No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
THE IMPROVEMENT OF THE WATER SUPPLY
IN
ABBOTTABAD
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

JULY 2004

JAPAN INTERNATIONAL COOPERATION AGENCY

Nihon Suido Consultants Co., Ltd.
Japan Techno Co., Ltd.

GM
JR
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PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of the Water Supply in Abbottabad and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team twice from 13th July to22nd September, 2003 and 25th January to 23rd February, 2004.

The team held discussions with the officials concerned of the Government of Pakistan, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Pakistan in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the teams.

July 2004

Yasuo Matsui
Vice-President
Japan International Cooperation Agency

July 2004

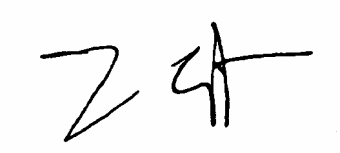
LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for the Improvement of the Water Supply in Abbottabad in the Islamic Republic of Pakistan.

This study was conducted by the joint venture between Nihon Suido Consultants Co., Ltd. and Japan Techno Co., Ltd., under a contract to JICA, during the period from July 2003 to July 2004. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

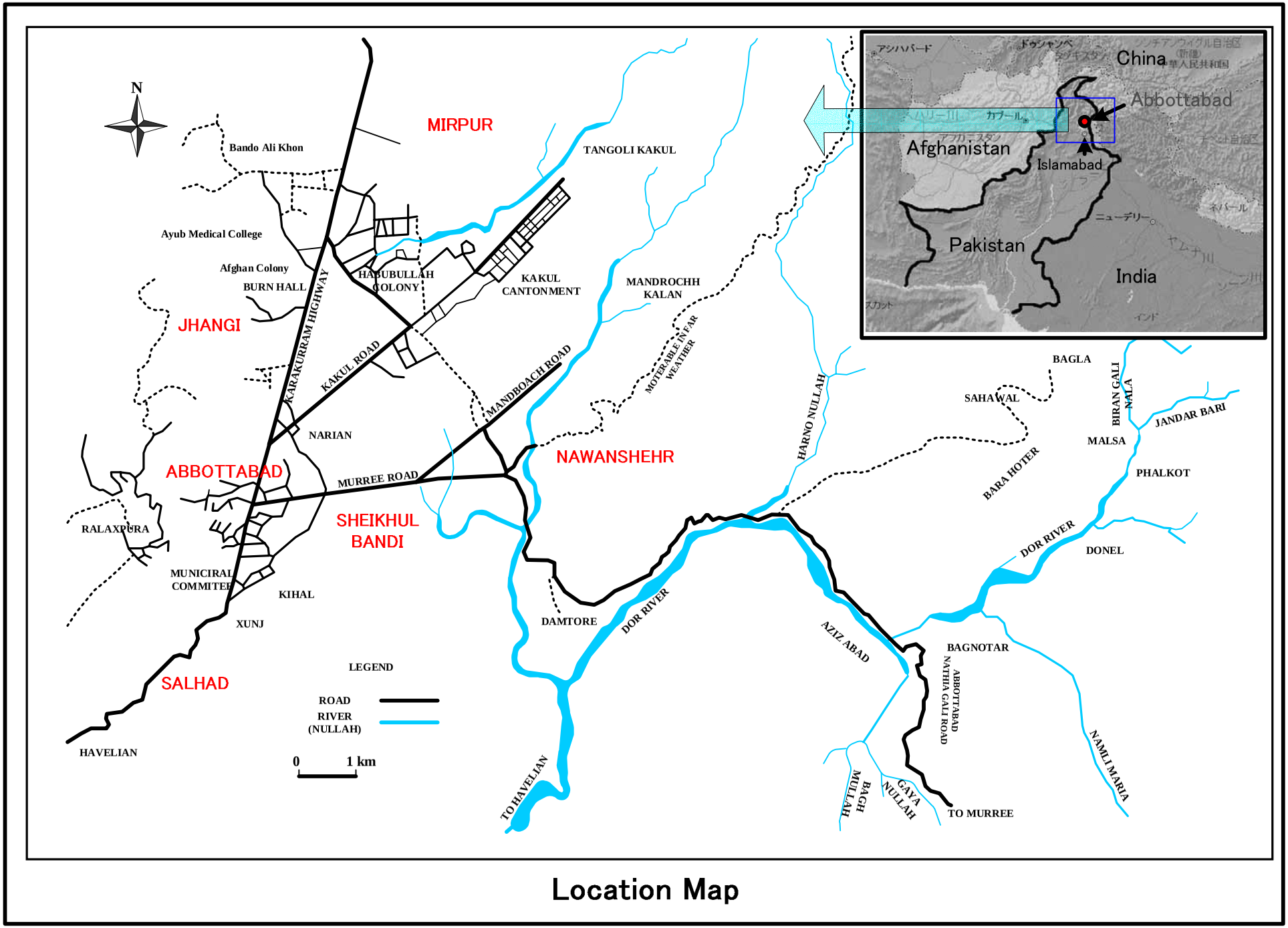
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Takeshi Sakai
Project Manager,
Basic Design Study Team on
the Project for the Improvement of the Water Supply in Abbottabad
The joint venture between Nihon Suido Consultants Co., Ltd. and Japan Techno Co., Ltd.

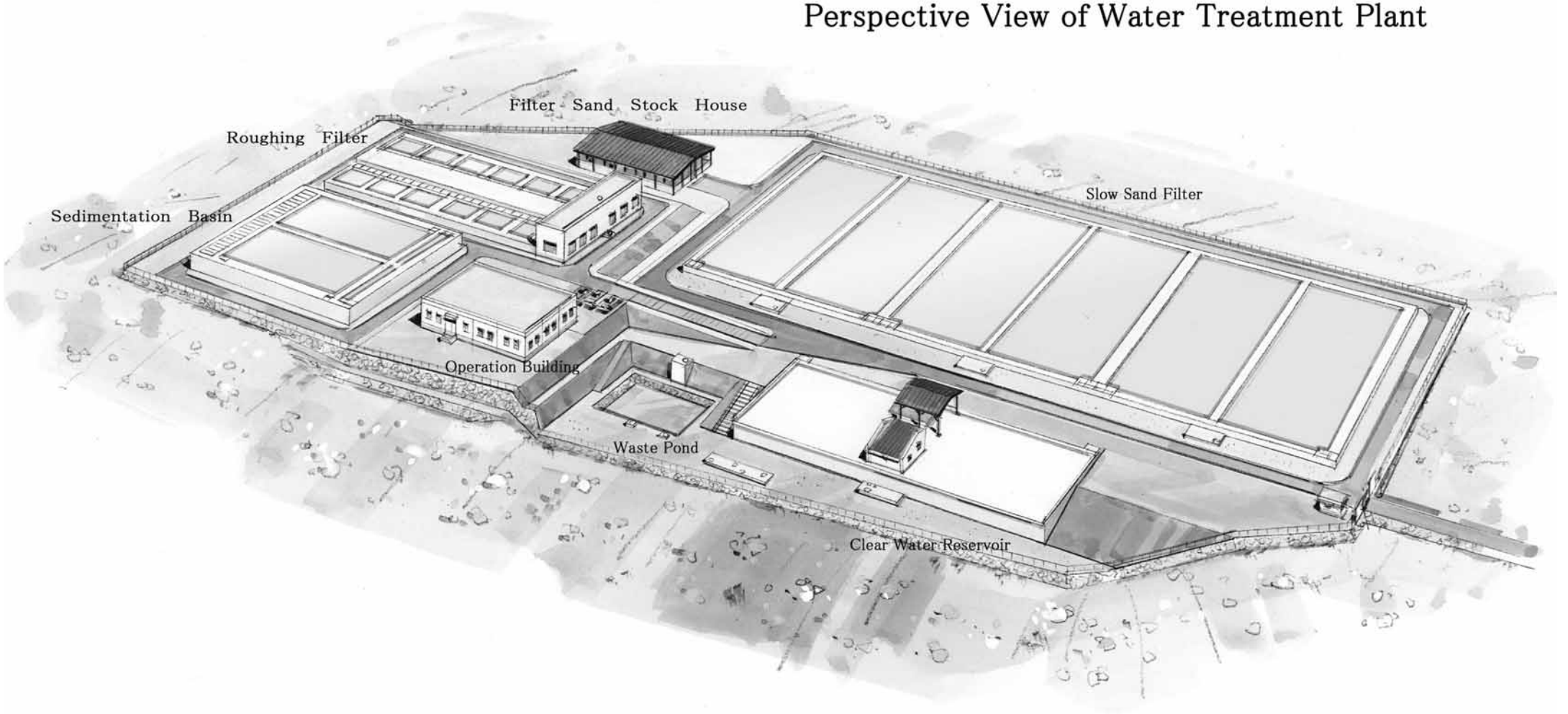
Location Map



Location Map

Perspective View of Water Treatment Plant

Perspective View of Water Treatment Plant



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Abbreviation

Abbreviations

Abbreviations

ADB: Asian Development Bank
BHN: Basic Human Needs
BOD: Biochemical Oxygen Demand
DIP: Ductile Iron Pipe
EIA: Environmental Impact Assessment
EPA: Environmental Protection Agency
GAWS: Greater Abbottabad Gravity Water Supply Scheme
IEE : Initial Environmental Examination
KfW : The German Development Bank
MES: Military Engineering Services
NTU: Nephelometric Turbidity Unit
NWFP : North West Frontier Province
PAHO : Pan American Health Organization
PHED: Public Health Engineering Department
PMA: Pakistan Military Academy
PMU : Project Management Unit
SP: Steel Pipe
SUDP: Second Urban Development Project
TMA: Town Municipal Administration
UFW: Unaccounted for Water
WASA : Water and Sanitation Agency
WAPDA : Water and Power Development Authority
WHO: World Health Organization
WSU: Water & Sanitation Unit

Units

cm:	centimeter
kg/m3:	kilogram per cubic meter
km:	kilometer
km2:	square kilometer
kW:	kilowatt
m:	meter
mm:	millimeter
m3:	cubic meter
m3/d:	cubic meter per day
l/s:	liter per second
lpcd:	liter per capita per day
N/mm2:	Newton per square millimeter
ppm:	parts per million
Rs.:	Pakistan Rupee
Rs./m3:	Rupees per cubic meter
US$:	United States Dollar

Summary

Summary

The Islamic Republic of Pakistan is located at the gateway of Central Asia and Western Asia, and borders India in the east, Iran and Afghanistan in the west, China in the north and Arabian Sea in the south. The territory is an area of 796,090 km2 (about 2.1 times bigger than that of Japan), and the population is 138 million people (in the year of 2000). The per capita gross national product (GNP) is 440 US dollars in 2000. As for geographical features, the elevation lowers gradually from the northwest to the southeast, and the mountain ranges of Himalaya, Karakorum and Hindu Kush stretch from the east to the west. Towering peaks of 8000m class such as K2, Nanga Parbat, rise high in Kashimir. There are Sulaiman Range in the west and Balochistan Plateau in the southwest. Thar Desert lays on the eastern border with India. Indus River passes through near the center of the country and forms a big plain. The subtropical dry climate prevails in the most of the land, the mountain climate in the north and temperate monsoon climate in the southern flat land.

Agricultural sector and textile industry represent Pakistan economy, and the key supporting economical growth is a stabilized growth of agricultural sector occupying 26% of the gross national product (in 2000). The trade deficit lasts constantly in Pakistan. In 2000, the foreign currency reserve was 2.46 billion dollars and the foreign debt balance of 32.1 bullion dollars. Nevertheless, in the recent years, the foreign currency reserve at the end of 2003 reached the level of exceeding 12 billion dollars corresponding the amount of annual import, owing to the increase of agricultural production by fortunate rainfall, export increase mainly of textile products, the extension of plant and equipment investment of private sector, and to the postponement of official debt of 12 billion dollars in Paris Club.

The Government of Pakistan has been undertaking the Social Action Plan (SAP) to recover the delay in social development under the advise of the World Bank. As a priority field of infrastructure development, the improvement of water supply and sanitation are included as a priority sector. The present water supply coverage ratio is estimated at 77% in urban area, 16% in rural area and 50% in average. The delay of improvement of water supply situation in rural area is significant. The Government of Pakistan established the national plan and promotes the improvement of water supply situation, in order to cope with the delay of development. Following to that, the Government formulated “Ten-Year Development Plan of National Water Sources Development Programme (2001 ~ 2010)” in 2001 and set more practicable targets for the improvement of water supply. The programme aims at the increase of service coverage of potable water from the present 63% to 84% within 10 years. This Project is related to the above-mentioned policy to improve water supply in local communities, and aims at the improvement of water supply in the two cities of Abbottabad and Nawanshehr and their peripheral Union Councils (12

villages) of Abbottabad District in North-West Frontier Province.

The water supply in Abbottabad and surrounding area has been developed relying on groundwater for a long period. In recent years, however, expansion and improvement of water supply are being required urgently to cope with the increasing population and expansion of urban areas in addition to decrease of the exploitation from the existing wells. Further, the current system is such system to pump up the well water to the distribution reservoirs located at a high position for water distribution, which results financial difficulty for operation due to high power cost. From the above circumstances, "The Greater Abbottabad Gravity Water Supply Scheme" was formulated by the Public Health Engineering Department (PHED) of Abbottabad District Government in 1990 to intake surface water from the valley located at the east of Abbottabad City as a stable and long term water source, in addition to the groundwater, and transmit it to the service area by gravity. ADB loan was called for and the ADB conducted the Feasibility Study in 1994. Further, PHED prepared addendum to Feasibility Study in 1997 but this project was not funded by ADB.

Following the above, the Government of Pakistan has applied to the Government of Japan for the request of the grant aid in December 2000. The outline of the request was a plan to supply water by gravity using the Beran Gali river located at the eastern part of Abbottabad City for the target year of 2020. The planned service areas are Abbottabad City, Cantonment Board, Nawanshehr City and 2 Union Councils of Sheikhul Bandi and Salhad with a capacity of 200 l/s. Responding to the request, the Government of Japan decided to carry out the preliminary study, and the Japan International Cooperation Agency (JICA) dispatched a preliminary study team during December 2002 ~ January 2003. As a result of investigation of the contents of the request, the project scope was reviewed. The following table shows the contents of request and the review results by the preliminary study:

Items	The Request	Preparatory Study
Service area	Abbottabad City, Cantonment Board, Nawanshehr City, Salhad U.C., Sheikhul Bandi U.C.	Abbottabad City, Nawanshshr City, Salhad U.C., Sheikhul Bandi U.C., Jhangi U.C., Mirpur U.C.
Target Year	2020	2010
Surface Water Sources	Beran Gali River Capacity: 200 l/sec	Gaya River and Bagh River Capacity: 150 l/sec
Groundwater Source	None	New Development: 97 l/sec Existing Capacity: 58 l/sec
Intake	No description	Infiltration gallery
Raw Water Transmission	Major raw water transmission main ϕ 450mm x 23 km	ϕ 400mm x 8 km
Water Treatment Facility	Rapid sand filtration	Roughing filter
Well Construction	None	24 sites
Treated water transmission	Included in raw water transmission main	ϕ 400mm x 9 km Replacement of existing transmission pumps

Following the above-mentioned preliminary study, the Government of Japan decided the implementation of the basic design study, and the JICA dispatched the basic design study team to the site during the period from 13th July to 22nd September, 2003 to confer with the persons concerned of the Government of Pakistan, and to carry out the field study and collection of data and information. As the results of field study, the gravity system requiring long-distance raw water transmission mains was proposed. Following that, the second site study was carried out from 25th January to 23rd February, 2004, in order to compare and review the pump-up system from the main stream of Dor River flowing near the water treatment plant and the above mentioned gravity system to verify the validity as a grant-aid scheme of Japan. As a result of comparison and review of the both systems after returning to Japan, the validity of the gravity system was verified, and the basic design draft report was explained to Pakistani side during a period from 23rd May to 6th June, 2004.

As shown in the above table, the results of the preliminary study were to take the surface water from two rivers of the Bagh River and the Gaya River (mountain stream of branches of Dor River) and construct 24 wells in Abbottabad Basin for water sources. As a result of verification of these water sources, it was concluded that the recharge of the groundwater in Abbottabad Basin is not sufficient to cope with the increasing water demand, even the present groundwater exploitation is already near the limit. On the other hand, the maximum daily demand of 26,500m3/d (306 l/s) was estimated in the target year of 2010. From the evaluation on the available capacity of the existing well water as 93 l/s, the required amount from new water sources to be developed was concluded at 18,400m3/d (213 l/s). At the same time, to cope with the water demand in the project areas, the available surface water sources were surveyed and possibility of utilization of the Namly Maira River, one of branches of the Dor River, was studied. As a result of the study, it was concluded that the intake of surface water of 200 litter/sec can be taken from the Namly Maira River in addition to the above-mentioned two rivers.

Based on the study on the above-mentioned water sources, water demand projection, present water supply conditions in the service area, existing facilities, status of operation and maintenance, etc., the following basic design policy was determined for this project:

Extent of Cooperation:

The service area shall be two cities of Abbottabad and Nawanshehr and 4 union councils of Sheikhul Bandi, Salhad, Mirpur and Jhangi, which may not deviate largely from the current service area. The remote areas, although they are within the administrative boundary, from the present service areas are excluded from the Project. Design of facilities is for the water demand of the target year of 2010 with the population served and capacity of water supply system set as follows:

Population Served		188,720
Water Supply Capacity	Surface Water System:	198 l/s (17,100m3/d)
	Groundwater System:	108l/s (9,400m3/d)

Further, the facilities to be constructed under the present scheme shall be up to the distribution reservoir to be constructed in each service area. The distribution network in the downstream is not included under the present grant aid scheme of Japan.

Contents and Capacity of Facilities:

The water supply facilities under the present scheme shall include two systems of surface water and groundwater systems as follows:

Surface Water System:

Capacity; 200 l/s

Facilities; Intake facilities (Gaya River, Bagh River and Namly Maira River) Raw water transmission mains, Water treatment plant, Treated water transmission mains, and Distribution reservoirs

Groundwater System:

Capacity 15 l/s (a total capacity of 4 new wells)

Facilities Wells (Narrian area: 4 wells), Replacement of existing well pumps (12 sites), Transmission mains, and Distribution reservoirs.

Based on the above-mentioned design policy, the contents of the basic design planned under the present scheme have been determined as follows:

Facilities	Surface water system	Groundwater system
Intake	Intake weir Bar screen type; 4 sites	Wells ϕ 250mm x depth 100m; 4 sites Replacement of existing well pumps; 12 sites
Raw water Transmission mains	ϕ 500mm x 4.7 km (DIP) ϕ 450mm x 6.1 km (DIP) ϕ 350mm x 1.8 km (DIP) ϕ 250mm x 4.5 km (S P) ϕ 200mm x 1.4 km (S P) ϕ 150mm x 2.0 km (S P)	-
Water treatment plant	Sedimentation Basin; 2 basins Roughing Filter; 12 filters Slow sand filter; 6 filters Clear water reservoir; 2 reservoirs Chlorine disinfection equipment; 1 set	-
Treated water Transmission mains	ϕ 500mm x 2.4 km (DIP) ϕ 400mm x 2.1 km (DIP) ϕ 300mm x 1.4 km (DIP) ϕ 250mm x 6.1 km (S P) ϕ 200mm x 1.1 km (S P) ϕ 150mm x 11.0 km (S P) ϕ 100mm x 0.2 km (S P)	ϕ 150mm x 2.3 km (S P) ϕ 100mm x 3.9 km (S P)
Distribution reservoir	Sheikhul Bandi 130 m3 Salhad 180 m3 Nawanshehr 340 m3 Mirpur 620 m3 Derawanda 220 m3 Banda Ghazan 530 m3	Banda Phugwarian 120 m3 Dobathar 300 m3 Lama Maira 110 m3

The Implementation Agency of the Project is Abbottabad District Government, and Project Management Unit (PMU) is established under the District Government for the project implementation. Upon the completion of the Project, a new organization (tentatively names as Gravity Water Supply Unit) will be established to operate and maintain the bulk water supply system under the control and guidance of Water Committee who will be formulated by the representatives of the existing three water supply agencies. The water supply services to the consumers in the service area are continued by the present three water supply agencies who receive water from the Gravity Water Supply Unit together with the operation of the existing wells.

In case the project is implemented by the Japan grant-aid scheme, the construction is divided into 2 phases. The total construction period is 31.5 months, including design period of 7.5 months. The total project cost for implementation of this plan is estimated at 2,970 million yen (2,325 million yen for Japanese side and 645 million yen for Pakistani side). The obligation of the Pakistani side includes land

acquisition for the water treatment plant site and four sites of well construction, power supply for the mentioned sites, assurance of right of way for raw and treated water transmission mains from the respective agencies, strengthening and expansion of the existing distribution network including necessary its rehabilitation, procurement and installation of water meters, and other relevant items for the project implementation such as various administrative procedures including exemption of tax and import duty, etc.

Technical and management guidance under the Soft Component Scheme will be carried out as the consulting services under the Project for the important items to facilitate the effects of the Project as follows:

① Capacity Building for Operation and Maintenance of Slow Sand Filtration System
② Technical Training for Well Management and Operation & Maintenance of Pumps
③ Management Guidance for Organizing the Surface Water Supply System
④ Management Guidance for Improving Water Revenue of the Existing Water Supply Agencies

Due to the execution of the Project, the following project effects are expected:

Direct effect

① Owing to the implementation of the project, water supply conditions are improved by extending the water supply hours to 24 hours from the present one hour or less in a day. The population served of the target year in 2010 is estimated at approximately 188,000 with its increase of approximately 67,000. The table below shows daily average water supply capacity, population served and service coverage as indexes, to indicate the degree of improvement with the comparison between conditions at the present and after project implementation.

Service area	Effect index	Before project implementation (2003)	After project implementation (2010)
Abbottabad City	Daily average water supply capacity	6,273 m3/d	8,068m3/d
	Population served	42,140	62,540
	Service coverage	79 %	100 %
Nawanshehr City	Daily average water supply capacity	2,619 m3/d	3,945 m3/d
	Population served	29,060	33,150
	Service coverage	100 %	100 %
Peripheral Unions	Daily average water supply capacity	4,274 m3/d	11,072 m3/d
	Population served	50,160	93,030
	Service coverage	57 %	85 %
Whole project area	Daily average water supply capacity	13,166	23,085
	Population served	121,360	188,720
	Service coverage	71 %	92 %

Indirect effect

① By switching the groundwater by pumping to surface water by gravity, the power cost for pump operation of well will be largely reduced. Especially in Abbottabad City, the reduction of power cost will be significant since the whole amount of water supply will be switched to surface water. Since the treatment plant is designed basically by gravity and manual operation, its power consumption is also small. Due to the low power consumption as the effect of the project, the operation and maintenance cost for Abbottabad City can be kept as low as about half in comparison with the cost before project implementation even in 2007.

② In many of the existing wells whose pumping rate is not appropriate one and exceeds the capacity of well yield, there is observed a caving phenomenon. And, in some cases, the well is abandoned within a short period of several years. This may be caused by defective construction of wells such as lack of gravel packing. The excessive pumping rate of well is also accelerates this phenomenon. At the event of the pump replacement of the existing wells, it is expected to prevent such phenomenon and to expand the well life by reviewing pumping rate suitable for the well yield and suppressing flowing of silt and clay into the well.

③ Though the statistics of symptom example number of waterborne disease is not obtained in Abbottabad City, it is reported that the number of patients of waterborne infectious disease (diarrhea and dysentery) who were treated in the medical institutions in 2002 is 9 persons per 1,000, among whom 3 persons suffered from diarrhea, in Nawanshehr City and peripheral villages. Still, dysentery that is serious diarrhea occurs in the area. It is expected that the improvement of water supply such as water supply capacity, service coverage and extension of service hours will contribute for reduction of such patients of waterborne disease.

As mentioned above, large effect of the project is expected for improvement of BHN including low income group of the project area, thus the validity to implement the grant-aid scheme of Japan is confirmed.

To obtain the effect of the project, the following is recommended to Pakistani side:

① The Project plans to intake from three branches of Dor River at 200 l/s. The NWFP has approved PC-1 for the implementation of the Project as the results of discussion with the authorities concerned. The NWFP explained that the water right of Dor River for the Project was also approved in accordance with the approval of PC-1. When the importance of the water right issue is taken into account, it is required by the NWFP to monitor with due attention on the adjustment of water usage

between Abbottabad District and Haripur District who will be affected by the intake at the upstream of Dor River in Abbottabad.

② It is essential to obtain the approval of Project Commission-1 (PC-1) from the Provincial and Federal Governments, which secure the obligation of Pakistani side for the implementation of the Project. In this connection, its approval is necessary to be obtained as soon as possible.

③ This plan is to supply potable water to the three existing water supply agencies through the new organization for bulk water supply established by Abbottabad District Government in accordance with the action programme, and completed facilities shall be properly operated by the new organization.

④ The flat rate system is adopted by the existing water supply agencies except Nawanshehr. Further, all of the three agencies cannot afford the operation and maintenance cost from the revenue of water tariff at the present. On the other hand, the operation of above-mentioned bulk water supply system is to be maintained owing to the revenue born by the existing water supply agencies as water tariff. Thus, it is desired that the existing water supply agencies shift the present flat rate system to metered rate system with appropriate tariff level. To facilitate the revenue from the water tariff, it is also necessary to improve tariff collection system. For this purpose, it is required to start planned installation of water meters in an early stage as possible.

⑤ The district government is recommended to study together with Abbottabad City and Nawnshehr City on the proposed action programme for the above important issues, the establishment of new organization for bulk water supply and water tariff revision of the existing water supply agencies, before the commencement of the Project to facilitate steady implementation.

⑥ The groundwater in the project area is still precious water resource for water supply, and for its preservation the groundwater monitoring is indispensable, including surveillance of groundwater level and exploitation. It is necessary to take immediate actions for monitoring of groundwater and required regulation of groundwater utilization by consultation with concerned agencies.

⑦ The Project is to supply the bulk water to the existing water supply agencies up to their reservoirs, and the effect will appear only after its distribution to the service area appropriately. Accordingly, it is necessary to strengthen and expand the distribution network, where required, including necessary rehabilitation of the existing distribution networks.

⑧ It will be necessary to improve drainage system first followed by the construction of sewerage system in the future against the increase of waste water due to the increase of water supply capacity by the implementation of the Project.

The Project for the Improvement of the Water Supply in Abbottabad in the Islamic Republic of Pakistan

Basic Design Report

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Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

The Government of Pakistan has been undertaking the Social Action Plan (SAP) to recover the delay in social development under the advise of the World Bank. Primary health improvement and the improvement of water and sanitation in local communities are included as a priority sector, and the efforts have been made for infrastructural development such as water supply facilities.

In the 8th Five Year Plan (1993/94 – 1997/98) the target was set to provide "all the nationals with safe drinking water". Following to that, in 2001 the Government formulated "National Water Sources Development Programme (2001 – 2010)", and set more practical targets for the improvement of water supply. The Programme aims at the increase of the coverage ratio of drinking water from the present level of 63% to 84% during the period of 10 years. This requires to supply additional 55 million people, among which, 27 million are to be in urban area and 28 million be in local communities.

The water supply in Abbottabad and the surrounding area have been developed by using groundwater as water sources. The expansion project for Abbottabad TMA funded by ADB had been implemented for the period from 1988 through 1997 with the target year of 2003. For the improvement of Nawanshehr water supply KfW has funded to develop new wells and transmission and distribution facilities. Further expansion and improvement of the water supply systems are, however, being required urgently to cope with the increasing population and expansion of the service areas in addition to decrease of the exploitation from the existing wells.

As there is a fear that the availability of groundwater resources in Abbottabad is declining due to the excess abstraction of groundwater in the area, the Public Health Engineering Department (PHED) of Abbottabad District Government has formulated "The Greater Abbottabad Gravity Water Supply Scheme" in 1990, which uses surface water from the upstream of Dor River located at the east of Abbottabad. ADB loan was called for and the ADB conducted the Feasibility Study in 1994. Furthermore, PHED prepared "Addendum to Feasibility Study" but this project has not been funded by ADB.

Following to the above, The Government of Pakistan has applied to the Government of Japan for the request of the grant aid in December, 2000. The outline of the request is shown in Table 1-1. After receiving the request the Government of Japan dispatched the preparatory study team during the period of December 2002 ~ January 2003 to study the content of the project, and the project scope was revised as shown also in Table 1-1.

Table 1-1 Request of the Government of Pakistan and Preparatory Study Results

Item	The Request	Preparatory Study
	Surface Water Gravity System	Surface Water Gravity System + Groundwater
Service Area	Abbottabad City, Cantonment Board Area, Nawanshehr City, Salhad U.C., Sheikuhlbandi U.C.	Abbottabad City, Nawanshehr City, Salhad U.C., Sheikuhlbandi U.C., Jangi U.C. Mirpur U.C.
Target year	2020	2010
Surface Water Sources	Beran Gali River: 200 l/s	Gaya River + Bagh River: 150 l/s
Groundwater Source	non	New: 97 l/s Existing: 58 l/s
Intake	No description	Infiltration
Raw Water Transmission	dia. 450mm 23km Incl. Clear Water Transmission	dia. 400mm 8km (partially dia.150 – 250)
Treatment Plant	Rapid Sand Filtration	Roughing Filter

1-2 Proposed Project

Based on the results of the preparatory study, the Government of Japan decided the implementation of the basic design study, and Japan International Cooperation Agency (JICA) dispatched the basic design study team from 13th July to 22nd September 2003 to confer with the officials concerned of the Government of Pakistan, and to carry out the field study and collection of data and information. As the results of the field study, the gravity system requiring long distance of raw water transmission mains was proposed. Following to that, the second field study was carried out to from 25th January to 23rd February, 2004, in order to compare and review the pump-up system taking raw water from the main stream of the Dor River flowing near the planned water treatment plant and the above mentioned gravity flow system, to verify the validity as a grant aid scheme of Japan. As the results of the comparison and review of above mentioned two systems after returning to Japan, the validity of the gravity flow system for raw water intake and transmission was verified.

The Project aims at the improvement of water supply conditions and securing stable water supply by utilizing surface water sources and applying the most of gravity flows from the intakes. The Project targets to satisfy the water demand in the year 2010. The Project is so planned as to supply drinking water to 100% of the population in the service areas in both Abbottabad City and Nawanshehr City, and 85% of that in Peripheral Union Councils so that the national target could be achieved.

The Project is composed of two systems, surface water system and groundwater system. The general scope of the Project is presented in Table 1-2 below.

Table 1-2 General Project Scope

Item	The Project Scope
Service Area	Abbottabd City, Nawanshehr City, Sheikhul Bandi U.C., Salhad U.C., Jhangi U.C., and Mirpur U.C.
Target Year	2010
Surface Water Sources	Gaya River, Bagh River, and Namly Maira River Capacity of Intake: 200 l/s
Groundwater Source	Existing Source: 88.5 l/s+Spring Water; 5.0 l/s New Development: 14.8 l/s
Surface Water System	
Raw Water Transmission Main	Dia. 500 – 150 mm: 20.5 km
Water Treatment Plant	Slow Sand Filtration Capacity: 200 l/s
Treated Water Transmission Main	Dia. 500 – 100mm: 23.4 km
Distributionr Reserviors	6 reservoirs, Total Capacity: 2,020 m3
Groundwater System	
Well Construction	4 Locations, Total Capacity: 14.8 l/s
Replacement of the Existing Well Pumps	12 Locations, Total Capacity: 88.5 l/s
Well Water Transmission Main	Dia.100 – 159mm: 6.2 km
Distribution Reservoirs	3 reservoirs, Total Capacity: 530 m3

In addition to the above physical scope, the technical and management guidance under the Soft Component Scheme is included in the Project as follows;

① Capacity Building for Operation and Maintenance of Slow Sand Filtration System,

② Technical Training for Well Management and Operation & Maintenance of Well Pumps,

③ Management Guidance for Organizing the Surface Water Supply System, and

④ Management Guidance for Improving Water Revenue for the existing three water supply agencies of Abbottabad TMA, Nawanshehr TMA and District Government handling water supply for the peripheral Union Councils.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Target Year of the Project

The Target year of the Project is the year 2010.

2-1-2 Service Areas and Population Forecast

The areas benefited by the Project are Abbottabad City, Nawansher City, and ten peripheral villages. The water supply systems in these areas are presently operated by Abbottabad TMA, Nawansher TMA and Works & Services Department of Abbottabat District Government, respectively. The ten peripheral villages are grouped into the four Union Councils, namely, Sheikhul Bandhi UC, Salhad UC, Mirpur UC and Jhangi UC. Among which, Jhangi UC further falls into Seven (7) areas; Derawanda, Jhangi, Lama Maira, Banda Gazan, Banda Dilazak, Banda Pugwarian and Dobatar. These peripheral villages have ten (10) independent water supply systems. Figure 2-1 shows the locations of these service areas. The cantonment board and military areas are excluded from the Project area.

The future population in the year 2010 is forecast based on the available Census data in 1981 and 1998. In addition, house count survey was conducted to grasp the appropriateness of the forecast for the projection of the population in the peripheral villages. Table 2-1 shows the Population Forecast in the Service Area.

Tabel 2-1 Population Forecast in the Service Area

Supply Area		Population 1998	Population 2003	Population 2010
1	Abbottabad City	47,609	53,340	62,540
2	Nawansher City	19,871	29,060	33,150
3	Sheikhul Bandi UC	18,193	10,780	13,350
4	Salhad UC	21,211	16,180	19,360
5	Mirpur UC	18,765	14,710	19,230
6	Jangi UC	26,226	45,810	57,490
6-1	Derawanda	—	9,630	12,090
6-2	Jangi	—	21,220	26,630
6-3	Banda Pugwarian	—	6,050	7,590
6-4	Dobatar	—	8,910	11,180
	Total	151,875	169,880	205,120

Note: present population (2003) of Slahad and Mirpur shown in the above table is population within the service area excluding those outside and remote areas from the service area.

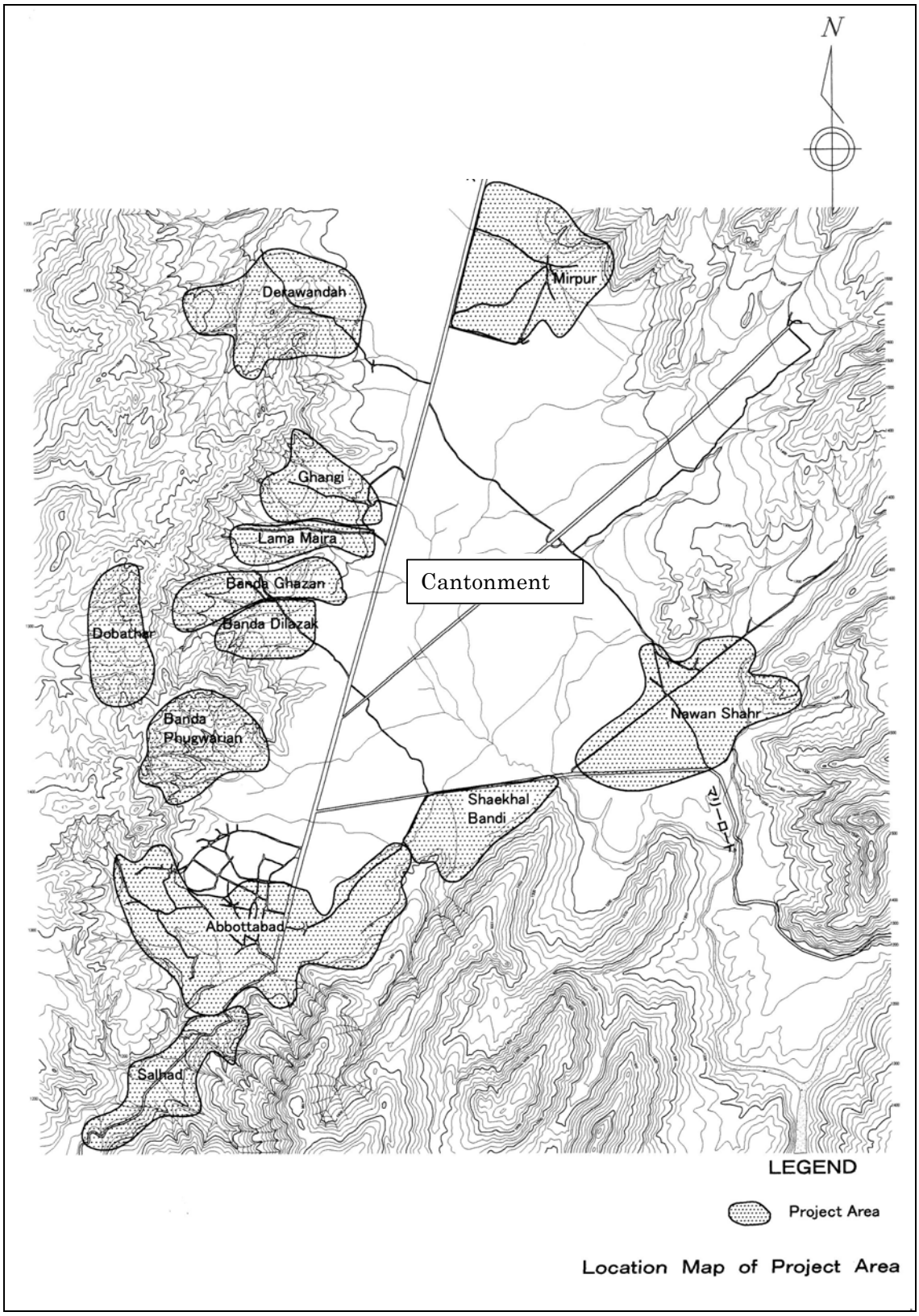


Figure 2-1 Project Area

2-1-3 Target Coverage of Water Supply Services

The total population in the service areas is estimated to be 169,880 in the year 2003, and the half of the population are residing in the peripheral villages. The present coverage ratios of water supply services in Abbottabad City, Nawansher City, and Peripheral Villages are estimated 79%, 100%, and 57%, respectively. Those who are not connected to the water supply services are mostly getting water from neighbours' taps. And it is inferred from this fact that the coverage ratio in Abbottabad City is actually almost 100%. The target coverages in the service areas were set to be 100% for both Abbottabad City and Nawanshehr City, and 85% for peripheral Union Councils referring the national target.

2-1-4 Per Capita Demand

Per Capita Demand in the service area was estimated by the survey on the actual water consumption data counted by the water meters in Nawansher as the water supply in Nawansher is operated by 24 hour supply basis with the metered water consumption. Domestic water consumption and Non-domestic water consumptions calculated from the records in the year 2002 are as follows:

Domestic Water Consumption

Number of Samples:	334
Annual Water Consumption:	15,406 m3
Average Day Water Consumption per Connection:	23.06 m3
Number of Consumers per Connection:	8.7 persons
Daily per Capita Consumption:	87 liter/capita/day

Non-Domestic Water Consumption

No. of Non-Domestic Connections/No. of Domestic Connections:	2.5%
Non-Domestic Water Consumption/Domestic Water Consumption:	Approx. 2
Non-Domestic Water Consumption:	5% of Domestic Consumption

Day Max Water Consumption

Day Max Water Consumption is 117% of Day Average Water Consumption as calculated from the seasonal change of water consumption indicated below.

