PALESTINIAN AUTHORITY (PA)
MINISTRY OF AGRICULTURE (MOA)
PALESTINIAN WATER AUTHORITY (PWA)

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF DOMESTIC, INDUSTRIAL AND AGRICULTURAL WATER SYSTEMS IN JORDAN VALLEY AND NORTHERN WEST BANK

MARCH 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

SANYU CONSULTANTS INC.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Sanyu Consultants Inc.

The survey team held a series of discussions with the officials concerned of Palestinian Authority, and conducted field investigations. As a result of further studies in Japan, 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 Palestinian Authority and Government of Japan.

Finally, I wish to express my sincere appreciation to the officials concerned of Palestinian Authority for their close cooperation extended to the survey team.

March 2013

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SUMMARY

1. Outline of the Palestinian Authority

- Natural conditions

Approx. 11 million in total of Palestinian lives in Israel, Jordan and other country including Palestinian territory. Palestinian Authority (hereinafter referred to as "PA") is composed of the West Bank (Area: 6,020 km^2, population: 3,880 thousand) and Gaza (Area: 365 km^2, population: 1,404 thousand, source: PA Central Bureau of Statistic). This study covers six(6) districts, namely; Jenin, Tubas, Qalqiliya, Tulkarem, Nablus and Jericho in the West Bank.

The West Bank belongs to the Etesian climate, that meteorological feature is a long dry summer and a short rainy winter. Average temperature is 17 degree centigrade in the central mountains, 25 degree in the Jordan valley. While rainy season is from October to April, precipitation concentrates within three(3) months from December to February. Annual precipitation is ranged from 400 to 700mm in the Central mountains and western part of the West Bank. In the eastern part of the West Bank, precipitation tends to decrease gradually toward the Jordan valley and the Dead Sea. The annual precipitation in Jericho city located at -250 m MSL ranges from 50 to 100 mm which is extremely low.

The central mountains ranged from 200 to 800 m MSL runs north to south in the center of the West Bank. The mountains are mainly consisting of limestone and forms undulating geography eroded by Wadis. Cities of Ramallah, Nablus and Tubas are built at hilly area in the mountains. The central mountains slope down to both east and west sides with undulation. The west side of the mountains continues to the coastal plain of Israel. Qalqiliya and Tulkarem are located at the middle mountain hills with 100 to 200 m MSL.

- Socio-economic conditions

Economy of PA has become worse due to "2nd Intifada" occurred in September 2000. Given this situation under the occupation of Israel, PA has been depending on Israeli economy for a long time. Since physical distribution has been under Israeli control, most of the necessities for living as well as labor market are dependent on Israel. Movement of labors and goods are restricted due to the lack of transportation between the West Bank and Gaza, blockade of Gaza, separation wall built by Israel, check gates, road blockade, in addition to the fact that 60% of Palestinian territory is occupied under area C where Israel controls security and administration. Table-1 shows industrial structure of PA in 2010.

Table-1 Industrial structure (occupying rate of GDP with 5.1 billion USD in 2010)

Agriculture /Fisheries	Industry	Construction	Sales/ Trading	Market	Public/ Defense	Service	Transport/ Communication	Others
5.5%	12.4%	9.7%	10.7%	5.5%	14.2%	22.3%	8.6%	11.1%

Source: PA Central Bureau of Statistic, 2011

2. Background of the Project

- Water resources and agriculture sectors

Water utilization in PA depends on groundwater (well) about 75%, by the Oslo Accords II (1995) with the government of Israel. The volume of annual water use is limited within 121 MCM (20% of available groundwater) in PA out of 607 MCM/year that is produced from the aquifer which Palestine side can access.

It is required to plan and use groundwater resources effectively; however, most of the agricultural infrastructures sourced by well and spring water are declined due to overage and/or deterioration. Urgent measures for improvement and rehabilitation of irrigation facilities are required.

In accordance with "Palestine Fundamental Principles (The 13th)" that prioritizes economic development and public infrastructure development, “Palestinian National Development Plan (2011-13)” put importance on the extension of arable farm land from 150,000 ha to 160,000 ha by improving existing irrigation systems and establishment of "Jericho Agro-Industrial Park (JAIP)".

- Domestic and industrial water sector

Israel controls development of water resources not only the water deficit but also water quality in Gaza area is a big issue. Less than 10% of the people can access proper drinking water facilities.

Projects assisted by international agencies had achieved to supply domestic water to 123 areas in recent several years in the West Bank. And yet, 90% of PA population has still been forced 10 to 15 days water cut a month in summer season. For 180,000 habitants or 1.6% of Palestinian population (11 million in 2010) are forced with unit of water supply volume less than 25 litters/capita/day recommended by WHO in minimum. Also, deterioration of facilities is worsening the water supply volume.

Main strategy related with domestic and industrial water sector shown in “Palestinian NDP” gives 1) to heighten ability of competiveness on agricultural productivity, 2) to enhance marketing accessibility to foreign market and 3) to contribute unemployment measures by activating labor market. JAIP is now under construction in Jericho city as a core project of the “Corridor for Peace and Prosperity” which advances economic development in Jordan Valley through cooperation of Palestine, Israel, Jordan and Japan, under the initiative of Prime Minister Koizumi (at the time in 2006).

- Background of the request

Under the above situations, PA requested to the Government of Japan in August 2010, to conduct two cooperation schemes, namely; 1)"Improvement of Domestic and Industrial Water Systems in Jericho City" aiming improvement of an existing distribution system and construction of a new well, and 2)"Improvement of Agricultural Water System in Jordan Valley and Northern West Bank" aiming rehabilitation of agricultural water sources including wells and spring with transmission / distribution systems and construction of reservoirs under the Japan’s Grant Aid Scheme.

For the request, JICA decided to conduct the scheme under this preparatory survey in December 2010, by the result of a preliminary survey with collecting basic information on conditions of water sources and existing transmission / distribution systems in October 2010. Also after the survey, JICA had a series of discussions and field investigation with Palestinian Water Authority (hereinafter referred to as "PWA") and Jericho municipality in February to March 2011.

And JICA proposed to PA side that the above two(2) schemes should be combined as one preparatory survey by the name of "Improvement of Domestic, Industrial and Agricultural Water Systems in Jordan Valley and Northern West Bank" since contents and scales of necessary survey for the two schemes are technically similar on the viewpoints of studying water source, transmission/distribution systems in the results of discussion with Ministry of Agriculture (hereinafter referred to as "MOA") in May 2011.

3. Study Results and Contents of the Project

By the above decision, JICA dispatched a team twice as the 1st field survey from September to October and as the 2nd field survey from November to December in 2012. The survey team had a series of discussion with the officials concerned of PWA and MOA, and examined the validity of the components requested by PA under the Japan's Grant Aid Scheme through the field investigations including collection of data and information on natural and socio-economic conditions.

- Improvement of Agricultural Water System

Based on the results of the field survey, JICA had selected the components with the criteria shown below, which were agreed by MOA as shown in Table-2.

1) Well license being approved by JWC (Israel-Palestine Joint Water Committee).
2) No funding available from any other donors.
3) Sustainability of the water resource exists.
4) Land owner (farmers) agree the construction for reservoir.
5) The schedule of the construction of the Treated Waste Water Plant (TWWP) is clear.

Table-2 Result of screening of requested component for Agricultural Water System

Items requested	Original request	Results of study
1. Reservoir construction and improvement of distribution systems	1) Reservoir construction: 40 sites 2) Rehabilitation of distribution system: 35 km	Out of selected 25 Irrigation sites; 1) New reservoir construction: 24 sites 2) Transmission pipe: 25 sites, L=17.5 km 3) Distribution system: 25 sites, L=35.6 km 4) Discharge meter installation 5) Distribution valve installation
2. Improvement of well sites	Rehabilitation of 11 well sites	Out of selected 9 well sites; 1) New pump installation: 9 sites 2) Well deepening: 6 sites 3) Well cleaning: 3 sites 4) New reservoir: 1 site 5) Pipeline length: 1.1 km 6) New pump house: 9 sites
3. Improvement of Nwaimeh Spring Water Canal	Rehabilitation length: 3 km	1) Rehabilitation length: 4.1 km 2) Distribution valve installation (17 nos.)
4. Soft component	To train technicians and farmers on operation and maintenance	1) To assist water management 2) To assist organizational management
5. Irrigation reservoir	35 sites	Out of scope
6. Irrigation system	160 sites	Out of scope

- Improvement of Domestic and Industrial Water Systems

This component is expected to supply domestic water to Jericho city and Akbat Jaber refugee camp, as well as industrial water to JAIP in near future. However, it is difficult to finalize distribution volume to each facility due that 1) JWC has not approved construction of a new well and 2) consent of water society (farmers) for well water mixing to Ein Sultan spring (SWAP) has not obtained yet. Tentative component in the result of study is shown in Table-3 at this moment.

Table-3 Present status of requested component for Domestic and Industrial Water Systems

Items requested	Original request	Results of study (Tentative)	Remarks
1. Construction of a new well	Well construction and pump installation	1) Assumed pump scale: 50 m^3/hr 2) New pump house: 1 no. 3) Electrical distribution panel: 1 set 4) Distribution pipeline: 1.8 km	1) JWC has not approved the license for a new well yet. 2) Consent of SWAP has not obtained yet.
2. Upgrading of Jericho No.1 well	Upgrading of pump scale from 60 to 180 m^3/hr	1) Pump installation: 180 m^3/hr 2) Upgrading of electrical panel :from 60 to 180 m^3/hr 3) Distribution pipeline-1: 3.5 km 4) Distribution pipeline-2: 0.4 km	Civil Administration (CA) of Israel has not given an approval for construction of Jericho No.1 well facilities yet.
3. Construction of Distribution pipeline	Length: 1.7 km	(Total of the above pipeline length: 5.7 km)	

4. Construction Period and Project Cost Estimation

- Detailed design and construction period

Detailed design stage takes six(6) months for surveying of 25 irrigation sites, deepening and pumping test of 9 well sites for Agricultural Water System, and drilling a new well by entrusted surveying for Domestic and Industrial Water Systems including field survey designing and cost estimation.

For procurement and implementation, mobilization takes three months after the commencement of construction, and pipe line and concrete works will be carried out sequentially. It takes six(6) months to procure pump equipments from manufacturing and transporting to the construction site. And taking that 25 irrigation sites scattered at five districts and hot weather in Jericho city for construction of Nwaimeh Spring Water Canal and Domestic and Industrial Water System into consideration, total construction period is estimated for 13 months.

Moreover, it is necessary for E/N approval to get permission from JWC and construction permit from CA.

- Project cost estimation

It is an estimated 283 million Japanese yen (JY) for the consulting services such as detailed design, supervising of construction and conducting of soft component plan, 1,004 million JY for construction of the Agricultural Water System and 199 million JY for the Domestic and Industrial Water Systems. The total cost to be incurred by the subject project implementation is about 1,497 million JY (Japanese side 1,486 million JY and Palestinian side 11 million JY). The amount estimated, however, does not indicate the ceiling limit in the E/N to be signed.

5. Project Evaluation

- Improvement of Agricultural Water System

Agriculture in PA is one of the key industries such as GDP by 5.6% and to employment rate by 11.2%, in addition to its contribution to the national commodity exports rate by 12.2% and is expected being base of food security and economic development of PA. However, agricultural infrastructures sourced by well and spring are declined due to overage and/or deterioration. In addition, water source is not utilized effectively by leakage from pipeline systems of transmission / distribution with inappropriate water utilization, urgent measures for improvement and rehabilitation of irrigation facilities are required.

Sub-projects of Improvement for Agricultural Water System, namely, 1) 25 irrigation sites, 2) 9 well sites and 3) Nwaimeh spring canal are targeting 1,724 ha of irrigation area in total, which occupies 22% of irrigable area 7,680 ha in Jericho, Tubas, Nablus, Tulkarem, Qalqiliya and Jenin districts in the West Bank, and covers 4,480 agricultural house hold (approx. 24,400 people).

By the improvement of well facilities, transmission / distribution pipeline systems and spring canal, it is expected to achieve better irrigation efficiency to reduce leakages and un-used water, and reservoir to be constructed makes flexible irrigation timing and duration. Also, soft component cooperated with JICA TA program contributes to activate farmer’s organization and advance their livelihood by better productivity in Jordan valley and northern West Bank areas.

Furthermore, if JAIP by conception of “Corridor for Peace and Prosperity” is operated, activates agricultural sector of PA will be achieved by supplying production which is now restricted by the separation wall to Israel, may transport to Jericho city.

- Quantitative effects

Table-4 Quantitative effects for Agricultural Water System Improvement

Name of index	Base value (year 2012)	Target value (year 2016)
1) Leakage and un-used water rate at 25 irrigation sites are decreased.	**% in all of 25 irrigation sites.	**% in all at 25 irrigation sites in total.
2) Irrigation area of 9 well sites is increased.	217 ha in all of 9 well sites.	354 ha in all of 9 well sites.
3) Leakage volume at Naimeh spring canal is decreased.	**%	** %
4) Study tour to JICA TA program sites is executed.	Not executed	3 times a year

Remarks) **% shown in the Table would be decided by the results of water leakage survey during the detailed design.

- Qualitative effects

1) Crop diversification is promoted at target sites by constructing reservoir since beneficiaries can decide irrigation time and timing by themselves.
2) Discord between agricultural beneficiaries and residents is reduced since water theft from Naimeh spring canal is stopped by becoming closed type (pipeline) from open canal.
3) Marketing range of agricultural product is expanded by exchanges with medium/small sized farmers under JICA TA program through soft component plan.
4) Un-steadiness on irrigation opportunity of farmers where their lands separated by walls constructed by Israel (at 5 irrigation sites) is reduced since irrigation time is flexible by construction of reservoirs.

- Improvement of Domestic and Industrial Water Systems

Since Jericho city targeted under the Project has high population increase rate with 2.7% annually and 10,000 people scale of 2(two) refugee camps, population of the city is calculated twice as much as within the next 27 years from the present. And as the city is one of the international tourism spots with 1 million tourists a year, increment of population and tourist in the future should be considered for water demand.

Moreover, the shortage of water supply to the southern city is a problem of the Jericho city waterworks system, since this area is located at high altitude and the capacity of the existing pipeline is insufficient. In addition, JAIP is now under construction in Jericho city as a core project rerated to conception of “Corridor for Peace and Prosperity” which advances economic development in Jordan valley. The JAIP is expected to provide economic opportunities and brings more demand of domestic and industrial water.

With the above circumstance, the Project plans to implement the upgrade of a dug well named Jericho No.1 and to construct a new well with 5.7 km length of transmission pipeline for conveying safe water to Jericho city, prior to cope 16% of the population increment by year 2016, and plans to supply 170 (30+140) m^3/hr volume of water to JAIP in stage 2 scheduled to be completed in 2016. In the results of the Project implementation, it aims to improve condition of water supply on both domestic as well as industrial uses and also contributes unemployment measures by activating labor market in Jordan valley in the West Bank.

Due to the fact that it is still illegible whether JWC concerned by Israel gives approval for the construction

of a new well and CA's performance of handling to Jericho No.1 well, however, realization of the scheme on Domestic and Industrial Water Systems improvement is not feasible at this moment.

- Quantitative effects

Table-5 Quantitative effects for Domestic and Industrial Water Systems Improvement

Name of index	Base value (year 2010)	Target value (year 2016)
1) Water supply population in Jericho city is increased.	19,589 population	22,762 population
2) Water supply unit is increased.	205 little/capita/day	219 little/ capita/day
3) Water supply volume from Jericho municipality to JAIP is increased.	30 m^3/hr by year 2014 funded by UNDP.	100 m^3/hr by year 2016 under the Japan's grant aid.

- Qualitative effects

1) Discord on water distribution between water society (farmers) and Jericho municipality is dissolved since SWAP (well water mixing to spring) is realized.
2) Conception of "Corridor for Peace and Prosperity" is advanced since water supply to JAIP is attained.
3) Duration of water supply cut during summer season is reduced and water can be supplied to difficult sites since supply volume to Jericho city is increased.

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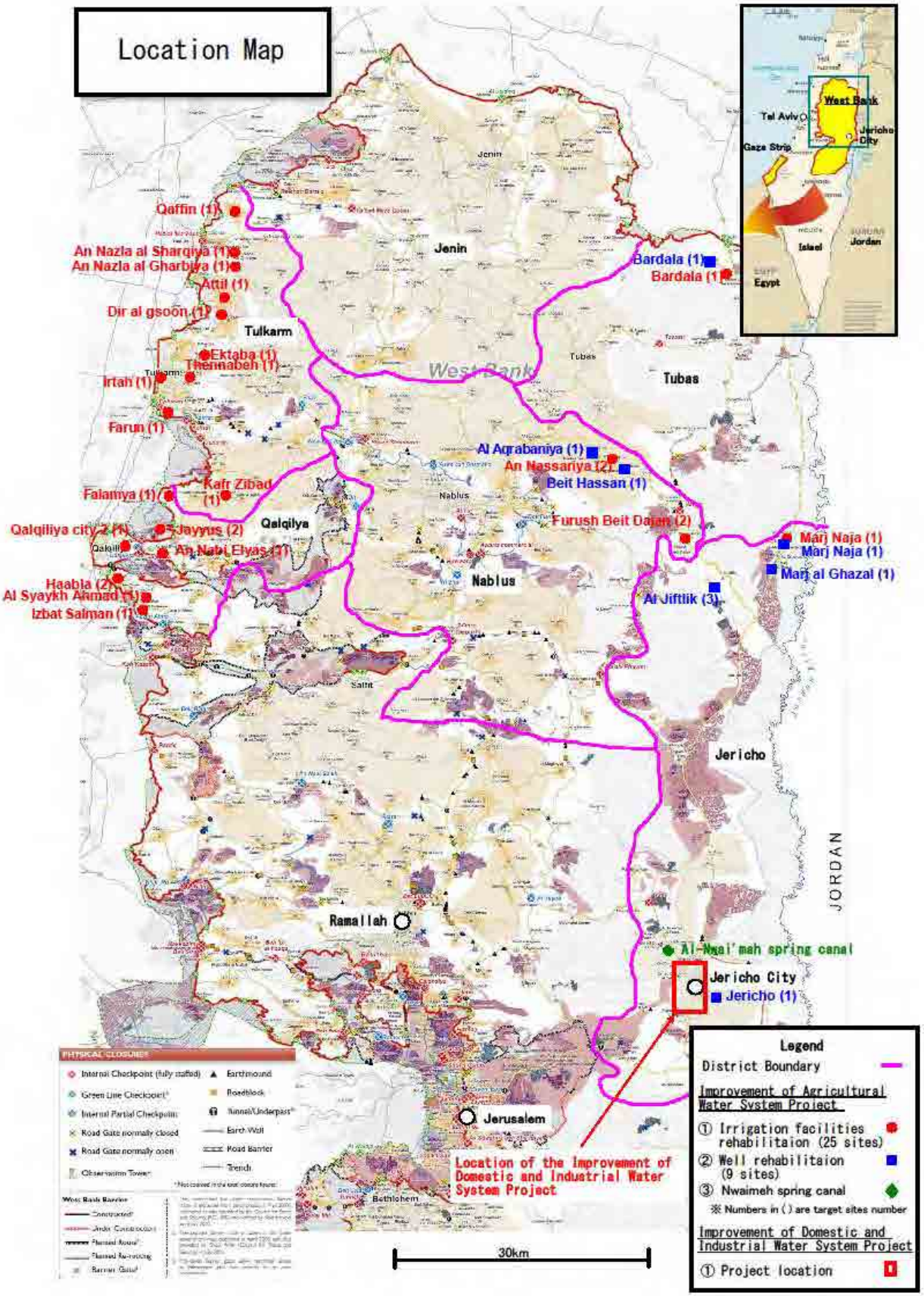
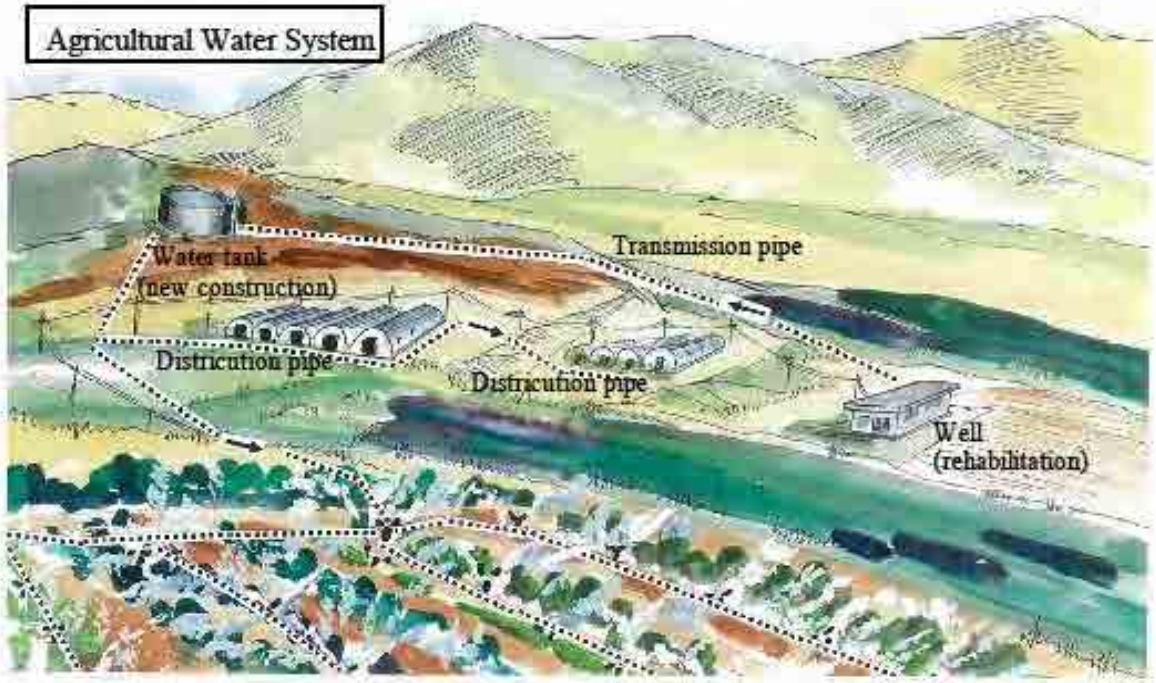
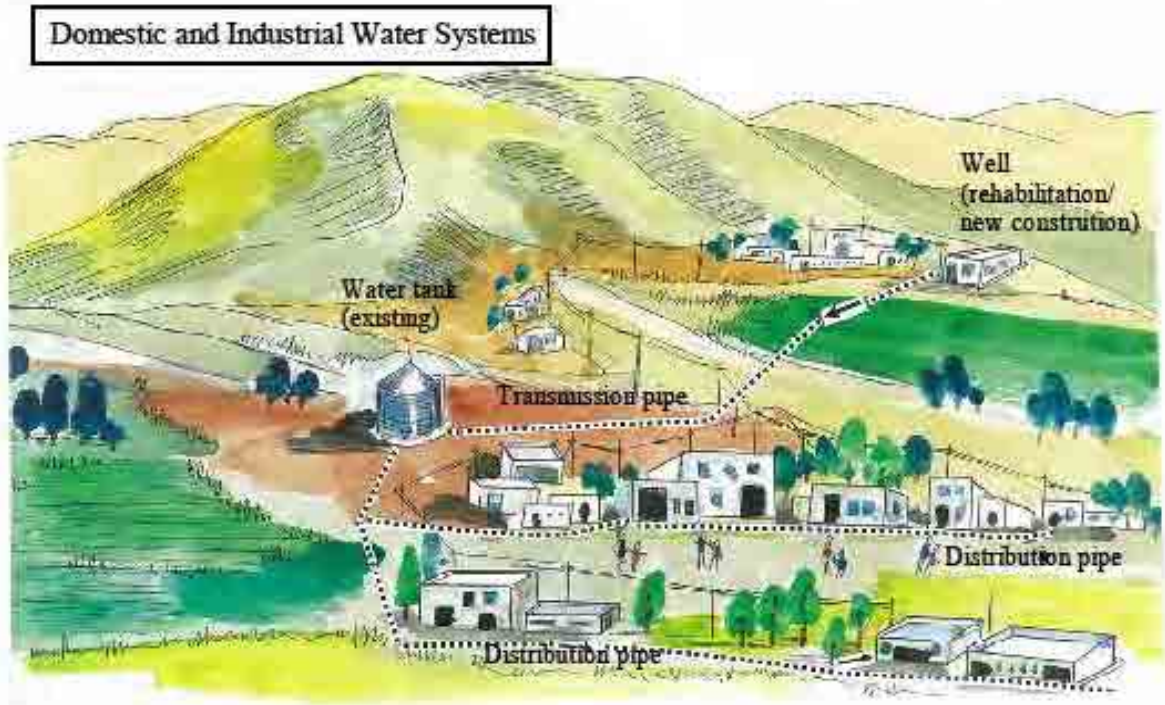
Location Map



Perspective





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ABBRIVIATIONS

Abbreviations

CA	Israel Civil Administrator
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
EQA	Environment Quality Authority
G/A	Grant Agreement
GOJ	Government of Japan
HDPE	High Density Polyethylene
HWL	High Water Level
IEE	Initial Environmental Evaluation
IFAD	The International Fund for Agricultural Development
JAIP	Jericho Agro-Industrial Park
JICA PP	JICA Pilot Project
JWC	Israel-Palestine Water Committee
KfW	Kreditanstalt für Wiederaufbau
LWL	Low Water Level
Mekerout	Israel Public Water Works
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOP	Ministry of Planning
NWC	National Water Council
PA	Palestrina Authority
PIEFA	Palestinian Industrial Estates and Free Zones Authority
PWA	Palestinian Water Authority
TWWP	Treated Waste Water Plant
USAID	The United States Agency for International Development
UNDP	United Nations Development Programme
UNRWA	United Nations Relief and Works Agency for Palestine Refugees
WBWD	West Bank Water Department
WUA	Water Users' Association

Area A	Both administration and police powers are controlled by PA
Area B	Administration is control by PA and police powers are controlled by CA
Area C	Both administration and police powers are controlled by CA
Separate Wall	The walls constructed by Israel with in PA border (Green line)

Unit

MCM	: Million Cubic Meter	m^3/hr	: cubic meter per hour
ϕ	: Diameter	m^3/s	: cubic meter per second
km^2	: square kilometer	ha	: hectare
m^3	: cubic meter	m^2	: square meter
m/s	: meter per second	Dunum	: 0.1 ha

Currency

JY	Japanese Yen
USD	US Dollar
NIS	New Israel Shekel

Exchange Rate (As of December 2011)

1 USD= 79.09 JY 1 NIS= 22.15 JY 1 USD= 0.28 NIS

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

PA requested to Government of Japan in August 2010, to conduct two cooperation schemes, namely; 1)"Improvement of Domestic and Industrial Water Systems in Jericho City" aiming improvement of an existing distribution system and construction of a new well, and 2)"Improvement of Agricultural Water System in Jordan Valley and Northern West Bank" aiming rehabilitation of agricultural water sources including wells and spring with transmission / distribution systems and construction of reservoirs under the Japan's Grant Aid Scheme.

For the request, JICA decided to conduct the scheme under this preparatory survey in December 2010, based on the result of the preliminary survey conducted on October 2010 where basic information were collected on conditions of water sources and existing transmission / distribution systems. After the survey, JICA conducted a series of discussions and field investigation with Palestinian Water Authority (hereinafter referred to as "PWA") and Jericho municipality from February to March 2011.

As a results of discussions with Ministry of Agriculture (hereinafter referred to as "MOA") in May 2011, JICA proposed to PA that the above two schemes should be combined as one preparatory survey by the name of "Improvement of Domestic, Industrial and Agricultural Water Systems in Jordan Valley and Northern West Bank" since contents and scales of necessary survey for the two schemes are technically similar from the viewpoints of studying water source, transmission/distribution systems.

With the above decision made, JICA dispatched a study team twice from September to October (1st field survey) and from November to December in 2012 (2nd field survey). The survey team had a series of discussion with the officials concerned of PWA and MOA, and examined the validity of the components requested by PA under the Japan's Grant Aid Scheme through field investigations including collection of data and information on natural and socio-economic conditions.

1-1-1 Improvement of Agricultural Water Systems

Based on the results of the field survey, JICA had selected the components with the following criteria agreed by MOA as shown in Table 1-1-1.

1) Well license to be approved by JWC (Israel-Palestine Joint Water Committee).
2) No funding available from any other donors.
3) Sustainability of the water resource exists.
4) Land owner (farmers) agree to the construction for reservoir.
5) The schedule of the construction of the Treated Waste Water Plant (TWWP) is clear.

Table 1-1-1 Result of screening of requested component for Agricultural Water System

Items requested	Original request	Results of study
1. Reservoir construction and improvement of distribution systems	1) Reservoir construction: 40 sites 2) Rehabilitation of distribution system: 35 km	Out of selected 25 Irrigation sites; 1) New reservoir construction: 24 sites 2) Transmission pipe: 25 sites, L=17.5 km 3) Distribution system: 25 sites, L=35.6 km 4) Discharge meter installation 5) Distribution valve installation
2. Improvement of well sites	Rehabilitation of 11 well sites	Out of selected 9 well sites; 1) New pump installation: 9 sites 2) Well deepening: 6 sites 3) Well cleaning: 3 sites 4) New reservoir: 1 site 5) Pipeline length: 1.1 km 6) New pump house: 9 sites
3. Improvement of Nwaimeh Spring Water Canal	Rehabilitation length: 3 km	1) Rehabilitation length: 4.1 km 2) Distribution valve installation (17 nos.)
4. Soft component	Train technicians and farmers on operation and maintenance	1) To assist water management 2) To assist organizational management
5. Irrigation reservoir	35 sites	Out of scope
6. Irrigation system	160 sites	Out of scope

1-1-2 Improvement of Domestic and Industrial Water Systems

This component is expected to supply domestic water to Jericho city and Akbat Jaber refugee camp, as well as industrial water to JAIP in near future. However, it is difficult to finalize distribution volume for each facility because of the following reasons; 1)JWC has not approved the construction of the new well and 2)Consent of water society (farmers) for well water mixing to Ein Sultan spring (hereinafter referred to as "SWAP") has not yet been obtained. Tentative component in the result of study is shown in Table 1-1-2 at this moment..

Table 1-1-2 Present status of requested component for domestic and industrial water systems

Items requested	Original request	Results of study (Tentative)	Remarks
1. Construction of a new well	Well construction and pump installation	1) Assumed pump scale: 50 m^3/hr 2) New pump house: 1 no. 3) Electrical distribution panel: 1 set 4) Distribution pipeline: 1.8 km	1) JWC has not yet approved the license for a new well. 2) Consent of SWAP not yet obtained.
2. Upgrading of Jericho No.1 well	Upgrading of pump scale from 60 to 180 m^3/hr	1) Pump installation: 180 m^3/hr 2) Upgrading of electrical panel: from 60 to 180 m^3/hr 3) Distribution pipeline-1: 3.5 km 4) Distribution pipeline-2: 0.4 km	Civil Administration (CA) of Israel has not yet given the approval for the construction of Jericho No.1 well facilities.
3. Construction of Distribution pipelines	Length: 1.7 km	(Total of the above pipeline length: 5.7 km)	

1-2 Natural Conditions

1-2-1 Meteorology and Hydrology

The West Bank belongs to the Etesian climate, that meteorological feature is a long dry summer and a

short rainy winter. Average temperature is 17 degree centigrade in the central mountains and 25 degree in the Jordan valley. While rainy season is from October to April, precipitation concentrates within three(3) months from December to February. Annual precipitation ranged from 400 to 700mm in the central mountains and western part of the West Bank (refer Figure 1-2-1). In the eastern part of the West Bank, precipitation tends to decrease gradually toward the Jordan valley and the Dead Sea. The annual precipitation in Jericho city located at -250 m MSL ranges from 50 to 100 mm extremely low.

Annual evaporation in the West Bank is shown in Figure 1-2-2. In the northwest region such as Jenin, Tulkarem and Qalqiliya, annual evaporation is less than 1,000 mm. It increases gradually toward central mountains and the Jordan Valley and surpasses 2,300 mm around the border between Jericho and Tubas.

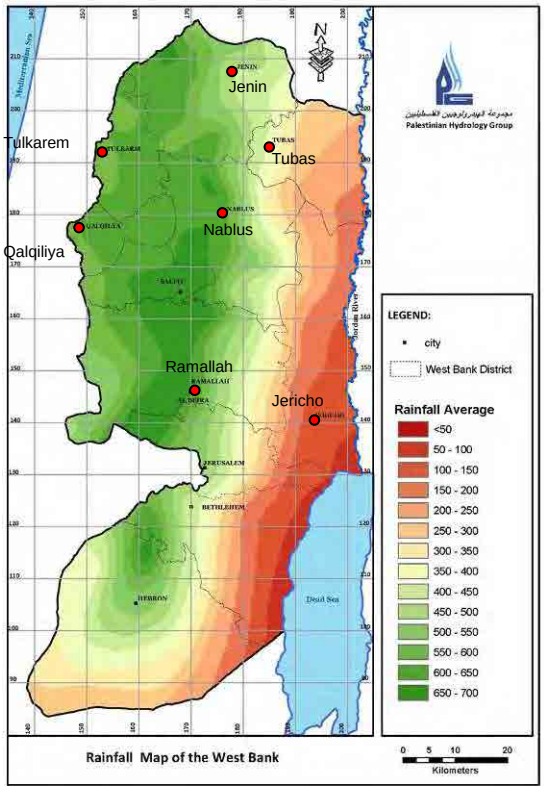


Figure 1-2-1 Rainfall map

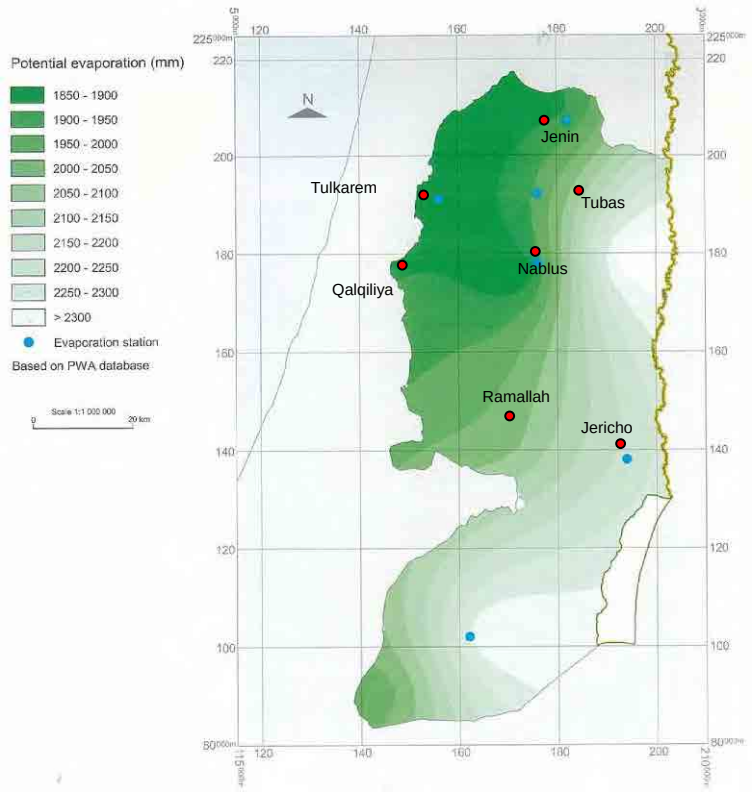


Figure 1-2-2 Evaporation map

1-2-2 Geography, Geology and Hydrogeology

(1) Geography

The central mountains ranged from 200 to 800 m MSL and runs north to south in the center of the West Bank. The mountains are mainly consisting of limestone and forms undulating geography eroded by Wadis. Cities of Ramallah, Nablus and Tubas are built at hilly area in the mountains. The central mountains slope down to both east and west sides with undulation. The west side of the mountains continues to coastal plain of Israel. Qalqiliya and Tulkarem are located at the middle mountain hills with 100 to 200 m MSL.

The main direction of faults in the West Bank is from north to south. There are many small oblique faults from northeast to southwest in the northern part of Jericho and Tubas. Wadis along with these small faults

form the valleys in the central mountains. In these valleys, Tertiary and Quaternary are deposited. Wadi Faraa is the largest one in these oblique faults.

(2) Geology

The geology of West Bank mainly consists of limestone sediment between Jurassic to Eocene, Tertiary accompanying chalk, dolomite, chart and so on. In Jordan valley and vicinity of Jenin, Quaternary is distributed in large part and conglomerate from Miocene to Pliocene is outcropped in partial area.

(3) Hydrogeology

(a) Aquifers

Geological profile along Wadi Faraa is shown in Figure 1-2-3, the location of which is shown in "Figure 1-2-4 Groundwater basin in the West Bank". Aquifers in the West Bank are divided into four(4) parts.

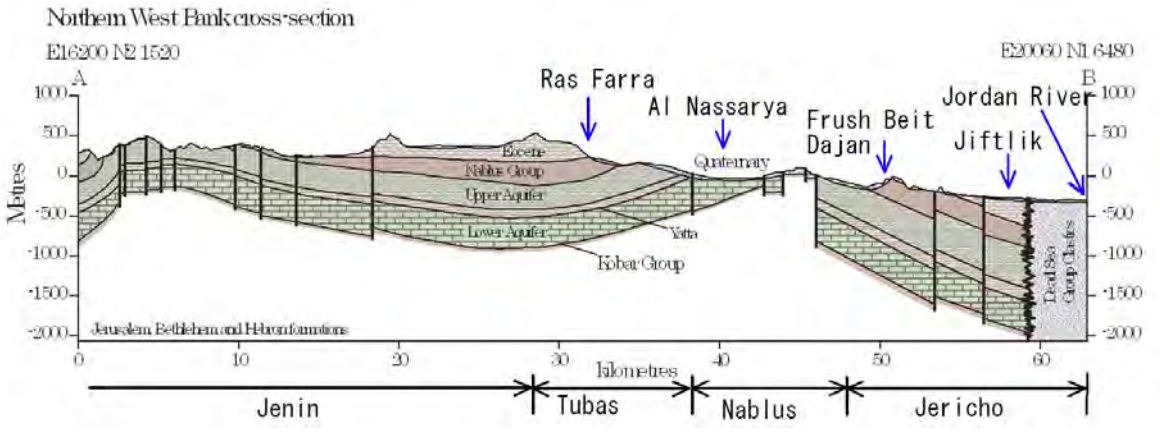


Figure 1-2-3 Geological profile along Wadi Farra

i) First aquifer (Shallow aquifer)

First aquifer contains Tertiary which developed in fans and Jordan River basin and limestone of Beida Formation and Nablus Formation. In Wadi Farra, Eocene limestone at upstream of Ras Farra and Quaternary along wadis are corresponded to the aquifer. Comparing other aquifers, the yield is small but a lot of wells in the West Bank are pumping from the aquifer.

ii) Second aquifer (Upper Aquifer)

Limestone and Dolomite of Jerusalem Bethlehem and Hebron formations in later Cretaceous comprise the second aquifer. The yield of this aquifer is quite large so that wells are mostly developed by Israel. In Wadi Farra, this aquifer is the main resources for domestic water of Israel settlement. Only limited number of Palestine set up wells from the aquifer. Jericho No.1 well is pumping from Hebron formation and the second aquifer is the main source of recharge for the first aquifer.

iii) Third aquifer (Lower aquifer)

Third aquifer underlies an aquiclude (Yatta layer) and consists of limestone and dolomite of Beit Kahil layer in Cretaceous. This is a good yield aquifer and forms springs at Al Nassarya in Wadi Farra.

iv) Forth aquifer (Deeper aquifer)

This aquifer consists of Jurassic Maleh layer, however the yield is considered as small amount.

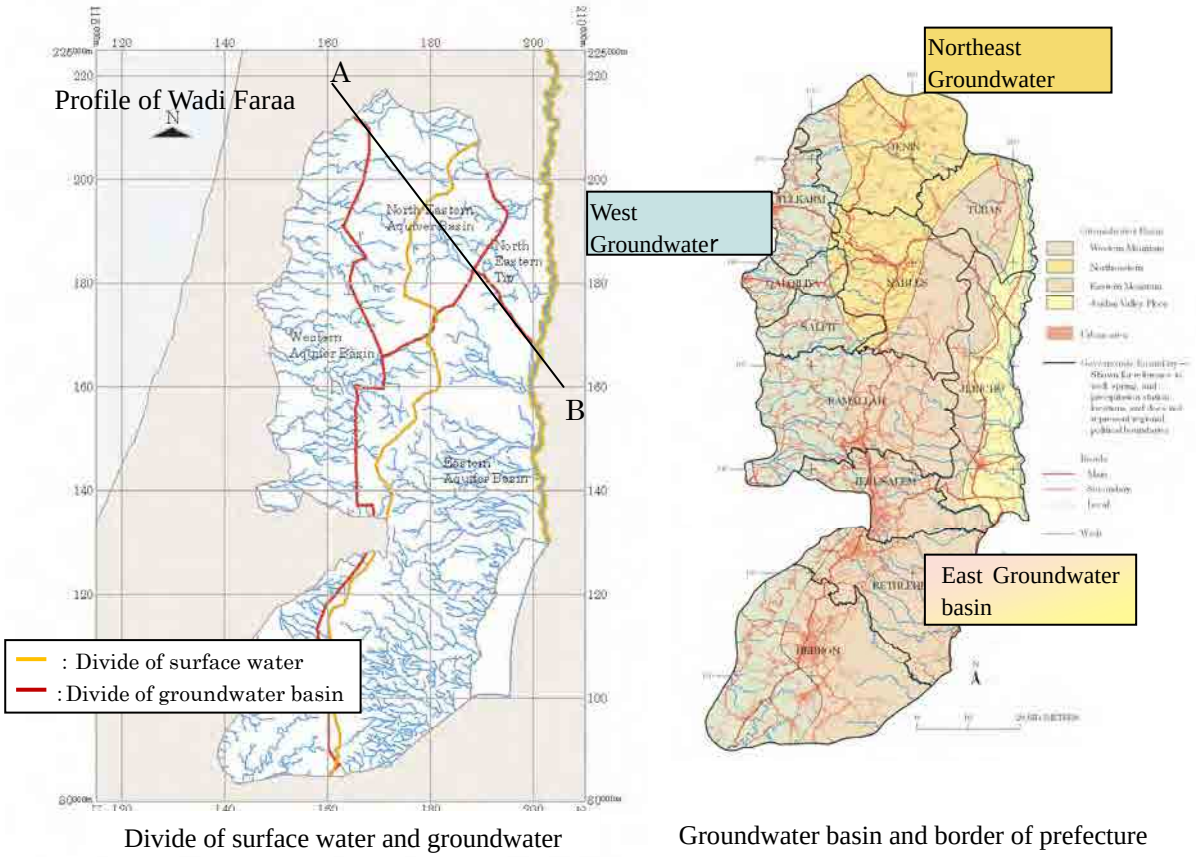
1-2-3 Groundwater, Springs, Water Quality

(1) Groundwater

The central mountains is a divide and surface water flows east or west through Wadis. In the vicinity of Jenin, the elevation of the central mountains is getting low and water flows northward (refer Figure1-2-4).

Meanwhile, the divide of groundwater dose not corresponded to that of surface water. The Jordan valley and the Dead Sea are located between African plate and Arabic plate so the geology of the West Bank is folded by the tectonic movement. The axis of anticline which is located eastward from the central mountains is the divide of groundwater in Wadi Farra.

The Groundwater basin in the West Bank is separated by three(3) basins such as East, Northeast and West. Largely, Qalqiliya, Tulkarem are comprised in the East groundwater basin, Jenin, the west part of Nablus and the west part of Tubas are in the Northeast, and the east part of Tubas, the east part of Nablus and Jericho are east.



Divide of surface water and groundwater

Groundwater basin and border of prefecture

Figure 1-2-4 Groundwater basin in the West Bank

Groundwater utilization of both Israel and Palestine is decided in Oslo Accord II shown as Table 1-2-1.

Table 1-2-1 Utilization and estimated potential of groundwater both Israel and Palestine

Groundwater Basin	Prefecture of the Project	Utilization of Israel (MCM/year)	Utilization of Palestine (MCM/year)	Total (MCM/year)
West	Qalqiliya Tulkarem	340 (93%)	22 (6%)	362
Northeast	Jenin Tubas(west) Nablus(west)	103 (71%)	42 (29%)	145
East	Tubas(east) Nablus(east) Jericho	40 (40%)	54+78*[1)] (132%)	100
Total		483	118+78	607

※1) 78 MCM remaining quantities to be developed from the Eastern Aquifer

West Groundwater is located in the rainy area of the West Bank so that the recharge to aquifer is relatively large. However, this basin is extended up to the Israel territory and the utilization of PA is fixed at 22 MCM/year while the potential is 362 MCM/year.

East Groundwater basin is the largest area in the West Bank. However, climate of this area is characterized by low precipitation and high evaporation and total utilization is 100 MCM/year. Utilization of PA is decided as 54 MCM/year but another 78 MCM/year is added anticipating future increase of water use. In the view of the new target, many wells were excavated after Oslo Accord, however, this decision is not considered agreeable and proper utilization of this basin is 100 MCM/year.

The area of Northeast Groundwater basin is small and the utilization is 145 MCM/year. Utilization of PA is 42 MCM/year.

These utilizations are less than water demand in every groundwater basin. The West Bank is short of water chronically.

(2) Condition of target rehabilitation well

For the purpose of confirming the condition of casing and screen in the target rehabilitation well, borehole camera survey was conducted to 19-14/058B in Jericho with cooperation of PWA. The result of the survey is described in Figure 1-2-5.

