Consultant: National Engineering Services
Pakistan Private Limited (NESPAK)

Location: Tehsil and District Chiniot,
Faisalabad Division

Prepared by: Environmental Services Pakistan
(ESPAK)

Web: www.espak.com.pk

Email: info@espak.com.pk



Validation # _____

Validation for Stack & Ambient Monitoring / Sampling

Dated: _____

Emission Monitoring under CTM-34 or OTM-39			
Facility Name & Address	Feasibility Study of Chiniot Project	No of Stacks / Sampling Point	
Phone	Chiniot, Punjab	AA-5	
Industry Category			
Analyzer Model & Make Environmental Scientific			
Average stack emission Values of CO, NOx (in mg/nm3)			
Excess Air / Excess Oxygen (%age):-			
Analyzer exposed for Ramp-Up phase to the sample gas for 5 minutes	Yes	NO	NA
Analyzer flow rate and EC temperature monitored during calibration and testing	Yes	No	NA
Test Data Phase of sample gas recorded with 15 second interval	Yes	No	NA
All key requirements to ensure QA/QC complied for said EPA approved Method	Yes	No	NA
Particulate Matter (PM) Monitoring / Sampling under USEPA Method 5 / 17			
Model & Make of Iso-kinetic PM Assembly			
The PM sampling train is complete as per Method 5 & 17	Yes	No	NA
Leak Test performed prior to sampling	Yes	No	NA
Field data Sheet for PM Sampling filled during PM sampling	Yes	No	NA
Data for determining of "K" factor & DGM "Y" Factor filled during sampling	Yes	No	NA
All method key requirements during sampling were complied to ensure QA/QC	Yes	No	NA
Filter of Particulate matter is suitable for metal Testing	Yes	No	NA
SOx sampling as per Method 8 (Thorin Indicator Method)			
The right absorbent solution are available for SOx Sampling	Yes	No	NA
The equipment is capable to maintain flow rate @ 2.0LPM or as per method 8 requirement	Yes	No	NA
Sampling for SOx is performed as per method	Yes	No	NA
Ambient Air Quality Monitoring by Automatic Monitors for CO, O3, SO2, NOx, PM2.5 & PM10			
In case of continuous monitoring at a site, One Point QC Check Single analyzer & zero/span check is performed every 14 days.	Yes	No✓	NA
The CE of NOx analyzer is ensured to be maintained within 96% - 104.1%	Yes	No✓	NA
Zero/span check is performed prior to starting ambient monitoring	Yes✓	No	NA
All key requirements for Critical & Operational Criteria for ambient air monitoring by automatic monitors were complied during monitoring	Yes✓	No	NA
The measuring techniques of monitors comply PEQS	Yes✓	No	NA
Ambient Air Sampling of SPM, PM10, Pb by High Volume Sampler			
In case of Sampling for SPM through samplers, the flow rate of sampler complies PEQS (1.1m3/min).	Yes✓	No	NA
Calibration of Sampler performed prior to sampling	Yes✓	No	NA
Vehicular Emissions & Noise Measurement			
Sampling of Vehicle emissions and noise measurement have been performed as per method and SOPs	Yes	No	NA

Remarks (If Any):- *Online*

Signature

Muhammad Ameer Hamza
Research Assistant
Environment Protection Agency
Punjab Lahore

Dated

6 to 12/12/2023

Signature

Muhammad Aslam
Environmental Services
EPD
Punjab



ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF THE PUNJAB
National Hockey Stadium, Gate No. 08
Gaddafi Stadium Complex, Lahore



Validation # _____

Validation for Wastewater & Drinking Water

Dated: _____

online

Project / Unit Name with Address and contact details		Feasibility Study of Chiniot Project Chiniot, Punjab		Sampling Point WW-2, DW-5, SW-5	
Validation No					
Name of Private Lab		ESPAK			
Waste Water (WW) Treatment facility		Drinking Water (W) Treatment Facility			
Primary Secondary Tertiary NA		Chemical RO ☒ NA			
Total WW collected Sample		Total Collected Drinking water samples			
Sample Tag for testing parameter is assigned on sample container		Yes ☒		NO ☐ NA	
Sample is preserved properly for each testing parameter		Yes ☒		NO ☐ NA	
Sample size is adequate for testing the target parameters		Yes ☒		NO ☐ NA	
Wastewater flow Measurement performed to ensure sample representativeness		Yes ☒		NO ☐ NA	
No. of Waste Water outlets 02	Waste Water Flow m ³ /hr from each outlet (Optional)	Water intake m ³ /hr (Optional)	Water Mass balance compiled during sampling (Optional)	Sample Type WW+SW+DW	
		Yes No		Grab ☒ Composite	
Parameter	Matrix W WW	Container	Sample Size	Preservation	Yes NO NA
Coliform, Total or Fecal	☒ ☐	Sterile Container	100 ml.	Refrigerate 6 C	☒ ☐ ☐
Coliform, Total or Fecal, Chlorinated Water	☒ ☐	Sterile Container	100 ml.	0.008% Thiosulphate & cooled 6 C	☒ ☐ ☐
Color, Turbidity	☒ ☐	P.G	300 ml.	Cool 6 C	☒ ☐ ☐
Hardness, Total	☒ ☐	P.G	300 ml.	HNO ₃ to pH < 2	☒ ☐ ☐
Nitrogen, Nitrate + Nitrite, Phenolic Compounds, Oil & Grease, COD, NH ₃	☒ ☐	P.G	2000 mL	H ₂ SO ₄ to pH < 2, Cool 6C	☒ ☐ ☐
Metals, General	☒ ☐	P.G Rinsed I.I HNO ₃	500 mL	HNO ₃ to pH < 2	☒ ☐ ☐
Cyanide, Total	☒ ☐	P.G	500 mL	NaOH to pH > 12, Cool 6C	☒ ☐ ☐
Pesticides, General	☐ ☐	Glass	1 Liter	Cool 6 C	☐ ☐ ☐
Field Parameters*					
Field parameter		pH meter, Model Make	Measurement Method	Calibrated In Field	Measured value
pH		pH Meter	HANA HI-2898107	Yes ☒ NO ☐	7.8
Temp				Yes ☒ NO ☐	24.4°C
Cl					

Signature

Muhammad Ammar Hamza
Muhammad Ammar Hamza
Research Assistant
Environment Protection Agency
Punjab Lahore

Dated
6 to 12/12/2023

Signature

Muhammad Aslam
Muhammad Aslam



DISCLAIMER

This report is produced in compliance with the client request of NESPAK for Chiniot Dam project. The information contained in this report was collected and produced from site visit, monitoring and analysis data. The information provided and contained in this report is to the best of our knowledge, correct and up to date. Environmental Services Pakistan Pvt Ltd (ESPAC) accepts no responsibility for changes made to this document once report is submitted to the client.

Signature: _____

Chief Chemist: Muhammad Arfan

Dated: December 28, 2023

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ABBREVIATIONS

ISO:	International Organization for Standardization
APHA:	American Public Health Administration
BDL	Below Detectable Limit
CO:	Carbon Monoxide
EPA	Environmental Protection Agency
NO:	Nitrogen Oxide
NO ₂ :	Nitrogen Dioxide
NO _x :	Oxides of Nitrogen
PEQS:	Punjab Environmental Quality Standards
PEPA:	Pakistan Environmental Protection Act 1987
PM:	Particulate Matter
SO ₂ :	Sulphur Dioxide
SOP:	Standard Operating Procedures
USEPA	United States Environmental Protection Agency
ESPAK:	Environmental Services Pakistan
BOD:	Biological Oxygen Demand
COD:	Chemical Oxygen Demand

UNITS

ppm:	Parts per Million
mg/l	Milligram per Litre
mg/Nm ³ :	Milligram per Normal cubic meter

CHAPTER# 1. INTRODUCTION

1.1 Introduction of Project

The proposed 17 m-high zoned earthfill embankment dam, which is to be located in Tehsil and District Chiniot, Faisalabad Division, Punjab, is designed to store surplus flows from the Chenab River to meet downstream irrigation water requirements as well as generate electricity for the national grid. The reservoir will be bound by left and right sides dykes/embankments to create a gross storage capacity of 1110 million m³ (0.9 MAF) and a live storage capacity of 1048 million m³. The dam is projected to generate 80 megawatts of cheap and environment friendly electricity.

The government would provide Rs 50 million, under the public sector development programme (PSDP), whereas Rs 66.33 million would be provided by WAPDA's own resources.

1.2 Introduction of Environmental Lab

Environmental Services Pakistan Pvt Ltd – ESPAK is a well-established laboratory certified for IMS ISO9001:2015, ISO14001:2015, ISO45001:2018 and ISO17025 is offering a wide range of environmental monitoring and testing, consultancy services throughout Pakistan. Certified from Environment Protection Department EPD Punjab and Pak EPA. ESPAK provides a wide range of environmental testing capabilities including Drinking Water Analysis, Waste Water Analysis, Metal Tracing using ICP- AES, Stack Emission Monitoring, Ambient Air Monitoring, Vehicle Emission Monitoring, Air and Noise Mapping, and other field monitoring services.

Company address: Office No. 731, Block 2, Sector D1, Shah Jilani Road, Township, Lahore, Pakistan

Contact: +9242 3515 4012-16, +92 312 084 9999

1.3 Objectives of Study

The objective of this study is to:

- Comply with the regulatory requirements of the project;
- Assessing the impact of project operations on surrounding areas
- Analyze water quality.

1.4 Scope of Services

The environmental monitoring was conducted at advised locations for following environmental parameters.

- Ambient Air Monitoring

- Noise Level Monitoring
- Drinking Water Sampling & Analysis
- Surface Water Sampling & Analysis
- Waste Water Sampling & Analysis

Table 1-1: Scope of Services

Sr. No.	Parameters	Sampling Duration	Quantity
1.	Ambient Air Monitoring	24 Hours Sampling	05
2	Noise Level Monitoring	24 Hours Sampling	05
3	Drinking Water Sampling	Grab Sampling	05
4	Surface Water Sampling	Grab Sampling	05
5.	Waste Water Sampling	Grab Sampling	02

1.5 Monitoring Duration

The environmental monitoring was conducted at advised locations for following environmental parameter through EPA Certified Environmental Laboratory; Environmental Services Pakistan (ESPAK) from 06-12-2023 to 13-12-2023.

1.6 Monitoring Team

1.6.1 Field Team

Table 1-2: List of Field Team

Sr. No.	Name	Designation	Qualification	Experience
1.	Mehmood Aslam	Field Analyst	MS. Environmental Sciences	02 Years
2	Usman Muddasar	Field Analyst	BS Chemistry	1.5 Years

1.6.2 Laboratory Team

Table 1-3: List of Laboratory Team

Sr. No.	Name	Designation	Qualification	Experience
1.	Muhammad Arfan	Chief Chemist	M.Phil Chemistry	20 Years
2.	Muhammad Shahid	Lab Analyst (Chemist)	M.Sc. Chemistry	7 Years
3.	Khizra Bano	B.Sc. Biological Sciences	Lab Analyst (Micro Biology)	2 Years
4.	Abdul Aziz	Asst. Lab Analyst	B.S Chemistry	1 Year
5.	Ghulam Mustafa	Asst. Lab Analyst	B.S Chemistry	1 Year
6.	Muhammad Riaz	Asst. Lab Analyst	B.S Chemistry	6 Months
7	Samahir Khalid	Trainee Lab Analyst	M Phil. Chemistry	6 Months
8.	Saima Riaz	Trainee Lab Analyst	M Phil. Chemistry	6 Months

1.7 Project Monitoring Points

Locations for monitoring of Ambient Air and noise level environmental parameters are following.

Table 1-4: List of Ambient Air and Noise Sampling Locations

Sr. No.	Monitoring Locations	Coordinates
I.	Chenab Nagar, Chiniot	31.754051°N, 72.93828°E
II.	Basti Pathan, Chiniot	31.750185°N, 72.965444°E
III.	Tailwala, Chiniot	31.944349°N, 73.146107°E
IV.	Basti Mallah, Chiniot	31.849522°N, 72.120593°E
V.	Langer Makhdoom, Chiniot	31.892546°N 73.056438°E

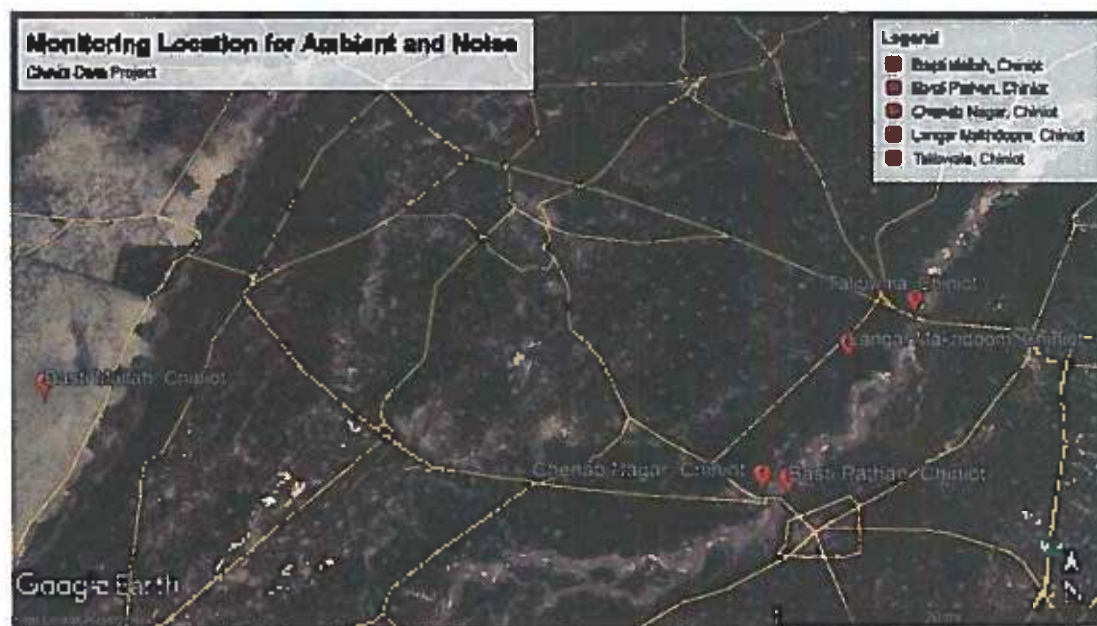


Figure 1-1: Locations of Ambient Air and Noise

Table 1-5: List of Drinking Water Sampling Locations

Sr. No.	Sampling Locations	Sampling Methodology
I.	Drinking Water from Hand Pump of Langer Makhdoom (GPS: 31.748396°N, 72.958912°E)	Grab
II.	Drinking Water from Hand Pump of Talibwala (GPS: 31.943828°N 73.145538°E)	Grab
III.	Drinking Water from Hand Pump Basti Patthan (GPS: 31.849818°N 73.120799°E)	Grab
IV.	Drinking Water from Hand Pump of Kot Muhammad Yar (GPS: 31.89211°N 73.054876°E)	Grab
V.	Drinking Water from Hand Pump of Muslim Colony, Changrainwala (GPS: 31.750495°N 72.9436°E)	Grab

Table 1-6: List of Surface Water Sampling Locations

Sr. No.	Sampling Locations	Sampling Methodology
I.	Surface Water from Chenab River near Chenab Nagar (GPS: 31.768167°N 72.973083°E)	Grab
II.	Surface Water from Chenab River near Basti Patthan (GPS: 31.936665°N 73.146742°E)	Grab
III.	Surface Water from Chenab River near Talibwala (GPS: 31.944845°N 73.147034°E)	Grab
IV.	Surface Water from Chenab River near Kot Muhammad Yar (GPS: 31.895323°N 73.057683°E)	Grab
V.	Surface Water from Chenab River near Changrainwala (GPS: 31.848633°N 73.12083°E)	Grab

Table 1-7: List of Waste Water Sampling Locations

Sr. No.	Sampling Locations	Sampling Methodology
I.	Wastewater from Stream of Kerseh Sheik (GPS: 31.849833°N 73.12083°E)	Grab
II.	Wastewater from Stream of Həsit Khwa (GPS: 31.849058°N 73.028088°E)	Grab

CHAPTER# 2. METHODOLOGY

Following is the brief description of methodology adopted for this environmental monitoring:

2.1 Survey Planning

The project started with a planning of project activities with a management of NESPAK

2.1.1 Identification of Monitoring Locations

NESPAK provided location of project sites. Following criterion was used to finalize the sampling locations on the given site.

- Area where there will be project activities;
- Present environmental conditions at the site.

2.2 Sampling and Analysis Methods

The sampling and testing methods are given in following sections of the report.

2.1 Ambient Air Quality Monitoring

ESPAK Mobilized laboratory is used to measure the ambient air and noise level at mention site. Ambient air quality monitoring was conducted at advised sampling locations to assess the concentration of pollutants (Carbon monoxide, Oxides of Nitrogen (NO, NO₂), Sulphur dioxide (SO₂), Ozone, PM_{2.5}, PM₁₀, and SPM). Selection of monitoring locations was based on the environmental factors including wind direction on the particular day and amount of turbulence in the air etc.

Reference method used for the measurements are included as Table 2.1 while the description is provided in subsequent sections.

Table 2-1: Methodology of Ambient Air Quality Monitoring

Air Pollutant	Monitoring Technique	Instrument Used	Reference Method	Sampling Duration
Carbon monoxide (CO)	Non-Dispersive Infrared Absorption (NDIR)	Thermo Scientific CO Analyzer	40 CFR Part 50, App. C (US-EPA)	8 hours
Sulfur Dioxide (SO ₂)	UV Fluorescence (UVF)	Thermo Scientific SO ₂ Analyzer	EQSA-0197-114 (US-EPA)	24hours

Air Pollutant	Monitoring Technique	Instrument Used	Reference Method	Sampling Duration
Oxides of Nitrogen	Reduced Pressure Chemiluminescence (CLD)	Thermo Scientific NO _x Analyzer	40 CFR Part 50, App F (US-EPA)	24 hours
Ozone O ₃	Non-Dispersive UV Absorption (NDIR)	Thermo Scientific O ₃ Analyzer	40 CFR Part 53	1 Hour
Particulate Matter (PM ₁₀ , PM _{2.5})	Beta Ray Absorption Method	Met one BAM	40 CFR Part 50, App J (US-EPA)	24 hours
Particulate Matter (SPM)	Gravimetric Method	High Volume Air Sampler	40 CFR Part 50, App J (US-EPA)	24 Hours

2.1.1 Carbon monoxide (CO)

Carbon monoxide (CO) was monitored using Thermo-Scientific. The Thermo Scientific CO Analyzer measures CO concentration using a non-dispersive infrared (NDIR) absorption method that is based on the nature of CO in that it absorbs special infrared light. Continuous data was recorded for 24 hr.

2.1.2 Sulphur Dioxide (SO₂)

Sulphur dioxide was monitored using Thermo Scientific SO₂ Analyzer. The Thermo Scientific SO₂ Analyzer measures SO₂ using UV fluorescence method that operates on the principle that when the SO₂ molecules contained in the sample gas are excited by ultraviolet radiation they emit a characteristic fluorescence in the range of 220- 240 nm. This fluorescence is measured and the SO₂ concentration is obtained from changes in the intensity of the fluorescence. Continuous data was recorded for 24 hr.

2.1.3 Oxides of Nitrogen

Oxides of Nitrogen (NO_x) were monitored using Thermo Scientific NO_x Analyzer. The analyzer measures NO, NO₂ and NO_x using chemiluminescence (CLD) method with the help of chemical reaction between NO₂ and O₃. Continuous data was recorded for 24 hr.

2.1.4 Ozone O₃ Measurement Analyzer

Sulphur dioxide was monitored using Thermo Scientific O₃ Analyzer. Sampling was conducted for period of 1 hour at identified sampling locations. The analyzer automatically measures and records ozone concentration levels (in milligrams or micrograms per cubic meter) using the industry-proven principle of non-dispersive UV absorption.

2.1.5 Particulate Matter (SPM, PM₁₀ and PM_{2.5})

Particulate matter concentration in terms of PM₁₀ and PM_{2.5} was monitored in the ambient air with the help of Met one continuous particulate monitor BAM 1020. PM₁₀ and PM_{2.5} Sampling was conducted for period of 24 hours at identified sampling locations. The BAM 1020 automatically measured and recorded airborne particulate concentration levels (in micrograms per cubic meter) using the industry-proven principle of beta ray attenuation.

Suspended Particulate Matter (SPM) was measured through gravimetric sampling method by using of high-volume air sampler. The sampling continues for 24 hours at identified sampling locations. For this purpose, fiber glass filters were used to collect the SPM. The filters were stored and transported to ESPAK Laboratory for further analysis.

2.1.6 Noise Level

Noise level monitoring was conducted at identified locations using BENTECH Sound Meter. All noise monitoring was conducted in accordance with the guidance set out in BS 7445:2003. Measurements were made using 1/1 Octave in accordance with IEC61260-1:2014 and ANSI S1.11-2004. Meters were calibrated and checked before and after each measurement period by using sound level calibrator.

2.2 Water Sampling

Following methodology was adopted for water sampling and analysis:

2.2.1 Sample Collection

The water samples were collected from identified sampling points. The sampling was carried out in accordance to the Standard Operating Procedures (SOP) based on the recognized methods of United State Environmental Protection Agency (USEPA), World Health Organization (WHO) and American Public Health Administration (APHA) for water sampling and analysis.

2.2.2 Measurement of Field Parameters

Parameters that quickly degrade after they are sampled must be tested in the field. Following parameters were measured in field that can significantly change during storage and transportation. These includes: -

✓ pH (Measured at site)

✓ Temperature

2.2.3 Preservation

Preservation is important in order to minimize the changes in the sample. The collected water samples were preserved in appropriate containers as per APHA Guidelines, the method of which is given as under:-

For COD, organics and nitrates sample is preserved below pH -2 by addition of sulphuric acid. For metals sample is preserved below pH-2 by adding nitric acid. For BOD and inorganic sample is stored below 4 °C.

2.2.4 Sample Identification and Chain of Custody

The collected samples were labeled and assigned a unique sample identification number, sampling date and time of collection to collected samples. All the relevant information (sample location, time of collection, sample identification, temperature, pH, collected by, preservation techniques etc.) was recorded immediately on the Chain of Custody form signed by ESPAK field Analyst.

2.2.5 Transportation

A shipping container (ice box with eutectic cold packs instead of ice) with maintained temperature of 4° C $\pm$ 5 °C was used for transporting the sample from the collection site to the environmental laboratory.

2.2.6 Parameters

Parameters provided in the scope of work for the testing include following:

- Waste Water
- Surface Water
- Drinking Water

The samples of waste water were collected from identified sampling points. The collected samples were given to laboratory for analysis of parameters that are listed in table 2.2.

2.2.7 Methods of Analysis

Drinking water:

Parameters and Methods used for the testing these parameters are included in Table 2.3

Table 2-2: List of Parameters of Drinking Water

S. No.	Parameter	Method	Reference
1.	Total Coli forms	Membrane Filtration method	APHA - 9222 B
2.	Fecal Coli forms	Membrane Filtration method	APHA - 9222 C
3.	(E. coli)	Membrane Filtration method	APHA - 9222 C
4.	Color	Visual Comparison method	SMWW 2120 C
5.	Taste	Organoleptic	-
6.	Odor	Organoleptic	-
7.	Turbidity	Nephelometric Method	APHA 2130B

S. No.	Parameter	Method	Reference
8	Total Hardness as CaCO_3	EDTA Titrimetric Method	SMWW 2340C
9	TDS	Gravimetric method	SMWW 2540 C
10.	pH	By pH meter	SMWW 5210
11.	Aluminum (Al)	ICP-AES	U.S. EPA-200.7
12.	Antimony (Sb)	ICP-AES	U.S. EPA-200.7
13.	Arsenic (As)	ICP-AES	U.S. EPA-200.7
14.	Barium (Ba)	ICP-AES	U.S. EPA-200.7
15.	Boron (B)	ICP-AES	U.S. EPA-200.7
16.	Cadmium (Cd)	ICP-AES	U.S. EPA-200.7
17.	Chloride as (Cl ⁻)	ICP-AES	SMWW 4500Cl B
18.	Chromium Trivalent and Hexavalent	ICP-AES	U.S. EPA-200.7
19.	Copper (Cu)	ICP-AES	U.S. EPA-200.7
20.	Cyanide (CN ⁻)	Ion selective electrode	SMWW 4500 CN F
21.	Fluoride (F ⁻)	Ion selective electrode	U.S. EPA-8214
22.	Lead (Pb)*	ICP-AES	U.S. EPA-200.7
23.	Manganese (Mn)	ICP-AES	U.S. EPA-200.7
24.	Mercury (Hg)	ICP-AES	U.S. EPA-200.7
25.	Nickel (Ni)	ICP-AES	U.S. EPA-200.7
26.	Nitrate (NO ₃ ⁻)	Cadmium reduction method	SMWW 4500 NO ₃ B
27.	Nitrite (NO ₂ ⁻)	Colorimetric method	SMWW 4500 NO ₂ B
28.	Selenium (Se)	ICP-AES	U.S. EPA-200.7
29.	Residual Chlorine	DPO Method	SMWW 4500 Cl B
30.	Zinc as (Zn)*	ICP-AES	U.S. EPA-200.7
31.	Phenolic Compound (as Phenols)	4-Aminoantipyrine Method	SMWW 5530C

Note: APHA=American Public Health Association, ASTM = American Society for Testing and Materials, SMWW = Standard Method for the Examination of Water and Waste Water 23rd Edition.

Surface water/Wastewater:

Parameters and Methods used for the testing (these parameters are included in Table 2.4

Table 2-3: Parameters and Methods Used for Testing of Surface Water/Waste Water

S. No	Parameters	Method / Equipment Used	Reference
1	pH value (H ⁺) *	By pH meter	SMWW 4500H ⁺ B
2	Biochemical Oxygen Demand (BOD ₅) at 20 °C	Incubator, Titration	SMWW 5210 B

3	Chemical Oxygen Demand (COD)*	Digester & Photometer	SMWW 5220 D
4	Total Suspended Solids (TSS)*	Gravimetric method	SMWW 2540 D
5	Total Dissolved Solids (TDS)*	Gravimetric method	SMWW 2540 C
6	Phenolic Compounds (as Phenol)	4-Aminoantipyrine Method	SMWW 5530 C
7	Grease and Oil (as n-HEM)	Pyrex Glassware	U.S. EPA 1664 B
8	Chloride (as Cl ⁻) *	Argentometry Titration	SMWW 4500Cl ⁻ -B
9	Fluoride (as F ⁻) *	Ion Selective Electrode	U.S. EPA 9214
10	Cyanide (as CN ⁻)	Ion Selective Electrode	SMWW 4500 CN ⁻ F
11	An-Ionic detergents (as MBAS)	Spectrophotometer	SMWW 5540 C
12	Sulfate (SO ₄ ²⁻) *	Gravimetric method	SMWW 4500 - SO ₄ ²⁻ C
13	Sulfide (S ²⁻)	Titration Method	SMWW 4500 - S ²⁻ F
14	Ammonia (NH ₃)	Ion Selective Electrode & Meter	SMWW 4500-NH ₃ - D
15	Chlorine (Cl)	DPD Method	SMWW 4500-Cl B
16	Cadmium (Cd)	ICP-AES	U.S. EPA-200.7
17	Chromium (Trivalent and Hexavalent)	ICP-AES	U.S. EPA-200.7
18	Copper (Cu)	ICP-AES	U.S. EPA-200.7
19	Iron (Fe)	ICP-AES	U.S. EPA-200.7
20	Lead (Pb)	ICP-AES	U.S. EPA-200.7
21	Manganese (Mn)	ICP-AES	U.S. EPA-200.7
22	Mercury (Hg)	ICP-AES	U.S. EPA-200.7
23	Selenium (Se)	ICP-AES	U.S. EPA-200.7
24	Nickel (Ni)	ICP-AES	U.S. EPA-200.7
25	Silver (Ag)	ICP-AES	U.S. EPA-200.7
26	Zinc (Zn)	ICP-AES	U.S. EPA-200.7
27	Arsenic (As)	ICP-AES	U.S. EPA-200.7
28	Barium (Ba)	ICP-AES	U.S. EPA-200.7
29	Boron (B)	ICP-AES	U.S. EPA-200.7
30	Total Toxic Metals	---	Calculated Value
31	Temperature	Thermometer	SMWW-2550-B

Note: SMWW = Standard Method for the Examination of Water and Wastewater, 23rd Edition (2017)

USEPA: United States Environmental Protection Agency

CHAPTER# 3. RESULTS AND DISCUSSION

3.1 Ambient Air

The testing results for ambient noise and air quality (CO, NO_x, SO₂, PM₁₀, and PM_{2.5}) are included in this section of the report. To gain a general idea of the air quality, CO, NO_x, SO₂, PM₁₀, and PM_{2.5} concentrations were measured at the designated sample location. From 08-12-2023 to 13-12-2023, 24-hour monitoring was conducted to assess the ambient air quality.

3.1.1 CO Measurements

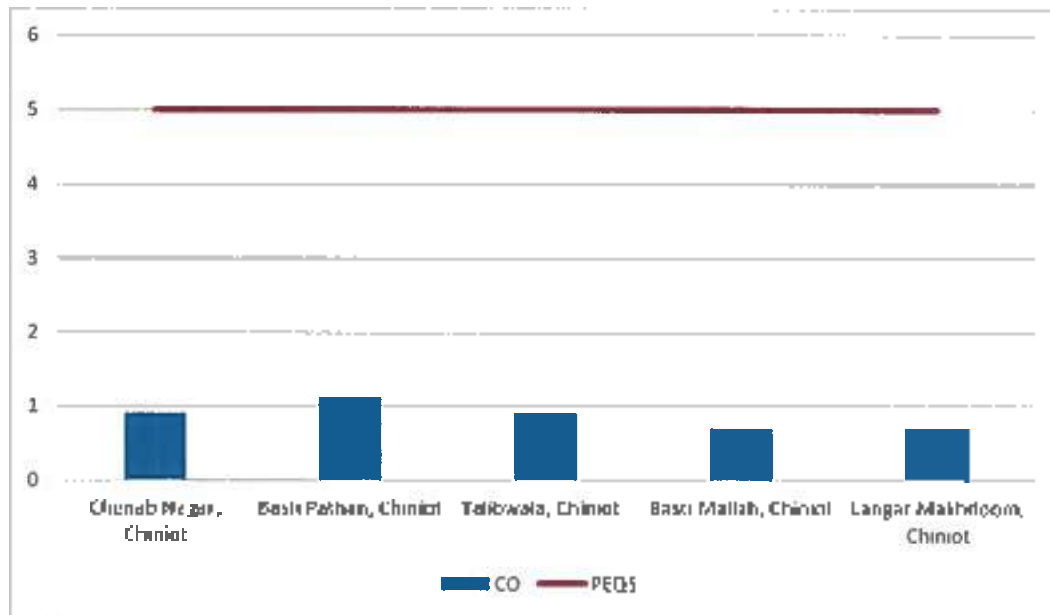


Figure 3-1: Comparison of Average CO Measurements with PEQS

Discussion:

Carbon monoxide was measured 24 hours at all sites, and the levels at all sites found under the PEQS-permissible limits (5.0 mg/m³). Graphical representation of CO at all sites with comparison of PEQS limits are shown in above figure 3-1. Detailed monitoring reports are attached as Annexure-A.

3.1.2 NO, NO₂ Measurements

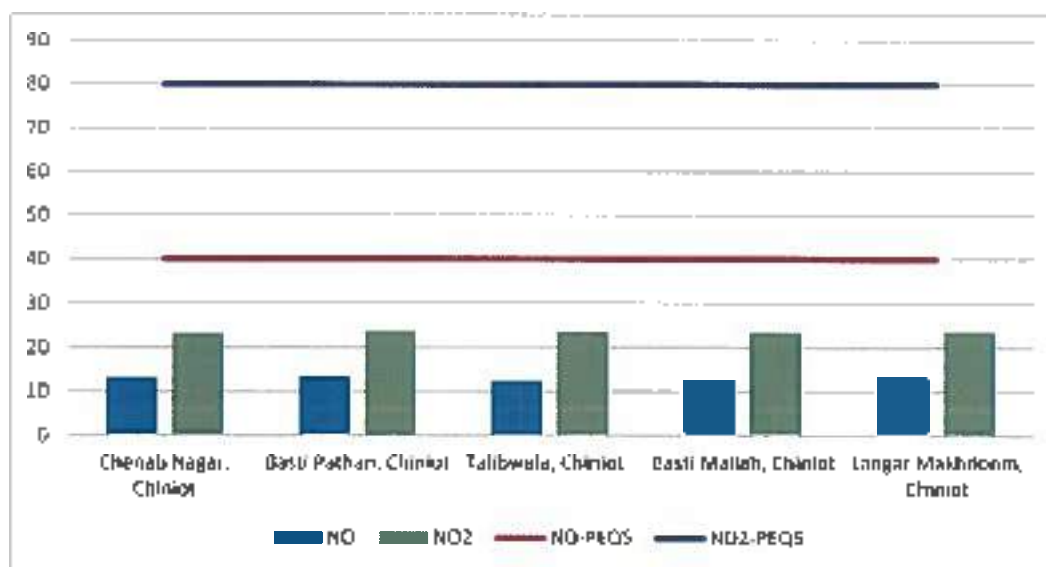


Figure 3-2: Comparison of Average NO and NO_x Measurements with PEQS

Discussion:

Nitrogen Oxides and Nitrogen Dioxides was separately measured for 24 hours at all sites, and the concentration levels at all sites found under the PEQS-permissible limits (40 mg/m³ and 80 mg/m³ Respectively). Graphical representation of NO and NO₂ at all sites with comparison of PEQS limits are shown in above figure 3-2. Detailed monitoring reports are attached as Annexure-A.

