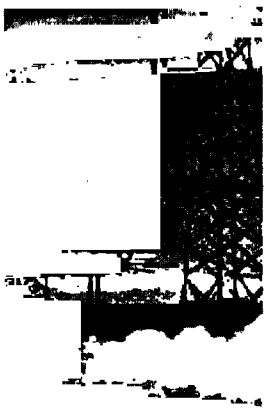

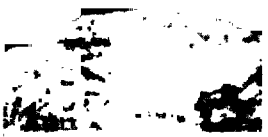

Hyderabad Electric Supply Company

HESCO

E1503

VOL. 8

HESCO 6th STG Project

Environmental and Social Assessment

Volume 1 of 2 – Main Report

Ref.: FRT07V03HES

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ÉLAN

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Executive Summary

The Hyderabad Electric Supply Company (HESCO) is planning to undertake the 6th Secondary Transmission and Grid (STG) project in various parts of its territory. HESCO is seeking financing from the World Bank (WB) for this 5-year project. In line with the prevailing legislation in the country and WB safeguard policies, an environmental and social assessment (ESA) of the project has been carried out. This document presents the report of this assessment.

Study Methodology

The present study was conducted using a standard methodology prescribed by national and international agencies. Various phases of the study included screening, scoping, data collection and compilation, stakeholder consultation, impact assessment, and report compilation.

Legislative Framework

The Pakistan Environmental Protection Act, 1997 (PEPA 1997) requires the proponents of every development project in the country to conduct an environmental assessment and submit its report to the relevant environmental protection agency.

In addition, the World Bank Operational Policy 4.01 (OP 4.01) requires that environmental and social assessment be carried out before commencing projects such as the 6th STG. The OP 4.12 specifies the procedure that needs to be followed to address the involuntary resettlement the project would cause.

The present ESA has been carried out in response to the above-mentioned Act and WB safeguard policies.

Project Overview

The overall objective of the HESCO's 6th STG project is to help increase the efficiency, reliability, and quality of its electricity supply. The project seeks to decrease technical as well as commercial losses, increase electricity availability, and improve the voltage profile within the HESCO's electricity network.

In its total span of five years, the 6th STG project envisages establishment of fifteen new grid stations, in addition to converting seven, augmenting nineteen, rehabilitating 216, and extending another ten of the existing grid stations. The project also includes laying of 451 km of new and rehabilitation of 2,980 km of existing transmission lines.

The present ESA addresses the project components that will be undertaken during the Year 2006-07. These include the establishment of four new grid stations, in addition to the extension of one and conversion of four grid stations. A total of about 111 km of new transmission lines will also be added to the existing HESCO system during this period.

Description of the Environment

The project area lies in the Lower Indus Plain, which essentially forms the western extension of Indo-Gangetic Plain. The Indus Plain has been made up of the silt brought by the Indus and its numerous tributaries, such as Jhelum, Chenab, Ravi and Sutlej on the east bank, and Kabul, Kurram, Tochi, and others on the west bank. The Indus Plain is known for its agricultural fertility and cultural development throughout history.

Topographically, Sindh can be divided into four distinct parts with the dry and barren Kirthar Range in the west, a central alluvial plain bisected by the Indus River, a desert belt in the east, and the Indus delta in the south. The entire project area is located in the central alluvial plain on either sides of the Indus River.

The agriculture is by far the main economic activity in the project area, which lies within the Indus Basin Irrigation system – one of the most extensive canal irrigation systems in the world. The groundwater extraction augments the canal water for irrigation in the area.

Ecologically, the project area was once part of the thorn forest ecozone. However, urban centers, villages and agriculture activities have greatly modified this ecozone in most parts of the project area. Whatever wild species now found in the area are essentially those which have adapted to the modified conditions and presence of human beings.

Administratively, the project area falls under various districts of Sindh. These include Jacobabad, Shikarpur, Larkana, Sanghar, Hyderabad, Mirpur Khas, Badin and Thatta.

Stakeholder Consultation

Stakeholder consultations were carried out as part of the ESA study. These consultations were conducted with the institutional as well as the grassroots stakeholders. It was ensured that the rural women were also included during these consultations. The main objectives of the consultations were to: apprise the stakeholders about the proposed project activities; obtain their views, concerns and recommendations; and address/incorporate them in the project design - thus enhancing the environmental and social performance of the project.

Impact Assessment and Mitigation

During the present ESA, the project's potential social and environmental impacts were identified. Each identified impact was then characterized with respect to its nature, reversibility, geo-extent, consequence-severity and likelihood. Based upon this characterization, the impacts were then assessed to be of high, medium or low significance.

The ESA revealed that most of the impacts of the proposed project would be confined to the construction phase and temporary in nature. Appropriate control and housekeeping measures – recommended in the ESA – would address these issues adequately. The environmental and social monitoring would ensure compliance to and effectiveness of these control measures.

The key social issues identified and assessed as described above included land procurement, damaged crops and safety hazards. The ESA has recommended that the

land for the grid stations should be acquired in accordance with the Land Acquisition Act of 1894, on the basis of *willing seller – willing buyer*, mutually agreed prices and the owner having the option to refuse selling the land. The project will acquire a total of about 16 acres of land in this manner. To mitigate the damaged crops – caused by the transmission line construction activities – the ESA has recommended payment of compensation to the landowners/cultivators. The ESA has estimated that crops would be damaged over a total of about 793 acres of land belonging to about 400 landowners/cultivators. The associated compensation amount has been estimated to be about Rs. 6.9 million. Finally, to address the safety concerns associated with the construction activities, and the electrocution risk, precautionary measures have been included in the ESA.

The key environmental impacts of the proposed project as identified in the ESA included soil erosion and degradation and water contamination. The soil erosion would be caused by the grid station and transmission line construction activities, particularly in the hilly terrain of the project area. These concerns will be addressed through appropriate siting, design and construction techniques employed during the proposed project. The soil and water contamination could be caused by the inappropriate waste disposal and leakage/spillage of oils and chemicals. These concerns will be forestalled through waste disposal system recommended in the ESA.

The total cost of the environmental and social management of the project, including implementing the mitigation measures has been estimated to be about Rs. 13.8 million. This includes the crop compensation of about Rs. 6.9 million mentioned earlier.

Environmental and Social Management Plan

An environmental and social management plan (ESMP) has been developed to provide an implementation mechanism for the mitigation measures identified during the ESA. The ESMP provides the organization structure for the environmental and social management system during the project, and defines the roles and responsibilities of various players. The ESMP includes a mitigation plan, a monitoring plan, the communication and documentation requirements, and training needs, in the context of the environmental and social management of the project.

Findings and Recommendations

On the basis of the overall impact assessment and, more specifically, the nature and magnitude of the residual environmental and socioeconomic impacts identified during the present ESA, it is concluded that the proposed project is unlikely to cause any significant, lasting impact on the social, physical and biological environment of the area, provided that the proposed activities are carried out as mentioned in this report, and the mitigation measures included in this report are completely and effectively implemented.

The key recommendations pertaining to the environmental and social performance of the proposed project are as follows:

- The ESA and ESMP should be included in the project tender documents. The ESMP should be included in the construction contracts, so that the mitigation measures become a contractual binding over the contractors.

- HESCO should follow the Resettlement Plan (RP) for acquiring land for the project, and to compensate the project affected persons (PAPs).
- HESCO should acquire in-house environmental management capacity. For this purpose, an Environment and Social Cell should be established with in the Company. Initially, at least one each of environmental and socioeconomic experts should be part of the Cell.
- The Company should develop a comprehensive program to eliminate the PCB-containing transformer oil from its entire system. To start with, the grid stations and workshops should be provided with the PCB testing kits. The present status of soil contamination in the grid stations, warehouses and workshops should also be determined through site investigations.
- HESCO should develop its Environmental and Social Policy, which should demonstrate the Company's commitment towards sound environmental management practices throughout its operations. The Company should adhere to the environmental legislation and regulations, particularly for conducting environmental and social assessments for all its future projects.

Acronyms

AJK	Azad Jammu and Kashmir
Amsl	Above mean sea level
BHU	Basic Health Unit
BOD	Biological oxygen demand
CITES	Convention on International Trade in Endangered Species
COD	Chemical oxygen demand
Cusecs	Cubic feet per second
DC	Deputy Commissioner
DCO	District Coordination Officer
DISCO	Distribution Company
DO	Dissolved oxygen
ECA	Employment of Child Act
EDO	Executive District Officer
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ESA	Environmental and Social Assessment
ESG	Environmental and Social Guidelines
ESI	Environmental and Social Inspector
ESMP	Environmental and Social Management Plan
ESO	Environmental and Social Officer
ESR	Environmental and Social Report
FESCO	Faisalabad Electric Supply Company
GDP	Gross Domestic Product
GENCO	Generating Company
GEPCO	Gujranwala Electric Power Company
GIS	Geographical information system
GoP	Government of Pakistan
GRM	Grievance Redressal Mechanism
GSC	Grid Station Construction (Department)
GSO	Grid Station Operation (Department)
GS	Grid Station
GWh	Gega watt hour
Ha	Hectare
HDI	Human Development Index
HESCO	Hyderabad Electric Supply Company
HSE	Health safety and environment
HT	High tension

IBIS	Indus Basin Irrigation System
ICT	Islamabad Capital Territory
IEE	Initial Environmental Examination
IESCO	Islamabad Electric Supply Company
IUCN	International Union for Conservation of Nature
KESC	Karachi Electric Supply Company
KM	Kilometer
KV	Kilo volts
KWh	Kilo watt hour
LAA	Land Acquisition Act (of 1894)
LESCO	Lahore Electric Supply Company
LOS	Laws of Seas
LPG	Liquefied petroleum gas
LT	Low tension
MAF	Million acre feet
MARPOL	Marine Pollution (Convention for the Prevention of Pollution from Ships)
MEA	Multilateral Environmental Agreements
MEPCO	Multan Electric Power Company
MVA	Mega volt amperes
MW	Mega watts
M&E	Monitoring and Evaluation
NEQS	National Environmental Quality Standards
NGO	Non Governmental Organization
NOx	Oxides of nitrogen
NTDC	National Transmission and Dispatch Company
NTPS	Natural (Gas) Thermal Power Station
NWFP	North Western Frontier Province
OP	Operational Policy
O&M	Operation and Maintenance
PAPs	Project affected persons
PCB	Poly Chlorinated Biphenyl
PEPC	Pakistan Encl Protection Council
PESCO	Peshawar Electric Supply Company
PD	Project Director
PEPA	Pakistan Environmental Protection Act
PM	Project Manager
PM	Particulate matter
POP	Persistent Organic Pollutants
P&DD	Planning and Development Department

QESCO	Quetta Electric Supply Company
RH	Relative humidity
RHC	Rural Health Center
RP	Resettlement Plan
RPF	Resettlement Policy Framework
SCARP	Salinity Control and Rehabilitation Project
SPDC	Social Policy and Development Center
STG	Secondary transmission and grid
TB	Tuberculosis
TDS	Total dissolved solids
ToR	Terms of Reference
XEN	Executive Engineer
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
WAPDA	Water and Power Development Authority
WB	World Bank
WBG	World Bank Group
WWF	World Wide Fund for Nature

Contents

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Exhibits

1 Introduction

The Hyderabad Electric Supply Company (HESCO) is planning to undertake the 6th Secondary Transmission and Grid (STG) project in various parts of its territory (see **Exhibit 1.1** for HESCO territory and project location). HESCO is seeking finances from the World Bank (WB) for a portion of this 5-year project. In line with the prevailing legislation in the country and WB safeguard policies, an environmental and social assessment (ESA) of the project has been carried out. This document presents the report of this assessment.

1.1 Project Proponent

HESCO is a public utility company, providing electricity to the entire Sindh province, except for Karachi and parts of the Thatta district. HESCO was incorporated in 1998 under the Companies Ordinance 1984. Before this, it was one of the eight Area Electricity Boards of the Water and Power Development Authority (WAPDA).

Established in 1958, WAPDA had two wings: Water and Power. The Water Wing was (and still is) responsible for developing and managing large water reservoirs and barrages, while its Power Wing was a vertically integrated utility, responsible for generation, transmission and distribution of electricity throughout Pakistan (except for the City of Karachi, where the Karachi Electric Supply Company – KESC - performs a similar function).

Under its un-bundling and restructuring program, WAPDA's Power Wing has been broken down into eight distribution companies collectively called DISCOs, four generating companies collectively called GENCOs and a transmission company called National Transmission and Dispatch Company (NTDC). HESCO is one of the eight DISCOs; the other seven DISCOs are:

- Peshawar Electric Supply Company (PESCO) - responsible for electricity distribution in the entire North Western Frontier Province (NWFP), northern parts of Azad Jammu and Kashmir (AJK) and the Northern Areas.
- Islamabad Electric Supply Company (IESCO) - carrying out electricity distribution in Islamabad, Rawalpindi, Jhelum, Chakwal and Attock districts. In addition, IESCO also supplies bulk electricity to the central and southern parts of AJK.
- Gujranwala Electric Power Company (GEPCO), which distributes electricity in Gujranwala, Sialkot, Mandi Bahauddin, Hafizabad, Narowal and Gujrat districts.
- Lahore Electric Supply Company (LESCO) – supplying electricity to Lahore, Kasur, Sheikhupura and Okara districts.
- Faisalabad Electric Supply Company (FESCO) - responsible for electricity distribution in Faisalabad, Sargodha, Khushab, Jhang, Toba Tek Singh, Bhalwal, Mianwali and Bhakkar districts.

- Multan Electric Power Company (MEPCO), which distributes electricity in the southern districts of the Punjab province.
- Quetta Electric Supply Company (QESCO) - supplying electricity to the entire Balochistan Province, except Lasbela, which is covered under the KESC network.

Recently, TESCO – Tribal Areas Electric Supply Company – has also been established.

1.2 Project Background and Justification

Pakistan as a whole is an energy-deficient country and per capita electricity generation has traditionally been low (581 KWh as against the World average of 2,657 KWh[1]). The electricity demand in the country has grown at a rapid pace since 1985. Consumption of electricity increased from 17,608 GWh in 1985 to 55,507 GWh in 2004, representing an annual average growth rate of 6.2%. The growth in the electricity demand has however been uneven over the years. The consumption grew at a rate of 11% during 1985-99, the growth rate slowed down to 6.9% during 1990-95 and 2.5% during 1996-2000. Since the year 2000 however, the trend has reversed and electricity demand has picked up, mirroring the overall economic growth in the country. During the period 2001-04, the electricity demand grew at a rate of 3.3% (NEPRA 2005).

The electricity demand in the country is projected to grow at an annual compound growth rate of 7.9% during the period 2005-10, and increase from 15,500 MW in 2005 to 21,500 MW in 2010, as shown in **Exhibit 1.2**. This growth has been projected on the basis of increase both in population and per capita income; **Exhibit 1.3** presents the linkage between the increasing population, per capita income and electricity consumption.

Much like rest of the country, HESCO is also experiencing growth in the electricity demand, as shown in **Exhibit 1.4**. In order to meet this increasing demand, the existing secondary transmission and grid system (132 and 66 KV) has to be expanded, in addition to the increased generation and primary transmission (500 KV and 220 KV) capacity. Towards this end, HESCO, being responsible for the expansion, operation and maintenance of the secondary transmission and grid (STG) system within its territory, has developed the 6th STG project.

The project includes establishment of new grid stations, extension / conversion / augmentation of existing grid stations and laying of new transmission lines. The project will ensure supply of electricity in new areas, load reduction on presently overloaded grid stations and transmission lines, and improvement in the voltage profile as well as the system reliability.

1.3 Project Overview

The overall objective of the 6th STG project is to help increase the efficiency, reliability and quality of the electricity supply. The project seeks to decrease the technical as well

[1] Source: Medium Term Development Framework 2005-10, Government of Pakistan, 2005.

as commercial losses, increase the electricity availability, and improve the voltage profile, within the HESCO's electricity network.

The 6th STG is a 5-year project, from 2006-7 to 20010-11[2], and has been broken down in five distinct year-wise phases. Each phase of the project consists of establishing new grid stations, extending/upgrading/augmenting existing grid stations, and laying transmission lines. The key components of these phases, as given in the Project Description Document (PDD), are tabulated below.[3]

	2006-07	2007-08	2008-09	2009-10	2010-11	Total
New Grid Stations (GS)	4	2	4	3	2	15
GS Conversion	4	1	0	0	2	7
GS Augmentation	4	1	4	6	4	19
GS Extension [4]	16	13	14	9	4	56
Rehabilitation of GS [5]	60	50	52	26	28	216
New Transmission Lines (km)	111	170	130	27	13	451
Rehabilitation of Transmission Lines (km) [6]	868	686	629	586	211	2,980

HESCO is seeking the WB financing for the first three years of the project. The present ESA addresses a portion of the STG components to be undertaken during year 2006-07 (see **Section 1.4.3** for study scope).

1.4 ESA Study

1.4.1 Need of the Study

The World Bank Operational Policy 4.01 (OP 4.01) states that "The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making"[7]. The study also responds to OP 4.12 on involuntary resettlement, and provides the required mitigation measures through a Resettlement Plan (RP).

In addition, the Pakistan Environmental Protection Act, 1997 (PEPA 1997)[8] requires the proponents of every development project in the country to submit either an Initial

[2] The original PC1 was prepared for the project duration from 2003-04 to 2007-08.

[3] The original year-wise distribution of work within the total project duration as given in the PC1 has subsequently been revised, based upon changing load demand and priorities.

[4] Not included in the present ESA.

[5] Not included in the present ESA.

[6] Not included in the present ESA.

[7] Excerpts from OP4.01 – Environmental Assessment. January, 1999.

[8] Act No. XXXIV of 1997. The Gazette of Pakistan, Islamabad, December 6, 1997.

Environmental Examination (IEE) or "where the project is likely to cause an adverse environmental effect," an Environmental Impact Assessment (EIA) to the concerned environmental protection agency (EPA). The IEE/EIA Regulations 2000 issued under the PEPA 1997 provide separate lists for the projects requiring IEE and EIA.

1.4.2 Study Objectives

The objectives of the present ESA are to:

- assess the existing environmental and socioeconomic conditions of the project area,
- identify likely impacts of the proposed project on the natural and human environment of the area, to predict and evaluate these impacts, and determine significance of these impacts, in light of the technical and regulatory concerns,
- propose appropriate mitigation measures that should be incorporated in the design of the project to minimize if not eliminate the adverse impacts,
- assess the compliance status of the proposed activities with respect to the environmental legislation and WB's OPs,
- develop an environmental and social management plan (ESMP) to provide an implementation mechanism for the mitigation measures identified during the study.

1.4.3 Study Scope

The present ESA study covers the following components of the proposed 6th STG project which will be carried out during the year 2006-07:

- New grid stations: 4 (Larkana III, Chamber, Bukhshapur and Tando Bago)
- Grid station extension: 1 (Nooriabad)
- Grid station conversion: 4 (Matiari, Kandiari, Samaro and Naukot)
- Transmission lines: 111 km

These components of the 6th STG project will be referred to as the 'proposed project' and the area where these components are located will be referred to as the 'project area' in this report. The study addresses the potential environmental and social impacts that may be encountered during the construction and operation phases of the proposed project, in accordance with the terms of reference (ToR) provided by HESCO for this purpose. (See **Appendix A** for the ToR of the ESA.)

1.4.4 Study Methodology

The key steps that were followed while conducting the ESA are briefly described below.

Scoping

During this phase, key information on the project was collected and reviewed. A 'long list' of the potential environmental as well as social issues likely to arise as a result of the

project was developed. The stakeholder analysis was also carried out for the consultation to be carried out subsequently.

Stakeholder Consultation

Stakeholder consultations were carried out during the ESA study. Meetings were held in Islamabad and Hyderabad with the institutional stakeholders and key environmental and social issues discussed. Extensive consultations with the grass root stakeholders were carried out at the project sites (grid station locations and transmission line routes). Efforts were made to solicit the concerns and views of rural women as well, and a female staff was part of the study team conducting the stakeholder consultations. While women were present in most of the consultations held, women-only consultations were conducted by the female staff. The main objective of the consultations was to apprise the key stakeholders about the project details, and to obtain their concerns, apprehensions and recommendations regarding the proposed activities.

Data Collection/Compilation

During this phase, data was collected and compiled, in order to develop a baseline of the project area's physical, biological and human environment. For this purpose, both review of secondary sources and field data collection were carried out. Field visits to each of the new grid station sites, existing grid stations (which are to be extended/augmented/ upgraded) and transmission line routes were carried out.

The secondary resources that were consulted included reports of the studies carried out earlier, published books and data, and relevant websites. With the help of these resources a generic profile of the entire project area was developed.

In addition to the above, extensive field visits were carried out in order to collect the primary data specific to the project sites (grid station locations and transmission line routes). During these field visits, key information on environmental and social parameters was collected. During the primary data collection, environmental as well as social hot spots falling at or near the project sites were identified, and most importantly, the project affectees were determined.

During the field investigations, detailed information was collected on the cultivated area falling under the transmission line routes, since damage to the crops would be the primary asset loss during the proposed project. Information was also collected on the owners/tenants of the cultivated land under the transmission lines.

Impact Assessment

During the impact assessment, the environmental, socioeconomic, and project information collected in previous steps was used to determine the potential impacts of the proposed project. Subsequent to this, the potential impacts were characterized in order to determine their significance. Mitigation measures were identified where required to minimize the significant environmental impacts. (Impact assessment methodology is further discussed in **Chapter 8** of this document.) A management framework was also developed in the form of an ESMP for the implementation of the mitigation measures

identified during the study. The social screening checklist, provided in the terms of reference (ToR), was also used as one of the tools to conduct the social impact assessment.

The impact assessment has been carried out and the associated mitigation measures recommended on the basis of the surveyed transmission line routes and other project locations. Variations in the impacts and associated mitigation measures are expected if the project components are moved outside the surveyed corridor.

1.4.5 Environmental and Social Guidelines

As described in **Section 1.4.3** above, the present ESA study covers the project components to be carried out during the year 2006-07, which is the first year of the 3-year project slice for which the WB financing is being sought. For the project components to be carried out during the remainder of the 3-year slice (ie, 2007-08 and 2008-09), details such as grid station locations and transmission lines routes are not known, and hence a detailed ESA cannot be conducted for this portion of the project at this stage.

In order to provide a broad framework to address the environmental as well as social aspects during this phase of the project (ie, 2007-08 and 2008-09), a set of environmental and social guidelines (ESG) has been prepared.

The ESG is a stand-alone document and has been provided under separate cover.

1.4.6 Resettlement Plan

Since the total number of the project affectees is expected to be more than 200, a Resettlement Plan (RP) has been developed, in accordance with the WB OP 4.12, in order to address the resettlement issues arising as a result of the project. The RP provides entitlement framework, compensation assessment and disbursement procedure, grievance redressal mechanism, monitoring requirements, resettlement budget and disclosure procedure for the proposed project.

The RP is a stand alone document and has been provided under separate cover.

1.4.7 Study Team

The ESA team consisted of environmental and socioeconomic experts having considerable experience in their respective field of expertise. The list of the experts is provided in **Appendix B**.

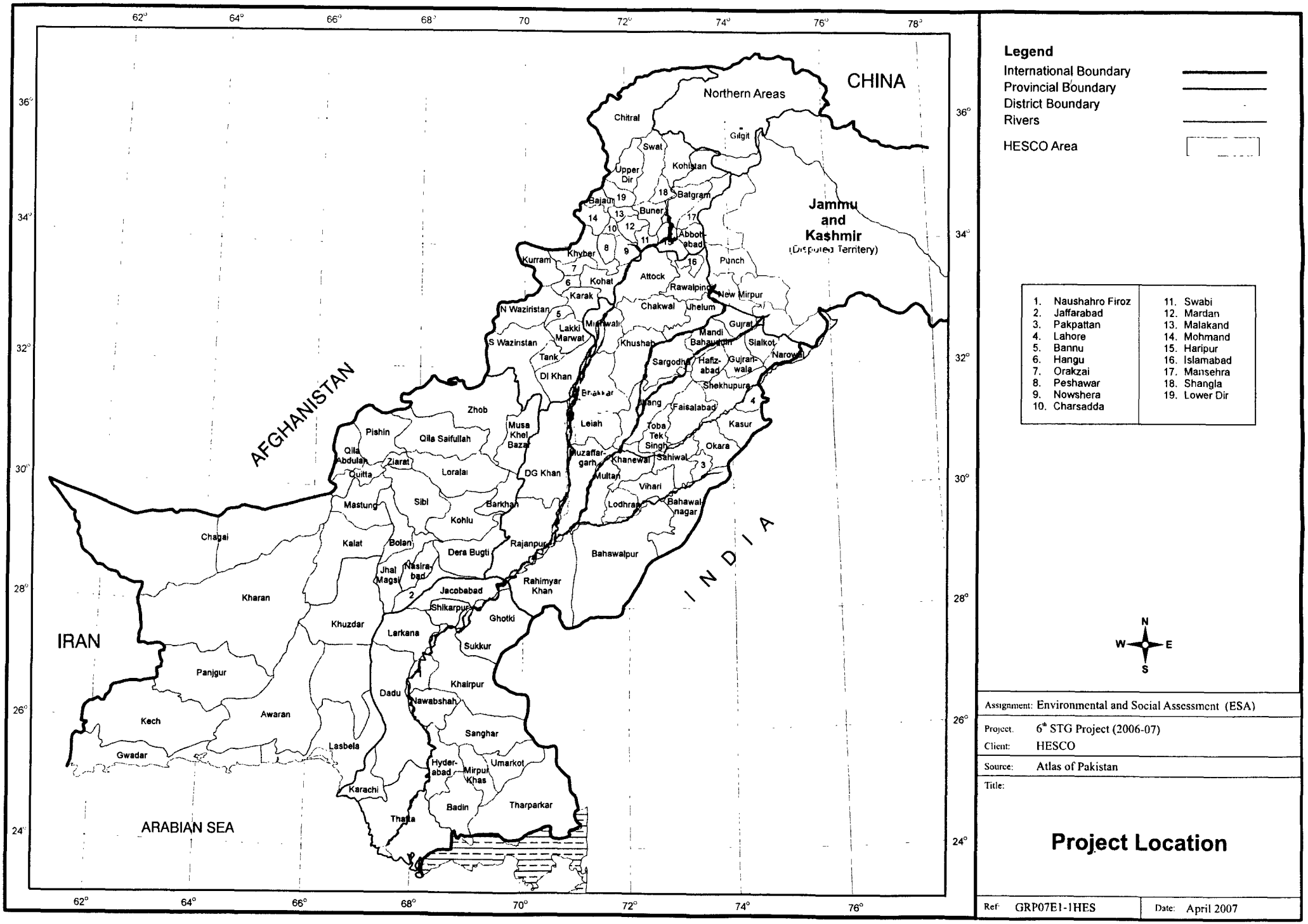
1.5 Document Structure

Chapter 2 discusses the World Bank's safeguard policies, as well as the regulatory, legislative and institutional setup in the country, relevant to the environmental and social assessment. The Chapter also outlines the international environmental agreements to which the country is a party. **Chapter 3** provides a simplified description of the proposed 6th STG project and its components. The environmental baseline conditions are

presented in **Chapter 4**, whereas the existing social and socioeconomic conditions of the project area are described in **Chapter 5**. The project alternatives are evaluated in **Chapter 6**. The stakeholder consultation has been covered in **Chapter 7**. The environmental impacts are assessed and their respective mitigations recommended in **Chapters 8**, whereas **Chapter 9** details the social impacts of the project and the respective mitigation measures. **Chapter 10** outlines the implementation mechanism for the mitigation measures, in the form of an environmental and social management plan. Finally, **Chapter 11** presents the findings and conclusion of the study.

Exhibit 1.1: Project Location

(Please see the following page.)



Legend

- International Boundary
- Provincial Boundary
- District Boundary
- Rivers
- HESCO Area

1. Naushahro Firoz	11. Swabi
2. Jaffarabad	12. Mardan
3. Pakpattan	13. Malakand
4. Lahore	14. Mohmand
5. Bannu	15. Haripur
6. Hangu	16. Islamabad
7. Orakzai	17. Mansehra
8. Peshawar	18. Shangla
9. Nowshera	19. Lower Dir
10. Charsadda	

N
W E
S

Assignment: Environmental and Social Assessment (ESA)

Project: 6th STG Project (2006-07)

Client: HESCO

Source: Atlas of Pakistan

Title:

Project Location

Ref: GRP07E1-1HES

Date: April 2007

Exhibit 1.2: Projection of Power Demand Growth - Pakistan

Year	Total Demand (MW)
2005-06	15,500
2006-07	16,600
2007-08	17,900
2008-09	19,600
2009-10	21,500

Table borrowed from NEPRA's State of the Industry Report – 2005
(Source: Mid Term Development Framework).

Exhibit 1.3: Population, Income and Electricity Consumption – HESCO

Year	Population (Million)	Per Capita Income (Rs)	Energy Sale (GWh)	Per Capita Energy Consumption (kWh)
2000-01	24.40	18,000	3,722	151
2001-02	24.90	19,440	3,871	153
2002-03	25.42	20,995	4,026	156
2003-04	25.94	22,675	4,187	159
2004-05	26.47	24,489	4,354	162
2005-06	27.02	26,448	4,529	165
2006-07	27.58	28,564	4,710	169
2007-08	28.14	30,849	4,898	172
2008-09	28.72	33,317	5,094	175
2009-10	29.32	35,982	5,298	178

Source: Table-5. PC1 Proforma 6th STG Programme, Sub Transmission Lines and Grid Stations, 2003-04 to 2007-08. HESCO September 2004.

Exhibit 1.4: Historical and Projected Electricity Demand- HESCO

Year	Total Demand (MW)	Growth Rate (%)
2005-06	1,084.80	4.62
2006-07	1,170.87	8.01
2007-08	1,244.07	6.25
2008-09	1,335.85	7.38
2009-10	1,429.84	7.04
2010-11	1,598.97	6.23

Source: Data provided by HESCO.

2 Policy, Legal and Administrative Framework

This Chapter discusses the policy, legal and administrative framework as well as institutional set-up relevant to the environmental and social assessment of the proposed project. Also included in the Chapter are the environmental and social guidelines from the national agencies as well as international donors and other organizations.

2.1 The World Bank Operational Policies

The WB Operating Policies (Ops) relevant to the proposed project are discussed in the following sections.

2.1.1 Environmental Assessment (OP 4.01)

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making.[1] The OP defines the EA process and various types of the EA instruments.

The proposed project consists of activities which have environmental and social consequences, including:

- Damage to assets (such as crops),
- Loss of land,
- Deterioration of air quality,
- Water contamination and consumption,
- Damage to top soil, land erosion,
- Safety hazard.

To identify the extent and consequences of these impacts, and to develop an EMP for their mitigation, an ESA is being carried out, in accordance with this OP.

2.1.2 Involuntary Resettlement (OP 4.12)

The WB's experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or

[1] Excerpts from WB OP 4.12. WB Operational Manual. January 1999.

lost. This policy includes safeguards to address and mitigate these impoverishment risks.[2]

The overall objectives of the Policy are given below.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

The Policy defines the requirement of preparing a resettlement plan or a resettlement policy framework, in order to address the involuntary resettlement.

For the proposed project, land will need to be acquired for the establishment of the new grid stations. During the site/route selection, settlements are generally avoided, however at some places acquisition of cultivable land – though temporary - cannot be avoided.

Similarly, crops along the proposed transmission lines may be damaged during the construction and operation phases of the proposed project.

In view of the above, the OP 4.12 will be triggered, and since the number of affectees is expected to be more than 200, a Resettlement Plan (RP) has been developed in accordance with this OP (the RP is provided under separate cover).

2.1.3 Forestry (OP 4.36)

The objective of this Policy is to assist the WB's borrowers to harness the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.

None of the project components would be located inside any forested areas. Hence the OP 4.36 is not triggered.

2.1.4 Natural Habitat (OP 4.04)

The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank therefore

[2] Excerpts from WB OP 4.12. WB Operational Manual. December 2001.

supports the protection, maintenance, and rehabilitation of natural habitats and their functions ...[3]

All of the proposed project components are located in areas where the natural habitat has already been significantly modified, as a result of human habitation, cultivation and associated activities. Also, no protected areas are known to exist at or in the immediate vicinity of the project sites. Therefore the OP 4.04 is not triggered for the proposed project.

2.1.5 Pest Management (OP 4.09)

Through this OP, the WB supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides.

This OP is not triggered since the proposed project does not involve usage of pesticides. (Usage of the chemical herbicides to clear vegetation under the transmission lines will not be allowed during the proposed project.)

2.1.6 Safety of Dams (OP 4.37)

The Policy seeks to ensure that appropriate measures are taken and sufficient resources provided for the safety of dams the WB finances. However this OP is not relevant since the proposed project does not involve construction of dams.

2.1.7 Projects on International Waterways (OP 7.50)

This OP defines the procedure to be followed for projects the WB finances that are located on any water body that forms a boundary between, or flows through two or more states. However, no project components will be located on any such waterways, hence this OP is not triggered.

2.1.8 Cultural Property (OP 4.11)

The World Bank's general policy regarding cultural properties is to assist in their preservation, and to seek to avoid their elimination. The specific aspects of the Policy are given below.[4]

- The Bank normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed so as to prevent such damage.
- The Bank will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. In some cases, the project is best relocated in order that sites and structures can be preserved, studied, and restored intact in situ. In other cases, structures can be relocated, preserved, studied, and restored on alternate sites. Often, scientific study, selective salvage, and museum preservation before destruction is all that is necessary. Most such projects should include the training and strengthening of

[3] Excerpts from WB OP 4.04. WB Operational Manual. June 2001.
[4] Excerpts from the OPN 11.03. WB Operational Manual. September 1986.

institutions entrusted with safeguarding a nation's cultural patrimony. Such activities should be directly included in the scope of the project, rather than being postponed for some possible future action, and the costs are to be internalized in computing overall project costs.

- Deviations from this policy may be justified only where expected project benefits are great, and the loss of or damage to cultural property is judged by competent authorities to be unavoidable, minor, or otherwise acceptable. Specific details of the justification should be discussed in project documents.
- This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is itself financing the part of the project that may affect cultural property.

During the present ESA, no site of historical, cultural or archaeological importance was found to be affected by the project. Hence OP 4.11 is not triggered.

However, in case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance during the project execution, the work will be stopped at that site. The cultural property will be protected from damage, the provincial and federal archeological departments will be notified immediately, and their advice sought prior to resumption of any further construction activities in these sites.

2.1.9 Indigenous People (OP 4.10)

For purposes of this policy, the term "Indigenous Peoples" is used in a generic sense to refer to a distinct, vulnerable, social and cultural group possessing the following characteristics in varying degrees:[5]

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- an indigenous language, often different from the official language of the country or region.

The OP defines the process to be followed if the project affects the indigenous people.

During the ESA, no indigenous people - with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process - were found in the areas where different project components would be located. Therefore this OP is not triggered.

[5] Excerpts from the OP 4.10. WB Operational Manual. July 2005.

However if such groups are identified during the project implementation, the proponents will develop an Indigenous People Development Plan, in compliance with the OP and get it approved by the Bank.

2.1.10 Projects in Disputed Areas (OP 7.60)

Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. In order not to prejudice the position of either the Bank or the countries concerned, any dispute over an area in which a proposed project is located is dealt with at the earliest possible stage.

The Bank may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed for country A should go forward without prejudice to the claims of country B. [6]

HESCO territory does not fall in any of the disputed areas. Hence this OP is not triggered.

2.1.11 Disclosure of Project Document

Whenever the Bank requires an environmental assessment (EA), the proposed borrower prepares an EA report as a separate, free-standing document. The EA report is publicly available (a) after the borrower has made the draft EA report available at a public place accessible to project-affected groups and local NGOs in accordance with OP/BP 4.01, *Environmental Assessment,* and (b) after such EA report has been officially received by the Bank, but before the Bank begins formal appraisal of the project. [7] In line with Policy (and the requirements of the national law –discussed later in the Chapter), HESCO will disclose this ESA to all the stakeholders before the commencement of the proposed project. The ESA report will be made available to the stakeholders. In addition, the executive summary of the ESA will be translated into Urdu language, and made available to the affected communities (and also kept at the project sites). In addition, the Executive Summary of the ESA will be disclosed through the HESCO's official website.

2.1.12 Applicability of Safeguard Policies

Applicability of the WB safeguard policies – on the basis of the discussion in **Sections 2.2.1** to **2.1.10** above - with respect to the environmental and social issues associated with the proposed project is summarized below.

Operational Policy	Triggered
Environmental Assessment (OP 4.01)	Yes
Involuntary Resettlement (OP 4.12)	Yes
Forestry (OP 4.36)	No

[6] Excerpts from the OP 7.60. WB Operational Manual. November 1994.
[7] Excerpts from the World Bank Policy on Disclosure of Information. June 2002.

Operational Policy	Triggered
Natural Habitat (OP 4.04)	No
Pest Management (OP 4.09)	No
Safety of Dams (OP 4.37)	No
Projects in International Waters (OP 7.50)	No
Cultural Property (OP 4.11)	No
Indigenous People (OP 4.10)	No
Projects in Disputed Area (7.60)	No
Disclosure of Project Information	Yes

2.2 Laws and Regulations

Pakistan's statute books contain a number of laws concerned with the regulation and control of the environmental and social aspects. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is a relatively new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific. The laws relevant to the developmental projects are briefly reviewed below.

2.2.1 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (the Act) is the basic legislative tool empowering the government to frame regulations for the protection of the environment (*the 'environment' has been defined in the Act as: (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relaticnships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the inter-relationships between any of the factors specified in sub-clauses 'a' to 'f'*). The Act is applicable to a broad range of issues and extends to socioeconomic aspects, land acquisition, air, water, soil, marine and noise pollution, as well as the handling of hazardous waste. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the National Environmental Quality Standards (NEQS) specified by the Pakistan Environmental Protection Agency (Pak-EPA) has been prohibited under the Act, and penalties have been prescribed for those contravening the provisions of the Act. The powers of the federal and provincial Environmental Protection Agencies (EPAs), established under the Pakistan Environmental Protection Ordinance 1983,[8] have also been considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint.

[8] Superseded by the Pakistan Environmental Protection Act, 1997.

The requirement for environmental assessment is laid out in Section 12 (1) of the Act. Under this section, no project involving construction activities or any change in the physical environment can be undertaken unless an initial environmental examination (IEE) or an environmental impact assessment (EIA) is conducted, and approval is received from the federal or relevant provincial EPA. Section 12 (6) of the Act states that this provision is applicable only to such categories of projects as may be prescribed. The categories are defined in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 and are discussed in **Section 2.2.2** below.

The requirement of conducting an environmental assessment of the proposed project emanates from this Act.

2.2.2 Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000[9] (the 'Regulations'), developed by the Pak-EPA under the powers conferred upon it by the Act, provide the necessary details on preparation, submission and review of the IEE and the EIA. Categorization of projects for IEE and EIA is one of the main components of the Regulations. Projects have been classified on the basis of expected degree of adverse environmental impacts. Project types listed in Schedule I are designated as potentially less damaging to the environment, and those listed in Schedule II as having potentially serious adverse effects. Schedule I projects require an IEE to be conducted, provided they are not located in environmentally sensitive areas. For the Schedule II projects, conducting an EIA is necessary.

The proposed project falls under the Schedule II of the Regulations, hence an EIA has to be conducted for it. The present ESA will be considered equivalent to the EIA of the proposed project, since its scope, structure and extent comply with the relevant guidelines issued by the Pak-EPA (the guidelines are further discussed below).

2.2.3 National and International Environmental Standards

National Standards

The National Environmental Quality Standards (NEQS), promulgated under the PEPA 1997, specify the following standards:

- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources,
- Maximum permissible limits for motor vehicle exhaust and noise,
- For power plants operating on oil and coal:
  - Maximum allowable emission of sulfur dioxide,
  - Maximum allowable increment in concentration of sulfur dioxide in ambient air,
  - Maximum allowable concentration of nitrogen oxides in ambient air, and

[9] S.R.O. 339 (1)/2001. Pakistan Environmental Protection Agency, Islamabad. 2000.

- ► Maximum allowable emission of nitrogen oxide for steam generators as function of heat input.

- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment and sea (three separate set of numbers).

Selected NEQS for liquid effluents discharged to inland waters, gaseous emission from industrial sources and emissions from motor vehicles are provided in **Exhibits 2.1, 2.2** and **2.3**, respectively. These standards will be applicable to the gaseous emissions and liquid effluents discharged to the environment from the proposed project.

International Standards

The NEQS do not cover the ambient air quality or water quality standards. The international standards for ambient air quality and drinking water quality are presented in **Exhibits 2.4** and **2.5**, respectively.

For noise, the NEQS are limited to the vehicular noise. For noise generated by other sources, the WB standards are usually applied. The allowable noise limits per these standards are 55 dB(A) for daytime and 45 dB(A) for nighttime, measured at the receptor.

2.2.4 Land Acquisition Act, 1894

The Land Acquisition Act (LAA) of 1894 amended from time to time has been the de-facto policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

WAPDA has been acquiring land for the grid stations under the provisions of this Act. For the proposed project as well, HESCO plans to use this Act to acquire land for the new grid stations. However, the Urgency/Emergency Clause (Section 17) will not be used, in the absence of an urgency or emergency. This Clause does not allow appeals or recourse in case of dispute on the land price.

2.2.5 National Resettlement Policy / Ordinance

The Ministry of Environment, Local Government and Rural Development formulated a draft policy in 2004 on involuntary resettlement with technical assistance from ADB. The policy aims to compensate for the loss of income to those who suffer loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pasture, water rights, public infrastructure like mosques, shrines, schools and graveyards.

The government has also developed a document entitled "*Project Implementation and Resettlement of the Affected Persons Ordinance, 2002*", later referred to as the "*Resettlement Ordinance*", for enactment by provincial and local governments, after incorporating local requirements. The Ordinance, being a new law, shall be supplementary to the LAA as well as other laws of Pakistan, and wherever applicable

under this policy. However, if necessary, appropriate amendments to the LAA 1894 will also be proposed to facilitate the application of the Resettlement Ordinance.

There has not been much progress on the enactment of the Resettlement Ordinance; hence this is not relevant for the proposed project.

2.2.6 Telegraph Act, 1885

This law was enacted to define the authority and responsibility of the Telegraph authority. The law covers, among other activities, installation and maintenance of telegraph lines and posts (poles). The Act defines the mechanism to determine and make payment of compensation associated with the installation of these lines and posts.

Under this Act, the land required for the poles is not acquired (or purchased) from the owner, nor the title of the land transferred. Compensation is paid to the owner for any structure, crop or tree that exists on the land; cost of the land is not paid to the owner.

WAPDA has been installing the transmission lines and towers, and determining the associated compensation, on the basis of this Act. For the proposed project as well, HESCO will use this Act. However, the land under the towers will be acquired and compensated if there is loss of access, and productive use of the land by the landowners/affectees is impacted.

2.2.7 Sindh Wildlife Protection Act, 1972

This law was enacted to protect the province's wildlife resources directly and other natural resources indirectly. It classifies wildlife by degree of protection, ie, animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Act specifies restrictions on hunting and trade in animals, trophies, or meat. The Act also defines various categories of wildlife protected areas, ie, National Parks, Wildlife Sanctuaries and Game Reserve.

This Act will be applicable to the construction as well as operation and maintenance (O&M) activities of the proposed project.

2.2.8 Forest Act, 1927

The Act authorizes Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set fire in the forest, quarries stone, removes any forest-produce or cause any damage to the forest by cutting trees or clearing up area for cultivation or any other purpose.

This Act will be applicable to the construction as well as O&M activities of the proposed project.

2.2.9 Canal and Drainage Act, 1873

The Canal and Drainage Act (1873) prohibits corruption or fouling of water in canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage. This Act will be applicable to the construction and O&M works to be carried out during the proposed project.

2.2.10 The Sindh Irrigation Act, 1879

This Act has relevance to the study due to the presence of the extensive irrigation network in the project area. This Act covers the construction, maintenance and regulation of canals for the supply of water and for the levy of rates of water supplied in the Sindh. In this Act "canal" includes channels, pipes and reservoirs constructed and maintained by the Government for the supply for storage of water. Under section 27 of the Act a person desiring to have a supply of water from a canal for purposes other than irrigation shall submit a written application to a Canal Officer who may, with the sanction of the Provincial Government give permission under special conditions. The Act also prohibits the damaging, altering, enlarging or obstructing the canals without proper authority.

This Act will be applicable to the construction as well as O&M activities of the proposed project.

2.2.11 Provincial Local Government Ordinances, 2001

These ordinances were issued under the devolution process and define the roles of the district governments. These ordinances also address the land use, conservation of natural vegetation, air, water and land pollution, disposal of solid waste and wastewater effluents, as well as matters relating to public health.

2.2.12 Antiquity Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The Act is designed to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archeological significance.

Under this Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity, and
- If during the course of the project an archeological discovery is made, it should be protected and reported to the Department of Archeology, Government of Pakistan, for further action.

This Act will be applicable to the construction as well as O&M activities of the proposed project.

2.2.13 Mines, Oil Fields and Mineral Development Act, 1948

This legislation provides procedures for quarrying and mining of construction material from state-owned as well as private land. These procedures will have to be followed during the proposed project.

2.2.14 Factories Act, 1934

The clauses relevant to the HESCO's proposed project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous substances. The Pakistan Environmental Protection Act of 1997 (discussed above), supersedes parts of this Act pertaining to environment and environmental degradation.

2.2.15 Pakistan Explosive Act, 1884

This Act provides regulations for the handling, transportation and use of explosives during quarrying, blasting and other purposes. The transmission line tower installation sometimes needs blasting at rocky/mountainous areas, however for the HESCO's proposed project, no such blasting is envisaged.

2.2.16 Employment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others).

HESCO and its contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

2.2.17 Pakistan Penal Code, 1860

The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

2.3 Obligations under International Treaties

Pakistan is signatory of several Multilateral Environmental Agreements (MEAs), including:

- Basel Convention,
- Convention on Biological Diversity, Convention on Wetlands (Ramsar),
- Convention on International Trade in Endangered Species (CITES),
- UN Framework Convention on Climate Change (UNFCCC),

- Kyoto Protocol,
- Montreal Protocol,
- UN Convention to Combat Desertification,
- Convention for the Prevention of Pollution from Ships (MARPOL),
- UN Convention on the Law of Seas (LOS),
- Stockholm Convention on Persistent Organic Pollutants (POPs),
- Cartina Protocol.

These MEAs impose requirements and restrictions of varying degrees upon the member countries, in order to meet the objectives of these agreements. However, the implementation mechanism for most of these MEAs is weak in Pakistan and institutional setup non existent.

In order to address this state of affairs, the GoP has recently approved a PC1 for the establishment of the National MEA Secretariat under the Ministry of Environment in Islamabad. The Secretariat will handle and coordinate activities, and develop action plans for each MEA vis-à-vis the country's obligation under these agreements. The Secretariat will then be responsible to ensure implementation of these action plans. The Secretariat will also evaluate future MEAs and advise the Government for acceding (or otherwise) these agreements.

For the proposed project, the Stockholm Convention has the direct relevance. The Convention addresses the eradication of the persistent organic pollutants (POPs). The transformer oil used to contain poly-chlorinated biphenyl PCB), which is one of the POPs. Though now its usage has been abandoned, old transformers in Pakistan still contain oil containing PCB (this issue is further discussed in **Chapters 6** and **8** of this report).

2.4 Institutional Setup for Environmental Management

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals.

The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports (IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise).

The proposed projects would be located in the Sindh Province. Hence this ESA report will be sent to the Sindh EPA for review.

2.5 Environmental and Social Guidelines

Two sets of guidelines, the Pak-EPA's guidelines and the World Bank Environmental Guidelines are reviewed here. These guidelines address the environmental as well as social aspects relevant to the proposed project.

2.5.1 Environmental Protection Agency's Environmental and Social Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below.

- Guidelines for the Preparation and Review of Environmental Reports,
- Guidelines for Public Consultation,
- Guidelines for Sensitive and Critical Areas,
- Sectoral Guidelines.

It is stated in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency Environmental Guidelines.

2.5.2 World Bank Environmental and Social Guidelines

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

- Pollution Prevention and Abatement Handbook 1998: Towards Cleaner Production
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues.
- Social Analysis Sourcebook.
- All environmental and social safeguard operational policies.

Exhibit 2.1: Selected NEQS for Waste Effluents

Parameter	Unit	Standards (maximum allowable limit)
Temperature increase	°C	< 3
pH value (acidity/basicity)	pH	6-9
5-day biochemical oxygen demand (BOD) at 20 °C	mg/l	80
Chemical oxygen demand (COD)	mg/l	150
Total suspended solids	mg/l	200
Total dissolved solids	mg/l	3,500
Grease and oil	mg/l	10
Phenolic compounds (as phenol)	mg/l	0.1
Chloride (as Cl)	mg/l	1,000
Fluoride (as F)	mg/l	10
Sulfate (SO_4)	mg/l	600
Sulfide (S)	mg/l	1.0
Ammonia (NH_3)	mg/l	40
Cadmium	mg/l	0.1
Chromium (trivalent and hexavalent)	mg/l	1.0
Copper	mg/l	1.0
Lead	mg/l	0.5
Mercury	mg/l	0.01
Selenium	mg/l	0.5
Nickel	mg/l	1.0
Silver	mg/l	1.0
Total toxic metals	mg/l	2.0
Zinc	mg/l	5
Arsenic	mg/l	1.0
Barium	mg/l	1.5
Iron	mg/l	8.0
Manganese	mg/l	1.5
Boron	mg/l	6.0
Chlorine	mg/l	1.0

Source: Government of Pakistan (2000).

Notes:

1. The standard assumes that dilution of 1:10 on discharge is available. That is, for each cubic meter of treated effluent, the recipient water body should have 10 m^3 of water for dilution of this effluent.
2. Toxic metals include cadmium, chromium, copper, lead, mercury, selenium, nickel and silver. The effluent should meet the individual standards for these metals as well as the standard for total toxic metal concentration.

Exhibit 2.2: NEQS for Industrial Gaseous Emissions

mg/Nm^3 unless otherwise stated

Parameter	Source of Emission	Standards (maximum allowable limit)
Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale or equivalent smoke number
Particulate matter [1]	(a) Boilers and furnaces: i. Oil fired ii. Coal fired iii. Cement Kilns	 300 500 300
	(b) Grinding, crushing, clinker coolers and related processes, metallurgical processes, converters, blast furnaces and cupolas	500
Hydrogen Chloride	Any	400
Chlorine	Any	150
Hydrogen fluoride	Any	150
Hydrogen sulphide	Any	10
Sulphur Oxides [2, 3]	Sulfuric acid/Sulphonic acid plants	5,000
	Other Plants except power Plants operating on oil and coal	1,700
Carbon Monoxide	Any	800
Lead	Any	50
Mercury	Any	10
Cadmium	Any	20
Arsenic	Any	20
Copper	Any	50
Antimony	Any	20
Zinc	Any	200
Oxides of Nitrogen [3]	Nitric acid manufacturing unit	3,000
	Other plants except power plants operating on oil or coal: i. Gas fired ii. Oil fired iii. Coal fired	 400 600 1,200

Source: Government of Pakistan (2000).

Explanations:

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1% sulphur content in fuel oil. Higher content of sulphur will cause standards to be pro-rated.
3. In respect of emissions of sulphur dioxide and nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to NEQS specified above, comply with the standards provided separately.

Exhibit 2.3: NEQS for Motor Vehicles Exhaust and Noise

Parameter	Standards (maximum permissible limit)	Measuring Method
Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.	To be compared with Ringlemann Chart at a distance of 6 meters or more.
Carbon Monoxide.	New Vehicle = 4.5% Used Vehicle = 6%	Under idling conditions: non-dispersive infrared detection through gas analyzer.
Noise	85 db(A)	Sound meter at 7.5 meter from the source.

Source: Government of Pakistan (2000).

Exhibit 2.4: WHO Ambient Air Quality Standards

Pollutant	Maximum Allowable Limit	Units	Averaging Time
CO	35	ppm	1 hour
NO_X	106	ppb	1 hour
SO_2	134	ppb	1 hour
PM_{10}	70	$\mu g/m^3$	24 hours

Source: World Health Organization.

Exhibit 2.5: WHO Drinking Water Quality Standards

Element/ Substance	Symbol/ Formula	Normally Found in Freshwater/Surface Water/Groundwater	Health Based WHO Guideline
Aluminium	Al		0.2 mg/l
Ammonia	NH_4	< 0.2 mg/l (up to 0.3 mg/l in anaerobic waters)	No guideline
Antimony	Sb	< 4 µg/l	0.005 mg/l
Arsenic	As		0.01 mg/l
Asbestos			No guideline
Barium	Ba		0.3 mg/l
Berillium	Be	< 1 µg/l	No guideline
Boron	B	< 1 mg/l	0.3 mg/l
Cadmium	Cd	< 1 µg/l	0.003 mg/l
Chloride	Cl		250 mg/l
Chromium	Cr^{+3}, Cr^{+6}	< 2 µg/l	0.05 mg/l
Colour			Not mentioned
Copper	Cu		2 mg/l
Cyanide	CN^-		0.07 mg/l
Dissolved oxygen	O_2		No guideline
Fluoride	F	< 1.5 mg/l (up to 10)	1.5 mg/l
Hardness	mg/l $CaCO_3$		No guideline
Hydrogen sulfide	H_2S		No guideline
Iron	Fe	0.5 - 50 mg/l	No guideline
Lead	Pb		0.01 mg/l
Manganese	Mn		0.5 mg/l
Mercury	Hg	< 0.5 µg/l	0.001 mg/l
Molybdenum	Mb	< 0.01 mg/l	0.07 mg/l
Nickel	Ni	< 0.02 mg/l	0.02 mg/l
Nitrate and nitrite	NO_3, NO_2		50 mg/l total nitrogen
Turbidity			Not mentioned
pH			No guideline
Selenium	Se	< < 0.01 mg/l	0.01 mg/l
Silver	Ag	5 – 50 µg/l	No guideline
Sodium	Na	< 20 mg/l	200 mg/l
Sulfate	SO_4		500 mg/l
Inorganic tin	Sn		No guideline
TDS			No guideline
Uranium	U		1.4 mg/l
Zinc	Zn		3 mg/l

Source: World Health Organization, 1993.

3 Project Description

This Chapter provides a simplified description of various components of the proposed project and their salient features, location, and phases.

3.1 HESCO's Existing System

HESCO is one of the eight DISCOs which have been established as a result of WAPDA's restructuring. The key technical data of the HESCO's system is provided in **Exhibit 3.1**.

3.1.1 HESCO Area

The area within the HESCO network comprises the following districts of the Sindh province:

- Jacobabad, [1]
- Sukkur,
- Shikarpur,
- Larkana,
- Nawabshah,
- Khairpur,
- Ghotki,
- Dadu,
- Tando Allahyar
- Matiari
- Kashmore
- Naushahro Feroze,
- Hyderabad, [2]
- Badin,
- Sanghar,
- Umerkot,
- Tharparkar,
- Thatta, [3]
- Mirpur Khas.
- Tando Mohammad Khan
- Jamshoro
- Qamber.

Exhibit 3.2 presents a map of the HESCO system.

The total population in this area is about 28 million[4]. The major urban centers of the area include Hyderabad, Sukkur, Larkana, Mirpur Khas, Shikarpur and Nawabshah.

3.1.2 Transmission Lines

The HESCO system comprises of one-hundred-and-four 132-KV and forty-one 66-KV transmission lines. A list of these transmission lines is provided in **Exhibit 3.3**.

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[1] Jacobabad has recently been subdivided to carve out a new district.
[2] Hyderabad has recently been subdivided to carve out new districts.
[3] Parts of the Thatta district are covered by Karachi Electric Supply Company (KESC).
[4] Source: Table-5. PC1 Proforma 6th STG Programme, Sub Transmission Lines and Grid Stations, 2003-04 to 2007-08. HESCO September 2004.

3.1.3 Grid Stations

There are seventy-nine 132-KV and thirty-eight 66 KV grid stations within the HESCO system; a list of these grid stations is provided in **Exhibit 3.4**.

3.2 Project Objectives

The overarching objective of the 6th STG project is to increase the efficiency, reliability and quality of the electricity supply. The project aims to achieve:

- Strengthening of electricity transmission network to reduce bottlenecks and improve system reliability and quality
- Strengthening of electricity distribution network to reduce losses and improvement in supply.

This will be achieved by adding new grid stations, upgrading/augmenting/converting the existing ones and adding new transmission lines.

3.3 Project Components

In its total span of five years, the 6th STG project envisages establishment of fifteen new grid stations, in addition to converting seven, augmenting nineteen, rehabilitating fifty-six, and extending another fifty-six of the existing grid stations. The project also includes laying of 451 km of new and rehabilitation of 2,980 km of existing transmission lines.

The present ESA addresses the project components which will be undertaken during the Year 2006-07. These components and their salient information are tabulated below.

