THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF WATER AND IRRIGATION (MWI)
WATER AUTHORITY OF JORDAN (WAJ)
YARMOUK WATER COMPANY (YWC)

THE PROJECT FOR THE STUDY ON WATER SECTOR FOR THE HOST COMMUNITIES OF SYRIAN REFUGEES IN NORTHERN GOVERNORATES, IN THE HASHEMITE KINGDOM OF JORDAN

FINAL REPORT

MAY 2017

JAPAN INTERNATIONAL COOPERATION AGENCY

TEC INTERNATIONAL CO., LTD.
YACHIYO ENGINEERING CO., LTD.
NIHON SUIDO CONSULTANTS CO., LTD.

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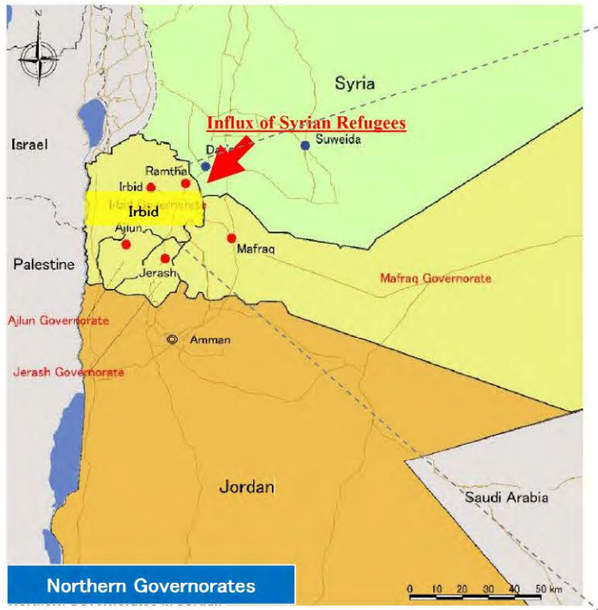
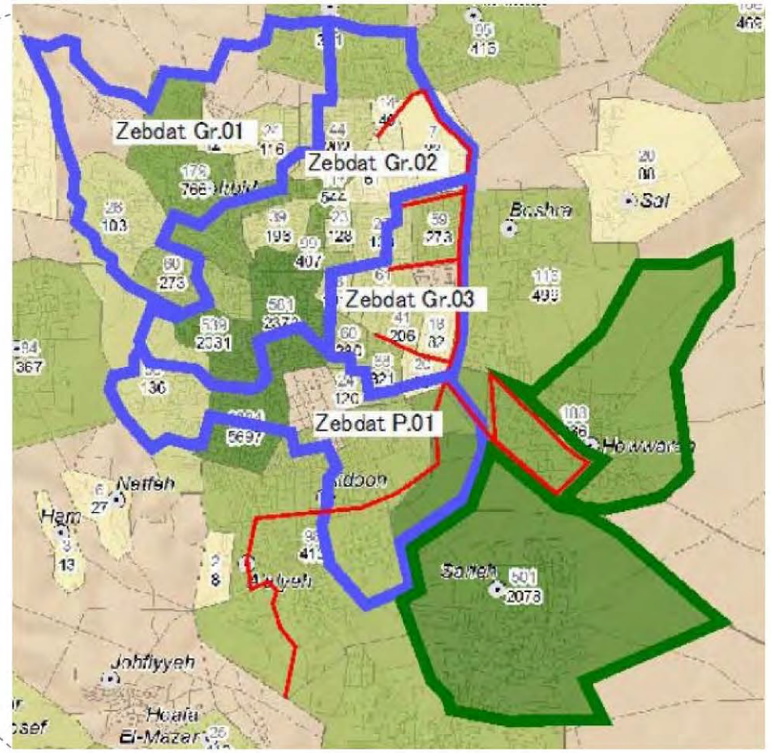
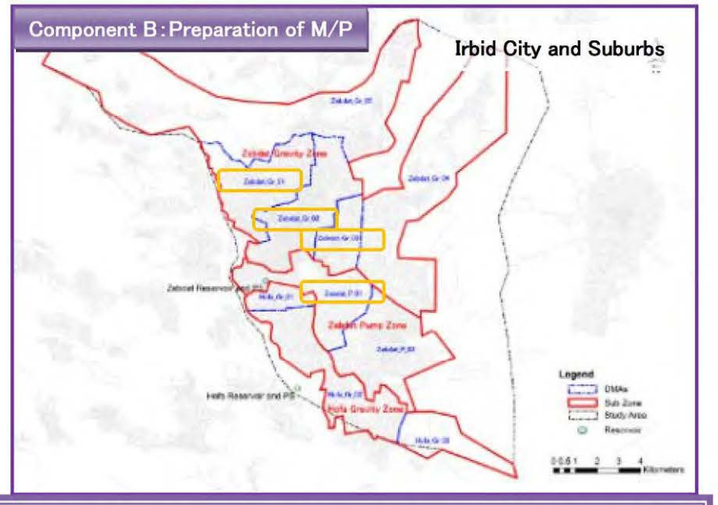


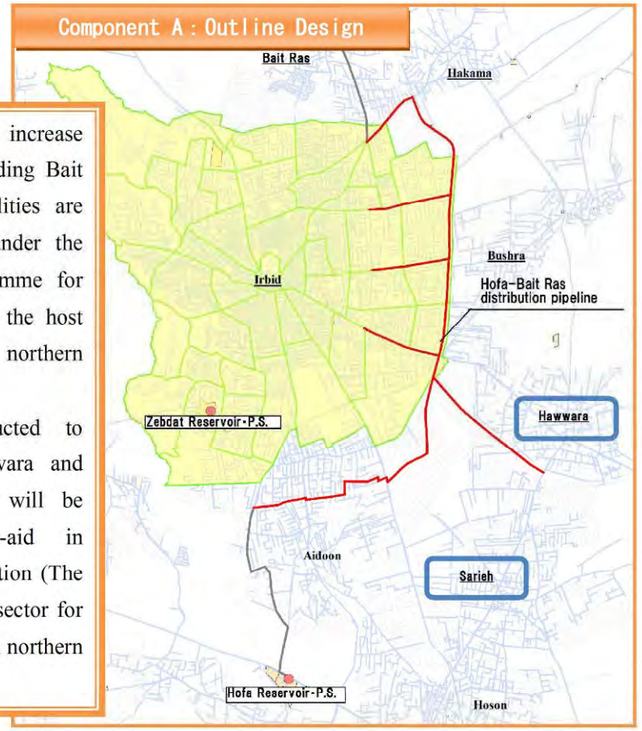


Component B : Preparation of M/P



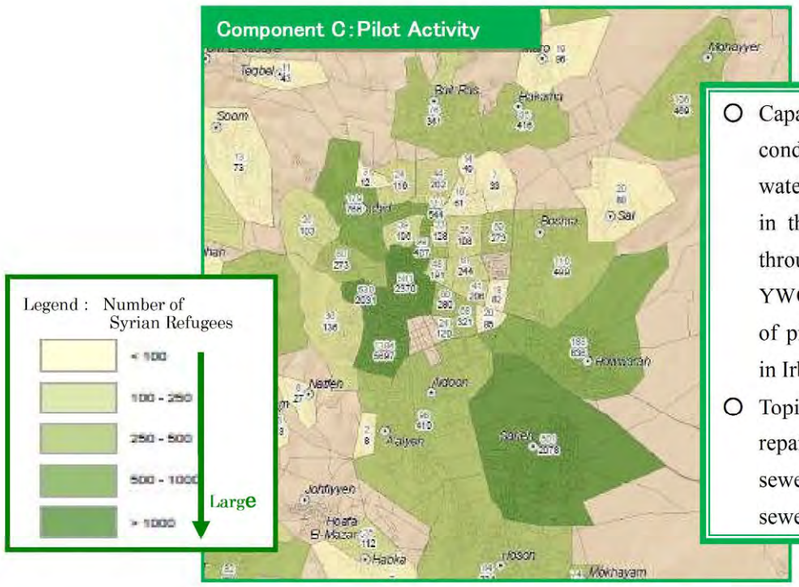
- Master plan of water supply and sewerage was prepared for 2 cities (Irbid and Ramtha) and 3 cities (Irbid, Ramtha and Mafraq). Target year is 2035 and 4-staged investment plan (each by 2020, 2025, 2030 and 2035).
- Draft tender documents were prepared for the first stage projects (with a target year of 2020) first stage investment. The project areas are Zebdat Gr.01 to 03 and Zebdat P.01 in the left figure. It will be implemented by

Component A : Outline Design



- (First) outline design was conducted to increase water supply volume to Irbid city including Bait Ras and Hawwara. The proposed facilities are implemented and completed in 2017 under the Japanese grant-aid scheme (The programme for urgent improvement of water sector for the host communities of Syrian refugees in northern governorates).
- (Second) outline design was conducted to rehabilitate distribution pipes in Hawwara and Sarieh, Irbid. The proposed facilities will be implemented under Japanese grant-aid in association with an international organization (The project for urgent improvement of water sector for the host communities of Syrian refugees in northern governorates, phase 2).

Component C : Pilot Activity



- Capacity development was conducted so as to improve water and sewerage services in the northern governorates through technical transfer to YWC operational staffs. Sites of pilot projects were mainly in Irbid.
- Topics were skills of leakage repair to reduce leakage and sewer cleaning to prevent sewer flooding.

Project Overview

DEFINITION OF PROJECT AND SUB-PROJECT

- "Project" is defined as "technical cooperation for development planning, the project for the study on water sector for the host communities of Syrian refugees in the northern governorates, the Hashemite Kingdom of Jordan."
- The Project consists of 3 components A, B and C.
  - ✓ Component A, Preparation of outline designs for the most prioritized projects
  - ✓ Component B, Formulation of development plan of water supply and wastewater management in the Syrian refugees affected areas
  - ✓ Component C, Implementation of pilot activities on small-scale repairs etc.
- Various schemes were selected and implemented under the 3 components of the Project. Each scheme is defined as a "sub-project" in the report. In total the following 7 sub-projects were conducted.
  - ✓ First outline design under component A
  - ✓ Second outline design under component A
  - ✓ Water Master plan in Irbid and Ramtha under component B
  - ✓ Sewerage Master Plan in Irbid, Ramtha and Mafraq under component B
  - ✓ Preparation of draft tender document for Irbid water supply under component B
  - ✓ Pilot activities on water sector under component C
  - ✓ Pilot activities on sewerage sector under component C

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ABBREVIATION

AFD	Agence Française de Développement (French Development Agency)
BHN	Basic Human Needs
DMA	District Metered Area
DN	Nominal diameter (indication of ductile cast iron pipe for inside diameter)
E/N	Exchange of Notes
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
G/A	Grant Agreement
JICA	Japan International Cooperation Agency
JD	Jordanian Dinar
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
Lpcd	Liters per capita per day (L/capita/day)
MCM	Million cubic meter
MCM/y	Million cubic meter per year
MP	Master Plan
MWI	Ministry of Water and Irrigation
OD	Outside diameter (indication of high density polyethylene (HDPE) pipe for outside diameter)
O & M	Operation & Maintenance
PMU	Programme Management Unit
PN	Nominal Pressure
PRV	Pressure Reducing Valve
ROU	Regional Operation Unit
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
WASH	Water, Sanitation & Hygiene
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
YWC	Yarmouk Water Company

CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 Situation and Issues

Jordan that is arid and semi-arid is considered to be one of the poorest countries in water resources in the world. The available water resources per capita is very low, at a level of 45m^3/capita/year, far below the internationally recognized poverty level of 1,000 m^3/capita/year and the competition among various demands on limited fresh water quantities is ever increasing. The growing population and the climate and topographical conditions of the country have caused enormous pressure on the limited water resources and created a severe water supply-demand imbalance.

Over-abstraction is common in the wells, the main water resources in Jordan, resulting in continuous drop in water table. In addition, Disi fossil water developed in southern Jordan has started to be used recently. Water supply is intermittent in many parts of Jordan: few days' supply per week.

Moreover, the rapid rise in the number of Syrian refugees since the beginning of the crisis in Syria in March 2011 has caused a huge challenge on the water sector. The number of Syrian refugees registered and to be registered in UNHCR as of December 2013was 570 thousands. However, the total number of Syrian refugees was estimated to be over 1 million including non-registered population in the country. About 20 % of Syrian refugees reside in the camps, constructed by UNHCR and so on and the remaining 80 % lives in the cities, towns and villages in Jordan. Those cities, towns and villages, called as Host Communities exist mainly in the northern governorates.

Population of the northern governorates was estimated as 1.66 million in 2009 (2.69 million in 2015 census). Per capita water availability is reaching very low levels due to large influx of Syrian refugees. As a result, in some locations, tensions between the refugees and Jordanian people on water availability are rising. In addition, hygienic environment is worsened and sewers are choked by illegal dumping of foreign objects due to increase in generation of sewage and solid waste.

Measures to improve the condition of Syrian refugees' camps had been progressed well by such humanitarian organization as UNHCR and NGO. On the other hand, measures to the host communities had not been progressed well despite large loads on the infrastructures and public services due to large influx of Syrian refugees. Public water supply system covers 97% of the population and public sewerage service covers about 50% of population (82% in the cities and 35% in the rural areas) in the northern governorates. The public water supply and sewerage systems had faced with such issues as their deterioration and leakage and they had become overloaded to cope with the increasing population.

Under these circumstances, the Jordanian government requested for Japanese assistance to improve the above-mentioned situations on the water sector. In response, the Japanese government has decided to extend assistance to Jordan through JICA.

1.2 Outline of the Project

The Project in this report summarizes the activities and results of Technical Cooperation for Development Planning "The Project for the Study on Water Sector for the Host Communities of Syrian Refugees" in the Northern Governorates, Hashemite Kingdom of Jordan (hereinafter called to "the Project"), which is composed of 3 components (see section 1.4).

(1) Expected Goals

The goals of the project are to contribute to improvement of the host communities in water supply and

wastewater management in the northern governorates consisting of Irbid, Mafraq, Jerash and Ajlun. In order to attain the goals, the followings are conducted:

- To assess the effect of Syrian refugees on water supply and wastewater management services in the northern governorates,
- To prepare a comprehensive study for the water supply and wastewater management services in the host communities of Syrian refugees,
- To prepare outline (basic) designs for the most prioritized projects and
- To conduct pilot activities.

(2) Duration

Planned : 3 years and 1 month from December 2013 to December 2016

Actual : 3 years and 5 months from December 2013 to April 2017, details of which are explained in section 2.1.

(3) Counterpart Organization

The following are counterpart organizations for the Project. Ministry of Water and Irrigation (MWI) is a policy-making organization. Under the guidance of MWI, Water Authority of Jordan (WAJ) is constructing facilities and managing bulk water supply. WAJ used to operate and maintain local wells, distribution facilities and sewerage facilities but has transferred their operation and maintenance functions to the newly set-up regional operating companies. YWC is a regional operating company in the northern governorates.

- Supervising Organization : Ministry of Water and Irrigation (MWI)
- Implementing Organization : Water Authority of Jordan (WAJ)
- Operating Organization : Yarmouk Water Company (YWC)

(4) Outline of Target Sector and Area

- Sector : Water supply and wastewater management services
- Area : 27,409 km^2 (Northern governorates, Irbid, Mafraq, Jerash and Ajlun)
- Beneficiaries : 2.69 million persons (in 2015, census) (Northern governorates)

1.3 Purpose of the Project

(1) Relation of the Project with the National Policy

Water sector has been one of the important sectors since long and even before the Syrian crisis. The main policy of water sector, “Water for Life: 2008 to 2022” states that its main objectives are supplying of safe and adequate drinking water, sustainable use of water resources, adaptation to the climate change etc.

The Jordanian government (The Ministry of Planning and International Cooperation and other related Ministries) and development partners (UN organizations, Bi-lateral aid organizations, NGO etc.) had jointly been working for the influx of Syrian refugees. They have organized 2 coordination groups: one is a working group on humanitarian aid focusing on the refugees’ camps and another is the host community support platform dealing with development needs of the host communities. WASH task forces are organized respectively under the above 2 groups as one of the important sectors. The results of

discussion and recommendations were later compiled as the National Resilience Plan that includes the following:

- Analysis of issues on water sector with which the host communities had faced
- Planning of measures to solve the issues
- Understanding measures already being implemented and planned to be implemented
- Recommendation of measures to be taken by donor agencies

(2) Relation of the Project and Other Projects

Sub-projects were selected in the Project so as to create a multiple effect for the sub-projects and other projects without duplication. The sub-projects are defined as outline designs, master plan, pilot activities and so on that were proposed and conducted in the Project. In order to do so, the following was taken:

- Collection of information on discussions and planning of the task forces
- Coordination with the task forces
- Cooperation with the development partners

1.4 Component of the Project

(1) Components

The Project consists of the 3 Components. Component A responds to urgent needs while Component B deals with needs from mid to long-term point of view. Component C is intended to provide technical transfer (capacity development) for immediate needs with small-budget as pilot activities.

Component A:	Preparation of outline designs for the most prioritized projects
Component B:	Formulation of development plan of water supply and wastewater management in the Syrian refugees affected areas
Component C:	Implementation of pilot activities on small-scale repairs etc.

(2) Outputs (Outcomes)

The following outputs are prepared to achieve the objectives:

Component A

Formulation of priority project and outline design of the priority project, based on which Japanese grant-aid scheme will be conducted.

Component B

Formulation of mid-term development plan on the water sector in the host communities

Component C

Pilot activities on detection and repair of leakage, cleaning of sewer etc.

Capacity Development (through Component B and Component C)

Implementation of the projects based on the above outputs will contribute to improvement of water

supply service (water supply duration times, water pressure etc.) and increase of sewer-connected households.

(3) Activities

The following activities were conducted:

1) Component A: Preparation of outline designs for the most prioritized projects that should be implemented quickly

① Confirmation of the contents and reason of the priority projects requested by the Jordanian side

② Review of current situation and issues based on the existing needs assessment reports

③ Confirmation of contents, progress status and future progress plan of the projects by the development partners

④ Confirmation of necessity and adequacy of each requested project and prioritization of each project

⑤ Selection of project(s) based on the above, on which outline design will be conducted.

