PALESTINIAN WATER AUTHORITY
PALESTINIAN AUTHORITY

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT
OF
WATER DISTRIBUTION FACILITIES
IN
THE NORTHERN DISTRICTS OF THE WEST BANK (PHASE 2)
IN
PALESTINIAN AUTHORITY

MAY 2000

JAPAN INTERNATIONAL COOPERATION AGENCY
PACIFIC CONSULTANTS INTERNATIONAL

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PREFACE

In response to a request from the Palestinian Interim Self-government Authority (PA) the Government of Japan decided to conduct a basic design study on the Project for Improvement of Water Distribution Facility in the Northern Districts of the West Bank, Phase 2 and entrusted the study to the Japan International Cooperation Agency (JICA).

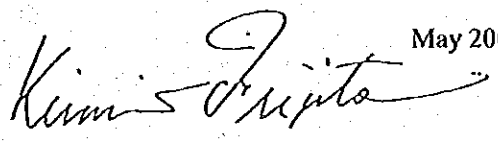
JICA sent to PA a study team from October 28 to December 15, 1999.

The team held discussions with the officials concerned of PA, 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 PA 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 two countries.

I wish to express my sincere appreciation to the officials concerned of PA for their close cooperation extended to the teams.

May 2000



Kimio Fujita
President
Japan International Cooperation Agency

May 2000

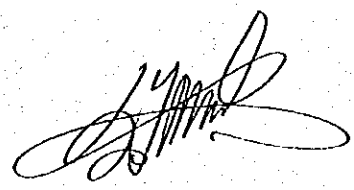
LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Improvement of Water Distribution Facility in the Northern District of the West Bank, Phase 2.

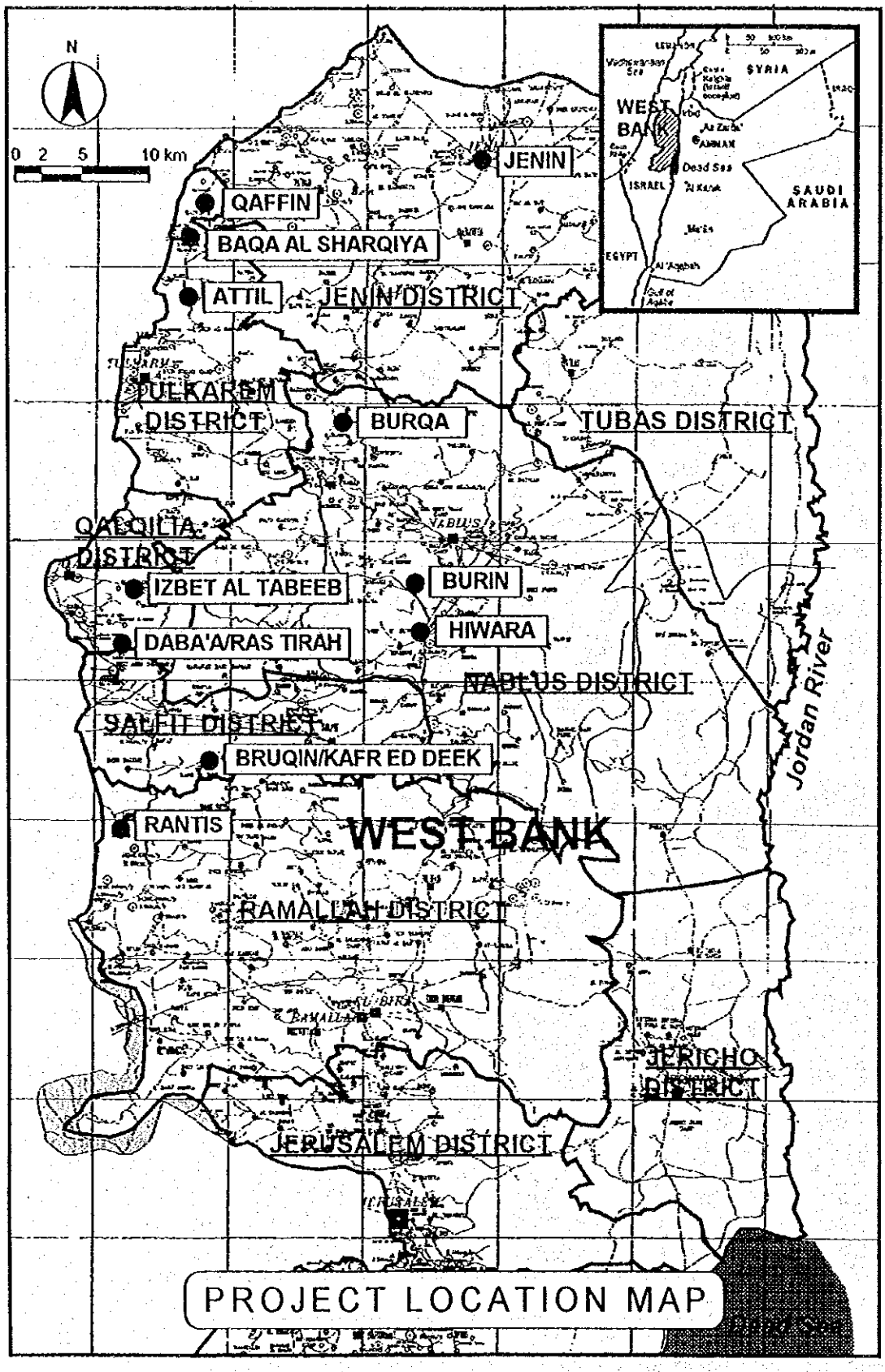
This study was conducted by Pacific Consultants International, under a contract to JICA, during the period from October 20, 1999 to June 16, 2000. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of PA and formulated 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,