Month	7 – 8	9 - 10	11 - 12	1- 2	3 - 4	5 - 6	Average
Water Consumption (m3)	17,986	14,031	16,087	12,591	15,179	16,663	15,406
Ratio to Average	1.17	0.91	1.04	0.82	0.99	1.08	1.00

Water consumption declines to the minimum during the winter months of January – February, and elevates to the maximum during the summer months of July – August.

According to the above analysis, per capita demands are estimated as follows:

Abbottabad City	
Domestic Water Consumption	90 lpcd
Non-domestic Water Consumption	13 lpcd (15% of Domestic Water Consumption)
Unaccounted-for Water	26 lpcd (UFW ratio 20%)
Day Average Water Demand	129 lpcd
Peak Factor (Day Max./Day Ave.)	1.15
Nawanshehr City and Peripheral Villages	
Domestic Water Consumption	90 lpcd
Non-domestic Water Consumption	5 lpcd (5% of Domestic Water Consumption)
Unaccounted-for Water	24 lpcd (UFW ratio 20%)
Day Average Water Demand	119 lpcd
Peak Factor (Day Max./Day Ave.)	1.15

2-1-5 Water Demand Projection

Water demand projection in the year 2010 is shown in Table 2-2.

Table 2-2 Water Demand Projection in the Year 2010

Water Supply Service Areas	Population In the Service Area	Population Served		Water Demand		
		Service Coverage (%)	Population Served	Per Capita Demand (lpcd)	Day Average Water Demand (m3/d)	Day Max Water Demand (lit/s)
Abbottabad City	62,540	100	62,540	129	8,068	107
Nawansher City	33,150	100	33,150	119	3,945	52
Sheikhul Bandi UC	13,350	85	11,350	119	1,351	18
Salhad UC	19,360	85	16,460	119	1,959	26
Mirpur UC	19,230	85	16,350	119	1,946	26
Jangi UC	57,490	85	48,870	119	5,861	77
Derawanda	12,090	85	10,280	119	1,223	16
Jangi	26,630	85	22,640	119	2,694	36
Banda Pugwarian	7,590	85	6,450	119	768	10
Dobatar	11,180	85	9,500	119	1,131	15
Total	205,120		188,720		23,085	306

2-1-6 Water Source Planning

2-1-6-1 Groundwater Potential

Well construction sites for the Project area are located in the Orush Plain divided by Dor River and Mangai River. Among the existing wells, however, the wells for Mirpur and Derawanda are included in the different river system, Mangai River system. Major catchment area of the groundwater sources related to the Project is about 76 km2, and

more than 90% of the existing wells abstracting groundwater from the Orush Plain are dependent on this catchment area (Orush Catchment Area).

The Orush Catchment Area is divided into four areas; 1) Kakul Area (40.4km2), 2) Western Area (8.3 km2), 3) Seikhul Bandi Area (8.2 km2) and 4) Orush Plain (19.1 km2). Besides this catchment area, there are Mirpur-Derawanda Catchment Area belonging to Mangi River System and Salhad Catchment Area belonging to Dor River system.

The main aquifer in the Orush Plain is the artesian aquifer recharged from Kakul Area, and most of the existing wells are constructed in this area. The specific yields of these wells are 100 to 300 m3/day/m, and those located at the mid or down stream are of flowing artesian wells. The aquifer recharged from Western Area has lower specific yield of 50 to 100 m3/day/m, and the water table has a tendency of declining these years.

The following conditions are set to estimate the total capacity of groundwater recharge from the above catchment areas:

- Annual Average Precipitation
  - Kakul Station: 1,349.5mm
  - Bara Gali Station: 3,335mm
- Rainfall infiltration ratio: 15%
- Discharge from springs 125 l/s
- Recharged groundwater is not lost to the outside of the areas.

In the past 30 years the lowest precipitation was 939.7mm in 2001, the second lowest 1,046.4mm in 2002, and the third lowest 1,098.5mm in 1993 according to the precipitation data at Kakul Station, and the groundwater recharge is estimated as follows:

- Average Year: 15.8 million m3/year
- The worst drought year (2001): 11.3 million m3/year
- The second worst drought year (2002): 12.5 million m3/year
- The third worst drought year (1993): 13.2 million m3/year

In the Project Area and Cantonment Area groundwater and spring water are presently abstracted for the various purposes, namely, 1) Water Suppy to Abbotabad City, Nawansher City and Periferal Villages, 2) Water Supply in Cantonment Area, and 3) Water Supply for Military Facilities, 4) Others such as private use. The present abstraction reaches to the amount of 11.6 million m3/year, and in the project target year 2010 the water demand is estimated to be 17.7 million m3/year.

In Table 2-3 the water demand in the Project Area and Cantonment Area is compared with the groundwater recharge amount. Table 2-3 also shows the water balance in various cases of drought. Even in the year with average precipitation the balance shows minus in the year 2007. Moreover, this estimate is based on the condition that groundwater penetrated

into underground will never be lost to outside of the area and all the groundwater can be abstracted from the wells. It is implicated that the present groundwater abstraction is almost balanced to the recharge in average year.

The concern that the exploitation of groundwater in this area is reaching almost the limit is also derived from the fact that Iliyashi mosque spring has dried up since 1998. The exhaustion of this spring located at the north-east of Orush Plain means that water pressure in the artesian layer in the Plain is decreasing. Accordingly it is implicated that the water table is declining and compression subsidence of the groundwater layer will follow resulting in exhaustion. It is suggested that the monitoring and control of groundwater abstraction is required in the Project area and necessary actions are urgently required.

Groundwater consumption in Abbottabad area is mainly for water supply purposes including the Cantonment Area. The groundwater is very precious water source in this area and must be maintained for the future continuous use. In this context it is concluded that groundwater abstraction by newly developed wells in the Project should be controlled as low as possible, and preferably it should be maintained within the range that the present abstraction substituted by the surface water system.

Table 2-3 Water Balance Forecast between Groundwater Recharge and Groundwater Abstraction

	2003	2004	2005	2006	2007	2008	2009	2010
1. Water Demand								
	3,980	4,512	5,043	5,575	6,107	6,639	7,170	7,702
Cantonment Board	1,388	1,699	2,009	2,320	2,630	2,941	3,251	3,562
Military Facilities	1,648	1,648	1,648	1,648	1,648	1,648	1,648	1,648
Others	872	872	872	872	872	872	872	872
Sub-Total	7,838	8,731	9,572	10,415	11,257	12,100	12,941	13,784
Discharge by Spring	3,942	3,942	3,942	3,942	3,942	3,942	3,942	3,942
Total	11,780	12,673	13,514	14,537	15,199	16,042	16,833	17,726
2. Groundwater Recharge								
Average Year	15,801	15,801	15,801	15,801	15,801	15,801	15,801	15,801
Worst Drought year	13,187	13,187	13,187	13,187	13,187	13,187	13,187	13,187
2nd Worst Drought Year	12,476	12,476	12,476	12,476	12,476	12,476	12,476	12,476
3rd Worst Drought Year	11,281	11,281	11,281	11,281	11,281	11,281	11,281	11,281
3. Balance								
Average year	4,021	3,128	2,287	1,264	602	- 241	- 1,082	- 1,924
3rd Worst Drought Year	1,407	514	- 327	- 1,350	- 2,012	- 2,855	- 3,696	- 4,539
2nd Worst Drought Year	698	- 197	- 1,038	- 2,061	- 2,723	- 3,566	- 4,407	- 5,250
The Worst Drought Year	- 499	- 1,392	- 2,233	- 3,256	- 3,918	- 4,761	- 5,602	- 6,445

2-1-6-2 Evaluation of Existing Wells

Existing wells were evaluated whether those can be utilized for the future continuous abstraction based on the present operating conditions, surrounding hydrogeological situation, and the interviews to the operators. Table 2-4 summarizes the results of evaluation.

Table2-4 Evaluation of Existing Wells

	Area	T/W No.	Present Status	Measures to be Taken for Future Continuous Use	Abrtaction(l/sec)	Operating Hour	Daily Abstraction (m3/d)	Average Abstraction (l/sec)
1	Derawandah	No.1	pump broken	Abandon due to too close location to No.2 well and very old construction	0	0	0.0	
		No.2	duty	Replace the pump.	5	18	324.0	
		No.3	duty	Replace the pump and reduce the abstraction.	3	18	194.4	
	Total						518.4	6.0
2	Jhangi	No.1	duty	Replace the pump	5.5	18	356.4	
		No.2	duty	Replace the pump	4	18	259.2	
	Total						615.6	7.1
3	Lama Maira		duty	Replace the pump	5.5	18	356.4	
	Total						356.4	4.1
4	Banda Phugwarian	No.2	duty	Replace the pump	5	18	324.0	
		No.3	no service	Install a pump and electrical facilities. Control the abstraction carefully as the existing well is very close.	4	18	259.2	
	Total						583.2	6.8
5	Dobathar		duty	Replace the pump.	4.5	18	291.6	
	Total						291.6	3.4
6	Banda Dilazak		duty	Replace the pump.	5.7	18	369.4	
	Total						369.4	4.3
7	Banda Ghazan		duty	Replace the pump.	4.5	18	291.6	
	Total						291.6	3.4
8	Salhad	No.1	duty	Replace the pump.	6.5	18	421.2	
		No.2	duty	Replace the pump.	5.5	18	356.4	
		No.3(D/W	duty	Abandon due to contamination by drainage from Abbottabad City	0	0	0.0	
	Total						777.6	9.0
9	Sheikhul Bandi	No.2	duty	capable of continuous use	6.2	18	401.8	
		No.3	duty	capable of continuous use	5.2	18	337.0	
		No.4	duty	capable of continuous use	5.2	18	337.0	
	Total						1,075.8	12.5
10	Mirpur	Spring	duty	Abondon due to	0	0	0.0	
		No.1	duty	capable of continuous use	6	18	388.8	
	Total						388.8	4.5
11	Nawanshehr	No.1	duty	capable of continuous use	13	18	842.4	
		No.2	duty	capable of continuous use	7	18	453.6	
		No.3	duty	capable of continuous use	11	18	712.8	
		No.4	duty	Replace the pump.	5.5	18	356.4	
	Total						2,365.2	27.4
12	Abbottabad						0.0	
	Stoney Jheel	No.1	duty	Abandon due to the interference among the surrounding twelve wells operated by Cantonment Board, MES and PMA in the near future.	0	0	0.0	
		No.2	pump broken		0	0	0.0	
		No.3	duty		0	0	0.0	
		No.4	pump broken		0	0	0.0	
	Nawanshehr	No.1	duty	Abandon due to caving risk in the near future	0	0	0.0	
		No.3	duty	Abandon due to caving risk in the near future	0	0	0.0	
		No.4	duty	Abandon due to caving risk in the near future	0	0	0.0	
		No.5	duty	capable of continuous use with reduced abstraction (Reserve as a standby for emergency use.)	10	0	0.0	
		No.6	duty	capable of continuous use with reduced abstraction (Reserve as a standby for emergency use.)	5	0	0.0	
		No.7	duty	capable of continuous use with reduced abstraction (Reserve as a standby for emergency use.)	7	0	0.0	
		No.8	no service	Land issue should be solved			0.0	
		No.9	no service	Land issue should be solved			0.0	
	Narrim	No.6	duty	Abandon due to caving risk in the near future	0	0	0.0	
		New No.	no service	Land issue should be solved			0.0	
		New No.	no service	Land issue should be solved			0.0	
	Total						0.0	0.0
					Grand Total			88.5

In the evaluation of the wells the following are taken into account for the continuous future use:

- The future abstraction is suppressed to 80 to 100% of the present abstraction, and operation hour is extended to 18 hours to alleviate the loading to the aquifers. Lowering abstraction rate per hour can decrease the inflow velocity into wells to avoid silt and sand flowing into wells as well as reduction of incrustation resulting in extension of well lives
- The abstraction from those wells presently overloaded should be decreased to 50 to 80% of the present level.
- In those wells which have excess yields for the present pump capacities the abstraction may be increased to an appropriate level.

It was judged based on the above conditions that 20 wells (excluding 9 wells for Abbottabad City) among 21 existing wells are capable for continuous future use. Regarding the 9 wells serving for Abbottabad City caving has been observed in many wells which were already abandoned or with a significant fear for continuous future use except three wells, although these three wells also need reduction of abstraction urgently.

In conclusion, groundwater abstraction with the continuous use of the existing wells is only allowed to Nawanshehr City and Peripheral Union Councils. The total abstraction is planned to be 88.5 l/s (7,700 m3/day), which is equivalent to approximately 57 % of the present abstraction.

2-1-6-3 Surface Water Source Availability

1) Intake Flow

The surface water sources for the Project are Gaya River, Bagh River and Namly Maira River, which are the branches of Dor River located at the east of Abbottabad. The river flow in this district tends to be of plentiful discharge during the period of July and August, and has a tendency to be of drought water discharge during that of May and June. The field survey was conducted unfortunately during the period of the plentiful discharge, the drought water flow could not be directly measured. Instead, the actual discharges of the three rivers were measured and then the base flow during the plentiful discharge period and that during the drought discharge period were compared.

Table 2-5 shows the actual water discharges in the three rivers, and the total flow is approximately 500 l/s.

Table 2-5 Measurement Results of Actual River Water Discharges of Gaya River, Bagh River, and Namly Maira River (l/s)

Date	Bagh River Upstream	Bagh River * Downstream	Gaya River	Namly Maira River
Aug. 6, 2003	206**	-	127	148**
Aug. 10, 2003	131	-	128	123
Aug. 8, 2003	148	256	123	124
Average	139	256	126	132

Note: - *: The discharge of Bagh River Downstream includes the discharge from the branch of the Bagh river downstream.
**:These are excluded for the averages.

It is estimated that the base flow during the plentiful discharge period for Bagh River and Gaya River is approximately 380 litre/sec in total, and approximately 130 litre/sec for Namly Maira Riveraccording to the above discharge measurement result.

From the river discharge data at the Rajoia station for Dor River it is estimated that the ratio of the minimum discharge (base discharge) during May by that during July is 1: 1.95. This ratio is adopted to estimate the base flows for the three water source rivers during the drought period, and that is estimated to be approximately 250 l/s. The following intake amounts shown in Table 2-6 were assessed as the possible water sources for the project.

Table 2-6 Possible Intake Amount and Planned Intake Amount from the Three Rivers (l/s)

	Bagh River Upstream	Bagh River Branch	Gaya River	Namly Maira River	Total
Possible Intake	70	58	63	66	257
Planned Intake	54	45	49	52	200
Surplus	16	13	14	14	57

2) Water Right

In Pakistan, the concept of the water right and its right have not yet been established, and it is determined that the water right shall be coordinated within the district or the province. The water right among the interested stakeholders in the District is coordinated under the Governor of the District at the event of this Project. As for the new water intake from Bagh River, Gaya River and Namly Maira River, there may be enumerated the existence of effect on water intake by the existing intake facilities at the planned intake point of Gaya River for Damtor Village, as a directly related matter in the Abbottabad District. The intake amount of the existing facility for Damtor Village is 10 l/s. On the other hand, the flow of 63 l/s is expected even during the drought period, considering the measurement results of the flow rate of Gaya River at the downstream of the intake point for Damtor Village (as the 50% of measured flow of 126 l/sec, refer to Table 2-5). Accordingly, the intake for Damtor Village by the existing facility will not be affected, even though the new intake of 50 l/s is

made.

The surface water intake of 200 l/s is planned in total from the three rivers above mentioned, and its effect to the downstream of the Haripur District was reviewed as follows.

According to the precipitation records in the past 42 years (1961 – 2002) at Kakul by Kakul Meteorological Station of Abbottabad, the annual average rainfall was 1349mm and it was recorded at 940mm in 2001 that was the worst drought year in the past. The second and third drought years were 2002 and 1993 respectively, and their rainfall were 1046mm and 1099mm. Appendix 6-4 (1) shows the precipitation data in Kakul. Dor River flows down to Haripur District with its source in Abbottabad Area, and its catchment area is 608km2 with its total length of 70km. There is a flow gauging station at Rajoia of Dor River (catchment area: 292km2) by the Hydrology and Irrigation Department of the NWFP and the daily flow is observed. Appendix 6-5 (1) shows the flow observation records at Rajoa for the recent three years from 2000 to 2002 including those for the worst and the second drought years.

According to the above flow observation records, the river flow rate of 623 l/sec was recorded as the minimum flow rate in May 2001 during the periods of 40 years in the past. The report, "The Regional Study for Water Resources Development Potential for The Metropolitan Area of Islamabad-Rawalpindi" conducted by JICA in 1988, presumed the drought flow of Dor Rive at Rajoia 650l/sec. Key river flow rates at Rajoia comparing with the ratio of planned intake flow of 200 l/s under the Project are summarized in Table 2-7. The catchment area in Haripur is estimated as 518 km2 according to the above mentioned study, and estimated key flow rates at Haripur obtained from the ratio of the catchment areas between Rajoia and Haripur are also shown in Table 2-7 together with the ratio of the planned intake flow under the Project. The outline of Dor River system is presented in Figure 2-2.

Table 2-7 Comparison of Dor River Flow and Intake Flow under The Project

Year	Precipitation	Flow Rate of Dor River at Rajoia/Haripur (l/s)					
		Drought Flow (355 days)		Low Flow (275 days)		Ordinal Flow (185 days)	
2001	Worst Drought Year (940mm)	623	1,120	1,112	2,000	1,667	3,000
		32%	18%	18%	10%	12%	7%
2002	2nd Drought Year (1046mm)	856	1,540	1,096	1,970	1,649	2,970
		23%	13%	18%	10%	12%	7%
2000	Ordinal Year (1142mm)	1,073	1,930	2,467	4,410	2,999	5,390
		19%	10%	8%	5%	7%	4%

It is noted that no significant change of the conditions of the survey area including Dor River system is considered, since the above study in 1988, no project proposed in the study

has been implemented.

As shown in Table 2-7, the intake flow under the Project was about 32 % of the drought flow at Rajoia during the most drought year in 2001. Its was about 18% comparing with the low flow in 2001. The above ratios become 19% and 8% in 2000, having similar precipitation to that of ordinal year during the past 40 years. On the other hand, these ratios are estimated comparing with the river flow at Haripur as about 18% and 10% to the drought and low flows respectively for the most drought year in 2001. Similarly these ratios are estimated as 10% and 5% for ordinal year in 2000. As the annual average discharge of Dor River at Haripur, the above mentioned study presumes approximately 155 million m3, and the annual water intake amount of approximately 6 million m3 by this Project is calculated as only 4% of the above mentioned annual discharge. Therefore, it can be said that the water intake in the upstream under the Project will not give a big effect on the downstream.

On the other hand, according to the Irrigation Department of NWFP, the irrigation water is widely utilized in the downstream of Haripur District, possessing the existing two irrigation systems of approximately 5.6m3/sec in total as design capacity. These two systems intake water by the common intake facility located at approximately 4km in the upstream of Haripur City. However, It is considered that the above design capacity of 5.6 m3/s will be rather big when the above river flows, especially during drought periods are taken into account. It was reported that the river flow rate during dry season on 31st May, 2004 was approximately 0.83m3/s at the intake point above mentioned, representing only 15% of the planned intake flow of the said design capacity. This means that the irrigation water is absolutely insufficient during the dry season at least, regardless of the water intake in the upstream of Dor River by this Project. It was also reported that the river flow rate at Havelian (catchment area; 415 km2), the downstream of Rajoia, was 1.36m3/s on the said day, and it indicates that the river flow rate is reduced by 0.5m3/s or more at the intake point for the said irrigation. The water utilization in this section along Dor River is not clear, and unidentified withdrawal of river water such as irrigation purpose is assumed.

As for the Project, the NWFP had decided its implementation as the result of discussion with the Irrigation Department and other authorities concerned. At the same time, the NWFP shall consider the effective use of water resources through the survey on the irrigation purpose, demand fluctuation by seasons, and present operation practice of the existing irrigation networks.

Although the NWFP explained that the approval of water right for the Project was made through the approval of PC-1, it is required by the NWFP to monitor with due attention on the adjustment of water usage between Abbottabad District and Haripur District whose water usage will be affected by the intake at the upstream of Dor River in Abbottabd when

the importance of the water right issue between two districts is taken into account.

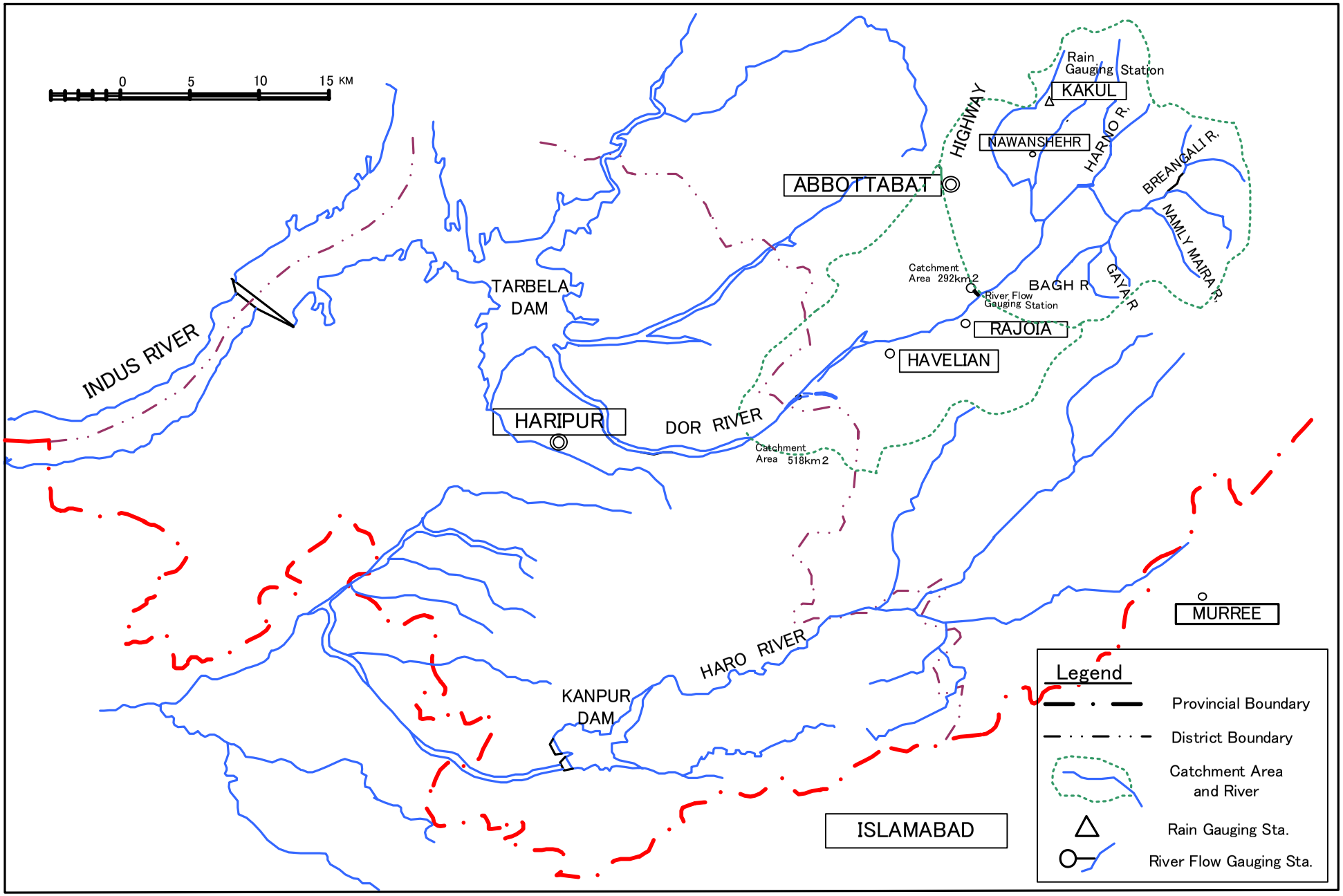


Figure 2-2 Outline of Dor River System

2-1-6-4 Water Supply Planning by Groundwater and Surface Water Systems

Based on the assessment of the groundwater potential, evaluation of the present use of groundwater and the evaluation of surface water sources, the water supply plan in the Project Area in the target year 2010 is summarized as follows:

- Population in Service Area: 205,120
- Service Coverage: 85% - 100%
- Population Served: 188,720
- Water Demand: 306 l/s
- Existing Well Capacity 93.5 l/s (including Dhodial Spring)
- Water Supply Capacity
  - Surface Water System: 200 l/s (totally new development)
  - Groundwater System: 108.3 l/s (only 15 l/sec is new exploitation)

After introducing the surface water system the water supply in Abbottabad City will be totally dependent upon the surface water system. In Nawanshehr and Peripheral Union Councils the systems are supplied by the combined system of the surface water system and groundwater system except Banda Pugwarian and Dobatar. Table 2-8 shows the distribution plan of the surface water and groundwater to the service areas.

Table 2-8 Distribution Plan of Surface Water and Groundwater

Service Area	Water Demand	Existing Wells and Springs for the future continuous use			Balance	Water Sources to be Newly Developed		
	2010 (lit/sec)	Wells	Springs	Total (lit/sec)	(lit/sec)	Wells	Surface Water	Total (lit/sec)
1 Abbottabad TMA	107	0	0	0	107	0	107.0	107
2 Nawanshehr TMA	52	27.4	5.0	32.4	19.6	0	19.6	19.6
3 Sheikuhlbandi U.C.	18	12.5	0	12.5	5.5	0	5.5	5.5
4 Salhad U.C.	26	9.0	0	9.0	17	0	17.0	17.0
5 Mirpur U.C.	26	4.5	0	4.5	21.5	0	21.5	21.5
6 Jangi U.C.								
1) Derawanda	16	6.0	0	6.0	10.0	0	10.0	10.0
2) Jangi	9	7.1	0	7.1	1.9	0	1.9	1.9
3) Lama Maira	8	4.1	0	4.1	3.9	0	3.9	3.9
4) Banda Gazan	10	3.4	0	3.4	6.6	0	6.6	6.6
5) Banda Dilazak	9	4.3	0	4.3	4.7	0	4.7	4.7
Sub-total of 1) to 5)	36	18.9	0	18.9	17.1	0	17.1	17.1
6) Banda Pugwarian	10	6.8	0	6.8	3.2	3.2	0.0	3.2
7) Dobatar	15	3.4	0	3.4	11.6	11.6	0.0	11.6
Sub-total of Jangi U.C.	77	35.1	0	35.1	41.9	14.8	27.1	59.0
Total	306	88.5	5.0	93.5	212.5	14.8	197.7	212.5

2-1-7 Basic Concept of Surface Water System and Groundwater System

2-1-7-1 Surface Water System

As for the methods of intake and raw water transmission, the gravity system as originally requested by the Pakistani side leads to the method where the raw water is transmitted from the river upstream located far from the service area to the water treatment plant, as a result. Accordingly, the raw water transmission pipeline becomes long as approximately 23

km, so that the project may require a sizable cost for construction. Therefore, the review was conducted from the viewpoints of the cost effectiveness, such as construction cost, maintainability, economy, etc., in comparison with an alternative with pump-up intake and raw water transmission from the river (Dor River) near to the water supply service area. At the event of selection for the location of intake by pump-up, two locations of Damtor and Harnoi were compared under two conditions where (1) they are near to the planned location of the water treatment plant and (2) their access to the intake point is easy. After reviewing and investigating the matters such as ensuring of intake amount and easiness of construction work concerning the above-mentioned two locations, Damtor was selected as an alternative. The alternative study was conducted to compare these alternatives. The results of comparison between the gravity system and the pump-up intake system at Damtor are as follows:

① Though construction cost of the gravity system is a little higher, there is not significant difference.
② As for maintenance cost, power cost of pump-up system is significantly higher.
③ Easiness of operation and maintenance of both systems is judged almost the same.

As a result of comprehensive evaluation as above-mentioned, it was concluded that the gravity system will be adopted. The details of the comparison and review contents are described in [Appendix 6-1].

2-1-7-2 Groundwater System

The groundwater system was planned based on the assessment of groundwater potential and evaluation of the existing conditions of the tube wells.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Present Conditions of the Existing Water Supply Systems

1) Abbottabad City Water Supply System

The existing Abbottabad water supply system is dependent on the three well fields, namely, Shoney Jheel, Nawanshehr, and Narrian, and operated by Abbottabad TMA. Groundwaters are pumped up to the three booster pump stations, and then further boosted to the distribution reservoirs located at the high elevation hill of the Abbottabad Basin. After that water is distributed from these reservoirs to the consumers by gravity.

Figure 2-3 shows the outline of the entire water supply system of Abbottabad. The system is further divided into the three transmission and distribution systems, namely, Shoney Jheel Well Field System, Nawanshehr Well Field System, and Narrian Well Field System. These booster pump stations are located at the elevation of approximately +1,200m, and the water is transferred to the reservoirs at the elevation of around +1,300m. Most of the customers of the Abbottabad Water Supply System are residing at the southern slopes of the Abbottabad Basin, and supplied from these high elevation reservoirs. Part of the water is further boosted to the higher reservoir to supply people living at the higher elevation.

Kehal (Aram Bagh) System

Groundwater from the two tube wells at Nawanshehr Well Field is transferred to Aram Bagh Booster Pump Station and then pumped up to Kola Kehal Reservoir. The water is then transferred to four reservoirs by gravity and distributed to the customers. Part of water is supplied to the consumers living at the higher elevation by pumping.

Kunj System

Groundwater from the three tube wells at Nawanshehr Well Field and one tube well at Narrian Well Field is transferred to the Kunj Booster Pump Station, and then boosted to Kunj Qadeem Reservoirs. There are two booster pumps with different capacities. One is used to transfer to Kunj Qadeem Reservoir, and the other is to Banda Sapan and for direct pumping to the lower area in the city. From Kunj Qadeem Reservoir water is further pumped to the higher reservoirs.

Jinnah System

Groundwater from the three tube wells at Stoney Jheel Well field is transferred to Jinnah Booster Pump Station, and then further pumped to Jail Reservoirs. Jail Reservoirs distribute water to the lower area, and part of water is further pumped up to Charri Reservoir and Shimla Reservoir to serve the population at the higher elevation.

2) Nawanshehr City Water Supply System

Water sources of Nawanshehr City Water Supply System are composed of four tube wells and one spring. Distribution system is divided into five zones as shown in Figure 2-4 "Outline of Nawanshehr City Water Supply System".

In the year of 1999, the three tube wells and a elevated reservoir were constructed with the financing from KfW, and the half of the houses in Nawanshehr are enjoying water supply from this system with 24 hour basis service. The rest of the Nawanshehr City falls into Maira Zone where the ground elevation is relatively higher, Ex-City Zone, Gujar Bandhi Zone and Dhodial Zone. Each of these zones is supplied by the independent distribution system.

In Maira Zone groundwater from one old tube well constructed in 1984 is transferred to Maira Reservoir and then supplied by gravity. Ex-City Zone, Gujar Bandi Zone and Dhodial Zone are dependent on Dhodial Spring as a sole water source. The Dhodial Spring water is pumped up to Bazar Elevated Tank, Gujar Bandi Reservoir and Dhodial Reservoir, and then distributed to the respective zones by gravity. Part of the spring water is also transferred to Maira Reservoir.

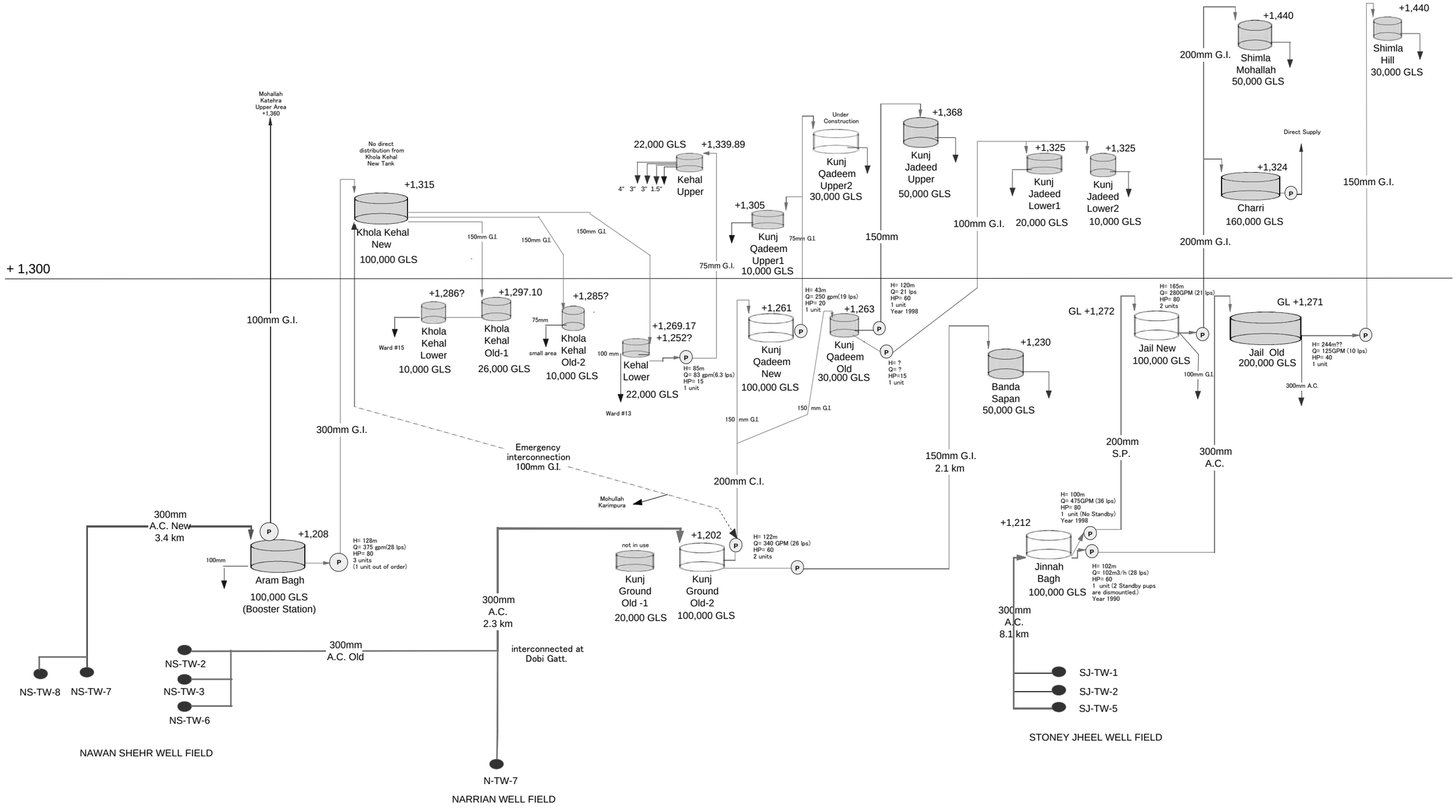


Figure 2-3 Outline of Existing Abbottabad City Water Supply System

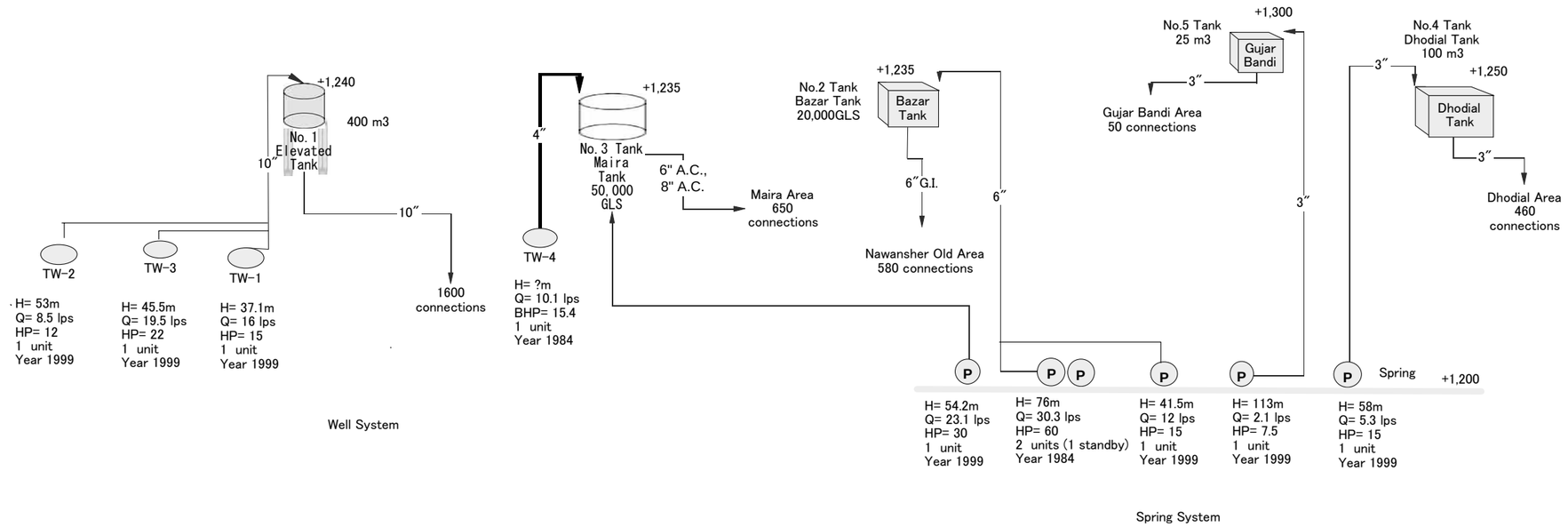


Figure 2-4 Outline of Existing Nawanshehr City Water Supply System

3) Water Supply Systems in Peripheral Union Councils

There are four peripheral union councils around the Abbottabad City. These peripheral union councils are further divided into 12 small areas, and supplied by ten (10) independent water supply systems. Among these systems, Lama Maira area does not have a distribution reservoir and groundwater from the tube well is directly supplied to the consumers. The other nine (9) areas have distribution reservoirs, and groundwater from tube wells are transferred to the reservoirs and then distributed by gravity. Figure 2-5 shows outlines of tube well water supply systems in the peripheral union councils. Operation hour differs area to area but the supply is commenced after filling these reservoirs and water is not supplied during the night time.

