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PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY

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GHAZI- BAROTHA HYDRO POWER PROJECT

500 KV TRANSMISSION LINES SYSTEM

SUPPLEMENTARY REPORT ON ENVIRONMENTAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN-II

FINAL REPORT

MAY 2000

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Vol 5

NATIONAL TRANSMISSION AND DESPATCH COMPANY LTD

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DATED: 01-07-2000.

THE WORLD BANK ISLAMABAD (Social Development Team) 03 JUL 2000 RECEIVED

Ms. Zia Al-Jalaly,
Resettlement Specialist,
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ISLAMABAD

SUBJECT:- **Transmission Arrangements For Power Dispersal of Ghazi Barotha Hydro Power Project Final Report on Environmental Impact Assessment (EIA) And Resettlement Action Plan (RAP-II)**

This is in continuation of our letter No.6744-52/CE/EHV/N/NTDC/GBP-1(A) Dated June 05, 2000, please find enclosed two copies of the final report on Environmental Impact Assessment (EIA) and Resettlement Action Plan(RAP-II) for further necessary action.

THE WORLD BANK ISLAMABAD 03 JUL 2000 RECEIVED

Yours truly,

01.07.2000

(AZIZ-UR-RAHMAN)
CHIEF ENGINEER(EHV)"N"NTDC
LAHORE

CC:-

1. Member (Water) Wapda House, Lahore, Attn:G.M(D&C).
2. Member (Power) Wapda House, Lahore.
3. Chief Executive(NTDC) 414-Wapda House, Lahore.
4. G.M&PD (Ghazi Barotha Hydropower Project) Power Channel Village Post Office Hattian, G.T.Road, Attock alongwith a copy of subject report.
5. G.M(T&G) NTDC, Wapda House, Lahore.
6. Chief Executive / Construction Manager, Pakistan Hydro Consultants 22-A, E-2, Gulberg-III, Lahore.
7. M/s. NESPAK, NESPAK House, 1-C, N-Block, Model Town Extn: Lahore, Attn:- Mr. Tariq Shah, Project Manager.
8. P.D 500KV(EHV) North, NTDC, GSC House, Lahore.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1. INTRODUCTION

This report deals with the studies on the Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP-II) for the power dispersal system from Ghazi-Barotha Hydropower Project (GBHP). The present report is a supplemental to the previous EIA and RAP reports prepared for GBHP. Therefore, the policies for environmental mitigation and resettlement adopted for this report generally follows the ones that were framed for the main project.

2. THE PROJECT

Ghazi-Barotha Hydropower Project will have a power generation installed capacity of 1450 MW with an average annual energy output of 6,600 GWh. The Government of Pakistan has planned the dispersal of the power generated by GBHP through WAPDA's existing network Of the total power dispersal and augmentation programme, the scope of present study is limited to the following three sets of lines of the system.

1. Two 500 kV Circuits from Barotha Switchyard to Rewat Grid Station.
2. Two 500 kV Tarbela-Barotha (I & II) Incoming Lines.
3. Two 500 kV Barotha-Gatti (I & II) Outgoing Lines

The proposed power transmission system is schematically shown in Drawing 1-1. The whole stretch of the transmission lines covered in the present study fall in the Province of Punjab To keep the environmental impacts at a minimum level, the transmission lines will be placed on double circuit towers except where there will be a concern regarding the reliability of towers. As such, the total stretch of transmission lines under study is about 235 kilometers with a span of about 11m to 28 m between the conductors. However, for safety reasons a 50-m wide corridor has been considered.

3. ENVIRONMENTAL AND RESETTLEMENT REQUIREMENTS

In consideration of its effects, the Project falls in Category "A" with respect to project screening classification of the World Bank. To keep this component of GBHP in line with the main Project, a comprehensive environmental and resettlement study has been carried out.

The Project falls under the purview of two sets of official environmental and resettlement regulations. These include the ones established by the Government of Pakistan / Government of Punjab and the international donor agencies. For the present Project, financing is being arranged from Asian Development Bank (ADB) and Islamic Development Bank (IDB). Therefore, the regulations of this agency are applicable. However, the regulations of ADB are similar to that the World Bank. Therefore, to keep this component of GBHP in line with the main Project, the regulations set by the World Bank have been followed.

4. APPROACH ADOPTED FOR THE STUDY

The Project was planned and designed by M/s National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK). It is a normal practice of WAPDA that the routes of the high-tension transmission lines, particularly that of 500 kV lines, are so selected that the disruption to the settlements and ecological settings of the Project area is minimised. For the purpose, different routes were considered to select an environment friendly route. However, a separate study has been carried out to further screen the Project for environmental and resettlement considerations and prepare comprehensive EIA and RAP-II. The study has been carried out in line with the guidelines issued by the GOP and the World Bank. This includes comprehensive surveys, and scoping sessions with local communities, government officials and knowledgeable persons.

5. BASELINE CONDITIONS OF THE PROJECT AREA

Population and Settlement Pattern

Three sets of the transmission lines will traverse through two tehsils (Attock and Fatehjang Subdivisions) of District Attock and one tehsil (Rawalpindi Subdivision) of District Rawalpindi. These will pass through the land areas of 54 villages. Of these, 15 villages fall in Tehsil Attock, 19 in Tehsil Fatehjang and 20 in Tehsil Rawalpindi.

Besides main settlements of villages, there are quite large number of out-reach habitations spread over the vast land areas of the villages. These out-reach settlements comprise a single abode or a cluster of tens of houses. With a few exceptions, the alignments of the transmission lines generally avoid main settlements of the villages. However, about 87 small settlements (Dhoks) fall within a reach of about one-kilometer of the proposed alignment of the transmission lines. Of these, 36 settlements were surveyed to study the socioeconomic and cultural setup of the Project area.

In spite of belonging to different castes, viz., Awan, Syed, Pathan, Rajput etc., the majority of the households are attached with the agriculture. Of the total adult male population, 70% are agriculturists, 16% are in government service (mostly in army) and 8% in private service, and 5% are labourers or unemployed. About 1% people are in business, running shops in the villages.

It has been reported that there are about 2,000 unemployed persons in the surveyed settlements. These include grown up children that do not go to school and the adults who are partly engaged in agriculture business because of small landholding. Of these, about 23% have some skill. The skills include driving, welding, carpentry, ironmonger, etc.

The female survey has indicated that only 30% women are just housewives and do not contribute in the family earnings. Of the remaining, about 49% women are though housewives they take active part in the farming activities. Either they assist the male members or run the agricultural or poultry farms independently. About 14% women have adopted handicraft manufacturing for supplementing their husbands' income. The remaining 7% are in other professions, like teachers, Health Visitors, Midwifery (Daia), etc.

Education level in the Project area is rather low. Of the adult population, the literacy rate is 40% for male members and 20% for female members. Of the literate population, the level of education is mostly below matriculation. The trend of higher education, particularly in female population, is low. This is because of low income of the population and non-availability of institutions of higher education in the area.

Health services are almost non-existing in the settlements surveyed. Of the 36 settlements, only two places have Basic Health Units. There is only one main village, Bahtar, where a hospital is also available. Even traditional medical practitioners, like Hakim, LHVs/midwives, Dispensers, etc. are scarce. The people are mostly dependent on charms and blessings (Taweez/Dhaga) obtained from Shrines. The serious patients are taken to hospitals in main towns, which may be up to 50 km away.

The availability of social amenities in the settlements surveyed is very poor. Of the 36 settlement only 25 are electrified, nine have water supply schemes, while open drainage system is available in one settlement only. About 140 tubewells, 310 open wells and 380 hand-pumps have been reported in the surveyed settlements that meet the consumptive and non-consumptive water requirements of the population.

Only 24 settlements have proper roads, and of these, only 14 settlements have transportation facilities. Telephone facility is available in six settlements and post office facility is available to eight settlements. Natural gas is available in one settlement only. The people of other settlements predominantly use fuelwood brought from the their fields and wasteland. Twenty-seven settlements have reported that their source of fuelwood will be across the transmission lines

Land Resources

The Project area forms the northwestern part of the Pothwar Plateau, extending from Indus River to beyond Soan River. The area is characterised by high hills, highly eroded land and undulating loess plains dissected by large number of deep drainage channels. Very limited area of the Project may be designated as level plains. Besides scattered hillocks in the Project area, there are two mountain ranges, Kala-Chitta and Khairi Murat.

The Haro, Soan and Kanshi Rivers comprise the main drainage of the Pothwar Uplands, having a complex network of tributaries. The riverbeds lie far below the general level of the land. Consequently erosion has been very active in the plains and has resulted in a network of deep gullies.

About 60% of the stretch of the transmission lines pass through a land area constituted of hilly terrain, gullies or having moderate to steep slopes. Only about 39% of the stretch pass through a land, which is either level to nearly level or developed for terraces.

The soils of the Project area are of complex nature derived from the alluvial deposits of local streams, wind-blown loess, and primary soils derived from sandstone and shale. The soils of alluvial origin are generally of medium texture; those of wind deposits are of fine texture, while those of primary origin are generally coarse.

Land Use and Agriculture

About 44% of area of the Project corridor is used for agricultural purposes, while about 8% area is under forest. The remaining 48% area is mostly wasteland with some economic use for grazing. This is due to very rugged/broken topography of the area. Of the cultivated area, about 97% is barani (rainfed) and about 3% is irrigated.

The crops of the barani land include wheat, oil seeds, fodder and gram during winter, and maize, millets, pulses and fodder during summer. The major crops however are wheat and maize, which occupy about 92% and 45% of the barani area, respectively. The yields of the crops are generally very low.

Landholdings and Tenure-ship

About 62% families have landholdings smaller than five Kanals. Even of these, about 81% families have landholdings of one Kanal or less. About 93% of the families are below subsistence level, which hold about 7% of the total land area. The remaining about 93% of the land is shared by only 7% families. Most of these families are absentia landlords, whose land is cultivated by the small landholders or land-less farmers on tenancy basis. Of the total farming communities, 53% are owner-cum-tenants cultivators, 15% are owner cultivators and about 32% are land-less tenants.

Small landholders have expressed fear that if the towers are erected on their owned small piece of land they will be left with no land to cultivate. Similarly, the tenants feel that if the compensation for the land is made, it will be taken away by the owners and the tenants will be deprived of any compensation.

Water Resources

The Project area is drained by numerous natural drainage channels (nullahs) forming a complicated network. Major nullahs have generally perennial flows, while the small nullahs are mostly non-perennial draining the surface run-off during rainy seasons. These nullahs drain their load directly in Haro and Soan Rivers or through rivulets. Ultimately these rivers drain in Indus River.

Numerous natural wetlands (impoundment) are scattered in the Project area, but none of these is of significant size. Besides, many small and large manmade water bodies are located close-by the alignments of the transmission lines. Neither these will obstruct the construction of transmission lines nor the lines will have any effect on the ecosystem of the wetlands.

Biological Resources

The Project area is quite rich in natural flora, particularly in the reserved forests of Kala-Chitta, Khairi Murat Mountains and other hills. Besides, vegetation is also found scattered all over the area. In accordance with the land use and landforms, the Project corridor has been divided into 9 Landscape Ecological Unites (LSEU). These units are colonised by different set of natural vegetation. The most common vegetation, however, include *Acacia modesta, Olea fernaginia, Dodonea viscosa, Chrysopogan sceleratus* and *Digiteria oliaris, Zizyphus nummularia, Zizyphus jujuba, Tamarix aphylla, Fig palmata* and *Olea fernugian*, etc.

The transmission lines will pass through 5 reserved forest areas. These include Kala Chitta, Khairi Murat, Kawah Gar, Chabbiwali and Dhungi. A clearance has been obtained from the Department of Forestry, Punjab to construct the transmission lines through the reserved forest areas.

About 48 terrestrial bird species and 27 waterfowls have been recorded from the Project area. The important mammal species reported especially from the reserved forests are about 11 in number. Besides, reptiles, amphibians and common mammals like field rates are very common in the Project area.

During construction of the transmission lines care would be taken to cause minimum disruption to the habitats of the reserved forest areas.

Climate

The Project area is characterized by two distinct seasons, summer and winter. Summers are very hot with a mean maximum temperature of 34.8° C at Islamabad and 37.9° C at Attock during June. Winters are cool with a mean minimum of 2.5° C at Islamabad and 2.18° C at Attock. The annual average rainfall is about 900 mm at Rawalpindi/Islamabad and about 600 mm at Attock. Of the total annual rains in Attock, about 39% are received in July and August, while it is about 51% for Islamabad/Rawalpindi. May and June are characterized with occasional windstorms. The transmission lines have been designed keeping in view the prevailing climatic conditions of the Project area. For this, the 30-years (from 1959 to 1988) climatic data for the two concerned districts, Attock and Rawalpindi/Islamabad were kept in view.

6. ALTERNATIVES CONSIDERED

Alternative Options for Power Dispersal from GBHP

WAPDA has planned to interconnect the powerhouse of Ghazi-Barotha Hydropower Project with the existing network of power dispersal. The powerhouse can be interconnected with the existing system in a variety of arrangements. Eight different alternatives were studied in order to select the most optimum/least-cost solution. The optimum solution was further studied for the years 2005 and 2010.

All the alternatives have been compared based on transmission system losses, capital cost and reliability of the network. In evaluating the optimum/least-cost transmission interconnection arrangement, project worth (utility value) concept was used. The arrangement with the highest relative project worth (utility value) was selected.

Analysis of Alternative Routes for Transmission Lines

The proposed plan will constitute six 500 kV lines. The construction of these lines will obviously occupy substantial area, thus leaving significant impacts on the local environmental and social setup. To minimise their impacts, it has been planed to place the lines for most of their lengths on double circuit towers, with the exception of areas where the integrity of the tower foundations are at risk.

It is obvious that in aligning a transmission line, cost consideration is of prime importance. The most economically viable alignment will be the one that has the shortest route and the soil conditions are reliable for the tower foundations. Moreover, for keeping the cost of resettlement at minimal, the environmental and social considerations are also important in aligning the line. As such, WAPDA and the Consultants considered four alternative routes for each line during planning stage. The alternative routes for a set of line fall many miles apart from each other. As such, the studies covered about 20-km to 30-km wide strip and the most appropriate routes were selected. Moreover, as referred elsewhere, a 100-m wide corridor for the selected route of each line was surveyed in detail to provide a margin of further adjustment in the alignment.

7. POTENTIAL IMPACTS OF THE PROJECT

WAPDA is fully aware of the impacts of the extra-high-voltage transmission lines. Therefore, possible steps have been taken to minimise the impacts of the lines on the physical, biological and human resources of the Project area. To achieve this target a number of modifications were made in the routes of the lines during planning stage. The salient features of the finally selected alignments are that:

- the lines would avoid settlements, large or small, except for a few scattered houses and other buildings. these include 36 houses, 3 farmhouses and 1 poultry farm in a stretch of about 235 km.

- the lines routes would mostly be through broken and eroded terrain, consequently only 44% of their stretch pass through barani cultivated land,
- the lines have avoided disruption of cultural and archaeological properties,
- in spite of existence of a large number (220) of transportation infrastructures (viz., roads, railway lines and village tracks), and power and telephone lines (94) in the routes of the proposed transmission lines, these would be crossed without any disruption,
- the lines would have minimum effects on the social infrastructures, the total length will effect only 2 tubewells, 2 pump houses, 4 wells,
- the social disruption by the lines would be minimum,
- the lines would avoid any health hazards as safe clearance have been provided to the conductors from the ground and over infrastructures, and
- the lines would have insignificant effect on the water resources of the Project area.

In spite of the fact that the effect of the transmission lines on the agricultural land is not much, the people have shown concern about that. The conductors being at safe distance from the ground, these will not restrict agricultural activities. Even the land under the towers, which comes to about 15 ha of all type of land (including about 4 ha of cultivated land), may be used for agriculture because of enough clearance available for normal agricultural practices However, the people have reservation for that. Therefore, WAPDA has planned to give a compensation package to the landowners for such land. This is because, under law WAPDA do not acquire land for transmission lines.

The other aspect of concern is the disruption of natural vegetation in the reserved forest areas About 8% of the stretch of the power lines will fall in 5 reserved forest areas. For that, WAPDA is in the process of negotiation with the Forestry Department, Punjab. Should there be a need of re-vegetation of forest areas, which will be carried out by WAPDA.

Two transmission lines pass close to the land acquired by Civil Aviation Authority for new Islamabad Airport. Though the transmission lines will be located at a safe distance from the airstrip, these may be in the range of flight zone of the aeroplane. WAPDA has approached CAA for obtaining clearance certificate. The same is under process.

8. ENVIRONMENTAL MITIGATION AND RESETTLEMENT ACTION PLANS

As referred earlier, appropriate actions have been taken to make a project compatible with its environment. Maximum effort has been made to avoid settlements and cultivated lands. For this, even a high-cost preposition has been adopted to place the lines for their maximum possible lengths on double circuit towers. Section 7 illustrates that these actions have resulted in limited adverse effects on the local environment. However, what so ever adverse effects are foreseen these will be compensated through the following actions:

- The restriction to agricultural practice on the land under the towers will be compensated through an appropriate package.

- The cultivated lands temporarily required for construction activities will be compensated for loss of crops.

- The Project will compensate the owners of the disrupted houses with cash for not only covering the replacement cost of the structure but also for the land. As such, the disrupted family will be in a position to purchase land elsewhere for their housing.

- The other built-up properties will be compensated on replacement cost of the structure only.

- Trees and shrubs will be compensated according to the provisions set in the law and explained in Resettlement Action Plan for GBHP.

- Following the policy agreed in the Resettlement Action Plan for GBHP, Ghazi-Barotha Taraqiati Idara (GBTI), an NGO appointed by WAPDA on the Project will assist in the process of valuation and compensation.

- When making payment for the compensation for land and/crop, it will be ensured that the tenants get their due share according to Land Acquisition Act and RAP for GBHP.

- As per requirement of the law, the Executing Agency will obtain permission in writing from the Department of Forestry for cutting the trees and other vegetation falling in the ROW of the lines or required for the access tracks. This is particularly with reference to the reserved forest areas. The same has been obtained and attached with the report.

- The Executing Agency will instruct the Contractors to re-vegetate the areas of cutting after the completion of the work. This will be controlled through the Contract Clause. The amendment clause in this regard has been attached with the report.

- The Contract Clauses will bind the Contractors to carry out excavation and blasting under the controlled conditions and avoid dust pollution, particularly near the settlements.

- The ditches excavated by the Contractors for the tower foundations will be refilled, as this will be obligatory under the Contract Clause. The ground will be restored to previous condition.

In addition to above, the services of Ghazi-Barotha Taraqiati Idara (GBTI) will be extended to cover this component of the main Project. These will include assistance to WAPDA and entitled persons on the matters related with the valuation and compensation, and providing a share from the funds allocated for Integrated Regional Development Programme (IRDP). However, this share will be in proportion to the effects of this component on the Project area.

9. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Table 7.1 (Chapter 7) illustrates the suggested management plan for the compensatory actions relating to environmental mitigation and resettlement. The table enlists the probable effects, actions taken to resolve the issues and the institutions responsible for acting.

Table 7.1 also indicates the aspects that need monitoring. These include issues relating with payment of compensation, dust and noise pollution by blasting, re-vegetation of reserve forest area, disruption to communities during construction and effects of EMF on health. The table suggests appropriate need for monitoring of these aspects and the agencies to act.

For monitoring various aspects, the first requirement is to develop monitoring procedures. Fortunately, these are available with WAPDA Environmental Cell (WEC) in the form of Protocols prepared in collaboration of Monitoring Consultants. These include protocols both for environmental and social aspects. The services of WEC will be extended to cover this component of Ghazi-Barotha Hydropower Project (GBHP).

Another aspect that is not directly related with the subject of environment is the stability and integrity of the towers and conductors. However, indirectly this also relates to social environment. Any breakdown in the system will not only interrupt the power supply and cost money, but also may be hazardous for the local communities at the point of breakdown. Therefore, every precaution is taken in the design and implementation of the transmission line that such breakdowns are eliminated under the prevailing severity of the local climatic conditions (Chapter 2). In spite of this, WAPDA maintains Patrolling Staff that frequently monitors the system.

10. INSTITUTIONAL ARRANGEMENT AND STRENGTHENING

The monitoring activities will involve various institutions. Besides the engineering staff of WAPDA attached with construction supervisions and maintenance, these will include Ghazi-Barotha Taraqiati Idara (GBTI), and WAPDA Environmental Cell (WEC).

11. ENVIRONMENT RELATED COSTS

The estimated environmental and resettlement related cost is about Rs. 12 million. This includes compensation for disrupted infrastructure, compensation for crops and trees, and cost of re-vegetation of reserve forest area, and monitoring-related cost.

CHAPTER I

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 GENERAL

This report deals with the studies on the Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP-II) for the power dispersal system from Ghazi-Barotha Hydropower Project (GBHP), which comprise two Barotha-Rewat 500 kV (kilo Volt) lines. The studies also cover the component of the system that facilitates in and out arrangements for 500 kV Tarbela-Gatti Lines II and I.

The present report is a supplemental to the previous EIA and RAP reports[1] prepared for GBHP. Therefore, the policies for environmental mitigation and resettlement adopted for this report generally follows the ones that were framed for the main Project.

Previously, environmental studies for power dispersal system of GBHP were carried out in 1995-1996 and a draft report[2] was prepared in 1998. The purpose of the present report is to strengthen the previous report and to meet the requirements of the directives for environmental protection and resettlement issued by the Government of Pakistan and international donor agencies.

1.2 THE PROJECT

Ghazi-Barotha Hydropower Project will have a power generation installed capacity of 1450 MW with an average annual energy output of 6,600 GWh. The Government of Pakistan has planned the dispersal of the power generated by GBHP through WAPDA's existing network. Total power dispersal arrangement is described in Section 2.2 of this report. However, the scope of present study is limited to the

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1 Pakistan Hydro Consultants; Environmental Assessment Executive Summary; 1994; which presents the main findings of the environmental and resettlement studies; it is available in English and Urdu.

Pakistan Hydro Consultants; Volume 7 of the Feasibility Report; 1991; which presents the detailed results of the environmental and social studies carried out during the feasibility studies.

Department of Archaeology and Museums, Government of Pakistan; Report on Archaeological Studies; 1991; which presents the results of the survey of archaeological and historical sites.

Pakistan Hydro Consultants; Report on Supplementary Environmental Studies; 1992; which presents the results of the supplementary studies undertaken during the tender design stage.

Pakistan Hydro Consultants; Report on Additional supplementary Environmental Studies; 1994; which presents the results of the additional studies undertaken during the pre-construction stage.

Pakistan Water and Power Development Authority; Resettlement Action Plan; 1994; prepared with the assistance of PHC in accordance with the provision of OD 4.30, "Involuntary Resettlement"; it is available in English and Urdu.

Pakistan Water and Power Development Authority/PHC; Report on Supplemental Environment and Resettlement Study for the Additional Proposed Actions for the Barrage; 1996; prepared during construction stage.

2 Pakistan Water and Power Development Authority; Ghazi-Barotha Hydropower Project, Supplemental [illegible] Assessment, Transmission Lines Associated with the Project; Final Draft Report, July 1998.

following three sets of lines of the system. The detailed description of the component lines of these sets is given in Section 2.2. These include the followings:

1. Two 500 kV Circuits from Barotha Switchyard to Rewat Grid Station,
2. Two 500 kV Tarbela-Barotha (I & II) Incoming Lines,
3. Two 500 kV Barotha-Gatti (I & II) Outgoing Lines.

The proposed power transmission system described above is schematically shown in Drawing 1-1. The stretch of the existing Tarbela-Gatti Lines I & II between in and out connections with Barotha Switchyard will be dismantled. The whole stretch of the transmission lines covered in the present study fall in the Province of Punjab.

To keep the environmental impacts at a minimum level, the transmission lines are placed on double circuit towers, except where there will be a concern regarding reliability of towers.

1.3 ENVIRONMENTAL AND RESETTLEMENT REQUIREMENTS

1.3.1 General

It is well known fact that for the last four decades the world has been passing through a scenario of an increasing awareness about environmental and resettlement concerns both in public and official circles. This led to promulgation of policies, regulations and laws for control of environmental degradation. In these regulations much attention has been given to the environmental impact assessment of the development projects and planning mitigatory/compensatory actions as a part of the project to minimise the adverse affects.

The total stretch of transmission lines under study is about 235 kilometers with a span of about 11m to 28 m between the conductors. Considering a 50-m wide corridor for safety reasons, the area of Project influence comes to about 11.75 sq. km (1175 ha). Even this area is spread over the distance from Barotha to Rewat which is about 120 km. As such, the magnitude of the area of project influence broadly becomes insignificant. Moreover, the alignment of the transmission line is so planned that it avoids settlements and major environmentally sensitive areas. Therefore, this component of the Project is anticipated to have minimal environmental and social affects. The only area of concern is the temporary effect of this component of the Project on natural vegetation.

The GBHP has been placed in environmental screening Category "A" consistent with the procedures of the World Bank and has been the subject of an environmental assessment. This supplemental report forms an element of the overall environmental assessment and has been prepared at a later date in order to allow for full evaluation and design of the transmission line component of the Project. This approach is consistent with the Project Loan Agreement between the Government of Pakistan and the World Bank.

The Project falls under the purview of two sets of official environmental and resettlement regulations. These include the ones established by the Government of Pakistan / Government of Punjab and the international donor agencies. This component of the Project will be funded by the Asian Development Bank (ADB) and Islamic Development Bank (IDB). The former has environmental and resettlement requirements that are similar in approach to those of the World Bank. However, the donor agencies have agreed that the environmental assessment and resettlement procedures of the World Bank will be used for all components of the Project to allow for a uniform approach.

1.3.2 Government of Pakistan

In spite of existence of a number of laws regulating the public practices regarding the use of natural resources and cultural properties, the Government of Pakistan (GOP) issued an Ordinance in 1983 relating to environmental protection. This has now been regularised by an Act, namely "Pakistan Environmental Protection Act 1997" [3].

The Act has made it mandatory to carry out an environmental impact assessment (EIA) of a development project. The Act requires that EIA should include identification of the potential effects of the project on baseline conditions, evaluation of preventive, mitigatory, and compensatory measures, formulation of environmental management and training plans and monitoring arrangement, etc. The Government of Pakistan has also framed guidelines for EIA of projects in various sectors[4].

The Act also spells out the need of establishment and enforcement of National Environmental Quality Standards (NEQS). These standards were first formulated in 1990, which were later revised in 1993. Efforts are underway to upgrade the National Environmental Quality Standards (NEQS) and for implementing of the legislation.

Provincial environmental departments are also working on the formulation and enforcement of environmental statutes. Environmental Protection Department (EPD) Punjab has circulated new statutes and penalty actions, which would be applicable to all the existing and future industries in Punjab Province.

The GOP has also been time to time issuing policies and measures for improving various sectors, including agriculture, livestock, forestry, fisheries, energy and industry. These measures are mainly concentrated on enhancement of production and improvement of their economic conditions. Though environmental improvement has received some weightage while adopting measure for sectoral improvement, clear-cut policies were not framed for long term planning. These are in preparation following the recommendations made in the National Conservation Strategy (NCS)[5], prepared in cooperation with the International Union for Conservation of Nature (IUCN), now known as World Conservation Union (IUCN).

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[3] Government of Pakistan: Act No.XXXIV; Pakistan Environmental Protection Act; 1997.
[4] Environment & Urban Affairs Division, Ministry of Housing & Works, Government of Pakistan; Environmental Impact Assessment Guidelines (Vol.-I); 1986.
[5] National Conservation Strategy Secretariat, GOP; National Conservation Strategy, 1991.

As referred earlier, a number of other laws deal with the environmental and social aspects related with the development of projects. The details of the applicable laws have been given in Feasibility Report (Volume 7) for GBHP[1]. However, these are briefly described below:

- **The Land Acquisition Act, 1894 (including later amendments).** This Act sets out the rules for acquiring land needed and other built-up properties affected by a project, and compensating the owners. However, it does not cover the aspect of resettlement of affected population. In this respect, the GOP is in the process of formulating laws and policies with the assistance of ADB. However, WAPDA has developed their own resettlement policy and had been applying the some for their projects.

- **The Antiquities Act, 1975.** This Act prohibits destruction, damage and defacement of antiquities. It restricts any development plan or scheme or new construction within 200 feet (60 m) of a protected immovable antiquity, except with the approval of the Director General of the Department of Archaeology and Museums, GOP. Even the Government may prohibit or restrict excavation, blasting, heavy vehicle movement or any other such activity in the vicinity of the immovable antiquity.

- **The Forest Act, 1927 and later amendments.** This Act establishes the right of the Government to designate areas for reserved forest, village forest and protected forest, and may acquire such areas for prohibiting or restricting the public use of the resources or other activities.

- **The Protection of Trees and Brushwood Act of 1949.** This Act prohibits cutting or lopping of trees and brushwood without permission of the Forest Department.

- **The Local Government Ordinance of 1979.** Section 93 of this Ordinance pertains to environmental pollution. Under the Ordinance the local councils are authorised to restrict activities causing pollution to air, water or land. They may also initiate schemes for improving the environment.

- **The Punjab Wildlife Protection Act, 1974.** This Act not only controls hunting of animals, but also designates areas for sanctuaries and protection of rare and endangered species.

- **The Telegraphy Act, 1910.** The Act was promulgated for installation of telegraph polls and stringing. This Act makes a provision of installing polls/towers without acquiring any land. However, provision is there for temporary acquisition of land during the construction period. As such, compensation is made for the loss of crop for a specific period.

- **The West Pakistan Water and Power Act, 1958.** This Act authorizes WAPDA to construct and operate electrical transmission lines with powers and obligations of a licensee under the Telegraphy Act of 1910. This Act also establishes policy for land acquisition and compensation, as well as the degree of liability of WAPDA for damages sustained by landowners or others.

> The Electricity Act (IX), 1910.

> **Pakistan Penal Code 1860.** This defines the penalties for violation against polluting air, water bodies and land.

1.3.3 The World Bank

The World Bank has adopted it as policy that for Bank's aided project the borrower country is required to carry out its environmental assessment. In addition, the borrower is obliged to implement measures to mitigate anticipated environmental impacts, to prepare an environmental management, monitoring and institutional strengthening plan. In this respect, the World Bank has issued guidelines for the areas of concern in the form of Operative Directives (ODs).

The applicable ODs for this component of the Project are:

- OD 4.00: "Environmental Policies"
- OD 4.01: "Environmental Assessment"
- OD 4.30: "Involuntary Resettlement"
- OD 4.50: "Cultural Properties"
- OD 14.70: "Involving Non-governmental Organizations in Bank-Supported Activities".

These guidelines form the basis of environmental assessment of the Project. Moreover, the Environmental Assessment Sourcebook[6] of the World Bank, particularly its Chapter 10, has been widely used for the purpose. The section on "Electric Power Transmission Systems" of Chapter 10 of the Sourcebook provides a detailed account of the issues related with the electric power transmission system. It also defines the areas to be considered in the environmental assessment and the probable effects on various resources. The Environmental Assessment sourcebook also includes an Update, which provides guidance on addressing archaeological, historical and sacred sites in the environmental assessment process.

1.4 APPROACH ADOPTED FOR THE STUDY

The Project was planned and designed by M/s National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK) – hereinafter called the Planner. It is a normal practice of WAPDA that the route of the high-tension transmission lines, particularly for 500 kV lines, is so selected that the disruption to the settlements and ecological settings of the Project area is minimised. For the purpose, different routes were considered to select an environment friendly route. However, a separate study has been carried [illegible] to further screen the Project for environmental and resettlement considerations and

[illegible]

[6] [illegible] Department, World Bank; Environmental Assessment Sourcebook, World Bank Technical Paper Numbers [illegible] and 154; 1991.

prepare comprehensive EIA and RAP-II. The study has been carried out in line with the guidelines issued by the GOP and the World Bank.

After having detailed discussions with WAPDA and the Planner, a reconnaissance of the Project corridors was carried out to identify the areas of specific concerns that need detailing. These are as follows:

- **Scoping Sessions:** According to Operational Directives of the World Bank, a scoping session is an important element of the overall environmental assessment. Scoping session is a tool where the public participation is ensured in the project planning and identifying the environmental mitigation and resettlement needs of the project. Though the proposed alignments of the transmission lines generally avoid major urban or village settlements, about 87 out-reach settlements fall in the close vicinity of the corridors. Therefore, to ensure maximum participation of the local communities over 50 localities were selected for conducting scoping sessions. The detailed account of the scoping sessions is given in Chapters 3 and 5 of this report.

- **Socioeconomic Surveys:** To collect information on the socioeconomic condition of the area two type of surveys were carried out. These include Village Level Survey and Individual Survey. Both male and female members of the communities were covered in these surveys. The socioeconomic aspects described in Chapter 3 of this report are based on the information collected from these surveys.

- **Ecological Survey:** The proposed transmission lines at places pass through areas of public and private forest reserves. As the construction will involve cutting and clearing of the corridors from vegetation, therefore, it was considered imperative to carry out detailed ecological study. For the purpose, WAPDA deputed an ecologist from its own pool. The Ecologist prepared a report on this, which is attached as Appendix "C". However, the main findings have been discussed in Chapters 3 and 5 of this report.

- **Study on Bird Migration through Indus Flyway:** Relating to the concern of impact of the transmission lines on the migratory birds, a study was carried out on the Indus Flyway. The study report is attached as Appendix "D" and the findings have been discussed in Chapters 3 and 5.

- **Archaeological Survey:** Realising the need of the law, the Department of Archaeology and Museums was approached and entered into a contract with them to carry out a survey of the Project corridor for identifying antiquities, if any. The findings of the survey by the Department are given in Chapter 3.

- **Detailed Survey of Corridors:** WAPDA carried out a detailed survey of 100-m corridor along the alignment of the proposed transmission lines. Accordingly, the planners prepared Plan and Profile maps. These maps show various land features and infrastructures falling within the corridors. These have been enlisted in tables 3.3 through 3.11 along with comments for needful actions, if required to meet the safety standards. The infrastructures likely to be disrupted or falling within the safety limits of the corridors were surveyed in detail to establish the ownership, occupancy, built-up area and type of construction, and valuation of the property for compensation purposes. The same has been discussed in Chapter 5.

- **Census Survey:** Besides the detailed survey of the private infrastructures falling within the corridors of the transmission lines, a census survey has been carried out for the areas where the towers are to be located. The findings of this survey are attached as Appendix "E" and discussed in Chapter 5.

- **Other Contacts and Data Collection:** In view of the scope of the study, some specific contacts were made with different government agencies. These included the departments of Forestry, Wildlife and Agriculture, and other agencies like Geological Survey of Pakistan (GSP), Survey of Pakistan, Soil Survey of Pakistan, Civil Aviation Authority (CAA), Bureau of Statistics of GOP, Local Administration, WAPDA, NESPAK, etc. Discussions were carried out with the knowledgeable people of these departments and necessary information was collected.

1.5 APPENDICES

The following appendices are provided with this report:

- **Appendix "A": List of Preparers and Contributors**

This appendix provides the list of the persons who have participated in carrying out surveys and in the preparation of the report. This is as required by the World Banks procedures.

- **Appendix "B": List of Persons Contacted**

This appendix provides a list of the persons contacted to discuss various aspects of the report.

- **Appendix "C": Ecological Study Report**

This appendix includes the study report on ecological aspects of the corridors of the transmission lines.

- **Appendix "D": Study on the Indus Flyways of the Migratory Birds**

This appendix includes the study report on the Indus Flyways of the migratory birds.

- **Appendix "E": Census Survey**

This appendix enlists the findings of the census survey carried out for the working area to be occupied by the construction of towers during the initial six months of construction period of In and Out arrangement of Tarbela-Gatti Lines I and II. This is in compliance to the requirements of the World Bank procedures. A census survey is a relatively a lengthy process and time consuming. For early completion of this report, the present census survey report covers only part of the construction area. The remaining area will subsequently be covered for the census survey and a supplementary report will be issued.

- **Appendix "F": Clearance Certificates**

This appendix includes certificates obtained from different agencies to fulfil the requirements of the Government of Pakistan and Funding Agencies. These include the certificates from the following agencies:

- Department of Archaeology and Museums, Government of Pakistan
- Forestry Department, Government of Punjab
- Environment Protection Department, Government of Punjab
- Civil Aviation Authority

- **Appendix "G": Contract Clause for Re-vegetation of Forest Area**

The matter of inclusion of clauses related with the environmental aspects in the Contract Document was discussed at length with the Consultants (M/s NESPAK). They have agreed to include such clauses in the new contract for Barotha-Rewat Lines, while amendments will be issued for the already awarded Contract for Incoming and Outgoing Lines. In this regard one major amendment relating to restoration of sites and re-vegetation has already been issued to the Contractor. This is attached in Appendix "G".

- Appendix "H" Data on Income and Expenditures of Affectees.

CHAPTER 2

DESCRIPTION OF THE PROJECT

CHAPTER 2

DESCRIPTION OF THE PROJECT

2.1 BRIEF DESCRIPTION OF GHAZI-BAROTHA HYDROPOWER PROJECT

To meet the acute shortage of electric power in the country, the Government of Pakistan planned to construct Ghazi-Barotha Hydropower Project (GBHP). The planning and design study of the Project, and documentation for tenders were carried out during 1990-1994. At present, the project is under construction and is anticipated to be completed by the year 2003.

The Project is located in the northern part of Pakistan and falls in the districts of Swabi and Haripur of NWFP, and Attock of Punjab. It is a major run-of-the-river power project, utilising the fall of about 76 m in the Indus river between the tailrace of Tarbela dam and the confluence of the Indus and Haro rivers, a distance of about 63 km.

The Project has three basic elements: a barrage, a power channel and a power complex (Drawing 2-1). The relatively flat slope of the power channel will permit most of the river drop to be utilised for power generation. The flow diverted into the power channel will be returned to the Indus River after passing through the power complex, with no consumptive use of the water.

The barrage is located about 7 km downstream of Tarbela dam and just upstream of Ghazi village. This will re-regulate the daily discharges from Tarbela and divert flows into the power channel. Compensation water during the low-flow season and excess flows during the high-flow season will be released downstream of the barrage. The barrage will be able to pass the flood of record through its 20 standard bays and 8 undersluices at normal pond level. A fuse plug will help pass extreme floods. The barrage also includes a public-road bridge for crossing of the Indus River.

The concrete-lined power channel will convey up to 1,600 cumecs from the barrage to the power complex. The channel is 52 km long with a bed width of 58.4 meter. The water depth in the power channel at full capacity will be 9 m. The bed slope of the power channel is 1 in 9,600 and will have a water velocity of 2.33 m/s. The channel has been provided underdrainage facilities to keep the groundwater table below the channel invert. There will be 34 road bridges, a railway bridge, 12 pedestrian bridges and 45 cross-drainage structures.

The power complex is located near the confluence of the Indus and Haro rivers, in the vicinity of Barotha village. It comprises a forebay, a siphon spillway, two headponds, a power intake structure, five penstocks, a powerhouse with five 290 MW turbo-generators, and a tailrace channel. The headponds will allow daily peaking operations.

The Project will have an installed generating capacity of 1,450 MW. Maximum power will be available during the critical months of May and June when the national system is short of power. The average-annual energy output will be about 6,600 GWh. The power will be transmitted by 500 kV circuits to WAPDA's national grid system.

The total capital cost of the Project, at September 1993 price levels, is estimated at US$ 2,166 M including the transmission links to the national grid, physical contingencies, price contingencies and engineering. The cost will have a local component of US $ 804 M and a foreign component of US $ 1,362 M.

Economic studies have demonstrated that the Project forms part of the least-cost expansion of the Pakistan power system for the full range of sensitivity analyses performed. The Project has an EIRR of 22.0% and an FIRR of 14.9%.

The contracts for civil works for Barrage (C-01) and Power Channel (C-02) were awarded in December 1995 and for Power Complex (C-03) in February 1997. The work on these contracts duly started on commencement dates and the construction work is in progress. For reasons, the contractors of C-01 and C-02 claimed extension of time. As per status in January 2000, these contracts are expected to be completed by June 2001 and December 2001, respectively. Similarly, the construction of the Power Complex is delayed. It is anticipated that the works under the contract C-03 will be completed by July 2003.

The electrical and mechanical works for the three components of the Project fall in nine different contracts. The detail of these contracts is given below. The completion dates of these contracts are in accordance with the schedules updated as on January 2000.

- ME-01 deals with the supply and installation of Turbines. The date of commencement for the contract is November 1997 and the completion date is July 2003.
- ME-02 deals with the Generators. The date of commencement for the contract is December 1997 and the completion date is July 2003.
- ME-03 deals with High Voltage switch gears, SCADA and Transformers. The date of award of the contract is August 1999. The completion date is expected to be July 2003.
- ME-04 deals with powerhouse cranes, auxiliary cranes and Gantry cranes. The date of commencement for the contract is June 1997 and the completion date is April 2002.
- ME-05 deals with the Transformers. The date of commencement for the contract is April 1999 and the completion date is March 2002.
- ME-08 deals with the SCADA and Telecommunication system. The date of commencement for the contract is August 1998 and the completion date is July 2003.
- ME-09 deals with the Gates equipment for Barrage and Power Complex. The date of commencement for the contract is January 1997, while the date of completion

for their installation at the Barrage is December 1999 and that for Power Complex is March 2002.

According to latest schedule (January 2000) of the Project commissioning plan, the first unit will be ready for testing and commissioning by August 2002. Each of the remaining four units will be commissioned with an elapse of 2 months time. As such, the last unit will be ready for testing and commissioning by April 2003. In view of this, the construction of power dispersal system is supposed to be completed before August 2002.

2.2 POWER DISPERSAL ARRANGEMENTS

2.2.1 General

The power generated from Ghazi-Barotha Hydropower Project will be dispersed through WAPDA's existing network. The interconnection of GBHP with WAPDA's existing network has been studied in detail (Load Flow Studies). The powerhouse at Barotha can be connected in a variety of arrangements. Eight different technical alternatives were studied in order to select the most suitable solution (Ref. Chapter 4 of the Report). The selection of the ultimate solution was made based on its technical feasibility, economic viability and environmental soundness.

The proposed power dispersal scheme includes two 500 kV circuits from Barotha Switchyard to Rewat Grid Station near Rawalpindi. In addition to these, both the existing 500 kV transmission lines running between Tarbela and Gatti (near Faisalabad) will be interconnected with Barotha Switchyard through in and out arrangements. The proposed scheme also includes extension of 500 kV switchyard at Rewat within its existing boundaries to accommodate new lines from GBHP.

As a part of power augmentation plan approved by GOP in 1995, one 500 kV transmission line (about 244 km long) will be constructed from Rewat to Lahore through a Grid Station constructed at Gujranwala. The plan will also include 220 kV twin-bundle double circuit transmission line (about 69 km long) from Barotha Switchyard to Peshawar via Nowshehra and Shahibagh Grid Stations.

Accordingly, the components of the power dispersal arrangement from GBHP and that of augmentation plan will include the followings:

- Two Barotha-Rewat 500-kV Lines.
- Two Tarbela-Barotha 500-kV Incoming Lines.
- Two Barotha-Gatti 500-kV Outgoing lines.
- One Rewat-Gujranwala-Lahore 500-kV Line.
- Two Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle Lines.
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided

2.2.2 Components of 500 kV Transmission System Covered in the Study

Of the total power dispersal/augmentation programme described in previous section, the scope of present study include the following components:

1. Two 500 kV Circuits from Barotha Switchyard to Rewat Grid Station, comprising the following set-up:

   - 500 kV Barotha-Rewat Double Circuit (B-R D/C) Lines (I & II), constituted of two segments. Segment I (about 56.9 km stretch) running from Barotha Switchyard up to Tarnol-Fateh Jang Road, and Segment II of about 2-km length at the end portion passing through a narrow corridor near Rewat Grid Station.

   - 500 kV Barotha-Rewat Single Circuit (S/C) Line-I starting from B-R D/C Segment I at Tarnol-Fateh Jang Road and terminating at B-R D/C Segment II Line, a stretch of about 47.7 km.

   - 500 kV Barotha-Rewat Single Circuit (S/C) Line-II starting from B-R D/C Segment I at Tarnol-Fateh Jang Road and terminating at B-R D/C Segment II, a stretch of about 49.3 km.

2. Two 500 kV Tarbela-Barotha (I & II) Incoming Lines, comprising the following set-up:

   - A stretch of about 26.5 km Tarbela-Barotha Double Circuit (I & II) Incoming Line originating from Barotha Switchyard and extending to a point near Tarbela-Gatti line I.

   - A stretch of about 2.5 km Tarbela-Barotha Incoming Single Circuit Line-I, connecting with existing Tarbela-Gatti Line-I at Tower number 114.

   - A stretch of about 6.4 km Tarbela-Barotha Incoming Single Circuit Line-II, connecting with existing Tarbela-Gatti Line-II at Tower number 112.

3. Two 500 kV Barotha-Gatti (I & II) Outgoing Lines, comprising the following set-up:

   - A stretch of about 29.9-km Barotha-Gatti Double Circuit (I & II) Outgoing Lines originating from Barotha Switchyard and extending to a point near Tarbela-Gatti line I.

   - A stretch of about 1.7 km Barotha-Gatti Outgoing Single Circuit Line-I, connecting with existing Tarbela-Gatti Line-I at Tower number 140.

   - A stretch of about 11.7 km Barotha-Gatti Outgoing Single Circuit Line-II, connecting with existing Tarbela-Gatti Line-II at Tower 143.

The layout plan of the proposed power transmission system described above is shown in Drawing 2-2. The stretch of the existing Barotha-Gatti Lines I & II between in and out connections with Barotha Switchyard will be dismantled.

The whole stretch of the transmission lines covered in the present study fall in the districts of Attock and Rawalpindi of Punjab Province. As may be seen from the Drawing 2-2, these lines are so routed as to avoid urban centres and major rural settlements. The proposed alignments also avoid disruption of the cultural properties and graveyards. Generally, the area has rugged topography with undulating land crisscrossed by a number of nullahs, rivulets and rivers, and at places high-rise hills. The lands with mild to moderate slopes have been terraced for barani (rain-fed) agriculture. At places, well/canal irrigation is also practiced.

The final alignments of the transmission lines have been selected after considering many alternative routes. Besides technical, the environmental/resettlement concerns were the main considerations in the selection of the routes of the proposed transmission lines. The provision of the double circuit arrangements in the System has been made to keep the environmental impacts at a minimum level. Therefore, for the major part, the transmission lines are placed on double circuit towers, except where there will be a concern regarding reliability of towers.

Due to rugged topography of the area, the stability and suitability of ground for tower foundation was the main consideration in their placing. As such, the spacing between the towers is not uniform. This is shown in Table 2.1 through Table 2.9 attached at the end of this chapter.

The spacing between outer conductors in the single circuit lines is in the range from 18 m to 28 m, while for double circuit it is in the range from 11 m to 15 m. The variation in spacing between the outer conductors is due to use of different types and elevations of the towers.

In consideration of the configuration of the existing Tarbela-Gatti lines, the in and out arrangements have been provided with conductors of 3 bundles each. On the other hand, the new Barotha-Rewat lines have been provided with conductors of 4 bundles each.

The detailed technical considerations of the towers, the conductors and other auxiliaries are given in Section 2.3.

2.3 DESIGN CRITERIA

2.3.1 Design Standards

General

Subsequent paragraphs present the basic parameters adopted in planning and design of the transmission system. These design parameters are based on WAPDA's existing specifications and practices for transmission line projects. These are presented illustrate that necessary measures have been taken for the safety of the system, and consequently that of the people.

Climatic Considerations:

It is a well-known fact that the local climatic conditions substantially control the selection of the material to be used for a transmission line. The regulatory climatic factors include temperature, wind velocity, thunderstorm levels, relative humidity, atmospheric pollution etc.

The proposed transmission system has been designed in consideration of the prevailing climatic conditions of the Project area. For this, climatic data from various meteorological stations was collected and statistically analysed for recurrence of 50 years. Based on this, the design levels of various climatic factors are as shown below:

Maximum Temperature	**52.5° C (65.5° C with heat generated by current)**
Minimum Temperature	-4.6° C
Every day temperature	25 ° to 27° C
Maximum wind Velocity	160 km/hr (44.4 m/s)
Isokeraunic level	77-120 thunderstorms days/year
Maximum Relative humidity	90%
Atmospheric Pollution	Industrial

Conductors and Line Configurations:

The selection of conductors is based on electrical, mechanical and atmospheric pollution considerations. The size of conductors is determined such that the corona and radio interference levels are within the international acceptable limits. ACSR 795 KCM Drake (Aluminum Conductors Steel Reinforced) conductor has been selected. According to this standard, each conductor constitutes 7-strand steel core with zinc coating, and an overlay of 26 strands of aluminum. The current carrying capacity of a bundle is 895 Amps.

Studies and economic analysis were carried out to determine the optimum size of conductors. In consideration of this, Barotha-Rewat I & II lines have been designed with an arrangement of 4 bundles, while the In and Out arrangements of Tarbela-Gatti I & II lines will comprise 3 bundles. The conductors in the bundles shall have a spacing of 457 mm and the bundle shall be placed in vertical formation for double circuit towers and horizontal formation for single circuit towers.

The phase spacing of the bundles at towers as well as at mid span has been determined by taking into account the following restrictions:

> Minimum conductor-to-leg clearance of 4 m.
> Space to accommodate insulator strip (V-String with 90°)

- Space to provide tower steel on the bridge and cross arm of towers between the two phases for waist type towers.

The ultimate tensile strength (UTS) limits for conductor tension will be as given below:

- 22% of UTS under no wind condition every day stress at every day temperature, final condition
- 50% of UTS under full wind load (44.7 m/sec) at every day temperature, final condition.
- 30% of UTS under no wind load condition at minimum temperature, initial condition.

The "Guide Lines for Transmission Line Structural Loading" prepared and published by the American Society of the Civil Engineers or IEC 826 "overhead line support loading" have been used for estimating wind loads on the system.

Towers:

Tower Structures: All towers shall be self-supporting type, lattice steel structures, fabricated from galvanized structural steel shapes. The steel employed will be in accordance with the latest addition of the following standards:

- ASTM "A 36" Standard Specification for Standard Steel.
- ASTM "A 572" Standard Specification for High Strength Low Alloy Columbium-Vanadium Steels of Structural Quality.
- ASTM "A 123" Standard for zinc (Hot Galvanized) coating on products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strips.
- ASTM "A 325": High-strength bolts for structural steel joints including suitable nuts and plain hard washers.
- ASTM "A 153" Standard for galvanizing of bolts, nuts and washers, etc.

Horizontal configuration has been used for single circuit towers, while double circuit towers are designed with vertical configuration. Four types of towers will be used in the system. These include "Suspension", "Angle", "Dead End/Terminal" and "Transposition".

The detailed tower design has generally been carried out in accordance with the principle set out in the "Guide of Steel Transmission Towers Manual No. 52" of the American Society of Civil Engineers.

Towers have been designed for the following span limits:

	Double Circuit Towers 4-Bundle/3-Bundle	Single Circuit Towers 4-Bundle
Ruling Span	365 m	395m
Wind Span	380m	410m (Suspension Tower) 366m (Angle Tower)
Weight Span	450m 730m	500m (Suspension Tower) 610m(Angle Tower)
Outline dimensions:	As per WAPDA's practice for 500 kV lines.	
Clearance & Loading	Towers base dimensions have been optimized keeping in view the Conditions of the terrain as well as economics in the foundation cost.	

All towers will be equipped with danger plates, number plates and anti-climbing devices. Every tenth tower shall have an aerial marker mounted on a bridge to facilitate identification during maintenance patrolling by helicopter.

Tower Spotting: Tower spotting has been done with the consideration of the following factors:

- Selection of proper tower type and its optimum location,
- Achievement of economical tower heights with safe clearance,
- Assurance of compliance with design load criteria,
- Location of towers to minimize risk of foundations being damaged by flood, shifting of sands, etc.
- Providing a clearance of 20 m for the nearest conductor of another power line, existing or planned.
- Avoiding interference with or obstruct to any road way or track which is regularly used by wheeled vehicles, draught animals or pedestrians
- In areas of shifting sand, extra ground clearance has been allowed to ensure that movement of the sand dunes will not reduce conductor clearance below the minimum safe value.
- The requirements of the relevant authorities regarding distance of towers from roadways and railways have been complied.

Foundations: All tower foundations have been designed as individual leg footings with 4 legs per tower. The following foundation types have been considered depending upon the results of soil investigations.

- [illegible]
- Semi-submerged

- Submerged
- Piles

Depending also on the engineering parameter of the soils under various conditions referred above, different types of foundations have been recommended. This will be decided when the Contractor carries out soil investigations at the time of construction.

The foundations will be about 2-3 m below the ground level with only tower footings protruding up to 1 m above the ground. The general steel structure of the tower will have a clearance of 6 m to 8 m from the natural ground. This will facilitate the farmers to utilize the ground underneath the tower.

Pile foundation is considered for tower location at river crossing and at places where the soil condition does not permit the use of normal spread footing type foundation. Under the present condition of the area, no pile foundation is required. However, with the future scenario when Kalabagh Dam will be constructed, the towers of the initial reaches of the proposed transmission lines will be submerged in the reservoir. Consequently, pile foundations have been proposed in these reaches.

Insulation

The transmission lines have been provided with appropriate insulation assemblies These have been determined based on degree of contamination in air, power frequency operating voltage, switching and lighting surge voltage under the particular service conditions of the line. The type of insulators, Creepage distance and shed diameter has been selected to suite with the existing practice of WAPDA. In this regard, the following standards have been adopted.

- ANSI C29.1: American National Standard for Electric Power Insulators.
- ANSI C29.2: American Nation Standard for Wet Process Porcelain and Toughened Glass Insulators.
- IEC 575: thermal/mechanical performance test on string-insulator units.
- Other relevant ANSI, ASTM and IEC standards.

2.3.2 Safety Parameters

General

For extra high voltage (EHV) lines safety considerations are of two types. Ones are related with the safety of the system, while others are those that relate to the public. It is for this reason that WAPDA has adopted a 50-m wide (25 m either side from the central conductor) corridor as ROW for 500 kV transmission lines. The aspects to be considered in this regard are discussed in the following paragraphs.

Aspects of Safety of the System

Conductor to Tower Clearance: For the safety of the system, it is imperative that any factor that may interrupt the power supply should be considered in the design. In that matter, the clearance of the conductor from tower legs and trusses is of prime importance. Therefore, in the design a minimum clearance of 4 m has been adopted. This is based on regulations of GOP/WAPDA and minimum requirements of National Electrical Safety Code (ANSI C2). With this clearance, there is 99% probability of withstanding switching surge of 3-sigma margin due to maximum over voltage under adverse climatic conditions.

Earthing of the System: Every tower is connected to an earthing system. This is to keep tower footings resistance at a level lower than 10 ohms. For this, two earth electrodes of copper-clad steel rods are sunk vertically into the ground to a minimum depth of three meter.

Lightning Performance: The tower geometry, clearance and insulation of the system is designed to perform safely within the permitted lightning intensities. In this respect, consideration has been given to the tower footing resistance and Isokeraunic level of the area. The accepted level is one tripout/100 km/year due to lightning.

Aspects of Public Safety

General Aspects: In view of public safety, WAPDA has adopted a policy of keeping a 50-m wide corridor clear of all obstructions for 500 kV (and for 220 kV) transmission lines (25 m on either side from the centerline). However, WAPDA allows general farm practices within this corridor, but tree plantation that exceeds a height of 3 m is not allowed. As such, the existing orchards having fruit trees with a height of not exceeding 3 m are allowed to remain under the lines. Similarly, Open wells, including Persian wheels, are allowed to remain under the transmission lines. However, tubewells are not permitted under the high voltage conductors. This is for the reason that piping and cranes used to refurbish such wells could come into contact with the lines.

No residential or other public building, like factory, school, hospital, etc. is permitted within the corridor. However, farm buildings, which are not used for residential purposes are allowed to remain under the extra high voltage lines, provided an 8-m clearance is maintained. The height of the towers can be increased to accommodate such buildings. In densely populated areas, however, the minimum distance from the centerline can be reduced to 21 m, which gives a minimum horizontal clearance of 12 m from the outer conductors.

Conductor to Ground Clearance: The conductor to ground clearance is desirable to be worked out based on over voltage due to switching surge. In this consideration safe clearance is required to be provided for moving objects under the line with a height of 4.5 m, withstanding switching surge of 3-sigma margin with 99.7% probability under adverse atmospheric conditions. This should keep the maximum voltage gradient at ground level and maximum current induced in a person less than the internationally allowable values. As such, the total conductor to ground clearance shall in no way be less than 9 meter. This is in accordance to the regulations of Government/WAPDA.

WAPDA has accepted current international standards for conductor to ground clearances for the construction of 500 kV transmission line projects. The specific standard accepted is that of the National Electrical Safety Code (ANSCI C2), currently applicable in the United States.

The permissible conductor clearances (at a maximum temperature of 65.5° C) are as follows:

➢ Cultivated land traversed by vehicles	9.00 m
➢ Road and Streets	9.00 m
➢ Communication and Power Lines	
♦ Power Lines up to 132 kV	4.50 m
♦ Power lines up to 220 kV	5.00 m
♦ Power lines up to 500 kV	6.70 m
➢ Highways	11.75 m
➢ Railroads	11.75 m
➢ Electrified railroad trolley wire	4.50 m
➢ River at high flood level	7.00 m
➢ Places accessible to pedestrians only	8.00 m
➢ Building roofs not accessible to people	6.00 m
➢ Building roofs accessible to people	8.00 m
➢ Tops of trees (orchards)	6.00 m
➢ Canals	9.00 m
➢ Lightning protection wires	4.00 m

2.4 CONSTRUCTION PROCEDURES

2.4.1 General

As discussed in Section 1.3.1, except for a few areas the Project will have insignificant effects on the local environment. Several precautions have been built-in in the selection of routes for the lines and design of the system to minimise the environmental degradation. However, the construction of the system is one area which may disrupt the environmental and social setting to a certain degree. To keep such disruption/degradation at minimal, the contractor will be required to adopt [illegible] engineering practices and follow the specified codes of construction of transmission lines. In this respect, WAPDA has laid down some construction procedures. These are discussed in the following paragraphs.

2.4.2 Accesses to Construction Sites

In aligning the extra high-voltage transmission line, an effort is made to pass it through a terrain that is thinly populated and rarely approached. As such, the accessibility to construction sites becomes a problem. The contractor has to develop a large number of tracks for transporting the material. This results in severe damage to natural vegetation and disruption to habitats. However, in the case of present Project the situation is not so. The whole lengths of the proposed transmission lines are approachable through about 67 major or minor metalled roads and about 147 Kutcha village tracks. Almost all the village tracks are linked to the metalled roads and are thus accessible to vehicles. There may be, however, certain areas in the hilly tracts where the contractor has to develop a few tracks. New access tracks will be made by tractor mounted blades having normal width of about four to five meters. While, steel channels & pipes will be used for making temporary small bridges on nullahs and rivulets. In this respect, care will be taken that the disruption to the natural vegetation is kept at minimal.

In the contract, WAPDA specifies that the contractor will not cause any damage to the existing roads and village tracks. However, in case of any damage, the contractor will be responsible for repair. In this context, WAPDA bounds the contractors by withholding a 10% amount from the contractors interim certificates submitted to the Engineer for the payment.

2.4.3 Clearing Right-of-Way (R.O.W)

To minimise the environmental impacts, WAPDA normally impose restrictions on clearing of natural vegetation from Right-of-Way (ROW). This is allowed to an extent that is necessary for the safe construction and operation of the lines. For this, the area required for placement of tower footing has to be completely cleared of vegetation, crops and trees. In the rest of the ROW, selective clearing is done. Trees over 2.5 meters in height, which may obstruct stringing or create hazard/danger to the transmission line, have to be removed. On the other hand, the clearing of desert vegetation is restricted to that which is required for placement of footings and for the assembly and erection of towers and wire pulling site. While no such clearance is allowed in orchards or other areas having fruit bearing trees except specifically approved by the Engineer in case of having no other alternative. WAPDA has given advantage to the landowner that the cleared materials such as trees, crops etc. will be the property of landowner. While other materials such as fossils, coins and antiquities discovered on the site of the work, will be deemed as the property of WAPDA/Department of Archaeology and Museums.

The clearance of ROW from vegetation is done by mechanical means or by using herbicides. The latter method is used where the vegetation is very thick and the [illegible] not accessible by the machinery. Such conditions are not encountered in the Project corridor. Therefore, the use of herbicides is not foreseen. The same has also been confirmed from the contractor mobilised for construction of In and Out lines. However, should there be a need of use of herbicides, the contractor will do so with the prior approval of the Engineer, who will be full responsible for overseeing their safe use.

2.4.4 Tower Foundations and Erection

Siting of Towers

The tower locations have been indicated by the Consultants on Plan and Profile drawings. These have been tabulated in Tables 2.1 through 2.9. Based on this, the contractor carries out investigation for the site suitability for foundation. This pertains to physiographic and geo-technical investigations of ground including subsoil and groundwater testing. If the subsoil conditions do not allow for any type of foundation specified by the Engineer, the location of the tower is changed along the centerline in consultation with the Engineer, without affecting the alignment of the transmission line.

Excavation and Backfilling of Foundation

Depending upon the type of tower and subsoil condition, the tower footings have variable dimensions. However, on an average a 900 sq. m working area is required for excavation of normal foundation and 1200 sq. m for that of pile foundation. The depth of excavation for normal foundation varies from about 2 m to 5 m. The excavation for tower footing is carried out either manually or by mechanical excavator as per site requirement. In rocky areas, some blasting may also be involved.

After fixing steel rebars and concreting, the ditch is refilled with excavated material and the site is brought to the original ground level. As such, only four tower pedestals protrude above the ground level by about 0.5 m for normal foundation and about 1.4 m for pile foundation. Under submerged condition, however, the elevation of the pedestals is determined from the water levels. The diameter of the pedestals varies from about 0.7 m to 1.1 m.

Steel Tower Erection

Tower erection is done on the concreted locations with the help of Derrick Poles or crane. The required working area for this activity is about 250 sq. m for each tower. The tower is erected in panels of 2 m to 3 m height. The panels are assembled on the ground, lifted in parts with the help of Derrick Poles/crane and then joined together with nut and bolt, which are tightened to the specified torque.

2.4.5 Stringing of Conductors and Shield wire

After tower erection is accomplished for a reasonable reach, stringing activity is started. This involves preparing tower to tower accesses for tractor movement by clearing a strip of about 5 m wide from all the obstacles; positioning of tensioner, puller and conductor reel; installation of insulators and other hardware, etc. The tensioner and puller are temporarily anchored on the both ends of the stringing stretch, which is normally 3 km to 6 km. At road, railway and power/telephone line crossings, rider poles are provided during stringing. This is to avoid any interruption to traffic or shutdown of the power in the existing lines.

2.5 CONSTRUCTION SCHEDULE

The Consultants (M/s NESPAK) have prepared an implementation schedule for the Project. Revised Version of the schedule has been attached as Table 2.10. The schedules for ADB and IDB sponsored components have been shown separately. These include In and Out Tarbela-Gatti Lines I and II at Barotha (Contract 1) and Barotha-Rewat I and II Lines (Contract 2), respectively. According to the schedule, the Contract 1 has been awarded in October 1999 and the Contractor has mobilised. The Contract 2 is tentatively scheduled to be awarded by May 2000.

In spite of the fact that the Contract 1 has been awarded, the Contractor has not yet started the construct for want of clearance of EIA and RAP, i.e., this report, from the concerned agencies. According to the original schedule, the work on Contract 1 was expected to be completed by March 2001. The delay in the preparation and approval of this report is likely to delay the completion of this component for few months.

According to the revised schedule, the completion date for the Contract 2 is May 2002. This includes construction, final inspection and testing of the lines.

2.6 WORK FORCE

The Project involves many construction activities. For the purpose of ease, these are lumped into three main activities, namely foundation laying, tower erection and conductor stinging including fixing of accessories. Accordingly, three types of construction crews are deployed for the work. The work force required for each main activity is as shown in the table on page 2-15.

It is estimated that for accomplishing the work as per schedule, three to four crews of each type will be required. As such, about 800 people will be engaged for about 20 months. Of these, the unskilled labour will be 400 people, which would be hired from the local communities.

WORK FORCE REQUIREMENT

Staff	Foundation Crew	Tower Erection Crew	Conductor Stringing Crew
Site In-charge	1		
Site Engineer	1	1	2
Supervisor	1	-	4
Foreman	1	1	2
Astt. Foreman	1	1	2
Surveyors	1	-	1
Skilled Workers	12	8	14
Semi-Skilled Workers		8	14
Unskilled/helpers	22	21	49
Drivers	2	3	4
Total	42	44	92

2.7 PATROLLING AND INSPECTING PROCEDURES AND SCHEDULE

A 500 kV transmission line is a vital link in the transmission grid system of Pakistan. Any outage on the line would seriously disrupt the power supply to the major load centres, possibly creating extensive damage and losses. Therefore, every effort is made to keep these free from any breakdowns. Careful patrolling or inspection of the lines may eliminate all unscheduled power shutdowns. Grid Station Construction (GSC) Division of WAPDA maintains regular patrolling/inspection staff for the purpose.

The patrolling crews are scheduled to carry out a general inspection of the transmission line after every 3 months, while a comprehensive inspection is carried out after every 3 years.

WAPDA has prepared maintenance manuals, which enlist the items to be checked by the Inspection Crew during patrolling. Following paragraphs provide a checklist for each structure.

Foundation

- Check for any soil settlement around the foundation chimney, any unusual cracks between the stub angle and concrete and/or cracks in the concrete chimney.
- Check for erosion in and around the tower foundation. Where erosion exists note the locations and extent on the inspection form, take a measurement from the centre line. Note if a stream (Nullah) or dry wash is causing the erosion.

note any damage done by farming operations near or under the tower. Towers located in the active hill-torrent zone will require inspection on a continual basis.

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

Steel Works

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

Conductor, Shieldwire, Hardware and Insulators

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

- Check every bolt, nut, pin and cotter pin on the conductor shoe, shackles, connecting links and other hardware fittings for looseness or missing.

- Check for chips, dirt and/or lightning "tracks or marks" on the insulators. This lightning mark will especially show up on the first few insulators nearest the tower attachment point.

  There will not be cracks of any size in the insulators because before porcelain will crack, a piece of the insulator will break off. Always look around the base of every tower for pieces of insulators, pin, bolts, nuts etc.

- Check every clevis pin in the insulator strings for missing cotter pins. Note that a clevis pin can work itself half way out and still holds. First, the cotter pin falls out, next with the continual vibration the clevis pin can very slowly work itself out to a point where the pin only holds by half of the clevis. You can spot this condition by a slight tilting of the insulator below or beyond the loose pin. This also applies to shackle or hardware pins and is a very serious condition. Report it immediately.

- Check the stock-bridge dampers on the shieldwire to make sure they are in the proper position.

  Dampers can slip out on the wire and their effect is greatly reduced or lost. Also, check for missing dampers.

- On dead end towers, check the jumpers to see that all bolts are tight in the jumper pads. Also, there should be no missing or loose pins.

- Along the line, check the conductor spacer dampers for loose bolts or broken dampers. Check the conductors for frayed or broken strands.

- Spot-check ground clearance and observe if any building or structure is being constructed under the line. Also, check for any tree growing near or under the line. Report these conditions immediately.

TABLE 2.1
LOCATION OF TOWERS
Tarbela-Barotha Incoming Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
		0	0		15.70		Angle yet to be given
DD3	52°-38'-37" (L)	263	263	263	19.70	12.40	
DA3	16°-29'-53" (L)	539	276	275	19.70	12.00	
DD3	20°-55'-31" (L)	916	377	377	17.70	19.00	Tailrace area
DD3	20°-41'-26" (L)	1,850	934	934			Void from RD 915 to 1849
DS3		2,181	331		27.70	9.00	
DS3		2,431	250		15.70	10.00	
DS3		2,691	260		21.70	13.20	
DS3		3,101	410		25.70	10.20	
DA3	3°-29'-32"	3,413	312	1,563	21.70	14.20	From 0+00 to 3+412 diversion may be required for settlement in front of Barotha Model Village.
DS3		3,831	418		21.70	10.00	
DS3		4,111	280		19.70	16.00	
DS3		4,469	358		19.70	10.00	
DS3		4,841	372		23.70	9.80	
DS3		5,191	350		21.70	11.20	
DS3		5,543	352		25.70	18.80	
DS3		5,891	348		21.70	12.00	
DS3		6,291	400		21.70	11.00	
DS3		6,501	210		21.70	12.60	
DS3		6,851	350		19.70	19.00	
DS3		7,141	290		21.70	13.20	
DS3		7,551	410		21.70	9.20	
DS3		7,921	370		17.70	9.60	
DS3		8,211	290		21.70	14.60	
DS3		8,491	280		21.70	15.20	
DS3		8,841	350		19.70	16.80	
DA3	10°-22'-42" (L)	9,126	285	5,713	15.70	9.60	
DS3		9,472	346		25.70	13.40	
DS3		9,754	282		21.70	9.80	
DS3		10,200	446		17.70	13.00	
DA3		10,490	290		19.70	11.40	
DA3		10,770	280		19.70	10.00	
DS3		11,186	416		19.70	11.40	
DS3		11,510	324		19.70	8.80	Top of very narrow cliff at RD 11260 may need cutting by 1 m.
DS3		11,790	280		19.70	13.20	
DS3		12,230	440		19.70	11.00	
DS3		12,430	200		17.70	14.20	
DS3		12,780	350		25.70	11.20	
DS3		13,060	280		21.70	13.00	
DS3		13,430	370		17.70	12.00	
DD3	28°-18'-30" (L)	13,898	268	4,672	17.70	12.00	
DS3		14,000	302		18.70	10.40	
DS3		14,290	290		18.70	11.00	
DA3	12°-46'-48" (R)	[illegible]	342	[illegible]	17.70	10.00	
DS3		15,134	502		21.70	16.00	

TABLE 2.1
LOCATION OF TOWERS
Tarbela-Barotha Incoming Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DA3	7°-58'-48" (L)	15,288	154	656	15.70	14.40	
DA3		15,560	272		19.70	14.00	
DA3	11°-14'-30" (R)	16,050	490	762	15.70	13.40	
DS3		16,290	240		25.70	12.00	
DS3		16,690	400		17.70	12.30	
DS3		16,950	260		17.70	10.00	
DS3		17,320	370		17.70	13.60	
DS3		17,690	370		19.70	10.20	
DS3		18,070	380		19.70	10.00	
DS3		18,330	260		19.70	14.40	
DS3		18,730	400		21.70	9.80	
DS3		19,070	340		21.70	9.00	
DS3		19,400	330		17.70	11.40	
DS3		19,710	310		19.70	10.40	
DS3		20,054	344		21.70	9.00	
DS3		20,430	376		17.70	12.00	
DS3		20,740	310		19.70	11.00	
DS3		21,070	330		19.70	10.00	
DS3	1°-42'-0" (L)	21,411	341	5,361	19.70	11.50	For safety of nearby houses falling outside the corridor, the tower will be relocated appropriately or fenced.
DS3		21,744	333		19.70	9.40	
DS3		22,078	334		21.70	9.40	
DD3	25°-55'-30" (R)	22,474	396	1,063	19.70	10.00	
DS3		22,790	316		17.70	13.00	
DS3		23,134	344		19.70	9.60	
DS3		23,510	376		19.70	9.00	
DS3		23,870	360		21.70	10.00	
DS3		24,260	390		21.70	11.00	
DS3		24,588	328		17.70	9.00	
DS3		24,870	282		17.70	13.00	
DA3	2°-22'-39" (R)	25,148	278	2,674	17.70	11.00	
DS3		25,470	322		19.70	11.00	
DS3		25,870	400		21.70	10.00	
DS3		26,140	270		17.70	11.00	
DD3		26,442	302	1,294	19.70	14.00	Switch-over Tower from DC to SC I & II

Note:
- DA3 — Double Circuit Mild Angle Tower (Angle < 20°)
- DS3 — Double Circuit Suspension Tower
- DD3 — Double Circuit Dead End Tower or with Angle > 20° but < 60°

TABLE 2.2
LOCATION OF TOWERS
Tarbela-Barotha Incoming Single Circuit I

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DD3	7°-30'-15" (L)	0	0				Switch-over Tower from DC to Incoming SC I & II
DGM		260	260		19.25	14	
SGM		640	390		21	15	
SGM		1,044	404		22.5	15	
DGM	48°-28'-47" (L)	1,391	347	1,391	25.3	12	
SGM		1,770	379		31.5	10	
DGM		2,196	426		19.25	14	
DGM	51°-4'-40" (L)	2,467	271	1,076	19.25	12	Connection with existing 500 kV Tarbela-Gatti line at Tower # 114.

Note
DD3 Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
DGM Guddu-Multan Type Dead End Tower, without or with Angle > 20° but < 60°
SGM Guddu-Multan Type Suspension Tower

TABLE 2.3
LOCATION OF TOWERS
Tarbela-Barotha Incoming Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DD3	1°-00'-00" (R)	0	0				
DGM		250	250		19.25	15	
SGM		716	466		21	10	
SGM		1,036	314		19.5	16	
SGM		1,314	284		21	10	
SGM		1,694	380		21	11	
SGM		2,094	400		27	9.8	
SGM		2,410	316		30	18	
SGM		2,800	390		21	16	
DGM	19°-17'-0" (L)	3,144	344	3,144	17.65	9	
SGM		3,510	366		25.5	12	
SGM		3,826	316		22.5	9	
SGM		4,218	392		25.5	9	
SGM		4,620	402		30	9	
SGM		4,880	260		18	15	
DGM	45°-39'-0" (L)	5,372	492	2,228	17.65	10	
SGM		5,560	188		22.5	9	
SGM		5,900	340		21	14	
DGM		6,180	280		19.25	9	
DGM	52°-14'-45" (L)	6,406	226	1,034	19.25	13	Tarbela-Gatti-II Connection at Tower # 111.