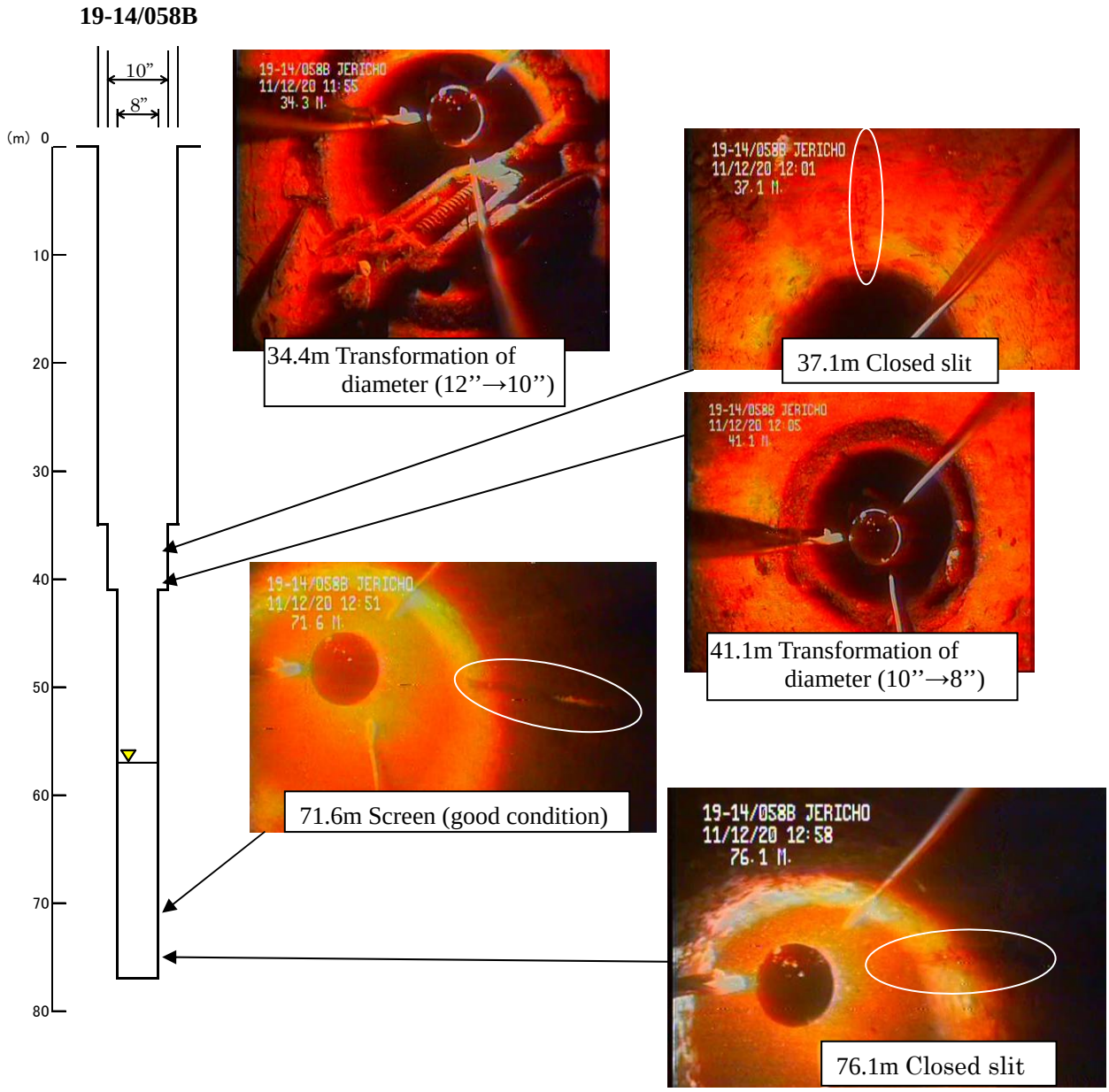


Figure 1-2-5 Results of borehole survey

1) Although the casing is rusty, there is no problem about its structure and strength.
2) The well had already deepened and the diameter of the casing changes 12 inch at the ground level to 8 inch at the bottom.
3) Almost slits of casing is closed by crud that prevents inflow to casing. This is main reason why groundwater level is down.
4) Equipment fell inside the casing, and this must be removed before the rehabilitation of the well.
5) Well depth almost corresponds to that of mentioned in the Feasibility Study.

Well inventory for rehabilitating was prepared in the Feasibility Study; however, different well structure was confirmed by the borehole survey as mentioned above. Seeing the picture of present well condition is very important so that borehole camera survey shall be conducted for the remaining eight(8) wells in the

detailed design stage before rehabilitation.

1-2-4 Water Quality of Domestic Water in Jericho City

The water resources of Jericho city is Ein Sultan spring. Electric conductivity is low with ranging from 650 to 700μS/cm and has good quality as compared with the wells in Jericho city. For example, conductivity of Jericho No.1 well is approx 1,700 μS/cm.

1-2-5 Water Quality of Irrigation Water

The sources of most of wells used for irrigation in the West Bank are groundwater. Water quality in each prefecture is mentioned below;

(a) Jenin

Electric conductivity in the west side of the central mountains is less than 1,000 μS/cm while at the east side is relatively higher, at 1,000 to 2,000 μS/cm. The east side has less rainfall and high saline groundwater in deep is mixed surface groundwater. Also high evaporation in this area causes concentration of salinity in groundwater.

(b) Tubas

Miocene and Quaternary are distributed in Wadi Farra and northern part of Tubas. Electric conductivity in this area indicates less than 750 μS/cm and has good quality. However, at the downstream of Wadi Faraa, electric conductivity is 750 to 2,250 μS/cm due to high evaporation. In the Central part of Tubas, where geology is Eocene, electric conductivity is high, ranging from 750 to 2,250 μS/cm.

(c) Tulkarm and Qalqiliya

Quality of the West groundwater basin, in both prefectures, is judged generally as good. Average electric conductivity is 600 to 700 μS/cm, but salinity of groundwater tends to increase.

(d) Nablus

Nablus is located at upstream of Northeast groundwater basin and in high precipitation area. Electric conductivity is 250 to 750 μS/cm. Also, the same value is observed in the Wadi Farra area.

(e) Jericho

Electric conductivity at the middle stream of Wadi Farra is about 250μS/cm, however, at the down stream near the Jordan River surrounding Jericho City, it ranged from1,500 to 4,000 μS/cm. Electric conductivity is considered very high from 1,000 to 5,000 μS/cm. Meanwhile, middle part of Jericho, Auja located, electric conductivity is 1,000 μS/cm and relatively low.

1-2-6 New Well at Jericho City

(1) Outline of the new well

In order to distribute domestic water to JAID, which under constructed in Jericho city, drilling of a new well is applied to JWC in Duyk Al Tahta area. The proposed drilling site had already been decided after discussions among PWA, Jericho city and so on. The details are shown in Table 1-2-2 and Figure 1-2-6.

Table 1-2-2 Outline of new well

Location	Duyk Al Tahta (North of Jericho Resort Village)
Project No.	515/5/2011
Coordination（Israel 1923）	X= 193.209 Y=143.394
Elevation	-233m
Quantity of water needed	140,000m^3
Drilling depth estimated	150m

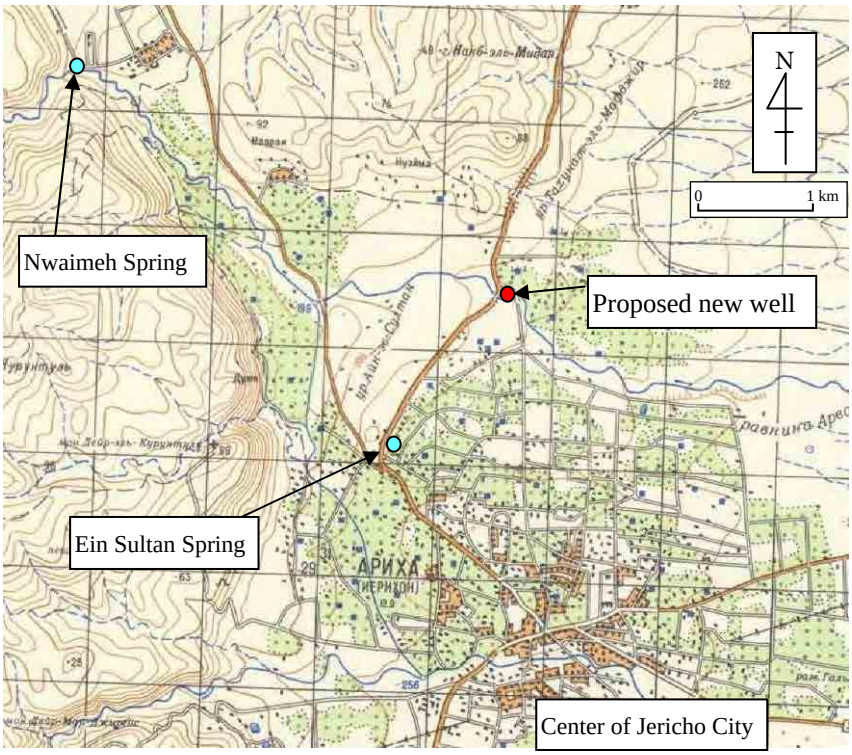


Figure 1-2-6 Location map of the proposed new well

(2) Location of the new well

Deltaic cleared land engulfed by roads and Wadi Nwaimeh in Duyk Al Tahta area is proposed drilling site shown in Figure 1-2-7 and 1-2-8.

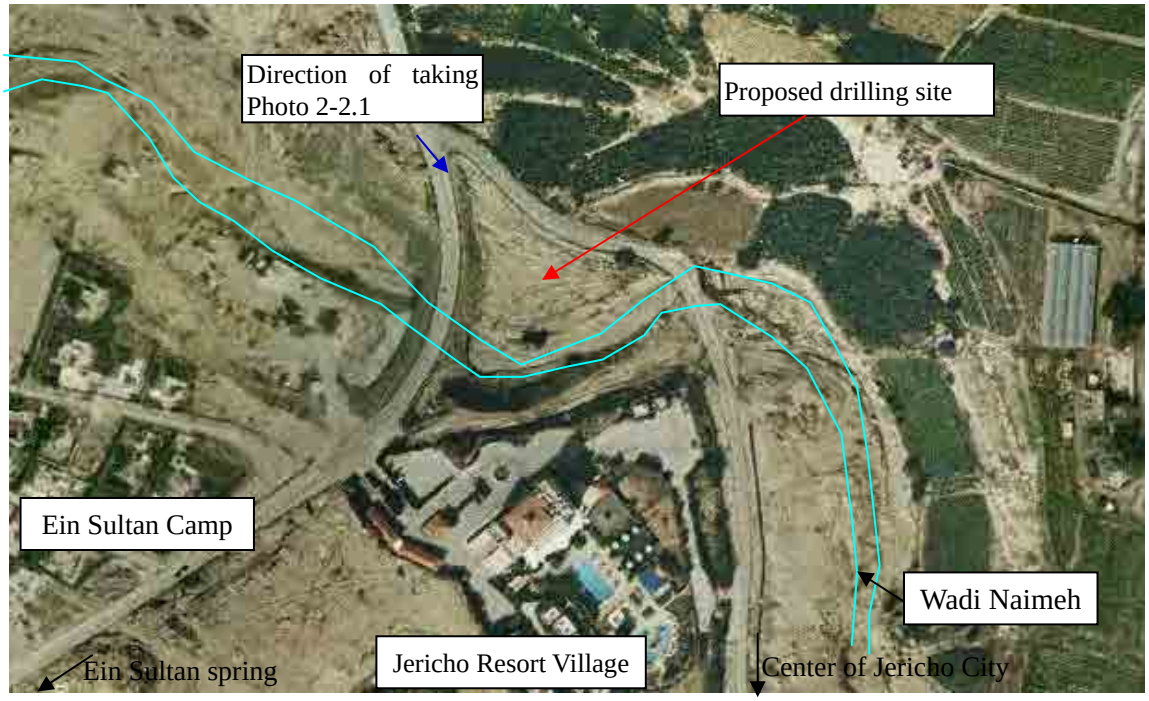
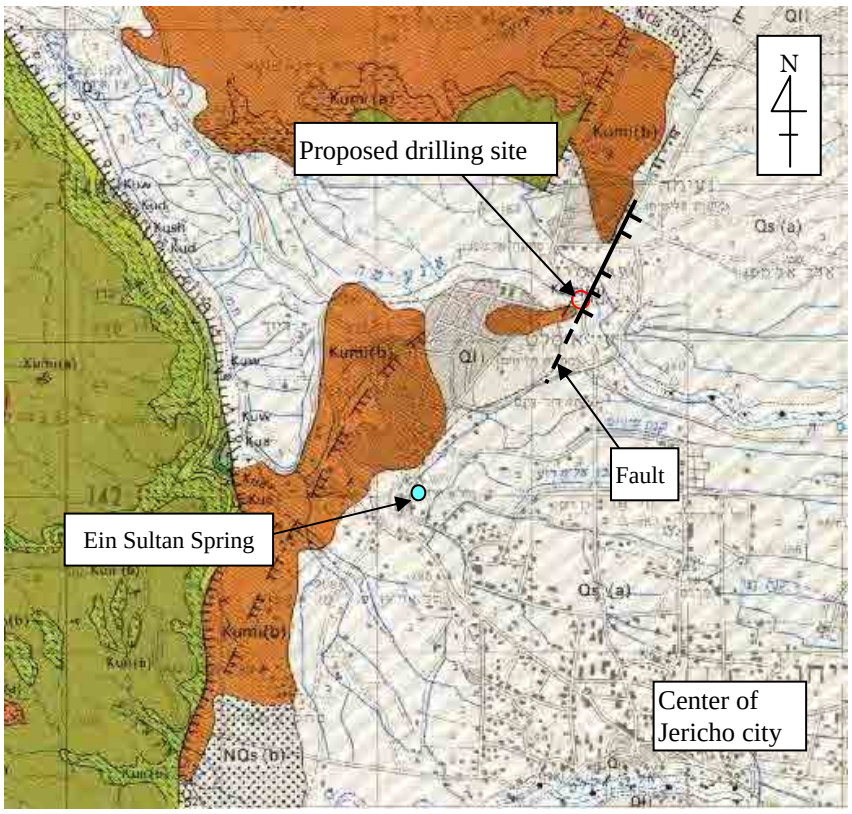


Figure 1-2-7 Detail map of the proposed drilling site

Figure 1-2-8 Proposed drilling site

(3) Geography and Hydrogeology surrounding the new well



Era	Period	Epoch	Formation	Symbol		Geology
Cenozoic	Quaternary	—	Lisan		Qli	Sandstone, Conglomerate, Gravel, Mudstone, Aragonite
	Tertiary-Quaternary	Pliocene-Pleistocene	Samra		Qs(a)	Sandstone, Conglomerate, Gravel, Mudstone, Limestone
Mesozoic	Cretaceous	Campanian	Upper Mishash		Kumi(b)	Chert, Chalk, Limestone
			Lower Mishash		Kumi(a)	Chert, Chalk, Limestone
			Menuha		Kum	Chert, Chalk
		Turonian	Bezer		Kun(b)	Limestone, Marl, Dolomite

Figure 1-2-9 Geological map surrounding proposed drilling site

Geology of the west side of the fault consists of Cretaceous limestone and Tertiary and Quaternary sediment crop out oppose side of the fault. The new well site is located near the fault at the base of the geological map and it is difficult to estimate the detailed geological structure of the drilling site from geological survey.

(4) Electric sounding

For the purpose of conforming geological structure of drilling site and fixing exact drilling point, electric sounding was carried out.

Vertical sounding wad conducted at three points in the proposed site as shown in Figure 1-2-10. The result of the sounding indicates that geology of this site is estimated to consist of three layers (refer Figure

1-2-11). First layer is Quaternary, which consists of deposit of Wadi, ranges surface to 30 m depth. Second is chalky chart extends 100 m depth and crush zone of this layer is estimated as good aquifer. Chalk is estimated as aquiclude underlays the second layer. So that the depth of wells surrounding the proposed site are reached 150m for acquiring enough pumping yield, new well is also designed to drill 150m.

Figure 1-2-10 Location of vertical

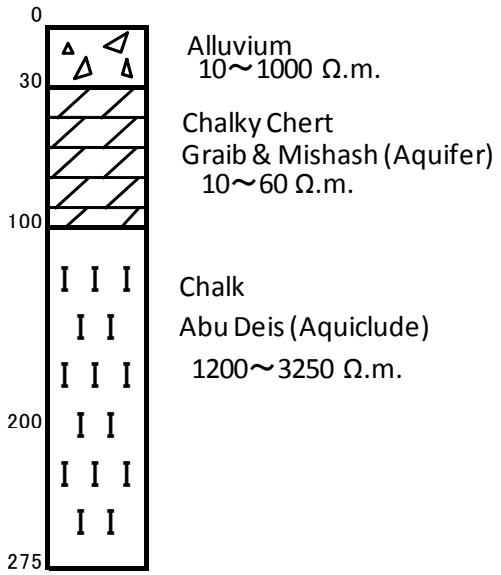


Figure 1-2-11 Estimated geological column

P11 shows the lowest electric resistibility in chalky chart among 3 sounding points and estimated to have high potential of groundwater development, so that drilling will be conducted at P11.

1-3 Environmental and Social Considerations

1-3-1 Environmental assessment

(1) Outline of proposed project

The Project consists of two(2) components, namely; 1)"Improvement of Agricultural Water System" and 2)"Improvement of Domestic and Industrial Water Systems". The above 1) includes reservoir construction and improvement of distribution systems for 25 irrigation sites, rehabilitation of 9 well sites and Nwaimeh Spring Water Canal. And the above 2) includes upgrading of Jericho No.1 well, construction of a new well and construction of distribution pipelines at each well.

The Project is not assumed to be significant adverse impacts on the environment. However, the Project seems to have unexpected impacts on the environment, based on the JICA Guideline for environment and Social Consideration (April 2010), this project is classified into Category B.

(2) Policy, legal and administrative framework in the recipient country

The Palestine Environmental Law was enacted in 1999 and showed the basic stance for environmental management in PA. Based on the law, the "Palestinian Environmental Assessment (EA) Policy" was approved by the Ministerial Council in Resolution in April 2000. EA procedure is shown in Figure 1-3-1. EA procedures in PA must examine contents of projects and judged procedure of Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) by Environment Quality Authority (EQA).

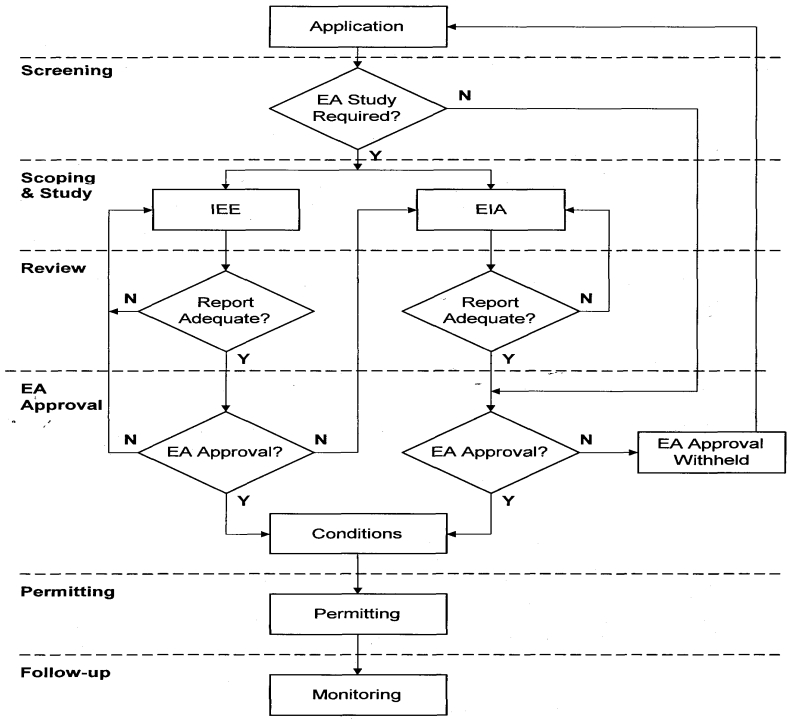


Figure 1-3-1 Procedures for EA administrative

According to the responsible person of environmental assessment in EQA, the project will be relevantly judged to be IEE by contents of the project. Regarding procedures for EA administrative, first of all, applicants will submit applications of EA to EQA. Then, Terms of Reference (TOR) of IEE will be instructed from EQA. And applicants will submit the IEE report and obtain the approval. The term of procedure will take about one month from submission of the IEE report to approval. Since the project is classified into Agricultural scheme, Domestic and Industrial scheme, MOA will make applications and IEE report on Agricultural scheme and PWA will do the Domestic and Industrial scheme.

Jordan Valley and Northern West Bank are divided into three(3) areas. Both administration and police powers are controlled by PA in Area A, administration is controlled by PA and police powers by Israel in area B, and Both administration and police powers are controlled by Israel in Area C. Though the project sites are located in three(3) areas, called; A, B and C, procedures for EA are not different from areas according to MOA. Basically, EQA shall provide the approval for all areas.

(3) Terms of Reference for Environmental Study

According to the results of assessment, the rating item was the B, No.27 Transportation and Traffic, No.38 Worker Health and Safety, No.39 Noise and Vibration; hence the need to implement the detailed environmental study. The proposed study methods and contents, Terms of Reference (TOR) for the detailed environmental study are shown as below;

Table 1-3-1 Proposed TOR for Environmental Study

No.	Environmental Parameters	Study Contents	Study Methods
27	Transportation and Traffic	- Impacts caused by construction works - Traffic accident	1. Confirmations of traffic and hearings in and around the sites 2. Confirmations of the construction components, construction methods, construction period, scale and extent construction, kind of necessary construction machinery, number of necessary vehicles and so on
38	Worker Health and Safety	- Accident by construction works	1. Confirmations of the construction components, construction methods, construction period, scale and extent construction, kind of necessary construction machinery, number of necessary vehicles and so on 2. Confirmations of the current condition in and around the sites
39	Noise and Vibration	- Impacts caused by construction works	1. Confirmations of the construction components, construction methods, construction period, scale and extent construction, kind of necessary construction machinery, number of necessary vehicles and so on 2. Confirmations of residential facility in and around the sites, hearings in and around the sites

(4) Arrangement of Environmental Study results (including prospects results)

Environmental Study results (prospects results) based on the scoping are shown in Table 1-3-2.

Table 1-3-2 Environmental study results (prospects results)

Environmental Parameters	Study results
-Transportation and Traffic -Worker Health and Safety -Noise and Vibration	1. Impacts on transportation and traffic are predicted to occur in the construction of the buried pipes in the improvement of domestic and industrial water systems in Jericho city. Impacts on Worker Health and Safety, and Noise may occur in all construction of the pipe line. 2. Since pipe laying works involve excavation, it is necessary to ensure the safety for construction workers including vehicle traffic and fall of the pedestrian. For instance, installation of construction sign, placement of security guards and installation of the hump (shaped hill uplift zone). 3. Traffic volume in construction sites increase mainly during rush hour, but the rest of the time the traffic is less. Since it is difficult to work during the day in the heat wave period (May - October), construction works are implemented in early morning or evening. It is necessary to consider that traffic volume will be predicted to concentrate in this hour. 4. Main construction vehicle are trucks, dumps, backhoes and concrete mixer car. It is desirable to use a low-noise, low vibration type construction machinery, with not work at night near the residence areas. 5. Since some residential areas close to the construction sites in Jericho city, it is necessary to confirm the working hour and material transportation route before construction.

(5) Analysis of Environmental Study result

For the above-mentioned items, it will do impact assessment. Though negative impact in pipe laying works can not be avoided, significant environmental and social issues will not occur when appropriate measures are done accordingly.

Regarding Transportation and Traffic, Worker Health and Safety, this can be responded to by providing appropriate installation of construction sign for vehicle traffic and pedestrian, and by traffic control with the placement of security guards. In addition, safety is enhanced with the installations of humps for slowing down vehicle traffic. Regarding Noise and Vibration, impacts can be mitigated by using a low-noise and low vibration type construction machineries and not working at night near the residence.

(6) Monitoring Plan Formulation

Regarding Transportation and Traffic, Worker Health and Safety, Noise and Vibration, proposed monitoring plan are shown in Table 1-3-3. MOA is the representative of implementation agency in PA side, and performs monitoring. Contents of proposed monitoring plan are included in the regular confirmation of construction status, and this is implemented by the regular budget of the MOA. Since agricultural sector is the large-scale construction, MOA will represent the implementation agency.

Table 1-3-3 Proposed monitoring plan

Environmental Parameters	Proposed Monitoring Plan
-Transportation and Traffic -Worker Health and Safety	[Method] Confirmations of traffic jam or not in construction sites Confirmations of appropriate safety measures in construction sites [Period] Term of pipe laying works [Times/ Frequency] Once a month
-Noise and Vibration	[Method] Confirmations for work situation of heavy equipment in construction sites Hearings in and around the sites and confirmation of complaints [Period] Term of pipe laying works [Times/ Frequency] Once a month

(7) Consultation meetings with stakeholders

For improvement of Domestic and Industrial Water Systems, MOA/PWA should consider the consent of Water Society through Jericho municipality and farmers group for mixing water from the spring water. However, MOA/PWA has not obtained consent from farmers group yet.

1-3-2 Land Acquisition and Involuntary Resettlement

(1) Improvement of Agricultural Water System

For land acquisition and involuntary resettlement, considerable and significant item are new reservoir tank facilities. Required land for construction of the new reservoir tank is approximately 400m^2 (20m x 20m). Since the new reservoir tanks are installed for irrigation within agricultural land owned by farmer or village council, there is no problem for land acquisition. In addition, construction lands are managed by landowner, there are no illegal houses (refer Figure 1-3-2).

Since installation of reservoir tank will achieve expansion of irrigated area through effective use of limited water resources, and the efficiency of existing irrigation systems, there are huge benefits to farmers. Though construction of reservoir tank for improvement of Agricultural Water System proposed 47 sites initially, the construction sites selected only 25 sites after confirming consent of construction land, and evaluating the sustainability of water sources and overlap with other donors and so on.

(2) Improvement of Domestic and Industrial Water Systems

The main component of the proposed project is the construction of new well and pipe laying works. The required land for construction of the new well facility is approximately 400m^2 (20m x 20m). Since the new well facility is constructed in wasteland surrounded by roads and Wadi, there is no need of resettlement. In addition, proposed construction site is public land managed by Jericho city, therefore no issue or problem on land acquisition (refer Figure 1-3-3).

Pipe laying works will be constructed from each well to the existing agricultural canals under public road, to avoid problems on land acquisition and involuntary resettlement.

Figure 1-3-2 Proposed construction site

Figure 1-3-3 Proposed construction site

1-3-3 Others

(1) Monitoring format (draft)

The Monitoring format (draft) of the Project is shown in Appendix 7-4. This is prepared by MOA/PWA with assistance and support from those in charge of Environmental and Social Consideration.

(2) Environmental checklist (draft)

The Environmental checklist (draft) of the Project is shown in Appendix 7-5. These are prepared by MOA/PWA and with assistance and support from the Environmental and Social Consideration Group.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Agricultural Water System

2-1-1 Basic Concept of the Project

(1) Overall goal and Project target

"Palestinian National Development Plan (2011-13)" put importance on the extension of arable farm land from 150,000 ha to 160,000 ha by improving existing irrigation systems such as well, spring, and by improvement of agricultural infrastructures" and constructing new wells and expansion of distribution network.

Scheme on Improvement of Agricultural Water System, which is a part of the Project aims to utilize limited water source restricted by Israel and to improve existing well facilities and irrigation systems which are not functioning well or completely non-functional. Overall goal, Project target and so on are shown in Figure 2-1-1.

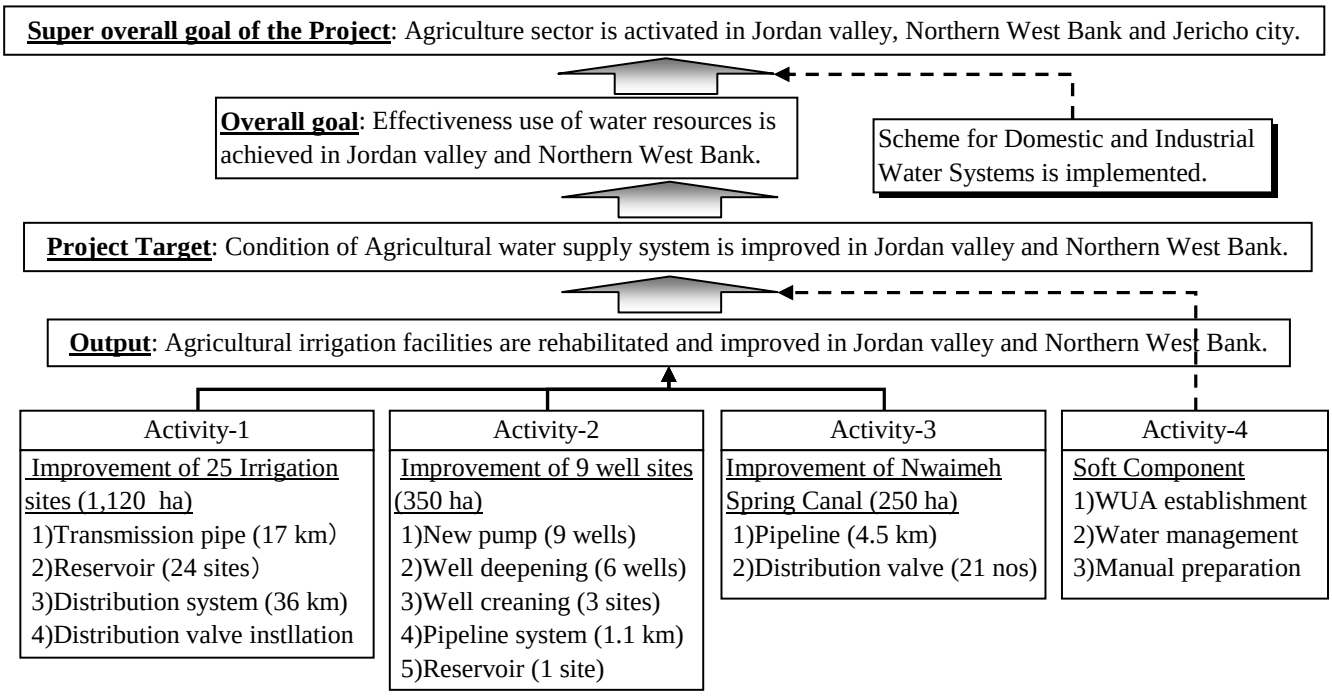


Figure 2-1-1 Outline of the Project target and activities in the scheme of Agricultural Water System improvement

(2) Outline of the Project

Ptoject Design Matrix (PDM) for the scheme of Agricultural Water System is shown in Table 2-1-1.

Table 2-1-1 Project Design Matrix (PDM) for the scheme for Agricultural Water System Improvement

1.Project title: Project: Improvement of Agricultural Water System in Jordan Valley and Northern West Bank (As of June 2012)
2.Project duration: December 2012 to November 2014
3.Project target areas: Palestine West Bank, Jordan Valley and Northern West Bank: Irrigation area 1,724 (1,120+354+250) ha
4.Targe group: Indirect beneficiaries 943,000 people as of 2008 (within surveyed 6 districts)
Direct beneficiaries: Approx.24,000 people (4,482 HH x 5.3 head/HH), approx.4,482 house hold (3,965+367+150)

Outline of the Project	Indexes	Indexes shown at	Important assumptions
Super overall goal Agriculture sector is activated in Jordan valley, Northern West Bank and Jericho city.	Up to 2020; Agricultural production in Jordan valley, Northern West Bank and Jericho city is transferred to JAIP.	・ Agricultural statistical data ・ JAIP operation record	・ Policy of PA is not changed. ・ Concept of "Corridor for Peace and Prosperity" is being continued.
Overall goal Effective use of water resources is achieved in Jordan valley and Northern West Bank.	Up to 2018; Treated waste water is widely used for industrial and agricultural purpose.	・ Numbers of Treated waste water plant to be constructed	・ License volume for PA is not changed. ・ JAIP is constructed on schedule. ・ Scheme of industrial and domestic water systems is implemented.
Project target Condition of Agricultural water supply system is improved in Jordan valley and Northern West Bank.	Up to 2016; ・ Water saving rate at each 25 irrigation sites become 40%. ・ Leakage and un-used water rate at 25 irrigation sites decrease **%[1] in all. ・ Irrigation area of 9 well sites increase 137 ha (354-217) in all. ・ Leakage from Nwaimeh spring water canal decrease **%[2]. ・ MOA continues to monitor WUA activity more than once a month. ・ Study tour for training on agriculture to JICA TA program area is conducted more than 3 times a year.	・ JAIP operation record ・ Discharge meter of reservoir ・ WUA operation record	・ Well facilities to be rehabilitated are maintained as they are. ・ Improved Extension for Value-Added Agriculture in the Jordan River Rift Valley (JICA TA program) is not suspended.
Output Agricultural irrigation facilities are rehabilitated and improved in Jordan valley and Northern West Bank.	Up to 2016; ・ Deteriorated 25 irrigation systems are improved. ・ 510 (620-110) m^3/hr of pump discharge is increased by rehabilitation of 9 well facilities are improved. ・ 4.1 km length of Nwaimeh spring water canal is improved. ・ WUA is established at 34 (25+9) irrigation areas. ・ Activation of the Project is cooperated with JICA TA program.	・ JICA monthly report ・ Well operation record ・ WUA manual ・ Soft component final report	・ CA (Israel) permits construction of reservoir. ・ Land owners do not cancel the agreement on land provision for reservoir construction. ・ Electricity supply for well pump operation is not stopped.
Activity ・ To rehabilitate transmission facilities ・ To construct reservoirs ・ To rehabilitate distribution pipeline systems ・ To improve existing well and pump facilities ・ To install discharge meters ・ To improve Nwaimeh spring water canal ・ To assist MOA for WUA establish, Water management, organizational management, O&M	Inputs (Japan's grant aid scheme) *.* Billion Japanese yen ・ To study outline design ・ To carry out detailed design ・ To prepare tender documents ・ To assist tendering procedure ・ Construct facilities ・ To carry out Soft component ・ To have inspections ・ To have monitoring and evaluation	(Palestine side) *.*million Japanese yen ・ To secure land for reservoir construction ・ To promote transfer of right to use of well from owner to WUA ・ To obtain construction permit from CA ・ To organize monitoring structure for O&M ・ To take environmental approval if any ・ To secure staff and fund for the above arrangements	・ Well facilities is not personalized (Right to use of well is transferred to WUA). Pre-conditions ・ No trouble will occur during construction around separate wall. ・ CA permits all of construction.

Remarks) %[1] and %[2] shown in the Table would be decided by the results of water leakage survey during the detailed design.

2-1-2 Outline Design of the Japanese Assistance

2-1-2-1 Design Policy

2-1-2-1-1 Basic Policy

(1) Target site and scope of the cooperation

(a) Narrowing process for target sites of newly applied components (rehabilitation of distribution facilities and construction of reservoir tank)

Newly applied components comprised rehabilitation of distribution facilities and construction of reservoir tank. These components will be applied to the 47 existing irrigation systems which have three kinds of water resources, such as 1) wells, 2) Treated Waste Water Plant TWWP and 3) Mekerout as shown in Table 2-1-2.

Table 2-1-2 Contents of application

Component	Quantity	Sites		Water resources of irrigation	
rehabilitation of distribution facilities	35 km	47 sites		1) Well:	41 sites
		Jenin	10 sites	2) TWWP:	5 sites
		Tubas	4 sites	- start operation in 2012:	2 sites
		Qalqiliya	11 sites	- under construction:	1 site
construction of reservoir tank	40 sites	Tulkarem	14 sites	- planning:	1 site
		Nablus	4 sites	- no information:	1 site
		Jericho	4 sites	3) Mekerout:	1 site

From the results of the First survey, some considerations were applied to determine viability and final selection of sites such as 1) planned rehabilitation by other donors, 2) rejected by well owner, 3) reservoir tank is unessential and 4) water resource is not sustainable and were therefore are dropped from the candidate site. No.2 Briqin 2 in Jenin which resource is TWWP is omitted considering the TWWP is planning phase. Judgment of other TWPP sites will be done waiting the results of the Secondary survey. In the first survey, candidate sites were narrowed down from 47 to 33.

In the secondary survey, two unlicensed sites, one under constructing TWWP site, one UNDP project site and a site where the land owner rejected to offer his land are dropped from the list. Therefore candidate sites were narrowed down from 33 to 28 in the survey.

MOA strongly committed to complete the construction of three TWWP sites, No.9 Jenin Field, No.6 Anabota Forest & Field and No.7 Ramin and requested to include in the project candidates. The study team intended to omit these 3 sites from candidates; however the decision of the conclusion was postponed. Discussion about these TWWP sites between JICA and the study team was held in Tokyo after the study team returned back to Japan. Judging from three risks for construction such as 1) unfinished construction of TWWP facility before start of JICA project, 2) adaptability of treated water relevant to water quality and 3) Agreement from farmers to use treated water for irrigation, these sites were omitted from candidates. Consequently, 25 sites were selected as candidates of JICA project.

Table 2-1-3 Outline of 47 irrigation sites and narrowing process of these sites

District	Village No.(47 sites)	Name	Water resources: Well/ Treated waste water/ Mekerout	Planned irrigation area (duram)	Beneficial family	Licensed pump dischrge ('000CM/yr)	Reason for excluding (1st survey): TWW on the drawing board	Overlapped with UNDP	Rejected by well owner	Tank is unnecessary	Sustainability of water resource	Reason for excluding (2nd survey): Licensed pump discharge is unconfirmed	Progress of TTW Construction	Land problem of tank	Newly-overlapped with UNDP	Final judgement	Area (ABC): Well (W)/ Tank (T)/ Beneficiary area (B)/ Separated well(S) W/R/B	Case (A,B,C,D,E,F,G)
1. Jenin	1.	Birqin 1	17-20/022	60	30	44					×					×	A	—
	2.	Birqin 2	TWW			—	×									×	B	—
	3.	Birqin (Jarba)	17-19/002	500	15	53					×					×	B	—
	4.	Kafr Dan 1	17-20/006	150	17	118			×							×	B	—
	5.	Kafr Dan 2	17-21/009	200	30	55					×					×	B	—
	6.	Kafr Dan 3	18-21/003	152	27	247					×					×	BBB	—
	7.	Kafr Dan 3 ⇒Al Yamun 1	17-21/034	550	260	294					×					×	B	—
	8.	Al Yamun 2	TWW（USAID）			na	△	→	→	→	→	→	×			×	?	—
	9.	Jenin Field	TWW（KfW）				△	→	→	→	→	→	○	→	→	×	A	—
	10.	Az Zababdi	18-20/070	50	90	na					×					×	CCC	—
2. Tubas	1.	Faraa 1	18-18/051	300	135	na						×				×	AAA	—
	2.	Faraa 2	18-19/002	600	122	na			×							×	AAA	—
	3.	Faraa 3	18-18/052	500	56	na						×				×	AAA	—
	4.	Bardala	Mekerout	500	120	900										○	CCC	F
3. Qalqilya	1.	Jayyus plain 1	15-17/012	600	115	124										○	SSS	E
	2.	Jayyus plain 2	14-17/040	400	60	95										○	SSS	B
	3.	Falamya	15-18/001	250	250	176										○	C	A
	4.	An Nabi Elyas	15-17/005	300	80	224										○	C	B
	5.	Azzun	15-17/007	400	75	90					×					×	BCC	—
	6.	Haabla 1	14-17/008a	350	140	154										○	BCC	B
	7.	Haabla 2	14-17/005	450	152	108										○	C	B
	8.	Al Mudawwar ⇒Syaykh Ahma	14-17/044	1,000	115	89										○	C	D
	9.	Izbat Salman	15-17/043	600	115	153										○	C	A
	10.	Qalqiliya city 1	14-17/031	400	83	102								×		×	CCC	—
	11.	Qalqiliya city 2	14-17/027	400	210	163										○	ABC	B
4. Tulkarm	1.	Qaffin	15-20/007	400	380	151										○	BBB	E
	2.	An Nazia al Gharbiya	15-20/004	300	400	345										○	BBB	A
	3.	Illar 1	15-19/042	700	na	400		×								×	B	—
	4.	Illar 2	15-19/023	640	41	205									×	×	C	—
	5.	Attil	15-19/036	1,000	130	299										○	BSS	B
	6.	Anabta forest & field	TWW (Nablus West)			—	△	→	→	→	→	→	○	→	→	×	B	—
	7.	Ramin⇒Nablus West				—	△	→	→	→	→	→	○	→	→	×	?	—
	8.	Thennabeh	15-19/038	500	209	123										○	C	B
	9.	Irtah	15-18/010	400	290	163										○	CCC	A
	10.	Farun	15-18/006	200	195	110										○	SCS	A
	11.	Kafr Zibad	15-18/012	400	190	146										○	B	C
	12.	An Nazia al Sharqiya	16-20/005	300	150	68										○	CBB	D
	13.	Dir al gsoon	15-19/029	700	170	352										○	BBS	A
	14.	Ektaba	15-19/044	350	50	225										○	AAB	E
5. Nablus	1.	An Nassarya 1	18-18/036 (PP)	450	26	130										○	CCC	A
	2.	An Nassarya 2	18-18/031a	300	11	69										○	BCC	B
	3.	Frush Beit Dajan 1 (shared with regional water system)	19-17/044	450	372	91										○	CCC	G
	4.	Frush Beit Dajan 2 (shared with regional water system)	19-17/047	450	17	46										○	CCC	A
6. Jericho	1.	Al Jiftlik 1	19-17/023	2,500	221	45				×						×	CCC	—
	2.	Al Jiftlik 2	19-17/055(PP)	1,500	21	300				×						×	C	—
	3.	Marjal Ghazal	20-17/019	500	85	20			×							×	C	—
	4.	Marj Naja	20-17/010	500	18	205										○	BBC	A
			Total of 25 sites	11,550	3,965	4,709												

○ ; Candidated site (25 sites)
△ ; Water resources is TWW(3 sites)
× ; Excluded from the project(19 sites)

Case A:	9
Case B:	8
Case C:	1
Case D:	2
Case E:	3
Case F:	1
Case G:	1
Total	25

(b) 11 target sites for rehabilitation of wells

In JICA F/S survey, 45 candidate sites for well rehabilitation proposed by MOA were narrowed down to 19 sites. Eights (8) wells were selected as pilot project sites in the F/S survey and seven (7) wells were rehabilitated except one (1) well since water quality was unacceptable. Remaining 11 sites were candidates of this project, however, two (2)wells, No.1 (#18-18/016) in Tubas and No.5 (#19-15/028A) in Jericho, were omitted by the reason of unlicensed by JWC. Consequently, nine (9) wells were selected for candidates of this project.

(2) Basic policy of rehabilitation 25 sites

(a) Irrigation system after rehabilitation

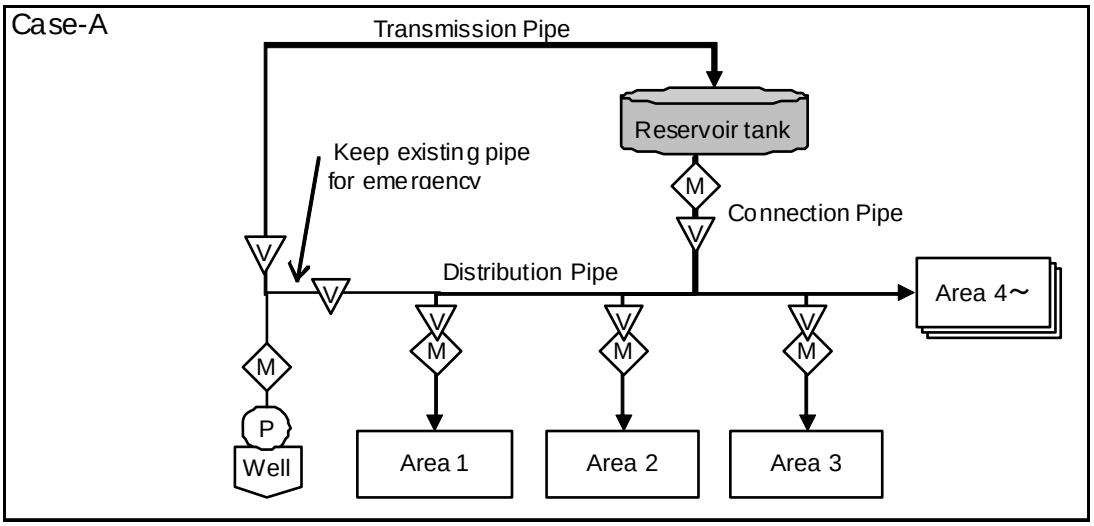
A pump and terminal irrigation facilities are directly connected to an existing irrigation system. More specially, pumped water from well are transmitted to the farm through pipeline and watered by drop irrigation and by sprinkler. In this irrigation system, the following are the points at issue.

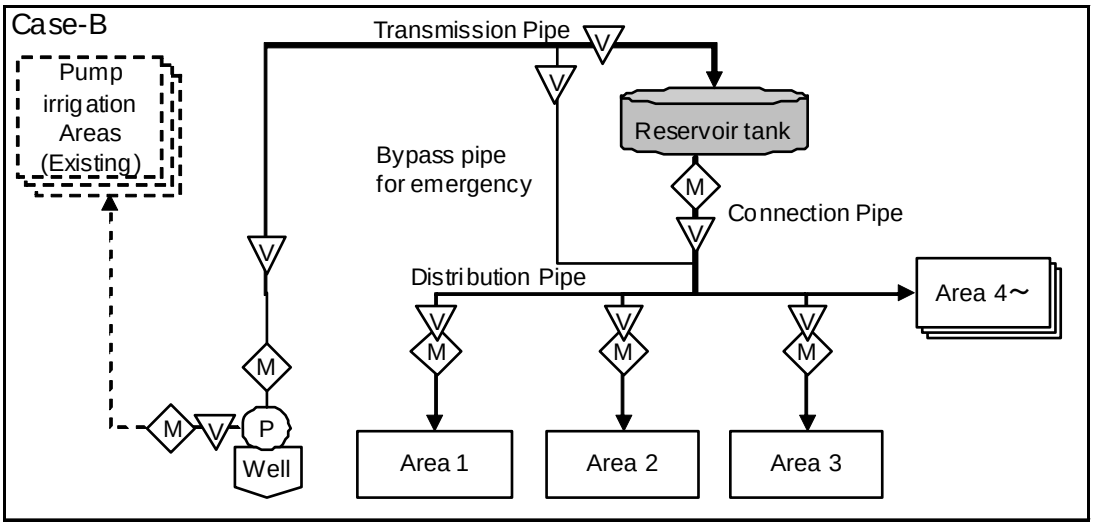
1) Present irrigation operation system adopted is rotation system. While some farmer irrigates, others can not use water. Therefore, it is very difficult to meet demands from each farmer considering the condition of crop growth or soil moisture.
2) Some farmers constructed reservoir tank and irrigation pond individually. However, high construction and operation cost inhibit the expansion of these irrigation facilities.
3) Distribution time of irrigation water is decided constant. If necessary distribution time is several minutes, for instance 30 minutes distribution is allocated to every farmer. Therefore, unnecessary water is taken and wasted.
4) Irrigation area per unit time has restricted pump capacity. Valve operation must be done during night time in some irrigation site where pump capacity is small. Night operation involves risks of injuries of snakes and vermin.
5) Limited access to oppose side of separation walls make coordination of irrigation time harder.
6) In this irrigation system, pump and terminal irrigation facilities are directly connected and pressure tank is not installed in most site. Operation in terminal irrigation facilities generates negative pressure in irrigation system and damages to pumps and meters.
7) Most of distribution pipes made by steel have deteriorated with leakages from pipe and air valves.