Soichiro Yumoto
Project Manager,
Basic Design Study Team on
the Project for Improvement of Water Distribution Facility
in the Northern Districts of the West Bank, Phase 2
Pacific Consultants International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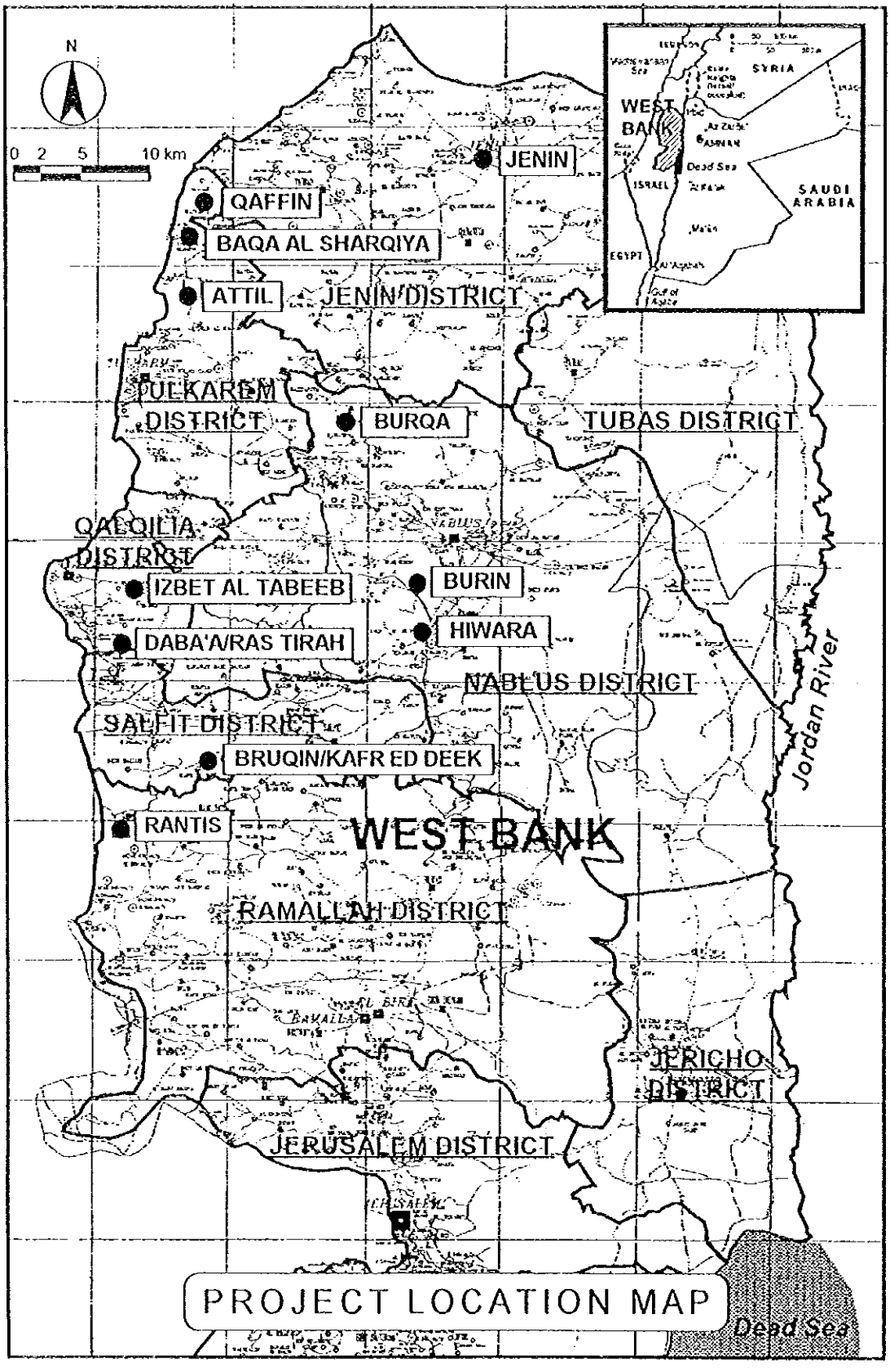
HIWARA
DABA'A/RAS TIRAH
NABLUS DISTRICT
SALFIT DISTRICT
BRUQIN/KAFR ED DEEK
RANTIS
WEST BANK
RAMALLAH DISTRICT
JERICHO DISTRICT
JERUSALEM DISTRICT
Jordan River
SYRIA
WEST BANK
ISRAEL
SAUDI ARABIA
EGYPT
Dead Sea
PROJECT LOCATION MAP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JERUSALEM DISTRICT
Jordan River
Dead Sea
SYRIA
WEST BANK
ISRAEL
SAUDI ARABIA
EGYPT
PROJECT LOCATION MAP

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IN
THE NORTHERN DISTRICTS OF THE WEST BANK, PHASE 2

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Abbreviations

JWC:	Joint Water Committee
KFW:	Kreditanstalt Fuer Wiederaufbau
Mekorot:	Israeli National Water Company
MOLG:	Ministry of Local Government
MOPIC:	Ministry of Planning and International Cooperation
NORAD:	Norwegian Agency for Development Cooperation
PCU:	Palestinian Contractors Union
PDP:	Palestine Development Plan
PECDAR:	Palestine Economic Development and Reconstruction
PCBS:	Palestine Central Bureau of Statistics
PWA:	Palestinian Water Authority
SCF:	Save the Children Federation
UNDP:	United Nation Development Program
USAID:	United States Agency for International Development
WBWD:	West Bank Water Department

CHAPTER I
BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

The Palestinian Interim Self-government area is located on the east coast of the Mediterranean sea consisting of the Gaza Strip (360km^2) and the West Bank (5,860km^2). The area faces to the Hash mite Kingdom of Jordan with the Jordan river on its east side, and is surrounded by the Israeli territory on the other sides. The population of the West Bank is estimated at about 1.56 million in July 1998. There are many Israeli settlements in the area, and its population is estimated at about 150,000. About 75 % is Muslims, and others are Christians and Jewish.

After the Israel - PLO Declarations, since May 1994 when the self-government arrangements were commenced in the Gaza strip and Jericho, Palestinians have been gradually transferred the power and responsibilities for self-government through the negotiations with Israel. The water supply is considered as the most important basic infrastructure in the semi-desert area, and according to the Palestine Development Plan (PDP, 1999 - 2003) prepared at the beginning of 1999, about 45 % of the total budget from 1999 to 2000 amounting to 4,056 million US$ is allocated for the infrastructure development and natural resources management sector, and out of the amount allocated for this sector about 44 % is allocated for the water resources and sewerage treatment including water supply.

The water supply facilities in the West Bank have been controlled by the Israelis so far, and the daily water supply per capita is set so low comparing with that of Israel. During the occupation by Israel, any rehabilitation was not carried out and most of the distribution facilities are deteriorated being left without any repair long time. As a result, unaccount water volume is considered so large as about 40 % that the water is not reached to the villagers who need the water. Under these situation, it is considered urgent to improve the existing water distribution facilities in order to use the water effectively for providing against the demand increasing due to rapid population growth.

The Palestinian Interim Self-government Authority (PA) selected 26 areas, and prepared the plans of feasibility study level after getting the approvals of JWC (Joint Water Committee), and made a request for grant aid for the Project for Improvement of Water Distribution Facilities in the Northern Districts of the West Bank to the Government of Japan. Out of these 26 areas, the implementation for 13 areas which satisfy the following four (4) conditions was commenced.

i) JWC approval is obtained.
ii) Local administrative units operate and manage the provided water supply facilities.
iii) Owner of the water source is clearly identified.
iv) Construction periods are short.

Furthermore, out of remaining 13 areas, 11 areas which fulfill the above condition i) to iii) were selected for the basic design of the second phase. This report presents the results of the phase 2 of basic design.

CHAPTER 2
CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objectives of the Project

The objective of the Project is to improve the water supply services in quantity and quality as well as the living condition of the northern districts of the West Bank by increasing a water supply volume to 96 l/day/capita conducting the rehabilitation and expansion of the existing old and deteriorated water distribution facilities in the area.

2.2 Basic Concept of the Project

(1) General

The water supply facilities in the West Bank have been controlled by the Israelis so far, who consider the surface water of the Jordan river and the groundwater of the area as one of the important basis of the country. This historical relation is being changed as the power and responsibility of self-government increase, and the Palestinian autonomy on the water supply aspect is also gradually expanded. However, these are actually the common water sources which Palestinian and Israelis share, and hence two administrations exist in the water supply sector. All of the water supply projects has to be approved by the Joint Water Committee (JWC).

Under Article 40 of the Oslo Peace Accords, it is considered difficult to explore the groundwater in northern area though 78 MCM/year of exploitation is allowed in the eastern aquifer. As for the surface water resources, the Palestinian has the water right of 257 MCM/year in the Jordan river basin, but actual usage of water is subject to further negotiation in peace talks with Israel. According to Facility Master Plan prepared under the assistance of USAID, the water supply volume is planned to be increased to 41.1, 41.8, 42.1 and 97.7 MCM/year in Jenin, Nablus, Ramallah and Hebron - Bethlehem areas by 2020. The Water Sector Strategic Master Planning Study under French assistance proposes in its draft report that new wells to provide the water of 359 MCM/year are developed by 2020 to decrease the Mekorot's (Water supply company of Israel) supply to 0 by 2020 increasing the capacity of own sources instead. However, it is considered to take long time until these plans are realized and to need to overcome various hazards and obstacles such as negotiation with Israeli. It is, therefore, considered to be the most realistic to improve the existing deteriorated water supply facilities and to increase the accounted water volume in order to provide the water necessary for the rapidly increasing demand of the returnees.