3.1.3 SO₂ Measurements

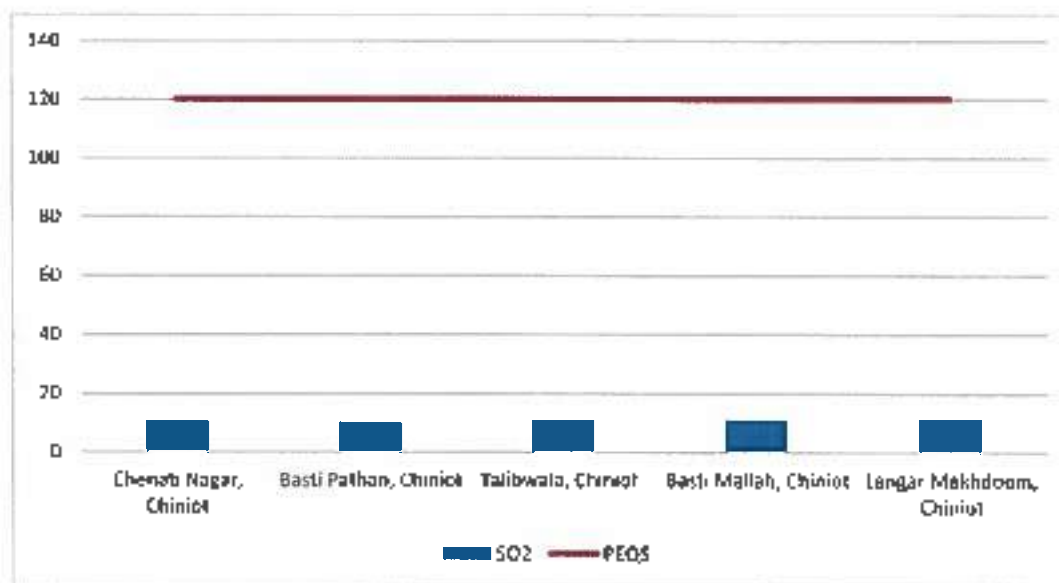


Figure 3-3: Comparison of Average SO₂ Measurements with PEQS

Discussion:

The concentration levels of Sulphur Dioxides (SO_2) were measured for 24 hours at all sites, and the concentration levels at all sites found under the PEQS-permissible limits (120 mg/m^3) as presented in above figure 3-3. Detailed monitoring reports are attached as Annexure-A

3.1.4 O_3 Measurements

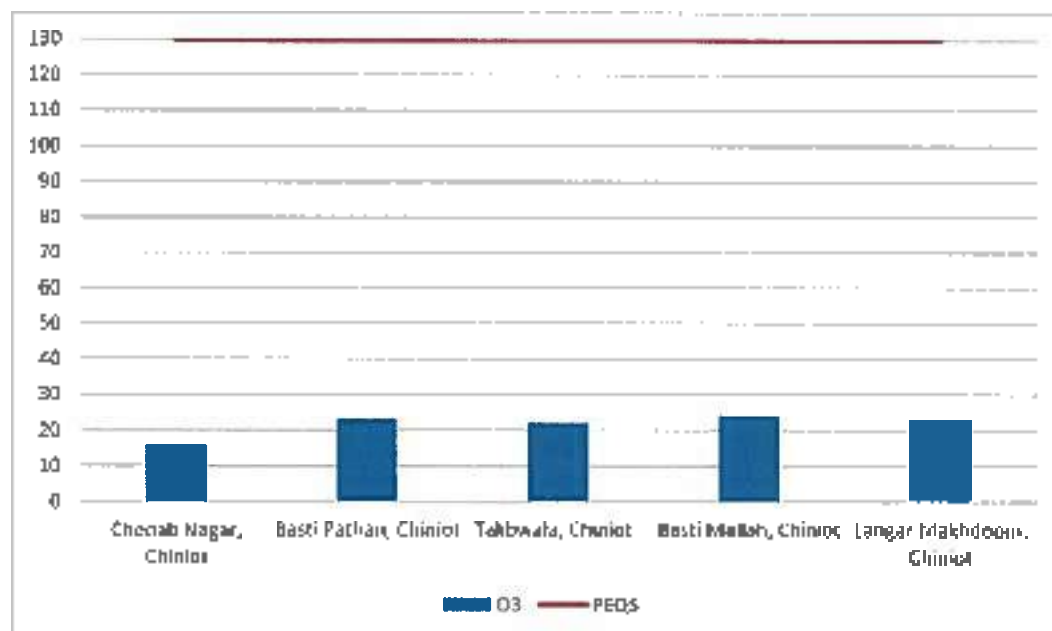


Figure 3-4: Comparison of Average O_3 Measurements with PEQS

Discussion:

The concentration levels of Ozone (O_3) were measured for the first 1 hour at all sites and the concentration levels at all sites found under the PEQS-permissible limits (130 mg/m^3). Graphical representation of concentration is presented in above figure 3-4. Detailed monitoring reports are attached as Annexure-A.

3.1.5 PM₁₀, PM_{2.5} and SPM Measurements

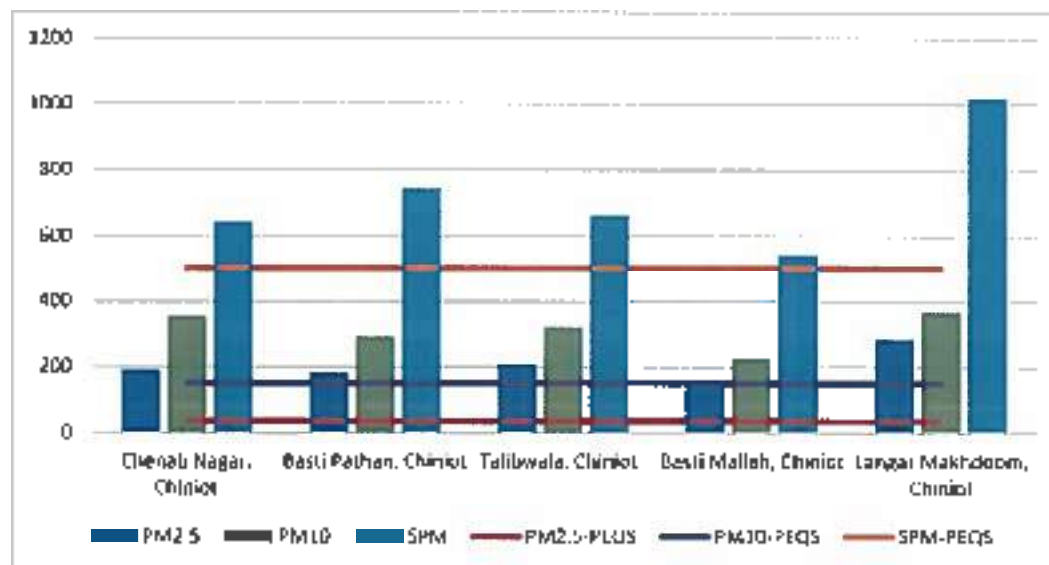


Figure 3-6: Comparison of Average PM₁₀, PM_{2.5} and SPM Measurements with PEQS

Discussion:

Concentration levels of PM₁₀, PM_{2.5} and SPM were monitored for 24 hours at all sites with a Met one BAM analyzer. Concentration levels of PM₁₀, PM_{2.5} and SPM have been found exceeding the limits of PEQS. Graphical representation of concentration is presented in Figure 3-4 above. Detailed monitoring reports are attached as Annexure-A.

3.2 Background Noise Level Analysis

Noise is an important environmental stressor and is essential part of Environmental studies for IEE/EIA related projects etc. Noise has become a very important "stress factor" in the environment of human. The term "noise pollution" has been recently used to signify the hazard of sounds which are consequence of modern-day development, leading to health hazards of different type. Noise is described as an unwanted sound emitted from un-avoidable sources of anthropogenic activities.

The noise monitoring activity was carried out at the project site and the surrounding areas of project site. Detailed environmental monitoring reports are attached as Annexure-B

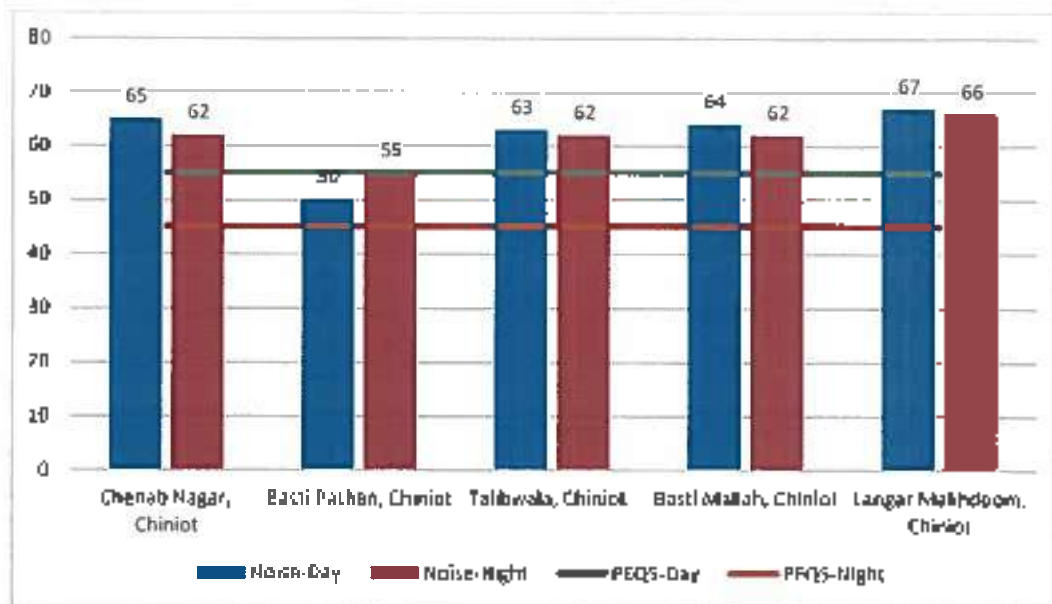


Figure 3-6: Comparison of Noise Levels with PEQS

3.3 Drinking Water Analysis

Drinking water is collected from five different hand pumps which was preserved according to standard method and submitted to ESPAK laboratory for analysis of different physical, chemical and microbiological parameters.

3.3.1 Total Dissolved Solids

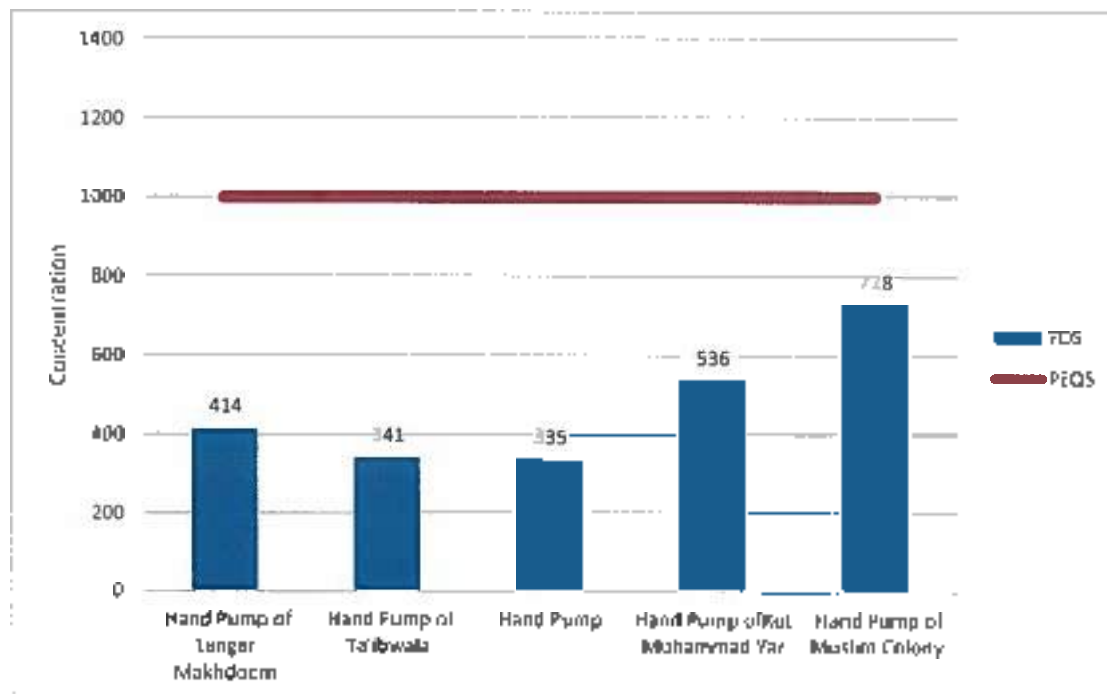


Figure 3-7: Concentration of TDS in Drinking Water with PEQS

Discussion

Drinking water sample was collected from five location, which preserved according to standard method and submitted to ESPAK laboratory. According to the laboratory reports, it is found that the all parameters of drinking water are within limits of PEQS except turbidity. Detailed reports are attached as **Annexure-C**.

3.4 Surface Water Analysis

Surface waters are always exposed to atmospheric environment on the surface of earth in the form of mobile and immobile situation including snow masked mountains, Ice-caps, Glaciers, rivers, non-river streams, rain, sleet, wetlands, watersheds and oceans. These waters are potable or toxic would depend on environment of adjoining area. Surface Water are type of water which all the time exposed to the Atmosphere Environment and can be the target of any anthropogenic or non-anthropogenic activities at any moment of time. Surface resourced chemical and biological pollution and thus are not used for sensitive applications such as drinking directly, unless it is pretreated.

3.4.1 Biochemical Oxygen Demand (B.O.D)

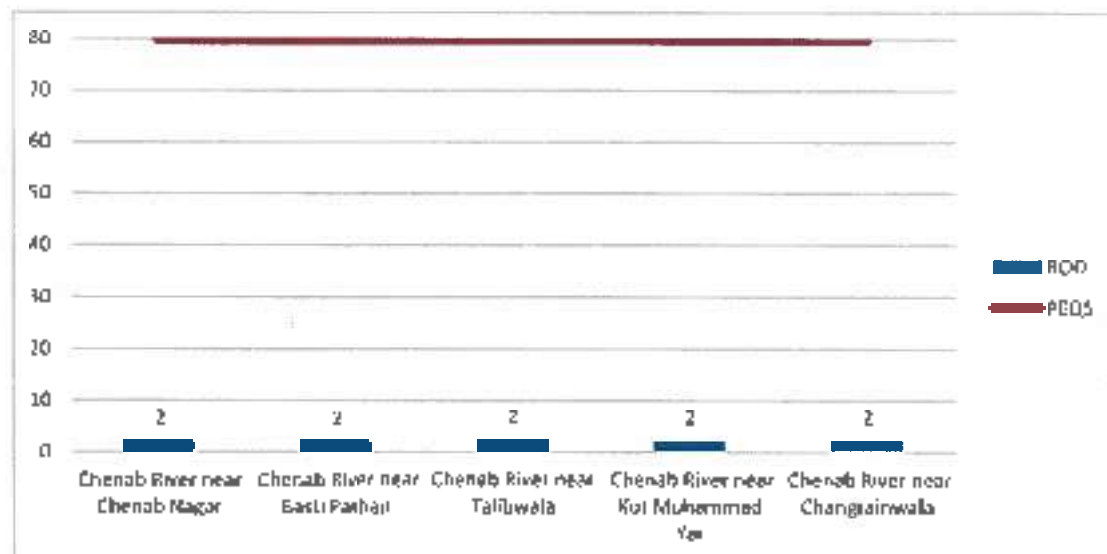


Figure 3-8: BOD Concentration in SW

3.4.2 Chemical Oxygen Demand (C.O.D)

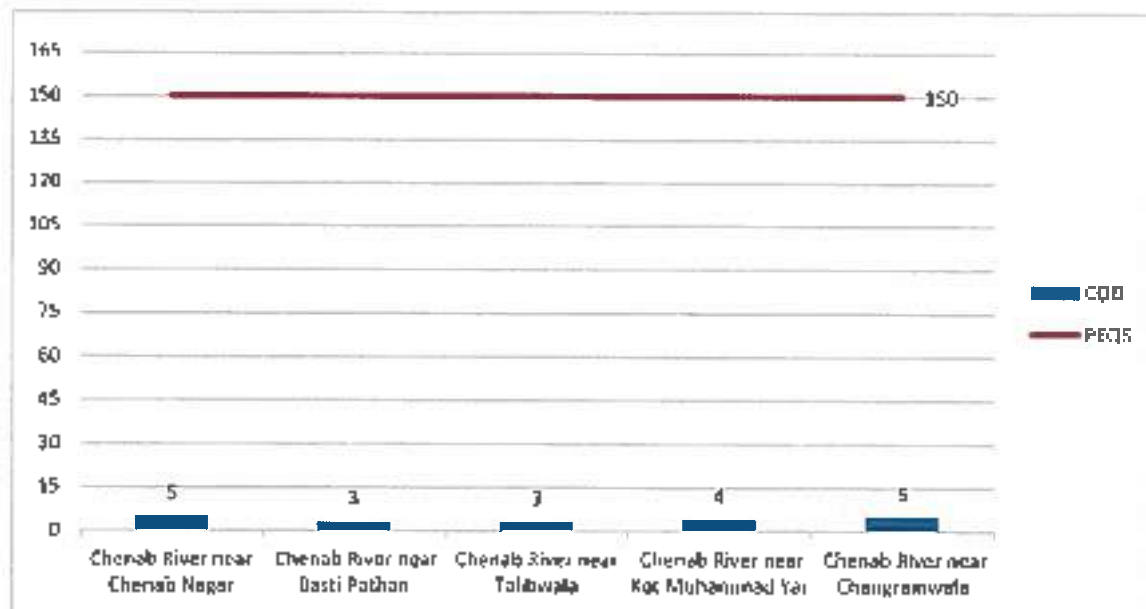


Figure 3-9: COD concentration in SW

3.4.3 Total Suspended Solids

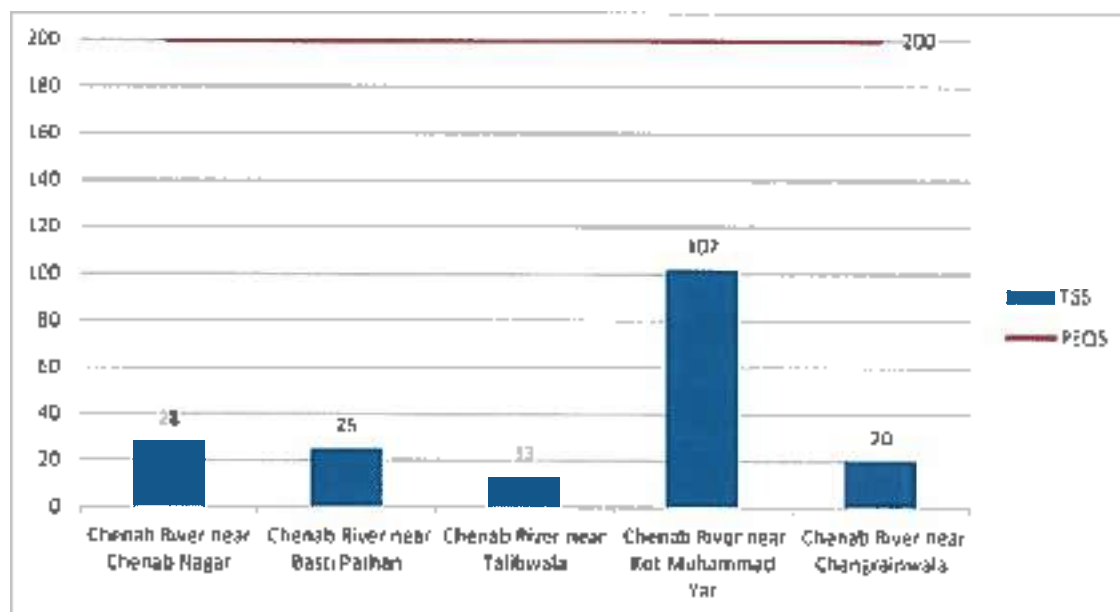


Figure 3-10: TSS concentration in SW

3.4.4 Total Dissolved

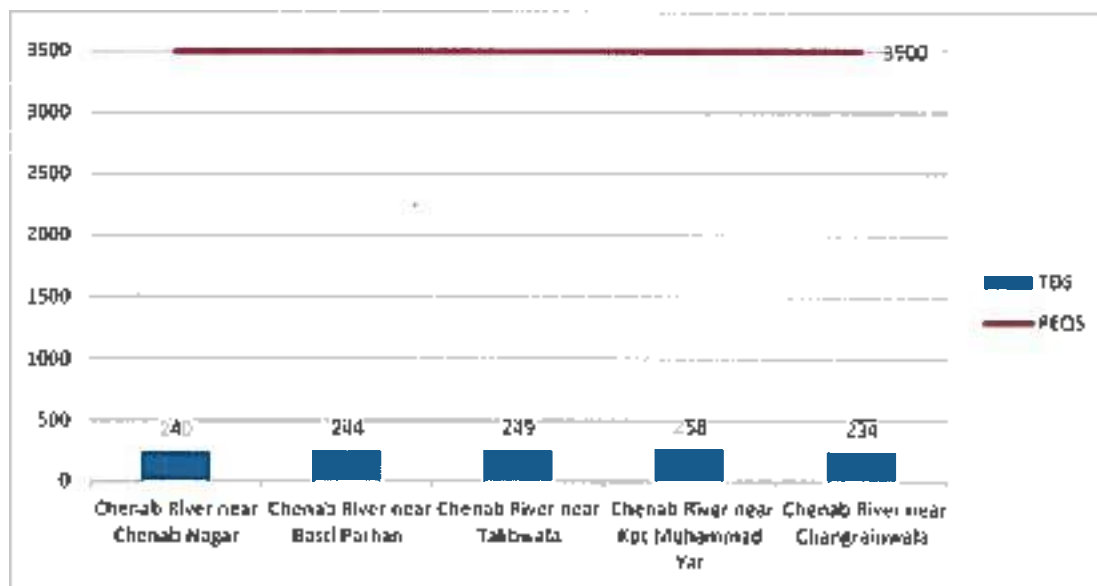


Figure 3-11: T.D.S concentration in SW

Discussion

Surface water samples were collected from five different locations, which preserved according to standard method and submitted to ESPAK laboratory. According to the laboratory reports, it is found that the few parameters of ground water are exceeding the limits of PEQS that include sulfide and TDS. Detailed reports are attached as Annexure-D.

3.5 Waste Water Analysis

Wastewater is regarded as significant carrier of unforeseen pollutants emanated from anthropogenic derived activities be it is domestic or industrial or else. Usually, in solution or suspension, that is purposely removed from a community as rejected waste. Also known as domestic or municipal wastewater, it is characterized by physical condition, chemical and toxic constituents, and its bacteriologic status (which organisms it contains and in what quantities).

3.5.1 Biochemical Oxygen Demand (B.O.D)

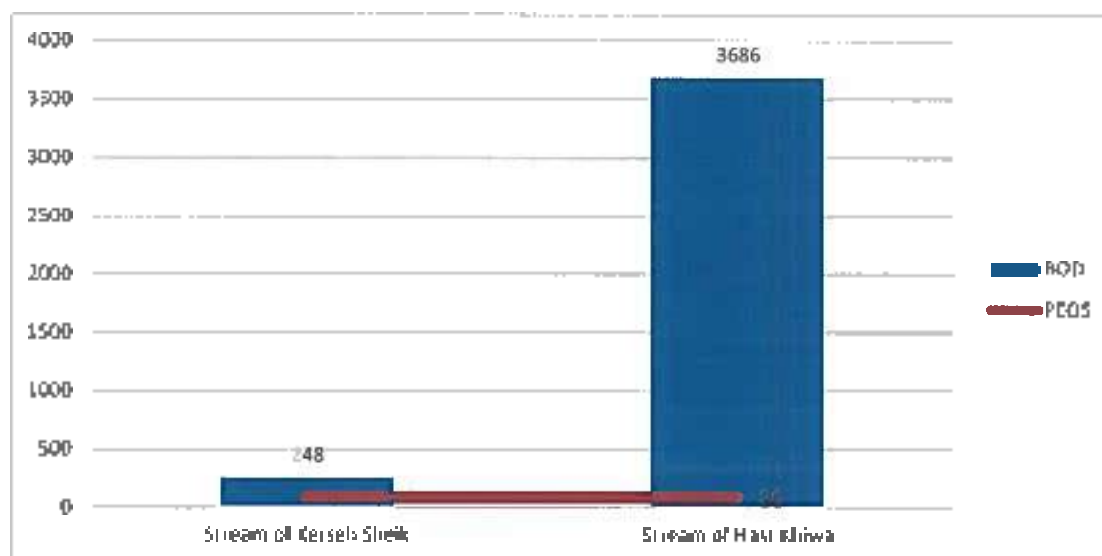


Figure 3-12: BOD Concentration in WW

3.5.2 Chemical Oxygen Demand (C.O.D)

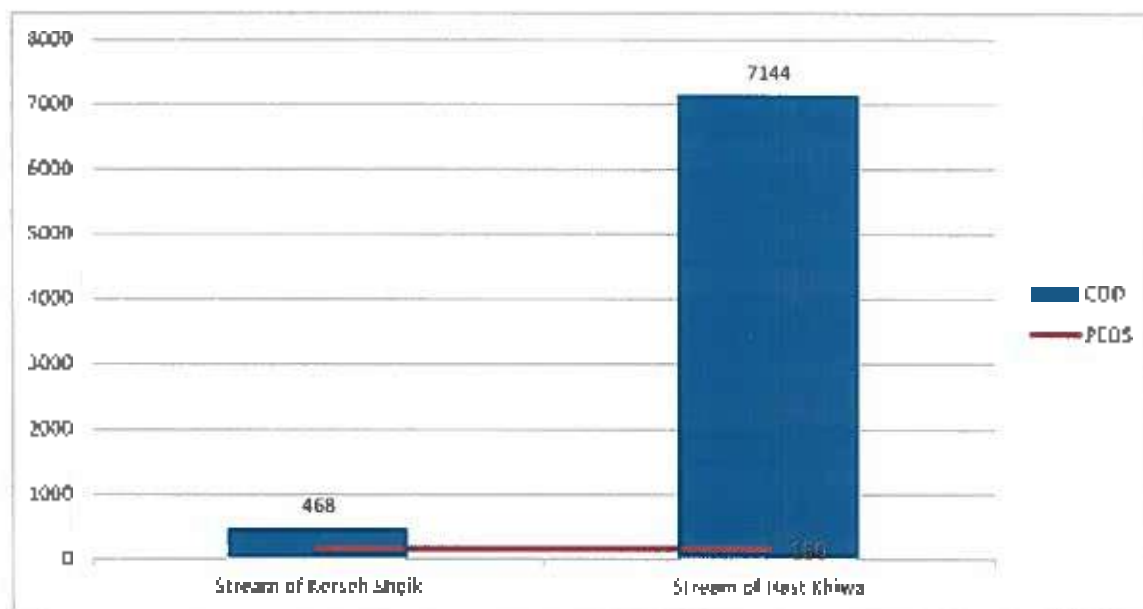


Figure 3-13: COD concentration in WW

3.5.3 Total Suspended Solids

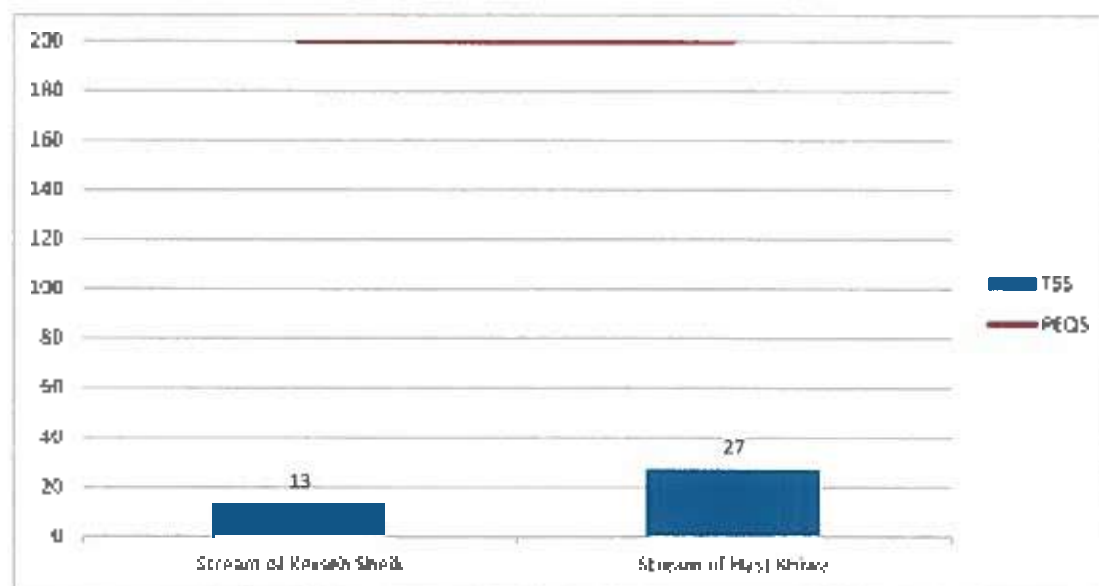


Figure 3-14: TSS concentration in WW

3.5.4 Total Dissolved Solids (T.D.S)

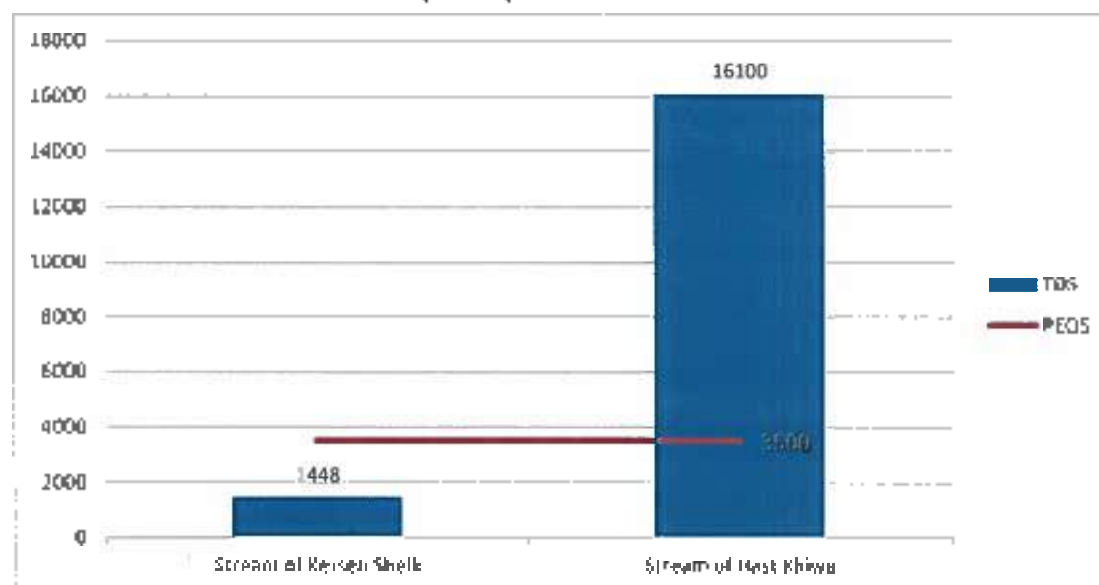


Figure 3-15: T.D.S concentration in WW

Discussion

Wastewater samples were collected from two different locations, which preserved according to standard method and submitted to ESPAK laboratory. According to the laboratory reports, it is found that a stream values are within limits of PEQS but at Stream of Hasi Khiwa values are exceeding. Detailed reports are attached as Annexure-E.

CHAPTER# 4. CONCLUSION

All average values of Ambient Air are in within the range of PEQS except Particulate Matter. The air quality monitoring was carried out in periphery of project at feasible locations this covered all directions of wind including downwind as well as upwind directions with respect to plant. The result shows that air quality around all sides of project is almost the same.

Five drinking water samples, five surface water and two waste water sample are analyzed, and compared with Punjab Environmental Quality Standards. Surface water and drinking water are in compliance while wastewater is exceeding the PEQS Limits.

ANNEXURE – A

AMBIENT AIR MONITORING REPORTS

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)



Reference Number: ESPAK/0796P/23/AA/7534/00707 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project
 Telephone No: --- Nature of Sample: Ambient Air
 Date of Sample Collection: 06/12/2023 Monitoring Location: Chenab Nagar, Chinot (GPS: 31.754051°N 72.93828°E)
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK Grab / Composite: Continuous - 24 Hours
 Date of Completion of Analysis: 07/12/2023

S. No	Parameters	Limit Values (PEQS-24 Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m ³ (8 Hours)	0.9 mg/m ³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO ₂)	120 µg/m ³	10.2 µg/m ³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O ₃)	130 µg/m ³ (1 Hour)	15.7 µg/m ³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m ³	13.0 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO _x	80 µg/m ³	23.0 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter PM ₁₀	35 µg/m ³	180 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM _{2.5}	150 µg/m ³	354 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m ³	642 µg/m ³	High Volume Sampler	Exceeding Prescribed Limits
9	Lead (Pb)	1.5 µg/m ³	0.3 µg/m ³	AAS (ICP-AES) after Sampling by HVS	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

NOTE:

- The report should be reproduced as a whole and not in parts.
- The responsibility of the ethical use of this report lies with the client.
- The values represent sample conditions when monitoring/testing was carried out.
- The report data is not intended to be used legally by the client.

- Sample Analyzed By: Usman Mudassar
Analyst (Field)
- Name of Chief Analyst with Seal: Muhammad Arfan
- Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager
Date: 15/12/2023

----- End of Report -----



Report Reference	ESPAK/0796P/23/AA/7534/00707
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK
Address	1-C, Block-N, Model Town Extension, Lahore
Project Name	Feasibility Study of Chariot Dam Project
Monitoring Location	Chenab Nagar, Chariot
GPS Coordinates	31.754051°N 72.93928°E
Monitoring Date	06-12-2023 to 07-12-2023

Date - Time	CO	SO ₂	O ₃	NO	NO ₂	PM _{2.5}	PM ₁₀	SPM	Temp.	RH	Wind Speed	Wind Direction
	mg/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	°C	%	m/s	
06-12-23 22:00	0.6	11.8	15.7	11.3	23.5	341	382	642	15.0	80.0	0.3	NE
06-12-23 23:00	0.7	12.9		12.7	23.9	304	391		14.0	76.0	0.4	E
07-12-23 0:00	0.5	11.0		10.2	22.0	235	328		13.0	78.0	0.4	E
07-12-23 1:00	0.4	10.6		14.8	24.2	277	292		11.0	84.0	0.2	E
07-12-23 2:00	0.8	9.7		13.7	24.7	219	378		10.0	88.0	0.1	SE
07-12-23 3:00	1.3	11.2		10.9	23.2	178	309		10.0	90.0	0.1	SE
07-12-23 4:00	1.2	13.2		12.2	25.2	181	245		9.0	94.0	0.3	S
07-12-23 5:00	1.4	13.7		11.3	25.0	187	250		9.0	96.0	0.2	S
07-12-23 6:00		10.2		11.8	25.4	153	240		8.0	98.0	0.3	SE
07-12-23 7:00		10.1		11.2	23.4	184	214		8.0	97.0	0.4	SE
07-12-23 8:00		12.1		12.5	24.4	151	272		8.0	97.0	0.2	N
07-12-23 9:00		9.9		14.8	24.3	155	246		8.0	98.0	0.3	N
07-12-23 10:00		8.4		16.4	24.2	117	252		9.0	95.0	0.5	W
07-12-23 11:00		9.4		16.3	22.6	92	186		13.0	80.0	0.6	W
07-12-23 12:00		8.7		16.9	23.0	71	147		15.0	75.0	0.8	SE
07-12-23 13:00		10.2		16.2	22.1	58	145		18.0	71.0	0.9	SW
07-12-23 14:00		8.6		15.0	24.9	54	151		19.0	64.0	1.2	SW
07-12-23 15:00		8.9		11.7	21.5	58	298		19.0	60.0	1.4	NW
07-12-23 16:00		7.4		10.1	20.3	68	285		17.0	62.0	0.9	NW
07-12-23 17:00		8.8		10.0	22.2	158	517		16.0	60.0	0.7	N
07-12-23 18:00		9.8		10.6	20.2	274	740		15.0	58.0	0.5	N
07-12-23 19:00		9.1		13.1	20.0	310	628		13.0	70.0	0.8	NE
07-12-23 20:00		9.5		13.5	20.2	417	779		12.0	74.0	0.5	SE
07-12-23 21:00		9.7		14.7	22.2	298	790		12.0	76.0	0.3	SE

Average	0.9	10.2	15.7	13.0	23.0	189.8	354.0	642
Maximum	1.4	13.7	15.7	16.9	25.4	417.0	790.0	642
Minimum	0.4	7.4	15.7	10.0	20.0	54.0	145.0	642

Monitored By: M Usman Mudassar

Cepa

Lahore Office
Office No. 731,
Block - 2, Sector D1,
Shah Jilani Road, Township
Lahore, Pakistan.
Tel: +92 (42) 3515 4015-16

Islamabad Office
Office No. 314, 3rd
Floor, Gulberg Empire,
Gulberg Greens,
Islamabad, Pakistan.
Tel: +92 (51) 5915060

Peshawar Office
Unit No. 244-TE,
Dean's Trade Center
Sadat Cantt.
Peshawar, Pakistan.
Tel: +92 312 0849999

CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)



Reference Number: ESPAK/0796P/23/AA/7535/00708 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project
 Telephone No: ----- Nature of Sample: Ambient Air
 Date of Sample Collection: 08/12/2023 Monitoring Location: Basti Pathan, Chinot (GPS: 31.750185° N 72.965444° E)
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 09/12/2023 Grab / Composite: Continuous - 24 Hours

S. No	Parameters	Unit Values (PEQS-24 Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m ³ (8 Hours)	1.1 mg/m ³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO ₂)	120 µg/m ³	9.9 µg/m ³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O ₃)	130 µg/m ³ (1 Hour)	23.0 µg/m ³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m ³	13.2 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO ₂	80 µg/m ³	23.6 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter PM ₁₀	35 µg/m ³	181 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM _{2.5}	150 µg/m ³	292 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m ³	744 µg/m ³	High Volume Sampler	Exceeding Prescribed Limits
9	Lead (Pb)	1.5 µg/m ³	0.5 µg/m ³	ASS (ICP-AES) after Sampling by HVS	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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- The report data is not intended to be used legally by the client.