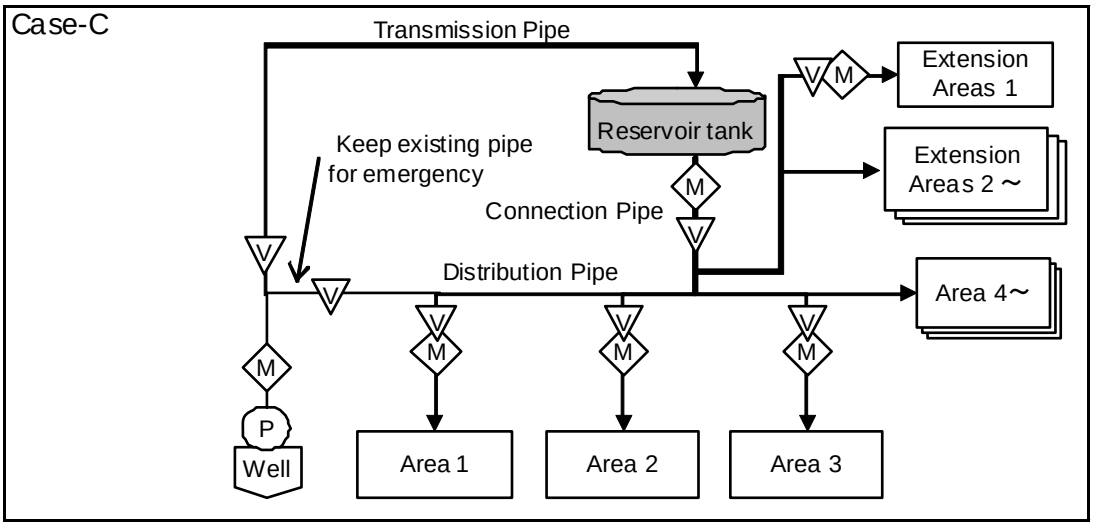
To resolve above problems, reservoir tank will be constructed to existing irrigation system. Consequently, stored pumped water in these tanks before distribution will make farmer get irrigation water according to their needs. The scope of components applied comprised of the following facilities;

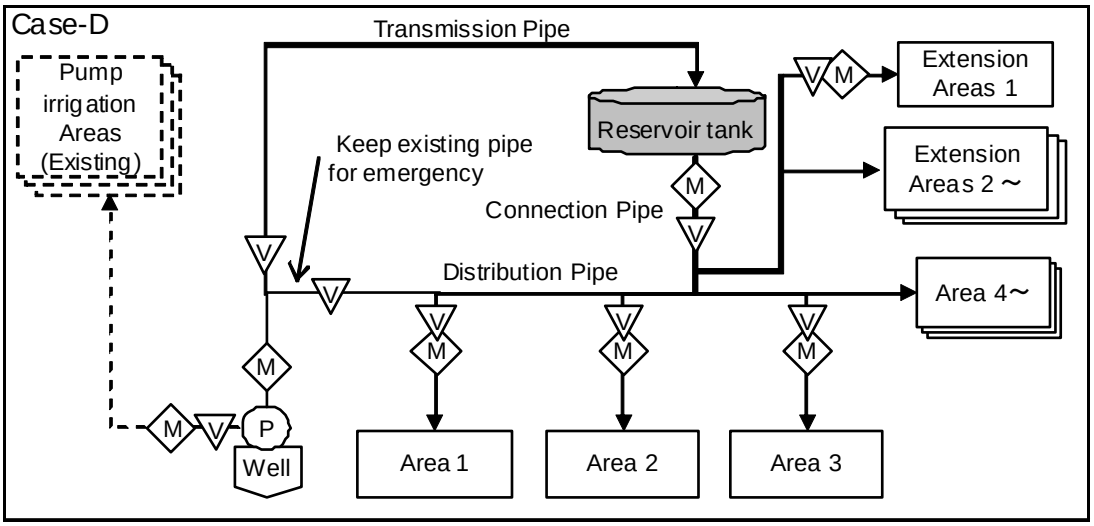
1) Construction of transmission pipe from well to reservoir tank and incidental facilities
2) Construction of reservoir tank and incidental facilities
3) Rehabilitation of distribution pipe and incidental facilities
4) Construction of connection pipe between reservoir tank and distribution pipe and incidental facilities

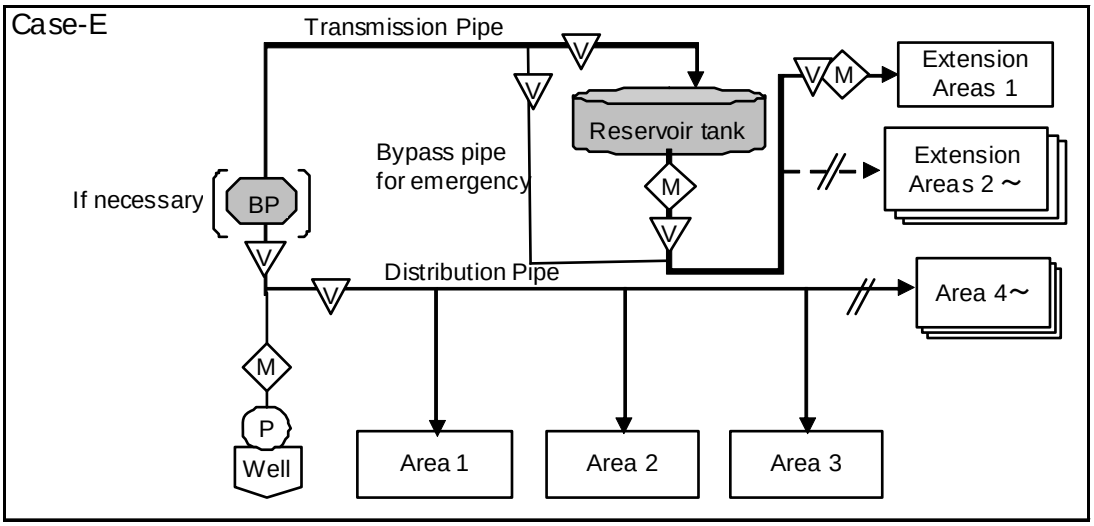
Irrigation systems after rehabilitation are classified into 7 patterns as shown in Figure 2-1-2.

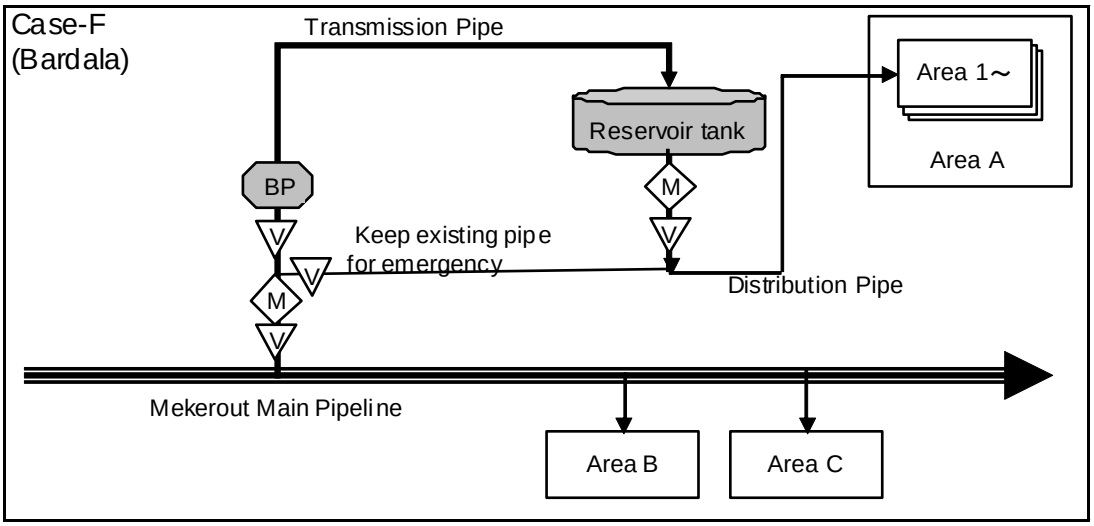







Case-D
Transmission Pipe
Pump irrigation Areas (Existing)
Keep existing pipe for emergency
Reservoir tank
Extension Areas 1
Extension Areas 2 ~
Connection Pipe
Distribution Pipe
Area 4~
Area 1
Area 2
Area 3
Well
P
M
V


Case-E
Transmission Pipe
Bypass pipe for emergency
If necessary
BP
Reservoir tank
Extension Areas 1
Extension Areas 2 ~
Distribution Pipe
Area 4~
Area 1
Area 2
Area 3
Well
P
M
V


Case-F
(Bardala)
Transmission Pipe
Reservoir tank
Area 1~
Area A
BP
Keep existing pipe for emergency
Distribution Pipe
Mekerout Main Pipeline
Area B
Area C
M
V

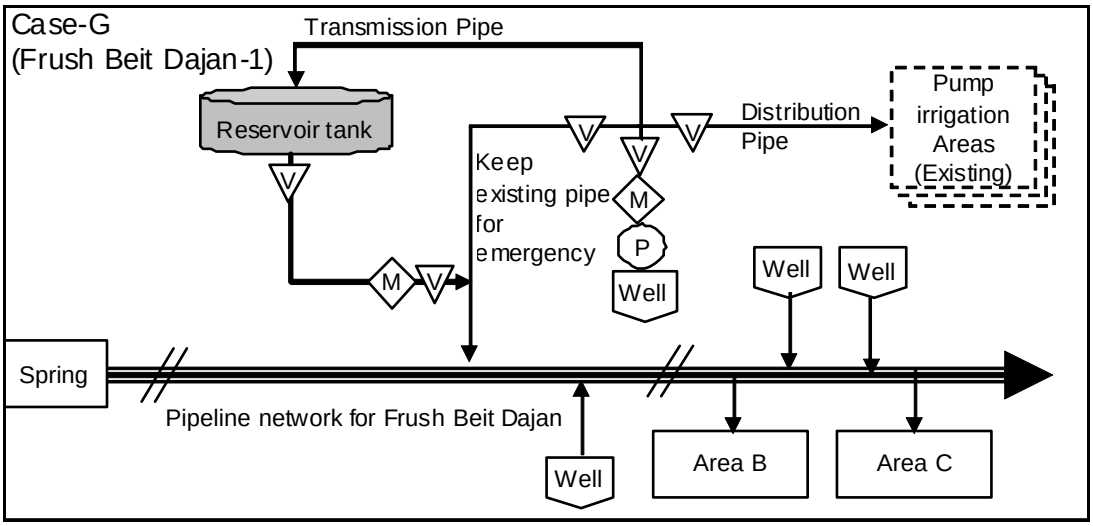


Figure 2-1-2 Diagram of irrigation systems after rehabilitation

(b) Policy for expansion of irrigation area

Expansion of irrigation area is considered in five(5) irrigation sites, namely, Jayyus plain 1, Al Syaykh Ahmad, Qaffin, Kafr Zibad, and Ektaba. However, licensed pump discharge is decided for each well and over pumping is prohibited strictly. Expansion plan is considered for only the sites that will secure the necessary pump discharge for expansion.

(c) Transmission facilities from well to reservoir tank

With the construction of reservoir tank, transmission pipe has to be constructed as well. In five(5) sites, namely, Bardala, An Nazia Sharqiya, Kafr Zibad, Ektaba, Marl Naja, the elevation of planned reservoir tank is high, so booster pump has to be installed to pump up to reservoir tank. Operation cost of booster pump is expensive and it dumps on the water charge. However, farmers agreed to install booster pump and increase of water charge in every five (5) sites, therefore installation of booster pump is planned in these five(5) sites.

(d) Reservoir tank

Various type of materials are used to reservoir tank, such as concrete, FPR, steel and colgate to which MoA applied, are constructed in the West Bank. From the aspect of durability and maintenance, concrete tank is preferred. However, approval of Israel is compulsory for construction of water-related permanent structures like concrete reservoir tank. It takes long time to obtain Israel's approval and this will affects the implementation of the project.

It is considered that colgate tank is a temporary facility and the approval is not necessary for that construction in the West Bank however above opinion is not stipulated. MOA judged that the approval is not necessary for construction of colgate tank, therefore re colgate tank is adopted in the project.

(e) Replacement of distribution pipes and its scope

Distribution facilities were constructed over 40 years ago around the same time that wells drilled.

Repaired rusted steel pipes by welding, thinned pipe thickness, leakage from depleted valve packing are found in distribution facilities. Total replacement at the soonest time possible is desired.

Bardala and An Nassarya 2 have been constructed for about 30 years. From the perspective of the lifetime of facilities, immediate replacement is needed for these two sites, however, the replacement of distribution pipe is not carried out. In some sites in Tulkarem, part of pipes had been replaced by other donors. These pipes shall be used without replacement in the project. Reserved water of Frush Beit Dajan 1 plans to flow to another irrigation district at the downstream through integrated irrigation pipe network in this area, consequently, this site is also withdrawn from the candidate of the project.

In deciding the scope of component, decrease in leakage section with the replacement has a priority. However, functional assessment for the total section of the applied distribution pipe around 90 km is very difficult from the aspect of survey cost and period. Also, distribution pipes in all applied sites have to be replaced sooner or later regardless of the degree of deteriorated condition of distribution pipes. Therefore, the replacement shall cover prioritized sites and prioritized sections.

Index of the prioritization is thought of as the licensed pumping quantity of each well from the respect of utilization of limited water resources. Otherwise, the replacement of irrigation system accompanied with new construction of reservoir tank demands exchanges of existing pipes hydraulically to some sections. To operate the new irrigation system, these sections shall be replaced by priority. In consequence, replacement section of distribution pipe is decided based on the following policies. Length of distribution pipes to be rehabilitated is shown in Table 2-1-4.

(1st priority) The sections, which pipe diameters, shall be enlarged or the coefficient of friction shall be reduced, according to installation of reservoir tank and effective use of existing pump.

(2nd priority) Remaining sections shall be selected according to licensed pumping quantity in each site in term of effective use of water resources.

Table 2-1-4 Distribution pipe length to be rehabilitated considering annual licensed pump discharge

	Annual licensed pumping quantity (thousand m^3/year)				
	Over 200	150～200	100～150	Less than100	sum
Nos of site	6	6	7	3	22
Total license quantity (thousand m3/year)	1,650	960	843	369	3,822
Existing pipe (m)	27,750	22,450	23,750	13,450	87,400
Necessary replacement length (m)	19,950	19,350	20,450	8,350	68,100
1st priority	12,510	9,555	8,005	5,535	35,605
2nd priority	7,440	9,795	12,455	2,815	32,495
Candidate site	・An Nabi Elyas ・An Nazia al Gharbiya ・Attil ・Dir al gsoon ・Ektaba ・Marj Naja	・Falamya ・Haabla 1 ・Izbat Salman ・Qalqiliya city 2 ・Qaffin ・Irtah	・Jayyus plain 1 ・Haabla 2 ・Al Syaykh Ahmad ・Thennabeh ・Farun ・Kafr Zibad ・An Nassarya 1	・Jayyus plain 2 ・An Nazia al Sharqiya ・Frush Beit Dajan 2	

* Bardala, An Nassarya 2, Frush Beit Dajan 1 are excluded from candidates.

(f) Installation of corporation cocks and flow meters at each household

To change irrigation system drastically from a rotation system which charged by time to a pay-for-use system which charged by quantity, flow meters shall be installed at corporation cocks. Otherwise, flow meters shall be installed by water user association for the sections which are not replaced in this project.

(g) Connection between reservoir tank and distribution pipe

In the sites which excluded from replacement of distribution pipe, existing distribution pipe shall be used continuously and connection pipe between reservoir tank and distribution pipe shall be installed in this project. In case the difference in elevation between reservoir tank and farm land, small booster pump is installed by water user association.

(h) Installation of bypass pipe

Maintenance of reservoir tank such as exchange of waterproof sheet in every 5 years is necessary. Bypass pipe connecting transmission pipe and distribution pipe directly shall be installed to irrigate in a maintenance period.

(3) Basic policy on the rehabilitation of 9 wells

Nine (9) existing well irrigation systems became dysfunctional because of degraded well facilities such as wells, pumps and generators and so on. However, the existing transmission and distribution facilities are still in good condition. Accordingly, the rehabilitation work aims to recover the function of these irrigation systems through improvement of well facilities. Another two (2) well irrigation systems have problems in the transmission and distribution facilities, so these facilities are also rehabilitated in addition to well facilities. Especially, No.8 well (#19-15/028A) has bee requested to have new construction of transmission facilities, storage tank, and distribution facilities, therefore the rehabilitation plan reflects the results of verification of validity and effectiveness of the plan. In the verification, the effect of the well irrigation systems to surrounding water resources are reviewed referring the distribution system and utilization of surrounding wells, operation and maintenance situation in the JICA F/S's pilot project sites, and the systems and activities of WUA.

(4) Basic policy for rehabilitation of Nwaimeh spring canal

This component was proposed as priority component in JICA F/S survey. Basic concept of rehabilitation of Nwaimeh spring canal is as follows. Component c) and d) includes installation of pipeline of existing secondary canal from main canal to each reservoir tank or each farm land and installation of flow control valve and flow meter for every branch points. However, the applied scope of the project is targeted only at the main canal. Therefore, the purposes of rehabilitation in this project are concept a), b) and prevention of soil inflow to canal.

1) Improvement of spring canal
   a) Decrease of transmission loss
   b) Preventing inflow of sewage water to spring canal
   c) Introduce fair water allocation to rightful person
   d) Introduce of distribution monitoring system
2) Improvement of organization of water use and maintenance
   e) Establishment and enhancement of maintenance organization
   f) Training of water management in farm land

Applied canal length for rehabilitation is 3 km, however, 4.7 km of pipeline of open canal and 2.0 km of rehabilitation of open canal are proposed in JICA F/S survey. Discussion among stakeholders of this canal, it was confirmed that few farmers use branch canals and the benefit of rehabilitation is brought to limited farmers. Otherwise, average leakage rate of main canal is very large, estimated at 34 %. Therefore, only main canal shall be rehabilitated in this project.

The rehabilitation section ranged from Sta. 1+330, which the end point of rehabilitation work in the pilot project in JICA F/S survey, to Sta. 5+430, which the end point of Al-Nwai'mah spring canal and its length extends to 4,100m. In addition, three aging water bridges are renovated. These lengths are long and their construction cost is estimated to be expensive, so pipes are planned to bury under riverbed of Wadi. Also, sediment in Wadi causes inflow of mud water to main canal in some points, this sediment shall be removed in this project.

2-1-2-1-2 Policy on Natural Environmental Condition

Groundwater basins in the West Bank consist of 3 basins, namely, West groundwater basin, Northeast groundwater basin and East groundwater basin. Generally, Qalqiliya and Tulkarem are located in West groundwater basin. Jenin, the western part of Nablus and the western part of Tubas are in Northeast groundwater basin. East groundwater basin contains Jericho, the eastern part of Tubas and the eastern part of Nablus (refer Figure 2-1-3). Palestinian and Israeli extraction quantity from each groundwater basin are decided as Table 2-1-5 in Oslo Accords II.

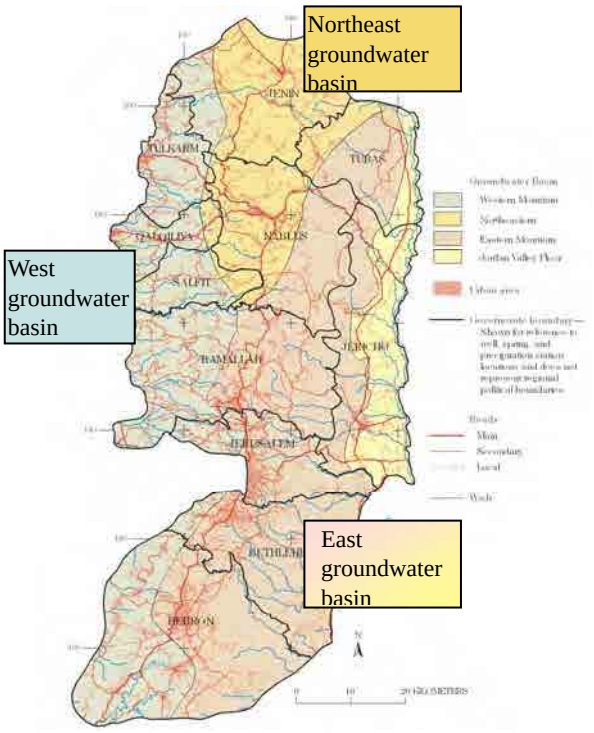


Figure 2-1-3 Groundwater basins in the West Bank

West groundwater basin is located in rainy area in the West Bank and estimated large amount of water recharges to aquifers. However, this basin expands to Israeli side widely; PA extraction is only 22 MCM/year of 362 MCM/year which total extraction

from this basin.

East groundwater basin has the largest area; however, less precipitation and much evaporation are reduced pump discharge from the basin. Total extraction is estimated at 100 MCM/year and 54 MCM/year of this are allocated to Palestine. Also, 78 MCM/year of extraction is added to Palestine foreseeing the expansion of water demand in the West Bank in future.

Table 2-1-5 Extraction water quantity for Palestine and Israel

Groundwater basin	Target districts in this project	Extraction for Israel (MCM/yr)	Extraction for Palestine (MCM/yr)	Total (MCM/yr)
West groundwater basin	Qalqilia Tulkarem	340 (93%)	22 (6%)	362
Northeast groundwater basin	Jenin Western part of Tubas Western part of Nablus	103 (71%)	42 (29%)	145
East groundwater basin	Eastern part of Tubas Eastern part of Nablus Jericho	40 (40%)	54+78*[1)] (132%)	100
Total	-	483	118+78	607

※1) 78 MCM remaining quantities to be developed from the Eastern Aquifer in future.

PWA manages their groundwater project within the decided extraction and also licenses proper extraction to each well. These wells are approved by JWC as well. In this project, JWC's approval for extraction is presupposed to construction. Also, irrigation plan is designed not to exceed the yearly licensed extraction.

2-1-2-1-3 Policy on Social Condition

Various kinds of permissions are requested by Israel for construction works in the West Bank. For smooth construction, smooth acquirement of Israeli permissions is essential in each stage of construction. The Exchange of Notes (E/N) of the project must be concluded after confirming acquirement of these permissions.

The component of the project is water resources development and rehabilitation of water related facilities, by approval by Joint Water Committee (JWC) is necessary before implementing this project. Moreover, below-mentioned areas are established in Palestine.

Area A: The area under the Palestinian Authority civilian control and security

Area B: The area under the Palestinian Authority civilian and the Israeli Civil Administrator (CA) security control

Area C: The area under the CA civilian control and security

Area C (between separation wall and green line):

The area under the CA civilian control and security, where permission is required to access to farm land and water resources located Israel side of separation wall

At construction stage, joint inspection with CA and prior permission for workforce plan and mobilization of construction materials and machineries are required from contractors except construction in Area A.

Because most of materials are conveyed via Israeli ports to Palestine, there is fear that carrying into construction sites of materials will be delayed for the reason that inspection at the custom office and accession of import permit will require much time. Procurement plan shall consider sufficient period examining procurement circumstance in Palestine.

Procedure of JWC's and CA's approvals and permits are entrusted to the Palestine side. The necessity of application is also judged by Palestine side. It is difficult to eliminate risks that Israel constrains to stop the construction or to reapply approvals and permits in construction stage. Either way, necessity approvals and permits shall be confirmed before concluding E/N through discussion with Palestine side. Delay in approvals and permits are assumed to have bad influence to the conclusion. The GOJ shall cooperate to obtain these approvals and permits.

2-1-2-1-4 Agricultural Condition

Rehabilitation of exiting irrigation facilities in this project improves agricultural circumstance. Crops are selected at farmers' own discretion. Improvement of stabilized and flexed supply of irrigation water promotes to introduce productive crops. However, licensed pump discharge of each well are already decided, drastic change of crops is not assumed to make. Therefore, irrigation plan in the project is drawn referring to existing cropping pattern.

Irrigation water requirement is decided from climate characteristic, soil moisture characteristic and water consumption characteristic of target crops. MOA calculated irrigation water requirement in each governorate using FAO software, "CROPWAT". Cropping pattern of typical crops, monthly maximum daily average irrigation water requirement and annual irrigation water requirement are shown in Figure 2-1-4.

Irrigation plan in this project shall be decided using existing cropping pattern and irrigation water requirement of each crop calculated by MOA.

Jericho, Tubas, Nablus*1

	Crop	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Annual water requirement(mm)
		Summer		Winter						Spring				
Annual Plant	**Greenhouse**													
	Cabbage		10.4	4.3	3.9									369.7
	Cauliflower		10.4	4.7	4.0									366.3
	Cucumber		7.4	5.0	3.8	2.6	2.1	3.2	5.6	6.9	6.8			1004.1
	Tomato	10.6	5.5	5.6	4.3	2.1	2.0	3.6	5.8	6.1				1121.1
	Open													
	Eggplant								3.1	8.4	10.0	10.7	10.7	1176.1
	Onion			3.2	2.3	0.2	0.2	0.2	3.2	3.3				221.5
	Potato							1.9	3.7	8.3	9.8	9.2		750.9
	Tomato								4.1	8.1	9.9	9.9		821.2
	Squash							1.0	4.6	7.8	8.3			462.1
	Spring wheat				0.4	0.4	0.4	0.4	4.5	7.5	9.4			658.2
Permanent	Banana(1st year)	0.0	0.0	0.0	0.2	0.2	0.2	0.2	2.8	7.4	9.5	5.0	9.7	940.9
	Banana(2nd year)	10.6	8.9	5.9	2.4	0.2	0.2	0.2	5.6	8.3	10.4	11.1	11.1	1987.4
	Grapes	7.6	6.4	3.5	0.3	0.3	0.3	0.3	0.3	4.2	7.2	7.8	7.9	1188.2
	Citrus families	5.8	4.7	2.5	0.4	0.4	0.4	0.4	0.4	4.0	5.7	6.0	6.2	1047.8
	Date	8.1	7.0	4.3	0.6	0.6	0.6	0.6	0.6	5.4	8.0	8.7	13.8	1500.3

*1 Because data was unavailable, water requirement in Nablus is applied the data of Jericho and Tubas which have similar claimet with Nablus

*2 Figures on bar charts are indicated the maximum average daily water requirement (mm) in each month.
Divide total volume of intermittent irrigation water by days of intermittent irrigation in basis of calcuration of "Cropwat" by MoA

Tulkarem, Qalailia

	Crop	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Annual water requirement(mm)
		Summer		Winter						Spring				
Annual Plant	**Greenhouse**													
	Tomato													686
	Cucumber	3.2	4.1	3.4	2.6	1.7	1.4	1.8	2.7	2.7				612.9
	Open													
	Eggplant	5.5							0.5	3.3	5.3	5.7	5.7	702.2
	Tomato								0.6	2.7	5.1	5.6	5.1	475.7
	Squash								0.8	3.0	5.0	5.0		293.5
	Squash 2								0.8	3.6	4.7			229.3
	Cauliflower		4.3	2.3	0.0									133.6
	Cabbage		3.8	1.8	0.0									125.4
	Thymu				0.4	0.4	0.4	0.4	0.4	0.4	3.7			186.3
Permanent	Olive	3.1	2.8	10	0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.0	3.2	468.1
	Citrus families	3.1	2.8	2.2	0.4	0.4	0.4	0.4	0.4	0.4	2.8	3.1	3.2	514.9

Jenin

	Crop	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Annual water requirement(mm)
		Summer		Winter						Spring				
Annual Plant	**Greenhouse**													
	Tomato		5.2	3.1	3.4	3.3	2.3	1.6	2.2	3.8	4.8	4.5		802.4
	Cucumber		4.4	4.2	4.5	2.8	1.8	1.6	2.2	3.8	4.0			699.2
	Thymu				0.3	0.3	0.3	0.3	0.3	0.3	4			121.2
	Open													
	Cabbage			5.5	2.5	2.0								188.1
	Cauliflower			7.4	2.9	1.9								193.4
	Tomato	6.3								3.1	5.5	7.4	7.4	737.2
	Potato							0.5	2.7	5.4	6.7	6.3		495.3
	Squash									2.4	6.4	7.0		458.7
	Eggplant	7.1								2.8	6.8	7.3	7.4	861.3

Source : Soil and Irrigation Department, MOA

Figure 2-1-4 Irrigation water requirement of each crop

2-1-2-1-5 Policy on Operation and Maintenance

Regarding the well irrigation sites, WUA will be in charge of future O/M for the facilities. Technical assistance for the establishment, management and enhancement of WUA as well as the enhancement of the monitoring system of MOA will be planned by Soft component program.

Regarding the Nwaimeh spring irrigation canal, water management committee and Nwaimeh village council will be jointly in charge of future O/M for the facilities, same as the present management system.

2-1-2-1-6 Policy on Environmental and Social Considerations

Since the Project does not accompany with land acquisition and involuntary resettlement, considerable and significant impacts will not be predicted. Though almost construction sites are within agricultural land and far from houses, a part of construction site is located along houses in rehabilitation of Nwaimeh spring water canal. Therefore, it is necessary to consider mitigation measures, for instance, construction machinery that will be selected should low-noise and low vibration type machineries for pipeline construction.

2-1-2-1-7 Policy on Construction and Procurement

There are ready-mixed concrete plants and reinforcing bar factories in major cities of the project area. General-purpose equipments are also available in the market. Since a large number of construction works such as well rehabilitation works, constructions of irrigation pipes and reservoir facilities similar to this project have been carried out in the surrounding project area, the required equipments and heavy machines can be procured in local markets.

If the Japanese prime contractor will import these, it is necessary to obtain permission of tax exemption from Israel. In other project, long-time processing of permit for tax exemption causes significant extension of implementation schedule. Therefore, procurement will be made from Israel or PA suppliers in order to avoid the risks.

2-1-2-1-8 Policy on Employing Local Consultant and Contractor

There has been many building and civil works projects implemented all over the PA. Design, planning and implementation management with this project have been carried out by local consultants, and constructed by local contractors. If the project will utilize local professional contractors, delay of construction and delivery equipments caused by Israel CA will be reduced. For design and construction management suitable to local conditions, it will be desirable to use local professional contractors and local consultants.

2-1-2-1-9 Policy on Quality Requirement of Proposed Facilities and Equipment

Many similar projects have been implemented in the design standards and quality control standards of Palestine by MOA. Since it is considered that the contents of these standards are consistent with the

international criteria, the criteria of PA should be taken.

Since a number of similar projects have been implemented in the design standards and quality control standards of PA by MOA, and conform to the international standards that the contents of the criteria, according to the criteria of PA.

2-1-2-1-10 Policy on Implementations Schedule

The implementation schedule is decided considering significantly lowering of working efficiency during heat wave period in Jericho, Tubas and Nablus, and the required period for the importation of pump equipment.

2-1-2-1-11 Policy on Construction Supervision

Construction sites of this project are distributed in five prefectures through the central part to the northern part of the West Bank. Therefore, in order to manage efficiently, main office will be placed at Ramallah, and field office will be located at Tulkarm and Jericho, with placement of necessary personnel to supervise project execution.

2-1-2-2 Basic Policy

2-1-2-2-1 25 Irrigation Sites

Diameter of distribution pipes, volume of reservoir tank and diameter of transmission pipes are decided by following flowchart as shown in Figure 2-1-5.

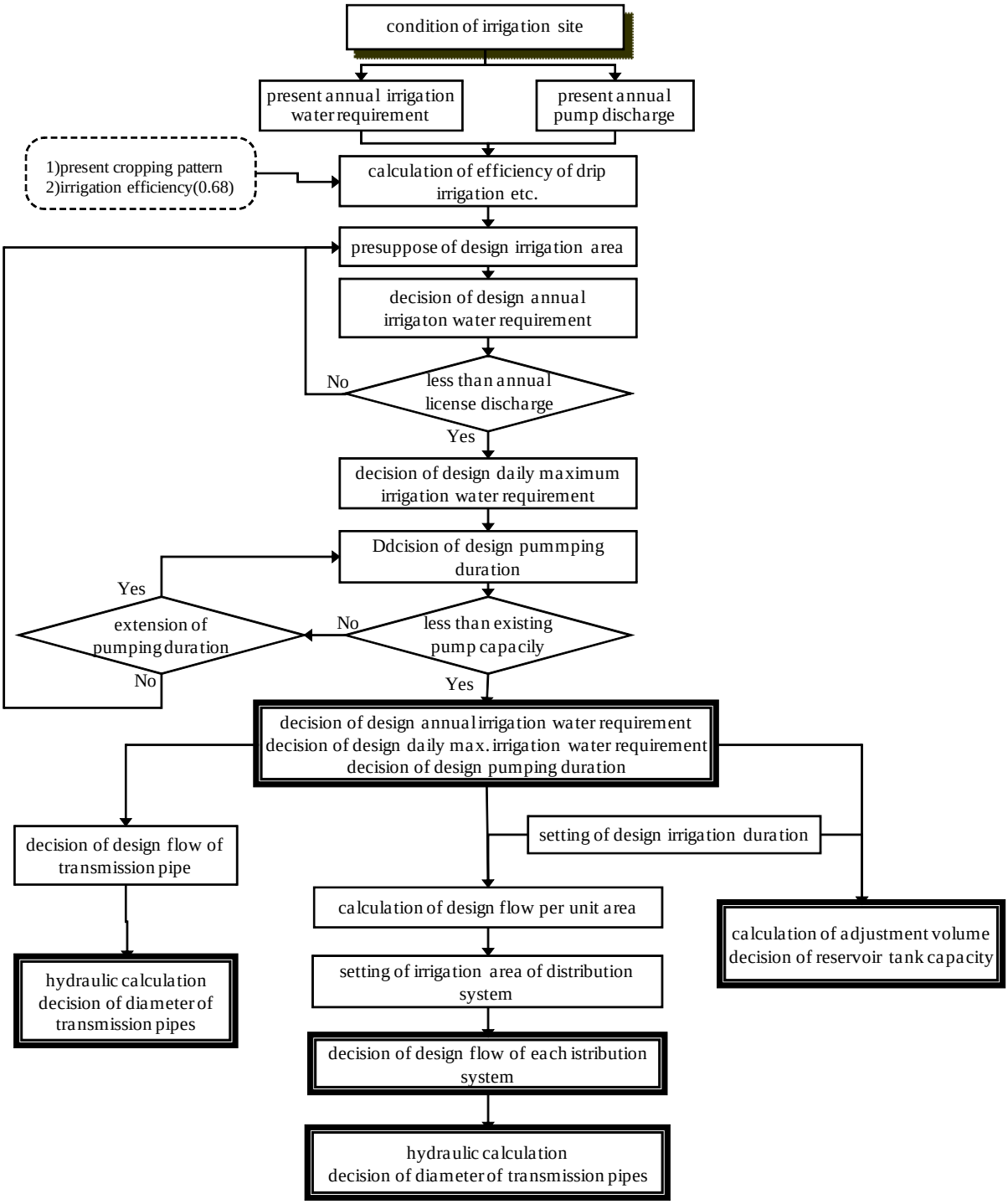


Figure 2-1-5 Flowchart for deciding diameter of pipes and volume of tank

(1) Calculation of irrigation water requirement

The necessary rough irrigation water requirement is obtained dividing the product of net irrigation requirement (m^3/day/ha), calculated through the use of CROPWAT by MOA and irrigation area by combined irrigation efficiency. Combined irrigation efficiency (E) is obtained from convey efficiency (Ec), canal efficiency in farm field (Eb) and application efficiency in farm field (Ea), however, 0.68 is set up as a

Palestine standard value by MOA. Irrigation water requirement of each facilities are calculated considering rough irrigation water requirement, irrigation duration (distribution duration) and transmission duration.

Rough irrigation water requirement

= net irrigation water requirement per unit area x irrigation area / combined irrigation efficiency

Yearly and monthly irrigation water requirement and daily maximum irrigation water requirement based on existing cropping pattern in each site is tabulated in Table 2-1-6.

Table 2-1-6 Irrigation water requirement and daily maximum net irrigation water requirement

Site		Present irrigation area(ha)	Irrigation water requirement (m3/yr)	Unit irrigation water requirement (m3/yr/ha)	Maximum daily average irrigation water requirement(m3/day) considering intermittent days													Daily max. irrigation water requirement (m3/day/ha)
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	max.	
Tubus																		
4	Bardala	50.0	475,850	9,517	334	418	1,107	1,940	1,955	1,282	1,063	1,448	955	764	586	397	1,955	39.1
Qalqiliya																		
1	Jayyus plain 1	40.0	205,160	5,129	162	166	186	235	1,149	1,229	1,260	1,203	1,049	826	174	176	1,260	31.5
2	Jayyus plain 2	40.0	187,930	4,698	150	154	163	163	952	1,054	1,088	1,086	1,208	897	162	163	1,208	30.2
3	Falamya	25.0	97,590	3,904	174	191	257	350	1,140	657	649	551	551	441	226	191	1,140	45.6
4	An Nabi Elyas	30.0	146,560	4,885	52	52	147	490	1,182	1,300	1,238	458	407	309	52	56	1,300	43.3
6	Haabla 1	35.0	134,140	3,833	94	98	116	151	638	705	720	680	1,139	762	106	103	1,139	32.5
7	Haabla 2	45.0	133,130	2,958	61	61	91	196	652	744	735	845	1,245	663	61	65	1,245	27.7
8	Al Syaykh Ahmad	30.0	152,500	5,083	100	100	130	235	955	1,055	1,055	775	700	550	100	108	1,055	35.2
9	Izbat Salman	60.0	193,860	3,231	104	112	190	400	1,042	1,149	1,118	1,755	1,136	486	128	116	1,755	29.3
11	Qalqiliya city 2	40.0	212,510	5,313	175	191	271	467	1,039	1,313	1,328	1,216	948	668	223	193	1,328	33.2
Tulukalem																		
1	Qaffin	40.0	192,400	4,810	160	160	1,185	1,935	2,905	0	0	0	0	0	160	160	2,905	72.6
2	An Nazia al Gharbiya	30.0	183,900	6,130	420	540	810	810	0	0	0	960	1,230	1,020	780	510	1,230	41.0
5	Attil	144.0	768,060	5,334	1,440	1,840	2,850	3,340	1,410	1,130	1,080	3,750	4,702	3,722	2,640	1,740	4,702	32.7
8	Thennabeh	50.0	287,800	5,756	280	360	710	1,410	1,550	1,690	1,590	1,190	820	680	520	340	1,690	33.8
9	Irtah	40.0	231,690	5,792	78	90	257	1,041	1,817	1,596	1,596	1,636	123	102	114	87	1,817	45.4
10	Farun	16.0	66,930	4,183	74	78	87	87	465	310	320	342	321	254	86	80	465	29.1
11	Kafr Zibad	36.0	124,240	3,451	192	224	344	512	1,148	448	408	256	328	272	288	216	1,148	31.9
12	An Nazia al Sharqiya	21.0	52,270	2,489	64	72	90	90	306	93	96	157	596	364	88	71	596	28.4
13	Dir al gsoon	74.0	338,960	4,581	460	580	960	1,450	1,410	1,130	1,080	1,510	1,832	1,342	820	550	1,832	24.8
14	Ektaba	23.0	130,140	5,658	78	98	238	641	886	943	730	717	261	214	138	94	943	41.0
Nablus																		
1	An Nassarya	45.0	223,740	4,972	172	242	667	998	1,420	1,457	850	983	849	836	337	194	1,457	32.4
2	An Nassarya	34.3	162,074	4,725	154	170	418	569	565	875	830	931	690	612	328	168	931	27.1
3	Frush Beit Dajan 1	45.0	134,250	2,983	80	80	80	80	560	620	640	1,570	1,010	440	80	86	1,570	34.9
4	Frush Beit Dajan 2	42.0	205,110	4,884	124	132	261	642	1,488	1,585	1,104	1,083	754	596	148	137	1,585	37.7
Jericho																		
4	Marj Naja	50.0	336,700	6,734	250	360	1,320	2,380	3,040	2,060	1,070	0	1,780	970	820	300	3,040	60.8

Gross irrigation water requirement, which is derived from irrigation water requirement and irrigation efficiency (0.68) calculated by above calculation, is quite different with present pump discharge. This difference is caused by water saving by drip irrigation. Calculated average water saving efficiency is about 0.6, so water saving efficiency is anticipated in design irrigation water requirement. And water saving efficiency is variable in each site according to variety of crops, cropping method (outdoor/greenhouse) and irrigation method (drip/sprinkler). Therefore, designed water saving efficiency is calculated in each site, in consideration of 1) volume of annual irrigation requirement should be less than annual license volume, and 2) designed irrigation area should be same to or more than existing area of each of the 25 irrigation sites.

Irrigation water requirement = rough irrigation water requirement x designed water saving efficiency
(average water saving efficiency in each 25 irrigation site)

On the basis of above Irrigation water requirement, design discharge of transmission and distribution

pipes are calculated. Design discharge in three sites, Falamya, Izbat Salman, Qaffin are less than existing pump discharge if transmission duration is decided 20 hours, so these design discharge is defined by pump discharge ability. However, 24 hours pump operation enables to pump up the volume of irrigation water requirement. In regard to above three site, design discharge is set as pump discharge ability when these pump operating 24 hours.

On the other hand, design discharge of distribution pipe is varied by each irrigation area. Design discharge of each interval of distribution pipe is obtained by multiplying the design discharge of distribution pipe per unit area calculated at 10 hours irrigation as shown in Table 2-1-7 by each irrigation area.

Table 2-1-7 Irrigation water requirement in each site

site	Water resources	Design discharge of transmission pipe (m^3/sec/)	Design discharge of distribution pipe per unit area (m^3/sec/ha)	Remarks
Tubas				
Bardala	Mekerout	0.013	0.00056	
Qalqiliya				
Jayyus plain 1	Well #15-17/012	0.021	0.00083	The adjustment volume of 14 hours time difference
Jayyus plain 2	Well #14-17/040	0.013	0.00056	The adjustment volume of 14 hours time difference
Falamya	Well #15-18/003	0.017	0.00159	The adjustment volume of 14 hours time difference
An Nabi Elyas	Well #15-17/005	0.022	0.00097	
Haabla 1	Well #14-17/008a	0.015	0.00093	
Haabla 2	Well #14-17/005	0.015	0.00062	
Al Syaykh Ahmad	Well #14-17/044	0.022	0.00096	
Izbat Salman	Well #15-17/015	0.018	0.00072	The adjustment volume of 14 hours time difference
Qalqiliya city 2	Well #14-17/027	0.017	0.00075	
Tulkarem				
Qaffin	Well #15-20/007	0.025	0.00148	The adjustment volume of 14 hours time difference
An Nazia al Gharbiya	Well #15-20/004	0.025	0.00167	
Attil	Well #15-19/036	0.025	0.00035	
Thennabeh	Well 15-19/038	0.028	0.00083	
Irtah	Well #15-18/010	0.025	0.00084	
Farun	Well #15-18/006	0.022	0.00139	
Kafr Zibad	Well #15-18/012	0.018	0.00100	
An Nazia al Sharqiya	Well #16-20/005	0.022	0.00127	
Dir al gsoon	Well #15-19/029	0.031	0.00083	
Ektaba	Well #15-19/044	0.022	0.00145	
Nablus				
An Nassarya	Well #18-18/036	0.018	0.00080	
An Nassarya	Well #18-18/031a	0.025	0.00131	
Frush Beit Dajan 1	Well#19-17/044	0.010	0.00071	
Frush Beit Dajan 2	Well#19-17/047	0.019	0.00093	
Jericho				
Marj Naja	Well #20-17/010	0.026	0.00127	

(2) Volume of reservoir tank

Volume of reservoir tank is calculated from terminate irrigation duration and adjustment volume of time lag of pump duration. Irrigation duration of each site is variable; however, maximum pump duration (irrigation duration) is about 20 hours through a year. Terminate irrigation duration after installing reservoir tank is

decided during daylight (10 hour) meeting demand of farmers and volume of reservoir tank shall meet at least 10-hours adjustment volume of time lag. Therefore, volume of reservoir tank is decided calculated by following formula and colgate reservoir tank (diameter and height) are designed to meet the calculated volume.

Adjustment volume of time lag = Pump discharge x (design pump duration - terminate irrigation duration)
= 10 x Pump discharge

Design pumping duration of three sites, Falamya, Izbat Salman and Qaffin, is calculated as 24 hours. Also, Jayyus plain 1 and Jayyus plain 2 are desired to operate all day with the view to these locations between the separation wall and the green line. Above five(5) sites' tank capacity is made with an allowance of 14-hours adjustment volume. The existing concrete reservoir tank in Marj Naja was recently constructed however, transmission pipe is broken. Therefore, rehabilitation work is limited to replacement of transmission pipe. Tank capacities of each site are tabulated in Table 2-1-8.

Table 2-1-8 Tank capacities of each site

Site name	Water resources	Tank capacity (m^3)
Tubas		
Bardala	Mekerout	700
Qalqiliya		
Jayyus plain 1	Well #15-17/012	1,100
Jayyus plain 2	Well #14-17/040	700
Falamya	Well #15-18/003	600
An Nabi Elyas	Well #15-17/005	800
Haabla 1	Well #14-17/008a	600
Haabla 2	Well #14-17/005	600
Al Syaykh Ahmad	Well #14-17/044	800
Izbat Salman	Well #15-17/015	1,000
Qalqiliya city 2	Well #14-17/027	600
Tulkarem		
Qaffin	Well #15-20/007	900
An Nazia al Gharbiya	Well #15-20/004	900
Attil	Well #15-19/036	900
Thennabeh	Well 15-19/038	800
Irtah	Well #15-18/010	900
Farun	Well #15-18/006	800
Kafr Zibad	Well #15-18/012	700
An Nazia al Sharqiya	Well #16-20/005	800
Dir al gsoon	Well #15-19/029	1,100
Ektaba	Well #15-19/044	800
Nablus		
An Nassarya	Well #18-18/036	700
An Nassarya	Well #18-18/031a	900
Frush Beit Dajan 1	Well#19-17/044	400
Frush Beit Dajan 2	Well#19-17/047	700
Jericho		
Marj Naja	Well #20-17/010	500 (use existing tank)

(3) Planning of transmission pipe

Hazen-Williams formula is adopted for hydraulic calculation of pipeline.

$V = 0.355 \times C \times D^{0.63} \times I^{0.54}$

$Q = 0.279 \times C \times D^{2.63} \times I^{0.54}$

$I = hf / L = 10.667 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85}$

Where, V: velocity (m/sec） Q: quantity (m^3/sec) I : hydraulic gradient D : diameter (m)
C: coefficient of velocity L : length of pipe (m) Hf : head loss (m)

Coefficient of velocity C is varied from the types of lining, diameters and ages, however, C is decided practically as follows except the case calculating the flexion loss.

Galvanized Steel Pipe (GSP)	C = 100
Ductile cast iron pipe (DIP) with mortal lining	C = 130
High Density Polyethylene (HDEP)	C = 150

Total of flexion loss, valve loss and other loss with the exception of friction head loss is estimated 10 % of friction head loss. The result of hydraulic calculation is tabulated in Table 2-1-9.

