GHAZI - GARIALA HYDROPOWER PROJECT

FEASIBILITY REPORT

FILE COPY

VOLUME 7

ENVIRONMENTAL ASSESSMENT

AUGUST 1991

PAKISTAN HYDRO CONSULTANTS

A Joint Venture of
- National Engineering Services Pakistan (Pvt) Ltd.
- Associated Consulting Engineers ACE (Pvt) Ltd.
- Ewbank Preece Ltd.
- Harza Engineering Company International L.P.
- Binnie & Partners (Overseas) Ltd.
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FEASIBILITY REPORT

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CHAPTER 1

INTRODUCTION
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INTRODUCTION

1.1 GENERAL

This Volume is part of the Feasibility Report for the Ghazi-Gariala Hydropower Project (the Project) prepared at the completion of Stage I of the Engineering Study, and presents the results of the environmental assessment of the Project.

This Volume also serves as the Environmental Assessment Report required by the World Bank (Operation Directive 4.00, Annex A) and has been prepared accordingly.

The objectives of this Volume are to:

- provide a comprehensive record of the baseline conditions of the Project area, covering socioeconomic and cultural aspects of the local populace and physical environmental condition of the Project area and its surroundings,
- describe the Project features, and
- analyse their effects on the baseline conditions.

This Volume also describes the proposed mitigation measures to eliminate, or at least minimise, the negative effects and enhance the secondary benefits.

The objective of the overall development and operational strategy adopted for the Project has been to make it environmentally acceptable, as well as technically and economically feasible. Consideration of environmental issues from the very beginning of the planning and design stages has helped to minimise the Project effects. The proposed mitigatory and compensatory actions will result in minimal adverse effects of the Project on the human and physical environment of the area.

An international environmental panel of experts reviewed the Draft Environmental Assessment Report and concluded that:

"The Ghazi Gariala Hydropower Project has the potential of being a showcase project for WAPDA to demonstrate its concern for the environment and related social issues. Environmental costs are not high. Mitigation measures can easily be built into the Project. The consultants have already done much of the groundwork. A few relatively minor issues, dealing with the operationalisation of the Project, remain to be tackled. They can easily be accommodated within the existing time frame of the Project."

7-1.1
The panel's review found that the following issues had been resolved in the draft document:

"general acceptability of (a) the approach used in the environmental and social impact analysis of the structural elements of the proposed Project, including siting and design approach for barrage, power channel and power complex; (b) recommended mitigation plan for resettlement and compensation; (c) proposed mitigation plan for archaeological, historical and religious sites."

The panel recommended:

- revisions to the draft environmental assessment to:
  - strengthen the presentation and analysis of alternatives, environmental impacts, mitigation activities and monitoring plan; and
  - include the arrangement for implementing the recommended social mitigation plan and for facilitating economic development in the Project area.
  - supplementary studies to develop operational criteria for discharge of compensation water and for the management of the created impoundments.

The Draft Report has been revised to incorporate the suggestions made by the review panel. The additional studies recommended are being undertaken and the results will be presented in supplementary documentation.

1.2 DESCRIPTION OF THE PROJECT

The Project is located in the northern part of Pakistan. Its purpose is to utilise the fall of the Indus river between the tailrace of Tarbela dam and the confluence of the Indus and Haro rivers to produce electricity in an economically viable and environmentally benign manner.

The Project will comprise three basic components: a diversion barrage on the Indus river 7 km downstream of Tarbela dam, a power channel about 52 km long, and a 1,425 Megawatt (MW) power generating complex on the left bank of the Indus river downstream of Attock gorge (Drawing 7.1.1).
The barrage will be located just upstream of the left bank village of Ghazi. It will impound a pond with a normal maximum surface elevation of 340 m (1115.5 ft). In addition to maximising the head for the Project, the pond will provide storage for diurnal re-regulation of the fluctuations in discharge that will result when Tarbela operates in a peaking mode.

Water from the barrage pond will pass through a regulating headworks structure into an open power channel with a design capacity of 2,000 cubic metres per second (cumecs). The channel will be concrete-lined, with a trapezoidal cross-section and side slopes of 2H:1V. At full supply level, it will be approximately 113 m wide, with the water 9.0 m deep. The water velocity will be 2.35 m/s (7.7 ft/s) at full supply. The right-of-way for the channel, including access roads, will be about 140 m (460 ft) in width, but in areas where it is in fill or deep cut it will be substantially wider.

The power channel will terminate in a forebay near the village of Barotha, from which water will flow through penstocks to a powerhouse and thence through a tailrace channel, 2 km long, discharging into the Indus river. Headponds for storing water for peaking operation, with an area of 320 ha, will be located on either side of the forebay.

1.3 BASIS FOR THE ENVIRONMENTAL STUDY

The past three decades have seen increasing public and official awareness that a project that develops natural resources may accrue costs in a number of unforeseen ways, while returning benefits in other ways not expected by its planners. Some of these benefits and costs may be only indirectly related to the primary objectives of the project, and their relationship to the project may be difficult to predict or even to establish after the fact. The science of environmental management, by which these ancillary benefits and costs are predicted, evaluated, and included in the planning process, tends to engender controversy, for many conscientious planners believe that a project should be evaluated on the basis of its primary benefits and costs, and that the secondary, or environmental, benefits and costs are too nebulous to be included in project evaluation.

Worldwide experience with hundreds of projects has shown, however, that these environmental benefits and costs are real, definable, and often predictable, although not always amenable to economic evaluation. Without (and sometimes with) the environmental assessment process, unexpected effects on natural resources or human living standards often occur, ranging from the creation of new resources (e.g., fisheries) to the loss or degradation of vital existing resources, at the risk of inconvenience, hardship or even death for some members of the population.
Spurred by public pressure, governments and international development agencies have developed requirements and procedures to ensure that potential benefits and peripheral costs are taken into account in planning resource development projects. The result has been to make the planning process more comprehensive and equitable in terms of resource use and distribution. An underlying concept of this refinement is that it is unwise, and some say unethical, to develop one resource in such a way as to needlessly preempt the development or use of other vital resources. A corollary is that it is socially unfair (and politically unwise) to inflict the cost of development on one segment of society out of proportion to the benefits received.

This underlines the social significance of environmental management. Environmental effects are important because society considers them so, and different societies, as well as different social groups within a society, place divergent values on a given resource and its management. Foremost among the social effects of a project that most groups agree are important is the physical displacement of people from their homes or livelihoods. This effect is sufficiently serious, and its remedies sufficiently complex, that it is usually considered an integral part of project development, rather than an environmental impact.

The identification and assessment of potential environmental effects serves no purpose unless the findings are translated into enhancement and mitigation actions. Since environmental management is both a predictive and a corrective process, its effectiveness depends on close interaction between the environmental scientists and sociologists on one hand, and engineers and economists on the other. This interaction allows the environmental specialist to understand the planning and design of the project and the engineer to appreciate the importance of environmental problems. Between them, they can make appropriate modifications to the project, or compensatory modifications of the environment, to enhance secondary benefits and mitigate adverse effects.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Need for Environmental Regulations

Notwithstanding the social and economic benefits, each and every development project interacts, to various degrees, with human, biological and physical resources of the project area and its environs. This interaction may induce favourable or unfavourable changes in the environmental baseline conditions of the area of project influence. It has been experienced that lack of environmental considerations in the project planning in the past has invariably resulted in environmental degradation. Consequently, the past three decades have seen increasing public and official awareness, the world over, regarding environmental problems in general as well as associated with a development project. This leads to promulgation of official regulations for
pollution control and environmental protection. These regulations demand an environmental impact assessment of the development project and planning mitigatory/compensatory actions to minimise the adverse impacts.

The Project falls under the influence of two sets of official environmental regulations. These are established by the Government of Pakistan and the World Bank.

These regulations have been taken into account in the development of the Project.

1.4.2 Government of Pakistan

A number of laws have been enacted by the Government of Pakistan from time to time to regulate the public practice regarding land use, water use, land reclamation and drainage, forestry, wildlife, archaeological and historical properties, public health, energy, etc. However, the milestone of Pakistani environmental law and regulation is Ordinance No. XXXVII, "Control of Pollution and Preservation of Living Environment", enacted on December 1983. This was made effective from February 1984 with the establishment of the Pakistan Environmental Protection Council (PEPC), headed by the President of Pakistan, and the Pakistan Environmental Protection Agency (PEPA), headed by an appointed Director General. PEPC is a policy making body, while PEPA has the responsibility for establishing environmental quality standards, and implementing and enforcing the Ordinance. To assist the PEPA, Provincial Environmental Protection Agencies have also been established.

The Ordinance requires the preparation of an environmental impact statement for projects of significant size or projects likely to have significant environmental impact (Ref. 7.1.1). For the preparation of such a document, the Government of Pakistan published Environmental Impact Assessment Guidelines in 1986, covering various project fields, including dams and reservoirs, and development of energy resources (Ref. 7.1.2). Very recently, the Government of Pakistan, with the assistance of the International Union for Conservation of Nature and Natural Resources (IUCN), has also drafted a 'National Conservation Strategy', which provides a realistic study of why and where Pakistan's natural resources are threatened and how they can be harnessed and managed to their sustainable best (Ref. 7.1.3).

The Government of Pakistan has issued a standard proforma questionnaire for the preparation of environmental impact statements. A copy is attached as Appendix H. The statement will be compiled by WAPDA and will then be reviewed by PEPA, which will recommend to the Government of Pakistan whether or not the Project should be allowed to proceed.
Other Pakistani legislation relevant to environmental issues of this Project are as follows:

- The Land Acquisition Act, 1894 (including later amendments).
- The Forest Act, 1927 and later amendments.
- The Local Government Protection Ordinance, 1979 (Section 93 pertaining to Environmental Pollution).
- The Electricity Act (IX) 1910.
- The Factories Act.
- The Soil Reclamation Act (No. XXI), 1992 and later amendments.
- The Canal and Drainage Act (No. VIII), 1975 and later amendments.

In the light of Project activities and environmental baseline conditions of the Project area, the regulatory laws applicable to the Project will be the Land Acquisition Act, Antiquities Act, Local Government Ordinance (Section 93), Forestry Act for the protection of trees and brushwood, and Factories Act for the safety of workers. The detailed account of the Land Acquisition Act is given in Appendix C, while the applicable rules of the remaining laws are discussed in the following paragraphs.

With the Antiquities Act, the Government of Pakistan instituted a Department of Archaeology and Museums to designate and protect antiquities and national monuments. An antiquity is defined as an ancient product of human activity, any ancient object or site of historical, ethnographical, anthropological, military or scientific interest, any national monument or any other object declared by the Government of Pakistan to be an antiquity. The Director General of the Department is authorised to take steps necessary for the custody, preservation and protection of antiquities.

If a protected, immovable antiquity is in danger of destruction, injury or falling into decay, the Government of Pakistan may direct the provincial government to acquire it. The Government of Pakistan may also acquire movable antiquities in order to preserve them. The owner of an immovable or protected antiquity can enter into an agreement with the Director General for
maintenance, custody, terms of public access and payment of expenses. It is prohibited to destroy, break, deface, damage, alter, injure, or mutilate any antiquity. Restrictions on dealing in antiquities, exporting and trafficking and on archaeological excavation or exploration are also established.

The Act protects antiquities from various forms of development. For example, no development plan or scheme or new construction can be undertaken within 200 feet (60 m) of a protected immovable antiquity, except with the approval of the Director General of the Department. The Government may prohibit or restrict mining, quarrying, excavating, blasting, heavy vehicle movement, or similar operations in order to protect an immovable antiquity.

The Local Government Ordinance of 1979, Section 93, pertains to environmental pollution. An urban local council may prepare and implement schemes for the prevention of pollution of air by gases, dust or other substances exhausted or emitted by automobile engines, factories, brick or lime kilns, crushing machines for grain, stone, salt or other materials and such other sources of air pollution as the by-laws may provide. An urban council may prepare and implement schemes for the prevention of the pollution of water or land from such sources and in such manners as by-laws may provide.

The Forest Act of 1927 established the right to designate reserved forests, village forests and protected forests. The government can take control of forest and lands belonging to private persons to protect the forest for special purposes and it has the power to assume management. The government may manage forests at the request of the owners, and may also levy duty on timber and other forest products and control such in transit. The Protection of Trees and Brushwood Act of 1949 prohibits cutting or girdling of trees and brushwood without permission.

1.4.3 The World Bank

Until mid-1989, the World Bank's environmental policies were codified under the title "Environmental Aspects of World Bank Work" (OMS 2.36), but they currently are being reissued as Operational Directives (O.D.), mostly in the 4.00 Series and lettered annexes. The following are particularly relevant:

- O.D. 4.00, Annex A, "Environmental Assessment".
- O.D. 4.00, Annex B, "Environmental Policy for Dam and Reservoir Projects".
- O.D. 4.00, Annex D, "Wildlands: Their Protection and Management".
- O.D. 4.30, "Involuntary Resettlement".
- O.D. 4.50, "Cultural Property".

7-1.7
Drafts of several Operational Directives were issued in September 1990. These included:

- Social and Cultural Issues in Environmental Review,
- Indigenous Peoples,
- Social Issues in Ecologically Sensitive Areas,
- Cultural Property,
- Involuntary Resettlement,
- New Land Settlement, and
- Induced Development.

In addition to guidelines for evaluating and managing the environmental effects of a project, the Bank codifies 'best practice' to be applied in four areas:

- Environmental reconnaissance at the project identification stage.
- Environmental clauses to be included in bidding documents and contracts.
- Environmental unit to be established in the development agency, to be actively involved in all major projects.
- An independent environmental Panel of Experts to be established for every large project with major environmental implications.

1.5 APPROACH ADOPTED FOR THE PROJECT

The Ghazi-Gariala Hydropower Project is probably the first project of its kind where the engineers, economists and environmental scientists have worked together as an integrated team throughout the development of Project layout and feasibility-level designs. This has helped in meeting efficiently the objectives of the environmental process and addressing the directives of the Government of Pakistan, the World Bank and other agencies.

A continuous interaction between the Project planners and the environmental scientists has made it possible to mitigate a number of environmental effects of the Project either through siting the Project components appropriately or by adopting suitable designs.
A series of scoping sessions and informal meetings with Government officials, public representatives and local people have proved to be a useful tool for identifying various socioeconomic, cultural and environmental aspects of the Project area. This process has made it easier to take appropriate decisions in the Project planning and design. This has also helped to plan viable compensatory modifications of the environment, such as disposal of a huge volume of spoil from the power channel as irrigated spoil banks, which will have significant economic utility later.

1.6 APPENDICES

The following Appendices are provided with this report:

**Appendix A : Other Literature Studied**

This Appendix lists the documents consulted in the preparation of the report, in addition to those listed as references in the individual Chapters.

**Appendix B : Scoping Sessions and Contacts**

This Appendix covers the records of the scoping sessions held with representatives of the civil administration, the general public and probable affectees in the Project area.

**Appendix C : Land Valuation Study**

This Appendix provides the results of the case study carried out on land acquisition and compensation procedures adopted by WAPDA at the Chashma Right Bank Canal Project, and the recommended procedures for the Ghazi-Gariala Project.

**Appendix D : Social Survey of the Project Area**

The results of village surveys undertaken to obtain baseline data in order to identify and analyse the socioeconomic impacts of the Project are provided in this Appendix.

**Appendix E : Social Survey of Women in the Project Area**

Baseline data on the existing conditions of women and children is presented in this Appendix in order to assess the impact of the Project on the social life of the female population in the area.
Appendix F: List of Preparers and Contributors

This Appendix lists the staff of the Consultants who have participated in the preparation of this report, as required by the World Bank procedures.

Appendix G: List of Persons Contacted

This Appendix provides a list of the persons contacted regarding significant aspects of the report.

Appendix H: Government of Pakistan's Proforma for Environmental Impact Assessment

The proforma for environmental impact assessment to be submitted by WAPDA to the Government of Pakistan is given in this Appendix, together with references to the sections of the report containing the information required to be included in the proforma.

In addition to the above Appendices, there is a separate report (Ref. 7.1.4) on the archaeological studies carried out for the Project, the main features of which have been described in Chapter 3.

REFERENCES

7.1.1 Ministry of Law and Parliamentary Affairs (Law Division); Government of Pakistan's Ordinance No. XXXVII, The Control of Pollution and Preservation of Living Environment, 1983.


CHAPTER 2

PROJECT DESCRIPTION
CHAPTER 2
PROJECT DESCRIPTION

2.1 OVERVIEW OF THE PROJECT

Ghazi-Gariala is a hydropower project which will use an existing and reliable source of energy, the Indus river, to generate large amounts of electricity. The Project will harness the potential head offered by a steep length of the Indus river which starts below Tarbela dam and extends through the Attock gorge.

The Pakistan Water and Power Development Authority (WAPDA) carried out a pre-feasibility study of the Project and published a Pre-feasibility Report in 1987 (Ref. 7.2.1). On the basis of the Pre-feasibility Report, the Government of Pakistan and the UNDP, with the World Bank acting as the executing agency, decided to proceed with studies covering the feasibility of the Project and the preparation of detailed design and tender documents.

A contract for these studies was signed on December 26, 1989 between the World Bank, WAPDA and a joint venture (Pakistan Hydro Consultants) consisting of the following firms:

- National Engineering Services Pakistan (Pvt) Ltd.,
- Associated Consulting Engineers ACE (Pvt) Ltd.,
- Ewbank Preece Ltd.,
- Harza Engineering Company International L.P., and
- Binnie & Partners (Overseas) Ltd.

According to the Terms of Reference, the Consultants' scope of services was divided into the following stages and tasks:

Stage I - Feasibility Study

Task I - Comparison of Alternative Layouts
Task II - Feasibility of the Selected Layouts

Stage II - Design Studies and Preparation of Tender Documents

Task I - Engineering Design of Scheme.
Task II - Preparation of Tender Documents.

Under Task I of Stage I, various alternative sites for different Project components were analysed on engineering, environmental and economic considerations (Chapter 4) and the most feasible alternative was recommended in the Report on Selection of Project
Layout (Ref. 7.2.2). After the approval of WAPDA and the World Bank, the Consultants proceeded with the feasibility study of the Project, including the environmental assessment.

### 2.2 PROJECT FEATURES

The Project will comprise the following three main components (Drawing 7.1.1):

- A barrage located about 7 km downstream of Tarbela dam, forming a pond (with a surface area of 1,140 ha and 70 M cu m live storage capacity) which allows diurnal re-regulation of the discharges from Tarbela and diverting water into
- A 52 km long concrete-lined power channel, with a capacity of 2,000 cumecs, located on the left bank of the Indus river and following a uniform gradient to
- A power complex, located near the confluence of the Indus and Haro rivers, comprising a forebay, spillway, headponds, intake, penstocks, 1425 MW powerhouse, switchyard and tailrace channel.

The principal data of the Project is given in Table 7.2.1.

It is envisaged that the construction of the Project will take about 63 months from the award of the main civil works contracts to the commissioning of the last generating unit (Drawing 7.2.1). The expected life span of the Project will be 60 years. The executing and operating agency of the Project will be WAPDA.

A brief discussion of the layout, design, construction and operational features of the three major components of the Project is given in the subsequent sections.

### 2.3 BARRAGE AND STORAGE POND

#### 2.3.1 Location

The barrage will be located on the Indus river, approximately 7 km downstream of Tarbela dam. The left abutment will lie about 800 m upstream of the village of Ghazi and the right about 1 km upstream of Galla (Drawing 7.2.2). Environmental considerations have played a significant role in the selection of the barrage site (Chapter 4).
2.3.2 General Layout

The functions of the barrage will be to create a pond with a normal retention level of El. 340.0 m, to smooth out diurnal flow fluctuations when Tarbela is generating in a peaking mode, and to divert these smoothed flows into the power channel.

The barrage will comprise several components (Drawing 7.2.2). From the right (north) bank, these will consist of a fuse plug and guide bank 1,550 m long, a weir (standard bay) section of 20 bays, totalling about 400 m, a dividing island about 300 m wide and 900 m long, an undersluice section of 8 bays (partly to remove sediment), a head regulator for the power channel, and a left guide bank 1,000 m long.

The right guide bank will serve to direct the flow of the river towards the centre of the bed, where it will be regulated by the gated section of the barrage. The guide bank is designed to provide smooth approach conditions that will help prevent sediment deposition. The structure consists of a 850 m upstream section, tied to the high bank of the river, that is designed as a fuse plug, and a 550 m downstream section, tied to the weir section of the barrage, with a 150 m extension downstream of the weir. The fuse plug will function as a safety valve in the rare event of a flow significantly exceeding the design flood of 18,700 cumecs.

Each of the 20 standard bays of the barrage will have a sill at El. 333.0 m, with an 18 m wide radial gate to maintain the pond at its normal retention level during the high-flow period.

The dividing island will streamline the entry of water to the head regulator and undersluice bays on one side and to the standard bays on the other.

The undersluice structure will serve partly for flood release and partly to remove sediment that would otherwise enter the power channel. It will have a sill at El. 326.0 m, with radial gates controlling orifice outlets. The three bays closest to the head regulator will have a skimming platform designed to separate the relatively sediment-free upper water layers from the more heavily laden lower ones, so as to minimise sediment entry into the power channel.

The head regulator will have ten bays each 18 m wide, with a sill at El. 333.0 m, and will control flows into the power channel.

Along both banks of the Indus river between Tarbela and the barrage, there are low-lying areas that would be flooded by the barrage pond if not protected by bunds. About 2 km of embankments, up to about 7 m high but significantly lower for much of their length, will be required on the right bank between the Pehur pumping station and the Tarbela dam. On the left bank, parts of the Ghazi-Tarbela road and some Government-owned buildings will be relocated.
2.3.3 Storage Pond

Surface Elevation

The pond created by the barrage will have a normal retention level of El. 340.0 m at the barrage. This level was selected as the maximum elevation that will not have a significant effect on the tailwaters of Tarbela. The maximum depth in the existing low water channel at the barrage under normal operating conditions will be approximately 16 m. The pond will be more shallow along the rest of the barrage and towards the upstream end.

Area and Characteristics

The pond will have a surface area of 1,140 ha at normal retention level. It will be roughly rectangular in shape, bounded by the dam and the barrage at the ends and the river banks at the sides. Its length, from the barrage to Tarbela dam, will be approximately 7 km and its width will vary between 750 and 2,100 m. The maximum storage capacity at normal retention level will be 70 M cu m.

Tributaries

There are no significant tributaries to the Indus in the reach of the barrage pond, only seven left-bank nullahs, the largest of which, Dal Darra, drains an area of 11 sq km. Dal Darra also receives the flow from the Tarbela spillways. On the right bank there are only tiny, intermittent streams.

2.3.4 Construction

Schedule

Overall Timing. The construction of the barrage is expected to require 51 months, including a mobilisation period of 6 months (Drawing 7.2.1).

Sequencing. The barrage will be constructed in two stages. The schedule envisages two river-diversion stages to avoid excessively high cofferdams required for a single-stage diversion. The construction will be approached from the left bank because of the existing access to the site. Therefore, the first-stage cofferdam will enclose the areas of construction located near the left bank. This will cover the power channel head regulator, skimming platform, underslides, dividing island and left guide bank. After the river has been diverted through the underslides, the second-stage cofferdam will be built to enclose the areas of standard bays and right guide bank.
Seasonal Aspects. The scheduling of activities related to river diversion has been based on the duration of the river flood season (May to October). Other construction activities will not be significantly affected by seasonal considerations.

Land Acquisition. Nearly all of the barrage structures will be located in the river bed. The head regulator and left guide bank will occupy land already owned by WAPDA. Therefore, no land acquisition will be required.

Workforce

Number and Composition. The contractor's workforce for the barrage will comprise approximately 2,500 workers. In addition to the contractor's personnel, WAPDA and the Consultants will have a supervisory staff of about 300 at the site.

Source. Most of the workforce will be Pakistani, with some senior staff drawn from the international construction labour pool. Among the Pakistanis, preference will be given to local people who are affected by the Project. It is expected that a large proportion of the semi-skilled and unskilled categories and some of the higher skill categories can be filled from the local population; the remainder of the staff for the higher skill categories will be filled from the larger cities.

Housing and Transportation. The permanent barrage colony will accommodate the WAPDA and Consultant's supervisory staff, and possibly the contractor's senior construction staff for the initial few months. Semi-permanent housing for other professionals will be constructed near the barrage site at appropriate places. Labourers and semi-skilled workers will live at home or in temporary camps at the work area. The work camp will be located along the left bank between the Tarbela-Lawrencepur road and the river near the Tarbela check-post. The contractor will run buses through local villages to transport labourers to and from the work area.

Public Safety and Convenience

Protection of the Site. As the work area will mostly be located in the river bed and fringes which belong to WAPDA, inconvenience to the local population is unlikely. However, for the security of the contractor, the work area will be fenced and security guards appointed.
Public Access to Resources. No resource will be obstructed by the construction activities of the barrage.

Protection from Injury. The contact of the public with the work area is expected to be minimal, therefore no extraordinary measures would be required to protect the public from accidents. However, fencing, security guards and warning signs will be required.

Control of Dust and Noise. The generation of dust and noise is always associated with construction machinery. There may be some effect of dust and noise on the villagers of Ghazi village on the left bank and Galla village on the right bank. Therefore, it will be desirable to adopt measures to control dust and noise generation.

Access Roads

The existing Tarbela-Lawrencepur (TL) road will be used for the access to the work area, as has been the case for the Tarbela dam project. This road passes through the villages of Khalo and Ghazi. Therefore, the contractor will have to take appropriate measures to minimise accidents and disruption. Moreover, the junction of the TL road and the Sirikot road will be very close to the contractor's work area and arrangements will be required for the diversion of public traffic.

Work Areas

The work area will be located along the left bank of the river (Drawing 7.1.1).

Borrow and Spoils

The borrow area for fine aggregate will be Kundi Dara (Ghazi sand), while coarse aggregate will be generated from the excavation area of the river bed at the barrage site. The core material and rock for riprap will mostly be obtained from areas near the right bank. The spoil will be used locally for embankments.

2.4 POWER CHANNEL

2.4.1 Location

The power channel will function to convey water from the barrage pond to the power complex. It will commence at the head regulator of the barrage (Drawings 7.1.1 and 7.2.2), extend directly southeast for 500 m, then bend around Ghazi to run generally.
southwest for about 20 km, where it will gradually bend westward to cross the Grand Trunk road at about RD 28. It will then pass through the Kamra Aeronautical Complex, at RD 33-34, bend northwest at RD 35, along the 335 m contour and just before RD 40 turn southward to pass southwest through a ridge that exceeds El. 380 m. After 6 km, it will swing to the west to enter the forebay at about RD 52. Environmental considerations have played a major role in the selection of the alignment of the power channel (Chapter 4).

2.4.2 Design Characteristics

The power channel will be 112.6 m across at the water surface, 9 m deep, and about 52 km long.

The power channel will have a bed slope of 1 in 10,000. It will have a trapezoidal cross section, 76.6 m across the bottom with side slopes of 2H:1V (Drawing 7.2.3). With a freeboard of 1.5 m, the top width of the channel will be 118.6 m. The channel is designed for a water velocity of 2.35 m/s (7.7 ft/s). It will be lined with concrete, 150 mm thick on the sides and 125 mm thick on the bottom.

The channel will have a service road on each side. In sections where the channel is excavated in deep cut, the slope of the cut above the service roads will be determined by stability considerations, but is not expected to be steeper than 1H:3V with 5 m wide berms at 10 m vertical intervals.

2.4.3 Crossings

Roads

Two types of structure will be required over the channel: cross drainage structures to pass the flows of nullahs, and bridges to pass vehicles, pedestrians, and livestock, as well as other forms of transportation (railroad, gas and water pipelines). In order to minimise the disruption of commerce, agriculture, and the daily lives of the local people, 33 bridges will be built across the channel, the locations of which are shown in Table 7.2.2 and on Drawing 7.2.4.

At present, the alignment is crossed by one arterial road (the Grand Trunk road), four district roads, some minor roads and many tracks. Four categories of bridges have been established for these crossings:

- **Arterial Road Bridge (ARB).** There will be only one arterial road bridge, at the G.T. road. It will be 9.3 m wide, to carry the two-way traffic of the Grand Trunk road. As the road will cross the channel at an angle of 57°, the bridge will be 223 m long. It will have pedestrian walkways on both sides.
- **District Road Bridge (DRB).** These will be two-lane bridges, 8.2 m wide. Like the ARB, they will be capable of carrying a full military load of 70 t tanks. They will have pedestrian walkways. Two bridges at Kamra will have larger carriageway widths as shown in Table 7.2.2.

- **Village Road Bridge (VRB).** These will be used for minor roads, surfaced or unsurfaced depending on the use of the existing track. They will be two-lane, 4.3 m wide, and provided with sidewalks.

- **Minor Bridge (MB).** These bridges are intended to carry primarily pedestrians and livestock although they will have the capacity to carry most vehicles, being 3.7 m wide. They will not have sidewalks, as they are provided at locations where vehicular traffic will be infrequent.

Many of the road bridges in the first 25 km of the channel are combined with nullah superpassages, for several reasons: the combined structure is less expensive than two separate structures, the head loss in the power channel is reduced by combining piers, and most of the nullahs currently serve as roadways and footpaths, so are the logical sites for crossings. All nullah superpassages, with or without roadways, will be accessible for pedestrians to use as bridges.

**Railway**

The railroad between Attock city and Peshawar will require a large bridge, about 200 m long.

**Irrigation Channel**

The water for the Qibla Bandi irrigation service area supplied to the northwest of the channel will be carried by a pipe on the combined nullah superpassage and minor bridge at RD 17+550.

**Nullahs**

The 52 nullahs (including branches) which will be crossed by the channel alignment represent essentially the drainage system of the area, except for the two major rivers (Indus and Haro). They produce infrequent but occasionally large flows, so that even the smaller nullahs cannot be ignored. Several alternatives for managing the nullah flows have been considered, including:

- **Superpassage.** A bridge to carry the nullah over the channel, usable when the nullah bed is higher than the channel, allowing for structural clearance.
- **Siphon.** A conduit under the power channel, with the outlet bed above the top level of the conduit; usable when the nullah bed is below the channel surface but higher than the bottom of the channel.

- **Culvert.** A conduit under the channel, used when the nullah bed is sufficiently below the bottom of the channel to permit a straight conduit and free drainage of water.

- **Inlet.** With this structure, the nullah flow would discharge into the channel, instead of being carried across it.

Of these four alternatives, three will be used. Siphons are highly prone to fill with sediment. The channel has therefore been aligned to avoid the need for siphons. In general, where it is necessary to carry the nullah flow across the power channel, a superpassage is preferred. However, culverts have been provided in three instances where the nullah is incised. Where the nullah is small, its water will be channelled into the power channel, by the use of an inlet structure with a sediment trap.

Each cross-drainage structure will be designed to suit the hydrology of that nullah, the local topography, and the foundation conditions. At places, nullah branches have a combined cross-drainage structure. This has been done where the nullahs concerned already join together a short distance downstream of the channel route. Thus there will be a total of 45 structures: 26 superpassages, 3 culverts and 16 inlets.

Standardisation has been possible for flumes, piers and some other aspects. The standard flume will be an open concrete channel 5 m wide inside and 1.5 m deep. A superpassage will combine two to six such flumes (see Table 7.2.2) to achieve the required capacity. An exception is the crossing for Kundi Dara, the large nullah near Ghazi, which will contain 12 flumes. The slope from one end of the flume to the other will be 1:100.

At the upstream end of each superpassage, the nullah will be trained by embankments. At the downstream end, the water will flow into a stilling basin and then back into its former channel.

Each superpassage has been designed to pass the 100-year return flood. Since the Probable Maximum Flood (PMF) is several times higher, the excess flows will spill into the power channel through 1.5 m slots between the flumes. A typical layout and section of a superpassage is shown on Drawings 7.2.5 and 7.2.6.

Each culvert has been designed to pass the 100-year return flow without surcharging. Higher flows will be passed by surcharging, causing the culvert to flow under pressure.

7-2.9
Superpassages not combined with road bridges will have a provision for pedestrian traffic. This will also assist in the crossing of the channel during construction.

2.4.4 Borrow and Spoil

Quantities

The construction of the channel will generate approximately 90 M cu m of soil and rock. The material will have the following composition:

- Sandy clayey silts 8 M cu m
- Silts/silty clays 6 M cu m
- Sand/silty sands 67 M cu m
- Gravel 5 M cu m
- Argillite 4 M cu m

A number of options were considered for disposing of this material. The selected plan combines several of these and is described in Chapter 4. The recommended options include use of the material for:

- fill and aggregate,
- additional freeboard along the channel,
- terracing in the hills, and
- irrigated spoil banks along the channel, restored to agriculture.

Land Acquisition

Various options of land acquisition can be used. These include lease, use fee, or outright purchase. Spoil operations will be of fairly short duration in a given location (less than a year), but the whole spoil process will extend over the entire construction period, and rehabilitation of spoil banks is likely to extend beyond Project completion. The process of land acquisition and subsequent return to use is complex and will need to be carefully handled.

The process of spoil deposition will be that each area receiving spoil will be stripped of topsoil, then covered with spoil from an area being excavated, and finally spread with topsoil from the next segment of excavation. At the edges the spoil bank will graded to a slope of 2H:1V. The upper surface will be graded
nearly level, to allow irrigation for which tubewells will be provided. Ramps with relatively flat gradients will be provided to allow convenient access to the top of each bank. The sides of spoil banks will be grassed to provide protection against erosion.

2.4.5 Construction

Schedule

Overall Timing. The construction of the power channel is expected to require 51 months, including mobilisation.

Sequencing. It is anticipated that the channel will be constructed in two segments. The sequence of these segments and the interrelationships of land acquisition and preparation, excavation and construction, and post-construction finishing (e.g. seeding of slopes of spoil banks) will have important environmental ramifications.

Seasonal Aspects. The drainage system for each segment of the channel, including accommodation of nullah flows by cross-drainage structures, must be in place prior to the advent of the next rainy season.

During the hot season (May through August), concreting of the lining will have to be suspended during the middle of the day (10 am to 5 pm).

Workforce

Number and composition. The contractor's workforce for the power channel will comprise approximately 2,600 workers, of which 100 will be administration and management, 600 skilled workers, 1,500 semiskilled workers and 400 unskilled workers. In addition to the contractor's personnel, WAPDA and the Consultants will have a supervisory staff of about 200 at the site.

Source. Most of the workforce will be Pakistani, with some senior staff drawn from the international construction labour pool. Among the Pakistanis preference will be given to local people who are affected by the Project, such as farmers who have lost land or have been temporarily separated from their lands. It is expected that a large proportion of the semi-skilled and unskilled categories and some of the higher skill categories can be filled from the local population; the remainder of the staff for the higher skill categories will be filled from the larger cities.
Housing and Transportation. The permanent colony is expected to be available for housing senior construction staff. Semi-permanent housing for senior staff and professionals will be constructed at key points such as Lawrencepur and near the power complex. Labourers and semi-skilled workers will live at home or in temporary camps at the work area. All temporary camps and workshops will be placed on land designated for spoil.

The contractor will run buses through the local villages to transport labourers to and from the work areas. Administrative and skilled workers are expected to have their own transportation but a bus from centralised living accommodation will be provided.

Public Safety and Convenience

Protection of the Site. The section of channel under construction is expected to be fenced to exclude pedestrians, livestock and vehicles. This is a matter of site security as well as public safety. A conveyor system is expected to be used for the movement of most of the spoil. The channel service roads will be in heavy use by vehicles hauling excavated material to spoil areas and supplies (e.g., concrete materials) to the active work areas.

Public Access to Resources. With an under-construction stretch of the power channel fenced off, means must be provided for the villagers on one side of the channel to reach cropland, pasture, schools and markets on the other side. Careful management procedures will have to be adopted to permit pedestrians, livestock and farm vehicles to cross safely. As the nullah crossings will be completed in advance of the excavation of the channel and pouring of the concrete lining, they will be available as public crossings.

Protection from Injury. The measures proposed for providing for public crossings of the construction area are also intended to ensure public safety. Other measures, such as security guards in dangerous areas, secure storage of hazardous chemicals, and proper waste disposal, also will serve to protect the public.

Control of Dust, Fumes and Noise. The contractor will water down areas of haul road in the vicinity of villages, in order to minimise dust. Good working practices will help to reduce fumes and noise.

Access Roads

The service roads along the channel will be the main routes of local access within the site. Some new haul roads will be developed within the spoil areas and for the borrow areas.
Work Areas

The contractor will develop all his work areas in spoil sites or on existing spoil.

Borrow and Spoil

The borrow areas for fine aggregate will be Kundi Dara, Qibla Bandi and near Lawrencepur, while coarse aggregate will be generated from the spoil, from the river bed and from existing quarries.

2.5 POWER COMPLEX

2.5.1 Location

The power complex will be the western terminus of the Project, located near the village of Barotha, on the left (east) bank of the Indus river. It will discharge the flows into the Indus river immediately upstream of the mouth of the Haro river.

2.5.2 Layout

Components

The power complex (Drawings 7.2.7 and 7.2.8) will consist of a forebay, two headponds, a power intake, five penstocks, a powerhouse, a spillway, a tailrace channel, a switchyard and ancillary structures. There will be a colony for the operational staff.

Forebay

A forebay with an area of approximately 250 by 1000 m will receive water from the power channel and deliver it to a power intake structure consisting of five gates, one for each penstock, provided with trash racks to remove floating debris. The forebay also will contain the spillway intake, which will have a capacity of 2,000 cumecs, enabling it to handle the full discharge of the power channel in the event of power plant shutdown.

The spillway will discharge into the tailrace channel, after passing through a stilling basin and a baffled chute to dissipate energy. The forebay will have an opening into each headpond, through a concrete sill structure which could be closed off with bulkhead gates for maintenance.
Penstocks and Powerhouse

Water from the intakes will enter five steel penstocks, each approximately 220 m long (the length is non-uniform, due to the layout) and 10.6 m in diameter. They will lead into a massive, reinforced concrete powerhouse of conventional design, housing five vertical-axis Francis turbines driving 285 MW generators.

Tailrace

The water discharged by the powerhouse will be carried to the Indus river in a deep channel, approximately 2 km long, discharging into the river about 100 m upstream of the confluence with the Haro. It will be a concrete-lined channel, 11 m deep at the nominal tailwater elevation of 263 m, and 34 m wide. The water elevation in the tailrace will vary with the water level in the Indus. In view of the need to have the tailwater elevation as near as possible to that of the Indus, the tailrace channel will lie in an excavated cut up to 200 m wide at the surface.

Access Roads

A new access for the construction of the power complex will be provided by means of a road linking the Haji Shah-Attock road to the site, bypassing Attock city.

It will be necessary to provide new access to the villages of Barotha, Jaba and Dher, as the existing roads cross the area to be occupied by the headponds. An access road to the powerhouse will circle the south headpond and cross the tailrace on a bridge. This will also serve as a relocated access to Barotha. There will be a new road from the district road around the north headpond to the remaining portions of the present reach to Dher and Jaba.

The bridge across the tailrace channel, approximately midway between the powerhouse and the river, will also replace an existing track between Barotha and farmland to the south of the nullah.

2.5.3 Construction

Schedule

Overall timing. The construction of the power complex will require 63 months from the award of the main civil works contract to full operation, including a period of 12 months in which the units are tested and commissioned. This schedule assumes that certain priority items (eg access, land acquisition and the bulk excavation for the powerhouse) are effectively expedited (Drawing 7.2.1).

7-2.14
Sequencing. In a project as intricate as this one, involving large amounts of excavation and fill, and new logistic systems, the interrelationships of tasks are critically important and dominate construction scheduling. A period of nine months preceding the award of the general contract will be used for preparatory works including land acquisition, construction of access roads, water and electric lines, offices and housing for the administration and construction management staff. As the excavation of the powerhouse foundation is on the critical path for the whole complex, it will be undertaken as a separate contract before the main works.

The main contractor is expected to begin mobilising in the fourth month of the first year. This will be a complex process lasting about 9 months, during which both mobilisation and construction activities will take place. A key date will occur in the middle of Year 5, when the power channel will begin to deliver water. This will require a series of operational components in the power complex to be completed, as well as certain activities such as closure of units not yet ready to receive water, and flooding of the tailrace.

Seasonal Aspects. The basic construction schedule of the power complex is independent of seasons.

Workforce

Number and Composition. The contractor's workforce for the power complex will comprise about 2,700. In addition, WAPDA and its Consultants will have a staff of about 300 at the site.

Source. As in the case of the other components, the majority of the workforce will be Pakistani. Preference will be given to local people, but the labour pool locally is weak in terms of appropriate expertise. The main contractor will be encouraged to provide training during the mobilisation period, as has been successfully done on other large projects in Pakistan.

Housing and Transportation. All temporary buildings erected by the contractor will be located within the headpond areas. The contractor will transport workers to the construction areas by bus. The permanent power complex colony will accommodate the WAPDA and Consultant's supervisory staff, and possibly the contractor's senior construction staff for the initial few months.
Public Safety and Convenience

Protection of the site. All active work areas will be fenced and guarded, for security as well as public safety.

Public Access to Resources. The sequencing of power complex accessory structures, such as the bridge across the tailrace cut, will be such that pedestrians and their livestock will be able to reach traditional grazing areas or croplands. Similarly, arrangements will be made to maintain existing supplies of irrigation water to village lands during the construction period.

Protection from Injury. Steps to protect the public from injury by Project activities will include fencing, security guards (including those where public tracks cross haul roads), and warning signs for both construction personnel and the public.

Control of Dust and Noise. The generation of dust and noise is an inevitable aspect of construction, generally acceptable except close to residential areas. The contractor will be required to water down the haul roads where they pass close to residences, and to adopt good working practices to limit disturbance due to noise.

Access Roads

The construction area will be interlaced with haul roads especially from areas of excavation to areas of spoil. Most of these will be temporary and, where possible, placed within the headpond areas. A new access road will be provided to connect the Goriala-Dakhner road with the Attock-Haji Shah road so that heavy traffic will bypass Attock city during construction. Widening of a few existing roads will also be required.

Work Areas

All temporary work areas will be placed within the headpond areas. These will include construction offices, materials storage, fuel dumps, vehicle yards and shops. When it is necessary to store fill materials it will be done within the headpond areas.

Borrow and Spoil

Some construction materials will be obtained locally. Although a substantial volume of material will be generated by the powerhouse and tailrace excavations, not all of this material will be suitable for construction. Borrow areas are planned south of Barotha, possibly using the bed deposits of the Haro river,
for gravel and sand, and in the limestone hills near Dakhner for rock.

Much of the 14 M cu m of excavated material is expected to be used in the headpond embankments, which will require 11 M cu m. Of this, 7.4 M cu m will come from the spoil and the remainder from borrow areas. The excess will be spoiled within the dead storage of the headponds, or locally in areas of poor land and gullies.

2.6 OPERATION

2.6.1 Barrage and Pond

Releases from Tarbela Dam

The inflow to the barrage pond will consist almost entirely of releases from Tarbela dam. The long term average annual flow volume of the Indus at Tarbela is 74,300 M cu m which is equivalent to an average flow rate of about 2,350 cumecs. However, the natural flows have a strong seasonal variation, with about 83% of the total annual flow occurring in the five months from May to September (Drawing 7.2.9). The Tarbela reservoir is used to regulate these flows. The live storage available in Tarbela reservoir at the planned time of commissioning of the Ghazi-Gariala Hydropower Project will be about 9,700 M cu m, which is about 13% of the average annual flow volume.

The releases from Tarbela reservoir are governed by the requirements of the irrigation system, which are determined on a 10-day pattern. The historical operation of Tarbela reservoir is shown in Drawing 7.2.9. The difference between inflow and releases from Tarbela during lean months is met from the reservoir, which has conserved water from high flows during the previous monsoon. About 12.5% of the stored water is released during the late kharif season (September), about 70% during rabi season (October to March), and the remaining 17.5% during early kharif (April to early June).

For the purpose of Project operation studies, the Kirmani release pattern for Tarbela dam has been widely used. This was developed in the early 1970s on the basis of a study of the variation of river inflows and the downstream irrigation demand over the year. Drawing 7.2.9 depicts the requirements according to Kirmani criteria and historical releases.

In addition to regulation on a 10-day basis, the operation of Tarbela during the low-flow season is subject to daily and hourly variations. The daily variations are determined by irrigation needs, while hourly variations are governed by power requirements. On an hourly basis, Tarbela is operated in a peaking-mode during the low-flow season, with maximum output in the evening hours. These variations will become more pronounced when Tarbela operates as a peak-load station, after the
commissioning of an additional four units of 432 MW each presently being installed (the existing being 10 units of 175 MW each). The peak discharge from the additional units will be dependent on the Tarbela reservoir levels. However, on average the discharge will increase from 1,900 to 3,450 cumecs, without affecting the 10-day irrigation requirements. If, as proposed, a further three units are added, the output will rise to 4,800 MW and the peak discharge to 4,650 cumecs. This increase is planned after Kalabagh is built, because irrigation releases will otherwise be adversely affected when the reservoir is below spillway crest level.

The mode of operation of Tarbela in the future will be determined by several factors, foremost among these being the extent of sedimentation of the reservoir, the availability of upstream storage, and the overall generation picture. At present, Tarbela retains more than 90% of the sediment carried in by the Indus. The sediment has formed an alluvial delta whose front is moving toward the dam at about 600 m per year, the rate varying with the drawdown level of the reservoir. When the delta reaches the dam, an event estimated to occur in about 2015, sediment outflow will increase substantially. When Tarbela is essentially filled with sediment, around 2050, the outflow water will contain about the same sediment content as the inflow (less some of the coarser material). With little storage capacity, Tarbela will then operate as a run-of-river plant. The rate of sedimentation of the Tarbela reservoir will be considerably reduced if the proposed dam at Basha is constructed, 320 km upstream of Tarbela.

In the interim, which includes most of the life of the Ghazi-Gariala Hydropower Project, operation of Tarbela's turbines is expected to move to a peaking mode during the low-flow season, providing most of its daily discharge to the barrage pond during hours of peak electricity demand.

**Pond Elevations and Releases**

On average, the Tarbela 10-day releases are above 2,000 cumecs for about 40% of the time (mid-May to mid-October). During this period, the barrage pond will be maintained at a constant level of El. 340.0 m to maintain the design flow in the power channel. Regulation of the barrage pond surface elevation will be achieved by the undersluice and standard gates. The system will maintain the pond at El. 340.0 m at flows up to 18,700 cumecs. Larger, very rare, flows will result in a rise in pond elevation up to an extreme maximum of 1.5 m.

During the dry season, when Tarbela releases less than the channel capacity of 2,000 cumecs, the Project will have reduced energy output. The discharge of the head regulator to the channel will be maintained at a constant value related to the 10-day discharge from Tarbela, with the barrage pond level fluctuating during each day to accommodate peaking discharges from Tarbela. The maximum drawdown will be about 5 m. Under
those conditions, the Ghazi-Gariala powerhouse will use the headpond storage to provide maximum power and energy during the peak hours. During the non-peak hours, the turbine discharge will be reduced to less than the power channel flow to allow the headponds to refill.

Downstream Releases

During periods of low flow, when the discharge from Tarbela is not sufficient to require spilling at the barrage, a relatively small flow will be maintained in the river downstream. This water is expected to come from seepage under the barrage and from gate leakage but, should that prove insufficient to meet the requirements, additional water will be released through a dedicated compensation water outlet. Project economics have been based on a minimum residual flow at the barrage of 28 cumecs.

Velocities in the Pond

At times of high flow, the water velocity in the barrage pond will approach, but not exceed, those observed under current flood conditions. When the flow is low, the velocity, especially in the downstream end of the pond where the cross section will be greatest, will be quite low, in the range of 0.1 to 0.3 m/s.

2.6.2 Power Channel

Regularity of Flow and Elevation

To the extent possible, the power channel will be operated at the design flow of 2,000 cumecs, with a surface elevation of 339.7 m at the head regulator and 334.0 m at the forebay. This will give a uniform depth of 9 m and a lining freeboard of 1.5 m. During the dry season, depending on water availability in the barrage pond (as predicted on a 24-hour basis), the level at the head regulator will drop to a minimum, in January, of about El. 335.0 m (Drawing 7.2.10). Changes in water level will be gradual.

In the event of loss of load and hence sudden shutdown of the turbines, a surge will be created. This will trigger the operation of the adjacent siphon spillway. Of the remainder of the surge, some will be dissipated in the headponds and the rest will move up the power channel, causing a rise in water level of up to 1 m in a few minutes. This will reduce in height along the channel due to friction.

Velocities

At full flow, the velocity in the power channel will be 2.35 m/s, while at lower flows it will be reduced.
Nullahs

The nullahs normally flow for only a few hours in a given rainfall event and the smaller storms may not produce enough flow to reach the downstream parts of the nullah. A major rainstorm in the hills produces a sudden flow in the nullahs, which may last for several hours. Flood flows up to the 100-year event will pass over the nullah superpassages or through the nullah culverts and down the existing beds, except for those small nullahs provided with inlets to the channel. At superpassages, any flow in excess of the 100-year flood will overflow the sides, pass through slots between the flumes and into the channel.

2.6.3 Power Complex

Mode of Operation

The tail regulator will maintain a constant level upstream in the power channel and release a constant flow into the forebay equal to the flow through the head regulator. The power complex will be operated to maximise the benefits of the Project within the constraints of water availability and the design of the Project.

Under normal operating conditions, the headpond weirs will be kept open so that the ponds will allow peaking operation. This is expected to be carried out for at least 8 months of the year. During the four months of lowest flows (November to February), operation as a base-load project may be of greater value to the national power system. During peaking periods, the water level in the headponds will drop relatively rapidly, reaching a maximum of 5 m fall in 4 hours. Refilling will be gradual over the remaining 20 hours.

2.7 OPERATION AND MAINTENANCE WORKFORCE

2.7.1 Number

The planned permanent staff for the Project will number about 1,400 (214 for the barrage, 386 for the power channel and 800 for the power complex). Of these, 16 will be senior professionals (1 Chief Engineer, 2 Superintending Engineers and 13 Executive Engineers); 38 junior professionals (including 2 professionals for fisheries and range management); about 100 sub-engineers and technical staff; about 200 administrative, accountants and office support staff; and about 800 skilled and semi-skilled labourers. Besides this operation and maintenance staff for the Project, the total will include appropriate staff for medical and paramedical facilities, school facilities and maintenance of colonies, together totalling about 250.
2.7.2 Source

It is anticipated that the professionals and technical staff will be drawn from all parts of Pakistan, while some or all of the administration, skilled and semi-skilled personnel will be recruited locally. Recommendations in this regard are given in Chapter 6.

2.7.3 Accommodation

The majority of the staff will be accommodated in three colonies proposed for the barrage, power channel and power complex. The location of these colonies is shown on Drawing 7.1.1. The total area required for these colonies will be 88 ha (16 ha for the barrage colony, 22 ha for the power channel colony and 50 ha for the power complex colony). The colonies will be provided with basic amenities like water supply, electricity, gas, telephone and appropriate sewerage and drainage systems. The colonies for the power channel and the power complex will also be equipped with dispensaries and schools. The barrage colony will, however, utilise the nearby facilities at Tarbela colony.

REFERENCES


7.2.2 Pakistan Hydro Consultants; Ghazi-Gariala Hydropower Project, Report on Selection of Project Layout, September 1990.
### TABLE 7.2.1

**PRINCIPAL PROJECT DATA**

<table>
<thead>
<tr>
<th>BARRAGE</th>
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<tbody>
<tr>
<td>Normal pond level</td>
<td>340.0 m</td>
</tr>
<tr>
<td>Maximum (survival) pond level</td>
<td>341.5 m</td>
</tr>
<tr>
<td>Design flood discharge capacity</td>
<td>18,700 cumecs</td>
</tr>
<tr>
<td>Discharge intensity</td>
<td>37.5 cumecs/m</td>
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<tr>
<td>Survival flood capacities</td>
<td></td>
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<tr>
<td>Gated sections (max)</td>
<td>24,900 cumecs</td>
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<tr>
<td>Fuse plug</td>
<td>23,300 cumecs</td>
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<tr>
<td>Combined (max)</td>
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<td>Construction flood</td>
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<td>Gate size</td>
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<tr>
<td>Gate type</td>
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</tr>
<tr>
<td>Crest level</td>
<td>333.0 m</td>
</tr>
<tr>
<td>Undersluices</td>
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<td>Head regulator</td>
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<tr>
<td><strong>POWER CHANNEL</strong></td>
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<tr>
<td>Design flow</td>
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<td>Design 'n' value</td>
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<tr>
<td>Longitudinal slope</td>
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### TABLE 7.2.1

**PRINCIPAL PROJECT DATA**

**POWER CHANNEL**

(Cont'd)

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<tr>
<td>Length</td>
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<td>Full supply depth</td>
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<tr>
<td>Bed width</td>
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<tr>
<td>Side slope</td>
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<td>Total excavation</td>
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**POWER COMPLEX**

**Penstock diameter**

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<tr>
<td>10.6 m</td>
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**Turbines**

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</thead>
<tbody>
<tr>
<td>Type</td>
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</tr>
<tr>
<td>Number</td>
<td>5</td>
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<tr>
<td>Design output</td>
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</tr>
<tr>
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<tr>
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<td>Design flow</td>
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<td>Runner discharge diameter</td>
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**Generators**

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<td>Synchronous speed</td>
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**Headpond & Forebay**

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<tr>
<td>Live volume</td>
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**Annual energy output**

(average hydrology)

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<tbody>
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<tr>
<td>With peaking</td>
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</tr>
<tr>
<td>LOCATION RD NO. (km)</td>
<td>SR. NO.</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------</td>
</tr>
<tr>
<td>00 + 800</td>
<td>1</td>
</tr>
<tr>
<td>01 + 585</td>
<td></td>
</tr>
<tr>
<td>02 + 250</td>
<td>2</td>
</tr>
<tr>
<td>02 + 515</td>
<td>3</td>
</tr>
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7-2.24
### TABLE 7.2.2

**BRIDGES AND CROSS-DRAINAGE STRUCTURES**

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<tr>
<th>LOCATION RD (km)</th>
<th>CROSS DRAINAGE STRUCTURES</th>
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CHAPTER 3

BASELINE CONDITIONS
CHAPTER 3

BASELINE CONDITIONS

3.1 METHODOLOGY

3.1.1 Delineation of the Study Area

The limits of an environmental study should encompass all areas where project effects may reasonably be expected. Worldwide experience has shown that most effects occur in the region of the project, but a river development project may have effects hundreds of miles away, notably at the river's estuary. Areas to be occupied by project structures obviously are included in the environmental studies, but additional areas that depend on or interact with resources in the immediate project areas should also be included.

For the Ghazi-Gariala Hydropower Project, the study area comprises the areas of all Project structures, including alternative locations, as well as areas linked to them by resources, such as the barrage pond and adjacent lands, the riverain area of the Indus river downstream of the barrage up to the confluence with the Haro river, and the areas where spoil from the channel and the power complex may be placed.

Broadly, the Project area for environmental considerations extends from the Gandghar mountains in the east to the Attock gorge in the west, including the reach of the Indus downstream of the gorge to the confluence with the Haro river. In the north-south direction it covers the land stretching from the right bank of the Indus river (including right bank villages) almost to the Haro river (Drawing 7.3.1). This area falls approximately between latitudes 33° 45' and 34° 10' North, and between longitudes 72° 15' and 72° 40' East. The area of greatest interest is situated near the left bank of the Indus river.

Certain topics within the environmental study have more restricted study areas, depending on the nature of the anticipated Project effects and the status of Project siting. The archaeological reconnaissance, for example, is restricted to areas to be directly affected by the Project structures including spoil banks and borrow areas.

3.1.2 Purpose of the Baseline Study

An environmental baseline study is intended to establish a data base against which potential project effects can be predicted and later managed. As such, it must include all resources that can reasonably be expected to be affected by a project. Fortunately, worldwide experience with a variety of development projects allows the planner to predict with reasonable assurance where to expect project effects.
The baseline description is intended to accomplish two objectives:

- to provide the reader (including the project planners) with sufficient general knowledge of the project area, and
- to allow the reader and planners to evaluate the potential efficacy of actions to mitigate adverse impacts and enhance benefits.

The first requires a general description of regional resources, including those not expected to be affected by the project. The second requires a more detailed description, quantitative where possible, of those resources that may be affected by the project.

As the project develops from conception through pre-feasibility and feasibility to design, the knowledge of which resources are socially important and which are likely to be affected by the project allows the environmental scientist to place emphasis appropriately. Scoping meetings help by focusing attention on areas of public and official concern. Therefore, great emphasis has been given to scoping sessions in the environmental assessment study of the Project (Appendix B).

### 3.2 GEOGRAPHY

#### 3.2.1 Physiography

The Project area forms the north-western part of the Potawar plateau. It is characterised by high hills, rolling plains and level plains. The hills belong to the Attock range, which extends from the Indus river to Kamra in an west-east direction and Attock Khurd to Dakhner in a north-south direction, and the Gandghar mountains which border the Project area to the east. The plain area of the Project mostly belongs to two major landforms, cover flood plain and rolling sand plain. Active flood plain and alluvial fan areas are also identified in the Project area. The area is crossed by a series of natural drainage channels (nullahs) originating in the hills, and most terminate at the Indus river.

The Project area can be divided into three main tracts (Drawing 7.3.1). These are:

- Ghazi tract, in Tehsil Haripur of District Abbottabad;
- Chhachh tract, mainly in Tehsil Attock and partly in Tehsil Haripur, and
- Sarwala tract, in Tehsil Attock.
The Ghazi tract is triangular with its vertex near Ghazi village and its base against the Chhachh tract. The Indus river and Gandghar mountains form the other two sides of the triangle. The land area of the tract mostly consists of cover flood plain with a small area of alluvial fans at the foothills of the Gandghar mountains. No active flood plain has been identified in this tract. The surface relief is generally undulating with a number of rather steep nullahs.

The Chhachh tract is almost trapezoidal in shape bounded by the Indus river on the north, the Gandghar mountains on the east, the Grand Trunk road (GT road) on the south and the Ghazi tract on the north-east. The land mostly consists of cover flood plain with some active flood plain and alluvial fan. The tract is generally level with a gentle slope towards the river. There are a number of nullahs crossing this tract, but many of them disappear on the plain.

The Sarwala tract extends from the GT road to Barotha. The tract is generally more rugged than the Ghazi tract and is mostly rolling sand plain with frequent hills and rock outcrops and deeply incised nullahs. Occasionally, there are flat valleys in this area. The elevations of this tract are generally higher than elsewhere and reach about 400 m near Kamra.

### 3.2.2 Rivers

The Indus is the largest river in Pakistan. It originates in Tibet on the north slope of the Himalayas, flows through Kashmir and Gilgit and into Tarbela reservoir. Downstream of Tarbela, it flows in a broad, braided channel for 48 km, then turns south after its confluence with the Kabul river, into the 8 km long Attock gorge. It then flows for approximately 152 km to re-enter the Indus plains below Kalabagh. In addition to the Kabul, the Haro enters at Gariala, about 7 km downstream of the Attock gorge.

### 3.2.3 Political/Administration Units

The Project area falls in two provinces of Pakistan - the Punjab and North West Frontier Province (NWFP) - and involves three districts: Swabi, Abbottabad and Attock (see Drawing 7.3.1). The Indus river forms the boundary between the NWFP and the Punjab from a point near Ghurghushti to well downstream of Gariala. Thus, the barrage and the upstream 12 km of the power channel are located in the NWFP, and the remainder of the Project in the Punjab.

Within NWFP, the Indus also forms the boundary between districts, with the result that the right abutment of the barrage and some accessory structures are located in the Swabi District (NWFP) and the left abutment of the barrage and the headworks, as well as
the first 12 km of channel, are located in the Abbottabad District (NWFP). The remainder of the Project is entirely in the Attock District of the Punjab.

### 3.2.4 Settlement Pattern

The population of the Project area resides in villages and towns of several hundred to several thousand people. The largest are the Ghazi/Khalo complex (1991 estimated combined population of 6,140), Ghurghushti (16,550), and Hazro (17,600), but Attock city (50,380) is not far away (Drawing 7.3.1). Along the reach of the channel from the barrage site to the junction of the Tarbela-Lawrencepur (TL) road with the Hazro road, the villages tend to be in a line between the TL road and the Indus river. Beyond the junction up to the GT road, the villages are lined along the Hazro road as well as spread over the area up to the Indus river. Past the GT road there are fewer villages and they are more scattered. The Pakistan Aeronautical Complex at Kamra contains a concentration of several thousand military personnel and their dependants. From there to the power complex, the villages are smaller and more widely spaced. There are a few villages along the Indus, south of Attock gorge, that depend on the alluvial soils of the flood plain and land along the nullahs.

### 3.3 LAND RESOURCES

#### 3.3.1 Geology

**Surface Geology**

Most of the Project area contains unconsolidated alluvium deposited in the geological history by the Indus river and its tributaries, the Kabul and Haro rivers. Later, these deposits were reworked by stream flows of nullahs and by winds, resulting in erosion and fresh deposits. The depth of alluvial deposits generally exceeds 30 m.

In the Ghazi and Chhachh tracts the alluvial deposits form a thick mantle overlying the bed rock. The material on the surface is generally silty sand, underlain by alternate beds of gravels and sand. In the first few kilometres, boulders and cobbles are also found in the nullahs beds. Boulders and gravels are generally of slatey and phyllitic composition and angular to sub-angular with a mixture of rounded to sub-rounded gravels deposited by the river. There are wind-blown (loess) deposits at many places on top of the riverain alluvium.

The Sarwala tract, which stretches between the Attock-Cherat range and the Haro river, is geologically a part of the Attock (Campbellpur) basin. The alluvial sediments in the basin are very thick and were deposited by the ancient Indus, Kabul and Haro rivers.
The sequence of deposition in the area is as follows:
- recent alluvium comprising sands, silts, gravels and occasional large boulders carried down during ice ages,
- siltstones,
- sandy gravels,
- Siwalik-type sandstone,
- reworked sandy gravels, and
- post-Siwalik Soan conglomerates.

The hills near Kamra, forming an eastern extension of the Attock-Cherat range, consist of argillites, limestone and quartzites. The hills on the right bank near the barrage site consist of Hazara formations comprising crystalline metamorphic rocks with non-fossiliferous sedimentary deposits and some gabroic intrusions. The rocks are generally characterised by extensive folding, faulting and shearing associated with crustal deformations.

**Faulting and Seismicity**

The geology of the Project area is closely related to the formation process of the Himalayan ranges, involving the collision of the Indian and Asian crustal plates. This has resulted in intense deformation, with complex folding, involving high-angle strike-slip faults and crustal thickening expressed in a series of thrust faults. The following main tectonic features exist in the Project area and are related to the Himalayan and Hazara thrust systems (Drawing 7.3.2):
- Darband fault
- Panjal fault
- Khairabad fault
- Cherat fault
- Hissartang fault
- Main Boundary Thrust (MBT) fault.

Analysis of historical data shows that the earthquakes that have affected the Project area are mostly associated with the movement of rocks along these faults. Some of the earthquakes have also resulted from large events at greater distances.
The pre-instrumented data indicates the occurrence of several Modified Mercalli (MM) intensities in the range V to VIII, with an event in 25 AD which may have reached an intensity of IX to X.

The instrumental data for the present century shows that earthquakes of magnitude greater than 5 on the Richter scale have frequently been recorded, but there have been only three events of magnitude greater than 6 recorded within a 200 km radius of the Project.

In the planning and design of the Project structures, due consideration has been given to the events and intensities of earthquakes in the area. In this respect two criteria have been adopted. In general the structures have been designed for an Operational Basis Earthquake (OBE). This is an earthquake level which the structures can withstand and still remain operational. The appropriate magnitude for the OBE has been determined from a probability study based on the available instrumental data.

A seismic event very much larger than those for which a probability of exceedance can be estimated could occur. It is not economical to design all structures to withstand such an unlikely events with no damage.

It is considered that an earthquake of magnitude M=6.5 could occur at the closest location on the Darband fault to the barrage, and that an earthquake of M=7.0 could result in rupture of an inclined segment of the Main Boundary Thrust fault close to the power complex. Therefore, to avoid widespread loss of life, the water-retaining structures have been designed on the basis of a Maximum Credible Earthquake (MCE).

Such structures include the following:

- the barrage rim embankments,
- the power channel embankments and culverts, and
- the headpond and forebay embankments.

3.3.2 Soils

The soils of the Project area are alluvial or loess sands or sandy loams, varying in agricultural capability from poor to very good. The Reconnaissance Soil Survey, Campbellpur, 1970 (Ref. 7.3.1) indicates four major soil associations as occurring along the power channel corridor and in the power complex area (Drawing 7.3.3). These are described below.
The Argan association (that includes Argan soil series, its variants and Miami soil series) occupies the level plain of Chhachh tract around Hazro, extending to the bank of the Indus and inland 10 km near Hattian. Along the river, Argan soils extend upstream from about Momanpur to Qazipur. There are no soils of this series along the power channel corridor, but they are found along the narrow flood plain in the tailrace area. These soils are brown to dark brown loams to fine sandy loams, strongly calcareous (pH 8.0-8.2). The 'A' horizon, 8-15 cm deep, is well separated from the 'B' horizon, which is 90-150 cm deep. These widespread soils have high agricultural value, supporting tobacco, vegetables, wheat, and maize, often with irrigation from wells.

The Ghazi association (that includes the Ghazi soil series, its variants, and Rajar and Wazirabad soil series) is found along the Indus river from Ghazi to beyond Ghurghushti and southwest along the Hazro road. The first 6 km and a short stretch from RD 15 to RD 17 of the power channel fall in this soil association. Like the Argan soils, they are brown to dark brown sandy loams, strongly calcareous (pH 8.0-8.4). The 'A' horizon is clearly separated from the 'B' horizon, which extends from about 10 to 70 cm in depth. Most of the Ghazi soils in the Project area have been developed for irrigated farming of wheat, maize, sorghum and millet, using groundwater.

The Rajar complex (that includes Rajar, Qutbal, Ghazi and other soil series) borders the Ghazi soils along the first 17 km of the power channel corridor and occurs in 7 patches 1 to 4 km long from about RD 17 to the railroad near Rumian (RD 44). These are very deep, well-drained, medium textured, yellowish brown silt loams. They are calcareous loess soils (pH 8.0-8.2) with a thin 'A' horizon (12-15 cm) over a 'C' horizon that extends to 150 cm depth or more. Rajar soils are used for dry-farming of wheat, sorghum, and millet, but their capability for agriculture is not considered high. Occasionally they are developed for irrigated agriculture.

The Wazirabad association (that includes Wazirabad, Jand, Pindorian and Kuada soil series) dominates the area along the power channel from near Barazai (RD 17) to the area of the headponds. They are deep, well-drained, brown to dark brown loamy sands, and are non-calcareous. The 'A' horizon is 12-15 cm deep and the 'B' horizon up to 150 cm. These soils support dryland farming of wheat, grams as winter crops and groundnut (peanut) as a summer crop.

The hilly area in and around the headponds is classified as 'rough, broken land'. The soils are sandy and stony and broken by eroded gullies in places. There are some arable fields, presumably of Wazirabad soils, that are used for barani agriculture.
3.3.3 Land Use

Land use in the area is determined largely by physiography, soils and water availability. Population pressure also plays a major role. Thus, while land may be classified by capability from very good agricultural land, suitable for irrigated agriculture, to poor grazing land (unsuitable for cropping and not even good for grazing), and further to agriculturally unproductive land, these designations are made by agronomists and not by farmers. Many areas are subject to uses for which they are unsuitable. Such use may degrade the land resulting in deforestation and/or erosion.

The land of the Ghazi and Chhachh tracts lying between the Indus river and the Tarbela-Hazro road is intensively used for agriculture under irrigation through wells and tubewells. The intensity of irrigated agriculture decreases farther from the road in southeast direction (towards the foothills of the Gandghar mountains).

Village surveys, field observations and the study of fresh aerial photographs (January 1991) indicated that the land within the corridor of the power channel and the spoil banks is generally good to moderately productive under barani agriculture. Irrigated lands are generally concentrated in the villages of Kholo, Isa, Malak Mala and Barazai.

The lands of the southern reach of the Chhachh tract (Khagwani to GT road) and that of the Sarwala tract are mostly barani with moderate to marginal productivity levels for general arable crops. However, this tract is beneficially used for peanut cultivation. Grazing of goats is practiced on all of the lands that are incapable of barani agriculture.

There is no dedicated (reserved) forest near the Project structures and no real forest in the culturable areas. Small copses of trees are found in many of the smaller nullahs and along the nullahs flowing into the Indus. Downstream of Attock gorge near Dakhner, these copses become dense enough in places to be called riverine forest.

