Environmental Impact Assessment

Islamic Republic of Pakistan: Second Power Transmission Strengthening Project

Project Title: Power Interconnection between Ghazi Barotha, Tarbela, 500kV Islamabad West and 500kV Faisalabad West Grid Station

September, 2025

Client: National Grid Company of Pakistan Limited (NGC)

(Formerly NTDC)

Consultant: M/s Barqaab – STEPS (JV)

ABBREVIATIONS

AC	–	Alternating Current
AOI	–	Area of Influence
DC	–	Direct Current
EHS Manager	–	Environmental, Health, and Safety Manager (under ESIC)
EIA	–	Environmental Impact Assessment
EMF	–	Electromagnetic Field
EMP	–	Environmental Management Plan
ESIC	–	Environment and Social Impact Cell
GIIP	–	Good International Industry Practice
GoP	–	Government of Pakistan
GRC	–	Grievance Redress Committee
GSHAP	–	Global Seismic Hazard Assessment Program
HSE	–	Health, Safety and Environment
IESS	–	Consultant's International Environmental Safeguards Specialist
IUCN	–	International Union for Conservation of Nature
LDA	–	Lahore Development Authority
NGC	–	National Grid Company of Pakistan Limited
NOC	–	No Objection Certificate
NTDC	–	National Transmission & Despatch Company
OPGW	–	Optical Ground Wire
PBC	–	Pakistan Building Code
PEPA	–	Pakistan Environmental Protection Agency
PEQS	–	Punjab Environmental Quality Standards
PHA	–	Parks and Horticulture Authority
PM	–	Particulate Matter
PMU	–	Project Management Unit
PPE	–	Personal Protective Equipment
PTCL	–	Pakistan Telecommunication Company Limited
PTSP	–	Power Transmission Strengthening Project
RoW	–	Right of Way
SNGPL	–	Sui Northern Gas Pipeline Limited
SSEMP	–	Site-specific EMP
T/L	–	Transmission Line
WAPDA	–	Water & Power Development Authority

WASA	–	Water and Sanitation Authority
WHO	–	World Health Organization

WEIGHTS AND MEASURES

µg/m^3	–	Microgram per cubic meter
Amsl	–	Above mean sea level
dB(A)	–	Decibels (A-weighted)
Km	–	Kilometer
km^2	–	Square Kilometer
M	–	Meter
m^3/sec	–	Cubic meter per second

CONVERSIONS

1 meter	–	3.28 feet
1 hectare	–	2.47 acre

CONTENTS

Executive Summary **xvi**

Project Proponent and the Study Consultant **xiii**

1. INTRODUCTION **1-1**

1.1 Brief Description of the Project **1-1**

1.2 Environmental Category **1-1**

1.3 Objective of EIA **1-1**

1.4 Project Proponent and the Study Consultant **1-2**

1.5 Nature, Size, Magnitude and Location of the Project **1-3**

1.6 Consultant EIA Team **1-3**

1.7 Approach and Methodology **1-5**

1.7.1 Literature Review 1-5
1.7.2 Review of Environmental Laws and Institutional Requirements 1-5
1.7.3 T/L Corridor Identification and Route Optimization Study 1-5
1.7.4 Delineation of Corridor of Impact 1-6
1.7.5 Survey of COI 1-6
1.7.6 Analysis of Alternatives 1-6
1.7.7 Environmental Baseline Survey of the Project 1-7
1.7.8 Stakeholder Consultations 1-9
1.7.9 Impact Assessment and Mitigation Measures 1-9
1.7.10 Environmental Management Plan 1-10

1.8 Organization of Report **1-10**

2. DESCRIPTION OF THE PROJECT **2-1**

2.1 General **2-1**

2.2 Objectives of the Project **2-1**

2.3 Project Scope of Work **2-1**

2.4 Project Location **2-2**

2.5 Accessibility **2-2**

2.6 Design Aspects **2-3**

2.6.1 Design Components 2-3
2.6.2 Design Standards 2-8
2.6.3 Safety Parameters 2-10

2.7 Construction Aspects **2-11**

2.7.1 Contractor Arrangements 2-11
2.7.2 Implementation Schedule 2-11
2.7.3 Construction Camps 2-12
2.7.4 Batching Plants 2-12
2.7.5 Manpower Requirements 2-12

2.7.6 Construction Materials and Transport 2-13
2.7.7 Construction Procedures 2-13
2.7.8 Stringing of Conductors and Overhead Ground Wire 2-15
2.7.9 Equipment and Machinery Requirement 2-15
2.8 Operation and Maintenance Arrangements 2-16
2.8.1 Foundations 2-16
2.8.2 Steel Works 2-16
2.8.3 Conductor, Overhead Ground Wire, Hardware and Insulators 2-17
2.9 Project Cost 2-17

3. ANALYSIS OF ALTERNATIVES 3-1
3.1 General 3-1
3.2 No Project Option 3-1
3.3 Technological Alternatives 3-2
3.3.1 Conductor Alternatives 3-3
3.3.2 Tower Design Alternatives 3-3
3.3.3 Use of Single Tower/ Corridor in Protected Areas 3-3
3.4 T/L Route Alternatives 3-4
3.4.1 Route A Transmission Line 3-4
3.4.2 Route B Transmission Line 3-5
3.4.3 Route C Transmission Line 3-6
3.5 Environmental Considerations 3-6
3.6 Social Aspect 3-7
3.7 Economic Aspect 3-8
3.8 Comparison of the Proposed Routes 3-9

4. DESCRIPTION OF THE ENVIRONMENT 4-1
4.1 General 4-1
4.2 Data Collection for Baseline Study 4-1
4.3 Physical Environment 4-1
4.3.1 Topography 4-1
4.3.2 Geology and Soil 4-4
4.3.3 Seismology 4-6
4.3.4 Land Use 4-8
4.3.5 Climate 4-10
4.3.6 Water Resources 4-13
4.3.7 Solid Waste and Wastewater Situation 4-16
4.3.8 Ambient Air Quality 4-16
4.3.9 Ambient Noise Levels 4-21
4.3.10 Water Quality 4-24
4.3.11 Environmentally Sensitive Receptors 4-33

4.4 Ecological Environment 4-36
4.4.1 Study Area 4-36
4.4.2 Field Survey 4-37
4.4.3 Aquatic Ecological Resources 4-42
4.4.4 Terrestrial Ecological Resources 4-43
4.4.5 Threatened and Endemic Fauna Species in the Project Area 4-57
4.4.6 Protected Areas in Project Area 4-58
4.5 Socioeconomic Environment 4-62
4.5.1 Data Collection Methodology 4-62
4.5.2 Administrative Setting 4-62
4.5.3 Demographics 4-63
4.5.4 Profile of the Respondents 4-64
4.5.5 Family Size, Age, and Gender Ratios 4-66
4.5.6 Languages Spoke 4-67
4.5.7 Religion 4-67
4.5.8 Education Level 4-67
Housing Conditions 4-69
4.5.9 Household Income 4-69
4.5.10 Expenditure 4-70
4.5.11 Access to Infrastructure 4-71
4.5.12 Landholding 4-72
4.5.13 Traffic Situation on Existing Roads 4-72

5. Anticipated Project Impacts and Mitigation Measures 5-1
5.1 Delineation of Project Corridor of Impact 5-1
5.2 Positive Impacts of Proposed T/L Construction 5-1
5.3 Potential Adverse Impacts of T/L 5-1
5.4 Methodology for Impact Assessment 5-2
5.4.1 Scoping 5-2
5.4.2 Prediction of potential impacts 5-2
5.4.3 Evaluation of the significance of potential impacts 5-2
5.4.4 Mitigation measures 5-4
5.4.5 Residual impacts 5-4
5.4.6 Management actions and monitoring 5-4
5.5 Pre-construction (Design) Phase Impacts 5-4
5.5.1 Lack of Integration of EMP/EIA Requirements into Construction Bid Documents 5-8
5.5.2 Lack of Planning in T/L Design 5-8
5.5.3 Lack of Project Human Resources 5-10
5.5.4 Improper Location of Construction Camps 5-10
5.5.5 Selection of High-Noise Equipment in the Planning Stage 5-11
5.5.6 Minimization of Waste Generation in Planning Stage 5-11

5.5.7 Disruption to Existing Drainage Pathways and Utilities 5-12
5.5.8 Removal of Vegetation/Trees 5-13
5.5.9 Impacts on Sensitive and High Value Areas 5-14
5.5.10 Bird Collision and Electrocution Risk 5-14
5.5.11 Electromagnetic Field (EMF) 5-15
5.5.12 Impact on Community Safety due to the Structure/ Mechanical Failure of the Overhead Conductors. 5-20
5.5.13 Land Acquisition 5-20
5.6 Construction Phase Impacts 5-22
5.6.1 Physical Environment 5-28
5.6.2 Ecological Environment 5-47
5.6.3 Socioeconomic Environment 5-53
5.7 Operation Phase 5-62
5.7.1 Physical Environment 5-65
5.7.2 Ecological Environment 5-69
5.7.3 Socioeconomic Environment 5-72
5.8 Induced Impacts of Applied Measures 5-74
5.9 Cumulative Impacts 5-75
5.10 Climate Risk and Vulnerability Assessment 5-77

6. Information Disclosure, Consultation and Participation 6-1
6.1 Objectives 6-1
6.2 Consultation Methodology 6-1
6.3 Community Consultation 6-2
6.4 Institutional Consultation 6-2

7. ENVIRONMENTAL MANAGEMENT PLAN 7-1
7.1 General 7-1
7.2 Construction Schedule 7-1
7.3 Summary of Impacts and Mitigation Measures 7-1
7.4 Capacity Building and Training 7-2
7.5 Equipment Maintenance Details 7-14
7.6 Environmental Monitoring and Reporting 7-15
7.7 Institutional Arrangement 7-22
7.8 Communication and Record Keeping 7-24
7.8.1 Stakeholder Coordination 7-24
7.8.2 Data Recording and Maintenance 7-24
7.8.3 Database 7-24
7.8.4 Meetings and Reporting 7-25
7.8.5 Social Complaint Register 7-25

7.8.6 Photographic Records 7-26
7.8.7 Non-Compliance of the EMP 7-26
7.8.8 Review of Recorded Data 7-26
7.9 Environment Management Cost 7-26

8. Conclusion and Recommendations 8-1
8.1 Conclusion 8-1
8.2 Recommendations 8-2

ANNEXURES

Annexure 1 : Land Use Map..... 9-2
Annexure 2: Lab Monitoring Reports..... 9-3
Annexure 3: Waste Management Plan..... 9-41
Annexure 4: OHSE Management Plan..... 9-45
Annexure 5:Tree Afforestation Plan 9-50

LIST OF FIGURES

Figure 1-1: Location Map of Proposed T/L 1-4
Figure 1-2: RoW and COI of the Proposed T/L 1-7
Figure 2-1 Connection of 220kV Mansehra and Tarbela T/L with Islamabad West grid station 2-2
Figure 2-2: Tower Layout of “DS1” Tower Type 2-5
Figure 2-3: Tower Layout of “DA1” Tower Type 2-6
Figure 2-4: Tower Layout of “DD1” Tower Type 2-7
Figure 3-1: Objective Function of Conductor Optimization 3-3
Figure 3-2: Route Alternatives Considered 3-11
Figure 3-3: Route Options near Kala Chitta NP 3-12
Figure 3-4: Land Use around Kala Chitta National Park 3-13
Figure 4-1: Photographs Depicting Topography of the Project Area 4-2
Figure 4-2: Topography of the Project Area 4-3
Figure 4-3: Geology of the Project Area 4-5
Figure 4-4: Seismic Zoning Map of the Proposed T/L 4-7
Figure 4-5: Land Use in Project COI 4-9
Figure 4-6: Annual inflows (MAF) Jhelum and Chenab Rivers. (WAPDA data) 4-15
Figure 4-7: Major Surface Water Resources in the Project Area 4-15
Figure 4-8: Tube wells Installed for Groundwater Extraction 4-16
Figure 4-9: Ambient Air Quality Sampling Site 4-18
Figure 4-10: Air Quality Sampling Locations Map 4-19
Figure 4-11: Ambient Noise Sampling Locations Map 4-22
Figure 4-12: Photos of Noise Measurement in the Project Area 4-23
Figure 4-13: Surface Water Sampling Photographs 4-26
Figure 4-14: Surface Water Sampling Locations of Proposed T/L 4-28
Figure 4-15: Drinking Water Sampling Photographs 4-31
Figure 4-16: Drinking Water Sampling Locations of Proposed T/L 4-32
Figure 4-17: Location of Sensitive Receptors in Project COI 4-35
Figure 4-18: Ecological Study Area Map 4-38
Figure 4-19: Photographs of Different Habitat Types in the Terrestrial Study Area 4-40
Figure 4-20: Sampling Locations for Flora and Fauna 4-41
Figure 4-21: Fish Species in the Project Area 4-43
Figure 4-22: Photographs of Plant Species in the Study Area 4-45
Figure 4-23: Photographs of Invasive Plant Species in the Study Area 4-47
Figure 4-24: Photographs of Mammalian Species Sign in Study Area 4-50
Figure 4-25: Asian Migratory Birds Flyway 4-52
Figure 4-26: Bird Species Photographed in the Study Area 4-54
Figure 4-27: Herpetofauna species observed in the Terrestrial Study Area 4-57
Figure 4-28: View of Chini National Park near Proposed T/L Route Area 4-59
Figure 4-29: Proposed T/L Route Passing through Chinji National Park 4-60
Figure 4-30: Proposed T/L Route Passing through Kala Chitta National Park 4-61
Figure 4-31: District-wise Rural and Urban Population 4-66
Figure 4-32: Survey Population Age Groups 4-67
Figure 4-33: Average Monthly Income 4-70
Figure 4-34: Household Income Sources 4-70
Figure 4-35: Access to Social Amenities 4-72
Figure 4-36: Snapshot of Socioeconomic Conditions in the COI Area 4-75
Figure 5-1: Electromagnetic Spectrum 5-17
Figure 5-2: Magnetic Strength from Overhead T/Ls 5-17
Figure 5-3: General Drawing of Septic Tank 5-42
Figure 6-1: Locations of Community Consultations 6-20
Figure 6-2: Community Consultation Photographs (Male) 6-23

Figure 6-3: Community Consultation Photographs (Female) 6-25
Figure 6-4: Photographs from Consultations with Institutions 6-38

LIST OF TABLES

Table 1-1: Team Composition for the EIA Study 1-3
Table 2-1: Design Data of Complete Conductor 2-3
Table 2-2: Selected Metrological Station 2-8
Table 2-3: Permissible Conductor Clearances 2-11
Table 2-4: Tentative Implementation Schedule of the Proposed T/L 2-12
Table 2-5: Estimated Manpower Requirement 2-12
Table 2-6: Estimated Construction Materials for Single Tower 2-13
Table 2-7: Tentative List of Machinery and Equipment for the Execution of the Project.... 2-15
Table 3-1: Expected Commissioned Dates of Various HPPs..... 3-1
Table 3-2: Options Considered for Proposed T/L 3-2
Table 3-3: Comparison of Routes Considering Land Use..... 3-8
Table 3-4: Comparison of Routes Considering Other Land Features 3-8
Table 3-5: Comparative Matrix 3-9
Table 3-6: Settlements Around Chinji NP 3-13
Table 4-1: Values of Seismic Zones of Pakistan 4-6
Table 4-2 : Seismic Zone Categorization, PBC 1986..... 4-6
Table 4-3: Summary of Land Use in the Project COI..... 4-8
Table 4-4: Monthly Temperature at Islamabad and Faisalabad Stations 4-10
Table 4-5: Mean Monthly Rainfall at Islamabad and Faisalabad Stations..... 4-11
Table 4-6: Relative Humidity at Islamabad and Faisalabad Stations 4-12
Table 4-7: Wind Speed Recorded at Islamabad and Faisalabad Stations 4-13
Table 4-8: Details of Air Quality Sampling Locations 4-17
Table 4-9: Ambient Air Sampling Results..... 4-20
Table 4-10: Description of Noise Level Sampling Locations..... 4-23
Table 4-11: Noise Level Monitoring Results..... 4-24
Table 4-12: Water Quality Sampling Locations Description..... 4-25
Table 4-13: Surface Water Sampling Results..... 4-26
Table 4-14: Drinking Water Sampling Results..... 4-29
Table 4-15: Sensitivity Risk Scale 4-33
Table 4-16: Sensitive Receptors and Environmental Value..... 4-33
Table 4-17: Summary of Land Use in the Project COI..... 4-36
Table 4-18: Habitat Types for the Terrestrial Sampling Locations 4-37
Table 4-19: Vegetation Cover, Plant Count, and Diversity by Habitat Type..... 4-45
Table 4-20: Mammal Signs and Sightings in the Study Area..... 4-49
Table 4-21: Total Bird Sightings, Density, and Diversity by Habitat Type 4-53
Table 4-22: Herpetofauna Sightings in the Study Area..... 4-56
Table 4-23: List of Threatened Species Found in the Project Area..... 4-57
Table 4-24: District Wise Population Details..... 4-64
Table 4-25: Main Localities of the Project Area 4-64
Table 4-26: Settlement Type of Surveyed Households..... 4-66
Table 4-27: Distribution of Respondents' Education Level 4-68
Table 4-28: District-wise Literacy Rates 4-68
Table 4-29: Housing Conditions of Surveyed Households..... 4-69
Table 4-30: Monthly Household Income Level 4-69
Table 4-31: Details of Household Expenditures..... 4-71
Table 4-32: Status of Landholding of Survey HHs..... 4-73
Table 5-1: Evaluation of Impact Significance Matrix (Likelihood Scale) 5-3
Table 5-2: Evaluation of Impact Significance Matrix (Consequence Scale) 5-3
Table 5-3: Evaluation of Impact Significance Matrix (Risk Score Table) 5-3
Table 5-4: Screening of Potential Impacts at Pre-construction (Design) Phase 5-5
Table 5-5: Tree Species Potentially being Affected 5-13
Table 5-6: Magnetic Fields Observed for Overhead Transmission Lines..... 5-18

Table 5-7: Safety Distances for 500kV Transmission Line 5-18
Table 5-8: Potential Impacts during Construction Phase 5-23
Table 5-9: Construction Equipment Noise Ranges, dB (A) 5-31
Table 5-10: Construction Equipment Vibration Level 5-34
Table 5-11: Predicted Minimum Separation between Piling Operations and Sensitive Buildings 5-35
Table 5-12: Estimated Wastewater Generated by Workforce in Construction Camps 5-40
Table 5-13: Tree Species Potentially being Affected 5-47
Table 5-14: Potential Impacts at Operation Phase 5-63
Table 6-1: Community Stakeholder Views / Concerns 6-3
Table 6-2: Views / Concerns of Female Members of the Community in COI 6-14
Table 6-3: Summary of the Concerns/ Views from Institutional Consultations 6-26
Table 7-1: Environmental Management and Mitigation Matrix 7-3
Table 7-2: Training Schedule 7-14
Table 7-3: Environmental Monitoring Plan (EMP) 7-17
Table 7-4: Instrumental Environmental Monitoring Plan 7-19
Table 7-5: Implementation Arrangements 7-22
Table 7-6: Roles and Responsibilities for Implementation of EMP 7-22
Table 7-7: Periodic Reporting Mechanism 7-25
Table 7-8: Estimated Cost for Contractor's EMP Implementation 7-26
Table 7-9: Estimated Cost for Consultant for EMP Implementation 7-27
Table 7-10: Estimated Cost for ESIC's EMP Implementation 7-27

EXECUTIVE SUMMARY

The Government of Pakistan requested financing from ADB to finance the proposed Pakistan Power Transmission Strengthening Project (PTSP, or the Project). The project aims to enhance energy security and reliability of the national power system, contributing to sustainable, inclusive economic growth and improved quality of life aligned with the National Power Policy 2021 and Pakistan 2025: One Nation, One Vision.[1] The key project components are listed below:

i. Construction of one new 500kV double circuit transmission line from the interconnection points at 500kV Ghazi Barotha HPP-Rewat GS T/L to 500kV Faisalabad West substation (approx. 277 km);

ii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat GS T/L to Islamabad West substation (approx. 6 km);

iii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat CCT-II to Islamabad West Substation (approx. 6 km);

iv. 220 kV D/C Transmission Line for In/Out of ISPR-Manshera 220 kV SC at Islamabad West Substation (approx. 21 km); and

v. 220 kV D/C Transmission Line for In/Out of Tarbela/Kamra-ISPR 220 kV SC at Islamabad West Substation (approx. 12.5 km).

Project Proponent and the Study Consultant

NGC, under the Ministry of Energy, is the project proponent. The NGC headquarters is situated at the Water and Power Development Authority (WAPDA) House, Lahore.

The NGC has engaged M/s. BARQAB-STEPS (JV) to conduct consultancy services, including Environmental Impact Assessment (EIA) for the project. Therefore, this EIA report has been prepared for the above-mentioned project components to fulfil the requirements of the Punjab Environmental Protection Agency (Punjab-EPA).

Project Description

The project comprises of following components:

i. Construction of one new 500kV double circuit transmission line from the interconnection points at 500kV Ghazi Barotha HPP-Rewat GS T/L to 500kV Faisalabad West substation (approx. 277 km).

[1] Government of Pakistan. 2014. Pakistan Vision 2025: One Nation, One Vision. Islamabad

ii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat GS T/L to Islamabad West substation (approx. 6 km).

iii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat CCT-II to Islamabad West Substation (approx. 6 km).

iv. 220 kV D/C Transmission Line for In/Out of ISPR-Manshera 220 kV SC at Islamabad West Substation (approx. 21 km.

v. 220 kV D/C Transmission Line for In/Out of Tarbela/Kamra-ISPR 220 kV SC at Islamabad West Substation (approx. 12.5 km).

The project passes through the urban and rural areas of five districts in Punjab. The overall cost of the whole scheme of proposed T/L is PKR 103,789.03 million. The implementing agency (IA) of the Project plans to complete this project from January 2026- December 2028.

Description of the Environment

A summary of the existing environmental conditions of the project area is presented below.
The 100 m Corridor of Impact (COI) has been used as a benchmark for comparison of the baseline conditions before and after the construction phases of the project. The COI includes the actual RoW of the project as well as the surrounding areas where positive and adverse impacts may be foreseen due to the implementation of the proposed project. RoW and CoI of the proposed T/L from the center line is 25 meters and 50 meters, respectively in general. However, in the area where sensitive receptors fall or for ecological importance and for socioeconomic surveys, an area beyond CoI was considered.

Physical Environment

The proposed T/L will pass through the agricultural plains of the Chiniot, Sargodha, and Khushab districts, and enter the rain-fed cultivated areas of Talagang and Attock districts in the Pothohar region. The elevation in the project COI varies from 155m to 880m msl, with a mean elevation of 324 msl.

Analysis of the land use within the Project COI indicates that the majority of the T/L passes through agricultural areas, which account for 76.4% of the COI. Scrub Forest covers 16.3%, while built-up areas make up 5.3%. The remaining area consists of waterbodies and rangeland.

Most of the region consists of Quaternary formations composed of alluvium - unconsolidated surficial deposits of silt, sand, and gravel. In the Chiniot district, Pre-Cambrian basement rocks containing iron ore deposits are also present.

According to the Pakistan Building Code (PBC) classification, the Project area lies within Seismic Zones 2A and 2B, corresponding to ground acceleration values between 0.8 m/s^2-2.4 m/s^2, indicating a minor to moderate earthquake damage risk.

Based on the Köppen-Geiger climate classification system, the COI predominantly falls within a hot semi-arid climate zone, characterized by very hot, dry summers, mild to cool winters, and highly seasonal monsoon rainfall. The average annual rainfall across the project area ranges from 1,323 mm to 381 mm. summer temperatures often exceed 40 °C for June and July, while winter temperatures in the northern areas can drop to 3°C. Average wind speeds are high in March in the northern part, while Faisalabad experiences strong winds in July.

Chenab and Jhelum are the major rivers in the project area, along with numerous small streams (nullahs) and springs. The proposed T/L crosses the Chenab and Jhelum Rivers between tower no. 101-102 and 359-360, respectively.

To determine the physical baseline condition, sampling points were selected based on land use and proximity to sensitive receptors. Samples were collected, tested, and analyzed for water, air, and noise. Four sampling points were taken for noise and air quality. Two (02) surface water samples and four (04) drinking water sampling points were also selected.

Primary air quality data indicate that all measured values were within the PEQS limits. The SO_2, NO, and NO_2 levels slightly exceed the WHO Global Air Quality Guidelines (AQG) at locations AQ-01 and AQ-02. PM_{10} levels exceeded the WHO AGS for all sampling points, while the $PM_{2.5}$ were elevated at AQ-01 and AQ-02. High PM_{10} levels are usually attributed to factors such as industrial emissions, vehicular exhaust, dust, and weather conditions that trap pollutants.

Measurement of sound levels at all four sampling points indicated that noise levels were within PEQS limits for both daytime and nighttime.

As groundwater is used for drinking purposes in the area, water samples from four groundwater sources were analyzed and compared against the PEQS for drinking water. At all sampling points, all tested water quality parameters were found to be within the World Health Organization (WHO) and the PEQS drinking water standards.

Fauna and Flora

The ecological baseline was established using primary data from field surveys, secondary data from literature reviews, and consultations with local experts familiar with the Project area.

The study area has been classified into five types of habitats: agricultural land (75.9%), scrub forest (16.6%), built-up area (5.6%), waterbodies (1.4%), and rangeland (0.5%). Out of 15 planned sampling sites in the ecological study area, four were located in agricultural land, four in scrub forest, two in built-up areas, and one in rangeland. Three fishing sampling sites were also selected - two are in the Chenab and Jhelum Rivers, and one in a pond. The distribution of these sampling sites corresponds proportionally to the representation of each habitat type within the study area.

Three fish species were collected using cast nets: Mori, Giant River Catfish (*Sperata seenghala*), and Reba Carp (*Cirrhinus reba*). In addition, local farmers reported four fish

species being cultivated in the pond for commercial purposes: Grass Carp, Mori, Common Carp, Raho, and Silver Carp.

During the May 2025 survey, a total of 29 species of plants were recorded in the study area. The area is dominated by plant species such as *Prosopis juliflora, Parthenium hysterophorus, Dalbergia sissoo, Acacia modesta, Acacia nilotica,* and *Calotropis procera.* Large-sized plant species were primarily observed in Agricultural Land and Scrub Forest habitats.

Three invasive plant species - *Prosopis juliflora*, *Parthenium hystrophorus*, and *Lantana camara* - were observed in the Terrestrial Study Area. *Parthenium hystrophorus* is widely distributed, mostly present in agricultural fields and along the roadside. *Prosopis juliflora* was observed mostly along the roadside, particularly in hilly areas. None of these species are classified as threatened, endemic, or protected at either global or national level.

Based on the field survey and interviews with local residents, the presence of several mammal' species was recorded, including the Five-Striped Palm Squirrel (*Funambulus pennantii,* Golden Jackal (*Canis aureus*), Red Fox *(Vulpes vulpes),* Small Indian Mongoose *(Herpestes javanicus),* Crested Porcupine (*Hystrix indica*), Cape Hare *(Lepus capensis),* and various *rodent species.* Domestic animals observed in the area include cows, sheep, goats, cats, and camels.

A total of 1055 individual birds representing 45 species were recorded during the ecological field survey. The most abundant bird species in the terrestrial study area were House Sparrow *Passer domesticus*, House Crow *Corvus splendens,* Cattle Egret *Bubulcus ibis,* and Common Myna *Acridotheres tristis*, etc.

Among the bird species reported from the Study Area, only the Southern Grey Shrike is globally listed as Vulnerable on the IUCN Red List of Threatened Species. Additionally, two species observed in the terrestrial study area - the Black Kite and Honey Buzzard *Pernis apivorus* - are included in CITES Appendix II.

Seven herpetofauna species were observed in the terrestrial study area. The most abundant was the Indian Flapshell Turtle. Indian Monitor Lizard (*Varanus bengalensis)* and Asian Garden Lizard (*Calotes versicolor)* were recorded at three and two sampling locations, respectively. Other species observed during field surveys include Brown Roofed Turtle (*Pangshura smithi*), Punjab Snake-eyed Lacerta (*Ophisops jerdoni*), Skittering frog (*Euphlyctis cyanophlyctis*) and Indus Valley Toad (*Duttaphrynus stomaticus*).

Based on available literature and IUCN Data, a total of 20 terrestrial threatened vertebrate species have been identified in the project area. These include 3 mammal species, 11 bird species, and 6 herpetofauna species. One endemic mammal species - the Punjab Urial - is also found in the project area.

The proposed transmission line crosses two national parks: the Chinji National Park and Kala Chitta National Park. While several wildlife game reserves, national parks, and wildlife

sanctuaries are located along the proposed transmission line, they are not situated in the immediate vicinity to the project's site.

Socioeconomic Environment

The social baseline for this project is based on primary data collected through field surveys and community engagement, as well as secondary data obtained from official records and published sources.

The key districts traversed by the proposed transmission line include Attock, Talagang, Khushab, Sargodha, and Chiniot - all located in Punjab Province.

According to the 2023 Census conducted by the Pakistan Bureau of Statistics (PBS), the total population of these five districts exceeds 16 million. The districts of Faisalabad and Sargodha are the most populous, with a population of 9,075,819 and 4,334,448, respectively. The average household size across most districts is 6.

During the socioeconomic field survey, 1231 households - comprising a total population of 11,079 - were surveyed, and residents within the project's COI were interviewed. Of the surveyed population, 55% are male, and 45% are female.

The majority of the population resides in rural areas and primarily depend on agriculture for their livelihood. Approximately 55% of the survey population is literate, but only 3% have attained undergraduate or higher education. According to PBS census data, Chiniot has the lowest literacy rate (55%), while Attock, Talagang, and Faisalabad have literacy rates of 70% and higher.

Of the surveyed households, 54% live in semi-pacca structures, 37% in pacca houses, and 9% in katcha houses. Notably, 98% of the households own their houses.

Income levels serve as a key indicator for livelihood. Half of the surveyed population earns between 35,000-50,000 PKR per month, 26% earn between 50,000-75,000 PKR, and 21% earn above 75,000 PKR. Only 3% of households fall below the poverty line, earning less than 35,000 PKR per month.

Most households' expenditures fall within the 20,001-50,000 PKR range, closely aligned with their income levels. Given the current cost of living and inflation, many households are struggling to meet their basic expenses.

The major languages spoken in the Project COI are Punjabi and Urdu, with other languages like Saraiki, Hindko, Kashmiri, and Pashto also spoken in some areas.

The population is predominantly Muslim, with smaller communities of Christians, Sikhs, and Hindus.

Ninety-eight percent (98%) of households are connected to electricity; however, frequent unannounced load shedding and voltage fluctuations are common issues.

Most households (89%) in the COI do not have access to clean drinking water through a formal water supply system. Furthermore, only 17% of households are connected to a sewerage system, which leads to significant inconvenience during the rainy season when streets become flooded and muddy.

Primary healthcare facilities are accessible to approximately 40% of the households. In terms of education, 93% of households report access to primary schools for both girls and boys. However, there is a lack of quality higher educational institutions within the project COI.

Landholdings in the COI are generally small scale. About 42% of households own between 2.51 and 5 acres of land, while 20% (242 households) own less than 2.5 acres. Approximately 21% of households own landholdings of 15 acres and more.

Potential Environmental Impacts and Mitigation Measures

Environmental and socioeconomic impacts are assessed through a structured process involving scoping, prediction of potential impacts, evaluation of the significance of the predicted impacts, identification of mitigation measures and assessment of residual impacts after the implementation of those measures. The final step in the assessment process involves identifying monitoring requirements to ensure that the residual impacts remain within predicted limits and to provide timely information if impacts exceed those limits.

The significance of potential or the predicted impacts is evaluated based on their associated risk levels or their effects on the receiving environment.

Risk is assessed by considering both the likelihood that a project activity will affect the environment and the severity of consequence of the effect occurring. It is often described like this:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

Based on these criteria, potential impacts of their likelihood, consequence, risk and residual impacts in design, construction and operation phases are tabulated below:

Table I: Design Phase -Screening of Potential Impacts

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
1	Lack of Integration of EMP/EIA Requirements into Construction Bid Documents	3	3	9	Low
		Likely	Major	Significant	
2	Lack of planning in T/L Design[2]	5	3	15	Low
		Certain	Major	Critical Risk Level	
3	Lack of Project Resources	3	3	9	Low
		Likely	Major	Significant	
4	Improper Location of Camp Sites	3	3	9	Low
		Likely	Major	Significant	
5	Noise caused by Construction Equipment	3	2	6	Low
		Likely	Moderate	Moderate	
6	Electromotive Force (EMF)	3	3	9	Low
		Likely	Major	Significant	
7	Waste Generation	3	3	6	Low
		Likely	Major	Significant	
8	Disruption To Existing Drainage Pathways and Utilities	3	3	9	Low
		Likely	Major	Significant	

[2] Covering (i) Route Selection (i.e., Loss of Biodiversity due to route passing through National Parks or Social issues, resettlement/relocation of assets and displacement of people), (ii) Transmission hindrance for aircraft, (iii) Structure Design (soil erosion, landslide and slope stability impact due to natural geo-hazards), (iv) Tower Placement Add-ons, (v) Visual Amenity, and (vi) Mechanical Failure of the Overhead Conductors.

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
9	Removal of Vegetation/trees	3	3	9	Low
		Likely	Major	Significant	
10	Impacts on Sensitive and High-Value Areas	5	3	15	Low
		Certain	Major	Critical Risk Level	
11	Bird Collision Risk due to the Transmission Line Intersecting the Indus Flyway	3	3	9	Low
		Likely	Major	Significant	
12	Electrocution Risk for Large Birds (e.g. raptors) due to Poor Conductor Spacing	3	3	9	Low
		Likely	Major	Significant	
13	Visual Intrusion from Towers Affecting Scenic/ Recreational Value in National Parks	3	3	9	Moderate
		Likely	Major	Significant	
14	Natural Hazard Risks (Flooding, Earthquakes etc.)	3	3	9	Low
		Likely	Major	Significant	
15	Impact on Community Safety	3	3	9	Low
		Likely	Major	Significant	
16	Livelihood Loss During Land Acquisition	3	3	9	Low
		Likely	Major	Significant	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

Construction Phase -Screening of Potential Impacts

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
Potential Impacts on Physical Environment					
1	Impacts of Site Accessibility	5	3	15	Moderate
		Certain	Major	Critical Risk Level	
2	Dust from construction activity and Air emissions from construction equipment and vehicles	5	3	15	Low
		Certain	Major	Critical Risk Level	
3	Noise from construction vehicles and heavy equipment	5	3	15	Low
		Certain	Major	Critical Risk Level	
4	Sediment run-off from construction sites	3	3	9	Low
		Likely	Major	Significant	
5	Impact on Water Resources Quality and Quantity	3	3	9	Low
		Likely	Major	Significant	
6	Untreated disposal of effluent from worker camps and batching plant(s)	3	3	9	Low
		Likely	Major	Significant	
7	Vibrations	3	2	6	Low
		Likely	Moderate	Moderate	
8	Traffic Congestions	3	2	6	Low
		Likely	Moderate	Moderate	
9	Solid Waste Disposal	3	3	9	Low
		Likely	Major	Significant	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
10	Impact on Occupational Health and Safety	3	3	9	Low
		Likely	Major	Significant	
12	Existing T/L Crossings	3	3	9	Low
		Likely	Major	Significant	
13	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	
Ecological Resources					
1	Habitat Fragmentation and Vegetation Loss, especially in Protected Areas (e.g., Chinji and Kala Chitta NPs)	3	3	9	Low
		Likely	Major	9Significant	
2	Noise from Construction Activities and Camps may Cause Disturbance to Avifauna and Mammals.	3	3	9	Low
		Likely	Major	Significant	
3	Dust, Emissions, and Chemical Spills Affect Birds and Habitat Quality	3	3	9	Low
		Likely	Major	Significant	
4	Accidental Death of Reptiles and Small Mammals during Site Clearing, Excavation and Rehabilitation Activities at Construction Sites and Camps (esp. In hibernation season)	3	3	9	Low
		Likely	Major	Significant	
5	Increased Accessibility Leading to Illegal Poaching of Species Like the Pangolin and Migratory Birds	3	3	9	Low
		Likely	Major	Significant	
6	Spread of Invasive Plants (Prosopis, Parthenium) due to Surface Soil Disturbance	3	3	9	Low
		Likely	Major	Significant	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
7	Construction Activities During River Crossing Will Affect Aquatic Life and Riparian Habitat	3	3	9	Low
		Likely	Major	Significant	
8	Loss of Nesting Resources for Ground-Nesting Birds due to Erosion and Soil Compaction	3	3	9	Low
		Likely	Major	Significant	
9	Work during Bird Migration Season Potentially Causes Disturbance and Increased Bird Deaths	3	3	9	Low
		Likely	Major	Significant	
Community Health, Safety, Occupational Safety and Socioeconomic Impacts					
1	Increased Employment Opportunities and local economy (Positive Impact)	3	2	6	Low
		Likely	Moderate	Moderate	
2	Overutilization of local resources	3	2	6	Low
		Likely	Moderate	Moderate	
3	Social Conflicts due to the Influx of Workers/ Resources	3	2	6	Low
		Likely	Moderate	Moderate	
4	Impact on Community Health and Safety Risk	2	3	6	Low
		Unlikely	Major	Moderate	
5	Impact on Physical Cultural Resources (PCRs)	2	3	6	Low
		Unlikely	Major	Moderate	
6	Uncontrolled solid waste disposal, communicable diseases	3	3	9	Low
		Likely	Major	Significant	
7		2	3	6	Low

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
	Natural Hazard Risks (Flooding, Earthquakes etc.)	Unlikely	Major	Moderate	
8	Security of Construction Crew and Project Facilities	3	3	9	Low
		Likely	Major	Significant	
9	Loss of Income/livelihood	2	3	6	Low
		Unlikely	Major	Moderate	
10	Relocation of Infrastructure	2	3	6	Low
		Unlikely	Major	Moderate	
11	Gender Issues	2	3	6	Low
		Unlikely	Major	Moderate	
12	Effects on Indigenous People	2	3	6	Low
		Unlikely	Major	Moderate	
13	Impacts on local communities/workforce	3	3	9	Low
		Likely	Major	Significant	
14	Traffic Congestion	2	3	6	Low
		Unlikely	Major	Moderate	
15	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

Operation Phase -Screening of Potential Impacts

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
1	Noise/ Corona Effect	2	3	6	Low
		Unlikely	Major	Moderate	
2	Impact of Faulted SF6	2	3	6	--
		Unlikely	Major	Moderate	
3	Electrocution and Collision of Birds	3	3	9	Low
		Likely	Major	Significant	
4	Long-term Degradation of Habitat from Repeated Vegetation Clearance	3	3	9	Low
		Likely	Major	Significant	
5	Poaching Risk During Operational Maintenance of the T/L	3	3	9	Low
		Likely	Major	Significant	
6	Occupational Health and Safety	3	3	9	Low
		Likely	Major	Significant	
7	Community Health and Safety Risk	3	3	9	Low
		Likely	Major	Significant	
8	Visual Amenity	3	3	9	Low
		Likely	Major	Significant	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
9	Aircraft Navigation Safety	1	3	3	-
		Unlikely	Major	Low	
10	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	
11	Collapsing of Towers	2	3	6	Low
		Unlikely	Major	Moderate	
12	Working failure of electronic devices/equipment	2	3	6	Low
		Unlikely	Major	Moderate	
13	Breaking of conductors	2	3	6	Low
		Unlikely	Major	Moderate	
14	Existing Power Transmission Line Crossing	3	3	9	Low
		Likely	Major	Significant	
15	Induced Impacts of Applied Measures	2	3	6	Low
		Unlikely	Major	Moderate	
16	Cumulative and Induced Impacts	2	3	6	Low
		Unlikely	Major	Moderate	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

Environmental Management Plan

An environmental management plan (EMP), which establishes the linkages between the environmental and social impacts, mitigation strategy, and the agencies responsible for execution. The EMP covers:

i. A comprehensive listing of mitigation measures (actions).

ii. The institution(s)/ person(s) responsible for implementation of specific actions.

iii. The parameters to be monitored to ensure the effective implementation of the actions.

iv. A timescale for the implementation of actions has been indicated, subject to the project life cycle.

v. A plan for impact mitigation and monitoring for the construction and operation activities

Proposed Project activities were reviewed and their potential impacts on the physical, biological, and socio-economic environment were assessed. Where appropriate, mitigation measures have been recommended to keep potential adverse environmental impacts within acceptable limits.

An EMP has been developed in this report to effectively implement the mitigation measures identified in the impact assessment. The Contractor will be primarily responsible for the implementation of the EMP and SSEMP. The contractor will develop an internal monitoring and reporting mechanism for all activities undertaken.

Conclusion and Recommendations

Baseline environmental and socioeconomic information was collected from a variety of sources, including published literature and field surveys. Baseline studies were conducted on the physical environment, including water resources, ecological, and socioeconomic environment conditions of the COI around the Project route.

Proposed Project activities were reviewed and their potential impacts on the physical, biological, and socio-economic environment were assessed. Where appropriate, mitigation measures have been recommended to keep potential adverse environmental impacts within acceptable limits.

If the Project construction and operation activities, including the implementation of all proposed mitigation measures, are carried out as described in this document, the anticipated impact of the project on the area's natural and socioeconomic environment shall remain well within acceptable limits.

The major recommended mitigation measures are summarized as follows:

- Temporary labor camps will be developed and will be facilitated with proper drainage facilities.
- Soil erosion and contamination, water contamination, air pollution, and high noise levels will be controlled with the use of good engineering practices.

- Fair and negotiated compensation following the prevailing market prices will be made for the loss of crops and trees during the construction activities of the project.
- The contractor will take due care of the environment and local community and its sensitivity towards local customs and traditions.

The EMP proposed in this document will be implemented with full diligence and thoroughness.

1. INTRODUCTION

The Government of Pakistan requested financing from ADB to finance the proposed Pakistan Power Transmission Strengthening Project (PTSP, or the Project). The project aims to enhance energy security and reliability of the national power system, contributing to sustainable, inclusive economic growth and improved quality of life aligned with the National Power Policy 2021 and Pakistan 2025: One Nation, One Vision.[3]

1.1 Brief Description of the Project

The Project comprises of following components:

i. Construction of one new 500kV double circuit transmission line from the interconnection points at 500kV Ghazi Barotha HPP-Rewat GS T/L to 500kV Faisalabad West substation (approx. 277 km).

ii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat GS T/L to Islamabad West substation (approx. 6 km).

iii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat CCT-II to Islamabad West Substation (approx. 6 km).

iv. 220 kV D/C Transmission Line for In/Out of ISPR-Manshera 220 kV SC at Islamabad West Substation (approx. 21 km).

v. 220 kV D/C Transmission Line for In/Out of Tarbela/Kamra-ISPR 220 kV SC at Islamabad West Substation (approx. 12.5 km).

The project passes through the urban and rural areas of five districts in Punjab.

The project is in Punjab province, as shown in **Figure** 1-1.

1.2 Environmental Category

The local regulations, the T/Ls (11kV and above) and distribution projects are included in Schedule II which requires an EIA under the Punjab Environmental Protection Act, 1997, the Review of Initial Environmental Examination and Environmental Impact Assessment Regulations (IEE-EIA Regulations 2022), current project falls under Schedule II (List of projects requiring EIA), *Category A-2 Transmission line more than 132 kV and grid station.*

1.3 Objective of EIA

The prime objective of the EIA study is to fully meet the statutory requirements set forth by the Punjab Environmental Protection Act - 1997 (as amended up to 2017) and to facilitate decision

[3] Government of Pakistan. 2014. Pakistan Vision 2025: One Nation, One Vision. Islamabad.

making by the Punjab Environmental Protection Agency (Punjab-EPA) regarding grant of No Objection Certificate (NOC) / Environmental Approval for the Project.

The overall objective of this EIA is to elucidate the anticipated aspects of the proposed intervention and to propose necessary mitigation measures to prevent/minimize adverse impacts on the surrounding environment and community. To achieve this objective, an assessment of the existing environmental conditions of the project corridor is a prerequisite and therefore, included after collecting the baseline data of major environmental attributes acquired from primary and secondary sources. This EIA has been prepared to ensure adequate environmental and social management during construction and implementation stages of the proposed project. It provides mechanisms to ensure that potentially significant environmental and social impacts of the proposed project are identified, assessed, and mitigated as appropriate.

More specific objectives of this EIA report 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 and ensure public consultation, participation with major stakeholders; and
- Provide Environmental Management Plan (EMP) for all stages of the project as a tool for the implementation of the suggested measures along with a monitoring and evaluation mechanism with adequate resources, including implementing agencies' capacity building.

1.4 Project Proponent and the Study Consultant

NGC, under the Ministry of Energy, is the project proponent. The NGC headquarters is situated at the Water and Power Development Authority (WAPDA) House, Lahore.

The NGC has engaged M/s. BARQAB-STEPS (JV) to conduct consultancy services, including Environmental Impact Assessment (EIA) for the project. Therefore, this EIA report has been prepared for all above mentioned components to fulfil the requirements of the Punjab-EPA.

1.5 Nature, Size, Magnitude and Location of the Project

The proposed T/Ls passes majorly through five (05) districts of the Punjab province, namely Chiniot, Sargodha, Khushab, Talagang and Attock. A map depicting T/L crossing various districts of the Punjab is provided in **Figure 1-1**. The proposed project comprises of 5 T/Ls .

1.6 Consultant EIA Team

The consultant's team involved in conducting the EIA study is provided in **Table 1-1**.

Table 1-1: Team Composition for the EIA Study

Sr. #	Name	Designation
1.	Mr. Aashar Habib	Team Lead / Environment Specialist
2.	Ms. Maryam Ijaz	Environmentalist
3.	Dr. Waseem Ahmad Khan	Ecologist
4.	Mr. Ikram Ullah Khan	Field Biologist / Mammologist
5.	Mr. Sakhawat Ali	Ornithologist
6.	Mr. Abdul Hamid	Social & Resettlement Specialist
7.	Ms. Naila Jabeen	Gender Specialist
8.	Ms. Hania Arif	GIS Specialist
9.	Mr. Zia u Din	Enumerator
10.	Mr. Faizan Abid	Enumerator

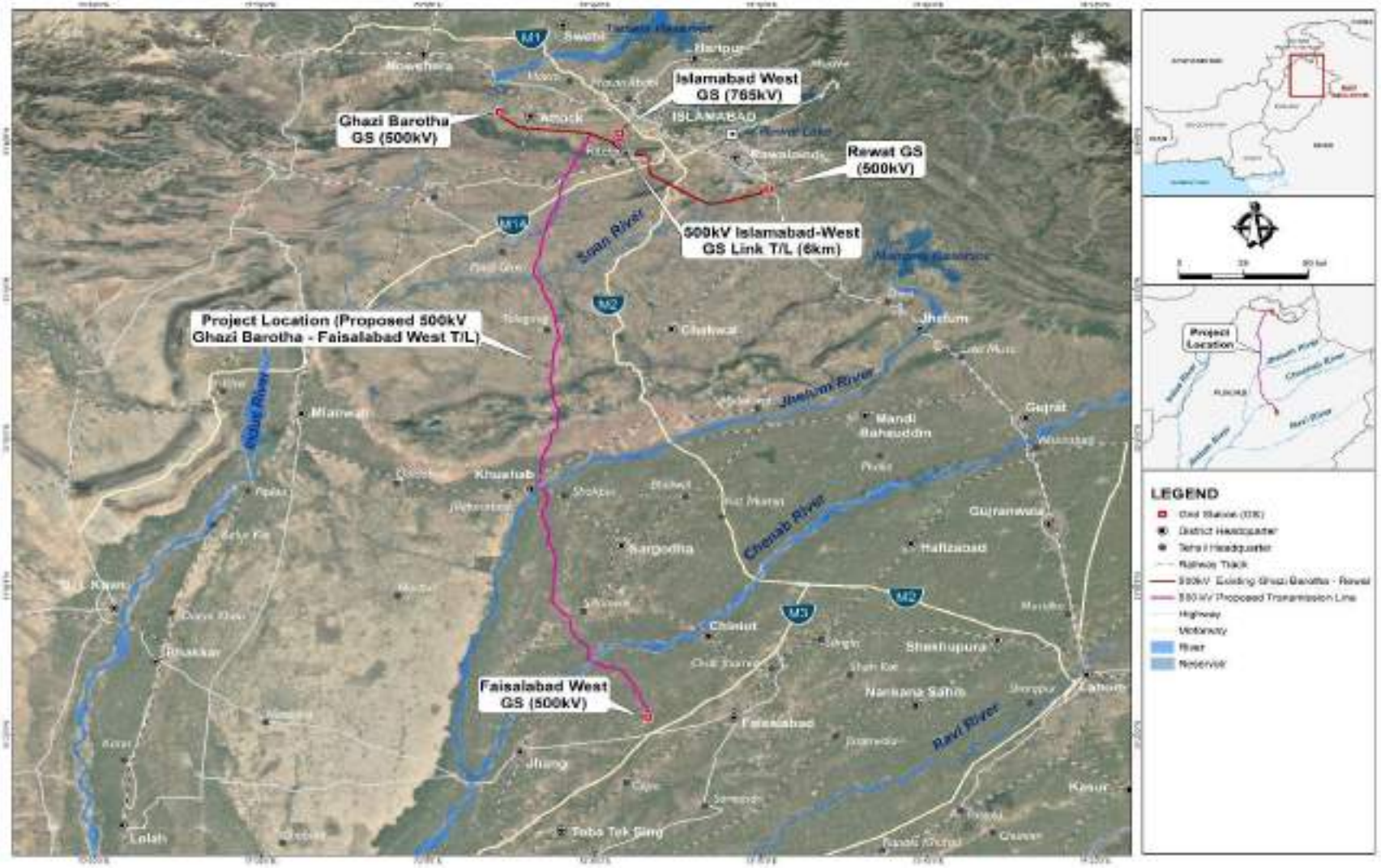


Figure 1-1: Location Map of Proposed T/L

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 proposed T/L project, that included (a) review of National Environmental Legislations (b) Google Earth Satellite Imagery; (c) Relevant District Census Reports (DCR) and any other relevant documents/drawings; and (d) Reference documents such as EIA of 500kV Double Circuit T/L from 1) Maira Switching Station to Islamabad West Grid Station; 2) Karot Switchyard to Maira Switching Station; and 3) Sangal to Maira Switching Station.

1.7.2 Review of Environmental Laws and Institutional Requirements

The proposed T/L project needs to comply with all the applicable environmental policies, laws, guidelines, acts and legislation of the GoP, policies and guidelines related to the project have been discussed in detail in Chapter 2 of this EIA report.

1.7.3 T/L Corridor Identification and Route Optimization Study

The optimal route selection is the most cost-effective method of reducing the environmental and social impacts of the construction and operation of the T/L. In the initial corridor identification, various specialties developed criteria so that all such constraints can be considered.

The following environmental criteria were used in addition to technical and design considerations for the proposed T/L route:

- Avoid towns/populated areas;
- Avoid protected/reserved forests, national parks, game reserves, where possible;
- Avoid cultural, religious and historical buildings;
- Maintain minimum disturbance to the natural habitat and vegetation;
- Maintain appropriate distance from the sensitive receptors (500 m); and
- Avoid large water bodies like lakes, rivers or streams.

After the marking of proposed T/L route based on the above criteria, route optimization was carried out jointly by the design and environmental teams STEPS.

Prior to the start of the route optimization, Right of Way (RoW) of the proposed T/L was marked. The objective of this activity was to obtain a first-hand overview of the project environmental and social setting and to conduct an initial analysis of the physical, biological and social constraints posed within the proposed T/L initial route for further optimization.

STEPS experts developed criteria for route optimization, based on the GIS, existing information and experience. Efforts were made to optimize the route in such a way as to avoid environmentally sensitive areas such as protected/reserved forests, game reserves, wildlife sanctuaries, archaeological and historical sites, settlements etc. The objective of route optimization was to finalize the route that will minimize technical and environmental constraints.

1.7.4 Delineation of Corridor of Impact

The Corridor of Impact (COI) includes the actual Right-of-Way (RoW) of the project as well as the surrounding areas where positive and adverse impacts may be foreseen due to the implementation of the proposed project. RoW and COI of the proposed T/L from the center line are 25 meters and 50 meters, respectively in general. However, in the area where sensitive receptors fall for ecological importance and for socioeconomic surveys, an area beyond COI was considered.

In addition, the COI also includes the sites of the proposed construction camps along the route. A schematic sketch of the RoW and generic COI of the proposed T/L is provided in **Figure 1-2**.

1.7.5 Survey of COI

A team of environmental and social experts, including ecologists, carried out the environmental and social survey of the COI to familiarize themselves with the local conditions and the environmental settings. During the survey, the information regarding the topography, soils, rock, surface water, groundwater, flora and fauna, protected areas, social settings, and villages/towns along the COI was observed.

1.7.6 Analysis of Alternatives

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

An analysis of different alternatives was carried out for the selection of the most feasible T/L route of the study in consultation with NGC, in order to select the most viable route keeping in view the environmental, economic and social constraints. Moreover, the No Project Option (NPO) was also considered with reference to the energy crisis and its effect on the country's economy. This exercise confirmed the justification for the need for the proposed Project.

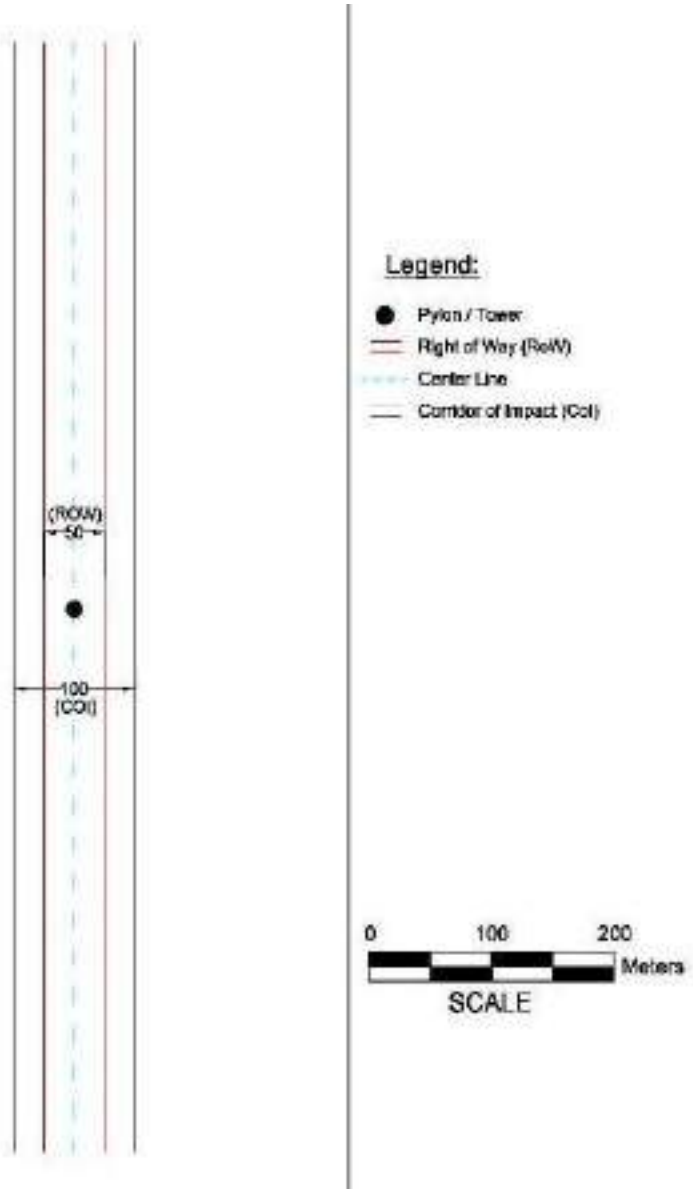


Figure 1-2: RoW and COI of the Proposed T/L

1.7.7 Environmental Baseline Survey of the Project

After the selection of the most feasible route for the T/L based on satellite images and the delineation of COI, detailed environmental survey was carried out within the COI. Detailed investigations/surveys were carried out for environmental parameters on which any adverse or positive impacts were envisaged by the implementation of the proposed T/L project. Baseline surveys were carried out during the months of February & March 2025. Prior to the start of field activities, comprehensive checklists, proformas and mAPs were developed covering the following main parameters:

Physical Environment

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

- Land resources (including land use pattern, contamination of soil and soil erosion etc.);
- Water resources (including available surface and groundwater resources and natural streams, 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.
- Existing solid waste management and effluents disposal practices and storm water drainage.
- Buildings and infrastructure details, including residential, commercial and animal shed for complete/partial relocation.
- Religious, cultural and heritage information (mosques, shrines, graveyards);
- Archaeological monuments; and
- Other private/public infrastructures such as roads, T/Ls, telephone poles, hand pumps, tube wells, etc.

Ecological Environment

- 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, etc.);
- Agriculture and livestock;
- Reserved forests, Guzara forests, Community forests/ Private forests and wildlife sensitive or notified areas in COI;
- Migratory birds corridors, and
- Endangered species (both flora and fauna).

Socioeconomic Environment

A sample survey was carried out within the COI in order to develop the socio-economic baseline information of the general settled population. The following major aspects were covered in the socio-economic baseline survey of the sample population settled along the COI:

- Demographic characteristics.
- Literacy status/ education.
- Nature of business/occupation.
- Livelihood/income.
- Living standard of the population.
- Access to credit.
- Social Infrastructure available.

- Gender issues.
- Pressing needs of the people.
- Community perception about the Project etc., and
- Other aspects.

1.7.8 Stakeholder Consultations

The Consultants identified project stakeholders and held meetings with them during the surveys to receive feedback on the expected 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, Archaeology, Agriculture, Social Welfare, Punjab-EPA, Non-Governmental Organizations (NGOs), etc. to discuss the issues/constraints and get their views and feedback to mitigate the potential environmental impacts associated with the implementation and operation of the project. The proceedings of the consultations/meetings, along with the photographs and list of participants, are documented in **Chapter 7**.

1.7.9 Impact Assessment and Mitigation Measures

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 (Physical & ecological)
- Matrices; and
- Overlays

Identification of potential environmental and social impacts in terms of their nature, magnitude, extent, location, timing and duration was carried out. The impacts were correlated to the Project location, design stage, construction as well as operation stage. Based on the impacts prediction methods and as a result of public/stakeholder consultations, the experts screened the adverse environmental impacts for inclusion in the mitigation measures and EMP. The same process was followed for the identification of social impacts. Public consultations (which provided feedback on 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 (RoW, height of the T/L Towers and sitting of facilities), through improved monitoring and management practices (storage of construction materials, labor camps, waste disposal, disposal of construction debris etc. or through monitory compensation).

1.7.10 Environmental Management Plan

An EMP 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 EMP activities, existing and suggested framework, necessary approvals, training needs, and the required further studies. The EMP also includes organizational setup, a monitoring mechanism, a monitoring plan, and environmental and social parameters to be monitored with their frequency. Similarly, costs for environmental monitoring, ecological and social components/social mitigation measures were also included as part of the EMP. Environmental monitoring, evaluation, auditing, and reporting mechanisms were also proposed in the EMP.

1.8 Organization of Report

This report contains ten (10) chapters. The contents of the chapters are described as follows:

- **Chapter 1**– "Introduction" describes the introduction, location of the project, objective and purpose of the EIA report;
- **Chapter 2** – "Description of the Project" furnishes an overall description of the project, features and key components, timeframe, and cost;
- **Chapter 3** – "Project Need and Alternatives" provides details on alternate routes and options considered for the proposed interventions, location, and design;
- **Chapter 4** – "Description of the Environment" comprises a detailed narrative of the existing (baseline) conditions of the project area, with respect to its physical, biological and socio-economic environment.
- **Chapter 5** – "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 6** – "Information Disclosure, Consultation and Participation" provides a 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** – "Environmental Management Plan" provides the mechanism to be adopted for the implementation of measures and monitoring the environment during all stages; and
- **Chapter 10** – "Conclusion and Recommendations" gives the conclusion of the impact assessment study and recommendations for the construction and operational stages.

2. DESCRIPTION OF THE PROJECT

2.1 General

This Chapter provides an overview of the project of the proposed T/L route, project components, design considerations, construction procedures, and operation and maintenance activities. The safety parameters to be followed by NGC during the construction and operation stages, as well as construction arrangements and procedures to be adopted for T/L, have been discussed in detail in this section.

2.2 Objectives of the Project

The main objective of the project is to remove the transmission system constraints for reliable dispersal of power from upcoming HPPs in the northern part of the network to the load centers in the mid-country.

This proposed T/L will not only facilitate the smoother transmission of power but also alleviate the overloading of existing 500kV T/Ls after commissioning of Tarbela 5th Extension and Dasu HPPs in the future, under normal and N-1 contingency conditions, thereby ensuring reliability and resilience for the optimal operation of the network.

2.3 Project Scope of Work

The scope of work for the proposed project is as follows:

i. Construction of one new 500kV double circuit transmission line from the interconnection points at 500kV Ghazi Barotha HPP-Rewat GS T/L to 500kV Faisalabad West substation (approx. 277 km).

ii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat GS T/L to Islamabad West substation (approx. 6 km).

iii. Construction of one new 500kV double-circuit transmission line from the interconnection point at 500kV Ghazi - Barotha HPP-Rewat CCT-II to Islamabad West Substation (approx. 6 km).

iv. 220 kV D/C Transmision Line for In/Out of ISPR-Manshera 220 kV SC at Islamabad West Substation (approx. 21 km).

Connection of 220kV Mansehra and Tarbela T/L with Islamabad West grid station. Re-routing 6 km segment of 500 kV Rawat-Barotha T/L is also depicted in **Fig 2-1** below.

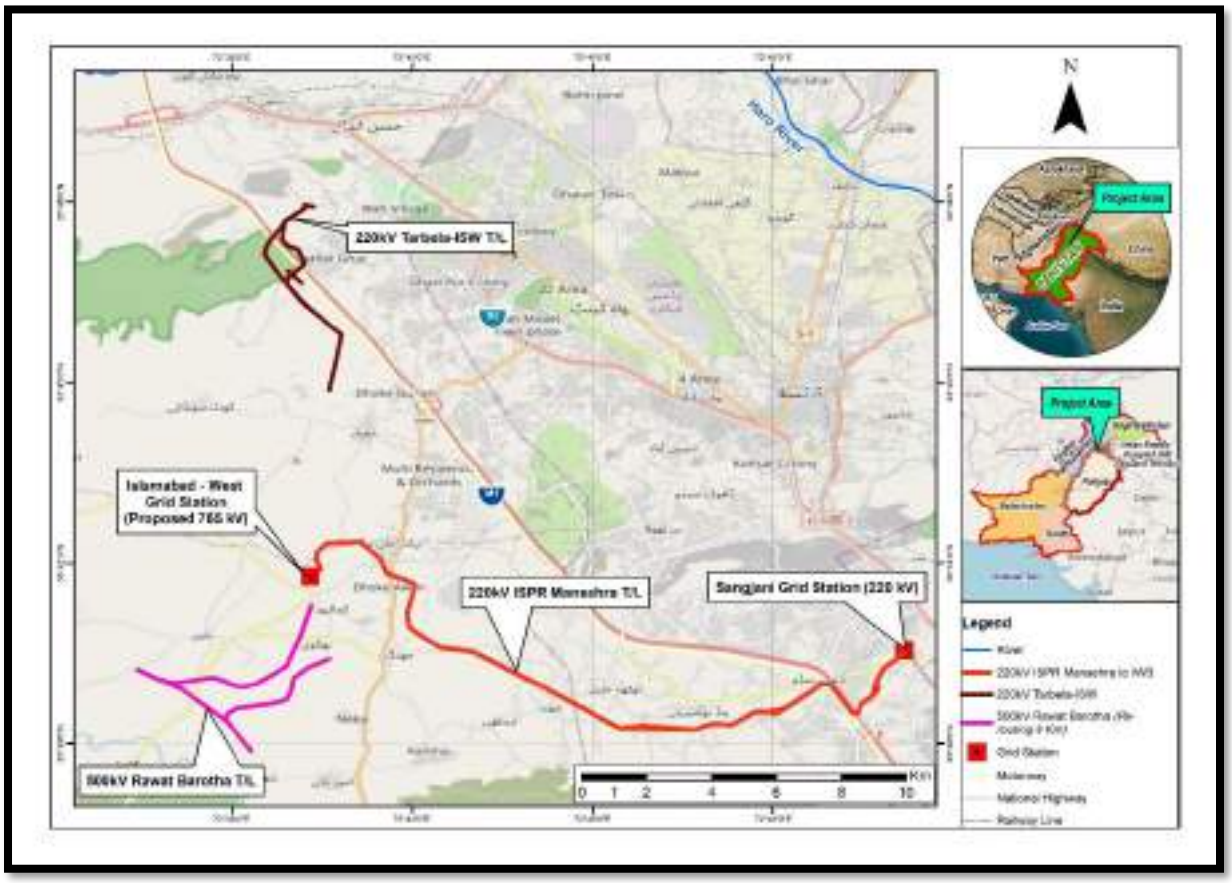


Figure 2-1 Connection of 220kV Mansehra and Tarbela T/L with Islamabad West grid station

2.4 Project Location

The proposed TLs passes through five (05) districts of Punjab, including Chiniot, Sargodha, Khushab, Talagang and Attock. The location of the proposed T/L is shown in **Figure 1-1**.

2.5 Accessibility

The proposed T/Ls can be approached through various major roads and the railway network from upcountry and down country. The proposed T/L is approachable through major roads such as Bhowana-Pansra Road, Bhowana-Aminpur Road, Jhang-Chiniot Road, Silianwali-Jhamra Road, Jhang-Sargodha Road, Shahpur-Sahiwal Road, Khushab-Sargodha Road, Talagnag-Chakwal Road, Talagang-Fatehjang Road, Pindi Gheb-Attock Road, Islamabad-Dera Ismail Khan Motorway (M-14), Rawalpindi-Kohat Road and Fatehjang-Attock Road. However, temporary access roads will be built where no track or road access is available to a tower location after consultation with the local community and compensation for damages to the crops will be done as per requirement.

2.6 Design Aspects

The designed aspects of the all TLs are discussed below.

2.6.1 Design Components

a) Conductors and Line Configurations

The selection of the conductor is based on electrical power transfer on an N-1 contingency basis, mechanical, altitude, and atmospheric pollution considerations. The size of conductor is determined in such a way that the corona and radio interference levels are within the internationally acceptable limits and has already been used in existing T/Ls in Pakistan. Based on the Conductor Span and Bundle Optimization study, the quad bundle ACSR Drake conductor is concluded to be the technically and economically optimal design solution for the 500kV Ghazi Barotha to Faisalabad West T/L. The design data is presented in **Table 3-1.**

Table 2-1: Design Data of Complete Conductor

Sr. No.	Description / Item	Code / Qty / Unit
1	Conductor Name	ACSR “Drake”
2	Diameter	28.14 (mm)
3	Cross Section	468 (mm^2)
4	D.C. Resistance at 25°C	0.07195 (Ω/km)
5	Rated ultimate strength	14,174 (kgs)
6	Weight	1628 (kg/km)
7	Lay Ratio:	
a)	Aluminum	
i)	Outermost Layer	10 to 13
ii)	Second Layer	10 to 16
8	Direction of Lay	
a)	Aluminum	
i)	Outermost Layer	Right Hand
ii)	Second Layer	Left Hand
b)	Steel	
i)	Outermost Layer	Right Hand
9.	Nominal Copper Equivalent Area	246 (mm^2)
10.	Current carrying capacity, Amps (40°C ambient, 40°C rise, 0.6 m/Sec. wind and 0.5 emissivity factor)	840
11.	Volume conductivity %age of IACS	61.2 %age

b) Bundle Optimization

After selection of the conductor for the T/L, it is important to determine and optimize the conductor bundle configuration which will deliver the optimal technical and economic performance for the line.

c) Design Data for 500kV T/L Towers

The following are the main types of towers considered for these T/Ls:

Double Circuit Tower Type “DS1”

Double circuit straight tower type “DS1” will be utilized for line angles up to 2°. The tower consists of 45.525m basic body, 6.0m body extension and leg extensions of 2.0 m, 4.0 m, 6.0m & 8.0 m. Maximum wind and weight spans at 0°line angle will be 380m & 450m respectively.

Double Circuit Tower Type “DA1”

Double circuit strain tower type “DA1” will be utilized for line angles up to 20°. The tower consists of 43.0m basic body, 6.0m body extension and leg extensions of 2.0 m, 4.0 m, 6.0m & 8.0 m. Maximum wind and weight spans at 20° line angle will be 380m & 730m respectively.

Double Circuit Heavy Angle/Terminal Tower Type “DD1”

Double circuit strain tower type “DD1” will be used for line angles up to 60° and as dead-end/terminal tower up to 20° angle of entry. The tower consists of 43.0m basic body, 6.0m body extension and 2.0 m, 4.0 m, 6.0m & 8.0m leg extensions. Maximum wind and weight span limits will be 380m & 730m respectively for line angles up to 60° and 20° in terminal condition.

Outline of the following tower type are shown in **Figure 2-1** to **Figure 2-3** .