Table 2-1-9 Hydraulic calculation of transmission system of each site

Site name	Length L (m)	Discharge Q (m^3/s)	C	Diameter of pipe D (m)	Friction loss hf (m)	Velocity V (m/s)	Other loss (m)	Gross Head loss (m)	Height difference (m)	Necessary Pump head (m)
Tubas										
Bardala	270	0.013	150	0.100	6.52	1.66	0.65	7.17	11.88	22.05
Qalqiliya										
Jayyus plain 1	600	0.021	150	0.150	4.89	1.19	0.49	5.38	10.13	18.51
Jayyus plain 2	200	0.013	150	0.150	0.67	0.74	0.07	0.74	2.50	6.24
Falamya	1,800	0.017	150	0.150	9.92	0.96	0.99	10.91	26.20	40.11
An Nabi Elyas	250	0.022	150	0.150	2.22	1.25	0.22	2.44	4.50	9.94
Haabla 1	50	0.015	150	0.150	0.22	0.85	0.02	0.24	2.00	5.24
Haabla 2	150	0.015	150	0.150	0.66	0.85	0.07	0.73	6.00	9.73
Al Syaykh Ahmad	1,150	0.022	150	0.150	10.21	1.25	1.02	11.23	37.50	51.73
Izbat Salman	200	0.018	150	0.150	1.22	1.02	0.12	1.34	24.20	28.54
Qalqiliya city 2	260	0.017	150	0.150	1.43	0.96	0.14	1.57	1.40	5.97
Tulkarem										
Qaffin	50	0.025	150	0.150	0.56	1.42	0.06	0.62	-1.52	2.10
An Nazia al Gharbiya	1,100	0.025	150	0.150	12.37	1.42	1.24	13.61	29.16	45.77
Attil	350	0.025	150	0.150	3.94	1.42	0.39	4.33	11.00	18.33
Thennabeh	1,300	0.028	150	0.150	18.03	1.59	1.80	19.83	21.20	44.03
Irtah	250	0.025	150	0.150	2.81	1.42	0.28	3.09	30.20	36.29
Farun	250	0.022	150	0.150	2.22	1.25	0.22	2.44	5.50	10.94
Kafr Zibad	1,800	0.018	150	0.150	11.02	1.02	1.10	12.12	77.70	92.82
An Nazia al Sharqiya	1,500	0.022	150	0.150	13.32	1.25	1.33	14.65	74.00	91.65
Dir al gsoon	250	0.031	150	0.200	1.03	0.99	0.10	1.13	12.00	16.13
Ektaba	2,700	0.022	150	0.200	5.91	0.70	0.59	6.50	106.00	115.50
Nablus										
An Nassarya	1,200	0.018	150	0.150	7.35	1.02	0.74	8.09	80.50	91.59
An Nassarya	782	0.025	150	0.150	8.79	1.42	0.88	9.67	24.81	37.48
Frush Beit Dajan 1	720	0.010	150	0.100	10.71	1.27	1.07	11.78	57.50	72.28
F rush Beit Dajan 2	450	0.019	150	0.150	3.05	1.08	0.31	3.36	53.26	59.62
Jericho										
Marj Naja	500	0.026	150	0.150	6.05	1.47	0.61	6.66	31.00	40.66

The alignment of transmission pipe is planned along existing road in principle to avoid land acquisition. Transmission pipe is buried under road, so steel pipe or ductile cast-iron pipe are adopted in this project. Operation and maintenance facilities, such as sluice valve, air valve and sludge valve etc. are installed at proper positions.

Table 2-1-10 Length and diameter of transmission pipe in each site

Site	Water resources	Transmission pipe		
		HDPE-200	HDPE-150	HDPE-100
Tubas				
Bardala	Mekerout			385
Qalqiliya				
Jayyus plain 1	Well #15-17/012		600	
Jayyus plain 2	Well #14-17/040		200	
Falamya	Well #15-18/003		1,800	
An Nabi Elyas	Well #15-17/005		250	
Haabla 1	Well #14-17/008a		50	
Haabla 2	Well #14-17/005		150	
Al Syaykh Ahmad	Well #14-17/044		1,150	
Izbat Salman	Well #15-17/015		250	
Qalqiliya city 2	Well #14-17/027		300	
Tulkarem				
Qaffin	Well #15-20/007		50	
An Nazia al Gharbiya	Well #15-20/004		1,100	
Attil	Well #15-19/036		265	
Thennabeh	Well 15-19/038		1,270	
Irtah	Well #15-18/010		320	
Farun	Well #15-18/006		250	
Kafr Zibad	Well #15-18/012		1,700	
An Nazia al Sharqiya	Well #16-20/005		1,515	
Dir al gsoon	Well #15-19/029	250		
Ektaba	Well #15-19/044	2,700		
Nablus				
An Nassarya	Well #18-18/036		1,200	
An Nassarya	Well #18-18/031a		782	
Frush Beit Dajan 1	Well#19-17/044	Sharing of the same pipe for transmission and distribution		
Frush Beit Dajan 2	Well#19-17/047		450	
Jericho				
Marj Naja	Well #20-17/010		500	
Total		**2,950**	**14,152**	**385**
		17,487		

(4) Planning of distribution pipe

Most existing pipe is exposed however replaced pipe will be buried under present alignment in crop field basically. For distribution pipe, HDPE (High Density Polyethylene) is adopted. In the sections where exposed piping is unavoidable, steel pipe is connected to HDPE pipe by weld. To obtain the permission of rehabilitation work at Israeli controlled roads and near the separation walls is assumed to be difficult, therefore, existing pipe will be used at these sections. The length of pipe shall be replaced in each site obtained by hydraulic calculation as shown in Table 2-1-11.

Table 2-1-11 Length and diameter of distribution pipe in each site

Site	Water Resources	Length of distribution pipe (m)					
		HDPE-300	HDPE-250	HDPE-200	HDPE-150	HDPE-100	Total
Tubas							
Bardala	Mekerout	0	0	0	385	0	385
Qalqiliya							
Jayyus plain 1	Well #15-17/012	0	0	500	0	0	500
Jayyus plain 2	Well #14-17/040	0	0	0	1,130	0	1,130
Falamya	Well #15-18/003	0	1,100	0	700	0	1,800
An Nabi Elyas	Well #15-17/005	0	0	0	0	0	0
Haabla 1	Well #14-17/008a	0	0	1,300	0	0	1,300
Haabla 2	Well #14-17/005	0	0	330	300	0	630
Al Syaykh Ahmad	Well #14-17/044	0	0	750	765	0	1,515
Izbat Salman	Well #15-17/015	0	480	340	0	0	820
Qalqiliya city 2	Well #14-17/027	0	0	0	1,530	0	1,530
Tulkarem							
Qaffin	Well #15-20/007	0	0	400	1,870	0	2,270
An Nazia al Gharbiya	Well #15-20/004	1,100	1,000	2,850	1,000	0	5,950
Attil	Well #15-19/036	0	1,500	0	0	0	1,500
Thennabeh	Well 15-19/038	0	850	1,250	0	0	2,100
Irtah	Well #15-18/010	0	0	250	1,585	0	1,835
Farun	Well #15-18/006	0	850	0	0	0	850
Kafr Zibad	Well #15-18/012	0	0	870	660	0	1,530
An Nazia al Sharqiya	Well #16-20/005	0	0	50	2,060	240	2,350
Dir al gsoon	Well #15-19/029	0	600	410	270	0	1,280
Ektaba	Well #15-19/044	0	0	570	1,860	0	2,430
Nablus							
An Nassarya	Well #18-18/036	0	0	880	0	0	880
An Nassarya	Well #18-18/031a	0	500	0	0	0	500
Frush Beit Dajan 1	Well#19-17/044	0	0	0	0	720	720
Frush Beit Dajan 2	Well#19-17/047	0	0	450	0	0	450
Jericho							
Marj Naja	Well #20-17/010	0	650	500	200	0	1,350
Total		**1,100**	**7,530**	**11,700**	**14,315**	**960**	**35,605**

2-1-2-2-2 Rehabilitation of 9 Well Sites

(1) Basic concept

Though conditions of transmission and distribution systems are quite good on nine (9) well sites, well, pump and electrical facilities should be rehabilitated due to overage and/or deterioration. This rehabilitation scheme is the basic concept. There are some nonfunctional water supplies and distribution systems among some the nine(9) well sites, therefore, some of them should be rehabilitated.

In No.8 well site, because of the necessity to construct a series of water supply - water tank - distribution systems, the rehabilitation plan of the site should be reflected in the survey results, which are existing water supply system's status around the site, the operation and maintenance situation rehabilitated by JICA Pilot Project (PP), and Water User Association (WUA)'s activity status, reviewing the impact to the water resources around the site.

(2) Type of rehabilitation

Rehabilitation types and their details of 9 well sites are shown in Table 2-1-12 and Figure 2-1-6.

Table 2-1-12 Rehabilitation type of 9 well sites

Type	Rehabilitation scheme	Reason
Type A	1) Deepening or Cleaning 2) Pumping facility、Electric facility	It is good condition in existing water pipes; hence it can be connected to existing pool and distribution water system if the well is rehabilitated.
Type B	1) Deepening or Cleaning 2) Pumping facility、Electric facility 3) New construction of water pipe (whole or part)	It is not good condition in whole or part existing water pipes; hence it is necessary to rehabilitate existing pool and distribution water system if the well is rehabilitated.
Type C	1) Deepening or Cleaning 2) Pumping facility、Electric facility 3) New construction of water pipe 4) New construction of water tank	There are no water pipes and pools, hence it is necessary to construct water pipes and water tank if the well is rehabilitated.

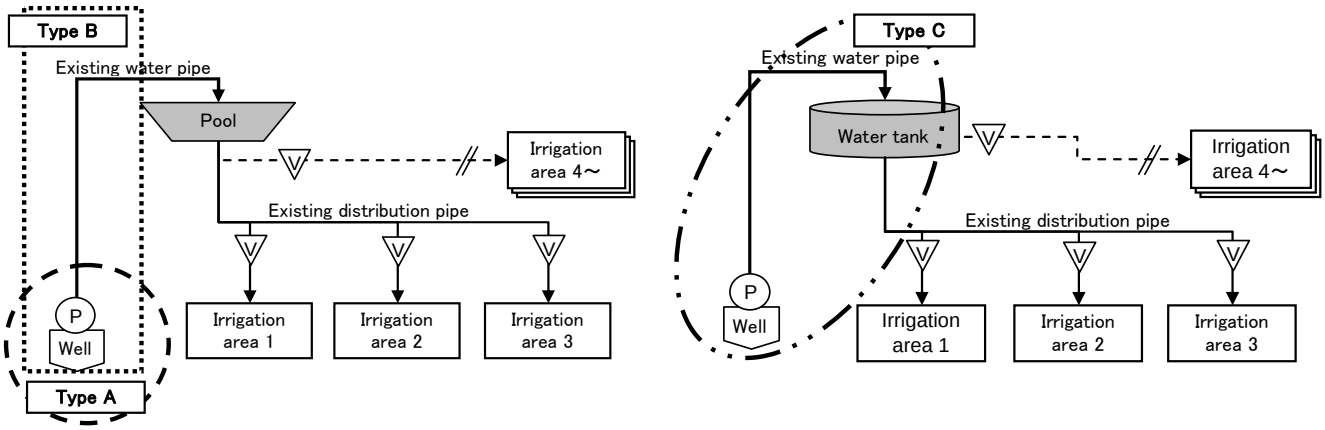


Figure 2-1-6 Rehabilitation type of 9 well sites

(3) Rehabilitation plan of 9 well sites

(a) Irrigation area and basic rehabilitation plan

Irrigation area and basic rehabilitation plain plan of 9 well sites are shown on Figure 2-1-7.

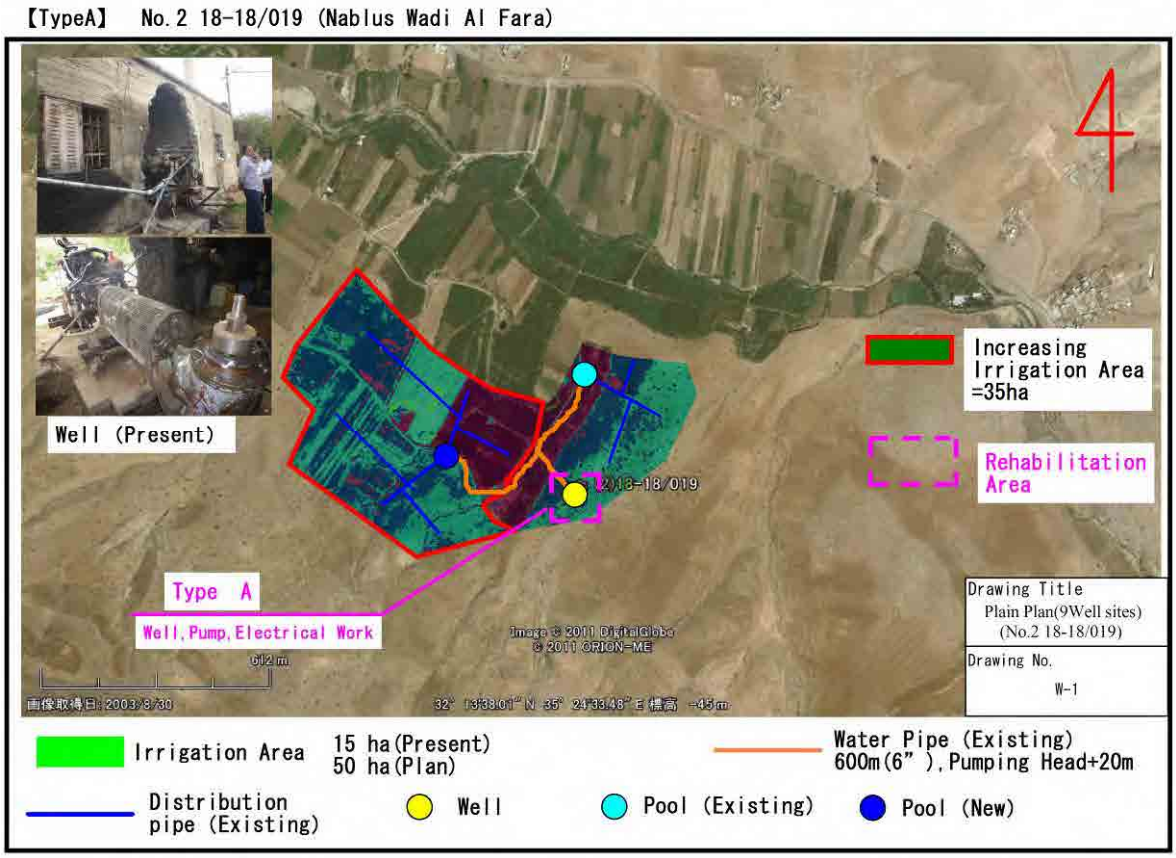


Figure 2-1-7 (1/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.2 well)

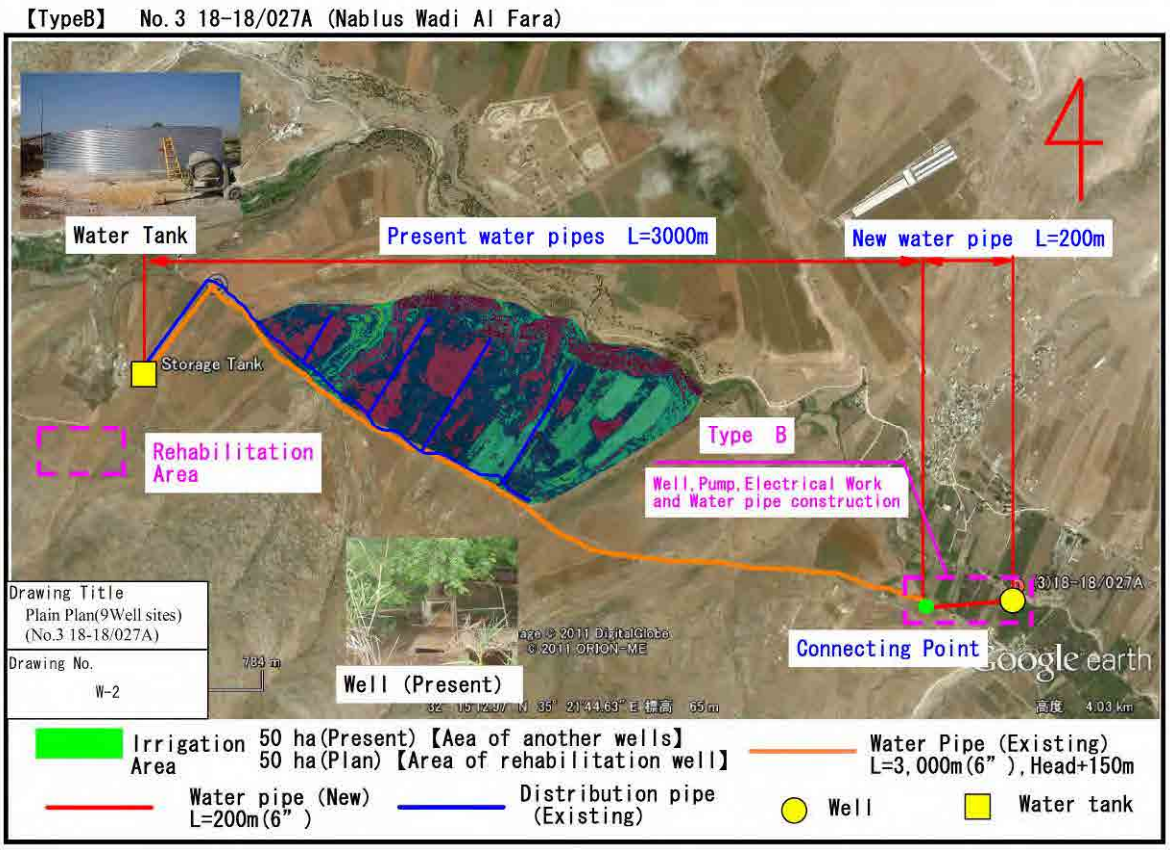


Figure 2-1-7 (2/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.3 well)

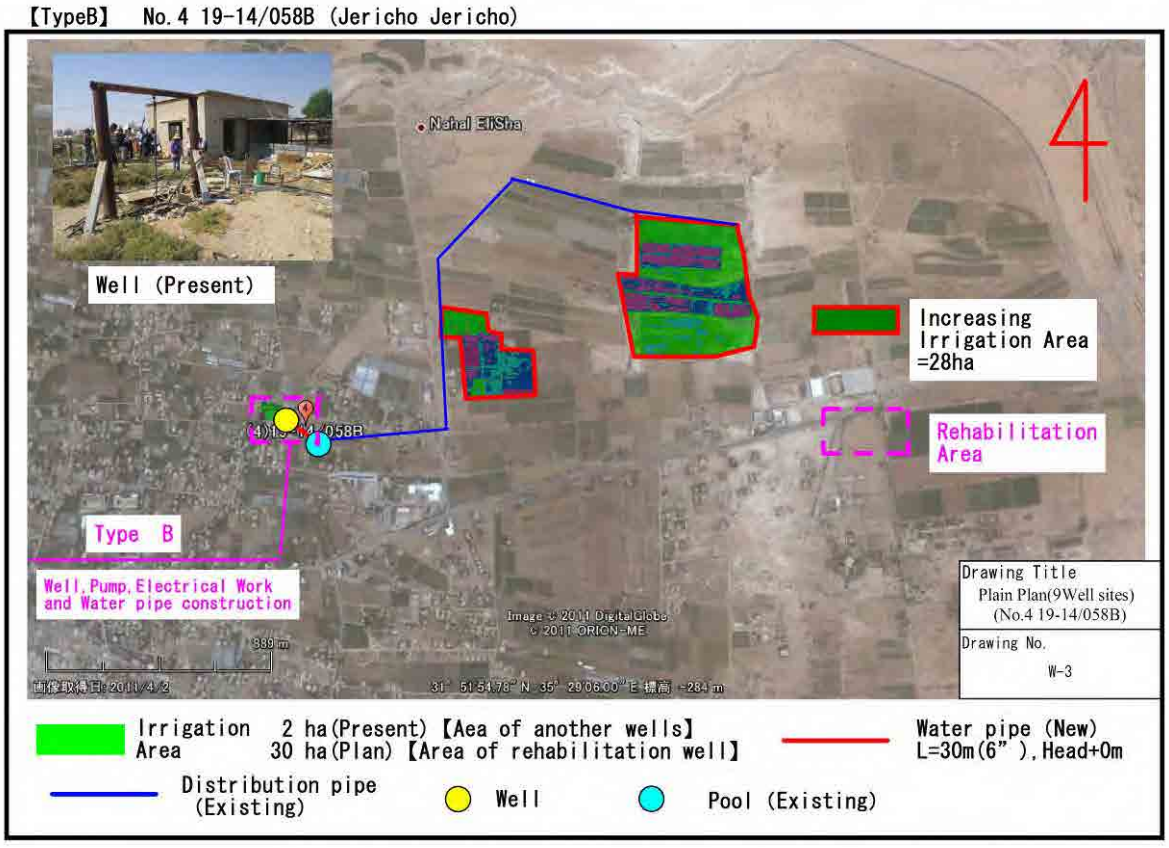


Figure 2-1-7 (3/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.4 well)

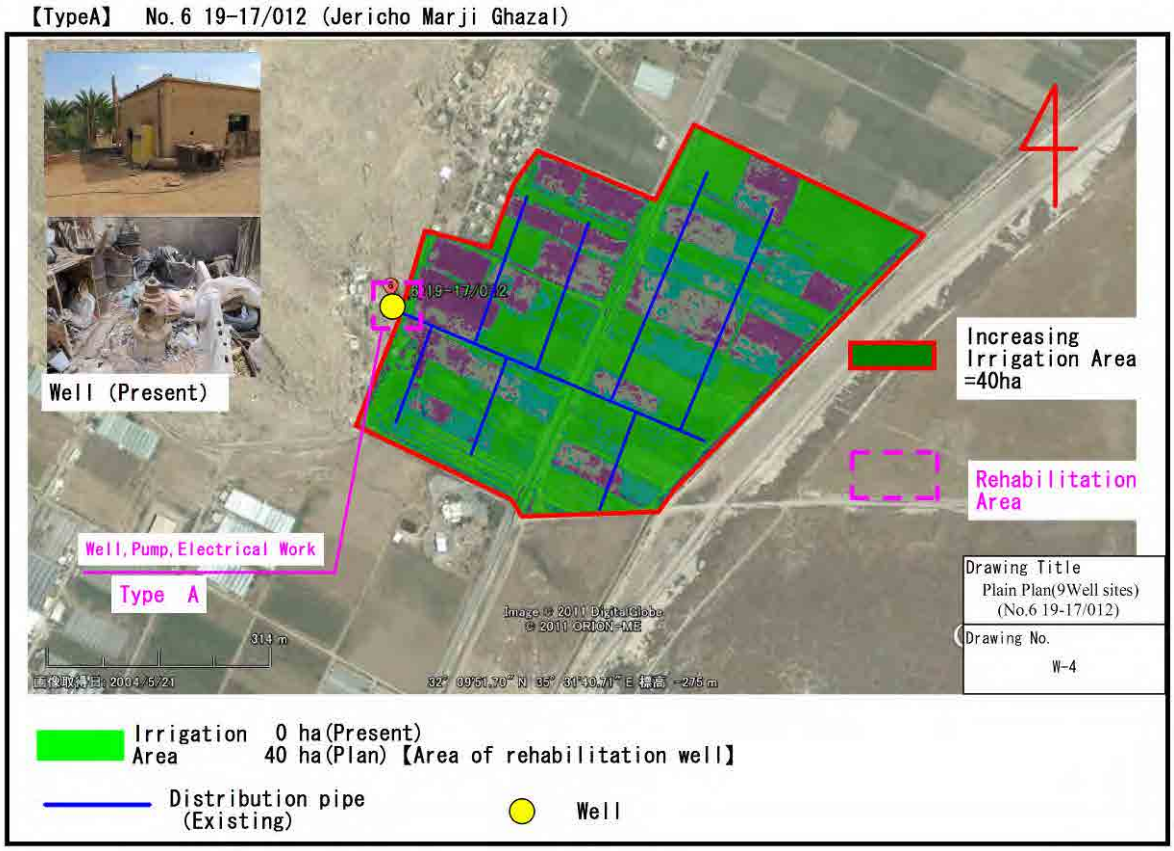


Figure 2-1-7 (4/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.6 well)

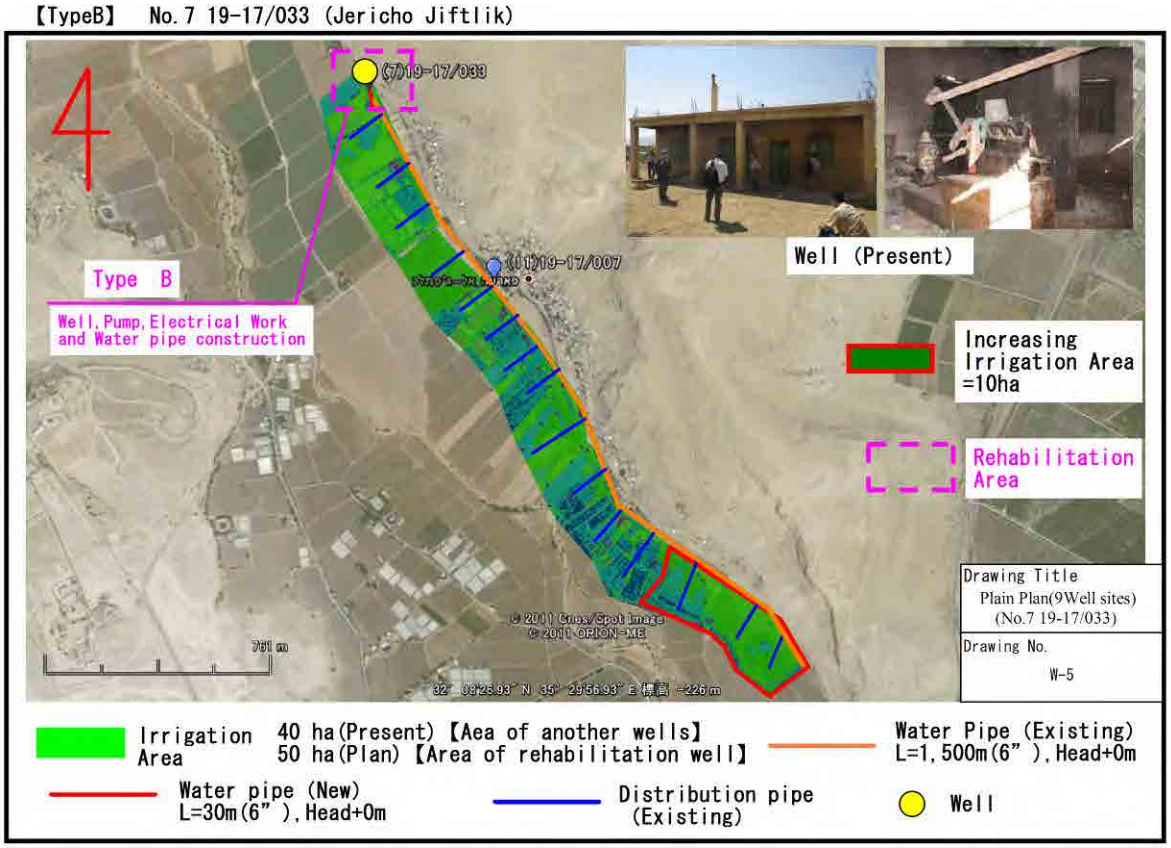


Figure 2-1-7 (5/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.7 well)

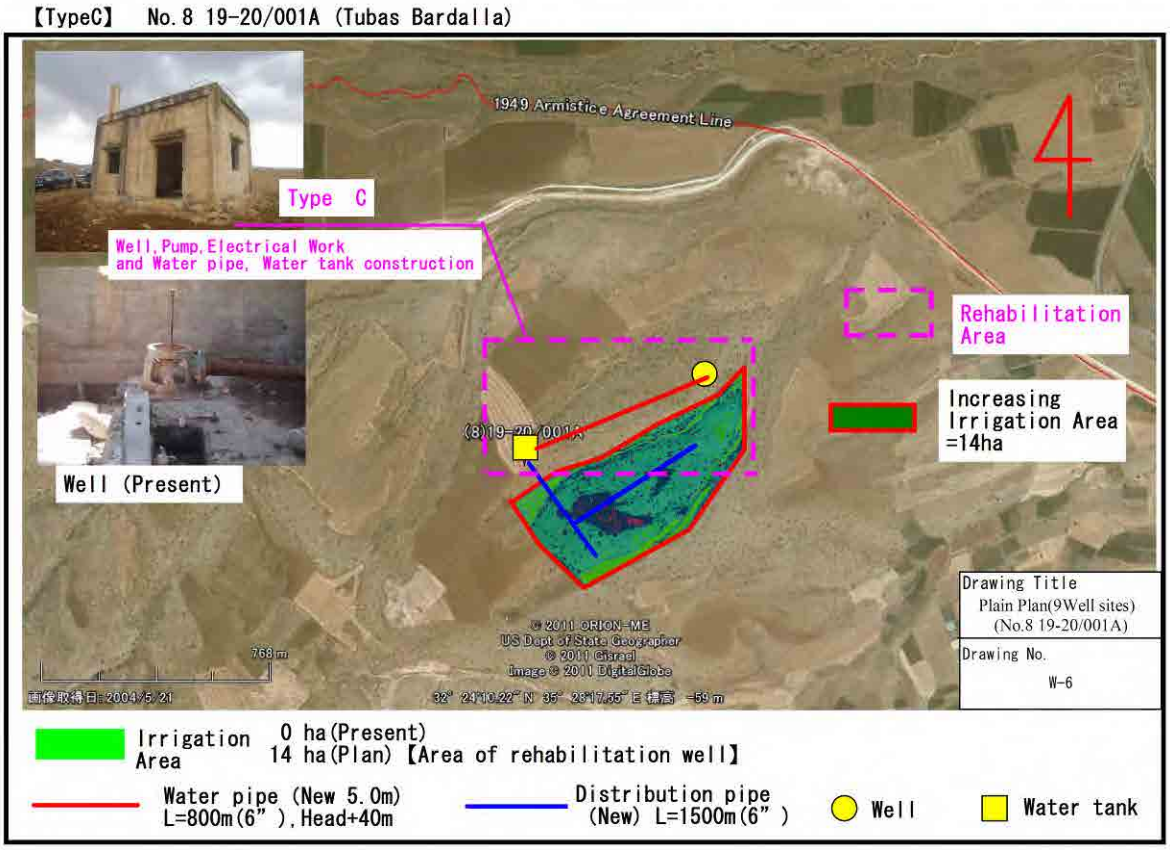


Figure 2-1-7 (6/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.8 well)

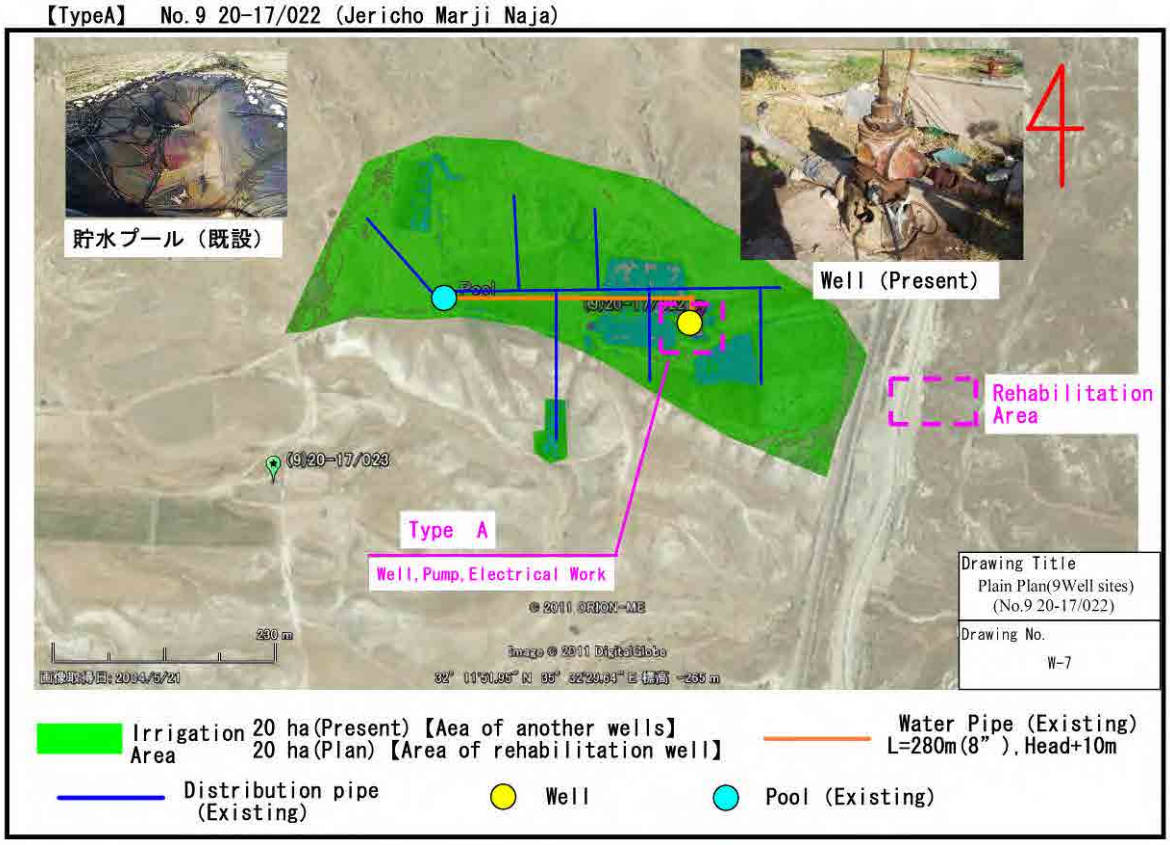


Figure 2-1-7 (7/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.9 well)

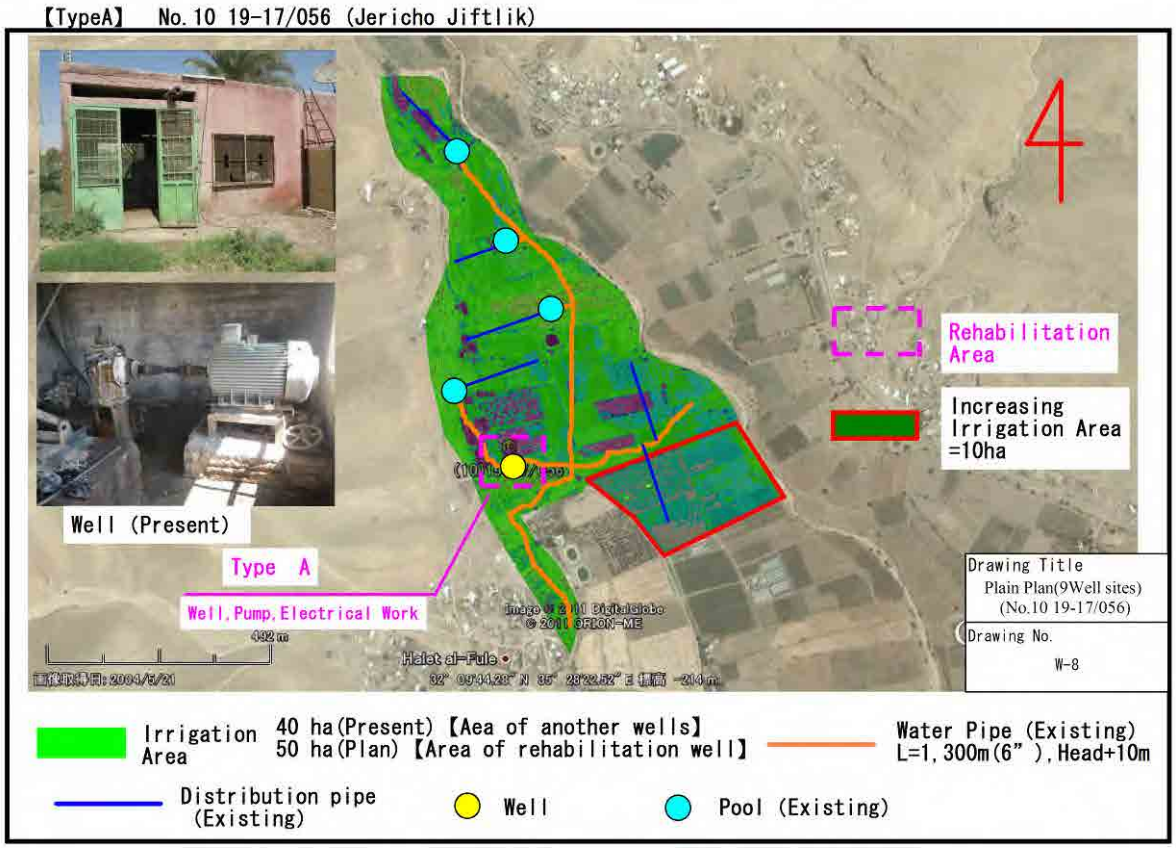


Figure 2-1-7 (8/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.10 well)

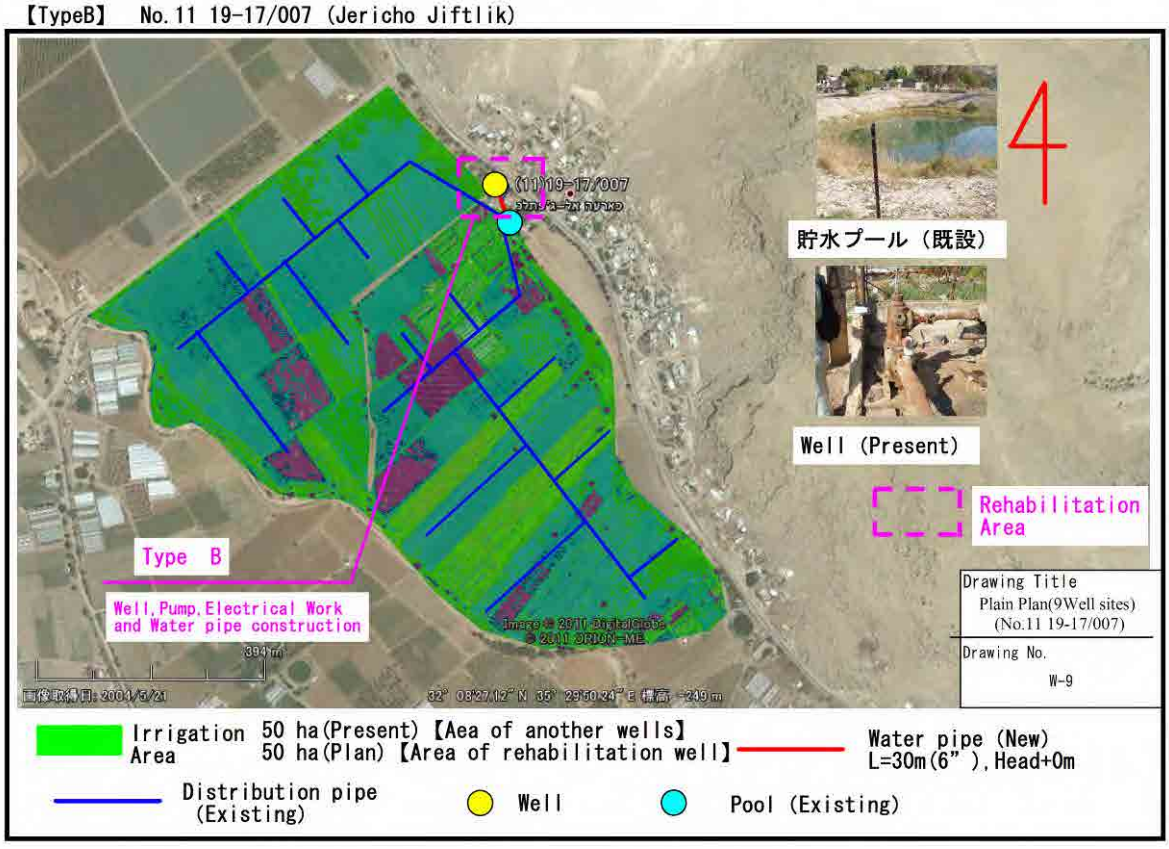


Figure 2-1-7 (9/9) Irrigation area and basic rehabilitation plan of 9 well sites (No.11 well)

(b) Design pump abstraction volume

Figure 2-1-8 shows the calculation flow of design abstraction volume in 9 well sites.

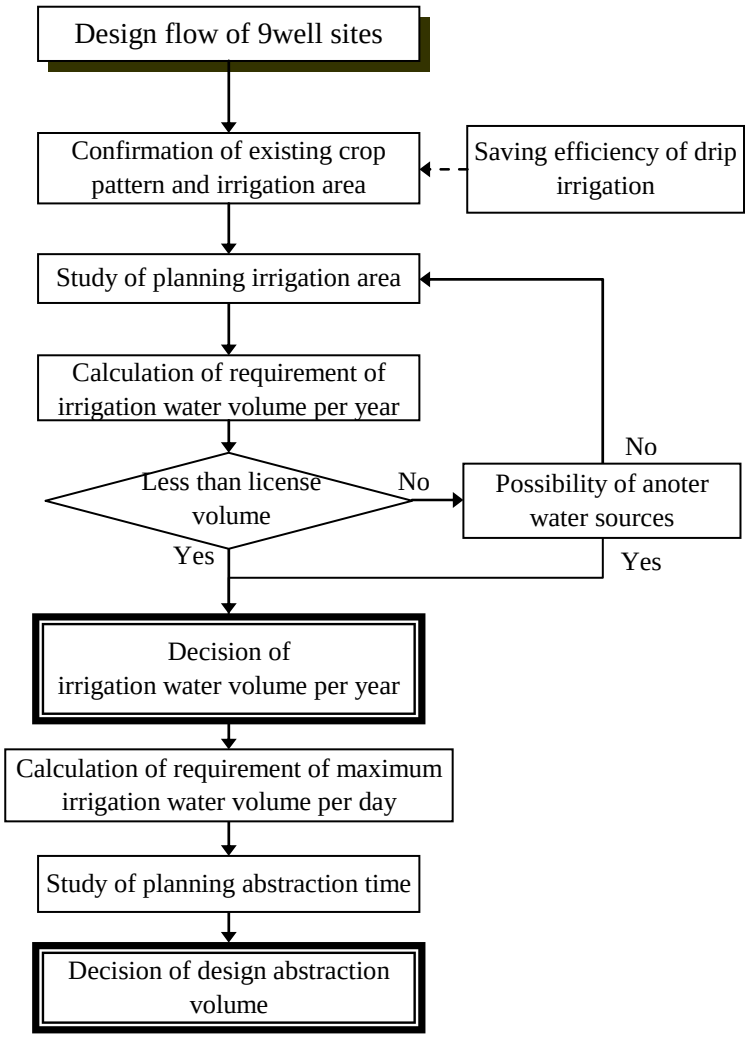


Figure 2-1-8 Flow chart of design abstraction volume of pumping of 9 well sites

(c) Calculation of design pump abstraction volume（For example, No.2 well）

1) Confirmation of existing crop pattern and irrigation area, and Study of planning irrigation area

On the basis of existing cropping pattern, irrigable area and the willingness to irrigate each crop should be asked from the farmers. In No.2 well, the plan is to irrigate the total area planted to cucumber, potato, citrus, and thyme.

2) Calculation of requirement of irrigation water volume per year

Irrigable area and willingness to irrigation times requirement of irrigation water by each crop equals total requirement of irrigation water volume per year.

Net water requirement（m^3/year）＝214,600 (m^3/year)

Gross water requirement＝Net water requirement／Irrigation efficiency (0.68)

＝214,600／0.68＝315,588(m^3/year)

Water saving efficiency（m^3/year）: It should be adopted the same as 25 Irrigation sites =0.4

Requirement of abstraction volume considered water saving efficiency

＝Gross water requirement（m^3/year）×water saving efficiency

＝315,588×0.4＝126,235（m^3/year）

3) Comparison of the license volume and the requirement of the abstraction volume

The license volume and requirement of abstraction volume should be compared with water saving efficiency. And then it is necessary to be within the license volume.

The requirement of the abstraction volume 126,235 (m^3/year)< The license volume 131,000 (m^3/year) **OK**

4) Calculation of requirement of maximum irrigation water volume per day

The requirement of maximum irrigation water volume per day according to the "CROPWAT" should be calculated.

The requirement of maximum irrigation water volume（m^3/day）＝1,476 (m^3/day)

5) Decision of design abstraction volume

The design abstraction volume should be calculated on the basis of 20 hours irrigation, the same as 25 Irrigation sites.

Decision of design abstraction volume (m^3/hr)＝1,476 (m^3/day) / 20(hr/day)＝74 (m^3/hr)

Table 2-1-13 Calculation on necessity of pump capacity by using No.2 well

■No.2 18-18/019 (Nablus Wadi Al Fara)

	Crop	Irrigation area (ha)	Requirement of irrigation water volume per year (mm/year)	Water demand (m^3/year)	Requirement of maximum irrigation water volume per day(m3/day)											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.	Wheat			-	-	-	-	-	-	-	-	-	-	-	-	-
2.	Cabbage		150	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	Califlower		150	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Cucumber	5.0	800	40,000	105	160	280	345	340	-	-	-	370	250	190	130
5.	Tomato		750	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	Eggplant		778	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	Onion		225	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	Potato	5.0	534	26,700	-	100	185	415	490	460	-	-	-	-	-	-
10.	Zucchini		550	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	Banana			-	-	-	-	-	-	-	-	-	-	-	-	-
12.	Banana 2			-	-	-	-	-	-	-	-	-	-	-	-	-
13.	Grape		900	-	-	-	-	-	-	-	-	-	-	-	-	-
14.	Citrus	10.0	921	92,100	40	40	40	400	570	600	620	580	470	250	40	40
15.	Date		1,300	-	-	-	-	-	-	-	-	-	-	-	-	-
16.	Thyme	30.0	186	55,800	120	120	120	120	1,110	-	-	-	-	-	120	120
	Total	50.0														
Net water requirement				214,600	265	420	625	1,280	2,510	1,060	620	580	840	500	350	290
Gross water requirement(Irrigation efficiency=0.68)				315,588	390	618	919	1,882	3,691	1,559	912	853	1,235	735	515	426
Requirement of abstraction volume considered of water saving efficiency				126,235	156	247	368	753	1,476	624	365	341	494	294	206	170
License volume				131,000												
Water volume from the another water source				-												
Requirement of pump power(m^3/hr)【20hour irrigation】					8	12	18	38	74	31	18	17	25	15	10	9

6) Comparison of Requirement of abstraction volume (Cropping plan) and from interview of farmers and F/S

Table 2-1-14 shows the comparison of requirement of abstraction volume (cropping plan) and from results of discussions with farmers and F/S. The design abstraction volume is designed by the requirement of abstraction volume from cropping plan, however, they should compare requirement from cropping plan and from results of discussion with farmers and F/S.

Table 2-1-14 Comparison of requirement of abstraction volume (cropping plan) and from hearing farmers and F/S

No.	Well No.	Requirement of abstraction volume (Cropping plan) (m^3/h)	Requirement of abstraction volume from hearing farmers and F/S (m^3/h)	Design abstraction volume (m^3/h)
2	18-18/019	74	80	80
3	18-18/027A	80	80	80
4	19-14/058B	46	50	50
6	19-17/012	61	70	70
7	19-17/033	61	70	70
8	19-20/001A	31	70	40
9	20-17/022	54	60	60
10	19-17/056	69	70	70
11	19-17/007	92	100	100

(d) Well No.3, 7, 11 sites

At present irrigation area of No.3, 7, 11 sites is irrigated by taking water from other water source, because t well is not operational as shown by Table 2-1-15. If these areas take all the license volume for themselves, there will be shortage of irrigation water. Thus their irrigation area will be more than existing one to be based on taking other water resources, and they should decide pump power to provide water during the peak period of dry season.