⑥ Natural condition survey

⑦ Environmental and social consideration survey

⑧ Formulation of plan of facilities and equipment

⑨ Outline design

⑩ Procurement condition survey

⑪ Implementation plan survey

⑫ Survey on management and operation and maintenance plan

⑬ Preliminary cost estimation

⑭ Analysis of requirement of technology transfer on management and operation and maintenance based on activities of Components B and C etc.

⑮ Analysis of outcomes, benefits and evaluation indexes of the project

2) Component B: Formulation of development plan of water supply and wastewater management in the Syrian refugees affected areas

① Collection and analysis of current existing information (development plans, hydrological information, existing water and wastewater management facilities etc.)

② Analysis and recommendation of contents, target year, update interval etc. of the project based on the following:

- Coordination with the WASH task force of the Host Community Support Platform.
- Confirmation of the activities of the WASH task force.
- Conformity with the Platform in its activities and plans

③ Estimation of demand considering Syrian refugees' influx and estimation of demand and supply imbalance

④ Formulation of mid-term development plan of water supply and wastewater management considering Syrian refugees' influx for about 5 years.

⑤ Development of mid-term plan and recommendation of short and mid-term projects based on

analysis of the actual situation

⑥ Environmental and social consideration survey

⑦ Updating mid-term plan and short and mid-term projects, reflecting change of situations

⑧ Coordination with and feedback to the Platform and WASH task force.

⑨ Technology transfer through formulation of development plan

3) Component C: Implementation of pilot activities on small-scale repairs etc.

① Selection of pilot activities

② Procurement of equipment and materials necessary for the pilot activities including a preparation of sub-contracts

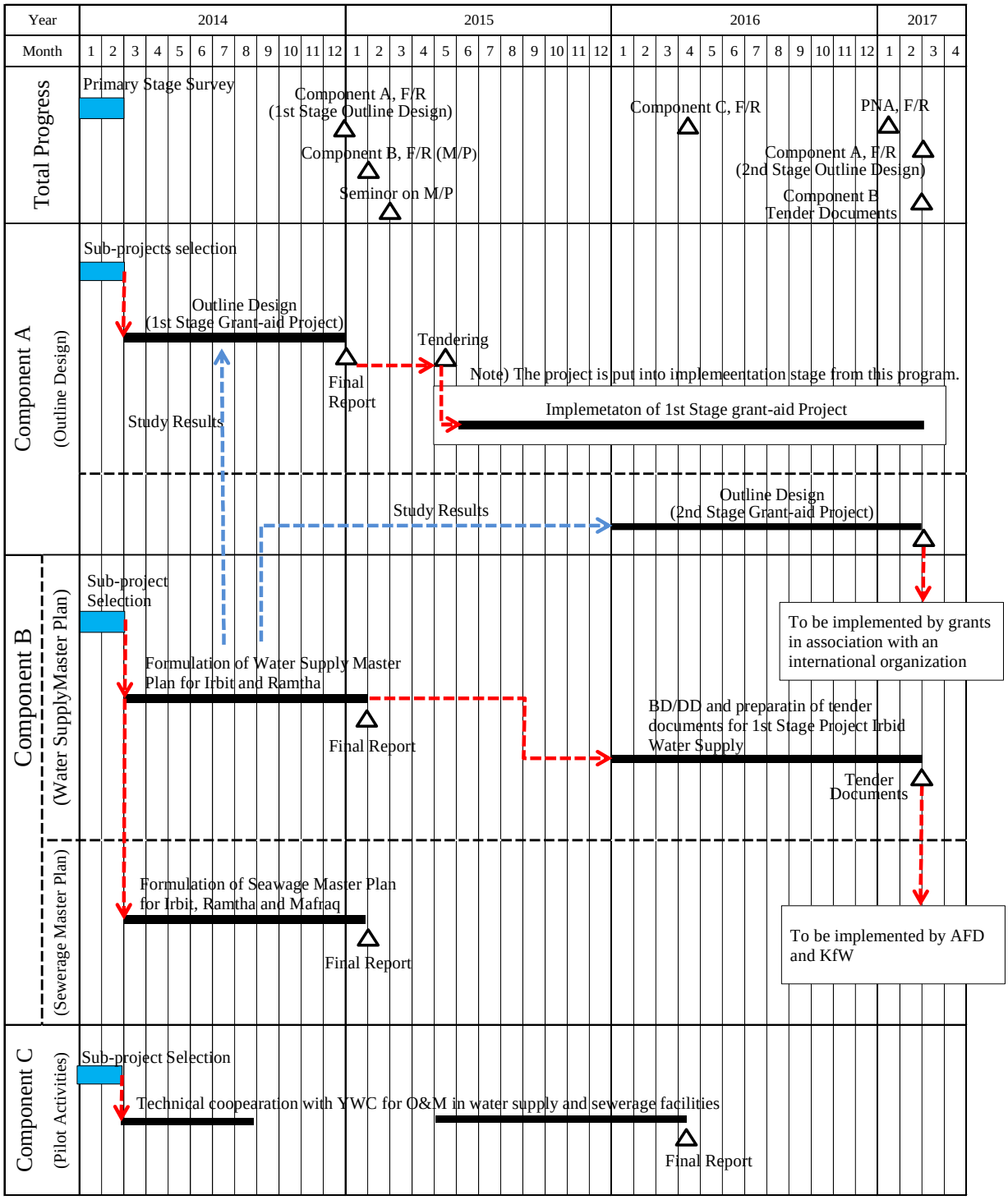
③ Implementation of pilot activities

④ Analysis of implemented pilot activities and feedback it to the Component B

CHAPTER 2 OUTLINE OF ACTIVITIES

2.1 Schedule

The implemented schedule of the 3 Components is shown in Figure 2.1.



F/R: Final Report M/P: Master Plan B/D: Basic Design D/D: Detailed Design O&M: Opearation and Maintenace

Study Process Flow Study Results Flow

Figure 2.1 Implemented Schedule of the 3 Components

2.2 Sub-Project Selection of Components A and B considering the National Resilience Plan

(1) Project in the National Resilience Plan

Selection of sub-projects for each Component is included in this project. Figure 2.2 shows the selected sub-projects.

Issues in water sector were firstly identified through mainly participation in the WASH task force. Many issues and countermeasures that are compiled eventually as a National Resilience Plan, have characters of acceleration of the planned measures considered before the Syrian crisis. Early implementation of these planned measures will increase and improve facilities' capacity and to meet the increased demand due to influx of the Syrian refugees. Among the countermeasures, those related to the northern governorates are shown below.

① Extension of the National Bulk Water Corridor from Amman to the northern governorates (see Figure 2.3)

② Rehabilitation and development of the eastern wellfields in the northern governorates

③ (Eastern) Transmission facilities between the (Za'atary) reservoir collecting Disi fossil water and the eastern wellfields water and reservoirs in cities within the northern governorates (see Figure 2.4)

④ Development of Wadi Arab 2nd phase system including expansion of (western) transmission facilities

⑤ Rehabilitation of various wells and pumps

⑥ Rehabilitation of pipes in various areas

⑦ Extension of wastewater treatment plants

⑧ Extension of sewer and pumping station in various areas

Much assistance on the above countermeasures had been extended. Items ① to ④ above are the facilities of either increase or transfer of water resources and are much positive influence to the selected sub-projects, improvement of water supply services. Their outlines are shown below.

① Extension of Disi fossil water to the northern governorates
Disi fossil water that has already been sent to Amman for the water demand in Amman will be extended to the northern governorates. The transmission facilities are implemented in 2 sections.

- First section between Abu Alanda reservoir in Amman and Khaw reservoir in Zarqa, assisted by AFD
- Second section between Khaw reservoir in Zarqa and Za'atary reservoir in Mafraq assisted by KfW

② Rehabilitation and development of the eastern wellfields in the northern governorates, assisted by KfW

③ Eastern transmission facilities between the Za'atary reservoir collecting Disi fossil water and the eastern wellfields water and reservoirs in cities within the northern governorates assisted by USAID and others

④ Wadi Arab 2nd phase system

- Detailed design assisted by USAID
- Construction assisted by AFD and EIB

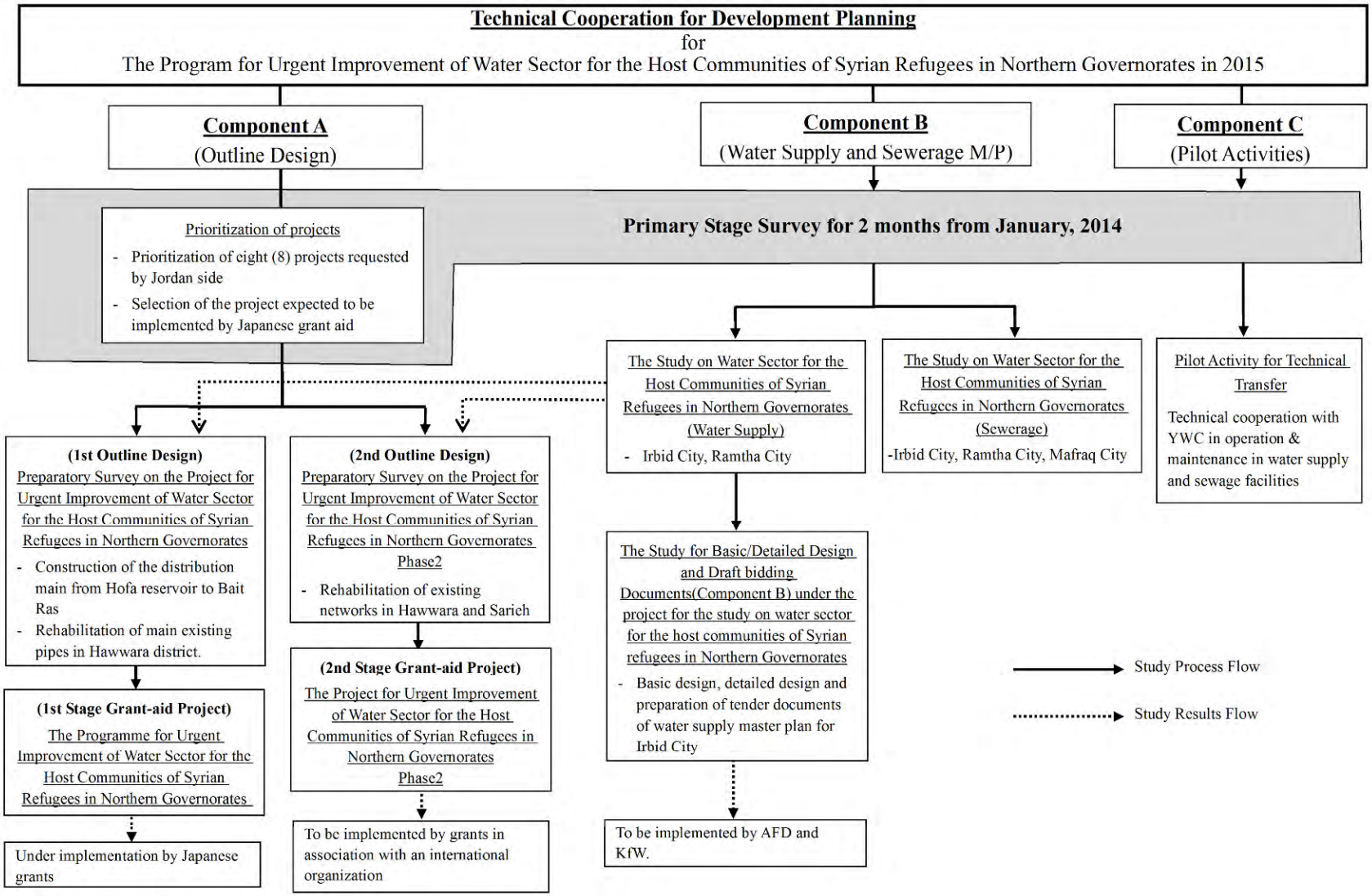
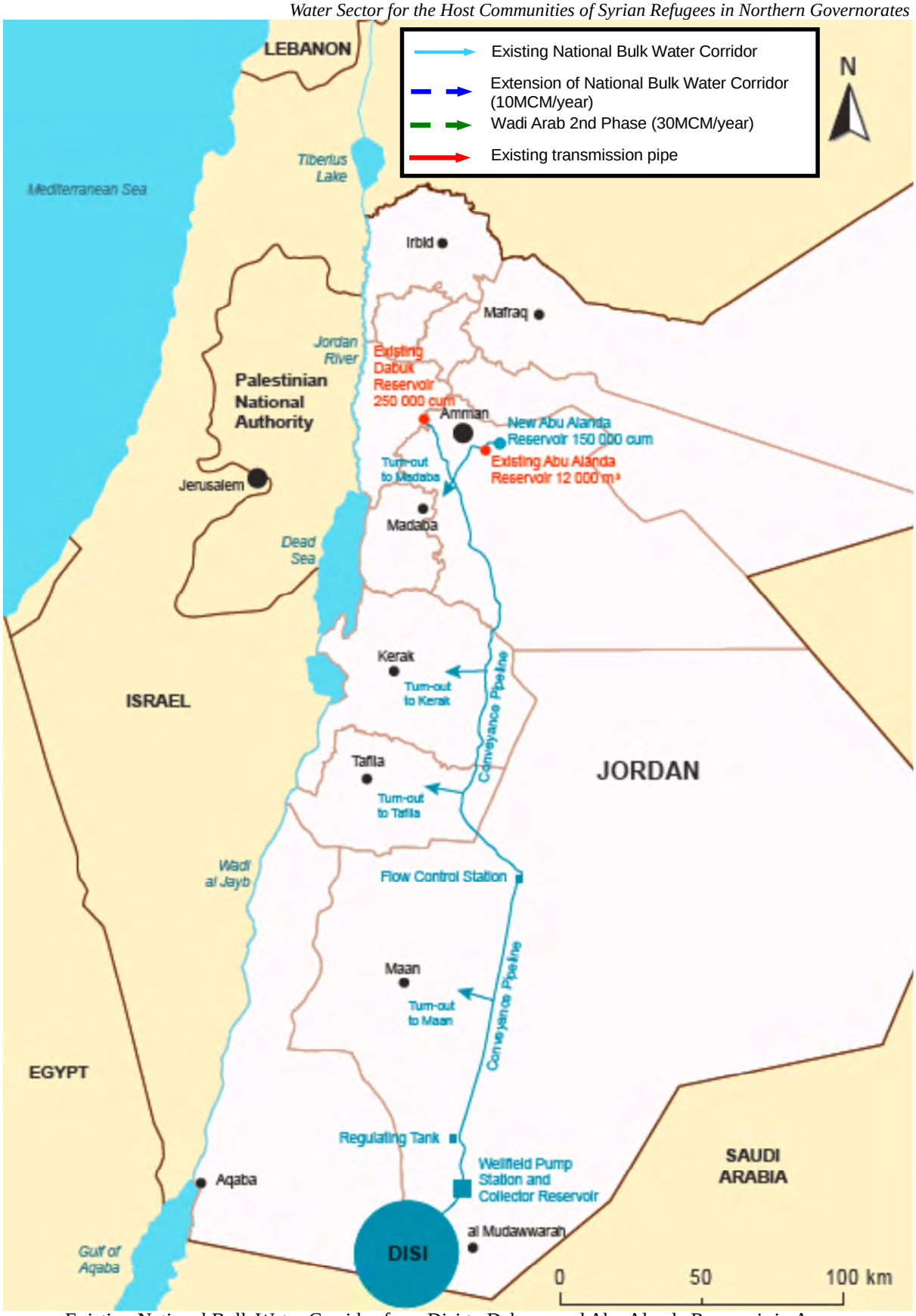
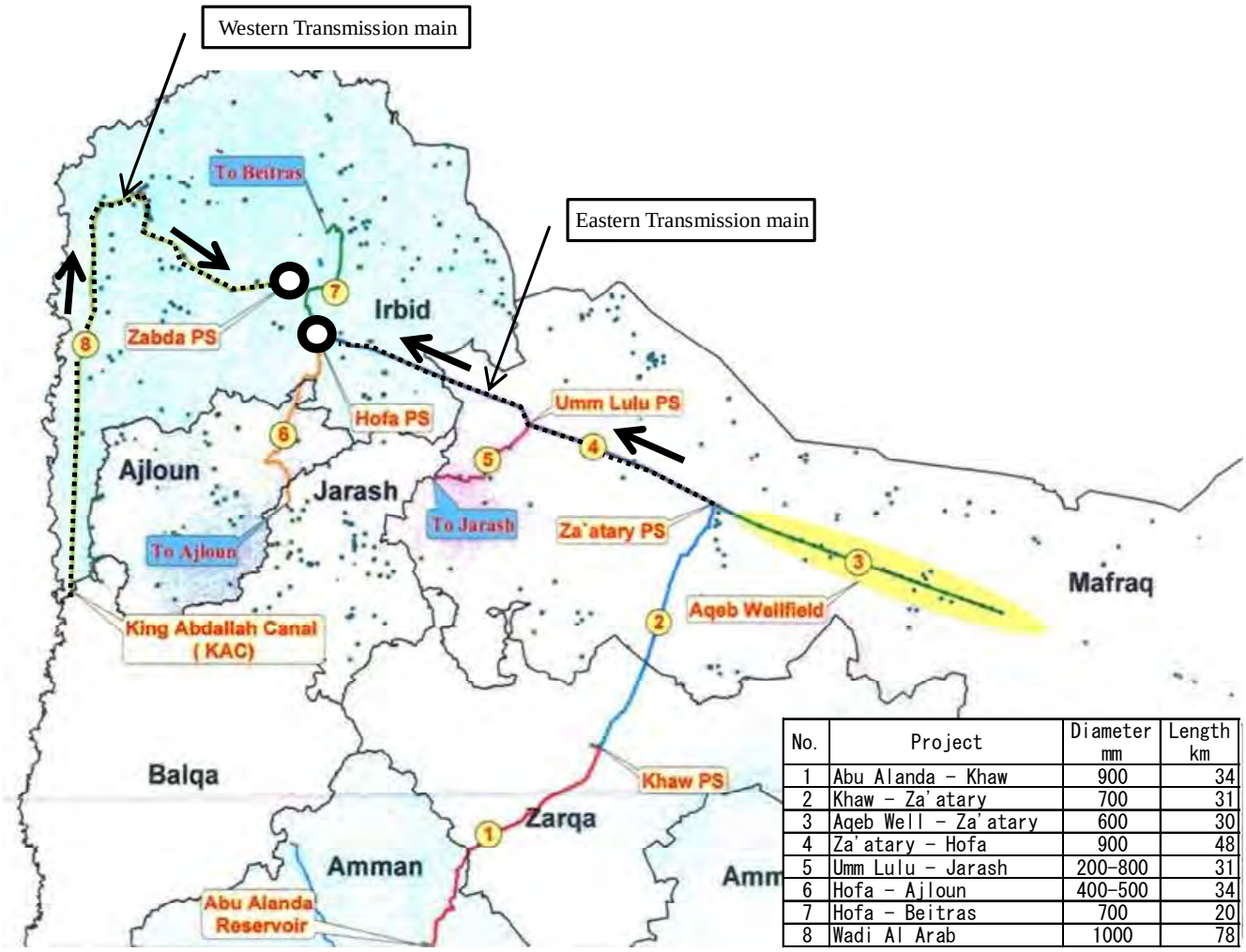