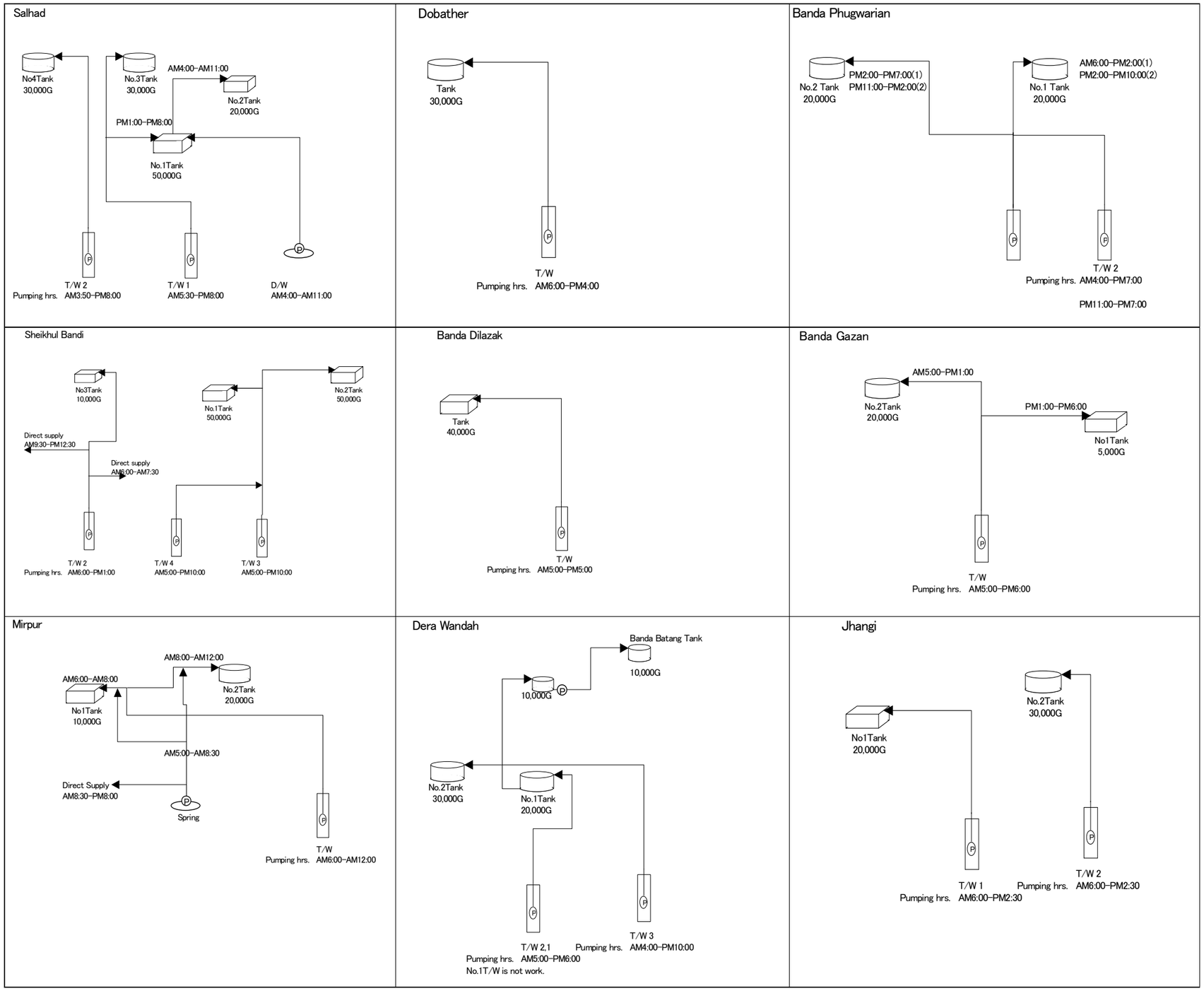


Figure 2-5 Outline of Existing Tube Well Water Supply Systems in Peripheral Union Councils

2-2-1-2 Design Policy

1) Basic Policy for Natural Conditions

- The proposed intake sites and raw water transmission routes for the surface water system are located among the hilly area. In order to avoid possible damages due to land sliding or falling rock, there should be taken into account the structures of the facilities, materials of pipes, pipe protection, and access roads for the maintenance in the design.
- The surface water system is of gravity flow system utilizing the height difference between the intakes and water treatment plant site. Depending on the elevation of the raw water transmission routes the statistic internal pressure of pipe at the low elevation points will be very high. It is necessary to select suitable pipes and valves for such high water pressure, and pressure releasing chambers are necessary to be designed at appropriate locations.
- Raw water turbidity has a tendency of increasing sharply to very high level after the heavy rainfall during the rainy seasons. The design of the water treatment plant should consider such sudden change of water quality.

2) Basic Policy for Socio-economical Conditions

- The major raw water transmission pipe route is along Murree Road which is managed by the Provincial Government. This road has been developed by cutting sharp mountain slopes to connect Abbottabad and Murree, and there is no alternative connecting route between these cities. Care should be paid during the construction period to maintain the normal transportation and avoid any accidents derived from the construction work.
- The present water tariff seems to be very low. In order to improve the water supply management after the implementation of the Project, discussion with the implementing agency is necessary to raise the water tariff with due consideration of household income level, affordability of consumers and subsidy levels borne by the relevant governments. It is necessary to propose appropriate and practically adoptable level of water tariff.

3) Basic Policy for Construction and Procurement Circumstances

- One of major components of the Project is the pipeline construction work. Among the pipes used for the Project those pipes with the diameters less than 250mm are to be of steel pipe which is locally produced and widely used in Pakistan. However, larger diameter pipes with more than 300mm are to be of Ductile Cast Iron Pipe (DIP) in consideration of strength against external load, high pressure resistance and easier installation. Since DIP is not available locally, procurement from the third countries is to be considered.

4) Basic Policy for Utilizing Local Contractors

- There are contractors available in Abbottabad District and Peshawar Province having experience in tube well construction in Abbottabad Basin, and those contractors are utilized for the Project. Pumps for tube wells are also manufactured locally and utilized for the Project.
- Regarding the construction works for the water treatment plant, intakes, raw water and treated water transmission mains, and reservoirs, utilizing major contractors in Pakistan should be considered in view of the magnitude of the works.

5) Basic Policy for the Management Capacity of Implementation Agency

- A new organization is necessary to set up for operating and managing the new surface water gravity system. It is also necessary to define clearly the roles and responsibilities of the three agencies, namely, Abbottabad TMA, Nawanshehr TMA and Abbottabad District (Works & Services Dept.) in operating the new system. With regard to the establishment and sound commencement of the new institution it should be considered to introduce the managerial guidance by Japanese consultants in order to assist the processes.
- Operation and maintenance of the water treatment plant introduced in the Project will be the first experience in this district, and the technical guidance by the Japanese consultants should be also provided to ensure the capacity building for operation and maintenance of the new system.

6) Basic Policy for Facilities

Major components of the facilities are intake facilities, raw water transmission facilities, water treatment plant, treated water transmission facilities and distribution reservoirs for the surface water system. For the groundwater system those are tube wells, treated water transmission facilities and distribution reservoirs.

- Regarding raw water transmission mains installed along sharp slopes at upstreams of Namly Maira River, Bagh River and Gaya River, various alternative pipe installation should be considered not only of underground but of exposed installation, hanging, etc. depending on the surrounding site conditions.
- The raw water transmission facilities are one of the most important facilities in the surface water system. As the statistic water pressure in the pipeline becomes very high at the lower elevations of the pipeline route, it is necessary to consider such high pressure in the selection of pipe materials and valves. Moreover, pressure releasing chambers are constructed at the appropriate locations so as to design the facilities as the maximum statistic pressure of 25 kg/cm2.
- The treatment plant facilities are so designed to obtain the finished water quality which conforms to the WHO Drinking Water Quality Guideline values. It should be also considered to adopt the facilities with easier operation and maintenance, so that manual operation is preferred to automatic control.
- In order to avoid the excess abstraction and well caving phenomena observed in the existing tube wells, it is necessary to set the appropriate abstraction capacities for the wells to be constructed or rehabilitated in the Project. In addition, devices for a minimum monitoring and controlling the operation of wells should be provided.

7) Basic Policy for Construction Method and Period

- Access to the upstream of the rivers is not easy, and only foot paths with sharp slopes are available. In such sites tractors may be used to carry construction materials up to where they can approach, and then manpower is used to the sites. Widening such foot paths might be necessary in such cases.
- Construction site for water treatment plant is mostly covered with rock, and the excavation by giant breakers, backhoes and blasting will be required. The volume of rock excavation is significant and sufficient time for this excavation work should be considered in the construction scheduling.
- Magnitude of pipe laying work is significant. As the total construction period is very limited the pipe laying work should be done simultaneously by several teams exclusively working for pipe laying. It is necessary to consider sufficient deployment of personnel of contractors as well as local consultant staff for inspecting the different sites.

2-2-2 Basic Plan

After the implementation of the Project the surface water system will be newly added to the existing water supply systems composed of only groundwater sources. This new surface water system will be introduced by utilizing the existing facilities effectively.

2-2-2-1 Surface Water System

1) Intake Facilities

Siting of Intake

The locations of the intakes are sited at the elevations as shown in Table 2-9 to enable gravity flow up to the proposed water treatment plant of which elevation is about +1,360m.

Table 2-9 Elevations of Intake Sites for Bagh River, Gay River, Namly Maira River (m)

Intake River	Bagh River Upstream	Bagh River Branch	Gaya River	Namly Maira River
Intake Flow	54 l/sec	45 l/sec	49 l/sec	52 l/sec
Elevation of Intake	＋1429m	＋1428m	＋1422m	＋1626m

The high elevation of Namly Maira River Intake is set as there is a higher elevation of about +1,600m on the way of the raw water transmission mains.

Method of Intake

Bar screen type, which has screen in front of intake mouth to avoid floating materials entering into the intake, is adopted considering the intake amount of raw water and the surrounding conditions of the intakes as this type can ensure stable intake by avoiding the damage by rock falling from upstream.

The bar screen type is divided into backward intake method and bottom intake method. The structure of the backward intake method is a bit complex when compared with the bottom intake method. Since the both methods do not make much cost difference the former is preferred as more reliable and stable for intake.

2) Raw Water Transmission Mains

The raw water flow is set to be 200 litre/sec, provided that the water loss for treatment processes in the treatment plant is 1.0 % of the total water supplied by the surface water system, 198 litre/sec.

Raw Water Transmission Route

The raw water transmission route is shown in Figure 2-6. The route is divided into several segments depending on the site conditions for pipe laying work.

- at the sharp slopes along Bagh River, Gaya River and Namly Maira River
  (segment: 1 to 2, 4 to 6, 5-1 to 5, 5-2 to 5, 5 to 6)
- from the confluence of Bagh River and Gaya River to Murree Road where vehicles can not get access
  (segment: 6 to 7)
- along the narrow road from Namly Maira River to Murree Road with many bends and 4m road width
  (segment: 2 to 3)
- along Murree Road with sharp gradient and many bends, most of this route is of rock.
  (segment: 3 to 7)
- along Murree Road near to the foot of the Treatment Plant site with narrow road shoulders
  (segment: 7 to 7b)
- at the very sharp slope of the hill to the Treatment Plant
  (segment: 7b to 8)

Table 2-10 shows the list of raw water transmission facilities.

Table 2-10 Pipe Diameters, Type of Pipe Materials and Lengths of Pipelines for Raw Water Transmission Mains

Facilities	Route	Reference No. in Fig. 2-4	Flow (litre/sec)	Specifications	Quantity
Raw Water Transmission Main	from Namly Maira Intake to Namly Maira Bridge	1～2	52	φ250、 SP	1570 m
	from Namly Maira Bridge to the connecting point with Murree Road	2～2a	52	φ250、 SP	1460 m
		2a～3	52	φ200、 SP	670 m
	from the above connecting point to the connecting point with Bagh/Gaya raw water mains	3～7	52	φ150、 SP	1800 m
	from Gaya Intake to the confluence with Bagh River	4～6	49	φ200、 SP	720 m
	from Bagh Intake to the confluence with Bagh Branch (Bandi Nullah)	5-1～5	54	φ250、 SP	930 m
	from Bagh Branch Intake to the confluence with Bagh River	5-2～5	45	φ150、 SP	240 m
	from the confluence with Bagh River and Bagh Branch to the confluence with Gaya River	5～6	99	φ250、 SP	500 m
	from the confluence with Bagh River and Gaya River to the connecting point with the raw water main from Namly Maira	6～7	148	φ350、 DIP	1750 m
	from the connecting point of Bagh/Gaya/Namly Maira mains to the Treatment Plant (along Murree Road)	7～7a	200	φ450、 DIP	6140 m
		7a～8	200	φ500、 DIP	4710 m
Pressure Releasing Chamber		①②③		RC Structure	3 sites

Since the elevation at the Namly Maira Intake is as high as +1626m it is necessary to control the static water pressure in the raw water transmission main. For this purpose pressure releasing chambers are to be constructed at the locations of ①, ②, ③ in Figure 2-6. The elevations of these chambers are approximately, +1550m, +1400m and +1370m, respectively. Setting free water tables in these chambers allows to design the raw water transmit with the maximum water pressure of 25 kg/cm2.

Selection of Pipe Material

Due to the topographic feature of the raw water transmission route with up-and-down elevations and the surrounding natural conditions of Murree Road where the raw water trunk main (dia. 450mm – 500mm) runs, it is preferred to select the pipe materials which have strong resistance against high internal water pressure and external shock load in order to ensure the safety of the pipelines in the future. In this regard, Ductile Cast Iron Pipe (DIP) and Steel Pipe (SP) are both advantageous. However, SP requires skillful welding work for the pipe connections, and extra excavation in the trench is necessary for welding work. Moreover, welded parts are to be tested and treated for preventing possible leakage and corrosion. Accordingly, SP requires relatively longer time during pipe laying when compared with DIP, and is inferior to DIP in easiness of the pipe laying work.

Of the smaller diameter pipes less than dia. 250mm, these pipes are installed where the internal pressure is not high, and steel pipes which are of local product are utilized.

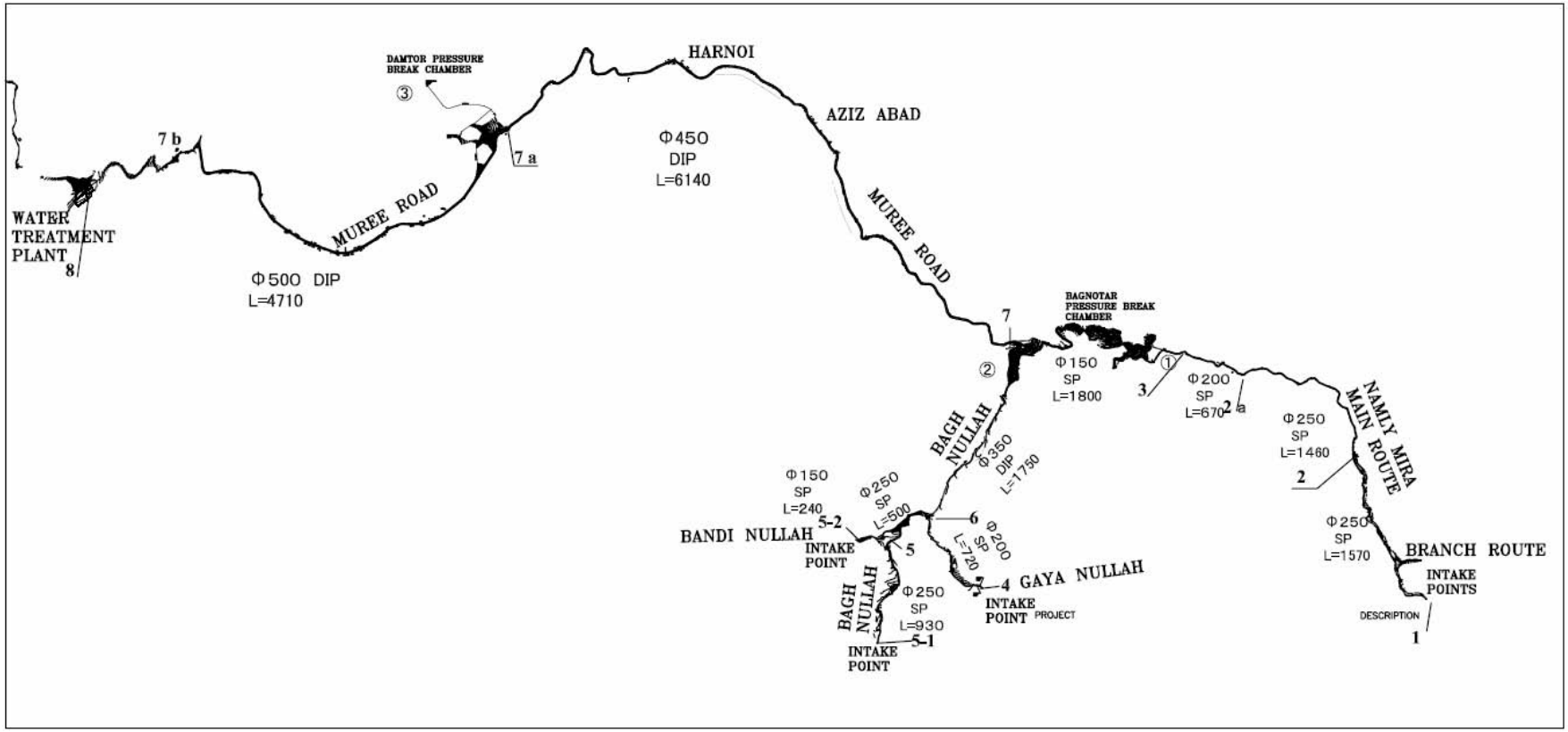


Figure 2-6 Location of Intakes, Raw Water Transmission Main, Pressure Releaseing Chamber, Water Treatment Plant

3) Water Treatment Plant

Raw water turbidity is usually low, but tends to increase sharply during a certain period of time after rainfall. The turbidity extremely increases when torrential rain hit the catchment area. The 24 hour raw water turbidity measurement, which was conducted for 20 days in August 2003, revealed that very high turbidity over 1000 NTU was observed once during the measurement period after heavy rainfall. After heavy rainfall the turbidity also increase and 270 NTU was observed at maximum. But the turbidity decreased as low as less than 10 NTU within 4 hours.

Taking into account the above characteristic of raw water turbidity the following treatment processes are required.

① Sedimentation Basin → ② Roughing Filter→ ③ Slow Sand Filter → ④ Clear Water Reservoir → ⑤ Chlorination

Sedimentation Basin

It is presumed that extremely high raw water turbidity may appear several times a year. During such high turbidity the treatment plant should stop the operation. Sedimentation Basin is planned to avoid such high turbid water entering into the succeeding treatment processes by creating time so that the operator can take necessary action against such high turbidity. In practical operation a certain period of time is necessary for the operators to judge emergency stop of the operation after analyzing the turbidity. Considering this period, the retention time of the sedimentation basin is set to be two hours. Desludging from the basin is designed by manual scraping after emptying the basin.

Roughing Filter

Filter run period of slow sand filters are extremely shortened by the increase of raw water turbidity after rainfall. In order to alleviate the turbidity load to slow sand filters roughing filters is introduced to reduce 50% of raw water turbidity. There are three types of roughing filters, namely, of horizontal flow, downflow and upflow. Horizontal flow type is of simpler structure but the flow rate should be kept at the lower rate compared with the other two. The upflow type can achieve the highest filtration rate and the downflow type is designed with the medium flow rate.

The upflow type is adopted in this project as it can obtain higher filtration rate and easiness of washing the filter media. Filtration rate adopted is 1.5 m/hr (36m/day)

Slow Sand Filter

Slow sand filters are commonly designed to have filtration rate of 4 to 5 m/day. Incase that raw water turbidity is constantly low the filtration rate of 8m/day is rarely applied. The raw water turbidity, however, requires to be reduced by roughing filters the filtration rate of the

slow sand filters is set to be 5 m/day. The filter media are sand and gravel which are locally available.

Clear Water Reservoir

Clear water reservoir is designed to serve constant and stable water transmission to the service areas and to maintain the transmission during the period when the raw water intake is stopped. According to the results of the continuous measurement of raw water turbidity the duration necessary to cut off emergently the raw water inflow into the plant is approximately 6 hours. Such cases, however, may happen only several times a year. It is considered very conservative to have a full capacity of 6 hours. The capacity is designed to be 3 hours which is sufficient to maintain stable and constant transmission and provide effective chlorine contact time for disinfection.

Disinfection Facilities

The existing water supply systems have no disinfection facilities as water sources of deep well is generally free from pathogenic contamination. However, the surface water sources are exposed to such contamination risk and a certain disinfection processes are necessary to ensure the bacteriological safety of water to be supplied.

In consideration of no experiences of chlorination, chlorination using bleaching powder or calcium hypochlorite is recommended as liquid gas chlorine requires more careful handling and strict control of operation. Bleaching powder or calcium hypochlorite is applied in the form of solution by the use of gravity flow feeders at the clear water reservoir. The designed dosing rate of effective chlorine is 2 ppm at maximum considering the distance to the consumers.

Other Facilities

Water supply facilities are necessary for the water use in the plant and preparation of chlorine solution. Operation Building is constructed to facilitate the operation and maintenance of the facilities. The Building accommodates offices, a meeting room, laboratory, store, library, kitchen, and lavatories.

Operation & Maintenance Road

In addition to the daily operation work at the plant periodical access by vehicles is necessary to supply bleaching powder and filter media to the plant. Moreover, in case that valves or pipes require to be repaired, heavy load truck should be able to get access to the plant. For these purposes, paved road with 3 m width is required from the nearest public road to the plant as the operation & maintenance road.

The general feature of major facilities of the water treatment plant is presented in Table 2-11.

Table 2-11 Major Features of the Water Treatment Plant

1 Treatment Capacity	Q =	17,300 m3/day (200 lit/s)	
		1 % water loss and consumption in the process	
2 Sedimentation Basin			
Type	Rectangular Horizontal Flow Plain Sedimentation		
No. of Basin	N =	2 basins	
Retention Time	T =	2 hours	
Volume	V =	1,460 m3	
Dimension	W 12m x L 24m x D 2.5m x 2 basins		
Miscellanecus	Inlet Stop Log	4 units/basin	
	Perforated Walls	1 unit	
	Effluent Weir	1 unit	
	Drain Valve (φ150mr	1 unit/basin	
	Drain Pipe (φ200mm	1 unit	
	Washing Pump/Piping	1 unit	
3 Roughing Filter			
Type	Upflow		
No. of Basin	N =	12 basins	
Filtration Rate	V =	36 m/day	(1.5 m/hr)
Dimension	W 6.6m x L 6.1m x D 1.3m x 12 filters		
Filter Gravel	3 layers	φ 24～50mm × 50	cm
		φ 12～18mm × 30	cm
		φ 8～12mm × 20	cm
Underdrain System	RC Perforated Slab		
Wash System	Flow Rate	60 cm/min	
Piping	Inlet main	φ350 mm	
	lateral	φ150 mm	
	Outlet main	φ300 mm	
	lateral	φ150 mm	
	Washwate main	φ600 mm	
	Drain lateral	φ400 mm	
Miscellanecus	Outlet Weir	2	
	Washwater Weir	1	
	Washwater Tank	150 m3	
4 Slow Sand Filter			
Type	Constant Water Level at Inlet		(Stop Log)
No. of Filter	N =	6 filters	(Standby 1 filter)
Filtration Rate	V =	5 m/day	(0.2 m/hr)
Dimension	W 16m x L 43.5m x D 2.35m x 6 filters		
Filter Sand	Effective Dia.	φ0.4 mm	
	Uniformity Coefficient	2.0 at maximum	
	Thickness	90 cm	
Filter Gravel	4 Layers	φ 60 mm × 15	cm
		φ 20～30mm × 10	cm
		φ 10～20mm × 10	cm
		φ 3～ 4mm × 10	cm
Underdrain	Main	W0.6×H0.3 Concrete Block	
	Lateral	φ100mm Perforated Pipe (PVC)	
Piping	Inlet	φ200 mm	
	Outlet	φ350 mm	
	Backflow	φ150 mm	
	Drain	φ100 mm	
Miscellanecus	Inlet Weir	1 unit	
	Outlet Weir	1 unit	
	Sand Washer	1 unit	

5 Clear Water Reservoir		
No.	N =	2 basins
Retention Time	T =	3 hours
Volume	V =	2,148 m3
Dimension	W 16.5m x L 21.7m x D 3m x 2 basins	
Piping	Inlet	φ350 mm
	Outlet	φ350 mm
	Overflow	φ300 mm
	Drain	φ150 mm
6 Disinfection Facilities		
Disinfectant	Bleaching Powder	
Dosage Rate	Max	2 ppm
	Ave	1 ppm
Dosing Method	Gravity Feeder	
Dosing Point	Inlet at Clear Water Reservoir	
Solution Tank	No. of Tank	2 unit (1 standby)
	Volume	3 m3
Doser		2 unit (1 standby)
7 Operation Building		
Structure	RC W 12m x L 18m	
	Entrance hall	18 m2
	Engineer Office	18 m2
	Office	56 m2
	Meeting Room	30 m2
	Water Quality Laborato	9 m2
	Store/Library	22 m2
	Lavatories/Sink/etc.	63 m2
8 Water Supply and Sanitation		
Water Tank	FRP	1 m3
Supply Pump	75 lit/min	2 unit (1 standby)
Septic Tank	20 person cap.	1 unit
9 Yard Piping		
Raw Water Inlet Pipe		φ500 mm
Raw Water Flow Mete	Waltman type	φ400 mm
Interconnection		φ400～350 mm
Roughing Filter - Slow Sand Filter Interconnec		φ450～200 mm
Slow Sand Filter - Clear Water Reservoir Inter		φ350 mm
Clear Water Transmission		φ500 mm
Clear Water Flow Met	Waltman type	φ400 mm
10 Landscaping		
Road		1600 m2
Stone Masonry	h = 1.0～5.0m	530 m
Fence		475 m

4) Treated Water Transmission Mains

Total amount of treated water transmission is planned to be 198 litre/sec in accordance with the water demand projection for the year 2010. Table 2-12 shows the supply amount to each service area.

Table 2-12 Treated Water Transmission to Service Areas

Service Area	Supply (lit/s)	Facilities to Receive the Supply
Abbottabad City*1	107	
Aram Bagh System	53.5	Connected to Existing Transmission Pipe to Existing Khola Kehal Reservoir
Kunj System	32.1	Connected to Existing Transmission Pipe to Kunj GadeemReservoir
Jinnah System	21.4	Connected to Existing Transmission Pipe to Jail Reservoirs
Nawanshehr City	19.6	Supplied to New Reservoir to be constructed
Sheikuhlbandi U.C.	5.5	Supplied to New Reservoir adjacent to Existing Reservoir
Salhad U.C.	17.0	Supplied to New Reservoir
Mirpur U.C.	21.5	Supplied to New Reservoir to be constructed adjacent to Existing Reservoir
Jhangi U.C.	26.2	
Derawanda	10.0	Supplied to New Reservoir to be constructed adjacent to Existing Reservoir
Jhangi*2	17.1	Supplied to New Reservoir to be constructed adjacent to Existing Reservoir
Total	198	

Note : *1 Distribution to the three systems in Abbottabad City is determined by proportions of the existing reservoir capacities.
*2 Jhangi is composed of four (4) existing systems (Jhangi, Lama Maira, Banda Gazan, Banda Dilazak).

Treated Water Transmission Routes for Surface Water System

Treated Water Transmission System for the Surface Water Gravity System is divided into the two routes as shown in Figure 2-7.

① Abbottabad – Salhad Route

The transmission main is laid along the sharp hill slope from the treatment plant and takes the western route after meeting Murree Road. Then, it is branched to New Sheikulbandi Reservoir on the way and it goes along Shinar／Link Road. It will be connected to the existing transmission pipes at Aram Bagh Booster Pump Station and Kunj Booster Pump Station. After meeting Kala Kolum Highway (KKH) it is further divided into the two directions; one to Jinnah Booster Pumping Station and the other to new and exisiting Salhad Reservoirs. The pipes to Salhad are installed along KKH, which is national highway.

② Nawanshehr – Mirpur Route

The transmission pipeline to this route is branched from the transmission main at the Murree Road. It goes through Nawanshehr City and then reaches KKH through PMA Road. After that it is divided into the northern direction and southern direction. The former will be extended through KKH to New Mirpur Reservoir and also branched to New Derawanda Reservoir. The latter is laid along

KKH to supply water for New Banda Gazan Reservoir.

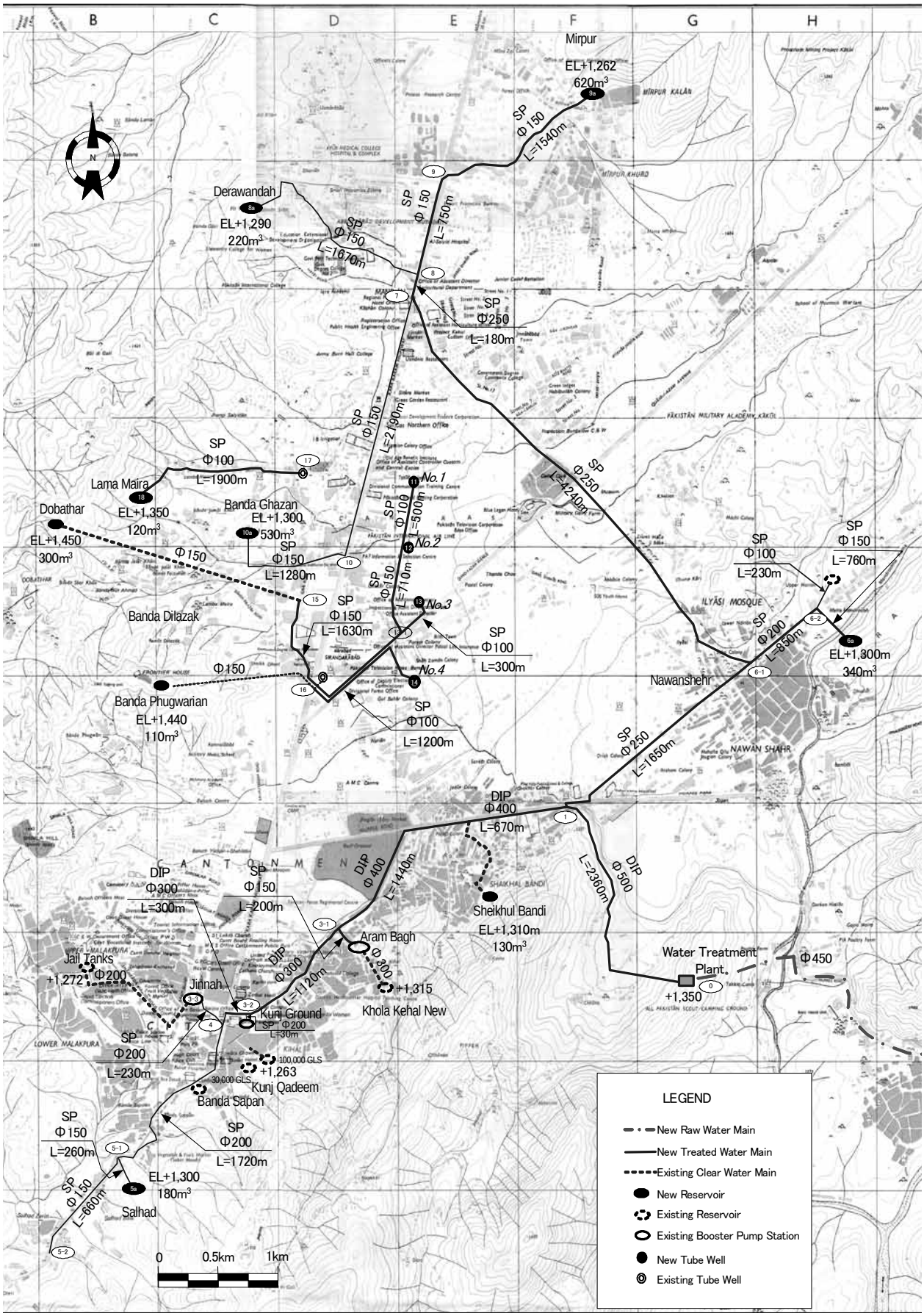


Figure 2-7 Location of Treated Water Transmission Main, Tube Wells and Reservoirs

Diameters, Pipe Materials and Pipeline Lengths of Treated Water Transmission Main

Table 2-13 tabulates the diameter, type of pipe material and length of each pipeline to be newly installed for the surface water system.

Table 2-13 Diameters, Type of Pipe Materials, Lengths of Pipelines for Treated Water Transmission Mains

Pipeline Route	Reference No. in Figure 2-5	Flow (l/s)	Diameter, Pipe Material	Length
Abbottabad - Salhad Direction				
Water Treatment Plant - Connection with Murree Road	0～1	197.7	φ500、 DIP	2360 m
Connection with Murree Road - Branch Point to Sheikhulbandi Reservoir	1～3-0	129.5	φ400、 DIP	670 m
Branch Point to Sheikhulbandi Reservoir - Branch Point to Aram Bagh Booster Pump Station	3-0～3-1	124.0	φ400、 DIP	1440 m
Branch Point to Aram Bagh Booster Pump Station - Aram Bagh Booster Pump Station	3-1～3a	21.4	φ150、 SP	200 m
Branch Point to Aram Bagh Booster Pump Station - Branch Point to Kunj Booster Pump Stat	3-1～3-2	102.6	φ300、 DIP	1120 m
Branch Point to Kunj Booster Pump Station - Kunj Booster Pump Station	3-2～3b	32.1	φ250、 DIP	30 m
Branch Point to Kunj Booster Pump Station - Connection with KKH	3-2～4	70.5	φ300、 DIP	300 m
Connection with KKH - Jinnah Booster Pump Station	4～3-3	53.5	φ200、 SP	230 m
Connection with KKH - Branch Point to New Salhad Reservoir	4～5-1	17.0	φ150、 SP	1720 m
Branch Point to New Salhad Reservoir - New Salhad Reservoir	5-1～5a	6.0	φ150、 SP	260 m
Branch Point to New Salhad Reservoir - Connecting Point with the Existing Pipe	5-1～5-2	11.0	φ150、 SP	660 m
Nawansher Direction				
Connection with Murree Road - Crossing with PMA Road	1～6-1	68.2	φ250、 SP	1650 m
Crossing with PMA Road - Branch Point to New Nawanshehr Reservoir	6-1～6-2	19.6	φ200、 SP	850 m
Branch Point to New Nawanshehr Reservoir - new Nawanshehr Reservoir	6-2～6a	11.6	φ150、 SP	760 m
Branch Point to New Nawanshehr Reservoir - Existing Maira Reservoir	6-2～6b	6.3	φ100、 SP	230 m
Mirpur／Derawanda Direction				
Crossing with PMA Road - Connection with KKH	6-1～7	48.6	φ250、 SP	4240 m
Connection with KKH - Branch Point to New Derawanda Reservoir	7～8	31.5	φ250、 SP	180 m
Branch Point to New Derawanda Reservoir - New Derawanda Reservoir	8～8a	10.0	φ150、 SP	1670 m
Branch Point to New Derawanda Reservoir - Branch Point to New Mirpur Reservoir	8～9	21.5	φ150、 SP	750 m
Branch Point to New Mirpur Reservoir - new Mirpur Reservoir	9～9a	21.5	φ150、 SP	1540 m
Banda Gazan Direction				
Connection with KKH - Branch Point to New Banda Gazan Reservoir	7～10	17.1	φ150、 SP	2190 m
Branch Point to New Banda Gazan Reservoir - New Banda Gazan Reservoir	10～10a	17.1	φ150、 SP	1280 m

New treated water transmission pipelines are connected to the existing transmission pipes when water is supplied to the existing reservoirs. In case that water is supplied to new reservoirs new pipelines are also extended to these reservoirs.

Flow Control Facilities

In order to control the inflow into the reservoirs water level control valves are installed at the reservoirs listed in Table 2-14. Flowmeters are also installed.

Table 2-14Existing and New Reservoirs Which Need Water Level Control Valves and Flowmeters

Supply System	Name of Reservoir	Existing/New	Capacity	Diameter of Inlet Pipe (mm)
Kehal System	Khola Kehal New	Existing	100,000GLS	300
Kunj System	Kunj Qadeem New	Existing	100,000GLS	150
	Kunj Qadeem Old	Existing	30,000GLS	150
	Banda Sapan	Existing	50,000GLS	150
Jinnah-Jail System	Jail Old	Existing	200,000GLS	200
	Jail New	Existing	100,000GLS	200
Nawanshehr	Maira	Existing	50,000GLS	100
	New	New	340m3	150
Salhad	Tank No.1	Existing	50,000GLS	150
	New	New	180m3	150
Mirpur	New	New	620m3	150
Sheikhul Bandi	New	New	130m3	100
Derawanda	New	New	220m3	150
Banda Gazan	New	New	530m3	150

2-2-2-2 Groundwater System

1) Replacement of Existing Well Pumps

Need of replacement of existing well pumps was determined taking into consideration the followings:

(1) The year of installation and degree of wearing of pumps,

(2) The present operation condition of pumps in comparison with the pump rating; in other words, if the operation condition of pumps does not follow the rating, the pump head originally designed does not meet the actual situation due to change of well operating water level, or, the capacity of pumps has varied from the original design due to wear of pump impellers, etc.,

(3) The matching of appropriate abstraction and pump rating; in other words, the excessive puming rate is supposed if the pump rating exceeds the well capability, and, on the other hand, inefficient operation cannot be avoided if the pump rating is low comparing with the well capability.

Among the existing 21 wells excluding 9 wells serving for Abbottabad TMA, 12 wells are judged to be replaced as listed in Table 2-15. Prior to the replacement of these pumps well

cleaning and simplified pumping test should be conducted to determine the appropriate pump specifications to maintain the sufficient water table for proper operation.

Furthermore, it is necessary to add the following functions for proper monitoring and operation of the wells.

① A guide pipe for inserting a water level meter should be installed in the casing for periodic monitoring of the water table in the well.

② Limit switch and water level meter should be provided to stop the pump operation, when the abnormal drawdown of water table happens, for the protection of the pump.

③ Flowmeter should be provided to monitor proper abstraction. Ultrasonic Flowmeter is suitable as the internal water pressure is very high.

Table 2-15 List of Pumps to be Replaced

Area	T/W No.	Specification of Existing Pumps			Year of Installation	Year of Manufacturing	Present Condition
		type	head (m)	discharge (l/sec)			
1 Derawandah	No.2	B	192.1	7.6	1997	1984	Operated at 71% of Nominal Pump Capacity
	No.3	S	122	8.8	1995	1996	Drawdown of water table observed, Excess abstraction by unsuitable capacity pump, Insufficient pump head
2 Jhangi	No.1	S	152.5	12.6	1979	1974	Drawdown of water table observed but constant operation, very old pump
	No.2	B	289.7	7.6	1992	1993	Drawdown of water table
3 Lama Maira		B	122	12.6	1982	1982	Old Pump
4 Banda Phugwarian	No.2A	S	274.5	7.6	1998	1992	Operated at 36% of Nominal Pump Capacity, No drawdown of water table observed
5 Dobathar		S	305	9.5	1986	1986	Operated at 61% of Nominal Pump Capacity, Drawdown of water table observed
6 Banda Dilazak		S	189.1	7.6	1988	1988	Operated at 95% of Nominal Pump Capacity, Drawdown of water table observed
7 Banda Ghazan		S	289.7	12.6	1988	1988	Operated at 44% of Nominal Pump Capacity, Drawdown of water table observed
8 Salhad	No.1	S	192.1	5.3	1995	Unknown	Tendency of water table drawdown
	No.2	S	201.3	10.1	1996	Unknown	
9 Nawan Shahr	No.4	S	76.25	10.1	1984	1984	Old Pump

S：submersible pump B：borehole pump

2) New Tube Well Construction

The surface water system can not provide the water supply to Banda Phugwarian and Dobatar as these areas are located at the higher elevation where the gravity flow can not reach. New tube well construction is necessary to satisfy the water demand of the above areas. According to the demand projection additional groundwater exploitation necessary in these areas is 14.8 l/s. The locations of the new well sites are decided based on the following criteria:

① The well locations should be close to the service areas.

② Sufficient discharge is secured.