Table 2-1-15 Well from taking another water resources

【Existing】

No.	Well No.	Irrigation area (ha)	Requirement of abstraction volume (existing) (m^3/year)	Abstraction volume (m^3/year)	Water volume from the another water source (m^3/year)	Remarks
3	18-18/027A	50	125,794	-	125,794	Now this well is not working, so it is irrigated by taking another water resources.
7	19-17/033	40	61,197	-	61,197	〃
11	19-17/007	50	93,670	-	93,670	〃

【Plan】

No.	Well No.	Irrigation area (ha)	Requirement of abstraction volume (existing) (m^3/year)	Abstraction volume (m^3/year)	Water volume from the another water source (m^3/year)	Remarks
3	18-18/027A	50	125,794	30,000	95,794	Now this well is not working, so it is irrigated by taking another water resources.
7	19-17/033	50	116,100	56,000	60,100	〃
11	19-17/007	50	93,670	39,000	54,670	〃

(e) Well No.8 site

Well No.8 site license volume is 16,000m^3/year and it is much smaller than other well sites. And yet it is used by only itself due to no another water resources. According to the JICA F/S study and interview with farmers, the result of pump design abstraction volume is 70m^3/hr, but necessary irrigation water volume by the irrigation plan is to be 40m^3/hr. In addition, abstraction time is designed as 10 hours/day at only Well No.8 site, based on discussions with farmers.

(f) Calculation of pump design abstraction volume by estimation from the design irrigation area

Pump design abstraction volume by estimation from the design irrigation area is shown on Table 2-1-16.

Table 2-1-16 Pump design abstraction volume by estimation from the design irrigation area

Well No.	No.2		No.3		No.4		No.6		No.7	
Design irrigation area(ha)	50		50		30		40		50	
	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)
Net water requirement (A)	215	2,510	214	2,720	89	1,560	134	2,080	197	2,080
Gross water requirement (B=A/0.68) (Irrigation efficiency=0.68)	316	3,691	314	4,000	131	2,294	197	3,059	290	3,059
Consideration of water saving efficiency(0.40) (C=B*0.4)	126	1,476	126	1,600	52	918	79	1,224	116	1,224
Require pump power(m^3/hr) (D=C/20hours)		74		80		46		61		61
Design pump power(m^3/hr)		80		80		50		70		70

Well No.	No.8		No.9		No.10		No.11	
Design irrigation area(ha)	14		20		50		50	
	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)	1,000m3/年	m3/month (maximum)
Net water requirement (A)	26	518	112	1,835	386	2,335	159	3,120
Gross water requirement (B=A/0.68) (Irrigation efficiency=0.68)	38	762	164	2,699	568	3,434	234	4,588
Consideration of water saving efficiency(0.40) (C=B*0.4)	15	305	66	1,080	227	1,374	94	1,835
Require pump power(m^3/hr) (D=C/20hours)		31		54		69		92
Design pump power(m^3/hr)		40		60		70		100

(4) Deepening and cleaning of rehabilitated wells

As shown in Table 2-1-17, No.9 (20-17/022), No.10 (19-17/056), and No.11 (19-17/022) should be rehabilitated by cleaning, and the others should be rehabilitated by deepening of small diameter in the existing wells. The result of rehabilitations could get the design abstraction water. But the diameter of top casing could be measured, that of the underground and bottom could not be measured. Thus they could be decided by the existing data and discussions with farmers. In the detailed design (D/D), deepening diameter should be decided by the borehole test. Figure 2-1-9 and 2-1-10 show concept of deepening, and Table 2-1-17 shows deepening of 9 well sites.

Table 2-1-17 Deepening of 9 well sites

No.	Well No.	Description	Quantity (m)	Well Diameter	Casing Diameter	Reason
2	18-18/019	Deepening	80	200 mm	150 mm	Additional drilling in existing aquifer
3	18-18/027A	Deepening	170	300 mm	250 mm	
4	19-14/058B	Deepening	80	250 mm	200 mm	
6	19-17/012	Deepening	50	300 mm	250 mm	
7	19-17/033	Deepening	100	300 mm	250 mm	
8	19-20/001A	Deepening	80	200 mm	150 mm	
9	20-17/022	Cleaning	1(LS)	-	-	
10	19-17/056	Cleaning	1(LS)	-	-	
11	19-17/007	Cleaning	1(LS)	-	-	

Figure 2-1-9 Engineering work for deepening at F/S (19-17/047)

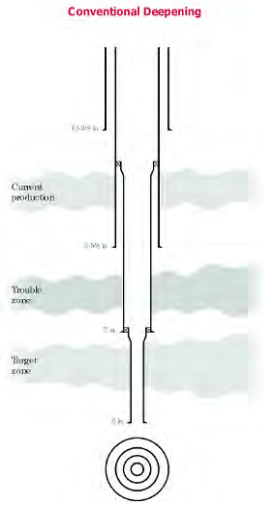


Figure 2-1-10 Concept of deepening

(5) Adoption of the pump type and power source type

(a) Pump type

The pump type should adopt the “Vertical pump”, because of maintenance and durability and so on as mentioned in Table 2-1-18.

Table 2-1-18 Adoption of the pump type

	Submergible pump	Vertical pump	Horizontal pump
Merit	・Initial cost is cheapest. ・It is not necessary to construct the pumping station as motor is under the water.	・It is easy to maintain the pump as motor is above the well. ・It is much experience in Palestine, so the reliability is high. ・Though initial cost is more expensive as compared to the other pump types, durability and economical efficiency is higher than submergible pump.	・Gear ratio makes it possible to increase abstraction volume. ・It is easy to maintain the pump because motor is above the well. ・Though initial cost is more expensive as compared to the submergible pump, durability and economical efficiency is higher than submergible one.
Demerit	・Durability is lower than the other pump type as motor is under the water. ・It is difficult to maintain the motor due to under the water.		・There are few experiences in Palestine as the well pump type. ・The scale is bigger as pump is horizontal position.
Maintenance	△	◎	◎
Durability	△	◎	◎
Economical efficiency	◎	○	○
Experiences in Palestine	○	◎	X
Adoption		○	

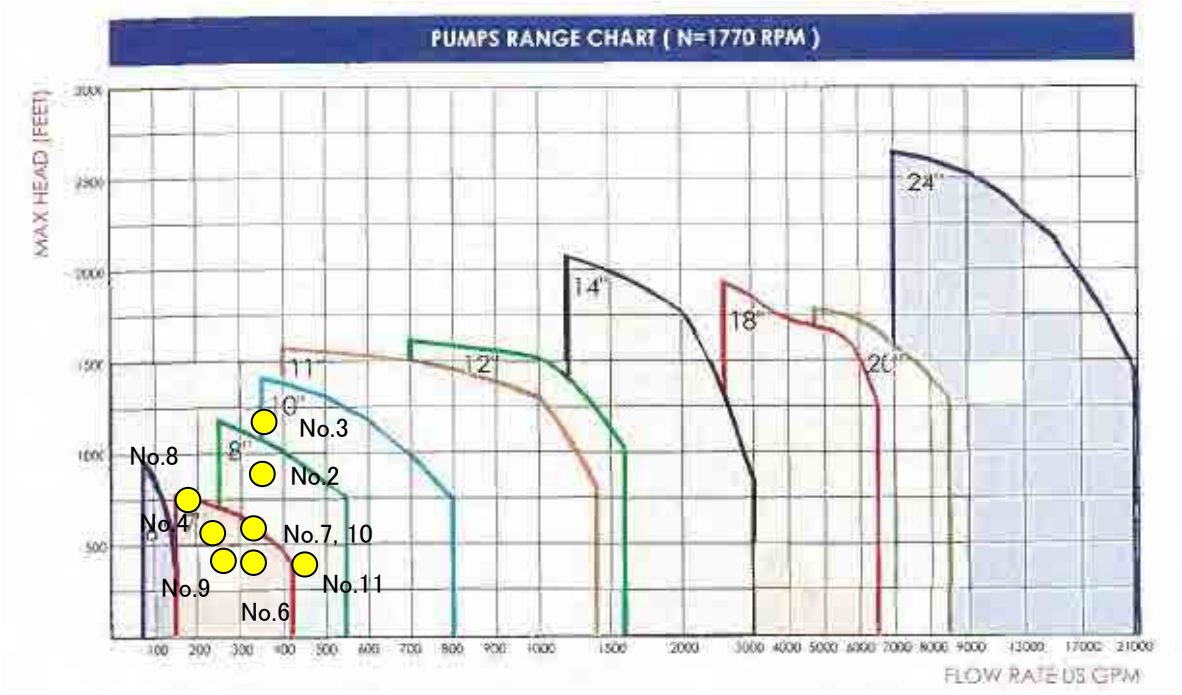
(b) Power source type

Power source type is designed by the situation of the existing commercial power and future's possibility of the commercial power, according to the discussions among the related parties.

Table 2-1-19 Pump type and power source type

No.	Well No.	Power source type	Pump type
2	18-18/019	Commercial power	Vertical pump
3	18-18/027A		
4	19-14/058B		
6	19-17/012		
7	19-17/033	Diesel generator	Vertical pump
8	19-20/001A		
9	20-17/022		
10	19-17/056	Commercial power	Vertical pump
11	19-17/007	Diesel generator	Vertical pump

The pump power of the 9well sites is designed by the "PUMP RANGE CHART" as shown in Figure 2-1-11.



1 m = 3.2808 ' (feet)　　1 m3/h = 4.4033 GPM (gallon/min)

(Reference) PUMP RANGE CHART of the Vertical pumps　※Designed by manufacturing corporations

Figure 2-1-11 Pump range chart of the Vertical pumps

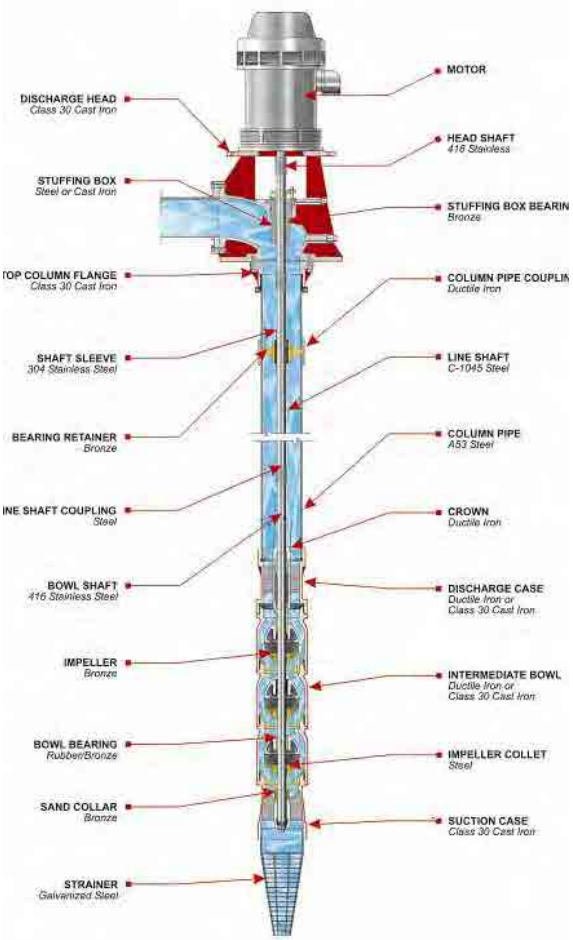


Figure 2-1-12 Outline of cross section for vertical pump

(c) Installing pump location

Pump should be installed deeper in accordance with the existing casing diameter checked by bore hall camera survey since static water level of 9 well sites would be remarkably decreased. And pump elevation to be set should be more 10m higher than well bottom to avoid sedimentation.

(d) Calculation of design total pump head

Flow velocity in HDPE should be more than 0.3m/s to avoid sand accumulation in the pipe. HDPE pipe that should be adopted is 6 inch diameter similar to that use in PA except existing pipelines. Table 2-1-20 shows the result of calculation of design total pump head.

Table 2-1-20 Calculation of design total pump head

Well No.	unit	No.2	No.3	No.4	No.6	No.7	No.8	No.9	No.10	No.11
Type		A	B	B	A	B	C	A	A	B
1.Actual pump head	(m)	240	365	150	107	147	230	109	145	95
2.Head loss	(m)	28.61	72.51	17.52	17.61	39.24	19.23	18.09	26.46	17.78
3.total pump head	(m)	268.61	437.51	167.52	124.61	186.24	249.23	127.09	171.46	112.78
	(m)	270	440	170	130	190	250	130	180	120

(e) Output power of pump and diesel generator

1) Calculation of pump output power

Calculation of pump output power is executed as shown below;

$P_1 = 0.163 \cdot Q \cdot H \cdot (1+R) / (\eta_P + \eta_g)$

$P_2 = 1.341 \times P_1$

P_1 : Pump output power (kW)、P_2 : Pump output power (hp)

H : Total pump head (m)

η_P : Pump efficiency = 0.7 (Practical accomplishment as a vertical pump)

η_g : Reducer efficiency = 1.0

R : Excess efficiency = 0.1

2) Calculation of diesel generator output power

Calculation of diesel generator output power is executed by Palestinian local method.

P3＝1.5×P1

P3：Diesel generator output power (kW)

Table 2-1-21 Calculation of Pump and Diesel generator output power

No.	Well No.	Abstruction Volume 【Design】 Q (m^3/h)	source of power	Total pump head H (m)	Pump efficiency η_p	Reducer efficiency η_g	Excess efficiency R	Pump output power P1=0.163･Q･H･(1+R) / (η_p+η_g) (kW)	(hp)	Diesel generator output power P3=1.5･P1 (kW)	(hp)
2	18-18/019	80	Commercial power	270	0.7	1.0	0.1	100	130	-	-
3	18-18/027A	80	Commercial power	440	0.7	1.0	0.1	150	210	-	-
4	19-14/058B	50	Commercial power	170	0.7	1.0	0.1	40	50	-	-
6	19-17/012	70	Commercial power	130	0.7	1.0	0.1	40	60	-	-
7	19-17/033	70	Diesel generator	190	0.7	1.0	0.1	60	80	90	120
8	19-20/001A	40	Diesel generator	250	0.7	1.0	0.1	50	60	75	90
9	20-17/022	60	Diesel generator	130	0.7	1.0	0.1	40	50	60	75
10	19-17/056	70	Commercial power	180	0.7	1.0	0.1	60	80	-	-
11	19-17/007	100	Diesel generator	120	0.7	1.0	0.1	60	70	90	105

(f) Electrical facility

All electrical facility of distribution panel and connecting cable and so on should be rehabilitated due to beyond the durable period.

(g) Valve

Valves and meters to be rehabilitated in 9 well sites are set as Figure 2-1-13. It is necessary for the flow meters to have the telemetry systems. It was confirmed that the telemetry systems must be developed by Palestine side.

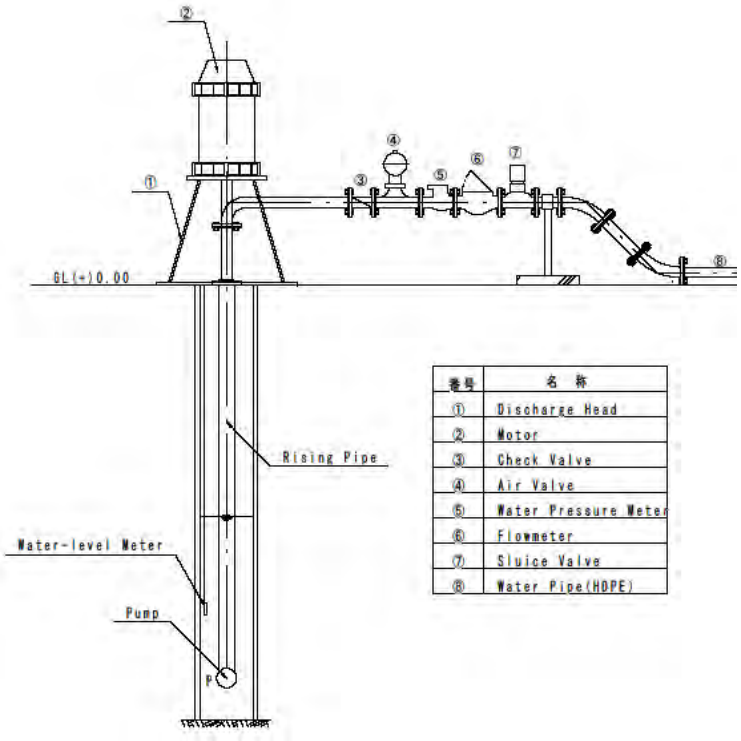


Figure 2-1-13 Top of the structure in 9 well sites

(h) Pump station

1) Removal of the pump station

It is necessary to remove the pumping station in existing ones (No. 2, 6, 7, 8, 10). Since it is impossible for the deepening or cleaning machine to go near the pump station. Table 2-1-22 shows the Removal dimensions of the pump station of 9 well sites.

Table 2-1-22 Removal dimensions of the pump station of 9 well sites

No.	Well No.	Removal	Dimensions of the pump station	Structure
2	18-18/019	○	B =6.0m、L =6.0m、H =3.5m	Block
3	18-18/027A	—	—	—
4	19-14/058B	—	—	—
6	19-17/012	○	B =5.5m、L =6.0m、H =3.5m	Block
7	19-17/033	○	B =6.0m、L =12.0m、H =4.0m	Block
8	19-20/001A	○	B =4.5m、BL=6.5m、H =4.5m	Block
9	20-17/022	—	—	—
10	19-17/056	○	B =5.0m、L =7.0m、H =3.5m	Block
11	19-17/007	—	—	—

2) New construction of the pump station

Table 2-1-23 shows type of the new construction of the pump station of 9well sites. Distance between Pump facility and station wall should be more than 0.6 m. And on the B and C type, distance between diesel generator and pump should be more than 1.0m, while distance between entrance and pump should be more than 2.0 m due to the stock room.

- Type I : Commercial power
- Type II : Diesel generator (Design power 75kW～105kW)
- Type III : Diesel generator (Design power 120kW)

Table 2-1-23 Type and dimensions of the new construction of the pump station of 9 well sites

No.	Well No.	Power source type	Dimensions of the New construction of the pump station	Structure	Type
2	18-18/019	Commercial power	B =4.0m、L =4.0m、H =3.5m	Block	I
3	18-18/027A		B =4.0m、L =4.0m、H =3.5m		I
4	19-14/058B		B =4.0m、L =4.0m、H =3.5m		I
6	19-17/012		B =4.0m、L =4.0m、H =3.5m		I
7	19-17/033	Diesel generator	B =5.0m、L =6.0m、H =3.5m		III
8	19-20/001A		B =5.0m、L =6.0m、H =3.5m		III
9	20-17/022		B =4.0m、L =6.0m、H =3.5m		II
10	19-17/056	Commercial power	B =4.0m、L =4.0m、H =3.5m		I
11	19-17/007	Diesel generator	B =5.0m、L =6.0m、H =3.5m		III

(6) Capacity of the water tank

The decision of capacity of the water tank is the same as Reservoir Construction and Improvement of Distribution Systems for 25 Irrigation sites. It should be planned by the difference between irrigation time and abstraction time of well. According to the discussions with farmers, the time difference is around 10 hours. The water tank capacity should be 10 hours water supply. Thus capacity of the water tank is calculated as shown in the following equation. And the water tank can be planned the capacity about the tank diameter and height.

Capacity of the water tank (No.8 19-20/001A)

Capacity of the water tank ＝ Pump abstraction volume (m^3/hr)×(Water supply time –Irrigation time)

＝ Pump abstraction volume (m^3/hr)×10 hours

＝ 40 (m^3/hr)×10 hours

＝ 400 (m^3)

(7) Water supply pipe extension

Table 2-1-24 shows the new water supply pipe extension in 9well sites. New water supply pipe extension (No. 3, 4, 7, 8, 11 wells of the 9 sites) should be installed under the ground, and pipe type should

adopt the HDPE pipe.

Table 2-1-24 New water supply pipe extension of the 9 sites

Well No.	Type	Water tank	New water supply pipe extension
No.2	A	—	—
No.3	B	—	200m to the connecting point
No.4	B	—	30m to existing pool
No.6	A	—	—
No.7	B	—	30m to the connecting point
No.8	C	○	800m to new constructed pool
No.9	A	—	—
No.10	A	—	—
No.11	B	—	30m to existing pool
Total	9	1	1,090 m

(8) Suggestion to the detailed design

Deepening of the well is the very important component for the rehabilitation of the 9 well sites. As described above, on this basic design, the well design abstraction volume and the dynamic water level are designed based on existing data and JICA Feasibility Study result. Since pump test is not carried out, the result of pump test after deepening makes it possibility to modify the pump head and pump size.

If the deepening is executed at the construction period, the design plan may be changed; then there will be delay in the approval of the modifications by CA. Thus deepening and the survey of pumping test should be implemented at detailed design period.

2-1-2-2-3 Nwaimeh Spring Canal

Main canal is improved to pipeline in the rehabilitation. Interval of rehabilitation is from the end point of pilot project (Sta.1+330) to the end point of main canal (Sta.5+430) and its total length reaches 4,100 m. Three existing water bridges crossing wadi are deteriorated and dammed mud water in Wadi inflows in rainy season, therefore, water bridges will also be improved with pipeline construction. New construction of water bridge entails high cost as the length of existing bridges are long, so the interval is improved to pipeline under Wadi (refer Figure 2-1-14).

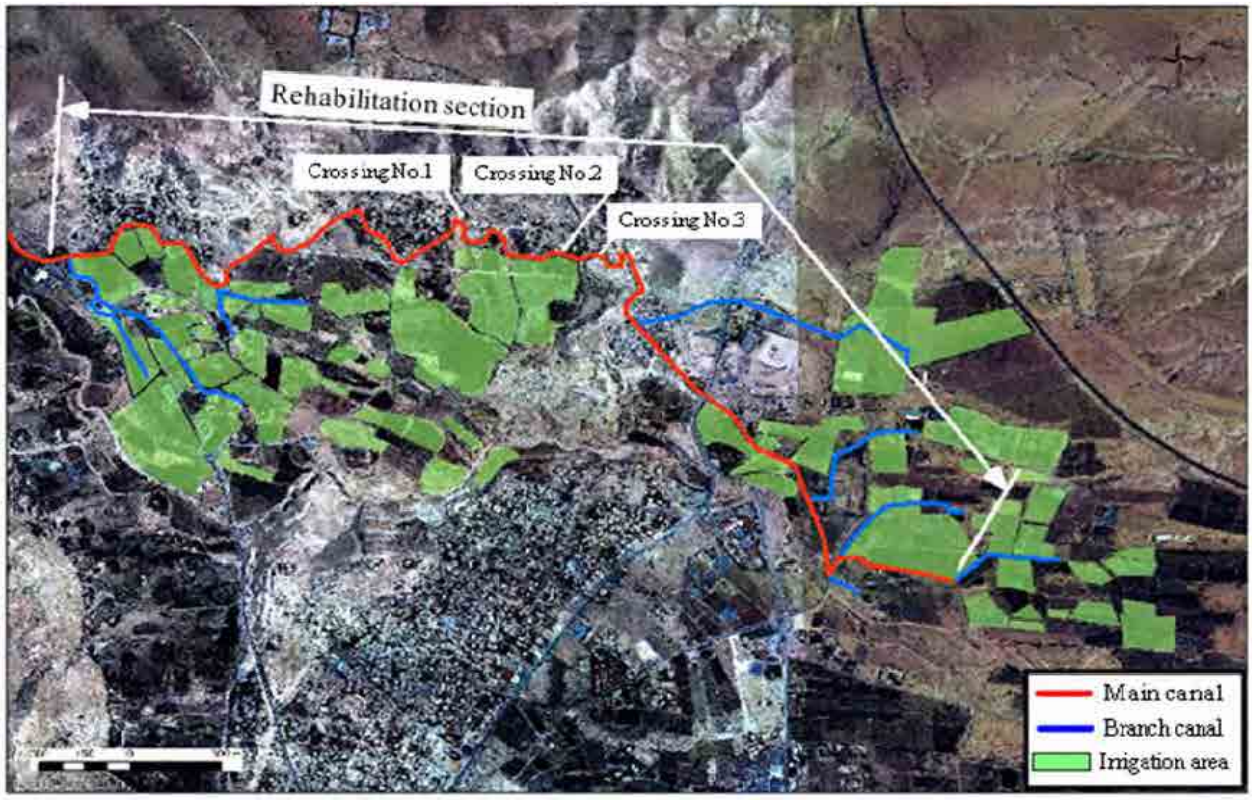


Figure 2-1-14 Interval of rehabilitation of Nwaimeh spring canal

Diversion works are needed at diverging points from main canal to branch canal and to farm field (private pond) directly. Total of 17 diversion works are planned as shown in Table 2-1-15. Also, air valves and blow off facilities are installed at proper points.

Table 2-1-25 Main component of rehabilitation of Nwaimeh spring canal

Main component	Quantity
Rehabilitation of main canal	4,100 m
Crossing under Wadi	3
Diversion work (to branch canal)	5
Diversion work (to private pond)	12
Air valve	1
Blow off facility	10

(1) Crossing under Wadi

Three crossings are buried over 2.0 m from riverbed for assuring the safety of pipeline against erosion. Steel pipes connected by welding are buried at crossing to avoid washout in case the pipeline is exposed due to degradation of river bed. To avoid degradation of river bed and to protect pipeline, groundsill which is 0.5 m depth of concrete block is constructed above pipeline and gabion which has adaptability against degradation is set at the downstream of the groundsill. Air valve and blow off facility is installed at crossing (refer Figure 2-1-15 and 2-1-16).

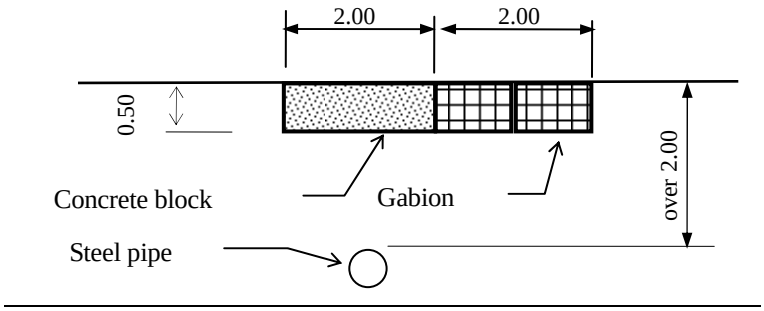


Figure 2-1-15 Standard cross section of crossing under Wadi

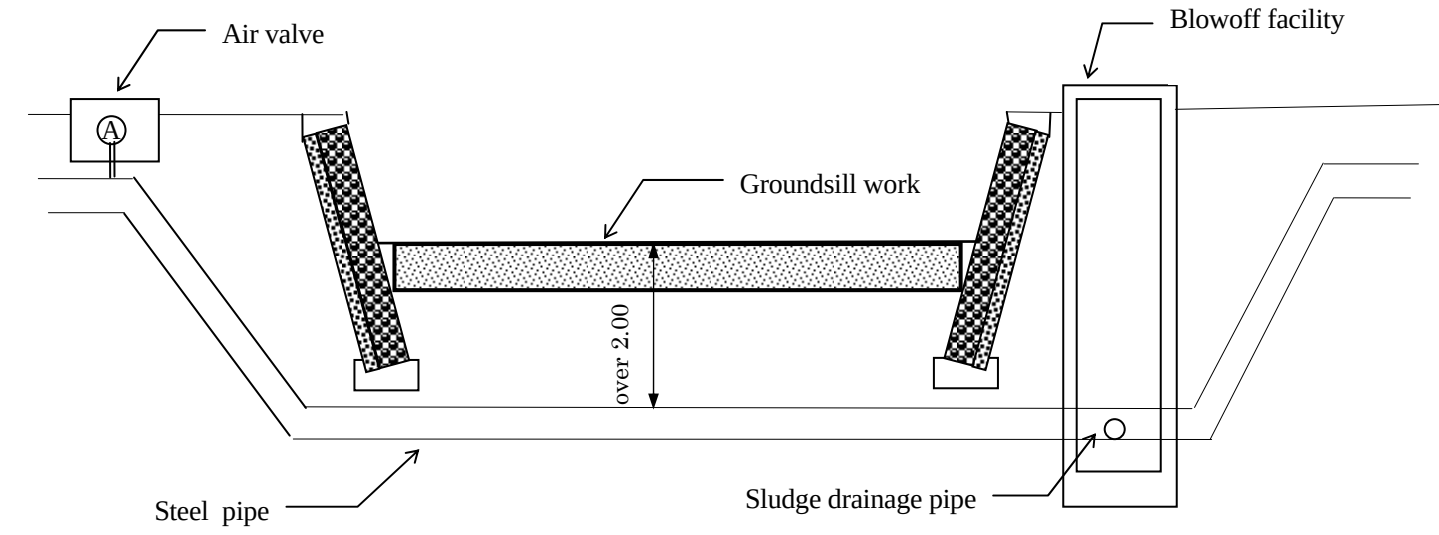
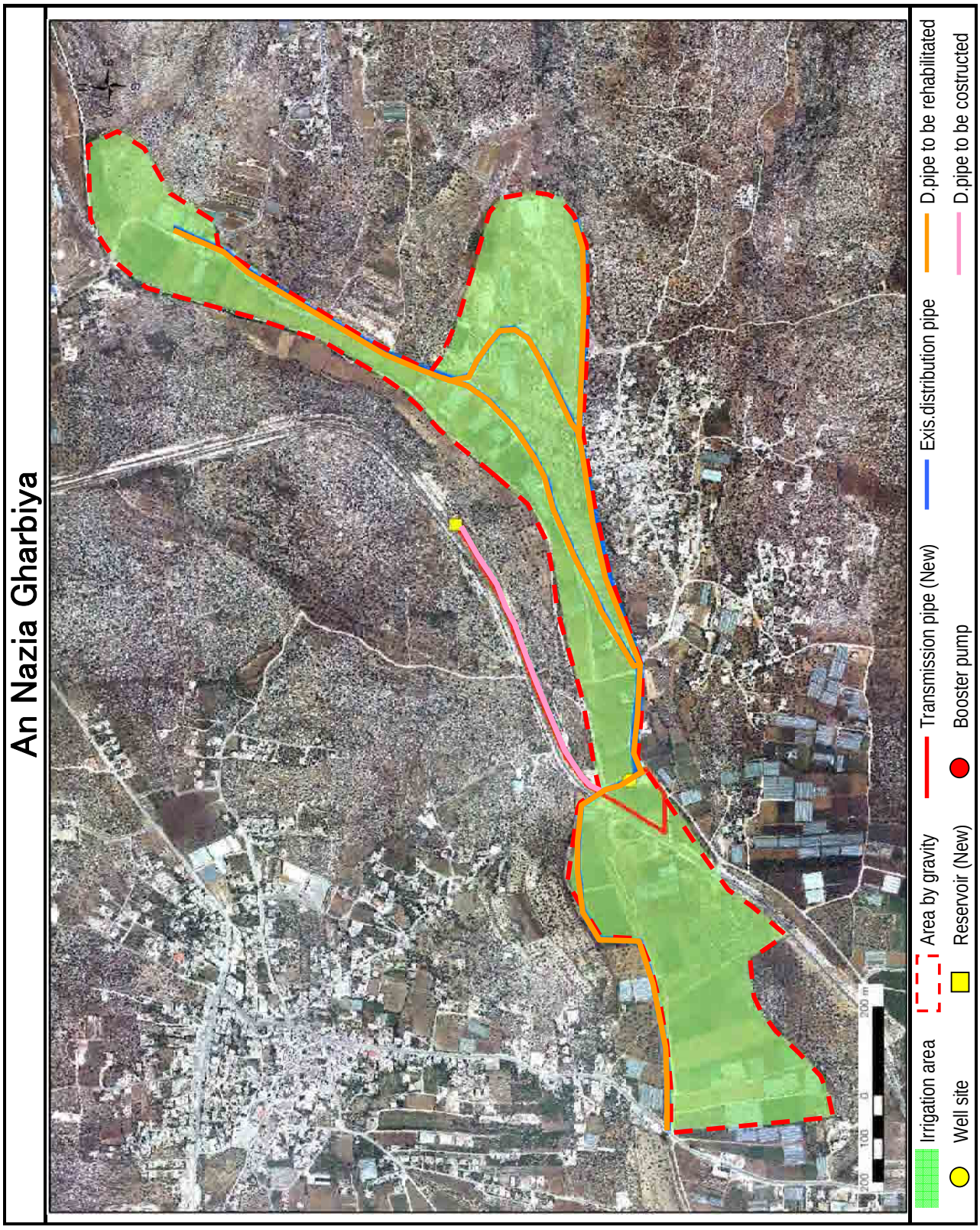


Figure 2-1-16 Standard longitudinal profile of crossing under Wadi

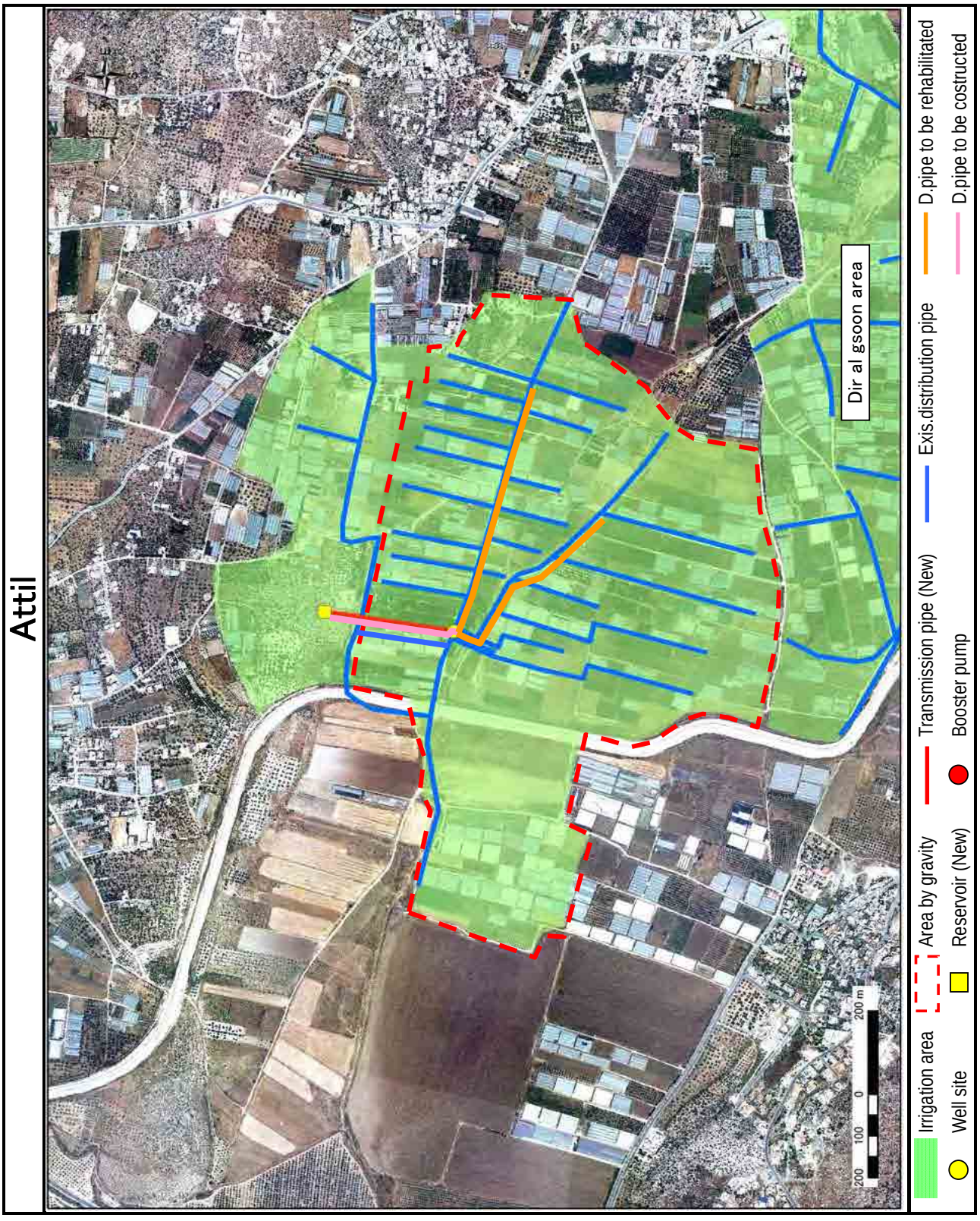
2-1-2-3 Outline Design Drawing

Table 2-1-26 List of drawings

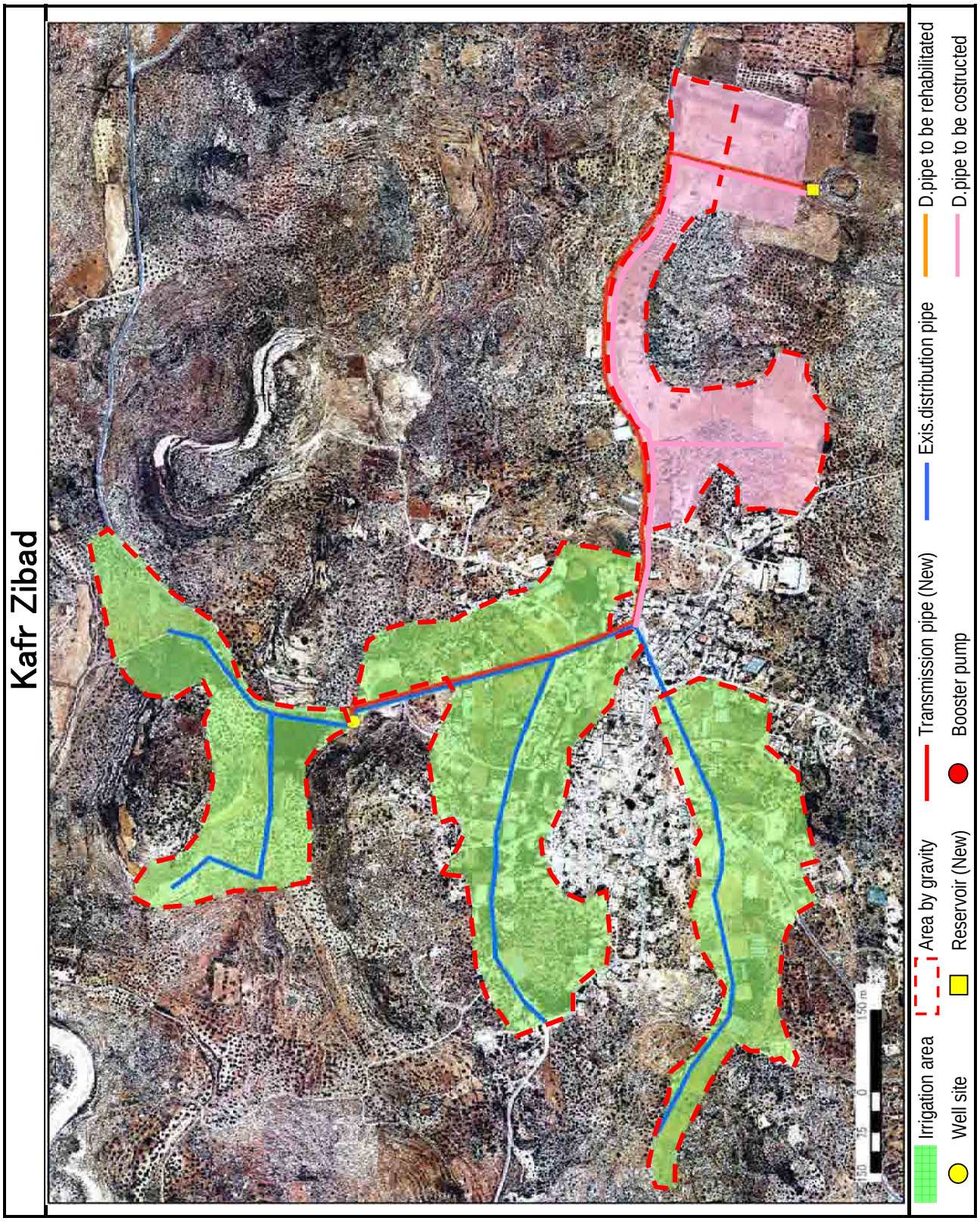
No.	Title
Reservoir Construction and Improvement of Distribution Systems for 25 Irrigation sites	
A-1	Case A　Plain Plan (An Nazia Gharbiya)
A-2	Case B　Plain Plan (Atil)
A-3	Case C　Plain Plan (Kafr Zibad)
A-4	Case D　Plain Plan (Qaffin)
A-5	Case E　Plain Plan (Marj Naja)
A-6	Case F　Plain Plan (Bardala)
A-7	Case G　Plain Plan (Frush Beit Dajan 1)
A-8	Water Tank Structure
Rehabilitation of 9 well sites	
W-1	Plain Plan (9Wells)（No.2 18-18/019）
W-2	Rehabilitation Plan (9Wells)（No.2 18-18/019）
W-3	Pumping Station Structure（Type Ⅰ）



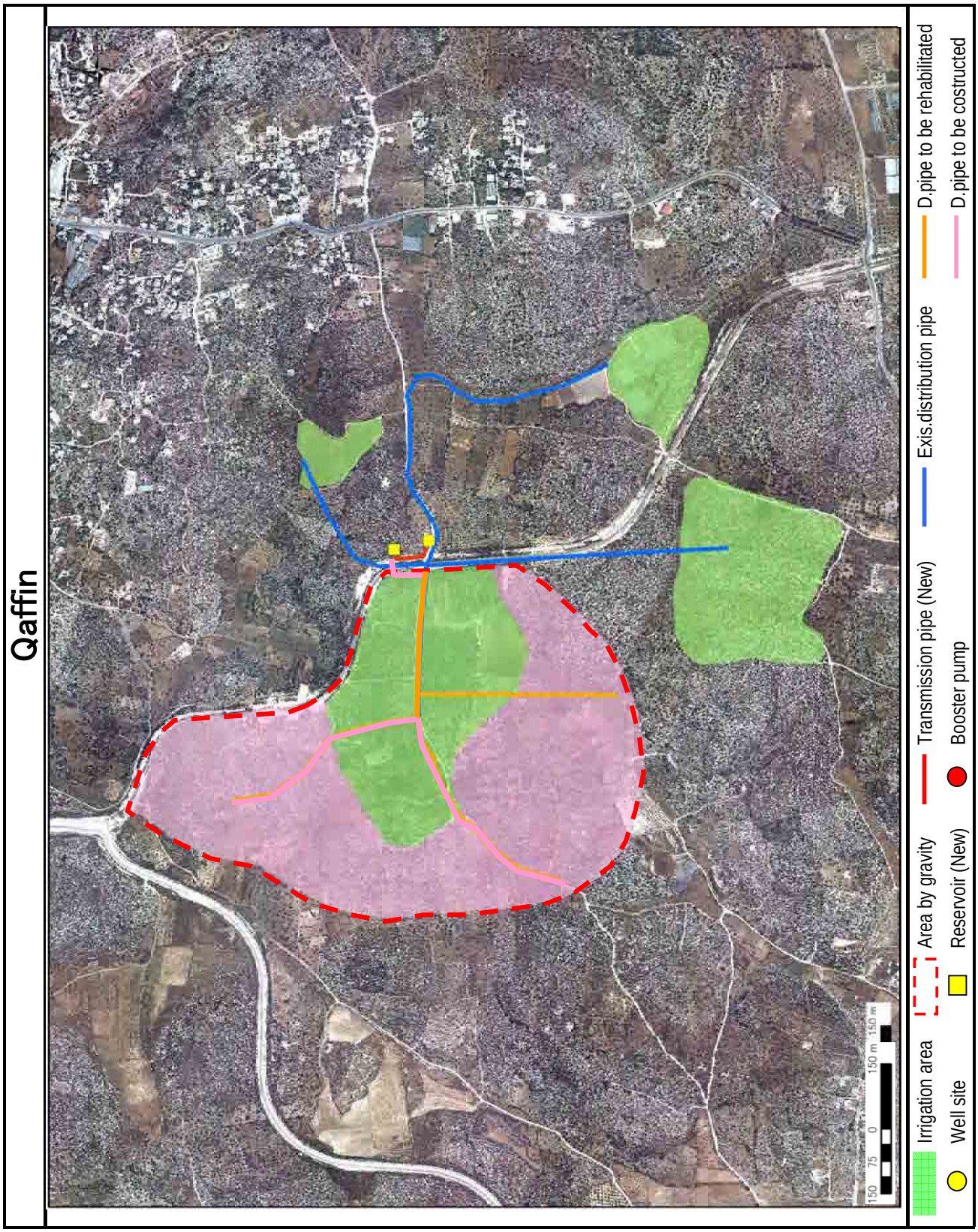
A-1 Case A Plain Plan (An Nazia Gharbiya)



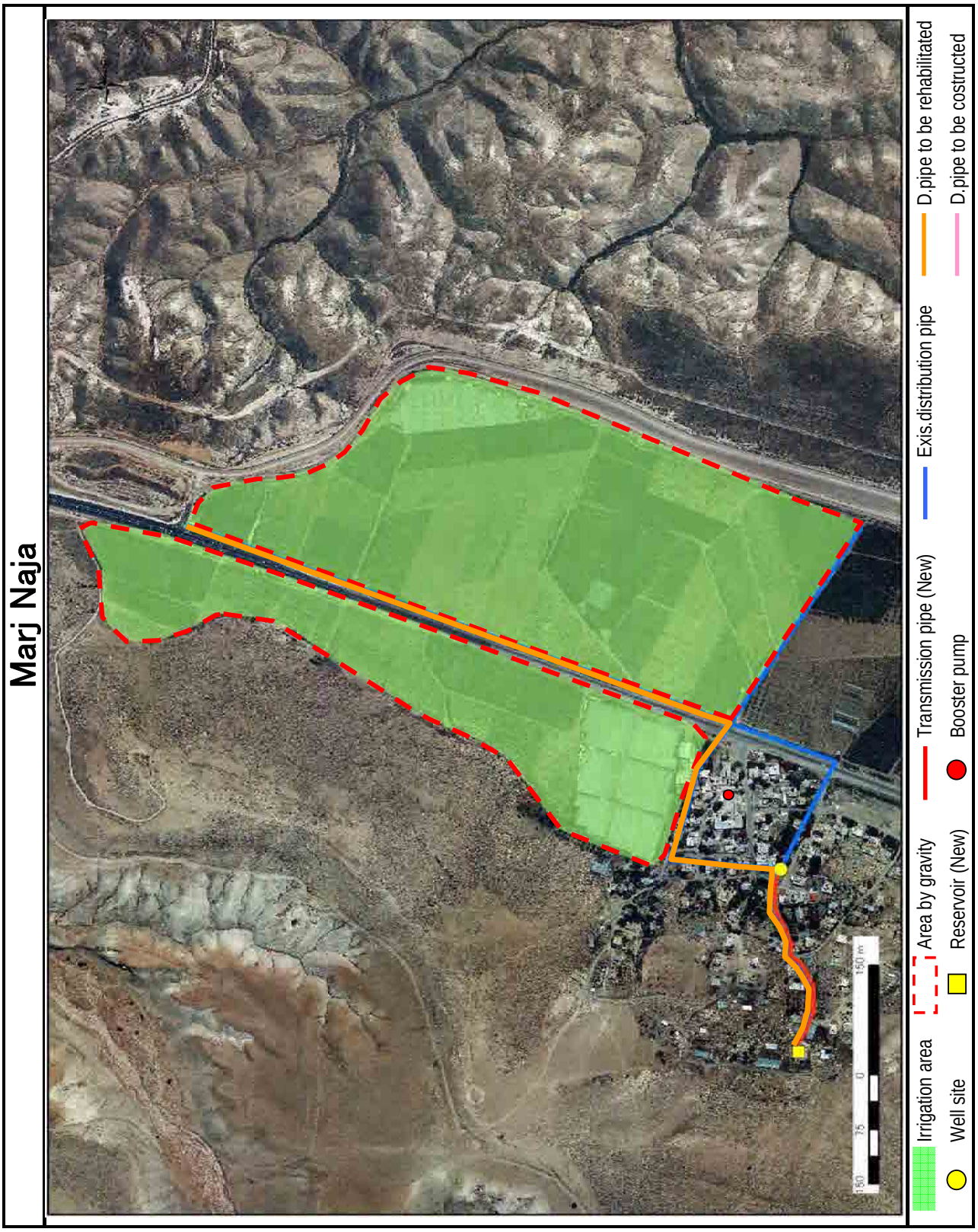
A-2 Case B Plain Plan (Attil)



