No.

THE BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR REHABILITATION AND EXPANSION OF THE WATER SUPPLY NETWORKS
IN
NORTH/MIDDLE JORDAN VALLEY
IN
THE HASHEMITE KINGDOM OF JORDAN

DECEMBER 2004

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation and Expansion of the Water Supply Networks in North/Middle Jordan Valley in the Hashemite Kingdom of Jordan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Jordan a study team from July 18 to September 1, 2004.

The team held discussions with the officials concerned of the Government of Jordan, 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 Jordan 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 Hashemite Kingdom of Jordan for their close cooperation extended to the teams.

December, 2004

Seiji Kojima

Vice-President

Japan International Cooperation Agency

December, 2004

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Rehabilitation and Expansion of the Water Supply Networks in North/Middle Jordan Valley in the Hashemite Kingdom of Jordan.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from July, 2004 to December, 2004. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Jordan 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.

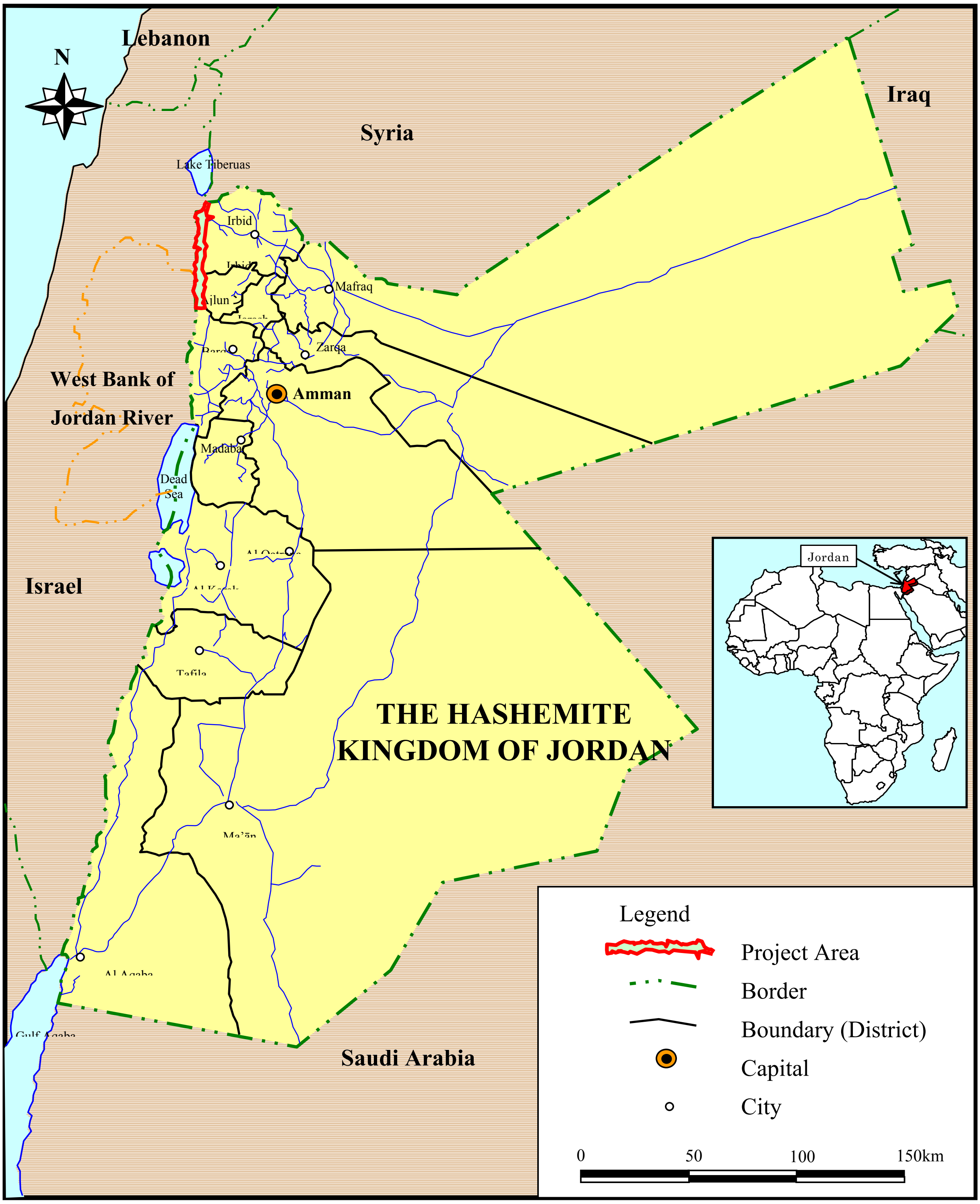
Very truly yours,

Masatoshi Seno

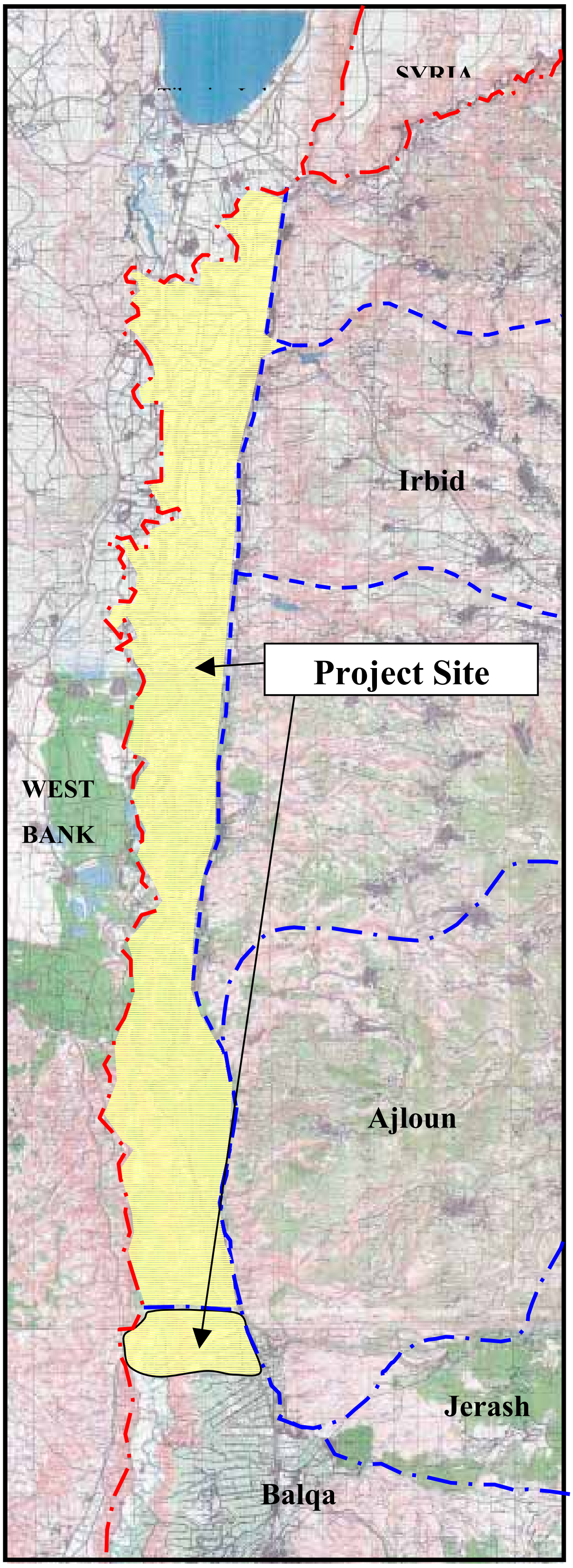
Chief Consultant,

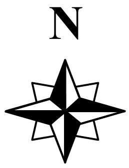
Basic Design Study Team on the project for Rehabilitation and Expansion of the Water Supply Networks in North/Middle Jordan Valley in the Hashemite Kingdom of Jordan

Yachiyo Engineering Co., Ltd.



THE HASHEMITE KINGDOM OF JORDAN



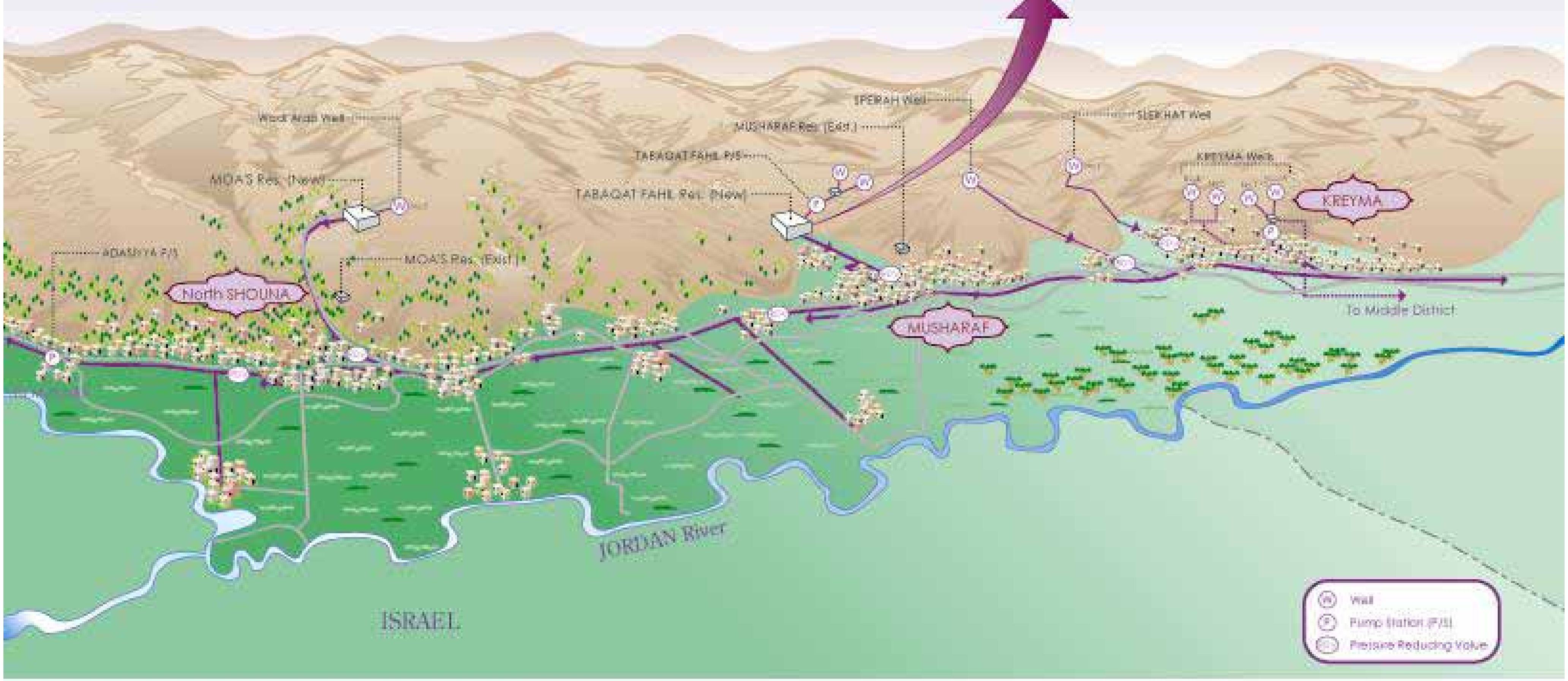


Name of Towns & Villages in the Project Site

Area	Name of Town & Village
North Jordan Valley (North Shouna)	Adasiyya
	North Shouna
	Almansheyeh
	Waqqas
	Eskan Waqqas
	Qulei'at
	Almashare'a
	Wadi Al-Rayan
	Eskan Ma'ath
	Asskukhneh
	Alfiddieen
	Almaramsha
	Tall Alarbaa'een
	Bosseileh
	Seil Alhimma
	Al-Harawayeh
	Azzamalyeh
	Tabaqat Fahil
	Kreyma
	Abu Sedu
	Sleikhat
	Alqarin
	Abu Habil
	South Karemeh
	Eskan Karemen
	Sowfarah
Middle Jordan Valley	Al-Balwaneh
	Ghor Al-Balwaneh

Project Site

- New Moa's Res. & Tabaqat Fahil Res. completion image -



- The completion image of Water Supply Networks -

LIST OF FIGURES AND TABLES

ABBREVIATIONS

DCIP	Ductile Cast Iron
E/N	Exchange of Notes
EIB	European Investment Bank
F/S	Feasibility Study
HDPE	High Density Polyethylene
HWL	High Water Level
ISO	International Organization for Standard
IT	Information Technology
JD	Jordan Dinar
JICA	Japan International Cooperation Agency
JVA	Jordan Valley Authority
KfW	Kreditanstalt fur Wiederaufbau
l/c/d	Liter per capita per day
LWL	Low Water Level
M/D	Minutes of Discussion
MCM	Million Cubic Meter
MWI	Ministry of Water and Irrigation
NGWA	Northern Governorate Water Administration
NGO	Non-governmental Organization
O & M	Operation and Maintenance
OJT	On-the-Job Training
PMU	Project Management Unit (executed by WAJ)
PN	Nominal Pressure
PS	Pump Station
PVC	Polyvinyl Chloride
RC	Reinforced Concrete
ROU	Regional Operating Unit
SCADA	Supervisory Control and Data Acquisition
UFW	Unaccounted for Water
US$	U.S. Dollar
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan

SUMMARY

SUMMARY

The Hashemite Kingdom of Jordan (hereinafter referred to as “Jordan”) is a nation with one of the smallest per capita supply of water in the world (200m^3 compared with a world average of 7,700m^3). Due to a rapid increase in population, water-related problems have been increasing in recent years. In Jordan, water is treated with the utmost importance and the effective and impartial utilization of its limited water resources has always been part of national water policy. Water supply regulating on a national scale is one typical measure. A socioeconomic development plan, fundamental to Jordan, states the following goals of the water and irrigation sector.

① Reducing the rate of the unaccounted for water
② Optimizing exploitation of water sources according to the priorities of the maximum economic benefit
③ Increasing individual’s share of domestic water

The aim of Jordan water policy is to achieve the above-mentioned goals. In addition, it also receives aid from donors and international organizations. Furthermore, Japan continues to support Jordanian water policy through a successive grant aid scheme and technical cooperation.

Jordan is forging ahead with its water policy in accordance with the basic plan. Many nation-wide projects are being implemented simultaneously, such as the utilization of brackish underground water as a new water resource, recycling of sewerage water for irrigation, reducing leakage by replacing existing water supply pipelines, and by introducing a supervisory control and data acquisition (SCADA) system for efficient control of the water supply system.

The areas subject to the Project are the North and Middle Districts of Jordan Valley (area 240km^2, population 114,382). The North and Middle Districts of Jordan Valley are located in the heavily eroded southern Jordan River Valley at an elevation near or below sea level. Here, the headwaters of the Jordan River flow south from the Sea of Galilee (Lake Tiberius) and empty into the Dead Sea, creating a fertile agricultural zone across the river basin. Despite a temperate climate during the winter season, temperatures soar in all other seasons, the average temperature reaching 40℃ in the summer. Most of the relatively affluent population resides in highland towns such as Amman and Irbit. The unemployment rate in the Jordan Valley is high at approximately 30%, the highest in Jordan.

In these districts, pipelines including asbestos pipes laid in 1978 have been deteriorating, and there is significant leakage occurring. Due to the conspicuous obsolescence of pumping systems and reservoirs, etc., the water supply cannot keep up with the increasing number of residents living at the foot of the mountains which has taken place in recent years. The problem of insufficient feed water

pressure for consumers has become evident. In order to maintain am adequate level of feed water pressure, the problem is being addressed through complicatedly system of valves installed at minutely-zoned reservoirs. However, due to the haphazard way in which repairs have been carried out, the existing water supply system has become extremely complex and the system cannot be adequately operated simply through valve operation. Therefore, a radical solution including a review of the existing water supply system has been requested. Measures taken by Jordan for the said districts through the project include the reduction of leakage in four (4) provinces in the northern Jordan Valley (Irbid, Mafraf, Ajloun and Jarash) which began in 2003 with aid from KfW. At present, a conceptual design has been completed and the sequence of undertakings according to priority is being made so that major projects can get underway. In three (3) provinces in the Middle Region including the Middle District of the Jordan Valley (Zarqa, Madaba and Balqa), feasibility studies (F/S) are underway employing a local consultant firm through independent funding of the Water Authority of Jordan (WAJ). The priority of future project sites is now being discussed. Compared with other districts, generally speaking, the water policy in North and Middle districts of the Jordan Valley is lagging behind, with Jordanian measures still in the early stages.

Taking the above-mentioned plan into account, Jordan made a request to Japan for a grant aid scheme for upgrading and expansion of existing water supply facilities in the North and Middle districts of the Jordan Valley where measures for water policy especially have fallen behind. The Project aims at improving current water supply conditions by reducing the amount of leakage and increasing service per capita through the improvement and expansion of the existing water supply facilities within the project sites.

In response to the request, and in order for the Government of Japan to implement a basic design study for the Project, the Japan International Cooperation Agency (JICA) dispatched a basic design study team from July 17 to September 2, 2004. The study team discussed the request contents with the concerned parties from the Government of Jordan and the Water Authority of Jordan (WAJ), carried out a study of current conditions at the project sites, and collected related materials.

Based on the field survey, it was soon apparent that the WAJ is strongly requesting that improvements be made to facilities, not only the repair of individual equipment in the existing watery supply system, but also the upgrading to an efficient water supply system. As mentioned earlier, the existing water supply system has become very complex due to inefficiency in repairs, which has given rise to disproportion in feed water pressure in each service zone (water distribution zones) and invited problems such as insufficient feed water pressure on plateaus and an increase in leakage due to excess water pressure in lowland areas. Since the repair of individual equipment is not enough to alleviate the problems, the study team considers the existing water supply facilities to be a system and has determined that facilities should be improved through a review of its functionality. Accordingly, the basic design will take this into consideration. The major differences between the contents of the initial request and matters newly confirmed are as follows.

① Since the existing Sleikhat reservoir, including the contents of the request, is only permitted to use the headwater (source) for irrigation, this proves that it has not been utilized since December 2003. Consequently, as a result of the discussions with the WAJ it is going to be excluded from the Project.

② Since the main distribution pipes and transmission pipes subject to replacement are the existing asbestos pipes, pipelines of insufficient diameter, and pipes to be newly laid due to a route change, as a result of reviewing the state of existing pipelines, leakage conditions and existing facilities observed during the field survey, the extent of construction to be implemented by the Japanese side is confirmed to be approximately 61km instead of 52km as stated in the request contents.