Project Component	Features
New Grid Stations	
1. Bukhshapur	132 KV grid station; 1 x 10 MVA transformer 2 x 11 KV feeders
2. Larkana-III	132 KV grid station; 1 x 10 MVA transformer 4 x 11 KV feeders
3. Chamber	132 KV grid station; 1 x 10 MVA transformer 3 x 11 KV feeders
4. Tando Bago	66 KV grid station; 1 x 10 MVA transformer 4 x 11 KV feeders
Conversion of Existing Grid Stations (66 KV to 132 KV)	
5. Matiari	132 KV grid station; 1 x 10 MVA transformer
6. Kandiari	132 KV grid station; 1 x 10 MVA transformer

Project Component	Features
7. Samaro	132 KV grid station; 1 x 10 MVA transformer
8. Naukot	132 KV grid station; 1 x 10 MVA transformer
Extension of Existing Grid Stations	
9. Nooriabad	132 KV grid station; 1 x Transformer Bay
New Transmission Lines	
10. Feed for the proposed Bukhshapur Grid Station (In/Out from Kandhkot – Kashmore transmission line)	Length: 0.05 km
11. Feed for the proposed Tando Bago Grid Station (Tee-off from Badin – Pangrio transmission line)	Length: 3.57 km
12. Feed for the proposed Larkana-III Grid Station (Tee-off from Larkana – Naseerabad transmission line)	Length: 6.78 km
13. Feed for Kandiari Grid Station (In/Out from Sanghar – Mirpur Khas transmission line)	Length: 1.87 km
14. Feed for Matiari Grid Station (In/Out from Hala Road – Hala transmission line)	Length: 0.82 km
15. Humayun – Jacobabad transmission line	Length: 20.98 km
16. Samaro – Naukot transmission line	Length: 55.96 km
17. Feed for the proposed Chamber Grid Station (Transmission line from Tando Allahyar Grid Station to Chamber).	Length: 27.09 km

The above components are shown in **Exhibit 3.5** and described in the following sections.

3.3.1 Bukhshapur Grid Station

Bukhshapur – a small town on the Indus Highway in Jacobabad district – and its surrounding areas are currently been supplied electricity from two grid stations at Kandhkot and Kashmore. Owing to the fact that this area is far away from these grid stations, the 11-KV feeders in the area are lengthy and fully loaded. As a result, the distribution network in the area experiences low-voltage and frequent power outages. Also, the existing feeders have limited provision for any future load growth.

In order to address the above problems, and in view of the anticipated load growth, a new 132-KV grid station has been planned at Bukhshapur. This will result in the reduced losses associated with low-voltage on the existing feeders, fewer power outages and improved voltage profile, while also catering to the future load growth in the area. Furthermore, the proposed Bukhshapur grid station will provide relief to the existing grid stations at Kashmore and Kandhkot, thus enabling them to absorb additional load.

The new grid station will be fed from the 132-KV Kandhkot – Kashmore transmission line, which runs close to the proposed site for the new grid station.

The new grid station will have one power transformer, having a capacity of 10 MVA. Initially, two of the existing 11-KV feeders from the Kandhkot and Kashmore grid stations will be shifted to the new grid station. Additional feeders will be added as and when new consumers are connected to the system.

About 4 acres of land is usually required for the grid station of this size. The land currently being considered for this purpose is located just outside the Bukhshapur town, about a kilometer from the Indus Highway. The land is currently under cultivation and is privately owned. HESCO plans to acquire the land under the Land Acquisition Act, on the basis of 'willing buyer – willing seller', at market prices, with consensus on prices, and the landowner to have the option to refuse to sell the land.

3.3.2 Larkana-III Grid Station

The southern parts of Larkana City and the surrounding settlements are currently being fed by the Larkana-I and Larkana-II grid stations. The electricity demand in the area is increasing because of the increasing population. The 11-KV feeders in the area are lengthy and fully loaded. As a result, the distribution network in the area experiences low-voltage and frequent power outages.

In order to address the above problems, and in view of the anticipated load growth, a new 132-KV grid station south of the Larkana City has been planned. This will result in the reduced losses associated with low-voltage on the existing feeders, fewer power outages and improved voltage profile, while also catering to the future load growth in the area. In addition, the new grid station will also relieve the existing grid stations (Larkana-I and Larkana-II), thus allowing additional load to be absorbed by these grid stations.

The proposed grid station will be fed from the existing Larkana – Naseerabad transmission line through a new 7-km long transmission line (further discussed later in the Chapter).

The new grid station will have a transformer having a capacity of 10 MVA. Initially, four existing 11-KV feeders from the Larkana-I and Larkana-II grid stations will be shifted to the new grid station. Additional feeders will be added as and when new consumers are connected to the system.

About 4 acres of land is usually required for the grid station of this size. HESCO is looking for a suitable tract of land near the road leading to Baqrani, south of Larkana. The land is currently under cultivation and is privately owned. HESCO plans to acquire the land under the Land Acquisition Act, on the basis of 'willing buyer – willing seller', at market prices, with consensus on prices, and the landowner to have the option to refuse to sell the land.

3.3.3 Chamber Grid Station

Chamber (a small town south of Tando Allahyar) and its surrounding areas are currently being fed from Tando Jam and Tando Allahyar grid stations. Owing to the large distances and increasing electricity demand, the 11-KV feeders in the area are lengthy

and fully loaded. As a result, the distribution network in the area experiences low-voltage and frequent power outages, with little provision for further expansion.

In order to address the above problems, and in view of the anticipated load growth, a new 132-KV grid station at Chamber has been planned. This will result in the reduced losses associated with low-voltage on the existing feeders, fewer power outages and improved voltage profile, while also catering to the future load growth in the area. In addition, the new grid station will also relieve the existing grid stations (Tando Jam and Tando Allahyar), thus allowing additional load to be absorbed by these grid stations.

The proposed grid station will be fed from the 132-KV Tando Allahyar grid station, which is about 21 km north of the proposed site. A new 132-KV transmission line will be constructed for this purpose (further discussed later in the Chapter).

The new grid station will have one transformer having a capacity of 10 MVA. Initially, three existing 11-KV feeders from the Tando Allahyar and Tando Jam grid stations will be shifted to the new grid station. Additional feeders will be added as and when new consumers are connected to the system.

The land currently being considered for this grid station is located just east of the Chamber town. The land is currently under cultivation and is privately owned. The landowner intends to donate the land to HESCO for the proposed grid station. It will be ensure that all land transfer procedures are completed and the land title is transferred to HESCO.

3.3.4 Tando Bago Grid Station

Tando Bago and its surrounding areas are currently being fed from the Talhar, Pangrio and Badin grid stations. Owing to the large distances and increasing electricity demand, the existing distribution system in the area is already overloaded and can hardly meet the prevailing electricity demand. Long feeders also result in high energy losses and frequent power outages, and also have little provision for any load expansion.

In order to address the above problems, and in view of the anticipated load growth, a new 66-KV grid station has been planned at Tando Bago. This will result in the reduced losses associated with low-voltage on the existing feeders, fewer power outages and improved voltage profile, while also catering to the future load growth in the area. In addition, the new grid station will also relieve the existing grid stations (Talhar, Pangrio and Badin), thus allowing additional load to be absorbed by these grid stations.

The proposed grid station will be fed from the existing 66-KV Badin - Pangrio transmission line, which is passing at a distance of about 4 km from the proposed grid station site.

The new grid station will have one transformer having a capacity of 10 MVA. Initially, four 11-KV feeders from the Talhar, Pangrio and Badin grid stations will be shifted to the new grid station. Additional feeders will be added as and when new consumers are connected to the system.

The land currently being considered for this purpose is located along the Tando Bago – Badin road just outside the Tando Bago town. The land is currently under cultivation and

is privately owned. HESCO plans to acquire the land under the Land Acquisition Act, on the basis of 'willing buyer – willing seller', at market prices, with consensus on prices, and the landowner to have the option to refuse to sell the land.

3.3.5 Conversion of Matiari Grid Station

The existing Matiari grid station is currently on the 66-KV system. The grid station is currently fed from the 220/132/66-KV, 40 MVA power transformer installed at the 220-KV Hala Road grid station through a 25-km long transmission line. This transmission line is very old and is in deteriorated condition, thus causing technical losses and voltage drop. The 11-KV feeders in the area are also overloaded, and there is little provision for any future load growth. Maintaining the desired voltage levels is also a problem. Most importantly, the 66-KV system is fast becoming obsolete, and obtaining spares and replacements is becoming more and more difficult.

In view of the above situation, conversion of the 66-KV system to the 132-KV system has been envisaged. The conversion will help improve the system parameters, while meeting the growing demand of the electricity in the area. In addition, the grid station will be connected to the national grid.

The upgraded grid station will have one transformer having a capacity of 10 MVA. The grid station will be fed through approximately one kilometer long transmission line which will be connected to the Hala Road – Hala transmission line (further discussed below).

For the proposed conversion, enough space is available in the existing grid station, and HESCO will not need to acquire additional land for this purpose.

3.3.6 Conversion of Kandiari Grid Station

The existing Kandiari grid station is currently on the 66-KV system. The grid station is fed from the 132/66-KV, 7.5 MVA power transformer installed at the 132-KV Sanghar grid station through a 44-km long transmission line. This transmission line is very old and is in deteriorated condition, thus causing technical losses and voltage drop. The existing power transformer as well as the 11-KV feeders are fully loaded, and the system cannot cater to any additional load. Maintaining the desired voltage levels is also a problem. Most importantly, the 66-KV system is fast becoming obsolete, and obtaining spares and replacements is becoming more and more difficult.

In view of the above situation, conversion of the 66-KV system to the 132-KV system has been envisaged. The conversion will help improve the system parameters, while meeting the growing demand of the electricity in the area. In addition, the grid station will be connected to the national grid.

The upgraded grid station will have one transformer having a capacity of 10 MVA. The grid station will be fed through the 132-KV Sanghar – Mirpur Khas transmission line.

The grid station has ample space for the new transformer and associated equipment. Therefore no additional land will need to be acquired for the conversion.

3.3.7 Conversion of Samaro Grid Station

The existing grid station is currently energized at 132-KV. The existing 66/11-KV power transformer of 10/13 MVA capacity is fed from the 132/66-KV 40 MVA power transformer installed at the Samaro grid station. The existing power transformer at the grid station, as well as the 11-KV feeders originating from it, are fully loaded, and the system cannot cater to any additional load. Maintaining the desired voltage levels is also a problem. Most importantly, the 66-KV system is fast becoming obsolete, and obtaining spares and replacements is becoming more and more difficult.

In view of the above situation, conversion of the 66-KV system to the 132-KV system has been envisaged. The conversion will help improve the system parameters, while meeting the growing demand of the electricity in the area.

The upgraded grid station will have one 132/11-KV transformer (replacing the existing 132/66-KV and 66/11-KV transformers) having a capacity of 10 MVA. The grid station is already connected to the 132-KV system, hence there is no need for any new transmission line as part of the grid station conversion.

The grid station has ample space for the new transformer and associated equipment. Therefore no additional land will need to be acquired for the conversion.

3.3.8 Conversion of Naukot Grid Station

Currently, the Naukot grid station is connected with the 66-KV system. The grid station is fed from the 132/66-KV, 40 MVA power transformer installed at the 132-KV Samaro grid station through a 45-km long transmission line. The existing transmission line is very old and is in deteriorated condition, thus causing technical losses and voltage drop. The existing power transformer as well as the 11-KV feeders are fully loaded, and the system cannot cater to any additional load. Maintaining the desired voltage levels is also a problem. Most importantly, the 66-KV system is fast becoming obsolete, and obtaining spares and replacements is becoming more and more difficult.

In view of the above situation, conversion of the 66-KV system to the 132-KV system has been envisaged. The conversion will help improve the system parameters, while meeting the growing demand of the electricity in the area. In addition, the grid station will be connected to the national grid.

The upgraded grid station will have one transformer having a capacity of 10 MVA. A new 132-KV transmission line will be constructed from the Samaro grid station (discussed later) to feed the proposed power transformer at the converted Naukot grid station.

The grid station has ample space for the new transformer and associated equipment. Therefore no additional land will need to be acquired for the conversion.

3.3.9 Extension of Nooriabad Grid Station

Currently, the Nooriabad grid station has one 132-KV – 11-KV transformer of 10 MVA capacity. Several new factories are coming up in the area, and the existing power transformer at the grid station does not have enough extra capacity. Therefore, another transformer of 10 MVA capacity is proposed to be added at this grid station.

The grid station has ample space for the new transformer bay and associated equipment. Therefore no additional land will need to be acquired for the extension of the grid station.

3.3.10 Transmission Line to Feed Bukhshapur Grid Station

The Bukhshapur grid station is proposed to be established as part of the 6th STG project (see **Section 3.3.1**). The grid station will be fed from the Kashmore – Kandhkot transmission line, which passes very close to the proposed site for the new grid station. A double circuit transmission line will be constructed for the in-out arrangement from the above mentioned transmission line. The length of the proposed transmission line is expected to be about 50 m.

3.3.11 Transmission Line to Feed Larkana-III Grid Station

This 132-KV transmission line will provide feed to the new Larkana-III grid station which will be established as part of the HESCO's 6th STG project (see **Section 3.3.2**). The proposed transmission line will start from the existing Larkana - Nseerabad transmission line, and will have a total length of about 7 km.

Single circuit transmission line will be constructed on the double circuit towers. For the proposed length of 7 km, about 30 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.12 Transmission Line to Feed Chamber Grid Station

This 132-KV transmission line will provide feed to the new Chamber grid station which will be established as part of the HESCO's 6th STG project (see **Section 3.3.3**). The proposed transmission line will start from the existing 132-KV Tando Allahyar grid station, and will have a total length of about 27 km.

Single circuit transmission line will be constructed on the double circuit towers. For the proposed length of 27 km, about 100-105 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.13 Transmission Line to Feed Tando Bago Grid Station

This 66-KV transmission line will provide feed to the new Tando Bago grid station which will be established as part of the HESCO's 6th STG project (see **Section 3.3.4**). The proposed transmission line will start from the existing 66-KV Pangrio-Badin transmission line, and will have a total length of about 4 km.

A single circuit transmission line will be constructed to provide the feed. For the proposed length of 4 km, about 13-14 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.14 Transmission Line to Feed Matiari Grid Station

This 132-KV transmission line will provide feed to the existing Matiari grid station which will be converted to the 132-KV system as part of the HESCO's 6th STG project (see **Section 3.3.5**). The proposed transmission line will start from the existing 132-KV Hala Road – Hala transmission line, and will have a total length of about 1 km.

A double circuit transmission line will be constructed on the double circuit towers for the in/out arrangement. For the proposed length of 1 km, about 3-4 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.15 Transmission Line to Feed Kandiari Grid Station

This 132-KV transmission line will provide feed to the existing Kandiari grid station which will be converted to the 132-KV system as part of the HESCO's 6th STG project (see **Section 3.3.6**). The proposed transmission line will start from the existing 132-KV Sanghar – Mirpur Khas transmission line, and will have a total length of about 2 km.

A double circuit transmission line will be constructed on the double circuit towers for the in/out arrangement. For the proposed length of 2 km, about 7-8 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.16 Samaro - Naukot Transmission Line

This 132-KV transmission line will provide feed to the existing Naukot grid station which will be converted to the 132-KV system as part of the HESCO's 6th STG project (see **Section 3.3.8**). The proposed transmission line will start from the existing 132-KV Samaro grid station, and will have a total length of about 56 km.

A single circuit transmission line will be constructed on the double circuit towers. For the proposed length of 56 km, about 190-200 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.3.17 Humayun - Jacobabad Transmission Line

This 132-KV transmission line will provide second feed to the existing 132-KV Jacobabad grid station. The proposed transmission line will start from the existing 132-KV Humayun grid station, and will have a total length of about 21 km.

A single circuit transmission line will be constructed on the double circuit towers. For the proposed length of 21 km, about 75-80 towers would be required, though exact quantity would be determined once the detailed design is carried out.

3.4 Construction Activities

A simplified description of the activities to be carried out during the project execution is provided below. The project through its agreement(s) with the contractor(s) will ensure that the contractor(s) implements the mitigation measures detailed in the ESMP (**Chapter 10** of the present document), as well as follows the principles laid out in the entitlement framework on land acquisition and payment of all types of compensation.

3.4.1 Establishment of New Grid Stations

The activities which will be carried out for the establishment of the new grid stations (Bukhshapur, Chamber, Tando Bago and Larkana-III) are provided below. (HESCO has initiated some early activities, such as site identification for the proposed grid stations.)

1. First of all, the location where the new grid station should be established is identified. This will be carried out on the basis of load on the existing feeders, load on the nearby existing grid stations, lengths of the existing feeders, trend of the load growth and future outlook of the area.

2. After the broad identification of the required location, availability of land will be determined. Usually, 3 candidate sites are identified at this stage.

3. In order to make the final selection, a committee of concerned departments (usually Design Department, NTDC, GSC and Planning) will be constituted. After the site inspection, the location of the proposed grid station will be finalized.

4. Land will be acquired through the district/city administration (now district government), following the procedure laid down in the Land Acquisition Act. **Exhibit 3.6** provides a summary of the land that will be acquired for the proposed project.

5. The site will be surveyed and its topographical maps developed. This activity will be carried out by the GSC department. Soil survey and geo-technical investigations will also be carried out at this stage.

6. The contour plan and result of the above investigations will be sent to the Design Department.

7. The Design Department will prepare the detailed design of the grid station, including the civil design, construction drawings, general layout plan and equipment details.

8. The tenders will be floated for the equipment purchase. In parallel to this, estimates for the civil works will be prepared and approvals obtained from the concerned authority.

9. Subsequent to the above, tendering, proposal evaluation and contract awarding will be carried out for the civil construction and equipment supply.

10. Once equipment is available, it will be handed over to GSC Department, who will install it once the civil works are complete.

11. Once the installation is complete, the system will be tested jointly by the GSO and GSC departments.

12. After the testing, the grid station will be commissioned and put into operation.

For the proposed project, some of the grid station works can be implemented through turn-key contracts, where the contractor is responsible for the supply, installation and commissioning of the entire grid station.

Furthermore, in view of the extent of the works under the proposed project, HESCO may employ a supervision consultant, in order to ensure quality of the construction, installation and testing works.

3.4.2 Conversion/Extension of Existing Grid Stations

The activities to be carried out for the grid station extension (Nooriabad) or conversion (Samaro, Naukot, Matiari and Kandiari) during the proposed project will be quite similar to the ones described above in **Section 3.4.1**, except that the land will not need to be acquired for these project components. Hence the first four of the activities as listed in **Section 3.4.1** will not be undertaken; the rest of the activities will mostly be same.

3.4.3 Laying of Transmission Lines

The activities which will be carried out for the laying of transmission lines are provided below. (HESCO has initiated some early activities, such as identification of the proposed transmission line routes.)

1. First of all a reconnaissance site visit will be carried out by the GSC Department in order to determine feasible routes for the transmission line.
2. Three candidate routes will be marked on the map, and sent to the Design Department.
3. The Design Department will approve one of the routes.
4. The GSC will carry out detailed survey (plain tabling as well as profiling) of the approved route.
5. The results of the detailed survey will be sent to the Design Department.
6. The Design Department will prepare the detailed design.
7. Based upon the detailed design, the material will be procured after tendering.
8. Subsequent to the above, tendering for the construction works will be carried out and contract awarded.
9. Construction activities will be started by demarcating the tower locations. Compensation will be determined and disbursed.
10. Construction of the tower foundation will be taken in hand. Towers will be erected subsequent to this.
11. Once towers are erected, stringing will be carried out and accessories (insulators, etc.) installed.
12. Once installation is complete, testing will be carried out. After that the line will be commissioned and put into operation.

3.4.4 Staffing during Construction Phase

The maximum staffing levels during the construction phase of the proposed project is expected to be 100-150 at a project site, though exact numbers can only be determined once detailed construction planning is carried out.

3.5 Operation and Maintenance Activities

The proposed grid stations will be manned round the clock and important parameters (voltage, load, power factor, etc.) monitored. Daily log sheets will be filled recording the key data. Any abnormality will be recorded and concerned departments informed for taking remedial measures. The key activities will include:

- Operation of grid stations
- Scheduled maintenance
- Checking/testing of transformers
- Testing of breakers
- Testing of protection system
- Transmission line patrolling
- Washing/replacement of insulators
- Emergency maintenance
- Locating the fault
- Carrying out repairs or replacements
- Restoring the system to the normal operating conditions.

Maintenance of Transformers

Power transformer repairs: The minor repairs for the power transformers will be carried out at the grid stations, however for the major repairs, the transformers will be transported to the WAPDA's Power Transformer Reclamation Workshop at Kot Lakhpat, Lahore.

Distribution transformer repairs: No field repair is normally allowed for the distribution transformers. If the transformers are damaged within the warranty period (usually 2 years after delivery), these will be returned to the suppliers. If damaged after this period, the transformers will be sent to the Distribution Transformer Reclamation Workshop located in Sukkur.

Transformer oil testing: The dielectric strength of the transformer oil filled in the power transformers will be tested every year at the gird stations. For this purpose, a simple device called the oil testing set will be used. Oil sample will be taken out of the transformer and test performed. A record will be maintained for these yearly tests. No action will be taken if the test results are within the prescribed limits. However, if the dielectric strength of the transformer oil is found to be less than the allowable limits, the oil will be replaced.

After every five years, a more comprehensive test will be carried out for the transformer oil. Three oil samples will be taken from each transformer and sent to the WAPDA's High Voltage and Research Laboratory in Faisalabad. At the Laboratory, the following tests will be carried out:

- Flash point;

- Viscosity;
- Moisture;
- Gas content; and
- Dielectric strength.

Currently, no tests are performed to check the presence of poly-chlorinated biphenyl (PCB) in the transformer oil, though the transformer specifications include a clause that the oil should be PCB-free. (The PCB analysis will be included in the future testing – further discussed later in the document.)

Transformer Oil Disposal – Current Practice: The transformer oil is mostly recycled in the transformer workshops. The unusable waste oil is disposed through contractors. WAPDA procedures include a list of approved firms for the disposal of the used transformer oil.

Not much is known about the fate of the waste oil leaving the workshops, however the probable end uses include burning in brick kilns, oil recycling facilities, miscellaneous works in small workshops and even as a massaging oil (thought to be useful for joint pains).[5]

Staffing during O&M Phase

The new grid stations to be established during the proposed project would need a crew of about ten personnel responsible for the O&M activities. The converted or extended gird stations would not need any additional manpower. For the transmission line maintenance activities, the current manpower strength of the GSC department can be enhanced appropriately. The additional staffing requirement for this purpose is expected to be about 15-20 personnel having the requisite qualification and experience.

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[5] Assessment of the waste disposal practices in the transformer maintenance workshops was not included in the scope of the present study. The information given here is mostly based upon the anecdotal sources.

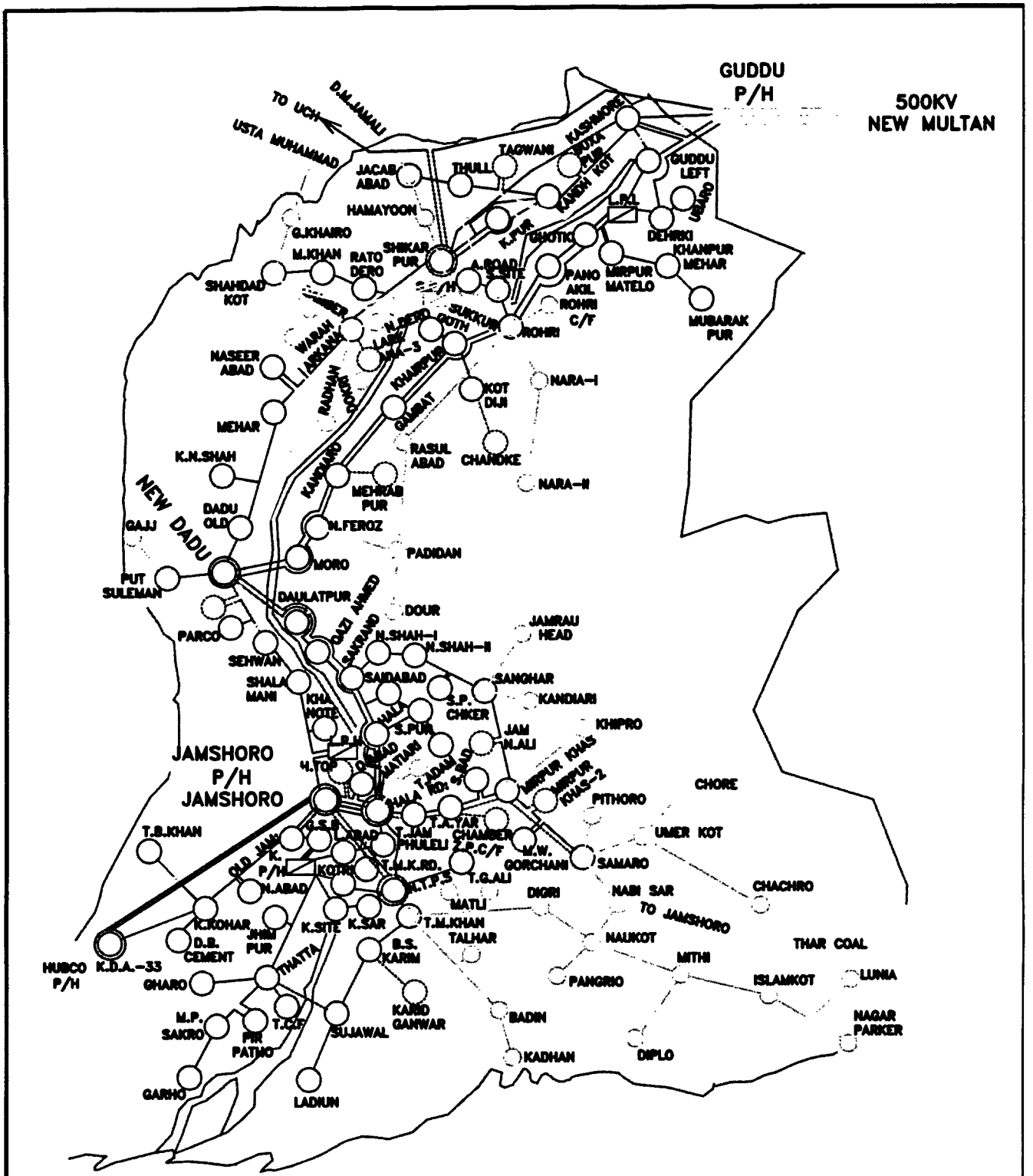
Exhibit 3.1: HESCO's Technical Profile

132 KV grid stations (numbers)	79
66 KV grid stations (numbers)	38
Peak load demand (MW) (2002-03)	968
Peak load demand (MW) (2003-04)	1,007
Units purcahsed (GWh) 2003-04	5,797
Units sold (GWh) 2003-04	3,751
Transmission line (km) (132 KV)	3,484
Transmission line (km) (66 KV)	1,681
HT lines (km)	39,421
LT lines (km)	20,079
132-KV transformer (numbers)	125
66-KV transformer (numbers)	44
11-KV transformers (numbers)	45,068
Domestic consumption (GWh) (2003-04)	1,747
Domestic consumers (numbers) (2003-04)	950,391
Commercial consumption (GWh) (2003-04)	248
Commercial consumers (numbers) (2003-04)	220,762
Industrial consumption (GWh) (2003-04)	985
Industrial consumers (numbers) (2003-04)	19,669
Agricultural consumption (GWh) (2003-04)	535
Agricultural consumers (numbers) (2003-04)	21,012

Sources: State of Industry Report 2005, National Electric Power Regulatory Authority. Project Description Document, HESCO, 2006.

Exhibit 3.2: HESCO System

(Please see the following page.)



Legend

	EXISTING GRIDS	EXISTING LINES	PROPOSED GRIDS	PROPOSED LINES
1-500KV				
2-220KV	○	———	○	- - - - -
3-132KV	○	———	○	- - - - -
4-66KV				
THERMAL STATION	▨			

Assignment: Environmental and Social Assessment

Project: 6th STG Project

Client: HESCO

Source: Data Provided by HESCO

Title:

HESCO System

Ref: GRP07E3-XHES

Date: April 2007

Exhibit 3.3: Transmission Lines in HESCO's Area

	Description	Length (km)
132-KV Transmission Lines		
01	132 KV Rohri – Ghotki L-3	70.06
02	132 KV Rohri – Pano Aqil L-4	35.05
03	132 KV Rohri – Gambat L-3	54.90
04	132 KV Rohri – Khairpur L-4	24.76
05	132 KV Rohri – Sukkur Site	17.00
06	132 KV Ghotki – LPL	35.88
07	132 KV Ghotki – Pano Aqil	35.28
08	132 KV Ghotki – Mirpur Mathelo	23.00
09	132 KV Ghotki – Rohri	70.06
10	132 KV Mirpur Mathelo – LPL	13.00
11	132 KV Mirpur Mathelo – Ghotki	23.00
12	132 KV Mirpur Mathelo – Khanpur Mahar	19.05
13	132 KV Daherki – Mirpur Mathelo	17.05
14	132 KV Daherki – LPL	8.00
15	132 KV Daherki – Ubaro	14.86
16	132 KV Guddu Left – LPL	44.05
17	132 KV Guddu Left – Ghotki	77.05
18	132 KV Gambat – Khairpur	29.94
19	132 KV Gambat – Kandiaro L-3	46.00
20	132 KV Gambat – Kandiaro L-4	46.00
21	132 KV Khanpur – Mubarakpur	21.05
22	132 KV Sukkur Site – Arain Road	14.60
23	132 KV Khairpur – Pir-Jo-Goth	14.61
24	132 KV Khairpur – Kotdiji	15.87
25	132 KV Shikarpur – Arain Road	36.00
26	132 KV Kashmore – Kandhkot	52.00
27	132 KV Kashmore – Shikarpur	115.00
28	132 KV Kashmore – Guddu Left	29.00
29	132 KV Kashmore – TPS Guddu L-4	16.00
30	132 KV Kashmore – TPS Guddu L-5	16.00
31	132 KV Kandhkot – Shikarpur	78.00
32	132 KV Kandhkot – Thull	48.00
33	132 KV Thull – Jacobabad	37.00
34	132 KV Shikarpur – Lodra SKR-2	26.00
35	132 KV Shikarpur – Lodra SKR-7	7.00
36	132 KV Shikarpur – Lodra SKR-8	6.20
37	132 KV Ratodero –Lodra	60.00

	Description	Length (km)
38	132 KV Ratodero –Larkana	23.00
39	132 KV Ratodero –Miro Khan	24.15
40	132 KV Larkana – Nasirabad	46.00
41	132 KV Mehar – Naseerabad	22.00
42	132 KV Mehar – Dadu	52.00
43	132 KV Mehar – Fareedabad	
44	132 KV Dadu New – Dadu Old	3.00
45	132 KV Bhan Saeedabad – Dadu	24.00
46	132 KV Bhan Saeedabad – Shalmani	97.00
47	132 KV Miro Khan – Shahdadkot	16.29
48	132 KV New Jamshoro – Qasimabad JMS-1	16.00
49	132 KV New Jamshoro – Hala Road	14.00
50	132 KV New Jamshoro – Old Jamshoro JMS-3	3.50
51	132 KV New Jamshoro – Old Jamshoro JMS-4	3.50
52	132 KV New Jamshoro – Lakhra -I - Amri	63.00
53	132 KV New Jamshoro – Lakhra-II	25.65
54	132 KV Bulri Shah Karim – Sujawal	40.00
55	132 KV Hala Road - N.T.P.S	13.00
56	132 KV Hala Road - Tando Jam	36.00
57	132 KV Kotri Power House – Thatta (T-Off Jhampir)	110.00
58	132 KV Kotri Power House – Kotri Site	3.00
59	132 KV Kotri Power House – Latifabad	10.00
60	132 KV Kotri Power House – Gulshan-e-Shahbaz-II	3.00
61	132 KV Kotri Power House – Old Jamshoro	13.00
62	132 KV Jhampir – Jherruk	6.00
63	132 KV Hala – Sakrand	45.00
64	132 KV Hala – Hala Road	65.00
65	132 KV Hala – Shahdadpur	22.00
66	132 KV Old Jamshoro -Gulshan-e-Shahbaz	10.00
67	132 KV Old Jamshoro – Nooriabad – Kalu Kohar	65.00
68	132 KV Kalu Kohar – KDA-33	90.00
69	132 KV Kalu Kohar – Dada Bhoy Cement Factory	12.00
70	132 KV Kalu Kohar – Thana Boola Khan	23.00
71	132 KV Kalu Kohar – Essa Cement Factory	3.50
72	132 KV Kazi Ahmed – Dadu	75.00
73	132 KV Kazi Ahmed – Hala Road	145.00
74	132 KV Mirpur Khas – Mirwah Gorchani – Samaro	72.00
75	132 KV Mirpur Khas – Sanghar	62.50
76	132 KV Moro – Kandiaro	60.00

	Description	Length (km)
77	132 KV Moro – Dadu	32.20
78	132 KV Moro – New Jatoi	16.00
79	132 KV Nawabshah Site – Nawabshah –I	8.00
80	132 KV Nawabshah-I – Nawabshah –II	4.50
81	132 KV Nawabshah II – Shahpur Chakar –Sanghar	60.50
82	132 KV N.T.P.S – Kotri Site (T-Off Kohisar)	15.00
83	132 KV N.T.P.S – Tando Muhammad Khan	36.00
84	132 KV N.T.P.S – Zealpak Cement Factory	3.00
85	132 KV Noshero Feroze - Kandiaro	30.00
86	132 KV Noshero Feroze – Dadu	59.00
87	132 KV New Jatoi – Kandiaro	48.00
88	132 KV Phuleli – Latifabad	14.00
89	132 KV Phuleli – 220 KV Hala Road	7.00
90	132 KV Pir Patho – Mirpur Sakro	28.00
91	132 KV Sujawal – Bulri Shah Karim	40.00
92	132 KV Sujawal – Ladyoon	38.00
93	132 KV Sakrand – Dadu	145.00
94	132 KV Sakrand – Nawabshah I	24.00
95	132 KV Sakrand – Nawabshah Site	21.00
96	132 KV Shahdadpur – Tando Adam	19.00
97	132 KV Thatta – Gharo	68.00
98	132 KV Thatta – Sujawal	35.00
99	132 KV Thatta – Thatta Cement Factory	18.00
100	132 KV Thatta – Pir Patho	18.00
101	132 KV Tando Jam – Tando Allahyar	37.00
102	132 KV Tando Allahyar – Sultanabad – Mirpur Khas	35.00
103	132 KV Tando Mohammad Khan – Bulri Shah Karim	41.00
104	132 KV Sanghar – Mirpur Khas	62.00
66-KV Transmission Lines		
01	66 KV Tando Muhammad Khan – Badin	81.00
02	66 KV Tando Muhammad Khan – Matli	20.00
03	66 KV Matli – Tando Ghulam Ali	30.00
04	66 KV Tando Ghulam Ali – Digri	31.00
05	66 KV Badin – Kadhan	38.00
06	66 KV Badin – Pangrio	46.31
07	66 KV Noukot – Pingrio	24.00
08	66 KV Kaloi – Pangrio	
09	66 KV Digri – Naukot	48.00
10	66 KV Mithi – Diplo	42.00

	Description	Length (km)
11	66 KV Mithi – Islamkot	45.00
12	66 KV Noukot - Mithi	56.00
13	66 KV Umerkot – Chacharo	75.00
14	66 KV Islamkot – Nagarparkar	80.00
15	66 KV Samaro – Nabisar – Naukot	45.00
16	66 KV Samaro – Pithoro	24.00
17	66 KV Samaro – Umerkot	36.00
18	66 KV M.P.Khas – Khipro	56.00
19	66 KV Sanghar – Mirpur Khas	62.00
20	66 KV Sanghar – Kandiari	44.00
21	66 KV Sanghar – Jamrao Head	39.00
22	66 KV Hala Road – Matiari	25.00
23	66 KV N/Feroze – Padiddan	23.00
24	66 KV Padiddan – Dour	30.00
25	66 KV Rohri – Nara-I - Nara-II	174.14
26	66 KV Rohri – Rasoolabad	66.00
27	66 KV Rasoolabad – Padiddan	74.96
28	66 KV Rasoolabad – Thari Mirwah	30.00
29	66 KV Rohri – T.P.S Sukkur	2.04
30	66 KV Sukkur Site – T.P.S Sukkur	4.60
31	66 KV Sukkur City – Naudero	82.60
32	66 KV Sukkur City – Sukkur Site	11.05
33	66 KV Shikarpur – Sukkur City	38.00
34	66 KV Shikarpur – Jacobabad	40.00
35	66 KV Larkana – Kambar	22.00
36	66 KV Larkana – Radhan – Dokri	93.00
37	66 KV Larkana New –Larkana Old – Naudero	13.00
38	66 KV Kambar – Shahdadkot	36.00
39	66 KV Shahdadkot – Usta Muhammad	42.00
40	66 KV Shahdadkot – Warah - Kambar	36.00
41	66 KV Noudero - Larkana	18.60

Source: Data provided by HESCO.

Exhibit 3.4: Grid Stations in HESCO's Area

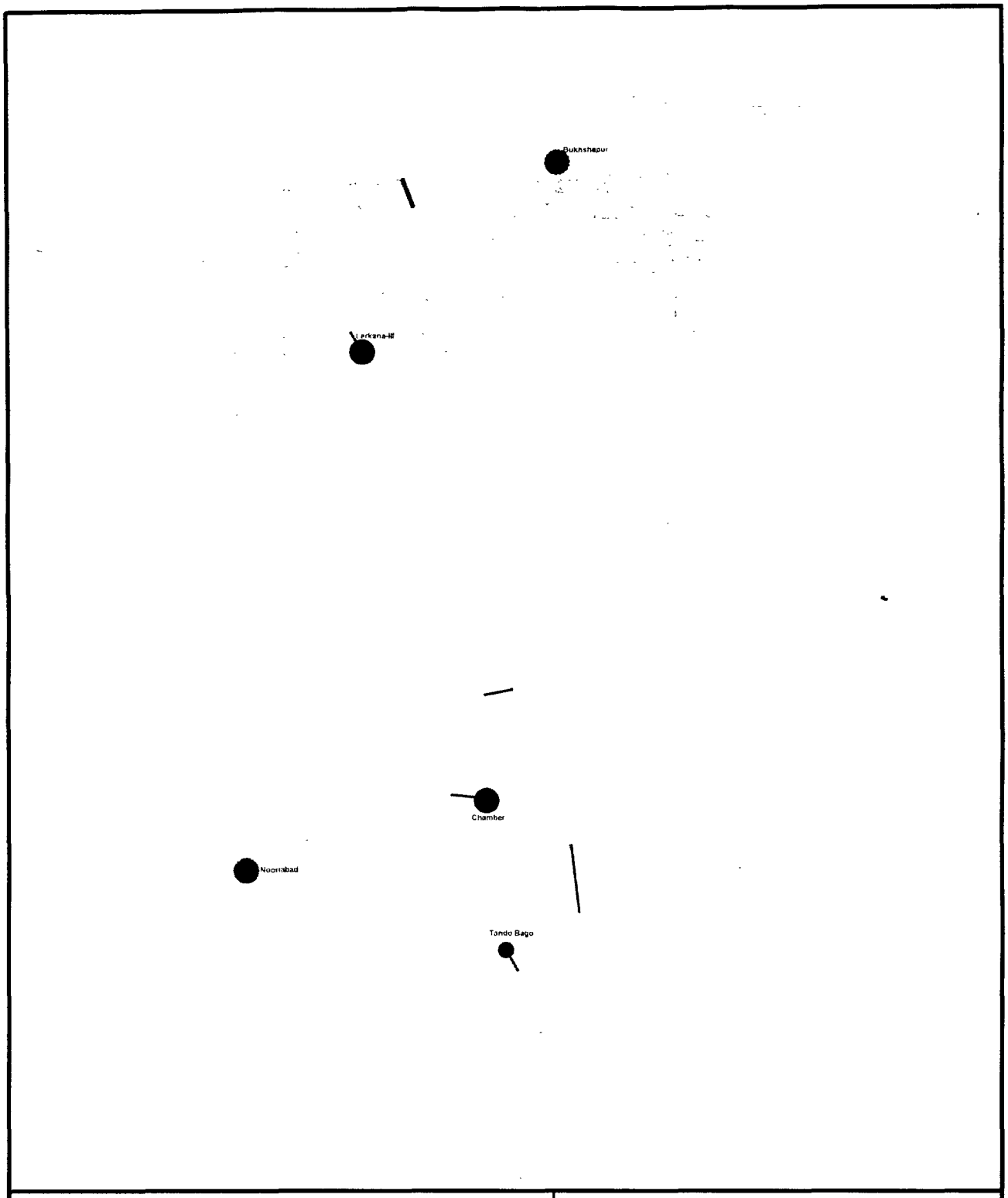
1	132-KV NTPS	46	66-KV Tando Jan Mohammad
2	132-KV Kotri Site	47	66-KV Kaloi
3	132-KV Jamshoro	48	132-KV Hala
4	132-KV Jhampir	49	132-KV Kazi Ahmed
5	132KV Jherruck	50	132-KV Moro
6	132-KV Gulshan-e-Shahbaz	51	132-KV Naushero Feroze
7	132-KV Gharo	52	132-KV Kandiaro
8	132-KV Kalu Kohar	53	132-KV Nawabshah-I
9	132-KV Khanote	54	132-KV Nawabshah-II
10	132-KV Mirpur Sakro	55	132-KV Nawabshah Site-III
11	132-KV Pir Patho	56	132-KV Shahpur Chakar
12	132-KV Sujawal	57	132-KV Sanghar
13	132-KV Thatta	58	132-KV Sakrand
14	132-KV Tando Mohammad Khan	59	132-KV Saeedabad
15	132-KV Phulleli	60	132-KV Shahdadpur
16	132-KV Bulri Shah Karim	61	132-KV Tando Adam
17	132-KV Ladiun	62	132-KV Bhan Saeedabad
18	132-KV Nooriabad	63	132-KV Doulatpur
19	132-KV Thana Bola Khan	64	66-KV Daur
20	66-KV Badin	65	66-KV Kandiari
21	66-KV Kadhan	66	66-KV Matiari
22	66-KV Matli	67	66-KV Padidan
23	66-KV Tando Ghulam Ali	68	66-KV Head Jamrao
24	66-KV Talhar	69	66-KV Tando Adam
25	132-KV Mirpur Khas	70	132-KV Rohri
26	132-KV Tando Allahyar	71	132-KV Arain Road, Sukkur
27	132-KV Mirwah	72	132-KV Khairpur
28	132-KV Sultanabad	73	132-KV Pir-Jo-Goth
29	132-KV Samaro	74	132-KV Kot Diji
30	132-KV Latifabad	75	132-KV Gambat
31	132-KV Qasimabad	76	66K-V Rasoolabad
32	132-KV Kohsar	77	132-KV Mubarkpur
33	132-KV Tando Jam	78	132-KV Sukkur Site
34	66-KV Umerkot	79	132-KV Pano Aqil
35	66-KV Digri	80	132-KV Ghotki
36	66-KV Khipro	81	132-KV Mirpur Mathelo
37	66-KV Mithi	82	132-KV Khanpur Mehar
38	66-KV Naukot	83	132-KV Deharki
39	66-KV Nabisar	84	132-KV Ubaro
40	66-KV Pithoro	85	132-KV Guddu Left
41	66-KV Pangrio	86	66-KV Nara-I
42	66-KV Diplo	87	66-KV Nara-II
43	66-KV Chachro	88	66-KV Sukkur City
44	66-KV Nagar Parkar	89	66-KV Thari Mirwah
45	66-KV Islamkot	90	132-KV Larkana

91	132-KV Rato Dero	104	132-KV Kashmore
92	132-KV Dadu	105	66-KV Humayun
93	132-KV Sehwan	106	66-KV Warah
94	132-KV Shalmani	107	132-KV Jacobabad
95	132-KV Khairpur Nathan Shah	108	66-KV Garhi Khairo
96	132-KV Nasirabad	109	66-KV Larkana
97	132-KV Johi	110	132-KV Shahdadkot
98	132-KV Mehar	111	66-KV Radhan
99	132-KV Faridabad	112	66-KV Dokri
100	132-KV Shikarpur	113	66-KV Kamber
101	132-KV Kandhkot	114	66-KV Naudero
102	132-KV Thull	115	132-KV Miro Khan
103	132-KV Karampur		

Source: Data provided by HESCO.

Exhibit 3.5: Project Components

(Please see the following page.)



Legend

New Transmission Line

New Grid Station

Grid Station Conversion

Extension

Assignment:	Environmental and Social Assessment
Project:	6th STG Project
Client:	HESCO
Source:	Data Provided by HESCO
Title:	**Project Components**
Ref: GRP07E3-5 HES	Date: May 2007

Exhibit 3.6: Land to be Acquired for Project

Description	Land Take	Number of Landowners/Affectees
New grid stations (qty: 4)	16 acres (4 acres for each grid station) permanent land take	4

4 Description of the Environment

This Chapter describes the environmental conditions of the project area before the commencement of the proposed activities. The environmental baseline in this Chapter addresses the physical and biological aspects of the project area.

Since the proposed project components are located in different parts of the HESCO area (see **Exhibit 3.5** for the location of project components), a generic overview of the environmental conditions of this entire area is presented. A more specific description of the immediate surroundings of various project components is provided separately, where appropriate. This site specific description is augmented by the schematic diagram of the grid station locations as well as transmission line routes - provided at the end of this Chapter, and photographs – provided in **Appendix C** of this report. In view of the absence of any major development activities underway at or around the project sites or any other natural/anthropogenic phenomenon, the environmental conditions of the project sites are unlikely to experience any significant change before the project commencement.

4.1 Physical Environment

4.1.1 Physiography, Topography and Geology [1]

On the basis of the physical environment and geology, the project area falls in the Indus Basin, which is briefly described below.

The Indus Basin essentially forms the western extension of Indo-Gangetic Plain, and has been made up of the silt brought by the Indus and its numerous tributaries, such as Jhelum, Chenab, Ravi and Sutlej on the east bank, and Kabul, Kurram, Tochi, and others on the west bank. The Indus Plain is known for its agricultural fertility and cultural development throughout history.

The left bank tributaries of the Indus River all meet at Panjnad and flow as one large stream for about 75 km before joining the Indus at Mithankot, and south of it, the Indus flows almost alone up to the Arabian Sea without receiving any noticeable tributary.

The average annual discharge of the Indus – 92 million acre feet (MAF) at Attock Khurd – is much higher than the combined discharge of its tributaries. There is a great fluctuation in their seasonal discharge, especially in the hot summer and rainy season. Almost all of its tributaries and the Indus itself have their sources in snow and glaciated areas of Himalayan, Karakoram and Hindukush mountain systems.

On the basis of hydrology and land form, the Indus Plain can be divided into the Upper and Lower Indus Plains. The Upper Indus Plain differs from the Lower Indus Plain (where the project area is located) primarily because of the major tributaries (Jhelum, Chenab, Ravi and Sutlej) divide the land surface into several interfluves or '*doabs*'. The

[1] Sources: Atlas of Pakistan, Government of Pakistan, 1997. Sindh State of Environment and Development, IUCN, 2004.

two plains are separated by a narrow corridor near Mithankot where the Sulaiman range approaches the Indus River. The Lower Indus Plain is very flat, generally sloping to the south with an average gradient of 95 mm per km (6 inches per mile). The Lower Indus Plain can be divided in five distinct micro-relief land forms: active flood plain; meander flood plain; cover flood plain; scalloped interfluves; and the Indus delta. In the northeast, the meander flood plain is more extensive, while in the central and lower Indus Plain, the cover flood plain is more prominent.

Topographically, Sindh can be divided into four distinct parts with the dry and barren Kirthar Range in the west, a central alluvial plain bisected by the Indus River, a desert belt in the east, and the Indus delta in the south. The entire project area is located in the central alluvial plain on either sides of the Indus River.

Geological Setting: The prevailing geologic conditions in the region are the results of extensive inundation, depositions, coastal movements, and erosions over a long period of time in the geological ages. The geology of the region is closely related to the formation process of Himalayan ranges resulting in intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The important tectonic changes which have had so much influence in the region are feebly visible particularly in the Indus Plain, and it is only by considering the geology on a broader regional scale, as well as in site specific detail, that the effects can be appreciated.

Most parts of Sindh are covered either by recent alluvium or wind-borne sand. The principal features of geological significance are to be found in the hilly portions of the province, towards the west of the Indus. Outlying extensions of this hilly tract occur east of the Indus as well, near Sukkur, Hyderabad and Jerruck. The isolated hills of Nagarparkar on the northern border of the Rann of Kutch belong to quite a different system both geographically and geologically.

The hilly region of western Sindh consists almost entirely of rocks belonging to the tertiary system of geological nomenclature. It is only along the Laki Range and in its neighborhood that there are some exposures of rocks belonging to the next older system, the Cretaceous. With the exception of some volcanic beds associated with these Cretaceous strata, all the rock formations of western Sindh are of sedimentary origin. All of the more important hill masses consist of limestone. A great majority of these limestone deposits belong to the Nummultic period and are largely built up of the accumulated shells of foraminifera, principally those belonging to the genus Nummulites.

4.1.2 Soils [2]

The soil in the plains of Sindh is plastic clay that has been deposited by the Indus. Combined with water it develops into a rich mould and without water it degenerates into a desert. Nearly the entire Indus valley has soil which is extremely friable and easily disintegrated by the flow of water. Resultantly, the water always contains a large amount of suspended silt.

[2] Source: Sindh State of Environment and Development, IUCN, 2004.

4.1.3 Land Use [3]

Agriculture, followed by forestry, is the main land use in the central alluvial plain. Although more than 50 percent of the total geographical area is cultivable, only 26 percent of it is actually located in the central plain. The land inside the Indus embankments is almost equally employed by agriculture and forestry, while that outside the embankments is more extensively utilized for agriculture in the form of sparsely distributed irrigated plantations. The land use in Sindh is given in **Exhibit 4.1**.

4.1.4 Meteorology and Climate

Meteorology

The climate of most parts of the Project Area is arid characterized by four district seasons in a year, that is, winter from Mid-November to February, spring during March and April summer from May to Mid-September and autumn from Mid-September to Mid-November. There exist several meteorological stations in the project area; data recorded at some of these stations is provided in the following sections.

Temperatures

June is the hottest month in most parts of the project area, with mean daily maximum temperature recorded as 44.33 °C.[4] January is the coldest month in the area, with the mean daily minimum temperature recorded as 5.42 °C.[5]

Mean daily maximum and mean daily minimum temperatures of various districts in the project area are presented in **Exhibits 4.2** and **4.3**, respectively.[6] In view of the very small differences among these temperatures, this data can be taken as representative for the entire project area.

Rainfall

Average annual rainfall in the project area ranges between 110 mm (Jacobabad) and 222 mm (Badin). Maximum rainfall (about 60% of the total annual) occurs during the Monsoon season (July, August and September), while the period of minimum rainfall or drier period is October and November.

Mean monthly rainfall data of various locations within the project area is provided in **Exhibit 4.4**.[7]

Humidity

July, August and September are the most humid months in the area, whereas May and June are the least humid months. Average monthly relative humidity (RH) values at various locations in the project area are provided in **Exhibit 4.5**.[8]

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3 Source: Sindh State of Environment and Development, IUCN, 2004.

4 Recorded at Jacobabad (see **Exhibit 4.2**).

5 Recorded at Chor (Umerkot) (see **Exhibit 4.3**).

6 *Temperature Normals* recorded for the period 1961 to 1990. Source: District Census Reports. (*Normals* for the period subsequent to 1990 are not published yet.)

7 Rainfall *Normals recorded* for the period 1961 to 1990. Source: District Census Reports. (*Normals* for the period subsequent to 1990 are not published yet.)

Climate

Pakistan's latitudinal and longitudinal extents and its northern rim of lofty mountains, are the two factors, which have a great bearing not only on the temperature and rainfall patterns, but also on the general circulation of the atmosphere on the southern Asia.

Climate of Pakistan according to Koppen's classification[9] falls under the following five types:

Tropical Semi-arid with Dry Winter: This climate type prevails in Karachi, Hyderabad, and southern Khairpur Division. The mean annual temperature is above 18 °C.

Tropical Arid: This is characterized by average annual temperature of about 18 °C with dry winters. This includes southern Kalat and whole of the Indus Plain.

Cold Semi-arid With Dry Summer: This climate type covers central Kashmir, Peshawar, D.I. Khan, Quetta and northern half of Kalat Division.

Snow Forest Climate: This climate type is characterized by average temperature of coldest month below 0 °C. Mean temperature of the warmest month is between 10 and 22 °C. It includes northern mountainous areas and parts of Kashmir.

Extreme Cold: This climate type is characterized by average temperature of the warmest months between 10 and 0 °C. It comprises eastern and northern parts of Kashmir, Chitral, Gilgit and Laddakh.

Based upon the above classification, most parts of the proposed project area are included in the Tropical Arid climate zone, while some southern parts of Sindh are located in the Tropical Semi-arid with Dry Winter climate zone.

Ambient Air Quality

Some of the project sites are located close to the roads experiencing vehicular traffic, which causes air pollution. These include the following:

- Tando Bago grid station site
- Portions of the Humayun – Jacobabad transmission line
- Matiari grid station
- Portion of the Tando Allahyar – Chamber transmission line (particularly near the Tando Allahyar grid station)
- Naukot grid station
- Samaro grid station
- Portions of the feed for the Larkana-III grid station
- Nooriabad grid station
- Kandiari grid station.

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8 Humidity *Normals* recorded for the period 1961 to 1990. Source: District Census Reports. (*Normals* for the period subsequent to 1990 are not published yet.)

9 *Climatic Regions of West* Pakistan, Pakistan Geographical Review. Kazi, S. A.,1952.

However only at two of the above sites – portion of the Humayun–Jacobabad transmission line, and Tando Allahyar grid station - the ambient air quality is expected to exceed the acceptable limits defined by the national and international standards (given in **Exhibit 2.4**), in view of the heavy vehicular traffic at these places.

Since the primary source of air pollution at the above sites is the vehicular emissions, the key pollutants likely to be found at these locations include carbon monoxide (CO), oxides of nitrogen (NO_X), sulfur dioxide (SO_2), and particulate matter (PM). A typical air quality data for some urban centers in the country is presented in **Exhibit 4.6**, which can be used as a generic ambient air quality baseline for these locations.[10]

The remaining project components (grid stations sites and transmission line routes) are located well outside the metropolitan centers. There does not exist any large industry or any other significant pollution source near these sites/routes either. The agricultural activities do cause some environmental degradation associated with the use of agro-chemicals and operation of agricultural machinery. However, this degradation is of low level since the project area is not known for heavy use of agrochemicals such as pesticides, or agricultural machinery. As a result, the ambient air quality of these sites is expected to be well within the acceptable limits, and no major criteria pollutants are likely to be found in excess of the limits prescribed by national and international standards (see **Section 2.2.3** for the ambient air quality and emission standards).

4.1.5 Surface Water Resources

The River Indus is the prime surface water resource of Sindh. Salient information of this river is provided below.

Indus River: The Indus River is the main source of surface water in the project area (and in the country). The Indus rises in Tibet, at an altitude of about 18,000 feet (5,486 m) amsl, and has a total catchment area of 654,329 km^2. Length of the Indus River in the country is about 2,750 km. Five main rivers that join the Indus from the eastern side are Jhelum, Chenab, Ravi, Beas and Sutlej. Besides these, two minor rivers - Soan and Harrow also drain into the Indus. On the western side, a number of small rivers join Indus, the biggest of which is River Kabul with its main tributaries i.e. Swat, Panjkora and Kunar. Several small streams such as Kurram, Gomal, Kohat, Tai and Tank, also join the Indus on the right side. **Exhibit 4.7** shows Indus River and its tributaries; **Exhibit 4.8** presents key facts about the river. .

The Indus River exhibits great seasonal variations, with more than 80% of the total annual flow occurring during the summer months, peaking in June, July and August. **Exhibit 4.9** presents flow data of the Indus.

The Indus River and its tributaries on an average bring about 154 MAF of water annually. This includes 144.9 MAF from the three western rivers and 9.14 MAF from the eastern rivers. Most of this, about 104.7 MAF is diverted for irrigation, 39.4 MAF flows to the sea and about 9.9 MAF is consumed by the system losses which include evaporation, seepage and spills during floods. The flows of the Indus and its tributaries vary widely

[10] A site-specific air quality baseline will be established before site mobilization at each grid station site (further discussed in ESMP later in the document).

from year to year and within the year. As is the case with the water availability there is significant variation in annual flows into sea.

The Indus Delta: Historically, the Indus Delta has formed in an arid climate under conditions of high river discharge to the proportion of 4 billion tons of sediment per year. In the past, this has contributed to a prograding seaward of the delta as a result of interaction of fluvial and marine processes and a moderate tide range of approximately 2.6 meters. Progradation has occurred in spite of extremely high wave energies of the order of 1,400 million ergs/sec. During the past six decades, however, the construction of dams and barrages and extensive engineering works upstream has reduced the sediment load to 100-650 million tons per year (based on different studies). This decrease in sediment load together with the extremely high wave energies is expected to cause rapid reworking and transgression of the Indus delta.

What makes Indus delta unique is the fact that it experiences the highest wave energy of any river in the world. During the monsoon season, from May-September, the delta front receives more wave energy in a single day than the Mississippi delta receives in the entire year.