The hills to the east of the channel support brush and scattered trees. Lands to the west of the railroad and north and west of the channel are considered 'poor grazing land' (ie unsuitable for cropping) but many level upland areas have been cleared for barani crops. The area west of Dakhner and Nurpur Karam Alia is largely open fulai/meskeet woodland. Reserved forest areas exist in the Kala Chittas, the low hills of the Attock range near Attock Khurd, and the Rakhs along the right bank of the Haro river, which are far away from the Project.
3.4 CLIMATE

3.4.1 Rainfall

The climate of the Project area is characterised by two distinct seasons; summer and winter, each of which produces some rainfall. The principal rains occur in the summer and are caused by the monsoon, while those in winter (December to mid-March) result from cyclonic storms from the southwest.

Tarbela receives an average of 860 mm of rainfall, about 40-45% of this in July and August. Annual rainfall at Attock city is about 600 mm. The summer rains tend to occur in relatively brief and intense events, the maximum daily rainfall recorded at Tarbela since 1961 being 182 mm, on July 25, 1985. During August 2, 1976, 281 mm was recorded at Gariala and on September 14, 1958, 285 mm fell at Haripur in about 15 hours.

3.4.2 Temperature

The Project area has a sub-humid sub-tropical climate, with hot summers and cool winters. June is usually the hottest month with a mean maximum temperature (1961-1990) of 44°C and the maximum recorded during the period of 47.7°C. Tarbela is normally a degree or two warmer than Attock city. January is the coldest month, with a mean minimum of 4.8°C at Tarbela (2°C at Attock city) and a record low temperature of -1°C at Attock city.

3.4.3 Air

The prevailing wind directions are northwest and west. Monthly mean wind velocities at Tarbela from 1979 to 1990 ranged from 2.8 to 6.3 km/h (1.5 to 3.4 knots). The maximum wind recorded at Chaklala (near Rawalpindi) since 1969 was 143 km/h (76 knots); the maximum recorded at Peshawar was 130 km/h (70 knots). Air quality is good throughout the region, there being no major sources of air pollution.

3.4.4 Evaporation

The area is relatively dry most of the year, with an average annual relative humidity of 39% at Attock city and 58% at Tarbela. Average annual pan evaporation at Tarbela is about 2,500 mm, the highest being in May and June, just before the start of the monsoon.
3.5 WATER RESOURCES

3.5.1 Tarbela Reservoir

The Indus river at Tarbela has an average annual flow of about 74,300 M cu m, equivalent to 2,350 cumecs. About 83% of this flow is received during five months from May to September. To meet irrigation requirements and generate power, a dam was constructed at Tarbela in 1974. Of the total flow, about 15% is stored in the Tarbela reservoir for release for irrigation during the dry months.

The gross storage capacity of the reservoir is 13,700 M cu m and the initial live storage capacity was 11,470 M cu m. The reservoir area is about 153 sq km at the full storage level of El. 472.4 m. The width of the reservoir varies from place to place. At the main dam site it is about 2.7 km wide and at places about 6 km wide. The length of the reservoir creeks extends up to about 95 km.

The side slopes of the reservoir near the dam are generally steep and rocky, with the result that the slopes are devoid of any vegetation to support fishery. However, in the backwater regions the conditions are more favourable for aquatic ecosystems and a fishery is well developed there.

3.5.2 Indus River

Reach A - Tarbela Dam to Barrage Site

Below Tarbela dam, the river flows southwest for about 10 km before turning west. The bed slopes at approximately 1.4 m/km (1:700). In the first 7.5 km, the channel is 1.5 to 2.0 km wide, with well defined banks. Within the banks, the river is braided at low flows, but at higher flows it fills its bed bank to bank. During the drier months, the entire flow is derived from the powerhouse discharge at the right (west) end of the dam and follows the right bank for about 2 km.

Spillway discharges are directed into a nullah, Dal Darra, from which they emerge into the river about 1.5 km downstream of the dam. This flow follows the left bank for 1.8 km then crosses to the right bank, joining the other channel just downstream of the Pehur pumping station which supplies the Pehur irrigation canal on the right bank. The combined flow recrosses the channel and meets the left bank at the barrage site, just upstream of Ghazi.

The bed in this reach is composed of sand, gravel and cobbles. Semi-permanent bars occur along the left bank 1-2 km upstream of the barrage site. These support scattered trees and some herbaceous vegetation.
Flows in this reach are determined by the operation of Tarbela dam, which in turn is governed by the requirements of the irrigation systems downstream. In the high-flow season, the reservoir is gradually filled, usually reaching top storage level by the second half of August. The stored water is released during the drier months in order to provide irrigation water.

From Tarbela to the confluence with the Kabul river, there being no significant tributary, the flow in the Indus is essentially what is released at the dam. During the period from October 1976 through September 1989, the 10-day average release ranged from 550 cumecs in late January to about 6,100 cumecs in mid-August (Drawing 7.2.9). Annual maximum one-hour releases during that period ranged from just under 9,500 cumecs (1985) to about 14,100 cumecs (1989).

The minimum mean daily outflows at Tarbela from 1976 through 1990 (post-Tarbela period) generally ranged from 119 to 626 cumecs (average 390 cumecs) in the month of January. There was even a period of 8 days in January 1977 when there was no release. During the immediate pre-Tarbela period (1960 through 1974), the minimum mean daily flows at Darband during January were in the range of 380 to 459 cumecs (averaging 406 cumecs).

Reach B - Barrage Site to Kabul River

Between the barrage site and the Kabul river, a distance of 41 km, the Indus crosses a plain with an average slope of about 1 m/km (1:1,000). The river bed is 2.2 to 4.5 km wide, with channels meandering within it. As in Reach A, the bed is composed of coarse sand, gravel and cobbles. There are numerous large bars, some of which can be considered semi-permanent islands, as they are flooded during every high-flow period. Others are permanent and support thick vegetation. They are proprietary and support trees, pasture, and some croplands, but even these are not inhabited. The proprietary rights belong to the villages located along the river banks.

Flows in this reach are almost the same as in Reach A, there being no significant permanent tributaries. The Badri river on the right bank discharges about 0.5 cumecs of permanent flow some 23 km downstream of the barrage site. There are also numerous nullahs that enter from the hills to the southeast and many produce brief periods of substantial flow. The largest of these, Kundi Dara, enters the Indus immediately downstream of the barrage site. Its 40-year flood is estimated at about 520 cumecs and its 100-year flood at about 600 cumecs. Although these flows are substantial, they are of such short duration that their incremental contribution to the flow of the Indus is not significant.
To assess the quality of the river water in the reaches A and B, sampling was carried out at seven sites in the river during high flows (August) and low flows (December). The water sampling included the following sites:

**Right Bank**
- Upstream of Galla village
- Downstream of Galla village
- Downstream of Pontia village

**Left Bank**
- Upstream of Ghazi village
- Downstream of Ghazi village
- Downstream of Khalo village
- Downstream of Momanpur village.

At each site two samples were collected, one near the bank and the other from mid-stream. In addition to the river water samples, two sewerage outlets were sampled, one at Ghazi village and the other at Jallo village. The water and sewage samples were analysed for their physical, chemical, biological and oxygen related properties. The water quality data are reported in Table 7.3.1.

The river water is slightly alkaline, its pH varying from 7.6 to 8.0 at various locations. The ion concentration, total dissolved solids, and metals are within the desirable limits for human consumption (Ref. 7.3.7). Generally these parameters are a little higher during the low-flow periods than during the high-flow periods, but are still within the desirable limits. Total hardness during the high-flow period is also within the desirable limit. It increases during the low-flow period, exceeding the desirable limit, but is still within the permissible limit. The results of laboratory tests indicate that the BOD$_5$ of the Indus river samples was between 3 to 12 ppm, and the coliform counts were high.

However, the results of Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and bacterial counts provided by the laboratory cannot be considered reliable as the testing was not carried out promptly. Further sampling and testing will therefore be carried out during the supplementary study in November and December 1991.
Reach C - Kabul River to Power Complex Tailrace Site

The river channel is nearly straight in this reach, with only one island, Ghiri Island, an uninhabited lump of rock some 500 m wide and separated from the east bank by an intermittent channel.

There are no major tributaries in this reach, only a series of nullahs, most of them small. A few, of which Jaba nullah is by far the largest, are perennial, but their contribution to the flow of the Indus is insignificant.

The average minimum and maximum mean daily flows during the months of January and July were 649 cumecs and 13,795 cumecs respectively at Mandori for the pre-Tarbela period (1965 through 1975). For the post-Tarbela period (1976 through 1982) the average minimum and maximum mean daily flows during the same months were 758 cumecs and 11,798 cumecs, respectively.

Reach D - Downstream of Power Complex Tailrace Outfall

About 100 m downstream of the tailrace outfall site, the Indus is joined by the Haro river, flowing from the east. The average annual flow in the Haro is about 25 cumecs.

3.5.3 Kabul River

The Kabul river originates in central Afghanistan, flows east past the city of Kabul, and enters Pakistan about 20 km north of Landi Kotal, NWFP. Near Jalalabad, in Afghanistan, it receives a major tributary, the Kunar (or Chitral) which originates in the Hindu Kush range of northern NWFP.

Shortly after entering Pakistan, the Kabul enters the reservoir of the Warsak hydropower project. Near Peshawar, it receives another major tributary, the Swat. It then flows past the city of Nowshera and joins the Indus 30 km later.

The Kabul river peaks about two months earlier than the Indus, in June or early July. It discharges into the Indus an average volume of 27,000 M cu m (1961-88). The highest monthly average flow during the period of record was 3,540 cumecs, in June 1961. Low flows occur in February or March, the record low being 164 cumecs in 1985.

3.5.4 Haro River

The Haro river originates near Nathia Gali, at an elevation of about 2,000 m in the foothills of the Pir Pangal mountains, and flows westward to join the Indus near Gariala. Its catchment area is 1,180 sq km. It is fed by numerous small streams and nullahs but only a few large tributaries. The largest is Nandana Kas, which joins the Haro from the south, 30 km from its mouth.

7-3.13
For some 40 km upstream of its crossing by the GT road, the Haro occupies a gravelly flood plain 500 to 1,200 m wide, with the low water channel meandering from bank to bank. In the reach from the GT road to the Haro's confluence with the Indus, the flood plain is narrower, 50 to 200 m, and the course of the river meanders strongly. On the outside of some bends the river has created siltstone cliffs up to 50 m high.

The annual discharge of the Haro averages approximately 780 M cu m, according to 11 years of record at Gariala between 1969 and 1981 (1978 and 1980 missing). The peak instantaneous flow during the period was 4,757 cumecs, on August 2, 1976, this also being the day of the maximum daily average flow of 3,341 cumecs, with the day's discharge being 288.7 M cu m. In most years, flow builds rapidly during July to a peak in August, then diminishes during September. The year's minimum flow is typically 6 to 7 cumecs and usually occurs in May or June, although there often is also a period of low flow in October or November.

### 3.5.5 Nullahs

A number of nullahs cross the proposed alignment of the power channel, starting from high ground on the left side of the channel and running towards the Indus. The nullahs have catchment areas ranging from less than 1 sq km to 40 sq km. A total of 41 catchment areas have been identified between Ghazi and the power complex. Within some catchments, the nullah is braided, with channels dividing and combining. Consequently, the number and locations of nullah channels intersected by the power channel varies with the choice of alignment.

With the proposed alignment of the power channel, there will be 59 nullah branches crossing the channel. The nullahs are intermittent streams whose flows result from rainstorms in their basins. Because their catchment areas are small and poorly vegetated, flows tend to be abrupt and short-lived, usually measured in hours after the cessation of rain.

Most of the nullahs have no generally recognised names and therefore they have been given sequential identification numbers according to their catchments, starting from the barrage. There are 40 catchments with their drainage channels crossing the power channel alignment. Within some catchments, the nullah is braided. Consequently, in certain catchments more than one nullah channel will cross the alignment. In such cases, each branch has been distinguished by a suffix (Table 7.2.2).
3.5.6 Groundwater

The Project area, being a part of the Potawar plateau, has generally an undulating surface relief. As a result, depths to the water table are not uniform. According to a 1986 survey by WAPDA (Ref. 7.3.2), which covered about 24,000 ha of the Project area, 21% of the surveyed area is very poorly to poorly drained (water table within 2 m of the surface), 4% is moderately well drained (water table within 2 to 3 m), and 75% area is well drained (water table below 3 m). The very poorly and poorly drained area extended from Hazro to the GT road and beyond Madrota. According to this survey, the power channel from RD 19+000 to 45+000 will cross patches of poorly drained land.

Groundwater is presently a major source of irrigation and domestic water in the Project area. Therefore, a study has been carried out to evaluate the existing pattern of distribution of groundwater and likely changes that may result from the implementation of the Project. Fortnightly observations, from April to December, were made of the depth to the water table at 156 selected open wells and 74 piezometers, spread over the Project area. In addition, reference was also made to the reports on hydrogeological investigations carried out by WAPDA (Ref. 7.3.3 to 7.3.5) and consultants/contractors for the Pakistan Aeronautical Complex. The results of the review of existing information are presented in the following paragraphs.

From the data on the wells, it has been inferred that the depth of the water table is similar to that in the WAPDA observations of 1986. In the Ghazi tract of Tehsil Haripur and the north-eastern part of the Chhachh tract of Tehsil Attock, the water table depth in wells during the wet season generally lies in the range 10 to 23 m, with a few wells in the range of 5 to 10 m. In the southwestern part of the Chhachh tract, up to the GT road, the water table depth generally varies from 0.4 to 3 m. A similar situation has been observed in the Rumian area of the Sarwala tract.

The fluctuations in the water table between wet and dry seasons vary throughout the Project area. It has been observed that the fluctuations are in the range 2 to 4 m in the area from Ghazi to Qazipur, while it is generally 0.2 to 2 m in the rest of the area. This leads to the conclusion that, in the area between Ghazi and Qazipur, the river flows play a major role in groundwater recharge, while in the rest of the area the river effect is negligible. This situation is also confirmed from a groundwater contour map prepared from the recent well observation data.

From a study of WAPDA reports and the groundwater contour plan, it appears that the groundwater in the reach between Ghazi and Qazipur slopes away from the Indus river, thus confirming the recharge from the river. Beyond Qazipur the direction of groundwater flow gradually reverses, so that it is from high ground towards the river. It is also observed that, beyond
Qazipur, the groundwater gradient follows the general trend of surface topography. This indicates that the major source of recharge is precipitation.

According to WAPDA hydrogeological investigations for the Ghazi sub-basin (Ref. 7.3.3), which comprises 72 sq km of plains and 182 sq km of catchment area along the Gandghar mountains, the water balance is as follows:

<table>
<thead>
<tr>
<th>GROUNDWATER INFLOW SOURCE</th>
<th>QUANTUM M cu m/y</th>
<th>GROUNDWATER OUTFLOW SOURCE</th>
<th>QUANTUM M cu m/y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface inflow from river (from beyond Ghazi to Qazipur)</td>
<td>35</td>
<td>Subsurface outflow to the river downstream of Qazipur</td>
<td>38</td>
</tr>
<tr>
<td>Subsurface inflow from Hazro basin</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water recharge from precipitation and runoff from piedmont area of Gandghar mountains</td>
<td>4</td>
<td>Groundwater withdrawal by pumping</td>
<td>11</td>
</tr>
<tr>
<td>Return flow of groundwater used for irrigation</td>
<td>1</td>
<td>evaporation losses</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total 58</td>
<td></td>
<td>56</td>
</tr>
</tbody>
</table>

In this sub-basin the recharge by percolation from rainfall and runoff in the piedmont area corresponds to only 2% of the rainfall over the catchment area. This is probably related to the steep slope of the ground. The balance between inflow and outflow contributes to the rise of the water table and provides additional potential for pumped extraction. The aquifer characteristics suggest that there is a good groundwater potential.

In the Hazro basin, which extends in an east-west direction from Ghurghushti up to the Attock ranges and in a north-south direction from the Indus river to the GT road, the situation is quite different. According to WAPDA's report (Ref. 7.3.4), the effective area of the basin comprises 544 sq km with an annual precipitation of 580 mm, and the water balance is as follows:

7-3.16
<table>
<thead>
<tr>
<th>GROUNDWATER INFLOW SOURCE</th>
<th>QUANTUM M cu m/y</th>
<th>GROUNDWATER OUTFLOW SOURCE</th>
<th>QUANTUM M cu m/y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water recharge from precipitation and surface run-off (20% of the precipitation)</td>
<td>64</td>
<td>Withdrawal through wells</td>
<td>9</td>
</tr>
<tr>
<td>Recharge from irrigation water (10% of the pumped water)</td>
<td>1</td>
<td>Discharge through effluent stream (Chel nullah)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total 65</td>
<td>Discharge to the Indus river</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outflow to Ghazi sub-basin</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge through evaporation from land area</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total 54</td>
<td></td>
</tr>
</tbody>
</table>

The excess of the inflow over the outflow contributes to the rise of the water table and has caused waterlogging of part of the Chhachh plain. WAPDA has classified the Hazro basin as a Class I potential zone for groundwater development.

The Project area beyond the high land near Rumian up to Barotha falls in the Haro river basin (Ref. 7.3.5) and forms about 3% of the total Haro basin area. The WAPDA report on the Haro basin deals with the total area as a unit. Therefore, it is difficult to estimate the groundwater statistics for this part of the Project area. However, the recharge to the groundwater from precipitation and flow from other areas is estimated at about 15 M cu m/year, which is almost balanced out through discharges to the river and into nullahs, pumping and evaporation. The WAPDA report has classified this area as a Class III potential zone for groundwater development.

### 3.6 Biological Resources

#### 3.6.1 Vegetation

**Terrestrial Plant Communities**

Throughout the Project area, the natural plant communities have been heavily modified by the human population, especially in the densely populated area northeast of the GT road. This modification has varied from cutting shrubs and limbs of trees for fodder or fuelwood to complete clearing for agriculture.
The native vegetation in the area was tropical thorn forest, sometimes called 'rakh forest' (Ref. 7.3.6). It is a low, evergreen forest, under 10 m high, dominated by kandi (Prosopis spicigera), meskeet (P. julifora), fulai (Acacia modesta), farash (Tamarix aphylla), and ber (Zizyphus iujuba). In the smaller nullahs, where a permanent water table is available to roots, babul (Acacia nilotica) can be found. There is no reserved forest near the Project structures. There are reserved areas in the Kala Chitta hills, in the low hills of the Attock-Cherat ranges near Attock Khurd, and in the rakh forests along the right bank of the Haro river, but these are well outside the area of Project influence.

Heavy grazing by goats or lopping for cattle has tended to alter this woodland in favour of unpalatable species, such as the shrubby malla (Zizyphus nummularia), or toxic ones, such as the milkweed (Periploca aphylla).

In the agricultural areas, some native trees are allowed to survive for shade, fodder, or fuelwood, and a few exotic species are encouraged or actively cultured. These include some fruits, such as lime, orange, olive, mulberry and fig, and trees for fuelwood or erosion control, such as eucalyptus, bahar (Populus euphraticus), mulberry (Morus albus), and ipil-ipil (Leucaena leucocephala). Hemp (marijuana, Canabis sativa) is a common shrub on field edges. Along the Tarbela-Lawrencepur road, WAPDA has maintained a plantation of poplar (Populus cilieta) and shisham (Dalbergia sisso).

Wheat is the dominant winter crop grown in the Attock District, covering nearly half of the total cropped area of 520,000 ha. Another third of the area is devoted to maize. Millet (bajra) also is an important crop, with about 8% of the cropped area, as is sorghum (jawar) with about 5%. Lately, groundnut has become an important cash crop over the rolling sand plains of the Project area. Tobacco is also an important cash crop in the Hazro area.

Aquatic Plant Communities

There are no permanent natural wetlands in the Project area, other than pools along the banks of the rivers and the edges of reservoirs. Both Tarbela and Qibla Bandi reservoirs undergo such extensive drawdowns that their banks are virtually devoid of aquatic vegetation. Aquatic plant communities are not ecologically significant in the Project area.

The possible occurrence of ecologically significant wetlands in the Indus floodplain channel will be examined in the supplementary ecological studies.
3.6.2 Fauna

Terrestrial

The Gazetteer of the Attock District (1930) identified that the terrestrial fauna included leopard, hyena, jackal, fox, urial, chinkara and hare. Leopard, hyena and urial were found in the Kala-Chitta range and occasionally on outlying spurs. Jackal existed in all parts of the tract. Chinkara existed in the maira land and ravines of Tehsil Attock. Hare were found on all the low hill spurs. Fox were reported to exist in the vicinity of Attock city. However, the populations of these animals were not large.

With the increase in human population and the deforestation of large areas of the tract, the animal population has further reduced. Leopard and hyena apparently have disappeared from the area. Another substantial population of urial, chinkara, and a few leopard exist in the Kala-Chitta range. It is also inhabited by grey partridge, Chukor and seese. The Government of the Punjab has declared the Kala-Chitta range a game reserve, where hunting of the wild animals is allowed only with permits.

Jackal and hare are plentiful in all parts of the tract. Wild boar exist in the belas (river islands) and thick growth along the lower banks. Snakes are not very common in the area. Lizards of different kinds and rats are common.

Game birds of the area include blue rock pigeon, kaunk (chukor), seese, grey partridge, large and small sandgrouse. Quail in large numbers visit the area in spring and autumn. Waterfowl are also found during winter.

Game animals of the area are generally wild boar and hare. There is a total embargo on hunting urial and chinkara, because of their rarity.

Aquatic

The aquatic life of the area is principally fish. The commonest fish in the Indus river and ravines are mahsheer (Barbus putitora), rohu (Labeo rohita), thaila (Catla catla), Chaina (Mystus oar) and mallah (Shizothorax sp.).

There is no large scale fishery in the Project area. There are a number of part-time fishermen who camp on the islands along the Indus river, mostly during the months when the river flows are receding. Their catch is often sold in the local market, thus supplementing their income. There are fishermen in the power complex area who take fish to the market in Attock city once or twice a week. In Ghazi, fish is normally available on village market day (Tuesday) and occasionally during the rest of the week.
3.7 SOCIAL AND CULTURAL ISSUES/RESOURCES

3.7.1 Methodology

The evaluation of social and cultural baseline conditions has been based on an examination of available official census and social data, extensive field observations, scoping sessions, and the results of a social survey undertaken in 15 villages in the area affected by the Ghazi-Gariala Hydropower Project (Drawing 7.3.1). Scoping sessions have been used to gain the initial participation of local groups in identifying the environmental impacts of the Project, assess their significance, and suggest social strategies to mitigate or enhance environmental impacts. The village survey was designed to gain an understanding of the social and economic life of the affected area and thus the potential impacts of the Project.

To meet the study objectives the socioeconomic survey was based on the 'Rapid Rural Appraisal' method rather than through structured interviews. A team of three male (including one expatriate fluent in Urdu and Pashto) and two female sociologists was formed. The team members worked in two groups, one conducting the male sessions and the other dealing with the female gatherings. The gatherings were arranged at the Union Council level, where the villagers of constituent villages were invited through announcement by the Chairman of the respective Union Council. Each session consisted of two parts, the first comprised the scoping process at the Union Council level and the second a village-level survey of randomly selected villages. In all, 10 Union Councils were covered, where 14 scoping sessions were held, in addition to village-level socioeconomic surveys of 15 villages. The details of this process are reproduced in Appendices B (Section B.7), D and E. The areas covered are indicated on Drawing 7.3.1.

Generally, the scoping sessions and village survey worked well. However, the team felt that some social groups, rural farm labour, village service groups, and herdsmen, either were not adequately represented in the respondent groups or were intimidated by more influential landholders. As much as time and opportunities permitted, team members sought the views of these groups in less structured settings. Although sessions for women were conducted separately by female sociologists on the team, the team did find some resistance to interviewing women. This was particularly true in the villages of the upper and central Chhachh. In every case, however, local leaders were persuaded that their womenfolk had legitimate concerns in the areas of health and education and the sessions were organised, if a little belatedly (Appendix B, Section B.8).
3.7.2 Parameters of the Project

Throughout the social assessment, the team kept in mind that the purpose of the Project is the generation of electricity, and not the economic development of the region through the provision of irrigation water. As there appear to be no direct developmental benefits to the region from the Project, the effort here has been focussed on the disruptive aspect of the Project and at suggesting mitigation and compensation measures. Nonetheless, keeping in mind World Bank guidelines that mitigation alone is not a sufficient response, several development measures have been suggested as part of a compensation package.

The analysis in this chapter is based largely on the village survey, with the aim of focussing on the major impacts of the Project. Additional data are reproduced in Appendices D and E for use in establishing the developmental needs of the region.

3.7.3 Historical and Social Context of the Project Region

The Project passes through a region rich in history, archaeology, and the farming, over many centuries, of a fertile alluvial soil. Most of the great conquerors of India came through the Chhachh plain, probably crossing the Indus river at or near the ancient ferry crossing between Hund (Und, Udabhanda, Waihind) and Malla (a ferry crossing here is still used by the local people). These included Alexander, Mahmud of Ghazni, and Babar, the founder of the Mughal Empire, to note perhaps the best known. The Chhachh is full of old mounds, including two in the Project alignment at Musa Kudlathi, where the remains are of the Gandharan Period. Other historical associations are more recent. Kathera at the foot of the Gandghar mountains is the old capital of the Tahir Kheli Pathans, a tribe that held off the Sikhs and then returned to dominate the northern Chhachh under the British. Hazro, the ancient urban centre of the plain, was headquarters for the Hijrat Movement during the Khilafat Struggle after World War I, and both Hazro and Ghurghushti have madrassahs with venerable traditions in Islamic jurisprudence.

3.7.4 Social-Ecological Sub-regions in the Project Area

The Chhachh Plain

The area traversed by the Project is divided into two distinct ecological zones. The first of these is the Chhachh, which runs from Ghazi south to the higher ground that carries the Grand Trunk road between Lawrencepur and the Attock Fort. The Chhachh is a fertile plain locked in by the hills and the Indus river. It is a densely populated region of ancient village sites, intensive cultivation, and small landholders: Pathans, Awans, Gujars, and Maliars, known for their skill, vigour, and enterprise. The soil is a rich loam deposited by hill torrents. The best land is in the north and centre, where old stone-faced
wells attest to long cultivation. The land to the east along the foothills is drier and rain-dependent (barani), except in the upper sections of the deeper nullahs (Pipliala, Khairbara, Kathera, Qibla-Bandi) where permanent flows irrigate orchards and fields. The land to the south of Hazro along the meandering Chel river is subject to waterlogging and to destructive flash floods during the summer rains. A century ago the Chel region was marsh land, the haunt of highway robbers preying on caravans passing along the Grand Trunk road.

The Sarwala

The second region is the Sarwala, a dry tract south of the Grand Trunk road, centred on the modern city of Attock. The Sarwala encompasses the high ground, between the Chel and the Haro river, which rises into the Attock hills at its western end. Much in contrast to the Chhachh, the Sarwala is poor, sparsely populated, and dependent on rain-fed cultivation. Villages and wells are infrequent and the land is substantially eroded, particularly where nullahs and washes lead down to the Haro in the south and the Indus in the west. The people of the Sarwala are hardy Khattar and Awan tribesmen, who have long exported their surplus population to the industrial and commercial centres to the south and to service in the armed forces. No parochial group in Pakistan has contributed more men to the military and police than the Awans, whose heartland is the Potawar plateau and the Salt Range, immediately south of the Project area.

The Indus Riverain (Sailaba)

Two areas on the margins of the Project area could be affected by the Project. The first of these is the broad Indus flood plain and the river bank villages on both sides. These villages get benefit from the river and the islands (belas) in its flood plain for fuelwood, grazing land, and, to a lesser extent, for fish, water, and minimal cultivation. The impacts of reduced seasonal water flows on these villages could be more difficult access to water for laundry, which also provides a social meeting point for women, and for large herds of cattle, up to several thousand head, which graze in the belas near the downstream villages (Section 3.7.6).

The Gandghar Mountains

The second area that could be marginally affected is the Gandghar mountains, which close off the Chhachh plain on its eastern side. The Gandghar, and the bench-like footing that lies between the mountain wall and the true plain is substantially populated. The people of these areas: Tahir Khelis on the bench, Mashwani Pakhtuns and Gujars in the upper villages, depend on the lowlands for markets, employment, and health and educational facilities. Cultivation in these uplands is mostly barani, although permanent
flows in the upper valleys under the Gandghar (Pipliala, Khairbara and Kathera nullahs) provide for intensive, irrigated cultivation in villages like Bandi.

Considerable two-way traffic passes between these upland and mountain villages and the market town of Ghazi-Khalo. Forest products: wood, grasses, resins, honey, eggs, and fruit, are traded for grains, vegetables and consumer goods in Ghazi. All the major upland villages have scheduled transport to and from Ghazi operated by private entrepreneurs. The lateral route, a gravel road to Ghazi via Ghazi Hamlet, is the most heavily used for market traffic, although tracks are also used along nullah beds to villages like Isa and Qazipur on the main road.

3.7.5 Structure of Society

The structure of society in both the Chhachh and Sarwala reflects a long history of invading tribes moving in to dispossess pre-existing landholding groups, that were either driven out in the process or forced down into tenant or kammi (village service group) occupational-status groups. Landholding tenures in the Chhachh were based originally on right by conquest, a category recognised by the British beginning with their first land settlements. Here and there older social strata, Khattars in the Sarwala and Gujars in the Chhachh, held out against incoming Awans and Pakhtuns (Pathans), while others joined the groupings of detribalised service groups at the bottom of the social pyramid.

The current ethnic settlement pattern in the Chhachh results from two centuries of Pakhtun invasions between the beginning of the 16th and the end of the 18th centuries. These left the best land in the hands of various subsections (Alizais, Sadhozais, Manduris, Barazais and Tahir Khelis) of the Utmanzai clan of the Yusufzai tribe.

As late as 1930, Pathans owned 78% of the land in the Attok portion of the Chhachh and comprised 82% of the landowners. Based on the village survey, these figures have not greatly changed. In the 15 villages surveyed, spread across Ghazi, the Attok Chhachh and the Sarwala, 78% of the landholders were Pakhtun and 13% were Awans. Gujars, who had reclaimed much of the Chhachh from marshland during the early Mughal years, were largely driven into the higher ground along the Gandghar, where they remain today, with the exception of a small pocket in the Chel area around Musa Kudlathi.

The village system that evolved in the Chhachh and Sarwala was influenced by the way land settlement policies adopted by British administrators in the mid-19th century overlay older customary rights and obligations. The region had been widely devastated in the aftermath of the Sikh-Durrani wars and by the operations of a rapacious Sikh revenue administration. The British successfully stabilised the situation by investing proprietary rights in land
in those groups that had local political authority, recognising
the claims of permanent tenants, and encouraging the adoption of
cash rents by both landlords and tenants.

These policies did not, however, disestablish older customary
economic relationships which had long been a part of the
integrated village system. The latter enabled tenants to take
in-kind divisions of the crop, allowed kammis to assert share
rights in the village harvest, and granted common access to
fishing and grazing areas and woodlands. Despite the stratified
nature of social relationships in the traditional village, the
system worked to incorporate incoming tribes as occupational-
status groups, regulate access to environmental resources and
protect the incomes of the weaker social groups.

As early as the start of this century, the Chhachh began to
export part of its surplus labour as the younger sons of
landlords and occupancy tenants took service on ships out of
Karachi and Bombay. The capital thus acquired was used to clear
debt, buy land, cultivate snuff tobacco, build pukka houses, and
improve family diets.

By the time Pakistan gained its independence, the Chhachh was
perhaps the most intensively cultivated rural tract in the Punjab
outside the immediate environs of the major cities. Yields were
almost double those achieved elsewhere in the province. Wheat,
maize, sugarcane, vegetables and tobacco were the chief crops, of
which snuff tobacco was, and remains, the most valuable. However,
the region was not without problems. Peace and relative
prosperity meant a rapid growth in population, the fragmentation
of landholdings, smaller farm sizes, and increasing indebtedness.

The Chhachh still represents a transition zone between the
Pakhtun (Pathan) and Punjabi cultural spheres. Pakhtun
traditions are visible in the maintenance of clan and sub-clan
marriage boundaries, the strict veiling of women in the Pakhtun
villages, and the strong support in the area for Sunni-Hanafi
orthodoxy and its institutions. Pashto is still spoken in
Pakhtun villages in central Chhachh, although nowhere does it
entirely replace the more common Hindko, a Punjabi dialect. The
Chhachh Pathans retain a loyalty to Pakhtunwali (the tribal code
of the Pakhtuns), but in practice they are less prone than their
cousins across the river to pursue this code.

Pakhtun cultural norms are much diluted in the Chhachh and it is
more accurate to see the dominant clans as landholding biraderis
(extended occupational-lineage networks) functioning within the
integrated village system rather than as tribal Khans ruling over
a subject population. Political and social authority is
operated vertically through a stratified social order and there
is no sign of the classical jirga (council of free men) typical
of Pakhtun tribes across the Indus. Influential Pakhtun khans do
dominate the electoral politics of the area, but they are not a
unitary body and compete for power through different families,
clans, factions and political parties.

7-3-24
3.7.6 Social Baseline and General Conditions

This Section discusses general demographic and social conditions in the Project region. Additional data are available in Appendices D and E.

Population Profile

Over the past twenty years, population growth in the Project region has been tempered by emigration to other parts of Pakistan and abroad. Intercensal growth rates dropped from an average of 40.2% between 1961 and 1971 to only 16.2% between 1972 and 1981 in Attock District.

It is estimated that, in 1991, the two Tehsils, Haripur in the North West Frontier Province and Attock in the Punjab, have a combined population of about 950,000. This figure is based on an assumed intercensal (1981-1991) growth rate of 16%. Probably only a third of this number live in the subregions traversed by the Project, while about 109,000 people are estimated (1991 projection) to live in the 48 villages whose land is directly affected by either the power channel or the powerhouse. An estimated 2,900 landholders and 250 tenants will lose all or part of their land to the Project. These estimations have been made on the basis of village level surveys (Appendix D).

The Project area contains only two organised urban areas: Attock city under a Municipal Committee, and Hazro under a Town Committee, neither area being physically touched by the Project. Based on the 1972-1981 intercensal annual urban growth rate for the Attock District of 2.6%, the projected 1991 population of Attock city may be 50,400 and Hazro about 17,600.

Two other population centres, both having land physically within the Project area, are large enough to be considered for organised town committee status: Ghazi-Khalo and Ghurghushti. It is estimated that Ghurghushti may have as many as 16,550 people in 1991. Ghazi-Khalo would have approximately 6,500 today based on the growth rate used above, but Ghazi-Khalo inhabitants say their area has grown more rapidly and Union Council officials estimate the combined population of Ghazi-Khalo and Ghazi Hamlet at about 11,000. The Union Council has applied to the Government of the North West Frontier Province for the incorporation of these three areas as a Town Committee. Indeed, there is every indication that Ghazi-Khalo has grown into a substantial market and service centre.

The classification of areas in the Chhachh and along the Grand Trunk road as urban or rural is at times rather artificial. Road junctions like Hattian-Kamra Mor, Hazro Mor, and Ghurghushti-Muskeenabad are emerging as substantial roadside bazaars. In addition, many of the large villages south and east of the
Ghurghushti-Hazro road are expanding toward each other and toward the road, taking up cultivated land and developing new market and service centres.

Rural population densities are highly variable throughout the region. The highest densities are in the Chhachh villages (about 350 persons per square km in 1981) and along the Grand Trunk road, and lower in the Sarwala (110 persons per square km in 1981) and in the Gandghar. In the villages directly affected by the Project, literacy levels (1981 data) run from a high of 44.4% at Khalo to 2.2% at Dakhner, with most villages in the 20-30% range. Female literacy is generally around 10-16%.

The occupational structure of the Project area is still largely dominated by agrarian occupations: cultivation and its traditional service sector. According to 1981 data, between 54 and 58% of the civilian labour force is involved in such occupations, with the remainder involved in transportation, public service, industry and the skilled professions. According to the field research, some 15% of the males in the region leave for service in the military, police, government or private firms.

Official emigration figures are difficult to come by, since the largest movement occurred in the 1981-1991 period. In the survey of 15 villages, it was found that a total of 3,706 households had one or more members abroad. It is estimated that the villages directly affected by the Project may have 12,000 to 13,500 emigrants working elsewhere in Pakistan or abroad. One village, Ghurghushti, has about 3,000 abroad, most of them in the United Kingdom. Although sex ratios have normally been in favour of males (105:100 for Abbottabad District and 102:100 for Attock District, 1981 data), it is possible that heavy emigration has either evened this off or slightly reversed it.

There appear to be relatively constant streams of migrants going out to and returning from the Gulf and Western countries. Emigrants do not necessarily settle permanently abroad, even in the West. Their links with the ancestral village through ties of sentiment, kinship, and culture remain strong. Emigrants return to their villages to visit families, invest, marry off their daughters, and retire. But they also bring with them new ideas, demands for better social services, and a view that governmental bodies should be more accountable and responsive to the popular will.

Administration and Government

The Project traverses portions of two Provinces. The barrage and upper section of the power channel (to RD 12+200) lie in the North West Frontier Province (NWFP), while the remainder of the power channel and the powerhouse are in Punjab. This region is governed under the bureaucratic and political systems standard in Pakistan outside the tribal areas. The strongest concentration of administrative power continues to lie at the District level,
making the District Commissioner a key figure in virtually all aspects of government within his territorial purview. Increasingly, however, elective political bodies are asserting roles in policy and administration. For most villagers in the Project area, the Union Council Member is becoming a counter to the lowest level of officialdom. Moreover, elections to the Union and District Councils generate as much interest in the villages as elections to the Provincial and National Assemblies. Union Councils are important because they help finance local schools and push for better health services.

The Punjab portion of the Project lies in Attock tehsil, the most developed portion of Attock District. Attock city, the district headquarters, is virtually contiguous with the Project area, providing the region with access to a whole range of nation-building departments and economic development institutions, such as the Agricultural Development Bank.

The NWFP portion of the Project is more isolated from its key administrative centres. Although part of Haripur tehsil, the Ghazi area is screened from both Haripur and the District headquarters town of Abbottabad by the Gandghar mountains. Although a road crosses this range from Ghazi via Sirikut, most of those going to do business at Haripur or Abbottabad go through Punjab by way of Hasan Abdal. Union Council officials at Ghazi are pressing for a new road over the Gandghar from Ghazi via Jari Khas, which would benefit more upland villages and provide a quicker route to Haripur. Despite their seeming isolation, however, the people of the Ghazi region would strongly oppose any attempt to incorporate them administratively into Swabi District after the barrage is constructed. Long traditions of enmity with those on the opposite bank would make such a move difficult to implement.

Law and order in the Project region is maintained by provincial police and constabulary forces. The thana at Hazro is the base for the Eagle Flying Squad, a rapid response police unit equipped with one Toyota Land Cruiser and one Datsun pick-up truck. Crime in both the Ghazi and Attock sections of the Project area appears to be considerably lower than in other parts of the Punjab and NWFP. Both the dominant Pakhtun and Awan groups have reputations for social discipline and for maintaining law and order.

The Indus river is seen by left-bank villagers as a barrier that protects the privacy and security of their villages. Inquiries in one river-bank village in the Attock Chhachh revealed that in the past two years the surrounding villages had experienced one incidence each of female abduction, car theft, and kidnapping for ransom.
Social Services

Social services in the Project region appear to be about average for Pakistan. Virtually all the villages in the region have a primary school for boys and two-thirds have a primary school for girls. Middle and high schools for boys are available at convenient distances throughout the Chhachh and to a lesser extent in the Sarwala. There are fewer such schools for girls, making it difficult for girls in the smaller and more distant villages to attain these levels of education. Colleges for both men and women are located at Tarbela colony, Hazro and Attock city. Ghazi has an intermediate college for men.

Health services are far less developed than those for education. Virtually every village has a dai or local health volunteer and at least half have either a doctor or a medical compounder. Basic Health Units are present at Ghazi, Ghurghushti, Hazro, Dhok Khagwani and Dakhner. Dispensaries have been located at Ghazi and Hazro, while Attock and Haripur have civil hospitals. The hospital at Abbottabad is a teaching hospital and has the best facilities in the two districts. Those with the most serious illnesses try to reach Abbottabad.

The incidence of illness does not seem any higher in the Project area than for Pakistan generally. According to the village survey, children suffer most from diarrhoea, hepatitis, colds and pneumonia. Women say they suffer most from kidney and stomach diseases (gastro-enteritis). Many have problems throughout the maternity cycle and infant mortality in the villages surveyed appears to run from 5% to 12.5% of live births.

Women in the Project Area

Society in both the Chhachh and Sarwala remains essentially traditional despite changes in status and income levels. According to the survey, marriage remains largely within the tribe or biraderi (extended occupational-lineage networks), with most out-biraderi marriages probably of a hypergamous nature (moneyed families marrying up to acquire status). The veiling of women is broadly observed, though more strictly in the Pathan and Sayyid villages. Nowhere, however, is veiling total, nor are women restricted from certain kinds of movements: to the river bank or other water point for washing clothes and visiting with other women, to the homes of relatives, to visit shrines and health facilities, to attend marriages, to shop in markets. These movements are part of the social and cultural life of the villages.

Women can also be found working in the fields in non-Pathan villages, where they belong to the families of small-holders, holder-cum-tenants, tenants, and kammis (artisans). According to the survey, women in these social groups not only perform their traditionally assigned roles in the domestic domain, such as child-rearing, cleaning, cooking (including churning), washing,
and making clothes, but they contribute directly to the acquisition of household income. Women help to plant, harvest, and process crops, care for poultry and livestock, and help renovate their homes at least twice a year by plastering and whitewashing.

Women in the Project area expressed strong interest in development. They want:

- More schools.
- More and better health facilities.
- More attention to public health.
- Better transport.
- Recreational facilities.
- The development of vocational/industrial centres for women.
- Marketing facilities for their products.
- Employment for all groups in the population, including women.
- More banks and post offices.
- Small loan programmes.
- Better relief for widows and orphans from the Zakat Committees.
- The provision of secure polling booths for women during elections.

In both the 1988 and 1990 national elections, women were unable to vote because secure booths for women were not provided by local officials, despite the fact that such facilities are mandated by the regulations of the Electoral Commission.

Infrastructure

The Project area already supports several of Pakistan's most important infrastructural assets, Tarbela dam and its transmission facilities probably being in a class by itself. But also of primary significance are the Grand Trunk road, which traces a route at least as old as recorded history, the Pakistan Railways main line between Peshawar and Karachi, the bridges across the Indus at Attock, and the Sui Northern gas transmission line.
Main roads from Kamra and Haji Shah link the GT road with Attock city. Other main roads connect Ghazi-Ghurghushti with the GT road at Hattian (via Hazro) and Lawrencepur. Secondary roads in the Project area link Attock city with Gariala and Gariala with the Attock bridge. From Gariala the district road runs south, climbs over the Kala-Chitta range, crosses the Rawalpindi-Kohat road at Basal, and connects down through Pindigheb to Mianwali. Two-thirds of the villages in the Project area have tertiary metalled roads connecting the main village centre with a nearby secondary or main road.

Attock city is also a railway junction. A branch line runs south through the Kala-Chitta Range with connections to Kohat and to Multan via Mianwali.

**Business and Industry**

Three large-scale industrial operations are located in the Project area. Two of these, the Kamra Aeronautical Complex and the Sanjwal Ordinance Factory, are public sector projects under the Ministry of Defence Production. The third is the well-known Lawrencepur Woollen Mills. A medium-size flour mill is located near Hattian.

The total number of workers in these industrial units is unavailable, although it is apparent that the defense industries employ few locals. About 4% of the workers in these units are from local villages. Lawrencepur, however, draws most of its workers from the surrounding villages but this appears to be highly variable. One village in the survey, Musa Kudlathi, provided 150 workers to Lawrencepur, while contiguous villages provided none.

Although it was not possible to get precise data, the Project area has experienced a significant growth in small-scale industries, such as the production of snuff (naswar), the extraction of nicotine for pharmaceutical purposes, and small power loom establishments (2 to 6 units). Even more impressive is the explosion of shops and businesses owned by single proprietors or by families.

A large proportion of these businesses are small agro-industrial units: tractor repair workshops, tyres and batteries, water pumps, hardware outlets, small food processing units, saw mills and furniture-making shops (which use wood harvested elsewhere). During a brief survey of Hazro Mor, 21 tractor repair shops and 17 repair shops for other vehicles (autos, minibuses, and trucks) were found. At the roadside market centres of Jamshedabad and Muskeenabad-Ghurghushti, there were counted a combined total of 15 small furniture factories, each employing from 3 to 8 workers.

There clearly is scope for private investment in small to medium industries in the Project area. Considerable capital is probably available from expatriates returning from the Gulf and the West.
At least a portion of the small industrial development already underway is financed by such resources. The large village of Ghurghushti has five banks with a combined total capital of US $ 13.6 M (Rs. 300 M), much of it returned from expatriate workers. About 80% of the households in this village have someone abroad, most of them in Great Britain.

Local officials and village leaders expressed considerable interest in industrial development. They believe Ghazi should have been sanctioned a portion of the industries allocated to the Gadoon Industrial Estate. They want the railway from Lawrencepur to Tarbela rebuilt and extended across the barrage to the Gadoon Estate. They point out that Ghazi has good communications, water, an educated and skilled labour pool, and natural resources. They believe that cement, glass and ceramics, paper, fruit processing, oil pressing, leather, and textile industries could be profitably located at Ghazi. The Ghazi Union Council has applied for an industrial estate for 4 to 5 factories. In addition, the three villages of Aldo, Mian Dheri and Hassanpur have set aside a combined area of 25 ha for a small industrial estate.

Sand is the only material mined in the Project area. Most of this comes from the area east of the TL road around Qibla Bandi, although several large sand quarries are located in and around the village of Musa Kudlathi verging on the Project alignment. Most of this sand is taken by truck to Hasan Abdal, where it is purchased by glass factories, or to Islamabad-Rawalpindi, where it is used for construction. The best sand is east of the TL road. There is some attempt to restore sand quarries by planting eucalyptus trees.

**Agriculture**

Agriculture remains the primary economic sector in the region, employing about 56% of the civilian labour force (Attock tehsil, 1981), a figure that probably does not reflect the contributions made by women and children to farm family incomes. The agrarian calendar is the same here as elsewhere in Pakistan.

The rabi season extends from November to March, the kharif from April to October. Wheat is the major crop and is planted on 55% of the cultivated land during the rabi sowing. Wheat yields run from 4,000 to 5,500 kg per ha in the 15 villages surveyed. Tobacco and groundnuts are the major cash crops in the Project area. By planting on the drier sandy soils, farmers can harvest between 3,200 and 5,600 kg of groundnuts per ha. Each bag (40 kg) of groundnuts brings US $ 16-17 (Rs. 350-375) at 1990 prices. The local farmers emphasise that groundnuts have made profitable the cultivation of previously marginal soils.
Cultivation in the region is largely barani (rainfed). Land use in the 15 villages surveyed is as follows:

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area of villages</td>
<td>18,340</td>
<td>100.0%</td>
</tr>
<tr>
<td>Area under barani cultivation</td>
<td>9,335</td>
<td>50.9%</td>
</tr>
<tr>
<td>Area irrigated</td>
<td>4,965</td>
<td>27.1%</td>
</tr>
<tr>
<td>Area under orchards</td>
<td>55</td>
<td>0.3%</td>
</tr>
<tr>
<td>Area used for pastures</td>
<td>2,034</td>
<td>11.1%</td>
</tr>
<tr>
<td>Area under woodlands</td>
<td>232</td>
<td>1.2%</td>
</tr>
<tr>
<td>Culturable waste</td>
<td>896</td>
<td>4.9%</td>
</tr>
<tr>
<td>Wasteland</td>
<td>823</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

Interestingly, these figures for 15 villages compare well with the data for Attock tehsil reported in the 1980 Agricultural Census, where 73.8% of the land was reported as barani cultivation and 25.0% was under some form of irrigation.

Farmers in the region have made considerable investment in mechanisation and in lift technologies to recover groundwater. In the villages surveyed, 307 tractors were found, which works out to approximately 20 tractors per village.

The favourite form of pumping appears to be that of putting small electric pumps (0.5 to 2 HP) on open wells. Given the uneven nature of the topography, this is the most efficient method of irrigating micro command areas. There were 1,741 such pumps in the 15 villages surveyed, some 1,555 of these having multiple owners. There were also 237 tubewells, most of them small in horsepower, and 723 traditional Persian wheels. Tubewells are normally installed in wells in place of old Persian wheels. Interestingly, the patwaris (keepers of village records) record only 9 tubewells in the villages surveyed. Landowners apparently avoid recording improvements, to avoid paying higher taxes.

Landholdings in the Project region tend to be small and fragmented, with some 12% of small landholders taking on additional land as sharecropping tenants. Most of the landholders, 88% in the villages surveyed, held farms smaller than 5 ha, the standard minimum economical holding in the Punjab. In fact, given the richness of the soils in the Chhachh and the tradition there of intensive cultivation, it is believed that independent families (as opposed to joint families) can remain self-sufficient on as little as 0.25 ha. As the table below shows, there are few landholders who command more than 10 ha, the point at which farming begins to generate a substantial surplus for significant investment.
LANDHOLDING PATTERNS
(SURVEY OF 15 VILLAGES - NOVEMBER 1990)

<table>
<thead>
<tr>
<th>LANDHOLDER'S STATUS</th>
<th>LANDHOLDING PATTERNS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 5 ha</td>
<td>5-10 ha</td>
<td>More than 10 ha</td>
</tr>
<tr>
<td></td>
<td>No.      %</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Owners</td>
<td>6,227    76.7</td>
<td>729</td>
<td>69.8</td>
</tr>
<tr>
<td>Owners/Tenants</td>
<td>859      10.6</td>
<td>290</td>
<td>27.8</td>
</tr>
<tr>
<td>Tenants</td>
<td>1,033    12.7</td>
<td>25</td>
<td>2.4</td>
</tr>
</tbody>
</table>

In addition to their generally small size, landholdings are also seriously fragmented, as is noted in the data collected in the survey:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of estates</td>
<td>9,338   100.0%</td>
</tr>
<tr>
<td>Number consolidated</td>
<td>939   10.1%</td>
</tr>
<tr>
<td>Number in 2 fragments</td>
<td>938    10.0%</td>
</tr>
<tr>
<td>Number in more than 2 fragments</td>
<td>7,461 79.9%</td>
</tr>
</tbody>
</table>

In areas of variable soils, uncertain access to irrigation water, or uneven topography, farmers tend to resist the consolidation of landholdings. Spreading their holdings across a diverse area provides more security, particularly where the beds of hill torrents frequently shift. Only 25% of the villages surveyed had undergone land consolidation, and in one of these the farmers regretted it since the construction of the power channel would wipe out the consolidated holdings in its path, rather than spreading the effects more widely on the village landholders.

Livestock

The livestock of the Project area comprise cattle, buffaloes, sheep, goats, camels and donkeys. The population of various types of livestock in the survey villages totals to about 33,000 (Appendix D). Livestock is normally raised for domestic purposes, selling the natural increase in local markets. As such about 50% of the livestock population is commercialised. According to the survey, 42% of the domestic livestock is kept and fed at the farmhouse in the village on fodder crops raised for that purpose or on grass harvested by women from village lands. The remainder is pastured on village lands, usually as a single village herd. Pasture land constitutes 11% of the area in the villages surveyed, but this is in reality only marginally better than ghair mumkin (wasteland).

The informal survey of the riverain villages in the lower part of the affected reach of the Indus river has revealed that a few villages, like Malla and Noor Mali, maintain commercial herds of cattle. These herds are kept by the river bank villagers on large, grass-covered islands (belas) in the broad flood plain.
where the river braids into multiple channels. These herds can number between 1,000 and 2,000 head of cattle for each village. The Indus riverain herds, some of them prized Dhanni cattle, are taken to market at Gondal on the Grand Trunk road.

In theory, the riverain is demarcated by village boundaries, despite whatever action the river has on creating and destroying pasturable land. Villagers on the same side of the river generally follow village boundaries in pasturing their herds, but villagers on one side of the river have little compunction about using the land of villages on the opposite bank if the deep channel cuts those villages off from their belas. The isolation of belas from the villages exists in the upstream reach of the river in the Ghazi area because here the main river creek is relatively narrow and deep with high velocity. In downstream reaches the water flows in many shallow creeks; thus there is no isolation. The impact of reduced water flows due to the Project would be to improve the access to the belas and thus make more grazing area available (Section 5.2.3).

The villages in the uplands east of the power channel alignment and in the Gandghar mountains raise some cattle, but mostly sheep and goats for market. The upland villagers use the Tuesday market (mandi) at Ghazi-Khalo to market their livestock.

Woodland

Woodland constitutes a very small portion of the village area, totalling some 232 ha in the villages surveyed, or an average of about 15 ha per village. Wood is an important source of fuel, although it is not the exclusive source; LPG, kerosene, coal and dungcakes also being used. The Gandghar mountains provide wood for villages throughout the Project area.

Very often, graveyards are included as village forested areas. In general, the village elders, who oversee the graveyards, prohibit wood cutting in these areas, although villages are less consistent about allowing foraging in these areas. Dhok Khagwani prohibits any extractive activity in its large, wooded graveyard and pays a chowkidar (watchman) to enforce this prohibition. However, the villages that use the Mian Khadi Baba necropolis as a graveyard prohibit wood cutting but allow pasturing cattle there.

3.7.7 Land Rights and Access to Environmental Resources

The integrated village system, as it has evolved in the Chhachh-Sarwala region, continues to regulate access to land and environmental resources. However, it is clear that demographic pressures and economic change are having important effects on how village social groups treat proprietary rights, divide labour, distribute resources, and view rankings within the traditional system of socioeconomic stratification. Clearly, the key social
distinction within the village continues to be whether or not one owns land. Land ownership not only provides access to relatively secure, productive resources, but it defines social status and delimits access to the critical arenas of bureaucratic and political authority. Hence, land is valued for more than its productive capacity and it is rarely given up easily. New sources of wealth, like work opportunities elsewhere in Pakistan and abroad, and the emergence of a strong agro-service sector, are changing the way capital is accumulated and used, but it will be a generation or more before other sources of wealth can compete in rural Pakistan with land as the arbiter of status and authority.

It is important to note that land in the Project area is wholly privately held, except where the government has taken land for roads and other infrastructural uses, major projects like Tarbela and Kamra, and various defence purposes. Common village land, shamilat, in the Attock Chhachh was sub-divided in 1954 and largely taken over by the dominant landholders in each village. Even the hill torrent beds (darrahas or nullahs) are privately owned and considerable effort goes into the creation of cultivable fields in the nullahs by the construction of check dams to collect and hold silt-laden runoff.

The islands in the Indus riverain are also privately held, although this ownership is expressed differently to account for the fact that the river is constantly changing the shape of the islands in its stream. The zamindars (landholders) in the right bank village of Pontia claim the wooded islands in the riverain are owned by the zamindari families of the village in proportion to the amount of land they own above the flood plain. Each zamindar family has a watchman (chowkidar) who sees to it that unauthorised cutting is fined and that the other zamindars do not take more than their share. According to the villagers of Mallah on the left bank, the downstream grass-covered islands (belas) are also privately held and are occasionally cultivated in the kharif season. For the most part, however, the landholders cooperate to allow the village's commercial cattle herd to use the belas as pasture.

In like manner, the uplands east of the Project and the Gandghar mountain wall, which is more heavily forested than appears from the plain, are all privately held areas. The Forestry Department controls the cutting of trees, mainly Chir Pine, but makes no attempt to regulate the harvesting of brush, fodder and other forest products.

3.7.8 Ethnic/Tribal Groups

General

Although the Chhachh region is to some degree demarcated by a tribal/cultural line that historically separates Pakhtun from Punjabi peoples, this is not a line that is particularly distinct
in local settlement patterns nor is it one characterised by social or political conflict. The intermixing of languages (Pashto and Hindko), the evolution of Pakhtun tribes into landholding brotherhoods (biraderis), and the non-applicability of pakhtunwali (the Pakhtun tribal code) in the region have greatly diluted the attachment of the Pakhtun tribes in Chhachh to the Pakhtun cultural world across the Indus. Indeed, the people on the left bank, both Pakhtun and Punjabi, have more in common with each other than they do with those who live on the right bank.

This does not mean that inter-village and intra-village factionalism and conflict do not exist in this area. Villages are constantly alert to ensure that their lands and their byways are not encroached upon by neighbouring villages, and the honour of the purdah system is not violated by outsiders. Movements to and from the fields and pastures are monitored by villagers to ensure that outsiders do not bring their tractors or flocks across village boundaries. Each village has its own right of way marked on the village cadastral survey (lutha), although influential villagers sometimes take over this land for cultivation if a nullah is nearby to provide lateral movement within the village lands.

The Project area contains no permanently settled indigenous people in the meaning of the World Bank guidelines. Seasonal migrants, however, do pass through the area and some stay on for the cold season. These are the Powindah folk (also called Kuchis), who belong to a variety of Ghilzai tribes, such as the Suleiman Khel. Traditionally, they summer in the Hazarajat highlands beyond Ghazni in Afghanistan, and winter throughout Pakistan. Although disrupted by the Afghanistan conflict, these transhumant patterns have largely survived the war. The Powindahs are pastoralists who forage their herds along roads, in wastelands and in village pastures where they may pay a small fee. They also harvest grasses and other natural fodders, hire themselves out as day labour on construction projects, provide additional labour during harvests, and trade or sell herbs, semi-precious stones (lapis) and other items. The powindahs have been passing through since time beyond memory and are an accepted part of the local scene. Their flocks are not large enough to damage the ecology and they provide a useful source of inexpensive labour.

The Project area also harbours a substantial Afghan refugee population between Ghazi and Ghurghushi. They have built mud houses on three sides of the airstrip, including part of the area to be traversed by the power channel. Approximately 200 mud houses may have to be shifted here for the construction of the channel. This population is supported in part by public and private relief organisations and in part by employment in the local economy. It is regarded as a temporary population and will be encouraged to return to Afghanistan when conditions in that country permit.

7-3.36
In case they do not go back to Afghanistan, alternative housing may have to be found for those refugees whose dwellings are in the channel alignment.

**Landholding Group**

Society in the Project area is ranked by landholding status and occupation. By custom, local leaders come from the old landed and chiefly families, although those individuals within this elite who actually wield authority are informally selected by dint of interest, ability, connections, and personal magnetism. The old ruling clans: Tahir Kheli, Sadhozai, Jadoon, Alizai, Sayyid and Awan, retain a strong link with the land in the Chhachh. Only 11 absentee landlord estates were found in the 15 villages surveyed, and most of these have immediate relations still in the village.

The elite families have, of course, used their access to education and to high public and private service to establish branches in Islamabad and other major cities in Pakistan and abroad. Though still well-founded around Ghazi, Khalo, Khairbaba, and Kathera, the Tahir Kheli kinship network is international in scope, with members of a younger generation working in advanced research in the United States and one now serving in the US Mission to the United Nations with Ambassadorial rank.

Although the large landed families have considerable rein to protect their interests, they cannot with impunity violate customary social responsibilities or ignore the reciprocal economic obligations inherent in the integrated village system. Certainly, one of the most basic obligations of the leading zamindars is to mediate in local disputes, serve as a channel of communication between the village folk and various layers of the bureaucracy, and promote the interests of the village and its people with the government. The arrival of electoral politics has by no means overturned the old order, but it has expanded the number of local interests that have to be accommodated and represented.

The traditional leaders are adept at using electoral politics, because they know it is not enough anymore to be a Khan. They have to deliver patronage to the village in the form of jobs and development schemes. Some of them have developed contacts widely with both domestic and foreign development agencies. A large Project, such as the Ghazi-Gariala Hydropower Project, provides numerous opportunities to assert influence on behalf of their own and their village's interests. On the other hand, there will be a loss of land to the Project and pressures may grow to obtain adequate compensation for their people.

Quite apart from the old, leading families, where wealth and status apparently remain secure, are the landholders. They are at the other end of the scale, where estates have become

7-3.37
increasingly subdivided and fragmented. This has resulted from
the natural increase of the population, the effects of the laws
of inheritance, and the recent conversion of various categories
of permanent tenancy rights (mokarridari and malkan ala) into
landholding rights. Economic pressures on these landholders are
severe, particularly since education for white collar jobs has
not always provided the younger generation in this group with
either a route out of the village or a chance to get on the
ladder of upward economic mobility. For this generation,
education has often meant entrapment in low-paying government
jobs or unemployment. Their frustrations and alienation are very
real, and they regard the Project as a potential source of
badly-needed employment.

Non-landholding Occupational Groups

Two other groups are present in the Project area villages. These
are the tenants-at-will, a group that includes general field
labour and herdsmen, and the village artisans (kammis). A third
group, that of mussalis, or menials, has largely disappeared from
the villages surveyed, and probably accounts for at least a
portion of those migrating into the cities. The survey did not
indicate a large body of tenants in the Project area, except at
Ghurghushti, which has 700 of the total of 1,058 tenants reported
in the 15 villages. Many former tenants may have moved up to
landholding status with the conversion of permanent tenancies and
many others may have joined the drift to the cities and towns.

The line between pure tenancy and small landholdership is not
always distinct and many small landholders supplement their
incomes by sharecropping for others. Interestingly, all the
tenants in the survey were sharecroppers, who took a portion of
the crop; one-third if the landlord paid for seed, fertiliser and
water, and one-half if the sharecropper paid for these inputs.
No examples of tenants paying cash rents were found and only two
instances were reported of modern farmers renting substantial
areas for capital-intensive, mechanised farming.

Ironically, the landless group that appears to be doing the best
economically is that of the village artisan groups (kammis).
More than any other group apart from the big landlords, the
artisans have found a way out of the village by adapting their
skills to new mechanical and small industrial opportunities
available in the rapidly growing roadside bazaar-cum-agro service
centres. These include Hazro Mor, Hattian, Muskeenabad,
Jamshebadab and Ghazi-Khalo. Again, relatively few artisans are
left in the villages surveyed: 389 of which a large number (150)
were in Ghurghushti. Most of the artisans reportedly were still
taking in-kind payments based on old share rights, but 45% of
those left in the villages were taking cash payments.

At the same time, inquiries in Jamshebadab, Muskeenabad and Hazro
Mor revealed that most of the tractor drivers, mechanics,
machinists and carpenters in these roadside bazaars had started

7-3.38
either as artisans or are the sons of artisans in the contiguous villages. In some cases, former village artisans are the owners of tractors, various mechanical shops and small furniture factories. This group is the best placed to take advantage of the next stage of the agro-industrial revolution in Pakistan and, indeed, to benefit by applying their skills in the construction of the Project.

3.7.9 Local Organisations

Much of the organised, cooperative effort at the village level occurs in the agricultural sector, where groups join to invest in activities that are otherwise beyond their individual resources. These include land levelling, building bunds, diverting nullahs, and, most frequently, investing in lift schemes for groundwater. In the survey, it was found that 89% of the small pumps on open wells and 42% of the tubewells were group-owned.

Private organisations and interest groups are not a major feature of social life in the Project area. Political parties tend not to be organised below the Union Council level and even these usually appear only for elections before fading away again. Political party organisations do function at the town level and in the larger villages (Ghazi-Khalo, Ghurghushti), but they have yet to amass sufficient popular backing to challenge the traditional local leadership.

Most villages have one or more associations to administer the village mosque or mosques. This means upkeep, providing for an imam and when necessary upgrading the washing facilities by putting in an overhead tank and electric pump. Mosque associations do use whatever extra resources they have to assist widows and orphans, although the government-mandated Zakat Committees rarely go below the Union Council.

Several youth associations are present in the Chhachh. These include the Falcon Youth Organisation in and around Ghazi, the Youth Welfare Society at Mian Dheri and Hassanpur, the Chhachh Naujawan Tanzim in and around Hazro, and the Azad Naujawan Tanzim, also at Hazro. These youth associations assist with funerals, provide scholarships, books and tuition to poor students, and assist at weddings. The Falcon Youth Organisation also organises street clean-up campaigns in Ghazi-Khalo, and has pressed the Union Council for street lights and rubbish bins.

There are no formal women's organisations in the region, although a private women's industrial training centre in Khalo provided a rallying point for women protesting at the lack of polling booths for women in the last election. Women do, however, cooperate informally in the settlement of disputes among women and in providing small loans to help each other purchase materials to make handicrafts.

7-3.39
3.7.10 Cultural Resources

General

Given the location of the Project astride one of the most ancient and well-travelled corridors for invasion and migration in the world, it would be surprising if the Project did not impinge in some way on sites of historical, religious, and archaeological value (Drawing 7.3.4).

Religious Sites - Mosques and Shrines

The Hazro area is an old centre for Islamic learning. Madrassahs in Ghurghushti, Barazai and Hazro have sent ulema (scholars of Islamic Law) to places all over North India (before 1947) and Pakistan, as well as to Afghanistan and Soviet Central Asia. Many of the villages in the Chhachh have old mosques, some with exquisitely carved pillars and doors that would grace any museum. These buildings are of historical value, although the villagers often have only a vague idea of how old they are.

The Project area has numerous shrines, though none is of national importance. Virtually every village has its pir or baba and there are several shrines close to the power channel alignment that draw devotees from throughout the region. These include the shrine of Chand Pir at Jallo, that of Sakhi Shah Habib Qalandar at Hattian, and the shrine of Haji Rehman Baba at Khairbara. Perhaps the most interesting group is the line of shrines along the high ground west of the Lawrencepur road. According to local tradition, these are the graves of officers of Sayyid Ahmad Shaheed Barelwi, who, like their leader, died fighting the Sikhs (1828-1830). The near veneration of saints and the resort to shrines are active, popular traditions in this area. Indeed, both Chand Pir (d. 1975) and Haji Rehman Baba (d. 1955) are recent shrines, while the domes over the graves of Mian Khadi Baba (d. 1830) and Habib Qalandar (d. 1580) are very recent.

Graveyards

For the most part, graveyards in the Project area are large and well cared for. The necropolis around Mian Khadi Baba, which is used by five villages, is said to have 50,000 graves. Most villagers still use the old central graveyards, although there is a trend toward small family graveyards as some villagers move out to homesteads (deras) in their fields. The more reformed orthodox school, that of Deoband, has a strong footing in the Madrassahs in Ghurghushti, but apparently not with the common man. Like other groups such as the Jamiat-Ahle-Hadees and the Jama'at-i-Islami, the Deobandis emphasise the injunction that graves be as simple and impermanent as possible. Most of those who live here are traditional, unreformed Muslims, whose alim follow the Barelvi interpretations of Hanafi-Sunni orthodoxy. Villagers accord great respect to the memory and graves of their
forefathers and some would rather lose their homes than see the graves of their ancestors disturbed.

### 3.7.11 Archaeological Resources

#### General

The Project area traverses a region rich in archaeological sites, most of them dating from the Gandharan (2C BC-2C AD), Kushana (3C-5C AD), Hindu Shahi (9C-11C AD), and Mughal (16C-18C AD) periods. The ancient high road to India ran in a northwest to southeast axis, connecting Taxila (Taksashila) with the major cities in the Vale of Peshawar (Purushapura). This road may have crossed the Chhachh Plain through modern Lawrencepur, Musa Kudlathi, Hazro and Malla. At Malla, it probably crossed the Indus to Hund, which is thought to be the ancient ferry crossing of Und (Uda, Udabhanda).

Several old mounds are evident along this route, particularly around Hazro and at Malla. This route was altered by Akbar the Great, who began building the fort at Attock in 1581 AD and established there the ferry crossing for the Grand Trunk road. This route was maintained by the British, who built the double-decked road-railway bridge across the Indus (1880-1883). In 1980, a new road bridge was completed across the Indus at Khairabad, just upstream from the fort, at the place where the old boat bridge had crossed in Mughal and early British times.

Archaeological sites in the Chhachh, Sarwala and the Gandghar mountains have yet to be properly identified and explored. British period archaeologists like General Alexander Cunningham and Sir John Marshall concentrated on the great mounds in the Vale of Peshawar (Charsadda and Shahbazghari) and the multiple sites at Taxila. Since independence, much of the archaeological work in this region has focused on stone age cultures like that of the Soan river. There are indications that the Chhachh region contains numerous sites, although most of these will not be affected by the Project, including the Hindu Shahi period fort above Pehur, the numerous Buddhist sites in the Gandghar mountains, the mounds around Hazro and along the river bank, and the great fort at Attock. The Museum at Taxila has two inscriptions in Kharoshti (Kushana Period) from the Chhachh region, one from Kamra, which has probably been an inhabited village site from Buddhist times, and one from near Mansar.

A number of sites, however, are within the Project area. Two of these are directly within the alignment of the power channel and four others are so close they will have to be protected from spoiling operations. These sites, and the effects of the Project on them, are noted below. Given the nature of this topic, it seems appropriate to identify the sites, assess their importance, and note the effects of the Project on each in one discussion. Mitigation measures will be discussed in Chapter 6.
This discussion is based on an archaeology field survey undertaken by a team headed by the Curator of the Taxila Museum (Ref. 7.3.8). Since virtually all the sites noted below are new to the Department of Archaeology, Pakistan, the results of the findings will be published by the Department.