Note:
DD3 Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
DGM Guddu-Multan Type Dead End Tower, without or with Angle > 20° but < 60°
SGM Guddu-Multan Type Suspension Tower

TABLE 2.4
LOCATION OF TOWERS
Barotha-Gatti Outgoing Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance from Ground in back span (m)	Remarks
		0	0				Angle yet to be given
DD3	34°-15'-9" (L)	252	252	252	21.70		Plannig of Transmission line from Barotha Switchyard to RD 252 is yet to be finalised, therefore clearance of the conductor from ground not known.
DD3	39°-57'-31" (L)	473	221	221	19.70	16.00	
DA3	8°-35'-36" (L)	838	365	365	19.70	9.00	
DA3	5°-11'-3" (L)	1.229	391	391	19.70	15.00	
DS3		1.590	361		19.70	10.00	
DA3	2°-57'-0" (L)	1.855	265	626	21.70	18.00	
DS3		2.179	324		23.70	14.00	
DS3		2.509	330		21.70	11.00	
DS3		2.829	320		23.70	16.00	
DS3		3.129	300		21.70	13.00	
DA3	13°-53'-0" (R)	3.535	406	1.680	15.70	9.00	
DS3		3.779	244		23.70	9.00	
DS3		4.099	320		19.70	17.00	
DD3	23°-45'-15" (L)	4.347	248	812	15.70	12.00	
DS3		4.689	342		17.70	11.00	
DS3		5.049	360		17.70	9.00	Crossing Haro River
DS3		5.349	300		19.70	13.00	
DS3		5.629	280		17.70	11.00	
DS3		5.989	360		17.70	11.00	
DS3		6.269	280		17.70	10.00	
DS3		6.519	250		21.70	13.00	
DA3	1°-46'-15" (R)	6.924	405	2.577	19.70	9.00	
DS3		7.239	315		19.70	11.00	
DS3		7.489	250		17.70	11.00	
DS3		7.779	290		17.70	12.00	
DS3		8.073	294		19.70	12.00	
DA3	19°-21'-40" (L)	8.412	339	1.488	19.70	9.00	
DS3		8.769	357		19.70	10.00	
DS3		9.135	366		19.70	9.00	
DS3		9.449	314		21.70	10.00	
DA3	12°-47'-25" (L)	9.866	417	1.454	19.70	9.00	
DA3	4°-26'-25" (R)	10.289	423	423	19.70	11.00	
DA3		10.609	320		19.70	11.00	
DS3		11.069	460		19.70	10.00	
DS3		11.329	260		19.70	13.00	
DS3		11.689	360		19.70	10.00	
DS3		11.989	300		19.70	10.00	
DS3		12.229	240		27.70	18.00	
DS3		12.489	260		25.70	11.00	
DS3		12.949	460		27.70	14.00	
DS3		13.229	280		27.70	6.00	The peak of the hill will need cutting by 3 m to get required ground clearance.
DS3		13.629	400		25.70	10.00	
DA3		13.979	350		25.70	13.00	Railway Crossing

TABLE 2.4
LOCATION OF TOWERS
Barotha-Gatti Outgoing Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance from Ground in back span (m)	Remarks
DA3	2°-58'-20" (L)	14.380	401	4.091	25.70	10.00	
DA3		14.953	573		25.70	12.00	Nandana Kass Crossing
DA3		15.469	516		21.70	13.00	
DS3		15.749	280		17.70	10.00	
DA3	16°-8'-0" (L)	16.158	409	1.778	17.70	12.00	
DS3		16.489	331		17.70	13.00	
DS3		16.893	404		15.70	10.00	
DS3		17.161	268		17.70	12.00	
DS3		17.389	228		21.70	15.00	
DA3	12°-12'-17" (R)	17.910	521	1.752	21.70	9.00	Nandana Kass Crossing
DS3		18.287	377		21.70	10.00	
DS3		18.639	352		23.70	11.00	
DS3	1°-8'-30" (R)	18.997	358	1.087	21.70	9.00	
DS3		19.319	322		19.70	12.00	
DS3		19.609	290		21.70	14.00	
DA3	8°-54'-0" (L)	19.997	388	1.000	19.70	10.00	
DS3		20.411	414		21.70	11.00	
DS3		20.747	336		21.70	13.00	
DS3		21.101	354		25.70	10.00	
DS3		21.455	354		25.70	9.00	
DS3		21.839	384		27.70	14.00	
DS3		22.149	310		21.70	10.00	
DS3		22.521	372		19.70	9.00	
DS3		22.899	378		21.70	9.00	
DS3		23.269	370		23.70	11.00	
DS3		23.629	360		21.70	10.00	
DS3		23.969	340		21.70	9.50	
DS3		24.329	360		19.70	11.00	
DS3		24.661	332		19.70	11.00	
DA3	1°-55'-0" (L)	25.015	354	5.018	17.70	10.00	
DS3		25.395	380		21.70	10.00	
DS3		25.675	280		17.70	12.00	
DS3		26.045	370		21.70	12.00	
DA3	1°-58'-20" (R)	26.225	180	1.210	21.70	17.00	Attock-Fateh Jang Road Crossing
DS3		26.615	390		21.70	12.00	
DS3		26.955	340		23.70	9.00	
DS3		27.355	400		21.70	12.00	
DS3	1°-34'-40" (L)	27.700	345	1.475	21.70	12.00	Humak Road Crossing
DS3		27.994	294		17.70	15.00	
DS3		28.294	300		17.70	13.00	
DS3		28.564	270		17.70	11.00	
DS3		28.904	340		17.70	11.00	
DS3		29.204	300		19.70	13.00	
DS3		29.554	350		19.70	9.00	
DD3	10°-0'-0" (R)	29.934	380	2.234	19.70	12.00	Switch-over Tower from DC to SCs I & II

Note— DA3 Double Circuit Mild Angle Tower (Angle < 20°)
DS3 Double Circuit Suspension Tower
DD3 Double Circuit Dead End Tower or with Angle > 20° but < 60°

TABLE 2.6
LOCATION OF TOWERS
Barotha-Gatti Outgoing Single Circuit I

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DD3	10°-0'-0" (R)	0	0				
DGM	25°-46'-40" (R)	328	328	328	19.25	10.00	
SGM		600	272		18.00	12.00	
TGM		870	270		27.00	12.00	
TGM		1,070	200		27.00	18.00	
DGM		1,482	412		17.65	10.00	
DGM	42°-47'-20" (R)	1,694	212	1,368	19.25	15.00	Tarbela-Gatti II Connection at Tower # 140

Note:
- DD3 — Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
- DGM — Guddu-Multan Type Dead End Tower, without or with Angle > 20° but < 60°
- SGM — Guddu-Multan Type Suspension Tower
- TGM — Guddu-Multan Type Transposition Tower

TABLE 2.6
LOCATION OF TOWERS
Barotha-Gatti Outgoing Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearence of Conductor from Ground in Backspan (m)	Remarks
DD3		0	0				
DGM		260	260		17.65	12.00	
SGM		664	404		21.00	9.00	
SGM		1,060	396		27.00	11.00	
SGM		1,290	230		31.50	24.00	
SGM		1,530	240		21.00	17.00	
SGM		1,980	450		21.00	11.00	
AGM	15°-34'-30" (R)	2,334	354	2,334	19.25	9.00	Distance of Angle Tower from DC tower
SGM		2,730	396		18.00	9.00	
SGM		2,990	260		18.00	12.00	
SGM		3,284	294		19.50	10.00	
AGM	1°-4'-15" (R)	3,645	361	1,311	19.25	9.00	
SGM		4,040	395		27.00	9.00	
SGM		4,450	410		18.00	10.00	
SGM		4,850	400		18.00	13.00	
SGM		5,240	390		18.00	9.00	
SGM		5,500	260		19.50	13.00	
DGM	31°-48'-00" (L)	5,749	249	2,104	19.25	10.00	
SGM		6,080	331		19.50	11.80	
SGM		6,380	300		18.00	10.00	
TGM		6,794	414		27.00	9.40	
TGM		7,156	362		27.00	9.00	
SGM		7,538	382		22.50	9.40	
SGM		7,950	412		19.50	10.00	
AGM	16°-13'-12" (R)	8,277	327	2,528	17.65	14.00	
AGM		8,640	363		17.65	7.00	
SGM		9,070	430		18.00	11.00	
AGM	06°-48'-41" (R)	9,408	338	1,131	19.25	9.00	
SGM		9,794	386		27.00	9.00	
SGM		10,200	406		21.00	18.00	
SGM		10,460	260		21.00	14.00	
SGM		10,820	360		21.00	9.00	
SGM		11,180	360		21.00	10.00	
DGM		11,480	300		19.25	10.00	
DGM	36°-52'-30" (R)	11,731	251	2,323	19.25	15.00	Tarbela-Gatti II Connection at Tower # 142

Note: DD3 Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
DGM Guddu-Multan Type Dead End Tower, without or with Angle > 20° but < 60°
AGM Guddu-Multan Type Mild Angle Tower (Angle < 20°)
SGM Guddu-Multan Type Suspension Tower
TGM Guddu-Multan Type Transposition Tower

TABLE 2.7
LOCATION OF TOWERS
Barotha-Rewat Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
		0	0		17		Angle yet to be given
DD1	50°-04'-25"	285	285	285	21.00	13.00	
DA1	18°-03'-24"	578	291	291	19.00	11.80	
DA1	10°-06'-37"	962	380	386	17.00	17.00	Tailrace area
DS1		1140	178		17.00	13.40	
DA1		1500	360		19.00	11.20	
DA1	16°-09'-06"	1933	433	971	17.00	11.80	
DS1		2280	347		21.00	16.40	
DS1		2640	360		21.00	11.80	
DS1		3010	370		21.00	9.00	
DA1	06°-44'-27"	3315	305	1077	23.00	16.00	
DS1		3675	360		27.00	9.40	
DS1		3973	298		23.00	13.00	
DS1		4253	280		29.00	9.00	
DS1		4535	282		19.00	17.00	
DS1		4963	428		27.00	9.00	
DA1		5269	306		17.00	10.20	
DA1		5903	634		25.00	9.00	
DA1		6193	290		21.00	13.00	
DA1		6783	590		21.00	9.00	Haro river crossing. The level of sag of conductor is lower (El. 292.6 m) than the high flood level (El. 297 m) in the river. The submergence of the conductor at high flood is dangerous. Correction will incorporated in the final design.
DS1		7023	240		23.00	16.00	
DS1		7373	350		27.00	9.80	
DS1		7613	240		17.00	15.40	
DS1		8063	450		23.00	9.00	
DS1		8307	244		17.00	12.00	
DA1		8803	496		21.00	14.60	
DD1	31°-39'-30"	9167	364	5852	21.00	11.00	
DS1		9575	408		21.00	9.00	
DS1		9903	328		19.00	11.20	
DS1		10287	384		23.00	9.00	
DS1		10573	286		23.00	12.80	
DS1		10913	340		17.00	13.00	
DS1		11239	326		23.00	9.80	
DS1		11543	304		21.00	9.80	
DS1		11857	314		17.00	8.00	Ledge at RD 11793 will be cut by 2 m to achieve required clearance.
DS1		12113	256		27.00	9.80	
DA1		12603	490		21.00	8.80	Ledge at RD 12553 will be cut by 1 m to achieve required clearance.
DA1		12983	380		23.00	13.00	
DS1		13343	360		21.00	10.60	
DS1		13683	320		21.00	13.00	
DS1		14043	360		21.00	11.80	
DS1		14357	314		21.00	11.80	
DS1		14713	356		21.00	11.40	
DS1		15003	290		19.00	10.00	
DS1		15375	372		19.00	13.80	
DS1		15711	336		21.00	9.40	
DS1		16043	332		21.00	13.00	
DA1	08°-53'-18"	16348	305	7181	19.00	11.00	
DS1		16633	285		17.00	18.40	
DS1		16903	270		19.00	12.80	
[illegible]	07°-00'-20"	17188	[illegible]		19.00	18.00	
[illegible]		[illegible]	[illegible]	[illegible]	16.00	14.00	
DS1		17538	380		21.00	9.20	
DS1		17893	354		27.00	10.80	
DS1		18243	350		23.00	13.20	

TABLE 2.7
LOCATION OF TOWERS
Barotha-Rewat Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DS1		18465	222		19.00	15.00	
DS1		18947	482		23.00	4.00	The ground clearance of the conductor in back span is 4 m, 7 m, 7 m & 5 2 at RDs 18542, 18582, 18698 & 18713, respectively. Either the towers will be raised or peaks will be truncated to get the desired clearance of 9 m
DS1		19183	236		19.00	14.00	
DS1		19583	400		17.00	9.00	
DS1		19883	300		19.00	10.00	
DS1		20233	350		25.00	9.00	
DA1		20603	370		21.00	10.00	
DA1		21073	470		23.00	9.00	
DS1		21547	474		21.00	9.00	
DS1		21803	258		27.00	18.00	
DS1		22073	270		23.00	9.00	
DS1		22493	420		19.00	9.00	
DS1		22713	220		17.00	12.00	
DS1		22983	270		19.00	13.00	
DS1		23363	380		21.00	12.00	
DS1		23693	330		19.00	12.40	
DS1		23993	300		17.00	11.00	
DA1	19°-11'-00"	24264	271	7105	21.00	13.00	
DS1		24643	379		21.00	11.00	
DS1		25013	370		21.00	9.00	
DD1	38°-31'-20" (R)	25323	310	1059	17.00	12.60	
DS1		25689	366		23.00	9.00	
DS1		26023	334		19.00	13.00	
DA1	18°-36'-50"	26356	333	1033	21.00	11.00	
DS1		26840	484		21.00	10.00	
DS1		27086	246		23.00	16.00	
DS1		27486	400		25.00	9.00	
DS1		27726	240		17.00	12.00	
DS1		28006	280		23.00	11.50	
DS1		28246	240		23.00	16.00	
DA1		28746	500		21.00	8.00	Ledge at RD 28536 will be cut by 1 m to achieve required clearance
DS1		29126	380		23.00	8.00	Ledge at RD 28982 will be cut by 1 m to achieve desired clearance.
DS1		29496	370		21.00	12.00	
DS1		29868	370		29.00	9.00	
DS1		30136	270		25.00	17.00	
DS1		30546	410		21.00	9.00	
DS1		30856	310		25.00	14.00	
DA1		31046	190		29.00	24.00	
DA1		31616	570		29.00	?	Broken area, ground levels not marked on plan & profile. Projection of ground levels from back & forward spans indicate that the conductors are touching the ground This section will be redisigned
DS1		31866	250		19.00	18.00	
DS1		32190	324		17.00	11.00	
DD1	20°-38'-18" (R)	32565	375	6709	21.00	10.60	
DS1		32922	357		21.00	10.00	
DS1		33236	314		23.00	10.00	
DS1		33556	320		21.00	11.80	

TABLE 2.7
LOCATION OF TOWERS
Barotha-Rewat Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DA1		33946	390		27.00	16.00	
DA1		34506	560		23.00	8.00	Ledge at RD 34126 will be cut by 1 m to achieve desired clearance.
DS1		34796	290		17.00	11.00	
DS1		34996	200		17.00	13.00	
DS1		35354	358		17.00	12.00	
DS1		35706	352		25.00	12.00	
DS1		36052	346		23.00	9.00	
DS1		36402	350		23.00	9.00	
DS1		36710	308		17.00	14.00	
DS1		37026	316		25.00	13.00	
DS1		37384	358		21.00	9.00	
DS1		37746	362		21.00	9.00	
DS1		38066	320		27.00	16.00	
DS1		38426	360		29.00	18.00	
DS1		38796	370		21.00	12.00	
DD1	22°-13'-00"	39118	322	8553	19.00	13.00	
DS1		39476	358		21.00	10.00	
DS1		39846	370		21.00	10.00	
DS1		40156	320		21.00	13.00	
DA1		40546	390		21.00	6.40	The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. 6.4 m clearance may not affect herding, if any.
DA1	11°-53'-20" (R)	40735	189	1617	23.00	12.00	
DD1	15°-22'-00"	41326	591	591	19.00	9.00	
DA1		41586	260		21.00	9.00	
DS1		41906	320		19.00	12.00	
DS1		42160	254		21.00	13.00	
DS1		42436	276		17.00	10.60	
DS1		42616	180		17.00	14.00	
DS1		42976	360		17.00	9.00	
DS1		43296	320		21.00	9.00	
DS1		43616	320		19.00	11.00	
DA1		43906	290		17.00	13.80	
DA1	05°-34'-06" (R)	44197	291	2871	19.00	5.40	The ground of the back span is very sleep, therefore it is unlikely to be used for agricultural purposes 5.4 m clearance may not affect herding, if any.
DS1		44581	384		25.00	9.00	
DS1		44866	285		29.00	21.00	
DS1		45082	216		21.00	25.00	
DS1		45506	424		19.00	10.00	
DS1		45796	290		29.00	16.00	
DS1		45984	188		29.00	26.00	
DS1		46436	452		17.00	10.40	
DS1		46706	270		17.00	10.80	
DS1		46956	250		21.00	12.80	
DS1		47338	382		21.00	12.60	
DS1		47566	228		19.00	15.80	
DS1		47950	384		21.00	9.00	
DS1		48236	286		21.00	12.00	
DS1		48666	430		23.00	8.00	
DS1		48026	260		21.00	9.00	
DD1	40°-[illegible]-00" (R)	48257	331	[illegible]	18.00	[illegible]	Change has been provided from RD 48257 to 62020. [illegible] have been made accordingly.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
DS1		49372	315		21.00	11.00	

TABLE 2.7
LOCATION OF TOWERS
Barotha-Rewat Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DS1		49980	414		23.00	8.40	Peak at RD 49032 will be cut by 1 m to achieve desired clearance.
DS1		50306	320		21.00	14.40	
DS1		50716	410		23.00	10.60	
DS1		51026	310		19.00	10.80	
DS1		51396	370		21.00	9.00	
DS1		51696	300		21.00	13.00	
DA1	17°-14'-45" (R)	52021	325	2764	17.00	10.40	
DA1		52289	268		27.00	13.00	
DA1		52593	304		17.00	15.00	* There are two alternative proposals for tower location between RDs 52289 & 52969. In case of Option 1 an additional tower is provided at RD 52593, while in option 2, no tower is proposed at this RD. * The peak of the hill at tower location will be cut by 6 meters to achieve the desired clearance and solid ground for foundation.
DD1		52969	376		21.00	5.00	* The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. A clearance of 5 m may not affect herding, if any. * Back span is for alternative # 1. In case, alternative 2 is adopted, the tower at RD 52593 will not be provided. As such, the back span will be 680 m, which may not be recommended for safety reasons. Therefore, alternative 1 will be adopted.
DA1		53329	360		29.00	6.00	* The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. Six m clearance may not affect herding, if any.
DA1		53729	400		17.00	6.00	* The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. Six m clearance may not affect herding, if any. * The peak at the tower site will be cut by 5 meters to erect tower on solid ground.
DA1		53913	184		17.00	15.80	* The peak at the tower site will be cut by 3 meters to erect tower on solid ground.
DA1		54439	526		23.00	5.00	* The ground of the back span is very steep & rocky, therefore it is unlikely to be used for agricultural purposes. Five m clearance may not affect herding, if any.
DS1		54759	320		21.00	11.00	

TABLE 2.7
LOCATION OF TOWERS
Barotha-Rewat Double Circuit I & II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DS1		55129	370		21.00	9.00	* The tower is located in a depression. The area is needed to checked. * Vertical clearance is 9 m, but diagonally 8.4 m. May need raising of conductor.
DS1		55429	300		21.00	13.00	
DS1		55799	370		21.00	11.60	
DS1		56089	290		21.00	11.00	
DA1		56539	450		25.00	12.60	
DD1	?	56882	343	4861	19.00	12.40	End of Barotha-Rewat Double Circuit Section 1 (from Barotha to Tarnol-Fateh Jang Road). Further extension is the last piece of Double Circuit till Rewat Grid Station.
DD1	05°-09'-00" (R)	0	0				End of Single Circuits I & II and start of Barotha-Rewat Double Circuit Section 2.
DS1		350	350		21.00	11.00	
DS1		740	390		21.00	11.00	
DA1		1023	283		23.00	15.00	
DD1	48°-15'-16" (R)	1432	409	1432	29.00	10.60	
DS1		1820	388		23	15	
DD1	11°-46'-38" (R)	2108	288	676	21	10.6	According to last RD of 2108, the back span comes to 288 m. However, tower to tower distance as marked on the profile is 388 m. As such last RD comes to 2188.
Gantry		2188	60				Rewat Gridstation

Note:
DD1 — Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
DA1 — Double Circuit Mild Angle Tower, with Angle < 20°
DS1 — Double Circuit Suspension Tower

TABLE 2.8
LOCATION OF TOWERS
Barotha-Rewat Single Circuit I

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DD1	49°-45'-00" (L)	0	0		17		End tower of Barotha Rewat Double Circuit Section 1
DGM	38°-44'-50" (R)	298	298	298	19.25	15.00	
SGM		540	242		21.00	9.00	
SGM		910	370		18.00	13.00	
SGM		1286	376		21.00	15.00	
SGM		1598	312		19.50	9.00	
AGM	17°-46'-45" (L)	1929	331	1631	19.25	10.00	
AGM		2270	341		19.25	9.00	
SGM		2600	330		21.00	9.00	
SGM		3024	424		22.50	9.00	Nine meters vertical distance from water level of pond
SGM		3390	366		21.00	13.00	
SGM		3750	360		21.00	9.00	
SGM		3964	214		22.50	14.00	
SGM		4340	370		18.00	10.00	
SGM		4600	260		21.00	12.00	
SGM		4940	340		18.00	10.00	
SGM		5240	300		22.50	11.00	
DGM	49°-59'-15" (L)	5576	336	3647	19.25	12.00	
SGM		5910	334		21.00	9.00	
SGM		6206	296		21.00	9.00	
SGM		6500	294		21.00	9.00	
SGM		6820	320		19.50	11.00	
SGM		7148	328		18.00	11.00	
SGM		7500	352		21.00	9.00	
SGM		7850	350		21.00	12.00	
SGM		8230	380		21.00	9.00	
SGM		8536	306		19.50	11.00	
SGM		8934	398		21.00	10.00	
SGM		9316	382		21.00	9.00	
SGM		9690	374		21.00	11.00	
SGM		9940	250		22.50	15.00	
SGM		10300	360		25.50	9.00	
SGM		10600	300		18.00	12.00	
AGM	7°-07'-25" (R)	10891	291	5315	23.80	11.00	
SGM		11186	295		19.50	11.00	
SGM		11600	414		21.00	9.00	
SGM		11976	376		22.50	10.00	
SGM		12360	384		22.50	9.00	
SGM		12620	260		18.00	15.00	
SGM	1°-03'-10" (L)	12957	337	2066	18.00	[illegible]	
SGM		13226	269		21.00	16.00	
SGM		13580	354		21.00	11.00	
SGM		13976	396		22.50	10.00	
SGM		14266	290		22.50	9.00	

TABLE 2.8
LOCATION OF TOWERS
Barotha-Rewat Single Circuit I

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
DGM	0°-23'-00" (R)	14727	461	2107	17.65	7.00	* Vertical clearance along the sloping ground is 9 m, but perpendicular to the ground is 7 m. The area is under the forest, which may be occasionlly used for herding and borrowing feulwood. The acquired perpendicular clearance may not obstruct these activities. * Cutting of conical cliff of hill will be done for the construction of foundation
AGM		15136	409		20.70	6.00	Vertical clearance along the sloping ground is 9 m, but perpendicular to the ground is 6 m. This may not affect the people and animals on the ground for the reasons mentioned for RD 14727.
SGM		15516	380		30.00	14.00	
SGM		15836	320		27.00	9.00	
SGM		16276	440		25.50	10.00	
SGM		16626	350		27.00	14.00	
SGM		17076	450		25.50	9.00	
SGM		17306	230		27.00	17.00	
AGM		17886	580		26.80	5.00	Cutting of conical peak of cliff will be done to get the required clearance.
SGM		18336	450		27.00	9.00	
SGM		18574	238		31.50	22.00	
SGM		18836	262		21.00	9.00	
SGM		19176	340		27.00	5.00	Cutting of conical peak of cliff will be done to get the required clearance.
SGM		19456	280		31.50	6.00	Cutting of conical peak of cliff will be done to get the required clearance.
AGM		19656	200		26.80	18.00	Diversion will be provided from RD 19656-20896 for spotting towers on suitable locations.
SGM		20986	330		21.00		Vertical clearance not known due to diversion.
AGM		21325	339			-	
SGM		21678	353		19.25	9.50	
SGM		21956	278		21.00	9.00	
SGM		22236	280		18.00	14.00	
SGM		22598	362		18.00	11.00	
SGM		22836	238		21.00	10.00	
SGM		23136	300		30.00	9.00	
SGM		23386	250		30.00	10.00	
					30.00	19.00	

TABLE 2.8
LOCATION OF TOWERS
Barotha-Rewat Single Circuit I

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
SGM		23796	410		31.50	9.00	
SGM		24116	320		30.00	9.00	
SGM		24486	370		19.50	14.00	
SGM		24656	170		18.00	13.00	
SGM		24896	240		31.50	16.00	
SGM		25146	250		30.00	9.00	
SGM		25536	390		22.50	13.00	
SGM		25822	286		25.50	9.00	
SGM		26126	304		21.00	8.00	Cutting of conical peak of cliff will be done to get the required clearance.
AGM	17°-59'-43" (L)	26314	188	10178	19.25	15.00	
SGM		26706	392		21.00	10.00	
SGM		27106	400		22.50	7.00	Vertical clearance along the sloping ground is more than 9 m, but perpendicular to the ground is 7 m. This may not affect the people and animal on the ground for the reasons mentioned for RD 14727
SGM		27346	240		22.50	15.00	
SGM		27712	366		22.50	13.00	
SGM		28136	424		21.00	11.00	This portion is crossing Soan River. No tower will be placed in the river.
SGM		28422	286		21.00	15.00	
SGM		28806	384		21.00	11.00	
SGM		29094	288		27.00	12.00	
SGM		29566	472		27.00	9.00	
DGM	53°-11'-08" (L)	29834	268	3520	17.65	12.00	Cutting of conical cliff of hill will be done for the construction of foundation
SGM		30166	332		22.50	11.00	
SGM		30566	400		22.50	9.00	
SGM		30846	280		30.00	18.00	
SGM		31366	520		25.50	9.00	
SGM		31646	280		21.00	16.00	
SGM		32026	380		21.00	10	
SGM		32396	370		21.00	9.00	
SGM		32746	350		21.00	9.00	
SGM		33140	394		21.00	9.00	
SGM		33530	390		21.00	9.00	
SGM		33936	406		21.00	9.00	
SGM		34336	400		19.50	10.00	
SGM		34666	330		21.00	10.00	
SGM		35056	390		31.50	9.00	
SGM		35456	400		21.00	9.00	
SGM	—	35746	290		21.00	17.00	
SGM		36066	320		25.50	9.00	
SGM		36278	210		24.00	22.00	
DGM	22°-22'-00" (R)	36513	237	6679	22.50	10.00	
SGM		36906	393		28.50	18.00	

TABLE 2.8
LOCATION OF TOWERS
Barotha-Rewat Single Circuit I

Type of Tower	Offset Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in back span (m)	Remarks
SGM		37298	392		21.00	9.00	Cutting of conical cliff of hill will be done for the construction of foundation.
SGM		37576	278		18.00	11.00	
SGM		37951	375		21.00	11.00	
SGM		38266	315		21.00	10.00	
SGM		38616	350		22.50	10.00	
SGM		38970	354		19.50	12.00	
SGM		39316	346		18.00	12.00	
AGM	13°-53'-20" (L)	39587	271	3074	16.15	12.00	
SGM		39906	319		31.50	8.00	Vertical clearance along the sloppy ground is more than 9 m, but perpendicular to the ground is 8 m. This may not affect the people and animal on the ground for the reasons mentioned for RD 14727
SGM		40396	490		25.50	9.00	
SGM		40686	290		21.00	10.00	
SGM		41036	350		27.00	9.00	
SGM		41336	300		27.00	9.00	
SGM		41716	380		30.00	9.00	
SGM		42126	410		25.50	9.00	
SGM		42476	350		21.00	10.00	
SGM		42736	260		18.00	11.00	
SGM		42936	200		19.50	11.00	
SGM		43176	240		19.50	9.00	
SGM		43582	406		18.00	11.00	
SGM		43866	284		18.00	10.00	
SGM		44206	340		22.50	11.00	
SGM		44606	400		19.50	9.00	
SGM		44806	200		19.50	15.00	
SGM		45146	340		21.00	11.00	
DGM	23°-19'-00" (L)	45476	330	5889	20.70	10.00	
SGM		45946	470		21.00	9.00	
DD1	05°-09'-00" (R)	47712	1766	2236			* Diversion will be provided for crossing over 220 kV (Mangla- Burhan) transmission lines (3 Nos.). * End of single circuit 1 at RD 47712 & start of double circuit Barotha -Rewat Double circuit section 2.

Note:
- DD1 — Tarbela-Lahore Type Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
- DGM — Guddu-Multan Type Single Circuit Dead End Tower, without or with Angle > 20° but < 60°
- AGM — Guddu-Multan Type Single Circuit Mild Angle Tower (Angle < 20°)
- SGM — Guddu-Multan Type Single Circuit SuspensionTower

TABLE 2.9
LOCATION OF TOWERS
Barotha-Rewat Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in backspan (m)	Remarks
DD1	05°-47'-00" (R)	0	0		17		End tower of Barotha Rewat Double Circuit Segment I.
DGM	32°-27'-25"	327	327	327	19.25	17.00	
SGM		620	293		25.50	9.00	
SGM		1116	496		21.00	10.00	
SGM		1420	304		21.00	10.00	
SGM		1770	350		21.00	15.00	
AGM	16°-27'-10" (L)	2101	331	1774	19.25	11.00	
AGM		2440	339		19.25	10.00	
SGM		2846	406		22.50	9.50	
SGM		3180	334		21.00	12.50	
SGM		3568	388		22.50	9.00	
SGM		3920	352		27.00	13.00	
SGM		4360	440		25.50	9.00	
SGM		4730	370		21.00	11.00	
SGM		5150	420		18.00	9.00	
SGM		5500	350		22.50	9.00	
SGM		5780	280		19.50	9.50	
AGM	17°-56'-45" (L)	6080	300	3979	17.65	11.00	
SGM		6392	312		22.50	13.00	
SGM		6764	372		31.50	5.00	Cutting of conical peak of a cliff will be done to get desired clearance.
SGM		7150	386		31.50	11.00	
SGM		7510	360		18.00	15.00	
DGM	38°-00'-35" (L)	7790	280	1710	19.25	11.50	
SGM		8260	470		19.50	9.00	
SGM		8520	260		18.00	9.00	
SGM		8830	310		21.00	11.00	
SGM		9220	390		22.50	9.00	
SGM		9580	360		25.50	9.50	
SGM		9920	340		21.00	11.00	
SGM		10276	356		19.50	10.00	
SGM		10610	334		18.00	10.00	
SGM		10840	230		18.00	15.00	
SGM		11220	380		21.00	9.00	
SGM		11490	270		18.00	15.00	
SGM		11720	230		21.00	11.00	
SGM		12060	340		19.50	11.00	
SGM		12390	330		21.00	11.00	
AGM	05°-28'-40" (R)	12697	307	4907	17.65	10.00	Tower is located at the edge of a terrace. For safety reason the tower will be shifted
AGM		12978	281		17.25	12.00	
AGM		13348	370		23.70	11.00	

TABLE 2.9
LOCATION OF TOWERS
Barotha-Rewat Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in backspan (m)	Remarks
DGM		13932	584		17.65	5.00	* Hilly area (Khairi Murat range). The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. Five meter clearance may not affect herding, if any.
DGM		14424	492		17.65	4.00	* Hilly area (Khairi Murat range). * The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. Four meter clearance may not affect herding, if any.
DGM		14646	222		17.65	8.00	* Hilly area (Khairi Murat range) * Peak will be truncated for construction of foundation.
DGM		14784	138		22.25	6.00	* Hilly area (Khairi Murat range) * The ground of the back span is very steep, therefore it is unlikely to be used for agricultural purposes. Six meter clearance may not affect herding, if any * Tower is located on very steep slope of the hill
DGM		15478	694		20.70	9.00	
AGM		15838	360		28.35	13.00	* Clearance of motorway from conductor is 13 m.
SGM		16268	430		21.00	10.00	
SGM		16618	350		12.50	11.00	
SGM		17078	460		25.50	10.00	
SGM		17428	350		18.00	16.00	
SGM		17738	310		21.00	11.00	
SGM		18188	450		25.50	9.00	
SGM		18548	360		18.00	13.00	
AGM		18928	380		28.35	9.00	
AGM		19400	472		19.25	1.50	
AGM		19878	478		28.35		Ground elevation of this area is not available.
SGM		20168	290		31.50		Ground elevation of this area is not available.
AGM		20538	370		25.35		Ground elevation of this area is not available.
AGM		20946	408		16.15	9.50	
SGM		21248	302		18.00	13.00	

TABLE 2.9
LOCATION OF TOWERS
Barotha-Rewat Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in backspan (m)	Remarks
AGM		21612	364		26.80	12.00	
AGM		22038	426		28.35	11.00	
SGM		22548	510		22.50	13.00	
SGM		22808	260		21.00	10.00	
SGM		23028	220		21.00	10.00	
AGM		23478	450		26.80	12.50	
SGM		23908	430		31.50	10.00	
SGM		24128	220		21.00	20.00	
SGM		24386	258		31.50	16.00	
SGM		24878	492		31.50	9.00	
SGM		25178	300		25.50	12.00	
SGM		25628	450		21.00	7.00	Cutting of conical peak of a cliff will be done to get desired clearance.
SGM		25928	300		31.50	14.00	
SGM		26318	390		31.50	9.00	
SGM		26728	410		27.00	18.00	
SGM		27108	380		31.50	9.00	
SGM		27508	400		31.50	19.00	
SGM		27768	260		31.50	8.30	For desired clearance cutting of hillock will be done.
SGM		28018	250		22.50	22.00	
SGM		28368	350		27.00	20.00	
SGM		28698	330		22.50	18.00	
SGM		29144	446		25.50	10.00	Crossing of Soan River. No tower is placed in the river.
SGM		29508	364		27.00	16.00	
SGM		29838	330		22.50	14.00	
DGM	21°-38'-37" (L)	30248	410	17551	19.25	9.00	
SGM		30640	392		25.50	10.00	
SGM		31028	388		27.00	9.00	
DGM	27°-10'-29" (L)	31336	308	1088	16.15	12.00	
SGM		31708	372		18.00	10.00	
SGM		32080	372		25.50	14.00	
SGM		32508	428		21.00	9.00	
SGM		32798	290		27.00	16.00	
SGM		33308	510		31.50	9.00	
SGM		33592	284		25.50	22.00	
SGM		34038	446		22.50	10.00	
SGM		34382	344		18.00	15.00	
SGM		34698	316		27.00	11.00	

TABLE 2.9
LOCATION OF TOWERS
Barotha-Rewat Single Circuit II

Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in backspan (m)	Remarks
SGM		35088	390		22.50	7.00	Vertical clearance along the sloping ground is 9 m, but perpendicular to the ground is 7 m. The area is under the forest, which may be occasionally used for herding and borrowing feulwood. The acquired perpendicular clearance may not obstruct those activities.
AGM	01°-00'-00" (R)	35324	236		17.65	8.00	Vertical clearance along the sloping ground is 15 m, but perpendicular to the ground is 8 m. This may not affect the people and animal on the ground for the reason mentioned for RD 35088.
AGM		35868	564		28.35	8.00	
DGM		36548	660		28.35	6.00	Vertical clearance along the sloping ground is 9 m, but perpendicular to the ground is 6 m. This may not affect the people and animal on the ground for the reason mentioned for RD 35088.
SGM		37088	540		18.00	9.00	
SGM		37308	220		18.00	13.00	
SGM		37758	450		25.50	9.00	
SGM		38078	320		28.50	24.00	
AGM		38558	480		22.50	9.00	
SGM		38898	340		31.50	18.00	
SGM		39338	440		31.50	7.00	Vertical clearance along the sloping ground is 9 m, but perpendicular to the ground is 7 m. This may not affect the people and animal on the ground for the reason mentioned for RD 35088.
SGM		39648	310		21.00	18.00	
SGM		40018	370		22.50	9.00	
SGM		40338	320		30.00	18.00	
SGM		40598	260		31.50	9.00	
SGM		40928	330		30.00	11.00	
SGM		41398	470		25.50	20.00	
SGM		41598	200		21.00	22.00	

TABLE 2.9
LOCATION OF TOWERS
Barotha-Rewat Single Circuit II

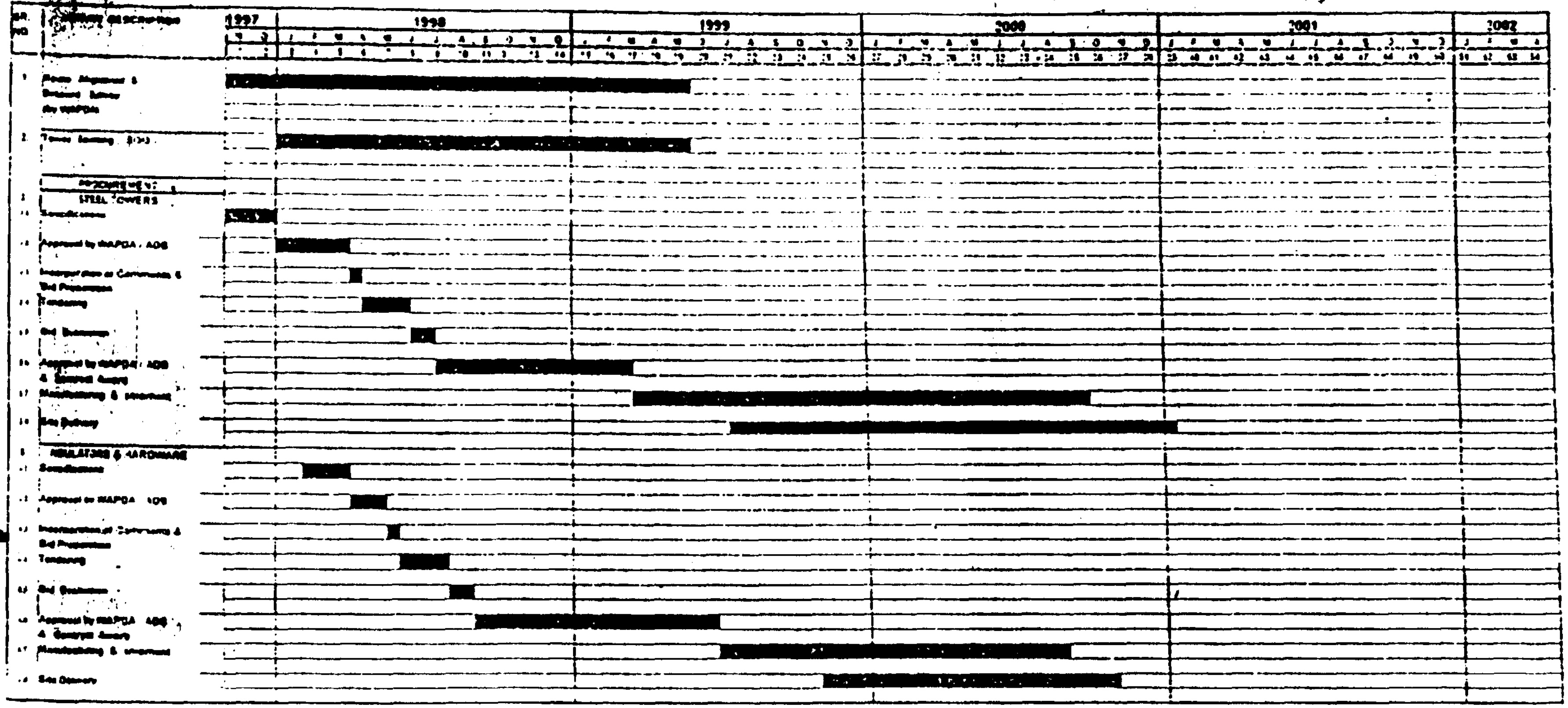
Type of Tower	Offset-Angle of Transmission Line	Reduced Distance (m)	Tower to Tower Offset (m)	Distance Between Angle Towers (m)	Tower Height (m)	Minimum Clearance of Conductor from Ground in backspan (m)	Remarks
SGM		42066	468		22.50	7.00	Vertical clearance along the sloping ground is 8 m at this point, but perpendicular to the ground is 7 m. This may not affect the people and animal on the ground for the reason mentioned for RD 35088
SGM		42348	282		21.00	19.00	
SGM		42768	420		27.00	9.00	
SGM		43018	250		31.50	13.00	
SGM		43268	250		27.00	22.00	
SGM		43588	320		21.00	10.00	
SGM		43848	260		18.00	14.00	
SGM		44110	262		27.00	15.00	
SGM		44508	398		31.50	10.00	
SGM		44758	250		18.00	15.00	
SGM		45058	300		25.50	13.00	
SGM		45508	450		27.00	9.00	
SGM		45848	340		21.00	13.00	
SGM		46228	380		22.50	9.00	
SGM		46468	240		18.00	13.00	
SGM		46778	310		27.00	16.00	
SGM		47156	378		22.50	11.00	
DGM	41° 56'-00" (L)	47538	382		17.65	9.00	
SGM		47858	320		18.00	11.00	
SGM		48228	370		31.50	11.00	
SGM		48498	270		31.50	33.00	
SGM		48728	230		18.00	17.00	
DGM		49048	320		19.25	12.00	
DD1		49299	251		19.00	12.00	Start of Barotha-Rewat Double Circuit Segment 2 near Rewat Grid Station

Note:

DD1	Tarbela Lahore Type Double Circuit Dead End Tower, without or with Angle > 20° but < 60°
DGM	Guddu-Multan Type Single Circuit Dead End Tower, without or with Angle > 20° but < 60°
AGM	Guddu-Multan Type Single Circuit Mild Angle Tower (Angle < 20°)
SGM	Guddu-Multan Type Single Circuit Suspension Tower

TABLE 2-10

GHAZI BAROTHA HYDRO POWER PROJECT
IN & OUT ARRANGEMENT OF TARBELA - GATTI
500 KV TRANSMISSION LINES AT BAROTHA
(ADB LOAN NO. 1424 - PAK)
ENGINEERING AND CONSTRUCTION SCHEDULE



SCHEDULE

TABLE 2-10

GHAZI BAROTHA HYDRO POWER PROJECT
IN & OUT ARRANGEMENT OF TARBELA - GATTI
500 KV TRANSMISSION LINES AT BAROTHA
(ADB LOAN NO. 1424 - PAK)
ENGINEERING AND CONSTRUCTION SCHEDULE

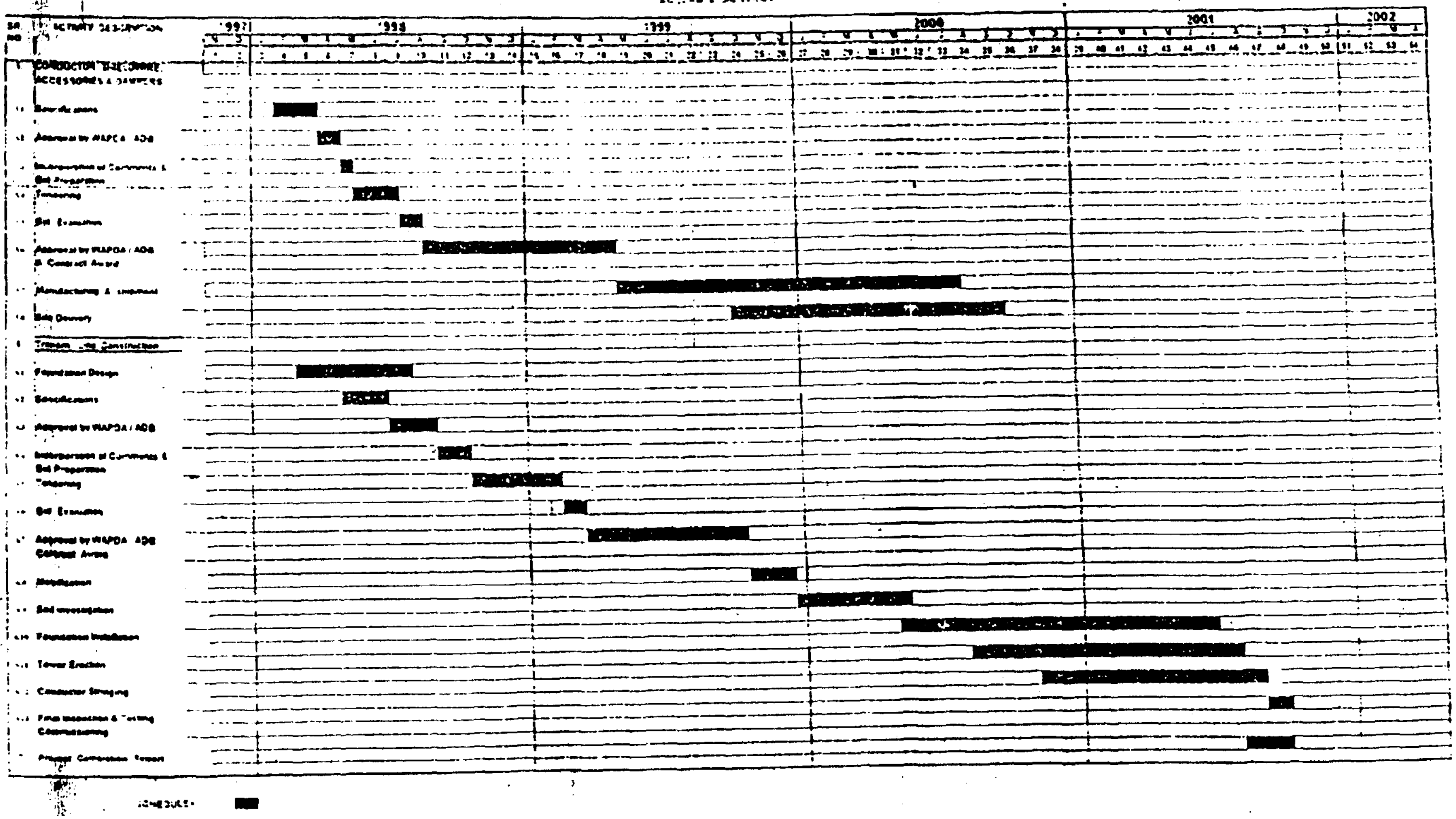


TABLE 2.10

GHAZI BAROTHA HYDRO POWER PROJECT
500 KV BAROTHA - REWAT TRANSMISSION LINE
(Under IDB Loan)
ENGINEERING AND CONSTRUCTION SCHEDULE

REVISION - 2 (15-05-2000)

(S/C 100 KM & D/C 60 KM)

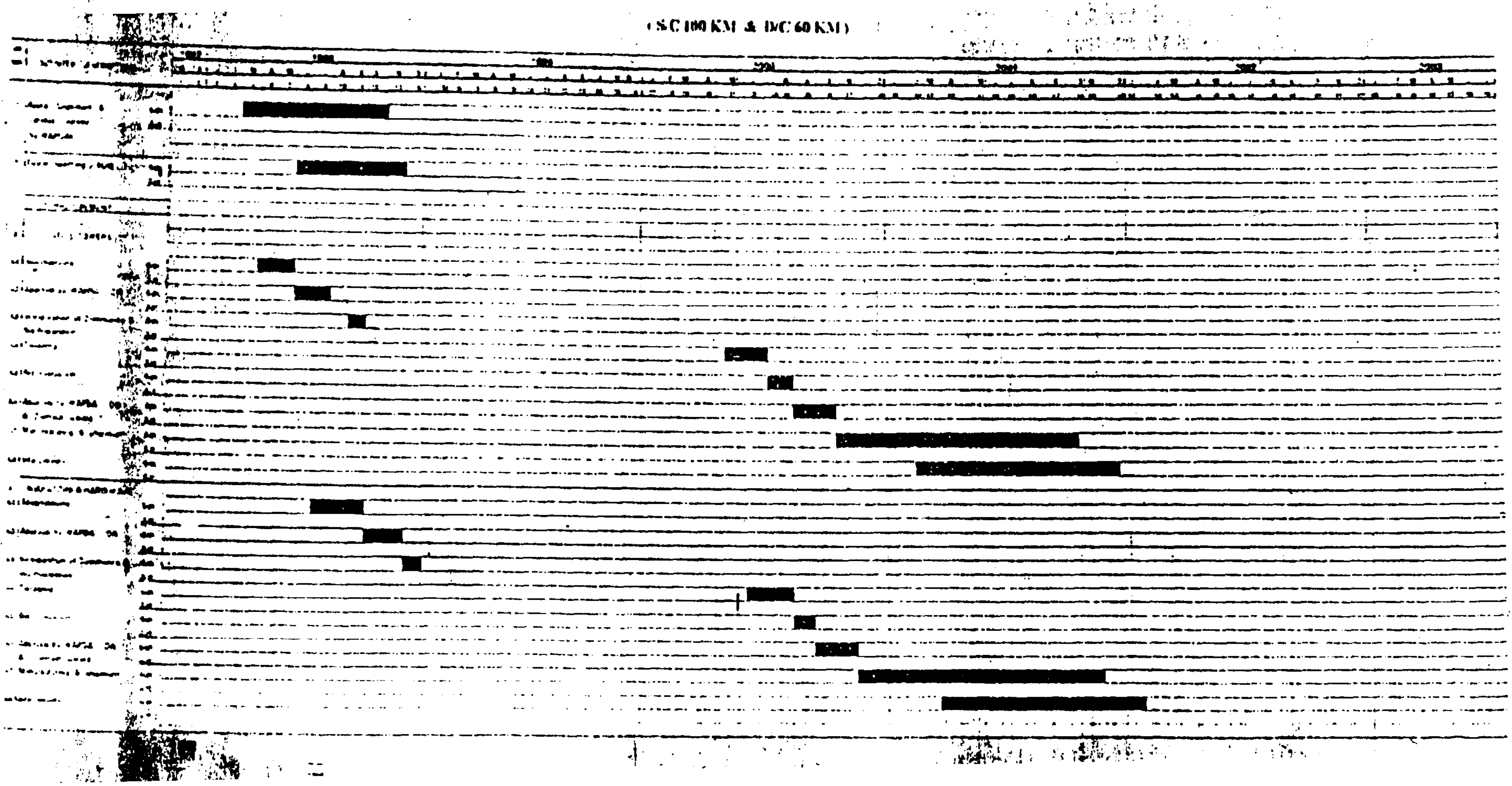
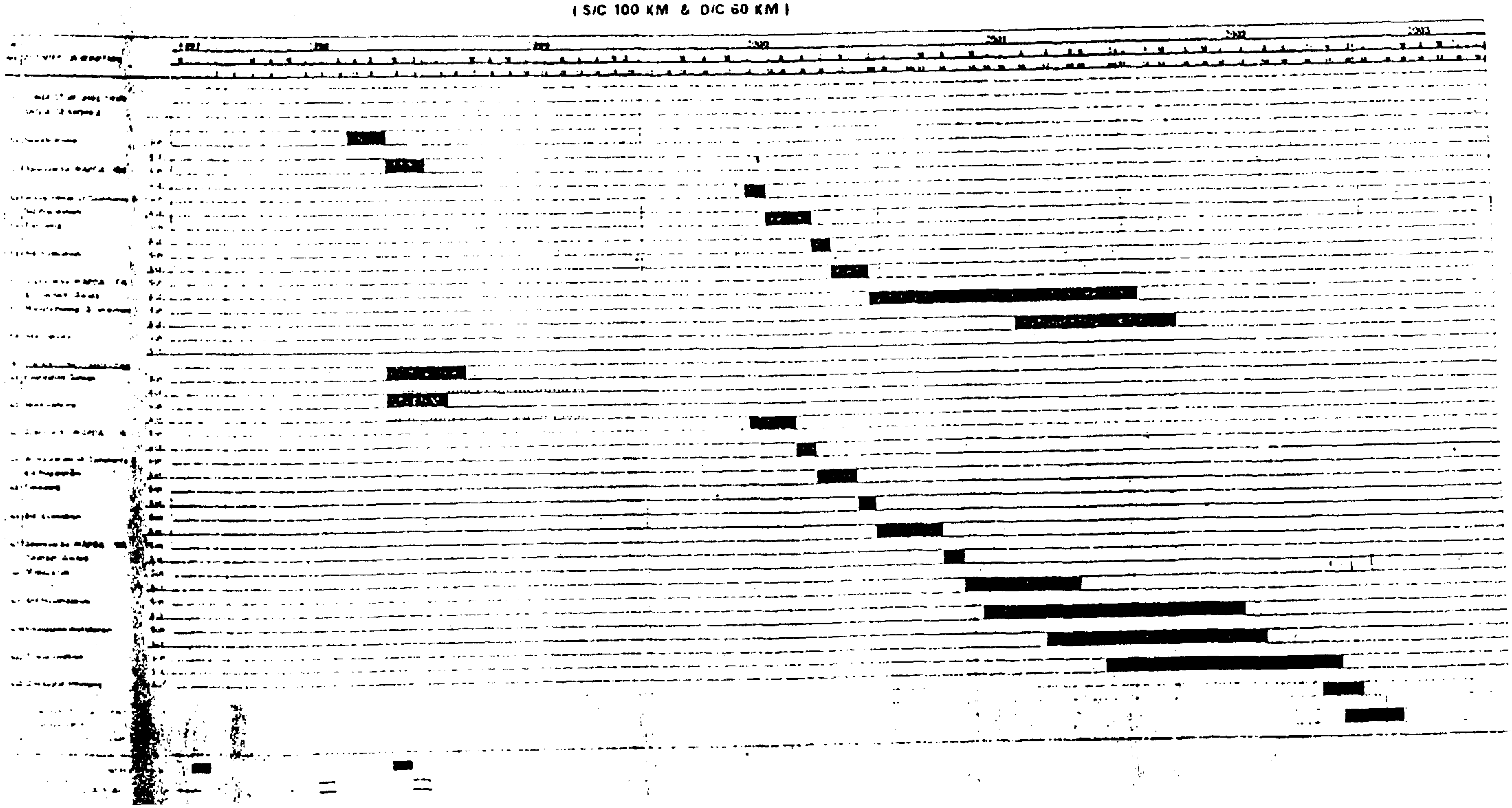


TABLE 2.10

GHAZI BAROTHA HYDRO POWER PROJECT
500 KV BAROTHA - REWAT TRANSMISSION LINE
(Under IDB Loan)
ENGINEERING AND CONSTRUCTION SCHEDULE

REVISION 2 (15-05-2000)

(S/C 100 KM & D/C 60 KM)



CHAPTER 3

BASELINE CONDITIONS OF THE PROJECT AREA

CHAPTER 3

BASELINE CONDITIONS OF THE PROJECT AREA

3.1 DEFINITION OF THE PROJECT AREA

The proposed alignment of the power dispersal system covered under the present study lies between 33° 46' north and 33° 28' north, and between 72° 14' east and 73° 11' east. The alignment of the transmission lines will generally follow a direction from west to east, Barotha lying in the west and Rewat in the east.

In general, the area of Project influence will be limited to a 50-m wide corridor along the transmission lines. During construction period, however, this may be more than the specified corridor (Chapter 2). As a principal, WAPDA will instruct the contractor to restrict the major construction activities within the corridor. However, the movement of vehicles for transportation of material can not be limited within the corridor. Generally, for this purpose metalled roads and village tracks will be used which are spread over many miles away from the corridor. Moreover, the contractor would need to develop some more approaches where existing tracks are not available. As such, it is difficult to specify the area that is likely to be affected by the construction-related traffic.

For the purpose of this report, however, a corridor of 2-km width along the transmission lines has been selected to overview the effects of the Project on social environment of the area, particularly with reference to the traffic. Therefore, the settlements selected for scoping sessions and socioeconomic surveys extend to about one kilometer on each side of the proposed alignment of the transmission lines. For other environmental aspects, however, a corridor of 100-m width has been selected. This is because that in exceptional case the construction activities may extend beyond the specified 50-m wide corridor.

As referred earlier in Section 2.4.4, should there be a need, the adjustment in the tower location is done in the longitudinal section of the alignment rather than in the transverse section. However, if required otherwise, it would be limited within the specified 50-m corridor.

The subsequent sections describe the baseline conditions of the area of Project influence according to the above-narrated criteria.

3.2 GEOGRAPHY

3.2.1 Physiography

The Project area forms the northwestern part of the Pothwar Plateau, extending from Indus River to beyond Soan River. The area is characterised by high hills, highly eroded land and undulating loess plains dissected by large number of deep drainage channels. Very limited area of the Project may be designated as level plains. Besides scattered hillocks in the Project area, there are two mountain ranges, Kala-Chitta and

Khairi Murat. The detailed account of the Physiography of the Project area is given subsequently when dealing with the land resources.

3.2.2 Settlement Pattern

Three sets of the transmission lines (Incoming & Outgoing lines of Tarbela-Gatti I & II, and two Barotha-Rewat lines) will traverse through two tehsils (Attock and Fatehjang Subdivisions) of District Attock and one tehsil (Rawalpindi Subdivision) of District Rawalpindi. These will pass through the land areas of 54 villages. Of these, 15 villages fall in Tehsil Attock, 19 in Tehsil Fatehjang and 20 in Tehsil Rawalpindi.

In spite of the fact that the major part of the population in the Project area reside in central settlements of the villages, there are quite large number of out-reach settlements spread over the vast land areas of the villages. These out-reach settlements may comprise a single abode or a cluster of tens of houses. There may be many reasons for such settlement pattern. However, the survey has indicated that there are two main reasons for this. Firstly, the high prices of the land near the main settlements of the villages forced the people to move the abodes of their expanded families in their land area. Secondly, the topography of the land is generally so rugged that the people face difficulty in travelling for their routine agricultural activities, herding and collection of fuel-wood. These out-reach settlements are generally given the names after the titles of the notables with a prefix of Dhok or Bahek.

With a few exceptions, the alignments of the transmission lines generally avoid main settlements of the villages. However, these pass close-by many Dhoks. Following the referred criteria of the Project influence, about 87 Dhoks/villages fall in 2-km wide corridor of three sets of the transmission lines. Of these, 50 were selected for conducting scoping sessions and 36 for socioeconomic surveys.

Total population of 54 villages, through land area of which the transmission lines will pass, is about 108,839 persons constituting about 13,655 households. This is based on the census[1] carried by GOP in 1998. This includes the population residing in the Dhoks and Baheks. The Census Reports do not give demographic data of the Dhoks. The socioeconomic surveys depict that the 36 Dhoks/villages surveyed have a population of about 12,373 persons constituting about 2,095 households. As such, the proportionate projected population of 87 Dhoks/villages comes to about 29,900 persons constituting about 5,062 households.

3.2.3 Political/Administration Units

The Project falls in Punjab Province of Pakistan, involving its two districts, Attock and Rawalpindi. For the purpose of administration and revenue collection, the districts are subdivided in tehsils. These are further subdivided in Qanungo Halqa and Potwar Circles. Each Potwar Circle includes three to four villages and four to five

[1] Bureau of Statistics, Government of Pakistan; Census Reports of Districts of Attock and Rawalpindi; 1998

Potwar Circles constitute a Qanungo Halqa. Fifty-four villages accommodating the transmission lines fall in thirty-four Potwar Circles and nine Qanungo Halqas.

Besides administration by the establishment of the Government, the area is also administered by the public representatives through Local Government. A Union Council covering four to five villages form the grass-root level unit of the Local Government. Tehsil Councils and District Councils make next higher tiers of this setup. The Project area comes under the jurisdiction of 13 Union Councils, 3 Tehsil Councils and 2 District Councils.

3.3 CLIMATE

3.3.1 General

The northwestern part of the Pothwar Plateau falls in the sub-tropical sub-humid climatic zone of Pakistan. It is characterized by two distinct seasons, summer and winter. Summers are very hot with occasional windstorms during May and June, and heavy monsoon rains during July and August. Winters are cool with rather spares rainfall resulting from cyclonic thunderstorm from the southwest. The transmission lines have been designed keeping in view the prevailing climatic conditions of the Project area. For this, the 30-years (from 1959 to 1988) climatic data for the two concerned districts, Attock and Rawalpindi/Islamabad were kept in view. These are shown in Table 3.1 and discussed in subsequent paragraph.

3.3.2 Rainfall

Attock City receives an average of about 600 mm of rainfall annually. The precipitation increases in east-word direction from Attock, which is the general direction of the routes of the transmission lines. The annual average rainfall in Islamabad/Rawalpindi is over 900 mm. Of the total annual rains in Attock, about 39% are received in July and August, while it is about 51% for Islamabad/Rawalpindi. The summer rains tend to occur relatively brief but intense events. The 30-year rainfall data for Islamabad show that the maximum 24-hour rainfall had been 269 mm in August

3.3.3 Temperature

Table 3.1 depicts the mean-daily maximum and minimum, and extreme temperatures for the cities of Attock and Islamabad for the observation period from 1959 to 1988. June is usually the hottest month with a mean maximum temperature of 34.8° C at Islamabad and 37.9° C at Attock. The record highest temperature at Islamabad and Attock had been 46° C and 48.16° C, respectively, which are much less than the maximum temperature (52.5° C) considered for the design of the transmission lines.

January is the coldest month, with a mean minimum of 2.5° C at Islamabad and 2.18° C at Attock. The record lowest Temperature at Islamabad and Attock had been 3.[illegible] and -3.36° C, respectively, which are within the limit of minimum temperature (-4.6° C) considered for the design of the transmission lines.

3.3.4 Air

The prevailing wind directions are northwest and west. Monthly-mean wind velocities at Islamabad from 1959 to 1988 ranged from 0.53 to 1.50 m/s (1.91 to 5.40 km/h). The maximum wind recorded at Chaklala (near Rawalpindi) since 1959 had been 143 km/h, which is much less than the wind velocity (160 km/hr) considered for the design of the transmission lines.

There is no major source of air pollution in the Project area. Generally, the industries in the region are located along the GT Road leading from Rawalpindi to Attock and Peshawar, which is about 5 km to more than 15 km away from the routes of the transmission lines. Thus, the air quality is good throughout.

3.3.5 Humidity

The area is relatively dry most of the year. The maximum and minimum values of the annual average relative humidity at Rawalpindi/Islamabad are 90% and 25%, respectively. These values for Attock are 63% and 40%. The values for relative humidity generally match the one considered for the design of the transmission lines.

3.4 LAND RESOURCES

3.4.1 Geology

As referred earlier, the Project area forms the part of Pothwar Plateau. The plateau has a complex geological history. The present day geological formations have developed from the deposits of Tertiary and Quaternary eras in a localized geo-syncline, which had it continuation with the much larger Indo-Gangetic Geo-syncline. In geological history, the area was subjected to cycles of mountain building, folding and faulting, alluvial and loess deposition and erosion.

The area is mainly underlain by inter-bedded conglomerates, sandstone, shale and siltstone. It was subjected to the process of mountain building, folding and faulting during the Pliocene and early Pleistocene periods. The periods of uplift and deformation alternated with the periods when erosion was dominant. Later, in the Pleistocene, a mantle of silt, locally mixed with water-laid sand and gravel, was deposited in the irregular troughs that had been carved out by folding of bedrock and erosion. The silt was probably picked up from the alluvial plains along the major rivers outside the area and annually carried to the Pothwar Upland by cyclonic winds before the outbreak of monsoon.

The Haro, Soan and Kanshi Rivers comprise the main drainage of the Pothwar Uplands, having a complex network of tributaries. Unlike the rivers of the Punjab

Plains, the riverbeds lie far below the general level of the land. Consequently erosion has been very active in the plains and has resulted in a network of deep gullies.

The rocks of Kala-Chitta and Khairi Murat ranges belong to Murree and Siwalik series. Generally, these are devoid of active faults and seismic activities. However, these are subjected to landslides due to weathering by rainwater and winds. Therefore, the tower foundation laid down on a stable ground would rarely witness any risk of damage. The experience from the existing 500 kV transmission lines from Tarbela to Gatti that pass over the Kala-Chitta Mountains supports this postulate.

3.4.2 Landforms

Owing to the reasons described above, the Project area exhibits a complex geomorphology. The area is characterized by high hills, highly eroded land and undulating loess plains dissected by large number of deep drainage channels. Drawing 3-1 shows the distribution of various types of landforms in the Project area[2]. This is based on the reconnaissance survey carried by Soil Survey of Pakistan. The statistical data presented in Table 3.2 has been developed from this drawing. The table depicts the stretches (in km) of various transmission lines passing through different landforms. The table shows that the major part (62.2%) of the land area through which the transmission lines will pass is either severely eroded and broken, highly undulating upland or mountainous. About 21.6% of the land constitute dissected loess plains or river terraces. While only about 15.4% of the land are level or nearly level. The agriculture is mostly concentrated on the last two categories of the land. The dissected plains and part of the undulating upland are used for agriculture by developing terraces.

A detailed account of the land formation falling in the corridors of various transmission lines is shown in Tables 3.3 through 3.11. These tables have been developed from the Plan and Profile drawings prepared by the design consultants (M/s NESPAK) based on the detailed survey carried out by WAPDA. The tables enlist land features and type of land along with natural drainage systems encountering in various reaches of the transmission lines. Moreover, the tables also enlist infrastructures falling within 100-m corridor of the transmission lines. In spite of the fact that a 50-m wide corridor is considered for safety reason, a 100-m wide corridor has been selected during survey. This is for allowing any adjustment in the tower location during construction in consideration of foundation problems or for avoiding disruption of infrastructures and other subjects of environmental concerns.

An abstract of the land features shown in tables referred above is given in Table 3.12. Accordingly, about 60% of the stretch of the transmission lines pass through land with hilly terrain, gullies or having moderate to steep slope with broken area. About 39% of the stretch pass through lands, which are either level to nearly level or developed to terraces. These figures almost coincide with those abstracted from the reports of Soil Survey of Pakistan.

[2] Adopted from Reconnaissance Soil Survey Reports for Districts of Campbellpur (Attock) and Rawalpindi prepared by Soil Survey of Pakistan in 1970 and 1967, respectively.

The topography of the area, soil condition and the intensity of rainfall indicate that the lands of Project area are generally susceptible to erosion. This aspect along with the measures taken to minimise the impact from the construction activities is discussed in Section 5.2.1.

3.4.3 Soils

The soils of the Project area are of complex nature derived from the alluvial deposits of local streams, wind-blown loess, and primary soils derived from sandstone and shale. The soil formations are closely associated with landforms[2]. Subsequent paragraphs give a brief account of these soils.

Soils of Wind Deposits: Loess Plains and Dissected Loess Plains are constituted of Guliana, Basal, Bahtar, Qutbal, Missa, Domel, Ragar, Miani and Jabbi Soil Series. Theses soils have developed from the wind deposits of calcareous to non-calcareous nature. Texturally, they vary from Silt Loam to Silt Clay. Jabbi Soil Series is Silt Clay Loam admixed with gravelly material of alluvial origin. The soils are generally deep with week to moderate structure, except Qutbal and Ragar soils that are massive. Some of the calcareous soils, Bahtar, Basal and Domel, contain Kaukar zone at varied depths. As indicated in the section on Landforms, the topography of these soils varies from level to severely dissected. The level soils are used for restricted cropping of wheat, millets, maize and groundnut under dry farming. Partly the soils are also used for vegetables under well irrigation.

Soils of Alluvial Deposits: The landforms of Cover Flood Plains and Dissected River Terraces are constituted of Soan, Khair, Argan and Shahdara Soil Series. These have developed from alluvial deposits of calcareous nature. Soan and Argan soils are old river deposits on Dissected River Terraces and Cover Floodplains, respectively. While Shahdara and Khair soils are recent deposits found in Active Flood Plains. Texturally, they range from sandy loam and loam to silt loam. The soils are generally deep with week to moderate structure. Topography ranges from level to severely dissected. The level soils are used for restricted cropping of wheat, groundnut and sorghum under dry farming and vegetables under well irrigation.

Soils of Primary Origin: Balkassar, Qazian, Kahuta, Tarnaul, Dhulian and Khaur Soil Series are of primary origin developed from the sandstone and shale of Kala-Chitta and Khairi Murat ranges. The associated landforms are Weathered Rock Plains and Ridge and Trough Upland. The soils derived from sandstone include Balkassar, Qazian, Dhulian and Kahuta. Texturally, they range from loamy sand to sandy clays and are generally calcareous. The rest of the soils are derived from shale. These are clay loam to silt clay in texture and are calcareous in nature. The lands are generally undulating, partially developed into terraces for cropping. The soils are used for restricted cropping of wheat inter-cropped with millets, muster oil seeds and pulses.

3.4.4 Land Use and Agriculture

Land Use

The land use information for the Project area is available from three sources, viz., Soil Survey of Pakistan, socioeconomic survey of the Project Corridor carried out under the study and the Revenue Record. The last source provides the land use pattern for the whole of the village area, which does not represent the condition existing in the specified limits of the corridor. As the transmission lines have been so aligned that these pass through the least developed area, the information from the Revenue Record may give a distorted picture of the land use. Therefore, the representative information available from the former two sources has been used for the purpose of this report. Though the land use information from the Soil Survey of Pakistan is rather out dated, a field confirmation has been carried out by reconnaissance of the Project corridor.

Table 3.13 shows the land use distribution of the corridor of the transmission lines, as abstracted from the land use map developed by Soil Survey of Pakistan[2]. Accordingly, the area used for agricultural purposes comes to about 44%, while about 8% area is under forest. The remaining 48% area is mostly wasteland with some economic use for grazing. This is due to very rugged/broken topography of the area.

The land use information collected during socioeconomic survey of 36 settlements is shown in the following table:

LAND USE DISTRIBUTION FOR SETTLEMENTS SURVEYED

Land Use Class	Distribution of Proprietary Area (ha)	Percent
Cultivated Land	7500	47.15
Orchards	1576	9.91
Social Forestry	75	0.47
Pasture Land	3021	18.99
Waste Land with some use for grazing	1487	9.35
Ghair Mumkin (Not Available for Economic Use)	2247	14.13
Total	15906	100.00

Agriculture

The village level survey has shown that of the cultivated area, about 97% is barani (rainfed) and about 3% area is irrigated. The irrigation water is obtained from nine small size tubewells and sixty-one open wells fitted with Persian Wheels.

The crops of the barani land include wheat, oil seeds, fodder and gram during winter, and maize, millets, pulses and fodder during summer. The major crops however are wheat and maize, which occupy about 92% and 45% of the barani area, respectively. The yields of the crops are generally very low. On the average, wheat yields about 2,000 kg per hectare (100 kg per Kanal) and maize about 1,100 kg per hectare (60 kg per Kanal). The irrigated land is mostly used for wheat and vegetables. The reported increase of crop yields due to input of irrigation is not much. For example, the average yield of wheat crop comes to about 2,500 kg per hectare under irrigation, as against 2,000 kg per hectare for barani land.

Landholdings and Tenure-ship

The village level survey has indicated that the landholdings are generally very small. These are shown in the table given below.

LANDHOLDING SIZE DISTRIBUTION AMONG THE HOUSEHOLDS SURVEYED
(Abstracted from village level survey)

Landholding Size (K)*	No. of Households	Percent
0-5	1306	62.34
5-10	175	8.35
10-20	146	6.97
20-50	183	8.74
50-100	137	6.54
Above 100	148	7.06
Total	2095	100.00

Note: * " K" stands for Kanal (conventional measure of land); 1 Kanal = 0.05 hectare

The table shows that about 62% families have landholdings smaller than five Kanals. Even, of these about 81% families have landholdings of one Kanal or less. Keeping in view the limit of subsistence-level landholding of 100 Kanals for barani area, about 83% of the families are below that level.

Generally, the families holding land below subsistence-level own about 7% of the total land area of the villages surveyed. The remaining about 93% land is shared by only 148 families. Most of these families are absentia landlords, whose land is cultivated by the small landholders or land-less farmers on tenancy basis. The tenancy terms are generally on share cropping. The crop sharing is normally 75% and 25% among the tenants and landlord, respectively, when the expenditures of inputs are borne by the tenants. If the expenditures are borne by the owner, it is shared on 50% basis.

The status of the Tenure-ship in the surveyed villages is as shown in the table below:

STATUS OF TENURE-SHIP IN THE VILLAGES SURVEYED

Tenure-ship Class	No. of Cultivators	Percent
Owner Cultivators	444	15.07
Owner-cum-Tenant Cultivators	1,562	53.02
Tenant Cultivators	940	31.91
Total	2,946	100.00

Of the total male population in the surveyed villages, about 2,946 persons are associated with agriculture. Of these, 53% are owner-cum-tenants cultivators, 15% are owner cultivators and about 32% are land-less tenants. Because of land reforms, occupancy-tenants are non-existing in Pakistan. (Occupancy-tenants had formal inheritable cultivation rights but not the ownership of the land. By law, their rights of cultivation could not be terminated and they had the right in the share of the land cost, if the owner sells that piece of land). The tenants in the Project area are non-occupancy or tenants-at will. About 65% are formal tenants and 35% are informal. Formal tenants are the ones whose names appear in the Revenue Record as cultivators. Informal tenants are not registered in Revenue Record.

With this status of small landholdings of a major chunk of the households and high rate of tenure-ship in the Project area, the farming communities have shown their concern about the construction of transmission lines on their land. Small landholders have expressed fear that if the towers are erected on their owned small piece of land they will be left with no land to cultivate. On the other hand, the tenants feel that if the compensation for the land is made, it will be taken away by the owners and the tenants will be deprived of any compensation.

3.5 WATER RESOURCES

As referred earlier, the Project area is drained by numerous natural drainage channels (nullahs) forming a complicated network. Major nullahs have generally perennial flows, while the small nullahs are mostly non-perennial draining the surface run-of during rainy seasons. These nullahs drain their load directly in Haro and Soan Rivers or through rivulets, of which the prominent ones are Nandana, Gunga, Ratiala, Bahudra, Tanar, Jabbi, Basala, Sipiala, Jawa, Kharkkan, etc. Ultimately these rivers drain in Indus River, Haro River near Village Gariala and Soan River at upstream of Kalabagh. The average-monthly river flows of the two rivers at places lying close to the Project area, Rawalpindi for Soan River and Sanjwal for Haro River, are given in Table 3.14

The flow pattern of these rivers show that unlike the major rivers of Pakistan, May and June is the lean months, while July, August and September are the months of highest discharges. This indicates that there is no contribution from the snowmelt. They carry only water from the rains and groundwater seepage.