Table 2.1 shows the summary of project's activities, the indicators for verifying project's performance, the means of verification, and the assumptions for obtaining the envisaged effects of the project.

(2) Planning Framework

<Target Year>

Since the construction works are expected to be commenced in November 2000 and scheduled for completion in March 2002, it is considered reasonable to set the target year at 2005 as same as the 1st phase project.

<Design Population Served>

The design population served is estimated for 2005 based on the census data carried out in 1997 by the Palestine Central Bureau of Statistics (PCBS). The population growth rate is set at 3.0 % for natural increase and 3.5 % for social increase by returnees after 2001as shown below.

- 3.0%: 1997 - 2000
- 3.5%: 2001 - 2005

The design population served is set for each area as tabulated below:

Design Population Served in Each Area

Area	Population 1997 (PCBS)	Population 2005	Area	Population 1997 (PCBS)	Population 2005
1. Jenin*	35,791	46,450	5. Attil	7,763	10,075
2. Burin Group Villages	13,271	17,225	6. Qaffin	6,525	8,468
Burin	*1,923*	*2,496*	7. Baqa Al sharqya	3,055	3,965
Assira Al Qibliya	*1,708*	*2,217*	8. Burqin/Qafur Ed Deek	6,406	8,314
Iraq Burin	*576*	*748*	*Burqin*	*2,659*	*3,451*
Madama	*1,239*	*1,608*	*Qafur Ed Deek*	*3,747*	*4,863*
Sarra	*2,161*	*2,805*	9. Daba/Ras Tirah	474	615
Till	*3,542*	*4,597*	*Daba*	*192*	*249*
Urif	*2,122*	*2,754*	*Ras Tirah*	*282*	*366*
3. Burqa	3,012	3,909	10. Rantis	2,047	2,657
4. Hiwara	4,332	5,622	11. Izbet Al Tabeeb	150	195

Note *: The population served by the improved distribution networks under the project is estimated as 6,095 and 7,910 for 1997 and 2005, respectively.

<Design Water Supply>

A water consumption of 140 l/day/capita is considered in the PA's long term plan for 2020, though its water resources are limited. In the design, an annual per caipta water consumption of 35 m^3 equivalent to about 96 l/day/person which is agreed by both Israeli and Palestinian is applied for 2005 as same as in the 1st phase project. As shown in the following table, this supply volume is considered smaller than the available water source volume either by Mekorot supply or from existing wells.

Area-wise Demand and Available Water Sources

Area	Population Served in 2005	Water Source	Annual Demand (m^3)	Water Source Capacity (m^3)	Remarks (Base of Water source Capacity)
1. Jenin	46,450	Well & Mekorot	1,627,608	2,189,000	Well No.1:20-80m^3/hr、Well No.2:200m^3/hr、Mekorot:30-70 m^3/hr、Supply for 11 villages: 1,000 m^3/day (Water Tanker)
2. Burin Group Village	17,225	Mekorot	603,564	613,200	App. to JWC: 70m^3/hr
3. Burqa	3,909	Spring & Mekorot	136,971	157,044	Spring: PWA Record、Mekorot (by Tanker): 120m^3/day (App. To JWC)
4. Hiwara	5,622	Mekorot	196,995	199,655	App. JWC: 547m^3/day
5. Attil	10,075	Ex. Well	352,397	365,000	Agreement: 1,000m^3/day

Area-wise Demand and Available Water Sources

Area	Population Served in 2005	Water Source	Annual Demand (m^3)	Water Source Capacity (m^3)	Remarks (Base of Water source Capacity)
6. Qaffin	8,468	Ex. Well	296,719	Unlimited	Well License: Unlimited
7. Baqa Al sharqya	3,965	Ex. Well	138,934	146,000	Agreement: 400 - 500m^3/day
8. Bruqin/Kafur Ed Deek	8,314	Mekorot	291,323	266,450	App. to JWC: 730m^3/day
9. Daba/Ras Tirah	615	Ex. Well	21,550	36,500	Agreement: 100m^3/day
10. Rantis	2,657	Mekorot	93,101	112,112	JWC Approval for Israeli Project
11. Izbet Al Tabeeb	195	Mekorot	6,833	9,125	App. to JWC: 25m^3/day

(Note) - The annual demand is worked out based on the annual consumption of 35m^3/capita (96 l/day/capita) as agreed in JWC and the served population estimated for 2005.
- The population is estimated for 2005 based on the census results of 1997 and the agreed growth rate.

(3) Confirmed Contents of the Request

<Selected Areas for Implementation>

Considering the possibility to take the measures necessary prior to the implementation, the expectable economic effect of the project, and the reliability of operation and maintenance, the following four (4) areas are rejected from those for implementation.

- Daba/Ras Tirah and Izbet Al Tabeeb areas:
  The beneficiaries are considered so less comparing with the scale of necessary facility that any remarkable effect of the project is not expected, because the water charge expected to be set after the completion is considered on almost same level as that for present supply system by water tankers.
- Burin Group of Villages area:
  The installation of the Mekorot connection is not assured to be made in time without any delay, even though the project is approved by JWC, and the number of beneficiary of the new facility is less comparing with the expected scale of the facility to be provided.
- Burqin/Kafur Ed Deek area:
  The installation of the Mekorot connection is not assured to be made in time without any delay, even though the project is approved by JWC.

The following table shows the comparison of components of the requested and the selected projects.

Comparison between the Requested and the Selected Projects

Area		Requested Contents			Selected for Implementation		
		Pipeline Length (m)	Resevoir (Nos.)	Booster P/S (Nos.)	Pipeline Length (m)	Reservoir (Nos.)	Booster P/S (Nos.)
Jenin	Jenin	8,450			8,570		
Nablus	Burqa	10,000			10,342		
	Hiwara	19,750	1		21,055	1	
	Burin	24,000	7	2	Rejected from those for Implementation		
Turkalem	Attil	26,600	1	1	27,164	1	1
	Kaffin	13,120			16,166		
	Baqa Al Sharkya	10,500	1		10,197	1	

Comparison between the Requested and the Selected Projects

Area		Requested Contents			Selected for Implementation		
		Pipeline Length (m)	Resevoir (Nos.)	Booster P/S (Nos.)	Pipeline Length (m)	Reservoir (Nos.)	Booster P/S (Nos.)
Salfit	Bruqin/Kafur Ed Deek	26,120	2		Rejected from those for Implementation		
Qalqirya	Daba/Ras Tirah	5,400	1	1	Rejected from those for Implementation		
	Izbet Al Tabeeb	2,000			Rejected from those for Implementation		
Ramallah	Rantis	11,300	1		11,933	1	
Total		166,240	14	4	105,427	4	1
Others		Provision of house connection materials and their installation.			Provision of pipe materials for facilitating installation of house connection		

<License and Approval>

To assure the effective project implementation, it is necessary to confirm the status on the licenses and approvals related to the implementation such as i) application and approval of JWC, ii) groundwater extraction license and iii) agreement with the owner of wells on water allocation. The documents related to these aspects were collected as tabulated below.