The archaeology field survey was conducted in January 1991. The team made a general survey of the barrage area, surveyed out to 500 m on either side of the centreline of the power channel as marked on the ground, and made a general survey of the power complex site.

### Barrage and Storage Pond

The only archaeological site of note found in this area is the Hindu Shahi Period fort on top of Pehur hill. It is well above the barrage pond level and will remain physically unaffected by the Project. There is a very small chance that the site could be threatened by unsupervised visitors if the barrage pond becomes a major tourist attraction.

### Power Channel

All the directly affected archaeological sites are along the power channel:

- Mounds at Hassanpur (72° 35' 47" E and 33° 58' 42" N; or right of RD 10+100). These are two mounds with artifacts suggesting Kushana to Hindu Shahi Period settlement. They are located to the right of the alignment and are close enough to be affected by the construction of spoil banks. These mounds should not be covered with spoil.

- Musa I at Musa Kudlathi (72° 29' 27" E and 33° 52' 00" N; or in channel at RD 25+650). A Buddhist stupa and monastery site, probably of the Kushana Period (3C to 5C AD). The small pieces of stucco work recovered here show the red paint characteristic of this period. The western end has suffered unauthorised excavations, which reveal evidence of stone walled structures. The eastern end is intact. This site should be excavated and recovered before the construction of the power channel.

- Musa II at Musa Kudlathi (72° 29' 27" E and 33° 52' 00" N; top of mound is 400 m to the right of the channel centreline at RD 25+650). Probably an old settlement site, possibly related to the Musa I site. Buddhist monasteries were usually located away from villages or towns, but sufficiently close to enable monks to go into town for their food. The site is a rounded mound, terraced by farmers. The top has graves and has remained intact. This site should be kept free from construction or spoiling operations.
Musa III at Musa Kudlathi (72° 29' 9" E and 33° 51' 30" N; RD 26+450). Buddhist stupa and monastery of the Kushana and possibly the late Gandharan (2C AD) Periods. Fragments of schist stone and stucco sculptures on the surface suggest this site has been raided. (Villagers told the Social Survey Team in November that this mound had been partly bulldozed several years ago by people looking for statues.) This site is partly in the channel alignment and should be excavated and recovered.

Pindanwala Tibba at Musa Kudlathi (72° 28' 45" E and 33° 51' 47" N; top is 500 m to the right of the channel centreline at RD 26+750). A very promising site, possibly a small urban settlement from the late Gandharan period. The archaeology team noted a band of cultural deposits 8 m thick, with the surface covered with shards and schist fragments. The mound has suffered some damage from farmers trying to level it, but appears not to have been raided. This mound should be kept free from any construction or spoil bank activity.

Jatial nullah site. Shards were identified on the surface of Jatial nullah site. The investigation has shown that this is relatively a recent site and may be a camping ground for powindahs. Therefore, the disruption of this site by the power channel would not matter. There are also recent graves near to this site which will not be disrupted by the channel.

Dakhner nullah mound (72° 17' 53" E and 33° 50' 00" N; top of mound is 300 m to the right of the channel centreline at 44+800). Based on the discovery of a hand axe or stone striker and other evidence of the manufacture of stone tools, this is a paleolithic (Old Stone Age) site (0.5 million years old). The mound is topped by an active pir's tomb and graveyard. The mound should be left free from any construction or spoiling activity.

Dakhner Fort and Stupa (72° 14' 26" E and 33° 50' 15" N). Locally known as 'Pathri' (the place of stones), this site is high on the shoulder of the Attock hills above the Indus river, just opposite Darwazi on the NWFP side. The fort is from the British Period, but the large stupa here is from the Kushana Period. This area is well away from the power channel.

**Power Complex**

There is considerable evidence of stone age cultures in the area where the Haro and Indus rivers come together. The protection afforded by the rivers and deep nullahs, and the presence of game in what then must have been a forested plateau between the Attock
and Kala-Chitta ranges, clearly made this a favoured site for early stone age man. The discovery in the mid-1940s of the major petroglyph site at Gariala and the new discovery of a paleolithic site near Dakhner support this conclusion. No traces of stone age cultures have been found in the Barotha nullah, but some may have been covered up by deposits from the stream, or scattered by erosion and the construction and cultivation of fields. It is possible that excavation for the powerhouse and tailrace channel will come across stone age tools, although it is doubtful that these will be recognised for what they are.

For the present, the known artifacts threatened by the Project are two large boulders with petroglyphs. One is south of the Dher village road and would be flooded by the northern headpond. The other is in a narrow, deep nullah immediately to the east of the Haro-Indus confluence at 72° 15' 7" E and 33° 46' 7" N. It could be damaged by construction operations. Others may be present but undiscovered in the area. If such boulders can be lifted by cranes, they should be moved to the Taxila Museum or displayed near the power complex.

REFERENCES

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7.3.2 WAPDA Soils & Reclamation Directorate; Soils and Agronomic Surveys in Ghazi-Gariala Project area, 1986.


7.3.4 WAPDA Groundwater Hydrology Project; Hydrogeology of Hazro Area Potawar, 1979.

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7.3.6 Champion H. G.; Seth S. K. and Khuttak G. M.; Forest Types of Pakistan, Forest Institute, Peshawar, 1969.

7.3.7 International Reference Centre for Community Water Supply and Sanitation, WHO Collaborating Centre; Small Community Water Supplies, Technology of Small Water Supply Systems in Developing Countries; Technical Paper Series-18 (Page 46), 1986.

# TABLE 7.3.1

## REPRESENTATIVE QUALITY DATA OF RIVER WATER AND SEWAGE

### LOW-FLOW PERIOD (DECEMBER, 1990)

<table>
<thead>
<tr>
<th>Site Location</th>
<th>Sample Location</th>
<th>Odour</th>
<th>Colour</th>
<th>Physical Parameter</th>
<th>pH</th>
<th>Turbidity</th>
<th>Chemistry (ppm)</th>
<th>Chemicals</th>
<th>Anions</th>
<th>TDS</th>
<th>Suspended</th>
<th>Total</th>
<th>Heavy Metals</th>
<th>Oxygen</th>
<th>Bacterial Properties</th>
<th>Count</th>
<th>Bacterial Count</th>
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**Key:**
- **neg** = negligible
- **ND** = Not detected
- **MF/100 ml** = Membrane filter count of coliform
- **MPN/100 ml** = Most Probable Number of coliforms/100 ml
- **NTU** = Nephelometric Turbidity Unit
- **TNC** = Total non countable
- **TDS** = Total dissolved solids
- **ppm** = Parts per million
TABLE 7.3.1
REPRESENTATIVE QUALITY DATA OF RIVER WATER AND SEWAGE
HIGH-FLOW PERIOD (AUGUST, 1990)

| SITE LOCATION | PHYSICAL PARAMETER | TURBIDITY | pH | Na | K | Ca | Mg | NH4 | SO4 | Cl | PO4 | NO2 | NO3 | TDS | SOLID | AS | Cu | Co | Ni | pp.m | Fe | Pb | Cu | H | Mn | Cd | COD | BODS | TNC |
|---------------|---------------------|-----------|----|----|----|----|----|-----|-----|----|-----|-----|-----|-----|-----|-------|-----|-----|----|----|-----|-----|-----|-----|-----|-----|
| Near bank     | Odourless           | Colourless| 31 | 7.6| 0.28| 1.17| 19 | 6   | 0.31| 0.4 | 0.0 | 0.044| 0.0 | 187 | 13 | 73  | 56  | ND | ND | ND | ND | 72  | 15 | 52  | Positive |
| Midstream     | Odourless           | Colourless| 35 | 7.6| 0.69| 1.56| 18 | 13 | 0.21| 0.5 | 0.001| 0.029| 175 | 12 | 99  | 54  | 0.1 | ND | ND | ND | ND | 180 | 17 | 60  | Positive |
| Near bank     | Odourless           | Colourless| 29 | 7.6| 1.38| 1.56| 18 | 3   | 0.29| 0.68 | 0.001| 0.028| 173 | 11 | 59  | 54  | 0.2 | ND | ND | ND | ND | 80  | 32 | TNC | Positive |
| Midstream     | Odourless           | Colourless| 26 | 7.7| 1.81| 1.17| 18 | 5.3 | 0.36| 0.64 | 0.002| 0.011| 172 | 11 | 67  | 52  | 0.0 | ND | ND | ND | ND | 32  | 15 | TNC | Positive |
| Near bank     | Odourless           | Colourless| 27 | 8.0| 1.38| 1.56| 22 | 2   | 0.22| 0.84 | 0.002| 0.011| 171 | 11 | 61  | 52  | 0.1 | ND | ND | ND | ND | 36  | 27 | TNC | Positive |
| Midstream     | Odourless           | Colourless| 7.6| 0.92| 1.56| 19 | 5   | 0.35| 0.6  | 0.004| 0.026| 190 | 19 | 67  | 62  | 0.0 | ND | ND | ND | ND | 24  | 20 | 35  | Positive |
| Near bank     | Odourless           | Colourless| 17 | 8.0| 1.15| 1.56| 18 | 5   | 0.31| 0.3  | 0.002| 0.008| 175 | 26 | 67  | 54  | 0.0 | ND | ND | ND | ND | 13  | 15 | 40  | Positive |
| Midstream     | Odourless           | Colourless| 16 | 8.0| 0.69| 1.17| 18 | 3   | 0.24| 0.6  | 0.008| 0.011| 180 | 20 | 58  | 58  | 0.0 | ND | ND | ND | ND | 32  | 21 | 46  | Positive |
| Near bank     | Odourless           | Colourless| 19 | 8.0| 1.38| 1.17| 18 | 5.3 | 0.36| 0.64 | 0.002| 0.011| 190 | 21 | 55  | 54  | 0.0 | ND | ND | ND | ND | 46  | 36 | 50  | Positive |
| Midstream     | Odourless           | Colourless| 13 | 8.0| 1.15| 1.56| 20 | 4   | 0.26| 0.8  | 0.004| 0.008| 149 | 15 | 65  | 60  | 0.0 | ND | ND | ND | ND | 118 | 12 | 35  | Positive |
| Near bank     | Odourless           | Colourless| 14 | 7.9| 0.32| 1.35| 12 | 9   | 0.24| 0.6  | 0.008| 0.008| 176 | 12 | 65  | 60  | 0.0 | ND | ND | ND | ND | 128 | 12 | 45  | Positive |
| Midstream     | Odourless           | Colourless| 25 | 8.0| 0.69| 2.26| 18 | 5   | 0.23| 0.7  | 0.008| 0.029| 190 | 10 | 65  | 64  | 0.0 | ND | ND | ND | ND | 46  | 26 | 35  | Positive |
| Near bank     | Odourless           | Colourless| 23 | 8.0| 0.69| 1.95| 18 | 6   | 0.28| 0.8  | 0.004| 0.002| 162 | 14 | 71  | 60  | 0.0 | ND | ND | ND | ND | 46  | 36 | 45  | Positive |
| Midstream     | Odourless           | Colourless| 20 | 7.5| 0.88| 7.6 | 42 | 21 | 0.21| 0.4  | 0.05 | 0.25 | 0.006| 0.06 | 470 | 107 | 181 | 219 | 0.1 | ND | ND | ND | ND | 46  | 39 | TNC | Positive |
| Near bank     | Odourless           | Colourless| 25 | 6.9| 25 | 202 | 47 | 28 | 0.28| 0.94 | 0.008| 0.002| 779 | 81 | 230 | 399 | 0.1 | ND | ND | ND | ND | 144 | 132| 60  | Positive |

leg = negligible
ND = Not detected
MF/100 ml = Membrane filter count of coliform/100 ml
MPN/100 ml = Most Probable Number of coliform/100 ml
NTU = Nephelometric Turbidity Unit
TNC = Total not countable
TDS = Total dissolved solids
ppm = Parts per million
CHAPTER 4

ALTERNATIVE DEVELOPMENTS
4.1 NEED FOR POWER

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 power. The pace of development in these sectors in Pakistan had been considerable during the last three 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 endeavoured 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:

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal (MW)</td>
<td>5440</td>
<td>5440</td>
<td>5440</td>
<td>5440</td>
<td>5440</td>
<td>5440</td>
</tr>
<tr>
<td>Hydro (MW)</td>
<td>2868</td>
<td>2974</td>
<td>2910</td>
<td>2555</td>
<td>2065</td>
<td>2100</td>
</tr>
<tr>
<td>Total (MW)</td>
<td>8308</td>
<td>8414</td>
<td>8350</td>
<td>7995</td>
<td>7505</td>
<td>7540</td>
</tr>
<tr>
<td>Demand (MW)</td>
<td>6952</td>
<td>7396</td>
<td>6640</td>
<td>7029</td>
<td>7164</td>
<td>7648</td>
</tr>
<tr>
<td>Margin (MW)</td>
<td>1356</td>
<td>1018</td>
<td>1710</td>
<td>966</td>
<td>341</td>
<td>-108</td>
</tr>
<tr>
<td>(%)</td>
<td>19.5</td>
<td>13.8</td>
<td>25.8</td>
<td>13.7</td>
<td>4.8</td>
<td>-1.4</td>
</tr>
</tbody>
</table>

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. During the months of May and June the reservoir water levels in Tarbela and Mangla dams are generally at their minimum, whereas the power demand is at its peak. The result is a negative reserve margin during these months. Similarly, in January the irrigation canals are shut for their annual maintenance and therefore irrigation releases are small. This results in a shortage of energy.

WAPDA's power and energy demand projections up to the year 2010/2011 are shown in Table 7.4.1. The table shows that, by the turn of the century, power demand will rise to 18,531 MW and will
reach 37,343 MW by 2010/2011. If substantial new capacity cannot be brought on line as required, there will be large shortfalls.

4.2 ALTERNATIVE MEANS OF MEETING POWER DEMAND

4.2.1 No Action

There are two types of 'no action' alternative:

- the Project is not constructed and power demand is not met, or
- the Project is not constructed and power demand is met through alternative investment.

In the first instance, the power shortages would cause planned and possibly unplanned outages, with severe consequences for national development, especially in the industrial and agricultural sectors. According to WAPDA estimates, the economic value of one unit of unserved energy would be Rs. 6.50/kWh at July 1990 prices. On this basis, by the turn of the century there will be an economic loss of about US $ 14 billion per annum.

Therefore, it is imperative that generation capacity should be increased to meet the rising demand.

Pakistan currently uses a large variety of energy sources, each of which has advantages and disadvantages, depending on its uses. The main energy sources are fuelwood (primarily for domestic cooking and heating), fossil fuels, consisting of coal and petroleum products (for domestic and industrial heat production, transport, and generation of electricity), and water power (for generation of electricity). Pakistan does not have strong winds nor high tidal ranges, so these possible sources of electricity generation are not feasible. Solar photovoltaic conversion could tap a large resource, but its technology has not yet reached the stage where it is economical except for small scale specialised applications such as stand-alone telecommunications. Other sources, such as biogas, do not enjoy a resource base in Pakistan. Thus the feasible sources are fossil fuel and hydropower.

The most likely short-term solution would be the burning of fossil fuels, either in gas turbines or in oil-fired or coal-fired thermal plants. Generation expansion studies have shown these solutions to be more expensive, and they are known to cause air quality degradation.

In the case of Pakistan, which is not self-sufficient in petroleum and whose coal is not suitable for large-scale thermal electric generation, this solution would increase the country's dependence on external fuel sources and adversely affect the balance of payments.
The feasibility study of the Project has included detailed analysis of alternative investment options, with and without the Ghazi-Gariala Hydropower Project, to meet the increasing power demand throughout the Project life (Volume 9). For the purpose of this report these are summarised in the subsequent section.

4.2.2 Alternative Investment Options

To meet the future power demand, the Government of Pakistan has planned to exploit every possible means of power generation, i.e., fossil fuel, nuclear and hydropower. In the overall planning sequence of WAPDA there are two categories of prospective power generating plants. One set is firmly planned and committed, while the other is candidate. The committed generating plants, along with their commissioning dates, are shown in Table 7.4.2. The candidate hydropower plants are included in Table 7.4.3, which also depicts the earliest commissioning dates as provided by WAPDA. In addition to these candidate hydropower plants, WAPDA has also indicated that, to meet the power shortfalls, additional thermal plants may be commissioned. These may include the following units:

- 300-MW oil-fired steam turbine,
- 210-MW oil-fired steam turbine,
- 500-MW coal-fired steam turbine,
- 100-MW gas turbine unit burning distillate, and
- 900-MW nuclear plant.

In a preliminary analysis, the 210 MW oil-fired plant was found to have no advantage over the 300 MW oil-fired plant, so the former was dropped from the list of candidate plants. In addition, the programme for retiring existing thermal plant up to 2010 was supplied by WAPDA.

In order to assess and compare the value of alternative plant options to the Pakistan power system, a least-cost expansion programme was developed for each case studied. This was carried out using the computer program ASPLAN. Within ASPLAN, the pertinent data for the candidate plants is considered. The program identifies the least-cost planting programme which meets the predicted power and energy demands with a required minimum planting margin. System costs are calculated over the full life of the Project. Total costs are then discounted back to the present day at a selected discount rate, normally 10%.

Consideration was also given to the need for base load versus peaking power, and to resource reliability and price stability.
Under all scenarios, hydropower has been shown to be the most attractive option for meeting future demand, with each available project (Kalabagh, Basha, etc) being selected from the list of candidate plant as soon as it was available. With Ghazi-Gariala included in the list of candidate plant, it was selected immediately and the total system costs reduced significantly. The following table shows results for some of the alternative Ghazi-Gariala schemes studied.

<table>
<thead>
<tr>
<th>CHANNEL CAPACITY (Cumecs)</th>
<th>GENERATING CAPACITY (MW)</th>
<th>HEADPOND CAPACITY (M cu m)</th>
<th>PV @ 10% OF SAVINGS (US $ M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,600</td>
<td>1,140</td>
<td>0</td>
<td>759</td>
</tr>
<tr>
<td>1,800</td>
<td>1,285</td>
<td>0</td>
<td>801</td>
</tr>
<tr>
<td>2,000</td>
<td>1,425</td>
<td>0</td>
<td>938</td>
</tr>
<tr>
<td>1,600</td>
<td>1,140</td>
<td>5</td>
<td>785</td>
</tr>
<tr>
<td>1,800</td>
<td>1,285</td>
<td>5</td>
<td>834</td>
</tr>
<tr>
<td>2,000</td>
<td>1,425</td>
<td>5</td>
<td>955</td>
</tr>
<tr>
<td>2,000</td>
<td>1,710</td>
<td>10</td>
<td>958</td>
</tr>
</tbody>
</table>

Of the Project options considered, a 2,000 cumecs capacity channel was shown to result in the largest reduction in system costs. It was also shown that there would be benefit in providing headpond capacity to allow peaking operation. This overall conclusion remains valid for a wide range of sensitivity tests of the underlying assumptions, including the timing of the commissioning of Kalabagh dam. These tests are reported in detail in Volume 9 of this Report.

An important advantage of hydropower over thermal energy production was not factored into the cost comparisons, except in calculations of capital costs. This is the non-polluting nature of hydropower as compared with fossil fuel or nuclear power. Some environmental costs are incurred in the construction of any type of facility, and the mitigation of such costs figures more strongly in the capital cost of a hydroelectric project than in a fossil-fuel thermal plant. The environmental costs of fossil-fuel thermal plants rarely are mitigated in developing countries, but they remain, primarily in the area of air quality degradation.

4.3 PROJECT ALTERNATIVES

4.3.1 Barrage

Location

In the reach between 7 and 12 km downstream of Tarbela dam, the Indus river is relatively narrow and offers a number of possible locations for a barrage. Downstream of that reach, the river broadens considerably and there is no high ground for the right
abutment of the barrage. Five barrage sites were identified in the selected reach, the middle of which (Site C) is the location selected by WAPDA in the Pre-feasibility Report (Drawing 7.4.1).

The two downstream sites (D and E) were rejected during the layout phase of the feasibility study, because long embankments would be required to tie the barrage to the high ground on the right bank and because costly left bank embankments would be required to protect villages. Moreover, because of the slope of the river bed, the height of the barrage required to maintain the desired head would be considerably greater than for the upstream sites. The additional costs would not be balanced by gains in storage capacity of the pond. Site B, whose left abutment was virtually in the town of Ghazi, offered no technical advantages to offset the severe social and economic disruption that it would cause; it, too, was discarded.

Sites A and C were compared on the basis of river approach conditions, storage capacity, river bed levels, length of the left guide embankment, head reach of the power channel and environmental aspects. The advantages and disadvantages of these siting options are shown in Table 7.4.4.

River approaches at both sites were considered satisfactory for construction of the barrage. In storage capacity, Site C offered an advantage, about 97 M cu m at El. 340.0 m versus 71 M cu m for Site A. As the pond silts up, this advantage becomes greater, capacities being reduced to 52 and 35 M cu m, respectively. The gradient of the river bed results in Site C requiring a higher and more expensive barrage than at Site A. Site C would require a long, water retaining left bank guide wall to protect the settlements of Ghazi and Khalo, with greater risk to the villages. Site A, being farther upstream, necessitates a longer power channel, with additional road and nullah crossings.

Economic studies have shown that the lower capital cost of Site A more than compensates for the longer power channel and reduced storage volume.

The environmental effects of Sites A and C are roughly equal, once care is taken to minimise the effects on Ghazi and Khalo (essentially one population centre, cut by a large nullah). Most of the environmental effects are linked with the power channel, but the location of the channel is largely determined by the barrage alignment. Both alternatives would cause some disruption of movements and communications, especially during construction. Both would bring economic gains, in the form of increased sales for village merchants and employment for local people.

However, on long term socioeconomic and land use considerations, Site A is preferred to Site C. At present the twin villages of Ghazi and Khalo are well established market-places. With the barrage and its associated bridge located at Site A, the Project will not affect the existing value of these villages, rather the markets will flourish. With the barrage at Site C, the value of
the markets at Ghazi and Khalo will diminish to a certain degree, and a new market-place will develop at Isa. This will change the existing land use pattern of Isa village which is presently agrarian. The villagers of the locality have also preferred Site A. Site A was therefore selected for the barrage.

Configuration

The configuration of the barrage has been determined by geotechnical, hydraulic, hydrological and environmental considerations, the last being primarily the need to provide protection for lands on the left and right banks of the barrage pond and the desire for the secondary benefit of a new road crossing of the Indus river. The barrage is a complex structure comprising a number of components whose position and design are governed by other factors:

- **Standard Bays**, with flood gates, to discharge flows greater than those required for hydropower; their number is determined by hydrology, their design primarily by hydraulics and other engineering considerations.

- **Undersluices**, to contribute to flood discharge capacity, flush some of the sediments that would otherwise enter the power channel, and to maintain the capacity of the barrage pond; their design is determined by hydraulic and engineering aspects.

- **Dividing Island**, to separate the undersluices from the standard bays and provide streamlined flow to both sections; its location and design are determined largely by hydraulic and geotechnical factors.

- **Head Regulator**, to control the flow into the power channel; its location and design are determined by hydraulic and engineering considerations.

- **Guide Banks**, to provide smooth approach conditions for the water flowing through the standard bays, undersluices and head regulator; their locations and designs are governed by hydraulic and geotechnical factors.

- **Protective Bunds**, at the edges of the barrage pond to prevent flooding of residences and infrastructure along the existing river banks; their locations and heights are determined by pond elevation and topography, and their design by geotechnical aspects.

- **Compensation Water Outlet**, to be placed in the left abutment of the undersluices.
The overall configuration of the barrage is largely determined by the need to arrange the above components in a technically sound way, to allow ease of construction and operational reliability. With the exception of structures whose purpose is primarily environmental protection, environmental considerations play a small role in the design of the barrage.

The operation of the barrage will have some environmental effects which will be different in the low-flow and high-flow seasons. In the high-flow season, the releases from Tarbela will exceed the capacity of the power channel and therefore the barrage pond will remain full, with excess water being discharged downstream through either the standard bays or the undersluices. The choice of discharge method will depend on the total flow at the time and the situation regarding sediments. Because the retention time in the barrage pond during the high-flow season will be only around 4 to 8 hours, there should be no problems of deoxygenation of the water released from the deeper undersluices.

During the low-flow season, the barrage gates will be closed and the water level in the pond will fluctuate daily by up to 5 m in response to peaking operation at Tarbela. Downstream of the barrage, seepage flows underneath the barrage and groundwater flows from the banks of the river will be supplemented by releases, as needed, to maintain satisfactory conditions in the river downstream. The releases will be made through a dedicated outlet at the left end of the undersluices.

Groundwater recharge is discussed in Chapters 5 and 6.

Dimensions

The most important barrage dimension from the environmental viewpoint is the normal pond level. The surface elevation of the pond was selected to maximise the head of the Project without significantly affecting the operation of Tarbela dam and its powerhouse. Careful study of the Tarbela tailwater levels resulted in the selection of a normal pond level of El. 340.0 m.

The capacity of the flood discharge system has been based on the flood of record in the Indus river, which occurred in 1929. That flood is estimated to have passed 18,700 cumecs at the Project site, a value adopted as the Project design flood and with a return period of over 200 years. Additional discharge capacity, for very rare floods, is provided by a fuse plug in the right guide bank.

A flood of 14,500 cumecs, having a return period of about 40 years, has been adopted as the construction flood, in order to balance the cost of cofferdams against the risk of flood damage.

7-4.7
Low Head Hydropower

The possibility of installing a low-head hydroelectric plant in the barrage was discussed in the WAPDA Pre-feasibility Report. Water exceeding the power channel capacity would only be available for about 4 months each year. It has been concluded that most of this surplus water will be required for flushing sediments from the barrage pond, and sufficient water will not be available for economic hydropower generation at the barrage.

4.3.2 Power Channel

Number of Channels

The possible use of two parallel power channels was examined in the pre-feasibility studies, in recognition that their use offered greater operational flexibility and easier maintenance, despite their higher cost. In those studies, the channels were considered to carry 740 and 620 cumecs respectively, totalling somewhat less than the 2,000 cumecs eventually selected for the single channel.

The possibility of using twin power channels was examined during the feasibility study, and was found to offer the advantage of greater flexibility of operation but at an uneconomical additional cost. Technical problems have been encountered with twin channels in Pakistan and elsewhere, related to the stability of the lining in one channel when empty being affected by seepage from the adjacent full channel.

The decision in favour of a single channel was made on technical and economic grounds, but environmental considerations also favour the single channel alternative, which will require much less land and produce less spoil for disposal.

Alignment

The selected alignment of the channel was arrived at after a study of a number of factors, the main ones being the need to avoid villages, graveyards, shrines, and other cultural properties, the technical requirements of cross drainage, the identification of a route through the Pakistan Air Force and Pakistan Aeronautical Complex (PAF/PAC) facilities at Kamra, and the cost of land taken.

The proposed alignment has evolved during the feasibility study after detailed topographic, geological and socio-cultural studies of various alignment options falling within the study area shown on Drawing 7.4.2. The most economical alignment for a channel is one where the quantities of cut and fill are balanced. Such an alignment was identified for the power channel from its start to the beginning of the high ground west of the Kamra complex. This alignment would have passed through several long-established
villages and this was considered environmentally unacceptable. Therefore, in this reach, the power channel route has been moved southwards where necessary in order to avoid all villages. The resulting alignment would then have passed through several graveyards, some of which are very large. Accordingly, further modifications have been made to the alignment to avoid these graveyards.

The region where the channel crosses the Grand Trunk road is largely dictated by the route taken through the Kamra Aeronautical Complex and the approach from upstream. The crossing of the Grand Trunk road has been selected to avoid an important shrine and several graveyards.

Possible routes through the Kamra Aeronautical Complex were studied in depth. Five alternative routes were examined, including two that skirted the Complex to the north and south, respectively. Following discussions with the concerned authorities, a mutually acceptable alignment was selected that passes through a relatively undeveloped part of the Complex.

In the reach between Kamra and the power complex, the channel has to cross a ridge of high ground and a deep cutting is unavoidable. The alignment of the channel has been established largely on geotechnical and cost grounds. The main differences in environmental effects between alternatives are in the amounts of sand and rock to be spoiled. The advantages and disadvantages of the alignment options considered are shown in Table 7.4.4.

Design

The design of the power channel has been based on technical and economic factors, except for some minor aspects such as safety features. Once the design capacity was established, a technical and economic balance between flow velocity (including sediment transport capacity) and head losses governed the choice of cross sectional area and slope. The side slope of the channel has been determined on the basis of the properties of the materials through which the channel passes.

Spoil Disposal

Criteria. The considerable volume of excavated material that will be produced by the power channel construction necessitated a careful examination of all possible means of disposal. The primary criteria applied were as follows:

- Environmental Acceptability. An option that provided some environmental benefit was favoured over one that exerted an adverse effect, even if the cost was somewhat higher. Land use change is the principal environmental effect and it could be positive or negative. Much depends on how the spoil area is treated after placement.
Economic Cost. There are two principal costs involved, land acquisition and haul distance. The high land values in the Chhachh area make it desirable to treat the spoil areas carefully in terms of soil layering, grading, providing water and drainage, and reseeding.

Options Considered. Eleven possible means of disposing of spoil have been investigated and are discussed below. Of these, the first seven have been found to be both technically and environmentally feasible:

1. **Material for Construction.** To the extent possible, excavated material will be used in construction, for concrete aggregate, for filter materials, for riprap and as impervious core material.

2. **Embankment and Bulk Fill Material.** Fill material will be required along several reaches of the power channel for the construction of embankments above existing ground level. In addition, the dividing island of the barrage, the embankments along the edges of the pond and the embankments for the headponds at the power complex will require bulk fill material, which could be obtained from the adjacent reaches of the channel.

3. **Terracing of Wasteland and Uneven Farmland.** There are places in the region where land capability could be improved by topographic modification. One such area is in the hills southeast of the power channel near RD 8 to RD 11 and another is to the west of Kamra between RD 36 and RD 40. Spoil placed in this manner and properly terraced, drained and planted, would become useful land. This would improve the value of about 400 ha of land.

4. **Terracing for the Extension of Villages.** The spoil could be used to create level land around the villages of Ghazi, Khalo, Kamra Khurd and Kamra, improving the opportunities for village expansion.

5. **Banks for Additional Freeboard.** The addition of elevated banks along the channel where it is not in deep cut would provide the benefit of additional freeboard and a barrier against wind-blown sand on adjacent farmland. These bank would have a top width of 25 m and height of 3.5 m above the service road. They would have the advantage of minimal haul distance. After finishing, they would be grassed and planted with local tree species. For security and protection purposes, this strip would be retained by WAPDA.

6. **Spoil Banks.** Even with some or most of the above options adopted, a substantial volume of spoil will remain. This would be placed in areas of poor quality land and limited
to 3.5 to 10 m of height in flat land areas or 15 m in hilly areas. Properly graded and covered with topsoil previously removed from the channel excavation and from the area occupied by the spoil banks themselves, these spoil banks will be returned to productive use. It is planned to provide tubewells to irrigate these spoil banks.

7. **Nullah Reclamation.** The beds of some nullahs, especially those being trained or combined as part of the Project, could be modified with spoil for more effective land use. The quantities of material required would be small.

8. **Disposal into the Indus River.** Before the construction of Tarbela dam, the Indus river transported about 250 M t per year of sediment past the barrage site. Now it carries some 10 M t of suspended sediment annually, to which are added the downstream contributions of the Kabul, Haro, and Soan rivers, as well as those of numerous nullahs. There is therefore considerable spare sediment transport capacity in the Indus river compared with natural conditions. It would be possible to place spoil in the Indus river at several points, letting it be carried away by the flood flows. Several factors have caused this option to be discarded. First, the fate of various size fractions cannot be predicted with any confidence and there might be adverse effects on downstream barrage pools and their irrigation systems. Second, haul distances are relatively large, compared to those of other options, being on average 11 km.

9. **Construction of Ponds for Aquaculture and Stock Watering.** This would be a useful and environmentally desirable means of spoil disposal, but local interest in aquaculture is small and the amount of spoil disposed of would be minuscule compared with the total.

10. **Road Construction.** There are a few instances of on-going road construction or of borrow pits from past road projects where spoil could be placed. These needs are small, however, and the haul distances generally large.

11. **Stockpiling for Local Use.** Consideration has been given to storing spoil for future use by local communities in land levelling, nullah management or other purposes. The quantity of such spoil that could be used by villages within an economical haul distance of the channel is small. Therefore, the option has not been included in the overall spoil package. Moreover, few villages have enough spare land to maintain large stockpiles of fill material.

The planning of spoil disposal is discussed in Chapter 6.
Land Acquisition. Several alternatives are available for the process of spoil site acquisition and disposal after spoiling. These are as follows:

- **Outright Purchase and Retention by WAPDA.** If land were taken for additional freeboard, this method would be used.

- **Outright Purchase and Resale.** This assumes that the spoil area has been reconditioned and can be used for its former purpose.

- **Outright Purchase and Donation to Village.** This might be used where compensatory mitigation is needed to offset some adverse effect.

- **Lease.** With proper stipulations in the lease agreement to ensure that the price is equitable and that the land is returned to the owner in a suitable condition, temporary use could be obtained. Land owners in the Project area favour this arrangement, due to misgiving about land acquisition and payment procedures. However, this procedure could result in disputes regarding the condition of the land when it is returned.

On balance, the purchase and resale option appears preferable.

Crossings

Two basic types of crossings are required for the power channel: for the flash flows of the nullahs and for pedestrians, livestock and vehicles. The locations and designs of both types of crossings have been worked out through the study of many alternatives, both in philosophical approach and specific design. Further changes may take place if additional factors come to light that affect planning decisions. A railway bridge is also required near Rumian.

Cross drains (nullah crossings) initially were considered as either inverted siphons (a passage dipping under the channel and back up to or near ground level), culverts, or superpassages, but the passing of flows over the channel turned out to be technically and economically superior to passing flows under the channel. Only where a nullah is deeply incised will it be passed under the channel. Along the section between Khalo and the Grand Trunk road, the alignment has been moved slightly toward the southeast (uphill) in certain reaches in order to allow superpassages to be used.

There are a number of options available as regards the capacity of cross-drainage works. Typically on irrigation projects, this is related to a flood with a return period similar to the design life of the project. Because Ghazi-Gariala is a power project, a
conservative approach to the operational safety of the Project has been adopted. Thus superpassages have been designed to pass the estimated 100-year flows. The structures have also been designed to allow flows larger than the 100-year level to overflow into the power channel. The approaches to each crossing, the flume over the power channel, and the stilling basin have been based on standard hydraulic and other engineering technology.

The second type of crossing is the road bridge, for vehicles, livestock and pedestrians. Various alternatives were considered, based on traffic type and volume, ranging from a narrow footbridge for pedestrians and livestock to an arterial road bridge for the Grand Trunk road. In order to cater to future traffic growth in the area, it was decided to provide vehicular bridges even where only footpaths currently exist. Where use by large vehicles will be so infrequent as to pose negligible risk to pedestrians or livestock, a one-lane minor bridge will be used. Elsewhere district and village road bridges, with sidewalks, will be provided.

The number of bridges and their locations has been the subject of considerable study, due to their cost, the associated head losses in the channel, to social interactions between adjacent villages, and to the burden imposed upon the population of additional travel distance and time. Inevitably, some additional distance will be added for pedestrians who find their routes blocked by the channel, but an attempt has been made to minimise this inconvenience by placing bridges as close as possible to existing travel routes. The resulting average spacing of these crossings is much smaller than normal on large canals in Pakistan. Because every nullah in the upstream reach of the alignment carries a certain amount of foot traffic, pedestrian/livestock passage will be possible at every cross drainage structure.

4.3.3 Power Complex

Capacity and energy output

The generating capacity of the power complex was established during the layout studies on the basis of assured flow (as delivered by the power channel) and available head (which varied among the power complex sites considered).

The layout stage installed capacity was 1,200 MW but, with the inclusion of headponds, the capacity has increased to 1,425 MW. The average annual energy output will be about 7,700 GWh.

Location

During the feasibility study, five potential power complex sites were studied, ranging along the Indus river between Dakhner and the Haro river (Drawing 7.4.3). In addition, consideration was
given to locating the power complex on the Haro river, some 14 km upstream of its confluence with the Indus, thus shortening the power channel by about 15 km. The relatively steep slope of the Haro between that point and the Indus, however, reduced the head from about 70 m to about 40 m, negating the advantage gained by shortening the channel.

Of the other five sites under consideration, the northernmost, near Dakhner, was rejected when the foundation rock was found to be badly fractured and faulted. The site possessed no significant advantage over the downstream sites and would also result in a reduced head, so was given no further consideration.

The Gariala site, the most downstream of the five, was believed to offer the advantage of a ridge that would carry the power channel nearer to the Indus, shortening the tailrace channel. When the ridge was found to be too narrow and dissected for that function, the site was dropped from further consideration.

The three remaining sites, named for the nearby villages of Jaba, Dher, and Barotha, were studied in terms of topography, geology and geotechnics, hydrology, construction, and operation, as well as potential environmental problems.

At each site, the tailrace would have to be excavated down to the level of the Indus river in order to achieve the maximum head. At the Jaba site, the necessity of avoiding the village and a major graveyard resulted in a high volume of excavation (23.5 M cu m). The Barotha site would also require substantial excavation (12.9 M cu m), while the Dher site would require relatively little (7.7 M cu m). The shorter tailrace at Dher is partly offset by the need for a 2 km extension of the power channel.

The geological and geotechnical studies did not indicate any serious differences among the sites.

The available head is greatest at the Barotha site, followed by Dher. At Jaba, high potential flows in the large nullah could cause some problems in design for energy dissipation and sediment flushing. These problems are also present at the other two sites, but to a minor degree. In terms of construction and operation, the three sites are roughly equivalent.

There are no serious environmental problems that make one site overwhelmingly more desirable than another, provided the Project avoids the village, graveyards and shrines, that other infrastructure is maintained or replaced, and that access is provided across or around the Project structures.

The Barotha site is considered to offer the greatest overall technical advantage for the power complex. The higher costs at Barotha are more than offset by higher energy production over the life of the Project.

7-4.14
At the Barotha site, two alignments were considered for the tailrace channel, one passing north, the other south of the village. The south alignment was selected largely on the basis of tailwater elevation, there being a 0.8 m improvement in average head due to the slope of the surface of the Indus river (Table 7.4.4).

Most of the habitations of Barotha village are situated on the north (right) bank of the nullah. Irrigated agriculture, using water diverted from the nullah, has been developed in three areas, along both banks of the nullah and to the west of the main village, with the greatest intensity on the south side of the nullah.

In a scoping session, the villagers expressed a preference for the alignment to the north of the village, pointing out that it would displace no residences and only barani agriculture. The south alignment they considered would not only disturb some residences, but also severely affect the existing agricultural arrangements of the village.

The adverse effects of the south alignment can be mitigated by protecting the water supply of the remaining irrigated areas and by replacing the irrigated lands that would be taken. Care must be taken to ensure that the individuals whose lands are taken receive the benefits of the replacement irrigation system.

For siting the headponds and for their sizing, a number of alternatives of surface area and number of ponds have been considered within a general area east of Barotha and Dher. The selected site would serve a power complex near either village. The purpose of a headpond is to provide live storage to allow the turbines to be operated in a peaking mode without excessive loss of head and without necessitating flow changes in the power channel. An important factor in siting the headponds has been the avoidance of major nullahs, since they can carry large quantities of sediment. The only feasible option is to create the ponds by embankments enclosing ground on the west side of the ridge that parallels the Indus river.

A balance has been sought between the benefits of high storage volume and the cost of moving the embankments down-slope, thus making them higher and longer. Environmental considerations are limited to the area of land that would be submerged.

Design

The design of the power complex is determined by site topography, foundations conditions, hydraulics and other engineering considerations.
Spoil Disposal

The selected site will generate about 13 M cu m of excavated material from the tailrace and powerhouse area and another 1 M cu m from stripping of the embankment area. The material would be largely silt and sand, which must be used or disposed of. The embankments for the headponds are expected to require about 11 M cu m, part of which come from the excavated material (7.4 M cu m). The balance will be met from the excavation of the adjacent reach of the power channel and from borrow areas. The spoil rejected for embankment fill will be used to improve wasteland and gullies.

4.4 PROJECT OPERATION ALTERNATIVES

In the optimisation and economic studies of the Project, various operational options have been considered. The factors considered in these studies included the following:

- The hydrology of the Indus as it affects the operation of Tarbela, and the long-term changes to be expected at Tarbela as a result of sedimentation of the reservoir, the addition of more turbines and the conjunctive use of Tarbela, Kalabagh and Basha dams.

- The long-term effects of increasing discharges of sediment from Tarbela on the live storage capacity of the barrage pond.

- The effects of building Kalabagh dam on the Project, both as regards the changes in discharge patterns at Tarbela and the higher tailwater levels at the power complex during certain times of the year when Kalabagh will be full or nearly full.

- The effects of different headpond capacities and alternative installed turbine-generator capacities in allowing the Project to be operated as a peaking station.

These alternatives have been shown not to have major effects on the feasibility or economics of the Project. They are discussed in Volume 9 of the Feasibility Report.

4.5 CONCLUSIONS

The optimisation studies and least-cost analyses undertaken have demonstrated that:

- Among the options considered, the optimum channel capacity for the Project is 2,000 cumecs.

- The Project forms part of the least-cost expansion plan.
for the Pakistan power system and will result in savings with a present value of about US $ 950 M at a discount rate of 10%.

- Provision of headpond storage, to allow peaking operation, will be advantageous.

- The optimisation is independent of the incorporation of the Kalabagh dam project into the least-cost expansion plan.

The studies have shown that the 1,425 MW (5 units) and 1,710 MW (6 units) alternatives offer comparable benefits over a wide range of assumptions, and that larger capacities could be preferable in certain cases, e.g., with a lower discount rate.

Studies have shown that it would be viable to develop a near-optimum Project initially and reserve the possibility of expanding the installed capacity at a later date.

It has therefore been recommended that the Project for initial implementation should be as follows:

<table>
<thead>
<tr>
<th>Barrage location</th>
<th>Upstream site (Site A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power complex location</td>
<td>Barotha</td>
</tr>
<tr>
<td>Channel capacity</td>
<td>2,000 cumecs</td>
</tr>
<tr>
<td>Headpond capacity</td>
<td>15 M cu m</td>
</tr>
<tr>
<td>Installed capacity</td>
<td>1,425 MW (5x285 MW)</td>
</tr>
</tbody>
</table>

An even larger headpond (up to about 25 M cu m) would be desirable as the site topography is such that the additional cost would be minimal. However, this would result in a significant increase of the maximum height of embankment and sufficient geotechnical information is not yet available to recommend the larger headpond capacity. This aspect will be reviewed in the design stage.

Economic and financial analyses of the recommended Project have given the following results:

- Capital cost (July 1990 prices) US $ 1,911 M
- Economic internal rate of return 22.3%
- Benefit/cost ratio 2.78
- Financial internal rate of return 15.7%
### TABLE 7.4.1

**NATIONAL POWER AND ENERGY FORECAST**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ENERGY GENERATED (GWh)</th>
<th>AUXILIARY LOSS</th>
<th>ENERGY SENT OUT (GWh)</th>
<th>POWER GENERATED (MW)</th>
<th>AUXILIARY LOSS (MW)</th>
<th>POWER SENT OUT (MW)</th>
<th>LOAD FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990/91</td>
<td>41641</td>
<td>2.60%</td>
<td>40558</td>
<td>7793</td>
<td>145</td>
<td>7648</td>
<td>60.5%</td>
</tr>
<tr>
<td>1991/92</td>
<td>45723</td>
<td>2.64%</td>
<td>44516</td>
<td>8557</td>
<td>162</td>
<td>8395</td>
<td>60.5%</td>
</tr>
<tr>
<td>1992/93</td>
<td>50201</td>
<td>2.68%</td>
<td>48856</td>
<td>9395</td>
<td>181</td>
<td>9214</td>
<td>60.5%</td>
</tr>
<tr>
<td>1993/94</td>
<td>54823</td>
<td>2.72%</td>
<td>53332</td>
<td>10260</td>
<td>200</td>
<td>10060</td>
<td>60.5%</td>
</tr>
<tr>
<td>1994/95</td>
<td>59861</td>
<td>2.76%</td>
<td>58209</td>
<td>11203</td>
<td>222</td>
<td>10981</td>
<td>60.5%</td>
</tr>
<tr>
<td>1995/96</td>
<td>65370</td>
<td>2.80%</td>
<td>63540</td>
<td>12234</td>
<td>246</td>
<td>11988</td>
<td>60.5%</td>
</tr>
<tr>
<td>1996/97</td>
<td>71387</td>
<td>2.83%</td>
<td>69367</td>
<td>13360</td>
<td>271</td>
<td>13089</td>
<td>60.5%</td>
</tr>
<tr>
<td>1997/98</td>
<td>77954</td>
<td>2.87%</td>
<td>75717</td>
<td>14589</td>
<td>300</td>
<td>14289</td>
<td>60.5%</td>
</tr>
<tr>
<td>1998/99</td>
<td>84425</td>
<td>2.91%</td>
<td>81968</td>
<td>15800</td>
<td>330</td>
<td>15470</td>
<td>60.5%</td>
</tr>
<tr>
<td>1999/2000</td>
<td>91430</td>
<td>3.00%</td>
<td>87833</td>
<td>17111</td>
<td>362</td>
<td>16749</td>
<td>60.5%</td>
</tr>
<tr>
<td>2000/01</td>
<td>99017</td>
<td>3.04%</td>
<td>96046</td>
<td>18531</td>
<td>399</td>
<td>18132</td>
<td>60.5%</td>
</tr>
<tr>
<td>2001/02</td>
<td>107235</td>
<td>3.08%</td>
<td>103975</td>
<td>20069</td>
<td>438</td>
<td>19631</td>
<td>60.5%</td>
</tr>
<tr>
<td>2002/03</td>
<td>116137</td>
<td>3.13%</td>
<td>112560</td>
<td>21735</td>
<td>480</td>
<td>21255</td>
<td>60.5%</td>
</tr>
<tr>
<td>2003/04</td>
<td>124617</td>
<td>3.17%</td>
<td>120716</td>
<td>23322</td>
<td>524</td>
<td>22798</td>
<td>60.4%</td>
</tr>
<tr>
<td>2004/05</td>
<td>133711</td>
<td>3.22%</td>
<td>129472</td>
<td>25024</td>
<td>569</td>
<td>24455</td>
<td>60.4%</td>
</tr>
<tr>
<td>2005/06</td>
<td>143474</td>
<td>3.26%</td>
<td>138854</td>
<td>26851</td>
<td>620</td>
<td>26231</td>
<td>60.4%</td>
</tr>
<tr>
<td>2006/07</td>
<td>153947</td>
<td>3.31%</td>
<td>148928</td>
<td>28811</td>
<td>674</td>
<td>28137</td>
<td>60.4%</td>
</tr>
<tr>
<td>2007/08</td>
<td>165184</td>
<td>3.35%</td>
<td>159716</td>
<td>30914</td>
<td>734</td>
<td>30180</td>
<td>60.4%</td>
</tr>
<tr>
<td>2008/09</td>
<td>175924</td>
<td>3.40%</td>
<td>170031</td>
<td>32924</td>
<td>791</td>
<td>32133</td>
<td>60.4%</td>
</tr>
<tr>
<td>2009/10</td>
<td>187358</td>
<td>3.45%</td>
<td>180988</td>
<td>35064</td>
<td>856</td>
<td>34208</td>
<td>60.4%</td>
</tr>
<tr>
<td>2010/11</td>
<td>199536</td>
<td>3.50%</td>
<td>192652</td>
<td>37343</td>
<td>925</td>
<td>36418</td>
<td>60.4%</td>
</tr>
</tbody>
</table>
# Table 7.4.2

## Committed Generation Planting Programme

<table>
<thead>
<tr>
<th>YEAR</th>
<th>STATION</th>
<th>CAPACITY ADDED (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. WAPDA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989/90</td>
<td>Jamshoro 1</td>
<td>1 x 250</td>
</tr>
<tr>
<td></td>
<td>Jamshoro 2</td>
<td>1 x 210</td>
</tr>
<tr>
<td>1990/91</td>
<td>Jamshoro 3,4</td>
<td>2 x 210</td>
</tr>
<tr>
<td></td>
<td>Kot Addu C/C conv. 1-4</td>
<td>2 x 112</td>
</tr>
<tr>
<td></td>
<td>Multan 1</td>
<td>2 x 100</td>
</tr>
<tr>
<td>1991/92</td>
<td>Guddu Gas Turbines</td>
<td>2 x 100</td>
</tr>
<tr>
<td></td>
<td>Multan Oil 2,3</td>
<td>2 x 210</td>
</tr>
<tr>
<td></td>
<td>Tarbela 11,12,13</td>
<td>3 x 432</td>
</tr>
<tr>
<td>1992/93</td>
<td>Guddu C/C conv.</td>
<td>1 x 100</td>
</tr>
<tr>
<td></td>
<td>Lakhra coal (FBC)</td>
<td>3 x 50</td>
</tr>
<tr>
<td></td>
<td>Tarbela 14</td>
<td>1 x 432</td>
</tr>
<tr>
<td></td>
<td>Mangla 9,10</td>
<td>2 x 100</td>
</tr>
<tr>
<td></td>
<td>Hab River</td>
<td>1 x 323</td>
</tr>
<tr>
<td>1993/94</td>
<td>Hab River</td>
<td>3 x 323</td>
</tr>
<tr>
<td></td>
<td>Kot Addu C/C conv. 5-8</td>
<td>2 x 112</td>
</tr>
<tr>
<td></td>
<td>Chawama low head</td>
<td>270</td>
</tr>
<tr>
<td>1994/95</td>
<td>Lakhra Coal (FBC) 4-5</td>
<td>2 x 50</td>
</tr>
<tr>
<td></td>
<td>Cashma Low Head Hydropower</td>
<td>270</td>
</tr>
<tr>
<td>1995/96</td>
<td>Lakhra Coal (FBC) 6</td>
<td>1 x 50</td>
</tr>
<tr>
<td>1998/99</td>
<td>Nuclear</td>
<td>2 x 300</td>
</tr>
<tr>
<td>B. KESC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989/90</td>
<td>Bin Qasim 3,4</td>
<td>2 x 210</td>
</tr>
<tr>
<td>1991/92</td>
<td>Bin Qasim 5</td>
<td>1 x 210</td>
</tr>
<tr>
<td>1992/93</td>
<td>Bin Qasim 6</td>
<td>1 x 210</td>
</tr>
<tr>
<td>1993/94</td>
<td>West Wharf Steam</td>
<td>1 x 210</td>
</tr>
<tr>
<td>1994/95</td>
<td>West Wharf Steam</td>
<td>1 x 210</td>
</tr>
</tbody>
</table>

## WAPDA Rehabilitation Programme

The following plants are assumed to be rehabilitated for service in 1990/91

<table>
<thead>
<tr>
<th>Plant</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multan Steam</td>
<td>4 x 65</td>
</tr>
<tr>
<td>Faisalabad Steam</td>
<td>2 x 66</td>
</tr>
<tr>
<td>Guddu Steam 1,2</td>
<td>2 x 110</td>
</tr>
<tr>
<td>Guddu Steam 3,4</td>
<td>2 x 210</td>
</tr>
<tr>
<td>Sukkur Steam</td>
<td>4 x 12.5</td>
</tr>
<tr>
<td>Quetta Steam</td>
<td>2 x 7.5</td>
</tr>
<tr>
<td>Faisalabad GTs</td>
<td>8 x 25</td>
</tr>
<tr>
<td>Shahdara</td>
<td>2 x 13.25</td>
</tr>
<tr>
<td>Shahdara</td>
<td>4 x 14.75</td>
</tr>
<tr>
<td>Kotri 3-6</td>
<td>4 x 25</td>
</tr>
<tr>
<td>Quetta GT</td>
<td>1 x 5.7</td>
</tr>
<tr>
<td>Quetta GT</td>
<td>1 x 12.6</td>
</tr>
<tr>
<td>Quetta GT</td>
<td>2 x 25</td>
</tr>
</tbody>
</table>
**TABLE 7.4.3**

CANDIDATE HYDROPOWER PLANTS

<table>
<thead>
<tr>
<th>PLANT</th>
<th>CAPACITY</th>
<th>EARLIEST COMM. DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jinnah</td>
<td>140 MW</td>
<td>1995/96</td>
</tr>
<tr>
<td>Taunsa</td>
<td>110 MW</td>
<td>1996/97</td>
</tr>
<tr>
<td>Ghazi Gariala</td>
<td>1425 MW</td>
<td>1997/98</td>
</tr>
<tr>
<td>Kalabagh (units 1–4)</td>
<td>1200 MW</td>
<td>1998/99</td>
</tr>
<tr>
<td>Kalabagh (units 5–8)</td>
<td>1200 MW</td>
<td>1999/2000</td>
</tr>
<tr>
<td>Tarbela (units 15–17)</td>
<td>1296 MW</td>
<td>2000/01</td>
</tr>
<tr>
<td>Kalabagh (units 9–12)</td>
<td>1200 MW</td>
<td>2001/02</td>
</tr>
<tr>
<td>Basha 1–2</td>
<td>1708 MW</td>
<td>2002/03</td>
</tr>
<tr>
<td>Basha 3–4</td>
<td>1708 MW</td>
<td>2003/04</td>
</tr>
<tr>
<td>Dasu 1</td>
<td>932 MW</td>
<td>2004/05</td>
</tr>
<tr>
<td>Dasu 2</td>
<td>932 MW</td>
<td>2005/06</td>
</tr>
<tr>
<td>Dasu 3</td>
<td>932 MW</td>
<td>2006/07</td>
</tr>
<tr>
<td>Dasu 4</td>
<td>932 MW</td>
<td>2007/08</td>
</tr>
<tr>
<td>Bunji</td>
<td>645 MW</td>
<td>2008/09</td>
</tr>
<tr>
<td>Thakot</td>
<td>1207 MW</td>
<td>2009/10</td>
</tr>
</tbody>
</table>
TABLE 7.4.4
COMPARISON OF ALTERNATIVES CONSIDERED

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO ACTION</td>
<td>Project not built; power from other sources</td>
<td>* National power demand met</td>
<td>* Air quality degradation</td>
</tr>
<tr>
<td></td>
<td>Project not built; power demand not met</td>
<td>* No land loss</td>
<td>* Higher cost (fossil fuel)</td>
</tr>
<tr>
<td>POWER SOURCE</td>
<td>Fossil fuels</td>
<td>* No social disruption</td>
<td>* Hindered local/national economic development</td>
</tr>
<tr>
<td></td>
<td>Other hydropower (Kalabagh &amp; Basha, which are in the planning process)</td>
<td>* Less social disruption</td>
<td>* Air quality degradation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Less competition with other fuel demands</td>
<td>* Competition with other fuel demands</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Cooling water effects, heating of river water</td>
<td>* High transportation cost for Basha</td>
</tr>
<tr>
<td>BARRAGE</td>
<td>Location: Site A</td>
<td>* Land taken is less productive</td>
<td>* Resettlement (Kalabagh)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Less social obstruction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location: Site C</td>
<td>* Slightly less inundation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low-head hydropower at peak flows</td>
<td>* Socio-economic growth for Ghazi-Khalo</td>
<td></td>
</tr>
<tr>
<td>POWER CHANNEL</td>
<td>Use of two channels</td>
<td>* Greater storage capacity</td>
<td>* Little different from A, but</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Additional energy extraction at little extra cost.</td>
<td>* Less favorable to Ghazi-Khalo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Project could function with one channel out of service</td>
<td>* Less flood water available for sluicing</td>
</tr>
<tr>
<td></td>
<td>Alignments: balanced cut and fill</td>
<td>* Less spoil to be disposed of</td>
<td>* Groundwater pressure might endanger empty channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* Greater land taking</td>
</tr>
<tr>
<td></td>
<td>Alignments: on high ground</td>
<td>* Avoids disruption of population centres</td>
<td>* Disruption of population centres</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Better crossings for nullah flows through superpassages</td>
<td>* Lower structural integrity of the channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Improved integrity against pressure of water</td>
<td>* Difficulties in nullah crossings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* More excavation; greater volume to be spoiled</td>
</tr>
<tr>
<td>TYPE</td>
<td>DESCRIPTION</td>
<td>ADVANTAGES</td>
<td>DISADVANTAGES</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>POWER CHANNEL</td>
<td>Avoiding shrines/graveyards</td>
<td>* Reduced cultural impacts</td>
<td>* Slightly more excavation</td>
</tr>
<tr>
<td>(Cont'd)</td>
<td>Route through Kamra:</td>
<td>* No impact on air base</td>
<td>* Slight increase in length</td>
</tr>
<tr>
<td></td>
<td>north</td>
<td>* Least cost routing</td>
<td>* Substantially greater length</td>
</tr>
<tr>
<td></td>
<td>centre</td>
<td>* Little impact on air base</td>
<td>* Channel in fill, replacement of structures</td>
</tr>
<tr>
<td></td>
<td>south</td>
<td>* Reclaim land previously eroded</td>
<td>* Considerable excavation required</td>
</tr>
<tr>
<td>Spoil disposal:</td>
<td>river bank</td>
<td>* Recover wastelands and eroded farmland</td>
<td>* Uncertainty as to ultimate fate of material</td>
</tr>
<tr>
<td></td>
<td>reclamation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>terracing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>additional freeboard</td>
<td>* Overflow surge protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>spoil banks</td>
<td>* Convert some marginal lands into irrigated croplands</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nullah reclamation</td>
<td>* Large volumes possible</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Make nullah beds more useful</td>
<td></td>
</tr>
<tr>
<td>POWER COMPLEX</td>
<td>Location:</td>
<td>* Shorter power channel</td>
<td>* Requires careful management to meet goals</td>
</tr>
<tr>
<td></td>
<td>Dakhner</td>
<td></td>
<td>* Land acquisition/sale may be sensitive</td>
</tr>
<tr>
<td></td>
<td>Gariala</td>
<td></td>
<td>* May re-erode quickly unless protected with proper grade and vegetation</td>
</tr>
<tr>
<td></td>
<td>Jaha</td>
<td></td>
<td>* Prohibitive geotechnical problems</td>
</tr>
<tr>
<td></td>
<td>Dher</td>
<td></td>
<td>* Topography not suitable</td>
</tr>
<tr>
<td></td>
<td>Barotha north</td>
<td>* Ridge brings power channel to within 1 km of river</td>
<td>* Long (4 km) tailrace channel</td>
</tr>
<tr>
<td></td>
<td>south</td>
<td>* Economically best site</td>
<td>* Smaller head</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Less agricultural disruption</td>
<td>* Highest seismic risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(than south alternative)</td>
<td>* Narrowness of ridge means less structural security for channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Maximum head of all sites</td>
<td>* Head loss of 0.8 m (1.1 %)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* Disruption of irrigated agriculture</td>
</tr>
</tbody>
</table>
CHAPTER 5

POTENTIAL EFFECTS OF THE PROJECT
CHAPTER 5
POTENTIAL EFFECTS OF THE PROJECT

5.1 APPROACH TO ASSESSMENT

5.1.1 Types of Effects

'Effect' vs 'Impact'

During the 1970s, when the world environmental movement was developing what is now called 'environmental science', the interactions between a project and its surrounding resources were called 'impacts'. Since most early environmental studies focused solely on adverse effects, the term 'impact' came to have a negative connotation. The 'Environmental Impact Study' (EIS) was a critique of the project, rather than the management tool it would eventually become. As the science of environmental management matured and became integrated into the planning process, engineers and other planners came to recognise that a project may have hidden beneficial impacts and these, too, could be developed through more effective planning. Environmental scientists realise that the more comprehensive analysis, which includes benefits, would make their activities more useful to the project. To preserve the neutrality of the environmental study, the term 'effects' has come to be favoured over 'impacts' and will be used.

Direct and Indirect Effects

The effects of a project or action on human or natural resources often consist of chains or networks of interactions of varying importance. A link in the system may of itself be relatively unimportant, but may be a key to an important effect elsewhere in the system. In analysing these networks of effects, it is usual to identify the environmental change actually caused by the construction or operation of the project, which is considered the 'direct' (or 'primary') effect, and work down the cause-effect chain through the 'indirect' ('secondary,' 'tertiary,' etc) effects.

For example, an irrigation project may withdraw a large fraction of the dry-season flow from a river for consumptive use on farmlands. Reduction of flow downstream of the diversion would be a direct effect of project operation. The flow reduction reduces the assimilative capacity of the river for human and animal wastes, an indirect effect. Depending on the volume and quality of those wastes, a further indirect effect, reduced water quality, may ensue. Reduced water quality may also be an indirect result of other project effects, such as the increased use of agricultural chemicals or increased population density in the service area. The deterioration of water quality, which may take many forms, may have further effects on human health and life.
These effects, several linkages removed from the direct effect of the project on flow, probably are predictable, but may not be reliably quantifiable and hence not amenable to economic evaluation.

**Potential vs Residual Effects**

In the several steps of environmental assessment described below, a potential environmental effect is identified and broadly evaluated as to magnitude and importance. If the environmental management process is working well, many potential adverse effects will be eliminated or substantially reduced during project planning and design. Adverse effects that cannot be so mitigated become 'residual' and must be acceptable for the project to go forward. There are numerous examples of projects whose residual impacts (usually involving massive resettlement, but occasionally the degradation of important natural resources) were so severe that the project was dropped.

Secondary project benefits occasionally are enhanced or realised during project planning, such as by careful planning of access roads. However, their development is usually postponed until the completion of project construction. This is often due to the secondary benefit falling in the area of responsibility of an agency other than the one sponsoring the project.

**5.1.2 Identification of Potential Effects**

**Reference Base**

Effective environmental planning depends on reliably predicting a project's effects on resources and managing those effects to achieve the greatest gain (or the smallest loss). The basis for the prediction is knowledge of the proposed project, of local resources with which it is expected to interact, and of how similar projects elsewhere have affected their environments. No project can be identical to the one under consideration and none can have precisely the same environment, but even an unusual project such as the Ghazi-Gariala Hydropower Project will contain components similar to those found in other projects. Considerable judgement is required to evaluate the similarities and differences among projects and to translate these into environmental effects.

Fortunately, there is a wealth of published material on the environmental effects of development projects worldwide. This information base reduces considerably the uncertainty of environmental predictions.
Information Required

Ideally, there should be a continuous feedback loop between project planners and environmental scientists, the former identifying alternative sites and designs and the latter providing an environmental evaluation (with suggestions for mitigation of adverse effects) of each alternative. The environmental screening is then incorporated into decisions on alternatives, along with technical and economic criteria.

This process has been accomplished on the Project to a remarkable degree, with the result that virtually all foreseeable effects were identified, evaluated, and taken into account in the Project design, leaving only a minimal number in the category of unavoidable adverse effects.

For this process to operate, two types of information are required: a comprehensive description of all resources likely to be affected by the component under consideration, and an understanding of the project component itself. The baseline information must include all resources, natural and human and all aspects of those resources that may be expected to be touched, directly or indirectly, by the project. Conversely, project information must include all aspects of construction or operation that might affect the environment; not only the physical components, but the work force, access, and resource demand. Some aspects of the project may not have been finalised by the time the design (and the environmental assessment) has been completed, necessitating a continuing environmental analysis.

Information Sources

There are two primary sources of baseline information: literature and field surveys. The literature base includes a variety of books and journal articles, as well as agency reports. Field surveys are necessary when the literature base is weak or the information must be very specific to the project area. The former applies, for example, to Indus river water quality data and the latter to socioeconomic and cultural resource data. Reconnaissance-level field surveys have been performed to supplement the literature on biological resources. Aerial photographs have also proved useful in this regard. Some information, particularly on the attitudes and concerns of the Project area population, was obtained through a series of scoping meetings held at the village, district and provincial levels.

Information on Project alternatives considered and selected was obtained, verbally and by memoranda and drawings, from the engineers responsible for the various Project components. Many of these alternatives also are discussed in other volumes of this Report.

7-5.3
Systematic Approach

Various components of the Project will interact with local resources in different ways and at different times. Therefore, it is useful to divide the Project into units small enough that the interactions may be examined individually, as well as collectively.

The main components of the Ghazi-Gariala Hydropower Project are the barrage, the power channel and the power complex, but each of these is in effect a major project. Various aspects of each are treated separately: the main structure, water bodies, materials requirements, work force, spoil disposal, etc, and examined both in terms of the construction period and the much longer period of Project operation.

The resettlement of people displaced by the Project through the loss of homes or land is a mitigation action, but usually is treated as a Project component, since it exerts its own effects on resources.

Each project sub-component, or unit, interacts directly with a particular set of environment components, resulting in the sort of effects networks described above. The interactions also are varied in type, degree and time. A resource may be affected consumptively, by displacement, by contamination or even psychologically (usually limited to human resources).

The number of project-resource interactions is potentially very large, certainly in the hundreds, but most are easily disposed of. Many environmental scientists have found it useful to tabulate the interactions by means of a matrix, with project units on one axis and environmental resources on the other. It is not unusual for such a matrix to include 30-40 project units and 50 or more environmental subdivisions, resulting in 1,500-2,000 intersects, each a potential project effect. The number of meaningful intersects invariably is much smaller, usually less than 50.

5.2 ASSESSMENT OF POTENTIAL EFFECTS

5.2.1 Project Impact Matrix

General

To identify the impact 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 7.5.1. The impacts of various Project components have been assessed separately for the construction and operational phases.
Construction Phase Impacts

The construction phase impacts are mostly of a temporary nature and their magnitudes are subject to the engineering management practices adopted during construction. Such impacts are the ones related to the following aspects:

- soils (erosion and slope stability),
- energy resources,
- surface water quality,
- air quality,
- noise,
- disruption to the biological environment,
- public health,
- interruption of communications,
- at-risk population/safety,
- community stability, and
- cultural and religious values/properties.

The soil-related issues include soil erosion, slope stability, and effects on agricultural soils due to fugitive dust created through blasting and excavation activities at the structure sites and borrow/spoil areas. Agricultural soils are also subject to deterioration due to spills of toxic material. These effects will be more pronounced with the construction of the power channel than with the barrage and the power complex. To minimise these effects the contractors should use the best engineering management practices. The contract documents will include specific clauses to impose environmental protection practices on the part of the contractor. The supervisory consultants should be vigilant that these clauses are adhered to by the contractor in full.

Besides the disruption of biological environment due to land clearing for the construction of structures, there may also be disruption by the work force in need of fuelwood. Any such damage to the resource is unlawful and will be controlled by introducing appropriate clauses in the contract documents.

Safety hazards are associated with the operation of construction machinery, equipment and tools, transportation, blasting, land cutting and slides, fires, etc. The causes of safety hazards are usually complex involving human errors, operational faults of machinery and unforeseen incidences. The majority of the causes
are controllable with efficient management, staff training, machinery maintenance and other preventive measures. Accident prevention is essentially an engineering and administrative problem and rests mainly on strict compliance with established safety rules and regulations.

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 stone-cutting, blasting and movements of equipment. Fumes and smoke from burning materials may cause acute respiratory irritation and bronchitis.

Contamination of water resources by obnoxious material may create health hazards for the population using that water. For the safety of the 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, helmets, full boots and gloves.

In addition to the preventive and precautionary measures, each camp will have a dispensary equipped with first-aid material, dressing material and necessary drugs essential for communicable disease, like cholera, dysentery, typhoid, paratyphoid, hepatitis, malaria, etc.

The most prominent impact of the construction of the power channel will be the interruption of movement of the local population. This will be minimised by allowing the public access via the cross drainage structures, which will be constructed before the excavation of the relevant section of the power channel. In this way, the public will pass under the service roads and thus be segregated from the two-way construction-related traffic along the channel.

The location of construction camps near villages could disturb the local communities and may create social and cultural problems. Therefore, the contractors will be required to impose regulations on the workforce to avoid any law and order situation and an appropriate clause will be included in the tender documents.

The most severe potential impact of the Project during construction phase will be the land acquisition and resettlement. This aspect is dealt with in greater detail in Section 5.2.2.

The Project construction will enhance employment opportunities for the local people, which will help to reduce the economic stress created by the process of land acquisition. The detailed discussion of these aspects is provided in Chapter 6.
Operational Phase Impacts

Table 7.5.1 indicates that the effects of the Project operation are mostly beneficial. Besides the generation of power and electrical energy for overall development of the country, the local population will benefit in the following ways:

- The Project will provide important and badly needed employment opportunities to the local people, both during construction and over the operational life of the Project.

- The barrage pond and headponds will assist in the establishment of aquatic ecosystems and fisheries, which will improve the nutrition level of the local population.

- The provision of a bridge along the barrage will improve the communication between left and right banks of the Indus river. This will benefit the Ghazi-Khalo markets, while the cost of transport across the Indus will be reduced as a result of not having to follow the hilly and winding road to Tarbela dam.