In spite of the fact that numerous natural wetlands (impoundment) are scattered in the Project area, none of these is of significant size. A few of these are located within the corridors of the transmission lines. These are indicated in Tables from 3.3 to 3.11. They will not obstruct the construction of transmission lines or vise versa. Besides, numerous small and large manmade water bodies are located close-by the alignments of the transmission lines. Of these, five are sizeable. These include the reservoirs of small dams, i.e., Shahpur, Sipials, Dhala, Khasala and Java dams. The reservoir of Shahpur Dam is located about 4-5 km away from the Barotha Rewat Double Circuit (D/C) I & II lines towards west at about RD 45+000. The reservoir of Sipials dam falls in between two single-circuit (S/C) transmission lines of Barotha-Rewat at about RD 7+ from their off-take from Barotha-Rewat D/C (Segment I). This reservoir is only a few hundred meters away from either of these transmission lines. Dhala reservoir lies very close to the Barotha-Rewat S/C-II at RD 24+. During drawdown of the reservoir, it clears of the alignment of transmission lines, but during maximum retention level, it may encroach within the right-of-way. Khasala reservoir lies about 2 km away from the Barotha Rewat S/C-I line towards north at about RD 27+. The reservoirs have been created by damming small streams for supply of drinking and irrigation water to the local communities.

The biological study of the project area has indicated that the route of the flight of migratory water fowls is mainly along the Indus river (Figs. 2 & 3 of Append.D). The small dams such as Sipiala and Dhala reservoirs have not enough capacity to provide feeding and breeding place to a large number of migratory as well as sedentary birds. However, a limited number of secondary migrants may rest in these reservoirs. The wire span of the suspension towers (proposed for the project) is 9 meters phase to phase and this space is quite safe for flying the birds even through the wires, hence no significant negative impact of proposed transmission lines will be exerted on bird flights.

The important water bodies in NWFP as shown in Fig.1 and Table-2 of Append.-D are Tanda Dam, Thanedarwala Game Reserve, Kheshi Reservoir, Malugul Dhand and Kandar Dam. All these wetlands are on the right side of the Indus and attract the migratory birds. Consequently the migratory birds will keep themselves away from the transmission lines extending from GBHP. Moreover the entire in fly and out fly routes are also on the right side, hence no influence of project activities will be extended to the birds migrating to the above mentioned water bodies. The important wetlands on the left side of Indus are Mangla Reservoir and Rasul Barrage, which are also 80-90 km from the proposed route of transmission lines.

High Voltage (500 KV) transmission lines viz., Tarbela-Gatti I & II and Tarbela-Rewat-Lahore are already existing in the area. The Rewat-Lahore Section of transmission line passes very close to the Rasul Barrage which is an important habitat for feeding and breeding of migratory as well as sedentary bird as evidenced by the average population of birds given in Table-1. No mortality of birds has been noted/commented as a result of current. However, rare cases of bird's mortality have been noted on low-tension wires but this is only due to large size nesting on the electric poles.

3.6 BIOLOGICAL RESOURCES

3.6.1 General

To identify the bio-diversity of the Project area, an ecological survey has been carried out. The findings of the survey are reproduced in the form of a report, which is attached as Appendix "C". An abstract of the report is presented in this section:

The Project corridors have been divided into nine Land Scape Ecological Units (LSEUs). This is in consideration of the landforms, land use and bio diversity identified in the Project area. These LSEUs are as given below:

1. Excavated area of GBHP
2. Abandoned lands/Grazing lands
3. Cultivated lands
4. Water ways (streams and Torrents)
5. Water bodies (reservoirs of small dams)
6. Eroded (Broken) lands
7. Weathered Rock Plans
8. Piedmont Plains
9. Hill Slopes

3.6.2 Flora

General

The Project area is quite rich in natural flora, particularly in the reserved forests of Kala-Chitta, Khairi Murat Mountains and other hills. Besides, vegetation is also found scattered all over the area. The following paragraphs provide a brief account of the vegetation found on various landforms defined above.

Ecological Setting of Excavated Area

Excavated area includes the switchyard, tailrace and other areas of Ghazi Barotha Hydropower Project falling within the alignment of the transmission lines. The excavation activity in these area has eliminated the flora permanently.

Ecological Setting of Abandoned Land

Abandoned area is mostly the one that is acquired for the purpose of some development works, but not still utilized. Such includes area acquired for the new Islamabad airport, which falls close to Barotha-Rewat S/C I and II lines, and that acquired for expansion of Rewat Grid Station. These areas were previously cultivated and contained natural vegetation including trees, shrubs, grasses, etc. After acquisition, most of the vegetation was removed for fuel purposes. Presently, these areas bear grasses and forbs with some scattered bushes. The dominant grass in this area is *Imperata cylindrica and Phychosia mimosa. The Cynodon dactylon is colonizing* at moist places.

Ecological Setting of Cultivated Area

Eucalyptus camaldulensis is very popular in social forestry. Besides growing this in clusters on farmlands and hill slopes, the farmers also plant these around the border of their field as windbreak. Planted-tees also include *Albizzia lebbeck, Broussonetia papyrifera, Melia azadirachta, M. azedrach, Figa religiosa*, etc. These are found scattered in the fields. Besides, scattered natural vegetation is also found in the cultivated areas. The trees predominantly include *Zizyphus jujuba, Acacia modesta, Tamarix aphylla, Fig palmata and Oleafernugian. Zizyphus nummularia* is the dominant natural shrub, which is associated with grasses like *Cymbopogan javaraneusa, Imperata cylindrica and Desmostachya bipinnata*

Ecological Setting of Streams and Wetland

As referred earlier, the streams in the Project area are generally very deep with severally eroded steep banks. These banks occasionally hold trees of *Acacia modesta, shrubs like Calotropis procera* and grasses like *Chrysopogon serrellatus Cympopogan javaraneusa*, etc. The torrents with stable muddy banks dominantly bear

Imperata cylindrica associated with scattered trees of *Acacia modesta*. The grasses, *Cynodon dactylon* and *Imperata cylindrica* are dominant at places where moisture remains available throughout the year. Hydrophytes dominate in perennial slowly flowing streams. These include *Typha angustata, Arundo donax, Scirpus sp., Cyprus sp.*, and *Paspalum distichum*. At low flow regime or during dry periods, species like *Saccharum spontaneum, Paspalum distichum, Polygonum plebum*, etc. colonizes on gravelly substratum of some nullahs.

The wetland and reservoirs of the small dams bear hydrophytes including *Arundo donax, Typha sp., Paspalum distichum* grasses, which provide shelter for migratory and sedentary bird.

The construction of the Project will not disrupt the ecology of the wetlands significantly, as the towers will be placed at a safe distance from such LSEU

Ecological Setting of Eroded Lands

The severely eroded lands bear scanty vegetation with a varied bio-diversity. Therefore, no definite plant associations can be recognised. At places where the erosion is very active, this LSEU is devoid of any vegetation, while at other place scattered vegetation is found with variety of associations. *Cymbopogan javarencusa* is the only grass that has a trend to grow along with *Rhyncosia minima*.

Ecological Setting of Weathered Rock Plains

The areas with deep soils on Weathered Rock Plains are generally used for agricultural purposes. However, the areas with shallow soil crusts and slopes have been colonized by *Zizyphus nummularia, Dodonia viscosa, Justicia adhtoda* and *Cybopogan javarnecusa*. Infrequently *Acacia modesta, Matnus roglusus, Digiteria oliaris, Dicliptura roxbergiana, Perploca aphyla, Heliotropium trignosum, Salvia prbia* and *Tarerniara sp.*

Ecological Setting of Piedmont Plains

The vegetation of Piedmont Plain includes dominant trees like *Digitaria oliaris, Eragrost cynosouroides* associated with *Acacia nilotica, Prosopis juliflora* and shrubs like *Prosopis glandulosa, Zizyphus nummularia* and *Capparis aphyla*.

Ecological Setting of Hilly Terrain (Reserved forests)

Hilly and mountainous areas show a high bio-diversity, particularly the protected and reserved forest areas. The transmission lines pass through or near-by a number of reserved forests. These include reserved forests of Kawah Gar, Chhibbiwali, Kala-Chitta, Khairi Murat and Dhungi. With the exception of unavoidable circumstances, the transmission lines avoid the reserved forest areas. Crossing of Barotha-Rewat D/C I & II lines over Kala-Chitta reserved forest, and that of Barotha-Rewat S/C I & II

About 27 species of water birds (Table-3, Appendix-C) has been identified in the area of GBHP. The important water bodies in NWFP as shown in Fig.1 and Table-2 of Append.-D are Tanda Dam, Thanedarwala Game Reserve, Kheshi Reservoir, Malugul Dhand and Kandar Dam. All these wetlands are on the right side of the Indus and attract the migratory birds. Consequently the migratory birds will keep themselves away from the transmission lines extending from GBHP. Moreover the entire in fly and out fly routes are also on the right side (Fig.3 & 4 of Appendix-D), hence no influence of project activities will be extended to the birds migrating to the above mentioned water bodies. The important wetlands on the left side of Indus are Mangla Reservoir and Rasul Barrage which are also 80-90 Km from the proposed route of transmission lines. Moreover, the comparison of Tables-1&2 of Appendix-D reveals that the average population in above mentioned water bodies of NWFP ranges from 52-918 birds as compared to the average population of 18531 birds at Rasul Barrange. It may be concluded that transmission lines will have insignificant effect on the migratory birds.

over Khairi Murat reserved forest was unavoidable, as these forests fall across the alignment of the lines. Similarly, negotiation of Tarbela-Barotha-Gatti D/C I & II lines with Kawah Gar reserved forest was unavoidable due to the existence of settlements along the border of the forest.

The reserved forests on high mountains hold scrub forest at its climax stage showing clear strata of trees, shrub and grasses. The dominant species, however, include *Acacia modesta, Olea fernaginia, Dodonea viscosa, Chrysopogan scleratus* and *Digiteria oliaris*. The dominant vegetation of medium protected hills includes *Echnochloa sp.* in association with *Justacia adhatoda*. Low unprotected hills have generally undergone to excessive cutting for fuel leaving behind grasses, forbs and some bushes. These include *Penesetum sp., Cymbopogan jatvarancusa, Digitaria oliaris, Zizyphus nummularia* and *Capparis aphylla*.

About 8% of the total stretch of transmission lines (about 235 km) will pass through five reserved forest areas, namely Kawah Gar, Chabbiwali Gar, Kala Chitta, Khairi Murat and Dhungi. The spread of these forests is shown in Table 3.2 as Rough Mountain Land. These are not protected forests or national parks, and are accessible to the local communities for limited borrowing of fuelwood and herding. This is to avoid heavy cutting of the vegetation, thus denudation of the hills. The ecological study of these areas has indicated that these do not bear any rare and endangered species that are likely to be eliminated by the construction activities (see also Section 5.2.4). The vegetation that is likely to be cleared from the limited construction site is widely spread in the vicinity. This, in time, may encroach into the affected areas.

3.6.3 Fauna

The information on fauna in the Project area has been collected from the Punjab Wildlife Department. Table 3.15 shows the most common fauna found in Project area. Accordingly, about 48 terrestrial bird species and 27 waterfowls (migratory birds) have been recorded from the Project area. The important mammal species reported especially from the reserved forest areas, mostly in Kala Chitta, are about 11 in number. Besides, reptiles, amphibians and common mammals like field rats, hares, boars, etc., are very common in the Project area.

The construction activities will have minimum affect on the terrestrial wildlife of the forest areas. This is because that the lines will pass through the regions of the forests, which do not have thick vegetative growth, thus, rarely populated by the wildlife. Moreover, the construction activity will be limited in a narrow corridor and will be of a short duration. As such, the wildlife will have quite a large area of the forests to take shelter (see also Section 5.2.4).

3.7 HUMAN RESOURCES

3.7.1 History

There are evidences that the Project area has been settled since stone ages. However, historically the first record of civilization of the area dates back to Aryans. In the 15 century BC, the Aryans from the Asia Minor invaded the area from the northwest and pushed the old inhabitants, Dravidians, towards east and south of India. Then Takkas, who were snake worshippers, followed after few centuries. They founded Taxila that remained Capital City of the region for many centuries. One of their chiefs, Raja Gaj, founded Gajipur at the site of modern Rawalpindi.

In 326 BC, Alexander crossed the Indus river and marched against Taxila. Raja Ambhi of Taxila allied himself with the Greeks and fought against Raja Porus of Lahore. After the death of Alexander, Chandar Gupta established Maurayan dynasty in the region. Maurayas remained in power for about a century. In 262 BC, Ashoka adopted Buddhism as a state religion. Later in 190 BC, Greeks again conquered Taxila and ruled the region for about a century. Kushans followed the Greeks. The Kushan rule persisted for another century and they founded the famous Gandhara art. By the invasion of Huns in third century AD, the Kushan rule and Buddhism declined in this region and Hinduism again established its footings. Rajputs are the descendent of Huns, who ruled the area until seventh century AD. After that, the glory of Taxila and Gandhara was over and the region became a principality of Kashmir

In 8th century, this region became the part of Hindushahi Kingdom of Kabul. After the spread of Islam in Iran and Afghanistan, the capital of Hindushahi Kingdom was shifted to Hund, a town located at the right-bank of Indus River in Swabi District. At the beginning of 10th century, Islam came to this region, when Mahmood of Ghazni defeated the Hindu Raja in a fight occurred in Chhachh Plains near Attock. Mahmood Ghaznavi bestowed the region on Ghakkar Shah, whose descendents ruled the area for 8 centuries directly or under the flag of Mughals. Ghakkars ruled the area until 1765, when their chief was slain in a battle against Sikh. Sikh rule was not very long. In 1849, they surrendered to British army at Rawalpindi.

Besides invasion of different races from the northwest, the area had witnessed intrusions of various tribes from the south. These included Janjuas, Khattars, Ghebs, Awans, Malyars, Alpials, Jodharas, etc.

3.7.2 Socioeconomic and Cultural Setup

General

This section briefly deals with the social and cultural setup of the people of the Project area. This has been compiled from the socioeconomic survey carried out in 36 settlements falling close to the routes of the transmission lines. The settlements surveyed were well stratified over the Project corridor as to give a representative picture of the area.

The survey was carried out for both male and female members of the societies. To gather maximum information four-level survey was planned. These included two village-level surveys, one each for male and female members of the communities. The male survey was aimed to obtain necessary demographic information of the settlements, while the female survey was oriented towards female-related information only. Besides, individual-level surveys for both male and female members were carried out. It covered about 600 male members and 200 female members.

For the purpose, two survey parties were mobilised, one to cover the Attock end of the Project and other for Rawalpindi end. Each survey party comprised two male members and one female member. For each type of survey separate questionnaires were prepared and pre-tested.

The findings of these surveys are briefly discussed in the subsequent sections.

Population Profile

As referred in Section 3.2.2, the surveyed settlements are constituted of about 2,095 households with a total population of about 12,373 heads. Gender-wise distribution of the population is given in the following table.

Gender-Wise Distribution of Population

Population Division	Numbers	Percent
Male	4,190	33.86
Female	3,900	31.52
Children	4,283	34.62
Total	12,373	100

About 99% of the households are Muslims and the remaining are mostly Christians. Ethnically, the population belongs to different clans. These are shown in table given on page 3-16. The majority of the households are Awan (42%), followed by Syed (15%), Khathar Pathan (14%) and Rajput (8%). The service groups (Kamie) also form a sizeable fraction (10%). These include Tarkhan (carpenters), Lohar (ironmongers), Naee (barbers), Julaha (weavers), Musali (sweepers), etc.

Professional Groups

In spite of belonging to different castes, the majority of the households are attached with the agriculture. Of the total adult male population, 70% are agriculturists, 16% are in government service (mostly in army) and 8% in private service, and 5% are labourers or unemployed. About 1% people are in business, running shops in the villages.

It has been reported that there are about 2,000 unemployed persons in the surveyed settlements. These include grown up children that do not go to school and the adults who are partly engaged in agriculture because of small landholding. Of these, about 23% have some skill, while 77% persons are unskilled. The skills include driving, welding, carpentry, ironmonger, etc.

Ethnic Groups

Serial #	Ethnic Group	Number of Households	Percent
1	Awan	882	42.11
2	Syed	313	14.95
3	Khathar	300	14.32
4	Rajput	160	7.64
5	Bhatti	22	1.05
6	Mughal	39	1.86
7	Qureshi	26	1.24
8	Maliar	23	1.09
9	Gujar	42	2.01
10	Paracha	14	0.66
11	Kamie	204	9.73
12	Other Castes	70	3.34
	Total	2095	100.00

The female survey has indicated that about 49% women are though housewives they take active part in the farming activities either assisting the male members or running the farms independently. Of these, a few women are landowners. Others are running dairy farms or poultry farms. About 14% women have adopted handicraft manufacturing for supplementing their husbands' income. Only about 30% women are just the housewives, while the remaining 7% are in other professions, like teachers, Health Visitors, Midwives (Dai), etc. The women in various professions have indicated a monthly income ranging from Rs. 500 to Rs. 25,000. Majority of the housewives has shown their interest in learning some skill to supplement the household income.

Education Status

The literacy status of the adult population of the surveyed settlements is as given the table below

Distribution of Population according to Literacy Rate

Category	Male	Percent	Female	Percent	Total	Percent
Literate	1695	40.45	768	19.70	2463	30.44
Illiterate	2495	59.55	3132	80.30	5627	69.56
Total	4190	100	3900	100	8090	100

The table shows that the literacy rate is more for adult male population (about 40%) as compared to the female population, which comes to about 30%. On the whole, about 70% adult population is illiterate. The education level of the adult population is shown in the table below. Of the literate population, the level of education is mostly below matriculation. The trend of higher education, particularly in female population, is low. This is because of low income of the population and non-availability of institutions of higher education in the area.

Level of Education

Education Level	Male Population		Female Population	
	Nos.	Percent	Nos.	Percent
Primary	662	39.05	278	36.19
Middle	389	22.94	323	42.05
Matriculation	374	22.06	99	12.89
Intermediate	136	08.02	38	04.95
Graduate	67	03.95	23	02.99
Masters	51	03.00	5	0.66
Professional	16	00.99	2	0.26
Total	1695	100	768	100

Table given below shows the number of various types of institutions, both for male and female population, available in the region. Except for a few, these institutions are generally located in the main settlements of the villages, which may be 2 to 6 km away from settlements surveyed.

Education Facility

Type of Institution	Male Institutions & Strength			Female Institutions & Strength		
	No. of Institutions	No. of Teachers	No. of Students	No. of Institutions	No. of Teachers	No. of Students
Masjid-Madrasa	12	10	860	01	02	80
Primary School	22	50	5,877	15	29	3,042
Middle School	03	15	750	01	07	550
High School	02	27	2,700	01	08	700
College	0	0	0	0	0	0
Vocational	0	0	0	0	0	0
Total	39	102	10,187	18	46	4,372

The table shows that the region is devoid of any institutions for higher education. For this, the students have to go to Attock, Fatehjang and Rawalpindi.

Of the total strength of the school, about 3000 students, which form 75% of the children population, are from the settlements surveyed. The remaining students are from the main and other settlements of the villages.

Health Facilities

Health services are almost non-existing in the settlements surveyed. Of the 36 settlements, only two places have Basic Health Units. There is only one main village, Bahtar, where a hospital is also available. Even traditional medical practitioners, like Hakim, LHVs/Dai, Dispensers, etc. are scares. Of the 36 settlements, there is Dais at 15 places, Hakim at one place and Dispenser at one place. The people are mostly dependent on charms and blessings (Taweez/Dhaga) obtained from Shrines. The serious patients are taken to hospitals in main towns, which may be up to 50 km away.

The most common diseases in the area are malaria, asthma, skin and eye infections, hypertension, gastro-enteritis, diabetes, etc., in the order of mention.

Malaria is a very common disease of the Project area. This is mainly because there are numerous large and small impoundments in the area, which include natural and manmade lakes, and some extent village ponds and open drains. These help in the breeding of mosquitoes. Two main mosquito species[1] (vectors), viz., *Anopheles culicifacies* and *Anopheles stephensi* are found in the Project area. The Project area being mainly rural in setup, the former is the prime source of transmitting both benign malaria, *Plasmodium vivax* (60-70%), and malignant malaria, *Plasmodium falciparum* (30-40%). This species normally breeds in clean water of the lakes and village ponds. *Anopheles stephensi* is mainly an urban vector and transmits benign malaria. Culex mosquitoes are rare in the Project area. This is because that the undulating terrain of the Project area rarely helps in creating impoundments of village wastewater, which is the main breeding ground for this mosquito species.

Other Social Amenities

In spite of the fact that these villages are located close to the country's Capital City, the availability of social amenities in the settlements surveyed is very poor. Of the 36 settlement only 25 are electrified, nine have water supply schemes, while open drainage system is available in one settlement only. About 140 tubewells, 310 open wells and 380 hand-pumps have been reported in the surveyed settlements that meet the consumptive and non-consumptive water requirements of the population.

Only 24 settlements have proper roads for link with the rest of the country, and of these, only 14 settlements have transportation facilities. Telephone facility is available in six settlements and post office facility is available to eight settlements. Natural gas is available in one settlement only. The people of other settlements predominant use fuelwood brought from the their fields and wasteland. Twenty-seven settlements have reported that their source of fuelwood will be across the transmission lines.

[1] Pakistan Hydro Consultants; Report on Supplementary Environmental Studies; Chapter 4, 1992.

Marketing

Of the surveyed settlements, twenty-four settlements have been reported to have about 88 shops. Of these, the people from the eleven settlements have reported that the items of the daily use are available from the local shops. Fourteen settlements do not have any shop .The people have to travel 2 to 40 km for acquiring item of daily use

Family Income

Income of the people of the Project area has been abstracted from the individual male survey. This has been shown in the table below.

Annual Income for Different Categories of Families in the Project Area

Category of Families	Landholding Size (Kanal) (Hectare)	Annual Income from Agriculture (Rs.)			Annual Income from Other Sources (Rs.)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Below Subsistence Level	< = 100 K < = 5 ha	2,000	100,000	24,640	0	120,000	27,336
Small Farmers	100-200 K 5-10 ha	12,000	150,000	49,500	0	146,000	29,500
Medium Farmers	200-400 K 10-20 ha	9,000	252,000	97,500	0	60,000	25,257
Large Farmers	> 400 K > 20 ha	5,000	200,000	114,428	0	48,000	16,857
Landless Families	-	-	-	-	6,000	96,000	38,190

The table gives the annual income from agriculture and other sources for various categories of families with respect to landholding size. This includes minimum, maximum and average incomes of the peoples interviewed during the survey. The minimum and maximum income figures have been taken for the individual farmers falling within the respective group, whereas the average value has been derived for all the members of that group. Though the trends of minimum and maximum incomes of various agricultural groups have relatively odd distribution with respect to the landholding size, the average incomes show a good relationship. There may be many reasons for this. The main ones are that at individual level, which is the basis for abstracting the minimum and maximum income figures, the income is dependant on the type of land, crops sown and the input used for cropping. However, when average of the whole lot is taken then variations in the factors mentioned above are accounted for

It has been observed that the family income from the land is largely supplemented by income from other sources. Such trend is more pronounced in the case of families with small landholdings than otherwise. About 82% of the farmers with landholdings below subsistence level have other source of income. The trend for other categories is 75%, 57% and 43% respectively for farmer with small, medium and large landholdings.

3.7.3 Cultural and Archaeological Properties

During reconnaissance visits of the Project area, a number of shrines, cultural buildings and mounds were found lying near the Project corridor. The detailed survey revealed that about 10 cultural/religious properties, i.e., shrines (2) and graveyards (8) fall in the Project corridor (see Tables 3.3 through 3.11 and a table in Section 5.2.5). One of the shrines, at Jodh, is located at about 30 m away from the centerline, which is a safe distance for the pilgrimage activities. The other shrine at Dhok Kala Khan was located at a distance of 5 m from the centerline. The alignment of the transmission line in this section has been changed. Thus increasing the distance of the Ziarat (shrine) and near-by houses has increased between 30 to 95 m.

Most of the graveyards are located in the corridor near to the centerline. It has been assured that no tower is located in the graveyards. Safe conductor clearance over the graveyards will not obstruct the burial activities. Though disruption of the graves may occur during stringing of the conductor, this being a matter of creed, the contractors will take every care in avoiding such disruption. In spite of this, the Engineer will pass on instructions to the contractors to observe the sanctity of the graveyards.

Though the alignments of the transmission lines generally have avoided structures of cultural importance, the chances were there that the Project might disrupt hidden monuments. In this regard, the Department of Archaeology and Museums was contacted. It was learnt that even the department has limited information about the area. This being an obligatory under law that a clearance certificate should be obtained from the department before constructing the Project, the Department has suggested a survey. In this respect, WAPDA entered a contract with the Department to carry out the study of the area. After carrying out field survey, the Department has reported that no archaeological site/evidence has been discovered. Accordingly, the Department has issued a clearance certificate. This is attached in Appendix "F".

TABLE 3.1
METEOROLOGICAL DATA FOR THE PROJECT AREA

Month	Temperature °C								Relative Humidity (%)				Rain Fall (mm)		Wind	
	Mean daily				Highest Max.		Lowest Min.		Max.		Min.		Mean Monthly Total		Average wind velocity meter/sec	
	Max.		Min.													
	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock	Islamabad	Attock
January	17.50	16.52	2.50	2.18	26.10	24.08	3.30	-3.36	95.00	81.00	25.00	49.00	61.25	57.25	0.92	
February	19.30	19.94	5.20	5.21	30.00	29.30	7.30	-2.90	92.00	75.00	22.00	42.00	61.25	29.25	1.29	
March	23.90	23.50	9.90	10.75	34.00	26.88	12.50	3.36	88.00	74.00	18.00	44.00	78.40	55.25	1.50	
April	30.10	29.74	15.10	16.52	40.60	40.88	17.30	7.34	86.00	60.00	21.00	35.20	43.12	39.50	1.40	
May	33.90	36.57	19.60	20.44	45.00	45.92	19.40	12.32	79.00	43.00	16.00	25.00	22.54	21.50	1.48	
June	38.70	41.09	23.70	26.26	48.00	48.16	25.80	17.26	73.00	41.00	13.00	23.00	52.63	19.50	1.40	
July	34.80	37.91	24.40	26.21	44.40	47.04	27.00	19.04	91.00	65.00	31.00	45.00	224.42	120.50	1.29	
August	33.60	36.57	23.60	25.04	40.60	42.56	26.00	18.49	95.00	69.00	44.00	48.00	248.92	105.50	0.90	
September	33.20	35.56	20.80	22.90	38.10	40.28	22.00	10.08	94.00	63.00	31.00	44.00	32.08	50.25	0.73	
October	30.80	31.70	13.90	14.39	36.70	37.52	15.00	2.24	91.00	56.00	19.00	33.00	20.34	19.00	0.62	
November	25.10	24.30	7.50	7.34	32.20	33.04	10.60	-1.12	95.00	55.00	22.00	39.00	11.52	13.75	0.53	
December	19.90	18.26	3.00	3.30	27.20	25.20	3.30	-2.24	92.00	58.00	29.00	49.00	21.81	55.50	0.72	
Mean Yearly	28.40	29.33	14.10	15.13	36.74	36.58	15.68	5.77	89.67	53.33	24.67	39.67				
Total Yearly													928.31	583.75		

TABLE 3.2
DISTRIBUTION OF TRANSMISSION LINES WITH RESPECT TO LANDFORMS

Map Legends	Landforms	Stretch of Transmission Lines in km										Total Stretch of Lines falling in Various Landforms	
		I	II	III	IV	V	VI	VIIA	VIII	IX	VIIB	km	%
1	Level to Nearly Level Loess Plains	-	-	-	-	-	1.48	10.40	10.47	5.30	-	28.55	12.20
2	Nearly level Cover Flood Plains	-	-	-	-	-	-	-	5.16	2.37	-	7.53	3.21
3	Dissected Loess Plains with Gentle to Steep Slopes	5.50	2.47	4.45	8.46	1.69	5.50	7.39	2.51	1.98	-	39.94	17.01
4	Dissected River Terrace	-	-	-	-	-	-	-	6.34	4.33	-	10.67	4.54
5	Severely Eroded Land with Deep Gullies	1.30	-	1.96	-	-	-	13.68	10.56	16.42	-	49.42	21.05
6	Rough Broken/Rugged Land	15.04	-	-	20.98	-	3.47	13.65	4.04	2.54	-	59.63	25.39
7	Weathered Rock Plains (Upland with Severe Undulations)	1.72	-	-	-	-	-		5.70	7.78	2.25	18.45	7.86
8	Rough Mountain Land	2.09	-	-	-	-	1.28	5.49	1.59	5.59	-	18.44	7.85
9	Active Flood Plains					-	-	-		0.39	-	0.39	0.17
10	Miscellaneous land (river bed, tailrace channel etc.)	0.29	-	-	0.59	-	-	0.28	0.34	0.20	-	1.70	0.72
	Total Length of Lines	26.44	2.47	6.41	29.93	1.69	11.73	56.88	47.71	49.30	2.25	234.82	100.00

Note:

Transmission Line # I	Tarbela-Barotha Incoming Double Circuit I & II
Transmission Line # II	Tarbela-Barotha Incoming Single Circuit I
Transmission Line # III	Tarbela-Barotha Incoming Single Circuit II
Transmission Line # IV	Barotha-Gatti Outgoing Double Circuit I & II
Transmission Line # V	Barotha-Gatti Outgoing Single Circuit I
Transmission Line # VI	Barotha-Gatti Outgoing Single Circuit II
Transmission Line # VIIA	Barotha-Rewat Double Circuit I & II Segment 1
Transmission Line # VIII	Barotha-Rewat Single Circuit I
Transmission Line # IX	Barotha-Rewat Single Circuit II
Transmission Line # VIIB	Barotha-Rewat Double Circuit I & II Segment 2

TABLE 3.3
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	196	* Terraced land with steep slopes.	1. 11 kV line at RD 143 with a clearance of 10 m from the proposed TL.	Beyond RD 0+00 up to switchyard is still a loose section as its finalisation is attached with the layout of Gantry Tower at switchyard, which is under planning.
196	624	* Level to nearly level land with very mild slope. * Barotha Nullah at RD 598-610.		
624	916			ROW of Tailrace Channel of GBHP.
916	2240	* Highly broken land with deep gullies, part of which redeveloped to level land. * Nullah between RD 1168-1438, 1506-1579 & 1686-1818		On request from Barotha people, deep gullies have been filled to redevelop it for agriculture
2240	4110	* Undulating land with gentle to moderate slopes.	1. Graveyard at RD 2526-2660 along central line stretching by 20 m on left side and beyond 50 m on right side. 2. Kutcha village tracks at RDs 2801& 2840. 3. 11 kV lines at RDs 2832, 3276, 3324, & 3761 with clearance from proposed TL by 4 m, 6 m, 7 m & 7.5 m, respectively. 4. Metalled road (Attock-Dakhner road) at RD 3295-3307. 5. Metalled road (Attock-Basal Road) at RD 3731-3761.	1. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3.) 2. Clearance for existing power lines is within safe limits.
4110	6344	* Undulating land with moderate to steep slopes, deep gullies at places. * Nullahs at RDs 4894-4934, 5350-5424, 5802-5830 & 6165-6200.	1. Kutcha village track at RD 4379. 2. Metalled road at RD 5665-5673.	
6344	7920	* Broken land with steep slopes. * Nullahs (4 No.) at RDs 6344-6490, 6704-6794, 6942-7020, & 7595-7847.	1. Kutcha village track at RD 7378.	1. Towers are located on stable ground.

TABLE 3.3
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Double Circuit I & II

Reduced Distance (m) From	Reduced Distance (m) To	Land Features	Infrastructure	Remarks
7920	9150	* Undulating land with moderate slopes and gullies at places. * Nullahs at RD 8354-8359, 8563-8583, & 8629-8737.	1. Kutcha road at RD 8232-8238, 9039-9042. 2. 11 kV line at RD 8271 with a clearance of 7.5 m.	
9150	10223	* Rather broken land with deep gullies * Nullah at RD 9974-10137.		1. Towers are located on stable ground.
10223	10747	* Level to nearly level land with gentle slope	1. Kutcha village track at RD 10433-10442, & a footway at RD 10603 2. Railway line (Attock-Jand) at RD 10723-10726 with clearance of 13 m from proposed TL. 3. Telephone line at RD 10747	
10747	13650	* Generally broken land with deep gullies and level to nearly level land at places. * Nullahs (6 Nos.) at RDs 10892-10967, 11071-11100, 11128-11148, 11223-11230, 11281-11306, & 11879-12198 * Haro River at RD 13145-13369	1. Kutcha village tracks at RDs 11647, & 11733. 2. Metalled road (Attock-Fateh Jang Road) at RD 12341-12361 3. Metalled road (Attock-Humak Road) at RD 12647-12651. 4. 11 kV line at RD 12911 with a clearance of 5 m from proposed TL. 5. Pumphouse at RD 13164-13170 on the edge of right bank of Haro River at a distance of 20 m from central line of the corridor.	1. Removal of pumphouse would not be required
13650	14290	* Level to nearly level land with very gentle slope	1. Kutcha village tracks at RD 13866-13873, & 14239-14246	
14290	16380	* Hilly area with steep slopes and deep gullies * Nullahs (3 Nos.) at RDs 14806-15037, 15387-15510, & 15787-15830.	1. Houses at RD 16042-16052 at a distance of 36 m away from central line on right side	1. Houses are located at safe distance from the proposed line, therefore resettlement is not required
16380	16830	* Terraced land with gentle to moderate slopes	1. Kutcha village track at RD 16880-16886.	

TABLE 3.3
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
16880	20054	• Generally undulating land with gentle to moderate slopes, and level to nearly level plateau at places • Nullahs (3 Nos.) at RDs 17373-17413, 18368-18418, & 19232-19234.	1. Kutcha village track (6 Nos.) at RDs 16880-16886, 17141-17145, 17175-17179, 17716-17720, RD 19427 (footway), & 19861-19874. 2. Houses at RD 188317-18366 at distance of 35 m from the central line on right side. 3. Houses at RD 18870-18878 at as distance of 44 m from the central line on left side. 4. Houses at RD 18940-18948 at a distance of 44 m from the central line on right side. 5. 11 kV line at RD 19433 with a clearance of 6 m from the proposed TL. 6. Houses at RD 20546-20556 at a distance of 28 m from the central line on left side. 7. Graveyard at RD 19734-19861 along central line stretching up to 28 m on right side and beyond 50 m on left side.	1. All the houses in the corridor in this stretch are at a safe distance from the proposed transmission line (TL), therefore, resettlement is not required. 2. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3)
20054	21590	• Generally level to nearly level land with gentle slope, and at places terraced	1. LT power line at RD 20277 with a clearance of 7 m from the proposed Transmission line (TL). 2. Kutcha village track crossing central line at RDs 20479 & 20542. 3. Houses at RD 20639-20676 at a distance of 18 m from the central line on right side 4. 11 kV line at RD 20773 with a clearance of 6.4 m from the proposed TL. 5. Metalled road at RD 20778-20784.	1. Houses at serial No. 3 and 6 are within recommended limit for safety (25 m), therefore these are to be relocted. 2. The houses at serial No. 9 are though out side the recommended limit, a DS3 Tower is located at the same RD. Therefore, to minimise resettlement the tower may be relocated appropriately.

TABLE 3.3
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Double Circuit I & II

Reduced Distance (m) From	Reduced Distance (m) To	Land Features	Infrastructure	Remarks
			6. Houses at RD 20784-20815 at a distance of 6 m from the central line on right side. 7. Kutcha road at RD 21241-21248. 8. 11 kV line at RD 21400 with a clearance of 11 m from the proposed TL. 9. Houses at RD 21400-21436 at a distance of 30 m from the central line on left side, DS3 Tower is located at RD 21410.	
21590	23130	• Terraced land with some undulations and broken area. • Nullahs (3 Nos.) at RDs 22226-22408, 22554-22574, & 22830-22923	1. Houses at RD 21890-21916 at a distance of 14 m from the central line on right side. 2. Metalled road 22122-22130. 3. House at RD 22520-22532 at distance of 38 m from the central line on left side. 4. 11 kV line at RD 22834 with a clearance of 7.5 m from the proposed TL. 5. Houses at RD 22835-22868 at distance of 40 m from the central line (located at the bank of Nullah) on right side. 6. Metalled road at RD 22877-22881.	1. Houses at serial No. 1 are within recommended limit for safety (25 m), therefore the residents are to be resettled and the structures to be removed
23130	26442	• Undulated terraced land with gentle to moderate slopes, and level to nearly level ground at places. • Nullahs at RDs 23184-23262, 24012-24335 (meandering nullah with alternate creeks and high ground), & 25306-25351.	1. LT power line at RD 24725 with a clearance of 4.5 m from the proposed TL. 2. Kutcha village track at RD 24735. 3. Houses at RD 24815-24830 at a distance of 40 m from the central line on left side. 4. 11 kV line at RD 25107 with a clearance of 5 m from the proposed TL. 5. Metalled road at RD 25114-25121.	1. Tower at RD 24260 fall in the nullah area but located on stable and high ground.

TABLE 3.4
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	1391	• Terraced land with mild slope. • Nullah at RD 392-440.	1. 11 kV line at RD 668 with a clearance of 8 m from the proposed (T.L) 2. Grave yard at RD 680-720 at a distance of 20 m on right side. 3. Houses from RD 724-752 at a distances of 32 m from centre line on right side. 4. 11 kV line at RD 793 with a clearance of 9m from the centre line. 5. Metalled Road (Daurdad Road) at RD 1123.	1. Resettlement of the households is not required. 2. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area.(Reference Section 5.3)
1391	2467	• Terraced land with mild slope. • Nullah at RD 1883-1925.	1. 11 kV line at RD 2040 with a clearance of 5.5 m from the proposed (T.L) 2. Pump house and well from RD 2068 at a distances of 10 m from centre line on left side. 3. Metalled road at RD 2131-2137.	Existing 500 kV Tarbela -Gatti line.

TABLE 3.5
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Tarbela-Barotha Incoming Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
0	3144	• Terraced land with mild slope. • Nallahs at RDs 430-482, 570-590, 874-962, 1953-2046 & 2519-2589.	1. Houses at RD 720-760 at a distance of 35m on left side. 2. 11 kV line at RD 789 with a clearance of 10m from the proposed (T.L) 3. Metalled road (Dhaurdad Road) at RD 1200-1215. 4. Graveyard at RD 1210-1230 at a distance of 20 m on right side. 5. 11 kV at RD 1615 with a clearance of 5 m from the proposed (T.L) 6 500 kV (Tarbela-Gatti Transmission line circuit I) at RD 2326. 7. House at RD 2322-2332 at a distance of 42 m from centre line on right side. 8. 11 kV line at RD 2350 9. Kutcha village track at RD 2412-2416 10. Houses at RD 2636-2649 at a distance of 8m from cente line on left side. 11. Houses from RD 2674-2688 at a distance of 44 m from the centre line on right side.	1. This portion of Tarbela-Gatti Transmission line will be dismantled after re-routing it through Barotha. 2. Houses at RD 2636 are required to be removed and residents resettled. 3. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3)
3144	6406	• Stepped land with mild slope and undulation at places. • Pond at RD 4150-4188 • Nullahs at RD 4492-4500, 4544-4571 & 5625-5660	1. Metalled road (Sanjwal-Pind Fazal Khan Road) at RD 3261-3266. 2. Metalled road (Saka Abad) at RD 3426-3436. 3. Kutcha village tracks at RDs 3943-3945, 4898-4902. 4. Houses at RD 5825-5860 at a distance of 22 m from the centre line on right side.	1. Relocation of houses at RD 5825-5860 and resettlement of households is required

TABLE 3.6
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	925	* Level to nearly level land with gentle slope. * Barotha nullah between RD 914-925. * Drainage depressions between RD 308-317 and between RD 601-616.	1. 11 kV line at RD 124.	Beyond RD 0+00 up to switchyard is still a loose section as its finalisation is attached with the layout of Gantry Tower at switchyard, which is under planning.
925	1205	* ROW of Tailrace Channel of GBHP.		
1205	1855	* Highly broken land part of which redeveloped to level land, * Nullah between RD 1448-1494. * Haro river between RD 1660-1812 along the right half of the corridor with its bank 5-10 m away from the central line.	1. Kutcha village track between RD 1192-1204.	On request from Barotha people, deep gullies have been filled to redevelop it for agriculture.
1855	3228	* Undulating Land with gentle to moderate slopes, with depressions at places. * Nullah at RD 2601-2697.	1. Kutcha village track between RD 2897-2909. 2. Well at RD 2969 at 22 m away from the central line on right side. 3. Metalled road between RD 2969-2973. 4. House at RD 2973 about 42 m away from the central line on right side at the edge of the road. 5. 11 kV line at RD 3015 with a clearance of about 6 m from the proposed line.	Relocation & resettlement works are not required.

TABLE 3.6
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
3228	4778	• Broken to undulating land with moderate to steep slopes and depressions at places. • Nullahs at RD between 3228-3497 and 4538-4554.	1. 11 kV line at RD 3801 with a clearance of 12 m from the proposed TL. 2. Metalled road between RD 3831-3843. 3. Kutcha village track at RD 4232. 4. Graveyard between RD. 4728-4778 about 30 m away from central line on the left side.	1. No relocation or resettlement works involved. 2. No disruption to graveyard during construction period.
4778	5087	Haro River.		
5087	5645	• Uneven land with gentle to moderate slopes.	1. Watercourse at RD 5477.	No relocation involved
5645	6923	• Broken land with deep gullies and level plateau at places. • Nullah at RD between 6621-6708.	1. 11 kV line at RD 6435 with a clearance of 7 m. 2. Kutcha village track between RD 6431-6435. 3. Houses at RD 6501-6509 about 38 m away from central line on left side (or 25 m away from the outer conductor).	No relocation and resettlement required.
6923	8908	• Level to nearly level land with mild slope. • Nullah at RD 7737 about 8 m away from central line.	1. Metalled road at RD 7096-7099. 2. Railway line at RD 7167. 3. Lined watercourse at RD 7204. 4. 11 kV line at RD 8008 with a clearance of 3.4 m. 5. Metalled road at RD 8021-8029. 6. Houses at RD 8048-8068 at distance of 22 m on left side of central line. 7. Kutcha village track at RD 8294-8303. 8. Lined watercourse at RD 8378. 9. Kutcha village track at RD 8439-8447.	1. The proposed line may need raising by 1 m at RD 8008 to give safe clearance to existing 11 kV line. 2. Houses are falling within the range of 25 m from central line, resettlement of the households is required.

TABLE 3.6
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
8908	11403	• Generally broken land having steep slopes with level to nearly level plateau at places. • Nullahs (5 Nos.) at RDs 8991-9000, 10390-10436, 10722-10884, 11112-11163, & 11358-11403.	1. Metalled road at RD 9346-9354. 2. House at RD 10312-10318 at a distance of 40 m from central line on left side. 3. House at RD 10308-10318 at a distance of 30 m from central line on right side. 4. Metalled road at RD 10378-10390.	1. No resettlement is required. 2. Towers are located on stable ground.
11403	12228	• Level to nearly level land with mild slope.	1. Lined watercourse stretching from RD 11738 to RD 11908 in the corridor, crossing central line at RD 11800. 2. Lined watercourse stretching from RD 11808 to RD 12014 in the corridor, crossing central lines at RDs 11825 & 12012. 3. House at RD 11884-11898 at a distance of 12 m from central line on left side. 4. 11 kV line at RD 11949 with a clearance of 7 m from proposed transmission line. 5. Metalled road at RD 12015. 6. Lined watercourse at RD 12030.	1. Resettlement would be required.
12228	13408	• Undulating land with steep slopes, at places high rising cliffs.	1. House at RD 12298-12316 at distance of 10 m from the central line located on cliff having a clearance of 8 m from the conductor. 2. Kutcha village track at RD 12965.	1. House is needed to be removed and household resettled. 2. The peak of the cliff at RD 13078 will be cut by about 3 m to give required clearance.

TABLE 3.6
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m) From	To	Land Features	Infrastructure	Remarks
13408	15128	* Broken land with steep slopes * Nullahs (4 Nos.) at RDs 13434-13592, 13662-13692, 13896-13920, & 14072-14085 * Nandana Kas (rivulet) at RD 14410-15915	1. Railway line at RD 14190. 2. Telephone line at RD 14194	
15128	16158	* Undulating land with moderate to steep slopes * Nullah at RD 15899-15953	1. Kutcha village track at RD 16060-16076	
16158	17909	* Rather broken land with steep slopes, at place level to nearly level plateau * Nullah at RD 16912-17083 * Nandana Kas (rivulet) at RD 17423-17863	1. Kutcha village track at RD 16531-16535 2. Metalled road at RD 17243-17256 3. 11 kV line 17264 with a clearance of 6 m from proposed transmission line.	
17909	18996	* Level to nearly level land with gentle slope	1. House at RD 17966-17996 at a distance of 16 m from the central line on right side	1. Resettlement would be required
18996	20120	* Undulating land with moderate to steep slopes	1. Kutcha village track at RD 19186-19194 2. Kutcha village track at RD 20039-20045 3. LT line at RD 22058 with a clearance of 10 m	
20120	20917	* Level to nearly level land with mild slope	1. Kutcha track at RD 20274	
20917	29933	* Undulating land with gentle to moderate slopes, at places level to nearly level terraces * Nullahs (9 Nos.) at RDs 22807-22875, 23018-23070, 24303-24466, 24888-24947, 26730-26797, 27031-27064, 27157-27182, 27896-27942, & 29250-29336	1. Houses at RD 21218-21246 at a distance of 34 m away from central line on right side. 2. Kutcha village tracks (8 Nos.) at RDs 21364, 22115, 22503, 22984, 23755, 24174, 24556, 25340, & 25849 3. Mud house at RD 22199 at a distance of 16 m from central line on right side.	1. Resettlement of residences would be required for serial Nos 3, 4, 5, 6, & 7 of the previous column

TABLE 3.6
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
		• Water pond at RD 29002-29029 extending from central line by 30 m on right side.	4. House at RD 22729-22757 on the central line. 5. Mud house at RD 23812-23824 at a distance of 10 m from the central line on left side. 6. House at RD 24022-24029 at a distance of 20 m from the central line on left side. 7. Mud house at RD 24494-24500 at a distance of 2 m from the central line on left side. 8. Abandoned houses at RD 25637-25663 along the central line. 9. Metalled road (Attock-Fateh Road) at RD 26110-26115 crossing the corridor diagonally. 10. 11 kV line at RD 26364. 11. Metalled road (Attock-Humak Road) at RD 27617-27626.	

TABLE 3.C

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
		* Water pond at RD 29002-29029 extending from central line by 30 m on right side.	4. House at RD 22729-22757 on the central line. 5. Mud house at RD 23812-23824 at a distance of 10 m from the central line on left side. 6. House at RD 24022-24029 at a distance of 20 m from the central line on left side. 7. Mud house at RD 24494-24500 at a distance of 2 m from the central line on left side. 8. Abandoned houses at RD 25637-25663 along the central line. 9. Metalled road (Attock-Fateh Road) at RD 26110-26115 crossing the corridor diagonally. 10. 11 kV line at RD 26364. 11. Metalled road (Attock-Humak Road) at RD 27617-27626.	

TABLE 3.7
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	1083	* Undulating Land with moderate slope.	1. Kutcha village track between RD 293-300. 2. Land drainage depression between RD 359-367. 3. Metal road between RD 749-754.	Off-taking from Tarbela-Barotha-Gatti Outgoing Double Circuit I & II at RD 0+00.
1083	1529	* Broken land with steep slopes and a nullah between RD 1200-1333.	1. Graveyard on higher ground between RD 1454-1468 extending from central line to the end of the corridor on the left side.	Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3)
1529	1694	* Uneven land with mild slope.	1. Kutcha village track between RD 1529-1536.	Termination & connection of proposed line with existing 500 kV Tarbela-Gatti TL # I line at Tower # 139.

TABLE 3.8
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Single Circuit II

Reduced Distance (m) From	To	Land Features	Infrastructure	Remarks
0	1495	* Level to nearly level land with gentle slope. * Nullah at RD 368-386.	1. Metalled road at RD 708-712. 2. Mud houses at RD 1158-1186 at a distance of 28 m from central line on right side. 3. Kutcha village track at RD 1225. 4. 500 kV Tarbela-Gatti I at RD 1251.	1. No relocation or resettlement works involved. 2. Existing 500 kV line will be dismantled after its connection with Tarbela-Barotha- Gatti Outgoing Single Circuit I.
1495	1917	* Broken land with deep gullies at RD 1596-1700 * Nullah at RD between 1700-1917.	1. Kutcha village track 1504-1519.	
1917	3040	* Level to nearly level land with gentle to moderate slope. at place broken area. * Nullah at RD 1588-1686.	1. Kutcha village track between RD 3011-3021.	
3040	5250	* Broken area with deep gullies, and * Nullahs at RDs 3319-3382, 3451-3567, 3691-3873, 4263-4409, & 4956-5164. * Nandana Kas (rivulet) at RD 4495-4804.		1. Towers are located on stable ground.
5250	5750	* Level to nearly level land with moderate to steep slopes.	1. LT line at RD 5401 with a clearance of 5.2 m from the proposed TL. 2. Metalled road (Attock-Langar road) between RD 5462-5472. 3. 11 kV line at RD 5528 with a clearance of 8 m from the proposed TL.	

TABLE 3.8
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Gatti Outgoing Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
5750	7600	* Level to nearly level land with moderate slope. * Nullah at RD 6434 - 6548.	1. LT line at RD 6030 with a clearance of 7.4 m from the proposed TL. 2. Kutcha village tracks at RDs 6280, 7134 and 7438. 3. LT line at RD 7188 with a clearance of 10 m from the proposed TL.	
7600	8500	* Highly broken area with deep gullies, and * Nullahs at RDs 7711-7736, 7811-7859, 8016-8175, 8338-8368, & 8406-8477.		1. Towers are located on stable ground.
8500	9780	* Hilly area with steep to moderate slope and * Pond at RD 8971-9047 * Nullah at RD 9740-9765		1. Towers are located on stable ground.
9780	11731	* Terraced Land with moderate slope and * Nandna Kas at RDs 10010-10097 & 10509-10647.	1. Tubewell at RD 10009 and at a distance of 12m from center line on left side. 2. Metalled road between RD10427-10433. 3. Tubewell at RD 10520 at a distance of 16m from the center line on right side. 4. Kutcha village track at RD 10708-10711.	1. Connected to tower No 142 of existing Tarbela -Gatti 500 kV transmission line II. 2. Tubewells are to be removed and relocated at a safe distance. The boreholes to be refilled with earth to avoid accidents.

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Double Circuit I & II

Reduced Distance (m) From	To	Land Features	Infrastructure	Remarks
Barotha Rewat Double Circuit I & II (Segment I)				
0	668	* Terraced land with gentle slope. Initial 100 m has steep slope. * Nullah at RD 644-668.		
668	950	* Acquired land for GBHP	1.Tailrace area	
950	1932	* Highly broken land, part of which redeveloped to level land. * Nullahs between RD 1210-137? and 1580-1652.		On request from Barotha people, deep gullies have been filled to redevelop it for agriculture.
1932	3315	* Undulating land with leveled terraces at places, generally gentle slope. * Nullahs at RDs 2388-2396 and 2875-2966.	1. Kutcha village track at RD 2180. 2. Pipe line at RD 2820. 3. Metalled road (Attock-Gharalia road) at RD 2898-2906. 4. 11 kV line at RD 2966	
3315	3675	* Terraced land with gentle to moderate slopes.	1. 11 KV line at RD 3375. 2. Metalled road (Attock-Basal road) at RD 3375-3393. 3. Kutcha village track at RD 3513-3531.	
3675	5786	* Highly broken land with steep slopes and cultivated area. * Nullah along with broken land at RDs 3993-3997, 4341-4401, 4704-4721, 4868-4925, 5112-5136, 5161-5175, 5602-5786		
5786	7067	* Terrace land with level areas at places * Haro river from RD 6300-6714 * Nullah at RD 7460	1. Kutcha village way at RD 5901-5909 2. 11 KV transmission line at RD 5981 clearance 7.6 m from the proposed transmission line.	
7067	9017	* Broken area with cultivation land * Nullahs at RDs 7460-7553, 7745-7850, 8571-8625, 8662-8728.	1. Kutcha village tracks at RDs 7634, 8364. 2. Well at RDs 7723, 8489 at a distance of 26 and 22 m from centre line on right side. 3. Houses at RDs 7725 and 8491 at a distance of 22 and 20 m from the centre line on right side. 4. Water Course at RD 7754.	1. Removal of houses at RDs 7725 and RD 8491 and resettlement of households is required.
9017	10771	* Terrace land with mild slope.	1. Line water course at RDs 9303, 9444, 9515, 9838. 2. Metalled road at RD 9537-9542. 3. Kutcha village track at RDs 9634-9638, 9959-10027 (along the centre line) 4. Water pipe line 9959. 5. 11 KV line at 10488 with a height clearance of 6 m from the proposed transmission line. 6. Metalled road 11 KV at 10490-10505.	
10771	11415	* Broken area with undulating land at places.		
11415	12553	* Undulating land and broken land with moderate slopes. * Nullahs at RDs 12179-12326.	1. Kutcha village track at RD 11613-11619. 2. Metalled road at RD 12048-12057	

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Double Circuit I & II

Reduced Distance (m) From	Reduced Distance (m) To	Land Features	Infrastructure	Remarks
12553	14041	* Terraced / Level ground with cultivation.	1. Mud house at RD 12715-12721 at a distance of 16 m from the centre line on the right side. 2. Railway line at RD 12832-12842. 3. T.P line at RD 12854 with a clearance of 10 m. 4. Kutcha village track at RD 13496-13501 5. Metalled road at RD 13532-13554. 6. Houses at RDs 13989-13995 at distance of 26 m from the centre line on right side. 7. Metalled road at RD 13995-14006 8. 11 KV line at RD 14009 with a clearance of 8 m from the proposed (T.L)	
14041	16633	* Leveled ground with mild to moderate slope	1. House at RD 14102-14122 at a distance of 36 m from the centre line on left side. 2. LT. line at RD 14132 with a clearance of 5 m from the proposed (T.L) 3. Kutcha village track at RD 15035-15040. 4. Metalled road at RD 15603-15609 5. 11 KV line at RD 15610 with a clearance of 5 m from the proposed (T.L) 6. Metalled road at RD 16417-16452.	Relocation of the house is not required.
16633	19883	* Leveled to undulated land with nalahs at RDs 18809-18848	1. T.P line at RD 16659 with a clearance of 9 m from the proposed (T.L). 2. 11 KV line at RD 16838 with a clearance of 5 m from the proposed (T.L). 3. LT. line at RD 16857 with a clearance of 7.5 m. 4. LT. line at RD 17146 with a clearance of 10 m. 5. Houses at RD 17159-17179 at a distance of 32 m from centre line on right side. 6. Kutcha village track at RD 17647-17654.	1. Resettlement is not required.
			7. 11 KV line at RD 18073 with a clearance of 5.2 m from the proposed (T.L) 8. Metalled road at RD 18345-18351 9. Kutcha village track at RD 19271-19278	

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
19883	23323	* Undulated land with broken area at places. * Nulahs at RD 19915-19945, 21378 21432, 21712-21742, 22251-22309, 22800-22930, 23046-23186, 23213-23293.	1. House at RD 20584-20594 at a distance of 46 m from the centre line on left side. 2. Kutcha village tracks at RDs 20351, 21312, 22508. 3. Mud house at RD 21913-21933 at a distance of 30 m right from the centre of the proposed(T.L) 4. Mud house at 22583-22603 at a distance of 20 m from the centre line o the right side.	1. Resettlement of the household residing in the mud house at RDs 22583-22603 is required.
23323	24264	* Leveled ground with mild to moderate slope. * Nulahs at RD 23527-23604	1. Kutcha village track at RD 23871	
24264	26772	* Undulated land * Nulahs at RD 24547-24565, 24751 24801, 25441-25486, 26405-26600	1. Kutcha village tracks at RD 23487, 25353. 2. House at RD 25274-25280 at a distance of 20 m from the centre line on left side. 3. Dera at RD 25969-25984 at a distance of 34 m from the centre line on the left side. 3. Mud house at RD 26730-26736 at a distance of 12 m right side from the centre line of proposed (T.L.)	1. Resettlement of the households residing in a house at RDs 25274-25280 and a mud house at RD 26730-26736 is required.
26772	28046	* Level ground with mild to moderate slope * Nulahs at RDs 27195-27305, 27815-27875		
28046	28982	* Undulated ground with broken area. * Nullahs at RD 28344-28524 28802-28925	1. Kutcha village track running along the centre line from RDs 28625-28666.	
28982	32502	* Broken area with cuts * Nulahs (7 Nos.) at RDs 29782-29822, 29899-29929, 30414-30528, 30659-30817, 30878-30970, 32016-32125, 32214-32319.	1. 500 KV (Tarbela -Gatti-(I)) at RD 29841 with a clearance of 5m from the proposed (T.L)	This portion of existing Tarbela-Gatti line (I) (T.L) will be dismantled after redirecting it through Barotha.
32502	34126	* Undulated ground with moderate slope	1. LT. line at RD 32652 with a clearance of 6.3 m. 2. Houses at RDs 32711-32726 at a distance of 18 m from centre line on left side of the proposed (T.L) 3. Kutcha village track at RD 33118-33122. 4. Metalled road at RD 33176-33184 5. 11 KV line at RD 33327 with a clearance of 8 m. 6. LT. power line at RD 33394 with a clearance of 5m from the proposed (T.L) 7. Kutcha Village track at RD 33405. 8. Mud houses at RD 33826-33840 at a distance of 10 m from the centre line on the left side	1. Resettlement of households residing in houses at RDs 32711 327263 and RD 33826-33840 is required and structures removed.

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha Rewat Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
34126	37256	* Undulated land with broken area * Nalahs at RD 34126-34433, 34842-34957, 35032-35126, 35170-35881, 36566-36596.	1. Mud house at RD 34799-34827 extending from centre line to 31 m from the centre line on the right side. 2. Houses at RDs 34829-34839 at a distance of 10 m from centre line on right side. 3. Kutcha village track at RD 36306-36312	
37256	40316	* Leveled ground with mild slope * Nalah at RD 40319-40321	1. 11 KV line at RD 38171 with a clearance of 11 m from the proposed (T.L.) 2. Houses at RDs 38173-38193 and 38210-38224 at a distance of 4m and 12 m from the centre line on right and left side respectively. 3. L.T. line at RD 38263 with a clearance of 13 m from the proposed (T.L.). 4. 500 KV Tarbela - Gatti (II) at RD 38281 5. Guava garden from RD 38335-38387. 6. Kacha village track at RD 38575-38579 7. Metalled road at RD 38706-38720 8. L.T. line at RD 38755 with a clearance of 9.5 m from the proposed (T.L.) 9. Kacha village track at 39960-39961 10. 11 KV line at RD 40200 with a clearance of 11 m from the proposed (T.L.) 11. Metalled road at RD 40337-40345	1. Resettlement of households of houses at RDs 38173-38193 & 38210-38224 is required, and structures removed. 2. This portion of existing Tarbela-Gatti line (II) will be dismantled after redirecting it through Barotha.
40316	44133	* Kalla-Chitta range with high hills and undulating ground at places * Nalah at RD 43830-43836	1. Well at RD 43358 at a distance of 4m from centre line on right side of the proposed (T.L.) 2. Grave-yard from RD 43501-43526 extending from centre line up to a distance of 20 m on left side and 30 m on Right side. 3. Kacha village track at RD 43536-43542. 4. Houses at RD 43666-43688 on the cente line and extending to the distance of 12 m on right side. 5. Water coarse at RD 43932.	1. House at RD 43666-43688 will be removed and residents will be resettled 2. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3 of the text)

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha Rewat Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
44433	48775	* Terraced land with nulahs at RDs 45824-45830, 46061-46123, 47005-47190, 47708-47712, 48438-48508.	1. 11 KV line at RD 44528 with a clearance of 15 m from the proposed (T.L). 2. 11 KV line at RD 44638 with a clearance of 15 m from the proposed (T.L). 3. Metalled road at RD 44898-44908 4. 11 KV line at RD 44926 with a clearance of 17 m. 5. 66 KV line at RD 44959 with a Clearance of 7 m from the proposed (T.L) 6. Kutcha village track at RD 45338-45342 7. Metalled road at RD 45458-45466. 8. 132 KV line at RD 45869 with a clearance of 6 m from the proposed (T.L) 9. Kutcha village track at RD 45871 10. Gravel road at RD 46036. 11. Houses at RD 46156-46176 at a distance of 24 m from centre line on left side. 12. Water course at RD 47423 13. 11 KV line at RD 47602 with clearance of 7 m from the proposed (T.L.) 14. Kutcha village track at RD 48259. 15 House at RD 48291-48331 at a distance of 14 m from Centre line on left side 16. Kutcha village at 48367 17 11 KV line at 48588 with a clearance of 7.5 m. 18. Kutcha village track 48705. 19. house at 48707-48727 at a distance of 20 m from centre line on right side.	1. Only compound wall of the house at serial # 15 needs to be dismantled and compensation paid accordingly.
48775	50151	* Undulating land with steep slopes. * Nulahs (2 Nos.) at RDs 49216-49547, 50741-50795	1. Metalled road at RDs 49029-49039, 49170-49180, 50217-50226 2. Kutcha village tracks at RDs 49584, 50138. 3. House at RD 50615-50625 at a distance of 6 m from centre line on right side. 4. House at RD 51021-51041 at a	1. Removal of the house is required and the residents resettled.
50151	51926	* Steeped land with mild to moderate slope. * Pond at RD 50640-50652	1. Kutcha village track at RD 51653.	
51926	54331	* Hilly area (Khairi Murat range) with steep slopes.	1. Kutcha village tracks at RDs 52990, 53345	
54331	56882	* Broken area with shallow gullies, Terraces land at places. * Nulahs at 54787-54897, 55354-55539, 56020-56124.	1. House at RD 55726-55742 at a distance of 26 m from the centre line on the right side. 2. 11 KV line at RDs 56280 and 56560 with a clearance of 14 m and 5.5 m from the proposed (T.L.) respectively. 3. Kutcha village track at RD 56601. 4. Metalled road (Fateh Jang-Tarnol) at RD 56638.	* End of Barotha - Rawat Double Circuit I & II - Segment 1

TABLE 3.9

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Double Circuit I & II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
Barotha Rewat Double Circuit I & II (Segment II)				
0	2247	• Terraced land with mild slope. • Nullah at RD 446-703. • Pond at RD 1553-1612.	1. LT line at RD 106 with a clearance of 5 m from the proposed TL. 2. House at RD 963-980 at a distance of 16 m from centre line on left side. 3. Kutcha village track at RD 988. 4. House at RD 1023-1040 at a distance of 22 m from the centre line on right side. 5. LT lines at RDs 1001 and 1076, with a clearance of 14 m and 12 m, respectively from the proposed TL. 6. House at RD 1331-1358 at a distance of 20 m from centre line on left side. 7. House at RD 1340-1350 at a distance of 18 m from centre line on right side. 8. Well at RD 1460 at a distance of 2 m from the centre line on right side. 9. 11 kV line at RD 1489 with a clearance of 14 m from the proposed TL.	1. Gantry Tower at RD 2247 of Rewat Grid station. 2. Houses at serial # 2, 4, 6 and 7 the transmission line would need removal and resettlement of the affectees required.

TABLE 3.10

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	1286	• Undulated land with moderate to steep slopes, some broken area near Nullah. • Nullah at RD 736-840.	1. Kutcha village track at RD 462. 2. Houses at RD 470-500 at a distance of 40 m from centre line on left side.	1. Removal of houses is not required, therefore no resettlement.
1286	3024	• Terraced land with mild slope. • Pond at RD 1558--1570 (12 m x 28 m) at distance of 4 m from central line on right side • Pond from RD 2770-2870 (100 m x 80 m) extending on both sides of the centre line by 40 m • Nullah at RD 2870-2984 off-taking from the pond and running parallel to the centre line at a distance of 5m from the central line on right side.	1. Kutcha village track at RD 1548-1552. 2. 11 kV line at RD 1890 with a clearance of 6 m from the proposed TL. 3. Telephone lines at RDs 2006 & 2031 with clearance of 7 m & 5.5 m, respectively. 4. Railway Line (Rawalpindi-Fateh Jang) at RD 2014	1. No relocation works are involved.
3024	6200	• Terraced land with mild to moderate slopes, undulations at places. • Nullah starting from RD 4004 and running along the central line up to RD 4250 having an average width of 35 m. • Nullahs at RD 5165-5196 & 5529-5560.	1. Kutcha village tracks (4 Nos.) at RDs 3550, 4471, 5196 & 5617 2. Grave at RD 4910 at distance of 12 m from the central line on left side. 3 House at RD 5594-5620 at a distance of 20 m extending up to 50 m from the central line on left side.	1. House will not require removal as the corner of the house nearest to the transmission line is the boundary wall of the courtyard. 2. A tower is located at RD 4940 which is close to the grave at RD 4910. Care has to be taken during construction of tower and stringing while working near the grave. (Reference Section 5.3)
6200	7100	• Undulated land with moderate slopes, level areas at places.		
7100	9900	• Stepped land with mild slope. • Water logged area from RD 8754-8813	1. Kutcha village track at RDs (7 Nos.) 7276, 7462, 7953, 8187, 8451, 8918 & 9237. 2. LT line at RD 9733 with a clearance of 9 m from the proposed transmission line. 3. Metalled road at RD 9779-9785.	
9900	11010	• Undulated land with moderate slopes, level areas at places. • Nullahs at RDs (2 Nos.) 10063-10135, 10376-10438.		

TABLE 3.10

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
11010	13846	• Terraced land with generally moderate slope, occasionally gentle slope. • Nullahs at RDs 11270-11296 & 12184-12520.	1. Kutcha village track at RD 11039 & RD 13005-13009. 2. Houses at RDs 11039-11078. At a distance of 26 m from the center line on right side. 3. Mud house from RD 11606-11631 at a distance of 10 m from centre line on left side. 4. Metalled roads at RD 11681-11685, & 13183-13192. 5. Mud houses at RD 13134-13148 at a distance of 18 m from the central line on left side. 6. Telephone line at RD 13193 with a clearance of 14 m from the proposed TL.	1. Removal and resettlement of Mud house at serial No. 3 is required. 2. Some of the houses at serial No. 5 require removal and resettlement of the residents will be required.
13846	14466	• Broken area steep slopes, terraces at places • Nullahs at RDs 13856-13880 & 14332-14398.	1. Kutcha village track at RD 14148-14152.	
14466	16056	• Hilly area of Khairi Murat and undulating land of foot hills with steep to moderate slopes. • Nullahs at RDs 15220-15289 & 15436-15450	1. Kutcha village tracks (2 Nos.) at RDs 15113, & 15681. 2. Motorway (M2) at RD 14950-15002 having clearance of 23 m from proposed TL. 2. Graveyard at RD 15645-15666 existing along the central line extending on both sides by 30 m.	1. Care has to be taken during construction and stringing that graveyard is not disrupted. (Reference Section 5.3)
16056	16636	• Terraced land with mid slope, level area at places • Drainage depression at RD 16393-16420.		
16636	17306	• Undulating land with mild slopes, Terraces at places. • Drainage depressions (3 Nos.) at RD 16664-16714, 16780-16807, & 16845-16882.		
17306	19656	• Highly broken area with stony ridges/hills at places. • Nullah at RD 17627-17664. • Drainage depressions at various places. • Water pond at RD 19127-19150 starting a distance of 10 m from the central line and extending up to 30 m on left side.	1. Kutcha village tracks (3 Nos.) at RD 18854, 19099, & 19336. 2. Pumphouse at RD 18758-18768 at a distance of 16 m from the central line on right side.	• Pumphouse would need removal and compensated.
19656	20986	• Highly broken land with narrow ridges and deep gullies.		1. No suitable site is available for erecting towers. Realignment is required in this reach. Consultants are working on this.

TABLE 3.10

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit I

Reduced Distance (m) From	Reduced Distance (m) To	Land Features	Infrastructure	Remarks
20986	22236	• Level to nearly level land with gentle slopes, terraces at places.	1. Metalled Road (Chakri Road) at RD 21182-21194. 2. 11 kV line at RD 21284 with a clearance of 6.4 m from the proposed TL. 3. School building at RD 21316-21325 at a distance of 37 m from central line on left side. 4. Metalled road at RD 21364-21372.	1. School building is though at a safe distance from the proposed transmission line, the danger is there that the children may approach under the TL. Therefore, WAPDA will fence the school area, in case boundary wall does not exist.
22236	26314	• Highly broken land with narrow ridges and deep gullies, level to nearly level areas at places • Nullahs (4 Nos.) at RD 22466-22480, 22656-22668, 22896-22910, 22988-22996, & 24526-24536. • Nullah meandering through the corridor between RD 23436 and 23736 crossing the central line at 4 places • Nullah meandering through the corridor between RD 24272 and 24446 crossing central line at 2 places	1. Mud house at RD 22252-22260 at a distance of 22 m from the central line on right side. 2. Kutcha village tracks at RD 23254, & 25029.	1. Removal of the Mud house and resettlement of the residents is required.
26314	27336	• Undulating land with moderate slopes	1. Kutcha village track at RD 26612. 2. 11 kV line at RD 27237 with a clearance of 6.5 m from the proposed TL. 3 Metalled road (Hadiala Road) at RD 27245-27262. 4. Telephone line at RD 27275 with a clearance of 13 m from the central line.	
27336	29094	• Level to nearly level land with gentle slopes, terraces at places. • Nullah at RD 28308-28318. • Soan River at RD 27772-28114.	1. Water coarse at RD 27371. 2. Well at RD 27657 at a distance of 16 m from the centre line on left side. 3. Kutcha village track at RD 29070.	No tower is located in the river bed.
29094	31336	• Generally broken land with terraces and level areas at places • Nullahs (4 Nos.)at RDs 29166-29186, 30276-30288, 30686-30704 & 30922-30956 • Pond at RD 31286-31305 extending on both sides from centre line to a distance of 20 m and 30 m.	1. Kutcha village track at RD 29856.	

TABLE 3.10
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Rewat Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
31336	34336	• Terraced land with mild slope. • Nullahs at RDs (3 Nos.) 32928-32942, 33292-33485 & 34126-34135.	1. Village tracks at RDs 32212, 33639 & 34208. 2. 11 KV line at RD 33206 with a clearance of 5 m from the centre line. 3. Metalled road (Gorakh pur) at RD 33208-33214. 4. Pump house at RD 33719 at a distance of 28 m from centre line on right side.	1. Removal of the pump house is not required.
34336	37846	• Generally broken land with some level and terraced area. • Nullahs (8 Nos) at RDs 34426-34446, 34556-34578, 35606-35616, 35876-35882, 36760-36778, 36960-37034, 37252-37258 & 37466-37472.		
37846	39587	• Generally Undulated land with moderate slopes developed to terraces.	1. Kutcha Village tracks at RDs 38032, 38497. 2. Pump house at RD 38632 at a distance of 30m on left side of the proposed (TL.) 3. Metalled roads at RDs 38675-38680, 39565-39570 (Sangra Road). 4. 11 KV line at RD 38829 with a clearance of 7 m from the proposed (TL.). 5. Pump house at RD 39471 at a distance of 32 m from the central line on left side. 6. 11 KV line at RD 39555 with a clearance of 7.6 m from the proposed (TL.).	
39587	40396	• Undulating land with steep slopes and terraces at places. • Nullahs at RDs 39678-39729 & 40027-40096	1. Kutcha village track at RD 40248 & 40345	
40396	43726	• Highly broken area with steep to moderate slopes • Nullahs at RDs(3 Nos.) 41971-42020, 43042-43060 & 43407-43413.	1. Kutcha village track at RD 40776.	