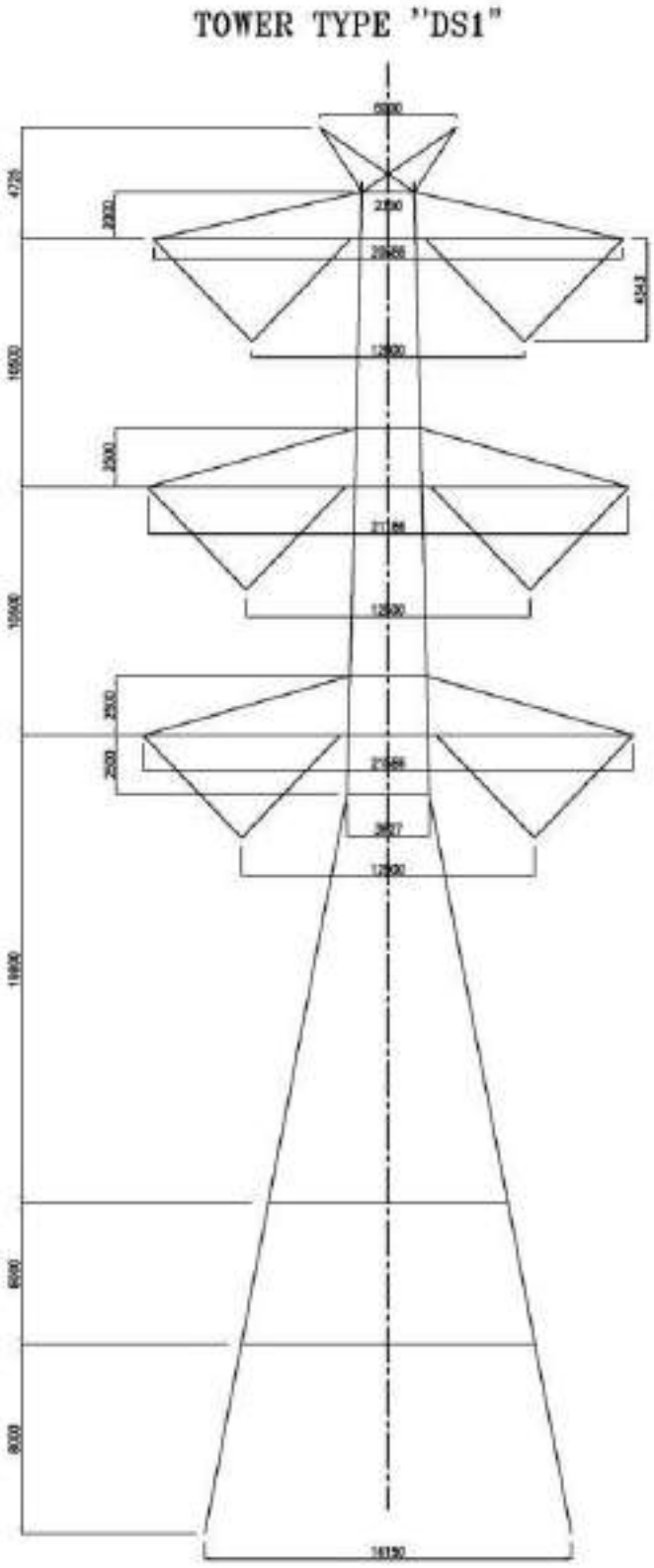


Figure 2-2: Tower Layout of "DS1" Tower Type

TOWER TYPE ''DA1"

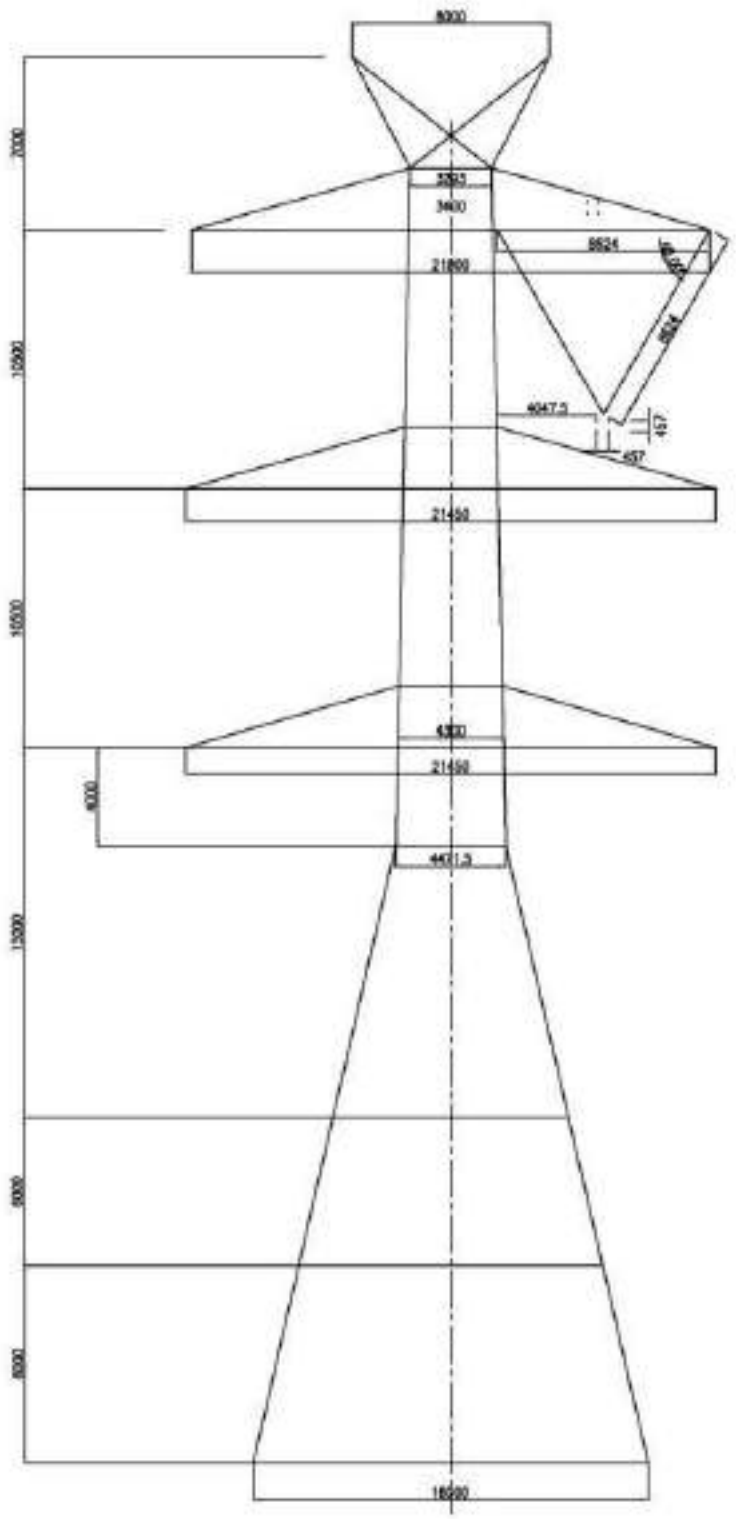


Figure 2-3: Tower Layout of "DA1" Tower Type

TOWER TYPE "DD1"

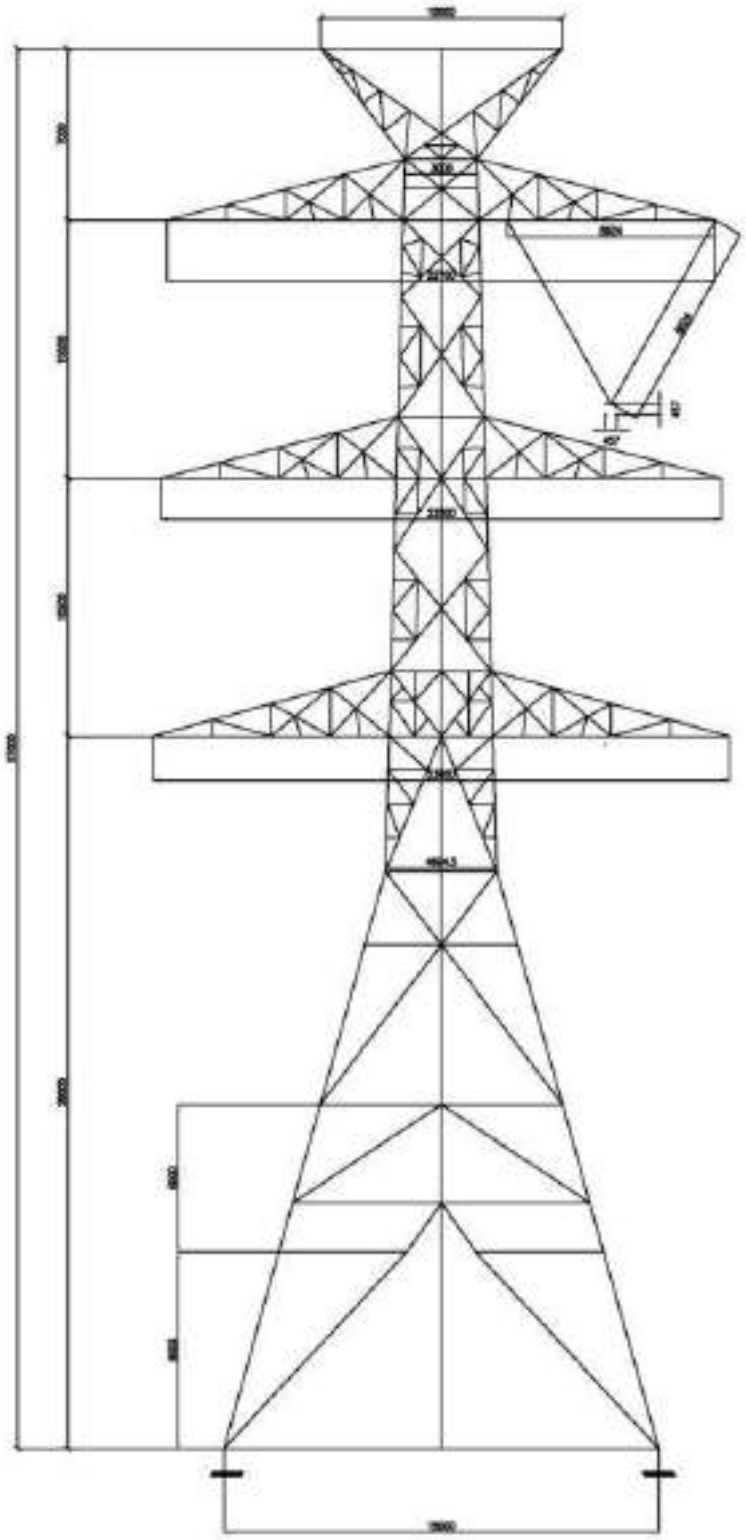


Figure 2-4: Tower Layout of "DD1" Tower Type

2.6.2 Design Standards

NGC has developed design parameters for the planning and design of transmission systems in Pakistan. The design parameters are based on standard NGC's existing specifications and practices for the existing as well as ongoing T/Ls. The design parameters considered for the proposed system are described below in detail.

a) Climatic Consideration

To obtain climatic and atmospheric data for the selection of conductor and design of the T/L, meteorological stations of the Pakistan Meteorological Department (PMD) at Faisalabad, Sargodha, and Chakwal were identified as being located in the vicinity of the proposed T/L route.

Table 2-2: Selected Metrological Station

Sr. No	Met Station	UTM Coordinates	Approx. Elevation above Sea (meters)
1.	Faisalabad	31^0 26' N 73^0 08' E	185.6
2.	Sargodha	32^0 03' N 72^0 40' E	187
3.	Chakwal	32^0 55' N 72^0 51' E	519

b) Tower Spotting

Tower spotting will be performed considering the following factors:

- Selection of the proper tower type and positioning at the optimum location.
- Achievement of economical tower heights with safe clearance from ground and nearby objects;
- Assurance of compliance with design load criteria;
- Location of towers to minimize the risk of foundations being damaged by flood, erosion, landslides, geo-hazards, etc.;
- Providing a minimum clearance of 20m from the outer conductor to the nearest conductor of another power line, existing or planned;
- Avoiding interference with or obstruction to any roadway or track being regularly used by wheeled vehicles, animals, or pedestrians;
- Minimize the cutting of mature trees to the extent possible and to avoid densely forested areas;
- In areas of landslides (if any), extra ground clearance will be needed to ensure that movement of the earth will not reduce conductor ground clearance below the minimum safe value; and
- The requirements of the relevant authorities regarding the distance of towers from the roadways and railways.

c) Tower Foundations

American Concrete Institute (ACI), IEEE Guideline for Transmission Structure Foundation Design and Testing (IEEE Standard 691-2001) will be used for tower foundations.

All the tower foundations will be designed as individual leg footings, with 4 legs per tower. The following foundation types will be considered depending upon the results of the soil investigations.

- Shallow foundation (square);
- Dry;
- Semi-submerged;
- Submerged;
- Deep Foundation; and
- Piles.

Depending on the engineering parameters of the soils under various conditions, different types of foundations will be recommended. The final choice will be made after the Contractor has carried out soil investigations at the time of construction.

The foundations will be about 2.5 to 4m below the Natural Surface Level (NSL) with only tower footings protruding up to 0.7m above the ground. The general steel structure of the tower will have a clearance of at least 10m from the natural ground. This will allow the farmers to utilize the ground underneath the tower.

Pile foundation is considered for tower locations at river / stagnant / flash flood areas at places where the soil conditions do not permit the use of shallow foundations. The exact number of pile foundations will depend on subsurface investigations at the Tower locations at the time of construction.

The concrete grade shall be of C-15, C-25, C-30, etc., while steel shall be of grade-60 conforming to ASTM A615 Standard. Equivalent quality materials meeting the above specifications can also be used.

d) Insulation

The T/L has been provided with appropriate insulator assemblies. These have been determined based on the degree of contamination in air, power frequency, operative voltage, switching, and lightning surge voltage under the particular service conditions of the line. The type of insulators, creepage distance, and shed diameter have been selected in accordance with the existing international standards for a similar voltage level.

- ANSI C29.1: American national standards for electric Power insulators;
- IEC Publication 383: Insulators of overhead lines with a normal voltage above 1000V;
- IEC 575: Thermal-Mechanical performance test on string-insulator units; and

- Other relevant ANSI, ASTM (American Society for Testing Materials) and IEC Standards.

2.6.3 Safety Parameters

For Extra High Voltage (EHV) lines, safety considerations are of two types, namely system safety and public safety. It is for this reason that NGC has adopted a 50m wide (25m on either side of the centerline) corridor as the RoW for 500kV T/Ls. The aspects to be considered in this regard are as under:

(a) System Safety

- ***Conductor to Tower Clearance****:* For the safety of the system, it is imperative that any factor that may interrupt the power supply should be considered in the design. The clearance of the conductor from tower legs and trusses is of prime importance. Therefore, in the design, a minimum clearance of 4 meters has been adopted under extreme wind conditions. This is based on regulations of WAPDA and the minimum requirements of the National Electric Safety Code (ANSI C2). With this clearance, there is a 99% probability of withstanding a switching surge of a 3-sigma margin due to maximum overvoltage under adverse climatic conditions.
- ***Earthing of the System:*** Every tower is connected to an earthing system. This is to keep the tower footings resistance at a level lower than 10 ohms. For this, two earth electrodes of copper-clad steel rods are sunk vertically into the ground to a minimum depth of 3 meters, and the locations where the required resistance is not achieved, crow footing will be done.
- ***Lightning*** Performance***:*** The tower geometry, clearance, and insulation of the system are designed to perform safely within the permitted lightning intensities. In this respect, consideration has been given to the tower footing resistance and the Isokeraunic level of the area. The accepted level is one trip-out/ 100 km/ year due to lightning.

(b) Public Safety

- ***General Aspects*****:** In view of public safety, NGC has adopted a policy of keeping a 50-meter-wide corridor clear of all obstructions for 500kV T/L (25 meters on either side from the centerline). However, NGC allows general farm practices within this corridor, but tree plantation that exceeds a height of 2.5 meters is not allowed. As such, the existing trees with a height of not exceeding 2.5 meters are allowed to remain under the lines. No residential or other public buildings, such as factories, schools, hospitals, etc., are permitted within the corridor. However, farm buildings, which are not used for residential purposes, are allowed to remain under the high voltage lines, provided a minimum 10-meter clearance is maintained. The height of the towers can be increased to accommodate such buildings.
- **Conductor *to Ground Clearance:*** The conductor to ground clearance is desirable to be worked out based on overvoltage due to switching surge. In this consideration, safe clearance is required to be provided for moving objects under the line with a height of 4.5 meters, withstanding switching surge of 3-sigma margin with 99.7%

probability under adverse atmospheric conditions. This should keep the maximum voltage gradient at ground level and maximum current induced in a person less than the internationally allowable values. As such, the total conductor to ground clearance shall in no way be less than 10 meters. This is in accordance with the regulations of GOP and NGC practice. NGC has accepted current international standards for conductor to ground clearances for the construction of 500kV T/L Projects. The specific standard accepted is that of the National Electrical Safety Code (NESC), currently applicable in the United States. The permissible conductor clearances (at a maximum temperature of 90^{o}C) are given in **Table** 2**-3.**

Table 2-3: Permissible Conductor Clearances

Sr. No.	Description	Clearance (m)
1	Across Country	9.00
	a. Across Street or Intersection	9.00
	b. Along Street	9.00
	c. Across Private Property, Footpath and Places Inaccessible to Vehicular Traffic	8.00
2	Roads and Highways	11.75
3	Rivers and Major Canals H.F.L	9.14
4	Railway Track (inside/outside station limit)	11.75
5	Building Part (Vertical & Horizontal)	8.00
6	Earth Part of Lines (insulated services, guys, earth wire, etc.)	4.00
7	Telegraph Lines	4.57
8	132kV Lines	4.50
9	220kV Lines	5.00
10	500kV Lines	6.70

2.7 Construction Aspects

2.7.1 Contractor Arrangements

NGC has planned to implement the Project through International / Local Contract Bidding.

2.7.2 Implementation Schedule

Execution of the project is proposed to be commenced during the year 2025-26 and to be completed by 2027-28. The tentative implementation schedule of the T/L is attached as **Table 2-4**.

Table 2-4: Tentative Implementation Schedule of the Proposed T/L

Aspects	Arrangements
Implementation period	January 2026–December 2028
Estimated completion date	December 31, 2028
Estimated Loan Closing Date	March 31, 2029

2.7.3 Construction Camps

The proposed T/L has approx. length of 283km, and three to four construction camps are proposed to be constructed. However, the exact numbers and locations of these camps will be decided by contractors as per their work plan. The construction camps will include residential quarters, washing areas, a kitchen, toilets, fuel storage, water storage, sewage disposal arrangements, firefighting arrangements, electric generators, and others. Preference will be given to establishing these camps within the NGC-owned premises or settled areas. Otherwise, the land for these camps will be obtained on a rental or lease basis. Proper waste (solid and liquid) handling facilities will be developed, and the waste will be disposed of as per recommendations in this EIA.

The contractor, before mobilization for construction, will submit a site camping layout plan as part of the Contractor's Site Specific EMP (SSEMP). The layout plan will clearly show all camp facilities, including runoff and sewerage drainage streams and end disposal points. A machinery yard will also be needed for each construction team; it can be combined with the construction camp or established separately. The machinery yard will be used as parking bays, maintenance, washing bays, fueling arrangements, oil and fuel storage, firefighting arrangements, and tools and parts storage.

2.7.4 Batching Plants

The contractors may need to establish concrete mixing and batching plants for tower foundation construction. These plants will be established at appropriate places based on the distance from and accessibility to the tower locations. The batching plants will be equipped with dust control arrangements and be away from water bodies and settlements.

2.7.5 Manpower Requirements

For the execution and operation of the proposed project, the manpower requirement is given in **Table 2-5**.

Table 2-5: Estimated Manpower Requirement

Sr. No.	Description	For Execution	For Operation
1	Professional and Technical	7	2
2	Administrative	2	2
3	Skilled	16	28

Sr. No.	Description	For Execution	For Operation
4	Non-skilled and others	21	4
	Total	46	36

Source: PC-1, February 2025

The total number of crew, skilled and unskilled labor, to be employed will depend on the Contractor's activity schedule at the time when the contract is awarded. The Contractor will be advised to hire unskilled labor from the local communities. A training program will be conducted for unskilled workers.

2.7.6 Construction Materials and Transport

Based on similar nature of T/L projects, it has been derived that tentative quantity of material cement, coarse aggregates, fine aggregates (sand) and steel required for the installation of single tower along with its sources is given in **Table 2-6.**

Table 2-6: Estimated Construction Materials for Single Tower

Sr. No.	Type of Material	Quantity/Tower	Source
1.	Cement	300 bags	From nearby Cities
2.	Sand	20 cu.m	Locally
3.	Crush	30 cu.m	Locally
4.	Steel	2800 kg	Karachi and Lahore

The material will be transported to the nearby WAPDA and NGC workshop. From there, it will be shifted to tower spotting where the steel tower will be assembled.

2.7.7 Construction Procedures

This section describes all the stages of the T/L construction that may cause a potential impact on the biophysical and social environments, i.e. preparatory works that include access roads and the clearance of the RoW, construction of foundations, erection of towers and laying of cable.

Access to the Construction Sites

Most of the towers are easily accessible through existing roads. However, certain areas where the Contractor has to develop or improve a few new access roads by following the natural topography of the area and minimum damage to the trees.

According to usual terms and conditions laid down by NGC, the Contractor will be bound not to cause any damage to the existing roads and village tracks during construction works and due to movement of heavy vehicles. However, in case of any damage, the Contractor will be responsible for its repair. In this regard, NGC bounds the Construction Contractor by withholding a 10% amount from the Contractors' interim bills submitted to the Engineer for payments to exert the Contractor to complete his pending works.

Clearing of ROW

To minimize the environmental impacts, NGC normally imposes restrictions on the clearing of natural vegetation from ROW. This is allowed to the extent that it is necessary for the safe construction and operation of the lines. For this, the area required for the placement of tower footings will be completely clear of vegetation, crops and trees. In the rest of the ROW, selective clearing will be carried out. Trees more than 2.5m high, which may obstruct stringing or create hazard/danger to the T/L, will be removed. On the other hand, the clearing of scrub and vegetation is restricted to what is required for placement of footings and for the assembly and erection of towers and wire pulling at site.

While no such clearance is allowed in forest or other areas of ecological importance, except as specifically approved by the Engineer in the case of having no other alternatives. NGC allows that the cleared materials such as trees, crops etc., will be the property of the landowners while other materials such as fossils, coins and antiquities discovered on the site of the work will be deemed as the property of GOP.

Tower Foundations, Erection and Stringing of Conductor

(a) Siting of Towers

Siting of towers is based on physiographic and geotechnical investigations of the ground including subsoil and groundwater testing. If the subsoil conditions do not allow for any type of foundation specified by the designer, the location of the tower is changed along the centerline in consultation with the Engineer, without affecting the overall alignment of the T/L.

(b) Excavation, Concreting and Backfilling of Foundation

Depending upon the type of tower and subsoil condition, the tower footings have variable dimensions. However, on average a 400 m^2 working area is required for the excavation of normal foundation and 500 m^2 for that of pile foundation. The depth of excavation for the normal foundation varies from about 3 to 4 m. The excavation for tower footing is carried out either manually or by mechanical excavator as per site requirements. In rocky areas, some controlled blasting may also be involved.

After fixing steel rebars and concreting, the ditch is refilled with excavated material and the site is brought to the original ground level. As such, only four tower pedestals protrude above the ground level by about 0.7m for normal foundations and about 1.8m for pile foundations.

(c) Steel Tower Erection

Tower erection is carried out on the concreted locations with the help of Derrick poles or a crane. The required working area for this activity is about 84 m^2 for each tower. The tower is erected in panels of 2 m to 3 m height. The panels are assembled on the ground, lifted in parts with the help of Derrick poles/cranes and then joined together with nuts and bolts, which are tightened at the specified torque.

2.7.8 Stringing of Conductors and Overhead Ground Wire

After tower erection is accomplished for a reasonable reach, stringing activity is started. This involves preparing the tower to access tractor movement by clearing a strip of about 10m wide of all obstacles. The positioning of the tensioner and puller is temporarily anchored on both ends of the stringing stretch, which is normally 3 to 6km. At road, railway, and telephone line crossings, rider poles are provided during stringing to avoid any interruption to traffic or shutdown of the power in the existing line. Shutdowns will be arranged for power lines crossing the transmission route and temporarily delinked and undipped from the towers.

2.7.9 Equipment and Machinery Requirement

The following machinery and equipment will be required for civil work, erection/installation, testing, pre-commissioning, and commissioning of the proposed T/L project. A tentative list of machinery and equipment is presented in **Table** 2**-7.**

Table 2-7: Tentative List of Machinery and Equipment for the Execution of the Project

Sr. No	Equipment Type and Characteristics
1	Total Stations, Theodolite & Level
2	Real Time Kinematic (RTK)
3	Winch Machine (8ton ~ 8ton)
4	Tensioner and Puller for Quad Bundle Conductor (ACSR Bunting)
5	Puller for Bull wire
6	Bull wire 8 ton (5000m)
7	Pilot Line/Reel Winder (min 8000m)
8	Reel Carriers for 2600m conductor length
9	Derrick/Gin Pole
10	Crane 20 ton
11	Crane 60 ton
12	Crane mounted trucks (4x4)
13	Travelers for quad bundle Bunting Conductor
14	Travelers for Aluminum Clad Shield Wire
15	Travelers for Optic Fiber Ground Wire (OPGW)
16	100-ton Hydraulic Compressor with Jack
17	60-ton Hydraulic Compressor with Jack
18	Dies set (for Bunting Conductor and Aluminum Clad Shield Wire for each machine as per specifications
19	General tools for Erection & Stringing of T/Ls

Sr. No	Equipment Type and Characteristics
20	Instruments for Testing & Commissioning of T/Ls
21	Any other relevant T & P and machinery required for the successful completion of the work
22	Tractor Trolley
23	Trucks for Material Shifting
24	Jeep 4x4

2.8 Operation and Maintenance Arrangements

A 500kV T/L is a vital link in the transmission grid system of Pakistan. Any outage on the line would seriously disrupt the power supply to major load centers, possibly causing extensive damage and losses. The Grid Station Operation (GSO) division of NGC (WAPDA) maintains regular patrolling / inspection staff for patrolling and inspection of the lines.

NGC's patrolling crews are required to carry out a general inspection of the T/L after every 3 months, while a comprehensive inspection is carried out after every 3 years. Based on WAPDA maintenance manuals, the following paragraph enlists the items to be checked by the inspection crew during patrolling.

2.8.1 Foundations

Check for any soil settlement around the foundation chimney, any unusual cracks between the stub angle and concrete and/or cracks in the concrete chimney.

Check for erosion in and around the tower foundations. Where erosion exists, locations and extent are noted on the inspection form, take measurement are taken from the centerline. Note if a stream (Nullah) or dry wash is causing erosion. Also, note any damage done by farming operations near or under the tower. Towers located in the active hill-torrent zone will require inspection on a continual basis.

In areas where the line crosses hills / lowest slopes, very careful checking of the ground clearance and the amount of foundation chimney that is exposed must be done. It is anticipated that during different times of the year, either soil may drift up on the tower legs or chimney may be exposed. These should be noted and immediate corrective measures taken to ensure uplift capability by replacing the backfill or re-establishing minimum ground clearance.

2.8.2 Steel Works

Look for bent or missing steel members, missing or loose bolts. An excellent test in addition to visual inspection is to strike the tower leg angle sharply with a stick of wood or rubber hammer. Any loose bolts or members will produce a rattling sound.

2.8.3 Conductor, Overhead Ground Wire, Hardware and Insulators

Conductor is the most important part of the line. A very thorough visual inspection has to be made. The checklist for this component includes the following:

- Check every bolt, nut, pin and cotter pin on the conductor shoe, shackles connecting links and other hardware fittings for looseness or missing;
- Check for chips, dirt and/or lightning "Tracks or marks" on the insulators. This lightning mark will especially show up on the first few insulators nearest the tower attachment point. There will not be cracks of any size in the insulators because before porcelain cracks, a piece of the insulator will break off. Always look around the base of every tower for pieces of insulators, pins, bolts, nuts, etc.;
- Check every ball in the insulator strings for missing cotter pins. Note that the ball can work itself half way out and still holds. First, the cotter pin falls out, next with the continual vibration the ball can very slowly work itself out to a point where the ball is only held by half of the socket. One can spot this condition by a slight tilting of the insulator below or beyond the loose ball. This also applies to shackle or hardware pins and is a very serious condition. Report it immediately;
- Check the stock-bridge dampers on the conductor to make sure these are in the proper position. On dead end towers, check the jumpers to see that all the bolts are tight in the jumper pads. Also, there should be no missing or loose slots;
- Along the line, check the conductors for frayed or broken strands; and
- Spot-check ground clearance and observe if any building or structure is being constructed under the line. Also, check for any tree growing near or under the line. Report these conditions immediately.

2.9 Project Cost

The overall cost of the whole scheme of proposed T/Ls is PKR 103,789.03 million.[4]

[4] Source: PC-1, 2024.

3. ANALYSIS OF ALTERNATIVES

3.1 General

This section presents the different alternatives that have been considered in the project. The analysis has been carried out critically to justify the need for the project and the selected options. The alternatives that have been considered during this study are:

- No Project Option (NPO)
- Technological Alternatives
- T/L Route Alternatives
- Environmental Considerations
- Social Considerations
- Economic Alternatives

3.2 No Project Option

The presently installed capacity of small, medium, and large-sized hydropower projects (HPPs) in the northern part of the NGC's network is about 10,000 MW. During the high-water months in summer, power flows from HPPs in the north to the mid-country load centers mainly through 500kV networks.

The power transfer capacity of this 500kV network is adequate to transmit existing hydro generation to mid-country load centers. There are many HPPs of various capacities in the north, which are either planned or under construction, including Suki Kinari HPP (884MW) which has recently been commissioned.

Following **Table 3-1** lists some large HPPs which are expected to be commissioned within the next three years. With increasing hydroelectric generation in the north, the existing transmission infrastructure will be inadequate to manage the increased power flow, especially with upcoming projects like, Tarbela 5th Extension and Dasu. This underscores the need for reinforcing the 500kV transmission interface from north to mid-country for reliable and secure dispersal of cheap hydro power from the new power plants.

Table 3-1: Expected Commissioned Dates of Various HPPs

Sr. No.	Name of Power Plant	Capacity (MW)	Expected Commissioning Date
1.	Tarbela 5th Extension HPP	1,530	Unit # 1: November 2025 Unit # 2: December 2025 Unit # 3: January, 2026
2.	Dasu HPP	2,160	Unit # 1: March 2027 Unit # 2: April 2027 Unit # 3: May 2027

Sr. No.	Name of Power Plant	Capacity (MW)	Expected Commissioning Date
			Unit # 4: October 2027 Unit # 5: November 2027 Unit # 6: December, 2027

Source: PC-1, February 2025

After the commissioning of Tarbela 5th Extension and Dasu HPPs, the power flow on the existing 500kV transmission lines would increase significantly, which would overload the 500kV network.

In short, there would be transmission constraints in the reliable evacuation of power from these two HPPs to the mid-country load centers. In order to remove the above system constraints in the future, various alternative solutions were considered, resulting in the identification of the following three potential options (**Table 3-2**).

Table 3-2: Options Considered for Proposed T/L

Sr. No.	T/L Options	Estimated Cost (million USD)
1.	± 500kV HVDC: 2,000MW VSC-HVDC bi-pole from Islamabad West to Faisalabad West. This option also requires land for converter stations and grounding stations at both ends.	1,500
2.	765kV HVAC: Double Circuit T/L from Islamabad West to Faisalabad West. This option involves upgrading the existing 500kV Faisalabad network to 765 kV, along with acquiring additional land.	670
3.	500kV HVAC: Double Circuit Transmission Line from Ghazi Barotha to Faisalabad West (283 km)	327

Source: PC-1, February 2025

Among these options, the 500kV HVAC T/L was found to be the most cost-effective. Although the other two alternatives were evaluated for potential additional benefits, no significant advantages were identified over the 500kV HVAC solution. As a result, the first two options were ruled out, and the 500 kV HVAC alternative was selected for further studies.

Based on the facts mentioned above, NPO, if exercised, evacuation of power from upcoming HPPs in northern region to the load centers in the mid country is not possible due to transmission system constraints (i.e., overloading of existing 500kV T/Ls after commissioning of Tarbela 5th extension and Dasu in future, under normal & N-1 contingency condition). In light of the above situation, NPO is not acceptable.

3.3 Technological Alternatives

Technological alternatives can be considered mainly in terms of available power conductor and tower types, which could be utilized for the construction of Ghazi Barotha to Faisalabad West T/L, depending on the external factors, e.g. temperature, wind speed, elevation and topography of the area.

3.3.1 Conductor Alternatives

At HV level, the power conductor of an overhead T/L must be optimized and evaluated both technically and economically. The objective in the optimization of a conductor is the minimization of the total Life-Cycle Cost (LCC), which is a sum of Capital Investment Cost (CIC) and Total Cost of Operation (TCO), i.e., the cost of losses (**Figure 3-1**). Both cost components depend on the conductor cross cross-sectional area.

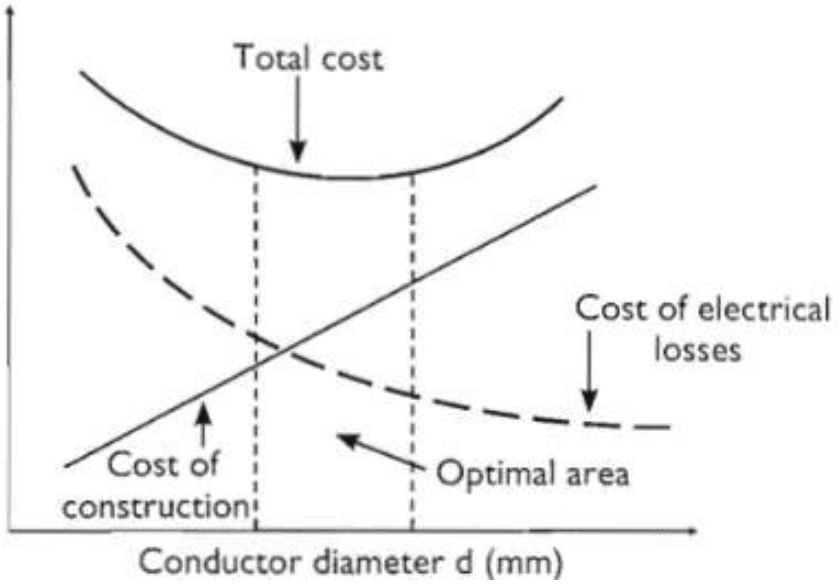


Figure 3-1: Objective Function of Conductor Optimization

Generally, in Pakistan, all HV T/Ls are constructed with ACSR conductor except the lines falling beyond Guddu, which are constructed with All Aluminum Alloy Conductor (AAAC) due to corrosion concerns. Since, the proposed T/L passes through various districts of the Punjab with relatively lower atmospheric corrosion, the existing practice of NGC was maintained and only ACSR Drake conductors as per ASTM standards are considered for looping In/Out of the 500kV Ghazi Barotha – Rawat Single Circuit (S/C) T/L at Faisalabad West Substation.

3.3.2 Tower Design Alternatives

Based on the survey and spotting of Ghazi Barotha to Faisalabad West T/L, various tower types, i.e., DS1, DA1 and DD1, along with their respective design span, line deviation angle, etc., are proposed. Details of these towers, including their layouts, are already provided in the **Project Description** section.

3.3.3 Use of Single Tower/ Corridor in Protected Areas

An idea was floated if the project could use existing towers of the existing T/L in Protected Areas by upgrading and improving pylons' Design and Structure for 4-line 500kV Conductors.

Running 4 lines on the same towers will be a risky decision for NGC. There were examples presented by design experts about similar issues in former Soviet republics, e.g. in

Uzbekistan, the engineers rejected the proposal to have 500kV double-circuit lines because if 1 tower failed, then 2 circuits would fail.

3.4 T/L Route Alternatives

The T/L route selection is the process of selecting an optimized route for the construction of a T/L between a defined start and end points, directly or via pre-determined intermediate way points. Determination of T/L route helps not only in minimizing the superfluous level of effort but also in optimizing the time and resources.

The T/L route alignment has been finalized by considering the following features, and efforts have been made to avoid or minimize impacts on the environment, social, and economic aspects. Route alternatives are shown in **Figure 3-4**

- Optimize total T/L length;
- Avoid or minimize disturbance to game reserves, wildlife sanctuaries, national parks, reserved forests, and ecologically sensitive areas (where possible);
- Possible avoidance or realignment of T/L with migratory bird fly routes;
- Possible avoidance or realignment of T/L with densely and sparsely populated areas, indigenous and tribal settlements and private / Govt. infrastructures;
- No disturbance to the archaeological sites / historical monuments (if any);
- Graveyards, shrines, and culturally important areas should be avoided and protected;
- Try to avoid dense forest, difficult terrain, extreme altitudes, steep slopes, landslides and unapproachable locations (where possible);
- Proximity to existing highway/roads for ease of mobility, construction, and maintenance access;
- Avoid crossing over major water resources, i.e., rivers, streams, etc. (if possible); and
- Maintain adequate clearance from the existing / under-construction 132kV overhead T/Ls and avoid unnecessary crossings.

The proposed T/L has been evaluated based on the above-mentioned criteria. Three (03) overall T/L routes have been considered for the proposed T/L, namely “Route A”, “Route B,” and “Route C”, which are described below.

3.4.1 Route A Transmission Line

The path of this route is similar to Route B, except that Route A deviates near the area where Chinji National Park is located, and instead of passing through the Chinji National Park, the suggested alternative avoids it and suggests a route towards the eastern side of the park. Route “A” is marked on **Figure 3-2**.

Before the start of the field activities for route optimization of T/L, a tentative route with 128 Nos. of angle markers (Ams) was marked on Google imagery by the design experts to avoid settlements, infrastructures, and forest areas to the extent possible.

Route A has a total length of 284.6 kilometers, and it passes through Kala Chitta National Park for 2.1km but does not pass through Chinji National Park. However, on the route, there are a few salt mining areas located, and the route is of difficult terrain for access and also forests are found in dense concentrations. Two to 03 settlements also fall on this route.

3.4.2 Route B Transmission Line

The second option for the transmission line is referred to as Route B. For most of its length, from Islamabad to the Jhelum River, route B is in the vicinity of an already existing 500kV transmission line. After the crossover from the Jhelum River, route B will deviate and move toward Faisalabad West GS. Route “B” is marked on **Figure 3-2**.

This route B has a total length of 283km and crosses through Kala Chitta National Park for 2.10km and Chinji Park for about 4.68km. The T/L route area in Chinji NP consists of a modified habitat due to human interventions from nearby communities. Also, the area consists of sparsely populated herbs and shrubs. It is worth noting that there is already an existing 500kV transmission that is passing through the national park and almost parallel to the proposed Route “B”.

A team of experts, including environmental professionals, T/L design experts, and surveyors, followed the route “B” for route optimization by making physical, ecological, social, and other observations at the site. The route optimization team evaluated this route by identifying various kinds of features with the major emphasis on environment, settlements, social issues, ecologically sensitive areas, and flood-prone areas etc. It is noteworthy to mention that in route optimization, consideration is given to the shortest possible route along with accessible roads/paths near the tower locations as practicable as possible based on technical and economical construction, and thereafter maintenance of the proposed T/L.

Although effort has been made to avoid game reserves, national parks, and forest areas/tree cutting during route optimization of Ghazi Barotha to Faisalabad West T/L, however, at some places T/L passes through Chinji National Park and Kala Chitta NP.

A recent reconnaissance survey of the National Parks, especially at Chinji NP by Environmental Professionals found that the construction footprints of existing T/L were not found at two tower locations. Trees were found regenerated, and the habitat was not different from other neighboring land of the NP. Also, the existing T/L pylons were found at a higher altitude on the uneven land/ hilly edges of the NP, which gives more height to T/L conductors' clearance and trees were found uncut and unharmed.

The land surface in Chinji NP is uneven, and very limited access tracks are available. The construction will not develop any new access route in the NP area, and existing tracks will be used to the extent possible. This is due to the nature of the terrain in the area, so instead of building a new track for the contract, it will be profitable to carry the material to the construction

sites by animal carts or lifting by workers. The existing T/L in the Chinji NP was built on the same approach.

The Route “B” was further optimized especially on the basis of settlements and ecologically sensitive areas. The route optimization survey was started from Bahtar to Faisalabad West substation, and the study team adopted the same approach as described in route alignment criteria to minimize the environmental and resettlement issues along with the technical and economic aspects.

The route B as it runs parallels to an existing 500kV T/L in protected areas thus will reduce the chances of intense fragmentation of the NP habitat as maintenance may be easier, and one team can look after both T/Ls during the operational phase, so a reduction of footprints and use of resource envisaged by use of common access roads and resources. This will further help in reducing land disturbance and fragmentation of habitat.

3.4.3 Route C Transmission Line

A third alternative route for the project was suggested by the expert team, named as route “C” in **Figure 3-2**

This route is located farther west and diverges significantly from Routes A and B and intersects protected areas at different locations.

Though this route also bypasses Chinji National Park on western edge, but it passes closer to the designated Ramsar Site Complex, located about 25km in west, therefore increasing the risk of bird collision and electrocution.

It is the longest of the three options (about 293km), involves more crossings of water bodies, and requires the greatest number of road, canal, and forest interactions. As such, it poses the highest potential for environmental and construction challenges.

3.5 Environmental Considerations

A comparative assessment of the environmental impacts associated with the three alternative transmission line routes revealed that all options intersect with environmental components such as water bodies and sensitive areas, particularly the Chinji and Kala Chitta National Parks. However, the extent and nature of these interactions vary significantly among the alternatives.

The description and types of land features of the proposed routes are given **Table** 3-4 and **Table 3-5**

National Parks

As illustrated in **Figure 3-2**, Route B traverses a 2.10km stretches within the Kala Chitta National Park, closely following the alignment of an existing power transmission line. Field surveys confirm that this alignment avoids major forested zones and primarily passes through

sparsely vegetated scrubland, as shown in **Figure 2-3** and **Figure 3-**4 and Kala Chitta NP. This minimizes the need for vegetation clearance and reduces potential ecological disruption

In contrast, Route C would require a new corridor through the same national park, extending approximately 6.29 km—nearly three times the length of Route B within the protected area. Since Route C does not follow any existing infrastructure, it would likely result in greater disturbance to local flora and fauna due to the creation of a new right-of-way.

Given these factors, Route B presents a more environmentally responsible and feasible option, offering a reduced ecological impact through shorter park intrusion, alignment with existing infrastructure, and minimal vegetation disturbance. **Figure 3-4** shows the settlement/built-up area near the National Parks.

Water Bodies

The project area includes two major rivers, River Jhelum and River Chenab, which are prominent hydrological features in the region. All three transmission line route alternatives inevitably cross these rivers, as there are no technically or economically viable routes that can bypass them due to their geographical positioning between the origin and destination points.

In addition to these major crossings, each alternative also intersects multiple smaller water bodies, including canals, streams, and distributaries, which are part of the extensive irrigation network in the area. While efforts have been made to minimize the number and length of such crossings during route optimization, completely avoiding water bodies is not feasible due to the dense presence of surface water systems across Punjab's agricultural landscape.

As provided in the **Table** 3-4, Route A crosses 7 water bodies, Route B crosses 5 water bodies, and Route C crosses 8 water bodies. Among the proposed Route B crosses the least number of waterbodies.

3.6 Social Aspect

An assessment of the three alternative routes indicates that Routes A and C pose the least risk of community displacement and land acquisition challenges.

Field surveys and spatial analysis show that Route B traverses areas with sparse settlement patterns, thereby minimizing the need for relocation of households or disruption to livelihoods.

The reduced social footprint of Route B contributes to its overall feasibility and acceptability among local stakeholders. Visual and noise impacts are also important considerations in the siting of transmission lines, particularly in areas close to residential or commercial zones. Route B, by aligning with an existing transmission corridor, helps consolidate infrastructure and reduces the visual clutter that would result from introducing a new line in an undisturbed area.

This approach also limits the cumulative noise impact associated with construction and maintenance activities. In contrast, Route C would introduce a new corridor through relatively undisturbed landscapes, potentially affecting the visual quality and ambient noise levels in

those areas. Therefore, Route B offers a more socially acceptable solution with lower aesthetic and acoustic disturbances.

3.7 Economic Aspect

From an economic standpoint, Route B offers the most cost-effective solution among the three alternatives. It has the shortest total length (283 km), which directly translates into reduced material, labor, and construction costs.

Although Route B requires 169 lattice steel towers, which is marginally more than Route A (168 towers), the difference is negligible and outweighed by the overall route optimization benefits.

In contrast, Route C, being the longest route (293 km) and requiring 179 towers, results in the highest construction costs due to increased quantities of conductors, towers, foundations, and associated civil works. Route A, while slightly shorter than Route C, also involves higher costs than Route B due to its less efficient alignment and similar tower count. Therefore, considering total line length, number of structures, and associated land and material requirements, Route B is economically the most viable option.

Table 3-3: Comparison of Routes Considering Land Use

Route Options	National Park	TL within Protected Area Length (km)	Total TL Length (km)	Water Body Crossing (No.)	Agricultural land	Forest	Settlements
TL Route C	Kala Chitta NP	6.29	293	08	54.0%	45.0%	1.0%
	Chinji NP	2.27					
TL Route B	Kala Chitta NP	2.10	283	05	60.0%	40.0%	0.0%
	Chinji NP	4.68					
TL Route A	Chinji NP	0.00	287	07	59.0%	40.0%	1.0%
	Kala Chitta NP	2.10					

Table 3-4: Comparison of Routes Considering Other Land Features

Description	Route A	Route B	Route C
Existing 500kV Crossing	2 No.'s	3 No.'s	2 No.
Existing 220kV Crossing	1 No.	1 No.	1 No.
Existing 132kV Crossing	11 No.'s	14 No.'s	12 No.'s
Road Crossings	31 No.'s	33 No.'s	43 No.'s

Description	Route A	Route B	Route C
Canal Crossings	15 No.'s	22 No.'s	27 No.'s
River Crossings	2 No.'s	2 No.'s	2 No.'s
Railway Crossings	4 No.'s	4 No.'s	3 No.'s
Agricultural Land (of total Land in CoI)	59.0%	60.0%	54.0%
Covered Forest Area	40%	40%	45%
Settlements	1%	0	1%

3.8 Comparison of the Proposed Routes

A Multi-Criteria Analysis (MCA) was conducted to systematically evaluate and compare the various alternative routes for the proposed power transmission line. This analysis incorporated a comprehensive set of criteria, including environmental impacts (such as effects on biodiversity, vegetation, and water bodies), social factors (like potential displacement, community concerns, and cultural heritage), and economic considerations (including construction and maintenance costs). Each alternative was assessed and scored based on these factors, allowing for a balanced comparison that supports informed decision-making.

The MCA also considered the proximity of each alternative to environmentally sensitive areas, such as the national parks, as well as the alignment with existing transmission infrastructure. Routes that followed or paralleled existing corridors were favored where feasible, as they tend to reduce land acquisition needs and minimize ecological disruption. The results of this analysis were used to identify the most viable and least impactful route, ensuring that environmental, social, and economic priorities were all appropriately considered in the selection process.

The results that Route B is the most favorable option, achieving the highest total score of 51 (**Table 3-5**). This route demonstrates the lowest environmental and social impacts, largely due to its alignment away from sensitive habitats and populated areas. It also offers significant cost advantages as the shortest route, with favorable terrain and minimal construction challenges. Additionally, Route B runs parallel to an existing transmission line, which helps reduce land acquisition needs and environmental fragmentation. Based on these findings, Route B is recommended as the preferred alignment for the project.

Table 3-5: Comparative Matrix

Criteria	Route A	Route B *(Preferred)*	Route C
Environmental Impact	6	7	6
Social Impact	5	8	6
Economic Cost	4	9	6
Technical Feasibility	6	8	5

Criteria	Route A	Route B *(Preferred)*	Route C
Proximity to Sensitive Areas/ Protected Areas	5	2	4
Proximity to Existing Infrastructure	4	9	6
Sharing Corridor	0	8	0
Total Weighted Score	30	51	33

Notes: Scores are on a scale of 1–10 (10 = most favorable).

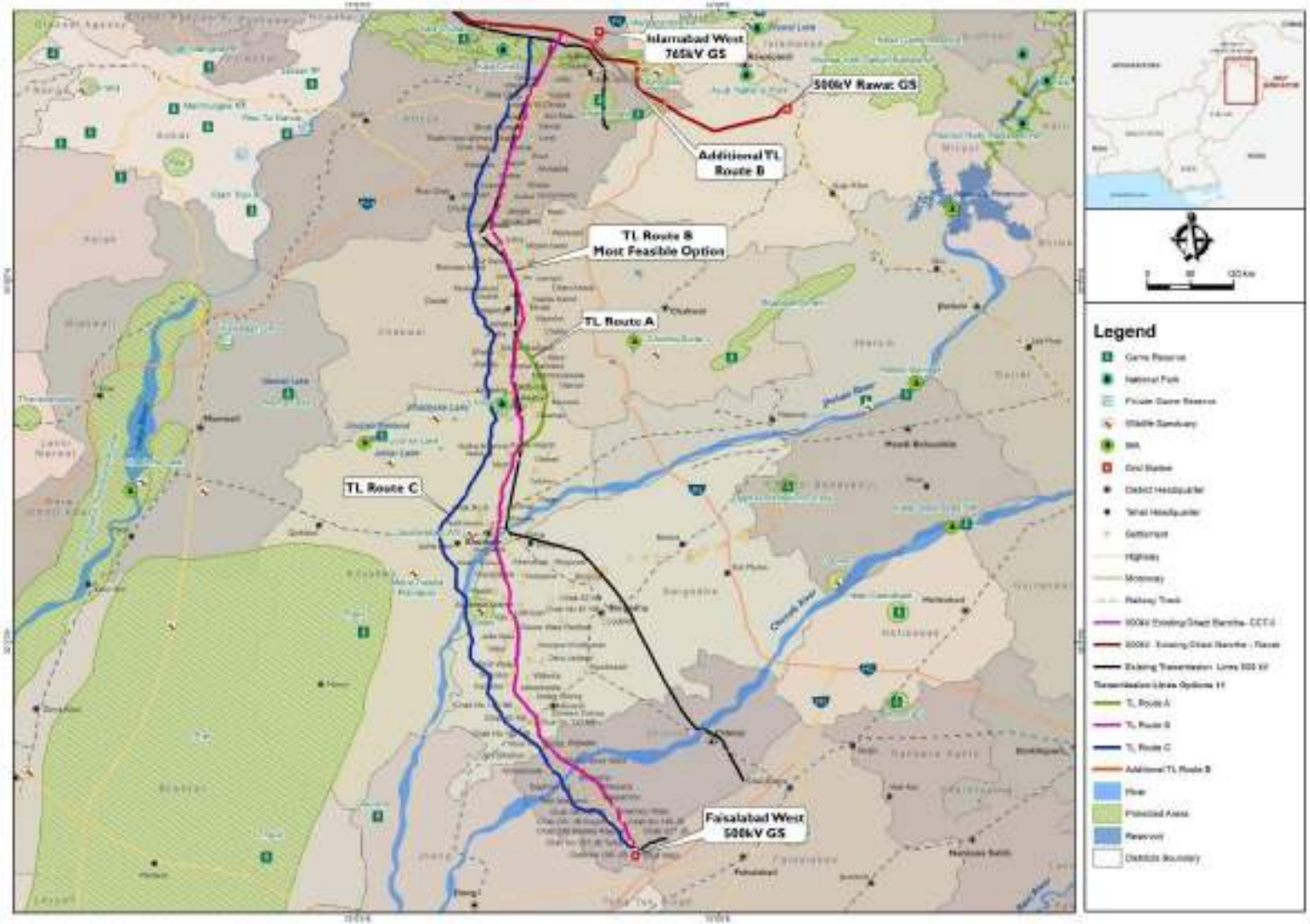


Figure 3-2: Route Alternatives Considered

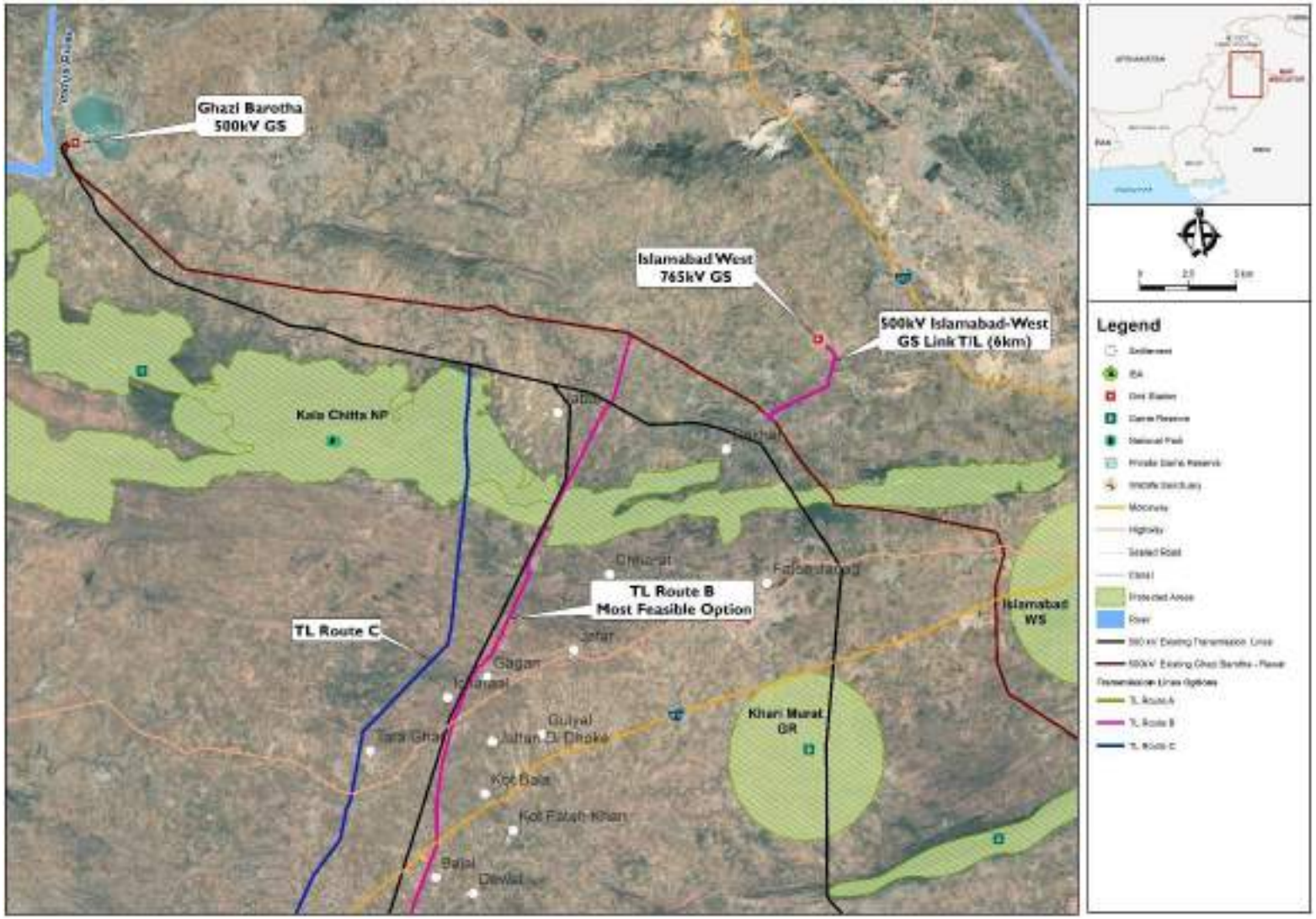


Figure 3-3: Route Options near Kala Chitta NP

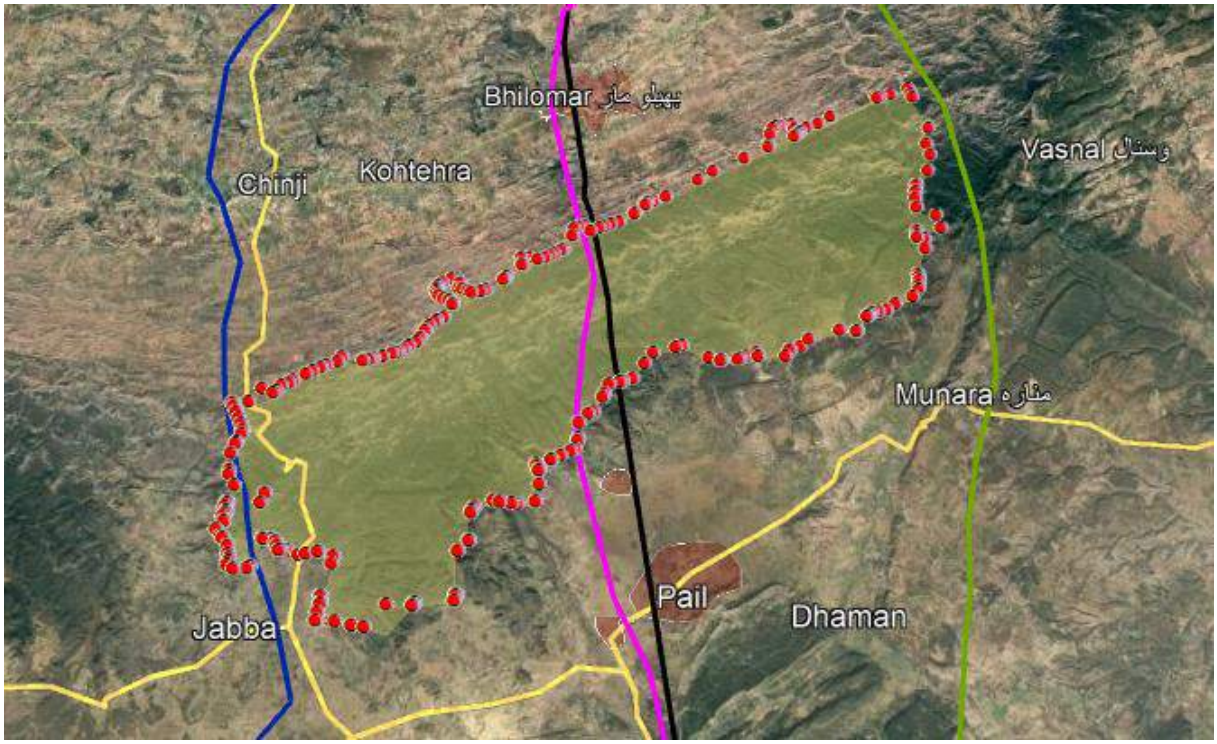


Table 3-6: Settlements Around Chinji NP

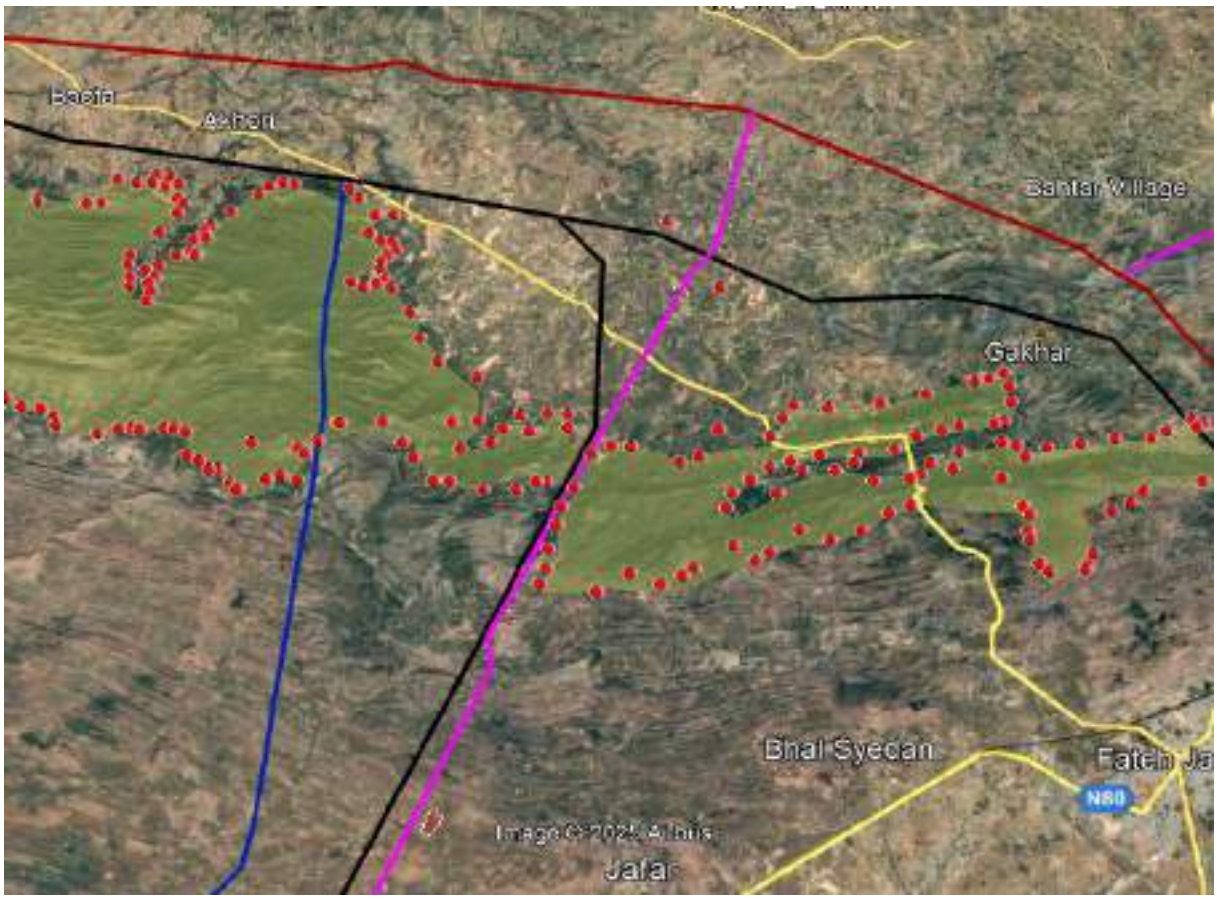


Figure 3-4: Land Use around Kala Chitta National Park

4. DESCRIPTION OF THE ENVIRONMENT

4.1 General

This chapter provides a description of the baseline physical, ecological, and socio-economic conditions along the 500kV Double Circuit T/L from Ghazi Barotha to Faisalabad West Substation within the COI and ROW. The information presented in this section was collected from the field surveys and the available literature.

The 100m COI will be used as a benchmark for comparison of the baseline conditions before and after the construction phases of the project. The potential impacts of a T/L project on the plain, hilly, and semi-hilly terrain of the T/L route and the existing environmental conditions will be considered in the process.

The land use maps are provided as **Annexure I,** which shows the extent of the COI and ROW along the T/L route for the baseline data collection.

Section 1.7 explains the delineation of the COI and ROW in detail. 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.

4.2 Data Collection for Baseline Study

The data presented in the forthcoming sections have been collected from both primary and secondary sources. For the primary data acquisition, the EIA team conducted the reconnaissance, route optimization, and detailed field visits. For reconnaissance and route optimization field was conducted in the months of January and February 2025. However, detailed field visits for data collection of physical, ecological and socioeconomic environment were conducted in February and March 2025.

The major objective of the field visits was to collect the baseline data on physical, eco-biological, and social aspects along with identification, assessment and categorization of the significant environmental and social impacts of the proposed T/L. The secondary data was collected from published sources/reports and relevant departments, which were also verified through visual observations during reconnaissance, route optimization and detailed surveys.

4.3 Physical Environment

The following section provides an overview of the information on the physical environment of the COI collected from primary as well as secondary sources. Parameters covered include topography, geology, seismicity, soil, climate, water resources, ambient air quality and noise, solid waste, and land use along the corridor of interest of the proposed transmission line.

4.3.1 Topography

The proposed T/L will traverse through plain, semi-hilly and hilly areas of the Punjab province. It passes through the agricultural plains of the district Chiniot, Sargodha, and Khushab and

enters the rain-fed cultivated areas of Talagang and Attock districts of Pothohar region. The elevation of the project area ranges from 105 meters above sea level (msl) to 4,496 msl.

The elevation in the project COI varies from 155m to 880m msl, with a mean elevation of 324 msl.

Figure 4-1 shows the photographs of the project area topography.

Figure 4-2 represents the map of the elevation profile of the project area.

Agricultural Fields of the Punjab near Khushab

Agricultural Fields near Naya Lahore

Semi Mountainous View near Talagang

Mountainous Area in the Project Area

Figure 4-1: Photographs Depicting Topography of the Project Area

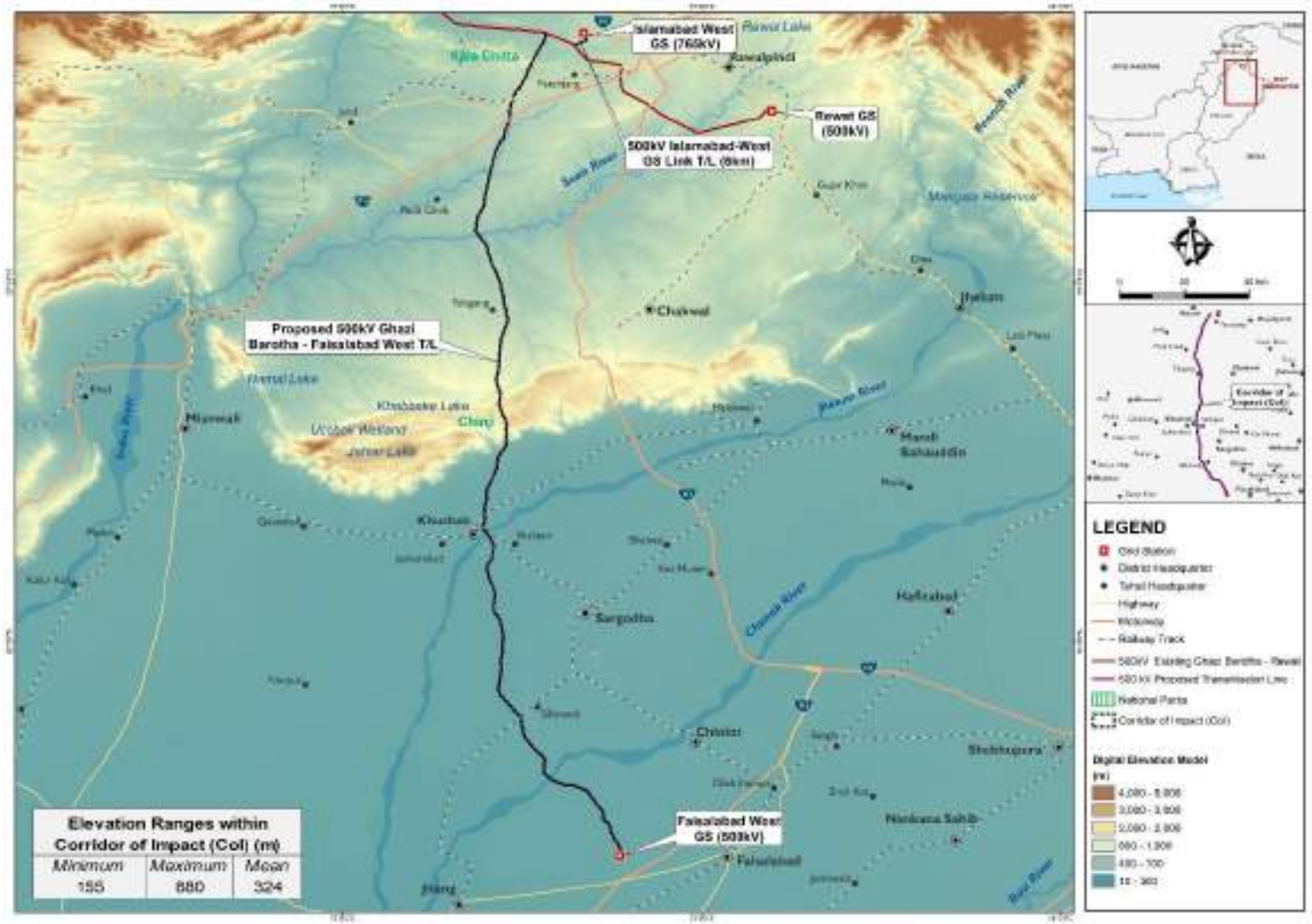


Figure 4-2: Topography of the Project Area

4.3.2 Geology and Soil

The project area lies in the fertile plains of the Punjab. The proposed T/L passes through districts Chiniot, Sargodha, Khushab, Talagang, and Attock. The soil formation is alluvial due to the Rivers Jhelum and Chenab. There are considerable hilly areas in all five districts. These hill formations constitute the northern outcrops of the Indian shield of Precambrian era. These rock outcrops are very high and can be used as gravel (crush) for construction when broken and crushed. The sand extracted from the riverbed is superior and is commonly used for building purposes. Pre-Cambrian basement rocks of iron ore deposits are found in the Chiniot district.

With the exception of these rocks, the remaining part is an alluvial plain. The surface soil is brown in color and medium textured i.e., silty clay / loamy clay at the plain area, while in the hilly area it is of gravelly mixtures. The soil depth in most of the locations varies between 3-10 feet. This sub-stratum contains fine sand. A considerable part of the T/L's dominant physiographic feature is the highly dissected Pothohar Plateau.

Chiniot district’s geology features alluvial plains along the Chenab River, with some rocky outcroppings of slate and sandstone. The soil, primarily alluvial, is suitable for agriculture, but also includes sandy and silty materials.

The Talagang district exhibits diverse soil types and geological features. The area’s soil is predominantly light-textured, with sandy loam and sandy clay loam being dominant. The geology reveals exposed strata from Cambrian to Tertiary, including the coal-bearing Patala Formation. The region also experiences significant soil erosion, particularly in areas with high-intensity rainfall.

The Attock District in Pakistan exhibits a variety of soil and geological features. The area is characterized by flood plain deposits, alluvial fan deposits, and stream channel deposits, primarily composed of clay, silt, sand, and gravel. The geology is influenced by the Indus and Kabul rivers, as well as the Attock-Cherat Range.

The geology of the project is shown in **Figure 4-3**. Most of the region is quaternary type with formation from alluvium, unconsolidated surficial deposits of silt, sand and gravel.