- The diversion of Indus river flows into the power channel will reduce the intensity of floods in the downstream reaches as far as the confluence with the Haro river. This will reduce or stop the present loss of village land due to scouring by the river along the left bank.

- The development of spoil banks for irrigated agriculture will help to reduce the resettlement problem and stabilise the economic condition of the affectees.

- The Project will reduce the damaging effects of major floods run off in the nullahs, particularly in the Chhachh tract, by allowing overflow into the power channel at the superpassages and by the provision of inlets for small nullahs.

- Downstream of the barrage, the reduction in the areas of residual pools during the low-flow season should reduce the prevalence of mosquitoes.

- The underdrainage system for the power channel should reduce groundwater levels where these are near the surface in the Chhachch plain, thus reducing waterlogging problems.

The adverse effects of the Project may be as follows:

- Diversion of river water into the power channel will reduce the downstream flows, which could result in some deterioration of the water quality during low-flow periods.
The Project will pose some safety hazards. These will be relatively more severe in the case of the power channel than the barrage or the headponds. Appropriate education of the public, and safety features, will be necessary.

The Project may lower the groundwater levels to the extent that existing wells and tubewells are adversely affected. These aspects will have to be monitored regularly throughout the Project life so that appropriate remedial action may be taken to alleviate the problems.

The creation of the barrage pond and headponds could result in some development of disease vectors (mosquito) but is unlikely in view of the daily operation cycles of these ponds.

The reduced flows downstream of the barrage may facilitate the crossing by criminals from one bank to the other. This concern was expressed by left bank villagers in local scoping meetings.

A detailed discussion of these effects is given in the subsequent paragraphs. The mitigation measures are described in Chapter 6.

5.2.2 Land Resources

Barrage and Pond

The most conspicuous direct effect of the barrage will be the creation of a permanent water body of 1,000 ha in place of a 7 km stretch of braided river channel. The present land use of the reach is limited to some extraction of fuelwood and cobbles. In addition to the pool, about 140 ha of riverbed, including 2 or 3 ha of adjacent land, will be taken by the barrage and its associated structures.

Another direct, and largely permanent land use change will be the conversion of 35-40 ha across Kundi Dara nullah from Ghazi into the construction work area for the barrage (Drawing 7.1.1). This area will later be used for backfill behind the left guide bank. Present use of part of this land seems to be just as fallow land, which provides local residents with some fodder and fuelwood. Most of the area is, however, occupied by a WAPDA nursery which can be relocated elsewhere. As the construction work area, it will be largely cleared, fully fenced, and provided with workshops, offices, storage facilities, and vehicle parking. Upon completion of the barrage, the land is expected to be retained by WAPDA for the operation and maintenance of the barrage.

The barrage colony will be located within the existing Tarbela colony facilities, if possible. Otherwise, WAPDA will acquire about 16 ha of barani land near Ghazi Hamlet.
It was learnt from the village-level scoping sessions that the Indus river is scouring the lands of the villages of Ghazi, Khalo, Isa, Jallo, Qazipur, Hasanpur and Mian Dheri during the high-flow season. The diversion of 2,000 cumecs into the power channel will reduce the intensity of high floods. Hydraulic model studies have indicated a beneficial impact of the barrage on the left bank of the river downstream.

Some indirect effects on land use are expected. The commercial growth of Ghazi, that has been noticeable during the construction of Tarbela and since, probably will accelerate due to the presence of the construction work area, the Project itself and the new crossing of the Indus river. This is likely to result in some agricultural land, already highly priced in this area, becoming more valuable as commercial or industrial property, and changing into those categories.

This shift is not necessarily undesirable, as land values tend to reflect the level of prosperity of the area and farmers are not compelled to sell their lands to private developers. Some of the roadside land near the barrage colony will be converted to commercial use, as shops spring up in support of the colony.

The land use changes in the Ghazi area are expected to continue after the Project is commissioned, spurred by the increased traffic resulting from the crossing. Some change may also be expected on the right bank in Galla, but the main economic effect is likely to be felt at Topi, where the new crossing will tie into the road between Pehur and Mardan. Some conversion of agricultural land to commercial land is likely to occur there.

Power Channel

The main direct effect of the power channel on land use will be the permanent conversion of approximately 1162 ha (including some margin for contingencies described in Section 6.4.2) of land from various uses to that of the power channel, including its parallel roads and cuts. Current use of this land is as follows:

<table>
<thead>
<tr>
<th>LAND USE WITHIN THE POWER CHANNEL RIGHT-OF-WAY (PERMANENTLY ACQUIRED)</th>
<th>ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated arable land</td>
<td>67</td>
<td>5.8</td>
</tr>
<tr>
<td>Barani arable land (rainfed)</td>
<td>300</td>
<td>25.8</td>
</tr>
<tr>
<td>Marginally barani and pasture land</td>
<td>472</td>
<td>40.6</td>
</tr>
<tr>
<td>Wasteland (with some grazing potential)</td>
<td>237</td>
<td>20.4</td>
</tr>
<tr>
<td>Urban/residential/farmstead</td>
<td>33</td>
<td>2.8</td>
</tr>
<tr>
<td>Kamra Aeronautical Complex</td>
<td>53</td>
<td>4.6</td>
</tr>
<tr>
<td>Total</td>
<td>1162</td>
<td>100.0</td>
</tr>
</tbody>
</table>

7-5.9
Some of the land currently is not being used to its full potential. Some land in barani agriculture could be irrigated. Some tracts of open land, e.g., near Ghazi, Khalo and Ghurghushti, are considered by the Union Council (and their owners) to have high value due to their suitability for future urban expansion. This aspect has been considered in the distribution of land area.

An additional area of about 1,750 ha (including some margin for contingencies) will be used for the disposal of material excavated from the power channel. The present use of that land is as follows:

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated arable land</td>
<td>110</td>
<td>6.3</td>
</tr>
<tr>
<td>Barani arable land</td>
<td>517</td>
<td>29.5</td>
</tr>
<tr>
<td>Marginally barani and pasture land</td>
<td>747</td>
<td>42.7</td>
</tr>
<tr>
<td>Wasteland (with some grazing potential)</td>
<td>376</td>
<td>21.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,750</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The precise means by which this land will be acquired by the Project and made available to the public after placement of spoil has yet to be determined. Certainly it will be removed from its present use for a period of up to a year while the power channel is under construction in that area. The most probable means of acquiring this land area will be on a semi-permanent purchase basis and resold to the public after placement of spoil, with the affected land-owners getting first chance (Chapter 6).

The power channel colony, located near Lawrencepur, will take 22 ha of land that is currently in barani (rainfed) agriculture and pasture. The contractor's camp and work area will be located on the areas acquired for the development of spoil banks.

**Power Complex**

The greatest land use change induced by the power complex will be the conversion of 320 ha from sparse woodland, barani agricultural land and wasteland to the headponds. Another 55 ha will be taken by the embankments of the ponds. The power complex structures (forebay, penstocks, powerhouse, switchyard, access roads and tailrace) will require 175 ha of land. After accommodating contingencies, it is assumed that 649 ha will be acquired collectively for these components of the power complex. The breakdown of this area according to land use, as observed from the aerial photographs, is as follows:
LAND USE IN AREAS TO BE OCCUPIED BY POWER COMPLEX STRUCTURES, HEADPONDS AND EMBANKMENTS

<table>
<thead>
<tr>
<th>Land Use</th>
<th>ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated arable land</td>
<td>20</td>
<td>3.1</td>
</tr>
<tr>
<td>Barani arable land</td>
<td>250</td>
<td>38.5</td>
</tr>
<tr>
<td>Pastures, marginally barani and woodland</td>
<td>180</td>
<td>27.7</td>
</tr>
<tr>
<td>Wasteland (with some grazing potential)</td>
<td>194</td>
<td>29.9</td>
</tr>
<tr>
<td>Residential/farmstead</td>
<td>5</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>649</td>
<td>100.0</td>
</tr>
</tbody>
</table>

An additional 100 ha of land will be used for the permanent power complex colony east of the Gariala-Dakhner road (Drawing 7.1.1) and for the access road from Attock-Haji Shah road to the power complex area. The present use of this area is mostly for barani agriculture and grazing land. The construction camp and work area will be located within the area acquired for the headponds.

Some indirect land use effects may be expected in the Barotha area, as the influx of Project workers brings money into the area. Some lands, especially along the existing roads, will acquire value as commercial property and may change their use through sale, lease, or development by their owners. This will be beneficial to the local population.

5.2.3 Water Resources

Barrage Pond and Downstream Effects

**General.** The existing flow pattern of the Indus river has been described in Section 3.5.2. In general, there is a cycle of low-flow and high-flow periods during the year. The low-flow period normally extends from mid-October through April. There being no significant tributary in the river reach from Tarbela to the confluence with the Kabul river, the low flow in the Indus is essentially what is released from Tarbela reservoir through the irrigation and power tunnels and this is regulated according to the irrigation requirements at the downstream barrages. The high flows are discharged over the spillways of the dam, in addition to the releases from the power tunnels. Periodic small contributions also come from nullah runoff during the high-flow season.

The Project is designed to divert most of the low flow into the power channel via the barrage. In the river reach between the barrage and the Kabul river, from mid-October through mid-May, some surface flows are expected to remain. These will include seepage from the barrage pond, leakage at barrage gates, groundwater outflow from the left bank and flow from the Badri
Khawar tributary on the right bank. These are estimated to amount to about 20 cumecs. However, all Project performance and energy calculations have been based on a minimum release of 28 cumecs downstream of the barrage, a figure which was adopted in the Layout Report for compensation water (Ref. 7.5.1). The balance between the seepage flows and the total compensation flow will be released from a valved outlet at the left end of the undersluices.

During the high-flow season, the river downstream of the barrage will receive the majority of the flow from Tarbela.

In this section, a detailed account is presented on the effect that the changed pattern of the river flow during the low-flow period is likely to leave on the social and ecological conditions in the parts of the Project area dependent on the existing water resource. To analyse the situation, it is desirable to list out the probable roles of river water in the social setup of man and in the ecosystem. This is as follows:

- Contribution to the groundwater recharge.
- Human consumptive and non-consumptive use.
- Animal needs.
- Requirements of the natural vegetation.
- Irrigation requirements.
- Fisheries and waterfowl.
- Dilution of sewage disposal.

**Effects on Groundwater.** The existing flow pattern of groundwater in the Project area has been discussed in detail in Section 3.5.6. Here the effect of the barrage and its pond on the movement of groundwater in the Ghazi sub-basin and Hazro basin is discussed to elaborate the mitigation requirements in this regard.

Under the existing flow pattern of the Indus river, it is estimated that the aquifer of the Ghazi sub-basin is recharged from the river in the reach from upstream of Ghazi to Qazipur. The average annual inflow in this river reach amounts to about 35 M cu m (1.1 cumecs). With minimum river flows downstream of the barrage for the low-flow period, the inflow from the river reach between Ghazi and Qazipur will be cut off.

By comparing the water levels of the river at the Ghazi gauge and that of an open well near the bank in front of the river gauge, it has been observed that the water level in the well is about one metre below that of the river during low flows, while the difference during high flow is about 3 m. This means that, with
no water in the river, the reach between Ghazi and Qazipur will act as a groundwater-depletion front like the reach between Qazipur and Mian Dheri.

However, during the high-flow period, when ample water will be released from the barrage, this reach will again act as a recharge zone. On the other hand, with the water level in the barrage pond raised to El. 340.0 m, the groundwater recharge of the Ghazi sub-basin will be enhanced.

Under such conditions, the loss of inflow from Ghazi to Qazipur during the low-flow season will be recovered, although the amount of the enhanced inflow from the barrage pond cannot be accurately estimated.

Downstream, from Qazipur to Barotha, the Indus river acts as a drainage channel not only for the surface flows of the surrounding ground but also for groundwater. Presently the groundwater outflow into the river reach between Qazipur and Mian Dheri (about 4 km) is 38 M cu m/y (1.2 cumecs), from Mian Dheri to the Attock gorge 10 M cu m/y (0.3 cumecs), and from Dakhner to Barotha about 10 M cu m/y (0.3 cumecs).

With reduced release of water at the barrage during the low-flow period, the water levels in the river from Ghazi to the confluence with the Kabul river will be lower than the existing levels. This will result in slight increases in the gradient of the groundwater in the surrounding area with a consequent increase in the volume of outflow throughout this length. The transmissivity and the groundwater gradient in the Hazro basin being low, 250 sq m/d and 1:600, respectively, the change in gradient is not expected to increase the outflow significantly. However, in the case of the Ghazi sub-basin, the average value of transmissivity is 10,000 sq m/d and the slope is rather steep, ie 1:350. This will result in the enhancement of groundwater outflow particularly when the reach between Ghazi and Qazipur also becomes a depletion front.

There will be an inflow from the barrage pond to the Ghazi sub-basin, but this will be mostly drained by the power channel underdrainage system and discharged to the river downstream of the barrage.

On the basis of the above discussion, the impact of the reduced river flow during the low-flow period on the groundwater regime will not be severe. This is supported by a study of the data available for the period from March 1990 through January 1991 and WAPDA's reports on groundwater studies of the area (Section 3.5.6). However, the interaction of surface flow and groundwater regime along the river is complex and therefore will be carefully monitored after the Project is built in order that any need for mitigation can be identified and appropriate action taken (Chapter 7).
Effects on Human Consumptive and Non-consumptive Use of Water.

There are ten villages along the right bank of the Indus river in the reach from the proposed barrage site to the confluence with the Kabul river. Of these only the people of Galla, which is immediately downstream of the barrage, benefit from the river during low-flow periods and that is through the exposure of the subsurface current of the river near the village. This is because the water discharged through the Tarbela power tunnels takes a turn toward the left bank upstream of Galla. The remaining villages on the right bank are totally devoid of low-flow water.

Along the left bank there are 16 villages near the river. Of these 12 are located in Tehsil Haripur, which has a waterfront of about 11 km. In the socio-environmental survey, it was observed that human use of river water in the total reach of 41 km is limited to about 15 villages (1 on the right bank and 14 on the left bank).

The survey also revealed that the majority of the population in the Project area meet their consumptive and nonconsumptive water requirements from groundwater, extracted either from open wells by buckets, Persian wheels, hand pumps or mechanical pumping, or from tubewells (see Appendix D).

Of the 15 villages covered in the survey, 4 fell in the belt of 12 villages on the left bank referred to above. The population of about 5,500 people in these 4 village draws about 330 buckets per day of average 12 litre capacity from the Indus, mainly for drinking. Part of this is also used for nonconsumptive purposes. As such, only a very small percentage (about 10%) of the consumptive requirement in these villages is met from the river, while the remaining needs are met from groundwater.

The social survey has revealed that taking drinking water from the river is customary among the very poor people. This is more common during the summer season, as the river water, being derived from snow melt, is relatively cooler than groundwater and the poor cannot afford cooling facilities.

The survey also indicated that about 500 people in the 4 villages (less than 10% of the total population) go to the river daily for bathing and laundry. This is not due to competition for scarce water but just for a change and recreation. The laundry is mainly carried out by women, who go out in groups to meet socially. If any other isolated corner is available where they can do their washing without disturbance, they will go there as well.

Effect on Animal Consumptive Use of Water. Animal needs for water are mostly limited to livestock, as significant wildlife populations do not exist in the riverain area. There is a very thin population of wild boar hidden in the belas (river islands). The jackal population, although relatively large, is found mostly in the deserted highlands and is rarely dependent on river water.
Livestock has been estimated to have a population of about 15,000 of various types in the villages along the left bank of the river. Of this, about half consists of commercial cattle mostly belonging to two villages (Malla and Noor Mali). Reportedly, these are kept on the belas during the low-flow period and are dependent on river water. Since the total water requirement of these cattle is equivalent to a uniform flow of much less than 0.1 cumec, the proposed minimum flow of 28 cumecs will not be a constraint.

Of the remaining stock, which is mainly domestic, 50% is driven to the river for grazing and drinking. According to the survey, however, the majority of villages (90%) reported that they have enough water other than the river to meet their domestic and livestock requirements.

If the need for supplementary water supplies is identified after the Project is complete, this could be met by providing small tubewells in that area (Chapter 6). The availability of adequate water will be monitored (Chapter 7) during Project operation.

**Effect on Natural Vegetation.** The permanent river islands and banks in general, and occasional semi-permanent bars, are covered with thick natural vegetation consisting of trees, shrubs and grasses. Such areas are invariably the property of one village or another. The villagers get benefit from such areas by cutting fuelwood or pasturing their livestock.

This natural vegetation is unlikely to be affected by the reduction of river flow during the dry season, for several reasons. First, the dry season falls in winter when evapotranspiration and vegetative growth are low. Second, the soils will conserve water during flood periods to supplement the requirements of the low-flow period. The latest aerial photographs, which were taken during December-January 1990-91, show that even after the recession of floods for 3 months there was still standing water in low lying areas in the river bed. This indicates that the river strata are saturated from the previous flood. Third, seepage and releases from the barrage and groundwater will also maintain a significant flow.

Instead, it is expected that, with the small reduction in flood discharge, some islands/bars will be spared from submergence and it is likely that the less flood-tolerant plant species will increase. The limited loss of vegetation on river islands and in the riverain area occupied by the barrage and its pond will be balanced by the enhancement of vegetation downstream of the barrage. The beneficiaries of the enhancement, however, will not be the same people who lose their riverain resource in the barrage pond.
Effect on Irrigation. The survey established that there is no direct use of river water for irrigation through pumping or otherwise. Flood plains are occasionally cultivated during rabi (winter season) as the water recedes from the active flood plains. Here the crops rely on water retained in the soil from the summer flood. There is just over 80 ha of such land in the villages of Malla and Noor Mali. With the Project, such areas may be affected as the flood releases from the barrage will be smaller than existing ones and winter flows to supplement the sub-surface irrigation through capillary action will be reduced. However, there is a possibility that part of this area will be available for double cropping through well/tubewell irrigation.

Scoping sessions revealed that the majority of the people having land at the edge of the flood channel would be pleased to have the severity of the flood reduced, as their land is eroded and scoured by the flood every year and they have to spend considerable effort and money to reconstruct the protective structures. Along the left bank a number of wells and tubewells have been abandoned because of such scouring activity. With the floods reduced by the barrage, people will be better able to develop wells and tubewells, which in turn will replace by irrigation any losses imposed by reduced capillary action from lower flows in the river.

Effect on Fisheries and Waterfowl. Fisheries and waterfowl are not very important resources in the river reach from the barrage to the Kabul river. At present, the fishing industry in the barrage area and downstream is limited. A few hundred fishermen supplement their normal income by fishing during the period that the river flows are decreasing. As the fishing techniques are conventional, the catch is generally small. The barrage pond will create a somewhat better opportunity for a commercial fishery.

Rights to fishing are important. Fishing on the left bank (Attock Tehsil) is regulated by permit but, on the right bank, villagers in Topi carried out public demonstrations and prevented the imposition of a permit system there.

The use of the river channel by migratory waterfowl will be evaluated during the supplementary ecological studies.

Effect on Water Quality. In general, the quality of river water is related to the volume of flow. Water quality during the low-flow season is poorer than during the high-flow season. This effect becomes more pronounced where population centres are situated near the river.

There are a number villages along both banks of the river, but none of them has a proper sewerage and drainage system. The household sewage, which is mostly constituted of kitchen and washing waste, is disposed of into open earthen or brick lined street drains leading towards the river or a nullah. Most of the
sewage flow dissipates through evaporation or infiltration into the ground and only a very small part reaches the river. The human waste is rarely disposed of in these drains. The local population has either constructed septic tanks for this purpose or use out-house facilities.

This state of affairs was confirmed through field observation and interviews, and also from laboratory analysis of river water samples. The river water samples were collected from seven sites to represent water quality at upstream and downstream ends of major village clusters during high-flow (August) and low-flow (December) periods (Section 3.5.2). In addition, sampling was also done on two sewerage outlets, one in Ghazi village and the other in Jallo village.

The comparison of laboratory results of river water at the upstream and downstream ends of a village shows that there is almost insignificant contribution of pollution from the village sewerage. This situation will persist till an efficient sewage collection and disposal system is introduced for the villages. Keeping in view the fact that most cities do not yet have such a system, this is unlikely to take place in the Project life. Nevertheless, the quality of river water will be regularly monitored. The proposed mitigation action is discussed in Chapter 6.

**Power Channel**

**Effect on Surface Water Resources.** The power channel will affect the water resources of the Project area in many ways, but none of the effects will be such that they cannot be mitigated by acceptable measures.

The course of the power channel has been planned to follow approximately the 355 m contour and thus will run across the land slope. As a result of this, the channel will intersect about 59 nullahs (including branches) along its full length. These drainage channels are flashy in nature. The obstruction of these nullahs has been mitigated in the Project by providing cross drainage structures.

The nullahs, particularly those flowing in the Chhachh plains, can have devastating effects on the villages during their occasional high flows. In village level scoping sessions, the villagers asked for proper training of these nullahs or diversion, if possible. The provision of inlets to the channel on several of the nullahs (total inlets being 16) in that area will reduce the severity of the flood damage. Moreover, nullah flows greater than the 100-year floods will overflow the crossings into the channel. Thus the truly devastating floods will be reduced.

The power channel will cross an irrigation watercourse that originates from Qibla Bandi dam. The total command area of this irrigation system is about 350 ha, of which the irrigation...
supply system of about 65 ha lies across the channel alignment. The Project will provide a suitable piped crossing of the channel.

**Effect on Groundwater Resources.** A possible effect on the water resource of the Project area, due to the power channel being largely in cut, is the obstruction of groundwater flows. For most of its length, the power channel crosses the natural slope of the groundwater. Over a large reach, the invert level of the channel is higher than the groundwater levels and thus flows will not be affected.

In the initial 1 or 2 km and at various places in the channel reach from RD 19 through RD 45, the invert level of the power channel will be lower than the groundwater levels. This could result in some obstruction of groundwater flow, except that the Project includes an underdrainage system which will lower the groundwater level where it is above the channel invert. Groundwater flows in the strata below the channel invert will be essentially unchanged.

In spite of the fact that the power channel will be concrete lined, there will be a limited amount of seepage. This small seepage outflow may affect the natural balance of the groundwater. On the other hand, the underdrainage system is designed to maintain groundwater levels below the channel invert, in case the channel ever has to be dewatered. This reduction in levels should reduce the incidence of waterlogging to some extent. Changes in groundwater levels will be monitored and appropriate remedial measures put in hand where necessary (Chapter 7).

**Power Complex**

**Effect on Surface Water Resources.** In the power complex area the main source of permanent water is the Barotha nullah, which not only collects the surface runoff of about 3.5 sq km of catchment area, but also acts as an outlet for groundwater outflow. The surface runoff is seasonal and flashy. The 100-year flood has been estimated to be about 90 cumecs. The groundwater outflow forms the perennial flow in the nullah. The dry-season flow is estimated at about 0.1 cumecs, part of which is diverted by the local people for irrigation purposes through two water courses running along both banks of the nullah at a height safe from floods. The water is diverted into the water courses through two concrete structures built on the nullah.

The main effects of the power complex and its headponds will be the obstruction of flows of Barotha nullah, disruption of the headworks of the existing irrigation network, and consumption of part of the irrigated land (about 20 ha). The main tributary of Barotha nullah, which contributes the major proportion of the perennial flow, would be interrupted by the south headpond.

7-5.18
Under mitigation measures, the Project will reinstate the existing irrigation system and provide additional irrigation for the northern belt of the Barotha plain to compensate for the loss of existing irrigated land.

There was a suggestion from the local people in a scoping session that the tailrace be routed to the north of the village where the agriculture is mostly rainfed (see Chapter 4). Providing substitute irrigation supplies to the northern belt of the Barotha plain may compensate for the situation on a broader view, but the individuals owning irrigated land in the nullah and river terraces will not directly benefit from new irrigation north of the village unless they are allowed appropriate access.

One favourable effect of the headponds will be that they will intercept the surface runoff of the catchment area, thus reducing the erosion of surface soil and the growth of the nullahs, both of which reduce the area of agricultural land.

**Effect on groundwater resources.** In the area around the headponds, the ground permeability is generally low (10^{-5} cm/s). This limits the availability of water for extraction and thus there is little use of groundwater in this area. There will be some seepage from the headponds into the ground, which will augment groundwater resources. The initial seepage flow is estimated at about 1 cumec (32 M cu m/yr). The additional water may result in slightly increased flows in the deeply incised nullahs nearby, which will be beneficial, eg for livestock watering.

Groundwater levels in the area of the power complex will be monitored and necessary mitigatory measures adopted (Chapter 7).

**5.2.4 Biological Resources**

**Barrage and Pond**

The effects of the barrage and its pond on biological resources have been covered in Section 5.2.3 and are not repeated here. However, a discussion of fishery development in the barrage ponds is useful, because it will be a secondary benefit of the Project.

A fishery is likely to develop in the barrage pond, as in major reservoirs and in the downstream barrage pools, but productivity may be limited by several factors:

- **Depth.** Where the sides of the pond are steep the depth will be too great for developing a good bottom flora. The ideal depth, in clear water, is 2 m. Few rooted plants do well in depths over 5 m. Such conditions will be available at times in the limited area of the pond along the left bank's upstream end.

7-5.19
**Drawdown.** If Tarbela is operated in peaking mode during the dry season, the barrage pond will be drawn down during the day and refilled during the evening hours of peak demand. This will mean that the best areas for aquatic ecosystems will be exposed to drying for several hours each day during the winter. This will inhibit the growth of rooted aquatic plants.

**Nutrients and Flushing.** The water released from Tarbela is relatively low in nitrates and phosphates, basic nutrients for an aquatic ecosystem. If these nutrients can be retained in bottom sediments and plants, a productive ecosystem may develop. The fine sediments discharged by Tarbela will tend to settle in the barrage pond and form bottom muds. However, high concentrations of suspended sediments are expected during May and June, after the delta in Tarbela reservoir reaches the dam, and will act to the detriment of the fishery.

Therefore, an economically viable fishery may develop in the barrage pond with proper management, consisting of the establishment of an ecosystem tolerant to deep water and diurnal fluctuations. Stocking may be useful in some parts of the pond. A limitation on catch size, to retain the breeding age population, will also help in maintaining the fishery.

**Power Channel**

There are no Government-owned natural forests or reforestation areas within the right-of-way of the channel or the spoil banks. Communal woodlands in the graveyard areas will be avoided. However, the latest aerial photographs show about 10 small private woodlands and some scattered farmland trees will be affected. The Project will compensate this loss by cash compensation.

There appear to be no elements of the natural fauna that would be affected by the power channel. Like other large canals, the channel will be a hazard for animals and reptiles. There will be a risk of drowning of human beings and farm animals. The Project will include appropriate safety measures to reduce the risks to humans and livestock, but little can be done to prevent the occasional loss of wild animals (Chapter 6).

**Power Complex**

None of the components of the power complex will disrupt natural woodland. The vegetation in the area is generally scattered with some concentration in the nullahs. Therefore, disruption of this source will be limited. The Project will, however, compensate the losses by cash compensation.
The tailrace channel will pose a hazard to mammals and reptiles, but most wild animals swim well enough to survive the trip to the Indus. The risk of accidental drowning of human beings and farm animals will be small as the headponds will have slow currents and gentle slopes, and the tailrace will not be easily accessible, unlike the nearby Indus river.

Fishery development in the headponds will be limited. Though the slopes of the floor of the headponds will be gradual, particularly in the backwater regions, the drawdown pattern may not favour the establishment of aquatic ecosystem. The headponds will be drawn down up to 5 m within four evening hours and brought back up during the remaining hours of the day. Consequently, the areas favourable for the establishment of aquatic ecosystems will remain exposed to drying for several night hours. This condition is relatively more favourable than in the barrage pond. However, the area of the water body is not very large (320 ha at maximum level), which will limit the scale of fishery development.

The high velocity of water in the tailrace (up to 4 m/s) and the concrete lining will prevent fishery development in the tailrace.

5.2.5 Social and Cultural Resources

General

In a general way, the negative effects of the Ghazi-Gariala Hydropower Project on the local populations will be balanced both by the positive effects of the Project on those who live and work in the Project area, and the enormous contribution such a Project will make to the industrial and agricultural development of Pakistan. Of the latter there can be no doubt. The generation of about 7,700 GWh of electricity is urgently needed to fill the current shortfall in the demand for energy. If not remedied, currently projected shortfalls in capacity up to the turn of the century will have serious implications for national economic development.

Barrage and Pond

The construction of the barrage on the Indus river between Ghazi and Galla and the resulting pond will have substantial social, occupational and economic effects on the local populations on both sides of the river. In one degree or another, socioeconomic effects will occur in the construction phase, the early operational phase and in the longer-term period of the Project. Some effects will be evident immediately, some will take time to alter current social and economic conditions, while still others are probably as yet unforeseen.
Water Resources: Access and Social Usage. Control over local water resources has always had important political and social implications, and any alteration in supply, access, or quality can have reverberations throughout a local society, town or, indeed, a region. The Indus river and its village waterfronts have always been "socially neutral" areas, providing unrestricted access to the river stream for transportation, for water and all its uses, and for social intercourse.

The barrage at Ghazi will reduce the flow of water in the river until the flow into the power channel at Ghazi is returned from the tailrace at Barotha. Project performance and energy calculations have been based on a flow of 28 cumecs downstream of the barrage. This flow, which will comprise seepage and leakage from the barrage supplemented by discharges from the compensation water outlet, will be augmented by groundwater flows into the river downstream from Qazipur and the permanent flow from the Badri Khawar, a small tributary on the right bank. Together, these will maintain a flow in the Indus river between Ghazi and Khairabad.

The environmental and public health implications of the reduction in the river flow during the low-flow season have already been discussed, but two potential social effects should be noted:

- Any loss of flow along village waterfronts or the stagnation of water there would close off an important social meeting point in the village, particularly for women. Although only about 10% of a village's supply of water for domestic purposes is met from the river, considerably more than 10% of the village women find their way to the river front at some time in the week. Field visits to water front at Galla on the right bank and to several villages on the left bank (including Malla) revealed active water fronts.

- Any loss of unrestricted access to water by those who really depend on the river could cause subtle changes in village power relationships. Certainly, in the left bank villages, any loss of river water would throw the poorest social group into greater dependence on those who have their own private supplies. In Galla on the right bank, the one public well in the village, which is outside the mosque, will still be available to all, but the location and administration of any compensation supply will have to be kept free from those who might use it to exert undue influence in the village.

The Barrage as a Bridge: Communications and Urbanisation. There is very little question that bridging the river at Ghazi and Galla, together with the construction mobilisation for the Project, will have a major effect on the size and socioeconomic complexity of Ghazi-Khalo on the left bank and Galla, Pehur and Topi on the right bank.

7-5.22
The current 16 km route across Tarbela dam between Topi and Ghazi will be reduced to 6 km across the barrage. The Tarbela route, which is closed at night for security reasons, carries substantial commercial traffic, even though this route is indirect and winding. The more direct barrage route certainly will facilitate traffic between Swabi and Abbottabad Districts and could become an alternate route between Mardan and its hinterland and the Islamabad-Rawalpindi region. Transporters serving the Gadoon Industrial Estate will find this the most convenient link to the road network serving industrial and population centres in the Punjab and Sind.

In addition to increased traffic, and the complex of fuel, maintenance and market facilities that will expand to serve it, the mobilisation effort to build the barrage and the power channel will bring a large number of workers to Ghazi. These developments will have considerable effects on Ghazi in particular, although whether these are positive or negative will depend on how they are handled:

- **More rapid population growth.** Ghazi has already had a rapid spurt of growth as a consequence of Tarbela, which has put pressure on scarce land for urban expansion and pushed land prices higher than those of surrounding agricultural land. A second spurt in growth will enhance these pressures, possibly driving local land prices beyond the reach of small and middling merchants and creating social tensions between those who hold land and those who do not.

- **Growing business and commercial opportunities.** The injection of substantial resources into the area will mean a new prosperity for the bazaar and opportunities for suppliers and local contractors. According to local officials, Ghazi already has approximately 300 commercial establishments. Most of these will probably grow and others will spring up to fill gaps in the supply of goods and services.

- **Growing pressure on administrative and social services.** This kind of growth will test severely the capacity of the local administration and its social services to respond. Ghazi is still governed by a Union Council, a thin administration that is already inadequate to cope with the growing pains of what is an established market town. The Project colony will have educational, medical, recreation and shopping facilities for those directly associated with the Project. Even so, educational, medical and public health facilities in Ghazi appear to be under more than normal pressure and would be hard put to cope with the numbers coming into the area in addition to those directly associated with the Project.
New work opportunities for unskilled and skilled workers. The labour demand for the Project in these categories should be met largely from the existing labour pool in the Project area, a development that would reduce the impact that thousands of out-of-area workers would have. The longer term effects of this must also be considered, however. The potential for a "boom-bust" cycle and a post-Project depression for the Ghazi area should not be ruled out, particularly if steps are not taken to create more permanent work opportunities in the region.

Law and Order. The seasonal lowering of the deep stream in the river below Ghazi could lead to increased incidents of social conflict in the Indus riverain. Conflict could occur as landholders attempt to reassert control over riparian village lands currently cut off by the deep stream. Villagers regard those who live and work in the belas beyond the deep stream as absconders (criminals fleeing from the police), whom they would eject if they could gain access in significant numbers across the main river channel. Generally, the deep stream delimits use of the riverain by river bank villages, as villagers from either bank move out to exploit the riverain until they are stopped by the main river channel. The fact that today this channel bears little relationship to inter-village and inter-provincial boundaries, suggests at least some potential for conflict should the deep stream become greatly reduced in flow.

A deeper worry in the Project area is that the seasonal flow reduction in the deep stream will interrupt the role of the Indus as a barrier against unwanted intrusions from the other bank.

Public Health and Safety. The operation of the barrage and creation of the barrage pond may affect the public health of local population in the vicinity of the barrage in two ways. Firstly, the reduction of flows may affect the water quality in the river creek adjacent to the villages on the left bank. Secondly the barrage pond may become a habitat for disease vectors, such as malaria mosquitoes. The potential for mosquito breeding at the periphery of the barrage pond appears to be low due to the daily fluctuations in the pond level over most of the year. However, this possibility will be examined in detail as part of the supplementary studies. Mitigation and monitoring programmes, if needed, will be described in the supplementary report.

The barrage pond may also pose safety hazards for the local population and tourists but, for the reasons described in Section 6.4.9, these hazards will be no greater than those posed by the Indus at present.
The Barrage: Cultural Resources. Apart from an old fortification on the hill above Pehur, the barrage area contains no cultural resources of major significance. A small river bank shrine upstream from Galla may, however, come under the mean surface level of the barrage pond. The Project will provide a protective embankment to avoid flooding, if any.

Power Channel

General. The power channel is the largest physical component of the Project and by its size and length will have the greatest environmental and social effects on the Project region. Indeed, so large is the channel that its very size becomes an environmental consideration. This structure, the largest of its kind, cuts a wide swathe laterally through the land of some 48 villages on its 52-km passage from the barrage at Ghazi to the power complex at Barotha. The minimum right-of-way for the power channel, including access roads, will be approximately 140 m in width, but in areas where it is in fill or deep cut it will be substantially wider. When the area to be affected by spoil is included, it becomes clear that the channel has the potential to alter the physical characteristics of the region, including water resources, and to change its agrarian economy, unless appropriate mitigation measures are included.

A second concern stems from the placing of such a major Project in a region already affected by large public sector investments, namely the Tarbela Dam Project and its associated infrastructure, and the Sanjwal-Kamra defense industrial complexes. It can be argued that it is socially unfair to inflict the costs of development on one segment of society or on a single geographical region out of proportion to the benefits received.

This is particularly an issue in the Project region because of the broadly held perception that government agencies have not adequately addressed resettlement and compensation issues in the planning and construction of the major projects already located there. Whatever its validity, this perception is acute in the area affected by the Tarbela Dam Project, as well as the Kamra area, and villages along the Lawrencepur road that have only recently received compensation for land acquired by military authorities.

All of this does not mean the Project should not be built here; sites for hydropower projects are not easy to come by and most residents of the Project area do appreciate the need to resolve Pakistan's power crisis. What it does mean is that the local perception of the government's past performance on the social and environmental aspects of major projects is a factor that must be taken into consideration in determining both the effects of the Project and those mitigation and compensation measures that are proposed. This includes compensation for land permanently taken, resettlement and redevelopment schemes, the satisfactory completion of mitigation measures, and the involvement of local
leaders and Project affectees in decisions that directly affect them.

**Effect on Dwellings.** Since it almost completely avoids village and built-up areas, the power channel will have only a minimal effect on human habitations. The most significant impact on dwellings will occur in three areas. First, in Ghazi the grading requirements for the village road bridge across the channel will cause damage to dwellings on the outer edge of the village.

Second, the channel will virtually eliminate some 30-35 households in the settlement of Banda Feroze, an outlying suburb of Ghurghushti. Third, a further 7-10 houses and a mosque lie within the channel alignment at the point where it exits the Kamra Complex. Apart from these instances, an estimated 50-60 additional isolated dwellings lie within the channel right-of-way or the spoil areas, giving a total of 80-100 dwellings affected by this component of the Project.

In the Ghazi area, the channel will also disrupt about 200 mud houses of Afghan refugees. This will not be a social constraint as this settlement is temporary and can be shifted to another suitable area; this could be the spoil banks developed in this locality.

**Disruption of the Agrarian Economy.** The channel will have a potentially major effect on the village-based agrarian economy of the Project area, unless appropriate mitigation measures are provided. The permanent withdrawal of land from cultivation, the disruption of daily farm movements, and the potential squeezing out of some among the poorest social groups in the villages, namely the landless tenants and the artisans, are likely direct social effects of the channel.

Two additional concerns may be mentioned here, though these are discussed in Section 5.2.3: the potential effect of the channel on the groundwater aquifer, and its effect on the patterns of surface flow. The latter issue affects both periodic flooding in several villages and, more generally, the deposition of silt, which is a key factor in the natural fertility of the soil and the formation of new fields.

The withdrawal during the construction period of some 2,900 ha in the channel area from cultivation, pastureland, orchards, woods, etc, would have a negative effect on village and household economies. This is particularly true for a finely balanced barani area, where so many families depend on minimal and marginal land. It is estimated that over 2,400 landholders own land in the areas designated for the power channel and spoil areas. Some of those who lose part of their land will be left with uneconomical holdings. If it is assumed that each landholder represents a household, then over 13,000 persons will be affected.
The loss of income to the village probably will be most felt by those with the least resources; the landless tenants and the artisans. Landless tenants farming areas that lie within the channel right-of-way or spoil areas would not only lose their livelihoods but would have no right to compensation according to conventional practice. Artisans who had reciprocal obligations with those landowners losing land would also lose that part of their incomes, but they would not be hurt so severely as the landless tenants. Because they lack skills that can be transferred to the bazaar or to the small scale agro-industrial sector, landless tenants have shown less capacity to maintain their livelihoods when forced off the land. It is estimated that about 250 households, comprising some 1,375 individuals, may be affected in this way.

The channel would have a major effect on the daily movements farmers and herdsmen make in the Project area if bridges were not provided. By passing laterally through the land of 48 villages, the channel would cut each village off from part of its land.

Movements vary with the seasons. Farmers often visit their land twice a day during the months when they cultivate and harvest their crops, typically going and coming by tractor or cart. Based on the survey of 15 villages in the Project area, which occurred after the channel centreline was marked on the ground, it is estimated that there are over 12,000 local movements by tractors and/or carts across the channel alignment in those 15 villages in an average month. If extrapolated to 48 villages, the figure for monthly movement by tractors and carts in the part of the Project area affected by the channel would be equivalent to about 1,300 local movements per day. This includes movement for cultivation, haulage, and other transportation needs.

Livestock movements across the channel alignment also appear to be frequent. Only four of the 15 villages surveyed had designated pasture areas across the channel alignment, but all the villages said they grazed livestock on field stubble across the channel alignment. Livestock is more important in the Sarwala area, where three villages were surveyed. Livestock movements across the channel alignment may be more frequent and more generalised here than in the Chhachh.

Because the nullah crossings and road bridges will be situated at the points where most of this traffic now takes place, the interference with local movements will be minimal. A few farmers or herdsmen may be forced to travel a few hundred extra metres to reach a crossing.

Cultural and Social Resources. The alignment of roads, villages, markets, and social facilities suggests that the alignment of the channel could only infrequently obstruct local movements to schools, hospitals, markets, government offices and non-agrarian jobs.
Two cultural activities that could be more frequently obstructed, however, are funerals and visits to shrines. In many cases, the graveyards used by the villages would lie on the other side of the power channel. The necropolis at Mian Khadi Baba, for example, is used by five villages, all on the opposite side of the channel.

Visits to several shrines could also be obstructed by the channel. Shrines are usually visited on Fridays and then more by women than men. The important shrines also have annual fairs (melas) to commemorate the death anniversary of the saint (pir or baba), to which thousands of devotees may come. These include the three shrines between the channel alignment and the Lawrencepur Road: Mian Khadi Baba, Chalghazi Baba and Paracha Baba, which are visited by villagers from the western side of the channel. Also included is the shrine of Haji Rehman Baba at Khairbara, visited by villagers from Ghazi down to Ghurghushti, all on the other side of the channel alignment. Near each of these shrines, however, there will be cross drainage structures with provisions for pedestrian traffic, in addition to bridges.

Safety. There are various safety implications associated with the power channel. At full supply, the water in the channel will be approximately 113 m wide, 9 m deep, and moving at a velocity of 2.35 m/s (7.7 ft/s). It will, moreover, be a concrete lined channel, lacking purchase along its banks for a swimmer. Any human or animal that should fall into the channel would be swept rapidly away. Safety features like hand holds will help save some lives, but it is doubtful that all would be able to reach them. Unfortunately, the presence of water in the channel will attract some who want to swim, wash clothes, and possibly water their livestock. However, the inherent dangers can be greatly reduced by mitigation measures, which are described in Chapter 6.

Power Complex

Disruption of Agrarian Economy. The powerhouse, together with its headponds, forebay, switching yard, spillway, and tailrace will take up about 649 ha of land, most of it from Barotha, with a smaller portion from Dher. Most of the land taken consists of barani cultivation, pastureland, waste, and some woods in the nullahs to the east of the village site. Here the construction of the terminus of the power channel, the headponds, and the powerhouse will take out portions of the village roads from the Gariala-Dakhner district road to Barotha, Dher and Jaba. The tailrace will interrupt a cart track between Barotha and Gariala. This track is used by some Barotha residents who live in two clusters of houses across the southern nullah.

The largest environmental consideration at Barotha is the effect of the Project on the irrigation system in the southern nullah, which is based on a permanent flow of water. Two small check
dams and an aqueduct feed irrigation channels on both sides of the southern nullah and irrigate a total of 42 ha of land. The tailrace will displace about 10 ha of irrigated land and about 30 dwellings in several groups on the southern bank of the nullah and in the area of the headponds.

Further concerns at Barotha are the effects on the village of the loss of land and income, the influx of a construction work force and the resources it brings, and the new employment and business opportunities which the presence of the Project must surely generate. Clearly there are benefits as well as costs here.

The costs and benefits at Barotha are difficult to balance. On the one hand, the irrigation system in the southern nullah is unique in this region and requires a degree of cooperative organisation to maintain and operate. On the other hand, Barotha as a whole is a particularly poor village and could benefit from the development associated with the power complex, even though such development will alter the village community and its traditional structure of authority.

As is evident from the village scoping session, the villagers do want the development associated with the power complex, but they prefer that the tailrace channel go north of the village. The mitigation programme (Chapter 6) is expected to make the southern alignment more acceptable to the village.

**Resettlement.** About 30 dwellings in deras outlying Barotha will require reconstruction and approximately 400 landholders of Barotha and Dher villages will be affected in the process of land acquisition.

**Public Health and Safety.** The diurnal operation of the headponds and daily replenishment of water will counteract mosquito breeding. To further reduce the chance of malarial propagation, the headpond areas will be properly cleared and graded to eliminate the pockets of low lying areas where the water can stand overnight during the drawdown period. This aspect will be studied in detail as part of the supplementary environmental studies.

The headponds and tailrace may also pose safety hazards, the mitigation of which is discussed in Section 6.4.9.

**Construction and Maintenance.** The construction period will have major effects on Barotha. In addition to about 2,700 construction workers, the site will house about 300 WAPDA and other personnel during the construction period. The permanent operating and maintenance staff at the power house complex will number about 770. Most of these will be housed in a permanent colony proposed to be built on the eastern side of the Gariala-Dakhner road.
During construction, the headpond site will host workshops, batching and aggregate plants, and a steel fabrication plant (for the penstocks), in addition to housing for the contractor's camp. The following effects of the construction period are foreseen:

- The effect of employing workers from Barotha on the village agricultural system. In general, a substantial improvement in income and living standards should result from the Project. A sufficient number of unemployed and underemployed individuals live in Barotha, Dher, Jaba, Nurpur Karam Alia, Dakher and Gariala to fill most of the unskilled and some of the skilled worker positions at the power complex without undermining the agricultural system. Moreover, due to the poor agrarian economy in the area, the farming folk would prefer to join the work force. This may mean that more women and children will be drawn into cultivation and harvesting.

- Potential effects on the health of the villages and the work force. This includes workers bringing in diseases (eg malaria), the impact of improper sewage disposal from the construction camp on the villages, particularly if it gets into the permanent flow in the Barotha and Dher nullahs, and construction accidents. The proper treatment of sewage is an essential mitigation measure.

- Physical effects on the village caused by any interruption of communications, the threat to safety from the tailrace and headponds, and damage to village lands and crops. This could include permanent damage to the village from actions taken during the construction phase, such as the improper disposal of used lubricants and other chemicals. It would also include the costs and benefits of possibly splitting the village between the current site and a new bazaar area that probably will spring up between the temporary construction camp and the permanent colony.

- Law and order problems arising from intrusions by construction workers into socially and/or culturally sensitive areas. This would include the whole interface between the Project and the villages: how and with whom in the villages should the Project deal, how should labour be hired, etc. Decisions of this nature can alter patterns of status and authority in the village and lead to unnecessary and avoidable tensions within the village and between the village and the Project.

REFERENCE

7.5.1 Pakistan Hydro Consultants; Ghazi-Gariala Hydropower Project, Report on Selection of Project Layout, September 1990.
<table>
<thead>
<tr>
<th>ENVIRONMENTAL COMPONENTS</th>
<th>PHYSICAL ENVIRONMENT</th>
<th>BIOLOGICAL ENVIRONMENT</th>
<th>SOCIAL ENVIRONMENT</th>
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<td>Energy/Mineral Resources</td>
<td>Groundwater Quality</td>
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<td>Structure</td>
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<tr>
<td>POWER CHANNEL</td>
<td>Channel</td>
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</tbody>
</table>

| NA : Not Applicable | MA : Medium Adverse | LB : Low Beneficial |
| ND : Not Determinable | LA : Low Adverse | MB : Medium Beneficial |
| HA : High Adverse | O : None or Insignificant | HB : High Beneficial |
### Table 7.5.1: Project Impact Matrix

<table>
<thead>
<tr>
<th>Operational Phase</th>
<th>Power Complex</th>
<th>Environmenal Components</th>
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**Table 7.3**
CHAPTER 6

MITIGATION AND RESETTLEMENT
CHAPTER 6
MITIGATION AND RESETTLEMENT

6.1 TYPES OF ACTION

6.1.1 Approach

The purpose of a mitigation programme is to manage environmental effects in a manner that minimises adverse impacts and maximises secondary benefits. It is a planning step that evolves naturally from the process of identifying and assessing potential impacts. Mitigation is best conducted throughout the planning process, when changes can be made at the least cost, and usually more effectively.

As mitigation is a process of making a project more compatible with its environment, two approaches present themselves: refine the project to reduce its effects on resources, or alter its environment to the same end. In general, planners prefer to keep the project in its idealised state and make compensatory changes in the environment, but in fact many acts of mitigation take place before the first project component reaches its ultimate configuration.

6.1.2 Modification of the Project

Siting

Environmental considerations enter into overall siting decisions, such as the avoidance of major population centres by the project or its extensions (e.g., a reservoir) and in fine tuning to avoid important features such as cultural areas or transportation infrastructure. In the case of support facilities, such as access roads, construction camps and operation colonies, more flexibility of siting may be permitted than with the principal components, so environmental matters may be more influential in siting these.

Design Changes

The extent to which environmental mitigation can be incorporated in the design of a project depends on the type of effect to be mitigated. Some effects, such as safety hazards or interruptions of transportation or production systems, may be managed with only minor changes in the project. Other effects, such as the inundation of a population centre, may require major changes in the project, such as a reduction in reservoir elevation or the addition of a protective embankment. If these are unacceptable to project planners, compensatory mitigation, such as resettlement, may be favoured. The selection of the mitigation approach may involve a complex mix of technical, social and economic factors.
Changes in Construction

There is a tendency among environmental scientists to concentrate on the design of the project itself while ignoring the potential impact of construction. This is partly because the environmental staff are rarely conversant with construction methods and because the details of construction may not be available to them at the time of the environmental assessment. An assumption is made that the adverse effects of construction will be local and temporary and that construction methods are established and unchangeable.

This is not always the case, however. Fugitive dust, accident risks, demands for resources, and environmentally damaging actions by the workforce may exert widespread and largely irreversible adverse effects.

On the other hand, the construction of the project may offer opportunities to mitigate the effects of other aspects of the project, by employing displaced landowners, by careful routing of access roads for later use, or by siting temporary structures where they may be of subsequent use to the local populace. Protection of resources or enhancement of the local economy may require restrictions on the contractor or his voluntary cooperation, for example in the possession of firearms, protection of fuel resources, or the exclusion of intruders in culturally sensitive areas.

Changes in Project Operation

Occasionally it is necessary to mitigate an adverse effect of the project by a change in the mode of operation. The scope for such change may be very limited, unless the capacity for change is planned in from the start. The change may involve the use of an important local resource, such as water, or it may simply be a shift in working hours to avoid interfering with local traffic patterns.

6.1.3 Compensatory Mitigation

Definition

Compensatory mitigation is a programme of environmental management that alters an effect of the project by actions within the environment that do not affect project design, construction, or operation. Such an action may be planned or implemented at any point during the project development sequence. Many compensatory actions are taken in response to unforeseen effects uncovered by monitoring programmes or brought to the attention of the project agency by the local people.
Resettlement

The resettlement of people displaced by a project is a complex and often costly operation, requiring careful planning and execution. It exerts its own environmental effects, which may require mitigation. Depending on the magnitude and complexity of the programme, it may be handled by staff separate from the environmental study, as is the case on the present project.

Other actions

Compensatory actions are as varied as the effects they are intended to mitigate. Often they require detailed and prolonged cooperation between the project agency and some other organisation. Several broad categories are commonly used, often in combination, as discussed below.

Structures. These could involve protective embankments, new roads, bridges, fences or even buildings. On occasion, a waste water collection system or treatment facility is provided.

Administrative/Regulatory Measures. Sometimes regional or local laws and regulations must be changed or new ones enacted, to avoid an adverse effect. The change may be as slight as a change in speed limit on a road, or some measure to protect public health.

Training/Education. Public safety or health may be protected by educating people about the project, its dangers and benefits.

Salvage/Extraction of Resources. In areas to be inundated, covered with spoil, or otherwise affected by a project, resources such as fuelwood or minerals or even archaeological monuments may be economically extracted prior to the project effect.

6.2 TIMING OF MITIGATION

6.2.1 Project Modification

Modifications to the project may be prohibitively costly if the effects are not predicted and evaluated early in the planning process. This requires close and continuing interactions between the engineering planners and the environmental staff. Project modifications not accomplished prior to the design of the project rarely are budgeted in and therefore seldom are implemented.
6.2.2 Compensatory Actions

Depending on their importance and cost, compensatory mitigation actions should be identified and funded early in project development, even if only as a contingency fund. If these programmes are not in the overall project budget, they are likely to be underfunded and neglected. Similarly, postponement of implementation past the project construction period generally results in inadequate attention to the mitigation programme.

6.3 Mitigation vs Monitoring

It is generally acknowledged that some environmental effects are difficult to identify and evaluate prior to project construction or operation. Even effects that have been mitigated may be misjudged, or the success of the mitigation measure may not be up to expectations. Thus, a general environmental monitoring programme (see Chapter 7) should always be considered, as a back-up to environmental assessment and mitigation.

6.4 Mitigation Actions Incorporated in Planning and Design of the Project

6.4.1 Compensation Water Releases from the Barrage

Assessment of Compensation Water Requirement

The probable effects of the Project on the flow pattern of the river and on various aspects related to the surface water are discussed in Section 5.2.2. Of these, the greatest concern is the potential deterioration of water quality downstream of the barrage during the low-flow period. The possible loss to the local population of river water for nonconsumptive uses during the low-flow period is also important.

To resolve this situation a comprehensive study was carried out to evaluate the optimum water releases from the barrage.

As noted earlier (Section 5.2.2), there are a number of villages along both banks of the Indus. Of these, one village (Galla) on the right bank and twelve villages in the first 11 km of the river on the left bank would be most affected as they are located very close to the existing river creek. Because they are farther away from the low-flow channel and do not depend on the river for water, the other villages on the right bank have been omitted in the assessment of compensation water. Similarly on the left bank of the river, in the reach from 11 km to about 41 km, the villages are generally located away from the river with the exception of Akhund Dheri and Garhi Matni. Therefore, these have been taken into account. In addition, Mansar Camp and Mullan Mansoor have been considered because their sewage is disposed of in the Chel nullah which ultimately meets the Indus. Malla and Noor Mali have also been considered, as these villages, though
located away from the river creek, keep commercial cattle on the belas during the low-flow period.

To estimate the annual requirement of water for both consumptive and nonconsumptive use and the sewage effluent for the villages referred to above, the population figures of the 1981 Census were projected over the Project life. The average population growth rate was based on the growth during the 1961 to 1972 and 1972 to 1981 census periods. These calculations, which show the population of the region doubling about every 17 years, represent an extreme case and result in a future population density that probably could not be supported by the economic base of the region, even with substantial improvements in agricultural production. However, this extreme case was studied in order to obtain an upper limit for the water requirements. Accordingly, the figures for representative years would be as follows:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LEFT BANK VILLAGES</th>
<th>RIGHT BANK VILLAGE (GALLA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cumecs</td>
<td>cumecs</td>
</tr>
<tr>
<td>1991</td>
<td>0.050</td>
<td>0.009</td>
</tr>
<tr>
<td>1997</td>
<td>0.057</td>
<td>0.010</td>
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<tr>
<td>2017</td>
<td>0.141</td>
<td>0.027</td>
</tr>
<tr>
<td>2037</td>
<td>0.351</td>
<td>0.080</td>
</tr>
<tr>
<td>2057</td>
<td>0.600</td>
<td>0.169</td>
</tr>
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</table>

In evaluating the water requirements, it has been assumed that per capita consumption of water will increase from 90 l/d (20 gallons/d) through 270 l/d (60 gallons/d) within the Project life (60 years). This anticipates an improvement in the living standards of villagers and other social and economic development over the lifetime of the Project. Moreover, the water requirements have been increased to allow the daily water consumption to be concentrated into 16 hours each day.

As noted in Chapter 3, the consumptive and nonconsumptive water requirements of the villages in the Project area are largely met from sources other than the river (mainly groundwater). This practice is very likely to continue in future, as groundwater is the most technically feasible and economically viable source, and does not need any sophisticated treatment. However, part of the nonconsumptive requirement presently met from the river water will have to be considered in the assessment of compensation water.

Sewage production was calculated on the basis of water consumption. On the basis of general practice of sanitary engineers (Ref. 7.6.1), it has been assumed that 85% of the water consumed will be returned as crude sewage to the sewerage system and ultimately to the river. In practice, much of the raw sewage produced in the villages does not reach the Indus or even the
nullah into which the drains discharge, since the drainage systems are porous and the flows are small. Some bacterial breakdown of the sewage takes place in the drains, as evidenced by algal growth, and in the soil beneath. In order to estimate an upper bound figure, these losses have been ignored. The sewage quantities estimated on this basis would be as follows:

**SEWAGE PRODUCTION**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LEFT BANK VILLAGES</th>
<th>RIGHT BANK VILLAGE (GALLA)</th>
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</thead>
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<tr>
<td></td>
<td>cumecs</td>
<td>cumecs</td>
</tr>
<tr>
<td>1991</td>
<td>0.028</td>
<td>0.005</td>
</tr>
<tr>
<td>1997</td>
<td>0.032</td>
<td>0.006</td>
</tr>
<tr>
<td>2017</td>
<td>0.080</td>
<td>0.016</td>
</tr>
<tr>
<td>2037</td>
<td>0.199</td>
<td>0.045</td>
</tr>
<tr>
<td>2057</td>
<td>0.340</td>
<td>0.096</td>
</tr>
</tbody>
</table>

The provision for the waste water to be produced by the barrage colony on the left bank has been also included.

To preserve the environment of the villages and to protect the human and animal populations from the inherent danger of disease carrying germs in sewage, the crude sewage should be treated before being discharged into the river, particularly during low-flow periods. The Pakistan Environmental Protection Agency (PEPA) has fixed standards for various physical and chemical parameters of sewage effluent disposed of into open streams (Ref. 7.6.2).

It is an obligation of the concerned agency to provide appropriate treatment facilities to maintain the concentrations of various pollutants in the effluent within the specified standards. However, keeping in view the pace of development in the country, particularly in the rural areas, the sophisticated treatment of sewage from widely scattered villages with small populations cannot be expected for some time. Therefore, for the purpose of present planning, the simplest treatment technique of dilution of the sewage has been considered.

Based on the laboratory analyses of the samples of river water and sewage effluent collected during the high-flow and low-flow periods (Table 7.3.1) and following the standards for BOD₅ for final sewage effluent of 80 mg/l as adopted by the Pakistan Environmental Protection Agency, the cumulative surface water flow requirement for dilution of sewage effluent will be as tabulated below:
WATER REQUIREMENT FOR DILUTION
(AFTER PAKISTANI STANDARDS OF BOD$_5$)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LEFT BANK VILLAGES cumecs</th>
<th>RIGHT BANK VILLAGE (GALLA) cumecs</th>
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<tr>
<td>1991</td>
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<tr>
<td>2057</td>
<td>2.660</td>
<td>0.751</td>
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</table>

In evaluating the dilution factor, the BOD$_5$ load of raw sewage has been anticipated to increase from an average value of 250 mg/l through 550 mg/l, on the assumption that, with time, more phenolic materials will be in use and some industrialisation in the area will add to the BOD$_5$ load. Similarly, the BOD$_5$ load of the receiving stream has been assumed to increase from 12 mg/l to 20 mg/l due to the discharge of pollutants by upstream settlements.

The diluted sewage effluents will need additional in-stream dilution by a ratio of 10:1 to render the water suitable for general purposes. Therefore, the ultimate water requirement for dilution will be as shown on the table below:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LEFT BANK VILLAGES cumecs</th>
<th>RIGHT BANK VILLAGE (GALLA) cumecs</th>
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<tr>
<td>1991</td>
<td>0.71</td>
<td>0.12</td>
</tr>
<tr>
<td>1997</td>
<td>0.81</td>
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<td>2017</td>
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<td>0.68</td>
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<tr>
<td>2037</td>
<td>12.99</td>
<td>3.17</td>
</tr>
<tr>
<td>2057</td>
<td>26.60</td>
<td>7.51</td>
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</tbody>
</table>

These are upper limits of water requirements based on very conservative assumptions regarding the population served, the sewage production and the proportion of the sewage reaching the river. Of the villages considered, only Ghazi-Khalo is likely to have a sewerage system in the foreseeable future. In this case, based on the same assumptions as described above, the flows required for sewage dilution would be 0.2 cumecs initially and reach only 5.6 cumecs by 2057.

In addition to the water requirement for the dilution of sewage, there will be a need for about 0.005 cumecs of water at river reaches 23+550 and 28+000 for commercial cattle kept by Malla and Noor Mali, which is just a small fraction of the total water released. This water would not need to meet human use standards.
Mitigation Measures

Preliminary estimates are that, in the initial years of the Project, there will be about 17 cumecs of seepage into the river from the barrage pond. Based on the typical permeabilities of the barrage foundations that have been measured, and the available gradient of the river, less than 1 cumec will remain below the surface. The remainder will reappear as a surface flow, mostly in the deepest channel along the left bank. Thus there will be a significant flow downstream of the barrage. This assumption is supported by the actual situation in the Sulemanki-Islam reach on the Sutlej, the Balloki-Sidhnai reach on the Ravi, and the Trimmu-Panjnad reach on the Chenab. In these cases, in spite of complete closure of the barrages during low flows, the river channels never get dry.

There will also be a contribution from the groundwater outflow from the Ghazi and Chhachh tracts and also from right bank of the river. Presently, it is estimated that groundwater discharges about 1.5 cumecs into the river from Qazipur to the confluence with the Kabul river (Section 3.5.6). Under Project conditions, the reach from Ghazi to Qazipur will also act as a discharge front during the low-flow period. This will add substantially to the surface flow in the river channel by discharging enhanced groundwater inflow from the elevated water body in the barrage pond (Section 5.2.3).

In addition, there is a perennial tributary (Badri Khawar river) contributing an annual average flow of about 0.5 cumecs on the right bank of the Indus about 23 km downstream of the barrage.

The operation, energy output calculations and the economics of the Project, however, have been based on a minimum release of 28 cumecs downstream of the barrage, even in the initial years of the Project. This will cover the seepage and leakage losses and additional releases, if required, during the low-flow season.

For operational flexibility in the release of compensation water, the Project will include a controlled pipe outlet at the left flank of the barrage undersluices. The operation of the outlet will be regulated in the light of results of regular monitoring of the water quality downstream. If the need arises, tubewells will be provided for the downstream villages. One tubewell of about 0.03 cumecs capacity will be provided for Galla village to meet initial requirements. Additional tubewells will be provided elsewhere as the need is identified by the monitoring process.

The Project will also provide facilities for the safe disposal of the wastewater from Galla village.
6.4.2 Resettlement

Resettlement due to Dislocation of Housing Units

A large-scale water resource development almost invariably involves the displacement of large numbers of people. In such cases, a resettlement programme becomes an inevitable part of the project. Resettlement is always a disruptive and painful process, both socially and economically. It dismantles production systems, disorganises human communities and breaks up long-established social relationships. In recognition of the hardship and human sufferings caused by involuntary resettlement, the World Bank has adopted a policy that, whenever feasible, involuntary resettlement should be avoided or minimised.

In the case of the Project, this issue was given particular consideration from the initial planning stages. This induced the study of many different siting options for various Project components. Various options under study were analysed for their socio-environmental aspects including resettlement issues. Commentary on these aspects was recorded in the Report on Selection of Project Layout (Ref. 7.6.3). It has also been discussed in Chapter 4 of this Volume.

Technical reasons, as well as the resettlement issues and other socio-environmental aspects, favoured the selected site of the barrage. The barrage structures or its pond will not involve any resettlement, as almost all the population centres on both banks of the river will be downstream of the barrage. The low-lying areas of Dillingham, Abbaseen and Pehur canal colonies on the right bank will be protected from rare floods by low rim embankments. A few buildings on the left bank will be disrupted, however. These include a Government Vocational Institute and its Hostels, a nursery and a water works. A private building will be demolished by the intake structure of the power channel. The owners will be compensated under the Project.

Similarly, siting the power channel on slightly higher ground southeast of the villages would minimise the resettlement problem. The most economic alignment, where the balance between cut and fill could be maintained, would have disturbed about 16 villages with a population of about 40,000 people. Aware of the difficulties involved for the local population and the Government in the process of resettlement, the channel alignment has been planned to avoid such population centres. The proposed alignment will meet this requirement.

With the proposed alignment, about 80-100 housing units spread over the area to be acquired for the power channel and the spoil banks would be disturbed and have to be relocated. The major disruption will be that of the Aeronautical Complex Colony at Kamra. But this will not be a resettlement issue in a real sense, as the Project will compensate Kamra Complex Authority for the dislocation of the colony. The Authority will be responsible for the resettlement of its own staff in a new colony in the area.
The relocation of private property, however, will be the responsibility of the Project and executed by WAPDA.

Of the options studied for siting the power complex, none would have any serious resettlement issue. It is characteristic of the Sarwala tract, where the power complex will be sited, that the population is sparse with some concentration along the nullahs. As each optional site was located on one nullah or another, to make use of the nullah for the tailrace, there would have been minor disruption of dwellings, no matter which site was selected. Therefore, resettlement issues did not influence the siting of the power complex. The proposed site of the power complex including the headponds will not require major resettlement. There are about 30 dwellings which will be disturbed by the tailrace and the headponds. The Project will relocate these dwellings within the locality.

**Resettlement due to Land Acquisition**

The area requirement for various Project components is estimated as follows:

<table>
<thead>
<tr>
<th>PROJECT COMPONENT</th>
<th>AREA REQUIREMENT (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrage including structures and pond</td>
<td>1140</td>
</tr>
<tr>
<td>Barrage embankments and backfill area</td>
<td>40</td>
</tr>
<tr>
<td>Permanent land for power channel</td>
<td>1162</td>
</tr>
<tr>
<td>Temporary land for spoil banks</td>
<td>1750</td>
</tr>
<tr>
<td>Power complex including structures, headponds, tailrace, and road relocations for villages of Barotha, Dher and Jaba</td>
<td>649</td>
</tr>
<tr>
<td>Permanent colonies for the barrage, power channel and power complex and access road for power complex</td>
<td>138</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4879</strong></td>
</tr>
</tbody>
</table>

Of the total, the 1180 ha required for the barrage, its pond and backfill will largely include the river bed and its fringes. The fringe area belongs to the Government, therefore would not involve resettlement. About 53 ha will be acquired from the Kamra Aeronautical Complex. It is estimated that about 3,646 ha will be acquired from private landowners assuming that, during actual acquisition, if the land of an individual farmer is fragmented or the leftover land is less than an economic unit for the family, WAPDA will also acquire such pieces of land (Appendix B). The
The average landholding in the 15 villages surveyed is only 1.5 ha, while that of District Attock was 2.4 ha, according to the 1980 Census of agriculture. Based on the pattern of distribution of landholdings in the Project corridor, it is estimated that about 2,900 cultivators will be affected. Of these, a large number of cultivators will lose a substantial part of their land because the landholdings in the area are generally small. In the absence of any comprehensive survey data, it is difficult to estimate the number of landholders who will lose almost all of their land or retain less than the economic unit needed to support a family. In developing the resettlement plan, WAPDA's staff will individually survey the affected landowners.

In the absence of such data, the following estimates have been made based on the village survey (Appendix D). According to this survey the distribution of affectees with respect to landholding size will be as follows:

<table>
<thead>
<tr>
<th>LANDHOOLDING SIZE</th>
<th>% AGE DISTRIBUTION OF CULTIVATORS IN SURVEYED VILLAGES</th>
<th>NO. OF AFFECTEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 ha</td>
<td>87</td>
<td>2523</td>
</tr>
<tr>
<td>5 to 10 ha</td>
<td>11</td>
<td>319</td>
</tr>
<tr>
<td>More than 10 ha</td>
<td>2</td>
<td>58</td>
</tr>
</tbody>
</table>

On the assumption that about 75% of the cultivators falling in the first two categories will either lose almost all of their land or the leftover area will be below the accepted economic unit for a family, the number of dislocated landholders will come to about 2000. This does not include tenants-at-will who cultivate land in the Project area and who will also face dislocation. There may be about 250 of these.

Village-level scoping sessions and surveys indicated that about 70% of the affectees would prefer cash compensation on the grounds that substitute land will not be available in the vicinity of their home and they do not want to migrate to other provinces or districts (Appendix B). The remaining fraction of the affectees opted for land for land compensation if it is located within the Punjab. However, the majority of the people opted for a substitute production system that may be in industry or the service sector, but again located in the area. This aspect is discussed in detail in Section 6.5.2.
As such, the resettlement problem in the Project will not be of sufficient gravity to mandate the planning of a separate development project. However, the Project has been planned so that the land acquired for spoil banks of the power channel will be developed, provided with irrigation by tubewells, and resold to the interested affectees (Section 6.4.3). According to the scoping sessions, if irrigation were to be provided along the power channel, the farmers would be happy to have even half of their original landholdings.

It is estimated that, out of about 2000 ha (including additional land acquired due to fragmentation) required for the spoil banks, about 1750 ha will be available for resale after keeping a strip about 25 m wide alongside the channel banks for stability and security purposes. It is proposed to sell this land to the assumed 2000 severely affected cultivators. The execution of the resettlement/development programme will be the responsibility of WAPDA.

The schedule of redevelopment of spoil banks and their disposal to the farmers will be a continuous process. It will run in parallel with the excavation activity of the power channel.