TABLE 3.10

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit I

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
43726	47712	* Terraced land with mild slope. * Nullahs at RDs (3 Nos.) 44333-44633, 45778-45796 & 46472-46498.	1. Metalled Roads at RDs 43808-43818 , 44776-44784 & 46395-46408. 2. 11 kV line at RD 44832 with a clearance of 7.8 m from the proposed T.L. 3. Kutcha village tracks at RDs 44854, 45308, 46090, 46113 & 47701. 4. Houses (Dhok Kala Khan) at RD 44880-45026 at a distance of 10 m - 20m from centre line on left side. 5. Grave (Ziarat) at RD 45130 at a distance of 5m from the centre line on right side. 6. 11 kV lines at RDs 45975 & 47670. 7. LT. line at RD 46355. 8. House at RD 46355-46365 at a distance of 30 m from the centre line on left side. 9. 220 kV (Mangla- Burhan) Transmission line at RD 46570-46582. Conductor clearnnce from the ground at central line of proposed (TL.) is 26.2 m.	1. The alignment of the transmission line has been changed been to avoid the disruption of houses of Dhok Kala Khan and Ziarat (shrine). With the new alignment the distances of the houses & Ziarat ranges from 30 m to 95 m. 2. Diversion of the proposed (TL.) is required from RD 45946 to RD 47712 to get a clearance from the existing 220 kV line, the Engineer is working on this

TABLE 3.11
LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR
Barotha-Rewat Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
0	1924	• Terraced land with gentle slope. • Nullahs at RD 742-822, and 896-916.	1. Kutcha village tracks at RDs 452, 1229, 1489, & 1702. 2. LT. line at 1668 with clearance of —	1. Height of LT. line have not been shown on the drawing
1924	3100	• Leveled to nearly level land with terraces at places. • Nullah at RD 2519-2558.	1. Railway line at RD 2148-2170.	1. The RDs include a telephone & a telegraph line on right and left side of the railway line. The clearance of these lines are 6 & 8 m respectively from the proposed
3100	3900	• Terraced land with gentle slope.	1. Kutcha village tracks at RDs 3235 & 3426.	
3900	5800	• Terraced land with undulations at places • Nullahs at RDs 4025-4118 and 4182-4282	1 House at RD 4291-4300 at a distance of 30 m from the centre line on right side and RD 4900-4950 at distance of 30 m from the centre line on left side	
3315	3675	• Terraced land with gentle to moderate slopes	1. 11 kV line at RD 3375 2. Metalled road (Attock-Basal road) at RD 3375-3393 3. Kutcha village track at RD 3513-3531.	
3675	5786	• Highly broken land with steep slopes and cultivated area. • Nullah along with broken land at RDs 3993-3997, 4341-4401, 4704-4721, 4868-4925, 5112-5136, 5161-5175, 5602-5786		
5786	7120	• Broken land with steep gullies. • Nullahs at RDs 5826-5848 & 5900-5924	1. Kutcha village way at RD 6955. 2. LT. at RDs 6966 & 7036	
7120	8380	• Leveled land with mild to moderate slope • Nullahs at RDs 7354-7400 & 7922-8006	1. Kutcha village tracks at RDs 7740 & 8317	
8380	9540	• Undulated land with moderate to steep slopes, terraces at places. • Nullah at RD 8732-8779. • Nullah stretching between RD 9100-9176 along the central line.	1. Kutcha village track stretching between RD 9246 to 9272 along the central line.	
9540	12978	• Terraced land with generally mild slopes, but steep slopes and undulating land at places. • Nullahs at RDs 11050-11100, 11371-11394, 12209-12290 & 12416-12490	1. Kutcha village track at RD 11453. 2. LT power line at RD 11740 with a clearance of 12.5 m from the proposed TL. 3. Telephone at RD 11755 with a clearance of 11 m from the proposed TL.	

TABLE 3.11

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
12978	13648	* Level to nearly level land with mild slopes. * Nullah at RD 13394-13402. * Water pond at RD 13079-13099 at a distance of 20 m from the central line of the corridor on left side.	1. Kutcha village track at RD 13278.	
13648	15448	* Hilly area (Khairi Murat range) with high peaks and steep slopes.		
15448	15948	* Undulated land with mild to moderate slopes, terraces at places.	* Motorway (M2) at RD 15715-15750	
15948	16628	* Level to nearly level land with mild slopes, terraces at places	1. Well at RD 16186 at a distance of 16 m from central line of the corridor on right side.	
16628	17208	* Undulating land with mild slopes.		
17208	18188	* Broken land with steep slopes * Nulah at RD 17272-17367. * Nullah stretching along the central line of the corridor from RD 17706 to 17973.		
18188	20946	* Highly broken land with steep slopes & deep gullies. * Nullah along with broken land at RDs 18328-18338, 18708-18744, 19216-19260, 19428-19438, 19542-19562, 19748-19778, 20032-20072, 20678-20690		
20946	25628	* Highly broken land with undulation at places * Nullahs at 24654-24778, 25104-25128	1. Kutcha village tracks at RDs 21317, 22574, 23927 2. Metalled road (Chakri Road) at RD 21905-21914 3. 11 KV line at RD 21941 with a clearance of 6m from the proposed (T.L.) 4. Reserved forest in the whole corridor stretching from RDs 23881-23926 5. Dam (?) from RDs 25432-25606	

TABLE 3.11

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
25628	28508	• Undulation with mild to moderate slope and high ground at places. • Nullahs at RDs 27060-27070, 27413-27417, 27584-27588 & 27866-27945	1. House at RD 28123 at a distance of 10 m from the centre line on right side . 2. Metalled road from 28154-28161. 3. 11 KV line at RD 28176 with a clearance of 14 m. 4. Telephone line at RD 28202 with a clearance of 16 m from the proposed (T.L). 5. Water coarse at RD 28464.	
28508	29518	• Leveled ground. • Soan River from RD 28771-28966	1. Well at RD 28586 at a distance of 21 m from central line of the corridor on right side. 2. Water coarse stretching along the centre line from RD 28586-28679 3. House (room only) at RD 29306 at a distance of 4m left side of the central line. 4. Wells at RD 29312 & 29414 at a distance of 16m & 6m from the centre line on Right side.	1. Removal of room and well is required and compensated
29518	30468	• Stepped land with mild slope and broken areas at places	1. Kutcha village tracks at RDs 30461-30465	
30468	31318	• Broken land • Nullahs at RDs 30723-30754, 30848-30856, 31055-31061 & 31168-31180.	1. Kutcha village tracks at RDs 30625, 31340	
31318	32798	• Stepped land with mild slope. • Nalah at RD 31814-31828, 31883-31916, 32235-32380, • Pond At RD 32568-32592 at a distance of 10 m on right side of the proposed (T.L)	1. Kutcha village track at RD 31464	
32798	33838	• Undulated land with broken area.	1. House at RD 32806 at a distance of 11 m from the centre line on left side. 2. Kutcha village tracks (2 Nos.) at RD 33398 & another stretching along centre line at RD 33453-33499	

TABLE 3.11

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
33838	35888	• Stepped land with moderate to steep slopes. • Nullahs stretching along centre line from RDs 34207-34294, 34966-34972, 35117-35191, 35242-35254, 35533-35537, 35621-35745. • Pond from RD 34503-34560 starting from a distance of 20m from centre line on right side & extending to the left side up to the end of Corridor.	1. Kutcha village tracks at RDs 34564 & 34864. 2. 11KV line at RD 34753 with clearance of 11.5 m 3. Metalled road at RD 34758-34768. 4. Grave yard crossing the centre line at RD 34781-34806 and extending up to RD 34864 on the left side of the centre line.	1. Graveyard is likely to be disrupted during construction activities. There is no Tower in this stretch, however, disruption may occur during stringing. Therefore, the Contractor needed to be vigilant during the work in this area. (Reference Section 5.3 of the text)
35888	39332	• High hilly and broken area • Nullahs at RD 35909-36028, 36121-36199, 36210-36291, 36742-36757, 36908-36968, 37442-37538, 38008-38028, 38286-38296, 38348-38366, 38694-38710, 38838-38854, 38836-38852 & 38980-39046	1. Kutcha village track at RD 37779-37784.	
39332	40338	• Stepped land with mild slope and undulation at places.	1. 11 KV line at RD 40260 with a clearance of 14 m from the centre line on the proposed transmission line. 2. Metalled road at RD 40285.	
40338	42066	• High hills with steep slopes and undulating land with broken area at places • Nullah at RD 41312-41366, 41758-41783.	1. Kutcha village track k at RD 40511-405156 2. House (room) at RD 40628 at a distance of 22 m on left side of the proposed (TL)	
42066	45508	• Undulating land with broken areas • Nullahs at RDs 42377-42383, 42550-42556, 42604-42612 & 44170-44429 (Stretching along the centre line)	1. Metalled road at RD 45020-45034	

TABLE 3.11

LAND FEATURES & INFRASTRUCTURE FALLING WITHIN 100 m CORRIDOR

Barotha-Rewat Single Circuit II

Reduced Distance (m)		Land Features	Infrastructure	Remarks
From	To			
45508	49299	* Stepped land with mild slope. * Nullahs at RDs 46878-46912, 47448-47468, 47757-47768 & 48351-48371. * Pond At RD 32568-32592 at a distance of 10 m on right side of the proposed (T.L)	1. Metalled road at RD 46412-46424. 2. 11 KV line 46412 with a clearance of 7 m from the proposed (T.L) 3. Abandon house without slab at RD 46958 at a distance of 12 m from the centre line on right side. 4. T.P line at RD 47001 with a clearance of 7 m from the proposed (T.L) 5. Metalled road at RD 47006-47014 6. 220 KV double circuit (Mangle-Burhan line) at RD 48276 with a clearance of 6m from the proposed (T.L) 7. 11 KV line at RD 49232 with a clearance of 6m from the proposed transmission line. 8. Kutcha village track at RD 49257.	1. Removal of the house is not required. 2. Start of double circuit (Barotha Rewat) transmission line near Rewat Grid station.

TABLE 3.12
DISTRIBUTION OF TRANSMISSION LINES WITH RESPECT TO LAND FEATURES

Map Legends	Landforms	Stretch of Transmission Lines in km										Total Stretch of Lines falling in Various Landforms	
		I	II	III	IV	V	VI	VIIA	VIII	IX	VIIB	km	%
1	Level to Nearly Level Land with Gentle to Moderate Slopes	3.13	-	-	5.62	-	5.07	7.90	2.67	4.60	-	28.98	12.34
2	Land with Moderate to Steep slopes, Developed toTerraced Land	2.18	2.47	6.41	-	-	1.95	11.67	18.12	17.31	2.25	62.35	26.55
3	Undulating Land with moderate to steep slopes	11.87		-	14.28	1.25	-	15.66	7.54	6.16	-	56.75	24.17
4	Broken Land	6.88	-	-	9.44	0.45	3.43	14.89	17.46	14.06	-	66.61	28.37
5	Hills and Mountains	2.09	-	-	-	-	1.28	6.49	1.59	6.97	-	18.42	7.85
6	Miscellaneous Land (including Tailrace Channel, Rivers, etc.)	0.29	-	-	0.59	-	-	0.28	0.34	0.20	-	1.70	0.72
	Total Length of Lines	26.44	2.47	6.41	29.93	1.69	11.73	56.88	47.71	49.30	2.25	234.81	100.00

Note:

Transmission Line # I	Tarbela-Barotha Incoming Double Circuit I & II
Transmission Line # II	Tarbela-Barotha Incoming Single Circuit I
Transmission Line # III	Tarbela-Barotha Incoming Single Circuit II
Transmission Line # IV	Barotha-Gatti Outgoing Double Circuit I & II
Transmission Line # V	Barotha-Gatti Outgoing Single Circuit I
Transmission Line # VI	Barotha-Gatti Outgoing Single Circuit II
Transmission Line # VIIA	Barotha-Rewat Double Circuit I & II Segment 1
Transmission Line # VIII	Barotha-Rewat Single Circuit I
Transmission Line # IX	Barotha-Rewat Single Circuit II
Transmission Line # VIIB	Barotha-Rewat Double Circuit I & II Segment 2

TABLE 3.13
DISTRIBUTION OF TRANSMISSION LINES WITH RESPECT TO LANDUSE

Map Legends	Landuse	Stretch of Transmission Lines in km										Total Stretch of Lines falling in Various Landuse	
		I	II	III	IV	V	VI	VIIA	VIII	IX	VIIB	km	%
1	Predominantly Well Irrigated Agriculture with Occasional Dry Farming	-	-	-	-	-	-	-	3.00	-	-	3.00	1.28
2	Predominantly Rainfed Agriculture with Occasional Well Irrigation	6.20	2.47	4.81	5.00	0.63	2.30	13.60	7.80	3.40	2.25	48.47	20.64
3	Restricted Cropping with Some Grazing	-	-	-	4.40	-	-	17.03	13.70	13.30	-	48.43	20.63
4	Grazing With Some Restricted Cropping	-	-	-	-	-	-	-	1.80	2.60	-	4.40	1.87
5	Grazing With Some Unused Land	17.86	-	1.60	19.94	1.06	8.15	19.48	19.48	22.42	-	109.99	46.84
6	Forests	2.09	-	-	-	-	1.28	6.49	1.59	5.99	-	18.44	7.85
7	Predominantly Unused Land	-	-	-	-	-	-	-	-	-	-	0.00	0.00
W	Misc. Area	0.29	-	-	0.59	-	-	0.28	0.34	0.59	-	2.09	0.89
	Total Length Of Lines	26.44	2.47	6.41	29.93	1.69	11.73	56.88	47.71	49.30	2.25	234.81	100.00

Note:

Transmission Line # I	Tarbela-Barotha Incoming Double Circuit I & II
Transmission Line # II	Tarbela-Barotha Incoming Single Circuit I
Transmission Line # III	Tarbela-Barotha Incoming Single Circuit II
Transmission Line # IV	Barotha-Gatti Outgoing Double Circuit I & II
Transmission Line # V	Barotha-Gatti Outgoing Single Circuit I
Transmission Line # VI	Barotha-Gatti Outgoing Single Circuit II
Transmission Line # VIIA	Barotha-Rewat Double Circuit I & II Segment 1
Transmission Line # VIII	Barotha-Rewat Single Circuit I
Transmission Line # IX	Barotha-Rewat Single Circuit II
Transmission Line # VIIB	Barotha-Rewat Double Circuit I & II Segment 2

TABLE 3.14
AVERAGE-MONTHLY RIVER DISCHARGES

Month	Discharges of Haro River at Sanjwal (cumec)	Discharges of Soan River at Rawalpindi (cumec)
January	11.19	12.02
February	14.50	7.53
March	16.06	7.19
April	17.53	9.96
May	11.89	3.19
June	8.86	2.03
July	26.31	66.66
August	44.43	81.78
September	23.65	40.38
October	10.31	6.12
November	8.84	4.29
December	9.85	4.55

TABLE 3.15
IMPORTANT WILDLIFE SPECIES OF ATTOCK AND RAWALPINDI AREAS

Sr. No.	Common Name	Scientific Name
	A. BIRDS	
1	Black partridge	Francolinus frantolinus
2	Grey partridge	Francolinus pondicerionus
3	Chakur	Alectrois chakar
4	See see partridge	Amnoperdix griseogularis
5	Common paraih kite	Milvus migrans
6	Black winged kite	Elanus caeruleus
7	White backed vultuse	Gyps bengalensis
8	Shikra	Accipiter badius
9	Kestrel	Falco tinnunculus
10	Rose ringed parakeet	Psittacula krameri
11	Blue rock pigeon	Columba livia
12	Ring dove	Streptopelia decacoto
13	Red turtle dove	Streptopelia tranquebarica
14	Common starling	Sturnus vulgaris
15	White cheeked bulbul	Pynonotus levcogenys
16	Red vented bulbul	Pyconotus cafer
17	Common myna	Acridotheres tristis
18	Bank myna	Acridoteres ginginianus
19	Spotted owlet	Athene brama
20	House swift	Apus affinis
21	Pied king fisher	Ceryle rudis
22	White breasted king fisher	Halcyon snyrensis
23	Indian roller	Corocias benghaleneses
24	Hoopoe	Upupa epops
25	Little green bee-eater	Merops orientalis
26	Golden backed wood peacker	Dinopium benghalense
27	Crested lark	Galerida cristata
28	Wire tail swallow	hirundo smithii
29	Grey shrike	Lanius excubitor
30	Rufous black shrike	Lanius schach
31	Balck drongo	Dicrurus adsimilis
32	House sparrow	Passer domesticus
33	House crow	Corvus splendens
34	Common babbler	Turdoides caudatus
35	Jungel babbler	Turdoides striatus
36	Pied fly catcher	Ficedula hypoleuca
37	Reed warbler	Acrocephalus scirpaceus

TABLE 3.15
IMPORTANT WILDLIFE SPECIES OF ATTOCK AND RAWALPINDI AREAS

Sr. No.	Common Name	Scientific Name
38	Great reed warbler	Acrocephalus stentoreus
39	Indian magpie robin	Copsychus saularis
40	Pied bush chat	Saxicola caprata
41	Purple sun bird	Nectarinia asiatica
42	Black red start	Phoenicurus ochruros
43	White Wag tail	motacilla alba
44	Yellow wag tail	Motacilla flava
45	large pied wag tail	Motocilla maderaspatensis
46	Indian tree pie	Dendrocitta vagabunda
47	common qualil	Coturnix coturnix
48	Red wattled lapwing	Vanellus indicus
	B. MAMMALS	
1	Urial	Ovis orientalis punjabiensis
2	Hill fox	Valpus valpus
3	Jackal	Conis aureus
4	Poriupine	Hystrix Indica
5	Chinkara	Gazella gazella
6	Jungel cat	Felis chaus
7	Wild boar	Sus scrofa
8	Palm squirrel	Fanambulus pannanti
9	Wolf	Cranis lupus
10	Common leopard	Panthera paradus (reported)
11	Cape hare	Lepus capensis
	C. WATERFOWL	
1	Little grebe	Tachybaputs ruficollis
2	Great crested grebe	Podiceps. Cristatus
3	Indian pond heron	Ardeola grayii
4	Cattle egret	Bubulcus ibis
5	Little egret	E. garzetta
6	Great egret	E. alaba
7	Purple heron	Ardea purpurea
8	Grey heron	A. cinerea
9	Ruddy shelduck	Tadoran ferruginea
10	Eurasian wigeon	Anas penelope
11	Gadwall	A. strepra
12	Common (green-winged) teal	A. crecca
13	mallard	A. platyrhynchos
14	Northern pintail	A. acuta

TABLE 3.15
IMPORTANT WILDLIFE SPECIES OF ATTOCK AND RAWALPINDI AREAS

Sr. No.	Common Name	Scientific Name
15	Northern shoveler	A. clypeata
16	Common pochard	Aythya ferina
17	Tufted duck	A. fuligula
18	Moorhen	Gallinula chloropus
19	Common coot	Fulica atra
20	Black-winged stilt	Himantopus himantopus
21	Northern lapwing	Vanellus vanellus
22	Red-wattled lapwing	V. indicus
23	little ringed plover	Charadrius dubius
24	Redshank	Tringa totanus
25	Greenshank	T. nebularia
26	Common sandpiper	Actitis hypoleucos
27	Little stint	Calidris minuta

CHAPTER 4

ALTERNATIVES CONSIDERED

CHAPTER 4

ALTERNATIVES CONSIDERED

4.1 GENERAL

In the modern age, electric power has a pivotal position in the national economy Progress in industrial and agricultural sectors depends on an assured supply of electric power. The pace of development in these sectors in Pakistan had been considerable during the last four decades, with the result that the demand for power has increased tremendously. In the meantime, the pressure of population growth has also progressively increased power demand in the domestic and commercial sectors. The Government of Pakistan has always endeavored to meet this ever-increasing demand by installing more and more hydro and thermal power plants. In spite of priority-level efforts, the firm power generating capacity of the country has been generally lower than the peak demand, particularly during the early summer months. As a result, load shedding has become a common feature

The following table shows the existing power demand, generating capacity and sent out demand balance for the year 1996-97 for WAPDA power system

TABLE SHOWING ELECTRIC POWER GENERATION, DEMAND AND SHORTFALL DURING YEAR 1996-1997

Source of Power Generation	Power Generation/Demand (MW) During					
	July-Aug	Sept-Oct	Nov-Dec	Jan-Feb	Mar-Apr	May-June
Thermal Power	4784	5033	3809	5479	5365	5191
Hydro Power	3560	3472	3931	2100	1482	2647
Total	8344	8505	7740	7579	6847	7838
Demand	8576	8567	7780	7679	8541	8772
Shortfall	232	62	40	100	1694	934
% Shortfall	2.71	0.72	0.51	1.3	19.83	10.65

Source WAPDA

The shortfall in generating capacity is related to the variability in the available hydropower due to fluctuations in the river flows and water levels in the reservoirs and the need to release water from storage to meet specific irrigation demands. The reservoir water level in Mangla dam is generally at its minimum during March, while that of Tarbela is minimum during May. The power demand on the other hand starts picking up in March and continues to rise until June, when it is at its peak. The result is a negative reserve margin during these months

Similarly, in January the irrigation canals are shut down for their annual maintenance and therefore irrigation releases are small. This results in a shortage of energy.

Ghazi-Barotha Hydropower Project was planned to increase the power generation capacity of the country and to reduce the shortfall in generation over demand. As referred earlier, GBHP is under construction and will be ready for commissioning by August 2002 It is; therefore, imperative that the dispersal arrangement of the power generated by GBHP is ready by that time. WAPDA has considered various alternative systems for the dispersal of the power and selected the one, which is the most efficient and economic. The alternative options of dispersal system studied by WAPDA are discussed in the subsequent sections.

4.2 ALTERNATIVE OPTIONS FOR POWER DISPERSAL FROM GBHP

4.2.1 General

WAPDA has planned to interconnect the powerhouse of Ghazi-Barotha Hydropower Project with the existing network of power dispersal. The powerhouse can be interconnected with the existing system in a variety of arrangements. Eight different alternatives were studied in order to select the most optimum/least-cost solution The optimum solution was further studied for the years 2005 and 2010.

All the alternatives have been compared based on transmission system losses, capital cost and reliability of the network. In evaluating the optimum/least-cost transmission interconnection arrangement, project worth (utility value) concept was used. In this method, a value is assigned to an arrangement (project) based on its capital cost, cost due to transmission system losses and cost of electric power not served. The objective that best represent the cost is (1/x), i. e. the value of the project relatively decrease with increase in cost. Further, the probability of the arrangement being selected is calculated from the system (Composite System) reliability. The utility value of the arrangement calculated by adding the assigned values and multiplying it with the system reliability, etc. (1-LOLP) where LOLP is the composite system Loss of Load Probability. The arrangement with the highest relative project worth (utility value) is selected.

4.4.2 Alternatives Considered

The various alternatives (cases) studied are briefly discussed below:

Alternative- I (Case-I)

Alternative-I includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit

- All the generation will be at 500 kV bus

This alternative apparently seems feasible. The cost due to system losses is on the higher side, but the capital cost is relatively low. However, the cost of electric power not served is high and the alternative has the lowest relative reliability. The reliability of the system will further decrease with future system-load growth in the Peshawar area, offsetting the capital cost.

Alternative-2 (Case-2)

This alternative includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit
- Barotha-Peshawar 500 kV single circuit
- All generation will be at 500 kV bus

Alternative-2 is also an apparently feasible solution. The 500 kV Barotha-Peshawar line does not help the system reliability as it strain the Peshawar 500 kV bus and the 500/200 Transformer(s). Therefore, its relatively high project worth has to be neglected.

Alternative-3 (Case-3)

This alternative includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit
- Barotha-Peshawar 500 kV single circuit.
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided

In this alternative, the capital cost is relatively high for achieving better system reliability and reduction in system losses. The Barotha-Peshawar 500 kV line is under utilized.

Alternative-4 (Case-4A)

The proposed dispersal arrangements for this alternative are as follows:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit
- Barotha-Peshawar 500 kV single circuit.
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line

- Barotha-Burhan 220 kV twin bundle D/C line
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided.

This option also has very high capital cost. Again, Barotha-Peshawar 500 kV line and Barotha-Burhan 220 kV lines are under utilized. The significant improvement in reliability is offset by the increased capital cost.

Alternative-5 (Case-4B)

This alternative includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line
- Barotha-Burhan 220 kV twin bundle D/C line
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided

This alternative is similar to alternative-4 minus the Barotha-Peshawar 500 kV line. Compared to the earlier case, there is significant reduction in capital cost with the same level of the system reliability and relatively small increase in transmission system losses. The Barotha-Burhan 220 kV line is still under utilized.

Alternative-6 (Case-5A)

This alternative includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit.
- Rewat-Gujranwala-Lahore 500 kV single circuit.
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line.
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided

This option has the highest relative system reliability. The capital cost and cost due to losses is relatively low. The lines toward Peshawar are reasonably loaded.

Alternative-7 (Case-5B)

This alternative includes the following arrangements:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit.
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line
- Generation at 500 kV and 220 kV buses (3 unit at 500 kV bus and 2 unit at 220 kV bus). A 500/220 kV transformer will be provided

This alternative is same as alternative-6 (case-5) except that two generators are on the 220 kV bus. The capital cost of the configuration is almost same as that of the alternative-6. The system reliability has decreased as connecting generators on the 220 kV Barotha bus increases the power flow on the Barotha-Nowshera-Shahibagh 220 kV line. In addition, the system losses are relatively higher as there is the reduction of power flow on Treble-Peshawar 500 kV line.

Alternative-8 (No Action Case)

This case does not consider the dispersal of Ghazi-Barotha Hydropower Project. This option is factually a "No Action" alternative. The load flow study for this alternative indicates that with the present load apparently there will be no significant change in the countries dispersal system. However, with the growth in load by 10 % in Peshawar and Rawalpindi areas there will be significant reduction in the system voltages. This study dictated a need for a major alternative plan in case there are any changes in Ghazi-Barotha commissioning plans.

4.2.3 Conclusions

In order to evaluate the project alternatives with a highest project worth, system reliability study were carried out for years 2001 and 2005. Alternative-1 & 2 had high project worth in year 2001 .due to low system cost and relatively comparable reliability values. However, in the year 2005 with increase in the system load and without any improvement in the area in the primary system the reliability of alternative-1 & 2 went down, increasing the relatively project worth of the Alternative 6 (Case-5A).

In view of the above analysis, it is revealed that the transmission interconnection arrangement of Alternative-6 (Case 5A) is the optimal solution and may be opted for Ghazi-Barotha Hydropower Project. The brief description of the interconnection is (Case 5A) is as follows:

- Tarbela-Gatti 500 kV double circuit in and out at Barotha.
- Barotha-Rewat 500 kV double circuit
- Rewat-Gujranwala-Lahore 500 kV single circuit.
- Barotha-Nowshera-Shahibagh-Peshawar 220 kV twin bundle D/C line.
- All generation will be at 500 kV bus. A 500/220 kV transformer will be provided.

Five load flow studies, based on generation plan, for the above selected alternative have been conducted for the year 2001, 2005 and 2010. In the year 2005, the system should be able to hold without any major change in the primary network in Peshawar area. However, in 2010 the area would need significant improvements/enhancements in the transmission system. In addition, any change in the generation plan, i.e Kalabagh (Hydel) and/or Taunsa (Thermal-steam) will be requiring major studies to transmit power to Peshawar area.

4.3 ANALYSIS OF ALTERNATIVE ROUTES FOR TRANSMISSION LINES

The proposed plan for power dispersal from GBHP will constitute six 500 kV lines (2 lines for Tarbela-Barotha Incoming, 2 lines for Barotha-Gatti Outgoing and 2 lines for Barotha-Rewat). As such, the construction of these lines will occupy substantial area, thus leaving significant impacts on the local environmental and social setup. To minimise their impacts, it has been planed to place the lines for most of their lengths on double circuit towers, with the exception of areas where the integrity of the tower foundations are at risk.

It is obvious that in aligning a transmission line, cost consideration is of prime importance. The most economically viable alignment will be the one that has the shortest route and the soil conditions are reliable for the tower foundations. Moreover, for keeping the cost of resettlement at minimal, the environmental and social considerations are also important in aligning the line. As such, different alternative routes for the lines were considered by WAPDA and the Consultants during planning stage.

In consideration of the above parameters, WAPDA has carried out surveys and studies on four alternative routes each for all the transmission lines concerned. Generally, different routes for a set of line fall many miles apart from each other. As such, the studies covered about 20-km to 30-km wide strip and the most appropriate routes were selected. Table 4.1 illustrates the main features of all the alternative routes studied for the concerned transmission lines. The table also provides an analysis of these routes leading to the selection of the final routes. Moreover, as referred elsewhere, a 100-m wide corridor for the selected route of each line was surveyed in detail to provide a margin for further adjustment in the alignment, if so required. A case for such reference is the adjustment of the alignment in Barotha-Rewat S/C Line-I near Dhok Kala Khan to avoid disruption of houses and a shrine (Ziarat)

TABLE 4.1
ANALYSIS OF ALTERNATIVE ROUTES

Line System	Route No.	Description of Route	Land/Soil Condition	Effect on Agriculture	Effects on Settlement/ Infrastructure	Effects on Social/Cultural Setup	Effects on Ecology	Analysis	Conclusion
Tarbela-Barotha (T-B) Incoming Lines I & II	I	Starting from Barotha switchyard heading towards north, then after encircling North Headpond and crossing power channel, it heads towards north of Attock city. Here it squeeze through area between Attock & Sanjwal Cantonment and leads towards existing Tarbela-Gatti (T-G) Line-I after passing very rugged land.	Highly unstable eroded land, deep gullies with steep slopes	Little agriculture due to land conditions	Disrupting settlements between Attock & Sanjwal	Involving removal of infrastructures from civil and cantonment areas, and resettlement of relatively large population	Insignificant effect on the ecology	Favourable from agriculture and ecological point of view, but involves relatively large resettlement. Land conditions are not suitable for tower foundation.	Not favourable, thus not Selected.
	II	Starting from Barotha switchyard and going round South Headpond, it passes close to the adjoining villages of *Sarwala, Shakar Dara and Shin Bagh*. From here onward it squeezes through Attock Cantonment and suburbs of Attock city. From here it passes through very rugged land before terminating at the existing Tarbela-Gatti Line-I	Highly unstable eroded land, deep gullies with steep slopes. Before Attock city, the line passes through agricultural land.	Barani and irrigated agriculture in upper reaches, while little agriculture in the down reaches due to land conditions	Disruption of settlements near villages and suburbs of Attock	Involving removal of infrastructures from civil and cantonment areas, and resettlement of relatively large population	Insignificant effect on the ecology	Favourable from agriculture and ecological point of view, but involves relatively large resettlement. Land conditions are not suitable for tower foundation.	Not favourable, thus not Selected.
	III	This alternative follows a route almost *parallel to alternative II* towards the south, avoiding the settlements of villages, Attock City and Cantonment.	Land conditions are generally suitable for tower foundations, except for a certain reach at the lower end.	Lands are generally used for barani agriculture	Insignificant disruption of settlements and population	Insignificant effect on social & cultural setup.	Insignificant effect on the ecology	Favourable from ecological and resettlement point of view, but partially unsuitable for land conditions.	Generally favourable conditions, but not selected.
	IV	This alternative follows a further southward route almost parallel to alternative III, avoiding the settlements of villages. The line passes negotiating Khawa Gar reserved forest	Land conditions are suitable for tower foundations.	Lands are used for barani agriculture and grazing	Insignificant disruption of settlements and population.	Insignificant effect on social & cultural setup.	Slight effect on the ecology of the Khawa Gar Reserved Forest.	Though slight effect on the ecology, the route has ideal conditions for siting of towers and with respect to resettlement.	Most favourable, thus selected for routing Tarbela-Barotha Incoming Lines

TABLE 4.1
ANALYSIS OF ALTERNATIVE ROUTES

Line System	Route No.	Description of Route	Land/Soil Condition	Effect on Agriculture	Effects on Settlement/ Infrastructure	Effects on Social/Cultural Setup	Effects on Ecology	Analysis	Conclusion
Barotha-Gatti (B-G) Outgoing Lines I & II	I	Starting from Barotha switchyard, it crosses tailrace channel and Haro River near Ghariala village. Onwards it is heading towards Kala-Chitta Mountain Range with an alignment south of Jabbi village. After separation of B-G S/C Outgoing I near Jabbi village to join existing T-G Line I, B-G S/C Outgoing Line II crosses Kala-Chitta Range just negotiating northern end of army area. Then passing south of Fateh Jang City negotiating air strip belonging to PAF, it heads towards existing T-G Line II.	Land conditions are generally suitable for tower foundations, involves blasting in Kala-Chitta Range. Army may impose restriction on blasting in their area.	Lands are used for barani and irrigated agriculture (from Shakar Dara and Shah Pur dams), grazing and rather thick reserved forest on Kala-Chitta Range.	Avoid villages but will involve resettlement of population of suburbs of Fateh Jang City.	May effect the social and cultural setup of Fateh Jang City.	Significant effect on the ecology of the Kala Chitta reserved forest.	The route involves disruption of army area and ecology of the reserved forest. Moreover, it passes through difficult hilly terrain involving blasting and longer route, thus increasing the cost.	This alternative has not been selected.
	II	Follows a southward route almost parallel that of alternative I. Beyond Jabbi village, the B-G S/C Line II crosses the Kala-Chitta Range just negotiating the southern end of the army area and heading towards south of Fateh Jang city for connection with existing T-G Line II.	Land conditions are generally suitable for tower foundations, involves blasting in Kala-Chitta Range. Army may impose restriction on blasting in their area.	Lands are used for barani and irrigated agriculture (from Shakar Dara and Shah Pur dams), grazing and rather thick reserved forest on Kala-Chitta Range.	Avoid villages but may have resettlement issue at Fateh Jang city.	May effect the social and cultural setup of Fateh Jang city.	Significant effect on the ecology of the Kala Chitta reserved forest.	The route involves disruption of army area and ecology of the reserved forest. Moreover, it passes through difficult hilly terrain involving blasting and longer route, thus increasing the cost.	This alternative has not been selected.
	III	Follows a route similar to that of alternative II, except that B-G S/C Line II will pass through a relatively open area within the city of Fateh Jang before its connection with existing T-G Line II.	Land conditions are generally suitable for tower foundations, involves blasting in Kala-Chitta Range. Army may impose restriction on blasting in their area.	Lands are used for barani and irrigated agriculture (from Shakar Dara and Shah Pur dams), grazing and rather thick reserved forest on Kala-Chitta Range.	Avoid villages but may disrupt housings at Fateh Jang, thus involving rather large resettlement.	Will effect the social and cultural setup of Fateh Jang city.	Significant effect on the ecology of the Kala Chitta Reserved Forest.	The route involves disruption of army area and ecology of the reserved forest. May involve resettlement at Fateh Jang city. Moreover, it passes through difficult hilly terrain involving blasting and longer route, thus increasing the cost.	This alternative has not been selected

TABLE 4.1
ANALYSIS OF ALTERNATIVE ROUTES

Line System	Route No.	Description of Route	Land/Soil Condition	Effect on Agriculture	Effects on Settlement/ Infrastructure	Effects on Social/Cultural Setup	Effects on Ecology	Analysis	Conclusion
	IV	Takes a route north of all other alternatives. Near the north end of village Jabbi, B-G S/C Outgoing I separates for connection with T-G Line I and B-G S/C Line II takes a straight route to join T-G Line II before Kala-Chitta Range.	Land conditions are suitable for tower foundations	Lands are used for barani agriculture and grazing	Insignificant disruption to settlements and population	Insignificant effect on social & cultural setup	Insignificant effect on the ecology	No disruption to army area; insignificant effect on the ecology and social setup; shortest route resulting low cost.	Favourable on environmental and cost considerations, this route has been selected.
Barotha-Rewat (B-R) Double Circuit (I & II) Lines	I	This is a north-most route in a corridor of about 10 km width selected for aligning B-R D/C I & II. It passes through northern fringes of Khawa Gar reserved forest and over the northern end of Kala-Chitta Range. Before crossing Kala-Chitta, the route passes through an area reserved for the army. Immediately after crossing Kala-Chitta the D/C culminates to bifurcate into S C I & II.	Land conditions are generally suitable for tower foundations, except at places where soil are highly susceptible to erosion, also involves blasting on Kala-Chitta Range.	Lands are used for barani agriculture, grazing and reserved forests of Kala-Chitta and Khawa Gar.	Insignificant disruption to settlements and population.	Insignificant effect on social & cultural setup, but effects army area.	Significant effect on the ecology of the Kala Chitta and Khawa Gar reserved forests.	The route involves disruption of army area and ecology of the reserved forests.	This alternative has not been selected.
	II	This route passes south of alternative I, negotiating southern fringe of Khawa Gar reserved forest, then turns north-east passing through Chibbiwali Gar reserved forest. From here the route turns south-east to cross over the Kala-Chitta Range at a point belonging to army. Immediately after, it passes close to the northern limit of lake of Shahpur dam and culminates near Rawalpindi-Fateh Jang road to bifurcate into S C I & II.	Land conditions are generally suitable for tower foundations, except at places where soil are highly susceptible to erosion, also involves blasting on Kala-Chitta Range in army area.	Lands are used for barani agriculture, grazing and reserved forests of Kala-Chitta and Chibbiwali Gar.	Insignificant disruption to settlements and population.	Insignificant effect on social & cultural setup, but effect army area.	Significant effect on the ecology of the Kala Chitta and Chibbiwali Gar reserved forests.	The route involves disruption of army area and ecology of the reserved forests.	This alternative has not been selected.

TABLE 4.1
ANALYSIS OF ALTERNATIVE ROUTES

Line System	Route No.	Description of Route	Land/Soil Condition	Effect on Agriculture	Effects on Settlement/ Infrastructure	Effects on Social/Cultural Setup	Effects on Ecology	Analysis	Conclusion
	III	This route passes further south of alternative II above, avoiding the forest areas of Khawa Gar and Chhbiwali Gar and crosses the Kala-Chitta without interfering with army area. However, in later reach it passes close to the northern suburbs of Fateh Jang City where the line bifurcates into S/C I & II.	Land conditions are generally suitable for tower foundations, may involve blasting on Kala-Chitta Range.	Lands are used for barani agriculture, grazing and reserved forest of Kala-Chitta.	Significant disruption to settlements and population of Fateh Jang city.	Significant effect on social & cultural setup of Fateh Jang city.	Significant effect on the ecology of the Kala-Chitta Range.	The route involves disruption of population and ecology of the reserved forests.	This alternative has not been selected.
	IV	Up to Kala-Chitta this route is characteristically similar to that of alternative III. It crosses Kala-Chitta at a place where vegetation is less and avoids army area. Then passing 4-5 km away from the northern limit of the lake of Shahpur dam, it terminates near Rawalpindi Fateh Jang road to bifurcate into S/C I & II as in case of alternative II.	Land conditions are generally suitable for tower foundations, may involve blasting on Kala-Chitta Range.	Lands are used for barani agriculture, grazing and reserved forest of Kala-Chitta.	Insignificant disruption of settlements and population.	Insignificant effect on social & cultural setup.	Relatively less effect on the ecology of the Kala-Chitta Range.	Favourable route with respect to effects on population, ecology and economy on cost.	This route has been selected.
Barotha-Rewat (B-R) Single Circuit (S/C) Lines I & II	I	Associated with alternative route I for B-R D C, the single circuit lines will take north-most route, passing north and close to the boundary of the area acquired by Civil Aviation Authority for new Islamabad Airport. After that, it intercepts an existing 500 kV line (Tarbela-Rewat). In later reach it passes through Adiala reserved forest and difficult terrain of Soan River.	Land conditions are not conducive in the down end reach near Soan River.	Lands are used for barani and irrigated agriculture, grazing and reserved forest of Adiala.	Insignificant disruption of settlements and population, but may interfere with flights from the airport.	Insignificant effect on social & cultural setup.	Significant effect on the ecology of the Adiala reserved forest.	Involves many concerns relating to ecology, interference with existing 500 kV line and airport, and soil conditions for tower foundations.	This route has not been selected.

TABLE 4.1
ANALYSIS OF ALTERNATIVE ROUTES

Line System	Route No.	Description of Route	Land/Soil Condition	Effect on Agriculture	Effects on Settlement/ Infrastructure	Effects on Social/Cultural Setup	Effects on Ecology	Analysis	Conclusion
	II	Associated with alternative route II for B-R D/C, the single circuit lines will take a course south of the boundary of area acquired by Civil Aviation Authority for new Islamabad Airport. After that, this route passes over Khairi Murat Range affecting reserved forest. Later after intercepting the existing 500 kV line (Tarbela-Rewat), it passes through a difficult terrain of Soan River.	Land conditions are not conducive in the down end reach near Soan River.	Lands are used for barani and irrigated agriculture, grazing and reserved forest of Khairi Murat.	Insignificant disruption to settlements and population, but may interfere with flights from the airport.	Insignificant effect on social & cultural setup.	Significant effect on the ecology of Khairi Murat reserved forest.	Involves many concerns relating to ecology, interference with existing 500 kV line and airport, and soil conditions for tower foundations.	This route has not been selected.
	III	Associated with alternative route III for B-R D.C. the single circuit lines will take a southern-most course moving farther away from the new Islamabad Airport. After that, this route passes over Khairi Murat Range where the growth of the forest is relatively thick. Later it passes through Dhungi reserved forest and takes rather long route to Rewat, where the bed of the Soan River is flatter and quite wide.	Land conditions are not conducive in the down end reach near Soan River.	Lands are used for barani and irrigated agriculture, grazing and reserved forests of Khairi Murat and Dhungi.	Insignificant disruption of settlements and population.	Insignificant effect on social & cultural setup.	Significant effect on the ecology of Khairi Murat and Dhungi reserved forests.	Involves many concerns relating to ecology, interference with existing 500 kV line and airport, and soil conditions for tower foundations.	This route has not been selected.
	IV	Associated with alternative route IV for B-R D/C, the single circuit lines will almost take the course as that of alternative II for S.C lines, with some modifications that these lines will pass to some extent away from the new Islamabad Airport and crosses Khairi Murat Range and Dhungi forests where the growth is relatively thin. The crossing over Soan river is also at a place where the soil conditions are conducive for tower foundations. This route is also not intercepting with the existing Tarbela-Rewat line	Land conditions are generally suitable for tower foundations.	Lands are used for barani and irrigated agriculture, grazing and reserved forests of Khairi Murat and Dhungi.	Insignificant disruption to settlements and population.	Insignificant effect on social & cultural setup.	Rather less effects on the ecology of Khairi Murat and Dhungi reserved forests.	Comparing with other alternatives, this route has the least environmental effects and is more technically sound.	This route has been selected.

CHAPTER 5

POTENTIAL IMPACTS OF THE PROJECT

CHAPTER 5

POTENTIAL IMPACTS OF THE PROJECT

5.1 GENERAL

Rather than a critique, the environmental impact assessment is a tool to manage a project in such a manner that its adverse effects are minimized or mitigated, and benefits are enhanced. For achieving this objective, it is necessary that the project planning and environmental assessment be carried out side by side. This involves a continuous interaction between the project planners and environmental scientists. In the case of the present project, this approach was adopted. Consequently, besides carrying out an assessment of the alternatives at early stage of planning, a lot consideration was given in minimizing the environmental and resettlement impacts associated with the selected alignments of the transmission lines. Accordingly, a report on Environmental Impact Assessment was prepared by WAPDA in 1998[1] The present report has been prepared to strengthen the previous report by adopting internationally accepted guidelines and directives for environmental assessment and preparing mitigation and resettlement action plans

Effective environmental and resettlement planning requires a reliable prediction of project effects on the resources of the project area. Key to the environmental assessment is the knowledge of the baseline environmental conditions of the project area and experiences gained from the similar projects elsewhere. Interaction with local communities and knowledgeable people is another source, which helps in predicting the project effects and need for mitigation. In the present study, these aspects were given due consideration. Therefore, as referred in Chapter 1, in addition to collecting information on physical, biological and human resources from published literatures, information was also collected through surveys and counseling with the local communities. Moreover, a focused survey and interaction with the local communities was also carried out in the areas where 500 kV transmission lines are already existing. This has significantly helped in the assessment of the effects of the proposed Project

5.2 ASSESSMENT OF POTENTIAL IMPACTS

5.2.1 Project Impact Matrix

To identify the impacts of the Project on the physical, biological and social environment of the Project area and to categorise them in accordance with their significance, a Project Impact Matrix has been prepared. This is presented in Table 5.1 The impacts of various Project components have been assessed separately for the construction and operational phases. Following paragraphs provides a generalised

[1] General Manager Planning (Power), Pakistan Water and Power Development Authority; Ghazi-Barotha Hydropower Project, Transmission Lines Associated with the Project, Supplemental Environmental Assessment. Final Draft Report; July 1998

discussion on various concerned aspects, while the detailed account of the potential effects is given in subsequent sections of this chapter

Construction Phase Impact:

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction WAPDA is particular about this and has incorporated clauses in the Contract Documents relating to good construction-management practices.

The probable impacts of the construction are the ones related to the following areas:

- Agricultural lands and soils
- Housings/Infrastructures
- Energy resources
- Surface water quality
- Groundwater quantity
- Air quality
- Noise
- Disruption to the terrestrial ecosystem
- Migratory Species
- Pest animals
- Public health
- Land use
- Interruption of public communication
- Employment
- At-risk population/safety
- Population disruption & Community stability

The direct impact of the Project on the land resources has been dealt with in Section 5.2.2. Here only indirect impacts have been discussed. The most concerning aspects include soil erosion, slope stability, and the effect on agricultural soil due to fugitive dust created through blasting and excavation activities This will be particularly associated with the excavation and stockpiling of the spoil material from the tower foundations To some extent, stringing will also induce disturbance to the agricultural lands.

In consideration of the topography of the area, soil conditions and intensity of rainfall, the tower foundations have been placed on stable grounds. This particularly implies to the towers located near the streams. Here the towers have been placed at a safe distance from the sharply sloping banks of the streams. Similar precaution has been taken along the slopes of the hills. As such, the construction of tower foundations or otherwise would not escalate the soil erosion significantly than normally occurring under the prevailing conditions.

Agricultural soils are also subject to deterioration due to spills of toxic material. To minimize these effects the contractor should use the best engineering-management practices The contract documents will include the specific clauses to impose environmental protection practices on the part of contractor. The supervisory consultants should be vigilant that these clauses adhered to by the contractor in full.

The effect of the Project on housing/infrastructures is discussed in detail in the relevant sections.

The Project is foreseen to affect the energy source, fuelwood, of the Project. This has been discussed in detail in the relevant section. However, here attention is drawn towards the malpractice that is normally associated with the construction of such projects. Besides the disruption of biological environment due to land clearing for the construction of towers and stringing, there may also be a disruption by the work force in need of fuelwood. Any such damage to the resource is unlawful. This aspect was discussed with the Contractor mobilised for the execution of In and Out lines. As reported by the Contractor, the construction crew will be stationed in rented houses in the close by villages instead of camping at the site. As such, the unlawful cutting of the fuelwood will be eliminated.

The excavation or blasting for tower foundation and to some extent stringing near the streams may affect the surface water quality. However, this can be checked by carrying out controlled blasting and handling excavated spoil in a good engineering manner. In this respect the Engineer will be vigilant.

It is envisaged that the construction of the Project will not involve heavy machinery/equipment or chemicals that will emit heavy smoke or fumes to significantly effect the air quality. Significant contribution of fugitive dust and smoke is speculated from the construction-related traffic. The contractor is required to use well-tuned vehicles, maintain the tracks properly and regularly sprinkle water, particularly in the proximity of settlements.

Noise pollution will mainly be associated with traffic and blasting of rocks for tower foundation in hilly area. Some noise may also be generated if machinery is deployed for excavation of soft soil material. The contractor is desired to impose check on noise pollution, particularly when working near settlements.

As referred elsewhere, certain reaches of the transmission lines (Barotha-Rewat S/C I & II) will lie close to water bodies. These water bodies may be used as resting-places by some odd flocks of migratory birds cut-off from the main group travelling along the Indus River (see Section 5.2.4 and Appendix "D"). The close-by construction activities may cause disturbance to the birds.

As referred in Table 4.1, the transmission lines will pass through the reserved forest areas where the growth is not very thick. Therefore, it is unlikely that such areas would have any significance for being used as habitats by major terrestrial fauna. However, their absence in totality will not be justifiable. The construction activities in the reserved forest areas will not only affect these habitats due to forest clearance but also may frighten the terrestrial fauna. This, though unavoidable, may be kept minimal by controlling the construction activities in such sensitive areas. The excavation for towers foundation, and to some extent stringing, will cause disturbance to the colonies of pest animals, particularly field rats, boars, etc.

Health hazards arise through many sources. The source of greatest concern during construction is dust. Pulmonary tuberculosis and silicosis may result from the dust generated by stonecutting, blasting and movement of equipments. Fumes and smoke from burning material may cause acute respiratory irritation and bronchitis. These diseases normally occur by exposure to such conditions for a long time. Normally, the Contractors keep the working crew on permanent basis. This results in very frequent exposure of the crew to such conditions. Therefore, this demands adopting precautionary measures on part of the Contractor.

Contamination of water resources by obnoxious material may create health hazards for the population using that water. For the safety of workers and local population, construction activities should be carried out under strict control. Waste material (water and garbage) should be disposed off in a safe manner. Moreover, the sanitation of the construction camp and work places should be proper. The workers should be supplied with proper protection materials such as goggles, masks, helmets, full boots and gloves.

Safety hazards are associated with the operation of construction machinery, equipment, tools, transportation, handling of steel panels during tower erection, blasting, land cutting and slides, fires etc. The causes of safety hazards are usually complex involving human errors, operation faults of machinery and unforeseen incidences. The majority of the causes are controllable with efficient management, staff training, machinery maintenance and other preventive measures. Control of injuries or fatal accidents are essentially engineering and administrative problem and rests mainly on strict compliance with established safety rules and regulations.

In addition to the preventive and precautionary measures, the contractor will be well equipped with first-aid material including dressing material and necessary drugs.

The construction of the Project, particularly stringing, may cause interruption to the movement of the local population going across the alignment of the lines for their daily farming activities and herding. This may be minimised by adjusting the timings of stringing. The movements of the local population for their work are mostly in the morning and evening hours. The contractor may utilise the time in between these two rush timings for stringing.

Stationing of the construction crew within the villages or locating the construction camps near them could disturb the local communities and may create social and cultural problems. Therefore, the contractors would be required to impose regulations on the workforce to avoid any law and order situation.

Though the workforce required for the construction is not much, the Project construction to some extent will provide employment opportunities for the local people. On discussion, the Contractor has indicated that the skilled labour is permanently maintained while unskilled labour is engaged from the local communities.

The matter of inclusion of clauses related with the environmental aspects mentioned above and restoration of construction sites was discussed at length with the

Consultants (M/s NESPAK). They have agreed to include such clauses in the new contract for Barotha-Rewat Lines, while amendments will be issued for the already awarded Contract for Incoming and Outgoing Lines. In this regard one major amendment relating to restoration of sites and re-vegetation has already been issued to the Contractor. This is attached in Appendix "G".

Operational Phase Impacts

Table 5.1 gives two sets of operational phase effects of the Project. Ones are related with local area and others are those, which encompass the nation-wide effects. These two are separately discussed as under.

Local Effects:

With the increase in electric power capacity of the country, it is likely that the local communities may benefit from the supply of power for their domestic and agriculture use. Otherwise, it is envisaged that the transmission lines during operational phase will not contribute to any other benefit for the local community, rather it will have some adverse effects but of low level. The areas of such impacts are as follows:

- In spite of the fact that the Project will not impose any hindrance in the normal farming activities within the corridors of the transmission lines, the farmers will be restricted to general cropping or small size tree plantation. The detailed discussion on this aspect is given in the relevant section below.

- Similarly, the rules and regulations do not allow construction of residential or public utility buildings within the corridor of the transmission line. This restriction may be a problem for those whose limited landholdings fall within the corridor.

- Single Circuit components of Barotha-Rewat Lines may interfere with the flights of air crafts from the new Islamabad airport. The detailed account of this aspect is given in Section 5.2.5.

- The flow of current in the conductors affects the air quality in two ways. Extra-high electric voltage generates a very strong electromagnetic field (EMF) around the conductor. This causes ionisation of the air resulting in a corona formation around the conductor, which may extend up to 4 m under adverse atmospheric conditions. The process of ionisation of the air also results in generating crackling noise, which is high under cloudy condition. However, the instrumental measurements during survey indicated that the noise level in the sunny day is less than 60 dbl

- The transmission lines passing close-by the water bodies may interfere with the flights of migratory birds. Besides a physical obstruction caused by the lines and the towers, the flight may also be affected by the electromagnetic flux around the conductors. The latter obstruction is rather more pronounced than the former. However, the study has shown that in view of the routing pattern of the flights of the migratory birds through Indus Basin, such effect is insignificant for this Project (Reference Section 5.2.4).

- The transmission lines may also be hazardous for sedentary birds. However, it has been noticed that due to EMF and crackling noise, the birds rarely approach near to the lines. The same has been confirmed by the local farmers of the areas where 500 kV lines exist and by the WAPDA people who are involved in patrolling activities.

- Even though a safe ground clearance has been provided for the conductors, the local communities have shown the concern that the EMF will hinder their movements across the transmission lines. This, to a certain extent, affects the community stability.

- Besides safety hazards due to EMF, the people have shown their concerns that the towers endanger the life of their cattle. The cattle are of the habit to use angle sections of the towers to scratch their skin under the horns, which some times get stuck in the tower and causes hazard.

Nation-wide Effects:

The dispersal of electric power generated from GBHP will obviously enhance power supply condition of the country. This will of course be in many ways beneficial for the nation. A few of these are as given below:

- This will increase the nation-wide electric power capacity. This will reduce the incidences of load shedding and thus ensure to a certain extent uninterrupted supply. Moreover, the power to be dispersed through the present system is hydroelectric generated, which is relative cheaper than the one produced through thermal resources. This is hopefully going to reduce the power tariffs. As such, this will help in the development of the country through industrialisation and other infrastructure development.

- This will also benefit the agricultural sector through installation of tubewells and more use of groundwater. Although exploitation of groundwater will have negative effect on the resource, this will be beneficial in high groundwater/waterlogged areas. Related with this is also the control of disease vectors and thus is beneficial for public health.

- An ensured and relatively cheaper electric supply will help in reducing the unrest in the nation caused by the load shedding and high tariffs of the electric power.

5.2.2 Effects on Land Resources

Apparently, the most conspicuous effect of the transmission lines will be that on land resources, particularly that is utilised for agricultural purposes. However, if it is analysed in detail, the situation does not seem to be of that gravity. Conductors being elevated from the ground, the land underneath can be utilised for cultivation.

Although, there will be some restriction on tree plantation that reach to a height more than 4 m, the land may also be utilised for orchards like citrus. Experience from the existing 500 kV transmission lines shows that, in spite of the fact that the people have shown some resentment, the lands under them are freely used for agricultural purposes

However, if there is some concern that is for the land where the towers are to be located. In this context, a focus survey was carried out along the existing 500 kV transmission lines. The observations on the usage of land under the towers in cultivated areas have shown a mixed trend. Of the total towers observed, the lands under about 70% towers were cultivated. The remaining 30% were left out for many reasons. The main reason being, the farmers have large landholdings and thus they do not bother to cultivate the lands underneath the towers. Topography is another reason for this. Some of the landowners are however afraid of cultivating these lands.

Notwithstanding above, the area to be restricted for utilisation by the transmission lines is not that alarming. It is estimated that with 50-m wide corridors, about 235 km stretch of the transmission lines will restrict an area of about 588 ha. Table 3.13 shows that only about 44% of the transmission lines' routes pass through lands that are used for agriculture purposes. As such, about 259 ha of land will have slight restricted use for agriculture. The restriction will be for not planting tall trees under the lines

Statement Showing Land Area to be occupied by the Towers

Name of Line	Description of Circuit	Length of Line (km)	Number of Towers	Approximate Area Under Towers (sq. m)
Tarbela-Barotha-Gatti Incoming	Double Circuit I & II	26.4	78	19,453
	Single Circuit I	2.5	8	1,401
	Single Circuit II	6.4	20	3,542
Tarbela-Barotha-Gatti Outgoing	Double Circuit I & II	29.9	88	21,982
	Single Circuit I	1.7	7	1,146
	Single Circuit II	11.7	27	5,843
Barotha-Rewat	Double Circuit I & II (Segment I)	56.9	168	45,326
	Single Circuit I	47.7	136	24,168
	Single Circuit II	49.3	138	23,812
	Double Circuit I & II (Segment II)	2.3	6	2,126
Total		234.8	676	148,799

As referred earlier, the major land use effect will be on the lands underneath the towers. Table given above indicates the number of towers falling in each line and approximate areas that are to be affected. The table shows that the system will have about 676 towers likely to occupy about 15 ha of land in a stretch of about 235 km According to land use data, about 7 ha of this land is under cultivation.

However, during construction period the affected area will be more than the one indicated above. Construction of tower foundation and its erection are of particular concern This will not involve areas of tower locations but also surroundings where the excavated soil is to be temporarily stockpiled and the areas to be utilised for storing the materials and fabricating the tower panels. As such it is estimated that for construction of a tower about 0.2 ha of land area will be required. Similarly, stringing will also have negative impacts on the land resources through out the stretch of the transmission lines. According to the Contractor's report only about 5-m strip for tower to tower is cleared from the crop/trees and utilised for stringing. The owners are paid compensation for the loss of crops for a specified period. Normally, in a stretch of about 3 to 6 km one to two crop seasons are lost for the erection of towers and stringing The owners are compensated for loss of crops accordingly (reference Chapter 6)

5.2.3 Effects on Water Resources

Generally, the Project will not have any significant effect on the water resources, both surface and groundwater, of the Project area. As described in Section 5.2.1, exception is however there. In spite of the fact that in the Project planning care has been taken not to locate towers within the stream beds, quite a few number of towers are located along the banks of the streams Therefore, some temporary pollution of surface water resources may occur when excavation or rock blasting for the tower foundation is carried out near the streams Stringing over the streams may also contribute to pollution of the surface water from dust However, if the work is carried out in controlled manner, this will not be of any significance to affect the aquatic life or hinder its usage for domestic purposes by the local population. This is because the streams already carry suspended soil material and other contaminants.

5.2.4 Effects on Biological Resources

General

The effects on the biological resources are of two types. One is related with the terrestrial ecosystem, while the other is related with the migratory species. The latter is localised near the water bodies, but the former is wide spread all along the stretch of the transmission lines These have been briefly discussed in Section 5.2.1, but a detailed account is given in the following paragraphs.

Effect on Flora

The terrestrial ecosystem is closely associated with the type of landform and land use Table 3.2 shows that about 46% area is broken and severely eroded. According to ecological study, such areas bear very sparse vegetation (Section 3.6.2). Similarly, cultivated lands, which form about 44% of the total stretch of the transmission lines, also bear scattered vegetation. About 8% of the total stretch (about 235 km) of the power lines will pass through forest area.

The report on the ecological study is attached at Appendix "C". The conclusions drawn by the Ecologist for the effects of the transmission lines on natural vegetation are as follows:

1 No rare or endangered plant species are identified in the Project area. Therefore, the fear of elimination of such species is not there.

2 Vegetation cleared in the Barotha switchyard site was mainly composed of weeds of no economic value as evidenced by the type of adjoining vegetation. The construction activities thus have insignificant environmental impact in this area.

3 The streams and hill torrents in the area are flowing below the natural surface level. The mobility of construction machinery will not be possible in this landscape. No tower will be installed in the bed of a stream or torrent so no plant or animal species will be affected.

4 The cultivated fields are already devoid of thick cover of natural vegetation. The bio-diversity is very low. A few trees and shrubs growing on the borders of fields may be cut during the erection of towers and stringing, but it will have no significant negative environmental impact.

5 The abandoned agricultural fields hold some grasses of low economic and ecological value. The disruption of these species will impose insignificant negative environmental impact.

6 The wetlands/small dams are not within the right-of-way (ROW) so flora and fauna of this Landscape Ecological Unit (LSEU) will not be affected.

7 The eroded/broken lands are not easily accessible for vehicles. The transportation of material will be done on the existing routes hence no negative environmental impact will be exerted on the flora and fauna of this LSEU.

8 The weathered rock plains host no rare or endangered plant or animal species. The construction activities will result in insignificant and temporary loss of vegetation.

9 The cutting of trees and shrubs in piedmont plain is already in process. The cutting of vegetation for erection of transmission lines will be an insignificant adding factor for reduction in vegetation cover in this LSEU.

10 The high bio-diversity in some hills (reserved forests) will be affected significantly due to clearance of vegetation under ROW and uprooting for construction of access roads and tower pads. However, this factor will be temporary and localized because similar vegetation exists to a wider extent on

both sides of ROW. However, the re-vegetation of these areas has been made mandatory under the Project. This will eliminate the impact in a short term.

11 The overall project is environmentally feasible and executable with the provision of monitoring the re-vegetation activities on access roads in reserved forests after construction phase.

During village surveys, an assessment was made for the trees, shrubs and other vegetation falling within the corridors of the transmission lines. The assessment was based on observations, counting of trees for specific area and reports from the local communities. A crosscheck for the survey-reported figures was made with the vegetation cover in various landforms as reported by the Ecologist. Accordingly, it is estimated that the Project will affect something about 30,000 trees and shrubs. Of these, the figures for various economically important trees and shrubs may be as shown in the table below.

Barotha-Rewat D/C I & II (Segment) will also pass through a Guava Orchard extending from RD 38,335 m to 38,387 m. Normal varieties of guava trees are of about 3 to 4 m height, thus the removal of the trees underneath the conductors would not be required. Some trees will however be cut down at the tower locations.

Statement Showing Estimated Number of Economic Trees Likely to be Affected

Type of Tree/Shrub	Botanical Name	Number
Phulai	*Acacia modesta*	9000
Berri	*Zizyphus nummularia*	3000
Eucalyptus	*Eucalyptus sp.*	1000
Shesham	*Dalbargia sisso*	200
Kikar	*Acacia nilotica*	600
Mulberry	*Morus alba*	100
Bakain	*Melia azedrach*	300
Kauo	*Olea cuspidata*	100
Total		14300

Effect on Migratory Birds

The study on the migratory birds has revealed that the main wetlands used by the migratory birds as their resting-place are located in territory along the Right Bank of the Indus River (Reference Fig. 1 of the study report in Appendix "D"). Thus the main fly routes of these birds follow a course along the Right Bank of the Indus River (see Figures 3 and 4 of the referred report). Of the two water bodies falling in the Project corridor, the nearest one to the main flight route lies about 60 km toward east. As such, these water bodies are occasionally visited by the odd flocks of the birds. Related to this, the study has concluded that:

- The birds during migration fly at a height between 500 m to 2000 m, whereas height of the towers of the transmission lines is 40 m maximum. As such, the towers or the lines would not obstruct the flight of these birds.

- The span between the conductors is about 6 m and the ground clearance is over 9 m. Consequently, the birds can fly safely through the available clearance.

- Extra high voltage lines are already existing in the area, but no mortality of birds has been noted/documented.

- Only two small dams, Sipiala and Dhala, are situated near the corridor. These two dams have deep reservoirs having less aquatic vegetation. Thus these could provide shelter and feed for a large number of resting birds. Consequently, most of the birds tend to fly towards more potential wetlands along Indus and Jhelum rivers, which are far away from the proposed route of the transmission lines

5.2.5 Effects on Existing Infrastructures

General

Tables 3.3 through 3.11 provide the details of the infrastructures falling within the 100-m wide corridors of the transmission lines. These include buildings, communication facilities, power/telephone lines and other infrastructures. The tables also indicate the reach-wise locations of these infrastructures and their offset in the corridor with reference to the proposed central line of the alignments. The remarks column suggests appropriate actions required for mitigation and resettlement. The Design Consultants have been accordingly informed and they are reviewing the Project to incorporate the feasible suggestions.

An abstract of the above-referred tables is given in the table given on page 5-12.

The table shows that the three sets of the proposed transmission lines will cross over about 69 metalled roads, 147 village tracks and 6 railway lines. The Project will not impose any obstruction to the communication system falling in the routes of the transmission lines. Appropriate clearance has been provided at the crossing of railway lines, roads and village tracks. This is as specified in accordance with their utility. Even during the construction, arrangement will be made to avoid any interruption caused by stringing to the flow of the traffic (see Section 2.4).

The table shows that about 94 power and telephone lines fall in the routes of the proposed transmission lines. During construction of the Project, arrangements will be made to avoid any interruption to the working of the existing lines (Section 2.4). Similarly, safe clearance has been provided at the crossings of these existing power and telephone lines. The problem however exists at the crossing of 220 kV Burhan-Rewat Line. Here due to the configuration of the ground, specified clearance has not been achieved with the existing arrangement. The Planners are in the knowledge of this problem and are reviewing the design

The table also shows that about 82 residential and public utility buildings, and 41 other infrastructures fall in the 100-m corridors of the transmission lines. Of these some structures, though not affected directly by the construction of transmission lines, are required to be relocated for safety reason. The criteria adopted for relocation or resettlement is in the paragraph below.

Statement Showing Different Infrastructure falling in 100-m Corridor

Infrastructures	Description	Number falling within 100-m Corridor	Number of Structures Needing Relocation/Removal
Communication System	Metalled Roads	67	
	Kutcha Village Tracks	147	
	Railway Lines	6	
	Total	**220**	
Power/Telephone Lines	220, 132, 66 kV Lines	4	
	LT Line	20	
	11 kV Line	59	
	Telephone Line	11	
	Total	94	
Buildings	Residential Houses	69	36
	Farmhouses (Deras)	11	3
	School	1	
	Poultry Farm	1	1
	Total	**82**	**40**
Other Infrastructures	Pump House	5	2
	Tubewell	2	2
	Wells	10	4
	Graveyard/Shrine	10	
	Watercourses	10	
	Water Pipelines	4	
	Total	**41**	**8**

Relocation will be required for residential houses falling within safety limit of 25 m from the central line. For safety reasons, farmhouses, wells and other public utility buildings falling underneath the lines will also need removal. However, if those fall outside the limits of outer conductors but are located within 25 m from the central lines, will not be removed. Tubewells falling underneath the conductors are also required to be relocated, as their refurbishing may be risky and hazardous.

As such, about 36 residential houses, 3 farmhouses, 1 poultry farm, 2 pump houses, 2 tubewells and 4 open wells will be removed. These infrastructures are spread over the whole stretch of various transmission lines. Notwithstanding other infrastructures, residential houses are of specific concern for resettlement reasons. No where along the routes of the transmission lines these houses exist in a cluster. These are located at different reaches of various transmission lines. The total population of the disrupted 36 houses is 267 persons

In view of the numbers and spread of the residential buildings that need to be relocated, it is presumed that it would not need a comprehensive planning for their resettlement. A fair compensation based on replacement cost for the lost property including that of land will meet the requirement. Compensation for the land is recommended for the purchase of a plot elsewhere by the affectee for the construction of his new house. This aspect is more elaborated in Chapter 6.

A school building of primary level also falls in 100-m corridor of Barotha-Rewat S/C I Line. The building is located at a safe distance (35 m from the central line) from the transmission line. However, the risk is there that the children may approach underneath the lines to play or climb up the tower. For the safety of the children, the towers will be fenced properly.

Matter of Specific Concern

The proposed alignments of Barotha-Rewat Single Circuit Lines (both I and II) pass very close to the land area acquired by Civil Aviation Authority (CAA) for development of a new airport for Islamabad (Drawing 2-1 Sheet 5 of 7). The distance of the boundary of the acquired area from Barotha-Rewat (B-R) S/C I Line ranges between 0.5 km (at RD 10,891 m) and 3 km (at RD 1,929), while from Barotha-Rewat S/C II Line it ranges between 2.5 km (at RD 10,500 m) and 3.5 km (at RD 2,100). The development plan of the airport shows that no buildings will be erected along the boundary of the acquired area lying close to the proposed transmission lines. Even the shortest distance of the proposed location of the airstrips from the transmission lines will be about 4.5 km. As such, the transmission lines will not impose any obstruction to the development of the infrastructures.

The concerning issue is the likely obstruction to the flights and radio communication. The longitudinal axis of the runway is almost perpendicular to the routes of both the transmission lines. Thus, these lines come in the way of landing or off-taking routes of the airplanes. A projection of the axis of the airstrip will intersect the transmission lines at about RD 4,000 m and 3,500 m for B-R S/C I and II, respectively. These conceptual points of intersection lie about 8 to 8.5 km away from the centre of the airstrip. This region falls within the Outer Horizontal Zone of the flights. This zone extends up to about 16 km from the centre of the airstrip and the airplanes may descend to a height of about 152 m above natural surface level (NSL) of the airstrip. An effort was made to obtain the planned elevations of the airstrip and those of towers falling in the way of the flights of the airplanes, but this was not available.

The Government of Pakistan has issued a Notification[2] that clearly spells out the both horizontal and vertical distances of clear zones for the flights and their radio communication. In planning the transmission lines in these regions, these parameters are required to be observed. It is also worth mentioning that at the other end of the

[2] Government of Pakistan, Ministry of Defence; Statuary Notification (S.R.O); October 3, 1994

runway exists another 500 kV transmission line that runs from Tarbela to Rewat. This also comes into the critical flight zone.

In the draft report the attention of the design Consultants was drawn on this aspect. In compliance, the Consultants have approached the Civil Aviation Authority (CAA) and explained the situation. On demand, all the related documents were handed over to CAA for scrutiny by their experts stationed at their Headquarter at Karachi. Consequent to this, the concerned area was visited by a team comprising experts from CAA, Consultants and EHV (WAPDA). According to the decision made after this visit, the Survey of Pakistan has been inducted to carry out the survey of the area. As soon as the survey is completed the data will be submitted to CAA for their review. If there is an indication from the survey data that there will be no obstruction to the flights, CAA will issue a clearance certificate, which will be circulated to the concerned agencies separately. However, should there be the situation otherwise, the Consultants would change the alignment of the transmission line accordingly. In that case, the new alignment for that portion will be re-evaluated for its environmental impacts before construction.

5.2.6 Effects of Electromagnetic Field (EMF)

The people of the areas where 500 kV transmission lines already exist have shown great concern about the effects of electromagnetic field on the human and animal lives, health and daily work (Section 5.2.7). Such concerns have also been expressed the world over. It is considered that a long-term exposure to the EMF from extra high-voltage transmission lines could adversely affect the health of those living or working close to such line. There is a particular concern over children studying in schools near these lines.

There was a time when neither the specific health effects nor the distance at which such effects pertain over time were understood. However, recently the U.S. Department of Energy has issued a report on the public health effects of extra-high-voltage transmission lines on population living near them. It was a prospective epidemiological study, the results of which showed that medical anomalies for that population were statistically no different from those of populations living at a greater distances from such lines. In a paper Calcanea[1] gave the following statement on health issues.

"It is certain that short-term exposure to field of even greater amplitude than that generated by the high-voltage lines is not dangerous to humans or other animals. Research on, the effects of longer exposure is still to be conducted in co-operation with research institutions and the power utilities. However, scientific panels that have reviewed the research performed to date have concluded that the greater part of evidence does not demonstrate that longer exposure is harmful".

However, in consideration of the public concerns, the routes of the lines have been so selected that they avoid settlements and, as could be possible, pass through land tracts

[1] Calcanea, Environmental Concerns for High-Voltage Transmission Lines in UNIPEDE Countries; Journal of EED, ASCE; 1996.

sparsely used by public. Under unavoidable circumstances, an appropriate clearance has been provided where the effect of EMF is minimal. It is proven that EMF decreases with the square of the distance from line. This criterion was adopted for providing clearance. Wherever, such clearance is not provided in the present design, the Consultants have been informed to do the needful. Such locations are shown in Tables 2.1 through 2.9

5.2.7 Effects on Social and Cultural Resources

General

As discussed in the foregoing sections, in totality the implementation of the Project will have nominal adverse impacts on the land and other natural and physical resources of the Project area. As such, the disruption to the economic and social resources will be minimal, though these may be of some significance in a localised scenario or for individual cases.

It is a well-known fact that the disruption of a poor society is mostly due to economic hardships. The economy of the people of the Project area is mainly based on agriculture. Therefore, any loss to this resource will disrupt the farming communities. The Project Impact Matrix indicates that the construction activities will have some negative impact of medium level on the land resource/land use. This will however be mostly limited in the areas where towers are to be installed. It is estimated that for installation of about 700 towers, only half of those may fall in cultivated area, about 500 farming families will face some hardships. This will be off-set by the compensation that they will get for the loss of crops and by the employment opportunities that they will have during the implementation of the Project (Section 5.2.1 and 6.5.2). The contractor will particularly be instructed to employ unskilled and semi-skilled labour from the local communities.

Notwithstanding all this, the local communities have their own concerns regarding effects of the Project on their socioeconomic condition. Therefore, it is desirable that analysis of the Project is made based on these concerns. These are discussed in the subsequent sections.

Public Concerns

Public concerns about the Project were obtained through discussion with the communities of about 50 places, including the ones where 500 kV transmission lines already exist. These discussions were held in the form of scoping sessions with gatherings of male and female population separately. Table 5.2 shows the venues of scoping sessions along with number of male and female participants.

In the scoping sessions, the community participants were comprehensively apprised about the Project. With the help of maps and charts, they were informed about the dimensions of the towers, their spans and other information relating to the conductors. Then with the help of WAPDA Surveyors, the people were explained about the alignment of the transmission line by taking them to site, and walking along the route

This followed discussions on their concerns. Of these, some concerns are almost common for the communities contacted, while other specific ones are related to certain communities only. These are as discussed below:

Common Concerns:

- The main concern of almost all the communities is the affect on their agricultural lands. They have emphasised that WAPDA should acquire the land that will be occupied by the towers and the conductors. On explaining that in accordance with the law, Government does not acquire land for a transmission line or its towers. The people suggested the following:
    - If the transmission line passing through the land of an owner having less than five Kanals (< 0.25 ha), his entire land should be acquired.
    - For others, the land underneath the towers should be acquired.
    - Crop compensation for the other areas should be double than the normal paid for the loss of crop seasons. As such, it should be for two crops against the land affected by the lines and for four crops where the towers are installed
- The compensation should be paid at the spot and before the physical work is initiated.
- The affected peoples, as well as the locals should be consulted for determining the land value and crop compensation.
- Tenant, no matter it is formal or informal, should be given due share in the crop compensation
- Each owner of the residential building should appropriately be compensated for the building as well as the land, so that he could buy land elsewhere and construct proper house.
- The loss of other properties, like wells and trees, should also be fairly compensated.
- Unskilled and semiskilled labour for this Project should be engaged from the affected communities.
- An independent organization should be established for the guidance of the local communities and for resolving their problems related to the compensation. It should also have the mandate for the development of the affected area.
- The affected villages should be provided with electricity on priority basis.
- WAPDA should give surety to the people that any loss to human and animal life and property during operation of the transmission line would be compensated

- The transmission lines will devalue the lands; therefore it is desirable that this should be compensated in the form of area development. The relevant departments should be advised to provide basic social amenities on priority basis. These include link roads, electricity, health facilities, natural gas and telephone, etc.

- A reasonable percentage from the profit from the Project should be reserved for the development of affected areas

- The areas where more than one line will be passing should be considered vulnerable and thus given special consideration for development

- As to the effects of the current in the transmission lines on their daily life, the people have reacted differently. Some of the reactions are as follows:

  - About 73% people have claimed that their land being underneath or across the lines, their farming activities will be affected.

