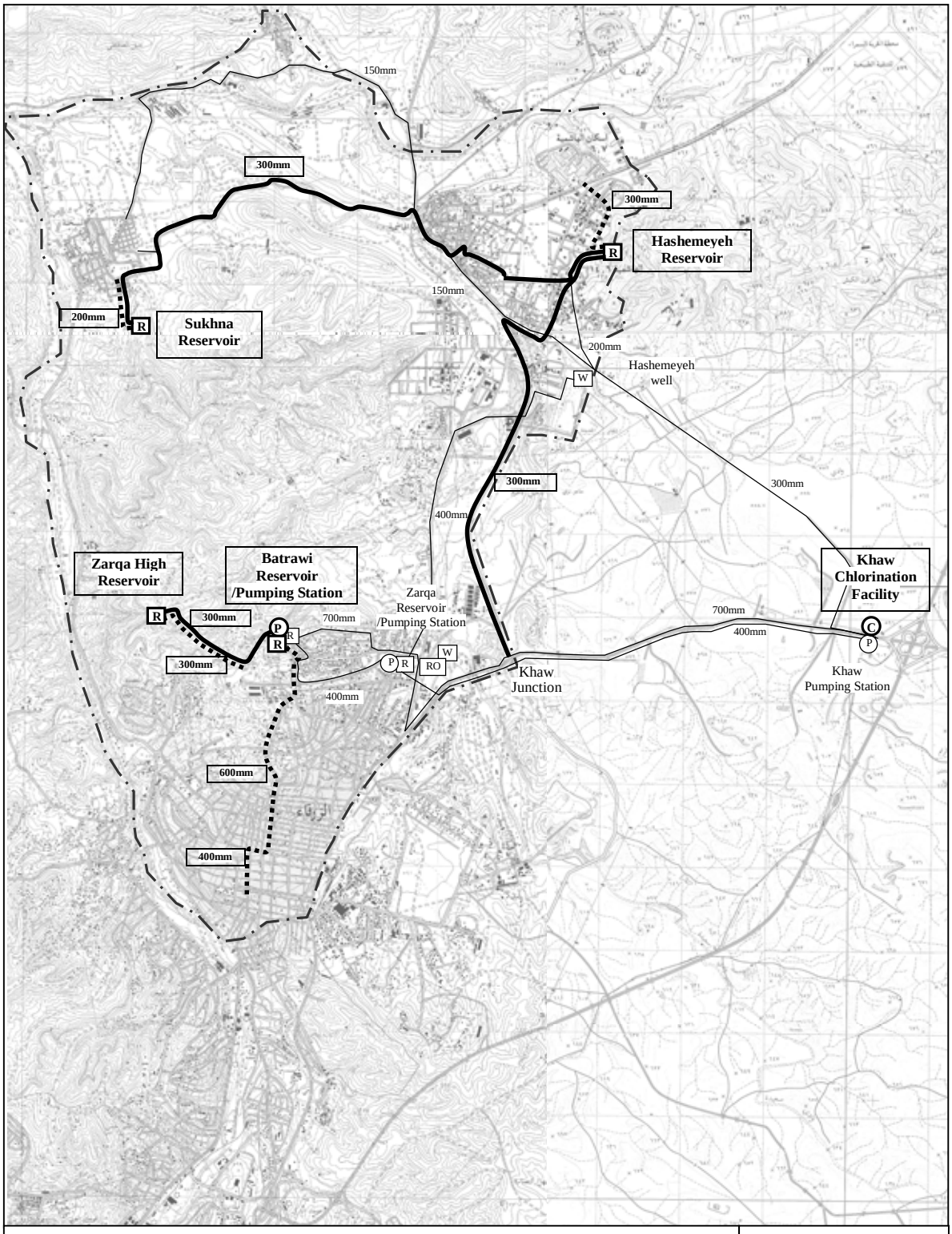
2.2.3 Basic Design Drawing

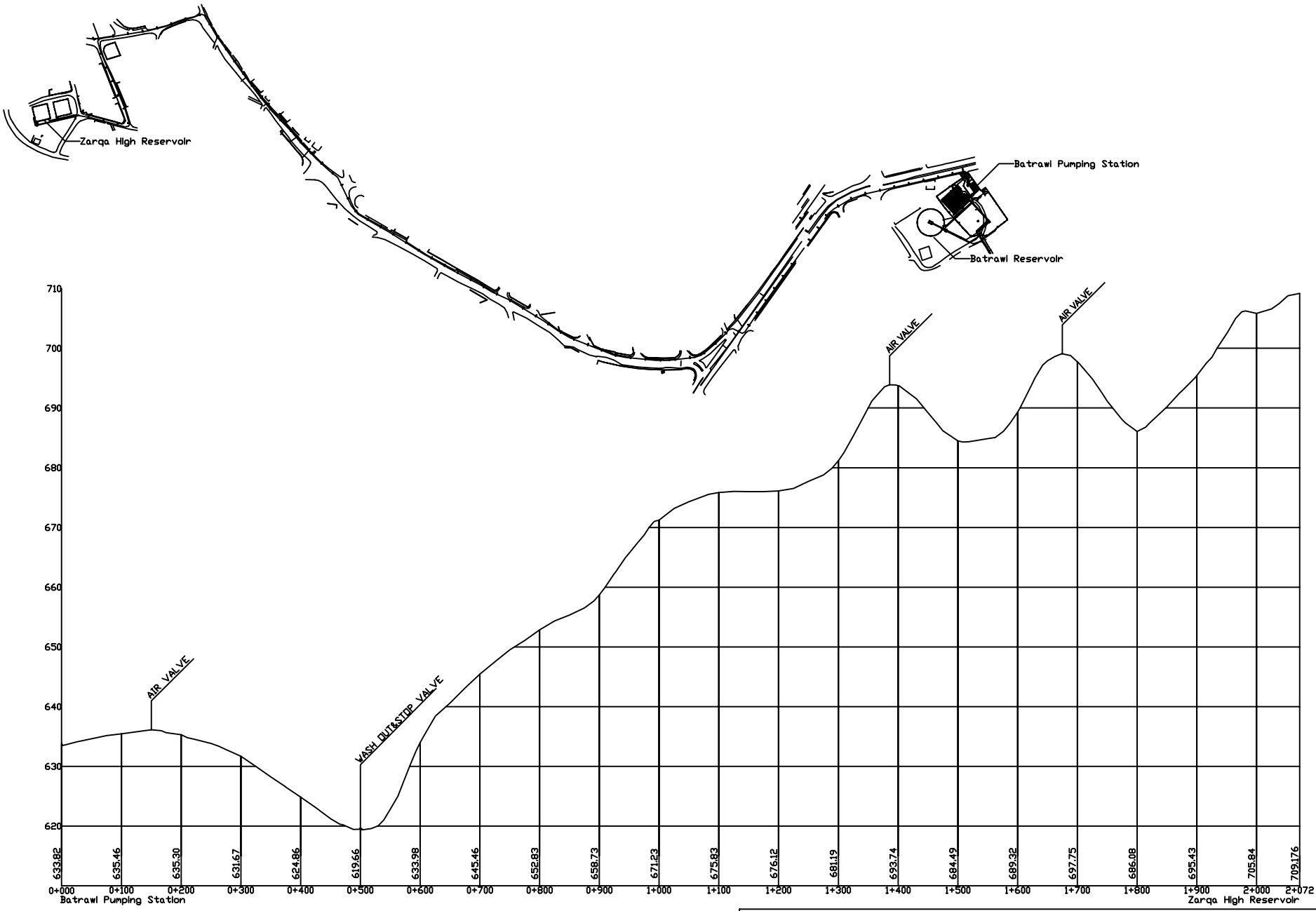
Basic design drawings of the project are listed below and shown in the following pages.