Figure 2.2 Japanese Assistance Program and Projects



Existing National Bulk Water Corridor from Disi to Dabouq and Abu Alanda Reservoir in Amman through Khaw Pumping Station to Za'atary, Mafraq

Figure 2.3 Extension of National Bulk Water Corridor (Disi Fossil Water) and Transmission Facilities in the Northern Governorates



No.	Project	Diameter mm	Length km
1	Abu Alanda – Khaw	900	34
2	Khaw – Za'atary	700	31
3	Aqeb Well – Za'atary	600	30
4	Za'atary – Hofa	900	48
5	Umm Lulu – Jarash	200–800	31
6	Hofa – Ajloun	400–500	34
7	Hofa – Beitras	700	20
8	Wadi Al Arab	1000	78

Figure 2.4 Transmission Pipe in the Northern Governorates

① and ② are extension of national bulk water corridor (to be operational in 2018)

③ is conveyance pipe from the eastern wellfields (Existing)

④ is conveyance pipe from Za'atary Reservoir called as Eastern Transmission Pipe in the report. (Existing)

⑤ and ⑥ are branch pipes of Eastern Transmission Pipe (to be operational in 2018)

⑦ is conveyance pipe from Zebdat Reservoir to Hofa Reservoir (to be operational in 2017, scope of Component A)

⑧ is conveyance pipe from Wadi Arab system called as Western Transmission Pipe in the report (Existing and 2nd phase to be operational in 2020)

(2) Selected Sub-Project of Components A and B

The transmission facilities are either already constructed or planned to be constructed; however distribution facilities from the reservoirs in cities to cities and towns are not planned. Therefore those distribution facilities and sewerage facilities to meet increased demand are selected as sub-projects, namely

- Outline design of main distribution facilities from Hofa reservoir (to where Disi fossil water etc. will be transmitted) to Irbid City (see Figure 2.9) as Component A and
- Master plan of water distribution facilities and sewerage facilities in the cities of Irbid, Ramtha and Mafraq as Component B.

All 3 cities are thought to have large Syrian refugees and faced with difficulty in coping with increasing water demand and wastewater generation because they are the large cities in the northern governorates: Irbid City[1], the capital of Irbid governorate is the largest city in the northern governorates while Mafraq city, the capital of Mafraq governorate is the second largest city. Ramtha is the 3rd largest city in the northern governorates. However, water distribution facilities in Mafraq city was dropped at the initial stage of the project because KfW expressed intension of early implementation of the facilities.

2.3 Water Demand and Available Water Resources in Northern Governorates

Before explanation of activities of Components A and B in sections 2.4 and 2.5, water demand and available water resources that are common in both Components are explained in this section.

In other countries, water supply and sewerage facilities are generally planned to meet the water demand of the target area where water sources are identified and developed to meet water demand. However, in Jordan where available water resources are limited and difficult to develop to meet water demand, large-scale facilities such as treatment plants, transmission pipes, trunk sewers and distribution mains are better to be planned based on available water resources.

Additional available water resources of 10 MCM/year from Disi fossil water was already decided to be allocated to the northern governorates in order to mitigate the gap of water demand and supply imbalance at the beginning of the project. On the other hand, water allocation to each city and town within the northern governorates was to be decided. In order to estimate available water to each city including sub-project areas, the following are conducted considering fair water allocations to each city and town in the northern governorates; The available water in the 3 sub-project areas are basis for outline design (Component A) and master plan (Component B).

(1) Estimation of Water Demand in the Northern Governorates

After selection of sub-projects for all Components, all Components had started simultaneously in early 2014. Water demand and available water resources need to be known at the beginning of each project. In order to know available water resources in Irbid, Mafraq and Ramtha, water demand in each city of the northern governorates should be known first and then water allocation to each city need to be estimated considering all available water resources in the northern governorates including available water transferred from outside of the northern governorates. The estimation methods are as follows:

- Water demand in each city and town in the northern governorates are firstly estimated.
- Then, total water demand in the northern governorates is estimated as 118 MCM/year in 2035. Figure 2.5 shows regional water demand. In Irbid, demand is about 36 MCM/year. These demands do not include demand of Syrian refugees.
- Demand for the Syrian refugees needs to be considered as well.
- Future number of Syrian refugees was difficult to estimate. Therefore, number of Syrian refugees as of 2013 that was available at the start of the project, was agreed with WAJ to consider for the facilities' planning.
- The number of Syrian refugees accounted for about 20% of the Jordanian population in 2013.

[1] Irbid City in this report is used as Greater Irbid Municipality consisting of Irbid urbanized area (sometimes called as Irbid City in narrow sense) and its suburban areas such as Hawwara, Sarieh, Bait Ras and Hoson.

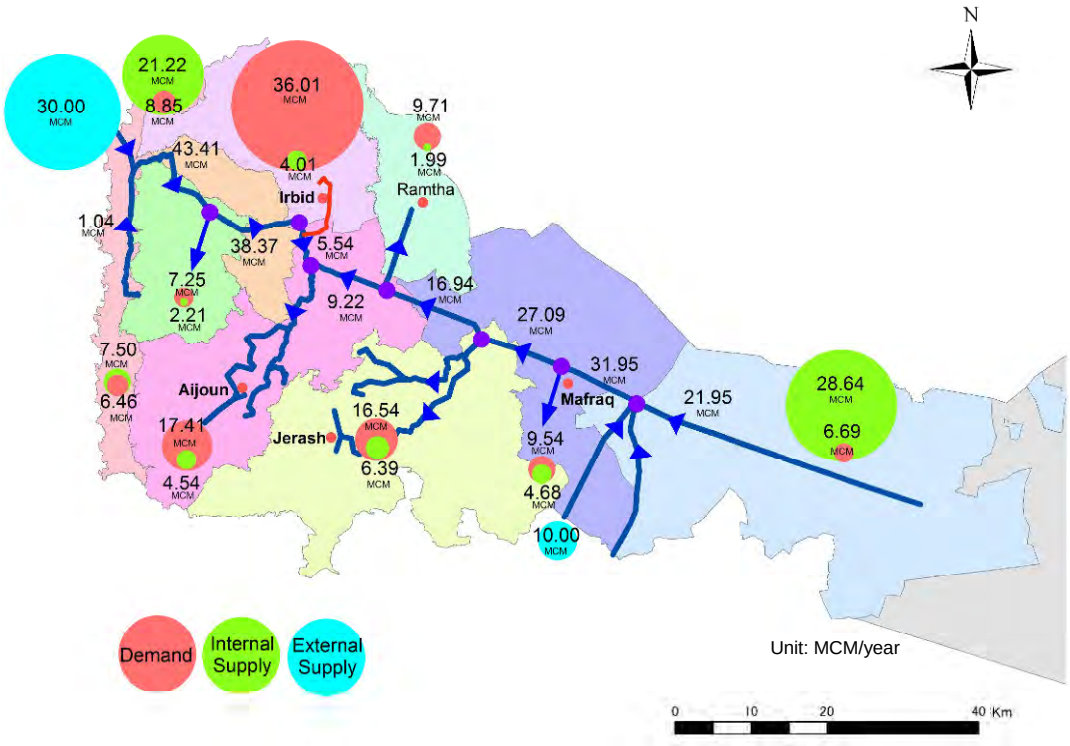


Figure 2.5 Regional Water Demand in 2035, 118 MCM/year in the Northern Governorates[2]

Water of 32 MCM/year will be allocated in Irbid increasing from 12.31 MCM/year when Disi Fossil water and Wadi Arab 2nd phase is completed.

(2) Estimation of Available Water in the Northern Governorates

Total available water resources for the northern governorates are estimated at 121 MCM/year (see Figure 2.6) after 2020 in the following manners:

There are 4 types of water resources development by stage for the northern governorates.

① Large number of existing small wells scattered in the northern governorates. Planned yields from the existing wells are assumed unchanged as the existing yields of 72 MCM/year.

② Additional wells in the eastern wellfields in the northern governorates, nine (9) MCM/year of additional water was available from the eastern wellfields in 2014.

③ Disi fossil water allocated to the northern governorates will be 10 MCM/year in around 2018.

④ Planned Wadi Arab 2nd project in the northern governorates. Thirty (30) MCM/year of water developed at the Wadi Arab 2nd project will be allocated totally to the northern governorates by 2020.

[2] Demand in each city and town are grouped into demand in region that is defined according to sub-transmission pipes.

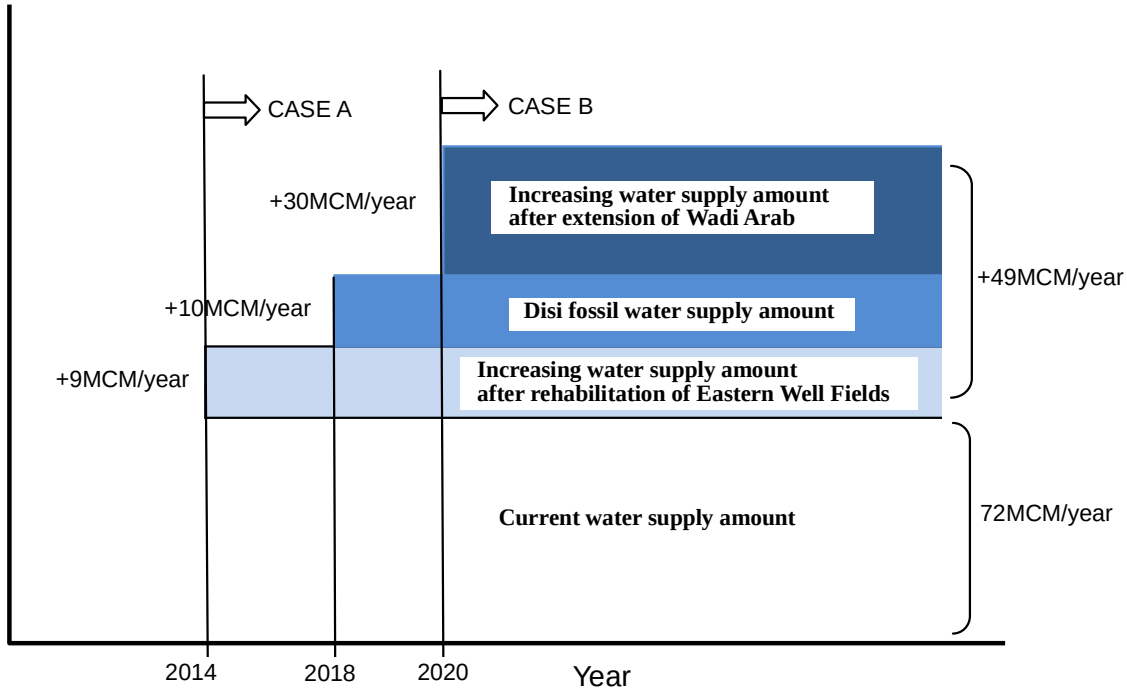


Figure 2.6 Development Stages of Additional Water Resources

(3) Water Demand and Supply Balance in the Northern Governorates

Water demand of 118 MCM/year and available water resources of 121 MCM/year will be balanced in 2035 in the northern governorates if number of Syrian refugees is not counted. Considering a number of Syrian refugees, available water resources will not be adequate in 2035. Available water can meet demand in 2028, 7 years ahead of 2035.

(4) Current Water Allocation to the Project Areas

Available water was 72 MCM/year in 2012 in the northern governorates that was transferred to demand areas such as Irbid and Ramtha through mainly the eastern and western transmission pipes as shown in Figure2.7. Irbid City including some supplemental water to the north of Irbid received water of 12.31 MCM/ year (Receiving 16.34 – Sending out 4.03) through the western transmission pipe.

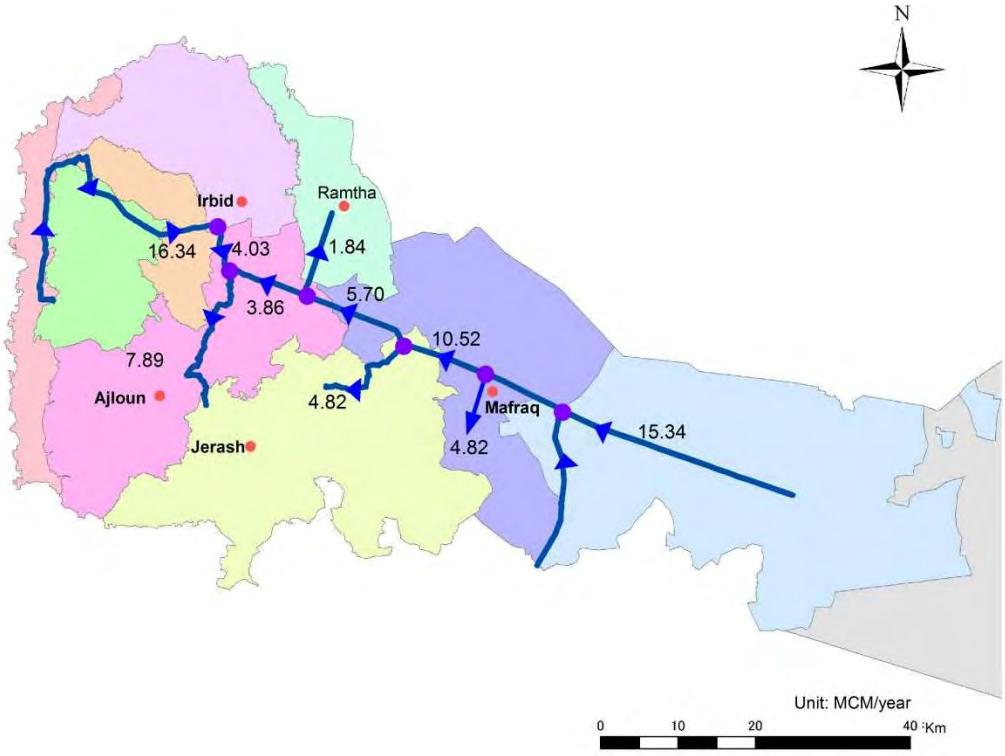


Figure 2.7 Water Allocation as of 2012

(5) Available Water to the Sub-Project Areas (from 2018 up to completion of Wadi Arab 2nd phase project)

In 2018, 91 MCM/year of water will be available in the northern governorates (72 from the existing wells and 19 from the Disi and the eastern wellfields). In this case, water to the sub-project areas will be as follows (see Case A in Figure 2.8):

- Ramtha and Mafraq cities will continue to be supplied water through the eastern transmission pipe in the northern governorates.
- Irbid City will continue to receive water through the western transmission pipe in the northern governorates. In addition, Irbid City will receive water through the eastern transmission pipe in the northern governorates.
- Distribution main pipes were decided for Component A to distribute additional water coming through the eastern transmission pipe to Irbid City immediately.

(6) Available Water to the Sub-Project Areas (after completion of Wadi Arab 2nd phase project)

After additional water of the Wadi Arab 2nd phase project is available, Irbid City will receive water again only through the western transmission pipe (see Case B in Figure 2.8).

In the master plan, water supply facilities are planned for both cases: without and with 30 MCM/year water.