It is assumed that the spoil banks developed during the first year of the Project implementation will be rehabilitated and processed to be handed over to the farmers during the second year. Thus the farmers should be able to crop during the third year. Likewise the disposal activity of the spoil banks will continue till one year after the excavation and spoiling of the excavated material.

The land acquisition will be carried out during the preparatory stage of the Project implementation. Therefore, the time span between the land acquisition and actual need for construction could be one to three years. Leaving land unproductive for such a period will be a national loss. Therefore, the Project has planned to lease the land to the farmers till it is handed over to the contractor according to the requirements of the construction schedule. According to this programme, the farmers will lose about two years crop. In the meanwhile he can make up his loss by investing the sale proceeds in saving schemes for two years. WAPDA's Environmental Cell and the Project NGO should provide guidance on this.

Other aspects of the resettlement are discussed in Section 6.5.3.

6.4.3 Spoil Disposal and Rehabilitation of Spoil Banks

Spoil Disposal

The estimated quantities of the excavated material from various Project components will be as follows:
The excavated material will comprise sand, silty sand, silt, silty clay, gravels, siltstone, Siwalik-type sandstone, argillite, etc. Thus the material could be utilised for the construction of embankments, bulk fill at the barrage, filter materials, coarse aggregate and stone riprap.

Of this, about 19 M cu m will be utilised in the embankments for the barrage, power channel and power complex. This leaves a total of about 91 M cu m to be disposed of.

Banks for additional freeboard will be provided along the power channel in areas where the channel is partly in embankment or where the service road is at the natural surface level. These banks will be about 3.5 m high and 25 m wide. Such areas are located in the level plains of Chhachh tract. The total length of these banks would be about 30 km and use about 8 M cu m of the spoil. The main purpose of these banks will be to provide a safety margin against unexpected high water levels. The elevated banks will also help to reduce wind blown sand and silt from nearby farming activities entering the channel. They will also add to the security and safety of the public and their animals.

In addition to the use of excavated material listed above, part of the coarse aggregate requirements for the Project structures and for stone pitching and riprap will be met from the excavated material (aggregate from river gravels excavated at the barrage site and riprap material from rock excavation near Kamra). The Project will require about 2 M cu m of coarse aggregate, of which about 50% will be obtained from the barrage and the channel spoil and the rest from borrow areas located at Dakhner, Dhok Kumharan and Barotha. Suitable rock excavated from Kamra (3.7 M cu m) will be utilised where necessary for stone pitching.

As such, the balance spoil will be about 78 M cu m. This spoil will have to be disposed of elsewhere. Nearly all the spoil will come from the power channel, as the excavated material from the barrage and the power complex will mostly be consumed locally. The barrage will use additional fill material excavated from the power channel.
The easiest and most economic method of disposing of the spoil would be stockpiling the material alongside the power channel. Although this method will be cost effective, it is not desirable either technically or environmentally. As these stockpiles are not easily manageable, their erosion by rain and wind will not only affect the operation of the Project but also spoil the adjacent land area. The same will apply if the material is transported and dumped in stockpiles elsewhere. Disposing of the material into the Indus river may be economic for certain upstream reaches of the power channel, but will involve substantial haulage for the rest of the channel. Moreover, this option may affect the operation of downstream barrages. Therefore this option has been discarded (Section 4.3.2).

Many options have been studied for the satisfactory disposal of this spoil (see Chapter 4 of this Volume). The most actively considered options are the construction of spoil banks along the power channel and terracing of wasteland and farmland. Other options include reclamation of land along the bank of the Indus river and filling deep gullies and nullahs.

The terracing of wasteland and farmland has been proposed for areas where the surface relief is very rugged. Such areas have been identified near Hasanpur, between channel RD 8 and RD 11, and in the region downstream of Kamra, between RD 36 and RD 40. The proposed terraced areas will use about 10 M cu m of spoil.

Embankments will be built behind the banks provided for the additional freeboard of 3.5 m. This will use a further 23 M cu m of spoil.

Independent spoil banks are proposed where the channel will pass through high ground. In these areas, agriculture is not so intensive or productive due to the poor quality of land, uneven surface and lack of irrigation facilities. Such areas are located in Ghazi and Sarwala tracts. They will be independent of the power channel, but located close to it to economise on haulage (Drawings 7.6.1 to 7.6.14). These spoil banks will use about 35 M cu m of spoil.

Spoil material will also be used to reclaim farmland scoured by the river or gully erosion. The people of the villages of Isa, Jallo, Qazipur, Hasanpur and Mian Dheri have indicated that, for many years, the Indus has been eroding and scouring their farmland during the high-flow season. Because of meandering of the river, the main channel is encroaching into the left bank. After the commissioning of the Project, the river flow pattern and scouring process is liable to change. An understanding of the river action downstream of the barrage will be gained from the hydraulic models. The need for the reclamation/rehabilitation of various reaches of the river will then be decided. Sociologically and technically, however, this option is fully supported. About 4 M cu m of spoil from the power channel has been proposed to be utilised in this manner.

7-6.14
Filling of gullies which have eroded agricultural land north of Barotha village is also considered to be a viable option, while filling of the nullah south of Barotha village, from where aggregate may be borrowed, may leave a secondary effect. The land along the nullah is presently used for grazing which will be disturbed. However, dumping spoil in the nullah will add more levelled land for agriculture. Such areas may consume about 6 M cu m of spoil from the tailrace.

Rehabilitation of Spoil Banks

The concept behind the construction of spoil banks and terraces is that the land areas so acquired could be developed for agriculture, if irrigation is also provided. The plan is that the land area required for the spoil banks and terracing will be purchased from the land owners and resold to interested affectees after redevelopment.

In view of this, the spoil banks and terraces will have to be so constructed that they are stable against erosion by wind or rain. They will have to be reasonably compacted so that rain or irrigation water would not cause settlement of the fill resulting in uneven ground, voids or gullies. Limiting the height of the spoil banks will be an important factor both aesthetically and for the convenience of those who will cultivate the land. The spoil bank should more or less match its surroundings. It will also be important to provide the banks with easy ramps for use by cultivators, farm machinery, beasts of burden and other farm animals.

The most important factor in the rehabilitation of spoil banks for agriculture is the dressing of their surface with fertile 'A' horizon soil. From an agricultural point of view, a soil which is devoid of nutrients, organic matter and bacteria is of little value. Irrespective of the type and quality of soil of agricultural land, the organic activity is mostly concentrated in the top 300 mm or so. This decreases with the depth and at a certain depth it diminishes to almost nil. Therefore, it will be essential that arrangement be made to dress the bulk fill of the spoil banks with top soil stripped from the excavation area of the power channel and from the natural soil that would otherwise be lost underneath the spoil banks themselves. The optimum requirement for topsoil for rehabilitation of spoil banks will be about 6 M cu m, while the topsoil stripped from the power channel and spoil bank areas will total about 8 M cu m. Therefore there will be ample topsoil available.

All these factors have been considered in the planning. Some of the aspects have been incorporated in the design, such as the expanse of the spoil banks, elevations, slope protection measures and access ramps. However, the management aspects of spoil banks during the construction phase and after are actions that will require attention at the appropriate time.

7-6.15
In the Project it is planned that the banks for additional freeboard and a 25 m wide strip of the spoil banks will be retained and maintained by WAPDA. A proper vegetation cover will be provided on the top and the slopes facing the power channel, using natural anti-erosion matting such as jute where necessary to help seeds develop. This cover will not only protect the spoil banks from erosion but also trap sand and silt from the adjacent farmland blown by wind or farming activities. The vegetation cover will include a hedge at the outer brim of the banks followed by one or two rows of eucalyptus/poplar trees and grass on the slopes. This will not only resolve the problem of erosion but also add to the sense of security and safety of the public and animals.

The method of construction of spoil banks is discussed elsewhere under construction schedule. Proper procedures will be used for dumping, spreading and compacting the spoil. A schedule has been developed for efficiently dressing the spoil banks with top soil at minimum cost. In this schedule, after the top soil has been stripped for reuse a spoil bank will be constructed by dumping and partially compacting excavated material from the adjacent reach of the power channel. Then the top soil from the next reach of the power channel and/or that from the area of next spoil bank will be spread over the already constructed bank. This will proceed as a continuous operation in parallel with channel construction, thus minimising damage to the topsoil by storage.

The dimensions of the spoil banks will vary according to the physiography and present land use of the area concerned. The width at right angles to the power channel will vary from 70 m to 800 m, while in vertical direction it will be 3.5 m to 10 m in level and rolling plains. In hilly terrain it will reach a maximum height of 15 m. Access ramps will be provided on each side at the spoil banks.

As noted in Section 6.4.2, the spoil banks excluding the 25 m wide strip retained by WAPDA will be resold to the farmers to accommodate as many affected farmers as possible. The landholdings of most of the resettled farmers would be smaller than their present holdings. To help make these landholdings economically viable, the Project will provide irrigation facilities for the land on spoil banks. In this respect, about 150 small tubewells of capacity 7 l/s (0.25 cusecs) will be provided. These have been worked out on a crop delta of 281/s for 80 to 100 ha with 50% utilisation factor for tubewells. The Project will also provide irrigation facilities and vegetation cover for the maintenance of the strip maintained by WAPDA.

The additional development of spoil banks to make them ready for cultivation, such as preparation of levelled plots and construction of water distribution channels and bunds, will however, be the responsibility of farmers. As noted in the resettlement plan, the Project will intend to accommodate the maximum number of affectees on the spoil banks. Therefore, the reallocated land area of a farmer would be smaller than his

7-6.16
original holding (about one half). It is also proposed that the land will be resold at the same rate as that at the time of acquisition. Therefore, the farmers will be saving almost half of the compensated amount, part of which will be spent on development of the land and part will be compensation for loss of crops for up to two years.

6.4.4 Protection of River banks

As noted in Section 5.2.3, the reduction in flood flows downstream of the barrage will help to reduce the loss of village lands alongside the river due to scour. Initial model tests have confirmed that, during floods, the flow velocities along the frontage of the villages of Ghazi and Khalo will be significantly reduced.

6.4.5 Public Movements

The barrage and its pond will not hinder the movements of local population. Instead, the provision of a crossing along the barrage will facilitate public traffic between the left and right banks, which presently uses the winding road in the hills and over Tarbela dam. This is an additional benefit of the Project. Secondary benefits of the bridge are discussed in Chapter 5 of this Volume.

The power channel, due to its length and width, will be a barrier for the daily activities and movements of local population. It will not only cross one arterial road, four district roads and a railway line, but also obstruct about 70 village tracks along its length. The provision of bridges on main roads and railroad is normally an obligation under such projects. But providing bridges to connect the unimproved tracks is invariably ignored or less frequently addressed.

This aspect has been given very serious consideration in the Project planning. In the majority of cases, the village land area is elongated in shape with the long axis across the power channel, with the result that most villages would be cut off from a portion of their farmlands.

This issue was invariably raised by the villagers in the village-level scoping sessions. The suggestion frequently was made to locate bridges on paths which are so defined in the official record of Revenue Department (see Appendix B and Chapter 5). The official record was consulted to identify the approved tracks. Most of the nullahs, which are dry for most of the year, were identified as tracks and they are commonly used for village traffic. There are other tracks which crisscross the land and connect one nullah to another.

7-6.17
The Project includes 33 bridges including one arterial road bridge at GT road, five district road bridges and one railroad bridge (Table 7.2.2). One additional district road bridge will be located at the head regulator of the power channel to carry the traffic of Tarbela and Sirikot road to and from Ghazi and beyond. The arterial road bridge at the Grand Trunk road will be a four-lane dual carriageway to accommodate future increases in traffic.

The balance of 26 bridges will provide access routes for the villagers in their daily movements, mainly to and from their farmlands. In places, for technical and economic reasons, two or three tracks have been combined for one crossing. The link between village tracks and the bridge will be through the channel service roads.

As noted above, the majority of the village tracks fall within the nullahs: therefore, wherever possible the bridges have been combined with the cross drainage superpassages. There are 14 such cases. The remaining 12 of the 26 superpassages will be made accessible for pedestrian traffic through appropriate ramps.

Thus there will be a total of 45 crossing facilities over the 52 km length of the power channel. This is much more frequent than normal with large canals and will help to minimise the constraints imposed by the Project.

Village roadways and paths will also be interrupted in the power complex area. The headponds will obstruct the access roads of Barotha, Dher, and Jaba from the Gariala-Dakhner road. A major track connecting Barotha and Gariala will also be obstructed by the tailrace, in addition to some minor pedestrian and animal tracks leading to farmlands from Barotha village.

The Project will relocate the access roads of Barotha, Dher and Jaba around the embankment of the headponds. A bridge will be provided over the tailrace to link Barotha and Gariala.

An important feature related to the power complex is the development of some of the existing highways and the construction of new access roads to the power complex area. This is not a mitigatory action but it will provide an additional benefit to the local people, particularly where new roads will be constructed.

### 6.4.6 Cultural Properties

Cultural properties include shrines, graveyards, archaeological monuments and historical buildings. The people of the Project area are strongly attached to their religion and culture. Shrines and graveyards are regarded as a sacred heritage and receive devoted attention from the people. The importance of the shrines and graveyards in the life of the local population is noted in Chapter 3 of this Volume. The location of various cultural places is shown on Drawing 7.3.4.
Wherever possible, shrines and graveyards have been avoided or protected. In the Project area, shrines and graveyards are generally located on higher ground to avoid the best arable land. In the Chhachh plain they are located at about the El. 335 m contour. Therefore, they are a potential obstacle to the alignment of the power channel. To avoid them, the alignment of the power channel has been adjusted in places.

The graveyards are normally established on communal land, where a forest is also maintained for fodder and fuelwood. This situation was particularly identified in the village areas of Pandak, Khaghwani, Shirani, Musa Kudlathi, Bahadur Khan and Jatial. It is at the first four villages where the proposed channel alignment has been diverted to avoid graveyards. Similarly, in the Kamra village area, the channel alignment has been shifted towards the hills to avoid two graveyards.

Near Ghurghushti (RD 14), the channel will pass unavoidably through a private graveyard of about 13 graves. The Project will arrange to shift this graveyard to an appropriate place. Similarly, a few graves of an old and abandoned graveyard will also be affected by the tailrace of the powerhouse. They will be treated likewise. A few graveyards falling in the spoil bank areas will not be disturbed.

In the barrage pond area there is a minor shrine of a Shaheed Baba located on the right bank about one km upstream of Galla village. The shrine will be protected from flooding by an embankment.

The preservation and salvage of archaeological sites is discussed in Section 6.5.4.

6.4.7 Groundwater Movements and Anti-Waterlogging Measures

The effects of various Project components on groundwater and its movement have been described in Section 5.2.3. Of the most probable effects, some are crucial and would need modification in design, not only to mitigate the impact of the structure on groundwater but also to protect the structure itself. Therefore, in such cases the mitigatory works have been incorporated in the design. There are other potential effects which can be mitigated independently of design modifications. These will be treated later when appropriate data is available through monitoring to permit their design.

The probable effect of the barrage on the groundwater of the Ghazi area will be an increase in recharge from the barrage pond. This will be beneficial because it will feed the aquifer of the piedmont area of the Ghazi tract, where groundwater levels are generally deep.
It is expected, however, that a substantial part of this recharge will be depleted into the river during the low-flow period. This results partly because the depletion front of Ghazi sub-basin will increase to about 11 km (from Ghazi to Mian Dheri), instead of existing front of 4 km (from Qazipur to Mian Dheri) and partly because the transmissivity of the strata of this basin is on average 10,000 sq m/day. The drainage facility provided along the left bank of the power channel in the first 1.5 km reach will also help in reducing the effects of excess recharge from the barrage pond.

The power channel has been designed with underdrainage systems to suit the categories of groundwater levels. In each case, the groundwater level will be maintained below the channel invert level, to ensure the safety of the lining if the channel is ever dewatered.

In the first category, existing groundwater levels are at least 3 m below the channel invert. Here no special drainage measures are proposed but the changes in groundwater levels will be carefully monitored. If significant rises occur, tubewells will be installed as necessary. Therefore, in these reaches, which are mainly between RD 1+500 and RD 20, effects on groundwater movements will be negligible.

In the second category, groundwater levels are up to 3 m above channel invert level. Here a system of tubewells or pumped sumps will lower the groundwater to channel invert level. The extraction of groundwater will have a small regional effect because levels downhill of the channel will be reduced slightly. This will improve those areas which are presently waterlogged.

In the third category, existing groundwater levels are more than 3 m above the channel invert. A gravity drainage system is proposed, with the drainage water being discharged into suitable incised nullahs. This will improve areas presently waterlogged. The relatively large reduction in groundwater levels may adversely affect nearby wells. These should be replaced by new tubewells or the pumped water from the underdrainage system provided for irrigation. The monitoring process will identify the gravity of the problem and mitigate the effects accordingly (Chapter 7).

The effect of the headponds on the groundwater has been discussed in Section 5.2.3. In the absence of comprehensive groundwater data for this region accurate predictions cannot yet be made about its behaviour after the Project. Therefore, continuous monitoring is proposed and, should the need arise, appropriate mitigation measures will be implemented (Chapter 7).
6.4.8 Relocation/Replacement of Infrastructure Facilities

The provision of bridges for the existing roads and railroad, and the replacement of displaced dwellings have been discussed in Section 6.4.2 and 6.4.5. In this section the provisions made in the Project for the rehabilitation of other public and private infrastructure facilities will be dealt with.

Two types of public infrastructure will be disturbed by the Project. One category comprises infrastructure which does not have a direct link with the populace of the Project area. This includes the Government Vocational Institute and its hostels in the Tarbela colony, the water supply system and approach roads of Tarbela colony in the barrage area, over 30 power and telephone lines and a gas pipeline in the corridor of the power channel.

The second category comprises infrastructure which directly supports the local population. This includes 3 public tubewells (in Ghazi, Khalo and Isa), 2 overhead tanks (in Ghazi and Khalo) and one irrigation water course (from the Qibla Bandi dam in the Barazai area).

The Project will include realigning the roads, power and telephone lines and gas pipeline and provide proper crossings where necessary. New tubewells and overhead tanks will also be installed. The irrigation channel will be provided with a proper crossing over the power channel.

The privately-owned infrastructure will include about 10 small tubewells and about 30 open wells and Persian wheels. There are also two water diversion structures and two irrigation canals in the Barotha nullah. The Project will provide replacement cost for the tubewells, wells and Persian wheels. The irrigation diversion structures and canal system in the Barotha nullah will be replaced by appropriate new works.

6.4.9 Safety Measures

Every large project poses some risk to the lives of human beings and animals. This is common with a water resource development project, because water is always an attraction to people, domestic animals and wildlife. In the Project, there will be four large bodies of water, the barrage pond, power channel, headponds and the tailrace, all having their own characteristics.

The barrage pond will be spread over an area of about 1140 ha with a maximum depth of about 16 m at the deepest channel. The pond will become more shallow towards the upstream end. For many reasons, this reach of the river is not presently in frequent use by the people. Of these, the main contributory factors are that there is no village settlement in this reach and the slopes on both banks are generally steep.
However, the people of downstream villages occasionally use the river to transport men and goods downstream on inflated tubes, even during the high-flow season. Assuming that the river velocity will be less under Project conditions than at present during the high-flow season, the risk of accidental drowning would be reduced in the barrage pond. Therefore, no mitigation measure will be required in this respect. However, people using the pond for any reason during the flood season should take care not go near the barrage spillway when the gates are open. WAPDA O&M personnel should keep a watch on this and display permanent sign boards well above these dangerous points.

The headponds will have a combined area of about 320 ha, with normal full supply level at El. 334 m. The maximum depth of the water body near the embankments and nullah cuts (falling within the headpond area) will be in the range of 15 to 30 m. This will taper in the backwater region to nil. The headponds will be added attractions for the local people and their animals. In the backwater region there will be little risk. However, the deep-water region should pose only a slight risk of accidental drowning.

With a slope of 2.5H:1V of the embankment and riprap slope protection, the water body will be easily accessible to the people and animals. Though the water in the ponds will normally have low velocities, people and their animals should be discouraged from approaching from this side. This can be done by displaying sign boards and providing safety instruction to the villagers through schools, pamphlets and local institutions.

The power channel presents a clear source of danger to the people and their livestock. At full supply, the water in the channel will be approximately 113 m wide, 9 m deep and moving at a velocity of about 2.35 m/s (7.7 ft/s). Any human or animal that fell into the channel would be swept away rapidly and would not be able to get out because the channel will be lined and there will be no vegetation to hold on to. It will be imperative, therefore, to adopt measures to minimise such accidents. Some of these measures have been incorporated in the design of the Project, while others are cautionary and will be implemented through specially arranged programmes (Section 6.5.4).

The mitigatory measures provided in the Project include fencing the channel at places where it is close to habitations or graveyards and shrines. Fencing will also be provided for a certain length (100 m) on both sides of the bridge crossings as well as along the bridges themselves. The reaches for which fencing will be provided are as follows:
<table>
<thead>
<tr>
<th>Left Bank</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD 1+600 to</td>
<td>For the villages of Ghazi, Khalo, Isa, Jallo, Bhai &amp; Jammun on right bank and Ghazi Hamlet on left bank.</td>
</tr>
<tr>
<td>RD 3+400</td>
<td></td>
</tr>
<tr>
<td>RD 13+000 to</td>
<td>For the villages of Ghurghushti, Barazai on right bank and Kotkay and intensively cultivated areas on left bank.</td>
</tr>
<tr>
<td>RD 18+000</td>
<td></td>
</tr>
<tr>
<td>RD 21+000 to</td>
<td>For a row of villages from Alizai to Hattian on the right bank and a row of graveyards &amp; shrines on the left bank.</td>
</tr>
<tr>
<td>RD 24+000</td>
<td></td>
</tr>
<tr>
<td>--</td>
<td>For Kamra Khurd &amp; Kamra Kallan.</td>
</tr>
</tbody>
</table>

The reach of the channel beyond RD 35+500 passes through terrain which is very sparsely populated. Habitations like Thikarian, Kisran, Gondal, Madrota, Haji Shah, Rumian and Nurpur Karam Alia will be far from the channel. Therefore, fencing will not be provided in this reach. However, WAPDA should maintain a hedge along the banks throughout the length of the power channel.

To enable people who do fall in the channel accidentally, grab rails will be provided along both banks at about 500 m spacing in general and 100 m in highly populated areas.

Any vehicles travelling along the service roads and going out of control, due to tyre burst or other reason, will be prevented from falling into the channel by a high kerb. To prevent animals using service roads, cattle grids will be provided at all crossings except where service roads are used as public roads.

The tailrace will pose similar risks as the power channel. However, it is assumed that the contact of people and animals will be insignificant because they have a water resource in the nullah near by and in the Indus river. Berms along the side slopes of the tailrace will help prevent people from falling into the water. Therefore, the risk of drowning is not that severe and protective measures have not been included. However, education of the people will be necessary to make them aware of the dangers.
6.4.10 Borrow Areas

The selection of borrow areas for aggregate is still under consideration, because the investigations regarding expanse of the area and quality of the material has not yet been completed. However, the probable sites will be as follows:

<table>
<thead>
<tr>
<th>PROJECT COMPONENT</th>
<th>FINE AGGREGATE</th>
<th>COARSE AGGREGATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrage</td>
<td>Ghazi sand</td>
<td>Indus river bed gravels at the barrage site.</td>
</tr>
<tr>
<td>Upper reaches of</td>
<td>Ghazi sand/</td>
<td>Indus river bed gravels, and Dhok Kumharan limestone.</td>
</tr>
<tr>
<td>power channel</td>
<td>Qibla Bandi sand</td>
<td></td>
</tr>
<tr>
<td>Lower reaches of</td>
<td>Lawrencepur sand</td>
<td>Dhok Kumharan limestone, Dakhner limestone, and</td>
</tr>
<tr>
<td>power channel</td>
<td></td>
<td>gravel deposits near Barotha.</td>
</tr>
<tr>
<td>Power Complex</td>
<td>Lawrencepur sand</td>
<td>Gravel deposits near Barotha, and Dakhner limestone.</td>
</tr>
</tbody>
</table>

Of these sites Dhok Kumharan, Dakhner, Qibla Bandi and Lawrencepur are the sites which are presently being quarried. The Indus river bed will, anyhow, be excavated for the barrage structure. Therefore, in these areas there will not be much change in the land use and thus the Project will not have any adverse effect. It will rather increase the income of the people who own the relevant land.

However, other possible sources, including Ghazi sand and gravel deposits near Barotha village, need some consideration. Ghazi sand will be obtained from the bed and banks of the Kundi nullah. Part of the nullah bed is presently developed for agriculture by terracing and constructing embankments to protect the crops from seasonal flows. Moreover, not far from the left bank of the nullah, there exists the Tarbela Dam Resettlement Colony. Similarly, the Pakistan Military Academy has very recently acquired a large piece of land in the vicinity and use the site as a camping ground.

The Indus terrace near Barotha has practically no agricultural activity at present. However, due to perennial flow in the deep nullah near Barotha there is a growth of vegetation, which is used by the local people for herding on a small scale.

The Indus terrace near Barotha may be archaeologically important as the ruins of Bagh Nilab are not far from Barotha. Therefore an archaeological survey will be needed before final selections are made.
It is recommended that, if these sites are selected for quarrying, the sites should be acquired on a rental basis and the affected population should be properly compensated for the loss of crops and forging area. After use, the sites should be rehabilitated to an acceptable condition.

6.5 ACTIONS REQUIRING ATTENTION

6.5.1 General

Environmental effects have been given careful consideration in the planning and design of the Ghazi-Gariala Hydropower Project. These effects include the physical impact of the Project's structures on the land and its water resources, the social impact on the region's village communities, and downstream secondary and tertiary effects that might not be immediately apparent. This Report proposes mitigation measures that have the least negative effects on the local population. Wherever possible, such mitigation measures have been integrated into the physical design and proposed implementation of the Project. Areas where Project effects and mitigations are beneficial to the local population of the Project area have also been identified.

In addition to mitigation measures built into the physical planning and construction of the Project, actions that require careful attention have also been identified. Although not part of the physical aspects of the Project, these actions nevertheless may be crucial to its social feasibility. These action areas include land valuation and compensation, the redevelopment and resettlement of the spoil areas, and a broader regional development programme that would 'compensate' in a general way the Project area for the sacrifices it has made and will continue to make in the national interest. This includes a recommendation to develop some industry in the region to provide those who lose their land with a substitute production system.

Such a developmental effort would be managed and coordinated by a Project NGO, a non-governmental organisation whose initiation would be supported by WAPDA, but which thereafter would become a self-sustaining organisation.

6.5.2 Land Acquisition: Valuation and Compensation

The Issues

No single issue is more critical to the social acceptability of the Ghazi-Gariala Hydropower Project than that of how the land acquired for the Project will be valued and compensated. The landowners who have land in the Project alignment are extremely concerned about receiving fair and prompt compensation for their land. There is a broadly held view in the region that government authorities have not adequately addressed compensation and
resettlement issues in the planning and construction of major national projects. This perception is particularly acute in the areas affected by the Tarbela Dam Project and the Kamra Aeronautical Complex, as well as in village areas along the Lawrencepur-Tarbela road that have recently received compensation for land acquired by the Pakistan Military Academy.

One result of this perception is demands for more reliable compensation and implementation procedures. These include the resolution of outstanding Tarbela claims prior to the start of land acquisition for the Ghazi-Gariala Hydropower Project, the appointment of an outside monitoring group to oversee compensation and settlement operations and the settlement of all claims arising from land acquisition under this Project, including the completion of replacement structures like the municipal water tanks at Ghazi and Khalo, prior to the construction of the Project. There is also a strong sense that with Tarbela and Kamra the area has already done its share on behalf of national development and that any additional sacrifice due to the Ghazi-Gariala scheme should be recognised in the grant of local development schemes for the Project area.

Part of this may be based on the desire to gain both leverage over the implementation of the Project and additional advantage for the region. Nonetheless, concerns about compensation are very real and may result in opposition to the Project.

Such a situation can be avoided by a variety of actions, including the following:

- A decision by the relevant authorities to base land valuation on current market rates for the purposes of this Project,
- The opening up of channels of communication between WAPDA and those directly affected by the Project,
- A commitment by WAPDA to give priority in employment to the affectees both in the construction of the Project and in filling openings in all categories in the permanent operating and maintenance staff, and
- A commitment by WAPDA to actively facilitate and coordinate local development schemes for the Project area.

Local Attitudes Toward Compensation

Land is highly prized in the Chhachh and there is considerable resistance among smallholders to the loss of their land, particularly among those who would lose all or most of their holdings. Land is also quite expensive in the Chhachh, the result of a much greater demand than supply and the access to outside incomes in the West and Gulf of those who want to purchase land
at home. The situation is quite different south and west of the Grand Trunk road in the Sarwala tract, where poor villages struggle with dry and less productive soils.

Local responses to the land acquisition problem resolved into the following four issues during the village level scoping sessions carried out in November 1990:

- **Land for Land.** Considerable interest was expressed in gaining land in compensation for acquired land, although in practice most landholders interviewed in the Chhachh villages knew that no government land was available in their own region. The Chhachh landholders were less willing than those in Sarwala to move elsewhere in the country and, unable to get land for land, preferred cash compensation for the loss of their estates. The strongest interest in land for land was expressed in the Sarwala villages. All who expressed an interest in land for land wanted developed, irrigated land, even where this was to replace barani land they were losing. Moreover, they would accept resettlement in the Punjab but not elsewhere, and wanted to be resettled as compact bodies, not scattered in several areas or villages.

- **Land for Money.** As noted, much of the compensation issue revolves around this question. Landholders who own land around the major villages (Ghazi-Khalo and Ghurghushti) say this land is needed for urban expansion and should be compensated at urban rates. Leaders and notables at Ghazi-Khalo pointed out that the alignment and size of the power channel and the taking of land for a permanent operating colony, in addition to land for a cantonment recently acquired by the Ministry of Defense, leaves Ghazi-Khalo very little room to expand and will drive up the price of the land that remains. In the cultivated areas, zamindars worry that land they have developed with tubewells and orchards, but which is not yet reclassified in the revenue record, will be compensated at its previous value. In most villages surveyed, landholders and local notables want a committee established with local representation to negotiate land prices. In some cases, affected zamindars want an outside third party to negotiate land prices.

- **Land for Water.** Nothing would do more to make this Project acceptable to the affected region than the provision of water for irrigation. The local zamindars believe that irrigation would enable them to maintain viable incomes on less land and view this as a practical and equitable solution for the loss of part of their land. Given the nature of the topography, the preferred method is for tubewells to be placed on both sides of the power channel, provided the aquifer conditions are favourable.
Land for Shares. In addition to one-time cash settlements, the scoping sessions discussed several alternative ideas aimed at maintaining more secure and longer term livelihoods for those who lost land, particularly for those who would lose all their land. These included the optional investment of compensation as shares in joint local-provincial or local-private industrial cooperatives, as well as the partial privatisation of the Project, with affectees given a priority in purchasing shares in the utility. Sufficient interest was expressed in such schemes to justify keeping them as possible future alternatives. Unfortunately, Pakistan has had little experience with industrial cooperatives, although there is an old agrarian cooperative society movement and much of modern Karachi has been built by cooperative housing societies. A plan to partially privatise the Project would require legislation. Recently the Government has allowed private entrepreneurs into the power generation industry. This would require rapid and forceful action by WAPDA and the legislators in order to have a land-share exchange mechanism in place by the time land acquisition for the Project is initiated.

Recommendations on Land Valuation and Acquisition

The following recommendations are based on a Land Valuation Study undertaken in Stage II of the Chashma Right Bank Canal Project, a perusal of the Land Acquisition Act (1894) and its amendments, including the Rules for Punjab Land Acquisition (1983), and concerns expressed by the potential affectees in village scoping sessions in the Project area. The Land Valuation Study, together with more detailed recommendations, is attached to this Volume as Appendix C.

No new legislation is being recommended for the Ghazi-Gariala Hydropower Project. Current laws and regulations have sufficient scope to validate the recommendations, although current procedures, and possibly interpretations, may have to be modified somewhat.

Perhaps the most important recommendation is that land taken for the purposes of the Ghazi-Gariala Hydropower Project should be valued according to the current market value at the time notification is given under Section 4 of the Land Acquisition Act. The current market value not only gives the landowner a fair price for his land, but it reflects what the people of the area regard as the true value of land. This is not a purely economic value, for land is not seen simply as a commodity and held for what it can produce. Land defines status and authority and for many small landowners comprises the sole patrimony they can pass on to their sons.
Although used effectively in the past, the average of mutations (land transfers by sale, as recorded in the Tehsildar's Office) taken over the past one year does not any longer present an accurate basis for determining current market value. There are three reasons for this:

- Firstly, mutations as recorded do not represent the true price of the transaction. Sellers and purchasers of land do not report the true price, in order to reduce the land transfer tax and the District Council tax, both of which are proportional. Mutations can understate the true price of land by more than 50%.

- Secondly, land values are rising rapidly in the Chhachh, particularly along roads and in areas contiguous to towns and large villages. In the Kamra area, between 1980 and 1988, the value of land increased by 364%, or an average of almost 22% a year.

- Thirdly, the record of mutations could begin to reflect infructuous or false land transfers, as landowners who own property in the Project alignment organise paper transfers to drive the mutations recorded artificially high. If they do not find some way of avoiding the tax, they calculate that whatever they pay in taxes will be only a portion of what they gain when they receive compensation for their land.

The Land Acquisition Act does not require the Deputy Commissioner, who as Collector would fix the value of land, to use the record of mutations to determine the value of land, but leaves it to his discretion and, ultimately, to a court of law. Land values are generally known in an area and can be approximately determined by general inquiry, as well as by interrogating both those who have land to sell and those who are looking for land to purchase.

It is therefore recommended that the Deputy Commissioners of Abbottabad and Attock each make an objective assessment of the true market value of all categories of land in the Project area. This can be done by supplementing the information on prices recorded in the Tehsil by a general inquiry among the population at large. The best method of doing this would be through dialogues at the village level. This a task ideally suited to the social organisers attached to the Project NGO. The latter could be contracted by WAPDA to elicit the true market value of land through dialogues with the farmers of the villages within the alignment of the Project. This information would be collected in the minutes of the village meetings, collated, and presented to the two Deputy Commissioners. The meetings should be attended by observers from WAPDA and the Revenue Department.

7-6.29
In addition to the recommendation on determining land values, the following suggestions should also be considered:

- Values for various classes of land should be fixed for an entire revenue assessment circle or some other practicable unit, rather than village by village. This would simplify land valuation procedures and avoid resentment between neighbouring villages. The section of the Project area between Ghazi and Ghurghushti can be taken as one unit. The quality of land between Ghurghushti and Dhok Khagwani appears to be fairly uniform, and this area can be taken as a unit. The land in the southern Chhachh around Musa Kudlathi is sandier in the higher elevations near the Lawrencepur road, but also more affected by waterlogging in the area of the Chel creek. The villages of this area could be grouped as a unit. The villages south and west of the Grand Trunk road occupy much the same kind of land, although values here would differ depending on the proximity of the village estates to urban areas and cross-road bazaars.

- The basis for determining the class of a particular piece of land should be according to a fresh field assessment, not by reference to the revenue record. The revenue record is far out of date and does not contain most of the improvements in irrigation and cropping made over the last two decades, largely because area farmers have been reluctant to record improvements they have made and thereby pay the higher revenue applied to more productive land. This non-reporting is a problem for the administration, not the Project, to sort out. As far as the Project is concerned, compensation should reflect the facts on the ground.

- During the land acquisition process, the fragmented land area of an individual should also be acquired, if he so desired.

- Mining rights should be taken into consideration in the calculation of land value. There are no known minerals in the area in the strict sense of the term, although sand is mined in parts of the Project area. It may be necessary to create a separate category for sand quarry land and compensate owners for the current market value of the remaining sand.

Valuation of Buildings and Tubewells

Based on the procedures observed in the Chashma Right Bank Canal Project (Stage II), the schedule of rates for buildings and other built-up assets used by WAPDA needs revision to make it commensurate with market values and principles of equity. It is recommended that the value of all built-up assets should be based
on replacement cost. The deduction of 10% of the value of such assets as depreciation does not seem justified when the acquisition is involuntary. The deduction of a further 25% for the value of the demolished building material is also questionable. Certainly, a homeowner should have the right to salvage any material: doors, wooden rafters, etc., from his dwelling or other structure, but this requires labour and he still has to transport this material and rebuild elsewhere. A deduction for expensive tubewell machinery retained by the owner is more supportable, provided the decision to retain such machinery is voluntary.

Non-Proprietary Land Rights

Although the rights of permanent tenants and village artisan groups have not been considered for compensation in the Chashma Right Bank Canal Project (Stage II) process, courts have held that such customary rights are part of the aggregate rights in land to be compensated in land takings. As permanent tenants apparently have gained proprietary rights and disappeared as a socioeconomic group in the Project area, the issue currently would revolve around compensation for tenants-at-will and village artisan groups.

The artisan or service (kammis) groups are probably in a stronger position to claim compensation, since their rights to a proportion of the village harvest at the division of the crop are based on custom. It is recommended that these rights be compensated to the degree that incomes are lost either temporarily or permanently by land takings in the Project. The level of compensation for artisans should be decided by the Collector under the terms of the Land Acquisition Act, but in consultation with the advisory committee of local notables and artisan leaders.

Tenants-at-will are sharecroppers who have no rights in land, beyond annual contracts with landowners. These contracts are usually verbal and set the terms under which the crop will be divided. These tenants have no legal rights in land and hence have no legal basis to claim compensation. It is expected that some tenants will find employment on the Project or in industries developed in the area, while others will continue to cultivate once the spoil banks have been redeveloped and brought under cultivation.

The social organisers of the Project NGO can also be tasked to dialogue with the affected farmers and the tenants about the degree to which tenants-at-will should be compensated for losing access to land under the Project. This would the tenants a key input into a decision that would affect their livelihoods.
Temporary Acquisition

Section 35 of the Land Acquisition Act clearly stipulates that temporary acquisition of land for borrow areas and construction activities should be carried out through an agreement between the acquiring agency and the landowners. The terms and conditions of the agreement should be acceptable to both parties. In the Chashma Right Bank Canal Project, however, there are cases where WAPDA and the affected landowners agreed to a figure compensating landowners for damage to their lands and then this figure was unilaterally reduced at the discretion of the Land Acquisition Collector.

The terms of the Land Acquisition Act (Section 35) should be adhered to in determining compensation for the use of and damage to temporarily acquired areas. For the purposes of this Project, insofar as is possible, land for construction camps should be sited in the spoil areas. This land will be purchased from the landowners and any damage to these areas presumably will be rectified in the levelling and preparation of the spoil areas for irrigated cultivation.

6.5.3 Resettlement

Land Resumption: Resettlement and Redevelopment

The past practice of simply paying farmers for the loss of their land to major canal projects should not be applied to the Ghazi-Gariala Hydropower Project. This method has not worked well in the past, as most farmers spend their money on immediate needs and gratifications, or in ill-considered investments, and end up in an impoverished condition and with little means of maintaining their livelihoods. It is believed that a land-for-redeveloped land procedure is feasible for the Project. Such a procedure can be implemented to reduce the long-term negative effects on the agrarian resources and capabilities of the affected villages.

Providing redeveloped land and irrigation on levelled spoil areas would also eliminate or at least reduce the need for a costly out-of-area resettlement programme. Experience with involuntarily resettlement clearly suggests that keeping rural people in their ancestral villages is a far better alternative than uprooting them and resettling them in distant villages. The social and political problems of integrating into established villages elsewhere are extremely difficult. For these reasons alone, involuntary resettlement should be avoided or at least minimised.

The most viable alternative to out-of-area resettlement for the Project is, as noted above, resettlement on redeveloped spoil areas in the Project area. This solution probably would be acceptable to the affected farmers. Water for irrigation is a near universal demand in the Project area. During the scoping sessions in November 1990, the farmers expressed a willingness to give up half their land if the other half would be given water,
arguing that they could maintain viable incomes on less land. Landholders were also amenable to having their land levelled with spoil, provided the topsoil was returned and they were compensated for the loss of crops. The population directly affected by land takings is relatively small (about 2,900 landholders and a further 250 tenants and herdsmen, for a total population of 15,950 assuming an average of 5.5 members per family) compared with that affected by the Tarbela dam, but it is not insignificant.

The land-for-redeveloped land procedure aims to use the massive surplus of spoil generated by the construction of the power channel to create more highly productive farmland than was generally present before the Project. This is more than merely rehabilitating spoil and borrow areas. It means developing the land by providing permanent tubewell irrigation and taking additional steps after replacing topsoil to ensure that the land can be productively farmed. In a specific way, this plan aims to improve the productivity of redeveloped spoil areas sufficiently to accommodate those who will have permanently lost their land to the channel right-of-way. In a general way, it aims to keep on the land those who now farm it and to keep occupation/kinship groups and village communities from undergoing the socially destructive effects of splitting up, with some staying in the village and others migrating to distant places.

A key factor in the successful rehabilitation of the spoil banks will be the avoidance of stockpiling of the topsoil, which rapidly destroys the bacteria and invertebrate life which are vital to its fertility. Therefore the earthmoving for the channel has been planned as a swift once-through operation, spoil being spread, compacted and levelled as soon as it is excavated, followed by topsoil removed from ahead of the spoil spreading operation and placed without storing or rehandling.

This once-through operation would be readily organised by the international contracting experience available to the Project, and will minimise costs by avoiding rehandling of either the spoil or the topsoil. The provision of tubewells for irrigating the spoil banks could be carried out by a separate contractor, if desired.

The process of land acquisition and subsequent return to use could be complex. Given the projected number of 2,900 landholders involved, however, the economic and social aspects of a land-for-redeveloped land procedure probably are manageable.

Keeping these problems in mind, the land-for-redeveloped land procedure is expected to work as follows:

- The implementing authority will purchase all the land for the channel and the spoil areas. Compensation for land will be given at current market values, but only after WAPDA completes a field survey to ensure that those farmers who have improved their land do not lose out
because these improvements have not been recorded by the patwaris. Compensation payments will be prompt and direct, ie from WAPDA to the landholder, without any intermediaries.

Farmers losing land will be briefed on the scheme and told they have the first right to purchase redeveloped land along the channel. Generally, those losing irrigated land will be able to purchase the same amount of redeveloped land, while those losing barani land will be able to purchase about half the amount of redeveloped land. Farmers would not necessarily regain the same place on the village map they had given up, but would regain land in their own village. Farmers will be asked to opt in or out of the scheme. Those opting in will be allowed to purchase land at the same price per unit area that they had sold it at, with the additional value of the redeveloped land compensating for the loss of crops for the period between the loss of their land and until they can bring in a crop on their redeveloped land. They will also be encouraged to keep a portion (possibly 60%) of their sale proceeds in secure saving schemes pending the purchase of redeveloped land.

WAPDA will retain the channel right-of-way, including access roads and a 25 m green strip, the area for the powerhouse complex, headponds and tailrace, and additional land for permanent operating colonies.

Irrigation is critical to the success of this plan. Groundwater will be the source. If, for any reason, large tubewells cannot be installed to irrigate the land, water will have to be provided from open wells fitted with small pumps as is conventional in the area. The pumps/tubewells can be shared by two or more cultivators. This has been recommended on the basis of village surveys, which has indicated that the majority of wells/pumps/tubewells are shared by the farmers.

The land will be sold to the affected landholders in the village as soon as the spoil bank work has been completed. The modalities of demarcating the plots and their resale should be worked out by the affected farmers themselves. This process should be initiated and carried through by the social organisers of the Project NGO.

The tubewells will be made over to the farmers without cost, each gaining a share in the joint ownership of the well equal to his share of the land commanded by the well. Since each tubewell will average 20 owners, the Project will need to provide a strong institutional input to enable the farmers to find acceptable solutions to the quartet of water allocation, distribution, resource mobilisation, and maintenance associated with irrigation management. The Project NGO will be tasked with
developing and implementing a plan for Tubewell Users Associations in the resettled areas.

- The Project NGO will also mobilise needed public and private expertise, including the Agricultural Extension staff, to help farmers work out any problems, improve their yields, and restore their livelihoods as soon as possible.

- The village of Barotha will be specially affected, as the power complex, the headponds and tailrace, and permanent housing areas, will have a significant impact on the irrigation system in the southern nullah, on village roadways and communications, and on the extent of its arable land. The villages of Dher and Gariala will also be affected, though to a lesser degree. The contractor will realign and reconstruct village roads from the Gariala-Attock road to Dher and Barotha and provide a minor bridge across the tailrace. The irrigation system in the southern nullah will be preserved, if need be by supplying two or three tubewells, if headpond construction interrupts the permanent flow now in the nullah.

- Resettlement of the landholders affected by the tailrace and headponds will be required. Though spoil from the tailrace will be available to level gully land in Barotha, the area will be too small to resettle them. As very extensive areas will be levelled in Nurpur Karam Alia, Dakhner, and Rumian and provided with irrigation, it may alternatively be possible to set aside land there for farmers displaced by the power complex. Given the similarity of the biraderis, Awans and Khattars, in these villages and the probable existence of intervillage marriage connections, this probably can be done if local village leaders and institutions are brought into the resettlement process. This issue should be tasked to the Project NGO, whose social organisers can initiate and carry through a dialogue between the Barotha resettles and the villagers of Dakhner, Rumian, and Nurpur Karam Alia.

- There are some instances where isolated dwellings lie within the land required for the Project. The people who live in these dwellings will be provided with new dwellings within or as close as possible to the community with which they identify. They will also be compensated for the loss of any other immovable property and for moving expenses. About 130 dwellings will be affected in this way by the Project. The Project NGO should be responsible for monitoring the provision of replacement dwellings for those destroyed during the construction of the power channel, power house, and tailrace.
The socioeconomic conditions of the affected population should be assessed by the Project NGO in order to obtain a socioeconomic baseline to assist in monitoring the social effects of the Project. This should be a house-to-house, landholding-to-landholding survey. It should be initiated as soon as possible after the Project has been approved. The data should be maintained in a database for reference and comparative purposes.

The socioeconomic survey of the area to be purchased should include:

- the number of people in the Project alignment and their exact dwelling locations marked on a map. This map should also show all other buildings, tubewells, and immovable properties, including graveyards,

- their demographic structure, kinship and social groupings,

- their economic and resource base, and

- their attitudes, desires and perceived needs regarding resettlement on redeveloped land.

The landholding survey will be a field survey carried out by WAPDA survey staff acting under the coordination of the WAPDA social unit. A representative of the Project NGO will be assigned to monitor the landholding survey to ensure that landholding boundaries and characteristics are accurately recorded. The location of specific landholdings can be gained from the village maps (luthas or musavis) and jamabandis (record of land rights). But these should be checked on the ground.

The landholding survey should provide the following:

- The exact location marked on a map of all landholdings in or affected by the land takings for the construction of the Project, including the spoil and borrow areas. This map should include those landholdings that lie partially inside and partially outside the total area to be taken for construction.

- The landholdings on the map must be marked according to productivity, that is, whether they are chahi-nehri (irrigated), barani (rainfed), orchard (graded by age and type), or ghair mumkin (waste), etc. This must be determined by the field survey and in consultation with the landowner. The jamabandi specifically must not be used here, as its information typically is very out of date. The survey team should include a soil/land valuation expert.
This map should show all existing tubewells, watercourses, bunds, aqueducts, woodlots, orchards, darrahs (torrent beds), and any other farm associated buildings or structures.

When the socioeconomic and landholding surveys have been completed, WAPDA will prepare a detailed resettlement report aimed at restoring the livelihoods of the affected population by providing redeveloped land on levelled spoil areas. The resettlement report should include:

- The detailed findings of the socioeconomic survey.
- The detailed findings of the land survey.
- The schedule and method of compensation.
- A schedule of village-level briefings to acquaint the farmers with the redevelopment plan.
- A detailed schedule for the construction and preparation of the spoil areas to be redeveloped, with dates of initiation and completion of the various redevelopment and resettlement tasks up to the termination of economic and financial assistance.
- A detailed plan to maintain farm family support payments during the construction of the Project and to provide facilities for farmers to hold the proceeds of land acquisitions for the future purchase of redeveloped land.
- An equitable procedure for demarcating and selling redeveloped land to the affected farmers. This will have to be done on a village basis through a dialogue with the affected farmers initiated by the social organisers of the Project NGO. The farmers themselves should decide the siting of the tube wells, the best layout of plots, and a method of distributing these among the affected farmers (eg by ballot).
- Cost estimates for land acquisition, redevelopment, construction of new dwellings, provision of building materials, provision of services, assistance with moving, and follow-up support.

Out-of-Area Resettlement

The survey work and actions discussed above do not mean that out-of-area resettlement should be ruled out, particularly if, contrary to expectations, a significant number of affected landowners cannot be resettled in the spoil areas. Much of Punjab is cultivated by settlers (abadkars) who voluntarily moved into various canal colonies over the past century and brought
previously dry areas into highly productive farming. These abadkars moved mostly as village groups into areas that were sparsely inhabited by pastoral tribes and set up entirely new villages. Despite occasional resistance from several of the pastoral tribes of the bar lands (higher areas between the rivers brought under canal irrigation), this colonisation effort worked very well.

If this becomes necessary in this Project, those from each village needing or desiring out-of-area resettlement will be too few to establish separate daughter villages on unsettled land in an area still undergoing colonisation (eg Khushab, Mianwali, Bakkhar). Project resettlees not gaining spoil lands would probably be insufficient in numbers to form the nucleus of more than two to four new villages. In this event, the Project resettlees should be moved to previously unsettled land and settled in culturally distinct groups; Pathan landowners in one village, Punjabi landowners in a second. The Khushab-Mianwali-Bakkhar triangle would be ideal as the tribal and biraderi groups here are similar to those in the Sarwala and Chhachh. Resettlees should gain land that is already commanded by irrigation, preferably in contiguous village blocks, so that involuntary resettlement becomes part of an agricultural development rather than simply a social rehabilitation programme. At a minimum, resettlees should receive economically viable estates in the new area of about 10 ha, and should be assisted in their efforts to improve their former living standards, income earning capacity, and production levels.

### 6.5.4 Construction Period Issues

#### General

The construction period of the Project will provide the region with important benefits, particularly in employment, but it also raises concerns about the effect of construction and large work forces on local village communities.

Ghazi and Barotha will host large construction workforces that will benefit some local groups, such as merchants, but which will place strains on local communities and their resources. With an expected population of only about 800 in 1991, Barotha will be swamped by a workforce that could be well over 3,000 at its height and a permanent colony of some 3,500, including families.

#### Employment

The commitment to provide employment on a priority basis to those directly affected by the Ghazi-Gariala Hydropower Project should be a requirement of this Project. It should also be a key part of the monitoring programme. This is first and foremost an equity issue, but it also provides the means to create a positive interest in the Project in the region to help counter any
opposition that may emerge. It will also lessen the impact on the region of outsiders coming in and result in more of the resources put into the region through salaries staying there.

An important part of this commitment will be for WAPDA to hire local people for its permanent cadre to help staff the operating and maintenance colonies for the Project. This would include jobs for malis (gardeners), chowkidars (watchmen), drivers, and clerks, as well as openings for service professionals such as teachers, doctors and nurses.

The first priority for employment should be given to those directly affected by the loss of land and/or occupation. This includes those tenants and field labourers who work on land acquired for the Project. In order to achieve equitable recruitment on the Project, it is recommended that a system of work permits be introduced. Two categories should suffice; one for landowner and tenant households whose land is acquired by the Project, and the other for residents of affected villages who have not suffered a direct loss.

One work permit per household should be issued. The work permit may be transferable between members of the same household. What constitutes a household should be left to the villagers to decide through village level dialogues initiated by the Project NGO.

The work permit should not be treated as an employment contract. It serves to identify a labour pool of potential employees to whom the contractor or contractors would be required to give preference when recruiting employees. It is suggested that the contractor or WAPDA invest in training the pool of Category A potential recruits in the skills likely to be needed on the Project. Based on data taken from 10 villages in the Project alignment, the contractor should be able to fill a large part or even most of his labour demand from this region:

<table>
<thead>
<tr>
<th>TYPE OF LABOUR</th>
<th>NO. IN 10 VILLAGES</th>
<th>EXTRAPOLATED TO 50 VILLAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck Drivers</td>
<td>99</td>
<td>500</td>
</tr>
<tr>
<td>Dozer Drivers</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Masons*</td>
<td>249</td>
<td>1,250</td>
</tr>
<tr>
<td>Electricians</td>
<td>23</td>
<td>100</td>
</tr>
<tr>
<td>Pipe Fitters</td>
<td>31</td>
<td>150</td>
</tr>
<tr>
<td>Clerks</td>
<td>331</td>
<td>1,650</td>
</tr>
<tr>
<td>General Labour</td>
<td>1,355</td>
<td>6,750</td>
</tr>
<tr>
<td>Other**</td>
<td>161</td>
<td>800</td>
</tr>
</tbody>
</table>

* Includes 3 masons who worked on the Chashma Barrage.
** Includes surveyors, mechanics, cooks, etc.
These figures are meant to convey a general sense of the labour availability in the area. They do not include data from Ghurghushti, Ghazi-Khalo, or the urban areas of Hazro and Attock city. Nor do they include an estimate of labour available from the numerous villages in the region not physically touched by the Project.

**Cultural Properties: Shrines and Mosques**

As every effort has been made to avoid shrines, graveyards, mosques, and historical sites, the problem of removals has been minimised. At present, one graveyard and one mosque have been found located within the alignment of the Project.

The graveyard to be removed is at Banda Feroze (southern suburb of Ghurghushti) and consists of 13 graves. WAPDA will be responsible for moving the graveyard after obtaining a fatwah (pronouncement of Islamic Law) from the senior-most 'alim (scholar of Islamic Law) at Ghurghushti. An effort should be made to have this fatwah signed by other ulema of all schools of thought in the immediate area. WAPDA will have to purchase land for a new graveyard if necessary, pay for the removal and reconstruction of graves, and compensate each family for the mental and spiritual suffering it may have undergone in this process. The amount of such compensation can be fixed in consultation with the senior 'alim. This procedure should be followed should other small graveyards be discovered within the Project land taking.

Similarly, the mosque immediately west of the Kamra Complex, should be relocated in consultation with the imam, mosque committee, and, if necessary, senior 'alims in Kamra Village. The construction of a new mosque and the land required will have to be paid for.

**Cultural Properties: Rescue of Known Archaeological Sites**

In an area so rich in archaeology, it is perhaps fortunate that relatively few archaeological sites are affected by the Project and, moreover, that none of these appears to be unique or of surpassing national significance. The policy on archaeological sites should be clearly designed to prevent or minimise damage to such sites and to shift away from emergency interventions to the preservation and sustaining of archaeological sites. This can be accomplished by the relocation, restoration, and preservation of sites, study on alternative sites, or the selective salvage, and the preservation of excavated finds in museums. The option selected should depend on how national archaeologists and expert consultants judge the value of each site.

Pakistan occupies one of the oldest inhabited and civilised parts of the globe and it probably would be difficult to build any major project in the Indus plain that did not affect some
archaeological site. This, coupled with the large number of sites that are already under public protection, low funding for archaeology and limited public interest, means that the Department of Archaeology cannot properly preserve and keep up sites of national and even international importance, much less take on new ones. Moreover, at this stage in the country's economic and cultural development, there is very little public support or sympathy for preserving archaeological sites if this means delaying or stopping major development projects.

For this Project, high priority has been given to the location of archaeological sites and a representative of the Department of Archaeology has been involved in the discovery process. The Project has funded a literature search and a field survey by the Department of Archaeology, the results of which were noted in Chapter 3. As noted there, two Kushana Period sites, each a Buddhist stupa and monastery, will be intercepted by the power channel near the village of Musa Kudlathi. Two other sites near Musa, one near Hasanpur, and one near Dakhner are close enough to the Project to need protection from construction operations and the building of spoil banks.

In the current view of members of the Department of Archaeology, the best option for the two intercepted sites is to excavate and study the sites and remove the artifacts to the Taxila Museum for detailed analysis. This presumably will become the Departmental view once all the reports have been submitted. Both sites have already been partially raided, one reportedly with a bulldozer, by unauthorised seekers of money, other valuables, and statues. Although neither site is sufficiently important, in view of this Project, to preserve on its own, such a recovery effort will save what is left at two sites and hopefully stimulate the excavation of nearby untouched sites, thus beginning the process of bringing the Chhachh into its own as an area of historical significance.

The land encompassing the sites should be purchased as soon as possible by WAPDA upon the initiation of the Project. This may mean purchasing somewhat more land here than would be normal for the power channel. Arrangements should already have been made for the Department of Archaeology to begin excavations as soon as the land is transferred to WAPDA. It is expected that the excavation and study of the sites could be completed in a period of two to three months. It is difficult to estimate the time required when what may be found is still unknown. The two sites can be excavated simultaneously by work parties of 10 men each, each supervised by an experienced archaeologist and a student archaeologist.

There is a slim chance that the grouping of four sites represents a larger and more important complex that lies under alluvium deposited by the hill torrents over hundreds of years. An early rescue effort would discover this and give WAPDA and the Department of Archaeology enough time to decide its significance and take steps accordingly, even if this meant a slight local realignment of the power channel, without interrupting the
construction schedule for the power channel. At RD 25+650 and RD 26+450 respectively, the two intercepted sites are fairly close to the start of the proposed northern front excavation of the power channel. This will begin at RD 34+180 and proceed upstream to RD 0+000.

Once the archaeological excavation and rescue are complete, the power channel can be constructed through the site. Any trenching areas contiguous to the power channel that are not directly affected by construction can be filled in to protect what remains. The effect of groundwater on these and the nearby archaeological sites should be an aspect of the programme of groundwater monitoring. Generally, buried archaeological remains suffer damage if groundwater levels are too high.

Cultural Properties: Unanticipated Discoveries

It is always possible that there will be unanticipated discoveries of archaeological remains by the construction crews. The contractor's senior staff and WAPDA's site managers will be briefed about the potential importance of such discoveries. In the event of such a chance find, WAPDA officials will follow these procedures:

- notification of the Department of Archaeology representative at Taxila (the Curator of the Museum),
- request for a representative to make a site inspection with an offer to provide transportation and other assistance,
- cessation of work in the vicinity of the find until the visit of the representative, and
- decision by the Department of Archaeology on possible salvage or excavation (usually required within 48-72 hours of notification).

Heavily-Impacted Areas

Project effects will be particularly concentrated in two places: Ghazi-Khalo and Barotha. Both sites will be physically affected by a major component of the Project and each will house large labour forces dedicated in part to the construction of that component as well as to the contiguous section of the power channel.

Barotha in particular will be affected by new employment opportunities and higher incomes quite outside the traditional village economy and its structure of authority. How the village copes internally with the social change that inevitably will come its way is perhaps best left up to the village itself.
However, there are other areas where Project mitigations should be considered:

- The proper disposal of sewage and environmentally harmful chemicals from the worker camps and work sites. Sewage must be collected and treated, before it is passed into any nearby nullah.

- Access by the people of the immediately affected villages, Barotha, Dher, Jaba, and Gariala, to the medical and educational facilities established by WAPDA at the permanent colony site. Workers and their families throughout the Project area should have access to medical facilities set up for the Project.

- WAPDA and the contractor must respect the purdah of the village. This means the contractor will enforce restrictions that would keep workers away from culturally and socially sensitive areas and from committing intrusions unwanted by the village.

- Wherever possible, WAPDA and the contractor should deal with the established village leaders. This will enable them to retain a degree of authority during a period of rapid change. Although it is difficult to predict such things, keeping the village structure of authority intact should increase the chance that social change will be evolutionary in its longer-term impact, and not wholly disruptive.

Public Safety and Convenience

The aspects of public safety and convenience during construction have been discussed in Chapter 2 under the respective Project components. These include the following issues:

- protection of the site,
- public access to resources,
- protection from injuries,
- control of dust, fumes and noise, and
- increased road hazards.

The aspects of public health and safety during construction have also been discussed in Section 5.2.1, where emphasis has been laid on adopting efficient management and engineering practices by contractors and supervisory engineers to minimise the construction-related hazards. Specific clauses will be included in the contract documents to impose requirements related to public safety and convenience.

7-6.43
Public Relations Safety Programme

In addition to the physical features of the Project designed to enhance its safety (Section 6.4.9), WAPDA will initiate a public relations programme to emphasise to the public the danger of the power channel for swimming, laundry, and watering livestock. Radio and television can be used in the region to alert the public when the power channel is commissioned.

The villages of the immediate Project area will need a more intensive contact programme. Special efforts will need to be made at the village dialogues to raise awareness about the potential dangers posed by the power channel. Should the villagers insist on it, additional fencing may need to be provided. In addition, the safety message can be spread by involving the school teachers of the Project area. This can be done by providing the school teachers of the Project area with packets of informational materials, including posters for school room walls, and visiting them personally to ask that they support the programme and to answer any questions they may have. Posters can also be put up in mosques, Basic Health Units, and in the bazaars, to make the public at large aware of the dangers inherent in the channel. Such posters should get their message across entirely graphically.

Safety is also a monitoring issue. Any sustained increase in deaths and accidents involving any of the Project components would result in the staging of another safety programme.

6.5.5 Social Support and Development Organisation (Project NGO)

The Tarbela Dam Project, the Kamra Aeronautical Complex, the acquisition of land for a military cantonment at Ghazi and for training areas for the Pakistan Military Academy, and the proposed Ghazi-Gariala Hydropower Project have led to rising expectations among the local population who would like to participate increasingly in the development they perceive around them. Failure to carry them along could give rise to frustration among the youth and jeopardise the Project.

Furthermore, like the handling of the effects, mitigations, and compensatory actions of the Project, development is not always equitable. In most cases, those who have local influence can ensure that they benefit the most from Project compensations, while those who have the resources to take advantage of development resources and lack the capacity to protect their interests when Project compensatory plans are put into effect. Social differences can be exacerbated, possibly leading to instability.
As the single-largest actor on the scene, WAPDA is uniquely placed to facilitate the transition of the people of the Project area to the modern world. It is obligatory that WAPDA meet the challenge, not necessarily by undertaking all development activities sought by local villagers and townsmen, but by helping to attract development investments from national and international sources, to bring in social services and economic and technical inputs. Since WAPDA is already planning to invest in infrastructure development in the Project area, and since the importance of the Project to the national economy is well recognised by all sectors of the government, these investments can accelerate the impact of secondary investments.

It is recommended that WAPDA, as soon as possible, underwrite the preparation of an integrated regional development scheme with a mandate to facilitate the economic development of the Project region by fostering farmers' organisations and small industrial estates as vehicles for development, and providing small scale inputs to enable such development.

After approval of the proposal, WAPDA may co-sponsor the formation of the Non-Government Organisation (NGO), or contract the implementation of the scheme to an NGO with demonstrated ability to implement such a plan. The development scheme should run independently of the Ghazi-Gariala Hydropower Project, although its services should be available on a contract basis to assist WAPDA in the social implementation and monitoring of the Project, including its mitigation and compensatory activities.

Existing successful models in Pakistan, such as the Aga Khan Rural Support Programme, the Orangi Pilot Project, and the Sarhad Rural Support Corporation, suggest that such a scheme may be more effectively set up and implemented as a non-governmental organisation. The establishment of the Sarhad Rural Support Corporation by the Government of the North-West Frontier Province, and the Baluchistan Rural Support Programme by the Government of Baluchistan, provide precedents for the establishment of such NGOs by government departments. The Agha Khan Rural Support Programme has demonstrated its capacity both to effect grass roots change through its support to village-level social organisations and to assist the Governments of the NWFP and Baluchistan in establishing the new rural support NGOs on those two provinces.

It is strongly recommended that WAPDA undertake to support such a study now, so that a functioning NGO will be in place before land acquisition for the Project begins. The preparation of an integrated regional development scheme, its funding and implementation, could take up to a year. There should be no delay in this matter.
The benefits to WAPDA of such an approach would be considerable:

- WAPDA would help to found an NGO that could, on a contract basis, be of great assistance in implementing key social aspects of the Ghazi-Gariala Hydropower Project. These include determining accurate land values through village dialogues, working with resettled farmers to organise land distribution and Tubewell Users Associations on the redeveloped spoil banks, creating and maintaining a baseline socioeconomic data base for use in monitoring the effects of the Project, and assisting in a variety of monitoring tasks during the life of the Project. In essence, the benefit to WAPDA will be the creation of a network of farmers' organisations through which the social organisation aims of WAPDA can be achieved.

- WAPDA's financial investment will be limited to the sponsoring of the project proposal, estimated to involve a three-month consultancy. Subsequently, WAPDA may submit the proposal to interested donors through the Economic Affairs Division. The current donor climate is highly favourable to this approach. Support for the establishment of the NGO should not be difficult to obtain, not for downstream projects.

- WAPDA is in a position to earn considerable goodwill among the local population with very little investment. A number of difficult issues, like land valuation and the modalities of the spoil bank resettlement, could cause tensions in the years ahead. An NGO that actively supports the equitable resolution of disputes and promotes development would go a long way to reassuring the people of the Project region that they stand to gain, not lose, from the Ghazi-Gariala Hydropower Project.

- The Project NGO can be used in future WAPDA projects in the region, including the construction of the Kalabagh dam. The experience and skills developed during the implementation of the Ghazi Gariala Hydropower Project would be of enormous benefit in the implementation of the more complex Kalabagh Dam Project.

The benefit to the people of the Project region will be that, in the processes of organising to cope with the effects of the Project and of achieving development, they will create local institutions to sustain development activities, manage services such as tubewell irrigation, provide savings and credit facilities, encourage micro-enterprise development, and be a continuous forum for communication with WAPDA through regular village dialogues facilitated by a team of trained and experienced social organisers.
The NGO will also mobilise development support for townsfolk affected by the Project, including town planning expertise, water and sewage treatment facilities, and small industrial estates.

In summary, then, in addition to its broader developmental role in the region, the Project NGO can be tasked with the following:

- Discover current market values of land through village dialogues and present findings to the Deputy Commissioners of Attock and Abbottabad.

- Initiate village dialogues with tenant families to decide equitable compensation for the loss of livelihoods during the construction of the Project.

- Conduct a detailed socioeconomic survey of the area to be acquired for the Project.

- Oversee the landholding survey of the Project land take which is to be carried out by WAPDA.

- Maintain a database of the information collected in both the household socioeconomic and landholding surveys.

- Assist WAPDA in the preparation of the resettlement report for the spoil areas. This should include a process for demarcating and distributing plots in the redeveloped area, a plan for implementing Tubewell Users Associations, and a plan for mobilising government extension services to enable farmers to restore their livelihoods as quickly as possible.

- Oversee local labour hiring to ensure that the Work Permit system is indeed providing labour to those most affected by the Project.

- Oversee the replacement of dwellings.

- Oversee the Barotha construction area, to ensure that irrigation is maintained on both sides of the southern nullah, and that land acquisition, access roads, work sites, housing areas (temporary and permanent), social services and sewage disposal meet environmental standards and do not destabilise the village.

- Initiate dialogues with the villages of Dakhner and Rumian to see if landholders who lose land in Barotha and Dher can be accommodated on the large spoil areas in the lands of these villages.

- Work with local leaders and construction supervisors to ensure that safety measures during construction can be coordinated with the movements required for agriculture, herding, funeral processions, etc.
Use village dialogues to reinforce safety concerns about the power channel.

6.5.6 Building Social Organisation Capacity Within WAPDA

In the long run, it is desirable for an agency like WAPDA, which has extensive dealings with the rural population, to develop in-house social organisation capacity. This will enhance WAPDA's ability to communicate with rural communities, resolve potential disagreements, and mobilise them for participation in development activities. The Project should serve as a learning school to better understand WAPDA's need for social organisation capability.

With expansion and appropriate assistance (Chapter 7), the WAPDA Environmental Cell can undertake the following tasks:

- Be responsible for gaining the relevant certifications of the Project from official agencies and departments responsible for the protection of environmental and archaeological resources.

- Work with WAPDA surveyors to ensure that the required landholding survey (Section 6.5.3) is thoroughly carried out.

- Be responsible for organising graveyard removal at Banda Feroze Khan, including working out the fatwah with the ulema and compensation for the affected individuals.

- Oversee the lease of temporary borrow areas and compensation for their use. This should include ensuring quick payments to landholders for inadvertent damage to fields and crops.

- Liaise with the Project NGO.

- Coordinate the collection of data during the monitoring period by WAPDA units, including the Surface Water Hydrology Project and the Directorate of Tubewell and Groundwater Monitoring.

6.5.7 Project Area Development

Upgrading Ghazi to a Town Committee. An early step that is strongly recommended is the upgrading of Ghazi-Khalo from a Union Council headquarters to a Town Committee. This is needed to give the Ghazi-Khalo area the administrative capacity it needs to cope with the massive effects of the Project. The Town Committee should include the area around Ghazi Hamlet and the Tarbela Resettlement Colony, as well as the area to be taken for the Barrage Colony. The new cantonment area will presumably have its
own administration, but its presence will be a factor in the growing urbanisation of the area.