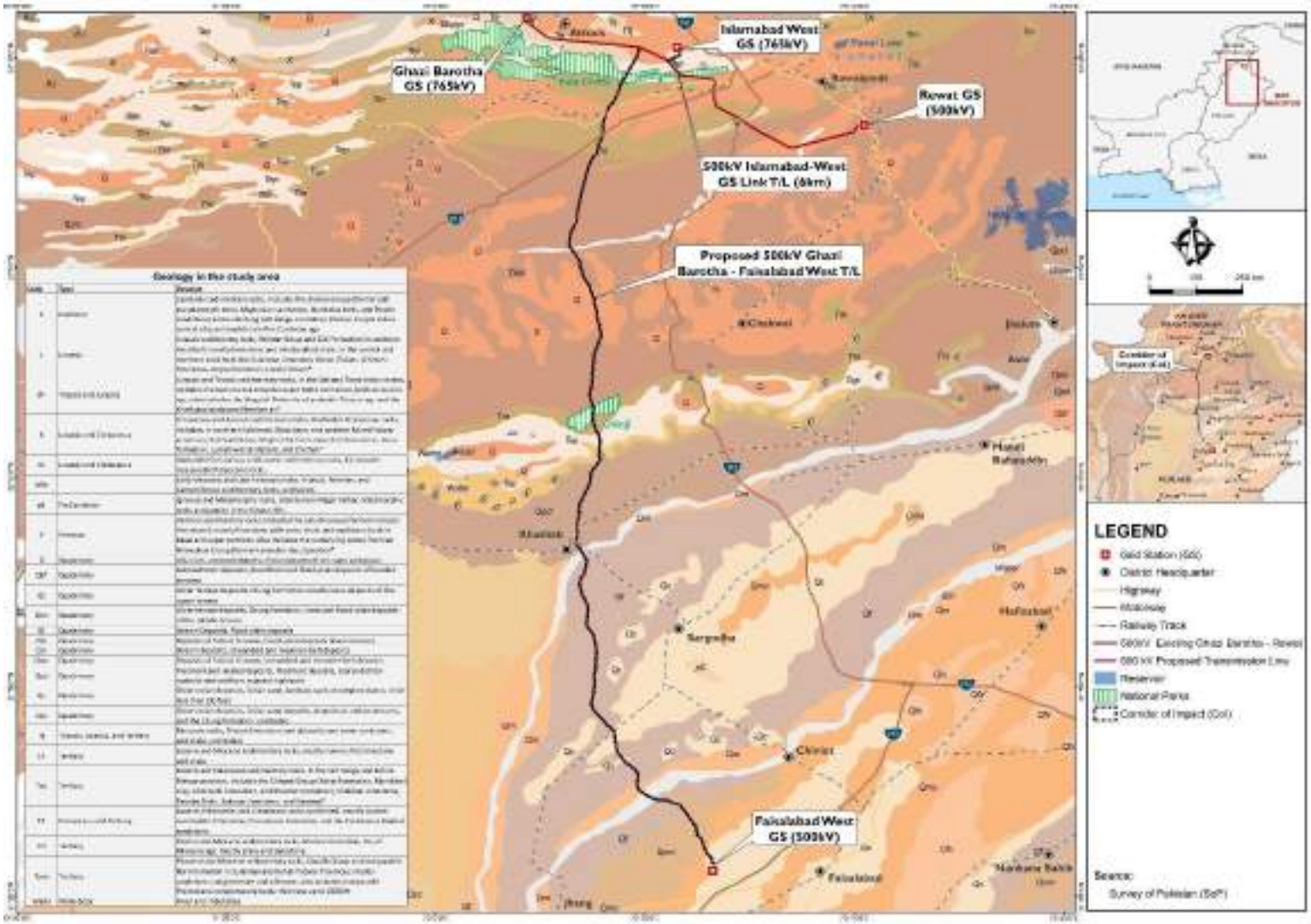


Figure 4-3: Geology of the Project Area

4.3.3 Seismology

In 2007, the Pakistan Building Code (PBC) revised the seismic zone categorization to 5 seismic zones based on peak ground acceleration (PGA) values obtained through Probabilistic Seismic Hazard Assessment (PSHA). The boundaries of these zones are defined on the basis as shown in **Table 4-1**.

Table 4-1: Values of Seismic Zones of Pakistan

Zone	PGA (g)
1	0.05 to 0.08
2A	0.08 to 0.16
2B	0.16 to 0.24
3	0.24 to 0.32
4	> 0.32 g

The Global Seismic Hazard Assessment Program (GSHAP)[5] launched in 1992, conducted a seismicity analysis in 1999 (**Table 4-2**).

Table 4-2 : Seismic Zone Categorization, PBC 1986

Seismic Zone	Peak Horizontal Ground Acceleration
0	Negligible damage
1	Minor damage, distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 seconds, corresponding to intensity V and VI of the M.M. scale
2	Moderate damage corresponds to intensity VII of the M.M. scale
3	Major damage corresponds to intensity VII and higher of the M.M. scale

The proposed T/L route passes through the areas that fall in zone-2A and zone-2B, as shown in **Figure 4-4.** This project area lies in a minor and moderate zone where high-intensity earthquakes can lead to minor or moderate damage depending on the spatial location.

[5] Global Seismic Hazard Assessment Program.

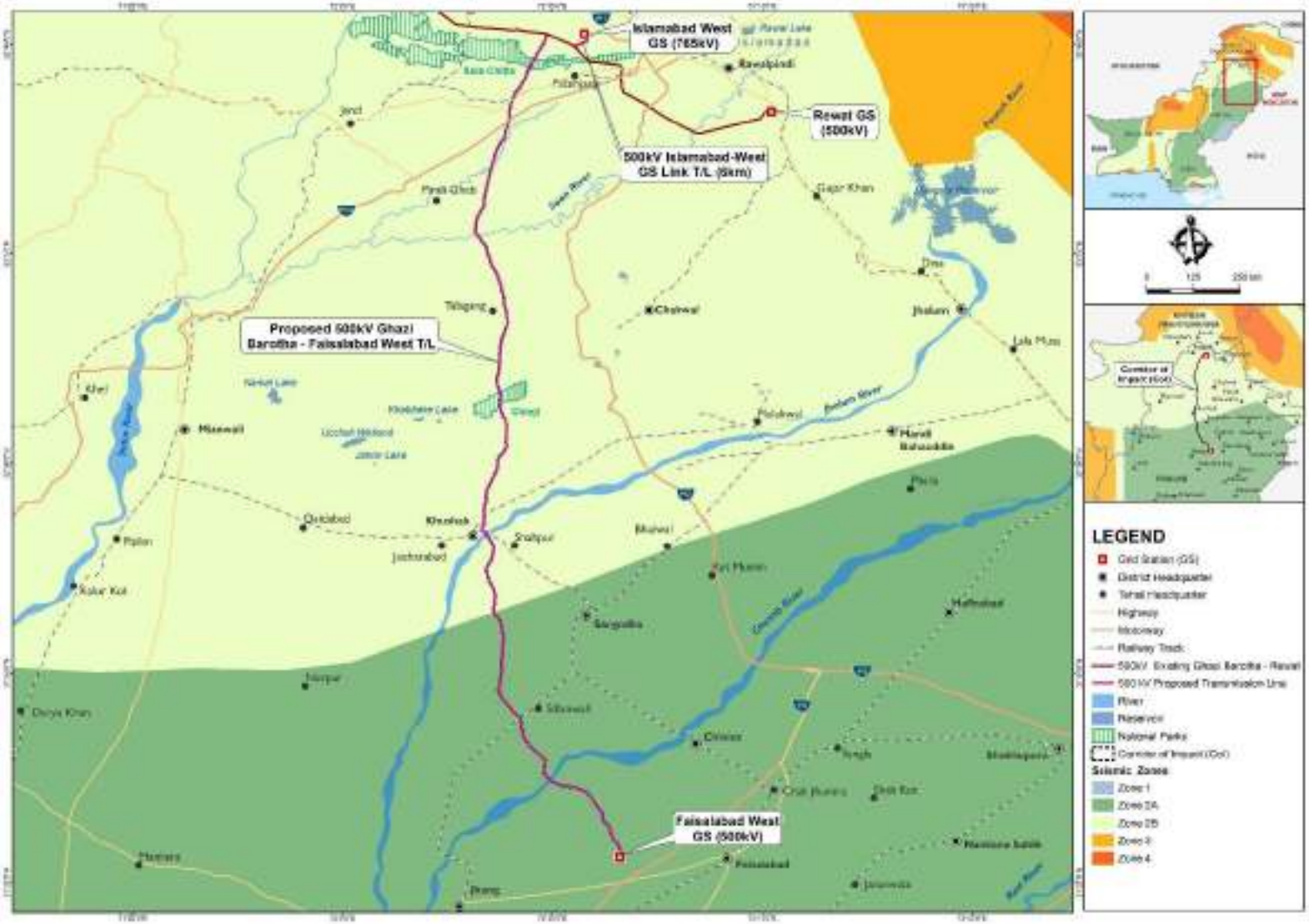


Figure 4-4: Seismic Zoning Map of the Proposed T/L

4.3.4 Land Use

Analysis of the land use of Project COI indicates that most of the T/L passes through agricultural areas, which account for 76.4% of the COI area. Scrub Forest covers 16.3% of the COI area, while 5.3% of the COI is built-up area. The rest of the area consists of waterbodies and rangeland.

A GIS-based index land use map of the proposed T/L has been developed and shown in **Figure 4-**5, whereas detailed land use maps are provided as **Annexure I**. Land use categories of ROW and COI are also provided in **Table 4-3**.

Table 4-3: Summary of Land Use in the Project COI

Land use/Land cover	Area (km^2)	Percentage of COI
Agricultural Land	879.4	75.9%
Scrub Forest	192.2	16.6%
Built-up Area	64.8	5.6%
Waterbody	15.8	1.4%
Rangeland	5.9	0.5%
Total	**1158.1**	**100%**

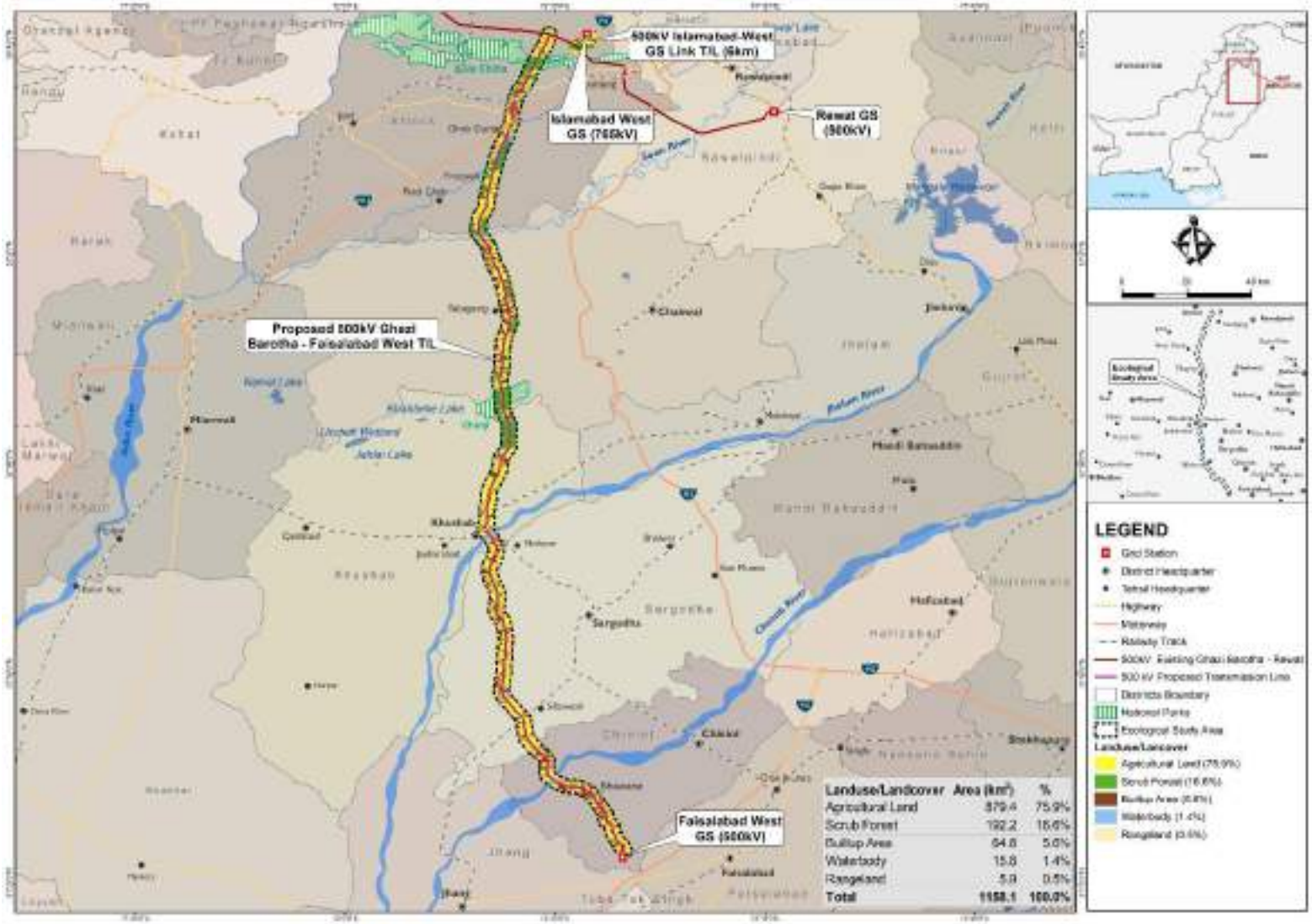


Figure 4-5: Land Use in Project COI

4.3.5 Climate

Climate is the average course or condition of the weather at a place, usually over the years as exhibited by temperature, wind, and precipitation.

According to the Köppen-Geiger climate classification system, the COI predominantly falls in the hot semi-arid climate zone. This classification is characterized by very hot and dry summers, mild to cool winters, and highly seasonal rainfall, with most precipitation occurring during the monsoon months (June to September). In some locations, especially nearer to the eastern parts of Punjab, the climate may border on the humid subtropical (Cwa) zone, which features hot, humid summers and dry winters.

This section presents the climate details of the meteorological gauging stations situated near the T/L from Ghazi Barotha to Faisalabad West substation. Two (02) meteorological stations were identified near to the T/L route, which includes Islamabad (Zero Point, 33 o 37’ N, 73 o 05’ E) and Faisalabad (31 o 26’ N, 73 o 08’ E). These meteorological stations are installed and operated by the Pakistan Meteorological Department (PMD).

The T/L route mainly passes through a humid subtropical and subtropical semi-arid climate of Pakistan. The project route is influenced by two rainy seasons: the southeastern monsoon during summer and the western winds during the winter season. The average monthly values for temperature, rainfall, relative humidity, and wind speed were obtained for the two mentioned Weather Stations. This average is based on the data from the year 1991 to 2020.

Temperature

Table 4-5 shows the average monthly mean maximum and mean minimum temperatures of the two weather stations, which are considered to represent the temperature conditions in the proposed T/L route.

The meteorological data shows that the temperature rises gradually and reaches its peak in June, which is the hottest month for both locations. After that, the temperature decreases with the advent of the monsoon in July. The months of December and January experience a severe drop in temperature. Summer is marked by monsoon rains, which usually occur in July and August.

Table 4-4: Monthly Temperature at Islamabad and Faisalabad Stations

Months	Temperature (0C)					
	Islamabad			Faisalabad		
	Mean Max.	Mean Min.	Mean	Mean Max.	Mean Min.	Mean
Jan	18.1	2.2	10.2	19.0	4.7	11.8
Feb	20.0	5.1	12.6	22.1	7.5	14.8
Mar	24.6	9.6	17.1	27.1	12.9	20.0

Months	Temperature (0C)					
	Islamabad			Faisalabad		
	Mean Max.	Mean Min.	Mean	Mean Max.	Mean Min.	Mean
Apr	30.5	14.1	22.3	34.1	18.3	26.2
May	36.0	18.7	27.4	39.1	23.7	31.4
Jun	37.9	22.2	30.1	40.2	26.7	33.5
Jul	34.8	23.8	29.3	37.3	27.2	32.3
Aug	33.3	23.4	28.4	36.4	26.7	31.6
Sep	33.0	20.3	26.7	35.6	24.0	29.8
Oct	30.4	13.2	21.8	32.8	17.4	25.1
Nov	25.8	7.1	16.5	27.3	11.0	19.2
Dec	20.4	3.2	11.8	21.7	5.8	13.7

Source: Pakistan Meteorological Department

Rainfall

Mean monthly rainfall data and the number of rainy days recorded at Islamabad and Faisalabad climatic stations in the vicinity of the proposed T/L are given in **Table 4-**5. The average annual rainfall of the project area varies from 1,323 mm to 381 mm. The maximum rainfall occurs during July and August, which is about 50% of the annual rainfall. Winter rain generally occurs from January to March, whereas November is normally the month with the least precipitation.

Table 4-5: Mean Monthly Rainfall at Islamabad and Faisalabad Stations

Months	Mean Monthly Rainfall (mm)	
	Islamabad	Faisalabad
Jan	59.0	11.1
Feb	89.0	19.1
Mar	87.7	23.8
Apr	59.6	23.7
May	38.2	14.9
Jun	78.2	43.8
Jul	368.6	100.8
Aug	334.7	87.0
Sep	123.3	42.5
Oct	32.7	4.7

Months	Mean Monthly Rainfall (mm)	
	Islamabad	Faisalabad
Nov	11.9	2.0
Dec	40.4	7.1
Annual	**1323.3**	**381.1**

Source: Pakistan Meteorological Department

Relative Humidity

The relative humidity data of the Islamabad and Faisalabad met stations is given in **Table 4-6**. The data reveals that for both locations the relative humidity levels are generally higher at 00:00 hours, while lower relative humidity levels are recorded at 12:00 hours. Relative humidity levels are high in August, while they are extremely low during the peak temperature months of May and June.

Table 4-6: Relative Humidity at Islamabad and Faisalabad Stations

Months	Relative Humidity (%)					
	Islamabad			Faisalabad		
	00:00 hr	03:00 hr	12:00 hr	00:00 hr	03:00 hr	12:00 hr
January	92.8	91.6	51.6	89.9	87.8	51.9
February	89.5	86.9	47.4	87.3	81.8	44.4
March	87.4	80.1	43.3	82.7	74.1	40.1
April	83.3	67.0	37.1	68.8	54.3	29.3
May	71.2	51.8	30.2	57.6	43.3	25.5
June	72.1	53.8	33.1	64.2	51.5	31.8
July	87.6	76.7	56.5	79.0	70.7	50.0
August	92.5	84.2	65.1	83.0	75.2	54.7
September	92.1	81.9	58.6	84.1	73.8	47.2
October	92.3	84.9	55.1	81.5	71.3	39.2
November	93.3	89.2	58.0	86.6	81.8	45.1
December	93.9	93.0	58.0	87.8	86.3	50.1

Source: Pakistan Meteorological Department

Wind Speed

The mean monthly wind speed at Islamabad and Faisalabad met stations around proposed T/L is given in **Table 4-7**. At the Islamabad station, average wind speeds are the highest in March, while Faisalabad experiences stronger winds in July. Based on the data, the southern

area of the proposed T/L i.e., Faisalabad will experience higher winds and for longer duration (April to September) in comparison to the northern part of the T/L.

The data indicates that the wind speeds are generally lower at 00:00 hours and higher at 12:00 hours. Overall, both weather stations show that wind speeds are higher in summers compared to winters.

Table 4-7: Wind Speed Recorded at Islamabad and Faisalabad Stations

Months	Wind Speed (knots)					
	Islamabad			Faisalabad		
	00:00 hr	03:00 hr	12:00 hr	00:00 hr	03:00 hr	12:00 hr
January	0.3	0.2	1.8	0.5	0.5	1.4
February	0.4	0.4	2.7	0.9	0.9	2.8
March	0.6	0.4	3.2	1.1	1.4	3.0
April	0.6	0.7	2.7	1.7	2.5	3.5
May	0.7	0.7	2.6	1.8	3.4	3.8
June	0.6	0.8	2.8	2.1	4.1	4.4
July	0.7	0.8	2.2	2.1	4.1	4.6
August	0.6	0.5	1.5	1.6	3.5	4.4
September	0.3	0.3	1.0	1.0	2.3	3.4
October	0.2	0.2	0.8	0.6	1.0	1.6
November	0.2	0.1	0.6	0.3	0.5	0.8
December	0.1	0.2	0.8	0.4	0.4	0.8

Source: Pakistan Meteorological Department

4.3.6 Water Resources

The major surface water sources in the project area are the Chenab and Jhelum Rivers. The proposed TL will pass over Jhelum River near Khushab area, and it will pass over the Chenab River near Bhawana.

To assess the existing surface and groundwater quality of different sources, water samples were collected from the COI. The laboratory test results for groundwater, surface/wastewater samples are discussed in the following sections.

Surface Water

Chenab and Jhelum are the major rivers in the project area besides numerous small streams (nullahs) and springs. The proposed T/L crosses the Chenab and Jhelum Rivers between tower no. 101-102 and 359-360, respectively. The hydrology of the Chenab and Jhelum Rivers is given below.

Chenab River

The Chenab River originates from Himachal Pradesh in India and flows through the Jammu region of Jammu & Kashmir and enters Pakistan. It is the second largest tributary of the river Indus and collects water from all the other tributaries, but retains its name until it merges with the river Indus. The river's flow is primarily sustained by glacier melt, snowmelt, and monsoon rainfall, making it a perennial water source in the region.

The Chenab River has a total length of 1,361km with 28 billion cubic meters annual flow. In Pakistan, Chenab is vital for irrigation and water supply in Punjab. Barrages on the river Chenab from upstream to downstream are located at Marala, Khanki and Trimmu. It delivers about 25 MAF per year to the Marala Headworks.

Jhelum River

The hydrology of the Jhelum River is heavily influenced by snowmelt from the Karakoram and Himalayan ranges and the southwest monsoon. It originates from Indian Occupied Jammu & Kashmir and flows through the valley of Kashmir, receiving tributary waters from the Neelum River before emptying into the Mangla Dam. It flows through the plains and eventually joins the Chenab River at Trimmu in Jhang District.

Mangla Dam was constructed in 1961–1967 following the signing of the Indus Waters Treaty. It has a storage capacity of 10,150 million m^3. The water from this reservoir is used for hydropower generation and irrigation purposes. Its average discharge near Mangla Dam is about 1,026.6 m^3/s, although this can vary widely depending on seasonal glacial melt and rainfall.[6]

The Jhelum River yields an average of about 23 MAF per year, primarily from snowmelt. It has a total length of about 725km (450 miles) and is the westernmost of Punjab's five major rivers.

Figure 4-5 shows the annual flows for Chenab and Jhelum Rivers from the year 1922 to 2015.[7] Chenab's recent decade of flows is most often below the mean, which raises water concerns downstream. Some monthly inflows have higher variability than in the other western rivers, particularly the months just before (March and April) and just after the monsoon (September–December).

6 FAO Transboundary River Basin Overview – Indus Report 2011.

7 Wescoat Jr, James L., Afreen Siddiqi, and Abubakr Muhammad. "Socio-hydrology of channel flows in complex river basins: Rivers, canals, and distributaries in Punjab, Pakistan. *"Water Resources Research* 54.1 (2018): 464-479.

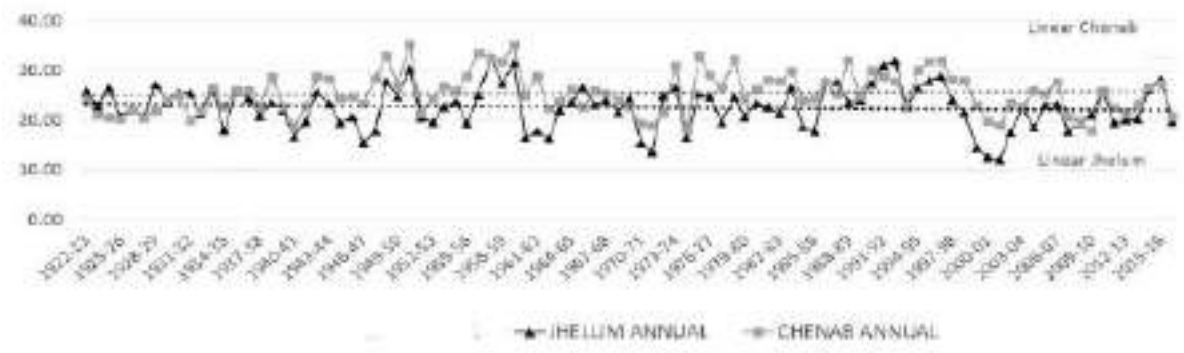


Figure 4-6: Annual inflows (MAF) Jhelum and Chenab Rivers. (WAPDA data)

Figure 4- 7shows the major surface water resources, i.e., Chenab River and Jhelum River.

A View of Chenab River

A View of the Jhelum River

Figure 4-7: Major Surface Water Resources in the Project Area

Groundwater

Mostly groundwater is available throughout the length of the proposed T/L. The water table depth from the surface varies from 40 to 400 feet, depending on the location. The areas along the riverbanks have a shallow water table, whereas hilly terrains mostly have a deep-water table.

Figure 4-8 provides the photographs of the tube wells installed for groundwater extraction in the Project Area.

Figure 4-8: Tube wells Installed for Groundwater Extraction

4.3.7 Solid Waste and Wastewater Situation

Currently, there is no conventional solid waste management system in place in the project COI. Most solid waste is openly dumped in heaps at various locations near villages. Some waste also ends up in local drainage canals, and open burning of solid waste is a common practice.

The primary components of solid waste in the region include paper, plastic, organic waste (such as food and animal waste), and general household garbage. Organic and livestock waste is gathered in a designated area and processed into compost. Local farmers then use this compost as a natural fertilizer for their agricultural fields.

4.3.8 Ambient Air Quality

To determine the ambient air quality of the COI, the following pollutants were selected for an evaluation, based on the expected emissions from the Project activities and the level of risk to human health posed by these pollutants.

- Respirable particulate matter—Coarse (PM_{10}), Fine ($PM_{2.5}$) and suspended particulate matter (SPM)
- Sulfur dioxide (SO_2)
- Oxides of Nitrogen (NO_X)—Mainly Nitrogen dioxide (NO_2) and Nitric oxide (NO)
- Carbon Monoxide (CO)
- Ozone (O_3)
- Lead

Methodology and Sampling

Air quality sampling was carried out at four locations in the project COI in February 2025.

The sampling locations were selected based on the land use within the COI and the proximity of sensitive receptors to the proposed project. Most of the sampling locations are in settlement areas and near healthcare and educational institutions.

Photographs of the air quality sampling setup at the selected locations are shown in **Figure4-9**.

Ambient air quality data for CO, Lead (Pb), NO, NO_2, SO_2, O_3, SPM, PM_{10}, and $PM_{2.5}$ were monitored at four (04) points. The map of sampling locations is shown in **Figure 4-**10 whereas environmental monitoring and testing reports are provided as **Annexure II**.

A description of sampling locations and the rationale for selection is given in **Table 4-8**

Table 4-8: Details of Air Quality Sampling Locations

Sampling ID	Location	Tower Stretch	Coordinates	Rationale
AQ-01	Faisalabad West Grid Station	Loose Point	31°24'11.33"N 72°46'16.60"E	This sampling point is near Grid Station site and is located near settlements.
AQ-02	Govt. Primary School (Girls), Chabeel	AM 54 to 55	32°23'39.25"N 72°23'46.06"E	The sampling point is near educational institutions and settlements.
AQ-03	Sariyal Mosque, Talagang	AM 91 to 92	32°56'44.61"N 72°26'43.70"E	The sampling point is located near a religious site and settlements.
AQ-04	RHC Bahtar	AM 163 to 164	33°38'40.17"N 72°32'19.96"E	This sampling point is near a health facility and settlements.

Ambient Air Monitoring near Faisalabad West Grid Station (AQ-01)

Ambient Air Monitoring near the Govt. Primary School (AQ-02)

Ambient Air Monitoring near Sariyal Mosque, Talagang (AQ-03)

Ambient Air Monitoring near RHC Bahtar (AQ-04)

Figure 4-9: Ambient Air Quality Sampling Site

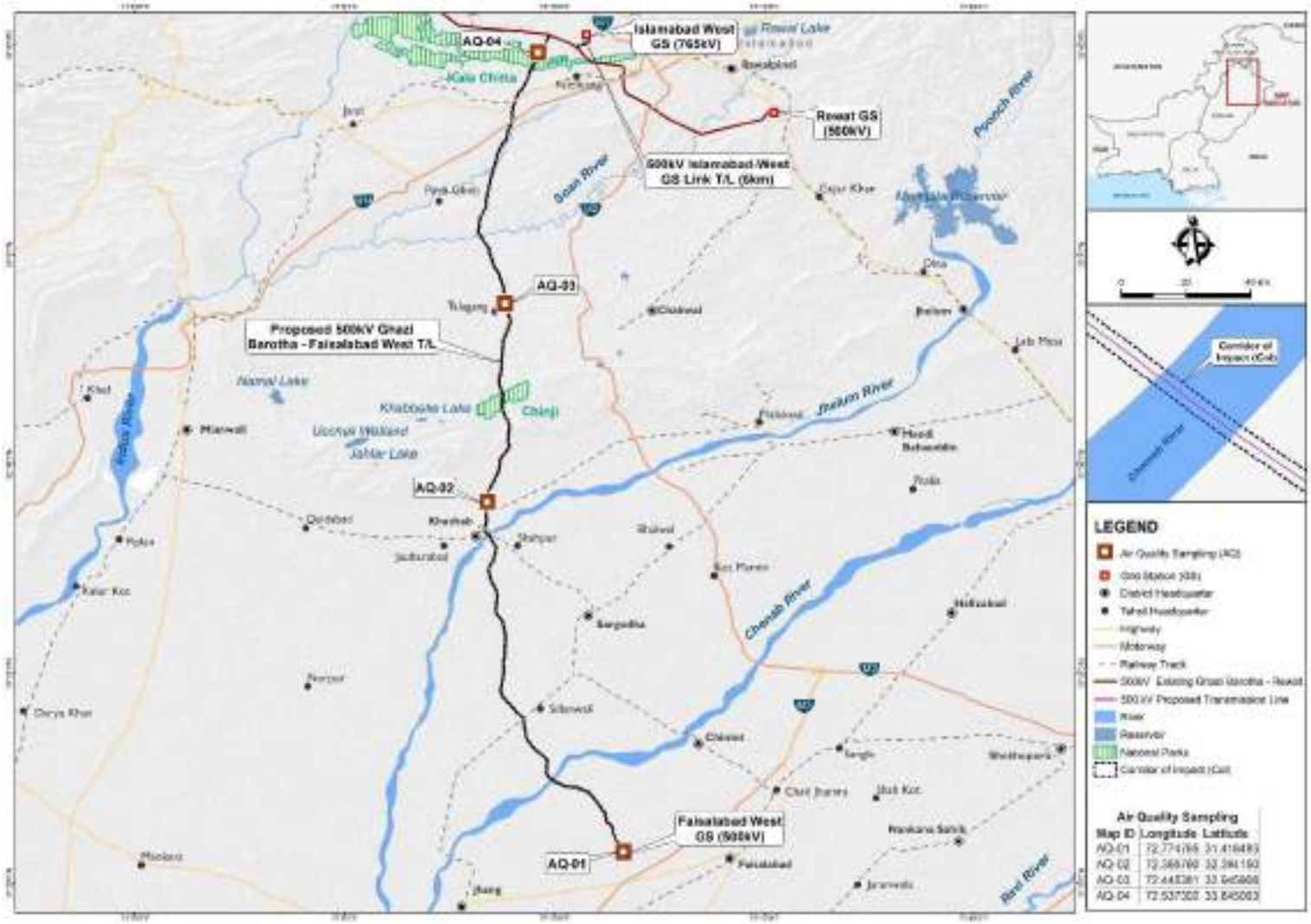


Figure 4-10: Air Quality Sampling Locations Map

Results

The summary of the ambient air sampling points is provided in **Table 4-**9.

All ambient air quality parameters at all the sampling locations were within the permissible levels of PEQS.

The SO_2, NO, and NO_2 are slightly higher than the WHO Global Air Quality Guidelines (AQG) values at the locations AQ-01 and AQ-02. The values of PM_{10} are higher than the WHO AGS for all sampling points. While the $PM_{2.5}$ is higher at sampling points AQ-01 and AQ-02. High PM_{10} levels are usually attributed to various factors such as industrial emissions, vehicle exhaust, dust, and weather conditions that trap pollutants. As the samples were taken near the road, where the traffic contributes to the air dust particles. These factors contribute to the presence of particulate matter with a diameter of 10 micrometers or less in the air, leading to elevated PM_{10} levels.

Domestic point sources of air pollution are emissions from wood and kerosene burning stoves, brick kilns burning solid waste and small diesel standby generators used in some households. The non-point sources of air pollution are few vehicles along the COI i.e. cars, trucks and loaders that provide supplies to the area.

The emissions during the construction and operation will be very well dissipated in the open terrain and there will be no cumulative effect from the project. The other major source of air pollution is dust arising from construction and other ground or soil disturbance, during dry weather, and from movement of local traffic on poorly surfaced or damaged access roads.

Table 4-9: Ambient Air Sampling Results

Monitoring Points	Pollutants								
	CO mg/m³	Lead ug/m³	NO ug/m³	NO_2 ug/m³	SO_2 ug/m³	PM_{10} ug/m³	$PM_{2.5}$ ug/m³	O_3 µg/m³	SPM µg/m³
Monitoring Duration	**24 hours**	**24 hours**	**24 hours**	**24 hours**	**24 hours**	**24 hours**	**24 hours**	**24 hours**	**24 hours**
AQ-01	0.29	0.29	7.38	10.50	6.79	62.32	10.21	100.5	106.1
AQ-02	0.18	0.04	8.18	13.89	9.11	90.0	29.6	98.7	108.5
AQ-03	0.24	0.01	6.00	13.51	12.73	82.88	27.9	92.4	110.6
AQ-04	0.10	0.014	5.33	13.09	9.94	80.0	24.6	51.3	111.69
PEQS	5	1.5	40	80	120	150	35	130	500
WHO Global Air Quality Guideline	4	0.5[8]	25	25	40	45	15	100[9]	-

Note: "- ''means information is not available or not applicable.

[8] Lead (Pb): Annual mean value is set at 0.5 µg/m³.

[9] O_3 (Ozone): Values are given for the maximum daily 8-hour mean and peak season mean.

4.3.9 Ambient Noise Levels

This section defines the baseline ambient noise levels in the project COI in a manner that can be used for the assessment of the noise impact of the proposed Project. Noise levels were measured at four selected locations considered representative of the nearby receptors of possible noise disturbance from the Project.

The following is a brief description of the terminology used in this assessment:

- Sound: A vibratory disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone
- Noise: Sound that is loud, unpleasant, unexpected, or otherwise undesirable
- Decibel (dB): A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
- A-Weighted Decibel (dB(A): An overall frequency-weighted sound level in decibels, which approximates the frequency response of the human ear. The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. Therefore, when assessing potential noise impacts on people, an electronic filter is used that de-emphasizes certain frequencies in a manner corresponding to the human ear's decreased sensitivity to low and extremely high frequencies. All the noise levels reported in this **Section** are A-weighted.
- Equivalent Sound Level (Leq): The equivalent steady-state sound or vibration level, which is a stated period.

Methodology and Sampling

Noise level measurements were taken at the four sampling locations, whose details are provided in **Table 4-**10. These sampling locations were selected based on land use and proximity to sensitive receptors.

The noise level at the locations was monitored, and readings were recorded for 24 hours at the sites. The map of the noise level sampling locations is provided in **Figure 4-**11.

Figure 4-12 show photographs taken while noise levels were measured at the sampling locations.

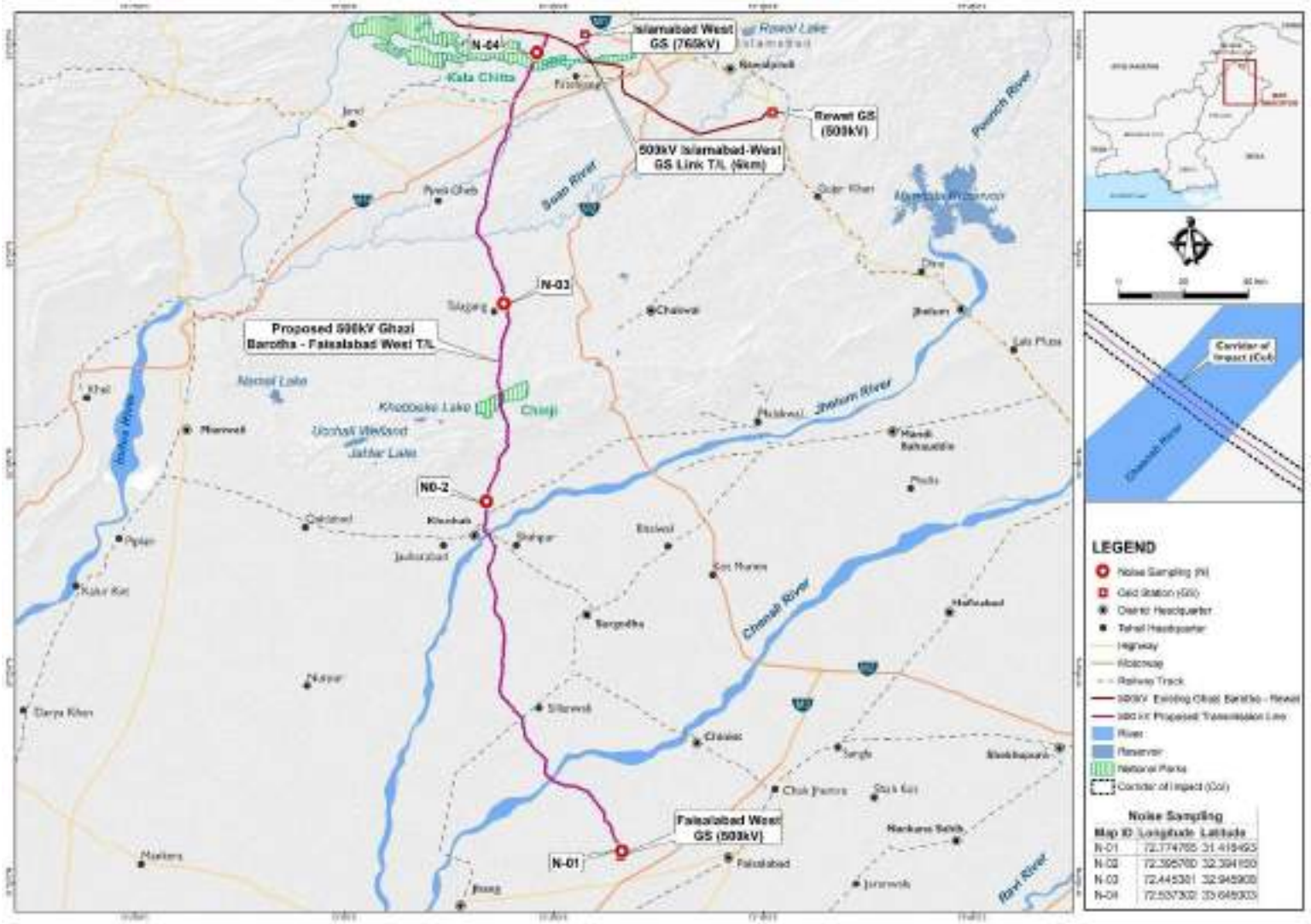


Figure 4-11: Ambient Noise Sampling Locations Map

Table 4-10: Description of Noise Level Sampling Locations

Sampling ID	Location	Tower Stretch	Coordinates	Rationale
NL-01	Faisalabad West Grid Station	Loose Point	31°24'11.33"N 72°46'16.60"E	This sampling point is near Grid Station site and is located near settlements.
NL-02	Govt. Primary School (Girls), Chabeel	AM 54 to 55	32°23'39.25"N 72°23'46.06"E	The sampling point is near educational institution and settlements.
NL-03	Sariyal Mosque, Talagang	AM 91 to 92	32°56'44.61"N 72°26'43.70"E	The sampling point is located near religious site and settlements.
NL-04	RHC Bahtar	AM 163 to 164	33°38'40.17"N 72°32'19.96"E	This sampling point is near a health facility and settlements.

AQ monitoring near Faisalabad West Grid Station (NL-01)

AQ Monitoring near Govt. Primary School A(NL-02)

AQ Monitoring near Sariyal Mosque, Talagang (NL-03)

AQ Monitoring near RHC Bahtar (NL-04)

Figure 4-12: Photos of Noise Measurement in the Project Area

Results

A summary of the noise level monitoring results in provided in **Table 4-11**

The results were compared with the PEQS for noise Commercial area (B) with a limiting value of 65 dB (daytime), and 55 dB (nighttime). The measured values of noise for all the sampling locations are within PEQS limits for both daytime and nighttime.

The major sources of noise pollution in the area are road traffic, particularly at locations where the proposed transmission line intersects the major roads, highways, and motorway.

Table 4-11: Noise Level Monitoring Results

Sr. No.	Monitoring Points	Duration	Time of the Day	PEQS Limits dB(A)	Noise Level in dB(A) Leq
1	NL-01	24 Hours	– Day Time	65	42.03
			– Nighttime	55	36.01
2	NL-02	24 Hours	– Day Time	65	37.36
			– Nighttime	55	30.61
3	NL-03	24 Hours	– Day Time	65	37.08
			– Nighttime	55	28.51
4	NL-04	24 Hours	– Day Time	65	35.13
			– Nighttime	55	27.67

Day Time hour: 06:00am to 10:00pm
Nighttime hours: 10:00pm to 06:00am

4.3.10 Water Quality

Methodology and Sampling

The water quality was defined based on primary data collected during field sampling and testing. The work for external monitoring and testing was carried out by Punjab-EPA approved environmental laboratory named M/S Tti Testing Laboratories.

A total of six water samples were collected for testing in February 2025 including two (02) surface water samples and four (04) drinking water samples were collected. These Sampling locations points were selected based on the land use within the COI and the presence of sensitive receptors, particularly water bodies in the proximity of the project area.

Table 4**-12** provides the details of the water sampling points.

Table 4-12: Water Quality Sampling Locations Description

Sampling ID	Tower Stretch	Sampling/ Monitoring Points	Coordinates	Rationale
Surface Water				
SW-01	AM 19 to 20	SW-01 Chenab River	31°39'8.32"N 72°36'0.75"E	This point is selected as the T/L is crossing a major surface water body i.e., Chenab River.
SW-02	AM 50 to 51	SW-02 Jhelum River	3217'42.80"N 72°23'20.17"E	This point is selected as the T/L crossing the major surface water body i.e., Jhelum River.
Drinking Water Sampling				
DW-01	Loose Point	DW-01 Faisalabad West Grid Station	3124'11.33"N 72°46'16.60"E	This sampling point is near the Grid Station site and is located near settlements.
DW-02	AM 54 to 55	DW-02 Govt. Primary School (Girls), Chabeel	32°23'39.25"N 72°23'46.06"E	The sampling point is near an educational institution and settlements.
DW-03	AM 91 to 92	DW-03 Sariyal Mosque, Talagang	32°56'44.61"N 72°26'43.70"E	The sampling point is located near a religious site and settlements.
DW-04	AM 163 to 164	DW-04 RHC Bahtar	33°38'40.17"N 72°32'19.96"E	This sampling point is near a health facility and settlements.

Surface Water

To document the existing surface water quality, two (02) grab samples of water were collected. All the samples were labelled, preserved, and transported to the laboratory for testing.

Figure 4- 13shows photographs taken during the surface water sampling activities.

The map of sampling locations for surface water is shown in **Figure 4-14**.

Surface Water Sampling from Chenab River (SW-01)

Surface Water Sampling from Jhelum River (SW-02)

Figure 4-13: Surface Water Sampling Photographs

Results

Since the surface water is not used for drinking purposes directly, the results were compared with the PEQS for industrial and municipal effluents, as presented in **Table 4-**13.

The surface water sampling results showed that for both locations, the water quality parameters were within the permissible limits of PEQS for industrial and municipal effluents.

Table 4-13: Surface Water Sampling Results

Sr. No	Parameter	Units	PEQS	SW-01	SW-02
1	pH	--	6 – 9	7.58	8.10
2	Biochemical Oxygen Demand (BOD_5) at 20°C	mg/L	80	09	07
3	Chemical Oxygen Demand (COD)	mg/L	150	24	20
4	Total Suspended Solids (TSS)	mg/L	200	12	09
5	Total Dissolved Solids (TDS)	mg/L	3500	278	216
6	Phenolic Compounds (as Phenolic)	mg/L	0.1	N. D	N. D
7	Grease and Oil	mg/L	10	N. D	N. D
8	Chloride	mg/L	1000	29	33
9	Fluoride	mg/L	10	N. D	N. D
10	Cyanide	mg/L	1	N. D	N. D
12	Sulfate (SO_4^{2-})	mg/L	600	57	36
13	Sulfide (S^{2-})	mg/L	1.0	N. D	N. D

Sr. No	Parameter	Units	PEQS	SW-01	SW-02
14	Ammonia (NH_3)	mg/L	40	N. D	N. D
15	Chlorine (Cl)	mg/L	1.0	N. D	N. D
16	Cadmium (Cd)	mg/L	0.1	N. D	N. D
17	Chromium (Cr)	mg/L	1.0	N. D	N. D
18	Copper (Cu)	mg/L	1.0	N. D	N. D
19	Lead (Pb)	mg/L	0.5	N. D	N. D
20	Mercury (Hg)	mg/L	0.01	N. D	N. D
21	Selenium (Se)	mg/L	0.5	N. D	N. D
22	Nickel (Ni)	mg/L	1.0	N. D	N. D
23	Silver (Ag)	mg/L	1.0	N. D	N. D
24	Total Toxic Metals	mg/L	2.0	N. D	N. D
25	Zinc (Zn)	mg/L	5.0	N. D	N. D
26	Arsenic (As)	mg/L	1.0	N. D	N. D
27	Barium (Ba)	mg/L	1.5	N. D	N. D
28	Boron (B)	mg/L	6.0	N. D	N. D
29	Iron (Fe)	mg/L	8.0	N. D	N. D
30	Manganese (Mn)	mg/L	1.5	N. D	N. D
31	Temperature	NS	--	25	25
32	Conductivity	NTU	NS	482	376

NS: Not Specified ND: Not Detected

Drinking Water

To assess existing groundwater quality, four (04) water samples were collected. The samples were properly labelled, preserved, and transported to the laboratory for testing. All samples were tested against standard drinking water parameters.

As groundwater in the area is used for drinking purposes, it is referred to here as drinking water. **Figure 4-**15 shows photographs taken during sampling of drinking water within the Project COI. The map of sampling locations for the groundwater is provided in **Figure 4-16**.

Results

The results of these samples, along with the respective PEQS for drinking water and WHO drinking water quality standards, are shown in **Table 4-**14.

At all sampling points, the tested water quality parameters were found within the permissible levels set by the PEQS. This indicates that the groundwater quality within the proposed project COI is satisfactory.

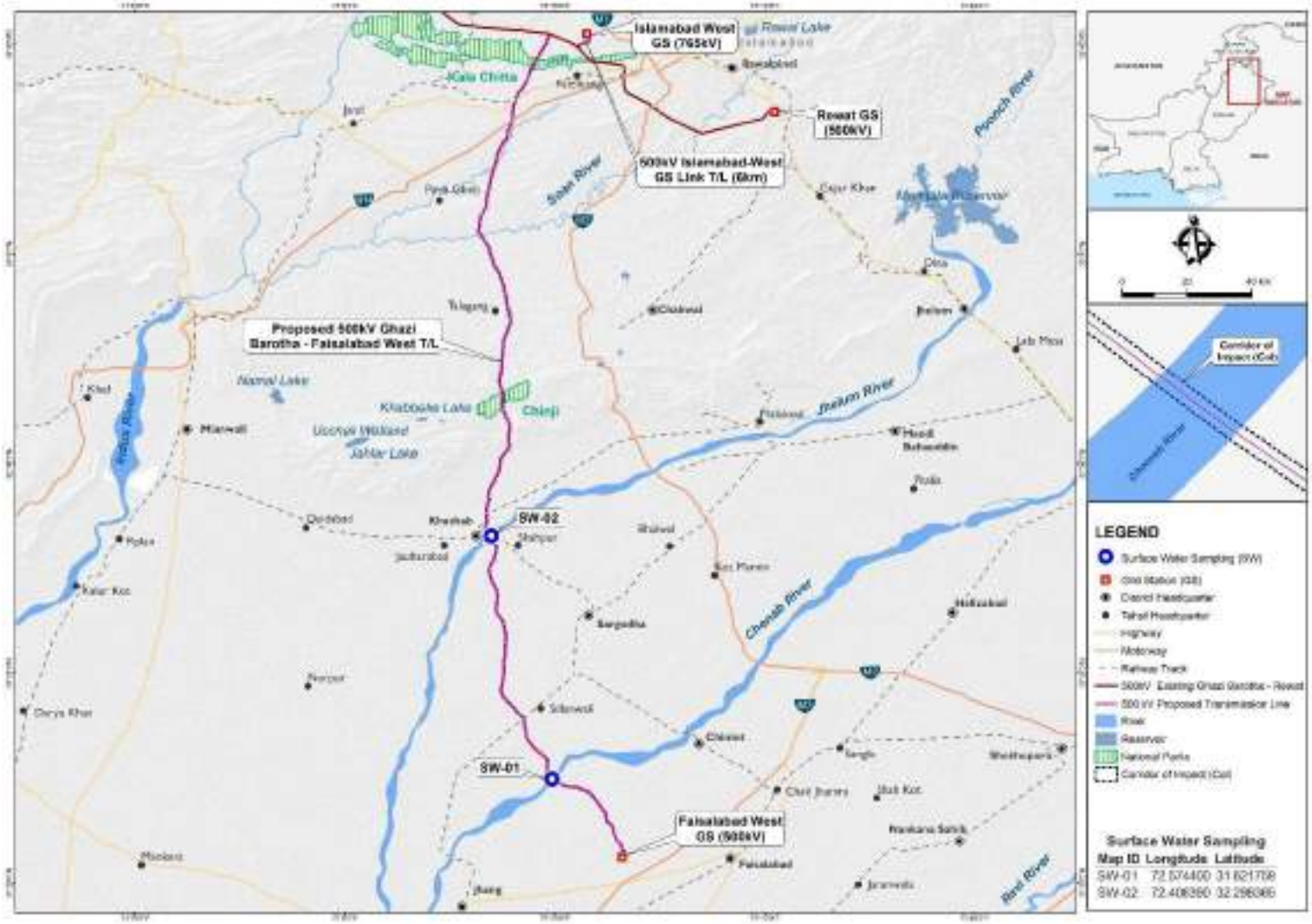

Islamabad West GS (765kV)
Rawat GS (500kV)
500kV Islamabad-West GS Link T/L (6km)
Proposed 500kV Ghazi Barotha - Faisalabad West T/L
SW-02
SW-01
Faisalabad West GS (500kV)
Indus River
Jhelum River
Chenab River
Sutlej River
Ravi River
Khabbaki Lake
Jahlar Lake
Chinji
Mianwali
Sargodha
Khushab
Jauharabad
Chiniot
Jhang
Kalar Kot
Dera Khan
Mankera
Pakpattan
Bhalwal
Pind Dadan Khan
Talagang
Chakwal
Jhelum
Lab Mor
Kallar Kahar
Choa Saidan Shah
Hadali
Pabbi
Kamra
Hasan Abdal
Hattian Bala
Haripur
Havelian
Mansehra
Abbottabad
Kohat
Parachinar
Bannu
Dera Ismail Khan
Zhob
Quetta
Loralai
Sibi
Khuzdar
Panjgur
Turbat
Gwadar
Hub
Karachi
Hyderabad
Mirpur Khas
Nawabshah
Sukkur
Jacobabad
Shikarpur
Khairpur
Dadu
Larkana
Moro
Shahdadkot
Kandhkot
Kashmore
Ghotki
Rahim Yar Khan
Bahawalpur
Multan
Khanewal
Vehari
Lodhran
Kot Addu
Muzaffargarh
Layyah
Bhakkar
Mianwali
Jhang
Toba Tek Singh
Faisalabad
Gojra
Sahiwal
Okara
Pakpattan
Kasur
Lahore
Sheikhupura
Nankana Sahib
Jaranwala
Kamoke
Gujranwala
Sialkot
Narowal
Gujrat
Mandi Bahauddin
Phalia
Wazirabad
Gujar Khan
Rawalpindi
Attock
Taxila
Haripur
Abbottabad
Mansehra

Table 4-14: Drinking Water Sampling Results

Sr. No	Parameter	Units	PEQS	DW-01	DW-02	DW-03	DW-04
1	Fecal Streptococci/ Enterococci	cfu/100ml	Must not be detectable in any 100mL sample	N. D	N. D	N. D	N. D
2	Total Coliform Bacteria	cfu/100ml	Must not be detectable in any 100mL sample	N. D	N. D	N. D	N. D
3	Color	TCU	≤15	< 5	< 5	< 5	< 5
4	Taste	Non-Objectionable/ Acceptable	Non-Objectionable/ Acceptable	N. A	Acceptable	N. A	Acceptable
5	Odor	Non-Objectionable/ Acceptable	Non-Objectionable/ Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
6	Turbidity	NTU	<5	< 5	< 5	< 5	< 5
7	Total Hardness as $CaCO_3$	mg/L	<500	341	257	165	221
8	Total Dissolved Solids (TDS)	mg/L	<1000	828	388	298	375
9	pH	---	6.5 – 8.5	7.38	7.42	7.89	7.53
10	Chloride (as Cl^-)	mg/L	<250	45	35	39	13
11	Cyanide	mg/L	≤ 0.05	N. D	N. D	N. D	N. D
12	Fluoride	mg/L	≤ 1.5	0.37	0.35	0.33	0.23
13	Nitrate	mg/L	≤ 50	3.11	1.71	9.29	4.20
14	Nitrite	mg/L	≤ 3	0.004	0.006	0.006	0.008
15	Residual Chlorine	mg/L	0.2 – 0.5	N. D	N. D	N. D	N. D
16	Phenol Compounds	mg/L (WHO)	NS	N. D	N. D	N. D	N. D

Sr. No	Parameter	Units	PEQS	DW-01	DW-02	DW-03	DW-04
17	Aluminum (Al)	mg/L	≤ 0.2	N. D	N. D	N. D	N. D
18	Arsenic (As)	mg/L	≤ 0.05	N. D	N. D	N. D	N. D
19	Boron (B)	mg/L	0.3	N. D	N. D	N. D	N. D
20	Barium (Ba)	mg/L	0.7	N. D	N. D	N. D	N. D
21	Cadmium (Cd)	mg/L	0.01	N. D	N. D	N. D	N. D
22	Chromium (Cr)	mg/L	≤ 0.05	N. D	N. D	N. D	N. D
23	Copper (Cu)	mg/L	2	N. D	N. D	N. D	N. D
24	Mercury (Hg)	mg/L	≤ 0.001	N. D	N. D	N. D	N. D
25	Manganese (Mn)	mg/L	≤ 0.5	N. D	N. D	N. D	N. D
26	Lead (Pb)	mg/L	≤ 0.05	N. D	N. D	N. D	N. D
27	Nickel (Ni)	mg/L	≤ 0.02	N. D	N. D	N. D	N. D
28	Selenium (Se)	mg/L	0.01	N. D	N. D	N. D	N. D
29	Zinc (Zn)	mg/L	5.0	N. D	N. D	N. D	N. D
30	Sodium (Na)	mg/L	--	91.36	44.72	37.65	39.99
31	Antimony (Sb)	mg/L	≤ 0.005	N. D	N. D	N. D	N. D
32	Conductivity	uS/cm	--	1366	684	532	672
33	E.Coli	cfu/100ml	--	N. D	N. D	N. D	N. D
34	Potassium (K)	mg/L	--	N. D	2.95	2.20	2.41

NS: Not Specified ND: Not Detected

Drinking Water Sampling near Faisalabad Grid Station (DW-01)

Drinking Water Sampling near Govt. Primary School (DW-02)

Drinking Water Sampling near Sariyal Mosque, Talagang (DW-03)

Drinking Water Sampling near RHC Bahtar (DW-04)

Figure 4-15: Drinking Water Sampling Photographs

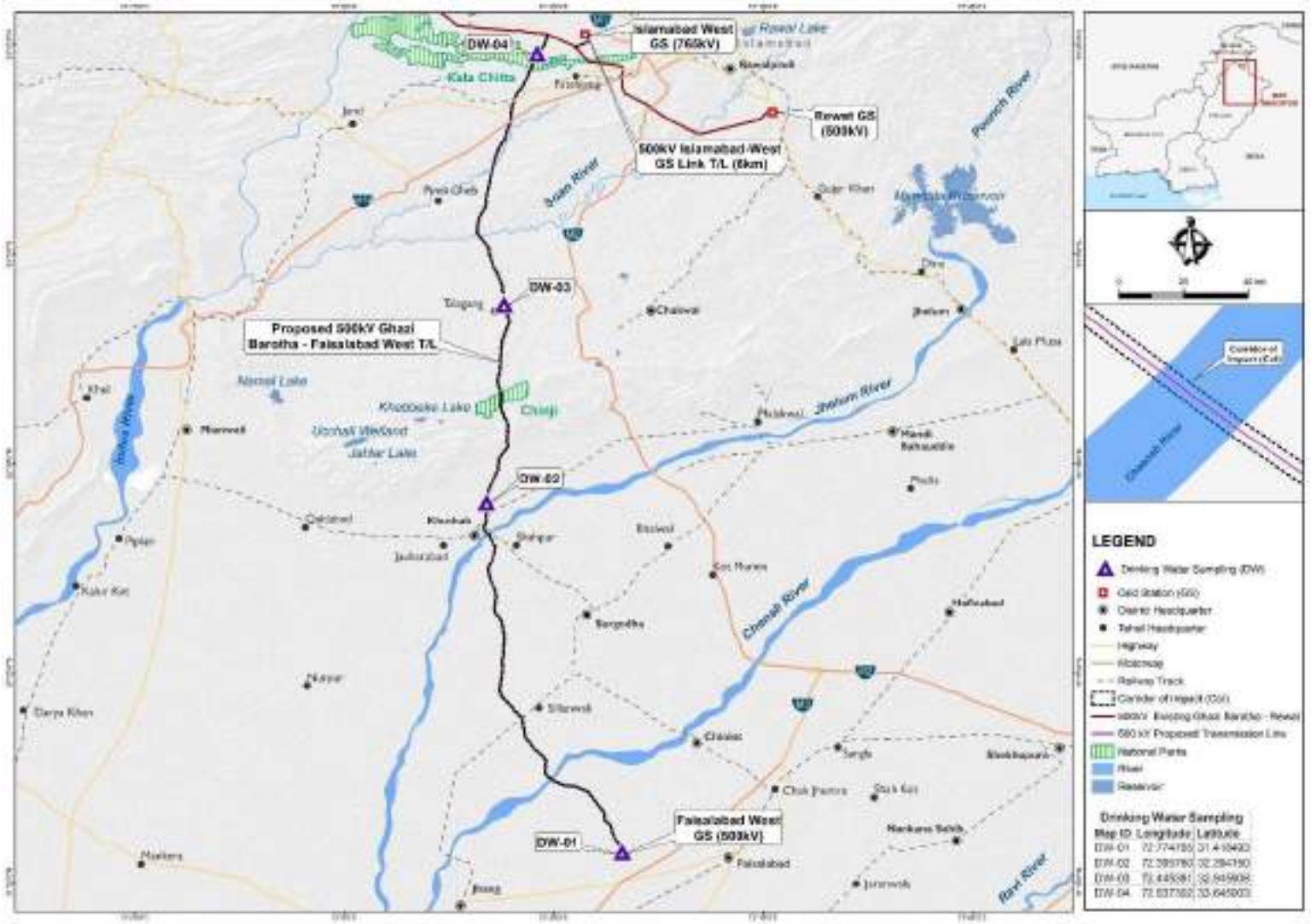


Figure 4-16: Drinking Water Sampling Locations of Proposed T/L

4.3.11 Environmentally Sensitive Receptors

Sensitive receptors refer to people or places that are more susceptible to the adverse effects of pollutants and social disturbance, due to the developmental projects. Thus, sensitive receptors need to be identified to evaluate the potential impacts of the proposed project on public health and the environment, and necessary mitigation measures to minimize the impact.

The sensitivity of each receptor is categorized using a three-tier risk scale based on its vulnerability and potential exposure. The risk levels are classified as High, Medium, and Low. **Table 4-15** shows a description of the risk scale.

The sensitive receptors identified for the proposed project within COI are residential areas, educational institutions, health facilities, and religious places (graveyards and mosques). These receptors are particularly vulnerable during the construction phase due to potential impacts from air pollutants emissions, noise and vibration, traffic jams/access, the temporary edifice of construction camps, and mobilization activities.

The type of sensitive receptor feature assigned sensitivity, and number of the features for the assigned category are tabulated in **Table 4-16** and location is shown in **Figure**.4-17

Table 4-15: Sensitivity Risk Scale

Risk Category	Description
High	Definitely susceptible to the potential impact of project activity and the high priority of mitigation
Medium	Moderate susceptibility to the potential impact of project activity, and the mitigation of impact is required
Low	Unlikely (or low likelihood) impact, minor deterioration and/or short–term impact and/or small footprint

Table 4-16: Sensitive Receptors and Environmental Value

Feature Category	Feature Sensitivity	Number of Features Found
Waterbody	High	4
Waterbody	Medium	32
Waterbody	Low	5
Buildup Area	High	57
Commercial	High	5
Commercial	Medium	1
Drinking Water	High	1
Farms	High	2
Farms	Medium	4

Feature Category	Feature Sensitivity	Number of Features Found
Agricultural Farms	Low	4
Forest Land	Low	1
Main Sealed Road	Medium	8
Religious Sensitivity	High	5
Railroad	Medium	1
Sealed/ Unsealed Road	Low	55
Road and Waterbody	Medium	2
Road and Waterbody	Low	1

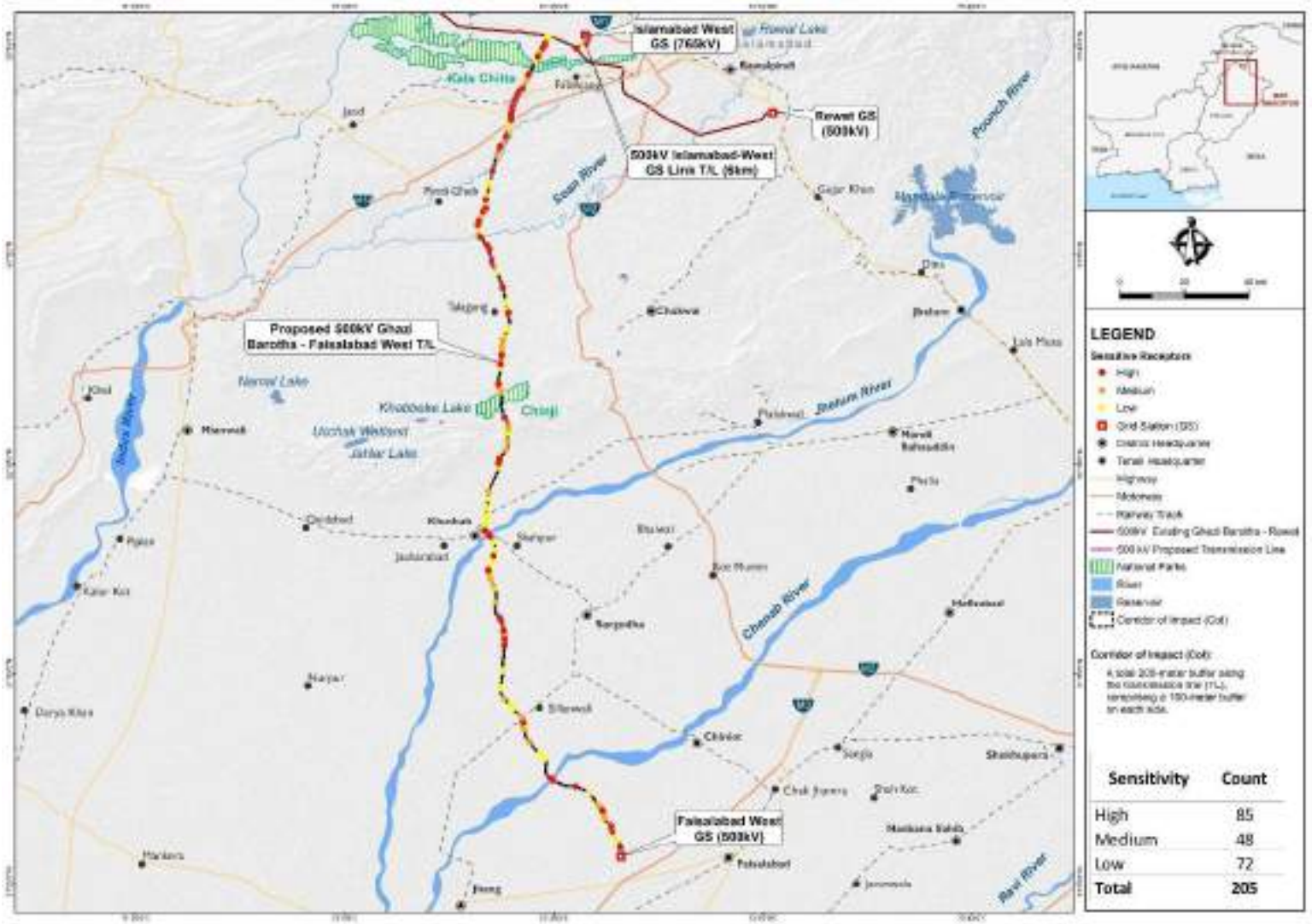


Figure 4-17: Location of Sensitive Receptors in Project COI

4.4 Ecological Environment

The ecology baseline report was compiled based on primary data and supplemented with a thorough literature review. Sources of information for the preparation of this baseline included published literature, reports, scientific journals, as well as information obtained from national and globally recognized sources such as the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Additionally, a primary field survey was conducted in March 2025, followed by another survey for gap filling on May 11 and May 12, 2025, to collect data and information on the aquatic and terrestrial ecological resources within and around the project area.

4.4.1 Study Area

The ecological baseline study for aquatic and terrestrial resources, including fish, vegetation, mammals, birds, and herpetofauna, was conducted within a 4 km wide buffer (2 km buffer on each side) along the proposed 283 km long 500 kV double circuit transmission line from Faisalabad West Grid Station to the Ghazi Barotha–Islamabad West transmission line, and additional existing 500kV T/L (6 km) from Islamabad West 765 kV GS to 500 kV Ghazi Barotha – Rawat T/L, covering a total expected area of approximately 1,158.1 km² (**Figure 4-**18).

The study area has been classified into five types of habitats: agricultural land (75.9%), scrub forest (16.6%), built-up area (5.6%), waterbodies (1.4%), and rangeland (0.5%). Out of 15 planned sampling sites in the ecological study area, four are located in agricultural land, four in scrub forest, two in built-up areas, and one in rangeland (**Table 4-**17). Three fishing sampling sites, two in the Chenab and Jhelum Rivers, and one in a pond, were used to collect samples. These sampling distributions correspond proportionally to the percentage representation of each habitat type within the study area.

A map of the study area and 15 sampling locations for terrestrial ecological resources is given in **Figure 4-20** Sampling was conducted in all types of habitats to obtain high-quality information regarding different species across various classes. The reason for selecting different sampling locations in different habitats is mainly because of the affiliation of some flora and fauna species to a specific habitat.

The proposed transmission line passed through the Jhelum River and the Chenab River. Fish sampling was carried out at two different locations along the riverbank of both rivers. The **Figure 4-20.** shows fish sampling locations in the study area.

Table 4-17: Summary of Land Use in the Project COI

Land use/Land cover	Area (km^2)	Percentage of COI
Agricultural Land	879.4	75.9%
Scrub Forest	192.2	16.6%
Built-up Area	64.8	5.6%
Waterbody	15.8	1.4%

Rangeland	5.9	0.5%
Total	**1158.1**	**100%**

4.4.2 Field Survey

Initial field surveys were completed in March 2025, followed by another visit in the second week of May 2025 to fill the gaps of the initial survey.

Sampling Locations

Sampling locations for aquatic and terrestrial ecology are provided in **Figure 4-19.** The locations were selected taking into account five types of habitats. These include agricultural land, rangeland, built-up area, scrub forest, and waterbody. The number of sampling locations was based on the percentage representation of the habitats in the Study Area. Four sampling locations were selected in the agricultural land, four sampling locations were chosen in the scrub forests, three locations were chosen in the Waterbody, two locations were chosen in the built-up area, and one location was in the rangeland type habitat. Photos of major habitats found in the study area are given in **Figure 4-19**. The habitat type at each sampling location is listed in **Table 4-18**.

Table 4-18: Habitat Types for the Terrestrial Sampling Locations

No.	Habitat Type	Sampling Points
1	Agriculture Land	S1, S3, S10, and S11
2	Scrub Forest	S8, S9, S12, and S14
3	Waterbody	S2, S6, and S13
4	Built-up Area	S4 and S5
5	Rangeland	S7

Survey Methodology

The methodology used to collect data on aquatic and terrestrial ecological resources is summarized below.

Fish

Fish sampling was carried out at a total of three sampling locations. The sampling locations for fish are shown in **Figure 4-20.** Among the three sampling sites, two are located in the Chenab and Jhelum Rivers, and one is in a pond. A cast net was used for fish sampling. A 90-meter stretch along the riverbank was sampled. Fish captured were identified using the available keys in the literature. Besides using cast nets, locals were interviewed to identify the fish species reared in the pond/lakes within the study area for commercial use.