③ Well construction is allowed and practically possible. (500m should be maintained in distance between any two wells.)

Well construction site was selected at Narrian area located eastern side of KKH as indicated in Figure 2-7. These new wells are located at the artesian field in Abbottabad Basin, and the specific discharge is estimated at 100 to 300 m3/day/m. The existing wells constructed in such places where high specific discharge is expected are being used to abstract high yields such as 10 to 20 l/s. But such high discharge may cause caving. Accordingly, it is proposed to maintain the lower yield, approximately 6 litre/sec, from each new well constructed in the Project in order to prevent caving and achieve sustainable abstraction.

To satisfy the water demand four new wells are required. Among which, one well is for Banda Phugwarian, and three for Dobathar.

3) Groundwater Transmission Pipelines

Groundwater abstracted from the four new wells are transmitted to the reservoirs where the surface water system can not feed the water. In conjunction with the construction of these four wells, the following transmission pipelines are to be constructed as shown in Table 2-16.

Of Lama Maira System, there is no reservoir at present and the system is modified to construct a new reservoir and transmit the groundwater from the existing well to the reservoir. Water from this reservoir is supplied for areas with higher elevations.

Discharge from each well is determined, provided that daily demanded water at each area is abstracted with 18 hours operation of wells. Accordingly the diameters of transmission pipelines are designed to satisfy this condition.

Table 2-16 List of New Transmission Pipelines for Groundwater System

Route	Reference No. in Fig. 2-5	Flow (l/s)	Diameter, Type of Pipe Material	Length
Dobatar System				
New Tube Well No.1～New Tube Well No.2	11～12	5.2	φ100、 SP	500 m
New Tube Well No.2～Connecting Point with Pipeline from New Tube Well No.3	12～13-1	10.3	φ150、 SP	710 m
New Tube Well No.3～Connecting Point with Pipeline from New Tube Well No.2	13～13-1	5.2	φ100、 SP	300 m
Connecting Point of Two Pipelines from New Tube Wells No.2 and No.3～Connecting Point to Existing Pipeline	13-1～15	15.5	φ150、 SP	1630 m
Banda Pugwarian System				
New Tube Well No.4～Connecting Point to Existing Pipeline	14～16	4.3	φ100、 SP	1200 m
Lama Maira System Existing Tube Well～New Lama Maira Reservoir	17～18	5.5	φ100、 SP	1900 m

2-2-2-3 Locations and Capacities of New Distribution Reservoirs

Need of a new distribution reservoir in each service area is evaluated based on the following conditions. New reservoirs are planned where the capacities of the existing reservoirs are insufficient to the water demands in 2010.

- Required reservoir capacity should be 8 hour of maximum daily water demand
- Where there are several reservoirs in a system, distribution from each existing reservoir is estimated in accordance with the capacity of respective reservoir, and proportion of the distributions is obtained. Reservoir capacities are designed, provided that this proportion is not changed in the future.
- The present transmission flows from the existing wells to the existing reservoirs are adjusted in conjunction with the replacement of well pumps.
- The capacities of the reservoir for respective systems are determined in accordance with their future demand and proportion of distribution from the reservoir.
- Existing Reservoirs and water sources are effectively used as much as possible.
- Principally the new surface water system supplies only to the new reservoirs. Supply from the new surface water system to the existing reservoirs is only allowed when the above configuration can not balance the water demand and supply.

As the results of the above analysis the nine reservoirs are necessary to be constructed as listed in Table 2-17. The locations of these reservoirs are shown in Figure 2-7. The structure of new reservoirs is of RC structure.

Table 2-17 List of New Distribution Reservoirs to be constructed

System	Type of Water Sources	Capacity (m3)
Sheikuhlbandi	Surface Water	130
Salhad	Surface Water	180
Nawanshehr	Surface Water	340
Mirpur	Surface Water	620
Derawanda	Surface Water	220
Banda Gazan	Surface Water	530
Lama Maira	Groundwater	110
Banda Phugwarian	Groundwater	120
Dobatar	Groundwater	300

The Figures 2-8 to 2-18 explain conceptually the modifications of water transmission and distribution in each system.

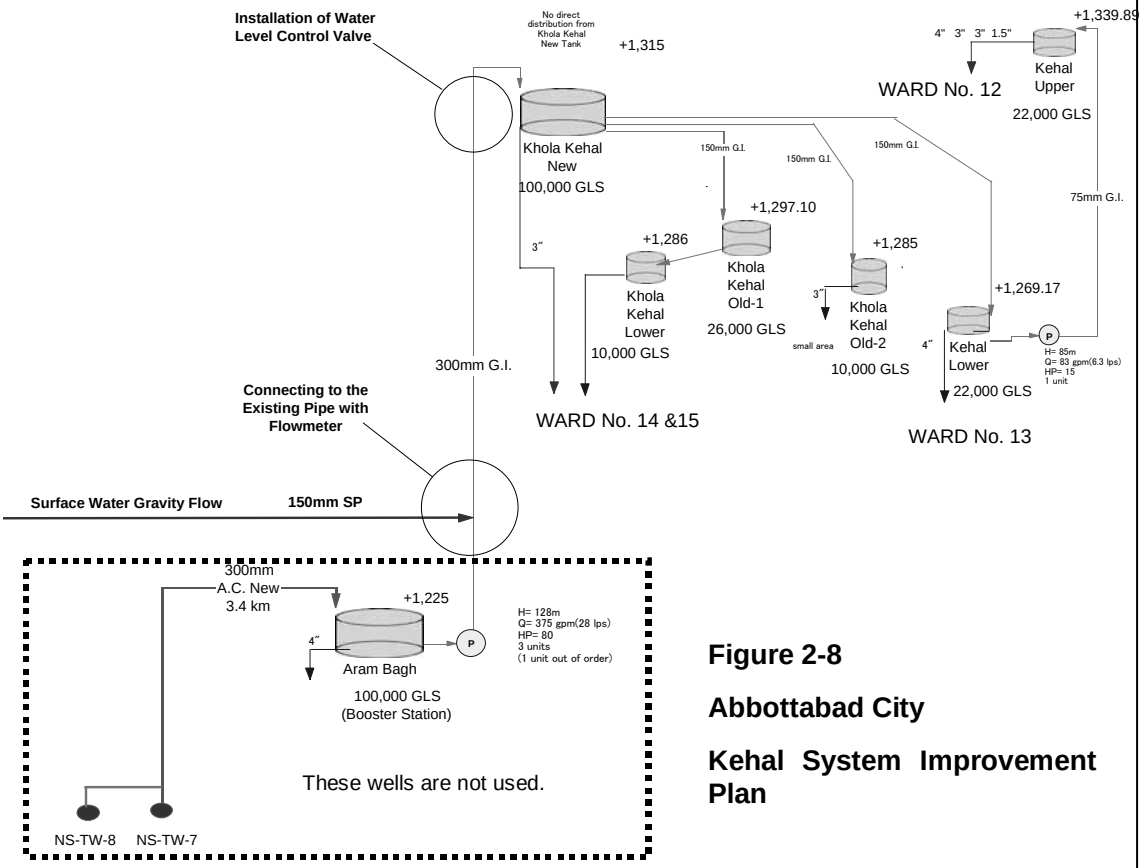


Figure 2-8

Abbottabad City

Kehal System Improvement Plan

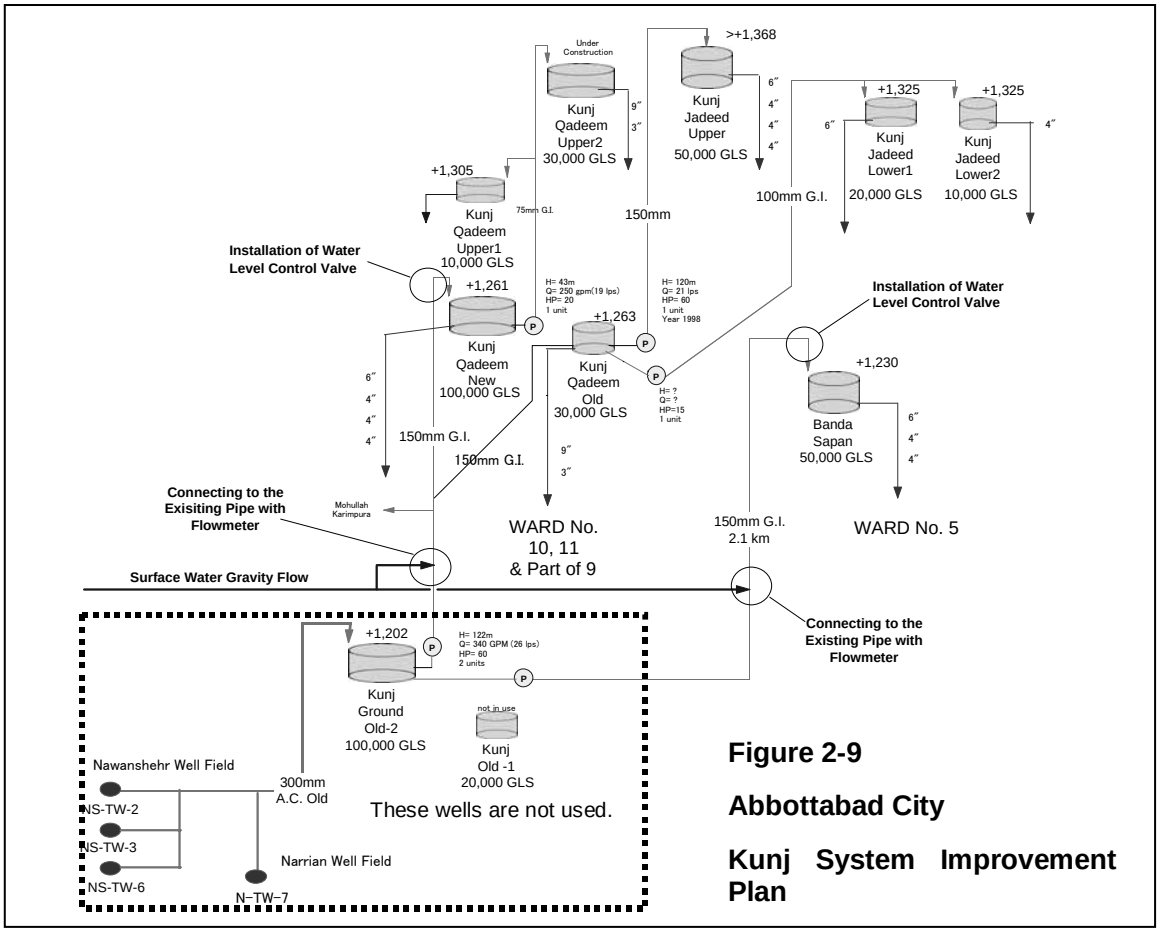


Figure 2-9

Abbottabad City

Kunj System Improvement Plan

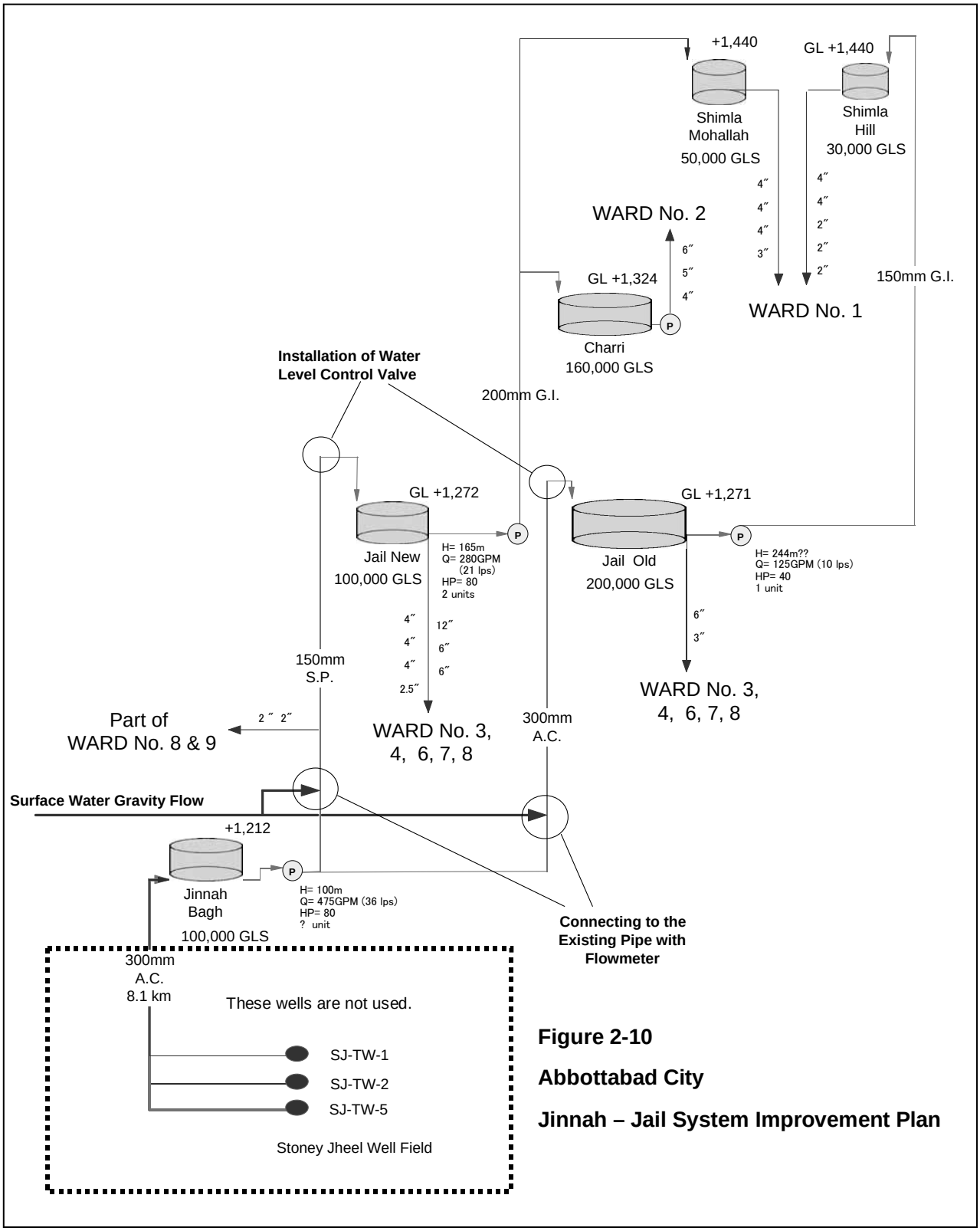


Figure 2-10

Abbottabad City

Jinnah – Jail System Improvement Plan

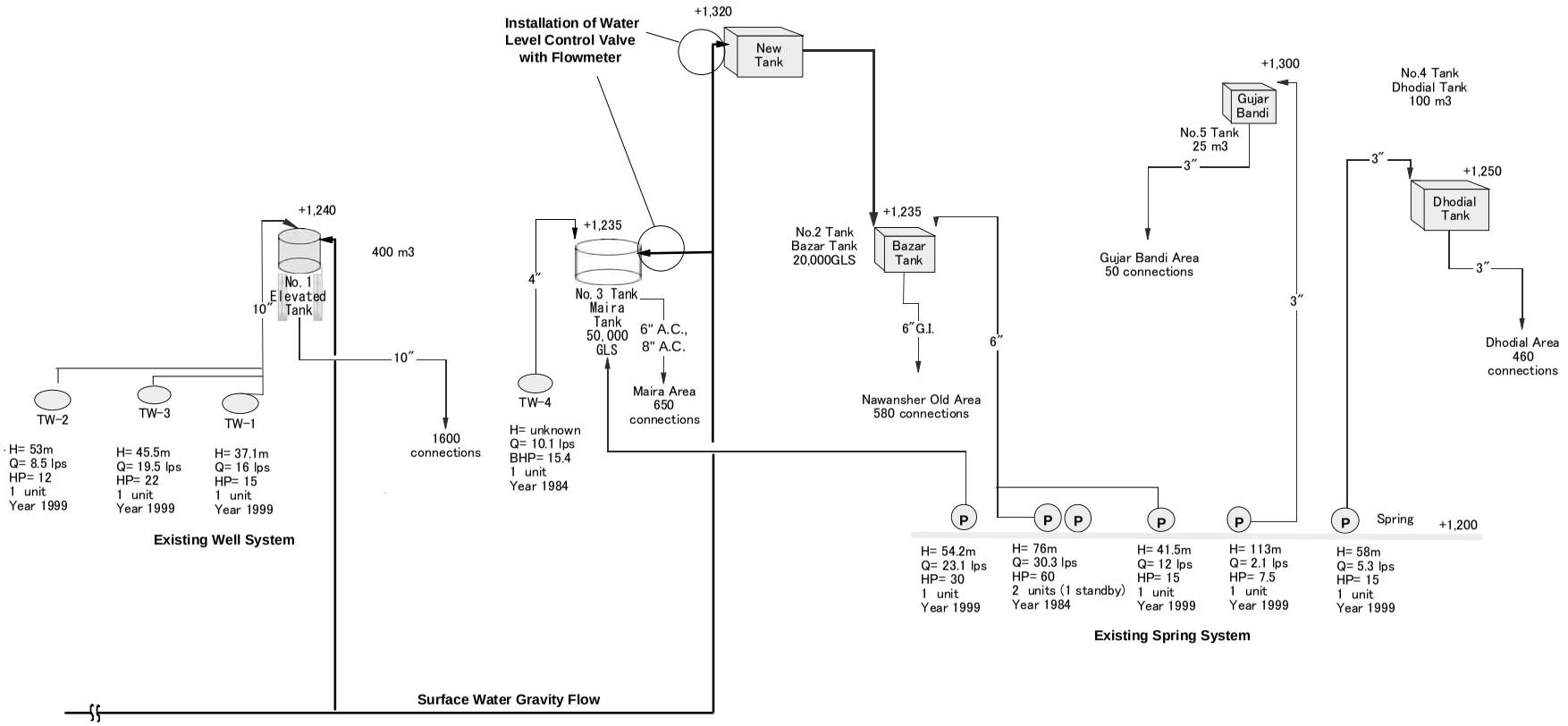
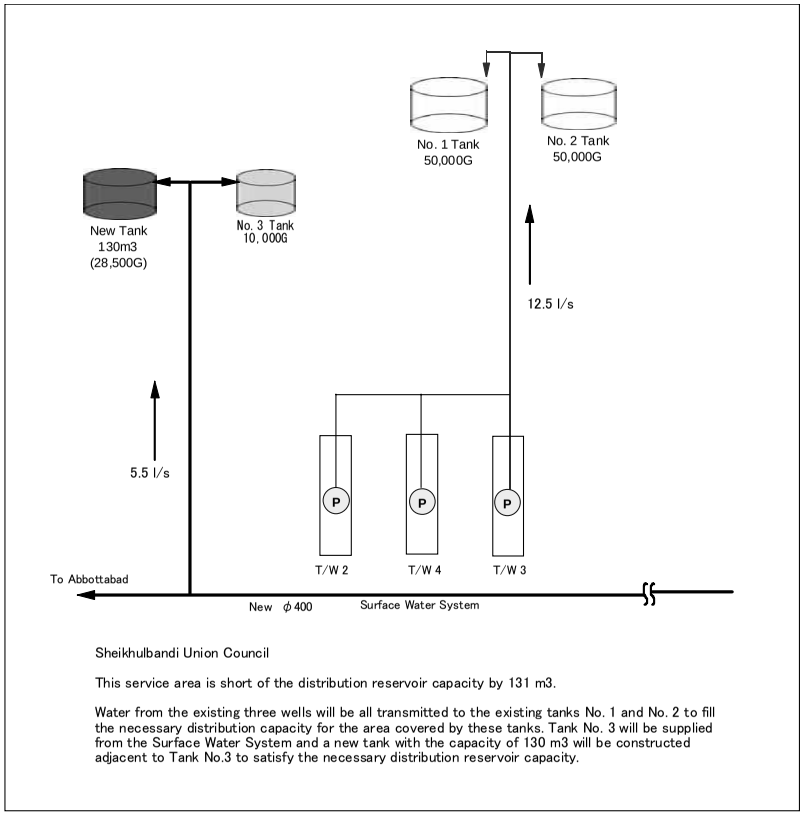


Figure 2-11 Nawanshehr System Improvement Plan

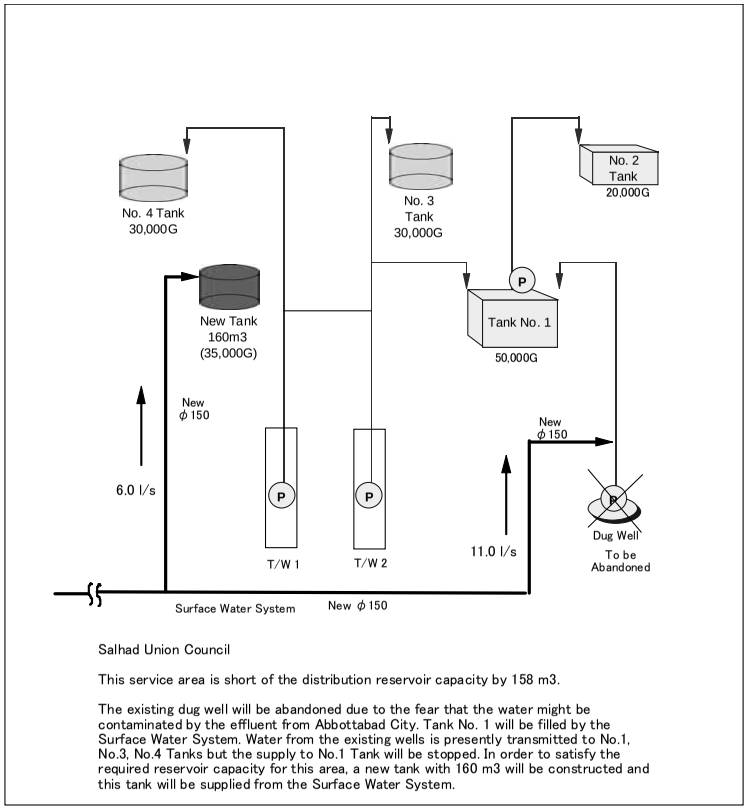


Sheikhulbandi Union Council

This service area is short of the distribution reservoir capacity by 131 m3.

Water from the existing three wells will be all transmitted to the existing tanks No. 1 and No. 2 to fill the necessary distribution capacity for the area covered by these tanks. Tank No. 3 will be supplied from the Surface Water System and a new tank with the capacity of 130 m3 will be constructed adjacent to Tank No.3 to satisfy the necessary distribution reservoir capacity.

Figure 2-12 Improvement Plan of Water Transmission for Sheikhulbandi

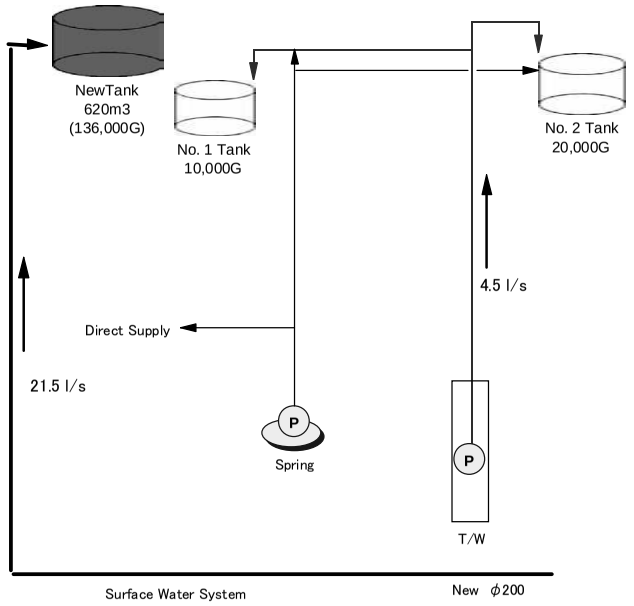


Salhad Union Council

This service area is short of the distribution reservoir capacity by 158 m3.

The existing dug well will be abandoned due to the fear that the water might be contaminated by the effluent from Abbottabad City. Tank No. 1 will be filled by the Surface Water System. Water from the existing wells is presently transmitted to No.1, No.3, No.4 Tanks but the supply to No.1 Tank will be stopped. In order to satisfy the required reservoir capacity for this area, a new tank with 160 m3 will be constructed and this tank will be supplied from the Surface Water System.

Figure 2-13 Improvement Plan of Water Transmission for Salhad

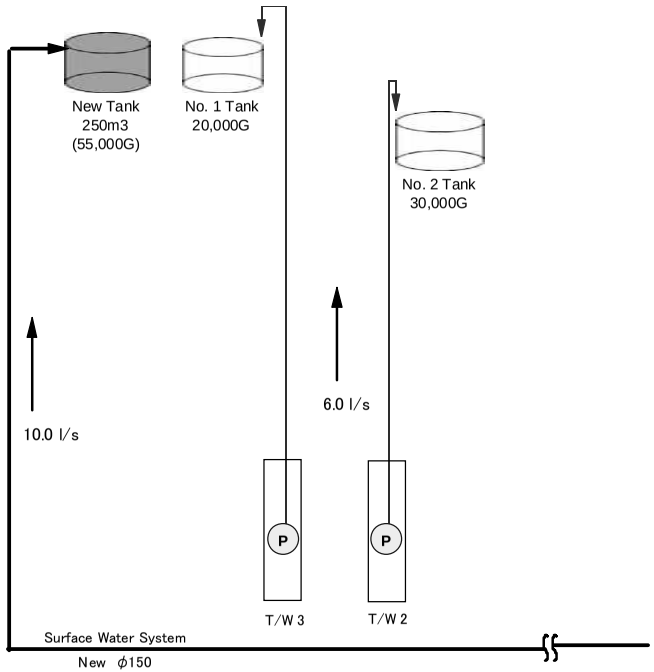


Mirpur Union Council

This service area is short of the distribution reservoir capacity by 613 m3.

There are presently one tube well and one spring. The spring has a tendency of dry-up during the draught seasons, and it is not included in the improvement plan. Water from the existing well will be supplied to No.1 and No.2 Tanks. Water from the Surface Water System. is supplied to a new tank constructed adjacent to No. 1 Tank. to satisfy the required distribution capacity in this area.

Figure 2-14 Improvement Plan of Water Transmission for Mirpur

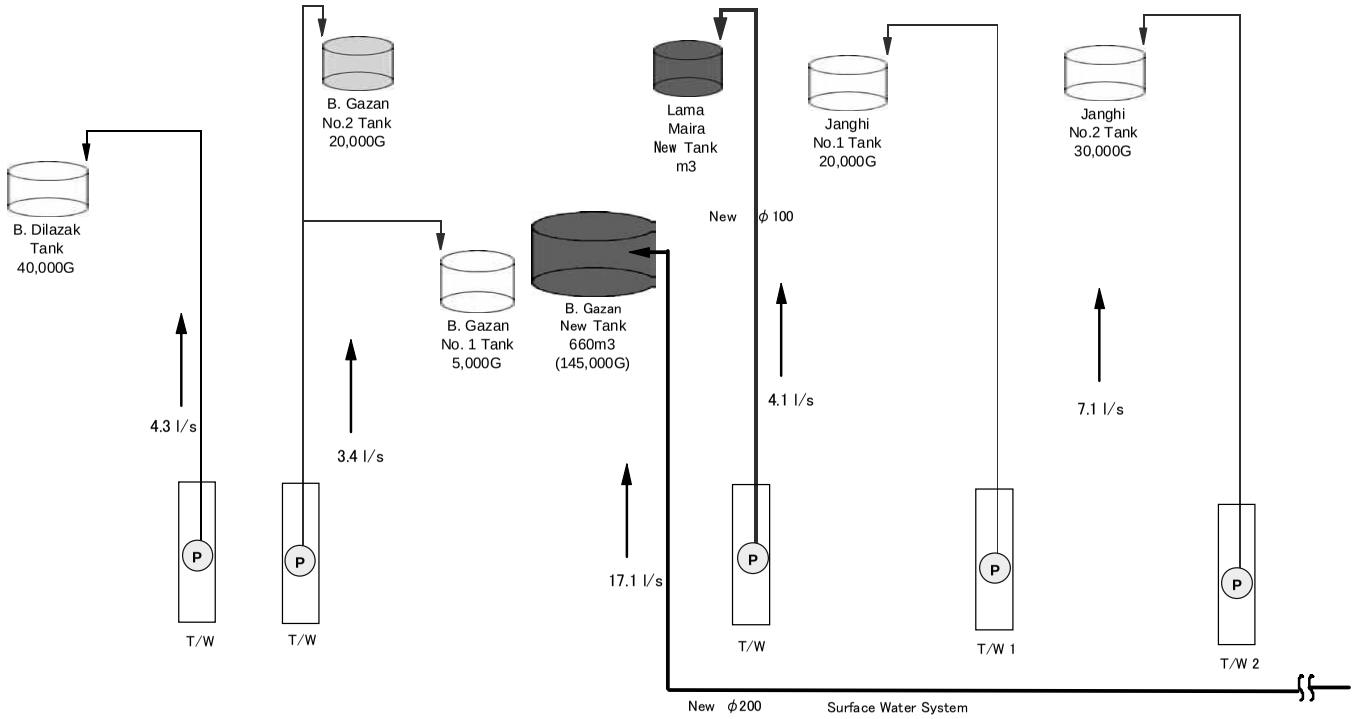


Derawanda Area

This are is short of the distribution reservoir capacity by 249 m3.

Tank No.2 has a sufficient reservoir capacity for the area distributed from this Tank. But Tank No. 1 has insufficient capacity to cover the rest of the service area. A new tank with a capacity of 250m3 will be constructed near Tank No.1.

Figure 2-15 Improvement Plan of Water Transmission for Derawanda



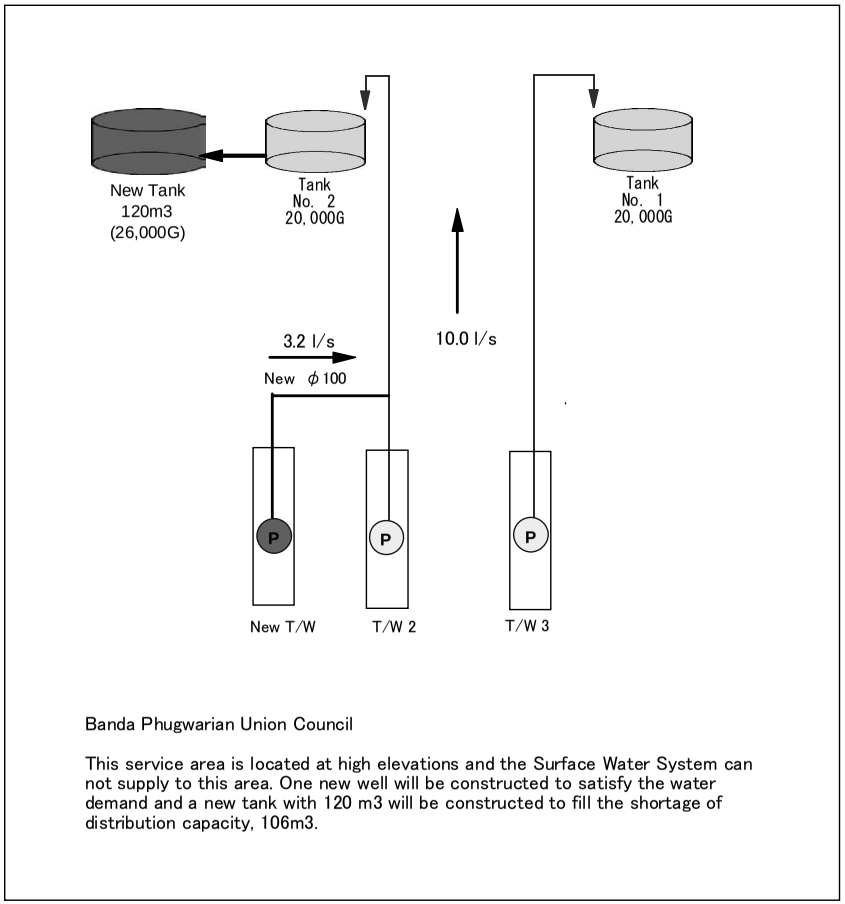
Janghi Union Council (Banda Dilazak, Banda Gazan, Lama Maira, Janghi)

This Water Supply System is a combined system for Banda Dilazak, Banda Gazan, Lama Maira and Janghi areas. This service area is divided into the higher area of which elevation is more than +1,300 m and the lower area of which elevation is below ;1,300 m. In principle, the higher area is supplied by the wells and the lower area is supplied from the Surface Water System.

Water from Lama Maira is presently supplied directly without a reservoir. This system is modified so that the water is transmitted to a new tank constructed at the high elevation of ;1,350 m for the supply to the consumers living at high area. Waters from the other existing wells are also transmitted to the tanks at hjgh elevations for the same purpose.

In order to satisfy the water demands in the lower areas a new tank will be constructed adjacent to the existing Banda Gazan Tank.

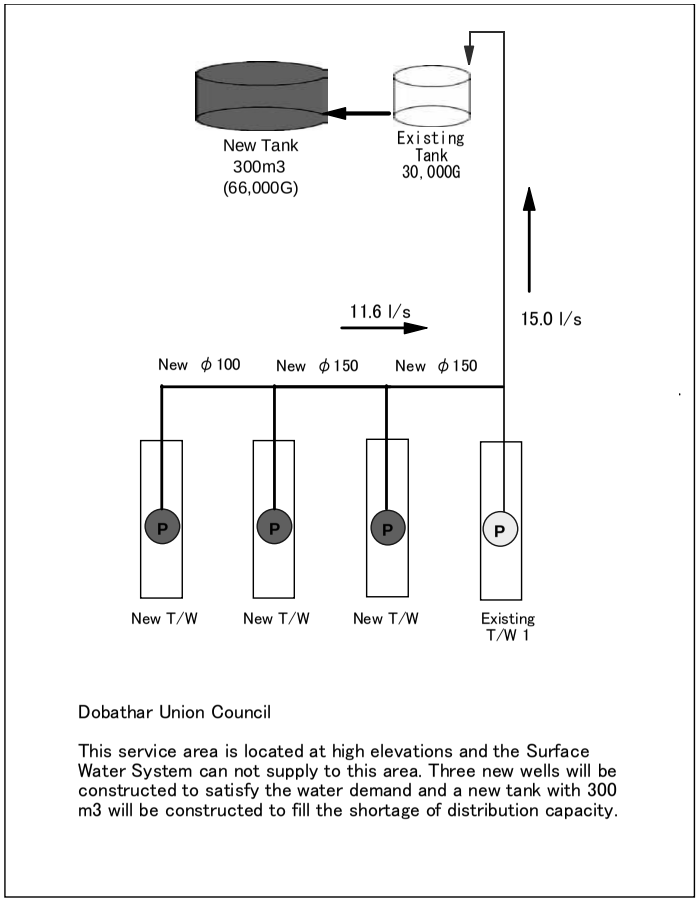
Figure 2-16 Improvement Plan of Water Transmission for Jhangi Union Council (Lama Maira, Jhangi, Banda Gazan, Banda Dilazak)



Banda Phugwarian Union Council

This service area is located at high elevations and the Surface Water System can not supply to this area. One new well will be constructed to satisfy the water demand and a new tank with 120 m3 will be constructed to fill the shortage of distribution capacity, 106m3.

Figure 2-17 Improvement Plan of Water Transmission for Banda Phugwarian



Dobathar Union Council

This service area is located at high elevations and the Surface Water System can not supply to this area. Three new wells will be constructed to satisfy the water demand and a new tank with 300 m3 will be constructed to fill the shortage of distribution capacity.