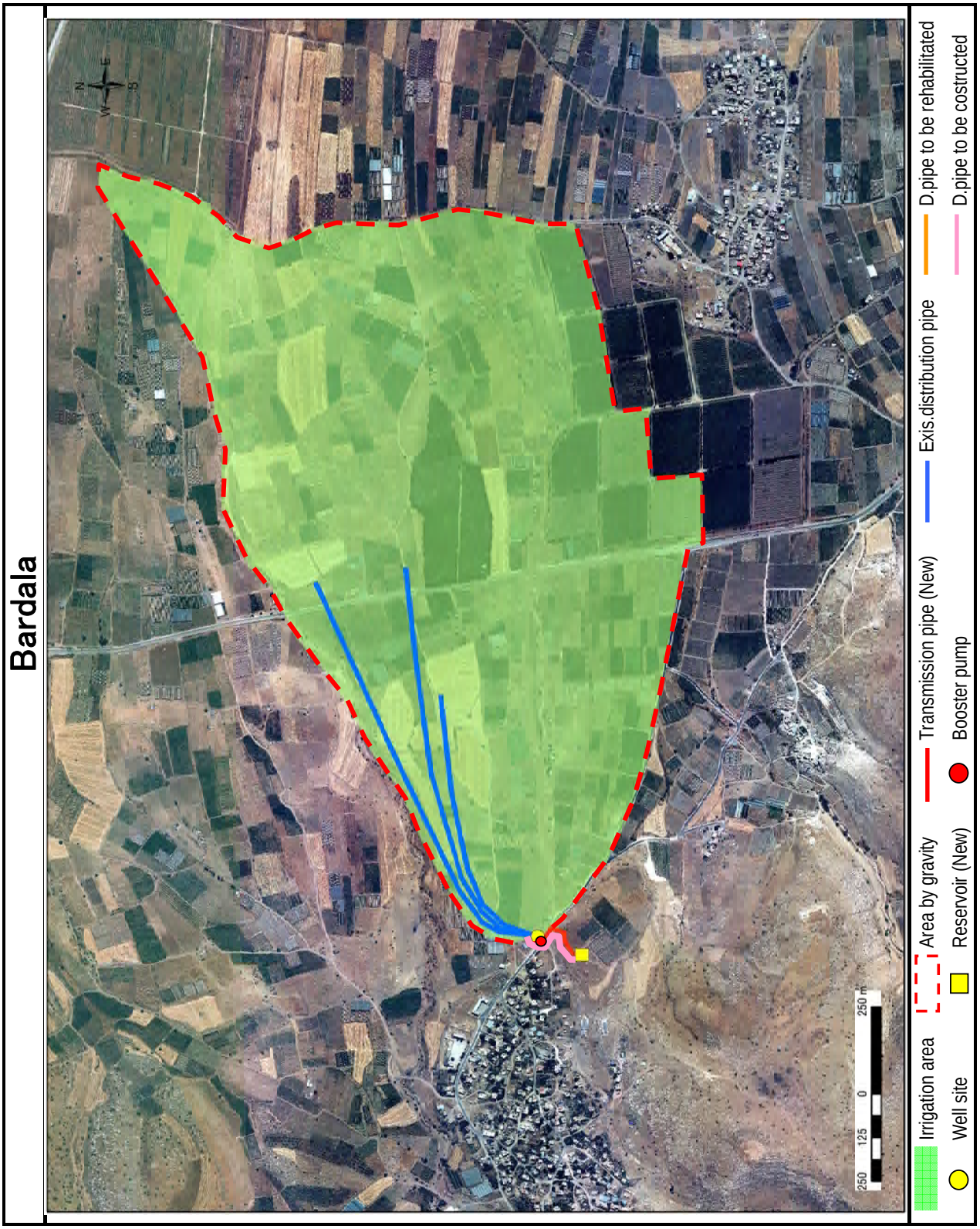
A-3 Case C Plain Plan (Kafr Zibad)



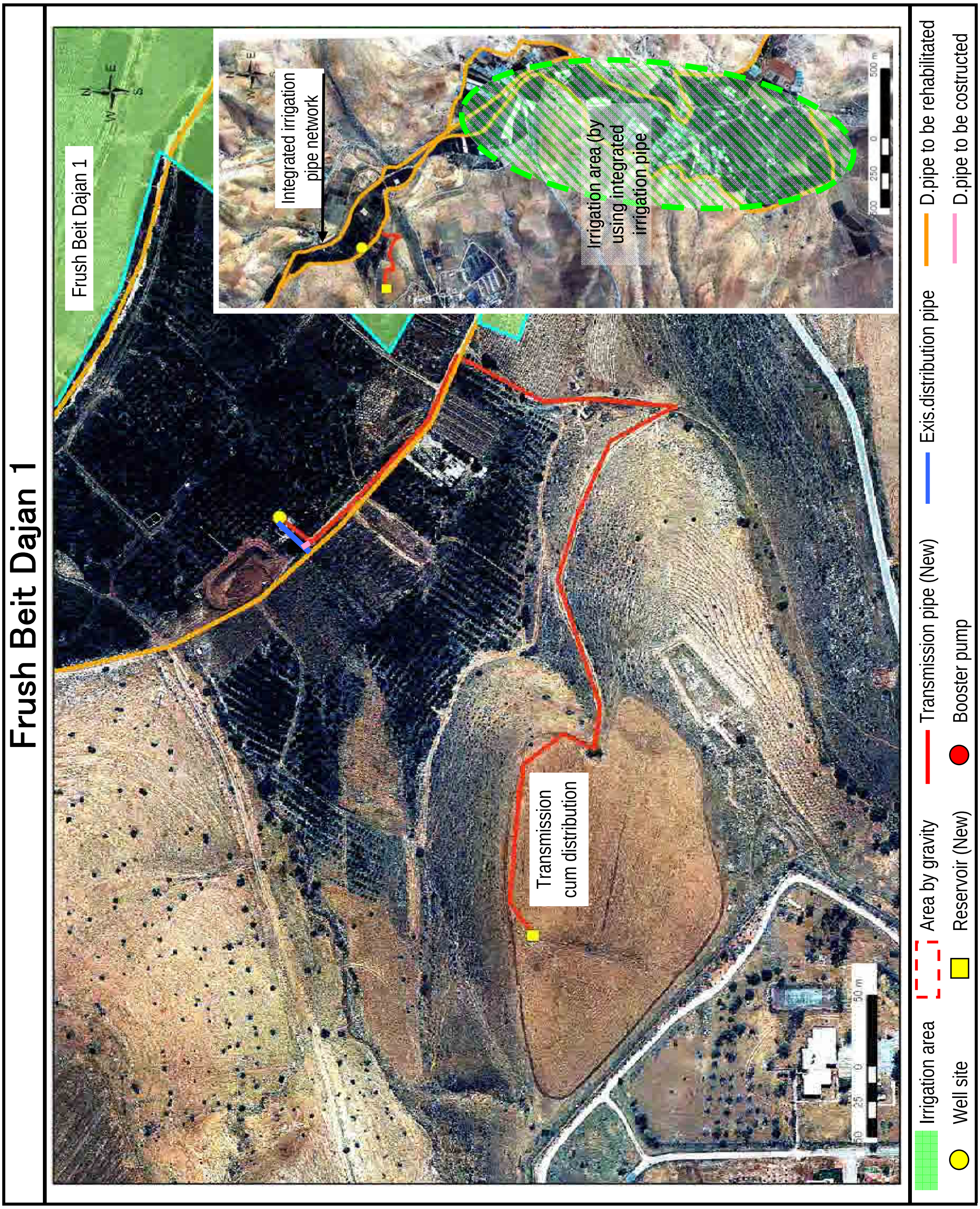
A-4 Case D Plain Plan (Qaffin)



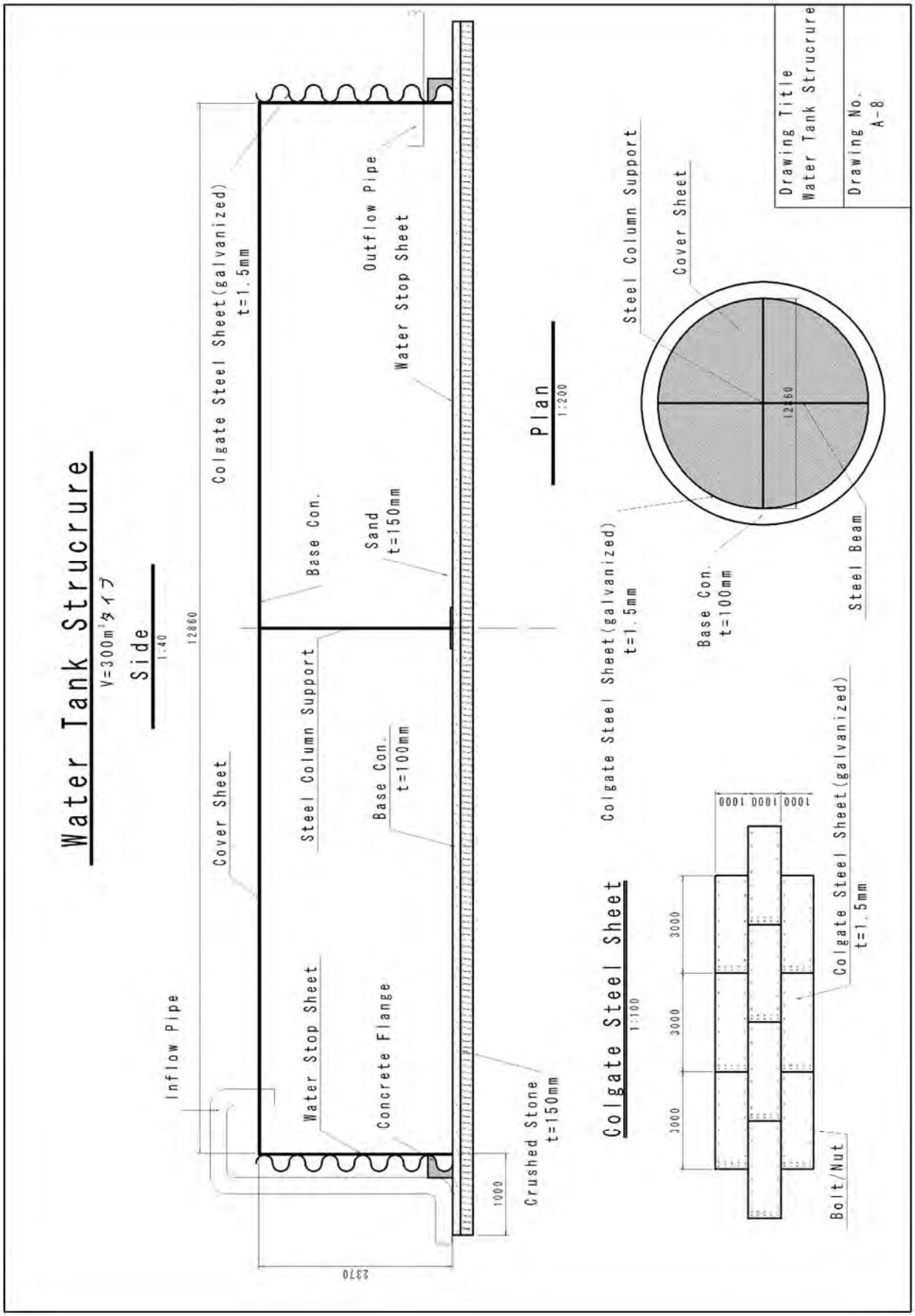
A-5 Case E Plain Plan (Marj Naja)



A-6 Case F Plain Plan (Bardala)

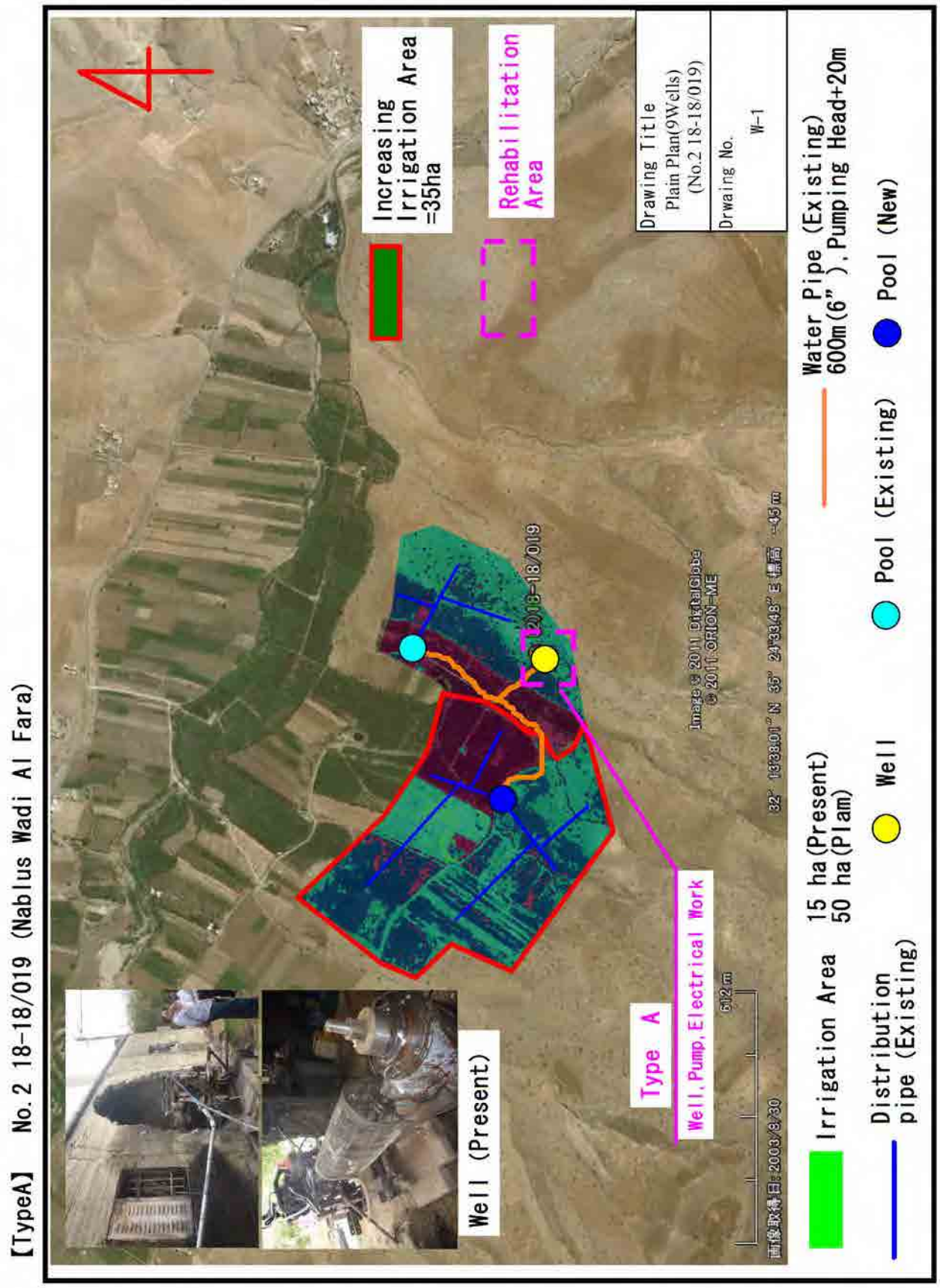


A-7 Case G Plain Plan (Frush Beit Dajan 1)

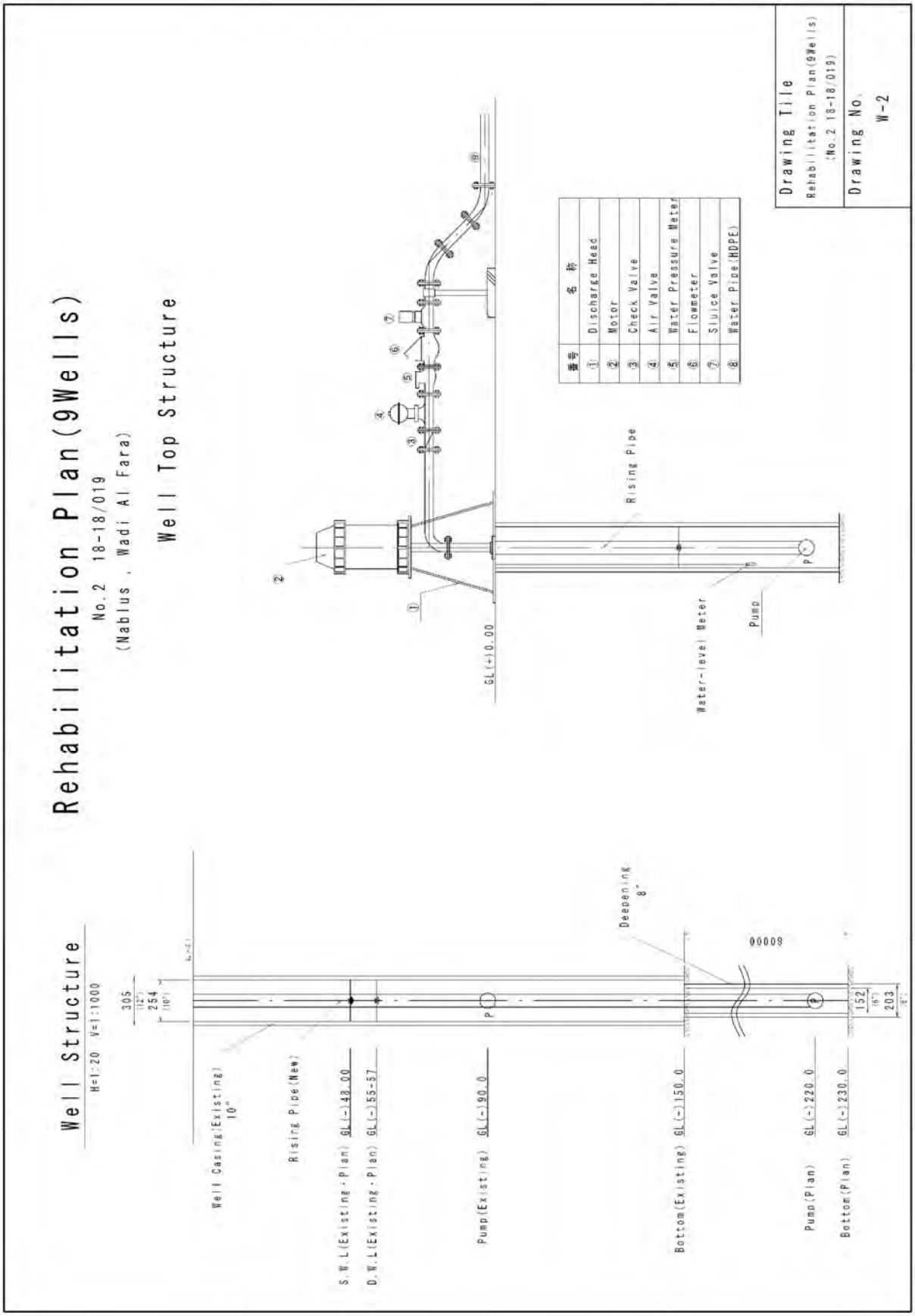


A-8 Water Tank Structure

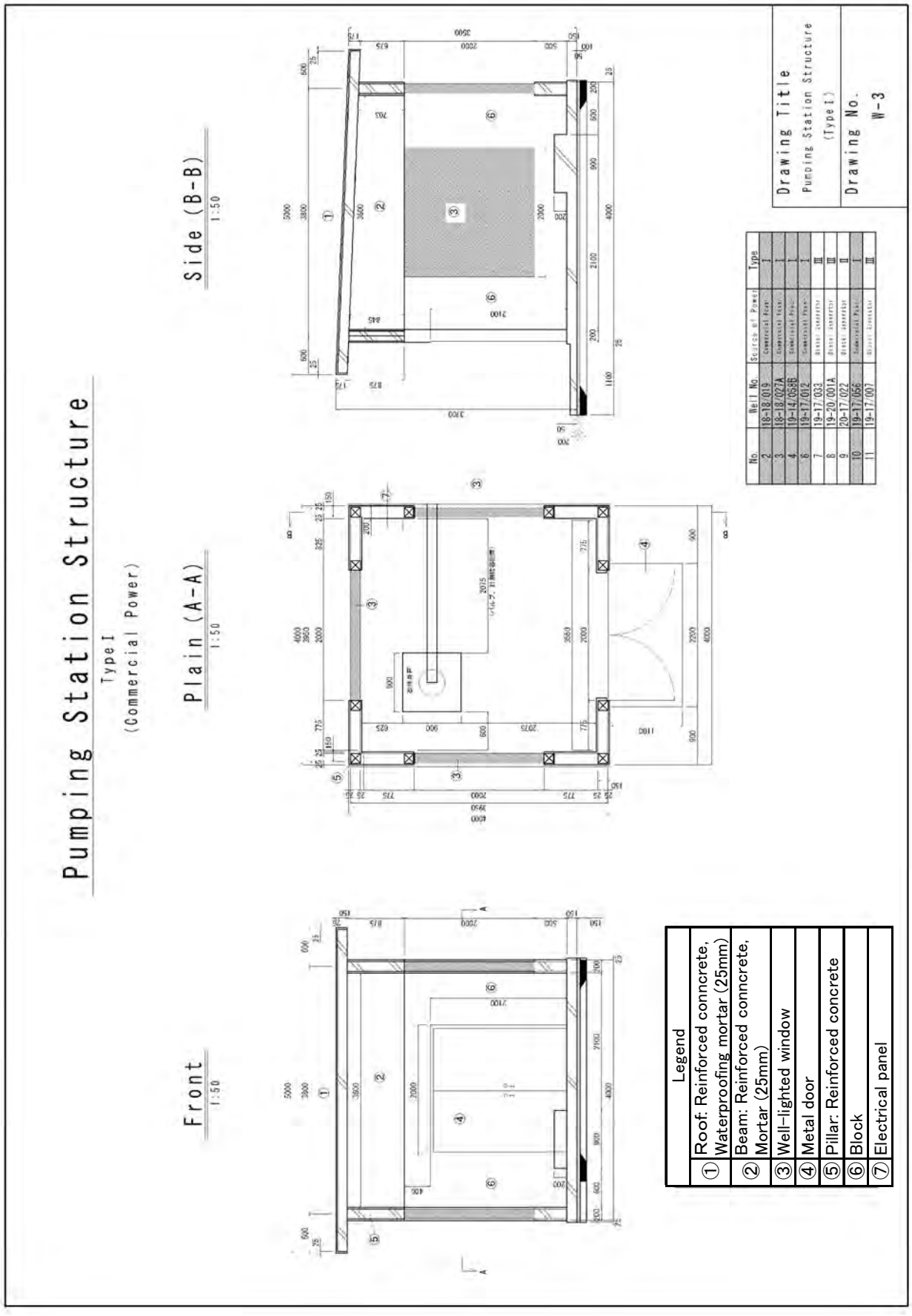
【Rehabilitation of 9 well sites】



W-1 Plain Plan (9 Wells)（No.2 18-18/019）



W-2 Rehabilitation Plan (9 Wells) (No.2 18-18/019)



W-3 Pumping Station Structure (Type I)

2-2 Improvement Plan of Domestic and Industrial Water System

2-2-1 Basic Concept of the Project

(1) Overall goal and Project target

The main strategic objectives such as “To enhance the competitiveness of Palestinian products and services”, “To promote economic integration and access to external markets”, “To ensure a vibrant labor market and combat unemployment” are indicated in “The National Development Plan 2011-2013”. Based on the National Development Policy, JAIP is under construction in the Jericho city as a core project of the “Corridor for Peace and Prosperity” concept which the Japanese Government promotes. JAIP is expected to create a lot of economic opportunity and the demand increase of industrial water is expected.

Although the repair and construction of the water pipe and water tower construction, etc. were already implemented by UNDP etc. so far, the amount of demanded water of Jericho city continues to grow. This project “Improvement Plan of Domestic and Industrial Water System” will try to secure the required water supply.

Design water supply in this Project is described in Table 2-2-1. 40 m^3/hr of 170m^3/hr (150+50), increased under this project is planned tube distributed to Jericho city and 130m^3/hr for JAIP. Therefore, the target year of this project is settled in 2016 uniformed to that of JAIP project.

Table 2-2-1 Distribution of design water supply (m^3/hr)

	Jericho city	Irrigation	AJC	JAIP	ASC	Total
Present	300	330	60	0	20	710
Planned	340	330	60	130	20	880
Increase	40	0	0	130	0	170

AJC :Aqbat Jaber Camp
JAIP :Jericho Agro-Industrial Park
ASC :Ein Al Sultan Camp

This project aims to secure industrial water in JAIP and to improve the amount of water supply to Jericho city. Quantitative effects shown in Table 2-2-2 is expected

Table 2-2-2 Quantitative effect of the Project

Item	Quantitative Effect	Numerical basis
Design population served	The increase 16%	19,589 population (2010) → 22,762 population (2016)
Unit of design water supply amount	The increase 14LPCD	205 LPCD (2010) → 219 LPCD (2016)
Water supply reservation to JAIP	130m^3/hr of water supply	Reservation of enough water demand equal to design maximum daily supply

The overall goal and the project target, etc. in the domestic and an industrial water improvement plan are shown in Figure 2-2-1.

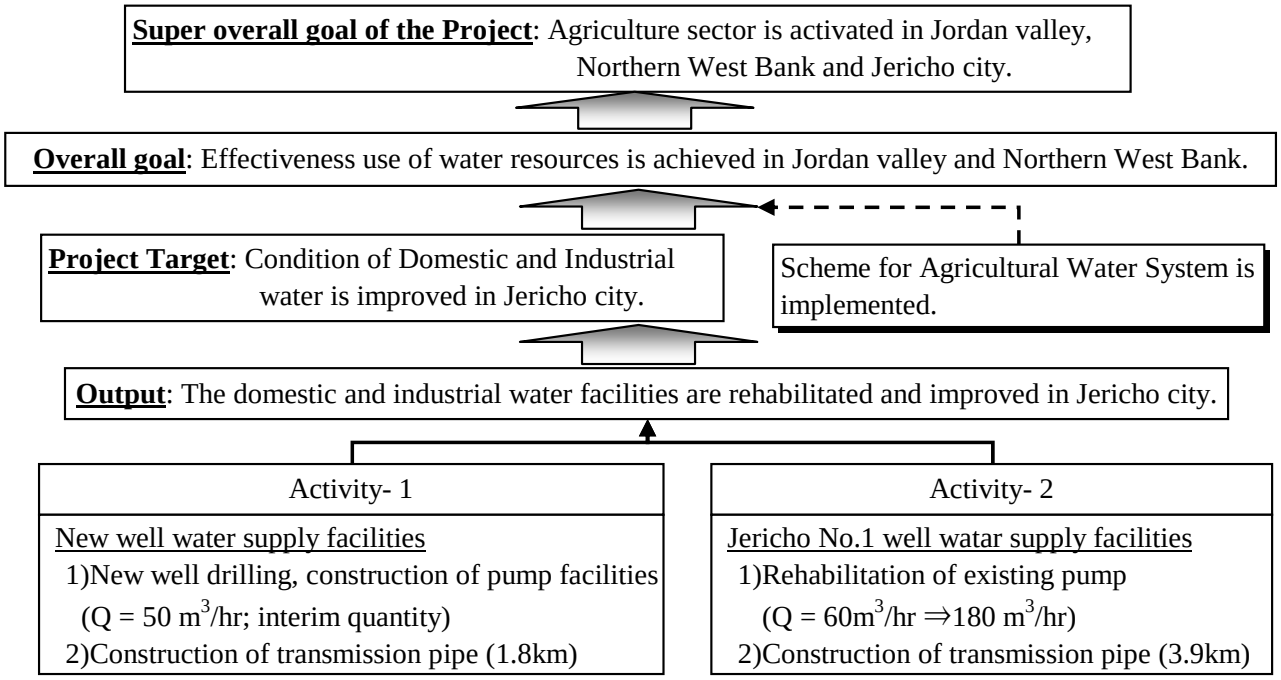


Figure 2-2-1 Outline of the Project target and activities in the scheme of Domestic and Industrial Water System improvement plan

(2) Summary of the project

Summary of the domestic and industrial water rehabilitation plan is shown in Table 2-2-3. Drawings of facilities and plan are shown in Figure 2-2-2 and Figure 2-2-3.

Table 2-2-3 Summary of the domestic and industrial water facilities plan

Item		Summary
New well	Pump facilities	New well drilling and construction of the pump facilities ($Q=50\ m^3/hr$; interim value)
	Transmission facilities	D150 mm SP, L=1,755 m (new well – beginning point of the Ein Al Sultan spring canal)
Jericho No.1 well	Pump facilities	Rehabilitation of the existing pump facilities ($Q=60\ m^3/hr \rightarrow 180\ m^3/hr$)
	Transmission facilities	D200 mm SP and D250 mm SP, L=3,540 m (Jericho No.1 well - canal upstream of irrigation pump station) D200 mm SP, L=356 m (above pipeline – Jericho main reservoir)

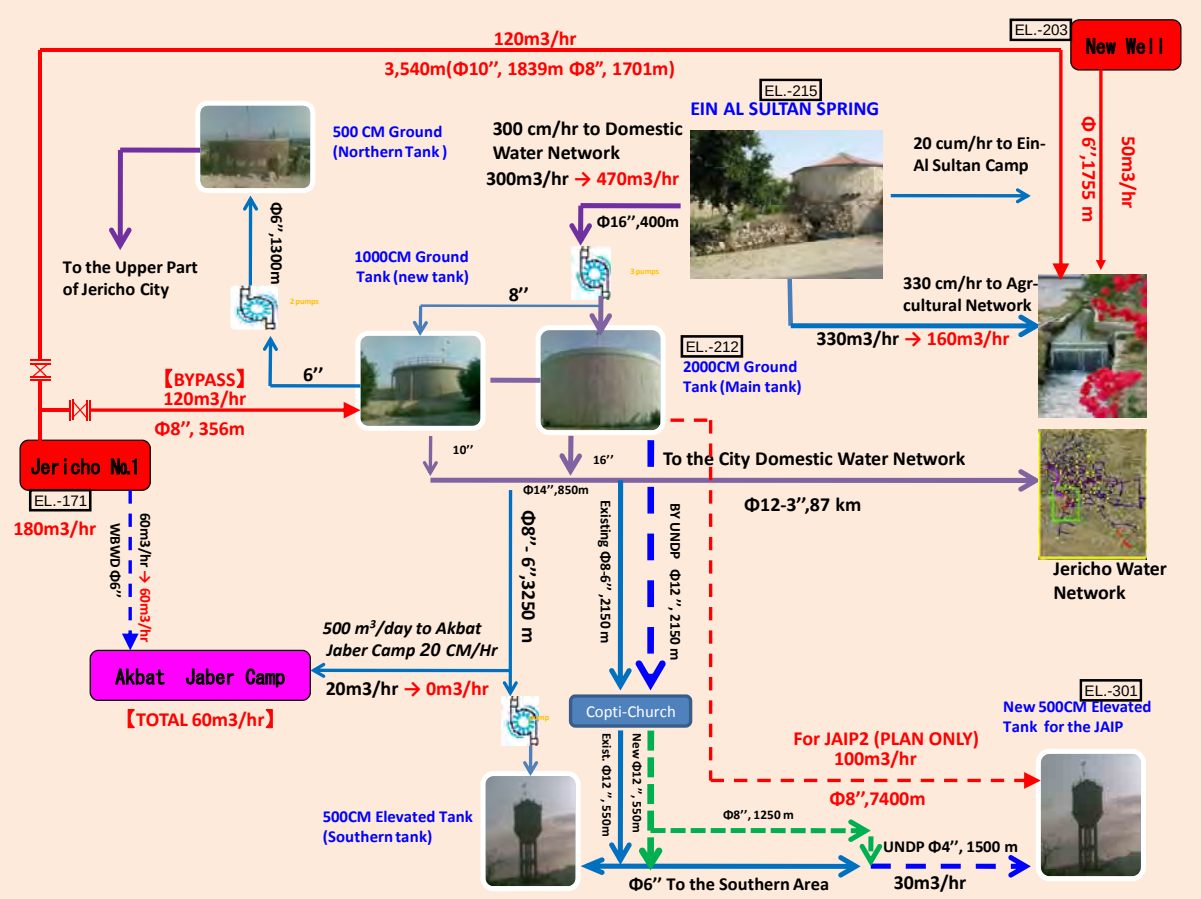


Figure 2-2-2 Outline of facilities

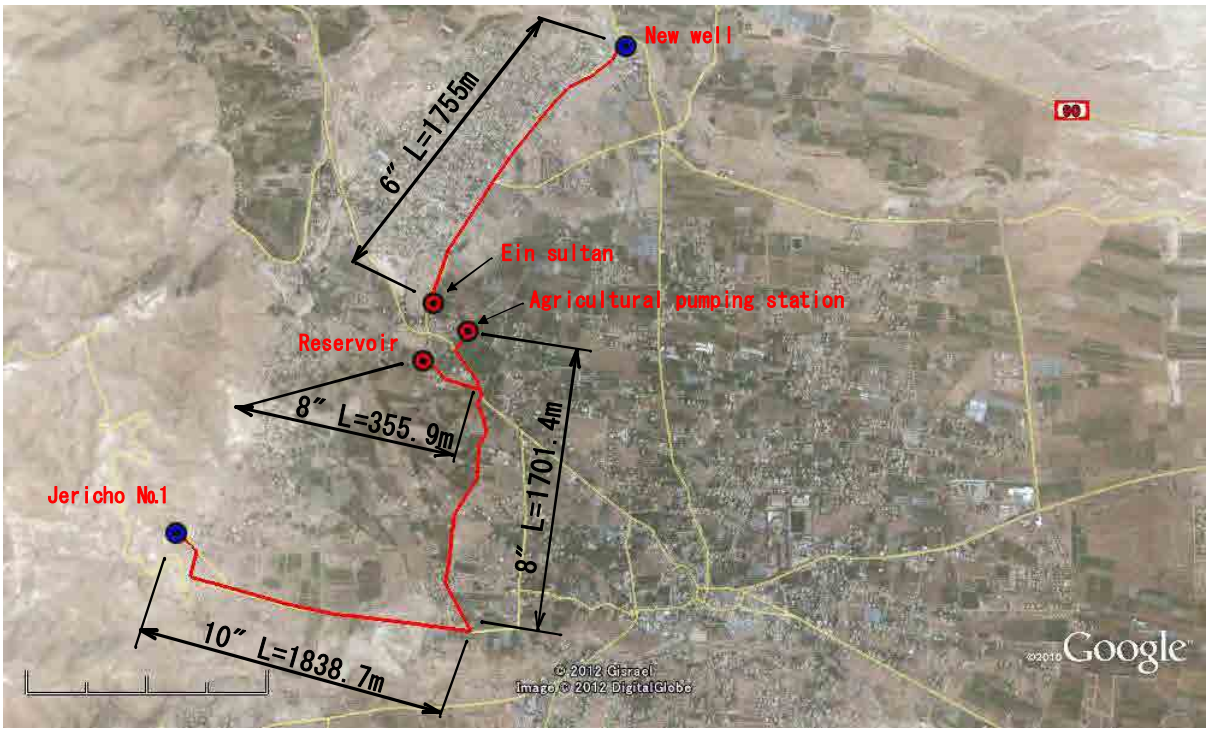


Figure 2-2-3 Outline Facilities Plan

Moreover, summary of the project is shown in Table 2-2-4 “Project Design Matrix (PDM).”

Table 2-2-4 Project Design Matrix (PDM) Improvement Plan of Domestic and Industrial Water System

1.Project name: Improvement Plan of Domestic and Industrial Water System at Jericho city (As of April 2012)
2.Project period: December 2012 – November 2014
3.Project target area: Jericho city, the West Bank
4.Target group: population of Jericho city (Including refugee camp) : 33,700 persons (2010)
Prospective population growth in Jericho city by 2016 ; 3,173 persons (22,762－19,589: without refuge camp) Unit of water supply amount of Jericho city：250LPCD、water supply demand: 40m^3/hr>(3,173persons x 250LPCD/24hours)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Super Overall Goal The agricultural sector in Jordan valley and northern West Bank is activated.	By 2020； The agricultural products in Jordan valley and northern West Bank in addition to the surrounding of the Jericho city are transported to JAIP.	・Agricultural statistical data ・JAIP operation record	・The policy of the Palestinian Authority is not changed. ・"Corridor for Peace and Prosperity" concept is continuously supported.
Overall Goal Efficient practical use of water resources is attained in Jericho city, and Jordan valley and northern west bank.	By 2018； Sewage treatment water is widely reused for industry water and agricultural use.	・Waterworks statistical data ・Well operation record	・Israel does not limit agreed PA water use.
Project Purpose I Situation of domestic and industrial water supply in Jericho city is improved.	By 2016； ・Population supplied of Jericho city increases by 16%. (3,173/19,589 persons) ・Unit of water supply increases by 14LPCD (219-205) ・Jericho city supplies 130m^3/hr water to JAIP (by Japanese assistance/UNDP/other donor , etc.)	・JAIP water supply log ・Well operation record	・The population (refugee and tourists are included) of the Jericho city does not increase drastically ・There is no major change in the number of tenant companies and required water supply of JAIP (JAIP-2 is built as planned).
Outputs Domestic water facilities in the Jericho city are repaired and improved.	By 2014； ・2 well for water supply facilities are improved in the Jericho city. ・Supply and service pipe are constructed 2line , 5.65km ・Amount of water supply in Jericho city increase 40m^3/hr (50+180-60-130)	・Construction monthly report ・Jericho water section control log ・Well control log	・The water rights person of Ein Sultan spring water irrigation canal is not opposed to well water mixture. ・An obstacle does not arise in facilities construction (CA approves construction).
Activities ・Drilling the new well ・Rehabilitate Jericho No.1 well ・Install well pump ・Construct distribution and service pipe	Input plan （Japanese side） *.*million yen ・Outline design ・Detail design ・Creation of tender document ・Assistance of tender ・Implementation of construction ・Monitoring and assessment	（Palestinian side） *.*million yen ・Securing of construction site ・Acquirement of construction approval ・Procedure of environment	・Construction of Jericho No.1 well resumes. Pre-conditions ・JWC recognizes new well drilling. ・Jericho city and MOA take the farmer agreement to well water mixture. ・CA issues construction approval.

2-2-2 Outline Design of the Japanese Assistance

2-2-2-1 Design Policy

2-2-2-1-1 Basic Policy

The basic policy of the project is configured as follows;

(1) The permission of JWC about new well drilling is not obtained, it will be implemented at detailed design or construction, and well ability is 50m^3/hr from a circumference track record. Similarly, the depth of well drilling is assumed to be 150 m, and as designed. The design of a pump facility and water supply facility are designed by the same assumption numerical value.

(2) Target year of completion is set to 2016 for the JAIP stage II, and set the amount of water supply to JAIP being maximum daily supply of actual design value of JAIP. However, change of water supply demand is predicted by the number of moving-in companies, and the types of industry, the deliberations about amount of water supply are required before completion.

(3) Since consent of farmers for mixing well water to Ein Sultan spring has not been obtained, designed numerical value could not been finalized. Considering the required water quality for Jericho municipality, it is desirable that all volume of Jericho No.1 well water is supplied for agriculture purpose. In this case, if volume of agriculture use is decreased from Ein Sultan spring, better quality and more volume of water can be supplied to Jericho municipality. If so, water supply to Aqbat Jaber Camp is also increased through the water supply net work of Jericho municipality. Unless coordination among concerning agencies are well managed, available discharge of 180 m^3/hr in Jericho No.1 should be designed to be able to supply water both for agriculture use and Jericho city reservoir.

(4) As WBWD delays construction of Jericho No.1, final form of it is not clear. Therefore, pipe facilities, electric equipment, etc. should be checked at detailed design and should be modified as necessary.

2-2-2-1-2 Policy to Natural Environment Conditions

The climate condition of the Jericho prefecture which is the target of this project are as follows: altitude (-)200 to (-)300m; the rainy season is from October – March; the dry season maximum temperature is about 30 to 40 degree; monthly rainfall is 6 to 60 mm; and intense heat is from March to October. The dry season comes intense heat, so that work shift is changed into early morning or night, and this is considered in the plan to avoid decline in working efficiency as much as possible.

2-2-2-1-3 Policy to Social Conditions

The water supply unit price of the Jericho city which is the target of this project is set at a cheap charge as compared with other cities. Therefore, it is considered as the facilities design which reduce maintenance

fee as much as possible. The head of water of a pump is low stopped, in order to control the appreciation of an electric bill, it gives a flexibility to pipe diameter a pipeline loss small.

2-2-2-1-4 Policy to Administration and Maintenance

The Jericho city water service department will take charge of the operation and maintenance of the facilities. Management will select the equipment easily adopted in the Jericho city or the neighboring town. Moreover, priority is given to domestic products so that supply of spare parts and repair may become readily available.

2-2-2-1-5 Policy to Environmental and Social Considerations

In this project, land acquisition and resettlement will not occur; hence no adverse impact is expected. However, the pipeline will be installed under the public road, hence, securing of traffic by single-sided mutual passing of a detour etc. is needed. Moreover, as to the noise and vibration during the construction, it is necessary to select and use machines that will not create so much noise and vibration

2-2-2-1-6 Policy to Construction and Procurement Situation

The contents specified to Labor Standards Law in PA are kept, and an execution scheme is formulated. And the matter shown in the below-mentioned “guideline”, “standard drawing”, and “technical specification” is observed.

Manual labor, such as a staff of an engineer's etc. construction supervision, reinforcing-bar placer, and plasterer, is employed from Ramallah if needed, and the common worker of monotonous work is employed from the circumference of the construction site. Cement, sand, aggregate, wood, a steel rod, a steel pipe, light oil, gasoline, etc. are supplied in PA.

In addition, about a pump, it lets a local agency and an import trader pass, and supplies the import from Israel or Europe from a domestic market synthetically in consideration of the maintenance management after construction, the marketability of the spare parts, economical efficiency, etc.

2-2-2-1-7 Policy to the Local Contractor’s (Contractor and Consultant) Practical Use

It is considered in the plan to utilize local construction firm of PA as Japanese subcontractor. The local consultant considers it as the plan utilized for construction supervision or maintenance management instruction as a Japanese consultant's local staff similarly. In addition, after investigating and evaluating the technical capabilities of a local construction contractor and a consultant, a construction track record, the ordering track record from other donors, a possession machine, funding ability, etc., it selects.

2-2-2-1-8 Policy to the Setup of the Grade of the Facilities and Equipments

The setup of the grade of the facilities and equipments set as the grade equivalent to the track record in PA. In consideration of the ease of maintenance management and procurement of the spare parts, it sets up in grades with high durability by a grade with many use track records.

2-2-2-1-9 Policy to the Construction Method, Procurement and Time for Construction

At the Jericho city, water pipe construction and pump facilities construction were carried out recently by UNDP, WBWD, and assistance of France. Hence, in the construction method and procurement, carrying out domestic technical specification, example of similar construction is determined as reference.

The waterworks pipeline of the distribution pipe is planed to be laid under a public road. In consideration of not having much traffic of public road and preventing-operation efficiency, a part of road is occupied and it is considered as a plan to prepare a temporary enclosure.

2-2-2-2 Basic Design (Facilities and Equipment Plan)

Basic design carries out the following standards of PA to reference.

1) Planning and Design Guidelines "Construction and installation of pipes in water supply and sewerage trenches", PWA September 2000 (hereinafter referred to as "Guidelines")
2) Appendix of standard drawings (hereinafter referred to as "standard drawing")
3) GENERAL TECHNICAL SPECIFICATIONS FOR WATER SUPPLY NETWORKS – PWA 1998 (hereinafter referred to as "Technical Specifications")

(1) Rehabilitation Plan of Jericho No.1 well

(a) Outline of construction

It is the construction which rehabilitates the pump of 60 m^3/hr which is under construction by WBWD at present to 180 m^3/hr, and main type of works are as in Table 2-2-5. The pump model used is taken as same type of the existing pump and a vertical pump with many actual achievements in PA (for details, see [2-1-2-2]).

Table 2-2-5 Type of works of Jericho No.1

Type of works	Quantity
Removal of existing pump (60 m^3/hr)	1 set
Construction of pump (vertical pump, 180 m^3/hr)	1 set
Reconstruction of control panel	1 set
Reconstruction of electric receiving panel	1 set
Construction of electric wiring	1 set
Construction of incidental earthwork	1 set
Construction of incidental pipeline (pipe, air valve, scour valve, flow meter)	1 set

(b) Hydraulic evaluation

The well structure of Jericho No.1 and the water level of the balance tank are as in Figure 2-2-4.