1. Sample Analyzed By: Usman Mudassar
Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Inam Malik
General Manager
Date: 15/12/2023

End of Report



Report Reference	ESPAK/0796P/23/AA/7535/00708
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK
Address	1-C, Block-M, Model Town Extension, Lahore
Project Name	Feasibility Study of Channel Dam Project
Monitoring Location	Basti Pathan, Chahot
GPS Coordinates	31.750185°N 72.965444°E
Monitoring Date	08-12-2023 to 09-12-2023

Date + Time	CO	SO ₂	O ₃	NO	NO ₂	PM _{2.5}	PM ₁₀	SPM	Temp.	RH	Wind Speed	Wind Direction
	mg/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	°C	%	m/s	
08-12-23 9:00	1.4	2.0	23.0	16.6	24.2	250.0	135.0	744	12.1	87.0	0.6	SE
08-12-23 10:00	1.3	2.2		14.3	24.5	157.0	162.0		11.4	83.0	0.2	SE
08-12-23 11:00	1.3	2.3		12.9	23.8	122.0	284.0		13.9	85.0	0.3	S
08-12-23 12:00	1.5	2.2		13.6	22.9	103.0	298.0		14.2	91.0	0.3	S
08-12-23 13:00	0.5	2.3		11.2	23.4	79.0	233.0		13.6	95.0	0.4	SE
08-12-23 14:00	0.8	2.7		13.6	24.7	76.0	302.0		13.9	97.0	0.4	SE
08-12-23 15:00	0.7	2.5		10.9	24.7	118.0	108.0		13.1	103.0	0.6	NE
08-12-23 16:00	1.4	2.0		11.6	25.1	174.0	442.0		12.5	103.0	0.5	F
08-12-23 17:00		2.7		11.4	25.0	214.0	511.0		12.6	105.0	0.6	F
08-12-23 18:00		2.2		11.5	25.9	203.0	480.0		12.4	104.0	0.7	E
08-12-23 19:00		2.0		11.8	23.9	296.0	357.0		11.4	104.0	0.5	N
08-12-23 20:00		2.4		10.3	24.3	142.0	211.0		11.2	106.0	0.6	N
08-12-23 21:00		2.4		14.8	24.3	157.0	128.0		10.2	102.0	0.8	W
08-12-23 22:00		2.2		15.5	20.7	181.0	196.0		9.4	101.0	0.9	W
08-12-23 23:00		2.7		12.0	22.1	190.0	223.0		8.3	96.0	1.1	SE
09-12-23 0:00		2.0		10.2	22.9	181.0	258.0		8.2	93.0	1.2	NE
09-12-23 1:00		2.0		12.0	22.8	144.0	263.0		7.0	101.0	1.5	NE
09-12-23 2:00		2.8		13.1	22.2	150.0	377.0		6.9	97.0	1.7	NE
09-12-23 3:00		2.1		10.3	23.8	113.0	323.0		6.5	99.0	1.7	NE
09-12-23 4:00		2.8		9.6	21.9	133.0	342.0		6.5	97.0	1	N
09-12-23 5:00		2.0		12.1	23.2	136.0	350.0		5.0	95.0	0.8	SW
09-12-23 6:00		2.3		12.7	20.4	388.0	416.0		5.3	107.0	1.3	SW
09-12-23 7:00		2.0		12.2	21.1	343.0	417.0		5.9	107.0	0.8	NE
09-12-23 8:00		2.1		14.6	24.0	507.0	409.0		6.6	104.0	0.6	NE
Average	1.1	2.4	23.0	13.1	23.6	183.6	251.6	744				
Maximum	1.5	2.7	23.0	16.7	25.9	343.0	511.0	744				
Minimum	0.5	2.0	13.0	9.6	20.4	78.0	123.0	744				

Monitored By: M Abrar Wadai

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CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)



Reference Number: ESPAK/0796P/23/AA/7536/00709 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project
 Telephone No: _____ Nature of Sample: Ambient Air
 Date of Sample Collection: 09/12/2023 Monitoring Location: Talabwala, Chinot (GPS: 31.944349°N 73.146107°E)
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 10/12/2023 Grab / Composite: Continuous - 24 Hours

S. No	Parameters	Limit Values (PEQS-24 Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m ³ (8 Hours)	0.9 mg/m ³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO ₂)	120 µg/m ³	10.5 µg/m ³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O ₃)	130 µg/m ³ (1 Hour)	22.0 µg/m ³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m ³	12.3 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO ₂	80 µg/m ³	23.5 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter PM ₁₀	15 µg/m ³	208 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM _{2.5}	150 µg/m ³	320 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m ³	662 µg/m ³	High Volume Sampler	Exceeding Prescribed Limits
9	Lead (Pb)	1.5 µg/m ³	0.6 µg/m ³	AAS (ICP-AES) after Sampling by HVS	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Note:

- The report should be reproduced as a whole and not in parts.
- The responsibility of the ethical use of this report lies with the client.
- The values represent sample conditions when monitoring/testing was carried out.
- The report data is not intended to be used legally by the client.

1. Sample Analyzed By: Usman Mudassar
Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager
Date: 15/12/2023

End of Report



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Report Reference	ESPAK/07967/23/AA/7536/00709
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK
Address	1-C, Block-F, Model Town Extension, Lahore
Project Name	Feasibility Study of Chaniel Dam Project
Monitoring Location	Talibwala, Cholot
GPS Coordinates	31.944349°N 73.146102°E
Monitoring Date	09-12-2023 to 10-12-2023

Date - Time	CO	SO ₂	O ₃	NO	NO ₂	PM ₁₀	PM _{2.5}	SPM	Temp.	RH	Wind Speed	Wind Direction
	mg/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	°C	%	m/s	
09-12-23 13:00	1.4	13.0	22.0	12.8	23.9	114.0	270.0	663	23	76	0.7	NE
09-12-23 14:00	0.7	8.6		9.8	23.6	98.0	232.0		23	76	0.3	NE
09-12-23 15:00	0.9	7.1		11.2	23.3	99.0	230.0		22	78	0.1	NE
09-12-23 16:00	0.8	9.3		10.2	22.0	97.0	210.0		21	78	0.1	E
09-12-23 17:00	1.3	7.6		13.8	24.0	464.0	676.0		21	80	0	E
09-12-23 18:00	1.0	8.9		9.5	23.7	396.0	900.0		20	83	0	E
09-12-23 19:00	0.8	8.3		10.4	22.6	269.0	498.0		19	85	0.2	SE
09-12-23 20:00	0.9	9.6		12.9	22.5	268.0	427.0		18	85	0.1	SE
09-12-23 21:00		10.0		11.3	21.0	458.0	457.0		16	86	0.2	SE
09-12-23 22:00		11.4		10.8	25.0	276.0	461.0		15	86	0.3	SE
09-12-23 23:00		13.8		17.4	22.3	335.0	500.0		14	87	0.1	N
10-12-23 00:00		10.5		14.4	23.8	142.0	215.0		13	89	0.2	N
10-12-23 01:00		9.3		10.9	23.1	104.0	195.0		12	89	0.4	N
10-12-23 02:00		9.9		13.9	24.9	105.0	109.0		10	90	0.5	N
10-12-23 03:00		10.8		13.2	21.4	152.0	214.0		9	91	0.7	SW
10-12-23 04:00		11.0		14.4	23.4	150.0	220.0		8	92	0.3	SW
10-12-23 05:00		11.8		12.9	24.8	127.0	167.0		6	92	1.1	SW
10-12-23 06:00		13.0		13.4	23.2	112.0	228.0		6	94	1.3	SW
10-12-23 07:00		11.7		10.7	21.2	144.0	170.0		6	94	0.8	N
10-12-23 08:00		12.2		10.6	24.5	157.0	398.0		7	95	0.6	N
10-12-23 09:00		12.8		13.1	23.0	178.0	237.0		8	92	0.4	N
10-12-23 10:00		13.3		11.3	25.3	175.0	261.0		11	87	0.7	NE
10-12-23 11:00		8.5		16.5	21.8	152.0	286.0		11	81	0.4	SE
10-12-23 12:00		10.8		15.4	23.2	159.0	275.0		15	86	0.2	SE

Average	0.5	10.5	22.0	12.8	23.6	308.4	330.1	663
Maximum	1.4	13.8	22.0	16.5	25.8	464.0	676.0	663
Minimum	0.7	7.1	22.0	9.4	21.4	97.0	109.0	663

Monitored By:	M Uman Rudekar

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CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)



Reference Number: **ESPAK/0796P/23/AA/7537/00710** Date: **15/12/2023**

Name of Industry/Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

Address: **1-C, Block-N, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chiniot Dam Project**

Telephone No: **-----** Nature of Sample: **Ambient Air**

Date of Sample Collection: **10/12/2023** Monitoring Location: **Basti Mallah, Chiniot (GPS: 31.849522°N 72.120593°E)**

Sample Collected/Sent By: **Usman Mudassar, Analyst (Field), ESPAK** Grab / Composite: **Continuous - 24 Hours**

Date of Completion of Analysis: **11/12/2023**

No	Parameters	Limit Values (PEQS-24 Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m ³ (8 Hours)	0.7 mg/m ³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO ₂)	120 µg/m ³	10.9 µg/m ³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O ₃)	130 µg/m ³ (1 Hour)	24.0 µg/m ³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m ³	12.3 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO ₂	80 µg/m ³	23.3 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter PM ₁₀	35 µg/m ³	156 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM _{2.5}	150 µg/m ³	226 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m ³	591 µg/m ³	High Volume Sampler	Exceeding Prescribed Limits
9	Lead (Pb)	1.5 µg/m ³	0.4 µg/m ³	AAS (ICP-AES) after Sampling by HVS	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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- The values represent sample conditions when monitoring/testing was carried out.
- The report data is not intended to be used legally by the client.

Sample Analyzed By: **Usman Mudassar**
Analyst (Field)

2. Name of Chief Analyst with Seal: **Muhammed Arfan**

3. Signature of Incharge of the Environmental Laboratory:

Name: **Usman Malik**
General Manager
Date: **15/12/2023**

----- End of Report -----

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Report Reference	ESPAK/0796P/23/AA/7537/00710
Name of Industry/ Client	National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
Address	1-C, Block-N, Model Town Extension, Lahore
Project Name	Feasibility Study of Chenab Dam Project
Monitoring Location	Basti Mallah, Chenab
GPS Coordinates	31.849522°N 72.120693°E
Monitoring Date	10-12-2023 to 13-12-2023

Date - Time	CO	SO ₂	O ₃	NO	NO ₂	PM ₁₀	PM _{2.5}	SPM	Temp	RH	Wind Speed	Wind Direction
	mg/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	ug/m ³	°C	%	m/s	
10-12-23 15:00	0.2	8.7	24.0	9.6	21.9	54	210	641.0	25	73	0.3	SE
10-12-23 17:00	0.2	9.1		9.4	21.8	36	219		24	74	0.6	SE
10-12-23 18:00	0.2	9.3		11.6	27.5	130	216		22	73	0.6	SE
10-12-23 19:00	0.4	9.7		10.4	22.8	140	195		20	73	0.4	SE
10-12-23 20:00	0.4	10.5		13.9	27.3	184	250		17	81	0.1	S
10-12-23 21:00	0.58	11.3		12.7	22.6	167	270		16	90	0.1	S
10-12-23 22:00	0.2	10.9		10.2	22.6	176	213		15	94	0.5	S
10-12-23 23:00	0.2	11.4		12.8	22.4	183	197		13	96	0.4	S
11-12-23 00:00		11.0		13.3	22.6	157	205		11	98	0.5	NE
11-12-23 01:00		11.3		13.9	23.6	141	174		8	91	0.6	NE
11-12-23 02:00		10.2		13.7	25.3	150	191		8	97	0.4	NE
11-12-23 03:00		11.3		12.8	18.7	151	176		7	98	0.5	NE
11-12-23 04:00		11.5		12.9	14.7	138	166		6	95	0.7	N
11-12-23 05:00		11.0		10.6	14.5	157	206		6	97	0.8	N
11-12-23 06:00		11.5		11.1	24.8	175	133		6	96	1	N
11-12-23 07:00		11.6		11.3	24.2	171	145		5	97	1.1	N
11-12-23 08:00		9.8		10.5	24.7	287	135		7	97	1.3	W
11-12-23 09:00		10.7		15.3	25.1	158	148		7	98	1.1	W
11-12-23 10:00		9.2		12.8	25.1	133	134		10	89	1.3	W
11-12-23 11:00		9.1		13.6	24.8	103	177		11	88	0.8	NW
11-12-23 12:00		10.0		12.3	24.4	94	221		13	84	0.7	NE
11-12-23 13:00		9.8		10.1	11.8	109	197		15	76	1	NE
11-12-23 14:00		13.7		13.8	16.1	125	206		17	74	0.7	SE
12-12-23 15:00		11.3		9.5	10.7	176	254		18	73	0.5	SE
Average	0.2	10.9	24.0	12.3	25.3	153.8	208.0	641.0				
Standard Dev.	0.9	15.7	24.0	15.3	25.3	175.0	245.0	641.0				
Maximum	0.4	8.7	24.0	9.4	20.7	186.0	266.0	641.0				

Monitored By: M. Usman Khan

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CHEMICAL ANALYSIS TEST REPORT (AMBIENT AIR)



Reference Number: **ESPAK/0796P/23/AA/7538/00711** Date: **15/12/2023**

Name of Industry/Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

Address: **1-C, Block-N, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chinot Dam Project**

Telephone No: **---** Nature of Sample: **Ambient Air**

Date of Sample Collection: **11/12/2023** Monitoring Location: **Lahar, Makhdoom, Chinot (GPS: 31.892546°N 73.056438°E)**

Sample Collected/Sent By: **Usman Mudassar, Analyst (Field), ESPAK** Grab / Composite: **Continuous - 24 Hours**

Date of Completion of Analysis: **12/12/2023**

No	Parameters	Limit Values (PEQS-24 Hours)	Concentration	Method / Equipment Used	Remarks
1	Carbon Monoxide (CO)	5 mg/m ³ (8 Hours)	0.7 mg/m ³	Non Dispersive Infrared Absorption (NDIR)	Within Prescribed Limits
2	Sulfur Dioxide (SO ₂)	120 µg/m ³	13.0 µg/m ³	UV Fluorescence (UVF)	Within Prescribed Limits
3	Ozone (O ₃)	130 µg/m ³ (1 Hour)	22.9 µg/m ³	Non Dispersive UV Absorption	Within Prescribed Limits
4	Oxides of Nitrogen as NO	40 µg/m ³	13.0 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
5	Oxides of Nitrogen as NO ₂	80 µg/m ³	23.4 µg/m ³	Chemiluminescence Detection	Within Prescribed Limits
6	Particulate Matter PM ₁₀	35 µg/m ³	283 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
7	Particulate Matter PM _{2.5}	150 µg/m ³	366 µg/m ³	Particulate Sensor	Exceeding Prescribed Limits
8	Suspended Particulate Matter (SPM)	500 µg/m ³	1017 µg/m ³	High Volume Sampler	Exceeding Prescribed Limits
9	Lead (Pb)	2.5 µg/m ³	0.8 µg/m ³	ASS (ICP-AES) after Sampling by HVS	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Ambient Air, 2016

Uncertainty of Measurement (U₉₅) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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Sample Analyzed By: **Usman Mudassar**
Analyst (Field)

Name of Chief Analyst with Seal: **Muhammad Arfan**

Signature of Incharge of the Environmental Laboratory:

Name: **Imran Malik**
General Manager
Date: **15/12/2023**



End of Report

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Report Reference	ESPAK/0796P/23/AAJ/532/007LI
Name of Industry/ Client	National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
Address	I-C, Block-46, Model Town Extension, Lahore
Project Name	Feasibility Study of Chaniot Dam Project
Monitoring Location	Langer Makhdoom, Chaniot
GPS Coordinates	31.892546°N 73.036438°E
Monitoring Date	11-12-2023 to 12-12-2023

Date - Time	CO	SO ₂	O ₃	NO	NO ₂	PM ₁₀	PM _{2.5}	SPM	Temp.	RH	Wind Speed	Wind Direction
	mg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	°C	%	m/s	
13-12-23 19:00	0.7	11.1	22.9	10.4	24.5	147.0	214.0	1017	17	83	0.4	NE
16-12-23 20:00	0.6	10.1		10.1	23.7	156.0	214.0		16	84	0.5	NE
09-12-23 21:00	0.3	12.1		11.7	23.3	135.0	217.0		16	84	0.3	NE
08-12-23 21:00	0.1	12.3		11.4	23.7	103.0	227.0		15	86	0.1	NE
07-12-23 21:00	0.1	12.3		12.7	27.1	179.0	304.0		15	86	0.2	S
07-12-23 21:00	0.7	12.7		12.9	27.7	315.0	575.0		14	87	0.1	S
07-12-23 00:00	0.7	12.7		12.9	27.7	315.0	575.0		17	85	0.4	S
06-12-23 14:00	0.8	12.8		15.0	21.8	327.0	462.0		17	89	0.3	S
05-12-23 2:00	0.4	12.7		10.6	21.4	271.0	304.0		17	90	0.4	SW
04-12-23 3:00		11.0		12.1	24.1	176.0	320.0		9	93	0.5	SW
03-12-23 4:00		11.0		12.4	25.1	249.0	304.0		8	93	0.3	SW
02-12-23 5:00		11.5		12.5	25.9	202.0	298.0		7	94	0.4	SW
01-12-23 6:00		11.5		13.0	23.3	215.0	259.0		7	94	0.6	W
30-11-23 7:00		11.6		11.0	23.2	240.0	283.0		9	91	0.7	W
29-11-23 8:00		11.5		10.8	24.7	187.0	301.0		10	91	0.9	W
28-11-23 9:00		11.9		15.5	24.7	189.0	490.0		11	89	1	W
27-11-23 10:00		11.3		14.4	24.5	293.0	351.0		12	87	1.3	N
26-11-23 11:00		11.7		13.6	23.8	226.0	321.0		13	86	1.4	N
25-11-23 12:00		11.7		14.2	24.2	650.0	570.0		14	86	0.8	H
24-11-23 13:00		11.7		16.2	22.1	427.0	417.0		15	85	0.6	NE
23-11-23 14:00		10.5		16.8	25.0	515.0	398.0		13	85	0.8	NE
21-11-23 15:00		10.5		9.5	20.5	107.0	367.0		14	86	0.4	SE
21-11-23 16:00		10.5		10.2	21.7	314.0	801.0		13	87	0.4	SE
20-11-23 17:00		12.9		13.7	23.0	270.0	374.0		13	87	0.4	SE
19-11-23 18:00		11.3		13.3	21.5	244.0	297.0					
Average	0.7	11.0	22.9	11.0	23.4	283.0	319.7	1017				
Maximum	0.8	11.5	22.9	16.1	25.9	728.0	823.8	1017				
Minimum	0.4	8.3	12.0	9.5	20.5	103.0	214.0	1017				

Monitored By: Mr. Usman Akmal

Usha

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ANNEXURE – B
BACKGROUND NOISE LEVEL MONITORING
REPORTS

NOISE MONITORING REPORT



Reference Number: ESPAK/0796P/29/N/7539/00809 Date: 15/12/2023

Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 3-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinot Dam Project

Telephone No: _____ Nature of Sample: Noise

Date of Sample Collection: 06/12/2023 Grab / Composite: Continuous-24 Hours

Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 07/12/2023

Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Chenab Nagar, Chinot (GPS: 31.754051°N 72.93818°E)- Day time	55 dB(A)	65 dB(A)	Exceeding Prescribed Limits
2	Chenab Nagar, Chinot (GPS: 31.754051°N 72.93818°E)- Night time	45 dB(A)	62 dB(A)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Industrial Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)

• Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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1. Sample Analyzed By: Usman Mudassar
Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager

Date: 15/12/2023

End of Report



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Report Reference	ESPAK/0796P/23/N/7539/00809	
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK	
Address	1-C, Block-N, Model Town Extension, Lahore	
Project Name	Feasibility Study of Chanlot Dam Project	
Monitoring Location	Chenab Nagar, Chanlot	
GPS Coordinates	31.754051°N 72.93828°E	
Monitoring Date	06-12-2023 to 07-12-2023	
		dB (A) Leq
Day Time	06-12-23 22:00	66.4
	07-12-23 7:00	51.5
	07-12-23 8:00	66.9
	07-12-23 9:00	63.7
	07-12-23 10:00	65.7
	07-12-23 11:00	65.3
	07-12-23 12:00	66.9
	07-12-23 13:00	66.1
	07-12-23 14:00	66.8
	07-12-23 15:00	68.1
	07-12-23 16:00	66.7
	07-12-23 17:00	67.0
	07-12-23 18:00	64.4
	07-12-23 19:00	75.5
	07-12-23 20:00	60.9
	07-12-23 21:00	61.9
Average Day time		65
Night Time	06-12-23 23:00	66.8
	07-12-23 0:00	67.4
	07-12-23 1:00	69.3
	07-12-23 2:00	68.8
	07-12-23 3:00	67.2
	07-12-23 4:00	67.3
	07-12-23 5:00	43.4
	07-12-23 6:00	43.4
Average Night time		62
Monitored By:		M. Usman Mudassir

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NOISE MONITORING REPORT



Reference Number: ESPAK/0796P/23/N/7540/00810 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chiniot Dam Project
 Telephone No: _____ Nature of Sample: Noise
 Date of Sample Collection: 08/12/2023 Grab / Composite: Continuous-24 Hours
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 09/12/2023
 Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Basti Pathan, Chiniot (GPS: 31.750185°N 72.965444°E) - Day Time	55 dB(A)	59 dB(A)	Exceeding Prescribed Limits
2	Basti Pathan, Chiniot (GPS: 31.750185°N 72.965444°E) - Night Time	45 dB(A)	55 dB(A)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Residential Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)
 • Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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1. Sample Analyzed By: Usman Mudassar
Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
 General Manager
 Date: 15/12/2023

End of Report



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Report Reference	ESPAK/0796P/23/N/7540/00810	
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK	
Address	1-C, Block-N, Model Town Extension, Lahore	
Project Name	Feasibility Study of Chaniot Dam Project	
Monitoring Location	Basti Pathan, Chaniot	
GPS Coordinates	31.750185°N 72.965444°E	
Monitoring Date	08-12-2023 to 09-12-2023	
		dB (A) Leq
Day Time	08-12-23 9:00	63.2
	08-12-23 10:00	57.9
	08-12-23 11:00	57.7
	08-12-23 12:00	57.4
	08-12-23 13:00	59.4
	08-12-23 14:00	58.1
	08-12-23 15:00	61.0
	08-12-23 16:00	59.9
	08-12-23 17:00	61.9
	08-12-23 18:00	57.7
	08-12-23 19:00	60.2
	08-12-23 20:00	56.2
	08-12-23 21:00	55.5
	08-12-23 22:00	55.8
	09-12-23 7:00	55.9
	09-12-23 8:00	68.1
Average Day time		59
Night Time	08-12-23 23:00	54.7
	09-12-23 0:00	54.8
	09-12-23 1:00	54.3
	09-12-23 2:00	54.8
	09-12-23 3:00	54.6
	09-12-23 4:00	54.2
	09-12-23 5:00	56.4
	09-12-23 6:00	54.4
Average Night time		55
Monitored By:		M Usman Mudassir




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NOISE MONITORING REPORT



Reference Number: ESPAK/0796P/23/M/7543/00811 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAC)
 Address: 1-C, Block N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project
 Telephone No: _____ Nature of Sample: Noise
 Date of Sample Collection: 09/12/2023 Grab / Composite: Continuous-24 Hours
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 10/12/2023
 Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Unit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Tallbawla, Chinot (GPS: 31.944349°N 73.146107°E) - Day time	55 dB(A)	53 dB(A)	Exceeding Prescribed limits
2	Tallbawla, Chinot (GPS: 31.944349°N 73.146107°E) - Night time	45 dB(A)	61 dB(A)	Exceeding Prescribed limits

PEQS: Punjab Environmental Quality Standards for Noise in Residential Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)
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1. Sample Analyzed By: Usman Mudassar
 Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
 General Manager

Date: 15/12/2023



----- End of Report -----

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Report Reference	ESPAK/0796P/23/N/7541/00811	
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK	
Address	1-C, Block-N, Model Town Extension, Lahore	
Project Name	Feasibility Study of Chanlot Dam Project	
Monitoring Location	Talibwala, Chanlot	
GPS Coordinates	31.944349°N 73.146107°E	
Monitoring Date	09-12-2023 to 10-12-2023	
		dB (A) Leq
Day Time	09-12-23 13:00	66.8
	09-12-23 14:00	63.4
	09-12-23 15:00	63.3
	09-12-23 16:00	59.1
	09-12-23 17:00	66.4
	09-12-23 18:00	65.6
	09-12-23 19:00	70.6
	09-12-23 20:00	66.2
	09-12-23 21:00	63.5
	09-12-23 22:00	69.1
	10-12-23 7:00	54.7
	10-12-23 8:00	54.4
	10-12-23 9:00	65.8
	10-12-23 10:00	56.1
	10-12-23 11:00	65.6
	10-12-23 12:00	62.1
Average Day time		63
Night Time	09-12-23 23:00	58.8
	10-12-23 0:00	57.4
	10-12-23 1:00	58.6
	10-12-23 2:00	66.1
	10-12-23 3:00	59.7
	10-12-23 4:00	67.8
	10-12-23 5:00	73.5
	10-12-23 6:00	57.5
Average Night time		62
Monitored By:		M Usman Mudassir

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NOISE MONITORING REPORT



Reference Number: ESPAK/0795P/23/N/7541/00812 Date: 15/12/2023
 Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-M, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project
 Telephone No: _____ Nature of Sample: Noise
 Date of Sample Collection: 10/12/2023 Grab / Composite: Continuous-24 Hours
 Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 11/12/2023
 Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Basti Mallah, Chinot (GPS: 31.849522°N 72.120593°E)- Day time	55 dB(A)	84 dB(A)	Exceeding Prescribed Limits
2	Basti Mallah, Chinot (GPS: 31.849522°N 72.120593°E)- Night time	45 dB(A)	62 dB(A)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Residential Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)
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 Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
 General Manager
 Date: 15/12/2023



End of Report

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Report Reference	ESPAK/0796P/23/N/7542/00812	
Name of industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK	
Address	1-C, Block-N, Model Town Extension, Lahore	
Project Name	Feasibility Study of Chaniot Dam Project	
Monitoring Location	Basti Mallah, Chaniot	
GPS Coordinates	31.849522°N 72.120593°E	
Monitoring Date	10-12-2023 to 11-12-2023	
		dB (A) Leq
Day Time	10-12-23 16:00	66.8
	10-12-23 17:00	63.4
	10-12-23 18:00	63.3
	10-12-23 19:00	59.1
	10-12-23 20:00	66.4
	10-12-23 21:00	65.6
	10-12-23 22:00	70.6
	11-12-23 7:00	67.9
	11-12-23 8:00	73.8
	11-12-23 9:00	62.0
	11-12-23 10:00	62.9
	11-12-23 11:00	87.3
	11-12-23 12:00	56.0
	11-12-23 13:00	52.0
	11-12-23 14:00	53.2
	11-12-23 15:00	50.0
Average Day time		64
Night Time	10-12-23 23:00	66.2
	11-12-23 0:00	63.5
	11-12-23 1:00	69.1
	11-12-23 2:00	58.9
	11-12-23 3:00	57.4
	11-12-23 4:00	58.7
	11-12-23 5:00	66.1
	11-12-23 6:00	59.8
Average Night time		62
Monitored By:		M. Usman Mudassir




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NOISE MONITORING REPORT



Reference Number: ESPAK/0796F/23/N/7543/00013 Date: 15/12/2023

Name of Industry/Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chiniot Dam Project

Telephone No: _____ Nature of Sample: Noise

Date of Sample Collection: 11/12/2023 Grab / Composite: Continuous-24 Hours

Sample Collected/Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 12/12/2023

Method/Equipment Used: Sound Level Meter

S. No	Measurement Point	Limit Values (PEQS)	Noise Level in dB(A) Leq	Remarks
1	Langer Mahdloom, Chiniot (GPS: 31.892546°N 73.056438°E)- Day time	55 dB(A)	67 dB(A)	Exceeding Prescribed Limits
2	Langer Mahdloom, Chiniot (GPS: 31.892546°N 73.056438°E)- Night Time	45 dB(A)	66 dB(A)	Exceeding Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Noise in Residential Area, 2016 Day Time Hours (6:00 am to 10:00 pm) Night Time Hours (10:00 pm to 6:00 am)

* Uncertainty of Measurement (U₉₅) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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Analyst (Field)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager

Date: 15/12/2023

End of Report



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Report Reference	ESPAK/0796P/23/N/7543/00813	
Name of Industry/ Client	National Engineering Services Pakistan (Pvt) Limited NESPAK	
Address	1-C, Block-N, Model Town Extension, Lahore	
Project Name	Feasibility Study of Chanlot Dam Project	
Monitoring Location	Langar Makhdoom, Chanlot	
GPS Coordinates	31.892546°N 73.056438°E	
Monitoring Date	11-12-2023 to 12-12-2023	
		dB (A) Leq
Day Time	11-12-23 19:00	66.5
	10-12-23 20:00	66.4
	09-12-23 21:00	65.8
	08-12-23 22:00	65.6
	30-11-23 7:00	67.1
	29-11-23 8:00	68.5
	28-11-23 9:00	68.6
	27-11-23 10:00	68.3
	26-11-23 11:00	68.2
	25-11-23 12:00	67.7
	24-11-23 13:00	67.6
	23-11-23 14:00	66.7
	22-11-23 15:00	65.9
	21-11-23 16:00	60.9
	20-11-23 17:00	71.3
	19-11-23 18:00	50.7
Average Day time		67
Night Time	07-12-23 23:00	66.3
	07-12-23 0:00	66.5
	06-12-23 1:00	65.8
	05-12-23 2:00	66.6
	04-12-23 3:00	66.2
	03-12-23 4:00	66.3
	02-12-23 5:00	66.2
	01-12-23 6:00	66.5
Average Night time		66
Monitored By:	M Usman Mudassir	

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ANNEXURE – C

DRINKING WATER ANALYSIS REPORTS

CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: ESPAK/0796P/23/DW/7544/01613 Date: 20/12/2023

Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinot Dam Project Nature of Sample: Drinking Water from Hand Pump of Langar Mahkdoom (GPS: 31.746396°N 72.969912°E)

Telephone No: ----

Date Sample Received: 13/12/2023 Grab / Composite: Grab

Date of Sample Collection: 12/12/2023

Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Unit/Value (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	—	Detected	SMWW 9222 B	—
2	Fecal Coliform Bacteria	Must not be detectable in any 100ml sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 100ml Sample	ND	SMWW 9222 H	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	7.2	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	0.3 NTU	SMWW 2130B	Within Prescribed Limits
8	Color	≤15 TCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	414 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	280 mg/L	SMWW 2140C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	----
12	Chloride (as Cl)*	<250 mg/L	15 mg/L	SMWW 4500Cl-B	Within Prescribed Limits
13	Fluoride (F)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN)*	≤0.05 mg/L	ND	SMWW 4500 CN* F	Within Prescribed Limits
15	Nitrate (NO ₃ -)	≤50 mg/L	ND	SMWW 4500NO ₃ *B	Within Prescribed Limits
16	Nitrite (NO ₂ -)	≤3 mg/L	ND	SMWW 4500NO ₂ *B	Within Prescribed Limits
17	Phenolic Compounds (as Phenols)	mg/L	ND	SMWW 5530 C	—
18	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Antimony (Sb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	0.7 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

Signature

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Peshawar, Pakistan.
Tel: +92 312 0849999



CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)

Reference Numbers:

ESPAK/0796P/23/DW/7544/01613

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)



S. No	Parameters	Unit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	50.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	50.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	50.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	50.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	50.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NGVS	ND	Screening Method	---

DWPEQS: Punjab Environmental Quality Standards for Drinking Water Quality, 2015

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

NGVS: No Guideline Value Set

ND: Not Detected

• Laboratory tests and measurements were carried out at $25 \pm 5^\circ\text{C}$ and $50 \pm 10\%$ Relative Humidity conditions unless required otherwise.

• Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of sample acceptance or rejection with equal shared risk due to measurement uncertainty.