Confirmed License and Approval

Dis.	Name of Area	Cate.	Type	Water Source	Mekorot Outlet	Applied Rate for JWC	Approval of JWC	Extraction License	Agreement for Water Allocation
Jenin	Jenin	A	Rep.	Ex. Well (17-20/051J) -Mekorot	Existing (No.128202)	-	Apr. 11, 1999	Unlimited (Domestic Use)	-
Nablus	Burqa	B	Ext. & Rep	Spring (BA/046, BA/047, BA/048) and Mekorot (Tanker)	Water Tanker (No.71296)	336 m³/day	Jan. 3, 2000	-	-
	Hiwara	B	Rep.	Mekorot	Existing (No.67247)	547 m³/day	Apr. 7, 1997	-	-
Tulkarem	Attil	B	Rep.	Ex. Well in Zaita (15-19/010)	-	1,080 m³/day	Aug. 16, 1998	Unlimited Domestic Use)	Zaita - Attil (1,000 m³/day)
	Qaffin	B	Rep.	Ex. Well (15-20/008)	-	1,320 m³/day	Aug. 16, 1998	Unlimited (Domestic Use)	-
	Baqa Al Sharkya	B	New	Ex. Well (15-20/005)	-	480 m³/day	Aug. 16, 1998	194,000 m³/year (Irrigation Use)	Baqa Al Sharqya - Private Owner) 400-500 m³/day
Ramallah	Rantis	C	Rep.	Mekorot	Existing (No.64126)	Not Necessary in Initial Period	Sep. 17, 1996	-	-

Fig. 2.1 illustrates the necessary procedures to be taken for obtaining the JWC approval. As for the projects located in the Area C, they are already checked by the Israeli civil administration in the process of JWC approval, and it is not necessary to obtain the approval from the civil administration again. If it is necessary to obtain the approval of the Civil Administration through the Public Works Department, it usually takes about two (2) weeks for the project to get approved by JWC to complete

the procedures.

<Contents of the Project>

The requested project includes the construction of distribution and transmission pipelines of 105.4 km, four (4) reservoirs and one (1) booster pump stations as tabulated below.

Contents of the Project

Area		Cat.	Length of Pipeline (m) Sub-Total	Total	Reservoir (Nos.) 200m³	300m³	500m³	Total	Booster P/S (Nos.)	Pipe Materials for House Connection (Nos.)
Jenin	Jenin	T		8,570						37
		D	8,570							
Nablus	Burqa	T		10,342						181
		D	10,342							
	Hiwara	T	660	21,055			1(G)	1		332
		D	20,395							
Tulkarem	Attil	T	4,601	27,164			1(E)	1	1	327
		D	22,563							
	Kaffin	T		16,166						241
		D	16,166							
	Baqa Al Sharkya	T	1,158	10,197		1(E)		1		136
		D	9,039							
Ramallah	Rantis	T	2,843	11,933	1(E)			1		141
		D	9,090							
Total			-	105,427	1	1	2	4	1	1,396

(Note) G: On-ground Type, E: Elevated Type, T: Transmission, D: Distribution

2.3 Basic Design

2.3.1 Design Concept

(1) Concept for Natural Conditions

<Climate>

The climate in the west bank is categorized as the Mediterranean type, which is characterized with rainy winter and dry and hot summer seasons. The annual rainfall varies widely from 150 mm to 1,100 mm. The average annual rainy day varies 25 to 55, which is not considered to substantially affect the construction works.

The wind is observed to be rather strong throughout a year with the maximum of 2.6 m/s in August in Jenin and 4.1 m/s in April in Nablus. In Tlukarem, the maximum observed is 2.5 m/s in April. It is, therefore, necessary to consider the wind load in the design of elevated reservoir tanks.

<Topography and Geology>

The altitudes of Ramallah and Jenin are measured to be about 750 m and 200 m, respectively, and those of the west bank are considered generally to be hilly area of which elevation varies from 400 m to 500 m.. The served areas of each project are generally situated in hilly slopes except for Jenin extending rather on a flat plain. There are many areas where slope exceeds 15 %, and it is considered necessary to provide some measures to prevent the filled materials

from erosion due to flushing by rain water. In hydraulic designs of pipeline networks, special attention should be paid to avoid the occurrence of pressure exceeding the limit and negative pressures. The lengths of pipe materials are needed to be worked out considering the slope distances.

As the project areas are covered generally by rocky materials with surface soil of about 0.3 m thickness, it seems to be difficult to proceed with the excavation work only with manpower, and so it is necessary to consider the application of rock excavation equipment in the construction planning such as back-hoe with an attachment of breaker. Since the limestone is found to be widely prevailing in the area, the steel pipe material of which outside is coated with polyethylene by extrusion method is recommended to be applied for the water supply system. Any recent record of earthquake was not found, and it is told to be quite rare possibility of earthquake in the area. Since there is no design standard against earthquake in Palestine, the Israeli standard for earthquake is applied for structural designs.

(2) Concept for Social Conditions

<JWC Approval>

The projects is to be implemented under the Japan's Grant Aid, and their implementation is subject to the approval of JWC and as for the projects located in the Area C the approval of the Israeli Civil Administration is required. Necessary measures for assuring the quality and quantity of water sources have to be taken by the PA side, and the improvement of the transmission and distribution networks is to be made under Japan's Grant Aid. The projects utilizing the existing wells and springs in Palestine are to be formulated so as to meet the licensed extraction volume, and in case the water has to be allocated from the neighboring villages, the project has to be planned not to exceed such agreed volume of allocation. If any approval of design modification or change is required in the course of implementation, such arrangement is to be taken by the PA side.

<Service Ratio>

In the areas where the existing water supply networks are available, the networks command 90 - 100 % of the residential areas and most of the household is connected to the network, through the pipelines of such networks are considered to be deteriorated because of long usage and their installation does not conform to the necessary standard and specifications. In design of the water supply system, therefore, it is considered that the improved supply system would cover 100 % of the residential areas expected for the target year of 2000, and that the same level of improvement would be considered for those areas that new water supply facilities are planned to be provided under the project.

(3) Concept for Construction and Procurement Conditions and Utilization of Local Contractors

<Construction Conditions>

There is the Palestine Contractors Union in the west bank area, and about 250 contractors are registered in the union. The registered contractors are classified into 5 categories, and out of these about 85 contractors are registered as those for the water supply and sewerage sectors, of which 19 are categorized in Class A. Most of the contractors have their bases in Ramallah and

Nablus cities executing construction works in various places in the west bank area. Most of the Class A contractors have experiences to work for the construction projects similar to water supply and sewerage construction under the foreign and international cooperation agencies. It is considered that the Japanese contractor selected for the project would hire some of the local contractors registered in Class A.

<Procurement>
Most of the materials to be incorporated in the project are available in the west bank or the Israeli areas, and their production is considered enough to supply the necessary quantities to the envisaged construction work. It is, therefore, necessary to employ the methods and manners with which such available materials and resources are utilized as much as possible. As for the pipe materials, there are two (2) manufactures in the Israeli area, and those prices may rise suddenly. Therefore, the procurement in third countries such as neighboring and European countries is to be considered in the procurement plan.

(4) Concepts for the Technical Level and the Operation and Maintenance Capacity of the Implementing Agency

While Palestinian Water Authority (PWA) and Ministry of Local Government (MOLG) are the implementing agencies of the project, the project facilities, after the completion of construction works, shall be transferred to municipalities and villages to be responsible for continuous operation and maintenance for the efficient water supply services. The Baqa Al Sharkya area which will introduce new distribution system has to manage such new system by themselves. In the other villages and municipalities other than Jenin, who have experiences to operate and maintain the existing facilities, the assigned staff numbers are considered insufficient and their institutional formation is considered below the minimum level for proper operation and maintenance of the system. The improper institutional establishment due to the technical and financial limitation and the insufficient billing, collection and cost management due to financial capability are remarkable.