Figure 2-18 Improvement Plan of Water Transmission for Dobatar

2-2-3 Basic Design Drawings

Based on the basic plan, the basic design drawings are prepared and shown in the succeeding paper. The list of the basic design drawings is as follows;

The First Phase Construction (Groundwater System)

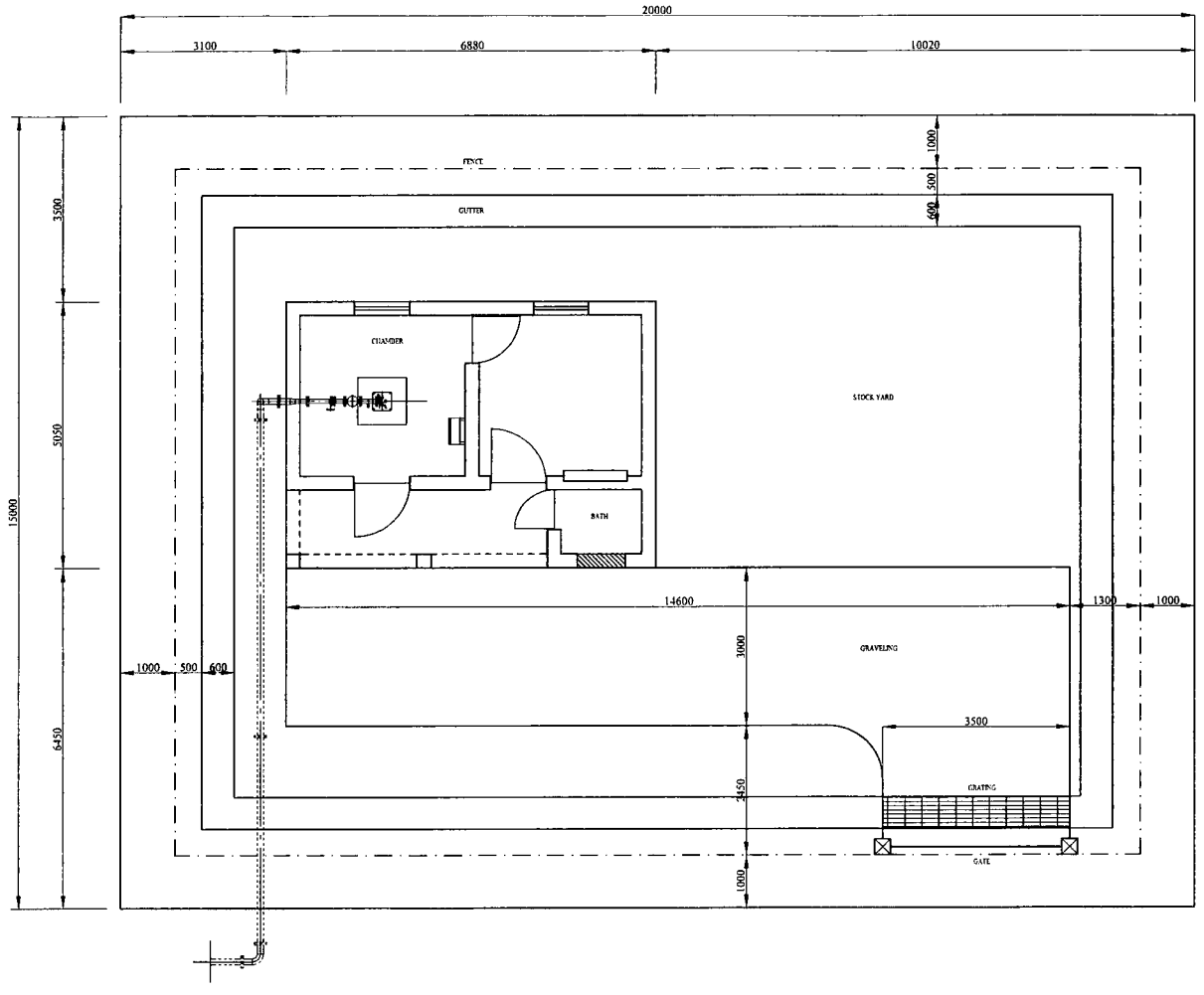
Drawing. No.		:	Scale
1	Tube Well Pumping Station General Plan	:	1/100
2	Tube Well Pump Piping Plan (New Tube Well Pump Station)	:	1/100
3	Tube Well Pump Pimping Plan (Existing Tube Well Pump Station)	:	1/100
4	General Plan of Banda Phugwarian Service Reservoir	:	1/100
5	General Plan of Lama Maira Service Reservoir	:	1/100
6	General Plan of Dobathar Service Reservoir	:	1/100

The Second Phase Construction (Surface Water System)

Drawing. No.		:	Scale
1	Namly Maira Intake Plan	:	1/100
2	Gaya Intake Plan	:	1/100
3	Bagh Intake Plan	:	1/100
4	Bandi Intake Plan (Branch of Bagh River)	:	1/100
5	General Drawing of Intake Structure	:	1/100
6	Structural and Piping Drawing of Bandi Intake	:	1/100
7	Water Treatment Plant System Flow	:	H:1/ 750 V:1/150
8	General Plan of Water Treatment Plant	:	1/500
9	General Plan of Sheikhul Bandi Service Reservoir	:	1/100
10	General Plan of Salhad Service Reservoir	:	1/100
11	General Plan of Nawanshehr Service Reservoir	:	1/100
12	General Plan of Derawanda Service Reservoir	:	1/100
13	General Plan of Mirpur Service Reservoir	:	1/100
14	General Plan of Banda Ghazan Service Reservoir	:	1/100
15	General Drawing of Service Reservoir (Structure)	:	1/100

Note） The scale shown above is used for original drawings (A3 size)

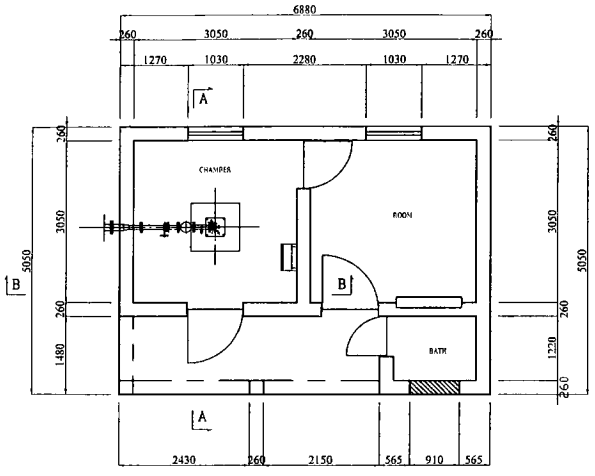
BASIC DESIGN DRAWINGS
FOR
THE PHASE I CONSTRUCTION



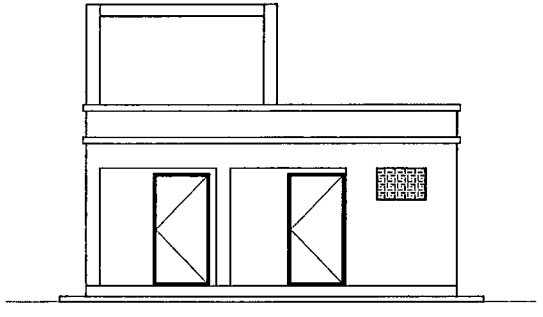
Tube Well Pumps Newly Installed

No.	Facility Name	Equipment Name
1	Tube Well Pump Station for Banda Phugwarian Area	Tube Well Pump No.1
2	Tube Well Pump Station for Dobaithar Area	Tube Well Pump No.2
3	Tube Well Pump Station for Dobaithar Area	Tube Well Pump No.3
4	Tube Well Pump Station for Dobaithar Area	Tube Well Pump No.4

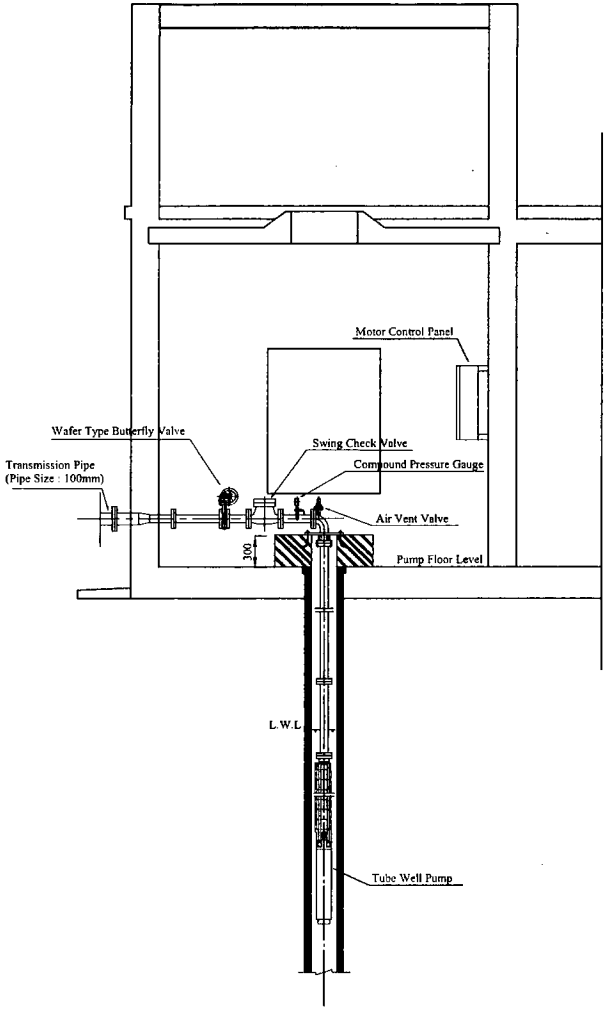
PROJECT			DESCRIPTION		DRAWING NO	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	New Tube Well Pump Stations	Tube Well Pump Station General Plan (井戸ポンプ場一般平面図)	1	S=1:100 for A3 size



PLAN



FRONT ELEVATION



SECTION B-B

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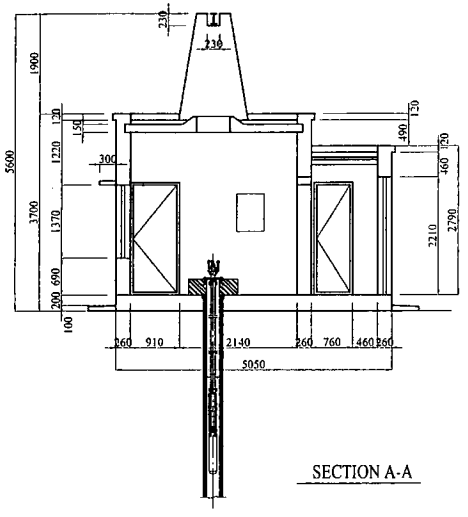


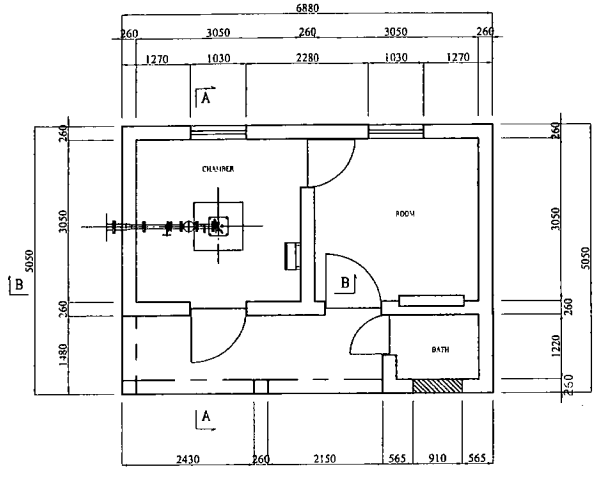
SECTION A-A

Tube Well Pumps Newly Installed

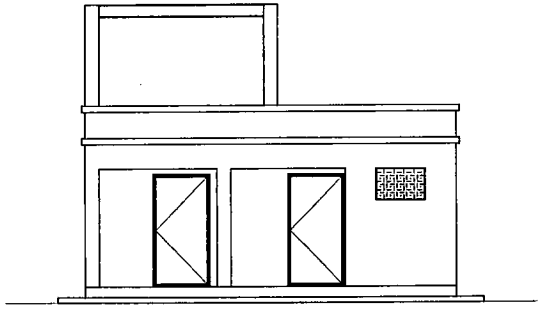
Flange Standard : ISO 7005-1

No.	Facility Name	Equipment Name	Pipe Size (mm)	Flange Rating
1	Tube Well Pump Station for Banda Phugwarian Area	Tube Well Pump No.1	65	PN40
2	Tube Well Pump Station for Dobathar Area	Tube Well Pump No.2	80	PN40
3	Tube Well Pump Station for Dobathar Area	Tube Well Pump No.3	80	PN40
4	Tube Well Pump Station for Dobathar Area	Tube Well Pump No.4	80	PN40

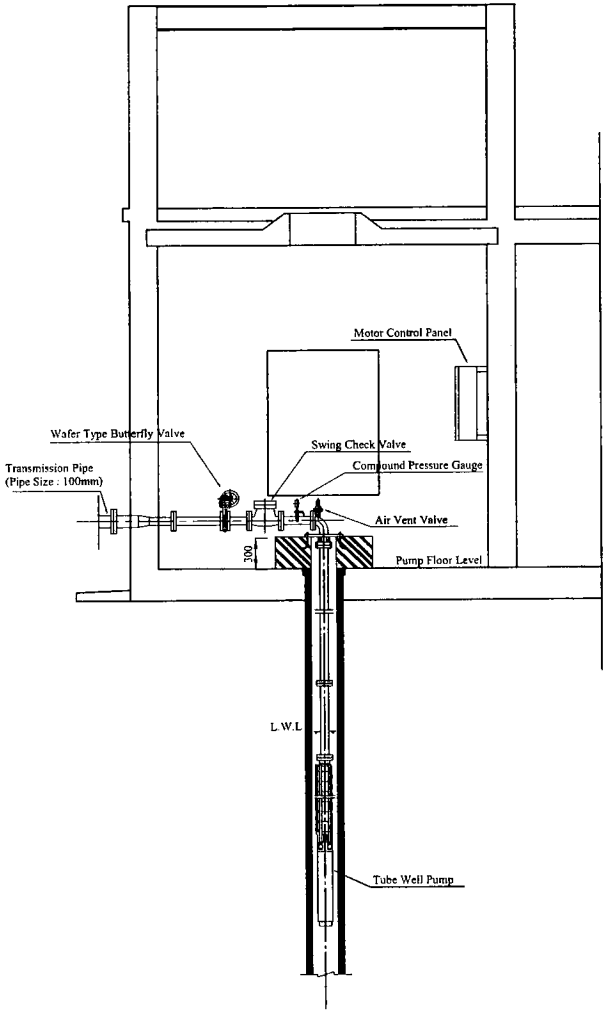
PROJECT		DESCRIPTION		DRAWING NO	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	New Tube Well Pump Stations	Tube Well Pump Piping Plan (井戸ポンプ配管図)	3	S=1:100 for A3 size



PLAN



FRONT ELEVATION



SECTION B-B

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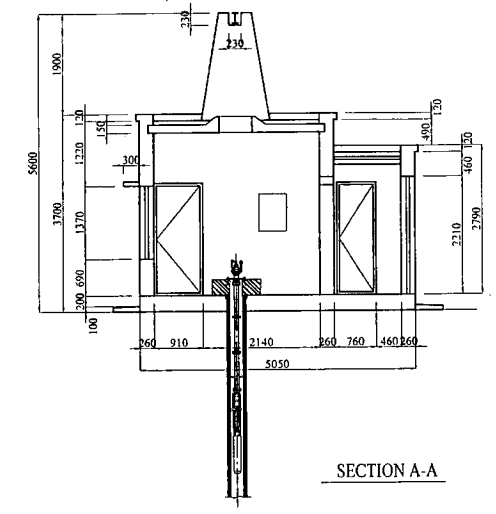


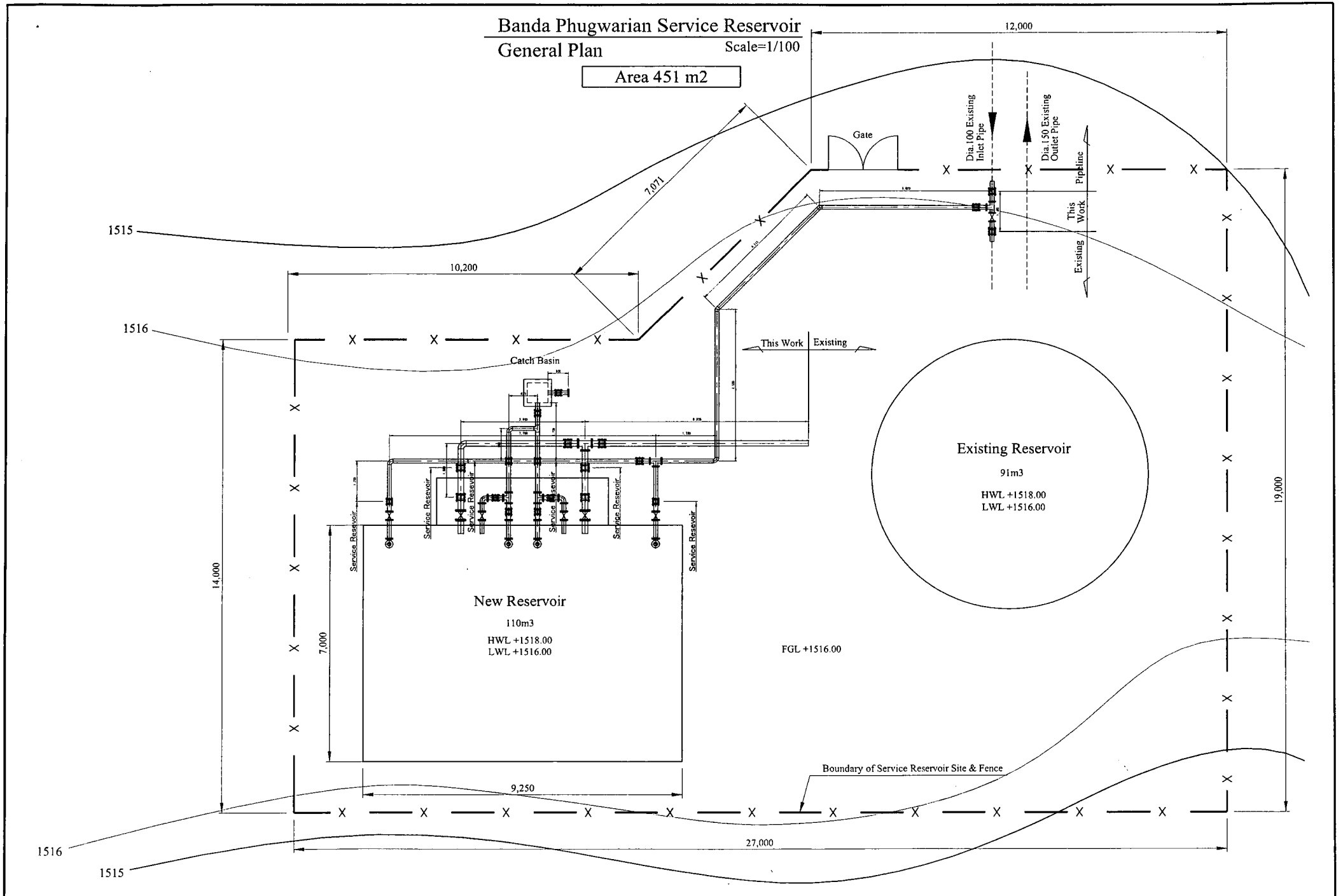
SECTION A-A

Tube Well Pumps Newly Replaced

Flange Standard : ISO 7005-1

No.	Facility Name	Equipment Name	Pipe Size (mm)	Flange Rating
1	Tube Well Pump Station for Derwanda Area	Tube Well Pump No.2	65	PN16
2	Tube Well Pump Station for Derwanda Area	Tube Well Pump No.3	65	PN16
3	Tube Well Pump Station for Jhungi Area	Tube Well Pump No.1	65	PN25
4	Tube Well Pump Station for Jhungi Area	Tube Well Pump No.2	65	PN16
5	Tube Well Pump Station for Lama Maira Area	Tube Well Pump No.1	65	PN25
6	Tube Well Pump Station for Banda Ghazan Area	Tube Well Pump No.1	65	PN25
7	Tube Well Pump Station for Banda Dilzak Area	Tube Well Pump No.1	65	PN16
8	Tube Well Pump Station for Banda Phugwarian Area	Tube Well Pump No.2	65	PN40
9	Tube Well Pump Station for Banda Phugwarian Area	Tube Well Pump No.3	65	PN25
10	Tube Well Pump Station for Dabanhar Area	Tube Well Pump No.1	65	PN40
11	Tube Well Pump Station for Salhad Area	Tube Well Pump No.1	65	PN25
12	Tube Well Pump Station for Salhad Area	Tube Well Pump No.2	65	PN25

PROJECT			DESCRIPTION		DRAWING NO	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	Existing Tube Well Pump Stations	Tube Well Pump Piping Plan (井戸ポンプ配管図)	4	S=1:100 for A3 size



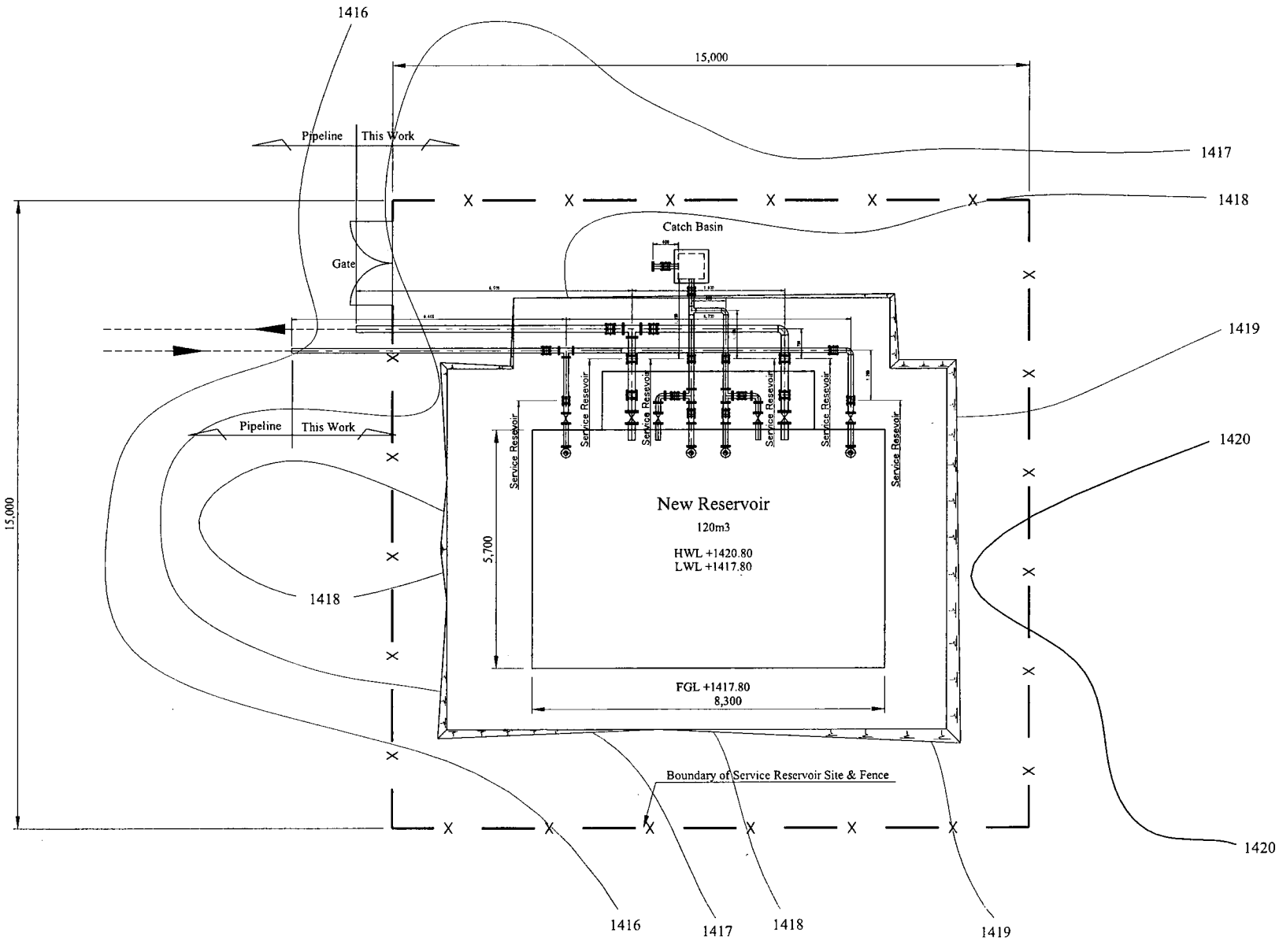
PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Banda Phugwarian Service Reservoir		1:100

Lama Maira Service Reservoir

General Plan

Scale=1/100

Area 225 m2

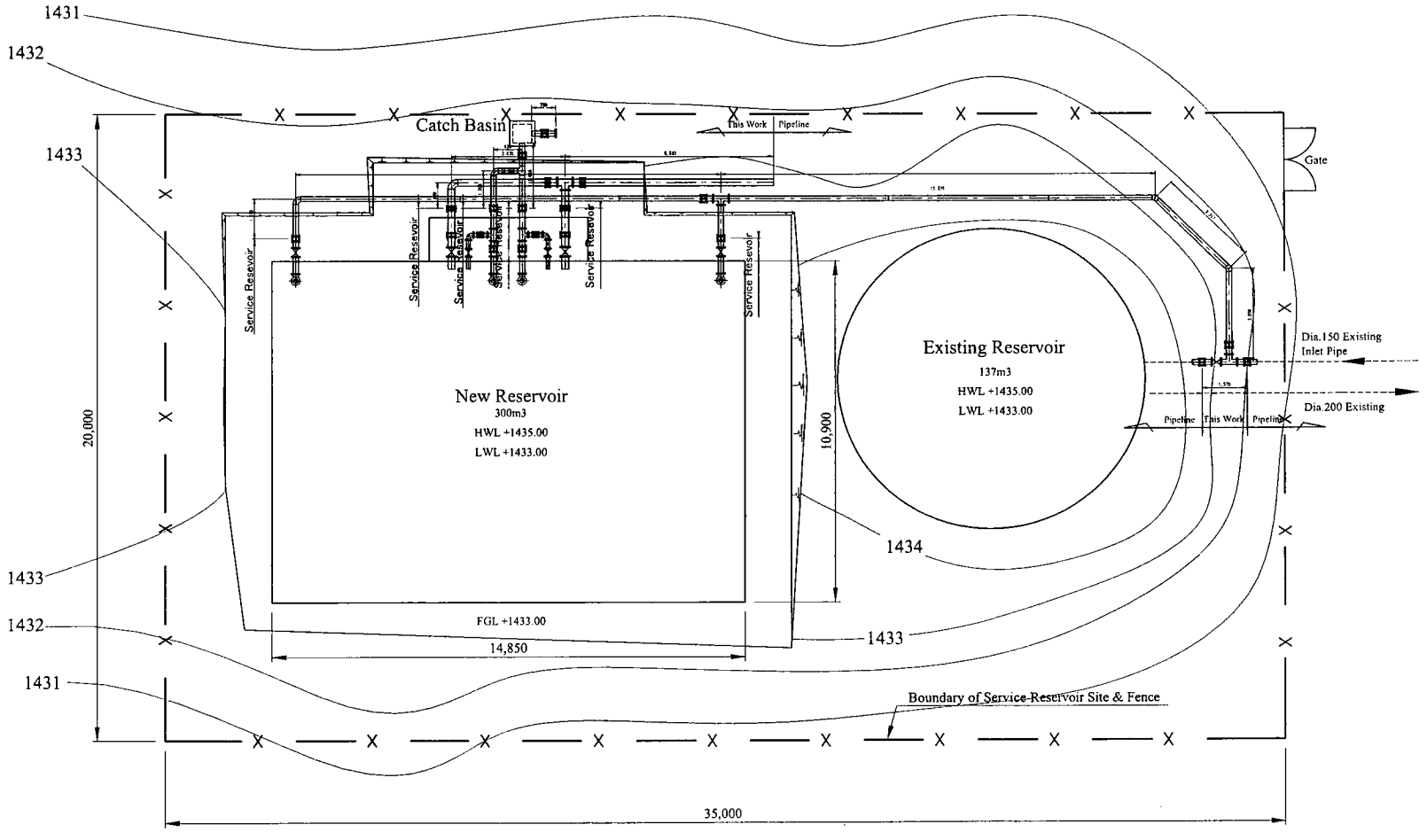


PROJECT: BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	DESCRIPTION: General Plan of Lama Maira Service Reservoir	DRAWING NO.	SCALE: 1:100

Dobathar Service Reservoir

General Plan Scale=1/150

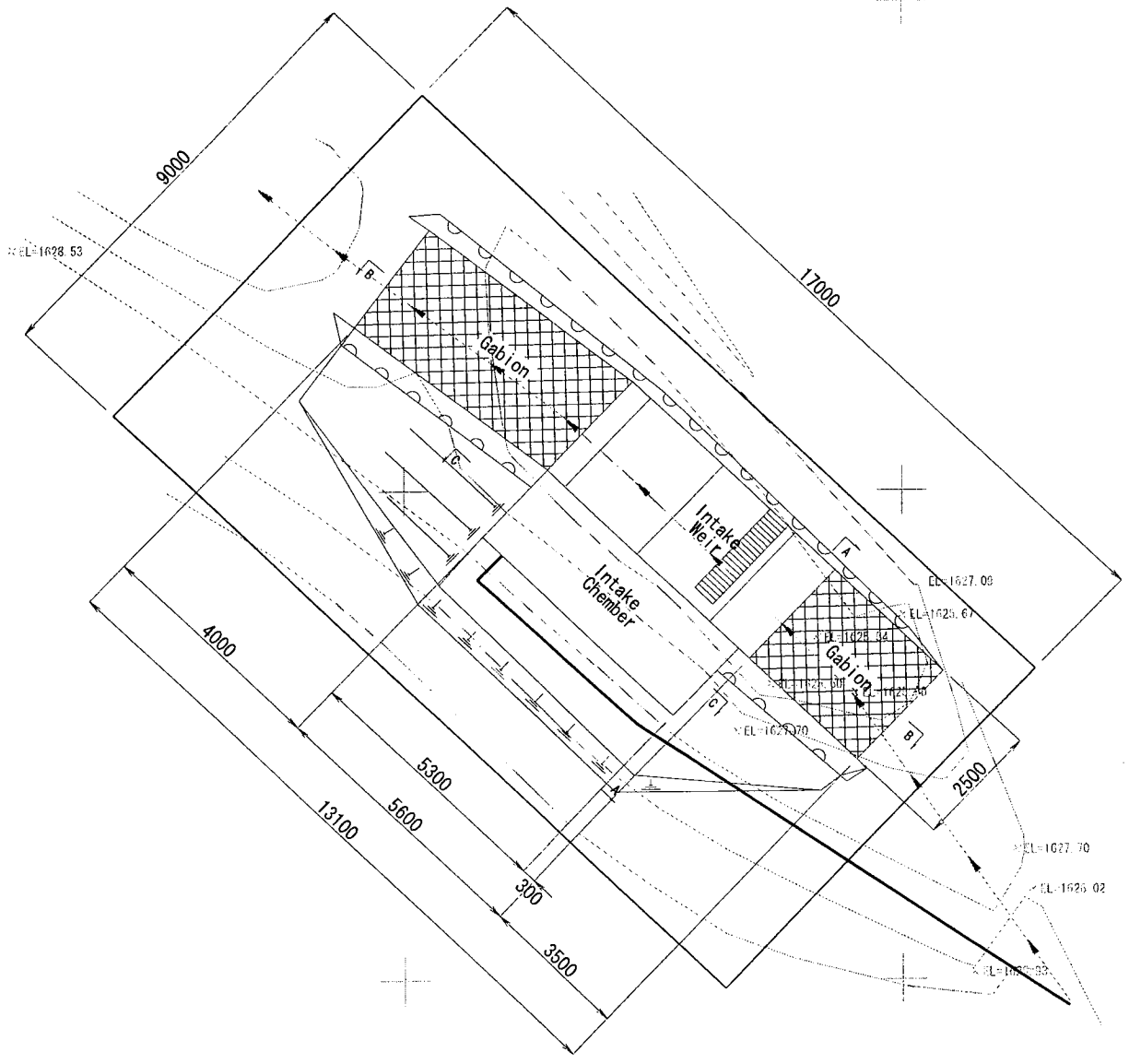
Area 700 m2



PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Dobathar Service Reservoir		1:100

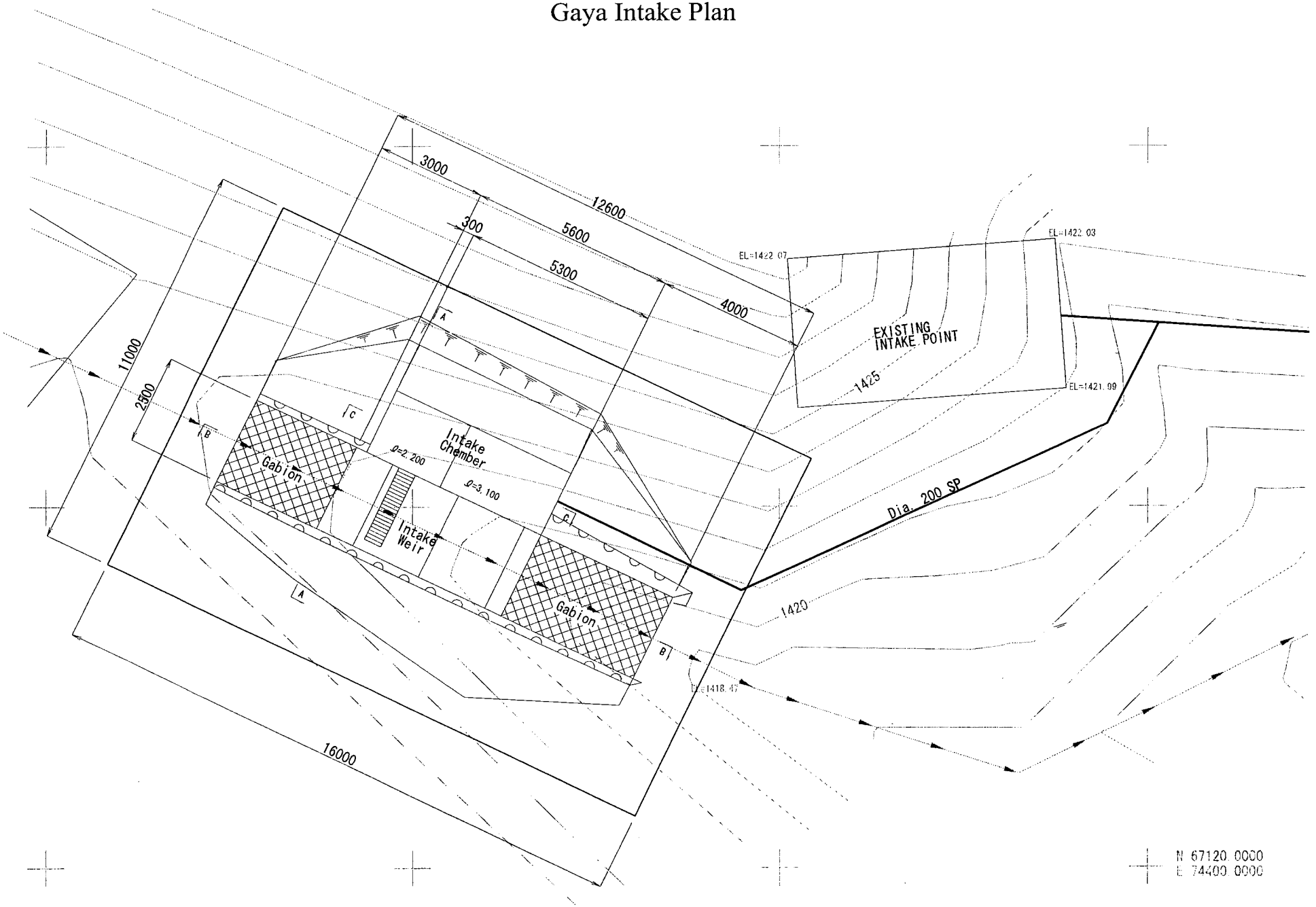
BASIC DESIGN DRAWINGS
FOR
THE PHASE II CONSTRUCTION

NAMLY MAIRA Intake Plan



PROJECT			DESCRIPTION	DRAWING NO	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	Namly Maira Intake Plan		1:100

Gaya Intake Plan



PROJECT		DESCRIPTION	DRAWING NO.	SCALE
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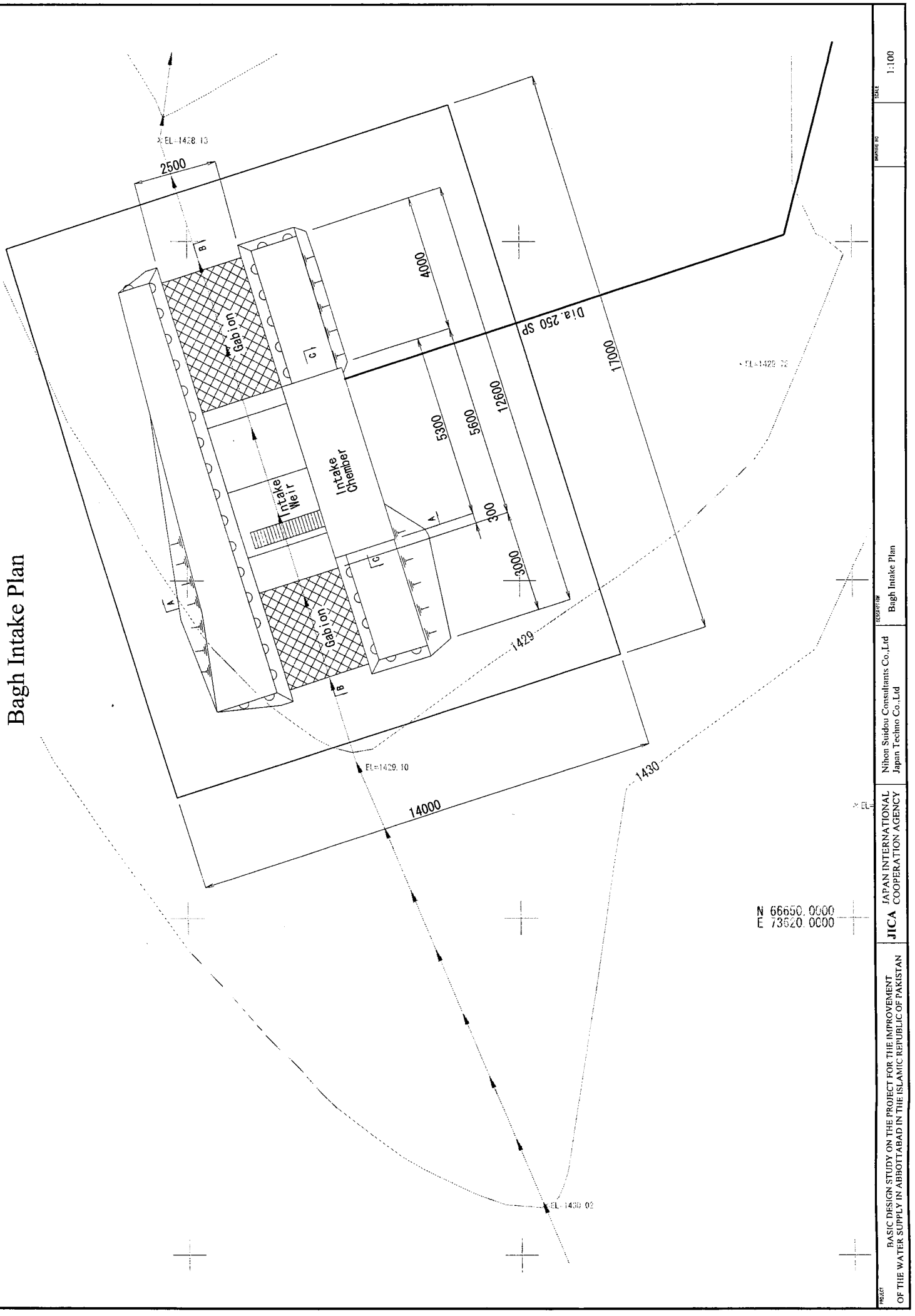
Bagh Intake Plan
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B
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Dia.250 SP
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Intake Chamber
A
300
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B
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N 66650.0000
E 73620.0000
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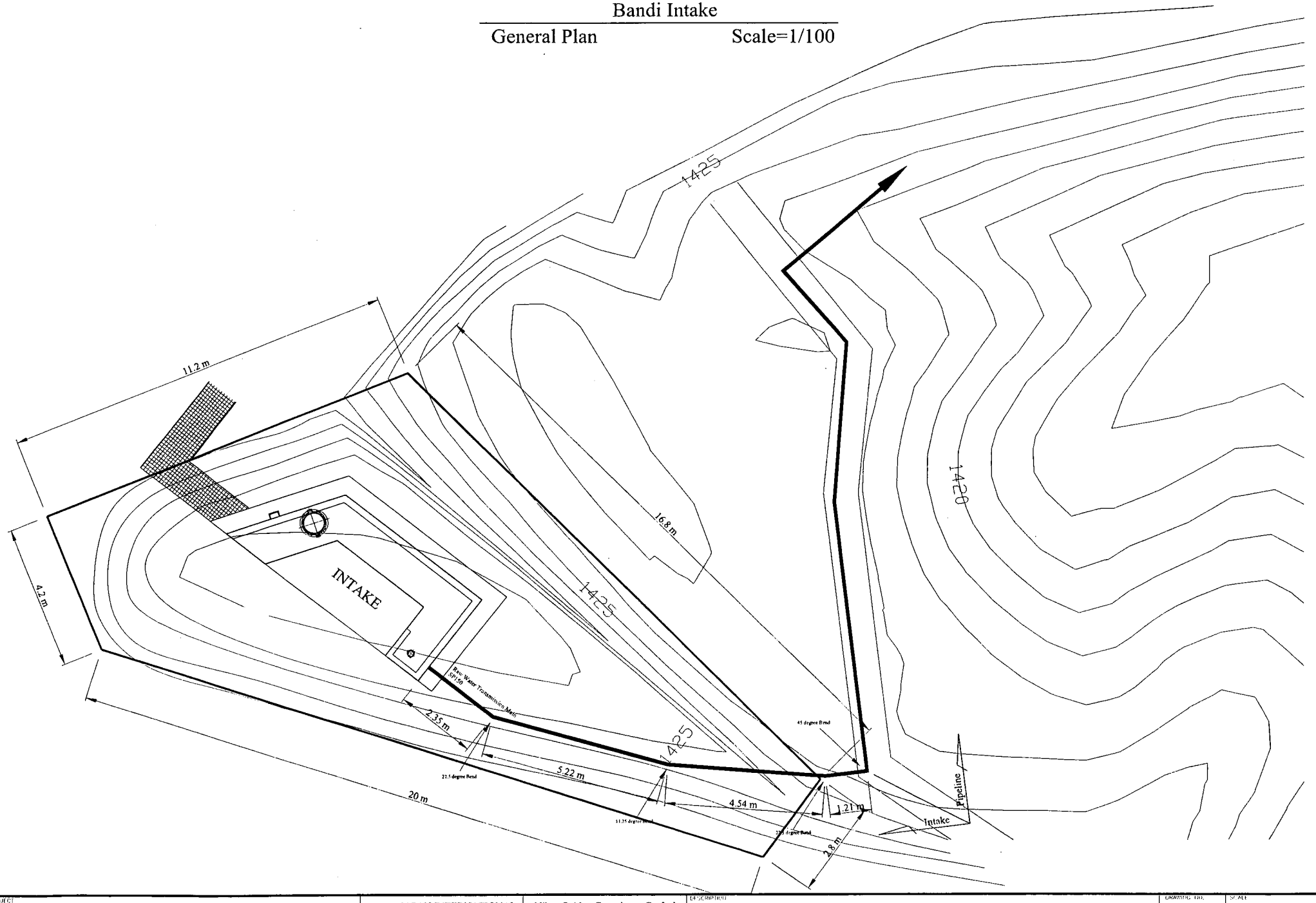
PROJECT
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN
JICA JAPAN INTERNATIONAL COOPERATION AGENCY
Nihon Suidou Consultants Co.,Ltd
Japan Techno Co.,Ltd
DESCRIPTION
Bagh Intake Plan
DRAWING NO
SCALE
1:100