③ With respect to the replacement of distribution branch pipes, it has been confirmed that materials will be procured by the Japanese side and construction will be carried out by the Jordanian side. Since the WAJ stipulates in the their specifications that the minimum diameters of distribution branch pipes should be 50mm, upon the request of the WAJ, all piles will be unified to 50mm from the requested 20mm to 50mm. Pipe variety subject to be replaced will be the existing galvanized pipes where water leakage often arises. As a result of an examination of drawings from the field survey, interviews and visual observation of ground pipes, the extension should be increased from the requested 50km to 74km in order to achieve the desired outcome of the Project. In addition, it is confirmed that this extension can be laid within the Japanese construction period.

④ With regards to the four (4) municipalities in the Middle District, although the overall existing water supply facilities in the Middle District should be examined as a system, independent repair of the requested reservoirs and booster pumps has proven to be difficult so they will be excluded. Accordingly, the mutual consent of the WAJ only includes the replacement of distribution and transmission pipes and the procurement of distribution branch pipes in the Middle District.

⑤ In the target year of 2010, a total shortage in service of approximately $154m^3$/hour against demand in the North District is expected. As a result of discussions with the WAJ, it has been confirmed that this shortage can be partially alleviated by supplementing water at Tabaqat Fahil Well No.9 in the said district to Irbid and water at Kreyma Wells No.4 and No.5 to the Middle District.

Based on the findings of these surveys, the necessity for improvement in water supply facilities has been confirmed and a basic design draft including soft components such as application technologies for the SCADA system to be introduced under the Project have been prepared.

The JICA dispatched a study team between November 6 to 13, 2004 to explain and discuss the contents of the Project and review the outline of the basic design.

Improvements in the existing water supply system, the basic design policy for the expansion plan, the design plan outline, and outline of the soft component program for technology transfer of the SCADA system are described in the following tables.

Basic Design Policy

Item	Improvement Policy	
Year	2003 (base year)	2010 (target year)
Daily Average Service per Capita	114 ℓ/person & day	129 ℓ/person & day
Leakage Rate	30 %	20 %
Daily Consumption per Capita	80 ℓ/person & day	103 ℓ/person & day
Served Population	117,674 persons	137,426 persons

Facility Plan Overview

Item	Target	Project Contents
Replacement of main distribution pipes and transmission pipes	North District	57,739 m
	Middle District	3,580 m
	Total	61,318 m
Provision of distribution branch pipes	North District	72,778 m
	Middle District	875 m
	Total	73,653 m
Renewal of Pump Stations (North District only)	Adasiyya Pump Station	- 56m^3/h x 274m x 2 units - 32m^3/h x 74m x 1 unit - Pump hut: 1 building
	Tabaqat Fahil Pump Station	- 160m^3/h x 10m x 1 unit - 188m^3/h x 64m x 3 units - Water receiver tank (380m^3) x 1 unit - Pump hut: 1 building
	Kreyma Pump Station	- 163m^3/h x 40m x 2 units - Pump hut: 1 building
Reservoir of Remodeling (only for North District)	Moa's Reservoir	1,600m^3 x 1 unit
	Tabaqat Fahil Reservoir	2,500m^3 x 1 unit
Construction of SCADA system (only for North District)	(1) North Shouna ROU (Regional Operating Unit) office Remote supervisory unit（telemeter panel, PC, CRT, printer and software, etc.） (2) Each pump station, reservoir and well Electromagnetic flow meter, water pressure gauge, telemeter panel and water level indicator	

Soft Component Program Overview (Technology Transfer of SCADA System)

Item	Project Contents
Technological guidance on application technologies for SCADA system	① Guidance on a maintenance method of equipment at the control center (North Shouna ROU office) ② Guidance on maintenance of measuring instruments (electromagnetic flow meter, water pressure gauge and water level indicator) ③ Guidance on a maintenance method of data transmission unit
Technical guidance on data processing, analysis and practical technology	① Guidance on a usage method of a program ② Guidance on data processing ③ Guidance on data analysis and practical usage ④ Guidance on an early detection methods when problems arise and troubleshooting

The estimated cost of the Project implemented through the Japanese grant aid scheme is ¥2.368 billion (estimated Japanese and Jordanian cost is ¥2.072 billion and ¥296 million respectively). However, the estimated cost does not immediately show the ceiling grant amount for the exchange of notes (E/N). The implementation period of the Project is anticipated to be 3.5 months for implementation design, 3.5 months for tendering and selection of contractors, and 27 months for procurement of equipment and materials and construction period.

After examination, the relevance of the Project from the aspects of urgency, benefit, competency of maintenance, financial affairs and environment is as follows.

A safe and stable water supply will be possible for resident in the North and Middle districts of the Jordan Valley where the condition of the water supply has deteriorated and the urgency is great. More specifically, since water supply facilities across the entire North Jordan Valley will be improved through the implementation of the Project, 137,000 persons will benefit (daily per capita consumption will increase from 80ℓ to 103ℓ). Furthermore, by replacing existing asbestos pipes and upgrading the distribution pipe network even to a small degree in Middle District municipalities, public health can be improved. In addition, through the replacement of the deteriorated transmission and distribution pipes and the adequacy of water pressure, the leakage ratio of approximately 30% in 2003 can be reduced to approximately 20% by the target year 2010. This will greatly contribute to the goal of reducing water as advocated in the Socio-economic Development Project which is the basic plan in Jordan.

The Northern Governorates Water Administration (NGWA) which is the competent agency for the WAJ in the North District and North Shouna ROU (regional operating unit) office, its subsidiary, will actually operate and maintain the Project facilities. The existing water supply facilities where complex operations have become the norm will be improved under the Project. Therefore, the number of maintenance-related operations will be alleviated. The North Shouna ROU office has 90 personnel with substantial experience and accomplishments in the maintenance of the North Jordan Valley water supply system. Consequently, no problems resulting from maintenance incompetence are expected.

The water sector at the WAJ, the top agency of the NGWA, faces a deficit every year, and its cumulative deficit increases annually. In order to promote sound management, measures for improving revenue and expenditures through a revision of realistic water charges should be taken. At the present time, the United States Agency for International development (USAID) is providing technical assistance from an institutional and organizational point of view, including an analysis of the cost price for water and establishing water charges. Since projects that are designed to improve the water supply system for the purpose sound management of the WAJ are being implemented through the European Investment Bank (EIB), KfW, Italy and syndicated loans from the World Bank, even in greater Amman which accounts for 40% of service load in Jordan, a sharp reduction in maintenance cost is expected at completion in 2005. The NGWA state of finances shows an annual deficit so it is forced to rely on government subsidies or overseas grant aid. An increase in accounted water volume is anticipated due to reductions in leakage following the implementation of the Project and this is expected to contribute to sound management. However, in order to promote radical sound management, after technical assistance is provided by the USAID from an institutional and organizational point of view, it would be appropriate for the WAJ to review its water charging system.

From the environmental aspects, there is the issue of disposing of old asbestos pipes due to replacement. As a result of discussions with the agency concerned in Jordan (Ministry of Environment), we were able to obtain confirmation that existing asbestos pipes would not be removed and instead left buried underground. Since the existing asbestos pipes are buried very deep, no environmental problems are expected. The locations of existing asbestos pipes have been specified and recorded through drawings. In addition, the prepared drawings will be distributed to the concerned authorities such as the WAJ and the Ministry of Environment.

In the interests of efficient implementation of the Project and its sustainable operation and maintenance, the WAJ, the NGWA and the North Shouna ROU office should carry out the following upon completion.

Undertakings taken by the Jordanian side

- Security and land creation for constructing reservoirs
- Laying of distribution branch pipes
- Laying of water supply connecting pipes at each household
- Lead-in of electrical wiring
- Lead-in of telephone lines
- Securing of increase in water supply necessary for project sites
- Securing of technical staff involved in operation technology at water supply facilities and guidance on technology to control the SCADA system

In implementing the Project through the grant aid scheme of the Government of Japan, although the above-mentioned undertakings are expected of the Jordanian side, the intensions of Jordan have been confirmed. Consequently, implementation of the Project and its importance remains high, and its relevance is also considered to be high.

CONTENTS

CHAPTER 1

BACKGROUND OF THE PROJECT

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BACKGROUND OF THE PROJECT

The North and Middle Districts of Jordan Valley, which subject to the Project, are located in the heavily eroded Jordan River Valley at an elevation near or below sea level. Here, the headwaters of the Jordan River flow south from the Sea of Galilee (Lake Tiberius) and empty into the Dead Sea, creating a fertile agricultural zone across the river basin. Despite a temperate climate during the winter season, temperatures soar in all other seasons, the average temperature reaching 40℃ in the summer. Most of the relatively affluent population resides in highland towns such as Amman and Irbit. The unemployment rate in the Jordan Valley is high at approximately 30%, the highest in Jordan.

In these districts, pipelines including asbestos pipes laid in 1978 have been deteriorating, and there is significant leakage occurring. Due to the conspicuous obsolescence of pumping systems and reservoirs, etc., the water supply cannot keep up with the increasing number of residents living at the foot of the mountains which has taken place in recent years. The problem of insufficient feed water pressure for consumers has become evident. In order to maintain am adequate level of feed water pressure, the problem is being addressed through complicatedly system of valves installed at minutely-zoned reservoirs. However, due to the haphazard way in which repairs have been carried out, the existing water supply system has become extremely complex and the system cannot be adequately operated simply through valve operation. Therefore, a radical solution including a review of the existing water supply system has been requested. Measures taken by Jordan for the said districts through the project include the reduction of leakage in four (4) provinces in the northern Jordan Valley (Irbid, Mafraf, Ajloun and Jarash) which began in 2003 with aid from KfW. At present, a conceptual design has been completed and the sequence of undertakings according to priority is being made so that major projects can get underway. In three (3) provinces in the Middle Region including the Middle District of the Jordan Valley (Zarqa, Madaba and Balqa), feasibility studies (F/S) are underway employing a local consultant firm through independent funding of the Water Authority of Jordan (WAJ). The priority of future project sites is now being discussed. Compared with other districts, generally speaking, the water policy in North and Middle districts of the Jordan Valley is lagging behind, with Jordanian measures still in the early stages.

Taking the above-mentioned plan into account, Jordan made a request to Japan for a grant aid scheme for upgrading and expansion of existing water supply facilities in the North and Middle districts of the Jordan Valley where measures for water policy especially have fallen behind. The Project aims at improving current water supply conditions by reducing the amount of leakage and increasing service per capita through the improvement and expansion of the existing water supply facilities within the project sites.

Through its grand aid scheme, Japan has implemented a water supply project in metropolitan areas such as Zarqa city, and Jordan has made a request for cooperation to the water supply sector in succession to the Government of Japan. In response to the request, and in order for the Government of Japan to implement a basic design study for the Project, the Japan International Cooperation Agency (JICA) dispatched a basic design study team from July 17 to September 2, 2004. The study team discussed the request contents with the concerned parties from the Government of Jordan and the Water Authority of Jordan (WAJ), carried out a study of current conditions at the project sites, and collected related materials.

The Project aims at improving the water supply conditions in rural residents by reducing a leakage amount through remodeling and improvement of the existing water supply facilities. Consequently, a service volume from each supply facility should be accurately grasped. The Project will conduct water supply control by introducing the SCADA system. Since the introduction of the SCADA system is one of the water policies in Jordan, the Project will plan to introduce the system

CHAPTER 2

CONTENTS OF THE PROJECT

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CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Overall Goal and Project Purpose

Jordan aims at improving water supply conditions by

① reducing the rate of the unaccounted for water,
② optimising exploitation of water sources according to the priorities of the maximum economic benefit, and
③ Increasing individual's share of domestic water

These are listed by the water and irrigation department in the socioeconomic development plan, which is the overall goal of the Project. The Project aims at improving residential life in the Project site (North Jordan Valley and northern part of Middle Jordan Valley) by upgrading the usage rate of limited water resources and increase in a water supply amount per capita by replacing the existing transmission pipes and distribution main pipes including asbestos pipes, by renewing pump stations, increasing the capacity of distributing reservoirs, SCADA system installation, and by providing distribution branch pipe materials.

2.1.2 Outline of the Project

To achieve the above-mentioned goals under the Project, the investment and activity plan is as follows. Consequently, the water supply in North Jordan Valley and northern part of Middle Jordan Valley will increase and the living conditions of residents will improve.

(1) Requested Japanese Assistance

① Replacement of main distribution pipes and pipes
② Replacement of pump stations
③ Expansion of reservoirs
④ Construction of the SCADA system
⑤ Provision of distribution branch pipes
⑥ Guidance on the SCADA system operation (Soft Component)

(2) Items to be implemented by the Jordanian side

① Construction to replace distribution branch pipes

② Procurement of materials necessary to replace each household service pipe and construction for replacement
③ Land reclaim and leveling for reservoirs
④ Arrangement of personnel necessary for application of the new SCADA system and maintenance of the transmission and distribution system
⑤ Necessary budgetary steps for the above-mentioned construction, operation and maintenance

(3) Facility Contents under the Project

A comparison between the requested contents confirmed by Jordan at the signing of the M/D of the Basic Design Study and facility contents finally formulated in the basic design is shown in Table 2-1-1.

Table 2-1-1 Comparison between Requested Contents and Facility Contents

Item	Requested Contents		Planned Contents		
	Specifications	Quantity	Specifications	Quality	Remarks
1. Replacement of distribution pipes					
Distribution Main／Transmission Pipes (Replacement to ductile pipes)	Diameter 100 to 300mm	52km	Diameter 100 to 400mm	61km	Japanese side will bear both materials and construction.
Distribution Branch Pipes (Replacement to HDPE pipes)	Diameter 20 to 50mm	50km	Diameter 50mm	74km	Materials procurement & laying construction will be taken by the Japanese side and Jordanian side respectively.
2. Renewal of pump stations					
Adasiyya Pump Station	For Mukaiba／Al-Adasyeh $Q=50m^3/h$, H =350m $Q=80m^3/h$, H =250m	2 units (Duty + standby)	For Mukaiba $Q=56m^3/h$, H =274m	2 units (Duty + standby)	Construction of pump house is included
			For Al-Adasyeh $Q=32m^3/h$, H =74m	1 unit	
Tabaqat Fahil Pump Station	Submerged Pump (Well No.9) $Q=50m^3/h$, H =150m	1 unit	$Q=160m^3/h$, H =10m	1 unit	Construction of pump house is included
	For Tabaqat Fahil $Q=75m^3/h$, H =125m $Q=50m^3/h$, H =150m	2 units (Duty + standby)	For Tabaqat Fahil Reservoir $Q=188m^3/h$, H =64m	3 units (2 duty + standby)	Construction of pump house is included
	-	-	Receiver Tank （$380m^3$）	1unit	
Waji Rajeb Pump Station	Booster Pump $Q=50m^3/h$, H =150m $Q=20m^3/h$, H =200m	2 units (Duty + standby)	Excluded form the Project		
Kreyma Pump Station	-	-	Booster Pump $Q=163m^3/h$, H=40m	2 units (Duty + standby)	Construction of pump house will be included
3. Reservoir Remodeling					
Moa's Reservoir	$650m^3$	1 unit	$1,600m^3$	1 unit	
Sleikhat Reservoir	$500m^3$	1 unit	Excluded form the Project		
Tabaqat Fahil Reservoir	$650m^3$	1 unit	$2,500m^3$	1 unit	
Kreyma Reservoir	$600m^3$	1 unit	No remodeling, newly installation of only booster pump		
Rajeb Reservoir	$1,000m^3$	1 unit	Excluded form the Project		
4. SCADA System	Measuring instruments (flow meters, water pressure gauges) for remote monitoring, central monitoring system at the North Shouna ROU office & data transmission devices	1 set	Measuring instruments (flow meters, water pressure gauges) for remote monitoring, central monitoring system at the North Shouna ROU office & data transmission devices	1 set	Only areas under the jurisdiction of North Shouna will be subject to the installation.

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

(1) Scope of the Basic Design

The Project covers the entire North Jordan Valley and a part of the Middle Jordan Valley. The North Shouna Regional Operation Unit (ROU), a sub organization of the Northern Governorates Water Administration (NGWA), and the Middle District Office, a sub organization of the AGWA, have jurisdiction over the water supply in North Shouna and Middle District respectively. Since the water transmission and distribution systems of the two project sites should be treated as perfectly independent from the viewpoint of both water balance, and operation and maintenance, these are taken into account in the formulation of the Project.

For water supply facilities in the Middle District, some water transmission and distribution pipelines and water transmission facilities (water reservoirs and booster pumps) will be subject to the repair. However, the water transmission facilities are required to be taken as one component of the entire water supply system in the Middle District, therefore necessary repair should be made simultaneously with other facilities in the entire system with its function evaluation. Repairing the water transmission facilities only under the Project would be far from a realistic and rational method. For such reason, rehabilitation for the Middle District should be limited to transmission and distribution pipelines in the subject areas. Water reservoirs and booster pumps will be excluded from the scope of the Project, because their repairs could be included in the scope of the entire rehabilitation plan of the Middle District which will be formulated in near future.

For the Middle District, this report describes only the design conditions related to the water transmission and distribution pipes in subject areas and presents the other contents for reference.

(2) Design Concept for Facility Rehabilitation

As strongly requested by the Jordanian side, the Project will take account of not only individual repair of the existing facility, listed in the request letter by Jordan, but also the effective utilization of potential energy by regarding the total water transmission facilities as a system.

1) Current State of the Existing Water Supply System

a. Water Supply System in the North District

The existing water supply system in North Shouna ROU consists of five sub-systems with their production wells (tentatively, Area-A, B, C, D and E). Production wells in

Area-A and B, located in the central northern region, yield relatively large water discharge and provide water from one well within each area. In contrast, in the southern region water discharge from production wells in Area-C, D and E is so small that the use of multiple wells is applied to sending water for service areas. Fig. 2-2-1 shows the outline of the water supply system of the entire North Shouna ROU, and Fig. 2-2-2 to 4 shows water supply sub-system of respective water service area. As shown in the sub-system of Area-B, the well source for Tabaqat Fahil service area differs from that of other areas in Area-B, i.e. Tabaqat Fahil Well No.5.

b. Water Supply System in the Middle District (for reference)

As a reference, the existing water supply system in the Middle District is shown in Fig. 2-2-5. Water supply to Dair Alla, located in the center of the Middle District, is done utilizing the Dair Alla booster pumps from main distribution pipes laid along the main road. However, the booster pumps are required to be repaired at any moment considering very bad current conditions. In this Project, Rajeb Water Reservoir and booster pumps installed close to the reservoir are excluded from the scope of the Project, because the capacity of the water reservoir and specification of the booster pumps are needed to be determined simultaneously with the Dair Alla booster pumps by examining the overall system of the Middle District.