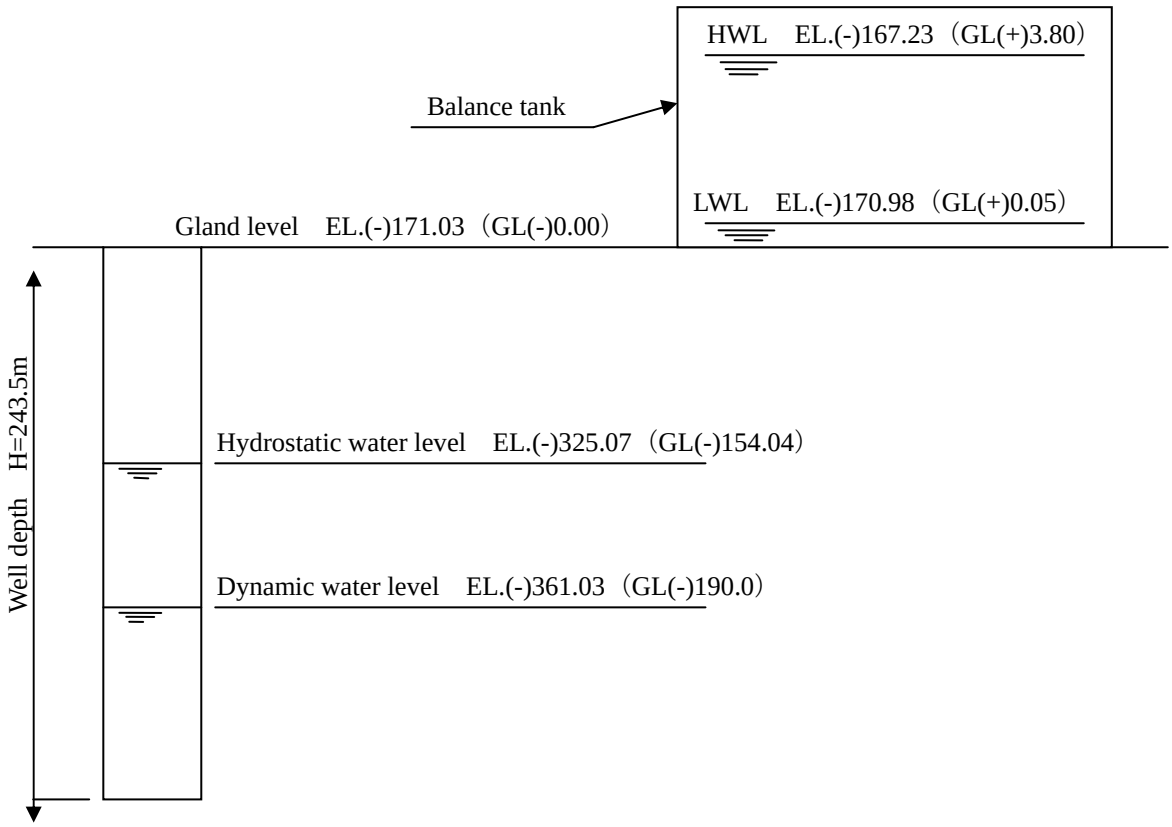


Figure 2-2-4 Well structure of Jericho No.1 and the water level of the balance tank

Actual pump head = Balance tank H.W.L. – Dynamic water level of well = (-)167.23 to (-)361.03 ＝ 193.80 m

As pipeline loss is 5 m, Total head = 193.80 + 5.00 = 198.80 m → 200 m

(c) Water quality after mixing of irrigation water

Prediction of TDS (total dissolved solids) and EC (electrical conductivity) well concerning salinity containing which is main issue for drinking water after mixing of springhead are shown in Table 2-2-6. The water quality of Jericho No.1 is calculated from the water quality test result of the production test in February 2011, and Ein Sultan spring water quality is calculated from the Jericho Waterworks Bureau data. The water quality of a new well is unknown, so mixed water calculation is the water quality at the time of mixing Jericho No.1 (140 m^3/hr) and Ein Sultan spring (190 m^3/hr).

The water for agricultural use standard of FAO is shown in Table 2-2-7 about the major crops around the Jericho city. The numerical value in a table shows the case where it becomes 0% of the crop damage over irrigation water. From these, it can be judged as a water quality standard of irrigation water that it is in general satisfactory.

Table 2-2-6 Calculation of water source and mixing irrigation water

Water quality parameter		Jericho No.1		Ein Sultan Spring		Mixing water calculation		Standard of drinking water quality	Ocean water (reference)	
		min	max	min	max	min	max	PWA	Sea of Japan	Dead sea
TDS	mg/l	1,033	1,180	322	385	624	722	1,000	35,000	350,000
EC	μs/cm	1,626	1,718	658	679	1,069	1,120	—	45,000	450,000

Table 2-2-7 Irrigation water standard (FAO)

Major crops	EC (μs/cm)
Sweet corn	1,100
cucumber	1,700
squash	—
tomato	1,700

On the other hand, in order to secure TDS 1,000 mg/lit. used as the water quality standard for drinking water, If the water quality of Jericho No.1 well is set to amount of Jericho No.1 well water: Ein sultan amount of water =23:77 when the water quality of maximum 1,180 mg/lit. And Ein Sultan spring is made into maximum 385 mg/lit., it is possible to adapt to the water quality standard for drinking water.

Namely, the inside of amount of distribution 340 m^3/hr which is the present plan, Even if it provides 78m^3/hr by mixture of Jericho No.1, it is possible to adapt to the water quality standard for drinking water (it is satisfied with the mixed rate of Jericho No.1:78 m^3/hr+ Ein Sultan spring 262 m^3/hr of the water quality standard for drinking water).

(2) Rehabilitation plan of new well

It is the construction which drilling the new well at the northern Jericho city, and installs a new pump facility, and main type of works are as in Table 2-2-8. However, it is the present condition that permission of well drilling is not obtained, so design water supply is assumed to be 50 m^3/hr from the past circumference track record, and a design is advanced. Well dynamic water level is unknown similarly, total head of pump is designed as 150 m. And, it is due to use only for agriculture, so disinfection equipment is not installed.

Table 2-2-8 Main works of the new well

Type of works	Quantity
Well drilling (L=150 m)	1well
Electric room, office	1wing
Installation of pump (vertical type 50m^3/hr)	1set
Construction of incidental pipeline (pipe, air valve, scour valve, flow meter)	1set
Power receiving equipment	1set
Control panel	1set
Earth work	1set

(3) Transmission pipe and incidental facilities

(a) Pipe material and diameter

The same steel pipe material used in the construction activities of UNDP and WBWD in 2011 will be used in the project the PVC pipe, and the ductile pipe is used for pipe material. A steel pipe is compared ductile and is economical, and it excels in intensity and durability as compared with a PVC pipe, it is judged that adoption is appropriate. A steel pipe is made in PA of outside polyethylene lining and inside mortar lining, and supply and repair are also easy for it.

Pipe diameter calculated by the Hazen-William formula, and decided the diameter of a required pipe.

(b) Hydraulic calculation

1) Jericho No.1 to irrigation canal

Hydraulic vertical section figure is shown as in Figure 2-2-5. Pipe diameter from the starting point to scour valve is 250 mm, and the lower stream is set to 200 mm. Pipe diameter is determined by securing the water level which can supply water to the Jericho city reservoir tank.

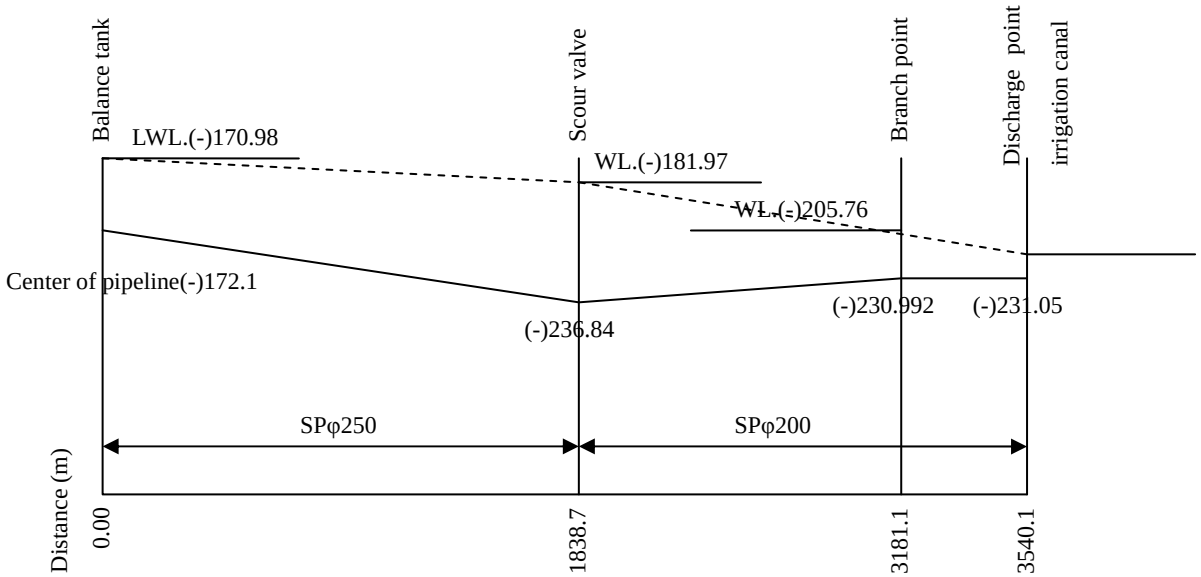


Figure 2-2-5 Hydraulic vertical plan of Jericho No.1 to irrigation canal

2) Branch point to Jericho reservoir tank

Pipeline diameter of branch point to Jericho No.1 is 200 mm (Refer to Figure 2-2-6).

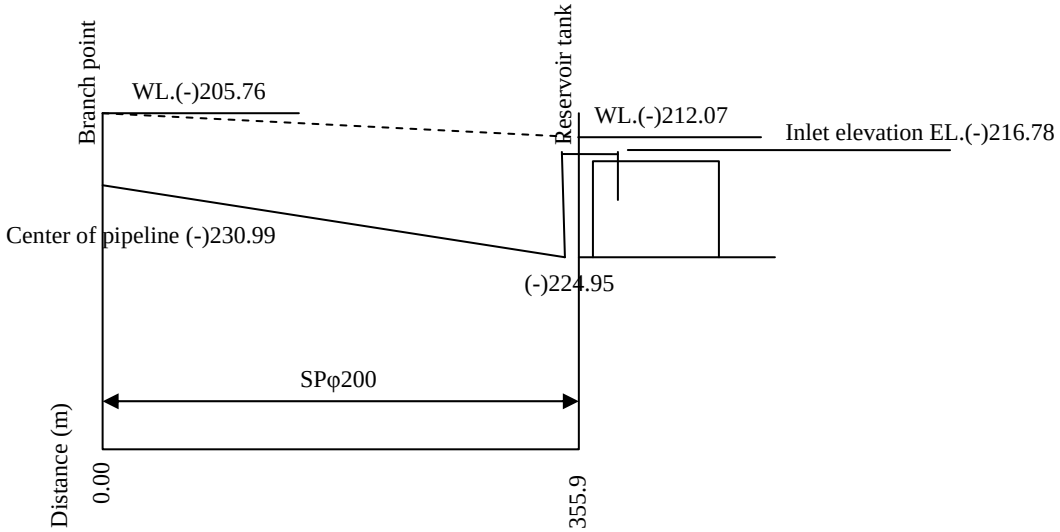


Figure 2-2-6 Hydraulic vertical plan of branch point to Jericho reservoir tank

3) New well to irrigation canal

It is considered as pipe diameter which becomes more than flow velocity 0.6 m/s so that it may become the minimum head of pump for maintenance cost mitigation, and it is decided as 150 mm. Design flow is taken as 50 m^3/hr (Refer Figure 2-2-7).

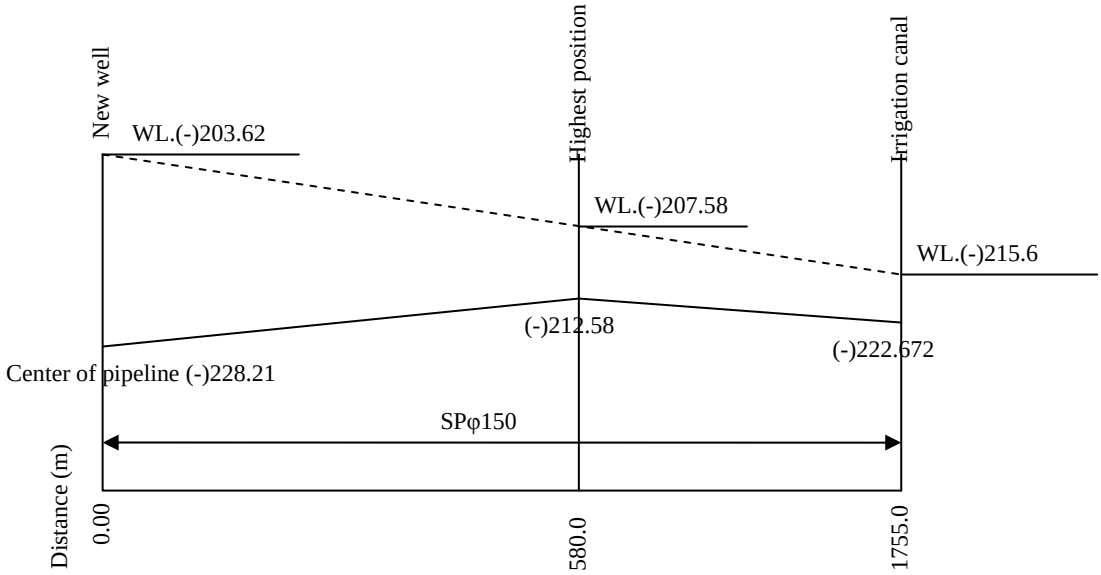


Figure 2-2-7 Hydraulic vertical plan of new well to irrigation canal

4) Hydraulic calculation

Hydraulic calculation is implemented by Hazen-William formula. Result is shown as Table 2-2-9.

Table 2-2-9 Results of hydraulic calculation of Jericho No. 1 and new well

Start point	End point	Length (m)	Upper water level	Downstream water level	Flow volume (m^3/hr)	Flow volume (m^3/s)	Pipe diameter (m)	Pipe line loss (m)	Flow velocity (m/s)
Well No.1	Diameter reduce point	1,838.7	-170.98	-181.97	180	0.050	0.25	10.992	1.019
Diameter reduce point	Branch point	1,342.4	-181.97	-205.76	180	0.050	0.20	23.790	1.592
Branch point	Irrigation canal	359.0	-205.76	-212.12	180	0.050	0.20	6.362	1.592
Branch point	Reservoir tank	355.9	-205.76	-212.07	180	0.050	0.20	6.307	1.592
New well	Highest point	580.0	-203.62	-207.58	50	0.014	0.15	3.959	0.793
Highest point	Irrigation canal	1,175.0	-207.58	-215.60	50	0.014	0.15	8.021	0.793

(c) Buried position and covering

Roadside is private land, therefore land buying over is needed, and pipeline lay under the road. In consideration of other underground pipes, deliberations with the Jericho city determined the position. Covering is taken as minimum 1.0 m shown in the guideline used as PA standard.

(d) Appurtenant facilities

The air valve and scour valve are installed as incidental facilities. The flow meter is installed in each water source. It installs an air valve and a scour valve at each route, due to each route are 3.5 km and 1.75 km, respectively. And, a sluice valve is installed in a branch position and a pump facility. Each structure is planned according to a standard drawing.

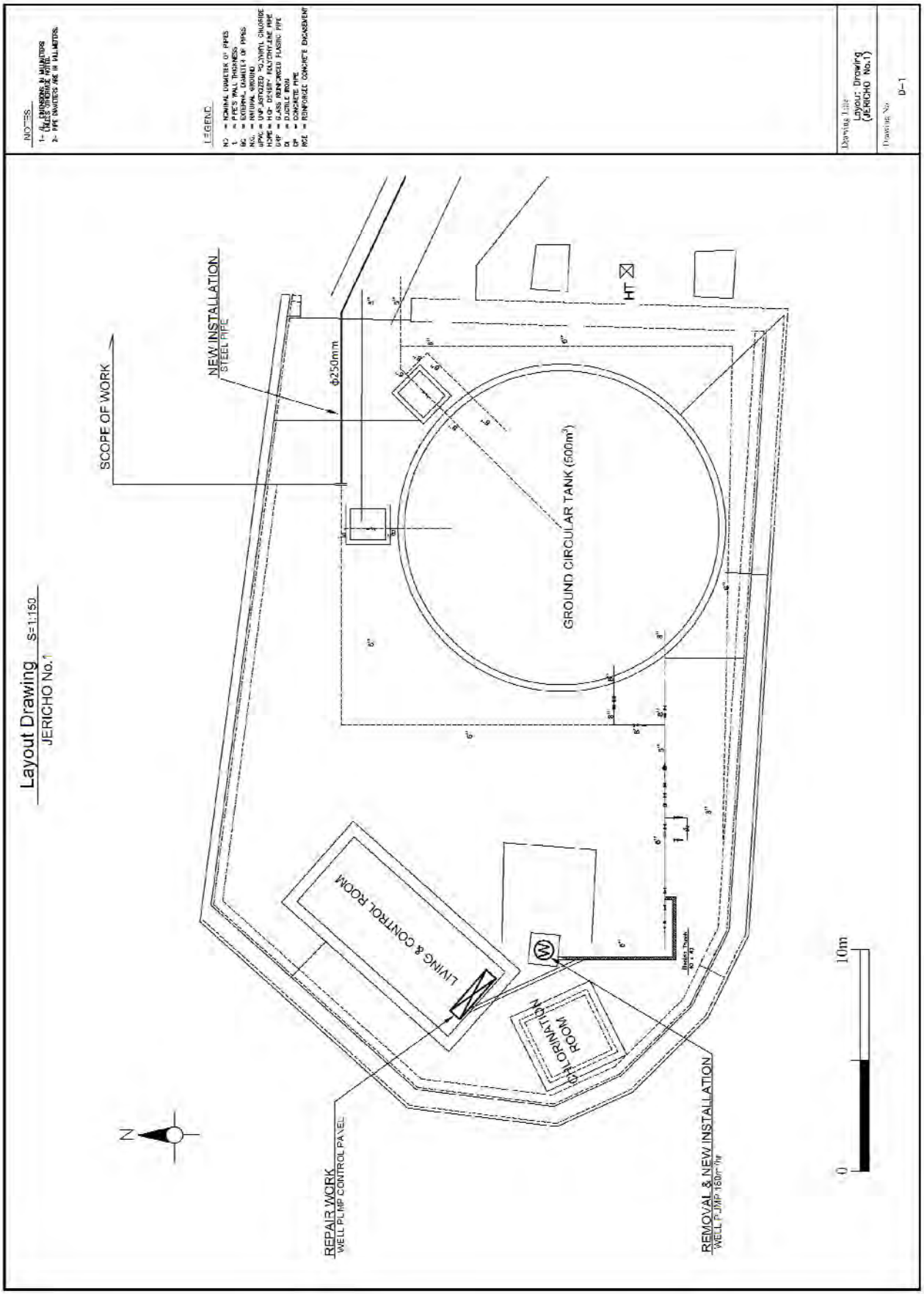
(e) Digging width and section of earth work

Selection of digging width and a backfill machine are according to a guideline.

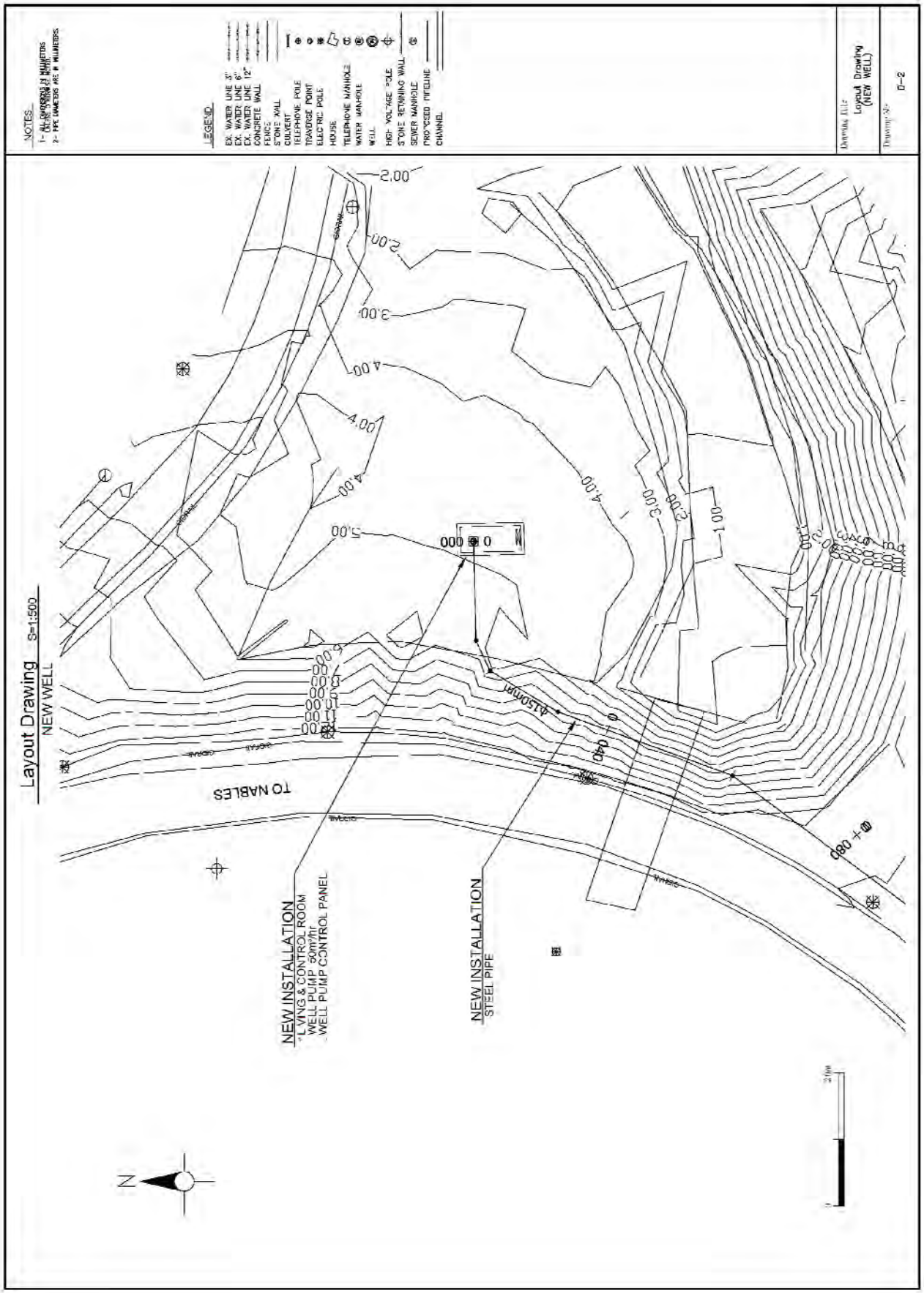
2-2-2-3 Outline Design Drawing (Domestic and Industrial Water Systems)

Table 2-2-10 List of Drawing

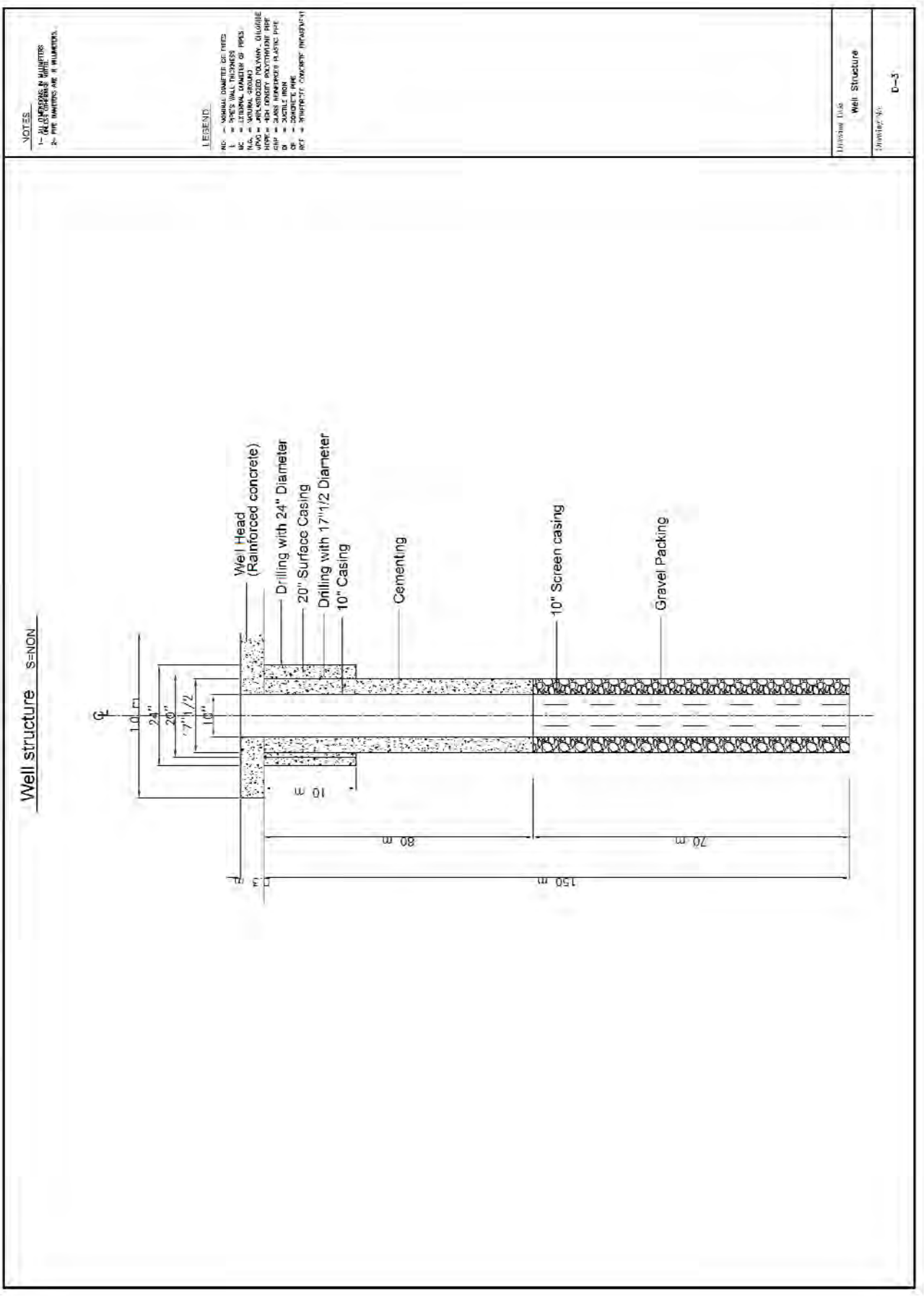
No.	Title
D-1	Layout Drawing (Jericho No.1)
D-2	Layout Drawing (New Well)
D-3	Well Structure
D-4	Standard Cross Section



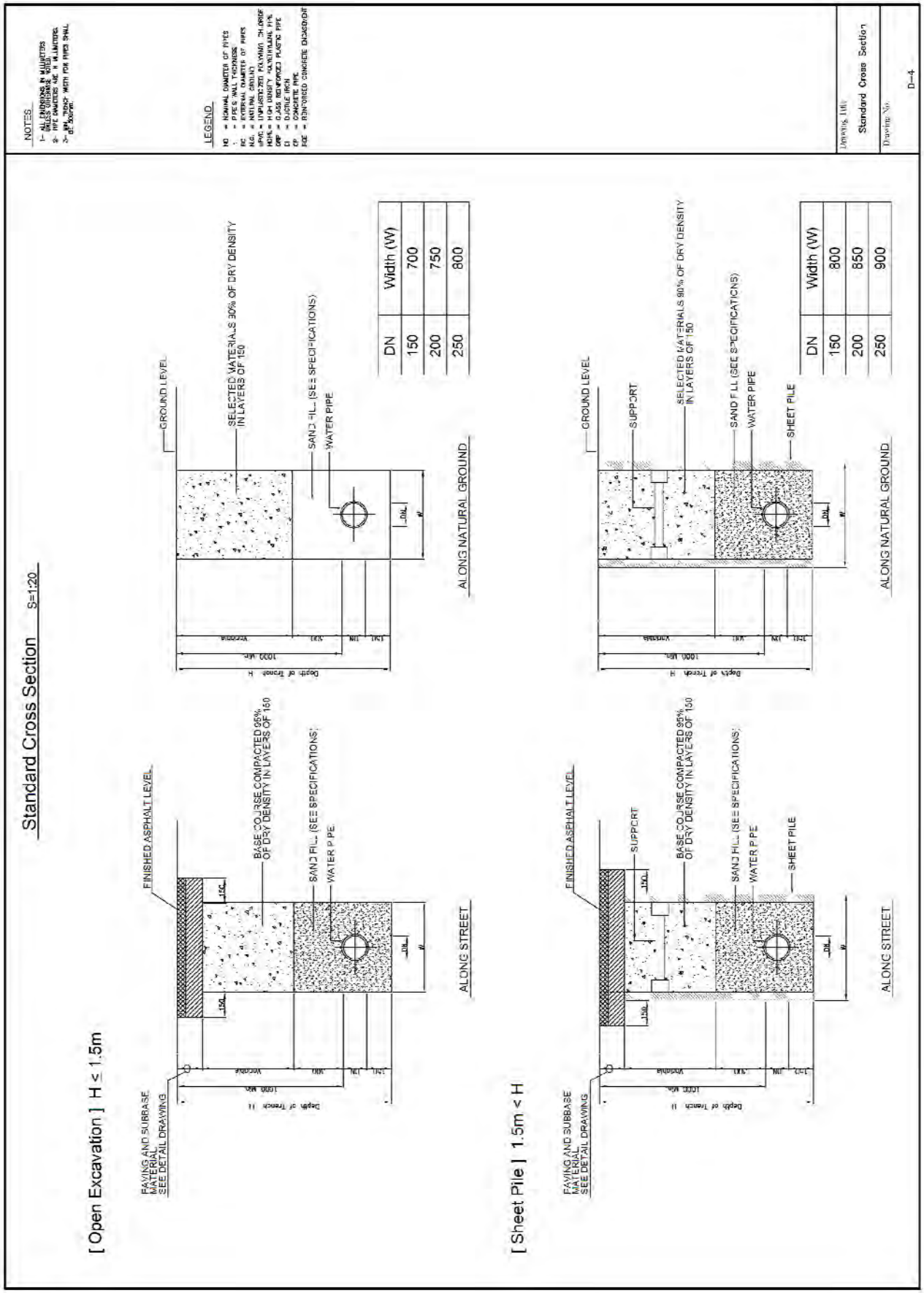
D-1 Layout Drawing (Jericho No.1)



D-2 Layout Drawing (New Well)



D-3 Well Structure



D-4 Standard Cross Section

2-3 Implementation Plan

2-3-1 Implementation Policy

Implementation agencies of Project are MOA and PWA, they are responsible for the implementation of each project component. However, MOA will be contracting party as representation of implementation agency for contract of supervision consultants and contractors. Implementation Structure is shown in Figure 2-3-1 and Figure 2-3-2.

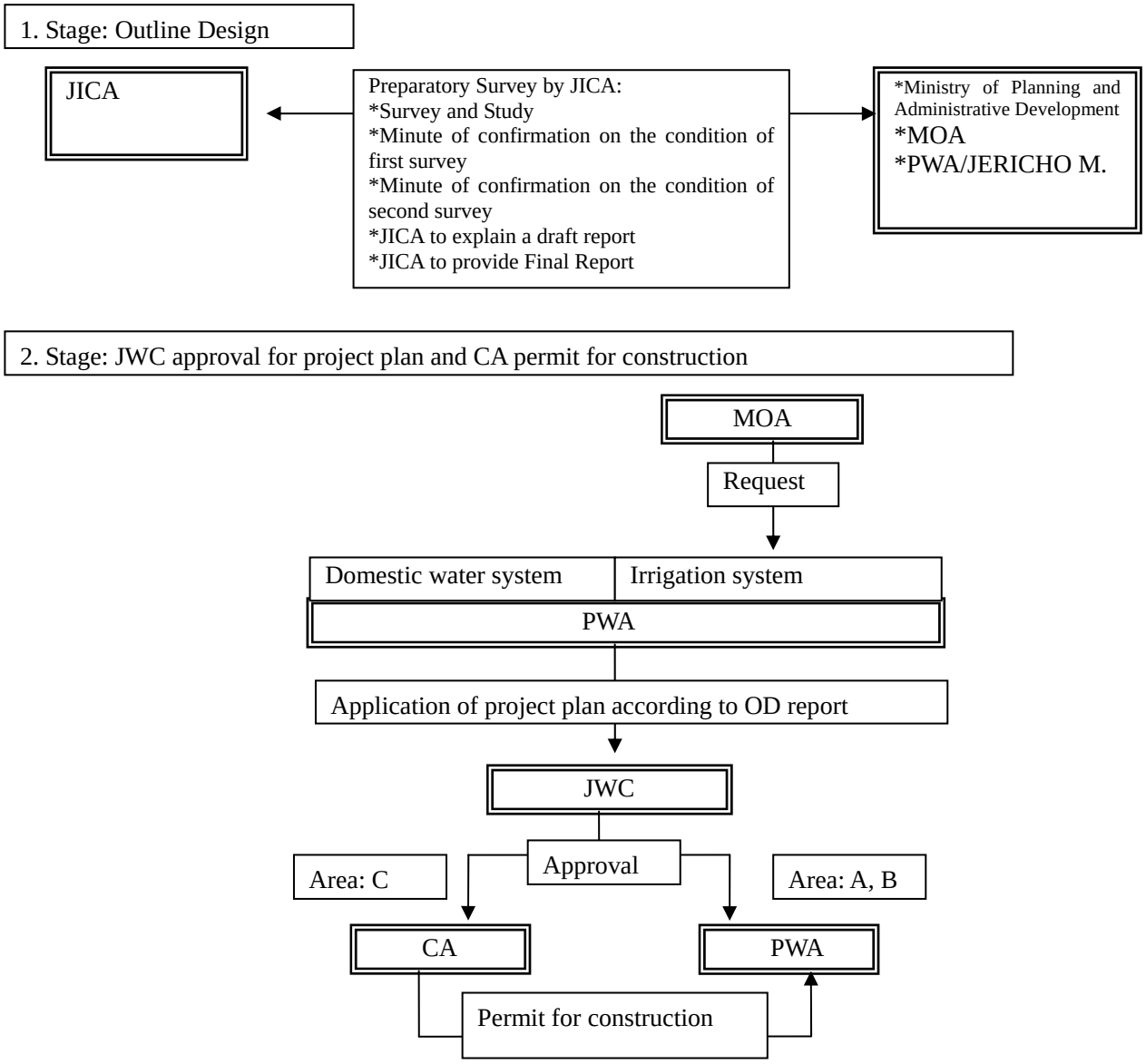


Figure 2-3-1 Implementation structure in project study stage and in approval for project plan

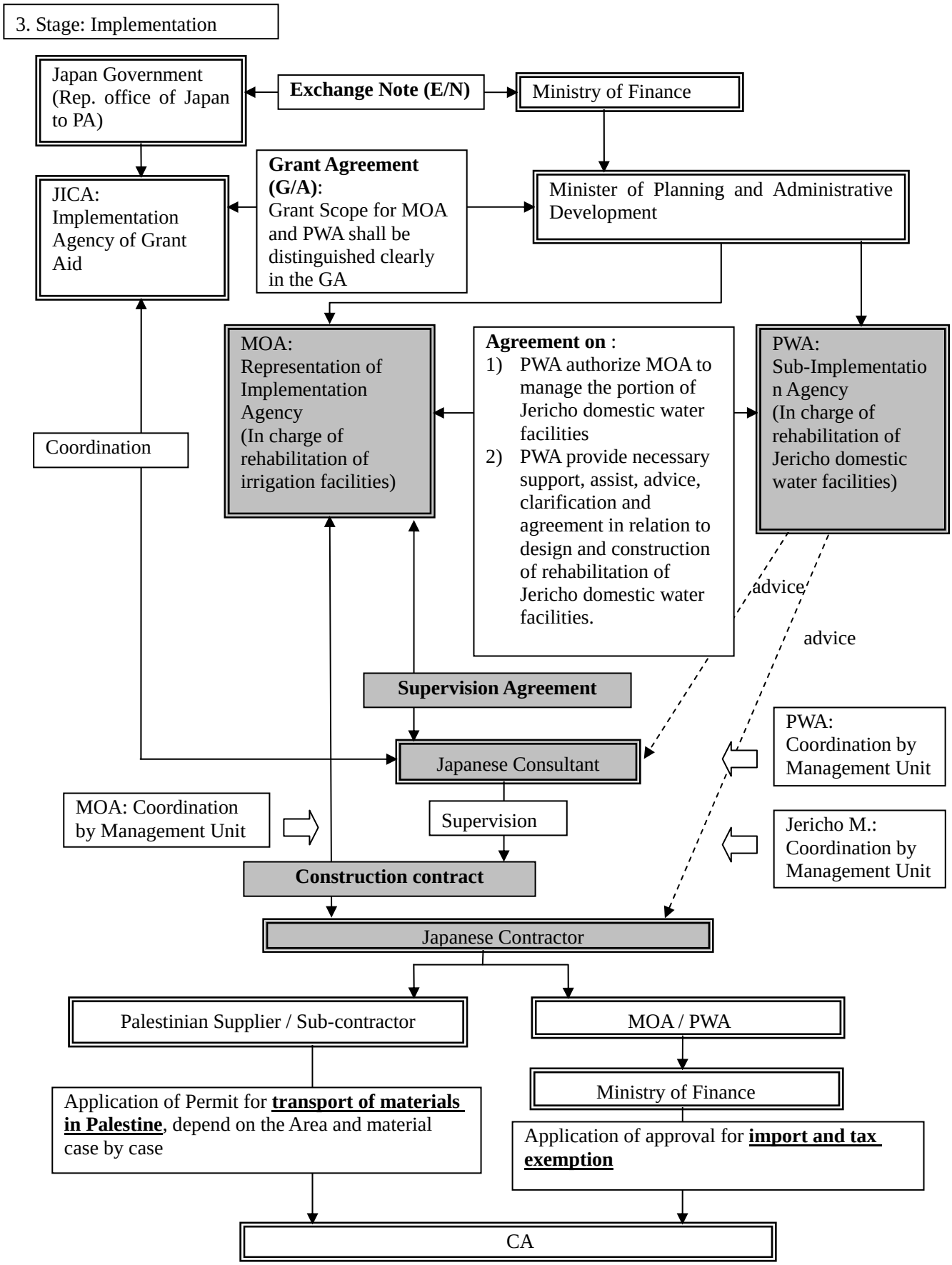


Figure 2-3-2 Implementation structure in implementation stage

2-3-2 Implementation Conditions

(1) Time required for local procurement of materials and equipment

According to information of the procurement period obtained during the field survey, well pump equipments take six months and other general equipments take one month from order to arrival in construction site. These are reflected to implementation schedule.

(2) Safety management plan and emergency contact system

This project will take the following measures into consideration in implementing the project.

1) Safety management plan shall be made up in order to respond measures for emergency
2) Communication network for emergency case shall be made up

2-3-3 Scope of Works

Considering the component and work place of construction, this project will make construction work and procurement plans as follows;

1) Reservoir construction and improvement of distribution systems for 25 irrigation sites
2) Rehabilitation of 9 well sites
3) Rehabilitation of Nwaimeh Spring Water Canal
4) Improvement of Domestic and Industrial Water Systems (Upgrading of Jericho No.1 well, construction of a new well and distribution pipelines from each wells)

2-3-4 Consultant Supervision

The scope of the consultant supervision includes detailed design, preparation of tender documents, tender and construction supervision. The Project consists of four(4) components as mentioned above, reservoir construction and improvement of distribution systems for 25 irrigation sites, rehabilitation of 9 well sites, Rehabilitation of Nwaimeh Spring Water Canal and improvement of Domestic and Industrial Water Systems. Personnel planning are corresponded the construction personnel system of contractor and construction supervision system of consultants.

2-3-5 Quality Control Plan

Item of foundation work and concrete construction to be covered by quality control plan under the construction supervision for the Project are shown in Table 2-3-1.

Table 2-3-1 Quality control plans

Work item	Control item	Methods	Frequency
Leveling work	Soil condition	Visual inspection	Every main part
	Width/ height	Measuring	Every main part
	Bearing capacity	Plate bearing test	Every main structure
Concrete	Aggregate	Grain sixe analysis	Every plant
	Cement	Quality certificate	Ones a month
	Concrete	Concrete chlorination test	Every shipping
		Water salty test	Ones a month
		Slump	Every part
		Compression test	Every part
		Schmidt hammer test	Small structures
Reinforcing	Strength	Tensile strength	Every supplier
	Arrangement position	Inspection	Every part
Structure	Dimensions	Measuring	Every main part

2-3-6 Procurement Plan

Procurement for major equipment / materials and construction machineries of this project are shown in Table 2-3-2. All equipment / materials and construction machineries are available in Palestinian market.

Table 2-3-2 Equipment/materials to be procured

Items	Sauce			Remarks
	Palestine	Japan	Third Country	
Structures				
1) Reinforcing bar	○			
2) Sand	○			
3) Aggregate	○			
4) Cement	○			
Well equipments (9 well sites, Domestic and Industrial Water Systems)				
1) Vertical pump	○			
2) Generator	○			
Pipes and Valves (25 irrigation sites, 9 well sites, Nwaimeh Spring Water Canal, Domestic and Industrial Water Systems)				
1) HDPE Pipe	○			
2) Steel Pipe	○			
3) Valves	○			
Reservoir Tanks (25 irrigation sites, 9 well sites)				
1) Corrugated steel board	○			

Table 2-3-3 Construction machineries to be procured

Items	Sauce			Remarks
	Palestine	Japan	Third Country	
Truck crane	○			4ton lift
Dump truck	○			10 t
Backhoe	○			0.35m^3
Well drilling machine	○			

2-3-7 Operation Guidance Plan

Operation guideline plan for Agricultural Water System Project is shown in Table 2-3-4. On 9 well rehabilitation sites, professional engineer will undertake initial O/M training to WUA O/M staffs focused on how to operate and maintain the new pumps/related accessories from the mechanical point of view. O/M training for whole irrigation system will be planned by soft component.

Table 2-3-4 Operation guideline plan for O/M (Agricultural Water System)

Facility	Trainee	Training items
9 wells (Well rehabilitation sites)	WUA O/M staffs (Well operation)	・O/M and inspection procedure of the pump ・O/M and inspection procedure of the flow meter, water level meter, and related accessories [Place] On site [Period] Total 9 days (1 day/well x 9 wells)

Operation guideline plan for Domestic and Industrial Water System Project is shown in Table 2-3-5. On new well and Jericho No.1 well, professional engineer will undertake initial O/M training to Jericho technical staffs focused on how to operate and maintain the new pumps/related accessories from the mechanical point of view.

Table 2-3-5 Operation guideline plan for O/M (Domestic and Industrial Water Systems)

Facility	Trainee	Training items
New well /Jericho No.1 well	Jericho O/M staffs (Well operation staff, O/M technicians)	・O/M and inspection procedure of the pump ・O/M and inspection procedure of the flow meter, water level meter, and related accessories ・O/M and inspection procedure of the chlorinator [Place] On site [Period] Total 2 days (1 day/well x 2 wells)

2-3-8 Soft Component Plan

Soft component is designed for undertaking technical support to WUA and MOA, in terms of 1)Technical support on water management and 2)Technical support on organization management enhancement.

In terms of 1)Technical support on water management, water management method is different according to the facility components. Therefore, soft component activities and achievements are designed with grouping by “Reservoir tank construction and distribution pipe rehabilitation sites” group and “Well rehabilitation sites” group.

On the other hand, in terms of 2)Technical support on organization management enhancement, expected WUA structure and operation rule are different according to the characteristic of community. Thus, soft component activities and achievements are designed with grouping by “Northern west bank area” group and “Jordan rift valley area” group.

Table 2-3-6 Grouping of the Target Sites by Facility Component and Area

		Grouping for Technical Assistance on Organization Management Enhancement		
		West Bank Area Group	Jordan Rift Valley Area Group	
Grouping for Technical Assistance on Water Management	Reservoir Tank Construction and Distribution Pipe Rehabilitation Sites group	Qalqilya 9 sites Tulkarem 10 sites	Nablus 4 sites Jericho 1 site Tubas 2 sites(※)	26 sites
		19 sites	7 sites	
	Well Rehabilitation Sites Group	Not Applicable	Nablus 2 sites Jericho 6 sites	8 sites
		0 site	8 sites	
		19 sites	15 sites	34 sites

(※): Both of the well rehabilitation component and the reservoir tank construction and distribution pipe rehabilitation component will be implemted at 1 site.

(1) Achievement of the technical assistance on water management (Target: WUA)

① 【Both group】
Necessary irrigational information will be consolidated and shared among farmers

② 【Both group】
Technical knowledge on water saving irrigation technique will be improved (by joint coordination with JICA technical cooperation project "The Project on Improved Extension for Value-Added Agriculture in the Jordan River Rift Valley")

③ 【Both group】
Efficient water management with utilizing water meter will be understood.

④ 【Reservoir tank construction and distribution pipe rehabilitation sites】
Effectiveness of the water reservoir tank will be understood.

⑤ 【Reservoir tank construction and distribution pipe rehabilitation sites】
Water management method with utilizing water reservoir tank will be mastered.

⑥ 【Well rehabilitation sites group】
Operation and maintenance method of well irrigation facility will be mastered.

⑦ 【Both group】
Irrigation water supply will be balanced with demand

(2) Achievement of the technical assistance on organization management enhancement (Target: WUA)

① 【Both group】
WUA will be established.

② 【Both group】

Role of the well owners and farmers will be clarified.

③ 【Both group】

WUA management system will be installed adequately.

④ 【Northern west bank area group】

Water fee collection system with utilizing water meter will be installed.

⑤ 【Jordan rift valley area group】

O/M cost sharing rate among WUA members will be agreed in WUA.

⑥ 【Both group】

Necessary O/M costs will be reserved in WUA.

⑦ 【Both category】

MOA's monitoring support system will be established.

Expected soft component activities are shown in Table 2-3-7.