Two areas where a new Town Committee might seek help from other national or provincial agencies would be, first, in general town planning to zone the limited area available to the town for commercial and residential areas, study and rationalise traffic patterns, and plan the physical construction of roadways, kerbs, drainage, etc. A second area where early assistance should be considered is in the planning and construction of a town sewage system to cope both with the increased supply of water from the newly completed public water supply system and the rapid expansion of population during and after the construction of the Project.

Social Development. The expansion of educational and health facilities at highly affected areas like Ghazi should be planned and implemented. The people of Ghazi specifically want a girls degree college, for example, and see provision of this as something that would partially repay them for the disruption they will suffer from the construction of this Project.

Upgraded Police Presence. The completion of the barrage at Ghazi and the seasonal lowering of the water level in the deep channel in the downstream reach of the Indus river may require upgraded police capabilities in the region. If required, police on both sides of the district (Abbottabad-Swabi) and provincial (Punjab-NWFP) boundaries should consider adding police 'flying squads' to check illegal activities and to improve police coordination across district/provincial borders.

Industrial Development. Industrial development should be regarded as a priority item to stabilise the employment situation in the region in the aftermath of the Project. As mandated by World Bank guidelines, this is necessary both to enable those who permanently lose their land to gain alternative livelihoods and to ensure that the Project area does not suffer a major depression in the aftermath of the construction period. Industrial development should be planned largely to come on stream as the construction of the Project nears completion so that labour coming off the Project can be absorbed.

WAPDA will approach the relevant provincial departments about the feasibility, planning and organisation of industrial estates at Ghazi and at two sites in Attock Tehsil, one of these possibly in the Chhachh and one in Sarwala. Land may already be available near Ghazi, where landowners at Mian Dheri, Hassanpur, and Aldo have set aside 20 ha for a small industrial estate.
In addition, field investigations in the Chhachh suggested both the availability of considerable private resources for investment in small to medium industrial enterprises and interest in such investment. Leaders at Ghazi believe their area would be suitable for oil mills, fruit products, glass and ceramics, leather, textiles, cement, and paper products.

**Agricultural Development.** The provision of irrigation would do more than anything else to develop the agriculture of this area. The construction as planned of small dams at Pipiala, Khairbara, and Kathera will provide irrigation for about 100 ha on both sides of the power channel. The feasibility and cost of placing additional tubewells along the power channel to irrigate areas beyond the spoil banks may be studied.

### 6.6 IMPLEMENTATION SCHEDULE

The mitigation works incorporated in the Project design, such as the outlet for compensation water release, cross drainage structures, bridges, underdrainage facilities, relocation of infrastructures to be combined with Project structures, public safety measures, etc., will be automatically implemented along with the Project structures. However, there are many other aspects of physical and social environment which need special consideration for their implementation as they are not reflected in the implementation schedule of the Project structures (Drawing 7.2.1). These aspects are as follows:

- Strengthening of Environmental Cell within WAPDA.
- Formation of Project NGO.
- Issues related to land acquisition.
- Development of spoil banks.
- Resettlement plan and implementation.
- Relocation and replacement of homes and other infrastructures.
- Salvage of archaeological sites.
- Rehabilitation of borrow areas.
- Project regional development plan.

The schedule for implementation of the proposed actions has been depicted on Drawing 7.6.15.
REFERENCES

7.6.1 Hammer, M. J.; Water and Wastewater Technology, 1986.


7.6.3 Pakistan Hydro Consultants; Ghazi-Gariala Hydropower Project, Report on Selection of Project Layout, September 1990.
CHAPTER 7

MONITORING

7.1 MONITORING PROGRAMME

7.1.1 General

A major infrastructure development such as the Ghazi-Gariala Hydropower Project invariably has significant effects on the natural and social environment. Most of these effects can be foreseen, although the precise impact may not always be immediately quantifiable. Other effects may not be foreseen and may become evident only sometime after the construction or the operation of the Project is underway. Careful planning enables decision-makers to anticipate many of these potential effects, weigh financial and environmental costs, choose the best solution, and provide mitigating measures where environmental and social costs cannot be avoided.

An effective monitoring and evaluation programme can be an acceptable solution to the problem, at the feasibility stage, of accurately identifying and evaluating environmental and social effects. Such a programme must be well-designed, rigorously carried out, and used for informed decision-making.

During the environmental analysis of the Project, a number of socio-environmental issues have been identified and efforts made to mitigate them through modifications of the proposed design or other compensatory actions. Some areas, however, will require monitoring during construction and operation of the Project. Some environmental effects are so complicated, or interactions between the Project and its environment so unpredictable, that a clear picture cannot be defined at the time of planning. In other cases, baseline data may be insufficient to draw the right conclusions. Further, some aspects may be so localised that experience from a similar project elsewhere cannot be applied directly to this Project.

On this basis, it becomes necessary to include a monitoring programme as a part of the Project. The need to monitor issues relating to land and the water resources in the Project area has already been identified in Chapter 6. In addition, several resettlement and sociological issues, which are presently indeterminable, may need attention in the later stages of the Project. Therefore, these have to be included in the monitoring programme.

A tentative schedule for the monitoring programme is shown on Drawing 7.7.1, while the aspects to be monitored are discussed in the following sections. Table 7.7.1 shows the proposed organisations responsible for monitoring activities.
7.1.2 Land Resources

The principal land resource that will require monitoring will be the spoil banks along the power channel, particularly their development for agriculture and the extent of any erosion. The effects of the Project on land use in the riverain area, between the barrage and the confluence with the Kabul, will also have to be monitored.

Some land use changes may be caused by reductions both in water levels and scouring of the river. It is proposed that such potential impacts should be monitored closely. The time schedule of monitoring will depend on the operation of the Project. Under more or less uniform operation, monitoring for 5 years would probably be sufficient. However, if there are changes in the operation of the Project for any reason, the monitoring may be scheduled accordingly.

Besides considering the general morphology of the riverain area, monitoring of the riverain ecology may also be required. This aspect is being considered and will be discussed in the supplementary environmental report.

As the spoil banks will be developed from the spare excavated material, they will be at risk of erosion by wind and rain. This not only will require the physical monitoring of the spoil banks, but also that of land-use practices.

On the basis of monitoring and experience elsewhere, guidelines will be prepared on land-use practices for the farmers. These will include ploughing techniques, cropping patterns and irrigation practices.

Physical monitoring of the spoil bank slopes will be a continuous process throughout the Project life. The maintenance of vegetation cover or stone riprap along the nullah banks will be required before the advent of the rainy season.

7.1.3 Water Resources

Water-resource monitoring will include both surface water and groundwater. This will involve both the quantitative and qualitative aspects of water resources.

As indicated earlier, the effect of sewage effluent on the quality of river water at present is insignificant because the volume of sewage effluent presently deposited into the river is very small.

In time, however, if a sewerage system is introduced for Ghazi-Khalo, the quality of the water in the Indus river may be affected in the low-flow season due to the additional sewage. This will require monitoring of the water quality in the river. The release of compensation water from the barrage will be based
on these monitoring results. The programme should run during the low-flow periods throughout the Project life. It may be desirable to establish a laboratory at the site to conduct selective water quality tests.

Groundwater will also need monitoring. In spite of the fact that this aspect has been studied and some mitigation measures have been provided in the Project design, groundwater behaviour under the Project conditions is not fully predictable in the absence of an extensive database. The most important issues to be included in the monitoring programme are the groundwater recharge from the barrage pond, changes in groundwater movement that may be caused by the power channel, and seepage from the headponds and the power channel. Moreover, the power channel underdrainage system may affect water levels in wells falling within the effective zone. All these aspects will need monitoring on a regular basis throughout the Project life.

7.1.4 Social Effects

Major projects like the Ghazi-Gariala Hydropower Project inevitably bring social change in their wake. Much of this is beneficial, particularly that which promotes economic and social development. But there is always another side to development: of wage earners, families, or skill groups left behind by new methods of production, of micro-economies destroyed by new technologies, or the disintegration of village communities by population growth and a capitalising economy. Some of this can be foreseen in a general way, although it is notoriously difficult to predict in detail. Much of it would occur, even in the Project area, whether or not the Ghazi-Gariala Hydropower Project was ever built. It seems clear that the longer a project is in place, the more difficult it becomes to separate the social effects of that project from the wider processes of social change also at work in a country or region.

Clearly, the Project's mitigation and monitoring programmes cannot be a panacea for all the problems that may emerge in the Project area. But these programmes can seek to mitigate those direct effects of the Project that have been anticipated and seek timely intervention in those that have not. Perhaps the strongest contribution a good monitoring programme of social aspects can make is to ensure that mitigation starts on the right foot from the very start of construction. If mitigation measures are ignored or inadequately implemented at the start of the Project, negative effects can grow rapidly. Improper sewage disposal at the construction sites, for example, could have a major impact on the health of those living in the area, as well as on worker productivity.

Monitoring will therefore be required to ensure that social mitigations and safeguards are implemented.
7.2 RESPONSIBILITY FOR PROGRAMME

7.2.1 General

As a function, monitoring is distinct from the operational function of the implementing agency. The purpose of monitoring and evaluation is not to generate data in order to justify predetermined courses of action, but to analyse effects and trends within the Project area regularly and independently of the implementing agency, and to recommend appropriate actions where mitigating circumstances are called for.

The monitoring and evaluation team acts as the eyes and ears of the decision-makers. Monitoring and evaluation are effective only if they function as a management information system. By implication, a monitoring system is effective only if the feedback loop to senior management is a very short one, and if the recommendations are valued by the decision-makers.

7.2.2 Monitoring Structure

WAPDA currently lacks an adequate capacity to monitor the implementation of the environmental mitigations and compensations recommended in this report. At present, the Environmental Cell at WAPDA consists of one environmental engineer and one social scientist. It is clearly understaffed, has relatively limited experience, and lacks access to senior decision-makers. The Environmental Cell at WAPDA urgently needs to be strengthened, but it is unlikely the cell can be sufficiently staffed, trained, and made independent to perform adequately the environmental monitoring of this Project.

Given the limited expertise in environmental monitoring within WAPDA, the following five-pronged approach is recommended to ensure the effective environmental monitoring of this Project:

- The WAPDA Environmental Cell, with appropriate support, will be the agency with the overall responsibility for the environmental monitoring of the Project. It will coordinate the monitoring activities of the different technical units within WAPDA, as well as those of the Project NGO. The Environment Cell should be strengthened through further recruitment and training, and by recognition on the part of senior management that environmental science is a fully-supported career track within the organisation. As its capabilities grow, the Cell will take over the tasks assigned to the Monitoring Consultants, as defined below.

- An external organisation, henceforth called the Monitoring Consultants, to support the Environmental Cell, as required, in the monitoring of all the environmental effects of the Project.
The technical divisions of WAPDA (such as the Central Monitoring Organisation, Surface Water Hydrology Project, Directorate of Tubewells and Groundwater Monitoring) to collect periodic data pertaining to land resources, river morphology, groundwater, riverain ecosystems and so forth. If the need arises, other provincial departments may also be involved in the collection of data and implementation of the recommended measures. These may include the departments of Agriculture (for soil conservation and agricultural practices), Local Government (for social infrastructure), Public Health Engineering (for sanitation and pollution control) and Communication & Works (for river training works).

The Project Non-Governmental Organisation (NGO) to evaluate social trends (foreseen and unforeseen), identify possible mitigation actions and consult with local organisations on their implementation.

An external Environmental Panel, which should evaluate environmental aspects on a periodic basis and, where necessary, suggest ways of strengthening the monitoring and evaluation process.

In order to monitor the Project, the Environmental Cell, supported by the Monitoring Consultants, should:

- Maintain a permanent presence in the Project area in order to monitor and evaluate the effects of the Project on different components of the environment, and on all segments of the population.

- In conjunction with the technical sections of WAPDA, the Project NGO, and the Environmental Division of the World Bank, prepare a list of indicators to monitor the environmental effects of the Project.

- Whenever necessary, undertake or commission additional studies or surveys to gain a more accurate picture of the effects of the Project.

- Periodically collate and review all relevant data to assess environmental conditions in the Project area in accordance with Operational Directive 4.00 of the World Bank.

- Produce six-monthly environmental reports on the state of the Project environment for WAPDA and the World Bank.

- Maintain access to the senior management of WAPDA and, through the Engineer, to the Project Contractor/s, immediately inform them of any environmental degradation, and recommend mitigation measures to offset the damage.
The specific monitoring responsibilities of the Environmental Cell, assisted by the Monitoring Consultants, should include:

- Overseeing land acquisition and compensation processes.

- Overseeing how temporary borrow areas are leased and compensated. This would include working out quick payments to landholders for inadvertent damage to fields and crops.

- Active involvement in the movement of families to ensure that replacement housing is at least comparable to that destroyed.

- Overseeing local labour hiring to ensure that those directly affected by the Project are given priority in hiring and that labour-hiring policies generally benefit the Project area.

- Overseeing the Barotha construction area, to ensure that irrigation is maintained along the nullah, and that land acquisition, access roads, work sites, housing areas (temporary and permanent), social services and sewage disposal meet environmental standards and do not destabilise the village. As it will likely be the first site for major excavation, Barotha will be a test case.

- Ensuring that safety measures during construction can be coordinated with the movements required for agriculture, herding, funeral processions, etc.

- Active involvement in the process of redeveloping the spoil banks. This includes working with the Project NGO to see that the land is brought into cultivable shape with plentiful water and adequate topsoil, developing the procedure by which the land in the spoil banks is resold to the affected farmers, and assisting in the formation of water users' associations for the tubewell irrigation of the spoil banks. The Cell should also mobilise from other agencies and ministries the expertise needed to assist the farmers in bringing the land back into productivity quickly.

The duties of the Project NGO have been described in Section 6.5.5. These will include assisting the Environmental Cell in the following monitoring tasks:

- Monitor the house-to-house, landholding-to-landholding survey.

- Monitor the land acquisition process to ensure that each landholder promptly receives the full price of his holding.
- Monitor the hiring of local labour for the Project.

- Monitor the long-term effects of the Project on the social aspects, including public health, of the affected area.
<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>PROJECT COMPONENTS</th>
<th>IMPACTS</th>
<th>MITIGATION/ENHANCEMENT</th>
<th>MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Resources</td>
<td>Barrage</td>
<td>* Land taking and conversion to project structure</td>
<td>* Land belongs to Government</td>
<td>* Overseeing by WAPDA Environmental Cell and Project NGO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Changes in land use at Ghazi: agricultural to commercial</td>
<td>* No mitigation needed; owners will benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Channel</td>
<td>* Conversion of 1,160 ha of land to Project use</td>
<td>* Fair and prompt compensation</td>
<td>* Overseeing by WAPDA Environmental Cell and Project NGO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Taking 1,750 ha for spoil disposal</td>
<td>* Equitable purchase/resale arrangements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Complex</td>
<td>* Land taking and conversion of 750 ha to Project structures</td>
<td>* Prompt payment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Commercial development along Attock-Dakhner Road</td>
<td>* Effective rehabilitation of spoil banks</td>
<td></td>
</tr>
<tr>
<td>Water Resources</td>
<td>Barrage &amp; Pond</td>
<td>* Change of flow in Indus River with potential contamination of pools by sewage</td>
<td>* Replacement with comparable irrigated land</td>
<td>* Overseeing by WAPDA Environmental Cell and Project NGO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Reduced flooding of recession agriculture lands downstream of barrage</td>
<td>* Fair and prompt compensation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Channel</td>
<td>* Reduced flooding of sailaba islands downstream of barrage</td>
<td>* No mitigation needed; owners will benefit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Complex</td>
<td>* Potential obstruction to groundwater flow</td>
<td>* Compensation water releases at barrage to supplement seepage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Waterlogging of soils from seepage</td>
<td>* Tubewell irrigation possible, depending on severity of impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Reduced flows in Barotha Nullah</td>
<td>* Underflow system incorporated in design</td>
<td>* Overseeing by WAPDA Environmental Cell with the assistance of Technical Division of WAPDA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* To be prevented by tubewells: should be slightly beneficial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* No action unless serious social effects are found</td>
<td>* Overseeing by WAPDA Environmental Cell with the assistance of Technical Division of WAPDA</td>
</tr>
</tbody>
</table>

TABLE 7.7.1
IMPACTS, MITIGATION AND MONITORING
Sheet 1 of 3
<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>PROJECT COMPONENTS</th>
<th>IMPACTS</th>
<th>MITIGATION/ENHANCEMENT</th>
<th>MONITORING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Resources</td>
<td>Power Complex (cont'd)</td>
<td>* Interruption of irrigation system</td>
<td>* Replacement of structures and provision of tubewells; if required</td>
<td>* Overseeing by WAPDA Environmental Cell, and Project NGO</td>
</tr>
<tr>
<td></td>
<td>Barrage &amp; Pond</td>
<td>* Reduced erosion by flood flows in smaller nullahs</td>
<td>* No action needed, beneficial</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Channel</td>
<td>* Potential fishery development in pond</td>
<td>* Management through stocking and controlled harvesting</td>
<td></td>
</tr>
<tr>
<td>Social/Cultural Resources</td>
<td>Power Complex</td>
<td>* No significant biological impacts</td>
<td>* No mitigation needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Complex</td>
<td>* Flooding woodland habitat</td>
<td>* No action proposed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Barrage</td>
<td>* Replacement of communal bathing/laundry areas with scattered water points, depriving village women of a gathering place</td>
<td>* Addition tubewell water points, if needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Change in social dependency relationships due to more restricted access to water</td>
<td>* Planning assistance for local administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power Channel</td>
<td>* Rapid population growth in Ghazi-Khalo, due to Project &amp; river crossing; results in stressing community services and facilities, schools, health centres, etc</td>
<td>* Resettlement on spoil banks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Regional and local loss of income from 1,160 ha of agricultural land</td>
<td>* Job opportunities to landless displaced persons</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* Overseeing by WAPDA Environmental Cell</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>* Project NGO to maintain contact with such families and apprise WAPDA Environmental Cell</td>
<td></td>
</tr>
<tr>
<td>RESOURCE</td>
<td>PROJECT COMPONENTS</td>
<td>IMPACTS</td>
<td>MITIGATION/ENHANCEMENT</td>
<td>MONITORING</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------</td>
<td>---------</td>
<td>------------------------</td>
<td>------------</td>
</tr>
</tbody>
</table>
| Power Channel (cont'd) | * Temporary loss of agricultural production and income from lands receiving spoil | * Resettlement on spoil banks  
* Hiring of farmers on Project labour force  
* Investment of balance sale proceed | * Education programmes on dangers of channel, in schools and village meetings  
* Warning posters in schools, clinics, public buildings, and at the channel  
* Fencing at villages, bridges, and other places where people are near the channel  
* Escape assistance: handrails extending into water | * Overseeing by WAPDA Environmental Cell and Project NGO  
* Assistance by Project NGO for reinvestment  
* WAPDA Environmental Cell to maintain contact with community leaders to learn of concerns through Project NGO |
| Power Complex | * Threat to public safety due to risk of drowning | * Planning assistance to families in managing new cash flow and altered resource base  
* Health checks for incoming workers  
* Careful attention to Project wastewater management | * Project NGO to monitor overall living conditions of affected families and apprise WAPDA Environmental Cell  
* Overseeing of contractor's wastewater management practices by WAPDA Environmental Cell  
* WAPDA Environmental Cell to monitor local conditions  
* Project NGO to be alert to problems as they develop and apprise WAPDA Environmental Cell. No formal monitoring other than keeping lines of communication open |
CHAPTER 8

ENVIRONMENTAL COSTS
CHAPTER 8
ENVIRONMENTAL COSTS

8.1 GENERAL

This Chapter deals with the costs to the Project in respect of additional works incorporated in the design for minimizing the social constraints, avoiding cultural properties and providing safety measures. The costs in respect of land acquisition, resettlement and relocation/replacement of private and public facilities are also dealt with in this Chapter. These costs are given in Table 7.8.1 and described in the subsequent sections.

Compared with the total Project cost (US $ 1,911 M), the environmental costs form about 6% if the cost of land for spoil banks is included and 4% if this cost is excluded.

8.2 BARRAGE AND POND

8.2.1 Land Acquisition Cost

The barrage, its pond, rim embankments and guide banks will occupy approximately 1,180 ha. From a study of the aerial photographs taken during January 1991 and information obtained from the local population through interviews at Galla and Ghazi, it is apparent that a large part of this area forms the river bed and inundated bars, with the local population having no claims on it. The total length of the left bank and the 4 km upstream length of the right bank and their fringes belong to the Government, being occupied by WAPDA colony on the left bank, and Dillingham, Abbaseen and Pehur canal colonies on the right. The remaining 1.5 km length of the right bank is, however, contiguous to private land, but the banks are steep and it is unlikely that the pond or the right abutment will use any private land.

Therefore, it appears that no land acquisition from private landholders will be involved and no provision has been made in the cost. However, if the barrage colony cannot be located within the existing Tarbela colonies, there will be an acquisition of 16 ha for the barrage colony. The unit cost of this area has been taken as that for urban land (Section 8.3.1) as this land is situated in the vicinity of Ghazi village (Appendices B and C).

8.2.2 Relocation and Replacement Costs

As noted in Chapter 5, the Project will disrupt two roads leading to the WAPDA colonies and dislocate buildings of the Government Vocational Institute, its hostel, a WAPDA nursery and water works of the WAPDA colony. The Project will relocate the roads and provide replacement costs for the other facilities. These costs are not environmental costs in a strict sense, but have been
reflected here as they are effects of the Project. Similarly, the cost of remodelling the Pehur canal intake structure has also been taken into account, because an irrigation canal has socio-environmental importance.

8.2.3 Rim Embankments

The Project will provide rim embankments for a short reach (about 2 km long) on the right bank. In spite of the fact that these embankments will have a secondary benefit of protecting the colonies on the right bank from rare floods, the main consideration is engineering. Therefore, this cost has not been considered as an environmental cost.

8.2.4 Compensation Cost

This relates to the additional facilities to be provided to compensate for the reduced river water downstream of the barrage during the low-flow period. This will include the installation of tubewells and the inclusion of a pipe outlet in the left flank of the barrage structure.

8.2.5 River Crossing

The Project will provide a road to connect the barrage with the right bank to facilitate public traffic across the river. The cost is considered as an environmental cost.

8.3 POWER CHANNEL

8.3.1 Land Acquisition Cost

The land requirement for the power channel right-of-way and the spoil banks will be about 2,630 ha. After allowing for additional acquisition due to fragmentation of individuals' land (Chapter 6), the acquired area will be about 2,912 ha. Of this, 1,162 ha (1,109 ha from private owners and 53 ha from the Pakistan Aeronautical Complex/Pakistan Air Force Base, Kamra) will be acquired on a permanent basis, while the remaining 1,750 ha of spoil banks and other excess acquired area would be resold to the farmers, after development, at the same rate at which it was acquired. Therefore, only permanently acquired areas will be charged to the Project. However, the initial acquisition of about 2,912 ha will be reflected in the cash flow requirements. Table 7.8.1 depicts the cost of land according to its utilisation and source.
The average rates for various types of lands used in the estimates have been developed keeping in view the prevailing land values in the Chhachh and Sarwala tracts (Appendix C). These are as follows:

<table>
<thead>
<tr>
<th>TYPE OF LAND</th>
<th>UNIT RATE US $/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban/residential</td>
<td>136,000</td>
</tr>
<tr>
<td>Irrigated</td>
<td>68,000</td>
</tr>
<tr>
<td>Barani (rainfed)</td>
<td>32,000</td>
</tr>
<tr>
<td>Marginally barani/pasture/woodland</td>
<td>14,000</td>
</tr>
<tr>
<td>Wasteland with some grazing potential</td>
<td>5,000</td>
</tr>
</tbody>
</table>

The unit costs given in Table 7.8.1 are the weighted averages assessed from the areal distribution of various types of land in the Project area as observed from the latest aerial photographs (Chapter 5) and the land rates given above.

8.3.2 Compensation Cost

This includes the cost of village roads and minor bridges provided in the Project to minimise the inconvenience to the local population.

8.3.3 Cost to Protect Cultural Properties

This includes the cost likely to be incurred in rescuing two archaeological sites at Musa Kudlathi.

8.3.4 Cost of Safety Measures

This includes the cost of fencing, grab rails, cattle grids, and other features to be provided along the power channel for safety purposes (Chapter 6).

8.3.5 Relocation and Replacement Costs

This includes the replacement and relocation cost of infrastructure facilities located in the power channel right-of-way and spoil banks. These are as follows:

- scattered housing units (80-100),
- tubewells large and small (10),
- wells (15),
- crossing of the irrigation water course near Barazai village (1),
- elevated water tanks (2),
- orchards/private woodland (10 ha), and
- scattered trees (about 20,000).

8.3.6 Rehabilitation/Redevelopment Cost of Spoil Banks

This includes the cost of the following works:
- tubewells for irrigation of farmland (150),
- tubewells for the 25 m wide strip retained by WAPDA (20),
- establishing grass on the 25 m wide strip and slopes, and
- mobile hoses and jet sprinklers.

The rehabilitation of spoil banks will also include spreading and some compacting of the spoil and dressing it with the topsoil removed from in front of the advancing excavations. The costs of these works have not been included here as they form part of the engineering costs.

8.3.7 Cost of Channel avoiding Villages and Graveyards

In the selection of the channel alignment, care has been taken to avoid villages and graveyards. This has induced an additional cost of about US $ 55.6 M in the power channel due to extra excavation, spoiling and a small increase in length. This has saved the Project the need to resettle about 16 villages (with a population of about 40,000 people) and the relocation/shifting of numerous graveyards (containing over 20,000 graves). This additional cost would be largely offset by increased costs associated with resettlement and the higher-value land required for the alignment with the least engineering cost. Furthermore, there would be greater opposition to the Project and severe risks of delaying its implementation.

8.4 POWER COMPLEX

8.4.1 Land Acquisition Cost

The power complex and headponds will require about 649 ha of land (including contingencies). The cost has been arrived at by following the method adopted in Section 8.3.1 but with the following unit rates of lands (the rates in the Sarwala tract being lower than those in the Chhachh tract):
<table>
<thead>
<tr>
<th>TYPE OF LAND</th>
<th>UNIT RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>90,000</td>
</tr>
<tr>
<td>Irrigated</td>
<td>45,000</td>
</tr>
<tr>
<td>Barani (rainfed)</td>
<td>23,000</td>
</tr>
<tr>
<td>Marginally barani/pasture/woodland</td>
<td>9,000</td>
</tr>
<tr>
<td>Wasteland with some grazing potential</td>
<td>4,500</td>
</tr>
</tbody>
</table>

8.4.2 Replacement and Relocation Cost

This includes the replacement/relocation cost of the following infrastructure/facilities:

- access roads of Barrotha, Jaba and Dher (7 km),
- housing units (30),
- water diversion structures (2),
- irrigation watercourse & aqueduct (2),
- wells (5),
- orchards/woodland (3 ha), and
- scattered trees (2,000).

8.5 INSTITUTIONAL AND MONITORING COST

The costs of strengthening the WAPDA Environmental Cell and monitoring the various parameters identified in Chapter 7 are included in the overall allowance of 8% of the Project costs for engineering and administration (Volume 8).
### TABLE 7.8.1

#### ENVIRONMENTAL COSTS

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>LOCAL (US$)</th>
<th>FOREIGN (US$)</th>
<th>TOTAL COST (US$)</th>
<th>EQUIVALENT (US$M)</th>
<th>% OF THE PROJECT COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barrage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Land acquisition for colony</td>
<td>16</td>
<td>ha</td>
<td>136,000</td>
<td>-</td>
<td>2.18</td>
<td>-</td>
<td>2.18</td>
</tr>
<tr>
<td>- Relocation/replacement of facilities</td>
<td>Ls</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.86</td>
<td>0.23</td>
<td>7.09</td>
</tr>
<tr>
<td>- River crossing</td>
<td>Ls</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.08</td>
<td>1.10</td>
<td>2.18</td>
</tr>
<tr>
<td>- Compensation Cost</td>
<td>Ls</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.10</td>
<td>-</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td></td>
<td></td>
<td>10.22</td>
<td>1.33</td>
<td>11.55</td>
<td>254.18</td>
<td></td>
</tr>
</tbody>
</table>

| **Power Channel** | | | | | | | |
| - Land Acquisition | | | | | | | |
| - Permanent without Kamra | 1109 | ha | 22,900 | - | 25.39 | - | 25.39 | 558.71 |
| - Permanent Kamra | 53 | ha | 136,000 | - | 7.21 | - | 7.21 | 158.58 |
| - Temporary for spoil banks | 1750 | ha | 20,500 | - | 35.88 | - | 35.88 | 789.25 |
| - Colony | 22 | | 22,700 | - | 0.50 | - | 0.50 | 11.00 |
| - Compensation Cost (VRB+MB) | Ls | - | - | - | 6.69 | - | 6.69 | 147.24 |
| - Cultural properties | Ls | - | - | - | 0.07 | - | 0.07 | 1.54 |
| - Works for safety measures | Ls | - | - | - | 4.12 | - | 4.12 | 90.84 |
| - Relocation/Replacement of Facilities | Ls | - | - | - | 3.00 | - | 3.00 | 66.00 |
| - Rehabilitation of spoil banks | Ls | - | - | - | 2.00 | - | 2.00 | 44.00 |
| **Sub Total** | | | 84.86 | 84.86 | 1866.96 | | | |

| **Power Complex** | | | | | | | |
| - Land Acquisition | | | | | | | |
| - Structure | 649 | ha | 12,000 | - | 7.79 | - | 7.79 | 171.34 |
| - Colony & access road | 100 | ha | 12,000 | - | 1.20 | - | 1.20 | 26.40 |
| | | | | | | | |
| **Sub Total** | | | 10.87 | 10.87 | 234.74 | | | |

| **Total** | | | 105.75 | 1.33 | 107.08 | 2355.88 | 5.6 |

| Less recovery on resale of spoil bank area | | | 35.88 | 35.88 | 799.25 | | | |

| Balance Cost | | | 89.87 | 1.33 | 71.20 | 1586.63 | 3.7 |

7-8.6
# PROJECT CONSTRUCTION SCHEDULE

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**LEGEND:**
- UNIT 1: FIRST UNIT COMMISSIONED
- >: CONTRACT AWARD

**NOTE:**
For detailed construction schedules, refer to drawings 841 through 844.
COMPARISON OF TARBELA INFLOWS, HISTORICAL RELEASES AND KIRMANI RELEASE REQUIREMENTS
FLOW PATTERNS IN POWER CHANNEL

FLOW (THOUSAND CUMECs)

TIME PERIOD

AUG  SEP  OCT  NOV  DEC  JAN  FEB  MAR  APR  MAY  JUN  JUL
KEY PLAN OF SOCIAL SURVEY AREA

NOTE:

THIS MAP IS BASED ON MAPPA SURVEY AT 1" = 400' WHERE POSSIBLE & ELSEWHERE ON 1:50,000 S.O.P. MAPS.

CONTOURS IN FEET.
CONCEPTUAL DIAGRAM SHOWING TECTONIC SETTING OF THE PROJECT AREA

DRAWING 7.3.2
NOTE:
THIS MAP IS BASED ON WAPDA SURVEY AT 1:50,000 SCALE AND ELSEWHERE ON 1:50,000 S.O.P. MAPS.
CONTOURS IN FEET.

LEGEND FOR SOILS:
ABSON ASSOCIATION
QAZI ASSOCIATION
RAJAR COMPLEX
WAREHABAD ASSOCIATION
ROUGH BROKEN LAND
ROCK OUTCROP
SIRKA ASSOCIATION
ROUGH MOUNTAINOUS LAND

LEGEN GENERAL
RIVER
ROAD
RAILWAY LINE
CONTOURS
SELECTED CHANNEL ALIGNMENT
DISTT. BOUNDARY
VILLAGES & TOWNS
GRAVEYARDS

SOILS OF THE PROJECT CORRIDOR

DRAWING 7.3.3
GHAZI GARIHALA HYDROPOWER PROJECT

LEGEND

EXISTING
- Town
- Village
- Utility road
- Canal
- Pipeline
- Road
- Railway
- High voltage transmission line
- Telephone line
- Tunnel
- Well

PROPOSED
- Slope
- Power
- Arched road bridge
- Dam road bridge
- Village road bridge
- Power bridge
- Railway bridge
- Road
- Cross drain - upstream
- Cross drain - downstream
- Sump

SCALE

ELEVATION
360 METERS

TOP OF LINING

NATURAL SURFACE LEVEL

GHAZI GARIALA HYDROPOWER PROJECT

POWER CHANNEL

PLAN & LONGITUDINAL PROFILE

RD 8+150 TO RD 12+200

LONGITUDINAL PROFILE

VERTICAL SCALE

HORIZONTAL SCALE
### SCHEDULE FOR IMPLEMENTATION OF MITIGATION WORKS

#### Sheet 1 of 2

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<th>YEAR AFTER START OF CONSTRUCTION</th>
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<td>1. Strengthening of Environmental Cell within WAPDA</td>
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<td>3. Issues related to land acquisition</td>
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<td>b) Cadastral survey</td>
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<td>c) Survey and village dialogue for current market values of land</td>
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<td>4. Development of spoil bank</td>
<td>a) Spoil disposal, compaction, and dressing with top soil</td>
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<td>b) Tubewell Installation on spoil banks</td>
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<td>5. Resettlement plan and implementation</td>
<td>a) Socio-economic survey/village dialogues for</td>
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<td>- Resettlement briefing,</td>
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<td>- Issue of work permits,</td>
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<td>- Tenant family support,</td>
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<tr>
<td>b) Preparation of resettlement plan</td>
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<td>c) Formation of water user association</td>
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<td>d) Implementation of resettlement plan</td>
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<td>6. Relocation and replacement of homes and other infrastructures</td>
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<tr>
<td>a) Household survey</td>
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<td>b) Relocation and replacement plan</td>
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<td>7. Salvage of archaeological sites</td>
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<td>8. Rehabilitation of borrow areas</td>
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<td>9. Supervision and monitoring of works by WAPDA Environmental Cell and Monitoring Consultants</td>
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<td>10. Project region development plan</td>
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<tr>
<td>a) Requirement survey</td>
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<td>b) Preparation of plan</td>
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<tr>
<td>c) Implementation</td>
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</table>

WAPDA
Project NGO
WAPDA Environmental Cell - Monitoring Consultants
Revenue Deptt./WAPDA

WAPDA - PNGO Joint
Department of Archaeology
PNGO - Local Government and other Departments

Draft Report
Final Report
Progress Report
### SCHEDULE FOR MONITORING PROGRAMME

**TASKS** | **PRE-CONSTRUCTION PERIOD** | **YEAR AFTER START OF CONSTRUCTION** | **OPERATION**
---|---|---|---
1. Appointment of Monitoring Consultants | | | 1
2. Preparation of monitoring programme including preparation of a list of monitoring indicators by WAPDA Environmental Cell/Monitoring Consultants after consultation with Technical Divisions of WAPDA/World Bank/PNGO | | | 2
3. During construction monitoring for implementation of proposed mitigation works, such as - Rehabilitation of spoil banks and installation of irrigation tubewells - Installation of tubewells for compensation water - Works related to the public safety - Relocation of infrastructure facilities - Archaeological/cultural properties - Social aspects | | 3 | 4
### SCHEDULE FOR MONITORING PROGRAMME

<table>
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4. Data collection by Technical Division of WAPDA regarding:
   - Land resources
   - Riverain morphology
   - Spoil banks
   - Water resources
     - River
     - Groundwater
   - River ecology

5. Social aspects including public health by PNGO

6. Collation and analysis of data, recommendations and planning of mitigation measures, if any by Monitoring Consultants in association with WAPDA Environmental Cell

7. Review by WAPDA planners/World Bank

8. Implementation of mitigation measures by WAPDA

---

**WAPDA**

**PNGO**

**WAPDA Environmental Cell - Monitoring Consultants**

**Reports**
APPENDIX A

OTHER LITERATURE STUDIED
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APPENDIX A
OTHER LITERATURE STUDIED

A.1 GENERAL

During the environmental assessment process, large volumes of published and unpublished literature were referred to. These included general literature on environmental assessment procedures and guidelines, environmental assessment reports of various projects and baseline data for the Project area available in different reports. Some of the publications have been utilised in the preparation of this Report. These have been listed at the end of the respective Chapters of this Report. The other literature consulted is listed herein.

A.2 REFERENCES

The following additional literature has been consulted:


- Environmental & Urban Affairs Division, Ministry of Housing and Works, Government of Pakistan; Environmental Profile of Pakistan, 1987.


7-A.1


APPENDIX B

SCOPING SESSIONS AND CONTACTS
# VOLUME 7
# ENVIRONMENTAL ASSESSMENT

## APPENDIX B
## SCOPING SESSIONS AND CONTACTS

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7-B(i)
APPENDIX B

SCOPING SESSIONS AND CONTACTS

B.1 INTRODUCTION

According to Paragraph No. 12 of Operational Directive 4.00 Annex A (Ref. 7.B.1), a scoping process is an important element of the overall environmental assessment for World Bank sponsored projects. The purpose of the scoping process is to identify and understand both the nature and extent of social or environmental impacts and to take the counsel of local Government agencies, public representatives, affected groups and local NGOs regarding the mitigation measures. The scoping process is, in reality, a public involvement mechanism designed to provide a forum wherein interested Government agencies, other public and private groups, and concerned individuals can express their views and concerns related to the proposed Project.

With this background, a number of scoping sessions have been conducted with civil administration, public representatives and probable affectees at Federal, Provincial, District, Union Council and village levels. Besides, personal contacts were made with various Provincial Departments in the Project area. A record of these scoping sessions and inter-agency meetings is presented in the subsequent Sections.

B.2 RECORD OF SCOPING SESSION WITH CIVIL ADMINISTRATION

The first scoping session was held at Tarbela on July 16, 1990 at 11 am in the Committee Room of Tarbela Dam Project. The meeting was attended by fifteen persons including three representatives of the civil administration of the concerned districts - Attock, Abbottabad and Swabi. They included the Deputy Commissioners of Abbottabad and Swabi Districts, and a senior official from Attock District representing the Deputy Commissioner.

The Commissioners of Rawalpindi, Abbottabad and Mardan Divisions were also invited to attend the scoping session. Due to last minute engagements of the Commissioners of Rawalpindi and Mardan they conveyed their regrets. Commissioner Abbottabad was on leave, hence the Deputy Commissioner Abbottabad was officiating as Commissioner. The remaining participants were from WAPDA (9) and PHC (3).

The meeting was chaired by the Member & Managing Director (Water), WAPDA. In his opening speech, the Chairman highlighted WAPDA's concern about the power shortage in the country and explained the Government's future action to overcome the crisis. He also gave reasons for the selection of Ghazi–Gariala Hydropower Project on a priority basis. He explained the philosophy and purpose of the scoping session, which is a public information forum and is basically an effort to involve different
sections of the local population to keep them informed and obtain their views as regards the social and environmental impacts of the Project. In this respect a series of such meetings was to be held at different levels - District, Union Council and village level. He then introduced Pakistan Hydro Consultants (PHC) and invited their Project Manager to brief the audience about the Project.

The Project Manager gave a comprehensive presentation dealing with the technical, engineering, financial and environmental aspects of the three major components of the Project - the barrage, the power channel and the power complex. He specifically explained the inherent socio-environmental issues of various layout alternatives. He explained that emphasis will be laid on avoiding disturbance to major population centres, graveyards, shrines and other cultural properties. Appropriate mitigation measures would also be incorporated in the Project design to minimise the inconvenience and hardship to the local population. This would include the release of compensation flows downstream of the barrage, bridging the channel at appropriate locations to ease the mobility of local population, minimising the consumption of valuable agricultural land, and formulating equitable land acquisition procedures and compensation levels for various type of land and properties.

After the presentation, the Chairman opened the floor for the questioning session. Various types of informative and issue-oriented questions were raised, which were satisfactorily answered by the Member and the Project Manager. The comments/questions put by various attendees were as follows:

Comment # 1 : Would there be protective embankments for the population centres on the right bank of the river as has been envisaged for Ghazi and Khalo in the case of Alignment "C"?

Comment # 2 : Why has Ghazi-Gariala Hydropower Project been given priority when other sites like Basha are also available?

Comment # 3 : What about the economic feasibility of this Project?

Comment # 4 : If the Project is so beneficial and has the least environmental impact, then why has it not been thought of earlier?

Comment # 5 : How will this Project fill the gap of lean generation period of Tarbela dam, when both the units will be dependent on the flows of the Indus river?

Comment # 6 : As regards compensation water, what will be the criteria of its assessment and what will be flow
situation of the river during low and high flow periods?

Comment # 7: District Authorities have proposed a modern colony on the right bank of the Indus river in the vicinity of the barrage pond area. The Project will improve the aesthetic and scenic beauty of the colony.

Comment # 8: It is suggested that irrigation supplies may be provided to the local population. This will ease their economic hardships and reduce the opposition towards the implementation of the Project. The local population had been once disturbed by the implementation of Tarbela dam, and now they will again be disturbed without any benefits.

Comment # 9: As envisaged, the barrage will be located in NWFP, while the power generation unit will be in the Punjab. What will be the Government's action as regards the apportionment of the royalty?

Comment # 10: What will be the output of the Project in terms of units, and what will be its contribution in the overall country's power output?

Comment # 11: What will be the effect of the prospective Kalabagh Dam Project on the power generation from the Project?

Comment # 12: When will the Project be completed?

Comment # 13: It is referred in the speech that the Project will avoid population centres. What will be the position of Kamra village where limited space is available for the right-of-way of the power channel? Similarly, Ghurghushti is a big town coming in the way of the channel, will that also be avoided?

Comment # 14: What will be the position where the channel crosses the roads and railroad? Will there be bridging and how will that be achieved during construction without disturbing the vehicular/railway movements?

Comment # 15: The Chhachh plain of Attock District is agriculturally very important in the district and the people invariably have small landholdings. The people are likely to resist land acquisition for the Project. What will be the policy to compensate the affected groups?
After the questioning session, the Chairman further emphasised the importance of the forum session and asked the civil authorities to extend every possible assistance for the organisation of such meetings with different local groups. The meeting was adjourned by the Chairman at about 1:00 pm.

B.3 RECORD OF SCOPING SESSION WITH MEMBERS OF DISTRICT COUNCIL, ABBOTTABAD

The second scoping session was held at Abbottabad on November 13, 1990 at 11 am in the District Council Hall. The meeting was attended by the representatives from District Council, District Administration, members of the Union Councils of Haripur Tehsil, Chief Engineer & Project Director, and Superintending Engineer (Ghazi-Gariala Hydropower Project) WAPDA, and the Project Manager, Sociologist and Manager Field Operations from PHC.

The session was conducted in the national language, Urdu. An Urdu pamphlet, which is attached at the end of this Appendix, was also distributed among the participants. The pamphlet included a brief description of the Project and enumerated measures incorporated in the planning to mitigate the foreseen socio-environmental impacts of the Project.

The meeting was chaired by the Chairman, District Council of Abbottabad District. In his opening speech, the Chairman introduced the visitors from WAPDA and PHC and explained the purpose of their visit. Then he invited Chief Engineer & Project Director (WAPDA), to provide the details of the Project. In his speech, the Chief Engineer briefly introduced the Project and highlighted the aims and objectives of the meeting. He explained the philosophy of the scoping session as a medium of public information through which not only is the Project introduced to the different sections of Government machinery, local Government agencies and the local population but also their views on socio-environmental issues are obtained so that these are incorporated in the Project planning. He then introduced PHC as the consultants for the Project and invited the Project Manager to provide details of the Project.

The Project Manager gave a comprehensive presentation of the Project. He dealt with the technical, engineering, financial and environmental aspects of the three major components of the Project - barrage, power channel and power complex. He compared the feasibility-level layout proposed by PHC with that of pre-feasibility proposal of WAPDA and explained the need for changes with reference to socio-environmental, technical and economic reasons. He also explained the various siting options studied for the Project components. These had been analysed to evaluate not only their technical and financial viability but also the inherent socio-environmental issues linked to each alternative. He explained that emphasis has been given to those options which avoided disturbances to major population centres, graveyards, shrines and other cultural properties. Consideration had also
been given to adopting various types of mitigation measures in the Project design with a view to minimising inconvenience and hardship to the local population, such as providing a large number of bridges and cross drainage structures over the power channel, provision of compensation flows downstream of the barrage, etc.

The presentation was followed by a question/answer session. Various types of informatory and issue-oriented questions were raised, which were satisfactorily answered by the Chief Engineer (WAPDA) and the Project Manager (PHC). The comments/questions put forward by various participants were as follows:

Comment # 1: Has the barrage Site 'A' been finally selected?

Comment # 2: If it is so, what are the marking pillars for, at other places in the river?

Comment # 3: Will the power channel be concrete-lined throughout the length?

Comment # 4: What will be the width of acquired land?

Comment # 5: Would the cross drainage structures on the power channel be used as bridges?

Comment # 6: Has the turning of the power channel near Ghazi Hamlet been provided to avoid the grid station?

Comment # 7: Ghazi is the most-affected area. Its land was first acquired for resettlement of affectees from Tarbela dam and for WAPDA colony. Then, the military has acquired a large piece of land and now the Ghazi-Gariaala Project would take over more land. Nobody has considered the development of this area and employment opportunities have not been provided to the local people in the ongoing project of Tarbela. Certain compensation cases have not been settled even after the lapse of 20 years of construction of Tarbela dam. Are there some plans for the settlement of problems of the people of Ghazi area?

Comment # 8: As has been indicated, the construction of a bridge across the river along the barrage will open business opportunities for the local people. Where will the land for the growth of Ghazi come from when the village would have the channel on one side and the river on the other?

Comment # 9: There is a trend of insurgence of dacoits and smugglers from the right bank of the river. The construction of a bridge along the barrage may
B.4 RECORD OF SCOPING SESSION WITH MEMBERS OF DISTRICT COUNCIL, ATTOCK

The third scoping session was held at District Council Hall, Attock on November 14, 1990 at 11 am. The meeting was attended by representatives from the District Council, the District Administration, members of the Union Councils of Attock Tehsil and Small Dams Organization of the Punjab. WAPDA was represented by Chief Engineer and Superintending Engineer (GCHP), while from PHC the Project Manager, Sociologist and Manager Field Operations participated in the meeting.

The session was conducted in the national language, Urdu. An Urdu pamphlet was also distributed among the participants. The pamphlet included a brief description of the Project and enumerated measures incorporated in the planning to mitigate the foreseen socio-environmental impacts of the Project.

The meeting was chaired by the Chairman, District Council of Attock District. In his opening speech, the Chairman introduced the visitors from WAPDA and PHC and explained the purpose of their visit. Then he invited the Chief Engineer & Project Director (WAPDA), to provide the details of the Project.

In his speech, the Chief Engineer briefly introduced the Project and highlighted the aims and objectives of the meeting. He explained the philosophy of the scoping session as a medium of public information through which not only is the Project introduced to the different sections of Government machinery, local Government agencies and the local population but also their views on socio-environmental issues are obtained so that these are incorporated in the Project planning. He then introduced PHC as the Consultants for the Project and invited the Project Manager to provide details of the Project.

The Project Manager gave a comprehensive presentation of the Project. He dealt with the technical, engineering, financial and environmental aspects of the three major components of the Project: the barrage, the power channel and the power complex. He compared the feasibility-level layout proposed by PHC with that of the pre-feasibility proposal of WAPDA and explained the need of the changes with reference to socio-environmental, technical and economic reasons. He also explained the various siting options studied for the Project components. These had been analysed to evaluate not only their technical and financial viability but also the inherent socio-environmental issues linked to each alternative. He explained that emphasis has been given to those options which avoided disturbances to major population centres, graveyards, shrines and other cultural properties. Consideration had also been given to adopting various types of mitigation measures in the Project design with a view to
minimising inconvenience and hardship to the local population, such as providing a large number of bridges and cross drainage structures over the power channel, provision of compensation flows downstream of the barrage, etc.

The presentation was followed by a question/answer session. Various types of informatory and issue-oriented questions were raised, which were satisfactorily answered by the Chief Engineer (WAPDA) and Project Manager (PHC). The comments/questions put forward by various participants were as follows:

Comment # 1 : What have been the criteria for locating the bridges on the power channel? The bridges should be located according to official tracks appearing in the land record.

Comment # 2 : A large tract of land in Chhachh area had already been acquired for the Tarbela-Lawrencepur road, the railway line and the camping ground of the Pakistan Military Academy. WAPDA has also used the land for installation of two 500-kV lines, while two more lines are proposed. The people cannot use about 150 feet on each side of the power line for plantation or other development activities except for arable farming. No compensation is paid for such areas. With the construction of the power channel, the land area will further reduce, with the result that there would be economic pressure on the people of the area. To provide some release from this pressure, irrigation supplies should be provided to the area.

Comment # 3 : If it is not possible to provide irrigation supplies from the channel, the Government should provide tubewells, the operation of which could be managed by the Small Dams Organisation of the Punjab. If such facilities are not provided, the people may start illegal pumping from the channel. The irrigation requirement of the area is about 6 cusecs.

Comment # 4 : Will the life of the Project be affected by the life span of Tarbela dam?

Comment # 5 : Will the service roads along both banks of the power channel be open for public use?

Comment # 6 : The fate of Khanpur dam is in front of us. WAPDA is invariably blamed for its delayed construction. In the light of this, what will be the fate of GGHP?
Comment # 7 : In Chhachh area, the groundwater level is not uniform. At places the groundwater level is very low, while in other areas it is so high that waterlogged conditions have developed. The people of such areas may object to the Project on the grounds that the power channel may contribute to further aggravate the waterlogged conditions. There are no drainage facilities available in the area. Therefore, it is necessary that the channel design and operation be such as to keep seepage to a minimum.

Comment # 8 : How will the water pumped by the drainage tubewells be disposed off?

Comment # 9 : The majority of the Chhachh area is well irrigated. Therefore, groundwater is very important for the people of this area. Will the pumping of water into the power channel affect the water table?

Comment # 10 : Your solution for the preservation of groundwater in Chhachh area is satisfactory. What will be the position in the barrage ponding area?

Comment # 11 : What measures will be adopted for the safety of the local population?

Comment # 12 : Why has the channel been diverted toward Kamra Aeronautical Complex beyond GT road? Would it not be better if it were taken southward to the Haro river?

B.5 RECORD OF SCOPING SESSION WITH THE MEMBERS OF THE NATIONAL AND PROVINCIAL ASSEMBLIES

The scoping session with Members of the National and Provincial Assemblies from the Project area was held at Tarbela on January 14, 1991 at 10 am in the Committee Room of Tarbela Dam Project. The meeting was attended by Members of the National Assembly (MNA) representing relevant areas of Attock and Swabi District. The MNA-elect of Abbottabad District, who is also the Speaker of the National Assembly, was not present in the meeting as he was on tour abroad. The meeting was also attended by Members of Provincial Assemblies representing relevant areas of Attock, Abbottabad and Swabi Districts. The Deputy Commissioner of Swabi District and a member of the Attock District Council, were also present.

The meeting was chaired by Member and Managing Director (Water), WAPDA. In his opening speech, the Chairman highlighted the purpose of the meeting and introduced the participants from WAPDA and Pakistan Hydro Consultants. He then invited the Project Manager of the Ghazi-Gariala Hydropower Project to brief the
The Project Manager gave a comprehensive presentation dealing with the engineering and environmental aspects of the three major components of the Project: the barrage, the power channel and the power complex. He gave a brief account of the pre-feasibility studies and highlighted the changes made in the feasibility-level design to improve the Project economics and alleviate the environmental impacts. He also explained the inherent socio-environmental aspects of various layout and design alternatives studied during the feasibility study. He gave a comprehensive account of the steps taken to mitigate the effects of the Project on the socio-cultural and environmental conditions of the Project area.

After the presentation, the Chairman opened the floor for questions. Various types of informative and issue-oriented questions were raised, which were satisfactorily answered by the Chairman. These were as follows:

Comment # 1: If Site 'C' for the barrage can provide more storage capacity thus more power generation, why has this site not been selected?

Comment # 2: The people of Kamra have complained that their graveyards would be affected by the power channel, so it is desired that this should be avoided. (This has been taken care of by shifting the alignment of the power channel further uphill).

Comment # 3: The power complex along with the headponds located at Barotha may affect Barotha village.

Comment # 4: Providing a railway bridge along the barrage should have also been considered as it will be useful for Gadoon Amanzai Industrial Estate. (The Chairman explained that the Pakistan Railway are aware of the Ghazi-Gariala Hydropower Project. If they have a plan to provide a bridge, they can approach WAPDA. In the absence of such communication, this facility cannot be provided by WAPDA on its own).

Comment # 5: It is realised that this Project is of national importance, but to watch the interest of the people is equally important. Therefore, it is necessary that the Project decisions should include steps for the welfare of local population not only in the economic field but also on social grounds. A complementary Regional Development Plan should be prepared.
Comment #6: WAPDA had prepared a feasibility report on the Ghazi Lift Irrigation Scheme for the supply of water to the Chhachh area. This was in parallel to the water supply to the Swabi District through Pehur canal. The latter was implemented, while the former was not taken up because this was located in the Punjab. It is a pity that villages like Barotha, Dher and Jaba have not been considered for basic amenities like electricity, roads and water supply, while villages like Nizampur on the other side of the river enjoy all the facilities. In the light of this, it is recommended that when the Government is spending two billion dollars for this Project, some additional amount may be provided in the Project cost for the development of the area. In this respect, it is recommended that the following four steps be adopted as an integral part of this Project:

- an irrigation scheme should be included, specially between the GT road and Barotha,
- all the villages should be provided with basic amenities, including village electrification of Dher, Jaba and Barotha, as a part of this Project. This will develop goodwill and ease the implementation of the Project,
- job opportunities should be guaranteed during the construction and operation periods for the local people, particularly for affectees, and
- the affectees should be equitably compensated for the loss of their land on the basis of the current market rates, instead of the one-year average. A local committee should be constituted for land assessment, valuation and payment of compensation.

Comment #7: These recommendations have been made on the grounds that the people are forcing the public representatives to take steps for stopping the Ghazi-Gariala Hydropower Project as the people of NWFP have done for Kalabagh dam. These are just layman's arguments. In the light of national interest we are consoling the local people on the plea that your demands would be taken up at the Government level. Therefore, it is requested that serious consideration should be given to the
suggestions referred to above. This should be treated as a complementary scheme and implemented simultaneously. (The Chairman explained that the purpose of this meeting was to listen to the problems of the local people as may arise due to this Project and he assured them that WAPDA will include these recommendations in the Report as minutes of the meeting).

Comment # 8 : Village road bridges should be provided on the paths/roads shown in the Revenue records of the area.

Comment # 9 : Since Full Supply Level (FSL) in the power channel will be higher than ground level of area towards the Indus river, it may cause waterlogging particularly in Ghazi and Khalo area.

Comment # 10 : The barrage pond will cause waterlogging in Topi and Swabi area where the water level is already high.

Comment # 11 : Road crossing arrangements should be provided through the drainage structures also.

Comment # 12 : The spoil should be spread specially between Churghushti and the GT road.

B.6 RECORD OF FORUM MEETING WITH THE SPEAKER, NATIONAL ASSEMBLY

The forum meeting with the Speaker of the National Assembly was held in Committee Room No. 1 of the National Assembly Building on March 13, 1991. The Speaker of the National Assembly is the MNA representing the Project area falling in Abbottabad District.

The meeting was also attended by the Aides of the Speaker, Member and Managing Director (Water) WAPDA, General Manager (HEP) WAPDA, Chief Engineer and Project Director (GGHP) WAPDA and Project Manager (GGHP) PHC.

The Member and Managing Director (Water) introduced the members from WAPDA and the Consultants to the Speaker. Details of the Project and its socio-environmental considerations were provided by the Project Manager PHC. After listening to the scope of the Project, the Speaker appreciated its importance. He, however, showed his concern on the difficulties of the population of the Project area. His main comments were related to the following issues:

- compensation water in the river downstream of the barrage,
nullah crossings and bridges across the power channel,
irrigation supply from the channel or tubewells for the area,
a girls' college for the Ghazi area,
an industrial estate for the Ghazi area,
a road between Ghazi and Charii Kasi to link the area with Hasan Abdal - a shorter route than the existing one via Lawrencepur, and
land compensation procedures should be streamlined and the difficulties faced by the people in the case of Tarbela Dam Project should not be repeated.

B.7 RECORD OF VILLAGE LEVEL SCOPING SESSIONS

The village level scoping sessions were held from November 15, 1990 through December 2, 1990. The venue of each session invariably was the Union Council building. To disseminate the Project information to a maximum number of people, an effort was made that each village of the respective Union Council likely to be affected by the Project was represented in the scoping session. The Chairman of the respective Union Council was informed about the purpose and date of the visit. He in turn disseminated the news through announcement from the mosques of the villages concerned. In all, 10 Union Councils were covered in 14 scoping sessions. In large Union Councils or those constituting sensitive areas, more than one session was arranged. The programme of the meeting was announced in each of the villages concerned through the Chairman, Union Council.

The scoping programmes proceeded as follows:

<table>
<thead>
<tr>
<th>VENUE</th>
<th>UNION COUNCIL</th>
<th>DATE</th>
<th>NO OF PARTICIPANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Ghazi</td>
<td>Nov. 15, 1990</td>
<td>27</td>
</tr>
<tr>
<td>Jallo</td>
<td>Ghazi</td>
<td>Nov. 17, 1990</td>
<td>23</td>
</tr>
<tr>
<td>Hasanpur</td>
<td>Ghazi</td>
<td>Nov. 18, 1990</td>
<td>43</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Ghazi</td>
<td>Nov. 20, 1990</td>
<td>12</td>
</tr>
<tr>
<td>Ghurghushti</td>
<td>Ghurghushti</td>
<td>Nov. 20, 1990</td>
<td>54</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>Malak Mala</td>
<td>Nov. 21, 1990</td>
<td>26</td>
</tr>
<tr>
<td>Bhangi</td>
<td>Bhangi</td>
<td>Nov. 24, 1990</td>
<td>32</td>
</tr>
<tr>
<td>Khagwani</td>
<td>Khagwani</td>
<td>Nov. 25, 1990</td>
<td>18</td>
</tr>
<tr>
<td>Musa</td>
<td>Musa</td>
<td>Nov. 26, 1990</td>
<td>29</td>
</tr>
<tr>
<td>Bahadur Khan</td>
<td>Bahadur Khan</td>
<td>Nov. 27, 1990</td>
<td>21</td>
</tr>
<tr>
<td>Kamra</td>
<td>Kamra</td>
<td>Nov. 28, 1990</td>
<td>31</td>
</tr>
<tr>
<td>Ghazi</td>
<td>Ghazi</td>
<td>Nov. 29, 1990</td>
<td>52</td>
</tr>
<tr>
<td>Nurpur Karam Alia</td>
<td>Rumian</td>
<td>Dec. 02, 1990</td>
<td>43</td>
</tr>
<tr>
<td>Barotha</td>
<td>Surag Salar</td>
<td>Dec. 02, 1990</td>
<td>107</td>
</tr>
</tbody>
</table>
In addition, informal visits were made to the villages located in the Gandghar mountains. These villages, though far away from the Project corridor, will be indirectly affected. The power channel will obstruct their communication with the central place of market and education, ie Ghazi. These villages include Khairbara, Pipliala, Bandi, Bandi Choa, Kathera, Ghara and Pir Thana. In these villages informal interviews of individuals were recorded.

Each scoping session started with an opening address of the Principal Environmentalist. This included a description of the Project features with the help of a map, the siting alternatives considered for various components and their impacts, the remnant impacts of the Project and their mitigation measures. The participant were also provided with an Urdu pamphlet describing the Project, its benefits and mitigation actions incorporated in the Project design.

After the briefing session the participants were invited to put forward questions, comments and suggestions. During this process it was observed that there were a few areas where almost all the villages have unanimity, while other issues are localised. These have been recorded here accordingly.

Common Issues

- The people generally have small landholdings. They would not like to part with their land, which is invariably the sole source of their livelihood.

- The people would like to have land for land if it is located in the vicinity. The people of Ghazi and Chhachh tracts felt strongly about this, while those Sarwala tract agreed to migrate to other districts of the Punjab if they are resettled there properly.

- In the absence of land-for-land compensation, they would accept cash.

- Land valuation on a one-year average basis was not acceptable. They wanted compensation at current market rates.

- They have asked for re-assessment of their land, as the revenue record has not incorporated the developments carried out lately.

- Formulation of a committee, with representation from the villages, for re-assessment and land valuation was strongly suggested.

- Compensation should be equitable and prompt.
Irrigation water for the area was overwhelmingly demanded. If not possible from the power channel, installation of tubewells was suggested.

Job opportunities on the Project for local people, particularly for those who would be affected by the Project, during construction and the operation period, was a general demand.

Industrialisation in the area was suggested to alleviate the hardship of land acquisition and for general development of the area. The existing facilities at Tarbela dam and Kamra Aeronautical Complex do not provide many opportunities to the local people. The people of Chhachh and Ghazi tracts suggested the establishment of industry on a cooperative basis with the Government as a party. They do not want big industrialists from Lahore, Karachi or other cities.

Villagers invariably asked for a separate bridge for their village, preferably on an existing track. Nullah crossings should also be made available for village traffic.

Uneconomic land pieces left over by the Project during the land acquisition process should also be acquired.

In the Chhachh and Ghazi areas, the nullah flows cause damage to the villages. Therefore, these should be properly trained or diverted. Construction of small dams on these nullahs was also suggested for flood protection and supply of irrigation water.

Disruption of graveyards and shrines should be avoided at all costs.

**Specific Issues**

- The land areas of Ghazi, Khalo and Ghurghushti villages should be classified as residential land.

- The channel should be shifted to the site of the abandoned railway track. If it is not possible, then the right-of-way of the railway track should be developed and distributed among the affectees of Barazai village.

- The alluvial fan in Chhachh area should be developed for irrigation for the affectees of Ghurghushti and Malak Mala villages.

- The river should be trained to protect the agricultural land of Jallo, Qazipur and Hasanpur villages.

7-B.14
The people of Barotha village suggested renaming the Project as Ghazi-Barotha Hydropower Project.

- Siting of the tailrace north of Barotha village was preferred, as the southern option will disrupt the irrigation system and consume irrigated land.

### B.8 RECORD OF VILLAGE LEVEL SCOPING SESSIONS WITH WOMEN

The village level scoping sessions with women were held from November 15, 1990 through December 2, 1990. The venues of scoping sessions were a girls' school or the house of a village notable. Two female sociologists conducted the scoping sessions and social survey of women. The procedure of disseminating the news regarding the scoping meetings was the same as used for the male scoping session (B.7). The scoping programme proceeded as follows:

#### SCHEDULE OF VILLAGE-LEVEL SCOPING SESSIONS AND SURVEY

<table>
<thead>
<tr>
<th>VILLAGE</th>
<th>UNION COUNCIL</th>
<th>DATE</th>
<th>FEMALES PRESENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Ghazi</td>
<td>Nov. 15, 90</td>
<td>23</td>
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<tr>
<td>Jallo</td>
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<td>Hasanpur</td>
<td>Ghazi</td>
<td>Nov. 18, 90</td>
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<td>Ghurghushti</td>
<td>Ghurghushti</td>
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<td>15</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Ghazi</td>
<td>Nov. 20, 90</td>
<td>44</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>Malak Mala</td>
<td>Nov. 21, 90</td>
<td>9</td>
</tr>
<tr>
<td>Barazai</td>
<td>Malak Mala</td>
<td>Nov. 21, 90</td>
<td>39</td>
</tr>
<tr>
<td>Walidad</td>
<td>Bhangi</td>
<td>Nov. 24, 90</td>
<td>15</td>
</tr>
<tr>
<td>Khagwani</td>
<td>Khagwani</td>
<td>Nov. 25, 90</td>
<td>17</td>
</tr>
<tr>
<td>Musa</td>
<td>Musa</td>
<td>Nov. 26, 90</td>
<td>17</td>
</tr>
<tr>
<td>Jatial</td>
<td>Bahadur Khan</td>
<td>Nov. 27, 90</td>
<td>17</td>
</tr>
<tr>
<td>Kamra Kalan</td>
<td>Kamra</td>
<td>Nov. 28, 90</td>
<td>23</td>
</tr>
<tr>
<td>Nurpur Karam Alia</td>
<td>Rumian</td>
<td>Dec. 02, 90</td>
<td>18</td>
</tr>
<tr>
<td>Barotha</td>
<td>Surag Salar</td>
<td>Dec. 02, 90</td>
<td>12</td>
</tr>
</tbody>
</table>

Each scoping session proceeded with an opening address by a female sociologist. This included the description of the project features with the help of a map, the siting alternatives considered for various components and their impacts, the remnant impacts of the Project and their mitigation measures. The participants were also provided with an Urdu pamphlet describing the Project, its benefits and mitigation actions incorporated in the Project design.

After the briefing session the participants were invited to put forward questions, comments and suggestions particularly related to the social problems of the womenfolk as related to the Project or otherwise. These are as follows:
Concerning the Project, almost all the participants have expressed their fears for the loss of income due to the process of land acquisition. They demanded substitute income sources in the form of job opportunities for their males in the Project or some new industries set up in the area.

Due to small landholdings, the women folk face difficulties in running the household. They feel a dire need of vocational opportunities for women to share the income-generating responsibilities of their males.

Health facilities in the area, particularly for mother and child care, are insufficient. This needs special attention of Government agencies.

Education facilities in general and for female children in particular are scanty.

Recreation facilities for children are not available.

B.9 OTHER CONTACTS

The members of the environmental assessment team visited various Government offices at Attock and Haripur to collect data/information about the Project area and discuss different issues.

These included the following offices:

- Agricultural Extension,
- Agricultural Statistics,
- Forestry and Wildlife,
- Farm Forestry,
- Soil Conservation,
- Public Health Engineering,
- Community Health,
- Land Revenue, and
- Civil Administration.

REFERENCE

ناظری کردار والی اور پر اجراً ہنگام

تعریف:

پاکستان کا ا animateWithDuration مسکنے سے نئے بھیتے سے ساتھ سے دوبارہ بیج جس کے
توارینے کے موجودہ سے ایک سے کوئی کم طاقت تک سنی ہوئی ہے۔ اس کے وجود میں سامنے ہوئے پاکستان
کا قرار دینے کی ضرورت ہے۔ میں تودہ چگا پر اجراً کے لئے۔ پاکستان کا ہمیشہ ہی کوئی ہمیشہ
کو ضرورت ہے کہ معاہدہ کا ہمیشہ پانی سے پانی میں گم کر کے سبھی پڑھی تو روشنی کے ہیں۔ پاکستان کے
کسے کسے ہے جس میں تودہ چگا حس کی مدد سے ملک کی ضرورت اور دو دوسرے پر اجراً کی 
رہنمائی کی۔ ہمیں دوسرے پر اجراً میں پاکستان کا ہمیشہ پانی سے پانی میں گم کر کے سبھی پڑھی تو روشنی کے
ساتھ معاہدے کا ہمیشہ پانی سے پانی میں گم کر کے سبھی پڑھی تو روشنی کے
جب کے ہیں۔ اس ہمیشہ پالنے گم کر کے سبھی پڑھی تو روشنی کے
فکر ہے پاکستان کا ہمیشہ پانی سے پانی میں گم کر کے سبھی پڑھی تو روشنی کے
ساتھ معاہدے کا ہمیشہ پانی سے پانی میں گم کر کے سبھی پڑھی تو روشنی کے

انضمام کے جزورات

ناظری کردار والی اور پر اجراً ہنگام کا اور پر اجراً ہنگام سے گنگا کا انضمام ہے۔
لا يوجد نص يمكن قراءته بشكل طبيعي من الصورة المقدمة.
APPENDIX C

LAND VALUATION STUDY
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APPENDIX C

LAND VALUATION STUDY

C.1 INTRODUCTION

As a part of the environmental studies for the Ghazi-Gariala Hydropower Project, the Consultants were required to carry out a land valuation study for the Project area. The study consists of two tasks.

Task 1 comprises a case study of land acquisition and compensation procedures recently adopted by WAPDA at Chashma Right Bank Canal Project (CRBC) - Stage II, which is currently under implementation. This includes an assessment of land acquisition procedures based on a review of reports and typical cases, discussions with concerned WAPDA staff of CRBC and civil authorities at D.I. Khan, and a field trip to the CRBC area to record the reactions of the affected population.

Task 2 comprises a thorough analysis of the case study referred to above; a field visit to the Project area, and recommendations for land acquisition procedures to be adopted for the Ghazi-Gariala Hydropower Project. This will be based on the inferences drawn from the case study and a field study carried out in the Project area on the lines as adopted for the CRBC case study. The ultimate objective of the study is to formulate recommendations for smooth progress, equitable procedures, and terms reasonably acceptable to the local population.