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- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

1. Sample Analyzed By:
 Inam-Ur-Rehman Analyst (Chemical)
 Abdul Aziz Analyst (Chemical)
 Muhammad Shahid Analyst (Chemical)
 Khaira Bano Analyst (Microbiology)
 Sanahir Khalid Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Inam Malik
 General Manager
 Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: ESPAK/D795P/23/DW/7544/01613 Date: 20/12/2023

Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinot Dam Project Nature of Sample: Drinking Water from Hand Pump of Langar Makhdom (GPS: 31.746396°N 72.969912°E)

Telephone No: ---

Date Sample Received: 13/12/2023 Grab / Composite: Grab

Date of Sample Collection: 12/12/2023

Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Limit Values (PWT-PECs)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	—	Detected	SMWW 9222 B	---
2	Fecal Coliform Bacteria	Must not be detectable in any 100ml sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 100ml sample	ND	SMWW 9222 H	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	7.2	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	0.3 NTU	SMWW 2130B	Within Prescribed Limits
8	Color	≤15 TCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	414 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	280 mg/L	SMWW 2340C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	---
12	Chloride (as Cl ⁻)*	<250 mg/L	15 mg/L	SMWW 4500Cl*B	Within Prescribed Limits
13	Fluoride (F ⁻)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN ⁻)	≤0.05 mg/L	ND	SMWW 4500 CN* F	Within Prescribed Limits
15	Nitrate (NO ₃ ⁻)	≤50 mg/L	ND	SMWW 4500NO ₃ *B	Within Prescribed Limits
16	Nitrite (NO ₂ ⁻)	≤3 mg/L	ND	SMWW 4500NO ₂ *B	Within Prescribed Limits
17	Phenolic Compounds (as Phenols)	MGVS	ND	SMWW 5530 C	---
18	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	0.7 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number:

ESPAK/0796P/23/DW/7544/01613

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	≤0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NGVS	ND	Screening Method	—

DWPEQS: Punjab Environmental Quality Standards for Drinking Water Quality, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

NGVS: No Guideline Value Set

ND: Not Detected

- Laboratory tests and measurements were carried out at $25 \pm 5^\circ\text{C}$ and $50 \pm 20\%$ Relative Humidity conditions unless required otherwise
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty

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1. Sample Analyzed By: Inam-Ur-Rehman Analyst (Chemical) Abdul Aziz Analyst (Chemical) Muhammad Shahn Analyst (Chemical) Khaira Bano Analyst (Microbiology) Samihr Khand Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Inam Malik
General Manager
Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: **ESPAK/0796P/23/DW/7545/01610** Date: **20/12/2023**

Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAC)**

Address: **1-C, Block-M, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chiniot Dam Project** Nature of Sample: **Drinking Water from Hand Pump of Talibwala (GPS: 31.943828°N 73.145539°E)**

Telephone No: **---**

Date Sample Received: **13/12/2023** Grab / Composite: **Grab**

Date of Sample Collection: **12/12/2023**

Sample Collected / Sent By: **Usman Mudassar, Analyst (Field), ESPAK**

Date of Completion of Analysis: **19/12/2023**

S. No	Parameters	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	---	Detected	SMWW 9222 B	---
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 100mL sample	ND	SMWW 9222 H	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	7.3	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	0.4 NTU	SMWW 2130B	Within Prescribed Limits
8	Color	≤15 TCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	341 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	256 mg/L	SMWW 2340C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	---
12	Chloride (as Cl ⁻)*	<250 mg/L	39 mg/L	SMWW 4500Cl B	Within Prescribed Limits
13	Fluoride (F ⁻)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN ⁻)	≤0.05 mg/L	ND	SMWW 4500 CN ⁻ F	Within Prescribed Limits
15	Nitrate (NO ₃ ⁻)	≤50 mg/L	0.3 mg/L	SMWW 4500NO ₃ ⁻ B	Within Prescribed Limits
16	Nitrite (NO ₂ ⁻)	≤3 mg/L	ND	SMWW 4500NO ₂ ⁻ B	Within Prescribed Limits
17	Phenolic Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	---
18	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	0.7 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

Signature

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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number:

ESPAK/0786P/23/DW/7545/01614

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameter	Limit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	50.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	50.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	50.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	50.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	50.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.4 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NGVS	ND	Screening Method	---

DWPEQS: Punjab Environmental Quality Standards for Drinking Water Quality, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

NGVS: No Guideline Value Set

ND: Not Detected

- Laboratory tests and measurements were carried out at $25 \pm 5^\circ\text{C}$ and $50 \pm 20\%$ Relative Humidity conditions unless required otherwise.
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1. Sample Analysed By: Imran-Ur-Rehman Analyst (Chemical) Abdul Aziz Analyst (Chemical) Muhammad Shahid Analyst (Chemical) Khaira Bano Analyst (Microbiology) Samahir Khalid Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager
Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: ESPAK/07960/23/DW/7548/01615 Date: 20/12/2023

Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAC)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinot Dam Project Nature of Sample: Drinking Water from Hand Pump of Basti Pathan (GPS: 31.849616°N 73.120799°E)

Telephone No: ---

Date Sample Received: 13/12/2023 Grab / Composite: Grab

Date of Sample Collection: 12/12/2023

Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Limit Values (DW:PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	---	12CFU/100 ml	SMWW 9222 B	---
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 100mL Sample	ND	SMWW 9222 H	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	7.3	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	0.1 NTU	SMWW 2130B	Within Prescribed Limits
8	Color	≤15 TCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	335 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	260 mg/L	SMWW 2340C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	---
12	Chloride (as Cl)*	<250 mg/L	12 mg/L	SMWW 4500Cl*B	Within Prescribed Limits
13	Fluoride (F)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN)	≤0.05 mg/L	ND	SMWW 4500 CN* F	Within Prescribed Limits
15	Nitrate (NO ₃ -)	≤50 mg/L	1 mg/L	SMWW 4500NO ₃ * B	Within Prescribed Limits
16	Nitrite (NO ₂ -)	≤3 mg/L	ND	SMWW 4500NO ₂ * B	Within Prescribed Limits
17	Phenolic Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	---
18	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Arsimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	≤7 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	≤0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

Usha

CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number:

ESPAK/0796P/13/DW/7546/01615

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameters	Unit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	≤0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.4 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NGVS	ND	U.S. EPA-200.7	---

DWPEQS- Punjab Environmental Quality Standards for Drinking Water Quality, 2016

SMWWA: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

NGVS: No Guideline Value Set

ND: Not Detected

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2. Name of Chief Analyst with Seal: Muhammad Arian

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager
Date: 20/12/2023

End of Report



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Peshawar, Pakistan.
Tel: +92 312 0849999



CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: **ESPAK/0796P/23/DW/7547/01616** Date: **20/12/2023**

Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

Address: **1-C, Block-M, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chinix Dam Project**

Telephone No: **---** Nature of Sample: **Drinking Water from Hand Pump of Kot Muhammad Yar (GPS: 31.89211° N 73.054876° E)**

Date Sample Received: **13/12/2023** Grab / Composite: **Grab**

Date of Sample Collection: **12/12/2023**

Sample Collected / Sent By: **Usman Mudassar, Analyst (Field), ESPAK**

Date of Completion of Analysis: **19/12/2023**

S. No	Parameters	Unit Values (DW-PCDS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	—	Detected	SMWW 9222 B	—
2	Fecal Coliform Bacteria	Must not be detectable in any 100mL sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 300mL sample	ND	SMWW 9222 H	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	7.5	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	6 NTU	SMWW 2130B	Exceeding Prescribed Limits
8	Color	<15 PCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<3000 mg/L	536 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	360 mg/L	SMWW 2340C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-Cl B	—
12	Chloride (as Cl ⁻)*	<250 mg/L	19 mg/L	SMWW 4500Cl-B	Within Prescribed Limits
13	Fluoride (F ⁻)*	<1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN ⁻)	<0.05 mg/L	ND	SMWW 4500 CN ⁻ F	Within Prescribed Limits
15	Nitrate (NO ₃ ⁻)	<50 mg/L	8 mg/L	SMWW 4500NO ₃ -B	Within Prescribed Limits
16	Nitrite (NO ₂ ⁻)	<3 mg/L	ND	SMWW 4500NO ₂ -B	Within Prescribed Limits
17	Phenolic Compounds (as Phenol)	NDVS	ND	SMWW 5530 C	—
18	Aluminum (Al)	<0.1 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Antimony (Sb)	<0.005 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	<0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	<0.7 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	<0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

Usha

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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number:

ESPAK/0796P/23/DW/7547/01616

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameters	Limit Values (DMA-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	≤0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NGVS	ND	Screening Method	—

DWPEQS: Punjab Environmental Quality Standards for Drinking Water Quality, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association,

Water Environment Federation USA (2017)

SEPA: United States Environmental Protection Agency

NGVS: No Guideline Value Set

ND: Not Detected

Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise

Uncertainty of Measurement (U₉₅) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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1. Sample Analyzed By: Inam-Ur-Rehman Analyst (Chemical) Abdul Aziz Analyst (Chemical) Muhammad Shahid Analyst (Chemical) Khizra Band Analyst (Microbiology) Samahra Khalid Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan

Signature of Incharge of the Environmental Laboratory:

Name: Inam Malik

General Manager

Date: 20/12/2023



-----End of Report-----

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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)



Reference Number: ESPAK/0796P/23/DW/7548/01617 Date: 20/12/2023
 Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAC)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chinot Dam Project Nature of Sample: Drinking Water from Hand Pump of Muslim Colony (GPS: 31.750495° N 72.9436°E)
 Telephone No: ---
 Date Sample Received: 13/12/2023 Grab / Composite: Grab
 Date of Sample Collection: 12/12/2023
 Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Unit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	Total Coliforms	—	Detected	SMWW 9222 B	—
2	Fecal Coliform Bacteria	Must not be detectable in any 100ml sample	ND	SMWW 9222 H	Within Prescribed Limits
3	E. Coli	Must not be detectable in any 100ml sample	ND	SMWW 9222 M	Within Prescribed Limits
4	Taste	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
5	Odor	Non Objectionable / Acceptable	Acceptable	Organoleptic	Within Prescribed Limits
6	pH*	6.5-8.5	8	SMWW 4500H*B	Within Prescribed Limits
7	Turbidity	<5 NTU	38.8	SMWW 2130B	Exceeding Prescribed Limits
8	Color	≤15 PCU	ND	SMWW 2120 C	Within Prescribed Limits
9	Total Dissolved Solids (TDS)*	<1000 mg/L	728 mg/L	SMWW 2540C	Within Prescribed Limits
10	Total Hardness as CaCO ₃ *	<500 mg/L	290 mg/L	SMWW 2340C	Within Prescribed Limits
11	Residual Chlorine	0.2-0.5 mg/L	ND	SMWW 4500-CLB	—
12	Chloride (as Cl ⁻)*	<250 mg/L	178 mg/L	SMWW 4500CLB	Within Prescribed Limits
13	Fluoride (F ⁻)*	≤1.5 mg/L	0.2 mg/L	U.S. EPA 9214	Within Prescribed Limits
14	Cyanide (CN ⁻)	≤0.05 mg/L	ND	SMWW 4500 CN ⁻ F	Within Prescribed Limits
15	Nitrate (NO ₃ ⁻)	≤50 mg/L	1 mg/L	SMWW 4500NO ₃ ⁻ B	Within Prescribed Limits
16	Nitrite (NO ₂ ⁻)	≤3 mg/L	ND	SMWW 4500NO ₂ ⁻ B	Within Prescribed Limits
17	Mercuric Compounds (as Phenols)	NGVS	ND	SMWW 5530 C	—
18	Aluminum (Al)	≤0.2 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
19	Antimony (Sb)	≤0.005 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Arsenic (As)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
21	Barium (Ba)	0.7 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Prescribed Limits
22	Boron (B)	0.3 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits

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CHEMICAL ANALYSIS TEST REPORT (DRINKING WATER)

Reference Number:

ESPAK/0796P/23/DW/7548/01617

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)



S. No	Parameters	Unit Values (DW-PEQS)	Concentration	Method / Equipment Used	Remarks
23	Cadmium (Cd)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Chromium (Cr)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Copper (Cu)	2.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Lead (Pb)	≤0.05 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Manganese (Mn)	≤0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
28	Mercury (Hg)	≤0.001 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Nickel (Ni)	≤0.02 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Selenium (Se)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
31	Zinc (Zn)	5.0 mg/L	0.8 mg/L	U.S. EPA-200.7	Within Prescribed Limits
32	Pesticides	NDVS	ND	Screening Method	---

DWPEQS: Punjab Environmental Quality Standards for Drinking Water Quality, 2016

SMWWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

NDVS: No Guideline Value Set

ND: Not Detected

- Laboratory tests and measurements were carried out at $25 \pm 5^\circ\text{C}$ and $50 \pm 20\%$ Relative Humidity conditions unless required otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of sample acceptance or rejection with equal shared risk due to measurement uncertainty.

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1. Sample Analyzed By:
Inam-Ur-Rehman Abdul Aziz Muhammad Shahid Khizar Band Samahia Khalid
Analyst (Chemical) Analyst (Chemical) Analyst (Chemical) Analyst (Microbiology) Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan *Urepha*

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik
General Manager
Date: 20/12/2023

End of Report



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ANNEXURE – D

SURFACE WATER ANALYSIS REPORT

CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: **ESPAK/0796P/23/SW/7549/00935** Date: **20/12/2023**

Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAC)**

Address: **3-C, Block-N, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chinot Dam Project**

Telephone No: **---** Nature of Sample: **Surface Water from Chenab River near Chenab Nagar (GPS: 31.768167°N 72.973063°E)**

Date Sample Received: **13/12/2023**

Date of Sample Collection: **12/12/2023** Grab / Composite: **Grab**

Sample Collected / Sent By: **Usman Mudassar, Analyst (Field), ESPAK**

Date of Completion of Analysis: **19/12/2023**

S. No	Parameters	Limit Values (WW-PCQS)	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺) [*]	6-9	7.7	SMWW 4500H ⁺ B	Within Limits
2	Total Suspended Solids (TSS) [*]	200 mg/L	28 mg/L	SMWW 2540 D	Within Limits
3	Total Dissolved Solids (TDS) [*]	3500 mg/L	240 mg/L	SMWW 2540 C	Within Limits
4	Chlorine (Cl) ⁻	1.0 mg/L	ND	SMWW 4500-Cl B	Within Limits
5	Chloride (as Cl ⁻) [*]	1000 mg/L	12 mg/L	SMWW 4500Cl ⁻ B	Within Limits
6	Fluoride (as F ⁻) [*]	10 mg/L	0.2 mg/L	U.S. EPA 9214	Within Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	ND	SMWW 4500 CN ⁻ F	Within Limits
8	Ammonia (NH ₃)	40 mg/L	ND	SMWW 4500-NH ₃ D	Within Limits
9	Sulfide (S ²⁻)	1.0 mg/L	ND	SMWW 4500 - S ²⁻ F	Within Limits
10	Sulfate (SO ₄ ²⁻) [*]	600 mg/L	42 mg/L	SMWW 4500 - SO ₄ ²⁻ C	Within Limits
11	Chemical Oxygen Demand (COD) [*]	150 mg/L	5 mg/L	SMWW 5220 D	Within Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	< 2 mg/L	SMWW 5210 B	Within Limits
13	Grease and Oil (as n-HEM)	10 mg/L	ND	U.S. EPA 1664 B	Within Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Limits
15	An-ionic detergents (as MBAS)	20 mg/L	0.4 mg/L	SMWW 5540 C	Within Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Barium (Ba)	1.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
18	Boron (B)	6.0 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Cadmium (Cd)	0.3 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
22	Iron (Fe)	6.0 mg/L	1.3 mg/L	U.S. EPA-200.7	Within Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Limits

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: **ESPAK/0796P/23/SW/7549/00895** Date: **20/12/2023**
 Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

S. No	Parameters	Limits Values (WW-PEQS)	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
30	Zinc (Zn)	5.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
31	Total Toxic Metals	2.0 mg/L	0.2 mg/L	Calculated Value	Within Limits
32	Temperature	≤37 °C	14.0 °C	SWWW 2550 B	Within Limits

WW-PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016
 SWWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)
 USEPA: United States Environmental Protection Agency

ND: Not Detected
 • Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.
 • Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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1. Sample Analyzed By: **Salma Ali** Analyst (Chemical) **Abdul Aziz** Analyst (Chemical) **Sanaullah Khalid** Analyst (Chemical) **Riaz Ahmad** Analyst (Chemical) **Muhammed Shahid** Analyst (Chemical)
 2. Name of Chief Analyst with Seal: **Muhammad Arfan**
 3. Signature of Incharge of the Environmental Laboratory:

Name: **Imran Malik**
 General Manager
 Date: **20/12/2023**



----- End of Report -----

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: ESPAK/0796P/23/SW/7550/00936 Date: 20/12/2023
 Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
 Address: 1-C, Block-N, Model Town Extension, Lahore
 Project Name: Feasibility Study of Chiriot Dam Project
 Telephone No: --- Nature of Sample: Surface Water from Chenab River near
 Date Sample Received: 13/12/2023 Besti Pathan (GPS: 31.93665°N 73.14674°E)
 Date of Sample Collection: 12/12/2023 Grab / Composite: Grab
 Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK
 Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Limit Values (WW-PQS)	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	8.3	SMWW 4500H ⁺ B	Within Limits
2	Total Suspended Solids (TSS)	200 mg/L	25 mg/L	SMWW 2540 D	Within Limits
3	Total Dissolved Solids (TDS)	3500 mg/L	244 mg/L	SMWW 2540 C	Within Limits
4	Chlorine (Cl)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Limits
5	Chloride (as Cl ⁻)	1000 mg/L	13 mg/L	SMWW 4500Cl ⁻ -B	Within Limits
6	Fluoride (as F ⁻)	10 mg/L	0.2 mg/L	U.S. EPA 9234	Within Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	ND	SMWW 4500 CN ⁻ F	Within Limits
8	Ammonia (NH ₃)	40 mg/L	ND	SMWW 4500-NH ₃ -D	Within Limits
9	Sulfide (S ²⁻)	1.0 mg/L	ND	SMWW 4500-S ²⁻ F	Within Limits
10	Sulfate (SO ₄ ²⁻)	600 mg/L	42 mg/L	SMWW 4500-SO ₄ ²⁻ C	Within Limits
11	Chemical Oxygen Demand (COD)	150 mg/L	3 mg/L	SMWW 5220 D	Within Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	< 2 mg/L	SMWW 5210 B	Within Limits
13	Grease and Oil (as n-HEM)	10 mg/L	ND	U.S. EPA 1664 B	Within Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Limits
15	Anionic Detergents (as MBAS)	20 mg/L	0.2 mg/L	SMWW 5540 C	Within Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Barium (Ba)	1.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
18	Boron (B)	6.0 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
22	Iron (Fe)	8.0 mg/L	1.1 mg/L	U.S. EPA-200.7	Within Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Limits

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)

Reference Number:

ESPAK/0796P/23/SW/7550/00936

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)



S. No	Parameters	Unit/Values (WW-PEQS)	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
30	Zinc (Zn)	5.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
31	Total Toxic Metals	2.0 mg/L	0.2 mg/L	Calculated Value	Within Limits
32	Temperature	53.7 °C	16.3 °C	SANVAN 2550 B	Within Limits

WW-PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

1. Sample Analyzed By:
 Salma Riaz Analyst (Chemical)
 Abdul Aziz Analyst (Chemical)
 Samahir Kholid Analyst (Chemical)
 Riaz Ahmad Analyst (Chemical)
 Muhammad Shahid Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan

3. Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik

General Manager

Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: ESPAK/0796P/23/SW/7551/00937 Date: 20/12/2023

Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinior Dam Project

Telephone No: ---

Date Sample Received: 13/12/2023 Nature of Samples: Surface Water from Chenab River near Talibwala (GP5-31.944845°N 73.147034°E)

Date of Sample Collection: 12/12/2023

Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK Grab / Composite: Grab

Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Limit Values (WW-PEQS)	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	7.7	SMWW 4500H ⁺ B	Within Limits
2	Total Suspended Solids (TSS)	200 mg/L	13 mg/L	SMWW 2540 D	Within Limits
3	Total Dissolved Solids (TDS)	3500 mg/L	249 mg/L	SMWW 2540 C	Within Limits
4	Chlorine (Cl ₂)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Limits
5	Chloride (as Cl ⁻)	1000 mg/L	13 mg/L	SMWW 4500Cl ⁻ - B	Within Limits
6	Fluoride (as F ⁻)	10 mg/L	0.2 mg/L	U.S. EPA 8214	Within Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	ND	SMWW 4500 CN ⁻ - F	Within Limits
8	Ammonia (NH ₃)	40 mg/L	ND	SMWW 4500-NH ₃ - D	Within Limits
9	Sulfide (S ²⁻)	1.0 mg/L	ND	SMWW 4500 - S ²⁻ F	Within Limits
10	Sulfate (SO ₄ ²⁻)	600 mg/L	49 mg/L	SMWW 4500 - SO ₄ ²⁻ C	Within Limits
11	Chemical Oxygen Demand (COD)	150 mg/L	< 3 mg/L	SMWW 5220 D	Within Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	30 mg/L	< 2 mg/L	SMWW 5210 B	Within Limits
13	Grease and Oil (as n-HEM)	10 mg/L	ND	U.S. EPA 1664 B	Within Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Limits
15	An-ionic detergents (as MBAS)	20 mg/L	0.4 mg/L	SMWW 5540 C	Within Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Barium (Ba)	1.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
18	Boron (B)	6.0 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
22	Iron (Fe)	6.0 mg/L	1.2 mg/L	U.S. EPA-200.7	Within Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Limits

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number:

ESPAK/0706P/23/SW/7551/00937

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAC)

S. No	Parameters	Limit Values (WW-PEQS)	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
30	Zinc (Zn)	5.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
31	Total Toxic Metals	2.0 mg/L	0.2 mg/L	Calculated Value	Within Limits
32	Temperature	±37 °C	15.6 °C	SMWW 2550 B	Within Limits

WW-PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

• Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.

• Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Notes:

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- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

- Sample Analyzed By:

Salma Riaz	Abdul Aziz	Samaira Khalid	Riaz Ahmed	Muhammad Shohid
Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)
- Name of Chief Analyst with Seal: Muhammad Arfan
- Signature of Incharge of the Environmental Laboratory:

Name: Imran Malik

General Manager

Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: **ESPAK/0796P/23/SW/7552/0093II** Date: **20/12/2023**

Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

Address: **1-C, Block-N, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chinot Dam Project**

Telephone No: **---** Nature of Sample: **Surface Water from Chenab River near Kot Muhammad Yar [GPS: 31.805323N 73.057683"E]**

Date Sample Received: **13/12/2023**

Date of Sample Collection: **12/12/2023** Grab / Composite: **Grab**

Sample Collected / Sent By: **Usman Mudassar, Analyst (Field), ESPAK**

Date of Completion of Analysis: **19/12/2023**

S. No	Parameters	Limit Values (WW-EQS)	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	8.3	SMWW 4500-H ⁺ B	Within Limits
2	Total Suspended Solids (TSS)*	200 mg/L	102 mg/L	SMWW 2540 D	Within Limits
3	Total Dissolved Solids (TDS)*	3500 mg/L	258 mg/L	SMWW 2540 C	Within Limits
4	Chlorine (Cl)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Limits
5	Chloride (as Cl ⁻)*	1000 mg/L	25 mg/L	SMWW 4500-Cl ⁻ B	Within Limits
6	Fluoride (as F ⁻)*	10 mg/L	0.2 mg/L	U.S. EPA 9214	Within Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	ND	SMWW 4500-CN ⁻ F	Within Limits
8	Ammonia (NH ₃)	40 mg/L	ND	SMWW 4500-NH ₃ -D	Within Limits
9	Sulfide (S ²⁻)	1.0 mg/L	ND	SMWW 4500-S ²⁻ F	Within Limits
10	Sulfate (SO ₄ ²⁻)*	600 mg/L	142 mg/L	SMWW 4500-SO ₄ ²⁻ C	Within Limits
11	Chemical Oxygen Demand (COD)*	150 mg/L	4 mg/L	SMWW 520 D	Within Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	< 2 mg/L	SMWW 5210 B	Within Limits
13	Grease and Oil (as n-HEM)	10 mg/L	ND	U.S. EPA 1664 B	Within Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Limits
15	Anionic detergents (as MBAS)	20 mg/L	0.5 mg/L	SMWW 5540 C	Within Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Barium (Ba)	1.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
18	Boron (B)	6.0 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
22	Iron (Fe)	8.0 mg/L	1.2 mg/L	U.S. EPA-200.7	Within Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Limits

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)

Reference Number:

ESPAK/0796P/23/SW/7552/00938

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt.) Limited (NESPAK)



S. No	Parameters	Limit Values (MWW-PEQs)	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
30	Zinc (Zn)	5.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
31	Total Toxic Metals	2.0 mg/L	0.2 mg/L	Calculated Value	Within Limits
32	Temperature	≤37 °C	36.1 °C	SMWW 2550 D	Within Limits

MWW-PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of sample acceptance or rejection with equal shared risk due to measurement uncertainty.

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- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

	Saima Riaz	Abdul Aziz	Samahir Khalid	Raza Ahmad	Muhammad Shahid
1. Sample Analyzed By:	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)
2. Name of Chief Analyst with Seal:	Muhammad Arfan				
3. Signature of Incharge of the Environmental Laboratory:					

Name: Imran Malik

General Manager

Date: 20/12/2023

----- End of Report -----



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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number: ESPAK/0796P/23/SW/7553/00939 Date: 20/12/2023

Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

Address: 1-C, Block-N, Model Town Extension, Lahore

Project Name: Feasibility Study of Chinot Dam Project

Telephone No: ---- Nature of Sample: Surface Water from Chanab River near Changrianwala (GPS: 31.849633°N 73.12083°E)

Date Sample Received: 13/12/2023 Grab / Composite: Grab

Date of Sample Collection: 12/12/2023

Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK

Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Limit Values (WW-PEOS)	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	7.5	SMWW 4500H ⁺ B	Within Limits
2	Total Suspended Solids (TSS)*	200 mg/L	20 mg/L	SMWW 2540 D	Within Limits
3	Total Dissolved Solids (TDS)*	3500 mg/L	234 mg/L	SMWW 2540 C	Within Limits
4	Chlorine (Cl)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Limits
5	Chloride (as Cl ⁻)	1000 mg/L	14 mg/L	SMWW 4500Cl ⁻ -B	Within Limits
6	Fluoride (as F ⁻)	10 mg/L	0.2 mg/L	U.S. EPA 9214	Within Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	ND	SMWW 4500 CN ⁻ F	Within Limits
8	Ammonia (NH ₃)	40 mg/L	ND	SMWW 4500-NH ₃ - D	Within Limits
9	Sulfide (S ²⁻)	1.0 mg/L	ND	SMWW 4500 - S ²⁻ F	Within Limits
10	Sulfate (SO ₄ ²⁻)	600 mg/L	73 mg/L	SMWW 4500 - SO ₄ ²⁻ C	Within Limits
11	Chemical Oxygen Demand (COD)*	150 mg/L	5 mg/L	SMWW 5220 D	Within Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	< 2 mg/L	SMWW 5210 B	Within Limits
13	Grease and Oil (as n-HexA)	10 mg/L	ND	U.S. EPA 1664 B	Within Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Limits
15	An-Ionic detergents (as MBAS)	20 mg/L	0.5 mg/L	SMWW 5540 C	Within Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
17	Barium (Ba)	1.5 mg/L	0.1 mg/L	U.S. EPA-200.7	Within Limits
18	Boron (B)	5.0 mg/L	ND	U.S. EPA-200.7	Within Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
22	Iron (Fe)	8.0 mg/L	1.1 mg/L	U.S. EPA-200.7	Within Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Limits

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CHEMICAL ANALYSIS TEST REPORT (SURFACE WATER)



Reference Number:

ESPAK/0796P/Z3/SW/7553/00939

Date: 20/12/2023

Name of Industry / Client:

National Engineering Services Pakistan (Pvt) Limited (NESPAK)

S. No	Parameters	Limit Values (WW-PEQS)	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Limits
30	Zinc (Zn)	5.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Limits
31	Total Toxic Metals	2.0 mg/L	0.2 mg/L	Calculated Value	Within Limits
32	Temperature	≤37 °C	15.0 °C	SM/WW 3550 B	Within Limits

WW-PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016

SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

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- Sample Analyzed By:

Salma Riaz	Abdul Aziz	Samaira Khalid	Riaz Ahmad	Muhammad Shahid
Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)	Analyst (Chemical)
- Name of Chief Analyst with Seal: Muhammad Arfan
- Signature of Incharge of the Environmental Laboratory:

Name: Umran Malik
General Manager
Date: 20/12/2023



----- End of Report -----

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ANNEXURE – E

WASTEWATER ANALYSIS REPORTS

CHEMICAL ANALYSIS TEST REPORT (WASTE WATER)


Reference Number: ESPAK/0796P/23/WW/7554/00940 **Date:** 20/12/2023
Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)
Address: 1-C, Block-N, Model Town Extension, Lahore
Project Name: Feasibility Study of Chinlot Dam Project
Telephone No: _____ **Nature of Sample:** Wastewater from Sareem of Kerseh
Date Sample Received: 13/12/2023 **Grab / Composite:** Grab **Shelf (GPS):** 31.849633°N 73.12083°E
Date of Sample Collection: 12/12/2023
Sample Collected / Sent By: Usman Mudassar, Analyst (Field), ESPAK
Date of Completion of Analysis: 19/12/2023

S. No	Parameters	Unit Values PEQS	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	7.8	SMWW 4500H ⁺ B	Within Prescribed Limits
2	Total Suspended Solids (TSS)*	200 mg/L	13 mg/L	SMWW 2540 D	Within Prescribed Limits
3	Total Dissolved Solids (TDS)*	3500 mg/L	1448 mg/L	SMWW 2540 C	Within Prescribed Limits
4	Chlorine (Cl)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Prescribed Limits
5	Chloride (as Cl ⁻)*	1000 mg/L	165 mg/L	SMWW 4500Cl ⁻ -B	Within Prescribed Limits
6	Fluoride (as F ⁻)*	10 mg/L	0.5 mg/L	U.S. EPA 9214	Within Prescribed Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	0.1 mg/L	SMWW 4500 CN ⁻ F	Within Prescribed Limits
8	Ammonia (NH ₃)	40 mg/L	87 mg/L	SMWW 4500-NH ₃ -D	Exceeding Prescribed Limits
9	Sulfide (S ²⁻)	1.0 mg/L	11 mg/L	SMWW 4500 - S ²⁻ F	Exceeding Prescribed Limits
10	Sulfate (SO ₄ ²⁻)*	600 mg/L	443 mg/L	SMWW 4500 - SO ₄ ²⁻ C	Within Prescribed Limits
11	Chemical Oxygen Demand (COD)*	150 mg/L	468 mg/L	SMWW 5220 D	Exceeding Prescribed Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	248 mg/L	SMWW 5210 B	Exceeding Prescribed Limits
13	Grease and Oil (as n-HEx)	10 mg/L	18 mg/L	U.S. EPA 1664 B	Exceeding Prescribed Limits
14	Phenolic Compounds (as Phenol)	0.1 mg/L	ND	SMWW 5530 C	Within Prescribed Limits
15	An-ionic detergents (as MBAS)	20 mg/L	0.3 mg/L	SMWW 5540 C	Within Prescribed Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
17	Barium (Ba)	1.5 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
18	Boron (B)	6.0 mg/L	0.7 mg/L	U.S. EPA-200.7	Within Prescribed Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Chromium (Trivalent) and Hexavalent	1.0 mg/L	0.5 mg/L	U.S. EPA-200.7	Within Prescribed Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Iron (Fe)	6.0 mg/L	0.7 mg/L	U.S. EPA-200.7	Within Prescribed Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Prescribed Limits

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CHEMICAL ANALYSIS TEST REPORT (WASTE WATER)



Reference Number: ESPAK/0796P/23/WW/7554/00940 Date: 20/12/2023
 Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameters	Limit Values PEQS	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Zinc (Zn)	5.0 mg/L	1.2 mg/L	U.S. EPA-200.7	Within Prescribed Limits
31	Total Toxic Metals	2.0 mg/L	1.4 mg/L	Calculated Value	Within Prescribed Limits
32	Temperature	≤37 °C	17.2 °C	SMWW 2550-B	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016
 SMWW: Standard Methods for the Examination of Water and Waste Water 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.
- Uncertainty of Measurements (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of sample acceptance or rejection with equal shared risk due to measurement uncertainty.

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- The report data is not intended to be used legally by the client.
- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

1. Sample Analyzed By: Salma Riaz Abdul Atif Samahir Khalid Riaz Ahmed Muhammad Shahid
 Analyst (Chemical) Analyst (Chemical) Analyst (Chemical) Analyst (Chemical) Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan *[Signature]*

3. Signature of Incharge of the Environmental Laboratory: *[Signature]*

Name: Imran Malik
 General Manager
 Date: 20/12/2023

End of Report



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CHEMICAL ANALYSIS TEST REPORT (WASTE WATER)



Reference Number: **ESPAK/0796P/23/WW/7555/00941** Date: **20/12/2023**

Name of Industry / Client: **National Engineering Services Pakistan (Pvt.) Limited (NESPAK)**

Address: **E-C, Block-N, Model Town Extension, Lahore**

Project Name: **Feasibility Study of Chinlok Dam Project**

Telephone No: **---** Nature of Sample: **Wastewater from Stream of Host Kiliwa (GPS: 31.819058°N 73.029098°E)**

Date Sample Received: **13/12/2023** Grab / Composite: **Grab**

Date of Sample Collection: **12/12/2023**

Sample Collected / Sent By: **Usman Mudassar, Analyst (Field), ESPAK**

Date of Completion of Analysis: **19/12/2023**

S. No	Parameter	Limit/Values PEQS	Concentration	Method / Equipment Used	Remarks
1	pH value (H ⁺)	6-9	9.7	SMWW 4500H ⁺ B	Exceeding Prescribed Limits
2	Total Suspended Solids (TSS)	200 mg/L	27 mg/L	SMWW 2540 D	Within Prescribed Limits
3	Total Dissolved Solids (TDS)	3500 mg/L	16100 mg/L	SMWW 2540 C	Exceeding Prescribed Limits
4	Chlorine (Cl)	1.0 mg/L	ND	SMWW 4500-Cl B	Within Prescribed Limits
5	Chloride (as Cl ⁻)	1000 mg/L	2459 mg/L	SMWW 4500Cl ⁻ B	Exceeding Prescribed Limits
6	Fluoride (as F ⁻)	10 mg/L	0.3 mg/L	U.S. EPA 9214	Within Prescribed Limits
7	Cyanide (as CN ⁻)	1.0 mg/L	0.6 mg/L	SMWW 4500 CN ⁻ F	Within Prescribed Limits
8	Ammonia (NH ₃)	40 mg/L	406 mg/L	SMWW 4500-NH ₃ D	Exceeding Prescribed Limits
9	Sulfide (S ²⁻)	1.0 mg/L	88 mg/L	SMWW 4500 - S ²⁻ F	Exceeding Prescribed Limits
10	Sulfate (SO ₄ ²⁻)	500 mg/L	428 mg/L	SMWW 4500 - SO ₄ ²⁻ C	Within Prescribed Limits
11	Chemical Oxygen Demand (COD)	150 mg/L	7144 mg/L	SMWW 5220 D	Exceeding Prescribed Limits
12	Biochemical Oxygen Demand (BOD ₅) at 20 °C	80 mg/L	3786 mg/L	SMWW 5210 B	Exceeding Prescribed Limits
13	Grease and Oil (as n-HExH)	10 mg/L	3 mg/L	U.S. EPA 1664 B	Within Prescribed Limits
14	Phenolic Compounds (as Phenol)	0.3 mg/L	ND	SMWW 5530 C	Within Prescribed Limits
15	An-ionic detergents (as MBAS)	20 mg/L	0.2 mg/L	SMWW 5540 C	Within Prescribed Limits
16	Arsenic (As)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
17	Barium (Ba)	1.5 mg/L	0.7 mg/L	U.S. EPA-200.7	Within Prescribed Limits
18	Boron (B)	6.0 mg/L	0.2 mg/L	U.S. EPA-200.7	Within Prescribed Limits
19	Cadmium (Cd)	0.1 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
20	Chromium (Trivalent and Hexavalent)	1.0 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
21	Copper (Cu)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
22	Iron (Fe)	8.0 mg/L	0.6 mg/L	U.S. EPA-200.7	Within Prescribed Limits
23	Lead (Pb)	0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
24	Manganese (Mn)	1.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
25	Mercury (Hg)	0.01 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
26	Nickel (Ni)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
27	Pesticides	0.15 mg/L	ND	Screening Method	Within Prescribed Limits

Lahore Office
Office No. 731,
Block - 2, Sector D1,
Shah Jilani Road, Township
Lahore, Pakistan.
Tel: +92 (42) 3515 4015-16

Islamabad Office
Office No. 314, 3rd
Floor, Gulberg Empire,
Gulberg Greens,
Islamabad, Pakistan.
Tel: +92 (51) 5915060

Peshawar Office
Unit No. 43-TF,
Dean's Trade Center
Sadar Cantt,
Peshawar, Pakistan.
Tel: +92 312 0809999



CHEMICAL ANALYSIS TEST REPORT (WASTE WATER)



Reference Number: ESPAK/07960/23/WW/7555/00941 Date: 20/12/2023
 Name of Industry / Client: National Engineering Services Pakistan (Pvt.) Limited (NESPAK)

S. No	Parameters	Units Values PEQS	Concentration	Method / Equipment Used	Remarks
28	Selenium (Se)	0.5 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
29	Silver (Ag)	1.0 mg/L	ND	U.S. EPA-200.7	Within Prescribed Limits
30	Zinc (Zn)	5.0 mg/L	1.3 mg/L	U.S. EPA-200.7	Within Prescribed Limits
31	Total Toxic Metals	2.0 mg/L	1.6 mg/L	Calculated Value	Within Prescribed Limits
32	Temperature	≤37 °C	17.8 °C	SMWW 2550 B	Within Prescribed Limits

PEQS: Punjab Environmental Quality Standards for Municipal & Liquid Industrial Effluents, 2016

SMWW: Standard Methods for the Examination of Water and Wastewater 23rd Edition, American Public Health Association, American Water Works Association, Water Environment Federation USA (2017)

USEPA: United States Environmental Protection Agency

ND: Not Detected

- Laboratory tests and measurements were carried out at 25 ± 5 °C and 50 ± 20 % Relative Humidity conditions unless required otherwise.
- Uncertainty of Measurement (UoM) data will be provided on request, where available. The statement of conformity, if provided in the report, is based on the decision rule of simple acceptance or rejection with equal shared risk due to measurement uncertainty.