The Indus delta is triangular in shape and occupies a large part of the province of Sindh, covering about 30,000 km^2. It is about 240 km in length along the axis of the river and 220 km at its widest, from Karachi to the great Rann of Kutch.

Hill Torrents: A distinct feature of the Kirthar Range on the Indus right bank (district Dadu in the HESCO area; see **Exhibit 1.1**) is the presence of hill torrents, which drain the western hilly areas towards the Indus River in the east. Most of these surface drains experience nominal flow, if any, during the dry weather. However, during the rainy seasons, sudden, high and gushing flows occur, causing flash floods in the downstream areas.

River Water Quality: The water quality of Indus River is generally considered excellent for irrigation purposes. The total dissolved solids (TDS) range from 60 mg/l in the upper reaches to 375 mg/l in the lower reaches of the Indus, which are reasonable levels for irrigated agriculture and also as raw water for domestic use. The disposal of saline drainage from various irrigation projects has been a major factor in the increased TDS in the lower reaches of the rivers in the Indus Plain. There is progressive deterioration downstream and the salinity is at its maximum at the confluence of the Chenab and Ravi rivers, where the TDS ranges from 207 to 907 mg/l. A slight improvement in water quality is noted further downstream at Panjnad due to dilution from the inflow from Sutlej River. The quality of the Indus water at Guddu, however, is within acceptable limits for agriculture; TDS being in the range of 164-270 mg/l.

In the upper reaches of the Indus River, the Dissolved Oxygen (DO) content remains above 8.5 mg/l which is well above the acceptable levels of 4 mg/l. The Biochemical Oxygen Demand (BOD) downstream of Attock has been recorded as 2.9 mg/l. At Kotri, it has a suspended solid (SS) content of 10 to 200 mg/l. Indus River water quality has been studied at the Dadu - Moro Bridge and Kotri Barrage, with nitrate levels at 1.1 and 7.5 mg/l, phosphate at 0.02 and 0.3 mg/l, BOD at 2.4 and 4.1 mg/l, faecal coliforms at 50 and 400 per ml, and aluminum at 1.8 and 0.2 mg/l respectively. Due to industrial waste

discharges from Punjab and Sindh, a high content of heavy metals such as nickel, lead, zinc and cadmium have also been found in Indus water.

Lakes: There exist several fresh water and brackish lakes in the Sindh province. The salient among these include Manchar, Keenjhar and Haleji lakes (further discussed in **Section 4.2**). In addition there exist a large number of small lakes and ponds in the irrigated areas of Sindh, most of which have been created as a result of extensive irrigation and very shallow groundwater.

4.1.6 Groundwater Resources

The Indus Basin was formed by alluvial deposits carried by the Indus and its tributaries. It is underlain by an unconfined aquifer covering about 15 million acres (60,700 km^2) in surface area. In Sindh, about 28% of the area is underlain by fresh groundwater. This is mostly used as supplemental irrigation water and pumped through tube-wells. Some groundwater is saline. Water from the saline tube-wells is generally put into drains and, where this is not possible, it is discharged into large canals for use in irrigation, after diluting with the fresh canal water.

Before the introduction of widespread irrigation, the groundwater table in the Indus Basin varied from about 12 m in depth in Sindh and Bhawalpur areas to about 30 m in Rechna Doab (the area between Ravi and Chenab Rivers). After the introduction of weir-controlled irrigation, the groundwater table started rising due to poor irrigation management, lack of drainage facilities and the resulting additional recharge from the canals, distributaries, minors, water courses and irrigation fields. At some locations, the water table rose to the ground surface or very close to the surface causing water-logging and soil salinity, reducing productivity.

In the late 1950s, the Government of Pakistan embarked upon a program of Salinity Control and Reclamation Project (SCARP) wherein large deep tube-wells were installed to control the groundwater table. Over a period of about 30 years, some 13,500 tube-wells were installed by the Government to lower the groundwater table.

The SCARP project initially proved to be quite effective in lowering the water table but with time, the performance of the SCARP tube-wells deteriorated. The development of deep public tube-wells under the SCARP was soon followed by private investment in shallow tube-wells. Particularly in the eighties, the development of private tube-wells received a boost, when locally manufactured inexpensive diesel engines became available. Most of these shallow tube-wells were individually owned.

In the last 25-30 years, ground water has become a major supplement to canal supplies, especially in the Upper Indus Plain, where ground water quality is good. Large scale tube-well pumpage for irrigation started in the early sixties. There are presently more than 500,000 tube-wells in the Indus Basin Irrigation System (IBIS). According to a study, the total groundwater potential in Pakistan is of the order of 55 MAF.

Major part of the groundwater abstraction for irrigation is within the canal commands or in the flood plains of the rivers. However, the amount of abstraction varies throughout the area, reflecting inadequacy/unreliability of surface water supplies and groundwater quality distribution.

The quality of groundwater ranges from fresh (salinity less than 1,000 mg/l TDS) near the major rivers to highly saline farther away, with salinity more than 3,000 mg/l TDS. The general distribution of fresh and saline groundwater in the country is well known and mapped, as it influences the options for irrigation and drinking water supplies. Generally, the quality and quantity of groundwater in the Indus Basin deteriorate from north to south, and from east to west.

The key water quality parameters of some of the locations in the project area are tabulated in **Exhibit 4.10**. **Exhibit 4.11** provides results of the water quality analysis carried out during the present study.

4.2 Biological Resources

This section provides an overview of the ecozones, wild flora and fauna, and the habitat conditions prevailing in the project area. The description in this section has been prepared on the basis of secondary literature review, and field visits carried out in the area during this ESA and earlier assignments.

4.2.1 Original Ecozones of Project Area

Tropical Thorn Forest Ecozone

This habitat was the most extensive ecozone of the Indus plain, and currently exists only in places where the land has not been converted for habitation or cultivation. This habitat comprises low forests of thorny and hard-wooded tree species, dominated by *Acacia* spp. The trees of such forests have short boles and low branching crowns. These are usually not close-growth trees hence their canopies touch each other in exceptionally favorable spots. The usual height of the trees is 20-30 feet (6-9 m). Other plants that grow mixed with *Acacia* include *Salvadora, Prosopis, Capparis,* and *Tamarix.* The shrubs of the ecozone included *Calotropis, Zizyphus, Suaed*, while herbs of the area included *Chenopodium, Calligonum, Haloxylon* and various species of grasses.

The major wildlife mammal species of this ecozone was Long-eared Hedgehog, Desert Hare, Porcupine, Desert Wolf, Jackal, Bengal Fox, Desert Fox, Honey Badger, Small Indian Civet, Grey Mongoose, Small Indian Mongoose, Striped Hyena, Indian Desert Cat, Caracal, Jungle Cat, Wild Boar, Nilgai, Blackbuck and Chinkara Gazelle. **Appendix D** provides a list of the key mammalian species of the area.

Birds of the ecozone included Grey Partridge, Peafowl, Common Quail, Ring Dove, Red Turtle Dove, Little Brown Dove, Green Pigeon, Hoopoe, Spotted Owlet, Barn Owl, Dusky Horned Owl, Indian Nightjar, Wryneck, Golden-backed woodpecker, Pied Woodpecker, Wood Shrike, Great Grey Shrike, Rufous-backed shrike, Fantail Flycatcher, Common babbler, Jungle babbler, Houbara Bustard, Great Indian Bustard and many other species of passerine birds. **Appendix D** provides a list of the key bird species of the area.

Reptiles of the area included Bengal Monitor Lizard, Garden Lizard, Spiny-tailed Lizard, Cobra, Krait, Vipers and Rat Snake. **Appendix D** provides a list of the key reptilian species of the area.

Riverine Tract Habitats

Originally the riverine habitats used to have heavy, seasonal floods. Since forecasting and prior warning were not available to the rural people, these habitats were not occupied for agriculture and habitation. Natural resource exploitation was also not extensive. As a result, this natural flora along the rivers flourished. These included: *Tamarix, Saccharum, populus* and *Acacia. Typha* growth was common wherever the water was stagnant or slow moving.

The mammals of such habitat included Hog Deer, Wild Boar, Fishing Cat, Jungle Cat, Small Indian Civet, Smooth-coated Otter and Indus Blind Dolphin. The wild avifauna of the area included around forty species of Ducks and Geese, Black Partridge, Countless number and species of waders, Purple Moorhen, Common and White-breasted Moorhen, Yellow-eyed Babbler, and several Passerine species. The key reptiles of the area included Monitor Lizard and several species of Turtles.

4.2.2 Modified Nature of Habitat

Major parts of the original habitats described in **Section 4.2.1** above have been modified into new habitats, primarily as a result of extensive cultivation and expanding urban centers as well as rural settlements. These new habitat types are briefly discussed below.

Agricultural Habitats

Most parts of Sindh are under very intensive irrigated cultivation. In addition, livestock rearing is also practiced extensively, and milk animals are common. The use of the chemical fertilizers and pesticides is very common. Several species of wildlife have adapted to the changed habitat. These include: Jackal; Jungle Cat, Bengal Fox, Small Indian Mongoose, Shrew, Rodent pests including Porcupine, Fruit Bats and Wild Boar. The avifauna which survived the modified habitat include Doves, Black Partridge, Cuckoos, Koel, Woodpeckers, Parakeets, Bulbuls, Babblers, Black Drongo, Bee-eaters, Finches and House Sparrow. The reptilian species of this modified habitat include Krait, Cobra, Saw-scaled Viper, Rat Snake and Monitor Lizard.

In these modified habitats, the winter bird species from Himalayas have reduced due to the extensive use of pesticides in these areas, since these species feed on the insects. These birds play an important role in controlling insects particularly in the forests.

Almost all of the project components are located in this type of habitat.

Rural and Urban Habitats

These include human habitations within agriculture areas, as well as the urban centers. Scavengers like Jackals are attracted to the garbage dumps and human feces for food. House Sparrows breed in the houses. Bank Mynas and Cattle Egrets feed on grasshoppers in the rangelands with cattle and buffalos. Banyan and Peepal trees still grow in villages. Green Pigeons and barbets feed in these trees.

Some of the oldest trees still stand in the old British era colonies. Some rare species of birds such as hornbills, Green Pigeon and Barbets still live on them. Large populations of

Pigeons breed in urban houses. Kites, Crows, Mynas, House Sparrows, and Alexandrine Parakeets breed in the urban areas.

Usually Shisham and Acacia trees are planted along side the roads and canals. Mostly Doves breed on such trees.

Very few sections of the project area (such as parts of the Humayun-Jacobabad and Tando Allahyar-Chamber transmission lines) are located in such type of habitat.

Migratory Birds

There are many migratory bird species, which still visit or pass through the modified ecozones. These include geese and ducks, cranes, many waders, raptors and large variety of passerine birds such as larks, cuckoos, rooks, ravens, starlings, tits, warblers and finches. Some of these birds fly in to stay for the winter, while the rest fly through. For many species the province serves as a breeding ground while others procreate in other areas but have been spotted in this region.

Appendix D presents a list of the important bid species of Sindh.

4.2.3 Wetlands [11]

Wetlands are among the most productive ecosystems in the world. Since Pakistan is situated on the flyway to Central Asia and South Asia, the birds breeding in Central and Northern Asia, migrate through Afghanistan to the Indus Valley, particularly to the wetlands across Sindh which are major wintering grounds of migratory water birds. Some of the important wetlands are briefly described below.

The Indus Dolphin Reserve is spread over 135 km from the Sukkur upstream to the Guddu Barrage. In 1974, the entire area was declared the home of the endangered Blind Dolphin. The major threats it faces include split populations of the dolphins due to dams and barrages on the River Indus, reduction in habitat size during dry season, high turbidity, pollution, and hunting. The number of dolphins at the site has increased from 150 in 1974 to 620 in 2001.

Manchar Lake, a threatened wetland dying from pollution and mismanagement, was once considered the largest freshwater lake in Asia. It is located about 12 miles west of the town of Sehwan Sharif and spread over an area of 100 square miles that was once renowned for its beauty and the large population of migratory birds and wild fowl. The water supply for Manchar Lake depends on water flows from River Indus via Aral Wah and Danistar Wah, storm water and hill torrents from Kirthar Hills and effluents from drainage units via Main Nara Valley Drain. Over the last two decades, the fresh water intake of the lake has declined significantly relative to the saline and toxic effluents discharged into it.

Keenjhar (Kalri) Lake is a large freshwater lake providing drinking water to Karachi. It is located in Thatta district. It was declared a Ramsar site in 1976 and later became a wildlife sanctuary under the Sindh Wildlife Protection Ordinance.

[11] Source: Sindh State of Environment and Development, IUCN, 2004.

Drigh Lake is a small, slightly brackish lake with extensive marshland. Located in Larkana district, the lake was declared a wildlife sanctuary in 1972, and became a Ramsar site in 1976.

Haleji Lake is a perennial freshwater lake with marshes and a brackish seepage lagoon. Considered a game reserve in 1971, this lake was declared a wildlife sanctuary and in 1976, the lake proceeded to become a Ramsar site. Haleji serves as an important source of water for Karachi besides being a popular recreational destination. The Lake is located in Thatta district.

Jubho Lagoon is a shallow, small brackish water lagoon with mudflats and marshes that support a large concentration of migratory birds including flamingos and endangered Dalmation pelicans, a rare species in the world. This was declared a Ramsar site in 2001 because of the efforts made by IUCN Pakistan. The lagoon is located in Thatta district.

Nurruri Lagoon is also a brackish, privately owned lagoon with barren mudflats that is visited by large concentrations of migratory water birds. It was also declared a Ramsar site in 2001. Increased salinity, sea intrusion, population pressures, agricultural and industrial pollution are major threats to this site. The lagoon is located in Badin district.

Deh Akro is a wildlife sanctuary consisting of four major habitats; desert, wetland, marsh, and agricultural. Located in Nawabshah district, it is a natural inland wetland ecosystem, which supports a variety of rare and endangered wildlife species. This area hosts a considerable number of rare fauna. Many indigenous fish species are also found here. Water scarcity during a persistent dry spell is adversely affecting this area.

Other lakes of the province include Badin and Kadhan Lagoons, Charwo Lake, Ghauspur Jheel, Hadiero Lake, Hamal Katchri Lake, Khango Lake, Khipro Lakes, Langh Lake, Mahboob Lake, Phoosna Lakes, Pugri Lake, Sadhori Lake, Sanghriaro Lake, Shahbuder and Jaffri Lake, Soonhari Lake and Tando Bago Lake.

None of the project components are located in the immediate vicinity of these wetlands.

4.2.4 Protected Areas

There exist one national park, thirty-three wildlife sanctuaries and sixteen game reserves in the HESCO area. A list of these protected areas is provided in **Exhibit 4.12**. However, none of the project components are located inside these areas.

4.3 Environmental Hotspots

In view of the greatly modified nature of the habitats, as described in **Section 4.2.2**, there do not exist any environmental hotspots at or around any of the proposed project components.

4.4 Description of Grid Station Sites and Transmission Line Routes

Salient information of the grid station sites and along different transmission line segments is provided in the following sections

4.4.1 Bukhshapur Grid Station Site

The site for the proposed grid station is located along a local road, a few kilometers outside Bukhshapur town along the Indus Highway. The site is currently under cultivation and privately owned. The area is fairly plain without any undulations. No major water bodies exist in the vicinity of the site. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination at the proposed site. A small settlement exists at a distance of about 50 m from the proposed site. Owing to the modified nature of the area, no natural vegetation or wildlife resources of any significance exist at or in the vicinity of the proposed site.

No significant developmental activities are being undertaken at or around the proposed site.

Exhibit 4.13 presents the schematic drawing of the proposed site and its surroundings. **Section C.1** in **Appendix C** presents some photographs of the area.

4.4.2 Larkana-III Grid Station Site

The site for the proposed grid station is located along a local road, a few kilometers south of the Larkana City. The site is currently under cultivation and privately owned. The area is fairly plain without any undulations. No major water bodies exist in the vicinity of the site, except a water course that runs across the road at a distance of about 20 m from the proposed site. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination at the proposed site. A small settlement exists at a distance of about 100 m from the proposed site. Owing to the modified nature of the area, no natural vegetation or wildlife resources of any significance exist at or in the vicinity of the proposed site.

No significant developmental activities are being undertaken at or around the proposed site.

Exhibit 4.14 presents the schematic drawing of the proposed site and its surroundings. **Section C.2** in **Appendix C** presents some photographs of the area.

4.4.3 Chamber Grid Station Site

The site for the proposed grid station is located along a local road, a few kilometers outside Chamber Town, about 22 km south of Tando Allahyar. The site is currently under cultivation and privately owned. The area is fairly plain without any undulations. No major water bodies exist in the vicinity of the site. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination at the proposed site. A small settlement exists at a distance of about 150 m from the proposed site. Owing to the modified nature of the area, no natural vegetation or wildlife resources of any significance exist at or in the vicinity of the proposed site.

No significant developmental activities are being undertaken at or around the proposed site.

Exhibit 4.15 presents the schematic drawing of the proposed site and its surroundings. **Section C.3** in **Appendix C** presents some photographs of the area.

4.4.4 Tando Bago Grid Station

The site for the proposed grid station is located along the Tando Bago - Badin road, just outside the Tando Bago Town. The site is currently under cultivation and privately owned. The area is fairly plain without any undulations. No major water bodies exist in the vicinity of the site. No significant sources of water contamination exist in the area, nor are there any signs of soil contamination at the proposed site. However, the vehicular traffic on the road that exists adjacent to the proposed site is likely to cause some air pollution in the area. Owing to the modified nature of the area, no natural vegetation or wildlife resources of any significance exist at or in the vicinity of the proposed site.

No significant developmental activities are being undertaken at or around the proposed site.

Exhibit 4.16 presents the schematic drawing of the proposed site and its surroundings. **Section C.4** in **Appendix C** presents some photographs of the area.

4.4.5 Feed for Bukhshapur Grid Station

The Kandhkot – Kashmore transmission line, from which the feed for the proposed grid station is to be originated, is almost adjacent to the proposed site for the Bukhshapur grid station. Hence the area description given in **Section 4.4.1** above applies to the grid station feed as well.

See **Section C.1** in **Appendix C** for the photographs of the area.

No significant developmental activities are being undertaken in the area, as mentioned in **Section 4.4.1** above.

4.4.6 Feed for Larkana-III Grid Station

The proposed feed for the new Larkana-III grid station would originate from the existing Larkana - Naseerabad transmission line. The total length of the feed is about 5 km. The tee-off point and entire length of the proposed route are located in the cultivation fields. There exist a few settlements between the tee-off point and the proposed site for the grid station, however, the route has been adjusted to avoid these settlements. The route also crosses a few local roads and several water courses. The terrain is almost entirely flat with no undulations. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route, except for some local roads which are under construction.

Exhibit 4.17 presents the schematic drawing of the proposed route. **Section C.5** in **Appendix C** presents some photographs of the route.

4.4.7 Feed for Chamber Grid Station

The proposed feed for the new Chamber grid station would originate from the existing Tando Allahyar grid station. The total length of the proposed feed is about 22 km. The

initial portion of the route (about 1 km) runs parallel to the main Hyderabad – Tando Allahyar – Mirpur Khas road, in the existing right of way. A few small squatters exist in the right of way, which will need to be removed while constructing this portion of the transmission line.

Beyond the above mentioned area, the route generally passes through cultivated area. The route has been deviated where necessary to avoid the settlements that exist in the area. The route also crosses a few local roads and several water courses. The terrain is almost entirely flat with no undulations. No significant sources of water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. However, a significant portion of the route runs along roads, hence the vehicular traffic is likely to cause air pollution in the area. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.18 presents the schematic drawing of the proposed route. **Section C.6** in **Appendix C** presents some photographs of the route.

4.4.8 Feed for Tando Bago Grid Station

The proposed feed for the new Tando Bago grid station would originate from the existing Badin - Pangrio transmission line. The total length of the proposed feed is about 4 km. The tee-off point and entire length of the proposed route are located in the cultivation fields. There exist a few settlements between the tee-off point and the proposed site for the grid station, however, the route has been adjusted to avoid these settlements. The route also crosses a few local roads and several water courses. A few water ponds also exist in the area. The terrain is almost entirely flat with no undulations. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.19 presents the schematic drawing of the proposed route. **Section C.7** in **Appendix C** presents some photographs of the route.

4.4.9 Feed for Matiari Grid Station

The proposed feed for the conversion of Matiari grid station would originate from the existing Hala Road - Hala transmission line. The total length of the proposed feed is about 1 km. The tee-off point and entire length of the proposed route are located in the cultivation fields. The short length of the route does not cross any settlements or road. The terrain is almost entirely flat with no undulations. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist at or in the vicinity of the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.20 presents the schematic drawing of the proposed route. **Section C.8** in **Appendix C** presents some photographs of the route.

4.4.10 Feed for Kandiari Grid Station

The proposed feed for the conversion of Kandiari grid station would originate from the existing Sanghar – Mirpur Khas transmission line. The total length of the proposed feed is about 2 km. The tee-off point and entire length of the proposed route are located in the cultivation fields. The short length of the route does not cross any settlements or road. The terrain is almost entirely flat with no undulations. No significant sources of air pollution or water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.21 presents the schematic drawing of the proposed route. **Section C.9** in **Appendix C** presents some photographs of the route.

4.4.11 Humayun – Jacobabad Transmission Line

The total length of the proposed transmission line is about 22 km. Most parts of the proposed route are located in the cultivation fields. The route crosses a few local roads and several water courses. The terrain is almost entirely flat with no undulations. Several deviations have been made in the proposed route to avoid settlements that exist in the area. No significant sources of water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. However, several portions of the route run close to the roads, where ambient air quality is likely to be affected by the vehicular traffic. The last portion of the proposed route passes over a congested settlement. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.22 presents the schematic drawing of the proposed route. **Section C.10** in **Appendix C** presents some photographs of the route.

4.4.12 Samaro – Naukot Transmission Line Route

The total length of the proposed transmission line is about 60 km. Most parts of the proposed route are located in the cultivation fields, though there exist several uncultivated patches of land in the area. The route crosses a few local roads and several water courses. The terrain is almost entirely flat with no undulations. Several deviations have been made in the proposed route to avoid settlements that exist in the area. No significant sources of water contamination exist in the area, nor any visible signs of soil contamination along the proposed route. However, several portions of the route run close to the roads, where ambient air quality is likely to be affected by the vehicular traffic. Owing to cultivation and habitation in the area, no natural vegetation or wildlife resources of any significance exist along the proposed route.

No significant developmental activities are being undertaken along the proposed route.

Exhibit 4.23 presents the schematic drawing of the proposed route. **Section C.11** in **Appendix C** presents some photographs of the route.

Exhibit 4.1: Land Use in Sindh

Land Use	Area (Million Ha)	Percentage
Not Sown	3.022	21.446
Current Fallow	1.439	18.935
Cultivable Waste	2.688	10.212
Total Available for Cultivation	7.149	50.593
Not Available for Cultivation	5.830	41.374
Forest	1.125	7.984
Unreported	0.007	0.049
Total	**14.091**	**100.000**

Source: Sindh State of Environment and Development, IUCN, 2004.

Exhibit 4.2: Meteorological Data – Mean Monthly Maximum Temperatures

Degrees Celsius

Month	Hyderabad [a]	Umerkot [b]	Sanghar [c]	Badin	Jacobabad
January	25.04	26.49	24.31	25.78	22.60
February	28.15	29.16	27.06	28.59	25.24
March	33.38	34.52	33.29	34.02	31.28
April	38.87	39.12	39.25	38.40	38.00
May	41.62	41.49	43.53	39.85	43.08
June	40.15	39.72	43.23	38.02	44.33
July	37.40	36.19	40.37	35.11	40.56
August	36.30	34.51	38.60	33.61	38.24
September	36.84	35.70	38.14	34.36	37.00
October	37.19	37.12	37.14	35.80	35.32
November	31.95	32.98	31.59	31.87	30.06
December	26.27	27.95	25.53	26.68	24.11
Annual	**34.47**	**34.52**	**35.19**	**33.48**	**34.15**

Source: Data Processing Centre, Pakistan Meteorological Department, Karachi

[a] Measured at Hyderabad Air Port. [b] Measured at Chor. [c] Measured at Nawabshah.

Exhibit 4.3: Meteorological Data – Mean Monthly Minimum Temperatures

Degrees Celsius

Month	Hyderabad [a]	Umerkot [b]	Sanghar [c]	Badin	Jacobabad
January	11.08	5.42	5.92	8.73	7.68
February	13.62	8.71	8.72	11.60	10.48
March	18.50	14.29	14.22	16.80	16.30
April	22.98	20.12	19.71	21.80	22.33
May	26.16	24.50	24.59	25.47	26.74
June	28.07	27.17	27.67	27.46	29.38
July	27.81	26.82	27.60	27.04	29.22
August	26.71	25.73	26.33	26.06	28.25
September	25.34	23.88	23.77	24.87	25.85
October	22.27	18.54	18.18	21.70	20.29
November	17.29	11.89	12.23	15.86	14.08
December	12.50	6.62	7.39	10.10	8.74
Annual	**21.03**	**17.84**	**18.00**	**19.76**	**19.95**

Source: Data Processing Centre, Pakistan Meteorological Department, Karachi.

Exhibit 4.4: Meteorological Data – Precipitation

mm

Month	Hyderabad [a]	Umerkot [b]	Sanghar [c]	Badin	Jacobabad
January	1.17	0.62	1.64	0.96	3.10
February	3.87	1.96	1.88	3.60	7.03
March	5.05	4.55	3.14	2.30	10.32
April	5.74	3.50	3.05	2.49	1.93
May	3.47	2.97	1.33	0.69	1.74
June	13.84	19.74	8.35	10.76	4.70
July	56.66	79.03	51.80	70.49	36.79
August	60.75	74.53	45.41	89.88	26.31
September	21.41	22.95	10.42	34.43	11.21
October	1.50	2.07	2.87	3.72	2.31
November	2.10	3.57	1.49	1.67	1.14
December	1.99	0.90	2.73	1.11	3.69
Annual	**177.55**	**216.39**	**134.11**	**222.10**	**110.27**

Source: Data Processing Centre, Pakistan Meteorological Department, Karachi.

[a] Measured at Hyderabad Air Port. [b] Measured at Chor. [c] Measured at Nawabshah.

Exhibit 4.5: Meteorological Data – Relative Humidity

%

Month	Hyderabad [a]	Umerkot [b]	Sanghar [c]	Badin	Jacobabad
January	47.90	45.52	59.98	50.38	50.88
February	45.38	44.45	56.00	48.81	48.23
March	42.40	42.55	50.62	48.36	42.76
April	41.88	42.73	44.66	48.97	33.01
May	46.96	46.81	42.63	53.10	30.93
June	56.35	56.40	51.81	60.70	41.16
July	63.42	67.23	62.10	69.61	56.18
August	65.26	70.15	66.06	72.55	62.20
September	61.37	64.76	62.38	69.78	59.38
October	47.65	50.78	55.16	59.15	48.87
November	46.40	44.58	59.48	53.88	45.75
December	49.26	46.84	62.47	52.46	52.73
Annual	**51.19**	52.11	**56.03**	**57.56**	**47.70**

Source: Data Processing Centre, Pakistan Meteorological Department, Karachi

[a] Measured at Hyderabad Air Port. [b] Measured at Chor. [c] Measured at Nawabshah.

Exhibit 4.6: Ambient Air Quality in Urban Centers

Pollutant	*Units*	*Rawalpindi*	*Lahore*	*Karachi*	*Quetta*	*Peshawar*
Total suspended particles (TSP)	$\mu g/m^3$	435.0	886.0	390	680	489
Particulate matter of size less than 10 micron (PM_{10})	$\mu g/m^3$	230.0	300.0	280	310	310
Sulfur dioxide (SO_2)	Ppb	37.0	55.7	44	45.5	42
Carbon monoxide (CO)	Ppm	16.5	26.8	22.8	18.0	16.5
Oxides of nitrogen (NO_X)	Ppb	40.0	55.0	42	41	42.5
Ozone	Ppb	42.0	51.0	48.0	44.4	48.0

Source: Ambient air quality tests carried out by SUPARCO, 2004.

Exhibit 4.7: Indus River and its Tributaries [a]

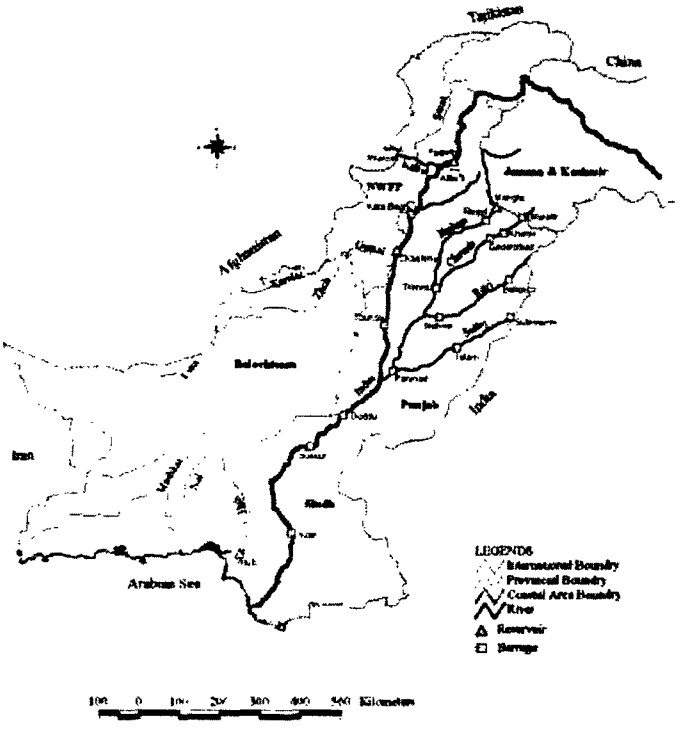


Exhibit 4.8: Key Facts about Indus River [a]

Length of River Indus in Pakistan:	1,708 miles (2,767 km)
Important Engineering	Tarbela Dam and Ghazi Barotha Hydro Power Project
Structures on the River:	Jinnah Barrage (950,000 cusecs),
	Chashma Barrage (1.1 million cusecs),
	Taunsa Barrage (750,000 cusecs),
	Guddu Barrage (1.2 million cusecs),
	Sukkur Barrage (1.5 million cusecs) and
	Kotri Barrage (750,000 cusecs)
Catchment Area:	252,638 miles^2 (663,023 km^2)
Annual Average Flow:	48.0 MAF (41.41 Kharif and 6.61 Rabi)

[a] Source: Pakistan Water Gateway.

Exhibit 4.9: Water Flow in Indus River

Average Annual Flow - 1922-61 (MAF)	Average Annual Flow - 1985-95 (MAF)	Average Annual Flow - 2001-02 (MAF)
93.00	62.70	48.00

Source: Pakistan Water Gateway.

Mean Monthly Flow in Indus at Sukkur from 1940-41 to 1996-97

Month	Flow (Bm^3)	Percentage
January	1.29	1.41%
February	0.46	0.50%
March	0.81	0.88%
April	2.55	2.78%
May	5.21	5.69%
June	9.61	10.49%
July	21.78	23.77%
August	31.57	34.45%
September	13.66	14.91%
October	3.27	3.57%
November	0.75	0.82%
December	0.67	0.73%
Total	**91.63**	**100%**

Exhibit 4.10: Water Quality in Project Area

Water Quality Parameter	Unit	Hyderabad			Sukkur		
		Min.	Max.	Avg.	Min.	Max.	Avg.
Alkalinity	m.mol/l	1.50	5.80	1.96	1.20	11.20	3.38
Arsenic	µg/l	0	200.00	13.80	0	0	0
Bicarbonate	mg/l	75.00	290.00	98.00	60.00	560.00	168.75
Calcium	mg/l	25.00	88.00	33.93	22.00	76.00	34.33
Carbonate	mg/l	0	0	0	0	0	0
Chloride	mg/l	5.00	124.00	25.33	3.00	216.00	50.25
Chromium	Ppb	0	25.00	9.20	0	8.00	1.92
Conductivity	µS/cm	260.00	1,150.00	387.00	170.00	1,877.00	570.00
Fluoride	mg/l	0.20	0.42	0.46	0	0.56	0.26
Hardness	mg/l	100.00	370.00	136.33	85.00	390.00	171.25
Iron	mg/l	0.02	3.90	1.33	0.20	1.20	0.57
Magnesium	mg/l	8.00	36.00	12.47	7.00	68.00	20.50
Nitrate (N)	mg/l	0.50	4.00	2.14	1.00	5.60	4.16
pH	-	6.50	7.70	7.15	7.10	7.80	7.47
Phosphate	mg/l	0	0.22	0.05	0.01	0.22	0.08
Potassium	mg/l	4.00	10.00	5.94	4.10	10.00	5.36
Sodium	mg/l	10.00	102.00	26.20	9.00	306.00	89.75
Sulfate	mg/l	28.00	138.00	45.07	25.00	250.00	96.75
TDS	mg/l	161.00	782.00	244.93	144.00	1,314.00	468.00
Turbidity	NTU	2.00	160.00	40.80	0.50	154.00	54.59
Total Coliform	MPN/100 ml	0	16.00	4.20	0	9.00	4.42

Water quality analyses of multiple test points. Source: National Water Quality Monitoring Programme, PCRWR.

Exhibit 4.11: Water Quality at Project Sites

Water Quality Parameter	Unit	Guideline Value	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Color	TCU	15	Colorless	Colorless	Colorless	Light Muddy	Light Muddy	Colorless	Light Muddy	Colorless
Odor	-	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless	Odorless
Taste	-	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able	Unobjection-able
Turbidity	NTU	5.0	2.5	2.3	2.6	22.0	28.0	2.8	35.0	3.2
pH	-	6.5-8.5	7.5	7.3	7.1	7.2	7.3	7.1	7.3	7.2
Conductivity	µS/cm	-	704.0	1,880.0	9,350.0	2,400.0	3,150.0	1,750.0	953.0	1,083.0
Salinity	g/l	-	0.3	1.0	5.2	1.2	1.6	0.9	0.5	0.5
TDS	mg/l	1,000.0	451.0	1,203.0	5,984.0	1,536.0	2,016.0	1,119.0	610.0	693.0
Chloride	mg/l	250.0	40.0	298.0	2,530.0	443.0	550.0	174.0	110.0	126.0
Bicarbonates	mg/l	-	290.0	315.0	365.0	395.0	360.0	330.0	270.0	280.0
Carbonates	mg/l	-	-	-	-	-	-	-	-	-
Hardness	mg/l	500.0	330.0	560.0	1,180.0	670.0	850.0	580.0	310.0	370.0
Arsenic	µg/l	10.0	-	-	-	-	25.0	-	-	-
Total Coliform	-	Not Present	Present	Not Present	Not Present	Present	Present	Not Present	Present	Not Present
E-Coli	-	Not Present	Present	Not Present	Not Present	Present	Present	Not Present	Present	Not Present

Key: S-1: Bukhshapur Grid Station Site; S-2: Larkana-III Grid Station Site; S-3: Chamber Grid Station Site; S-4: Tando Bago Grid Station Site; S-5: Matiari Grid Station; S-6: Kandiari Grid Station; S-7: Samaro Grid Station; S-8: Naukot Grid Station.

Note: Groundwater samples collected from the above mentioned sites and tested at the High Tech Central Resource Laboratory, University of Sindh, Jamshoro, March/April 2007.

Exhibit 4.12: Wildlife Protected Areas in HESCO Area

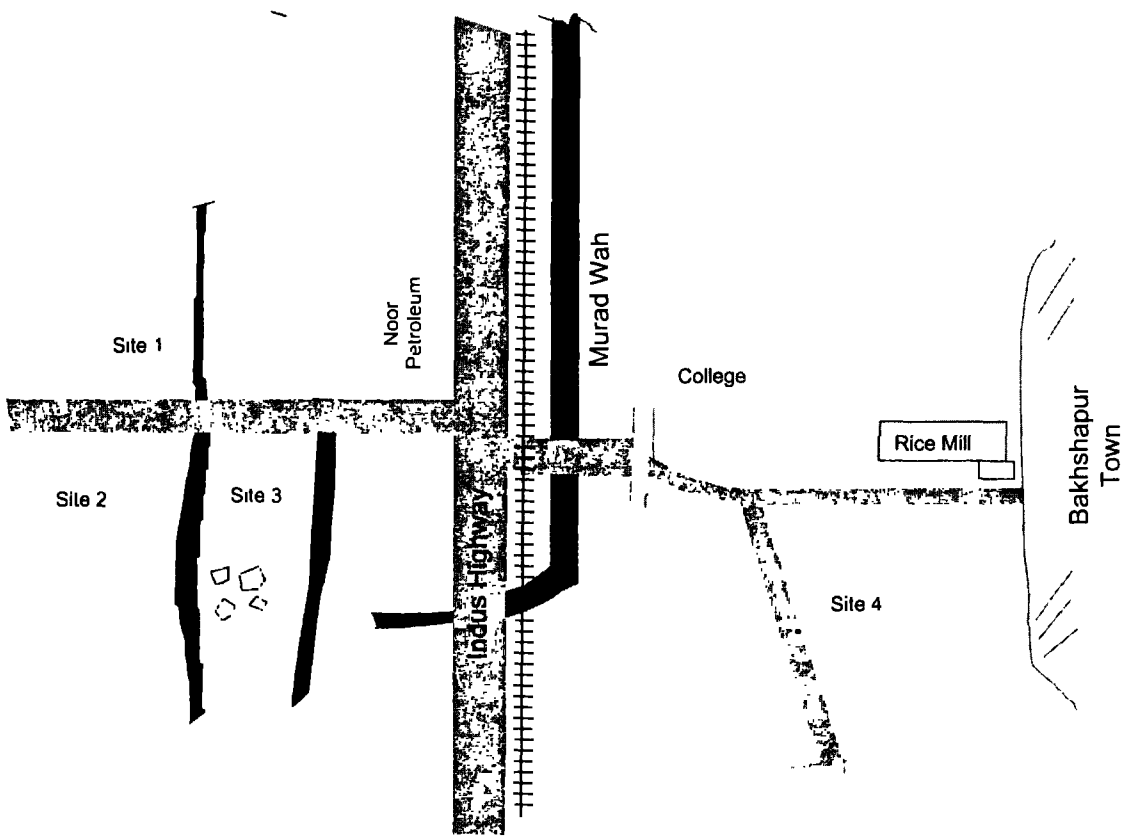
Protected Area Name	Area (ha)	Classification	Coordinates
Bijoro Chach	121	Wildlife Sanctuary	Not Recorded
Cut Munarki Chach	405	Wildlife Sanctuary	Not Recorded
Deh Akro/Nara Canal	20,000	Wildlife Sanctuary	27/42 N. 68/52 E.
Deh Jangisar	314	Game Reserve	Not Recorded
Deh Khalifa	429	Game Reserve	Not Recorded
Deh Sahib Saman	349	Game Reserve	Not Recorded
Dhoung Block	2,098	Wildlife Sanctuary	Not Recorded
Dograyon Lake	648	Wildlife Sanctuary	Not Recorded
Dosu Forest	2,312	Game Reserve	Not Recorded
Drigh Lake	164	Wildlife Sanctuary	Not Recorded
Ghamot	27,283	Game Reserve	Not Recorded
Ghondak Dhoro	31	Wildlife Sanctuary	Not Recorded
Gullel Khon	40	Wildlife Sanctuary	Not Recorded
Gulsher Dhand	24	Wildlife Sanctuary	Not Recorded
Hadero Lake	1,321	Wildlife Sanctuary	24/50 N. 67/53 E.
Hala	954	Game Reserve	25/48 N. 68/25 E.
Haleji Lake	1,704	Wildlife Sanctuary	24/49 N. 67/44 E.
Hilaya	324	Wildlife Sanctuary	Not Recorded
Indus River	44,200	Game Reserve	28/24 N. 69/45 E.
Keti Bunder South	8,948	Wildlife Sanctuary	24/08 N. 67/27 E.
Keti Bunder North	23,040	Wildlife Sanctuary	24/08 N. 67/27 E.
Khadi	81	Wildlife Sanctuary	Not Recorded
Khairpur Game Reserve	Not Recorded	Unclassified	27/32N. 68/47 E.
Khanpur	Not Recorded	Unclassified	Not Recorded
Khat Dhoro	11	Wildlife Sanctuary	Not Recorded
Khipro	3,885	Game Reserve	25/49 N. 69/21 E.
Kinjhar (Kain) Lake	13,468	Wildlife Sanctuary	29/54 N. 70/57 E.
Kirthar	308,733	National Park	25/44 - 27/15 N. 67/10.E
Kot Dinghano	30	Wildlife Sanctuary	Not Recorded
Lakht	101	Wildlife Sanctuary	26/36 N. 67/53 E.
Langh (Lungh) Lake	19	Wildlife Sanctuary	27/30 N. 68/03 E.

Protected Area Name	Area (ha)	Classification	Coordinates
Mahal Kohistan	70,577	Wildlife Sanctuary	Not Recorded
Mejiran	24	Wildlife Sanctuary	Not Recorded
Mando Dero	1,234	Game Reserve	Not Recorded
Marho Kohn	162	Wildlife Sanctuary	Not Recorded
Miani Dhand	57	Wildlife Sanctuary	25/27 N. 68/23 E.
Mirpur Sakro	777	Game Reserve	24/32 N. 67/38 E.
Mubahat Dero	16	Wildlife Sanctuary	Not Recorded
Munarki	12	Wildlife Sanctuary	Not Recorded
Nara	109,966	Game Reserve	27/42 N. 68/52 E.
Nara Desert	223,590	Wildlife Sanctuary	Not Recorded
Norang	243	Wildlife Sanctuary	Not Recorded
Pai	1,969	Game Reserve	Not Recorded
Pir Mahfooz Game Reserve	Not Recorded	Unclassified	Not Recorded
Pir Pagara Game Reserve	Not Recorded	Unclassified	Not Recorded
Runn of Kutch	320,463	Wildlife Sanctuary	Not Recorded
Sadnani	84	Wildlife Sanctuary	Not Recorded
Samno Dhand	23	Wildlife Sanctuary	Not Recorded
Shah Lanko	61	Wildlife Sanctuary	Not Recorded
Surjan, Sumbak, Eri and Hothiano	40,632	Game Reserve	25/25 N. 67/55 E.
Takkar	43,513	Wildlife Sanctuary	27/15 N. 68/49 E.
Tando Matha Khan	5,343	Game Reserve	Not Recorded

Source: Guidelines for Sensitive and Critical Areas. Government of Pakistan. 1997.

Exhibit 4.13: Bukhshapur Grid Station and its Feed Schematic Diagram

(Please see the following pages.)



Legend

- Road
- Railway Track
- Canal/Water Course
- Village/Settlement
- Cultivation
- Transmission Line
- Selected Site

Assignment: Environmental and Social Assessment

Project: 6th STG Project

Client. HESCO

Source: Sketch Provided by HESCO | Not to Scale

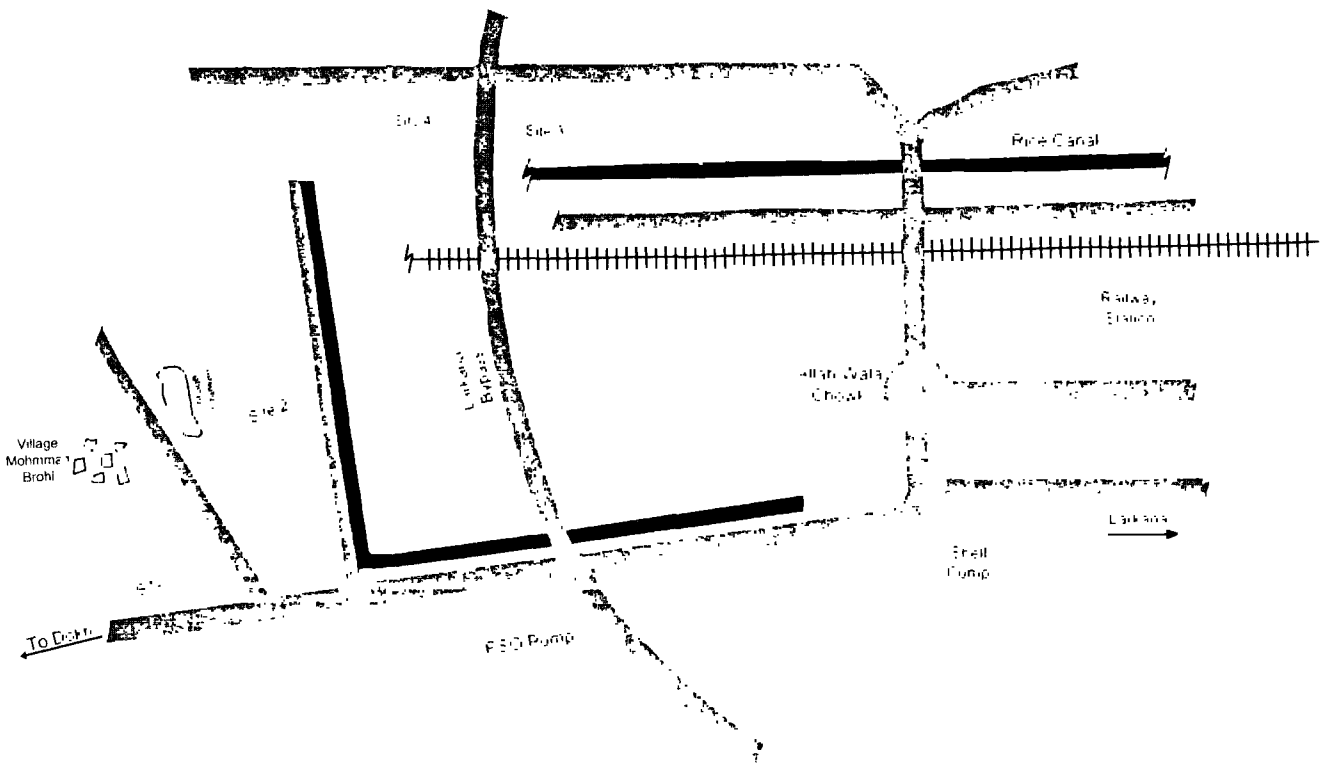
Title:

Site Plan
Bakhshapur Grid Station

Ref: HESCO-MP-008 | Date: April 2007

Exhibit 4.14: Larkana-III Grid Station Site Schematic Diagram

(Please see the following page.)



Legend

Road

Canal/Water Course

Village/Settlement

Cultivation

Selected Site

Assignment:	Environmental and Social Assessment
Project:	6th STG Project
Client:	HESCO
Source:	Sketch Provided by HESCO
	Not to Scale

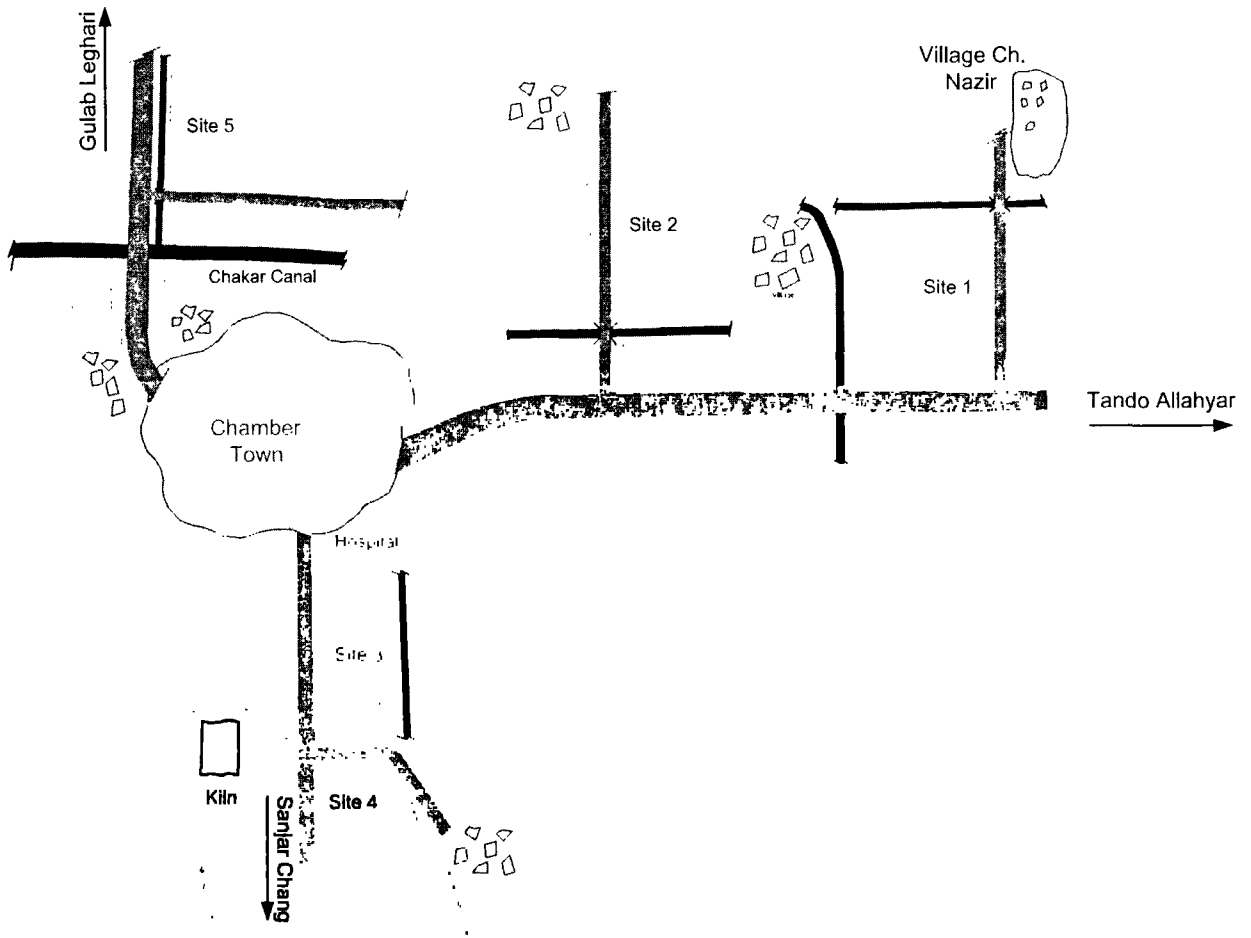
Title:

Site Plan for Larkana-III Grid Station

Ref. HESCO-MP-008	Date: April 2007

Exhibit 4.15: Chamber Grid Station Site Schematic Diagram

(Please see the following page.)



Legend

Road

Canal/Water Course

Village/Settlement

Cultivation

Transmission Line

Selected Site

Assignment: Environmental and Social Assessment

Project: 6th STG Project

Client: HESCO

Source: Sketc Provided by HESCO | Not to Scale

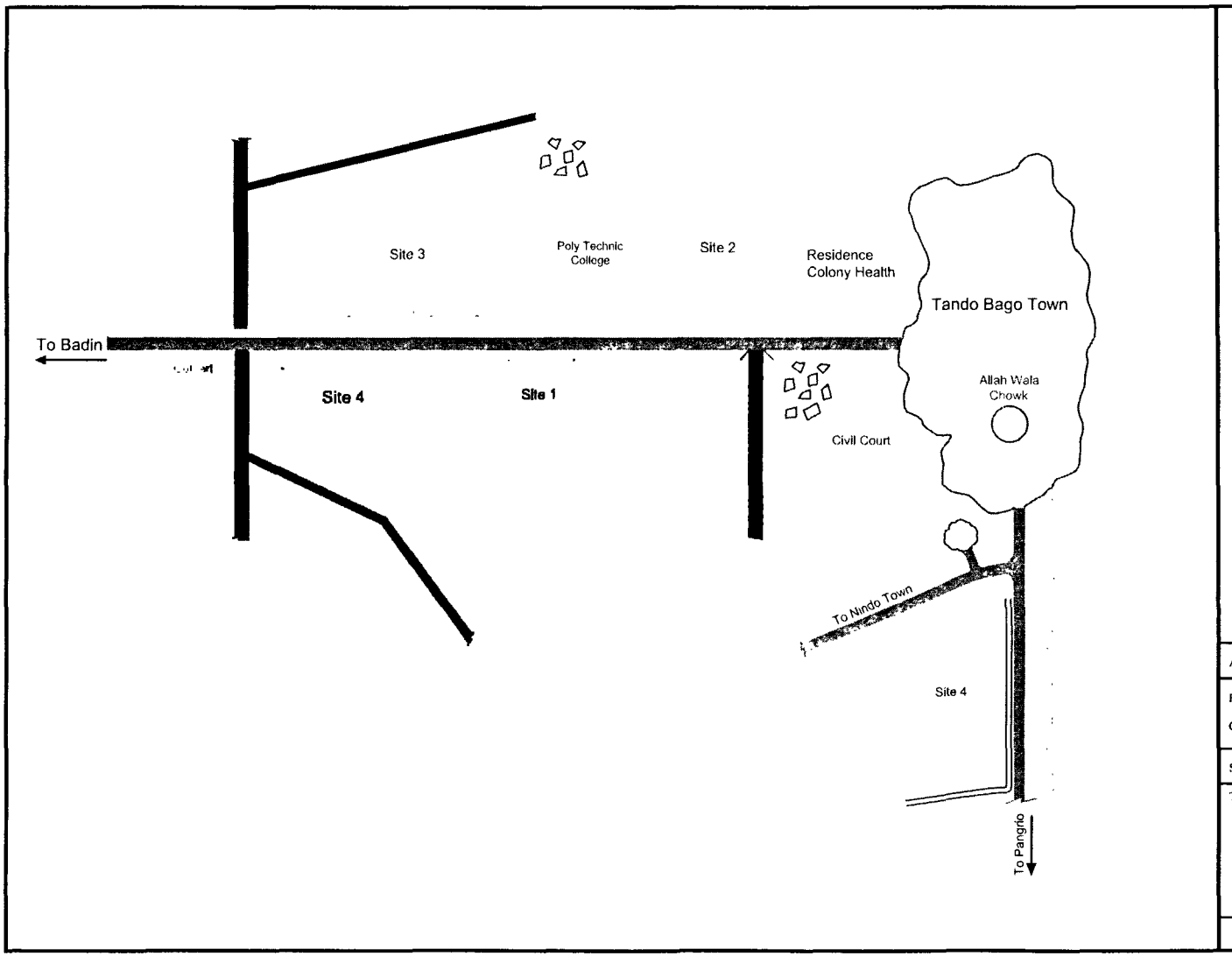
Title:

Site Plan for Chamber Grid Station

Ref: HESCO-MP-008 | Date: April 2007

Exhibit 4.16: Tando Bago Grid Station Site Schematic Diagram

(Please see the following page.)



Legend

- Road
- Canal/Water Course
- Village/Settlement
- Cultivation
- Transmission Line
- Selected Site

Assignment:	Environmental and Social Assessment
Project:	6th STG Project
Client:	HESCO
Source:	Sketch Provided by HESCO — Not to Scale

Title:

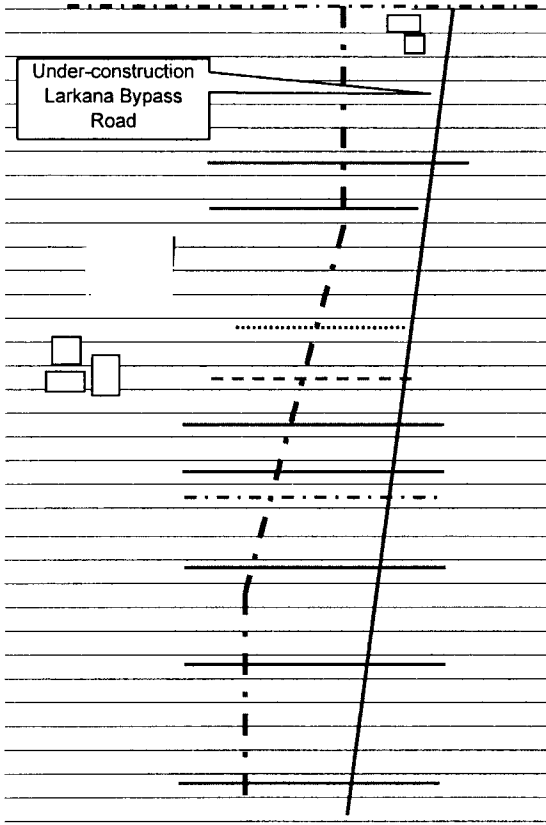
Site Plan for Tando Bago Grid Station

Ref:	HESCO-MP-008
Date:	April 2007

Exhibit 4.17: Feed for Larkana-III Grid Station Schematic Diagram

(Please see the following pages.)

Schematic Diagram: Feed for Larkana-III Grid Station (Sheet 1 of 3)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Tee-off		Cultivation	Plain	DC, NE, SH	Houses left of route.
150			Cultivation	Plain	DC	
300			Cultivation	Plain	DC	
450		Water drain	Cultivation	Plain	DC, DI, SE	
600		Road	Cultivation	Plain	DC , DI, SH	
	19°, 45´R					
750			Cultivation	Plain	DC	Fish pond right of route.
900			Cultivation	Plain	DC	
		11-kV feeder			DI	
1,050			Cultivation	Plain	DC	
		Track			DI, SH, NE	Village right of route
1,200			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
1,350			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
1,500		500-kV trans'n line	Cultivation	Plain	DC	
1,650			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
1,800	24°, 40´L		Cultivation	Plain	DC	
1,950			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
2,100			Cultivation	Plain	DC	
2,250			Cultivation	Plain	DC	
2,400		Nullah			DC, WC, SE	Cont'd to next sheet.