2) Rehabilitation of the Existing Water Supply System

Geographical features of water service areas show narrow and long, from east to west and from south to north respectively, where a large number of residents are increasing at the foot of the mountains on the eastern side of the trunk road running south to north. Consequently, the problem of deficiency in water pressure at higher elevations or in remote areas has being significant. Therefore, the Project includes the formulation of the countermeasures to eliminate the problem. Specifically, in rehabilitation planning for existing water reservoirs, necessary water pressure will be secured by moving the reservoir to higher levels as well as reservoir volume expansion. For the Kreyma reservoir located in the southern region, the installation of new pump equipment will be planned to raise supply water pressure from the water reservoir because the acquisition of an appropriate land can not be secured for the reservoir. In addition, pressure reducing valves will be planned to install in water supply pipe lines to eliminate the problem of excessive water pressure in lower distribution zones.

Then again, since existing transmission and distribution pipes at the Project site were laid under extremely complicated conditions, based on the claims of consumers up to the present it is possible these pipes were improved in a haphazard fashion. As a consequence, valve operation is much more difficult during rationing water supply service in the summer season, so it is hard to confirm if rationing water supply service is normally carried out. The Project is designed to improve the system for easy operation of valves by simplifying the existing water supply pipelines as much as possible.

Furthermore, in order to promote reasonable operation and maintenance of the water supply, a monitoring system it is planned to install. Since water supply amount from the headwater and receiving amount at the water service area are subject to monitoring, dates will be respectively collected on the water supply side using the SCADA system and on the receiving side by installing a flow meter in water supply pipes.

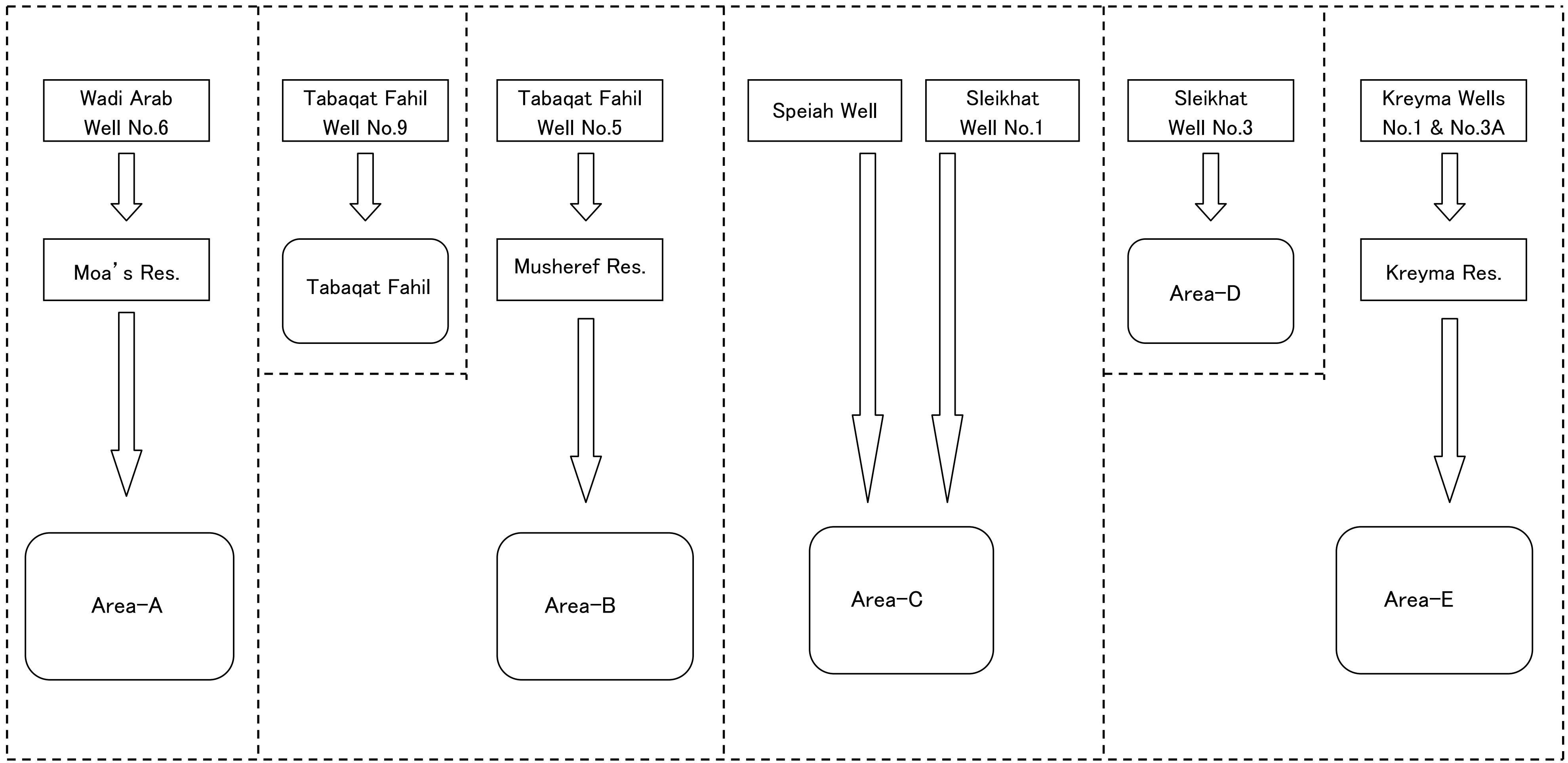


Fig. 2-2-1 Conceptual Drawing of the Existing Water Supply System in North District

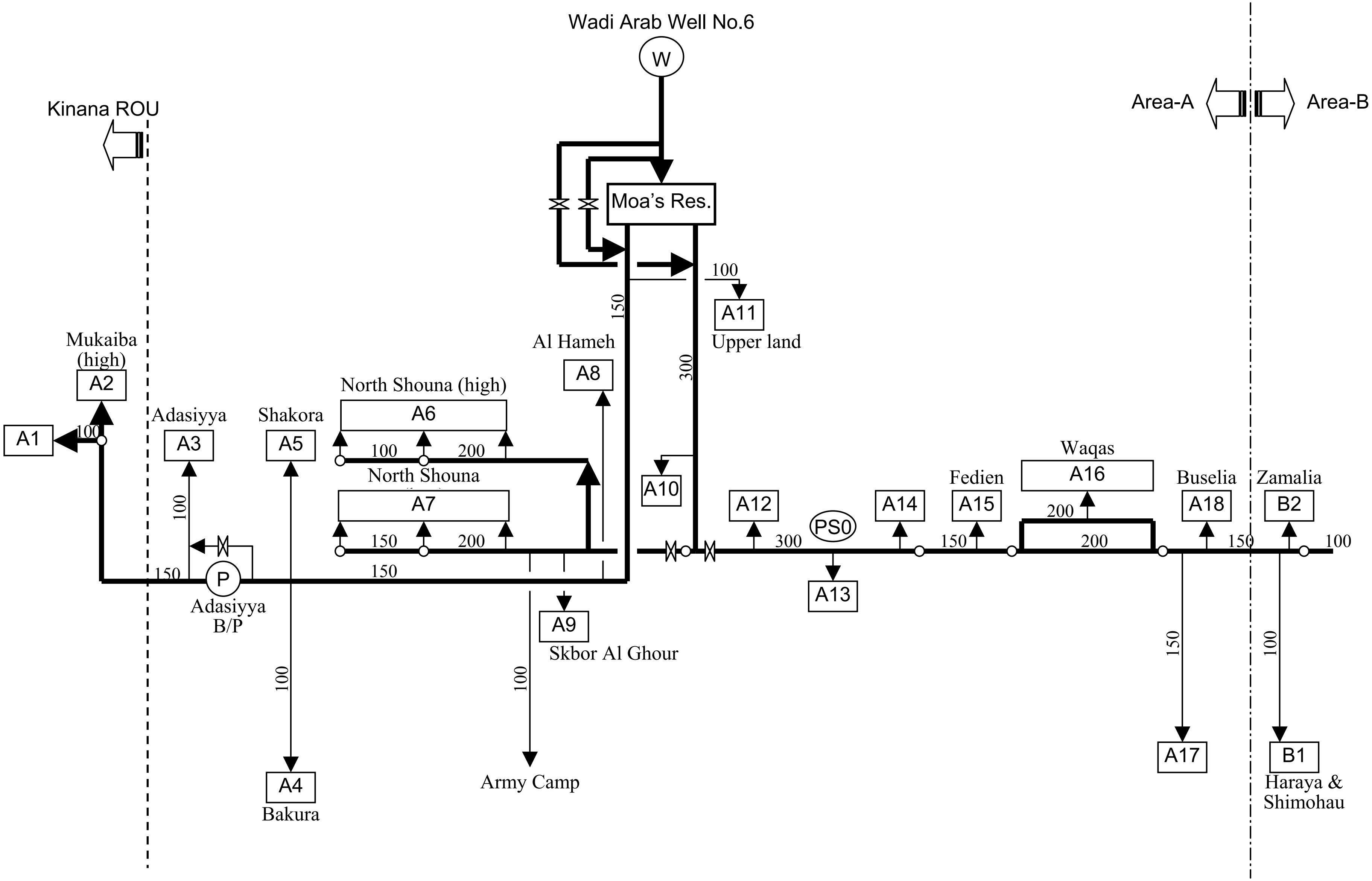


Fig. 2-2-2 Existing Water Supply System in North District (Area-A)

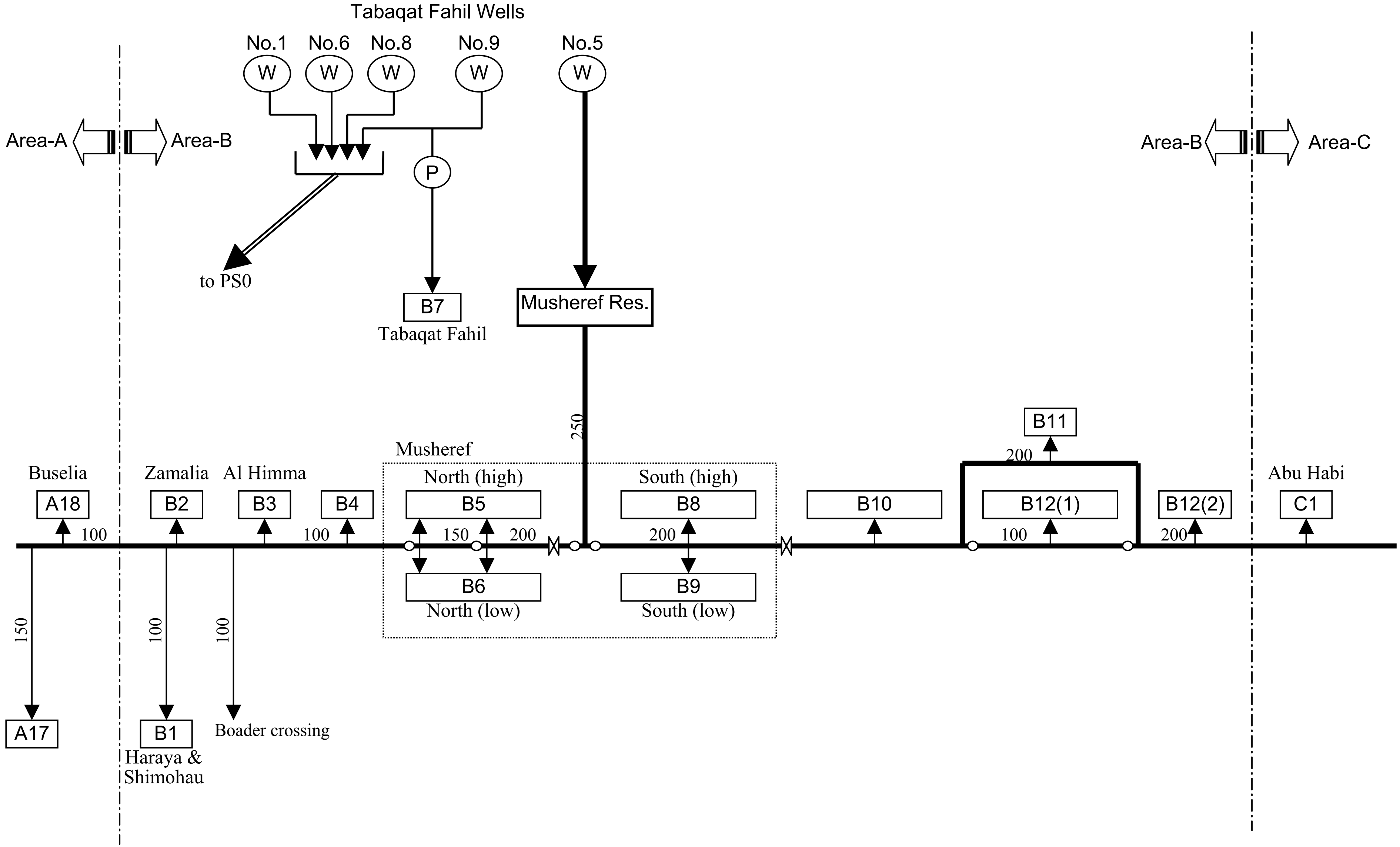


Fig. 2-2-3 Existing Water Supply System in North District (Area-B)

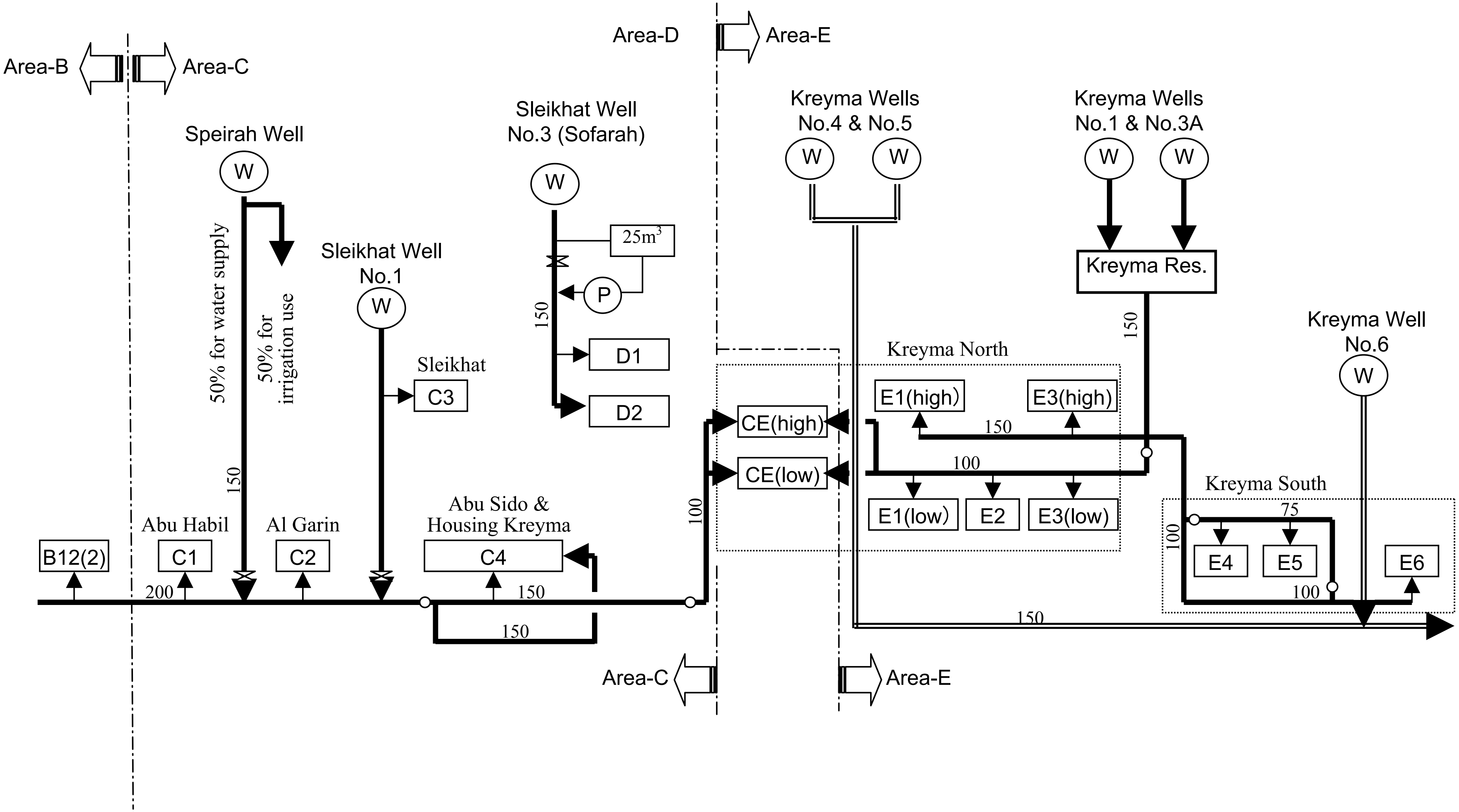


Fig. 2-2-4 Existing Water Supply System in North District (Areas-C, D and E)