Drawing No.	Title
JZP-GN-01	Facility Location plan
JZP-PL-01	Transmission Main – Batrawi Pumping Station to Zarqa High Reservoir
JZP-PL-02	Transmission Main – Khaw Junction to Hashemeyeh Reservoir
JZP-PL-03	Transmission Main – Hashemeyeh Reservoir to Sukhna Reservoir
JZP-PL-04	Distribution Mains – Zarqa High Reservoir to the Existing Distribution Line
JZP-PL-05	Distribution Mains – Hashemeyeh Reservoir to the Existing Distribution Line
JZP-PL-06	Distribution Mains – Sukhna Reservoir to the Existing Distribution Line
JZP-PL-07	Distribution Mains – Batrawi Reservoir to the Existing Distribution Line
JZP-PL-08	Main Pipeline Typical Drawing
JZP-PL-09	Typical Installation Drawing of Valves
JZP-RV-01	Facility Layout of Zarqa High Reservoir (2,500 m^3)
JZP-RV-02	Structural Plan of Zarqa High Reservoir (2,500 m^3)
JZP-RV-03	Facility Layout of Hashemeyeh Reservoir (1,500 m^3)
JZP-RV-04	Structural Plan of Hashemeyeh Reservoir (1,500 m^3)
JZP-RV-05	Facility Layout of Sukhna Reservoir (1,000 m^3)
JZP-RV-06	Structural Plan of Sukhna Reservoir (1,000 m^3)
JZP-RV-07	Facility Layout of Batrawi Reservoir (14,000 m^3)
JZP-RV-08	Structural Plan of Batrawi Reservoir (14,000 m^3)