  - About 61% have claimed that their livestock herd in the areas. Therefore, these are likely to be affected

  - About 51% people have proclaimed that the village life will be affected

  - About 37% people have said that the lines will disrupt their social life

  - As far as the effects on the public health is concerned only 35% considered it hazardous. On the contrary, the people from the areas where transmission lines are already existing said that they have felt shock when passing underneath the lines, particularly under bad weather conditions. It escalates when one is holding a metallic item. They have also reported loss of life of cattle

Specific Concerns

The communities of various villages have also expressed their specific concerns. These are as follows

Barotha: The people complained that Barotha village is the most affected village by GBHP. It has lost almost half of the agricultural land. It is encircled by the power complex on three sides. The open land towards the Indus River is going to consumed by the set of power lines. On this plea they demanded for shifting the whole settlement near Barotha Model Village.

This is covered by the RAP for GBHP. Appropriate action is being taken by GBHP authorities

Gariala: The village is already affected by GBHP. The people have complained that WAPDA has not handled the land acquisition process properly. Three sets of lines will pass side by side through their plains, the only place available for the housing of people of Gariala village. People demand that they should be given plots near Barotha Model Village.

This is covered by the RAP for GBHP. Appropriate action is being taken by GBHP authorities.

Salar: All the lands of the village are owned by Khans and cultivated by the formal tenants. They demanded that the crop compensations should be given to them as per law.

Crop compensation shall be given in accordance with the compensation valuation criteria to be followed by the valuation committee.

Dherikot: The lines will pass through rich agriculture lands. The alignment may be changed to pass through adjacent barren land.

The alignment of the transmission line was finalized by ensuring that minimum cultivated land is influenced by it. Adjustment of alignment to by-pass agriculture land at one area may result in realignment of the entire route and consequent impediments all along in the form of buildings, structures etc.

Jabbi: The people have demanded that the Government should acquire the lands for the towers as was done in case of Tarbela-Gatti line, which passes close to this village. They also demanded that the height of the transmission line should be increased.

The acquisition of land shall be in accordance with the requirements. The height of towers takes into account clearance of conductors which ensure safety to life and property.

Dhok Ajri: The people demanded that for the safety of villagers the angle of the transmission line should be slightly changed.

The proposed route of the line and the alignment in terms of angles in the area adjacent to Dhok Ajri is the best option for the transmission line. At this stage any variation in line angle will change the complete alignment.

Bota: The people of Bota village complained about delays in payments for Attock-Fetchjang road. Based on this past experience, they demanded that the compensations should be given before the commencement of work.

Compensation in the form of interim payments shall be made at the time of commencement of work.

Zaindi and Neka: People are tenants living in the houses constructed on the land of owners. They have demanded that the compensation for the houses should be given to them instead of the owners.

Compensation for the houses shall be paid to the owners of the structures. Compensations for purchase of land shall be paid to the tenent at the rate of agricultural land along with credit for construction of house from the GBTI fund.

Neka: About 500 Kanals area of the village mountainous area is used for stone crushing. After installment of the transmission line, the blasting will be strictly prohibited. This will cause an economic loss to the villagers amounting to about Rs. 500,000 per annum. Moreover, about 300 laborus will be unemployed eventually.

To confirm the situation a site visit was made and discussion held with the contractor of the quarry and labour from Neka village. At the site it has been observed that the activity of quarrying is taking place on a different hilly range than the one where the transmission line will be installed. These ranges run parallel to each other with a distance of over 500 m apart, and the location of the tower from the quarry is about one km. It is learnt that the rock blasting at the quarry is carried out under controlled condition to avoid damages to the houses of the contractor located about 200 m away from the quarrying site. As such, it is anticipated that this activity will not affect the tower foundation. Similarly, the transmission line will not impose any obstruction to the quarrying activity. It is also learnt that out of the total strength of 15 people working at the quarry 10 are from the village Neka and not 300 as reported by the villagers during the scoping session.

Tarbeth: Village lands are common because settlement of the village lands has not yet been made by the Government. In this situation how the Government will compensate the people.

Compensation shall be made on the basis of valuation carried out. Entitlements shall have to be fixed by the Government. Following the procedure of RAP for GBHP the funds will be deposited with the Deputy Commissioner for distribution to the affectees.

Jhod: The people showed their concern that their lands will devalue due to the lines. They also informed that the line would pass through a forest, which is allocated to a shrine. According to their belief, cutting of trees causes curse. Therefore, such action is strictly prohibited in this area. People also demanded for a water supply scheme, as they drink water from a dirty nullah.

A repeated site visit revealed that the reported forest near the shrine is just a cluster of a few tens of trees. Of these, only about two trees lying close to the proposed tower foundation will need removal, while a few trees falling in the right-of way of the conductors will need trimming. The matter was discussed with the notables of the village. The do not have any objection for fixing the line in that area, except that they demanded cash compensation, which is to be spent on the maintenance of the shrine. It is their belief that any income from the trees of the area would cause a curse if the amount were used elsewhere other than the maintenance of the shrine.

Doian: The people informed that a new housing scheme is under process along Attock-Fatehjang road. They showed their concern that the line will devalue that land.

The route of the transmission line traverses through a corridor at a safe distance from the site of the housing scheme. This should not be cause for any devaluation of the housing site.

Kahutra: The Government should complete Suspended work of the project of Kahutra-Akhori Link road.

This matter shall have to be addressed to Government of Punjab. GBTI shall be asked to take up the matter with Highway Department Government of Punjab.

Mian Rashida, Cog Choudhry, and Chak Fatu: The people of these three villages have complained, that Government has acquired 4500 Kanals of land for the new Islamabad Airport. The land was acquired in 1984 but the compensation has not yet been paid. They also complained that they are totally encircled by different projects. Toward north is the airport and toward east is the motorway. Now there will be transmission lines towards south. Therefore, no land is left for cultivation.

Adequate and timely compensation for the transmission line should reduce the grievances of the people.

Lari Malana and Dhok Paracha: The people complained that they have not been compensated for the lands acquired for the motorway and a transmission line, which was constructed in 1992.

Assurance to people followed by prompt compensation shall be made which shall develop confidence of people in the executing staff of the subject project.

Sukh Chaipur: The people have shown their concern about compensation as they have already affected by oil exploration and a transmission line, for which they have not compensated.

Assurance to people followed by prompt compensation shall be made which shall develop the confidence of people in the executing staff of the subject project.

Terhia, Lundi Syedan and Chhaprian: The village is surrounded by forest from three sides and the only side left will be occupied by the transmission line.

The line clearances shall afford the people safe access from the side which shall be occupied by the transmission line.

Most the public concerns have already been discussed in the subsequent sections. In addition, appropriate mitigation and resettlement plans have been suggested to address the public concerns. These plans are given in Chapter-6.

5.3 EFFECTS ON CULTURAL AND ARCHAEOLOGICAL PROPERTIES

As reported earlier, about 10 cultural sites, including 2 shrines and 8 graveyards fall within the corridor of the transmission lines. One of the shrine at Dhok Kala Khan has been avoided by making adjustment in the alignment of the transmission line, while the other located at Jhod is over 30 m away from the centerline of the transmission line. As such, it would not cause any safety hazard to pilgrims.

The existence of graveyards in the right-of-way is, however, of some concern. It has been assured that no tower is located within graveyard areas and a safe conductor clearance has been provided to avoid any obstruction to burial activity. Disruption of graves during stringing of the conductors is however a matter of concern. This way discussed with the Contractor engaged for construction of Incoming and Outgoing lines. It is reported that being Muslim the sanctity of the graveyards is strictly observed by the labour force. Depending upon the site conditions, alternate means would be adopted to avoid trespassing through the graveyard areas. However, the Engineer would remain vigilant in supervising the stringing activities in such sensitive areas.

In spite of he fact that no archaeological site/monument has been discovered in the Project corridor (Section 3.7.3), there are chances that some artifacts are found during excavation for the tower foundations. Such chance findings will be notified to the officials of the Department of Archaeology and Museums at Taxila, as it was practiced during the construction of the Ghazi-Barotha Hydropower Project. Further action will be taken on the advice of the department. If required, the location of the towers will be changed to avoid any disruption to such antiquities.

TABLE 5.1
PROJECT IMPACT MATRIX

ENVIRONMENTAL COMPONENTS / PROJECT COMPONENTS	PHYSICAL ENVIRONMENT: Agricultural Lands	Soils (Erosion/Stability)	Housing/Infrastructures	Energy/Mineral Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Groundwater Quality	Air Quality	Noise
Construction Phase										
a. Tower Foundation	MA	MA	O	MA	O	LA	LA	O	O	LA
b. Tower Erection	LA	LA	O	LA	O	O	O	O	O	LA
c. Installation of Accessories	LA	LA	O	O	O	O	O	O	O	O
d. Stringing	MA	LA	LA	MA	O	LA	O	O	O	LA
e. Construction related Traffic	LA	LA	O	MA	O	O	O	O	MA	MA
e. Weighted Overall	MA	LA	LA	MA	O	O	O	O	LA	LA
Operation Phase										
A. Local Effects										
a. Towers	LA	O	O	O	O	O	O	O	O	O
b. Conductors	O	O	LA	LA	O	O	O	O	O	O
c. Current	O	O	LA	O	O	O	O	O	LA	LA
d. Overall	O	O	LA	LA	O	O	O	O	LA	LA
B. Nation-wide Effects										
Over all Project	O	O	MB	HB	O	O	LA	O	O	O

ENVIRONMENTAL COMPONENTS / PROJECT COMPONENTS	BIOLOGICAL ENVIRONMENT: Aquatic Ecosystem	Wetland Ecosystem	Terrestrial Ecosystem	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors
Construction Phase										
a. Tower Foundation	O	O	MA	O	LA	O	O	O	LA	O
b. Tower Erection	O	O	LA	O	LA	O	O	O	O	O
c. Installation of Accessories	O	O	O	O	O	O	O	O	O	O
d. Stringing	O	O	MA	O	LA	O	O	O	O	O
e. Construction related Traffic	O	O	MA	O	LA	O	O	O	LA	O
e. Weighted Overall	O	O	MA	O	LA	O	O	O	O	O
Operation Phase										
A. Local Effects										
a. Towers	O	O	LA	O	LA	O	O	O	O	O
b. Conductors	O	O	MA	O	LA	O	O	O	O	O
c. Current	O	O	O	O	MA	O	O	O	O	O
d. Overall	O	O	LA	O	MA	O	O	O	O	O
B. Nation-wide Effects										
Over all Project	NA	NA	NA	NA	NA	NA	NA	NA	NA	LB

ENVIRONMENTAL COMPONENTS / PROJECT COMPONENTS	SOCIAL ENVIRONMENT: Public Health	Resource/Land Use	Communication System	Employment	At Risk Population/Safety	Population disruption	Community Stability	Cultural & Religious Values	Tourism And Recreation	Nutrition
Construction Phase										
a. Tower Foundation	LA	MA	O	HB	LA	LA	LA	O	O	MB
b. Tower Erection	O	LA	O	HB	MA	LA	LA	O	O	MB
c. Installation of Accessories	O	O	O	LB	LA	O	O	O	O	LB
d. Stringing	LA	MA	MA	HB	LA	LA	O	O	O	MB
e. Construction related Traffic	MA	LA	O	MB	MA	MA	LA	O	O	LB
e. Weighted Overall	LA	MA	LA	HB	LA	LA	LA	O	O	MB
Operation Phase										
A. Local Effects										
a. Towers	O	LA	O	O	LA	O	O	O	O	O
b. Conductors	O	LA	O	O	O	O	O	O	O	O
c. Current	LA	O	LA	O	LA	O	LA	O	O	O
d. Overall	LA	LA	LA	O	LA	O	LA	O	O	O
B. Nation-wide Effects										
Over all Project	LB	MB	LB	LB	O	NA	MB	NA	LB	LB

NA : Not Applicable
ND : Not Determinable
HA : High Adverse

MA : Medium Adverse
LA : Low Adverse
O : None or Insignificant

LB : Low Beneficial
MB : Medium Beneficial
HB : High Beneficial

TABLE 5.2

SUMMARY OF SCOPING SESSIONS HELD

Sr.No.	Date	Team - A			Team-B		
		Venue	Number of Participants		Venue	Number of Participants	
			Male	Fe-male		Male	Fe-male
1	29.6.99	Barotha	10	-		-	-
2	1.7.99	Gariala	23	15	Chapprin	18	13
3	2.7.99	Salar	22	12	Mehlu	22	10
4	3.7.99	DheriKot	20	15	Dulloo, Dhok Maliar	52	21
5	4.7.99	Nawa	22	18	Manuainwali Dhok, Mumtazabad	29	15
6	5.7.99	Jabbi	20	16	Kog Rashida, Kog Choudhry, Chak Fatu	28	15
7	6.7.99	Nikodar	26	16	Dhok Pothorian, Ladihal, dhok Bhatwana	30	37
8	7.7.99	Dhok Ajri	25	19	Dhok Tarkhan	15	17
9	8.7.99	Swaianwali Dhok	8	7	Lari Malwana	25	23
10	9.7.99	Dhok Mochian (Akhori)	29	10	Sukhchain Pur	10	11
11	10.7.99	Zaindi	24	15	dhok Shair Zaman, Dhok Jawa	19	9
12	11.7.99	Peroshahi	31	12	Sangar, Mohra Langial	15	20
13	12.7.99	Neka & Meka	-	-	Mohra Gar	16	31
14	13.7.99	Neka	20	12	Mohra Langar	13	25
15	14.7.99	-	-	1	Trahia	14	12
16	15.7.99	Bota	29	13	Thatha	20.	13
17	16.7.99	Tarbheth	35	28	Mian Ahmda	20	11
18	17.7.99	Johd	20	21	Dhala	24	10
19	18.7.99	Dhok Svedan (Langar)	25	18	Merashavef, Dhok Bhuda	14	18
20	19.7.99	Doian	30	12	Panan, Dhok Jawa	20	14
21	20.7.99	Dhok Briar	25	22	Dhok Paracha, Dhok Langriala	17	26
22	21.7.99	Kahutra	30	14	Dhok Lundisevdian, Dhok Pasi	21	18
23	22.7.99	Pind Tareir	32	12	Dhok Bagga, Dhok Babanoor (existing lines)	5	-
24	23.7.99	Dordad	-	19	Dhok Rait, Dhok Gangal (existing lines)	13	-
25	24.7.99	Dhok Sved Ahmed (Thatha Khaliel)	22	14	Dhok Alishan, Bhumble (existing Lines)	9	-
26	25.7.99	Pattewali Dhok	4	-	Dhok Chohan, Sarhandi, dhok Hasho (e-l)	13	-
		Total	523	341	-)	482	369

CHAPTER 6

ENVIRONMENTAL MITIGATION AND RESETTLEMENT ACTION PLANS

CHAPTER 6

ENVIRONMENTAL MITIGATION AND RESETTLEMENT ACTION PLANS

6.1 GENERAL

This chapter deals with the actions that are required for mitigating the effects of the Project on physical, biological and social environment on the Project area. It is imperative that appropriate actions are taken to make a project compatible with its environment. A reasonable compatibility can be achieved through two approaches. One is that the project is so refined and tuned that its effects on the resources are minimal, while the other approach is compensatory. Compensation could be through altering the environment in such a way that the adverse effects of the project are balanced through secondary benefits.

Both the approaches have been adopted for this Project. As referred in the previous chapters, the Project has been so designed that it will have the minimum effects on the physical, natural and human resources of the Project area. Maximum effort has been made to avoid settlements and cultivated lands. For this, even a high-cost preposition has been adopted to place the lines for their maximum possible lengths on double circuit towers. Chapter 5 elaborates that these actions have resulted in limiting the adverse effects on the local environment.

The lines will slightly restrict the use of about 259 ha of cultivated land for agricultural purposes. Of these, about 7 ha, that will be under the towers, will have some more restricted use for agriculture. As far as infrastructures are concerned, the Project will disrupt only 36 scattered residential buildings, 3 farmhouses, 1 poultry farm, 2 pump houses, 2 tubewells and 4 open wells. In addition, there will be a loss of about 30,000 trees, shrubs, etc from the reserved forests and other land areas. The details of these aspects have been given in Chapter 5.

The relevant sections below discuss the compensatory actions adopted for meeting these losses. Before dealing with the proposed actions for environmental mitigation and resettlement, it will be appropriate to give the background information that is leading to adopt the proposed measures. These have been discussed in Sections 6.2 through 6.5 below.

6.2 COMMUNITY PARTICIPATION

In line with the environment assessment procedures, a process of community participation is considered crucial in making decisions for compensatory actions. Therefore, a series of scoping sessions were held in the Project area to take the counsel on these aspects from the local communities. The detailed account of this is given in Section 5.2.7. In framing compensatory actions due weightage has been given to the concerns of the local communities.

Community participation is the most important feature of project implementation. The aims of community participation are the following:

- To elicit information from the local people about the social and economic resources upon which they depend for their livelihoods.

- To develop and keep open lines of communication between local communities. WAPDA. GBTI and Project Contractor.

In order to achieve these aims, twenty six (26) scoping sessions were held with the people of the villages expected to be included in the project alignment. The summary of scoping sessions and the public concerns are covered under Table. 5.2 and Section 5.2.7 respectively. In order to ensure continued public participation, a periodic follow up of the scoping sessions were arranged in the project area with all affectees to explain the various project provisions and any other matters they wished to discuss or have explained. These sessions shall cover:

- Detail of specific entitlements.

- Working of Land valuation committee comprising representatives of GBTI. NTDC, project contractor and the affectees.

- Schedule of resettlement related activities (if any).

- Grievance and appeal mechanism.

These sessions will provide an opportunity to re-emphasize the project's approach involving the communities in project planning and to reiterate that the participative process will continue into and throughout the implementation period.

The GBTI will be represented by a qualified sociologist who shall participate in all aspects related to valuation and compensation and issuance of certificates of compensation to each affectee and payment of compensation directly into bank accounts of the affectees.

The affected people will be involved in monitoring of land valuaiton and compensation, through working of the land valuation committee and through continued public participation.

6.3 FOCUSED CENSUS SURVEYS

Under the present study two set of focused census surveys have been carried out. One set of survey is related with the built-up properties and other infrastructures that either will be disrupted by the construction of the transmission lines or have to be removed for safety reasons. This survey was carried out on the basis of initial information available from the plan and profile drawings (reference Tables 3.3 through 3.11 in Chapter 3 and discussions in Section 5.2.5).

This survey was meant to confirm the need for relocation or removal of the properties and for establishing various parameters that needed for evaluating the properties and determining compensation packages. The survey identifies the ownership of the properties and the compensation amount that is foreseen by the owner. For the built-up properties details about the built-up and open area and type of construction were also recorded for their valuation in accordance with the policy set in the main Resettlement Action Plan (RAP) for Ghazi-Barotha Hydropower Project. Also complying with the policy of the main RAP, the ownership and tenancy status of the residential buildings was recorded along with the information about the families that occupy the houses. The related information has been presented in Appendix "E" and reproduced in Table 6.1

The second set of focused census survey covers the land areas that will be occupied by the towers of the transmission lines and the ones likely to be temporarily used for stacking the material and assembly of the tower panels during construction. Initially such survey was not possible because except for angle towers the location for other towers were not demarcated on the ground. In the absence of any ground reference, it was difficult to identify the land areas where the towers will be located and consequently the owners from whom the information has to be taken. The matter was discussed with the members of the World Bank Mission during their visit in February 2000. On their suggestion the assignment of conducting focused census survey for the work of In and Out lines for the initial six months of their implementation was taken up. The data for the same has been included in Appendix "E". The remaining areas of In and Out and Barotha-Rewat lines will subsequently be taken up for the census survey for which a supplementary report will be issued. A schedule for the census survey of the remaining area has been shown in Table 7.2.

Out of total 676 towers, 120 have been covered under the present census survey. The surveyed towers include 6 for Barotha-Gatti Outgoing S/C Line I, 34 for Barotha-Gatti Outgoing S/C Line II and 80 for Tarbela-Barotha Incoming D/C Lines I & II. The salient findings of this survey are enlisted below:

- Of the total 120 towers, 22 will fall in wasteland (Banjar). Of these 14 will fall in individual proprietary wastelands while the rest in communal owned wastelands.
- Of the remaining 98 towers falling in cultivated area, only one tower will be located in the well-irrigated land while the rest will fall in the rainfed-agricultural (barani) lands.
- The cultivated lands where the towers will be located comprise 93 Land Operational Units (LOUs). The majority of these LOUs are individually owned.

However, fifteen LOUs have multiple ownership, because the land inherited has been transferred jointly to the heirs. As such, the total affectees of the cultivated areas come to about 114 persons. If the privately owned wasteland is also taken into account, the number of affectees will come to about 131 persons.

- Normally one tower falls in each LOU. However, there are 4 LOUs, which will accommodate more than one tower. Similarly, about 5 towers will fall in more than one LOU, because the tower will be located at the boundaries of lands owned by different persons. The number of affectees given above takes such cases into account.

- The total landholdings of the affected persons varies from 7 Kanal (0.35 ha) to over 4000 Kanal (202 ha). The majority of the affectees (71%), however, have landholdings less than 100 Kanals (5 ha). Of the remaining about 21% have landholding between 100 and 500 Kanals (5 to 25 ha). The people having holdings greater than 500 Kanals (25 ha) form about 8% of the lot, including 6% of those that have holdings more than 1000 Kanals (50 ha).

- Generally the agricultural lands accommodating the towers are self-cultivated by the owners, with the exception of 19 places where the tenants cultivate the land.

- The land that is required for the construction of a tower would be about 4 Kanals.

- The Revenue Department of Attock District has provided a schedule of average yields for various crops on different type of lands in the district. This schedule is enclosed in Appendix "E". The schedule also includes the current market rates of farm produce. Crop compensation will be made accordingly. A similar schedule will also be collected for Rawalpindi District when the census survey of that region is undertaken.

6.4 CURRENT PROCEDURES OF WAPDA FOR IDENTIFICATION, EVALUATION, PAYMENT OF COMPENSATION TO THE AFFECTEES, AND ADDRESS OF GRIEVANCES

6.4.1 General

During the construction of 500 and 220 kV transmission lines, the damages to the crops, trees and built-up properties take place at the following stages.

- Survey/soil investigation.
- Concreting of tower foundation.
- Erection of towers.
- Stringing of conductors.

At each stage the damages are properly assessed, evaluated and compensated in accordance with the prevailing rules and regulations of the Government. In addition to these, the damages caused for the removal of high trees and built-up properties, for public safety and integrity of the transmission lines, from within the 50-m wide corridor are also adequately compensated. These are elaborated in details in the succeeding paragraphs.

6.4.2 Compensation at the Time of Survey/Soil Investigations

During detailed survey and soil investigation work for the tower footings, the damages caused to the existing crops are recorded and estimates prepared for the compensation amount by the concerned revenue staff - Potwari. The estimates are prepared in accordance to the approved rates provided by the concerned Deputy Commissioner. The record of the Potwari is verified by the Assistant Land Acquisition Officer (ALAO) and Sub Divisional Officer (SDO), who is the Engineer in-charge of the work. After verification the record is submitted to the competent authority for approval and arrangement of payment to the affectees. Accordingly the funds are released for prompt payment to the affectees.

6.4.3 Compensation at the Time of Construction of Foundation for Towers (Excavation & Concreting)

At the time of concreting of foundation of towers considerable movement of vehicles for transportation of materials/water and steel formwork is involved. This movement and storage of material cause damages to the existing crops. In this case also the damages for the access road to the tower locations are also recorded/evaluated. The concerned Revenue staff, including Potwari and Qanoongo, maintain the record which is verified by the ALAO and concerned SDO. The compensation amount for the damages is calculated in accordance with the prevailing approved rates for the crops/trees provided by the respective Deputy Commissioner. After verification, SDO submits the compensation cases to the competent authority for approval. On approval the payment is immediately made to the affectees. No payment is made for the land for the tower footing and the landowner is allowed for the use of land under the towers.

6.4.4 Compensation at the Time of Tower Erection and Installation of Insulators and Fittings

The same procedure is adopted as described in paragraph 6.4.3.

6.4.5 Compensation at the Time of Stringing of Conductors

The stringing of conductors involves the movement of equipment and vehicle along the corridor, which may involve the cutting of trees, and considerable damages to the existing corps. The revenue staff, including Potwari, Qanoongo and ALAO, is always at the site to complete the record for the damages. On completion of the estimates and their approval the compensation amount is disbursed promptly.

During stringing activities the built-up properties and other structures like pump houses that are likely to affect the required clearance for the transmission line are identified and evaluated for compensation and relocation. The Sub Divisional Engineer In-charge of the work along with the Sub Engineer (Civil) prepare the cost estimates for the relocation of these structures and after proper scrutiny and approval, the compensation is paid as per the rates announced by the Government.

6.4.6 WAPDA Practice for Passing Transmission Lines Near or Through Sensitive Areas

For the crossing the transmission line nearby or through the sensitive areas, the concerned agencies are approached for their approval. Any damages caused to the trees and other properties are duly recorded and paid as per rules of the agency. This particularly implies for crossing the transmission lines through forest areas. In this respect formal permission is obtained from the Provincial Department of Forestry and payment to the department are duly made for the damages to the trees. The payment is made in accordance with the rules set by the departments.

Similarly in case the transmission lines are passing nearby the existing or proposed Airports or other sensitive installations, proper clearance is obtained before the start of work

6.4.7 Redress of Grievances

The properties likely to damaged. removed or relocated is assessed and evaluated in the presence and in consultation of the affectees. Complete inventory of the property is maintained in the compensation registers. Should there be a need, the respective Revenue Record is also consulted. All the payments are made in the presence of local representative through cross-cheques.

In spite of all cares in making the assessment of the properties, the affected person may have objection or observation. The complaints are of varied nature, including the followings:

1. Dispute on ownership;
2. Relocation of towers;
3. Inadequate compensation;
4. Delays in the payment of compensation, resulting in court cases or references to Wafaqi Mohtasib (Federal Accountability Court);
5. Reluctance of the owners to install the structures before payment of compensation;
6. Type and number of trees to be removed; and
7. Encroachments and their claim.

Any complaint/representation made by the affectee is promptly investigated for quick redress. The Executive Engineer normally addresses the complaints at the spot. Should there be a need, even Project Director (Superintending Engineer) or Chief Engineer intervenes to entertain and scrutinize the grievances of the affectees.

6.4.8 Track Record of Compensation Payment

WAPDA has been prompt in making compensation payments for the damages to crops, trees and built-up properties caused by the construction of extra high voltage transmission lines. For the interest of the readers and to highlight WAPDA's track in this respect, it is desirable that a statistical record of the compensation payments for recently implemented transmission lines is reproduced. This is given in the following table.

AMOUNT OF COMPENSATION PAID FOR VARIOUS PROJECTS

Sr. No.	Name of Transmission Line	Amount of Compensation Paid (Rs.)
1	500 kV Tarbela-Lahore T/L	20,592,263
2	500 kV Lahore-Gatti-Multan T/L	23,519,732
3	500 kV Tarbela-Peshawar T/L	6,767,397
4	220 kV Multan-Vehari T/L	8,759,188
5	220 kV Vehari-Sahiwal T/L	8,427,462
6	220 kV Kot Addu-Multan T/L	2,385,115
7	220 kV Chashma-Daudkhel T/L	5,611,139
8	220 kV Peshawar-Daudkhel T/L	7,802,264
9	500 kV Lahore-Multan-Jamshoro T/L	39,061,777

6.5 POLICY AND LEGAL FRAMEWORK

The present programme of installing 500 kV transmission lines is a part of the main Ghazi-Barotha Hydropower Project (GBHP). As referred in Section 1.1, this report just supplements the previous environmental and resettlement studies for the actions to be undertaken for implementation of power dispersal scheme of GBHP. In this context, the policies adopted for the main Project will also be applicable to this programme. Chapters 2 and 6 of the Resettlement Action Plan[1] (RAP) for GBHP explain the policy and legal framework. In general, this policy and legal framework has been adopted for this programme. However, due to the nature of this component of the Project and the types of interventions that will be undertaken, some modifications in the land acquisition procedure have been proposed. These are as follows:

1. Complying with the provision of Telegraphic Act of 1910, WAPDA has adopted a policy for not acquiring land for installation of the transmission lines. The lands are temporarily occupied and the owners are paid for the loss of crops/crop season and damages to the trees and other properties. The

[1] Pakistan Water and Power Development Authority; Ghazi-Barotha Hydropower Project; Resettlement Action Plan; September 1994.

procedures described in Section 6.4 are followed as a matter of policy. The same policy will be adopted for this Project.

2. The land will be temporarily acquired for one or two crop seasons for which the owners will be compensated. After completion of the work of tower erection or stringing of conductor the lands will be restored and handed back to the owners. As referred elsewhere, the transmission lines do not impose much obstruction for normal cropping underneath. Even the lands under the towers can be brought into cultivation. The clearance under the towers will be enough that a tractor can easily pass through. This is also supported from the survey purposely carried out on the existing transmission lines (Section 5.2.2). According to the survey in about 70% of the cases the lands underneath the towers have been cultivated.

3. In the light of above, there will be no permanent land acquisition under the Project, thus involves no land for land compensation.

4. Normally temporary acquisition or occupation of land is carried out under Section 35 of the Land Acquisition Act. However, acquiring land under the Land Acquisition Act is a lengthy process and involves Provincial Government. This seems cumbersome to involve a setup of a Land Acquisition Collector (LAC) for acquiring small chunks of lands scattered along the routes of the lines. Under such conditions, even the Government of Punjab may hesitate in appointing a Land Acquisition Collector. Moreover, the finalisation of the tower locations is subject to soil investigations and other technicalities of the alignment. As such, it will be difficult to timely earmark the land to be acquired. To avoid this, it is therefore planned that the land will be acquired through direct negotiation with the landowner. This procedure will be in line with the desire of the local communities

5. On the desire of the local communities (Section 5.2.7) and as a policy set for GBHP, WAPDA will involve Ghazi-Barotha Taraqiati Idara (GBTI), an NGO established for GBHP, to assist in the matters related with the temporary acquisition of the lands. The services of GBTI will be utilised for all the steps involved in the process, including assessments of the crops and properties, price negotiation, payment of compensation, etc.

6. The cultivated lands that are likely to come under the conductors will not be acquired. However, crop compensation will be made for the period while stringing is in progress. The services of GBTI will be extended for assisting the Executing Agency for estimating the crop compensation.

7. When making payment for the compensation for land and/crop, it will be ensured that the tenants get their due share according to Land Acquisition Act and RAP for GBHP.

8. Adopting the entitlement package set for compensating the disruption of habitations in GBHP is not possible in the present programme. This is because the disrupted houses are widely scattered in 235-km stretch of the transmission

lines. Therefore, instead of establishing model villages and providing plots to disrupted families, the Project will compensate the owners with cash for not only covering the replacement cost of the structure but also for the land. As such, the disrupted family will be in a position to purchase land elsewhere for their housing

9 As the disrupted houses fall in agricultural lands, the compensation for the land under the house will be made accordingly, and will not be considered as residential area.

10. Other disrupted infrastructures will be compensated for the structures only on the replacement cost basis. No land compensation will be paid.

11 Trees and shrubs cut from the private land will be compensated according to the provisions set in the law and explained in Resettlement Action Plan for GBHP. The trees and shrubs cut from the reserved forest areas will be the property of the Department of Forestry, Punjab. However, to compensate the damage, WAPDA will carry out a re-vegetation programme under the Contracts. As referred earlier, an amendment for the same (Reference Appendix "G") has been issued to the Construction Contractor for In and Out Arrangement of the Transmission Lines and a pertinent clause will also be included in the Contract Agreement for constructon of Barotha-Rewat 500 kV lines.

12 All claims against land acquisition/crop compensation shall be registered by the affectees with the GBTI representatives. The cut off dates for eligibility for claims has been determined in order to prevent opportunistic encroachment and are as follows:

(i) In and Out Arrangement for Existing Tarbela-Gatti Lines 1and 2 at Barotha

A complete census has been carried out and base line data has been collected.

The date on which the census was completed i.e. May 28, 2000 is considered as the cut off date.

(ii) Two Barotha-Rewat 500 kV Transmission Lines

Census and collection of base line data shall be completed by end of October 2000. The actual date on which the census shall be completed shall be the cut off date.

6.6 ACTIONS FOR ENVIROMENTAL PROTECTION AND MANAGEMENT

As discussed in Chapter 5, the environmental effects of the Project are limited. The most concerning aspect is the disturbance to the natural vegetation and the soils. The disruption to these natural resources could be minimised by adopting good construction-management practices. In addition to that, some compensatory arrangements will further offset these effects. In this context, the Executing Agency will take the following steps:

1 As per requirement of the law, the Executing Agency will obtain permission in writing from the Department of Forestry for cutting the trees and other vegetation falling in the ROW of the lines or required for the access tracks. This is particularly with reference to the reserved forests. In this regard WAPDA has approached the Chief Conservator Forest of Rawalpindi Region. Chief Conservator has given a clearance and endorsed his comments to the Secretary of Forest Department for issuing a clearance certificate (see also Appendix "F")

2 The Executing Agency will ensure that the Contractors do not take unnecessary privilege of the permission obtained from the department for removal/cutting of the vegetation. Restriction will be imposed for cutting of vegetation unnecessarily.

3. The Executing Agency will instruct the Contractors to re-vegetate the areas of cutting after the completion of the work. This will be controlled through the Contract Clause (Appendix "G").

4. The Contract Clauses will bind the Contractors to carry out excavation and blasting under the controlled conditions and avoid dust pollution, particularly near the settlements.

5. The Contractors will be responsible to take measures to minimise and control of soil erosion at the construction sites and along the access roads.

6. The ditches excavated for tower foundations will be refilled by the Contractors, as this will be obligatory under the restoration clauses of the Contract. The ground will be brought to previous condition.

7. The Contractors will be responsible for the rehabilitation/repair of any roads damaged by their vehicles during the construction phase.

8. The Contractors will be responsible for the collection and proper disposal of construction wastes and lubricants used by their equipments.

9. The Contractors will be responsible for proper dismantling and clearing of construction camps after their work is completed.

10. In addition to supervising the construction work, the Executing Agency will regularly monitor that the works specified above are fully executed by the Contractors. In order to bind the Contractors for complying with the above conditions, an amount of 10% will be deducted from the interim payment certificates for the work done.

11. The aspect related to the disruption of graveyards and shrine at Johd and Kala Khan has already been discussed in Chapter 5. The shrine at Kala Khan has been avoided by changing the alignment, while that of Johd is about 30 m away from the central line. Thus the pilgrimage activity on these shrines will not be affected. As far as the graveyards are concerned, the contractor will cause any disruption during construction (see Section 5.3).

12. No archaeological site is foreseen to be disrupted by the construction of the transmission lines. Accordingly the Department of Archaeology and Museums has issued a clearance certificate, which is attached at Appendix "F". Should there be a chance finding of any antiquity during excavation for the towers, the same will be intimated to the Archaeology people at Taxila. The work at such sites will be stopped till the Department gives clearance. Should there be a need of changing the location of the tower that will be done under the instruction of the Department.

13. The construction of transmission lines will not involve a very large number of Construction Crews (see Section 2.6). As such, social problems arising due to interaction of the crews with the local communities will be insignificant. This particularly implies when at one time the construction activity will be spread

over 3 to 6 km and majority of the unskilled labour will be hired from the local communities (see also Section 5.2.1). However, the contractor will be instructed to take necessary measures to avoid social disruptions. This will include stationing of the crews in different localities spread over the at-one-time-construction length of the transmission line.

As also referred in Section 5.2.5, another aspect of concern is the alignment of the transmission line near the proposed airport for Islamabad. WAPDA has already taken-up this matter with the Civil Aviation Authority (see Section 5.2.5). Action in this regard will be taken in accordance with advice of the Civil Aviation Authority. However, should there be a need, the lines would be realigned. In realigning consideration will be given to the aspects of environment and resettlement. The same implies to other changes, which the Consultants are undertaking according to suggestions given in Tables 2.1 through 2.9 and Tables 3.3 through 3.11.

6.7 ACTIONS FOR RESETTLEMENT

6.7.1 Loss of Properties and Valuation

Built-up Property

As referred earlier, the Project will disrupt only 36 scattered residential buildings, 3 farmhouses, 1 poultry farm, 2 pump houses, 2 tubewells and 4 open wells. The details of these properties were obtained through a census survey and interview with owners. In fact, the detailed survey has been carried for all the properties falling within 100-m wide strip originally earmarked by WAPDA in a view of manipulating the tower locations on technical ground. The above-referred properties are those, which will fall within 50-m wide corridor. Should there be any change in the alignment, it will be minor and would not alter the present status. It is worth mentioning that at one place a cluster of houses was affected by the lines. Recently the alignment has been adjusted to save these houses.

Table 6.1 provides the details of the properties that are likely to be affected. The table identifies the type of the built-up property, name of the owner and its dimensions. For residential houses, it also includes size of the family, and covered and open areas. It also categorises the buildings in accordance with the type of construction, as laid down in the Resettlement Action Plan for GBHP.

The cost estimates for the properties are also given in the table. These are based on the present day value of the property. For its valuation, the owners of the properties were also consulted. Depending upon the pace of the Project implementation, the cost will be revised in accordance with the trend of the market. In this regard, the rates indicated in the RAP for GBHP will form the basis. These will be escalated up to the period when actual possession would be taken. The escalation will be made according to annual premium allowed under WAPDA rules.

Land

According to the policy adopted for this component of the Project (Section 6.5), the construction of the transmission lines will not involve permanent acquisition of land. The lands will be temporarily occupied after negotiation with the owners and they will be compensated by making payment for the loss of standing crops or cropping seasons.

The compensation package for the loss of crops and/or crop seasons will be evaluated on the basis of information provided by the concerned Revenue Department for crop yields on various types of lands and prevalent price of the produce. The same for the Attock region has been included in Appendix "E". Similar information will also be collected for the Rawalpindi region.

In spite of the fact that the schedules for crop yields and sale price of farm produce will form the basis for calculating the compensation package, the consultation of the farming communities will not looked down upon. Based on the scheduled estimates, WAPDA will negotiate with owners and tenants in the presence of a representative from GBTI and the Contractor.

The census survey (Appendix "E") identifies the owners and tenants of the lands where the towers will be erected. This will form the basis for contact with concerned people for negotiation and disbursement of the compensation amount.

6.7.2 Entitlement Packages

The Project does not involve resettlement of large significance that would need elaborate entitlement packages. However, to keep it in line with the main Project (GBHP), an entitlement package has been prepared in accordance with the policy described in Section 6.5. The same has been shown in Table 6.2. The table covers every possible loss that may occur due to the Project. It is foreseen that due to temporary acquisition of very small chunks of land scattered wide apart, some packages may not be applicable, such as loss of Ijaradari, tenancy, employment, etc.

The entitled persons (EPs) and the entitlement packages will mostly be in line with the policies laid down in Section 6.5. In addition to that, some more facilities have been proposed for entitled persons as shown in Table 6.2. These include credit facilities, access to training and employment. For the later, WAPDA will ensure that the affected people get employment with the Contractors.

The Project proposes that the services of Ghazi-Barotha Taraqiati Idara (GBTI) will be extended to cover this component of the main Project. These will include assistance to WAPDA and entitled persons on the matters related with the land acquisition and compensation, and providing a share from the funds allocated for Integrated Regional Development Programme (IRDP). However, this share will be in proportion to the effects of this component on the Project area. As such, GBTI will extend their services for short-term credit and vocational training facilities to the entitled persons only. This is also in view of the shortage of funds and resources available with GBTI. The persons who are entitled for these facilities are shown in Table 6 2.

6.7.3 Arrangement of Funds for Implementation of RAP and their Disbursement Procedures

For meeting the expenses of compensation payments, WAPDA has made the provision of funds in the Project Construction Contract. The Contract with Imperial Construction Company for the construction of In and Out lines, includes a provisional sum of Rs. 4.4 M for disbursement to the affectees in accordance with their entitlements. With this provision, the Contractor will make all the compensation payments to the affectees and later get these reimbursed from WAPDA. As this is a reimbursable cost, it contains a leverage of flexibility. The figure given in the Contract is a tentative one and has been derived from the experience on the implementation of previous projects.

This arrangement has been made to avoid any delay in making payment of the compensations to the affectees. With this arrangement the Contractor will have a free hand in disbursing the compensation amounts without involving procedural hindrances caused if the department makes the disbursement. However, it is not foreseen that the Contractor will have a total free hand to bypass the conditions spelled out in the main RAP for evaluation of compensation amount and prompt payment to the entitled persons. He is supposed to comply with such conditions particularly as given in Table 6.2. WAPDA will overview this activity and will be fully responsible for overall management of the resettlement activities.

The amount provided under this head will also cover the cost of re-vegetation of the reserved forest area. It is foreseen that the re-vegetation work under the construction contract for In and Out lines will not be much as the Incoming D/C Line will only affect a small fringe of Khawa Reserved Forest. However, Barotha-Rewat Lines will have significant effect on the natural vegetation. Therefore, the contract for this component will include sufficient amount to cater for this work.

6.8 REGIONAL DEVELOPMENT PROGRAMME

Chapter 3 shows that area of the Project influence is very far from the development of the present day. Even basic social amenities are not available to the majority of the affected communities. This demands that a development package should be lodged to reduce or at least minimise the hardships of the people. If looked on globally, the situation in this area is not worse than is experienced in other parts of the country. The condition will rarely improve unless the government gives priority to the social works programme.

Chapter 5 indicates that the Project is no way going to worsen the social condition of the area. The effects of the Project on natural and social environment will be minimal. Therefore, social development under the Project may not be emphasised as it was done for GBHP. In addition, for the reasons mentioned in Section 6.7.2, it seems unrealistic to extend IRDP in full to this area. Under the prevailing conditions of availability of the funds with GBTI, further extension of the programme will deprive the communities affected by GBHP.

In spite of this, WAPDA fully realises the social hardships of the area. To partly ameliorate these hardships, GBTI would allocate some amount from the IRDP funds provided for GBHP, which amounts to Rs. 176 M. It has already been indicated in Section 6.3 that for installation of 120 towers only 131 persons will be affected. If this figure is projected for total number of towers, i.e., 676, the figure for affected persons will come to about 750. As compared to the main Project where over 19,000 persons have been affected this figure is insignificant. As such, the effect of this component on the people is about 4% than that on the main project. Even if the quantum of the land to be occupied by the structures is consider this forms a nominal fraction than the one taken for the main Project (i.e., 15 ha against over 4000 ha for the main Project, which forms about 0.04% of the latter). Taking the figure of affected person into account, about 4% of the IRDP Fund, which comes to about Rs. 7 M, will be allocated by GBTI for this component. As referred above, these funds will mostly be utilised for providing credit to the affected population only. This will partially offset the restricted use of lands under the towers and the conductors.

TABLE 6.1
DETAILS OF INFRASTRUCTURES TO BE RELOCATED

Sr. No	Type of Infrastructure[1]	Owners Name: Plot[2]	Owners Name: Structure	Name of Occupant[3]	Status of Occupant[4]	Area of Plot: Covered area (Sq. m.)	Area of Plot: Open area (Sq. m.)	Area of Plot: Total area (Sq. m.)	Type of Construction[5]	No. of Residents: Above 25 years: Male	No. of Residents: Above 25 years: Female	No. of Residents: Below 25 year: Male	No. of Residents: Below 25 year: Female	Total	Estimated Cost[6] Rs.
	RESIDENTIAL BUILDINGS														
1	House	Muzaffar Khan	Ditto	Self	Owner	136.00	304.00	440.00	C	2	2	2	0	6	135,944.00
2	House	Kala Khan	Ditto	Self	Owner	126.00	259.00	385.00	C	3	2	1	1	9	44,504.00
3	House	Shah Nawaz	Ditto	Self	Owner	311.00	489.00	800.00	B	3	3	3	5	12	116,472.00
4	House	Noor Mohammed	Ditto	Self	Owner	102.48	247.66	350.14	C	1	1	3	-	5	36,277.92
5	House	Iqbal Khan	Ditto	Gul Hayat	Tenant	96.00	224.00	320.00	C	2	2	2	4	14	33,984.00
6	House	Rab nawaz	Ditto	Mohammed Sarwar	Tenant	71.75	130.00	201.75	C	3	1	-	-	2	25,399.50
7	House	Mohammed Azeem	Ditto	Self	Owner	52.00	292.00	344.00	C	1	1	4	1	7	21,348.00
8	House	Mohammed Akbar	Ditto	Self	Owner	122.00	411.00	533.00	C	3	1	-	4	5	43,188.00
9	House	Ghulam Mohammed	Ditto	Self	Owner	52.00	187.00	239.00	B	1	1	1	1	4	34,224.00
10	House	Fazal Elahi	Ditto	Self	Owner	51.75	490.00	545.00	B	3	3	4	3	13	28,566.00
						134.00			C	-	-	-	-	-	47,436.00
11	House	Ghulam Abbas	Ditto	Self	Owner	84.00	70.00	154.00	D	1	1	4	1	7	15,540.00
12	House	Maula Dad	Ditto	Self	Owner	50.00	339.00	511.00	B	3	3	3	1	-	33,120.00
						112.00	-	-	-	-	-	-	-	-	
13	House	Mir Afzal	Ditto	Mohammed Fayaz	Tenant	109.00	80.00	189.00	D	1	2	5	-	8	20,165.00
14	House	Tariq Azim	Ditto	Self	Owner	26.00	58.00	139.00	C	-	-	-	-	3	3,204.00
						55.00			D						10,175.00
15	House	Ghulam Abbas	Ditto	Shurap	Tenant	114.00	183.00	297.00	D		-	4	2	7	21,090.00
16	House	Amiral Ali	Ditto	Fida Jan	Tenant	28.81	80.00	108.81	C		2	4	5	12	0,198.74
17	House	Karam Khan	Ditto	Self	Owner	85.00	110.00	195.00	D	3	3	4	3	13	15,725.00
18	House	Tahir Khan	Mohammed Ilyas	Mohammed Ilyas	Tenant	33.00	231.00	374.00	C	2	1	3	1	7	32,922.30
19	House	Tahir Khan	Khan Mohammed	Khan Mohammed	Tenant	50.00	76.00	156.00	D	2	2	-	2	5	11,100.00
20	House	Ghulam Mohammed	Ditto	Self	Owner	190.00	258.00	448.00	C		1	1	4	7	67,250.00
21	House	Ghulam Jilani	Ditto	Self	Owner	137.00	342.00	479.00	C	3	2	2	2	7	48,498.00
22	House	Nazakat Khan	Ditto	Habib-ur-Rehman	Tenant	70.00	299.00	556.00	B	3	2	3	2	10	28,640.00
						147.00			C						59,118.00
23	House	Mohammed Khan	Ditto	Self	Owner	228.00	230.00	458.00	C	2	2	1	4	15	80,712.00
24	House	Azeem Khan	Ditto	Self	Owner	119.14	161.00	280.14	B	2	-	-	-	2	55,765.28
25	House	Pervez	Ditto	Self	Owner	80.50	375.00	472.50	B		1	1	4	7	44,436.00
						17.20									
26	House	Mir Dad	Ditto	Mumtaz Khan	Tenant	152.50	410.00	562.50	D	4	1	1	4	10	28,212.50
27	House	Raja Matloob	Ditto	Maherban	Tenant	73.50	99.00	172.50	C	1	1	1	2	5	25,019.00
28	House	Mohammed Sultan	Ditto	Self	Owner	243.40	352.60	596.00	B	4	4	1	5	14	134,356.80
29	House	Fazal Hussain	Ditto	Self	Owner	136.70	93.60	230.30	B	1	1	5	1	8	75,458.40
30	House	Taj Mohammed	Ditto	Self	Owner	41.30	72.00	163.00	C		2	3	-	5	32,320.20
31	House	Manzab Dar	Ditto	Self	Owner	96.52	242.48	339.00	A		-	2	3	5	35,651.32
32	House	Mohammed Fazl	Ditto	Self	Owner	216.00	1,095.00	311.30	A			3	5	8	214,056.00
33	House	Ghulam Mahandi	Ditto	Self	Owner	184.00	404.00	588.00	B	3	1	3	5	13	101,568.00
34	House	-		Mosque Imam		47.00	107.20	154.20	C						16,638.00
35	Room	M. Yousaf				71.40		71.40	C						25,275.60
36	Room	Naseem Khan				35.00		35.00	C				2		12,390.00
	TOTAL COST														[illegible]

TABLE 6.1

DETAILS OF INFRASTRUCTURES TO BE RELOCATED

Sr.No.	Type of Infrastructure[1]	Owner Name: Plot[2]	Owner Name: Structure	Name of Occupant[3]	Status of Occupant[4]	Area of Plot: Covered area (Sq. m.)	Area of Plot: Open area (Sq. m.)	Area of Plot: Total area (Sq. m.)	Type of Construction[5]	Above 25 years: Male	Above 25 years: Female	Below 25 years: Male	Below 25 years: Female	Total	Estimated Cost[6] Rs.
B	TUBEWELLS														
1	Tube Well														50,000.00
2	Tube Well														50,000.00
	TOTAL COST														100,000.00
C	PUMP HOUSE														
1	Pump House	Anwar	Ditto			25.00			A						23,775.00
2	Pump House	Mohammad Ismail	Ditto			54.00		265.00	A						51,514.00
	TOTAL COST														75,289.00
D	FARM HOUSES														
1	Dera	Khalo Khan	Muhammad Taj	Muhammad Taj	Tenant	30.00		100.00	D						6,650.00
2	Dera	Dr. Sh. Waheed	Ditto	Nasir Ahmad	Servant	56.98	77.00	133.98	C						30,170.92
3	Room (Dera)	Abdul Razaq				40.00		40.00	D						7,400.00
															44,220.92
E	WELLS														
1	Well	Haji Fateh Muhammad	Ditto												
2	Well	Amir Shah	Ditto												
3	Well	Abid	Ditto												
4	Well	Aftab	Ditto												
	TOTAL COST														100,000.00
F	POULTRY FARMS														
1	Poultry Farm	M. Aslam	Ditto	Self	-	355.00	-	355.00	[illegible]	-					[illegible]

Note

1 Define as Residential/Non-residential Buildings, School, Mosque, Deras, Bara, Ziarat, Shrine, Well, Tubewell, etc.

2 Name of owner of plot if different from that of structure

3 Verify the name of Occupant

4 Status of Occupant-Whether he is Lodger or Tenant.

5 Type A. Building: Brick Masonry in Cement mortar with reinforced concrete/reinforced brick roof and terrazzo floors (Chips).

Type B. Building: Brick Masonry in mud Mortar with reinforced concrete/reinforced brick roof and plain concrete floors.

Type C. Building: Burnt Bricks on External walls only, roofs of wood or pre-cast concrete battens and tiles and brick flooring.

Type D. Building: Mud houses with mud roofs, supported on battens

6 Inquire from the resident

TABLE 6.2

ENTITLEMENT PACKAGES

SR. NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
I	Temporary loss of production from privately-owned agricultural land	* Owner of land as verified from the Revenue Record and Census survey	1. Cash compensation for the loss of crop for one or two cropping seasons as applicable in accordance with the construction period on a particular area.	1. Access to a credit facility provided under IRDP in line with priorities fixed in accordance with the impact of the Project 2. Vocational training and self-employment schemes under IRDP in line with priorities fixed as above 3. Access to employment with the contractors	1. Determination of compensation through direct negotiation with Landowner - GBTI to assist in negotiation. 2. Prompt payments within stipulated period. 3. Payment of compensation amount through crossed cheques into accounts of the EPs 4. Issuance of Compensation Certificates to EPs. 5. Grievance resolution relating to entitlements. 6. Provision of the guardianship certificates for minors prior to payment being released. 7. Assure payment cheques to women owners are made out in their own name and deposited in their own accounts 8. Access to training and credit	1. Overall management by WAPDA Negotiation by the Contractor & assistance by GBTI 2. WAPDA, Contractor & GBTI 3. WAPDA, Contractor, GBTI, and Banks. 4. WAPDA & Contractor 5. WAPDA, Contractor, GBTI, & EP 6. Guardians of minors, WAPDA Contractor & GBTI 7. WAPDA & GBTI 8. GBTI
II	Loss of privately owned uncultivable land.	* Landowners as recorded in the Revenue Record	1. No Compensation to be made	1. Not applicable	Not applicable	Not applicable
III	Loss of Shamlat (common) land	As recorded in the Revenue Record	1. No compensation to be made	None	Not applicable	Not applicable
IV	Loss of crops, orchards and other trees.	Land owners tenants/ renters as per Revenue Record and to be verified in accordance with legal requirements	1. Cash compensation, as provided under the Law 2. If shamlat land is cultivated, compensation will be paid to the cultivators	None	1. Determination of compensation through direct negotiation with landowner. GBTI to assist in negotiation. 2. If the construction schedule permits, the cultivator will be allowed to harvest the crops	1. WAPDA, Contractor and GBTI 2. WAPDA

TABLE 6.2

ENTITLEMENT PACKAGES

SR. NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
V	Loss of Agricultural infrastructures (eg tubewells, open wells, deras, farm houses, poultry farms, etc	Land owners/tenants/ renters as appropriate	1. Replacement cost in cash.	None	1. Value of the facility will be determined by WAPDA & Contractor in consultation with EPs and GBTI	1. WAPDA, Contractor, GBTI & EP
VI	Loss of residential house	A. Owner occupant	1. Full replacement cost of the structure in cash to the owner of the house structure 2. Cost of the land to the occupant only, who may be owner of the land or tenant. The land will not be acquired by WAPDA. This will be just an assurance to the occupant. 3. If occupant of house is not owner of the structure, he will be entitled to get credit facility under IRDP of GBHP for construction of a house	1. Occupant will have the right to salvage housing material free of cost 2. WAPDA will provide 9 month for construction of new house by occupant. If the land is to be evacuated before completion of new house, WAPDA will arrange rented place on WAPDA cost or pay proportionate rent.	1. Valuation by WAPDA Engineering Division. 2. Payment to be released before the work starts. 3. Evacuation to be completed prior to requirement of land for construction	1. WAPDA Engineering Division & GBTI 2. WAPDA, Contractor & GBTI 3. WAPDA
VII	Loss of Land Tenancy Rights for temporarily acquired land A. Legal Tenants	Legal tenants in accordance with Revenue Record	1. Right to part of the cash compensation for the landowner in accordance with the provisions of the Law 2. Cash compensation for physical investments in land, including crops and trees. 3. Employment on the project on priority basis.	1. Access to a credit facility provided under IRDP in line with their priorities fixed in accordance with the impact of the Project. 2. Vocational training and self-employment schemes under IRDP in line with priorities fixed as above	Applicable actions 1 through 8 as for Category IA above	Actors for relevant actions as for Category IA above
	B. Informal tenants	Informal tenants as verified by GBTI through investigation.	1. Cash compensation for physical investments in land, including crops and trees 2. Employment on the project on priority basis.	1. Priority access to credit facility provided under IRDP 2. Vocational training and self-employment schemes under IRDP on priority basis	Applicable actions 1 through 8 as for Category IA above.	Actors for relevant actions as for Category IA above.
VIII	Loss of Rental Rights (haradari) for land to be acquired	Haradar as per contract	1. Right to part of the payment made to the landowner in accordance with the provisions of the Law	1. None	GBTI to mediate EPs & owner, if needed	WAPDA and GBTI

CHAPTER 7

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

CHAPTER 7

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.1 ENVIRONMENTAL AND RESETTLEMENT MANAGEMENT PLAN

The contents of the Chapters 3 and 5 indicate that in general the transmission lines will not cause much disruption to the environmental and social setting of the Project corridor. The effects of any significance have been covered under the environmental mitigation and resettlement actions. These are suggested in Chapter 6.

Moreover, the Design Consultants are still refining the design of the transmission lines for further ameliorating the effects. The areas where such design modifications are required have been indicated in Tables 2.1 through 2.9 and Tables 3.3 through 3.11 attached with Chapters 2 and 3, respectively. These aspects being under consideration of the Consultants and will be amended accordingly, have not been highlighted in the concerned Chapters. Only one area of the concern is the alignment of the lines near the proposed Islamabad airport. The actions taken on this aspect have been described in Section 5.2.5.

Table 7.1 illustrates the suggested management plan for the compensatory actions relating to environmental mitigation and resettlement. These are in line with the probable effects identified in Chapter 3 and 5. The table enlists these probable effects, actions taken to resolve the issues and the institutions responsible for acting. Moreover, the table also indicates the areas where monitoring is required and the institution responsible. The table is self-explanatory. Therefore, it is unnecessary to discuss these items here.

7.2 MONITORING PLAN

As may be seen from Table 7.1, there are different environmental and social areas that need monitoring. The main concerning areas for monitoring relate to the followings:

- Payment of compensation for loss of crops/cropping seasons and trees.
- Payment of compensation for the infrastructures and related mater for resettlement.
- Loss of income due to permanent occupation of land under the towers.
- Land pollution from spill of lubricants, fuel, obnoxious chemical, and construction waste material,
- Contamination of stream waters from spill of lubricants, fuel, chemicals and waste material,

- Dust, smoke and noise pollution by blasting, movement of vehicles, and operation of machinery,

- Erosion of land and soils from excavated sites and access roads.

- Clearance of ROW and areas for access roads from natural vegetation and re-vegetation of reserved forest area,

- Chance finding of antiquities,

- Safety and health hazards,

- Interruption of movement of local people going to-and-fro from their working places during stringing.

- Disruption to communities stability due to insurgence of construction crews,

- Effects of EMF on health, etc

The table suggests appropriate need for monitoring of these aspects and the agencies to act

For monitoring various aspects, the first requirement is to develop monitoring procedures Fortunately, these are available with WAPDA Environmental Cell in the form of Protocols prepared in collaboration of Monitoring Consultants These include protocols both for environmental and social aspects The available protocols cover most of the areas enlisted above These procedures will be adopted according to the requirement of this component of the Project

However, the effect of EMF on people and farm animals is a new area This needs a particular attention, as this aspect has never been considered in Pakistan. Thus, this will be a new area for the WEC to monitor. To develop procedures for monitoring this aspect, WEC will explore the technical literature and consult the knowledgeable people Base on these, internationally accepted procedures will be developed and adopted

Another aspect that is not directly related with the subject of environment is the stability and integrity of the towers and conductors. However, indirectly this also relates to social environment. Any breakdown in the system will not only interrupt the power supply and cost money, but also may be hazardous for the local communities at the point of breakdown. Therefore, every precaution is taken in the design and implementation of the transmission line that such breakdowns are eliminated under the prevailing severity of the local climatic conditions (Chapter 2). In spite of this, WAPDA maintains Patrolling Staff that frequently monitors the system This will be ensured that they follow the monitoring schedule as described in Section 2 7

The social impacts of lost assets or income shall be minimal and would be offset by the compensation. the effectees shall receive for loss of land / loss of buildings and structure / compensation for crops. A report on monitoring shall be produced on the basis of monitoring procedures developed for the project. As mentioned above the Protocols prepared by WAPDA Environmental Cell in collaboration with WAPDA's Monitoring Consultants shall form the basis of the report.

In order to ensure that the monitoring process is effectively conducted to address compensations in accordance with the entitlements. the GBTI shall keep a close liaison with the public / public representatives. The value of assets and crop compensation which shall be payable to the affectees shall be assessed in view of the prevailing cost of similar assets in the areas. This shall enable the affectees to replace lost assets with the compensations received.

The indicators that shall monitor the replacement values of assets are as follows:

1. VALUATION OF LAND

As explained in Section 6.5 "Policy and Legal Framework" land will be temporarily acquired for one or two crops seasons for which owners will be compensated. There will therefore be no permanent land acquisition under the project.

2. VALUATION OF BUILDINGS

Replacement cost of houses shall be evaluated in accordance with the evaluated rates for each category of the house. its type and construction. All other structures will be valued at full replacement cost. There will be no deductions for depreciation or for salvage.

3. VALUATION FOR CROPS, ORCHARDS AND TREES

For crops. compensation will be based on the market value of the crop. For orchards the valuation will be based on the net annual income from the orchard capitalized for 20 years. For other trees the valuation will be based on the market value taking into account the species and the size of the tree. Wood will be salvaged by the owner.

These indicators will greatly help in minimizing the possibility of affectees not receiving full compensation.

As explained in Section 6.7.2 "Entitlement Packages" the project does not involve resettlement in large magnitude and as such the effectees shall only loose small chunks of land scattered all along the Transmission Line route. In order to ensure that entitlements are sufficient, the valuation and compensation process shall take into account all losses in income of effectees to ensure that incomes are improved or at least are not reduced.

Also additional facilities have been proposed for entitled persons as shown in Table 6.2. These include credit facilities, access to training and employments for each category of entitled person.

As the quantum of work is restricted, dedicated services of a sociologist shall suffice. Also the funding shall be appropriated from the budget allocated by GBHP for the Resettlement Action Plan.

In order to reduce the grievances of affectees the Executive Engineer NTDC stationed at Rawalpindi shall promptly investigate and take remedial action. The Executive Engineer NTDC shall be assisted by the representative of GBTI. The grievances shall be registered by the affectees with the Executive Engineer NTDC through his site office at Barotha 500 kV Storage Yard, in writing, who within fifteen (15) days of a receipt of the grievance shall redress it to the satisfaction of the affectees. If however it can not be redressed within this period, it shall be recommended to the Project Director NTDC for appropriate action.

7.3 INSTITUTIONAL ARRANGEMENT AND STRENGTHENING

As referred in the preceding section, the aspects of monitoring for this component are not limited to the environmental and social areas. The integrity of the system is also involved, for which a regular patrolling by WAPDA staff is emphasised. As such, the monitoring activities will involve various institutions. Besides the engineering staff of WAPDA attached with construction supervisions, maintenance and patrolling, these will include Ghazi-Barotha Taraqiati Idara (GBTI) and WAPDA Environmental Cell (WEC).

WEC and GBTI will be the main organisations responsible for monitoring the environmental and social parameters related with this component of the Project. These two organisations are presently carrying out monitoring of environmental and social aspects of GBHP. The services of these institutions will be extended to cover this component of the Project as well. Accordingly, the responsibilities of these institutions have been indicated in Table 7.1. The scope of the duties of these organisations has been defined in Chapter 3 of the main RAP.

GBTI have enough background experience on the related aspects from the implementation of GBHP. They have the capacity and capability to smoothly handle the assignments. Though WEC have improved their skill of monitoring various environmental and social aspects, the need is still there for strengthening. For the same WAPDA is considering of engaging Monitoring Consultants.

With the induction of Monitoring Consultants, WEC will be in a position to take up the expanded activities of this component. The present staff strength of technical persons (5 No.) at the site is adequate to take up this assignment along with the present tasks of GBHP. The only aspect that is lacking is the proper guideline and training. This particularly implies for monitoring the effect of EMF. With the induction of Monitoring Consultants, this shortcoming will also be overcome.

To meet the needs of environmental management and monitoring, WAPDA will also arrange short training of the engineering staff deputed on construction and operation of the Project. In spite of the fact that security and safety procedures for power operation have been laid down and are accessible to WAPDA staff, their implementation is lacking. This will be ensured that these are observed and implemented. In addition to these, the staff will be trained for other environmental concerns. This will help in complying with the requirements of environmental management and monitoring.

7.4 IMPLEMENTATION SCHEDULE

Table 7.2 depicts the schedule for implementation of environmental and resettlement management and monitoring. This is linked with the construction activities of the Project. It is foreseen that the environmental and resettlement management will immediately be started when the first location of the tower is finalised after soil investigation. Construction related monitoring would continue until the end of construction and testing. The monitoring of certain aspects would continue for longer period. It is assumed that re-vegetation of the reserve forest would be done late in the construction period. Thus, its monitoring would be done accordingly. As the EMF effects on health are slow and may take much longer period to develop any symptom, its monitoring would be a continuous process. WAPDA will connect the monitoring of this aspect along with the patrolling activity.

7.5 ENVIRONMENT RELATED COSTS

The environmental and resettlement related cost includes the compensation for disrupted infrastructure, compensation for crops/cropping seasons and trees from the temporarily acquired lands for construction and access roads, and cost of re-vegetation of reserved forest area. Moreover, it would include the cost that is likely to occur in respect of environmental and resettlement-monitoring programme. The estimated costs of the items are given in the following table.

ENVIRONMENTAL AND RESETTLEMENT RELATED COSTS

Description	Numbers	Amount (Rs)
A. Infrastructures		
Residential Buildings	36	1,897,000
Farm houses	3	44,200
Poultry farms	1	196,400
Pump houses	2	78,300
Tubewells	2	100,000
Open Wells	4	100,000
Total A	48	2,415,900
B. Cost of Land for resettlement of Residences	About 2 ha	800,000
C. Compensation for Temporary occupation of Land		
Loss of Crops and Cropping Seasons	For 152 ha	2,400,000
Trees & shrubs	Estimated	3,700,000
Total C		6,100,000
D. Re-vegetation of forest	Estimated	2,200,000
Total A+B+C+D		11,515,900
E. Monitoring Cost	Estimated	1,000,000
Grand Total		**12,515,900**

The costs for infrastructures, compensation for loss of crops/cropping seasons and trees have been derived from the village and census surveys (Chapter 6), while the cost of re-vegetation has been estimated based on experience at GBHP. To summarise these include the following assumptions:

- The costs of infrastructures are the ones given in Table 6.1, which are based on the information given by the owners/occupants.

- The land area for resettlement of habitation has been derived keeping in view the total area of the existing housings given in Table 6.1 and adjusting it in accordance with the criteria set for resettlement in the main RAP (Reference Table 2.10 of the main RAP). The cost of the land has been derived based on the current prices for the barani land in the area.

- The compensation cost for crops/cropping seasons has been calculated on the following basis.

  - Temporary occupation of land for the construction purposes has been taken based on the assumption that construction of each tower will require about 4 Kanals, while the stringing will require 5-m wide strip throughout the stretch of transmission lines

  - One crop season for the occupied land will be lost.

  - Of the temporarily occupied land about 60% has been assumed to be cultivated as against 44% shown by the village-level survey. This will accommodate the unforeseen losses of crops/cropping seasons.

  - Compensation for trees and shrubs has been calculated based on the number of trees and shrubs likely to be affected as derived from the village-level survey.

- Cost of re-vegetation of the reserved forest areas includes the cost of labour, plant nurseries and initial watering

- The monitoring cost indicated in the draft report included the additional cost likely to occur for the expanded establishment and recurring expenses of GBTI and WEC, and necessary monitoring equipments for WEC. However, after discussions it has been decided that no additional payment will be made to GBTI for this additional task. This is on the following grounds:

  - WAPDA is of the view that this component is part and parcel of the Ghazi-Barotha Hydropower Project. Therefore, the endowment fund of Rs. 100 M already provided to GBTI is for the whole Project, which also includes the transmission-lines system.

  - GBTI since its inception has been saving over Rs. 4 M annually from the endowment funds, which was redirected towards the development activities in the region. Now with the availability of IRDP funds, the savings from the endowment funds are available for the execution of additional work for this component.

Based on the above decisions the GBTI-related cost for monitoring has been excluded. Thus the cost in this respect shown in table includes the recurring expenditure of WEC to cover this component and the cost of the equipments needed for monitoring water quality, electric flux and echo from the transmission lines, vibrations from blasting, etc

In order to provide additional financing to mitigate the social hardships of the area an amount of Rs. 7.0 million shall be allocated by GBTI from the IRDP funds provided for GBHP.

This amount has been earmarked to be disbursed under the following heads:

(i)	Short term credit facilities and self employment scheme	-	Rs. 6.0 million
(ii)	Vocational Training facilities	-	Rs. 1.0 million

7.6 ARRANGEMENT OF FUNDS FOR IMPLEMENTATION OF RAP

Section 6.7.3 explains the arrangement of funds made by WAPDA to meet the costs for the implementation of the RAP. The additional cost for monitoring will be met from the contingencies kept in the budget for the construction of the transmission lines. The cost for engaging Consultants (M/s. NESPAK) for the construction supervision is not related with the environment. WAPDA has made a separate arrangement of funds for the consultants, which for the reason has not been reflected in this report

TABLE 7.1

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Sr. No.	Resource	Project Components	Impacts	Resolution/Enhancement	Mitigation/Resettlement Actions and Responsibilities
1	Land Resources	• Towers	• Temporary consumption of land during construction	• Compensation for the loss of crops/cropping seasons and trees for the land to be temporarily acquired for construction of towers. • Fair compensation determined by negotiation and as allowed under the law.	• Fair evaluation of compensation package by WAPDA & Contractor. Finalisation of the compensation package after negotiation with the affectees. GBTI to mediate the negotiation. • Prompt payments made by the Contractor and cross-checked by WAPDA and GBTI
			• Restricted use of land under towers for agriculture during the operation of the lines.	• Survey of existing lines has shown that in majority cases the lands under the towers are used for agricultural purposes. These lands can safely be used by the people.	• Credit facility will be extended from IRDP funds to ameliorate the loss of income due to restricted use of land under the towers. GBTI will do needful as suggested in Chapter 6.
			• Temporary pit ditch formation at the location of the tower foundations.	• Restoration of the ground after construction of the foundations	• Contractor to comply with the restoration clauses. • Engineer to make observation that Contractor has fulfilled the requirement. • WAPDA Environmental Cell (WEC) to monitor the activity regularly.
		• Conductors	• Temporary consumption of about 5 m wide strip of land along the centre line by the tractor mounted equipment during stringing of the conductors	• Compensation for the loss of crops cropping seasons and trees for the land to be temporarily used during stringing activities. • Fair compensation determined by negotiation and as allowed under the law.	• Fair evaluation of compensation package by WAPDA & Contractor. Finalisation of the compensation package after negotiation with the affectees. GBTI to mediate the negotiation. • Prompt payments made by the Contractor and cross-checked by WAPDA and GBTI.
			• Restriction on plantation of trees that exceed in high more than 4 m and construction of residential buildings within 30 m corridor of the transmission lines.	• The land can be used for general arable cropping, orchards and plantation of trees of short height.	• Credit facility will be extended from IRDP funds to ameliorate the loss of income due to restricted use of land under the conductors. GBTI will do needful as suggested in Chapter 6.
			• Land pollution due to spill of lubricants, fuel chemicals and other waste material.	• Control through careful working of the Contractor's crews and proper disposal of wastes. Vigilant supervision by the Engineer and WAPDA.	• Strict compliance of contract clauses by the Contractor and supervision by the Engineer. • Monitoring by WEC.
		• Access tracks	• About 67 major roads and 147 village tracks are available for approaching the project corridor. Access tracks will be developed to connect the construction sites with the existing roads, where clearing of crops and vegetation will be done.	• Contractor is required to construct tracks where necessary and keep the damage minimum. • Fair compensation will be made for loss of crops and trees.	• Contractor to comply with the instructions from the Engineer. • WEC to monitor.

TABLE 7.1

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Sr. No.	Resource	Project Components	Impacts	Resolution/Enhancement	Mitigation/Resettlement Actions and Responsibilities
2	Water Resources	• Towers	• Contamination of stream waters from earth material generated from blasting and erosion from excavation for tower foundations and access roads.	• Applying good engineering practices, that includes controlled blasting, proper stockpiling of the excavated soil material and continuous maintenance of access roads.	• Contractor to implement. • Monitoring by WEC & GBTI.
			• Pollution of streams from spills of lubricants, fuel, chemicals and other waste material.	• Control through careful working of the Contractor's crews and proper disposal of wastes. Vigilant supervision by the Engineer and WAPDA.	• Strict compliance of contract clauses by the Contractor and supervision by the Engineer. • Monitoring by WEC.
			• Use of surface and groundwater resources for construction purposes.	• The quantum of water to be used will be insignificant as compare to the generally available resources. However, in areas where the water is scarce the Contractor will import it from other areas instead of taxing the local resources.	• Contractor to comply with the conditions. • Engineer to asses the situation and instruct the Contractor accordingly. • GBTI and WEC to monitor that the Contractor is not breaching the water rights of the communities.
3	Biological Resources	• Towers	• Vegetation clearing at tower sites for foundation, stacking of material and assembly of towers.	• Fair and prompt compensation for crops & trees on private land.	• Fair and prompt payment of compensation by WAPDA. GBTI to assist in negotiation • Payments cross-checked by GBTI
		• Stringing of conductors.	• Vegetation clearing of all types from 5 m wide strip along the corridor for movement of tractor-mounted equipment and placing of puller and tensioner machines.	• Re-vegetation in reserved forest area.	• Contractors to implement • Monitoring by WAPDA, WEC & GBTI
		• Access tracks	• Reserved forest are located on hills, which are normally inaccessible by vehicles. The material will mostly transported manually. Thus little effect on biological resource, except for a few areas.	• Re-vegetation in reserved forest area.	• Contractors to implement • Monitoring by WAPDA, WEC & GBTI
		• Conductors during operation.	• Clearing of 50-m wide corridor from tall trees exceeding 4 m height for safe operation of the system.	• Fair and prompt compensation for trees on private land and re-vegetation of reserved forest area with short trees.	• Contractor to comply. • Engineer to supervise. • WEC to monitor.
			• May interrupt the flights of odd flocks of migratory birds.	• The study has shown that the effect is insignificant. However, if any it is unavoidable.	• Not applicable.

TABLE 7.1

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Sr. No.	Resource	Project Components	Impacts	Resolution/Enhancement	Mitigation/Resettlement Actions and Responsibilities
4	Infrastructures	• Overall Project construction and operation	• Disruption to about 40 residential and other buildings, 8 agriculture-related structures falling within 30 m corridor	• Removal of structures and fair compensation on replacement cost basis as agreed with the affectees • Additional payment to the affectees of residential buildings to purchase land elsewhere for construction of house • Affectees to salvage building material free of cost. • Allowing a period of 9 months for construction of the new house or payment of a rent for the specified period	• WAPDA & Contractor to evaluate replacement costs and negotiate with the affectees • GBTI to mediate the negotiation and monitor that the payment is made according to agreement. • WAPDA/ Contractor to release payment before the structures are removed.
				• Suggestions have been given to the Design Consultants to review the design at certain places. These are indicated in Tables 3.3 through 3.11	• Design review by the Consultants to meet the design criteria. WAPDA to check that these are complied.
			• Transmission lines crossing over 220 roads and village tracks, and 94 power and telephone lines	• Appropriate measures will be taken to avoid disruption during construction. • Appropriate clearance would be provided to avoid interference	• Contractor is required to minimise disruption. • Engineer & WAPDA to monitor.
			• Likely disruption to flights of aeroplane near proposed Islamabad airport.	• If needed, design will be reviewed.	• Design review by the Consultants to meet the design criteria. WAPDA to check that these are complied.
5	Social and Cultural Resources	• Towers, Conductor stringing, and operation of project	• Interruption of community movement during stringing activities	• Unavoidable but for short duration. The Contractor should adjust the timings of stringing activities according to the routine of people of the area going to and fro for their works	• Contractor is required to minimise disruption • WAPDA to monitor
			• Social disruption of local communities due to insurgence of construction crews from other areas.	• Contractor should engage unskilled workers from the local communities, and control unnecessary mixing of others with the local society.	• Contractor to comply and take strict action for wrong doings of the crews.
			• Disruption of households.	• Fair and prompt compensation as mentioned above.	• As above under effect on infrastructures.
			• Disruption to cultural properties, such as shrines, graveyards.	• Suggestions have been given to the Design Consultants to review the design at certain places. These are indicated in Tables 3.3 through 3.11.	• Contractor to avoid disruption as suggested. Engineer to follow-up for the compliance of the suggestions. • WEC and GBTI to monitor.