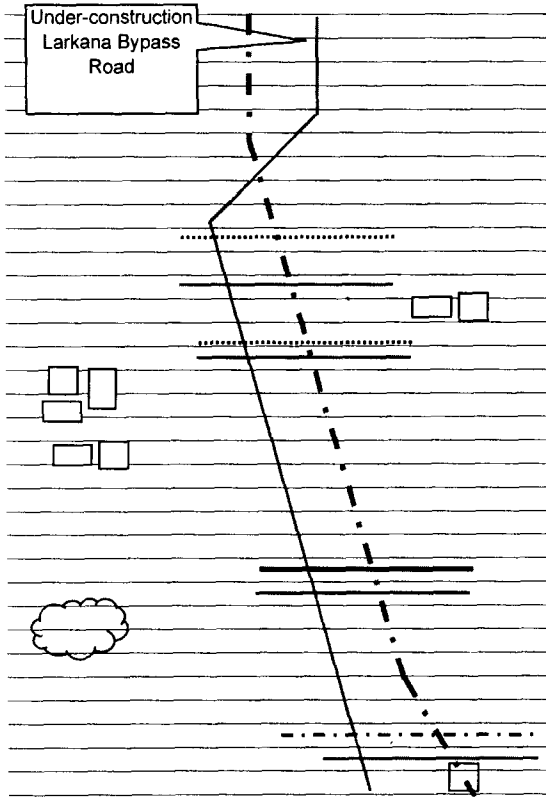
Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Not to scale

Cultivation

Schematic Diagram: Feed for Larkana-III Grid Station (Sheet 2 of 3)



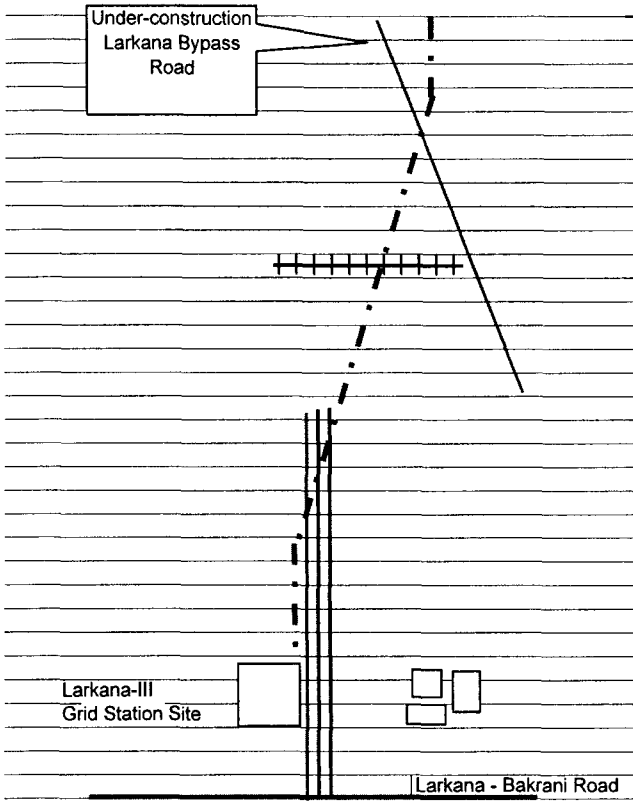
Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
2,400			Cultivation	Plain	DC	Cont'd from previous sheet
2,550			Cultivation	Plain	DC	
2,700			Cultivation	Plain	DC	
	35°, 50´ L					
2,850		Road	Cultivation	Plain	DC, DI, SH	
3,000			Cultivation	Plain	DC	
		11-kV feeder			DI	
3,150			Cultivation	Plain	DC	Fish pond right of route.
		Road			DI	
3,300			Cultivation	Plain	DC, NE, SH	Houses left of route.
		11-kV feeder			DI	
3,450		Drain channel	Cultivation	Plain	DC, DI, SE	
					DC, NE, SH	Village right of route
3,600			Cultivation	Plain	DC	
3,750			Cultivation	Plain	DC, NE, SH	Houses right of route.
3,900			Cultivation	Plain	DC	
4,050			Cultivation	Plain	DC	
		Canal			WC, SE, DI	Rice canal
4,200		Drain channel	Cultivation	Plain	DC, SE, DI	
4,350			Cultivation	Plain	DC	Stagnant water right of route.
4,500	8°, 0´ L		Cultivation	Plain	DC	
4,650		66-kV trans'n line	Cultivation	Plain	DC	
		Road			DI	
4,800			Cultivation	Plain	DC, SH, WC, SE	Fish farm on route.
						Cont'd to next sheet.

Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder; Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Feed for Larkana-III Grid Station (Sheet 3 of 3)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
4,800			Cultivation	Plain	DC	Cont'd from previous sheet
4,950			Cultivation	Plain	DC	
	30°, 10´ R					
5,100		Road	Cultivation	Plain	DC, DI	
5,250			Cultivation	Plain	DC	
5,400			Cultivation	Plain	DC	
5,550		Rail track	Cultivation	Plain	DC, DI	
5,700			Cultivation	Plain	DC	
5,850			Cultivation	Plain	DC	
6,000			Cultivation	Plain	DC	
6,150		Nullah	Cultivation	Plain	DC, WC, SE	
6,300		Drain channel	Cultivation	Plain	DC, SE, DI	
		Road			DI	
6,450	40°, 55´ L		Cultivation	Plain	DC	
6,600			Cultivation	Plain	DC	
6,750			Cultivation	Plain	DC	
6,780	Grid station site		Cultivation	Plain	DC, LA, SE, WC, SH, NE	Village across road and drain channel in front of the grid station site.

Not to scale

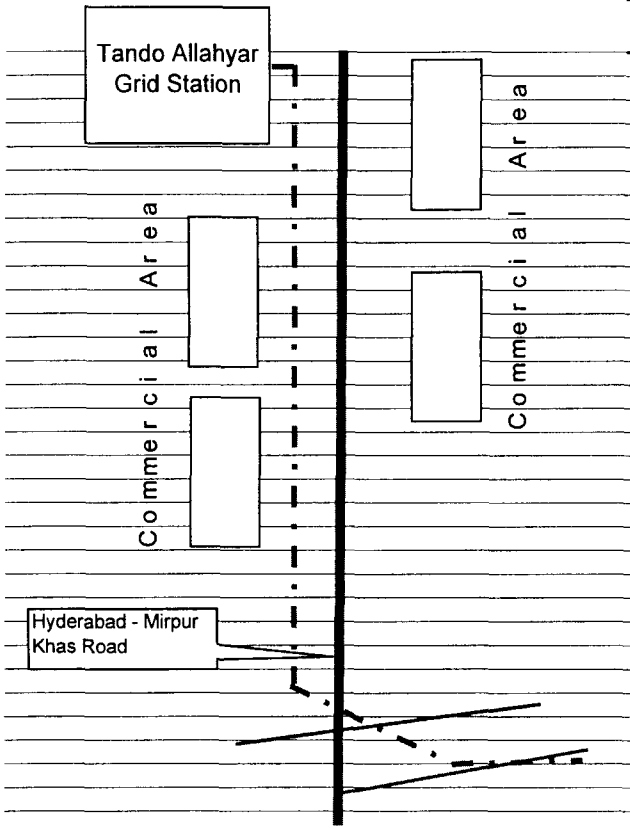
Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder; Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Exhibit 4.18: Feed for Chamber Grid Station
Schematic Diagram

(Please see the following pages.)

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 1 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Start		Grid station	Plain	SH, DE, NE, DI, PH	
80			RoW	Plain	SH, DE, NE, DI, PH	The propsoed route runs in the existing right of way (RoW), between road and building/commercial area along the road.
160			RoW	Plain	SH, DE, NE, DI, PH	
240			RoW	Plain	SH, DE, NE, DI, PH	
320			RoW	Plain	SH, DE, NE, DI, PH	
400			RoW	Plain	SH, DE, NE, DI, PH	
480			RoW	Plain	SH, DE, NE, DI, PH	
560			RoW	Plain	SH, DE, NE, DI, PH	
640			RoW	Plain	SH, DE, NE, DI, PH	
720			RoW	Plain	SH, DE, NE, DI, PH	
800			RoW	Plain	SH, DE, NE, DI, PH	
880			RoW	Plain	SH, DE, NE, DI, PH	
960			RoW	Plain	SH, DE, NE, DI, PH	
1,050	45°, 0´ L		RoW	Plain	SH, DE, NE, DI, PH	
		Road crossing			SH, DE, NE, DI, PH	
1,120		Canal crossing		Plain	SE, WC, DI	
	45°, 0´ L					
1,200		Road crossing			SH, DE, DI	(Contd. to next sheet)

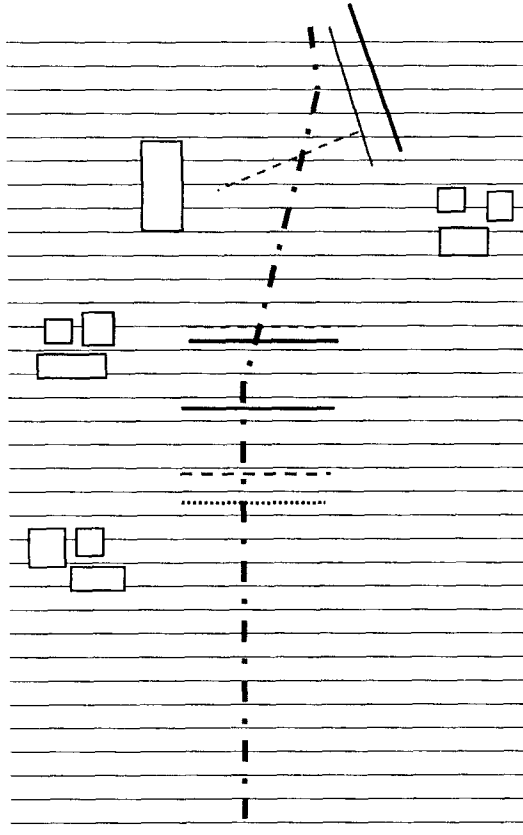
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 2 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
1,200				Plain	SH, DE, DI	Contd. from previous sheet
1,400	26°, 30´ R			Plain	SH, DE, DI	
1,600		Track crossing	Cultivation	Plain	DC, DI	Poultry farm right of route
1,800			Cultivation	Plain	DC, NE, SH	Settlement left of route
2,000			Cultivation	Plain	DC	
2,200			Cultivation	Plain	DC	
2,400		Track crossing	Cultivation	Plain	DC, DI, SH, NE	Settlement right of route
		Water course			DC, WC, SE, DI	
2,600	54°, 10´ L		Cultivation	Plain		
2,700		Drain channel			SE, DI	
2,800			Cultivation	Plain	DC	
3,000		Track crossing	Cultivation	Plain	DC, DI	
3,100		11-kV feeder			DC, DI	
3,200			Cultivation	Plain	DC	
					NE, SH	Settlement right of route
3,400			Cultivation	Plain	DC, SH	
3,600			Cultivation	Plain	DC	
3,800			Cultivation	Plain	DC	
4,000			Cultivation	Plain	DC	
4,200			Cultivation	Plain	DC	
4,400			Cultivation	Plain	DC	Contd. to next sheet.

Not to scale

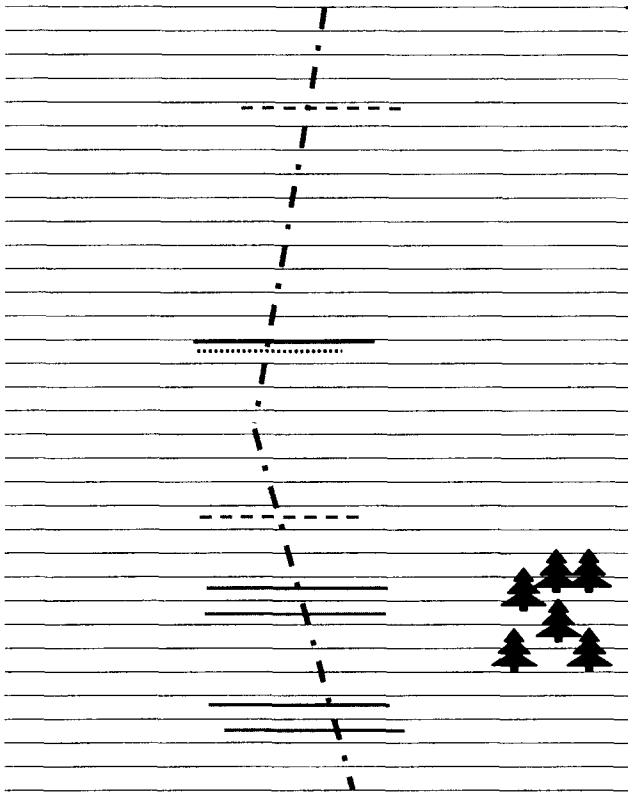
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 3 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
4,400			Cultivation	Plain	DC	Contd. from previous sheet
4,600			Cultivation	Plain	DC	
4,800		Track crossing	Cultivation	Plain	DC, DI	
5,000			Cultivation	Plain	DC	
5,200			Cultivation	Plain	DC	
5,400			Cultivation	Plain	DC	
5,600			Cultivation	Plain	DC	
5,800		Road; 11-kV feeder	Cultivation	Plain	DC, DI	
6,000			Cultivation	Plain	DC	
6,100	55°, 10´ L					
6,200			Cultivation	Plain	DC	
6,400			Cultivation	Plain	DC	
6,560					DC, DI	
6,600			Cultivation	Plain	DC	
6,800		Water course	Cultivation	Plain	DC, WC, DI, SE	Orchard left of route.
		Road			DI	
7,000			Cultivation	Plain	DC	
7,200			Cultivation	Plain	DC	
7,360		Canal crossing			DC, WC, DI, SE	
7,400		Road crossing	Cultivation	Plain	DC, DI	
7,600			Cultivation	Plain	DC	Contd. to next sheet.

Not to scale

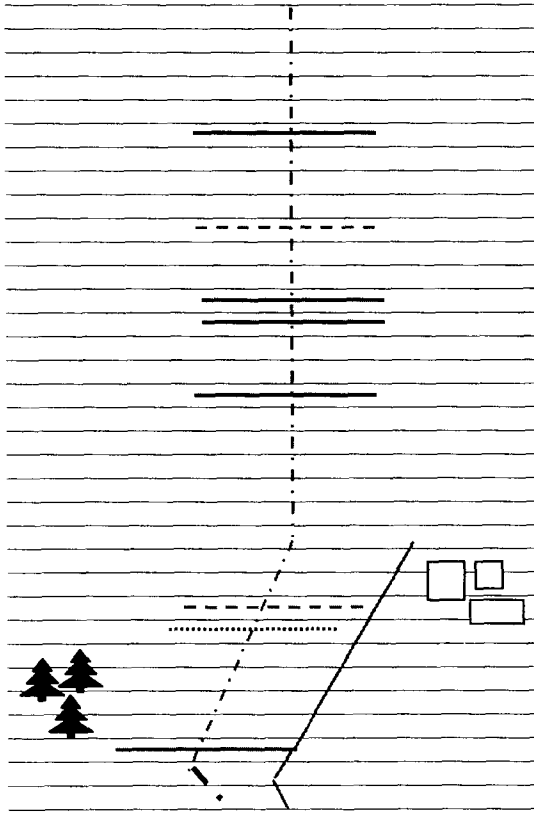
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 4 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
7,600			Cultivation	Plain	DC	Contd. from previous sheet
7800			Cultivation	Plain	DC	
8,000			Cultivation	Plain	DC	
8,160		Water course			WC, DI, DC, SE	
8,200			Cultivation	Plain	DC	
8,400			Cultivation	Plain	DC	
8,500		Track			DI	
8,600			Cultivation	Plain	DC	
8,800		Road	Cultivation	Plain	DC, DI	
8,860		Water course			WC, DI, DC, SE	
9,000			Cultivation	Plain	DC	
9,200		Water course	Cultivation		WC, DI, DC, SE	
9,400			Cultivation	Plain	DC	
9,500		Track			DI	
9,600			Cultivation	Plain	DC	
9,830	57°, 10' R		Cultivation	Plain	DC	
10,000			Cultivation	Plain	DC, NE, SH	Village left of route.
10,100		Track			DI	
10,200		11-kV feeder	Cultivation	Plain	DC, DI	
10,400			Cultivation	Plain	DC	Trees right of route.
10,600			Cultivation	Plain	DC	
10,700		Road		Plain	DI	
10,750	77°, 40' L		Cultivation	Plain	DC	Contd. to next sheet.

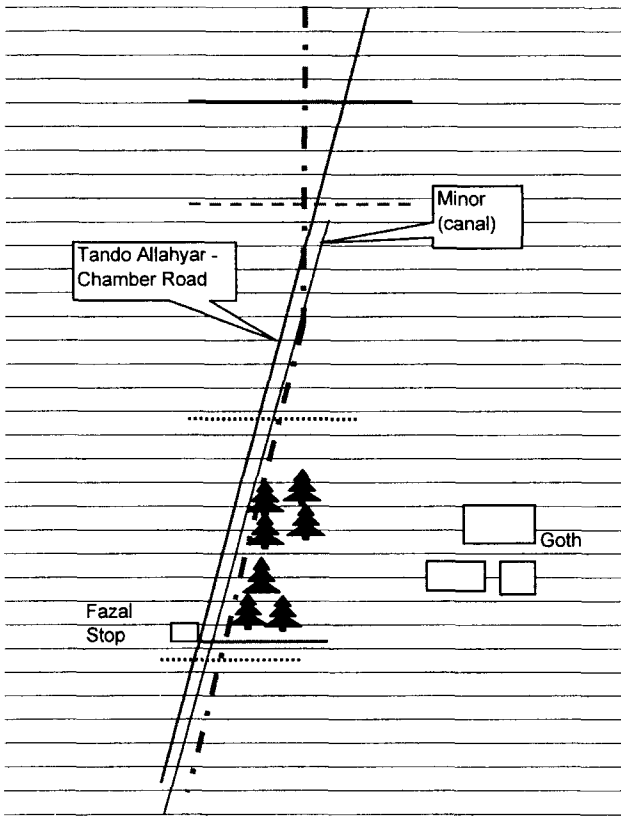
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 5 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
10,750			Cultivation	Plain	DC	Contd. from previous sheet
11000			Cultivation	Plain	DC	
11,200		Water course	Cultivation	Plain	WC, DI, DC, SE	
11,400			Cultivation	Plain	DC	
11,600		Track	Cultivation	Plain	DC, DI, WC	
11,750		Main Road	Cultivation	Plain	DC, DI, SH, WC	Tando Allahyar - Chamber
11,900		Minor (canal)			WC, DI, DC, SE	Road
12,000			Cultivation	Plain	DC, WC	
12,100	12°, 30´ R					
12,200			Cultivation	Plain	DC, WC	
12,400			Cultivation	Plain	DC, WC	
		11-kV feeder			DI	
12,600			Cultivation	Plain	DC, WC	
12,800			Cultivation	Plain	DC, WC	
13,000			Cultivation	Plain	DC, WC	Orchard on the route.
					NE, SH	Village left of route.
13,200			Cultivation	Plain	DC, WC	
						Orchard on the route.
13,400		Road	Cultivation	Plain	DC, WC, SH, NE	Fazal Stop
13,500		11-kV feeder			DI	
13,600			Cultivation	Plain	DC, WC	
14,000			Cultivation	Plain	DC, WC	
14,200			Cultivation	Plain	DC, WC	Contd. to next sheet.

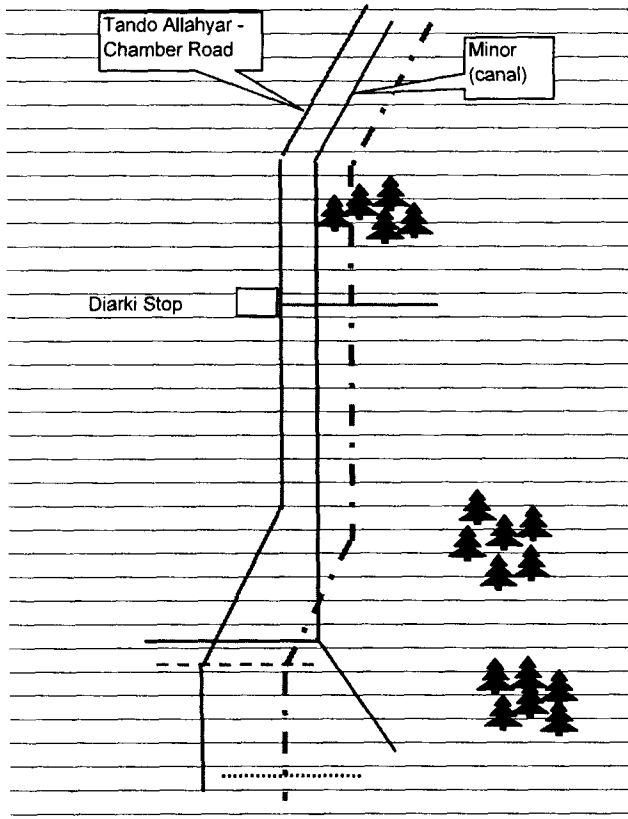
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 6 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
14,200			Cultivation	Plain	DC, WC	Contd. from previous sheet
14,400			Cultivation	Plain	DC, WC	
14,600			Cultivation	Plain	DC, WC	
14,800	11°, 30´ L		Cultivation	Plain	DC, WC	
15,000			Cultivation	Plain	DC, WC	Orchard on the route.
15,200			Cultivation	Plain	DC, WC	
15,400		Road	Cultivation	Plain	DC, WC, DI, SH, NE	Diarki Stop
15,600			Cultivation	Plain	DC, WC	
15,800			Cultivation		DC, WC	
16,000			Cultivation	Plain	DC, WC	
16,200			Cultivation	Plain	DC, WC	
16,400	48°, 20´R		Cultivation	Plain	DC, WC	Orchard left of route
16,600			Cultivation	Plain	DC, WC	
		Minor crossing			WC, DI, DC, SE	
16,800		Water course	Cultivation	Plain	WC, DI, DC, SE	
		Track			DC, DI	
17,000	50°, 40´ L		Cultivation	Plain	DC	Orchard left of route
17,200			Cultivation	Plain	DC	
17,400		11-kV feeder	Cultivation	Plain	DC, DI	Contd. to next sheet.

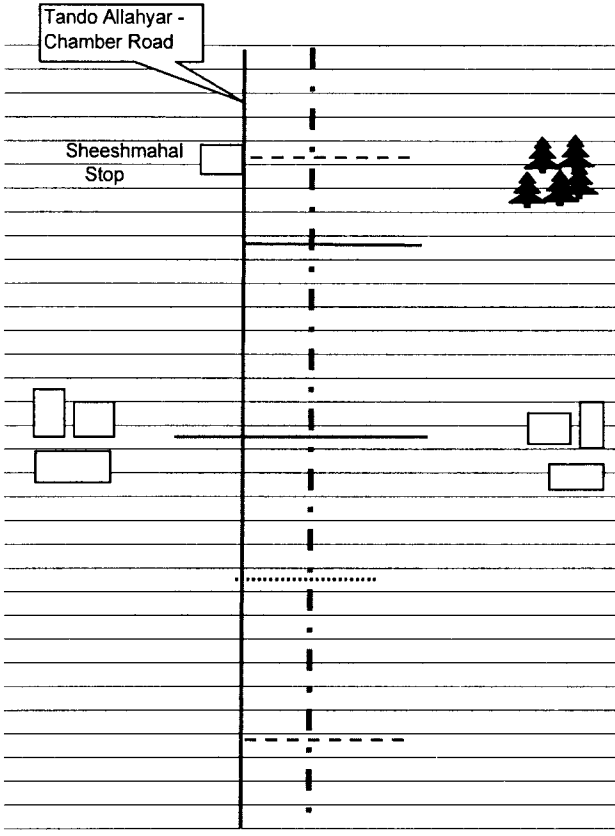
Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 7 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
17,400			Cultivation	Plain	DC	Contd. from previous sheet
17,600			Cultivation	Plain	DC	
17,800		Track	Cultivation	Plain	DI, SH, NE	
18,000			Cultivation	Plain	DC	Orchard left of route
18,200		Road	Cultivation	Plain	DI, SH	
18,400			Cultivation	Plain	DC	
18,600			Cultivation	Plain	DC	
18,800			Cultivation	Plain	DC	
19,000		Road	Cultivation	Plain	DI, DC, SH, NE	Goth left of route; village right of route
19,200			Cultivation	Plain	DC	
19,400			Cultivation	Plain	DC	
19,600		11-kV feeder	Cultivation	Plain	DC, DI	
19,800			Cultivation	Plain	DC	
20,000			Cultivation	Plain	DC	
20,200		Track	Cultivation	Plain	DC, DI	
20,400			Cultivation	Plain	DC	
20,600			Cultivation	Plain	DC	Contd. to next sheet.

Not to scale

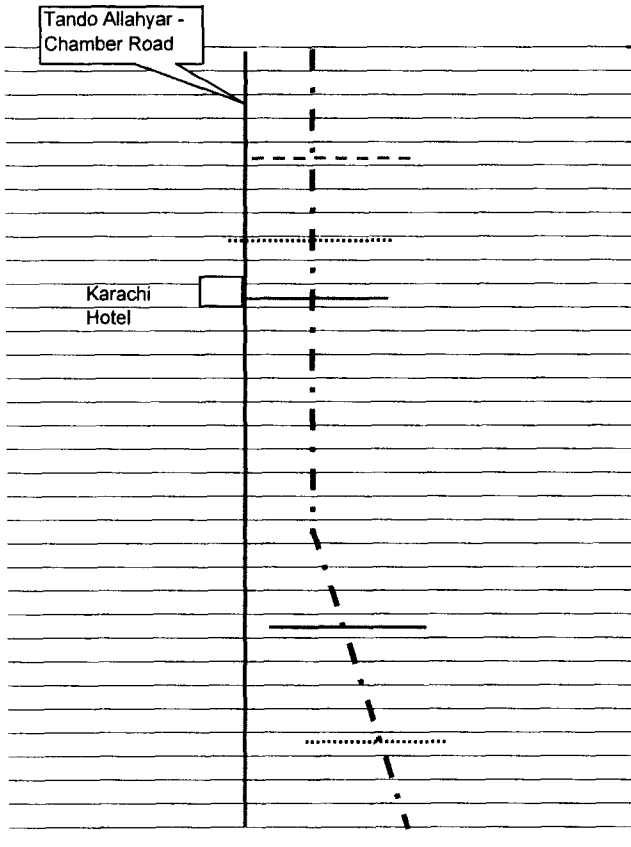
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 8 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
20,600			Cultivation	Plain	DC	Contd. from previous sheet
20,800			Cultivation	Plain	DC	
21,000			Cultivation	Plain	DI, DC	
21,200			Uncultivated	Plain		
21,400		11-kV feeder	Uncultivated	Plain	DI	
21,600		Road	Uncultivated	Plain	DI, SH, NE	
21,800			Uncultivated	Plain		
22,000			Uncultivated	Plain		
22,200			Uncultivated	Plain		
22,400			Uncultivated	Plain		
22,600	33°, 30´L		Cultivation	Plain	DC	
22,800			Cultivation	Plain	DC, DI	
23,000		Water course	Cultivation	Plain	WC, DI, DC, SE	
23,200			Cultivation	Plain	DC	
23,400			Cultivation	Plain	DC	
		11-kV feeder			DC, DI	
23,600			Cultivation	Plain	DC	
23,800			Cultivation	Plain	DC	Contd. to next sheet.

Not to scale

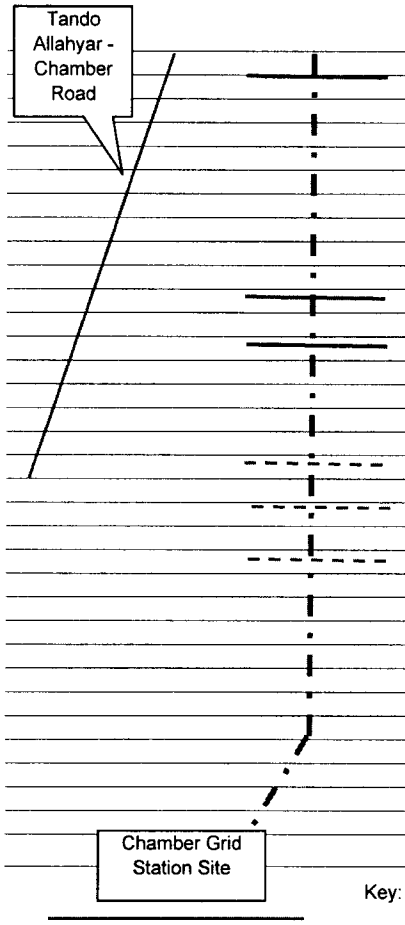
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Tando Allahyar - Chamber Transmission Line (Sheet 9 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
23,800			Cultivation	Plain	DC	Contd. from previous sheet
		Water course			WC, DI, DC, SE	
24,000			Cultivation	Plain	DC	
24,200			Cultivation	Plain	DC	
24,400			Cultivation	Plain	DC	
24,600			Cultivation	Plain	DC	
24,800		Road	Cultivation	Plain	DI, SH	
25,000		Water course	Cultivation	Plain	WC, DI, DC, SE	
25,200			Cultivation	Plain	DC	
25,400			Cultivation	Plain	DC	
		Track			DI	
25,600			Cultivation	Plain	DC	
		Track			DI	
25,800			Cultivation	Plain	DC	
		Track			DI	
26,000			Cultivation	Plain	DC	
26,200			Cultivation	Plain	DC	
26,400			Cultivation	Plain	DC	
26,600			Cultivation	Plain	DC	
	25°, 0´R					
26,800			Cultivation	Plain	DC, NE, SH	
27,000	Grid Station		Cultivation	Plain	DC, LA, SH, WC, DE, NE, DI	A small settlement near grid station site

Key:
- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

Not to scale

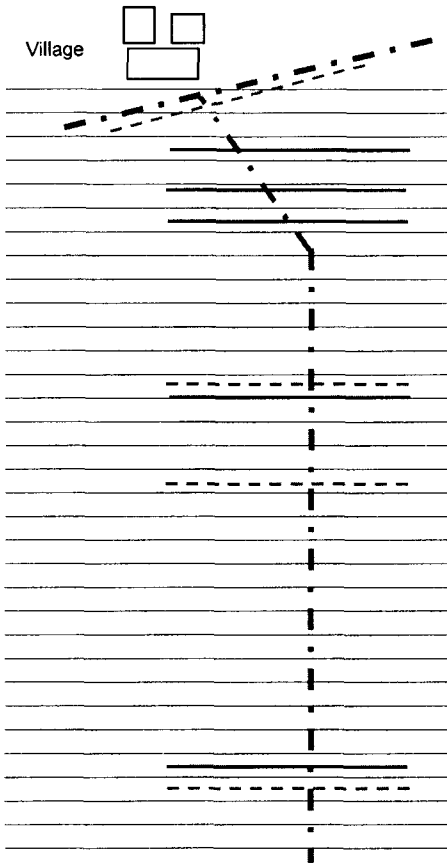
DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Exhibit 4.19: Feed for Tando Bago Grid Station Schematic Diagram

(Please see the following pages.)

Schematic Diagram: Feed for Tando Bago Grid Station (Sheet 1 of 2)



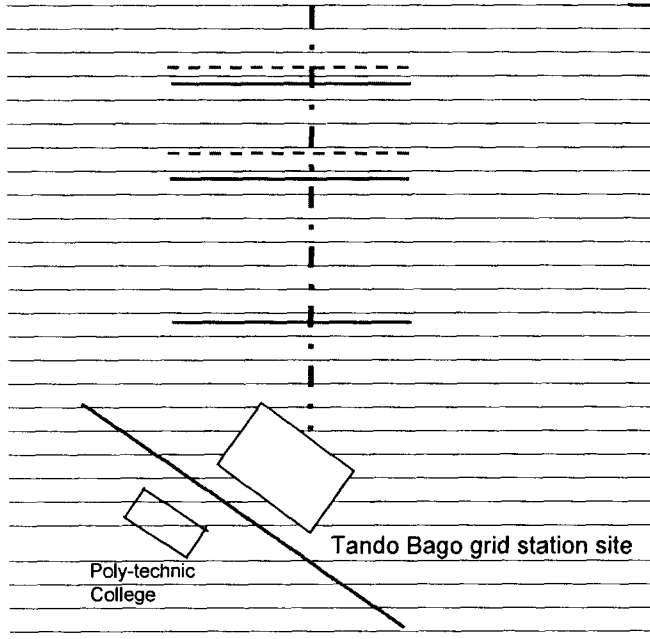
Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Tee-off		Uncultivated	Plain	SH, NE	Tee-off from the existing Pangrio-Badin transmission line.
		Track			DI	
125			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
250			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
375		Water course	Cultivation	Plain	DC, WC, DI, SE	
	22°, 0´R					
500			Cultivation	Plain	DC	
625			Cultivation	Plain	DC	
750			Cultivation	Plain	DC	
		Track			DI	
875		Water course	Cultivation	Plain	DC, WC, DI, SE	
1,000			Cultivation	Plain	DC	
		Track			DI	
1,125			Cultivation	Plain	DC	
1,250			Cultivation	Plain	DC	
1,375			Cultivation	Plain	DC	
1,500			Cultivation	Plain	DC	
1,625			Cultivation	Plain	DC	
1,750			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
1,875		Track	Cultivation	Plain	DC, DI	
2,000			Cultivation	Plain	DC	Cont'd to next sheet

Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder; Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Feed for Tando Bago Grid Station (Sheet 2 of 2)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
2,000			Cultivation	Plain	DC	Cont'd from previous sheet.
2,200		Track	Cultivation	Plain	DC, DI	
		Water course			WC, SE, DI	
2,400			Cultivation	Plain	DC	
2,600		Track	Cultivation	Plain	DC, DI	
		Water course			WC, SE, DI	
2,800			Cultivation	Plain	DC	
3,000			Cultivation	Plain	DC	
3,200			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
3,400			Cultivation	Plain	DC	
3,570			Cultivation	Plain	DC	
	Grid station site				DC, LA, SH, SE, DI, NE	

Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder

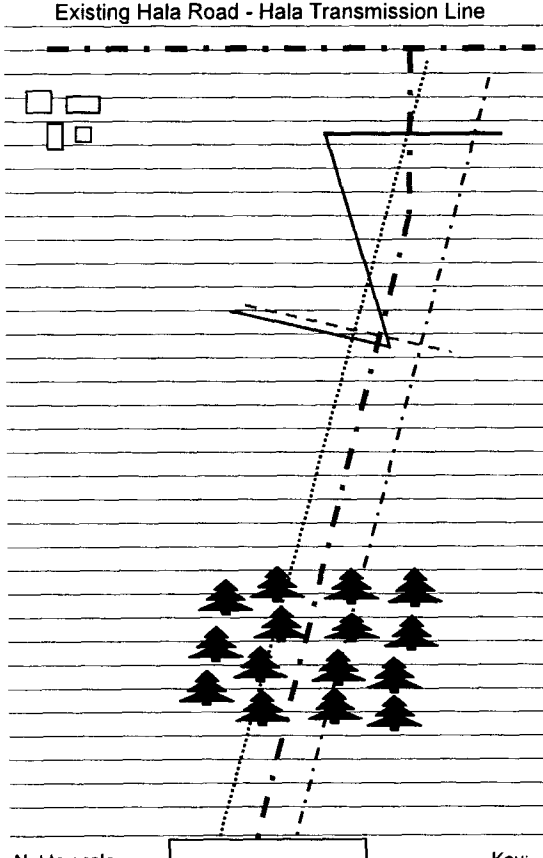
DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Exhibit 4.20: Feed for Matiari Grid Station
Schematic Diagram

(Please see the following page.)

Schematic Diagram: Feed for Matiari Grid Station (Sheet 1 of 1)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Tee-off	-	Cultivation	Plain		
50						
75		11-kV feeder	Cultivation	Plain	DI, DC, SH, DE	Village about 200m right of the route
100		Water course	Cultivation	Plain	DI, DC, WC, NE	
150	16°, 15' R	-	Cultivation	Plain	DC	
200	-	-	Uncultivated	Plain	-	
250	-	-	Uncultivated	Plain	-	
300	-	-	Cultivation	Plain	DC	
330		Water courses, track	Cultivation	Plain	DI, DC, WC, SE	
350	-	-	Cultivation	Plain	DC	
400	-	-	Cultivation	Plain	DC	
450	-	-	Cultivation	Plain	DC	
500	-	-	Cultivation	Plain	DC	
550	-	-	Orchard	Plain	DC	
600	-	-	Orchard	Plain	DC	
650	-	-	Orchard	Plain	DC	
700	-	-	Orchard	Plain	DC	
750	-	-	Cultivation	Plain	DC	
800		-	Cultivation	Plain	DC	Graveyard left of route
820	Grid Station	-	-	Plain	PH, WC	

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; 11-kV feeder

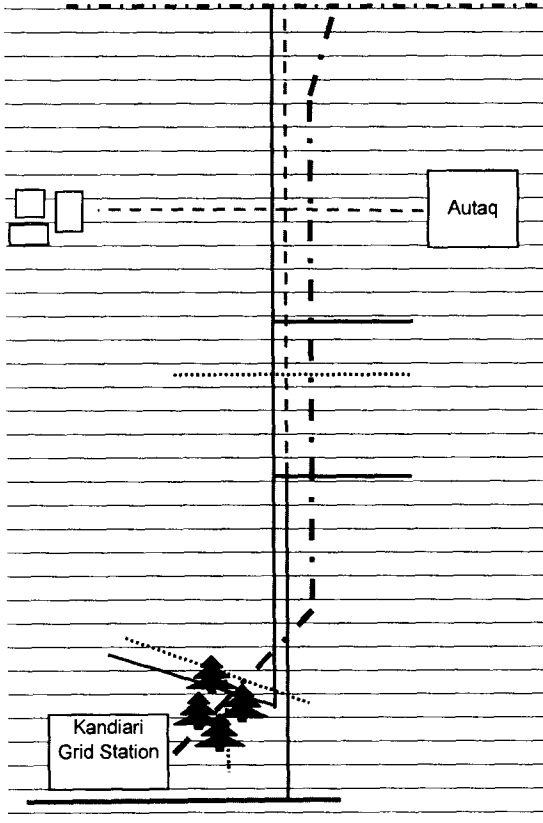
DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; SH: Safety hazards; PH: Public Health; NE: Noise emission.

Cultivation

Exhibit 4.21: Feed for Kandiari Grid Station
Schematic Diagram

(Please see the following page.)

Schematic Diagram: Feed for Kandiari Grid Station (Sheet 1 of 1)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Tee-off		Cultivation	Plain	DC	
125			Cultivation	Plain	DC	
	19°, 30´ L					
250			Cultivation	Plain	DC	
375			Cultivation	Plain	DC	
500	Track		Cultivation	Plain	DC, DI, SH, NE	Village right of route.
625			Cultivation	Plain	DC	
750			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
875			Cultivation	Plain	DC	
		11-kV feeder			DI	
1,000			Cultivation	Plain	DC	
1,125			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
1,250			Cultivation	Plain	DC	
1,375			Cultivation	Plain	DC	
1,500			Cultivation	Plain	DC	
	44°, 10´ R					
1,625			Cultivation	Plain	DC	
		Road; water course			DI, WC, SE	
1,750		11-kV feeders	Cultivation	Plain	DC, DI	
		Water course			DC, WC, SE, DI	Orchard on the route
1,870	Grid station		Cultivation	Plain	SH, WC, DE	

Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder

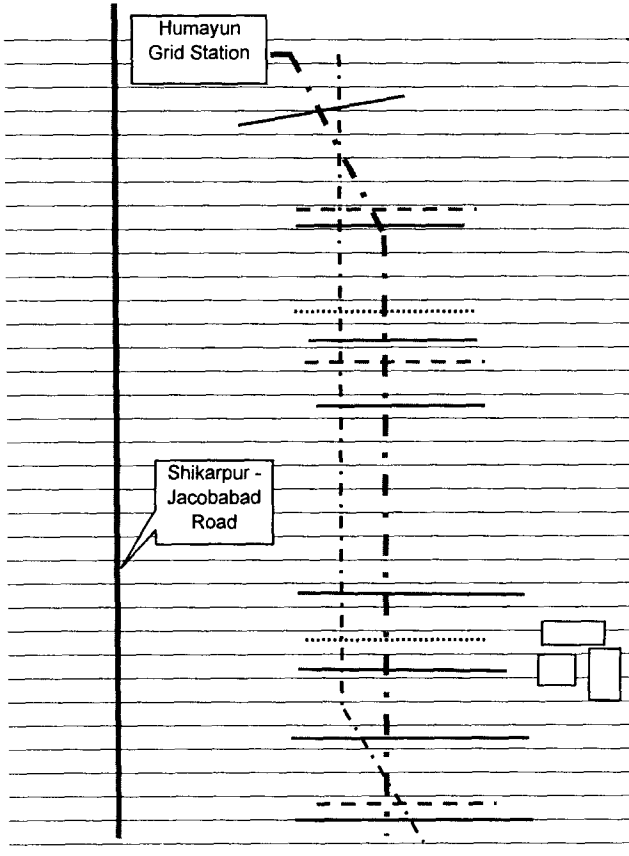
DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Exhibit 4.22: Jacobabad – Humayun Transmission Line Schematic Diagram

(Please see the following pages.)

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 1 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Start		Grid station	Plain	WC, SH, DC	
200			Cultivation	Plain	DC	
		Water course			DI, WC, SE, DC	
400		66-kV tr'n line	Cultivation	Plain	DC, DI	
600			Cultivation	Plain	DC	
		Track			DI	
800	54°, 30´ R	Water course	Cultivation	Plain	DI, WC, SE, DC	
1,000			Cultivation	Plain	DC	
		11-kV feeder			DI	
1,200		Road	Cultivation	Plain	DC, DI	
		Track			DI	
1,400			Cultivation	Plain	DC	
		Water course			DI, WC, SE, DC	
1,600			Cultivation	Plain	DC	
1,800			Cultivation	Plain	DC	
2,000			Cultivation	Plain	DC	
2,200			Cultivation	Plain	DC	
		Drain channel			DI, WC, SE, DC	
2,400			Cultivation	Plain	DC	
		11-kV feeder			DI	
2,600		Water course	Cultivation	Plain	DI, WC, SE, DC, NE	Villages left of route.
2,800			Cultivation	Plain	DC	
		Water course			DI, WC, SE, DC	
3,000			Cultivation	Plain	DC	
		66-kV tr'n line			DC, DI	
3,200		Track	Cultivation	Plain	DC, DI	
		Water course			DI, WC, SE, DC	(Contd. to next sheet)

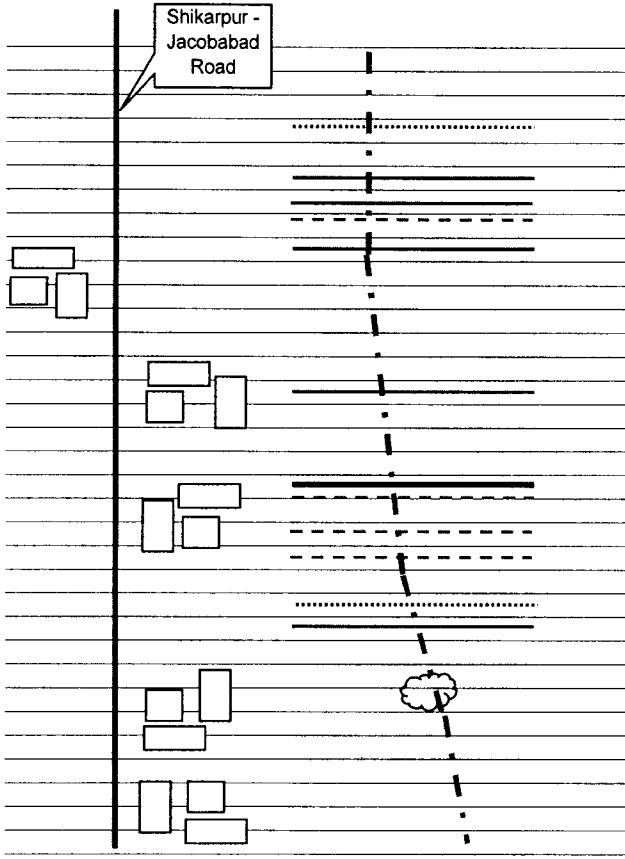
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation, SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 2 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
3,200			Cultivation	Plain	DC	Contd. From previous sheet
3,400			Cultivation	Plain	DC	
		11-kV feeder			DI	
3,600			Cultivation	Plain	DC	
		Water course			DI, WC, SE, DC	
3,800		Water course	Cultivation	Plain	DI, WC, SE, DC	
		Track			DI	
4,000		Water course	Cultivation	Plain	DI, WC, SE, DC	
	12°, 12´ L				NE, SH	Village right of route.
4,200			Cultivation	Plain	DC	
4,400			Cultivation	Plain	DC	
4,600		Water course	Cultivation	Plain	DI, WC, SE, DC	
					NE, SH	Village right of route
4,800			Cultivation	Plain	DC	
5,000		Canal	Cultivation	Plain	DI, WC, SE, DC	
		Track			DI	
5,200		Track	Cultivation	Plain	DC, DI	
		Track			DI, NE, SH	Village right of route
5,400	2°, 5´ L		Cultivation	Plain	DC	
		11-kV feeder			DI	
5,600		Water course	Cultivation	Plain	DI, WC, SE, DC	
5,800			Cultivation	Plain	DC	
						Water pond on the route
6,000	5°, 20´ R		Cultivation	Plain	DC, NE, SH	Village right of route
6,200			Cultivation	Plain	DC	
					NE, SH	Village right of route
6,400			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

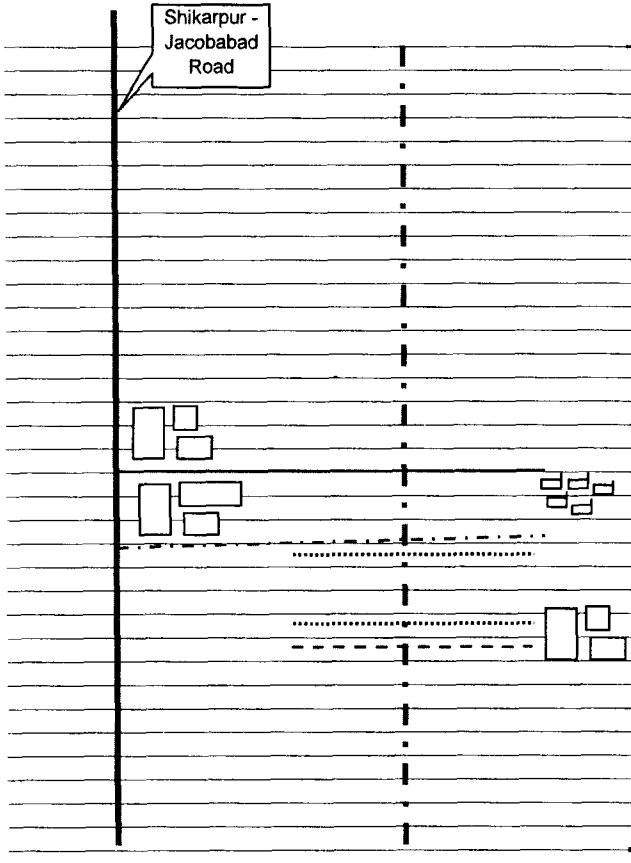
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 3 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
6,400			Cultivation	Plain	DC	Contd. From previous sheet
6,600			Cultivation	Plain	DC	
6,800			Cultivation	Plain	DC	
7,000			Cultivation	Plain	DC	
7,200			Cultivation	Plain	DC	
7,400			Cultivation	Plain	DC	
7,600			Cultivation	Plain	DC	
7,800			Cultivation	Plain	DC	
8,000			Cultivation	Plain	DC	
					NE, SH	Village right of route
8,200		Road	Cultivation	Plain	DC, DI, SH	Graveyard left of route
					NE, SH	Village right of route
8,400		track	Cultivation	Plain	DC, DI, SH	
		11-kV feeder			DI	
8,600			Cultivation	Plain	DC	
8,800		11-kV feeder	Cultivation	Plain	DC, DI	
		Track			NE, SH, DI	Village left of route
9,000			Cultivation	Plain	DC	
9,200			Cultivation	Plain	DC	
9,400			Cultivation	Plain	DC	
9,600			Cultivation	Plain	DC	
						(Contd. to next sheet)

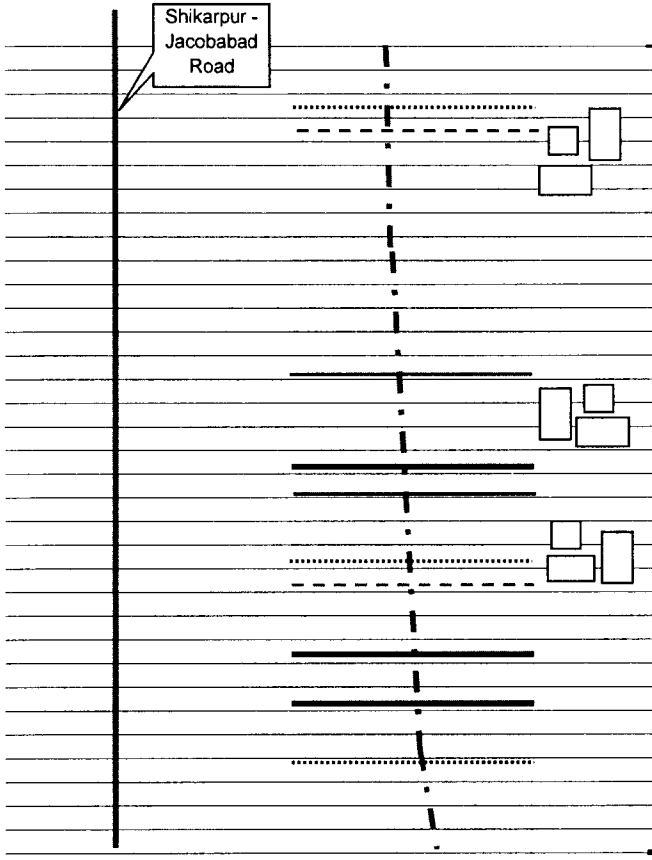
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 4 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
9,600			Cultivation	Plain	DC	Contd. From previous sheet
9,800		11-kV feeder	Cultivation	Plain	DC, DI	
		Track			DI	
10,000			Cultivation	Plain	DC, NE, SH	Village left of route
10,200			Cultivation	Plain	DC	
10,400	7°, 40´ L		Cultivation	Plain	DC	
10,600			Cultivation	Plain	DC	
10,800			Cultivation	Plain	DC	
		Water course			DI, WC, SE	
11,000			Cultivation	Plain	DC	
11,200			Cultivation	Plain	DC, NE, SH	Village left of route
		Canal			DI, WC, SE	
11,400		Water course	Cultivation	Plain	DC, WC, SE, DI	
11,600			Cultivation	Plain	DC	
		11-kV feeder			DI	
11,800		Track	Cultivation	Plain	DC, DI, NE, SH	Village left of route
12,000			Cultivation	Plain	DC	
		Canal			DI, WC, SE	
12,200			Cultivation	Plain	DC	
		Canal			DI, WC, SE	
12,400			Cultivation	Plain	DC	
	4°, 20´ L					
12,600		11-kV feeder	Cultivation	Plain	DC, DI	
12,800			Cultivation	Plain	DC	
						(Contd. to next sheet)

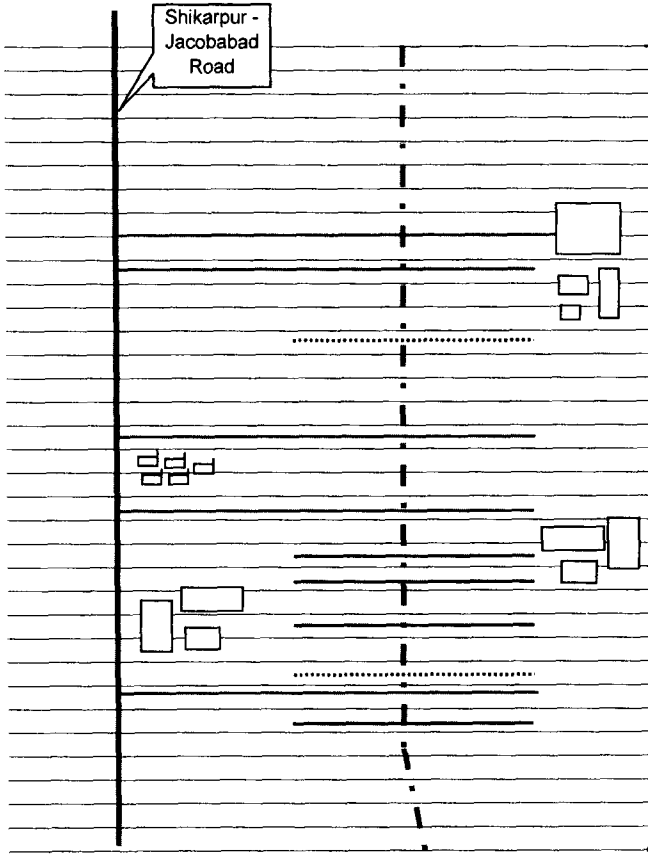
Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 5 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
12,800			Cultivation	Plain	DC	Contd. From previous sheet
13,000			Cultivation	Plain	DC	
13,200			Cultivation	Plain	DC	
13,400			Cultivation	Plain	DC	
		Road			DI	
13,600			Cultivation	Plain	DC, NE, SH	Agricultural Training Institute
					NE, SH	Village left of route
13,800			Uncultivated	Plain		
14,000		11-kV feeder	Uncultivated	Plain	DI	
14,200			Uncultivated	Plain		
14,400		Road	Uncultivated	Plain	DI	
						Graveyard right of track
14,600			Uncultivated	Plain		
		Road			DI	
14,800			Uncultivated	Plain		
		Water course			WC, SE, DI, NE, SH	Village left of route
15,000		Water course	Uncultivated	Plain	WC, SE, DI	
15,200		Water course	Uncultivated	Plain	WC, SE, DI, NE	Village right of route.
					SH	
15,400		11-kV feeder	Uncultivated	Plain	DI	
		Road			DI	
15,600		Water course	Cultivation	Plain	DC, WC, SE, DI	
	12°, 20´ L					
15,800			Cultivation	Plain	DC	
16,000			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

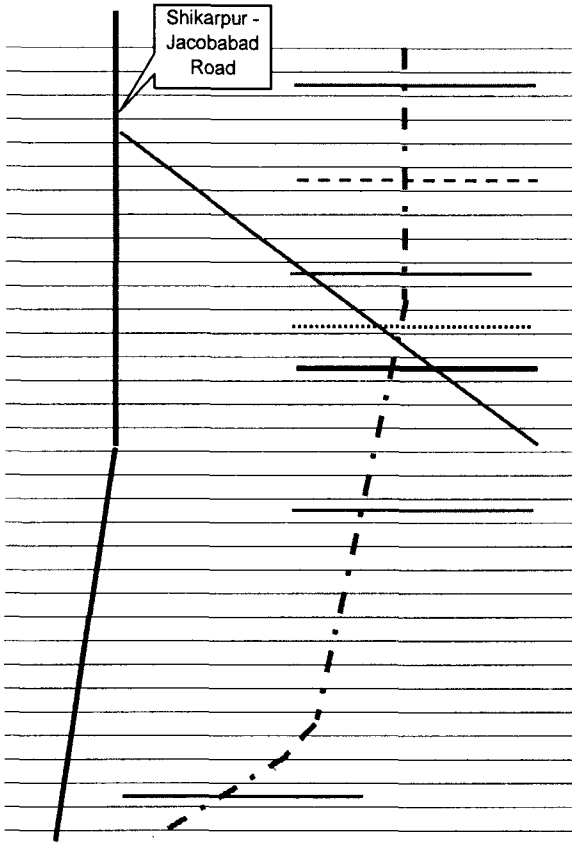
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 6 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
16,000			Cultivation	Plain	DC	Contd. From previous sheet
		Water course			WC, SE, DI	
16,200			Cultivation	Plain	DC	
16,400			Cultivation	Plain	DC	
		Track			DI	
16,600			Cultivation	Plain	DC	
16,800			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
17,000	30°, 32´ R		Cultivation	Plain	DC	
		11-kV feeder			DI	
17,200		Road	Cultivation	Plain	DC, DI	Jacobabad Bypass Road
		Canal			WC, SE, DI	
17,400			Cultivation	Plain	DC	
17,600			Cultivation	Plain	DC	
17,800			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
18,000			Cultivation	Plain	DC	
						City outskirts
18,200			Cultivation	Plain	SH	
18,400			Cultivation	Plain	SH	
18,600			Cultivation	Plain	SH	
18,800	53°, 0´ R		Cultivation	Plain	SH	
19,000	35°, 30´ R		Cultivation	Plain	SH	
		Drain channel			SE, DI	
19,200			Cultivation	Plain	SH	
						(Contd. to next sheet)

Not to scale

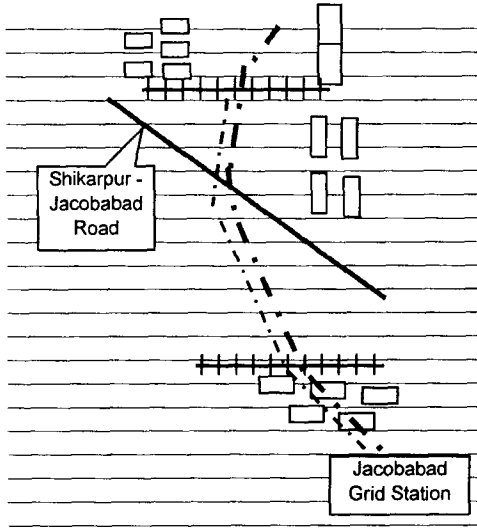
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Humayun - Jacobabad Transmission Line (Sheet 7 of 7)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
19,200			Residential and commercial	Plain	SH, NE, DE	Contd. From previous sheet
	30°, 32´ L					
19,400		Railway track		Plain	DI, SH, DE	Commercial area left of route
						Under construction colony right of route
19,600	18°, 30´ L			Plain	SH, NE, DE	
19,800		Main Road		Plain	SH, DE, NE, DI	Residential area left of route
20,000	6°, 10´ L			Plain	SH, NE, DE	Commercial area along the road
20,200				Plain		
					SH, NE, DE	The proposed transmission line will use some towers of the existing transmission line.
20,400				Plain		
20,600	7°, 25´ L	Railway track	Residential	Plain	DI, NE, DE, SH	
20,800			Residential	Plain	SH, NE, DE	The transmission line would pass over the thickly populated settlement.
20,980	Grid station		Grid station	Plain	WC, NE, SH	

Not to scale

Key:

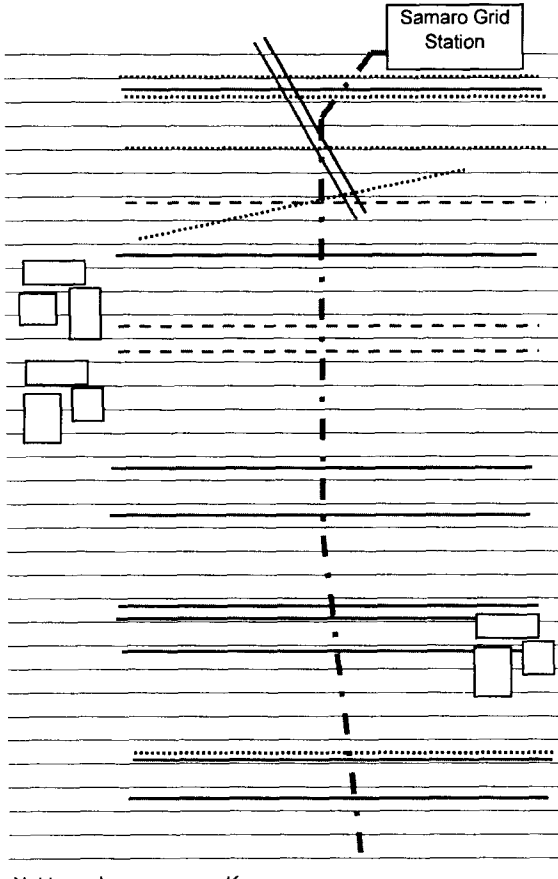
- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Exhibit 4.23: Samaro – Naukot Transmission Line Schematic Diagram

(Please see the following pages.)