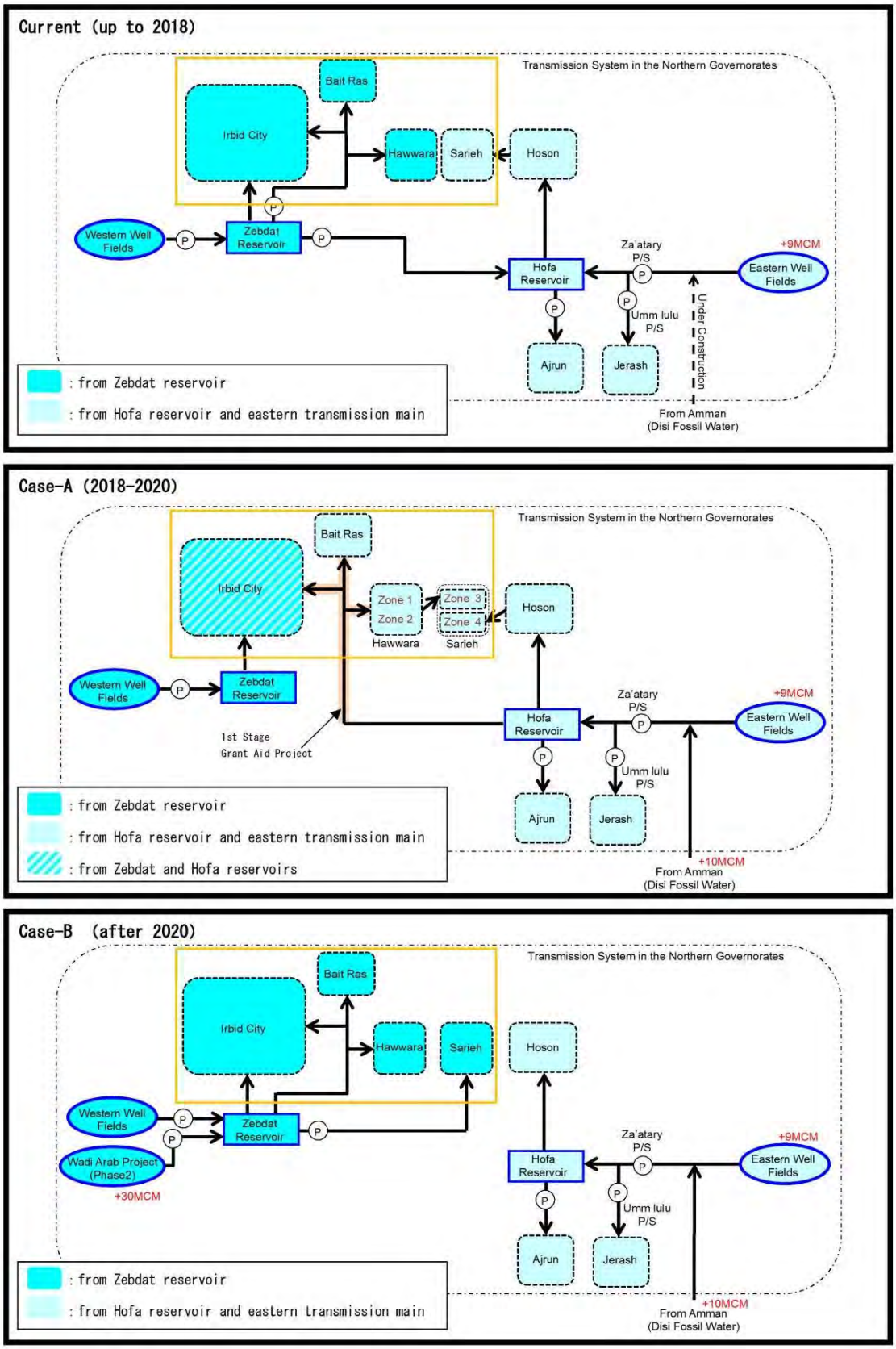


Figure 2.8 Schematic Staged Water Transfer to Irbid including Hawwara and Sarieh, Irbid Municipality[3]

[3] Irbid City in this figure means urbanized area in Irbid City. Hawwara, Sarieh, Bait Ras, Hoson and others including Irbid City in this figure constitute of Greater Irbid Municipality.(refer to Figure 2.4)

2.4 Component A: Preparation of Outline Designs for the Most Prioritized Projects

Two outline designs were conducted. First outline design was conducted in 2014 for the distribution pipe to Irbid City while second one was conducted from 2016 to 2017 for rehabilitation of the distribution pipes in Hawwara and Sarieh in Irbid.

2.4.1 Selection of the project from eight (8) sub projects proposed by Jordan side

From January to February, 2014, JICA study team conducted survey and evaluated eight (8) sub-projects proposed by Jordanian side (Table 2.1), and set an order of priority for selection of projects to be implemented by Japanese grant aid scheme. During the survey, the sub-project of 1C was found to be implemented by KfW. therefore, it was excluded from the list. The remaining seven (7) sub-projects was evaluated from the points of ①Urgency, ②Technical Relevance, ③Effectiveness, ④Necessity, and its priority order was decided and agreed with Jordanian side as shown in Table 2.2.

Table 2.1 Eight (8) sub-projects proposed by Jordan

Priority (Jordanian Side)	Project Title	Brief Description
1A	Irbid Main Conveyor Stage 1 (400 mm DI pipe of 2.5 km length)	It will transport water from Zebdat reservoir to Alia area increasing efficiency of water distribution in Irbid
1B	Hofa to Bait Ras Conveyor (Distribution) pipe	To increase efficiency of water transport and distribution in Irbid City, and Bait Ras where water shortage takes place (700 mm DI pipes)
1C	Main conveyor from Aqib 96 to Za'atary Pump station (15 km length of 600mm diameter)	The current conveyor from Aqib wells to Za'atary pump station is old and not sufficient to convey the amount of water that is produced in Aqib wells, accordingly, new large diameter pipe is needed
2	Rehabilitation of Hawwara water network	Hawwara is about 30,000 population located at the eastern part of Irbid City, its network is old and the non- revenue water ratio is high. Accordingly the network replacement is needed.
3	Miscellaneous Wastewater Networks in Irbid City	YWC has a program of connecting unserved houses to the city sewer network, this activity works against environmental pollution especially in the poor areas of the city.
4	Rehabilitation of Sarieh Water network	Similar to Hawwara above
5	Rehabilitation of Mafraq pump station	Many of the pump station in Mafraq governorate are in a bad condition, accordingly rehabilitation of those station is needed
6	Ramtha Southwest area wastewater networks	Ramtha is the nearest city to the Syrian boarders and the refuges influx started from the early stages of the crises. The targeted area is not connected to the sewage network and this will enhance the environmental situation in this extensively affected area.

Table 2.2 Priority Order of Sub-Projects after Evaluation

Priority		Sub-project	Evaluation			
After evaluation	Before evaluation		Urgency	Technical validity	Effectiveness	Necessity
1	1B	Hofa to Bait Ras Conveyor (Distribution) pipe	◎	△	◎	○
2	2	Rehabilitation of Hawwara water network	○	○	○	○
3	4	Rehabilitation of Sarieh Water network	○	○	○	○
4	6	Ramtha Southwest area wastewater networks	△	○	○	△
5	5	Rehabilitation of Mafraq pump station	○	○	△	△
6	1A	Irbid Main Conveyor Stage 1 (400 mm DI pipe of 2.5 Km length)	△	△	○	○
7	3	Miscellaneous Wastewater Networks in Irbid City	△	○	△	△
-	1C	Main conveyor from Aqib 96 to Za'atary Pump station	Excluded from evaluation because it was found to be implemented by KfW.			

Priority Level: ◎High ○Medium △ Low

Sub-projects with priorities 1 to 3 were selected, and two outline designs were conducted in Component A. First outline design covering sub-projects with priority 1 and part of priority 2 was conducted in 2014 while second one covering sub-projects with part of priorities 2 and 3 was conducted from 2016 to 2017.

Priority 1: Hofa to Bait Ras Conveyor (Distribution) pipe
Priority 2: Rehabilitation of Hawwara water network
Priority 3: Rehabilitation of Sarieh Water network

2.4.2 First Outline Design (1st Stage Grant-aid Project)

Preparatory survey on the project for urgent improvement of water sector for the host communities of Syrian refugees in the northern governorates (the first outline design) was conducted for the sub-projects of priorities 1 and part of 2. It was intended that, based on the outline design, Japan would immediately implement the project for urgent improvement of water sector for the host communities of Syrian refugees in the northern governorates (1st stage grant-aid project).

(1) Scope of the Project

Scope of the 1st stage grant-aid project is shown in Figure 2.9 and Table in 2.3. It consists of distribution pipes between Hofa reservoir and Bait Ras including branch pipes, and rehabilitation of distribution pipes in Hawwara. The length of pipeline is 18.6 km with diameter ranging from 400 mm to 600 mm in the former case. In the latter case, pipeline length is 13.4 km with diameter ranging from 100 mm to 300mm.

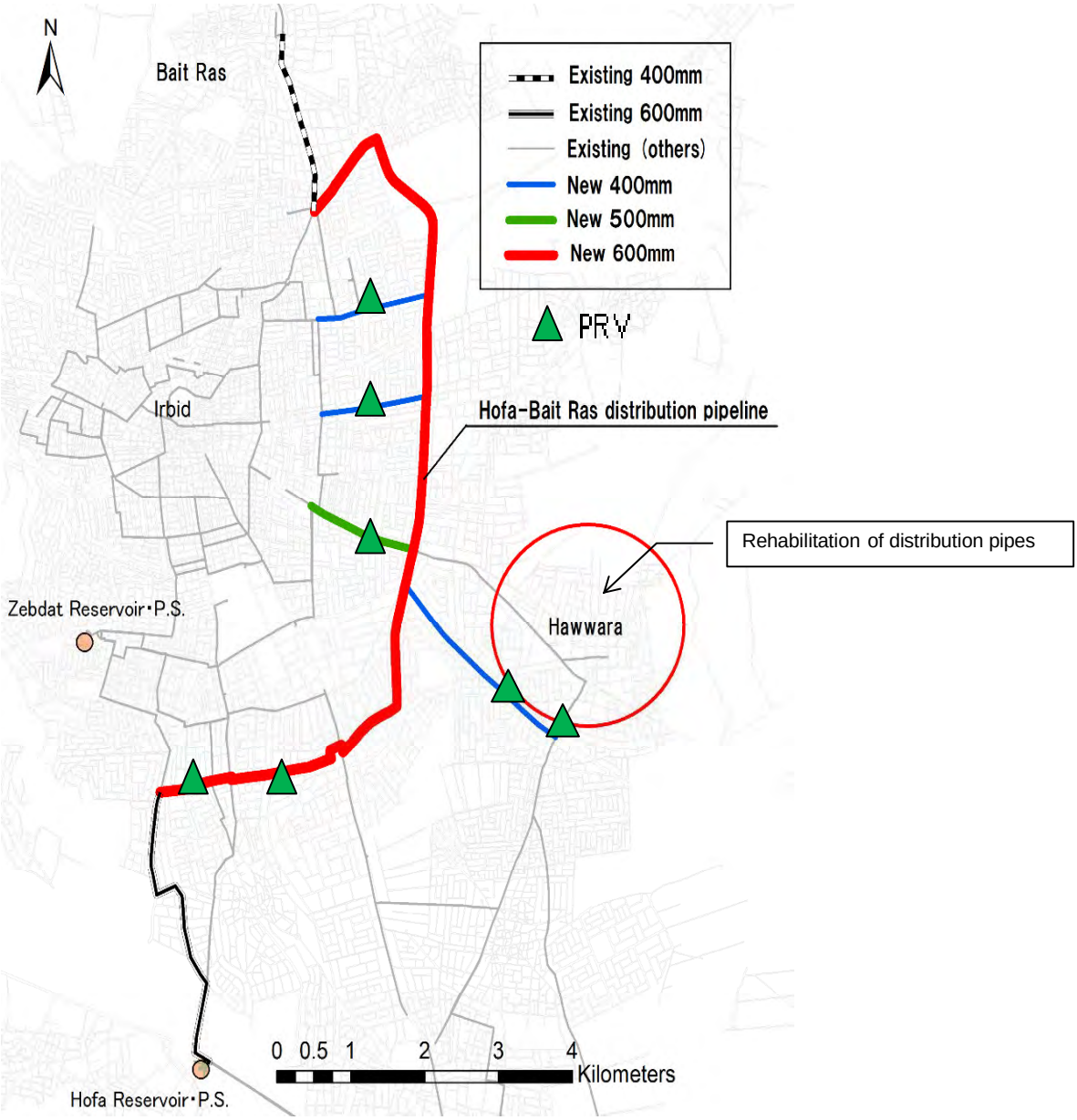


Figure 2.9 First Outline Design (1st Stage Grant-aid Project)

Table 2.3 Facilities of the 1st Stage Grant-aid Project

Item	Facilities
Construction of distribution main from Hofa reservoir to Bait Ras (Priority 1 sub-project)	DIP 600mm x 12.0km PRV x 2 locations
Construction of four (4) distribution branch pipes to Irbid City and Hawwara and Sarieh district (Priority 1 sub-project)	DIP 500mm x 1.4km DIP 400mm x 5.2km PRV x 3 locations
Rehabilitation of main pipes of existing network in Hawwara (Part of priority 2 sub-project)	DIP 100-300mm x 13.4km PRV x 2 locations

(2) Project Target Value

Target value of the 1st stage grant-aid project was set as shown in Table 2.4 for target year 2017. Out of these target values, distribution pipeline flow between Hofa and Bait Ras was set as Effective Index for the 1st stage grant-aid project.

Table 2.4 Status and Target Values of the Project (1st Stage Grant-aid Project)

Item		Unit	Current Status	Target Year (2017)	Type of target value
Number of "No water" complaints (Fair water supply index)		Number	20,801 (Irbid City, 2013)	8,000 (Average of past 8 years)	Target
Water supply pressure		MPa	Less than 0 - 0.75	0.25 – 0.75	Target
Distribution pipeline flow between Hofa reservoir and Bait Ras		**m^3/day**	**0**	**30,000**	**Effect index**
Supply value /lpcd (Estimated)	Jordanians	Lpcd	82	125	Reference
	Including refugees	Lpcd	68	106	Reference
Water use per capita per day (Estimated)	Jordanians	Lpcd	65	100	Reference
	Including refugees	Lpcd	54	85	Reference
Leakage ratio (assumed)		%	20% (Estimated)	15 %	Target
Leakage complaints	Number	Number	4,439 (Irbid City)	3,000	Target
Served population	Jordanians	Persons	344,724	368,827	Reference
	Including refugees	Persons	104,507	104,507	Reference
	Including refugees	Persons	449,231	473,334	Reference

(3) Obligation of Recipient Country

The obligation of the recipient country for the 1st stage grant-aid project is as follows.

Table 2.5 Obligation of Recipient Country (1st Stage Grant-aid Project)

Items
1. Installation of distribution pipeline
(1) To provide water and chemicals for testing
(2) To cooperate for construction work on the road including acquisition of its approvals and permissions, and traffic control procedure
(3) To cooperate during pipe connection work such as attendance at water suspension work, its notice to people and etc.
2. Common Items for construction works
(1) To provide temporary stock yards for construction materials and machineries and lands for temporary works
(2) To prepare disposal site for waste soil
(3) To provide water and chemicals for testing
3. Other Items
(1) To coordinate for required approvals and permissions from relevant authorities to implement detailed design and construction works
(2) To cooperate in consultation with residents living near the construction sites and to coordinate procedures for traffic control in works with relevant authorities
(3) To carry out necessary procedures for issue of A/P required for payments to Japanese Consultants and Contractor and to bear the commissions for advising and payment to a bank in Japan for banking services based upon the Banking Arrangement
(4) To ensure prompt unloading and customs clearance of the goods for the project at the port of disembarkation in Jordan
(5) To accord Japanese nationals whose services may be required in connection with the supply of products and services under the verified contract such facilities as may be necessary for their entry into Jordan and stay there for the performance of their works.
(6) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Jordan with respect to the supply of the products and services under the verified contract. And to take necessary measures for such tax exemption.
(7) To use, operate and maintain properly the facilities and equipment constructed or procured under the Japan's Grant Aid program.
(8) To bear all the expenses, other than to be borne by the grant Aid, necessary for construction of the facilities

(4) Population benefitted

The population estimated to be benefitted in 2017 when water is supplied through the distribution pipelines between the Hofa reservoir and Bait Ras is 473,000.

(5) Project targets and BHN

① The targets of the project

Project targets are 1) to increase the volume of water supplied to the area where water demand has increased (because of the inflow of Syrian refugees into the host communities) by using the water resource volume that has increased because of rehabilitation of the eastern well fields in the northern governorates and because of development of Disi fossil water and 2) to reduce water leakage by rehabilitating the distribution pipeline network of Hawwara area, and aims to satisfy basic human needs (BHN).

② Improving lifestyle of the residents and stabilizing their livelihood
The project will contribute to improving the water supply services and thereby improving the lifestyle of the residents. It will also contribute to improving the welfare program for the northern part of Jordan where a large number of Syrian refugees have taken shelter, contribute to harmony between Syrian refugees and host community, and stabilize the livelihood in the country.

③ Contributing to realization of targets of medium and long-term development plans
The "National Water Strategy" which is Jordan's medium to long-term plan has the policy of effectively using limited water resources to the maximum extent. This project will contribute to realizing the targets of the medium to long-term plan through reduction in water leakage and non-revenue water.

④ Matching Japan's aid policy and guidelines
Japan has announced aid equivalent to 60 million dollars at the 68th UN General Assembly meeting in September 2013 as humanitarian aid to Syria. The implementation of rehabilitation and provision of water sector facilities will contribute to lightening the load on the host communities that have accepted the Syrian refugees and matches the above mentioned guidelines; therefore it is highly valid.

(6) Project Effectiveness

① Quantitative effects
A flow of 30,000 m^3/day will be newly allocated to Irbid City and Bait Ras and Hawwara areas from the Disi fossil wells in the eastern part to the Hofa reservoir through distribution pipelines between the Hofa reservoir and the Bait Ras.

② Qualitative effects

- Water is being supplied generally once a week; however, the supply time will be increased with the increase in supply volume. The annually distributed volume of water from the Zebdat reservoir to Irbid City and Bait Ras area is about 12 MCM. However, at the completion of this project, the annual volume will increase by 11 MCM so that the total volume will become approximately 23 MCM/year. Consequently, the supply time may be expected to double and will become twice a week in 2017 when the project starts operation.
- The per capita water supply volume will increase with the increase in the supply time and the allocated (supplied) volume, and the unsatisfactory water supply area will also decrease.
- The non-revenue water will decrease with the setting of distribution zones in Hawwara area, rehabilitation of the distribution pipeline network and optimized distribution pressure.

(7) Project Implementation

Based on the outline design, the project started construction in 2015 and will be in operational in 2017 under the Japanese grant-aid scheme.

2.4.3 Second Outline Design (2nd Stage Grant-aid Project)

Following the first outline design, preparatory survey on the project for urgent improvement of water sector for the host communities of Syrian refugees in the northern governorates phase 2 (the second outline design for the 2nd stage grant-aid project) has been formulated.

The second outline design targeted to rehabilitation of distribution pipes in the remaining Hawwara and Sarieh areas that was planned to be included in the first outline design but not implemented due to budgetary constraints.