Bandi Intake

General Plan Scale=1/100

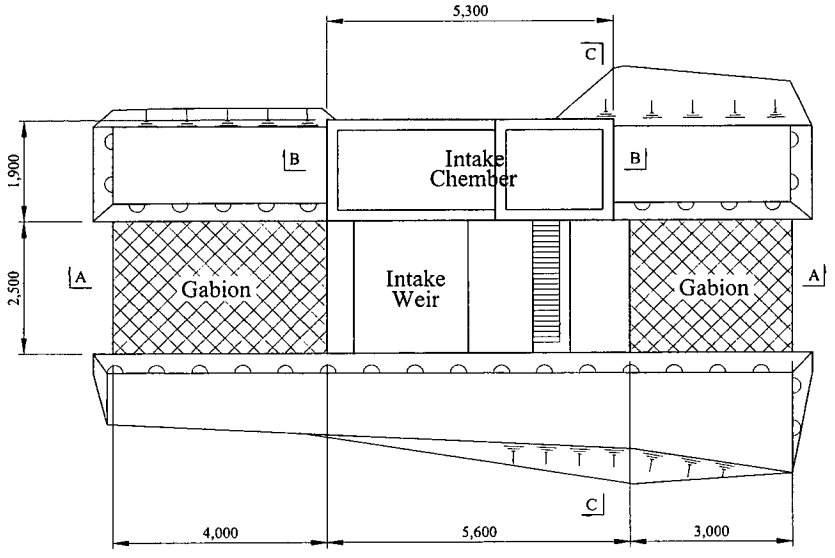


PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	Bandi Intake Plan		1:100

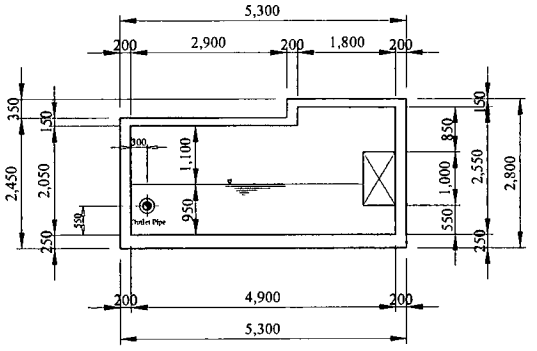
General Drawing of Intake Structure

Structure Scale=1/100

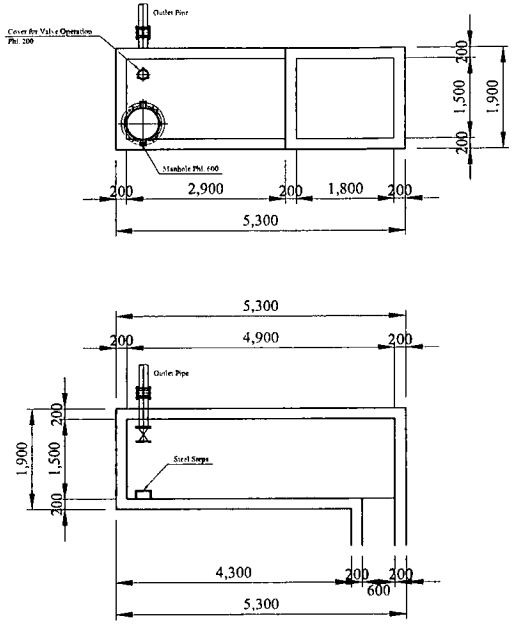
Plan



B-B Section



Intake Chamber Plan



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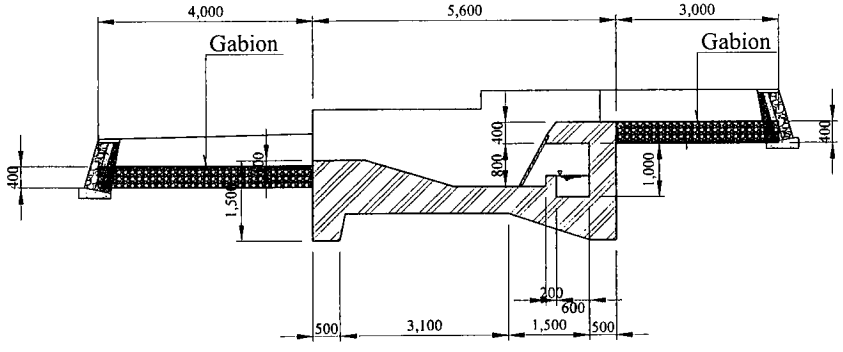
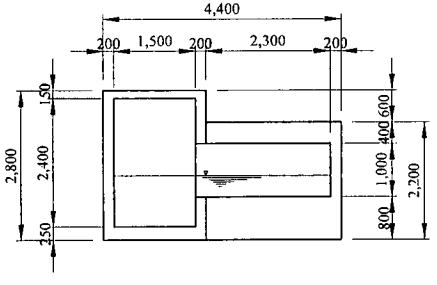


C-C Section

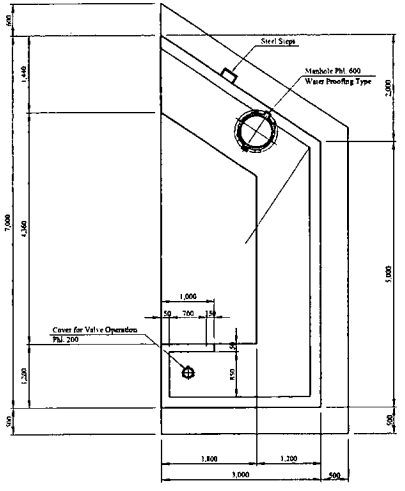


PROJECT		DESCRIPTION	DRAWING NO	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Drawing of Intake Structure		1:100

Bandi Intake

Structure and Piping Scale=1/100

Top Plan



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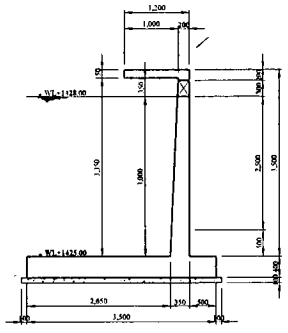

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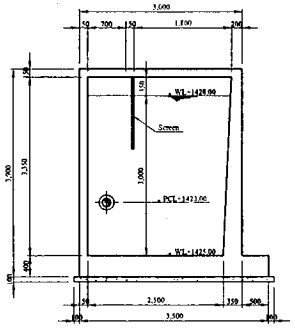

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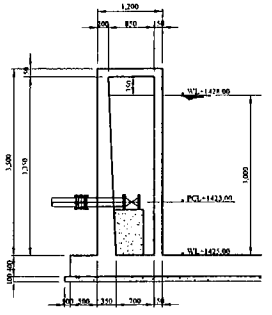
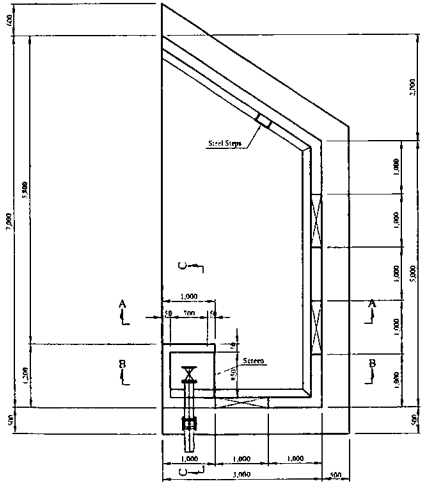


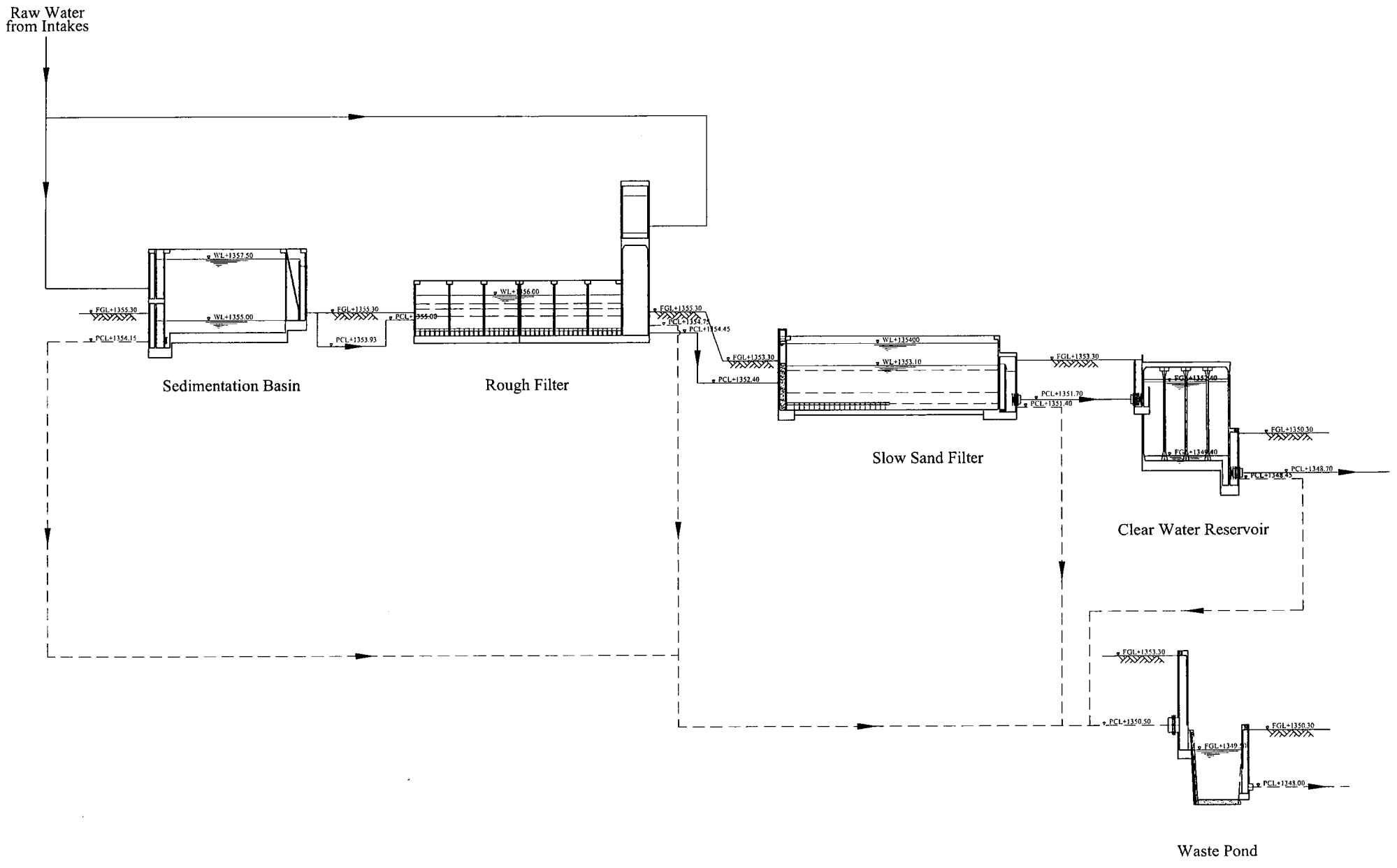
Plan



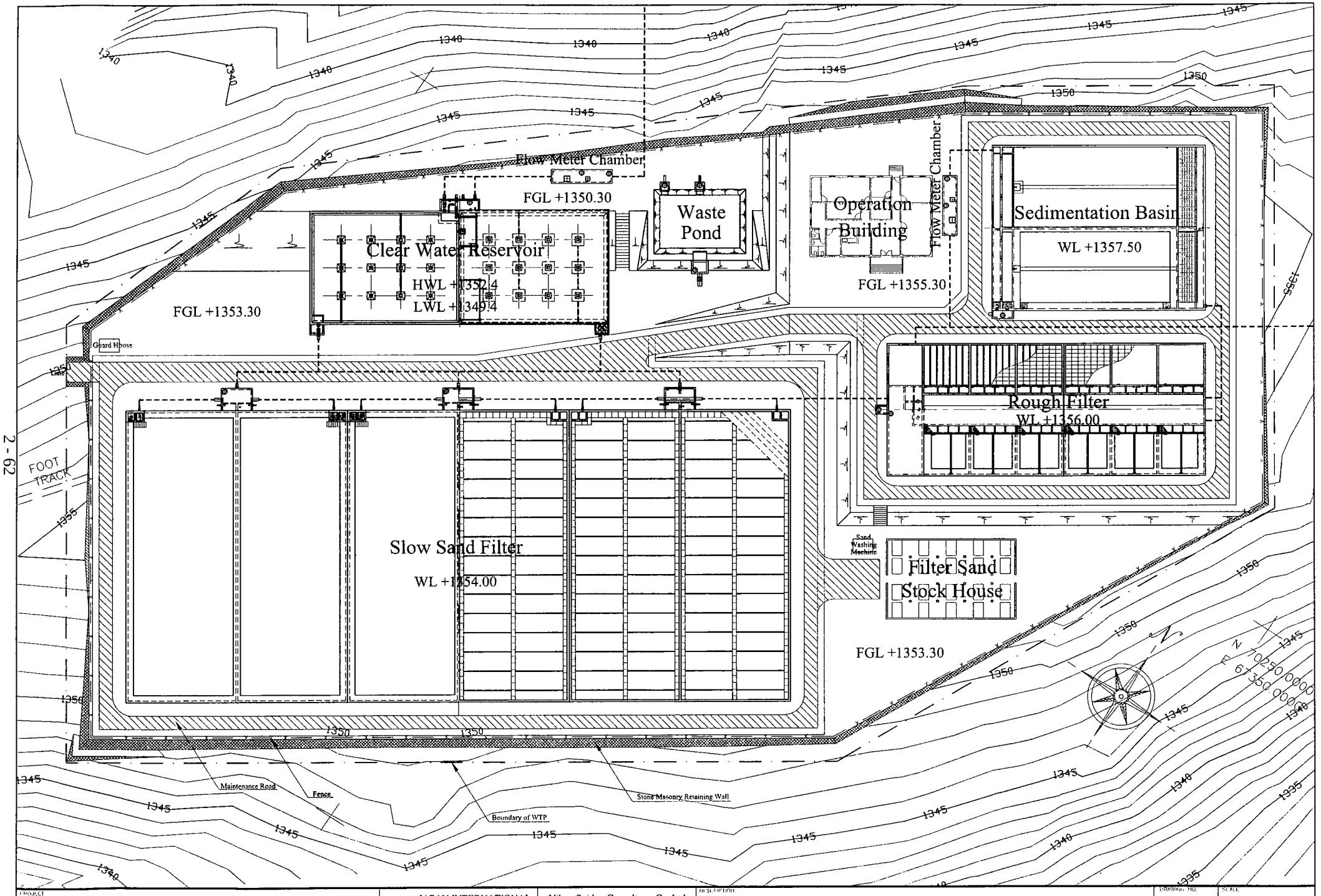
PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	Structural and Piping Drawing of Bandi Intake		1:100

Water Treatment Plant System Flow

Scale=H=1:750, V=1:150



PROJECT: BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	DESCRIPTION: Water Treatment Plant System Flow	DRAWING NO.	SCALE: H=1:750 V=1:150

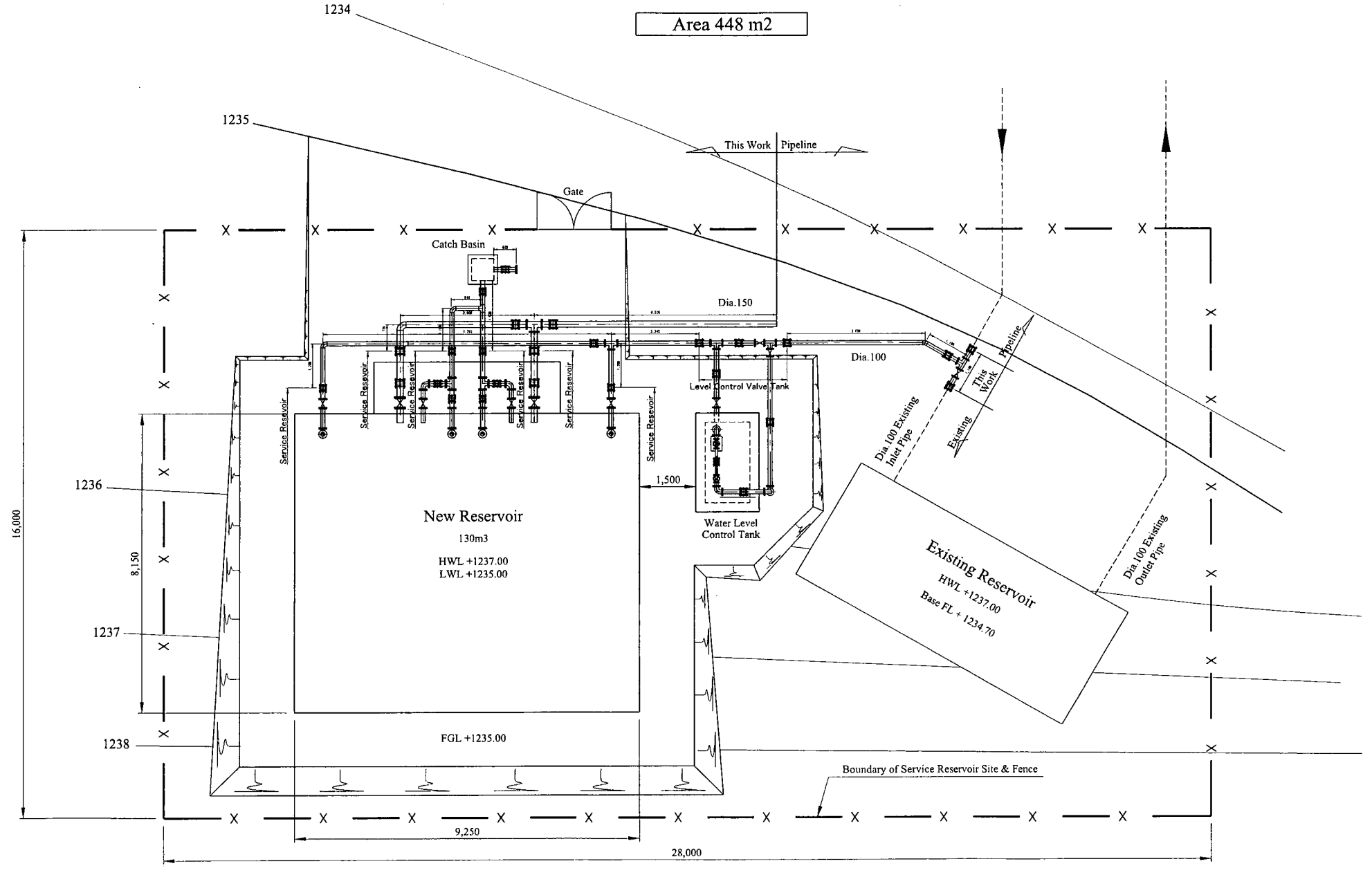


PROJECT			DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Water Treatment Plant	WTP-1	1: 500

Sheikhul Bandi Service Reservoir

General Plan

Scale=1/100

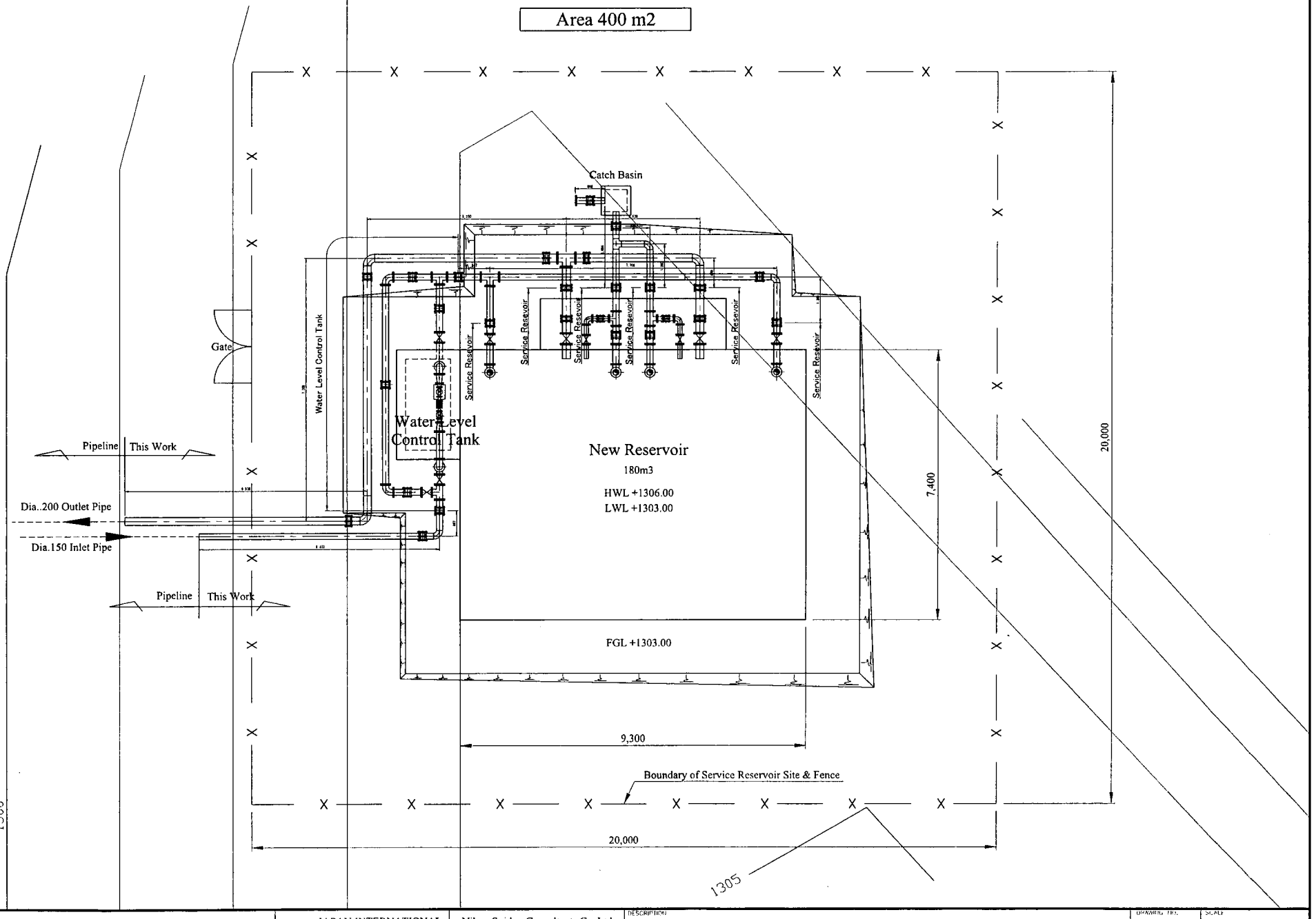


PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Sheikhul Bandi Service Reservoir		1:100

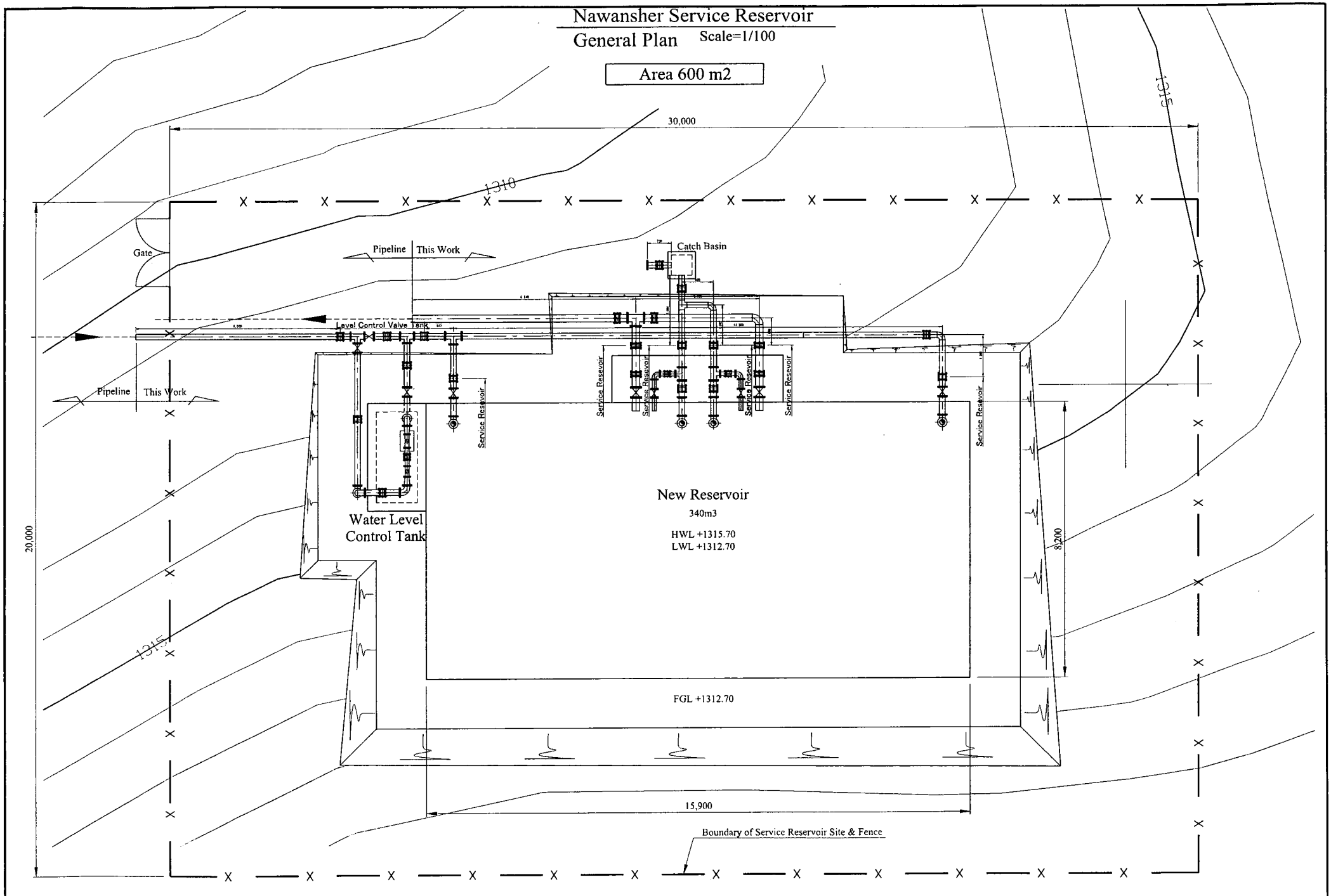
Salhad Service Reservoir

General Plan Scale=1/100

Area 400 m2



PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Salhad Service Reservoir		1:100

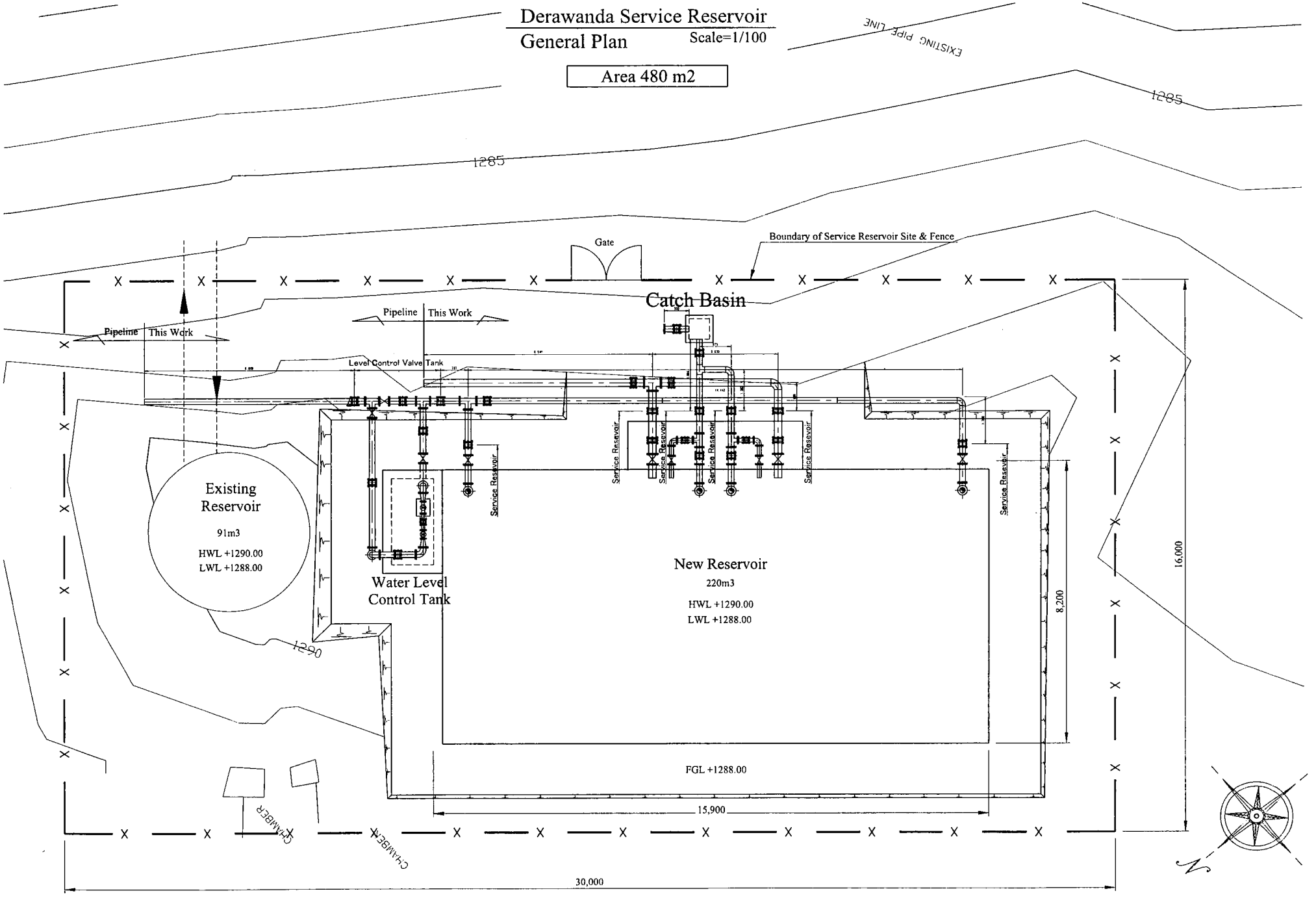


PROJECT			DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Plan of Nawansher Service Reservoir		1:100

Derawanda Service Reservoir
General Plan

Scale=1/100

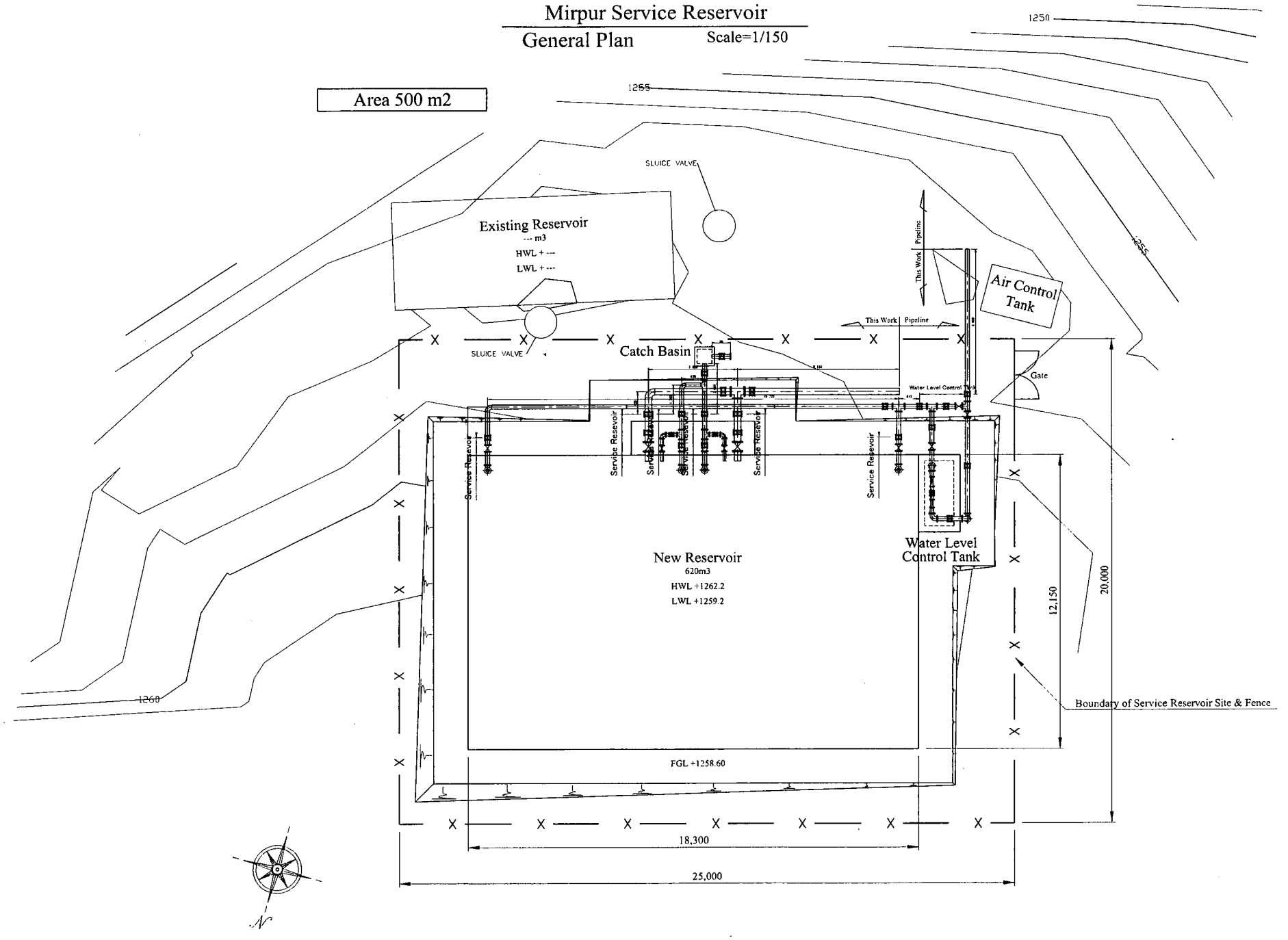
Area 480 m2



PROJECT: BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	DESCRIPTION: General Plan of Derawanda Service Reservoir	DRAWING NO.	SCALE: 1:100

Mirpur Service Reservoir

General Plan Scale=1/150

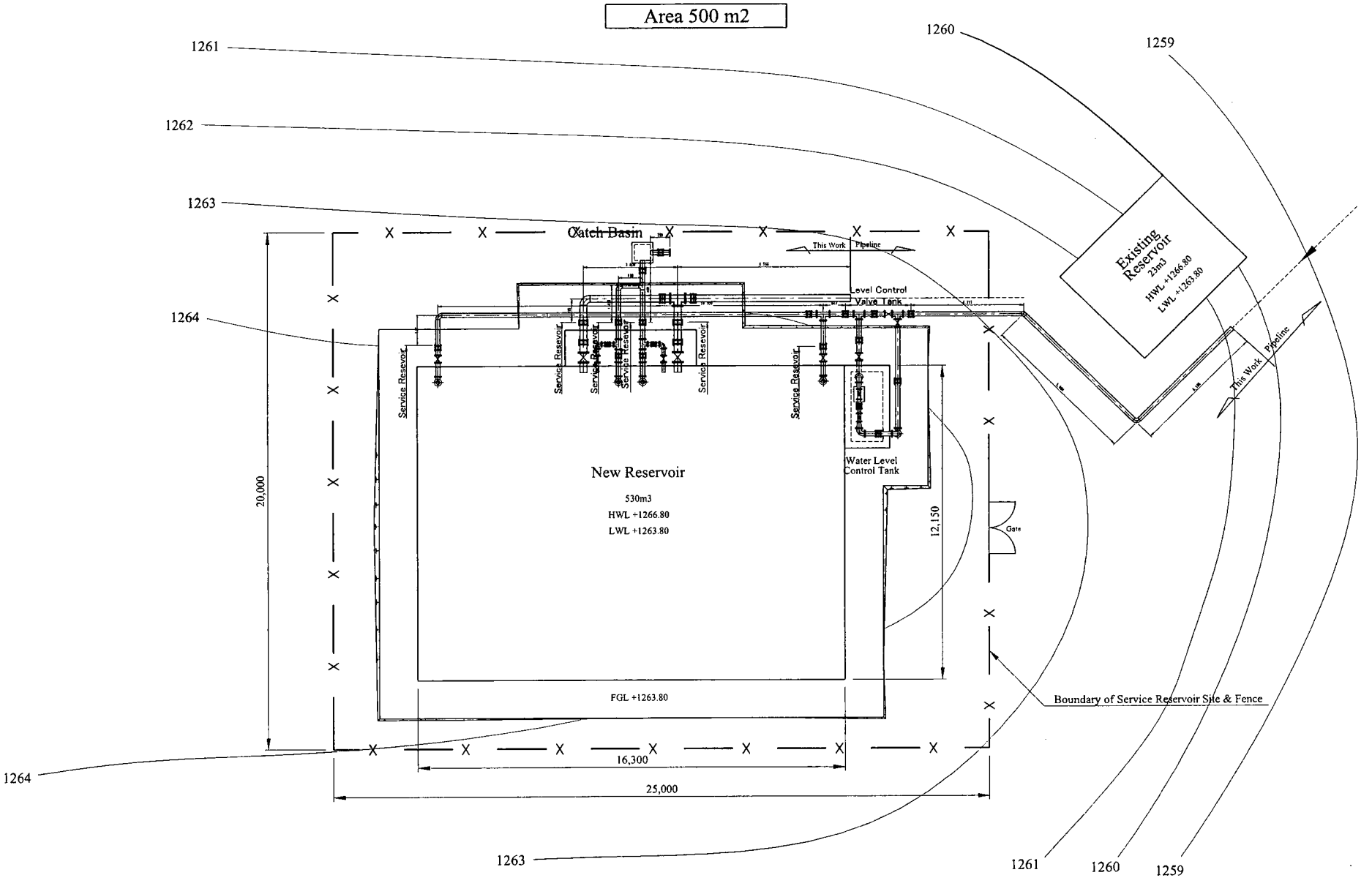


PROJECT: BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	DESCRIPTION: General Plan of Mirpur Service Reservoir	DRAWING NO.	SCALE: 1:100