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 1 of 9)



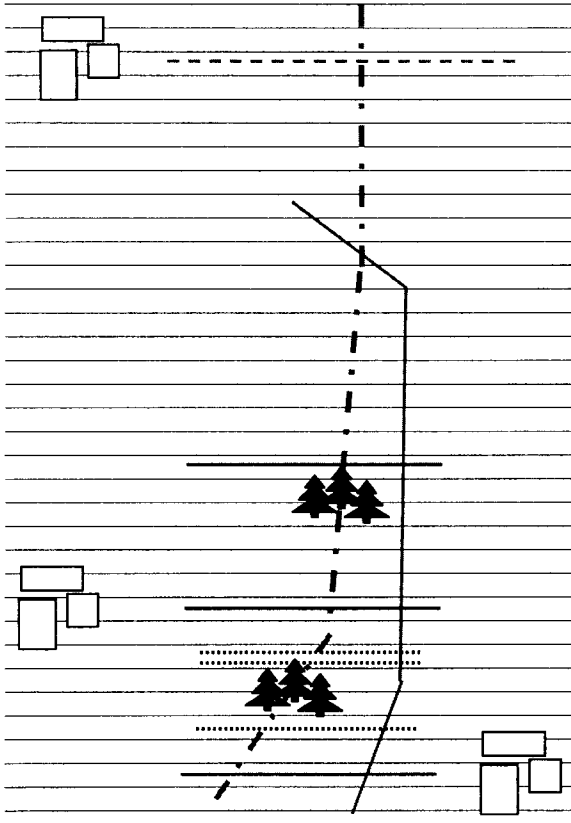
Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
0	Samaro Grid Station		Grid station	Plain	DC	
		11-kV feeders; road			DI	
400	57°, 0´ L		Cultivation	Plain	DC	
		Minor, road			DI, WC, SE	
800		11-kV feeder	Cultivation	Plain	DC, DI	
1,200		Track; 11-kV feeder	Cultivation	Plain	DC, DI	
1,600		Water course	Cultivation	Plain	DC, WC, SE, DI	
2,000			Cultivation	Plain	DC, NE, SH	Village right of route
		Track			DI	
2,400		Track	Cultivation	Plain	DC, DI, NE, SH	Village right of route
2,800			Cultivation	Plain	DC	
3,200			Cultivation	Plain	DC	
		Water course			SE, WC, DI	
3,600			Cultivation	Plain	DC	
		Road			DI	
4,000	5°, 50´ L		Cultivation	Plain	DC	
4,400			Cultivation	Plain	DC	
		Water courses			SE, WC, DI	
4,800			Cultivation	Plain	DC, NE, SH	Village left of route
		Water course			SE, WC, DI	
5,200			Cultivation	Plain	DC	
5,600			Cultivation	Plain	DC	
		11-kV feeder			DI	
6,000		Road	Cultivation	Plain	DC, DI	
		Minor (canal)			WC, SE, DI	
6,400			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

Key: Proposed Transmission Line; Existing transmission Line; Road; Canal/water course; Unpaved road/track; 11-kV feeder; Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 2 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
6,400			Cultivation	Plain	DC	Cont'd from previous sheet
6,800		Track	Cultivation	Plain	DC, DI, SH, NE	Village right of route.
7,200			Cultivation	Plain	DC	
7,600			Cultivation	Plain	DC	
8,000			Cultivation	Plain	DC	
8,400		Road	Uncultivated	Plain	DI	
	5°, 40´ R					
8,800			Uncultivated	Plain		
9,200			Cultivation	Plain	DC	
9,600			Cultivation	Plain	DC	
10,000			Uncultivated	Plain		
		Minor (canal)			WC, SE, DI	
10,400		Orchard	Uncultivated	Plain	DC	
10,800			Cultivation	Plain	DC	
11,200			Cultivation	Plain	DC2, NE, SH	Village right of route.
		Water course			WC, SE, DI	
11,600	26°, 10´ R		Cultivation	Plain	DC	
		LT feeders			DI	
12,000			Cultivation	Plain	DC	
		Orchard			DC	
12,400		LT feeder	Cultivation	Plain	DC, DI	
12,800		Water course	Cultivation	Plain	DC, WC, SE, DI, SH, NE	Village left of route. (Contd. to next sheet)

Not to scale

Key:

Proposed Transmission Line

Existing transmission Line

Road

Canal/water course

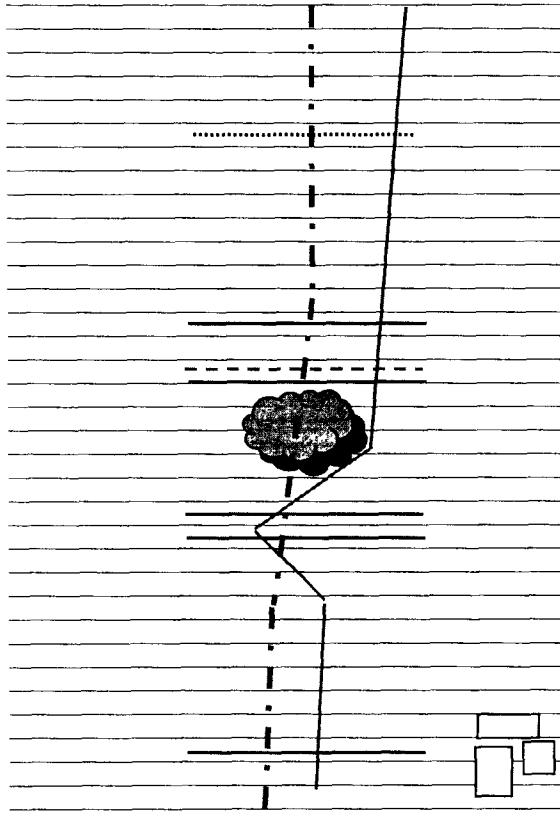
Unpaved road/track

11-kV/LT feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 3 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
12,800			Cultivation	Plain	DC	Cont'd from previous sheet
13,200			Cultivation	Plain	DC, DI	
13,600			Cultivation	Plain	DC	
					DI	
14,000			Cultivation	Plain	DC	
14,400			Cultivation	Plain	DC	
14,800			Cultivation	Plain	DC	
15,200	15°, 10´ R		Cultivation	Plain	DC	
		Water course			WC, SE, DI	
15,600			Cultivation	Plain	DC	
		Track			DI	
16,000		Water course	Cultivation	Plain	DC, WC, SE, DI	
						Stagnant water
16,400			Cultivation	Plain	DC	
16,800			Cultivation	Plain	DC	
		Road; water course			DI, WC, SE	
17,200		Water course	Cultivation	Plain	DC, WC, SE, DI	
		Road			DI	
17,600			Cultivation	Plain	DC	
	10°, 10´ L					
18,000			Cultivation	Plain	DC	
18,400			Cultivation	Plain	DC	
18,800			Cultivation	Plain	DC	
		Water course			WC, SE, DI, NE, SH	Village left of route.
19,200			Cultivation	Plain	DC	
						(Contd. to next sheet)

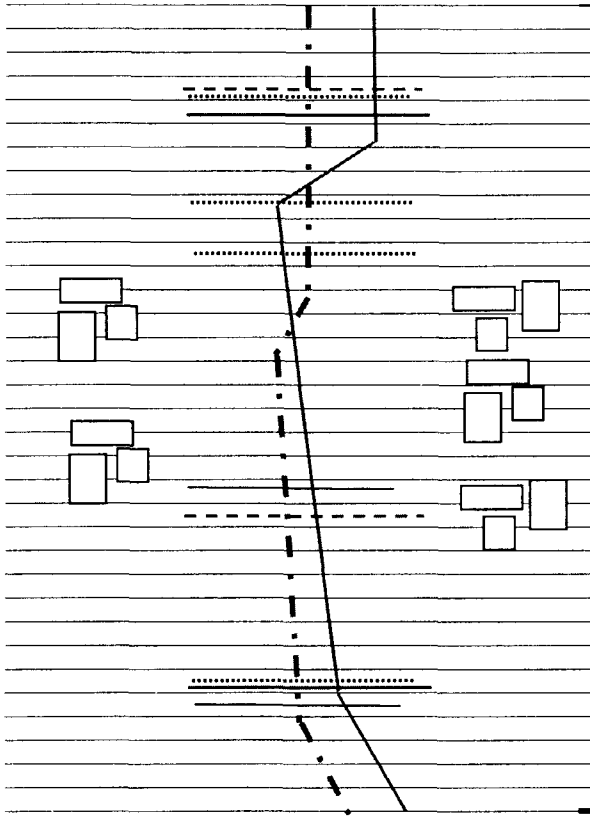
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV/LT feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 4 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
19,200			Cultivation	Plain	DC	Cont'd from previous sheet
19,600			Cultivation	Plain	DC	
		Track; 11-kV feeder			DI	
20,000		Road	Cultivation	Plain	DC, DI	
20,400			Cultivation	Plain	DC	
		Road			DI	
20,800		11-kV feeder	Cultivation	Plain	DC, DI	
21,200		LT feeder	Cultivation	Plain	DC, DI	
21,600	25°, 20´ R		Cultivation	Plain	DC, NE, SH	Village right of route.
		Road			DI, SH, NE	Village left of route.
22,000	28°, 10´ L		Cultivation	Plain	DC	
					NE, SH	Village left of route.
22,400			Cultivation	Plain	DC	
22,800			Cultivation	Plain	DC, NE, SH	Village right of route.
23,200		Water course	Cultivation	Plain	DC, WC, SE, DI	
		Track			DC, NE, SH, DI	Village left of route.
23,600			Cultivation	Plain	DC	
					DI	
24,000			Cultivation	Plain	DC	
24,400			Cultivation	Plain	DC	
24,800		11-kV feeder; road	Cultivation	Plain	DC, DI	
		Minor (canal)			WC, SE, DI	
25,200	25°, 20´ L		Cultivation	Plain	DC	
25,600			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

Key:

Proposed Transmission Line

Existing transmission Line

Road

Canal/water course

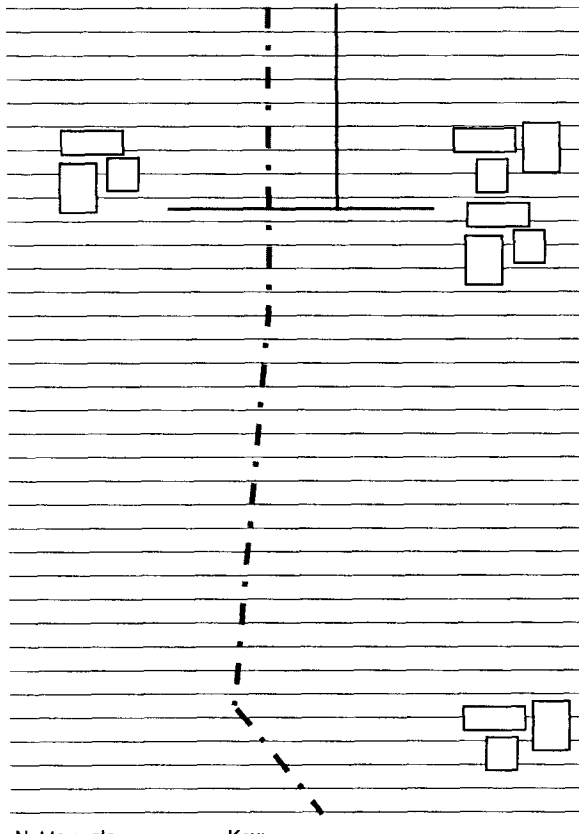
Unpaved road/track

11-kV/LT feeder

Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 5 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
25,600			Cultivation	Plain	DC	Cont'd from previous sheet
26,000			Cultivation	Plain	DC	
26,400			Cultivation	Plain	DC	
					NE, SH	Village right of route.
26,800			Cultivation	Plain	DC	
					DI	
27,200		Road	Cultivation	Plain	DC, DI, SH, NE	Village left of route.
27,600			Cultivation	Plain	DC, NE, SH	Village left of route.
28,000	8°, 10´ R		Uncultivated	Plain		
28,400			Uncultivated	Plain		
28,800			Uncultivated	Plain		
29,200			Uncultivated	Plain		
29,600			Uncultivated	Plain		
30,000			Cultivation	Plain	DC	
30,400			Cultivation	Plain	DC	
30,800			Cultivation	Plain	DC	
31,200			Cultivation	Plain	DC	
	40°, 0´ L					
31,600			Cultivation	Plain	DC, NE, SH	Village left of route.
32,000			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

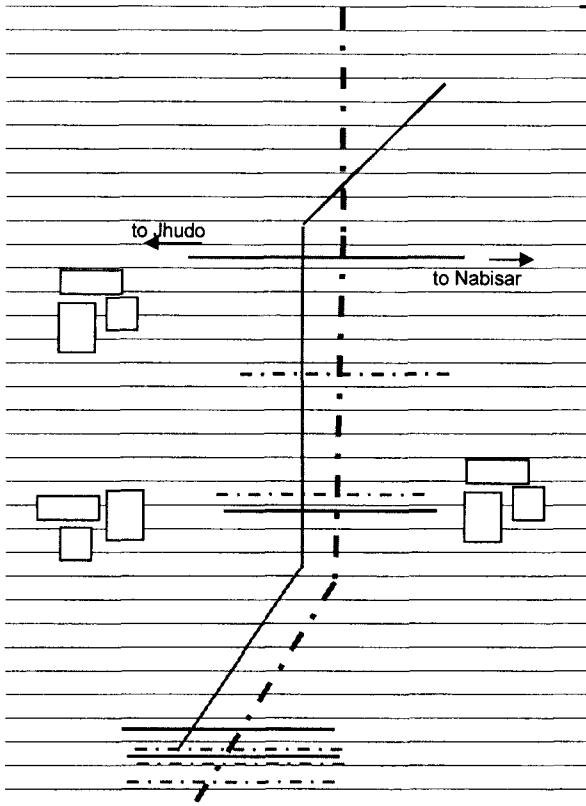
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV/LT feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 6 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
32,000			Uncultivated	Plain		Cont'd from previous sheet
32,400			Uncultivated	Plain		
32,800			Uncultivated	Plain		
33,200			Uncultivated	Plain		
		Road			DI	
33,600			Uncultivated	Plain		
34,000	5°, 0´ R	Road	Cultivation	Plain	DC, DI	
					NE, SH	Village right of route.
34,400			Cultivation	Plain	DC	
34,800			Cultivation	Plain	DC	
		66-kV trans'n line			DI	
35,200			Cultivation	Plain	DC	
35,600			Cultivation	Plain	DC	
36,000		Track	Cultivation	Plain	DC, DI, NE, SH	Village left of route.
		Water course			WC, SE, DI, SH, NE	Village right of route.
36,400			Cultivation	Plain	DC	
36,800	52°, 0´ R		Cultivation	Plain	DC	
37,200			Uncultivated	Plain		
37,600			Cultivation	Plain	DC	
38,000		Water course	Cultivation	Plain	DC, WC, SE, DI	
		Canal and tracks			DI, WC, SE	
38,400		Track	Cultivation	Plain	DC, DI	
						(Contd. to next sheet)

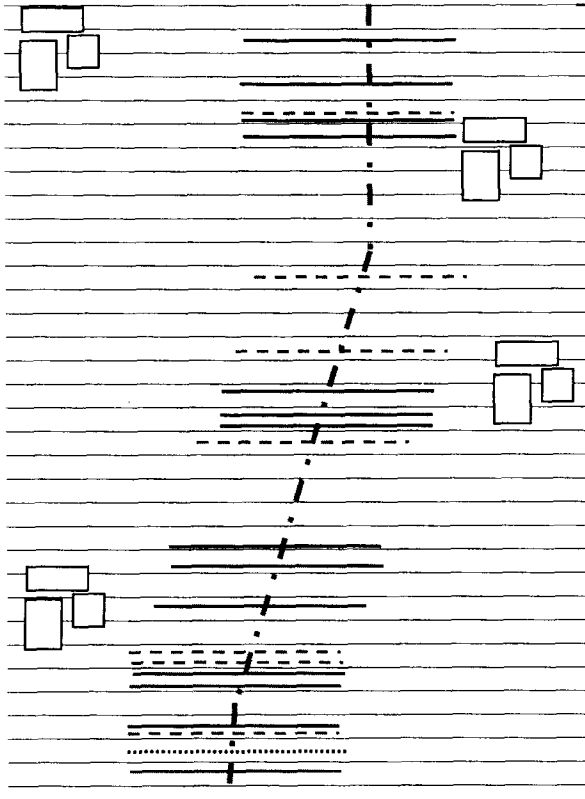
Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV/LT feeder
- Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 7 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
38,400			Cultivation	Plain	DC	Cont'd from previous sheet
		Water course			DI, WC, SE	
38,800			Cultivation	Plain	DC	
		Water course			DI, WC, SE, NE, SH	Village right of route.
39,200		Track, water course	Cultivation	Plain	DC, DI, WC, SE	
		Water course			DI, WC, SE	
39,600			Cultivation	Plain	DC, NE, SH	Village left of route.
40,000			Cultivation	Plain	DC	
40,400	34°, 0' R		Cultivation	Plain	DC	
		Track			DI	
40,800			Cultivation	Plain	DC	
41,200		Track	Cultivation	Plain	DC, DI	
					NE, SH	Village left of route.
41,600		Water course	Cultivation	Plain	DC, DI, WC, SE	
		Water courses			DI, WC, SE	
42,000		Track	Cultivation	Plain	DC, DI	
42,400			Cultivation	Plain	DC	
42,800		Water course	Cultivation	Plain	DC, DI, WC, SE	
		Water course			DI, WC, SE	
43,200			Cultivation	Plain	DC	
		Water course			DI, WC, SE, NE, SH	Village right of route.
43,600			Cultivation	Plain	DC	
		Tracks			DI	
44,000		Water course; road	Cultivation	Plain	DC, DI, WC, SE	
	16°, 15' L					
44,400		Water course; track	Cultivation	Plain	DC, DI, WC, SE	
		11-kV feeder			DI	
44,800			Cultivation	Plain	DC, DI, WC, SE	
						(Contd. to next sheet)

Not to scale

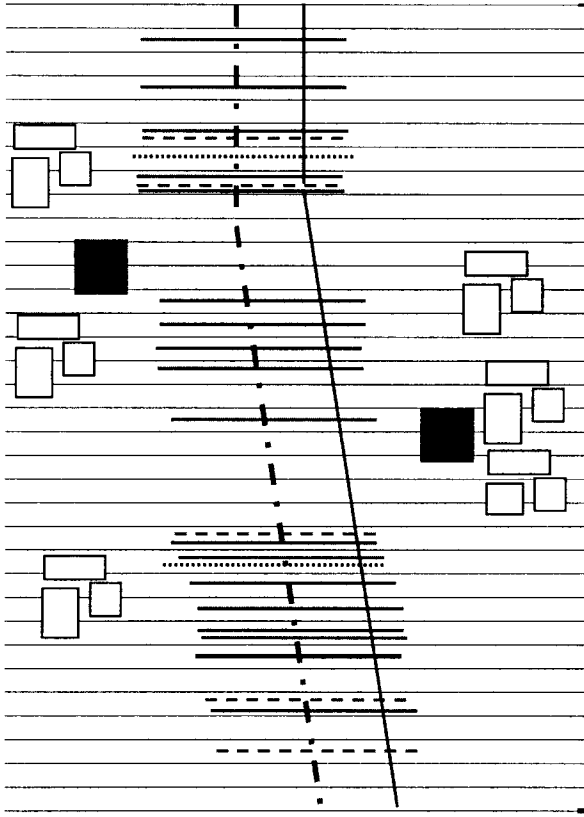
Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV/LT feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 8 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
44,800			Cultivation	Plain	DC	Cont'd from previous sheet
		Road			DI	
45,200			Cultivation	Plain	DC	
		Water course			WC, SE, DI	
45,600			Cultivation	Plain	DC	
		Water course; track			WC, SE, DI, NE, SH	Village right of route.
46,000		11-kV feeder	Cultivation	Plain	DC, DI	
		Water courses; track			WC, SE, DI	
46,400			Cultivation	Plain	DC	
	18°, 0´ L					
46,800			Cultivation	Plain	DC	Fish pond right of route.
47,200		Water course	Cultivation	Plain	DC, WC, SE, DI, NE, SH	Village left of route.
		Water course			WC, SE, DI	
47,600		Water course	Cultivation	Plain	DC, WC, SE, DI	Village right of route.
		Water course			WC, SE, DI	Village left of route.
48,000			Cultivation	Plain	DC	
		Road			DI	Fish pond left of route.
48,400			Cultivation	Plain	DC, DI	
					NE, SH	Village left of route.
48,800			Cultivation	Plain	DC	
49,200		Track. Water course	Cultivation	Plain	DC, DI, WC, SE	
		Road; 11-kV feeder			DI, NE, SH	Village right of route.
49,600		Water course	Cultivation	Plain	DC, WC, SE, DI	
		Water course			WC, SE, DI	
50,000		Water courses	Cultivation	Plain	DC, WC, SE, DI	
		Canal			WC, SE, DI	
50,400			Cultivation	Plain	DC	
		Track; water course			DC, WC, SE, DI	
50,800			Cultivation	Plain	DC	
		Track			DI	
51,200			Cultivation	Plain	DC	
						(Contd. to next sheet)

Not to scale

Key:

Proposed Transmission Line

Existing transmission Line

Road

Canal/water course

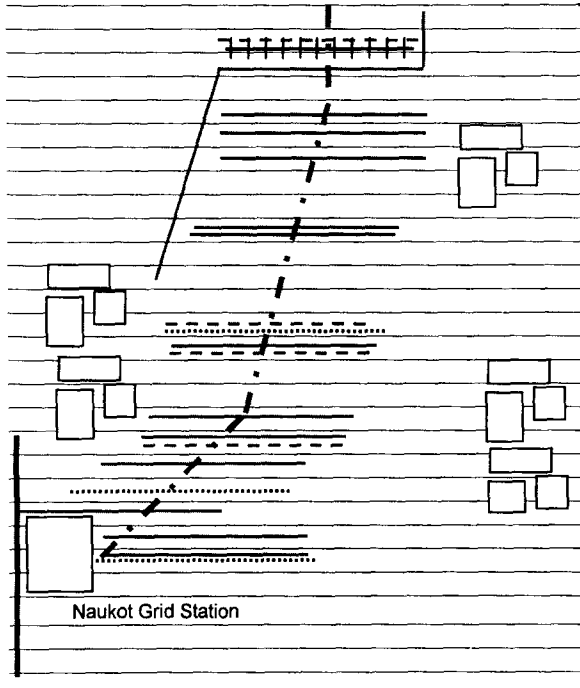
Unpaved road/track

11-kV/LT feeder

Cultivation

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Schematic Diagram: Samaro - Naukot Transmission Line (Sheet 9 of 9)



Length (m)	Transmission Line Feature	Infrastructure	Land Use	Land Form	Impacts	Notes
51,200			Cultivation	Plain	DC	Cont'd from previous sheet
		Track, Rail track			DI	
51,600		Road	Cultivation	Plain	DC, DI	
52,000	37°, 0´ R	Water course	Cultivation	Plain	DC, WC, SE, DI	
		Water course			WC, SE, DI, SH, NE	Village left of track
52,400		Water course	Cultivation	Plain	DC, WC, SE, DI	
52,800			Cultivation	Plain	DC	
		Road, water course			DI, WC, SE	
53,200			Cultivation	Plain	DC	
					NE, SH	Village right of route.
53,600			Cultivation	Plain	DC	
		Track, 11-kV feeder			DI	
54,000		Water course; track	Cultivation	Plain	DC, WC, SE, DI	
					NE, SH	Village left of track
54,400			Cultivation	Plain	DC, NE, SH	Village right of route.
	52°, 0´ R	Road			DI	
54,800		Road, track	Cultivation	Plain	DC, DI	
		Road			DI	
55,200		11-kV feeder	Cultivation	Plain	DC, DI	
		Road			DI	
55,600		Water course	Cultivation	Plain	DC, WC, SE, DI	
		Water course; 11-kV feeder			DI, WC, SE	
55,960	Naukot Grid Station		Cultivation	Plain	WC, SH, NE	

Not to scale

Key:

- Proposed Transmission Line
- Existing transmission Line
- Road
- Canal/water course
- Unpaved road/track
- 11-kV/LT feeder

DI: Damage to infrastructure; DC: Damage to crops; WC: Water contamination; SE: Soil erosion; DE: Dust emissions; LV: Loss of natural vegetation; SH: Safety hazards; LA: Land acquisition; PH: Public Health; NE: Noise emission.

Cultivation

5 Description of the Socioeconomic Conditions

This Chapter describes the general socioeconomic conditions of the HESCO area before the commencement of the proposed activities. The site-specific socioeconomic description of the area is provided in **Appendix E** of this report; **Exhibits 4.13** to **4.23** also show some socioeconomic features at and around the project sites (grid station locations and transmission line routes). In view of the absence of any major development activities underway at or around the project sites or any other natural/anthropogenic phenomenon, the socioeconomic conditions of the project sites are unlikely to experience any significant change before the project commencement.

5.1 Administrative Setup

As described in **Section 3.1.1**, the HESCO area consists of the entire Sindh Province, except the Karachi City and parts of the Thatta district. **Exhibit 5.1** provides an administrative map of the area. Of these, the project components are located in Hyderabad[1], Jacobabad[2], Larkana, Shikarpur, Sanghar, Badin, Thatta and Mirpur Khas districts (a limited portion of the Samaro – Naukot transmission line is located just inside the Umerkot district).

Much like rest of the country, the districts in the project area now have their respective district governments with the elected representatives as well as government functionaries. The district government is headed by the *Nazim*, who is a public representative elected by the people; while the government functionaries in the district include the District Coordination Officer (DCO) and Executive District Officers (EDOs). The EDO (Revenue) is the officer relevant for land acquisition in the district.

5.2 Socioeconomic Description

5.2.1 Overview

Sindh is the second largest province of Pakistan. The neighboring regions are Balochistan to the west and north, Punjab in the north, Rajasthan (India) to the east and the Arabian Sea and Gujarat (India) to the south (**Exhibit 5.1** presents a map of the Province). The province forms the lower Indus basin and lies between 23° and 28° North latitudes and 66° and 71° East longitudes. It is about 579 km in length from north to south and nearly 442 km in its extreme breadth (281 km average). It covers an area of 140,914 km^2.

The districts in the project area are situated in lower, central and upper Sindh. Thatta and Badin are the lower Sindh districts, Hyderabad, Mirpur Khas and Sanghar fall in the central part of Sindh, while the upper Sindh districts include Larkana, Shikarpur and Jacobabad. These districts are spread over the total area of 58,466 km^2, which is about

[1] Hyderabad district has been subdivided recently to carve out new districts (Tando Allahyar, Matiari and Tando Mohammad Khan).

[2] Jacobabad district has been subdivided to carve out a new district (Kashmore).

41.49 percent of the total area of Sindh. The total population of these eight districts is about 11.732 million which is about 38.45 percent of the total population of Sindh.

Thatta is largest district in terms of area among the districts in the project area, whereas Shikarpur is the smallest district. Hyderabad is the most populous district, with a population of 2.89 million, whereas Shikarpur is the least populous district in the project area with a population of 0.88 million. Population density is highest in Hyderabad to the extent of 523.9 persons per km^2 and lowest in Thatta district to the extent of 64.1 persons per km^2. **Exhibit 5.2** provides population data and area of these districts.

5.2.2 Historical Background

The earliest authentic history of Sindh dates from the time when Alexander the Great abandoned his scheme of conquest towards the Ganges, alarmed at the discontent of his soldiers. He embarked a portion of the army in boats, floated them down the Jhelum and the Chenab, and marched the remainder on the banks of the river till he came to the Indus. At that time Sindh was in the possession of the Hindus, the last of their rulers was Raja Sahasi, whose dynasty governed the kingdom for over two thousand years. In the sixth century BC, the Persians invaded Sindh. They defeated and slew the monarch in a pitched battle and plundered the province and then left. Eight years after his accession to the Persian throne, Darius I extended his authority as far as the Indus.

The Arab conquest of Sindh by Muhammad Bin Qasim in 712 AD gave the Muslims a firm foothold on the sub-continent. The description of Hiun Tsang, a Chinese historian, leaves no doubt that the social and economic restrictions inherent in the caste differentiations of Hindu society had however, gradually sapped the inner vitality of the social system and Sindh fell without much resistance before the Muslim armies.

In the 10th century, native people replaced the Arab rule in Sindh. Samma and Soomra dynasties ruled Sindh for long. These dynasties produced some rulers who obtained fame due to judicious dispensation and good administration.

In the 16th century Sindh was included in the Mughal Empire, and for a hundred and fifty years the chiefs paid tribute, but only as often as they were compelled to do so, to the Mughal Emperors in Delhi. In the 17th century, Kalhoras captured political power in the north western Sindh under the leadership of Mian Nasir Muhammad. Later, the lower Sindh with Thatta as its capital also came under the Kalhora administration. In the 18th century, Talpurs replaced Kalhoras as Sindh rulers.

In 1843 Sindh lost its independence the British regime. The Talpurs were defeated on the battlefields of Miani, Dubba and Kunhera and taken prisoners. Charles Napier who commanded the troops subsequently became the first Governor of the province of Sindh, which was annexed to the Bombay Presidency in 1843. It was after a long struggle that the cause of Sindh was supported by the Quaid-e-Azam Mohammad Ali Jinnah when he brought in his famous 14-points the demand of Sindh's separation from Bombay Presidency. Sir Agh Khan, G. M. Syed, Sir Abdul Qayyum Khan and many other Indian leaders also played their pivotal role in getting Sindh separated from the Bombay Presidency in 1936. After the independence of the country in 1947, Sindh maintained its status as a separate province.

5.2.3 Culture and Customs

Sindh province has rich culture, customs and traditions. Various parts of the project area have almost similar culture and customs with slight differences on the basis of ethnic and religious groups. Being traditional Muslims there is a greater influence of the Arabian culture, however, the traces of Hindu, Buddhism and other religious thoughts are also present in the cultural attitudes and approaches of the local communities. The *Pirs* and *Murshids* (religious leaders, saints) are held in high esteem and confidence amongst the Muslims particularly in the uneducated and poor class of the rural areas. Annual festivals at the shrines of saints are regularly held in which people very enthusiastically take part. Similarly, the Hindus also hold great confidence and reverence in Thakurs and Brahmans (the higher castes). The Brahmans usually perform spiritual rites of Hindus on special occasions.

Sindhi is the common language in the project area whereas Siraiki, Balochi, Brohi and Urdu are also spoken in various parts of the province.

5.2.4 Ethnicity and Castes

Majority of the population in the project area is Muslim and Sindhis. The castes mainly living in Thatta and Badin districts include Jokhio, Soomra. Sammo, Syed, Memon, Khoja, Rind, Lashari, Mekrani, Brohi, Chandio, Jat, Burfat, Chang, Jakhra, Palara, Sheikh, Qureshi, Gada, Khaskheli, Gandra, and Machhi. A large number of Hindus also live in both the districts.

The population of Hyderabad is a mixture of various heterogeneous groups and cultures. The main races are Talpurs, Syeds, Balochs, Soomra, Mirza, Sheikhs, Memon, Khatris, Qureshis and Abbasis. Besides, a large number of Urdu-speaking migrants from India are also settled here, in addition to some Pashtuns (pathans) and Punjabis.

The main religious groups in Mirpur Khas district are Muslims and Hindus. The main castes among Muslims include Syed, Talpur, Memon, Bhurgri, Lashari, Laghari, Ranghar, Panwhar, Halepota, Marri, Banglani, Gorchani, Khosa, Sameja, Gurgaj, Bhambhro, Jat, Arain, Qureshi and Sheikh. Amongst the Hindus most prominent are Brahman, Malhi, Lohana, Kirars, Soothar and Maheshwaveri. The people living in Sanghar District are of different castes and tribes including Syed, Nizamani, Marri, Keeria, Shar, Lashari, Mahar, Jat, Samma, Hingorja, Mangria, whereas Menghwar, Kolhi and Bheel are major castes among Hindus of the area.

The Upper Sindh districts of Larkana, Shikarpur and Jacobabad have majority of those tribes who have with the passage of time migrated from Balochistan and settled in the area. Being under the influence of those tribes these and other adjoining districts are usually considered as tribal and semi tribal districts of Sindh. The tribes in these areas include Jatoi, Mahar, Chandio, Magsi, Brohi, Bhuttos, Soomros, Abbassis, Abros, Shaikhs, Bughios, Unars, Khuhros, Israns, Mugheris, Rinds, Lariks, Chandios, and Sangis. Main languages spoken are Sindhi, Balochi, Brauhvi, Siraiki and Urdu.

There are some indigenous groups in Sindh such as Bheels, Meghwars and Kohlis, however these are not located in the project area and will not be negatively impacted by the project activities.

5.2.5 Poverty

Historically Sindh was a prosperous and rich province. However, presently Sindh is largely witnessing poverty and destitution. According to a recent study (ADB: Sindh Rural Development Project, 2000), poverty levels are high in Sindh: 37% of the population lives below the poverty line; 20% of the urban and 53% of the rural population is poor. The ADB study covering four districts - Thatta, Badin, Mirpur Khas and Sanghar - claims that poverty is widespread throughout the region. Health and education indicators are very poor in these areas. According to the report a majority of rural households in the area do not own land. Tenant farms alone represent 44% of all private farms. Of those who do own land in rural areas, fewer than 20% are large landlords but this group owns about 60% of the private farms. According to the nationwide comparative rankings of social indicators, Hyderabad and Mirpur Khas districts were in the first and second quartile, respectively; Thatta, Badin, Shikarpur, Larkana and Sanghar were in the third quartile; whereas Jacobabad found its place in the last quartile (see **Exhibit 5.3**).

According to the ADB Sindh Coastal and Inland Community Development Project Interim Report, the poverty figures in Badin and Thatta districts are higher, perhaps as high as 70 percent. According to this report, 54 percent of the population was found among the poorest category while 79 percent were poor. According to the report poverty was highly correlated with household economic characteristics such as land ownership and employment opportunities. Land owners are usually among the non-poor. The sea intrusion has badly affected the agricultural activities in these areas. According to the community perception of poverty, the poorest are those who have no capital or other resources of their own, mostly depend on the land and fishing grounds of others for their livelihood, and usually work on daily basis.

According to the district level ranking conducted by the renowned research institute: Social Policy and Development Center (SPDC) in year 2001, six out of the eight districts in the project area are ranked as highly deprived districts of Sindh. These include Thatta and Badin of lower Sindh, Mirpur Khas and Sanghar of central Sindh, and Shikarpur and Jacobabad of upper Sindh. Hyderabad district has found its place among the low-deprivation districts presumably due to its headquarter - the Hyderabad City, which is a commercial and industrial hub. Larkana - usually considered as the prosperous district, favored by the political leadership of past with the development programs and projects - has found its place in the medium deprivation group.

5.2.6 Main Occupations

Cultivation and the related businesses are the main occupations in the project area, much like most of the remaining parts of the HESCO area. The other key economic activities include fisheries, livestock rearing, and government as well as private sector jobs. In the coastal areas of Thatta and Badin, fisheries are among the prime livelihood activities of the majority of the people.

Livestock is also one of the key livelihood sources for the rural population of the area. The farmers in these districts traditionally keep a few heads of livestock, ranging from bullocks for draught to cows and buffalos for milk, and poultry for eggs and meat. There

have been many traditional communities in the area exclusively dependent on livestock for their livelihood, however, the importance of livestock as a source of income has declined over the years. Good breeds of buffalos and cows are found in these districts.

The Hyderabad District exhibits amalgamation of industrial, agriculture and commercial activities. The urban center of the district offers a significant number of employment opportunities in commercial and industrial setups, whereas cultivation remains the prime occupation in the rural parts of the district.

5.2.7 Gender Perspectives

There are slight differences in the gender perceptions, attitudes, roles and responsibilities in lower, central and upper Sindh. In these aspects, the coastal districts are less conservative compared to the upper and central Sindh areas. The tribal clans in the upper Sindh, as well as in Sanghar and Mirpur Khas districts of central Sindh are more conservative with regard to women and their status, roles and responsibilities.

The women particularly in the rural areas have fewer rights in all the aspects of their lives. The literacy data clearly corroborates this, and indicates that compared to men, the women are far behind in education, which is a key development indicator. Furthermore, this disparity is more generally prominent in the rural communities (see **Exhibit 5.4**). The male and female literacy in urban areas of Sindh is 69.75 and 56.66 percent, respectively (1998 census data). Whereas in the rural areas, the female literacy is only 12.23 percent compared to the male literacy, which is 37.89 percent. The rural female literacy is quite low in all districts of the project area, with Jacobabad being the worst in this respect (6%). Furthermore, the gap between the male and female literacy is also quite high, and this gap is generally more prominent in the rural areas, as shown in **Exhibit 5.4**. The gap between urban male and female literacy is highest in Jacobabad district, whereas Larkana has the highest gap between rural male and female literacy.

Women in most rural communities in the project area equally participate in livelihood activities along family lines. However, there exists a difference in mobility between Muslim and Non-Muslim women. Women from non-Muslim community work in the field right from the weeding to the harvesting. These women also receive money from farmers at the harvest; as such they are equal work sharers with men. While the Muslim women only work in the field at the harvest time. They do not frequency visit fields for work at any other time during the year.

Almost in all of the project area, women role in decision-making is also negligible. They mostly remain subordinate to men throughout their lives regarding important decisions concerning them and the family. Unmarried girls are preferred to stay at home or work in fields. Usually they are married at an early age. Exchange marriages are a common feature in the rural communities.

Women's household role is taken for granted. Since their work inside the house and in the fields goes largely unpaid, they cannot assert economic independence and this affects their status to a large extent. Agriculture economy in the villages and cultural values discouraging women mixing with men hamper women's access to the markets. Therefore, men get control on all capital, monetary and productive resources.

5.2.8 Education and Health

The overall literacy of Sindh as shown in **Exhibit 5.4** is 45.29 percent (1998 census data). The urban literacy is 63.72 percent which is substantially higher than the rural literacy which is 25.75 percent. In the project area, Hyderabad has the highest urban literacy (61%), whereas Jacobabad has the lowest urban literacy (44%). Larkana enjoys the highest rural literacy of almost 28 percent, whereas Jacobabad is again at the bottom of the list in the project area in terms of the rural literacy. Thatta is most backward in terms of the overall literacy (22%) compared to the other districts in the project area (see **Exhibit 5.5**).

Based on the literacy profile, the districts in Pakistan can be grouped into three categories: districts with high literacy rate (above 70%); districts with medium literacy rate (50 - 69%); and districts with low literacy rate (less than 50%). With an overall literacy rate of less than 50 percent, all the districts in the project area fall in the lowest category, as shown in **Exhibit 5.5**.

At about 24 percent, the overall educational enrolment in the entire Sindh province is also quite dismal. The project area exhibits significant variation in terms of the school enrolment, as shown in **Exhibit 5.6**. As expected, the urban enrolment figures are considerably higher than those for the rural areas. Sanghar has the highest urban and rural enrolment figures of about 46 percent and 21 percent, respectively. Thatta has the lowest urban and rural enrolment of about 32 percent and 11 percent, respectively (1998 census data).

A large number of educational institutions exist in the project area. These include primary, secondary and higher secondary schools, as well as colleges. **Exhibit 5.7** provides the key data on these institutions. Four universities are also located in the project area; these include Sindh University, Mehran Engineering University, Sindh Agricultural University Tando Jam and Liaquat University of Health Sciences.

A considerable number of health care facilities exist in the project area, as shown in **Exhibit 5.8**. These include a civil hospital (District Headquarter Hospital) in every district, Taluka Hospitals, Basic Health Units (BHUs), Rural Health Centers (RHCs), maternity homes, and dispensaries. However, their numbers compared to the population in the area are not sufficient to provide adequate coverage. Moreover, in the existing facilities, lack of trained staff, and shortage of medicines as well as medical instruments are some of the key problems – rendering most of these facilities particularly in the rural areas less effective if not outright dysfunctional. A particular problem in access to health services is the scattered nature of the population in the rural areas. As a result, many rural communities do not have any medical facilities, and the people from such areas usually face considerable hardships in going to the urban centers for the treatment of serious diseases.

This situation is even more dismal for the women, particularly in the rural communities. The women-exclusive health facilities, such as maternity homes, are very few and there is severe shortage of female health staff, either medical or paramedical. Malnutrition among women is a common phenomenon. This not only results in their poor health,

leading to low-birth weight babies, but also increases the burden on secondary health care facilities.

5.2.9 Agriculture

Agro-ecological Zones

The use of land is governed by several interacting factors, which are physical, biological, social and economic in nature. A clear vision of these factors is essential for increased agricultural production in any given region. The Pakistan Agricultural Research Council in 1980 divided Pakistan in ten agro-ecological zones, based on a survey carried out by FAO and review of the available literature on physiography, climate, soils, land use and other factors affecting agriculture production. These zones are shown in **Exhibit 5.9** and defined in **Exhibit 5.10**. According to this zonation, the project area falls under the Zone II, which is characterized by extensive cultivation, high summer temperatures and low rainfall.

Agricultural Production

Agriculture is the key source of livelihood in Sindh since the majority of population is associated with this sector. The total land area of Sindh, 14.1 million hectares (or 34.84 million acres), represents 18% of total geographical area of Pakistan. Out of this, nearly 50 percent or 7 million ha is available for cultivation (see **Exhibit 4.1**). More than 80% of the rural population depends on agriculture and its allied businesses. Agriculture is the dominant economic activity in the province.

About 80% of the agriculture land of the province is cultivated through controlled irrigation system. The irrigation system of Sindh comprises of three barrages at Sukkur, Guddu, and Kotri, having a gross command area of 15 million acres. However, cultivation takes place on only 8 million acres. The major crops of Sindh include rice, wheat, cotton, sugarcane and oilseeds. Sindh is also known for its orchards; mango, banana, guava and dates being some of the key fruits.

Wheat and rice are the key crops in the project area, whereas sugarcane and cotton are also some of the important crops of the area (see **Exhibit 5.11**). The total annual wheat production in the project area is about 1.33 million tons. At 0.37 million tons, the annual wheat production in Sanghar is the highest among the project area districts, whereas the annual wheat production of about 29 thousand tons in Thatta is the lowest in the project area. Low agriculture production in Thatta can be attributed to factors such as sea intrusion, low irrigation water availability, water logging and salinity. The total rice production in the project area is 1.57 million tons as shown in **Exhibit 5.11**. Larkana produces about 0.64 million tons of rice annually, which is the highest among the project area districts. The annual cotton production in the project area is about 1.25 million tons, of which Sanghar is the highest producer with 0.62 million tons. Similarly, the total annual sugarcane production in the project area is about 6.99 million tons, of which District Badin produces about 2.44 million tons – the highest production of this crop among the districts in the project area.

5.2.10 Irrigation System

The project area falls in the Indus Basin Irrigation System (IBIS), which is shown in **Exhibit 5.12** and briefly described below.

IBIS comprises of three major reservoirs, 16 barrages, 2 head-works, 2 siphons across major rivers, 12 inter river link canals, 44 canal systems (of which 14 lie in Sindh) and more than 107,000 water courses. The aggregate length of the canals is about 56,073 km. In addition, the watercourses, farm channels and field ditches cover another 1.6 million km.

Typical watercourse commands range between 200 and 800 acres. The system utilizes over 41.6 MAF of groundwater, pumped through more than 550,000 tube wells, in addition to the canal supplies.

Irrigated agriculture is the major user of both, surface and groundwater resources of Pakistan. The average annual river diversions for irrigation in the Indus Basin are of the order of 104.7 MAF, to irrigate over 14.6 million hectares. Of this, 67.11 MAF on average is diverted during the *kharif* period (summer crop), while 37.63 MAF is diverted during the *rabi* period (winter crop).

During the *kharif* periods of the last ten years, Punjab used 34.3 MAF annually, while Sindh and Balochistan used 31.4 MAF and NWFP used 2.35 MAF. During the *rabi* periods of the last ten years, average withdrawals by Punjab, Sindh and Balochistan and NWFP were 19.87 MAF, 16.06 MAF and 1.46 MAF, respectively.

Sindh has 14 public owned irrigation systems, which receive water from three barrages across the River Indus. These systems, with an aggregate length of 18,000 km of canals, serve an area of about 5.38 million hectares. There are 13 existing surface drainage systems in Sindh, which serve a total area of over 3.5 million hectares and have an aggregate length of about 4,800 km. New drains are also being constructed in the province. During the year 1999-2000, the total irrigated area, using all sources in Sindh, was of the order of 3.52 million hectares. This included 2.39 million hectares of irrigated land in the canal commands. The private tube-wells and wells irrigated 0.13 million hectares during the same period.

Groundwater Irrigation

An estimated 41.6 MAF of groundwater is pumped annually in Pakistan. According to a study, more than 90% of the extracted groundwater is used for irrigation purposes. Groundwater reservoirs are recharged from the rivers as well as the seepage losses from the canals, watercourses, farm channels and the fields.

Most of the ground water abstraction occurs in the Punjab. This was of the order of 34 MAF in the year 1999-2000, followed by Sindh, estimated at 5 MAF, Balochistan at 0.5 MAF and NWFP at 2.1 MAF. Large scale tube-well pumpage for irrigation began in the early sixties. The number of private tube-wells grew steadily with time. There are presently about 550,000 tube-wells in the IBIS and the annual pumpage in all canal command areas has been estimated to be 41.6 MAF.

Salinity and Water Logging

Before the introduction of the irrigation system, the water table was sufficiently deep. However, due to a lack of drainage facilities and improper water management, the water table rose, resulting in water logging and salinity.

About 25% of the irrigated area of Pakistan is affected by water logging and salinity/ sodicity problems. In addition to other measures like the Irrigation System Rehabilitation, Command Water Management and On-Farm Water Management programs taken up by different government departments, WAPDA completed 57 Salinity Control and Reclamation Projects (SCARPs). These cover a gross area of 7.81 million hectares. Surveys have indicated that water logging has reduced from 42% in the 60s to about 25% in 1977-79. Similarly, saline, saline-sodic and sodic soils were reduced from 6, 27 and 11% to 11, 24 and 3% respectively, in the same period of time.

5.3 Sites of Archeological, Cultural, Historical or Religious Significance

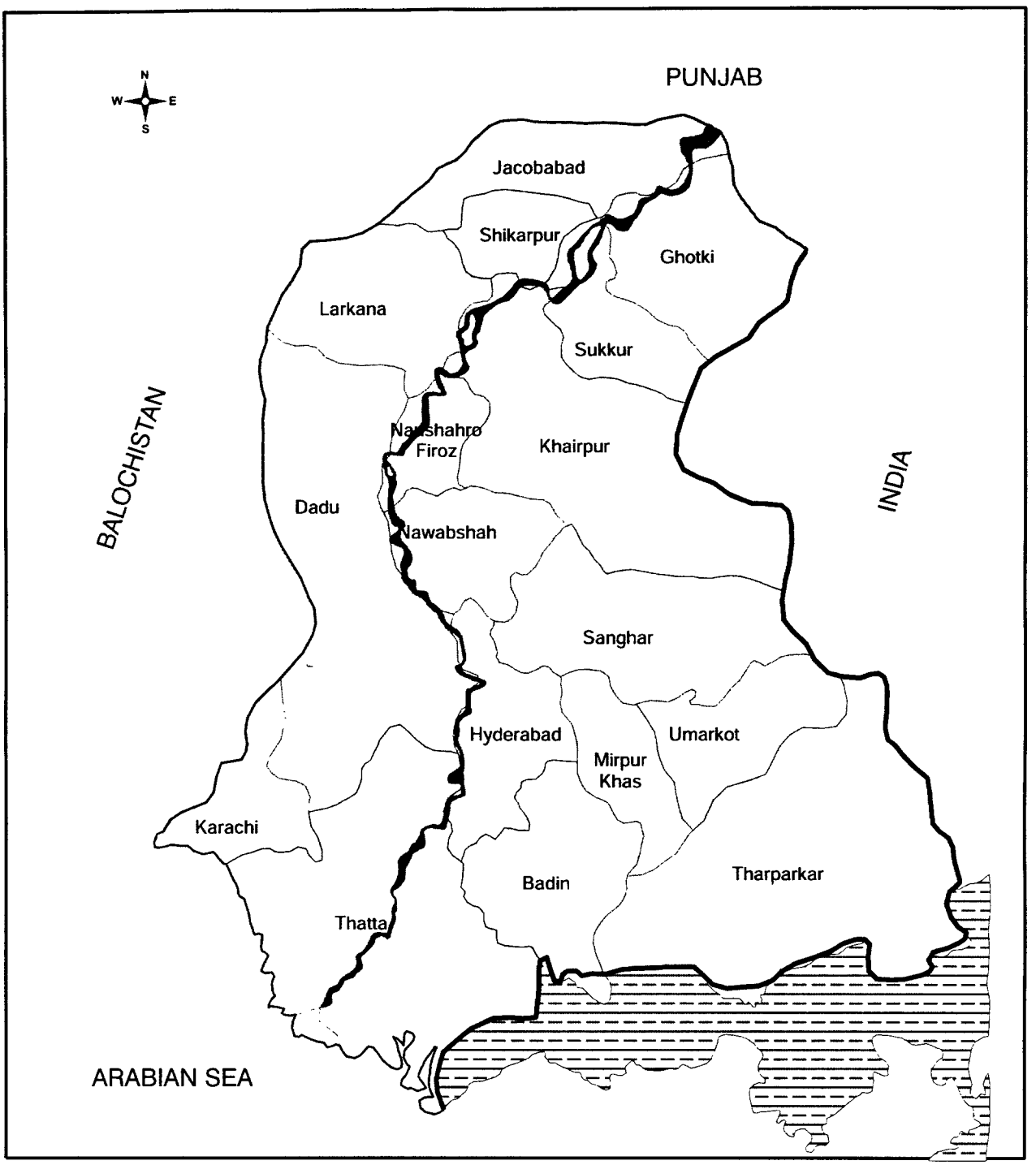
There exist a large number of sites of archeological, cultural, historical and religious significance in Sindh. The major ones include the archeological remains at Moen-Jo-Daro, which is one of the most important Indus Civilization sites, and the Makli Hills graveyard in the Thatta district. In addition, a large numbers of shrines exist in almost all parts of the project area. A list of these places located in the project area districts is provided in **Exhibit 5.13**. However, none of the project components are located at or near any known sites of archeological, cultural, historical and religious significance.

In addition, some graveyards exist along the transmission line routes as shown in **Exhibits 4.13** to **4.23**. However the project activities are not likely to damage these graveyards.[3]

[3] Chapter 9 includes mitigation measures to protect these graveyards.

Exhibit 5.1: Administrative Map of the Area

(Please see the following page.)



Legend

International Boundary
Provincial Boundary
District Boundary
Rivers
HESCO Area

Assignment:	Environmental and Social Assessment (ESA)
Project:	6th STG Project (2006-07)
Client:	HESCO
Source.	Atlas of Pakistan
Title.	**Administrative Map of Sindh**
Ref	GRP07E1-1HES
Date:	April 2007

Exhibit 5.2: Districts in Project Area
(1998 Census Data)

	Area (Km^2)	Population (Thousands)	Population Density (Persons per km^2)
Thatta	17,355	1,113	64.1
Badin	6,726	1,136	168.9
Hyderabad	5,519	2,891	523.9
Mirpur Khas	2,925	906	309.7
Sanghar	10,728	1,453	135.4
Larkana	7,423	1,926	259.6
Shikarpur	2,512	881	350.5
Jacobabad	5,278	1,426	270.1
Total (of the above 8 districts)	58,466	11,732	260.3
Sindh	**140,914**	**30,440**	**216.0**

Source: District Census Reports, 1999 and 2000.

Exhibit 5.3: Ranking of Districts by Human Development Index

DISTRICT	HDI	HDI Rank
Thatta	0.447	64
Badin	0.459	60
Hyderabad	0.532	23
Mirpur Khas	0.522	31
Sanghar	0.461	56
Larkana	0.435	67
Shikarpur	0.417	72
Jacobabad	0.393	77

Source: Pakistan National Human Development Report 2003

Exhibit 5.4: Literacy Ratio in the Project Districts by Gender
(1998 Census Data)

%

District	Male Urban	Female Urban	Literacy Gap Urban	Male Rural	Female Rural	Literacy Gap Rural
Thatta	56.98	33.90	23.08	28.31	08.34	19.97
Badin	56.24	31.33	24.91	30.66	09.23	21.43
Hyderabad	67.32	54.58	12.74	35.76	12.89	22.87
Mirpur Khas	68.02	50.92	17.10	34.21	10.98	23.23
Sanghar	64.65	40.55	24.10	36.18	10.17	26.01
Larkana	65.16	37.83	27.33	41.44	13.10	28.34
Shikarpur	68.34	41.26	27.08	36.88	10.15	26.73
Jacobabad	57.02	29.57	27.45	26.37	06.47	19.90
Sindh	**69.75**	**56.66**	**13.09**	**37.89**	**12.23**	**25.66**

Source: District Census Reports, 1999 and 2000.

Exhibit 5.5: Literacy Ratio in Project Area
(1998 Census Data)

%

District	Urban	Rural	Total
Thatta	45.92	18.99	22.14
Badin	44.76	20.52	24.63
Hyderabad	61.30	24.84	44.25
Mirpur Khas	59.80	23.13	35.97
Sanghar	53.15	23.94	30.87
Larkana	51.95	27.68	34.95
Shikarpur	55.33	23.92	31.94
Jacobabad	43.86	16.86	23.66
Sindh	**63.72**	**25.75**	**45.29**

Source: District Census Reports, 1999 and 2000.