(1) Scope of the Project

Scope of the 2nd stage grant-aid project is shown in Figure 2.10 and Table 2.6. The target areas is divided into 4 zones and 3 zones are included in the project implementation and one zone is not included or out of scope of the project after evaluation of benefit and priority, but its design was made as shown in Table 2.7 for reference.

Table 2.6 Scope of the Project for 2nd Stage Grant-aid Project

Area	Zone	Items		Unit	Quantity of Distribution Pipe			Remark
					Replace. of exist. pipe	Installation of new pipe	Total	
Hawwara	Zone 1	Distribution Pipe	DN300 (DCI)	m	0	0	0	
			DN200 (DCI)	m	0	0	0	
			DN150 (DCI)	m	775	0	775	
			DN100 (DCI)	m	8,792	4,804	13,596	
			OD63(HDPE)	m	10,033	10,803	20,836	
			Total	m	19,600	15,607	35,207	
		Trenchless(Jacking) Work		Place	2			Bagdad Road
	Zone 2	Distribution Pipe	DN300 (DCI)	m	262	0	262	
			DN200 (DCI)	m	512	0	512	
			DN150 (DCI)	m	1,420	593	2,013	
			DN100 (DCI)	m	7,622	6,035	13,657	
			OD63(HDPE)	m	11,284	14,922	26,206	
			Total	m	21,100	21,550	42,650	
		Trenchless(Jacking) Work		Place	2			Bagdad and Sarieh Road
Sarieh	Zone 3	Distribution Pipe	DN300 (DCI)	m	0	657	657	
			DN200 (DCI)	m	0	1,093	1,093	
			DN150 (DCI)	m	268	577	845	
			DN100 (DCI)	m	2,561	3,079	5,640	
			OD63(HDPE)	m	7,171	12,536	19,707	
			Total	m	10,000	17,942	27,942	
		Trenchless(Jacking) Work		Place	1			Petra Road
	Zone 4	PRV		Set	2			Sarieh Road and main Road
Total		Distribution Pipe	DN300 (DCI)	m	262	657	919	
			DN200 (DCI)	m	512	1,093	1,605	
			DN150 (DCI)	m	2,463	1,170	3,633	
			DN100 (DCI)	m	18,975	13,918	32,893	
			OD63(HDPE)	m	28,488	38,261	66,749	
			Total	m	50,700	55,099	105,799	
		Trenchless(Jacking) Work		Place	5			
		PRV		Set	2			

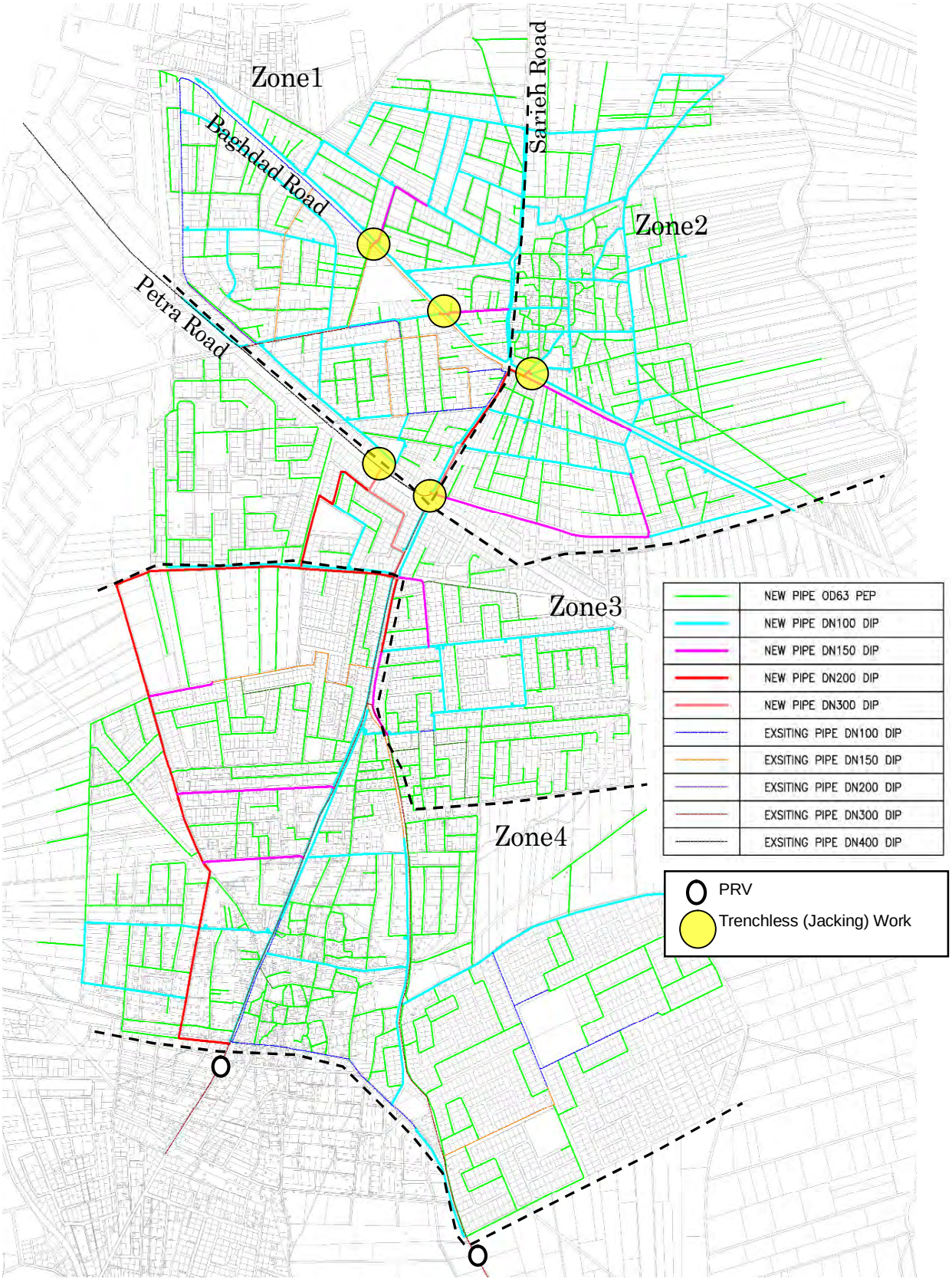


Figure 2.10 Second Outline Design for 2nd Stage Grant-aid Project

Table 2.7 Reference: Distribution Pipes in Zone 4 (designed, but out of scope of the Project)[4]

Area	Zone	Items		Unit	Distribution Pipe Quantity			Remark
					Replace. of exist. pipe	Installation of new pipe	Total	
Sarieh	Zone 4	Distribution Pipe	DN300 (DCI)	m	0	12	12	
			DN200 (DCI)	m	1,879	737	2,616	
			DN150 (DCI)	m	878	10	888	
			DN100 (DCI)	m	8,738	1,216	9,954	
			OD63(HDPE)	m	29,605	19,775	49,380	
			Total	m	41,100	21,750	62,850	

(2) Project Target Value

The effect index of the project and the reference and target values set are shown in Table 2.8 and Table 2.9, respectively.

Table 2.8 Effect Index of the Project in the Study Area (2nd Stage Grant-aid Project) [5]

Item	Unit	Current value (2016)	Target value (2020)	Remark
Water supply pressure	MPa	0.11 - 0.50	0.25 – 0.75	Effect index

Table 2.9 Target and Reference Values of the Project in the Study Area (2nd Stage Grant-aid Project) [6]

Item	Unit	Current value (*1) (2012)	Target value (2020) (*2)	Remark
Supply amount per capita per day	Lpcd	68	110	Reference value
Water use per capita per day	Lpcd	62 for Hawwara 54 for Sarieh	88	Reference value
Leakage ratio (assumed)	%	23%	20 %	Target value

[4] - From the view point of cost reduction, it is recommended that the jacking method be changed to the open-cut method if the Ministry of Public Works and Housing (MPWH) permits it.
- Quantity of pipes of each zone is estimated by two categories: replacement of existing pipe overlapped with existing pipes, and installation of new pipe in new route shown in Figure 2.10

[5] Some depression area is allowed to exceed the maximum pressure of 0.75 MPa, otherwise the facilities is inclined to be excessive and noneconomic design. However, even in this case, the maximum pressure should not be higher than 1.0 MPa.

[6] *1: the data of JICA water supply master plan for Irbid City

(3) Obligation of Recipient Country

The obligation of the recipient country for the 2nd stage grant-aid project is as follows.

Table 2.10 Obligation of Recipient Country (2nd Stage Grant-aid Project)

Items
1. Installation of distribution pipeline
(1) To provide water and chemicals for testing, cleaning and disinfection without charge
(2) To cooperate for construction work on the road including acquisition of its approvals and permissions, and traffic control procedure
(3) To cooperate during pipe connection work such as attendance at water suspension work, its notice to people and so on.
2. Installation of service pipes
(1) To Install service pipes including water meters
(2) To provide water and chemicals for testing
3. Common Items for construction works
(1) To provide temporary stock yards without charge for construction materials and machineries and lands for temporary works
4. Other Items
(1) To coordinate for required approvals and permissions from relevant authorities to implement detailed design and construction works
(2) To cooperate in consultation with residents living near the construction sites and to coordinate procedures for traffic control in works with relevant authorities
(3) To carry out necessary procedures for issue of A/P required for payments to Japanese Consultants and Contractor and to bear the commissions for advising and payment to a bank in Japan for banking services based upon the Banking Arrangement
(4) To ensure prompt unloading and customs clearance of the goods for the Project at the port of disembarkation in Jordan
(5) To accord Japanese nationals whose services may be required in connection with the supply of products and services under the verified contract such facilities as may be necessary for their entry into Jordan and stay there for the performance of their works.
(6) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Jordan with respect to the supply of the products and services under the verified contract and to take necessary measures for such tax exemption.
(7) To use, operate and maintain properly the facilities and equipment constructed or procured under the Japan's Grant-aid program.
(8) To bear all the expenses, other than to be borne by the grant-aid, necessary for construction of the facilities.
5. After the Project
(1) To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant-aid ➢ Allocation of maintenance cost ➢ Operation and maintenance of facilities ➢ Routine check/Periodic inspection

(4) Population benefitted

The population benefitted including Syrian refugees is estimated as 27,964 in Hawwara (Zone 1, 2) and Sarieh (Zone 3) as shown in table below.

Population benefitted in the target Year 2020

Area	Zone	Population	Project Scope	Population benefitted
Hawwara	Zone 1	10,008	Scope of the Project	**27,964**
	Zone 2	11,623		
	Total	21,631		
Sarieh	Zone 3	6,333		
	Zone 4	26,250	Designed but out of scope of the Project	
	Total	32,583	-	-

(5) Project targets and BHN

① The targets of the project
Same as 1st stage grant-aid project

② Contributing to realization of targets of medium and long-term development plans
Same as 1st stage grant-aid project

③ Matching Japan's aid policy and guidelines
Same as 1st stage grant-aid project

(6) Project Effectiveness

① Quantitative effects
Water will be distributed at adequate water pressure (0.25 – 0.75MPa) by optimized zoning and improvement of existing distribution pipes.

② Qualitative effects

- Leakage will decrease by replacement of aged pipes.
- Distributed water to Hawwara and Sarieh will increase by implementation of the 1st grant-aid project, and the improvement of transmission pipe lines and water resource development projects implemented by Jordan side. The project makes it possible to distribute this increasing water at adequate pressure, leading to even water supply and reduction of poor water supply area.
- Installation of new pipes in developing area without served pipe lines will contribute to expand water served area and population.

(7) Project Implementation

Based on the outline design, the Japanese government (cabinet) has approved to implement grant-aid project through the international organizations assistance (Japanese grant in association with an international organization).

2.5 Component B: Water Supply and Wastewater Management Plan

2.5.1 Selection of Sub-projects

As a result of discussion with WAJ and JICA considering the contents proposed in the National Resilience Plan, master plan of water supply system and wastewater management of 3 cities of Irbid, Ramtha and Mafraq were picked up as sub-projects for Component B to bridge between the reservoirs transferred from the water sources through the transmission facilities and the water supplied areas for large populations. The following sub-projects were selected, and studies have been implemented from January 2014 to January 2015 as Component B.

- Water supply master plan in Irbid and Ramtha.
- Wastewater master plan for six (6) sewerage districts (SWD) in Irbid, Ramtha and Mafraq.

2.5.2 Water Supply Master Plan in Irbid and Ramtha

(1) Contents of study

The contents studied are as follows:

① Existing conditions of the study area
② Existing water supply system
③ Allocated water to Irbid and Ramtha
④ Improvement plan in Irbid and its suburbs
⑤ Improvement plan in Ramtha and its suburbs
⑥ Considerations on operation / maintenance, institution and capacity development
⑦ Implementation schedule and cost estimate
⑧ Economic and financial evaluation
⑨ Environmental and social considerations
⑩ Conclusions and recommendations

(2) Target Year and Interval of Updating Contents in the Plan

After discussion with WAJ, the target year was decided as 2035, 20 years after the master plan. Such facilities as treatment plant and pumping stations are generally constructed at stages, say 5 years intervals in accordance with demand increase to avoid excessive initial costs investment.

(3) Number of Syrian Refugees considered in the Master Plan

Even without counting number of Syrian refugees, available water of 72 MCM/year could not meet water demand of 78 MCM/year in 2012. Therefore, water distribution facilities need to be improved immediately to supply the additional available water.

The master plan should also consider demand of Syrian refugees. As already explained, number of Syrian refugees in future is difficult to estimate. The previous trend of Syrian refugees is shown in Figure 2.11. After discussion with WAJ, number of Syrian refugees as of 2013 was used as fixed number for the master plan. Water demand of Jordanian population in 2013 (estimated population of Jordanian Department of Statistics) and fixed number of Syrian refugees was found out to be equal to water

demand of Jordanian population in 2022. Water demand of Jordanian population in 2028 and the fixed number of Syrian refugees was found out to be equal to water demand of Jordanian populations in 2035. In other words, the facilities required for Jordanian population in 2035, the target year, are needed in 2028 considering the fixed number of Syrian refugees (see Figure 2.12).

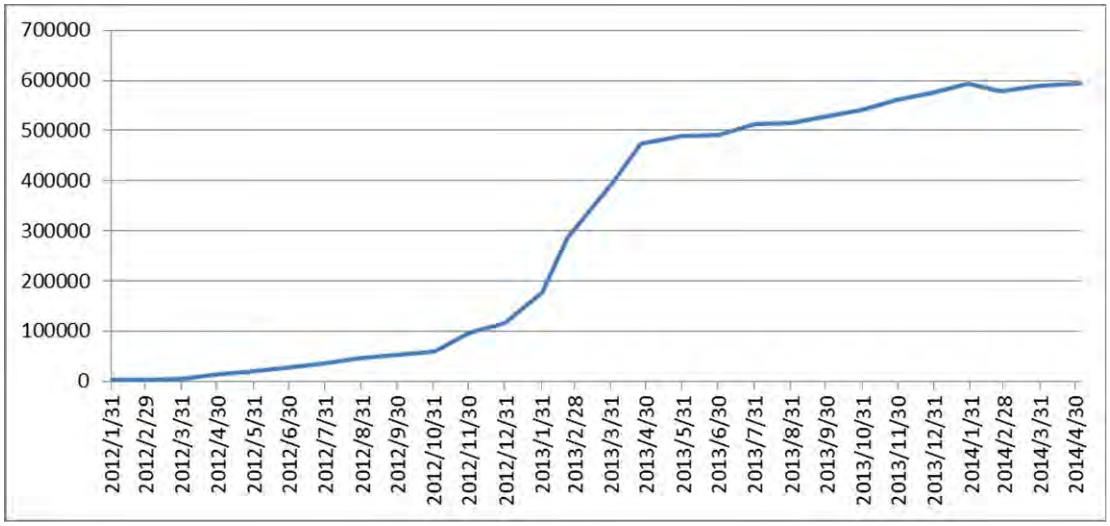


Figure 2.11 Syrian Refugees Registered with UNHCR

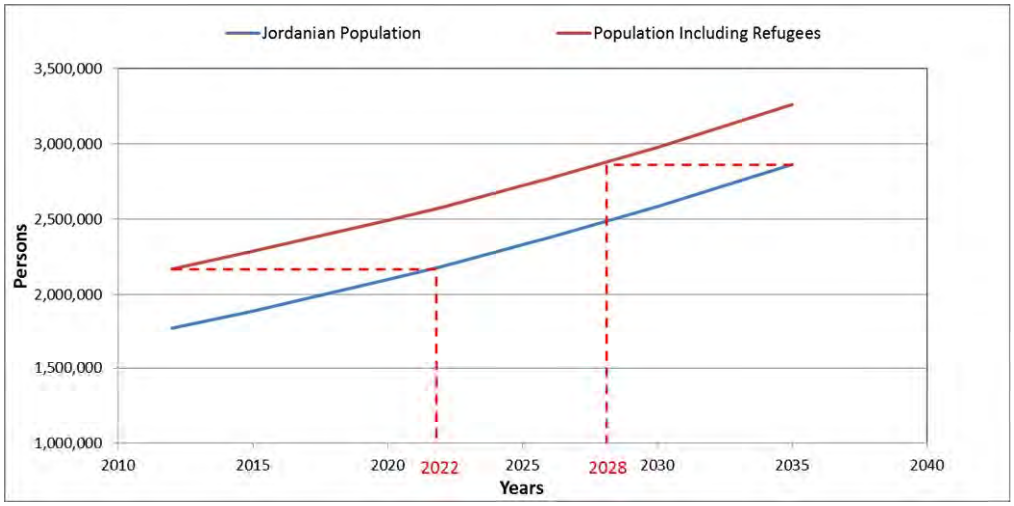


Figure 2.12 Projected Jordanian Population and Total Population Including Syrian Refugees

(4) Water Distribution Facilities Proposed in Water Master Plan

Distribution facilities are proposed for Irbid and Ramtha. In Ramtha, the distribution system is planned not to be changed but only to increase pipe size in replacement.