Banda Ghazan Service Reservoir

General Plan

Scale=1/150



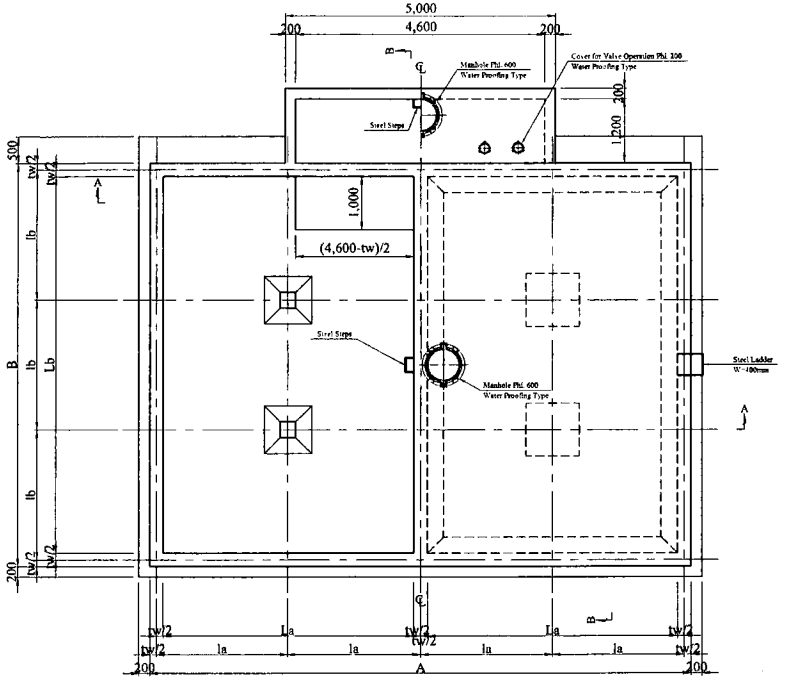
PROJECT: BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	DESCRIPTION: General Plan of Banda Ghazan Service Reservoir	DRAWING NO.	SCALE: 1:100

General Drawing of Service Reservoir

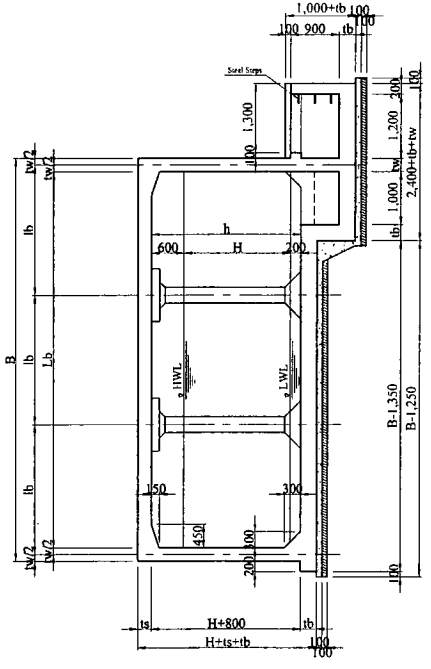
Structure

Scale=1/100

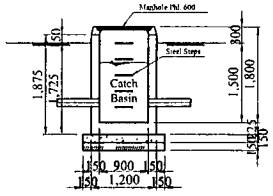
Plan



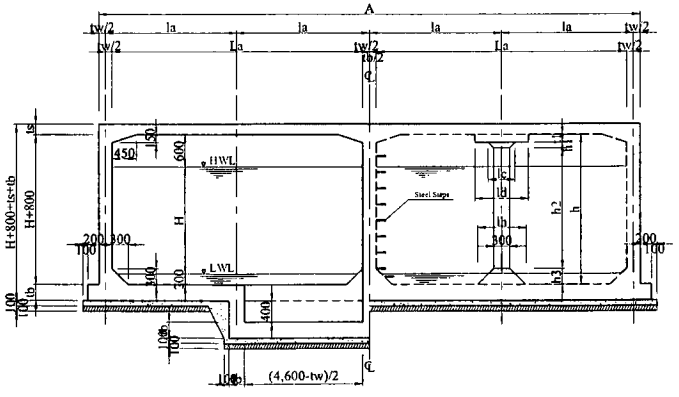
B-B Section



Catch Basin



A-A Section



Service Reservoir	Capacity (m3)	Dimension (m)										
		tb	tw	ts	la	(x la)	La	A	lb	(x lb)	Lb	B
1. Sheikhul Bandi	130	0.30	0.25	0.20	4.500	1	4.25	9.25	3.950	2	7.65	8.15
2. Salhad	180	0.40	0.30	0.20	4.500	1	4.20	9.30	3.550	2	6.80	7.40
3. Nawanshehr	340	0.40	0.30	0.20	3.900	2	7.50	15.90	3.950	2	7.60	8.20
4. Mirpur	620	0.40	0.30	0.20	4.500	2	8.70	18.30	3.950	3	11.55	12.15
5. Derawanda	220	0.30	0.25	0.20	3.850	2	7.45	15.65	3.850	2	7.45	7.95
6. Banda Ghazan	530	0.40	0.30	0.20	4.000	2	7.70	16.30	3.950	3	11.55	12.15
7. Lama Maira	120	0.40	0.30	0.20	4.000	1	3.70	8.30	2.700	2	5.10	5.70
8. Banda Phugwarian	110	0.30	0.25	0.20	3.900	1	4.25	9.25	3.375	2	6.50	7.00
9. Dobathar	300	0.30	0.25	0.20	3.650	2	7.05	14.85	3.550	'3	10.40	10.90

Service Reservoir	Capacity (m3)	Dimension (m)									
		lc	ld	lh	tc	t1	h1	h2	h3	h	H
1. Sheikhul Bandi	130	0.85	1.70	0.90	0.30	0.15	0.23	2.125	0.300	2.80	2.00
2. Salhad	180	0.85	1.70	0.90	0.30	0.15	0.23	3.125	0.300	3.80	3.00
3. Nawanshehr	340	0.80	1.60	0.90	0.30	0.15	0.20	3.150	0.300	3.80	3.00
4. Mirpur	620	0.80	1.60	0.90	0.30	0.15	0.20	3.150	0.300	3.80	3.00
5. Derawanda	220	0.80	1.60	0.90	0.30	0.15	0.20	2.150	0.300	2.80	2.00
6. Banda Ghazan	530	0.80	1.60	0.90	0.30	0.15	0.20	3.150	0.300	3.80	3.00
7. Lama Maira	120	0.70	1.40	0.90	0.30	0.15	0.15	3.200	0.300	3.80	3.00
8. Banda Phugwarian	110	0.80	1.60	0.90	0.30	0.15	0.20	2.150	0.300	2.80	2.00
9. Dobathar	300	0.75	1.50	0.90	0.30	0.15	0.18	2.175	0.300	2.80	2.00

PROJECT		DESCRIPTION	DRAWING NO.	SCALE
BASIC DESIGN STUDY ON THE PROJECT FOR THE IMPROVEMENT OF THE WATER SUPPLY IN ABBOTTABAD IN THE ISLAMIC REPUBLIC OF PAKISTAN	JICA JAPAN INTERNATIONAL COOPERATION AGENCY	Nihon Suidou Consultants Co.,Ltd Japan Techno Co.,Ltd	General Drawing of Service Reservoir (Structure)		1:100

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Organization for the Implementation of the Project

The Project will be executed based on the scheme of the Grant Aid of the Government of Japan. After the Exchange of Note between the two governments regarding the implementation of the Project, the Government of Pakistan will select the consultant and contractor who must be both Japanese corporate bodies for the implementation of the Project. Figure 2-19 shows the concept of the organization for the Project implementation.

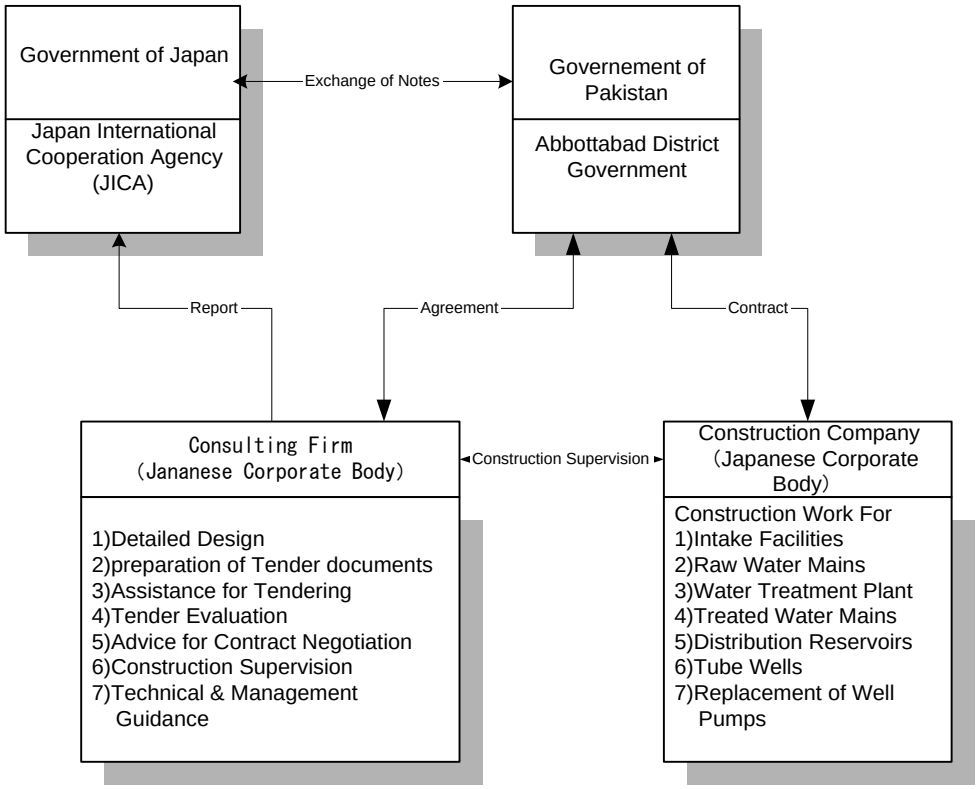


Figure 2-19 Concept of the Organization for the Project Implementation

① Implementing Agency

The implementing agency is the District Government Abbottabad under the Government of the NWFP. The Works & Services Department is responsible for implementing the Project smoothly in cooperation with the provincial and central government organizations concerned.

② Consulting Firm

The detailed design and construction supervision for the works financed by the Japanese side will be carried out by the consulting firm having experience of design and construction supervision for water supply facilities, who is a Japanese corporate body.

③ Contractor for Construction Work

The construction works financed by the Japanese side will be carried out by the contractor who is a

Japanese corporate body. The construction site is located at hilly and rocky area in the Abbottabad Basin of the NWFP, and the Project is a water supply construction work composed of a series of construction works for intake, raw water transmission mains, water treatment plant, treated water transmission mains and distribution reservoirs. It should be considered for the selection of the contractor that it has sufficient capacity and experiences and be capable of dispatching qualified engineers, construction materials and machineries necessary for the construction work.

(2) Local Contractors

Local contractors with sufficient experiences in the similar construction works are also utilized for the Project. Registrations of the construction firms are divided into four ranks from A to D. Among which, Rank A is the highest that should posses bachelors/qualified engineers, construction machinery such as tracks and trailers, and annual turnover more than Rs. 90,000,000. Construction firms of Rank A are available in Abbottabad, and those firms will be utilized as subcontractors.

Construction work	Utilization of Local Contractors	Rank of Registration
Well Construction	Local Well Construction Contractor	A
Transmission Pipe Laying Work	Local Civil Construction Contractor	A
Water Treatment Plant Construction	Local Civil Construction Contractor	A
Distribution Reservoir Construction	Local Civil Construction Contractor	A

2-2-4-2 Implementation Conditions

The construction site of the Project is generally of rock and rock blasting may be required for the excavation. The blasting work should be done with necessary safety measures and careful precautions for surrounding situation.

Pipe laying work for raw water transmission mains in the hilly area unforeseeable risks such as rock falling and land sliding may happen especially in the rainy season. Special safety measure should be taken as precaution at the site. Moreover, the pipeline route for raw water transmission main is mostly along the Murree Road of which both sides of the road are of cliffs. It should be necessary to pay due care for traffics during the pipe laying work.

Regarding the construction work in the mountains there are several sites where vehicles and construction machinery cannot get access. In such sites transportation of materials may be by manpower or tractors, and the construction work be done by manpower.

Of the labour control, it is necessary to consider the Islamic religious customs such as praying and fasting period.

2-2-4-3 Scope of Works

Scopes of Works for Japanese Side and Pakistani Side are summarized in Tables 2-18 to 2-22.

Table2-18 Scope of Well Construction and Existing Well Pump Replacement

Item	Japan	Pakistan
Land Acquisition and Site Clearance		○
Access Road Construction		○
Well Excavation	○	
Supply of Construction Materials	○	
Power Line Installation and Transformers		○
Control Panels and Low Voltage Power Receiving Facilities	○	
Supply and Installation of Well Pumps	○	
Dismantling of Existing Well Pumps and Supply and Replacement of Pumps	○	
Transportation and Scraping of Dismantled Materials		○
Pipe Laying and Connection from New Wells to Existing Pipelines	○	
Construction of Pumping House for New Wells	○	
Construction of Distribution Pipelines		○

Note：4 Sites for New Wells, 12 Sites for Existing Well Pump Replacement

Table 2-19 Scope of Intake Construction

Item	Japan	Pakistan
Land Acquisition and Site Clearance		○
Construction of Intake	○	

Table 2-20 Scope of Raw and Treated Water Transmission Mains

Item	Japan	Pakistan
Securing of Right of Way		○
Construction of Raw Water Transmission Mains	○	
Construction of Treated Water Transmission Mains	○	
Connections to Existing Pipelines and Facilities	○	
Rehabilitation or Enhancement of Existing Clear Water Transmission Pipelines		○
Installation of Water Level Control Valves and Flowmeters for Existing Distribution Reservoirs	○	

Table 2-21 Scope of Water Treatment Plant Construction

Item	Japan	Pakistan
Land Acquisition and Site Clearance		○
Operation and Maintenance Road Construction	○	
Construction of Water Treatment Plant Facilities	○	
Extension of Power Line to the Plant and Installation of Transformer		○
Installation of Low Voltage Power Receiving Facilities and Control Panels	○	
Construction of Drain Pipes from the Plant to the Discharge Point	○	

Table 2-22 Scope of Distribution Reservoir Construction

Item	Japan	Pakistan
Land Acquisition and Site Clearance (9 sites)		○
Access Road Construction		○
Construction of Distribution Reservoirs	○	
Pipe Laying and Connecting to Existing Pipelines from new Reservoirs (Only when new reservoirs are constructed adjacent to the existing reservoirs.)		○
Distribution Pipe Laying from New Reservoirs		○
Construction of Drain Pipes from the Reservoir to the Discharge Point		○

2-2-4-4 Consultant Supervision

(1) Construction Supervision

The selected consultant will make the following supervision works:

1) Check and approval of shop drawings
2) Factory inspection of major equipment and materials
3) Construction supervision
4) Final inspection of the construction works
5) Test operation and inspection of performance
6) Inspection of construction materials
7) Reporting of construction progress to both Japanese and Pakistani Sides
8) Advice for the works carried out by Pakistani Side
9) Technology transfer for operation and maintenance of the facilities
10) Assistance for the necessary procedures of Pakistani side responsibilities for execution of the Japan's Grant Aid Project

The Project is the construction works of a series of water supply facilities composed of Intake, Raw Water Transmission Mains, Water Treatment Plant, Treated Water Transmission Mains and Distribution Reservoirs for Surface Water System, and New Well Construction, Replacement of Existing Well Pumps, Distribution Reservoir Construction and Transmission Pipeline Construction for Groundwater System. In order to supervise consistently these various construction works throughout the period of the construction, it is necessary to deploy one resident engineer from the starting of the work till the inauguration of the facilities. Moreover, various specialists are required for spot supervising of the construction processes of different facilities.

Project Manager：	Commencement, Inspections
Resident Engineer：	Overall Construction Supervision
Well Specialist：	Supervision of Well Construction and Pump Replacement
Civil Engineer：	Construction supervision of Intake, Water Treatment Plant and Reservoirs
Pipeline Engineer：	Construction supervision of raw water and treated water transmission mains

Moreover, the Project site is vast, the construction sites are apart from each other, and many construction works are undertaken simultaneously at different sites. Accordingly, it is necessary to deploy the following local engineers at various construction sites to ensure the

inspection works and the safety at the sites.

One Civil Engineer (Intake), One Civil Engineer (Water Treatment Plant), One Civil Engineer (Distribution Reservoir), Two Pipeline Engineers (Raw Water Transmission Mains), Two Pipeline Engineers (Treated Water Transmission Mains), One Well Specialist.

2-2-4-5 Procurement Plan

Construction materials and equipment are in principle procured from Pakistan, Japan and the third countries. Countries from which materials and equipment are procured were determined taking into account the following conditions. Table 2-23 shows the procurement plan for major construction materials and equipment.

Table 2-23 Procurement Plan for Major Construction Materials and Equipment

	Pakistan	Third Countries	Japan
Construction Materials			
Common Construction Materials	○		
Materials for Temporary Work	○		
Construction Machinery	○		
Raw and Treated Water Transmission			
Steel Pipe	○		
Ductile Cast Iron Pipe		○	
Fittings and Valves		○	○
Water Treatment Plant			
Yard Piping Materials		○	○
Filter Sand	○		
Sand Washing Machine			○
Disinfection Facilities			○
Water Quality Test Facilities			○
Well			
Well Excavation Materials	○		
Well Pumps	○		
Electrical Equipment	○		

(1) Local Procurement

Considering easier maintenance after completion of the facilities it is preferred to select construction materials and equipment locally available as much as possible if sufficient supply of these products is expected in the local market. A construction material such as cement, aggregates, re-bars, forms, scaffolding, supports and steel materials, etc. are all available in Pakistan, and their qualities are also at acceptable levels. Accordingly, all the construction materials are procured locally.

Of construction machinery, these are also available in Pakistan and they can be leased from lease companies or construction companies.

(2) Procurement by Importation

Pipe materials such as galvanized steel pipes and steel pipes of which diameters are small are locally available with acceptable quality and sufficient supply capacity in the market. These pipes are also used in the Project as the prices are relatively lower and these are utilized for many water supply projects in Pakistan. It is, however, necessary to procure Ductile Cast Iron Pipes in medium-sized diameters from the third countries as these are not produced in Pakistan. Of the electrical equipment for well used in the Project can be procured locally.

(3) Plan of Transportation

1. Those procured in Japan will be shipped from Yokohama Port and delivered to Karachi Port. After the custom clearance they will be transported to Abbottabad through the inland route.
2. Those procured in the third countries will be shipped from the third countries to Karachi Port. After the custom clearance they will be transported to Abbottabad through the inland route.
3. The inland transportation routes are as shown in Table 2-24.

Table 2-24 Inland Transportation

Route	Items	Road Condition	Distance	Time for Transportation
Karachi – Abbottabad	Pipe Materials	Asphalt-paved National Highway	1200km	21hours
Islamabad – Abbottabad	Construction Machinery/ Pipe Materials	Asphalt-paved National Highway	180km	3 hours
Lahore – Abbottabad	Construction Machinery	Asphalt-paved National Highway	280km	4.6 hours
Abbottabad – Construction Sites	All Materials and Equipment	Asphalt-paved National Highway and Provincial Road. Narrow roads with/without pavement	Approx. 5～20km	30min～1 hour

2-2-4-6 Quality Control Plan

The quality control of the construction works is to be conducted in light of the technical specifications prepared by the consultants during the detailed design work, and the major control work items are listed in Table 2-25 together with indicators, control methods, and standards to be adopted. JIS or other equivalent International Standards are, in principle, to be used for the quality control.

Table 2-25 Major Work Items and Methods for Quality Control

Category	Control Item	Control	Method of Control	Applicable Standards	Frequency of Test	Records	Remarks
Pump Facilities	Pump	Conform to the Standards	Observation Shop-Drawing Test Report	JIS B 8301 JIS B 8302	When Received Factory Inspection	Record Test Result Table Approval Drawings	In the presence of Consultant
Pipe Material	Ductile Cast Iron Pipe	Conform to the Standards	Shop-Drawing	JIS G 5526 JIS G 5527	For each pipe laying section	Approval Drawings	
		Type	Observation		For each type、when received	Record	In the presence of Consultant
Pipe Laying Work	Joint	Joint Condition	Observation	—	During the course of Jointing Work	Report	In the presence of Consultant
			Pressured Leakage Test	No leakage observed	For each pipe laying section	Test Result Table	In the presence of Consultant
			Ultra Sonic Test		At one time for every 10 joints	Test Result Table	
Concrete Material	Reinforcing Bars	Type of Re-bar （deformed, round）	Observation	JIS G 3112 JIS G 3117	When received for each type		In the presence of Consultant
		Conform to the Standards	Test Report			Test Result Table	
	Cement	Type of Cement	Observation	JIS R 5210	When received.	Record	In the presence of Consultant
		Conform to the Standards	Test Report			Test Result Table	
	Water	Piped Water or Clear River Water	Observation	—	When mixed	Concrete Mixture Table	In the presence of Consultant
		Water Quality （River Water）	Water Quality Test	JIS A 5308 Appendix 9	Before mixture design	Test Result Table	
	Aggregates	Maximum diameters of Aggregates	Observation	Reinforced Concrete： 25mm	When Received.	Record	In the presence of Consultant
		Grain Size	JIS A 1102	JIS A 5005	Before mixture design	Test Result Table	
	Concrete Mixture	Conform to the Standards	Test Report	JIS A 6201-6207	When received	Test Result Table	When necessary.
	Storage of Materials	Place and Storage Conditions	Observation	—	When necessary.	Report	In the presence of Consultant
Concrete Placing Work	Concrete Design Mixture （Major Structures）	Test Mixture	Confirmation of Quality	28 day strength： 21N/mm2 Slump:10.0±2.5cm Air Content:±1.5% W/C Ratio : less than 65% (less than 55% for water retaining structure Cement:: more than 270kg/m3)	1 time before placing	Test Result Table	In the presence of Consultant
	On-site Concrete Mixture	Water Content of Small Aggregate Surface	JIS A 1111,1125	—	Each mixing	Test Result Table	In the presence of Consultant
		Grain Size of Aggregate	JIS A 1102	JIS A 5005	When received	Test Result Table	
		Temperatures of Water and Aggregates	Temperature Measurement	—	Each mixing	Test Result Table	In the presence of Consultant
		Water and Cement Volumes		Error: less than 1 %			

	Slump	Conform to the Specifications	JIS A 1101	10.0±2.5cm	Each placing	Test Result Table	In the presence of Consultant
	Air	Conform to the Specifications	JIS A 1128	±1.5%	Each placing	Test Result Table	In the presence of Consultant
	Compressive Strength	Laboratory	—	Approval of Consultant	Prior to the test	—	
		Sampling	JIS A 1132	7day Strength: 3 pcs 28day strength : 3pcs	Every 50m3 placing or 1 time per day 1time for one consecutive placing work	—	In the presence of Consultant
		Conform to the Specifications	JIS A 1108	Design Strength= 21 N/mm2	Every 50m3 placing or 1 time per day 1time for one consecutive placing work	Test Result Table	
	Leakage Test （Reservoir）	Conform to the Specifications	Water Level Measurement, Observation	No water level draw-down after 24 hours	After the structure is constructed	Test Result Table	In the presence of Consultant

2-2-4-7 Implementation Schedule

The implementation schedule of the Project is composed of two phases.

The detailed design for the two phases will be carried out at one time. At the detailed design stage the field survey will be carried out in Pakistan for the period of 2.0 months and succeedingly, the design work in Japan will be done for the period of 5.5 months in total in order to secure sufficient construction period in the Phase 2.

Phase 1 is the construction of the Groundwater System. It takes 9.0 months for procurement and construction work, and 1.0 month for test operation and inspection. (One month will be overlapped with the construction period.) The total period for Phase 1 including the detailed design period will be 14.5 months excluding a period for tendering.

Phase 2 is the construction of the Surface Water System. The detailed design period is 2.0 months, 15.0 months for procurement and construction, and 2.0 months for test operation overlapping 2.0 months with the construction period. The total period for Phase 2 is 17.0 months excluding a period for tendering.

The total implementation period, therefore becomes 31.5 months.

Figure 2-20 shows the implementation schedule of the Project.

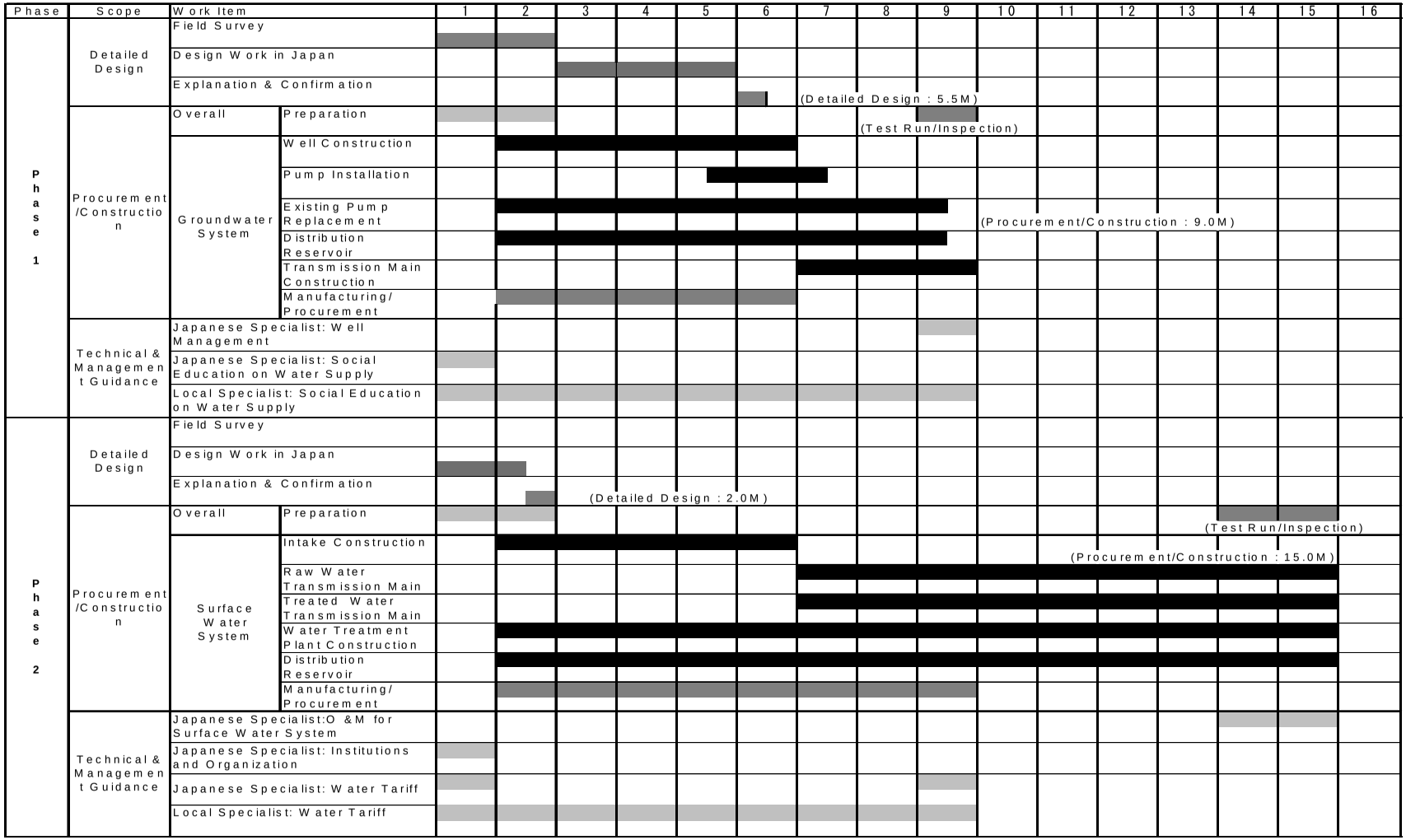


Figure 2-20 Implementation Schedule

2-3 Obligations of Recipient Country

2-3-1 Land Acquisition

Land acquisition for construction sites of Intake, Water Treatment Plant, Distribution Reservoirs, Wells and Pressure Releasing Chambers is the responsibility of the Government of Pakistan.

Intake：4 sites		
	Namly Maira River	153 m2
	Gaya River	176 m2
	Bagh River	238 m2
	Bagh Branch	150 m2
Water Treatment Plant：		
	Plant Site	15,650 m2
	Access and O&M Road	7,700 m2
Distribution Reservoirs：9 sites		
	Sheikhulbandi	448 m2
	Salhad	400 m2
	Nawanshehr	600 m2
	Mirpur	500 m2
	Derawanda	480 m2
	Banda Gazan	500 m2
	Banda Phugwarian	451 m2
	Lama Maira	225 m2
	Dobatar	700 m2
Wells：4 sites		each 300 m2 x 4 sites
Pressure Releasing Chamber：3sites		No.1 50m2, N0.2 50m2, No.3 100m2

2-3-2 Power Line to the Project Site

It is the obligation of the Government of Pakistan to provide the power distribution lines to the Water Treatment Plant site and four well construction sites as well as the installation of main circuit breakers and transformers. The capacity of power receiving is estimated at 15 KVA for water treatment plant and 30 KVA for each well site.

2-3-3 Obligations for New and Existing Distribution Reservoirs

The construction work of new distribution reservoirs carried out by Japanese side includes installation of water transmission pipes into the reservoirs, installation of water level control valves, installation of overflow pipes and drain pipes up to the manholes. The Pakistani side should install the overflow pipes and drain pipes extended to the discharge points.

The installation of distribution pipes is totally the responsibility of Pakistani side. Japanese side,

however, only has the responsibility up to the installation of outlet valves and outlet pipes of reservoirs.

Regarding the installation of new water transmission pipes to the existing reservoirs, Japanese side will install new pipelines to the connecting points with the existing transmission pipes as well as water level control valves.

If the existing reservoirs need any expansion or rehabilitation of distribution pipes, overflow pipes and drain pipes, these works are all the obligations of Pakistani side.

2-3-4 Right of Way for Raw and Treated Water Transmission Mains

The Implementing Agency should obtain necessary consents from the landowners in case pipes are installed under the private land or the land authorized by the other organizations.

Regarding the pipe laying under the pavement, road shoulder, drainage and sidewalks of the National Highway, Provincial Roads and other roads, the implementing agency should obtain Non-Objection Certificate (NOC) from the road authorities concerned. Road restoration is the responsibility of Japanese side, but for issuing the NOC the implementing agency should deposit the advance rental charges for the roads.

2-3-5 Procurement and Installation of Water Meters

In conjunction with the implementation of the Project, the Pakistani side is planning to introduce the water meters for Abbottabad TMA and peripheral Union Councils. Procurement and installation of the water meters are responsibilities of the Pakistani side.

2-3-6 Approval of PC-1

Approval of Project Commission – 1 (PC-1), which guarantees the obligation of Pakistani side, shall be obtained from the Central Government followed by the approval of Provincial Government for the implementation of the Project. Implementation agency requires to obtain the approval of PC-1 as soon as possible.

2-3-7 Others

In addition to the above obligations, Pakistani side should take the following responsibilities.

- To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities,
- To issue public notices regarding the effects by construction work.
- To bear the following commissions to the Japanese bank for banking services based upon the B/A;
  - Advising commission of A/P
  - Payment Commission
- To bear the payment commissions to the Pakistani bank for banking services,
- To ensure tax exemption and custom clearance of the products at the port of disembarkation in Pakistan,

- To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of the products and services under the verified contracts,
- To accord Japanese nationals, whose service may be required in connection with the supply of the products and the services under the verified contract, such facilities as may be necessary for their entry into Pakistan and stay therein for the performance of their work,
- To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant, and
- To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment

2-3-8 Cost Estimates for the Project

The project cost borne by Japan's Grant Aid is estimated to be 2,325 Million Yen based on the conditions described below. The period of construction is 24 months, and the breakdowns of the project cost are estimated as below.

(1) Project Cost Borne by the Japanese Side

Unit : million Yen

Cost Items		Phase 1	Phase 2	Total
Construction of Facilities	1. Intake/Well facilities	85	16	2,082
	2. Transmission Mains	118	1,165	
	3. Water Treatment Facilities	0	514	
	4. Distribution Reservoir	51	133	
Engineering Services (Detailed Design, Construction Supervision, Soft Component)				243

It is noted that the above cost estimate is provisional and would be further examined by the Government of Japan for approval of the Grant.

(2) Project Cost Borne by the Pakistani Side

The cost borne by the Pakistani Side: Rs. 300 Million (Approximately 645 million Yen)

1)	Land Acquisition:	Rs. 40.00 million
2)	Access Roads for Construction Sites:	Rs. 24.00 million
3)	Power Supply, Water Supply, Drainage, Telephone, Office Furniture:	Rs. 26.50 million
4)	Inter-linking of New/Old Reservoirs and Wells:	Rs. 18.00 million
5)	Expansion and Rehabilitation of Distribution Network:	Rs. 80.00 million
6)	Procurement and Installation of Water Meters:	Rs. 75.00 million
7)	Provision for Creation of Project Sub-division (PMU):	Rs. 5.97 million
8)	Commissions for Bank Arrangement, Custom Clearance:	Rs. 28.45 million
9)	Contingencies:	Rs. 2.08 million

(3) Conditions for Cost Estimates

1) Date of Estimates: As of March, 2004

2) Exchange Rates: US$1 = 108.21 Yen
Rs.1 = 2.15Yen

3) Period of Construction: Two (2) Phases
- Phase 1: 9 months
- Phase 2: 15 months

4) Others: The Project should be implemented in accordance with the procedures of Japan's Grant Aid Scheme.

2-4 Project Operation Plan

2-4-1 Organization for Management and Operation

After the completion of the Project the water supply in the service area is not only dependent on the groundwater system but also on the surface water system. Figure 2-21 shows the proportion of the dependence on both the groundwater system and the surface water system. In Abbottabad City, the water supply system is converted entirely to the surface water system. On the other hand, Banda Phugwarian and Dobatar systems are dependent 100 % on the groundwater system the same as before. Other areas are supplied by the combined systems of the groundwater system and the surface water system.

Regarding the wells, one (1) existing well pump of Nawanshehr is replaced, and construction of four new wells and eleven (11) well pumps are replaced in the peripheral Union Councils. Operation and maintenance of these wells will be responsibilities of the same Nawanshehr Water & Sanitation Unit and the Works & Services Department of Abbottabad District Government, respectively.

Of the Surface Water System, the system will provide bulk water supply to the existing systems operated by the three different agencies, namely, Abbottabad TMA, Nawanshehr TMA and the Works & Services Department of Abbottabad District Government. Therefore, it is very important to establish a new organization to operate and manage this new system by clarifying the responsibility of each agency for this new system.

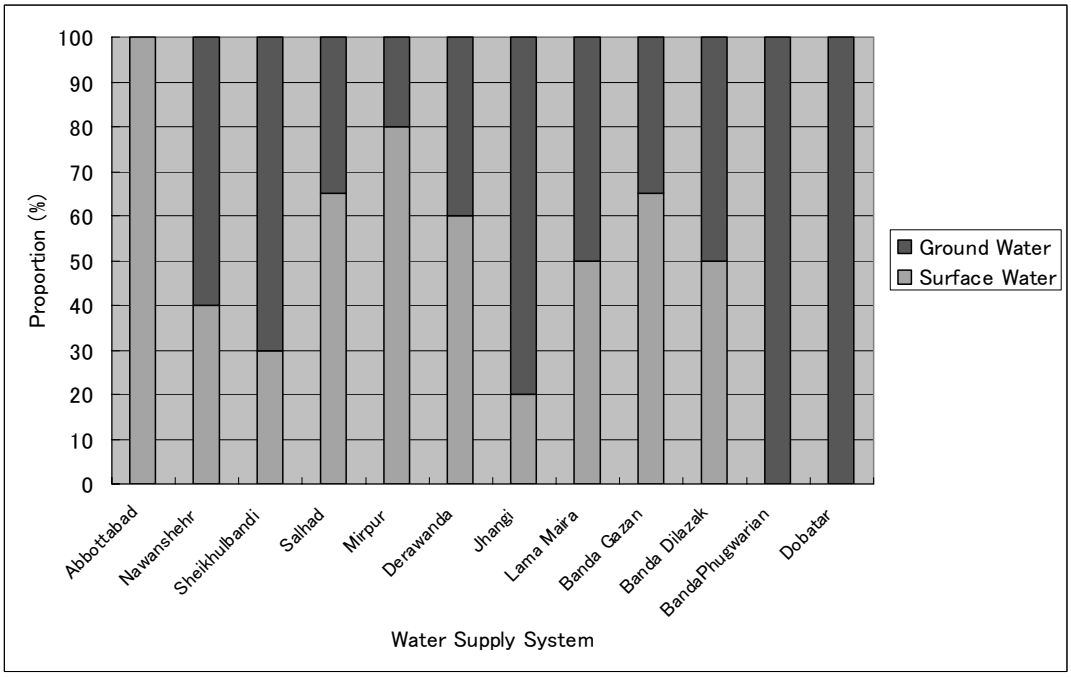


Figure 2-21 Proportions of Dependence on Surface Water System and Groundwater System

2-4-1-1 Operation and Management of Surface Water System

The Surface Water System will provide bulk water supply to the existing systems operated by the three different agencies, namely, Abbottabad TMA, Nawanshehr TMA and the Works & Services Department of Abbottabad District Government. The present organizations for water supply in these agencies are as illustrated in Figure 2-22. As shown in Figure 2-22 there seems no capacity to operate and manage the new system within the present organization. It is necessary to secure the personnel with appropriate backgrounds and establish a new independent organization exclusively working for this new system.