MOLG is, therefore, preparing and implementing a "Joint Water Council Promotion Program" and a "Operation and Maintenance Program" to strengthen the capacity of the water service entities in smaller villages. This Operation and Maintenance Program is to be implemented through the integrated training on water supply services, but requires disciplines not inherent in the ministry. Cooperation in such disciplines from PWA and WBWD is then indispensable, and it is necessary to establish the close formation among MOLG, PWA and WBWD suitable for cooperating each other toward the realization of proper operation and maintenance by the villages and municipalities.

West Bank Water Department (WBWD), which is also a division of PWA is operating a bulk water supply service. Four (4) among the seven (7) municipalities/villages under the project will receive the wholesale service of drinking water from WBWD. With personnel of some 110 employees including 14 engineers and other qualified personnel like water analyst, it is also maintaining water wells and water transmission mains owned by itself and by Mekorot, a water supply company of Israel. Neither PWA nor WBWD assumes responsibility on operation and maintenance of the project facilities. However, PWA, as the regulator of the Palestinian water

and wastewater sector, and WBWD, as the wholesaler of drinking water to the customers, shall maintain linkages to the operation and maintenance of the present project.

MOLG, in the capacity of organizing the municipal and village councils and guiding their development, shall promote joint water councils and undertake an integrated training program for the water supply services for upgrading the operation and maintenance capability of water supply entities such as joint water councils and water supply units of municipal and village councils under the present project. More generally, MOLG assumes responsibility on assisting sound and sustainable maintenance of financial positions and public services of the local self-government bodies.

(5) Concept for Scope and Grade of Facilities and Materials to be Provided under the Project

<Scope of the Facilities and Materials>

The project is to improve and provide the facilities and materials for the water supply facilities except for the water source such as wells, springs and Mekorot outlets. The area served by the improved system is set considering the population distribution in the target year of 2005. The house connection is planned to be provided by PA side in the same manner as Phase 1 project, but is to be so designed that the expenses to be shouldered by the PA side is reduced to minimum level.

<Grade of Facilities>

The grade of the facilities to be provided under the project is to be set considering technical level and skill of the authorities' staff who will be assigned for actual operation and maintenance works after the completion of the construction. Some technical training on this aspect will also be carried out, if required. In the selection of pipe materials, those materials available locally and easy in maintenance works will be selected.

(6) Concept for Construction Period

Considering the regulation of the Japan's Grant Aid Program, the grant aid project has to be implemented within one fiscal year. The project includes the construction of pipelines over 105. km, four (4) reservoirs and one (1) booster pump station, and its scale is considered quite large comparing with the available construction period. Therefore, it is proposed to employ the polyethylene pipe materials to reduce the construction period and to increase the hired local contractors, as well as employing more supervising staff accordingly.

2.3.2 Basic Design

The basic design for the requested areas are presented below.

(1) Design Condition

The employed designs conditions are summarized below.

Design Conditions

Items		Applied Values	Descriptions
Design Load	・ Roof Load	100kg/m^2	Live load on reservoir roof
	・ Wind Load	120kg/m^2	Israeli Standard (H=15m)
	・ Seismic Coeff.	0.1	Israeli Standard
	・ Unit Weight	2.4 t /m^3	Mass concrete
		2.5 t /m^3	Reinforced concrete

Design Conditions

Items		Applied Values	Descriptions
Allowable Stress	• Concrete	18 N/mm^2	Type B150, Allowable bending stress
		21 N/mm^2	Type B200, Allowable bending stress
	• Reinforcement Bars	1,400kg/cm^2	Round bar, Allowable strain stress
		1,600kg/cm^2	Deformed bar, Allowable strain stress
Foundation	• Bearing Capacity	20 t /m^2	Bearing capacity of soil foundation
	• Unit Weight of Soil	1.6 t /m^3	Including backfill materials
Guidelines	• Civil Works	PA and Japanese Standards and Guidelines	
	• Buildings		

(2) Components of Water Supply Facilities

The components of water supply facilities in the project are illustrated below.

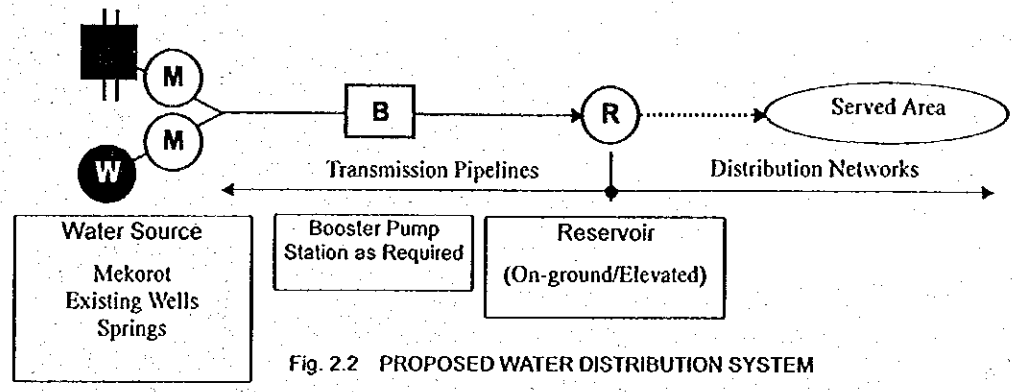


Fig. 2.2 PROPOSED WATER DISTRIBUTION SYSTEM

Integration of existing and planned Mekorot outlets, the existing irrigation and domestic wells and the existing springs are proposed as the water sources of the Project. Water from these sources is conveyed in most case to the reservoir through the transmission pipelines. A booster station is proposed to be installed in case the water pressure is considered insufficient for conveying the water to the reservoir because of topographic conditions. The elevated or on-ground reservoir is planned to be constructed in order to stabilize the water distribution throughout a day. The water stored in the reservoir is distributed through the distribution networks connected to each house.

(3) Transmission and Distribution Pipelines

The transmission pipeline is planned to convey the water from water source to the reservoir. Basically, the house-connection pipes are not branched out from the transmission pipe. A network of distribution pipeline is planned from the reservoir to the house-connection. In the design, the pipeline networks are planned based on those prepared by WBWD, and finalized considering the results of field survey as well as the discussion with the authorities of PA side.

<Selection of Pipe Materials>

Five (5) types of pipe diameters are applied for the pipeline networks of the project; 50 mm (2 in), 75 mm (3 in), 100 mm (4 in), 150 mm (6 in) and 200 mm (8 in). Four (4) types of pipe materials are compared considering the pipe types having predominantly used in Palestinian area so far; steel pipe with outside coating with polyethylene and inside mortar coating, galvanized iron pipe, ductile iron pipe, and high density polyethylene pipe, as shown below.

Comparative Statement of Pipe Materials

Material	Ease of Construction	Economy	Procurement	Remarks
1. Steel Pipe	Since welding is necessary at every joint, many welding technicians have to be employed resulting in long construction period.	Labor cost for welding becomes expensive resulting in large construction costs comparing with polyethylene pipes.	The material is available in Israeli area, and there are two (2) manufacturers.	Inside lined with mortar and outside coated with polyethylene.
2. Galvanized Iron Pipe	Pipes are jointed with socket easily, but special attention should be paid for avoiding damages on threads. Bend pipes have to be applied at every bending points, which results in increasing number of joints.	Predominantly applied for small diameter pipes less than 50 mm, and its price is considered normal.	Material is locally available.	Materials may get deteriorated in a few years.
3. Ductile Iron Pipe	Tyton joint with rubber ring is applied for the pipes with smaller diameter less than 300 mm. Though the joint treatment is easy, bend pipes are necessary at every bending points increasing number of joints.	Price is expensive.	Material is not available in Israeli area.	
4. High Density Polyethylene Pipe	Since small diameter pipes are supplied in roll of about 100 m, number of pipe joints are decreased substantially. The joints are made with electric fusion, which is considered quite easy for workers. The material is flexible to follow small bends with out applying bend pipes.	Price is the cheapest.	Material is available in Israeli area, and there are two (2) manufacturers.	