JZP-PS-01	Room Plan of Batrawi Pumping Station
JZP-CL-01	Facility Layout of Khaw Chlorination Facility
JZP-CL-02	Structural Plan of Khaw Chlorination Facility



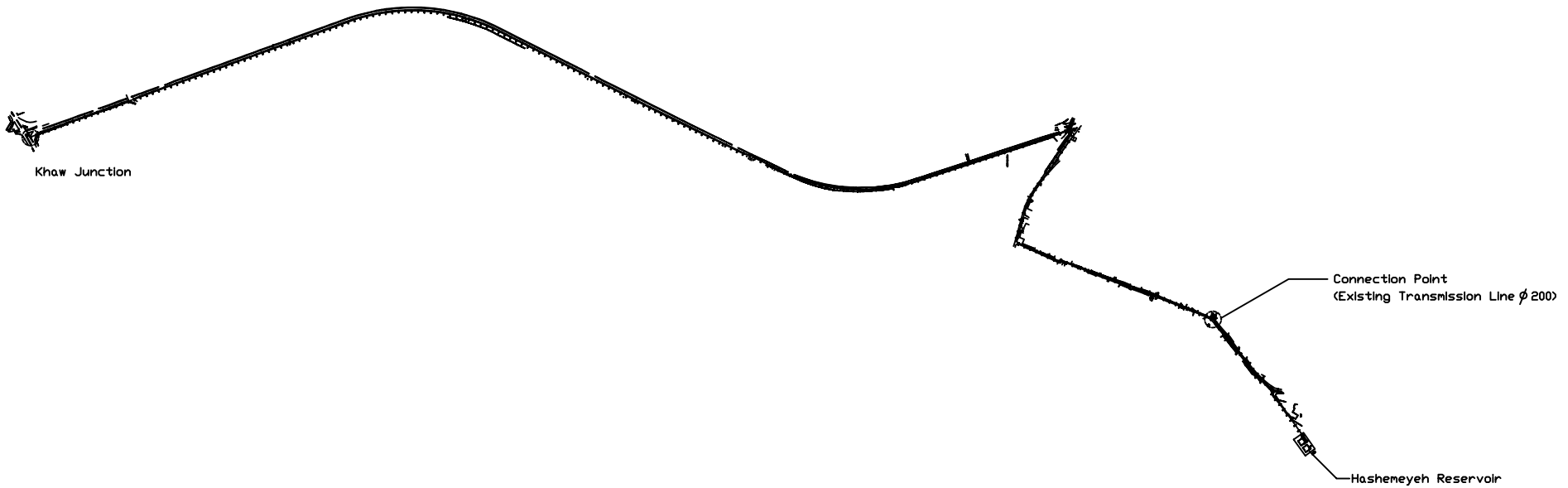
Facility Location Map	JZP-GN-01

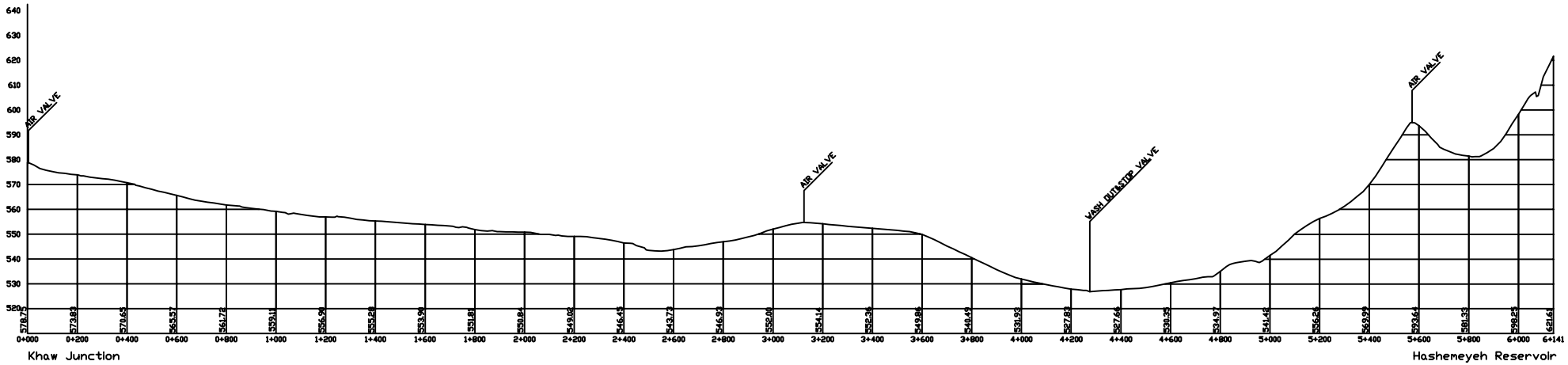
The Project for Improvement of the Water Supply System for the Zarqa District (Phase II) in the Hashemite Kingdom of Jordan