On the contrary, the distribution system in Irbid along with increase of diameter of pipe will change according to a development of additional water resources. The transition of water supply system for Irbid is explained below.

- Currently, water is transmitted to the Zebdat reservoir through the western transmission pipe in Irbid. Then, water is distributed from the Zebdat reservoir either by gravity or pumping.
- In case A when additional 19 MCM/year of water is available, water will be distributed both from the Zebdat reservoir and the Hofa reservoir as shown in Figure 2.13. The Zebdat

reservoir will continue to receive water through the western transmission pipe while the Hofa reservoir will receive water through the eastern transmission pipe. Most of the areas belonging to Zebdat pump zone will turn into Hofa gravity zone utilizing high elevation of Hofa reservoir. The distribution pipe to the Irbid and Bait Ras is constructed under Component A and will be operational in early 2017.

- In case B when additional 30 MCM/year of water is available, water to Zebdat reservoir from the eastern transmission pipe through Hofa reservoir will stop, and all water for Irbid will depend on the western transmission pipe reaching to the Zebdat reservoir. In this case, most of Irbid area will be supplied water from the Zebdat by gravity (see Figure 2.14).

Pipes required for both strengthening and rehabilitation are proposed to be implemented at 4 stages: strengthening of main pipes to accommodate for an increased water flow at 1st stage by year 2020 while rehabilitation of pipes at 2nd to 4th stages by years 2025, 2030 and 2035, respectively.

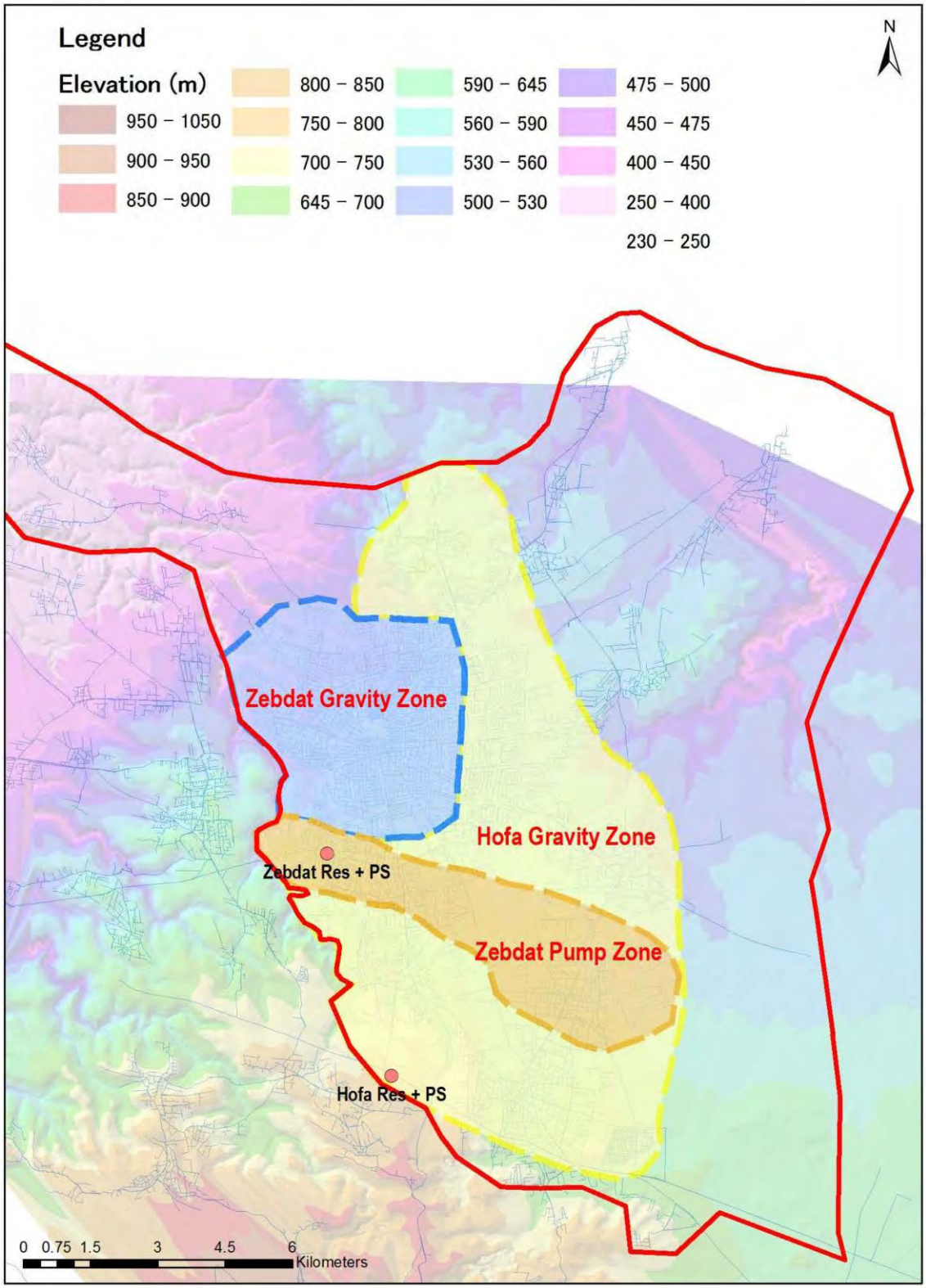


Figure 2.13 Distribution Zone in Irbid in case A between 2018 and 2020 (Additional Water from Disi Fossil Water and Eastern Wellfields)[7]

[7] Zebdat Pumping Zone will mostly turn into Hofa Gravity Zone.

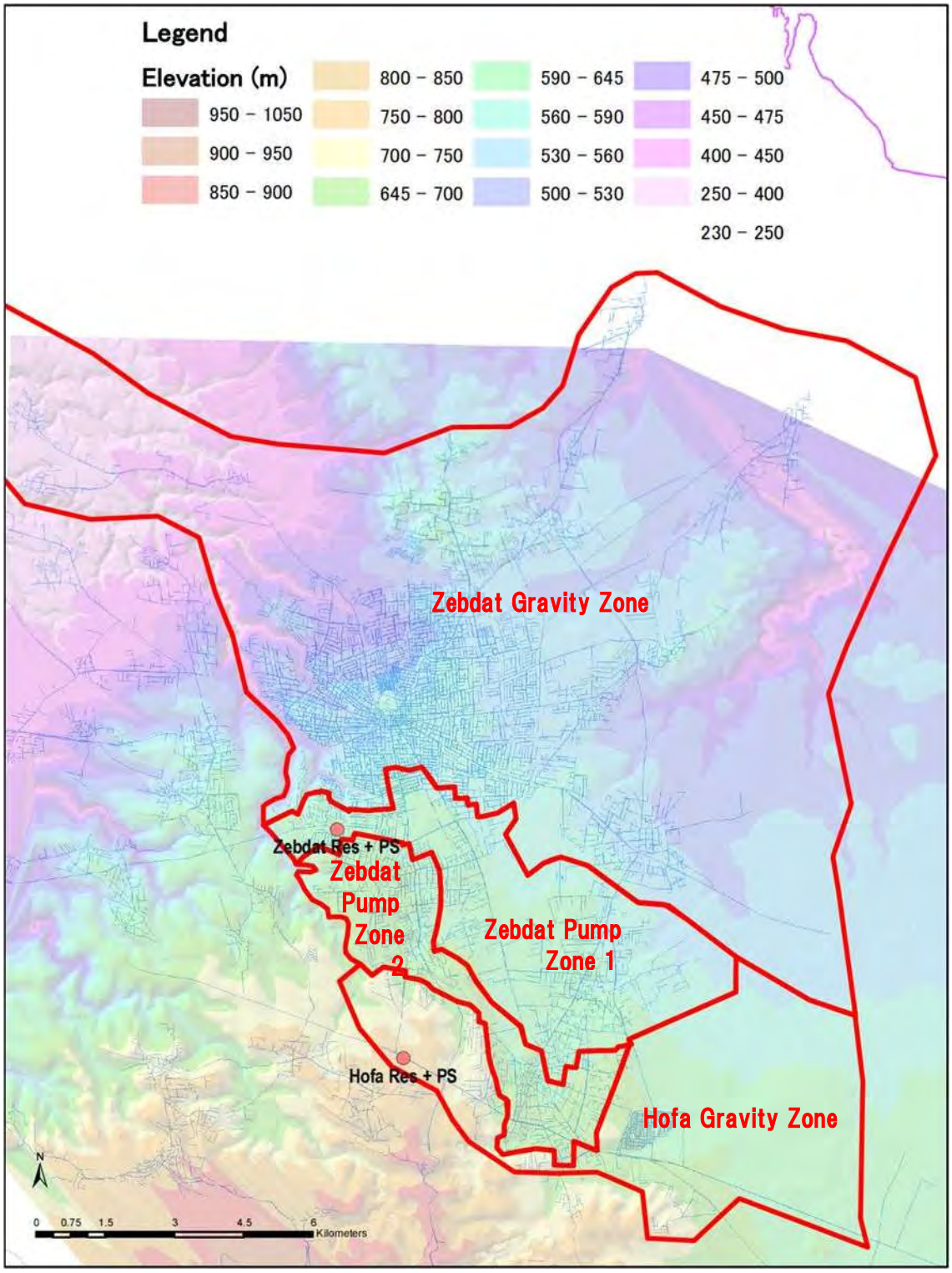


Figure 2.14 Distribution Zone in Ibid in case B after 2020 (Additional Water from the Wadi Arab 2nd phase)

(5) Seminar on Master Plans

Seminar was held in February 10, 2015 immediately after the master plan was prepared to disseminate their output to the related organizations including donor agencies. Number of participants was about 70 including WAJ, YWC, donor agencies and NGOs. The participants could understand the situations and required measures. As a result, some of the proposed projects were later utilized by them for their planning and implementation.

(6) Acceleration of Facilities Construction

Immediate implementation of the facilities construction was required based on the master plans' results to ease water demand-supply imbalance in the host communities. The 1st stage facilities are mostly of strengthening pipes to accommodate additionally available water.

At the request of the Jordanian side, part of the 1st stage water supply facilities in Irbid was selected for detailed designs in view of future funding by other development partners. The detailed design started in January 2016 and was completed in February 2017. The distribution system was the same as in the master plan but District Metered Areas (DMA) within the distribution zone was reorganized as shown in Figure 2.15 (Zebdat Gravity Zone) and Figure 2.16 (Zebdat Pump Zone). Primary mains are also proposed to transfer water from the Zebdat reservoir exclusively to each DMA. Inflow to each DMA will be monitored and controlled for equitable water distribution.

WAJ will soon call tendering of facilities construction with a planned construction period of 1 year. AFD and KfW are expected to provide soft loan jointly to WAJ to construct these facilities.

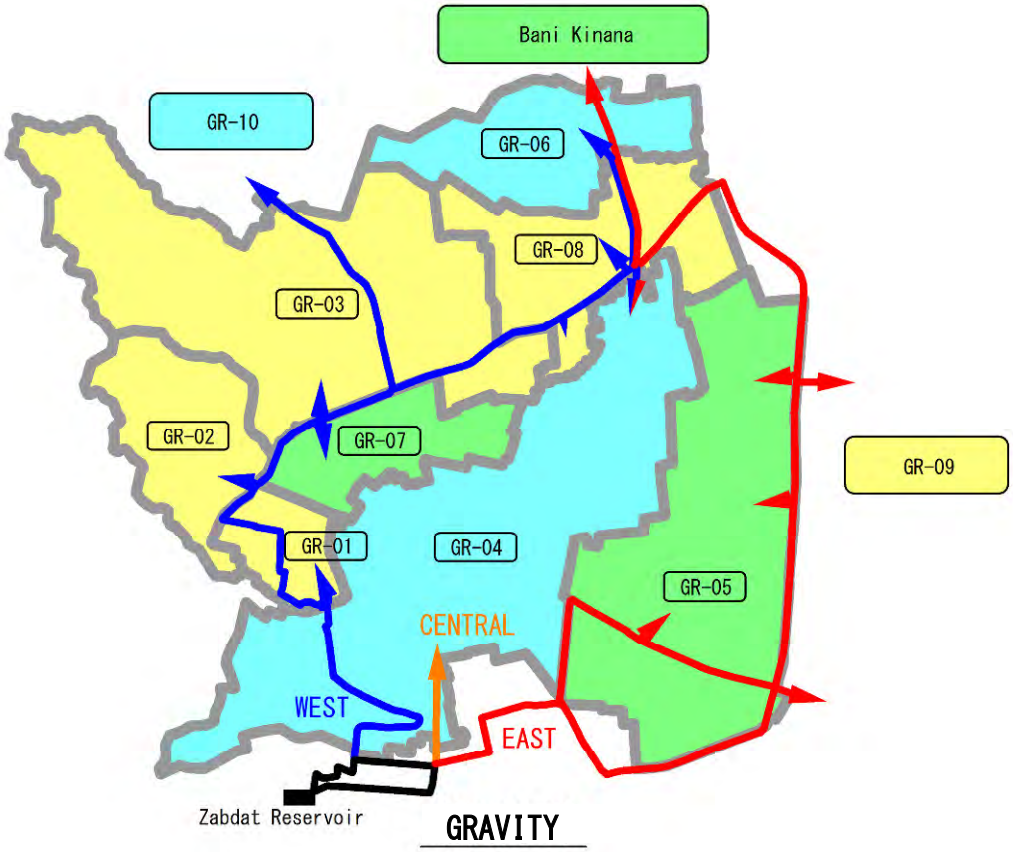


Figure 2.15 District Metered Areas (DMA) and Primary Mains in Zebdat Gravity Distribution System[8]

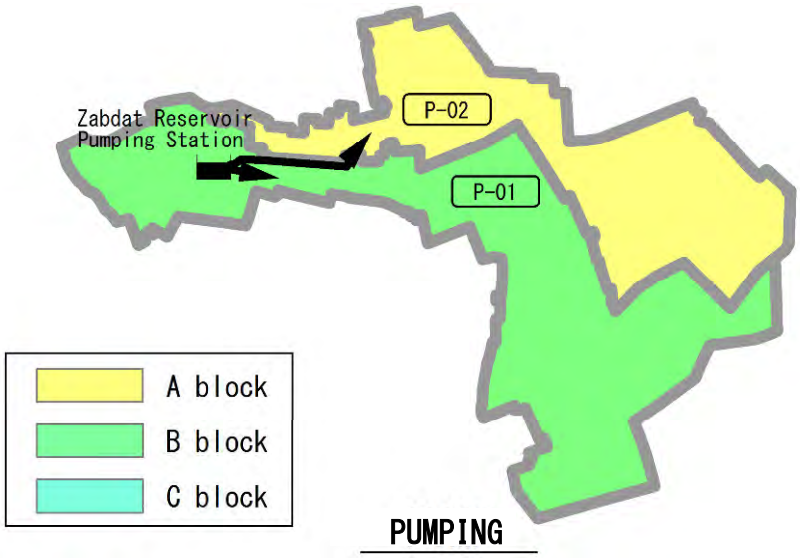


Figure 2.16 District Metered Areas (DMA) and Primary Mains in Zebdat Pumping Distribution System[9]

[8] Zebdat gravity zone will be divided into DMAs for equitable water distribution. East, Central and West primary mains conveys water only to each DMA (GR-01 etc.). Flow into each DMA will be monitored and controlled for equitable water distribution. Part of East primary mains will utilize part of the distribution main pipes from Hofa to Bait Ras, which will be constructed in the 1st stage grant-aid project.

[9] Zebdat pump zone 1 in Figure 2.14 proposed in Master Plan is sub-divided during the detailed design stage.

2.5.3 Sewerage Master Plan for Six (6) Sewerage Districts in Irbid, Ramtha and Mafraq

The urbanized areas in cities of Irbid, Ramtha and Mafraq are mostly covered by the sewerage system, and the existing capacities (including being expanded in Mafraq) of 6 wastewater treatment plants (WWTP) (4 in Irbid, 1 each in Ramtha and Mafraq) have adequate for the flow in 2013 even including the number of Syrian refugees. The proposed facilities are, therefore, for extension of served areas in settlements with more than 5,000 populations.

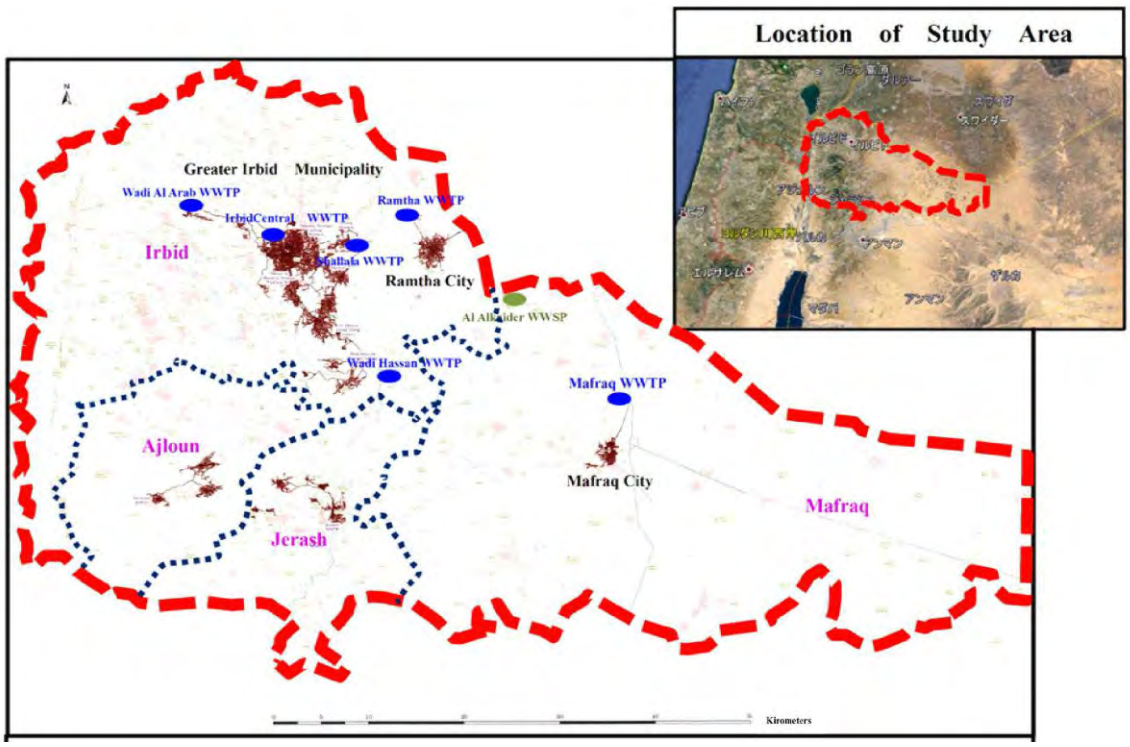


Figure 2.17 Location of Six (6) Sewerage Master Plan

(1) Contents of study

The contents studied for sewerage master plan are as follows:

① Existing conditions of the study area
② Existing wastewater management
③ Sewerage planning and design basis
④ Sewerage development plan
⑤ Institutional development plan
⑥ And capacity development plan
⑦ Implementation plan
⑧ Project cost estimate
⑨ Economic and financial evaluation
⑩ Environmental and social considerations
⑪ Priority projects
⑫ Conclusion and recommendations

(2) Target for Formulation of Sewerage Master Plan

Sewerage master plan is formulated for six sewerage districts (SWD) in Irbid, Ramtha and Mafraq on a basis

of wastewater generation of year 2035 and design effluent quality, as shown in Figure 2.17 and Table 2.11.