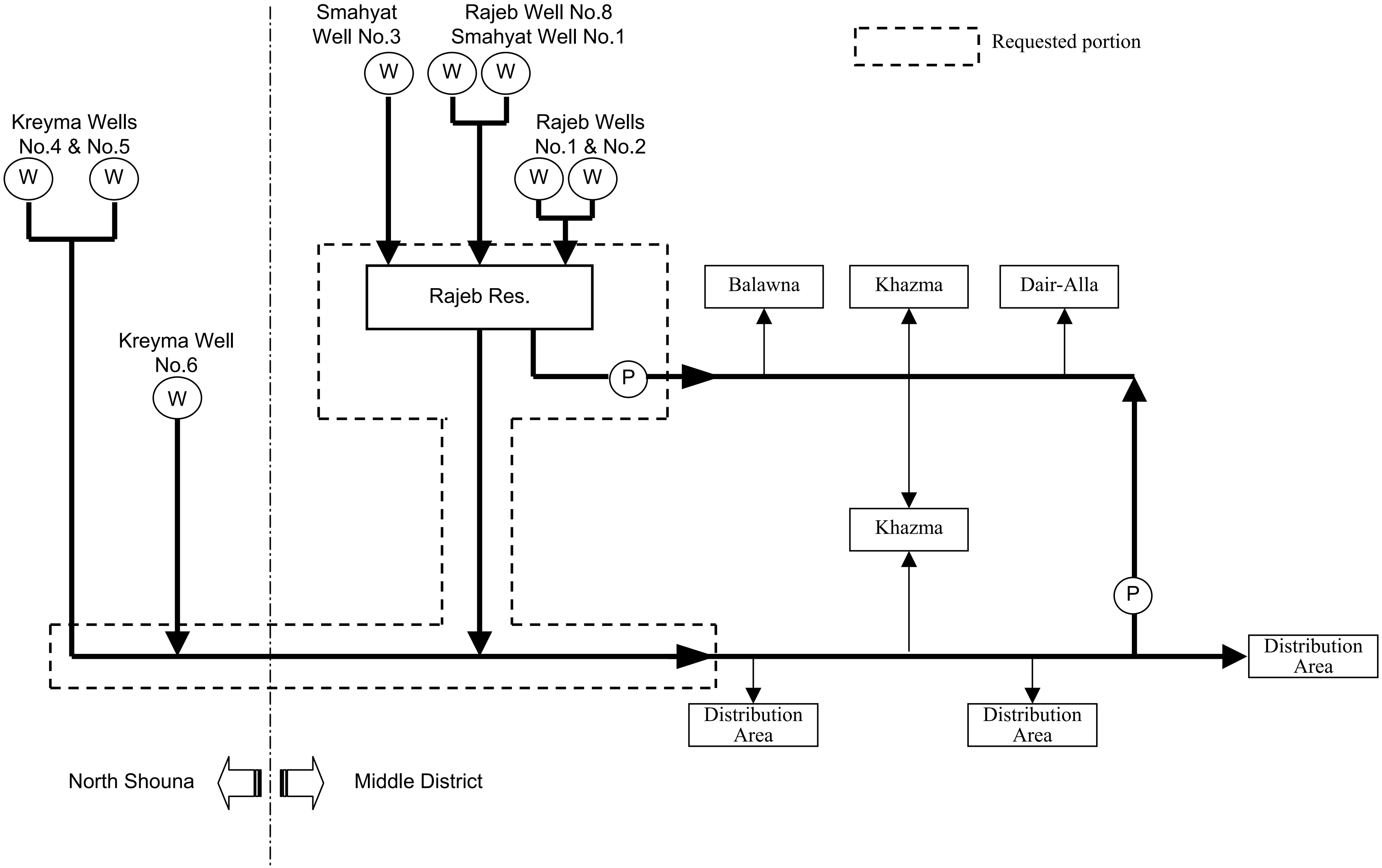


Fig. 2-2-5 Existing Water Supply System in Middle District (Reference)

(3) Design Concept for Natural Conditions

1) Meteorology

The Project site is located at the bottom of the Jordan Valley. The average monthly temperature is 12℃ in winter and 40℃ in summer. Accordingly, countermeasures against frost in the winter are unnecessary under the Project. Laying of water transmission and distribution pipes is justifiable from a structural point of view if a minimum covering of soil can be secured. In addition, thermal insulation work at pumping stations is not required. On the other hand, during the summer when temperatures are high, ventilation should be examined at pumping stations and electrical facilities.

2) Topography and Geology

Geological conditions at the Project site mainly consist of a gravel layer, sand bed and cobble-mixed gravel layer which are suitable for supporting the foundation structure.

Underground water level is low except for the Tabaqat Fahil source, so taking level into account in the planning of underground structures is unnecessary. The underground water level at the Tabaqat Fahil rservoir is expected to be higher then GL-5.5m from monitoring of water levels at the shallow well (Well No.9). Therefore, foundation structures should be installed taking underground water level into account. In addition, necessary measures for underground water should be taken in the planning of buried pipes in the said area.

3) Seismic Load

The seismic coefficient should conform to standards established by the Government of Jordan.

(4) Design Concept for Construction Conditions or Special Conditions in the Industry

Although expressways, roads and private residences are in operation at the present time at the Project site, rural communities and residential areas account for most of the said site so that there are not many local builders. Consequently, local builders in Ibid and Amman should be employed efficiently.

(5) Design Concept for Utilization of Local Contractors

General construction machinery such as back hoes, dump trucks, cranes, concrete mixers can be leased from local construction companies. General construction materials such as ready-mixed concrete and reinforcing steel can be procured locally. Whether or not mold forms and ground supports (internal scaffolding) will be supplied locally or procured from Japan will be decided based on profitability.

However, mass quantities and diversified construction works should be conducted simultaneously, making it necessary to formulate a comprehensive construction plan and to carry out schedule control, equipment and materials procurement management, quality control and safety management

Schedule control, quality control and safety management will be carried out through the dispatching of necessary engineers from Japan.

Key engineers to be dispatched from Japan are as follows:

- Engineers specialized in reservoir construction to ensure water tightness
- Engineers specialized in pipeline construction in urban districts and trunk line roads, and aqueduct construction
- Technicians for machinery and electricity of pump stations
- Engineers specialized in the SCADA system and soft component program

(6) Design Concept for Setting up Equipment Grades

Materials for main water supply pipes are prescribed in the WAJ criteria and include ductile cast iron pipes, steel pipes and high density polyethylene (HDPE) pipes. The Project will adopt ductile cast iron pipes of good reputation in Jordan of excellent workability and profitability. The specific contents to be examined will be described in 2.2.2 Basic Plan.

With respect to materials for distribution branch pipes (including fittings and valves), of specified products standardized by the WAJ, high density polyethylene (HDPE) pipes of good reputation and with excellent profitability will be adopted for branch pipes subject to the provision. Since the quantity subject to replacement tends to increase sharply over the requested quantity from the survey, budgetary measures of WAJ engaged in the work should be confirmed. The actual contents to be examined will be described in 2.2.2 Basic Plan.

(7) Design Concept for Construction Method and Period

In the implementation of actual work, the daytime temperature in summer is expected to reach 40℃. Therefore, concrete should be poured at night. Ready-mixed concrete for concrete work is scheduled to be procured from a ready-mixed concrete trader in Irbid at water reservoirs in consideration of quality and pouring volume.

The construction process for water reservoirs will be established first under the Project. Since the extension of main distribution pipes is approximately 61km, the total optimum process will be determined through the establishment of an appropriate number of teams.

As upgrading of the distribution pipeline network to be executed by the WAJ under the Project is also included, the work process of the Project should be formulated with sufficiently consideration given to the construction process for upgrading of the pipeline network.

When laying pipelines in urban districts, roads should be recoverable on the same day or within a short period of time. Therefore concrete work at sites should be avoided as much as possible and effective use of ready-made products examined.

(8) Environmental Considerations

Unnecessary asbestos pipes left due to replacement under the Project will not be removed and buried. After construction, a map showing the burial sites of the existing asbestos pipes should be prepared and submitted to the WAJ and the Ministry of Environment for easy identification.

(9) Traffic Situation

General roads in service will be excavated for pipeline construction under the Project. In particular, the trunk line running south to north in the Project site is a core road of material and human transportations in Jordan Valley. A construction plan should be formulated in due consideration of less traffic hindrance under close contact with the traffic authorities. In addition, in the case of construction, necessary safety measures should be taken by installing safety signs or safety facilities and arranging traffic personnel in due consideration of environmental safety.

2.2.2 Basic Plan

2.2.2.1 Design Conditions

(1) Target Year

The target year of this project shall be 2010 considering its urgency, which is a basic requirement of Japanese grant aid cooperation, approximately three years after the completion of facilities (end of 2007 anticipated). Then again, since 2003 is regarded as the base year, the prospects of the target year will be based on data from the base year.

(2) Project Site and Planned Service Population

1) Project Site

The Project will cover areas under the jurisdiction over North Shouna ROU from Al Adasiyya in the northern part to Kreyma in southern part of North District. Since water in North District is also supplied to some areas (Mukaiba) under the jurisdiction of Kinana ROU (refer to Fig. 2-2-2), the service population in this area should be included in the Project.

Although some municipalities shown in Table 2-2-1 located in the northern part of Middle District will be subject to the Project, with respect to the improvement in water supply pipes subject to the Project, not only the service amount for this area but also the total water supply system including the service amount to other areas should be evaluated. The Project will examine the site based on transmission amount from existing reservoirs instead of formulating an improvement plan for pipelines based on the planned service population in the Middle District. Of the total number of distribution pipes subject to repair under the Project, the existing asbestos pipes will be replaced. In addition, water supply volume from headwaters in the target year is expected to remain at the current volume, and diameters will be decided based on this volume.

2) Planned Service Population

a. Current Service Population

The administrative population in North District and Middle District is shown in Table 2-2-1 and Table 2-2-2 as reference respectivelly.

Table 2-2-1 Administrative Population in North District (2003)

Administrative Division (Municipality Name)	Administrative Population
Al Adasiyya	2,663
Skhor Al Ghour	16,588
Al Baqoura	853
Mouath	7,510
Al Himma	368
Tabaqat Fahil	20,333
Qulayat	6,702
Qanat Al Malik Abed Allah	17,478
Ghour Fara	1,357
Ghour Al Wahadna	22,933
Total	96,785

Source) Department of Statistics, Jordan

Table 2-2-2 Administrative Population of Middle District (for reference)

Administrative Division (Municipality Name)	Administrative Population
Balawna	5,679
Khazma	2,733
Al Rwaida	3,108
Dair-Alla	6,077
Total	17,597

Source) Department of Statistics, Jordan

Although the service population can be obtained by multiplying the administrative population by the water supply diffusion rate, there is no data on the water supply diffusion rate. Assuming that the water supply diffusion rate within North District is a figure close to 100% based on the water supply pipeline laying drawings of WAJ, both service population at the present time and the target year is assumed to be equal to the administrative population. In addition, water distribution areas set up based on source wells do not always coincide with administrative divisions. Therefore, based on data on the number of water supply customers from the GIS database of WAJ, the service population per service area in North District is determined by distributing the administrative population in each service area (Table 2-2-3). Since the service population includes the Mukaiba area which is an area under the jurisdiction of Kinana ROU, the service population was calculated based on the number of customers being supplied and was added to the service population for the North District. The Tabaqat Fahil area utilizes water source differently than the North District, so the amount of distribution cannot be clarified. Consequently, when current water supply conditions were evaluated it was excluded from North District.

Table 2-2-3 Service Population in North District (2003)

Water Supply Classification	Source Well	Competent Agency	Service Population
Area-A	Wadi Arab Well No.6	Kinana ROU (Mukaiba)	4,937
		North Shouna ROU	41,639
		Sub-total	46,576
Area-B	Tabaqat Fahil Well No.5 (Tabaqat Fahil Well No.9)	North Shouna ROU (Tabaqat Fahil Village)	29,625 (31,270)
Area-C	Speirah Well (50%) + Sleikhat Well No.1	North Shouna ROU	8,112
Area-D	Sleikhat Well No.3 (Sofarah)	North Shouna ROU	2,170
Area-E	Kreyma Wells (No.1 and No.3A)	North Shouna ROU	13,594
Total			100,077 (101,722)

Remarks) Numerical figures in ( ) indicate Tabaqat Fahil Village, where the water source is different from North Shauna ROU, is included in the service population.

b. Planned Service Population

The estimated service population in North District for the target year, which was based on the service population of the base year shown in Table 2-2-3, is demonstrated in Table 2-2-4. Therefore, this is regarded to be the planned service population for the target year. The planned service population includes the Tabaqat Fahil area, which was excluded from the service population in Area-B at the time the current water supply conditions were evaluated.

Table 2-2-4 Planned Service Population in North District (2010)

Distribution Division	Service Population (2003)	Service Population (2010)
Area-A	46,576	53,569
Area-B	29,625	34,073
Tabaqat Fahil Village Area	(1,645)	1,892
Area-C	8,112	9,330
Area-D	2,170	2,496
Area-E	13,594	15,635
Total	100,077 (101,722)	116,995

Population increase rate) 2.242% (2003-2008), 1.927% (2008-2010)

(3) Planned Leakage Rate

a. Current Leakage Rate

According to the Report on the Conceptual Design of “Water Loss Reduction Program in the Northern Governorates” (46 months from September 2003) implemented in the cooperation of KfW, in 2003 the indistinct water rate in North Jordan Valley was 53%. However, its breakdown is unknown. The indistinct water rate is divided into leakage rate due to physical leakage from pipelines and unaccounted-for water rate for which charges cannot be collected even though water is actually utilized. A reduction in leakage rate can be directly expected through the Project, whereas, the unaccounted-for water rate should be improved though water supply facilities or operation and maintenance of the organization. Therefore, it is difficult to establish a goal value. Accordingly, the Project will only establish a planned leakage rate.

For the purpose of estimating the present leakage rate, leakage testing of one village (Al-Adassiya) in North District was carried out. With the cooperation of Uncounted for Water (UFW), is subordinate organization of the WAJ, leakage testing was implemented. As a result, the present leakage rate in North District was estimated to be approximately 30%. On the assumption that the leakage rate is proportioned to water pressure by obtaining 48-hour continuous water pressure data in the case of installing a water pressure gauge in service pipes within villages for testing leakage, a method to identify the leakage amount based on a change in recorded data was applied.

b. Planned Leakage Rate

The report described earlier placed the planned leakage rate in 2005 and in 2015 to be 20% and15% respectively. In addition, in a similar project in Jordan, the planned leakage rate in 2010 is shown in the following table. However, it is difficult to quantitatively grasp the reduction effects of leakage with regards to facility improvement. The Project will set a planned leakage rate in the target year of 20% based on the above-mentioned report, a similar project in Jordan, and advice from related agencies.

Study or Project Name	Planned Leakage Rate (%)	Remarks
Target of Program Management Unit of WAJ	18	Irbid
Japanese Grand Aid in Zarqa (under construction)	20	Zarqa
Northern Governorates Water Transmission F/S	26	

(4) Planned Water Supply Amount

1) Present Water Supply Conditions

a. Service Capacity

The water supply in North District is managed through source wells, so there is no utilization of other water resources. As shown in the written request by Jordan, all of Sleikhat's spring water is used for irrigation and is not utilized for the water supply at the present time. In a similar manner, 50% of the water at the Speirah well shown in the written request is utilized for the water supply and the remaining 50% is utilized for irrigation.

It is pointed out that excessive pumping from wells is becoming a problem in Jordan. Therefore, the development of new wells is prohibited. With respect to existing wells, the current pumping level should not exceed the current level of pumped water. Based on the existing well date, it will be possible to maintain current water supply volume even in the target year. Accordingly, the Project will formulate a plan for the target year based on the amount of production at the current wells. The water supply capacity (annual average, annual maximum) of source wells per service area is shown in Table 2-2-5 and production volume by month is shown in Fig. 2-2-6.

Table 2-2-5 Water Supply Capacity of Source Well in North District (2003)

Unit: m^3/h

Source Well	Annual Average	Annual Maximum	Fluctuation (peak) Factor
Wadi Arab Well No.6	194.2	241	1.24
Tabaqat Fahil Well No.5	165.2	210	1.27
Speirah Well (50%) + Sleikhat Well No.1	41.0	50	1.21
Sleikhat Well No.3 (Sofarah Well)	11.8	26	2.17
Kreyma Wells (No.1 and No.3A)	63.2	79	1.25
Total	475.5	-	-

Remarks) Although part of the production volume at the Tabaqat Fahil Well is distributed only to the Tabaqat Fahil area, its volume cannot be clarified based on the data, so it was excluded from the water supply amount from source wells in North District.

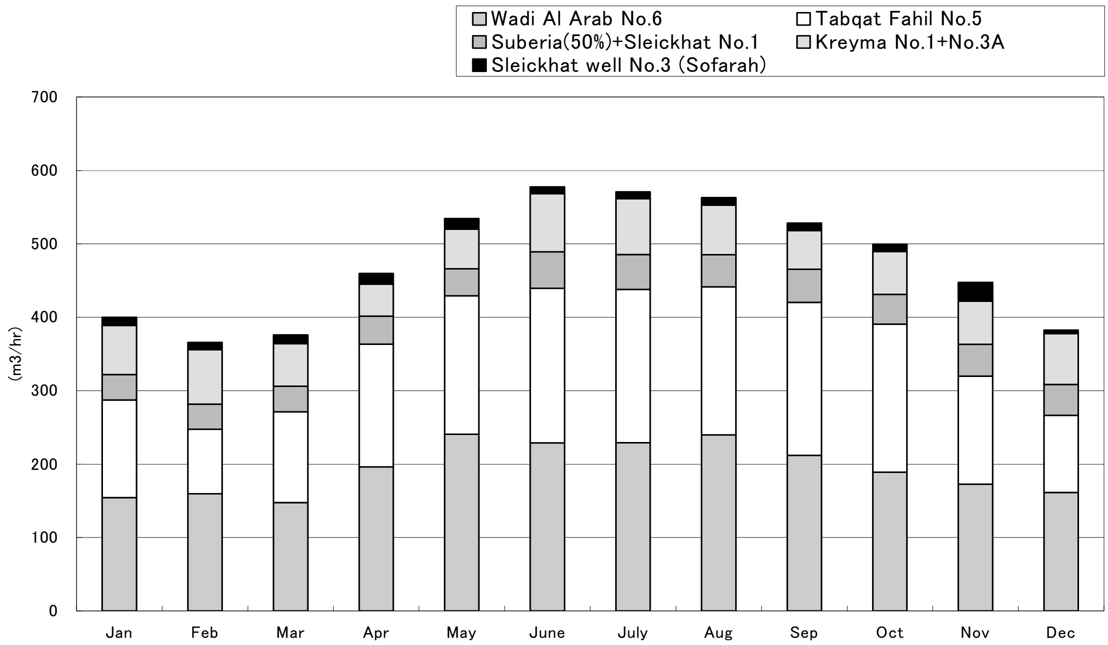


Fig. 2-2-6 Water Supply Capacity by Month from Source Wells in North District (2003)

b. Water Supply Amount

The water supply amount in North District is equal to production volume from wells. Water supply distribution zone and daily average water supply per capita are shown in Table 2.2-6. The daily average water supply per capita in North District is 114 ℓ/c/d.

Table 2-2-6 Water Supply Amount in North District and Daily Average Water Supply per Capita (2003)

Distribution Zone	Source Well	Daily Average Water Supply (m^3/h)	Service Population	Water supply per Capita (ℓ/c/d)
Area-A	Wadi Arab Well No.6	194.2	46,576	100
Area-B	Tabaqat Fahil Well No.5	165.2	29,625	134
Area-C	Speirah Well (50%) + Sleikhat Well No.1	41.0	8,112	121
Area-D	Sleikhat Well No.3 (Sofarah)	11.8	2,170	131
Area-E	Kreyma Wells (No.1 and No.3A)	63.2	13,594	112
Entire North District		475.5	100,077	114

Remarks) Tabaqat Fahil area, where the water source is difference from that of North Shouna ROU, is excluded.