TABLE 7.1

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Sr. No.	Resource	Project Components	Impacts	Resolution/Enhancement	Mitigation/Resettlement Actions and Responsibilities
			• No disruption to visible archaeological sites, but possibilities are there for chance findings	• Contractor to stop work immediately and notify to Engineer and WAPDA, who in turn contact the Department of Archaeology and Museums at Taxila.	• Contractor to remain vigilant during excavation activity. • Engineer/WAPDA to arrange visit of the staff of the department and get clearance or change the location of the tower. • WEC to monitor.
			• Disruption and health hazards to the workers and local communities due to fugitive dust, smoke and noise from the construction activities.	• Contractor to adopt good engineering practices, i.e., using machines and equipment of good condition and well-tuned, sprinkling of access tracks and working sites regularly with water, etc.	• Contractor to comply. • Engineer to supervise. • WEC to monitor.
			• Safety hazards for public and workers	• Contractor to provide safety gadgets to the workers, arrange emergency medicines and first-aid facilities at site. • Posting sign boards at appropriate places. • Fencing the work sites.	• Contractor to comply. • Engineer to supervise. • WEC to monitor.
			• Loss of income from the land to be used for construction and occupied permanently by the towers.	• Fair compensation for use of land during construction. • Credit facility to mitigate the effect of loss of income.	• WAPDA/Contractor/GBTI to do the needful. • GBTI to monitor.
			• Though not severe, disruption of society in the congested area near Barotha village.	• Unavoidable. Resettlement may be considered under prospective Kala Bagh Dam Project.	• WAPDA to take necessary action during implementation of Kalabagh Dam Project.
		• EMF effects	• Health hazards	• Appropriate clearance provided to dilute the effects on the ground. • At places where the desired clearance is not achieved, the Design Consultants are working to modify the design. The same has been indicated in Tables 2.1 through 2.9.	• Observation by WAPDA staff during patrolling. • WEC staff will be trained to monitor. • Design review by the Consultants to meet the design criteria. WAPDA to check that these are complied.
			• Hazardous to birds and waterfowls	• Unavoidable, but birds normally keep away due to crackling noise and ionisation of the air around the conductors.	• No action proposed.

TABLE 7.2

IMPLEMENTATION SCHEDULE FOR ENVIRONMENTAL MANAGEMENT AND MONITORING

For Incoming and Outgoing Lines I and II (ADB Component)

Sr. No.	ACTIVITIES
A	Construction Schedule
1	Contract Award
2	Soil Investigations
3	Foundation Installation
4	Tower Erection
5	Conductor stringing
6	Final inspection & testing
7	Required design modifications
B	Environmental Management Schedule
1	Census Survey
2	Compensation for Loss of Crops and Trees
	a. Identification of Tower Sites
	b. Negotiation with Owners
	c. Payment of Compensation
	d. Taking Possession of Land
3	Acquisition of Infrastructures
	a. Negotiation with Owners
	b. Payment of Compensation
	c. Salvage of Material by Owners
	d. Evacuation
4	Re-vegetation of Reserve Forest
C	Monitoring
1	Acquistion/Compensation Process including land, crops & infrastructures (GBTI)
2	Social Monitoring (WEC & GBTI)
3	Environmental Monitoring (WEC)
4	Monitoring Re-vegetation(WEC)
5	Montoring Effects of EMF(WEC)

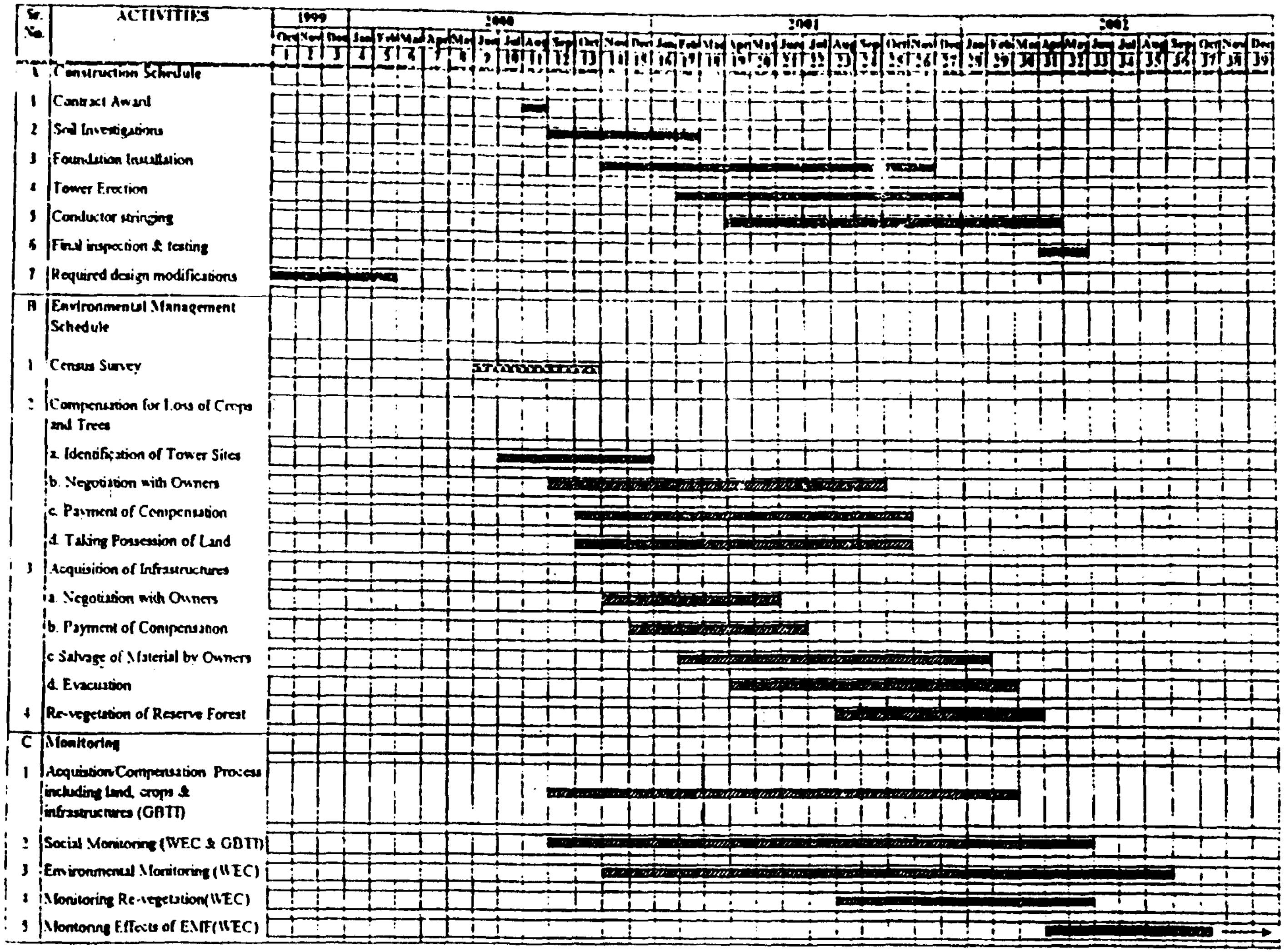
Timeline columns: 1999: Oct (1), Nov (2), Dec (3); 2000: Jan (4), Feb (5), Mar (6), Apr (7), May (8), Jun (9), Jul (10), Aug (11), Sep (12), Oct (13), Nov (14), Dec (15); 2001: Jan (16), Feb (17), Mar (18), Apr (19), May (20), Jun (21), Jul (22), Aug (23), Sept (24), Oct (25), Nov (26), Dec (27); 2002: Jan (28), Feb (29), Mar (30), Apr (31), May (32), Jun (33), Jul (34), Aug (35), Sept (36), Oct (37), Nov (38), Dec (39)

* Construction/Design Activities — Planned; Actual as delayed due to approval of RAP
* Environmental & Resettlement Implementation & Monitoring — Census Survey Completed; Census Survey for the remaining Part of Contract 1; Other Activities

TABLE 7.2

IMPLEMENTATION SCHEDULE FOR ENVIRONMENTAL MANAGEMENT AND MONITORING

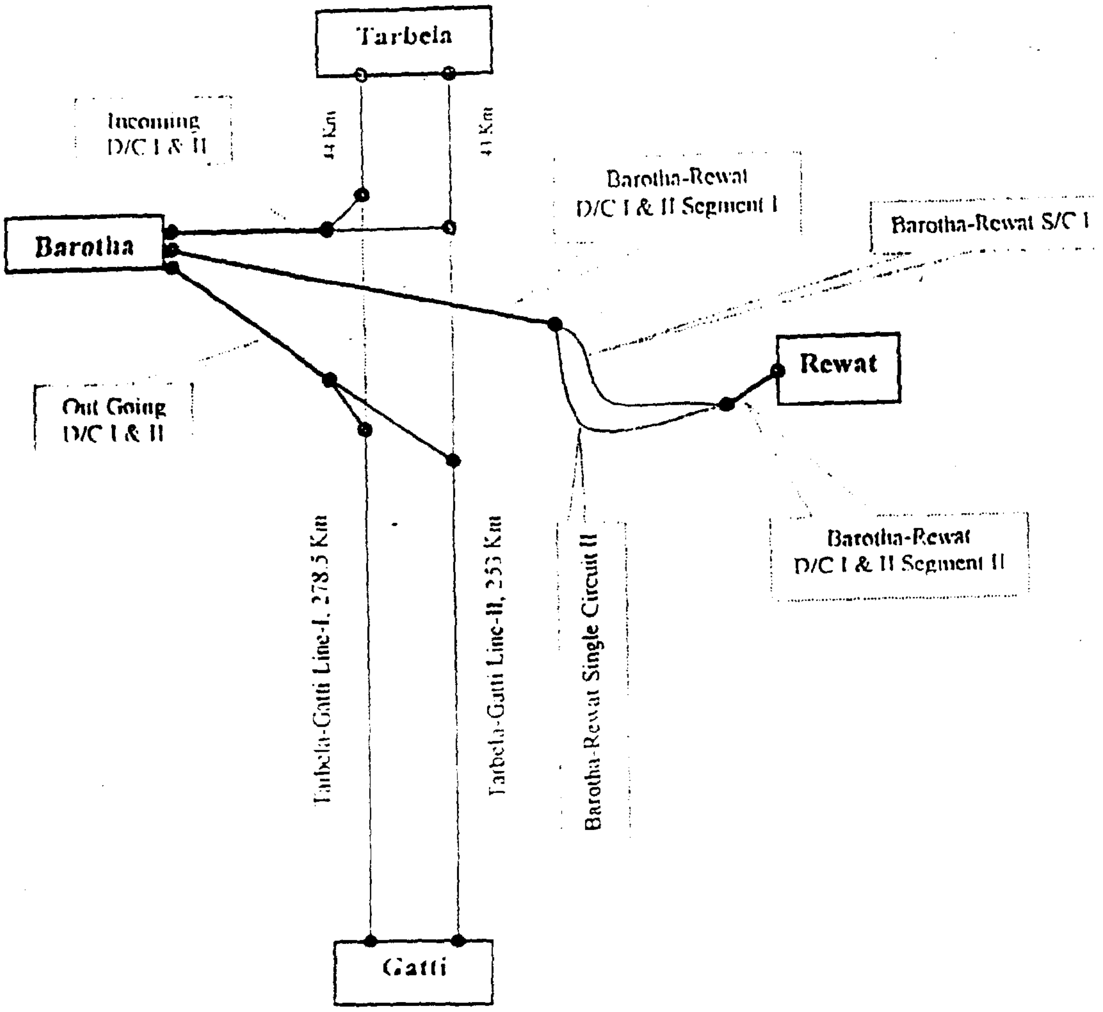
For Barotha Rewat Lines I and II (IDB Component)



* Construction/Design Activities

* Environmental & Resettlement Implementation & Monitoring — Census Survey; Other Activities

DRAWINGS



Drawing I-1
Schematic Plan of
500 kV Transmission Arrangement for
Power Dispersal of
Ghazi-Barotha Hydropower Project

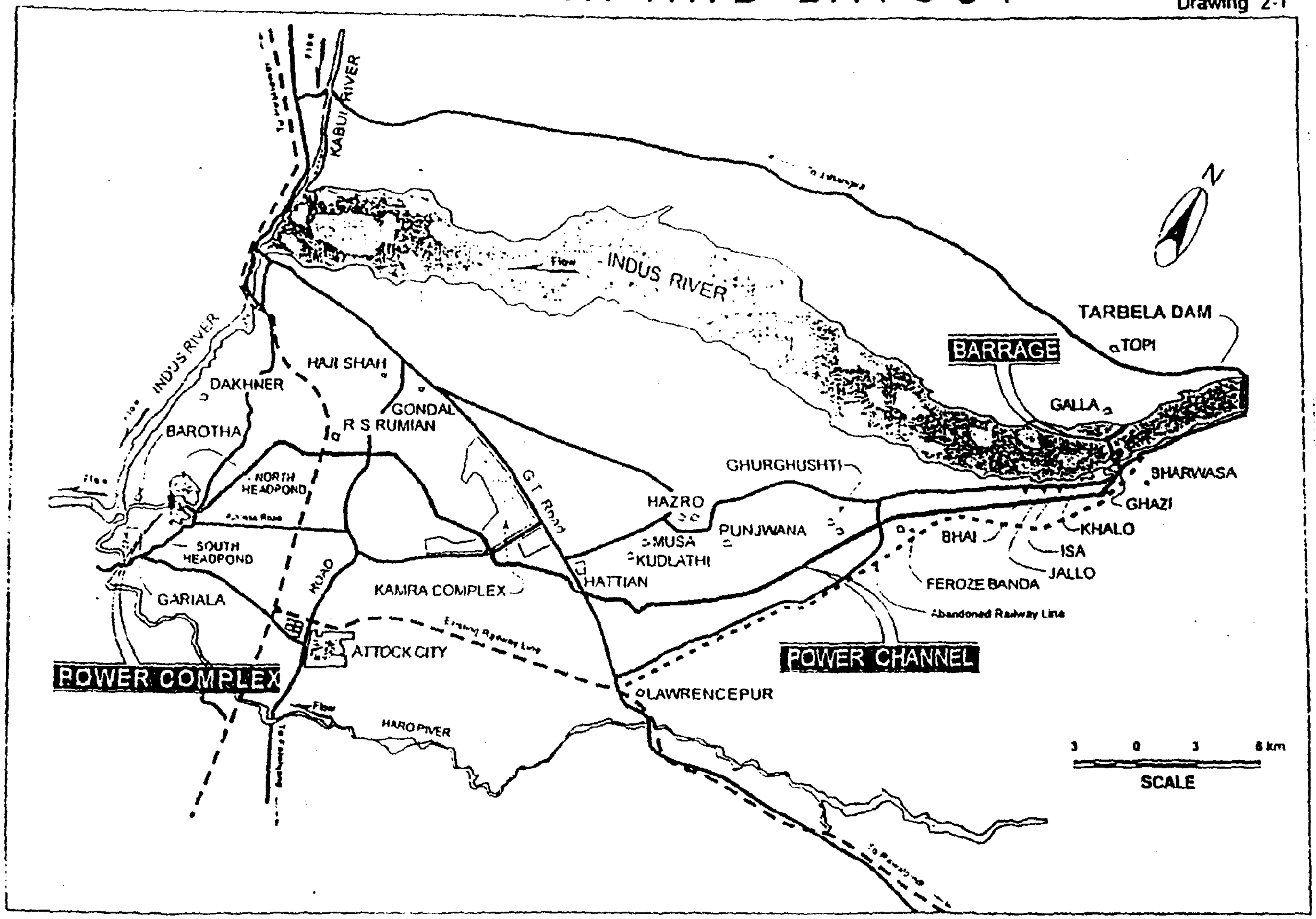
Legends:

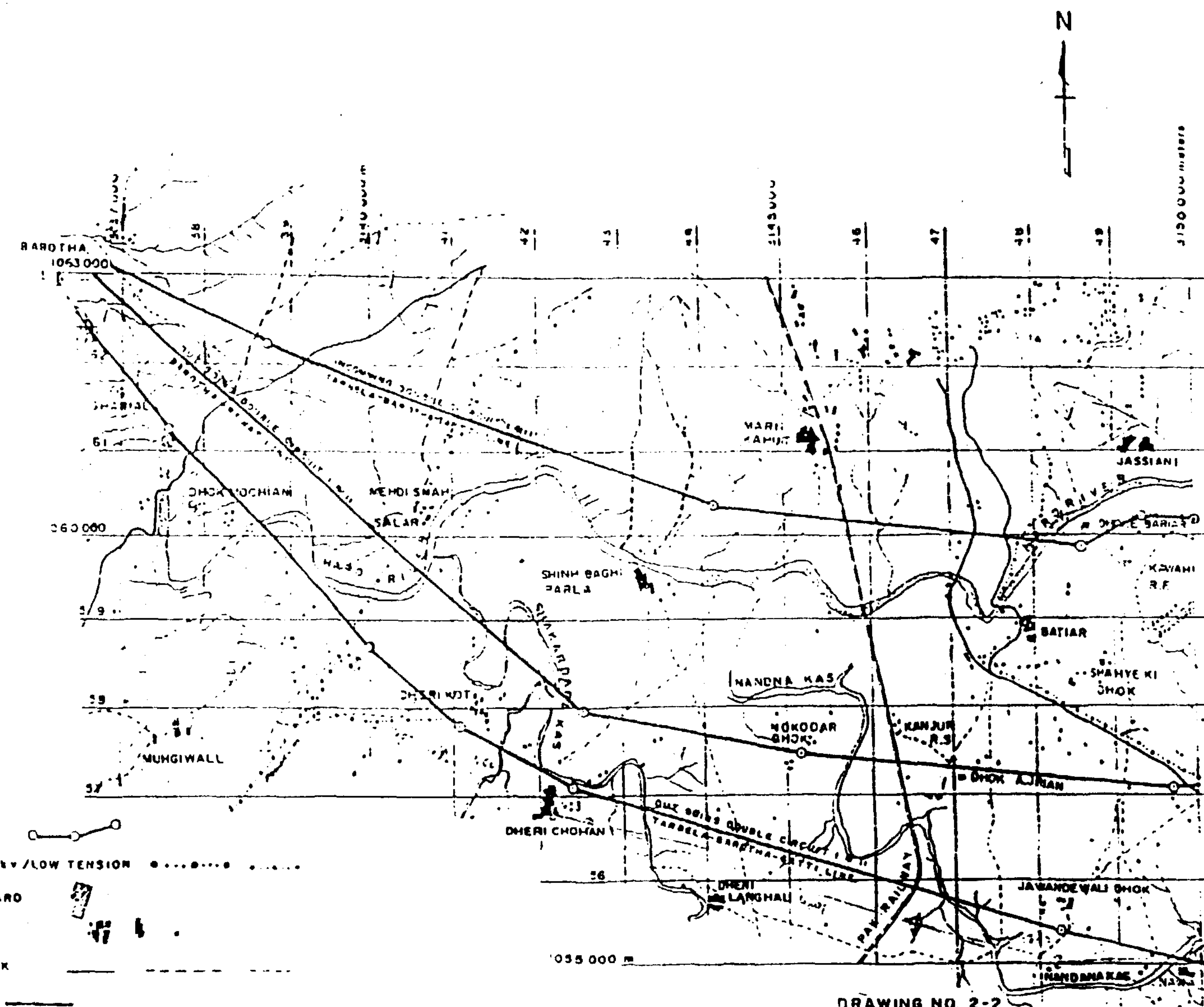
Single Circuit
To be Dismantle
Double Circuit
Grid Station/Switchyard

Note: Lengths are Approximate, Sketch Not to Scale.

PROJECT PLAN AND LAYOUT

Drawing 2-1





LEGEND

1. PROPOSED 500 kV LINES
2. EXISTING POWER LINE 500 kV / LOW TENSION
3. GRID STATION / SWITCH YARD
4. TOWN / VILLAGE / HOUSE
5. MAJOR ROAD / ROADS / TRACK
6. RAILWAY LINE
7. RIVERS / NULLAH
9. RESERVOIR

SCALE 1:50,000

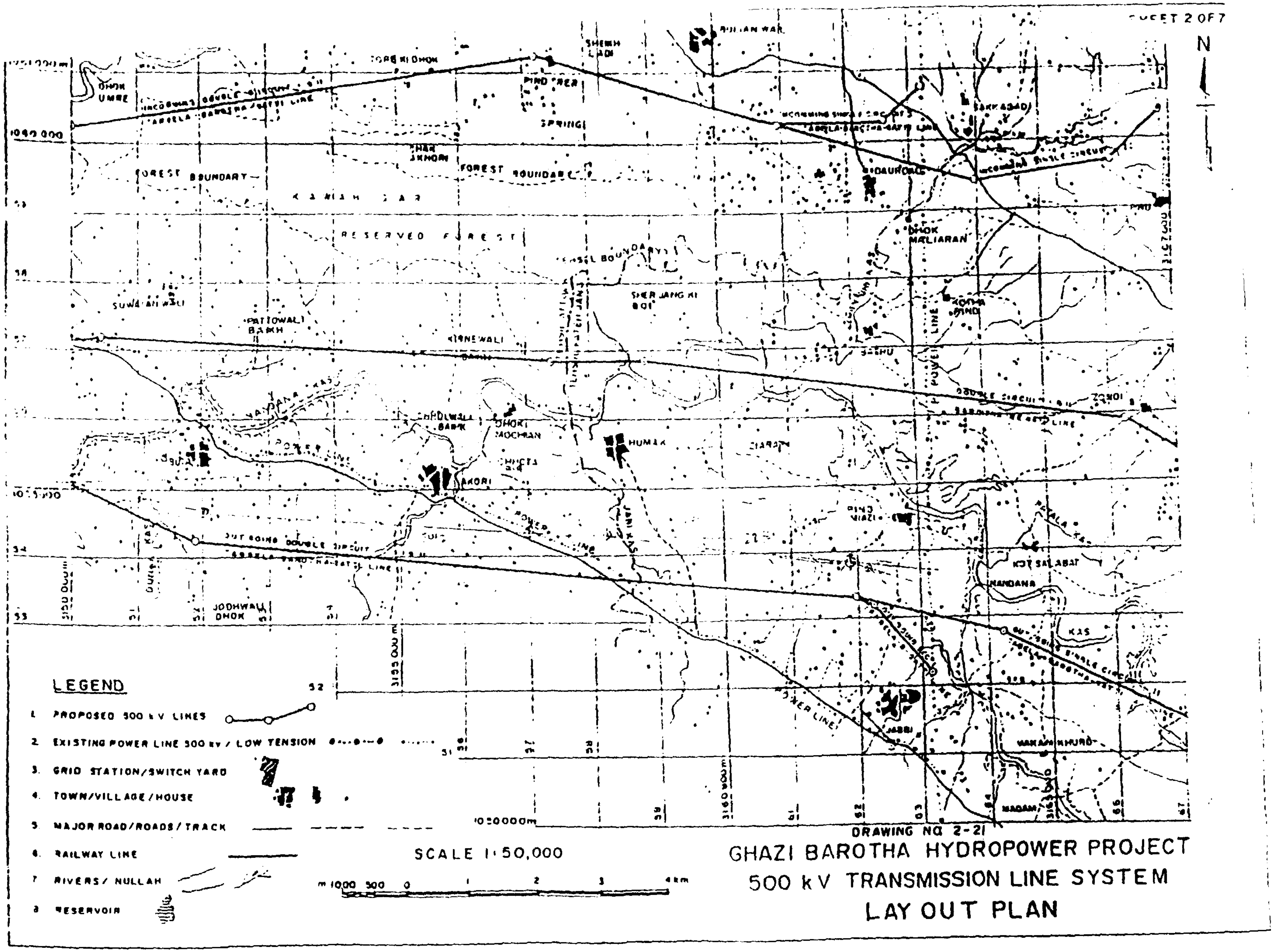
1000m 500 0 1 2 3 4 km

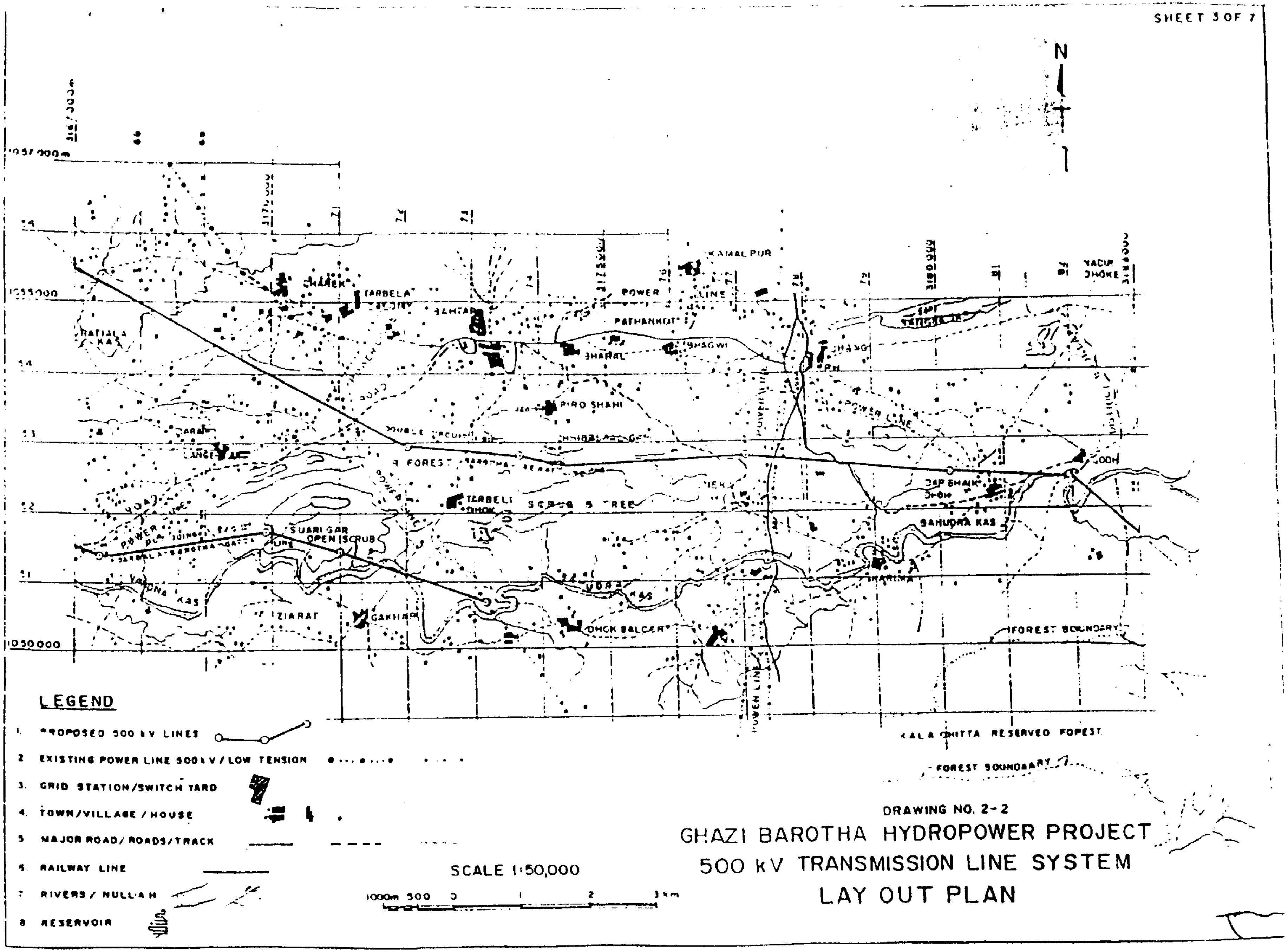
DRAWING NO. 2-2

GHAZI BAROTHA HYDROPOWER PROJECT

500 k V TRANSMISSION LINE SYSTEM

LAY OUT PLAN


SHEET 2 OF 7
N
FOREST BOUNDARY
RESERVED FOREST
TEHSIL BOUNDARY
POWER LINE
DOUBLE CIRCUIT
HUMAK
PIND NIAZI
KOT SALABAT
JABBI
NARA
SHERJANG KI BOI
PATTOWALI BAKH
JODHWALI DHOK
LEGEND
1 PROPOSED 500 kV LINES
2 EXISTING POWER LINE 500 kV / LOW TENSION
3 GRID STATION/SWITCH YARD
4 TOWN/VILLAGE/HOUSE
5 MAJOR ROAD/ROADS/TRACK
6 RAILWAY LINE
7 RIVERS/ NULLAH
8 RESERVOIR
SCALE 1:50,000
m 1000 500 0 1 2 3 4 km
DRAWING NO. 2-21
GHAZI BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINE SYSTEM
LAY OUT PLAN



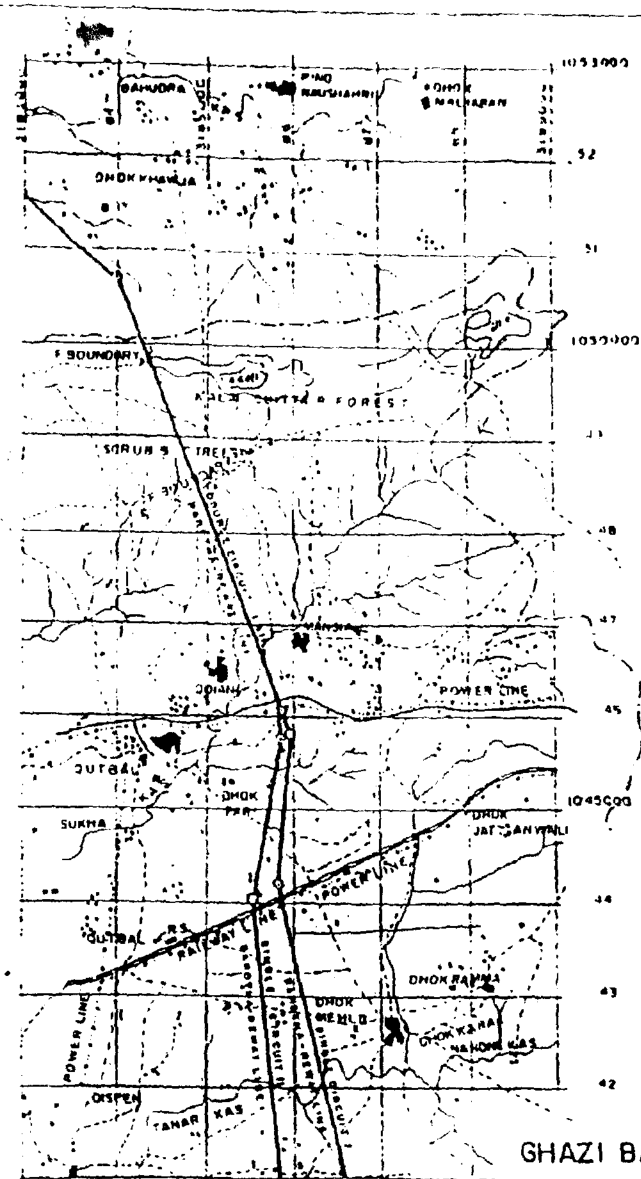
DRAWING NO. 2-2

GHAZI BAROTHA HYDROPOWER PROJECT

500 kV TRANSMISSION LINE SYSTEM

LAY OUT PLAN

N



SCALE 1:50,000

1000m 500 0 1 2 3 4km

LEGEND

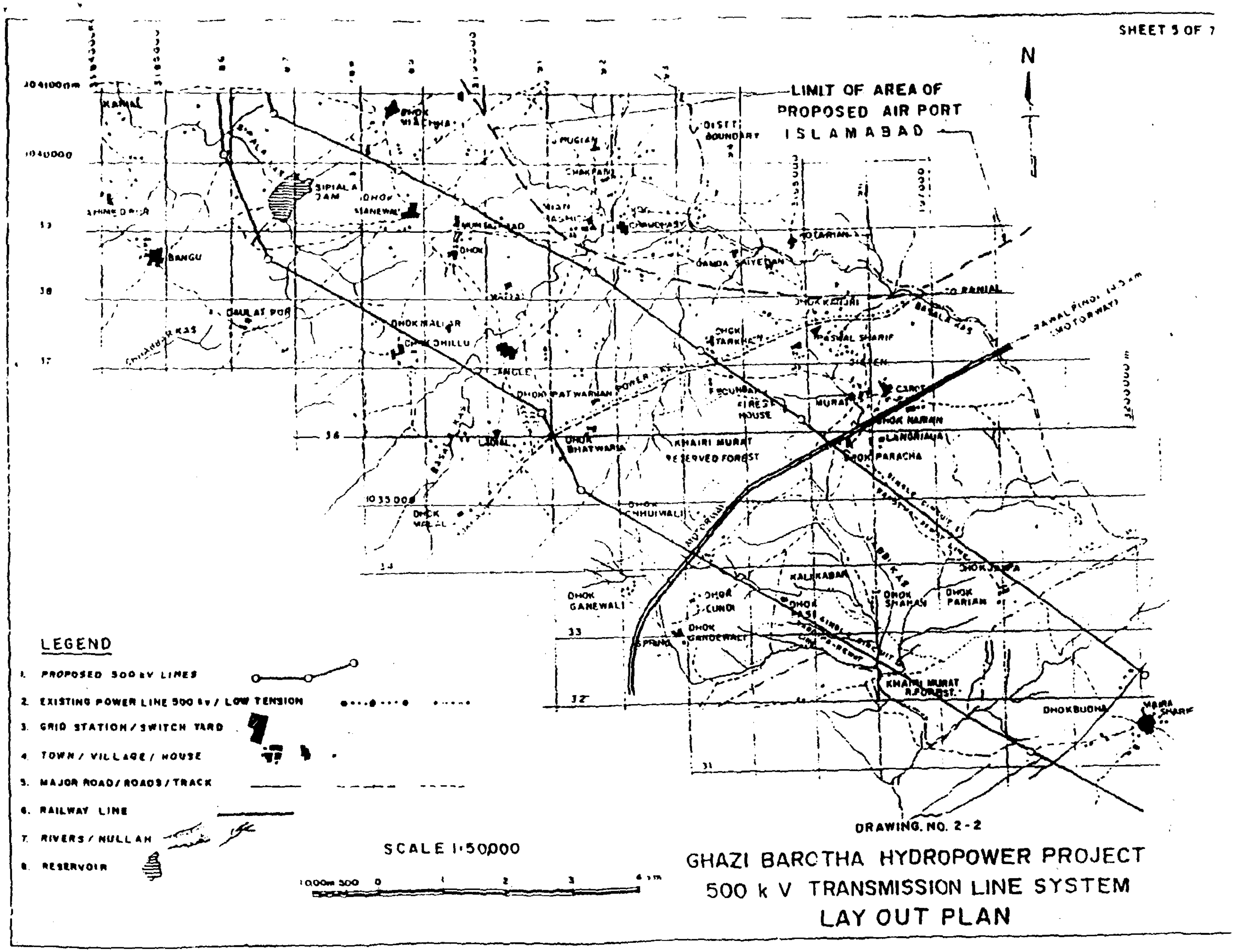
1. PROPOSED 500kV LINE
2. EXISTING POWER LINE 500 kV / LOW TENSION
3. GRID STATION/SWITCH YARD
4. TOWN / VILLAGE / HOUSE
5. MAJOR ROAD / ROADS / TRACK
6. RAILWAY LINE
7. RIVERS / NULLAH
8. RESERVOIR

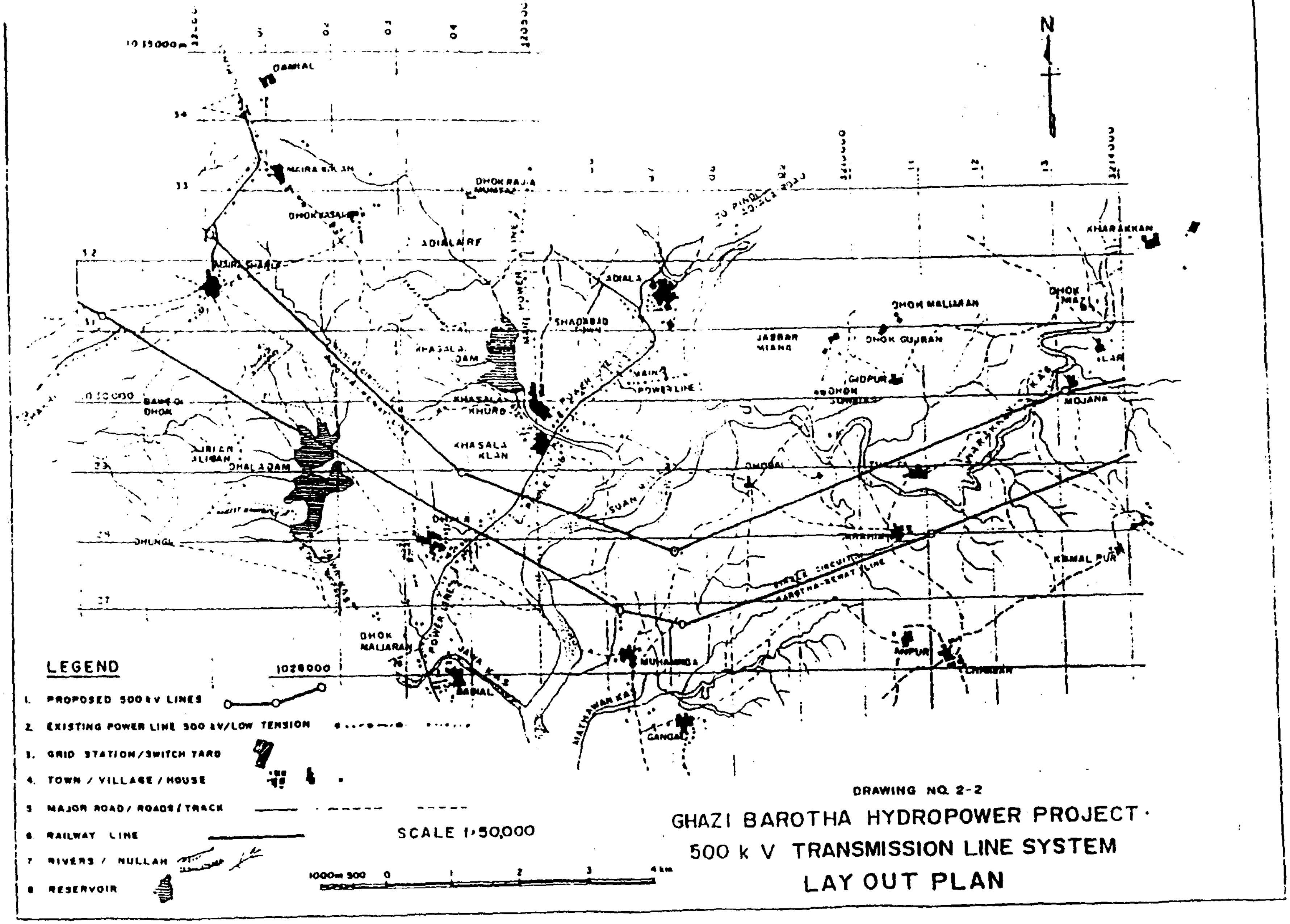
DRAWING NO. 2-2

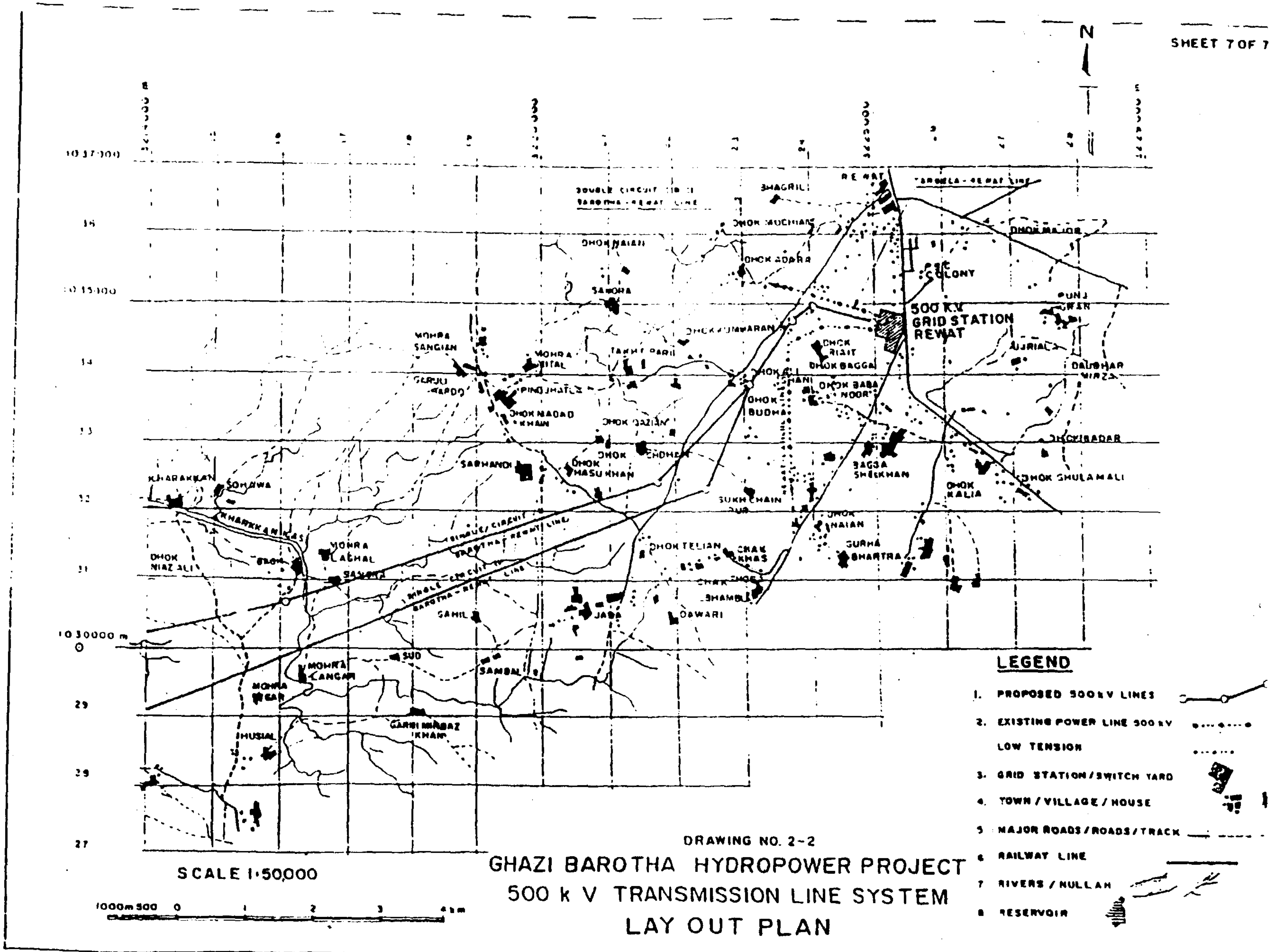
GHAZI BAROTHA HYDROPOWER PROJECT

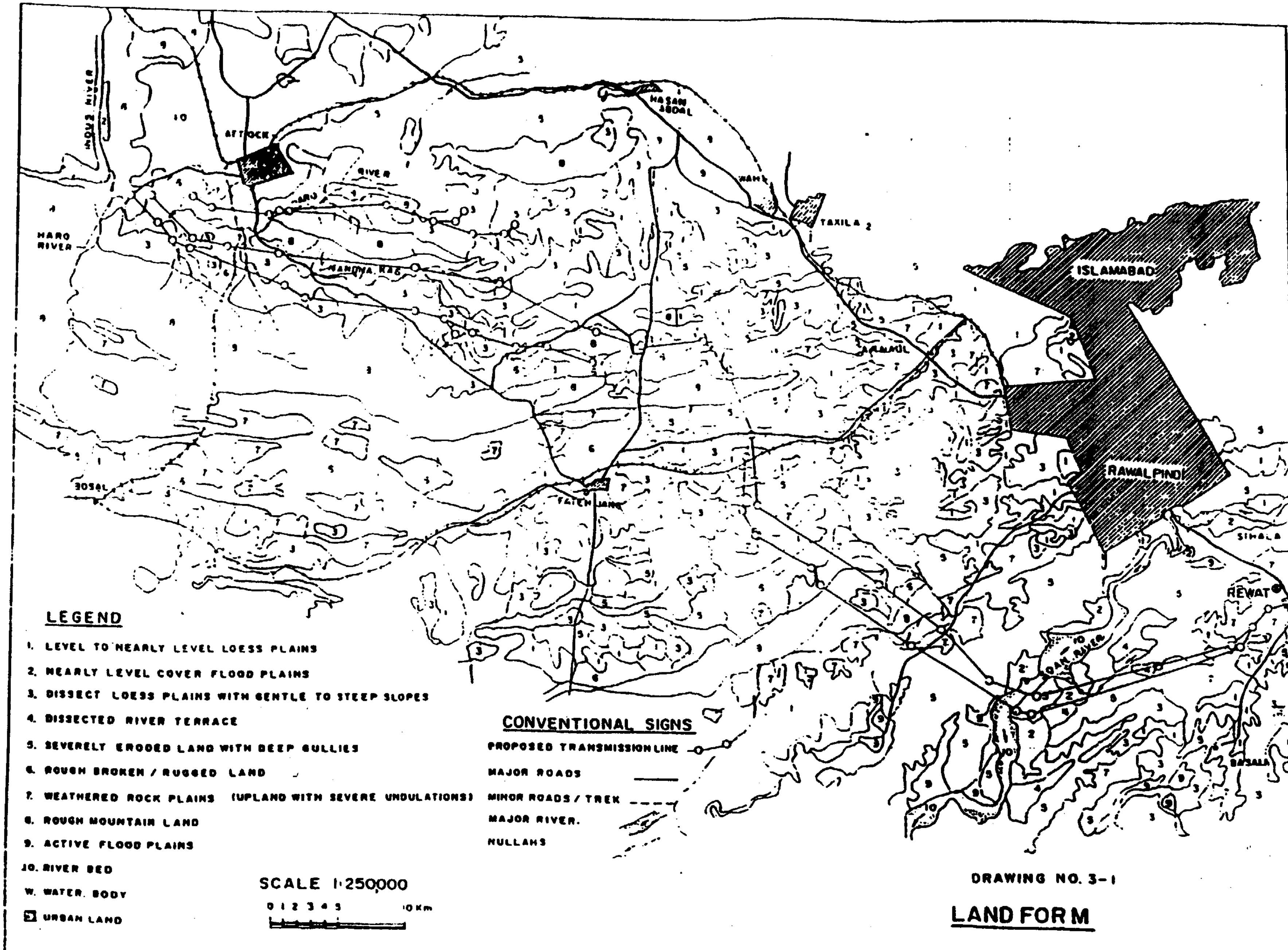
500 k V TRANSMISSION LINE SYSTEM

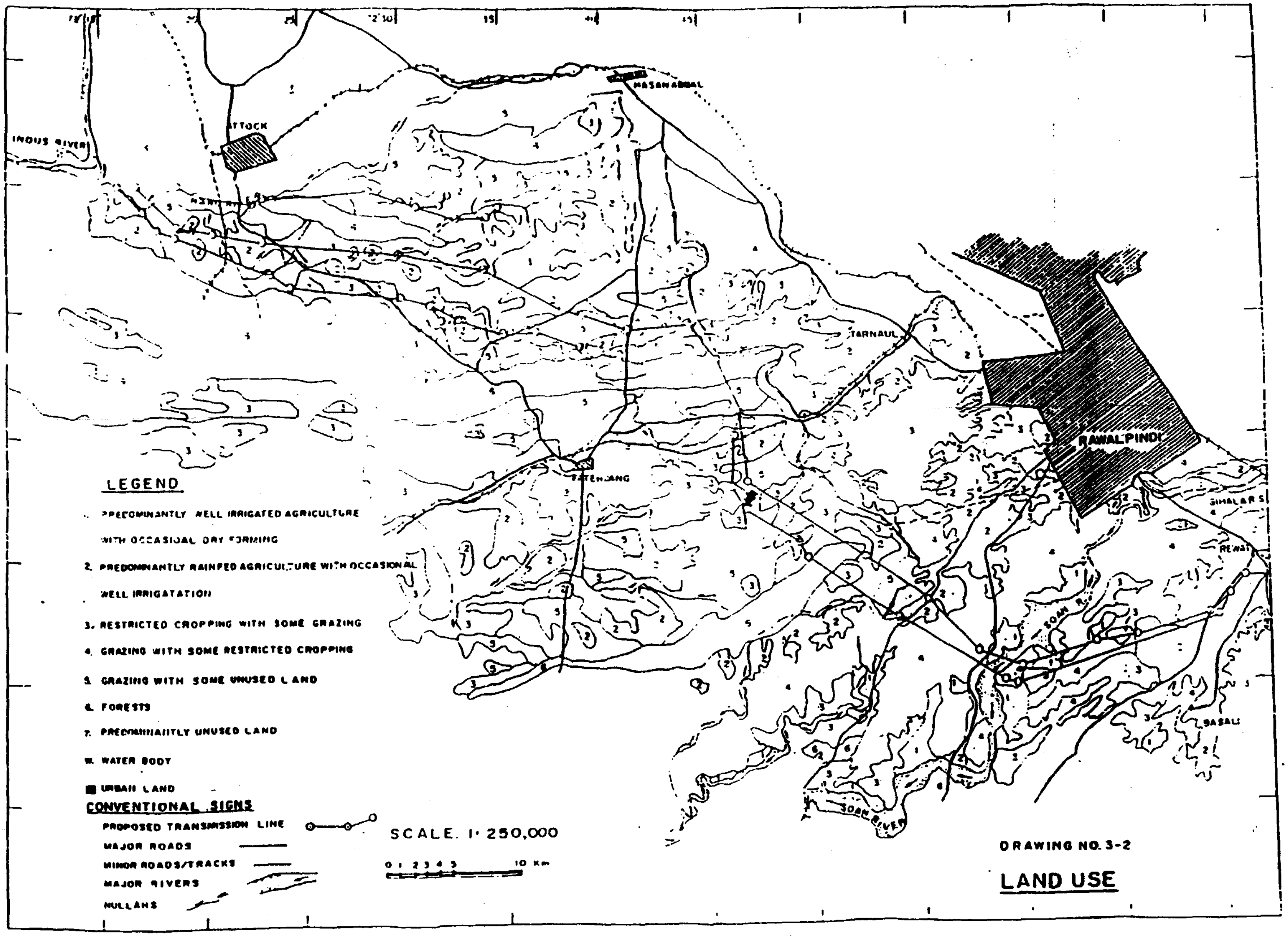
LAY OUT PLAN


SHEET 5 OF 7
N
LIMIT OF AREA OF
PROPOSED AIR PORT
ISLAMABAD
BANGU
SIPIALA DAM
DHOK MALLAR
DHOK PATWARIAN
DHOK BHATWARIA
KHAIRI MURAT
RESERVED FOREST
DHOK PARACHA
MURAT
DHOK GANEWALI
DHOK GANDEWALI
KALLKABAR
DHOK SHAHAN
DHOK PARIAN
KHAIRI MURAT R.FOREST
DHOKBUDHA
MAIRA SHARIF
DHOK NAMIAN
LANGRIALA
PASWAL SHARIF
GANDA SAIYEDAN
RAWALPINDI (MOTORWAY)
MOTORWAY
SINGLE CIRCUIT
LEGEND
1. PROPOSED 500 kV LINES
2. EXISTING POWER LINE 500 kV / LOW TENSION
3. GRID STATION / SWITCH YARD
4. TOWN / VILLAGE / HOUSE
5. MAJOR ROAD / ROADS / TRACK
6. RAILWAY LINE
7. RIVERS / NULLAH
8. RESERVOIR
SCALE 1:50,000
DRAWING NO. 2-2
GHAZI BAROTHA HYDROPOWER PROJECT
500 k V TRANSMISSION LINE SYSTEM
LAY OUT PLAN


N
LEGEND
1. PROPOSED 500 kV LINES
2. EXISTING POWER LINE 500 kV/LOW TENSION
3. GRID STATION/SWITCH YARD
4. TOWN / VILLAGE / HOUSE
5. MAJOR ROAD/ ROADS / TRACK
6. RAILWAY LINE
7. RIVERS / NULLAH
8. RESERVOIR
SCALE 1:50,000
1000m 500 0 1 2 3 4 km
1028000
ADIALA RF
ADIALA
KHASALA DAM
KHASALA KHURD
KHASALA KLAN
DHALA DAM
DHOK MALIARAN
DHOK GUJRAN
JABBAR MIANA
GIDPUR
MOJANA
KHARAKKAN
KAMAL PUR
MAIN POWER LINE
DHUNGI
MUHAMMADA
GANGAL
BABIAL
DRAWING NO. 2-2
GHAZI BAROTHA HYDROPOWER PROJECT
500 k V TRANSMISSION LINE SYSTEM
LAY OUT PLAN


SHEET 7 OF 7
N
500 K.V GRID STATION REWAT
PSC COLONY
REWAT
DHOK MAJOR
PUNJ GRAN
DAULHAR MIRZA
DHOK SHULAMALI
DHOK KALIA
BAGGA SHEIKHAN
GURHA SHARTRA
DHOK NAIAN
SUKH CHAIN PUR
CHAK KHAS
DHOK TELIAN
DAWARI
JABA
SAMBAL
SAHIL
SUD
MOHRA CANGAR
GARHI NIAZ KHAN
HUSIAL
SANGHA
MOHRA LAGHAL
KHARAKKAN
SOHAWA
DHOK NIAZ ALI
SARHANDI
DHOK HASUKHAN
DHOK QAZIAN
DHOK NADAO KHAN
PIND JHATLA
MOHRA SANGIAN
SANGRA
DHOK NAIAN
DHOK ADARA
DHOK MUCHIAN
BHAGRIL
DHOK KUMHARAN
DHOK BAGGA
DHOK BABA NOOR
DHOK BUDHA
LEGEND
1. PROPOSED 500 kV LINES
2. EXISTING POWER LINE 500 kV
LOW TENSION
3. GRID STATION / SWITCH YARD
4. TOWN / VILLAGE / HOUSE
5. MAJOR ROADS / ROADS / TRACK
6. RAILWAY LINE
7. RIVERS / NULLAH
8. RESERVOIR
SCALE 1:50,000
1000m 500 0 1 2 3 4 km
DRAWING NO. 2-2
GHAZI BAROTHA HYDROPOWER PROJECT
500 k V TRANSMISSION LINE SYSTEM
LAY OUT PLAN


INDUS RIVER
ATTOCK
HASAN ABDAL
WAH
TAXILA
ISLAMABAD
RAWALPINDI
HARO RIVER
NANDNA KAS
FATEH JANG
SIHALA
REWAT
SOAN RIVER
LEGEND
1. LEVEL TO NEARLY LEVEL LOESS PLAINS
2. NEARLY LEVEL COVER FLOOD PLAINS
3. DISSECT LOESS PLAINS WITH GENTLE TO STEEP SLOPES
4. DISSECTED RIVER TERRACE
5. SEVERELY ERODED LAND WITH DEEP GULLIES
6. ROUGH BROKEN / RUGGED LAND
7. WEATHERED ROCK PLAINS (UPLAND WITH SEVERE UNDULATIONS)
8. ROUGH MOUNTAIN LAND
9. ACTIVE FLOOD PLAINS
10. RIVER BED
W. WATER BODY
URBAN LAND
CONVENTIONAL SIGNS
PROPOSED TRANSMISSION LINE
MAJOR ROADS
MINOR ROADS / TREK
MAJOR RIVER.
NULLAHS
SCALE 1:250,000
0 1 2 3 4 5 10 Km
DRAWING NO. 3-1
LAND FORM


INDUS RIVER
ATTOCK
HASANABDAL
TARNAUL
RAWALPINDI
FATEHJANG
SIHALA
REWAT
BASALI
SOAN R.
SOAN RIVER
LEGEND
PREDOMINANTLY WELL IRRIGATED AGRICULTURE WITH OCCASIONAL DRY FORMING
2. PREDOMINANTLY RAINFED AGRICULTURE WITH OCCASIONAL WELL IRRIGATATION
3. RESTRICTED CROPPING WITH SOME GRAZING
4. GRAZING WITH SOME RESTRICTED CROPPING
5. GRAZING WITH SOME UNUSED LAND
6. FORESTS
7. PREDOMINANTLY UNUSED LAND
W. WATER BODY
URBAN LAND
CONVENTIONAL SIGNS
PROPOSED TRANSMISSION LINE
MAJOR ROADS
MINOR ROADS/TRACKS
MAJOR RIVERS
NULLAHS
SCALE 1:250,000
0 1 2 3 4 5 10 Km
DRAWING NO. 3-2
LAND USE

APPENDIX "A"

LIST OF PREPARERS AND CONTRIBUTORS

APPENDIX "A"

LIST OF PREPARERS AND CONTRIBUTORS

A.1 STUDY TEAM

Anis Ahmad Chaudry	Chief Environmentalist, PHC
Muhammad Tehseen	Principal Engineer (Environment), PHC
Dr. M. Ashraf Bodla	Ecologist, WAPDA
Sh. Amanullah	Curator, Arch. Deptt., Taxila Museum
Muhammad Bhadar Khan	Asstt. Dir., Arch. Deptt., Peshawar
M.H. Khan Khattak	Asstt. Dir., Arch. Deptt., Karachi
Tasawar Rashid	Sociologist, GBTI
Tehmina Kamal	Female Sociologist, GBTI
Wasif Ali Shah	Enumerator, GBTI
Imran Khan	Enumerator, GBTI
Naveed Iqbal	Enumerator, GBTI
Nádia Atta	Female Enumerator, GBTI
Shagufta Gulzar	Female Enumerator, GBTI
Mr. Iftikhar Ahmad	Surveyor, EHV, WAPDA
Mr. Muhammad Ayub	Surveyor, EHV, WAPDA
Mr. Abbas Ali	Surveyor, EHV, WAPDA
Mr. Muhammad Rafiq Malik	Surveyor, EHV, WAPDA
Malik Muhammad Safdar	Draftsman, PHC
Mr. Zahid Mahmood Bhatti	Computer Operator, PHC

A.2 OTHER CONTRIBUTORS

Amjad Agha	CE&CM, PHC
Clive Baker	DCM (Tech.), PHC
Ghulam Mustafa Dogar	Chief Engineer, PHC
Dr. Riaz Ahmad Khan	Chief Executive, GBTI
Aziz-ur-Rehman	Chief Engineer, EHV WAPDA
Nazir Ahmed Ghuman	Project Director, EHV WAPDA
Mr. Bashir Khan	Executive Engineer, EHV WAPDA
Mr. Saim Raza	Executive Engineer, EHV WAPDA
Mr. Raja Zafar Iqbal	Sub Divisional Officer, WAPDA

APPENDIX "B"

LIST OF PERSONS CONTACTED

APPENDIX "B"

LIST OF PERSONS CONTACTED

B.1 GOVERNMENT OFFICES

B.1.1 Civil Aviation Authority (CAA)

1. General Manager ATS Karachi
2. Director ATS Karachi
3. Zonal Manager CAA Rawalpindi
4. Sr. Estate Officer (Air Port) Islamabad
5. Asstt. Engineer (Civil)

B.1.2 Revenue Department

1. Tehsildar Tehsil Attock
2. Tehsildar Fatehjang
3. Tehsildar Rawalpindi

B.1.3 Geological Survey of Pakistan

1. Chief Geophysicist, Lahore
2. Superintending Geologist, Lahore
3. Director, Islamabad

B.1.4 Surveyor General of Pakistan Rawalpindi

B.1.5 Punjab Forest and Wildlife Departments

1. Secretary Forestry, Wildlife, Fisheries & Tourism Lahore
2. Chief Conservator of Forest, Northern Zone, Rawalpindi
3. Conservator of Forest Rawalpindi
4. Deputy Secretary (Planning) Lahore
5. Director General, Punjab Wildlife Department Lahore
6. Deputy Game Warden, Punjab Wildlife Department, Rawalpindi
7. Deputy Game Warden, Punjab Wildlife Department, Faisalabad

B.1.6 Environmental Protection Department

1. Secretary EPD Lahore
2. Director EPD North Region Lahore
3. Deputy Director (E.I) EPD Lahore
4. Director Pakistan EPA Islamabad

B.1.7 Archaeology Department Govt. of Pakistan

1. Director General Karachi
2. Curator Taxila Museum

B.1.8 Deputy Director Environmental (NDP) Sunny View, Lahore

B.1.9 Institutions

1. Incharge National Herbarium, Islamabad
2. Department of Botany, University of Punjab, Lahore
3. Plant Taxonomu Laboratory, Quid-e-Azam University, Islamabad

B.2 LOCAL COMMUNITIES

1. Notable of 52 villages where scoping sessions were carried out
2. Contact with 1,005 male and 710 female members of the communities of the villages where scoping sessions were held.

APPENDIX "C"

ECOLOGICAL STUDY REPORT

PAKISTAN

WATER AND POWER DEVELOPMENT AUTHORITY

ENVIRONMENTAL IMPACT OF HIGH POWER (500 KV) TRANSMISSION LINES GHAZI BAROTHA HYDROPOWER PROJECT ON FLORA AND FAUNA

ASSESSED BY

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EXECUTIVE SUMMERY

The construction of power transmission lines involves clearance of vegetation from right of ways (ROW), tower pads and access roads etc. To predict any negative environmental impact of constructing activities, flora and fauna existing within the proposed routes of extra high voltage (500KV) transmission lines incoming to and outgoing from Ghazi Barotha Hydropower Complex was studied.

The plant species growing in landscapes viz.; abandoned fields, cultivated lands, waterways (streams and torrents), eroded (broken) lands, weathered rock plains, and hill slopes were sampled following Braun Blanquet (1964) approach of phytosociology. In landscapes where systematic sampling was not possible e.g. in some streams and wetlands, the plant species were simply recorded. The information on fauna in the region was collected from Punjab Wildlife Department.

The species groups derived through the analysis of data have been described in each landscape unit supported with Association Tables. The floristic composition varies in different landscape units. The vegetation has been cleared completely in the excavated and settlement areas. The least number of species has been found in the cultivated fields whereas highest biodiversity has been found in the reserve scrub forests.

The construction of transmission lines involving clearance of vegetation from construction area and right of ways, access roads, tower pads and sub-stations will generally exert no negative environmental impact on the flora occurring in various LSEUs falling in the proposed route of transmission lines. The vegetation in the reserve forests will be damaged significantly but this impact will be localized and temporary as no rare or endangered species is growing there. Most of the species has capability to regenerate very soon after cutting. Furthermore, as mitigation measures, the re-vegetation will be done in the cleared areas.

There will be no negative significant environmental impact on the fauna of the area. The migration of the birds will be safe as the transmission lines lie opposite to the internationally recognized flying route of birds that is along the Indus River. The wetlands and small dams are not falling under the ROW hence no any hindrance for the waterfowls to fly and rest in these water bodies.

The mammals, reptiles, amphibians and other inhabitants of the forests will have to migrate temporarily to the adjoining areas during construction but later on there will be no hindrance in the movement of animal species.

It is concluded that the project is environmentally safe and feasible for execution with a condition to monitor the re-vegetation under ROW especially in the reserve forest zones

1 STUDY AIMS

The international donor agencies (World Bank, Asian Development Bank and OECF) do not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially out weight the environmental costs. If the Environmental Assessment (EA) indicates that a project significantly converts or degrades natural habitats, the project must include mitigation measures acceptable to the donor agencies.

The environmental consequences should be recognized early in the project cycle and taken into account in project selection, siting, planning and design by preventing, minimizing, mitigating or compensating for adverse environmental impacts and enhancing positive impacts. The Environmental Assessment includes the process of mitigating or managing environmental impacts throughout project implementation.

The construction of long electric transmission lines involves clearance of vegetation from powerhouse sites, right of ways (ROW) and construction of access roads, towers pads and substations. These activities may result in vegetation damage, habitat fragmentation or loss and invasion by exotic species along with the ROW, access roads and around substation sites.

To meet donor's requirements, as specified in Guidelines of World Bank (1991), ADB (1993) and OECF (1995), the present study was conducted as a part of EIA of Extra High Voltage (EHV) Transmission Lines (single and double circuit) in-coming and out-going from Ghazi Barotha Hydropower Complex. The impacts of these transmission lines on local flora and fauna has been predicated and presented in the present report. The appropriate mitigation measures for any negative impact has also been suggested where required.

2 THE PROJECT

The project is a part of overall transmission programme of Water and Power Development Authority (WAPDA) and will dispose of 1450 MW of power to be generated at Ghazi Barotha Hydro Electric Power Complex. The power complex shall comprise 5 units of 290 MW capacity with the first to be commissioned in September 2001. The project involves the following works;

(a) Construction of 500 kV transmission lines (single circuit 23 km - 60 km double circuit) for In & Out arrangement of existing Tarbela-Gatti 500 kV Transmission Lines Circuits 1 & 2 at Barotha.

(b) Two Barotha-Rewat 500 kV transmission lines along with necessary line bays at Rewat (100 km single circuit + 60 km double circuit).

3 MATERIALS AND METHODS

3.1 Site Visit Details

Visit Dates: 15-16 June 1999

3rd August – 10 August, 1999

Assessment by: Dr. Muhammad Ashraf Bodla, Deputy Director (Environment)
National Drainage Programme (NDP), WAPDA

Accompanied by:

- Mr. Muhammad Ashraf, Surveyor,
  EHV S&I, Sub Division, Lahore
- Mr. Abbas Ali, Surveyer,
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- Mr. Iftikhar Ahmad, Surveyor,
  EHV S&I, Sub Division, Islamabad
- Mr. Muhammad Ayub, Surveyor,
  EHV S&I, Sub Division, Multan
- Mr. Muhammad Amin, Survey Helper
- Mr. Muhammad Pervez, Driver

3.2 Technical Consultation for:

i) Plant species identification:

- Dr. Robina Rafiq
  Incharge National Herbarium
  Islamabad.
- Ms. Ghazala Naseem, Department of Botany, University of the Punjab, Lahore.
- Dr. Muhammad Nasir,
  Department of Botany
  University of the Punjab, Lahore.
- Miss Naheed Naz, Plant Taxonomy Laboratory,
- Botany Department Quaid-e-Azam University, Islamabad

- Mr. Tahir Akbar Plant Taxonomy Laboratory,
  Botany Department Quaid-e-Azam University, Islamabad

ii) Fauna:

- Dr. Aleem, Director General,
  Punjab Wildlife Department
  Lahore.

- Raja Muhammad Akram,
  Dy. Game Warden
  Punjab Wildlife Department.
  Rawalpindi

- Mr. Anwar Mann,
  Dy. Game Warden
  Wildlife Research Institute.
  Gutwala, Faisalabad.

3.3 Approach Used

Plant communities are complex phenomena, which can be variously classified. Because of the individualistic distribution of species and the continuity of communities, there is no single, natural unit of classification. Different choices of ways for defining community types imply different classifications of the same vegetation.

The vegetation was studied following the methods and concepts of Braun Blanquet (1964) which is essentially a floristic ecological approach that establishes the relationship between vegetation with all its component species and characteristics of the habitat. Various workers (Shimwell,1971; Mirza,1978; Baig,1981; Bodla,1996) have employed this system widely in different geo-botanical regions for the sampling and classification of plant communities.

Table 1 Domins-Krajina (Krajina, 1969) Cover Abundance Scale.

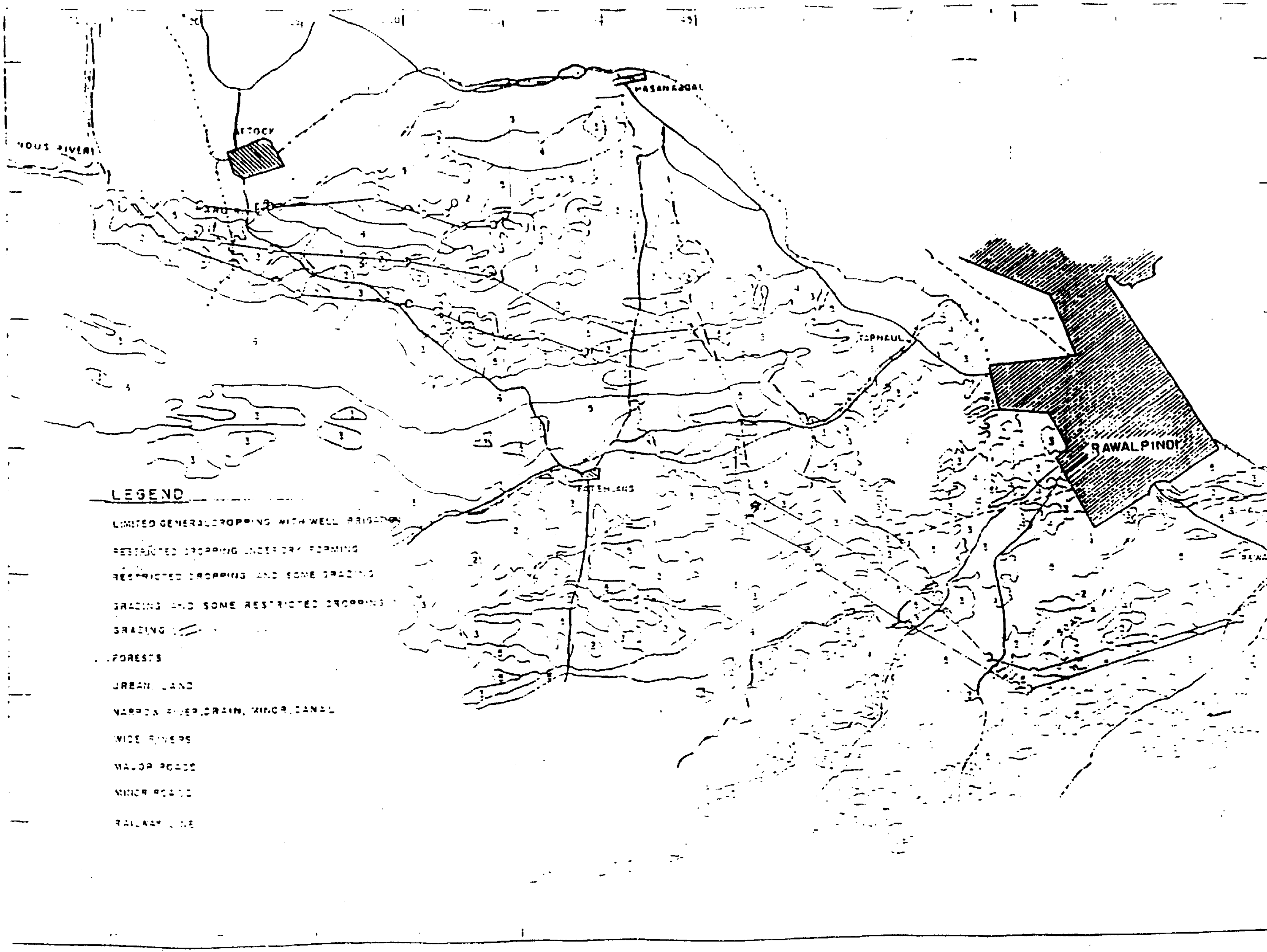
Domin-Krajina Scale	Range of abundance/cover	Cover %
10	any number, with complete cover	100
9	any number, with more than 3/4 but less than complete cover	75
8	any number, with 1/2 - ¾ cover	50-75
7	any number, with 1/3 - ½ cover	33-50
6	any number, with 1/4 - 1/3 cover	25-33
5	any number, with 1/10 – 1/4 cover	10-25
4	any number, with 1/20 – 1/10 cover	5-10
3	scattered with cover under 1/20	1-5
2	very scattered, with small cover	1
1	seldom, with insignificant cover	
+	solitary, with insignificant cover	

The cover of plant species is important attribute of vegetation as it is an expression of effectiveness, competition or dominance of plant species in a plant community. The percentage cover of species recorded from the study area was determined and coded using Domin-Krajina (1969) scale as given in Table 1. When a part or whole of the sample releve' was covered by different life forms (trees, shrubs, forbs and grasses etc.) each stratum of vegetation was studied separately.

3.4 Procedural Details

3.4.1 Delineation of Land Scope Ecological Units (LSEUs)

The physiographic maps on scale 1:250000 prepared by Soil Survey of Pakistan were consulted. The proposed route of 500 KV (single & double circuit) transmission lines in coming and out-going from GBHP complex was marked on the route Map 1). The right of way (ROW) of each line was traversed and study sites were stratified (for the convenience of identification of different plant associations) into different Land Scape Ecological Units (LSEUs).