Notes

- The report should be reproduced as a whole and not in parts.
- The responsibility of the ethical use of this report lies with the client.
- The values represent sample conditions when monitoring/testing was carried out.
- The report data is not intended to be used legally by the client.
- Only parameters marked with asterisk (*) are ISO 17025:2017 accredited.

1. Sample Analyzed By: Sakina Bilal Abdul Aziz Sanaullah Khaila Ali Ahmad Muhammad Shahid
 Analyst (Chemical) Analyst (Chemical) Analyst (Chemical) Analyst (Chemical) Analyst (Chemical)

2. Name of Chief Analyst with Seal: Muhammad Arfan *Wahid*

3. Signature of Incharge of the Environmental Laboratory: *Inchaleh*

Name: Imran Malik
 General Manager
 Date: 20/12/2023



----- End of Report -----

📍 **Lahore Office**
 Office No. 731,
 Block - 2, Sector D1,
 Shah Alani Road, Township
 Lahore, Pakistan.
 ☎ Tel: +92 (42) 3515 4015-16

📍 **Islamabad Office**
 Office No. 314, 3rd
 Floor, Gulberg Empire,
 Gulberg Greens,
 Islamabad, Pakistan,
 ☎ Tel: +92 (51) 5915060

📍 **Peshawar Office**
 Unit No. 43-TF,
 Dean's Trade Center
 Sadar Cantt,
 Peshawar, Pakistan.
 ☎ Tel: +92 312 0849999



ANNEXURE – F

CALIBRATION CERTIFICATE



Unitech Calibration Services
296, Business Center,
G11 Markaz, Islamabad
051-8869514
info@unitechcal.com

CALIBRATION CERTIFICATE

Certificate Number: 00803-23
Instrument Manufacturer: ENVIRONMENTAL S.A
Instrument Type: Ambient Air Quality Monitoring Station
Model Number: 0342e
Serial Number: 8189e
Calibration Date: August 8, 2023
Calibration Due Date: August 7, 2024

Calibration Procedure

The instrument detail above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest versions of the international standards

EN ISO/IEC 17025

CISPR-11 Radiated RF emission measurements

CISPR-11 Mains Terminal RF emission measurements

IEC-61000-3-3 Mains Terminal voltage fluctuation measurements

IEC-61000-3-2 where applicable.

Calibration Climate Conditions

The climate test conditions were all maintained within the permitted limits of EN ISO/IEC 17025

Temperature	24.4 °C $\pm$ 0.1 °C	Relative Humidity	39.2% $\pm$ 1 %RH
Static Pressure:	998 hPa	Ambient Noise level:	53 dB

Measurement Results

Sr.	Parameter(s)	Reference Value	Actual Value	Signal Source/Equipment
1-	O3 Gas	25.0 PPB	25 PPB	Ozone Generator
		48.0 PPB	48.6 PPB	Ozone Generator
		81.0 PPB	82.4 PPB	Ozone Generator
		100.0 PPB	101.9 PPB	Ozone Generator

Note:

The measuring instrument is adjusted by a Calibrator 4 levels of adjustment by an Ozone Generator Model T703.

Calibrator Details

Manufacturer	Serial	Description
Teledyne	0182	Ozone Generator Model T703

Calibration by:

Unitech Calibrations





Unitech Calibration Services
296, Business Center,
G11 Markaz, Islamabad
051-8869514
info@unitechcal.com

CALIBRATION CERTIFICATE

Certificate Number: 00004-23
Instrument Manufacturer: ENVIRONMENTAL S.A
Instrument Type: Ambient Air Quality Monitoring Station
Model Number: AF22e
Serial Number: 7504e
Calibration Date: August 8, 2023
Calibration Due Date: August 7, 2024

Calibration Procedure

The instrument detail above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest versions of the International standards.

EN ISO/IEC 17025

CISPR-11 Radiated RF emission measurements

CISPR-11 Mains Terminal RF emission measurements

IEC-61000-3-3 Mains Terminal voltage fluctuation measurements

IEC-61000-3-2 where applicable.

Calibration Climate Conditions

The climate test conditions were all maintained within the permitted limits of EN ISO/IEC 17025

Temperature	24.4 °C ± 0.1 °C	Relative Humidity	39.2% ± 1 %RH
Static Pressure:	998 hPa	Ambient Noise level:	53 dB

Measurement Results

Sr.	Parameter(s)	Reference Value	Actual Value	Signal Source/Equipment
1.	SO ₂ Gas	20.1 PPB	19.4 PPB	Gas Diluter + Cylinder
		50.2 PPB	49.1 PPB	Gas Diluter + Cylinder
		99.8 PPB	95.7 PPB	Gas Diluter + Cylinder
		502.0 PPB	492.4 PPB	Gas Diluter + Cylinder

Note:

The measuring instrument is adjusted by a Calibrator 4 levels of adjustment by a Gas Diluter.

Calibrator Details

Manufacturer	Serial	Description
Teledyne	0564	Gas Diluter Model T700
Honeywell Gases	776394	SO ₂ Gas Cylinder 10 PPM

Calibration by:

Unitech Calibration





Unitech Calibration Services
296, Business Center,
G11 Markaz, Islamabad
051-8869514
info@unitechcal.com

CALIBRATION CERTIFICATE

Certificate Number: 00805-23
Instrument Manufacturer: ENVIRONMENTAL S.A
Instrument Type: Ambient Air Quality Monitoring Station
Model Number: CO12e
Serial Number: 5891e
Calibration Date: August 8, 2023
Calibration Due Date: August 7, 2024

Calibration Procedure

The instrument detail above has been calibrated to the published test and calibration data as detailed in the Instrument handbook, using the techniques recommended in the latest versions of the international standards

EN ISO/IEC 17025

CISPR-11 Radiated RF emission measurements

CISPR-11 Mains Terminal RF emission measurements

IEC-61000-3-3 Mains Terminal voltage fluctuation measurements

IEC-61000-3-2 where applicable.

Calibration Climate Conditions

The climate test conditions were all maintained within the permitted limits of EN ISO/IEC 17025

Temperature	24.4 °C ± 0.1 °C	Relative Humidity	39.2% ± 1 %RH
Static Pressure:	998 hPa	Ambient Noise level	53 dB

Measurement Results

Sr.	Parameter(s)	Reference Value	Actual Value	Signal Source/Equipment
1-	CO Gas	500.0 PPM	499.9 PPM	Gas Diluter + Cylinder
		5.1 PPM	5.0 PPM	Gas Diluter + Cylinder
		10.4 PPM	10.1 PPM	Gas Diluter + Cylinder
		20.0 PPM	19.7 PPM	Gas Diluter + Cylinder

Note:

The measuring instrument is adjusted by a Calibrator 4 levels of adjustment by a Gas Diluter.

Calibrator Details

Manufacturer	Serial	Description
Teledyne	0564	Gas Diluter Model T700
Honeywell Gases	778361	CO Gas Cylinder 100 PPM

Calibration by:


Unitech Calibration



CALIBRATION CERTIFICATE

Certificate Number: 00806-23
Instrument Manufacturer: ENVIRONMENTAL S.A
Instrument Type: Ambient Air Quality Monitoring Station
Model Number: AC32e
Serial Number: 2229e
Calibration Date: August 8, 2023
Calibration Due Date: August 7, 2024

Calibration Procedure

The instrument detail above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest versions of the International standards

EN ISO/IEC 17025

CISPR-11 Radiated RF emission measurements

CISPR-11 Mains Terminal RF emission measurements

IEC-61000-3-3 Mains Terminal voltage fluctuation measurements

IEC-61000-3-2 where applicable.

Calibration Climate Conditions

The climate test conditions were all maintained within the permitted limits of EN ISO/IEC 17025

Temperature	24.4 °C ± 0.1 °C	Relative Humidity	39.2% ± 1 %rH
Static Pressure:	998 hPa	Ambient Noise level:	53 dB

Measurement Results

Sr.	Parameter(s)	Reference Value	Actual Value	Signal Source/Equipment
1-	NO Gas	5.0 PPB	5.0 PPB	Gas Diluter + Cylinder
		10.0 PPB	10.3 PPB	Gas Diluter + Cylinder
		50.0 PPB	53.6 PPB	Gas Diluter + Cylinder
		100.0 PPB	106.1 PPB	Gas Diluter + Cylinder
2-	NO2 Gas	5.0 PPB	4.11 PPB	Gas Diluter + Cylinder
		10.0 PPB	9.9 PPB	Gas Diluter + Cylinder
		50.0 PPB	50.2 PPB	Gas Diluter + Cylinder
		100.0 PPB	96.7 PPB	Gas Diluter + Cylinder

Note:

The measuring instrument is adjusted by a Calibrator 4 levels of adjustment by a Gas Diluter.

Calibrator Details

Manufacturer	Serial	Description
Teledyne	0564	Gas Diluter Model T700
Honeywell Gases	776317	NO Gas Cylinder 10 PPM
Honeywell Gases	400357	NO2 Gas Cylinder 5 PPM

Calibration by:

Unitech Calibrations



DEALS IN | Instrumentation | Calibration | Environmental Testing | Lifting Equipments | Inspection | Automation |

CALIBRATION CERTIFICATE

CERTIFICATE NO: ESP-123

PAGE NO: 1 OF 1

CUSTOMER NAME: Environmental Services Pakistan. ADDRESS: Office # 731 Block # 2, Sector D-I, Near Rias Chawh Town Ship, Lahore, Pakistan.	DOC NO: IT-483	
	DOC REV. DATE	REV. NO

03-03-2018 00

HISTORY OF THE INSTRUMENT:

EQUIPMENT:	Nalga Level Meter	PHYSICAL CONDITION:	OK
MAKE/MODEL:	China / GM-1356	LOCATION:	Field Section
MANUFACTURER:	BENTECH	CODE:	ESP/QC/F/016
RANGE:	30 ~ 135 dB	CALIBRATION CONDITION:	23.2°C
UNIT:	dB	HUMIDITY:	45~65%RH
LEAST COUNT:	0.1 dB	CALIBRATION DATE:	12-03-2023
SERIAL NO:	EA 2452325	NEXT CALIBRATION DATE:	11-03-2024

REFERENCE STANDARD INSTRUMENT TRACEABILITY:

Reference Standard Sound Calibrator & Digital Sound Meter, Calibration Certificate No: IT9972-05, Traceable to PMEL APF PAC KAMRA. Which in turn is traceable to International Standards of measurement in accordance with the metrology rule and regulation. Which is in compliance with relevant clauses of ISO/IEC 17025: 2017 Standard requirements.

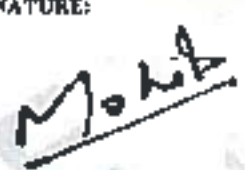
CALIBRATION RESULTS: (All results in dB)

NOMINAL READING ON INSTRUMENT UNDER CALIBRATION	AVERAGE OBSERVED READING ON THE REFERENCE STANDARD	DEVIATION
94.0	94.1	-0.1
114.0	114.0	0.0

These are test results, not a specification

REMARKS:

The instrument is fit for use.

CALIBRATED BY: SIGNATURE: 		LAB MANAGER: SIGNATURE: 

END

CALIBRATION CERTIFICATE

Date of Issue: 25-Jul-2023

Calibration Certificate #: CC/0017460

CUSTOMER DETAILS:

Customer Name: Environmental Services Pakistan
Address: Office No.731, Block-2, Sector D1, Shah Faisal Road, Township, Lahore
Request #: Verbal
Job #: IN/001015

DETAILS OF UNIT UNDER CALIBRATION:

Calibration Date: 18-Jul-2023 Calibration Due (Proposed): One (1) year from the date of calibration. (Where Required)
Location: Main Hall

UUC Description	Make	Model/Type	Serial #	Asset ID	Accuracy
COD Reader	HANNA	HI 139800	-	ESP-LAB-EQP-027	-

Condition: ☒ Working Satisfactory upon receipt ☒ Calibration done without relevant specification
☐ Not Working Satisfactory upon receipt ☐ Calibration done after adjustment / repair
☐ Found to meet specification upon receipt

ENVIRONMENTAL CONDITIONS DURING TEST:

Temperature: 23.5 °C ± 0.5 °C
Relative Humidity: 47.5 %RH ± 0.5 %RH

CALIBRATION METHOD:

Calibration Procedure: DKD-B-3-1 International Standard Procedure for Calibration of Digital Thermometers

TRACEABILITY:

Traceability: The measurements made by Al Meezan Industrial Metrology Services, are traceable to physical units of measurements (SI), through its state of the art, calibration standards that are controlled and maintained by AIMS. Reference equipment used is/are traceable to National / International standards through other prestigious calibration laboratories, details given below

Reference Equipment:

Description	Make	Model/Type	Asset ID	Certificate #	Traceability
Touch Probe Thermometer	Fluke	52 II	T-006	AIMS/INT/TC/23/0010	DCL Dubai

For calibration results see next page(s)



Approved Signatories:

Shahzad Ahmed (QM) ☐

Ghulam Sarwar (QM) ☐

Raz Ahmad (Lab Incharge) ☒

(Approved Signatory):



CALIBRATION CERTIFICATE

Date of Issue: 7-Aug-2023

Calibration Certificate #: CC/0017485

CUSTOMER DETAILS:

Customer Name: Environmental Services Pakistan
Address: Office No. 731, Block-2, Sector D1, Shah Jikail Road, Township, Lahore
Request #: Verbal
Job #: JN/001015

DETAILS OF UNIT UNDER CALIBRATION:

Calibration Date: 27-Jul-2023 Calibration Due (Proposed): One (1) year from the date of calibration. (Where Required)
Location: Lab

UDC Description	Make	Model/Type	Serial #	Asset ID	Accuracy
Autoclave	KAIPO	XXQSG41.46.280A	-	BSP-LAB-EQP-040	-

Condition: ☒ Working Satisfactory upon receipt ☒ Calibration done without relevant specification
☐ Not Working Satisfactory upon receipt ☐ Calibration done after adjustment / repair
☐ Found to meet specification upon receipt

ENVIRONMENTAL CONDITIONS DURING TEST:

Temperature: 23.5 °C ± 0.5 °C
Relative Humidity: 49.5 %RH ± 0.5 %RH

CALIBRATION METHOD:

Calibration Procedure: DK12-R-6-1 DKD-R-5-1

TRACEABILITY:

Traceability: The measurements made by Al Meezan Industrial Metrology Services, are traceable to physical units of measurement (SI), through its suite of the art, calibration standards that are controlled and maintained by AIMS. Reference equipment used is/are traceable to National / International standards through other prestigious calibration laboratories, details given below:

Reference Equipment:

Description	Make	Model/Type	Asset ID	Certificate #	Traceability
Pressure Data Logger	Medgeotech	PR140	P-013	TCSL-21-2423	NPL, UK
High Temperature Data Loggers	Medgeotech	HiTemp140	T-120 - T-122	AIMS/INT/CC/23/0101	DCI, Dubai

For calibration results see next page(s)



Approved Signatories

Shahid Ahmed (QM) ☐

Ghulam Sarwar (QM) ☐

Riaz Ahmed (Lab Incharge) ☒

(Approved Signatory):



CALIBRATION CERTIFICATE

Date of Issue: 7-Aug-2023

Calibration Certificate #: CC/0017489

CUSTOMER DETAILS:

Customer Name: Environmental Services Pakistan
Address: Office No. 731, Block-2, Sector D1, Shah Jilani Road, Township, Lahore.
Request #: Verbal
Job #: JN001015

DETAILS OF UNIT UNDER CALIBRATION:

Calibration Date: 27-Jul-2023 Calibration Due (Proposed): One (1) year from the date of calibration (Where Required)
Location: Main Hall

UUC Description	Make	Model/Type	Serial #	Asset ID	Accuracy
UV/Vis Spectrophotometer	SHIMADZU	UV-1800	A11635406453	ESP-LAB-EQP-031	-

Condition: ☒ Working Satisfactory upon receipt ☐ Calibration done without relevant specification
☐ Not Working Satisfactory upon receipt ☐ Calibration done after adjustment / repair
☐ Found to meet specification upon receipt

ENVIRONMENTAL CONDITIONS DURING TEST:

Temperature: 25.5 °C ± 0.5 °C
Relative Humidity: 49.5 %RH ± 0.5 %RH

CALIBRATION METHOD:

Calibration Procedure: AS TQ4 Calibration Procedure For UV/Vis Spectrophotometer

TRACEABILITY:

Traceability: The measurements made by Al Meezan Industrial Metrology Services, are traceable to physical units of measurements (SI), through its state of the art, calibration standards that are controlled and maintained by AIMS. Reference equipment used is/are traceable to National / International standards through other prestigious calibration laboratories, details given below:

Reference Equipment:

Description	Make	Model/Type	Asset ID	Certificate #	Traceability
Spectronic Standard Filters	EMC Labs	666S000	ITS-039	78501, 78502	PTB Germany

For calibration results see next page(s)



Approved Signatories

Shahzad Ahmed (GM)

Ghulam Sarwar (QAO)

Riaz Ahmed (Lab Incharge)



(Approved Signatory):



ANNEXURE – G

ENVIRONMENTAL APPROVAL



ENVIRONMENT PROTECTION DEPARTMENT

Government of the Punjab
National Hockey Stadium, Lahore.



CERTIFICATION AS AN ENVIRONMENTAL LABORATORY

In exercise of power conferred by clause (k) of sub section (1) of section 6 of the Punjab Environmental Protection Act 1997 (XXXIV of 1997), the Provincial Agency is pleased to certify the laboratory mentioned below as an Environmental Laboratory, for conducting tests & Analysis.

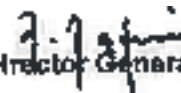
Name: -Environmental Services Pakistan

Address: -731, Block-2, Sector D-1, Shah Jahan Road, Township, Lahore.

Certificate No. 15-DD(Lab/EPA)/2022

1. This certification is valid as described below subject to fulfillment to the conditions of certification placed at Annex-F.
 - (a) Municipal & Liquid effluents as per Annexure-A.
 - (b) Drinking Water Quality as per Annexure-B.
 - (c) Industrial and Gaseous Emissions as per Annexure-C.
 - (d) Motor Vehicle Exhaust and Noise for in Use Vehicles registered before 01.07.2012 (For Diesel vehicle) & 01.07.2009 (for Petrol Vehicle) as per Annexure-D.
 - (e) Ambient Air & Ambient Noise as per Annexure-E.
2. This certification is subject to the conditions laid down in regulation 9 of the Certification of Environmental Laboratories Regulations, 2000 and QA/QC conditions contained in Annex-F.
3. This certificate is valid until 31.12.2024 unless earlier suspended or revoked.

Dated: 24/2/2022


Director General



ANNEXURE – H

PHOTOLOG

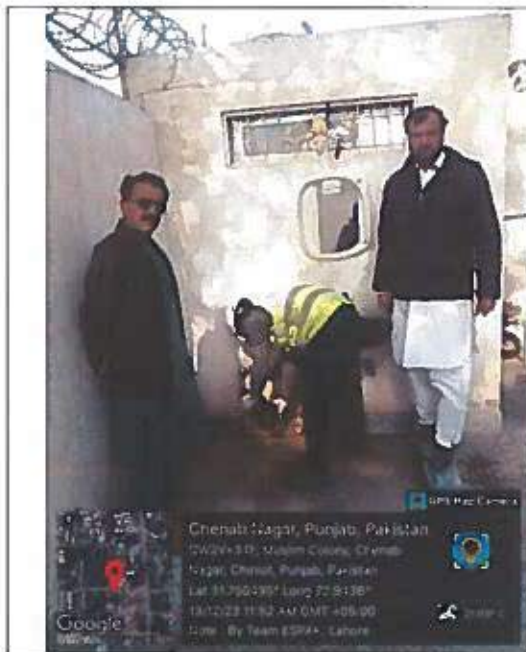


Figure # 6: Drinking water from Hand Pump of Langer Makhdum

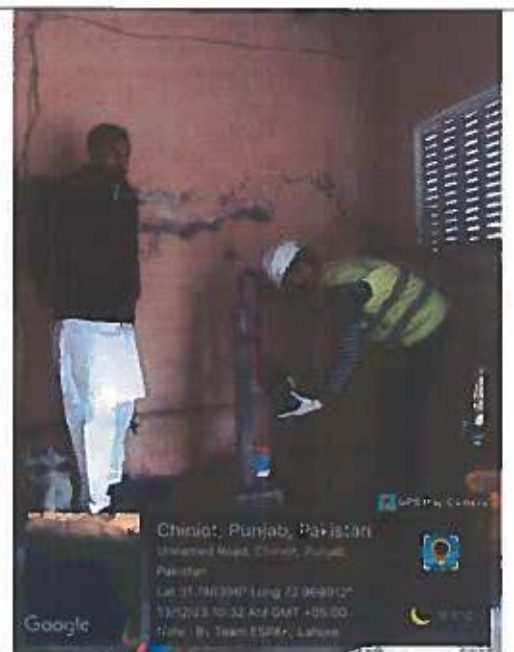


Figure # 7: Drinking water from Hand Pump of Talibwala

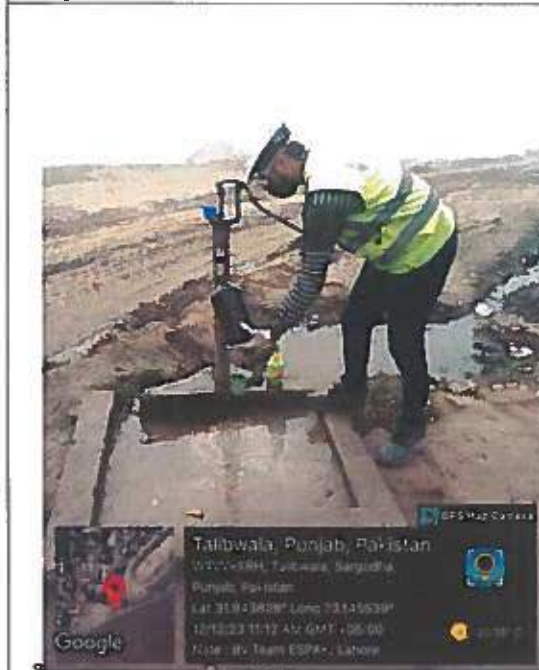


Figure # 8: Drinking Water from Hand Pump Basti Mallah

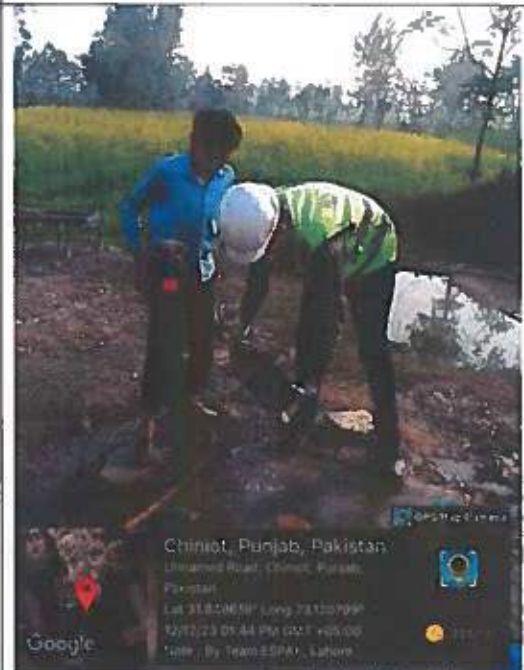


Figure # 9: Drinking water from Hand Pump of Kot Muhammad Yar



Figure # 10: Drinking water from Hand Pump of Muslim Colony

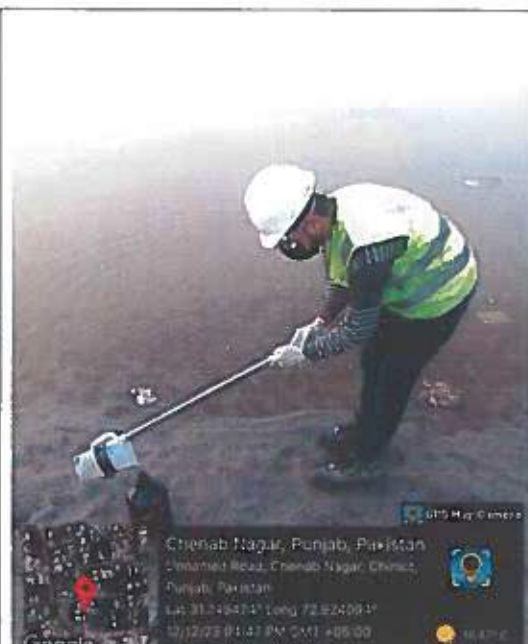


Figure # 11: Surface water from Chenab River near Chenab Nagar

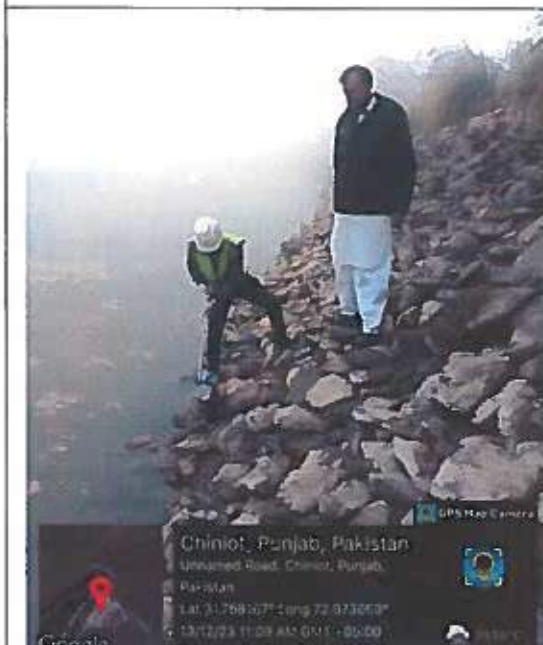


Figure # 12: Surface water from Chenab River near Bahl Pahan

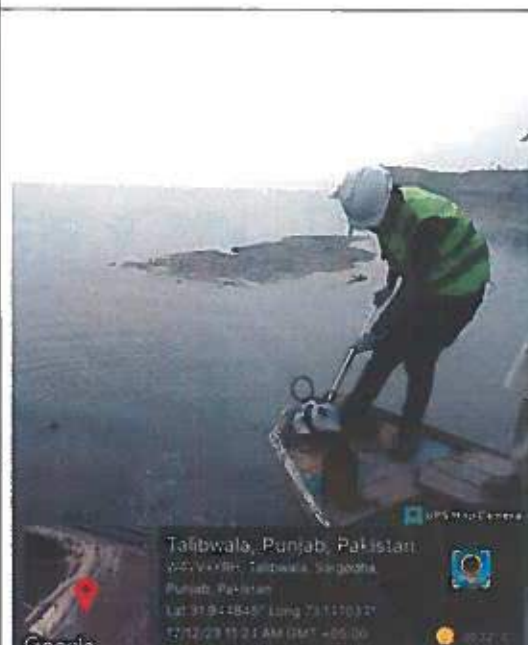


Figure # 13: Surface water from Chenab River near Talibwala

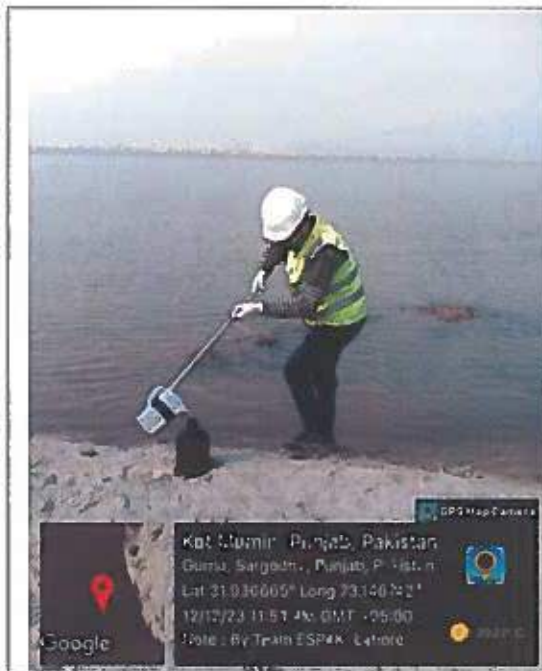


Figure # 14: Surface water from Chenab River near Kot Muhammad Yar

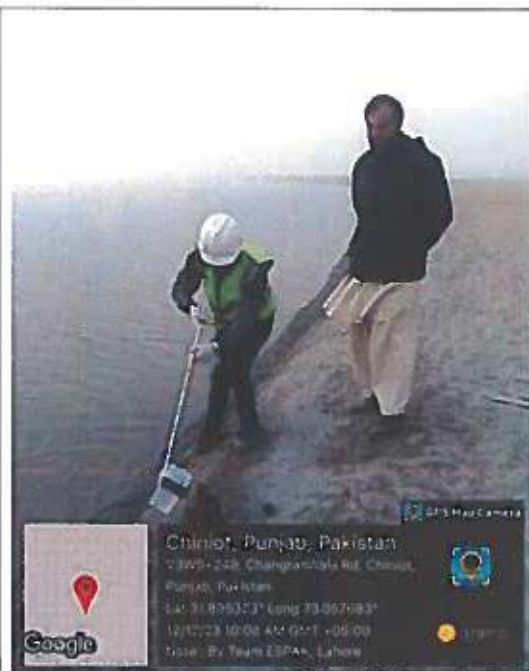


Figure # 15: Surface water from Chenab River near Chongraiwala

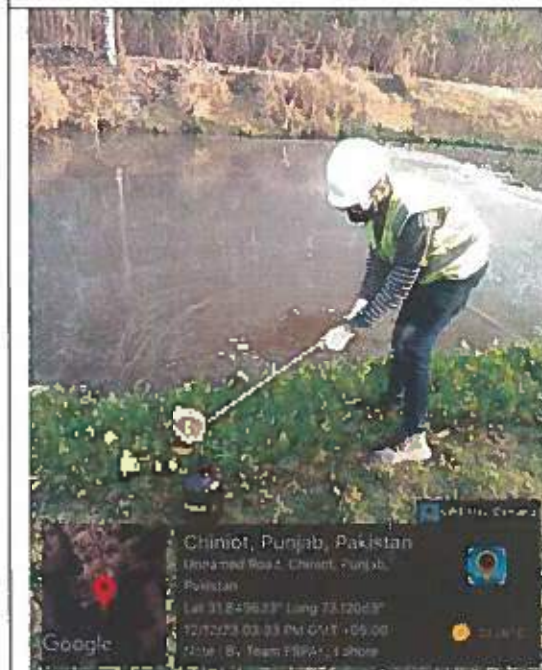


Figure # 16: Waste water from stream Of Kersah Shalk

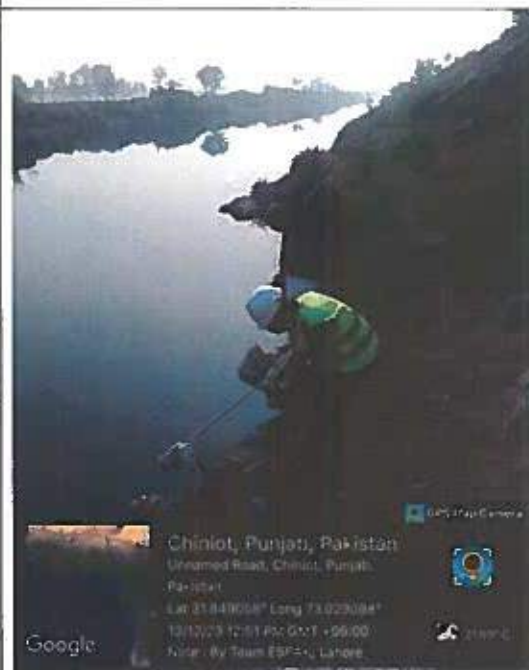


Figure # 17: Waste water from Stream of Hask Khwa

OUR INFORMATION

ENVIRONMENTAL SERVICES PAKISTAN

Address: Office # 731, Block # 2, Sector D-1,
Shah Jilani Road, Township
Lahore PK
Email: info@espak.com.pk
Phone: 042-55154012-17
HEX: T38429T-4
SERH: P/18429T-4

CUSTOMER

WATER & POWER DEVELOPMENT AUTHORITY
(WAPDA)
General Manager (Hydro) Planning WAPDA,
Sunny View Estate, Kasimiri Road, Lahore
Lahore PK
Region: Punjab
NTH: 9014201-2

SALES TAX INVOICE

SALES TAX INVOICE # IN-23-0071
BILLING DATE: 26-12-2023
DUE DATE: 25-01-2024
PURCHASE ORDER # GN/HF/D/DN/588/7023/852
MONTH: Dec-2023
PROJECT: Environmental Monitoring,
Sampling & Testing for
Chiniot Dam Project

Sr.#	Product Name	Description	Unit	Price (Rs.)	QTY	Amount (Rs.)
1	Ambient Air Quality	SO ₂ , NO, NO ₂ , SPM, PM ₁₀ , PM _{2.5} and Lead, CO, O ₃	No	29,000.00	5	145,000.00
2	Noise Level Monitoring	24 Hours Noise Monitoring	No	1,500.00	5	7,500.00
3	Drinking Water Analysis	As Per PEQS & TOR'S	No	12,000.00	5	60,000.00
4	Surface Water Analysis	As Per PEQS & TOR'S	No	12,500.00	5	62,500.00
5	Waste Water Analysis	As Per PEQS & TOR'S	No	12,500.00	2	25,000.00

Amount in Words: Three Hundred and Ninety Nine Thousand Only

BANK DETAILS

Bank Name	Bank Alfalah Islamic
Account Title	Environmental Services Pakistan
Account Number	PK22ALFH5506005000846740
Bank Address	New Garden Town Branch, Lahore

Gross Total: RS. 300,000.00
PRA TAX 16% RS. 48,000
Additional Charges:
Electricity Charges (16000's) RS. 30,000.00
Mobilization Charges RS. 21,000.00
Total Inclusive Amount: RS. 399,000.00

Kamran Afzal Created By
Shahzad Ahmad Khan Finalized By

Lahore Office
Office No. 731,
Block - 2, Sector D1,
Shah Jilani Road, Township
Lahore, Pakistan.

Islamabad Office
Office No. 314, 3rd
Floor, Gulberg Empire,
Gulberg Greens,
Islamabad, Pakistan.

Peshawar Office
Unit No. 244-TF,
Dean's Trade Center
Sadar Cantt,
Peshawar, Pakistan.



**ANNEX-IV: LETTER TO DEPARTMENTS FOR
CONSULTATION**



CE-I (HP)
Dy. No. 7/0
Date 13/7/23

PAKISTAN

WATER & POWER DEVELOPMENT AUTHORITY

Telephone: (042) 99202717
Fax: (042) 99202722
Email: gmhydroplanning@gmail.com
directordesignhp@gmail.com

General Manager (Hydro) Planning
WAPDA, Sunny View Estate,
Kashmir Road, Lahore

No. GM(H)P/D(D)/688/2023/ 8141-45

Date 11/07/23

The Secretary,
Forest, Wildlife and Fisheries Department,
Government of Punjab,
38-Ponch House, Multan Road near Chuburji, Lahore

Subject: DETAILED ENGINEERING DESIGN, PREPARATION OF TENDER
DOCUMENTS & PC-I OF CHINIOT DAM PROJECT

Chiniot Dam Project (CDP) is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage & 5 km from the Chiniot city and about 100 meters upstream of existing Railway Bridge on Chenab River (Location map is attached as Annex-A). In CDP, zoned embankment dam will be constructed by placing different local materials in various zones. The channel reservoir will be bounded on either side by the flood protection embankments / dykes to develop a storage capacity of 1,110 Mm³ (0.9 MAF) at an elevation of 192.0 m.a.s.l. The length of the left embankment on the upstream is 43 km while the right embankment length is planned as 40 km to maintain a reservoir level. In Chiniot Dam Project, embankment height generally varies from 18 m to 06 m.