Table 2.11 Planning Basis for Six SWDs

Item	Central Irbid SWD	Wadi Al-Arab SWD	Shallala SWD	Wadi Hassan SWD	Ramtha SWD	Mafraq SWD
1) Service Area (ha) in 2035	696	4,613	6,523	1,453	2,483	3,770
2) Service Population in 2035	118,200	328,900	307,300	35,400	201,200	156,200
3) Design Flows						
Average Daily (m^3/d)	10,880	28,430	22,520	2,490	17,270	14,360
Maximum Daily (m^3/d)	12,720	33,260	26,360	2,920	20210	16,800
4) Design Influent Quality						
BOD_5 conc. (mg/L)	706	752	887	924	757	707
SS conc. (mg/L)	652	694	819	853	699	653
5) Design Effluent Quality						
BOD_5 conc.(mg/L)	30	30	30	30	30	60
SS conc.(mg/L)	30	30	30	30	30	60
NH_4^+-N conc.(mg/L)	2.5	2.5	2.5	2.5	15	-
NO_3-N conc.	30	30	30	30	25	70
(mg/L) T-N conc.	45	45	45	45	45	80
(mg/L)						

(3) Improvement Plans for Six SWDs

The trunk sewers are sufficient for the flow in 2012 and even for the 2035. Improvements are mostly made for expansion of sewer areas. As a result of flow increase, capacities of the wastewater treatments need to be expanded.

Table 2.12 Sewerage Improvement Plans for Six SWDs

City	Irbid City				Ramtha City	Mafraq City
Item	Central Irbid SWD	Wadi Al-Arab SWD	Shallala SWD	Wadi Hassan SWD	Ramtha SWD	Mafraq SWD
1) Branch Sewer	No need	200mm CP, 316 km	200mm CP, 257 km	200mm CP, 61km	200mm CP 216 km	200mm CP, 442km
2) Trunk Sewer	No need	No need	200mm CP,3.3km 400mm CP,4.6km	No need	300mm CP, 4.3 km 150mm DIP, 2.4km 200 mm DIP, 4.7km 200mm DIP, (double), 5.25km 200mm DIP,(triple) , 5.16km long	300mm CP,19km, 200mm DIP,23km 250mm DIP,4km
3) Lift Station	No need	Hakama LS increase capacity of 2.32 m^3/min	Maghayer Manhole Pump and Al Hoson LS, capacity increase 1.42 m^3/min.	(Al Hoson LS is to be shifted to Shallala SWD)	4 manhole pumps	Mansha LS, capacity of 3.25 m^3/min, Mafraq LS, capacity of 2.14 m^3/min
4) WWTP	Sludge De-hydrator	3 sets of aeration tank and final sedimentation tank, capacity 3,500 m^3/d each	1 primary sedimentation tank, two oxidation ditches, and one final sedimentation tank, to cover the design flow increase of 8,520 m^3/d.	20 sludge drying beds. capacity is 1,200 m^3/d.	2 sets of aeration tank and final sedimentation tank and sludge de-hydrator, Capacity 4,400 m^3/d each.	2 lines of treatment facilities, capacity 3,600 m^3/d each
Present WWTP Capacity	12,000 m^3/d	20,800 m3/d	13,700 m3/d	2,800 m3/d	5,400 m3/d	6,550 m3/d

(4) Implementation Schedule

Sewer laying is planned at stages to increase the sewer areas, and the required trunk sewers and wastewater treatment plants to accommodate increased flow are also planned.

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Table 2.13 Implementation Schedule

City	Irbid City				Ramtha City	Mafraq City
Phase	Central Irbid SWD	Wadi Al- Arab SWD	Shallala SWD	Wadi Hassan SWD	Ramtha SWD	Mafraq SWD
Phase-1 (Y2017-21)	1) Sludge de-hydrator	1)Br. sewer 168km, 2)Hakama LS 2.32 m^3/min, 3)WWTP: 1 set of aeration tank and final sedimentation tank, capacity 3,500 m^3/d	1)Br. Sewer 90km, 2)Trunk sewer 3.3km, 3)Maghayer Manhole Pump	No plan	1) Br. Sewer 66km 2) Trunk Sewer 4.3 km (300CP) 3)1 set of aeration tank and final sedimentation tank, capacity 4,400 m^3/d and sludge de-hydrator	1)Br. Sewer 122km 2)Trunk Sewer, 15km(300CP), 3km (200DIP) 3) Mansha LS, capacity of 3.25 m^3/min 4) 1 line of facilities, capacity 3,600 m^3/d
Phase-2 (Y2022-26)	No plan	1)Br. Sewer 88km 2)WWTP: 1 set of aeration tank and final sedimentation tank, capacity 3,500 m^3/d	1) Br. Sewer 39km 2) Trunk Sewer 4.6km (400 CP) 3) Al Hoson LS is shifted from Wadi Hasan SWD, with capacity increase 1.42 m^3/min	1)Br. Sewer 18km 2)WWTP: 20 sludge drying beds	1)Br. Sewer 53km	1)Br. Sewer 164km 2)Trunk Sewer, 4 km(300CP) 3) Mafraq LS, capacity of 2.14 m3/min 4) 1 line of facilities, capacity 3,600 m^3/d
Phase-3 (Y2027-32)	No plan	1)Br. Sewer 61km 2)WWTP: 1 set of aeration tank and final sedimentation tank, capacity 3,500 m^3/d	1) Br. Sewer 129km 2) 1 primary sedimentation tank, 2 oxidation ditches, and 1 final sedimentation tank, to cover the design flow increase of 8,520 m^3/d.	1) Br. Sewer 43km	1) Br. Sewer 97km 2) Trunk Sewer 150-200mm DIP 3) 4 manhole pumps 4) 1 set of aeration tank and final sedimentation tank	1)Br. Sewer 156km 2)Trunk Sewer, 4km (250DIP)

(5) Evaluation on Sewerage Master Plan

① The economic evaluation for the project proposed is carried out based on analysis of the benefits and costs. The evaluation reveals that the EIRR of the project results in 18.6% as a whole, which exceed 10% of the opportunity cost of capital though the EIRRs vary from SWD to SWD. Therefore, the project is judged to be economically feasible.

② The financial evaluation is carried out based on the revenues and costs. The evaluation reveals the FIRRs of every SWD do not exceed 6% of the opportunity cost of capital. And the project results in -11.6% as a whole. It is apparent that the low level of present sewerage tariff and the huge project costs are the major reasons for the negative FIRR. Therefore the increase of sewerage tariff and the government grant to a part of the project cost are recommended to make the project financially feasible. Meanwhile, even though tariff increase and grants, the project net cash flow will be negative until the end of the phase-3. For this, the WAJ subsidies are required until the phase-3 to sustain the project financially.

③ The phase-1 project of Central Irbid SWD is recommended to implement as soon as possible, because the proposed sludge dewatering facilities for Central Irbid SWD are essential to treat and dispose of sludge properly.

④ To suggest implementation priorities to the proposed phase-1 projects of four SWD, these projects are compared and evaluated with four parameters: increased number of beneficiaries, need to expand the sewerage services, increased population coverage ratio, and cost performance. The phase-1 project of Shallala SWD gets the first priority and that of Wadi Al-Arab SWD gets the second priority. Both projects may be easier to implement because of less financial burdens to WAJ and YWC, in which the existing wastewater treatment plant facilities could be used efficiently without any investment (Shallala SWD) and with smaller investment (Wadi Al-Arab) compared with cases of Ramtha SWD and Mafraq SWD. Therefore, JICA Study Team recommends both phase-1 projects of Shallala SWD and Wadi Al-Arab SWD are implemented as priority projects.

⑤ Due to the huge costs, the phase-1 project of Mafraq SWD may be difficult to implement. The project of Mafraq SWD is expected to mitigate the Syrian refugee's impacts to the wastewater management of community. However, from the financial viewpoints, the phase-1 project should be modified to smaller investment plan such as service area would be limited only to urban city center and to stop the service provision to small suburban areas.

⑥ Negative environmental and social impacts are expected during construction period like noise, vibration, odor, etc. However, the negative impacts are not expected to be significant. These impacts can be mitigated by appropriate measures. For this, a monitoring plan is proposed. One more concern is occurrence of antiquities during excavation for construction. If found, the consultation with the concerned agency is required.

2.6 Component C: Pilot Activities for Technical Transfer

(1) Selection of Activities

Issues on water sector were identified and analyzed to select pilot activities in Component C. The pilot activities to which Japan will contribute, should soon improve water supply and wastewater services for Syrian refugees and the host communities. Poor water service was the largest problems followed by leakage in water supply sector while overflow of sewerage due to choking of sewers was the largest problem in wastewater sector.

Poor water service is caused by various reasons such as insufficient water flow, inadequate pipe size, inadequate pipe layout, insufficient water pressure control. In order to improve poor water service, overall distribution facilities planning and implementation of rehabilitation of pipes are required.

Reduction of leakage and opening of sewer choking requires structural measures as well. On the other hand, that requires soft measures such as leakage detection and leakage repair in tandem with structural measures. Components A and B deals with the structural measures and soft measures are taken under Component C.

(2) Leakage

Leakage repairs conducted by YWC were found inappropriate through seminars, lectures, hearings and practices of leakage detection and repairs: inappropriate leakage repairs made leakage occurring repeatedly at the same points. YWC realized effectiveness of leakage repairs through the seminars, lectures and practices of leakage detection and repairs, and requested JICA study team to transfer technology to staffs of other Regional Operating Offices (ROUs) instead of only staffs of Irbid ROU of

YWC. As a result, seminars etc. covered staffs of entire YWC by JICA study team.

(3) Sewer Choking

Seminars, lectures, hearings and practices of removing foreign objects were conducted; YWC did not remove them out and instead washed foreign objects away downstream by use of water jet machine. This method transfers foreign objects downstream only and choking often occurred downstream. YWC did not have adequate devices to remove foreign objects and then JICA provided vacuum cleaner to remove them. JICA study team taught principles and mechanism and train YWC counterparts on usage of the vacuum cleaner.

(4) Awareness-raising Activities

Pamphlets and signboards were produced jointly with YWC as one of awareness-raising activities. The topics on them were effective use of precious water and no dumping of foreign objects to sewers. T-shirts were produced and delivered to YWC staffs to increase their motivation. T-shirts were intended to make residents realize that YWC and JICA were working together on activities on the host communities.

(5) Activities Records of Water Supply

① Expected Outputs

Table 2.14 Expected Outputs of Activities (Water)

Activities	Target personnel	Outputs
Improvement of Technical Skill	Maintenance team of Irbid ROU and Training Department	1) Technicians of maintenance team understand proper pipeline works. 2) Technical skill of maintenance crew is improved. 3) Training department makes arrangement and plans for technical training.
Improvement of Promoting Public Awareness	Communication Department	1) Communication department takes actions for reproducing educational materials for water supply & sewerage as required.

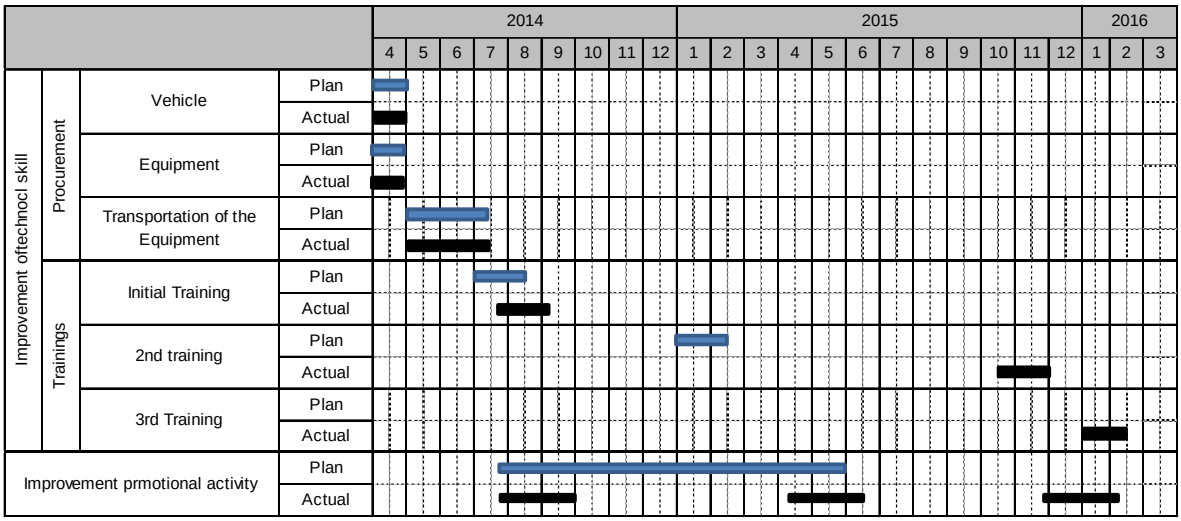
② Inputs for Activities

Table 2.15 Inputs for Activities (Water)

Activities	Inputs
Improvement of Technical Skill (in pipeline works)	**[Japanese Side]** 1) Dispatch of Japanese specialists for entire coordination 2) Dispatch of Japanese specialists for technical training 3) Procurement of the equipment and materials for the training 4) Provision of project cost **[Jordanian Side]** 1) Deployment of counterpart (Training department) 2) Working space for Japanese specialists 3) Training space
Improvement of Promoting Public Awareness	**[Japanese Side]** 1) Dispatch of Japanese specialists for entire coordination 2) Dispatch of Japanese specialists for technical training 3) Provision of project cost **[Jordanian Side]** 1) Deployment of counterpart (Communication department)

③ Schedule

Table 2.16 Schedule of Activities



④ Equipment Procurement

Table 2.17 List of Equipment Accompanied with Study Team

Items		Quantity
1. Welding Unit for PE Electric Fusion	1.1 Welding Unit 220V	1 lot
	1.2 Multi clamp	1 lot
	1.3 Scrapers including accessories	1 lot
2. Threading Tools	2.1 Electric Threading Tools	1 no.
	2.2 Manual threading tool	1 no.
3. Engine Driven Welder		1 no.
4. Portable Generator		1 no.
5. Mobile Compressor		1 no.
7. Fittings		1 lot
8. Tools for pipeline works (Pipe saw, cutter, wrenches, etc.)		1 lot

⑤ Results of Pilot Activities

Table 2.18 The result of the Activities

Activities	Status before the activity	Status or findings after the activity
Improvement of technical skill in pipeline works	• The technicians in maintenance crew of ROUs do not have technical knowledge in pipeline works.	• The trainees who had the technical trainings of the Project understand proper way in pipeline works. • Above trainees are good enough for playing a role of the trainers for informal training in YWC. • Engineer class of the trainees deems lack of engineering skill in water supply.
	The training department did not have experience of making a plan of training and its implementation.	• Some of the staffs are capable of planning and implementing the training. • Manager needs to be more flexible in sharing the works with the department staff.
Improvement of promoting public awareness	• The communication department was inactive for promoting public awareness.	• Impact of the activity is not felt from the department. • Female staff of the department has a motivation.

⑥ Recommendation for training

- To check up and make a list of the equipment of YWC's property for technical training,
- To make a list of short program or modules of the training that YWC's technicians can conduct training as trainer,
- To make a list of the equipment and consumables necessary for above training,
- To conduct the needs assessment survey for technicians and engineers in order to make training plans,
- To share the ideas on the trainings with the colleague of the training department in order to proceed the trainings, and
- To keep in touch with personnel concerned with above works in order to exchange the views each other.

⑦ Recommendation for improvement on promoting public awareness

- To take action for what they can develop at first, and do so that the education directorate welcomes the activity for public awareness, and
- To share the ideas with the colleague of the communication department in order to conduct efficiently,

⑧ Other considerations

- Technical staffs become capable of being trainers for training, but to develop the technical skill for the technicians will depend on the motivation of the manager of the training department.
- The training plan that is not based on needs survey becomes unfruitful training.
- Activity for the improvement of technical skill and promoting public awareness is active as long as the departments in charge have motivation.
- Female staffs are generally more active than the senior staffs.