ATTOCK
HASANABDAL
TARNAUL
RAWALPINDI
LEGEND
LIMITED GENERAL CROPPING WITH WELL IRRIGATION
RESTRICTED CROPPING AND SOME GRAZING
GRAZING AND SOME RESTRICTED CROPPING
GRAZING
FORESTS
URBAN LAND
WIDE RIVERS
MAJOR ROADS
MINOR ROADS
RAILWAY LINE

The following LSEUs were interpreted and used for description of the respective vegetation:

1. Excavated area
2. Abandoned lands
3. Cultivated fields
4. Water ways (Streams and Torrents)
5. Water bodies/small dams
6. Eroded (Broken) lands
7. Weathered rock plain
8. Piedmont plain
9. Hill slopes

3.4.2 Vegetation Sampling

For vegetation sampling, the interpretative Landscape Ecological Units were used for stratified sampling. Since vegetation in each LSEU in general was homogenous, a representative sample area under the ROW was selected and a starting point of a transect was chosen randomly. Keeping in view of the uniformity of the stand, two transects of 10 quadrats, separated by 10 meters each was placed along the ROW and perpendicular to it respectively. One meter square (1x1 meter) quadrat was used for grasses and herbacious vegetation, 2x2 m for shrubs and 4x4 m for trees as recommended by Weaver and Clements (1938).

On minimal area basis (Mueller-Dombois and Elenburg, 1974, Mirza 1978), the quadrat used as a sampling unit was designated as releve'. In LSEUs where the stratified sampling was not possible, the plant species were recorded and listed.

3.4.3 Analysis and Classification of Data

The synthesis of field data was carried out employing the tabular comparison method (Mueller-Dombois and Elenberg, 1974) to prepare a Synthesis Table that showed the releve' data in a well organized manner so that the important trends of species distribution between the sample stands could be easily recognized.

3.4.4 Presentation of Floristic Data

The data from LSEUs were analysed and different plant associations were abstracted and presented in detailed Association Tables.

4 VEGETATION DISTRIBUTION IN LAND SCAPE ECOLOGICAL UNITS

The plant species sampled/recorded from the study area are given in Table 2.

Table 2 FLORISTIC COMPOSITION OF LAND SCAPE ECOLOGICAL UNITS (LSEUs)

Species\LSEUs	Abandoned Lands	Waterways	Eroded Lands	Weathered Rock Plain	Piedmont Plain	Hill slopes
Artemesia scoparia						+
Arundo donax		+				
Acacia modesta			+	+		+
Acacia nilotica			+		+	
Abutilon indicum						+
Alhagi maurorum			+			
Achyranthes aspera			+			
Asparagus						+
Amarantus spinosus	+					
Boerhaavia procumens			+	+		+
Chrysonogan screllatus			+			+
Cyprus nivens			+	+		+
Cymbopogan iawarncusa			+	+		+
Cynodon dactylon	+	+			+	+
Cyprus rotundus			+	+		+
Carthamus oxycantha			+			+
Calotropis procera			+			+
Chenopodium album						+
Cannabis sativa	+	+				+
Capparis aphylla			+		+	+
Dodonea viscosa		+				+
Digneria oliaris		+		+	+	+
Dicanthium anulatum	+					+
Dalbargia sisso	+					
Desmostachya bipinnata	+	+	+	+	+	
Dicliptera roxburghiana				+		
Digera muricale						+
Evolvolus olsinoides						+
Echinochloa crusgali						+
Eragrostis cynosuroides					+	+
Fagonia cretica						+
Grewia asiatica					+	+
Heliotropium strigosum				+		+
Imperata cylindrica	+	+		+		+
Justicia adhatoda						+
Lantana alba						+
Lantana camera				+		+
Launea nudicaulis	+		+	+	+	
Matvnus roylensus		+	+	+		+
Oxalis corniculata		+	+			+
Olea fernuginia						+
Otostugi limba						+
Prosopis glandulosa						
Prosopis juliflora					+	
Phyechosia mimosa	+				+	
Penesetum						+
Paspalum distichum		+				
Periploca aphyla						+
Polygonum plebejum		+		+		
Rhyncosia minima					+	+
Segeretia sp.			+	+	+	+
						+

Salvia plebia				+		
Sporoholus palidus			+			+
Sida cordifolia			+			
Syranchulus sp.						+
Saccharum spontaneum		+	+	+		
Saccharum munja						+
Saussurea candicans						+
Solanum saratens				+		
Tarerniaria sp.			+	+		+
Tribulus terristis						+
Trichodesma indica	+					+
Typha angustata		+				
Zizypus nummularia	+		+		+	+
Zizyphus jujuba						+

The LSEU wise distribution of vegetation is given as below:

4.1 Excavated Area

The construction activities involving the huge amount of earth removal using heavy machinery has completely eliminated the flora permanently in the switch yard segment of the Project (Plate- 1). The newly constructed settlements also distructed the local vegetation. However, the species planted in the courtyards have started flourishing (Plate-2), which will result in turning the settlement areas green. The abandoned fields near the switch yard site and at other dry lands dominated with herbs such as *Carthymus*, *Peganum harmala*, *Convolvulus arvensis* and *Alhagi maurorum*. No tree species was found at this site because of excessive cutting of trees fuel purposes.

4.2 Abandoned Agricultural Land

Some of previously cultivated fields become abandoned due to acquisition of land for construction purposes and are currently being used as pasture area (Plate-3). The trees are cut for fuel purposes remaining behind grass and forbs with some scattered bushes. The dominant grass in this area is *Imperata cylindrica* growing in association with *Phychosia mimosa* (Annex.1.1). The *Cynodon dactylon* is colonizing at moist places. Some annuals such as *Chenopodium album*, *Launea nudicaulis* and perennial like *Dabergia sisso* were also found emerging out in this LSEU.

4.3 Cultivated Fields

In the cultivated landscapes, the landowners have planted the rows of *Eucalyptus camaldulensis* around the borders of the fields or as blocks within the fields (Plate-4). Some farmers have also planted this species even on the slopes of the hills (Plate-5).

Although *Eucalyptus* is a fast growing economical tree, which can grow in a variety of habitat conditions but due to its high transpiration rate (50 litres per day), it is not recommended for cultivation in areas having deeper ground water and around the normal agriculture fields. The high transpiration of these trees considerably depletes the soil moisture, which effects the growth of agricultural crops. The agriculture in the area depends on rains except at places where irrigation is practiced through well, watercourses from the small dams and lift irrigation from the nearby flowing streams.

The important crops in the area are wheat, maize, millets, peanuts, pulses and fodder. In irrigated areas a variety of natural vegetation also exists but scattered. The dominant trees in this landscape unit are *Zizyphus jujuba, Acacia modesta, Tamarix aphylla, Fig palmata* and *Olea ferrugiana*. Some planted trees such as *Albizzia lebbck, Broussonetia papyrifera*, Melia azadirachta, *M. azedrach, Figa religiosa etc.* were also found scattered in the fields and outside the settlements Plate- 6)..On the borders of the fields many shrubs grasses and herbs can be found associated in different combinations. The dominant shrubs in such area is *Zizyphus nummularia* which is generally associated with grass like *Cymbopogan javarancusa* and *Imperata cylindrica* and *Desmostachya* bipinnata.

4.4 Water Ways (Streams and Torrents)

The Horo River and some perennial streams/torrents locally known as Kas flow in the area. The important kas are, Nandana, Gannuri, Dunga, Ratiala, Bahudra, Tanar, Jabbi, Sukha, Tanar, Basala, Sipiala, Jawa, Kharkkan. In addition a number of small torrents which flow only during the rainy days. Depending on flow and the terrain through they transect, these water channel hold a variety of plant species in their banks and inundated portions..

Some torrents cause deep gully erosion (Plate-7). The eroded deposits on the banks hold scattered trees of *Acacia modesta*, shrubs *Calotropis procera* and grasses, *Chrysopogan secrellatus, Cympopogan javarancusa* etc. whereas frequently inundated and braided portions are dominated by *Sacchrum spontaneum* and *Desmostachya bipinnata*.

The torrents with comparatively stabilized muddy banks (Plate-8) are dominated by *Imperata cylindrica* associated with some scattered trees of *Acacia modesta*. The shallow torrents where the process of erosion is much pronounced do not bear any shrubs or trees. The grasses, *Cynodon dactylon* and *Imperata cylindrica* are dominant at places where moisture remains available throughout the year (Plate-9).

The stands of *Acacia modesta* and *Zizyphus nummularia* associated with a variety of grasses can be seen on the banks of deeper torrents which has maintained their permanent route of flow (Plate-10). At such localities the sufficient underground water remains available to the plant roots.

Under the crossing of proposed transmission lines over the Haro River, some grasses like *Imperata cylindrica, Cynodon dactylon* and *Sacchrum spontaneum* dominant Plate-11). However, the habitat at this particular place has been disturbed through carrying away gravel deposits for construction of Barotha Hydropower infrastructures (Plate-12).

The slowly flowing streams, which mainly collect water from the springs, exhibit panoramic scenes in the area (Plate-13 &14). The vegetation of these streams mainly composed of hydrophytes dominated by *Typha angustata* (Plate-15). The other associated hydrophytes in these habitats are *Arundo donax, Scirpus sp. Cyprus sp* and *Paspalum distichum*. At the flat banks, the dominant grasses are *Imperata cylindrica* and *Cynodon dactylon* whereas at gently slopes *Sacchrum spontaneum* becomes associated with above mentioned grasses. This type of habitat is ecologically very important as it hosts a variety of migratory or sedentary birds or it may be utilized for grazing by a variety of animals (Plate-16).

At low flow regime or during dry periods, species such as *Sacchrum spontaneum, Paspalum distichum, Polygonum plebum* etc. colonizes on the gravelly substratum of some torrents (Plate-17, Annex 1.2). At localized spots where water stands for a longer period, water-loving species like *Paspalum distichum* also associate with above-mentioned species. During monsoon rains, the speedy flow of these torrents de-roots and wash away most of these species (Plate-18).

4.5 Wetlands/Small Dams

Some portions of ROW also pass near the wet lands and small dams (Plate-19). The peripheral region of these reservoirs holds hydrophytes such as *Arundo donax, Typha sp. Paspalum distichum* grasses which provide shelter for the migratory and sedentary birds.

4.6 Eroded (Broken) Lands

The erosion process is active in these areas. The most common are gully and sheet erosion which results in uneven and broken landscape (Plate-20). Although a variety of species are growing in this habitat but no characteristic plant association can be isolated. Cymbopogan jawarencusa is the only grass has trend to grow along with *Rhyncosia minima*. All other species found in this habitat are scattered as evidenced from Annex. 1.3.

4.7 Weathered Rock Plain

Under the ROW of proposed transmission lines the soil formation as a result of rock weathering is in process. At the rocky slopes shrubs like *Zizyphus nummularia, Dodonia viscosa, Justicia adhatoda* along with *Cybopogan javarancusa* have colonized. The deeper soils formed due to the weathering of rocks are under cultivation (Plate 21). In confined basis where the soils remain moist through out the year *Desmostachya - Sacchrum spontaneum* association dominates (Annex.1.4; Plate-22). The shallow soil layer so formed holds a variety of plant species (Annex 1.5). *Cymbopogan jawanecosa* is most dominant species in this landscape unit, which is associated with *Boerhaavia procunteus* and *Cyprus nivens* (Plate-23). The other species infrequently growing along with above mentioned plants are *Acacia modesta, Matnus roglusus, Digiteria oliaris, Diclipira roxbergiana, Periploca aphyla, Heliotropium strigosum, salvia plebia and Tarerniara sp.*

4.8 Piedmont Plain

The piedmont plain has been formed under the foothills as a result of deposition of weathered material. Such deposits may contain sufficient amount of salts to make a soil saline or sodic depending on the nature of the salts.
The vegetation in this landscape is dominated by *Digitaria oliaris* and *Eragrostis cynosouroides* which are generally growing solitary (Annex. 1.6). The tree species scattered in this association are *Acacia nilotica, Prosopis juliflora* whereas shrubs are *Prosopis glandulosa, Zizyphus nummularia* and *Capparis apylla* (Plate-24). The other plant species found in this landscape are mentioned in referred Annex.1.6.

4.9 Hill Slopes

The project area lies in Pothohar Plateau where the height and slope of hills varies significantly. The vegetation distribution in such area depends on the height and slope of the hills, grazing and cutting of plants and level of protection.

At some hill slopes the vegetation has been cleared through excessive cutting leaving behind grasses, forbs and some shrubs including *Penesetum sp. Cymbopogan javarancusa, Degeteria, Zizypus numularia, Boerhavia diffusa, Cynodon dactylon, Ehnetia abtasifolia, Carthymus and Cyprus sp.* (Plate-25). Some hills hold very less vegetation due to heavy cutting and grazing pressure (Plate-26).

The low hill slopes where moisture retension is comparatively less and vegetation is protected from cutting are dominated by *Zizyphus nummularia* associated with *Boerhaavia procutens* and *Cyprus sp.* (Annex. 1.7 and Plate-27). The species with insignificant cover and frequency are also listed in above referred Annex.

The low hill slopes, which are protected both for cutting and grazing, hold a variety of plant species. On one of such hill slopes, near Adiala road crossing, *Justica adhatoda. Acacia modesta* is dominant plant association (Annex. 1.8;). The other plants found under this association with variation in cover and frequency are also mentioned in Annex.1.8.

The medium hills protected from cutting and grazing show high biodiversity. In a private property near Taraya village, 21 species were found growing in different combinations (Annex. 1.9). Among these plants, *Echnochloa sp.* is dominant which is associated with *Justacia adhatoda* (Plate-28). The other species under this association are also given in above referred Annex.

The forests with restricted cutting and grazing composed of tree species like *Acacia modesta* and *Olea fernaginia* (Annex. 1.10; Plates-29&30). The thick cover of plants restricted the growth of herbs and forbs underneath. The dominant grass under this association is *Chrysopogon scleratus*. The other occasionally occurring species are listed in Association Annex.1.10 already referred above.

The high biodiversity has also been found in Kala Chitta Reserve Forest, very well managed by the Punjab Forest Department. This scrub forest is at its climax stage showing clear strata of trees, shrubs and grasses (Plates 31&32). The dominant species growing in this area are *Olea Ferngìnia, Dodonea viscosa, Chrysopogan scleratus* and *Digiteria oliaris* (Annex. 1.11). The frequently occurring species along with the dominants are also mentioned in above referred Annex.1.11.

5 FAUNA

The information on Fauna in the project area has been collected from the Punjab Wild Life Department. The checklist of important wildlife species at Attock District and adjacent areas in Rawalpindi District is given in Table-3. Overall 48 terrestrial bird species and 27 waterfowls have been recorded from the area. The important mammal species reported especially from the reserve forests are 11 in number.

The following four small dams are located in the project area:

i) Sipiala Dam
ii) Dhola Dam
iii) Kasala Dam
iv) Java Dam

Many waterfowls come to rest and feed in the reservoirs of these dams as well as in small wetlands scattered in the area. The internationally recognized main flying route of water birds in Pakistan is along the Indus River. The migratory birds entering in Pakistan through Karakrum Range fly along the Indus River during winter and meanwhile exercise local migrations.

6 THE IMPACTS OF TRANSMISSION LINES

The proposed transmission lines have no negative environmental impact on Abandaned agriculture lands as there is no rare or endangered plant species was found. Moreover, no extensive clearance of vegetation is required during construction except the clearance of few trees of *Acacia modesta* growing at places on the borders of the fields.

Table 3 Checklist of important Wild Life Species at Attock Distt. And adjacent Areas in Distt. Rawalpindi

Sr. No.	Common Name	Scientific Name
A: Birds		
1.	Black partridge	Francolinus frantolinus
2.	Grey partridge	Francolinus pondicerionus
3.	Chakur	Alectoris chakar
4.	See see partridge	Amnoperdix griseogularis
5.	Common paraih kite	Milvus migrans
6.	Black winged kite	Elanus caeruleus
7.	White backed vultuse	Gyps bengalensis
8.	Shikra	Accipiter badius
9.	Kestrel	Falco tinnunculus
10.	Rose ringed parakeet	Psittacula krameri
11.	Blue rock pigeon	Columba livia
12.	Ring dove	Streptopelia decaocto
13.	Red turtle dove	Streptopelia tranquebarica
14.	Common starling	Sturnus vulgaris
15.	White checked bulbul	Pynonotus levcogenys
16.	Red vented bulbul	Pycnonotus cafer
17.	Common myna	Acridotheres tristis
18.	Bank myna	Acridotheres ginginianus
19.	Spotted owlet	Athene brama
20.	House swift	Apus affinis
21.	Pied king fisher	Ceryle rudis
22.	White breasted king fisher	Halcyon snyrensis
23.	Indian roller	Corocias benghalenses
24.	Hoopoe	Upupa epops
25.	Little green bee-eater	Merops orientalis
26.	Golden backed wood pecker	Dinopium benghalense
27.	Crested lark	Galerida cristata
28.	Wire tail swallow	Hirundo smithii
29.	Grey shrike	Lanius excubitor
30.	Rufous black shrike	Lanius schach
31.	Black drongo	Dicrurus adsimilis
32.	House sparrow	Passer domesticus
33.	House crow	Corvus splendens
34.	Common babbler	Turdoides caudatus
35.	Jungle babbler	Turdoides striatus
36.	Pied fly catcher	Ficedula hypoleuca

37.	Reed warbler	Acrocephalus scirpaceus
38.	Great reed warbler	Acrocephalus stentoreus
39.	Indian magpie robin	Copsychus saularis
40.	Pied bush chat	Saxicola caprata
41.	Purple sun bird	Nectarinia asiatica
42.	Black red start	Phoenicurus ochruros
43.	White Wag tail	Motacilla alba
44.	Yellow wag tail	Motacilla flava
45.	Large pied wag tail	Motocilla maderaspatensis
46.	Indian tree pie	Dendrocitta vagabunda
47.	Common quail	Coturnix coturnix
48.	Red wattled lapwing	Vanellus indicus
B)	MAMMALS	
1.	Urial	Ovis orientalis punjabiensis
2.	Hill fox	Valpus valpus
3.	Jackal	Conis aureus
4.	Poriupine	Hystrix indica
5.	Chinkara	Gazella gazella
6.	Jungle cat	Felis chaus
7.	Wild boar	Sus scrofa
8.	Palm squirrel	Fanambulus pennanti
9.	Wolf	Crnis lupus
10.	Common leopard	Panthera paradus (reported)
11.	Cape hare	Lepus capensis
C) Waterfowl		
1.	Little grebe	Tachybaptus ruficollis
2.	Great crested grebe	Podiceps. Cristatus
3.	Indian pond heron	Ardeola grayii
4.	Cattle egret	Bubulcus ibis
5.	Little egret	E. garzetta
6.	Great egret	E.alba
7.	Purple heron	Ardea purpurea
8.	Grey heron	A. cinerea
9.	Ruddy shelduck	Tadorna ferruginea
10.	Eurasian wigeon	Anas penelope
11.	Gadwall	A. strepra
12.	Common (green-winged) teal	A. crecca
13.	Mallard	A. platyrhynchos
14.	Northern pintail	A. acuta
15.	Northern shoveler	A. clypeata
16.	Common pochard	Aythya ferina
17.	Tufted duck	A. fuligula
18.	Moorhen	Gallinula chloropus

19.	Common coot	Fulica atra
20.	Black-winged stilt	Himantopus himantopus
21.	Northern lapwing	Vanellus vanellus
22.	Red-wattled lapwing	V. indicus
23.	Little ringed plover	Charadrius dubius
24.	Redshank	Tringa totanus
25.	Greenshank	T. nebularia
	Common sandpiper	Actitis hypoleucos
	Little stint	Calidris minuta

There will be no negative environmental impact of transmission lines on flora and fauna in the cultivated fields because of their scattered distribution. The loss of vegetation during construction will be insignificant.

The colonized species on the banks and dried beds of waterways are under the process of succession and adaptation. During monsoon, flooding may erode whole of the vegetation from this habitat or may result in another type of vegetation as aresult of succession. In addition, during the erection of electric wires, no excavation of such land will be required hence no adverse impact of electric wires will be exerted.

The transmission lines will impose no negative environmental impact, as no tower will be constructed in the water bodied. Furthermore, The flying root of migratory birds is along the Indus River that is on the opposite direction of the route of the transmission lines.

A large proportion of the land in the project area is severely eroded with less vegetation cover. The construction of new access roads in this area during construction phase of transmission lines will be uneconomical. The transportation of material is feasible through existing tracks. The construction activities thus, will exert not negative environmental impact on this landscape.

Acacia modesta which is most common tree growing in weathered rock plains may be destroyed through the project activities i.e. cutting during the erection of electric wires. The impact therefore, will be insignificant.
During the erection of wires some trees and shrubs growing in piedmont plain will be cut which in already by the local people to meet their fuel requirements. The cutting will not create any significant negative environmental impact because no rare and endangered plant species has been found in this habitat. Moreover the pruned/cut species will regenerate with the passage of time.

The constructing of access roads and tower foundations, in addition to cutting/clearance of vegetation under ROW in reserve forests will exert a significant negative environmental impact but it will be localized and temporary. The vegetation cut and pruned during erection of wires will generate itself with the passage of time. The vegetation for the construction of access roads and tower foundation will be uprooted along a maximum strip of 10 meters whereas similar plant communities are extending to a much distance on both sides of ROW. However to counter any possible negative environmental impact, the re-vegetation of ROW as well as access roads will be re-vegetated as mitigation measures.

The route of proposed transmission lines is opposite to the flying route that is along the Indus River and hence no negative environmental impact will be imposed on the migratory birds. In addition no important wetland is near the ROW so the resting and flying of birds will not be hindered.

The mammals and other terrestrial animals are concerned they will be disturbed temporarily during the construction phase i.e. construction of access roads installation of towers and erection of wires in the reserve forests. The transmission lines after construction however will not obstruct or restrict the movement of the animals.

7 CONCLUSIONS

From the study of vegetation and wildlife in the area it is concluded that:

1 Vegetation cleared in the switchyard site was mainly composed of weeds of no economic value as evidenced by the type of adjoining vegetation. The construction activities thus have no negative environmental impact in this area.

2 The streams and hill torrents in the area are flowing below the natural surface level. The mobility of construction machinery will not possible in this landscape. No tower will be installed in the bed of a stream or torrent so no plant or animal species will be affected.

3 The cultivated fields are already devoid of thick cover of natural vegetation. The bio-diversity is very low. The few trees and shrubs growing on the borders of fields may be cut during the erection of wires but it will have no significant negative environmental impact.

4 The Abandaned agricultural fields hold some grasses of low economic and ecological value. The compaction of these species will not result in any negative environmental impact.

5 The wetlands/small dams are not under the ROW so flora and fauna of this LSEU will not be affected.

6 The eroded/broken lands are not easily accessible for vehicles. The transportation of material will be done on the existing routs hence no negative environmental impact will be exerted on the flora and fauna of this LSEU.

7 The weathered rock plains host no rare or endangered plant or animal species. The construction activities will result in non-significant and temporary loss of vegetation.

8 The cutting of tress and shrubs in piedmont plain is already in process. The cutting of vegetation for erection of transmission lines will not be an adding factor for reduction in vegetation cover in this LSEU.

9 The high bio-diversity in some hills will be affected significantly due to clearance of vegetation under ROW and uprooting for construction of access roads and tower pads. However this factor will be temporary and localized because similar vegetation exists to a wider extent on both sides of ROW. However, the re-vegetation will have to be done under ROW to eliminate the impact in a short term.

10 The overall project is environmentally feasible and executable with the provision of monitoring the re-vegetation activities on access roads in reserve forests after construction phase.

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VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE UNIT:

LOCALITY: Adjacent to Rawat 500 Grid Station

Running No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No.	4	8	9	3	10	2	5	7	12	13	16	18	19	17	1	6	14	15	20	11
Total Cover (%)	91	90	95	95	143	70	63	52	70	55	41	36	37	68	50	40	50	45	115	100
Tree Layer														1						
Shrub + Herb Layer		10	5	6	2	5	2	5,	5	53		5	5			1	3	1	7	50
Grass Layer	50	60	90	85	60	40	50	85	90	90	90	65	50	80	45	40	50	30	30	35
No. of Species																				
Species/Cover (coded value)	3	2	2	2	3	2	4	2	3	2	2	3	4	3	1	1	3	2	4	2
Dalbergia sisso																	2			
Zizipus nimularia					8														8	
Imperata cylindrica	9	9	9	9	9	8	8	8	8	7	7	6	6	5	8	7	7	7	3	
Ptyechosia nimosa	5	4	3	3	3	4	3	3	3	5	1	4	4	3						
Chaecogrodin album	2											1								
Canabes sativa							2													
Trichodesera indica							3													
Desmostachya bipinnata																				9
Dicanthium foveolatum																	7			4
Cynodum daitylon									3				5	7				4	6	
Launea mudicaulis													3						6	

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: STREAM BED (MOIST)

LOCALITY: **At the cossing of Shahdara Kas**

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	1	5	6	3	4	7	13	19	20	12	15	11	17	14	2	8	9	10	16	18
Quadrat size M2																				
Cover (%):																				
Tree layer																				
Shrub + Herb layer:						5		15			5		35		5				5	
Grass layer:	95	95	100	97	100	80	80	80	40	90	75	85	35	95	90	45	95	32	30	80
Total Species:	2	2	2	2	2	3	3	3	3	3	3	4	4	2	2	3	4	3	2	
Species/Cover (coded value)																				
Arundo donax							5	5	5	2	3	3	5	5			7			3
Sacchrum spontaneum	9	9	7	1	2	2	6	8	5	7	8				9	6				
Impernta cylindrica	5	4	8	9	9	8	7							9						
Typha angustata										5		3				5	6	8		
Paspalum distichum									4			7	6				5	4	6	9
Cynodon dactylon												3				2				
Launea nudicaulis						2														
Digiteria oliaris																	3	5		
Desmostachya bipinnata																				
Matymus roylenses													6						3	
Oxalis corniculata													3							
Polygonum plebium								5							2					
Cannabis sativa											3									

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: **ERODED LAND (Depression)**

LOCALITY: Chakri-**Rawalpindi Road** 250 meters towards Barotha

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	1	2	3	4	5	6	7	8	9	10	14	12	11	16	15	19	17	13	18	20
Quadrat size M2	1	1	2	1	1	4	1	2	1	4	4	4	1	1	1	1	1	2	1	1
Cover (%):																				
Tree layer						50				75	100	50			10			10		7
shrub + Herb layer:			59			35		27	10	3	1	2	5	5	1	5	51	22	5	50
Grass layer:	80	80	80	100	100	70	75	90	60	30	90	50	50	50	20	65	15	50	13	70
Total Species:	1	1	6	1	2	4	2	3	3	3	3	3	2	2	3	3	4	6	3	4
Name of species/Cover (coded value)																				
Acacia nilotica						7					10									
Acacia modesta										9		7			3			4		3
Zizyphus nummularia																				3
Myrtus rotylansis						6											8	5		
Capparis aphylla			7					5										2		
Calotropis procera																3				
Crysopogan sp.	9							9	8											
Sporobolus pallidus		9	8													7				
Cyprus nivens			3			3								2			1			
Launea nudicaulis			1																	
Segeretia sp.			4			8														
Taverniaria sp.			3																	
Desmostachya bipinnata				10	8					6							4		4	
Sacchrum spontaneum					7		5													
Cynodon dactylon							7													
Rhyncosia minima								1	2	2	1	2			6					
Oxalis corniculata									2											
Cymbopogan jawarncusa											9	7	7	7	5	5	3			
Alhagi maurorum													2					8	2	
Cyprus rotundus																		3		
Boerhaavia procuntens																		2		
Achyranthes aspera																			3	
Carthamus oxycantha																				

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: WEATHERED ROCK PLAIN

LOCALITY: Near Parh Village

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	15	17	18	19	20
Releve' No:	1	2	3	4	5	6	10	11	16	17	18	19	20	12	14	15	13	7	8	9
Quadrat size M^2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover (%):																				
Tree layer																				
shrub + Herb layer:	4					15	1		2	5	1	5	2							2
Grass layer:	80	80	80	85	90	75	90	100	80	90	90	90	75	100	95	6	90	100	100	95
Total Species:	3	1	2	1	1	2	2	2	3	3	3	3	4	2	3	1	2	2	2	2
Name of species/Cover (Coded value):																				
Acacia modesta																				
Lantana comera	1										1		3							
Launea nndicaulis	2																			
Rhyncosia minima							4					3	3							
Solanum suratens									1	2					1		2			
Boerhaavia diffusa						5														
Desmostachya bipinnata	9	9	9	9	9	9	9	9	9	9	9	8	6	8	9	6				
Sacchrum spontaneum								6	4	4	2	5	7	7	3		8			
Imperata cylindrica																		9	9	9
Cyprus nivens			3															5	5	

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: WEATHERED ROCK PLAIN

LOCALITY: Daultpur-Mian Rashid Road Crossing

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	14	3	6	8	15	17	7	12	13	1	5	9	16	18	2	4	11	19	20	10
Quadrat size M^2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1
Cover (%):																				
Tree layer															10		50			
Shrub + Herb layer:	2		5		12				2	10	7	55	57	40	20	75				2
Grass layer:	90	100	92	92	82	79	80	25	75	25	60	35	10	10	50	50	15	80	17	25
Total Species:	3	2	3	2	3	2	2	3	3	2	3	4	4	3	4	2	2	2	2	3
Species/Cover (coded value)																				
Acacia modesta															4		7			
Matynus roylensus												6		5	2	9				
Boerhaavia procunrens			3						1	4	1	6	2	3						
Cymbopogan jawarancusa	9	9	9	9	9	9	8	8	8	6	8	6	4	3	7	8	6	8	5	
Cyprus nivens	3	1	1	1	1	1	3	3	3											2
Digiteria oliaris								3				2						6		5
Dicliptera roxburghiana											2				3					
Periploca aphylla													7							
Heliotropium strigosum					4														1	2
Salvia plebia	1																			
Taremiarn sp.													3							

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: PIEDMONT PLAINWEATHERED ROCK PLAIN

LOCALITY: Near Motorway 200 meters towards Rawat

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	16	15	13	4	14	8	11	12	1	6	9	10	7	2	3	5	17	18	19	20
Quadrat size M^2	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	4	1	1	1	1
Cover (%):																				
Tree layer			80													80				
shrub + Herb layer:		50		5	100	82					8	5	15	5	28	7	5		40	82
Grass layer:	90	80	80	60	60	65	5	10	5	100	60	70	90	30	90	90	92	90	80	75
Total Species:	2	2	2	2	2	4	1	1	1	2	4	3	2	2	3	4	4	3	3	3
Species/Cover (Coded value)																				
Acacia nilotica			9													9				
Prosopis juliflora																				
Prosopis glandulosa		7			10	9							5						5	
Zizyphus nummularia											2								6	9
Capparis aphylla				15											6					
Digiteria oliaris	9	9	9	8	8	7	5	4	3	4	7	7					9	7		
Eragrostis cynosuroides										9	4	4	9	6	9	9	4	6		
Desmostachya bipinnata																	2	4	9	9
Rhyncosia minima														3	2		3			
Polygonum plebum						1										3				2
Grewia asiatica											2	2								
Launea nudicaulis																1				
Cynodon dactylon	4					6														

Annex-1.7

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: HILL SLOPE

LOCALITY: Near Attock Basal Road crossing

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	10	9	13	16	18	7	8	17	20	15	1	14	3	6	4	5	12	19	11	2
Quadrat size M^2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
Cover (%):																				
Tree layer																				
Shrub + Herb layer:	100	91	20	110	107	3	32	37	42	15	36	97	11		6	10	2	28	47	5
Grass layer:	70	70	32	75	80	70	70	29	50	30	35	75	25	70	30	50	80		80	70
Total Species:	4	4	5	4	4	4	3	4	4	3	5	3	3	3	3	2	3	5	6	2
Species/Cover (coded value)																				
Ziryphus nummularia	10	9	9	9	9	6	6	6	6	4	4	3					5	4	7	
Boerhaavia procutens	4	4	4	3	5	2	1	5	1	3	6	2	4	2	2	4	1	2		
Cynodon dactylon		8	9	9	9	9	1	6	7	6	6	2	6	8	6	7			9	8
Carthamus oxyacantha	3	1	1	2		1		8	1		1			1	1			2	1	1
Eleusine flagellifera											4									
Cyprus nivens													1					<1		
Rhyncosia minima			2		.1												1	1	<1	
Imperata cylindrica																			1	
Eragrostis sp.	8																			
Tribulus terristis																			<1	

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: HILL SLOPE

LOCALITY: **At Adiala road crossing 300 meters towards Barotha**

Running No:	1	2	3	6	8	4	5	7	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	13	2	15	5	6	11	3	7	1	12	8	10	17	9	18	16	14	19	20	4
Quadrat size M^2	4	4	4	4	4	4	4	4	4	1	2	1	1	2	1	3	4	2	2	1
Cover (%):																				
Tree layer	10	40	100	70	40	80	80	60	20								100			
shrub + Herb layer:	96	60	75	40	25	40	23	35	86	70	40	32	15	25	16	15	26	5	83	3
Grass layer:	100	90	60	90	70	10	80	75	90	72	55	65	95	70	90	10	70	90	65	80
Total Species:	4	4	4	4	4	3	3	4	7	2	5	4	3	3	6	4	4	4	4	2
Name of species/Cover (coded value):																				
Justicia adhatoda	9	8	8	5	5	7	5	4	4	8	7	6	4	4	2					
Acacia modesta	4	7	10	8	7	9	9	8	5								10			
Zizypus nummularia			4								4			5		3	5	2	8	1
Grewia asiatica									8											
Eragrostis poeoides									9									9	5	
Cyprus nivens					4				3											
Asparagus sp.								9	2			1								
Capparis aphylla		4																		
Echnochloa crusgall		9	8	9	6						5					2			8	9
Cymbopogan jawarancusa	10						7									5	8			
Lantena comera				5				5												
Cynodon dactylon						4					3									
Sacchrum munja											7	7		8	9					
Grewia asiatica												1								
Sporobulus palidus	<1									8			9							
Abutilon indicum															3			1		
Canabis sativa																	<1			
Artemesea scoparia									5				3		3	4		1	3	
Calotropis procera															3					
Oxalis corniculata															2					

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT
LANDSCAPE: HILL SLOPE
LOCALITY: Near Taraya Village

Running No:	1	2.	3	4	5	6	7	8	14	9	10	11	12	13	15	16	17	18	19	20
Releve' No:	12	3	13	2	20	9	15	14	17	6	10	8	7	16	4	5	1	18	19	11
Cover (%):																				
Quadrat size M^2	4	1	2	4	4	1	1	1	4	1	1	1	1	2	1	1	1	1	1	1
Tree layer	100		1		15				30											6
shrub + Herb layer:	59	61	50	61	80	20	30	15	62	10	2		25	52	7	35	12			55
Grass layer:	2	20	50	11	2	25	40	23	10	95	90	55	45	41	63	75	50	25	20	50
Total Species:	7	5	4	12	3	6	4	5	6	6	4	5	4	4	3	5	4	1	1	4
Name of species/Coded value):																				
Acacia modesta	10			9	5				6											6
Zizyphus nummularia			1	7										8						
Dicanthium annulatum				4													6			
Cyprus nivens	2			2		4		1			3	4	3			3	5			
Digitaria oliaris																	4			
Chrysopogan screlatus																	3			
Elnochloa sp.	4	3	3	4	2	5	1	8	1	3	8	7	5	1	1					
Justacia adhatoda	7	7	7	6	9	5	5	4	4							3				
Taremieria sp.				4																
Heliotropium strigosum		4		1		4		4		4		6			3	4				
Abutilon sp.				1					3	3										
Boerhaavia procuntens		3				3	5			5	2	6	5			5				
Sporobolus palidus		5					7											5	5	4
Pennisetum orientalis				3																
Oxalis corniculata	1			2					1						2					
Chrysopogan sclerntus			8	7					4	8			8	7		8				
Artemesia scoparia										3										
Trichodesma indica						1					6	4								
Matynus rolylensus	1																			
Evolvolus olsionoides	<1																			1
Digera muricale								2						1						2

Annex-1.10

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: HILL SLOPE

LOCALITY: In between the Motorway and Fetch Jang Road

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	7	15	19	20	10	17	12	11	3	9	5	2	4	18	6	13	14	16	1	8
Quadrat size M^2	4	4	4	4	4	.	4	4	4	4	4	2	4	4	1	1	4	4	1	1
Cover (%):																				
Tree layer	80	90	75	80	90	80	60	50	70	30	40	20	40	80	80		15	15		
Shrub + Herb layer:		11	25	15	10	10	30	10	10	25	30	64	43	10		60	30	30	90	
Grass layer:	70	80	15	70	80	15	10	50	30		60	30	20	60	60	30	80	60	10	30
Total Species:	3	4	4	3	3	3	3	3	3	4	5	4	6	3	2	2	3	3	3	1
Species/Cover (coded value)																				
Acacia modesta											6			8			5	5		
Olea fernaginia	9	9	9	9	9	9	8	8	8	6	4	5	7	5						
Justaica adhatoda	7	5	5	5	4	4	6	4	4	8	8				8	6	6	8	4	
Chrysopogon scleranus	8	9	5	8	9	5	4	8	6	4	8	6	5	9	8	6	9	8	4	6
Ziziphus numularia											6		6							
Cyprus nivens												2								
Oxalis corniculata												1								
Dodonia viscosa													4							
Sansonia sp.													1							
Chenopodium album										5										
Ranunculus inentus		1																		
Salvia plebia													1							
Mytinus rolvlensis			1																	4

VEGETATION DISTRIBUTION UNDER RIGHT OF WAY (ROW) 500 KV TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

LANDSCAPE: HILL SLOPE

LOCALITY: Kala Chitta Reserve Forest

Running No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Releve' No:	19	2	1	10	12	13	15	9	14	16	5	6	4	11	20	7	18	8	3	17
Quadrat size M2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2
Cover (%):																				
Tree layer	100	100	80	75	80	82	85	60	60	60	50	60	25	10	20	82	85	15		
Shrub + Herb layer:	15	25	5	27	30	15	23	62	25	27	38	47	15	90	15	13	25	36	20	16
Grass layer:	55	32	70	76	61	56	5	27	83	86	82	91	57	76	82	30	51	90	43	56
Total Species:	7	7	5	7	8	8	9	8	7	9	8	12	8	5	5	5	7	7	7	7
Species/Cover (coded value)																				
Olea ferruginia	10	9	7	9	9	9	9	8	8	8	7	6	5	4	5	9	9			
Chrysopogon screllatus	7	5	7	8	8	8	6	5	8	8	9	9	7	8	9	6	8	9	6	6
Digiteria olioris	3	4	6	3	5	3	3	4	2	5	4	4	2	5	5			3	4	3
Dodonia viscosa	4	3	3	3	5	3	4	5	5	3	5	6	7	8			5	5	4	3
Acacia modesta		4	6			2	2			5		7			5	3		5		
Marytnus roylenes		5.		3	3	4	1	5	3		5	5	2			5	4	5		
Cyprtis nivens	1	3			1			3	<1	1	3	3			1		1	3	3	1
Periploca aphylla	1						3					3	3						3	
Heliotopium strigosum				<1	2	2	1				1	2	3				<1		<1	<1
Boerhanvia procutens											3	3	3						3	
Tribulus tristus								3		1		1				<1				<1
Digeria muricale					1	<1	<1			<1		<1		<1				1		
Otostugi limba	3			5				5	5	5				5			5			4

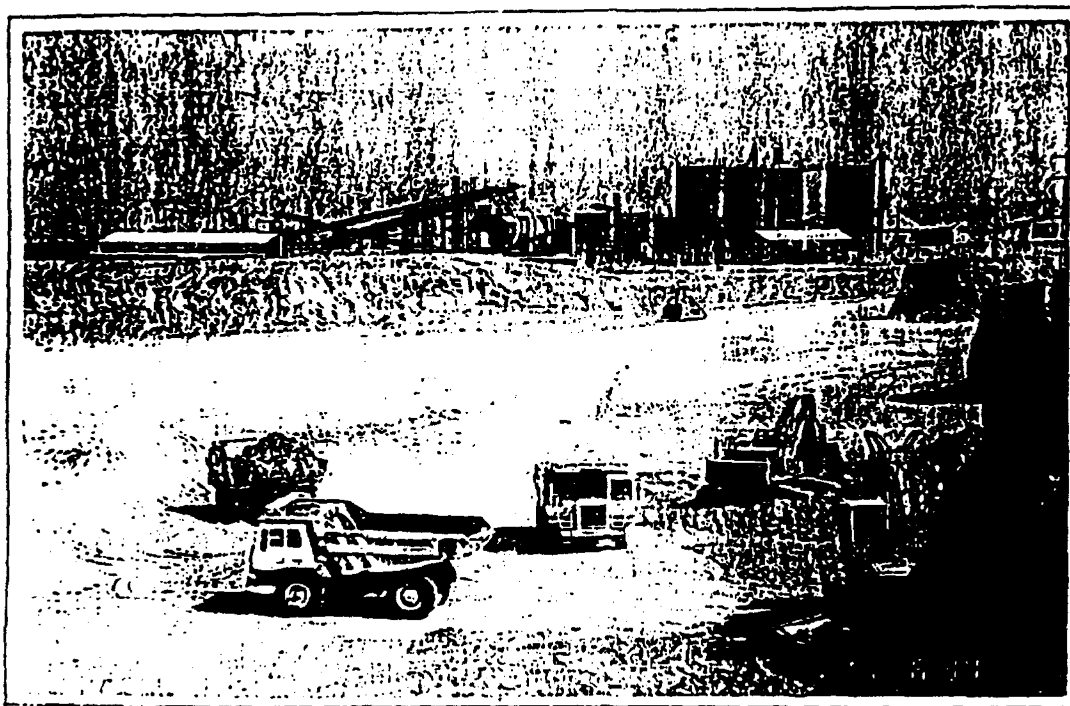

Plate 1 Excavation at switchyard site

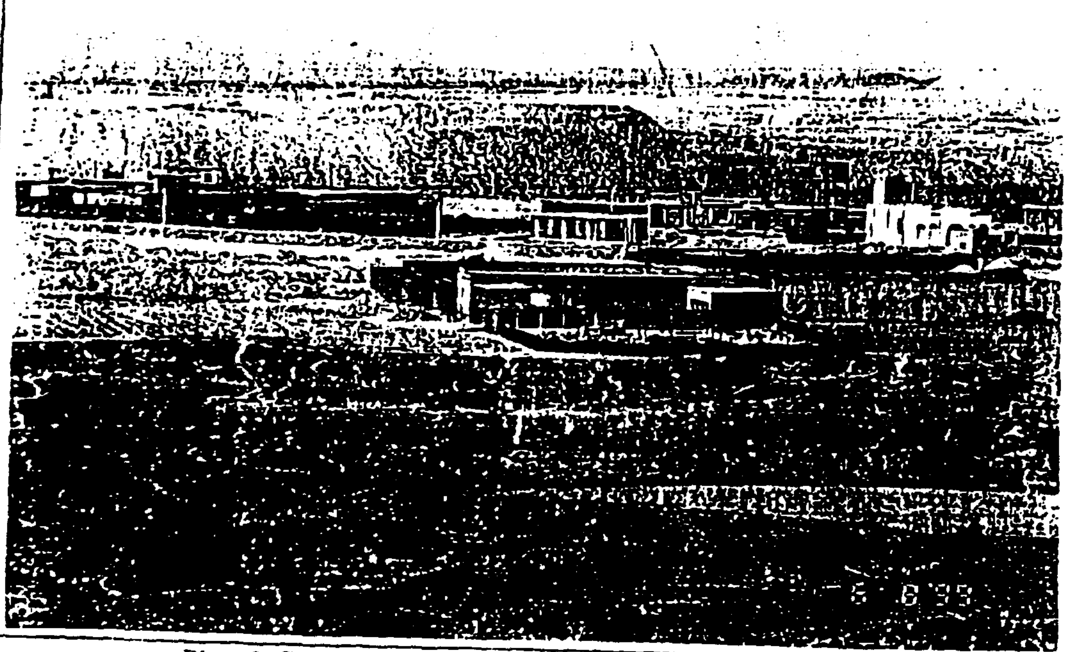

Plate 2 Plantation in courtyards at Barotha model village

Plate 3 An Abandaned field near Rawat presently being used for grazing

Plate 4 *Eucalyptus* plantations around the cultivated fields

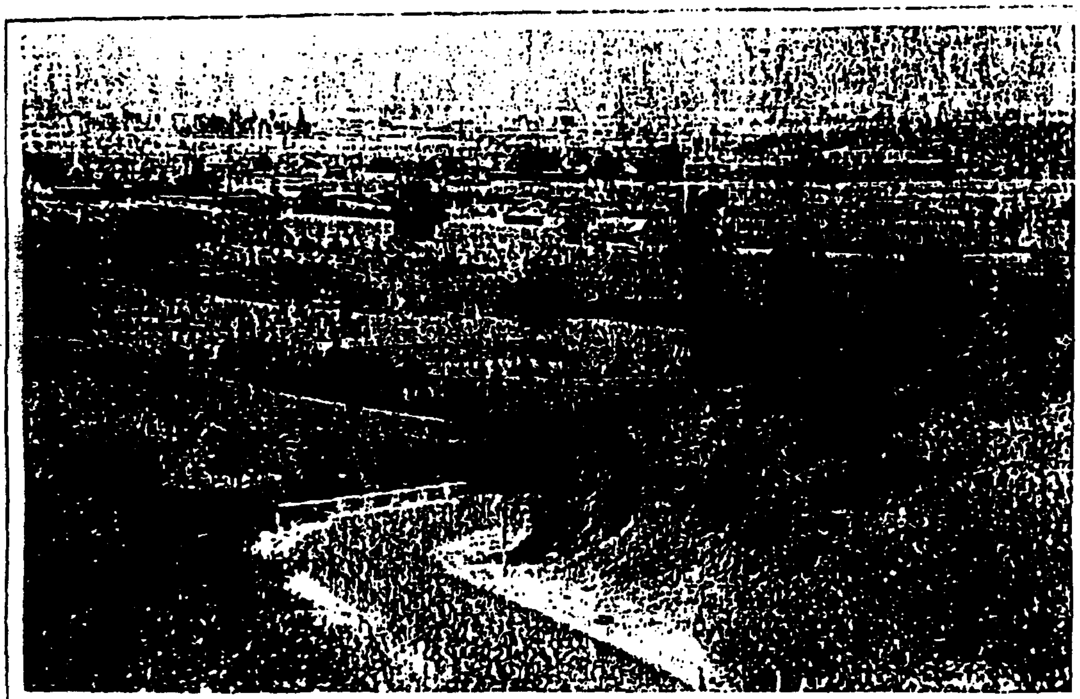

Plate 5 *Eucalyptus* plantation on the hill slopes

Plate 6 Agricultural fields in the project area

Plate 7 Deep erosion caused by torrents

Plate 8 Torrent with stabilized banks

Plate 9 Shallow torrent with low flow

Plate 10 *Acacia modesta* on the banks of a deep torrent

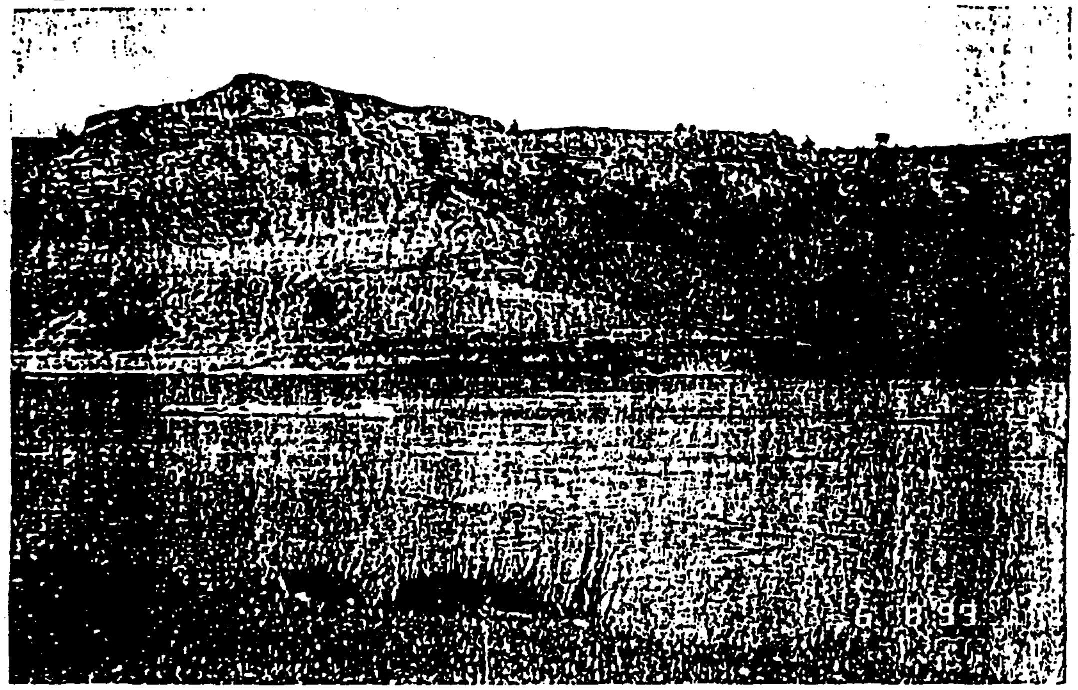

Plate 11 Crossing point of transmission line on the Haro River

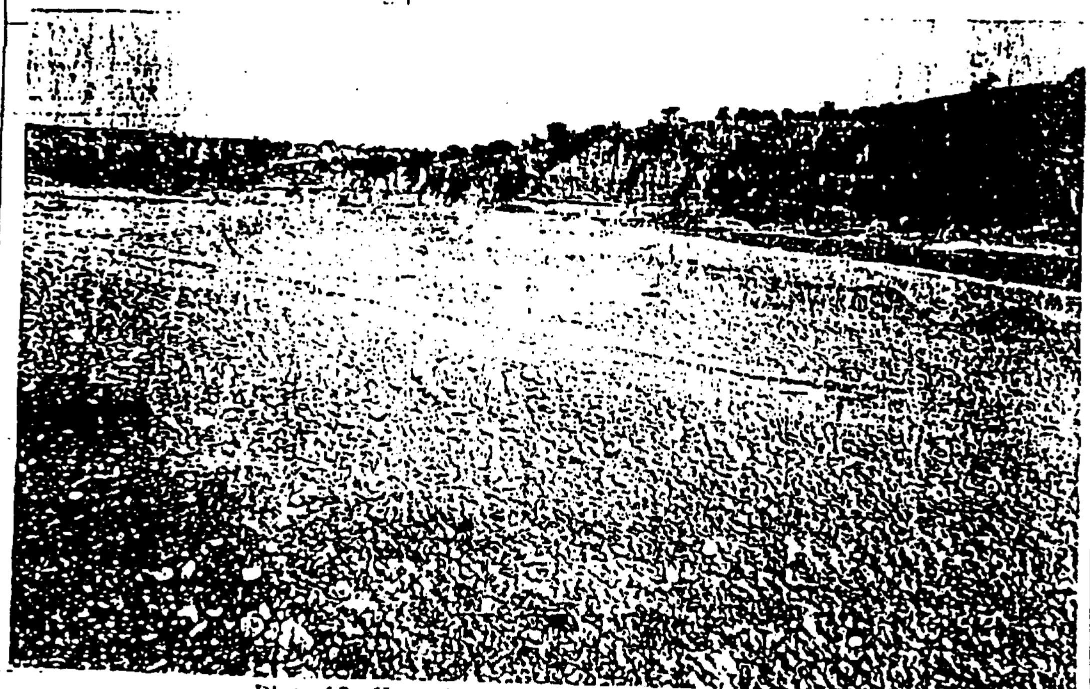

Plate 12 Gravel transportation from Haro river

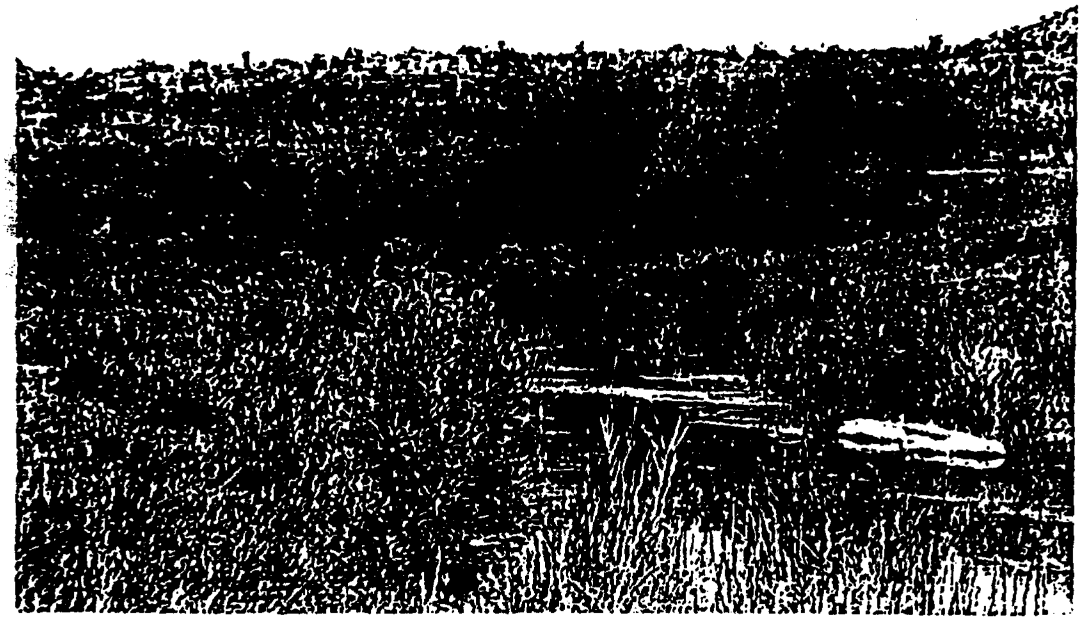

Plate 13 Stream holding a variety of plants on the banks

Plate 14 Stream dominated with aquatic plants

Plate 15 A thick stand of *Typha angustata*

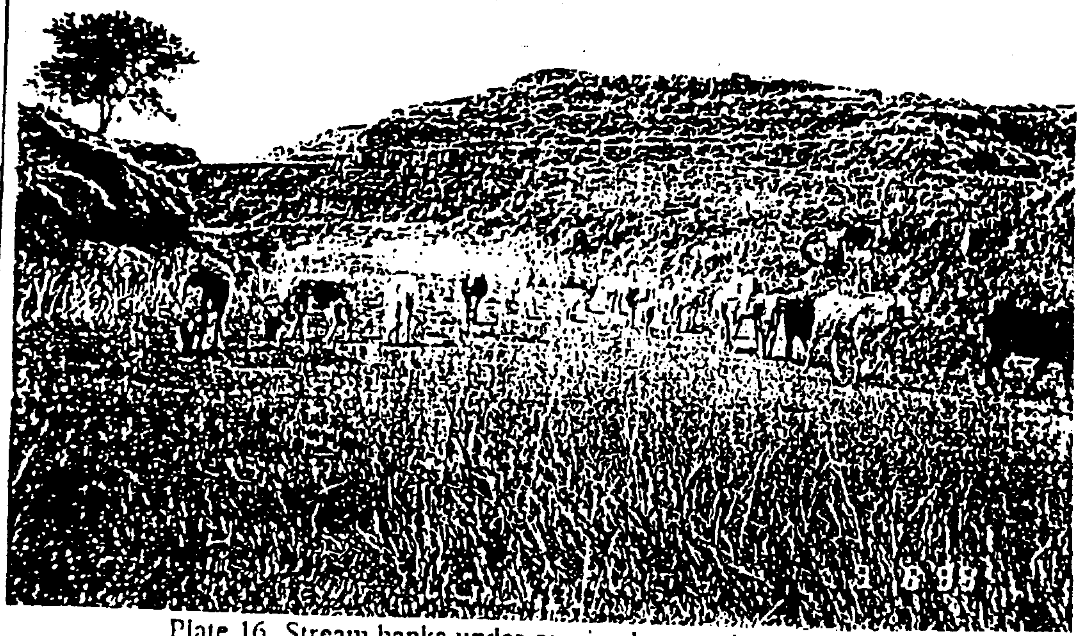

Plate 16 Stream banks under grazing by a variety of animals

Plate 17 Colonizing of grasses on gravely moist bed of a stream

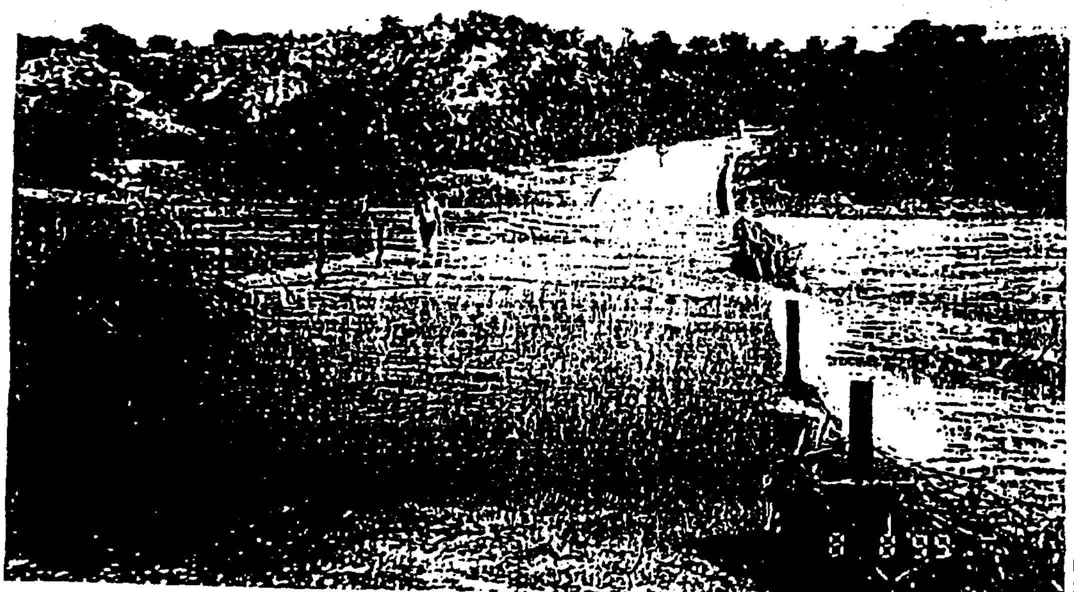

Plate 18 Washing away of vegetation due to flooding

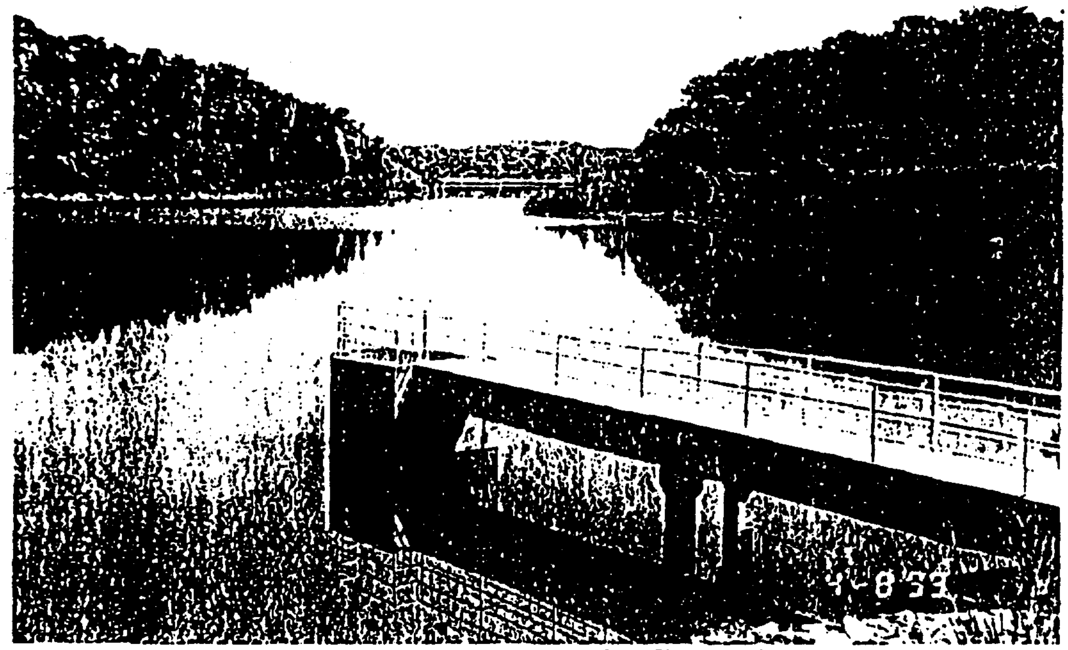

Plate 19 A view of Jawa Dam

Plate 20 Eroded (broken) land with less vegetation cover

Plate 21 Agriculture in weathered rock plain

Plate 22 Grass community in weathered rock basin

Plate 23 Shrubs and grasses in weathered rock plain

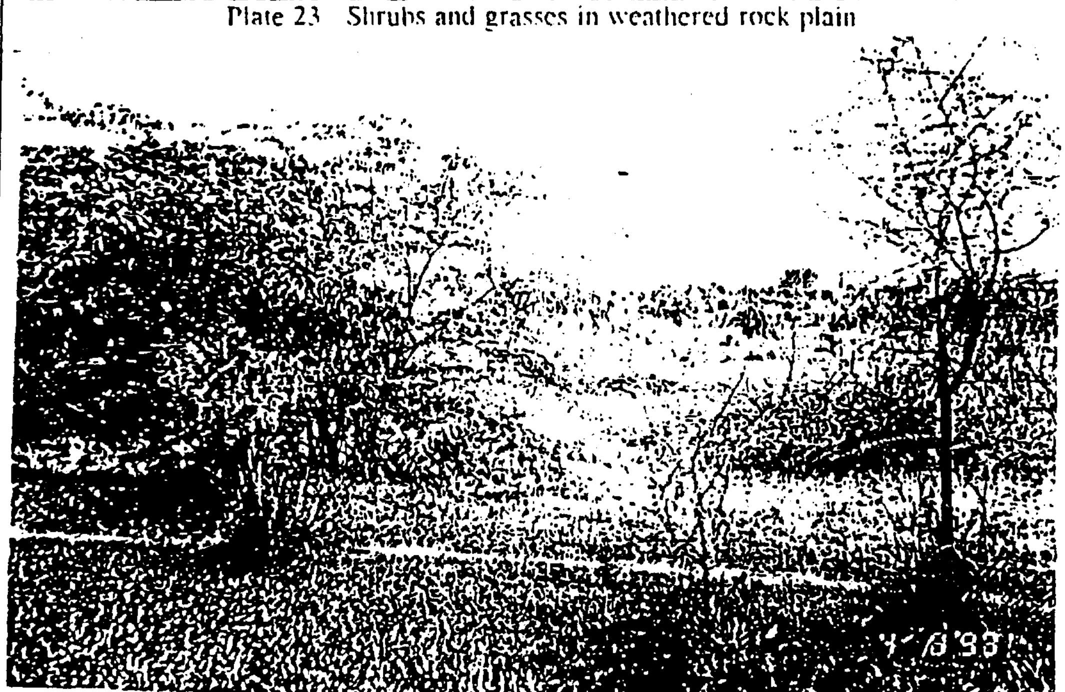

Plate 24 *Prosopis glandulosa* associated with grasses

Plate 25 *Zizyphus nummularia* along with grasses on a hill slope

Plate 26 Hill slope with little vegetation cover

Plate 27 *Zizyphus nummularia* on a hill slope

Plate 28 *Justicia adhatoda* and *Acacia modesta* on a hill slope

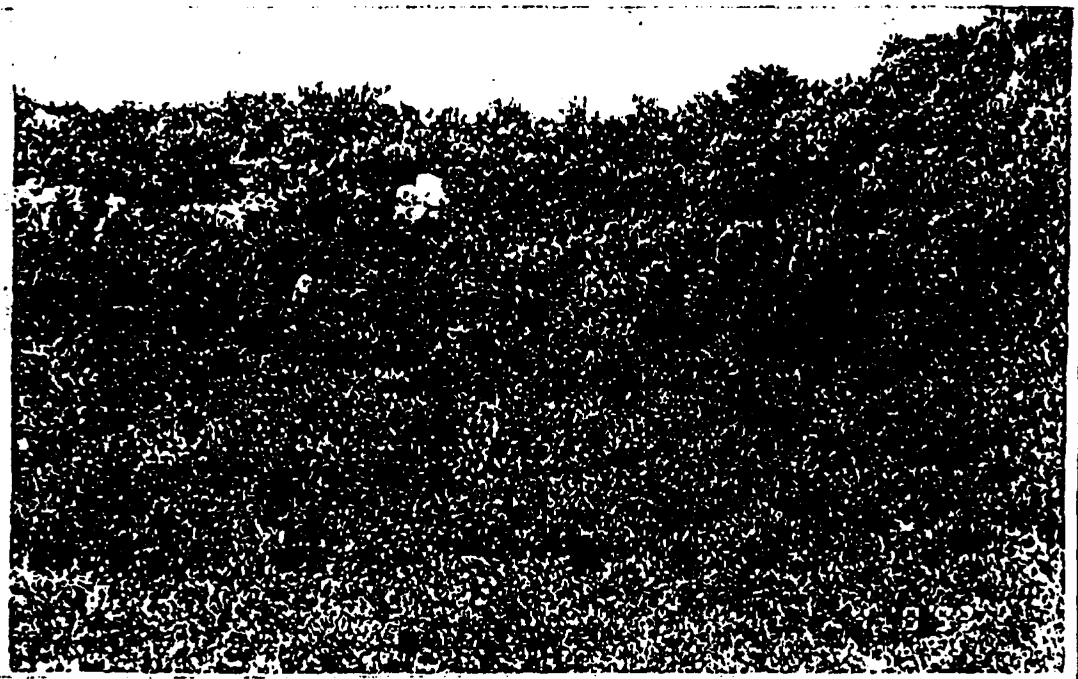

Plate 29 Scrub forest with scattered trees of *Olea ferruginia*

Plate 30 High biodiversity in Kala Chitta reserve forest

Plate 31 A broad view of Kala Chitta reserve forest

APPENDIX "D"

STUDY ON THE INDUS FLYWAYS OF THE MIGRATORY BIRDS

PAKISTAN
WATER AND POWER DEVELOPMENT AUTHORITY

BRIEF ON

BIRD MIGRATION THROUGH INDUS FLYWAY – IMPACT OF TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

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JANUARY, 2000

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BIRD MIGRATION THROUGH INDUS FLYWAY – IMPACT OF TRANSMISSION LINES FROM GHAZI BAROTHA HYDROPOWER PROJECT

Islamic republic of Pakistan is situated at the junction of three major region of Asia, central Asia , to the North, Middle East to the West and the Indian Sub-Continent to the East and the South East. Total area of inland water in Pakistan has been estimated at over 7,800,000 ha. This area includes 3,100,000 ha of rivers and major tributaries, 56,000 ha of irrigation canals, 110,000 ha of natural lakes. 92,000 ha of water storage reservoirs 108,000 ha of ponds, dhands and fish farms. 300,000 ha of Delta marshes (Indus) and over 4,000,000 ha of water logged areas, seasonally flooded plains and saline wastes.

WETLANDS IN PAKISTAN

Pakistan possesses a large variety of wetlands distributed almost throughout the country, from coastal mangroves and mudflats on the Indus delta to the glacial lakes of the high Himalayas. The River Indus and its tributaries provide an ideal habitat for wintering waterfowl come to Pakistan.

The importance of wetlands in Pakistan was first brought to the notice of the World Community in 1967 in a technical meeting on wetland conservation at Ankara. The important wetlands in the country are marked in Figure 1 and main features are given in Table-1.

ZOOGRAPHIC ASPECTS

In Pakistan there appear to be four following significant invasion routes:

The first comprises two separate avenues for the colonization of Oriental species into Pakistan on either edge of the great Indian Thar desert or Rajasthan desert. One lies in the extreme south-east corner of lower Sindh and the other in the north-east corner of Punjab. In Sindh the mitigating effect of the sea along the coastal belt with less extreme summer temperatures and more mesic conditions due to persistent sea breezes during the summer months has provided an evanue for colonization of many bird species. However, Rajasthan desert forms the obvious physical barrier to a wholesale invasion by a wider diversity of Oriental faunal species.

The second invasion route lies in the extreme south-west corner and through the Makran from southern Iran. Birds with North African or Mediterrahean affinities have colonized along this route.

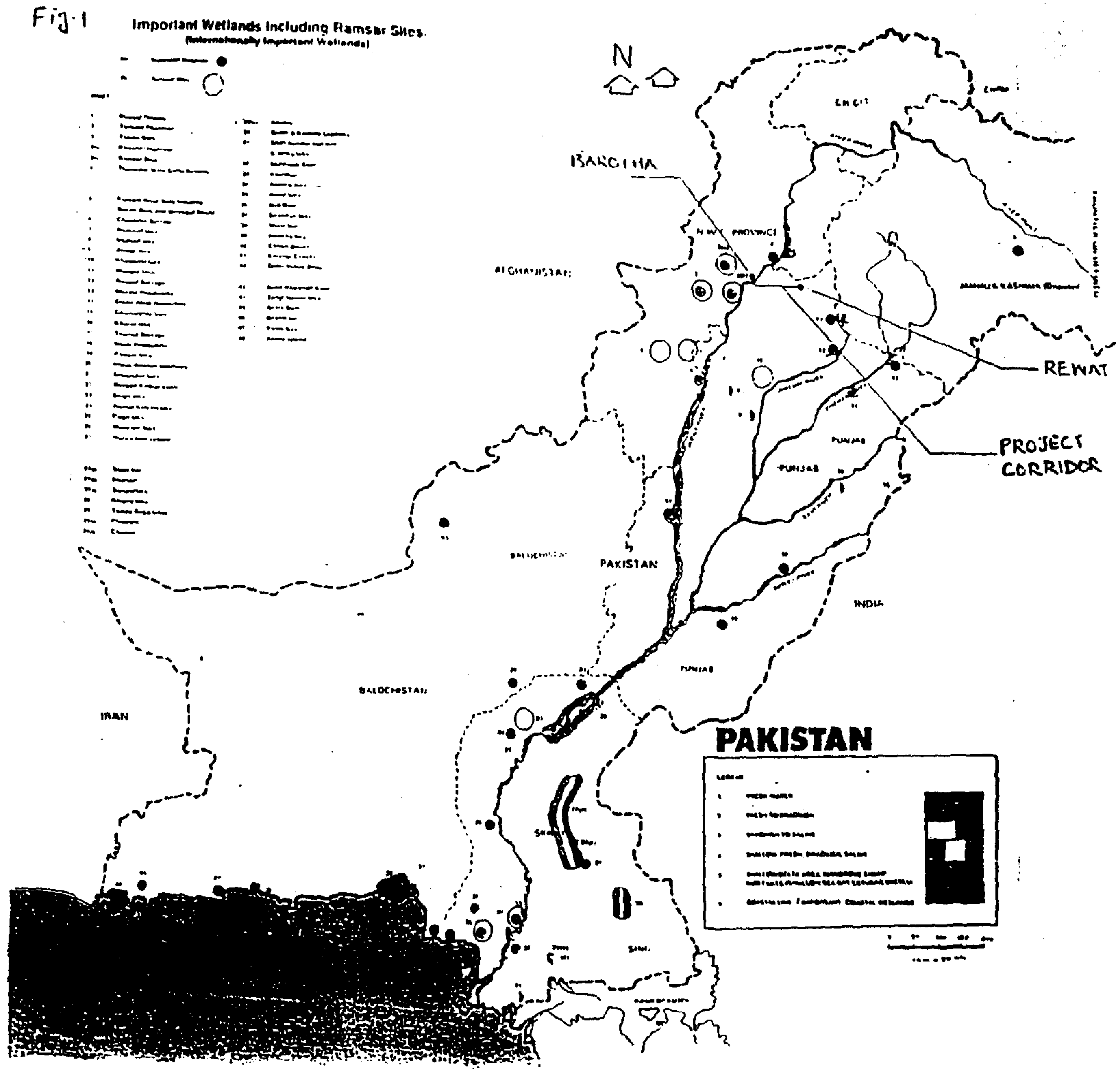
Fig-1
Important Wetlands Including Ramsar Sites.
N
BAROTHA
REWAT
PROJECT CORRIDOR
AFGHANISTAN
N.W.F. PROVINCE
PUNJAB
PAKISTAN
BALOCHISTAN
IRAN
INDIA
PAKISTAN

Table-1. List of Important Wetlands in Pakistan.

Sr. No.	Name of site	Province	Surface area (ha)	Average Population (1972-1989)	Highest Ever count
1.	Keenjhar Lake	Sindh	13468	101454	207541
2	Haleji Lake	-do-	1704	75282	013161
3	Nurri	-do-	-	72322	114752
4	Hamal Katchri Lake	-do-	-	47745	48744
5	Hub Dam	-do-	27219	39842	53502
6	Shah bander salt bed	-do-	20000	39517	66805
7	Pagri Lake	-do-	-	38236	49136
8	Jubho/kur	-do-	-	33947	51136
9	Hadero Lake	-do-	1321	29724	64440
10	Rup Lake	-do-	600	26193	49565
11	Clifton Beach	-do-	8 (km)	18044	20508
12	Soonhari or Dogrium Lake	-do-	245	17759	38067
13	Kalanger Lake	-do-	-	17075	30143
14	Snghryaro Lake	-do-	380	15610	27239
15	Drigh Lake	-do-	182	13898	34284
16	Manchar Lake	-do-	6000	13733	26792
17	Phoosna Lake	-do-	160	13049	20301
18	Mahboob Shah Lake	-do-	100	11227	33388
19	Chashma Barrage	Punjab	33109	61720	213441
20	Mangla Reservoir	-do-	26500	38120	44545
21	Head Marala	-do-	1620	22415	66706
22	Taunsa Barrage	-do-	6567	20110	28255
23	Rasul Barrage	-do-	1138	18531	25419
24	Head Qadirabad	-do-	2850	17345	45422
25	Lal Sohanra Lake	-do-	1935	14283	30960
26	Ucchali Lake	-do-	943	8592	29197

The third invasion route constitutes an extremely narrow belt or zone along the outer Himalayan foothills where there is an extension of a rather stunted and degenerate tropical dry deciduous forest biotope. In sheltered ravines or north-facing slopes of these foothills will be found an astonishingly rich association of Indo-Malaysian plant species, which provide an avenue for the invasion of many truly Oriental or Himalayan breeding birds. In this zone these Oriental species are on the western most extremity of their distributional ranges in Pakistan.