In this respect the Consultants engaged a Land Valuation Specialist who remained in the CRBC Stage II area from November 13, 1990 to November 25, 1990 to accomplish Task 1. After the completion of Task 1, he proceeded to Task 2. To accomplish this task he remained in the Project area from December 23, 1990 to January 4, 1991. His findings are discussed in the subsequent Sections.

C.2 TASK 1

C.2.1 Methodology

During his visit to the CRBC Stage II area, the Land Valuation Specialist contacted officials of WAPDA and land acquisition staff and had discussions on various aspects of the land valuation and compensation procedures adopted for the CRBC Project. Discussions were particularly oriented towards the step-by-step procedure adopted at CRBC, from the survey of the alignment to the final payment to owners of the land.

Photocopies of relevant documents were also obtained from WAPDA and land acquisition office to support the findings and to illustrate the deviations from the Land Acquisition Act made by
appropriate authorities under critical conditions and special circumstances encountered at the time of land acquisition.

In addition to assessing the Government's procedures for land acquisition, interviews were conducted with selected affectees to obtain their views on land acquisition procedures, valuation and compensation.

C.2.2 Land Acquisition Act

The laws for acquisition of land for public purposes such as urban development, new roads, railway lines and canals etc. were introduced in the year 1894 through the Land Acquisition Act. In addition, 'Rules for Punjab Land Acquisition' were also published in the Gazette of the Punjab, extraordinary, dated February 22, 1983 setting out the procedure for land acquisition. These rules are also applicable in NWFP. For the acquisition of land for CRBC the above-mentioned Act and Rules were implemented by WAPDA.

C.2.3 Institutional Set Up

Land acquisition staff working under WAPDA consists of the following:

- **Land Acquisition Collector WAPDA**
  (on deputation from Provincial Revenue Department)

- **Tehsildar (Land Acquisition)**

- **Naib Tehsildar (Land Acquisition)**

- **Kanungo (Land Acquisition)**

- **Four Patwaris (Land Acquisition)**

- **Kanungo (Land Acquisition)**

- **Four Patwaris (Land Acquisition)**

The duties of the various officials are as follows:
Patwari (Land Acquisition)

- to note down the names of the owners of the land from Jamabandi maintained by the Provincial revenue staff;

- to note down, on the prescribed form: tenants, field numbers with area, mode of irrigation and land revenue paid by the owners/tenants;

- when preliminary notification under Section 4 of the Land Acquisition Act is issued, to complete Naqsha (Form) No. 1 prescribed by the Department for land needed for any public purposes including: name of owner, mortgagee, permanent tenants, land area, land revenue collected in cash or kind, classification of land, crops, trees, wells, and houses existing on the land to be acquired; and

- on the basis of this information, to complete the form of Naqsha No. 2 after implementation of Section 8 of the Land Acquisition Act by the Collector, illustrating: field numbers which are to be acquired, area in acres, classification of land and compensation to be paid for the land, trees and buildings, if any, and total compensation.

Kanungo (Land Acquisition)

- he has to guide the Patwari (Land Acquisition) in legal matters and, if necessary, to solve any problem faced by the Patwari at site.

Naib Tehsildar (Land Acquisition)

- he has to check the work of Patwaris and Kanungos and to see that prescribed forms are filled up correctly by the lower staff which will be helpful in announcing the award by the Land Acquisition Collector.

Tehsildar (Land Acquisition)

- in addition to the duties prescribed for the Naib Tehsildar, he also inspects the site if classification of land is challenged by interested persons after issuance of notice under Sections 9 and 10 of the Land Acquisition Act.

Land Acquisition Collector

- collector usually means the Deputy Commissioner of a District. It may also mean any other Officer specially
appointed by the Provincial Government to perform the function of a collector under the Land Acquisition Act. All of the staff mentioned above is directly under him and works under his guidance. The Land Acquisition Act moves around the Collector. When notices under Section 9 and 10 of the Land Acquisition Act are notified, he gives a personal hearing to all objections relating to the measurement, classification of land and rate of compensation awarded as filed by the interested persons within 15 days after the date of publication of the notices under Sections 9 and 10. He makes enquiries into measurement, value and other claims under Section 11 of the Land Acquisition Act and announces the award.

C.2.4 Procedure of Land Acquisition

The acquiring agency has to submit an application to the Collector of the District to acquire land under the Act, giving full justification of the public purpose involved and minimum area required by it. Then the Collector of the District examines its feasibility taking into consideration the genuineness of the public purpose and suitability of the area proposed for acquisition. After examining the feasibility under Rule 4 of the Punjab Acquisition Rules 1983, the Collector issues a notification under Section 4 of the Act stating clearly the name of the village or locality, tehsil and details of dimensions and boundaries.

Section 4 states that:

"Whenever it appears to the Provincial Government that land in any locality is needed or is likely to be needed for any public purpose, a notification to that effect shall be published in the official gazette and the Collector shall cause public notice of the substance of such notification to be given at convenient places in the said locality".

Whenever the acquiring agency puts up an application to the Deputy Commissioner/Provincial Collector for notification of Section 4, the agency has to provide the details of the land to be acquired under Rule 5 of the Punjab Land Acquisition Rules, 1983.

After the issuance of this notification under Section 4, the Collector has to take immediate necessary steps to have the area surveyed and submit his report to the Commissioner not later than 60 days from the publication of the notice.

The Commissioner then has to issue a notification under Section 5. This has to be done not later than one year from the date of publication of the notification under Section 4.
Within six months of the publication of the notification under Section 5, the Commissioner has to issue a declaration under Section 6. If he fails to notify this declaration within this period the requisition proceedings shall be deemed to have to come to an end, unless the Board of Revenue, in its discretion, extends the time for the issuance of the notification under Section 6.

After the publication of the declaration under Section 6, the Land Acquisition Collector has to announce the award within a period of six months, failing which the entire responsibility towards the payment of 8% compound interest falls on the officials found guilty of inordinate delay.

Every objection received by the Collector under Section 5-A has to be disposed of by the Collector with the least possible delay and his report with recommendations under sub-section (2) or under sub-section (3), as the case may be, has to be forwarded to the Commissioner within a period of 90 days from the date of the publication of the notification under Section 5. The decisions of the Commissioner on these objections has to be announced by him within a period of three months from the date of receipt of the recommendation of the Collector. If the report of the Collector is not forwarded to the Commissioner or if the decision of the Commissioner is not announced within the period specified in the Rule, the objection shall be deemed to have been carried and the acquisition proceedings shall come to an end. The Collector, after an enquiry into the objections regarding measurements, value and claims, announces the award under Section 11 of the Land Acquisition Act.

The order of notification of the various sections which are involved in land acquisition procedures is given below:

<table>
<thead>
<tr>
<th>ORDER</th>
<th>SECTION NO.</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>Publication of preliminary notification and powers of officers thereupon.</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Payment for damage for entry into the land.</td>
</tr>
<tr>
<td>3</td>
<td>5A</td>
<td>Hearing of objections filed by any interested person regarding the acquisition of land and damage to the land by marking levels, boundaries and cutting trenches.</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>Declaration to be notified by the Commissioner that land is required for public purpose.</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>To take possession of the land to be acquired by the Collector after</td>
</tr>
</tbody>
</table>

7-C.5
declaration notified under Section 6 of the Land Acquisition Act.

6 8 The Collector shall thereupon cause the land to be marked out, measured and planned.

7 9 Notice to the interested persons that the Government intends to take possession of the land and that claims for compensation for all interests in such land may be made to the Collector.

8 10 This delegates power to the Collector to record statements of persons possessing any interest in the land or any part thereof as co-proprietor, sub-proprietor, mortgagee, tenant or otherwise.

9 23 Under this Section, the compensations to the owners are determined. Matters to be considered in determining compensation are as follows:

i) Market value of the land on the date of publication of the notification under Section 4.

ii) The damage sustained by the person interested by taking of any standing crops or trees.

iii) Damage sustained by the person at the time of the Collector's taking possession of the land.

iv) Damage sustained by the person at the time of acquisition of land injuriously affecting his other property, movable or immovable.

v) If compelled to change his residence.

vi) Damage resulting from diminution of profits.

10 24 Matters to be neglected in determining compensation.

11 11 Enquiry into measurements, value and claim and award by the Collector.
Under this Section the person interested may request the collector to refer the case to the court for determination/decision.

C.2.5 Valuation Procedures Adopted at CRBC

General

Land values and compensation are determined according to Section 23 of the Land Acquisition Act of 1894. Certain procedures are laid down to determine the amount of compensation to be awarded for land acquired under the Land Acquisition Act.

This Act cannot be ignored by the Collector, who is the Deputy Commissioner, or any other appointed authority, in determining compensation. This is a provision which is consistently upheld in various judicial decisions. Even an agreement between the affectee and the department acquiring the land cannot override the statutory provisions laid down in Section 23 of the Land Acquisition Act.

To determine the amount of compensation to be awarded for land acquired under this Act, the market value prevailing one year before the publication of notification under Section 4 is normally taken into consideration.

The word 'value' is certainly distinct from the word 'price'. A person may have paid an abnormally high price for a certain thing but when that thing is to be acquired by the Government for public purpose, it is not the price which is paid to him, but the value.

Compensation for the land under acquisition is usually determined on the principle of what a willing vendor might reasonably expect from a willing purchaser. The best evidence for the value of land to be acquired would be what a willing purchaser will pay for such land as could be judged from genuine sales effected at or about the time of notification of acquisition.

It is on this basis that land values have been determined by WAPDA in Stage II of the CRBC.

Agricultural Land

The average value of land has been worked out by the revenue staff on the basis of mutations available in the revenue record. This has been illustrated as follows:
<table>
<thead>
<tr>
<th>MUTATION NO.</th>
<th>DATE OF VERIFICATION</th>
<th>AREA *</th>
<th>TYPE OF LAND</th>
<th>TOTAL COST Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1017</td>
<td>30.09.85</td>
<td>4 0</td>
<td>Nul Chahi</td>
<td>2,700</td>
</tr>
<tr>
<td>1022</td>
<td>-do-</td>
<td>14 0</td>
<td>-do-</td>
<td>56,000</td>
</tr>
<tr>
<td>1023</td>
<td>-do-</td>
<td>15 0</td>
<td>-do-</td>
<td>60,000</td>
</tr>
<tr>
<td>1024</td>
<td>20.10.85</td>
<td>8 0</td>
<td>-do-</td>
<td>2,000</td>
</tr>
<tr>
<td>1035</td>
<td>28.11.85</td>
<td>6 9</td>
<td>-do-</td>
<td>32,500</td>
</tr>
<tr>
<td>1030</td>
<td>-do-</td>
<td>4 0</td>
<td>-do-</td>
<td>20,000</td>
</tr>
<tr>
<td>1064</td>
<td>28.11.85</td>
<td>0 4</td>
<td>-do-</td>
<td>2,000</td>
</tr>
<tr>
<td>1011</td>
<td>24.03.86</td>
<td>5 0</td>
<td>-do-</td>
<td>11,000</td>
</tr>
<tr>
<td>1028</td>
<td>-do-</td>
<td>72 1</td>
<td>-do-</td>
<td>72,000</td>
</tr>
<tr>
<td>1098</td>
<td>-do-</td>
<td>6 9</td>
<td>-do-</td>
<td>19,000</td>
</tr>
<tr>
<td>1012</td>
<td>-do-</td>
<td>17 3</td>
<td>-do-</td>
<td>46,530</td>
</tr>
<tr>
<td>1099</td>
<td>-do-</td>
<td>12 14</td>
<td>-do-</td>
<td>37,500</td>
</tr>
<tr>
<td>1033</td>
<td>22.04.86</td>
<td>27 18</td>
<td>-do-</td>
<td>65,000</td>
</tr>
<tr>
<td>1079</td>
<td>-do-</td>
<td>1 1</td>
<td>-do-</td>
<td>100,000</td>
</tr>
<tr>
<td>1111</td>
<td>22.04.86</td>
<td>2 0</td>
<td>-do-</td>
<td>2,800</td>
</tr>
<tr>
<td>1102</td>
<td>34.04.86</td>
<td>42 0</td>
<td>-do-</td>
<td>27,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>237 19</td>
<td></td>
<td>556,030</td>
</tr>
</tbody>
</table>

* (Note: 1 Kanal = 1/8th of an acre = 20 marlas = 505.9 sq m).

The 'osat yaksala' (annual average) of the above mutations in the revenue record comes to Rs. 2,336.75 per kanal for 'Nul Chahi' land.

From this average (osat) for nul chahi land, the land values for rod kohi, barani, banjar qadeem and ghair mumkin areas can be calculated by a unit formula for each category of land as fixed at the tehsil level by the Revenue Department according to produce index units.

These are as follows:

<table>
<thead>
<tr>
<th>LAND CLASS</th>
<th>P.I. UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nul Chahi (tubewell irrigation)</td>
<td>32.00</td>
</tr>
<tr>
<td>Rod Kohi (irrigated by hill torrents)</td>
<td>27.00</td>
</tr>
<tr>
<td>Barani (rainfed)</td>
<td>17.00</td>
</tr>
<tr>
<td>Banjar Qadeem (culturable waste)</td>
<td>8.50</td>
</tr>
<tr>
<td>Ghair Mumkin (waste land)</td>
<td>4.25</td>
</tr>
</tbody>
</table>

In village Ruknu (Tehsil and District D.I. Khan) only two mutations were available during the one year prior to the notification under Section 4 of the Land Acquisition Act. These were as follows:
<table>
<thead>
<tr>
<th>MUTATION NO.</th>
<th>DATE OF ATTESTATION</th>
<th>AREA KANAL</th>
<th>MARLAS</th>
<th>TOTAL COST RS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>103/1</td>
<td>13.11.85</td>
<td>297</td>
<td>16</td>
<td>148,850</td>
</tr>
<tr>
<td>106</td>
<td>-do-</td>
<td>49</td>
<td>9</td>
<td>24,900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>347</strong></td>
<td><strong>5</strong></td>
<td><strong>173,750</strong></td>
</tr>
</tbody>
</table>

The 'Osat Yaksala' of the above-mentioned mutations thus comes to Rs. 500.40 per kanal while the market value reported by the revenue staff of Tehsil D.I. Khan is Rs. 2,200 per kanal for the above-mentioned village. If the one-year average price is worked out on the basis of two mutations, then the owner of the acquired land will obviously suffer great loss. To avoid such discrepancies in determining the value of land, the Land Acquisition Officer is bound to take sales of similar land in the vicinity into consideration. As a result, land values in village Ruknu have been fixed as comparable to those of village Bhagwani Janubi to save the affectees from suffering heavy loss. As such, the value of similar land came to Rs. 1,450.62 per Kanal.

**Built-up Property**

The usual practice for assigning value to built-up property in CRBC Stage II is as follows:

1. The measurements of the building are taken and the quantity of each type of construction material is determined by the field engineering staff.

2. The value of the building is determined from prevailing WAPDA schedule rates.

3. An average deduction amounting to 10% of the cost as per Para 2 is made from the value of the building for depreciation.

4. Then 25% of the value as per Para 3 is deducted for material obtained from the demolition of the building which is handed over to the affectee.

5. The net price is then paid to the owner.

To illustrate the valuation procedure of a built-up property, an example is reproduced in Table 7.C.1

**Tubewells**

A similar approach has been adopted with regard to the compensation for tubewells on CRBC Project Stage II.
Land Development

No extra compensation is paid for land levelling and other developments like check dams, irrigation distribution channels, or consolidation of the land.

Orchards

The price of fruit bearing trees is obtained from the Director of Agriculture, who fixes compensation on the basis of total production for the estimated fruiting life of the trees based on the current market rate for the fruit. For trees not bearing fruit, the price is fixed according to the girth of the tree as per a schedule of rates available from the Forest Department.

C.2.6 Compulsory Acquisition Charges

According to Land Acquisition Act (Sub-section (2) Section 23), an amount of 15% over and above the value of the immovable property as assessed above has also been paid to the owners as compulsory acquisition charges.

C.2.7 Land Ownership

Land ownership is determined from the ownership column of the Jama Bandi Register Haqdaran Zamin (village record of land ownership) lying with the Revenue Patwari, or from the original record of the office of Kanungo in the Tehsil Headquarter.

C.2.8 Non-Proprietary Rights

Rights of permanent tenants and village service groups 'kammis' working for the farmers with a share in the produce are totally left out of the compensation on the plea that their names do not exist in the ownership column of Jama Bandi. WAPDA is of the opinion that, according to Land Acquisition Act, no compensation is paid to non-landowners and non-agricultural families.

It is said that the construction of the canal will enhance the productivity of land, upgrading the financial position of land owners, and consequently make tenants and 'kammis' better off as they will share in the enhanced produce.

C.2.9 Temporary Acquisition

Temporary acquisition for construction activities, camping, borrow and spoil areas was carried out through private negotiation between the owner and WAPDA. The procedure followed was according to the contents of Section 35 of the Land
Acquisition Act. According to the official record the agreement was entered with the following terms and conditions:

1) That the agreement will not only apply to the area for which order for occupation/use has been obtained from the Commissioner of the Division under Sub-Section (1) of Section 35 of the Land Acquisition Act, but also to the land for which order for use has not been so obtained but which has been occupied/remained in use by WAPDA.

2) WAPDA could not retain the land in question for a period of more than 3 years. However, they could return the land before the expiry of 3 years, if they so desire themselves.

3) Payment for the crops growing on the land at the time of change over of the possession was to be made by WAPDA.

4) That the compensation for such temporary acquisition was to be paid as under:

1. Nul chahi Rs. 200 per kanal per year
2. Sailaba Rs. 100 - do -
3. Banjar qadeem Rs. 53 - do -
4. Ghair mumkin Rs. 26 - do -

5) That at the time of restoration of land to the affectees, the Collector will carry out spot inspections in the presence of WAPDA's representative and take further action as under:

- That if the land is rendered so useless that it cannot be brought to its original shape, the Acquisition Department will be bound to acquire it permanently, if so directed by the Land Acquisition Collector.

- That WAPDA will carry out levelling/dressing if the Collector thinks that by so doing the land can be brought to its original shape.

- In case the Acquiring Department fails to do so, the Collector will direct payment of compensation for the damages caused by the Acquiring Department.

6) In case of difference of opinion, either party can go in reference to the Court of Law."
The written contract between interested persons and the Department should clarify whether the compensation for the occupation of the land and the material to be taken is to be paid in a lump sum or by monthly or other periodic payments. This was not done.

Moreover, at the time of agreement, no clarification appeared for Item 5. However, it was observed from the official record that the damages to the land was compensated in cash at the rate of Rs. 200 per kanal for Nulchahi land. Other type of lands were compensated at pro rata basis according to their produce index units. This was considerably less than the demand of the people, which was based on a precedent of the recently-completed Darya Khan road.

To arrive at a reasonable rate, a negotiation session had been held earlier between WAPDA staff and landowners, and a rate of Rs. 400 per kanal for Nulchahi land had been agreed. The landowners through their representatives had given in writing the acceptance of this rate. Superintending Engineer then referred the case to the Land Acquisition Collector to use his personal influence to further reduce the rate. Later, in a meeting between the Chief Engineer and the Land Acquisition Collector, it was decided that compensation should be at the rate of Rs. 200 per kanal for Nulchahi land and the decision was implemented.

C.2.10 Reaction of Affectees

To record the reaction of affectees relating to the land valuation and compensation procedures adopted by WAPDA, and to evaluate the channels of utilisation of awarded money by the local population, a sample survey was carried out to cover the head, middle and tail reaches of Chashma Right Bank Canal Stage II.

In all, 30 respondents were interviewed in six villages of the CRBC Stage II area. For the purpose of this survey, a questionnaire was prepared to include various types of information leading to the analysis of public opinion.

The findings of these interviews are as follows:

- In a majority of the cases the proportion of land acquired fell below 15% of the total land holding which varied from 50 kanals to 3000 kanals. In one instance 35% of the land holding of 100 kanals was acquired, leaving the farmer below subsistence level of farming, that is below 100 kanal (<5 ha).

- About 27% of the respondents were subsistence farmers. Land acquisition has further reduced their livelihood.

- In all cases, the compensation was made in the form of cash according to the land type and valuation made on a
one year average basis. In all cases, the assessed land values were much less than the prevailing market rates at the time of notification under Section 4.

The majority of the affectees (60%) have utilised the compensation money for unproductive purposes, including marriages, repayment of loans, medical treatment, purchase of household articles and/or construction of new houses; 10% spent their compensated amount for productive and unproductive purposes combined; while 23% utilised the amount productively by buying tractors, purchasing new land or developing the existing land. The remainder (7%) have not yet utilized their money, but have planned to utilise it for productive purposes.

The overall reaction of the affected population of the Chashma Right Bank Canal area is one of broad dissatisfaction with the compensation allowed to them by the Land Acquisition Collector, which they regarded as being very low. In their opinion, the best mode of compensation would have been to give alternative land from the state land readily available under CRBC Command Area in Stage II/III, or the market rate prevailing at the time of notification under Section 4 should have been paid to them.

Aggrieved by the award announced by the Land Acquisition Collector, 39 affectees in CRBC Stage-II area (which form less than 2% of the total affectees) have filed references under Section 18 of the Land Acquisition Act in different civil courts at D.I. Khan. Seven cases are under hearing in the Multan and Peshawar high courts. The main objection raised by the affectees are about 'qism-i-arazi' (classification of land), the low rate of compensation awarded to them, and damage sustained by them at the time of taking possession of the land. The majority of the cases were filed in the year 1989 and 1990 which are still sub-judice in different courts in D.I. Khan, Multan and Peshawar.

The majority of the affectees in Stage II area are illiterate and are not aware of the litigation process. Therefore, they have not sought some legal remedy to redress their grievances. Others have accepted the compensation under protest but have not gone to the court as they are unable to bear the expenses of litigation. They have made the sacrifice of receiving low compensation in the hope that when canal water is provided, it will enhance the productivity of their remaining land and so upgrade their financial position.

C.3 TASK 2

C.3.1 Methodology

During his visit to the Project area, the Land Valuation Specialist contacted officers/officials of GGHP (WAPDA), land acquisition staff of Tarbela Dam (WAPDA), revenue staff of
Tehsils Haripur (Distt. Abbottabad) and Attock (Distt. Attock) including the Office Superintendent of Dy. Commissioner/Collector Attock and the District Revenue Assistant.

In addition to other aspects, discussions with land acquisition staff at Attock were also held on the land valuation and compensation procedures adopted for the Pakistan Aeronautical Complex (PAC), Kamra, and the residential colony of the Mirage Rebuild Factory (MRF), Kamra.

Photocopies of relevant documents were also obtained from the land acquisition office of Tehsils Haripur and Attock to support the findings.

In addition to the above, interviews were also conducted with the probable affectees to test public opinion as regards land values and mode of compensation for the proposed acquired land in the Ghazi-Gariala Hydropower Project area.

**C.3.2 Land Valuation Procedure as Adopted on Kamra Complex**

Notification for acquisition of land measuring 128 kanals for construction of fuel installation No. 2 for PAC/Air Base was published in the Punjab Gazette on December 26, 1980. Of this, 100 kanals fell in the village of Kamala and 28 kanals in the village of Sahba. The average cost for the relevant period (December 27, 1979 to December 26, 1980) was obtained from Tehsildar Settlement for the village of Sahba. No transaction was effected in the village of Kamala during this period, therefore reliance had to be placed on the average cost of land in the former village because the lands of both villages are contiguous and the soils are of a similar nature. Compensation at the rate of Rs. 1,967.21 per kanal for Maira land and Rs. 491.80 for Chair Mumkin for the villages Kamala and Sahba was awarded by the Land Acquisition Collector on April 30, 1985. A delay of about two years and four months occurred in announcing the award by the Land Acquisition Collector, although this should have been done within two years of notification under Section 4 of the Land Acquisition Act.

In the meantime, the land values had increased greatly. In a transaction which matured in 1984, the land was sold at Rs. 10,000 per kanal. On this basis the affectees put up an application to appraise the land according to the latest transactions, which was rejected.

Further land acquisition proceedings were initiated on September 5, 1988 for acquiring land for the residential colony of MRF, Kamra, consisting of 1,332 kanal 9 marlas in the villages of Shamsabad, Viro, Kamala and Sahba. The Assistant Commissioner/Land Acquisition Collector proposed the following uniform rates for all the four villages, whose lands are in a compact block:

7-C.14
<table>
<thead>
<tr>
<th>KIND OF LAND</th>
<th>RATE Rs./kanal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chahi</td>
<td>18,664.00</td>
</tr>
<tr>
<td>Maira</td>
<td>9,124.08</td>
</tr>
<tr>
<td>Ghair mumkin</td>
<td>2,281.02</td>
</tr>
</tbody>
</table>

From the perusal of the rates prevailing in years 1980 and 1988 it is clear that value of the land has increased greatly, i.e. approximately 364% within 8 years.

### C.3.3 Present Land Values in the Project Area

To assess the land values in the Project area, the transactions effected during the year 1990 in the villages of Hasanpur, Chak Mirpur and Jamun of Tehsil Haripur and Pind Suleman Makhan, Nurpur Karam Alia, Rumian, Jaba, Dher and Shamshabad of Tehsil Attock have been obtained from the Revenue Patwaris. In doing so, an effort was made to collect as many transaction cases as possible for the villages likely to be affected by the Project.

Following the conventional procedure of fixation of land values for acquisition purposes, 'Yaksala Osats' (annual averages) were estimated from the transactions undertaken during 1990. These are shown in Table 7.C.2.

From the tabulated figures it can be observed that there is no consistency in the average price of similar types of land (Chahi, Maira, Kond or Ghair Mumkin) in different villages. Even the difference in the adjoining villages like Chak Mirpur, Hasanpur and Jamun is extraordinarily high. Similarly, within one village the average price of different types of land is not consistent with the produce index unit, in spite of the fact that the transactions had taken place within the same time span. For example, the average price of the Chahi land in Pind Suleman Makhan during 1989 was Rs. 12,195 per kanal, while for that of Maira land it was Rs. 18,305 per kanal in spite of the fact that the average produce index unit of these lands are 61 and 9 respectively. Price variations have also been observed within the individual transactions in a village which have no relation with the chronological sequence of sale deeds. For example, in the village of Shamsabad the average price of Chahi land for transactions effected during 1986-87 and 1987-88 came out to be Rs. 19,760 and Rs. 14,865 respectively.

This inconsistency in the land value is attributable to many factors, such as the proximity of the land to habitated areas and roads, accessibility, level of development and, of course, the demand and supply relationship at the time of actual sale. Moreover, there being a wide range of values of produce index for a particular land which again differ in both the tehsils of Attock and Haripur, the decision lies with the Patwari of the

7-C.15
area concerned to allocate the value of produce index to a certain piece of land. In the land valuation process, these anomalies will have to be considered through a committee.

C.3.4 Reaction of the Local Population

To record the views of the local population of the Project area as regards the land values and mode of compensation, interviews with probable affectees were conducted on a random sampling basis. Twenty respondents from eight villages in Tehsils Haripur and Attock were interviewed. For the purpose of this survey, a questionnaire was prepared.

The findings of these interviews are as follows:

- The majority of the respondents (13) are small land owners having a land holding below subsistence level, that is less than 100 kanals, six are medium level farmers (100 kanals to 200 kanals) and one has a landholding of 250 kanals.

- According to the assessment, about 5 out of 20 respondents will lose 100% of their land, while the remaining will lose less than 50%. (The sample being too small, much reliance could not be made on these findings).

- Being petty land owners, they are not ready to part with their land.

- The resistance to land acquisition will be more in the Ghazi tract of Tehsil Haripur and Chhachh tract of Tehsil Attock. This is because the lands of these tracts are relatively more developed, the people are politically strong, having financial backing of earnings from abroad, and the existence of a wide gap between the demand and supply of land in these areas. Such a situation, however, does not exist in Sarwala tract of Tehsil Attock. Therefore, less resistance will be faced in that area.

- In spite of such reaction against the land acquisition for Ghazi-Gariala Project and the situation of land holdings in the area, people are aware that the land will be acquired at the will of the Government. The majority of the respondents opted for cash compensation instead of land for land.

- Almost all the respondents objected to the land valuation procedures adopted by the Government. They disagree with the system of evaluating the land on annual average basis. Instead, they preferred that the present market value should be fixed through a committee which would include representatives from the local population.
The people of a particular tract would like to have a uniform rate for a certain type of land, instead of varying it from village to village.

The people generally do not agree with the land classes appearing in the land record of the Revenue Department. In this respect they suggested a fresh assessment of their land.

The people of Ghazi village want their land to be classified as residential area irrespective of any classification appearing in the record. This is because the majority of the land area of this village has been acquired for Tarbela Dam resettlement colonies and military installations, with the result that the limited land left is just sufficient to accommodate the expansion of the housing schemes of Ghazi.

The people preferred consolidation of their remaining land if it is fragmented by the Project structures. They have also desired that their total land should be acquired if the remaining land is less than an economic unit for the family.

C.4 CONCLUSION AND RECOMMENDATIONS

From the study of land acquisition, valuation and compensation procedures as conducted for Task 1 and Task 2, and the reactions of the local population thereto, it is considered imperative to improve/modify some of the procedures to promote smooth working of the acquisition process for the Ghazi-Gariala Hydropower Project. In the subsequent paragraphs some recommendations have been proposed to avoid resentment of local population and eliminate unnecessary litigations.

C.4.1. Land Acquisition Criteria

In the interest of the Project, the following points should be considered during the actual acquisition of land:

- If the land area of an individual left over from the actual area needed for the Project is less than the economic unit for the affected family, it should also be acquired, if the owner so desired.

- Where the left-over land is an economic unit, but is less than 25% of the individual's total area, preference should be given to the choice of the individual farmer as to whether he wants to keep it or dispose of it. The excess land acquired could be sold to the other interested affectees.
The spoil areas should be permanently acquired and then disposed of after development, to the affectees who show interest.

It is desirable that, whenever possible, where the individual's land is fragmented as a result of the land acquisition process, it should be consolidated.

C.4.2. Land Valuation Procedures

It is observed that the affectees of the CRBC Project area are generally dissatisfied with the assessed land values. This is not limited to the CRBC area. Even the affectees of Tarbela dam resettled in the Project area have similar complaints.

Keeping this in view it is recommended that:

- Instead of fixing the value of land on the basis of average of mutations taken place during the previous one year from the date of notification under Section 4, the present market value should be adopted. Section 23 of the Land Acquisition Act states that the compensation should be the market value of the land at the date of publication of the notification under Section 4 irrespective of the question how it is held.

The Legislature has not defined the term 'market value'. The commentary on Section 23 indicates that this was advisedly done, as any definition assigned to it would be open to much objection. Therefore, it was left to the discretion of the Collector and ultimately to the decision of a court of law.

Therefore, the criteria of fixing land value on one-year average basis is discretionary. Actually, the market value of the land is a price which a willing vendor, not obliged to sell, might reasonably expect to obtain from a willing purchaser. This definition has been adopted in many court decisions.

This means that the consensus of the landowners has great weight in determining the land value. Therefore, it is recommended that the market value of the land should be fixed in consultation with a committee of notables that represents the affectees.

To avoid the complication of land valuation procedures and the resentment of neighbouring farmers or the farmers of adjoining villages, it is recommended that the committee should fix a value of a particular type of land which should be applicable to a particular revenue assessment tract as a whole instead of varying it from village to village.
Instead of referring to the revenue record for the allocation of land class to the acquired land, a fresh assessment should be carried out because the available record at the Revenue Department is outdated and does not classify the land according to the development made lately and the type of crops taken.

Consideration should also be given to the present economic use of land other than agricultural production, if any. According to the definition of 'land' in the Land Acquisition Act, the proprietary rights extend throughout the verticality of the earth from centre up to the limits of the sky. Therefore, any borrow area and/or mining benefits presently drawn should also be considered in land valuation.

In a decision taken by Orissa court (AIR 1972 Orissa 203), the market value was defined as:

"Market-value ought not to be fixed ignoring adduced evidence regarding prior use (nature), neighbourhood area and actual/potential income-earning capacity."

C.4.3. Compensation Mode

In respect of the compensation mode, the following recommendations have been proposed:

- Pakistani farmers generally prefer land for land compensation. This was the overwhelming preference of affectees of the CRBC Project. Even in the Project area, a majority of the people indicated a preference for this mode, but on the condition that land is made available in the near vicinity. If land was not available locally, they prefer cash compensation or some substitute means of earning. However, there were some farmers who still preferred land for land compensation, if that is arranged within the Punjab. In this respect, it is recommended that whenever possible the choice of the individual affectee should be kept in view.

- According to the existing practice in Pakistan, land compensation is considered for projects where a large area is needed to be acquired, such as dam projects. In the case of land acquisition for canals or roads, compensation is generally provided in the form of cash, because in such projects only small fragments of individual's land have to be acquired without disturbing much the production system of the owners.

But in the case of the Project area, the people generally have small land holdings and the size of the channel is gigantic with the result that a substantial number of people will lose almost all land or the leftover land
would be too small to support the family. Therefore, to accommodate those affectees who prefer land compensation, some relaxation in the conventional compensation practice will be required.

It has been observed in the CRBC Project area, PAC Kamra and elsewhere that the release of compensation amounts is delayed. This should be avoided.

Cash compensation without providing a substitute production system to the affectees will leave them in a state of economic instability. Therefore, it is recommended that a committee should be formed to plan and provide guidance to the poor and illiterate farmers for re-investment of their compensation amounts or a substitute production system be provided in industrial or service sector. This is according to the content of World Bank guidelines on compensation.

C.4.4 Valuation of Built-up Property/Tubewells

The WAPDA schedule of rates for various items needs revision to make it realistic and commensurate with the market values. Deduction of 10% as depreciation does not seem justified when the resettlement is involuntary. Deduction of 25% of the value for the sale of demolished building material is not justified.

Even after making the improvement in the valuation procedure as referred to above, the question still arises, "Would the compensation be enough to re-construct the facility which the affectee previously had"? The reply would be negative. Therefore, it is recommended that the valuation should be on the basis of replacement value of the facility.

C.4.5. Non-Proprietary Rights

As stated earlier, the rights of tenants and village service groups are not considered in the compensation process. This needs to be revised in the light of the Land Acquisition Act and its interpretation in different court decisions. The definition of the 'person interested' in the Act is as follows:

"The expression 'person interested' includes all persons claiming and interested in compensation to be made on account of the acquisition of land under this Act; and a person shall be deemed to be interested in land if he is interested in an easement affecting the land;"

A legal decision of Lahore High Court (PLD 1966 Lah 111) in this respect states that:
"Word 'land' means totality of rights in land including tenancy rights. Suggestions that tenancy rights have no market value or their market value is incapable of being interpreted in terms of money is not acceptable".

In another court decision, the statement goes as under:

"All benefits to arise out of land to be assessed together and paid for under this Section No. 23. All interests in the land to be valued together. The expression 'benefits to arise out of land' thus includes all subordinate tenancies or leases, rent and profit easements over the land, fisheries etc and also mortgages or other charge or liens, beneficiaries or reversionary interest attached thereto and so forth. What has to be acquired in every case under Land Acquisition Act is the aggregate of rights in the land and not merely some subsidiary right as that of tenant".

As regards the apportionment of the value between landlord and tenants, the decision of Calcutta Court provides a guideline (ILR 40 Cal.64):

"As between a landlord and a tenant, the principle to be followed is to ascertain the amount of rent payable to the landlord and capitalise that rent at so many years' purchase, then put the money value upon the chance of enhancement of the existing rent, total these up and given the same to the landlord; the tenant is entitled to get the balance only".

On this ground it is recommended that the rights of tenants and other service groups should be compensated for GGHP.

C.4.6. Temporary Acquisition

Section 35 clearly dictates that temporary acquisition of land for borrow areas and construction activities should be carried out through an agreement between the acquiring agency and the landowners. The terms and conditions of the agreement should be acceptable to both the parties. In the case of CRBC Stage II it was observed that this has not been followed in totality. Here, after agreeing to a figure for compensation for damages, it was reduced at the discretion of the Land Acquisition Collector.
### TABLE 7.C.1

**ABSTRACT OF COST**

<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>RATE Rs.</th>
<th>AMOUNT Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Random rubble masonry in foundation and plinth.</td>
<td>211.98</td>
<td>% cft</td>
<td>394.70</td>
<td>836.68</td>
</tr>
<tr>
<td>2.</td>
<td>Pise wall</td>
<td>1,793.45</td>
<td>% cft</td>
<td>140.90</td>
<td>2,526.97</td>
</tr>
<tr>
<td>3.</td>
<td>Mud plaster</td>
<td>1,374.11</td>
<td>% sft</td>
<td>24.40</td>
<td>579.28</td>
</tr>
<tr>
<td>4.</td>
<td>Shisham wood door window fixed in.</td>
<td>22.02</td>
<td>P/s ft</td>
<td>14.00</td>
<td>308.28</td>
</tr>
<tr>
<td>5.</td>
<td>Wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Kikar wood</td>
<td>16.48</td>
<td>P/s ft</td>
<td>50.00</td>
<td>524.00</td>
<td></td>
</tr>
<tr>
<td>B) Shisham</td>
<td>2.54</td>
<td>P/s ft</td>
<td>100.00</td>
<td>254.00</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Batons of local wood quality</td>
<td>28</td>
<td>P/No.</td>
<td>8.00</td>
<td>224.00</td>
</tr>
<tr>
<td>7.</td>
<td>Tin parnalas (drainpipe)</td>
<td>3</td>
<td>P/No.</td>
<td>5.00</td>
<td>15.00</td>
</tr>
<tr>
<td>8.</td>
<td>Third class mud roofing</td>
<td>815.55</td>
<td>% cft</td>
<td>219.00</td>
<td>1,786.05</td>
</tr>
<tr>
<td>9.</td>
<td>Tandoor (indigenous oven)</td>
<td>1</td>
<td>P/No.</td>
<td>21.06</td>
<td>21.06</td>
</tr>
<tr>
<td>10.</td>
<td>Chullah Kacha (Stove)</td>
<td>3</td>
<td>P/No.</td>
<td>15.71</td>
<td>47.13</td>
</tr>
</tbody>
</table>

**Sub Total** | 7,422.45 |
**Add 25% on Item 1,2,3,4,5 and 9** | 1,255.23 |
**Less depreciation charge 10%** | 8,677.68 |
**Less 25% for material (to be taken by the owner)** | 7,809.91 |
**Net Payment** | 5,857.44 |
TABLE 7.C.2
ANNUAL AVERAGE LAND VALUES IN THE PROJECT AREA

<table>
<thead>
<tr>
<th>LAND TYPE</th>
<th>VILLAGE</th>
<th>TRANSACTIONS PROCEEDED</th>
<th>TOTAL AREA</th>
<th>AVERAGE VALUE PER KANAL</th>
</tr>
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<tr>
<td></td>
<td></td>
<td>No.</td>
<td>Year</td>
<td>Kanals</td>
</tr>
<tr>
<td>Chahi</td>
<td>Chak Mirpur</td>
<td>14</td>
<td>1990</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Hasanpur</td>
<td>10</td>
<td>1990</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Jammun</td>
<td>2</td>
<td>1990</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pindi Suleman</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Makhan</td>
<td>1</td>
<td>1989</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Shamsabed</td>
<td>17</td>
<td>1986-1988</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Shamsabed</td>
<td>4</td>
<td>1988-1989</td>
<td>7</td>
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<td>Maira</td>
<td>Chak Mirpur</td>
<td>4</td>
<td>1990</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Hasanpur</td>
<td>27</td>
<td>1990</td>
<td>202</td>
</tr>
<tr>
<td></td>
<td>Jammun</td>
<td>15</td>
<td>1990</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Pindi Suleman</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Makhan</td>
<td>4</td>
<td>1989-1990</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nurpur Karam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allia</td>
<td>2</td>
<td>1988</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Rumian</td>
<td>3</td>
<td>1990</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Jaba</td>
<td>1</td>
<td>1990</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Dher</td>
<td>10</td>
<td>1990</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Shamsabed</td>
<td>27</td>
<td>1987-1988</td>
<td>49</td>
</tr>
<tr>
<td>Kond</td>
<td>Hasanpur</td>
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<td>1990</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Jammun</td>
<td>1</td>
<td>1990</td>
<td>2</td>
</tr>
<tr>
<td>Rakker</td>
<td>Chak Mirpur</td>
<td>1</td>
<td>1990</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Jammun</td>
<td>2</td>
<td>1990</td>
<td>0</td>
</tr>
<tr>
<td>Ghair</td>
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<td>1</td>
<td>1990</td>
<td>0</td>
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<td>Mumkin</td>
<td>Hasanpur</td>
<td>9</td>
<td>1990</td>
<td>49</td>
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<tr>
<td></td>
<td>Jammun</td>
<td>16</td>
<td>1990</td>
<td>180</td>
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<td></td>
<td>Rumian</td>
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<td>Dher</td>
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<td>Qadeem</td>
<td>Jaba</td>
<td>1</td>
<td>1990</td>
<td>2</td>
</tr>
</tbody>
</table>

* (Note 1 Kanal = 20 marla = 505.9 sq m)
APPENDIX D

SOCIAL SURVEY OF THE PROJECT AREA
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<th>Page</th>
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<td>D.6.4</td>
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<td>7-D.7</td>
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<td>Effect of the Project on Socioeconomic Set Up</td>
<td>7-D.8</td>
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<td>D.8.1</td>
<td>Tractor/trolley</td>
<td>7-D.9</td>
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<td>D.8.2</td>
<td>Animal Power</td>
<td>7-D.9</td>
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<td>Machinery Trips Across the Power Channel</td>
<td>7-D.10</td>
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<td>D.9</td>
<td>LIVESTOCK</td>
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<td>D.9.1</td>
<td>Distribution Pattern</td>
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<td>D.9.2</td>
<td>Foraging Pattern and Movements</td>
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<td>SOCIAL INFRASTRUCTURE</td>
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<td>D.10.3</td>
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</tbody>
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**ATTACHMENT**

7-D(i)
APPENDIX D

SOCIAL SURVEY OF THE PROJECT AREA

D.1 INTRODUCTION

The objectives of the village survey were to identify, quantify and analyse the socioeconomic impacts of the Ghazi-Gariala Hydropower Project on the people who live in the villages in the Project area, as well as those in nearby areas whose lives and livelihoods will be affected by the Project. A separate social survey has been carried out of the women in the Project area. The results are presented in Appendix E.

D.2 METHODOLOGY

The survey work comprised two tasks:

- Task 1 included the scoping sessions. The purpose of the scoping sessions was to disseminate information about the Project to the maximum number of people of the Project area. To meet this goal, 14 scoping sessions were held at Union Council level. People were informed about the Project with the help of maps. Questions and queries from the participants were also invited, to understand their views on the Project.

- Task 2 was an interviewing survey. A structured interview schedule was filled in by the sociologists for all the sample villages. The sample questionnaire is attached at the end of this Appendix.

The proceedings of the scoping session have been reproduced in Appendix B, while the findings of the socioeconomic survey are discussed in this Appendix.

D.3 SAMPLE

The survey was planned to be conducted at village level rather than by individual interviews. For this purpose, a questionnaire was designed to meet the objectives of the Project study, that is to establish the baseline socioeconomic conditions of the area and to evaluate the likely impacts of the Project on the area.

For this study a sample comprising 15 villages was taken by the 'Simple Random Sampling Method'. The sample villages included, Isa, Jallo, Hasanpur, Ghurghushti, Mian Dheri, Malak Mala, Barazai, Walidad, Khagwani, Pandak, Musa, Saidan, Thikarian, Nurpur Karam Alia and Barotha.
In the study, special consideration was given to the participation in the interviewing process of a maximum number of people from all strata of life. For achieving maximum participation, the survey team announced the programme on loud speakers at least one day before conducting the interviews in that particular village.

D.4 GENERAL INFORMATION

The general information regarding the sample is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sample villages</td>
<td>15</td>
</tr>
<tr>
<td>No. of Union Councils concerned</td>
<td>10</td>
</tr>
<tr>
<td>Estimated population of the sample villages</td>
<td>62,300</td>
</tr>
<tr>
<td>No. of households of the sample villages</td>
<td>11,320</td>
</tr>
<tr>
<td>Average household size</td>
<td>5.5</td>
</tr>
<tr>
<td>No. of farmers in sample villages</td>
<td>9,338</td>
</tr>
<tr>
<td>Total area of the sample villages</td>
<td>18,340 ha</td>
</tr>
<tr>
<td>Area under cultivation</td>
<td>14,300 ha</td>
</tr>
<tr>
<td>Barani land</td>
<td>9,335 ha</td>
</tr>
<tr>
<td>Irrigated land</td>
<td>4,965 ha</td>
</tr>
<tr>
<td>Culturable waste/wasteland</td>
<td>1,719 ha</td>
</tr>
</tbody>
</table>

D.5 LAND RESOURCE

D.5.1 Land Use

The land use pattern and the frequency of occurrence of various land uses are given in the following table:

<table>
<thead>
<tr>
<th>LAND USE</th>
<th>NO. OF VILLAGES</th>
<th>AREA ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated land</td>
<td>15</td>
<td>14,300</td>
<td>78.0</td>
</tr>
<tr>
<td>Orchards</td>
<td>9</td>
<td>55</td>
<td>0.3</td>
</tr>
<tr>
<td>Farmland pastures</td>
<td>6</td>
<td>2,034</td>
<td>11.1</td>
</tr>
<tr>
<td>Farm forests</td>
<td>4</td>
<td>232</td>
<td>1.2</td>
</tr>
<tr>
<td>Culturable waste</td>
<td>6</td>
<td>896</td>
<td>4.9</td>
</tr>
<tr>
<td>Waste land</td>
<td>15</td>
<td>823</td>
<td>4.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>18,340</td>
<td>100.0</td>
</tr>
</tbody>
</table>

D.5.2 Irrigation Pattern

Different irrigation sources are being used by the local people, depending upon the availability of the source and type of land. In the survey area the major proportion of the cultivated land (9,335 ha) is barani (rainfed); only 4,965 ha (27% of the total area) are being irrigated through a variety of sources. The
distribution is given in the following table:

### SOURCE-WISE DISTRIBUTION OF IRRIGATED AREA

<table>
<thead>
<tr>
<th>IRRIGATION SOURCE</th>
<th>NO. OF VILLAGES</th>
<th>AREA ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qibla Bandi dam</td>
<td>2</td>
<td>860</td>
<td>17.3</td>
</tr>
<tr>
<td>Government tubewell</td>
<td>1</td>
<td>152</td>
<td>3.1</td>
</tr>
<tr>
<td>Private tubewells/pumps</td>
<td>2</td>
<td>801</td>
<td>16.1</td>
</tr>
<tr>
<td>Persian wheels</td>
<td>13</td>
<td>1,444</td>
<td>29.1</td>
</tr>
<tr>
<td>Persian wheels &amp; pumps</td>
<td>11</td>
<td>1,708</td>
<td>34.4</td>
</tr>
<tr>
<td>Indus river</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,965</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

During the survey, it was observed that conventional methods of irrigation (persian wheels) are gradually being replaced by pumps installed on the same wells. None of the villages is using the water of the Indus river for irrigation.

### D.5.3 Landholdings

The landholding pattern in the surveyed area is shown in the following table:

### DISTRIBUTION OF FARMERS ACCORDING TO OWNERSHIP

<table>
<thead>
<tr>
<th>HOLDING SIZE</th>
<th>OWNER</th>
<th>OWNER-CUM-TENANTS</th>
<th>TENANT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>&lt; 5 ha</td>
<td>6,227</td>
<td>87.9</td>
<td>859</td>
<td>71.6</td>
</tr>
<tr>
<td>5-10 ha</td>
<td>729</td>
<td>10.3</td>
<td>290</td>
<td>24.2</td>
</tr>
<tr>
<td>&gt; 10 ha</td>
<td>125</td>
<td>1.8</td>
<td>50</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7,081</td>
<td>100.0</td>
<td>1,199</td>
<td>100.0</td>
</tr>
</tbody>
</table>

There are 9,338 cultivators in the sample villages. Irrespective of ownership status, the majority of the farmers have small holdings - less than subsistence level for the Punjab, i.e., 5 ha. On the basis of total cultivated area in the sample villages, the average landholding comes to about 1.5 ha.

It is also evident from the data that, on the whole, the majority of the landholders (75.8%) are owners, while owners-cum-tenants are 12.8% and exclusively tenants are only 11.3%.
D.5.4 Land Fragmentation

Among the sample villages, only 4 had undergone prior Ishtmal (consolidation). The rest of the sample villages never had any Ishtmal. The land of the majority of cultivators in these villages is divided into fragments. The land fragmentation data is given in the following table:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>OWNER</th>
<th>OWNER-CUM TENANTS</th>
<th>TENANT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>I</td>
<td>529</td>
<td>7.5</td>
<td>63</td>
<td>5.2</td>
</tr>
<tr>
<td>II</td>
<td>455</td>
<td>6.4</td>
<td>134</td>
<td>11.2</td>
</tr>
<tr>
<td>III</td>
<td>6,097</td>
<td>86.1</td>
<td>1,002</td>
<td>83.6</td>
</tr>
<tr>
<td>Total</td>
<td>7,081</td>
<td>100.0</td>
<td>1,199</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Category I landholding consolidated
  II landholding in 2 pieces
  III landholding in more than 2 pieces

The table shows that the landholdings of almost 80% of the farmers are fragmented into over 2 fragments. Only 10% of farmers have land that is consolidated. This means that the Project will disturb the production system of a greater number of farmers than it would have done if the land had been consolidated. The even distribution of tenancy farmers in different fragmentation classes shows that the tenants tend to acquire consolidated land.

D.6 WATER RESOURCES

D.6.1 Surface Water Resources

The surface water resources in the sample villages are the Indus river, the water channel from Qibla Bandi dam, ponds and nullahs. Among the sample villages, only 2 use water from Qibla Bandi dam for irrigation purposes.

The Indus river water is used by 4 villages in the sample, which are located close to the river. None of the 4 villages uses Indus water for irrigation. Its use is for livestock and domestic purposes. In these four villages the total number of livestock is 2,198 head of which 1,030 (46.9%) are brought to the Indus for drinking and grazing.

The people of these four villages carry about 330 buckets of about 12 litre capacity daily for consumptive use. The total population of these villages is about 5,500. On the assumption...
that per capita consumptive use is 7 l/d, only about 10% of consumptive use is met from the Indus river. Moreover, the survey revealed that the main consumptive use of river water is in the village of Mian Dheri (250 buckets/d).

Normally, females wash clothes at home; only 6% of the female population has been noticed washing clothes in the Indus. Moreover, females do no go to the Indus for bathing. Only 13% of the male population goes to the Indus for bathing and then only in summer.

Only one village uses pond water for livestock and domestic purposes. About 35% of livestock is brought to the pond, while only 4% of females (in the working age group) go to the pond daily for washing. 32% of the male population goes to the pond for bathing.

Two villages, Nurpur Karam Alia and Barotha, use water from Jaba and Barotha nullahs for irrigation and other purposes.

D.6.2 Groundwater Resources

The people of the Project area meet their water requirements mostly from groundwater resources. Data about the ownership pattern and number of groundwater resources is given in the following table:

<table>
<thead>
<tr>
<th>RESOURCE</th>
<th>COMMUNITY No.</th>
<th>GROUP No.</th>
<th>INDIVIDUAL No.</th>
<th>GOVERNMENT No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open wells</td>
<td>1</td>
<td>84</td>
<td>6,681</td>
<td>-</td>
</tr>
<tr>
<td>Hand pumps</td>
<td>-</td>
<td>-</td>
<td>841</td>
<td>-</td>
</tr>
<tr>
<td>Persian wheel</td>
<td>-</td>
<td>506</td>
<td>217</td>
<td>-</td>
</tr>
<tr>
<td>Tubewells</td>
<td>-</td>
<td>100</td>
<td>136</td>
<td>1</td>
</tr>
<tr>
<td>Small pumps</td>
<td>-</td>
<td>1,555</td>
<td>186</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>2,245</td>
<td>8,061</td>
<td>1</td>
</tr>
</tbody>
</table>

The table indicates that government and community ownership patterns are very rare. Most of the resources are either group (22%) or individually owned (78%). About 89% of small pumps are group-owned and most of the open well (99%) and all of the hand pumps are individually owned. Normally a group does not consist of more than 3 or 4 persons.

Almost all of the water resources are multipurpose. They meet irrigation, domestic and livestock needs. Hand pumps, however, are used for domestic purpose.
Only one well sells water and that is government installed. None of the privately-owned tubewells sell water.

D.6.3 Water Availability Level

In response to a question concerning water availability, 12 out of the 15 sample villages (80%) reported that they have just enough water for domestic and livestock use, while they have a shortage for irrigation. Only one village reported that it does not have enough water either for irrigation or for domestic and livestock. Only two villages have reported to have enough water for all purposes, ie irrigation, domestic and livestock purposes.

D.6.4 Future Development Plan

Most of the villages in the Project area (10 out of 15 villages) are not making active efforts for more water. In 2 villages the people are making efforts at individual level, while 2 villages are trying to improve their water status on community level. Only one village is pursuing the government for more water.

The people in the Project area generally have enough water to meet the immediate needs of various kinds but they need more water to expand their cultivation and bring their barani land under irrigation. Because of rising prices, farmers cannot afford tubewells; they are looking forward to a Government scheme.

Responding to a question regarding the steps to be taken by the Government to meet the water requirement, different villages had different views. But the majority asked for tubewells. The responses are as follows:

<table>
<thead>
<tr>
<th>REQUIREMENT FROM GOVERNMENT</th>
<th>NO. OF VILLAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubewells should be installed</td>
<td>10</td>
</tr>
<tr>
<td>Water should be given from the power channel</td>
<td>-</td>
</tr>
<tr>
<td>Water should be given both from power channel and</td>
<td>2</td>
</tr>
<tr>
<td>tubewells</td>
<td></td>
</tr>
<tr>
<td>Water should be given from small dams</td>
<td>-</td>
</tr>
<tr>
<td>Water should be given both from small dams and</td>
<td>1</td>
</tr>
<tr>
<td>Govt. tubewells</td>
<td></td>
</tr>
<tr>
<td>No requirement</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

D.6.5 Tubewells Disrupted by the Power Channel

In the sample villages there are 27 tubewells located on one side of the proposed power channel and commanding land located on the other side. These tubewells are located in three surveyed villages, Isa, Hasanpur and Ghurghushti.
In Isa village there is only one tubewell which is Government owned. The majority of the farmers of Isa village depend upon this source. At least 70% of these farmers have land on each side of the power channel. If this tubewell is disrupted, the people of this village will be badly affected.

In Hasanpur village, one individually-owned tubewell will be disrupted.

The remaining 25 tubewells are located in the area of Ghurghushti village. All of these are individually-owned.

D.7 HUMAN RESOURCES

D.7.1 Classification of Society

Human beings can be classified in many ways. The classification can be based on age, sex, education status, living standards, caste or ethnic group, religion, occupation etc. For the purpose of this study, social (ethnic) and occupational (economic) groupings were selected to establish the effects of the Project on social ties and economic conditions.

There are about 20 social groups (castes or ethnic groups) in the survey area. However, the majority of the households belong to Pathan (71%) followed by Awan (12%). Of the remaining households the major groups are Gujar (5%), Khattar (2.5%), Syed (2%), Arain (2%) and Kammi (3%). The Kammis comprise 7 services groups. The remaining 7 social groups are in fractions (combined 2.5%).

The people of the Project area have strong ties within the families of their own ethnic group. Their forebears have lived there for centuries and they have developed a social set-up which is different from their kin elsewhere. They would not like to shift to other places in the process of resettlement. However, the Khattar, who live in the Sarwala tract, have agreed to migrate to another place provided the resettlement is done within the Punjab and the affected group of one locality are resettled at one locality.

The economic grouping includes landowners (zamindar), owner-cum-tenants, tenants, herdsmen, services groups (Kammi) and others (miscellaneous groups involved in business, farm labour, miscellaneous labour, services within the country or abroad). The largest group belong to the landowners, having 63% of the total households in the survey area. This is followed by miscellaneous groups (14%), owner-cum-tenants (11%), tenants (9%) and Kammi (3%). Herdsmanship as a profession is just a fraction of the total households. However, herding as a side business is common in other groups. The occupations of the households of the survey villages are shown in the following table:
DISTRIBUTION OF HOUSEHOLD OCCUPATIONS

<table>
<thead>
<tr>
<th>OCCUPATION GROUP</th>
<th>HOUSEHOLDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Absentee landowners</td>
<td>11</td>
</tr>
<tr>
<td>Primary landowners</td>
<td>7,081</td>
</tr>
<tr>
<td>Owner-cum-tenants</td>
<td>1,199</td>
</tr>
<tr>
<td>Tenants</td>
<td>1,058</td>
</tr>
<tr>
<td>Herdsmen</td>
<td>35</td>
</tr>
<tr>
<td>Kammi (service group)</td>
<td>389</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1,547</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11,320</td>
</tr>
</tbody>
</table>

D.7.2 Effect of the Project on Socioeconomic Set Up

Without mitigation measures, the most important effect of the Project will be the disruption by the power channel of communications between the villages located on either side of the power channel. The survey has revealed that the people of the Ghazi area have relationships with the people of villages on the Gandghar mountains. Moreover, the people of these villages are dependent on Ghazi village for marketing and education.

The other pronounced effect will be related to the economy of the area. The groups most affected by the Project would be those who are involved with agriculture.

Many landowners will lose some or all of their land, but they will get compensation for their land. The tenants will lose their livelihood without any compensation. The tenants in the survey area are "tenants-at-will" and not "occupancy tenants". They have no claim on the land they cultivate and thus are not considered for compensation. Kammis, who by tradition provide services in exchange for a share in the crop, will also be affected by the loss to the production system. However, it was observed during the survey that the trend has changed. The majority of the members of these groups have started their own businesses in their own trades (barber, blacksmith, cobbler, carpenter, potter, etc.) along the Hazro road and provide services to the villagers on cash payment.

Besides the effect on economic resources due to land acquisition, the Project will disrupt the daily movement of local population, particularly of those who have their land across the power channel and tailrace. The survey has indicated that these structures will cut off about 9,326 ha of the farmland of 15 sample villages (50% of total land) from village settlements. The land belongs to about 6,635 cultivators living on the other side of the village. The power channel will, likewise, cross the land area of 48 villages. Thus by projecting these figures over 48 villages, the number of cultivators so affected would be about 22,000.
The survey has indicated that farmers generally make two trips daily to the farmland. They normally go to their farmland on foot, by bicycle or sometimes by tractor.

If no additional bridges were provided for these villages except those for major roads, the additional travelling distance for various villages from their living place to the parted land would range from 0 to 15 km (average 7.5 km). As such, the additional daily travelling of 22,000 cultivators, with one trip a day, would be 330,000 km.

This will mean a loss of time, energy and income of the farming folk. This requires the provision of an appropriate number of bridges across the power channel.

D.8 FARM POWER

D.8.1 Tractor/trolley

According to the survey, there are 307 tractors and 287 trolleys in the villages surveyed. They are owned by the farmers and are mostly used for cultivation, haulage and transportation. The frequency of distribution of tractors/trolleys varies from village to village. The villages of Ghurghushti, Malak Mala and Barazai, which are contiguous villages and occupy very productive land, own 245 tractors and 230 trolleys.

In the villages falling in Ghazi and Sarwala tracts, the frequency of owning tractors is very small, ranging from 1 to 6, while in south Chhachh it is 9 to 16. The distribution of trolleys follows the same pattern.

D.8.2 Animal Power

Animal power includes the yoke for cultivation and carts for haulage and transportation. There are 233 yokes and 60 carts in the survey villages. The majority of the yokes exist in Ghurghushti and Barotha (with 100 yokes each), followed by Barazai (20). The maximum number of carts have been found in Saidan village (35) and the remainder are distributed in 8 villages, the number ranging from 4 to 2.

The area of land cultivated by yokes is, however, nominal (1%). About 99% of the farmlands are cultivated by tractors. Even the small farmers hire tractors from other farmers within the village or from neighbouring villages. It is observed that about 122 tractors are hired by the cultivators from other villages and about 52 tractors are rented out from these villages.
D.8.3 Machinery Trips Across the Power Channel

About 50% of the land area of the villages surveyed will lie on the far side of the power channel. Therefore, the movement of tractors and carts across the power channel would be very frequent. The following table gives the probable trips each month made by the tractors/trolleys and yokes/carts for farming, haulage and transportation to the land area across the power channel:

<table>
<thead>
<tr>
<th>PURPOSE OF TRIPS</th>
<th>MODE OF TRIPS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TRACTORS/ TROLLEYS</td>
<td>YOKES/ Carts</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Farming</td>
<td>2,872</td>
<td>33.2</td>
</tr>
<tr>
<td>Haulage</td>
<td>5,450</td>
<td>63.1</td>
</tr>
<tr>
<td>Transportation</td>
<td>320</td>
<td>3.7</td>
</tr>
<tr>
<td>Total</td>
<td>8,642</td>
<td>100.0</td>
</tr>
</tbody>
</table>

According to the data, 12,100 trips are made by the tractors/trolleys and yoke/carts per month in 15 villages. If this figure is projected over 48 villages likely to be affected by the power channel, there will be about 39,000 trips per month or 1,300 trips per day.

It is also evident from this data that the majority of these trips are for haulage, because the farmers use tractors with trolleys, and carts, for haulage of farm products, wood, sand and stone etc.

D.9 LIVESTOCK

D.9.1 Distribution Pattern

The livestock of the Project area include cattle, buffaloes, sheep, goats, camels and donkeys. The survey data has revealed that cattle and sheep are mainly maintained for commercial purpose, i.e., rearing for meat. Male cattle are also used for farming activities, haulage and transport (carts). Donkeys are mainly used as beasts of burden. Buffaloes and goats are mainly maintained for domestic use, milk and meat.
The distribution of these animals in the survey area is shown in the following table:

**LIVESTOCK OF THE SURVEY VILLAGES**

<table>
<thead>
<tr>
<th>KIND OF LIVESTOCK</th>
<th>ANIMAL HEADS</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>8,180</td>
<td>24.9</td>
</tr>
<tr>
<td>Buffalo</td>
<td>7,039</td>
<td>21.4</td>
</tr>
<tr>
<td>Sheep</td>
<td>6,448</td>
<td>19.6</td>
</tr>
<tr>
<td>Goat</td>
<td>7,191</td>
<td>21.9</td>
</tr>
<tr>
<td>Camel</td>
<td>443</td>
<td>1.3</td>
</tr>
<tr>
<td>Donkey</td>
<td>3,605</td>
<td>10.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32,906</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

With this distribution, it can be inferred that about 50% of the livestock are maintained for commercial purposes and 50% for household, farming activities and transport purposes.

**D.9.2 Foraging Pattern and Movements**

Survey data has revealed that about 60% of the households in the villages surveyed keep their animals in their fields and feed them on green fodder, hay and stubble. There is only one village where fodder is available in the local market. Therefore, the remaining households (40%) mostly depend on herding. There is no reserved grazing area or pasture land in the Project area. Herding is normally carried out on barren land, fallow land, along the nullahs and on roadside vegetation.

The uncommanded wasteland used as pastures is normally located on the other side of the channel. About 20% of the villages surveyed have categorically claimed that their pastures are located on the other side of the channel, thus the power channel will be an obstruction to the movement of their animals. The remaining 80%, although they have no pasturage, have claimed that, as most of their fields will be on the other side of the channel, foraging on fallow fields will be obstructed.

The markets for the sale of livestock are located in Ghazi-Khalo, Hazro and Gondal. None of the marketplaces will be obstructed by the Project. However, the constraints on grazing necessitates the provision of bridges.
D.10 SOCIAL INFRASTRUCTURE

D.10.1 Education

There are 33 schools (21 for boys and 12 for girls) in the 15 villages surveyed. Almost all the villages have primary schools for the boys, while 10 villages have such facilities for girls. Similarly, middle and high schools are available in 6 and 3 villages respectively for boys, and in 2 villages for girls.

The total number of students in the villages surveyed is 6,942 (4,745 boys and 2,197 girls). The primary and middle level education facilities are available within the village or in the nearby village. But for high school and college level education, the students have to go to Ghazi, Hazro or Attock. None of these locations will be disrupted by the Project.

D.10.2 Health Facilities

The health facilities in the villages surveyed are not satisfactory. There are only 3 Basic Health Units in 15 villages surveyed. Qualified doctors are available in 4 villages. Eight villages have dispensers. The patients normally have to visit Attock, Ghazi, Tarbela Colony Hospital and Hazro for treatment.

D.10.3 Market Place

Shops are available in 14 out of 15 villages surveyed. Here items of daily use like kerosene oil, pulses, vegetables, cooking oil, tea, etc., are readily available. For other household goods and farming implements the people have to go to Ghazi, Hazro and Attock.

7-D.12
ENVIRONMENTAL ASSESSMENT OF
GHAZI-GARIALA HYDROPOWER PROJECT

VILLAGE SURVEY

Had Bast No.__________________ Village__________________
Union Council_______________
Tehsil_______________________

I. Land Resource

Village area (acres) __________
Cultivated area ____________ Cultd. area by Irrg. Source
Orchards ________________ Canal ____________
Pasture land ______________ Tubewells ____________
Farm forest ______________ P. Wheel ____________
Culturable waste __________ Pump+Pw ____________
Waste land ______________ Barani ____________
Riverain _________________

Cropping Pattern and Intensities (To evaluate economic impact)

Major Crop With acreage and average yields

<table>
<thead>
<tr>
<th>Rabi</th>
<th>Kharif</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area(Acre/ Kanal)</td>
<td>Yield mds/kanal</td>
</tr>
<tr>
<td>Wheat</td>
<td>_________( )</td>
</tr>
<tr>
<td>Vegetables</td>
<td>_________( )</td>
</tr>
<tr>
<td>Grams</td>
<td>_________( )</td>
</tr>
<tr>
<td>Barley</td>
<td>_________( )</td>
</tr>
<tr>
<td>Tobacco</td>
<td>_________( )</td>
</tr>
</tbody>
</table>

7-D.13
### Crop inputs/Kanal

<table>
<thead>
<tr>
<th>Crops</th>
<th>No. of Ploughing</th>
<th>Seed Kg</th>
<th>Fertilizer (bags)</th>
<th>Hired Labour (Days)</th>
<th>Cost of Pesticides (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Urea</td>
<td>Potash</td>
<td>DAP</td>
</tr>
<tr>
<td>Rabi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tabacco</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundnut</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kharif</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
General Pattern of Land Holding  
(To Support data obtained from Patwari)

<table>
<thead>
<tr>
<th></th>
<th>&gt;25 acres</th>
<th>12.5 - 25 acres</th>
<th>&lt;12.5 acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Zamindars(owners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Owners + Tenants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Tenants</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Land Fragmentation

<table>
<thead>
<tr>
<th></th>
<th>Consolidated</th>
<th>2 Fragments</th>
<th>More than 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Owners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Owners + Tenants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Tenants</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

II. Water Resource

Surface Water Resource

1. River water

- Usage
  - Irrigation
  - Livestock
  - Domestic

- Distance

2. Canal from Qibla Bandi Dam

- Usage
  - Irrigation

- Distance

7-D.15
Livestock No. of Heads
Domestic Drinking Buckets/day
Washing Heads/day
Bathing Heads/day

3. Pond
Location
Distance

Usage
Irrigation How many acres

Livestock No. of Heads
Domestic Drinking Buckets/day
Washing Heads/day
Bathing Heads/day

Ground Water Resource

A) Inventory:

<table>
<thead>
<tr>
<th>Category</th>
<th>Community owned</th>
<th>Group owned</th>
<th>Individual owned</th>
<th>Irrig. Domestic</th>
<th>Domestic</th>
<th>No. of Beneficiaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand Pumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persian Wheel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tubewell (E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tubewell (D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7-D.16
B) Depth of Water Table
   (average)
   Wet season
   Dry season

C) **Tw Disruption Data**

   - No. of Tw/w existing on one side of Power Channel but having command on other side (owner land)
   - No. of Cases sell water
   - No. of Beneficiaries
   - No. of Beneficiaries owning land across the power channel
   - Hours sold (average per Tw) Rabi
   - Selling rate
     - Rabi
     - Kharif
   - Kharif

**Water Availability Level**

Does existing resource meet village requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>for Irrigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Domestic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Livestock</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If no, what are future development plans:

Name source & Quantify the efforts.