Table 2-3-7 Soft Component Activity Plan

Component	Activities	Schedule
1. Technical assistance on water management	[For Achievement ①]【Both group】 Detail irrigation map will be drafted together with farmers through the participatory rural appraisal. Various information on the irrigation area, location of the main facility, pipeline route, inventory of the farmers, cropping pattern, and so on, will be consolidated in the map. The map will be utilized as the base map of the water distribution plan. The map will also contribute to common understanding among farmers for irrigation.	At detail design stage
	[For Achievement②]【Both group】 The study tour toward to model sites of the JICA technical cooperation project "The Project on Improved Extension for Value-Added Agriculture in the Jordan River Rift Valley" will be carried out. Participants will be expected to learn technical knowledge of water saving irrigation and related cropping/farming. Workshop will be held after the study tour to discuss about adaptation of learned technique to their own farm.	At beginning of the construction stage
	[For Achievement③]【Both group】 Through the workshop, water management expert will explain that existing on-firm water management method relied on only pump operation hours increases water losses and makes household income decreased. Water management expert will enlighten the efficient water use with utilizing water meter. Water management expert will also enlighten the suitable water volume management by each crop.	At construction stage/ At completion of construction stage
	[For Achievement④]【Reservoir tank construction and distribution pipe rehabilitation sites group】 Through the workshop, water management expert explain about the purpose of water reservoir tank, efficient use of water reservoir tank, and the superiority of irrigation system with utilizing water reservoir tank.	At construction stage
	[For Achievement ⑤]【Reservoir tank construction and distribution pipe rehabilitation sites group】 Water management expert will train WUA staffs how to draft the water management & O/M manual adapted to the irrigation system with utilizing water reservoir tank. Contents of the manual covers followings; ・ Irrigation and water distribution plan with utilizing water reservoir tank, ・ Operation and maintenance plan for the irrigation system consisting of well facility, water transmission facility, water reservoir tank and water distribution facility. The manual will be drafted by WUA staffs together with water management	At construction stage/ At completion of construction stage

Component	Activities	Schedule
	expert through the OJT training so that WUA staffs can update the manual by themselves in the future. At completion of construction stage, practical training will be carried out using with manual. The manual will be finalized reflecting actual operation.	
	[For Achievement ⑥]【Well rehabilitation sites group】 Water management expert will train WUA staffs how to draft the water management & O/M manual adapted to rehabilitated well facility. Contents of the manual covers followings; ・ Irrigation and water distribution plan adapting new pump capacity, ・ Operation and maintenance plan for the pumps, generator and other related facilities. The manual will be drafted by WUA staffs together with water management expert through the OJT training so that WUA staffs can update the manual by themselves in the future. At completion of construction stage, practical training will be carried out using with manual. The manual will be finalized reflecting actual operation.	At construction stage/ At completion of construction stage
	[For Achievement ⑦]【Both group】 Water management expert will review the water use volume comparing with license water volume and necessary irrigation water volume for rainy season and dry season. In accordance with the analysis result, water management expert will draft the annual water distribution plan together with WUA staff through OJT training for optimizing limited water volume. At trial operation of the facility, water management expert will train WUA staffs how to monitor and record the pumping water volume, storage water volume and distribution water volume by OJT training.	At construction stage/ At completion of construction stage
2. Technical assistance on organization management enhancement	[For Achievement ①,②]【Both group】 WUA establishment activities will be separated by two stages, orientation stage (at detail design stage) and WUA establishment stage (at commencement of construction stage). In the orientation stage, organization management expert will make a presentation to farmers about project outline, purpose, facility components, and concept of WUA in order to obtain the basic consensus from community. In particular, well owner's understanding is most important thing for successful WUA organizing. Therefore, the concept and role of WUA must be explained to well owner sufficiently. In the WUA establishment stage, WUA member registration, agreement of the basic policy of WUA regulation among members, will be made. WUA will be established officially with registration to the government.	At detail design stage
	[For Achievement ③]【Both group】 Through a series of workshop, the details of WUA operation system such as the organization structure, WUA regulation, annually and daily activity plan, meeting holding procedure, and so on, will be determined and consolidated to the WUA management manual. In accordance with the decided organization structure, WUA board members will be selected. Organization management expert will train selected board members for necessary activities. At completion of construction stage, practical training will be carried out using with manual. The manual will be finalized reflecting actual operation.	At construction stage/ At completion of construction stage
	[For Achievement ④, ⑥]【Northern west bank area group】 Regarding the northern west bank area group, water tariff system with utilizing water meter will be installed. In accordance with the calculation result of necessary O/M costs , new water tariff and collection frequency will be determined among WUA members. Practical training for water meter reading, water fee collection, receipt issuance and financial management will be carried out. Organization management expert will check actual financial record whether enough water tariffs are collected or not, comparing with the plan.	At construction stage/ At completion of construction stage
	[For Achievement ⑤,⑥]【Jordan rift valley area group】 Regarding the Jordan rift valley area group, water payment system will be basically adapted to the O/M cost sharing system among farmers and well owners. In accordance with the calculation result of necessary O/M costs, new	At construction stage/ At completion of construction stage

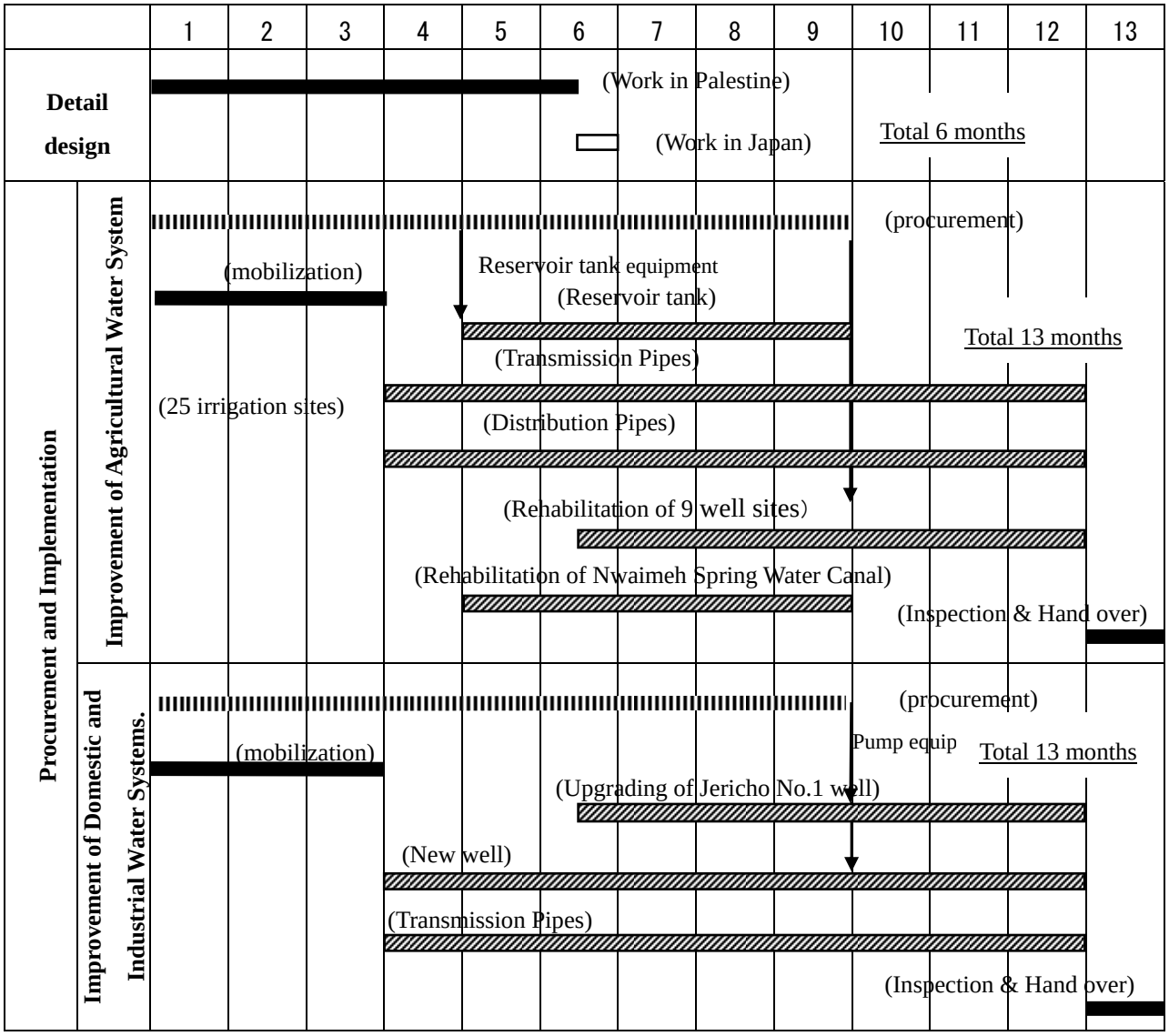
Component	Activities	Schedule
	O/M cost sharing rate will be determined among WUA members. Organization management expert will enlighten and train WUA staffs to record the collected income and O/M expenditure in the financial record book, and open it to WUA members. Organization management expert will check actual financial record whether enough amounts are collected or not, comparing with the plan.	
	[For Achievement ⑦]【Both group】 Organization management expert will discuss with MoA headquarter office and district office for the selection of department and persons to be in charge of WUA monitoring, at beginning of soft component implementation. Technical transfer of a series of organization management activities will be carried out to selected department and persons through OJT training. At completion of construction stage, organization management expert will support MoA headquarter office and district office to draft the annual WUA monitoring plan. Detail plan such as monitoring frequency, activity, budget, organization and so on, will be consolidated in the annual WUA monitoring plan.	At detail design stage/ At completion of construction stage

2-3-9 Implementation Schedule

Detail design stage takes six months for surveying of 25 irrigation sites, deepening and pumping test of 9 well sites, drilling new well of Domestic and Industrial Water Systems, field survey and detail design.

For procurement and implementation, mobilization takes three months after starting work, and pipe line works and concrete works will be carried out sequentially. Well pump equipments take six months from order to arrival in construction site. Since pipe line works of 25 irrigation sites are distributed five prefectures and extended, the number of parties should be increased to carry out. In addition, constructions schedule for Nwaimeh Spring Water Canal and Domestic and Industrial Water Systems are also reflected to decrease efficiency of works during heat wave period in Jericho. It is necessary to conclude E/N after approval from JWC and permit for construction from CA. Schedule for Implementation based on above are shown in Table 2-3-8.

Table 2-3-8 Schedule for Implementation



Improvement of Agricultural Water System will be implemented reservoir construction and improvement of distribution systems for 25 irrigation sites, rehabilitation of 9 well sites and Nwaimeh Spring Water Canal. And improvement of Domestic and Industrial Water Systems will be implemented upgrading of Jericho No.1 well, construction of a new well and construction of distribution pipelines from each wells.

2-4 Obligation of Recipient Country

In the case this project is implemented under the Japan's grant aid scheme, obligations to be undertaken by PA are shown in Table 2-4-1 during detailed design, preparation of construction, implementation and O/M for facilities and equipment to be procured under the Project.

Table 2-4-1 Obligation of recipient country

Common for Domestic, Industrial and Agricultural Water Systems	
1. To provide necessary data /information for detailed design and implementation for the Project	
2. To secure necessary lands for offices, stock yards for construction, etc.	
3. To secure access roads to construction sites before implementation	
4. To make arrangement for Banking arrangement (B/A) and Authorization to pay (A/P) and to bear their fees	
5. To take necessary actions on environmental assessment and to bear its cost	
6. To exempt Tax on products and services to be provided under the Project in PA	
7. To give guarantee for Japanese who work including entrance to PA and to secure safety during their stay in PA	
8. To make sure O/M for facilities to be constructed and procured under the Project	
9. To prepare fund for monitoring and following-up for facilities after implementation	
10. To secure transportation of construction materials in PA	
For Agricultural Water Systems	For Domestic and Industrial Water Systems
1) To construct fence of wells and water tanks 2) To make farmers consent of land occupying for construction of water tank 3) To make farmer consent of land occupying for transmission and distribution pipes 4) To prepare fund for MOA staff for implementation of Soft component including their salary, allowance, fuel etc. to be required.	1) To construct fence of wells 2) To provide necessary engineers of PWA and Jericho city PWA 3) To secure supervisors to be required for the project implementation including their salary, allowance, fuel etc. 4) To have consent of beneficiaries for mixing well water to spring

2-5 Project Operation Plan

2-5-1 Operation and Maintenance Plan for the Agricultural Water System Project

(1) Operation and Maintenance Plan for Well Irrigation Site (9 Wells rehabilitation sites, 25 Irrigation sites)

Operation and maintenance of the wells and irrigation facilities after the construction/rehabilitation will be undertaken by WUA. MOA district office will be responsible for the monitoring and technical support to WUA, directly. MOA headquarter office will coordinate their monitoring and technical support activities. WUA will be established by each well irrigation sites. WUA board members will be selected by the election or discussion among WUA members. WUA board members will be responsible for actual management of the well irrigation system. Expected WUA structure in the plan is shown in Figure 2-5-1.

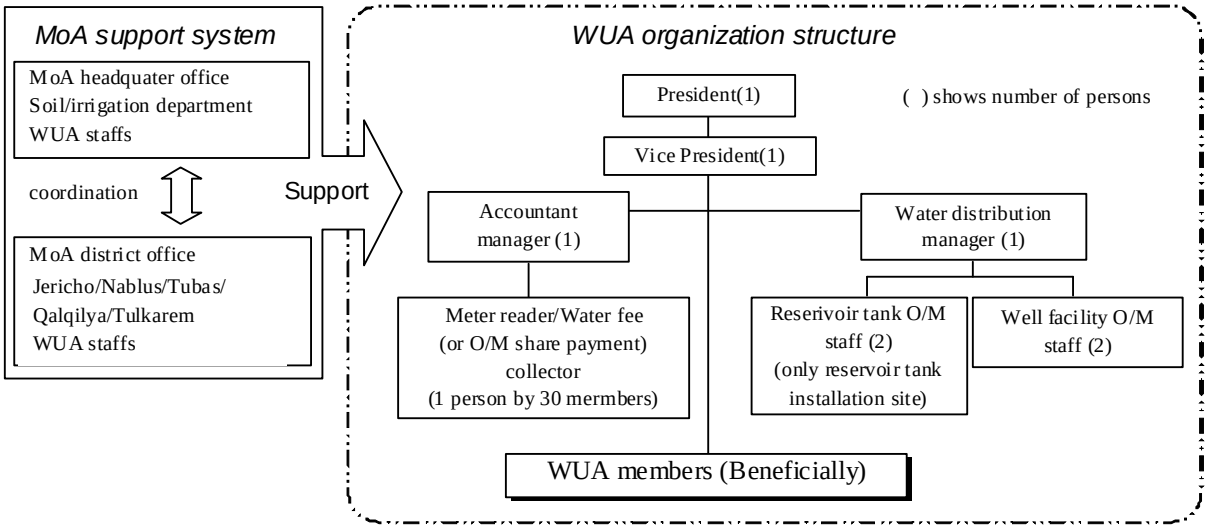


Figure 2-5-1 Expected WUA Structure for Well Irrigation System
(9 well sites, 25 irrigation sites)

Expected operation and maintenance activities are shown in Table 2-5-1. O/M activities are consisted from WUA organizational management, WUA's daily and periodical O/M activities and MOA's monitoring activity.

Table 2-5-1 O/M Plan for Well Irrigation Facility (9 well sites, 25 irrigation sites)

Responsible	Category	O/M activities
WUA	Management of WUA	・ Holding WUA regular meeting ・ Meter reading and water fee (or O/M cost sharing payment) collection ・ Financial management ・ Management of the WUA regulation, WUA member list, etc.
	Management of water quantity/water distribution	・ Drafting the annual/daily water distribution plan ・ Recording the actual water distribution volume ・ Recording the groundwater level in the well ・ Practice of the water saving irrigation
	O/M of well facility	・ Actual pump operation in accordance with the water distribution plan ・ Recording the pump operation hours and pump discharge rate ・ Daily maintenance/inspection ・ Periodical maintenance/inspection, replacement of the spare parts (lubricants, pump seal, etc)
	O/M of reservoir tank (only reservoir tank installation site)	・ Water division operation from reservoir tank to main pipeline and recording ・ Periodical cleaning of the reservoir tank ・ Periodical maintenance/inspection, replacement of the spare parts (Internal plastic seat, etc)
MOA	WUA monitoring support (Once a quarter of the year)	・ Confirmation of WUA activity record ・ Confirmation of financial record ・ Monitoring of O/M activity for facilities ・ Confirmation of the water distribution record (difference between actual volume and license water volume) ・ Monitoring of the practice condition of water saving irrigation ・ Technical advice to WUA

(2) Operation and Maintenance Plan for Nwaimeh spring canal

Operation and maintenance for Nwaimeh spring canal after rehabilitation will be undertaken by Nwaimeh village council and water management committee jointly as same as present system. Nwaimeh village council takes a stance that the village council should be responsible for the maintenance of overall canal system because village council is taking water for domestic water supply with no charge from water management committee. Thus, village council will keep their role of the maintenance of overall canal system. Water management committee will be responsible for water distribution. Expected O/M activities are shown in Table 2-5-2.

Table 2-5-2 O/M Plan for Nwaimeh Spring Canal

Responsibility	Purpose	Category	O/M activity
Village council	Overall	Overall	・ Drafting the overall O/M plan and implementation ・ Water tariff collection and book keeping (for domestic water) ・ Management of water right member list
	Overall	Water quantity management	・ Water flow monitoring (Water volume for domestic water and irrigation water)
	Drinking	O/M of the intake facility and water distribution facility	・ Cleaning of the grit chamber and water reservoir tank ・ Operation of the pump facility, daily/periodically maintenance and repair work ・ Purchasing the disinfectant ・ Replacement of the spare parts
	Irrigation	O/M of main canal	・ Periodical patrol inspection of the pipeline (leakage check) ・ Periodical inspection/repair work for valves
Water management committee (organized by water right holders)	Irrigation	Water distribution of main canal	・ Drafting the water distribution plan ・ Valve operation in accordance with the water distribution plan

Note) Thick-frame shows necessary O/M works related to the rehabilitated facilities by the project

2-5-2 Operation and Maintenance Plan for Domestic and Industrial Water System Project

Operation and maintenance after construction/rehabilitation wells will be undertaken by technical maintenance department under service division in Jericho city office. New supervisor for daily operation, inspection and cleaning work in the Jericho No.1 well and new well will be needed, respectively. Periodical inspection and repair works will be undertaken by maintenance engineers under technical maintenance department. Overall management for O/M works will be controlled by the manager of technical maintenance department.

Table 2-5-3 O/M Staff Allocation Plan for Jericho No.1 Well and New Well

Category	Daily Operation/ Inspection/Supervision/ Cleaning	Periodical Inspection/ Repair works
1. Jericho No.1 well	Supervisor (1 staff, new allocation)	Technical maintenance department (6 staffs)
2. New well	Supervisor (1 staff, new allocation)	
3. Overall management	Manager of technical maintenance department	

Operation and maintenance activities to be undertaken are shown in Table 2-5-4. Technical maintenance department is undertaking O/M works for similar facilities in present, thus there is no technical difficulties for O/M works.

Table 2-5-4 O/M Activity plan for Jericho No.1 well and New well

Category	Daily Operation/ Cleaning/Inspection	Periodical Inspection/Repair works
1. Jericho No.1 well	・ Pump operation and recording ・ Chlorinator operation and recording ・ Observation of water flow meter/ water level meter and recording ・ Daily inspection of the equipments ・ Cleaning of the pump room	・ Periodical inspection of the equipments ・ Replacement of the spare parts (lubricants, pump seal, etc) ・ Operation check and adjustment of water flow meter and water level meter
2. New well		
3. Overall management	・ Drafting and management of the water distribution plan ・ Management of the working record ・ Management of the daily/periodically inspection record	

2-6 Project Cost Estimation

2-6-1 Initial Cost Estimation

The total cost to be incurred by the subject project implementation is about 1,497 Million Japanese Yen (Japanese side 1,486 Million Japanese Yen and PA side 11 Million Yen), with detailed items as born by both Japan and PA side based on the demarcated obligation as discussed above. The estimation was done applying the estimation conditions as indicated below. The amount estimated, however, does not indicate the ceiling limit in the E/N to be signed.

(1) Cost to be born by Japanese side

Table 2-6-1 Total project cost under grant aid

Total cost estimated Approx.1,486 Million Yen

Cost items			Amount	
Facilities	Improvement of Agricultural Water System	25 irrigation sites (24 reservoir constructions, transmission pipelines of 17 km, distribution pipes of 36 km)	755	1,004
		9 well sites (rehabilitation of 9 well sites, 1 reservoir construction, transmission & distribution pipes of 1.1 km)	166	
		Rehabilitation of Nwaimeh Spring Water Canal (4.1 km)	83	
	Improvement of Domestic and Industrial Water Systems	Upgrading of Jericho No.1 well, (and construction of distribution pipelines 3.9km)	136	199
		Construction of a New well (and construction of distribution pipelines 1.8 km)	63	
Design/supervision/soft component				283
Cost of Contingency				To be confirmed

(2) Cost to be born by government of Palestine : 505,000 NIS (Approx. 11 Million Yen）

1) Land reservation for the temporary, such as stockyard etc. (land lent).	NIS	27,000	(0.6 Million Yen)
2) Commission for Banking Arrangement and A/P	NIS	33,000	(0.7 Million Yen)
3) Construction of fences around the Well facilities and reservoir	NIS	130,000	(2.9 Million Yen)
4) Land preparation for 24 Reservoir constructions	NIS	152,000	(3.4 Million Yen)
5) Cost required by implementation for soft component (a salary, a daily allowance, an on-site allowance, vehicle fuel cost)	NIS	163,000	(3.6 Million Yen)

(3) Estimation conditions

1) Estimation made at : December 2011
2) Exchange rate : 1USD = 79.09 Yen = 3.57 NIS (1 NIS = 22.15 Yen)
3) Construction period/
   Procurement period : As shown in the implementation schedule
4) Others : Cost estimation was made in accordance with the guidelines adopted for the grant aid and project by GOJ

2-6-2 Operation and Maintenance Cost

2-6-2-1 Operation and Maintenance Cost for Agricultural Water System Project

(1) O/M Cost for well irrigation sites (9 well rehabilitation sites, 25 irrigation sites)

Annual O/M cost after the construction/rehabilitation of the facilities in 9 well rehabilitation sites are calculated as shown in Table 2-6-2. Main O/M cost of 9 well rehabilitation sites is the running cost of well pump operation. O/M cost per $1m^3$ irrigation water is calculated as 0.88 NIS/m^3. On the other hand, average water price in the project area is around 1.30 NIS/m^3 according to the sub-contract survey result. Therefore, necessary O/M cost can be secured by same level of water fee setting in present. Annual pump operation hours are calculated by "License water volume / Pump discharge rate".

Annual O/M cost after the construction/rehabilitation of the facilities in 25 irrigation sites are calculated as shown in Table 2-6-3. Main O/M costs for 25 irrigation sites are the maintenance cost of reservoir tank and the running cost of booster pump (in case of booster pump installation site). O/M cost per $1m^3$ irrigation water is calculated as 0.06 NIS/m^3. While the O/M cost for the reservoir tank will be added to present O/M cost of existing well pump operation, additional amounts will be quite small. Therefore, necessary O/M cost can be secured by same level of water fee setting in present.

Table 2-6-2 Annual O/M Cost for 9 Well Rehabilitation Sites

District	Well No.	License water volume (m^3)	Well pump specification	O/M Items	Annual O/M cost (NIS)	Remarks
Nablus	18-18/019	131,000	80m^3/hr×270m×100kW	Electricity for pump operation	86,814	Electricity use, Pump motor 100kW x Operation hours 1,638hrs/year x 0.53NIS/kWh
				Repair, spare pars for pump	9,827	Pump lubrication, sealing material, etc (Estimated as equipment cost 27,568NIS x 3%)
				Sub-total	96,641	
Nablus	18-18/027A	30,000	80m^3/hr×440m×160kW	Electricity for pump operation	29,812	Electricity use, Pump motor 150kW x Operation hours 375hrs/year x 0.53NIS/kWh
				Repair, spare pars for pump	11,231	Pump lubrication, sealing material, etc (Estimated as equipment cost 374,364NIS x 3%)
				Sub-total	41,403	
Jericho	19-14/058B	59,000	50m^3/hr×170m×40kW	Electricity for pump operation	25,016	Electricity use, Pump motor 40kW x Operation hours 1,180hrs/year x 0.53NIS/kWh
				Repair, spare pars for pump	5,475	Pump lubrication, sealing material, etc (Estimated as equipment cost 182,502NIS x 3%)
				Sub-total	30,491	
Jericho	19-17/012	78,630 ※1	70 m^3/hr×130m×40kW	Electricity for pump operation	23,808	Electricity use, Pump motor 40kW x Operation hours 1,123hrs/year x 0.53NIS/kWh
				Repair, spare pars for pump	6,570	Pump lubrication, sealing material, etc (Estimated as equipment cost 219,002NIS x 3%)
				Sub-total	30,378	
Jericho	19-17/033	56,000	70m^3/hr×190m×60kW	Electricity for pump operation	88,256	Diesel generator use (120HP), Diesel 28L/hr x Operation hours 800hrs/year x 3.94NIS/L
				Repair, spare pars for pump	5,615	Pump lubrication, sealing material, etc (Estimated as equipment cost 187,182NIS x 3%)
				Repair, spare pars for generator	2,970	Diesel generator spare parts, etc (Estimated as equipment cost 99,000NIS x 3%)
				Sub-total	96,841	
Tubas	19-20/001A	16,000	40m^3/hr×250m×50kW	Electricity for pump operation	28,368	Diesel generator use (90HP), Diesel 18L/hr x Operation hours 400hrs/year x 3.94NIS/L
				Repair, spare pars for pump	5,615	Pump lubrication, sealing material, etc (Estimated as equipment cost 187,182NIS x 3%)
				Repair, spare pars for generator	2,700	Diesel generator spare parts, etc (Estimated as equipment cost 90,000NIS x 3%)
				Sub-total	36,683	
Jericho	20-17/022	73,000	60m^3/hr×130m×40kW	Electricity for pump operation	81,514	Diesel generator use (75HP), Diesel 17L/hr x Operation hours 1,217hrs/year x 3.94NIS/L
				Repair, spare pars for pump	6,739	Pump lubrication, sealing material, etc (Estimated as equipment cost 224,618NIS x 3%)
				Repair, spare pars for generator	2,160	Diesel generator spare parts, etc (Estimated as equipment cost 72,000NIS x 3%)
				Sub-total	90,413	
Jericho	19-17/056	330,000	70m^3/hr×180m×60kW	Electricity for pump operation	174,889	Electricity use, Pump motor 70kW x Operation hours 4,714hrs/year x 0.53NIS/kWh
				Repair, spare pars for pump	8,142	Pump lubrication, sealing material, etc (Estimated as equipment cost 271,413NIS x 3%)
				Sub-total	183,031	
Jericho	19-17/007	39,000	100m^3/hr×120m×60kW	Electricity for pump operation	33,805	Diesel generator use (105HP), Diesel 22L/hr x Operation hours 390hrs/year x 3.94NIS/L
				Repair, spare pars for pump	5,615	Pump lubrication, sealing material, etc (Estimated as equipment cost 187,182NIS x 3%)
				Repair, spare pars for generator	2,970	Diesel generator spare parts, etc (Estimated as equipment cost 99,000NIS x 3%)
				Sub-total	42,390	
Total		690,503			647,911	
				O/M cost per 1m^3 (NIS)	0.88	Σ Annual O/M cost / Σ License water volume
				Water price in present (for reference)	1.30	From sub-contract survey result (average rate of 26 irrigation sites)

※1: Adapted the annual necessary irrigation water volume instead of the license water volume because the license water volume is unclear.

Table 2-6-3 Annual O/M Cost for 25 Irrigation Sites

District	Irrigation site	License water volume (m^3)	Facility specification	O/M Items	Annual O/M cost (NIS)	Remarks
Tubas	Bardala	323,578 ※1	Reservoir tank: V=700m^3	Repair, spare parts for reservoir tank	5,370	Replacement of plastic seat, etc (Estimated as equipment cost 107,400NIS x 5%)
			Booster pump: 45m^3/h x	Electricity for pump	38,107	Electricity use, Pump motor 10kW x Operation hours 7,190hrs x 0.53 NIS/kWh
			20m x 10kW	Repair, spare parts for booster pump	486	Pump lubrication, sealing material, etc (Estimated as equipment cost 16,200NIS x 3%)
				Sub-total	43,963	
Qalqilya	Jayyus plain 1	124,000	Reservoir tank: V=1,100m^3	Repair, spare parts for reservoir tank	7,650	Replacement of plastic seat, etc (Estimated as equipment cost 153,000NIS x 5%)
Qalqilya	Jayyus plain 2	95,000	Reservoir tank: V=700m^3	Repair, spare parts for reservoir tank	5,370	Replacement of plastic seat, etc (Estimated as equipment cost 107,400NIS x 5%)
Qalqilya	Falamya	176,000	Reservoir tank: V=600m^3	Repair, spare parts for reservoir tank	4,800	Replacement of plastic seat, etc (Estimated as equipment cost 96,000NIS x 5%)
Qalqilya	An Nabi Elyas	224,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Qalqilya	Haabla 1	154,000	Reservoir tank: V=600m^3	Repair, spare parts for reservoir tank	4,800	Replacement of plastic seat, etc (Estimated as equipment cost 96,000NIS x 5%)
Qalqilya	Haabla 2	108,000	Reservoir tank: V=600m^3	Repair, spare parts for reservoir tank	4,800	Replacement of plastic seat, etc (Estimated as equipment cost 96,000NIS x 5%)
Qalqilya	Al Syaykh Ahmad	89,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Qalqilya	Izbat Salman	153,000	Reservoir tank: V=1,000m^3	Repair, spare parts for reservoir tank	7,080	Replacement of plastic seat, etc (Estimated as equipment cost 141,600NIS x 5%)
Qalqilya	Qalqiliya city 2	163,000	Reservoir tank: V=600m^3	Repair, spare parts for reservoir tank	4,800	Replacement of plastic seat, etc (Estimated as equipment cost 96,000NIS x 5%)
Tulkarem	Qaffin	151,000	Reservoir tank: V=900m^3	Repair, spare parts for reservoir tank	6,510	Replacement of plastic seat, etc (Estimated as equipment cost 130,200NIS x 5%)
Tulkarem	An Nazia al Gharbiya	345,000	Reservoir tank: V=900m^3	Repair, spare parts for reservoir tank	6,510	Replacement of plastic seat, etc (Estimated as equipment cost 130,200NIS x 5%)
Tulkarem	Attil	299,000	Reservoir tank: V=900m^3	Repair, spare parts for reservoir tank	6,510	Replacement of plastic seat, etc (Estimated as equipment cost 130,200NIS x 5%)
Tulkarem	Thennabeh	123,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Tulkarem	Irtah	163,000	Reservoir tank: V=900m^3	Repair, spare parts for reservoir tank	6,510	Replacement of plastic seat, etc (Estimated as equipment cost 130,200NIS x 5%)
Tulkarem	Farun	110,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Tulkarem	Kafr Zibad	146,000	Reservoir tank: V=700m^3	Repair, spare parts for reservoir tank	5,370	Replacement of plastic seat, etc (Estimated as equipment cost 107,400NIS x 5%)
			Booster pump: 81m^3/h x	Electricity for booster pump	38,202	Electricity use, Pump motor 40kW x Operation hours 1,802hrs x 0.53 NIS/kWh
			75m x 40kW	Repair, spare parts for booster pump	675	Pump lubrication, sealing material, etc (Estimated as equipment cost 22,500NIS x 3%)
				Sub-total	44,247	
Tulkarem	An Nazia al Sharqiya	68,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Tulkarem	Dir al gsoon	352,000	Reservoir tank: V=1,100m^3	Repair, spare parts for reservoir tank	7,650	Replacement of plastic seat, etc (Estimated as equipment cost 153,000NIS x 5%)
Tulkarem	Ektaba	225,000	Reservoir tank: V=800m^3	Repair, spare parts for reservoir tank	5,940	Replacement of plastic seat, etc (Estimated as equipment cost 118,800NIS x 5%)
Nablus	An Nassarya	130,000	Reservoir tank: V=700m^3	Repair, spare parts for reservoir tank	5,370	Replacement of plastic seat, etc (Estimated as equipment cost 107,400NIS x 5%)
Nablus	An Nassarya	69,000	Reservoir tank: V=900m^3	Repair, spare parts for reservoir tank	6,510	Replacement of plastic seat, etc (Estimated as equipment cost 130,200NIS x 5%)
Nablus	Frush Beit Dajan 1	91,000	Reservoir tank: V=400m^3	Repair, spare parts for reservoir tank	3,660	Replacement of plastic seat, etc (Estimated as equipment cost 73,200NIS x 5%)
Nablus	Frush Beit Dajan 2	46,000	Reservoir tank: V=700m^3	Repair, spare parts for reservoir tank	5,370	Replacement of plastic seat, etc (Estimated as equipment cost 107,400NIS x 3%)
Jericho	Marj Naja	205,000	Booster pump: 96m^3/h x	Electricity for booster pump	45,262	Electricity use, Pump motor 40kW x Operation hours 2,135hrs x 0.53 NIS/kWh
			50m x 40kW	Repair, spare parts for booster pump	945	Pump lubrication, sealing material, etc (Estimated as equipment cost 31,500NIS x 3%)
				Sub-total	46,207	
Total		3,829,000			263,957	
				O/M cost per 1m^3 (NIS)	0.06	Σ Annual O/M cost / Σ License water volume
				Water price in present (for reference)	1.30	From sub-contract survey result (average rate of 26 irrigation sites)

※1: Adapted the annual necessary irrigation water volume instead of the license water volume because the reservoir tank will be utilized for a part of license water volume.

(2) O/M Cost for Nwaimeh Spring Canal

Nwaimeh spring canal will be changed to open-closed type pipeline system. Pump system will be not installed, but spring water will be delivered by gravity. Therefore, direct running cost, such as the electricity cost for pump operation, will be not necessary. While the direct running cost is not necessary, Nwaimeh village council should accumulate around 1% of the project cost annually for the repair, maintenance and updating of the pipeline system in the future.

Table 2-6-4 Annual O/M Cost for Nwaimeh Spring Canal (for Irrigation Canal)

Items	Annual O/M cost (NIS)	Remarks
Repair, maintenance and updating of the pipeline system and related valves	25,617	Estimated as the project cost x 1%
Total	25,617	

On the other hand, Nwaimeh village council's financial condition in 2011 is shown in Table 2-6-5. Table shows that necessary O/M cost mentioned above will be covered by the profit from domestic water supply services.

Table 2-6-5 Financial Condition of the Nwaimeh Village Council in 2011

	Item	Amount (NIS)
Income	Water tariff collection on domestic water supply service	679,104
	Others	173,707
	Income total	852,811
Expenditure	Staff salary	146,406
	O/M cost for domestic water supply system	236,373
	Others	217,849
	Expenditure total	600,628
Balance (Profit)		252,183

Source: Nwaimeh village council

2-6-2-2 Operation and Maintenance Cost for Domestic and Industrial Water System Project

Annual O/M costs for the Jericho No.1 well and new well are shown in Table 2-6-6. Chlorination cost is not allocated for new well because new well will be used for irrigation purpose.

Table 2-6-6 Annual O/M cost for Jericho No.1 Well and Newly construction well

Facility	Pump Specification	O/M Item	Annual O/M cost (NIS)	Remarks
Jericho No.1 well	180m^3/hr x 200m x 210kW	Staff cost (new hiring)	26,256	Supervisor: 26,256 NIS/year x 1 person
		Electricity for pump	812,490	Pump motor 210kW x 20hrs operation/day x 365days x 0.53NIS/kWh
		Chlorination	197,110	Sodium hypochlorite (as 12% concentration, injection rate 2mg/l) 45 kg/day x 365days x 12 NIS/kg
		Repair, spare parts for pump	9,585	Pump lubrication, sealing material, etc (Estimated as equipment cost 19,500NIS x 3%)
		Sub-total	1,035,856	
New well	40m^3/hr x 200m x 210kW	Staff cost (new hiring)	26,256	Supervisor: 26,256 NIS/year x 1 person
		Electricity for pump	154,760	Pump motor 40kW x 20hours operation/day x 365days x 0.53NIS/kWh
		Repair, spare parts for pump	6,480	Pump lubrication, sealing material, etc (Estimated as equipment cost 216,000NIS x 3%)
		Sub-total	187,496	
		Grand total	1,223,352	

On the other hand, Jericho city water supply service sector's financial condition is shown in Table 2-6-7. Table shows that necessary O/M cost will be covered by the profit from water tariff collection on the existing water supply facilities and new construction/rehabilitation facilities by the project.

Table 2-6-7 Expected Financial Condition of Jericho City Water Sector after Project Implementation

	Item	Annual amount (Thousand NIS)	Remarks
Income	Water tariff collection on existing domestic water supply facilities	3,221	Actual amount from 2008 to 2011 (Average)
	Water fee collection on existing irrigation facilities	535	Actual amount from 2008 to 2011 (Average)
	Others	418	Actual amount from 2008 to 2011 (Average)
	Water tariff collection on new construction/rehabilitation facilities by the project	1,024	Water distribution quantity: 1,205 thousand m^3/day (220m^3/day x 20hrs/day x 365day x leakage rate 25%) as water price 1 NIS/m^3, collection rate 85%
	Income total	5,198	
Expenditure	Staff salary	1,247	Actual amount from 2008 to 2011 (Average)
	O/M cost for existing facilities	903	Actual amount from 2008 to 2011 (Average)
	Others	413	Actual amount from 2008 to 2011 (Average)
	O/M cost for new construction/ rehabilitation facilities	1,224	Refer to Table 3-6-2-2-1
	Expenditure total	3,787	
Balance (Profit)		1,411	

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3-1 Pre-conditions

(1) Agricultural Water System

Pre-conditions for the Project implementation are shown in Table 3-1-1.

Table 3-1-1 Pre-conditions on the Scheme for Agricultural Water System

Pre-conditions	Present situation on procedure
Before implementation	
1) Civil Administration (CA) of Israel examines contents of improvement plan of each site and permits their construction.	Before E/N, after GOJ approves the Project implementation under Japan's grant aid scheme, MOA should apply to CA showing contents of plan including location of well, length to be improved of transmission/distribution pipeline, reservoir with specification outline, etc. and obtain CA permits.
2) Land owner should agree to provide land for reservoir construction by written agreement.	Target areas for improvement with reservoir construction were selected in the basis on consent of land owner during the preparatory survey. Written agreements in each target site, however, are required for the implementation.
During implementation	
3) JWC has no objection to the deepening of nine(9) well sites which has already been approved by JWC.	JWC approval for deepening is not required any more since 9 well sites were selected from the area where necessary procedure for approval has already been taken during the preparatory survey.
4) Israel side does not obstruct on transporting necessary construction material from Israel and/or within PA territory.	In spite CA permits construction with reference to the above 1), it is a common scene that Israel military stops the transportation for construction materials on the road.
5) Israel military does not restrict construction of transmission/distribution pipelines around the separate walls constructed by Israel.	5 construction sites located in/out side of the separate wall should be taken into consideration during implementation stage.
6) In relation with sharing the use of well, consent of well owner and beneficiaries is written in the WUA by-law (Operation Manual).	Right of use for 9 well sites belonging to limited well owners should be co-operated with beneficiaries since target wells are rehabilitated under Japan's Grant Aid Scheme.

(2) Domestic and Industrial Water Systems

Pre-conditions for the Project implementation are shown in Table 3-1-2.

Table 3-1-2 Pre-conditions on the Scheme for Domestic and Industrial Water Systems

Pre-conditions	Present situation on procedure
Before implementation	
1) JWC approves a new well construction.	It was expected JWC would approve it by December 2011, however, has not been done yet as of May 2012. Water source for the Scheme for Domestic and Industrial Water Systems under Japan's grant aid, therefore, has not secured yet.
2) Construction of the facilities for Jericho No.1 well such as pump house, electrical distribution panel, fence and so on shall resume.	Approval for the construction being done by WBWD is not obtained from CA. Therefore, upgrade for Jericho No.1 well from 60 to 180 m^3/hr under Japan's grant aid, cannot be executed at this moment.
3) Consent to SWAP is given between Jericho municipality (domestic use) and Water society (agricultural use).	It may take a lot of time to obtain agreement between Jericho municipality and the Society due to the discord upon distribution rate to domestic and agricultural water use.

3-2 Necessary Inputs by Recipient Country

(1) Agricultural Water System

Irrigation methodology through reservoir to be constructed under the Project is aiming to effectiveness use of available water resources in PA will be new concept for well owner and beneficiaries. Available irrigation water to agricultural farm is restricted by pump operation time at present. After the project implementation, though irrigation volume by utilization of reservoir will be monitored through water meter to be installed, coordination between well owner and beneficiaries as well as among farmers are essential for water management, O&M (operation and maintenance) of the facilities by utilization of water in the reservoir. Since soft component plan may assist the above necessary managements, MOA should take necessary arrangements such as providing technical staff and shouldering the expense for those activities.

And it requires that consent of beneficiaries on use of facilities to be improved and/or constructed under the Project such pump, well, reservoir, etc. in cooperation with well owner and farmers. Also those consents should be clearly mentioned on O&M manual, WUA by-law being prepared through the soft component plan.

(2) Domestic and Industrial Water Systems

Project of JAIP should be completed successfully for realization of “Corridor for Peace and Prosperity” conception. PA is requested to provide necessary personnel for diplomatic handling with government of Israel for securing water sources, namely; Jericho No.1 well and a new well for Jericho city as well as JAIP,

3-3 Important Assumptions

(1) Agricultural Water System

Effect of the Project should be sustained in cooperation with on going JICA TA program (Improved Extension for Value-added Agriculture in the Jordan River Valley). Since training program to medium and small-sized farmers’ group on saving water, farming technology, value-added agriculture, marketing, extension and etc. under the JICA TA will be useful for the subjected project beneficiaries, “study tours” to the JICA TA program may be conducted through the soft component under the Project.

The above medium and small-size target farmers’ groups under TA program are expected as a base for agricultural products for JAIP. Accordingly, JAIP (stage 1 is scheduled to complete in 2012) which is one of the core projects for “Corridor for Peace and Prosperity” conception should be continuously accepted by PA.

(2) Domestic and Industrial Water Systems

Due to the fact that it is still illegible whether JWC concerned by Israel gives approval for the construction of a new well and CA’s performance of handling to Jericho No.1 well, however, realization of the scheme on Domestic and Industrial Water Systems improvement is not feasible at this moment. Toward to realize the

conception which is ODA policy of GOJ to PA, namely; “Corridor for Peace and Prosperity”, GOJ should continue steadily to negotiate with the Government of Israel.

3-4 Project Evaluation

3-4-1 Relevance

(1) Agricultural Water System

Agriculture in PA is one of the key industries such as GDP by 5.6% and to employment rate by 11.2%, in addition to its contribution to the national commodity exports rate by 12.2% and is expected being base of food security and economic development of PA. However, agricultural infrastructures sourced by well and spring are declined due to overage and/or deterioration. In addition, water source is not utilized effectively by leakage from pipeline systems of transmission / distribution with inappropriate water utilization, urgent measures for improvement and rehabilitation of irrigation facilities are required.

Concerned the above situations, in accordance with "Palestine Fundamental Principles (The 13th)" that prioritizes economic development and public infrastructure development, “Palestinian National Development Plan (2011-13)” put importance on the extension of arable farm land from 150,000 ha to 160,000 ha by improving existing irrigation systems sourced by well and spring.

Sub-projects of Improvement for Agricultural Water System, namely, 1) 25 irrigation sites, 2) 9 well sites and 3) Nwaimeh spring canal targets 1,724 ha of irrigation area in total, which occupies 22% of irrigable area 7,680 ha in Jericho, Tubas, Nablus, Tulkarem, Qalqiliya and Jenin districts in the West Bank, and covers 4,480 agricultural households (approx. 24,400 people).

And water utilization in PA depends on groundwater (well) about 75%, by the Oslo Accords II (1995) with government of Israel. The volume of annual water use is limited within 121 MCM (20% of available groundwater) in PA out of 607 MCM/year that is produced from the aquifer which Palestine side can access.

By the improvement of well facilities, transmission / distribution pipeline systems and spring canal, it is expected to be better irrigation efficiency to reduce leakages and un-used water, and reservoir to be constructed makes flexible irrigation timing and duration. Also, soft component cooperated with JICA TA program contributes to activate famer’s organization and advance their livelihood by better productivity in Jordan valley and northern West Bank areas.

Furthermore, if JAIP by conception of “Corridor for Peace and Prosperity” is operated, activates agricultural sector of PA by supplying production which is now restricted by the separation wall to Israel, may transport to Jericho city.

(2) Domestic and Industrial Water Systems

Main strategy related with domestic and industrial water sector shown in “Palestinian National Development Plan (2011-13)” gives 1) to heighten ability to service competiveness on agriculture, 2) to

enhance marketing accessibility to abroad and 3) to contribute unemployment measures by activating labor market. JAIP is now under construction in Jericho city as a core project related to conception of "Corridor for Peace and Prosperity" which advances economic development in Jordan valley, concerning "medium-long term policy as for live together in mutual for PA and Israel" by Prime Minister Koizumi (at the time in 2006) in cooperated-statement through PA, Israel, Jordan and Japan. The JAIP is expected to provide economic opportunities and brings more demand of domestic and industrial water.

Given the situation that Israel controls development of water resources, issues on domestic water sector in PA is water deficit. Projects assisted by international agencies achieved to supply domestic water to 123 areas in recent several years; however, 90% of PA population has still been forced 10 to 15 days water cut a month in summer season. And for 180,000 habitants or 1.6% of Palestinian population (11 million in 2010) are forced with unit of water supply volume less than 25 litters/capita/day recommended by WHO in minimum. Also, deterioration of facilities is worsening water supply volume.

Since Jericho city targeted under the Project has high population increase rate with 2.7% annually and 10,000 people scale of 2(two) refugee camps, population of the city is calculated twice as much as within the next 27 years from the present. And as the said city is one of the international tourism spots with 1 million tourists a year, increment of population and tourist in the future should be considered for water demand.

With the above circumstance, the Project will implement to upgrade a dug well named Jericho No.1 and to construct a new well with 5.7 km length of transmission pipeline for conveying safe water to Jericho city, prior to cope 16% of the population increment by year 2016, and plans to supply 170 (30+140) m^3/hr volume of water to JAIP in stage 2 scheduled to be completed in 2016. In the results of the Project implementation, it aims to improve condition of water supply on both domestic as well as industrial uses and also contributes unemployment measures by activating labor marketing in Jordan valley in the West Bank.

3-4-2 Effectiveness

(1) Agricultural Water System

(a) Quantitative effects

Expected quantitative effects for Agricultural Water System Improvement are shown in Table 3-4-1.

Table 3-4-1 Quantitative effects for Agricultural Water System Improvement

Name of index	Base value (year 2012)	Target value (year 2016)
1) Leakage and un-used water rate at 25 irrigation sites are decreased.	**% in all of 25 irrigation sites.	**% in all at 25 irrigation sites in total.
2) Irrigation area of 9 well sites is increased.	217 ha in all of 9 well sites.	354 ha in all of 9 well sites.
3) Leakage volume at Naimeh spring canal is decreased.	** %	** %
4) Study tour to JICA TA program sites is executed.	Not executed	3 times a year

Remarks) **% shown in the Table would be decided by the results of water leakage survey during the detailed design.

(b) Qualitative effects

Following qualitative effects are expected.

1) Crop diversification is promoted at target sites being reservoir constructed since beneficiaries can decide irrigation time and timing by themselves.
2) Discord between agricultural beneficiaries and residents is reduced since water theft from Naimeh spring canal is stopped by becoming closed type (pipeline) from open canal.
3) Marketing range of agricultural product is expanded since exchanges with medium/small sized farmers under JICA TA program through soft component plan.
4) Un-steadiness on irrigation opportunity of farmers where their lands separated by walls constructed by Israel (at 5 irrigation sites) is reduced since irrigation time is flexible by construction of reservoirs.

(2) Domestic and Industrial Water Systems

(a) Quantitative effects

Expected quantitative effects for Domestic and Industrial Water Systems Improvement are shown in Table 3-4-2.

Table 3-4-2 Quantitative effects for Domestic and Industrial Water Systems Improvement

Name of index	Base value (year 2010)	Target value (year 2016)
1) Water supply population in Jericho city is increased.	19,589 population	22,762opulation
2) Water supply unit is increased.	205 little/capita/day	219 little/ capita/day
3) Water supply volume from Jericho municipality to JAIP is increased.	30 m^3/hr by year 2014 funded by UNDP.	100 m^3/hr by year 2016 under the Japan's grant aid.

(b) Qualitative effects

Following qualitative effects are expected.

1) Discord on water distribution between water society (farmers) and Jericho municipality is dissolved since SWAP (well water mixing to spring) is realized.
2) Conception of "Corridor for Peace and Prosperity" is advanced since water supply to JAIP is attained.
3) Duration of water supply cut during summer season is reduced and water can be supplied to difficult sites since supply volume to Jericho city is increased.