2) Planned Water Supply Amount

a. Planned Daily Average Water Consumption per Capita

A feasible and proper value will be adopted as the planned daily water consumption per capita which will become the base of the Project based on the estimated value of the current water supply amount, values adopted from the similar project in Jordan, and the discussions with related agencies.

Dairy average water consumption per capita at the base year in North District can be estimated as follows:

Dairy average water consumption = Daily water supply per capita x (1 - leakage rate)
= 114 x (1- 0.3)=80 ℓ/c/d

Since related agencies estimate the present usage amount in North District to be approximately 80 to 90 ℓ/c/d, the above-mentioned estimated value is judged to be the most accurate value.

On the other hand, a similar project in Jordan sets the daily average water consumption per capita in 2010 as follows.

Improvement of the Water Supply System for the Zarqa District	JICA	100
Northern Governorates Water Transmission F/S	USAID	100

Based on the current water supply figures (80 ℓ/c/d) and the value adopted by a similar project (100 ℓ/c/d), the planned daily water consumption per capita will be 100 ℓ/c/d.

b. Planned Daily Water Supply Amount per Capita

The planned daily average water supply amount can be obtained as follows:

Planned daily average water supply amount per capita

= Planned daily water consumption per capita/ (1- planned leakage rate)

= 100 / (1-0.2) = 125 l/c/d

c. Planned Daily Average Water Supply Amount

The planned daily average water supply amount can be obtained as follows:

Planned daily average water supply amount

= Planned daily average water supply amount per capita x planned service population

= 125 x 116,995/1000=14,624m^3/day=609.3 m^3/hour

d. Deficit of Water Supply Amount for the Target Year (2010)

The deficit portion of water supply amount for the target year (2010) can be obtained as follows:

Deficit of water supply amount (daily average)

= Planned daily average water supply amount (2010) - Daily average of water supply amount (2003)

= 609.3 - 475.5 = 134 m^3/hour

(5) Planned Load (Peak) Factor

In order to obtain the design water amount, load rate at the peak time in the daily average water amount. Since consumer water consumption fluctuates, the planned load rate in daily average water amount will be obtained by establishing seasonal fluctuation and hourly fluctuation levels for one day. The planned load factor is the parameter on which the facility scale will be decided. If this value is large, facility safety can be designed. However, if this is unnecessarily large, it will invite excessive design. Should circumstances permit, a practical value should be adopted.

1) Planned Load Factor due to Seasonal Change

A planned load factor due to seasonal change will be set at 1.3 with reference to the actual value of the source well shown in Table 2-2-5. This value was also adopted by a similar project in Jordan (Zarqa project by JICA). The planned maximum daily water supply amount can be obtained through the load factor.

Planned maximum daily water supply amount

= Planned daily average water supply amount x Planned load factor (1.3)

2) Planned Load Factor due to Hourly Daily Change

Although a planned load factor due to hourly change can be obtained from the hourly change curve of water supply amount at the Project site, there is no data which can be applied. In other similar projects in Jordan, a maximum value of 1.5 is adopted (1.5 adopted by JICA's Zarqa project). However, load factor during rationing water supply service is regarded to be different from that during normal water supply periods. Accordingly, load rate during rationing water supply service is estimated to be lower than during normal water supply periods.

The Project will adopt 1.5 as the planned load factor during normal water supply and 1.5 of the maximum load rate during rationing water supply service. Accordingly, a corrected value will be adopted as the occasion arises. Based on this planned load factor, the maximum hourly water supply amount can be obtained. The maximum hourly water supply amount was applied to the designed flow for deciding a diameter of main distribution pipes and the value at the time of implementing normal water supply was applied to the designed flow under the Project. The value at the time of limiting water supply is utilized for evaluating whether or not the decided diameter is relevant even at the time of limiting water supply.

During normal water supply (Mid-October to April):

Planned maximum hourly water supply amount

= Planned daily water supply amount (maximum daily water supply between October and April) x Planned load factor (1.5)

At the time rationing water supply service (April to mid-October):

Planned maximum hourly water supply amount

= Planned maximum daily water supply amount (1.5 or less)

(6) Reservoir Capacity

The basic method for calculating reservoir capacity is to determine how much the changed portion of daily water supply can be stored. To be more specific, water is stored at night when there is less demand, and stored water is distributed during the daytime during when the demand is high, producing an hourly fluctuation curve of water supply at the Project site. However, no applicable data is available. Although one of the purposes of a reservoir is to store emergency water, considering the current state of absolute shortages of water resources at the project site, unnecessarily large reservoir capacity is impractical. In reference to the value adopted by similar projects, existing reservoir capacity and its application results, reservoir capacity will be an amount to secure eight hours or more of the daily average water supply. The daily average water supply amount is almost equivalent to the daily maximum water supply amount at the time of normal water supply (mid-October to April).

(7) Planned Water Supply Pressure

In principle, the planned water supply pressure will be 2.5 bars to 6 bars, and this range should be maintained as much as possible. The planned water supply pressure is the water pressure of service pipes that branch off to each consumer household. The minimum water pressure is 2.5 bars, which is the direct water supply to a 4-story building. Since the planned water supply pressure is generally adopted in Jordan, if the ceiling on water supply pressure is suppressed, satisfactory results can be obtained, even for leakage countermeasures.

2.2.2.2 Total Facility Plan

(1) Water Balance in the Target Year

Water balance at the project site was examined based on the assumption of securing the water supply shortage in the target year. The daily average water supply shortage is 134m^3/hour. The Jordanian side has approved that the amount distributed to Irbid via PSO is partially allotted. In actuality, the total amount of the Tabaqat Fahil Well No.9 will be utilized in North District. When observing the flow rate implemented during the study period (summer season), production volume at the Tabaqat Fahil Well No.9 is approximately 167m^3/hour. If this is regarded to be the maximum daily supply, the average daily supply will be approximately 128m^3/hour by dividing by 1.3 of the load factor rate, which is nearly the equivalent to the water supply shortage amount. In addition, the southern Kreyma area is far from Tabaqat Fahil, so it is difficult from a hydraulic point of view to benefit from an increase in new water resources. The Jordanian side has also approved that some of the water from the Kreyma Wells No.4 and No.5 distributed to Middle District will be assigned to this region. Consequently, the total water supply in the target year will be as follows:

Supply amount for the target year (daily average)

= Supply amount for the base year
+ Production volume at Tabaqat Fahil Well No.9
+ Partial production volume at Kreyma Wells No.4 and No.5

= 475.5 (m^3/h) + 134 (m^3/h) + 20(m^3/h) = 629.4 (m^3/h)

Water balance within the project site was calculated by reviewing the current distribution zoning based on the above-mentioned water supply amount and new zoning in the target year. Distribution zones and water balance are shown in the basic design drawing (No.JWP-GN-04) and Table 2-2-7 respectively.

Table 2-2-7 Water Balance in North District

Base Year (2003)				Target Year (2010)			
Distribution Zone	Daily Average Supply	Service Population	Per Capita Average Supply (l/c/d)	Distribution Zone	Daily Average Supply	Service Population	Per Capita Average Supply (l/c/d)
Area-A	194.2	46,576	100	Area-A	194.2	38,794	120
Area-B	165.2	29,625	134	Area-B	165.2+134 =299.2	52,191	138
Area-C	41.0	8,112	121	Area-F	116+20 =136	26,010	125
Area-D	11.8	2,170	131				
Area-E	63.2	13,594	112				
Overall	475.5	100,077	114	Overall	629.4	116,995	129

(2) Transmission and Distribution Water System Plan

Based on new zoning, the pipe diameter of transmission and distribution water pipes, installation of pressure reducing valves and pump specifications were decided through hydraulic calculations. The total system drawing and hydraulic calculation results are shown in Figs 2-2-7 to 9 and Figs 2-2-10 to 14 respectively.

In addition, the Tabaqat Fahil transmission system including rehabilitation of the water pump at Well No.9, and booster pump used to send water to the Tabaqat Fahil area and Musheref reservoir will be efficiently remodeled to a water transmission system.

(3) Layout of the Total Facility

Layout of the existing facility subject to upgrading under the Project is shown in the basic design drawing (JP-GN-01 to 03).

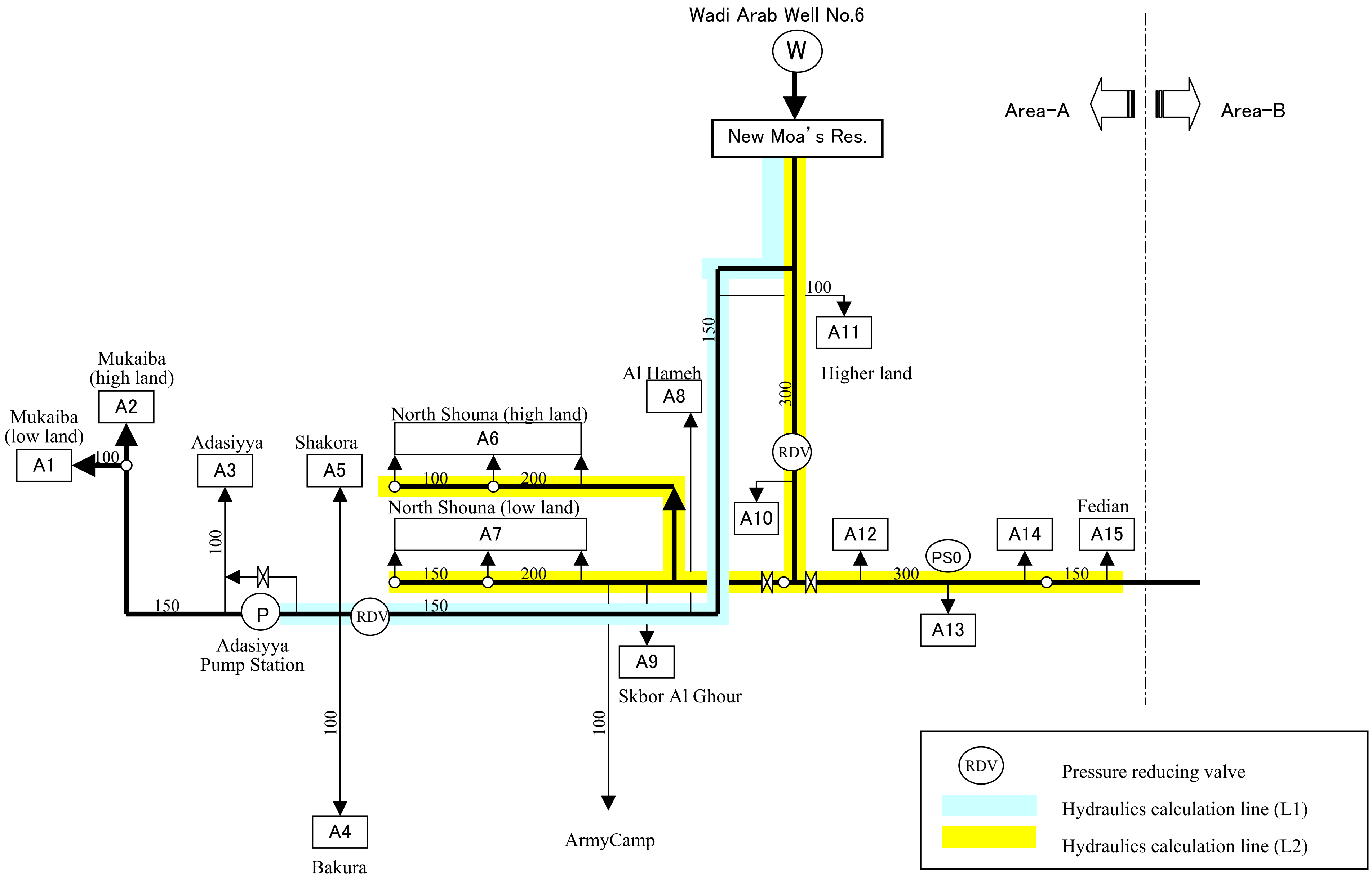


Fig. 2-2-7 Planned Water Supply System in North District (Area-A)

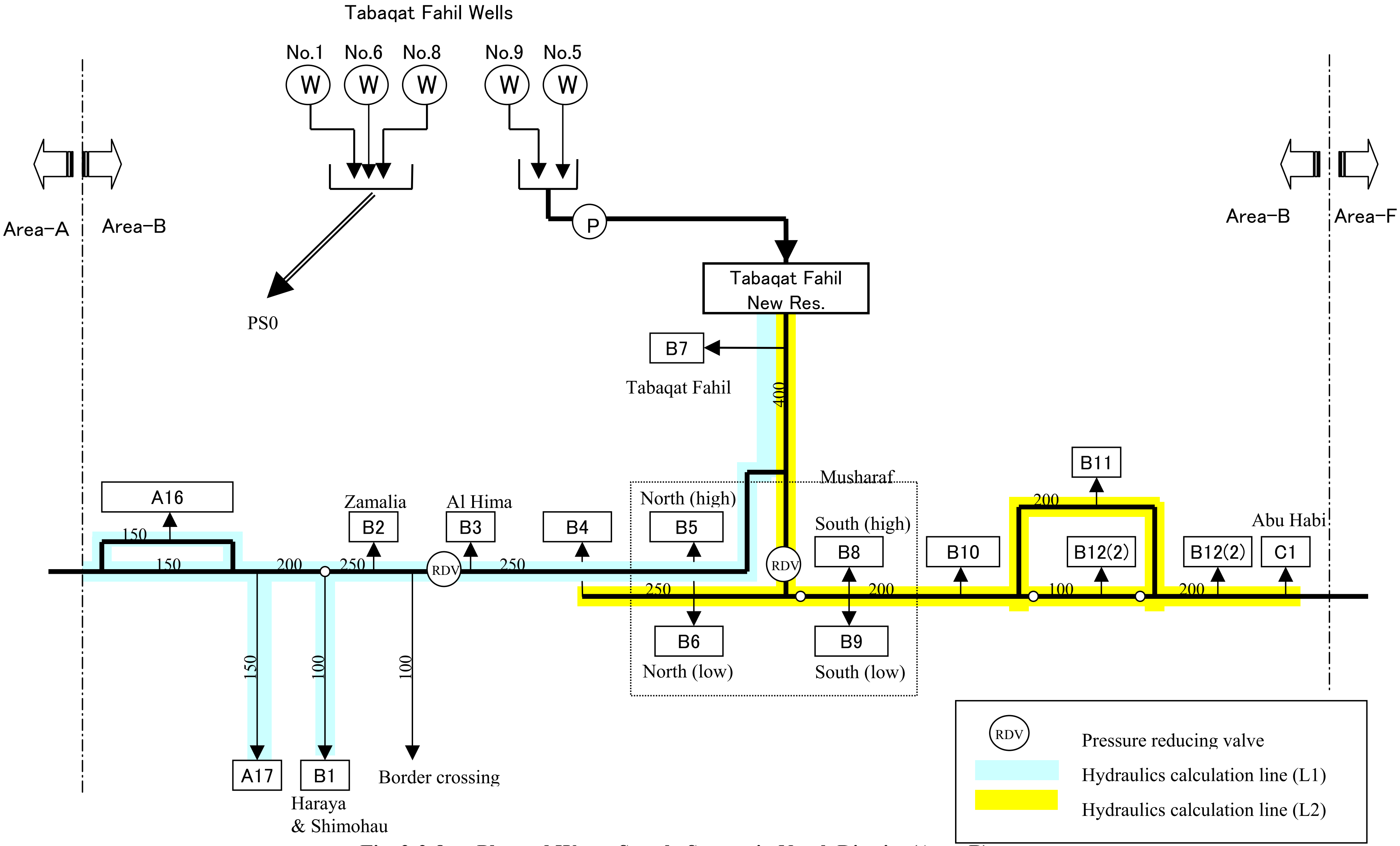


Fig. 2-2-8 Planned Water Supply System in North District (Area-B)

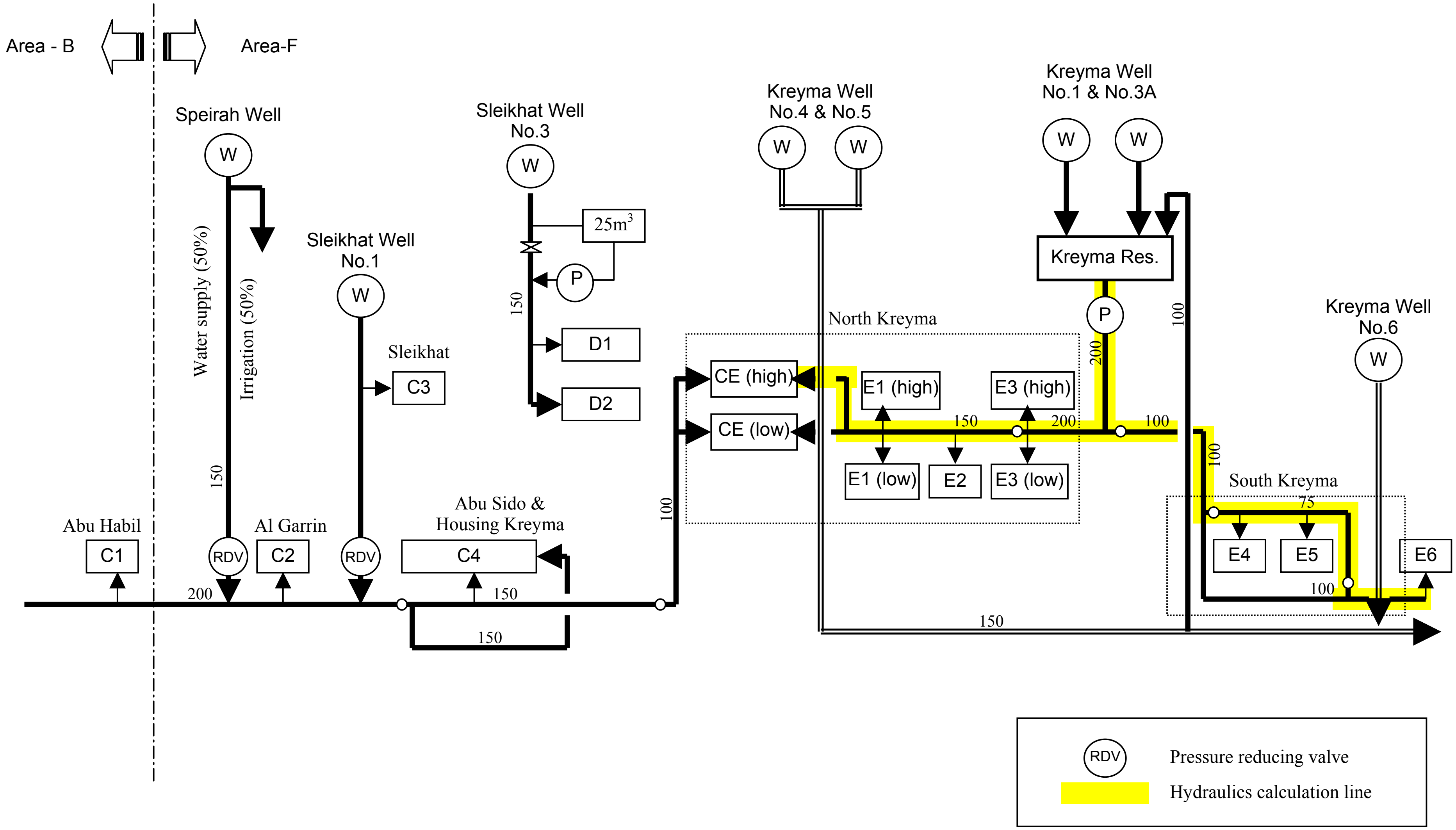


Fig. 2-2-9 Planned Water Supply System in North District (Area-F)