<table>
<thead>
<tr>
<th>Effort</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual effort</td>
<td></td>
</tr>
<tr>
<td>Community effort</td>
<td></td>
</tr>
<tr>
<td>Government support</td>
<td></td>
</tr>
</tbody>
</table>

What will villagers require from Govt.?
### III. Farm Power

**A) Tractor/Trolley**

<table>
<thead>
<tr>
<th>Tractor</th>
<th>Trolley</th>
<th>Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

**No. in Village:** Farmer owned

| Others |          |         |
| _____  | _____    | _____   |
|        |          |         |

**No. brought in:**

|          |         |
| _____    | _____   |
| where from|         |

**No. hired out of Village**

|          |         |
| _____    | _____   |
| where to |         |

**Tractor hire charges for Ploughing (Rs. per hour)**

|         |
| _____   |

**B) Animal Power**

**No. of Yoke in village**

|         |
| _____   |

**No. of Carts in village**

|         |
| _____   |

**No. of Carts brought in**

|         |
| _____   |

**No. of Carts moving out of village**

|         |
| _____   |

**C) Movements of farm machinery across the course of Power Channel:**

**Village area falling across the power channel (acres)**

|         |
| _____   |

**No. of Holdings**

|         |
| _____   |

**How many holdings cultivated with**

| Tractor | Yoke |
| _____   | _____|

7-D.18
How frequent is the movement:  

<table>
<thead>
<tr>
<th>No. of trips/month</th>
<th>Tractor/Trolley</th>
<th>Yoke/Cart</th>
</tr>
</thead>
<tbody>
<tr>
<td>for Farming activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Haulage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for People transport</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IV. Human Resources

Estimated Population ____________________________

No. of Households ____________________________

- Absentee Landlords ________ Beraderi ________
- Primary Zamindars ________ Beraderi ________
- Tenant Households ________ Beraderi ________
- Herdsmen Households ________ Beraderi ________
- Kammi Households ________ Beraderi ________
- Seasonal/Refugee ________ Beraderi ________

What is the average daily wage rate for a farm labour (Rs.)

How many households have one or more members working elsewhere?

Where? _______________________________________

How many Zamindars own land in village but live elsewhere?

If so, where do they live?

How many Tenants, Field Laborers, etc. in village work out?

If so, where do they work?

7-D.19
Is this a daily movement; if not, what is the cycle?

How many tenants, etc. live elsewhere and work here?

If so, where do they come from?

Is this a daily movement; if not, what is the cycle?

How frequently do cultivators visit their fields?

How do they get there (Walk, horse, bicycle, jeep)?

A) Herdsmen

Pattern of village herds

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of Households</th>
<th>Average No. per Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household Livestock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse/Donkey</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7-D.20
Commercial Livestock

<table>
<thead>
<tr>
<th>Livestock</th>
<th>No. of Households</th>
<th>No. of Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse/Donkey</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Foraging Pattern

Farm House feeding: [ ]

<table>
<thead>
<tr>
<th>Source from where Feed is obtained</th>
<th>Farmland</th>
<th>Road side</th>
<th>Pastures</th>
<th>Shops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road side</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pastures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grazing over:

<table>
<thead>
<tr>
<th>Grazing over</th>
<th>No. of Livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmland meadows</td>
<td></td>
</tr>
<tr>
<td>Farmland stubble</td>
<td></td>
</tr>
<tr>
<td>Road side stubble</td>
<td></td>
</tr>
<tr>
<td>Pastures/rangeland</td>
<td></td>
</tr>
</tbody>
</table>
Movement of livestock across the course of Power Channel:

Locations of grazing facilities for the village.

Location of sale point of feed

Routes to grazing area most frequently use.

Routes to market where animals are sold.

B) Tenant

No. of Mokarridars ________

No. of Occupancy Tenants_______ In-kind_______ Cash_______

No. of Tenants-at-will ________ In-kind_______ Cash_______

Batai for irr. land ________ for Barani___________

Rent of irr. land ________ for Barani___________

C) Village Service Groups (Kammi)

Services available in village

Number doing in kind service

Member doing cash service

How do land sales affect old share rights?

D) Women

Literacy level (% age)

Working women (% age)

Occupations adopted by working women

Farm land labour (% age)

Herding (% age)

Cottage industries (% age)
Handicrafts (% age) ________________
Joint tasks (% age) ________________

Is there a gathering place for women?

If yes, how frequent they meet? Yes ☐ No ☐
daily ☐ weekly ☐ monthly ☐

Health issues ____________________________________________

What are the prospects of future development of women folk ____________________________________________

V. Social Infrastructure
A) Education
Primary Schools Boys Girls
Where ___________________________ ___________________________
Distance ___________________________ ___________________________
How many ___________________________ ___________________________
Village Enrollment ___________________________ ___________________________
Other Enrollment ___________________________ ___________________________
=================================================================

Middle Schools Boys Girls
Where ___________________________ ___________________________
Distance ___________________________ ___________________________
How many ___________________________ ___________________________
Village Enrollment ___________________________ ___________________________
Other Enrollment ___________________________ ___________________________
=================================================================

7-D.23
<table>
<thead>
<tr>
<th>High Schools</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village Enrollment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Enrollment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>College/Tech. School</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village Enrollment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Enrollment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B) Health

<table>
<thead>
<tr>
<th>Facilities in Villages:</th>
<th>PATIENT PER WEEK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Hakkim</td>
<td></td>
</tr>
<tr>
<td>Homeopath</td>
<td></td>
</tr>
<tr>
<td>Dayya</td>
<td></td>
</tr>
<tr>
<td>Doctor</td>
<td></td>
</tr>
<tr>
<td>Dispenser</td>
<td></td>
</tr>
</tbody>
</table>

Where is the nearest basic health unit (BHU) ?

No. of Villagers visiting BHU per week ?
Where is the nearest Hospital?

No. of villagers visiting Hospital per week?

C) Market Place:

How many shops in village

Goods available?

What is the source of Fuel:

Availability point of Fuel:

Route to Mandi most frequently visited?

Route to nearest fertilizer/seed depot?

Route to nearest tractor repair facility?

Route to nearest TW parts shop?

Nearest Bus/Wagon Stop?

D) Cultural Aspects:

Shrines and Melas:
What shrines/Melas do villagers visit?

How many villagers visit per week/month?

Village marriage networks (How far out from village):

In the last ten years, how many marriages occurred by villagers marrying:

In the village ☐ In Contiguous Villg. ☐

Across the Indus ☐ In the Halqa/uc ☐

In the Tehsil ☐ Dist and Beyond ☐
E) Village Leadership:

Lambardar (Name, family, history, landholding etc.)

Village Councillor (Name, family history, landholding etc.)

Village Notables (As above)

Formal or informal village organizations

(Who keeps biradri record of Jehz, Mehr, Nindre?)
APPENDIX E

SOCIAL SURVEY OF WOMEN
IN THE PROJECT AREA
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E.2.3 The Sample 7-E.2
E.2.4 Scoping Sessions 7-E.2
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E.2.6 Data Analysis 7-E.3
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ATTACHMENT

7-E(i)
APPENDIX E

SOCIAL SURVEY OF WOMEN IN THE PROJECT AREA

E.1 INTRODUCTION

This study was undertaken with two specific purposes:

- to conduct village-level scoping sessions in which females were informed about the characteristics and benefits of the Ghazi-Gariala Hydropower Project, and their reactions were recorded; and

- to assess the impact of the Project on the social life of the female population.

For this purpose, the existing lifestyle of women and children and their participation in different social and economic activities were studied.

Information about the existing conditions of women and children can serve as a baseline to monitor the impact of the Project on these groups. It may also help to delineate channels for the delivery of services to women and children in rural communities affected by the Project. The survey data may be used to aid in the planning and provision of development programmes for women. This information may also be used as a benchmark to monitor the progress of such an action programme.

To fulfill the objectives of the survey, information was collected about:

- female opinions, comments and suggestions about the Project,
- existing educational facilities for females and parental attitudes about sending their children to school,
- existing health facilities,
- female participation in different activities and occupations,
- living conditions and domestic facilities,
- visits to shrines and melas (fairs),
- marriage patterns,
- general problems faced in different spheres of life, and
- their suggestions about future development.
E.2 METHODOLOGY

E.2.1 General

The study was conducted in mid-November 1990 in the areas likely to be affected by the Project.

In this connection, the Chairmen and Secretaries of the Union Councils (the lowest tier of local government), lady social workers, lady health visitors (LHVs), dais (midwives), lady councillors and lady teachers were informed prior to the visit of the survey team to their area.

The objectives of the study and the tentative dates of the visit were explained. The local officials made arrangements to gather the women in an appropriate place, ie a girl's school, landowner's house etc. In most cases this worked well, although in four villages the men initially objected to their womenfolk being interviewed.

E.2.2 Target Population

The respondents for this study were women of the Project area, who could understand the objectives of the Project and respond to questions about their existing lifestyle.

E.2.3 The Sample

Out of 48 affected villages in the Project area, 14 were selected randomly for study. Females of all social strata were invited to attend the scoping sessions without any limitation in their numbers.

E.2.4 Scoping Sessions

A large-size base map, indicating the proposed alignment of the Project structures and the location of villages, was used to describe the Project to the women. Informational pamphlets were also distributed and a question-answer session was held. The scoping sessions were held according to the schedule given in the following table:
### SCHEDULE OF VILLAGE-LEVEL SCOPING SESSIONS AND SURVEY

<table>
<thead>
<tr>
<th>VILLAGE</th>
<th>UNION COUNCIL</th>
<th>DATE</th>
<th>FEMALES PRESENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Ghazi</td>
<td>Nov. 15, 90</td>
<td>23</td>
</tr>
<tr>
<td>Jallo</td>
<td>Ghazi</td>
<td>Nov. 17, 90</td>
<td>30</td>
</tr>
<tr>
<td>Hasanpur</td>
<td>Ghazi</td>
<td>Nov. 18, 90</td>
<td>91</td>
</tr>
<tr>
<td>Ghurghushti</td>
<td>Ghurghushti</td>
<td>Nov. 20, 90</td>
<td>15</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Ghazi</td>
<td>Nov. 20, 90</td>
<td>44</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>Malak Mala</td>
<td>Nov. 21, 90</td>
<td>9</td>
</tr>
<tr>
<td>Barazai</td>
<td>Malak Mala</td>
<td>Nov. 21, 90</td>
<td>39</td>
</tr>
<tr>
<td>Walidad</td>
<td>Bhangi</td>
<td>Nov. 24, 90</td>
<td>15</td>
</tr>
<tr>
<td>Khagwani</td>
<td>Khagwani</td>
<td>Nov. 25, 90</td>
<td>17</td>
</tr>
<tr>
<td>Musa</td>
<td>Musa</td>
<td>Nov. 26, 90</td>
<td>17</td>
</tr>
<tr>
<td>Jatial</td>
<td>Bahadur Khan</td>
<td>Nov. 27, 90</td>
<td>17</td>
</tr>
<tr>
<td>Kamra Kalan</td>
<td>Kamra</td>
<td>Nov. 28, 90</td>
<td>23</td>
</tr>
<tr>
<td>Nurpur Karam Alia Rumian</td>
<td>Surag Salar</td>
<td>Dec. 02, 90</td>
<td>18</td>
</tr>
</tbody>
</table>

The detailed account of the female scoping sessions is presented in Appendix B.

### E.2.5 Data Collection

For the collection of data, a specific interviewing schedule was constructed. The study was based on group interviews. One questionnaire was filled out for each village. The sample questionnaire is attached at the end of this Appendix.

### E.2.6 Data Analysis

The collected information was transferred to data sheets and then presented in simple frequency distribution tables, along with an interpretation of the findings. Data on the female population was also collected from the offices of Union Councils.

### E.3 FINDINGS OF THE STUDY

#### E.3.1 General

Before discussing the general findings of the study, it may be appropriate to give a brief sketch of general information about the sample as shown in the following table.
The female population has been calculated according to the proportion of females in the total population of 14 villages during the 1981 census. Women above 14 years of age constituted 55% of the total female population. Female children of school age made up 30% of the total population. The remaining 15% was presumed to be female infants (0-4 years of age). The number of households in the 14 villages total about 10,940, of which 77% are agriculturists. The remaining 23% are, concerned with non-agricultural jobs inside and outside the villages.

The main biraderis in the Project area are Pathans (Tahir Khaeli, Alizai, Musazai, Inyat Khaeli, and Shah Khaeli), Gujar, Malyar, Malik (Awan), Gakhar, Kashmiri, Sadaat, Mughal, and Rajput.

E.3.2 Education

Educational Status of the Respondents

The educational status of females who attended the scoping sessions is instructive. The following table shows that a majority of women in the Project area are illiterate (66%). About 14% have been educated up to primary level, 20% to matric or above. Only a single female was found in the Project area at Jallo who has a master's degree in arts. Villages lack sufficient educational facilities for girls as well as boys.

<table>
<thead>
<tr>
<th>EDUCATIONAL LEVEL</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A.</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>B.A.</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>F.A.</td>
<td>6</td>
<td>1.6</td>
</tr>
<tr>
<td>SSC</td>
<td>25</td>
<td>6.8</td>
</tr>
<tr>
<td>Middle</td>
<td>37</td>
<td>10.0</td>
</tr>
<tr>
<td>Primary</td>
<td>52</td>
<td>14.0</td>
</tr>
<tr>
<td>Illiterate</td>
<td>245</td>
<td>66.2</td>
</tr>
<tr>
<td>Total</td>
<td>370</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Schooling Facility

The total number of females of school age (5-14 years) in the villages surveyed is 8,699, out of which 25% are going to school, according to the enrollment in the school registers. Grade-wise distribution of the enrollment is as follows:

<table>
<thead>
<tr>
<th>LEVEL OF SCHOOLS</th>
<th>SCHOOL LEVEL</th>
<th>NO. OF VILLAGES</th>
<th>ENROLLMENT</th>
<th>NO. OF TEACHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primary</td>
<td>7</td>
<td>1,041</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>2</td>
<td>587</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>1</td>
<td>584</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>14</td>
<td>2,212</td>
<td>18</td>
</tr>
</tbody>
</table>

The table reveals that 7 villages have only primary schools with 1,041 enrolled students and 19 teachers, while 4 villages, Isa, Jallo, Walidad, and Nurpur Karam Alia, have no schools for girls. The student-teacher ratio at the primary level is 1:54 (1 teacher per 54 students), and 1:39 and 1:65 in middle and high levels respectively. This enrollment also includes those children who come from villages other than those surveyed. Due to non-availability of girls schools above the primary level in 7 villages, females go to other places for education. The following table shows the villages where females go to schools.

<table>
<thead>
<tr>
<th>STUDENT VILLAGE</th>
<th>SCHOOL VILLAGE</th>
<th>ACROSS POWER CHANNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Isa</td>
<td>No</td>
</tr>
<tr>
<td>Jallo</td>
<td>Bhai, Kalo, Ghazi</td>
<td>No</td>
</tr>
<tr>
<td>Hassanpur</td>
<td>Ghazi, Khalo</td>
<td>No</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Ghazi, Khalo</td>
<td>No</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>Ghurghushti</td>
<td>No</td>
</tr>
<tr>
<td>Barazai</td>
<td>Ghurghushti</td>
<td>No</td>
</tr>
<tr>
<td>Walidad</td>
<td>Wardag</td>
<td>No</td>
</tr>
<tr>
<td>Musa Kudlathi</td>
<td>Hazro</td>
<td>No</td>
</tr>
<tr>
<td>Jatial</td>
<td>Kamra, Bahadur Khan</td>
<td>No</td>
</tr>
<tr>
<td>Kamra Kalan</td>
<td>Kamra, Hazro, Attock</td>
<td>Yes</td>
</tr>
<tr>
<td>Ghurghushti</td>
<td>Ghurghushti</td>
<td>No</td>
</tr>
<tr>
<td>Khagwani</td>
<td>Khagwani</td>
<td>No</td>
</tr>
<tr>
<td>Nurpur Karam Alia</td>
<td>Nurpur Karm Alia</td>
<td>No</td>
</tr>
<tr>
<td>Barotha</td>
<td>Barotha</td>
<td>No</td>
</tr>
</tbody>
</table>

7-E.5
Trend to Send Female Children to School

Different societies have different attitudes about sending their female children to schools. In the present study, of the total 10,940 households of 14 villages, 22% (2,359) are sending their daughters to school, 21% (2,295) do not have any female child of school age, while 57% (6,286) do not send their daughters to school, due to various economic and cultural reasons.

The following table shows the reasons for not sending female children to school.

### REASONS OF NOT SENDING FEMALES TO SCHOOL

<table>
<thead>
<tr>
<th>REASONS</th>
<th>VILLAGES</th>
<th>HOUSEHOLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No schooling facility</td>
<td>3</td>
<td>380</td>
</tr>
<tr>
<td>Poverty</td>
<td>4</td>
<td>435</td>
</tr>
<tr>
<td>Poverty + no schooling facility</td>
<td>2</td>
<td>220</td>
</tr>
<tr>
<td>Purdah observance</td>
<td>4</td>
<td>4,951</td>
</tr>
<tr>
<td>Poverty and purdah observance</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>6,286</strong></td>
</tr>
</tbody>
</table>

E.3.3 Vocational/Industrial Centres

In the sample area there are only 2 vocational centres. One is a private institution established in Isa, where young girls (10 to 16 years old) learn cutting, stitching, knitting and embroidery. Another centre is situated in Mian Dheri, where it is run by the Social Welfare Department. It contains 10 sewing machines donated by the NWFP Government and was established in the residence of a sewing teacher. Enrollment in this centre is 10. Neither of the centres has the capacity to train women from other villages.

E.3.4 Health Services

Modern Health Facilities

Health facilities in the Project area are inadequate to meet women's requirements. There are only 3 Basic Health Units (BHUs) in the 14 villages surveyed. Except for Ghurghushti, Khagwani and Kamra Kalan, women are deprived of medical facilities inside the village. The following table shows the staff availability in 3 BHUs of the survey villages:
MEDICAL PRACTITIONERS IN BHU's

<table>
<thead>
<tr>
<th>PRACTITIONER</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOCAL</td>
</tr>
<tr>
<td>Doctor (Male)</td>
<td>-</td>
</tr>
<tr>
<td>Nurse</td>
<td>-</td>
</tr>
<tr>
<td>Dispenser</td>
<td>2</td>
</tr>
<tr>
<td>LHV</td>
<td>1</td>
</tr>
<tr>
<td>Dai</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11</td>
</tr>
</tbody>
</table>

The table shows that only 22 medical staff were available for a female population of 13,880 in these 3 villages. Besides the medical staff in BHUs, there are 26 local traditional birth attendants (TBA) in the sample area. According to the women interviewed, the TBAs (dais) are not sufficiently trained in their profession. Medicines are frequently not available in these health units. People go to other villages or markets to buy medicines. Residents of Isa, Jallo, Hasanpur, Mian Dheri, and Malak Mala buy medicines from Ghazi, while others go to Hazro and Attock. Except for medical check-ups in the village BHUs, women have to go elsewhere in serious cases. However, the Project structures will not be a barrier to the villages surveyed for obtaining medical facilities.

No child immunisation centres were found in the area visited. Mobile teams, however, visit the villages for this purpose. The frequency of visits is shown in the following table.

PERIOD OF VISITS OF MOBILE TEAM

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>NO. OF VILLAGE</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>6</td>
<td>42.9</td>
</tr>
<tr>
<td>After three months</td>
<td>5</td>
<td>35.7</td>
</tr>
<tr>
<td>Yearly</td>
<td>1</td>
<td>7.1</td>
</tr>
<tr>
<td>No visit</td>
<td>2</td>
<td>14.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

According to this table, less than half of the villages receive a mobile team monthly for immunisations, while in five other villages such teams visit after three months. One village is visited once in a year and 2 villages have never been visited by a mobile team. These villages are Malak Mala and Barazai.
Traditional Health Care Practice

According to the survey, about 80% of the female population above 14 years of age do try some traditional method of curing diseases for themselves and children before attempting to get modern medical treatment. About 71% get 'taweez/dhaga' (charms) for the treatment of diseases. It was also reported that women have a strong belief in shrines and often go there to pray for help and give small offerings. The following table shows the shrines where women from various villages visit.

<table>
<thead>
<tr>
<th>VILLAGE</th>
<th>NAME OF SHRINE</th>
<th>ACROSS POWER CHANNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Chand Pir (Jallo)</td>
<td>No</td>
</tr>
<tr>
<td>Jallo</td>
<td>Chand Pir</td>
<td>No</td>
</tr>
<tr>
<td>Haspanpur</td>
<td>Haji Rehman Baba (Khairbara)</td>
<td>Yes</td>
</tr>
<tr>
<td>Ghurghushti</td>
<td>Haji Rehman Baba (Khairbara)</td>
<td>No</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Sufi Shah Baba</td>
<td>No</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>Pir Shah (Malak Mala)</td>
<td>No</td>
</tr>
<tr>
<td>Barazai</td>
<td>Shahid Baba (Barazai)</td>
<td>No</td>
</tr>
<tr>
<td>Walidad</td>
<td>Haji Rehman Baba (Khairbara)</td>
<td>Yes</td>
</tr>
<tr>
<td>Dhok Khagwani</td>
<td>Mian Shin Baba (Musa)</td>
<td>No</td>
</tr>
<tr>
<td>Musa Kudlathi</td>
<td>Mian Shin Baba (Musa)</td>
<td>No</td>
</tr>
<tr>
<td>Mian Khadi Baba</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Jatial</td>
<td>Sakhi Baba (Hattian)</td>
<td>No</td>
</tr>
<tr>
<td>Kamra Kalan</td>
<td>Mian Ali Baba (Thikarian)</td>
<td>No</td>
</tr>
<tr>
<td>Nurpur</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Karam Alia</td>
<td>Mushraf Bibi</td>
<td>No</td>
</tr>
<tr>
<td>Barotha</td>
<td>Shah Safaid (choi Bangla)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Prevalence of Diseases in Females in the Project Area

In the areas visited, females reported a variety of diseases which they frequently suffered. A majority of females have complaints of a variety of diseases including maternity problems, depression, headaches, skin and eye infections, eye weakness, kidney pain, ulcer, gastric problems, diabetes, heart problems, blood pressure, and asthma. The majority of women are not free to express their ideas and views in general household affairs. Women lack the right of decision making in many spheres of everyday life.
Maternity Problems

The duty of married women to bear children, particularly sons, is very strongly held in the Project area, as it is throughout the country.

In the sample area, many women complain of the problems they faced during pregnancy and after birth. These problems were pregnancy wastage, miscarriage, anaemia, iron deficiency, uterine ulcer, and the problems faced at the time of delivery. About 40% of married women said they had experienced one or more of these diseases.

In the rural areas of Pakistan, women face many health problems. These are: lack of medical facilities, untrained dais, unhygienic practices, a lack of nutritious food, a lack of family planning centres and knowledge about pre-natal and post-natal care. In the Project area, most women do not go to hospitals at the time of delivery, even when complications may be indicated, which increases the incidence of infant death and sometimes of mothers.

Children's Diseases

In the present study an effort was made to list the major and most frequent diseases of children in the Project area. Diarrhoea was one of the most often-quoted ailments among rural children. Other disease were: gastro-enteritis, vomiting, coughs and colds, fever, skin and eye infections, boils, ear diseases, malaria, measles, pneumonia and anaemia. These diseases may partly result from unhygienic environments and malnutrition.

E.3.5 Sanitation and Hygienic Conditions

Drains and Toilets

About 61% of the houses did not have any arrangement to drain waste water out of the house. The remaining 39% drain the water out of the house, irrespective of what happens to it out in the street. Of the 14 villages visited, 79% had drains in the street but these were overflowing. The villages appeared to lack gutters with sufficient capacity to cope with waste water or enough personnel willing to keep them unblocked.

According to this survey, villagers, both males and females, usually go out into the fields for toilet purposes. Most households, where the purdah system is strictly enforced, have some provisions for toilet inside the house. About 53% of total houses had such a toilet arrangement. Septic tanks are used for most toilets. The remaining 47% of houses did not have proper toilet arrangements. These households dispose of their wastes in the fields.
Source of Drinking Water

Open wells are the main source of water for drinking and domestic purposes in the visited areas. The residents of 8 villages mostly have open wells. On a majority of the open wells motor pumps are installed. The people of the remaining 6 villages have access to hand pumps. Village women complained that no chemicals have ever been supplied by the government to purify drinking water. A majority of residents of the Project area have a water facility inside their houses. A few residents had to bring water from outside their house. Some houses beside the Indus river also use river water.

Washing Facilities and Outside Washing Preference

About 99% of the households in the sample villages have a washing facility inside the house. In spite of this, females of 5 villages preferred washing clothes outside the house, especially in the summer season. Out of the total households in the Project area, 15% (1689) are situated near the river bank or a nullah. Among these, 33% of the households prefer to go outside for washing purposes. These households are mostly located in Nurpur Karam Alia and Barotha. Here a large number of women like to wash clothes at Jaba and Barotha nullahs respectively. According to them, drawing water in a large quantity from a well with a hand pump is troublesome work, so these women prefer to wash clothes in running water.

E.3.6 Female Occupation

General

Women play a vital role in the improvement of the quality of life in developing countries like Pakistan. In the home and in the community, women contribute directly to social and economic progress.

The concept of purdah generally leads to the belief that the role of women in the rural areas would be confined within the four walls of their homes. Nothing could be farther from the truth. There is no denying the fact that rural women play crucial roles outside the home.

In most of the rural areas, women work both out in the fields and in the domestic domain to help directly produce the household income. They contribute in both the production and processing of crops side by side with men.

Other activities, ie the care of poultry, livestock raising, plastering and whitewashing the homes, are performed by females. In addition to fulfilling their traditionally assigned roles like child-rearing, cleaning, cooking, washing, milking and
churning, they help their menfolk in sowing and extracting groundnuts. They renovate their mud houses about twice a year.

The present survey has focused on various roles and activities performed by females in the Project area because the farm labour provided by rural women is of vital importance.

Participation in Agricultural Activities

In the sample area, females of 10 villages participate in agricultural activities. Women in Hasanpur, Barazai, Walidad and Jatial had less participation.

**FEMALE PARTICIPATION IN AGRICULTURAL ACTIVITIES**

<table>
<thead>
<tr>
<th>TREND</th>
<th>NO. OF FEMALES</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participate</td>
<td>1,086</td>
<td>7</td>
</tr>
<tr>
<td>Do not participate</td>
<td>14,865</td>
<td>93</td>
</tr>
<tr>
<td>Total</td>
<td>15,951</td>
<td>100</td>
</tr>
</tbody>
</table>

As shown in the above table, of the total females above 14 years 7% participate in agricultural activities, while 93% do not participate due to the purdah system.

Most women work in their own fields (inside the village). Kammi females work in fields for landlords and get a share of 1/3 from the crop production.

Handicrafts

Out of the total female population above 14 years, 39% are doing handicrafts. In all the villages, women have a keen interest in:

- embroidery,
- stitching and sewing,
- making 'azaar bands' (a narrow woven cotton strip or belt used for tying a 'shalwar' (baggy trouser) around the waist.),
- making 'parandas' (a tape with three strands woven of thread to braid the hair),
- crocheting work,
- charpoy (cot) weaving,
- chair weaving, and
- knitting.

Most women sell their handicrafts in the markets of Hazro, Attock, Kamra, Bahadur Khan and Peshawar. They also work for each other inside the village. They charge Rs. 25-35 per suit for stitching, and Rs. 400 for full embroidery over a shawl. There is no real cottage industry in the villages surveyed.

**Participation in Livestock Tending**

Women of the Project area play an important role in livestock raising. They perform the following duties;

- chopping fodder,
- feeding in the manger,
- preparing cattle feed,
- cleaning the cattle shed, and
- milking.

**Work Area**

In spite of these occupational activities, participation by women outside the home is limited by the observance of purdah. Men in the area are very conservative and they do not like to send their females outside the home. About 60% of women in the Project area work solely within the four walls of the home. The female role in maintenance of the house is typical of rural areas.

**E.3.7 Market Facility**

Market facilities are inadequate in the Project area. Nine villages have less than 10 shops, while 3 villages have 11 to 20 shops. Ghurghushti and Kamra Kalan, both large villages, have 100 and 45 shops respectively.

**Availability of Items of Daily Use**

Items of daily use are normally available in most of the villages. Goods not available are usually brought from Ghazi, Hazro, Attock, Rawalpindi and Peshawar. Sometimes street hawkers bring things of general use into the village. In 12 villages, items of daily use are readily available, while in the remaining 2 villages, they are not.
Availability of Fish

Fish is not frequently available in the markets of the survey area. The villagers of the survey area reported that they buy fish from Ghazi, Hazro and Attock very occasionally as the price is high. In 3 villages, street hawkers bring fish once or twice in a month. Most women prefer fish if it is available at low prices.

Shopping Pattern

The survey data revealed that, in 10 villages, most shopping is done by males. In 3 villages, shopping is done by both males and females. The lower classes of the villages also do shopping for landowners. Women from middle class or wealthy families in the Project area are strictly in purdah. Their men do not let them go out of their houses. In Jatial, most shopping is done by females and children. In this village, females are less purdah-observing than in other villages and are more free in their ideas. Perhaps the proximity of the GT road and the Kamra bazaar has influenced these women. The Project will not pose any hindrance to the shopping activities of the villages surveyed.

E.3.8 Living Conditions

Housing

The majority of houses (77%) in the Project area are of 'Pucca' (brick masonry) construction and 33% are 'Katcha' (mud and wood structured). It was noted that, in spite of high socioeconomic status, villagers do not necessarily change their housing patterns. In Barazai the majority of houses were mud structured, but most families are fairly well off.

Migration and Domestic Facilities

Migration for economic purposes is an important factor in the living condition of the Project area. Many people in the Project area have migrated to other countries due to unemployment and financial problems. The majority of males who have emigrated from Kamra Kalan, Nurpur Karam Alia and Barotha have migrated to Peshawar, Rawalpindi and other major cities of Pakistan. In other villages, a majority of emigrants are living in the UK, USA, Saudi Arabia, Dubai, the UAE etc. Most people have small landholdings which cannot fulfill their basic needs. Most move out of the village in search of employment. Emigrants send home money or return with considerable savings and various luxury goods.
In the Project area luxury items were found to be common in many households. About 75% of households had a radio and T.V. Only Nurpur Karam Alia and Barotha are deprived of such luxuries due to the non-availability of electricity. In the other villages refrigerators, washing machines, motor pumps and other valuable items were reported. The VCR culture also exists in the Project area. In Ghurghushti, 30% of households have VCRs. In other villages less than 20% of the households have VCRs. In fact, the simple lives of villagers have been totally changed by migration. It was generally noted that where villagers have migrated to European countries in greater numbers, the domestic facilities are more common.

E.3.9 Cultural Aspects

Marriage Patterns

Marriage patterns vary from society to society. In the sample area, most marriages are within the biradari (same kinship group and family). About 81% of the total households marry within their own caste and family where a suitable match is available, whether inside or outside the village. In fact, villagers are bound in strong kinship ties. They prefer primary relationships which give them respect in the sight of others.

Financing Arrangement of Marriage Ceremonies

A majority of households use their savings to meet the expenses of marriage. Most marriages take place after the crop harvest to enable villagers to meet the marriage expenses. A few people sell their properties or take out a loan to purchase the dowry. Custom requires them to demonstrate their place in the biradari and village by giving a handsome dowry. Landowners also help 'kammis' (lower classes, who provide services to upper classes or landowners) and tenants to pay for marriages. A majority of parents usually marry their sons and daughters within the range of 15-25 years of age.

Visits to Shrine Melas

About one third of the surveyed villages lack a shrine or seasonal mela (fair) where females could go. Nine villages have shrine melas which 18% of the female population of the surveyed area visit. The shrines often visited by women of various villages are shown in the following table.
SHRINE MELAS WHERE FEMALES VISIT

<table>
<thead>
<tr>
<th>VILLAGE</th>
<th>NAME OF MELA</th>
<th>HELD IN MONTH</th>
<th>LOCATION OF SHRINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isa</td>
<td>Chandpir</td>
<td>June-July</td>
<td>Jallo</td>
</tr>
<tr>
<td>Jallu</td>
<td>Chandpir</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Hasanpur</td>
<td>Pirlal Hussain</td>
<td>&quot;</td>
<td>Hasanpur</td>
</tr>
<tr>
<td>Ghurghushti</td>
<td>Haji Rehman</td>
<td>August-Sept</td>
<td>Khairbara</td>
</tr>
<tr>
<td>Mian Dheri</td>
<td>Sher Mill Dad</td>
<td>&quot;</td>
<td>Mian Dheri</td>
</tr>
<tr>
<td>Malak Mala</td>
<td>None</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Barazai</td>
<td>Haji Rehman</td>
<td>August-Sept.</td>
<td>Khairbara</td>
</tr>
<tr>
<td>Walidad</td>
<td>None</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Khaqwani</td>
<td>None</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Musa</td>
<td>None</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Jatial</td>
<td>Saen Kalu Baba</td>
<td>September</td>
<td>Mansar</td>
</tr>
<tr>
<td>Kamra Kalan</td>
<td>Pir Gul Shah</td>
<td>June-July</td>
<td>Attock</td>
</tr>
</tbody>
</table>

The power channel will be an obstruction to the villagers visiting Haji Rehman Baba.

Recreational Facilities

There is no recreational facility available to the females and children in any of the villages surveyed. Females are deprived of gathering places such as community centres. The main opportunity for socialising outside the home is during family functions, like marriages. Women of Isa and Jallo go to the river bank for washing purposes, especially in summer season or on power load-shedding days. Visits to shrines also provide an occasion for women to meet.

Children are lacking play grounds or parks. They play cricket, hockey and other traditional games in the streets, open fields, or in their schools. The river bank is also used for recreational purposes. Children of the Indus river bank villages are fond of swimming in the river during the hot summer days. No case of a child drowning was reported.

Co-operation Among Women

About 60% of the women surveyed said they settled their disputes by mutual understanding, whereas 40% said they solved their disputes with the help of any elderly women, lady councillor, or an influential lady of the village. In case of major disputes, the family menfolk or an authoritative person is involved in its accommodation. It was revealed that sometimes a minor conflict among women may cause a major dispute among men resulting in a very serious situation which affects their social life. Sometimes
two groups from different castes came into conflict due to different cultural backgrounds. There are many sources of conflicts among females: children quarrelling, cutting grass from other's fields, throwing garbage in front of other houses, lending money to each other, dowry problems at marriage ceremonies, demands by in-laws, etc.

Assisting each other with small loans to help tide over bad times is a vague concept among most women. Landowners and highly placed people often help the Kammis and tenants financially. In Jatial, strong co-operation among females was reported. They often help each other to overcome bad circumstances.

Banking facilities are not available in most of the villages. Various traditional methods of saving money have been adopted by women. The committee system is one of the most frequently practised methods of saving money. In this system, a small amount of money is periodically contributed to a pool by its members and distributed among them within a fixed period. This period could be weekly, monthly or yearly. Women are satisfied with this method. It is very helpful to overcome rainy days.

E.3.10 Migration

Migration is an important factor for the economic betterment of individuals. The trend toward rural-urban migration is developing rapidly.

The people of the Project area have long experience with migration for economic reasons. The factors which lead the people toward migration are as follow:

- deficiency in regional resources,
- unemployment,
- desire for better facilities, and
- higher salaries.

Two types of migration are found in the Project area:

- internal migration (migration out of district or province but within Pakistan)
- international migration.

Males migrate to the big cities and other countries for employment. In the Project area, the majority of people have landholdings too small to fulfill their basic needs.
While in the cities or abroad, males send their earnings to their families. They return home on holidays and on special occasions. They also come back to the village to assist in sowing and harvesting.

From the Project area, migration to the following areas is common:

<table>
<thead>
<tr>
<th>INTERNAL</th>
<th>INTERNATIONAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peshawar</td>
<td>U.S.A.</td>
</tr>
<tr>
<td>Rawalpindi</td>
<td>England</td>
</tr>
<tr>
<td>Karachi</td>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>Taxila</td>
<td>Dubai</td>
</tr>
<tr>
<td>Attock</td>
<td></td>
</tr>
</tbody>
</table>

Migration and the consequent remittances affect the villages in the following ways:

- capital improvements in agricultural practices, ie purchase of additional land, tractors, etc. which increases crop production,
- the purchase of comforts, recreation and conveniences, eg refrigerators, televisions, kitchen items, etc,
- construction or expansion of houses, and
- changes in status, as symbolised in the capacity to give costly items, ie electric appliances, furniture, etc., to their daughters in dowry.
ENVIRONMENTAL ASSESSMENT OF GHAZI-GARIALA HYDROPOWER PROJECT

VILLAGE SURVEY

(FOR FEMALE POPULATION)

Had Bast No. _______ Village _________
Union Council _________
Tehsil _________

1. GENERAL

No. of females gathered to attend the session _______

Age:

12 to 40 years _______
41 and above _______

Occupation of the head of households:

No. H.H.

Agriculturist: _______
Non-agriculturist: _______

Caste: _______

No. of H.H. _______

2. SOCIAL INFRASTRUCTURE

Education

No. of Educated women in village: No. ______ % age _______

Level of Education:

How many stopped after Mosque/Madrassa _______

7-E.18
Primary ______
Middle ______
Matric ______
Above ______

No. of Illiterate women: ______

Do you send your children to school?

Yes____ No.____

If not, why:

Low income of household ______
Purdha system ______
Farm/Domestic activity ______
Not consider necessary due to male dominating society ______
No permission by:

Father ______
Mother ______

No schooling facility available:

Any other problem:

Industrial/vocational Educational centres

Where ______
Distance ______
How many (centres) ______
Village Enrollment ______
Other Enrollment ______

7-E.19
No. of Female Teacher in the school: ____

How many teachers live elsewhere and work here? ____

If so, where do they come from?

<table>
<thead>
<tr>
<th>Village</th>
<th>Distance</th>
</tr>
</thead>
</table>

No. of resident Female Teachers ____

### 3. HEALTH

**Health centres in the village:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Where (specify location)</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Basic Health Unit</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Hospital</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Mother child care centres</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Dispensary</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Child immunization centre</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Any other</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>- Visit of mobile team</td>
<td>Weekly</td>
<td>Fortnightly</td>
</tr>
</tbody>
</table>

**Medical Practitioners in the village**

<table>
<thead>
<tr>
<th>Female patient per week.</th>
<th>No.</th>
<th>Local</th>
<th>Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor</td>
<td>____</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>Lady Doctor</td>
<td>____</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>Homeopath</td>
<td>____</td>
<td>____</td>
<td>____</td>
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<tr>
<td>Dai/LHV</td>
<td>____</td>
<td>____</td>
<td>____</td>
</tr>
</tbody>
</table>
Female patient per week.  
<table>
<thead>
<tr>
<th>No.</th>
<th>Local</th>
<th>Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hakim</td>
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<tr>
<td>Dispenser</td>
<td></td>
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</tr>
</tbody>
</table>

Availability of medicines in these centres:

Yes ____ No. ____

If no, where do you get it from? ____________________

Distance_____

Do existing medical facilities meet women's requirements?

Yes ____ No. ____

Do crude/traditional health care practices exist in the village?

Yes ____ No. ____

If yes, what:

- Household Totka
- Taweez/Dhaga
- Where
- Distance
- Visit to shrines
- Where
- Distance
- Any other

7-E.21
Diseases:

Women:

<table>
<thead>
<tr>
<th>Nature of disease</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Children:

<table>
<thead>
<tr>
<th>Nature of disease</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Maternity problem:

Yes _______  No _______

If yes, nature of problem:

Pregnancy problem _______  _______
birth problem

after birth problem

death ratio:
    Mother
    Child

Sanitation and Hygienic Conditions:
    Drainage system  Yes___  No.___
    Toilet facility   Yes___  No.___
    Waste disposal system

Spray of Insecticide (DDT) in the village:
    Yes___  No.___

If yes, how many times in a year _______

Where team comes from? _______

Source of drinking water:

<table>
<thead>
<tr>
<th>Source</th>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tube well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handpump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any other (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is washing facility available in the house?  
Yes___ No.____

If no, where do you go for this purpose?  
Within village ______________________
Elsewhere ______________________

Is there any preference to do washing outside.  
Yes___ No.____

If yes, state reason ________________________________

4. OCCUPATION:

No. of working women ______
Selfemployed ______
Employed elsewhere ______
No. of non working women_______

Participation in Agricultural Activities:

Yes___ No.____

If yes;

Where   Distance

In own fields    ______    ______
Others fields   ______    ______

Nature of work in fields ________________________________

In case working in own fields, why?

For saving
Shortage of hired labour_______
Financial problems ______
In case of others fields, why?

Financial problems
Begar/Forced labour

Herding:

Yes ___ No. ___

If yes,

Herding own stock
Herding others

In case of others, why?

Financial problem
Begar/Forced labour

Source from where feed is obtained:

<table>
<thead>
<tr>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>From own fields</td>
<td></td>
</tr>
<tr>
<td>Farmland</td>
<td></td>
</tr>
<tr>
<td>Roadside</td>
<td></td>
</tr>
<tr>
<td>Pastures/rangeland</td>
<td></td>
</tr>
<tr>
<td>Shops</td>
<td></td>
</tr>
</tbody>
</table>

Grazing over:

<table>
<thead>
<tr>
<th>No. of livestocks</th>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmland meadows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roadside stubble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pastures/rangeland</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cottage Industries:

No. of cottage Industries ________
No. of women working in cottage industries ________
Where ________
Distance ________
Any problem ________

Handicrafts:

No. of women ________
Where do you sell your crafts? ________
Where ________
Distance ________
Any problem ________

Household cottage/Handicrafts setup:

Yes _____ No _____

If yes, do you work there? Yes _____ No _____

What type: Specify _______________________

Other occupations:

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No. of women</th>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Child labour:

<table>
<thead>
<tr>
<th>Occupations</th>
<th>No. of children</th>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
5. **MARKETING**

No. of shops in the village

Goods of daily use available?

Yes___ No.___

If no, where you get it from?

Distance

Who go for shopping purposes?

Self

Children

Males

Combined

Domestic servant

Fish:

Is fish available in the market?

Yes____

No____

If yes, how often do you eat fish from rive Sind?

Weekly

Fortnightly

Monthly

Whenever available

If fish was more available would you eat it more often?

Yes____

No____

If no, why____

____
6. CULTURAL ASPECTS

Marriage:

Married women _______
Unmarried women _______

Marriage Patterns:

Within Biradari _______
Out of Biradari _______
Within village _______
Out of village _______

Financing arrangement for marriage ceremonies:

Sale of Property _______
Savings _______
Loan _______
Other's help _______
Any other _______

Female age at marriage:

Below puberty _______
Teen age _______
Above _______

Shrines Melas/Gathering held in the village:

Yes___ No____

If no, is there any nearby where you visit?

Yes___ No____

<table>
<thead>
<tr>
<th>Melas</th>
<th>Season</th>
<th>Where</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

7-E.28
No. of females/children visit to melas:
   Within village _________
   Outside village _________

7. RECREATIONAL FACILITIES

Is there gathering place for women?
   Yes____ No ____

If yes how frequent they meet?
   Daily ____ Weekly ____ Monthly ____

Are recreational facilities available for children?
   Yes____ No ____

Are children fond of swimming?
   Yes____ No ____

If yes, where they go to swim?
   _________________________
   Distance ________________

Are play grounds available for children?
   Yes____ No ____

If yes, what type of facilities available:

_______________________________
_______________________________
_______________________________

8. LIVING CONDITIONS:

Type of house construction:
   Pacca ___________
   Semi Pacca ___________
   Katcha ___________
Domestic facilities:

- Radio/Tape Recorder
- T.V.
- Refrigerator
- Motor Pump (Water)
- Personal Transport
- Any other facility

9. MIGRATION:

Male Migration: Yes ___
No ___

If yes, purpose: ___

Who migrated from family:

<table>
<thead>
<tr>
<th>No. of Migrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
</tr>
<tr>
<td>Brother</td>
</tr>
<tr>
<td>Husband</td>
</tr>
<tr>
<td>Any other relative</td>
</tr>
</tbody>
</table>
Nature of Migration:

<table>
<thead>
<tr>
<th>No. of Migrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out of the village</td>
</tr>
<tr>
<td>Out of tehsil</td>
</tr>
<tr>
<td>Out of district</td>
</tr>
<tr>
<td>Out of province</td>
</tr>
<tr>
<td>Out of country</td>
</tr>
</tbody>
</table>

Effects of Migration in village Economy:

|
|----------------|

Effects on Socio-cultural life of females:

|
|----------------|

10. Do you co-operate to organize trips to shrine?

Yes ___ No ___

Brief note:

Help settle disputes

Yes ___ No ___

Assist each other with small loans to help tide over bad times:

Yes ___ No ___

Assist each other with small loans to facilitate cottage and handicraft industries:

Yes ___ No ___
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<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
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<td>PAKISTAN HYDRO CONSULTANTS</td>
<td>7-F.1</td>
</tr>
<tr>
<td>F.1.1</td>
<td>Environmental Assessment Team</td>
<td>7-F.1</td>
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<td>F.1.2</td>
<td>Engineering Group</td>
<td>7-F.1</td>
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<td>F.2</td>
<td>OUTSIDE CONTRIBUTORS</td>
<td>7-F.1</td>
</tr>
<tr>
<td>F.2.1</td>
<td>Department of Archaeology, Government of Pakistan</td>
<td>7-F.1</td>
</tr>
<tr>
<td>F.2.2</td>
<td>Water And Power Development Authority</td>
<td>7-F.1</td>
</tr>
</tbody>
</table>

7-F(i)
LIST OF PREPARERS AND CONTRIBUTORS

F.1 PAKISTAN HYDRO CONSULTANTS

F.1.1 Environmental Assessment Team

- Anis A. Chaudhry: Principal Environmentalist
- Peter L. Ames: Environmental Expert (Expatriate)
- Philip E. Jones: Sociologist (Expatriate)
- Rafiq A. Sheikh: Sr. Environmental Engineer
- Mohammad Tehseen: Sr. Environmental Engineer
- Mazhar-ul-Islam: Land Valuation Specialist
- Naveed Zafar: Sociologist
- Mussarat Naheed: Sociologist (Female)
- Asbah Chaudhry: Sociologist (Female)

F.1.2 Engineering Group

- Iftikhar Khalil: Project Manager
- A.C.J. Baker: Sr. Deputy Project Manager
- M. Ashraf Akhtar: Deputy Project Manager
- I. A. Khaliq: Chief, Barrage Group
- H. G. Fanshawe: Chief, Power Channel Group
- W. P. Kohl: Chief, Power Complex Group

F.2 OUTSIDE CONTRIBUTORS

F.2.1 Department of Archaeology, Government of Pakistan

- M. A. Haleem: Dy. Director/Curator,
  Archaeological Museum, Taxila.
- Gulzar M. Khan: Curator, Lahore Fort Museum,
  Lahore.

F.2.2 Water and Power Development Authority

- Muhammad Farooq
- Faqir Hussain Shah
- Mazhar Saeed
- Ghulam Mohammad: Revenue Staff, GGHP (Field)
  (For data collection)
# List of Persons Contacted

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<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
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</thead>
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<td>7-G.1</td>
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<tr>
<td>G.2</td>
<td>District Administration</td>
<td>7-G.1</td>
</tr>
<tr>
<td>G.3</td>
<td>Government Officials</td>
<td>7-G.1</td>
</tr>
<tr>
<td>G.4</td>
<td>WAPDA Officials</td>
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<tr>
<td>G.4.1</td>
<td>Concerned with GGHP</td>
<td>7-G.2</td>
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<tr>
<td>G.4.2</td>
<td>Others</td>
<td>7-G.2</td>
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<tr>
<td>G.5</td>
<td>District Level Representatives</td>
<td>7-G.2</td>
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<td>G.6</td>
<td>Union Council Representatives</td>
<td>7-G.3</td>
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<tr>
<td>G.7</td>
<td>Village Noteables</td>
<td>7-G.4</td>
</tr>
</tbody>
</table>
APPENDIX G

LIST OF PERSONS CONTACTED

G.1 NATIONAL/PROVINCIAL LEVEL REPRESENTATIVE

Mr. Gohar Ayub Khan  Speaker National Assembly (MNA, Haripur)
Mr. Sheikh Aftab Ahmad  Member National Assembly from Attock
Mr. Rehmanullah Khan  Member National Assembly from Swabi
Mr. Taj Mohammad Khanzada  Member Provisional Assembly of the Punjab from Attock
Mr. Sahibzada M. Sabir Shah  Member Provisional Assembly of the Punjab from Attock

G.2 DISTRICT ADMINISTRATION

Mr. Attaullah Khan  Deputy Commissioner, Abbottabad
Mr. Adnan Bashir Khan  Deputy Commissioner, Swabi
Mr. Khushnood Lashari  Deputy Commissioner, Attock
Mr. Riyasat Ali  Deputy Commissioner, Attock
Mr. Zamurrad Khan  General Assistant Revenue, Attock
Khawaja Shamail Ahmed  Assistant Commissioner, Haripur
Mr. Pervaiz Iqbal Malik  Tehsildar, Attock

G.3 GOVERNMENT OFFICIALS

Ch. Shabir Ahmad  Extra Assistant Director Agriculture, Attock
Ch. Nazir Ahmad  District Forest Officer, Attock
Syed Mohammad Iqbal  Director, Public Health Engineering Deptt., Attock
Ch. Mohammad Yousaf  Assistant Agricultural Engineer (Field), Barani Area Development, Attock
Dr. Mohammad Afazal Malik  District Health Officer, Attock
Mr. Abdul Halim Deputy Director, Small Dam Organisation, Islamabad.
Malik Dost Mohammad Statistical Officer (Agriculture), Attock

G.4    WAPDA OFFICIALS

G.4.1 Concerned with GGHP

- Mirza Mohammad Sadiq General Manager, GGHP
- Mr. Mohammad Hayat Chaddu Chief Engineer, & Project Director, GGHP
- Mr. Mohammad Afzal Khan Superintending Engineer, GGHP
- Mr. Abdul Ghaffar Director (Tech), GGHP

G.4.2 Others

- Mr. Rashid A. Chaudhry General Manager, Tarbela
- Mr. Haji Mohammad Chaudhry Chief Engineer (P&M), Tarbela
- Mr. Mohammad Sardar Khan Chief Engineer (AC&R), Tarbela
- Mr. Mohammad Nawaz Khan Superintending Engineer, Chashma Right Bank Canal, D.I. Khan
- Mr. Abdul Jalil Khan Land Acquisition Collector, Chashma Right Bank Canal, D.I. Khan
- Mr. Lutfe Ali Khan Project Director, Hydrogeology Directorate
- Syed Wali Waheed Environmental Engineer, Water Research Planning
- Mrs. Bushra Waheed Research Officer (Plant Ecology), HEPO

G.5    DISTRICT LEVEL REPRESENTATIVES

- Mr. Mehtab Khan Abbasi Chairman, District Council, Abbottabad
- Malik Atta Ullah Chairman, District Council, Attock
- Mr. Aslam Hayat Councillor, Ghazi
Mr. Ahsan Khan  
Councillor, Ghurghushti

Haji Dost Mohammad  
Councillor, Khaghwani

Mr. Mohammad Akram  
Councillor, Shah Dher

Mr. Abrar Hussain Shah  
Councillor, Musa

Mr. Haider Asghar Khan  
Councillor, Musa

Mr. Zikaraya Khan  
Councillor, Kamra

Mr. Mohammad Azeem  
Councillor, Rang Pur

Mr. Mohammad Iqbal  
Councillor, Thikarian

Mr. Aslam Hayat Khan  
Councillor, Bhai

Mr. Mohammad Yamin Khan  
Councillor, Malla

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<th>G.6 UNION COUNCIL REPRESENTATIVES</th>
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<tr>
<td>Mr. Saifur Rehman</td>
</tr>
<tr>
<td>Chairman, Union Council, Ghurghushti</td>
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<tr>
<td>Mr. Mir Afzal Khan</td>
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<tr>
<td>Chairman, Union Council, Ghazi</td>
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<tr>
<td>Mr. Zaman Khan</td>
</tr>
<tr>
<td>Chairman, Union Council, Bhangi</td>
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<tr>
<td>Mr. Safdar Khan</td>
</tr>
<tr>
<td>Chairman, Union Council, Bahadur Khan</td>
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<tr>
<td>Haji Khaliq</td>
</tr>
<tr>
<td>Chairman, Union Council, Kamra</td>
</tr>
<tr>
<td>Mr. Aziz Iqbal</td>
</tr>
<tr>
<td>Vice Chairman, Union Council, Ghazi</td>
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<tr>
<td>Mr. Orangzeb Khan</td>
</tr>
<tr>
<td>Vice Chairman, Union Council, Khaghwani</td>
</tr>
<tr>
<td>Haji Hashim Ali</td>
</tr>
<tr>
<td>Vice Chairman, Union Council, Rumian</td>
</tr>
<tr>
<td>Mr. Parid Khan</td>
</tr>
<tr>
<td>Secretary, Union Council, Musa</td>
</tr>
<tr>
<td>Mr. Umar Farooq Shah</td>
</tr>
<tr>
<td>Member, Union Council, Mian Dheri</td>
</tr>
<tr>
<td>Mr. Mohammad Zarin Khan</td>
</tr>
<tr>
<td>Member, Union Council, Ghazi</td>
</tr>
<tr>
<td>Mr. Mohammad Ilyas Khan</td>
</tr>
<tr>
<td>Member, Union Council, Ghazi (from Salam Khan)</td>
</tr>
<tr>
<td>Mr. Ghulam Sarwar</td>
</tr>
<tr>
<td>Member, Union Council, Kotehra</td>
</tr>
</tbody>
</table>
Mr. Allah Ditta, Member, Union Council, Qazipur
Mr. Rustam Khan, Member, Union Council, Kamra
Mr. Banaras Khan, Chairman, Usher/Zakat Committee, Musa

G.7 VILLAGE NOTEABLES

Lt. Col. Aurangzeb Khalo
Mr. Abdul Rehman Ghazi
Mr. Farman Ali Ghazi
Lt. Col. Sher Ali Khan Ghurghushti
Mr. Khane Zaman Kotehra
Sahibzada Abdul Zahir Nurpur Karamalia
Mr. Mohammad Ishaq Barazai/Malakmala
Ch. Shaukat Hussain Ex-Chairman, Union Council, Musa
Ch. Rab Nawaz Ex-Chairman, Union Council, Musa
Mr. Gohar Shah Numberdar, Isa
Mr. Naseem Khan Numberdar, Khagwani
Mr. Abdul Razaq Numberdar, Kamra
Mr. Noor Ahmed Numberdar, Dakhner
Mr. Malik Nawab Khan Numberdar, Nurpur Karamalia
Mr. Mohammad Khan Numberdar, Barotha
Mr. Fateh Khan Numberdar, Barotha
APPENDIX H

GOVERNMENT OF PAKISTAN’S PROFORMA FOR ENVIRONMENTAL IMPACT ASSESSMENT
APPENDIX H
GOVERNMENT OF PAKISTAN'S
PROFORMA FOR ENVIRONMENTAL IMPACT ASSESSMENT

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ATTACHMENTS
APPENDIX H

GOVERNMENT OF PAKISTAN'S
PROFORMA FOR ENVIRONMENTAL IMPACT ASSESSMENT

**H.1 GENERAL**

The following pages are a copy of the Government of Pakistan's Proforma for Environmental Impact Assessment. This proforma will be completed by WAPDA for review by Pakistan Environmental Protection Agency under Ordinance No. XXXVII (Control of Pollution and Preservation of Living Environment).

Page 7-H.18 gives the references to the text of this Environmental Assessment Report relevant to each section of the proforma.
GOVERNMENT OF PAKISTAN'S
PROFORMA FOR ENVIRONMENTAL IMPACT ASSESSMENT

<table>
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<tr>
<th>Types of Information</th>
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</table>

1. GENERAL

1.1 Name of the Project:

1.2 Official address at which correspondence can be made:

1.3 Name and address of Consultant appointed, if any:

1.4 Name, designation, and address of official authorised to deal with this Questionnaire/Proforma:

1.5 Date on which letter of intent was issued.

2. PROCESS DETAILS

2.1 Production Schedule:

2.1.1 List of main products proposed to be produced with designed daily production capacity:

2.1.2 List of by-products produced with designed daily product capacity:

2.1.3 Time phasing for achieving full production capacity

2.2 Raw Materials Consumption:

2.2.1 List all raw materials with daily consumption at full production capacity:

7-H.2
2.2.2 List all process chemicals/materials consumed with approximate quantities:

2.2.3 Is any recycled material from the waste of your Project or any other project used in the process? If so, please specify quantities and source.

2.2.4 Is any material salvaged from your waste stream reusable economically for any other?

2.3 Manufacturing Process:

2.3.1 Source of process know-how:

2.3.2 Give a brief description of the process technology utilized with a flow-chart. (Flow-chart of the process should be attached):

2.3.3 Have you any foreign collaboration?

2.4 Energy Consumption:

2.4.1 Source of energy:
   a) In-plant generation
   b) Public supply

2.4.2 If energy is generated in plant, type and quantity of fuel daily consumed:

3. GENERAL ENVIRONMENT (Site/climate settlement):

3.1 Site:

3.1.1 Where is the plant proposed to be sited?
<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Information or Sections of Environmental and Social Soundness Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attach map showing topographical features of the area.</td>
<td></td>
</tr>
<tr>
<td>3.1.2 Elevation above mean sea level:</td>
<td></td>
</tr>
<tr>
<td>3.1.3 Area of land proposed to be acquired:</td>
<td></td>
</tr>
<tr>
<td>3.1.4 Area proposed to be built up or developed:</td>
<td></td>
</tr>
<tr>
<td>3.1.5 Present use of the land: agriculture/forest/grazing/settlement/fallow</td>
<td></td>
</tr>
<tr>
<td>3.1.6 Indicate the nature of topography near the site: plains/valley/hilly</td>
<td></td>
</tr>
<tr>
<td>3.1.7 Specify site character: river basin/coastal/estuarine/land-locked</td>
<td></td>
</tr>
<tr>
<td>3.1.8 Is the land situated within any municipal or corporation jurisdiction?</td>
<td></td>
</tr>
<tr>
<td>3.1.9 Is the land situated in an approved industrial zone or estate? If so, please specify.</td>
<td></td>
</tr>
<tr>
<td>3.1.10 What, of the following features, exist within 30 km of the site?</td>
<td></td>
</tr>
<tr>
<td>i) Human settlements: specify population</td>
<td></td>
</tr>
<tr>
<td>ii) Agricultural land: Specify crops.</td>
<td></td>
</tr>
<tr>
<td>iii) Grazing land:</td>
<td></td>
</tr>
<tr>
<td>iv) Fisheries:</td>
<td></td>
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7-H.4
<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Information or Sections of Environmental and Social Soundness Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>v) Forest/sanctuary/natural park:</td>
<td></td>
</tr>
<tr>
<td>vi) Nullahs/streams/rivers:</td>
<td></td>
</tr>
<tr>
<td>vii) Ponds/lakes/dams:</td>
<td></td>
</tr>
<tr>
<td>viii) Estuary/sea:</td>
<td></td>
</tr>
<tr>
<td>ix) Hills/mountains:</td>
<td></td>
</tr>
<tr>
<td>x) Archaeological/Historic/cultural/scenic sites/Scientific Institutions/Hospitals/Sanatoriums/Religious importance:</td>
<td></td>
</tr>
<tr>
<td>ix) Industries, specify:</td>
<td></td>
</tr>
</tbody>
</table>

3.1.11 Type of flora and fauna, especially wildlife, endangered species:

3.1.12 Present employment or occupational pattern in the area:

3.1.13 Prominent Endemic Disease (Fluorosis, Malaria, Filaria, Malnutrition, etc).

3.1.14 Mortality rates: Infant, Material):

3.1.15 Any other observation regarding state of the environment?

3.2 Climate:

3.2.1 Indicate the climatic conditions at the site (e.g., arid, semi-arid, etc.).

3.2.2 Rainfall yearly average. Range:
Types of Information

Information or Sections of Environmental and Social Soundness Assessment

3.2.3 Temperature seasonal. Ranges:

3.2.4 Provide information on speed and direction of wind.

3.3 Settlement:

3.3.1 Total number of persons proposed to be employed:

(a) During construction:
(b) After completion:

3.3.2 Do you propose to build a township/housing quarters for your employees?

3.3.3 Area allocated for above:

3.3.4 Population to be accommodated:

3.3.5 Distance from township to plant site:

3.3.6 Services provided in township:

i) Water - daily consumption

ii) Sewer system:

iii) Sewage treatment:

iv) Garbage disposal:

v) Drainage:

vi) Any other:

4. WATER REQUIREMENTS

4.1 What treatment is given before use, if any?
4.2 Average daily quantities and characteristics of water consumed:
   i) Process and wash:
   ii) Cooling:
   iii) Sanitary:
   iv) Total:

4.3 Are adequate quantities of water available?
   i) At present:
   ii) For future expansion:

5. WASTEWATER DISCHARGES

5.1 Total quantity of wastewater discharged from the project per day:

5.2 Wastewater discharges per day from:
   i) Process and wash (with break up, where possible):
   ii) Cooling:
   iii) Sanitary:
   iv) Total:

5.3 How do you propose to discharge the wastewater?
   i) Separate streams/combined:
   ii) Continuous/intermittent:

5.4 Type of treatment proposed to be adopted: Give details and flow chart.
5.5 What standards for treatment effluent do you propose to adopt?

Does it conform to standards prescribed by State/Central Water Population Board, Local Authority, or other statutory authority?

5.6 Mode of final discharge: (Open channel/pipeline/covered drains)


5.8 Is any portion of the wastewater proposed to be recycled? If so, give details.

5.9 What methods do you propose to adopt for handling and disposal of sludge from treatment plants?

5.10 Indicate available information on wastewater characteristics before treatment as below.

a) **Physical Parameters:** Temperature, pH, colour, turbidity, odor, total solids, total suspended solids, and total volatile solids
b) Chemical Parameters:
Acidity, total, and pH;
Alkalinity, total and pH;
Hardness, total; BOD; COD;
Oil and Grease; total N;
Phosphates, total;
Chlorides; Sulphates;
Sodium; Potassium; Calcium;
and Magnesium.

5.11 What other specific toxic substances are discharged?

Please specify nature and concentration:
(inorganics, organics, including pesticides and organic chlorine compounds, phenols, lignin, mercaptans, heavy metals, and radioactive substances.

6. SOLID WASTES: PROCESS AND TREATMENT PLANTS

6.1 Total quantity of solid wastes in tonnes per day:

6.2 Nature of Wastes: lumps/Granules/Dust/Slurry/Sludge

6.3 Type of waste (organic, inorganic, ash, glass, natal, etc.).

6.4 Method proposed for disposal, including treatment plant:
Landfill/dumping/sea/lagoon/marsh/composting/incineration/sold
<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Information or Sections of Environmental and Social Soundness Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4.1 If landfill, possibility of leaching of toxic compounds into soil, ground water, or surface water:</td>
<td></td>
</tr>
<tr>
<td>6.4.2 If incinerated, details of incineration plant and procedures:</td>
<td></td>
</tr>
<tr>
<td>6.5 Do you anticipate any problems regarding collection, handling, and transport of solid wastes?</td>
<td></td>
</tr>
<tr>
<td>6.6 Are there any problems of subsequent pollution of air, water, or soil likely at the place of disposal of solid wastes?</td>
<td></td>
</tr>
</tbody>
</table>

### 7. ATMOSPHERIC EMISSIONS

7.1 Emission from fuel burning

7.1.1 Anticipated quantity of stack emissions:

7.1.2 Temperature of emission:

7.1.3 Composition of emission:

(a) Particulates and smoke nature and quantity:

(b) Gases:
- Sulfur dioxide
- Nitrogen oxides
- Hydrocarbons
- Carbon mono oxide
- Moisture
- Other, specify.
7.2 Emissions from process:

7.2.1 Anticipated emissions, quantity:

7.2.2 Temperature:

7.2.3 Composition of emissions

a) Particulates, nature and quantity:

b) Gases:

i) Sulfur dioxide
ii) Nitrogen oxides
iii) Carbon monoxide
iv) Ammonia
v) Acid Mists
vi) Halogens
vii) Hydrocarbons
viii) Mercaptans
ix) Others, specify:

7.3 Height of stacks(s), for atmospheric emissions:

7.4 Proposed air pollution control system:

7.5 Proposed method of handling and disposal of wastes trapped by pollution arresting equipment:

7.6 Are any standards of emission prescribed for or adopted by your industry?

8. OTHER TYPES OF POLLUTION

8.1 Is your project industry likely to cause noise pollution?
8.2 Is your project industry likely to cause any odor pollution?

8.3 Is your project industry likely to cause any thermal pollution?

8.4 Is your project industry likely to cause radioactive pollution?

If yes, what measures are proposed to be taken?

8.5 Describe the nature and extent of pollution nuisance caused during construction phases and measures taken to contain the same.

8.6 Work Environment Hygiene and Housekeeping:

8.6.1 What major health/safety hazards are likely in the working environment in your factors?

8.6.2 Describe the industrial hygiene measures you propose to adopt.

8.6.3 What provision have you made to conform to health and safety requirements as per Factories Act?

9. MANAGEMENT OF POLLUTION CONTROL

9.1 Give details of the organization set-up you propose to have for pollution control.
9.2 What is the level of expertise of the person in charge of pollution control?

9.3 Do you propose to monitor the pollution from your industry?
   If yes, give details.

9.4 What laboratory facilities do you propose to have for the above?

9.5 Give details of operation and maintenance of facilities you propose to have for treatment plants and pollution monitoring and control equipment.

10. COST OF POLLUTION CONTROL

10.1 Total expenditure proposed for pollution monitoring and control:

Type of expenditure

Capital
Recurring
(including monitoring)

11.1 Climate and Air Quality:
   i) Will the project modify the local wind behavior?
   ii) Will the project have an impact upon the local precipitation/humidity pattern?

7-H.13
iii) Will the project generate an impact upon the local temperature pattern?

iv) Will the project generate and disperse atmospheric pollutants?

v) Will the project generate any intense odors?

11.2 Water:

i) Will the project alter the hydrological balance?

ii) Will the project effect the ground water required in terms of quality/quantity, depth, and direction of flow?

iii) Will dewatering methods be necessary to undertake excavation?

iv) Will the project induce a major sediment influx into area water bodies?

v) Will the project impede the natural drainage pattern and/or induce alteration of channel form?

vi) Will the project impair existing surface waters through filling, dredging, water extraction, or other detrimental practices?

vii) Will recreation or aesthetic values be endangered?

11.3 Geotechnical:

(i) Is there risk of damage or loss resulting from tectonic/seismic activity and/or volcanic activity?
<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Information or Sections of Environmental and Social Soundness Assessment</th>
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</thead>
<tbody>
<tr>
<td>(ii) Are there mineral resources of potential value close to the project?</td>
<td></td>
</tr>
<tr>
<td>(iii) Will there be an increase in rock deposition/degradation as a result of the project?</td>
<td></td>
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<tr>
<td>(iv) Are there potential dangers related to slow failure or falling rock?</td>
<td></td>
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<tr>
<td>(v) Is there risk of major ground subsidence associated with the project?</td>
<td></td>
</tr>
</tbody>
</table>

11.4 Soil:

(i) Will there be a substantial loss of soil due to construction or operational practices?

(ii) Will there be a risk of losses due to instability?

(iii) Will project cause or be exposed to liquefaction of soils in slopes or foundations?

(iv) In case of settlement/heave, will there be a risk of damage of structures or services?

(v) Will the project modify the property of impacted soil?

11.5 Ecology:

(i) Are there rare/endangered species which require protection?

(ii) Are there species which are particularly susceptible to human activities?
(iii) Would the loss of certain plants species deny food or habitat to wildlife species?

(iv) Are there any unusual population communities of plants that may be of scientific value?

(v) Will project activities impair natural productivity?

11.6 Land Use and Land Capability:

(i) Will the project conflict with existing or proposed land use?

(ii) Will the project degrade land capability types?

11.7 Noise and Vibration:

(i) Will the internal noise level present a potential risk to the hearing of workers?

(ii) Will the safe operation of the project be affected?

(iii) Will the project create noise levels which will cause annoyance or discomfort to nearby properties?

(iv) Will the project cause damage to structures, both natural and manmade, due to vibration?

(v) Will the content of the scene perceived by the residents of the surrounding area be adversely affected by the project?
### 11.8 Visual Quality:

(i) Will the content of the scene perceived by the residents of the surrounding area be adversely affected by the project?

(ii) Will the coherence of the surrounding area be impaired by the project?
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<th>ITEM</th>
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<th>REFERENCE CHAPTER</th>
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<td>4.</td>
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<td>Chapters 2 and 3</td>
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<td>5.</td>
<td>Water Discharges</td>
<td>Chapter 2</td>
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<tr>
<td>6.</td>
<td>Solid Wastes: Process and Treatment Plants</td>
<td>Not applicable</td>
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<td>7.</td>
<td>Atmospheric Emissions</td>
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<tr>
<td>8.</td>
<td>Other Types of Pollution</td>
<td>Chapters 2 and 5</td>
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<td>9.</td>
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<td>Cost of Pollution Control</td>
<td>Chapter 8</td>
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<td>11.</td>
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