(6) Activities Records of Sewerage

① Activity Plan

Table 2.19 Activity plan implemented in the pilot activity

Necessary Item for the Urgent Problem		Activity implemented in pilot activity
(1) Reduction of sewer flooding	Advancement of customers' understanding	・ Establishment of homepage by the Call Center of YWC ・ Making a prevention maintenance plan
	Lack of periodical cleaning	・ Investigation and analysis of problems and proposing sustainable improvement ・ Cleaning by high pressure jet truck and high power vacuum truck ・ Organization of a suction work team ・ Organization of a sewer diagnosis work team ・ Making a working procedure by an expert ・ Advising the way how to work on the job training (OJT) by an expert ・ Formulating a prevention maintenance plan
	Implementation activity for soundness of sewers	・ Investigation and analysis of problems and proposing sustainable improvement ・ Organization of a sewer diagnosis work team ・ Formulating a prevention maintenance plan
(2) Replacement of equipment for high pressure jet trucks which are too old for use and depleted in functions		・ Investigation and analysis of problems and proposing sustainable improvement ・ Preparing a replacement plan ・ Formulating a prevention maintenance plan
(3) Removal of wastes, soil and sand which deposits in sewers		・ Investigation and analysis of problems and proposing sustainable improvement ・ Organization of a suction work team ・ Organization of a sewer diagnosis work team ・ Formulating a working procedure by an expert ・ Advising the way how to work on the job training (OJT) by an expert ・ Formulating a prevention maintenance plan
(4) Protection of frequent theft of manhole covers		・ Investigation and analysis of problems and long-term solution ・ Advising of study and selection of a manhole cover ・ Formulating a prevention maintenance plan
(5) Difficulty in locating a manhole because it is covered during road construction or repairing		・ Investigation and analysis of problems and proposing sustainable improvement ・ Advising to make a cooperation system with road competent authorities road work contractors ・ Formulating a prevention maintenance plan

② Input to be planned

Japanese Side

- Dispatch of the Expert
- Procurement of high power vacuum trucks and equipment for sewer diagnosis
- Expense necessary for the improvement of the technical skill on sewer cleaning works
- Expense necessary for promotional activity

Jordanian Side

- Establishment of the pilot activity team
- Arrangement of working space and furniture for the activities
- Provision of the data and information necessary for the activities
- Assisting JICA Expert Team, if and when needed, in relation to implementation of these activities

③ Schedule to be planned

Procurement of Equipment	:	April to July, 2014
1st Session	:	2 months from June, 2014 (equipment arrival at YWC)
2nd Session	:	1.5 months from May, 2015
3rd Session	:	2 months from August, 2015

④ Equipment Procurement

Table 2.20 Equipment Procured

No	Equipment Name	Q'ty	Main Specification	Remark
1	High power vacuum truck	3 trucks	2,800 L	・ for the work with existing high pressure jet trucks in Irbid
2	TV camera for sewer diagnosis	2 sets	Length of cable : 100m	・ Irbid : 2
3	Guide roller for a hose existing high pressure jet truck	10 pcs	for a manhole	・ for 5 high pressure jet trucks ・ 2 pcs necessary for the work
4	Guide roller for a TV camera for sewer diagnosis	4 pcs	for a manhole	・ for 2 sets of TV camera ・ 2 pcs necessary for the work
5	Sewer stop plug	4 pcs	with an air hose including an air pump	・ 2 sets necessary for the work ・ Irbid : 4
6	Smoke Tester for sewer	2 sets		・ Irbid : 2

⑤ Results of Activities

- Procured equipment was transferred to YWC as the planned schedule.
- 1st session was carried out as schedule. In this session, fundamental training for operation of the equipment was completed.
- 2nd and 3rd sessions were not held due to security risk of IS, because 2nd and 3rd sessions focused the field tra
- YWC has a capabili

CHAPTER 3 GOAL AND ACHIEVEMENT

3.1 Goal and Achievement of the Project

The project goal was contribution to improvement of the host communities in water supply and wastewater management in the northern governorates

Large number of Syrian refugees was regarded as being settled in large-sized cities and towns where many housing existed that were rented by the Syrian refugees. In order to achieve the project goal, therefore, the largest 3 cities were selected as the project area. Every Component of A, B or C was conducted in the selected 3 cities and each Component had the common goal with urgent, short-term, mid-term and long-term contributions. In addition, both structure and soft measures are included.

- Quick Response 1 (Component A) - 1st stage grant-aid project
  Installation of distribution pipes in Irbid City utilizing the increasing available water resources such as development and rehabilitation of the eastern well fields of the northern governorates (completed in 2015) and extension of Disi fossil water to the northern governorates (to be completed in 2017). The distribution pipes are now under construction as of March 2017 and will be operational in April 2017.
- Quick Response 2 (Component A) - 2nd stage grant-aid project
  Rehabilitation and improvement of the distribution pipes in Hawwara and Sarieh: Outline design will be completed in April 2017 to improve poor water supply by allocating the above available water resources and reducing leakage water in Hawwara and Sarieh.
- Development Plan from the Long-term Viewpoint (Component B) - master plan
  Wadi Arab 2nd phase water supply projects were planned to increase available water resources with a target year of 2020 in the northern governorates. As a result, amounts of water supply and wastewater generation will increase in every cities and towns of the northern governorates. Hence, master plan of water supply systems in Irbid and Ramtha cities and master plan of wastewater management in Irbid, Ramtha and Mafraq cities was conducted in 2014. The target year was set as 2035.
- Detailed Design from the Mid-term Viewpoint (Component B) - detailed design of distribution system
  The detailed design was conducted in 2016 for the 1st stage projects proposed in the water master plan in Irbid. It was intended that the facilities were constructed based on the detailed design so that available water resources to be developed in the Wadi Arab 2nd phase project would be distributed effectively to Irbid City. It is expected that AFD and KfW will finance the project in 2017 and the facilities will be constructed by 2018.
- Capacity Development - Leakage Reduction and Improvement of Poor Water Supply Service (Component A and C)
  Leakage is still high in Jordan although every effort was made by WAJ: rehabilitation of distribution pipes (structural measures) and technical transfer (capacity development) of leakage detection (soft measures). In this project, structural measures were implemented in Hawwara and Sarieh (Component A) while soft measures were conducted under Component C.
- Capacity Development – Sewer Choking (Component C)
  Techniques of sewer cleaning with provision of equipment were transferred.
- The combined activities mentioned above will improve poor water supply service in Irbid City using envisaged additional water resources: increase of water supply amount, increase of water supply duration, improvement of water pressure, reduction of poor water supply areas and so on, improvement of water supply situation in the host communities including Syrian refugees.

3.2 Goal and Achievement of Component A

(1) Goal set at Project Formulation Stage

Grant-aid project is immediately implemented based on the outline design of the priority sub-project.

(2) Achievement after Project Implementation

After a few months period of the sub-project selection, the 1st outline design for the 1st stage grant-aid project was conducted for the selected sub-project and completed in 2014. Then, the sub-project started construction based on the detailed design in 2015 and tendering of contractor selection in 2015. It will be completed in April 2017.

The 2nd outline design for 2nd stage grant-aid project started in December 2015 and will be completed in April 2017. The Japanese cabinet has approved grant funding in association with an international organization. It is expected that UNOPS will soon implement grant-aid project under the framework of the Japanese grant in association with an international organization.

3.3 Goal and Achievement of Component B

(1) Goal set at Project Formulation Stage

The studies are to be prepared so that the WASH task force can utilize them as materials for selecting priority projects. In addition, the selected projects are to be implemented.

(2) Achievement after Project Implementation

The studies were not prepared according to the goal set originally at project formulation stage because JICA study had not accumulated extensive knowledges on the northern governorates. WAJ was almost selecting projects that would accelerate the already considered and planned projects to improve the host communities. The large-scaled facilities were extension of the transmission facilities of bringing Disi fossil water. The small-scaled facilities were many rehabilitation of distribution facilities in cities, towns and villages, rehabilitation of pumps, and rehabilitation of wells.

Realizing the above situation, JICA study team had trying to seek effective and important but not-yet-listed projects. That is a kind of bridging facilities between the transmission facilities and rehabilitation of distribution pipes, namely the restructuring of the distribution facilities or distribution zoning along with rehabilitation of distribution network. This requires some short-term and mid-term approach of estimation of population and demand different from planning in the transmission facilities and the rehabilitation facilities. The transmission facilities require only developed water source amount and the rehabilitation requires only the existing facilities. As a result, master plan was formulated with a target year of 2035 and, detailed design was conducted on the 1st stage project proposed in the water master plan in Irbid City. The 1st stage project will be implemented soon with financial assistance of AFD and KfW. Further it is expected that the remaining 3 stages projects will also be financed and implemented.

Wastewater master plan showed that the existing sewers were almost adequate for the increased water amount due to sufficient sewer slope reflecting elevations differences and recently developed sewer facilities. The master plan was utilized as a difference to construct sewer in un-served suburban areas by other donors.

3.4 Component C

YWC staffs could acquire the following knowledge:

- Correct leakage repair method (repeat of leakage at same sites will not happen in future)
- Sewer choking will decrease in occurrence by use of the provided vacuum cleaner

CHAPTER 4 LESSONS LEARNED FROM THE PROJECT AND NOTES ON ASSISTANCE TO HOST COMMUNITIES IN FUTURE

JICA has immediately responded to the request of the Jordanian government on assistance to the host communities in late 2013 when the Jordanian government tried to find out measures to alleviate the impacts. The lessons were learned through the activities on water sector, based on which recommendations are made to keep fruitful results to the host communities in this chapter.

4.1 Jordanian Framework of Project Preparation and Quick Start of the Project

As is explained already in section 1.3, the Jordanian government and donor agencies were jointly working in 2013 to respond to the influx of Syrian refugees. JICA and JICA consultants participated in WASH task force organized by them from January 2014. The results were compiled as a National Resilience Plan including the followings:

- Analysis of issues on water sector with which the host communities had faced
- Understanding measures already being implemented and planned to be implemented
- Planning of measures to solve the issues
- Recommendations of measures to be taken by donor agencies

Participation in the WASH task force was very helpful to identify the effective measures to the host communities. The above 4 items were being discussed and JICA could understand measures waiting to be implemented. It was identified that new transmission facilities of increasing water sources amount and transferring produced water to demand areas were almost developed/ being developed or planned. Rehabilitation of source and transmission facilities such as wells, pumps and pipes were also the same situation. Therefore, development of distribution facilities was selected to supply produced and transmitted water to customers in the host communities and started implementation of the project in March 2014.

In summary the followings contributed to the quick start of the Project and identification of the effective measures for the host communities:

- WASH task forces were organized by the Jordanian government and others after the Syrian crisis.
- JICA could quickly respond to the assistance requested by the Jordanian government.
- JICA developed scheme of technical cooperation for development planning, consisting outlin design, development study and technical transfer (capacity development).
- JICA and JICA study team participated in the WASH task force.

4.2 Jordanian Framework of Project Implementation for the Host Communities

Preparation of the projects was effectively conducted by the Jordanian side through organizing task forces and working groups that were culminated as publishing the National Resilience Plan. Similarly, such plan was very effectively used for the Jordanian side in allocating projects to each donor agency. This method was useful for any project to be implemented quickly particularly under pressing needs like measures of the host communities where Syrian refugees were rapidly increasing.

Upon learning this kind of Jordanian methods, preparation of tender documents of the phase 1 works for Irbid City recommended in the water supply master plan was conducted. JICA expected at the start of tender documents preparation that a) the phase 1 works were urgently to be implemented for the host communities, 2) preparation of the tender documents were the first step towards realization of the

project and particularly 3) the Jordanian side would seek funding agencies during the preparation stage.

During the course of the tender documents preparation, AFD and KfW have expressed intension to finance the project. When this project is completed, water can reach to customers in Irbid city. This will be materialized by the international cooperation that was organized by the Jordanian government. The international organizations undertook the various projects. As explained already the following projects will bring the additionally available water to the entrance of Irbid city:

- Development of water sources (additional water)
- Construction of transmission facilities (from water source to main reservoirs)
- Development of distribution facilities

Rehabilitation of facilities, pumps, wells, pipes and so on. This type of procedures will contribute to the following:

- Early implementation of the project.
- Hence, benefit will be materialized quickly.
- Reasonable cost and similar quality of the projects prevailing in Jordan.

4.3 Good Interaction among Three Components in the Project

The project includes 3 Components A, B and C to cope with requirements in different types and stages: outline design for quick solution or project implementation (structure measure) as Component A, development study for mid- or long-term requirements or master plan as Component B and dissemination of Japanese assistance and technical transfer (capacity development) or soft measure as Component C.

Additional water of Disi fossil water was planned to be delivered to the reservoir in Irbid City in around 2018. The distribution facilities to deliver the additional water from the above reservoir to Irbid City need to be constructed by 2018. The facilities required for this purpose were taken as Component A, and outline design was conducted in the beginning of the project. Further, immediately after the outline design was completed it was implemented under the Japanese grant-aid scheme so as to ease demand-supply imbalance in the area.

At the same time, comprehensive new distribution system in Irbid City was planned under the Component B immediately after preparation of the master plan without seamless, in which a planning horizon was set as a mid-term. During the project in 2014 when the outline design was being undertaken, it was found that WAJ was also planning Wadi Arab 2nd phase project but funding agency had not been decided. Even though WAJ was still seeking funding agencies, JICA study team recognized WAJ's strong intention to seek funding agencies and construct it. Hence, JICA study team decided to prepare a master plan as 2 stages: 1st stage for development of Disi fossil water project and 2nd stage for Wadi Arab 2nd phase project. The facilities at the both stages were planned incorporating the facilities to be constructed under Component A so as to effectively utilize the facilities planned in Component B even in future scenario.

Skills of leakage repair as well as sewer cleaning or dechoking were transferred under Component C. Those skills were effective to quickly solve the above issues that Jordan had faced with. Leakage in the project area was high and leakage reduction is essential to utilize the limited water sources efficiently. Future demand in both Components A and B was estimated assuming that leakage amount would be reduced by utilizing transferred skills.

As explained, 3 Components i.e., master plan with situation analysis, urgent project finding and implementation, and technical transfer (capacity development), were interrelated. Urgent project was effectively identified and implemented considering mid- or long-term perspective or master plan

4.4 Preparation of Master Plan and Project Formation for Benefits

One of the strongest points of JICA's assistance is preparation of a master plan and formation of projects considering the actual beneficiary and from the viewpoint close to the beneficiary based on detailed situation survey and analysis. The survey in the master plan revealed that complaints of poor water supply have been rapidly increased to as much 10,000 in Irbid ROU since the start of influx of Syrian refugees, which are increasing friction between Host community and the Refugees. Other donors have mainly focused on improvement measures of bulk water balance including water resource development and transmission facilities. On the other hand, JICA found supply measures to actual beneficiaries lacked in these measures and JICA's assistance focuses on projects and planning more close to the actual beneficiaries in the City and towns. More detailed water allocations to each village and town in the region was prepared in the master plan, and required projects (construction of distribution facilities) to compensate between transmission system and actual users were formulated.

From the beneficiary's perspective, very effective bridging plan and projects have been formulated. Without this plan and projects, increased water resources for this region could not reach to the actual beneficiaries. Such methodology is effective in planning and project formation.

4.5 Suggestions to the Jordanian Side

4.5.1 Simultaneous Review of Distribution System along with Bulk Water Supply Development

The current top priority in WAJ seems development of additional bulk water supply system including water resources development such as Red Sea Dead Sea Project and increase of wastewater treatment for agricultural use to meet fresh water demand. The National Corridor scheme including Red-Dead Sea Project is being considered by the Jordanian side to allocate fresh water nation-wide.

Similarly important is distribution systems in such large cities as Amman, Zarqa and Irbid where the distribution systems are complicated and need to be reorganized whenever water resources are additionally added.

4.5.2 Reemphasis of Reduction of Leakage

Non-revenue water (including leakage) is still high in Jordan at around 50% although rehabilitation of pipes as preventive measures and corrective measures has been taken for long periods. The former have been financed by many donor agencies including JICA and the latter was assisted mainly by JICA through capacity building project for NRW reduction.

The preventive measures are pro-active because measures are taken before leakage takes place. The corrective measures alone in the existing dilapidated system where many leakages take place cannot reduce leakage. In that case, firstly preventive measures should be implemented first. This can be observed in Phnom Penh City. Once the preventive measures are implemented, then corrective measures should follow to maintain low leakage level.

The project includes rehabilitation of distribution pipes in Hawwara and Sarieh. If the pipes are appropriately laid and joined that is checked with water-tightness test after pipe laying, leakage water should decrease to reasonable level. To do so, all type of pipes from distribution main pipes to service pipes should be rehabilitated at the same time.

In order to effectively conduct preventive measures, inventory of areas such as District Metered Areas (DMA) should be formulated in terms of NRW. Then, areas to be rehabilitated should be prioritized with required pipes, fittings and required cost. Skills of pipe laying and leakage repairs are also important that will definitely govern leakage level.

4.5.3 Sewer Cleaning

Problems with sewer flooding happened frequently. The main causes appear to be blockage by debris such as clothing, plastic bottles, animal carcasses, rocks and sand. During the pilot activity, measures were recommended and implemented that were proved to be effective; YWC should continue to conduct the following proven measures:

- Public awareness activity to prevent dumping of foreign objects into manholes.
- Record of sewage manhole inspection.
- Periodical cleaning of sewers.
- Maintaining of high pressure jet trucks properly.

APPENDIX

APPENDIX Approval Letter Issued by WAJ on Draft Final Report

MINISTRY OF WATER AND IRRIGATION
Water Authority

Ref. : PMU/17/744
Date : 4/5/2017

Eng. Kazufumi MOMOSE
Team Leader
JICA Study Team

Technical Cooperation for Development Planning
the Project for the Study on Water Sector
for the Host Communities of Syrian Refugees in the Northern Governorates,

Subject: Our Approval on Draft Final Report of "Technical Cooperation for Development Planning for the Project for the Study on Water Sector for the Host Communities of Syrian Refugees"

Dear Sir,

We are pleased to inform you that we have no comments on the draft final report of "Technical Cooperation for Development Planning for the Project for the Study on Water Sector for the Host Communities of Syrian Refugees". It means "Summarizing Documents".

You are kindly requested to proceed to prepare the final report.

Sincerely yours

Secretary General / WAJ
Eng. Tawfiq Habashneh