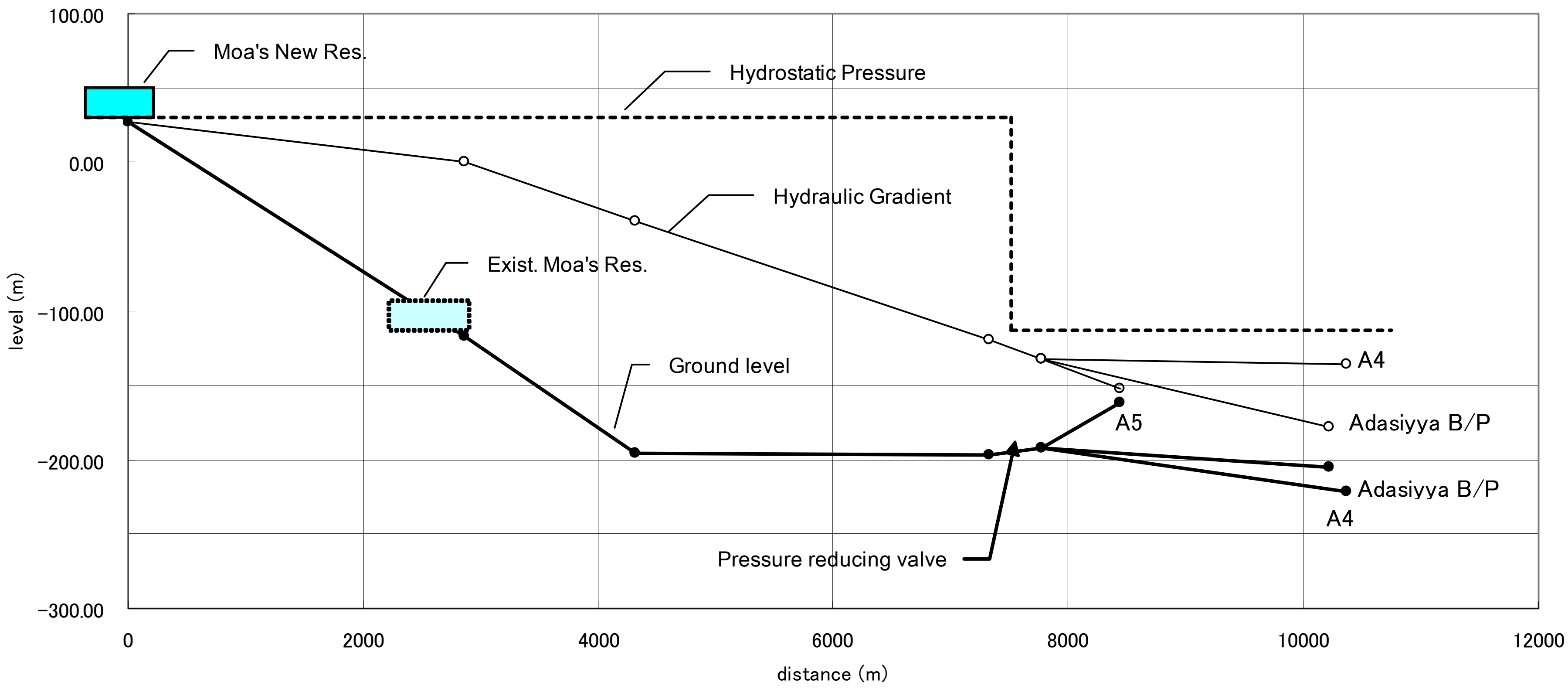


Fig. 2-2-10 Hydraulic Calculation (Area-A Line L1)

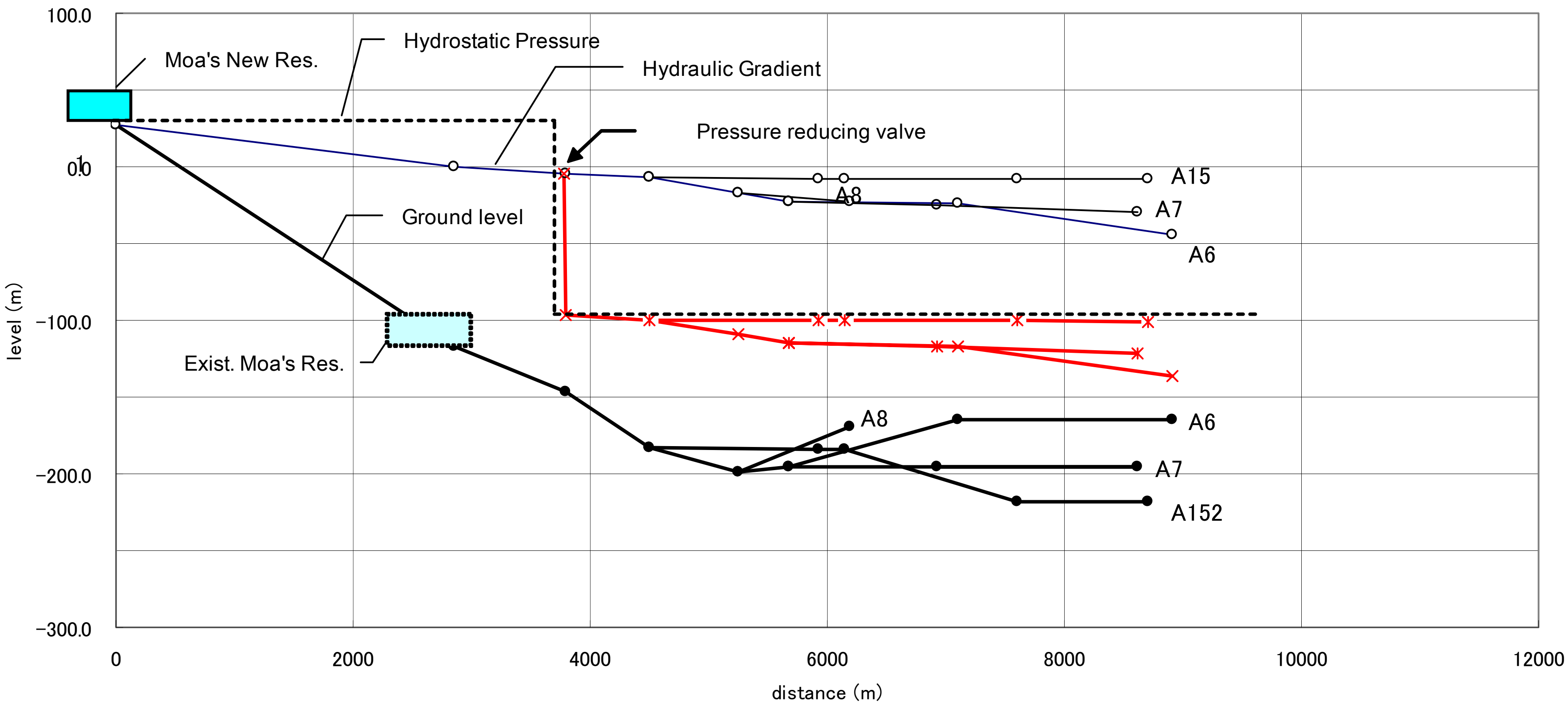


Fig. 2-2-11 Hydraulic Calculation (Area-A Line L2)

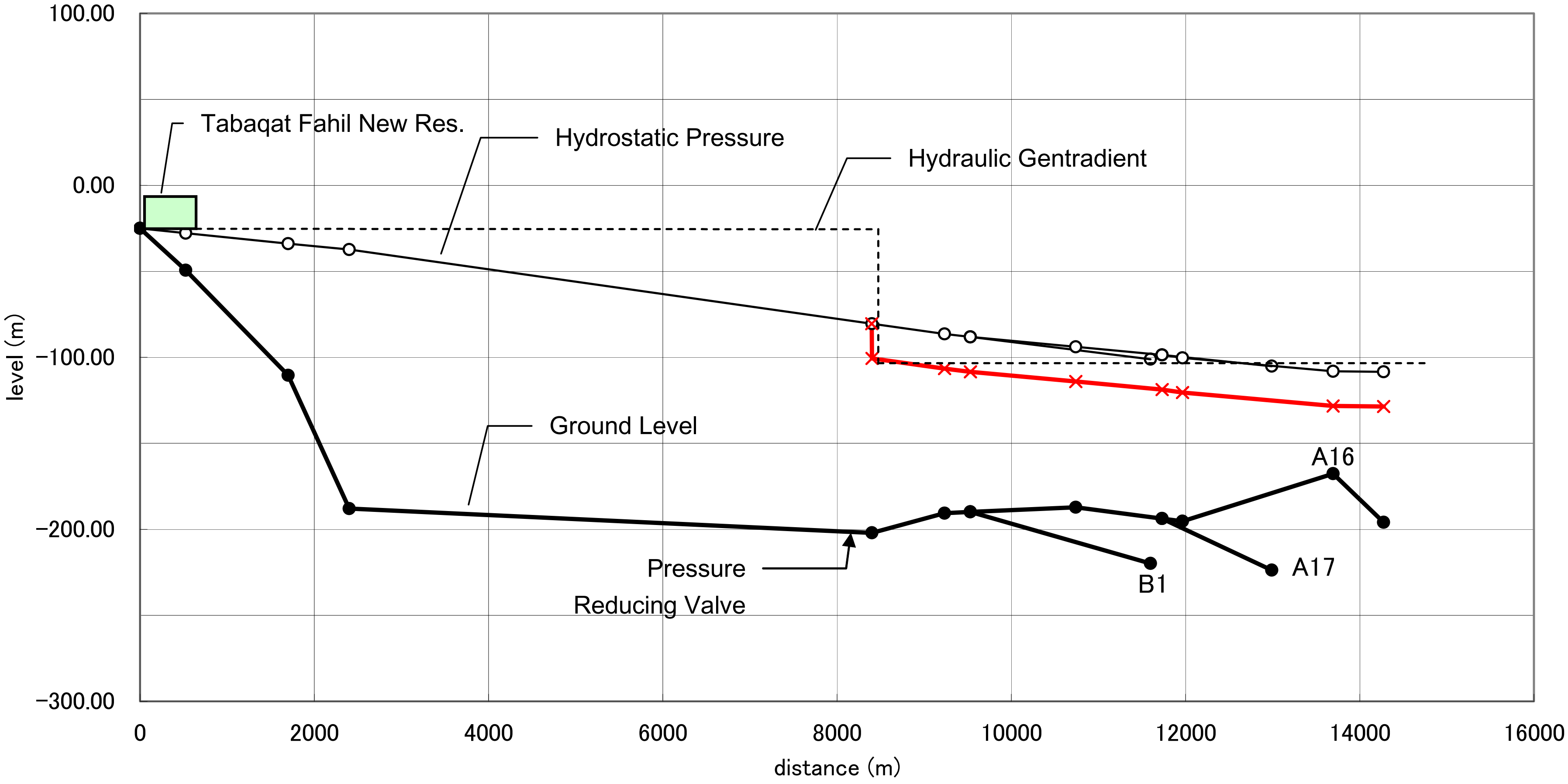


Fig. 2-2-12 Hydraulic Calculation (Area-B Line L1)

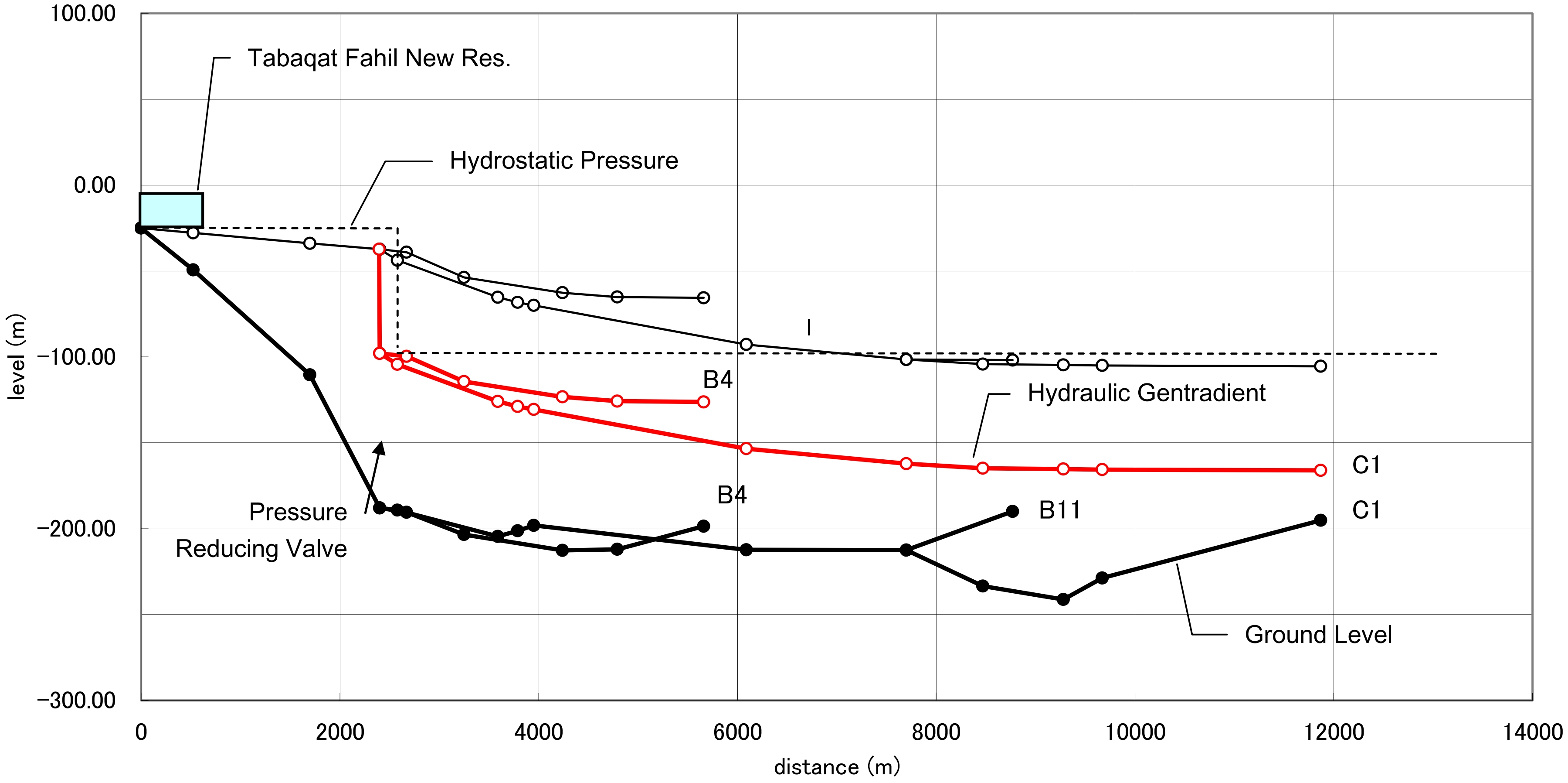


Fig. 2-2-13 Hydraulic Calculation (Area-B Line L2)

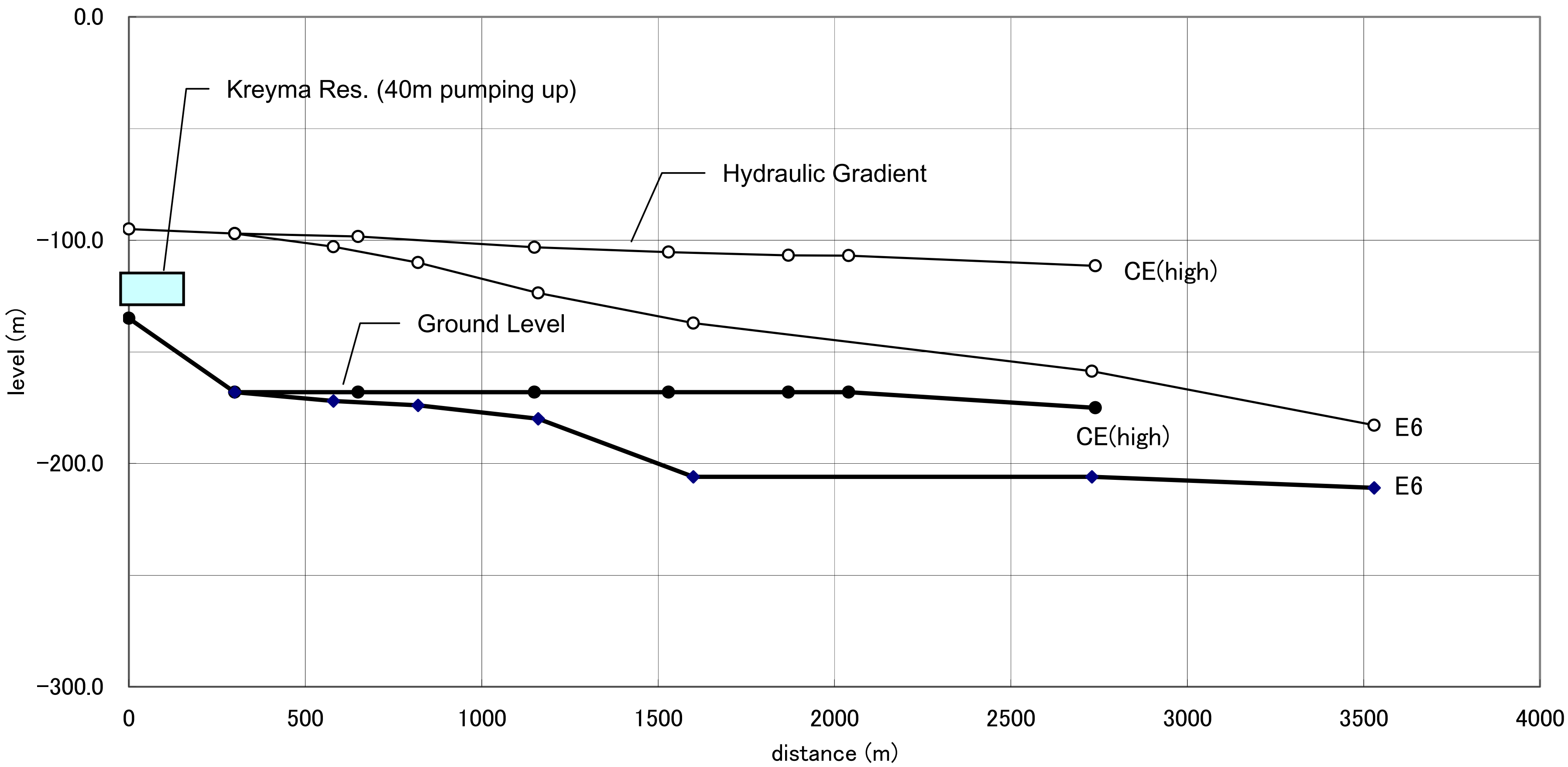


Fig. 2-2-14 Hydraulic Calculation (Area-F)

2.2.2.3 Rehabilitation Plan for Water Transmission and Distribution Pipelines

(1) Pipeline Rehabilitation Plan for Pipelines

1) Pipeline Rehabilitation Criteria

Based on the following three criteria, pipelines subject to rehabilitation were decided.