Considering the above advantage and disadvantages of pipe materials, the pipe materials to be applied for the project are selected as stated below.

- Transmission pipeline: Most predominantly used steel pipes (inside lined with mortar and outside coated with polyethylene).
- Distribution pipeline: (Larger diameter than 100 mm) Most predominantly used steel pipes (inside lined with mortar and outside coated with polyethylene) as same as transmission pipes.
- Distribution pipeline: (Smaller diameter of 50 mm - 75 mm) High density polyethylene pipes of which advantages are recognized in USAID projects.
- House connection pipes: Galvanized iron pipes most predominantly applied for house connection.

<Hydraulic Design Calculations of Pipeline Networks>

The hydraulic design calculations were carried out for each pipeline network with computers on the following conditions.

Condition of Hydraulic Design Calculations for Pipeline Networks

Items	Description
Design Conditions	Conforming to the Planning and design guidelines (PWA).
Application for Calculation	EPANET developed by the Environmental Protection Agency, US is applied for the calculation.
Design Discharge	Transmission pipeline: Design Daily Max. Discharge Distribution pipeline: Hourly Max. Discharge
Calculation Formulae	Hazen - Williams Formulae
Design Velocity	ϕ 50 (Polyethylene Pipe): 130, ϕ 75 (Polyethylene Pipe): 150

Condition of Hydraulic Design Calculations for Pipeline Networks

Items	Description
Factor	ϕ 100～ ϕ 200 (Mortar Lining): 130
Time Factor in a Day	Time 0-2 | 2-4 | 4-6 | 6-8 | 8-10 | 10-12 Coef. 0.5 | 0.3 | 0.5 | 2.0 | 1.5 | 1.1 Time 12-14 | 14-16 | 16-18 | 18-20 | 20-22 | 22-24 Coef. 1.0 | 1.1 | 1.2 | 2.0 | 1.3 | 0.8 Source: Planning and design guidelines (PWA) Max. is 2.0 and Min. is 0.3.
Dynamic Pressure	Maximum pressure: 8 bar (80 m) Minimum pressure: 2 bar (20 m)
Pressure at Outlet	(Unit: m) 1. Beginning point of transmission pipeline Area | Hiwara | Rantis Pressure at Beginning (Altitude) | 685 | 425 2. Beginning point of distribution pipeline The bottom elevation of reservoir is set as the pressure elevation at the beginning of distribution pipelines.

The results of calculation by computer are tabulated below.

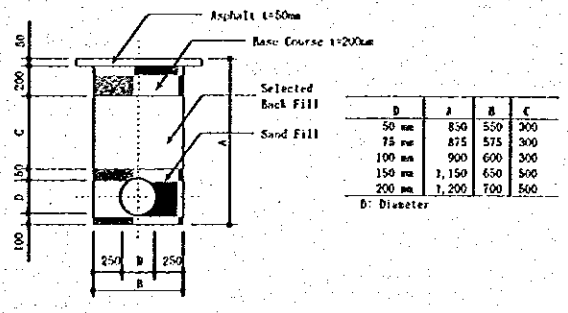
Results of Hydraulic Design Calculations by Computer

Project Area	Pressure (kg/cm^2)					
	Transmission			Distribution		
	Pressure at Water Source	Pressure at Reservoir or Booster P/S	No. of Reducing Valves	Max.	Min.	No. of Reducing Valves
1. Jenin	-	-	-	-	-	-
2. Burqa	-	-	-	8.5	1.1	4
3. Hiwara	19.1	11.3	1	7.0	1.7	1
4. Attil	8.0	0.0	-	-	-	-
5. Qaffin	-	-	-	8.0	2.3	1
6. Baqa Al Sharqiya	7.0	3.7	-	7.7	0.9	2
7. Rantis	14.0	0.0	-	-	-	-

Note: Since the areas of pipe replacement share only some parts in the whole supply system of Jenin city, the calculation for whole pipeline network is not conducted, but velocities and losses along the major pipelines are confirmed with simple hydraulic calculation.

<Placement of Pipes>

The transmission and distribution pipelines are set along the public roads in the villages and municipalities. However, in the Rantis area, some parts of the transmission pipelines are planned to be constructed along the main roads in the Area C, and the pipes have to be placed about 15 m away from the center of such main roads except for the areas where such placement is considered difficult due to obstacles such as housings, etc.



D	A	B	C
50 mm	850	550	300
75 mm	875	575	300
100 mm	900	600	300
150 mm	1,150	650	500
200 mm	1,200	700	500

Fig. 2.3 STANDARD CROSS-SECTIONS OF PLACED PIPES

Standard section of pipe placement and road crossing conform to the standard of PA as illustrated in Fig. 2.4.

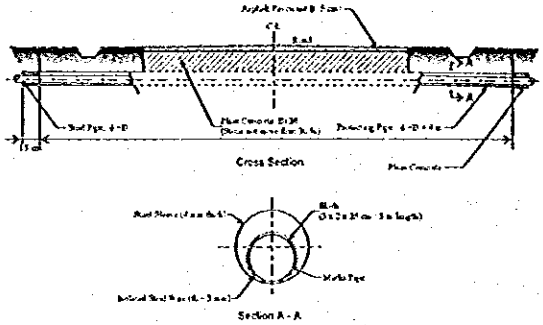


Fig. 2.4 STANDARD ROAD CROSSING

<Appurtenant Facilities>

The appurtenant facilities such as gate valves, air valves, drainage facilities, etc. will be provided in accordance with the Japanese and Palestinian standards as summarized in the following table.

Appurtenant Facilities for Transmission and Distribution Pipelines

Facilities	Description
Discharge Meter	The flow discharge is to be measured at the connections of each municipality or village. In Jenin, Hiwara, areas where the water is supplied by Mekorot, the flow meter installed by the Mekorot will be used. As for the other areas, flow meters will be installed to grasp the volume of water used for each municipality and village.
Gate Valve	Gate valves are to be installed at each connection from water source, diversion point of distribution pipeline and house connection point with an interval of not more than 1 km.
Pressure Reducing Valve	Pressure reducing valves are to be installed to reduce the downstream pressures in a design allowable range from 2 to 8 km/cm^2 when the pressure in such downstream areas exceeds the allowable maximum pressure.
Pressure Relief Valve	Pressure relief valves are to be installed after any pressure reducing valves, and will be calibrated to open at required pressure.
Check Valve	Check valves are to be provided at the beginning points and the end points connected to reservoirs in order to prevent back flow of water.
Single Mouth Air Valve	Single mouth air valves are to be installed in water meter box and raised points in transmission and distribution pipelines to remove the free air in pipes.
Combined Air Valve	Combined air valves are to be provided at points on transmission lines where the air free babbles are locked.
Drainage Facility	Drainage facilities are to be installed in depressed and lower portions of transmission and distribution pipelines. The pipelines of diameter more than 150 mm are considered in the design.
Thrust Block	The thrust blocks are to be provided where the water pressure is calculated more than 20 km/cm^2 in the transmission pipelines if soil mechanical conditions does not withstand such pressure levels.