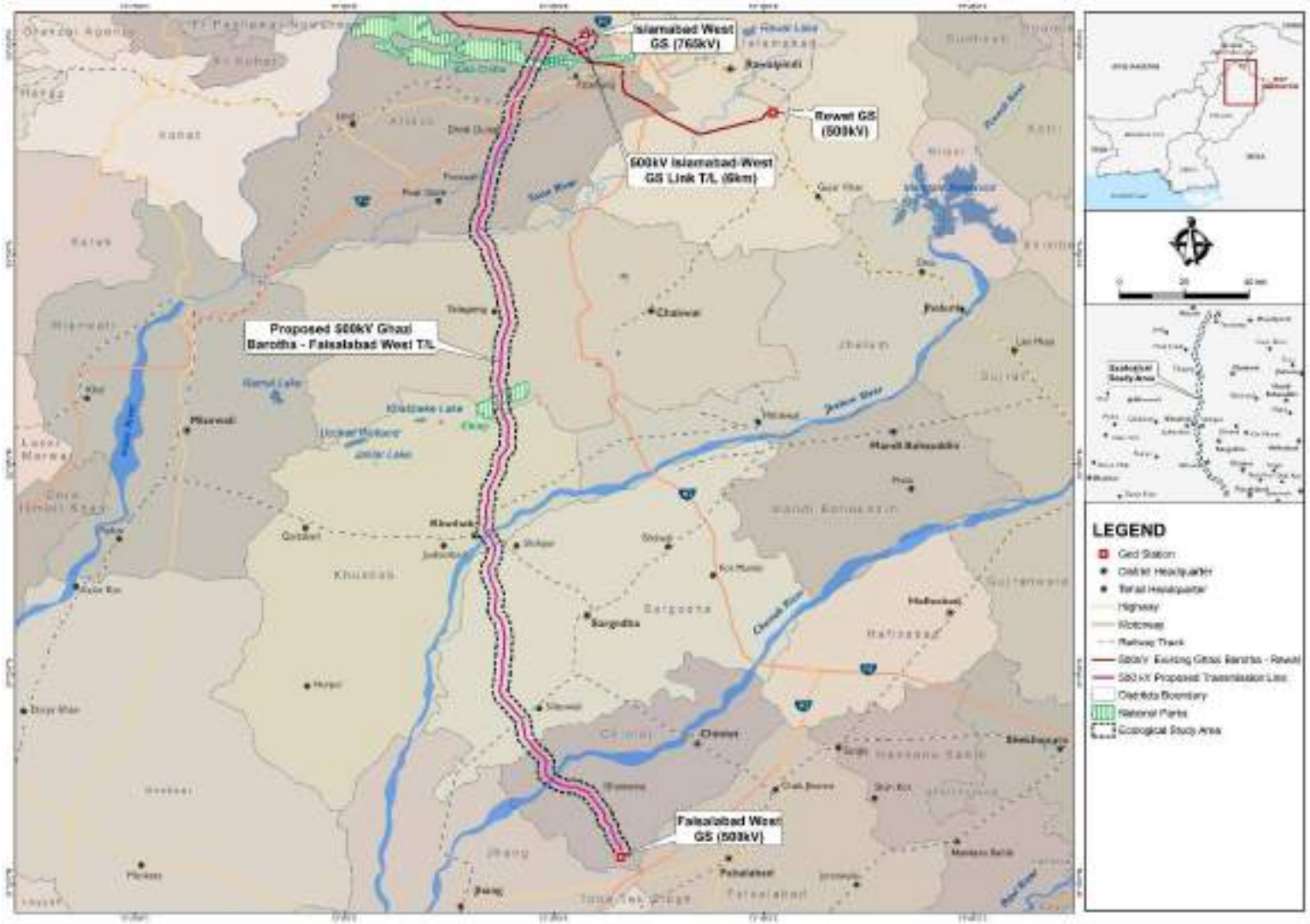


Figure 4-18: Ecological Study Area Map

Terrestrial Vegetation

The usual means of sampling vegetation for floristic composition is the quadrat. The vegetation in the terrestrial Study Area was sampled by the quadrate method, taking 3 quadrates of 5m x 5m at each sampling site. The first quadrat was taken at the beginning of the transect, the second at 250 meters, and the third at 500 meters. Plants from each quadrat were noted. Additional plant species in the area adjacent to the quadrat were also noted down. Cover, relative cover, density, relative density, frequency, relative frequency percentages, and Importance Value Index (IVI) for each species from the study area were calculated. The sampling locations for terrestrial vegetation are shown in **Figure 4-20**. The observed information (GPS reading, habitat type, species name, number of each species counted, and circumference of each species) at each sampling location was noted on a survey form.

Mammals

Line transects (500m long and 20m wide) were placed at each sampling location to record all mammals or their signs. All the mammal species sighted, or their signs (footmarks, droppings, dens, burrows, etc.) found, were identified with necessary information like coordinates of the site, species, sign type, sign age (on base of freshness), etc. GPS coordinates of the location and habitat type were also documented. Anecdotal information regarding specific mammals, like large carnivores, was also collected from the local people, and relevant literature was also used for mammals' baseline. The sampling locations for mammals are shown in **Figure 4-20**.

In addition to active search, the locals were interviewed about the presence of mammalian species in the area and the potential impact of line transmission on mammalian species and their habitats.

Birds

Line transect sampling involves an observer traveling along a predetermined line of a consistent length, recording the total number of birds, nests, and other relevant sites detected.[10] To count birds of different species, a total of 14 transects were placed at different locations in different habitats of the study area, each with an approximate length of 500m and 50m wide. A single observer spent approximately 40 minutes walking along each transect and counted all birds of each observed species on both sides of the transect.[11] Binoculars (Nikon 8245 ACULON A211 8 × 42) were used for observation.

All the associated habitats of the transect and the GPS location of each transect were marked. A digital camera was used for the photography of birds and associated habitats. The abundance of birds (number of individuals of each species observed) and diversity (number of species observed) were calculated. The sampling locations for birds are shown in **Figure**

[10] Gibbons, D. W., and R. D. Gregory (2006). Birds. In Ecological Census Techniques: A Handbook (W. J. Sutherland, Editor). Second Ed. Cambridge University Press, Cambridge, UK.

[11] Subedi, T. R., Virani, M. Z., Gurung, S., Buij, R., Baral, H. S., Buechley, E. R., Anadón, J. D., and Sah, S. A. (2018). Estimation of Population Density of Bearded Vultures Using Line-Transect Distance Sampling and Identification of Perceived Threats In the Annapurna Himalaya Range of Nepal. Journal of Raptor Research, 52(4), 443-453.

4-.20 .**In** addition, locals were interviewed about migratory birds and the potential impact of the transmission line on migratory and local birds in the form of collision and electrocution.

Herpetofauna

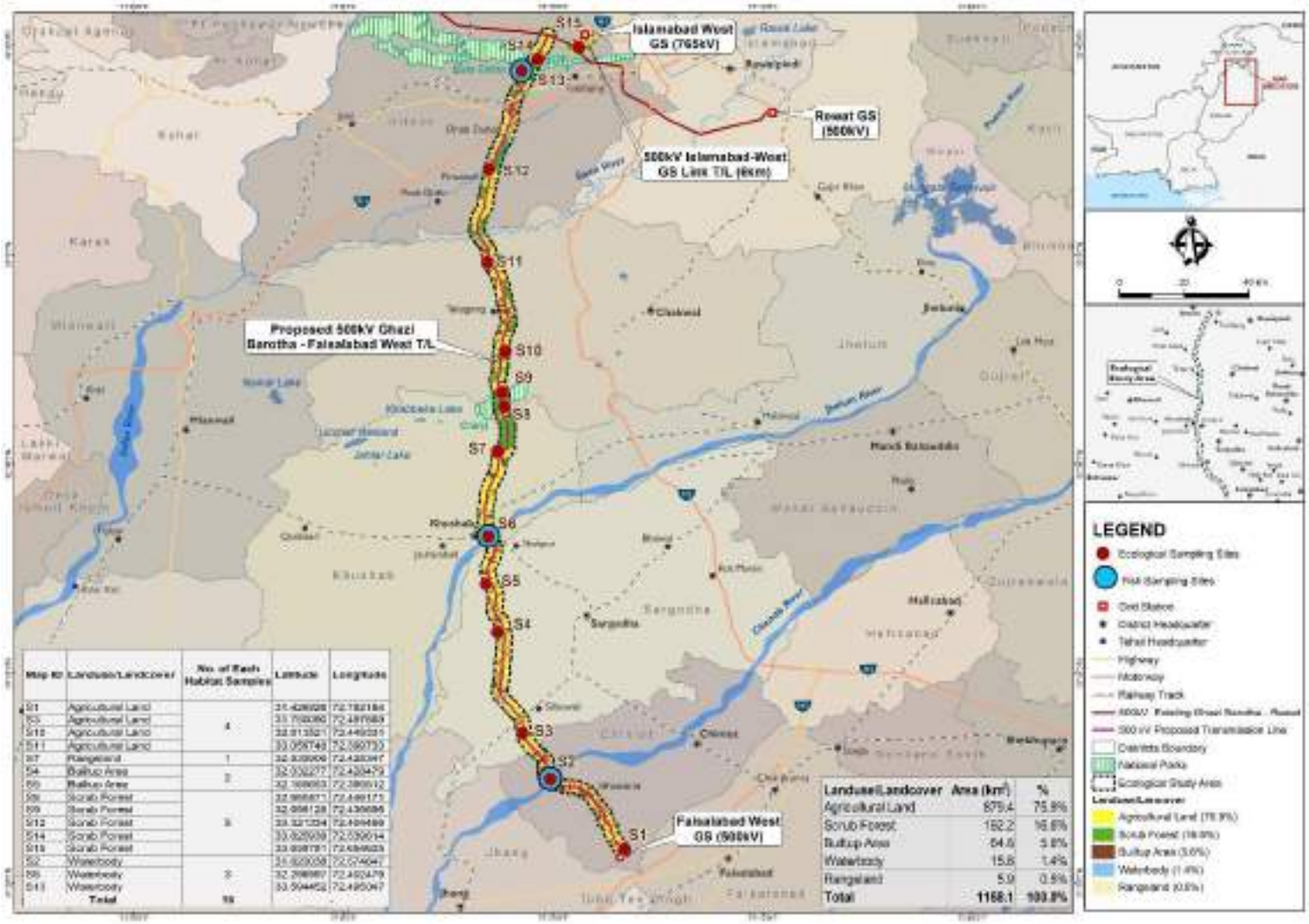
For the herpetofauna survey, line transects 500m long and 20m wide were walked at each sampling location**.** Active searching was carried out along the line transect to record the presence of herpetofauna species. The specimens were identified with the help of the most recent key available in literature. Density and diversity were calculated for each sampling point. Microhabitats (e.g., stagnant water bodies) were also searched for herpetofauna species, particularly for the presence of amphibians. The sampling locations for herpetofauna are shown in **Figure 4-20.**

Locals were interviewed about the presence of herpetofauna species in the project area and the potential impact of the transmission line on herpetofauna species and their habitats.

Collection of Anecdotal Information Related to Biodiversity

The local residents, officials of wildlife, forest, and fisheries departments, hunters, conservationists and teachers were interviewed in order to have an idea about the existence and distribution of various wild animals in the study area.

Figure 4-19: Photographs of Different Habitat Types in the Terrestrial Study Area



Map ID	Landuse/Landcover	No. of Each Habitat Samples	Latitude	Longitude
S1	Agricultural Land	4	31.426028	72.782184
S3	Agricultural Land		33.700360	72.187669
S12	Agricultural Land		32.913321	72.449231
S11	Agricultural Land		33.058743	72.360733
S7	Rangeland	1	32.839906	72.428347
S4	Builtup Area	2	32.032277	72.428479
S6	Builtup Area		32.768903	72.389512
S8	Scrub Forest	5	32.965871	72.446173
S9	Scrub Forest		32.956128	72.439686
S12	Scrub Forest		33.321334	72.494489
S14	Scrub Forest		33.625939	72.539014
S15	Scrub Forest		33.698781	72.589603
S2	Waterbody	3	31.920058	72.574647
S5	Waterbody		32.298987	72.492479
S13	Waterbody		33.594452	72.495047
	Total	15		

LanduseLandcover	Area (km²)	%
Agricultural Land	879.4	75.8%
Scrub Forest	192.2	16.6%
Builtup Area	64.6	5.6%
Waterbody	15.8	1.4%
Rangeland	5.9	0.5%
Total	1158.1	100.0%

Figure 4-20: Sampling Locations for Flora and Fauna

4.4.3 Aquatic Ecological Resources

Fish

Literature Review

The three main rivers, the Chenab River, the Jhelum River, and the Sowan River, fall in the area of the proposed project. Sufficient data are available on the fish fauna of these rivers, particularly the Jhelum and Chenab. However, this information primarily reflects the overall fish communities along the river stretches within Punjab Province and does not provide specific information on the stretches falling within the project area. Based on available literature, more than 50 fish species are documented from these rivers.[12] [13] [14] In the initial baseline report, a total of 8 fish species are documented from these rivers, including five commercially important fish species.

Commercially important fish species found in these rivers are Grass Carp *Ctenopharyngodon idella*, Common Carp Cyprinus carpio, Silver Carp *Hypophthalmichthys molitrix, Mori Cirrhinus mrigala, Raho Labeo rohita, Blue Tilapia Oreochromis aureus*, etc.

Among the fish fauna found in these rivers, none is included as endangered or critically endangered on the IUCN Red List. However, four species, the *Common Carp, Giant Devil Catfish Bagarius bagarius, Alwan Snowtrout Schizothorax plagiostomus,* and *Helicopter Catfish Wallagu attu* are listed globally as vulnerable. In contrast, the Silver Carp is listed as a Near Threatened species.[15]

Five fish species of conservation importance are found in the project and the surrounding area. These fish species include *Mahseer Tor putitora, Punjab Catfish Glyptothorax punjabensis, Stock's Catfish Glyptothorax stocki, Sufi's Catfish Glyptothorax sufii, Stone Loach Paraschistura naseeri,* and *Batasio pakistanicus.* Although all are listed as endangered on the IUCN Red List, there is no literature-based evidence confirming the presence of these species in the area.

Survey Results

Sampling was carried out at three sampling locations during the May 2025 Survey in the project area to document fish species. In addition to cast netting, local farmers within the project area were interviewed about the fish species they keep in ponds for commercial purposes. The locations of these are shown in **Figure 4-19**

[12] Altaf, M., Javid, A., Khan, A. M., Hussain, A., Umair, M., & Ali, Z. (2015). The status of fish diversity of river Chenab, Pakistan. *The Journal of Animal & Plant Sciences*, *25*(3), 564-569.

[13] Mirza, Z. S., Mirza, M. R., Mirza, M. A., & Sulehria, A. Q. K. (2011). Ichthyofaunal diversity of the river Jhelum, Pakistan. *Biologia*, *57*(1&2), 23-32.

[14] Mirza, Z. S., Mirza, M. R., & Javed, M. N. (2006). Fishes of River Jhelum from Mangla to Jalalpur near Head Rasool. *Biologia*, *52*, 215-227.

[15] *The IUCN Red List of Threatened Species* 2022: e.T61295A3102796. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T61295A3102796.en. Accessed on 23 May 2025.

A total of three fish species were captured through cast netting, including Mori, Giant River Catfish *Sperata seenghala,* and Reba Carp *Cirrhinus reba*.

The local farmers confirm four fish species they keep in the pond for commercial purposes. These commercially kept fish species include Grass Carp, Mori, Common Carp, Raho, and Silver Carp. Photographs of the fish species observed in the project area are shown in **Figure 4-20**. None of the observed fish species in the study area is listed as threatened in the IUCN Red List.

Reba Carp

Giant River Catfish

Figure 4-21: Fish Species in the Project Area

4.4.4 Terrestrial Ecological Resources

This section provides an overview of terrestrial ecological resources in and around the study area based on a review of available literature and recent field surveys. Terrestrial sampling locations are shown in **Figure 4-19**.

Terrestrial Flora

Literature Review

Due to the diverse climate and edaphic settings, Pakistan has a wide range of flora. In Pakistan, there are more than 6000 different species of higher plants.[16] Estimates indicate that 30% of all species are bi- or pluri-regional and 70% are uni-regional. The Irano-Turanian (45% of species), Sino-Himalayan (10%), Sahara-Sindian (9.5%), and Indian element (6%), are the four phytogeographical regions that may be found in Pakistan.[17] Information about the flora of the study area is very patchy, but there is information available on a larger scale. A total of more than 250 plant species from more than 60 families and 160 genera make up the floristic

[16] Ali, S.I. and M. Qaiser. 1986. A phytogeographic analysis of the phanerogams of Pakistan and Kashmir. Proc. Roy. Soc.Edinb., 89B: 89-101.

[17] Wariss, H. M., Pirzada, S. A., Alam, K., Anjum, S. H. A. Z. I. A., & Qureshi, R. (2014). Flora of Lal Suhanra National Park, Bahawalpur, Punjab, Pakistan. *Pak. J. Bot*, *46*(4), 1331-1341.

inventory of wild plants. The most abundant families are represented by *Poaceae, Fabaceae, Amaranthaceae,* and *Asteraceae*.[18] [19] [20] [21] [22]

The dominant plant species of the area are Chinaberry Tree *Melia azedarach*, Gum Arabic Tree *Acacia nilotica*, Phulai *Acacia modesta*, White Mulberry *Morus alba*, *Shisham Dalbergia sissoo*, Mesquite *Prosopis julifera*, Indian Siris *Albizia lebbeck*, Fig Tree *Ficus carica*, River Red Gum *Eucalyptus camaldulens, Dodonaea viscosa, Olea ferruginea*Indian Cherry *Ziziphus mauritiana,* etc.[23] [24]

Based on the IUCN Red List Criteria, none of the documented species from the wider Project area are globally threatened.

Survey Result

During the May 2025 survey, a total of 29 species of plants were observed in the study area. The indicators, including plant cover, plant count, and diversity per sampling location, describe the study area's floral conditions.

The study area is dominated by plant species such as *Prosopis juliflora*, *Parthenium hysterophorus, Dalbergia sissoo, Acacia modesta, Acacia nilotica,* and *Calotropis procera.* Among plant species, the large-sized plant species were observed in Agricultural Land and Scrub Forest habitats. The highest number of plant species was observed at sampling locations S8, S10, and S11, where a total of nine plant species were observed at each location. The vegetation cover, plant count, and diversity in the study area are provided in **Table 4-18** Some photographs of plant species observed in the study area are given in **Figure 4-22**.

[18] Waheed, M., e Hani, U., Arshad, F., Jabeen, A., Alamri, S., Siddiqui, M. H., ... & Bussmann, R. W. (2024). Exploring botanical diversity, ecological traits, and edaphic determinants in Kala Chitta National Park, Pakistan: implications for conservation and management. *Environmental and Sustainability Indicators*, *24*, 100501.

[19] Rizwan, M., Ahmad, K., Khan, Z. I., Ahmad, I., & Akhtar, S. (2023). Floristic composition of indigenous vegetation of Namal Valley, Mianwali-Punjab, Pakistan.

[20] Nawaz, T., Hameed, M., Ashraf, M., Ahmad, F., Ahmad, M. S. A., Hussain, M., ... & Ahmad, K. S. (2012). Diversity and conservation status of economically important flora of the Salt Range, Pakistan. *Pak. J. Bot*, *44*, 203-211.

[21] Ahmad, I., Ahmad, M. S. A., Hameed, M., Hussain, M., Ashraf, M. Y., Ahmad, F., & Malik, H. (2012). Status of plant diversity in the Soone valley, Salt Range, Pakistan. *Pak. J. Bot*, *44*, 59-62.

[22] Naeem, M., Salah-ud-Din Saber, A. U., Rao, R., & Ashraf, M. Y. (2000). Status of Flora in Chinji Forest Preserves. *Pakistan Journal of Biological Sciences*, *3*(5), 876-880.

[23] Waheed, M., e Hani, U., Arshad, F., Jabeen, A., Alamri, S., Siddiqui, M. H., ... & Bussmann, R. W. (2024). Exploring botanical diversity, ecological traits, and edaphic determinants in Kala Chitta National Park, Pakistan: implications for conservation and management. *Environmental and Sustainability Indicators*, *24*, 100501.

[24] Rizwan, M., Ahmad, K., Khan, Z. I., Ahmad, I., & Akhtar, S. (2023). Floristic composition of indigenous vegetation of Namal Valley, Mianwali-Punjab, Pakistan.

Table 4-19: Vegetation Cover, Plant Count, and Diversity by Habitat Type

May 2025 Survey

Sr No.	Habitat	Plant Count			Plant Cover (%)			Diversity (No. of Species per Sampling Location
		Max	*Min*	*Avg*	*Max*	*Min*	*Avg*	
1	Agricultural Land	32	20	24.25	6.48	3.82	4.89	4.5
2	Scrub Forest	28	16	21.0	6.97	3.32	5.12	2.20
3	Waterbody	36	24	30.00	6.42	1.20	3.41	3.67
4	Built-up Area	18	17	17.50	3.08	2.05	2.57	4.50
5	Rangeland	328	8	8.00	0.39	0.39	0.39	2.00

Calotropis procera

Prosopis juliflora

Eucalyptus camaldulensis

Dalbergia sissoo

May 2025 Survey

Figure 4-22: Photographs of Plant Species in the Study Area

Invasive Plant Species

Invasive species are mostly nonnative species introduced accidentally or intentionally by humans into a natural or established habitat where they threaten the environment, economy, and/or health. Several thousand alien species have become established in different parts of the world over the past couple of centuries. This biological pollution is considered as the second potential threat to natural biodiversity after habitat loss.[25]

Studies have indicated that 700 alien species are found in Pakistan. Of these six are considered to have an extremely invasive nature, including *Broussonetia papyrifera*, *Prosopis juliflora*, *Eichhornia crassipes*, *Salvinia molesta*, *Parthenium hystrophorus*, and *Lantana camara*.

During the May 2025 survey, three invasive plant species, *Prosopis juliflora*, *Parthenium hystrophorus*, and *Lantana camara,* were observed in the Terrestrial Study Area. *Parthenium hystrophorus* is widely distributed and mostly present in agricultural fields and along the roadside. *Prosopis juliflora* was observed mostly along the roadside, particularly in hilly areas.

Prosopis juliflora is a nitrogen-fixing, perennial, evergreen plant, found both as a bush and a medium-sized tree with a sizeable crown and an open canopy, growing to an average height of 5-10 m. At some places in Lower Sindh, it may gain a height of 14-16 meters.[26] *Prosopis juliflora* was introduced to Sindh in 1857 for dune stabilization, followed by the Government of Pakistan 1950s and 1960s.[27] *Prosopis juliflora* is considered one of the most dangerous invasive species for biodiversity, and in affected areas of Pakistan, this invasive species is eliminating the habitat of indigenous species at a catastrophic level.[28] Some photographs of invasive plant species observed in the study area are given in **Figure 4-23.**

Conservation and Protection Status

None of the species observed in the Study area or surroundings were found to be globally/nationally threatened species, endemic species, or protected species.

25 Qureshi, H., Arshad, M. and Bibi, Y., 2014. Invasive flora of Pakistan: a critical analysis. International Journal of Biosciences, 4(1), pp.407-427

26 Kazmi, S.J.H., Shaikh, S., Zamir, U.B., Zafar, H., Rasool, A., Tariq, F., Afzal, A. and Arif, T., 2009. Ecological and socio-economic evaluation of the use of Prosopis juliflora for bio-char production in Pakistan. *Pakistan: Drynet*, pp.1-54

27 Pasiecznik, N.M., Felker, P., Harris, P.J., Harsh, L., Cruz, G., Tewari, J.C., Cadoret, K. and Maldonado, L.J., 2001. *The Prosopis juliflora-Prosopis pallida complex: a monograph* (Vol. 172). Coventry: HDRA.

28 Qureshi, H., Arshad, M. and Bibi, Y., 2014. Invasive flora of Pakistan: a critical analysis. International Journal of Biosciences, 4(1), pp.407-427

Parthenium hystrophorus

Lantana camara

Lantana camara

Prosopis juliflora

May 2025 Survey

Figure 4-23: Photographs of Invasive Plant Species in the Study Area

Mammals

Literature Review

Mammals play important roles in all ecosystems, performing a broad range of critical functions.[29] Many species of mammals transform and shape the ecosystems in which they occur through a diversity of ecological pathways. For example, large herbivores affect ecosystems through the consumption and trampling of vegetation and by acting as key prey

[29] Lacher Jr, T.E., Davidson, A.D., Fleming, T.H., Gómez-Ruiz, E.P., McCracken, G.F., Owen-Smith, N., Peres, C.A. and Vander Wall, S.B., 2019. The functional roles of mammals in ecosystems. *Journal of Mammalogy*, *100*(3), pp.942-964.

for apex predators.[30] Similarly, carnivores often limit the number of their prey, thereby altering the structure and function of entire ecosystems. The trophic or engineering effects of some of the mammal species are so large that they are considered keystone species whose effects are not only disproportionately large relative to their abundance but are functionally irreplaceable.[31]

Pakistan has a varied range of ecosystems and unique ecological regions that support a rich diversity of animals, including mammals, birds, reptiles, amphibians, and fish.[32] Variations in climatic conditions and topography are significant predictors of mammalian species diversity, where different habitats support different species of mammals.[33] Faunal diversity also corresponds to the altitudinal variations that exist throughout the landscape of Pakistan.[34] particularly, the mountain areas of the country show an abrupt elevation change and have many distinct habitat types that harbor a large number of wildlife species.[35]

Pakistan has a rich diversity of mammalian fauna and is home to 10 of 18 known mammalian orders, which reflects significant diversity matching overall trends. About 195 mammalian species have been reported so far from different habitats across the country.[36] The mammalian species of the study area have not been studied in detail; however, based on the available literature on the wider area of the study area, anecdotal evidence, and previous baseline report, a total of about 29 species are present.[37] [38] [39] Common mammalian species found in the wider area of the study area include Golden Jackal Canis aureus, Red Fox *Vulpes vulpes*, Small Indian Mongoose *Herpestes javanicus*, Indian Crested Porcupine Hystrix indica, Wild Boar Sus scrofa, Cape Hare Lepus capensis, *Black Rat* Rattus rattus*, House Shrew Suncus murinus,* and *Indian Field Mouse* Mus booduga.[40]

---

30 Hobbs, N.T., 1996. Modification of ecosystems by ungulates. *The Journal of Wildlife Management*, pp.695-713.

31 Power, M.E., Tilman, D., Estes, J.A., Menge, B.A., Bond, W.J., Mills, L.S., Daily, G., Castilla, J.C., Lubchenco, J. and Paine, R.T., 1996. Challenges in the quest for keystones: identifying keystone species is difficult—but essential to understanding how loss of species will affect ecosystems. *BioScience*, *46*(8), pp.609-620.

32 Altaf, M., Javid, A., Munir, M.A., Ashraf, S., Umair, M., Iqbal, K.J., Khan, A.M. and Ali, Z., 2014. Diversity of wild mammalian fauna of Chenab riverine forest, Punjab, Pakistan. *JAPS: Journal of Animal & Plant Sciences*, *24*(5).

33 Getachew, A. and Mesele, Y., 2018. Species composition and relative abundance of medium and large mammals in Mengaza communal forest, East Gojjam, Ethiopia. *Journal of Ecology and the Natural Environment*, *10*(2), pp.34-40.

34 Altaf, M., Javid, A., Munir, M.A., Ashraf, S., Umair, M., Iqbal, K.J., Khan, A.M. and Ali, Z., 2014. Diversity of wild mammalian fauna of Chenab riverine forest, Punjab, Pakistan. *JAPS: Journal of Animal & Plant Sciences*, *24*(5).

35 IUCN and Government of Kyber Paktun Khawan, 1996.Sarhad provincial conservation strategy. IUCNPakistan and Government of Pakistan, Karachi.

36 Sheikh, K.M. and Molur, S., 2004, December. Status and red list of Pakistan's mammals. In *Based on the Conservation Assessment and Management Plan Workshop. IUCN Pakistan*.

37 Altaf, M., Javid, A., Munir, M. A., Ashraf, S., Umair, M., Iqbal, K. J., ... & Ali, Z. (2014). Diversity of wild mammalian fauna of Chenab riverine forest, Punjab, Pakistan. JAPS: Journal of Animal & Plant Sciences, 24(5).

38 Kanwal, R., & Ashraf, S. (2021). Diversity and density of mammals in Chinji National Park, district. International Journal of Forest Sciences, 1, 1-11.

39 Roberts, T.J. and Bernhard (principe d'Olanda.), 1977. The mammals of Pakistan.

40 Roberts, T.J. and Bernhard (Principe d'Olanda.), 1977. The mammals of Pakistan.

Based on the IUCN Red List Criteria, three threatened mammalian species are found in the project area. Among these threatened species, the Indian Pangolin Manis *crassicaudata* and Punjab Urial *Ovis vignei punjabensis* are globally listed as Endangered species, while the Common Leopard *Panthera pardus* is listed as Vulnerable. The Common Leopard and Grey Wolf *Canis lupus*, are also included in CITES Appendix I, while the Punjab Urial, Jungle Cat Felis chaus, and Indian Desert Cat *Felis silvestris ornate* are included in CITES Appendix II.

Survey Results

To address gaps identified in the initial baseline report regarding the abundance and diversity of mammalian species within the Terrestrial Study Area, sampling was conducted at 14 locations during the May 2025 survey. The locations of these are shown in **Figure 4-19.** The results of the surveys, based on the sightings or signs of the mammals observed, are provided in **Table 4-19**. Photographs of the mammalian signs observed are shown in **Figure 4-24**. In the present survey, signs and sightings of six mammalian species were confirmed in the study area. The Five-Striped Palm Squirrel *Funambulus pennantii* was the most abundant mammalian species in the study area. This species was observed in all three habitats of the study area.

The locals were also interviewed about the mammalian species in the study area. Based on the locals' information, the Indian Crested Porcupine, Wild Boar, Asiatic Jackal, and Red Fox are also present in the study area.

Table 4-20: Mammal Signs and Sightings in the Study Area

May 2025 Survey

Sr No	Common Name	Scientific Name	IUCN Status	Presence		Total
				Sighting	Sign	
1	Golden Jackal	*Canis aureus*	Least Concern	3	-	**3**
2	Red Fox	*Vulpes vulpes*	Least Concern	-	6	**6**
3	Small Asian Mongoose	*Herpestes javanicus*	Least Concern	1	-	**1**
4	Crested Porcupine	*Hystrix indica*	Least Concern	-	4	**4**
5	Cape Hare	*Lepus capensis*	Least Concern	1	-	**1**
6	Five-striped Palm Squirrel	*Funambulus pennantii*	Least Concern	10	-	**10**
7	Rodent spp.			-	8	**8**

Burrows of Rodent spp.

Scat of Red Fox

Digging Marks of the Indian Crested Porcupine

Scat of Red Fox

May 2025 Survey

Figure 4-24: Photographs of Mammalian Species Sign in Study Area

Birds

Literature Review

Birds are conspicuous, ubiquitous, and arguably the best-studied group of vertebrates on the planet.[41] Birds are highly mobile, occur globally in nearly all habitats, and fill many ecological roles. Birds are considered important health indicators of the ecological conditions and productivity of an ecosystem.[42] Addressing the environmental problems of an area, birds can be used as very appropriate bio-indicators, suggesting the status of biodiversity in general.[43]

41 Whelan, C.J., Wenny, D.G. and Marquis, R.J., 2008. Ecosystem services provided by birds. *Annals of the New York academy of sciences*, *1134*(1), pp.25-60

42 Schrag, A.M., Zaccagnini, M.E., Calamari, N. and Canavelli, S., 2009. Climate and land-use influences on avifauna in central Argentina: broad-scale patterns and implications of agricultural conversion for biodiversity. *Agriculture, Ecosystems & Environment*, *132*(1-2), pp.135-142.

43 Bhatt, D. and Joshi, K.K., 2011. Bird assemblages in natural and urbanized habitatZs along elevational gradient in Nainital district (western Himalaya) of Uttarakhand state, India. *Current Zoology*, *57*(3), pp.318-329.

Birds help to maintain the various carnivorous and omnivorous populations of the world and are reared worldwide for not only this purpose but for products such as down feathers too.[44]

Bird communities are correlated with topography, precipitation, latitude, altitude, and plant communities.[45] The composition and diversity of birds vary at every 1000m altitude due to changes in precipitation.[46] Pakistan has a rich diversity of avian habitats, from the dry alpine and moist temperate of the western Himalayas to the deserts of Baluchistan and Sind. In these diverse habitats, a wide variety of bird species, some 669 bird species, have been recorded. Pakistan's avifauna is a fascinating mix of Palearctic and Oriental, blending species that are at the western and eastern limits of their distribution.[47] Of the total 669 species birds species in Pakistan, 30% visit the country for a significant period of the year as long-distance migrants, 43% are either Palearctic species visiting Pakistan only for breeding and 28% are regular winter visitors, which breed mainly in trans-Himalayan northern regions.[48] The information about avian distribution across different habitats and Himalayan elevation zones across the region is scarce, fragmented, and preliminary.[49]

Based on published literature, around 220 bird species are found in and around the project area.[50] [51] The Endangered species found in the wider area of the project are White-headed Duck *Oxyura leucocephala*, Steppe Eagle *Aquila nipalensis*, Indian Skimmer *Rynchops albicollis*, Black-bellied Tern *Sterna acuticauda*, and Egyptian Vulture *Neophron percnopterus.* Common Pochard *Aythya ferina,* Macqueen Bustard *Chlamydotis macqueenii*, Greater Spotted Eagle *Clanga clanga,* Tawny Eagle *Aquila rapax,* and Southern Grey Shrike *Lanius meridionalis* are listed as Vulnerable in the IUCN Red Data Book. The only critically endangered species found in the area is the White-rumped Vulture *Gyps bengalensis*. Three species found in and around the project area are also included in CITES Appendix 1. These species include the Macqueen Bustard, Laggar Falcon *Falco jugger*, and Peregrine Falcon *Falco peregrinus*.

Besides the globally threatened species, many migratory bird species also pass through the proposed project area each year during winter, following the Indus Flyway (**Figure 4-25**). The common migratory birds that pass through the project area include Steppe Eagle, White-headed Duck, Lesser Whistling Duck *Dendrocygna javanica,* Greylag Goose *Anser anser,*

[44] Simeone, A., Araya, B., Bernal, M., Diebold, E.N., Grzybowski, K., Michaels, M., Teare, J.A., Wallace, R.S. and Willis, M.J., 2002. Oceanographic and climatic factors influencing breeding and colony attendance patterns of Humboldt penguins Spheniscus humboldti in central Chile. *Marine Ecology Progress Series*, *227*, pp.43-50

[45] Rahbek, C. and Graves, G.R., 2001. Multiscale assessment of patterns of avian species richness. *Proceedings of the National Academy of Sciences*, *98*(8), pp.4534-4539

[46] Price, T., Zee, J., Jamdar, K. and Jamdar, N., 2003. Bird species diversity along the Himalaya: a comparison of Himachal Pradesh with Kashmir. *Journal of the Bombay Natural History Society*, *100*(2&3), p.394â.

[47] Grimmett, Richard, Tom J. Roberts, Tim Inskipp, and Clive Byers. 2008. *Birds of Pakistan*. A&C Black.

[48] Roberts, T.J., 2002. Addition to the checklist of the birds of Pakistan, Vol. 1 Non-passeriformes, Vol. 2 Passeriformes. Journal-Bombay Natural History Society, *99*(2), pp.323-324.

[49] Ali, Z., 2006. Avian species analysis at three major wetlands complex Pakistan. *Biologia (Pakistan)*, *2*(2), pp.203-213.

[50] Raza, H., Mehmood, S., Khan, B. N., Bibi, F., & Ali, Z. (2015). Avian diversity of lahore zoo safari in winter season Lahore, Pakistan. *Journal of Animal & Plant Sciences*, *25*(3), 378-381.

[51] Grimmett, Richard, Tom J. Roberts, Tim Inskipp, and Clive Byers. 2008. *Birds of Pakistan*. A&C Black.

Bar-headed Goose *Anser indicus,* Common Shelduck *Tadorna tadorna,* Gadwall *Anas strepera,* Mallard *Anas platyrhynchos,* Common Teal *Anas crecca,* Garganey *Spatula querquedula,* Demoiselle Crane *Grus virgo,* Common Crane *Grus grus,* etc.

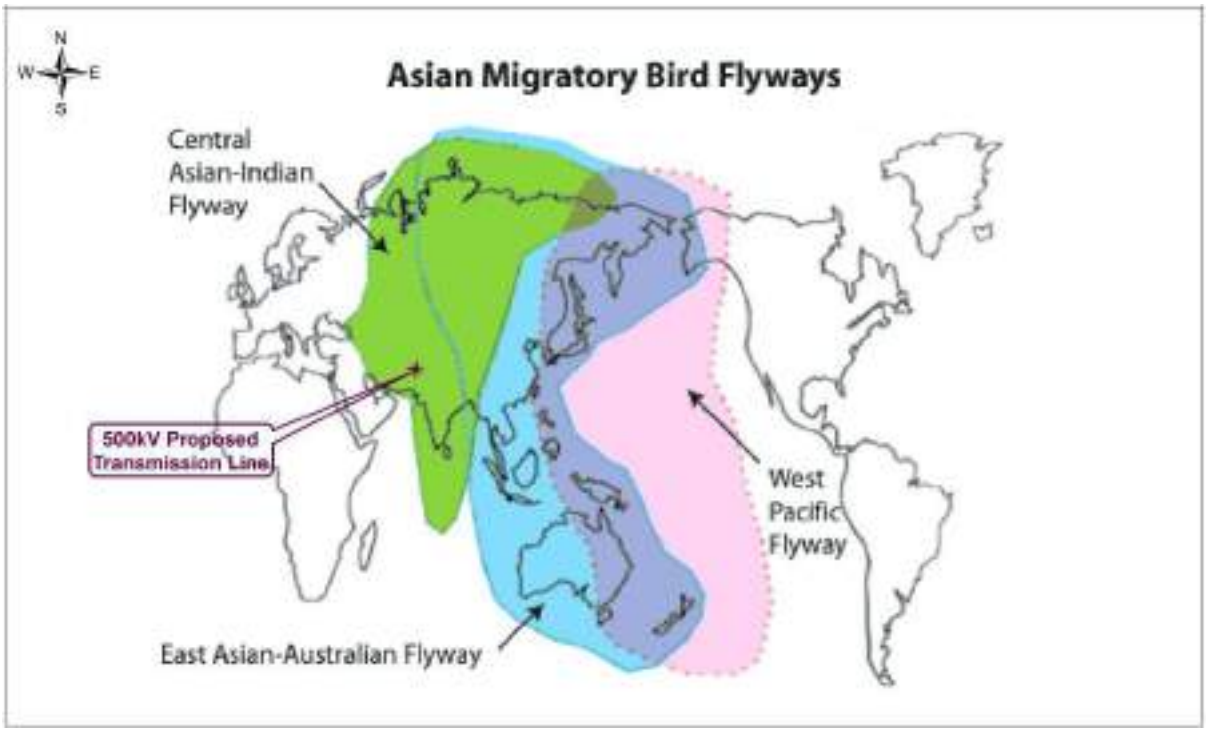


Figure 4-25: Asian Migratory Birds Flyway

Survey Results

Surveys for bird diversity and abundance were carried out in the Terrestrial Study Area in May 2025. A total of 15 locations were sampled, covering five types of habitats within the study area. A summary of the results by sampling locations, including the bird abundance and diversity, is provided in **Table 4-20.** Photographs of some bird species observed in the study area are given in **Figure** 4**-26**.

A total of 1096 bird individuals belonging to 32 species were observed. Maximum abundance was observed at Sampling Locations S5 and S2, where a total of 134 and 118 birds were observed, respectively. The abundant bird species in the terrestrial study area were House Sparrow *Passer domesticus*, House Crow *Corvus splendens,* Cattle Egret *Bubulcus ibis,* and Common Myna *Acridotheres tristis*, etc. Maximum diversity was observed at sampling locations S2, S3, and S11, where a total of 21, 20, and 19 bird species were observed, respectively.

Residents were consulted regarding the potential impacts of the proposed transmission line. They reported no perceived negative effects, basing their assessment on their observations of the existing transmission line, which they stated has not resulted in bird collisions or electrocutions to date.

Table 4-21: Total Bird Sightings, Density, and Diversity by Habitat Type

May 2025 Survey

Habitat	No. of Sampling Points	Total Sighting	Density	No. of Species
Agriculture Fields	4	301	75.25	32
Scrub Forest	4	285	57.00	29
Waterbody	3	268	89.33	32
Built-up Area	2	159	79.50	23
Rangeland	1	83	83.00	14
Total	**14**	**1096**	**73.07**	**32**

Conservation and Protection Status

Of the bird species reported from the Study Area, only the Southern Grey Shrike is globally listed as Vulnerable on the IUCN Red List of Threatened Species. Of the observed bird species in the terrestrial study area, the Black Kite and Honey Buzzard *Pernis apivorus* are included in CITES Appendix II.

Black-winged Stilt

White-breasted Kingfisher

Pied Bushchat

Common Hoopoe

Common Moorhen

Common Hawk Cockoo

Spotted Owl

Purple Sunbird

May 2025 Survey

Figure 4-26: Bird Species Photographed in the Study Area

Herpetofauna

Literature Review

Amphibians and reptiles hold a significant position amongst the vertebrates, play a vital role in the ecosystem and act as bio-indicators, play a dynamic role in the food web, and are a significant part of a healthy ecosystem. They are a major factor in the food web as they consume insects and also become the food of many avian and mammalian species. The diversity and distribution of many wildlife species, including herpetofauna, depend on the geographical position and climatic conditions of a region.[52]

In Pakistan, arid to semi-arid climatic conditions prevail that make it an amphibian-poor country; however, humid riparian conditions in the Indus valley, streams in the northern Himalayan sub-mountainous region, and water channels in the western Baluchistan highlands are home to more than 24 amphibian species that belong to four families, viz. Bufonidae,

[52] Hamid, H.N., Rais, M., Arif, M. and Noor, R., 2021. Amphibians and Reptiles of Sheikh Baddin National Park, Khyber Pakhtunkhwa: Diversity, Threats and Conservation Prospects. *Pakistan Journal of Zoology*, *53*(2), p.785.

Megophryidae, Microhylidae, and Ranidae.[53] The reptilian fauna of the country is represented by more than 200 species belonging to 23 families.[54] Six amphibians and 38 reptile species are endemic to Pakistan.[55]

The herpetofauna of the Project area has not been studied in detail. However, the presence of more than 30 herpetofauna species in the wider area of the project can be assumed from the literature. A total of 28 herpetofauna species have been reported in the initial baseline report, including one species of freshwater turtle, Indian Flap-shell Turtle *Lissemys punctata.*

Common reptile species found in and around the project area include Common Krait *Bungarus caeruleus*, Russell's Chain Viper *Daboia russelii*, Indian Rat Snake *Ptyas mucosus,* Diadem Snake *Spalerosophis diadema*, Cobra *Naja naja,* Leopard Gecko *Eublepharis macularius*, Oriental Garden Lizard *Calotes versicolor*, Indian Monitor Lizard *Varanus bengalensis*, Punjab Snake Eyed Lacerta *Ophisops jerdonii*, Striped Grass Skink *Eutropis dissimilis,* Skittering Frog *Euphlyctis cyanophlyctis*, and Indus Valley Toad *Duttaphrynus stomaticus*, Indian Bullfrog *Hoplobatrachus tigerinus*, etc.[56] [57]

Conservation of important herpetofauna species found in the project area includes the Indian Spiny-tailed Lizard *Saara hardwickii*, Indian Flap-shell Turtle, Indian Peacock Softshell Turtle *Nilssonia hurum*, Indian Brown Roofed Turtle *Pangshura smithii*, Crowned River Turtle *Hardella thurjii*, Indian Blackpond Turtle *Geoclemys hamiltonii,* and Indian Softshell Turtle *Nilssonia gangetica*.[58] [59] Although the presence of one turtle species was confirmed in the baseline report, however, the IUCN data shows the presence of five turtle species. Of these five species, the Indian Peacock Softshell Turtle*,* Crowned River turtle, Indian softshell Turtle, and Indian Blackpond Turtle are listed as Endangered in the IUCN Red List, while the Indian Flap-shell Turtle is listed as Vulnerable.[60] In addition to the turtle, the Indian Spiny-tailed Lizard is also listed globally as a vulnerable species.

Of the documented herpetofauna species from the wider area of the project, the Indian Peacock Softshell Turtle, Indian Softshell Turtle, and Indian Monitor Lizard are included in CITES Appendices I, while the Indian Spiny-tailed Lizard, Indian Flap-shell Turtle, Indian Brown Roofed Turtle, Crowned River Turtle, Indian Bullfrog is listed in CITES Appendices II.[61]

53 Khan, M.S., 2011. Herpetology of Pakistan part I-Frogs. *Nia Zamana Publications*, *14*, pp.1-96.

54 Khan, M.S., 2006. *Amphibians and reptiles of Pakistan* (p. 311). Malabar, Florida, USA: Krieger Publishing Company.

55 Ibid.

56 Khan, M. S. (2006). *Amphibians and reptiles of Pakistan* (p. 311). Malabar, Florida, USA: Krieger Publishing Company.

57 Ali, W., Javid, A., Hussain, A., & Bukhari, S. M. (2018). Diversity and habitat preferences of amphibians and reptiles in Pakistan: a review. *Journal of Asia-Pacific Biodiversity*, *11*(2), 173-187.

58 Khan, M. S. (2006). *Amphibians and reptiles of Pakistan* (p. 311). Malabar, Florida, USA: Krieger Publishing Company.

59 Ali, W., Javid, A., Hussain, A., & Bukhari, S. M. (2018). Diversity and habitat preferences of amphibians and reptiles in Pakistan: a review. *Journal of Asia-Pacific Biodiversity*, *11*(2), 173-187.

60 The IUCN Red List of Threatened Species. Available at https://www.iucnredlist.org.

61 CITES. Checklist of CITES Species. Accessed on May 23, 2025. Available at https://checklist.cites.org/#/en.

Survey Results

A total of 14 locations were sampled for herpetofauna during the May 2025 Survey. The locations of these are shown in **Figure 4-19**. A total of seven herpetofauna species were observed in the terrestrial study area. The most abundant herpetofauna species observed in the study area was the Indian Flapshell Turtle. A total of 40 individuals of the Indian Flapshell Turtle were observed. Indian Monitor Lizard *Varanus bengalensis* and Asian Garden Lizard *Calotes versicolor* were observed at three and four sampling locations, respectively. A summary of the herpetofauna species observed in different habitats of the study area is given in **Table 4-21.** Photographs of the herpetofauna species sighted in the terrestrial study area are provided in **Figure 4-27**.

Table 4-22: Herpetofauna Sightings in the Study Area

May 2025 Survey

Sr No	Common Name	Scientific Name	IUCN Status	Agriculture Fields	Scrub Forest	Water body	Total
1	Indian Flapshell Turtle	*Lissemys punctate*	Vulnerable			40	**40**
2	Brown Roofed Turtle	*Pangshura smithii*	Near Threatened			8	**8**
3	Indian Monitor Lizard	*Varanus bengalensis*	Near Threatened	4	4	1	**9**
4	Asian Garden Lizard	*Calotes versicolor*	Least Concern	3	4		**7**
5	Punjab Snake-eyed Lacerta	*Ophisops jerdoni*	Least Concern	2	2		**4**
6	Skittering Frog	*Euphlyctis cyanophlyctis*	Least Concern	12		25	**37**
7	Indus Valley Toad	*Duttaphrynus stomaticus*	Least Concern	3			**3**

Indian Flapshell Turtle

Asian Garden Lizard

Monitor Lizard (Roadkill)

Skittering Frog (froglet)

May 2025 Survey

Figure 4-27: Herpetofauna species observed in the Terrestrial Study Area

Conservation and Protection Status

Of the reported species, the Indian Flapshell Turtle is globally listed as Vulnerable, while the Indian Brown Roofed Turtle and Indian Monitor Lizard are listed as Near Threatened species in the International Union for Conservation of Nature (IUCN)'s Red Data Book. The Indian Monitor Lizard is included in CITES Appendix I, while the Indian Flapshell Turtle and Indian Brown Roofed Turtle are included in CITES Appendix II.

4.4.5 Threatened and Endemic Fauna Species in the Project Area

Based on available literature and IUCN Data, a total of 20 terrestrial threatened vertebrate species are found in the project area. These include three mammal species, 11 bird species, and six herpetofauna species. One endemic mammal species, the Punjab Urial, is also found in the project area. A list of threatened species found in the project is provided in **Table 4-23**

Table 4-23: List of Threatened Species Found in the Project Area

Sr No	Common Name	Scientific Name	IUCN Status	Restricted Range Species
Mammals				
1.	Indian Pangolin	*Manis crassicaudata*	Endangered	
2.	Punjab Urial	*Ovis vignei punjabensis*	Vulnerable	Endemic
3.	Common Leopard	*Panthera pardus*	Vulnerable	
Birds				
4.	White-rumped Vulture	*Gyps bengalensis*	Critically Endangered	
5.	White-headed Duck	*Oxyura leucocephala*	Endangered	
6.	Steppe Eagle	*Aquila nipalensis*	Endangered	

Sr No	Common Name	Scientific Name	IUCN Status	Restricted Range Species
7.	Indian Skimmer	*Rynchops albicollis*	Endangered	
8.	Black-bellied Tern	*Sterna acuticauda*	Endangered	
9.	Egyptian Vulture	*Neophron percnopterus*	Endangered	
10.	Common Pochard	*Aythya ferina*	Vulnerable	
11.	Macqueen Bustard	*Chlamydotis macqueenii*	Vulnerable	
12.	Greater Spotted Eagle	*Clanga clanga*	Vulnerable	
13.	Tawny Eagle	*Aquila rapax*	Vulnerable	
14.	Southern Grey Shrike	*Lanius meridionalis*	Vulnerable	
Herpetofauna				
15.	Indian Peacock Softshell Turtle	*Nilssonia hurum*	Endangered	
16.	Crowned River Turtle	*Hardella thurjii*	Endangered	
17.	Indian Softshell Turtle	*Nilssonia gangetica*	Endangered	
18.	Indian Black Pond Turtle	*Geoclemys hamiltonii*	Endangered	
19.	Indian Flap-shell Turtle	*Lissemys punctata*	Vulnerable	
20.	Indian Spiny-tailed Lizard	*Saara hardwickii*	Vulnerable	

4.4.6 Protected Areas in Project Area

The proposed transmission line crosses two national parks: the Chinji National Park and Kala Chitta National Park. Details are provided below:

Chinji National Park

The Chinji National Park was established in 1987 to protect and preserve the diverse flora and fauna of the area. The Park is located near Chinji Town in the district of Talagang of Punjab Province. The Park is spread over an area of 15,003 acres. The diverse habitat of the park supports a rich diversity of flora and fauna. The Chinji National Park is home to a remarkable array of wildlife, including over 250 species of birds, 30 species of mammals, and numerous reptiles and amphibians.

Based on published literature and initial baseline EIA, conservation of important fauna species of the Chinji National Park includes the Indian Pangolin, Punjab Urial, Grey Wolf, Egyptian Vulture, White-rumped Vulture, Steppe Eagle, Indian Narrow-headed Softshell Turtle, etc.

The proposed transmission line will pass through Chinji National Park, covering a total distance of approximately 4.7 kilometers within the park territory. **Figure 4-28** shows a view of Chini National Park near the proposed T/L route area, and **Figure 4-29** showing the alignment of the proposed transmission line as it crosses Chinji National Park.

Existing 500kV T/L View Passing Through the Chinji National Park

Existing 500kV T/L View Passing Through the Chinji National Park

The Habitat has been Modified, and Local Communities Often Herd Animals Within or Near the Park's Boundaries

May 2025 Survey

Figure 4-28: View of Chini National Park near Proposed T/L Route Area

Kala Chitta National Park

The Kala Chitta National Park is located in the district of Attock of Punjab Province. The Park was established in 1983 and is spread over an area of 16,948 hectares. The terrain of the park comprises a heterogeneous landscape of mountainous regions, woodlands, and grasslands, supporting a high diversity of flora and fauna. The Kala Chitta National Park is home to a remarkable variety of wildlife, including 180 species of birds, 22 species of mammals, and more than 20 species of herpetofauna.

Based on available literature on the region and the initial EIA report, several conservation-important species use the territory of the park. These conservation-important species include the Indian Pangolin, Common Leopard, Punjab Urial, Grey Wolf, Indian Python *Python molurus,* Steppe Eagle, White-rumped Vulture, Egyptian Vulture, and other migratory bird species.

The proposed transmission line will also traverse approximately 2 kilometers within the boundaries of Kala Chitta National Park. Map provided **Figure 4-30** showing the alignment of the proposed transmission line as it crosses Kala Chitta National Park.

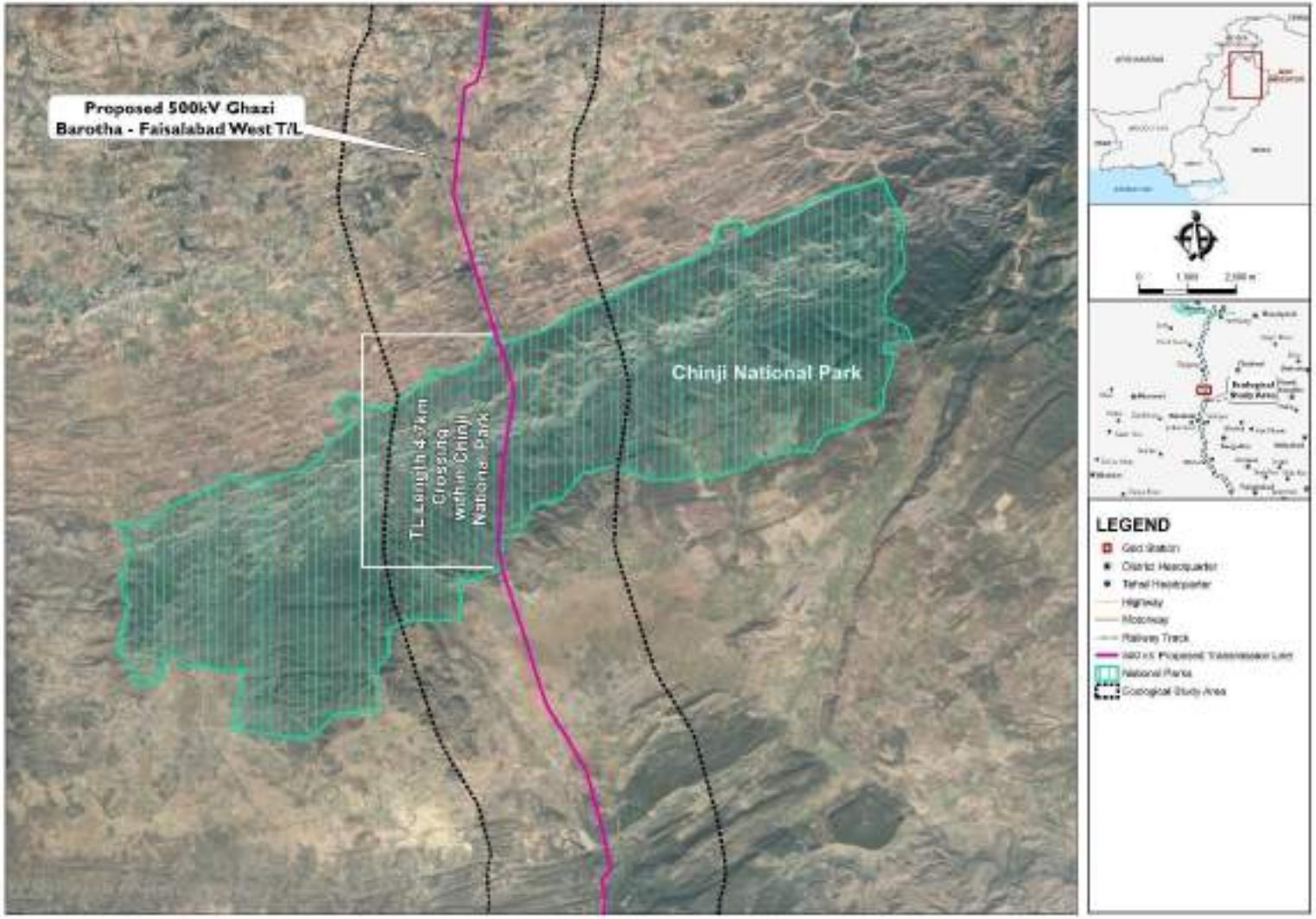


Figure 4-29: Proposed T/L Route Passing through Chinji National Park

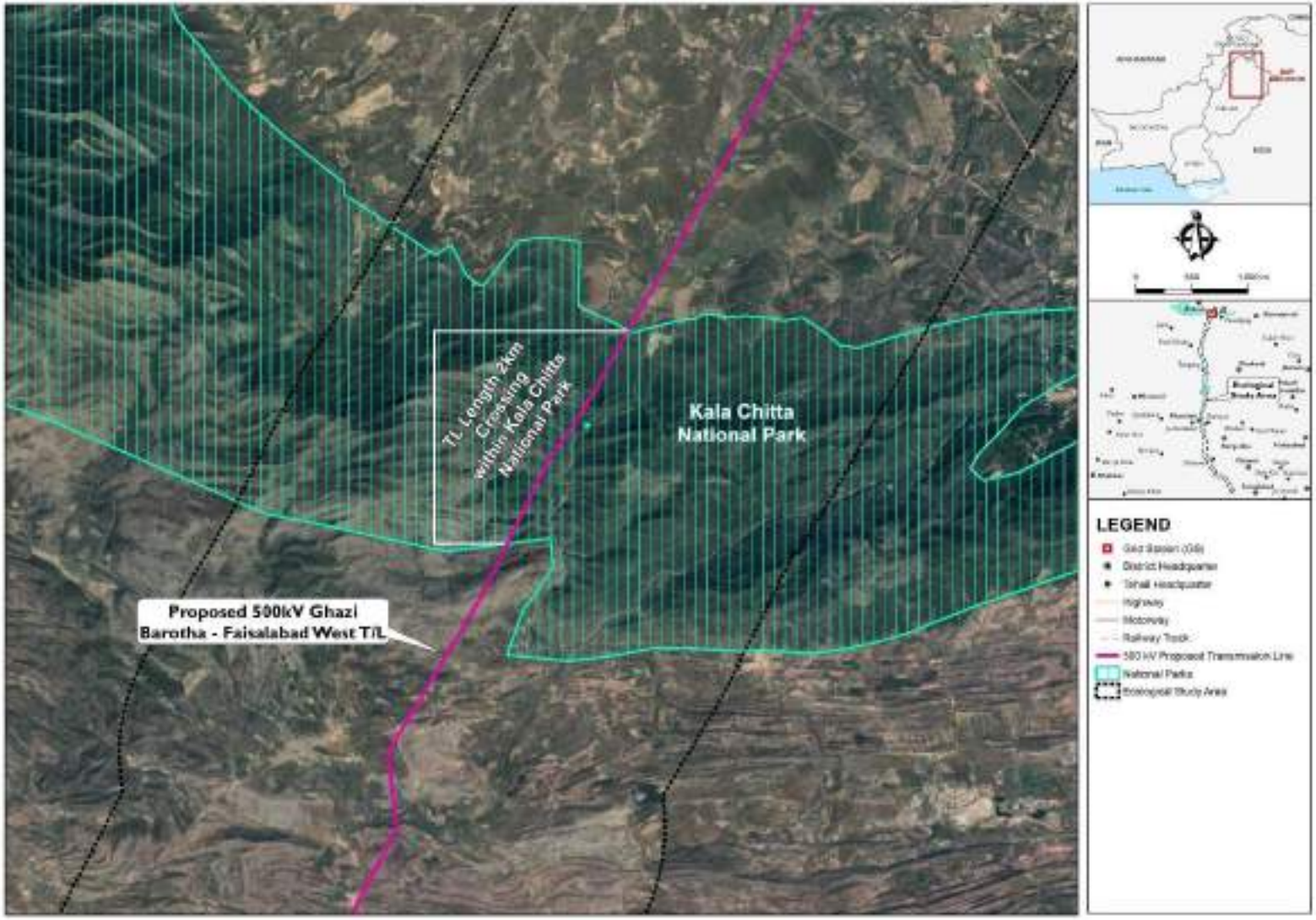


Figure 4-30: Proposed T/L Route Passing through Kala Chitta National Park

4.5 Socioeconomic Environment

This sub-section provides information on the socio-economic conditions of the project COI. It includes methodology, administrative setup, demographic characteristics, educational and institutional facilities, transportation, water supply, income sources, religious/archaeological and historical sites (if any) existing in the area.

This baseline provides an overview of the social and economic conditions of the project area based on primary and secondary data sources. This overview aids in understanding the socio-economic significance of the project area and helps identify any social risks that the project proponents must be aware of during the project design phase. The baseline data presented here also establishes a foundation for monitoring project activities throughout the project implementation and operations phase.

Figure 4-36 provides a snapshot of socioeconomic conditions in the area of COI.

4.5.1 Data Collection Methodology

The social baseline for this project is based on primary data collected through field surveys and community engagement, and secondary data extracted from already available sources like official records and published materials. The secondary sources of data include Design Drawings, the latest Population Census Report.

An on-site field survey of the proposed project was carried out. This included the collection of demographic and socio-economic baseline information. During the survey, the major focus was to collect information about educational levels, economic resources and dependencies, quality of life, availability of facilities, water resources and its use & satisfaction, general health status, perceived impacts of the project, their protective measures, basic needs, and the means to safeguard their interests during project implementation.

For the primary data collection, a comprehensive field survey of all the Affected Households (AHs), covering 100% of the AHs, was conducted using a pre-structured questionnaire. This data provides the socioeconomic profile of the Project Area and serves as baseline information for subsequent monitoring and evaluation studies.

Moreover, the primary data collection included focus group discussions (FGDs) with selected households, individual interviews with key informants, and a transection walk in the area, which helped the survey team to physically observe the socio-economic conditions in the project area. Meetings were held with entire stakeholders, including the Affected Households (AHs).

4.5.2 Administrative Setting

The project area spans a diverse administrative landscape, covering multiple districts within Punjab and extending from Ghazi Barotha in the vicinity of Islamabad to Faisalabad. The key districts traversed by the proposed transmission line include Attock, Talagang, Khushab,

Sargodha, and Chiniot. These districts fall under the jurisdiction of the Government of Punjab, with administrative structures in place to manage land use, public services, and community welfare.

Each district is subdivided into tehsils, which serve as the primary sub-administrative units and are overseen by Assistant Commissioners (ACs). These tehsils are further broken down into Union Councils (UCs)—the smallest units of rural governance. Within UCs, individual settlements or villages (locally known as mouzas) represent the grassroots level where most community interactions occur. This multi-tiered system facilitates localized governance and service delivery.

The Attock District, situated in northern Punjab, includes tehsils such as Fateh Jang, Pindi Gheb, Jand, Hazro, and Hassan Abdal. The proposed transmission line intersects areas in Fateh Jang and Pindi Gheb tehsils. Talagang, which was recently designated as a separate district in 2022 (previously part of Chakwal), consists of Talagang and Lawa tehsils.

In Khushab District, the alignment crosses through tehsils including Khushab and Noorpur Thal. These areas are characterized by agricultural landholdings and limited urbanization. The Sargodha District, one of the larger and more populous districts, similarly, Chiniot District formed in 2009 after being separated from Jhang—includes tehsils like Bhawana and Lalian. This district is marked by fertile agricultural lands and a high dependency on farming and livestock for livelihoods.

Governance in these districts operates under the framework of the Punjab Local Government Act, which mandates a decentralized model of administration. At the district level, the Deputy Commissioner (DC) serves as the chief administrative officer, responsible for coordinating among various line departments, revenue collection, and land acquisition procedures. Tehsil Municipal Administrations (TMAs) function at the sub-district level to manage urban services such as sanitation, water supply, and waste disposal.

Union Councils serve as the first point of contact for rural populations and play a crucial role in managing local records, resolving community disputes, and facilitating public consultations. They are often instrumental in organizing community-level engagement, particularly for development projects.

4.5.3 Demographics

Population and its characteristics

The demographic features include the information on the affected household's profile, gender composition, occupations, and literacy status of the people living in the Project Area.

The latest district-wise population data from the Pakistan Bureau of Statistics (PBS), based on the 2023 census, is shown in the **Table 4-24**.

The districts of Faisalabad and Sargodha are the most populous, with a population of 9,075,819 and 4,334,448, respectively. The average household size of most of the district is 6.

A glance at the gender ratio for the district shows that for all the districts, there are more males compared to the female population. The average annual population growth rate, which is based on the comparison to the last Census held in 2017, shows that Talagang district has the lowest growth rate, 1.86%. The average annual growth rate ranges from 2.38% to 2.7% for the rest of the districts.

Table 4-24: District Wise Population Details

District	Population (2023)	Male Population	Female Population	Average Household Size	Population (2017)	Avg Annual Growth Rate (2017-2023)
Attock	2,170,423	1,089,655	1,080,687	6.1	1,886,378	2.37%
Talagang	457,635	229,013	228,611	5.8	409,827	1.86%
Khushab	1,501,089	768,126	732,914	6.0	1,280,372	2.69%
Sargodha	4,334,448	2,194,156	2,139,911	6.3	3,696,212	2.70%
Chiniot	1,563,024	790,731	772,126	6.1	1,368,659	2.24%
Faisalabad	9,075,819	4,731,224	4,343,633	6.5	7,882,444	2.38%

4.5.4 Profile of the Respondents

During the field survey, 1231 households were surveyed in the project area. The respondents were interviewed throughout the length of the COI. The details of the main localities of the survey are mentioned in the **Table 4-25**.

The districts comprise both rural and urban areas. Based on the Pakistan Bureau of Statistics census 2023, the district-wise picture of rural and urban populations is provided in **Figure 4-31**. Faisalabad district has a higher urban population in comparison to the other districts, with 48% of its population living in urban areas. The remaining districts exhibit a relatively higher rural population compared to their urban counterparts.

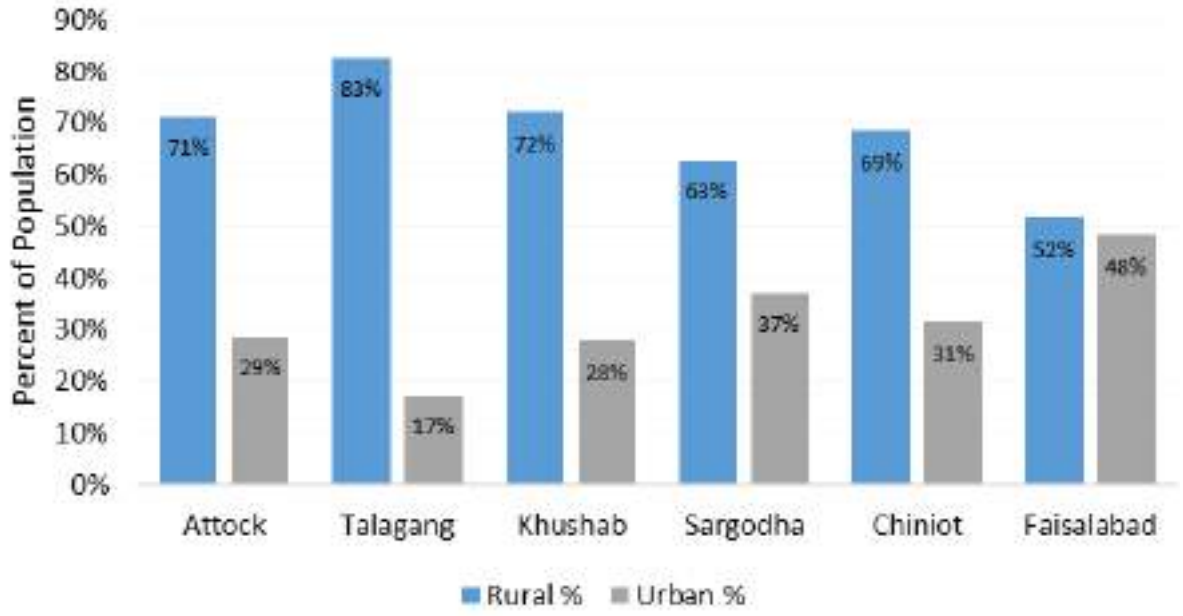
According to the field survey conducted for the baseline, all respondents were from rural areas. They have been residing in the locality for an extended period and are mainly involved in farming as their occupation.

Table 4-25: Main Localities of the Project Area

Sr No.	Village	Tehsil	District
1	199 Rehmo Ana	Bhawana	Chiniot
2	198 Dhol Wala	Bhawana	Chiniot
3	208 Sahmal	Bhawana	Chiniot
4	221 JB	Bhawana	Chiniot
5	Mouza Sarnanaga	Bhawana	Chiniot
6	Mouza Samundar	Bhawana	Chiniot

Sr No.	Village	Tehsil	District
7	Wijhalka	Lalian	Chiniot
8	Nur Pur Bhatha	Lalian	Chiniot
9	Ramdana	Lalian	Chiniot
10	147/148 Shamali	Sillanwali	Sargodha
11	Shamas Abad	Sillanwali	Sargodha
12	144/145 Shamali	Sillanwali	Sargodha
13	Mir Ahmad Sher Ghar	Sahiwal	Sargodha
14	Kichi Da Chak	Sahiwal	Sargodha
15	Mouza Dholka	Sahiwal	Sargodha
16	Pindi Wala	Sahiwal	Sargodha
17	Chichoka	Sahiwal	Sargodha
18	Chawy Wala	Sahiwal	Sargodha
19	Vijh	Sahiwal	Sargodha
20	Hussain Shah	Shah Pur	Sargodha
21	Jalal Pur	Shah Pur	Sargodha
22	Gujranwala	Shah Pur	Sargodha
23	Shah Yousaf	Shah Pur	Sargodha
24	Mangwal Kalan	Shah Pur	Sargodha
25	Shah Pur	Shah Pur	Sargodha
26	Khatta Sagral	Khushab	Khushab
27	Pail	Khushab	Khushab
28	Billomar	Talagang	Talagang
29	Chakwalian	Talagang	Talagang
30	Mamdot	Talagang	Talagang
31	Doke Jamal	Talagang	Talagang
32	Nakka Kohat	Talagang	Talagang
33	Dhoke Maliyan	Talagang	Talagang
34	Pira Jangla	Talagang	Talagang
35	Kot Saran	Talagang	Talagang
36	Feroz Wali	Pendigap	Attock
37	Makial	Pendigap	Attock

Sr No.	Village	Tehsil	District
38	Sahwal	Pendigap	Attock
39	Thathi Noor Ahmad Shah	Pendigap	Attock
40	Bajal	Fateh Jang	Attock
41	Kot fateh Khan	Fateh Jang	Attock
42	Kotera	Fateh Jang	Attock
43	Jabbi Kasran	Fateh Jang	Attock
44	Muqam	Fateh Jang	Attock



(PBS-2023)

Figure 4-31: District-wise Rural and Urban Population

Table 4-26: Settlement Type of Surveyed Households

Settlement Type	Surveyed Households (No.)	Surveyed Households (%)
Rural	1231	100
Semi Urban	0	0
Urban	0	0
Total	**1231**	**100**

4.5.5 Family Size, Age, and Gender Ratios

The field survey determined that the average household size is 9 in the project area. For a total population of 11,079 people, the male-to-female ratio is 55:45 among the respondents.