The fourth invasion route is down through the higher mountain ranges which extend roughly from north to south from Chitral through the NWFP via the Safed Koh, Waziristan and down into Balochistan. Many truly Himalayan mammals and birds have been able to extend their range southwards through these mountains.

Invasion routes can carry a two-way traffic and some Oriental species have been able to travel west-wards through lower Sindh and the Makran into the Middle East.

BIRD MIGRATION

Flyways of Waterfowl in Asia and Europe

The following seven flyways are recognized now along which water fowls move to their wintering areas. These were proposed by Isakov and Shevareva (1968) and accepted in the joint meeting of IUCN/IWRB/and ICBP. The birds migration occurs through Indus fly way or the 4th flyway from Siberia (Russia) via Afghanistan and China to Pakistan and Indus (Fig. 2).

1. Northern European – Scandinavian – North Sea.
2. European-Black Sea-Mediterranean
3. West Siberian-Caspian-Nile
4. Siberian-Kazakhastan-Pakistan-India (The Indus Flyway)
5. East Siberian-Tibet-Ganges
6. Manchurian-China-Japan
7. Kamcharka-Alaska-California

It is not too fanciful a metaphor to consider Pakistan as lying at the crossroads of Asia's major Palearctic bird migration routes. In fact the region is rather like the travel terminus of a Eurasian transport system for here will be found at certain seasons conspicuous numbers of birds which are merely in transit, whilst at other times there is an influx of winter visitors from northern breeding grounds or summer breeding visitors both from the northern mountain regions and from the Indus plains, to warmer more southern latitudes. The explanation for this phenomenon appears to lie more in Pakistan's strategic geographic location rather than in any natural endowment of transport facilities.

A large number of species of birds which breed during the summer months in northern parts of the Northern hemisphere, i.e. the China, USSR, Europe, North America and Canada, leave their 'houres' sometime during the months of August, September or October and migrate southwards to tropical areas or beyond, where the winter is not as severe as in their breeding territories. After passing the winter, they once again migrate back, sometime during spring, towards their breeding areas in the north.

In 1967 an internationally sponsored conference held at Ankara, Turkey to consider the wetland resources of the world, rated the Indus as the fourth major bird migration flyway in order of world importance, and a resolution to that effect was endorsed by the International Union for the Conservation of Nature, the International Wetlands Research Bureau and the International Council for Bird Preservation. Five years later at the Ramsar

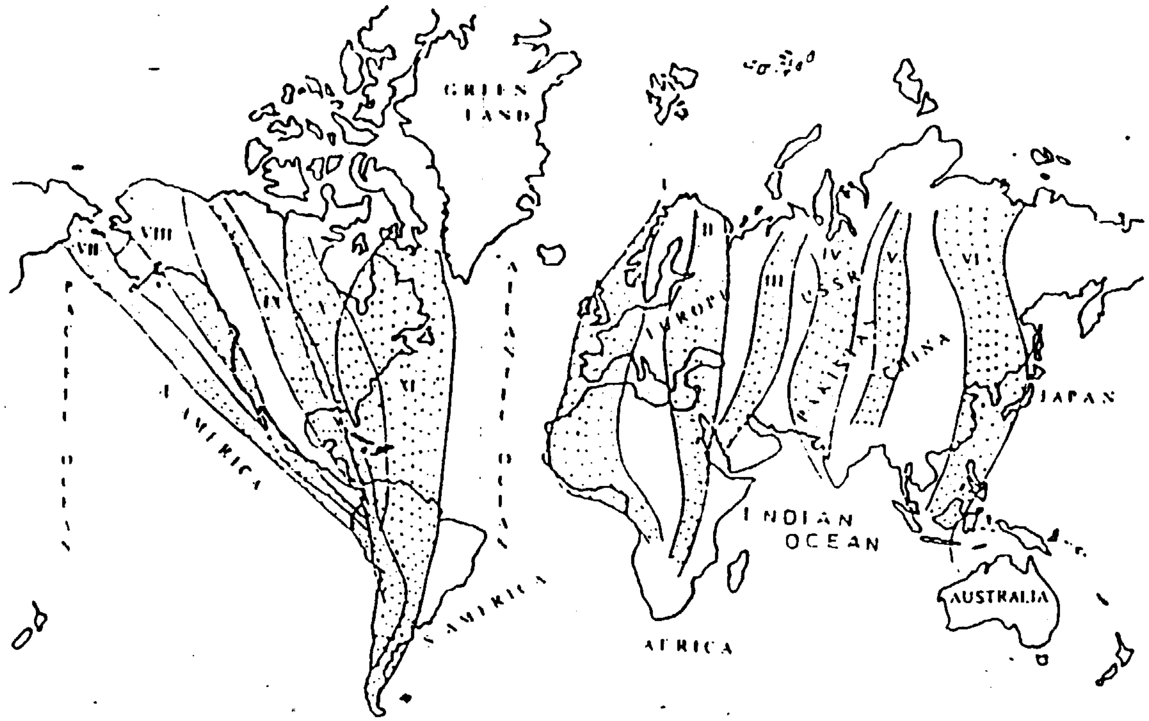

Fig. 2. Flyways of the migratory ducks in the world.

Wetlands Conference in Iran, it was again stressed that the Indus Wetlands were critical for a large part of the entire waterfowl population which in winter visited India, a part of Sri Lanka, and of course Pakistan.

The birds travel during their migratory journeys not only for several hours at a stretch, but the total distances traveled by them may run into thousands of miles in one way journey. Species like shore birds or waders, swifts and swallows, that travel from northern Europe to South Africa cover a distance of at least 6000 to 7000 miles one way.

The post-monsoon abundance of insect life and vegetative shelter provided by seasonal inundation, afford rich feeding conditions which attract a host of Palearctic winter visitors to the Indian subcontinent, not only from central Asia, but from as far away as Western Europe and eastern Siberia. Most of the sub continent's winter visitors come through Pakistan. Similarly lush feeding conditions prevail in many parts of Africa during the northern hemisphere winter and a very considerable population of Siberian and Trans-Caspian breeding birds migrate each autumn through Middle Eastern countries, including Pakistan en route to highland regions both north and south of the African Equator.

Ringing recoveries have amply demonstrated that a majority of winter visitors to the subcontinent enter via the Indus plains. Some come down the Indus river valley and its far northern tributaries such as the Kunhar, Gilgit, Hunza and Shyok rivers as well as the Chenab and Jhelum rivers further east. A very significant number enter from further west coming over the relatively low level Peiwar pass at the south-west corner of the Safed Koh range of mountains and following down the Kurram river. They thus avoid the high mountain barriers to the north altogether. Cranes, Snipe and Pelicans come by this Kuram valley route. Some of these autumn migrants fan out east wards into northern India and thus avoid the Rajasthan desert to the south, whilst others'follow the Indus river down to its delta.

Those birds reaching the Indus delta then follow the western seaboard of India until they end up in Sri Lanka . The bulk of central Asian and western Siberian Palearctic migrants which winter in east Africa, travel in the autumn through the plateau regions of Balochistan and the Indus basin across to the Rann of Kutch in India. During the return spring migration, it is possible that seasonal prevailing winds determine a more easterly northern flight path, as most Palearctic migrants from Africa than pass through Iran and Iraq and are not sighted in Pakistan.

An analysis based upon the species composition of Pakistan's bird fauna indicates the extent of these migratory patterns. Out of the total birds species 30 percent visit the country for a significant period of the year as long distance migrants while 43 percent are either Palearctic or Oriental species which come to Pakistan only for breeding. 28 percent of the total number of species are regular winter visitors, which breed extra-limitally and mainly in Trans-Himalayan northern regions.

Migration Categories

There are many species occurring in Pakistan, part of whose population appears to be sedentary, part extra-limital in breeding and present as long distance migrants, and part locally migratory.

Palearctic Winter Visitors

These are normally entirely non-breeding and mainly from the Soviet Union. In terms of number and variety of species this category covers the majority of all migrants which visit Pakistan. It includes four grebes. 19 species of duck and 2 wild geese, 2 storks, 2 pelicans and 1 cormorant, 2 herons, a spoonbill. Probably 6 rails and crakes , 4 cranes and bustards, at least 7 Charadridae, 12 Tringinae, 8 Calidridinae, 3 snips, 2 owls and at least 12 raptors. Amongst the passerines are 2 larks, 3 pipits and apportion of the entire Yellow headed and White Wagtail.

Palearctic Transit Migrants

These can be sub-divided into three categories:

i) Those species wintering in east Africa of which almost the whole population breeds outside of Pakistan and which are largely recorded on autumn passage only.

ii) Those species wintering in east Africa, a part of whose population beds in Pakistan and with a significant spring as well as autumn return passage though Pakistan territory.

iii) Species wintering largely in India and breeding extra-limitally but with a conspicuous spring and autumn passage through Pakistan in a south-east to north-west direction.

iv) Summer breeding visitors to the northern mountains of Pakistan. These can be divided into two sub-categories on the basis of zoogeographic affinities.

   a) Oriental or Himalayan species which winter in India as well as Pakistan.

   b) Palearctic species which winter in India and Pakistan of which part of their population breeds in the Himalayan region of Pakistan and part further north in the Soviet Union.

v) Monsoon or summer season breeding visitors from India or the Oriental region, which remain in lowland areas. A remnant population of some of these species remains during winter within Pakistan but there is noticeable influx in the spring or early summer month.

vi) Summer breeding visitors of Oriental affinity which perform an east-west migration. Largely along the Himalayan foothill zone, the Siwaliks and Duars.

vii) Oceanic or littoral migrants which do not breed in Pakistan. Both shoreline and pelagic species usually concentrate within 32 K.M of the coast and they are assumed to have arrived by oceanic routes and not over land across Pakistan.

viii) Altitudinal or inter-montane local migrants. The great majority of species breeding in the Himalayas perform some form of limited migration, either straggling gradually down to the foothills as winter progress or crossing several high ranges to winter in the northern regions of the plains. Some remain in their northern mountain breeding latitudes but descend only to immediate neighboring valleys. Pakistan has such a variety of montane local migrants that it is only practicable to list a few of the more conspicuous.

ix) Palearctic winter visitors (breeding extra-limitally), who visit only montane steppe and western border foothill regions of Pakistan and which apparently migrate partly in a north-west o south-east axis.

Birds ringed in the Soviet Union and shot in Pakistan include Bareheaded Geese *(Anser indicus)*, Grey legged Geese *(Anser anser)*, Common Teal *(A. crecca)*, Mallard *(Anas platyrhynchos)*, Pintail *(Anas acuta)*, the Large Cormorant *(Phalacrocrax carbo sinesis)*, Great White Egret *(Egretta alba)*, Gullbilled Tern *(Gelochelidon nilotica)*, the yellow-legged race of the Herring Gull *(Larus argentatus heuglini)* and the Spoonbill *(Platalea leucorodia)*.

Indian recoveries of birds which were ringed in the Soviet Union and which most certainly have entered via Pakistan include the Rose-colored Starling *(Sturnus roseus)*, Red breasted Flycatcher *(Musicapa ficedula)*, Great Black-headed Gull *(Larus ichthyaetus)*.

White and Black Storks *(Ciconia ciconia and C. nigra)*, Dalmatian Pelicans *(Pelecanus crispus)*, Common and Demoiselle Cranes *(Grus grus* and *Anthropodies vigro)* use a gliding technique as observed on migration in Pakistan. Theycircle round on a suitable thermal, often until they reach heights of nearly 5,000 meters (17,000 feet) and then they rapidly form into 'V' echelons or skeins and glide slowly downwards with occasional wing flapping to maintain height. Wagtails *(Motacilla spp)* and Pipits *(Anthus spp)* fly at no more than 100 meters (3-400 feet) above the ground.

When the Indus flyway commission was formulated in 1976, Pakistan also became the member of Ramser Convention. Since then annual waterfowl counts have been taken on major wetlands of Pakistan. The average population of waterfowl in some of important wetlands is given in Table-2.

Table-2 **Average Population of Waterfowl on each Ramsar Site from 1985 to 1989.**

Sr. No.	Name of site	Province	Waterfowl Census					Average Popula-tion/ Year
			1985 1999	1986		1987	1988	
1	Keenjhar Lake (Wildlife sanctuary)	Sindh	69702	70769	135749	207541	128161	122384
2	Haleji Lake (Wildlife sanctuary)	Sindh	41009	78604	63658	103161	96074	76381
3	Drigh Lake (Wildlife sanctuary)	Sindh	-	15695	2775	17442	15389	12825
4	Kahbekki Lake	Punjab	276	-	1471	2316	2195	1565
5	Tanda Dam	NWFP	648	-	764	840	1419	918
6	Thanedarwala (Game reserve)	NWFP	138	-	720	34	1549	610
7	Kheshi reservoir	NWFP	12	-	216	-	998	400
8	Malugul Dhand	NWFP	712	-	314	8	289	329
9	Kandar Dam	NWFP	20	-	89	3	95	52

The migratory birds after entering in Pakistan through the Indus flyway (Figures 3 & 4) disperse throughout the Indus Basin but concentrate to the wetlands where they can feed and breed in favourable environmental conditions. In Punjab the distribution of major migratory species is given in Table-3.

Fig. 3 Flyways to Pakistan

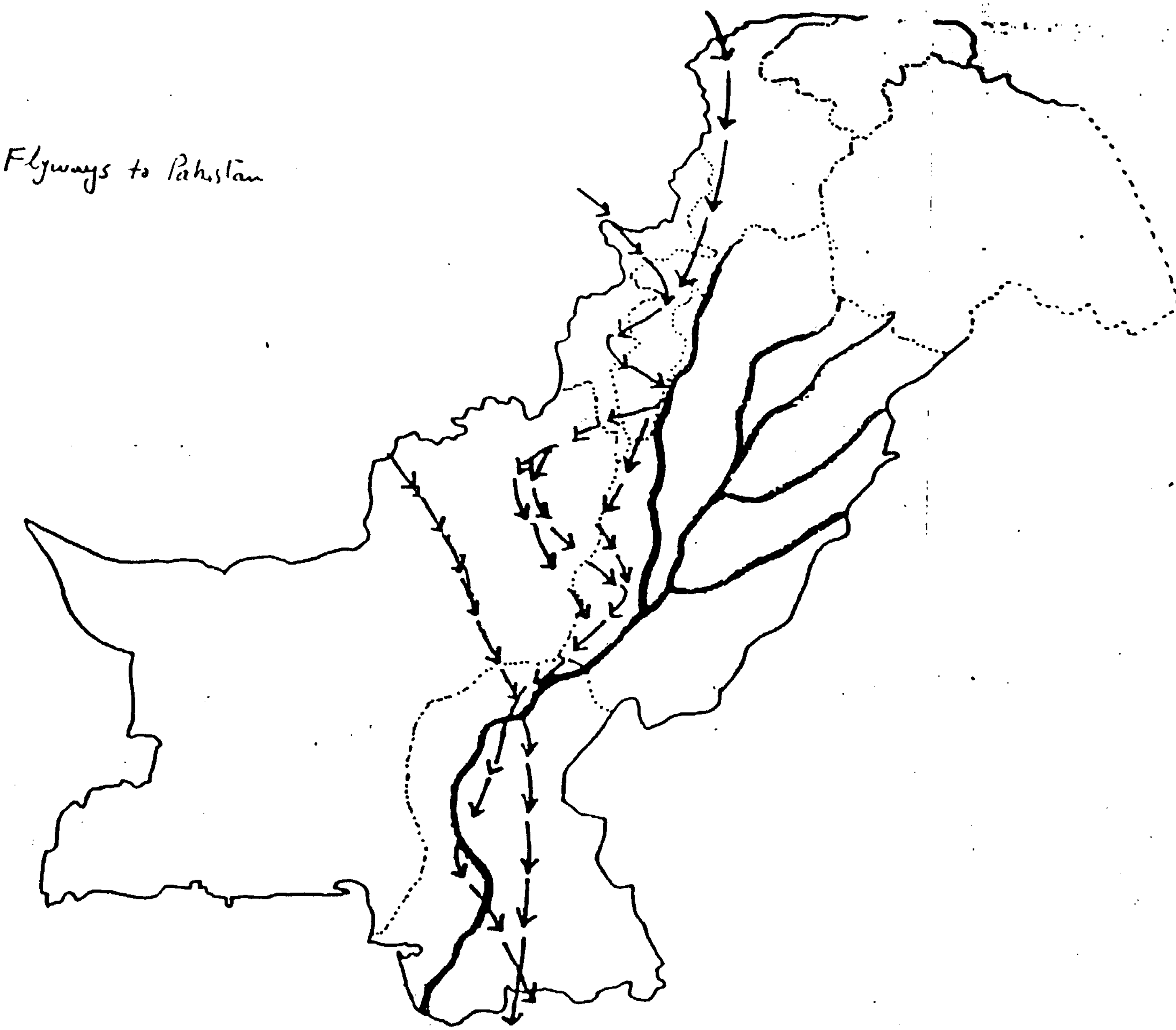

Fig. 4 Flyways from Pakistan

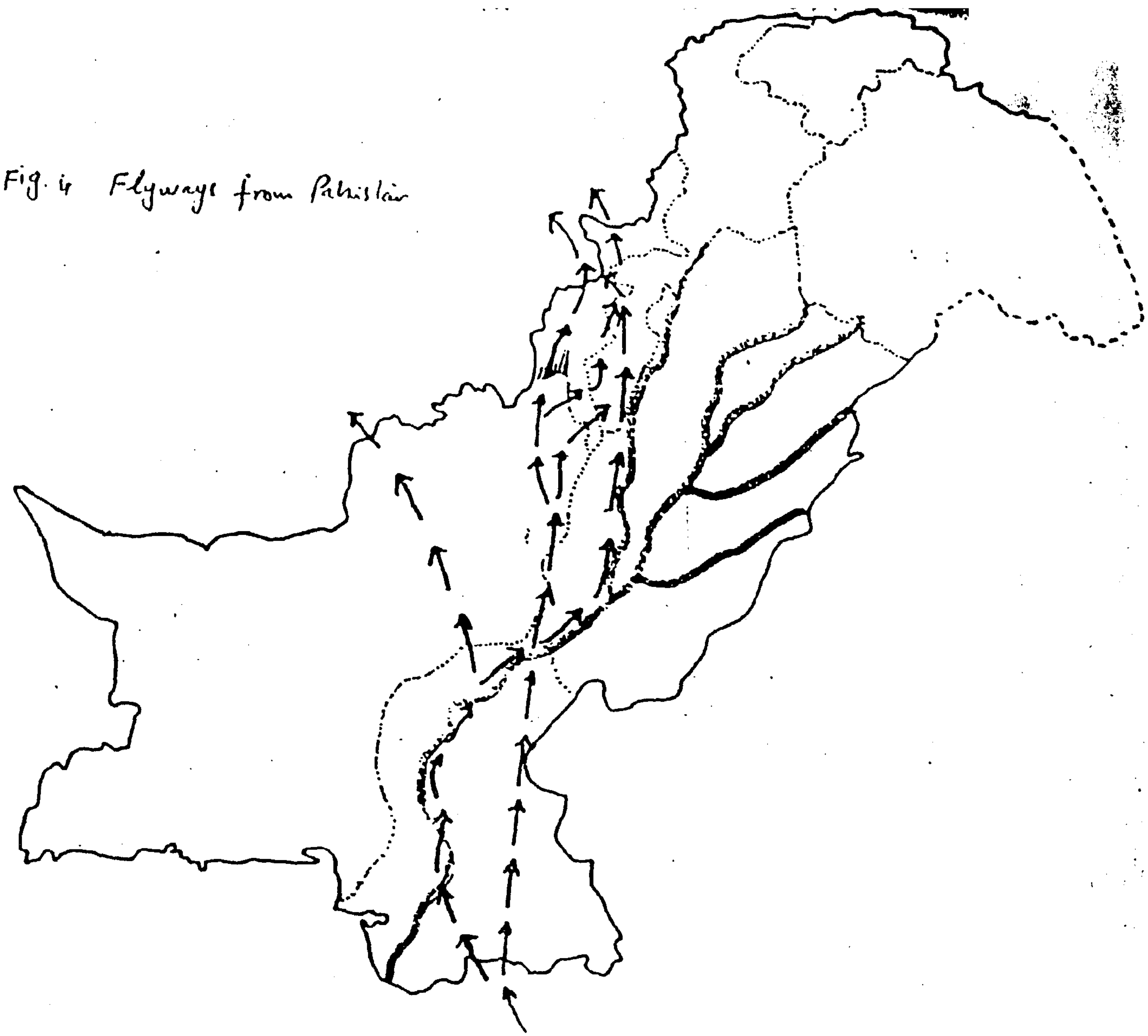

Table-3 **Distribution Areas of Migratory Birds in Pakistan.**

Sr. No.	Name of Species	Common Name	Season of Migration	Distribution Areas
1.	*Coturnix conturnix*	Common Quail or Grey Quail	Winter	All provinces of Pakistan.
2.	*Pterocles orientalis*	Imperial Sand Grouse or Black Bellied Sand Grouse		Thal, Cholistan in Punjab and Thar Desert in lower Sindh and Southern Balochistan.
3.	*Pterocles exustus*	Indian Sand Grouse		Balochistan, Sindh & Cholistan. Also in Peninsular Indus.
4.	*Chlamydotis undulata*	Houbara Bustard	Spring	Kohat, Kurram Valley N.W.F.P
5.	*Anthropoids virgo*	Demoiselle Crane	Winter	Regular Autumn migration recorded over Kohat, Bannu, Mianwali, Khushab, D. I. Khan, Muzaffargarh & D. G. Khan.
6.	*Grus grus*	Common Crane	Winter	Punjab/N.W.F.P.
7.	Anser anser	Grey lag Goose	winter	Salt Range, Ucchali, Taunsa Barrage, Sanqriaro lake, Sindh & Balochistan.
8.	Anser indicus	Bar Headed Goose	Winter	Indus River, Taunsa Barrage & Punjnad Head Works.
9.	*Tadorna ferruginea*	Ruddy Shel Duck or Brahminy Duck	Winter	All provinces on Lakes and Rivers.
10.	*Tadorna tadorna*	Common Shell Duck	Winter	All Lakes of Punjab & Sindh.
11.	*Anas platyrhynchos*	Mallard	Winter	All Lakes of Punjab & Sindh
12.	*Anas penelope*	Widgeon	Winter	Fresh Water Lakes along main rivers.
13.	*Anas clypeata*	Shoveler	Winter	Lakes, Irrigation reservoirs & Barrages
14.	*Anas querquedula*	Garganey	Winter	Ponds, Jheels and Marshy areas.
15.	*Anas grecca*	Common Teal	Winter	Water Lakes of Pakistan
16.	*Dendrocygna javancia*	Lesser Whistling Teal	Summer	Sindh & Punjab.
17.	*Oxyura leucocephale*	White Headed Duck	Winter	Salt range, lakes, and Jhelum lakes.
18.	*Falco-peregrinus*	Peregrine Falcon	Winter	Indus Plains mangrove creeks Karachi coast, irrigation Barrages, Jheels.

GBHP TRANSMISSION LINE PROJECT

The project is a part of overall transmission programme of Water and Power Development Authority (WAPDA) and will dispose of 1450 MW of power to be generated at Ghazi Barotha Hydro Electric Power Complex. The power complex shall comprise 5 units of 290 MW capacity with the first to be commissioned in September 2001. The project involves the following works:

(a) Construction of 500 kV transmission lines (single circuit 23 km + 60 km double circuit) for In & Out arrangement of existing Tarbela-Gatti 500 kV Transmission Lines Circuits 1 & 2 at Barotha.

(b) Two Barotha-Rewat 500 kV transmission lines along with necessary line bays at Rewat (100 km single circuit + 60 km double circuit).

IMPACT OF HIGH POWER LINES ON MIGRATION OF BIRDS

The construction of high voltage transmission lines will exert no hindrance for the migrating birds and hence have no overall negative impact on species movement and dispersal because:

- Among the four invasion routes of birds, three viz., (i) extreme south-east corner of lower Sindh and the north-east corner of Punjab, (ii) extreme south-west corner and through the Makran, and (iii) Hemalayan foot hills, are far away from the project area. The fourth invasion route down through the higher mountain ranges which extend roughly from north to south from Chitral through the NWFP via the Safed Koh, Waziristan and down into Balochistan also extend to the right side of the Indus whereas the corridor of the transmission lines lies on the left side (Refer figures 3 & 4).

- Important water bodies in NWFP as shown in Fig. 1 and Table-2 are Tanda Dam, Thanedarwala Game Reserve, Kheshi Reservoir, Malugul Dhand and Kandar Dam. All these wetlands are on the right side of the Indus and attract the migratory birds. Consequently the migratory birds will keep themselves away from the transmission lines extending from GBHP. Moreover the entire in fly and out fly routes are also on the right side, hence no influence of project activities will be extended to the birds migrating to the above mentioned water bodies. The important wetlands on the left side of Indus are Mangla Reservoir and Rasul Barrage which are also 80-90 km from the proposed route of transmission lines.

- High voltage (500 kV) transmission lines viz. Tarbela-Gatti I & II and Tarbela-Rawat-Lahore are already existing in the area. The Rawat-Lahore section of transmission line passes very close to the Rasul Barrage which is an important habitat for feeding and breeding of migratory as well as sedentary bird as evidenced by the average population of birds given in Table-1. No mortality of birds has been noted/documented as a result of current. However, rare cases of birds mortality has been noted on low-tension wires but this is only due to large size nesting on the electric poles.

- The comparison of Tables 1&2 reveals that the number of birds coming to the wetlands in NWFP are very low as compared to wetlands in Punjab and Sindh. It may be concluded that the migratory flocks either fly through Indus flyway to Sindh and Balochistan or divert to Rasul and Qadirabad barrages etc. well before reaching in the project area.

- The birds during migration fly at the height between 500 to 2000 meters whereas the transmission tower height is 40 meters maximum.

- The wire span of the suspension towers (proposed for the project) is 9 meters phase to phase and this space is quite safe for flying the birds even through the wires.

- Only two small dams namely Sipala Dam and Dhola Dam are situated near the ROW. These two dams have deep reservoirs having less aquatic vegetation, which could not support shelter, & feeding for large number of resting birds. Consequently most of the birds tend to fly towards more potential wetlands such as Ucchali lake and Rasool barrage, which are far further from the proposed route of transmission lines.

- The high risks of damage to the migrants in the project area are hunters and predators. The loss of lives of migratory birds from the predators is a natural phenomenon and it does not relate with the project activities. The access roads during construction phase might enhance hunting due to easy access of shooters to wetlands but above mentioned dams are located away from the major settlements. Moreover the access roads are temporary and will recover in short period.

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APPENDIX "E"

CENSUS SURVEY

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA

(Patal)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Cultivation Method	Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I. Barotha-Gatti Outgoing Single Circuit I															
1	140-1		Jabbi	Ahmed Nawaz & Fateh Sher	Abdul Aziz	58	4	Uncultivated-Banjar	Phalai-18	-	-	6	-	Purchased	
2	140-2		Jabbi	Mazhar Khan	Abdullah Khan	135	4	Cultivated - Barani	-	Wheat & Maize	Rahum Elahi S/o Muhammad Elahi	10	Tractor	Inherited	Compensation amount for crops to be shared according to law
3	140-3		Jabbi	- do -	- do -	40	4	Cultivated - Barani	-	Wheat	Muhammad S/o Jaya	5	- do -	- do -	Compensation amount for crops to be shared according to law
4	140-4		Jabbi	- do -	- do -	150	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
5	140-5		Jabbi	Noor Khan	S/o Feroze	100	4	Cultivated - Barani	-	Pulses	Self	-	- do -	- do -	
6	140-6		Jabbi	Muhammad Ashraf	Ch. Fateh Muhammad	160	4	Cultivated - Barani	-	Maize	Self	10	- do -	- do -	
II. Barotha-Gatti Outgoing Single Circuit II															
7	143-1		Jabbi	Allah Dad	Ch. Fateh Muhammad	150	4	Cultivated - Barani	-	Wheat	Self	8	Tractor	Inherited	
8	143-2		Jabbi	Naimat Shah, Jamshed & Bakhshazeb	Shahmeray	80	4	Cultivated - Barani	-	Wheat	Self	3	- do -	- do -	
9	143-3		Jabbi	Fazal Dad	Baza Khan	40	4	Cultivated - Barani	-	Wheat	Self	5	- do -	- do -	
10	143-4		Jabbi	Maqsood Khan	Noor Khan	127	4	Cultivated - Barani	-	Wheat	Self	10	- do -	- do -	
11	143-5		Jabbi	Lal Khan	Ali Gohar	163	4	Cultivated - Barani	-	Wheat	Self	4	- do -	- do -	
12	143-6		Jabbi	Major Tahir Khan	Sadiq Khan	800	4	Cultivated - Barani	Phalai- 3	Wheat	Self	21	- do -	- do -	
13	143-7						4								
14	143-8		Jabbi	Sher Ahmed	Noor Khan	30	4	Cultivated - Barani	-	Maize	Self	5	- do -	Purchased	
15	143-9		Jabbi	Mosam Khan	-	25	4	Cultivated - Barani	Phalai- 3	Wheat	Self		-	Inherited	
16	143-10		Jabbi	Malik Sadiq, Malik Akram & Malik Saadat	Malik Hassan Khan	500	4	Uncultivated - Banjar	Phalai- 30	-	-	6	Tractor	- do -	
17	143-11		Jabbi	Mazhar Khan	Abdullah Khan	800	4	Uncultivated - Banjar	-	-	-	11	- do -	- do -	
18	143-12		Jabbi	Mazhar Khan	Abdullah Khan	800	4	Cultivated - Barani	-	Wheat	Self	-	- do -	Inherited	
19	143-13		Langar	Rafaqat	Jumma Khan	200	4	Uncultivated - Banjar	-	-	-	12	- do -	- do -	

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA

(Fatial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information			Remarks
												Livestock (No.)	Cultivation Method	Type of Holding	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
20	143-14		Langar	Istab Khan	-	240	4	Cultivated - Barani	_	Oilseed	Safdar S/o Hassau	10	- do -	- do -	Compensation amount for crops to be shared according to law
21	143-15		Langar	Istab Khan	-	150	4	Cultivated - Barani	_	Wheat	Karam Dad S/o Pasda Khan	12	- do -	- do -	Compensation amount for crops to be shared according to law
22	143-16		Langar	Raja Khan	Ghulab Khan	300	4	Cultivated - Barani	_	Wheat	Self	12	- do -	- do -	
23	143-17						4								
24	143-18		Langar	Javed Khan	Inayat Ali	350	4	Cultivated - Barani	_	Wheat	Mirdad S/o Nawab	5	- do -	- do -	Compensation amount for crops to be shared according to law
25	143-19		Langar	- do -	- do -	350	4	Cultivated - Barani	_	Oilseed	Ghulam S/o Karam Dad	2	- do -	- do -	Compensation amount for crops to be shared according to law
26	143-20		Langar	- do -	- do -	350	4	Cultivated - Barani	_	Wheat	Asalm S/o Jhang Bahadar	3	- do -	- do -	Compensation amount for crops to be shared according to law
27	143-21		Langar	Ghulam Khan	Haji Ghulab Khan	60	4	Cultivated - Barani	_	Wheat	Self	6	- do -	- do -	
28	143-22		Langar	Asad Khan	Mumtaz Khan	400	4	Cultivated - Barani	_	Wheat	Raja Shah S/o Akbar Shah	13	- do -	- do -	Compensation amount for crops to be shared according to law
29	143-23		Langar	Sultan Shah	Saiden Shah	70	4	Cultivated - Barani	_	Wheat	Self	8	- do -	- do -	
30	143-24		Langar	Haji Sarwar	Bahadar	40	4	Cultivated - Barani	_	Pulses	Self	6	- do -	- do -	
31	143-25		Ghakhar	Sardar Mehmood Khan	Muhammad Khan	90	4	Uncultivated - Hill	Open Scrub Forest - 50 bushes	_	_	10	_	- do -	
32	143-26						4								
33	143-27			Muhammad Nawaz	Sher Ahmed	200	4	Uncultivated - Banjar	Open Scrub Forest - 50 bushes	_	_	12	_	- do -	
34	143-28		Ghakhar	Mst. Yousaf Sultan	-	45	4	Uncultivated - Banjar	Phalai- 14	_	_	_	_	- do -	

APPENDIX "E"

Sheet 3 of 8

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA
(Patial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information			Remarks
												Livestock (No.)	Cultivation Method	Type of Holding	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
35	143-29		Ghakhar	Muhammad Zaman	Ahmed Khan	14	4	Uncultivated - Banjar	-	-	-	12	-	- do -	
				Rab Nawaz Khan	Wara Khan										
				Amir Mukhtar	Kala Khan										
36	143-30		Ghakhar	Mst. Younat Sultan	-	18	4	Uncultivated - Banjar	Safaida - 65	-	-	-	-	- do -	
37	143-31		Behlol	Taj Muhammad	Karam Khan	60	4	Cultivated - Barani	-	Wheat	Self	8	Tractor	Purchased	
38	143-32		Behlol	Younas Khan	Muhammad Khan	80	4	Uncultivated - Banjar	-	-	-	13	-	- do -	
39	143-33		Behlol	Israil Khan	Muhammad Khan	30	4	Cultivated - Barani	-	Wheat	Self	14	Tractor	- do -	
				Taj Muhammad	Karam Khan										
40	143-34		Behlol	Muhammad Riaz	Muhammad Akbar	45	4	Cultivated - Barani	-	Wheat	Self	3	- do -	- do -	
III. Tarbela-Barottha Incoming Double Circuit I & II															
41	I-3		Barotha	Ahmed Khan	Ghulam Sarwar	80	4	Cultivated - Barani	-	Wheat	Self	4	Tractor	Inherited	
42	I-4		Barotha	Khan Bahadar	Mehnga Khan	60	4	Cultivated - Barani	-	Wheat	Self	3	- do -	- do -	
43	I-5		Barotha	Khan Bahadar, Fazal Dad, Sher Khan & Jafar Khan	Muhammad Khan	55	4	Cultivated - Barani	-	Wheat	Self	5	- do -	- do -	
				Taj Bibi	Khan Bahadar										
44	I-6	-	Barotha	Fateh Khan	Fazal Dad	12	4	Uncultivated - Nullah	-	-	-	-	-	- do -	
45	I-7		Barotha	Saif-ur-Rehman	-	40	4	Cultivated - Barani	-	Wheat	Self	2	Tractor	- do -	
46	I-8						4								
47	I-9		Ghariala	Sheikh Ijaz	-	16	4	Cultivated - Barani	-	Wheat	Self	3	- do -	- do -	
48	I-10		Ghariala	- do -	-	20	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
49	I-11		Ghariala	- do -	-	35	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
50	I-12		Ghariala	Safdar	Gulab	18	4	Cultivated - Barani	-	Wheat	Self	3	- do -	- do -	
51	I-13		Ghariala	Aurangzeb	Ghulab	16	4	Cultivated - Barani	-	Wheat	Self	2	- do -	- do -	

APPENDIX "E"

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA
(Patial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Miscellaneous Information: Cultivation Method	Miscellaneous Information: Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
52	I-14		Ghariala	Muhammad Nawaz	Sher Jhang	80	4	Cultivated - Barani	_	Oilseed	Self	2	- do -	- do -	
53	I-15		Ghariala	Malik Fateh Khan	Mian Ahmed	200	4	Cultivated - Barani	_	Oilseed	Razzaq	_	- do -	- do -	Compensation amount for crops to be shared according to law
				Sher Ahmed	Shahis	170		Cultivated - Barani	_	Wheat	Self		- do -	- do -	
54	I-16		Mongiwali	Ashraf	Sher Jhang	30	4	Cultivated - Barani	Beri - 4	Vegetable	Self	4	- do -	Purchased	
55	I-17		Mongiwali	Hukam Dad	Sikandar	30	4	Cultivated - Well Irrigated	_	Vegetable	Self	2	- do -	- do -	
56	I-18		Salar	Karam Dad	Mehdi Khan	30	4	Cultivated - Barani	_	Oilseed	Self	_	- do -	- do -	
57	I-19		Salar	Waheed Khan	Ghulam Muhammad Khan	3000	4	Cultivated - Barani	_	Oilseed	Hazar Khan S/o Noor M. Khan	8	- do -	Inherited	Compensation amount for crops to be shared according to law
58	I-20		Salar	Imran Khan	Doulat Muhammad Khan	4000	4	Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
59	I-21		Salar	Muhammad Asif Khan	Muhammad Nawaz Khan	2000	4	Cultivated - Barani	Safaida - 13	Wheat	Self	_	- do -	- do -	
60	I-22		Sarwala	Nisar Khan	Lal Khan	150	4	Cultivated - Barani	_	Wheat	Faiz Muhammad S/o Allah Bux	8	- do -	- do -	Compensation amount for crops to be shared according to law
61	I-23		Sarwala	Yousaf	-	40	4	Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
62	I-24		Sarwala	Allah Dad	Sadiq	32	4	Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
63	I-25		Sarwala	Haq Nawaz	Muhammad Ashraf	50	4	Cultivated - Barani	_	Wheat	Self	4	- do -	- do -	
64	I-26		Sheen Bagh	Miskeen	Wris Khan	40	4	Cultivated - Barani	_	Oilseed	Self	_	- do -	- do -	
				Karim Khan	Doulat Khan	18		Cultivated - Barani	_	Oilseed	Self	3	- do -	Inherited	
65	I-27		Sheen Bagh	Malik Hakmin Khan	-	200	4	Cultivated - Barani	_	Wheat	Khalil	4	- do -	- do -	Compensation amount for crops to be shared according to law

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA

(Patial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Miscellaneous Information: Cultivation Method	Miscellaneous Information: Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
66	I-28		Sheen Bagh	Bakhshan Khan	Aslam Khan	4500	4	Cultivated - Barani	_	Wheat	Self	9	- do -	- do -	
67	I-29		Sheen Bagh	- do -	- do -		4	Cultivated - Barani	_	Wheat	Karim Khan	_	- do -	- do -	Compensation amount for crops to be shared according to law
68	I-30		Sheen Bagh	- do -	- do -		4	Cultivated - Barani	_	Wheat	Sher Khan	_	- do -	- do -	Compensation amount for crops to be shared according to law
69	I-31		Mari	Munawar Khan	Banaris Khan	150	4	Cultivated - Barani	_	Maize	Self	4	- do -	- do -	
70	I-32		Mari	Ghulam Khan	Rashid Khan	200	4	Cultivated - Barani	_	Wheat	Tariq Khan S/o Waris Khan	8	- do -	- do -	Compensation amount for crops to be shared according to law
71	I-33		Mari	Mst. Hashmat Jan	Wife of Muhammad Akram	40	4	Cultivated - Barani	_	Wheat	Self	6	- do -	- do -	
72	I-34		Mari	Masood	Mir Haider	60	4	Cultivated - Barani	_	Wheat	Self	3	- do -	- do -	
73	I-35		Mari	Ehsan Khan	Ahmed Khan	100	4	Cultivated - Barani	_	Pulses	Self	_	- do -	- do -	
74	I-36		Baryar	Abdul Sattar	Muhammad Akbar	150	4	Cultivated - Barani	_	Pulses	Self	3	- do -	- do -	
75	I-37		Baryar	Sardar Iqbal Khan	Akbar Khan	400	4	Cultivated - Barani	_	Wheat	Zahir Ahmed S/o Fazal Dad	8	- do -	- do -	Compensation amount for crops to be shared according to law
76	I-38		Baryar	Hassan Akhtar & Mir Afzal	Haji Ahmed	100	4	Cultivated - Barani	_	Oilseed	Self	3	- do -	- do -	
77	I-39		Baryar	Noor Abdullah	Noor Ahmad	60	4	Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
78	I-40		Jasian	Shamim Khan, Nawazish Khan & Haji Ahmad Khan	Akbar Khan	1500	4	Cultivated - Barani	Phulai - 2	Wheat	Self	_	- do -	- do -	
79	I-41		Jasian	Shamim Khan, Nawazish Khan & Haji Ahmad Khan	Akbar Khan		4	Cultivated - Barani	Phulai - 3	Wheat	Self	_	- do -	- do -	
80	I-42		Jasian	Shamim Khan, Nawazish Khan & Haji Ahmad Khan	Akbar Khan		4	Cultivated - Barani	Phulai - 2	Wheat	Self	_	- do -	- do -	
81	I-43		Jasian	Shamim Khan, Nawazish Khan & Haji Ahmad Khan	Akbar Khan		4	Cultivated - Barani	Phulai - 4	Wheat	Self	_	- do -	- do -	

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA
(Patni)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Miscellaneous Information: Cultivation Method	Miscellaneous Information: Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
82	I-44		Baryar	Nawazish Khan	Akbar Khan	1500	4	Cultivated - Barani	-	Wheat	Self & Miskeen S/o Jandad	-	- do -	- do -	Compensation amount for crops to be shared according to law
83	I-45		Baryar	Shamim Khan	Akbar Khan	1500	4	Cultivated - Barani	-	Pulses	Self	-	- do -	- do -	
84	I-46		Kahutra	Shamlat Deh		1200	4	Uncultivated - Hill	Phalai - 150	-	-	-	- do -	Inherited	
85	I-47		Kahutra	- do -			4	Uncultivated - Hill	- do -	-	-	-	- do -	- do -	
86	I-48		Kahutra	- do -			4	Uncultivated - Hill	- do -	-	-	-	- do -	- do -	
87	I-49		Kahutra	- do -			4	Uncultivated - Hill	- do -	-	-	-	- do -	- do -	
88	I-50		Kahutra	- do -			4	Uncultivated - Hill	- do -	-	-	-	- do -	- do -	
89	I-51		Kahutra	- do -			4	Uncultivated - Hill	- do -	-	-	-	- do -	- do -	
90	I-52		Kahutra	Shahbaz	Ghulam Sarwar		4	Uncultivated - Hill	- do -	-	-	6	-	- do -	
91	I-53		Kahutra	Sheena Khan	Sher Khan	60	4	Cultivated - Barani	-	Wheat	Self	-	Tractor	- do -	
92	I-54		Kahutra	Asif Khan	Dilawar Khan	32	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
93	I-55		Kahutra	Shamlat Deh	-	200	4	Uncultivated - Hill	Open Scrub Forest - 50 bushes	-	-	-	- do -	- do -	
94	I-56		Kahutra	Muzafar Khan	Lal Khan	58	4	Cultivated - Barani	-	Wheat	Self	6	- do -	- do -	
95	I-57		Kahutra	Abdul Salam	-	35	4	Cultivated - Barani	-	Wheat	Self	1	- do -	- do -	
96	I-58		Kahutra	Rab Nawaz	Allah Dad Khan	40	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
97	I-59		Kahutra	Ali Khan	Mehar Khan	35	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	
98	I-60		Kahutra	Adalat Khan	Ghulam Muhammad Khan	32	4	Cultivated - Barani	-	Wheat	Self	6	- do -	- do -	
				Major Raza	Sadullah Khan										
99	I-61		Kahutra	Karam Dad	Noor Muhammad	50	4	Cultivated - Barani	-	Wheat - Gram	Self	-	- do -	- do -	
100	I-62		Kahutra	Muzafar Khan	Allah Dad Murshi	47	4	Cultivated - Barani	-	Oilseed	Self	-	- do -	- do -	
101	I-63		Kahutra	Muhammad Khan	Mehar Khan	30	4	Cultivated - Barani	-	Wheat	Self	-	- do -	- do -	

APPENDIX "E"

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA

(Patial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Miscellaneous Information: Cultivation Method	Miscellaneous Information: Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
102	I-64		Kahuta	Khalid Mehmood	Azad Khan	70	4	Cultivated - Barani	_	Wheat - Gram	Kala Khan	_	- do -	- do -	Compensation amount for crops to be shared according to law
103	I-65		Kahutra	Aurangzeb	Shahia	32	4	Cultivated - Barani	_	Wheat - Gram	Lal Khan	_	- do -	- do -	Compensation amount for crops to be shared according to law
104	I-66		Kahutra	Shamlat Deh		60	4	Cultivated - Barani	_	NALA	Self	_	_	- do -	
105	I-67		Kahutra	Sheikh Waheed	Fazal Karim	32	4	Cultivated - Barani	_	Wheat - Maize	Self	_	Tractor	- do -	
106	I-68		Khawa	Ghulam Muhammad	Noor Muhammad	40	4	Cultivated - Barani	_	Wheat - Maize	Self	8	- do -	- do -	
				Hayat Muhammad	Fateh Muhammad										
107	I-69		Khawa	Sardar	Qadar Khan	1500	4	Cultivated - Barani	_	Wheat -Pulses	Self	_	- do -	- do -	
108	I-70		Khawa	Raja Khan	Sher Jhang	280	4	Cultivated - Barani	_	Wheat - Maize	Sher Bahadar S/o Jhang Bahadar	_	- do -	- do -	Compensation amount for crops to be shared according to law
109	I-71		Khawa	Ayub Khan	Mirza Khan	300	4	Cultivated - Barani	_	Wheat - Maize	Self	3	- do -	- do -	
110	I-72		Khawa	Ghulam Farid	Sher Jhang	10	4	Cultivated - Barani	_	Wheat - Maize	Self _	_	- do -	- do -	
111	I-73		Khawa	Abdul Qayyum	Sher Jhang	30	4	Cultivated - Barani	_	Pulses	Self	_	- do -	- do -	
112	I-74		Khawa	Muhammad Nawaz & Malik Nisar	Muhammad Akram	60	4	Cultivated - Barani	_	Wheat	Hashim Khan S/o Muhammad Sadiq	_	- do -	- do -	Compensation amount for crops to be shared according to law
				Muhammad Sadiq, Muhammad Raza & Muhabat Khan	Kala Khan	40		Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
113	I-75		Khawa	Ahmed Khan	Sher Ahmed	100	4	Uncultivated - Hill	Open Scrub Forest - 30 bushes	NALA	_	_	_	- do -	
114	I-76		Khawa	Zareet Khan	Amir Dad	18	4	Cultivated - Barani	_	Wheat	Self	_	Tractor	- do -	
				Kala Khan, Nawaz Khan & Haji Hasti Khan	Shahdad										

APPENDIX "E"

Sheet 8 of 8

GHAZI-BAROTHA HYDROPOWER PROJECT
500 kV TRANSMISSION LINES SYSTEM
FOCUSED CENSUS SURVEY DATA
(Patial)

Sr.No	Tower	Location of Tower (Khasra #)	Village	Name of Owner	Father's Name	Total Landholding (Kanal)	Land Area to be Acquired (Kanal)	Type of the Acquired Land	Type & No. of Trees in Affected Area	Crops Sown Winter & Summer	Name of Cultivator	Miscellaneous Information: Livestock (No.)	Miscellaneous Information: Cultivation Method	Miscellaneous Information: Type of Holding	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
115	I-77		Bahlwal	Kala Khan, Nawaz Khan & Haji Hasti Khan	Shahdad	50	4	Cultivated - Barani	_	Wheat	Self	6	- do -	- do -	
116	I-78		Bahlwal	Hayat Shah	Shah Hussain	15	4	Cultivated - Barani	_	Wheat	Self	_	- do -	- do -	
117	I-79		Bahlwal	Sattar & Kala Khan	Nawaz Khan	25	4	Cultivated - Barani	_	Maize	Self	_	- do -	- do -	
				Shahna & Umar Khan	Bhola Khan	18		Cultivated - Barani	_	Maize	Self	_	- do -	- do -	
				Mst. Gohar	Wife of Rustam Khan	11		Cultivated - Barani	_	Pulses	Self	_	- do -	- do -	
118	I-80		Bahlwal	Maqsood & Qayyum Khan	Nawaz Khan	10	4	Cultivated - Barani	_	Oilseed	Self	6	- do -	- do -	
				Razaq	Qalandar	12		Cultivated - Barani	_	Wheat	Self	2	- do -	- do -	
				Shahzad & Khanzada	Karam Khan	14		Cultivated - Barani	_	Wheat	Self	5	- do -	- do -	
119	I-81		Bahlwal	Khan Dad	Azeem Khan	15	4	Cultivated - Barani	_	Wheat -Gram	Self	2	- do -	- do -	
120	I-82		Bahlwal	Shahid Khan	Karim Dad	8	4	Cultivated - Barani	_	Wheat -Gram	Self	3	- do -	- do -	
				Baz Muhammad	Karim Dad	12		Cultivated - Barani	_	Wheat -Gram	Self	_	- do -	- do -	
				Munsaf	Akbar Khan	7		Cultivated - Barani	_	Wheat -Gram	Self	1	- do -	- do -	
				Ali Haider	Wali Dad	14		Cultivated - Barani	_	Pulses	Self	5	- do -	- do -	
				Moharam Khan	Azeem Khan	18		Cultivated - Barani	_	Maize	Self	_	- do -	- do -	

E-8

CROPS YIELD BY TYPE OF LAND
AND THEIR RATE OF SALE IN VARIOUS REGIONS

Region	Crops	Crop yield per Kanal by Type of Land							Rate
		Irrigated Kg	LAS Kg	Lapara Kg	Hill Kg	Mera Kg	Riverain Kg	Rakar Kg	Per Kg (Rs)
CHACH									
	Maize	900	510	0	550	460	540	0	10.00
	Sorghum	0	320	0	400	290	0	0	15.00
	Millet	690	270	0	300	225	0	0	15.00
	Peanut	640	640	0	640	640	640	640	20.00
	Wheat	810	425	510	0	390	550	0	8.00
NALAH									
	Maize	840	490	0	530	390	520	0	10.00
	Sorghum	350	380	0	0	280	0	0	15.00
	Peanut	640	640	0	640	640	640	640	20.00
	Wheat	850	450	480	0	360	500	0	8.00
SARWALA									
	Maize	850	360	0	350	340	0	0	10.00
	Sorghum	310	0	0	350	280	0	0	15.00
	Millet	625	240	0	260	200	0	0	15.00
	Peanut	640	640	0	640	640	640	640	20.00
	Wheat	810	425	470	0	320	490	0	8.00

APPENDIX "F"

CLEARANCE CERTIFICATES

No. 39/17/95-Arch(P: II)
GOVERNMENT OF PAKISTAN
DEPARTMENT OF ARCHAEOLOGY

Karachi, the 17th January, 2000.

NO OBJECTION CERTIFICATE

The Department of Archaeology and Museums had carried out Archaeological Survey/Study along the proposed alignment of the following electric transmission lines in connection with Ghazi Baroth Hydropower Project (500 Transmission Lines) :-

I. 500 KV Barotha - Tarbella -Gatti (I&II) incoming lines of approximate length of 35.50 Kilometers.

II. 500 KV Barotha - Tarbella -Gatti (I&II) outgoing lines of approximate length of 42.30 Kilometers.

III. 500 KV Barotha - Rawat (I&II) lines of approximate length of 161.00 Kilometers.

Since no archaeological site/evidence has been recorded during this survey therefore this Department has no objection for the proposed work.

However, any evidence of Archaeological remains if found during the work may be brought in notice of this Department.

(SAEED-UR-REHMAN)
Director General

No. 39/17/95-Arch(P:II)   Karachi, the 17th January, 2000.

Copy forwarded for information and necessary action to the Curator, Archaeological Museum, Taxila with reference to his letter No.90/99-1154, dated 24th December, 1999.

D... of Archaeology
S.P.O. Taxila
Diary No. 33196
Date 27-1-2000

(TAHIR SAEED)
ASSISTANT DIRECTOR

Attested.

Curator
Archaeological Museum
TAXILA.

[illegible]

Office of the
Chief Conservator of Forests, Northern Zone, Rawalpindi.

To

The Secretary,
Govt. of the Punjab,
Forestry, Wildlife, Fisheries and
Tourism Department,
Lahore.

No. 966/AL dated Rawalpindi the [illegible]

Subject:- [illegible]

Reference : Your letter No. [illegible] dated [illegible]

[illegible]

[illegible] transmission line [illegible]

[illegible]

and near tower it is about 30 [illegible] trees come under transmission line. N.O.C may be granted.

Encl/as above.

Chief Conservator of Forests,
Northern Zone, Rawalpindi.

No. [illegible]/AL dated Rawalpindi the [illegible]

Copy is forwarded to the Conservator of Forests, Rawalpindi Circle for information with reference to his No. 1647/AL dated 14.3.2000.

Chief Conservator of Forests,
Northern Zone, Rawalpindi.

بسم اللہ الرحمٰن الرحیم

SURVEY OF PAKISTAN

No. 928 /40-?-Com
Office of No. 6 Party

Dated the 7-04-2000

Telegrams :- SURVEY PARTY
Telephone :-

FROM :-

THE OFFICER-IN-CHARGE NO. 6 PARTY
SURVEY OF PAKISTAN

To

The General Manager,
Air Trafic Services,
Headquarter C.A.A,
Karachi.

Sub:- ISSUANCE OF N.O.C TO WAPDA

Ref:- Chief Engineer letter No.2759-66/CT/TIN dated, 04-03-2000

As desired in the above referred letter the Survey work of 20 Nos Towers sites of 500 KV Transmission lines passing near by proposed Islamabad Airport has been completed. In this connection and as decided in the meeting with the ~~review~~ officials of C.A Authority, WAPDA and undersigned that the Survey of Pakistan will provide the distance of each tower from the center of Runway which are sufficient to issue the N.O.C to WAPDA by C.A.A. Therefore a list of 2 pages showing the distance of each tower from the center of runway is attached for your consideration.

The distance are written on the published sheet No. 43C/14 in red colour. It is further added that the coordinates of these towers will be supplied after obtaining the clearance from the Directorate of Military Intelligence G.H.Q Rawalpindi.

(signature)

([illegible])
O.C NO.6 PARTY
SURVEY OF PAKISTAN
[illegible]

Encl:- Two copies showing distance and Original Sheet No.43C/14 which belongs to WAPDA is attached.

Copy to:-

1. The Director Photogrammetry, Survey of Pakistan, Rawalpindi for his kind information, please.
2. The Chief Engineer [illegible] North N.T.D.C, Lahore for information, please.
3. The Executive Engineer 500 KV [illegible] for information, please.

756 994
57
1-6

NATIONAL TRANSMISSION AND DESPATCH COMPANY LTD

PH: # 5756993
FAX # 5756994

OFFICE OF THE
CHIEF ENGINEER(EHV)"N"NTDC
GSC HOUSE, GULBERG-III, LHR

NO 4521-29/CE/EHV/N/ GBP-1(A)

DATED: 19.4./2000.

Mr. Anis Ahmad Chaudhry,
Chief Environmentalist,
Pakistan Hydro Consultants(PHC),
Power Complex Colony,
BAROTHA-ATTOCK

SUBJECT:- Transmission Arrangement for Power Dispersal of Ghazi Barotha Hydropower Project -
Supplementary Report on Environmental Impact Assessment(EIA) & Resettlement Action Action Plan (RAP-II)

In continuation to this office letter No.3493-3501/CE/EHV/N Dated 25-03-2000, the required **"No Objection Certificates"** for the construction of T/Lines for the Power Dispersal of Ghazi Barotha Hydropower Project obtained from the following organizations through their letters shown against each are forwarded herewith for further necessary action please.

1) Civil Aviation Authority, Karachi(CAA) letter No.HQCA/1147/ATS(Vol-II) Dated 17-04-2000. ANNEX-I

2) Environmental Protection Deptt: (EPD) Govt: of Punjab Lahore, letter No.348/1204/F-01/2K-8/EIA/EPD Dated 18-04-2000. ANNEX-II

With the submission of Census Survey, N.O.C from Punjab Forest Deptt: inclusion of clauses for re-vegetation in the construction contract, NOC from CAA, Environmental Proteccion Deptt: and submission of revised schedule for T/Lines, all the required actions on the part of EHV (North) for EIA and RAP-II advised by Pakistan Hydro Consultants through their letter No.CM/CM/WL/7783 Dated 27-12-1999 have been completed.

In view of the above, it is requested to arrange submission of the final EIA & RAP-II report to the World Bank at the earliest for timely completion of the T/Line facilities for Power Dispersal of Ghazi Barotha Hydropower Project.

D.A/As above

19.4.2000.
CHIEF ENGINEER(EHV)
NORTH,NTDC
LAHORE

CC:-

1. Member (Water) Wapda House, Lahore, Attn:- Ahmed Khan Bhatti,G.M(P&D), 501-Wapda House, Lahore, w.r.t. his letter No.D/GBHP-36/119 DT: 28-02-2000
2. Chief Executive (NTDC) WAPDA House, Lahore.
3. Chief Executive and Construction Manager, Pakistan Hydro Consultants, 22-A, E-2, Gulberg-III, Lahore.
4. G.M & P.D(GBHP) Power Channel Village, G.T. Road, Hatlian Distt: Attock.
5. G.M(Coord:) Power, Wapda House, Lahore, w.r.t his letter No.727-28/GM(P)/T-30(PSM) dated 16-03-2000.
6. G.M(T&G) NTDC, Wapda House, Lahore.
7. P.D 500KV(EHV) North, NTDC, GSC House, Lahore.
8. M/s. NESPAK, NESPAK House, 1-C, N-Block, Model Town Extn: Lahore, Attn:- Mr. Tariq Shah, Projejct Manager.

ENVIRONMENT PROTECTION DEPARTMENT

Government of the Punjab
4 - Lytton Road, Lahore.

NO. 348/1204/F-01/2K/E-8/EIA/EPD.

DATED. 18 /04/2000.

To

The Chief Engineer (EHV) North,
National Transmission & Despatch Company Ltd.,
34-Industrial Area, Gulberg-III,
Lahore.

Subject: NOC OF ENVIRONMENTAL PROTECTION AGENCY, PUNJAB TRANSMISSION ARRANGEMENT FOR POWER DISPERSAL OF GHAZI BROTHA HYDROPOWER PROJECT (Ln 3965-Pak) ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND RESETTLEMENT ACTION PLAN (RAP-II)

Kindly refer to the Environmental Impact Assessment and Resettlement Action Plan-II (EIA & RAP-II) submitted vide No. 923-27/CE/EHV, dated 25-01-2000 for the above cited project for approval of Environmental Protection Agency, Punjab.

Environmental Protection Agency, Punjab approves the execution of aforementioned project subject to the following conditions:

(i) The proponent will take all remedial measures as proposed in the EIA & RAP of the subject project.

(ii) The proponent assumes full responsibility for all adverse environmental effects within and beyond the strip of 25 meters on either side of center line of the Transmission Line.

(iii) The proponent will compensate for the loss of trees and shrubs (approximately 30,000) because of the project by entering into a contract with the Forest Department, Punjab for providing plantation on state land.

(iv) All claims of the Project Affected People (PAPs) will be settled through Ghazi Brotha Taraquati Idara (GBTI).

DEPUTY DIRECTOR (T.T)

Endst. No __________/1204//F-01/_____/EIA/2000. Dated _______/04/2000.

A copy is forwarded for information to:

1. The Secretary, Government of the Punjab, Forest, Wildlife & Fisheries Department.
2. Dr. Riaz Ahmed Khan, Chief Executive, Ghazi Barotha Taraquati Idara (GBTI), P.O. Box No.11, G.P.O, Attock..
3. [illegible] EPA, Punjab, Lahore

ASSISTANT DIRECTOR (EIA)

TOTAL P.03

CAA

سول ایوی ایشن اتھارٹی

HEADQUARTERS
Civil Aviation Authority
Quaid-e-Azam International Airport
Karachi-75200 (PAKISTAN)
Tel No. 92 21 9218756
Fax No. 92 21 9218758
e-mail : gmmiscaa@www.fascom.com

HQCAA/1147/3/ATS(Vol-II) Dated 17th April 2000

Dear Sir,

TRANSMISSION ARRANGEMENTS FOR POWER DISPERSAL SCHEME OF GHAZI BAROTHA HYDROPOWER PROJECT ISSUANCE OF NOC BY CAA FOR THE SELECTED ROUTE OF 500KV T/LINES

1. Reference to your letter No 776-80/CE/EHV/N dated 22ND Janaury 2000 on the subject SOP letter No 928/40-0 Gen dated 7th April 2000 regarding issuance of NOC to WAPDA addressed to HQCAA and a copy endorsed to you.

2. Civil Aviation Authority has no objection to the erection of poles on circuit No 1 & II related with Power dispersal of Ghazi Barotha Hydro Project as per details given below:-

a) CIRCUIT No-1

• Tower No 7	Tower Height		1670 Feet	
• Tower No.10	"	"	1614Feet	
• Tower No.13	"	"	1568Feet	
• Tower No 18	"	"	1660Feet	Above Mean
• Tower No21	"	"	1700Feet	Sea Level
• Tower No24	"	"	1743Feet	
• Tower No27	"	"	1799Feet	

Chief Engineer (EHV),
North NTDC, 34
Industrial Area Gulberg-III
Lahore Fax No 5756994

(2)

b) CIRCUIT No.II

• Tower No.7	Tower Height		1662Feet	Above mean Sea Level.
• Tower No.90	"	"	1659Feet	
• Tower No.12	"	"	1557Feet	
• Tower No.13	"	"	1562Feet	
• Tower No.18	"	"	1613Feet	
• Tower No.21	"	"	1661Feet	

3. CAA has no objection for the erection of rest of the remaining towers. The height of the above stated towers should not be increased without the permission of CAA. These towers should be lighted by day & night.

4. This is for your further necessary action.

Assuring you our best cooperation at all times.

Sincerely,

(M.JAHANGIR KHAN)
General Manager ATS

Copy to:
1. OC No-6 Party
SOP Rawalpindi

2. Airport Manager
CAA Islamabad Airport

APPENDIX "G"

AMENDMENT CLAUSE FOR RE-VEGETATION

PAKISTAN WATER AND POWER
DEVELOPMENT AUTHORITY
LAHORE - PAKISTAN

TRANSMISSION ARRANGEMENTS FOR POWER DISPERSAL OF GHAZI BAROTHA HYDROPOWER PROJECT
(ADB LOAN NO. 1424-PAK)

CONTRACT DOCUMENTS 2017-4 CONSTRUCTION OF TRANSMISSION LINE FOR IN AND OUT ARRANGEMENT OF TARBELA - GATTI 500 kV CIRCUITS 1 & 2 AT BAROTHA

VOLUME 1

AMENDMENT NO. 1

MARCH 2000

NATIONAL
ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED
NESPAK HOUSE, 1-C BLOCK "N", MODEL TOWN EXTENSION LAHORE - PAKISTAN

CONTRACT DOCUMENTS 2017-4
CONSTRUCTION OF TRANSMISSION LINE FOR IN & OUT ARRANGEMENT OF TARBELA-GATTI 500 KV CIRCUITS 1 & 2 AT BAROTHA

AMENDMENT NO. 1

TABLE OF CONTENTS

TRANSMISSION ARRANGEMENTS FOR
POWER DISPERSAL OF GHAZI BAROTHA
HYDROPOWER PROJECT
(ADB LOAN NO. 1424-PAK)

CONTRACT DOCUMENTS 2017-4
FOR CONSTRUCTION OF TRANSMISSION LINE
FOR IN AND OUT ARRANGEMENT
OF TARBELA-GATTI 500 KV
CIRCUITS 1 & 2 AT BAROTHA

AMENDMENT NO. 1

Clause 42(3) of Conditions of Contract - Part I shall be read as follows:

Contractor will pay compensation for unavoidable crop damage, tree cutting relocation/damages to houses etc. that occurs on the right of way in cultivated areas and cost of acquisition of land (if required) for installation of towers and NTDC will reimburse the same on actual basis to the Contractor after verification of his invoices by the concerned NTDC site engineer.

The additional cost of restoration/re-vegetation of sites, if any, and duly verified by NTDC/NESPAK Site Engineers shall be payable to the Contractor at actuals. The identification of quantum of re-vegetation required shall be made at the commencement of the work and approved by NTDC and NESPAK.

for ICC (Pvt) Ltd.

...HAMMAD ...
Executive Director

ICC

APPENDIX "H"

DATA ON INCOME AND EXPENDITURES OF AFFECTEES

SOCIO-ECONOMIC IMPACT OF 500 kV TRANSMISSION LINES SYSTEM

A detailed social survey has been conducted to assess the socio-economic impact of Transmission Arrangements for power dispersal of Ghazi Barotha Hydropower Project on people whose livelihoods are likely to be affected by the transmission lines system. The survey was completed on May 28, 2000.

The survey work was carried out by holding scoping sessions, personal contact and collecting information through two types of questionnaires. The first for collecting data on income and expenditure for thirty-six house holds, three farm houses and one poultry farm and the second for persons losing 25% of their land.

The questionnaire mainly covered data relating to income and expenditure to meet the objectives of the project and establish base line socio-economic conditions and likely impact on the residents of the area.

The data is enclosed herewith as Annexures I, II and III.

p:\tl\ribds.doc

Social Impact
Ghazi Barotha Hydropower Project
500 kV Transmission Line System
36 Houses

S No	Type of Infrastructure[1]	Owner's Name		Name of Occupant[3]	Status of Occupant[4]	Area of Plot			Type of Construction[5]	Estimated Cost	Annual Income		Total	Expenditure	Income Loss Due To Disruption
		Plot[2]	Structure			Covered area (Sq. m.)	Open area (Sq. m.)	Total area (Sq. m.)		Rs.	Agriculture Rs.	Other Sources Rs.	Rs.	Rs.	
A.	RESIDENTIAL BUILDINGS														
1	House	Muzaffar Khan	Ditto	Self	Owner	336.00	564.00	900.00	C	118,944.00	6,000	36,000	42,000	36,000	4,200
2	House	Kala Khan	Ditto	Self	Owner	126.00	269.00	395.00	C	44,604.00		36,000	36,000	33,000	3,000
3	House	Shan Nawaz	Ditto	Self	Owner	211.00	489.00	700.00	B	116,472.00	6,000	41,000	47,000	42,000	2,800
4	House	Noor Mohammad	Ditto	Self	Owner	102.48	247.66	350.14	C	36,277.92	28,000	126,000	154,000	75,000	8,000
5	House	Iqbal Khan	Ditto	Gul Hayat	Tenant	96.00	224.00	320.00	C	33,954.00	35,000	278,000	313,000	150,000	5,000
6	House	Rab Nawaz	Ditto	Muhammad Sarwar	Tenant	71.75	130.00	201.75	C	25,399.50	90,000	48,000	138,000	78,000	5,000
7	House	M. Azeem	Ditto	Self	Owner	62.00	282.00	344.00	C	21,948.00	11,400	48,400	59,800	31,000	3,500
8	House	M. Akbar	Ditto	Self	Owner	122.00	411.00	533.00	C	43,188.00	11,400	72,000	83,400	43,000	3,800
9	House	Ghulam Muhammad	Ditto	Self	Owner	62.00	187.00	249.00	B	34,224.00	30,600	10,000	40,600	24,000	3,600
10	House	Fazal Elahi	Ditto	Self	Owner	51.75	460.00	645.00	B	28,556.00	68,400	46,000	114,400	50,000	6,000

Social Impact
Ghazi Barotha Hydropower Project
500 kV Transmission Line System
36 Houses

S. No.	Type of Infrastructure[1]	Owner's Name		Name of Occupant[3]	Status of Occupant[4]	Area of Plot			Type of Construction[5]	Estimated Cost	Annual Income		Total	Expenditure	Income Loss Due To Disruption
		Plot[2]	Structure			Covered area (Sq. m.)	Open area (Sq. m.)	Total area (Sq. m.)		Rs.	Agriculture Rs.	Other Sources Rs.	Rs.	Rs.	
11	House	Ghulam Abbas	Ditto	Self	Owner	84.00	70.00	154.00	D	15,540.00	315,000	120,000	435,000	270,000	3,000
12	House	Maula Dad	Ditto	Self	Owner	60.00	339.00	511.00	B	33,120.00	9,000	30,000	39,000	35,500	6,000
13	House	Mir Afzal	Ditto	M. Fayyaz	Tenant	109.00	80.00	189.00	D	20,165.00	240,000	20,000	260,000	150,000	3,400
14	House	Tariq Azam	Ditto	Self	Owner	26.00	58.80	139.80	C	9,204.00	300,000	40,000	340,000	290,000	3,200
15	House	Ghulam Abbas	Ditto	Shingi	Tenant	114.00	183.00	297.00	D	21,090.00	315,000	120,000	435,000	270,000	3,500
16	House	Anayat Ali	Ditto	Fida Jan	Tenant	28.81	80.00	108.81	C	10,198.74	300,000	40,000	340,000	250,000	3,200
17	House	Karram Khan	Ditto	Self	Owner	85.00	110.00	195.00	D	15,725.00	50,000	40,000	90,000	30,000	3,800
18	House	Tahir Khan	Muhammad Ilyas	Muhammad Ilyas	Tenant	93.00	281.00	374.00	C	32,922.00	-	-	-	-	-
19	House	Tahir Khan	Khan Muhammad	Khan Muhammad	Tenant	60.00	96.00	156.00	D	11,100.00	-	-	-	-	-
20	House	Ghulam Muhammad	Ditto	Self	Owner	190.00	258.00	448.00	C	57,250.00	30,000	20,000	50,000	35,000	3,200

Note: At Sr. No 18 & 19. Mr. Tahir Khan (Ex. MPA) holds more than 500 Acres of Agriculture Land and One Flour Mill. Exact income / expenditure can not be assessed.

Social Impact
Ghazi Barotha Hydropower Project
500 kV Transmission Line System
36 Houses

S. No	Type of Infrastructure[1]	Owner's Name: Plot[2]	Owner's Name: Structure[2]	Name of Occupant[3]	Status of Occupant[4]	Area of Plot: Covered area (Sq. m.)	Area of Plot: Open area (Sq. m.)	Area of Plot: Total area (Sq. m.)	Type of Construction[5]	Estimated Cost Rs.	Annual Income: Agriculture Rs.	Annual Income: Other Sources Rs.	Total Rs.	Expenditure Rs.	Income Loss Due To Disruption
21	House	Ghulam Jilani	Ditto	Self	Owner	137.00	342.00	479.00	C	48,498.00	32,000	35,000	67,000	46,000	4,200
22	House	Nazakat Khan	Ditto	Habib-ur-Rehman	Tenant	70.00	299.00	536.00	B	38,640.00	275,000	30,000	305,000	196,000	4,500
23	House	M. Khan	Ditto	Self	Owner	228.00	730.00	958.00	C	90,712.00	35,000	130,000	165,000	72,000	4,800
24	House	Azeem Khan	Ditto	Self	Owner	119.14	161.00	280.14	B	55,765.28	40,000	57,500	97,600	46,000	4,700
25	House	Parvez	Ditto	Self	Owner	80.50	375.00	472.20	B	44,436.00	-	30,000	30,000	24,000	-
26	House	Mir Dad	Ditto	Mumtaz Khan	Tenant	152.50	410.00	562.00	D	28,212.50	22,000	6,000	28,000	24,000	4,300
27	House	Raja Matloob	Ditto	Meharban	Tenant	73.50	99.00	172.50	C	26,019.00	-	-	-	-	-
28	House	M. Sultan	Ditto	Self	Owner	243.40	352.60	596.00	B	134,356.00	36,000	50,000	86,000	70,000	4,100
29	House	Fazal Hussain	Ditto	Self	Owner	136.70	93.60	230.30	B	75,458.40	12,000	29,000	41,000	35,000	3,800
30	House	Taj Muhammad	Ditto	Self	Owner	91.30	72.00	163.00	C	32,320.20	34,000	-	34,000	30,000	3,000

Note: At Sr. No. 27, The Owner Raja Matloob is a transporter and he has refused to claim any compensation against the property.

Social Impact
Ghazi Barotha Hydropower Project
500 kV Transmission Line System
36 Houses

S. No.	Type of Infrastructure[1]	Owner's Name		Name of Occupant[3]	Status of Occupant[4]	Area of Plot			Type of Construction[5]	Estimated Cost	Annual Income		Total	Expenditure	Income Loss Due To Disruption
		Plot[2]	Structure			Covered area (Sq. m.)	Open area (Sq. m.)	Total area (Sq. m.)		Rs.	Agriculture Rs.	Other Sources Rs.	Rs.	Rs.	
31	House	Mansab Dar	Ditto	Self	Owner	96.52	242.48	339.00	A	95.651.32	22.000	32.000	54 000	42,000	3.300
32	House	Muhammad Fazil	Ditto	Self	Owner	216.00	1095.00	1311.00	A	214 056.00	-	50.000	50.000	50,000	-
33	House	Ghulam Muhandi	Ditto	Self	Owner	184.00	404.00	588.00	B	101.568.00	65.000	35.000	100.000	70,000	3.500
34	House	-		Mosque Imam		47.00	107.20	154.20	C	15.638.00	-	25.000	25.000	20.000	-
35	Room	M. Yousaf				71.40		71.40	C	25.275.60	75.000	10.000	85.000	70.000	2.500
36	Room	Naseeb Khan				35.00		35.00	C	12,390.00	90.000	100.000	190.000	150,000	4.100

Social Impact
Ghazi Barotha Hydropower Project
500 kV Transmission Line System
3 Farm Houses & 1 Poultry Farm

FARM HOUSES														
Dera	Khaki Khan	Muhammad Taj	Muhammad Taj	Tenant	90.00	210.00	300.00	16.650.00	15000.00	10000	25000.00	24000	2900
Dera	Dr Sh. Waheed	Ditto	Nasir Ahmad	Servant	56.98	77.00	133.98	20.170.92	72000.00	120000	192000.00	120000	4500
Room	Abdul Razaq				40.00		40.00	7 400.00	22000.00	48000	70000.00	62000	3200
POULTRY FARM													
Poultry	M. Aslam	Ditto	Self	-	355.80	-	355.80	196.401.00	70000.00	20000	90000.00	78000	-

Annex. III

List of Persons Loosing Land Over 25%
Ghazi Barotha Hydropower Project
500 kV Transmission Line System

Sr. No.	Name of Occupant	Total Land	Loosing	Remaining	Over 25%
1	Pervaiz	2	2	0	100%
2	Kala Khan	2	2	0	100%
3	M. Fazil	2	2	0	100%