- Of the existing transmission and distribution pipes, all asbestos pipes will be repaired. Asbestos pipes are easily connected to distribution branch pipes so water can be easily stolen. In addition, since it is difficult to maintain water tightness at the connections to distribution branch pipes, leakage tends to occur within the connecting parts. In addition, asbestos pipes are excluded from the criteria of the WAJ for health reasons, and are subject to replacement.

- Compared with pipe diameters obtained through hydraulic calculation, pipelines of insufficient size will be replaced. In particular, main distribution pipes from the Tabaqat Fahil and Kreyma reservoirs will be replaced with pipes of larger diameter.

- In line with the change in existing transmission and main distribution pipelines, new laying of pipeline will be also subject to the Project. Changes in pipeline routes in line with the transfer of Moa's and Tabaqat Fahil reservoirs will be subject.

2) Total Extension of Pipelines subject to rehabilitation

The extension of transmission and main distribution pipes subject to rehabilitation is shown in Table 2-2-8 and Table 2-2-9. The total extension of transmission and main distribution pipes subject to the Project will be approximately 61km.

Table 2-2-8 Pipeline Extension Subject to Rehabilitation (North District)

Diameter (mm)	Transmission Pipe (m)	Distribution Pipe (m)	Total (m)
400	1,254	2,400	3,654
350	0	0	0
300	2,500	2,860	5,360
250	0	8,975	8,975
200	0	23,520	23,520
150	0	6,945	6,945
100	850	8,435	9,285
Total	4,604	53,135	57,739

Table 2-2-9 Pipeline Extension Subject to Rehabilitation (Middle District)

Diameter (mm)	Transmission Pipe (m)	Distribution Pipe (m)	Total (m)
400	0	0	0
350	0	1,510	1,510
300	0	2,070	2,070
250	0	0	0
200	0	0	0
150	0	0	0
100	0	0	0
Total	0	3,580	3,580

3) Leakage Countermeasures

As a measure in distribution zones where sufficient water cannot be provided due to lack of service pressure, the water transmission pressure from reservoirs will be raised by moving the existing reservoirs to a higher elevation. On the other hand, if the transmission pressure from reservoirs increases, service pressure within low distribution zones will increase excessively. This could invite an increase in leakage.

In order to satisfy these two objectives simultaneously, appropriately maintenance of water pressure in the transmission and main distribution pipes is planned by installing pressure reducing valves in the main distribution pipes. The location of pressure reducing valves and amount of pressure reduction are indicated in 2.2.2.1: Hydraulic Calculation.

4) Measures to Improve Facility Maintenance

At the present time, branch distribution pipes are being removed from the main distribution pipe in a complex and inefficient manner. Water restrictions implemented during the summer require a great deal of labor in the operation of valves at these connections. In order to reduce the burden, the connections between the main distribution pipe and branch distribution pipes will be simplified, and a single connecting pipe is planned.

However, laying conditions for existing distribution pipes is complicated, especially in the urban areas of North Shouna and Musheref districts. The Project will involve the branching of header pipes from the main distribution pipe and use these pipes for connecting each branch pipe. For easy operation of valves when restricting water supply, sluice valves will be installed in these connecting pipes.

(3) Pipe Materials

Pipe materials will be selected from four types of ductile cast iron pipes, asphalt coated steel pipes (black steel pipes), galvanized steel pipes and hard polyethylene (HDPE) pipes stipulated in the WAJ criteria. However, considering the diameters (100mm to 400mm) of transmission and main distribution pipes, the target pipe types will be ductile cast iron and steel. Of these two types of pipe materials, based on actual results in Jordan and the reasons described below, aside from the distribution pipes around pump facilities and reservoirs, ductile cast iron pipes will be adopted as materials for transmission and main distribution pipes. Steel pipes (black) will be used for pipes around pump facilities and reservoirs.

Ductile cast iron pipes will be adopted for transmission and main distribution pipes for the following reasons:

・ Since it is easy to lay pipes, it is possible to complete the recovery including excavation, pipe laying and backfilling in a short period of time at each construction section, so the period of influence for vehicles and passengers during construction is short.
・ Since pipe welding, lining inside and outside of welded part and welding inspections through X-rays, etc. are not required, the construction cost will remain low. Although expenses for materials of maximum diameter ϕ 400mm are almost the same, for smaller diameters the cost will be less.
・ Since coupling is easier than that of steel pipes, the construction period will be shorter.
・ The necessary strength of external and internal pressure can be sufficiently secured.
・ Anticorrosion and workability are better than steel pipes.

(4) Auxiliary Facility Plan

Auxiliary equipment such as sluice valves or air valves will be planned as follows with the consent of the Jordanian side.

1) Sluice Valves

Sluice valves will be installed for approximately 2km of the branching off section of transmission and main distribution pipes, crossing sections, aqueducts and straight pipes. The primary specifications are as follows.

Type	:	Sluice valve (350mm in diameter or smaller)
		Butterfly valve (400mm in diameter)
Material	:	Cast iron or ductile cast iron
Connecting method	:	Flange joint (adjustable pipe section inside and outside valve chest)

2) Wash-out Valves

Wash-out valves to be installed at the concavity of pipelines and aqueducts will be designed for lower pipelines. The primary specifications are as follows.

Type	:	Sluice valve (80 or 100mm in diameter)
Material	:	Cast iron
Connecting method	:	Flange joint
Blow-off method	:	Draining into small rivers (wadi)

3) Air Valves

Air valves to be installed at the convex of pipelines and aqueducts will be designed for higher pipelines. Major specifications are as follows.

Type	:	Double air valve (400mm in diameter), single air valve (350mm in diameter or smaller)
Connecting method	:	Flange joint

4) Pressure Reducing Valves

Despite pressure fluctuations on the upstream side, to maintain constant pressure on the downstream side pressure reducing valves will be installed. By arranging valves of two different ranges in a parallel manner to immediately react against pressure on the upstream side efficient effects from pressure reduction will be designed. The primary specifications are as follows.

Type	:	Mechanical self-operating type
Connecting method	:	Flange joint
Accessories	:	Stop valves, safety vales and hydraulic gauges, etc.

5) Protection of Fittings

Fittings will be protected using concrete blocks except for in urban areas. Mechanical joints will be adopted to prevent breakaway in urban areas.

(5) Crossing Method in Water Channels or Small Rivers

The crossing method in water channels or small rivers will be aqueducts or bridge-fixing method. Aqueducts will be adopted in the crossing section of the King Abdra Canal. Bridge-hanging method or steel pipe crossing method will be applied to other sections.

1) Aqueducts

- Since the supporting length is short at approximately 12m, a simple supporting method will be applied.
- Materials for prescribed aqueducts will be steel.
- The bottom of an aqueduct will be higher than the bottom of a bridge.
- Flexible tubes will be installed at both ends of the laying section of the aqueduct in due consideration of differential settlement.
- Air valves will be installed near the center of the highest aqueduct level.

2) Bridge-fixing and Steel Pipe Crossing Method

- The crossing at small rivers except for the king Abdra Canal will be Bridge-hanging or a steel pipe crossing method.
- If pipes can be installed on a bridge, a bridge-hanging method will be adopted by installing brackets on the bridge.

If the crossing section is a box culvert or if pipes cannot be installed on a bridge because pipes are already installed, pipes on both sides should be covered by concrete by adopting a steel pipe crossing method and the coupling should be applied to the connection using ductile pipes.

(6) Construction Techniques

Pipe laying construction between standard sections except for water channel crossing sections of transmission and main distribution pipes will be implemented through an open-cut method in due consideration of economy. With respect to aqueduct foundation, since construction will be done from the water channel side and the intensity is greater as groundwater measures, a retaining method with wood sheet pile will be adopted for safety of construction.

Due to the simplicity of the joint construction method between standard sections, inexpensive materials, construction expenses and security of required water tightness, T- type (push-on) joints will be applied. In addition, K-type (mechanical) joints will be adopted at bending sections etc. due to their workability.

2.2.2.4 Reservoir Rehabilitation Plan

(1) Capacity Setting

The following four reservoirs in the North district are subject to rehabilitation upon the request of the Jordanian side. However, as a result of a field survey, the Sleikhat reservoir is presently not being utilized and was therefore excluded from the Project.

・ Moa's reservoir
・ Musheref reservoir (Tabaqat Fahil reservoir)
・ Sleikhat reservoir (presently not utilized)
・ Kreyma reservoir

For reservoir capacity, in order to secure eight hours or more of average daily water, it should be planned after considering the water supply amount from new reservoirs. The planned capacity of reservoirs is shown in Table 2-2-10. However, since the Kreyma reservoir exceeds the necessary capacity even in the target year, new water supply pumps will be installed in order to increase water supply pressure without increasing its capacity.

In order to increase capacity and secure water supply pressure, the Moa's and Musheref (Tabaqat Fahil) reservoirs will be moved to a higher location than the existing reservoirs. However, after the transfer only new reservoirs will be utilized and the existing reservoirs are regarded not to be utilized.

Table 2-2-10 Reservoir Capacity in North District

Reservoir	Existing (2003)		New Plan (2010)		
	Capacity (m^3)	Supply amount (m^3/hr)	Capacity (m^3)	Supply amount (m^3/hr)	Storing time (hour)
Moa's reservoir	625	194.2	1,600	194.2	9.7
Msheref reservoir (Tabaqat Fahil reservoir)	650	165.2	2,500	165.2+134 = 299.2	8.4
Kreyma reservior	600	41.0	600	41+20 = 61	9.8

Remarks) The existing Kreyma reservoir will be utilized as is, so other existing reservoirs will be not utilized.

(2) Structural Type and Shape

Rectangular reinforced concrete construction which is common in Jordan and familiar to local builders should be applied for the structural type of reservoirs.

(3) Foundation Type

Since the soil composition at reservoirs is a sand bed or gravel layer, general direct foundation will be generally applied.

(4) Reservoir Design

The following policies will apply to reservoir design. A similar design will be applied to a water receiver at the Tabaqat Fahil water supply pump station.

1) Design Load of Reservoir Roof

Since it is a non-walking roof, constant load conditions should be $100/m^2$.

2) Seismic Factor

The seismic factor to be applied to reservoir design will be 0.2 in accordance with Jordan's criteria.

3) Reservoir Height

Although reservoir height will fall within a scope of 5 to 6m which is regarded to be the economic height, wherever possible reservoir height and effective depth will be kept to 5m and 4.1m respectively, lower than another similar project in Jordan.

- The water receiver at the Tabaqat Fahil pump station should be lower if possible considering the high groundwater level, large soil bearing capacity is not expected, and the surrounding environment (ruins).
- Since part of the geology at the Moa's reservoir is expected to bank up, in order to prevent differential settling, reservoir height should be as low as possible.

(5) Auxiliary Equipment

The following auxiliary equipment will be installed at reservoirs. In addition, a monitoring system to oversee inflow and outflow at reservoirs and the water level of reservoirs will be described later in 2.2.2.6: SCADA system.

- Inflow pipes
- Outflow pipes
- Bypass pipes
- Overflow pipes

- Drain pipes
- Air pits, manholes, ladders
- Chlorine injectors (chlorine bombs are excluded)
- SCADA system

2.2.2.5 Rehabilitation Plan for Booster Pumps and Distributing Pumps

(1) Pump Rehabilitation Plan

Approximately ten years have elapsed since installation of the existing pumps so they have reached their anticipated life. Consequently, all the existing pumps will be replaced with new ones. In addition, until the completion of the Project, as is necessary to continuously utilize the existing facilities, a shift from existing to new equipment will take place through an exchange in pipe arrangement. Pumping equipment to be covered by the Project is as follows.

- Al-Adasiyya pump station (rehabilitation of existing pumping equipment)
- Tabaqat Fahil pump station (rehabilitation of existing pumping equipment)
- Kreyma pump station (new installation)

(2) Pump House Design

All new pump equipment will be installed indoors, and pump houses will be designed and constructed according to the following.

1) Structure

- Reinforced concrete will be used for the structure.
- Concrete blocks will be used for the walls.
- Direct foundation will be applied.

2) Design Load

- Roof Load will be 100kg/m^2 similar to the reservoirs.
- Seismic coefficient will be 0.1.

(3) Al-Adasiyya Pump Station

The existing Al-Adasiyya pumps provide water for two different service areas. The necessary discharged pressure for pumps to the Al-Adasiyya area is relatively small compared with the Mukaiba area, so the pressure will be adjusted by throttling the pump's outlet valves. Since this pressure adjustment is associated with a significant energy loss, in the pump rehabilitation plan a different pump per distribution zone will be installed. However, the same pump for the Mukaiba district will be installed as a stand-by pump which will be shared by two distribution zones. The primary equipment is as follows.

1) Pump Specifications and Number of Units

a. For Water Supply to Mukaiba Area

- Number of pumps : 2 units (1 duty pump, 1 stand-by pump)
- Pumping Type : Multi-stage centrifugal pump
- Rated flow rate : 56 m^3/h
- Rated pump head : 274m

b. For Water supply to Al-Adasiyya Area

- Number of pumps : 1 unit
- Pumping Type : Centrifugal pump
- Rated flow rate : 32 m^3/h
- Rated pump head : 74m

2) Electrical Equipment

- Incoming panel : 1 side
- Pumping control panel : 3 sides
- Telemeter panel : 1 side (refer to 2.2.6: SCADA system)

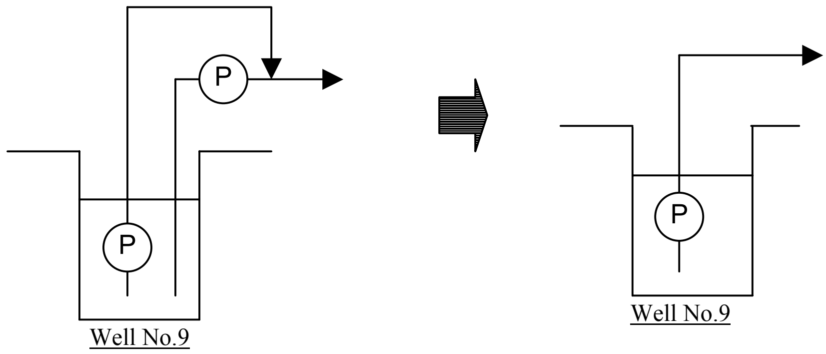
3) Auxiliary Equipment

- Pump house : 1 set (RC construction)
- Piping (steel pipe) : 1 set
- Measuring instrument : Electromagnetic flow meter, pressure detector (2.2.2.6: SCADA system)

(4) Tabaqat Fahil Pump Station

Existing pump systems to be remodeled are the submerged pump at Well No.9 and the booster pumps for the water supply to the Tabaqat Fahil area. In due consideration of the total production volume at Well No.9 to be utilized in North District and transfer of the existing Msheref reservoir to the Tabaqat Fahil area, the Project will upgrade the existing pumping system while reviewing the existing water supply system as follows.

・ The water supply through parallel operation between the submergible pump and land pump at Well No.9 will be stopped and water will be sent through a single submergible pump in order to meet well production volume.



・ The existing booster pump to the Tabaqat Fahil area located upland will be remodeled by installing a new water supply pump at the Tabaqat Fahil reservoir.

The primary equipment is as follows.

1) Pump Specifications and Number of Units

a. Submergible Pump for Well No.9

- Number of pumps : 1 unit
- Pumping Type : Submergible
- Rated flow rate : 160 m^3/h
- Rated pump head : 10m

b. Transfer Pump

- Number of pumps : 3 units (2 duty and 1 stand-by pumps)
- Pumping Type : Centrifugal pump
- Rated flow rate : 188 m^3/h
- Rated pump head : 64m

2) Electrical Equipment

- Incoming panel : 1 side
- Pumping control panel : 3 sides
- Telemeter panel : 1 side (refer to 2.2.2.6: SCADA system)

3) Auxiliary Equipment

- Pump House : 1set
- Receiver tank (380 m^3) : 1 unit (RC product, rectangle)
- Piping (Steel pipe) : 1 set
- Measuring instrument : Level detector, electromagnetic flow meter, pressure detector (2.2.2.6: SCADA system)

(5) Kreyma Pump Station

In order to increase the water supply pressure from Kreyma reservoir, a new water supply pumping system will be installed. The primary equipment is as follows.