The field data regarding the distribution of age categories indicates that 11% of the population consists of children under 15 years, while 45% falls within the age range of 16-45 years. Furthermore,35% of the population is aged between 46-60 years, while the age group above 60 makes up 9% as shown in **Figure 4-32**.

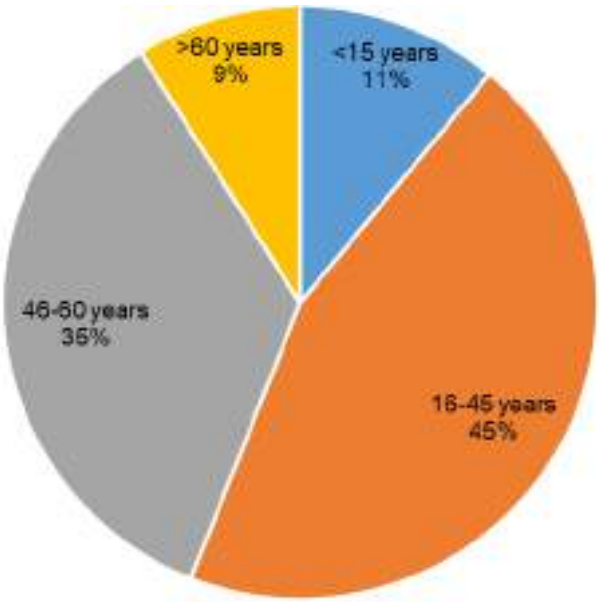


Figure 4-32: Survey Population Age Groups

4.5.6 Languages Spoke

The main languages spoken in the Project COI are Punjabi and Urdu. Other languages like Saraiki, Hindko, Kashmiri, and Pashto.

4.5.7 Religion

The area has a predominantly Muslim population, with smaller communities of Christians, Sikhs, and Hindus also residing there.

4.5.8 Education Level

In general, literacy levels in the province have improved and continue to be a priority among development strategies. The introduction of new policies means a majority of parents are taking their children to school. Although there is improvement in the education, but literacy level is still very low which is one of the largest factors of poverty in province households especially in rural areas, as it leads to reduce income generating opportunities, particularly for women.

The results from the field survey regarding literacy and educational levels show a similar picture. **Table 4-27** presents the distribution of education levels among the respondents. Overall, 6% of respondents are infants (below 4 years old), while 37% reported being illiterate. In terms of education distribution, 23% of respondents have received education up to the primary level, 8% up to middle school, and 14.0% are Matriculates. Additionally, 7% and 2%

of respondents have education up to the intermediate and graduation levels, respectively. Only 1% of respondents have education up to master's level or above.

Table 4-28 shows the total population literacy rates along with gender-wise literacy rates for the respective districts. The district Attock (70%), Talagang (75%), and Faisalabad (73.4%), have overall higher literacy rates compared to the other districts. The Chiniot district with only 55% educated population has the lowest literacy overall. Comparing the literacy rate among different genders, it can be clearly seen that in all the districts more males are literate compared to the female and transgender population. With transgenders having the lowest literacy rate in each district.

The lack of higher educational infrastructure is the main hindrance to higher education attainment, with respondents having to travel long distances of 6 to 10km. The situation for girls pursuing higher education is particularly challenging due to poor law and order situations and conservative attitudes towards women's education in the project area. Notably, 10% of respondents have received Deeni (religious) education and can recite the Holy Quran only.

Table 4-27: Distribution of Respondents' Education Level

Educational Level	Project Area	
	No	Percentage
Infant (4 years and below)	138	6
Illiterate	452	37
Primary	269	23
Middle	96	08
Matriculation	168	14
Intermediate	89	07
Graduate	32	02
Master & above	16	1
Total	**1231**	**100.0**

Table 4-28: District-wise Literacy Rates

PBS-2023

District	Total Literacy (%)	Male Literacy (%)	Female Literacy (%)	Transgender
Attock	70.22%	79.69%	60.66%	58.00%
Talagang	75.63%	86.48%	64.91%	9.00%
Khushab	62.52%	75.59%	49.03%	42.86%
Sargodha	66.73%	73.63%	59.62%	27.60%
Chiniot	55.00%	64.64%	45.19%	31.75%

District	Total Literacy (%)	Male Literacy (%)	Female Literacy (%)	Transgender
Faisalabad	73.41%	77.34%	69.11%	44.00%

Housing Conditions

Ownership and housing conditions are crucial indicators of living standards and household well-being. According to field investigations, most respondents reside in Semi-Pacca housing (54%), 37% of the houses surveyed are pucca, and 9% are kutcha houses. **Table 4-29** shows the details of the respondents regarding housing conditions.

In terms of ownership, 98% of the houses surveyed in the project COI are living in their own houses.

Table 4-29: Housing Conditions of Surveyed Households

Project	Housing Conditions				
		Pacca	Semi Pacca	Katcha	Total
500kV TL Ghazi Barotha – Faisalabad West	Percent	37	54	9	100
	Number of HH	455	668	108	1231

4.5.9 Household Income

Understanding the economic patterns of households is crucial for effective project planning and execution. The field survey identified various income-generating activities undertaken by respondents within the project area. The data indicates that all respondents primarily engage in farming activities. Additionally, they supplement their income through diverse means such as livestock rearing, government and private sector employment, and jobs as drivers and laborers.

The results of household income levels are presented in **Table 4-30**, which indicates that 3% of households fall below the poverty line with an income of less than PKR 35,000. While 50% of households fall within the income range of PKR 35,001 to 50,000, 26% of households have income in the range of 50,001 to 75,000, 17% in the income range of 75,001 to 100,000, and only 4% of households have income exceeding PKR 100,000. (**Figure 4-33).**

Table 4-30: Monthly Household Income Level

Sr. No.	Income Level (PKR/Month)	Number of Households	Percentage (%) of Households
1	0 – 35,000	33	3
2	35,001- 50,000	618	50
3	50,001- 75,000	315	26
4	75,001 – 100,000	211	17

Sr. No.	Income Level (PKR/Month)	Number of Households	Percentage (%) of Households
5	Above 100,000	54	4
Total		**1,231**	**100**

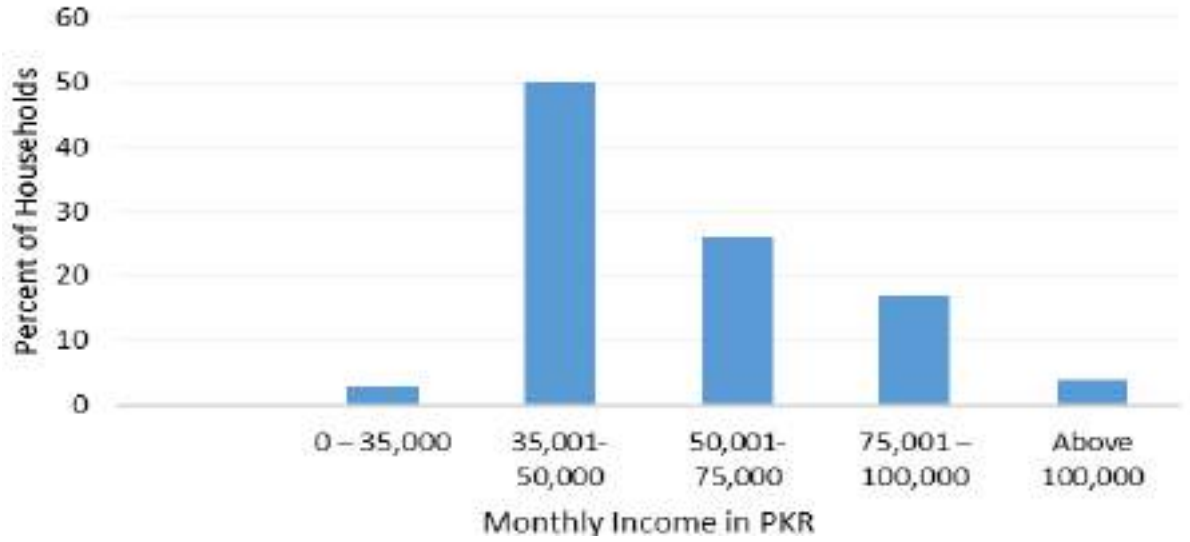


Figure 4-33: Average Monthly Income

Figure 4-34 below provides insight into the economic activities and income sources among households. On average, each household has 5.1 members engaged in various economic activities, indicating a significant contribution from multiple family members towards generating income. The majority, constituting 63% of households, have two or more income sources, while 37% rely on a single source of income. This distribution underscores the diversified income strategies adopted by households, with a substantial portion leveraging multiple sources to sustain their livelihoods.

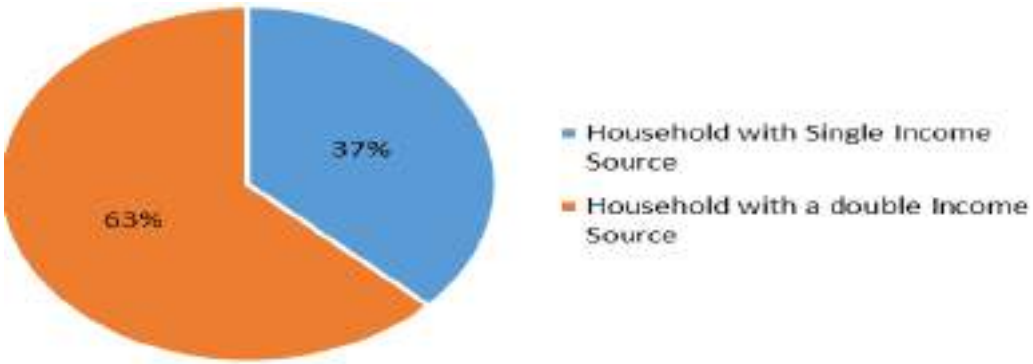


Figure 4-34: Household Income Sources

4.5.10 Expenditure

The expenditures include food and non-food items like fuel, education, health, clothing, utility charges, house rent, and other miscellaneous expenditures. **Table 4-31** shows the monthly

expenditures of households surveyed, most of the households' expenses are in the 20001-50000 rupees range. As mentioned earlier, this is the range of most households' monthly income. With the current cost of living and inflation, these people are hardly able to meet their expenses. Those with higher incomes are able to save some amount monthly.

Table 4-31: Details of Household Expenditures

Sr No	Description of Expenditure (Rs)	Food Items and Non-Food Items	
		No. of Households	**% of Households**
1	Below 20,000	33	3
2	20001- 35000	628	51
3	35001- 50000	411	33
4	50001 – 65000	112	9
5	65001 and above	47	4
Total		**1,231**	**100**

4.5.11 Access to Infrastructure

Figure 4-35 presents insights into the access to utility situation in the project area. The data reveals that 98% of households are electrified, but the resident's express dissatisfaction due to unannounced load shedding and voltage fluctuations. Furthermore, concerns about the electricity tariffs highlight affordability challenges for the people. None of the households surveyed have access to the natural gas line.

The field survey reveals that a majority of households, around 85%, do not have access to drinking water through a water supply system. Around 17% of households have access to sewerage systems, indicating a significant gap in sanitation infrastructure. Furthermore, the data indicates that primary healthcare facilities are accessible to 40% of households, indicating relatively average coverage in this essential service. These findings underscore the need for improvements in facilities and infrastructure reliability, service delivery, and affordability to ensure a satisfactory living environment for all residents.

Additionally, the provision of primary education facilities is good, with approximately 93% of households having access to them. Primary schools are available for both boys and girls in the area, highlighting efforts towards gender equality in education.

The field data indicates that 87% of households have access to roads, facilitating mobility and connectivity within the community. Overall, where the infrastructures are available, there remain areas for improvement, particularly in ensuring access to safe drinking water and enhancing the quality and reliability of essential services.

Residents have expressed concerns about the challenging living conditions, particularly during rainy seasons, when streets become muddy due to inadequate drainage, impacting their quality of life. However, addressing the deficiency in sewerage/drainage and drinking water

infrastructure is essential to enhance the environmental health and well-being of residents, particularly during adverse weather conditions.

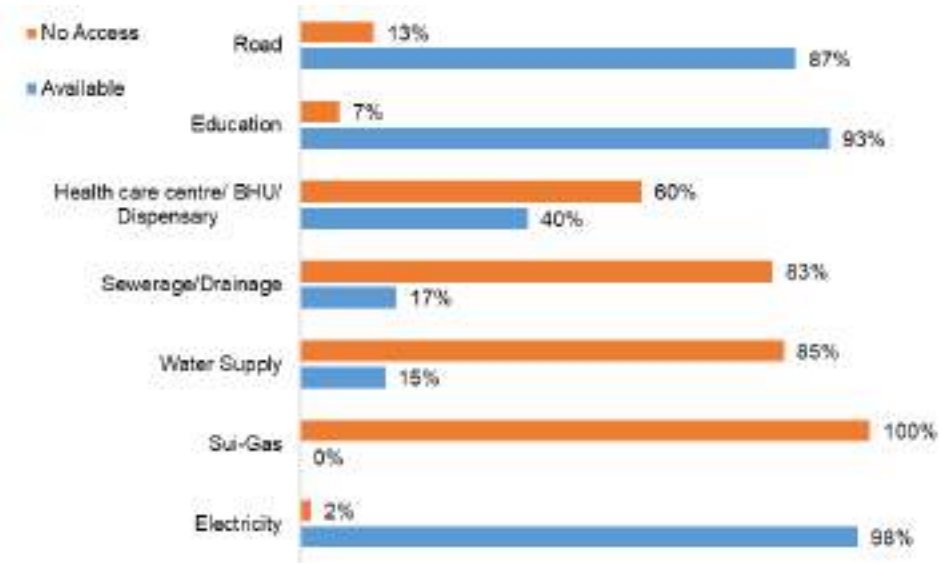


Figure 4-35: Access to Social Amenities

4.5.12 Landholding

Landholding refers to ownership or legal control of a piece of land by an individual, household, community, or institution. It is a critical aspect of rural economies and land-based development activities, shaping livelihoods, agricultural productivity, and socio-economic status. Patterns of landholdings, such as size, tenure type, and distribution, often reflect broader issues of equity, land use planning, and access to resources. Understanding these patterns is essential for informing policies related to land acquisition, rural development, and infrastructure projects.

The **Table 4-32** presents the distribution of landholding sizes among 1,231 households surveyed, offering insight into patterns of land ownership within the study area. The largest proportion of households, 42% (511 households) own between 2.51 and 5 acres of land, indicating a prevalence of small to medium-scale landholders. A significant share, 20% (242 households), possess less than 2.5 acres, highlighting a substantial segment of marginal or land-poor households who may be more vulnerable in terms of livelihood security. Households owning between 5.1 and 15 acres make up 17% (220 households), while those with 15.1 to 25 acres account for 12% (145 households). The smallest group, comprising just 9% (113 households), holds more than 25 acres, reflecting a relatively limited concentration of large landowners in the sample. This distribution underscores a landholding structure dominated by small and medium landowners, which may have important implications for agricultural productivity, resource access, and eligibility for development interventions or compensation mechanisms in land acquisition contexts.

4.5.13 Traffic Situation on Existing Roads

The proposed project is of linear type (283km length), and various major roads and local roads will be used for accessing tower locations and material transport. On a particular road, the

number of vehicles is 3 to 5 per day during the construction period. The addition of such a small number to the existing road traffic situation will, therefore, have no incremental impact.

Table 4-32: Status of Landholding of Survey HHs

S. No	Landholding status among the surveyed HHs		
	Landholding Size	Total HHs by Landholding Size	%
1	Less than 2.5 acres	242	20
2	2.51 -5 acres	511	42
3	5.1- 15 acres	220	17
6	15.1- 25 acres	145	12
7	>25	113	9
	Grand Total	**1231**	**100**

One of the Canals in the Project Area

One of the Canals in the Project Area

Agricultural Activities Using Tube Wells in the Project Area

Canal-fed Agricultural Fields in the Project Area

Rain-fed (Arid) Land in Chakwal District

Type of Kacha Houses in the Project Area

Mosque in the Project Area

A Sugar Mill in Mosque in the Project Area

Cattle Farms

Goods Transport Using Donkey Carts

Primary School Located within Project Area

Another Primary School Located within Project Area

Cattle Herding in the Project Area

Livestock of the Project Area

Fuel Sources in the Project Area

Transmission Lines Passing through the Project Area

Agricultural Field of the Project Area

Street and Housing Conditions of the Project Area

A Tailor Shop in the Project Area

A Barber Shop in the Project Area

Figure 4-36: Snapshot of Socioeconomic Conditions in the COI Area

5. Anticipated Project Impacts and Mitigation Measures

This section discusses the Project's potential impact on the area's physical, ecological, and socioeconomic environment and mitigation measures that will reduce, if not eliminate, its adverse impact.

5.1 Delineation of Project Corridor of Impact

Before proceeding to the environmental analysis of the Project, it is imperative to delineate the project corridor of impact (COI). The COI has already been described in **Section 1.7**.

5.2 Positive Impacts of Proposed T/L Construction

An anticipated positive impact on socio-economic conditions during the construction phase is the creation of limited-time employment opportunities for the local population. Since the project interventions will require substantial input from local labor, even people with relatively lower levels of education or skills could get short-term employment.

Another positive impact will be the creation of other small-scale income generation opportunities, e.g., tuck shops, tea shops, or mechanics.

The construction of the proposed T/L will help towards the development of infrastructure, business, and routine life in these areas.

Development of business during the construction phase will cause socio-economic uplift of the locals along the COI. The socio-economic impacts like employment, education, living standard, and cultural uplift during the interaction with locals are the indirect benefits due to the Project implementation, and

Other similar projects in the region have found that the average household income increases substantially with the construction of power infrastructure projects. This is mainly on account of the continuous supply of electricity to the industry, and the availability of other occupational opportunities.

5.3 Potential Adverse Impacts of T/L

Apart from the positive impacts of the T/L, there are some potentially significant adverse environmental and social impacts on the local environment. The proposed Project is divided into three (03) phases i.e., Pre-construction/ Planning and Design Phase, Construction Phase, and Operation and Maintenance (O&M) Phase. The Pre-construction phase includes all stages before the construction Phase (i.e., site investigation works i.e., topographical, geotechnical, seismic studies, etc.); the Construction Phase includes all stages from mobilization of the Contractor to the completion of the Project; and the Operation Phase starts after the Construction Phase which includes the inspection and repair works.

Adverse impacts envisaged at these three (03) phases of the proposed T/L along with their proposed remedial or mitigation measures, are discussed after the description of the methodology.

5.4 Methodology for Impact Assessment

Environmental and socioeconomic impacts are assessed in the following stages:

5.4.1 Scoping

Scoping is a broad term that refers to the process through which potential environmental issues associated with the proposed project are identified. Potential impacts are identified by various means. These include,

- Selection of the T/L corridor and proposed route marking with the help of Google Earth; and then finalization of the proposed T/L route by adopting the Route Optimization Criteria and subsequent refinement through field observations.
- Geological studies for slope stability.
- Identification of the National Parks along the route, along with their legal status and boundaries.
- Desk study of engineering investigations, studies, and designs.
- Environmental quality baseline monitoring of air, noise, surface and ground water.
- Detailed review and analysis of primary and secondary data available for all environmental parameters in the project area such as physical, ecological and social resources.
- Socio-economic survey to assess the extent of land acquisition and resettlement, occupation, income, and poverty levels of the affected households.
- Consultations with executing and implementing agencies, local government, affected community, traditional and religious leaders of the community.
- Stakeholder consultations with relevant departments, government agencies at local and provincial levels, and
- Knowledge assimilation of international best practices on environmental assessment of T/L projects.

5.4.2 Prediction of potential impacts

This step refers to the evaluation and prediction, quantitatively, if possible, of the anticipated impacts of the proposed Project on various environmental factors.

5.4.3 Evaluation of the significance of potential impacts

The significance of the potential impacts can be determined by considering both the consequences and the likelihood of the occurrence of the impact. The consequence of the proposed activity is evaluated by comparing it against recognized significance criteria, such

as institutional recognition, technical recognition, scientific or technical knowledge, or judgment of recognized experts, public recognition, and professional and experience-based interpretation of the evaluator.

The significance of potential or the predicted impacts is evaluated based on their associated risk levels or effects on the receiving environment.

Risk is assessed as the likelihood that activity will affect the environment, as well as the consequence of the effect occurring. It is often described like this:

Risk = Likelihood X Consequence

Likelihood definition, consequence scale and risk score evaluation approach is provided in **Table below**

Table 5-1: Evaluation of Impact Significance Matrix (Likelihood Scale)

Likelihood	Definition	Score
Certain	Will certainly occur during the activity at a frequency greater than once every week if preventative measures are not applied	5
Likely	Will occur more than once or twice during the activity but less than weekly if preventative measures are not applied	3
Unlikely	May occur once or twice during the activity if preventative measures are not applied	2
Rare	Unlikely to occur during the project	1

Table 5-2: Evaluation of Impact Significance Matrix (Consequence Scale)

Consequence	Definition	Score
Catastrophic	The action will cause unprecedented damage or impacts on the environment or surrounding communities	5
Major	The action will cause major adverse damage to the environment or surrounding communities	3
Moderate	Limited adverse environmental or social impacts such as localized, short term noticeable change in stormwater quality, or short-term changes in ecosystems or nuisance to communities, etc.	2
Minor	No or minimal adverse environmental or social impacts	1

Table 5-3: Evaluation of Impact Significance Matrix (Risk Score Table)

	Consequence			
	Catastrophic	Major	Moderate	Minor
Certain	25	15	9	5
Likely	15	9	6	3

Unlikely	4	6	4	2
Rare	5	3	2	1

Risk Scores: **Critical**: 15 – 25 **Significant/ Moderate:** 6 – 10, **Low**: 1 – 5

Critical and moderate risks will be addressed in EMP by proposing appropriate mitigation measures.

5.4.4 Mitigation measures

If it is determined that the predicted impact is significant, practicable mitigation measures are identified to reduce impacts for each activity to acceptable levels.

5.4.5 Residual impacts

This step refers to the identification of the anticipated remaining impacts after mitigation measures have been applied.

5.4.6 Management actions and monitoring

The last step in the assessment process is the identification of the monitoring requirements to confirm that the residual impacts are within the predicted limits and to provide timely information if the impacts exceed predicted limits.

5.5 Pre-construction (Design) Phase Impacts

Proper planning during project design can significantly reduce the negative impacts at the time of construction and operation.

A summary of screening of potential impacts at the pre-construction (design) phase, based on the methodology discussed in **Section *5.1***, is provided in **Table 5-4**.

Table 5-4: Screening of Potential Impacts at Pre-construction (Design) Phase

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
1	Lack of Integration of EMP/EIA Requirements into Construction Bid Documents	3	3	9	Low
		Likely	Major	Significant	
2	Lack of planning in T/L Design[62]	5	3	15	Low
		Certain	Major	Critical Risk Level	
3	Lack of Project Resources	3	3	9	Low
		Likely	Major	Significant	
4	Improper Location of Camp Sites	3	3	9	Low
		Likely	Major	Significant	
5	Noise caused by Construction Equipment	3	2	6	Low
		Likely	Moderate	Moderate	
6	Electromotive Force (EMF)	3	3	9	Low
		Likely	Major	Significant	
7	Waste Generation	3	3	6	Low
		Likely	Major	Significant	

[62] Covering (i) Route Selection (i.e., Loss of Biodiversity due to route passing through National Parks or Social issues, resettlement/relocation of assets and displacement of people), (ii) Transmission hindrance for aircraft, (iii) Structure Design (soil erosion, landslide and slope stability impact due to natural geo-hazards), (iv) Tower Placement Add-ons, (v) Visual Amenity, and (vi) Mechanical Failure of the Overhead Conductors.

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
8	Disruption To Existing Drainage Pathways and Utilities	3	3	9	Low
		Likely	Major	Significant	
9	Removal of Vegetation/trees	3	3	9	Low
		Likely	Major	Significant	
10	Impacts on Sensitive and High-Value Areas	5	3	15	Low
		Certain	Major	Critical Risk Level	
11	Bird Collision Risk due to the Transmission Line Intersecting the Indus Flyway	3	3	9	Low
		Likely	Major	Significant	
12	Electrocution Risk for Large Birds (e.g. raptors) due to Poor Conductor Spacing	3	3	9	Low
		Likely	Major	Significant	
13	Visual Intrusion from Towers Affecting Scenic/ Recreational Value in National Parks	3	3	9	Moderate
		Likely	Major	Significant	
14	Natural Hazard Risks (Flooding, Earthquakes etc.)	3	3	9	Low
		Likely	Major	Significant	
15	Impact on Community Safety	3	3	9	Low
		Likely	Major	Significant	
16		3	3	9	Low

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
	Livelihood Loss During Land Acquisition	Likely	Major	Significant	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

5.5.1 Lack of Integration of EMP/EIA Requirements into Construction Bid Documents

Assessment

The bidding documents must reflect the requirement to select a qualified and experienced Contractor from the perspective of ensuring implementation of required environmental and social safeguards during project development.

Mitigation Measures

The mitigation measures described below will be implemented while completing the final design of the Project.

- The 'Environment & Social Impact Cell (ESIC), NGC at the project management unit (PMU) to check that design and bid documents are responsive to key environmental, social, and safety considerations, and that the proposed method of work reflects the boundaries defined in the EMP. Further, PMU to ensure the contractor's environmental safeguards capacity before construction starts.
- The bid documents must include the EMP, and its implementation cost must be reflected in the bill of quantity (BoQ).

5.5.2 Lack of Planning in T/L Design[63]

Assessment

Areas in high seismologically sensitive zones can be prone to more earthquakes, which can cause damage to power infrastructure, including transmission lines and pylons. However, no past data was found with NGC or in secondary sources that the project area has experienced power infrastructure damage due to earthquakes.

The Climate Risk and Vulnerability Assessment (CRVA) of September 2025 concluded that changes in intensity and frequency of extreme weather events and unseasonal deviations from average weather will affect current and future energy infrastructure, supply reliability, and the energy sector's profitability. Therefore, additional investment is required to ensure the transmission network is resilient to climate change and natural disasters.

According to these classifications (**Section 5.3**), the Project is located in Zone 2 in PBC 2007 classification, which is for the moderate zone where high-intensity earthquakes can lead to moderate damage. Therefore, this aspect must be considered during the TL final design.

The pre-construction (design) phase planning is very important for the following parameters. Better planning will produce less environmental and social impacts during later phases of construction and operations.

[63] Covering (i) Route Selection (i.e. Loss of Biodiversity due to route passing through National Parks or Social issues, resettlement/relocation of assets and displacement of people), (ii) Transmission hindrance for aircraft, (iii) Structure Design (soil erosion, landslide and slope stability impact due to natural geo-hazards), (iv) Tower Placement Add-ons, (v) Visual Amenity, and (vi) Mechanical Failure of the Overhead Conductors.

- Route Selection to avoid major disturbance to settlements, sensitive areas including biodiversity rich areas and aircraft navigation routes.
- Transmission Structure Design
- Tower Placement
- Add-ons
- Visual Amenity
- Mechanical Failure of the Overhead Conductors

Mitigation Measures

The mitigation measures described below will be implemented while completing the final design of the Project.

- Using corridor-sharing with existing T/Ls for minimizing right-of-way (RoW) requirements. Preference will be given to a route with minimum community displacement and minimum tree-cutting requirement.
- Better planning during the selection of RoW will generate fewer negative socioeconomic impacts on the affected persons and help reduce possible damages in future due to floods or heavy rainfall or earthquakes.
- Selection and use of the latest available technology for reducing the magnetic field from T/Ls.
- Choosing a T/L tower with aesthetic appeal such as the darker color of oxidized steel structures may blend in better with nature.
- Making minor adjustments in tower locations to avoid archaeological sites or minimize effects on agricultural operations.
- Adding flight diverters/ color markers to conductors to minimize bird collisions with the wires.
- Location of high-voltage transmission and distribution lines in less populated areas, where possible, to mitigate the impact on natural disasters (floods), visual amenity and noise. This will also create less land acquisition and resettlement issues.
- T/L will pass through the sparsely populated areas, and proper design planning is still required to avoid minimal disturbance to local businesses, residential areas, public facilities, and utilities.
- Mechanical failure of overhead conductors can happen as the material ages and degrades. Use of high-quality material and proper installation of conductors will reduce the risks in the long term.
- The structures of the T/L such as tower bases should be built as per the rules of the Pakistan Building Code (PBC).
- The tower bases should be built considering the local climatic conditions.

- Project construction facilities should be built considering climatic conditions such as risk of flash flooding in case of high precipitation events.
- Material testing and tensile strength of conductors must be checked before commencement of works.

5.5.3 Lack of Project Human Resources

Assessment

The lack of environmental and social safeguards team and lack of capacity within the project proponent and contractors create implementation issues of the project environmental safeguard documents, including local law requirements, EIA, and NoC.

Mitigation Measures

The mitigation measures described below will be implemented while completing the final design of the Project.

- The ESIC/PMU to make sure that it is staffed by the EHS Manager, the Deputy EHS Manager and the Assistant EHS Manager in addition to the social safeguard staff.
- The ESIC/PMU to ensure, contractor's environmental safeguards capacity before construction starts. Make sure that the Construction Contractor assigns and retains a full-time and qualified ESO and a full-time and qualified HSO.

5.5.4 Improper Location of Construction Camps

Assessment

The selection of campsites for construction and field residence is a very important step to be taken by the contractors before mobilization for construction. Poor planning in the selection of the sites and poor camping facilities can cause environmental and social issues during construction.

Campsites near residential areas can cause disturbance to the local community and invade their privacy.

Construction camp sites may lead to environmental degradation in the surrounding area, including soil and vegetation/crops disruption, and pollution. This can have an impact on the livelihoods and health of local communities.

Mitigation Measures

The mitigation measures described below will be implemented while completing the final design of the Project.

- Camps to preferably set at already existing NGC facilities. Otherwise, camp locations must be at least 200-300m from the sensitive receptors, including settlements and water bodies.

- Development of the campsite plans indicating walkways, car parking, recreational areas, rooms, kitchen, dining, storm run-off, toilets and sewerage lines and treatment, disposal, freshwater storage, and lines, etc.

5.5.5 Selection of High-Noise Equipment in the Planning Stage

Assessment

An increase in ambient noise levels is expected in the construction phase of the Project, especially in areas near sensitive receptors and during the operation phase due to the corona effect (hissing noise produced due to ionization of air around high voltage T/L). An early assessment of the pre-construction (design) phase of sensitive receptors will be useful.

Mitigation Measures

The following measures will be implemented to ensure that the cumulative noise impacts are within acceptable limits during construction activities:

- Construction Contractor to conduct detailed acoustic assessments before mobilization and include in Site-specific EMP (SSEMP) for all residential buildings, schools, (other sensitive structures within 50m of RoW.
- After the assessment, identify the areas where noise barriers are required. Also, suggest noise-reducing devices for equipment such as mufflers and silencers.
- The audible noise of the T/L (corona effect) is most severe under wet conditions. During detailed design, it will be ensured that audible noise under wet conditions is within acceptable limits.
- During detailed design, it will be ensured that audible noise as per CISPR18-2 “Methods for measurement of RI characteristics of overhead power lines and high voltage equipment” shall be either category I (which is Interference not audible) or category II (which is Interference just perceptible).

5.5.6 Minimization of Waste Generation in Planning Stage

Assessment

The T/L equipment brings a lot of packages of material with it. Preplanning is required for disposal of such packaging materials. Also, during construction, liquid and solid waste is expected to generate such as surplus excavated soil, sewerage waste, hazardous waste, etc.

The appropriate solid and liquid waste management needs to be assessed at the pre-construction (design) phase and its implementation cost must be reflected in BoQ.

The potential kinds of waste that will generate during project implementation phases include:

- Clearing and grading activities can generate tree branches, stumps, and other vegetation waste.
- Material handling activities, such as the transportation of construction materials, can generate packaging waste such as plastic, paper, and cardboard.

- Construction activities such as drilling, trenching, and concrete pouring can generate construction debris such as concrete rubble, metal scraps, and plastic pipes.
- Operational waste: During the operation of the transmission line, maintenance activities can generate solid waste such as used equipment parts, lubricating oils, and batteries.

Mitigation Measures

The following measures will be implemented to ensure that adequate management and disposal options for all wastes are in place:

- Construction contractors can minimize waste generation by implementing efficient work practices, such as reducing the use of packaging materials, reusing, and recycling materials, and planning construction activities to minimize waste generation.
- Different types of waste generated should be segregated, such as metal scraps, concrete, plastic, and hazardous waste.
- Construction materials such as steel, aluminum, and copper can be recycled.
- Disposal of waste should be carried out in an environmentally responsible manner, such as using the local waste management facilities, and recycling facilities,
- Hazardous waste must be disposed of through certified contractors.
- With the help of local waste management authority, suitable location, and method to dispose of waste must be selected based on waste type by ensuring minimize environmental impact.
- Designate disposal sites in the contract and cost unit disposal rates accordingly.

5.5.7 Disruption to Existing Drainage Pathways and Utilities

Assessment

The construction of Project may affect the drainage system and irrigation crossings and other public utilities if fall within right of way (RoW) or at tower supporting sites.

Construction activities near other public utilities, such as roads, bridges, and water supply systems can cause disruptions to these services and may require additional construction or maintenance work to ensure that they remain functional.

Mitigation Measures

- The possible mitigation measures, to be included in preliminary and detailed designs, are as follows:
- Transmission line construction should be planned and designed to minimize the impact on drainage systems, and other public utilities. This may involve avoiding sensitive areas or using alternative construction methods where possible.
- Identify locations where drainage or irrigation crossing, utilities within RoW may be affected by works.

- Regular monitoring of the construction site can help to identify and reduce potential impacts.
- Appropriate construction methods should be implemented to minimize the impact on drainage systems and other public utilities. For example, trenchless construction methods can be used to minimize excavation, and protection works to reduce disturbance to existing infrastructure.
- After construction is completed, restoration and rehabilitation of impacted drainage systems, and other public utilities should be undertaken to ensure that they are returned to their pre-construction condition.

5.5.8 Removal of Vegetation/Trees

Assessment

Most of the TL will pass through agricultural fields and partly pass through national parks. The local species of forest/wild trees, fruits, and vegetable orchards are raised by the local farmers. The current T/L will have an impact on these sources initially. The proposed T/L is expected to pass through Chinji National Park and Kala Chitta National Park.

Lack of planning in clearing RoW from trees can cause unnecessary cutting of trees.

The proposed T/L will pass through agricultural fields, including orchards raised by the farmers of the project area, and approximately 6,180 trees will be cut down, in which 900 are wood trees, whereas 5,280 are fruit trees. The details of the trees to be cut are given in **Table 5-5**.

All the tree details are approximate and tentative; the final number of trees and other resources will be provided/finalized during the construction phase of the project.

Table 5-5: Tree Species Potentially being Affected

Sr. No.	Local Name of Tree	Botanical Name	No. of Trees
Wood Trees			
1.	Phulai	Acacia modesta	222
2.	Kahu	Olea ferruginea	196
3.	Shisam	Dalbergia sissoo	170
4.	Eucalyptus	Eucalyptus camaldulensis	176
5.	Mulberry	Morus alba	74
6.	Neem	Azadirachta indica	62
	Sub-Total (A)		**900**
Fruit Trees			
7.	Plum	Prunus domestica	214
8.	Peach	Prunus persica	336
9.	Apricot	Prunus armeniaca	320
10.	Mango	Mangifera indica	410

Sr. No.	Local Name of Tree	Botanical Name	No. of Trees
11.	Citrus / Orange	Citrus sinensis	3,232
12.	Guava	Psidium guajava	768
	Sub-Total (B)		**5,280**
Total (A+B)			**6,180**

Mitigation Measures

The proposed mitigation measures will include:

- Incorporate technical design measures to minimize the removal of these trees and plantations, as far as possible.
- Compensatory planting of ten (10) trees against each fallen tree of similar floral function shall be planted; and,
- The plantation plan shall prefer the prevalent indigenous species of plants and ensure that there will be no exotic species in the plantation plan with known environmental setbacks.

5.5.9 Impacts on Sensitive and High Value Areas

Assessment

The T/L is passing mainly through agricultural fields and sparsely populated areas. However, a few protected areas such as Chinji National Park and Kala Chitta National Park, the RoW needs to be considered and well-planned during the design phase, ensuring minimum disturbance to the sensitive and high-value areas.

Mitigation Measures

The following mitigation measures will be implemented:

- Sitting the Project facilities away from any residential area and sensitive areas.
- If, siting of Project facilities cannot be avoided altogether, the area of disruption should be minimized, and the impacts should be mitigated.
- Using already existing RoW of transmission lines and roads.
- Final design will be prepared in a way that no mosques, graveyard, tomb, or any other religious/archaeological site within 20m boundary from the edge of the Project.
- No tower location will be spotted within water ways and nullahs.
- Construction of towers within national parks if not avoidable, should be completed with limited disturbances to flora and fauna.

5.5.10 Bird Collision and Electrocution Risk

Assessment

The transmission Line Intersecting the Indus Flyway.

Collisions may also occur if the T/Ls are difficult to see. Earth wires (sometimes called static or ground wires, which protect the power line from lightning strikes) are thought to be responsible for a much higher rate of collisions than the thicker, often bundled conductor wires. This is because they are harder for birds to see and are typically positioned at the top of the wire array, putting them in the flight path of birds which have taken avoiding action to fly over the conductors.

In addition to the above, bird collisions with power lines may result in power outages and fires.

Avian collisions with power lines could occur if located within daily flights or migration corridors, or if groups are traveling at night or during low-light conditions. Thousands of migratory birds like cranes, geese, ducks, storks, and raptors such as the Steppe Eagle migrate to Pakistan from Europe, and the Central Asian States each year during winter due to extreme winter conditions there. These migratory birds mostly enter Pakistan's northern area and follow the Indus Flyway and reach the southern part of the country, and they return to their native ground before the start of summer. The proposed project lies in the Indus Flyway, and common migratory birds that pass through this area include Northern Shoveler Spatula clypeata, *Bar-Headed Goose* Anser indicus, *Gadwall* Mareca strepera, *Mallard* Anas platyrhynchos, *Eurasian Teal* Anas crecca, *Northern Pintail* Anas acuta, Common Pochard Aythya ferina, Common Crane Grus grus, Demoiselle Crane Grus virgu, *Little Grebe* Tachybaptus ruficollis, etc. These migratory birds fly along the Indus Flyway at different times of the day. There are many stopover and wintering grounds for migratory birds (e.g., Kallar Kahar Lake) close to the proposed transmission line.

These migratory birds may use these wintering grounds as a resting ground during their migration to Pakistan, and as the transmission line is located in the migratory birds' flyway so there is a potential risk that collision with the proposed transmission line may occur.

Mitigation Measures

Reflective balls or a moving tag with different colors should be installed on lines to attract the birds’ attention. Reflective ball installation is very important for reducing mortality, especially among the nocturnal migrant species.

A line space of about 2.5m should be ensured between different conductors and between conductors and grounded wires or hardware. This mitigation will minimize the electrocution of large-sized birds such as vultures and other raptor species.

After implementing the above measures, the residual impact is considered low.

5.5.11 Electromagnetic Field (EMF)

Assessment

Electric fields are produced by voltage and increase in strength as the voltage increases whereas magnetic fields result from the flow of electric current and increase in strength as the current increases. The operation of the Project will result in the production of EMF which needs to be controlled to protect the environment and public health.

EMF is also created by electrical household appliances such as motors in refrigerators, vacuum cleaners, microwaves, televisions, and computers. Due to the proximity of humans to household appliances, the level of EMF is often far greater than those levels produced by T/Ls fixed on high towers.[64]

Magnetic fields generated by electric lines are in the extremely low-frequency (ELF) range of the electromagnetic spectrum. The energy from these magnetic fields is very small. Magnetic fields from appliances and T/Ls cannot break molecular bonds. The highest frequency electromagnetic radiation, like gamma rays, can break apart DNA and lead to cancer. Low frequency radiation such as microwaves, do not have enough energy to break molecular bonds but can heat food items.[65]

For overhead T/Ls, the magnetic fields typically range from about 5 to 150 mG (**Table 5-**6) depending on current load, separation of the conductors, and distance from the lines. In general, at a distance of about 300 feet from a T/L, measured magnetic fields are similar to typical ambient background levels found in most homes.[66]

The electromagnetic field interference is significantly dependent on the power line configurations, separation distance between T/L and objects underneath, separation distance between conductors of T/L, the T/L tower height, existence of the earth wire, and the length of system parallelism.[67]

In the literature, magnetic field data are presented in either units of Gauss (G) or Tesla (T). A milligauss (mG) is equal to one-thousandth of a Gauss (G). One Tesla is equal to 10,000 Gauss. A microtesla (μT) is equal to one-millionth of a Tesla or 10 mG.

Magnetic field strength and distances from overhead T/Ls is provided in **Figure 5-1**. This generalized graphic view shows how magnetic fields quickly diminish with distance.[68]

64 https://psc.wi.gov/Documents/Brochures/EMF.pdf.

65 Ibid.

66 Ibid.

67 Chaaban, Farid & Hassan, Heba. (2009). Modelling and Measurements of the Electromagnetic Field of High Voltage Transmission Lines: A Practical Case in Lebanon.

68 Ibid.

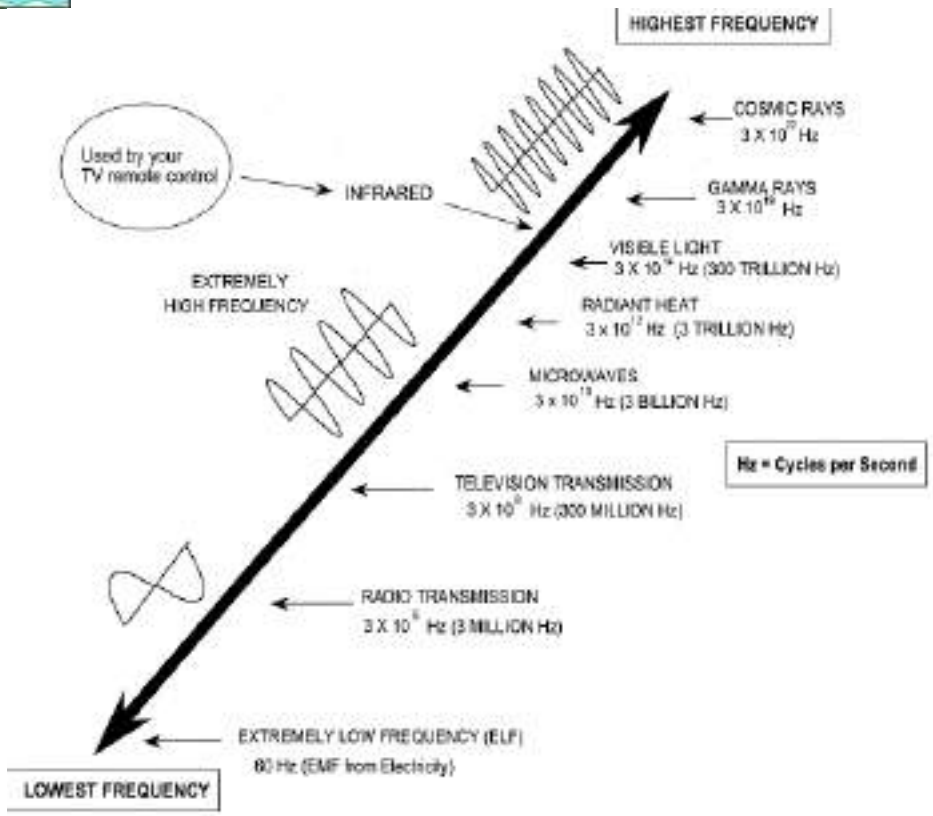


Figure 5-1: Electromagnetic Spectrum

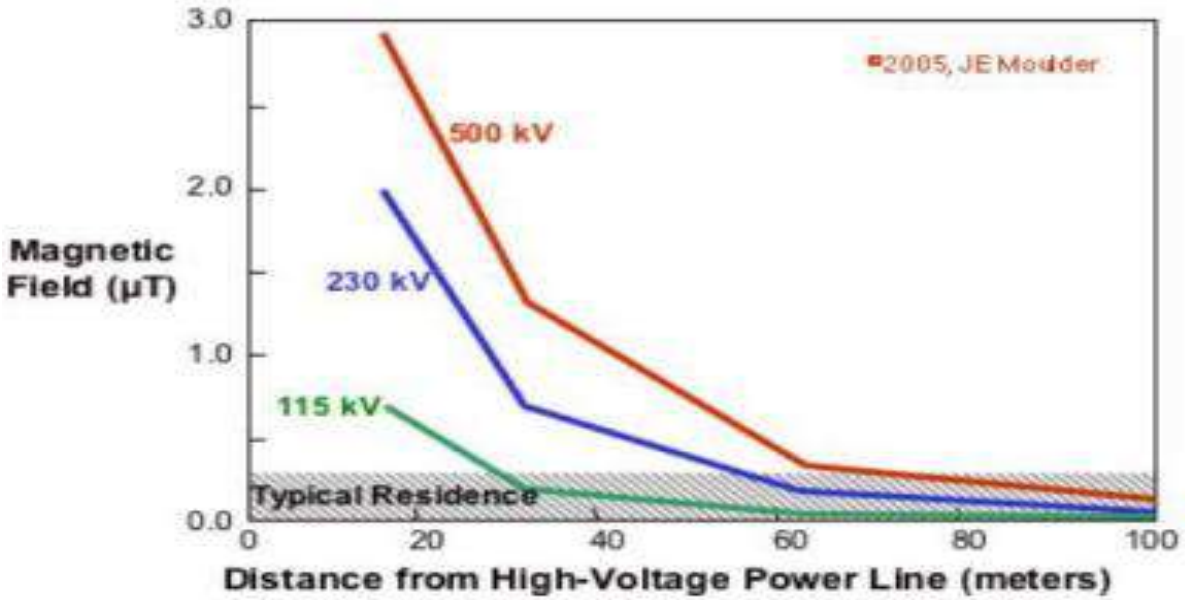


Figure 5-2: Magnetic Strength from Overhead T/Ls

Table 5-6: Magnetic Fields Observed for Overhead Transmission Lines

Overhead Transmission Line Voltages	Usage	Typical Magnetic Field Measurements (mG)				
		Maximum in ROW	Approximate Distance From Centerline (Feet)			
			50	100	200	300
115 kV	Average	30	7	2	0.4	0.2
	Peak	63	14	4	0.9	0.4
230 kV	Average	58	20	7	1.8	0.8
	Peak	118	40	15	3.6	1.6
500 kV	Average	87	29	13	3.2	1.4
	Peak	183	62	27	6.7	3.0

Table 5-7: Safety Distances for 500kV Transmission Line

Sr. No.	Description	Clearance (m)
1	Across Country	9.00
	a. Across Street or Intersection	9.00
	b. Along Street	9.00
	c. Across Private Property, Footpath and Places Inaccessible to Vehicular Traffic	8.00
2	Roads and Highways	11.75
3	Rivers and Major Canals H.F.L	9.14
4	Railway Track (inside/outside station limit)	11.75
5	Building Part (Vertical & Horizontal)	8.00
6	Earth Part of Lines (insulated services, guys, earth wire, etc.)	4.00
7	Telegraph Lines	4.57
8	132kV Lines	4.50
9	220kV Lines	5.00
10	500kV Lines	6.70

Source: National Electrical Safety Code, Rev 12

Many studies have been conducted by researchers through animal experiments, clinical studies, computer simulations, and human population (epidemiological) to determine the relationship between exposure to electromagnetic fields and impact on health such as childhood leukemia,[69] cardiovascular disease, cancer etc. In the past, numerous reports have presented conflicting information. Some of these reports have provided evidence of adverse health effects like anxiety and poor sleep;[70] while the results of most of these studies did not

[69] Tynes, T., & Haldorsen, T. (1997). Electromagnetic fields and cancer in children residing near Norwegian high-voltage power lines. *American journal of epidemiology*, *145*(3), 219-226.

[70] Bagheri Hosseinabadi, M., Khanjani, N., Ebrahimi, M. H., Haji, B., & Abdolahfard, M. (2019). The effect of chronic exposure to extremely low-frequency electromagnetic fields on sleep quality, stress, depression and anxiety. *Electromagnetic biology and medicine*, *38*(1), 96-101.

indicate any correlation between the electromagnetic field and chronic diseases emanating from power lines.[71] [72] [73]

Birds use electrical power lines, and towers for perching and nesting. Therefore, many bird species, like humans, are exposed to EMFs throughout their lives.[74]

The impact for this Project is low, as most of the Project RoW passes through agricultural fields or barren areas or forest areas. The impact of EMF can be moderate where settlement and commercial activities are ongoing.

Mitigation Measures

The following measures will be implemented at the pre-construction (design) phase to reduce the future impact on the environment:

- NGC's standard operating procedures (SOPs) of a minimum vertical ground clearance for T/L conductor mentioned in **Section 3.6** will be ensured.
- Raising the conductor's height above the ground to 8 m, typically by increasing tower height, would be ideal.
- Reducing conductor spacing.
- Arranging phases so that fields tend to cancel.
- Increasing transmission voltage (since magnetic field intensities are a function of current, and increased voltage, all things being equal, will result in reduced current).
- Reducing loads (and therefore, currents).
- Identification of potential exposure levels in the work area, including surveys of exposure levels and establishment of safety zones.
- Safety signs and warning zones should be highlighted to indicate EMF in the area.
- Limit access to properly trained workers and those equipped with appropriate PPE when entering safety zones.
- Increasing right-of-way widths or buffer zone widths, to move people further from T/Ls.
- Depth of trenches from the living environment will provide a reduction in EMF exposure since Magnetic field strength attenuates rapidly with distance from the source.

[71] Liu, J., Dawalibi, F. P., Ma, J., & Mitskevitch, N. (2006, August). Modeling techniques for analyzing electromagnetic interference caused by high voltage power lines to neighboring communication cables. In *The 2006 4th Asia-Pacific Conference on Environmental Electromagnetics* (pp. 235-243). IEEE.

[72] Valberg, P. A. (1996). Electric and magnetic fields (EMF): What do we know about the health effects. *International archives of occupational and environmental health*, *68*(6), 448-454.

[73] Kim J Fernie and S James Reynolds. The effects of electromagnetic fields from power lines on avian reproductive biology and physiology: a review. *Journal of toxicology and environmental health. Part B, Critical reviews.* Vol. 8(2).

[74] Biasotto, L. D., & Kindel, A. (2018). Power lines and impacts on biodiversity: A systematic review. *Environmental Impact Assessment Review*, *71*, 110-119.

5.5.12 Impact on Community Safety due to the Structure/ Mechanical Failure of the Overhead Conductors.

Assessment

Structure failure, especially near or at residential areas, may create public safety issues if robust design and construction using appropriate materials and design standards are not followed in the event of extreme weather and climatic conditions.

Overhead conductors are typically high voltage power lines, and mechanical or structural failure can result in electrical contact with the ground or other conductive objects, causing electric shocks that can be fatal or cause serious injuries.

Mitigation Measures

The following mitigation measures will be implemented at the pre-construction (design) phase:

- Ensure all safety aspects related to the safety of structure is considered.
- Ensure seismic design requirements are incorporated in the Project design.
- The T/L will be constructed using a very robust design and there is very low probability of mechanical failure even under extreme weather conditions. Nonetheless, the following special arrangements will be made in this section to ensure safety in case of mechanical failure of the T/L conductors.
- Installation of special tower/pole structures that would support a long span of up to 500m so that no tower/pole has to be installed inside the streets.
- Special tower/pole structures will be designed with load safety margin factor of 2.5 instead of generally used 1.5, thus having an extraordinary strength bearing margin to cater for any untoward mechanical hazardous situation.
- Special tower/pole structures will be designed to achieve enhanced vertical ground clearance of 15-20 meters, whereas the standard requirement of ground clearance of 500kV line is 7.1 meters.
- Installation of grounded metallic mesh beneath the lowest conductor to act as fall arrester in case of mechanical failure of the conductor in residential areas.
- The contractor will be responsible for refilling the trenches and restoring the excavated area to its original state. In the case of roads, this process will include levelling and surfacing the road with bitumen.
- Adequate lighting will be implemented near the trenches during nighttime.
- Appropriate warning signs will be placed at diversions, danger points, culverts, bridges, and construction sites to prevent accidents, especially during nighttime.

5.5.13 Land Acquisition

Assessment

Though no land will be acquired permanently for T/L, damage (infrastructure, crops, and trees) to the land may occur during T/L construction. T/L will also cross public infrastructures such

as roads and utilities, and so it may be impacted during the construction phase, causing traffic congestion and disturbance to the utility supply. This may result in loss of land, assets and time wastage for people commuting on this route. This impact will be permanent and highly adverse in nature.

Mitigation Measures

The proposed T/L will not involve the permanent land acquisition as per NGC practice in the light of Land Acquisition Act (LAA), 1894 and Telegraph Act, 1910. No permanent land acquisition will be made for the land at the tower footings as the landowner will be allowed to use the area under the towers after the installation. During the previous studies on other similar projects, it was particularly observed that people are using the land under the towers for agricultural purposes. However, for the construction of contractor camps, access roads, borrow areas etc., temporary lease of the land will be required.

Mitigation measures will involve careful alignment selection by the designer to minimize the impact by avoiding the acquisition of residential and commercial areas. Also, an adequate budget shall be provided in the project cost for the compensation to the affected people as per the Land Acquisition Act, 1894 and framing of a judicious and fair compensation package for the provision of compensation on the prevailing market rates.

- Where land acquisition is involved, NGC will follow the applicable law, the Land Acquisition Act 1894
- NGC to select the route in a way that minimum impact on infrastructure, trees and crops occur.
- Assessment of loss of land, trees, and crops (if any) due to construction of T/L towers.
- Preparation of land acquisition and resettlement plan (LARP) for the proposed Project before commencement of construction activities.
- All the impacts identified by the IEE will be incorporated into the project LARP and relevant entitlements will be included into the Entitlement Matrix.
- All the payments / entitlements are paid according to the Entitlement Matrix, prepared according to the LARP.

According to the Land Acquisition Act 1894, the following points are to be considered while determining compensation to the project affectees:

- The market value of the land at the date of publication of the notification under section 4 sub subsection (1).
- The damage sustained by the person interested, because of the taking of any standing crops, or trees which may be on the land at the time of the collector's taking possession thereof.
- The damage if any sustained by the person interested at the time of the collector's taking possession of the land because of acquisition injuriously affecting his other property, moveable, or immoveable, in any other manner, or his earning; and

- As a consequence of the acquisition of the land by the collector, the person affected is compelled to change his residence or place of business, the reasonable expenses incidental to such change.

5.6 Construction Phase Impacts

The construction phase impacts on the physical environment, ecology, and socioeconomic environment are listed separately in the sections below.

A summary of potential impacts at the construction phase, based on the methodology discussed in **Section 5.4**, is provided in **Table 5-8**.

Table 5-8: Potential Impacts during Construction Phase

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
Potential Impacts on Physical Environment					
1	Impacts of Site Accessibility	5	3	15	Moderate
		Certain	Major	Critical Risk Level	
2	Dust from construction activity and Air emissions from construction equipment and vehicles	5	3	15	Low
		Certain	Major	Critical Risk Level	
3	Noise from construction vehicles and heavy equipment	5	3	15	Low
		Certain	Major	Critical Risk Level	
4	Sediment run-off from construction sites	3	3	9	Low
		Likely	Major	Significant	
5	Impact on Water Resources Quality and Quantity	3	3	9	Low
		Likely	Major	Significant	
6	Untreated disposal of effluent from worker camps and batching plant(s)	3	3	9	Low
		Likely	Major	Significant	
7	Vibrations	3	2	6	Low
		Likely	Moderate	Moderate	
8	Traffic Congestions	3	2	6	Low
		Likely	Moderate	Moderate	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
9	Solid Waste Disposal	3	3	9	Low
		Likely	Major	Significant	
10	Impact on Occupational Health and Safety	3	3	9	Low
		Likely	Major	Significant	
12	Existing T/L Crossings	3	3	9	Low
		Likely	Major	Significant	
13	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	
Ecological Resources					
1	Habitat Fragmentation and Vegetation Loss, especially in Protected Areas (e.g., Chinji and Kala Chitta NPs)	3	3	9	Low
		Likely	Major	Significant	
2	Noise from Construction Activities and Camps may Cause Disturbance to Avifauna and Mammals.	3	3	9	Low
		Likely	Major	Significant	
3	Dust, Emissions, and Chemical Spills Affect Birds and Habitat Quality	3	3	9	Low
		Likely	Major	Significant	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
4	Accidental Death of Reptiles and Small Mammals during Site Clearing, Excavation and Rehabilitation Activities at Construction Sites and Camps (esp. In hibernation season)	3	3	9	Low
		Likely	Major	Significant	
5	Increased Accessibility Leading to Illegal Poaching of Species Like the Pangolin and Migratory Birds	3	3	9	Low
		Likely	Major	Significant	
6	Spread of Invasive Plants (Prosopis, Parthenium) due to Surface Soil Disturbance	3	3	9	Low
		Likely	Major	Significant	
7	Construction Activities During River Crossing Will Affect Aquatic Life and Riparian Habitat	3	3	9	Low
		Likely	Major	Significant	
8	Loss of Nesting Resources for Ground-Nesting Birds due to Erosion and Soil Compaction	3	3	9	Low
		Likely	Major	Significant	
9	Work during Bird Migration Season Potentially Causes Disturbance and Increased Bird Deaths	3	3	9	Low
		Likely	Major	Significant	
Community Health, Safety, Occupational Safety and Socioeconomic Impacts					
1	Increased Employment Opportunities and local economy (Positive Impact)	3	2	6	Low
		Likely	Moderate	Moderate	
2	Overutilization of local resources	3	2	6	Low
		Likely	Moderate	Moderate	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
3	Social Conflicts due to the Influx of Workers/ Resources	3	2	6	Low
		Likely	Moderate	Moderate	
4	Impact on Community Health and Safety Risk	2	3	6	Low
		Unlikely	Major	Moderate	
5	Impact on Physical Cultural Resources (PCRs)	2	3	6	Low
		Unlikely	Major	Moderate	
6	Uncontrolled solid waste disposal, communicable diseases	3	3	9	Low
		Likely	Major	Significant	
7	Natural Hazard Risks (Flooding, Earthquakes etc.)	2	3	6	Low
		Unlikely	Major	Moderate	
8	Security of Construction Crew and Project Facilities	3	3	9	Low
		Likely	Major	Significant	
9	Loss of Income/livelihood	2	3	6	Low
		Unlikely	Major	Moderate	
10	Relocation of Infrastructure	2	3	6	Low
		Unlikely	Major	Moderate	
11	Gender Issues	2	3	6	Low
		Unlikely	Major	Moderate	

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
12	Effects on Indigenous People	2	3	6	Low
		Unlikely	Major	Moderate	
13	Impacts on local communities/workforce	3	3	9	Low
		Likely	Major	Significant	
14	Traffic Congestion	2	3	6	Low
		Unlikely	Major	Moderate	
15	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

5.6.1 Physical Environment

Impacts from site accessibility

Assessment

The proposed T/L from Ghazi Barotha to Faisalabad West can be approached through various major roads and the railway network from upcountry and down country such as Bhowana-Pansra Road, Bhowana-Aminpur Road, Jhang-Chiniot Road, Silianwali-Jhamra Road, Jhang-Sargodha Road, Shahpur-Sahiwal Road, Khushab-Sargodha Road, Talagnag-Chakwal Road, Talagang-Fatehjang Road, Pindi Gheb-Attock Road, Islamabad-Dera Ismail Khan Motorway (M-14), Rawalpindi-Kohat Road and Fatehjang-Attock Road.

Development of new access roads/tracks and upgradation of existing roads/tracks may be required for accessing tower locations. Apart from the above, the proposed T/L is also crossing through hilly / semi-hilly terrain having accessibility issues which may require construction of access roads up to the tower locations.

Mitigation Measures

According to usual terms and conditions laid down by NGC, the Contractor will be bound not to cause any damage to the existing roads and tracks during construction works and due to the movement of heavy vehicles. However, in case of any damage, the Contractor will be responsible for its repair. In this regard, NGC binds the Contractor by withholding a 10% amount from the Contractor's interim bills submitted to the Engineer for payments to encourage the Contractor to complete their pending works.

For the development of new access roads, the contractor will be bound to consider the following mitigations to reduce the severity of this impact:

- Selection of access roads/tracks should be based upon certain criteria to ensure high stability, no or minimum tree cutting, least impact on fauna and avi-fauna, minimum disturbance to nearby settlements and other social amenities.
- The approach roads should be selected to avoid any soil degradation and erosion impacts.
- Compensation for the loss of trees and crops will be provided to the owner.
- Special care should be taken for known sensitive areas to ensure that all interested parties are aware of the type and location of work. Measures should be taken where necessary to protect such areas physically.
- Mitigations for the loss of tress and crops, soil erosion, soil contamination, air and noise pollution, waste generation, and loss of agricultural land provided in sections below will be adopted.

Once the mitigation measures given above are incorporated, it is expected that the project will not have any significant incremental impact related to the baseline dust and gaseous levels of

the area and economic losses from tree and crop damage. The effectiveness of the mitigation measures will be monitored during the construction and restoration phases.

Dust from construction activity and Air emissions from construction equipment and vehicles

Assessment

Fugitive dust and other emissions are expected from excavation, earthwork, construction site camps, vehicle traffic, and other construction activities including land clearing activities and materials stockpiles.

The baseline values for particulate matter were deducted from 62.32 to 90.0 µg/m^3 for PM_{10} and 10.21 to 29.6 µg/m^3 for $PM_{2.5}$. The values are well within PEQS but exceeding WHO AQGs values for PM_{10}, indicating already existing air pollutants in the area.

The construction works will be carried out within RoW i.e. 25m on both sides of T/L route. Since the T/L is passing nearby settlements therefore some sensitive receptors such as educational institutes, health facilities, and mosques are located at within <100m from center of T/L route.

The major activities related to construction which will generate dust emissions (or PM) during the construction phase include digging, excavation, vehicular movement, site preparation, loading/unloading of materials, stockpiles, compacting and rehabilitation of surface.

The amount of dust generation is highly dependent on the activity type, construction methods, and weather conditions during the activity hence any estimation of dust generation is highly uncertain therefore a worst-case area-based emission factor has been used to estimate the dust emissions from the construction activities. Level 1 general emission factor suggested in '*Improvement of Specific Emission Factors (BACM Project No. 1)' report (MRI 1996) prepared for the South Coast Air Quality Management District*' have been used to estimate the emissions from the construction activities (Muleski, G.E, Garman G. 1996).[75] The suggested emission factor of 0.11 ton/acre-month for average conditions and 0.40 ton/acre-month for worst-case scenarios (construction sites with active large-scale earth moving operations) were considered and worst-case scenario has been used for impact assessment.

- Emission Factor: 0.40 ton/acre-month
- Project Site Active Area: 154.3 Acre [a]
- Construction Phase time: 18 months
- Total Emission = 0.40 × 154.3 × 18 = 1067.8 tons in 18 months
- Emission Rate: 1.32 × 10^{-10} g/s/m^2 (208 hours per month Assumed)

Notes: [a] Right of way of 30m and 20km long and two campsites of approximately 6 acres land.

[75] Muleski, G.E, Garman G. (1996). Improvement of Specific Emission Factors (BACM Project No. 1); Prepared for South Coast Air Quality Management District, Contract 95040; Diamond Bar, CA.

Although the estimated emission rates are not significant, but as discussed before, the baseline concentrations of PM in the area are higher than the WHO AQGs values, therefore, additional dust could further deteriorate the quality of air in the area if not mitigated.

During the construction phase, the area of probable impact for air can typically reach 500m from the boundary of the construction site. It is envisaged that in areas more than 500m away from the construction area, the impact due to fugitive dust will be insignificant due to settling effects, unless there are exceptional gusts of wind, in which case a small amount of very fine dust particles (<10µm in diameter) could reach up to 1,000 m. Apart from human health impacts and nuisance, PM_{10} and $PM_{2.5}$ when deposited on vegetation inhibits photosynthesis and potentially degrades habitats and also affect the crop yield of agricultural fields nearby.

Therefore, based on the above discussions, unmitigated air quality impacts due to dust emissions are considered to be significant.

Mitigation Measures

A Dust Management Plan must be prepared by the Contractor.

The following mitigation measures will be used to limit dust generation during construction activities:

- Water will be sprinkled through a dedicated water-bowser at source, around the construction site and along the routes used for construction activities to prevent the generation of dust and to minimize the vicinity of settlements (houses, mosques, schools, markets and businesses, and hospitals), water bodies, orchards and fruit farms
- A speed limit of not more than 30 kilometers per hour (km/h) will be imposed on the vehicles in areas where the potential for dust generation is greater, including unpaved roads
- Fuel-efficient and well-maintained haulage trucks will be employed to minimize exhaust emissions
- Vehicles transporting soil, sand and other construction materials will be covered
- The movement of vehicles through densely populated areas will be avoided
- Water will be sprayed in bare areas that are prone to high dust emissions
- Stockpiled soil and sand will be kept slightly wet before loading, particularly in windy conditions
- Dust emissions at the camp and construction sites are to be minimized by implementing good housekeeping and sound management practices
- All project vehicles and other equipment will be maintained as per PEQS for vehicular emissions
- train the drivers to follow the plan, including being careful with speed limits, remaining on predefined haul routes, following safety rules, etc.

- The construction material will be stored in the boundary wall and no disturbance to the surrounding areas is expected. The contractor will be, however, be required to provide a traffic management plan before the commencement of work at the site.
- The need for large stockpiles will be minimized by careful planning of the supply of materials from controlled sources. Stockpiles (if required) will not be located within 30m of schools, hospitals, or other public amenities such as wells and pumps and should be covered with tarpaulins when not in use and at the end of the working day to enclose dust.
- Concrete plants will not be located close to any sensitive receptors.

Once the mitigation measures given above are incorporated, it is expected that the project will not have any significant incremental impact on the baseline dust and gaseous levels of the area. The effectiveness of the mitigation measures will be monitored during the construction and restoration phases.

Noise from construction vehicles and heavy equipment

Assessment

The T/L Row passes mostly through sparsely located settlements, hilly areas, and agricultural land.

The baseline values for noise levels at measured locations were found from 27.67 dBA to 42.03 dBA. The values are well within PEQS and WHO AQGs values.

The construction works will be carried out within RoW i.e., 25m on both sides of T/L route.

No or limited blasting activities (only in the salt range area) are anticipated in RoW.

Construction activity employing heavy machinery such as powered mechanical equipment and heavy traffic, such as trucks for transportation of construction materials and supplies can generate significant noise and vibration. The cumulative effects of several machines can be significant.

Table 5-9 represents typical noise levels from various construction equipment items[76]. It should be noted that the values indicated in the table may differ depending on the brand and age of machinery provided/used by the construction company.

Table 5-9: Construction Equipment Noise Ranges, dB (A)

Equipment	Quantity	Usage Factor %	Usage Factor	Distance ft	Actual Lmax (50ft)	Lmax	Leq
Batch Plant		15%	0.15	1066	83	56.4	48.2
Concrete Mixers	1	40%	0.40	1066	78.8	52.2	48.2
Crane	1	16%	0.16	1066	80.6	54.0	46.1

[76] EIA of PVC and Polymer Plant, Engro, Karachi/ EIA of Naveena Steel Mills, Karachi and other literature.

Equipment	Quantity	Usage Factor %	Usage Factor	Distance ft	Actual Lmax (50ft)	Lmax	Leq
Excavator	1	40%	0.40	1066	80.7	54.1	50.1
Tractor/Trolley	2	40%	0.40	1066	80	53.4	49.4
Bulldozers		40%	0.40	1066	80	53.4	49.4
Paver		50%	0.50	1066	77	50.4	47.4
Compactor	1	20%	0.20	1066	83	56.4	49.4
Pumps		50%	0.50	1066	77	50.4	47.4
Generators	1	50%	0.50	1066	80.6	54.0	51.0
Vibrators	1	20%	0.20	1066	76	49.4	42.4
Drilling machines		10%	0.10	1066	90	63.4	53.4
Compressors	2	40%	0.40	1066	77.7	51.1	47.1
Dump Truck	1	40%	0.40	1066	76.5	49.9	45.9
Welder	1	40%	0.40	1066	74	47.4	43.4

Mitigation Measures

A Noise Management Plan must be prepared by the Contractor.

The following specific measures will be adopted to mitigate any potential issues.

- No nighttime work will be allowed in residential areas of T/L's RoW.
- All heavy equipment and machinery will be maintained as per PEQS guideline values and with effective noise controlling devices in place such as silencers.
- To keep in line with the best international practice, construction work will only be conducted during daytime. No construction activities will be allowed during nighttime (10 PM to 6 AM).
- Vibration from the construction of piles to support pads may be required for some tower construction and maybe a significant impact but this should be for a short duration. Where vibration could become a major consideration (within say 50m of schools, religious premises, hospitals, or residences) a building condition survey will take place before construction.
- The physical effect of piling will be assessed before construction and measures will be discussed with the local population as well as the timing of the works to serve as a vehicle for further public consultation at the implementation stage and to assist in public relations.
- At nearby schools, the contractor will discuss with the school principals the agreed time for operating these machines and completely avoid machine use near schools during examination times, if such a need arises.