Exhibit 5.6: Enrolment Ratio in Project Area
(1998 Census Data)

District	Urban	Rural	Total
Thatta	32.22	10.82	13.25
Badin	36.25	13.26	17.05
Hyderabad	41.00	20.26	30.94
Mirpur Khas	43.53	20.15	28.05
Sanghar	45.61	20.89	26.67
Larkana	44.39	20.34	27.47
Shikarpur	35.63	12.19	17.47
Jacobabad	37.71	14.42	20.30
Sindh	46.64	19.60	23.78

Source: District Census Reports, 1999 and 2000.

Exhibit 5.7: Educational Institutes in Project Area
(1998 Census Data)

District	Numbers		
	Schools	Colleges	Others
Thatta	2,282	4	4
Badin	2,102	6	-
Hyderabad	3,343	12	1,132
Mirpur Khas	3,752	-	6
Sanghar	3,256	9	10
Larkana	2,803	14	-
Shikarpur	1,383	-	3
Jacobabad	2,594	7	3

Source: District Census Reports, 1999 and 2000.

Exhibit 5.8: Healthcare Facilities in Project Area

(1998 Census Data)

District	Number of Healthcare Facilities						
	Civil Hospital/ Other Hospitals	Taluka Hospitals	Basic Health Unit(s)/ Public Health Centers	Rural Health Centers	Maternity/ Community Health Centre(s)	TB Hospital / Clinic	Others (Sub Health Centres, Dispensaries, Private Facilities and Others)
Thatta	1	4	46	8	-	-	-
Badin	1	3	33	11	1	-	27
Hyderabad	3		59	13	4	15	58
Mirpur Khas	1	3					24
Sanghar	1	5	52	7	3	-	87
Larkana	5	6	43	9	4	-	116
Shikarpur	1	4					13
Jacobabad	2	3	27	6	1	1	2

Source: District Census Reports, 1999 and 2000.

Exhibit 5.9: Agro-ecological Zones of Pakistan

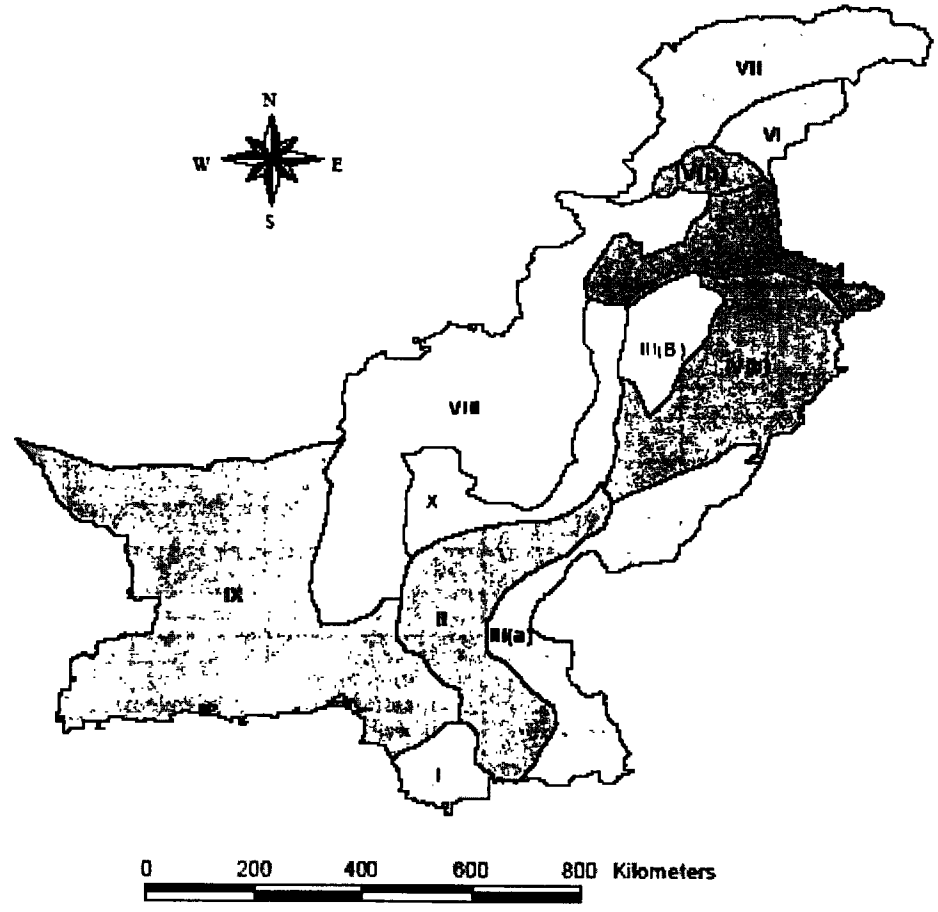


Exhibit 5.10: Characteristics of Agro-ecological Zones of Pakistan

Zone	Region	Temperature (°C)	Rain (mm)	Soil	Crops	Other Features
I	Indus Delta	34-40 19-20	125-250	Clayey Soil Silty Soil	Rice, Sugarcane, Pulses, Berseem, Wheat	Salinity of Soil, Poor Drainage
II	Southern irrigated plain	38-45 8-12	125-250	Silt Loam, Sandy Loam, Silty Clay	Rice, Wheat, Cotton, Sorghum, Mustered, Sugarcane, Gram	20% Salt Affected Area
III(a)	Sandy Desert	39-41 7	125-250	Sandy Soils, Moving Sand Dunes; Clayey Soils	Guar, Millets, Wheat	Dust Storm are Common
III(b)	Sandy Desert	40 5.5	150-350	Stable Sand Ridges (sand and loamy fine sand soils)	Gram, Wheat, Cotton, Sugarcane	Internal Drainage
IV(a)	Northern Irrigated Plain	39.5-42 6-6.2	200-500	Sandy Loam, Clayey Loam	Rice, Wheat, Cotton, Sugarcane, Maize, Oilseeds, Melons	Canal Irrigated Cropping
IV(b)	Northern Irrigated Plain	38 5	500	Clayey	Sugarcane, Maize, Tobacco, Wheat, Berseem	Intensively Cultivated Area
V	Barani Land	38-38.5 3.7	200-1000	Silty Loam, Silty Clayey loam, Clay Loam	Wheat, Millets, Rice, Maize, Oilseeds, Pulses, Fodder	Shallow Soils Unsuitable for Root Growth
VI	Wet mountain	35 0-4	>1000	Silt Loams, Silty Clay	Maize, Wheat, Rice, Deciduous Fruit	Steep Mountain Slopes
VII	Northern Dry Mountains	Varied	300-1000	Deep and Clayey formed of Colluvial material and alluvial deposits	Maize, Wheat, Fodders, Fruit, Apricot	Glaciers and Snow fields

...Continued, Exhibit 5.10

Zone	Region	Temperature (°C)	Rain (mm)	Soil	Crops	Other Features
VIII	Western Dry Mountain	30-39 -3 – 7.7	125-500	Strongly Calcareous Soils; Gravely soils	Fruit, Wheat, Vegetables, fodder, Maize	Numerous Hill Torrents
IX	Dry Western Plateau	33-40.5 3 – 15	50-200	Strongly Calcareous Silt Loams Gravely soils	Tropical Fruits, Wheat Summer Cereals	Sailaba agriculture system
X	Sulaiman Piedmont	40-43.6 5.8 – 7.6	125-250	Loamy, Clayey	Wheat, Gram, Lentils, Oilseeds, Millet Sorghum	Sailaba agriculture system

Exhibit 5.11: Annual Production of Key Crops in Project Area

Thousand Tons

District	Wheat	Rice	Cotton	Sugarcane	Maize	Bajra	Jowar	Barley
Thatta	28.7	108.7	2.2	136.4	0.1	0.0	0.1	0.4
Badin	70.9	128.9	19.2	2,440.2	0.0	0.1	0.1	0.4
Hyderabad	241.4	34.0	301.7	3,321.6	0.3	1.0	0.1	0.0
Mirpur Khas	256.8	0.0	296.2	438.5	0.6	0.1	0.5	0.0
Sanghar	365.7	0.2	619.0	622.0	0.3	0.6	0.8	0.0
Larkana	172.4	636.9	13.7	25.7	0.0	0.0	1.9	1.0
Shikarpur	79.0	301.5	0.8	4.3	0.0	0.0	0.5	0.2
Jacobabad	118.2	362.8	1.6	3.0	0.0	0.0	2.6	0.3
Total for above Districts	1,333.1	1,573.0	1,254.4	6,991.7	1.3	1.8	6.6	2.3
Sindh	2,750.3	1,721.0	2,648.0	11,243.4	1.6	12.7	43.7	2.9

Source: Development Statistics of Sindh, Bureau of Statistics, Government of Pakistan, 2004.

Exhibit 5.12: Irrigation Command Area

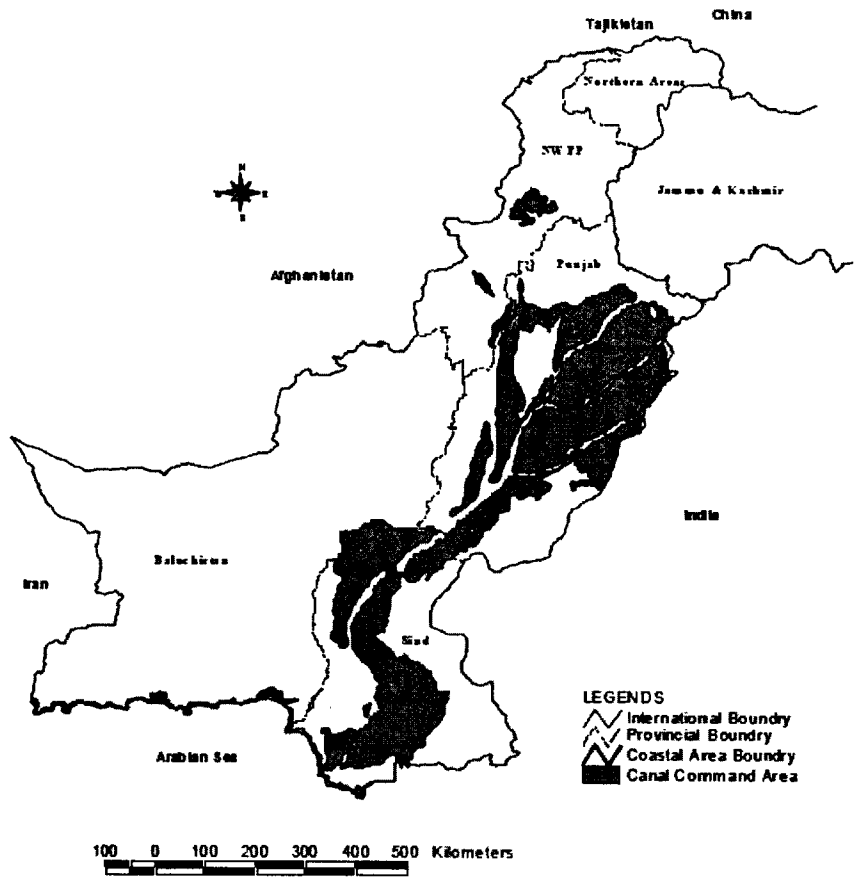


Exhibit 5.13: Places of Archeological, Historical or Religious Significance Falling in Project Area Districts

Badin District

1. Ruins of old city at Badin.

Hyderabad District

2. Tomb of Ghulam Shah Kalhora, Hyderabad.
3. Boundary Wall of Pucca Fort, Hyderabad.
4. Old office of Mirs, Hyderabad Fort, Hyderabad.
5. Tajar (Treasury) of Mirs, Hyderabad Fort, Hyderabad.
6. Tomb of Ghulam Nabi Khan Kalhora, Hyderabad.
7. Buddhist Stupa, (Guja) a few miles from Tando Muhammad Khan, Hyderabad.
8. Haram of Talpur Mirs, Hyderabad.
9. Enclosure containing Tombs of Talpur Mirs, Hyderabad.
10. Tower (Now used as water tank), Hyderabad Fort, Hyderabad.
11. Two Mosques and a Tomb, Tando Fazal, Hyderabad.
12. Tomb of Sarfaraz Khan Kalhora, Hyderabad.
13. Nasar-ji- Mosque, Mohalla Jhambhas, Nasarpur, Hyderabad.
14. Kiraiji Masjid, Mohalla Misri, Nasarpur, Hyderabad.
15. Mai Khairiji Masjid, Mohalla Memon, Hyderabad.
16. Mosque of Mirs, Hyderabad, ward "E", Hyderabad.
17. Enclosure containing Tombs of Talpur Mirs, Hyderabad.

Larkana District

18. Jhukar mound, Mithadaro, Larkana.
19. Moenjodaro, Buddhist monastery and prehistoric remains around Moenjodaro, Larkana.
20. Moenjodaro, Buddhist Stupa and prehistoric remains underneath, Moenjodaro, Larkana.
21. Tajjar Building, Jinnah Bagh, Larkana.
22. Tomb of Shah Baharo, Larkana.
23. Square Tower, near Dhamrao, Larkana.
24. Dhamrao Dero (three groups), Deh Dhamrao, Deh 67 Nasrat, Larkana.

Sanghar District

25. Brahmanabad (Mansura) locally known as Dalo Raja-ji-Nagri, Jamara, Tehsil Sinjhoro. Deh Dalore, Sanghar.
26. Mound Thulh, Deh Kot Bujar, Sanghar.
27. Graveyard, Tehsil Shahdadpur, Sanghar.

Thatta District

28. Brick dome to the north-east of tomb of Mubarak Khan (tomb of Fateh Khan's sister), Makli Hill, Thatta.
29. Tomb of Mubarak Khan son of Jam Nizamuddin, Makli Hill Thatta.
30. Tomb and compound wall of yellow stone to the south of Jam Nizamuddin, Makli Hill, Thatta.
31. Tomb and enclosure to the south-west of S. No. 92. Makli Hill, Thatta.
32. Tomb and enclosure to the west of the above tomb S. No. 93, Makli Hill, Thatta.

33. Brick dome to the south of the tomb S. No 94, above Makli Hill, Thatta.
34. Sultan Ibrahim and other tombs also but wrongly known a Amir Khalil Khan's tomb, Makli Hill, Thatta.
35. Tomb and compound wall of yellow stone to the south of Mirza Muhammad Baqi Tarkhan tomb (wrongly called Mirza Isa Khan's tomb), Makli Hill, Thatta.
36. Brick enclosure of Mirza Baqi Baig Uzbak's tomb, south of the tomb of Nawab Isa Khan the younger, Makli Hill, Thatta.
37. Dabgir Masjid, Makli Hill, Thatta.
38. Graveyard, Makli Hill, Thatta.
39. Goth Raja Malik graveyard known as Maqam Qadar Shah, Deh Raja Malik, Thatta.
40. Sonda graveyard, village Sonda, Thatta.
41. Jam Nizmuddin's tomb, Makli Hill, Thatta.
42. Baradari, Makli Hill, Thatta.
43. Tomb of Amir Sultan Muhammad son of Amir Hajika, Makli hill, Thatta.
44. Tomb of Nawab Isa Khan, the younger Makli Hill, Thatta.
45. Mirza Tughral Baig's tomb, Makli Hill, Thatta.
46. Tomb of Mirza Jani and Mirza Ghazi Baig, Makli Hill, Thatta.
47. Stone enclosure containing tombs of Nawab Isa Khan, Makli Hill, Thatta.
48. Mirza Muhammad Baqi Tarkhan's tomb (wrongly called Mirza Isa Khan's tomb) Makli Hill, Thatta.
49. Stone tomb with a dome on stone pillars by the side Mirza Jani Baig's tomb, Makli Hill Thatta.
50. Brick masjid and enclosure near Nawab Shurfa Khan's tomb (supposed to be the tomb of Sayyed Amir Khan), Makli Hill, Thatta.
51. Stone tomb with enclosure to the south of tomb of Mirza Muhammad Baqi Tarkhan, Makli Hill, Thatta.
52. Tomb of Mirza Muhammad Isa Turkhan I, Makli Hill, Thatta.
53. Brick tomb near the tomb of Qulia pir, Makli Hill, Thatta.
54. Tomb with superstructure on stone pillars to the north of tomb of Jam Nizamuddin, Makli Hill, Thatta.
55. Brick structure to the north of tomb of Jam Nizamuddin, Makli Hill, Thatta.
56. Two pavilions on stone pillars over the tombs to the southwest of tomb of Jam Nizamuddin. One is the tomb of Jam Sikandar Shah, Makli Hill, Thatta.
57. Kalan Kot, Makli Hill, Thatta.
58. Nawab Amir Khan's mosque, Makli Hill, Thatta.
59. Building with two domes near the Civil Hospital, Thatta, Makli Hill, Thatta.
60. Jama Masjid, Makli Hill, Thatta.
61. Sasian-Jo-Takar (Mirpur Sakro, Thatta.
62. Jama Masjid, Thatta.

WORLD HERITAGE MONUMENTS ON UNESCO LIST.

1. Mohenjodaro, District Larkana.
2. Makli Hill, Thatta.

Source: Guidelines for Sensitive and Critical Areas. Government of Pakistan. 1997.

Note: None of the above areas are located at or in the immediate vicinity of the proposed project components.

6 Analysis of Project Alternatives

This Chapter discusses various project alternatives that were considered during the design phase. The alternatives in this Chapter have been organized in three broad categories: management, siting and technical alternatives.

6.1 Management Alternatives

6.1.1 No Project Alternative

As described in **Section 1.2**, the electricity demand has been increasing during the past several years, and this trend is expected to continue as a result of the on-going economic uplift in the country. The key factors fueling the increasing power demand include increasing population, rapid urbanization, industrialization, improvement in per capita income and village electrification.

In order to match the increasing trend in the power demand, regular investments in various segments of the power network – generation, transmission, and distribution – is vitally important. Otherwise, the gap between the supply and demand will keep on increasing.

The proposed project seeks to upgrade the secondary transmission and grid network of the HESCO system. Establishing new grid stations and augmenting, converting, or upgrading the existing ones will provide the much needed relief to the over-loaded system, while also accommodating additional load. The establishment of new grid stations will also reduce the line losses and power breakdowns.

In case the proposed project is not undertaken, the HESCO system will not be able to cope with the increasing demand, the existing system will remain over-loaded, line losses will also remain high, and the system reliability will progressively decrease, with increasing pressure on the system. The Utility will also forego the opportunity of increasing its consumers as well as revenue associated with the system expansion.

In view of the above, the 'no project' option is not a preferred alternative.

6.2 Siting Alternatives

6.2.1 Grid Station Sites

HESCO considered multiple alternative sites for the Bukhshapur, Chamber, Tando Bago and Larkana-III grid stations (see **Exhibits 4.13** to **4.16**). These alternate sites were inspected during the field investigations as part of the present ESA, and various environmental and social parameters were observed. These parameters included land use, land form, proximity to any settlement, presence of any wildlife/natural vegetation of significance in the area, possibility and impact of any air or water contamination caused by the project activities, possibility of damage to any public infrastructure and other similar aspects. However the field investigations revealed that these alternatives were

quite similar with respect to the environmental and social aspects, as can be observed in the schematic drawings provided in **Exhibits 4.13** to **4.16**, and the mitigation measures discussed in **Chapters 8** and **9** will reduce the adverse impacts associated with the proposed activities to an acceptable level.

6.2.2 Routing Alternatives

While selecting the transmission line route, the GSC crew generally identifies three options. These include the shortest possible route between the two ends of the proposed transmission line. However this may not always be the most feasible route, in view of the settlements or any other sensitive area that come in the way. Therefore the most preferable route is the one which avoids settlements and other sensitive areas.

For the proposed project, while surveying the routes, the GSC team considered multiple routing options, and made efforts to avoid settlements and other sensitive locations as far as possible. During the field investigations as part of the present ESA, the key environmental and social aspects along the routes were identified and documented (see **Exhibits 4.17** to **4.23**). During these field investigations, it was ensured that each selected route was the best available option, and did not have an unacceptable level of environmental and social impacts. Furthermore, appropriate mitigation measures were incorporated in the design and implementation of the works to reduce the impacts. (The impact assessment and mitigation measures are discussed in **Chapters 8** and **9** of this document).

The key routing options of the transmission lines are discussed below.

Humayun – Jacobabad Transmission Line: The shortest route for the transmission line would pass over thickly populated area near the Jacobabad grid station (see **Exhibit 4.22**). However, deviations have been made in the route to avoid the settlements as far as possible. The last segment of this route does pass over a congested settlement near the Jacobabad grid station, however no alternative is available for this segment. Appropriate mitigation measures have been included in the mitigation plan (**Chapter 9**) to reduce the adverse impacts, particularly for the last segment of the transmission line. There exist no other environmental or social sensitivities along the proposed route.

Feed for Chamber Grid Station: The shortest route for the feed would pass over some settlements in and around Tando Allahyar town. However, the route has been aligned to avoid these settlements, though this has resulted in a longer transmission line. Now the route does not pass over any settlement, as can be seen in **Exhibit 4.18**.

In addition, the selected route passes over orchards at two locations (see sheets 5 and 6 of **Exhibit 4.18**). Avoiding these orchards would have increased the cost of the transmission line. With the help of appropriate mitigation measures (such as no tree cutting, no vehicle movement in the orchard, and payment of compensation for any slight damage to the trees – discussed in **Chapter 9**), the adverse impacts of the transmission line laying and operating on the orchards will be sufficiently reduced.

There exist no other environmental or social sensitivities along the proposed route.

Samaro – Naukot Transmission Line: The shortest route for the transmission line would pass over several small settlements between the two towns. However, deviations

have been made in the route to avoid the settlements. Now the route does not pass over any settlement, as can be seen in **Exhibit 4.23**.

In addition, the selected route passes over an orchard (see sheet 2 of **Exhibit 4.23**). Avoiding this orchard would have increased the cost of the transmission line. With the help of appropriate mitigation measures discussed above, the adverse impacts of the transmission line laying and operating on the orchard will be sufficiently reduced.

There exist no other environmental or social sensitivities along the proposed route.

Feed for Matiari Grid Station: The selected route passes over a fruit orchard, and no alternative exists to avoid this orchard. However, an existing gap that exists among the trees will be used to align the transmission line, thus minimizing the adverse impacts of the proposed works on the orchards. Furthermore, as described above, no vehicular movement will be allowed in the orchard, no trees will be cut and any minor damage that may be caused will be compensated.

Feed for Kandiari Grid Station: Much like the Feed for Matiari Grid Station discussed above, the selected route for the Kandiari Grid Station passes over a fruit orchard, and no alternative exists to avoid this orchard. However, the height of the transmission line will be increased, thus minimizing the adverse impacts of the proposed works on the orchards. Furthermore, as described above, no vehicular movement will be allowed in the orchard, no trees will be cut and any minor damage that may be caused will be compensated.

6.3 Technical Alternatives

6.3.1 Type of Grid Station

Generally, two types of grid station designs are available: conventional and gas-insulated.

The conventional grid stations have open yards for transformers and their accessories and the control panels and feeder panels are placed indoors. These grid stations require a large area (about 4 acres), which might be a problem in congested urban areas. The environmental and socioeconomic aspects of this type of grid station include safety hazard for the nearby population, particularly in the congested urban areas, and land requirement.

The gas insulated grid stations (GIS) on the other hand employ a very compact design, and most of equipment is fully enclosed and gas insulated. This allows the entire system to be placed indoors in considerably smaller space compared to the conventional design. However, the cost of these grid stations is several times higher than the conventional ones.

In view of the fact that the new grid stations as part of the proposed project are being planned outside the congested urban areas, the availability of land is not a problem. Hence the additional cost associated with the GIS cannot be justified, and the conventional grid station design is the preferred option for the proposed project. Additionally all safety precautions will be included in the GS design, in order to protect the people and livestock from the electrocution hazard.

6.3.2 Type of Circuit Breakers

Traditionally, oil-filled circuit breakers used to be installed at the 132-KV and 11-KV levels. However, now SF_6 (sulfur hexa-fluoride) circuit breakers are available for 132-KV and above, and vacuum circuit breakers are available for the 11-KV system. These breakers have very effective arc-quenching characteristics, compared to the old oil-type breakers. Therefore, these modern circuit breakers are the preferred option for the proposed project.

The environmental aspects of the oil-filled circuit breakers essentially pertain to the of soil and water contamination caused by the possible oil leakage.

For the HESCO's proposed 6th STG project, vacuum and SF_6 circuit breakers would be installed at the grid stations.

6.3.3 Type of Transformer Oil

Traditionally, transformer oil – meant for providing insulation and cooling of the transformer windings – used to contain poly-chlorinated biphenyls (PCB), a man-made chemical known for its excellent dielectric properties. However, this chemical was then found to be highly toxic, and more importantly, chemically very stable. Hence this chemical would not decompose or disintegrate naturally. Due to this property of PCB, it was included in a group of chemicals collectively known as persistent organic pollutants (POPs). **Appendix F** provides more information on PCBs.

Although, production and use of the PCB containing transformer oil is not allowed anymore in the West, it is still being used locally. In view of their extremely harmful effects however, use of this oil is not a preferred option for all applications, including the proposed project.

HESCO's specifications for the procurement of transformers clearly mention that the transformer oil should be PCB-free (though no tests are performed to confirm this). Hence the equipment purchased as part of this project would be PCB-free.

6.3.4 Type of Transmission Line Towers

Single Circuit vs. Double Circuit

For the single circuit 132-KV and 66-KV transmission lines, there exist two possible options for the type of the towers: single circuit and double circuit. The single circuit towers are designed for one circuit of the transmission line only, and there is no room for the second circuit in the future. On the other hand, using the double circuit towers for the single circuit transmission line provides the future expansion capacity on the same towers. The cost of the double circuit towers is slightly higher than the single circuit variants, however, in view of their expansion capacity, these towers are the preferred options for all the single circuit transmission lines which are included in the proposed project.

The environmental and socioeconomic aspects of the double-circuit tower include smaller footprint and lower land acquisition requirements (compared to two single-circuit towers).

Tower vs. Tubular Pole

The base of the transmission line towers is about 5 m × 5 m, and finding this much space in congested urban areas may be a problem. For such applications, WAPDA has been using tubular steel poles which require considerably less space. These poles are quite expensive compared to the conventional towers.

The environmental and socioeconomic aspect of the tubular pole includes smaller footprint, compared to the conventional tower.

Some of the transmission lines as part of the proposed project would need to pass through congested city areas (eg, Humayun – Jacobabad transmission line). For such transmission lines, the preferred option would be to use the tubular poles.

7 Stakeholder Consultation

This Chapter provides the objectives, process and outcome of the stakeholder consultations conducted as part of the ESA study.

7.1 Objectives

The stakeholder consultation is an integral part of the environmental and social assessment for a project such as the 6th STG, and aims to provide a two-way communication channel between the stakeholders and the project proponents. In line with this aim, the objectives of the stakeholder consultations conducted as part of the present ESA were to:

- develop and maintain communication links between the project proponents and stakeholders,
- provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and
- ensure that views and concerns of the stakeholders are incorporated into the project design and implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project.

7.2 Participation Framework

The stakeholder consultation is a continued process, and should be maintained throughout the project. The consultations carried out during the present ESA and reported in this Chapter are essentially a first step in this process. During the subsequent project phases as well, participation of the project stakeholders needs to be ensured.

Exhibit 7.1 charts out the proposed participation framework during different project phases, while **Exhibit 7.2** provides the conceptual framework employed during the stakeholder consultations carried out as part of the present ESA.

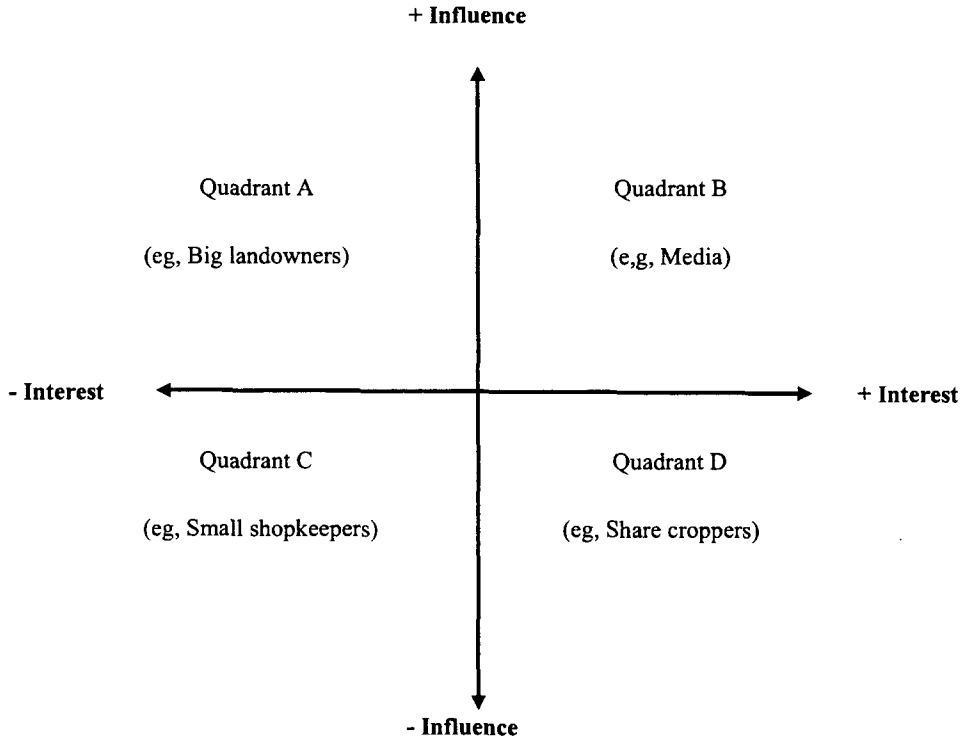
7.3 Stakeholder Identification and Analysis

The stakeholder analysis reveals the nature and magnitude of the stakeholders' interests in and influence on a project. The first step for the analysis is to identify the stakeholders, who are essentially not limited to those affected by the project. They also include those who can affect or influence the project. They can be winners, losers or indifferent. The stakeholder analysis aims to distinguish between the actual effects of the project on different stakeholders, and those stake stakeholders' perceptions about the project and its effects.

The second step in the stakeholder analysis is to analyze the interests and influence of the stakeholders, examining their assets and capabilities. The small landowners may have high stakes in a development project, but very little influence. As a contrast, the regulatory agencies may have very high influence but low interest in a project.

The third step is to differentiate stakeholders by their attachment to the status quo, or conversely, their desire/willingness to change.

The stakeholders can be best analyzed by comparing their commitment to the status quo against the influence they wield. The diagram given below conceptually presents the interplay of stakeholders' interest and their influence.[1]



The stakeholders that have considerable influence and are determined to prevent changes (Quadrant A in the above diagram), are the greatest challenges for many projects. The groups that want change, whether or not they have much influence, are the possible counterbalances (Quadrants B and D in the diagram). The project needs to find ways to increase the influence of groups that favor change but lack influence and to mediate between the influential groups that favor change and groups that oppose it.

During the present ESA, the stakeholder analysis was carried out to identify relevant stakeholders on the basis of their ability to influence the project or their vulnerability to be negatively impacted from it. This approach ensured that no relevant groups were excluded from the consultations, and appropriate engagement strategies were developed for each stakeholder.

[1] Source: Social Analysis Sourcebook: Incorporating Social Dimensions into Bank-Supported Projects. The World Bank. December 2003.

The key stakeholders identified, analyzed and consulted at various levels included the following:

- People directly affected by the Project (ie, project affected persons or PAPs).
- Project beneficiaries
- HESCO officials
- District governments
- Environment Protection Agency
- The broader interested community
- The NGOs, international organizations and other interest groups.

7.4 Consultation Process

Consultations with the project stakeholders were carried out while conducting the present ESA. A participatory and consultative approach was employed for information dissemination and data collection.

Meetings were held with a range of key informants as well as government and civil society stakeholders at different levels. The focus group discussions with the grass-root stakeholders were held, whereas meetings were held with the institutional stakeholders. These discussions were held with project affected people, project beneficiaries and other local communities in Hyderabad, Jacobabad, Shikarpur, Larkana, Sanghar, Mirpur Khas, Tando Allahyar, Badin, Umerkot and Thatta districts.

Efforts were made to include the women in the consultation process as much as possible. While women were included in most of the consultations, the women-only consultations were also held, and for this purpose, the consultation team included a female staff.

The consultation process was conceived to interact meaningfully with affected communities and other stakeholders. The consultations also helped better understand local knowledge with respect to the various sets of issues and concerns, and integrate these into the project design and ESMP. (Please see **Appendix E** for stakeholder consultation details.)

7.5 Consultations with Institutional Stakeholders [2]

The institutional stakeholder consultations were held with the representatives of the following organizations:

- Environmental Protection Agency (EPA)
- Sustainable Development Policy Institute (SDPI)
- Leadership in Environment and Development (LEAD) fellows
- Lok Parya (a local grass root level NGO)
- National Environmental Action Plan (NEAP)

[2] Some of the institutional stakeholder consultations discussed in this section were carried out during the ESA's for the IESCO and MEPCO 6th STG projects.

- International Union for Conservation of Nature (IUCN)
- Strengthening Participatory Organizations (SPO), Hyderabad
- South Asia Partnership-Pakistan, Hyderabad
- Provincial Health Development Institute (PDHI), Jamshoro
- Sindh Irrigation and Drainage Authority, Hyderabad
- Sindh Development Society, Hyderabad
- Sindh National Congress, Hyderabad
- Sindh Democratic Forum, Hyderabad.

In addition, a meeting was also held with Dr Yusuf Hyat, who was part of the Persistent Organic Pollutants (POPs) Project (implemented by the Pakistan Environmental Protection Agency, Islamabad).

Concerns Raised by Institutional Stakeholder

The institutional stakeholders raised several concerns and provided useful suggestions/recommendations. These are provided below.

- HESCO should fulfill the regulatory requirement of conducting environmental and social assessment of all of its projects.
- The project proponent should develop organizational capability for the implementation of ESMP, and to handle environmental / social issues during the project implementation as well as routine operation of the organization.
- The issues related to land acquisition and compensation should be appropriately addressed during the proposed project.
- The construction related issues – such as waste disposal, soil erosion and hazards for the nearby communities – should be adequately addressed during the proposed project.
- The potential environmental issues during the operation and maintenance of the proposed project – such as soil and water contamination caused by the leakage/spillage of the PCB-containing transformer oil – should be adequately mitigated.
- HESCO should have PCB testing arrangements at its grid stations and workshops.
- The PCB-containing transformer oil should be eliminated from the HESCO system.
- The effects of electromagnetic radiation caused by the high power transmission lines should be appropriately addressed during the proposed project.
- Community participation should be ensured to the extent practical during all phases of the project. Lessons learned during the similar projects in the past should be utilized.

7.6 Grass Root Stakeholders Consultations

The grass root consultations were carried out at the following project locations:

- Bukhshapur grid station site and its surroundings
- Larkana-III grid station site and its surroundings
- Chamber grid station site and its surroundings
- Tando Bago grid station site and its surroundings
- Transmission line route for the Larkana-III grid station feed
- Tando Allahyar – Chamber transmission line route
- Transmission line route for the Tando Bago grid station feed
- Humayun – Jacobabad transmission line route
- Transmission line route for the Matiari grid station feed
- Transmission line route for the Kandiari grid station feed
- Samaro – Naukot transmission line route.

Exhibit 7.3 presents list of the discussants and the key issues raised during the consultations. The questionnaire used during the consultations is provided in **Exhibit E.1** of **Appendix E**. A summary of these consultations is presented below; details of the consultations are provided in **Appendix E**.

7.6.1 Bukhshapur Grid Station Site

Consultations were held at the proposed site for the new grid station, and in Bukhshapur town. During the consultations, people of the area complained about low voltage, frequent interruptions and voltage fluctuation, which was causing a lot of problems for the residents of the area, while also damaging their electric appliances. This situation was also affecting the livelihood of the local population, as shared by the people interviewed. During the summers particularly, power outages caused considerable hardships for the people of the area.

The people of the area greatly supported the plans for the new grid station. They expected that after the establishment of the new grid station, the above described problems currently being faced by them would be alleviated. The villagers showed their concerns regarding any crop damaged by the project activities. They expected appropriate compensation for any such crop damage. The communities also wanted the project to generate employment opportunities for them.

Consultations were also held with owners and staff from some industrial units in the area (rice mills). They complained about the low voltage and frequent power interruptions, causing production loss as well as damage to the equipment. They welcomed the establishment of the new gird station in the area. in their opinion, the improved power availability will not only solve the above-described problems, but will also enable them and other industries in the area to enhance their production capacity, thus increasing their profits while also providing additional employment opportunities.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.2 Larkana-III Grid Station Site

Consultations were held at a nearby community. The residents of the community informed about poor quality of the electricity including low voltage, frequent interruptions and voltage fluctuations, which was causing a lot of hardships to them, and also damaging their electric appliances. Load shedding was cited as one of the problems faced by the people as well.

The people of the area greatly supported the plans for the new grid station. They expected that with the new grid station, the above described problems would be addressed. The participants of the consultation did not share any concern regarding the project.

The rural women were also included in the consultations, in order to inform them about the project, and to solicit their views and apprehensions.

7.6.3 Chamber Grid Station Site

Much like the consultees in other areas, the people interviewed at the proposed site for the Chamber grid station complained about low voltage, frequent power outages, faulty meters and over billing. The area being under cultivation, the crops suffered as a result of power outages and load shedding.

The people were in general supportive of the establishment of the proposed grid station at the site, and did not share any concerns or apprehensions in this regard.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.4 Tando Bago Grid Station Site

The residents of the area complained about low voltage, frequent interruptions and voltage fluctuation, which was a source of great anguish for them. Load shedding was cited as one of the problems faced by the people as well.

The people were generally supportive of the HESCO's initiative to establish the new grid station, and expected the Utility to incorporate all standard safety measures in the system. The residents of the area complained about lack of the development activities, in particular unavailability of drinking water in the area. They expected the project to provide jobs to them and also attract further development in the area.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.5 Humayun – Jacobabad Transmission Line Route

The communities consulted along the proposed route generally supported the project. They expected HESCO to compensate any crop damage caused by the construction activities. They expected that with the laying of the new transmission line, the electricity availability and its quality will improve. The people informed that they currently experienced frequent power outages, low voltage and extended load shedding.

A congested settlement exists near the Jacobabad grid station along the proposed route for the transmission line. In view of the congested and unplanned nature of the settlement, the proposed transmission line will have to be routed over the houses, and no alternative exists for this segment of the line.

The residents of this settlement were consulted as part of the stakeholder consultations. The respondents were unanimous regarding the danger this transmission line would pose while passing over their houses. Their concerns included their inability to construct higher buildings, owing to the low height of the transmission line, and risk of electrocution. They also shared their concerns regarding the harmful effects of the electromagnetic radiation caused by the high tension wires. While the residents acknowledged that the new transmission line would provide better electricity supply to the area, and they will also be benefited in this process, they opined that the grid station should be moved outside the city. (As discussed in **Section 6.2.2**, no alternative exists for this segment of the transmission line. However, appropriate measures have been included in the mitigation plan in **Chapter 9** and **10**, to address these impacts and public grievances).

The participants of other consultation meetings along the transmission line route expected HESCO to compensate them fully in case of any crops damaged during the project. They expected HESCO to incorporate all the necessary safety measures in the electricity network to protect them from the electrocution risk. They also hoped that the project would provide jobs to the local population, particularly the project affectees.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.6 Transmission Line Route for Larkana-III Grid Station Feed

The people interviewed along the proposed route shared their grievances associated with low voltage, frequent power outages and over billing. The population of the area greatly suffered because of the prevailing problems with the electric supply.

The people were in general supportive of the proposed project. Their concerns included possibility for damaged crops during the construction phase. They expected HESCO to compensate them for any such crop damage. They also expected HESCO to take all precautionary measures to minimize the safety hazards associated with the transmission lines. They also asserted that the project should provide employment opportunities to them.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.7 Tando Allahyar – Chamber Transmission Line Route

Several consultations were carried out along the proposed route for the Tando Allahyar – Chamber transmission line. The people interviewed informed about low voltage and frequent power outages. In addition, they complained about the difficulty in contacting the HESCO staff in case of electricity faults, and long durations to rectify such faults.

The people were in general supportive of the proposed project. They were generally aware that there would be some damage to the crops during the construction period, and they expected HESCO to provide compensation for such damages. The community along the proposed transmission line route near the Tando Allahyar grid station (along the Hyderabad – Mirpur Khas Road) shared their concerns about the project. They wanted that portion of the transmission line to be re-routed to avoid their houses/shops.

The communities expected that the project would create employment opportunities for them, and expected HESCO to provide them jobs. Some of the communities along the transmission line route, who currently do not have electricity supply, expected HESCO to provide them electricity connections. The communities present during the consultation expected HESCO to take all precautionary measures to protect them against the electrocution risk.

The rural women were also included in the consultations, in order to inform them about the project, and to solicit their views and apprehensions.

7.6.8 Transmission Line Route for Tando Bago Grid Station Feed

Consultations were held at several places along the proposed route. The people interviewed complained about low voltage and frequent power outages. They informed that the population of the area suffered as a result of power outages and load shedding.

The people were in general supportive of the proposed project. Their concerns included possibility for damaged crops during the construction phase. They expected HESCO to compensate them for any such crop damage. They also expected the project to provide employment opportunities to the locals.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.9 Transmission Line Route for Matiari Grid Station Feed

A consultation was held in the cultivation field along the proposed route of the Matiari grid station feed. The people interviewed shared their grievances associated with low voltage and frequent power outages. They informed that the daily life of the people in the area was badly affected as a result of power outages and load shedding.

The people were in general supportive of the proposed project. Their concerns included possibility for damaged crops during the construction phase. They expected HESCO to compensate them for any such crop damage. They also wanted HESCO to provide them jobs during the project.

Consultations were also held with the women of the area in order to inform them about the project, and to solicit their views and apprehensions.

7.6.10 Transmission Line Route for Kandiari Grid Station Feed

The people interviewed along the proposed route complained about low voltage, frequent power outages, faulty meters and over billing. The population of the area greatly suffered because of the prevailing problems with the electric supply.

The people were in general supportive of the proposed project, though some of them were not too sure about the project's benefits for them. Their concerns included possibility for damaged crops during the construction phase. They expected HESCO to compensate them for any such crop damage. They also wanted the project to provide employment opportunities to the local population.

7.6.11 Samaro - Naukot Transmission Line Route

Several consultations were held along the proposed route of the Samaro – Naukot transmission line. These consultations were held in the cultivation fields, at the road-side restaurants and in the communities. The people interviewed shared their grievances associated with the low voltage, frequent power outages, faulty meters and over billing. The population of the area greatly suffered as a result of power outages and load shedding.

The people were in general supportive of the proposed project. Their concerns included compensation for damaged crops during the construction phase. The communities present during the consultation expected HESCO to take all precautionary measures to protect them against the electrocution risk. They also hoped that the project would provide employment opportunities to them.

The rural women were also included in the consultations, in order to inform them about the project, and to solicit their views and apprehensions.

7.7 Summary of Concerns and Recommendations

A summary of the concerns raised and recommendations provided by the institutional as well as the grass root stakeholders is provided in **Exhibit 7.4**. An attempt has been made, during the present ESA, to address these concerns (discussed in **Chapters 8** and **9**).

Exhibit 7.1: Participation Framework

Project Stage	Proposed Tool	Stakeholders Consulted	Responsibility
Project Design Phase	Meetings with institutional stakeholders (carried out during the present ESA); Meetings with grass root stakeholders (carried out during the present ESA) (See **Section 7.3** for a list of key stakeholders.)	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	ESA consultant.
Project Construction Phase	Sharing of the project objectives, project components, major benefits, potential impacts, mitigation measures and Resettlement Plan with the affected communities (and other stakeholders).	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation.	Environmental and Social Inspector (ESI); Environmental and Social Monitor (ESM) (See **Section 10** for the definition and roles of ESI and ESM).
	Grievance Redressal Mechanism and Social Complaint Register (discussed in **Chapter 10**).	The affected communities.	ESI; ESM.
	Consultations with the communities during Compliance Monitoring and Effects Monitoring (discussed in **Section 10**).	Affected communities.	ESI; ESM.
	Fortnightly meetings at the site.	HESCO site staff; Contractors.	ESI; ESM.
	Consultations with the project affectees / communities during the external monitoring (discussed in **Chapter 10**).	Affected communities.	External monitoring consultant.
	Consultations with the project affectees / communities during the site visits by the WB monitoring missions.	HESCO site staff; Contractors; The affected communities.	WB monitoring missions.

....Cont'd., **Exhibit 7.1.**

Project Stage	Proposed Tool	Stakeholders Consulted	Responsibility
Project Operation Phase	Liaison with the communities around the grid stations; Liaison with the communities along the transmission line routes.	The communities around the grid stations and along the transmission line routes.	HESCO O&M staff; HESCO Environmental Cell (discussed in **Chapter 10**).
ESAs of subsequent phases of the 6th STG Project.	Meetings with institutional stakeholders; Meetings with grass root stakeholders.	Institutional stakeholders; Grass root stakeholders, including the communities to be affected during the project implementation; Affectees of the previous phase of the project (ie, 6th STG Project, 2006-07).	ESA Consultant.

Exhibit 7.2: Conceptual Framework

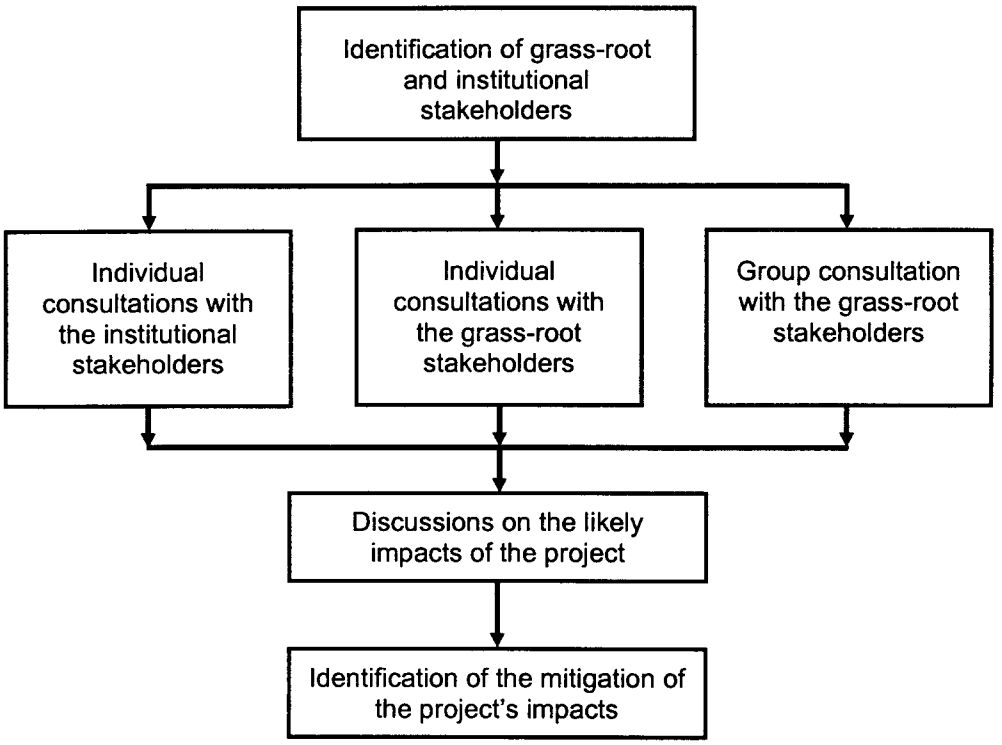


Exhibit 7.3: List of Participants during Grass Root Consultations

Location	Number and Type of Participants	Key Issue Discussed
Bukhshapur Grid Station Site and its Surroundings	99 Residents, farmers, housewives, landowners, mill owners, UC Nazims, influentials and others.	Inadequacy of the existing power supply in the area; Frequent load shedding and power outages causing hardship and economic loss; The project should minimize crop damage; Compensation should be paid for any crop damage/land acquisition. Project should provide employment opportunities to the local population.
Humayun – Jacobabad Transmission Line Route	122 Residents of the areas, housewives, farmers, shopkeepers, teachers, road-side restaurant owners/workers, brick kiln workers and others.	Frequent power failures and voltage fluctuation; Full compensation should be paid for any crop damage. All safety precautions should be taken to install electrical system. The residents of communities near Jacobabad Grid Station opposed the transmission line passing over their houses and shops. Project should provide employment opportunities to the local population.
Larkana-III Grid Station and its Feed	46 Residents of nearby villages, farmers, traders, housewives, shopkeepers, imam masjid and others.	Frequent power failures and low voltage. Frequent load shedding and power outages, causing hardship and economic loss. Full compensation should be paid for any crop damage/land acquisition. HESCO should take precautionary measures to minimize the risk of electrocution. Project should provide jobs to the local population.
Tando Bago Grid Station and its Feed	23 Residents of the area, farmers, influentials, landowners, traders, housewives.	Frequent power failures and voltage fluctuation. Payment of compensation for any crop damage. Project should provide employment opportunities to the local population.

...Continued **Exhibit 7.3.**

Location	Number and Type of Participants	Key Issue Discussed
Chamber Grid Station and its Feed	71 Shopkeepers, truck drivers, road-side restaurant owners and workers, farmers, landowners, UC Nazim, influentials, housewives and teachers.	Frequent power failures and voltage fluctuation. Minimize crop damage. Payment of compensation for any crop damage. Apprehensions regarding the transmission line alignment adjacent to the commercial area near Tando Allahyar grid station. Safety precautions should be taken during the project works. Project should provide employment opportunities to the local population. Project should provide electricity to those communities which currently do not have electricity connections.
Matiari Grid Station Feed	11 Farmers, residents and housewives.	Frequent power failures and voltage fluctuation. Project should provide employment opportunities to the local population. Full compensation should be paid for any crop damage/land acquisition.
Kandiari Grid Station Feed	13 Farmers, NGO worker, landowners, roadside restaurant workers and others.	Frequent power failures and voltage fluctuation. Payment of compensation for any crop damage. Project should provide employment opportunities to the local population.
Samaro - Naukot Transmission Line	34 Farmers, Govt. servants, shopkeepers, influentials and housewives.	Frequent power failures and voltage fluctuation. Minimize crop damage. Payment of compensation for any crop damage. All necessary safety precautions should be taken during the project works and during the operation of the system. Project should provide employment opportunities to the local population.

Exhibit 7.4: Summary of Communities' Concerns and Expectations

Institutional Stakeholders	**Concerns Raised**
	Land acquisition issues.
	Possibility of soil and water contamination caused by the PCB-containing transformer oil.
	Construction-related issues, such as waste disposal, soil erosion and hazard for communities.
	Effects of electromagnetic radiation caused by the high power transmission lines.
	Recommendations Provided
	HESCO should conduct environmental and social assessment of all of its projects.
	HESCO should develop organizational capacity for managing the environmental as well as social issues during its operations.
	HESCO should ensure community participation during all phases of the project.
	The PCB elimination program should be developed and implemented.
Grass Root Stakeholders	**Concerns Raised**
	Safety hazards caused by the transmission lines.
	Possibility of transmission line passing over the settlements and through the cultivation fields.
	Low height of the transmission line (Humayun – Jacobabad) thus causing safety hazard, and not allowing the residents to construct taller buildings/install antenna, etc.
	Electromagnetic radiation caused by the transmission line.
	Expectations Shared
	HESCO should take all safety precautions to minimize safety hazards associated with the transmission lines.
	The transmission line should avoid passing over the settlements or through the cultivation fields.
	The transmission line construction should minimize crop damage.
	Compensation should be paid to the affectees for any crop damage or land acquisition during the project.
	HESCO should provide employment opportunities to the local population near the project sites.
	HESCO should provide electricity to the communities near the project sites currently not covered by the electricity network.

8 Environmental Impacts and Mitigation

This Chapter assesses the potential impacts of the HESCO's proposed project (see **Section 1.4.3** for components of the proposed project) on the physical and biological environment of the project area. Also provided in the Chapter is the significance of the potential impacts, the recommended mitigation measures to minimize if not eliminate the potentially adverse impacts, and the residual impacts.

8.1 Impact Assessment Process

This section provides the environmental (and social[1]) impact assessment process that was employed during the present ESA.

8.1.1 Screening of Environmental Impacts

As part of the environmental impact assessment process, a screening matrix was developed - tailored specifically to the proposed project - focusing the potential environmental impacts during the design, construction and operation phases. The matrix examined the interaction of project activities with various components of the environment. The impacts were broadly classified as physical, biological and social, and then each of these broad categories further divided into different aspects. The potential impacts thus predicted were characterized in the matrix as follows:

- High negative (adverse) impact,
- Low negative impact,
- Insignificant impact,
- High positive (beneficial) impact,
- Low positive impact, and
- No impact.

The negative impacts predicted in this manner were the 'unmitigated' impacts. Appropriate mitigation measures were recommended as part of this ESA, thus reducing the occurrence possibility and severity of the potentially adverse impacts.

The negative impacts identified through this process are discussed later in the Chapter.

8.1.2 Impact Characterization

Once the potentially adverse impacts were identified as discussed above, these impacts were characterized. Various aspects of the impact characterization included:

- Nature (direct/indirect)
- Duration of impact (short term, medium term, long term)
- Geographical extent (local, regional)

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1 Social impacts are discussed in **Chapter 9**.

- Timing (project phase: before, during and after construction)
- Reversibility of impact (reversible/irreversible)
- Likelihood of the impact (certain, likely, unlikely, rare)
- Impact consequence severity (severe, moderate, mild).

The above aspects of environmental and social impact characterization are defined in **Exhibit 8.1**.

8.1.3 Impact Assessment and Mitigation

The impact assessment was carried out on the basis of impact characterization discussed above. It uses all the attributes of an impact listed above (and defined in **Exhibit 8.1**), particularly the likelihood of occurrence and consequence severity, in order to assess the impact to be of 'high', 'medium' or 'low' significance, as shown in **Exhibit 8.2**. Each environmental impact of the proposed project identified during the screening stage (as given in **Section 8.1.1**) and then characterized (as defined in **Section 8.1.2**), was assessed per the criteria given in **Exhibit 8.2**.

A project is not environmental (or socially) acceptable if it results in impacts with 'high' significance. Therefore, the impacts with 'high' significance must be brought down to 'medium' or 'low' significance through appropriate mitigation measures. An attempt is also made to bring the impacts with 'medium' significance to 'low' significance; environmental monitoring is necessary for such impacts to ensure that these do not transform to 'high' significance impacts. The impacts with 'low' significance do not usually need any mitigation.

8.1.4 Determination of Mitigation Measures

Subsequent to the impact characterization and assessment, appropriate mitigation measures were identified, in order to minimize if not completely eliminate the adverse impacts associated with project activities. The hierarchy of the mitigation measures is as follows. First, an attempt is made to altogether avoid the adverse impact through change in design, location or method of carrying out the proposed activity. If this is not possible, the significance of the impact is reduced through appropriate mitigation measures. As a last resort, compensatory measures are taken to minimize the adverse impacts of the proposed activities.

8.1.5 Assessment of Residual Impacts

The mitigation measures discussed above cannot always completely eliminate the adverse impacts of the project activities; often there are residual impacts even after the implementation of these measures. The final step of the entire impact assessment process is to determine the residual impact. These residual impacts are monitored during the project execution, in order to ensure that these remain insignificant.

The environmental impact characterization, mitigation measures and residual impacts are discussed in the following sections (the socioeconomic impacts and their mitigation are covered in the next Chapter).

8.2 Design Phase Considerations

The decisions made at the design phase of any project can be quite far reaching. For the proposed project, the aspects which can be significant with respect to the environmental impacts include:

- Site selection for grid stations
- Route selection for transmission lines
- Type of equipment.

The design phase impacts are screened in **Exhibit 8.3** and characterized in **Exhibit 8.4**, and can be readily preempted and avoided. These concerns and the measures to avoid/minimize them are tabularized below.

Impacts	Likely Causes of Environmental Impacts	Measures to be Incorporated in Project Design to Avoid Environmental Impacts
Soil erosion	Poor site selection; unstable soils.	■ Areas having unstable soil will be avoided for the grid station sites and transmission line routes. ■ Canal and river banks will be avoided while placing the transmission line towers.
Soil and water contamination	Absence of appropriate waste (solid and liquid) disposal arrangements/systems	■ Appropriate waste disposal systems will be included in the design of the grid stations and associated facilities.
	Using transformers with PCB-containing oil.	■ The transformer procured during the proposed project will be PCB-free. ■ Leaked oil collection arrangement (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the grid stations.
Loss of natural vegetation and threat to wildlife	Routing the transmission lines through forested and wildlife-sensitive areas	■ Areas having precious/sensitive natural vegetation and wildlife resources will be avoided for the grid station sites and transmission line routes, where possible. ■ Protected areas (national parks, wildlife sanctuaries and game reserves) will be avoided while selecting the grid station sites and transmission line routes.

8.3 Construction Phase Impacts

The construction phase will be by far the most significant part of the proposed project with respect to environmental considerations, since most of the impacts are likely to take place during this period.