(4) Reservoir

Reservoirs are provided to store the water conveyed from the water source such as Mekorot outlet, wells and springs, and to regulate the distributed water to meet the variation of demand in the service area and to mitigate the effect by emergency or accidental stop of water supply.

<Type of Reservoir>

The reservoirs made of reinforced concrete (RC) is most popular in PA. Since there is a manufacturer in Israeli area to produce ready-made tanks made of the fibre-reinforced plastic (FRP), a comparison between RC and FRP tanks are made in the aspects of construction, economy and durability. As a result, it is concluded that FRP tank has many advantages in economy as well as ease of construction, reducing the construction period. However, Israeli experts are required to visit the sites in the Areas A and B for delivery and installation of tank units. It is, however, found to be difficult to secure the safety for them because of political reasons. Therefore, considering the feelings of local dwellers, it is determined that RC-made

reservoirs are to be selected for the project except for some small balancing tanks of booster stations.

The shapes of reservoir tanks are rectangular for elevated type, either circular or rectangular for on-ground type of which capacities are more than 300 m^3 and less than 200 m^3, respectively.

<Reservoir Capacity>
The capacity of reservoir tank is set to store water for 8 - 12 hr of the maximum daily supply considering the standard capacity of 200 m^3 300 m^3 and 500m^3 used in PA. The following table presents the determined capacity of each reservoir.

Design Capacity of Reservoir Tank

Village/Municipality	Capacity (m^3)	Type	Village/Municipality	Capacity (m^3)	Type
1. Hiwara Municipality	500	On-ground	11. Baqa Al Sharqiya M.	300	Elevated
10. Attil Municipality	500	Elevated	15. Rantis Village	200	Elevated

The water level inside the reservoir tank is censored by the float, and the water flow is stopped when it reaches full level.

(5) Booster Pump Station

When the water pressure is not enough to convey the water to the site directly, the booster pump station will be provided to raise the water pressure to reach the reservoir tank. The principal features of the booster pump stations are tabulated below.

Principal Features of Booster Pump Station

Area	Daily Max. (m^3/day)	Discharge (m^3/hr)	Total Head (m)	Trans. Pipe (ϕ mm)	Balancing Tank (m^3)	Reservoir (m^3)	Elect. Source
Attil	822	100	80	200	200	500	Com. Sup

Note: Com. Sup.: Commercial Supply

The booster pump is stopped by the pressure rise due to closing the float valve at the full level of reservoir tank, and will start again after predetermined time period set by timer. The timing of starting operation is determined with confirmation of the various conditions such as water level of the balancing tank, etc. referring to the records and data collected during the actual operation.

(6) House Connection

<Provision of Connection Pipes>
Any pipelines cut in the construction work will be restored by the Japanese contractor under the Project except for the service pipes to each household, and the existing pipes will be abandoned at the existing position after construction of new pipes. The road pavement removed by excavation for the pipeline constructions will be fixed by the Japanese contractor under the Project.

In case that the house connection pipes are attached to the distribution pipes of which diameter is more than 75 mm, secondary pipes will have to be installed and smoothly connected to the

house connections by PA side as shown in the figure.

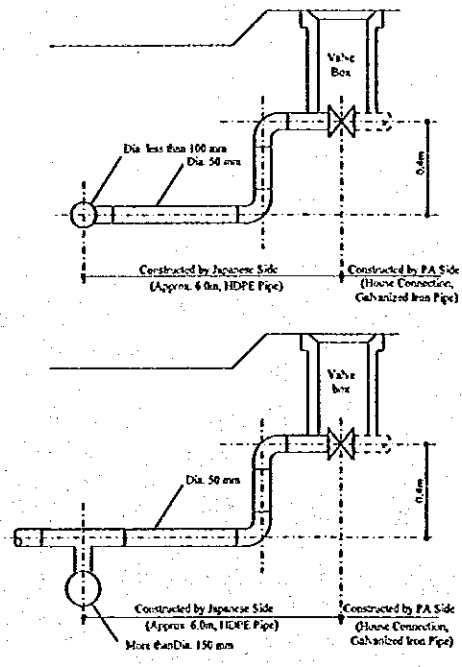


Fig. 2.5 HOUSE CONNECTION

- Manners in re-connection of secondary pipes
  Since the distribution pipes of the diameter more than 75 mm are installed mainly in the dense residential areas and large population is served directly by these pipes, the secondary pipes of 50 mm up to the stop valve will be constructed near the edge of the road area by Japanese side in order to facilitate smooth re-connection by the PA side with low cost.

- Places of connection to secondary pipes
  The locations of connection to the secondary pipes and their intervals are as stated below.
  - The connection is to be located at 25 m interval along the distribution pipelines, and at least one connection is to be provided in between any two (2) road intersections in the dense residential area.
  - In less densely populated residential areas, the connections are installed at every 100 m, along the distribution pipelines.

  These connections will be installed by Japanese contractor.

<Procurement of Materials for House Connection>

In order to facilitate the connection and re-connection works, the piping materials will be provided for the connection pipes from the delivery pipes of 50 mm diameter to the stop valves.

- Scope of the procurement for the piping materials to be provided
  The total length of delivery pipeline of 50 mm diameter shares about 65 % of the whole length of delivery pipelines, and the connections will be installed with a interval of 12 m in the residential areas and the maximum interval does not exceed 100 m. The portion to be treated under this procurement is illustrated in Fig. 2.6.

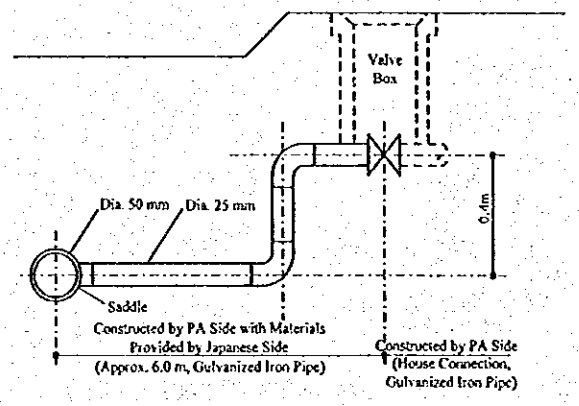


Fig. 2.6 MATERIALS PROCURED BY JAPANESE SIDE

- Location of connection
  The location of connection is determined considering the local conditions and density of the residential areas.

(7) Other Facilities

<Indicator of Installed Pipelines>

Where the pipeline is installed out of the road area, indicating posts as shown in Fig. 2.7 will be installed along such routes.

<Flush Prevention Block>

The erosion prevention block as shown in Fig. 2.8 will be installed along the pipeline routes of which slope is measured more than 15 % in order to prevent the filled materials from flushing out due to heavy rainfall.