- The noise level from construction activity can be reduced by regular maintenance of machinery. Noise can be controlled through engineering control e.g., hammering actions can be substituted by hydraulic.
- Ensure that the workers are wearing the necessary personal protection equipment (PPE's) such as earplugs, earmuffs, etc. where engineering control is not applicable to reduce the impact of noise.
- Equipment emitting excessive noise in comparison with other similar equipment will not be allowed to operate.
- Equipment under use will be regularly maintained, tuned, and provided with mufflers and speed controls to minimize noise levels.
- Blowing horns on all access roads except under emergency conditions will be prohibited.
- Muffled breakers and silenced diesel generators and compressors will be used to reduce construction noise.
- Contractors will take necessary measures to minimize noise nuisance using acoustic enclosures and barriers.

Once the mitigation measures given above are incorporated, it is expected that the project will not have any significant incremental impact on the baseline noise levels of the area. The effectiveness of the mitigation measures will be monitored during the construction, restoration, and operation phases.

Vibration

Assessment

Piling-induced ground vibrations can lead to human disturbance and structural damage.

Other construction activities employ heavy machinery such as powered mechanical equipment and heavy traffic, such as trucks for transportation of construction materials and supplies, can also generate vibration. The cumulative effects of several machines can be significant.

The construction works will be carried out within RoW, i.e., 25m on both sides of T/L route.

The majority of T/L falls in sparsely populated areas. Some sensitive receptors, such as schools and mosques, are located at about 100m from the center of T/L route.

Construction activities generate vibration. These activities include site clearing, site grading and soil compaction, pile driving, installation of deep foundations, and industrial dynamic sources such as forge hammers etc. This vibration-inducing equipment used for land clearing are excavators, dozers, loaders, and large trucks.

For comparison, building impact vibration levels are often noted as a single number quantifying the peak particle velocity (PPV), in in/sec or mm/sec.[77]

Table 5-10 provides a typical construction equipment vibration level. **Table 5-11** provides predicted minimum separation between piling operations and sensitive buildings.[78] These minimum recommended separations are important between the equipment and structures for minimizing vibration impacts.

According to the United States Bureau of Mines (USBM) RI 8507 vibration limits for 1- and 2-story houses, which are the most typical structures in urban and rural areas, the vibration limits in the resonance zone are 12.7 mm/s and 19.0 mm/s for walls with plaster and dry walls, respectively.[79]

British Standard provides vibration guidelines for two types of buildings.

- Industrial and heavy commercial buildings, the limit of 51 mm/s is used for frequencies from 4 to 100 Hz.
- Residential or light commercial type buildings, the limits are: 15 mm/s at 4nHz increasing to 20 mm/s at 15 Hz and then increasing to 50nmm/s at 40 Hz and above.[80]

Table 5-10: Construction Equipment Vibration Level

measured at 7.6m from the source

Equipment	PPV, in in/sec or m/sec
Vibratory Roller	5.6
Mounted Impact Hammer (Hoe Ram)	2.3
Grader	2.3
Compaction Machine	2.3
Excavator	2.3
Large Bulldozer	2.3
Loaded Trucks	1.9
Crane	1.9
Semi-Trucks	1.9
Cement Trucks	1.9
Dump Trucks	0.9

77 Svinkin, Mark R. "A choice of proper criteria for soil and structural vibrations from construction and industrial sources." *ICSMGE 2017â€“19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul, pp 1589â*. Vol. 1592. 2017.

78 D. White, et al. 2022. *Press-In Piling: Ground Vibration and Noise during Pile Installation*.

79 FTA Report No. 0123 (2018), Transit noise and vibration impact assessment manual, U.S. Department of Transportation, Federal Transit Administration.

80 BS 735-2:1993 (1993), Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (British Standard).

Equipment	PPV, in in/sec or m/sec
Jack Hammer	0.9

Table 5-11: Predicted Minimum Separation between Piling Operations and Sensitive Buildings

Building type (vibration limit from Eurocode 3)	Piling method					
	Press-in method (Eq^{n} 4)	Impact hammer (stiff clay / medium dense sand; (C=0.75) (Eurocode 3)		Vibrator (Eurocode 3) kJ/cycle		
		5 kJ/blow	25 kJ/blow	2 kJ/cycle	10 kJ/cycle	50 kJ/cycle
Architectural merit (2 mm/s)	3.5 m	26.5 m	59 m	16 m	36 m	78 m
Residential area (4 mm/s)	1.75 m	13 m	30 m	8 m	18 m	39 m
Light comer-cial (10 mm/s)	0.7 m	5 m	12 m	3.1 m	7 m	16 m
Heavy Indust-rial (15 mm/s)	0.5 m	3.6 m	8 m	2.1 m	5 m	10 m

Mitigation Measures

A Vibration Management Plan must be prepared by the Contractor.

The following specific measures will be adopted to mitigate any potential issues:

- The recommended separations between equipment operations and structures given in assessment above will be maintained during construction.
- It is recommended that construction will not be allowed during nighttime (10 PM to 6 AM) and will only be conducted during daytime.
- Vibration from the construction of piles to support pads may be required for some tower construction and maybe a significant impact but this should be for a short duration. Where vibration could become a major consideration (within say 100m of schools, religious premises, hospitals, or residences) a building condition survey will take place before construction.
- Use of better equipment with less vibration effects will be used such as Free-Suspended Vibrators (FSV).[81]
- The physical effect of piling will be assessed before construction and measures will be discussed with the local population as well as the timing of the works to serve as a vehicle for further public consultation at the implementation stage and to assist in public relations. At nearby schools, the contractor will discuss with the school

[81] VP Ground force. https://www.vpgroundforce.com/gb/footer-links/useful-links/industry-resources/reducing-ground-vibrations-during-the-piling-proce/.

principals the agreed time for operating these machines and completely avoid machine use near schools during examination times, if such a need arises.

- Ensure that the workers are wearing the necessary personal protection equipment (PPE's) such as earplugs, earmuffs, etc. where engineering control is not applicable to reduce the impact of noise.
- Equipment under use will be regularly maintained, tuned, and provided with mufflers and speed controls to minimize noise levels.

Once the mitigation measures given above are incorporated, it is expected that the vibration impacts will be significantly reduced at nearby buildings to RoW.

Sediment run-off from construction sites

Assessment

Construction of the Project will require clearing of some vegetation, excavation, and stockpiling of excavated and construction material.

The following potential impacts on the geomorphology and soil are identified:

- Loss of soil fertility due to loss of topsoil
- Contamination of soil due to the accidental release of solvents, oils, and lubricants.
- Failure of stockpile areas resulting in increased erosion and sediment flash.
- Generation of waste (hazardous and non-hazardous)
- Soil erosion and surface run-off from materials sourcing areas and site preparation activities.
- Potential for hazardous materials and oil spills associated with heavy equipment operation and fueling activities.

The significance criteria were found significant based on the methodology discussed in **Section 5.4**.

Mitigation Measures

The mitigation measures described below will be implemented to reduce the impacts listed above:

- All construction workers will be provided with awareness training on the prevention of waste generation and spill prevention.
- The topsoil can be preserved and used after the restoration of construction campsites and storage areas after the construction period.
- Surplus excavated material will be disposed of at appropriate or designated sites and will be disposed of in a manner that does not disturb the natural and community drainages and tracks.

- Equipment will be maintained properly to minimize oil or fuel leakages from construction machinery. Clean-up will be undertaken in the event of an oil spill larger than half a liter. This will include the removal of contaminated soil and its disposal of it at a proper location.
- All storage fuel tanks will be marked with their contents and stored in diked areas with an extra 10% of the storage capacity of the fuel tank. The area will be lined with an impervious base.
- Grease traps will be constructed wherever needed, to prevent the flow of oily water into drainage channels or waterbodies.
- Spill cleanup kits (shovels, plastic bags, and absorbent materials) will be available near fuel and oil storage areas. Should any accidental spills occur, immediate cleanup will be undertaken, and all cleanup materials will be stored in a secure area for further disposal. Disposal of such will be undertaken by a waste management company contracted by the Contractors. The waste management company must have the required licenses to transport and dispose of any hazardous waste before any such waste is removed from the site. The Contractors will keep copies of the company's licenses and provide waste transfer manifests at their campsite for routine inspection by the engineer.
- Cleanup kits will be carried in all fuel trucks.
- Fueling of construction vehicles and machinery will take place at designated places or over impermeable surfaces for fixed machinery.
- Hazardous materials will be stored in designated places having impervious linings.

In addition to the above, the following measures will also be implemented to specifically mitigate soil erosion and surface run-off:

- Schedule work in sensitive areas (e.g. water body) for dry season.
- Temporary erosion control plan one month before commencement of works.
- Proper installation of Temporary Drainage (TD) and Erosion Control (EC) before works within 50m of water bodies.
- Cut areas will be treated against flow acceleration while filled areas will be carefully designed to avoid improper drainage.
- Stockpiles will not be formed within such distances behind excavated or natural slopes that would reduce the stability of the slopes.
- In the short-term, either temporary or permanent drainage works will protect all areas susceptible to erosion.
- Measures will be taken to prevent pounding surface water and scouring slopes. Newly eroded channels shall be backfilled and restored to natural contours.

- The contractor will arrange to adopt suitable measures to minimize soil erosion during the construction period. Contractors will consult concerned authorities in the area before deciding mitigation measures.
- Clearing of green surface cover to be minimized during site preparation.
- Replanting trees to be done before the site is vacated and handed back to NGC with appropriate trees (other vegetation cover as appropriate) to ensure interception of rainwater and the deceleration of surface run-off.

After the mitigation measures given above are incorporated, it is expected that the Project will not have any significant residual impacts on the area's geomorphology or soil. The effectiveness of the mitigation measures will be monitored during the construction and restoration phases.

Impact on water resources (quality and quantity)

Assessment

Chenab and Jhelum are the major rivers in the project area, besides numerous small streams (nullahs). The proposed T/L crosses the Chenab and Jhelum Rivers between tower no. 101-102 and 359-360, respectively.

The following are the potential impacts on water resources that may result from the construction of the T/L Project:

- Contamination of surface and groundwater due to improper handling of materials, leakage of oil and fuels and discharge from construction activities.
- Increased usage of local water resources due to its use in construction activities; and blockade of natural drainage ways due to foundation construction.
- Possible disruption of water supply lines during construction, as in many locations the T/L is passing through the already existing road RoW, where public utilities like water supply lines and drainage lines are located.
- Damage to drainage lines during excavation activities, particularly for the underground cable.

If the wastewater generated from the construction site or camp is not disposed of properly, it can have an impact on the nearby area. In general, the impact of construction activities on water availability is less likely as there are few water resources available in the area.

Mitigation Measures

The following specific measures will be adopted to mitigate any potential issues:

- Erosion and sediment flash-control measures will be employed and maintained where necessary.
- Washing vehicles will be allowed only in designated places such as a local car wash or a similar facility to be built at the site with the provision of oil-water separators (OWS) and waste collection pits. Further details on the construction of OWS, waste

collection pits, and the handling of contaminated waste are included in the **Spill Prevention** and **Waste Generation** sections.

- Equipment will be maintained properly to minimize oil or fuel leakages from construction machinery.
- The natural drainage will be restored after the completion of the civil works of the tower foundations in areas where tower locations fall within the catchment of dry stream beds.
- The source of water for construction from authorized abstraction sources will be agreed between the local communities, local government, and the contractor.
- Water conservation techniques will be developed and implemented by the contractor.
- The care will be exercised while moving heavy machinery to avoid damage or blockage of water supply lines, natural waterways, and channels.
- Records will be kept of water usage in all Project activities.
- Construction camps and residential camps will not be built nearby water bodies.
- Debris and vegetation clogging culverts should be regularly cleared.

In addition to the above, the following are specific measures to mitigate hydrology and drainage aspects:

- Consideration of weather conditions when construction activities are undertaken.
- Limitations on excavation depths in use of recharge areas for material exploitation or spoil disposal.
- Use of landscaping as an integrated component of construction activity as an erosion control measure.
- Minimizing the removal of vegetative cover as much as possible and providing for its restoration where construction sites have been cleared of such areas.

In addition to the above, the following are specific measures to mitigate water quality impacts:

- Compile temporary drainage management plan one month before commencement of works.
- Proper installation of Temporary Drainage (TD) and Erosion Control (EC) before works within 50m of water bodies.
- Proper construction of TD and EC measures, maintenance and management including training of operators and other workers to avoid pollution of water bodies by the considerate operation of construction machinery and equipment.
- Storage of lubricants, fuels, and other hydrocarbons in self-contained dedicated enclosures >50m away from water bodies.
- Proper disposal of solid waste from construction activities and labor camps.
- Cover the construction material and spoil stockpiles with a suitable material to reduce material loss and sedimentation and avoid stockpiling near to water bodies.

- Topsoil stripped material will not be stored where natural drainage will be disrupted.
- Borrow sites (if required) will not be close to sources of drinking water.

Once the mitigation measures listed above are incorporated, it is expected that the project will not have any significant impact on the area's water resource. The effectiveness of the mitigation measures will be monitored during the construction and restoration phases.

Untreated disposal of effluent from worker camps and batching plant(s)

Assessment

The workers camp and construction camp facilities, such as batching plant (s) will produce effluent during construction and if not handled and treated appropriately, it can contaminate local land, surface, and groundwater resources.

Water from dewatering activities (during rainy season) has the potential to contain suspended solids and oil and grease and if disposed of untreated may affect the soil quality.

Table 5-12 below shows an estimate of the wastewater to be generated during the course of the construction phase of the project, assuming that on average, the water demand per person is 40 liters per day and that 80% of the water demand will become wastewater.

Table 5-12: Estimated Wastewater Generated by Workforce in Construction Camps

No. of Workforce*	Estimated Total Water Demand** (litters/day)	Estimated Wastewater Generated (litters/day)***
46	1,840	1,472

* Refer to Table 3-4 "Estimated Manpower Requirements"

** = (46)x(40) = 1,840 liters/day *** = 1,840 (80%) = 1,472 liters/day

Considering the laborers (about 46 in numbers) residing in the construction camp and the locally available labor, an average solid waste generation rate of 0.5 kg/capita/day[82] is adopted for the estimation of solid waste generation. Based on this assumption, a total of about 23 kg of solid waste will be generated from construction camps on a daily basis. The major components of the labor camp waste will be garbage, putrescible waste, rubbish and small portion of ashes and residues. Other types of waste may include inorganic construction wastes including hazardous waste. These wastes will be generated due to the construction activities and the materials used for construction. This waste would require proper disposal to minimize land and water contamination. This impact can be categorized as direct, moderate, site-specific, short term, temporary, high probability and reversible.

Mitigation Measures

The following specific measures will be adopted to mitigate any potential issues:

[82] 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.

- Domestic and chemical effluents from the construction camp will be disposed of by the development of on-site sanitation systems, i.e. septic tanks (i.e. shown in Figure 5-3). Proper monitoring to check the compliance of PEQS will be carried out; and,
- The sewage system for camps will be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewater.
- The solid residue from the septic tanks will be transported to the nearby municipal sewage disposal site.
- Lined wash areas will be constructed within the campsite or at the site, for the receipt of wash waters from construction machinery; and ensure proper labeling of containers, including the identification and quantity of the contents, hazard contact information, etc.
- The solid waste generated during construction and campsites will be safely disposed of in demarcated waste disposal sites and the contractor will provide a proper waste management plan.
- Ensure safe storage and handling of fuels, oils, and other hazardous substances according to standard safety practices. Disposal should be carried out through Punjab EPA-approved contractors and facilities.
- All efforts will be made for the proper disposal of solid waste, applying principles of reducing waste as far as possible, reusing what is practical and recycling all recyclable materials.
- Construction workers and supervisory staff will be encouraged and educated to practice waste minimization, reuse, and recycling to reduce the quantity of waste.

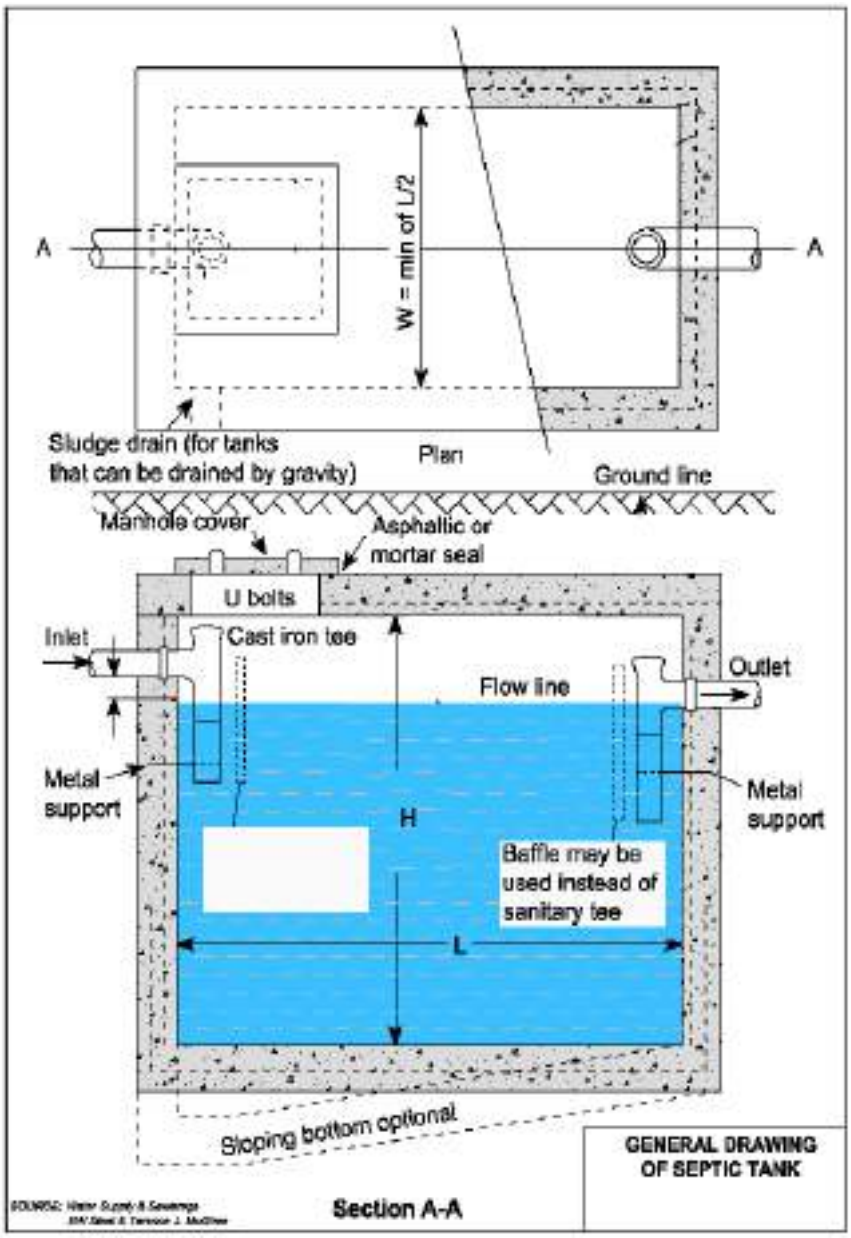


Figure 5-3: General Drawing of Septic Tank

Disposal of hazardous waste, spoils and other waste materials

Assessment

There is a possibility of the generation of hazardous and non-hazardous solid waste during construction, such as used vehicle oil filters, oil-contaminated cloths, used batteries, iron and copper, cotton and kitchen waste, solid residue from the septic tanks, etc. These can create a nuisance to the environment if not handled appropriately.

Mitigation Measures

Measures that will be implemented are as follows:

- Ensure safe storage and handling of fuels, oils, and other hazardous substances according to standard safety practices. Disposal should be carried out through Punjab EPA-approved contractors and facilities.
- Management and storage of fuel, waste oil, and hazardous waste will be planned in accordance with EHS General Guidelines on Hazardous Materials Management.[83] This includes the use of appropriate secondary containment structures capable of containing the larger of 110 % of the largest tank or 25% of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters.
- All efforts will be made for the proper disposal of solid waste, applying principles of reducing waste as far as possible, reusing what is practical, and recycling all recyclable materials.
- The solid waste generated during construction and campsites will be safely disposed of in demarcated waste disposal sites and the contractor will provide a proper waste management plan as part of SSEMP.
- The sewage system for camps will be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewater.
- The solid residue from the septic tanks will be transported to the nearby municipal sewage disposal site.
- Lined wash areas will be constructed within the campsite or at the site for the receipt of wash waters from construction machinery, and ensure proper labeling of containers, including the identification and quantity of the contents, hazard contact information, etc.
- Construction workers and supervisory staff will be encouraged and educated to practice waste minimization, reuse, and recycling to reduce the quantity of waste.

Impact on occupational health and safety

Assessment

The occupational health and safety hazards associated with the construction of T/Ls mainly include:

- Exposure to fall hazards from working at heights for poles and structures and cave-in hazards while working in ditches and excavations.
- Workers may be struck by falling objects, such as tools or equipment, or by moving vehicles or machinery.
- Injuries during drilling and excavation work.

[83] https://www.ifc.org/wps/wcm/connect/90231ba8-5bb3-40f4-9255-eaf723d89c32/1-5%2BHazardous%2BMaterials%2BManagement.pdf?MOD=AJPERES&CVID=nPtgwmI.

- Workers may be exposed to hazardous chemicals, such as solvents or paints, or to materials such as asbestos.
- The construction activities and vehicular movement at the construction site and access service roads may also result in roadside accidents particularly inflicting local communities who are not familiar with the presence of heavy equipment and machinery.
- Workers may be exposed to high temperatures and humidity while working in outdoor environments, which can lead to heat exhaustion or heat stroke.
- Complying with the safety precautions for the construction workers as per International Labor Organization (ILO) Convention No. 62, as far as applicable to the Project Contract.
- The selected route of the proposed T/L involves the crossings of some existing 132kV T/Ls. Crossing may be dangerous during the stringing action and operation phase, if proper clearance is not provided at the design phase of the Project. This impact can be categorized as direct, low, site-specific, short-term, temporary, low probability and reversible.

Mitigation Measures

The contractor will prepare the OHSE Management Plan as part of SSEMP.

The following prevention and control measures will be implemented to the extent feasible to mitigate any issue related to occupational health and safety:

- Provide adequate personal protective equipment (PPE) and working platforms as per the job requirements.
- Install occupational safety warning signs at construction sites and camps.
- Provide workers with a skull guard or a hard hat.
- Allow only trained and certified workers to install electrical equipment with safety and insulation measures in place.
- Test structures for integrity prior to undertaking work.
- Prepare and implement a fall protection program that will include training in climbing techniques and the use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers, among others.
- The fall protection system will be appropriate for the tower structure and necessary movements, including ascent, descent, and moving from point to point and fixtures will be installed, wherever possible, to facilitate the use of fall protection systems.
- Provide adequate work-positioning device systems for workers to the extent possible.
- Properly maintained hoist equipment will be used along with properly trained personnel.

- Proper safety belts (such as double lanyard safety harness) will be provided.
- Use a backup safety strap when operating power tools at height.
- Remove signs and other obstructions from poles or structures prior to undertaking work.
- Provide an approved tool bag for raising or lowering tools or materials to workers on structures.
- Prepare and implement an EMF safety program to prevent or minimize occupational hazards due to exposure to EMF.
- The contractor will prepare the OHSE Management Plan as part of the SSEMP. Also include provision of a safety champion program to be initiated on a monthly basis to encourage workers to adhere to H&S requirements.
- The plan will also include details related to labor working conditions and details on prohibiting child labor.
- Identify potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities.
- Worker's Accommodation Plan will be prepared in reference to Workers' Accommodation: Processes and Standards[84] as part of SSEMP and implemented.
- To maintain safe conditions for the general public and workers, lights (for nighttime visibility) and warning signs must be installed near excavation sites.
- Special care is required during the construction of towers as well as stringing of conductors. During the stringing of conductors, temporary shutdown of the existing T/Ls will be ensured to safeguard the workers and the surroundings. Proactive coordination is required between the construction staff and the relevant Grid Station operation staff to ensure the shutdown schedule.

Once the mitigation measures given above are incorporated, it is expected that the project will not have any significant incremental impacts. The effectiveness of the mitigation measures will be monitored during the construction, restoration, and operation phases.

Natural hazard risks (flooding, earthquakes etc.)

Assessment

The proposed T/L route passes through the areas that fall in zone-2A and zone-2B, as discussed in **Section 5**. This project area lies in a minor and moderate zone where high-intensity earthquakes can lead to minor or moderate damage, depending on the spatial location.

[84] International Finance Corporation and European Bank. 2009. *A guidance note by IFC and the EBRD Workers' Accommodation: Processes and Standards*. London.

Mitigation Measures

Mitigation measures include:

- The structures of the T/L such as tower bases, should be built as per the rules of the Pakistan Building Code (PBC).
- The tower bases should be built considering the local climatic conditions, including flooding.
- Project construction facilities should be built considering climatic conditions such as the risk of flash flooding in case of high precipitation events.
- Material testing and tensile strength of conductors must be checked before commencement of works.

Once the mitigation measures given above are incorporated, it is expected that the project will not have any significant incremental impacts. The effectiveness of the mitigation measures will be monitored during the construction, restoration, and operation phases.

Security of the construction crew and project facilities

Assessment

The project is located in Punjab province, and no security issues are envisaged.

However, there are some security installations near the project area that fall in Kala Chitta National Park. A security clearance may be required from relevant authorities in the area.

Also, foreign experts may be working/ visiting the project site; therefore, a security plan should be developed.

Mitigation Measures

Mitigation measures include:

- Security clearance may be required from relevant authorities in the area of Kala Chitta National Park
- A well-coordinated security plan should be prepared by a relevant expert and implemented in coordination with local law enforcement agencies.
- The plan should be able to address issues like force majeure circumstances and emergency response.
- The crew should be trained on how to act in case of such a condition.

Existing power transmission lines

Assessment

The selected route of the proposed T/L involves the crossings of the existing 132kV T/Ls. Crossing may be dangerous during the stringing action and operation phase, if proper clearance is not provided at the design phase of the Project. This impact can be categorized as direct, low, site-specific, short-term, temporary, low probability and reversible.

Mitigation Measures

Special care is required during the construction of Towers as well as the stringing of conductors. During the stringing of conductors, temporary shutdown of the existing T/Ls will be ensured to safeguard the workers and the surroundings. Proactive coordination is required between the construction staff and relevant Grid Station operation staff to ensure the shutdown schedule.

5.6.2 Ecological Environment

This section assesses the impacts on ecology in and around the Project site and outlines the proposed mitigation measures for the management of those impacts.

Habitat loss and impact on mammals, amphibians, birds, reptiles and aquatic ecology including fish fauna.

The proposed T/L will pass through agricultural fields, including orchards raised by the farmers of the project area and approximately 6,180 trees will be cut down in which 900 are wood trees whereas 5,680 are fruit trees. The details of trees to be cut are given in the **Table 5-13**. All the tree details are approximate and tentative the final number of trees and other resources will be provided/finalized during the construction phase of the project.

Table 5-13: Tree Species Potentially being Affected

Sr. No.	Local Name of Tree	Botanical Name	No. of Trees
Wood Trees			
1.	Phulai	Acacia modesta	222
2.	Kahu	Olea ferruginea	196
3.	Shisam	Dalbergia sissoo	170
4.	Eucalyptus	Eucalyptus camaldulensis	176
5.	Mulberry	Morus alba	74
6.	Neem	Azadirachta indica	62
	Sub-Total (A)		**900**
Fruit Trees			
1.	Plum	Prunus domestica	214
2.	Peach	Prunus persica	336
3.	Apricot	Prunus armeniaca	320
4.	Mango	Mangifera indica	410
5.	Citrus / Orange	Citrus sinensis	3,232
6.	Guava	Psidium guajava	768
	Sub-Total (B)		**5,280**

Sr. No.	Local Name of Tree	Botanical Name	No. of Trees
Total (A+B)			**6,180**

Habitat Fragmentation and Vegetation Loss, especially in Protected Areas (e.g., Chinji and Kala Chitta NPs)

Assessment

Construction-related activities may lead to habitat fragmentation and loss of wildlife habitat, particularly vegetation removal in two protected areas: the Chinji National Park, and the Kala Chiita National Park.

Due to the cutting of trees, birds will be compelled to fly away and find some safe shelter far away from the disturbed area.

Soil compaction and erosion can also affect grassland birds that feed on invertebrates by reducing prey abundance in the area. Due to soil compaction, crop production will decrease, which results in reduced habitat for birds. Erosion affects nesting resources for ground-nesting birds.

Mitigation Measures

Mitigation measures include:

- Minimize disturbance to vegetation and retain as much natural vegetation as possible.
- The afforestation plan must be implemented in a true sense to restore the habitats of avifauna and other wildlife species.
- As much as possible, limit the clearance of vegetation, either ground vegetation or tall trees, for the construction of access roads and camps. If possible, select those areas for camping sites where there is a smaller number of plants affected. Moreover, avoid cutting those trees that are the habitat of birds.
- Drivers of heavy machinery vehicles will be directed to use the right path for carriage of materials to the tower's footing and avoid loss of vegetation due to movements of the vehicles during construction work

Noise from Construction Activities and Camps may Cause Disturbance to Avifauna and Mammals

Assessment

Noise pollution during the construction phase, caused by heavy machinery, vehicle movement, and blasting, will disturb wildlife. Birds may experience irregular disturbance in their communication, mating, and hunting signals, potentially leading to decreased bird density with increased noise level. Mitigation Measures

Mitigation Measures

Mitigation measures include:

- Minimize disturbance to vegetation and retain as much natural vegetation as possible.
- Route planning to avoid areas of high bird use.
- Noise due to equipment should be avoided as much as possible using low-noise equipment.
- Workers should be restricted from going to sensitive areas now and then because birds and other wildlife can be disturbed due to human presence.
- Dust emission should be avoided to the possible extent.
- Contractors will warn their laborers not to do any activities which harm the trees and wild animals. For example, cutting trees for fuel wood and unusual disturbance disturb the wild animals. Workers can use those herbs and shrubs as fuel wood, which are coming in COI and which have no chance of being left;

Dust, Emissions, and Chemical Spills Affect Birds and Habitat Quality

Assessment

Fugitive dust emissions, exhaust emissions, improperly stored materials, soil compaction, drainage alteration, siltation, removal of vegetation, invasive weeds, forest fires, and chemical spills all contribute significantly to the decline of birds' populations.

Moreover, exhaust emissions cause air pollution, which causes toxic effects on birds, including behavioural changes and effects on reproductive success and demographics, such as changes in population density and changes in species. It is difficult to predict behavioural changes due to exhaust emissions.

Accidental spillage of fuel, oil, or lubricants from construction equipment may contaminate soil and water, affecting flora and fauna both terrestrially and in aquatic environments.

Mitigation Measures

- Minimize disturbance to vegetation and retain as much natural vegetation as possible.
- Route planning to avoid areas of high bird use.
- Workers should be restricted from going to sensitive areas now and then because birds and other wildlife can be disturbed due to human presence.
- Dust emission should be avoided to the possible extent.
- Use the existing roads for transportation if possible, and if construction of a new road is needed, then select those paths which have minimum vegetation cover or if possible, diversion of roads will be kept in mind in case of heavy loss of trees.

Accidental Death of Reptiles and Small Mammals during Site Clearing, Excavation and Rehabilitation Activities at Construction Sites and Camps (esp. In hibernation season)

Assessment

During the excavation period, accidental death of small mammals and reptiles may occur, particularly if the excavation-related activities are performed in winter, because reptile species mostly hibernate during this period of the year.

Mitigation Measures

Mitigation measures include:

- Schedule construction outside breeding/nesting and it would be best outside migratory seasons.
- Train and raise awareness regarding invasive plant species among Project staff and contractors.
- Provide awareness training to staff and contractors on prevention of injury of animals; identification of likely species found on site (Indian Pangolin, Red Fox, Asiatic Jackal, Indian Crested Porcupine, turtles species, etc.); identifications of animal hazards (such as venomous snakes); what to do if dangerous animals are encountered; report kills of large mammals and other migratory birds particularly designated species of conservation concern.
- The afforestation plan must be implemented in a true sense to restore the habitats of avifauna and other wildlife species.
- Contractors should guide the workers not to get involved in the killing, hunting, and trapping of birds and other wildlife species, and they should also be warned that those who are involved will be fired from the work.
- Route planning to avoid areas of high bird use.
- Avoid critical bird concentration areas to reduce direct and indirect impacts on the birds.
- Contractors will warn their laborers not to do any activities which harm the trees and wild animals. For example, cutting trees for fuel wood and unusual disturbance disturb the wild animals. Workers can use those herbs and shrubs as fuel wood, which are coming in COI and which have no chance of being left;

Increased Accessibility Leading to Illegal Poaching of Species Like the Pangolin and Migratory Birds

Assessment

Temporary roads and increased accessibility may lead to illegal hunting or poaching, especially of highly trafficked species like the Indian pangolin, Punjab Urial, turtle species, and migratory birds.

Mitigation Measures

Mitigation measures include:

- Provide adequate knowledge to the workers on relevant government regulations and punishments for illegal poaching and trade in animals and plants; incorporate in contract documents regulations for Project staff and contractors to avoid illegal poaching of wild animals.
- Use the existing roads for transportation if possible, and if construction of a new road is needed, then select those paths which have minimum vegetation cover or if possible, diversion of roads will be kept in mind in case of heavy loss of trees.
- Contractors will warn their laborers not to do any activities which harm the trees and wild animals. For example, cutting trees for fuel wood and unusual disturbance disturb the wild animals. Workers can use those herbs and shrubs as fuel wood, which are coming in COI and which have no chance of being left;

Spread of Invasive Plants (Prosopis, Parthenium) due to Surface Soil Disturbance

Assessment

Earthworks, equipment movement, and soil disturbance activities may further facilitate the introduction and spread of invasive plant species such as *Prosopis juliflora*, Lantana camara, Parthenium hysterophorus, etc.

Mitigation Measures

Mitigation measures include:

Prevent invasive plant species establishment on exposed stored soil. Invasive plant species Prosopis juliflora, Lantana camara, and Parthenium hysterophorus were observed in the Terrestrial Study Area during the current study.

Use the existing roads for transportation if possible, and if construction of a new road is needed, then select those paths which have minimum vegetation cover or if possible, diversion of roads will be kept in mind in case of heavy loss of trees.

Construction Activities During River Crossing Will Affect Aquatic Life and Riparian Habitat

Assessment

The transmission line will cross two rivers, posing a risk of water pollution, increased sedimentation, and disturbance of riparian habitats. Construction activities near riverbanks may affect aquatic species and reduce water quality downstream.

Mitigation Measures

Mitigation measures include:

No tower will be installed in the river's bed

Towers can be installed at least 50 m away from the riverbank if not avoidable.

Chemical spills into waterways should be banned as they may affect water birds and aquatic life.

Work during Bird Migration Season Potentially Causes Disturbance and Increased Bird Deaths

Assessment

The migratory birds visit Pakistan from late October to early April every year. Since the project is in important high-value areas for birds, thus construction during the migratory season may increase bird deaths.

Mitigation Measures

Mitigation measures include:

- Avoid construction during the migration season.
- If it is not avoidable, route planning to avoid areas of high bird use.
- Avoid critical bird concentration areas to reduce direct and indirect impacts on the birds.

Special measures need to be adopted to minimize impacts on important resources, such as activities during critical periods

Assessment

Due to the cutting of trees, birds will be compelled to fly away and find some safe shelter far away from the disturbed area.

Mitigation Measures

Mitigation measures include:

- Minimize disturbance to vegetation and retain as much natural vegetation as possible.
- The afforestation plan must be implemented in a true sense to restore the habitats of avifauna and other wildlife species.
- As much as possible, limit the clearance of vegetation, either ground vegetation or tall trees for the construction of access roads and camps. If possible, select those areas for camping sites where there is a smaller number of plants affected. Moreover, avoid cutting down those trees that are the habitat of birds.
- Drivers of heavy machinery vehicles will be directed to use the right path for carriage of materials to the tower's footing and avoid loss of vegetation due to movements of the vehicles during construction work
- For the replacement of one tree, ten trees will be planted in accordance with the tree plantation plan.

5.6.3 Socioeconomic Environment

The Project will have both positive and negative socio-economic impacts during the construction phase. Positive socio-economic impacts of the project are the creation of job opportunities and a boost to the local economy, while negative impacts include a disturbance to the privacy of locals, increased traffic congestion, increased risks of noise and community and occupational safety due to construction machinery and vehicles.

The following sections provide impact assessment, significance, and mitigation measures for the positive and negative impacts of the project and measures to maximize the benefits of the project.

Increased employment opportunities and the local economy

Assessment

Direct, indirect, and induced employment at the local level, resulting in increased incomes of people. The impact has positive and high significance as the Project will provide economic opportunities for local people.

Strengthening Measures

To maximize benefits to the local community, the following mitigation, enhancement, and good-practice measures will be adopted.

- The contractor and sub-contractors will explain the recruitment process to local communities.
- Local candidates will be given preference for jobs provided they have the required qualifications and skills for the position during project construction.
- Coordinate efforts to recruit unskilled labor, if any are required under the Project, from the adjacent areas.
- Local communities and stakeholders will be consulted before the start of work.

Overburden on local resources

During the construction, overburden on local resources is possible if the construction facilities such as workers camp and construction sites are dependent on local resources such water needs from public water supply, and it can create problems for local communities.

This can include increased consumption of local resources such as water resources and power use where it is available.

Mitigation Measures

Proposed mitigation measures include:

- The use of water will not disturb public water availability, and the source of water will be selected carefully.

- Contractor to source raw material and camp utilities from major cities like Rawalpindi and Faisalabad to avoid overburden on local resources.

Social conflicts due to the influx of workers

Assessment

The influx of workers into the COI can potentially result in the deterioration of social values and an increase in social conflict in the communities due to the in-migration of employees and job seekers. The presence of workers can also restrict the movement of local women, affecting their economic and social opportunities. The growth in population and associated economic disparity can result in increased crime, such as theft and robbery.

The impact has a moderate impact as most of the workers will be hired from local communities as this will provide a monetary benefit to the contractor as well by saving overheads on housing and food if the personnel hired are from other areas.

Mitigation Measures

Proposed mitigation, enhancement, and good-practice measures include.

- Require non-locals employed by the Project to adhere to a social 'code of conduct' in terms of relations with local communities, including restricting their movement to stay within camping sites.
- Provide employees and visitors with cultural awareness training.

Impact on physical cultural resources (PCRs)

Assessment

The location of mosques and other cultural and other heritage sites has been reviewed. Several mosques, graveyards, tombs, and other religious or archaeological sites are located within 100m from the edge of the Project. These places may be affected by noise, traffic congestion and construction-related activities. However, no structural damage to these sites is anticipated.

These impacts can be minimized by implementing relevant mitigation measures for each potential impact factor, such as noise control, traffic management, etc.

Mitigation Measures

A chance find procedure will be prepared to guide appropriate action in the event that any artefacts are discovered during construction activities.

Uncontrolled solid waste disposal

Assessment

The main issues of concern include uncontrolled or unmanaged disposal of solid and liquid wastes into watercourses and natural drains, improper disposal of stormwater and black water, and open defecation by construction workers.

Wherever water can accumulate in temporary drainage facilities, due to poor stormwater management, or improper disposal of site-generated wastewater there is the risk of mosquito and other insect breeding.

These impacts can significantly affect local communities if appropriate mitigation measures are not implemented.

Mitigation Measures

To mitigate these risks, the following measures are proposed:

- To maintain proper sanitation around construction sites, access to the nearby public lavatories will be allowed, or temporary toilets will be provided. Construction worker camps will be established as needed, depending on the scale of the work. These camps will be equipped with toilets connected to soakage pits, portable lavatories, or, at a minimum, pit latrines.
- Disposal of surplus materials will be coordinated with local authorities and approved before the commencement of construction. The Project is not expected to involve significant cutting and filling; however, minor excavations (up to 4m) and piling may be required for tower foundations (if required). Depending on the contract, the surface beneath the towers may need to be scrabbled to remove unstable materials or to stockpile topsoil.
- If surplus materials result from the removal of existing surface layers, they will be reused elsewhere on the Project sites before sourcing new soil, rock, gravel, or sand. The use of on-site materials will help minimize the need for extraction from external sources.
- Contractual clauses will require the contractor to prepare a materials management plan at least one month before construction begins. This plan will identify all sources of cement and aggregates and outline a strategy to balance cut and fill. It will also specify the methods for material extraction and include measures to mitigate nuisances to nearby residents.
- Financial compensation will not be accepted as mitigation for environmental impacts or environmental nuisance.
- Contractual clauses will require the contractor to produce a solid waste management plan to ensure proper disposal of waste materials.
- The plan will clearly state the methods to be employed before and during the extraction of materials and all the measures to be employed to mitigate nuisances to residents.
- Claims or complaints from the residents regarding construction-related nuisances or damages near the RoW will be considered and addressed promptly by the Contractor.
- Temporary and permanent drainage facilities will be designed to allow the rapid removal of surface water from all areas and to prevent the formation of standing water.

- The contractor will organize temporary access routes and alternative arrangements to prevent disruption to local community access and reduce short-term negative impacts.

Conflict Over Resources

Potential Impact

It is anticipated that local water resources will be utilized to meet the camp and construction requirements, bringing its use into competition with the local use. This may cause conflicts between the locals and the Contractors. This impact can be categorized as direct, low, local, short-term, temporary, low probability and reversible.

Mitigation Measures

The following measures will be carried out to mitigate the impacts of tapping local community water resources, where required:

- In areas of concern where the potable water is in short supply; the water will be provided through vehicles from nearby cities or from the river after formal and necessary approvals.
- As already mentioned in the mitigation of temporary land acquisition impact, the camps will be located at least 500m to 1,000m away from the nearest local settlements to prevent the contamination of community-owned water resources;
- Approval from the local administration and representatives of the concerned irrigation departments or other relevant authorities will be obtained before using the local surface water resources.
- The Contractor 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; and
- Guidelines will be established to minimize the wastewater during the construction activities and at campsites.

Gender issues

Assessment

As the proposed T/L route is passing through mostly the rural areas of Chiniot, Sargodha, Khushab, Talagang and Attock districts, outdoor women's activities in the field may be affected due to the construction activities. The induction of outside labor may create social and gender issues due to the unawareness of local customs and norms. It will also cause hindrance to the mobility of local women. Disturbance to the privacy of the local women will be due to outside workers working on the erection of towers and stringing of conductors.

Mitigation Measures

- The contractor must select the specific timings for the construction activities like Tower footings, erection and stringing of conductors so as to cause least disturbance to the local population particularly women considering their routine movement hours;
- The Contractor has to carry out the construction activities in such a way that the open field latrine usage timings by the local community particularly women, will not be affected. The normal timings to use the toilet facilities by the rural women are early in the morning and at evening so the Contractor will have to take care of these timings;
- Contractor will warn the staff strictly not to involve in any un-ethical activities such as theft, prostitution and to obey the local norms and cultural restrictions particularly with reference to the women; and
- While working on the erection of towers, if privacy of the nearby households is affected, the Contractor will inform the house owners to make some prior arrangements.

Loss of income/ Livelihood

Assessment

During the construction activities of the tower foundations, erection and stringing of conductor, people will suffer a loss in their annual income due to the loss of crops, trees etc. Furthermore, due to the erection of towers and the passing of T/L, the value of land may decrease on a long-term basis. This impact can be categorized as indirect, moderate, local, medium term, permanent, highly probable and irreversible.

Damages may occur to existing crops during the construction phase due to the following activities:

- Considerable vehicular movement for the transportation of materials/water and steel work will be involved at the time of concreting of tower foundations. This movement and storage of materials will cause damage to the existing crops; and
- The stringing of conductors involves movement of equipment and vehicles along the corridor, which may involve the cutting of trees and considerable damage to the existing crops such as Wheat, Maize, etc.

Based on the spotting of towers, route alignment, field visits, maps and experience of similar projects already implemented, it is estimated that about 1,269 hectares of crops of agriculture land in the COI is required to be cleared due to construction of the footings, field investigations, stringing of conductors, accessibility tracks/roads. It was revealed during the field survey that the whole section of this T/L, which is falling in Rawalpindi district of Punjab province, passes through hilly or semi-hilly areas. The affectees will lose their crops and fruits, maybe for two or more seasons, i.e., *Rabi (Spring Harvest)* and *Kharif (Autumn Harvest).* This impact can be categorized as direct, moderate, site-specific, medium term, temporary, high probability and reversible.

Mitigation Measures

- Fair, prompt and negotiated compensation for the crops and trees on private land will be provided to the affectees; and
- Affectees will be involved in the valuation process of crops and trees to maintain the fairness of the process.
- Compensation for the loss of crops to the landowners and cultivators as the case will be paid, in accordance with the prevailing market prices and uniformity in rates will be ensured within the local areas and in accordance with the provisions of the project specific RP to be made for this project;
- The whole process of payment to the farmers will be made transparent, judicious and without any discrimination or favor;
- The minimum possible area will be disturbed by the construction of new paths or roads for carriage of machinery and materials;
- As far as possible, barren land without any crop will be selected for the camp sites and disturbance to the crops and natural vegetation will be avoided as much as possible; and
- Efforts will be made to avoid damage to fruit trees otherwise compensation for the whole is required.

Relocation of private / public infrastructure

Assessment

Removal of the infrastructure like buildings, huts, animal sheds, tube-wells etc. will cause the loss of community shelters and sources of income. During the survey of proposed T/L route, many tube-wells were identified within ROW. However, no relocation is expected as the proposed project has the flexibility to provide proper horizontal/vertical clearance for safe passage over the existing infrastructure and proper route optimization at ground. This impact can be categorized as direct, low, site-specific, long term, temporary, low probability and reversible.

Mitigation Measures

In case of involvement of any structure near or within the RoW, the Contractor will first avoid the structure by re-aligning the particular tower to the extent possible. While in case, the re-alignment of tower will not be possible, the full market price of any equipment (non-moveable) and cost of reconstruction including labor charges will be paid to the affectees in accordance with all the provisions of RP to be developed for this project. Affectees will be allowed the salvaging of the demolished materials.

Religious, cultural and historical sites

Assessment

No notified religious, archaeological, cultural and historical sites are located within the COI (strip of 100 meters) including ROW (strip of 50 meters) of the proposed T/L.

Mitigation Measures

Since, no known historical, cultural or archaeological site is located within the Project corridor; therefore, any impact is applicable. However, the Contractor will train the construction staff and the site supervisors in archaeological site recognition, conservation procedures and temporary site protection. In case of a chance find (sudden finding of some archaeological site or artefact) during excavation, the Contractor must halt work at the site immediately and notify the Project Director, NGC for onward necessary actions and intimations at departmental levels.

Indigenous, vulnerable and women-headed households

Assessment

During the social field survey of the proposed 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. No women-headed household was identified during the social survey of the Project; therefore, no special measures are recommended. This impact can be categorized as direct, low, local, medium term, temporary, medium probability and reversible.

Mitigation Measures

- As referred earlier, no indigenous people have been identified in or along the Project corridor, so no mitigation is required;
- Assistance provisions for the vulnerable persons (if any) identified during baseline survey will be covered under RP report. The vulnerable persons shall be provided with all possible assistance and help for acquiring the skills and preference will be given to them for employment. Fair, prompt and negotiated compensation for the crops and trees on private land will be provided to the affectees. The persons having no land but exist in the ROW or a person who is going to lose over 50 % of his land will be considered as vulnerable people and will be specially treated to provide the maximum benefits; and
- As referred earlier, no women-headed household has been identified during the social field survey. So, no mitigation is proposed due to the implementation of the Project on women-headed households.

Traffic congestion

Assessment

As the T/L is to be constructed in mainly agricultural fields/ open areas and through sparsely populated areas. However, at a few locations, the T/L lies within the already existing roads. Therefore, a low impact on traffic is expected during the construction phase.

There will be an increase in traffic on the internal roads, used for the transportation of construction materials, spoils, equipment and machinery. However, the increase will be for a limited period i.e., during construction activities.

Mitigation Measures

Contractor to provide a traffic management plan as part of the SSEMP.

The following measures will be employed to minimize potential impacts:

- Efforts will be made to minimize the use of heavy trucks by preferring the transport of equipment and supplies using 4x4 pickups, wherever possible, and
- A speed limit of not more than 30 km/h will be imposed near settlements, on unpaved roads, and link roads for reducing traffic accident risks and dust generation.
- A traffic management plan, if required, will be prepared and submitted to NGC one month prior to the start of work. The vicinity of schools, hospitals, and communities will be considered while preparing plans and will be avoided to the extent feasible.
- Plans for alternate routes for heavy vehicles will be formulated and implemented. Existing roads will be used wherever practical for transportation of materials, and a 'no-shortcut' policy will be used.
- Plans for alternate routes for the public will be provided and passages for light traffic will be designated because excavation work is being carried out on major roads.
- While preparing plans of access routes, existing conditions of roads and bridges will also be considered to see if there is any requirement of widening and upgrading of access paths and roads.
- Traffic warning signs will be installed, and traffic regulations will be enforced during transportation of materials and equipment and machinery.
- Nighttime traffic will be avoided as much as possible.
- Drivers will be trained to give way to locals while driving on access tracks, to keep a close watch for wild/domestic animals and children while driving and to not throw any litter or cigarettes out of the vehicle. Training and refresher sessions will be arranged for awareness.
- Any damage to access tracks, metalled roads, watercourses, or the canal/river protection bunds, etc., will be appropriately repaired to bring these structures to their pre-construction condition. Any damage, which may cause hardship to the local community or wildlife, will be immediately repaired.

Community health and safety

Assessment

The construction activities and vehicular movement at construction sites may result in roadside accidents, particularly affecting local communities who are not familiar with the presence of heavy equipment. The quality of groundwater and surface water resources available in the nearby local communities may be affected due to the construction activities, oil spillage and leakage, roadside accidents, etc. The proposed project will also have the potential of air (dust pollution), noise, and vibrational impacts on the nearby community.

The laborers who work while carrying transmissible diseases may cause the spread of those diseases to local residents. Construction areas located near the residential settlements may also pose accident risk to people moving around those areas.

Mitigation Measures

Proper control will be maintained over construction activities and oil spillage/leakage from vehicles.

Laborers will be restricted to the construction site and camps, and interaction with local communities will be discouraged.

Ensure that the construction site is restricted to prevent entry by unauthorized individuals, particularly children;

Efforts will be made to raise awareness of road safety among drivers operating construction vehicles.

Timely public notifications will be issued for planned construction works.

Conduct comprehensive consultations with local communities to identify optimal solutions for diversions that maintain community integrity and social connectivity.

Seek cooperation with local educational institutions (schoolteachers) in each village along the route to support road safety campaigns.

Provide proper safety and diversion signage, particularly in urban areas and at sensitive and accident-prone spots.

Setting up speed limits in close consultation with local stakeholders.

Where necessary, consider installing additional guard rails at accident-prone stretches and sensitive locations.

The Communicable diseases of most concern during the construction phase, like - such as Sexually Transmitted Disease (STDs) including HIV/AIDS - will be prevented through initiatives involving health awareness, education, training of health workers , immunization programs, and providing health services; and

The risk of vector-borne diseases will be mitigated through various interventions aimed at eliminating the factors that promote the disease spread. This include preventing the breeding of larvae and adult vectors through sanitary improvements, eliminating breeding habitats near lose to human settlements, and by avoiding stagnant water accumulation.

Once the mitigation measures listed above are implemented, the project is not expected to cause any significant incremental impacts. The effectiveness of these measures will be monitored through the construction, restoration, and operation phases.

5.7 Operation Phase

The operational phase impacts on the physical environment, ecology, and socioeconomic environment are presented separately in the sections below.

A summary of potential impacts during the operation phase, based on the applied methodology, is provided in **Table 5-14**

Table 5-14: Potential Impacts at Operation Phase

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
1	Noise/ Corona Effect	2	3	6	Low
		Unlikely	Major	Moderate	
2	Impact of Faulted SF6	2	3	6	--
		Unlikely	Major	Moderate	
3	Electrocution and Collision of Birds	3	3	9	Low
		Likely	Major	Significant	
4	Long-term Degradation of Habitat from Repeated Vegetation Clearance	3	3	9	Low
		Likely	Major	Significant	
5	Poaching Risk During Operational Maintenance of the T/L	3	3	9	Low
		Likely	Major	Significant	
6	Occupational Health and Safety	3	3	9	Low
		Likely	Major	Significant	
7	Community Health and Safety Risk	3	3	9	Low
		Likely	Major	Significant	
8	Visual Amenity	3	3	9	Low
		Likely	Major	Significant	
9	Aircraft Navigation Safety	1	3	3	-

No.	Potential Impact	Likelihood (Certain, Likely, Unlikely, Rare)	Consequence (Catastrophic, Major, Moderate, Minor)	Risk Score (Critical, Significant/ Moderate, Low)	Residual Impact (Critical, Significant/ Moderate, Low)
		Unlikely	Major	Low	
10	Handling and Disposal of Hazardous Materials	3	3	9	Low
		Likely	Major	Significant	
11	Collapsing of Towers	2	3	6	Low
		Unlikely	Major	Moderate	
12	Working failure of electronic devices/equipment	2	3	6	Low
		Unlikely	Major	Moderate	
13	Breaking of conductors	2	3	6	Low
		Unlikely	Major	Moderate	
14	Existing Power Transmission Line Crossing	3	3	9	Low
		Likely	Major	Significant	
15	Induced Impacts of Applied Measures	2	3	6	Low
		Unlikely	Major	Moderate	
16	Cumulative and Induced Impacts	2	3	6	Low
		Unlikely	Major	Moderate	

15 - 25	Critical Risk Level	6 - 9	Significant/ Moderate Risk Level	1 - 5	Low-Risk Level

5.7.1 Physical Environment

Occupational Health and Safety

Assessment

The occupational health and safety hazards associated with the operation, repair, and maintenance, and decommissioning of T/Ls mainly include:

- Exposure to live power lines.
- Exposure to fall hazards from working at heights for poles and structures.
- Exposure to electric and magnetic fields, as workers typically have a higher exposure than the general public due to their proximity to electric power lines.

This poses e impact has a significant occupational health & safety risk if appropriate mitigation measures are not implemented.

Mitigation Measures

The following prevention and control measures will be implemented, to the extent feasible, to mitigate any issues related to occupational health and safety:

- The EHS (Environmental, Health, and Safety) Guidelines for Electric Power Transmission and Distribution will be followed during operational phase of the T/L.[85]
- All associated T/Ls will be shut down before conducting any repair or maintenance work as per the NGC's operation and maintenance procedures.
- Adherence to the standards of Occupational Health and Safety Guidelines.
- Only trained and certified workers will be allowed to maintain or repair electrical equipment, with proper safety and insulation measures in place.
- Live power distribution lines will be deactivated and properly grounded prior to performing any work on or in proximity to the transmission lines.
- Ensure proper use of special safety equipment and procedures when working near or on exposed energized parts of an electrical system.
- Ensure workers are properly isolated and insulated from energized parts using gloves or other approved insulation, and ensure that the energized part is also properly insulated from the worker.
- Test structures for integrity prior to commencing work.
- Prepare and implement a fall protection program that includes training in climbing techniques and the use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and procedures for rescuing fall-arrested workers.

85 https://www.ifc.org/en/insights-reports/2000/ehs-guidelines-power.

- The fall protection system will be appropriate for the tower structure and the necessary range of movements, including ascent, descent, and transition between points. Fixtures will be installed wherever possible to facilitate the use of fall protection systems.
- Provide an adequate work-positioning device system for workers, to the extent possible.
- Properly maintained hoist equipment will be used, operated by properly trained personnel.
- Proper safety belts (such as a double lanyard safety harness) will be provided.
- Use a backup safety strap when operating power tools at height.
- Remove signs and other obstructions from poles or structures prior to undertaking work.
- Provide an approved tool bag for raising or lowering tools or materials to workers on elevated structures.
- Prepare and implement EMF safety program to prevent or minimize occupational hazards related to EMF exposure.
- Identify potential exposure levels in the workplace, including conducting surveys of EMF levels for new projects and the use of personal monitors during working activities.
- Train workers in the identification of occupational EMF levels and hazards.
- Establish and clearly mark safety zones to distinguish work areas with elevated EMF levels from those safe for public exposure, limiting access to only properly trained workers.
- Prepare and implement action plans to reduce the adverse impacts of EMF exposure. These may include limiting exposure time through work rotation, increasing distance between the source and the worker where feasible, or the use of shielding materials.
- Use signs and physical barriers (e.g., locks on doors, gates, steel posts surrounding transmission towers).
- Ensure the depth of trenches near living environment help reduce EMF exposure, as magnetic field strength attenuates rapidly with distance from the source.

Corona effect

Assessment

The Project works will extend the power distribution. Maintenance will be on a small scale and infrequent. The operation of the T/L project is not likely to result in atmospheric pollution , nor will it generate liquid or solid waste during operation.

The ionization of air surrounding high voltage transmission lines, causing the conductors to glow, and produce a hissing noise, is called Corona Discharge or Corona Effect. This

phenomenon occurs when the electrostatic field across the transmission line conductors creates a condition of potential gradient. When the voltage of air surrounding the conductor exceeds 30kV/cm, a charging current starts to flow through the air indicating that the air has been ionized. The ionized air acts as a virtual conductor, producing a hissing sound accompanied by a luminous violet glow.[86] The Corona effects caused voltage loss and results in the production of O_3 and NO_X.[87]

During T/L operations, this hissing noise may increase, especially during the rainy season. This noise can be unpleasant and cause disturbance to people where T/L is passing through settlements.

Mitigation Measures

The height of the T/L and the right of way, as per NGC standard for 500kV T/L, discussed in **Section 3,** will be maintained to avoid audible noise issues.

In addition to the above, a more robust design for the T/L and increased ground clearance levels have been proposed for this project, as the alignment passes through settlements in some sections of the right-of-way.

Impact of Faulted SF6

Assessment

Sulfur Hexafluoride (SF6) is used as a circuit breaker in electric transmission operations. Toxic decomposition products are formed when SF6 gas is subjected to an electric arc. The decomposition products include metal fluorides, which appear as a white powder. Toxic gases with a characteristic odor of rotten eggs are also produced.

Faulted Sulfur Hexafluoride (SF6) will be handled carefully, following standard industry practices. The EHS Guidelines[88] on electric transmission and distribution will also be followed for the safe handling SF6.

SF6 is a highly flammable gas and can cause explosions if not handled properly. It may also pose human health effects risks, particularly affecting the respiratory system.[89]

However, the use of circuit breakers is very limited in the proposed Project because of its nature, which primarily involves a transmission line. Circuit breakers may be required only at shunt reactors to be installed at the connecting substations. A separate environmental study will be carried out for substitution-related investments.

Mitigation Measures

- Provide proper training and handling procedures for workers.

[86] Allumiax. 2021. *Corona Effect in TX Lines*. Seattle.

[87] Ibid.

[88] https://www.ifc.org/en/insights-reports/2000/ehs-guidelines-power.

[89] Concorde Specialty Gases. 2023. *Faulted SF6 Gas Circuit Breaker.* 2023.

- Ensure regular maintenance of equipment, and periodic checks of circuit breaker condition.
- Ensure proper disposal of equipment at the end of its service life.
- Avoid inhaling vapors remaining in a circuit breaker where arcing or corona discharges have occurred in the gas.
- Evacuate the faulty SF6 gas from the circuit breaker and flush the equipment with fresh air before performing any maintenance.
- Arc products which do not recombine, or which react with oxygen or moisture , are typically removed by the molecular sieve filter material within the circuit breaker.

Collapsing of towers

Assessment

Collapse of the Towers due to the high wind or earthquake will be dangerous for human as well as animal life and can cause loss to property. This impact can be categorized as direct, low, site-specific, long term, permanent, low probability and reversible.

Mitigation Measures

The Towers are designed on the basis of proper geotechnical investigations, geohazard assessment and climatic conditions of the area including maximum wind velocity and earthquakes which are normally based on last 50 years data. An effort has been made by the design team to ensure that no accident due to collapsing of Towers would occur during the life of the Project.

Breaking conductors

Assessment

Breaking of conductors due to any mishap will cause a safety hazard due to the current flow in the fields and crossing over roads, streams etc. This impact can be categorized as indirect, low, site-specific, long term, permanent, low probability and reversible.

Mitigation Measures

A detailed conductor optimization study has been conducted and quad bundle ACSR Drake conductor is found feasible for the proposed T/L. The aforementioned conductor has been selected on the basis of local climatic conditions including maximum wind velocity, temperature, snow load and humidity conditions. So, there is almost no risk of breaking of conductors. However, due to some unavoidable circumstances, if such a situation occurs, NGC has provided such an arrangement that the flow in the conductors will be automatically tripped instantaneously. So, no risk to human or animal life is envisaged due to the breaking of conductors.

Working failure of electronic devices/equipment

Assessment

Electric flux may interfere with electronic devices, especially communication related if brought closer to the conductors. This impact can be categorized as indirect, low, local, long term, permanent, low probability and reversible.

Mitigation Measures

The tower and conductor height are well above the required specification. This impact can be minimized by providing proper requisite clearance as studied in the conductor optimization report by the designer.

5.7.2 Ecological Environment

The ecological resources of the Study Area are described in **Section 4.4.4** (*Aquatic Ecological Resources*) and **Section 4.4.5** (*Terrestrial Ecological Resources*). The aspects affecting ecology and biodiversity in the Study Area and mitigation measures during the operation phase are summarized below:

Assessment

Bird interactions with T/L may become danger for the movement and flight of the local birds. Power lines are sometimes very dangerous for the local and migratory birds. Among the wild habitats, the ones with most interaction to power lines are the birds and there are many ways of interaction including electrocution, collision, fecal pollution and nesting as detailed below. Different conventions took place for the protection and conservation of avifauna on large scale and half of the total countries in the world are the members of those signed agreements.

Electrocution: Electrocution is death of bird that occurs because of electrical shock. Numerous factors contribute to avian electrocution potential including bird size, conductor separation, precipitation, wind direction, season, and bird age. Bird dimensions and conductor separation are particularly important when considering electrocution risk. For this reason, electrocutions are not expected on transmission structures with large electrical separations.

Collision: Birds face collision threats from power lines. Several factors contribute to species vulnerability to collision with overhead wires including bird size, maneuverability, flight behavior; habitat association near transmission lines; and utility structure type and location.

A T/L located between a feeding area and a roosting site can be problematic, especially when only a short distance separates them, resulting in short flights of birds at the critical height. Birds crossing power lines at low altitudes several times a day are more susceptible to collision. Conductors placed in a horizontal, rather than vertical, configuration decrease the number of wires a bird must avoid and, therefore, the risk of collision. The use of overhead static (OHS) wires and optical ground (OPG) wires; however, increases the likelihood of a collision. On transmission structures, birds most frequently collide with OHS and OPG wires.

Faecal Issues: Birds using power lines can create problems due to fecal contamination. Insulators can be contaminated with bird pollution due to roosting and nesting birds. Pollution can be created by small and large birds. Flashovers can occur from continuous contamination of bird droppings on a single spot on an electrical structure. An outage can occur across contaminated insulators, often after a light wetting event, such as light mist.

Large birds can produce fecal streamers, which can result in a flashover if the streamer is located between an energized conductor and a grounded power line component, such as lattice support. This can result in a streamer outage.

Nesting Hazards: T/Ls provide favorable nesting habitat, with many bird species using power structures for nesting. Unfortunately, nests are sometimes located in areas that compromise electrical clearances.

This impact can be categorized as direct, medium, site-specific, short term, temporary, low probability and reversible.

Operations and maintenance will be very small in scale, infrequent, and involve a minimum change to the existing conditions. The practice of allowing some re-growth of vegetation along the RoW will also provide ecological benefits and help in the rehabilitation of the disturbed soil surface.

The combination of the height of transmission towers and distribution poles, along with the electricity carried by transmission and distribution lines, can pose a significant risk to birds and bats through collisions and electrocutions. The proposed transmission line may result in bats and birds' mortality if appropriate measures are not maintained during the planning and construction phases.

The following potential risks of birds and bats may occur during the operation of the Project:

- Electrocution: the spacing of conductors (the current-carrying wires) and the availability of perches affect electrocution risk. The risk of electrocution for large birds from T/L is real, as these structures provide elevated positions for hunting and roosting.
- Electrocution occurs when a bird encounters two wires or when it perches on a conductive pylon and comes into simultaneous contact with a wire. The impact of bird electrocution depends on the electrotechnical design of a pylon and the surrounding natural features.[90] In short, birds may be electrocuted by power lines in one of three ways:
  - Simultaneously touching an energized wire and a neutral wire
  - Simultaneously touching two live wires; and

[90] EIA, 132kV TL, Nikachhu Pothead Yard to Mangdechhu Pothead Yard, ADB, 2014.

- Simultaneously touching an energized wire and any other piece of equipment on a pole or tower that is bonded to the earth through a ground wire.

- Vegetation control along the right-of-way (ROW) may disrupt wildlife and their habitats.
- Routine inspections, repairs, and vegetation management may disturb wildlife.
- Maintenance roads may continue to provide access for unauthorized individuals, potentially increasing the risk of illegal hunting and poaching, especially for highly trafficked species like pangolins.
- Excessive vegetation maintenance along the ROW may lead to the removal an unnecessary vegetation, resulting in continual replacement by successional species and increasing the likelihood of the invasive species establishment.
- The presence of transmission lines and towers within national parks and scenic landscapes may diminish the visual quality and recreational value of these protected areas.

The net impact of electrocution on large birds is not considered significant because an EMF exists around the high-voltage T/Ls, which produces noise, and this excessive noise tends to deter birds.[91] However, even if birds perch on the conductors, the risk only arises if they came into contact with two phases of the current. , Since there is sufficient distance between the two opposite-phase conductors, no significant danger to birdlife is expected. Birds collision and perching will be further minimized by installing visibility enhancement devices such as marker balls, bird deterrents, or diverters.

Mitigation Measures

Provide awareness training to staff and contractors on prevention of animal injuries; identification of likely species found on site (e.g., Indian Pangolin, Common Leopard, Red Fox, Asiatic Jackal, Indian Crested Porcupine, turtle species, migratory birds, etc.); identifications of animal hazards (such as venomous snakes); what to do if dangerous animals are encountered; report kills of large mammals and other migratory birds particularly designated species of conservation concern.

The following mitigations are proposed to avoid the electrocution and collision effects:

- Conduct regular maintenance of reflective balls or colored moving tags installed on transmission lines to enhance visibility and attract the birds' attention. Reflective ball installation is very important for reducing mortality, especially among nocturnal migrant species.
- Regularly maintain and ensure a minimum line spacing of approximately 2.5m between conductors and between conductors and grounded wires or hardware. This spacing reduces the risk of electrocution for large-sized bird species such as vultures and other raptors.

[91] .https://sciencing.com/sounds-frighten-birds-7807173.html, and https://en.wikipedia.org/wiki/Bird_scarer.

- Provide adequate training to workers on relevant government regulations and legal consequences of illegal poaching and wildlife trade; incorporate clauses in contract documents prohibiting for Project staff and contractors from engaging in illegal poaching of wildlife trade.
- To minimize disturbance to wildlife, schedule maintenance activities outside the breeding season.
- Implement selective and minimal vegetation clearance, avoiding complete clearing beneath transmission lines unless necessary for safety.
- Plant native species as compensatory vegetation for trees damaged during construction
- Regularly monitor the right-of-way and access roads for the presence of invasive plant species. Remove invasive species manually or through approved, targeted herbicides, followed by native vegetation restoration.
- Conduct periodic monitoring, particularly during the migration season, to assess the frequency of bird collisions and electrocutions.

5.7.3 Socioeconomic Environment

Community health and safety

Assessment

The community health and safety impacts associated with operation, and decommissioning of T/Ls include:

- **Electrocution:** Electrocution may occur through direct contact with high-voltage electricity or through contact with devices or equipment that are in contact with high-voltage electricity
- **Noise:** Noise in the form of buzzing or humming can is often be heard around transformers or high voltage power lines producing due to corona discharge. Noise from T/Ls reaches its maximum during precipitation events, including rain, sleet, snow, or hail, or fog. While the sound of rain typically masks the increase in noise produced by the T/Ls, other forms of precipitation (e.g., snow and sleet) and fog, can make the noise from overhead power lines more noticible and potentially disturbing to nearby residents.
- **Aircraft Navigation Safety:** Power transmission towers, if located near an airport or known flight paths, can pose a risk to aircraft safety - eigther directly through collision or indirectly through radar interference. However, both Faisalabad International Airport and Islamabad International Airport are located more than 20km away from the Project COI.
- **Impacts of EMF:** Some local residents believe that their movement in the project area will be restricted due to EMF, and the EMF may have adverse impacts on their health. Extensive research on the health and environmental impacts of EMF has been

conducted since the 1970s. Most studies and laboratory experiments have failed to show strong associations between EMF exposure and health effects. Several scientific panels convened by national and international health agencies, as well as the U.S. Congress, have reviewed this body of research. They concluded that there is insufficient evidence to confirm eighter the harmful effects or the safety of EMF exposure.[92] Since the Project is planned in a sparsely populated area, any potential impact from EMF exposure are envisaged to be minimal due to the safe distance from human settlements. Further assessment on EMF impacts is provided in **Section 4.2.10**

Mitigation Measures

The following prevention and control measures will be implemented, to the extent feasible, to mitigate impacts related to community health and safety:

- Signs and barriers (e.g., locking doors, gates, steel posts surrounding transmission towers) will be used to restrict unauthorized access.
- Conductive objects (e.g., fences or other metallic structures), installed near power lines will be properly grounded to prevent electrical shock.
- Vertical clearance requirements, as per international standards, will also be maintained, especially in populated areas. If required, engineering solutions will be considered to reduce EMF exposure from power lines and grid stations, such as increasing the height of transmission towers, modifying the size, spacing, and configuration of conductors, and shielding with metal alloys (Note: shielding is effective for reducing electric field exposure, but not magnetic field exposure.).
- Power lines will be designed with due consideration for landscape aesthetics and proximity to important environmental and community features.
- Use of noise barriers or noise-cancelling acoustic devices will be considered where necessary to minimize disturbance.
- Adherence to regional or national air traffic safety regulations will be ensured.
- Buried lines will be used in flight-sensitive areas where installation of overhead transmission lines poses risks.