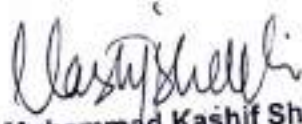
M/s Chiniot Dam Consultants Group (CDCG) – JV of National Engineering Services Pakistan (NESPAK) (Pvt.) Limited as Lead Consultant and Pakistan Engineering Services (PES) (Pvt.) Limited, BARQAAB (Pvt.) Limited, DOLSAR Engineering Inc. Company as JV partners are working on the subject Project. As a part of detailed design of subject project, an Environmental and Social Impact Assessment (ESIA) study needs to be carried out. The E&S team has initiated work on this ESIA.

Keeping in view the importance and urgency of the Project, you are requested to please intimate and direct your concerned departments/officials to identify the notified Forest and Wildlife Sensitive/Reserved/ Protected Areas and other features in the vicinity of the proposed Project and provide details (status, location, extent along with their total areas, boundary coordinates, details of buffer zones and copies of notifications) of these areas.

In this regard, M/s CDGC relevant E&S teams will also coordinate and visit relevant departments/offices to discuss and collect the required information. Your cooperation and facilitation in providing the

required information will be highly appreciated.

For further details and clarification, undersigned may be contacted. You may also contact, Mr. Muhammad Shariq Ahmed, Team Leader/Head ERSD, NESPAK at office No. 042-9909396 / Cell No. 0333-4579099.


(Engr. Muhammad Kashif Sheikh)
SE / Project Director
Chiniot Dam Project

Copy to:

1. Project Manager, Chiniot Dam Project, NESPAK House, 1-C, Block N, Model Town Extension, Lahore
- 2. Adviser (Hydro) Planning, WAPDA, Sunny View Estate, Lahore
3. APS to General Manager (C&M) WAPDA, Wapda House, Lahore
- ✓ 4. APS to General Manager / Chief Engineer-I (Hydro) Planning, Sunny View Estate, Lahore


9/01
APS
13/07/2023
13/07/2023



PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY

Telephone: (042) 99202717
Fax: (042) 99202722
Email: gmhydroplanning@gmail.com
directordesignhp@gmail.com

General Manager (Hydro) Planning
WAPDA, Sunny View Estate,
Kashmir Road, Lahore

No. GM(H)P/D(D)/688/2023/10843-48

Date: 28-11-2023

Deputy Commissioner,
District Chiniot.

Subject: **ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND RESETTLEMENT
ACTION PLAN (RAP) STUDIES AND STAKEHOLDER CONSULTATIONS
FOR CHINIOT DAM PROJECT**

Chiniot Dam Project (CDP) is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage & 5 km from the Chiniot city and about 100 meters upstream of existing Railway Bridge on Chenab River (Location map is attached as Annex-A). In CDP, zoned embankment dam will be constructed by placing different local materials in various zones. The channel reservoir will be bounded on either side by the flood protection embankments / dykes to develop a storage capacity of 1,110 Mm³ (0.9 MAF) at an elevation of 192.0 m.a.s.l. The length of the left embankment on the upstream is 43 km while the right embankment length is planned as 40 km to maintain a reservoir level. In Chiniot Dam Project, embankment height generally varies from 18 m to 06 m.

M/s Chiniot Dam Consultants Group (CDCG) – JV of National Engineering Services Pakistan (NESPAK) (Pvt.) Limited as Lead Consultant and Pakistan Engineering Services (PES) (Pvt.) Limited, BARQAAB (Pvt.) Limited, DOLSAR Engineering Inc. Company as JV partners are working on the subject Project. As a part of detailed design of subject project, an Environmental and Social Impact Assessment (ESIA) study needs to be carried out.

As per Terms of Reference (TOR) of the subject project, Environmental & Social Studies, Detailed Measurement Survey of Affected Structures and Stakeholders Consultations is a mandatory requirement for the acquisition of relevant data to identify and address the concerns and apprehensions of all stakeholders. In this regard, M/s Chiniot Dam Consultants Group (CDCG) relevant Environmental & Social (E&S) teams will also coordinate and visit relevant departments/offices to discuss and collect the required information.

Keeping in view the importance and urgency of the Project, it is requested to please intimate and direct the concerned departments/officials to fully cooperate with the Environmental & Social (E&S) teams of M/s Chiniot Dam Consultants Group (CDCG).

Your cooperation in this regard will be highly appreciated, please.


(Engr. Muhammad Kashif Sheikh)
SE / Project Director
Chiniot Dam Project

Copy to:

1. Adviser (Hydro) Planning, WAPDA, Sunny View Estate, Lahore
2. Project Manager, Chiniot Dam Project, NESPAK House, 1-C, Block N, Model Town Extension, Lahore
3. APS to General Manager (C&M) WAPDA, Wapda House, Lahore
4. APS to General Manager (Hydro) Planning, WAPDA, Sunny View Estate, Lahore
5. APS to Chief Engineer-I (Hydro) Planning, WAPDA, Sunny View Estate, Lahore



PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY

Telephone: (042) 99202717
Fax: (042) 99202722
Email: gmhydroplanning@gmail.com
directordesignhp@gmail.com

General Manager (Hydro) Planning
WAPDA, Sunny View Estate,
Kashmir Road, Lahore

No. GM(H)P/D(D)/688/2023/10848-53

Date, 28-11-2023

Deputy Commissioner,
District Sarghoda.

Subject: **ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND RESETTLEMENT
ACTION PLAN (RAP) STUDIES AND STAKEHOLDER CONSULTATIONS
FOR CHINIOT DAM PROJECT**

Chiniot Dam Project (CDP) is located on Chenab River in Tehsil and District Chiniot, Faisalabad Division, Punjab at about 100 km downstream of Qadirabad Barrage & 5 km from the Chiniot city and about 100 meters upstream of existing Railway Bridge on Chenab River (Location map is attached as Annex-A). In CDP, zoned embankment dam will be constructed by placing different local materials in various zones. The channel reservoir will be bounded on either side by the flood protection embankments / dykes to develop a storage capacity of 1,110 Mm³ (0.9 MAF) at an elevation of 192.0 m.a.s.l. The length of the left embankment on the upstream is 43 km while the right embankment length is planned as 40 km to maintain a reservoir level. In Chiniot Dam Project, embankment height generally varies from 18 m to 06 m.

M/s Chiniot Dam Consultants Group (CDCG) – JV of National Engineering Services Pakistan (NESPAK) (Pvt.) Limited as Lead Consultant and Pakistan Engineering Services (PES) (Pvt.) Limited, BARQAAB (Pvt.) Limited, DOLSAR Engineering Inc. Company as JV partners are working on the subject Project. As a part of detailed design of subject project, an Environmental and Social Impact Assessment (ESIA) study needs to be carried out.

As per Terms of Reference (TOR) of the subject project, Environmental & Social Studies, Detailed Measurement Survey of Affected Structures and Stakeholders Consultations is a mandatory requirement for the acquisition of relevant data to identify and address the concerns and apprehensions of all stakeholders. In this regard, M/s Chiniot Dam Consultants Group (CDCG) relevant Environmental & Social (E&S) teams will also coordinate and visit relevant departments/offices to discuss and collect the required information.

Keeping in view the importance and urgency of the Project, it is requested to please intimate and direct the concerned departments/officials to fully cooperate with the Environmental & Social (E&S) teams of M/s Chiniot Dam Consultants Group (CDCG).

Your cooperation in this regard will be highly appreciated, please.

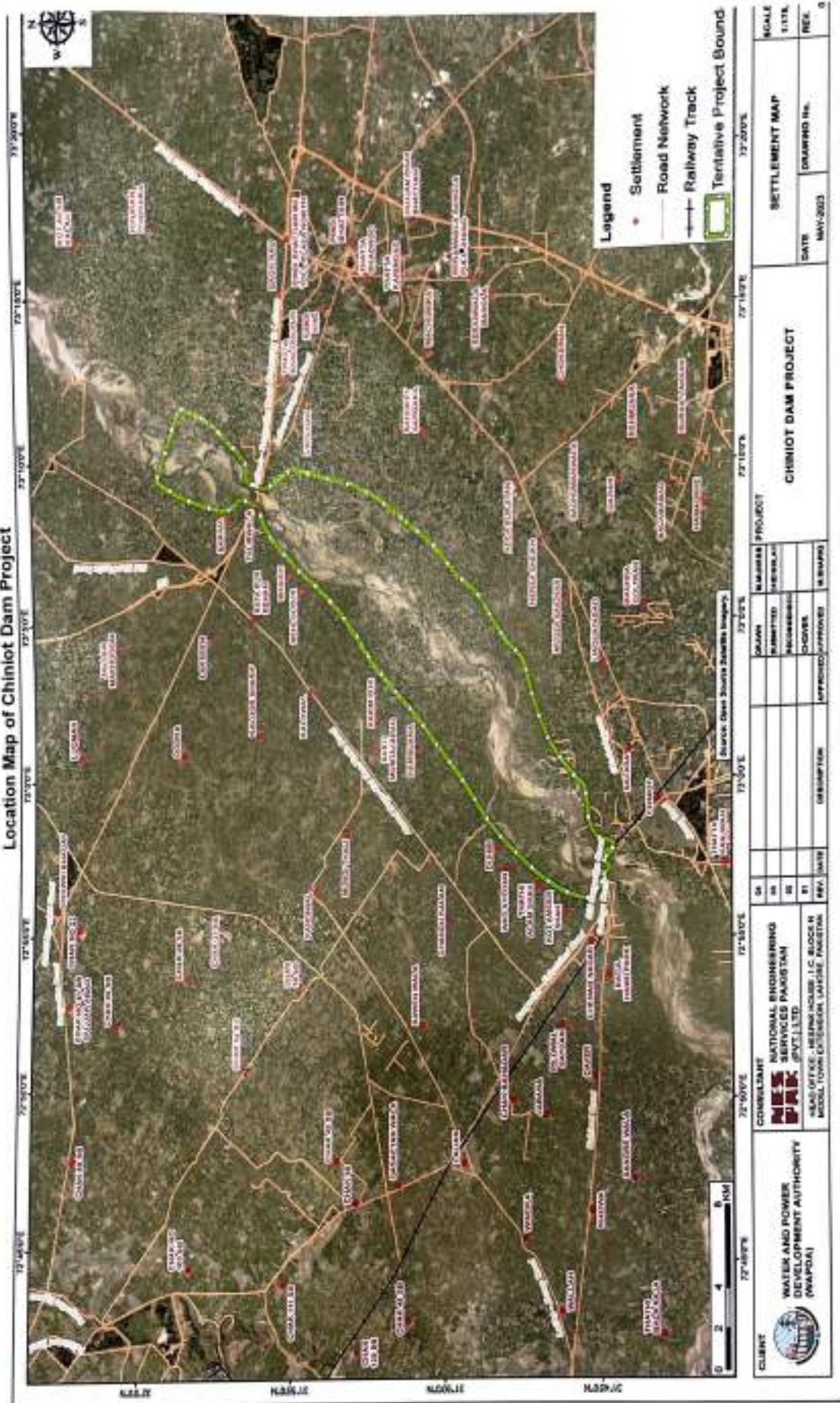
DA / as above


(Engr. Muhammad Kashif Sheikh)
SE / Project Director
Chiniot Dam Project

Copy to:

1. Adviser (Hydro) Planning, WAPDA, Sunny View Estate, Lahore
2. Project Manager, Chiniot Dam Project, NESPAK House, 1-C, Block N, Model Town Extension, Lahore
3. APS to General Manager (C&M) WAPDA, Wapda House, Lahore
4. APS to General Manager (Hydro) Planning, WAPDA, Sunny View Estate, Lahore
5. APS to Chief Engineer-I (Hydro) Planning, WAPDA, Sunny View Estate, Lahore

Location Map of Chinlot Dam Project



**ANNEX-V: LIST OF PARTICIPANTS IN VILLAGE LEVEL
CONSULTATIONS**

Village Buryumee Date 28-10-23
List of Participants

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	N. Nawaz	Sanad	Farmer	0300-7709642	
2	Mehdi	M. Hayat	Farmer	0321-7716771	
3	M. Asgar	M. Hayat	Farmer	0321-7716771	
4	Ameer	Saldar	Farmer	0321-7915242	
5	Riz	Alah Yar	Farmer	0321-7688491	
6	Aamjad	Ameer	Farmer	0322-7709045	
7	Geetha	M. Hayat	Farmer	0321-7709325	
8	Asim Ali	Alah Yar	Farmer	0322-7126363	
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Village = Dausa ~~Dausa~~
(Buryumer)
Date 28-10-23
List of Participants

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Allaf Hussain	M. Azam	Farmer	0322-601650	الطاف حسين
2	Jafar Hussain	M. Bath	Farmer	0342-3240970	جفار حسين
3	M. Manazir Ali	M. Hayat	Former	0323-6576571	منظر علي
4	Imran Ali	M. Yaq	Farmer	0325-8029838	عمران علي
5	Eaker	Jafar	Farmer	0322-7460623	عكر
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Village 2 Lal Bagh

List of Participants

Date 29-10-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Nazir Ahmed Lal		Farmer	0321-7709754	<i>[Signature]</i>
2	Mansha	Khan	Farmer	0322-7708328	<i>[Signature]</i>
3	Balain	Dala	Farmer	0322-6251877	<i>[Signature]</i>
4	Azam	Hayat	Farmer	0324-7120685	<i>[Signature]</i>
5	Taj	Walyam	Farmer	0321-7706329	<i>[Signature]</i>
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Village Basti Malah

List of Participants

Date 29-10-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Mahaz	Malah	Karmel	0306-6840359	محمد نواز
2	Riaz Hussain	Malah	Farmen	0321-3961621	Ri
3	Haz Mahaz	Asst Mohammad	Karmel	0309-5211772	شوق نواز
4	Zakir	Rehmat Ali	Karmel	0324-4967105	علی
5	Mehar Yaqoob	Aamer Ali	Farmen	0321-6032632	
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Village - Zaida D⁹
Bulji

List of Participants Date 30-10-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Mumtaz Hussain	M. Wazir	Farmer	0322-6511031	✓
2	Fauz Abbasi	M. Wazir	Farmer	0326-5443647	Fauz
3	Samer Abbasi	M. Khan	Farmer	0332-0602968	✓
4	Khalid Mahmood	M. Orangi	Farmer	0348-3970408	✓
5	Mumtaz	Allah Bakhsh	Farmer	—	✓
6	Shahid Gulzar	Nazir Ahmad	Farmer	0309-5516119	✓
7	Samand	Ameer	Farmer	—	✓
8	M. Naveez Khan	M. Orangi	Farmer	0322-7711314	✓
9	Mumtaz Hussain	M. Orangi	Farmer	0322-6511071	✓
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Village Thakha
31st Belal

List of Participants Date 30-10-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Khizer ^{Hayat}	Dasg	Farmer	0334-7505966	
2	M. Hayat	Dasg	Farmer	0334-529668	
3	Majid	Dasg	Farmer	0321-6123988	—
4	Nasir	Saleh	Farmer	—	
5	Muhammed	dasg	Farmer	—	—
6	Khan ^{Mumtaz}	Kameel	Farmer	—	
7	Abid	Riaz	Farmer	0321-5142455	
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Bulj Sarjan

List of Participants Date 01-11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Mumtaz Hussain	M. Hayat	Karmel	0300-2486415	<i>[Signature]</i>
2	Mumtaz	Noor Muhammad	Karmel	—	—
3	Riaz Hussain	Sahmir	Farmel	0321-6096554	<i>[Signature]</i>
4	Har, Nawaz	M. Hayat	1/Karmel	0333-6096554	—
5	Azmat	Muhammad	//	—	<i>[Signature]</i>
6	Mukhtar	Samand	//	—	—
7	Muhammad	Shah Muhammad	//	—	—
8	Pineh	Zulfiqar	1	—	<i>[Signature]</i>
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Village
Bury Badh

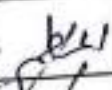
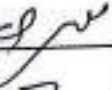
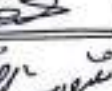
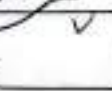
List of Participants Date 01-11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Allah Yar	Salah Muhammad	Farmer	03450608874	—
2	Allah ditto	Salah Muhammad	Farmer	—	—
3	Sanq-Allah	Ahmed Ali	Farmer	03422405479	—
4	Ghulam Abbas	Ahmed Ali	Farmer	—	—
5	Shahid Ali	Mansoor	Farmer	—	—
6	Fazir Mahmood	M. Aslam	Farmer	03454865880	—
7	Usman Ali	Badh	Farmer	0347-6299678	—
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Village -

Baharwala

List of Participants Date 02 11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Azam Ali	Ahmed	Farmer	0346-6473658	
2	M. Ashef	Sahna	Farmer	0345-5071657	
3	Ansari	Khan	Farmer	0341-5540897	
4	Salwar	Muhammed	Farmer	0342-1176311	
5	Gaz	Khan	Farmer	03 -	
6	Shoaib Akhtar	Sahib Khan	Farmer	0303-4677910	
7	Shahid Ahmed	Ahmed	Farmer	0348-6639890	
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Village
Langar Matho 00m

List of Participants Date 03-11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	GlaZ	M. Nanggo	Farmer 033	0334-4833 492	1st
2	Zohed Abbas Malgim	Farmer	0309-1525524	1st	
3	Ghulam Shabbir Noor Muhammed	Farmer	0332-5607645	Ghulam Shabbir	
4	Khizer Hayat Malg	Farmer	—	Khizer	
5	Mazhar Hussain Malg	Farmer	—		
6	Muhammed Malg	Farmer	—		
7	Safdar Hussain	Farmer	—		
8	M. Yae	Ghulam Muhammed	Farmer	—	
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Village
Baba Faid Colony
Talib Wali

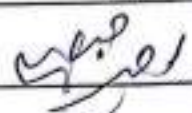
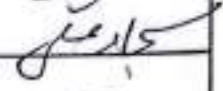
List of Participants

Date 05-11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Jhangir Ahmed	Sheer Muhammed	Farmer	0342-46641	0333-6713750
2	Tahir Abbas	Riaz Ahmed	Farmer	0301-1396182	
3	Haz Nawaz Wali	Yaqin	Farmer	0348-21529120	
4	M. Shahbaz	Sheer Muhammed	Farmer	0300-5753978	
5	Riaz Ahmed	Muhammed	Farmer	0333-8071260	
6	Allah Ditta	M. Hayat	Farmer	03	
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Village
Kaleha Garng

List of Participants Date -05-11-23

Sr. No.	Name	Father's Name	Occupation	Mobile No.	Signatures
1	Ameez Hayat	Mohammad	Ramul	0342-8939301	
2	Sajjad Ali	Bati Khan	Ramul	0393-2547544	
3	Sazang Khan	Bahdar Khan	Ramul	0342-6587794	
4	Nawab	Ashraf Khan	Ramul	0330-7699135	
5	Riaz	Mohammad Khan	Ramul	0346-3531236	
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ANNEX-VI: GUIDELINE QUARRY MANAGEMENT PLAN

GUIDELINE QUARRY MANAGEMENT PLAN

1.0 Introduction

After the completion of construction phase of the proposed project, it is the responsibility of the contractor to restore the site that has been disturbed due to construction activities. Water and Power Development Authority (WAPDA) should ensure that the environmental value of the project area is maintained for future generations to appreciate.

2.0 General Quarry Planning and Progressive Rehabilitation

A well-considered quarry development plan prior to starting work, or when opening up new areas will greatly reduce the effort required to achieve appropriate leading practice environmental and safety outcomes for quarry rehabilitation and closure.

The selection of a site, sequencing of quarrying and rehabilitation and final land-use should all be carefully planned prior to commencement of work at a quarry or borrow pit.

2.1 Progressive Rehabilitation

Progressive rehabilitation refers to the rehabilitation of completed parts of a quarry while extractive operations continue in other parts of the quarry. As new quarry sections are opened, worked out areas should be progressively rehabilitated to avoid increasing the total disturbed area of a quarry. Overburden and topsoil can be stripped from areas being opened up and placed directly onto worked out areas which are being rehabilitated. This will avoid double handling of materials and prevent degradation of the topsoil.

Progressive rehabilitation helps to minimize the visual impact of a quarry, control dust and erosion. It also assists in fostering good landowner and community relations.

Recommended progressive rehabilitation practices are:

- Agree on the final land form and use of a site with the relevant landowner.
- Rehabilitate in accordance with the intended final use of the land.
- Plan and develop the quarry in stages towards terminal areas so that progressive rehabilitation works can commence as soon as possible).
- Once the final landform is established, re-vegetate areas to stabilize the landform and to give the vegetation maximum time to establish while the quarry is still in operation.

2.2 Re-vegetation

Establishing a self-sustaining cover of vegetation is the best way to stabilize disturbed sites in the long term. Re-vegetation also minimizes the visual impact of quarries. Generally, the vegetation type which existed before the disturbance, or a similar vegetation type will regenerate most successfully.

Prior to the commencement of a quarrying activity the type of re-vegetation should be agreed with the landowner, and should be consistent with the proposed final land-use.

Some indigenous plant species may not thrive in areas where soil conditions are substantially different after quarrying. If this is the case, and the objective is to re-establish vegetation, which fulfils the function of the original native vegetation, then some species from outside the quarry area, may have to be introduced. Care must be taken to avoid introducing a species, which could become an unacceptable fire hazard, invade surrounding areas of native vegetation or become agricultural weeds.

Where agriculture is the planned land-use then the species planted should be those commonly used for pasture or crops known to be successful on soils of similar texture, drainage status, pH and fertility. Suitable legumes should always be considered for their ability to improve soil fertility.

3.0 Rehabilitation of Borrow Pits

Borrow pits are areas either in a road reserve or adjacent land holdings that have been used to extract materials such as gravels and soils. They can vary considerably in size, depending on the quantity of material taken and the borrow pits' reserve body of remaining material. The variable size, shape and nature of borrow pits preclude very specific recommendations; however the following general conditions apply:

- Before extraction commences, licenses and permits should be checked and limits of disturbance and/or clearing must be clearly marked out on the site before any ground disturbing activity takes place; and
- At the completion of extraction, the former borrow pit must be made stable and safe. This usually requires the sides of the pit to be reshaped with gentle safe grades. All disturbed areas associated with borrow pits must be retopsoiled, seeded, fertilized and mulched (if appropriate) as part of the restoration plan. Main Roads has been discouraging the conversion of borrow pits to stock watering points.

Reinstatement of Borrow Pits

- Reinstatement will be completed prior to handover of the completed road section. This may include the following:
- Fill excavated site with overburden stockpiles and perimeter berms, and graded to the desired slope and drainage path;
- Spread topsoil on top of the overburden;
- Develop/construct suitable surface slopes, drainage ditches and conduits to prevent water from collecting at the sites;
- Establish a vegetation cover corresponding to at least 75%¹ of the cover present prior to excavation (supporting photographs) and maintain following the first rains after reinstatement;
- Minimize erosion by focusing vegetation cover on side slopes of the excavated area; and
- Any required seeding will make use of local plant varieties

All the above mentioned measures need to be followed by the Contractor before handing over the site (s) back to the owner.

¹ RAPID PROGRAM BORROW PIT MANAGEMENT GUIDELINES, USAID

ANNEX-VII: CHANCE FIND PROCEDURE

CHANCE FIND PROCEDURE

1. 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 Antiquities Act, 1975, 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 areas 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.

2. 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 road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

3. RELEVANT LEGISLATION

It ensures the protection, preservation, development and maintenance of antiquities in the provinces of Pakistan. 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 relevant provincial governments 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 Archaeology, any archaeological discovery made during the course of the project.

4. REMEDIES AND PENALTIES

The Antiquities Act, 1975 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. "

5. 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) 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
- v. between DoA and WAPDA as to any required mitigation measures, which may include excavation and recovery of the item.
- vi. A precautionary approach will be adopted in the application of these procedures.

6. 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.

ANNEX-VIII: TREE PLANTATION PLAN

TREE PLANTATION/ AFFORESTATION PLAN

The basic purpose of afforestation/plantation of suitable species in the project area is to reduce the risk been made due to the cutting of trees for the proposed project and to enhance green cover and improve the overall environment of the area. Afforestation will not only reduce the risk been made but will also increase the carrying capacity of the area regarding many positive aspects.

Plantation will be done after the removal of trees during the construction work immediately. Plantation of indigenous trees species is highly important to maintain biodiversity and ecological balance. It is also important to prevent global warming, soil erosion and pollution.

Afforestation purifies the environment and helps in reducing the carbon dioxide level. Along with the importance of construction, the afforestation activity will further help in enhancing the socio-economic condition of the area and project sustainability.

Importance of Tree Plantation

- Trees contribute to their environment by providing oxygen, improving air quality, climate amelioration, conserving water, preserving soil, and supporting wildlife.
- Trees control climate by moderating the effects of the sun, rain and wind. Leaves absorb and filter the sun's radiant energy, keeping things cool in summer.
- Trees also preserve warmth by providing a screen from harsh wind.
- Trees also lower the air temperature and reduce the heat intensity of the greenhouse effect by maintaining low levels of carbon dioxide.
- Both above and below ground, trees are essential to the ecosystems in which they reside.
- Trees absorb and store rainwater which reduce runoff and sediment deposit after storms. This helps the groundwater supply recharge, prevents the transport of chemicals into streams and prevents flooding.
- Trees, shrubs and turf also filter air by removing dust and absorbing other pollutants like carbon monoxide, sulfur dioxide and nitrogen dioxide.

Objectives

- To restore native species
- To improve the quality of air and reduce its pollution
- To add colour to the landscape and enhance the beauty of the environment
- To uplift the quality of our living environment through active planting, proper maintenance and preservation of trees together with other vegetation.
- To Protect and conserve flora and fauna of the project area.
- To attract rain which has a positive impact on the project area at all.
- To reduce sedimentation by plantation in the project area which will act as a protection wall against wind-born dust particles, soil erosion and sliding.

Study Area Enhancement/Rehabilitation Plan

The project will be nourished with natural vegetation as some of the planted and natural trees may be damaged.

In the project area trees will be raised along the available spaces and designated forest lands in consultation with the forest department. A Total of **505,990 (1:10 compensation)** trees will be raised in lieu of **50,599** trees (Approximately-Counted through GIS. Same must be updated prior to the construction activities)

Note: *The compensation for Forest/Wood trees and fruits may be notified by the concerned Forest and Agriculture departments/competent authority with an Ecologist of the consultant team after a proper filed survey/assessment and consultation with local communities, for this purpose a special team to be constituted under the approval of competent authority, to assess the losses and propose proper compensations.*

Plantation Technique

Plantation of suitable broad leaved species is to be carried out in the immediate vicinity of the project area. The project area can be afforested and vegetation cover can be improved by adopting the standard afforestation technique of digging pits. The project area is suitable for plantation activities and can be managed thoroughly with care.

Pits

Pits should be dug in the project area at a linear spacing of 10'. The pits should be of 1.5 feet dia at the top and 1 foot dia at the bottom with a depth of 1-3/4" ft. The earth taken out of the pits will be deposited below each pit in a crescent shape, so as to form a ridge with a clear berm of 9 inches in front. The consecutive crescents will be joined to catch the maximum quantity of moisture. Moreover, planting should be carried out in the pits and sowing on the berms, before or immediately after the first shower of rain. The choice of species (Forest Department may change as per actual requirement and suitability *standards & Species as well) for the project area is given below:

Table: Recommended Species for Plantation in the Project Area

S. No.	Common Name	Scientific Name
1)	Kikar	<i>Acacia nilotica</i>
2)	Shisham	<i>Dalbergia sissoo</i>
3)	Ber	<i>Zizyphus sp.</i>
4)	Mulberry	<i>Morus alba</i>
5)	Neem	<i>Azadirachta indica</i>
6)	Siris	<i>Albizia lebbek</i>
7)	Dherek	<i>Melia azedarach</i>
8)	Bakain	<i>Melia azadirachta</i>

Planting should be completed early in the rains in as short a time as possible. The trees must be given time to become well-established prior to the dry season. A good rule of thumb is to start planting when the soil is moist to a depth of 15-25 cm or to the bottom of the planting

hole. Failures because planting is too late are more common than failures because of planting too early. To obtain good results and avoid labor shortage in these areas considerable preparatory planning is needed. The size of the plantation might have to be adapted to the availability of labor. If dry sites cannot be planted in time, planting should be postponed until the next season.

Cost

The cost and maintenance of about **505,990** plants for afforestation in the project area has been estimated including the cost of layout, digging, planting, carriage and watch and ward and its maintenance for four (04) years. **The table** shows the approximate and tentative cost of the plantation including four (04) years of maintenance (Standard).

***Note:** All these activities of the plantation plan should be implemented by the Forest Department. The department may change/update the standards including rates and choice of species as per rule and approved schedules.

Break-up of Expenditure per Avenue kilometer @ Rs. 1500/- per diem: Break-up of Expenditure per Avenue kilometer or 250 plants @ Rs. 1500/- per diem:

FIRST-YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Layout	1 Av.km	2 MD/Av.km	3000.00
2.	Digging of Pits 2.5 ft. each 2.5x250 = 625 cft.	625 cft.	5 MD/Av.km	7500.00
3.	Cost of Plants including	250 No.	Rs100/- plant	25,000.00
4.	Cost of planting of plants	250 No.	Rs. 25/- plant	6250.00
5.	Carriage of plants from private nursery to site including loading/unloading	250 No.	Rs. 10/- plant	2500.00
6.	Cost of Manure and Bhall (silt) including carriage	1 Av. Km		20,000.00
7.	H/watering 50 times 250x50 with water bowser, one driver and one coolie	12500 no.	5MD/per %0	100,000.00
8.	Weeding twice 250x2	500 no.	2 MD/per %	15,000.00
9.	Reopening of Pits twice (250x2)/cft/pit	500 cft.	2 MD/per %	15,000.00
10.	Unforeseen			5750.00
Total				200,000.00

SECOND YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 20% Restocking	50 No.	Rs.100/- plant	5,000.00
2.	Cost of planting	50 No.	Rs. 25/- plant	1250.00
3.	Carriage of plants	50 No.	Rs. 10/- plant	500.00
4.	H/watering 50 times with water bowser, one driver and one coolie	12500 no.	5MD/per %0	100,000.00
5.	Reopening of Pits twice (250x2)	500 cft.	2 MD/per %	1,5000.00
6.	Weeding twice 250x2	500 no.	2 MD/per %	1,5000.00
7.	Unforeseen			1250.00
Total				1,38,,000.00

THIRD YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 10% Restocking 25 No.	25 No.	Rs.100/- plant	2500.00
2.	Cost of planting	25 No.	Rs. 25/- plant	625.00
3.	Carriage of plants	25 No.	Rs. 10/- plant	250.00
4.	H/watering 40 times x250 no.	10,000 no.	5MD/per %0	75000.00
5.	Reopening of Pits twice (250x2)	500	5MD/per %0	3750.00
6.	Unforeseen			2875.00
Total				85,000.00

FOURTH YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	H/watering 30 times	7500 no.	5MD/per %0	56250.00
5.	Pruning and cleaning of plants	250 no.	5MD/per %0	1875.00
6.	Unforeseen			1875.00
Total				60,000.00

Cost for raising 1 Av. Km and Maintenance or 250 plants: = **Rs. 483,000/-**

For 4 years. The plantation may also be raised in nearby available spaces with close coordination with Forest Department.

Total cost for **505,990** plants and their maintenance for four (4) years = **Rs. 977,572,680/-**
or say

Total Cost= 977.57 Million PKR

Note: The above rates and calculations are approximate and tentative and will be updated according to the standard rates of concerned Forest and agriculture

Departments/Implementing agencies during the implementation stage, as per updated and approved standards.

Expected Outcome

1. Extensive plantation, raised will improve the ecological balance as both the flora and fauna are integral parts of the ecosystem. Native tree species will be resorted which is playing pivotal role in carbon sequestration, which leads to reduce global warming and storing more carbon.
2. Local people will also get direct benefits in terms of fodder for cattle, shade, job opportunities during plantations and maintenance for four years, clean air, and balanced temperature. Improved Green cover in the area will also attract the faunal species which are scared away due to construction activities. This shall reduce the noise and air pollution as well.
3. In many ways, the fauna of a tract is dependent upon flora for its resting, nesting and roosting activities. With the improved flora of the project area, due to the raising of a large number of trees, the fauna and especially the avifauna shall be attracted to the area. The birds, which were scared away due to noise and degradation of their habitat, shall return to the area.
4. Plantation in nearby available spaces shall not only reduce the noise and air pollution but will also be a source of attraction for humans, and Wildlife like mammals, reptiles' birds and other dependents.

ANNEX-IX: OCCUPATIONAL HEALTH AND SAFETY PLAN

GUIDELINE OCCUPATIONAL HEALTH AND SAFETY PLAN

Occupational Health and Safety covers all personnel working under the project and will be in line with the World Bank EHS guidelines on health and safety.

The Occupational Health and Safety program will aim to ensure that the workplace is safe and healthy by: addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and, specifying how consultation, training and information are to be provided to employees at various workplaces.

Some of the risks/hazards associated with workplaces are due to working close to or at sites associated with the various project construction activities. Other risks associated with the project construction phase include risk of increase of vector borne and other different diseases.

The following sections will be implemented during the construction phase to address and ensure workers' health and safety.

1.1 SCREENING AND REGULAR UNANNOUNCED CHECKING OF WORKERS

As per the procedure for hiring workers, all contractors and labor agencies are required to make all prospective workers undergo medical tests to screen for diseases and sicknesses, prior to selection and employment of any worker. The contractor is also responsible for ensuring that no worker who has a criminal record is employed at the project site. It will be ensured that all workers undergo medical tests to screen diseases at source and at sites in consultation with the designated Health Officer.

In addition to this, the Project Management will also undertake sudden, unannounced checks on workers to look for diseases such as COVID-19, HIV, STDs, and hepatitis and take necessary steps as mandated by the Contractual agreement between the Contractor and the Worker(s).

1.2 MINIMIZING HAZARDS AND RISKS AT THE WORKPLACE

To ensure safety at all work sites, the following will be carried out:

- i. Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.
- ii. Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.
- iii. Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.
- iv. Proper Housekeeping: Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse. Brick stacks will not be more than 7 feet in height and for concrete blocks they will not be more than 6 feet high.
- v. Removing all scrap timber, waste material and rubbish from the immediate work area as the work progresses.
- vi. Where scaffolds are required, ensuring that each scaffold or its components shall be capable of supporting its own weight and at least 4 times the maximum intended load applied or transmitted to it. The platform/scaffold plank shall be at least 15 inches wide and 1.5 inches thick. The rope should be capable of supporting at least 6 times

the maximum intended load applied or transmitted to that rope. Pole scaffolds over 60 feet in height shall be designed by a registered professional engineer and shall be constructed and loaded in accordance with that design. Where scaffolds are not provided, safety belts/safety nets shall be provided;

- vii. Ensure that all ramps or walkways are at least 6 feet wide, having slip resistance threads and not inclined at more than a slope of 1 vertical and 3 horizontal.
- viii. Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks from falling back into the excavated area and injuring those working inside excavated sites.
- ix. Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.
- x. Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.
- xi. Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

1.3 PROVISION OF PERSONAL PROTECTIVE EQUIPMENT

Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) to all workers. This will be included in the construction cost for each Contractor. Depending on the nature of work and the risks involved, contractors must provide without any cost to the workers, the following protective equipment:

- i. High visibility clothing for all personnel during road works must be mandatory.
- ii. Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.
- iii. Safety belt shall be provided to workers working at heights (more than 20 ft) such as roofing, painting, and plastering.
- iv. Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.
- v. Ear protecting devices shall be provided to all workers and will be used during the occurrence of extensive noise.
- vi. Eye and face protection equipment shall be provided to all welders to protect against sparks.
- vii. Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.
- viii. Safety nets shall be provided when workplaces are more than 25 feet (7.5 m) above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors or safety belts is impractical.