Various construction activities will invariably create environmental disturbances, which may have impacts on the physical and biological resources of the area (see **Exhibit 8.3**). Such impacts include the following:

- Physical Environment
  - Soil erosion, degradation
  - Air quality deterioration
  - Water contamination
- Biological Environment
  - Loss of/damage to the floral resources (natural vegetation) of the area
  - Loss of/damage to faunal resources (wildlife) of the area.

These impacts are characterized in **Exhibit 8.5** and can be readily preempted and mitigated. The mitigation measures recommended in this section will need to be incorporated in the execution of the project.

These impacts and their respective mitigation measures are discussed below.

8.3.1 Soil Erosion and Degradation

The soil-related issues include soil erosion, slope stability, and soil contamination. Soil erosion is likely to be caused by the vehicular traffic on unpaved roads, land clearing for construction camps, grid stations and transmission line towers, and the subsequent construction activities.

Soil may be contaminated as a result of fuel/oils/chemicals spillage and leakage, and inappropriate waste (solid as well as liquid) disposal. This is a potential impact at all of the project sites.

Exhibits 4.17 to **4.23** show the key locations of these impacts in various parts of the project area.

The unmitigated impacts related to soil erosion and contamination are characterized below.

- Nature: Direct
- Duration: Long term
- Geo extent: Local
- Reversibility: Mostly irreversible
- Likelihood: Likely
- Consequence: Major

- Impact significance: High.

Mitigation Measures

The following mitigation measures will minimize the soil erosion and contamination:

- Soil Erosion
  - Cut and fill at the proposed grid station site will be carefully designed, and ideally should balance each other. The surplus soil, if any, will be disposed at places approved by HESCO (the organizational arrangements for the environmental management during the project construction phase are defined in **Chapter 10** of this report). Such sites will be selected after surveying the area and ensuring that soil deposition will not have any significant impacts, such as loss of productive land, blocked access, natural vegetation or disturbance to drainage.
  - If necessary, fill material for grid station sites will be obtained from appropriate locations approved by HESCO. Such locations will be selected after surveying the area and ensuring that soil extraction will not have any significant impacts, such as soil erosion, loss of natural vegetation or disturbance to drainage.
  - Where the use of cultivated land is unavoidable for obtaining the fill material, the top 30 cm soil layer will be removed and stockpiled for redressing the land after removal of the borrow material. The excavation in such areas will be limited to 50 cm depth.
  - The fill material will not be obtained from any cultivation fields or orchards, without the permission of the land owner/cultivator.
  - Areas from where the fill material is obtained or surplus soil deposited, will be landscaped to minimize erosion and hazard for people and livestock.
  - Construction camp will be located in a stable and flat area, requiring minimal devegetation and leveling. The contractor(s) will obtain approval from the HESCO for this purpose.
  - Embankments and excavated slopes will not be left untreated/unattended for long durations. Appropriate slope stabilization measures will be taken per the design (eg, stone pitching).
  - Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water channels, water reservoirs and water ponds will be minimized.
  - After the completion of the construction works, the transmission line routes, campsites and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind.
  - Photographic record will be maintained for pre-project, during-construction and post-construction condition of the sites (grid station, transmission line/feeder routes, camps and access roads).
- Soil Contamination
  - Vehicles and construction equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.
  - For the domestic sewage from the construction camps, appropriate treatment and disposal system, such as septic tanks and soaking pits, will be constructed having adequate capacity. The contractor(s) will submit to the HESCO the plans for the camp layout and waste disposal system, and obtain approval.

- Waste oils will be collected in drums and sold to the recycling contractors.
- The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous waste will be kept separate and handled according to the nature of the waste.
- Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. The waste disposal plan submitted by the contractor(s) will also address the solid waste.

Residual Impacts

Appropriate construction practices and management actions as listed above will greatly minimize the soil erosion and contamination. The significance of the residual impacts is therefore expected to be 'low'.

The environmental monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

8.3.2 Air Quality Deterioration

Construction machinery and project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the project sites. Furthermore, construction activities such as excavation, leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions.

The project components that are located close to the communities, and may cause air quality deterioration include:

- Bukhshapur grid station site
- Chamber grid station site
- Portions of the Tando Allahyar – Chamber transmission line
- Larkana-III grid station site
- Portions of the feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Portions of the feed for Kandiari grid station
- Naukot grid station
- Samaro grid station
- Portions of the Samaro – Naukot transmission line.

Exhibits 4.17 to **4.23** show the key locations of these impacts in various parts of the project area.

Rest of the project sites are well away from the communities, hence no air quality issues are expected to arise.

The unmitigated impacts related to air quality deterioration are characterized below.

- Nature: Direct
- Duration: Short term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Minor
- Impact significance: Medium.

Mitigation Measures

The following mitigation measures will minimize the emissions and their impacts:

- Air quality analysis at each of the grid station sites will be conducted before mobilization of the construction crew, in order to establish baseline conditions of the ambient air quality at these locations.
- Construction camps will be established at least 500 m from communities (except when such camps are established inside the grid stations). The contractor(s) will obtain HESCO's approval for this purpose, as mentioned earlier.
- Construction machinery, generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. The exhaust emissions will comply with the NEQS (**Exhibit 2.3**).
- Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. The waste water from kitchen and washing area of the construction camp may be used for water spraying.
- Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions.
- While working within the communities for works such as transmission line laying, coordination with the communities will be maintained to minimize any detrimental impacts on the crops and settlements.
- Ambient air quality analysis will be carried out at the grid station sites once every two months during the construction phase.

Residual Impacts

The above measures will reduce the magnitude of the adverse impacts of the project on the ambient air quality, but will not eliminate them completely. However, the significance of the residual impacts on the air quality is expected to be low.

The environmental monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

8.3.3 Surface Water and Groundwater Contamination

The project activities that can contaminate soil, may also contaminate the surface water and groundwater. These include:

- Disposal of construction waste
- Solid waste disposal from construction camps
- Waste effluents disposal
- Equipment/vehicle maintenance
- Spillage/leakage of fuels, oils and chemicals.

In addition, vehicles and construction machinery operation near water bodies/water courses can potentially contaminate the surface water.

These impacts may be encountered at all of the sites during the construction phase of the project. However, at the project locations which are near the settlements (such as those listed in **Section 8.3.2** above), the consequence of these impacts will be more severe.

Exhibits 4.17 to **4.23** show the key locations of these impacts in various parts of the project area.

The unmitigated impacts of the proposed construction activities on the water quality of the area are characterized below.

- Nature: Direct and indirect
- Duration: Short to medium term
- Geo extent: Local
- Reversibility: mostly reversible
- Likelihood: Likely
- Consequence: Major
- Impact significance: High.

Mitigation Measures

The mitigation measures recommended to forestall soil contamination will also prevent water surface and groundwater contamination. Additional mitigation measures are given below.

- The groundwater quality analysis at each of the grid station sites (and campsites if established outside the grid stations) will be conducted before mobilization of the construction crew, in order to establish baseline conditions of the water quality at these locations.
- Construction camp will not be located within 500 m of rivers and major canals (unless it is placed inside the grid station). Location will be finalized after obtaining HESCO's approval.

- The contractor(s) will submit to the HESCO the plans for the camp layout and waste disposal system, and obtain approval.
- Groundwater quality analysis will be carried out at the grid station sites and campsites once a month during the construction phase.

Residual Measures

If the recommended mitigation measures are effectively employed, the project activities are unlikely to contaminate the water resources of the area in any significant manner. The residual impacts of the project on the water quality will therefore be negligible.

The environmental monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

8.3.4 Loss of Natural Vegetation

Land will have to be cleared for the grid stations, transmission line towers and parts of the transmission line routes. However all of the project sites are located in areas where the natural habitat has long been modified for habitation or cultivation. The sites selected/identified for the grid stations are located in cultivated areas. Hence establishment of these grid stations will not cause any damage to the natural vegetation of the area. Similarly none of the transmission line routes would be located in areas where any sensitive or significant natural vegetation now exists. No protected areas are known to exist at or around the project sites.

For clearing the vegetation under the transmission lines, chemical herbicides are also sometimes used. Indiscriminate usage of this method can cause significant loss of biodiversity.

Construction crew can also indulge in tree/shrub cutting to obtain fuel wood.

The unmitigated impacts of the proposed activities on the floral resources of the area are characterized below.

- Nature: Direct
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Irreversible (reversible in medium to long term)
- Likelihood: Unlikely to Possibly
- Consequence: Mild to Moderate
- Impact significance: Low to Medium.

Mitigation Measures

The following mitigation measures will further minimize negative impacts on the floral resource of the area:

- Clearing of natural vegetation and cutting of trees will be minimized as far as possible during the transmission line works.
- Herbicides will not be used to clear vegetation along the transmission line route (or at other project locations).
- For each transmission line route, a tree cutting plan will be prepared and submitted to HESCO for approval. A complete record will be maintained for any tree cutting or trimming. The record will include: the number, species, type, size, age, condition and photograph of the trees to be cut/trimmed.
- The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.
- No fires will be allowed in the open.
- Tree plantation plan will be developed and implemented at each of the grid stations included in the proposed project. Provisions will be made for tree plantation while designing the layout of the grid stations. This will compensate any tree cutting in the non forest area along the transmission lines. Indigenous tree species will be selected for plantation; Eucalyptus trees will not be used in any case.

Residual Impact

The potential impacts of the proposed project on the natural vegetation are expected to be mild in nature. With the help of the above mentioned mitigation measures, these impacts are expected to reduce further. Significance of the residual impacts on the floral resources of the area is therefore expected to be 'low'.

The environmental monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

8.3.5 Damage to Wildlife

As stated in **Section 8.3.4** above, most parts of the project area do not support any natural vegetation. Similarly, most of the native faunal species have long disappeared from the area, as a result of the expanding settlements and extensive cultivation. Whatever species currently exist in the area have adapted to the presence of human beings. None of the project activities are therefore expected to adversely affect whatever faunal resources are left in the area. Furthermore, no protected areas are known to exist at or near the project sites, as described above.

The unmitigated impacts of the proposed activities on the faunal resources of the area are characterized below.

- Nature: Direct
- Duration: Medium to long term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Unlikely to Possibly

- Consequence: Mild to Moderate
- Impact significance: Low to Medium.

Mitigation Measures

- Measures to protect and rehabilitate floral resources of the area discussed in **Section 8.3.4** above will also protect the wildlife resources of the area.
- The measures to prevent soil and water contamination will forestall any adverse impact on the faunal resources of the area.
- Garbage will not be left in the open.
- The project staff will not be allowed to indulge in any hunting or trapping activities.
- In case any project activity is carried out in any protected area, a separate environmental study will be carried out in accordance with the Change Management System defined in **Section 10.8** of this document.

Residual Impact

The potential impacts of the proposed project on the wildlife of the area are expected to be mild in nature. With the help of the above mentioned mitigation measures, these impacts are expected to reduce further. Significance of the residual impacts on the faunal resources of the area is therefore expected to be 'low'.

8.4 Operation Phase Impacts

The operation and maintenance (O&M) activities of the electricity network are environmentally benign by nature, and result in very few impacts, as shown in **Exhibit 8.3** and listed below.

- Contamination of soil and water as a result of inappropriate waste disposal (domestic solid waste, sewage, repair and maintenance waste, waste oils and chemicals, etc.)
- Contamination of soil and water as a result of leakage of transformer oil.

These negative impacts are characterized in **Exhibit 8.6**, and discussed below.

8.4.1 Soil Contamination

The O&M activities of the grid stations generate several types of wastes, which can cause soil contamination. These are listed below.

- Domestic solid waste from the offices and residences in the grid stations
- Sewage from the offices and residences in the grid stations
- Wastes from the repair and maintenance activities (discarded equipment and parts, packing materials, used oils and chemicals, cotton rags and the likes).

In addition, leakage and spillage of transformer oil can contaminate soil. Of particular concern is the possible soil contamination with PCB, since the old transformers and circuit breakers in the HESCO system are still likely to contain PCB-containing transformer oil (see **Section 6.3.3**).

These impacts can potentially occur at the grid stations included in the proposed project.

These unmitigated impacts are characterized below.

- Nature: Direct and indirect
- Duration: Short to medium term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Major
- Impact significance: High.

Mitigation Measures

The following mitigation measures will greatly minimize if not prevent the impacts of the proposed project's O&M activities on the soil of the area:

- The grid stations will have appropriate solid waste collection and disposal arrangements.
- The grid stations will have appropriate sewage handling system. The grid stations' sewage collection system will be connected to the Municipality operated sewerage system, if available. Otherwise, grid stations will have their own septic tanks and soakage pits.
- Waste oils and chemicals will be disposed in accordance with their respective Material Safety Data Sheet (MSDS). MSDS will be made available at the grid stations and maintenance workshops.
- Non-toxic recyclable waste (such as cardboard) will be given away for recycling.
- Toxic waste will be stored separately, and incinerated at an appropriate double chamber incinerator.
- Grid stations will have channels and drainage pits to collect any leaked oil from the transformers in the grid stations. This oil will be sent back to the workshop for recycling.
- Any soil contaminated by the oil/chemical spillage will be removed and disposed off appropriately in accordance with the MSDS of the spilled oil/chemical.
- HESCO's Environmental and Social Cell (ESC) will develop (or have it developed) a comprehensive plan for PCB testing and its complete elimination from all the transformers and circuit breakers from the entire network (an outline ToR of the PCB Elimination Plan development is provided in **Exhibit 8.7**). As a first step in this regard, the PCB test kits will be made available with the HESCO maintenance staff.

Residual Impact

With the help of the mitigation measures described above, the O&M activities will not have any significant impact on the soils of the area.

8.4.2 Water Contamination

The O&M activities which can contaminate soil can also adversely affect the surface as well as groundwater of the area. These include:

- Improper disposal of domestic solid waste from the offices and residences in the grid stations
- Improper disposal of sewage from the offices and residences in the grid stations
- Improper waste disposal from the repair and maintenance activities (discarded equipment and parts, packing materials, used oils and chemicals, cotton rags and the likes).

In addition, leakage and spillage of transformer oil can contaminate soil.

These impacts can potentially occur at all of the grid stations included in the proposed project.

These unmitigated impacts are characterized below.

- Nature: Direct and indirect
- Duration: Short to medium term
- Geo extent: Local
- Reversibility: Reversible
- Likelihood: Likely
- Consequence: Major
- Impact significance: High.

Mitigation Measures

The mitigation measures recommended in **Section 8.4.1** will also forestall any water contamination that could be caused by the project's O&M activities as well.

Exhibit 8.1: Impact Characterization

Categories	Characteristics
Nature	**Direct:** The environmental parameter is directly changed by the project. **Indirect:** The environmental parameter changes as a result of change in another parameter
Duration of impact	**Short-term**: lasting only for the duration of the project such as noise from the construction activities. **Medium-term**: lasting for a period of few months to a year after the project before naturally reverting to the original condition such as loss of vegetation due to clearing of campsite, contamination of soil or water by fuels or oil. **Long-term**: lasting for a period much greater than medium term impact before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical extent	**Local, regional (spatial dimension)**
Timing	**Construction** and **Operation**
Reversibility of impact	**Reversible**: when a receptor resumes its pre-project condition **Irreversible**: when a receptor does not or cannot resume its pre-project condition
Likelihood of the impact	**Almost Certain:** Impact expected to occur under most circumstances **Likely:** Impact will probably occur under most circumstances **Possibly:** Impact may possibly occur at some time **Unlikely:** Impact could occur at some time **Rare:** Impact may occur but only under exceptional circumstances
Impact consequence severity	**Major**: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora or fauna; has long-term effects (period of years) on socioeconomic activities of significance on regional level. **Moderate**: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes reversible damage or change in abundance or distribution over one generation of a population of flora or fauna; has short-term effects (period of months) on socioeconomic activities of significance on regional level. **Minor**: When an activity causes short-term (period of a few months) reversible damage to an environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short term (period of months) effects on socioeconomic activities of local significance. **Negligible**: When no measurable damage to physical, socioeconomic, or biological environment above the existing level of impact occurs.
Significance of impact	Categorized as **High, Medium**, or **Low** Based on the consequence, likelihood, reversibility, geographical extent, and duration; level of public concern; and conformance with legislative of statutory requirements.

Exhibit 8.2: Impact Assessment

Probability of Occurrence of Impact	Impact Severity		
	Severe	Moderate	Mild
Certain			Medium Significance
Likely		Medium Significance	Low Significance
Unlikely	Medium Significance	Low Significance	Low Significance

Exhibit 8.3: Environmental and Social Screening Matrix (Unmitigated)

	Physical					*Biological*		*Social and Socioeconomic* [2]											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Design Phase																			
Site Selection for Grid Stations	-1	0	0	0	0	-1	-1	-1	0	-1	-1	0	-2	-2	N	-1	-1	0	0
Route Selection for Transmission Lines	-1	0	0	0	0	-1	-1	0	0	-1	-1	0	-2	-2	-1	0	-1	0	0
Design of Grid Station	-2	0	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	-1	0	0
Equipment Selection	-2	0	-2	-2	0	0	0	0	-1	0	0	0	0	0	N	-2	0	0	0
Construction Phase-Grid Stations																			
Land Acquisition	N	N	N	N	N	N	N	-1	N	-2	-2	-1	-2	N	N	N	N	N	N
Mobilization of Contractors	-1	-1	-1	0	0	0	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Construction Camp Establishment	-1	-1	-1	-1	0	-1	0	-1	-1	-2	-2	-1	-1	-2	-1	-1	0	-1	-1
Construction Camp Operation	-2	-1	-2	-2	-1	-1	0	0	-1	0	0	0	0	-1	-1	-2	0	-1	-1
Transportation of Construction Materials and Supplies	-1	-1	-1	0	0	0	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Excavation for Foundations	-2	-1	-1	-1	0	-1	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Construction Works	-2	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Equipment Installation	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0

[2] Social impacts are discussed in **Chapter 9**.

.... Contd. **Exhibit 8.3**

	Physical					*Biological*		*Social and Socioeconomic*											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Construction Phase-Transmission Lines																			
Land Acquisition	N	N	N	N	N	N	N	-1	N	-2	-2	-1	-2	N	N	N	N	N	N
Mobilization of Contractors	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Construction Camp Establishment	-1	-1	-1	-1	0	-1	0	-1	-1	-2	-2	-1	-1	-2	-1	-1	-1	-1	-1
Construction Camp Operation	-2	-1	-2	-2	-1	-1	0	0	-1	0	0	0	0	-1	-1	-1	0	-1	-1
Transportation of Construction Materials	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Excavation for Foundations	-2	-1	-1	-1	0	-1	0	0	-1	0	-1	0	0	-2	0	-1	0	0	0
Construction of Foundations	-2	-1	-1	-1	-1	0	0	0	-1	0	-1	0	0	-2	0	-1	0	0	0
Erection of Towers / Poles	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Stringing	0	-1	0	0	0	0	0	0	-1	-1	0	0	0	-2	0	-1	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0
Contractor Demobilization	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Operation and Maintenance Phase																			
Grid Station O&M	-2	0	-2	-2	0	0	0	0	-1	0	0	0	0	-2	0	-2	0	0	0
Transmission Line O&M	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	-2	0	0	0	0	0

Key: -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible impact; +1: low positive impact; +2: High positive impact, N: no impact.

Exhibit 8.4: Environmental Impact Characterization for Project Design Phase (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Soil Erosion, Degradation	Direct	Long term	Local	Irreversible	Likely	Major	High
Surface Water Contamination	Indirect	Short term	Local	Reversible	Likely	Major	High
Groundwater Contamination	Indirect	Medium term	Local	Reversible	Likely	Major	High
Loss of/Damage to Natural Vegetation	Direct	Medium to Long term	Local	Irreversible	Possibly	Moderate	Medium
Loss of/Damage to Wildlife	Direct	Medium term	Local	Reversible	Possibly	Moderate	Medium

Exhibit 8.5: Environmental Impact Characterization for Project Construction Phase (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Physical Environment							
Soil Erosion, Degradation	Direct	Long term	Local	Irreversible	Likely	Major	High
Air Quality Deterioration	Direct	Short term	Local	Reversible	Likely	Minor	Medium
Surface water Contamination	Direct	Short term	Local	Reversible	Likely	Major	High
Groundwater Contamination	Indirect	Medium term	Local	Reversible	Likely	Major	High
Water Consumption; Availability	Direct and Indirect	Short term	Local; Regional	Reversible	Likely	Moderate	Medium
Biological Resources							
Loss of/Damage to Natural Vegetation	Direct	Medium to Long term	Local	Irreversible	Unlikely to Possibly	Mild to Moderate	Low to Medium
Loss of/Damage to Wildlife	Direct	Medium term	Local	Reversible	Unlikely to Possibly	Mild to Moderate	Low to Medium

Exhibit 8.6: Environmental Impact Characterization for Project Operation Phase (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Soil Contamination	Indirect	Short to medium term	Local	Reversible	Likely	Major	High
Water Contamination	Indirect	Short to medium term	Local	Reversible	Likely	Major	High

Exhibit 8.7: Outline ToR for Developing PCB Elimination Plan

- Review of the HESCO O&M activities, and system to handle transformers and transformer oil
- Review of the past practices in WAPDA to handle transformers and transformer oil
- Review of the systems and practices at the WAPDA's and HESCO's transformer maintenance work shops
- Study similar practices prevailing in other countries
- Developing action plan to identify PCB-containing transformers
- Developing action plan to segregate the PCB-free and PCB-containing transformers
- Developing action plan to isolate the PCB-free and PCB-containing transformers at the maintenance workshops
- Developing testing and monitoring procedures and systems
- Developing the documentation system
- Determining the capacity building needs and developing training program
- Consultations with the key stakeholders (such as the EPAs and relevant professionals)
- Report compiling.

9 Socioeconomic Impacts and Mitigation

This Chapter assesses the potential socioeconomic impacts of the HESCO's proposed project. The chapter also determines the significance of the potential impacts, recommends mitigation measures to minimize if not eliminate the potentially adverse impacts, and identifies the residual impacts.

9.1 Socioeconomic Impact Assessment Process

9.1.1 Social Screening Checklist

The social screening checklist provided in the ToR (see **Appendix A** for the ToR) was used to identify the key social issues associated with the proposed project and type of mitigation measures required to address them. **Exhibit 9.1** summarizes the social issues given in the checklist.

9.1.2 Screening, Characterization and Assessment of Socioeconomic Impacts

Screening, characterization and assessment of the project's socioeconomic impacts was carried out during this ESA, using the same framework as described in **Section 8.1**.

9.2 Design Phase Considerations

Much like the environmental considerations during the design of the proposed project (discussed in **Section 8.2**), the following aspects of the project can have bearing on its socioeconomic performance:

- Site selection for grid stations
- Route selection for transmission lines
- Equipment selection.

The design phase considerations are screened in **Exhibit 9.2** and characterized in **Exhibit 9.3**, and can be readily preempted and avoided. These concerns and the measures to avoid/minimize them are tabularized below.

Impacts	Likely Causes of Impacts	Measures to be Incorporated in Project Design
Resettlement Issues	Poor site selection; Poor route alignment	■ The grid stations to be established during the proposed project will be located in open areas, free of any existing structure. ■ The transmission line routes included in the proposed project will be selected avoiding settlements, buildings, other structures and cultivation, as far as possible, thus minimizing the resettlement issues (further

Impacts	Likely Causes of Impacts	Measures to be Incorporated in Project Design
		discussed later in the Chapter).
Safety hazards and public health concerns	Poor site selection; Poor route alignment; Inappropriate equipment selection (such as PCB-containing transformers)	■ All safety precautions will be taken to minimize the safety hazards and risk of accidental electrocution. These will include double periphery walls at the grid stations and appropriate clearance (between the live wires/connectors and the buildings/structures/trees). ■ Transmission lines will not be routed through the settlements as far as possible. Appropriate clearance will be maintained all along the transmission lines. ■ Appropriate waste disposal systems will be included in the design of the grid stations. These include sewage disposal, and if required, treatment system (eg, septic tank). ■ PCB-free transformers will be selected for the project. (This aspect is already included in the HESCO's transformer specifications.)
Noise emissions	Poor equipment selection	■ The project equipment, particularly transformers to be installed at the grid stations will meet the noise standards (70 dB(A) for industrial zones day and night; 45 dB(A) night and 55 dB(A) daytime for residential areas).
Aesthetic value	Intrusion in the natural landscape	■ Tree plantation will be carried inside and at the periphery of the grid stations, without compromising the safety aspects (ie, required clearances will be maintained). For this purpose, provision will be made in the site layout of the grid stations.
Blocked access	Poor site selection	■ While selecting the grid station site, it will be ensured that the facility does not block any existing route.
Damage to infrastructure	Poor design/route selection of transmission line	■ The transmission line route selection will be carried out to minimize interaction with the existing infrastructure. Appropriate design requirements (clearances, etc.) will be followed while crossing the roads, railway lines and canals. Similarly the tower locations will be selected at safe distances from roads, railway lines and canals.

9.3 Construction Phase Impacts

Much like the environmental impacts described in **Section 8.3**, most of the socioeconomic concerns will also arise during the construction phase of the proposed project.

The key socioeconomic concerns of the construction phase as identified with the help of the screening process (**Exhibit 9.2**) are as follows:

- Land acquisition and damage to crops
- Damage to infrastructure
- Damage to irrigation network
- Blocked access
- Noise and vibration
- Safety hazard
- Public health
- Gender issues
- Impacts on archeological, cultural, historical or religious significance.

These impacts are characterized in **Exhibit 9.4**, and assessed in the following sections.

9.3.1 Land Acquisition and Asset Loss

A total of 16 acres of land will need to be acquired for the four new grid stations envisaged during the proposed project. HESCO plans to acquire this land in accordance with the Land Acquisition Act on the basis of *willing Seller – willing buyer*. The land will be acquired on mutually agreed market price, and the landowner will have the option to refuse to sell the land.

In addition, about 870 acres of land would be used as temporary right of way (RoW) along the transmission line routes during the construction phase (117 km long × 30 m wide), and about 30 acres of land for accessing the transmission line route during the construction phase (one route every 5 km; 500 m long, 10 m wide).

For the towers of the transmission lines passing through the urban areas, considerable land will be required, which may not be available in the existing RoW (such as road sides). This aspect is likely to arise for the portions of the Humayun – Jacobabad and Tando Allahyar - Chamber transmission lines.

Most parts of the transmission lines would pass over the cultivated land, thus causing damage to crops during the construction phase of the project. This crop damage would take place over a total area of about 790 acres; the total number of affectees would be about 400. **Exhibit 9.5** provides a summary of the cultivated land that would fall under the proposed transmission lines (detailed list of the affected land and project affectees (ie, PAPs) is provided in **Section E.2** of **Appendix E**).

The project sites where this issue will be encountered include:

- Portions of the Tando Allahyar – Chamber transmission line
- Feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Feed for Kandiari grid station
- Portions of the Samaro – Naukot transmission line
- Portions of the feed for Tando Bago grid station
- Feed for the Matiari grid station.

In addition to the crops, some parts of the transmission line would pass through the orchards (see **Exhibits 4.18**, **4.20**, **4.21** and **4.23**, for Tando Allahyar – Chamber transmission line, Feed for Matiari GS, Feed for Kandiari GS, and Samaro – Naukot transmission line, respectively).

The proposed project is not likely to cause any other asset loss (please see **Exhibits 4.17** to **4.23** for the route maps of the transmission lines and key environmental/socioeconomic features along them).

The unmitigated impacts related to the land acquisition and damaged crops are characterized as 'high', as shown in **Exhibit 9.4**.

Mitigation Measures

The following mitigation measures are proposed to avoid potential losses due to land take and involuntary resettlement.

- A Resettlement Plan (RP) has been prepared to address the involuntary resettlement, including the damaged crops, caused by the project activities. The RP provides the entitlement framework, which is provided in **Exhibit 9.6**. Other aspects covered in the RP include institutional and implementation framework, the monitoring and documentation systems and the grievance redressal mechanism. (The RP is a stand-alone document and provided under separate cover.)
- Compensation will be paid for the crops damaged during the construction activities (see **Exhibit 9.5** for cultivated lands falling under the transmission lines). The compensation will be paid to the cultivator, and absence of the land title will not be a bar to receiving the compensation.
- Complete record will be maintained for the determination and payment of the compensation.
- It will be ensured that the land under the 132-KV and 66-KV transmission line tower remains available for cultivation (see **Exhibit 9.7** for a typical tower with cultivation underneath).
- In case the above is not possible, the land under the tower will be acquired in accordance with the LAA procedures (Section 17.4 of the LAA will not be used).
- Operation of project vehicles and construction machinery outside the RoW will be avoided. Attempts will be made to use existing tracks/roads to access the transmission line corridor/tower locations. In case new access routes are necessary,

the cultivated land will be avoided as far as possible. Damage to crops will be compensated (**Exhibit 9.5** includes the area under the access routes).

- The transmission lines will be aligned in a manner to avoid the orchards as far as possible. If unavoidable, no vehicular movement will be allowed inside any orchards, no fruit trees will be cut inside the orchards, and transmission lines will be aligned through the existing gaps between the trees.
- Tubular poles will be used where necessary, instead of conventional transmission line towers, for the following:
  - transmission line (feed for Chamber grid station) along the road near the Tando Allahyar grid station,
  - transmission line (Humayun – Jacobabad transmission line) near the Jacobabad grid station while passing through the congested settlement.
- The transmission line route will be aligned along the existing roads/RoW as far as possible.
- Grievance redressal mechanism will be put in place to address the community complaints.

Residual Impacts

The expectations of some of the affected landowners may not be completely fulfilled regardless of the compensation. However, with the help of above measures, the issue is likely to be adequately addressed. The residual impacts associated with the involuntary resettlement are therefore expected to be low to medium.

The monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.2 Damage to Irrigation Network

The project activities can potentially damage the irrigation network in and around the project sites. The construction activities, operation of project vehicles and construction machinery in the cultivation fields can damage the water courses.

The project sites where this issue may be encountered include:

- Tando Allahyar – Chamber transmission line
- Feed for the Larkana-III grid station
- Humayun – Jacobabad transmission line
- Feed for Kandiari grid station
- Samaro – Naukot transmission line
- Feed for Tando Bago grid station
- Feed for the Matiari grid station.

Exhibits 4.17 to **4.23** show the key locations where the irrigation network of the area is likely to be affected by the proposed activities.

The unmitigated impacts related to the irrigation network are characterized as 'high', as shown in **Exhibit 9.4**.

Mitigation Measures

The following mitigation measures are proposed to avoid potential loss due to agriculture.

- Operation of construction machinery and project vehicles will be avoided close to the canals and water courses.
- Any damage caused by the project activities will be completely repaired.

Residual Impacts

With the help of the above measures, impacts associated with the irrigation network will be reasonably mitigated, and the residual impacts will be quite negligible.

The social monitoring (discussed in **Chapter 10**) during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.3 Blocked Access

This issue can arise during the construction phase, particularly as a result of establishment of the construction camp or construction activities along the transmission line routes.

The unmitigated impacts related to the blocked access routes are characterized as 'medium' (see **Exhibit 9.4**).

Mitigation Measures

- In case of the blockage of the existing routes, alternate routes will be identified in consultation with affected communities.

Residual Impact

Following the availability of alternative routes, significance of the residual impact is expected to be quite negligible.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.4 Noise and Vibration

The construction activities and project vehicle movement close to the communities can cause noise and vibration.

The project components that will be undertaken close to the communities, and may cause noise and vibration include:

- Bukhshapur grid station site
- Chamber grid station site

- Portions of the Tando Allahyar – Chamber transmission line
- Larkana-III grid station site
- Portions of the feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Portions of the feed for Kandiari grid station
- Naukot grid station
- Samaro grid station
- Portions of the Samaro – Naukot transmission line.

The unmitigated impacts related to the noise caused by the project construction activities are characterized as 'medium' (see **Exhibit 9.4**). **Exhibits 4.17** to **4.23** show the key locations where the nearby communities are likely to experience noise and vibration caused by the proposed activities.

Mitigation Measures

- It will be ensured that the noise levels measured at the communities near the project sites (identified in **Exhibits 4.17** to **4.23**) are kept within the acceptable limits (70 dB(A) for industrial zones day and night; 45 dB(A) night and 55 dB(A) daytime for residential areas).
- Noise levels will be measured at the key locations described above. If the noise levels are found to be more than the prescribed limits, appropriate measures will be undertaken by the construction team such as rescheduling the works, using quieter equipment and/or erecting barriers to protect the communities from excessive noise.
- Vehicular traffic through the communities will be avoided as far as possible. Project routes will be authorized by the HESCO.
- Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.
- Vehicles will have exhaust silencers to minimize noise generation. The vehicles noise will comply with the NEQS (**Exhibit 2.3**).
- Nighttime traffic will be avoided near the communities, as far as possible.
- Movement of all project vehicles and personnel will be restricted to within work areas, to avoid noise disturbance.
- Working hours for construction activities within the communities will be limited to between 8 am and 6 pm (between 6 am and 8 pm during the summers).
- Liaison with the community will be maintained. Grievance redressal mechanism will be put in place to address the community complaints, as stated earlier.

Residual Impact

With the implementation of above measures, the significance of the residual noise impacts will be low.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.5 Safety Hazards

The construction activities will involve operation of heavy construction machinery, vehicular traffic, excavation and filling operations. These activities may pose some safety hazards to the local population.

During the testing and commissioning of the grid stations and transmission lines, the nearby population will be exposed to the electrocution risk.

As described in **Section 9.3.4** above, the following components of the project will be located close to the communities:

- Bukhshapur grid station site
- Chamber grid station site
- Portions of the Tando Allahyar – Chamber transmission line
- Larkana-III grid station site
- Portions of the feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Portions of the feed for Kandiari grid station
- Naukot grid station
- Samaro grid station
- Portions of the Samaro – Naukot transmission line.

The safety hazards will be more acute for the above project components, though certain level of these risks would still exist for rest of the project sites as well. **Exhibits 4.17** to **4.23** show the key locations of these impacts in the project area.

A small section of the Humayun – Jacobabad transmission line route passes through a congested settlement near the Jacobabad grid station (see **Section 4.4.11**). The proposed transmission line construction as well as testing and commissioning works would cause safety hazards for the residents of these houses.

The unmitigated impacts related to the safety hazards are characterized as 'high' (see **Exhibit 9.4**).

Mitigation Measures

- The construction sites will have protective fencing to avoid any unauthorized entry.
- The project drivers will be trained for defensive driving skills (environmental and social trainings are described in **Chapter 10**).
- Vehicular speeds near/within communities will be kept low to minimize safety hazards.

- Construction camp sites will be located at least 500 m away from the nearest community. Camp sites will be selected with HESCO's approval, as mentioned in **Section 8.3.1**.
- Firefighting equipment will be made available at the camps.
- The camp staff will be provided fire fighting training.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- Liaison with the community will be maintained. In particular, the nearby communities will be informed before commencing the testing and commissioning of the system. Protective fencing will be used where appropriate/possible. Awareness raising program will be implemented to educate the communities regarding the hazards associated with the transmission lines, and other electrical systems/equipment. Warning signs will be used at the appropriate locations.
- For the segment of the Humayun – Jacobabad transmission line passing through the settlement (near the Jacobabad grid station), GSC/contractor will prepare a work plan and submit to HESCO for approval. The construction works will not commence before the approval. The work plan will include measures to address the safety hazards for the houses / other structures that exist under the transmission line. The measures may include installation of a safety wire net below the transmission line to protect the houses underneath. The height of the transmission line will also be increased for this portion.
- HESCO will carry out electricity network improvement activities in the above settlement, in order create goodwill and to reduce the community grievances related to the proposed transmission line being routed over their houses.

Residual Impact

There will be a low level of residual impact of safety hazards associated with the vehicular traffic. The safety hazard issue with the construction activities will be negligible. The safety hazard during the testing and commissioning of the system will be from low to medium.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.6 Public Health Issues

The public health concerns to be addressed during the design phase of the proposed project have been discussed in **Section 9.2** above. There will be some similar concerns during the construction phase as well, primarily associated with the operation of the construction camps.

The public health issues can potentially arise at all of the project sites. **Exhibits 4.17** to **4.23** show the key locations of these impacts in the project area.

The unmitigated impacts related to the public health are characterized as 'high', as shown in **Exhibit 9.4**.

Mitigation Measures

The following mitigation measures will minimize the public health concerns during the construction phase of the project:

- The construction camps will have septic tanks and soaking pits of adequate size.
- Camps will be at least 500 m from any groundwater wells used by the community.
- The construction camps will have appropriate solid waste disposal mechanism (see **Section 8.3.1**).
- The construction camps and site offices will have first-aid kits.
- The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).

Residual Impacts

With the help of the above measures, the public health concerns during the project construction phase can be reasonably addressed. The significance of the residual impacts is therefore expected to be negligible.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.7 Damage to Infrastructure

The construction activities and associated vehicular traffic may damage the existing infrastructure in the areas such as roads, water channels and other structures (as shown in **Exhibits 4.17 to 4.23**).

The infrastructure may be damaged at all of the project sites.

The unmitigated impacts related to the infrastructure are characterized as 'medium' (see **Exhibit 9.4**).

Mitigation Measures

- All damaged infrastructure will be restored to original or better condition.

Residual Impact

Following the implementation of the above-recommended measure, there will be negligible level of residual impact.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.8 Gender Issues

The project works to be carried out within the rural communities may cause disturbance to the women of the area. Similarly, the construction camp operation and vehicular traffic may also cause some hindrance to women mobility.

In particular, these issues can potentially arise at the following locations:

- Bukhshapur grid station site

- Chamber grid station site
- Portions of the Tando Allahyar – Chamber transmission line
- Larkana-III grid station site
- Portions of the feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Portions of the feed for Kandiari grid station
- Naukot grid station
- Samaro grid station
- Portions of the Samaro – Naukot transmission line.

The unmitigated gender issues are characterized as 'medium' (see **Exhibit 9.3**).

Mitigation Measures

- The routes used by the women will be avoided as far as possible. If unavoidable, alternate routes to be identified for the communities, if required, especially along routes frequented by women, such as route to the local well or water source.
- Camp sites for construction will be 500 m away from the nearest community, as recommended earlier.
- Construction crew will avoid entering villages and settlements.
- Communities will be informed and consulted before commencing works inside or near the communities.
- Strict code of conduct will be maintained by the construction crew. Local norms will be respected.

Residual Impact

Despite the implementation of the above mitigation measures, there will be a low to moderate level of residual impact associated with the gender issues.

The social monitoring during the project execution will ensure compliance to the above mitigation measures and their adequacy, as well as significance of the residual impacts.

9.3.9 Child Labor

Although the use of child labor is not prevalent in the construction works such as those involved in the proposed project, however, the provisions of the Child Labor Act (see **Section 2.2.16**) will still be made part of the construction contracts, in order to ensure that no child labor is employed at the project sites or campsites.

9.3.10 Impacts on Sites of Historical, Cultural, Archeological or Religious Significance

As mentioned in **Section 5.3**, no sites of historical, cultural, archeological or religious significance are known to exist at or in the immediate of the project components that are known at this stage. However, during the construction works of the project, particularly, excavation, such sites or artifacts may be discovered.

There exist a few graveyards along the transmission line routes (see **Exhibits 4.17** to **4.23** for the schematic diagram showing the key features along the transmission line routes).

The unmitigated impacts on sites of historical, cultural, archeological or religious significance are characterized as 'medium' (see **Exhibit 9.4**).

Mitigation Measures

- In case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site.
- The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.
- The existing graveyards will not be damaged. The construction work close to the graveyards will be carried out after informing/consulting the relevant communities.

9.4 Operation Phase

Much like the environmental issues associated with the O&M activities, there are very few socioeconomic concerns which are expected during the operation phase of the proposed project. These concerns are listed below.

- Safety hazards
- Public health
- Loss of agricultures
- Noise emissions.

These impacts are characterized in **Exhibit 9.8** and discussed below.

9.4.1 Safety Hazard

The grid stations and transmission lines will pose electrocution risk to the HESCO staff as well as the nearby population and livestock. In particular, the following project components can cause safety concerns for the population of the area:

- Bukhshapur grid station
- Chamber grid station
- Tando Allahyar – Chamber transmission line
- Larkana-III grid station
- Feed for the Larkana-III grid station
- Humayun – Jacobabad transmission line
- Feed for Kandiari grid station
- Naukot grid station
- Samaro grid station

- Samaro – Naukot transmission line.

In particular, a segment of the Humayun – Jacobabad transmission line passes over a settlement, as described in **Section 9.3.5**. Operation of this proposed line will cause significant safety hazard particularly for the population living underneath the live wires.

The safety hazard issues have been characterized as 'high' (see **Exhibit 9.8**).

Mitigation measures

Design aspects of this issue have been discussed in **Section 9.2**, which will forestall major causes of electrocution. Additional measures are provided below.

- HESCO's O&M staff will be provided essential protective gears and equipment.
- HESCO's O&M staff will be provided safety training. Refresher courses will be arranged on regular basis.
- Firefighting equipment will be made available at the grid stations.
- The Emergency Response Plan (ERP), prepared by HESCO, will be made available at each grid station. Its salient points will be displayed at prominent places within each grid station. The O&M staff will be given training on the ERP. The Environmental and Social Cell (ESC) (discussed in **Chapter 10**) will review the ERP and with respect to the environmental and social considerations, and recommend changes if needed. The ERP will include procedure to inform the nearby communities in case of fire in the grid stations.
- The communities near the grid stations and transmission lines will be educated on the risk of electrocution, and how to avoid accidents.
- Appropriate signage on safety precautions will be installed at the key locations.
- The trees under the transmission lines will be regularly trimmed in order to maintain 8 m clearance.
- For the last segment of Humayun – Jacobabad transmission line which passes over the congested settlement, the wire net mentioned in **Section 9.3.5** will be maintained to protect the people living directly below the transmission line.

Residual Impacts

Despite the implementation of the above measures, there will be some residual safety hazards associated with the operation of the system. The significance of this impact is expected to be medium.

9.4.2 Public Health Concerns

There are the following three distinct types of public health concerns associated with the operation of the proposed project:

- Inappropriate solid waste and sewage disposal from grid stations and their residential areas
- Leakage of PCB-containing transformer oil

- Electromagnetic (EM) radiation caused by the high tension transmission lines.

The public health issues have been characterized as 'high' (see **Exhibit 9.8**).

Mitigation Measures

- The concerns associated with the waste disposal and PCB-containing transformer oil have been adequately discussed and addressed in **Sections 8.4.1** and **9.2**.
- Studies have shown that there is a weak evidence of health risk associated with the exposure to power frequency fields (excerpts from a document 'Power Lines and Cancer FAQ' are provided in **Appendix G**). However, since the proposed transmission line routes will be selected avoiding the settlements, there will not be any significant risk of EM radiation exposure.

9.4.3 Loss of Agriculture

During the repair and maintenance activities, crops along/under the transmission lines can potentially be damaged.

The project sites where this issue may be encountered include:

- Portions of the Tando Allahyar – Chamber transmission line
- Feed for the Larkana-III grid station
- Portions of the Humayun – Jacobabad transmission line
- Feed for Kandiari grid station
- Portions of the Samaro – Naukot transmission line
- Portions of the feed for Tando Bago grid station
- Feed for the Matiari grid station.

The impacts on cultivation have been characterized as 'medium' (see **Exhibit 9.8**).

Mitigation Measures

The following mitigation measures will address the concerns associated with the loss of agriculture during the O&M phase of the project:

- Damage to the crops will be avoided during the transmission line patrolling/maintenance.
- Any damage during repair the repair and maintenance activities will be compensated.
- Liaison with the nearby communities will be maintained in this regard.
- The grievance redressal mechanism will be maintained on continuous basis.

Residual Impacts

With the help of the above mitigation measures, the concerns associated with the loss of agriculture will be reasonably addressed and there will be negligible residual impacts.

9.4.4 Noise Emissions

The transformers installed at the proposed grid stations would generate some noise, which can adversely affect the nearby communities. This impact has been characterized as 'medium' (see **Exhibit 9.8**).

Mitigation Measures

The following mitigation measures will address the concerns associated with the noise generated by the transformers:

- Appropriate equipment selection, as recommended in **Section 9.2** will forestall any concerns associated with noise.
- Periodic noise measurements will be carried out at the outer fence of the grid stations, in order to ensure that the noise levels are within acceptable limits. If found beyond these limits at any stage, appropriate measures will be taken, such replacing the noisy equipment, and/or erecting noise barrier along the grid station outer periphery.
- Liaison with the nearby communities will be maintained in this regard.
- The grievance redressal mechanism will be maintained on continuous basis.

Residual Impacts

With the help of the above mitigation measures, the concerns associated with the noise emissions will be addressed and there will be negligible residual impacts.

Exhibit 9.1: Social Screening Checklist

People affected by the project	People living close to the grid stations and transmission line routes. For intensity of impacts, see **Exhibit 8.1**. The social impacts are discussed in **Sections 9.2** to **9.4**. Most of the PAPs are the farmers whose crops will be damaged during the construction and O&M of the transmission lines (discussed in **Sections 9.3.1**, **9.3.2** and **9.4.3**.
Poverty level of affected persons	Varies greatly, mostly associated with the locality. Most of the PAPs – farmers whose crops would be damaged - belong to middle and lower income groups. **Section 5.2.5** also discusses poverty in the project area.
Are the directly affected people agreeable to allow the project?	Yes (see **Section 7** for stakeholders consultation).
Social issues, impacts of the project.	Key impacts: damage to crops, safety hazards, public health and noise. **Sections 9.2** to **9.4** discuss all of the social issues.
Does the project require land?	The project will require about 16 acres of land, which will be acquired in accordance with the LAA (see **Exhibit 3.6** for a summary of land requirement)..
Is there any involuntary land acquisition?	The project will acquire 16 acres of land for the new grid stations, as mentioned above. In addition, temporary land acquisition will need to be carried out during the construction phase; crop compensation will be paid where such temporary acquisition involves cultivated land (see **Section 9.3.1**).
Are there any affected structures?	No structures are expected to be affected by the project.
Will there be any loss of livelihood of title and non title holders?	The loss of livelihood during the project is associated with the damaged crops discussed above. This loss will be temporary in nature, and will be compensated.
Is there any social conflict resolution mechanism in the communities?	The rural communities usually have '*panchayat*' system for conflict resolution. The project also proposes grievance redressal mechanism to deal with the communities' concerns about the project.
Are the social safeguards triggered?	OP 4.12 is triggered (see **Section 2.1**).
Any commercial activities affected in urban/rural areas?	No.

Exhibit 9.2: Environmental and Social Screening Matrix (Unmitigated)

	Physical					Biological		Social and Socioeconomic											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Design Phase																			
Site Selection for Grid Stations	-1	0	0	0	0	-1	-1	-1	0	-1	-1	0	-2	-2	N	-1	-1	0	0
Route Selection for Transmission Lines	-1	0	0	0	0	-1	-1	0	0	-1	-1	0	-2	-2	-1	0	-1	0	0
Design of Grid Station	-2	0	-2	-2	0	0	0	0	0	0	0	0	0	0	0	-2	-1	0	0
Equipment Selection	-2	0	-2	-2	0	0	0	0	-1	0	0	0	0	0	N	-2	0	0	0
Construction Phase-Grid Stations																			
Land Acquisition	N	N	N	N	N	N	N	-1	N	-2	-2	-1	-2	N	N	N	N	N	N
Mobilization of Contractors	-1	-1	-1	0	0	0	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Construction Camp Establishment	-1	-1	-1	-1	0	-1	0	-1	-1	-2	-2	-1	-1	-2	-1	-1	0	-1	-1
Construction Camp Operation	-2	-1	-2	-2	-1	-1	0	0	-1	0	0	0	0	-1	-1	-2	0	-1	-1
Transportation of Construction Materials and Supplies	-1	-1	-1	0	0	0	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Excavation for Foundations	-2	-1	-1	-1	0	-1	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Construction Works	-2	-1	-1	-1	-1	0	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Equipment Installation	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0

.... Contd. **Exhibit 8.3**

	Physical					Biological		Social and Socioeconomic											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Construction Phase-Transmission Lines																			
Land Acquisition	N	N	N	N	N	N	N	-1	N	-2	-2	-1	-2	N	N	N	N	N	N
Mobilization of Contractors	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Construction Camp Establishment	-1	-1	-1	-1	0	-1	0	-1	-1	-2	-2	-1	-1	-2	-1	-1	-1	-1	-1
Construction Camp Operation	-2	-1	-2	-2	-1	-1	0	0	-1	0	0	0	0	-1	-1	-1	0	-1	-1
Transportation of Construction Materials	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Excavation for Foundations	-2	-1	-1	-1	0	-1	0	0	-1	0	-1	0	0	-2	0	-1	0	0	0
Construction of Foundations	-2	-1	-1	-1	-1	0	0	0	-1	0	-1	0	0	-2	0	-1	0	0	0
Erection of Towers / Poles	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-2	0	-1	0	0	0
Stringing	0	-1	0	0	0	0	0	0	-1	-1	0	0	0	-2	0	-1	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0
Contractor Demobilization	-1	-1	-1	0	0	-1	0	0	-1	-2	-2	-1	0	-2	-1	-1	0	0	-1
Operation and Maintenance Phase																			
Grid Station O&M	-2	0	-2	-2	0	0	0	0	-1	0	0	0	0	-2	0	-2	0	0	0
Transmission Line O&M	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	-2	0	0	0	0	0

Key: -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible impact; +1: low positive impact; +2: High positive impact, N: no impact.

Exhibit 9.3: Impact Characterization for Project Design Phase (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Land acquisition (including loss of asset, loss of livelihood, damage to infrastructure)	Direct	Long term	Local	Irreversible	Likely	Major	High
Blocked access	Indirect	Long term	Local	Reversible	Possibly	Moderate	Medium
Safety hazards	Indirect	Long term	Local	Reversible	Likely	Major	High
Public health	Indirect	Medium to Long term	Local	Reversible	Likely	Major	High
Aesthetic value	Indirect	Long term	Local	Reversible	Possibly	Moderate	Medium

Exhibit 9.4: Characterization of Construction Phase Socioeconomic Impacts (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Land acquisition (including loss of asset, loss of livelihood, damage to infrastructure)	Direct	Long term	Local	Irreversible	Certainly	Major	High
Loss of agriculture	Direct	Long term	Local	Reversible	Likely	Major	High
Damage to Irrigation Network	Direct	Long term	Local	Reversible	Likely	Major	High
Blocked Access	Direct	Short term	Local	Reversible	Possibly	Moderate	Medium
Noise	Direct	Short term	Local	Reversible	Possibly	Moderate	Medium
Safety Hazard	Direct and Indirect	Short to Medium term	Local	Reversible	Likely	Major	High
Public health	Direct and Indirect	Short to Medium term	Local	Reversible	Likely	Major	High
Damage to Infrastructure	Direct and Indirect	Short term	Local; Regional	Reversible	Possibly	Moderate	Medium
Gender Issues	Indirect	Short term	Local	Reversible	Possibly	Moderate	Medium
Impacts on Sites of Archeological, Cultural, Historical or Religious Significance	Indirect	Long term	Local	Irreversible	Unlikely	Moderate	Medium

Exhibit 9.5: Summary of Crop/Tree Compensation

Description	Crop Damage Area (Acres)	Crop Compensation (Pak Rs.)	Compensation for Tree Removal (Pak Rs.)
Humayun - Jacobabad Transmission Line	127.39	1,120,989	35,000
Feed for Chamber Grid Station	170.26	1,498,262	45,000
Feed for Larkana-III Grid Station	53.16	467,840	15,000
Feed for Tando Bago Grid Station	26.69	234,899	7,500
Feed for Matiari Grid Station	4.45	49,149	0
Feed for Kandiari Grid Station	12.98	114,189	0
Samaro - Naukot Transmission Line	362.63	3,191,164	105,000
Access Routes	30.00	264000	0
Total	**787.56**	**6,940,492**	**207,500**
Grand Total			**7,147,992**

Note: See details in **Section E.2** of **Appendix E.**

Basis: Transmission line corridor for crop compensation: 30 m; crop compensation for two wheat seasons, at the rate of Rs. 4,400 per acre per season.

Exhibit 9.6: Entitlement Framework

Type of Loss	Definition of Entitled Persons	Entitlement Policy	Responsibility
Loss of agriculture land	Legal users with valid title, customary or usufruct rights.	PAPs will be entitled to: o Cash compensation for acquired land at mutually agreed market value, on the basis of willing buyer-willing seller, and the land owner to have option to refuse to sell the land. If LAA is used, an amount of 15% will be added to the market price, in accordance with the LAA. Section 17 of the LAA will not be used, in the absence of the emergency/urgency.	Tehsildar; Environmental and Social Inspector (ESI) (these are defined later in the document)
	Tenant, leaseholder and sharecropper	PAPs will be entitled to: o Reimbursement for un-expired lease.	Tehsildar; ESI
	PAPs without valid title (vulnerable encroachers or squatters)	PAPs will be entitled to: o Cash compensation for affected structures at replacement value.	Tehsildar; ESI
Loss of residential, commercial, industrial or institutional land	Legal users with valid title, customary or usufruct rights.	PAPs will be entitled to: o Cash compensation for acquired land at mutually agreed market value, on the basis of willing buyer-willing seller, and the land owner to have option to refuse to sell the land. If LAA is used, an amount of 15% will be added to the market price, in accordance with the LAA.	Tehsildar; ESI
	Tenant and leaseholder	PAPs will be entitled to: o Reimbursement for un-expired lease.	Tehsildar; ESI
	PAPs without valid title (vulnerable encroachers or squatters)	PAPs will be entitled to: o Cash compensation for affected structures at replacement value.	Tehsildar; ESI

Contd. **Exhibit 9.6.**

Type of Loss	Definition of Entitled Persons	Entitlement Policy	Responsibility
Structures (residential, commercial, industrial or institutional)	Owners of affected structure, with or without legal title, customary or usufruct rights	PAPs will be entitled to: o Cash compensation for affected structures, or portion of the structure, at replacement value. o Allowance to cover the repair cost of the remaining structure.	Tehsildar; ESI
Loss of common resources and facilities	Communities/households	o Replacement of the common property resources/facilities, in consultation with the affectees. o Access to equivalent resources/facilities.	Contractors; Environmental and Social Monitor (ESM); ESI.
Loss of standing crops	Households who cultivate the land	PAPs will be entitled to: o Cash compensation equivalent to the market value of damaged crops.	Tehsildar; ESI
Loss of trees	Owners of the affected trees (irrespective of the land title)	PAPs will be entitled to: o Cash compensation equivalent to the market value of trees on the basis of type, age and productivity.	Tehsildar; ESI
Loss of public infrastructure	Relevant agencies	Compensation in cash at replacement cost to respective agencies, or Restoration/repair of the damaged infrastructure in a similar or better condition as before.	Contractors; ESM; ESI.
Loss of or damage to religious sites (eg, mosques, graveyards, shrines)	Community and affected households	Replacement cost for religious sites. Cost of removal of graves and all related costs for its relocation.	Contractors; ESM; ESI.

Notes:

- Compensation for the affected structure will be calculated on the basis of the replacement cost at market prices, without taking salvage value into consideration.
- All compensations will be paid before commencement of the construction activities.

Exhibit 9.7: Typical Tower Design Allowing Cultivation Underneath

Exhibit 9.8: Characterization of Operation Phase Socioeconomic Impacts (Unmitigated)

Impact	Nature	Duration	Geo Extent	Reversibility	Likelihood	Consequence Severity	Impact Significance
Impacts on Cultivation	Indirect	Short to medium term	Local	Reversible	Possibly	Moderate	Medium
Public health	Direct and Indirect	Short to Medium term	Local	Reversible	Likely	Major	High
Safety Hazards	Indirect	Medium to long term	Local	Reversible	Likely	Major	High
Noise Emissions	Direct	Short term	Local	Reversible	Possibly	Moderate	Medium

10 Environmental and Social Management Plan

This Chapter presents the implementation mechanism – in the form of an environmental and social management plan (ESMP) - for the environmental and social mitigation measures identified during the present ESA, and reported in **Chapters 8** and **9** of this document, respectively. A resettlement plan has also been prepared and provided under separate cover, to address the involuntary resettlement caused by the proposed project.

10.1 Purpose and Objectives of ESMP

This ESMP provides the delivery mechanism to address the adverse environmental as well as social impacts of the proposed project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project works.

The specific objectives of the ESMP are to:

- Facilitate the implementation of the environmental and social mitigation measures identified in **Chapters 8** and **9** of this document, respectively;
- Define the responsibilities of the project proponents, contractors, and environmental monitors, and provide a means of effectively communicating environmental and social issues among them,
- Define a monitoring mechanism and identify monitoring parameters in order to:
  - Ensure the complete implementation of all mitigation measures, and
  - Ensure the effectiveness of the mitigation measures.
- Provide a mechanism for taking timely action in the face of unanticipated environmental or social situations,
- Identify environmental as well as social training requirements at various levels.

10.2 Components of the ESMP

The ESMP consists of the following:

- Institutional Arrangements
- Mitigation plan
- Monitoring plan
- Change management plan
- Communication and documentation
- Environmental and social trainings,
- Public disclosure requirements
- Budgetary estimates for ESMP implementation.

These are discussed in **Sections 10.3** to **10.10** below.

10.3 Institutional Arrangements

This section describes the organizational structure required for managing the environmental as well as social aspects of the proposed project. Also defined in this section are the roles and responsibilities of the various role players during the project.