1) Pump Specifications and Number of Units

- Number of pumps : 2 units (1 duty pump, 1 stand-by pump)
- Pumping Type : Centrifugal pump
- Rated flow rate : 163 m^3/h
- Rated pump head : 40m

2) Electrical Equipment

- Incoming panel : 1 side
- Pumping control panel : 2 sides
- Telemeter panel : 1 side (Refer to 2.2.2.6: SCADA system)

3) Auxiliary Equipment

- Pump House : 1 set
- Piping (Steel pipe) : 1 set
- Measuring instrument : Level detector, electromagnetic flow meter, pressure detector (2.2.2.6: SCADA system)

2.2.2.6 SCADA System Plan

(1) Outline of the SCADA System

The SCADA (Supervisory Control and Data Acquisition) system was originally developed in the electricity sector and is a system designed for instantly conducting optimum operations of the extensive electrical equipment by collecting data of power plants (supply side) scattered in each area and the demand side and grasping a hourly change in the supply-demand balance on behalf of human beings. The SCADA system has many advantages and is being introduced in the water supply sector in recent years.

Through the SCADA system, it becomes possible to make an accurate decision for a short period of time by accumulating the extensive and simultaneous data into a single location and inclusively regarding the overall water supply system. Especially, the system has many advantages for operating the complicated water supply system in urban areas. Accordingly, Jordan started to introduce the SCADA system mainly in urban areas represented by Amman.

The Project plans to introduce the SCADA system for the purpose of extensively monitoring at reservoirs and transmitting the data to a control office. The SACADA system consists of a measuring instrument to collect data at the monitoring sites, a telemetry system to transmit collected data to the parent station and data processing equipment at the monitoring center (North Shouna ROU office) for processing collected data. Telemeter panels will be installed in each monitoring site and to convey data and general public line will be utilized. The SCADA system under the Project will be a system to have the conformity with other SCADA systems in Jordan.

(2) Purpose of Installing SCADA System

The purposes of installing a SCADA system under the Project are as follows.

1) Monitoring of Water Supply Amount

In order to effectively utilize limited local water resources at the Project site, it is necessary to reduce the current high rate (53%) of unaccounted-for water. Consequently, the existing distribution system will be remodeled. At the same time, flow control monitoring to more accurately grasp distribution volume will be implemented.

2) Monitoring of Service Pressure

In the maintenance of water distribution system, grasping of flow rate and the maintenance of appropriate service pressure at the same time are important factors. Thus, water pressure at major water supply facilities and water level at reservoirs will be monitored.

3) Existing Well Monitoring

All water resources are managed through the water supply from existing wells, so well conditions should be constantly monitored. In order to the grasp conditions at two water resources (Wadi Arab No.6 and Tabaqat Fahil Wells No.5 and No.9) which account for more than 70% of the sources in the North district, changes in groundwater level at target wells will be monitored.

(3) Scope of the Project

The SCADA system for the Project will be installed within the jurisdiction of the North Shouna ROU. Assuming that the leading in of public lines (wired) to each monitoring site will be carried out by the Jordanian side, the scope of the Project for the Japanese side is as follows.

- Procurement and installation of measuring instruments (flow meters, pressure detectors, water level detectors) to be installed at major water supply facilities (source wells, reservoirs, distribution pump stations and booster pump stations)
- Procurement and installation of remote terminal units (ROU) to be installed at the above-mentioned water supply facilities
- Procurement and installation of OA equipment (such as a PC and a printer) for flow rate control monitoring
- Procurement and installation of software necessary for the SCADA system
- Technology transfer of application and maintenance for the SCADA system

(4) Primary Equipment for the SCADA System

1) Monitoring Equipment at Wadi Arab Well No.6

- Water level detector : 1 unit (groundwater level)
- Telemeter panel : 1 unit

2) Monitoring Equipment at Moa's reservoir

- Electromagnetic flow meter : 1 unit (reservoir inflow rate)
  : 1 unit (reservoir outflow rate)
- Water level detector : 1 unit (reservoir water level)
- Telemeter panel : 1 unit

3) Monitoring Equipment for Tabaqat Fahil wells

- Water level detector : 1 unit (groundwater level at Well No.5)
  : 1 unit (groundwater level at Well No.9)
- Electromagnetic flow meter : 1 unit (inflow rate from Well No 5 to receiver)
  : 1 unit (inflow rate from Well No.9 to receiver)
- Telemeter panel : 1 unit

4) Monitoring Equipment at Tabaqat Fahil reservoir

- Electromagnetic flow meter : 1 unit (outflow rate from reservoir)
- Water level detector : 1 unit (water level at reservoir)
- Telemeter panel : 1 unit

5) Monitoring Equipment at Kreyma Reservoir

- Electromagnetic flow meter : 1 unit (inflow rate from Kreyma Well No.1 to reservoir)
  : 1 unit (inflow rate from Kreyma Well No.3A to reservoir)
  : 1 unit (inflow rate from Kreyma Wells No.4 & 5 to reservoir)
  : 1 unit (discharge rate at Kreyma pumping system)
- Water level detector : 1 unit (water level at reservoir)
- Water pressure detector : 1 unit (discharge pressure at Kreyma pumping system)
- Telemeter panel : 1 unit

6) Monitoring Equipment at Speirah Well

- Electromagnetic flow meter : 1 unit (discharge rate from the well)
- Water pressure detector : 1 unit (discharge pressure from the well)
- Telemeter panel : 1 unit

7) Monitoring Equipment at Sleikhat Well

- Electromagnetic flow meter : 1 unit (discharge rate from the well)
- Water pressure detector : 1 unit (discharge pressure from the well)
- Telemeter panel : 1 unit

8) Monitoring Equipment for Al-Adasiyya Pumping System

- Electromagnetic flow meter : 1 unit (inflow rate to the Al-Adasiyya pumping system)
  : 1 unit (discharge rate to Mukaiba area)
  : 1 unit (discharge rate to Al-Adasiyya area)
- Water pressure detector : 1 unit (inflow pressure to the Al-Adasiyya pumping system)
  : 1 unit (discharge pressure to Mukaiba area)
  : 1 unit (discharge pressure to Al-Adasiyya area)
- Telemeter panel : 1 unit

9) Remote Monitoring System (to be installed within the North Shouna ROU office)

- Telemeter panel : 1 unit (indoor self-enclosed type, modem, telemeter unit, arrester for communications)
- PC : 1 unit (CPU 166Mhz or greater, memory 64Mb or greater, HD 2GB or greater)
- CRT : 1 unit (21-inch)
- Printer : 1 unit (color laser beam)
- Software : 1 set (application software for data display, data processing)

2.2.2.7 Piping Materials Procurement Plan

(1) Scope Setting

The major cause of leakage in the existing galvanized branch pipes was pointed out based on the field survey and measures to address the problem were submitted by KfW through its F/S study and discussions with JICA experts. Since a change to polyethylene pipes is requested, refurbishing of galvanized pipes is important if the Project is to achieve its objectives.

Consequently, drawings of municipal distribution branch pipes along the North Jordan Valley were prepared by conducting an on-site survey in the presence of WAJ personnel in charge of maintenance, or through an interview survey or visual observation of aboveground piping.

Distribution branch piping subject to the procurement will be set up as follows.

- Pipe types subject to replacement will be galvanized pipes based on priority of types in the feasibility study on measures for preventing leakage conducted by the KfW and the number of locations repaired in 2003.

- Diameters of distribution branch pipes to be procured will be unified into 50mm instead of requested 20mm to 50mm in response to the request of the WAJ because these are prescribed in specifications of the WAJ that the minimum diameter shall be 50mm.

- Target areas will be the North District and some parts of the Middle District in accordance with the request. However, areas facing military facilities or national boundaries will be excluded from the Project from both the aspects of safety during construction and acquisition of a construction license.

- With respect to the extension of pipelines subject to procurement , this will be judged based on municipal distribution branch pipe drawings and the results of new branch pipe construction in 2003 in the NGWA under WAJ to which the project site belongs.

(2) Straight Pipe Materials

Of the four types of ductile cast iron pipes, asphalt coated steel pipes (black steel pipes), galvanized steel pipes and high density polyethylene (HDPE) pipes stipulated in the WAJ's criteria, pipe materials will be selected. However, the diameters of branch pipes will be limited to smaller diameters such as 50mm. Therefore, HDPE pipes (PN16) which are relatively durable and quite economical in small diameters will be adopted. Distribution branch pipes subject to rehabilitation will be existing galvanized pipes which suffer from regular leakage.

High Density Polyethylene (HDPE) pipes: PN16, ISO 4427 or similar products

(3) Total Extension of Distribution Branch Pipes Subject to Procurement

The quantity of distribution branch pipes subject to the provision is estimated to be 73,653m which exceeds the quantity requested of 50km. The budgetary measures by Jordan for the laying work should be confirmed. The Jordanian side confirmed that they will secure enough budgets for the 2005-2007 fiscal years for laying distribution branch pipes to be executed by the Jordanian side and also confirmed that they will complete the construction for laying distribution branch lines before the completion of the project by Japanese side as described on Minutes of Discussions dated on November 11, 2004 at the explanation on Draft Report.

In addition, based on the 2003 results from construction of distribution branch pipes (35.2km/annual) by NGWA which had jurisdiction over the project site, the Jordanian side is judged to have sufficient competency to carry out work on 74km of distribution branch pipes under the Project.

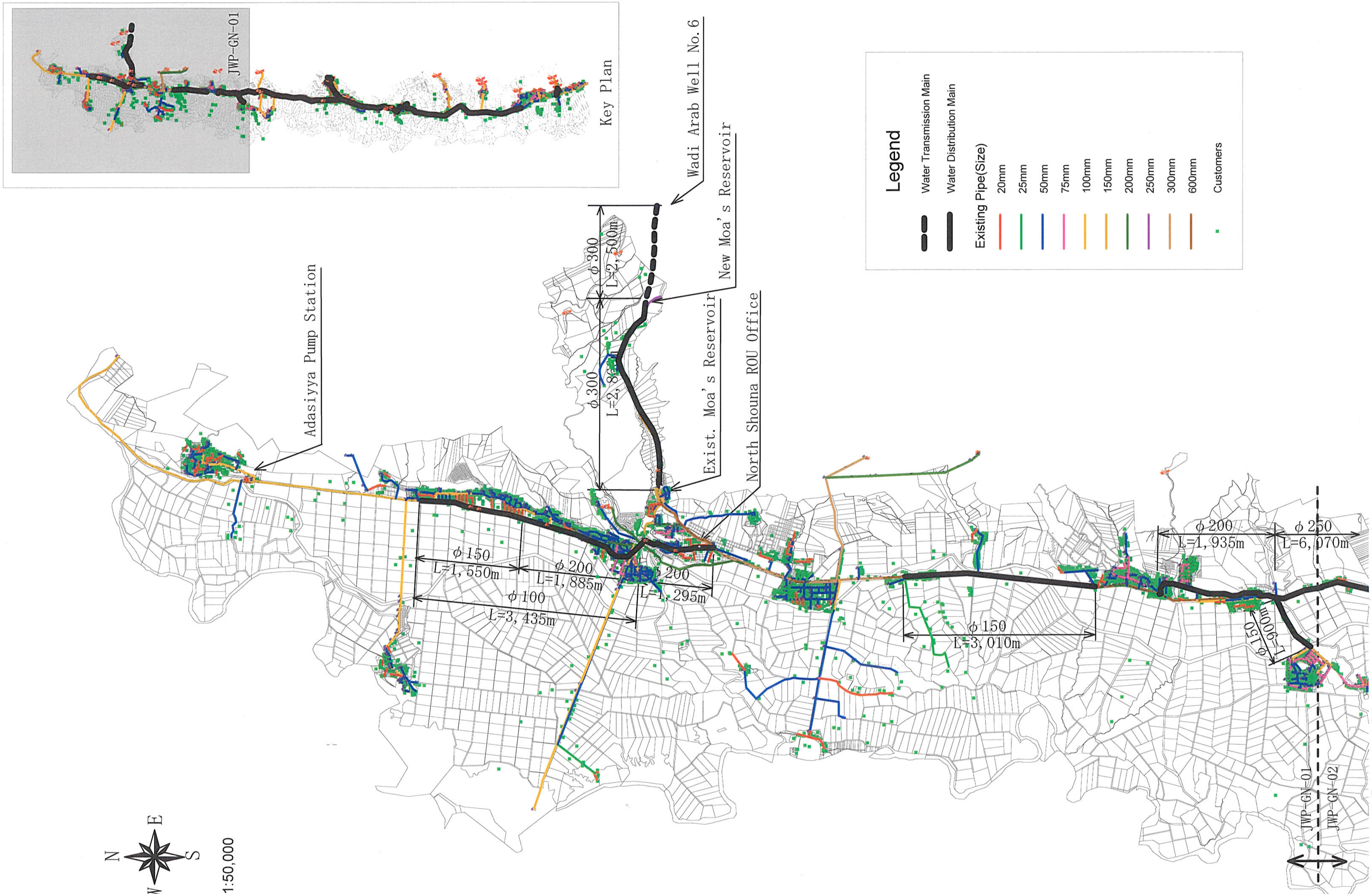
(4) Accessories

- Fittings (T-shape pipes, bend pipes)
- Connectors
- Saddles (main distribution pipes or connecting sections between header pipes and branch distribution pipes)
- Sluice valves (branching-off section)

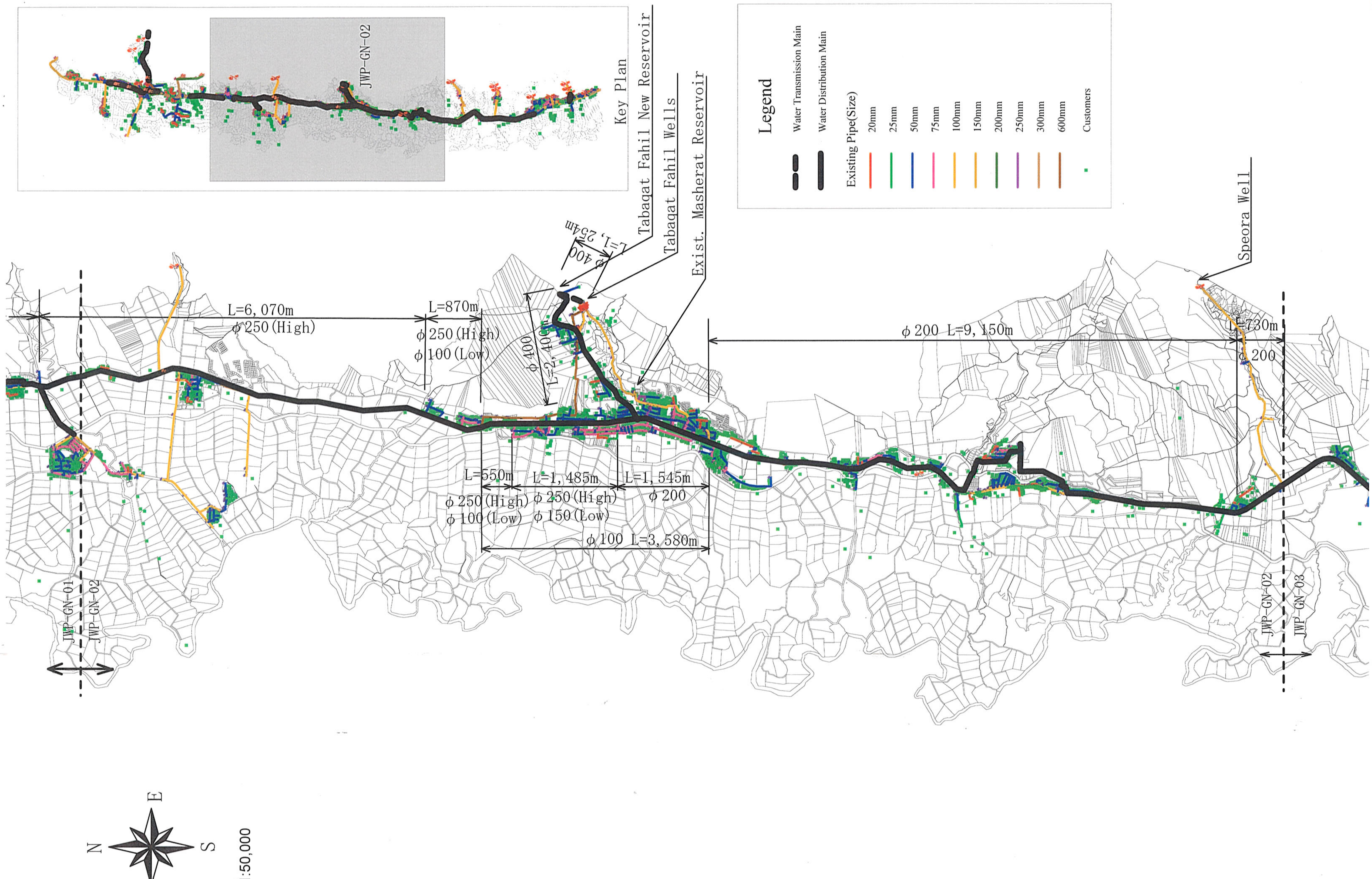
2.2.3 Basic Design Drawing

The basic design drawings of the Project are shown from next page as follows;

Drawing No.	Drawing Title
JWP-GN-01	General Layout (1/3)
JWP-GN-02	General Layout (2/3)
JWP-GN-03	General Layout (3/3)
JWP-GN-04	Water Distribution Zoning
JWP-GN-05	Flow Diagram around Moa's Reservoir
JWP-GN-06	Flow Diagram around Adasiyya Pump Station
JWP-GN-07	Flow Diagram around Tabaqat Fahil Pump Station
JWP-GN-08	Flow Diagram around Kreyma Pump Station
JWP-PL-01	Main Pipeline – Typical Section
JWP-PL-02	Typical Installation Drawing of Valves
JWP-PL-03	Typical Installation Drawing of Pressure Reduction Valve
JWP-PL-04	Plan of River Crossing
JWP-RD-01	Facility Layout of Tabaqat Fahil Reservoir
JWP-RD-02	Tabaqat Fahil Reservoir – Structural Plan
JWP-RD-03	Facility Layout of Moa's Reservoir
JWP-RD-04	Moa's Reservoir – Structural Plan
JWP-PS-01	Facility Layout of Tabaqat Fahil Pump Station
JWP-PS-02	Tabaqat Fahil Pump Station – Receiver – Structural Plan
JWP-PS-03	Tabaqat Fahil Pump Station – Pump Room - Plan
JWP-PS-04	Facility Layout of Kreyma Pump Station
JWP-PS-05	Kreyma Pump Station – Pump Room - Plan
JWP-PS-06	Facility Layout of Adasiyya Pump Station
JWP-PS-07	Adasiyya Pump Station – Pump Room - Plan



JWP-GN-01 General Layout (1/3)



JWP-GN-02 General Layout (2/3)