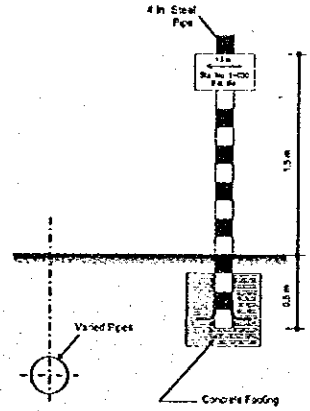


Fig. 2.7 ROUTE INDICATING POSTS

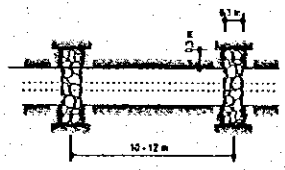


Fig. 2.8 FLUSH PREVENTION BLOCK

Table 2.1 Project Design Matrix

Narrative Summary	Objectively Verifiable Indidcators	Means of Verification	Important Assumptions
Overall Goal 1. Improvement of water supply services 2. Improvement of people's living conditions	1. Service rate in northern districts 2. Control of water borne diseases	- Statistics of Ministry of Health	- Realization of sustainable operation of water supply in the northern districts of West Bank
Project Purpose - Realization of stable water supply in quantity and quality	1. Quality of supplied water 2. Supplied water volume	1. Water quality records of Ministry of Health and WBWD 2. Records of billing and collection of water charge	- Improvement of water distribution facilities are performed in the northern districts of West Bank
Outputs 1. Improvement of water service ratio 2. Operation of sustainable water supply services	1. Number of registered households 2. Volume of accounted water, volume of water leakage, frequency of repair and amount of reserved fund for depreciation	1. Records of billing and collection of water charge 2. Daily records, breakdown of expenses, income statement and balance sheet	- No change in the Palestinian policy of water supply
Activities 1. Construction supervision with assistance of the Palestinian counterpart staff 2. Technical transfer through the supervision together with the Palestinian counterpart staff	Inputs Japanese Side 1. Improvement of transmission and distribution pipelines and related facilities such as reservoir, booster pump station, etc. 2. Provision of the materials for installation of house connections 3. Dispatch of the engineers for detailed design and construction supervision	PA Side 1. Assignment of required staff for operation and maintenance as well as management under the direction of MOLG 2. Construction of related facilities such as electricity supply, house connection, fences, drainages, etc. 3. Confirmation of owner, water allocation, etc. of water source 4. Assignment of counterpart personnel	- Completion of improvement of water supply facilities and commencement of water supply services - No replacement of assigned O & M staff and continuation of O & works Pre-conditions - All the approval and license has to be settled including JWC approval, extraction license, etc. - Ownership of water source, right of water use, etc. have to be obtained. - A management organization to receive the improved facilities has to be established.

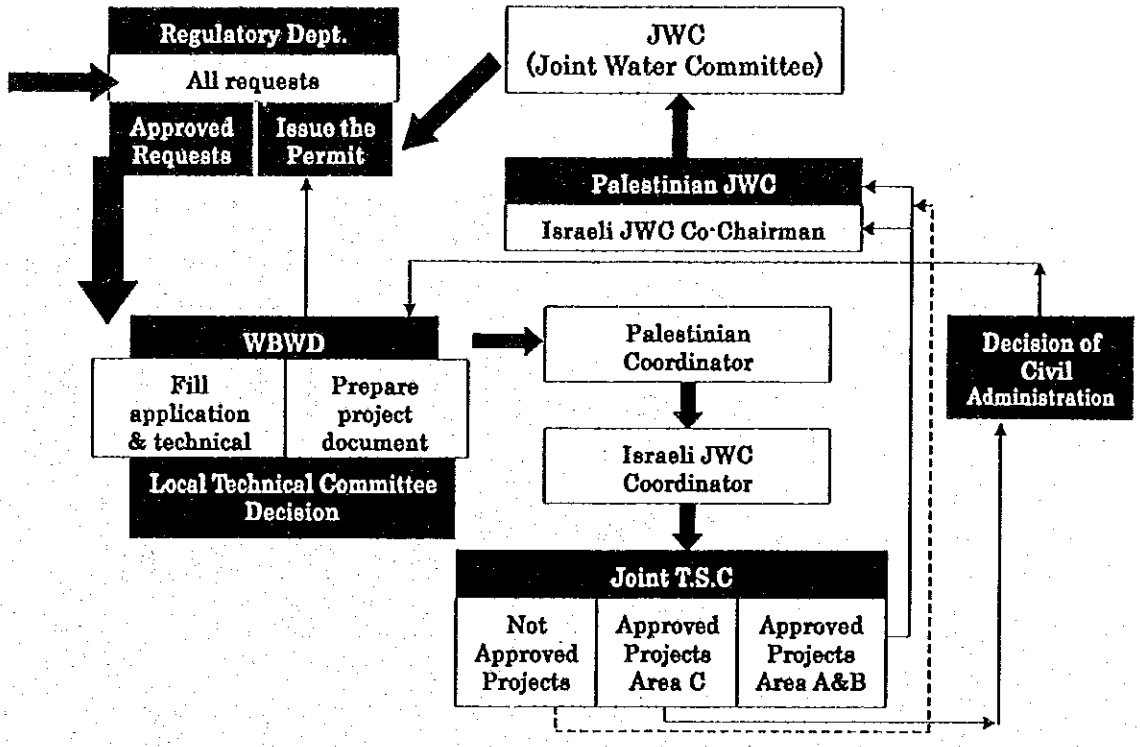


Fig. 2.1 PROCEDURES FOR JWC APPROVAL

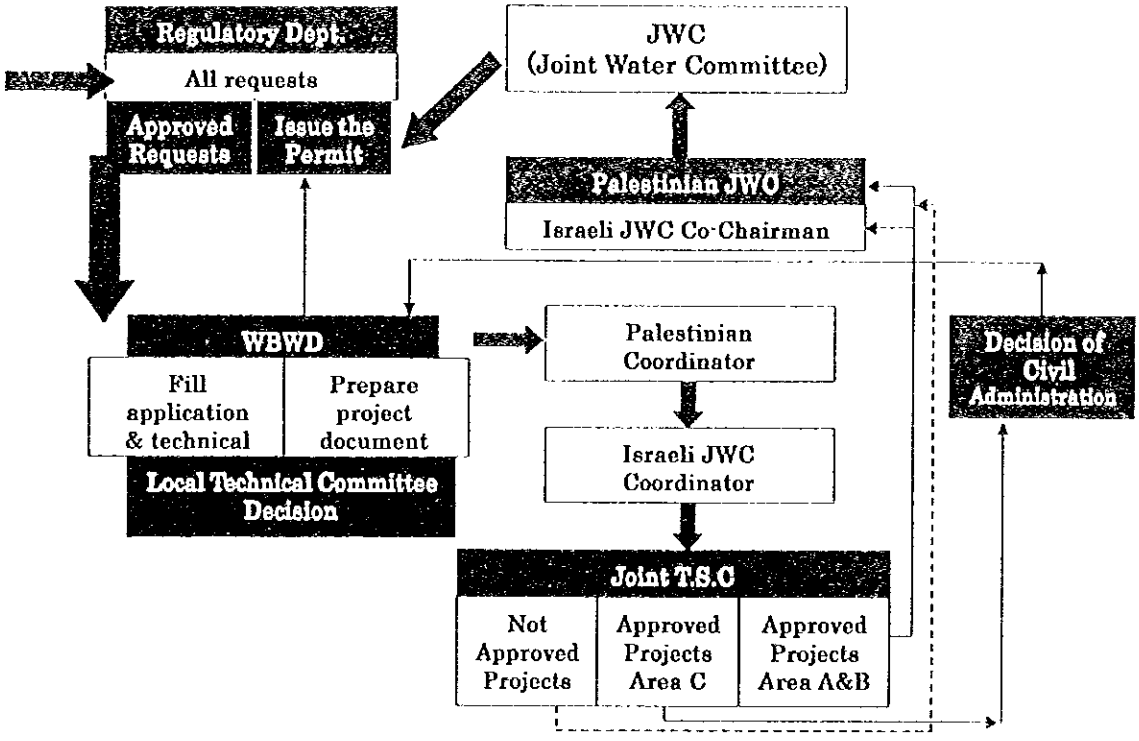


Fig. 2.1 PROCEDURES FOR JWC APPROVAL