10.3.1 Management Approach

HESCO will establish an Environmental and Social Cell (ESC) within the Organization, in order to handle the environmental and socioeconomic matters during the proposed project, other future projects as well as its routine operations.[1] The ESC will not be part of the proposed project organization, and will provide advisory services to the project and other HESCO departments. Initially, the ESC will have one environmental and one socioeconomic expert of relevant qualification and experience; the strength can be increased in the future as required.

Other essential features of the institutional arrangement proposed for the project are:

- HESCO will appoint Environmental and Social Inspectors (ESIs) for overseeing and monitoring the entire implementation of the ESMP and ESA.
- In case HESCO appoints Supervision Consultant, the ESIs will be appointed by the Consultant (instead of HESCO).
- The ESMP as well as environmental management requirements and specifications will be included in all contracts HESCO and its contractors/consultants execute.
- Each contractor will be required to appoint a dedicated field Environmental and Social Monitor (ESM) at the project site.
- HESCO, through the ESC, will cooperate with regulatory agencies (such as the Sindh EPA) and other stakeholders who may want to send their own teams to monitor the project activities.
- During the O&M phase of the project, ESC will be responsible to ensure the environmental and social performance of the operations.

10.3.2 Organizational Structure and Responsibilities

Construction Phase

The organizational structure for the construction phase ESMP is shown in **Exhibit 10.1**, and its salient features described below.

1. Primary responsibilities:
   - The GSC Department through its Project Director (PD) will be responsible for the project's compliance with the ESA and ESMP throughout the project. The ESC will assist GSC Department and will provide policy support in all environment and socioeconomic matters.

[1] The cost of ESC will not be included in the proposed project.

- The Supervision Consultant (if HESCO chooses to employ one) through its Resident Engineer (RE) will be responsible for ensuring that the contractors adhere to the quality requirements and other commitments including implementation of the ESMP and ESA.
- The contractors' Chief Executive Officer or Country Manager will assume the main responsibility for all environmental matters pertaining to their work.
- The PD will coordinate with relevant government departments (Sindh EPA) and other stakeholders through the ESI.

2. Field management and quality control:
   - Carrying out construction activities in an environmentally and socially sound manner during the construction phase will be the responsibility of the site managers of the contractor(s).
   - The GSC's site incharge (or RE, if the Supervision Consultant is employed) will be responsible for the environmental and social soundness of all construction activities.
3. On-the-job supervision and monitoring:
   - The ESM of each contractor will be responsible for the implementation of the ESMP during construction works. He will also be responsible for communication with and the training of their respective construction and camp crews in all aspects of the ESMP.
   - The ESI will ensure implementation of the ESMP in the field. He will also coordinate with the PD, the contractor's project management and ESM of each contractor. ESI will be part of HESCO's site organization if no Supervision Consultant is employed. Otherwise, the ESI will be part of the Supervision Consultant's site staff.
   - If any monitoring teams from government departments or from NGOs visit the field during the field activities, the ESI will be responsible for coordinating their visits.

The roles and responsibilities of HESCO's and contractors' personnel are summarized in **Exhibit 10.2**.

Operation Phase

During the operation phase of the proposed project, environmental and socioeconomic management will become a routine function, as an integral part of the O&M activities. The ESC will be the focal point for all matters relating to environmental and socioeconomic issues during the routine operations of the Organization. The ESC will advise various departments within HESCO for environmental and socioeconomic issues. The ESC will develop an environmental and socioeconomic management system for the Company, defining roles and responsibilities of various departments and their respective staff.

10.4 Mitigation Plan

The mitigation plan is a key component of the ESMP. It lists all the potential effects of each activity of the project and their associated mitigation measures identified in the ESA. For each project activity, the following information is presented in the plan:

- A listing of the potential impact associated with that project activity,
- A comprehensive listing of mitigation measures (actions),
- The person(s) responsible for ensuring the full implementation of the action,
- The person(s) responsible for monitoring the action,
- The timing of the implementation of the action to ensure that the objectives of mitigation are fully met.

The mitigation plan for the construction phase of the proposed project is presented in **Exhibit 10.3**.

It should be emphasized that the mitigation measures will have to be translated into environmental as well as social requirements and specifications to be made part of the contracts for the construction activities, with legal binding.

10.5 Monitoring Plan

The objective of environmental and social monitoring during the various phases of the proposed project will be as follows:

- Ensuring that the mitigation measures included in the ESA are being implemented completely.
- Ensuring the effectiveness of the mitigation measures in minimizing the project's impacts on social and environmental resources.

To achieve these objectives the following monitoring program will be implemented.

10.5.1 Compliance Monitoring

The compliance monitoring of the project activities is principally a tool to ensure that the environmental and social control measures identified in the ESA are strictly adhered to during the project activities.

Various aspects of the ESA compliance monitoring will be to:

- Systematically observe the activities undertaken by the contractors (and sub-contractors) or any other person associated with the project.
- Verify that the activities are undertaken in compliance with the ESA, ESMP and RP (RP is provided under separate cover).
- Document and communicate the observations to the concerned person(s) of the contractors, GSC Department and ESC, so that any corrective measures, if required, can be taken in a timely fashion.

- Maintain a record of all incidents of environmental and social significance, related actions and corrective measures.
- Maintain contact with the communities, solicit their views and concerns, and discuss them during the fortnightly meetings.
- Prepare periodic reports of the environmental and social performance of project.

The mitigation plan discussed in **Section 10.4** will be used as a management and monitoring tool for compliance monitoring. Inspection will be done using checklists prepared by the respective contractors, on the basis of the **Exhibit 10.3**, during the construction phase.

Compliance monitoring will be the responsibility of all organizations involved in the field activities, ie, GSC Department and the contractors. It will be carried out by the following:

- ESI
- ESM.

10.5.2 Effects Monitoring

The ESA predicts the impacts of the proposed project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental and social parameters. Based on this prediction, mitigation measures are introduced such that the predicted residual effects do not exceed acceptable levels. However, there is always an element of uncertainty in such predictions due to an insufficient grasp of the processes, limitations in prediction techniques, or inadequate data on the environment/social aspects. Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the project will exceed acceptable limits.

In order to address the above concerns, effects monitoring will be undertaken during the project activities, with the overall objective of proper management of environmental and social risks and uncertainties. Broadly, effects monitoring has the following objectives:

- To verify that the impacts of the proposed project are within acceptable limits, thus establishing credibility (public assurance).
- To immediately warn the project proponents (and the regulatory agencies, if required) of unanticipated adverse impact or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures.
- To provide information to plan and control the timing, location, and level of certain project activities so that the effects are minimized.
- To facilitate research and development by documenting the effects of the proposed project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future projects.

The effects monitoring plan is provided in **Exhibit 10.4**. The detailed methodologies will be developed during the detailed design phase of the project, when the specific

information on field activities will be known. The effects monitoring will comprise the following:

- Soil erosion
- Water quality
- Water consumption
- Air quality
- Noise
- Socioeconomic aspects
- Grievance monitoring.

In addition, contact will be maintained with the communities, their views and concerns solicited. The outcome of these consultations will be discussed during the fortnightly meetings at the site.

10.5.3 External Monitoring

In addition to the compliance and effects monitoring discussed above, HESCO will engage an independent consultants to carry out external monitoring on periodical basis. The objectives of this external monitoring will be to ensure that:

- the ESMP is being adequately implemented,
- mitigation measures are being implemented,
- the RP is being implemented
- the compliance and effects monitoring are being conducted,
- environmental and social trainings are being conducted, and
- complete documentation is being maintained.

The external monitoring consultants will periodically visit the project sites (grid stations as well as the transmission line routes), examine the compliance monitoring activities, review the documentation maintained at the site, interview key site staff, make spot checks, take photographs where necessary, interview the PAPs, and meet with the communities. After each external monitoring visit, the consultant will prepare a monitoring report and submit to HESCO. The report will include the observations made during the visits, highlight non-compliances observed, if any, salient information obtained from PAPs/communities, and make recommendations.

10.6 Communication and Documentation

An effective mechanism for recording, storing and communicating environmental and social information during the project is an essential requirement of an ESMP. The key features of such a mechanism are:

- Recording and maintaining all information generated during the monitoring in a predetermined format.

- Communicating the information to a central location.
- Storing raw information in a central database.
- Processing the information to produce periodic reports.

A description of the various components of the communication and documentation system is given below.

10.6.1 Data Recording and Maintenance

The forms to be used for recording information during the environmental and social monitoring will be developed by the ESI, under the supervision of ESC. These forms will follow a standard format, which will correspond to the database into which all the information gathered will be placed. All common fields will have identical formats in the database and on the forms. Check boxes will be used as much as possible for ease in filling out the forms and to facilitate data entry.

All forms will be numbered and a tracking system will be developed for each. Whenever a form is released for use in the field, its number will be recorded. The field staff will be required to account for each form after completion. In this manner, it will be ensured that all forms are returned to the office.

10.6.2 Meetings

The following environmental meetings will take place during the project:

- Project initiation meetings (once for each of the contractors).
- Fortnightly meetings.[2]

The purpose of the project initiation meetings will be to discuss the ESMP, and ensure full understanding and commitment from concerned parties for its implementation.

A periodic meeting will be held at site during the construction phase. The purpose of the meetings will be to discuss the conduct of the operation, non-compliances noted by the ESI or Contractors' ESMs, and any environmental / social issues identified in the field. The remedial measures will also be discussed and agreed during these meetings. The meeting will be recorded in the form of an environmental and social report (ESR) prepared by the ESI.

10.6.3 Grievance Redressal Mechanism

An attempt has been made during the present ESA to identify all potential impacts of the proposed project, to identify all PAPs, to provide mitigation measures to address the potential impacts, and to chart out a mechanism to implement these mitigation measures (including payment of compensation).

However during the project implementation, the stakeholders (mostly the communities in the vicinity of the project sites/transmission line routes) may still have some grievances

[2] Frequency of meetings may be adjusted per the situation.

with respect to the project activities, their impacts, compensation and other mitigation measures. The key reasons of these grievances are listed below:

- PAPs not enlisted,
- Losses (such as damaged crops) not identified correctly,
- Compensation inadequate or inappropriate,
- Dispute about ownership,
- Delay in disbursement of compensation,
- Improper distribution of compensation in case of joint ownership.

In order to address the above eventualities, the Grievance Redressal Mechanism (GRM) has been devised. The main objective of the GRM will be to provide a mechanism to mediate conflict and cut down on lengthy litigation, which often delays the infrastructure projects such as the 6th STG. It will also facilitate people who might have objections or concerns regarding the project activities, provide a public forum to raise their objections and through conflict resolution, address these issues adequately. The main functions of the GRM will be as follows:

- Provide a mechanism to the PAPs to address the problems arising as a result of project activities,
- Record the grievance of the PAPs, categorize and prioritize the grievances that need to be resolved,
- Determine and implement the mitigation actions to address the grievances,
- Report to the aggrieved parties about the developments regarding their grievances and the decision of the project authorities.

Under the GRM, the ESI will maintain the Social Complaint Register (SCR) at the sites to document all complaints received from the local communities or any other stakeholder. The information recorded in the Register will include date of the complaint, particulars of the complainant, description of the grievance, actions to be taken, the person responsible to take the action, follow up requirements and the target date for the implementation of the mitigation measure. The register will also record the actual measures taken to mitigate these concerns.

As soon as a complaint is received, the ESI will discuss it with the ESMs, and determine the remedial action. If required, consultations will also be undertaken with the contractor's site managers and GSC's PD. Once the remedial action is decided, implementation responsibility as well as schedule will be determined.

The proposed remedial action will be documented in the SCR, with complete details (by whom and by when). The proposed remedial action will be shared with the complainant. Similarly, the actual action taken will also be documented in the Register and shared with the complainant. The complainant's views on the remedial action taken will also be documented in the Register.

The SCR will be reviewed during the fortnightly meetings at the site during the project, and the action items discussed. The progress on the remedial actions will also be reviewed during the meetings.

The Register will also be shared with the PD and ESC, on regular basis, for information and further action, if any.

In order to address any unresolved grievances at a higher level of the organization, a Grievance Redressal Committee (GRC) will be constituted. The Committee will be headed by the PD, with ESI and the ESC social expert its other members. A suitable person from the relevant community will also be a member of this committee. Any un-resolved issue will be sent to the Committee for determining the remedial action.

The GRM's roles, responsibilities and implementation mechanism are explained in **Exhibit 10.5**.

10.6.4 Reports

The ESI will produce periodic reports based on the information collected. These will include reports for:

- Project initiation meetings with each contractor,
- Fortnightly meetings,
- Non-compliances,
- Effects monitoring.

These reports will be shared with the contractors, PD, Manager Construction, and ESC. The reports will also be made available for review, to the external monitoring teams, and to any other stakeholders who visit the site.

At the end of the construction phase, a final report will also be prepared.

10.7 Environmental and Social Trainings

Environmental and social trainings will help to ensure that the requirements of the ESA and ESMP are clearly understood and followed by all project personnel throughout the project period. The primary responsibility for providing training to all project personnel will be that of the ESI. The environmental and social training program will be finalized before the commencement of the project, during the detailed design phase. The training will be provided to the HESCO staff, the construction contractors, and other staff engaged for the project. Training will cover all staff levels, ranging from the management and supervisory to the skilled and unskilled personnel. The scope of the trainings will cover general environmental awareness and the requirements of the ESA and the ESMP, with special emphasis on sensitizing the project staff to the environmental and social aspects of the area. **Exhibit 10.6** provides a summary of various aspects of the environmental and social trainings.

During the O&M phase of the project, these trainings will continue to be conducted by ESC for all relevant staff of the Company, particularly from GSC, GSO and Planning departments.

10.8 Change Management

The present ESA has been carried out on the basis of the project information available at this stage. This is however possible that the changes are made in some components of the project, during the design and construction phases. In order to address the environmental and social implications of these changes, a simple framework has been devised, which is described in this section.

The change management framework recognizes the following three broad categories of the changes in the project:

- Category A changes,
- Category B changes, and
- Category C changes.

These categories are defined below.

10.8.1 Category 'A' Change

The 'Category A' change is one that will lead to a significant departure from the project described in the ESA and consequently requires a reassessment of the environmental and socioeconomic impacts associated with the change. In such an instance, HESCO will be required to conduct a fresh ESA of the changed portion of the project, and send the report of this assessment to the relevant agencies for approval (Pak-EPA). Examples of such changes are provided below.

- Any works inside protected areas (see **Section 4.2.4** for the protected areas in Sindh Province).
- Change in the transmission line route by more than 2 km of the original alignment. Or change in the route by less than 2 km, but the changed route has environmental and/or social sensitivity more than the original route.
- Increase in the transmission line length exceeding 20 % of the original design. Or increase in length by less than 20% but involving areas which are more sensitive – environmentally and/or socially – than the original route.
- Change in the grid station site by more than 1 km of the location studied during the ESA. Or change in the site by less than 1 km but the new location has a higher environmental and/or social sensitivity.
- Increasing the number of grid stations to be established.

10.8.2 Category 'B' Change

The category 'B' change is one that will entail project activities not significantly different from those described in the ESA, which may result in project effects with overall magnitude to be similar to the assessment made in this report. In case of such changes, the ESI (with assistance from the ESC) will be required to reassess the environmental and socioeconomic impacts of the activity, specify additional mitigation measures, if necessary, and report the changes to the relevant agencies (Contractors, ESC, Pak-EPA). Examples of such changes are provided below.

- Changes in the transmission line route by more than 500 m of the original alignment, but not exceeding 2 km, provided that the changed route does not have environmental or social sensitivity more than the original area.
- Increase in the transmission line length exceeding 10 % of the original design, but not exceeding 20%, provided that the extended route does not have environmental or social sensitivity more than the original area.
- Change in the grid station site by more than 500 m of the location studied during the ESA, but not exceeding 1 km, provided that the new location does not have environmental or social sensitivity more than the original area.

Such changes will necessitate site surveys for the transmission line routes or grid station sites, by the environmental and socioeconomic experts. A site specific assessment for any additional environmental as well as socioeconomic issues will need to be carried out. Complete record of the surveys and assessment will be maintained.

10.8.3 Category 'C' Change

A Category-C change is one that is of little consequence to the ESA findings. This type of change does not result in effects beyond those already assessed in the ESA, rather it may be made onsite to minimize the impact of an activity, such as re-aligning a particular section of the transmission line to avoid cutting a tree, or relocating construction campsites to minimize clearing vegetation. The only action required for such changes will be to record the change in the Change Record Register.

10.9 Public Disclosure

HESCO will disclose this ESA and ESMP to all the stakeholders before the commencement of the proposed project. The ESA report will be made available to the stakeholders at the sites designated by the EPA, in accordance with the national legislation (PEPA 1997). In addition, the executive summary of the ESA will be translated into Urdu language, and made available to the affected communities (and also kept at the project sites). This will ensure that the local communities are aware of the project, its key impacts, the mitigation measures and the implementation mechanism. In addition, the Executive Summary will be disclosed through the HESCO's official website.

10.10 Cost of Environmental and Social Management

The primary component of the environmental and social management cost pertains to the personnel dedicated for ESMP implementation. The other component relates to the environmental effects monitoring as discussed in **Section 10.5.2** and tabulated in **Exhibit 10.4**. The cost of mitigation measures detailed in **Exhibit 10.3** is completely integrated with the construction costs, and cannot be separated. The mitigation measures should be made part of the project design and hence included in the overall project cost. **Exhibit 10.7** provides the cost estimates for the environmental and social management of the proposed project.

Exhibit 10.1: Organizational Structure for Environmental and Social Management

(Please see the following page.)

Organizational Structure for Environmental and Social Management

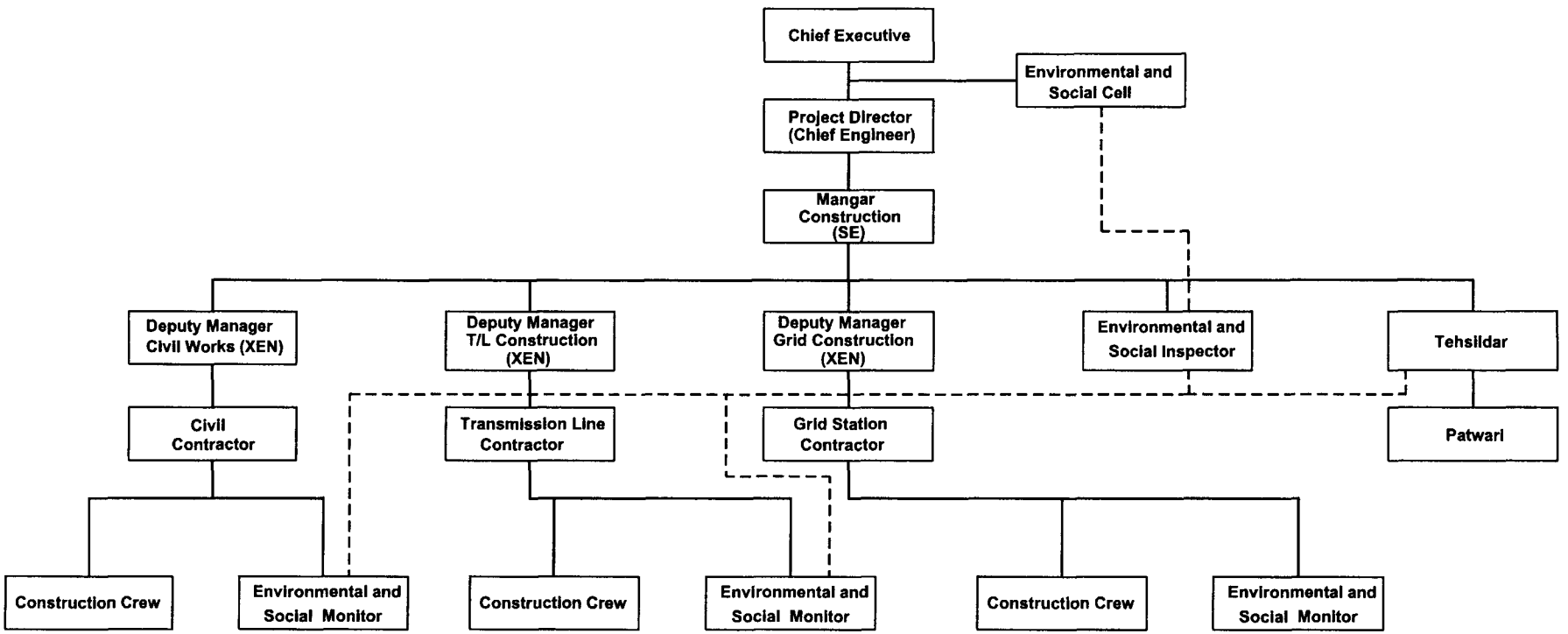

Exhibit 10.2: Roles and Responsibilities

Organization	Designation	Responsibilities
Environmental and Social Cell	Environmental and Socioeconomic Experts	• Advise GSC and other HESCO departments on matters relating to environment and social aspects of the project. • Advise and support ESI for the implementation of ESA and ESMP.
GSC Department	PD	• Fulfill HESCO's and GSC's obligations as laid out various project documents. • Ensure that the construction is carried out within the agreed timeframe according to satisfactory HSE and technical standards.
GSC Department (or Superviision Consultant)	Site Incharge (or RE if Supervision Consultant is employed)	• Facilitate field management of contractors; • Report regularly to the Project Manager and PD.
	Environmental and Social Inspector (ESI)	• Ensure that the entire project is conducted in an environmentally friendly and socially sound manner. • Ensure compliance with all relevant environmental laws. • Facilitate full implementation of ESMP and ESA requirements during the project. • Assist the PD and Project Manager in fulfilling HESCO's and GSC's environmental and social responsibilities, and keep them updated on environmental and social matters relating to the construction. • Review environmental and social reports (ESR), and ensure implementation of corrective measures, if any. • Coordinate with other stakeholders, including relevant EPAs.
Contractors	Site Manager	• Manage construction activities, manage construction crew, camp crew and other site personnel, in an environmentally and socially responsible manner; • Liaise with GSC's Project Manager; • Liaise with GSC's Site Incharge.
	Environment and Social Monitoros (ESM)	• Manage the implementation of mitigation measures given in the ESA and ESMP; • Manage implementation of entire ESMP; • Report regularly to Site Manager; • Liaise with ESI; • Provide environmental and social training to construction crew.

Exhibit 10.3: Mitigation Plan

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
1	Design Considerations	1.1	Soil Erosion	• Areas having unstable soil will be avoided for the grid station sites and transmission line routes. • Canal and river banks will be avoided while placing the transmission line towers.	GSC	ESC	Before construction (BC): during detailed designing of the project.
		1.2	Soil and water contamination	• Appropriate waste disposal systems will be included in the design of the grid stations and associated facilities. • The transformer procured during the proposed project will be PCB-free. • Leaked oil collection arrangement (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the grid stations.	GSC	ESC	BC
		1.3	Safety hazards and public health concerns	• All safety precautions will be taken to minimize the safety hazards and risk of accidental electrocution. These will include double periphery walls at the grid stations and appropriate clearance (between the live wires/connectors and the buildings/structures/trees).	GSC	ESC	BC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• Transmission lines will not be routed through the settlements as far as possible. Appropriate clearance will be maintained all along the transmission lines and feeders.			
		1.4	Noise emissions	• The project equipment, particularly transformers to be installed at the grid stations will meet the noise standards (70 dB(A) for industrial zones day and night; 45 dB(A) night and 55 dB(A) daytime for residential areas).	GSC	ESC	BC
		1.5	Aesthetic value	• Tree plantation will be carried inside and at the periphery of the grid stations, without compromising the safety aspects (ie, required clearances will be maintained). For this purpose, provision will be made in the site layout of the grid stations.	GSC	ESC	BC
2	PCB Elimination Plan	2.1	Soil and water contamination	• The PCB Elimination Plan will be developed (**Exhibit 8.6** provides outline ToR of the Plan).	Environmental and Social Cell (ESC)	Chief Executive	BC/DC
3	Contractor Mobilization and Demobilization	3.1	Soil Erosion and Contamination; Water Contamination	• Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water channels, water	Contractors	Environmental and Social Monitor (ESM)	BC; After construction (AC)

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				reservoir will be minimized. • Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.			
		3.2	Air Quality Deterioration	• Construction machinery and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. The vehicle exhaust will comply with the NEQS (**Exhibit 2.3**). • Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. • Project vehicles will avoid passing through the communities, farms and orchards as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions.	Contractors	ESM	BC; AC
		3.3	Noise	• Vehicles will have exhaust mufflers (silencers) to minimize noise generation. Vehicle noise will comply with NEQS (**Exhibit 2.3**).	Contractors	ESM	BC; AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable. • Vehicular traffic through the communities will be avoided as far as possible. Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.			
		3.4	Safety Hazards	• Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. • Project drivers will be trained on defensive driving. • Vehicle speeds near / within the communities will be kept low, to avoid safety hazard and dust emissions.	Contractors	ESM	BC; AC
		3.5	Damage to Infrastructure	• All damaged infrastructure will be restored to original or better condition.	Contractors	ESM/ESI	DC; AC
		3.6	Damage to Crops	• Operation of project vehicles outside the RoW will be avoided. Attempts will be made to use existing tracks/roads to access the transmission line	Contractors	ESM/ESI	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				corridor/tower locations. In case new access routes are necessary, the cultivated land will be avoided as far as possible. Damage to crops will be compensated			
		3.7	Damage to Irrigation Network	• Operation of project vehicles will be avoided close to the canals and water courses. • Any damage caused by the project activities will be completely repaired.	Contractors	ESM/ESI	DC
		3.8	Gender Issues	• The routes used by the women will be avoided as far as possible. If unavoidable, alternate routes to be identified for the communities, if required, especially along routes frequented by women, such as route to the local well or water source. • Strict code of conduct will be maintained by the construction crew. Local norms will be respected.	Contractors	ESM/ESI	DC
4	Construction Camp Establishment and Operation	4.1	Soil Erosion / Contamination	• The construction camps will preferably be established in the nearby grid stations. • Photographs will be taken to record the site conditions prior to the	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				establishment of the camp. • Construction camp will be located in a stable and flat area, requiring minimal devegetation and leveling. ESI's approval will be obtained for camp location. • Land clearing, leveling and grading will be minimized, and carried out in a manner to minimize soil erosion. • Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles close to the water channels, water reservoirs will be minimized. • Contractors will prepare a waste disposal plan and submit to ESI for his approval. • For the domestic sewage, appropriate treatment and disposal system will be constructed having adequate capacity. • Waste oils will be collected in drums and sold to the recycling contractors. • The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				waste will be kept separate and handled according to the nature of the waste. • Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. • The camp sites will be completely restored after the completion of the construction works. All temporary structures will be demolished, land leveled and re-contoured to the original condition or better. All debris and any other material will be removed from the site. The photographs taken prior to the camp establishment will be used to restore the area.			
		4.2	Air Quality Deterioration	• Construction camps, if located outside the grid stations, will be established about 500 m from communities. • Generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. • Fugitive dust emissions will be minimized by appropriate methods,	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				such as spraying water on soil, where required and appropriate. Waste water from kitchen and washing area of the construction camp may be used for water spraying. • Project vehicles will avoid passing through communities, farms and orchards. If unavoidable, max speed of 15 km/h will be observed to avoid excessive dust emissions.			
		4.3	Surface Water Contamination	• For the domestic sewage, appropriate treatment and disposal system will be constructed having adequate capacity. Waste oils will be collected in drums and sold to the recycling contractors. • The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous waste will be kept separate and handled according to the nature of the waste. • Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination.	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		4.4	Water Consumption	• Water will be obtained from the source approved by the ESI. • Astute planning will be employed to conserve water at the construction sites and camp. Water will be procured in a manner that least affects the local communities. Waste water recycling will be carried out for sprinkling and gardening purposes.	Contractors	Environmental and Social Inspector (ESI)	DC
		4.5	Loss of Vegetation	• Clearing natural vegetation will be avoided as far as possible. • The camp will be established in a natural clearing, outside forested areas. • Complete record will be maintained for any tree cutting. • The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.	ESM	ESI	BC; DC
		4.6	Noise	• Generators and vehicles will have exhaust mufflers (silencers) to minimize noise generation. The noise levels measured at the camp periphery will meet the WB standards.	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		4.7	Safety Hazards	• Protective fencing to be installed around the Camp to avoid any accidents. • Firefighting equipment will be made available at the camps. • The camp staff will be provided fire fighting training. • All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.	Contractors	ESM	BC; DC
		4.8	Public Health	• Camps will be at least 500 m from any groundwater wells used by the community. • The construction camps and site offices will have first-aid kits. • The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).	Contractors	ESM	BC; DC
		4.9	Social and Gender Issues	• Construction crew will avoid entering the villages and settlements. • No child labor will be employed.	ESM	ESI	BC DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
5	Transportation of Equipment and Construction Materials	5.1	Soil Erosion and Contamination; Water Contamination	• Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water channels, water reservoir will be minimized. • Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	ESM	DC
		5.2	Air Quality Deterioration	• The project vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. The vehicle exhaust will comply with the NEQS (**Exhibit 2.3**). • Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. • Project vehicles will avoid passing through the communities, farms and orchards as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions.	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		5.3	Noise	• Vehicles will have exhaust mufflers (silencers) to minimize noise generation. The vehicle noise will comply with the relevant NEQS. • Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable. • Vehicular traffic through the communities will be avoided as far as possible. Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities. • The noise levels will comply with the WB standards.	Contractors	ESM	BC; DC
		5.4	Safety Hazards	• Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. • Project drivers will be trained on defensive driving. • Vehicle speeds near / within the communities will be kept low, to avoid safety hazard and dust emissions.	Contractors	ESM	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		5.5	Damage to Infrastructure	• All damaged infrastructure will be restored to original or better condition.	Contractors	ESM	BC; DC
6	Grid Station Construction	6.1	Land Acquisition	• Land for the grid stations will be acquired in accordance with the LAA, on the basis of *willing seller – willing buyer*. The prices will be mutually agreed based upon market rates, and the land owner will have the option to refuse to sell the land. (Section 17.4 of the LAA will not be used.) • The entire land acquisition process will be properly documented. • Grievance redressal mechanism will be put in place to address the community complaints.	GSC Department	ESI	BC
		6.2	Loss of Agriculture	• The land price will include any existing crops at the time of the agreement. • Compensation will also be paid for damaged crops, if any, outside the acquired land. • Complete record will be maintained for the compensation determination and payment.	GSC Department	ESI	BC; DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		6.3	Blocked Access	• In case of the blockage of the existing routes, alternate routes will be identified in consultation with affected communities.	Contractor	ESM	BC; DC
		6.4	Noise and Vibration	• It will be ensured that the noise levels measured at the communities near the project sites (identified in **Exhibits 4.17** to **4.23**) are kept within the acceptable limits (70 dB(A) for industrial zones day and night; 45 dB(A) night and 55 dB(A) daytime for residential areas). • Noise levels will be measured at the key locations described above. If the noise levels are found to be more than the prescribed limits, appropriate measures will be undertaken by the construction team such as rescheduling the works, using quieter equipment and/or erecting barriers to protect the communities from excessive noise. • Working hours for construction activities within the communities will be limited to between 8 am and 6 pm.	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		6.5	Safety Hazards	• The construction sites will have protective fencing to avoid any unauthorized entry. • Before commencing the testing commissioning of the system, the nearby communities will be informed. Protective fencing will be used where appropriate/possible.	Contractor	ESM	DC
		6.6	Damage to Infrastructure, including Irrigation Network.	• All damaged infrastructure will be restored to original or better condition.	Contractor	ESM	DC
		6.7	Gender Issues	• Bypass routes will be identified, if required, especially those frequented by women folk, such as route to the local well or water source.	GSC Department	ESI	BC; DC
		6.8	Social Issues	• Construction crew will avoid entering villages and settlements. • Local social norms and practices will be respected. • No child labor will be employed at sites.	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		6.9	Sites of Historical, Cultural, Archeological or Religious Significance	• In case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.	GSC Department	ESI	BC; DC
		6.10	Soil Erosion	• Cut and fill at the proposed grid station site will be carefully designed, and ideally should balance each other. The surplus soil, if any, will be disposed at places approved by ESI. Such sites will be selected after surveying the area and ensuring that soil deposition will not have any significant impacts, such as loss of productive land, blocked access, natural vegetation and disturbance to drainage. • If necessary, fill material for grid station sites will be obtained from appropriate locations approved by ESI. Such locations will be selected after surveying the area and ensuring that soil extraction will not have any	Contractors	ESM; ESI	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				significant impacts, such as soil erosion, loss of natural vegetation and disturbance to drainage. • The fill material will not be obtained from any cultivation fields, unless allowed by the landowner/cultivator. • Where the use of cultivated land is unavoidable for obtaining the fill material, the top 30 cm soil layer will be removed and stockpiled for redressing the land after removal of the borrow material. The excavation in such areas will be limited to 50 cm depth. • Areas from where the fill material is obtained or surplus soil deposited, will be landscaped to minimize erosion and hazard for people and livestock. • Embankments and excavated slopes will not be left untreated/unattended for long durations. • After the completion of the construction works, campsites and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind.			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• Photographic record will be maintained for pre-project, during-construction and post-construction condition of the sites.			
		6.11	Soil Contamination; Water Contamination	• Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination. • For the domestic sewage, appropriate treatment and disposal system, such as septic tanks and soaking pits, will be constructed having adequate capacity. The contractor(s) will submit to ESI the plans for the camp layout and waste disposal system, and obtain approval. • Waste oils will be collected in drums and sold to the recycling contractors. • The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous waste will be kept separate and handled according to the nature of the waste. • Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil	Contractors	ESM, ESI	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				contamination. The waste disposal plan submitted by the contractor(s) will also address the solid waste. • Leaked oil collection arrangement (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the grid stations.			
		6.12	Air Quality Deterioration	• Ambient air quality measurements will be carried out at the key project sites (particularly the new grid station locations). • Construction machinery, generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. • Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. Since water availability is an issue in some of the areas, it is recommended that the waste water from kitchen and washing area of the construction camp may be used for water spraying.	Contractors	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• While working within the communities for works such as transmission line laying, coordination with the communities will be maintained to minimize any detrimental impacts on the crops and settlements.			
		6.13	Aesthetic Value	• Tree plantation will be carried inside and at the periphery of the grid stations, without compromising the safety aspects (ie, required clearances will be maintained). For this purpose, provisions will be made in the site layout of the grid stations.	GSC Department	ESI	AC
7	Construction of Transmission Lines	7.1	Loss of Agriculture	• Temporary RoW will be used along the proposed transmission lines, and for access routes to the transmission line corridor. • Compensation will be paid for the crops damaged as a result of the construction activities. The compensation will be paid to the cultivator, and absence of the land title will not be a bar to receiving the compensation. The **Resettlement Plan** (provided under separate cover) presents detailed procedure for the compensation	GSC Department	ESI	BC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				determination and payment. • Complete record will be maintained for the determination and payment of the compensation. • The orchards will be avoided as far as possible while aligning the transmission lines. If unavoidable, no vehicular movement will be allowed inside any orchards, no fruit trees will be cut inside the orchards, and transmission lines will be aligned through the existing gaps between the trees. • It will be ensured that the land under the transmission line towers remains available for cultivation. • In case the above is not possible, the land under the tower will be acquired in accordance with the LAA procedures (Section 17.4 of the LAA will not be used). • Operation of project vehicles and construction machinery outside the RoW will be avoided. Attempts will be made to use existing tracks/roads to access the transmission line corridor/tower locations. In case new			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				access routes are necessary, the cultivated land will be avoided as far as possible. Damage to crops will be compensated. • Grievance redressal mechanism will be put in place to address the community complaints.			
		7.2	Damage to irrigation network	• Operation of construction machinery or project vehicles near the water courses/canals will be avoided. • All damages to the water courses or canals caused by the project activities will be completely repaired.	Contractor	ESM	DC
		7.3	Blocked Access	• In case of the blockage of the existing routes, alternate routes will be identified in consultation with affected communities.	Contractor	ESM	BC; DC
		7.4	Noise and Vibration	• It will be ensured that the noise levels measured at the communities near the project sites (identified in **Exhibits 4.17** to **4.23**) are kept within the acceptable limits (70 dB(A) for industrial zones day and night; 45 dB(A) night and 55 dB(A) daytime for residential areas). • Noise levels will be measured at the	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				key locations described above. If the noise levels are found to be more than the prescribed limits, appropriate measures will be undertaken by the construction team such as rescheduling the works, using quieter equipment and/or erecting barriers to protect the communities from excessive noise. • Vehicular traffic through the communities will be avoided as far as possible. Project routes will be authorized by ESI. • Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities. • Vehicles will have exhaust silencers to minimize noise generation. • Nighttime traffic will be avoided near the communities. • Movement of all project vehicles and personnel will be restricted to within work areas, to avoid noise disturbance. • Working hours for construction activities within the communities will be limited to between 8 am and 6 pm.			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		7.5	Safety Hazards	• The communities near the transmission line routes will be informed about the construction activities. Protective fencing will be installed where required. • Before commencing the testing commissioning of the system, the nearby communities will be informed. Protective fencing will be used where appropriate/possible. • For the Humayun – Jacobabad transmission line works near the Jacobabad grid station, the GSC/contractor will prepare a work plan, highlighting the safety measures for the settlements under the transmission line. The plan will be submitted to HESCO for approval. No works will be commenced before the approval. • For the above segment of the transmission line, a safety wire net will be fixed below the transmission line wires to protect the houses below. • The height of the transmission line will be increased for the above segment of the transmission line.	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• HESCO will carry out electricity network improvement activities in the above settlement, in order create goodwill and to reduce the community grievances related to the proposed transmission line being routed over their houses.			
		7.6	Damage to Infrastructure	• All damaged infrastructure will be restored to original or better condition.	Contractor	ESM	DC
		7.7	Gender Issues	• Bypass routes to be identified, if required, especially along routes frequented by women, such as route to the local well or water source.	GSC Department	ESI	BC; DC
		7.8	Social Issues	• Construction crew will avoid entering villages and settlements. • No chills labor will be employed at the project sites.	Contractor	ESM	DC
		7.9	Sites of Historical, Cultural, Archeological or Religious Significance	• Extreme care will be employed while working through the graveyards that exist on the transmission line routes. No graves will be damaged. Construction activities will be carried out after consultation with the nearby/relevant community.	Contractor	ESM	DC
				• In case of discovery of any sites or artifacts of historical, cultural,	GSC Department	ESI	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.			
		7.10	Soil Erosion	• Embankments and excavated slopes will not be left untreated/unattended for long durations. • Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water bodies will be minimized. • After the completion of the construction works, the transmission line routes and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind. • Photographic record will be maintained for pre-project, during-construction and post-construction condition of the sites.	Contractor	ESM	DC
		7.11	Soil and Water	• Vehicles and equipment will not be repaired in the field. If unavoidable,	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
			Contamination	impervious sheathing will be used to avoid soil and water contamination.			
		7.12	Air Quality Deterioration	• Construction machinery, generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. • Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. • Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions. • While working within the communities for works such as transmission line laying, coordination with the communities will be maintained to minimize any detrimental impacts on the crops and settlements.	Contractor	ESM	DC
		7.13	Loss of Natural Vegetation	• Clearing of natural vegetation will be minimized as far as possible during the transmission line works.	Contractor	ESM	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				• Herbicides will not be used to clear vegetation along the transmission line route (or at other project locations). • For each transmission line route, a tree cutting plan will be prepared and submitted to HESCO for approval. A complete record will be maintained for any tree cutting or trimming. The record will include: the number, species, type, size, age, condition and photograph of the trees to be cut/trimmed. • The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed. • Tree plantation plan will be developed and implemented at each of the grid stations included in the proposed project. Provisions will be made for tree plantation while designing the layout of the grid stations. Indigenous tree species will be selected for plantation; Eucalyptus trees will not be used.			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		7.14	Damage to Wildlife	• Garbage will not be left in the open. The project staff will not indulge in any hunting or trapping activities. • A separate EA will be carried out in case any project component is located inside protected areas.	Contractor	ESM	DC
8	Miscellaneous	8.1	Public grievances	• The communities near the project sites that currently do not have access to the electricity network, will be provided electric connections.	HESCO	ESM	DC
9	Operation and Maintenance Activities	9.1	Safety hazards	• HESCO's O&M staff will be provided essential protective gears and equipment. • HESCO's O&M staff will be provided safety training. Refresher courses will be arranged on regular basis. • Firefighting equipment will be made available at the grid stations. • The Emergency Response Plan (ERP), prepared by HESCO, will be made available at each grid station. Its salient points will be displayed at prominent places within each grid station. The O&M staff will be given training on the ERP. The ESC will review the ERP	GSO	ESC	During Operation and Maintenance (O&M)

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				with respect to environmental/ social considerations, and recommend changes if needed. ERP will include procedure to inform the communities in case of fire in the grid stations. • The communities near the grid stations and transmission lines will be educated on the risk of electrocution, and how to avoid accidents. • Appropriate signage on safety precautions will be installed at the key locations. • The trees under the transmission lines will be regularly trimmed in order to maintain 8 m clearance. • For the last segment of Humayun – Jacobabad transmission line which passes over the congested settlement, the wire net will be maintained to protect the people living directly below the transmission line.			
		9.2	Loss of agriculture	• Damage to the crops will be avoided during the transmission line patrolling. • Any damage during repair the repair and maintenance activities will be	GSO	ESC	During O&M

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				compensated. • Liaison with the nearby communities will be maintained in this regard. • The grievance redressal mechanism will be maintained on continuous basis.			
		9.3	Noise emissions	• Noise measurements will be carried out at the outer fence of the grid stations, in order to ensure that the noise levels are within acceptable limits. If found beyond these limits at any stage, appropriate measures will be taken, such replacing the noisy equipment, and/or erecting noise barrier along the grid station outer periphery. • Liaison with the nearby communities will be maintained in this regard.	GSO	ESC	During O&M
		9.4	Soil and water contamination	• The grid stations will have appropriate solid waste collection and disposal arrangements. • The grid stations will have appropriate sewage handling system. The grid stations' sewage collection system will be connected to the Municipality operated sewerage system, if available. Otherwise, grid stations will have their	GSO	ESC	During O&M

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				own septic tanks and soakage pits. • Waste oils and chemicals will be disposed in accordance with their respective Material Safety Data Sheet (MSDS). MSDS will be made available at the grid stations and maintenance workshops. • Non-toxic recyclable waste will be given away for recycling. • Toxic waste will be stored separately, and incinerated at an appropriate double chamber incinerator. • Grid stations will have channels and drainage pits to collect any leaked oil from the transformers in the grid stations. This oil will be sent back to the workshop for recycling. • Any soil contaminated by the oil/chemical spillage will be removed and disposed off appropriately in accordance with the MSDS of the spilled oil/chemical.			

ESI: Environmental and Social Inspector;
ESM: Environment and Social Monitor;
PM: Project Manager;
GSC: Grid Station Construction (department);
BC: Before Construction;
DC: During Construction;
AC: After Construction;
GSO: Grid Station Operation (department).

Exhibit 10.4: Effects Monitoring Plan for Construction Period

No.	Monitoring Parameter	Monitoring Locations	Frequency [a]	Responsibility	Resource Requirement	Documentation
1	Visual observation of soil erosion	Construction sites, campsites	During routine monitoring	ESI	-	Record of observations; Photographs.
2	Water quality	At wells and surface waetr bodies near grid station and construction campsites	Before mobilization	Contractor/ESM	Sampling bottles	Complete record of sampling and analyses.
		Selected local wells	Monthly	Contractor/ESM	Sampling bottles	Complete record of sampling and analyses.
		Selected locations at nearby surface water bodies	Monthly	Contractor/ESM	Sampling bottles	Complete record of sampling and analyses.
4	Water consumption	Construction sites, campsite	Daily	Contractor/ESM	-	Complete record
5	Visual checks for any damage to water course, groundwater wells	Construction sites	During routine monitoring	ESI	-	Record of observations; Photographs.
6	Ambient air quality	Construction sites, camp sites	Before mobilization	Contractor/ESM	Ambient air quality monitoring equipment	Complete record of sampling and analyses.
		Construction sites, camp sites	Once every two months	Contractor/ESM	Ambient air quality monitoring equipment	Complete record of sampling and analyses.
7	Visual checks for exhaust emissions	Construction sites, camp site	During routine monitoring	Contractor/ESM	-	Record of observations; Photographs.
	Visual checks for dust emissions	Construction sites, camp site, project roads	During routine monitoring	Contractor/ESM	-	Record of observations; Photographs.

...Cont'd. **Exhibit 10.4.**

No.	Monitoring Parameter	Monitoring Locations	Frequency [a]	Responsibility	Resource Requirement	Documentation
8	Noise	At nearby communities	Fortnightly or during the construction activities causing noise.	Contractor/ESM	Noise meter	Complete record of noise measurements, locations, etc.
9	Public Grievances	At nearby communities	Throughout the field activities.	ESI	Social Complaint Register	Complete record to be maintained in the form of the Social Complaint Register.

[a] Frequency may be adjusted in the field according to the situation and results of the monitoring.

Exhibit 10.5: Grievance Redressal Mechanism

Stage	*Action*	*Action By*	*By When*	*Monitoring By*	*Notes*
Mobilization at site	Placement of Social Complaint Register (SCR) at the site office	ESM	At the time of site mobilization.	ESI	The SCR will have separate columns for: i) date of complaint; ii) description of complaint; iii) particulars of complainant; iv) details of action required/decided; v) person(s) responsible to take action; vi) person(s) responsible to monitor the action; vii) details of action taken (when, by whom, where); viii) comments of the complainant after the action taken. A separate SCR will be placed at each grid station included in the proposed project, and any other project site offices.
Complaint raised by any complainant	The complaint is recorded in the SCR.	ESM	-	ESI	The relevant columns of the SCR are filled.
Identification of remedial action	A meeting is held between ESM and ESI, and if required with PM and Site Incharge. The redial action is identified. The PD and ESC are informed regarding the grievance and the remedial action identified.	ESI	Within 2 days of the new complaint.	ESC	The relevant columns of the SCR are filled.
Implementation of remedial action	The remedial action is implemented	Contractors or HESCO, depending upon the nature of the remedial measure	To be decided for each remedial action.	ESI	The relevant columns of the SCR are filled.
Feed back to the complainant	Information is provided to the complainant regarding the remedial action taken. The comments/observations of the complainant are obtained and documented.	ESM	Within 1 week of the action taken.	ESI	The relevant columns of the SCR are filled.

...Cont'd. **Exhibit 10.5.**

Stage	*Action*	*Action By*	*By When*	*Monitoring By*	*Notes*
Fortnightly site meetings	The SCR will be discussed.	ESI	Fortnightly.	PM	The discussion will be documented in the minutes of meeting.
On monthly basis	The summary of SCR will be sent to PD and ESC.	ESI	Monthly.	PM	-

Exhibit 10.6: Environmental and Social Trainings

Contents	Participants	Responsibility	Schedule
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the ESA; Mitigation measures; ESMP; Social and cultural values of the area.	Design team; Selected HESCO management staff	ESC	Prior to the start of the project activities. (To be repeated as needed.)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Awareness of transmissible diseases Social and cultural values.	All site personnel	ESI and ESM	Prior to the start of the field activities. (To be repeated as needed.)
ESMP; Waste disposal	Construction crew	ESM	Prior to the start of the construction activities. (To be repeated as needed.)
Road safety; Defensive driving; Waste disposal; Cultural values and social sensitivity.	Drivers	ESM	Before and during the field operations. (To be repeated as needed.)
Camp operation; Waste disposal; Natural resource conservation; Housekeeping.	Camp staff	ESM	Before and during the field operations. (To be repeated as needed.)
Restoration requirements; Waste disposal	Restoration teams	ESM	Before the start of the restoration activities.

Exhibit 10.7: Cost of Environmental and Social Management

	Description	Cost (Pak Rs.)	Basis
1	Environmental and Social Personnel		
	ESI (3)	2,160,000	18 months × 40,000 PM [a]
	ESM (6)	0	To be included in the Contractor's cost
2	Environmental and Social Monitoring	45,000	Initial water analysis to determine baseline conditions (9 locations; 5,000 per sample).
		810,000	9 water samples per month; Rs. 5,000 per sample; 18 months. [b]
		80,000	Initial air quality analysis to determine baseline conditions (4 locations; 20,000 per location)
		480,000	4 air quality analysis every three months; 20,000 per analysis; 18 months. [b, c]
3	External Monitoring	840,000	3 × 1-day visits; 4 locations (GS): (12 days). 3 × 2 day visits; 5 TL locations (30 days). 42 days × !0,000 per day × 2 experts
4	Environmental and Social Trainings	440,000	11 training sessions × one-day duration; Rs 40,000 per training. [d]
5	Tree Plantation	100,000	About 500 trees to be planted at the grid stations.
6	Development of PCBs Elimination Plan	520,000	26 days × 20,000 per day.
7	Crop/tree compensation	7,470,492	See **Section E.2 of Appendix E** for details.
8	Cost of land for new grid stations	0	The cost of land is Rs. 1,242,180 for the new grid stations, and is already included in the proejct cost.
9	Miscellaneous Expenses	500,000	Lump sum
10	Contingencies	403,365	3 % of the above
	Total	**13,848,857**	

[a] The duration of the proposed project has been assumed as 18 months.

[b] Frequency of analysis may be adjusted by ESI on the basis of the previous results or sensitivity of area.

[c] Parameters for air quality monitoring to be determined by ESI, depending upon the area sensitivity/expected pollutants.

[d] Frequency of the trainings may be altered per the requirements.

11 Conclusions and Recommendations

This ESA has been conducted in line with the relevant guidelines of the WB and GoP. The objective of the ESA is to identify and assess the potential environmental and social impacts of the HESCO's proposed 6th STG project (2006-07). The ESA also includes public consultation with the institutional as well as grass root stakeholders, in order to apprise them of the project activities and to obtain their views and concerns.

This Chapter presents the conclusions of the key findings and recommendations for further actions.

11.1 Conclusions

The major conclusions of the ESA are:

- For the electricity transmission and grid station projects such as the 6th STG, environmental and social impacts are experienced primarily during the construction phase. The operation phase will have mostly insignificant impacts on the social, physical and biological environment of the area. This has been confirmed during the environmental and social assessment as part of this ESA. Furthermore, some of the impacts can be forestalled at the design stage as well.
- The potential impacts during the construction phase of the proposed project include land acquisition (resulting in loss of assets and/or loss of livelihood), loss of agriculture, damage to the irrigation network, soil erosion and contamination, water contamination, deterioration of ambient air quality caused by exhaust emissions and kicked-up dust, noise pollution, damaged infrastructure, safety hazards and public health concerns for the nearby communities.
- The key environmental and social management issues during the operation phase of the proposed project include waste disposal at the grid stations, safety hazards for the HESCO staff as well as the nearby communities, and loss of agriculture caused during the transmission line maintenance activities.
- All the recommended mitigation measures are contained in the ESMP, which will need to be made part of the construction contract(s). The ESMP provides the organization structure for the environmental and social management system during the project implementation, and defines roles and responsibilities of various role players. The ESMP includes a mitigation plan, which precisely defines the mitigation actions, executing persons, monitoring persons and timing of these actions. An environmental and social monitoring plan is also included in the ESMP, in addition to communication and documentation requirements, and training needs, in the context of environmental and social management.
- An RP has also been developed to provide framework and procedure to address the involuntary resettlement issues and to guide through the compensation assessment

and disbursement process during the proposed project. (The RP is provided under a separate cover.) The RP will also be made part of the construction contracts.

- The mitigation measures proposed in this ESA adequately address all the concerns raised by the stakeholders, as summarized in **Exhibit 11.1**.
- Based on the recommended mitigation measures provided in **Chapters 8** and **9**, the impacts identified in **Exhibit 8.1** will be sufficiently mitigated, and the residual impacts are expected to be within the acceptable limits. **Exhibit 11.2** presents the assessment of the residual impacts.
- On the basis of the overall impact assessment, more specifically, nature and magnitude of the residual environmental and socioeconomic impacts identified during the present ESA, it is concluded that the proposed project is unlikely to cause any significant, lasting impact on the social, physical and biological environment of the area, provided that the proposed activities are carried out as mentioned in this report, and the mitigation measures included in this report are completely and effectively implemented.

11.2 Recommendations

On the basis of the environmental and social impact assessment discussed in **Chapters 8** and **9**, and the conclusions provided in **Section 11.1** above, it is recommended that:

- The ESMP should be made a part of the contracts awarded by HESCO for the proposed project.
- The Company should follow the RP for addressing the involuntary resettlement issues (primarily pertaining to crops damaged as a result of construction activities), and to compensate the project affected persons (PAPs).
- HESCO will not purchase transformers having PCB-containing oil. However, old transformers in the HESCO system may still have PCB-containing oil. Therefore, a program should be developed to eliminate the PCB-containing transformer oil from its entire system. To start with, the grid stations and workshops should be provided with the PCB testing kits.
- In-house environmental and social management capacity should be developed in HESCO. For this purpose, an Environmental and Social Cell should be established within the company.
- HESCO should develop its Environmental and Social Policy, which should demonstrate the company's commitment towards sound environmental and social management practices throughout its operations.
- The company should adhere to the environmental legislation and regulations, particularly for conducting environmental and social assessments for all its future projects.
- HESCO and its contractors should employ local labor as much as possible.

- HESCO should ensure that the communities near the project sites, that currently do not have access to electric supply, will be provided electric connections.

Exhibit 11.1: Summary of Concern Raised by Stakeholders and their Mitigation

Concerns / Recommendations	Mitigation Measures
Land acquisition issues.	See **Sections 9.2** and **9.3.1**.
Possibility of soil and water contamination caused by the PCB-containing transformer oil.	See **Sections 8.2** and **8.4.1**.
Construction-related issues, such as waste disposal, soil erosion and hazard for communities.	See **Sections 8.3.1, 9.3.5** and **9.4.1**.
Effects of electromagnetic radiation caused by the high power transmission lines.	See **Sections 9.2** and **9.4**.
Safety hazards for people caused by the transmission lines	See **Sections 9.2, 9.3.5** and **9.4.1**.
Possibility of transmission line passing over the settlements	See **Sections 9.2, 9.3.5** and **9.4**.
HESCO should conduct environmental assessment of all of its projects.	See **Section 11.2**.
HESCO should develop organizational capacity for managing the environmental issues during its operations.	See **Section 10.3.1**.
Development of PCB elimination program.	See **Section 8.4.1**.
HESCO should take all safety precautions to minimize safety hazards associated with the transmission lines	See **Sections 9.2, 9.3.5** and **9.4.1**.
Payment of full compensation for the cost of land/damaged crops.	See **Section 9.3.1**.
Low height of the transmission line (Humayun – Jacobabad) thus causing safety hazard, and not allowing the residents to construct taller buildings/install antenna, etc.	See Section **9.3.5**.
HESCO should provide employment opportunities to the local population near the project sites.	See **Section 11.2**.
HESCO should ensure community participation during all phases of the project.	See **Sections 7.2** and **10.6.3**.
HESCO should ensure electric supply to the communities near the project sites.	See **Section 11.2**.

Exhibit 11.2: Environmental Screening Matrix (Mitigated)

	Physical					*Biological*		*Social and Socioeconomic*											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Design Phase																			
Site Selection for Grid Stations	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	N	0	0	0	0
Route Selection for Transmission Lines	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	N	0	0	0	0
Design of Grid Station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	0
Equipment Selection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0	0	0
Construction Phase-Grid Stations																			
Land Acquisition	N	N	N	N	N	N	N	0	N	0	0	0	-1	N	N	N	N	N	N
Mobilization of Contractors	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Construction Camp Establishment	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Construction Camp Operation	0	0	0	0	-1	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Transportation of Construction Materials and Supplies	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Excavation for Foundations	-1	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Construction Works	-1	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Equipment Installation	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0

...Contd. **Exhibit 11.2.**

	Physical					*Biological*		*Social and Socioeconomic*											
	Soil Erosion / Contamination	*Air Quality*	*Surface Water Quality*	*Groundwater Quality*	*Water Availability and Consumption*	*Natural Vegetation*	*Wildlife*	*Blocked Access Routes*	*Noise and Vibration*	*Impacts on Agriculture*	*Impacts on Irrigation Network*	*Livestock Grazing*	*Compensation Issues*	*Safety Hazard*	*Infrastructure*	*Public Health and Nuisance*	*Aesthetic Value*	*Cultural Issues*	*Gender Issues*
Construction Phase-Transmission Lines																			
Land Acquisition	N	N	N	N	N	N	N	0	N	0	0	0	-1	N	N	N	N	N	N
Mobilization of Contractors	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Construction Camp Establishment	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Construction Camp Operation	0	0	0	0	-1	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Transportation of Construction Materials	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Excavation for Foundations	-1	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Construction of Foundations	-1	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Erection of Towers / Poles	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Stringing	0	-1	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0
Testing and Commissioning	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
Contractor Demobilization	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	-1
Operation and Maintenance Phase																			
Grid Station O&M	0	0	0	0	-1	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
Transmission Line O&M	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0

Key: -2: High negative impact; -1: Low negative impact; 0: insignificant/negligible impact; +1: low positive impact; +2: High positive impact, N: no impact.

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