The specific PPE requirements for each type of work are summarized below.

Table 1: PPE Requirement List

Type of Work	PPE
Elevated work	Safety helmet, safety belt (height greater than 20 ft), footwear for elevated work.
Handling work safety	Helmet, leather safety shoes, work gloves.
Welding and cutting work	Eye protectors, shield and helmet, protective gloves.
Grinding work	Dust respirator, earplugs, eye protectors.
Work involving handling of chemical substances	Dust respirator, gas mask, chemical-proof gloves. Chemical proof clothing, air-lined mask, eye protectors.
Wood working	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Blasting	Hard hat, eye and hearing protection.
Concrete and masonry work	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.

Type of Work	PPE
Excavation, heavy equipment, motor graders, and bulldozer operation	Hard hat, safety boots, gloves, hearing protection.
Quarries	Hard hat, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.

1.4 PROCEDURES TO DEAL WITH EMERGENCIES SUCH AS ACCIDENTS, SUDDEN ILLNESS AND DEATH OF WORKERS

First aid kits will be made available at all times throughout the entire construction period by the respective contractors. This is very important, because most work sites will be at some distance from the nearest hospital. In addition to the first aid kits, the following measures should be in place:

- i. Provision of dispensaries by the individual EPC contractor.
- ii. A vehicle shall be on standby from the Project Office so that emergency transportation can be arranged to take severely injured/sick workers to the nearest hospital for immediate medical attention.
- iii. A designated Health Officer/worker for the Project will be identified as a focal person to attend to all health and safety related issues. This employee's contact number will be posted at all work sites for speedy delivery of emergency services. The focal person shall be well versed with the medical system and facilities available at the hospital.
- iv. Communication arrangements, such a provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

1.5 RECORD MAINTENANCE AND REMEDIAL ACTION

The Project Management will maintain a record of all accidents and injuries that occur at the work site. This work will be delegated by the contractor to the site supervisor and regularly reviewed every quarter by project management. Reports prepared by the contractor shall include information on the place, date and time of the incident, name of persons involved, cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

1.6 COMPENSATION FOR INJURIES AND DEATH

Any casualty or injury resulting from occupational activities should be compensated as per the local labor laws of Pakistan. Where compensation is sought by the injured party, proper procedures for documentation of the case will be followed, including a detailed report on the accident, written reports from witnesses, report of the examining doctor and his/her recommendation for treatment. Each individual contractor will be responsible for ensuring compensation for the respective workers.

1.7 AWARENESS PROGRAMS

The Project management will undertake awareness programs through posters, talks, and meetings with the contractors to undertake the following activities:

- i. Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS, COVID-19), work site health and safety, waste management (waste

- separation, recycling, and composting), and the illegality of poaching.
- ii. Make workers aware of procedures to be followed in case of emergencies such as informing the focal health person who in turn will arrange the necessary emergency transportation or treatment.

1.8 NOMINATION OF A HEALTH AND SAFETY FOCAL PERSON

Within each site (especially if different sites are being implemented by different contractors), a Health and Safety Focal Person will be appointed. The Terms of Reference for the focal person will mainly be as follows:

- i. Function as the focal person/representative for all health and safety matters at the workplace;
- ii. Responsible for maintaining records of all accidents and all health and safety issues at each site, the number of accidents and its cause, actions taken and remedial measures undertaken in case of safety issues;
- iii. Be the link between the contractor and all workers and submit grievances of the workers to the contractor and instructions/directives on proper health care and safety from the contractors back to the workers;
- iv. Ensure that all workers are adequately informed on the requirement to use Personal Protective Equipment and its correct use;
- v. Also responsible for the first aid kit and making sure that the basic immediate medicines are readily available.

1.9 SUGGESTED CONTENTS OF OCCUPATIONAL HEALTH AND SAFETY PLAN

The suggested contents of Occupational Health and Safety Plan to be developed by the Contractor(s) are described below:

- a Purpose
- b Scope of Application
- c Complying Basis
- d Occupational Health and Safety Objectives
- e Organization and Responsibility
 - Contractor's Project Manager
 - HSE Management Department of the Contractor(s)
 - Medical Treatment Room of the Contractor(s)
 - Subcontractor's Project Manager
 - Subcontractor's HSE Managers
 - Occupational Health and Safety
 - Community Health and Safety
- f Health Plan
 - Labour Protection
 - Sanitary Epidemic Prevention
- g Safety Plan
 - Summary
 - Qualification Review
 - Safety Training
 - Construction Plans and Documents
 - Control Measures
 - Monitoring Measures
 - Management of the Key Safety Accidents
- h Public Security Plan
- i Local Community Health and Safety

CONSTRUCTION HEALTH AND SAFETY CHECKLIST

GENERAL INTRODUCTION

This checklist identifies some of the hazards most commonly found on construction sites. The questions it asks are intended to help the safety supervisor decide whether the construction site is a safe and healthy place to work.

ACCESS ON SITE

- Can everyone get to their place of work safely?
- Are access routes free from obstructions and clearly signposted?
- Are holes protected with clearly marked and fixed covers to prevent falls?
- Are temporary structures stable, adequately braced and not overloaded?
- Will permanent structures remain stable during any refurbishment or demolition work?
- Is the site tidy, and are materials stored safely?
- Is lighting adequate, especially when work is being carried on after dark outside or inside tunnels?

WELFARE

- Are toilets readily available and are they kept clean and properly lit?
- Are there washbasins, hot and cold (or warm) running water, soap and towels?
- Are the washbasins large enough to wash up to the elbow and are they kept clean?
- Is there somewhere to change, dry and store clothing?
- Is there a place where workers can sit, make hot drinks and prepare food?
- Are drinking water and cups provided?
- Can everyone who needs to use them get to the welfare facilities easily and safely?

SCAFFOLDS

- Are scaffolds erected, altered and dismantled by competent people?
- Are all uprights provided with base plates (and where necessary, timber sole plates)?
- Are all uprights, ledgers, transoms and braces in position?
- Is the scaffold tied to the structure in enough places to prevent collapse?
- Are there double guard rails and toe boards or other suitable protection at every edge, to prevent falling?
- Are brick guards provided to prevent materials falling from scaffolds?
- Are the working platforms fully boarded and are the boards arranged to avoid tipping or tripping?
- Are there effective barriers or warning notices in place to stop people using an incomplete scaffold, e.g. where working platforms are not fully boarded?
- Is the scaffold strong enough to carry the weight of materials stored on it and are these evenly distributed?
- Does a competent person inspect the scaffold regularly, e.g. at least once a week if the working platform is two meter or above in height or at suitable intervals if less than two meter, and always after it has been altered or damaged and following extreme weather events?

- Are the results of inspections recorded and kept?
- Have proprietary scaffolds been inspected and are they being used in accordance with suppliers' instructions?
- Have the wheels of scaffolds been locked and outriggers deployed when in use and are the platforms empty when they are moved?

POWERED ACCESS EQUIPMENT

- Has the equipment been installed by a competent person?
- Are the operators trained and competent?
- Is the safe working load clearly marked?
- Is the equipment inspected by a competent person?
- Does the working platform of the powered access equipment have adequate, secure guard rails and toe boards or other barriers to prevent people and materials falling off?
- Have precautions been taken to prevent people being struck by the (i) moving platform; and (ii) falling materials?

TRAFFIC, VEHICLES AND PLANT

- Are vehicles and pedestrians kept apart? If not, do you:
- Separate them as much as you can and use barriers?
- Tell people about the problem, and what to do about it?
- Display warning signs?
- Can zero tail swing excavators be used or is there adequate clearance around slewing vehicles?
- Can reversing be avoided, e.g. by using a one-way system, or if not, are properly trained signallers used?
- Are vehicles and plant properly maintained?
- Have drivers received proper training and are they competent for the vehicles or plant they are operating?
- Are loads properly secured?
- Have you made sure that passengers are only carried on vehicles designed to carry them?
- Have you made sure that plant and vehicles are not used on dangerous slopes?

CRANES

- Is the crane suitable for the job?
- Has the lift been properly planned by an 'appointed person'?
- Is the crane on a firm, level base? Are the riggers properly set?
- Who is the appointed 'crane supervisor' responsible for controlling the lifting operation on site?
- Are the crane driver and signaller trained and competent?
- Is the load secure?
- Has the signaler and slinger been trained to give signals and to attach loads correctly?
- Have you made arrangements to make sure the driver can see the load or has a signaler been provided to help?

- Are people stopped from walking or working beneath a raised load?
- Does the crane have a current report of thorough examination and record of inspection?

EXCAVATIONS

- Is there adequate support for the excavation, or has it been sloped or battered back to a safe angle?
- Is there a safe method used for putting in the support, without people working in an unsupported trench?
- Is there safe access into the excavation, e.g. a sufficiently long and secured ladder?
- Are there barriers or other protection to stop people and vehicles falling in?
- Are properly secured stop blocks provided to prevent tipping vehicles falling in?
- Could the excavation affect the stability of neighboring structures or services?
- Are materials, spoil and plant stored away from the edge of the excavation to reduce the chance of a collapse?
- Is the excavation regularly inspected by a competent person?

MANUAL HANDLING

Are there heavy materials such as concrete lintels, curbstones or bagged products which could cause problems if they have to be moved by hand? If so, can you:

- choose lighter materials;
- use wheelbarrows, hoists, tail handlers and other plant or equipment so that – manual lifting of heavy objects is kept to a minimum;
- order materials such as cement and aggregates in 25 kilogram bags;
- Avoid the repetitive laying of heavy building blocks weighing more than 20 kilogram; and
- Have people been instructed and trained how to lift safely?

HAZARDOUS SUBSTANCES

- Have you identified all harmful substances and materials, such as asbestos, lead, solvents, paints, cement and dust?
- Have you checked whether a licensed contractor is needed to deal with asbestos on site?
- Have you identified and put into place precautions to prevent or control exposure to hazardous substances by:
 - o Doing the work in a different way, to remove the risk entirely;
 - o Using a less hazardous material; and
 - o Using tools fitted with dust extraction?
- Have workers had information and training so they know what the risks are from the hazardous substances used and produced on site, and what they need to do to avoid the risks?
- Have you got procedures to prevent contact with wet cement (as this can cause both dermatitis and cement burns)?

- Have you arranged health surveillance for people using certain hazardous substances?

NOISE

- Have workers had information and training so they know what the risks are from noise on site, and what they need to do to avoid those risks?
- Have you identified and assessed workers' exposure to noise?
- Can the noise be reduced by using different working methods or selecting quieter plant, e.g. by fitting breakers and other plant or machinery with silencers?
- Are people not involved in the work kept away from the source of the noise?
- Is suitable hearing protection provided and worn in noisy areas?
- Have hearing protection zones been marked?
- Have you arranged health surveillance for people exposed to high levels of noise?

HAND-ARM VIBRATION

- Have workers had information and training so they know what the risks are from hand-arm vibration (HAV) on site, and what they need to do to avoid those risks?
- Have you identified and assessed risks to workers from prolonged use of vibrating tools such as concrete breakers, angle grinders or hammer drills?
- Has exposure to HAV been reduced as much as possible by selecting suitable work methods and plant?
- Are reduced-vibration tools used whenever possible?
- Have vibrating tools been properly maintained?
- Have you arranged health surveillance for people exposed to high levels of hand-arm vibration, especially when exposed for long periods?

ELECTRICITY AND OTHER SERVICES

- Have all necessary services been provided on site before work begins and have you also identified existing services present on site (e.g. electric cables or gas mains) and taken effective steps (if necessary) to prevent danger from them?
- Are you using low voltage for tools and equipment, e.g. battery-operated tools or low-voltage systems?
- Where mains voltage has to be used, are trip devices (e.g. residual current devices (RCDs)) provided for all equipment?
- Are RCDs checked daily by users and properly maintained?
- Are cables and leads protected from damage?
- Are all connections to the system properly made and are suitable plugs used?
- Are tools and equipment checked by users, visually examined on site and regularly inspected and tested by a competent person?
- Where there are overhead lines, has the electricity supply been turned off, or have other precautions been taken, such as providing goal posts or taped markers?
- Have hidden electricity cables and other services been located (e.g. with a locator and plans) and marked, and have you taken precautions for safe working?

CONFINED SPACES

- Do you work in confined spaces where there may be an inadequate supply of oxygen or the presence of poisonous or flammable gas? If so, have you taken all necessary precautions?
- Confined spaces include tanks, sewers and manholes; they do not have to look dirty to be dangerous?

TOOLS AND MACHINERY

- Are the right tools or machinery being used for the job?
- Are all dangerous parts guarded, e.g. gears, chains drives, projecting generator shafts?
- Are guards secured and in good repair?
- Are tools and machinery maintained in good repair and are all safety devices operating correctly?
- Are all operators trained and competent?

FIRES AND EMERGENCIES

General

- Are there emergency procedures, e.g. for evacuating the site in case of fire or for rescue from a confined space?
- Do people on site know what the procedures are?
- Is there a means of raising the alarm, and does it work?
- Is there a way to contact the emergency services from site?
- Are there adequate escape routes and are these kept clear?
- Is there adequate first-aid provision?

Fire

- Is the quantity of flammable materials, liquids and gases on site kept to a minimum?
- Are they properly stored?
- Are suitable containers used for flammable liquids?
- Are flammable gas cylinders returned to a ventilated store at the end of the shift?
- Are smoking and other ignition sources banned in areas where gases or flammable liquids are stored or used?
- Are gas cylinders, associated hoses and equipment properly maintained and in good condition?
- When gas cylinders are not in use, are the valves fully closed?
- Is flammable and combustible waste removed regularly and stored in suitable bins or skips?
- Are suitable fire extinguishers provided?

PROTECTING THE PUBLIC

- Is the work fenced off from the public?
- Are the public protected from falling material?

- Have you provided a safe route through road works or pavement scaffolding for people with prams, wheelchair users and visually impaired people?
- When work has stopped for the day:
 - o Is the boundary secure and undamaged?
 - o Are all ladders removed or their rungs boarded so that they cannot be used?
 - o Are excavations and openings securely covered or fenced off?
 - o Is all plant immobilized to prevent unauthorized use?
 - o Are bricks and materials safely stacked?
 - o Are flammable or dangerous substances locked away in secure storage places?

**ANNEX-X: GUIDELINES TO COMBAT WITH
COVID-19**

PRECAUTIONARY ACTION AGAINST THE POTENTIAL RISK OF NOVEL CORONAVIRUS - COVID-19

INTRODUCTION

On February 11, 2020 the World Health Organization announced an official name for the disease that is causing the 2019 novel coronavirus outbreak, first identified in Wuhan China. The new name of this is coronavirus disease 2019, abbreviated as COVID-19. In COVID-19, 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease. Formerly, this disease was referred to as "2019 novel coronavirus" or "2019-nCoV".

Coronaviruses are a large family of viruses. Some cause illness in people, and others, such as canine and feline coronaviruses, only infect animals. Rarely, animal coronaviruses that infect animals have emerged to infect people and can spread between people. This is suspected to have occurred for the virus that causes Coronavirus Disease 2019 (COVID-19). Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) are two other examples of coronaviruses that originated from animals and then spread to people.

The risk of exposure to COVID-19 is no different for employees of Employer, Engineer, Contractor, and suppliers than for the general population. Contractor, therefore, must consider the physical well-being and safety of all the persons entitled to be on the Site and follow reasonable guidelines and recommendations of Government authorities and healthcare professionals. As experience has shown in other countries, confirmed cases of COVID-19 expand exponentially if health and safety controls are left unheeded.

Contractor should enforce all health and safety procedures at Site including sanitary protocols, proper hygiene, social distancing, use of personal protective equipment (PPE), toolbox talks on special COVID-19 requirements, and prompt reporting of health issues related to COVID-19. Contractors must put safeguards in place to keep workers exposed to COVID-19 away from Site for at least 14 days after the last potential exposure.

WHO declared the COVID-19 as a Public Health Emergency of International Concern (PHEIC) in January 2020 and afterwards announced the COVID-19 outbreak as pandemic on 11th March 2020 due to the widespread of the disease in 114 countries at that time. WHO Director General urged the countries to take action now to stop the disease.

The rapid spread of COVID-19 hits all the provinces of Pakistan Sindh, Balochistan, Punjab & Khyber Pakhtunkhwa including the Gilgit Baltistan and Azad Jammu & Kashmir. The prevailing virus creates the menacing and distressing situation when it arrived around the closed proximities of the Project Area.

Government of Pakistan has launched the National Action Plan for COVID-19 Pakistan to combat the challenge of prevailing virus, also available at <https://www.nih.org.pk/wp-content/uploads/2020/03/COVID-19-NAP-V2-13-March-2020.pdf>. The Government of Pakistan has launched the real-time data portal for COVID-19 <http://covid.gov.pk/>. These measures are mostly relating to the containment and awareness and capacity building. Besides this COVID-19 daily situation report is also available at <https://www.nih.org.pk/wp-content/uploads/2020/04/COVID-19-Daily-Updated-SitRep-03-April-2020.pdf>.

All the stakeholders are on board to jointly prevent/ limit/ control the spread of COVID-19. All of the staff is required to take precautionary measures as well as maintain social distances. The use of thermal guns for checking every single person body temperature, placement of

relevant flyers and disinfection spray inside of all the containers are few of the measures to combat COVID-19.

OBJECTIVE

Following are the objectives of this report to jointly prevent / limit/ control the spread of COVID-19 at Site that can hamper the progress of proposed Project:

1. To enhance understanding of the evolving COVID-19;
2. To share knowledge on COVID-19 and preparedness measures being implemented at Site;
3. To generate recommendations for adjusting COVID-19 containment and response measures; and
4. Outline the measures taken at Site. The advised measures will help all the stakeholders to plan their work continuity in response to the COVID-19.

Due to the evolving situation of the COVID-19, this document should be read in conjunction with the latest relevant advisories issued by WHO (especially "[Getting your workplace ready for COVID-19, 3 March 2020](#)") and Government of Pakistan.

WHAT IS CORONA VIRUS (COVID-19)

The COVID-19 belongs to a family of viruses known as the Coronaviruses, which can cause illnesses ranging from the common cold to more severe diseases, such as the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS)¹.

SYMPTOMS

The symptoms of the COVID-19 are similar to that of regular pneumonia. Typical symptoms include;

- Fever;
- Cough;
- Difficulty in breathing;
- Pneumonia;
- Runny nose;
- Sore throat; and
- Feeling of being unwell.

MODE OF SPREAD

Infected person – person transmission; Infected people can spread COVID-19 through their respiratory secretions via droplets produced when an infected person coughs or sneezes, similar to how influenza and other respiratory pathogens spread. The spread from person-to-person is most likely among close contacts (about 6 feet);

- Infected animals' dead or Alive;
- Air by coughing and sneezing;
- Close personal contact, such as touching or shaking hands;
- Touching an object or surface with a virus on it; and
- Touching your mouth nose or eyes before washing your hands.

¹ Source: World Health Organization

GENERAL STANDARDIZED PRECAUTIONARY MEASURES

Following measures/recommendations are suggested as a general guidance to be followed for the protection of potential impacts of COVID-19:

Since, there is no vaccine available to protect against human Coronavirus infections. Therefore, transmission can be prevented through following measures:

- Cover your mouth while cough or sneeze;
- Avoid close contact with people who are sick;
- Avoid the use of hard soap;
- Wash your hands often with liquid soap and water for at least 20 seconds;
- All the employees should ensure sanitization of hands at appropriate time;
- Avoid touching your eyes, nose, and mouth with unwashed hands;
- If you are concerned about your symptoms you should see your health care provider at site or in office;
- Use of Personal Protective Equipment (PPE) according to risk (a surgical or N95 mask);
- Do not spit, wrap your oral and nasal secretion with tissue and throw it in a covered dustbin;
- Balance your nutrition and exercise moderately;
- Sterilization / disinfection of medical devices at Site dispensaries; and
- Do not touch, buy or eat wild animals (gamey). Try to avoid visiting markets that sell such animals.

PROJECT SITE SPECIFIC PRECAUTIONARY MEASURES

Measures for protecting staff and labour from exposure to, and infection with, the COVID-19 depend on the type of work being performed and exposure risk, including potential for interaction with infectious people and contamination of the work environment. Regardless of specific exposure risks, following are the main actions that have been jointly taken at Site to combat the COVID-19:

Employer's Side

Employer should issue the notification containing the precautionary measures in the light of GoS guidelines to be implemented at Site. Upon receiving the Employer notification all the mentioned precautionary measures will be communicated to Engineer staff for compliance. Employer technical staff is also complying with the GoS guidelines and Contractor suggestion to control the spread of COVID-19 at Site in the best interest of the Project and country.

Consultant's Side

Consultant's top management will issue the orders in the light of GoS guidelines containing the precautionary measures to control the spread of COVID-19 for the staff working at Site.

Consultant staff at Site will fully complying with the orders including photographic evidence. Considering the severity of the prevailing virus Engineer devised the Standard Operating Procedure (SOP) containing precautionary action against the potential risk of novel corona virus.

Besides, above Consultant will ensure the following precautionary measures at Site.

- Adequate signage and information at all entrances and exits showing what is Corona Virus, how it spreads, what are the symptoms, standard precautions;

- The awareness session for the Contractor staff is equally important as of Consultant staff to combat the COVID-19 at Site. The Consultant will ensuring that Contractor is arranging such session at Site from time to time to reduce the potential risk of COVID-19. Further, all the newly inducted and existing staff have been given HSE training by the Consultant & Contractor.

Contractor's Side

Contractor will communicate various precautionary measures to Employer and Engineer through letters to control the spread of COVID-19 at Site. Following are the major steps to be taken by the Contractor:

- Contractor will convey the instructions and requirements of its superior unit for the prevention and control of COVID-19 epidemic at Site.
- Contractor will establish a special organization for epidemic prevention and control on the Project Site that is responsible for arranging, implementing, publicizing and supervising the epidemic prevention and control measures.
- Launch the plan for epidemic prevention and control on the project Site that includes:
 - o All personnel in temporary camp are required to wear masks;
 - o Contractor personnel incharge of Site to wear masks;
 - o Arranged special personnel to measure and record the temperature of all personnel when entering or leaving the temporary camp;
 - o If any person with fever, cold and other symptoms are found, they will be admonished to go home for isolation and asked about the development of the disease every day; and
 - o Propagate and implement the epidemic prevention measures for the staffs and labours and warn them not to go outside and home as much as possible.
- All these meetings should carried out through video conference.

Contractor is not limited to the above precautionary measures but practicing and implementing the following;

- Contractor will prepare a pamphlet for the awareness of Site staff to combat the COVID-19. It will also place/posted at strategic points at Site.
- Launch awareness campaign to inform all the staff and labour about the coronavirus, to use facemask, hand hygiene, cough etiquette, and avoidance of close contact with animals and consumption of their raw products.
- Everyday awareness speech in English and Urdu in the temporary camp.
- All the employees are not allowed to go outside of the Project Area or on vacation to their homes and on daily basis visit to sites;
- Contractor will provide medical masks and antibacterial liquid hand wash to all personnel.
- Contractor will prepare the isolation facility at Site and provided three isolated rooms for such patients inside the temporary camp. Each room have three beds, oxygen cylinder, sanitizers, isolation kit, hand wash.
- Thermal scanning will be carried out continuously in the morning for everybody at the main gate of temporary camp.
- Record will be maintained for everyone that includes the temperature value of each person with their names, every morning and afternoon go to each department for scanning separately and noted down their name with temperature values.
- Contractor carry out disinfectant spray on daily basis morning and afternoon in each office and rooms and all the area of the camp.
- SSWMB and Consultant staff will also requested by Contractor to do not interact physically rather through electronically by emails or video conferencing.

RECOMMENDATIONS FOR THE CONTROL OF COVID-19 AT SITE

To Avoid Transmission

For all personnel at Site, it is always a good to practice the following precautionary measures:

- Workers to remain at least two meters apart from each other at all times (social distancing) – i.e. spread out and reduce the number of people working together in one area of the site;
- Avoid eating lunch in the form of group in available mess/canteens at Site;
- Close site canteens/ food preparation and eating areas (avoid gatherings) – workers to bring their own prepared lunch to site and eat alone e.g. in their van, car, or in an open space;
- Avoid in-person meetings if possible. In the case that an in-person meeting is unavoidable, make sure to have it in a well-ventilated area with sufficient space for attendees to distance themselves from one another. For meetings such as toolbox talks, consider breaking them up into smaller group meetings versus one large meeting;
- Introduce enhanced cleaning procedures across the Site and touch points e.g. office equipment, plant and machinery controls, taps/toilet/washing facilities, handrails;
- Stagger start times on site to avoid congestion in entrance areas;
- Reduce the number of people on site inductions at any one time and hold them outdoors if possible;
- Stop workers moving across various sites (potential for cross contamination);
- No outsiders should be at the Project Site;
- Contractor, Consultant and Employer personnel are advised to avoid travelling and in case traveling is unavoidable, prior approval from the management should be essential. In case of travelling, the above mentioned measures need to be strictly followed by the traveller;
- Prompt identification and isolation of potentially infectious individuals is a critical first step in protecting workers and other Site staff. An isolated area should be available at Site to immediately isolate suspected person, as it is most important to stop its spread at Site.
- Rapid Response Team should be formed and be informed immediately in case of suspect and confirmed case of COVID-19.
- Medical team at Site should separate the suspected person displaying fever, cough or difficulty breathing from other personnel; and
- If a person has had close contact with an individual that has confirmed COVID-19, that person will not be allowed to return to the Site until he/she has been symptom free for 14 days.
- Clean and fumigate all the workplaces at Site on daily basis;
- Ask people to stay at home if they have fever, cough, difficulty in breathing, runny nose, sore throat as per organizational rules;
- An immediate replacement of solid soap with liquid anti-bacterial soap bottles may be appropriate.
- Provision of alcohol-based hand sanitizer need to available for all staff;
- Clean the religious places carpets and rugs. Have them washed in place over the weekend and then do regular cleaning;
- Have the cleaners/ maintenance crews regularly clean surfaces that are touched frequently by personnel with disinfectants such as in and out doors;
- Fresh medical tests of staff working should be carried out at Site;
- Dispose of all contaminated waste (gloves, paper, swab handles, etc.) into biohazard waste bags for disposal;

- Ensure that panic is not created. In fact the posters should start with statements such as do not panic and fear the virus but know and prevent; and
- Ensure proper ventilation system for all the personnel at Site.

Use of Personal Protective Equipment (PPEs)

- Necessary PPE should be available at Site all the times and are being issued to each personnel at Site;
- Practice of using masks is also being ensured by all parties at Site (a surgical or N95 masks);
- Re-usable PPE should be thoroughly cleaned after use and not shared between workers. Single use PPE should be disposed of so that it cannot be reused;

Outside Visitors

- Visitors should enter with strictly wearing visitors card;
- Ensure sanitization of hands;
- All parties should ensure that the sick persons should be wearing a surgical or N95 masks;
- Note down the complete information of outsiders before entrance;
- Proper screening should be carried out before entering the Site;
- Refrain from handshakes. Rather than shaking hands, visitors may explain why handshakes can contribute to the risk of spread;
- Attempt to maintain a general six (6) feet distance between themselves. This will be challenging to follow at all times but it is Engineer recommendation to follow;
- Refrain from and/or limit touching of workplace surfaces; and
- In addition to these on-site procedures, it is advised to follow their respective organizational instructions related to Site visits.

**ANNEX-XI: GUIDELINE EMERGENCY PREPAREDNESS
AND RESPONSE PLAN**

GUIDELINE EMERGENCY PREPAREDNESS AND RESPONSE PLAN

1.1 PURPOSE

The purpose of this Emergency Response Procedure is to provide measures and guidance for the establishment and implementation of emergency preparedness plans for the project. The aim of the Emergency Response Procedure is to:

- i. Ensure all personnel and visitors to the office/job sites are given the maximum protection from unforeseen events.
- ii. Ensure all personnel are aware of the importance of this procedure to protection of life and property.

1.2 EMERGENCY PREPARATION AND RESPONSE MEASURE SCOPE

The emergency management program is applied to all Project elements and intended for use throughout the Project life cycle. The following are some emergencies that may require coordinated response.

- i. Construction Accident
- ii. Road & Traffic Accident
- iii. Hazardous material spills
- iv. Structure collapse or failure
- v. Trauma or serious illness
- vi. Sabotage
- vii. Fire
- viii. Environmental Pollution
- ix. Loss of person
- x. Community Accident

1.3 RESPONSIBILITIES

The detailed roles and responsibilities of certain key members of the Emergency Response team available to assist in emergency are provided in **Table 1** below.

Table 1: Emergency Response Team

Action Group	Responsibility
Emergency Coordinator	▪ Overall control of personnel and resources. ▪ The Emergency Coordinator will support and advise the Site Safety Supervision as necessary. ▪ Serves as public relations spokes persons, or delegates to some staff member the responsibility for working with news media regarding any disaster or emergency. Also assure proper coordination of news release with appropriate corporate staff or other designated people.
Site Safety Supervision (Emergency Commander)	▪ Overall responsibility for activating emergency plan and for terminating emergency actions. ▪ Be alternative of emergency response chairpersons. ▪ Disseminates warnings and information as required to ensure all people in the immediate area have been warned and evacuated either by alarms or by word of mouth. ▪ Supervise the actions of the Emergency Response Team to ensure all persons are safe from the danger. ▪ Notify outside authorities if assistance is required. ▪ Carries the responsibility for coordinating actions including other organizations in accordance with the needs of the situation.

Action Group	Responsibility
	▪ Ensure maximum co-operation and assistance is provided to any outside groups called to respond to an emergency. ▪ Establish and appoint all emergency organization structure and team. ▪ Assures adequate delegation of responsibilities for all key positions of assistants on the Project to assist with any foreseeable emergency. ▪ Ensure resources available to purchase needed emergency response equipment and supplies. ▪ Assures that all persons on the Emergency Response Team aware and fully understand their individual responsibilities for implementing and supporting the emergency plan. ▪ Establish the emergency drill schedule of all identified emergency scenarios, track the status and evaluate the emergency. ▪ The Emergency Commander shall ensure that senior management personnel have been reported of the emergency as soon as practical after the event.
Security Team	▪ Ensure that the exit route is regularly tested and maintained in good working order. ▪ Maintain station at the security gate or most suitable location to secure the area during any emergency such that only authorized personnel and equipment may enter, prevent access to the site of unauthorized personnel. ▪ Assist with strong/activation of services during an emergency. ▪ Ensure vehicles and obstructions are moved to give incoming emergency vehicles access to the scene, if ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct any incoming emergency service to the site of emergency.
Rescue & Medical Team	▪ Protect the injured from further danger and weather. ▪ Provide treatment to the victim(s) to the best of their ability by first aid and then transfer to hospital. ▪ Remain familiar with the rescue activities and rescue apparatus. ▪ Assist outside medical services personnel when they arrive
General Administration Team	Response to support any requested general facilities for assisting Emergency Response Team in their work.
Government Relation Team	▪ Coordinate with local government on a matter of concerned in the emergency response plan to liaise with local officers in their affair for support Emergency Response Team. ▪ Coordinate emergency plan with the government authorities, local community.
Environment Team	In case of emergency related to the environmental pollution such as the chemical spill, oil spill into the ambient, the environment team will support the technical advice to control and mitigate the pollution until return to the normal situation.
Department Heads	▪ Call up of personnel into the safe location for protective life and property. ▪ Take immediate and appropriate action while Emergency Response Team is being mobilized. ▪ Keep in touch with the Emergency Commander ▪ Control and supervise operators and contractors on the implementation of this procedure, with consultation with Safety Team as necessary. ▪ Provide and maintain emergency equipment of their responsible areas.

Action Group	Responsibility
Other Staff and Employees	▪ All other staff and employees will remain at their workstations or assembly point unless directed otherwise from Emergency Response Team. ▪ Each supervisor will ensure that all members of his work group are accounted for and keep in touch with each of their Department Head.

1.4 PROCEDURE

Emergency situation and injuries to person can occur at any time or place either on Project site or elsewhere. The most two common types of emergencies on site are fire and serious accident.