Visual amenity

The impact of transmission and distribution facilities on visual amenities may be visually intrusive and undesirable for nearby residents.

However, it is common practice to implement both hard and soft landscaping measures, along with surface rehabilitation. This practice should be encouraged wherever practicable. Additional opportunities for visual enhancements can be assessed prior to construction.

[92] https://www.adb.org/projects/documents/green-power-development-project-2-nov-2014-eia.

Proposed enhancements should be discussed with the local community to support ongoing public consultation during implementation and to assist with public relations efforts.

Aircraft navigation safety

Assessment

Power transmission towers and T/L, if located near airports or known flight paths, can impact aircraft safety - eighter directly through the risk of collision or indirectly through radar interference. Both Faisalabad International Airport and Islamabad International Airport are located more than 20km away from the Project's COI. Although transmission lines are already connected to the grid station, it is still considered best practice to implement measures that enhance the visibility of the T/L to ensure aviation safety.

Mitigation Measures

The following prevention and control measures will be implemented to the maximum feasible extent:

Enhance the visibility of the power lines by placing colorful or fluorescent tapes on the towers and installing colorful balls on the conductors.

Keep power line cables at a lower height, where feasible, near potential navigation routes to minimize risks to low-flying aircraft.

Reduced pressure on local resources

During the operation phase, no negative social impacts are anticipated. On the contrary, communities are expected to benefit from the availability of uninterrupted power supply, which will help to reduce reliance on and demand for liquid petroleum gas, kerosene, diesel, and other fuels.

5.8 Induced Impacts of Applied Measures

The application of mitigation measures may potentially create unintended negative side effects. For example, spraying water on unpaved roads or construction areas is a common dust control method. However, this practice can also lead to the following induced effects:

- Water resource depletion, especially in arid regions,
- Soil erosion or runoff if over-applied or used on sloped terrains.
- Creation of standing water, which can promote mosquito breeding (vector-borne diseases).
- Localized flooding or slippery conditions.
- Increased fuel use and emissions from water trucks.
- Soil and groundwater contamination due to leaching.
- Damage to vegetation near application areas.
- Toxicity to aquatic life if chemicals are washed into water bodies.

- Public health risks if inhaled or contacted with skin, especially if they are untested or improperly applied.

While mitigation measures are essential for managing risks, each method must be evaluated holistically to ensure that new environmental or social issues are not inadvertently introduced.

5.9 Cumulative Impacts

Assessment

Cumulative impacts are those impacts that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important based on scientific k concerns and/or concerns of affected communities (local communities directly affected by the Project).[93]

This new T/L will connect at the existing 500kV Islamabad West GS- Rawat GS T/L and Faisalabad West GS, which are already operational or under development.

There is another 500kV T/L run parallel to the project within 50-100 meters. The 500kV Ghazi Barotha – Ghatti T/L has been operational since 2003.

The electromagnetic fields from both lines add together, potentially increasing the exposure level to nearby communities and sensitive areas.

As discussed in **Section 5.5.10**, current research hasn't conclusively proven health effects from EMF, public perception often becomes a concern. Two lines can create more cumulative corona discharge noise, especially during wet weather.

Higher combined EMF can increase induced currents in nearby conductive structures like 11kV lines and 132kV lines of distribution companies.

A wider corridor may be needed, or more intense vegetation management in the shared space, impacting biodiversity and ecosystems.

Repeated disturbance and expansion of cleared areas may further fragment wildlife habitats, especially for species sensitive areas such as Chinji and Kala Chitta National Parks.

Increased line width density raises the risk of bird strikes, particularly for migratory species or birds of nearby wetlands.

Doubling lines intensifies the visual footprint, affecting scenic or cultural landscapes. Adjacent landowners may face greater constraints due to proximity of multiple high-voltage lines

[93] Cadinale, Pablo, and Lorne Greig. "Cumulative Impact Assessment and Management: Guidance for Private Sector in Emerging Markets." In Good Practice Handbook: International Finance Corporation and ESSA Technologies Ltd, 2013.

therefore real or perceived impacts on property values due to aesthetics, EMF concerns, and reduced land usability.

Cumulative impacts on sacred sites, access routes, or traditional land uses (hunting, gathering, etc.) are often amplified.

Maintenance may be easier and one team can look after both T/L during the operational phase so a reduction of resource use.

Mitigation Measures

The Project T/L will be designed with a better tower structure and technology compared to the existing transmission system.

The measures to be taken in the pre-construction (design) phase will also further reduce the incremental EMF impacts of this T/L. The measures include,

- NGC's standard operating procedures (SOPs) of a minimum vertical ground clearance for T/L conductor mentioned in **Section 3.6** will be ensured.
- Reducing conductor spacing.
- Arranging phases so that fields tend to cancel.
- Increasing transmission voltage (since magnetic field intensities are a function of current, and increased voltage, all things being equal, will result in reduced current).
- Reducing loads (and therefore, currents).
- Identification of potential exposure levels in the work area, including surveys of exposure levels and establishment of safety zones.
- Safety signs and warning zones shall be highlighted to indicate EMF in the area.
- Limit access to properly trained workers and those equipped with appropriate PPE when entering safety zones.
- Increasing right-of-way widths or buffer zone widths, to move people further from T/Ls.

Use common access roads where feasible to reduce land disturbance.

Avoid excessive widening of the corridor by optimizing conductor spacing and tower design.

Use double-circuit towers or multi-circuit pylons to reduce spatial footprint.

Bird diverters and other devices which increase visibility will be installed, especially in areas with migratory or raptor populations.

Affected communities will be compensated as per market rates following the land acquisition and resettlement plan (LARP or RP).

5.10 Climate Risk and Vulnerability Assessment

Climate risk and vulnerability assessment (CRVA) has been carried out for the proposed Second Power Transmission Strengthening Project, to be implemented by the NGC of Pakistan in the Punjab province. The proposed project will construct 283km of 500kV double-circuit overhead transmission lines, transmission line bays at Faisalabad West Substation and install 2x111 MVAR shunt reactors at Faisalabad West Substation, 1x111 MVAR shunt reactors at Ghazi Barotha HPP and 1x111 MVAR shunt reactors at Islamabad West Substation.

Pakistan is frequently affected by natural hazards. The key natural hazards that will affect the proposed electricity transmission infrastructure are floods (both flash floods and riverine) and landslides. Other natural hazards such as erosion and earthquakes, may have direct impacts on the electricity transmission line built by the project.

Climate change is affecting electricity infrastructure by the changing weather conditions in which they operate. This can cause failures via physical hardware damage or creating operational conditions that exceed the hardware tolerance of the electricity infrastructure. As awareness of risks of climate change has risen, vulnerability assessment and adaptation planning studies have been rapidly emerging in recent years.

Baseline assessment and future projections of temperature, precipitation, floods, landslides, and other climate change parameters were reviewed, following the publications by the IPCC and climate change modelling carried out by various research groups.

Hazard identification, the likelihood of hazard, exposure and vulnerability of hazard, consequences of hazard, risk scoring, and risk levels or indexes of hazards were considered to identify the potential climate risk mitigation and adaptation measures. Based on the climate change risk assessment undertaken for this project, we have identified a range of possible near- and long-term climate change adaptation actions and financing that may be suitable for the proposed project.

Relocation of transmission line towers to avoid landslides, strengthening of transmission line tower foundations to withstand floods and landslides, and construction of retaining walls surrounding transmission line tower foundations in landslide-prone areas are adaptation measures proposed. The amount of adaptation financing to implement these measures is $ 22.82 million.

As the transmission infrastructure proposed is dedicated transmission connections for the transmission of electricity generated at hydropower plants, the investment qualifies as mitigation financing according to the Common Principles for Climate Mitigation Finance Tracking. Therefore, the amount of mitigation financing included in the investment is $ 384.48 million.

6. Information Disclosure, Consultation and Participation

Stakeholders are groups and individuals that are affected by or can affect the outcome of a project. Stakeholder engagement is a broad, inclusive, and continuous process between a developer of a project and its stakeholders. This process comprises a range of coherent approaches and activities that span the entire life cycle of the project. This is achieved by informing the stakeholders on time about the proposed project and its potential consequences on the environment and by encouraging their feedback.

The purpose of this exercise is to inform all the stakeholders about the project and include their concerns, suggestions, and opinions, and develop confidence amongst them that the project will be developed responsibly.

Continuous engagement with the local community and other stakeholders will be carried out throughout Project lifecycle, including the construction and operation phases.

6.1 Objectives

The basic objective of this activity was to have on board the APs and related Government institutions and other stakeholders through:

- Informing stakeholders about the proposed Project.
- Creating awareness about the proposed Project, including its impacts.
- Ensuring their support for the proposed Project.
- Rapport building with APs.
- Involving them in the process of determining the right direction for area development.
- Explain to them the requirements of the Punjab Environmental Protection Act, 1997 (as amended up to 2017)
- Providing an opportunity for the public to influence the proposed Project design; and
- Increasing public confidence in the proposed Project, its proponent, reviewers, and decision-makers.

6.2 Consultation Methodology

A stakeholder is an individual, group, or organization that is impacted by the outcome of a project. There are two types of stakeholders, i.e., community and institutions. Firstly, these stakeholders were identified. Separate consultations were conducted with stakeholders, where their concerns, suggestions, and opinions were documented on a consultation form. This input was taken into consideration while assessing the potential impacts of the project. Mitigation measures were recommended for each impact, considering the concerns, suggestions, and opinions expressed by the parties involved.

The baseline data for the EIA of the proposed T/L was collected from the field through field surveys conducted in the months of February and March 2025.

6.3 Community Consultation

The focus of this consultation is the population living near the proposed T/L route, i.e., the population that is living around the radius of up to 100m of the proposed T/L on each side.

To ensure a more inclusive consultation process, the vulnerable population within the COI, which includes women and the elderly, was actively included in the consultations.

The community consultations were conducted in Urdu and Punjabi to make the consultations understandable to the communities. The meetings progressed in the following manner:

- Stakeholders were introduced to the visiting team and briefed about the consultation process and its objectives.
- The main points of the BID were read out to the stakeholders in the language preferred by the community. Through the BID an overview of the Project and EIA process was provided
- Stakeholders could raise queries or concerns regarding the Project. Queries were responded to, and concerns were documented.

The list of the communities consulted, the dates of consultations, names, and contact details, their opinions, and the visiting team's responses to concerns are given in **Table 6-1 & 6-2.**

The location of these communities is shown in a *Google Earth* image map with the T/L passing near this area in **Figure 6-1**. Photographs from the public consultation sessions are presented in **Figure 6-2 & 6-3**.

6.4 Institutional Consultation

Various important government departments and private institutions were consulted to gather their concerns concerning the project activities.

Institution names, and contact details, their opinions, and the visiting team's responses to concerns are in **Table 6-3**.

The meetings progressed in the manner mentioned below.

- The EIA process that will be undertaken for the Project was briefly described, and the structure of the EIA report was presented to facilitate understanding of the process.
- Their opinion, concern, and issues related to the physical environment, socioeconomic environment and other general views about the project were documented.

Photographs from the public consultation campaign are presented in **Figure 6-4**.

Table 6-1: Community Stakeholder Views / Concerns

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
1	08-February 2025	Chak Pindi Das	8	Muhammad Ismail S/O Atta Muhammad Muhammad Iqbal S/O Atta Muhammad	▪ land will be affected ▪ awareness workshops for farmers should be conducted on sites	▪ The project does not require any land acquisition. ▪ The awareness workshop will be arranged before the start of civil work.
2	09-Feburary 2025	143 Shamali	10	Muhammad Mumtaz S/O Ali Muhammad Tahir Abbas S/O Umer Hayat	▪ satisfied and show no concerns.	▪ -
3	09-February 2025	Mouza Kalri	10	Ashir Ali S/O Liaquat Ali Amir Shehzad S/O Noor Muhammad	▪ payment of compensation should be made before civil work.	▪ Payment of compensation to APs is before starting construction as per the updated RP.
4	10-February 2025	Chak No 142 Shamali	7	Sadiq Ali S/O Abdullah Muhammad Jaffer S/O Abdul Majeed	▪ satisfied and shows no concerns.	▪ -
5	10-February 2025	Mouza Kot Najabat	5	Sadiq Ali S/O Abdullah Muhammad Jaffer S/O Abdul Majeed	▪ APs stated that kindly give us a good compensation amount of damages and jobs.	▪ APs will receive a good amount of damages compensation and jobs where feasible are provided by contractors and monitored by NGC.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
6	11-February 2025	Thatha Rehmo	5	Kazim Ali S/O Muhammad Riaz Saeed Waqar S/O Noor Muhammad	▪ APs stated that give us a compensation amount of damages as per market rate.	▪ APs will receive a good amount of damages compensation.
7	11-February 2025	Chak 466	5	Mian Muhammad Riaz S/O Mehar Ali Wasif Ali S/O Sajid Ali Muhammad Saleem S/O Sarfaraz	▪ APs expressed that chance of some environmental effects like noise/ vibration and dust emissions to the nearby community.	▪ Precautionary measures will be taken to minimize the environmental effects. Hence, the APs got satisfied.
8	12-February 2025	Noor Pur Batha	4	Mumtaz S/O Ramzan Muhammad Nawaz S/O Anwar Ai	▪ satisfied and shows no concerns.	▪ -
9	12-February 2025	Thatha Sarnanga	6	Saqib Saleem S/O Muhammad Shafi Misar Saleem S/O Muhammad Shafi	▪ APs stated that during civil work, laborers should take care of local norms and values (especially veil/pardah).	▪ During Civil work, laborers should take care of local norms and values (especially Veil/Pardah). ▪ Informed to APs that in case of any issue, they must address their complaint in GRC.
10	13-February 2025	209 Tarar	9	Khalid Hussain S/O Sooba Khan Qasim Sipra S/O Zafar Iqbal Amjad Ali S/O Saleh Muhammad	▪ APs stated that fix towers properly so that they cannot be dangerous for the local community.	▪ A competent team will be working on the tower installations, and no risk of collapse is foreseen.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
11	13-February 2025	Chak No 198	6	Falak Sher S/O Muhammad Hayat Gul Akbar S/O Ahmad Yaar	▪ APs stated that it's a govt land. but they are doing cultivation themselves. ▪ kindly make a payment of damages compensation to the cultivator.	▪ Payment of damages/compensation will be given to the cultivator.
12	14-February 2025	Chak No 466 Haty	5	Muhammad Akram S/O Haji Dara Khan Ghulam Abbas S/O Haq Nawaz Nazir Ali S/O Allah Deen	▪ payment of compensation should be made before civil work and give us a good payment of compensation.	▪ Payment of compensation to APs is before the start of construction as per the updated RP. ▪ They will receive a good payment of compensation for their damages.
13	14-February 2025	Chak No 466 Haty	6	Muhammad Arif S/O Khurshed Ali Riaz Ahmad S/O Noor Ahmad	▪ APs worried about damage to their agricultural land.	▪ They were informed that compensation covers all the damage at current market rates.
14	16-February 2025	Dera Bhatti Gujranwala	4	Irfan Haider S/O Mutalli Khan Muhammad Ahsan S/O Fazal Abbas Muhammad Hayyat S/O Haji Mehar Khan Muzamil Abbas S/O Muhammad Aziz	▪ satisfied and shows no concerns.	▪ -

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
15	16-February 2025	Gujranwala	4	Ghulam Mustafa S/O Atta Muhammad Hussain Ali S/O Rizwan	▪ APs stated that providing job opportunities to local residents within the project would significantly enhance their livelihoods.	▪ Jobs where feasible are provided by contractors and monitored by NGC.
16	16-February 2025	Shah Yousaf	6	Muhammad Ehsan S/O Khan Muhammad Irfan S/O Khan Muhammad	▪ satisfied and shows no concerns.	-
17	16-February 2025	Arar	5	Usman Farooq S/O Ahmad Yaar Muhammad Ramzan S/O Muhammad Ismail	▪ satisfied and shows no concerns.	-
18	17-February 2025	Vijh	4	Muhammad Rafique S/O Laal Khan Asif Bilal S/O Abdul Hameed Faryad Hussain S/O Muhammad Mukhtar Hussain	▪ APs stated that during civil work laborers should take care of local norms and values (specially veil/pardah).	▪ During Civil work labors should take care of local norms and values (Specially Veil/Pardah). ▪ Informed to APs that in case of any issue they must address their complaint in GRC.
19	16-February 2025	Mouza Kot Chugatta	7	Javed Iqbal S/O Gull Muhammad Abdul Wahab Shah S/O Syed Jameel Akhtar Ahmed Nawaz S/O Ahmad Hayyat	▪ APs worried about damage to their agricultural land.	▪ They were informed that compensation covers all damages at the current market rate.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
20	16-February 2025	Radhan Jadeed	5	Ehsan Ullah S/O Muhammad Manzoor Ehsan Ullah S/O Asad Ullah	▪ Satisfied and shows no concerns.	-
21	16-February 2025	Kotla Watni	4	Anayet Ullah S/O Aman Ullah Khan Sabir Khan S/O Aman Ullah Khan	▪ APs expressed the chance of some environmental effects like noise/ vibration and dust emissions to the nearby community.	▪ Precautionary measures will be taken to minimize the environmental effects. Hence, the APs got satisfied.
22	16-February 2025	Naraghi	10	Muhammad Shafique S/O Manzoor Hussain Asif Khan S/O Azam Khan	▪ APs stated that it's a govt. land. but they are doing cultivation there self. ▪ kindly make a payment of damages compensation to the cultivator.	▪ Payment of damages/compensation will be given to the cultivator.
23	16-February 2025	Pirah Jangla	8	Muhammad Asif S/O Ghulam Muhammad Ghulam Hussain S/O Jan Khan	▪ payment of compensation should be before civil work and give us a good payment of compensation.	▪ Payment of compensation to APs is before construction starts as per updated RP. ▪ PMC staff ensured that they would receive a good payment of compensation for their damage.
24	17-February 2025	Dhok Milyaran	4	Shakeel Ahmad S/O Ameer Akhtar Said Akbar S/O Haji Akbar	▪ Satisfied and shows no concerns.	-

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
25	17-February 2025	Dhok Maryan	5	Tahir Nadeem S/O Muhammad Hussain Muhammad Hussain S/O Allah Ditta Mubashir S/O Muhammad Ashraf	▪ Satisfied and shows no concerns.	-
26	18-February 2025	Mikyal	6	Raja Sultan S/O Raja Aslam Deen Muhammad S/O Muhammad Kan	▪ Satisfied and shows no concerns.	-
27	18-February 2025	Sipayal	3	Nazim Hussain S/O Khawar Ali Saleem Khan S/O Jaffar Khan	▪ The land will be affected ▪ Awareness workshops for farmers should be conducted on the sites	▪ The project does not require any land acquisition. ▪ The awareness workshop will be arranged before the start of civil work.
28	19-February 2025	Privaal	3	Shehzad Ali S/O Babar Ali Khan Umer S/O Babar Ali	Satisfied	-
29	19-February 2025	Pail	8	Tasawar Abbas S/O Noor Muhammad Muhammad Aziz S/O Muhammad Saeed	▪ Payment of compensation should be made before civil work.	▪ Payment of compensation to APs is before starting construction as per the updated RP.
30	20-February 2025	Gagan	8	Arif S/O Haji Ameer Afzaal S/O Bhatti Ali Ashaq S/O Zaid	▪ Satisfied and shows no concerns.	-
31	20-February 2025	Ichral	4	Mubashir S/O Fazal Saad S/O Adnan	▪ APs stated that kindly give us a good compensation	▪ APs will receive a good amount of damages

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Ali Khan S/O Muhammad Khan Haji Allah Ditta S/O Jahan Dad	amount of damages and jobs.	compensation and jobs, where feasible, are provided by contractors and monitored by NGC.
32	20-February 2025	Chak Sultan	4	Rustam Khan S/O Waseer Faiz Ali S/O Noora	▪ Satisfied and shows no concerns.	-
33	21-February 2025	Nawa Garan	8	Ibrar S/O Akhtar Jan Zafa Iqbal S/O Mian Noor Azmat Ullah S/O Sidmar Mughal	▪ APs expressed that chance of some environmental effects like noise/ vibration and dust emissions to the nearby community.	▪ Precautionary measures will be taken to minimize the environmental effects. Hence, the DPs were satisfied.
34	21-February 2025	Dhok Haji	5	Tufail S/O Muhammad Ali Adil Khan S/O Walayat Jasam S/O Hasam	▪ APs stated that it's a govt. land. but they are doing cultivation thereself. ▪ kindly make a payment of damages or compensation to cultivator.	▪ APs that payment of damages compensation will be given to cultivator.
35	22-February 2025	Bajal	6	Aftab Ahmad S/O Rab Nawaz Faisal Zaid S/O Muzaffar Khan Sher Khan S/O Sher Jang	▪ Payment of compensation should be before civil work and give us a good payment of compensation.	▪ Payment of compensation to APs is before construction starts as per updated RP. ▪ APs will receive a good payment of compensation for their damage.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
36	23-February 2025	Dorean	4	Niaz Ali S/O Hafiz Sultan Gulistan Ameer Abbas S/O Abdullah	▪ satisfied and shows no concerns.	-
37	23-February 2025	Thathi Noor Ahmad Shah	9	Amir Khan S/O Fateh Khan Habib Ali S/O Sher Muhammad Ahmad Ali S/O Sher Muhammad Ashir S/O Tahir Shehryar S/O Tahir	▪ APs stated that during civil work laborers should take care of local norms and values (especially veil/pardah).	▪ During Civil work, laborers should take care of local norms and values (especially Veil/Pardah). ▪ Informed APs that in case of any issue, they must address their complaint in GRC.
38	23-February 2025	Kot Sarang	7	Laal Khan S/O Noor Khan Manzoor Khan S/O Laal Khan Abrar Khan S/O Manzoor Khan	▪ APs worried about damage to their agricultural land.	▪ They were informed that compensation covers all damages at current market rate.
39	24-February 2025	Katha Sagraal	5	Mukhtar Ahmed S/O Atta Muhammad Muhammad Riaz S/O Salleh	▪ APs worried about damage to their agricultural land.	▪ They were informed that compensation covers all the damage at current market rates.
40	24-February 2025	Bhilomar	6	Imdad Hussain S/O Barish Hussain Asif S/O Muhammad Ashraf Abid Hussain S/O Muhammad Nawaz	▪ satisfied and shows no concerns.	-
41	24-February 2025	Chak Walia	9	Altaf S/O Ahmad Khan Muhammad Bakir S/O Muhammad Ismail	▪ APs stated that providing job opportunities to local residents within the	▪ Jobs where feasible will be provided by contractors and monitored by NGC.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Muhammad Nazir S/O Muhammad Ismail	project would significantly enhance their livelihoods.	
42	26-February 2025	Dhok Shabil	4	Muhammad Sadique S/O Bakhtawar Khan Muhammad Attique S/O Muhammad Siddique	▪ satisfied and shows no concerns.	-
43	26-February 2025	Dhok Jamal	4	Muhammad Sadique S/O Bakhtawar Khan Muhammad Attique S/O Muhammad Siddique	▪ land will be affected ▪ awareness workshops for farmers should be conducted on sites	▪ The project does not require any land acquisition. ▪ The awareness workshop will be arranged before the start of civil work.
44	27-February 2025	Naka Rehan	4	Ishtiaq S/O Abdullah Muhammad Hussain S/O Genabat Ali	▪ satisfied and shows no concerns.	-
45	27-February 2025	Thathi Noor Muhammad Shah	9	Awais S/O Haji Laal Khan Sultan Muhammad S/O Sher Muhammad	▪ payment of compensation should be made before civil work.	▪ Payment of compensation to APs is before starting construction as per updated RP.
46	27-February 2025	Sahwal	4	Noor Muhammad S/O Aman Khan Muhammad Altaf S/O Muhammad Khan	▪ satisfied and shows no concerns.	-
47	28-February 2025	Kundi Dheri	4	Kamran Khan S/O Muhammad Khan Imran Khan S/ Muhammad Khan	▪ APs stated that kindly give us a good compensation	▪ APs will receive a good amount of damages compensation, and jobs,

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
					amount for damages and jobs.	where feasible, are provided by contractors and monitored by NGC.
48	28-February 2025	Talagang Moorat	4	Arslan Malik S/O Muhammad Siddique Muhammad Abdullah S/O Muhammad Sadique	▪ satisfied and shows no concerns.	-
49	28-February 2025	Dhok Patwari	3	Muhammad Iqbal S/O Hayat Muhammad Mehtab S/O Hayat Muhammad Imran Ali S/O Haji Hayat	▪ DPs stated that during civil work, laborers should take care of local norms and values (especially veil/pardah).	▪ During Civil work, laborers should take care of local norms and values (especially Veil/Pardah). ▪ Informed DPs that in case of any issue, they must address their complaint in GRC.
50	28-February 2025	Mangial	4	Kashif S/O Shakeel Waqas S/O Haji Anar Banaras S/O Anar	▪ APs are worried about damage to their agricultural land.	▪ They were informed that compensation covers all the damage at the current market rates.
51	March 01, 2025	Pirah Jangla	5	Abdullah Khan S/O Muhammad Ameer Muhammad Basheer S/O Muhammad Ameer	▪ Satisfied and shows no concerns.	-
52	March 02, 2025	Kot Fateh Khan	5	Lal Khan S/O Nawab Khan Munraiz Khan S/O Aurangzeb	▪ APs expressed the chance of some environmental effects, like	▪ Precautionary measures will be taken to minimize the environmental effects.

Sr. No.	Date	Location/ Venue	No of Participants	Name of Main Participants	Major Concerns and Feedback	Redress Concerns and Feedback
					noise/ vibration and dust emissions, on the nearby community.	Hence, the APs were satisfied.
53	March 02, 2025	Kotehra	4	Sheryar S/O Umar Hayat Wali Muhammad S/O Allah Din	▪ APs stated that it's a govt land. but they are doing cultivation there self. ▪ kindly make a payment of damages compensation to the cultivator.	▪ Payment of damages will be given to the cultivator.
54	March 02, 2025	Muqam Khurd	4	Nawazish S/O Ahmad Khan Ghulam Jilani S/O Ghulam Rasool Ali Haider S/O Haider	▪ Payment of compensation should be made before civil work and give us a good payment of compensation.	▪ Payment of compensation to APs is before the start of construction as per the updated RP. ▪ APs will receive a good payment of compensation for their damages.

Table 6-2: Views / Concerns of Female Members of the Community in COI

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
1	24-February-2025	Chak No 199, Rehmoana	19	Zeenat W/O Ahmed Yar Amma Bagian W/O Ilyas Tahira Bibi W/O Asif Riffat Bibi W/O Sher Jung Maryum Bibi W/O Mian Nazar Muhammad Nadia Bibi W/O Muhammad Gulzar Kousar Bibi W/O Zulfiqar Mumtaz W/O Shah Nawaz Inza Shah Nawaz D/O Shah Nawaz Amna Shah Nawaz D/O Shah Nawaz Began Bibi W/O Muhammad Sardoom Fazilat W/O Muzammil Iqbal Rubab D/O Muzammil Iqbal Tabassum W/O Yousaf Shahzad Farwa Shahzad D/O Yousaf Shehzad Shehrbano Shahzad D/O Yousaf Shahzad Dua Zahra W/O Liaqat Komal Liaqat D/O Liaqat Ishrat Liaqat D/O Liaqat	▪ Instability ▪ Anxiety and uncertainty in women ▪ Effect of health, economic instability ▪ Uncertain income ▪ Social issues ▪ Handsome compensation ▪ Local employment ▪ Social anxiety over resettlement ▪ Insecurity ▪ Crop yield economics will decline	▪ Compensation will be provided as per the replacement cost of the lost assets ▪ Regarding the local movement during the construction stage, alternate routes will be provided, and contractor will be bound to compliance with the construction management plan. ▪ Jobs will be provided to the local people on a priority basis and the contractor will be contractually bound to ensure full compliance.

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
2	25-February-2025	Karor Wala	3	Nasreen W/O Zulfiqar Tahira Batool W/O Amir Hussain Sardar Bibi W/O Abdul Khaliq	▪ Satisfied	
3	25-February-2025	Icchar	3	Zamurad Bibi W/O Nasir Shah Sania Zahra W/O Rizwan Abbas Safira Iram W/O Ali Hussain	▪ Satisfied	
4	26-February-2025	Shah Pur	6	Shahzadi Iftikhar D/O Iftikhar Shanaz Bibi W/O Muhammad Shareef Nusrat W/O Zaid Fateh Bibi W/O Tasawar Iqbal Shamim Kousar W/O Touqeer Ahmed Saira Parveen W/O Tanveer Hayyat	▪ Economic issues/unemployment ▪ Social instability ▪ Health of children/women affectee	
5	26-February-2025	Sahiwal	3	Naheed Akhtar W/O Zulfiqar Fatima Bibi W/O Fida Muhammad Asia Batool W/O Muhammad Ashraf	▪ Ownership Right on Resettlement ▪ Provide Equitant Land as Compensation	
6	27-February-2025	Katha Sanghral	41	Bushra Azam D/O Sadi Ameer Rasool Bi W/O Ghulam Muhammad Rehana Kousar W/O Imdad Hussain Anaaran Bibi W/O Khaliq Bar Razia Aziz D/O Mehar Muhammad Aziz Shumaila Parveen W/O Muhammad Sohail	▪ Provide alternative livelihood support ▪ Direct compensation to women ▪ Displacement/disruption/stress/anxiety ▪ Safety and security concern	

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Manzoor Bibi W/O Rafique Ahmed Shamim Akhtar W/O Muhammad Iftikhar Hayat Bi W/O Mansab Khan Shamim Akhtar W/O Sultan Muhammad Mehtab Bi W/O Mazhar Hussain Sumaira Hayat W/O Arif Abbas Ruzina W/O Bhatti Alam Khatoon W/O Riaz Hussain Zakiya Kalsoom W/O Shahzad Gul Ghulam Aisha W/O Muhammad Nawaz Taj Bi W/O Ghulam Shabir Safiya Bibi W/O Misri Khan Aliya Parveen W/O Fakhar Abbas Rehmat Bibi W/O Allah Bakhsh Sakina Bibi W/O Sher Muhammad Gul Farhat Shaheen Muhammad Insar Iffat Shaheen W/O Muhammad Anwar Khan Barjees Akhtar W/O Muhammad Idrees Ambreen Gul W/O Waseem Iqbal Rukhsana Kousar W/O Gul Jahan Saira Qadir W/O Muhammad Imran	▪ Harassment/ gbv, risk will increase ▪ Direct compensation to affectee ▪ Provide legal awareness	

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Kaneez Fatima W/O Ahmed Khan Nasreen W/O Muhammad Aziz Razia Bibi W/O Muhammad Saeed Bilqees W/O Muhammad Lateef Maryum Bibi W/O Ahmad Yar Nasreen Akhtar W/O Ghulam Muhammad Rasool Bi D/O Ghulam Muhammad Bhag Bhari W/O Muhammad Mumtaz Asma Ahmad D/O Muhammad Imran Riba Bi W/O Muhammad Sher Tallat Nazir W/O Khan Muhammad Nagina Parveen W/O Muhammad Irfan Shamim Akhar W/O Muhammad Iftikhar Farhat Yasmeen W/O Sabir Hussain		
7	27-February-2025	Katha Masral	15	Saima Nasreen W/O Muhammad Nawaz Anees Begum W/O Haji Khan Rubina W/O Muhammad Mukhtar Kaneez Akhtar W/O Muhammad Javed Razia Aziz D/O Muhammad Aziz Samina Noureen W/O Ghous Muhammad Badshahi W/O Rab Nawaz	▪ Reduce crop yield/disturb farming ▪ Loss of social support ▪ Financial pressure / unemployment ▪ Provide handsome compensation	

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Kainat Bibi W/O Ameer Khan Munawar Begum W/O Muhammad Rafiq Rubina Shaheen W/O Muhammad Ramzan Nasreen S/O Muhammad Aziz Samina Sattar W/O Muhammad Safdar Hussain Naseem Akhtar W/O Muhammad Akram Parveen Akhtar W/O Muhammad Mumtaz Ghulam Aisha W/O Muhammad Ismail	▪ Resettlement can cause disturbance difficult to adjust in new environment ▪ Social issue due to resettlement	
8	28-February-2025	Pirah	17	Parveen Akhtar W/O Muhammad Sadique Shamim Akhtar W/O Nazar Abbas Ghulam Sakina W/O Muhammad Abbas Riffat Ameer W/O Zaid Iqbal Mukhtar Begum W/O Muhammad Nawaz Asiya Parveen W/O Shoukat Abbas Sayadan Bibi W/O Nadir Khan Noor Bhari W/O Abdul Khaliq Ghulam Zainab W/O Zahoor Ul Hassan	▪ Value of property will decline ▪ Uncertain failure ▪ Social uncertainty and stress in children and women ▪ Women with ownership rights of home must be given alternate home ownership ▪ Productivity of agriculture yield will decrease ▪ Social isolation ▪ Job insecurity	

Sr. No.	Date	Location/ Venue	No. of Participants	Name of Participants	Major Concerns and Feedback	Redress Concerns and Feedback
				Ghulam Fatima W/O Gul Sher Malik Nosheen Asghar W/O Asad Ul Haq Isra Shoukat W/O Nadeem Khaliq Sat Bhirai W/O Zafar Iqbal Shafqat Zahra W/O Muhammad Farooq Akbar Khalida Naseem W/O Gul Jahan Fouzia Parveen W/O Yasir Ul Rehman Tasbeeha Fatima W/O Imtiaz Haider	▪ Cultural adjustment ▪ Economic dependency	
9	28-February-2025	Dhok Pathan	8	Manzoor Begum W/O Noor Khan Riffat Bibi W/O Najab Khan Kalsoom Akhtar W/O Muhammad Asghar Jaweria Altaf W/O Ameer Afsar Shah Sultan W/O Muhammad Banaras Ammara D/O Muhammad Banaras Sania Bibi D/O Muhammad Banaras Umme Rubab D/O Muhammad Banaras	▪ Properties near a voltage line are difficult to sell/reduce market value ▪ Loss of social support/financial instability ▪ Economic struggle-diet related issue ▪ Harassment risks ▪ Direct compensation to women with ownership rights ▪ Higher risk of post-traumatic stress disorder (PTSD) ▪ Social isolation- cultural and Language Barrier	

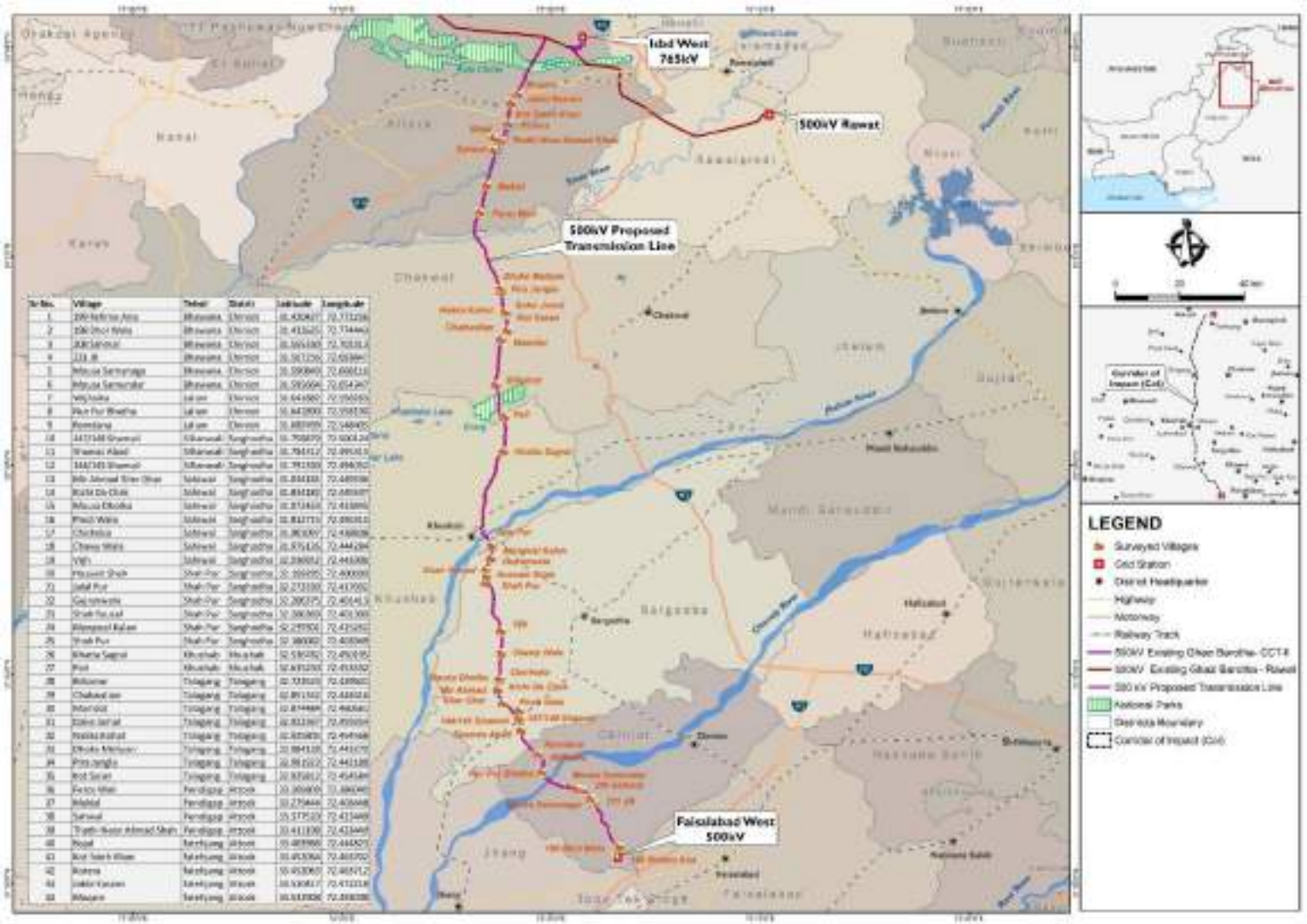


Figure 6-1: Locations of Community Consultations

Community Consultation at Chak No. 199 J/B, Chiniot

Consultative Session with the Community of Chak No. 198 J/B (Dhol Wala), Chiniot

Community Consultation at Sillanwali

Consultation underway with Locals of Sahiwal

Consultation with Locals of Shahpur

Community Consultation at Khushab

Consultation with Locals at Talagang

Community Consultation at Pirajangla

Community Consultation at Pindi Gheb

Community Consultation at Fateh Jang

Figure 6-2: Community Consultation Photographs (Male)

Female Community Consultations at Talagang

Female Consultations at Katha Sagral

Discussion and Consultation with Females at Khushab

Female Community Consultations at Shahpur

Female Community Consultations at Chak No. 199 J/B

Female Consultations at Chiniot

Figure 6-3: Community Consultation Photographs (Female)

Table 6-3: Summary of the Concerns/ Views from Institutional Consultations

Sr. No.	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions	Redress Concerns and Feedback
1	Mr. Noman Younis	Deputy Director (Research & Implementation)	Environment Protection and Climate Change Department (EPCCD), Punjab	nomanyounis@gmail.com	Concerns: ▪ Health impacts in locals due to electrocution Suggestions: ▪ Route optimization should be in a way to avoid settlements and disputed lands	▪ Efforts have been made to avoid settlements, especially residential areas and disputed lands, during route optimization.
2	Mr. Iqbal Khan Munj	Director Archaeology	Directorate General of Archaeology & Museums, Punjab	arch.punjab@gmail.com	Concerns: ▪ Any archaeological site may come within the proposed T/L route Suggestions: ▪ Route optimization should be in a way to avoid archaeological sites ▪ The minimum of 200 feet distance should be maintained between T/L route and the archaeology site or monument (if comes within the proposed T/L route) ▪ In case an archaeological site or monument is discovered during project implementation. The Department should be informed immediately	▪ Efforts have been made to avoid archaeological site or monuments during route optimization of proposed T/L project. ▪ A chance find procedure has been developed to report archaeological site or monument discovery to the Department during project implementation

Sr. No.	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions	Redress Concerns and Feedback
3	Mr. Muhammad Irfan Mr. Shahid Saleem	Manager Environment	ESIC-NGC	esic@ntdc.com.pk	Concerns: ▪ Health safety concerns for locals as well as for laborers ▪ Adverse impacts on flora and fauna of the project area	▪ The EIA Report covers all adverse impacts anticipated during various phases of the project. Their respective mitigation measures are also provided in the report.
4	Ms. Humaira Ayesha Mr. Muhammad Huzaifa	Senior Manager Wildlife Conservation Research Officer	World Wide Fund (WWF), Pakistan	042-35465972-77 haish@wwf.org.pk mhuzaifa@wwf.org.pk	Concerns: ▪ The route crosses National Parks (i.e. Chinji and Kala Chitta), which may pose threats to the flora and fauna of the area ▪ The labor may involve hunting and poaching of animals during the project implementation Suggestions: ▪ Human wildlife conflict should be avoided and labor should be trained / aware well in this regard	▪ Mitigation measures have been proposed in Chapter 6 of EIA Report to cope up the raised concerns and suggestions
5	Dr. Zulfiqar Ali	Professor (Wildlife & Environment)	Institute of Zoology, University of the Punjab	zali.zool@pu.edu.pk	Concerns: ▪ Flora & fauna of the area especially Chinji National Park and Kala Chitta National Park may be affected during the construction as	▪ Comprehensive mitigation measures regarding flora, fauna, and air & noise pollution have been suggested in Chapter-6 of EIA Report

Sr. No.	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions	Redress Concerns and Feedback
					well as operation phases of the proposed T/L project ▪ Air & noise pollution may also disturb the faunal species residing in above mentioned National Parks Suggestions: ▪ Air & noise pollution prevention measures should be taken, especially during the implementation phase of the proposed project ▪ Construction activities during night hours should be avoided ▪ Comprehensive mitigation measures should be devised and implemented, especially for construction and operational phases	▪

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
1	Mr. Ali Abbas Shah	Range Forest Officer	Forest Office-Chiniot	0300-8363455	Concerns: ▪ Land will be affected ▪ During rain health & safety hazards Suggestions: ▪ The health & safety of farmers should be ensured ▪ Compensation of affected crops and land should be given
2	Malik Shahbaz Khan	Deputy Director	Social Welfare & Bait-ul-mal, Chiniot	042-99204149	Concerns: ▪ Impact on the livelihood of locals ▪ Reasonable compensation Suggestions: ▪ Fair and handsome compensation for resettlement ▪ Employment opportunities for locals
3	Dr. Hina Sattar	Deputy Director	EPD-Chiniot	0800-02345 doe.chiniot@punjab.gov.pk	Concerns: ▪ The environment will be impacted negatively ▪ Mitigation measures should be implemented before the start of the project Suggestions: ▪ EIA must be conducted before the start of the project

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
					▪ Awareness workshops for farmers should be conducted on the sites
4	Mr. Shahzad Bhatti	Superintendent	Agriculture Department-Chiniot	chiniot.agri@yahoo.com	Concerns: ▪ Crop destruction ▪ Loss of livelihood ▪ Health impacts Suggestions: ▪ Farmers should be protected and given compensation for the loss
5	Dr. Muhammad Ajnum Ali Butter Mr. Gohar Rehman	Director General Official	Agricultural Extension Department-Sargodha	chiniot.agri@yahoo.com	Concerns: ▪ Farmers' crops will be affected ▪ Crop destruction ▪ Chances of electrocution Suggestions: ▪ Minimum damage to crops must be ensured ▪ Fair compensation must be given to the farmers
6	Mr. Sheraz	Assistant Director	Social Welfare Department-Sargodha	dbmcsargodha@gmail.com	Concerns: ▪ Residences should be protected ▪ Health concerns of nearby residents Suggestions: ▪ The line should be laminated to minimize impacts

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
7	Mr. Aziz	Sr. Clerk	EPA-Sargodha	doe.sargodha@punjab.gov.pk	Concerns: ▪ Consultation should be conducted through proper channel and meeting should be held between Govt. officials and concerned departments Suggestions: ▪ Thorough presentations should be given so that stakeholders can raise concerns by being informed about the project and its activities
8	Mr. Amjad Saleem	Sub Divisional Forest Officer	Forest Department-Sargodha	048-3223727 dfosargodha@yahoo.com	Concerns: ▪ Loss of trees and vegetation ▪ Loss of livelihood Suggestions: ▪ More trees should be planted and thoroughly monitored to regain the loss that occur during project activities
9	Representative of Deputy Director	Official	Agriculture Extension Department-Khushab	045-4920158 doaextkhb@yahoo.com	Concerns: ▪ Loss of plant population and green spaces ▪ Orchards will be affected ▪ Health and safety concerns of the farmers ▪ Agricultural practices will suffer Suggestions: ▪ The acquisition of land should be carried out prior to the installation of towers

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
					▪ Farmers must be made aware of the health impacts of the transmission lines
10	Mr. Amjad	Official	Forest Department-Talagang	057-9316189 dformchakwal@gmil.com	Concerns: ▪ Delays due to unwilling landowners ▪ Compensation disputes and community dissatisfaction ▪ Legal hurdles in securing clear title ▪ Displacement of communities ▪ Health and safety concerns (EMF exposure, accidents) ▪ Public opposition due to aesthetic reasons Suggestions: ▪ Involve local farmers, agricultural cooperatives, and landowners early in the route planning stage. ▪ Conduct village-level consultations to identify critical agricultural areas to avoid.
11	Representative of AC Talagang	Administration	AC Office Talagang	--	Concerns: ▪ Risk of Electrocution or accidents, especially in densely populated areas. ▪ Electromagnetic field exposure concerns and potential health effects on residents ▪ Land acquisition & compensation to landowners ▪ Livelihood loss if the residential area is affected

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
					▪ Possible disturbance of wildlife migration or local ecosystem ▪ Opposition from local communities due to safety, land or compensation concerns Suggestions: ▪ Ensure proper safety protocols are followed during installation & maintenance ▪ Conduct awareness campaigns for local residents on safety precautions ▪ Regular inspection and maintenance of T/L to prevent hazard ▪ Maintain a safe distance from residential areas i.e., schools, hospitals & markets ▪ Conduct fair and transparent compensation assessment on market value ▪ Engage local communities dialogue to address concerns & avoid conflicts
12	Mr. Sabir Hussain	AD Agriculture	Agriculture Department-Attock	doaextbwn@gmail.com	Concerns: ▪ Loss of land ▪ Disruption of farming activities ▪ Economic impact ▪ Safety Risk ▪ Interference with irrigation & drainage system

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
					Suggestions: ▪ Proper compensation & land valuation ▪ Alternative routing to avoid agricultural land ▪ Use of advanced transmission technologies to reduce land footprint
13	Mr. Zahid Hussain	Official	Wildlife Department-Attock	dwoattock@gmail.com	Concerns: ▪ Habitat destruction ▪ Threats to birds ▪ Electromagnetic effect ▪ Fire hazards Suggestions: ▪ Stakeholder collaboration to work closely with the wildlife department and local communities ▪ Real-time monitoring using drones, sensors or tracking devices to observe wildlife impact ▪ Long-term ecological studies ▪ Modify mitigation strategies in wildlife disturbances are detected
14	Mr. Sajid Ullah	Official	Social Welfare Department-Attock	doe.atock@punjab.gov.pk	Concerns: ▪ Health risks ▪ Impact on the livelihood of locals ▪ Mental & social stress ▪ Inequitable compensation

Sr. No	Representative of the Department	Designation	Department	Contact Details	Points of Discussion / Apprehensions
					Suggestions: ▪ Community engagement ▪ Fair and handsome compensation for resettlement ▪ Employment opportunities for locals ▪ Implement strict safety regulations & regular inspection

Consultation with Deputy Director (R&I) of EPCCD, Punjab

Consultation with the Director of Archaeology of the Directorate General of Archaeology & Museums, Punjab

Consultation with WWF, Pakistan's Officials

Consultation with Professor (Wildlife & Environment) of the University of the Punjab

Departmental Consultation Meeting with Forest Department Chiniot.

Departmental Consultation Meeting with Social Welfare Department Chiniot.

Departmental Consultation Meeting with Agriculture Department Chiniot.

Departmental Consultation Meeting with Agriculture Department Sargodha.

Departmental Consultation Meeting with Agriculture Department Sargodha.

Departmental Consultation Meeting with Social Welfare Department Sargodha.

Departmental Consultation Meeting with Forest Department Sargodha.

Departmental Consultation Meeting with Agriculture Department Khushab.

Departmental Consultation Meeting with Assistant Commissioner Talagang.

Departmental Consultation Meeting with Forest Department Talagang

Departmental Consultation Meeting with Agriculture Department Attock

Departmental Consultation Meeting with Social welfare Department Attock

Consultation with ESIC of NGC

Figure 6-4: Photographs from Consultations with Institutions

7. ENVIRONMENTAL MANAGEMENT PLAN

This section provides an overall approach for managing and monitoring environment-related issues and describes the institutional framework and resource allocations proposed by NGC to implement the Environmental Management Plan (EMP) for the T/L construction.

7.1 General

The main objectives of EMP are to:

- Provide the details of the project impacts along with the proposed mitigation measures, and a corresponding implementation schedule.
- Define the responsibilities of the project Implementing Agency, contractor, supervisory consultants, and other role players, and effectively communicate environmental issues among them.
- Define a monitoring mechanism, reporting frequency, auditing, and identifying monitoring parameters to ensure that all the mitigation measures are completely and effectively implemented.
- Identify the resources required to implement the EMP and outline the corresponding financing arrangements.

7.2 Construction Schedule

As mentioned in **Section 2.7**, the Project Implementing Agency (NGC) plans to have T/L completed within three (03) years, after completing the necessary arrangements, on the fast track. There will not be any significant land acquisition or compensation process, except for the crop compensation of the T/L towers. When the detailed designs are completed, tendering and award of contract will take place over about three to six months. The construction period will follow, and best estimates indicate between two to three years.

7.3 Summary of Impacts and Mitigation Measures

Environmental protection and enhancement are achieved in various ways. These approaches should begin right at the initial stage i.e., i) project location, ii) design, specifications, and tender/contract documents, iii) construction activities and iv) post completion activities i.e., operation and maintenance stage. Appropriate environmental management measures are required to be exercised in a cascade order by NGC at each stage of the project.

An EMP establishes the linkages between the environmental and social impacts, the mitigation strategy and the agencies responsible for execution. Thus, the EMP in **Table 7-1** covers:

- A comprehensive listing of mitigation measures (actions).
- The institution(s)/ person(s) responsible for implementation of specific actions.
- The parameters to be monitored to ensure the effective implementation of the actions.

- A timescale for the implementation of actions has been indicated, subject to the project life cycle and indicated as During Construction or During Restoration.
- Set out a basis for preparing the site-specific EMP (SSEMP) by the Contractor.

7.4 Capacity Building and Training

Personnel, including Contractors' personnel, working for or on behalf of the Project will receive training to maintain awareness of relevant environmental and social aspects, impacts and risks associated with the Project and corresponding controls. The training will also maintain awareness of the environmental benefits of improved personal performance and the potential consequences of departure from specified procedures.

Visitors to Project sites will receive relevant environmental and social awareness training as part of site induction training. Environmental training will help to ensure that the requirements of this EIA and EMP are clearly understood and followed by all Project personnel in the course of the construction phase.

The Contractors will have primary responsibility for providing training to all construction personnel in line with the Training Plan shown in **Table 7-2**. The plan will be finalized before the commencement of the training.

Table 7-1: Environmental Management and Mitigation Matrix

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Pre-construction (design) phase							
Lack of Integration of EIA /EMP/EIA Requirements into Construction Bid Documents	Refer section 6.5.1	Bid Preparation	BOQ	NGC	ESIC, NGC		See EMP implementation cost
Lack of Planning in T/L design	Refer section 6.5.2	The Design phase	RoW of T/L	NGC with the design consultant	NGC		Cost provided in a later row for bird diverters
Lack of Project Human Resources	Refer section 6.5.3	The Design phase	ESIC and field offices	NGC with the design consultant	NGC	Before construction begin	240,900
Improper Location of Camps Leading to Environmental and Social Issues	Refer section 6.5.4	During design phase and SSEMP preparation	Camps Location	Construction Contractor (CC) with consultants	NGC		NA
High Noise Equipment	Refer section 6.5.5	SSEMP preparation/ design phase	RoW of T/L	Construction Contractor with Consultants	NGC	One time before mobilization	5,000
Waste Generation	Refer section 6.5.6	SSEMP preparation/ Design phase	RoW of T/L	Construction Contractor with Consultants	NGC		NA

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Disruption to Existing Drainage Pathways and Utilities	Refer section 6.5.7	SSEMP preparation/ Design/ Rehab phase	RoW of T/L	Construction Contractor with Consultants	NGC		NA
Impacts on Sensitive and High Value Areas	Refer section 6.5.9	SSEMP preparation/ Design phase	RoW of T/L	Construction Contractor with Consultants	NGC		NA
Removal of Vegetation / Trees	Refer section 6.5.8	Design/ Construction phase	RoW of T/L	NGC with the design consultant/ Construction Contractor	NGC		NA
Bird Collision and Electrocution Risk	Refer section 6.5.10	Design phase	T/L	NGC with the design consultant/ Construction Contractor	NGC		20,000
EMF (Electromagnetic Field)/ Corona Effect	Refer section 6.5.11	SSEMP preparation/ Design phase	RoW of T/L	Construction Contractor with Consultants	NGC		NA
Impact on Community Safety due to Structure/ Mechanical Failure of the Overhead Conductors	Refer section 6.5.12	SSEMP preparation/ Design phase	RoW of T/L	Construction Contractor with Consultants	NGC		NA

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Temporary Land Acquisition	Refer section 6.5.13	SSEMP/ LARP preparation	RoW of T/L	NGC with the design consultant	NGC		NAv
Construction Phase							
Impacts During Site Accessibility	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and as needed	As per RP estimate
Dust from Construction Activity and Air Emissions from Construction Equipment and Vehicles	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and as needed	5,000
Noise from construction vehicles and heavy equipment	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Instrumental Monitoring: Monthly General.: Daily Basis	5,000
Vibration	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	General.: Daily Basis	2,500

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Sediment Run-off from Construction Sites	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	5,000
Impact on Water Resources Quality and Quantity	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	5,000
Untreated Disposal of Effluent from Worker Camps and Batching Plant(S)	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	NA
Solid Waste Disposal and Disposal of Effluent from Worker Camps and Batching Plant(S)	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	5,000
Traffic Congestions	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	
Handling and Disposal of	Refer section 6.6	During Construction	Project-wise facilities and	Construction Contractor with Consultants	NGC	Daily	5,000

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Hazardous Materials			construction sites				
Impact on Occupational Health and Safety	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	5000
Existing Power Transmission Lines	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily	NA
Noise from Construction Activities and Camps may Cause Disturbance to Avifauna and Mammals	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	
Dust, Emissions, and Chemical Spills Affect Birds and Habitat Quality	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	
Accidental Death of Reptiles and Small Mammals during	Refer section 6.6						

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Site Clearing, Excavation and Rehabilitation Activities at Construction Sites and Camps (esp. In hibernation season)							
Increased Accessibility Leading to Illegal Poaching of Species Like the Pangolin and Migratory Birds	Refer section 6.6						
Spread of Invasive Plants	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	
Construction Activities During River Crossing Will Affect Aquatic Life and Riparian Habitat	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Special measures need to be adopted to minimize impacts on important resources, such as activities during critical periods	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	
Ecological Impacts	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Daily and before the Construction Works are Completed	61,800
Increased Employment Opportunities and Local Economy	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Early Stages of Construction Stage	NA
Overburden on Local Resources	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Early Stages of Construction Stage	2,500
Social Conflicts due to Influx of Workers	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and daily as needed	2,500

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Impact on Physical Cultural Resources (PCRs)	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Before start of excavation activity begins	2,500
Uncontrolled Solid Waste Disposal, Communicable Diseases	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and daily as needed	2,500
Conflict Over Resources	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and daily as needed	NA
Gender Issues	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and daily as needed	NA
Loss of Income/ Livelihood	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and as needed	NA
Relocation of private / public infrastructure	Refer section 6.6	NA	NA	NA	NA	NA	NA

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Indigenous, vulnerable and women-headed households	Refer section 6.6	NA	NA	NA	NA	NA	NA
Traffic Congestion	Refer section 6.6						
Community Health and Safety	Refer section 6.6	During Construction	Project-wise facilities and construction sites	Construction Contractor with Consultants	NGC	Monthly and daily as needed	1000
Natural Hazard Risks (Flooding, Earthquakes etc.)	Refer section 6.6	During design and before construction starts	Project-wise facilities and construction sites	NGC design, construction constructor with consultants	NGC	Before Construction and During Construction	
Operation Phase							
Occupational Health and Safety	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	Before Maintenance Work Begins	Will be part of ESG routine Work Schedule
Corona Effect	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	Already part of design phase	Will be part of ESG routine Work Schedule
Collapsing of towers/ Breaking of conductors/ Working failure of	Refer section 6.7	NA	NA	NA	NA	NA	NA

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
electronic devices/equipment							
Impact of Faulted SF6	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	Before Maintenance Work Begins	As above
Electrocution and Collision of birds	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	Before Construction and During Construction	As above
Community Health and Safety Risk	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	Before Maintenance Work Begins	As above
Visual Amenity	Refer section 6.7	During Operations	RoW of T/L	NGC	ESIC, NGC	During project Lifecycle	As above
Aircraft Navigation Safety	Refer section 6.7	During Design	RoW of T/L	NGC	ESIC, NGC	In Designing Stage/ operations	As above
Cumulative and Induced impacts	Refer section 6.7	During Design	Project-wise facilities and construction sites	Construction contractor with consultants	NGC	In Designing Stage/ operations	As above
Induced Impacts of Applied Measures	Refer section 6.7	Construction/ Operational Phases	NGC	ESIC, NGC	NGC	NA	NA

Potential Impacts	Mitigation Measures (MM)	Timing to Implement MM	Location to Implement MM	Implementation Responsibility	Monitoring Responsibility	Frequency	Estimated Cost, US$
Security Concerns	Refer section 6.7	During Construction and Operations	GS and TL Route	NGC	NGC	As needed	As above

EPA= Environmental Protection Agency, COVID-19= Coronavirus Disease 2019, EMF= Electromagnetic Field, ESIC = Environment and Social Impact Cell, T/L = Transmission Line, HIV= Human Immunodeficiency virus, LARP= Land Acquisition and Resettlement Plan, NGC = National Grid Company, PMU= Project Management Unit, PPE = Personal Protective Equipment, RoW = Right of Way; NA= Not Applicable

Table 7-2: Training Schedule

Target Audience	Trainers	Contents	Schedule
Contractor Supervisors/ Managers	NGC's ESIC Team/ Consultants	Induction training per 'Training Plan'	Before the start of construction activities
Selected management staff from the contractor	Contractor	Key findings of EIA Mitigation measures EMP	Before the start of construction activities
All site personnel	Contractor	Mitigation measures of EMP and EIA SSEMP Camp rules	Before and during construction activities
Construction crew	Contractor	EMP Waste disposal procedures	Before and during construction activities
Drivers	Contractor	Road safety Defensive driving Road access restrictions Vehicle movement restrictions Waste disposal	Before and during the construction phase
Construction Staff	Contractor	Waste disposal Vehicle movement restrictions	Before and during the construction phase
Camp staff	Contractor	Camp operation Waste disposal Natural resource conservation Housekeeping Camp Rules	Before and during the construction phase

ESIC = Environment and Social Impact Cell

7.5 Equipment Maintenance Details

Construction

Equipment during the construction phase includes dump trucks, loader trucks, excavators, cranes, front-end loaders, fuel tankers, water bowser, cars, etc. This equipment and other machinery will only be repaired at designated sites at the warehouse.

Operations

Limited vehicle movement by the maintenance team will be required on a need basis.

7.6 Environmental Monitoring and Reporting

Implementation of the EMP during construction will be done by the contractors and supervised by Consultants and ESIC. The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the environmental monitoring plan (EMoP) prepared as part of the EMP (**Table 7-3** and **Table 7-4**).

The EMoP identifies environmental monitoring activities to ensure that negative environmental impacts are addressed properly. It identifies environmental parameters to be monitored, frequency of monitoring, applicable standards, agencies, and institutions responsible for monitoring; and provide indicative monitoring costs. The Consultants will assist the PMU in this regard. During construction, monitoring will be undertaken by contractors and the Consultants. PMU and NGC ESIC will monitor contractor's environmental performance. During the operation stage, monitoring will be the responsibility of NGC.

The main objectives of the pre-construction and construction phase EMoP will be:

- The compensation for loss of assets will be monitored during the pre-construction activities as per the latest rates announced by the government as every year, rates have to be revised by the government. This aspect will be strictly monitored.
- Monitor the actual impact of the construction activities on the project corridor's physical, biological, and socio-economic receptors. This will indicate the adequacy of the EIA.
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds that anticipated in the EIA.
- Ensure compliance with legal and community obligations including safety at construction sites.
- Monitor the impacts on land, water resources, air quality, noise level and cutting of trees in the project area as described in the EMP.

The main objectives of EMoP during the operation phase will be to:

- Appraise the adequacy of the EIA concerning the project's predicted long-term impact on the corridor's physical, biological, and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements, if necessary
- Compile periodic accident data to support the analysis that will help to minimize future risks.

The contractors will report the results and conclusions of EMP implementation and environmental monitoring to the PMU and ESIC NGC monthly. The budget for environmental monitoring shall be included as part of civil works contracts.

NGC through its PMU will:

- Establish and maintain procedures to monitor the progress of implementation of EMPs
- Verify the compliance with environmental measures and their progress toward intended outcomes.
- Document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports.
- Follow up on these actions to ensure progress toward the desired outcomes,

Table 7-3: Environmental Monitoring Plan (EMP)

Environmental Concern	Performance Indicator	Frequency to Monitor	Timing to Check	Locations to implement	Responsible to implement	Budget Estimate, US$	Resp supervision
Pre-Construction Phase							
Route Survey	Route survey to define alternative alignments (Field mapping with Global Positioning System (GPS) Equipment preferable)	1-time survey to finalize design	Detailed design	Complete project route and locations	NGC / PMU through route survey contractor	NA	NGC
Construction Phase							
Dust, equipment emissions, erosion, and noise control Waste management Camping Sites and Construction Site Selection	Incorporation of appropriate clauses in construction contracts (Field inspections to ensure that appropriate measures are implemented, and facilities are installed)	Once	Before construction	Complete project route and locations	NGC and PMU to include in bidding documents.	NA	NGC, ESIC
Encroachment and Physical Disfiguration	Landscape Conditions, Baseline Environment	Once (update monthly as necessary)	One Month after Construction Work	Complete project route and locations	Contractor	NA	NGC, ESIC
Soil Erosion	Soil Compression, Land Clearing, Vegetation Removal	Once (update monthly as necessary)	Before construction. Update monthly	Complete project route and locations	Contractor	NA	NGC, ESIC

Environmental Concern	Performance Indicator	Frequency to Monitor	Timing to Check	Locations to implement	Responsible to implement	Budget Estimate, US$	Resp supervision
Soil Contamination	Fuels Spillage, Chemicals Containers	Monthly	During Construction	Complete project route and locations	Contractor	NA	NGC, ESIC
Ecological Resources	Land Clearing, Habitat destruction	Monthly	Update monthly	Complete project route and locations	Contractor	NA	NGC, ESIC
Loss of Barani Crops	Number of People affected due to unavailability of Opportunistic Agriculture	Once (update monthly as necessary)	During Construction	Complete project route and locations	Contractor	NA	NGC, ESIC
Local Community Work Force	Disturbance due to Stringing, good engineering practices adopted	Once (update monthly as necessary)	Update monthly	Complete project route and locations	Contractor	NA	NGC, ESIC
Safety Hazards	Zero near miss, minor, major, and fatal accidents	Monthly	Update monthly	Complete project route and locations	Contractor	NA	NGC, ESIC
Operational Phase							
Electric Current	Earthing of the Towers, Safety Plan by the contractor to be followed	Monthly	During Operation	Complete project route and locations	ESIC	NA	NGC

Environmental Concern	Performance Indicator	Frequency to Monitor	Timing to Check	Locations to implement	Responsible to implement	Budget Estimate, US$	Resp supervision
Breaking of Conductors	Frequency of Conductors Tripping, Complaints reported	Quarterly	Throughout the Project	Complete project route and locations	ESIC	NA	NGC
Towers Collapse	Soil Geology, Climatic Conditions, Records on displacement (if any)	Six Monthly	During Implementation Phase	Complete project route and locations	ESIC	NA	NGC
Avifauna Movement	The reported death of Birds, Audit Report	Quarterly	After Transmission Line is erected	Complete project route and locations	ESIC	NA	NGC

ESIC = Environment and Social Impact Cell, NGC = National Grid Company, PMU=Project Management Unit, NA= Not Applicable

Table 7-4: Instrumental Environmental Monitoring Plan

No	Monitoring Parameter	Monitoring Location	Frequency	Responsibility	Resource Requirement	Criteria for Triggering Action	Budget Estimate, US$	Documentation
Construction Phase								
1	Water quality: pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS), hydrocarbon and PCBs. Solid waste	At representative existing wells (if any) within 100m of the campsite	Quarterly	Contractors to implement, ESIC staff to provide oversight via regular field inspections	Resources for water sample collection and analysis	Water quality deterioration that can be attributed to the effluents released by the project facilities using the applicable stringent standards given in **Section 2** of this EIA	7,200 (12 quarters)	A complete record of sample collection and analyses.

No	Monitoring Parameter	Monitoring Location	Frequency	Responsibility	Resource Requirement	Criteria for Triggering Action	Budget Estimate, US$	Documentation
	generation and disposal							
2	Ambient Air Quality: Suspended particulate matter (SPM)	Campsite Access road Communities within 100m of RoW, campsite, or access road	Quarterly	Contractors to implement, PMU staff to provide oversight via regular field inspections	Resources for monitoring dust generation	To ensure compliance with the applicable stringent standards given in **Section 2** of this EIA	14,400 (12 quarters)	Records of measured values to be maintained
3	Noise	Campsite Access road Communities within 100m of RoW, campsite, or access road	Quarterly	Contractors to implement, PMU staff to provide oversight via regular field inspections	Noise meter	To ensure compliance with the applicable stringent standards given in **Section 2** of this EIA	2,400 (12 quarters)	Records of measured values to be maintained
4	Visual check for exhaust emissions from equipment and vehicles	Campsite Access road RoW Other construction sites	Routine visits	Contractor	-	Personal judgment Compliance with PEQS for vehicle emissions	NA	Records of abnormal emissions.
5	Visual check for soil erosion	Campsite Access road RoW	Routine Visits	Contractor	-	Visible signs of any soil erosion	NA	Photographic record

No	Monitoring Parameter	Monitoring Location	Frequency	Responsibility	Resource Requirement	Criteria for Triggering Action	Budget Estimate, US$	Documentation
		Other construction sites						
6	Grievances of the local communities	Campsite Access road RoW Other construction sites	During field activities	Contractor	Monitoring register	Complaint resolution trends	NA	Complete grievance record to be maintained in the social complaint register.
		Operation Phase						
1	Dust, equipment emissions, and erosion control Waste management (Same parameters as during construction period)	All T/L s	As necessary based on inspections and complaints	NGC through PMU	Same resource as during construction period	Spot checks based on visual inspections and any complaints as necessary. based on inspections and complaints	This will be made part of NGC's annual plan for maintenance	ESIC internal reports

PEQS = Punjab Environmental Quality Standard, T/L = Electricity Transmission Line, NGC= National Grid Company, PMU=Project Management Unit, RoW = Right of Way, SAEMR = semi-annual environmental monitoring report

7.7 Institutional Arrangement

The lack of an environmental and social safeguards team and the lack of capacity within project implementing agencies and contractors create implementation issues of project environmental safeguard documents, including EIA, SSEMP, and no objection certificate (NoC). To overcome this, NGC will ensure institutional arrangements as described below.

NGC has established a PMU to implement the Project. The PMU's day-to-day project management includes procurement, project execution, financial management, and monitoring of and reporting on project progress. The PMU of NGC, which already exists and executes other projects, will implement environmental safeguard requirements through its dedicated wing, the ESIC. The ESIC is staffed by EHS Manager, a Deputy EHS Manager and an Assistant EHS Manager in addition to social safeguard staff. Further resources for environmental safeguards management will be provided by the Consultants.