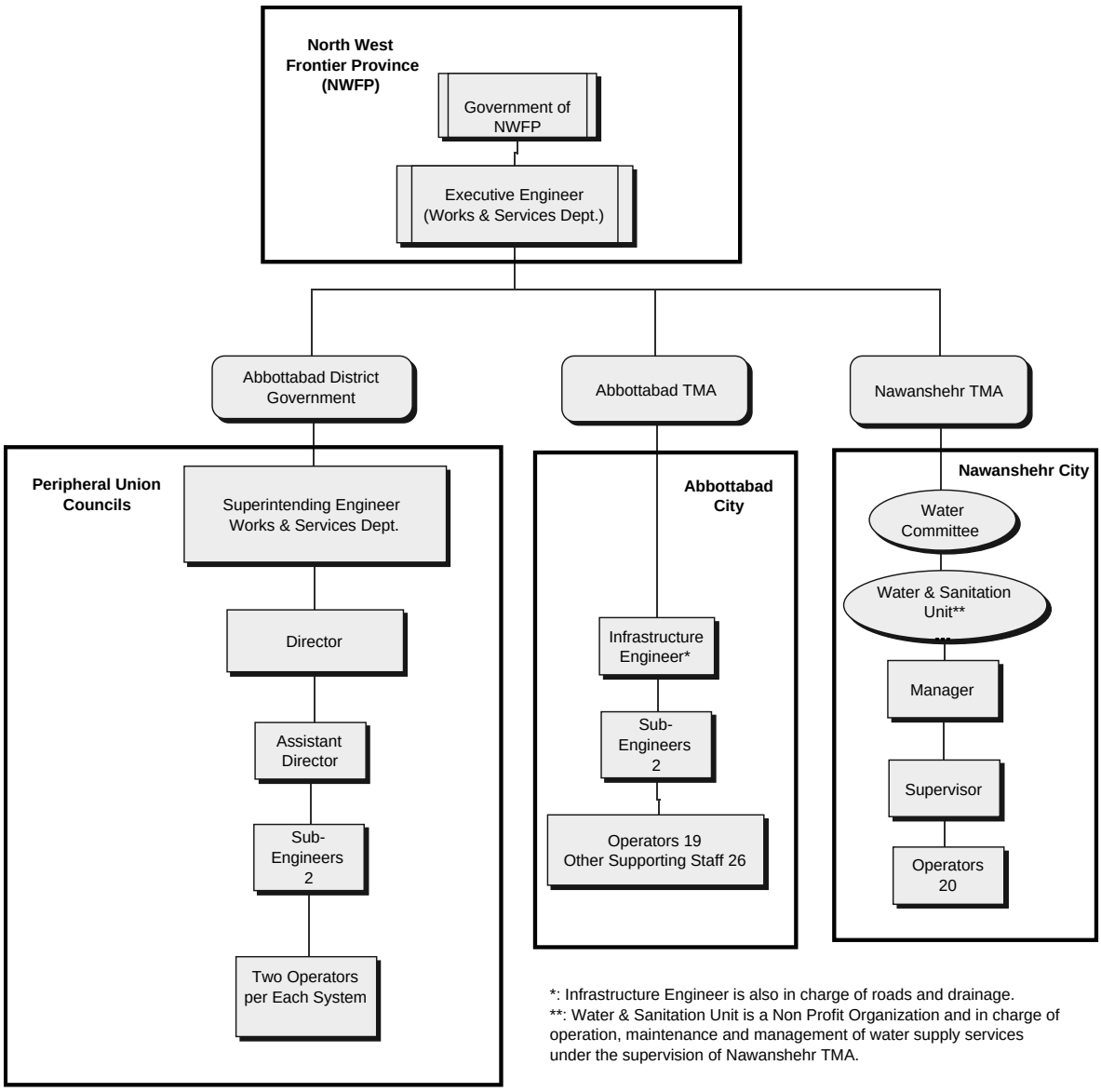


Figure 2-22 Present Organizations for Water Supply

Figure 2-23 illustrates conceptually the proposed set-up of the new independent organization for management of the surface water system (provisionally called, Gravity

Water Supply Unit). This Gravity Water Supply Unit should be of self-supporting accounting system, and manage entirely the intake, raw water transmission, water treatment and treated water transmission facilities to the distribution reservoirs.

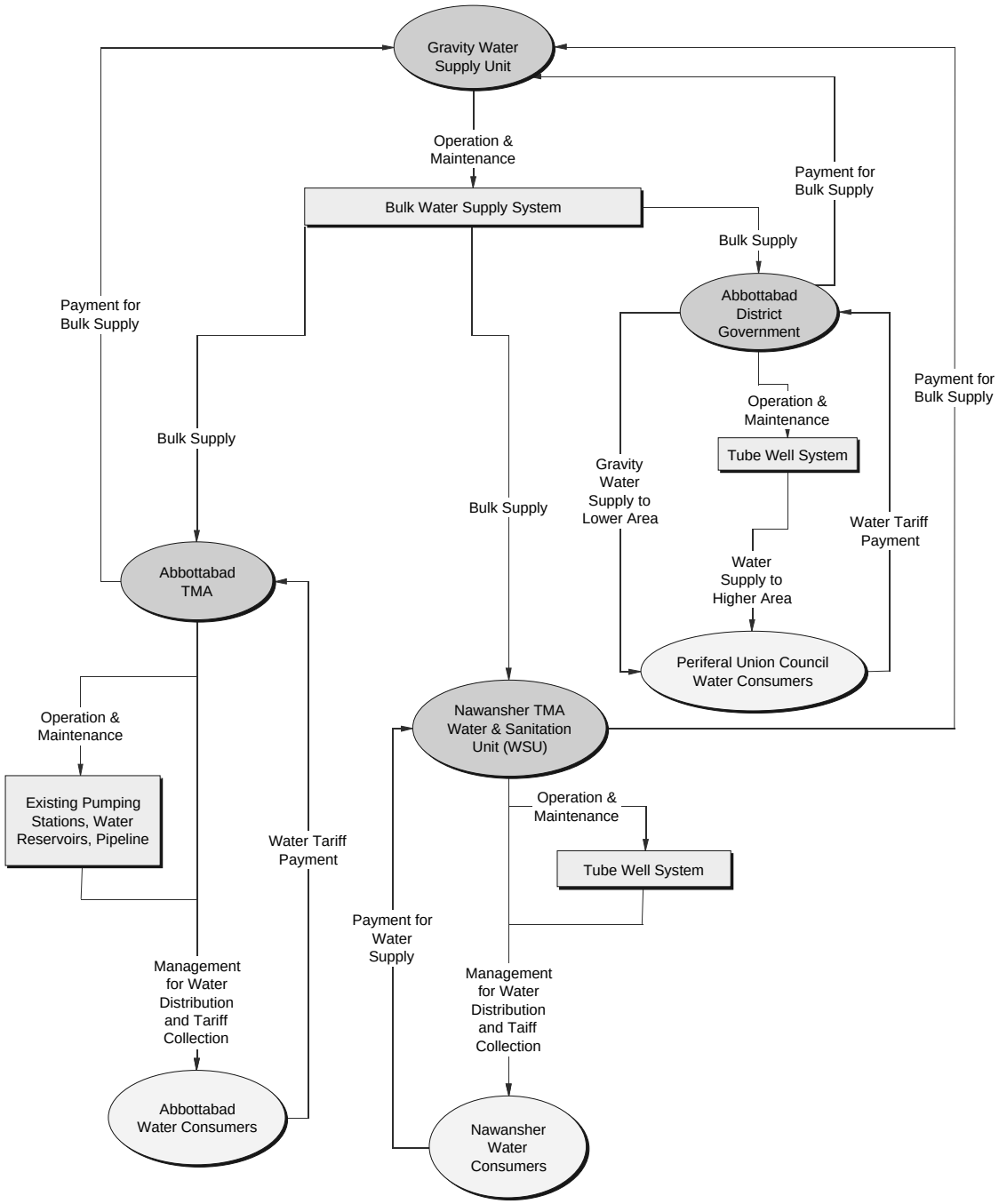


Figure 2-23 Conceptual Illustration of Surface Water System Management

On the other hand, Abbottabad TMA, Nawanshehr Water & Sanitation Unit, and Abbottabad District Government will receive bulk water supplies from the Surface Water

System through the treated water transmission mains operated by the Gravity Water Supply Unit. The distribution reservoirs, which receive the bulk supplies, are operated by the three different agencies, and water distributions from these reservoirs to consumers are the responsibilities of the three organizations. Accordingly, water tariff collection from the consumers is also carried out by the three agencies in the same way as before, and the three agencies will pay for the bulk supplies to the Gravity Water Supply Unit based on the metered amounts of bulk supplies.

Figure 2-24 shows the staff required for the Surface Water System and relations with the other organizations concerned.

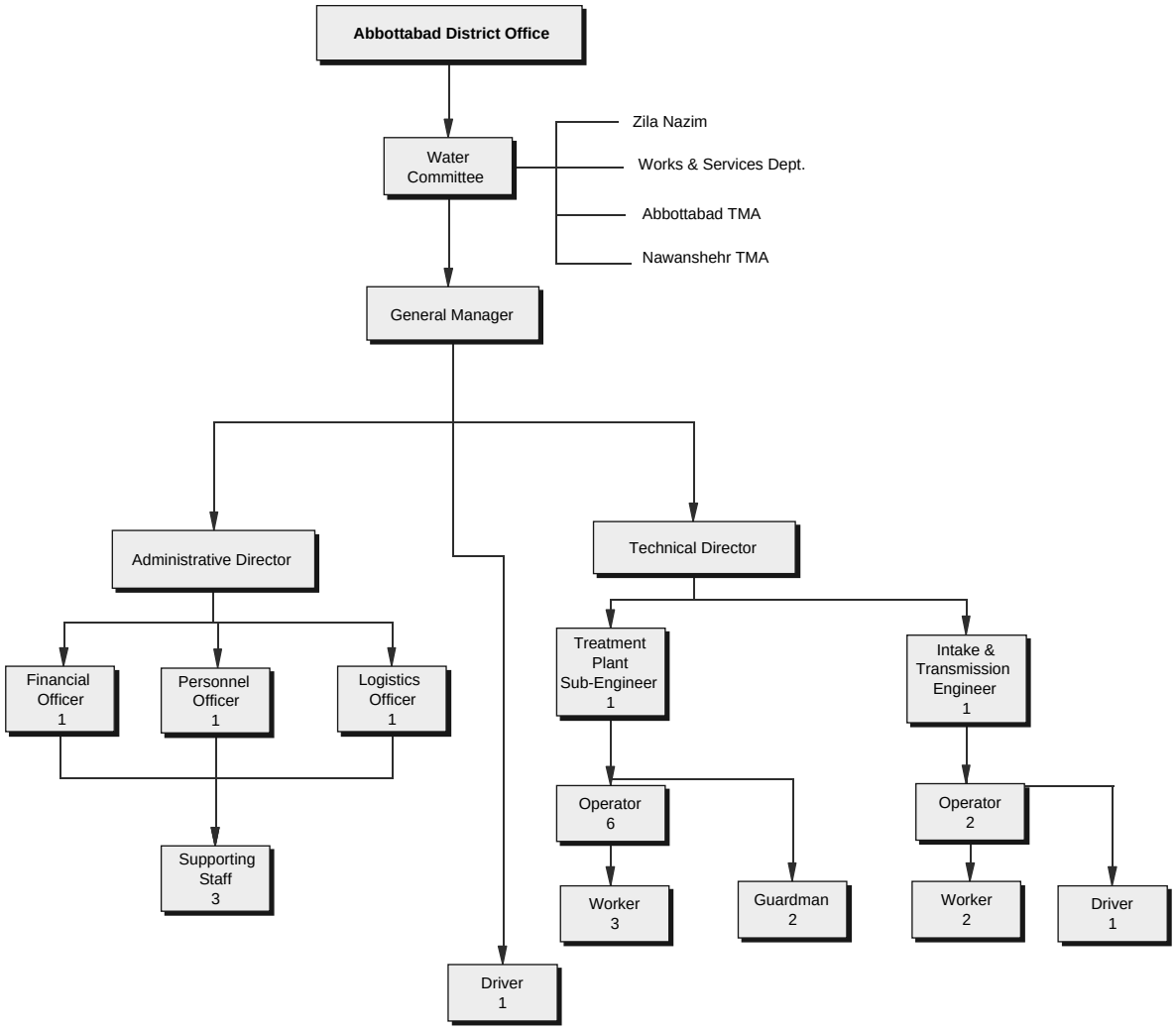


Figure 2-24 Organization Chart of Operation and Management for Surface Water System

As shown in Figure 2-23, the Gravity Water Supply Unit is the independent organization but it is supervised by the three organizations. It is recommended to set up the Water Committee represented by the three agencies to facilitate the coordination and cooperation between the three agencies and the Gravity Water Supply Unit.

In technical aspect of the management of the system, teams specialized in operation and maintenance of water treatment plant as well as transmission mains should be organized under the control of engineers. Accountant in charge of bulk water bill collections from the three agencies is also necessary.

The Gravity Water Supply Unit has the responsibility up to the water level control valves installed in the lines of treated water transmission mains. Downstream of the control valves, namely, the rest of transmission mains, distribution reservoirs including drains and overflows, distribution networks, house connections with water meters are all responsibilities of the three agencies.

2-4-1-2 Operation and Management of Groundwater System

Peripheral Union Councils and Nawanshehr TMA will continue to use the existing wells. And 4 new wells are constructed for the use of Peripheral Union Councils. These wells will be continuously operated and maintained by the Works & Services Department of Abbottabad District Government and Water & Sanitation Unit of Nawanshehr TMA. The Project provides modifications to control appropriate abstraction by adding basic monitoring functions in the well pump replacement work. As only four wells are added to the peripheral Union Councils it is not necessary to change the existing organization for operation but training on well management and operation & maintenance of pumps are necessary for the present operators.

It is important for the operators to keep the records of operation hour of pumps, water pressure and flow data and periodic water level reading as daily operation records

2-4-1-3 Strengthening of Water Bill Collection

Flat rate water tariff is presently adopted to Abbottabad TMA and Peripheral Union Councils. The Implementing Agency is, however, keen on introduction of metered water charges in conjunction with the Project implementation. Wasting of water derived from the flat rate consumers is considered significant and it is meaningful to introduce water meters from the viewpoint of the conservation of scarce water resources in the area in short of water resources.

Since Abbottabad TMA and Peripheral Union Councils have no experience of metered billing system, it is necessary to build up the capacity of various new works such as water meter installation, meter reading, customer education, new bill collection system based on consumption, etc.

Moreover, regarding billing for bulk water supplies by Gravity Water Supply Unit the bulk supply tariff setting and tariff collection system should be determined among Abbottabad TMA, Nawansheher TMA (Water & Sanitation Unit), and Abbottabad District Government

(Works & Services Department) and Gravity Water Supply Unit.

It is recommended to assist the capacity building of the agencies concerned for the management of the Surface Water System and introduction of water meters as well as revision of tariff policy through the management guidance conducted by a component of the consulting services.

2-4-2 Operation and Maintenance of Surface Water System

2-4-2-1 Operation and Maintenance of Water Treatment Plant

Water Treatment Plant is operated on 24-hour basis with three shifts of operators under the control of the engineer. Major daily operation and maintenance work is as follows:

- Raw Water Quality Monitoring:
  Raw Water Quality is generally stable with low turbidity, but sudden increase may happen when it rains upstream of the intakes. It is necessary to monitor the raw water turbidity periodically to take immediate actions such as stopping the inflow when necessary.
- Sedimentation and Filtration Processes:
  Periodic observation is necessary to know the degree of accumulation of sediments in sedimentation basins, and that of clogging of roughing filters and slow sand filters. Desludging from sedimentation basins, backwashing of roughing filters and scraping of slow sand filters are carried out when needed.
- Disinfection Process:
  Preparation of bleaching powder solution and controlling the dosage to maintain proper residual chlorine is necessary.
- Data Record:
  Treatment process monitoring such as flow, water quality, frequency of filter washing, filter scraping, consumption of bleaching powder etc. are recorded.

The implementing agencies and other organizations concerned have no experience of operating slow sand filtration system and disinfection by bleaching powder. It is necessary to provide technical training on operation of the treatment plant through the technical guidance as a component of the consulting services.

2-4-2-2 Operation and Maintenance of Intake, Raw Water Transmission Mains and Treated Water Transmission Mains

Periodic patrol of the intakes as well as water mains routes should be done by the operators under the control of transmission engineer. It is important to grasp any abnormal conditions of facilities including the surrounding situation of facilities at earlier stage. Leaks found out during the patrol should be immediately reported and repaired.

The bulk water supplies to distribution reservoirs are controlled by the water level control valves installed at the reservoirs. The operators should check the function of the valves and provide necessary maintenance such as cleaning of strainers.

In addition, the operators should read flowmeters installed before inlet of each distribution

reservoir, record the transmission flow data and check the function of the flowmeter.

Two operators are deployed for operation and maintenance of the intakes, raw and treated water transmission mains, flowmeters and water level control valves at the distribution reservoirs under the control of the transmission engineer.

2-4-3 Operation and Maintenance Cost

This chapter discusses the balance of the water revenue (water tariff collection) and expenses (power costs, chemical cost and personnel cost, etc.), need of water tariff revision, and need of subsidy from the Provincial Government.

2-4-3-1 Water Tariff

Abbottabad TMA, Nawanshehr TMA and Abbottabad District Government (for peripheral unions) are presently adopting the different water tariff systems.

Water tariff of Abbottabad TMA is set as indicated in Table 2-26, and it is the flat rate system without counting the actual consumptions of the customers. The water tariff falls into two categories for domestic use and commercial use. The tariff for commercial use is further divided into 9 subcategories such as hotels, barbershops, schools, and cinemas.

Table 2-26 Water Tariff of Abbottabad

Water Tariff (Monthly)
Abbotabad (2002-2003)

No	Type of connection	Rate	# Connection	Billing	%	Year
1	Domestic	Rs.60	4595	275700	85.3	3308400
	Commercial connection					
2	Hotel (Class-A) *	Rs.500	14	7000	2.2	84000
3	Hotel (Class-B) **	Rs.300	8	2400	0.7	28800
4	Hotel (Class-C) ***	Rs.225	11	2475	0.8	29700
5	Hotel (Class-D) ****	Rs.150	127	19050	5.9	228600
6	Barbars Shop (Class-A) #	Rs.250	15	3750	1.2	45000
7	Café,Bakery,Doctor Clinic, Private Scho	Rs.200	41	8200	2.5	98400
8	Barbars Shop (Class-B)##	Rs.100	32	3200	1	38400
9	Petro Pump	Rs.400	2	800	0.2	9600
10	Cinema	Rs.500	1	500	0.2	6000
	Total		4846	323075	100	3876900

Note
* 10 or more guest rooms
** 6-9 guest rooms
*** 1-5 guest rooms
**** No guest rooms, only resaurant
# 3 or more bath rooms
1-2 bath rooms

Nawanshehr TMA adopts water tariff based on the consumption measured by water meters. The water tariff is divided into two categories; Rs. 2.32/m3 for domestic use and Rs. 3/m3 for commercial use. Among the total connections there are only 85 connections for commercial use, and the commercial use is considered non-domestic use, which is not very clearly defined.

Abbottabad District Government, who is operating the water supply systems in the peripheral Union Councils, adopts the flat rate water tariff, which is fixed at Rs. 40/month/connection for any users.

It is a common fact all the three agencies cannot afford the operation and maintenance costs from their water revenues, and significant deficits are experienced every year. Table 2-27 shows the balance of water revenues and operation & maintenance costs in the fiscal year of 2001. It is also a fact that the water tariffs are set at very low compared with the average household income.

Table 2-27 Present Water Revenue and Operation & Maintenance Cost ('000 Rs.)

System	Present Operation and Maintenance Cost			Water Revenue	Balance
	Electricity	O&M Cost	Total		
Abbottabad TMA	15,800	5,920	21,720	3,877	-17,843
Nawanshehr TMA	3,840	960	4,800	1,800	-3,000
Peripheral Villages (Works & Services)	12,000	1,700	13,700	2,409	-11,291
Total	31,640	8,580	40,220	8,086	-32,134

2-4-3-2 Operation and Maintenance Costs and Water Revenues

Operation and maintenance costs and water tariff are estimated based on the following conditions:

a. Personnel cost: Calculated from the present level of salaries
b. Chemical cost: Calculated using the market price of bleaching powder for disinfection in Pakistan
c. Repair cost: 0.2% of the construction cost per year
d. Power cost: Calculated from necessary electricity for pump operation based on WAPDA electricity tariff (Sept. 2003)
e. Water Tariff Increased annually considering the socially affordable tariff which is 4% of the average household income at maximum

Table 2-28 shows the annual operation and maintenance costs for the Surface Water System and those costs for Abbottabad TMA, Nawanshehr TMA and Abbottabad District Government. Table 2-29 shows the comparison of the annual operation and maintenance costs and water revenues by water tariff collection. Abbottabad TMA and Nawanshehr TMA will be able to afford the operation and maintenance costs by their water revenue after the year of 2010, provided that water tariff should increase annually by 30%. The proportions of monthly water charges per connection to average monthly household income are 1.9% and 1.5%, respectively, and they are reasonably low. In contrast, the balance, in case of water supply systems in the peripheral Union Councils, will be plus after the year of 2014 with continuous increase of water tariff by 30% annually. The proportion of the monthly water tariff in the year 2013 to the average monthly household income in the peripheral

Union Councils is 3.7%. However, the overall water revenue of the three agencies will be almost balanced with the total cost in the year 2012, and exceed the cost after this year. It is desired to adopt cross subsidy policy between three water supply agencies to reduce the burden of the peripheral unions. Accordingly, the Provincial Government should subsidize the deficits that occur for several years after the Project completes.

As shown in Table 2-27, the present overall balance of the water revenues and the operation & maintenance costs reaches to the huge amount of Rs. – 32 million as annual deficit. Figure 2-25 shows the comparison of annual water revenues and the O&M costs after the completion of the Project, estimated with annual increase of water tariff by 30%. In the first year after the completion of the Project, the simulation indicates approximately Rs. 27 million of deficit, which is less than the present deficit experienced in the fiscal year 2001. In 2012 the total revenue and total cost of the three agencies are almost balanced, as the balances of Abbottabad TMA and Nawanshehr TMA are plus but only the peripheral Union Councils gives a deficit. Table 2-30 shows the water tariff levels for the three agencies in the year 2012 when the overall revenue and cost are nearly balanced.

Table 2-30 Degree of Water Tariff Increase and Effects on Household Income

System	Present Water Tariff	Water Tariff necessary to make Overall Balance of the Three Agencies nearly Zero (Year 2012)	Necessary Multiple for the Present Tariff	Percentage of Water Tariff in the Average Household Income (%)
Abbottabad TMA	2.23	8.28	3.7	2.51
Nawanshehr TMA	2.43	6.94	2.9	1.51
Peripheral Villages	1.61	7.77	4.8	2.88
Average	2.09	7.81	3.7	2.41

The above discussion implies that if the deficit of the peripheral Union Councils is filled by the profits of Abbottabad TMA and Nawanshehr TMA the total revenue and cost are balanced as a whole.

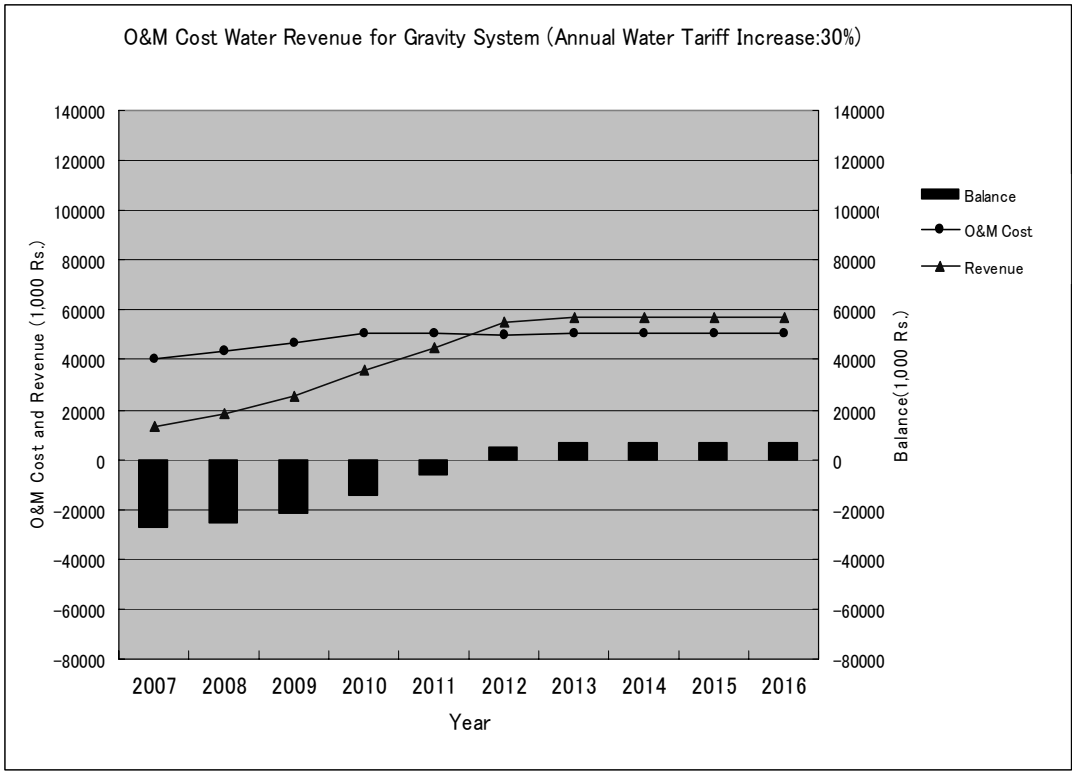
Table 2-28 Operation & Maintenance Cost for Surface Water System and Those Costs Incurred by Abbottabad TMA, Nawanshehr TMA and Abbottabad District

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Water Demand (Max.Day	m3/d	21,429	23,135	24,842	26,548	26,548	26,548	26,548	26,548	26,548	26,548
1 Bulk Water Supply System											
Water Production (Max.Day)	m3/d	13,948	15,059	16,170	17,280	17,280	17,280	17,280	17,280	17,280	17,280
Annual Production	m3	4,426,974	4,779,596	5,132,217	5,484,522	5,484,522	5,484,522	5,484,522	5,484,522	5,484,522	5,484,522
Personnel Cost	'000Rs.	5,230	5,230	5,230	5,230	5,230	5,230	5,230	5,230	5,230	5,230
Power Cost	'000Rs.	86	86	86	86	86	86	86	86	86	86
Chemical Cost (Rs.0.32/m3)	'000Rs.	1,417	1,529	1,642	1,755	1,755	1,755	1,755	1,755	1,755	1,755
Maintenance Cost	'000Rs.	2,360	2360	2360	2360	2360	2360	2360	2360	2360	2360
Total O & M Cost	'000Rs.	9,093	9,205	9,318	9,431	9,431	9,431	9,431	9,431	9,431	9,431
2 Abbottabad TMA System											
Water Production (Max.Day)	m3/d	7,990	8,419	8,849	9,278	9,278	9,278	9,278	9,278	9,278	9,278
Annual Production	m3	2,535,957	2,672,117	2,808,596	2,944,757	2,944,757	2,944,757	2,944,757	2,944,757	2,944,757	2,944,757
Power Cost (Rs.1.57/m3)	'000Rs.	3,981	4,195	4,409	4,623	4,623	4,623	4,623	4,623	4,623	4,623
Personnel /Maintenance Cost	'000Rs.	4,539	4,783	5,027	5,271	5,271	5,271	5,271	5,271	5,271	5,271
Bulk Water Supply	'000Rs.	4,910	4,971	5,032	5,093	5,093	5,093	5,093	5,093	5,093	5,093
Total O & M Cost	'000Rs.	13,430	13,949	14,468	14,987	14,987	14,987	14,987	14,987	14,987	14,987
3 Nawanshehr TMSA System											
Water Production (Max.Day)	m3/d	3,715	3,989	4,263	4,537	4,537	4,537	4,537	4,537	4,537	4,537
Annual Production	m3	1,179,109	1,266,074	1,353,039	1,440,004	1,440,004	1,440,004	1,440,004	1,440,004	1,440,004	1,440,004
Power Cost (Rs.2.00/m3)	'000Rs.	2,287	2,456	2,625	2,794	2,794	2,794	2,794	2,794	2,794	2,794
Personnel /Maintenance Cost	'000Rs.	2,358	2,532	2,706	2,880	2,880	2,880	2,880	2,880	2,880	2,880
Bulk Water Supply	'000Rs.	909	921	932	943	943	943	943	943	943	943
Total O & M Cost	'000Rs.	5,554	5,909	6,263	6,617	6,617	6,617	6,617	6,617	6,617	6,617
4 Peripheral Union Council											
Water Production (Max.Day)	m3/d	9,107	10,316	11,524	12,733	12,733	12,733	12,733	12,733	12,733	12,733
Annual Production	m3	2,890,483	3,274,209	3,657,617	4,041,343	4,041,343	4,041,343	4,041,343	4,041,343	4,041,343	4,041,343
Power Cost (Rs.4.46/m3)	'000Rs.	12,892	14,603	16,313	18,024	18,024	18,024	18,024	18,024	18,024	18,024
Personnel /Maintenance Cost	'000Rs.	5,174	5,861	6,547	7,234	7,234	7,234	7,234	7,234	7,234	7,234
Bulk Water Supply	'000Rs.	3,274	3,313	3,354	3,395	3,395	3,395	3,395	3,395	3,395	3,395
Total O & M Cost	'000Rs.	21,340	23,777	26,214	28,653	28,653	28,653	28,653	28,653	28,653	28,653
Ground Total	'000Rs.	40,324	43,635	46,945	50,257	50,257	50,257	50,257	50,257	50,257	50,257

Table 2-29 Comparison of Annual Operation & Maintenance Costs and Water Revenues with Increased Water Tariff

Items		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Water Tariff Increase; 30% per annum											
Abbottabad TMA System											
1 Water Sales	m3	1,927,328	2,030,809	2,134,533	2,238,016	2,238,016	2,238,016	2,238,016	2,238,016	2,238,016	2,238,016
2 O & M Cost	'000Rs.	13,430	13,949	14,468	14,987	14,987	14,987	14,987	14,987	14,987	14,987
3 Revenue	'000Rs.	5,589	7,656	10,459	14,256	18,531	18,531	18,531	18,531	18,531	18,531
4 Balance	'000Rs.	−7,841	−6,293	−4,009	−731	3,544	3,544	3,544	3,544	3,544	3,544
5 Water Tariff	Rs./mon	78	101	132	171	223	223	223	223	223	223
6 Ratio to Income	%	0.88	1.13	1.48	1.92	2.51	2.51	2.51	2.51	2.51	2.51
Nawanshehr											
1 Water Sales	m3	896,123	962,216	1,028,309	1,094,403	1,094,403	1,094,403	1,094,403	1,094,403	1,094,403	1,094,403
2 O & M Cost	'000Rs.	5,554	5,909	6,263	6,617	6,617	6,617	6,617	6,617	6,617	6,617
3 Revenue	'000Rs.	2,832	3,955	5,491	7,595	7,595	7,595	7,595	7,595	7,595	7,595
4 Balance	'000Rs.	−2,722	−1,954	−772	978	978	978	978	978	978	978
5 Water Tariff	Rs./mon	78	102	132	172	172	172	172	172	172	172
6 Ratio to Income	%	0.68	0.89	1.16	1.51	1.51	1.51	1.51	1.51	1.51	1.51
Peripheral Unions											
1 Water Sales	m3	2,196,767	2,488,399	2,779,789	3,071,420	3,071,420	3,071,420	3,071,420	3,071,420	3,071,420	3,071,420
2 O & M Cost	'000Rs.	21,340	23,777	26,214	28,653	28,653	28,653	28,653	28,653	28,653	28,653
3 Revenue	'000Rs.	4,591	6,768	9,840	14,129	18,367	23,865	31,021	31,021	31,021	31,021
4 Balance	'000Rs.	−16,749	−17,009	−16,374	−14,524	−10,286	−4,788	2,368	2,368	2,368	2,368
5 Water Tariff	Rs./mon	52	67	88	114	148	193	250	250	250	250
6 Ratio to Income	%	0.78	1.00	1.31	1.70	2.21	2.88	3.73	3.73	3.73	3.73
Total											
1 Water Sales	m3	5,020,218	5,481,424	5,942,631	6,403,839	6,403,839	6,403,839	6,403,839	6,403,839	6,403,839	6,403,839
2 O & M Cost	'000Rs.	40,324	43,635	46,945	50,257	50,257	50,257	50,257	50,257	50,257	50,257
3 Revenue	'000Rs.	13,012	18,379	25,790	35,980	44,493	49,991	57,147	57,147	57,147	57,147
4 Balance	'000Rs.	−27,312	−25,256	−21,155	−14,277	−5,764	−266	6,890	6,890	6,890	6,890
5 Water Tariff	Rs./mon	67	86	111	144	178	200	227	227	227	227
6 Ratio to Income (Average8,300)	%	0.81	1.04	1.34	1.73	2.14	2.41	2.73	2.73	2.73	2.73

Figure 2-25 Balance of Operation & Maintenance Cost and Water Revenue after the Project (Annual Tariff Increase of 30%)



In conclusion, the following arrangements among the three agencies and the support from the Provincial Government will be required.

- The present water tariffs should be raised to the levels as indicated in Table 2-29. (Although the water tariffs are raised annually by 30% in the above simulation it might be more practical to raise the tariffs twice up to those levels by the year 2012.)
- Abbottabad TMA, Water & Sanitation Unit of Nawanshehr TMA, Works & Services Department of Abbottabad District Government should properly collect the water tariffs from the consumers.
- These three agencies have to pay for the bulk supply provided by the Gravity Water Supply Unit according to the actual consumption measured by the flow meters installed in the Project.
- The whole costs and revenues as the three agencies are balanced in 2012. The balances for Abbottabad TMA and Nawanshehr TMA are plus, but the balance for Abbottabad District Government (Peripheral Union Councils) is minus. This deficit can be, however, covered by the tariff system introducing cross subsidy among the three agencies so that the total water revenues of the three agencies could fill the total operation and maintenance costs. If the tariff of each agency is set at the level of 2.4% of the average household income the cost and revenue will be balanced. It implies that if the water management of the three agencies are integrated to one body, the total costs are covered by the water revenues with the above tariff level.
- The Provincial Government should continue to subsidize the three agencies to fill the deficits after the completion of the Project. The amount of subsidy is, however, expected to reduce year by year if the water tariff is raised properly and the tariff is collected effectively. According to the simulation the subsidy for Abbottabad and Nawanshehr will be zero after the year 2013.

2-5 Other Relevant Issues

2-5-1 Technical and Management Guidance under Soft Component Scheme

(1) Objectives

Technical and management guidance will be carried out as consulting services in this Project. The guidance is composed of the following four components.

1) Capacity Building for Operation and Maintenance of Slow Sand Filtration System

The Implementing Agency, Abbottabad District Government, has no experience of operation of a water treatment plant although it is now handling the operation and maintenance of more than 200 water supply systems in the District, which were constructed by the District Government. It is necessary to transfer the proper technical knowledge on surface water treatment by slow sand filtration and practical know-how on operation and maintenance of the water treatment plant. Sufficient training is required for the engineers and operators of the Gravity Water Supply Unit, who will be in charge of the operation of the Surface Water System.

2) Technical Training for Well Management and Operation & Maintenance of Pumps

The present operation of well pumps is periodical on-off operation in a day in accordance with pre-determined schedule. It is necessary to provide training for the well operators regarding proper operation and maintenance of wells and pumps newly installed or replaced in the Project.

3) Management Guidance for Organizing the Management Unit for Surface Water System

The Surface Water System will be managed by an independent organization to provide bulk water supply to the three different agencies as explained in the previous section. It is necessary to provide advices or guidance through discussion with the three agencies and other agencies concerned, and facilitate the preparation and coordination for establishing the new organization, Gravity Water Supply Unit.

4) Management Guidance for Improving Water Revenue

Flat rate water tariff systems presently adopted in Abbottabad TMA and the peripheral Union Councils will be replaced by new tariff systems depending on the actual consumptions measured by water meters, which are to be introduced in the course of the Project. Management guidance is provided to support the revision of water tariff systems, introduction of water meters, improvement of bill collection systems for the improvement of

water revenue and consumers' manners for water conservation.

(2) Effects Anticipated

The following effects are anticipated as the outputs of the guidance:

- To secure the water production and water quality of the treated water targeted by the Project through the transfer of proper know-how of water treatment operation,
- To extend the life periods of well facilities by appropriate operation,
- To establish new agency who supply bulk water to the existing three water supply agencies,
- To organize necessary setup for revising the water tariffs and materializing water meter installation for the sound management of water supply, and
- To improve consumers' manner of water use for water conservation.

(3) Method of Introduction

The Project is implemented in two phases; Phase 1 is composed of construction work of the Groundwater System and Phase 2 is composed of the Surface Water System. In line with the implementation of the phased construction works technical and management guidance is introduced as described below. For executing the guidance input of the following Japanese specialists and local specialists are required.

1) Phase 1

- Japanese well specialist will prepare the manual for operation and maintenance of well facilities. Training is provided for operators and engineers in charge of wells by using the manual. The training is so provided to ensure the pump operation records and water table monitoring records.
- Japanese specialist for social education on water supply will prepare the Action Programme for Water Meter Installation with a help of local specialists assigned for social education, water tariff and water meter installation. The local staff assigned for social education will provide explanation and education on necessity of water tariff revision and water meter installation through visiting consumers or public hearing in accordance with the programme prepared.

Japanese Specialists

Well Specialist :	Technology transfer of operation & maintenance of well facilities.
Specialist for Social Education on Water Supply :	Preparation of the Action Programme for public education.

Local Specialists

Social Education on Water Use :	Facilitating the implementation of the Action Programme on public education.

Outputs :

Operation & Maintenance manual for Well Facilities, Action Programme for Public Education

2) Phase 2

- Japanese Specialist on Operation and Maintenance of Treatment Plant will prepare the O&M manual for the Surface Water System including the intake, raw water transmission main, water treatment plant and treated water transmission main. The overall training throughout the entire system is provided for the engineers according to the manual. Detailed training for each facility is provided for respective operators. In addition, pre-training for operation of complete slow sand filtration system in Japan is very effective prior to the starting of the training in Abbottabad using

actual new treatment plant.

- Japanese Institutional Specialist for organization will discuss with the agencies concerned regarding establishment of a new organization for the management of the Surface Water System. The Japanese Specialist will make advice and guidance to facilitate the establishment of a new organization several months prior to the completion of the facilities construction.
- Japanese Specialist for water tariff will prepare the Water Revenue Improvement Programme, and make necessary advices and guidance for the improvement of water supply management of Abbottabad TMA, Nawanshehr TMA and Abbottabad District Government regarding water tariff, water bill collection, customer relation, etc.
- Local specialist (water tariff) will assist the Japanese Specialist to give necessary advices to the water supply agencies for the improvement of the water tariff management.

Japanese Specialists

Operation & Maintenance Specialist：	Technology Transfer of Operation and Maintenance of Water Treatment Plant and Transmission Pipelines
Institutional Specialist：	Advice and Guidance for Setting up the Organization for the Surface Water System
Water Tariff Specialist：	Advice on Water Tariff Policy and Revenue Improvement and Preparation of Water Revenue Improvement Programme

Local Specialists

Water Tariff Specialist：	Advice on Water Tariff Policy and Revenue Improvement

Outputs：

Operation and Maintenance Manual for the Surface Water System, Water Revenue Improvement Programme