Figure 3.1 Emergency Procedures for Fire

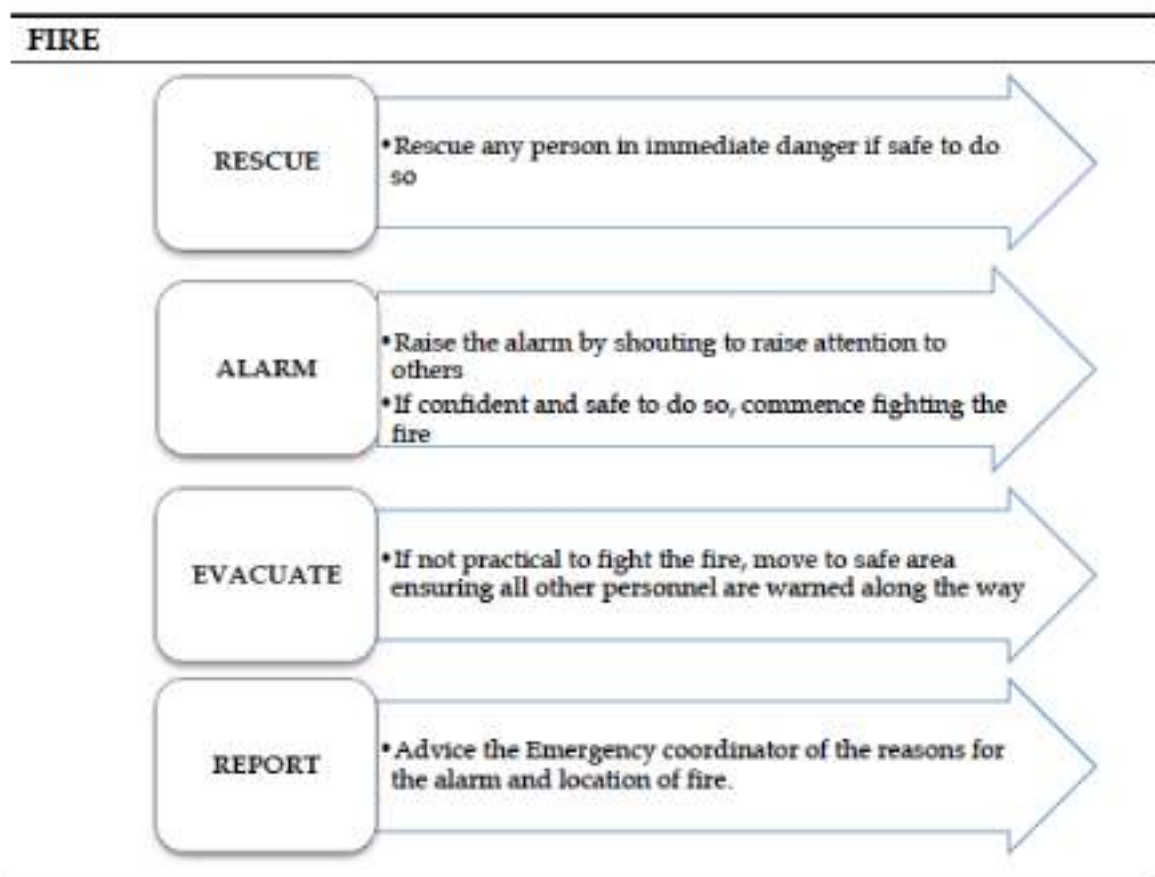
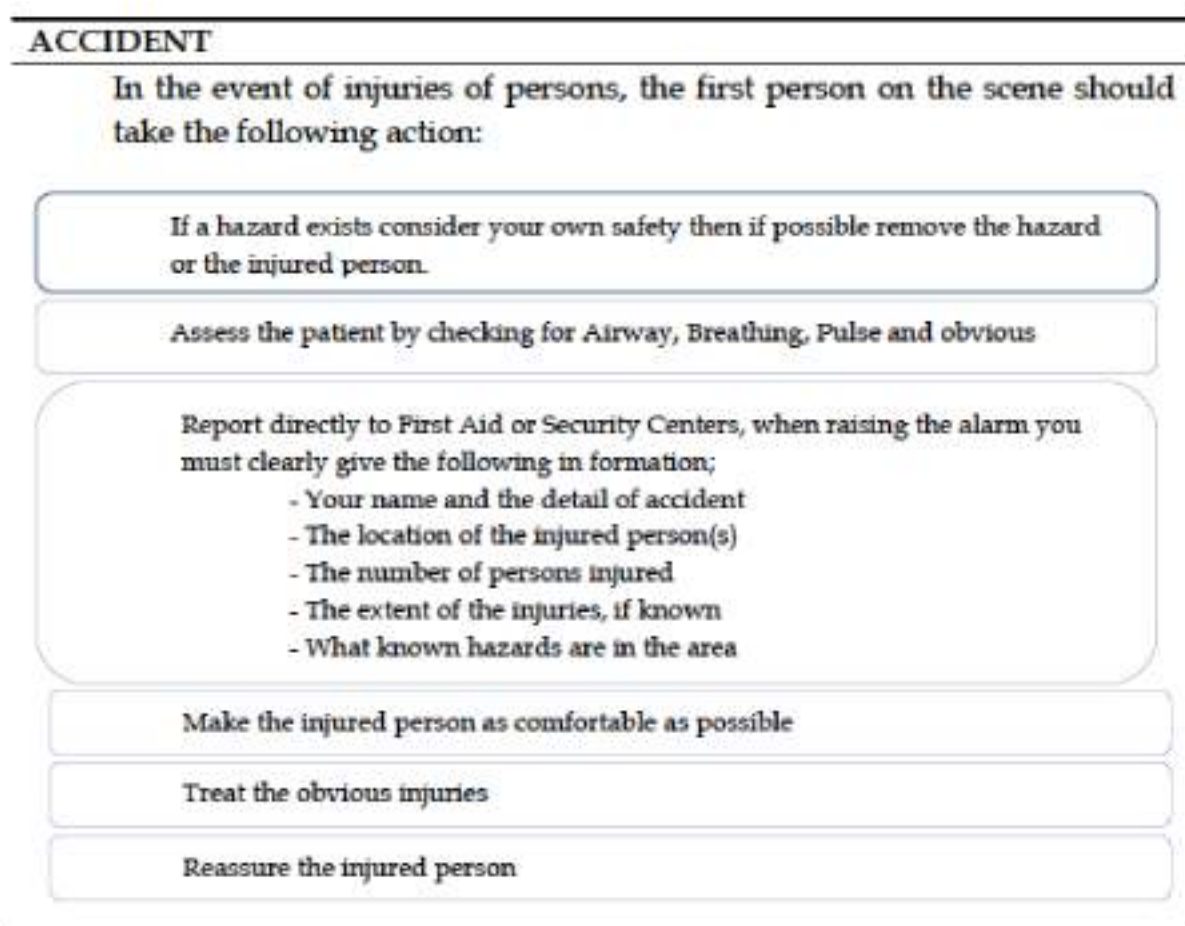


Figure 3.2 Emergency Procedures for Serious Accident



3.5 COMMUNICATION WITH AUTHORITIES / PRESS AT SITE

In the event of an accident or incident, only senior staff is permitted to give factual information to the authorities for resource of liability exposure. The press must be avoided politely, at all costs, with the terse comment that "the matter is under investigation and relevant information when available will be provided by our Head Office" Do not ever give your opinion or story.

1.5 FIRST AID PERSONS

Upon advice of medical emergency, make immediate assessment to response required and if necessary, advise security to summon ambulance or medical assistance, the qualified first aid attendant should also,

- Provide treatment to the victim(s) to the best of his/her ability.
- Ensure the safety of victims by ceasing any work activity in the area.
- Protect the injured from further danger and weather.
- Assist medical services personnel when they arrive.

1.6 GENERAL ADMINISTRATION TEAM

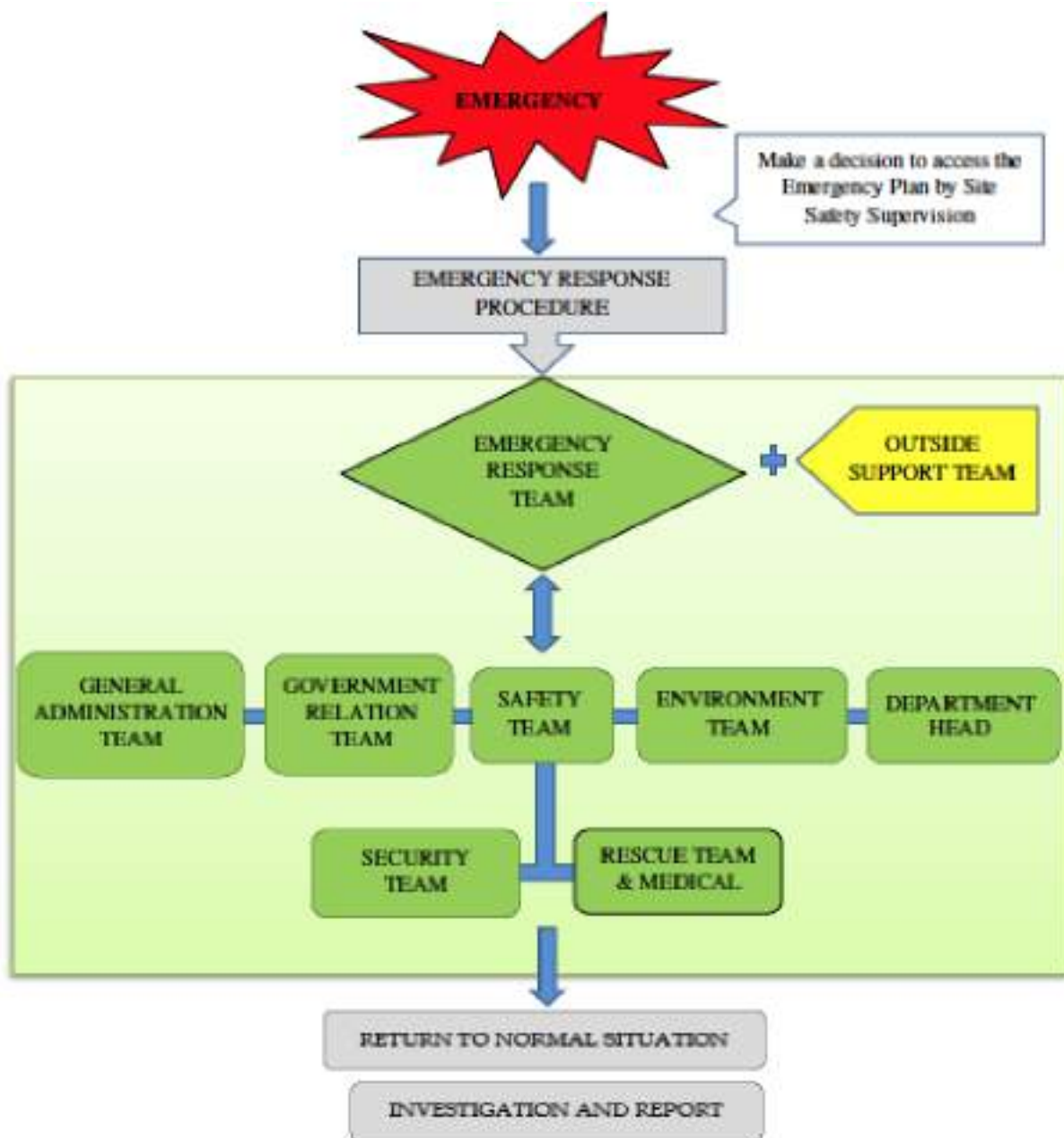
Upon advice of medical emergency, maintain contact with first aid personnel and summon ambulance if required.

1.7 SECURITY TEAM

- If ambulance or emergency services are attending the site, ensure clear access and personnel are located to direct vehicle closest to the scene.
- Prevent access to the site of unauthorized personnel (press, etc.).

1.8 EMERGENCY COORDINATOR

- The Emergency Coordinator shall assist emergency personnel at the scene as required through allocation of company resources.
- The Emergency Coordinator shall ensure next-of-kin are properly notified as soon as possible and give whatever company support and assistance is necessary to assist them bundle the situation
- The Emergency Coordinator shall ensure that senior management personnel are advised of the emergency as soon as practical after the event.



Note: Name of contact person and call number from Owner/ Contractor to be determined.

1.9 INCIDENT AND ACCIDENT REPORT

Section A: Identification Data										
Report No:	Date of Reported:				Reporter:		Sign:			
Job Title:					Company Name:					
Section B: Violence Rate										
Accident Violence: ☐ 01-Death ☐ 02-Serious Injury ☐ 03-Lost Time Injury ☐ 04-First Aid ☐ 05- Not Injury ☐ 06-Near Miss										
Property Damage Cost: ☐ 1-2,000 USD ☐ 2,001-10,000 USD ☐ 10,001-50,000 ☐ > 50,001										
Section C: Environmental Impact										
Affected area		☐ Construction area		☐ Public area						
Receptor		☐ None		☐ Workers		☐ Community				
Type of pollution		☐ Physical		☐ Chemical		☐ Biological				
Toxicity		☐ Non-toxic		☐ Low - toxic		☐ High - toxic				
Return to Normal		☐ 1 day		☐ 1 day to 1 week		☐ ≥ 1 week				
Cumulative impact		☐ Non-cumulative		☐ Cumulative						
Section D: Injured/Illness Employee										
1.Name:		Sex	Date of Birth:			Age:	Regular Job Title:		Experience:	
		☐ Male ☐ Female	Month	Day	Year				In this job title Years Weeks	In this Project Years Weeks
Site:		Company:		Reference:			Phone No:		Social Security Number	
Part of Body Injured or Affected:					Nature of Injury or Illness:					
☐ Head ☐ Hands ☐ Face ☐ Nose					☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture					
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck					☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction					
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder					☐ Hernia ☐ Foreign Body ☐ Chemical ☐ Contamination					
☐ Back ☐ Ankle ☐ Wrist ☐ Foot					☐ Skin (Occupational) ☐ Rash ☐ Irritation					
☐ Arms ☐ Thumb ☐ Fingers ☐ Internal										
Remark:					Remark:					
Section D: Injured/Illness Employee										
2.Name:		Sex	Date of Birth:			Age:	Regular Job Title:		Experience:	
		☐ Male ☐ Female	Month	Day	Year				In this job title Years Weeks	In this Project Years Weeks
Site:		Company:		Reference:			Phone No:		Social Security Number	
Part of Body Injured or Affected:					Nature of Injury or Illness:					
☐ Head ☐ Hands ☐ Face ☐ Nose					☐ Laceration ☐ Amputation ☐ Puncture ☐ Fracture					
☐ Eyes ☐ Legs ☐ Teeth ☐ Neck					☐ Strain & Sprain ☐ Burns ☐ Contusion ☐ Dry Heat Friction					
☐ Trunk ☐ Toes ☐ Elbow ☐ Shoulder					☐ Hernia ☐ Foreign Body ☐ Contamination ☐ Chemical					
☐ Back ☐ Ankle ☐ Wrist ☐ Foot					☐ Skin (Occupational) ☐ Rash ☐ Irritation					
☐ Arms ☐ Thumb ☐ Fingers ☐ Internal										
Remark:					Remark:					
Section E: Accidents/Incident Details										
Date Accident/Incident Occurred:			Time Accident/Incident Occurred:				Exact Location of the Accident / Incident:			

Details of the actual Job Being done at the time:		
Details of Accident / Incident / What actually happened?		
Section F: Accident Cause (Basic cause mark X / Contributing cause, if any mark O)		
UNSAFE CONDITIONS 1 ☐ Inadequately Guarded 2 ☐ Unguarded 3 ☐ Defective Tools, Equipment, or Substance 4 ☐ Unsafe Design or Construction 5 ☐ Hazardous Arrangement 6 ☐ Unsafe Illumination 7 ☐ Unsafe Ventilation 8 ☐ Unsafe Clothing 9 ☐ Insufficient Instruction 10 ☐ Lack of system of work Why was the unsafe act committed? _____	UNSAFE ACTS 1 ☐ Operating Without Authority / Training 2 ☐ Operating at Unsafe Speed 3 ☐ Marking SHB Device Inoperative 4 ☐ Using Unsafe Equipment or Equipment Unsafely 5 ☐ Unsafe Loading, Placing, Mixing 6 ☐ Taking Unsafe Position 7 ☐ Working on Moving or Dangerous Equipment 8 ☐ Distraction, Teasing, Horse Play 9 ☐ Failure to use Personal Protective Devices 10 ☐ Lack of effective instruction or supervision Why did the unsafe condition exist? _____	
Section G: Guide to Corrective Action (Base on the cause checked above, I am taking the following corrective action)		
UNSAFE ACT ☐ Stop the Behaviour ☐ Study the job ☐ Instruct (tell-show-try-check) ☐ Follow Up ☐ Enforce	UNSAFE CONDITION ☐ Remove ☐ Guard ☐ Warn ☐ Supervisory Training	If Supervisor can't handle, then recommend to ☐ Site Engineer, or ☐ Site Manager, or ☐ Project Manager, or ☐ Safety Committee
Detail below any immediate remedial actions that have been taken:		
Detail below any corrective and preventative actions that could be taken to prevent future re-occurrence:	Responsible	Completion Date

Section II: Witness Statement			
Witness Name		Interviewer Name	
Section I: Reviewed & Recommend by			
Recommendation: 			
Reviewed By:	Position:	Signature:	Date:
Remarks : If Accident or Incident happened with lost time injury and affected to the publicity must further report to Safety Department; : First Aid Cases will not applicable to this form; : The accident report shall submit to Safety Department within 3 days : Attached the photograph or sketch the location of accident / incident			

1.10 SUGGESTED CONTENTS OF EPRP

The Contractor should prepare the EPRP based on the guidelines provided in the above sections. The suggested structure of the EPRP is listed below:

1. Purpose
2. Applicable Scope
3. Preparation Basis
4. Emergency Response System
 - 4.1 Generals
 - 4.2 Emergency Response System
 - 4.3 Responsibilities
5. Major Safety Risks
6. Precautionary Measures
 - 6.1 Training and Exercise
 - 6.2 Hazard Source Monitor
 - 6.3 Alert Action
 - 6.4 Management Measures
7. Control Measures
 - 7.1 Response
 - 7.2 Response Procedures
 - 7.3 Emergency Response
 - 7.4 Emergency Completion and Restoration
8. Emergency Response Report and Settlement
9. Supporting Measures
 - 9.1 Communication
 - 9.2 Emergency Team
 - 9.3 Funding for Emergency
 - 9.4 Provisions and Resources
10. Records

**ANNEX-XII: GUIDELINE RESOURCE CONSERVATION
PLAN**

RESOURCE CONSERVATION PLAN

1. Introduction:

The resources in this world are not infinite. We are completely dependent on the resources of the earth to fulfill all our day to day requirements. Sustainable development calls for the need to conserve resources, especially the non-renewable resources.

2. Objective of the plan:

The Resource Conservation Plan is intended to make an effort towards achieving sustainable development. The objective of the resource conservation plan is to:

- Minimize the use of natural resources; and
- Mitigate/ prevent pollution contaminating the natural resources.

3. Planning:

Careful estimations of quantities of material, fuel, water and energy required directly or indirectly shall be done to avoid excessive or unnecessary wastage of these materials. In addition to this, pollution prevention strategies shall also be devised to prevent contamination of resources.

- The estimations include the following:
 1. Estimation of construction material required for the project
 2. Estimation of fuel consumption for construction machinery, construction vehicles and generators etc.
 3. Estimations of the energy requirements during all the stages of the project
 4. Estimations of water consumption for construction activities and construction camp sites.
- Strategies shall be planned to reduce loads on the identified resources to be consumed;
- Best management practices shall be devised to control or reduce pollution resulting from the activities during different stages of the project; and
- An inspector shall be assigned responsibility to oversee the ongoing activities to check the compliance of the planned strategies.

4. Execution of the plan:

The planned strategies shall be implemented to conserve the natural resources including but not limited to the following:

Material

- Material supplied shall be in conformance with the estimated quantities and excess material shall be returned to the supplier;
- Material wastage shall be avoided by using best management practices;
- Waste produced during the project execution shall be disposed off safely to the designated disposal sites through approved contractors; and
- Reuse of the materials shall be appreciated.

Fuel/Energy

- Reduce trips and optimize routes to and from the construction site for all kinds of activities;
- Regular maintenance of equipment and vehicles to avoid leaks and sustain efficient fuel consumption;
- Switch off/plug off idle equipment and vehicles to avoid wastage of fuel;
- Minimize warm up time, unnecessary acceleration and deceleration of the construction equipment and vehicles;
- Avoid unnecessary burning of fuel for cooking in construction camps;
- Avoid unnecessary heating/cooling systems during extreme weathers;
- Construction shall start in early hours of the day to avoid heat in summers and utilization of day light; and
- Alternate energy sources shall be considered for electricity generations during construction and operation to conserve fossil fuel as it is non-renewable resource.

Water

- Avoid using potable water for sprinkling, curing and washing of equipment/vehicles. Surface water or treated effluent can be used instead;
- Wastage of water should be controlled through providing proper valves and through controlling pressure of the water;
- Unnecessary equipment washings should be avoided;
- Awareness amongst workers shall be raised to conserve water and immediately report for any leaks detected; and
- Ensure protection of canal water from contamination resulting from construction activities.

Pollution:

- Emissions shall be reduced/controlled as far as possible and direct discharges to air shall be avoided by strictly adhering to the mitigation measures outlined in EIA report;
- Waste water shall not be discharged directly into the canal and must be managed as per the recommendations presented in EIA; and
- Construction & demolition waste and municipal solid waste shall not be dumped/ burnt openly and shall be handled according to the preventative measure given in EIA study.

5. Checking and Corrective Actions

The proponent shall bind the construction contractor through contract agreement to comply with the strategies outlined in the Resource Conservation Plan. The proponent shall also appoint an Inspector who shall monitor the daily onsite activities and shall report any issues/ concerns raised in relation to Resource Conservation Plan. The inspector shall recommend adequate corrective actions to mitigate the issues raised.

**ANNEX-XIII: GUIDELINE WASTE
MANAGEMENT PLAN**

CONSTRUCTION SPOIL AND WASTE MANAGEMENT PLAN

1. GENERAL INTRODUCTION

Construction work refers to a wide range of materials depending on their origin; they are categorized as excavation material, demolition materials, spoil and worksite waste material. Construction waste material and spoil of the proposed project consists mainly of concrete, bentonite, masonry, limestone, sandstone, metal, and wood. In addition to this, significant amount of municipal waste will also generate from the construction camps.

2. ORIGINS AND CAUSES OF CONSTRUCTION WASTE

Origins of Waste/Spoil	Causes of Waste/Spoil Material
Contractual	▪ Errors in contract documents; and ▪ Contract documents incomplete at commencement of construction.
Design	▪ Design changes; ▪ Design and detailing complexity; ▪ Design and construction detail errors; ▪ Unclear and unsuitable specifications; and ▪ Poor coordination and communication (late information, last minute client requirements, slow drawing revision and distribution).
Procurement	▪ Ordering errors (i.e. ordering items not in compliance with specification); ▪ Over allowances (i.e. difficulties to order small quantities); and ▪ Supplier errors.
Transportation	▪ Damage during transportation; ▪ Difficulties for delivery vehicles accessing construction sites; ▪ Insufficient protection during unloading; and ▪ Inefficient methods of unloading
On-Site Management and Planning	▪ Lack of on-site waste management plans; ▪ Improper planning for required quantities; ▪ Delays in passing information on types and sizes of materials and components to be used; ▪ Lack of on-site material control; and ▪ Lack of supervision.
Material Storage	▪ Inappropriate site storage space leading to damage or deterioration; ▪ Improper storing methods; and ▪ Materials stored far away from point of application.
Material Handling	▪ Materials supplied in loose form; ▪ On-site transportation methods from storage to the point of application; and ▪ Inadequate material handling.
Site Operation	▪ Accidents due to negligence; ▪ Unused materials and products; ▪ Equipment malfunction; ▪ Poor craftsmanship; ▪ Use of wrong materials resulting in their disposal; ▪ Time pressure; and ▪ Poor work ethics.
Residual	▪ Waste from application processes (i.e. over preparation of mortar); ▪ Off-cuts from cutting materials to length; ▪ Waste from cutting uneconomical shapes; and ▪ Packaging.
Other	▪ Weather ▪ Vandalism ▪ Theft

3. CONSTRUCTION WASTE MANAGEMENT PLAN

i) Waste Management Goals

The contractor established goal that this project will generate at least 50 percent less waste into landfills and the processes shall be employed to ensure that this goal is met. These shall include prevention of damage to materials to be incorporated into the work due to mishandling, improper storage, contamination, inadequate protection, minimizing poor quantity estimation, and through design.

ii) Responsibility

- a) The Contractor shall be responsible for the implementation of the administrative portions of this program, including the notification of subcontractor management, the training of the site supervisor and the onsite posting of this plan.
- b) The site supervisor shall be responsible for the implementation of the onsite portions of this program including the training of subcontractor personnel.

iii) Waste Prevention Planning

- a) In addition to other requirements specified herein it is a requirement for the work of this project that the contractor comply with the applicable city waste disposal requirements.
- b) Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling where practical and possible. Waste disposal in landfills shall be minimized as much as possible.
- c) Project Construction Documents: The Contractor will contractually require all subcontractors to comply with the Construction Waste Management Plan (WMP)". A copy of the WMP will accompany all subcontractor agreements and require subcontractor participation.
- d) The "Construction Waste Management Plan" shall be implemented and executed as follows and as on the chart:
 - i) Salvageable materials will be diverted from disposal where feasible;
 - ii) There will be a designated area on the construction site reserved for materials that can be recycled;
 - iii) Areas shall be marked to designate what recycle materials are to be stored there; and
 - iv) Hazardous waste shall be managed by a licensed hazardous waste vendor.

iv) Communication and Education Plan

- a) This Waste Management Plan will be posted onsite;
- b) Each subcontractor will be made aware of the intent of this project with respect to reduction of waste and recycling. Onsite recycling containers and/or areas will be plainly marked;
- c) The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan;
- d) All recycling containers and areas will be clearly marked;
- e) Lists of acceptable and unacceptable materials will be posted at the site; and
- f) All subcontractors will be informed in writing of the importance of non-contamination with other materials or trash.

v) Motivation Plan

The Contractor will conduct a pre-award meeting for subcontractors. Subcontractors under consideration will be required to attend the meeting to review project goals and requirements with the project team. Attendance will be a prerequisite for award of subcontracts. This

document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the job site.

vi) Expected Project Waste, Disposal, and Handling

The following chart identifies waste materials expected on the proposed project, their expected disposal methods and handling procedures. New items may be added as needed.

Material	Disposal Method	Handling Procedure
Land Clearing Debris	Keep separate for reuse and or wood sale. Suitable materials may be delivered to a composting site. Separate topsoil and rock for future landscaping use.	Keep separated in designated areas onsite.
Clean Dimensional Wood and Palette Wood	Keep separate for reuse by on-site construction or by site employees for either heating stoves or reuse in home projects. May be offered to public.	Keep separated in designated areas onsite.
Painted or Treated Wood	Reuse, off site recycle, and landfill.	Keep separated in designated areas onsite. Place in "Trash" container.
Concrete	Recycle when possible.	Keep separated in designated areas onsite.
Concrete Masonry Units	Keep separate for re-use by on-site construction or by site employees	Keep separated in designated areas onsite
Metals	Recycle off site when possible. Separate copper wire when possible.	Keep separated in designated areas onsite. Place in "Metals" container.
Gypsum drywall (unpainted)	Recycle with supplier when possible.	Keep scraps separate for recycling – stack on pallets in provided onsite. All scrap drywall should be taken back by contractor to drywall supplier
Paint	Reuse onsite; donate to Habitat for Humanity Restore.	Keep separated in designated areas onsite
Insulation	Reuse and landfill.	Keep separated in designated areas onsite.
Glass	Recycle locally.	Keep separated in designated areas onsite.
Plastics	Plastic Bottles: recycle locally; be aware of plastics that are acceptable to recycle facility.	Keep separated in designated areas onsite.

vii) Recycle Hauler

- a) To be determined;
- b) Contact Address; and
- c) Some or all recycle may be hauled by the authorized representative.

viii) Possible Recycle Locations and Acceptable Materials

- a) Coordinate with companies in concerned districts or which are registered with Metropolitan Corporation Chiniot that accept materials for recycle; and
- a) Using the above as a resource, a list will be kept indicating local opportunities for recycle of expected materials. New locations should be added as needed.

ANNEX-XIV: GUIDELINE SANITATION PLAN

GUIDELINE SANITATION PLAN

INTRODUCTION

This plan outlines the measures that can improve conditions of sanitation at construction sites during construction and operation phase.

1. PURPOSE OF THE PLAN'

The plan intends to ensure sanitation including the control of water supplies, excrete and wastewater disposal, refuse disposal, vectors of diseases, housing conditions, food supplies and handling, atmospheric conditions, and the safety of the working environment.

2. MANAGEMENT OF SANITATION DURING CONSTRUCTION PHASE

i) Responsibility

The Health and Safety Inspector designated by construction contractor shall also inspect sanitation conditions and ensure safe working environment for workers.

ii) Location of Camp Sites

The accommodation and ancillary facilities for labor shall be constructed and maintained to standards and scales approved by the Resident Engineer.

The camps must be located such that the drainage from and through the camps shall not endanger any domestic or public water supply.

All sites must be managed to avoid ditches and depressions to minimize nuisance due to stagnant water.

iii) Water Supply

An adequate and convenient water supply, approved by the appropriate health authority, must be provided in each camp for drinking, cooking, bathing and laundry purposes.

Potable water supply systems for labor camps occupants shall meet the drinking water quality standards of PEQS, 2016. In addition, the design of water system facilities shall be based on the suppliers Engineer's estimates of water demands. The drinking water must be monitored regularly for drinking water quality parameters.

At all construction camps and other workplaces, good and sufficient water supply shall be provided and maintained to eliminate chances of waterborne diseases to ensure the health and hygiene of the workers.

iv) Toilet Facilities and Hygiene

According to health and safety guidelines OR-OSHA number of toilets required at construction site is as one toilet for 20 workers. **Table 1** shows the number of toilets required in accordance with the number of employees at construction site. The total numbers of employees at construction site are estimated to be 450 persons.

Table 1: Number of Toilets Required for Employees at Construction Site

No. of Employees	No. of Toilets and Urinals by OSHA	Total No. Toilets and Urinals Required at Construction Site
Up to 20 Employees	1 Toilet	23 Toilets
Up to 40 Employees	1 Urinal	12 Urinals

Within the premises of every workplace, toilets and urinals shall be provided in an accessible place, and the accommodation, separately for each of these, as per standards prevailing in the province and country.

Toilet facilities adequate for the capacity of the camp must be provided. Each toilet room must be located, so as to be accessible.

A toilet room must be located within 200 feet of the camp. No toilet may be closer than 100 feet to kitchen and sleeping area.

These toilets must be distinctly marked by signs printed in native language of the persons occupying the camp, or marked with easily understood pictures or symbols.

Urinals troughs in privies must drain freely into the pit or vault, and the construction of this drain must be such as to exclude flies and rodents from the pit.

Proper facility for hand washing and other cleaning activities to be provided as follows:

- Provide individual hand towels from a sanitary dispenser and receptacles for disposing of waste towels;
- Providing hand soap and industrial hand cleaner for removing paints and other contaminants;
- Prohibited use of gasoline or solvent for hand washing; and
- Keep the floor of facilities dry to prevent spills and falls.

v) Waste Disposal

The sewage system for the camp must be designed, built and operated in compliance with the relevant legislation so that no health hazard occurs and no pollution to the air, ground or adjacent watercourse takes place.

Garbage bins must be provided in the camps and regularly emptied and the garbage disposed of in a hygienic manner.

Unless otherwise arranged for by the local sanitary authority, arrangement for disposal of excreta should be done in the already existing sewerage system in the area.

On completion of the works, all such temporary structures shall be cleared away, all rubbish burnt, excreta tank and other disposal pits or trenches filled in and effectively sealed off and the outline site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the engineer.

vi) Maintenance of Sanitary Facility

Proper maintenance of toilets and other sanitary facilities should assure by health and safety inspector. Toilets and other sanitary facilities shall be cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Receptacles shall be tarred inside and outside at least once a year.

All buildings, rooms and equipment and the grounds surrounding them shall be maintained in a clean and operable condition, and be protected from rubbish accumulation.

All necessary means shall be employed to eliminate and control any infestations of insects and rodents within all parts of any labor camp.

3. Management of Sanitation During Operational Phase:

A proper sanitation plan is to be adopted for maintaining the hygienic conditions during the operational phase of the project. These includes

- Site Clearance;
- Sewage Pipe Clearing, and
- Solid Waste Management.

i) Site Clearance

The construction contractor shall assure the clearance of construction machinery, vehicle and other equipment used during the construction period after the completion of the project.

ii) Solid Waste Management

Municipal solid waste and medical waste produced along the road should be collected and managed properly by the concerned department. Waste bins should be placed along the road side; regular cleaning of the road should be carried out using mechanical sweepers and at least two to four sweepers should be deputed for the whole proposed road to assure regular cleaning.

iii) Awareness and Training

A training and awareness sessions shall be conducted for workers before commencement of the Project. The implementation of sanitation plan would be more effective if the importance of hygiene; sanitation and safety are known to the workers.

**ANNEX-XV: GUIDELINE FOR CONTRACTOR'S TRAFFIC
MANAGEMENT PLAN**

GUIDELINE TRAFFIC MANAGEMENT PLAN

1. Need for Plan

During the construction period of the project, considerable vehicular movement carrying large amounts of material and machinery is expected. This will definitely interrupt the local traffic and is therefore important to manage the traffic to avoid the nuisance to local residents in terms of noise, dust, congestion and inconvenience.

2. The plan

The objective of Traffic Management Plan (TMP) is to define the requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from construction traffic.

The TMP will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such as tipping areas and wash-out areas. It is intended to compliment and work alongside relevant EMP. The TMP will be classed as “live” and therefore be subjected to updates as required.

The Contractor, at the time of the execution of the project, will prepare a comprehensive TMP in coordination with local traffic police department, WSD, emergency services and local administrative department. Works and Services Department (WSD) and CSC will review and approve the Contractor's TMP. The Contractor's TMP shall include following mitigation measures during its preparation:

- Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project development.
- Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project.
- Spoil dumpsites located close to project site to minimize journey distance and limit movements to site access roads.
- Construction of worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site.
- Provision of bus/minibus services for personnel living in nearby settlements.
- Movements of construction workers will be planned to avoid the busiest roads and times of day when traffic is at its greatest.
- Schedule deliveries and road movements to avoid peak periods.
- Driver training for HGV drivers and refresher course every six months for project drivers.
- Speed restrictions for project traffic travelling through communities (to be agreed with National Highway Authority).

- Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues.
- Run a pedestrian awareness programme.
- Temporary signage

The traffic management plan for the project corridor is provided below.

3. Other Recommendations

It is important to manage public access routes during construction because it can cause delay to local traffic and create a safety hazard both on and offsite. People working and living near the tower sites would be annoyed by the emissions, noise and visual intrusion of queuing vehicles. Some important factors involved in access routes and site traffic are as follows:

3.1. Public Access Routes

The use of public road for site access may be restricted in terms of:

Vehicle size, width and type of load

- Time limits
- Parking
- Pedestrian conflicts

Contractor should have consultation with the local police or local authority to address these issues and to effectively manage them before the beginning of the construction.

3.2. Site Workers Traffic

Site personnel should not be permitted to park vehicles right on the road; this will lead to disruption in material deliveries. Designated parking areas with appropriate parking space will be needed for this purpose; any plain area near construction site can be used for this purpose.

3.3. Site Rules

- Access to and from the site must be only via the specified entrance.
- On leaving the site, vehicles must be directed to follow the directions given.
- Drivers must adhere to the site speed limits.
- All material deliveries to site must keep allocated time limits.
- No material or rubbish should be left in the loading-unloading area.
- Develop a map for alternate routes showing material delivery services.
- Assign designated personnel on site to receive deliveries and to direct the vehicles.
- Monitor vehicle movement to reduce the likelihood of queuing or causing congestion in and around the area.

- Project vehicles should have a unanimous badge or logo on windscreen displaying that they belong to the project.

4. Contractor's Obligation

The traffic management plan of the Contractor should be safe enough and widening of any access roads and construction of the detours (as applicable and practical) must be completed prior to start of project construction activities so that heavy vehicular transportation for construction activities do not hinder the normal course of traffic lanes. Contractor must ensure that road closures are carried out by a competent person. The Contractor obligation must include the display of traffic signs according to the need to divert the traffic volume and to guide the road users in advance. The traffic sign, traffic light should be placed from any diverting route or road marking.

The Contractor should consider the environmental and social impacts of the traffic during construction. It will be sole responsibility of the Contractor to implement a plan which produces minimum nuisance to the local people and to the environment. Safety of the people should be given due importance. It will be under Contractor obligation to notify the traffic management plan and its later changes to CSC, WSD, emergency services and Traffic Police, and also publish weekly programme in the local newspaper.

PHOTOLOG

A Few Glimpses of the Site Visit





Structures Under Impact in Proposed Staff Colony



Crops Under Impact in the Proposed Reservoir Area



Reconnaissance Survey near Pathan Basti



Consultation near Basti Qazi Wala



Drain Channel Falling in the River Covered with Weeds



Darbar Boo Ali Qalandar



Bridge Over Chenab River and Transmission Lines



Drain Channel Falling in the River



Government Primary School Under Impact in
Proposed Staff Colony



Dam Site Area

Departmental Consultation



Consultation With DC Chiniot



Departmental Consultation with Irrigation Dept.



Departmental Consultation with EPA



Departmental Consultation with Irrigation Dept. SGD



Departmental Consultation with SNGPL FSD



Departmental Consultation with DD Local Government



Consultation with DD local government and District
Social Welfare officer Chiniot



Consultation at Site with officials of Forest Dept

Consultation with official of Fisheries Dept,
SGD



District Office Fisheries, DD Sargodha

Village Consultation



Consultation at Village Burk Ziada



Consultation at Village Thatha Shah Behlol



Consultation with local people



Socioeconomic Survey at Mouza Bux Wala



Consultation at Basti Malah



Socioeconomic Survey at Daira Fateh Sher



Consultation at Mouza Burj Umar



Consultation at Daira Nahme



Consultation at Mouza Kacha Gorna



Consultation at Talib Wala



Consultation at Thata Sargana



Consultation at Bahar Wala