High-level implementation arrangements are elaborated in **Table 7-5.**

Table 7-5: Implementation Arrangements

Aspects	Arrangements
Oversight body	Ministry of Energy (Power Division)
Executing agency	National Grid Company (formerly National Transmission & Despatch Company Limited (NTDC))
Implementation unit	The Program Management Unit (PMU) already working in NGC
Consulting Services	NGC will hire a team of experts for supervision. the Project Management Consultants (PMC), will provide supervision support to NGC

Specific roles and responsibilities for EMP implementation are provided in **Table 7-**6. Institutions responsible for executing and monitoring the environmental aspects of this project are:

Table 7-6: Roles and Responsibilities for Implementation of EMP

Aspect	NGC's ESIC Responsibilities	Contractor's Responsibilities	Estimated Cost, US$	Relevant Documentation
Contracting	Ensure that the SSEMP/ EMP implementation and internal monitoring and reporting requirements are included in the contract between NGC and the Contractors.	Understand the requirements and estimate the required resources.	NA	The contract between NGC and Contractors

Aspect	NGC's ESIC Responsibilities	Contractor's Responsibilities	Estimated Cost, US$	Relevant Documentation
SSEMP and subsequent Updates	Review and approve SSEMP.	Preparing SSEMP. Update SSEMP if any changes to the design have happened	5000	SSEMP Revised SEMP
Resources	Ensure the availability of resources required for EMP implementation, monitoring of Contractors, and preparing reports to authorities	Ensure the availability of resources required for EMP implementation and internal monitoring throughout the construction duration and reporting to NGC.	As per the budget given in EMP	Project SSEMP implementation and monitoring plans and budgets.
Environmental personnel	Assign and retain full-time and qualified EHS Manager, Deputy EHS Manager and Assistant EHS Manager for the Project	Assign and retain a full-time and qualified ESO and a full-time and qualified HSO	128,100	Job descriptions.
Monitoring surveys and inspections	Undertake periodic inspections and carry out field measurements, where needed over and above those of the Contractor. Review Contractor monitoring.	Systematically observe and collect data on environmental performance, undertake inspections, and carry out surveys	160,200	Inspection and survey reports.
Environmental inspections	Conduct periodic internal inspections of the construction sites and commission third-party (external) inspections	Conducting periodic internal audits.	NGC's role: 112,800	Audit reports.
Reporting	Ensure that periodic environmental monitoring reports are received from the Contractors and are reviewed. Prepare reports for the authorities if necessary	Generate monthly environmental monitoring reports and disseminate these to the management and appropriate staff members.	NA	Periodic reports.
Corrective actions	Verify that the activities that are carried out comply with the EIA or EIA and EMP and identify corrective actions if needed.	Carry out the required corrective actions.	NA	Corrective action record.

Aspect	NGC's ESIC Responsibilities	Contractor's Responsibilities	Estimated Cost, US$	Relevant Documentation
Maintenance of record	Maintain monitoring data and record of all incidents of environmental significance and related corrective measures.	Maintain monitoring data and record of all incidents of environmental significance and related corrective measures.	NA	Environmental databases.

ESIC = Environment and Social Impact Cell, ESO = Environmental Safeguards Officer, NGC = National Grid Company, HSO = Health and Safety Officer

7.8 Communication and Record Keeping

Communication among the different stakeholders/ institutions above and record keeping is an important aspect to consider.

7.8.1 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 proposed Project. In particular, the focus will be on the improvement and modification of the proposed intervention designs.

The institutional arrangements discussed in this section will be in place for continuous consultation throughout the process of planning and implementation. During construction, ESIC of NGC will have to implement both EMP and RP.

7.8.2 Data Recording and Maintenance

All forms to be used for recording information during the environmental monitoring will follow a standard format which will correspond to the database into which all the gathered information will be placed. Check boxes will be used as much as possible to facilitate data entry. A tracking system will be developed for each form.

7.8.3 Database

The database may include the following information:

- Training programs.
- Staff deployment.
- Non-compliances.
- Corrective actions
- List of environmental data; and
- List of environmental data to be maintained:
- Soil and land pollution;
- Disposal of waste;

- Water resources;
- Fuel oil and chemical spills;
- Vegetation record;
- Noise pollution;
- Air and dust pollution;
- Socio-economic data; and
- Ecological sensitivities.

7.8.4 Meetings and Reporting

Monthly meetings will be held at the 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** 7**-7,** along with information regarding persons responsible for report preparation and the review process. Additionally, minutes of meeting will also be submitted as part of routine environmental reports.

Table 7-7: Periodic Reporting Mechanism

Sr. No.	Report Category	Prepared by	Estimated Cost, US$	Reviewed by
1	Monthly	Contractors' Environment & Social Manager	NA	ESIC / SC
2	Quarterly	Supervision Consultant (SC)'s Environment & Social Safeguard Specialists	NA	ESIC
3	Bi-Annual Environmental Monitoring Report	Supervision Consultant (SC)'s Environment & Social Safeguard Specialists	NA	ESIC
4	Annual Report	Supervision Consultant (SC)'s Environment & Social Safeguard Specialists	NA	ESIC
5	Completion Report	Supervision Consultant (SC)'s Environment & Social Safeguard Specialists	NA	ESIC

NA: Not Applicable

The cost incurred for the reporting is included in the staff time cost of EMP implementation

7.8.5 Social Complaint Register

The Contractor will maintain a register of complaints records from local communities/workers and measures taken to mitigate these concerns.

7.8.6 Photographic Records

Contractors will maintain photographic records before mobilization of the RoW and camping sites and during the implementation of the proposed Project. As a minimum, the photographic records will include the site photographs, all the roads, camp sites, and monitoring activities etc.

7.8.7 Non-Compliance of the EMP

The implementation of the proposed EMP involves inputs from various functionaries. The Contractor will be primarily responsible for ensuring implementation of the mitigation measures proposed in the EMP, which will be part of the contract documents. The provision of the environmental mitigation cost will be made in the total cost of Project, for which the Contractor will be paid based on monthly compliance reports. However, if the Contractor fails to comply with the implementation of EMP and submission of the monthly compliance reports, deductions will be made from the payments to the Contractor claimed under the heads of environmental components.

7.8.8 Review of Recorded Data

All the data and communication recorded and maintained by the Contractor will be periodically reviewed and checked by SC and NGC, and necessary action will be recommended to the Contractor to improve the recording and documentation.

7.9 Environment Management Cost

An estimated cost for the implementation of mitigation measures prescribed in the Environmental Management Plan (EMP) has been provided in **Table 7-8, 7-9 & 7-10.**

The cost includes the hiring of staff,[94] arrangements for water sprinkling, provision of PPEs to workers, the arrangement of first aid kits at the site, and waste management, etc. The budget for tree plantation and landscaping is also included in the given cost, where required.

The cost does not cover the implementation of mitigation measures prescribed in the Environmental Management Plan (EMP) for the operational phase, which will be included as part of NGC's ongoing environment management program.

Table 7-8: Estimated Cost for Contractor's EMP Implementation

Item	Quantity	Unit cost	Estimated cost
SSEMP/ Other Management Plan Development preparation	Lumpsum	$5,000	$5,000
SSEMP/ EMP implementation: bird diverters, mobile toilets, PPEs, hazardous material disposal	Lumpsum	$61,000	$61,000

[94] The additional staff in ESIC and staff of consultants represent for complete Program covering all project.

Item	Quantity	Unit cost	Estimated cost
Planting of trees[95]	61,800	$1	$61,800
Instrumental Environmental Monitoring			
Water Quality	48 samples	$150	$7,200
Ambient Air Quality	48 samples	$300	$14,400
Noise Level	48 samples	$50	$2,400
Mobilization of HSO	24 months	$350	$8,400
		Total	$160,200

ESO = Environmental Safeguards Officer, HSO = Health and Safety Officer, SSEMP = site-specific environmental management plan

Table 7-9: Estimated Cost for Consultant for EMP Implementation

Item	Quantity	Unit Cost	Estimated Cost
International Environmental Safeguards Specialist (IESS)	4 months (intermittent)	$20,000	$80,000
National Environmental Safeguards Specialist (NESS)	24 months (full-time)	$1,200	$28,800
National Environmental Health and Safety Inspectors (NEHSIs)	24 months (full-time) x 2	$350	$16,800
Training in EMP and GRM	Lumpsum	$2,500	$2,500
		Total	$128,100

EMP = environmental management plan, GRM = grievance redress mechanism

Note: The cost of consultants represents for the complete Program covering the project

Table 7-10: Estimated Cost for ESIC's EMP Implementation

Item	Quantity	Unit Rate	Estimated Cost
EHS Manager	24 months (full-time)	$2,000	$48,000
Deputy EHS Manager	Same as above	$1,500	$36,000
Assistant EHS Manager	Same as above	$1,200	$28,800
		Total	$112,800

EMP = environmental management plan, GRM = grievance redress mechanism

Note: The cost of ESIC represents for all project

[95] The tree plantation plan is to be executed with the help of the forest department. It has been assumed that the department will be taking care of the maintenance of the trees under routine operations.

8. Conclusion and Recommendations

8.1 Conclusion

The Project involves construction of the 500kV D/C transmission line, approximately 280km long, on quad bundled Drake conductor, for looping In/Out of the existing single circuit Ghazi Brotha HPP – Rawat/Islamabad West overhead line at Faisalabad West substation, including two 500kV line bays at Faisalabad West substation, two 111 MVAR shunt reactors at Faisalabad West substation, one 111 MVAR shunt reactors at Ghazi Brotha HPP's Substation; and one 111 MVAR shunt reactor at Islamabad West substation and connection of 220 kV Mansehra and Tarbela T/Ls with Islamabad West grid station, re-routing 6 km segment of 500 kV Rawat-Baarotha T/L.

This Project passes through the districts of Attock, Talagang, Khushab, Sargodha, and Chiniot in Punjab.

Key components of the Project, construction materials, transport infrastructure, water requirements, generated emissions and schedule and staffing for the Project are also discussed in the EIA.

An EIA report in accordance with the national environmental requirements will be submitted to the Punjab EPA for obtaining environmental approval or a no-objection certificate (NOC).

Alternatives related to the construction method, technology, and TL RoW were analyzed. The 'No Project Alternative' was also discussed in detail, to ensure that the Project is sufficiently benefiting the local economy and is not unnecessarily degrading the environment.

Baseline environmental and socioeconomic information was collected from a variety of sources, including published literature and field surveys. Baseline studies were conducted on the physical environment, including water resources, and the ecological and socioeconomic environment conditions of the AOI around the Project site.

Proposed Project activities were reviewed and their potential impacts on the physical, biological, and socio-economic environment were assessed. Where appropriate, mitigation measures have been recommended to keep potential adverse environmental impacts within acceptable limits.

An EMP has been developed in this report to effectively implement the mitigation measures identified in the impact assessment. Contractor will develop SSEMP before construction activities start. The bid documents must include the EMP, and its implementation cost must be reflected in the bill of quantity (BoQ).

Therefore, if the Project's construction and operation activities, including the implementation of all proposed mitigation measures, are carried out as described in this document, the anticipated impact of the project on the area's natural and socioeconomic environment shall remain well within acceptable limits.

NGC will have the right to suspend works or payments if the Contractor is in violation of any of his obligations under the EMP and SSEMP.

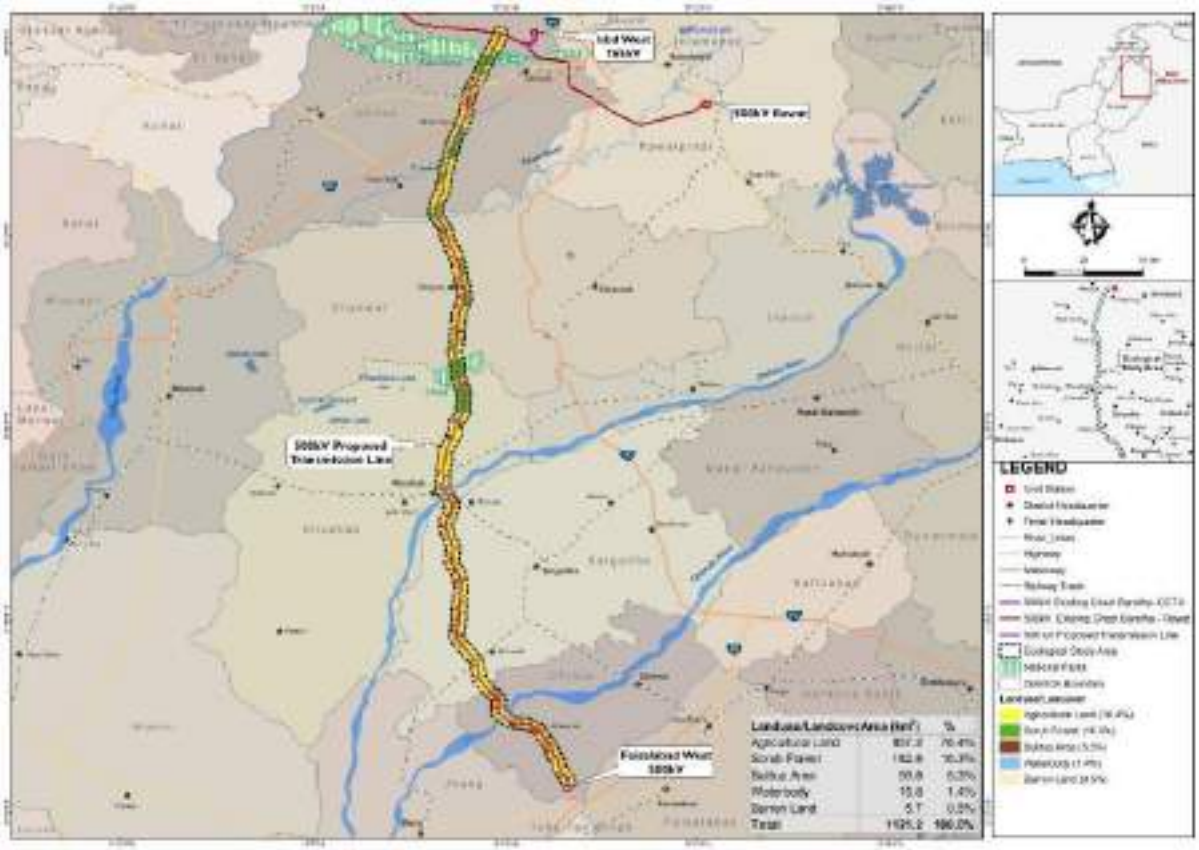
8.2 Recommendations

Comprehensive mitigation measures have been proposed in **Section 6** and **Section 9** of this report to minimize the negative impacts and to enhance the positive impacts of the project. However, major recommended mitigation measures are summarized as follows:

- Temporary labor camps will be developed inside the grid station boundary and will be facilitated with proper drainage facilities.
- Soil erosion and contamination, water contamination, air pollution, and high noise levels will be controlled with the use of good engineering practices.
- The contractor will develop plans as part of SSEMP such as traffic management, solid waste management, and material management, etc. before starting the construction activities. No access to the site will be allowed until the SSEMP is approved by the ESIC.
- Fair and negotiated compensation following the prevailing market prices will be made for the loss of crops and trees during the construction activities of the project.
- The contractor will take due care of the local community and its sensitivity towards local customs and traditions.
- EMP proposed in **Section 9** will be implemented with full diligence and thoroughness.

9. List of Annexures

Annexure 1 : Land Use Map



Annexure 2: Lab Monitoring Reports

TEST REPORT

Ambient Air Quality Monitoring

Project Name: **500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT**

Point Name: Point 1: Faisalabad West Grid Station

Monitoring Date: 23-02-2025 to 24-02-2025

Reference No: 06848-25

Results are as under

Sr.	Parameters	Unit	Results
1	Air Temperature	°C	27.2
2	Air Humidity	% rH	35.6

Average Ambient Air Quality Monitoring Results

Sr.	Parameters	Unit	PEQS^	Results	Remarks
1.	Carbon Monoxide (CO)	mg/m³	5	0.29	All Results are compliance to PEQS
2.	Nitrogen Oxide (NO)	µg/m³	40	7.38	
3.	Nitrogen Dioxide (NO_2)	µg/m³	80	10.50	
4.	Sulfir Dioxide (SO_2)	µg/m³	120	6.79	
5.	Ozone(O_3)	µg/m³	130	100.5	
6.	Suspended Particulate Matter(SPM)	µg/m³	500	106.1	
7.	Particulate Matter ($PM_{2.5}$)	µg/m³	35	10.21	
8.	Particulate Matter (PM_{10})	µg/m³	150	62.32	
9.	Lead (Pb)	µg/m³	1.5	0.019	

PEQS: Punjab Environmental Quality Standards

Note:

- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for Client's self-reference only.

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

7

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 784 201, Fax: (92-42) 3513 4955, URL: www.ttilabs.net

TEST REPORT

Hourly Ambient Air Quality Monitoring Results

Time	CO	NO	NO_2	SO_2	SPM	O_3	$PM_{2.5}$	PM_{10}	Pb
	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
8:00 AM	0.291	4.42	7.21	6.43	84.3	100.5	7.8	58.2	ND
09:00 AM	0.299	5.92	8.41	7.02	86.7		7.9	56.7	ND
10:00 AM	0.302	4.11	7.99	6.12	86.9		8.4	57.2	ND
11:00 AM	0.302	3.21	8.78	8.99	87.5		8.9	59.2	0.08
12:00 PM	0.27	7.01	11.28	8.98	88.6		8.8	60.3	0.1
01:00 PM	0.285	8.11	12.41	7.11	96.3		10.2	60.1	0.09
02:00 PM	0.302	7.98	11.27	3.02	98.4		10.4	63.3	0.01
03:00 PM	0.299	9.21	13.32	3.12	85.5		11.3	63.2	ND
04:00 PM		9.1	12.31	3.41	86.9		10.4	64.9	ND
05:00 PM		9.03	12.41	3.21	89.3		11.3	64.3	ND
06:00 PM		10.14	13.52	8.14	98.6		10.4	63.7	ND
07:00 PM		9.98	12.21	9.02	95.8		10.5	63.9	0.01
08:00 PM		10.99	14.92	8.72	98.4		11.3	64.4	ND
09:00 PM		8.24	10.81	9.14	99.9		10.4	63.7	ND
10:00 PM		7.72	10.71	5.01	121.4		10.5	63.9	0.03
11:00 PM		8.92	1187	7.99	128.4		11.2	65.7	0.04
12:00 AM		7.98	10.84	7.89	129.5		10.9	63.6	ND
1:00 AM		7.93	9.82	8.92	130.1		10.8	62.9	ND
2:00 AM		6.45	9.25	7.05	132.3		10.2	62.8	ND
3:00 AM		5.44	9.11	7.21	129.8		10.9	62.9	0.01
4:00 AM		6.48	9.15	8.25	123.9		9.9	63.1	0.02
05:00 AM		6.62	8.21	5.72	120.3		10.4	63.2	ND
06:00 AM		5.68	8.23	5.76	127.7		11.2	62.9	ND
07:00 AM		6.65	8.17	6.74	128.9		11.1	63.7	ND
Average	**0.29**	**7.38**	**10.50**	**6.79**	**106.1**	**100.5**	**10.21**	**62.32**	**0.019**

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TEST REPORT

Noise Level Monitoring Report

Sr.#	Time	Unit	Average Value	PEQS	Remarks
1	8:00 AM	dB(A)	39.5	55	All Results are compliance in PEQS
2	09:00 AM	dB(A)	40.6	55	
3	10:00 AM	dB(A)	39.8	55	
4	11:00 AM	dB(A)	39.3	55	
5	12:00 PM	dB(A)	40.5	55	
6	01:00 PM	dB(A)	45.8	55	
7	02:00 PM	dB(A)	43.3	55	
8	03:00 PM	dB(A)	48.4	55	
9	04:00 PM	dB(A)	40.6	55	
10	05:00 PM	dB(A)	46.9	55	
11	06:00 PM	dB(A)	48.3	55	
12	07:00 PM	dB(A)	46.6	55	
13	08:00 PM	dB(A)	40.3	55	
14	09:00 PM	dB(A)	39.6	55	
15	10:00 PM	dB(A)	38.0	45	
16	11:00 PM	dB(A)	38.9	45	
17	12:00 AM	dB(A)	36.3	45	
18	1:00 AM	dB(A)	35.3	45	
19	2:00 AM	dB(A)	35.3	45	
20	3:00 AM	dB(A)	34.1	45	
21	4:00 AM	dB(A)	35.3	45	
22	05:00 AM	dB(A)	34.9	45	
23	06:00 AM	dB(A)	36.8	55	
24	07:00 AM	dB(A)	36.3	55	
Average (Day time)			**42.03**	**55**	
Average (Night time)			**36.01**	**45**	

PEQS: Punjab Environmental Quality Standards

- Quality was assured through self-calibration of the instrument.
- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for client's self-reference only.

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TEST REPORT

Ambient Air Quality Monitoring

Project Name: 500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT

Point Name: Point 2: Govt Primary School (Girls), Chabeel

Monitoring Date: 24-02-2025 to 25-02-2025

Reference No: 06848-25

Results are as under

Sr.	Parameters	Unit	Results
1.	Air Temperature	°C	27.2
2.	Air Humidity	%rH	38.6

Average Ambient Air Quality Monitoring Results

Sr.	Parameters	Unit	PEQS*	Results	Remarks
1.	Carbon Monoxide (CO)	mg/m³	5	0.18	All Results are compliance in PEQS
2.	Nitrogen Oxide (NO)	µg/m³	40	8.18	
3.	Nitrogen Dioxide (NO_2)	µg/m³	80	13.89	
4.	Sulfur Dioxide (SO_2)	µg/m³	120	9.11	
5.	Ozone(O_3)	µg/m³	130	98.7	
6.	Suspended Particulate Matter (SPM)	µg/m³	500	108.5	
7.	Particulate Matter ($PM_{2.5}$)	µg/m³	35	29.6	
8.	Particulate Matter (PM_{10})	µg/m³	150	90.0	
9.	Lead (Pb)	µg/m³	1.5	0.04	

PEQS: Punjab Environmental Quality

Standards Note:

- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for Client's self-reference only.

For and on behalf of
TTi Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

8

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the laboratory. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TTi Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.ttilabs.net

TEST REPORT

Hourly Ambient Air Quality Monitoring Results

Time	CO	NO	NO_2	SO_2	SPM	O_3	$PM_{2.5}$	PM_{10}	Pb
	mg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
2:00 PM	0.12	11.123	15.88	9.048	86.3	98.7	29.1	89	0.04
3:00 PM	0.19	10.615	16.25	11.987	84.7		30.0	91	ND
4:00 PM	0.17	11.913	15.36	10.984	91.5		29.7	90	0.05
5:00 PM	0.29	12.714	17.62	9.813	102.5		29.3	88	0.1
6:00 PM	0.15	10.318	15.81	9.809	88.6		29.8	92	ND
7:00 PM	0.24	11.113	16.96	10.801	107.4		29.5	89	ND
8:00 PM	0.11	9.105	15.12	7.876	89.5		29.6	91	ND
9:00 PM	0.24	10.806	15.83	6.791	85.5		29.4	90	0.02
10:00 PM		9.556	14.53	7.739	102.8		30.0	89	ND
11:00 PM		8.331	14.25	6.728	89.3		29.2	92	ND
12:00 AM		8.458	15.99	6.719	117.8		29.7	90	ND
1:00 AM		7.351	12.93	8.710	127.8		29.6	88	ND
2:00 AM		8.323	12.84	8.707	98.4		29.5	91	ND
3:00 AM		7.193	11.77	8.739	107.8		29.8	90	0.05
4:00 AM		6.185	10.67	7.817	121.4		29.3	89	ND
5:00 AM		6.153	10.55	9.722	115.1		29.7	92	ND
6:00 AM		5.098	10.51	8.314	129.8		29.6	90	0.01
7:00 AM		6.090	13.46	9.395	130.1		29.2	89	ND
8:00 AM		5.401	14.78	8.378	112.7		30.0	91	ND
9:00 AM		6.422	13.25	9.331	120.8		29.1	90	0.09
10:00 AM		4.485	14.18	10.326	123.9		29.8	89	0.5
11:00 AM		5.515	13.10	11.318	120.8		29.5	92	0.1
12:00 PM		5.610	10.32	9.309	140.7		29.4	88	ND
01:00 PM		8.515	11.40	10.313	111.1		29.6	91	0.54
Average	**0.18**	**8.18**	**13.89**	**9.11**	**108.5**	**98.7**	**29.6**	**90**	**0.04**

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TEST REPORT

Noise Level Monitoring Report

Sr.#	Time	Unit	Average Value	PEQS	Remarks
1	2:00 PM	dB(A)	41.4	55	All Results are compliance in PEQS
2	3:00 PM	dB(A)	40.8	55	
3	4:00 PM	dB(A)	40.3	55	
4	5:00 PM	dB(A)	41.6	55	
5	6:00 PM	dB(A)	42.9	55	
6	7:00 PM	dB(A)	41.3	55	
7	8:00 PM	dB(A)	37.6	55	
8	9:00 PM	dB(A)	37.5	55	
9	10:00 PM	dB(A)	38.7	45	
10	11:00 PM	dB(A)	31.4	45	
11	12:00 AM	dB(A)	30.2	45	
12	1:00 AM	dB(A)	29.5	45	
13	2:00 AM	dB(A)	30.2	45	
14	3:00 AM	dB(A)	28.4	45	
15	4:00 AM	dB(A)	27.9	45	
16	5:00 AM	dB(A)	28.6	45	
17	6:00 AM	dB(A)	28.1	55	
18	7:00 AM	dB(A)	27.7	55	
19	8:00 AM	dB(A)	31.1	55	
20	9:00 AM	dB(A)	33.9	55	
21	10:00 AM	dB(A)	36.5	55	
22	11:00 AM	dB(A)	39.1	55	
23	12:00 PM	dB(A)	38.0	55	
24	01:00 PM	dB(A)	40.1	55	
Average (Day time)			**37.36**	**55**	
Average(Night time)			**30.61**	**45**	

PEQS: Punjab Environmental Quality Standards

- Quality was assured through self-calibration of the instrument.
- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for client's self-reference only.

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Ambient Air Quality Monitoring

Project Name: 500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT

Point Name: Point 3: Sanyal Mosque, Talagang

Monitoring Date: 26-02-2025 to 27-02-2025

Reference No: 06848-25

Results are as under

Sr.	Parameters	Unit	Results
1	Air Temperature	°C	28.1
2	Air Humidity	%rH	32.4

Average Ambient Air Quality Monitoring Results

Sr.	Parameters	Unit	PEQS*	Results	Remarks
1.	Carbon Monoxide (CO)	mg/m³	5	0.24	All Results are compliance in PEQS
2.	Nitrogen Oxide (NO)	µg/m³	40	8.00	
3.	Nitrogen Dioxide (NO_2)	µg/m³	80	13.51	
4.	Sulfur Dioxide (SO_2)	µg/m³	120	12.73	
5.	Ozone(O_3)	µg/m³	130	92.4	
6.	Suspended Particulate Matter(SPM)	µg/m³	500	110.6	
7.	Particulate Matter ($PM_{2.5}$)	µg/m³	35	27.9	
8.	Particulate Matter (PM_{10})	µg/m³	150	82.88	
9.	Lead (Pb)	µg/m³	1.5	0.01	

PEQS: Punjab Environmental Quality

Standards Note:

- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for Client's self-reference only.

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

9)

This test report is governed by the terms and conditions available overleaf or accessible at http://ttilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the laboratory. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.ttilabs.net

TEST REPORT

Hourly Ambient Air Quality Monitoring Results

Time	CO	NO	NO_2	SO_2	SPM	O_3	$PM_{2.5}$	PM_{10}	Pb
	mg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
8:00 AM	0.191	2.912	8.431	10.048	101.3	92.4	27.1	81.2	N.D
9:00 AM	0.203	4.312	10.941	14.984	123.7		28.3	80.1	N.D
10:00 AM	0.211	4.249	9.725	13.954	125.7		27.6	79.9	N.D
11:00 AM	0.209	3.931	9.613	15.813	128.7		28.5	77.5	N.D
12:00 PM	0.219	6.412	9.715	13.801	128.4		27.7	76.4	0.05
1:00 PM	0.291	5.521	12.626	10.809	131.7		28.2	73.3	N.D
2:00 PM	0.312	6.922	13.448	16.801	109.8		27.9	76.9	N.D
3:00 PM	0.293	6.012	13.83	17.796	105.5		27.4	81.4	0.01
4:00 PM		5.821	12.53	13.761	117.1		28.1	84.6	N.D
5:00 PM		8.931	14.25	19.798	110.4		27.8	81.6	N.D
6:00 PM		9.781	17.99	18.791	121.7		27.6	84.3	N.D
7:00 PM		6.921	15.95	20.739	127.8		28.3	85.9	N.D
8:00 PM		7.031	16.84	15.728	101.7		27.5	88.8	0.04
9:00 PM		7.921	15.77	14.719	104.9		28.0	91.4	N.D
10:00 PM		8.332	18.401	11.41	100.7		27.9	79.3	N.D
11:00 PM		6.322	13.317	9.53	105.1		28.2	81.5	N.D
12:00 AM		6.301	12.91	10.43	95.8		27.3	83.4	N.D
1:00 AM		6.23	13.806	9.31	100.7		27.9	86.4	0.01
2:00 AM		5.231	12.814	10.41	104.5		28.1	91.3	N.D
3:00 AM		5.226	12.653	9.26	98.6		27.7	86.9	N.D
4:00 AM		6.146	15.544	8.28	99.5		28.0	79.3	0.01
5:00 AM		5.319	14.532	7.19	100.7		27.6	84.1	N.D
6:00 AM		5.213	15.413	7.1	101.7		27.8	85.9	N.D
7:00 AM		3.181	13.41	7.05	108.7		27.9	87.9	N.D
Average	**0.24**	**6.00**	**13.51**	**12.73**	**110.6**	**92.4**	**27.9**	**82.88**	**0.01**

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 301, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TEST REPORT

Noise Level Monitoring Report

Sr.#	Time	Unit	Average Value	PEQS	Remarks
1	8:00 AM	dB(A)	35.3	55	All Results are compliance to PEQS
2	9:00 AM	dB(A)	38.2	55	
3	10:00 AM	dB(A)	37.3	55	
4	11:00 AM	dB(A)	36.2	55	
5	12:00 PM	dB(A)	38.4	55	
6	1:00 PM	dB(A)	38.3	55	
7	2:00 PM	dB(A)	39.1	55	
8	3:00 PM	dB(A)	40.8	55	
9	4:00 PM	dB(A)	41.3	55	
10	5:00 PM	dB(A)	38.6	55	
11	6:00 PM	dB(A)	38.2	55	
12	7:00 PM	dB(A)	39.3	55	
13	8:00 PM	dB(A)	36.3	55	
14	9:00 PM	dB(A)	38.5	55	
15	10:00 PM	dB(A)	30.7	45	
16	11:00 PM	dB(A)	31.2	45	
17	12:00 AM	dB(A)	29.8	45	
18	1:00 AM	dB(A)	28.4	45	
19	2:00 AM	dB(A)	29.4	45	
20	3:00 AM	dB(A)	25.2	45	
21	4:00 AM	dB(A)	26.2	45	
22	5:00 AM	dB(A)	27.2	45	
23	6:00 AM	dB(A)	28.5	55	
24	7:00 AM	dB(A)	29.1	55	
Average (Day time)			**37.08**	**55**	
Average(Night time)			**28.51**	**45**	

PEQS: Punjab Environmental Quality Standards

- Quality was assured through self-calibration of the instrument.
- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for client's self-reference only.

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TEST REPORT

Ambient Air Quality Monitoring

Project Name: 500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT

Point Name: Point 4: RHC Bahtar

Monitoring Date: 27-02-2025 to 28-02-2025

Reference No: 06848-25

Results are as under

Sr.	Parameters	Unit	Results
1	Air Temperature	°C	23.2
2	Air Humidity	%rH	38.6

Average Ambient Air Quality Monitoring Results

Sr.	Parameters	Unit	PEQS*	Results	Remarks
1.	Carbon Monoxide (CO)	mg/m³	5	0.10	All Results are compliance in PEQS
2.	Nitrogen Oxide (NO)	µg/m³	40	5.33	
3.	Nitrogen Dioxide (NO_2)	µg/m³	80	13.09	
4.	Sulfur Dioxide (SO_2)	µg/m³	120	9.94	
5.	Ozone(O_3)	µg/m³	130	51.3	
6.	Suspended Particulate Matter(SPM)	µg/m³	500	111.69	
7.	Particulate Matter ($PM_{2.5}$)	µg/m³	35	24.6	
8.	Particulate Matter (PM_{10})	µg/m³	150	80.0	
9.	Lead (Pb)	µg/m³	1.5	0.014	

PEQS: Punjab Environmental Quality

Standards Note:

- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for Client's self-reference only.

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

10

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.ttilabs.net

TEST REPORT

Hourly Ambient Air Quality Monitoring Results

Time	CO	NO	NO_2	SO_2	SPM	O_3	$PM_{2.5}$	PM_{10}	Pb
	mg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
01:00PM	0.121	7.21	11.03	10.42	114.7	51.3	24.1	79	N.D
02:00PM	0.119	7.01	12.24	9.32	101.8		24.9	81	0.1
03:00 PM	0.113	6.80	14.40	11.42	95.8		24.7	80	0.2
04:00 PM	0.108	6.90	13.48	10.18	124.7		24.3	78	N.D
05:00 PM	0.103	6.20	14.52	12.41	127.9		24.8	82	0.01
06:00 PM	0.098	5.19	15.58	14.03	110.4		24.5	79	0.02
07:00 PM	0.093	5.19	13.59	13.99	118.7		24.6	81	N.D
08:00 PM	0.09	4.19	12.09	17.89	115.5		24.4	80	N.D
09:00 PM		5.18	12.61	12.93	110.1		24.9	79	N.D
10:00 PM		4.18	13.43	9.39	100.4		24.2	82	N.D
11:00 PM		3.18	11.66	9.96	129.7		24.7	80	N.D
12:00 AM		4.17	10.06	7.38	99.8		24.6	78	N.D
01:00 AM		4.17	10.45	6.88	92.4		24.5	81	N.D
02:00 AM		4.97	9.04	6.38	101.4		24.8	80	N.D
03:00 AM		3.86	9.041	5.28	115.7		24.3	79	N.D
04:00 AM		4.86	12.35	5.26	130.7		24.7	82	N.D
05:00 AM		4.65	12.29	6.58	115.8		24.6	80	N.D
06:00 AM		5.15	14.38	7.61	125.1		24.2	79	N.D
07:00 AM		5.14	13.26	8.22	120.7		24.9	81	N.D
08:00 AM		6.10	17.32	9.24	111.6		24.1	80	N.D
09:00 AM		6.01	15.64	9.26	99		24.8	79	0.01
10:00 AM		5.21	14.56	10.78	101.7		24.5	82	N.D
11:00 AM		6.13	15.68	11.53	111.7		24.4	78	0.01
12:00 PM		6.48	15.73	12.24	132.4		24.6	81	N.D
Average	**0.10**	**5.33**	**13.09**	**9.94**	**111.69**	**51.3**	**24.6**	**80.0**	**0.014**

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 786 391, Fax: (92-42) 3513 4955, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555 URL: www.tilabs.net

TEST REPORT

Noise Level Monitoring Report

Sr.#	Time	Unit	Average Value	PEQS	Remarks
1	01:00PM	dB(A)	37.1	55	All Results are compliance in PEQS
2	02:00PM	dB(A)	38.2	55	
3	03:00 PM	dB(A)	38.8	55	
4	04:00 PM	dB(A)	39.7	55	
5	05:00 PM	dB(A)	40.4	55	
6	06:00 PM	dB(A)	39.6	55	
7	07:00 PM	dB(A)	38.1	55	
8	08:00 PM	dB(A)	36.2	55	
9	09:00 PM	dB(A)	35.5	55	
10	10:00 PM	dB(A)	30.9	45	
11	11:00 PM	dB(A)	30.3	45	
12	12:00 AM	dB(A)	29.1	45	
13	01:00 AM	dB(A)	26.1	45	
14	02:00 AM	dB(A)	25.4	45	
15	03:00 AM	dB(A)	25.6	45	
16	04:00 AM	dB(A)	27.1	45	
17	05:00 AM	dB(A)	26.9	45	
18	06:00 AM	dB(A)	27.3	55	
19	07:00 AM	dB(A)	29.4	55	
20	08:00 AM	dB(A)	30.9	55	
21	09:00 AM	dB(A)	30.4	55	
22	10:00 AM	dB(A)	31.1	55	
23	11:00 AM	dB(A)	33.3	55	
24	12:00 PM	dB(A)	36.1	55	
Average (Day time)			**35.13**	**55**	
Average(Night time)			**27.67**	**45**	

PEQS: Punjab Environmental Quality Standards

- Quality was assured through self-calibration of the instrument.
- The values were representative of process conditions when monitoring was carried out.
- The measurements were carried out on client's request.
- The client is responsible for lawful usage of reported data in the future.
- The report is valid for any court / negotiations / EPA Submission.
- Report has been issued for client's self-reference only.

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Pictorial Log:

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555 URL: www.tilabs.net

TEST REPORT

Report Number:	07052-25
Sampling Date:	23 Feb, 2025
Issue Date:	04 Mar 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Aadar Habib
Contact details	:	0332-4474450
Email	:	aabr.habib@gmail.com,

11 Sample Information

Sample Description:	:	Ground Water
Vendor Reference:	:	Faisalabad West Grid Station
Sample Collected by:	:	Mr. Ahsan Ameen(Chemist)
Sample Status:	:	Sealed Sample

12 Image of Sampling & Submitted Sample

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the sample(s) submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Test Results:

Ground Water Analysis: Faisalabad West Grid Station

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
1.	Taste	Sensory Evaluation	-	-	Not objectionable	Acceptable
2.	Odor	Sensory Evaluation	-	-	Not objectionable	Acceptable
3.	Color	APHA 2120 C	PtCo	≤ 5	≤ 15	< 5
4.	Turbidity	APHA 2130 B	NTU	≤ 2	< 5	< 5
5.	pH @ 25 °C	APHA 4500 H+B	pH Unit	0.01	6.5-8.5	7.38
6.	Conductivity	APHA 2510 B	µS/cm	-	N.S	1366
7.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	< 1000	828
8.	Fluoride	APHA 4500 D	mg/L	0.02	≤ 1.5	0.37
9.	Nitrates NO_3	APHA 4500 NO3 E	mg/L	0.04	≤ 50	3.11
10.	Nitrite, NO_2	APHA 4500 NO2 B	mg/L	0.001	≤ 3	0.004
11.	Residual Chlorine	APHA 4500 Cl G	mg/L	0.01	N.S	N.D
12.	Cyanide	APHA 4500 CN- E	mg/L	0.002	≤ 0.05	N.D
13.	Total Hardness (as $CaCO_3$)	APHA 2340 C	mg/L	4.0	< 500	341
14.	Chloride	APHA 4500 Cl B	mg/L	1.0	< 250	45
15.	Phenolic Compounds	APHA 5530 D	mg/L	0.05	N.S	N.D
16.	Aluminium (Al)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.2	N.D
17.	Antimony (Sb)	APHA 3111 / 3120 B	mg/L	0.005	≤ 0.005	N.D
18.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
19.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	0.7	N.D
20.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	0.3	N.D
21.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.01	N.D

This estimation is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms-and-conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues detailed therein. The report is issued strictly based on the testing of the samples submitted by the customer. The test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 911, Fax: (92-42) 3515 4505, URL: www.tilabs.net

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
23.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	2.0	N.D
24.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
25.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
26.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.5	N.D
27.	Mercury (Hg)	APHA 3112 / 3120 B	mg/L	0.001	≤ 0.001	N.D
28.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.02	N.D
29.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
30.	Selenium (Se)	APHA 3111 / 3120 B	mg/L	0.005	0.01	N.D
31.	Sodium (Na)	APHA 3111 / 3120 B	mg/L	1.0	N.S	91.36
32.	Potassium (K)	APHA 3111 / 3120 B	mg/L	1.0	N.S	5.42
33.	Total Coliform	ISO 9308-1	cfu/100ml	-	Absent	Absent
34.	E. coli	ISO 9308-1	cfu/100ml	-	Absent	Absent
35.	Fecal Streptococci / Enterococci	ISO 7899-2	cfu/100ml	-	Absent	Absent

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's use/reference only.*
- *Sample analyzed as received.*
- *Report is not valid for any Court / Negotiations / EPA Submission.*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirements.*
- *The lab environmental conditions are maintained at 25±3°C and humidity at 50±20%.*
- *Other Terms and Conditions are mentioned overleaf.*

---------- END OF REPORT ----------

This test report is governed by the terms and conditions available overleaf or accessible at http://www.ttilahore.com/terms&conditions.html. Attention is drawn to the limitation of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the laboratory. This test report may not be reproduced, except in full, without written approval of TTI Testing Laboratories.

TTI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 788 001, Fax: (92-42) 3515 4365, URL: www.ttilabs.net

TEST REPORT

Report Number: 06848-24
Sampling Date: 24 Feb, 2025
Issue Date: 04 Mar 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Ashir Habib
Contact details	:	0332-4474450
Email	:	ashr.habib@gmail.com

13 Sample Information

Sample Description:	:	Ground Water
Vendor Reference:	:	Govt Primary School (Chabeel)
Sample Collected by:	:	Mr. Ahsan Ameen(Chemist)
Sample Status:	:	Sealed Sample

14 Image of Sampling & Submitted Sample

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available on our website at http://www.ttilabs.net/terms&conditions.html. Attention is drawn to the limitation of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted to the Laboratory. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan
Tel: (92-42) 111 788 001, Fax: (92-42) 3515 4365, URL: www.ttilabs.net

TEST REPORT

Test Results:

Ground Water Analysis: Govt Primary School (Chahal)

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
1.	Taste	Sensory Evaluation	-	-	Not objectionable	Acceptable
2.	Odor	Sensory Evaluation	-	-	Not objectionable	Acceptable
3.	Color	APHA 2120 C	PtCo	≤ 5	≤ 15	< 5
4.	Turbidity	APHA 2130 B	NTU	≤ 2	< 5	< 5
5.	pH @ 25 °C	APHA 4500 H+B	pH Unit	0.01	6.5-8.5	7.42
6.	Conductivity	APHA 2510 B	µS/cm	-	N.S	684
7.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	< 1000	388
8.	Fluoride	APHA 4500 D	mg/L	0.02	≤ 1.5	0.35
9.	Nitrates NO_3	APHA 4500 NO3E	mg/L	0.04	≤ 50	1.71
10.	Nitrite, NO_2	APHA 4500 NO2B	mg/L	0.001	≤ 3	0.006
11.	Residual Chlorine	APHA 4500 Cl G	mg/L	0.01	N.S	N.D
12.	Cyanide	APHA 4500 CN- E	mg/L	0.002	≤ 0.05	N.D
13.	Total Hardness (as $CaCO_3$)	APHA 2340 C	mg/L	4.0	< 500	257
14.	Chloride	APHA 4500 Cl B	mg/L	1.0	< 250	55
15.	Phenolic Compounds	APHA 5530 D	mg/L	0.05	N.S	N.D
16.	Aluminium (Al)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.2	N.D
17.	Antimony (Sb)	APHA 3111 / 3120 B	mg/L	0.005	≤ 0.005	N.D
18.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
19.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	0.7	N.D
20.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	0.3	0.47
21.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.01	N.D

This test report is governed by the terms and conditions available on email or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitation of liability, indemnification and jurisdictional issues defined therein. This report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories
347-B, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
23.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	2.0	N.D
24.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
25.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
26.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.5	N.D
27.	Mercury (Hg)	APHA 3112 / 3120 B	mg/L	0.001	≤ 0.001	N.D
28.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.02	N.D
29.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
30.	Selenium (Se)	APHA 3111 / 3120 B	mg/L	0.005	0.01	N.D
31.	Sodium (Na)	APHA 3111 / 3120 B	mg/L	1.0	N.S	44.72
32.	Potassium (K)	APHA 3111 / 3120 B	mg/L	1.0	N.S	2.95
33.	Total Coliform	ISO 9308-1	Cfu/100ml	-	Absent	Absent
34.	E. coli	ISO 9308-1	Cfu/100ml	-	Absent	Absent
35.	Fecal Streptococci / Enterococci	ISO 7899-2	Cfu/100ml	-	Absent	Absent

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's self-reference only.*
- *Sample analyzed as received.*
- *Report is not valid for any Court / Negotiations / EPA Submission.*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirement.*
- *The lab environmental conditions are maintained at 21±3°C and humidity at 50±20%.*
- *Other Terms and Conditions are mentioned overleaf.*

--------- END OF REPORT ---------

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the validity of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-G, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Report Number: 07047-25
Sampling Date: 26 Feb, 2025
Issue Date: 04 Mar 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Aashar Habib
Contact details	:	0332-4474450
Email	:	ashr.habib@gmail.com.

15 Sample Information

Sample Description: : Ground Water
Vendor Reference: : Sariyal Mosque, Talagang
Sample Collected by: : Mr. Ahsan Ameen(Chemist)
Sample Status: : Sealed Sample

Image of Sampling & Submitted Sample

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available on/behalf or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Test Results:

Ground Water Analysis: Sariyal Mosque, Talagang

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
1.	Taste	Sensory Evaluation	-	-	Not objectionable	-----
2.	Odor	Sensory Evaluation	-	-	Not objectionable	Acceptable
3.	Color	APHA 2120 C	PtCo	≤ 5	≤ 15	< 5
4.	Turbidity	APHA 2130 B	NTU	≤ 2	< 5	< 5
5.	pH @ 25 °C	APHA 4500 H+B	pH Unit	0.01	6.5-8.5	7.89
6.	Conductivity	APHA 2510 B	µS/cm	-	N.S	532
7.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	< 1000	298
8.	Fluoride	APHA 4500 D	mg/L	0.02	≤ 1.5	0.33
9.	Nitrates NO_3	APHA 4500 NO3E	mg/L	0.04	≤ 50	9.29
10.	Nitrite, NO_2	APHA 4500 NO2B	mg/L	0.001	≤ 3	0.006
11.	Residual Chlorine	APHA 4500 Cl G	mg/L	0.01	N.S	N.D
12.	Cyanide	APHA 4500 CN E	mg/L	0.002	≤ 0.05	N.D
13.	Total Hardness (as $CaCO_3$)	APHA 2340 C	mg/L	1.0	< 500	165
14.	Chloride	APHA 4500 Cl B	mg/L	1.0	< 250	59
15.	Phenolic Compounds	APHA 5330 D	mg/L	0.05	N.S	N.D
16.	Aluminium (Al)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.2	N.D
17.	Antimony (Sb)	APHA 3111 / 3120 B	mg/L	0.005	≤ 0.005	N.D
18.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
19.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	0.7	N.D
20.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	0.3	N.D
21.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.01	N.D

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
23.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	2.0	N.D
24.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
25.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
26.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.5	N.D
27.	Mercury (Hg)	APHA 3112 / 3120 B	mg/L	0.001	≤ 0.001	N.D
28.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.02	N.D
29.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
30.	Selenium (Se)	APHA 3111 / 3120 B	mg/L	0.005	0.01	N.D
31.	Sodium (Na)	APHA 3111 / 3120 B	mg/L	1.0	N.S	37.65
32.	Potassium (K)	APHA 3111 / 3120 B	mg/L	1.0	N.S	2.20
33.	Total Coliform	ISO 9308-1	Cfu/100ml	-	Absent	Absent
34.	E. coli	ISO 9308-1	Cfu/100ml	-	Absent	Absent
35.	Fecal Streptococci / Enterococci	ISO 7899-2	Cfu/100ml	-	Absent	Absent

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's self-reference only.*
- *Sample analyzed as received.*
- *Report is not valid for any Court / Negotiations / EPA Submission.*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirement.*
- *The lab environmental conditions are maintained at 25±5° and humidity at 50±20%.*
- *Other Terms and Conditions are mentioned overleaf.*

--------- END OF REPORT ---------

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-G, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Report Number:	07064-25
Sampling Date:	27 Feb, 2025
Issue Date:	04 Mar 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Aashar Habib
Contact details	:	0332-4474450
Email	:	ashr.habib@gmail.com.

18 Sample Information

Sample Description:	:	Ground Water
Vendor Reference:	:	RHC Bahtar (Gabbi Mosque)
Sample Collected by:	:	Mr. Ahsan Ameen(Chemist)
Sample Status:	:	Sealed Sample

Image of Sampling & Submitted Sample

19

20

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available on/at/off or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the sample(s) submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Test Results:

Ground Water Analysis: RBC Bahtar(Gabbi Mosque)

Sr.#	Parameter	Method	Unit	MDL	FEQS Limit	Results
1.	Taste	Sensory Evaluation	-	-	Not objectionable	Acceptable
2.	Odor	Sensory Evaluation	-	-	Not objectionable	Acceptable
3.	Color	APHA 2120 C	PtCo	≤ 5	≤ 15	< 5
4.	Turbidity	APHA 2130 B	NTU	≤ 2	< 5	< 5
5.	pH @ 25 °C	APHA 4500 H+B	pH Unit	0.01	6.5-8.5	7.53
6.	Conductivity	APHA 2510 B	µS/cm	-	N.S	672
7.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	< 1000	375
8.	Fluoride	APHA 4500 D	mg/L	0.02	≤ 1.5	0.23
9.	Nitrate NO_3	APHA 4500 NO3E	mg/L	0.04	≤ 50	4.26
10.	Nitrite, NO_2	APHA 4500 NO2B	mg/L	0.001	≤ 3	0.008
11.	Residual Chlorine	APHA 4500 Cl G	mg/L	0.01	N.S	N.D
12.	Cyanide	APHA 4500 CN- E	mg/L	0.002	≤ 0.05	N.D
13.	Total Hardness (as $CaCO_3$)	APHA 2340 C	mg/L	8.0	< 500	221
14.	Chloride	APHA 4500 Cl B	mg/L	1.0	< 250	13
15.	Phenolic Compounds	APHA 5530 D	mg/L	0.05	N.S	N.D
16.	Aluminium (Al)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.2	N.D
17.	Antimony (Sb)	APHA 3111 / 3120 B	mg/L	0.005	≤ 0.005	N.D
18.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
19.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	0.7	N.D
20.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	0.3	0.32
21.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.01	N.D

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
23.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	2.0	N.D
24.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
25.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.05	N.D
26.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	≤ 0.5	N.D
27.	Mercury (Hg)	APHA 3112 / 3120 B	mg/L	0.001	≤ 0.001	N.D
28.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	≤ 0.02	N.D
29.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
30.	Selenium (Se)	APHA 3111 / 3120 B	mg/L	0.005	0.01	N.D
31.	Sodium (Na)	APHA 3111 / 3120 B	mg/L	1.0	N.S	39.99
32.	Potassium (K)	APHA 3111 / 3120 B	mg/L	1.0	N.S	2.41
33.	Total Coliform	ISO 9308-1	Cfu/100ml	-	Absent	120
34.	Fecal E. coli	ISO 9308-1	Cfu/100ml	-	Absent	Absent
35.	Fecal Streptococci / Enterococci	ISO 7899-2	Cfu/100ml	-	Absent	Absent

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's self-reference only.*
- *Sample analyzed as received.*
- *Report is not valid for any Court / Negotiations / EPA Submission.*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirement.*
- *The lab environmental conditions are maintained at 25±5° and humidity at 50±20%.*
- *Other Terms and Conditions are mentioned overleaf.*

---------- END OF REPORT ----------

This test report is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/termsconditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-G, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Report Number: 07048-25
Receiving Date: 01 Mar, 2025
Issue Date: 05 Mar, 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Aadnr Habib
Contact details	:	0332-4474450
Email	:	aabir.habib@gmail.com

21 Sample Information

Sample Description:	:	Surface Water
Vendor Reference:	:	Chenab River
Sample Collected By:	:	Mr. Muhammad Ahsan (Chemist)
Sample Status:	:	Sealed Sample

Image of Sampling & Submitted Sample

for and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available on/at or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

Tti Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.tilabs.net

TEST REPORT

Test Results:

Surface Water Analysis: Chenab River

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
1.	Temperature @ lab	APHA 2550 B	°C	0.1	-	25
2.	pH Value @ 25 °C	APHA 4500 H°B	pH Unit	0.01	6-9	7.58
3.	Conductivity	APHA 2510 B	µS/cm	1.0	N.S	482
4.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	3500	278
5.	Sulphate	APHA 4500-SO_4^{2-}E	mg/L	5.0	600	57
6.	Fluoride	APHA 4500 D	mg/L	0.02	10	N.D
7.	Total Chlorine	APHA 4500-Cl G	mg/L	0.01	1.0	N.D
8.	Cyanide	APHA 4500 CN E	mg/L	0.002	1.0	N.D
9.	Chloride	APHA 4500 Cl B	mg/L	1.0	1000	29
10.	Sulfide	APHA 4500-S^{2-} D	mg/L	0.002	1.0	N.D
11.	Oil & Grease	APHA 5520 B	mg/L	5.0	10	N.D
12.	Chemical Oxygen Demand (COD)	APHA 5220 D	mg/L	5.0	150	24
13.	Biochemical Oxygen Demand (BOD_5)	APHA 5210 B	mg/L	10.0	80	09
14.	Ammonia (NH_3)	APHA 4500 NH_3 C	mg/L	1.0	40	N.D
15.	Phenolic Compounds	APHA 5530 C	mg/L	0.01	0.1	N.D
16.	Total suspended Solids (TSS)	APHA 2540 D	mg/L	1.0	200	12
17.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
18.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	1.5	N.D
19.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	6.0	N.D
20.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.1	N.D
21.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	1.0	N.D
23.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
24.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	0.5	N.D
25.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	1.5	N.D
26.	Mercury (Hg)	APHA 3112B / 3120 B	mg/L	0.001	0.01	N.D
27.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
28.	Silver (Ag)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
29.	Selenium (Se)	APHA 3114B / 3120 B	mg/L	0.005	0.5	N.D
30.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
31.	Cobalt (Co)	APHA 3111 / 3120 B	mg/L	-	-	N.D
32	Total Toxic Metals	Calculation Method	-	-	2.0	N.D

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's self-reference only.*
- *Sampling is done by TTI Testing Laboratories.*
- *Report is valid for any Court/ Negotiations / EPA Submissions.*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirement.*
- *The lab environmental conditions are maintained at 23±3C° and humidity at 30±20%.*
- *Other Terms and Conditions are mentioned overleaf.*

---------- END OF REPORT ----------

This test report is governed by the terms and conditions available on/at/off or accessible at http://ttilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the sample(s) submitted by the customer. This test report may not be reproduced, except in full, without written approval of TTI Testing Laboratories.

TTI Testing Laboratories | 347-G, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore 54770, Pakistan
Tel: (92-42) 111 786 001, Fax: (92-42) 3515 4555, URL: www.ttilabs.net

TEST REPORT

Report Number: 07049-25
Receiving Date: 01 Mar, 2025
Issue Date: 05 Mar, 2025

Customer	:	STEPS Pakistan
Address	:	17 D Quaid E Azam Industrial Estate Lahore
Contact person	:	Mr. Ashar Habib
Contact details	:	0332-4474450
Email	:	ashar.habib@steps1.com

22 Sample Information

Sample Description:	:	Surface Water
Vendor Reference:	:	Jhelum River
Sample Collected By:	:	Mr. Muhammad Ahsan (Chemist)
Sample Status:	:	Sealed Sample

23 Image of Sampling & Submitted Sample

24

For and on behalf of
Tti Testing Laboratories

Hamad Ahmad
Head Food and Water Lab

This test report is governed by the terms and conditions available on/at/off or accessible at http://tilabs.net/terms&conditions.html. Attention is drawn to the limitations of liability, indemnities and jurisdictional issues defined therein. The report is issued strictly based on the sample(s) submitted to the customer. This test report may not be reproduced, except in full, without written approval of Tti Testing Laboratories.

TEST REPORT

Test Results:

Surface Water Analysis: Jhelum River

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
1.	Temperature @ lab	APHA 2550 B	°C	0.1	-	25
2.	pH Value @ 25 °C	APHA 4500 H+B	pH Unit	0.01	6-9	8.10
3.	Conductivity	APHA 2510 B	µS/cm	1.0	N.S	376
4.	Total Dissolved Solids (TDS)	APHA 2540 C	mg/L	5.0	3500	216
5.	Sulphate	APHA 4500-SO_4^{2-} E	mg/L	5.0	600	36
6.	Fluoride	APHA 4500 D	mg/L	0.02	10	N.D
7.	Total Chlorine	APHA 4500-Cl G	mg/L	0.01	1.0	N.D
8.	Cyanide	APHA 4500 CN E	mg/L	0.002	1.0	N.D
9.	Chloride	APHA 4500 Cl B	mg/L	1.0	1000	33
10.	Sulfide	APHA 4500-S^{2-} D	mg/L	0.002	1.0	N.D
11.	Oil & Grease	APHA 5520 B	mg/L	5.0	10	N.D
12.	Chemical Oxygen Demand (COD)	APHA 5220 D	mg/L	5.0	150	20
13.	Biochemical Oxygen Demand (BOD_5)	APHA 5210 B	mg/L	10.0	80	07
14.	Ammonia (NH_3)	APHA 4500 NH_3 C	mg/L	1.0	40	N.D
15.	Phenolic Compounds	APHA 5530 C	mg/L	0.01	0.1	N.D
16.	Total suspended Solids (TSS)	APHA 2540 D	mg/L	1.0	200	09
17.	Arsenic (As)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
18.	Barium (Ba)	APHA 3111 / 3120 B	mg/L	0.1	1.5	N.D
19.	Boron (B)	APHA 3111 / 3120 B	mg/L	0.1	6.0	N.D
20.	Cadmium (Cd)	APHA 3111 / 3120 B	mg/L	0.003	0.1	N.D
21.	Chromium (Cr)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D

This estimate is governed by the terms and conditions available overleaf or accessible at http://tilabs.net/terms-and-conditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. The test report may not be reproduced, except in full, without written approval of TI Testing Laboratories.

TI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 911, Fax: (92-42) 3515 4505, URL: www.tilabs.net

TEST REPORT

Sr.#	Parameter	Method	Unit	MDL	PEQS Limit	Results
22.	Copper (Cu)	APHA 3111 / 3120 B	mg/L	0.5	1.0	N.D
23.	Iron (Fe)	APHA 3111 / 3120 B	mg/L	0.1	8.0	N.D
24.	Lead (Pb)	APHA 3111 / 3120 B	mg/L	0.01	0.5	N.D
25.	Manganese (Mn)	APHA 3111 / 3120 B	mg/L	0.1	1.5	N.D
26.	Mercury (Hg)	APHA 3112B / 3120 B	mg/L	0.000	0.01	N.D
27.	Nickel (Ni)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
28.	Silver (Ag)	APHA 3111 / 3120 B	mg/L	0.01	1.0	N.D
29.	Selenium (Se)	APHA 3114B / 3120 B	mg/L	0.005	0.5	N.D
30.	Zinc (Zn)	APHA 3111 / 3120 B	mg/L	0.5	5.0	N.D
31.	Cobalt (Co)	APHA 3111 / 3120 B	mg/L	-	-	N.D
32	Total Toxic Metals	Calculation Method	-	-	2.0	N.D

Note:

PEQS = Punjab Environmental Quality Standards
MDL = Method Detection Limit
mg/L = milligram per liter
APHA = American Public Health Association
N.D = Not Detected
N.S = Not Specified

- *Report has been issued for client's reference only.*
- *Sampling is done by TTI Testing Laboratories*
- *Report is valid for any Court/ Regulations/ EPA Submissions*
- *Uncertainty of the parameters and laboratory conditions at the time of analysis can be provided as per client's requirement.*
- *The laboratory environmental conditions are maintained at 25±5°C and humidity at 50±20%*
- *Other Terms and Conditions are mentioned overleaf.*

---------- END OF REPORT ----------

This testreport is governed by the terms and conditions available overleaf or accessible at http://ttilabs.net/termsandconditions.html. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. The report is issued strictly based on the testing of the samples submitted by the customer. The test report may not be reproduced, except in full, without written approval of TTI Testing Laboratories.

TTI Testing Laboratories | 347-S, Quaid-e-Azam Industrial Estate, Kot Lakhpat, Lahore-54770, Pakistan.
Tel: (92-42) 111 786 911, Fax: (92-42) 3515 4565, URL: www.ttilabs.net

Annexure 3: Waste Management Plan

A.1 Waste Management Plan

A.1.1 Introduction

1. Construction waste 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 amounts of municipal waste will also be generated from the construction camps.

A.1.2 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 ordering small quantities); and ▪ Supplier errors.
Transportation	▪ Damage during transportation. ▪ Difficulties with 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

Origins of Waste/Spoil	Causes of Waste/Spoil Material
	▪ 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

A.2 Construction Waste Management Plan

A.2.1 Waste Management Goals

2. The contractor established a 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.

A.2.2 Responsibility

- 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.
- The site supervisor shall be responsible for the implementation of the onsite portions of this program including the training of subcontractor personnel.

A.2.3 Waste Prevention Planning

- In addition to other requirements specified herein it is a requirement for the work of this project that the contractor complies with the applicable city waste disposal requirements.
- 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.
- 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.
- The "Construction Waste Management Plan" shall be implemented and executed as follows and as on the chart:
  - Salvageable materials will be diverted from disposal where feasible

- There will be a designated area on the construction site reserved for materials that can be recycled
- Areas shall be marked to designate what recycled materials are to be stored there; and
- Hazardous waste shall be managed by a licensed hazardous waste vendor.

A.2.4 Communication and Education Plan

- This Waste Management Plan will be posted onsite.
- 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.
- The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan
- All recycling containers and areas will be clearly marked
- Lists of acceptable and unacceptable materials will be posted at the site; and
- All subcontractors will be informed in writing of the importance of non-contamination with other materials or trash.

A.2.5 Motivation Plan

3. 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 the award of subcontracts. This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the job site.

A.2.6 Expected Project Waste, Disposal, and Handling

4. 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 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 recycling, and landfill.	Keep separated in designated areas onsite. Place in “Trash” container.

Material	Disposal Method	Handling Procedure
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 drywalls 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.

A.2.7 Recycle Hauler

- To be determined.
- Contact Address; and
- Some or all recycling may be hauled by the authorized representative.

A.2.8 Possible Recycle Locations and Acceptable Materials

- Coordinate with companies in concerned districts or which are registered with Metropolitan Corporation Quetta that accept materials for recycling; and
- 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.

Annexure 4: OHSE Management Plan

A.3 Guideline Occupational Health and Safety Plan

5. 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.

6. 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.

7. 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 the risk of increase of vector borne and other different diseases.

8. The following sections will be implemented during the construction phase to address and ensure workers' health and safety.

A.4 Screening and regular unannounced checking of workers

9. 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 ensure that all workers undergo medical tests to screen diseases at source and at sites in consultation with the designated Health Officer.

10. In addition to this, the Project Management will also undertake sudden, unannounced checks on workers to look for diseases such as HIV, STDs, and hepatitis and take necessary steps as mandated by the Contractual agreement between the Contractor and the Worker(s).

A.5 Minimizing hazards and risks at the workplace

11. To ensure safety at all work sites, the following will be carried out:

- Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.
- Construction of barricades around construction sites and deep excavated pits, to cordon off and deter entry of unauthorized personnel and workers into these areas.
- Providing a safe storage site/area for large equipment such as power tools and chains, to prevent misuse and loss.
- 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.

- Remove all scrap timber, waste material and rubbish from the immediate work area as the work progresses.
- 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
- 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 horizontals.
- Stacking away all excavated earth at least 2 feet from the pit to avoid material such as loose rocks falling back into the excavated area and injuring those working inside excavated sites.
- Constructing support systems, such as bracing to adjoining structures that may be endangered by excavation works nearby.
- Only a trained electrician to construct, install and repair all electrical equipment to prevent risks of electrical shocks and electrocution.
- Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

A.6 Provision of Personal Protective Equipment

12. Risks for the health and safety of workers can be prevented by the 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 the work and the risks involved, contractors must provide without any cost with the workers the following protective equipment:

- High visibility clothing for all personnel during roadwork must be mandatory.
- Helmets 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.
- Safety belts shall be provided for workers working at heights (more than 20 ft) such as roofing, painting, and plastering.
- Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on their feet.
- Ear protective devices should be provided for all workers and will be used during the occurrence of extensive noise.
- Eye and face protection equipment shall be provided to all welders to protect against sparks.
- Respiratory protection devices shall be provided to all workers during the occurrence of fumes, dust, or toxic gas/vapor.

- 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.

13. The specific PPE requirements for each type of work are summarized below.

Table XIV-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 hats, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Blasting	Hard hat, eye and hearing protection.
Concrete and masonry work	Hard hats, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.
Excavation, heavy equipment, motor graders, and bulldozer operation	Hard hat, safety boots, gloves, hearing protection.
Quarries	Hard hats, eye protectors, hearing protection, safety footwear, leather gloves and dust respirator.

A.7 Procedures to Deal with Emergencies such as Accidents, Sudden Illness and Death of Workers

14. First aid kits will be always made available 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 taken:

- Provision of dispensaries by the individual EPC contractor.
- 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.
- 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.
- Communication arrangements, such as the provision of radios or mobile communication for all work sites, for efficient handling of emergencies, will be made.

A.8 Record Maintenance and Remedial action

15. 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 people involved, cause of the 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.

A.9 Compensation for Injuries and Death

16. 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.

A.10 Awareness Programs

17. The Project management will undertake awareness programs through posters, talks, and meetings with the contractors to undertake the following activities:

- Dissemination sessions will clarify the rights and responsibilities of the workers regarding interactions with local people (including communicable disease risks, such as HIV/AIDS), work site health and safety, waste management (waste separation, recycling, and composting), and the illegality of poaching.
- 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.

A.11 Nomination of a Health and Safety Focal Person

18. 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:

- Function as the focal person/representative for all health and safety matters at the workplace.
- Responsible for maintaining records of all accidents and all health and safety issues at each site, the number of accidents and their cause, actions taken and remedial measures undertaken in case of safety issues.
- 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.
- Ensure that all workers are adequately informed on the requirement to use Personal Protective Equipment and its correct use;

- Also responsible for the first aid kit and making sure that the basic immediate medicines are readily available.

A.12 Suggested Contents of Occupational Health and Safety Plan

19. The suggested contents of Occupational Health and Safety Plan to be developed by the Contractor(s) are described below:

- Purpose
- Scope of Application
- Complying Basis
- Occupational Health and Safety Objectives
- 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
- Health Plan
  - Labour Protection
  - Sanitary Epidemic Prevention
- Safety Plan
  - Summary
  - Qualification Review
  - Safety Training
  - Construction Plans and Documents
  - Control Measures
  - Monitoring Measures
  - Management of the Key Safety Accidents
- Public Security Plan
- Local Community Health and Safety

Annexure 5:Tree Afforestation Plan

TREE PLANTATION PLAN

500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT PROJECT

A.13 General Description

20. The Government of Pakistan requested the Asian Development Bank to finance the **500KV D/C TRANSMISSION LINE FROM FAISALABAD WEST FOR IN/OUT ON GHAZI BAROTHA-ISLAMABAD WEST CIRCUIT Project**. The proposed transmission line project is initiated to enhance the capacity, reliability, and efficiency of the regional power grid by facilitating the transfer of electricity from generation sources to distribution networks and end users. With increasing demand for electricity driven by population growth, industrial development, and rural electrification, the existing transmission infrastructure has become inadequate and prone to congestion and power losses. This project aims to construct a high-voltage transmission line, thereby supporting current and future energy needs.

21. This Tree Plantation Plan will be implemented as a part of the Environmental Management Plan during construction Phase.

A.14 Afforestation

22. The marginal land constituting the Proposed Project is Government ownership. Afforestation of over 60 percent of 60 acres land is planned to be done.

23. Slope and aspect being some of the determining factors for selection of appropriate plant species for afforestation shall be recognized. Whilst planting of suitable tree species like *Acacia modesta* (Phulai), *Acacia nilotica*(Kikar), *Ailanthus altisimma* (English Bakain) and *Albezzia lebbek* (Siris) shall be carried out at 20 feet x 30 feet spacing on gentle to moderate slopes (10-40%). Supplemental sowing in pits shall be allowed to ensure higher rate of success.

24. Afforestation including the Planting of saplings shall be carried out twice a year in spring and Monsoon seasons. Whilst watering of plants on steep slopes is next to impossible, efforts shall be made to do watering of plants in the stress period on the relatively accessible gentle to moderate slopes. The afforestation activities are tightly time-bound; therefore, all out efforts shall be made to capture the most conducive seasons to get maximal utility of the winter and summer rains.

25. Bulk planting shall be done in monsoon season to avail the monsoon showers followed by relatively colder months of the year to avoid desiccation. Beating up of failures not exceeding the allowable limit of 30% of the original work shall be done in the subsequent planting season.

26. Preference shall be given to the local species for its easier and better acclimatization with the locality factors like soil, precipitation, temperature, humidity and frost etc. Choice of the people for quick growing species to ensure early return to the community in view of its

adaptability with the local climatic and edaphic dynamics shall also be respected. Biodiversity shall be imperatively considered for all intents and purposes to help develop and ensure proper habitat for compatible life forms. Whilst Olea (Kao) and Shisham (Rose wood) planting shall be done in niches of deep soil on relatively colder aspects, Chirpine shall be tried sporadically for aesthetic purpose. Poplar.

A.15 Technical Inputs

27. Following the field visits the GIS expert would prepare and provide land-use and vegetation maps of the sub-project to understand the baseline situation of the area. Similar maps shall be developed later on at appropriate intervals to assess the differences taking place overtime.

28. The Environment Specialist, in consultation with the Divisional Forest Officer & Contractor Environmentalist, would develop an Action Plan spelling out various activities with timelines. The Project team accompanied by the forest staff shall periodically monitor the progress and right track the situation if going off the line during the construction period.

A.16 Benefits of Tree Plantation

29. The impacts of extensive afforestation activities are expected to be very encouraging as experienced in the earlier undertakings of similar nature. A host of activities would be generated all aiming at the green and scenic Project area. The benefits should be measured in tangible and intangible terms from standpoint of enhanced vegetal cover and scenic views.

30. Large scale afforestation on land shall create sufficient impact on aesthetics of the project area. The mixture of a variety of trees, shrubs and grasses used in the afforestation projects will provide further adornment to the serene and scenic environment of the area.

31. To say the least, afforestation is globally recognized as not only a nature friendly activity but also a socially acceptable, economically feasible and environmentally viable venture with no harmful side effects at all. It opens new avenues of livelihood and opportunities of benefits in the short, medium and long run. Vegetation being a natural renewable resource, maintains itself as a sustainable entity but with little conservation efforts and practices. These benefits are enormous, holistic, long-lasting and self-reliant with little care and attention of mankind. The vegetation cover greatly enriches the biodiversity of the area. It is like a dream that comes true and never rusts. It is in fact a bonanza of profits that keeps on expanding to cater to the needs and taste of all life forms. All the mankind, aquatic and terrestrial life, livestock, wildlife and micro-organism enjoy and relish upon the numerous benefits of these renewable resources.

32. The Tree plantation cost has already been provided in the report.