JZP-PL-01

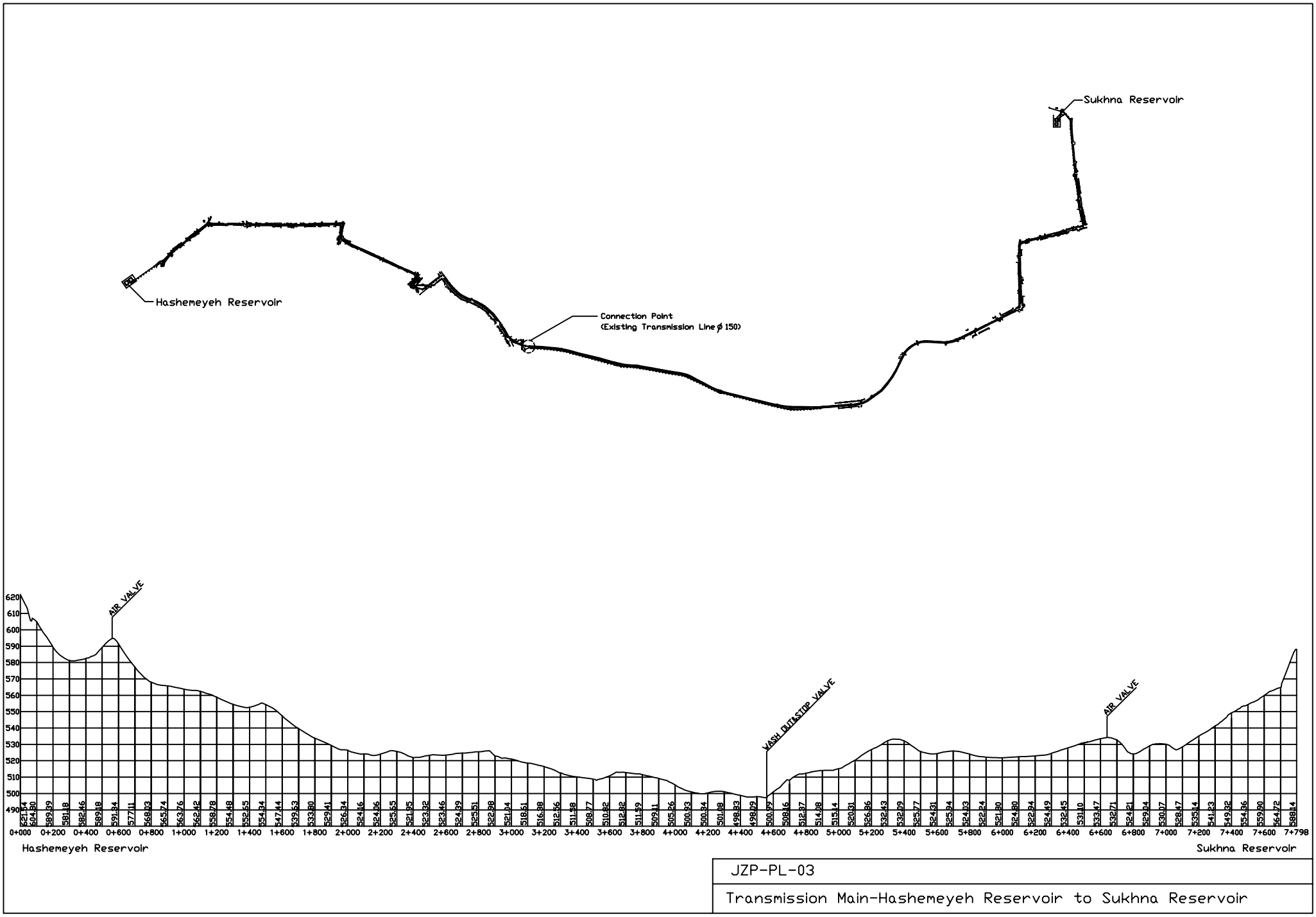
Transmission Main-Batrawi Pumping Station to Zarqa High Reservoir



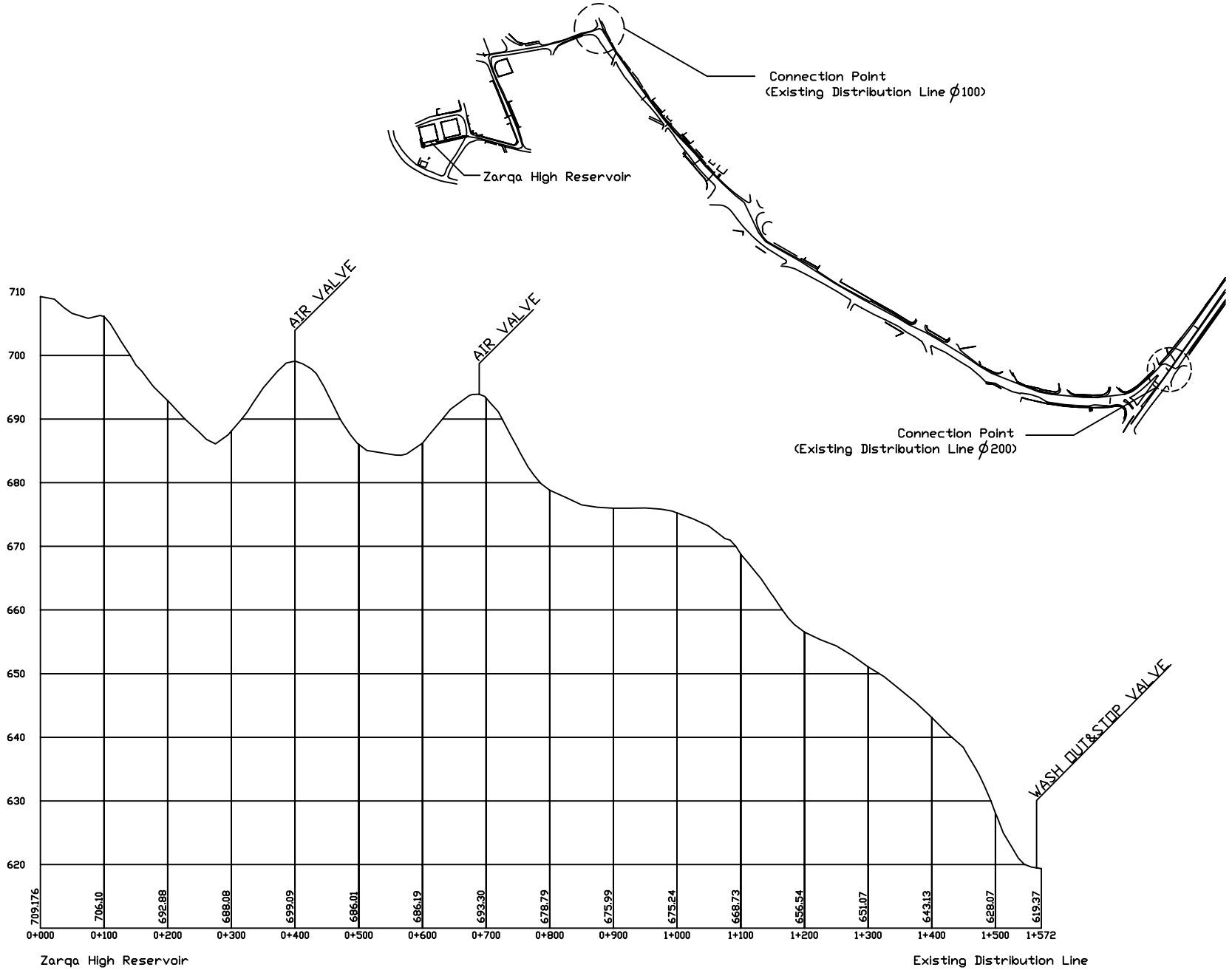


JZP-PL-02

Transmission Main-Khaw Junction to Hashemeyeh Reservoir

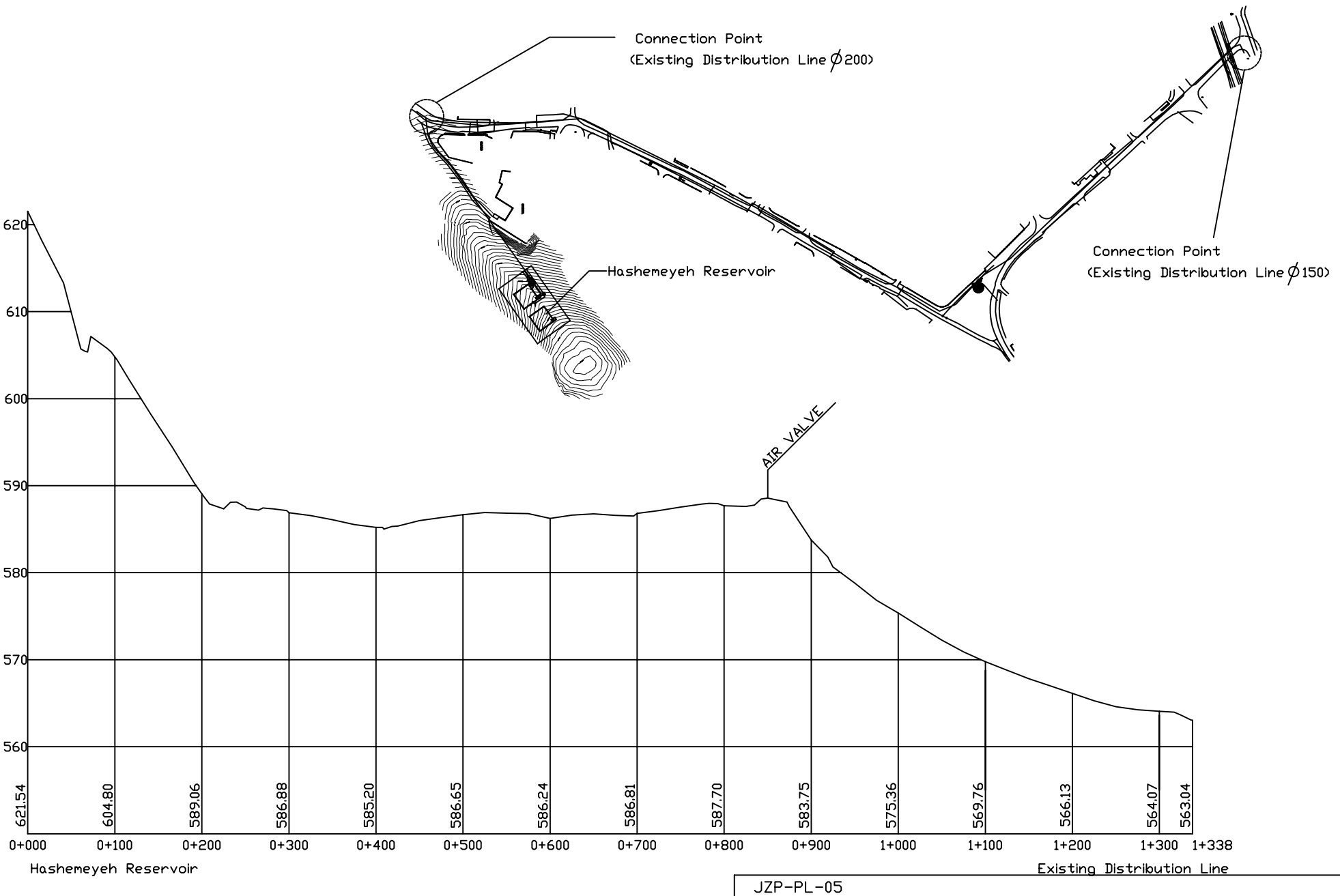


JZP-PL-03	
Transmission Main-Hashemeyeh Reservoir to Sukhna Reservoir	



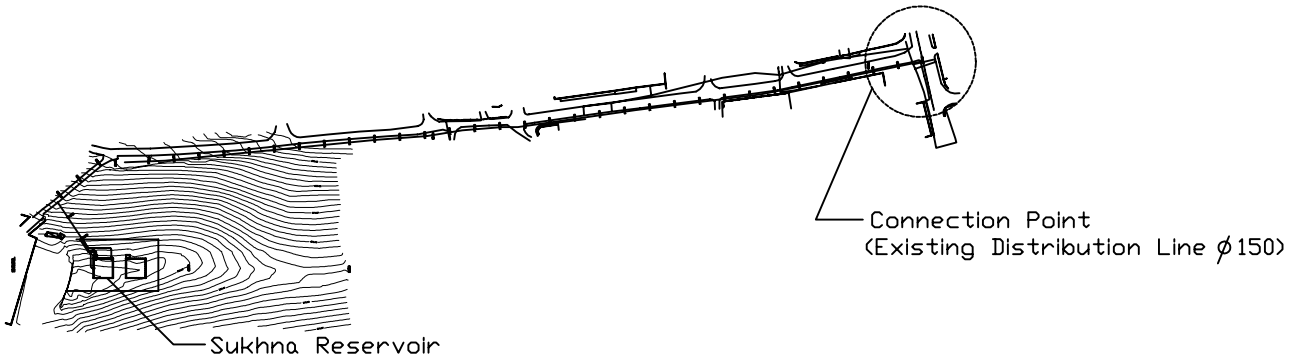
JZP-PL-04

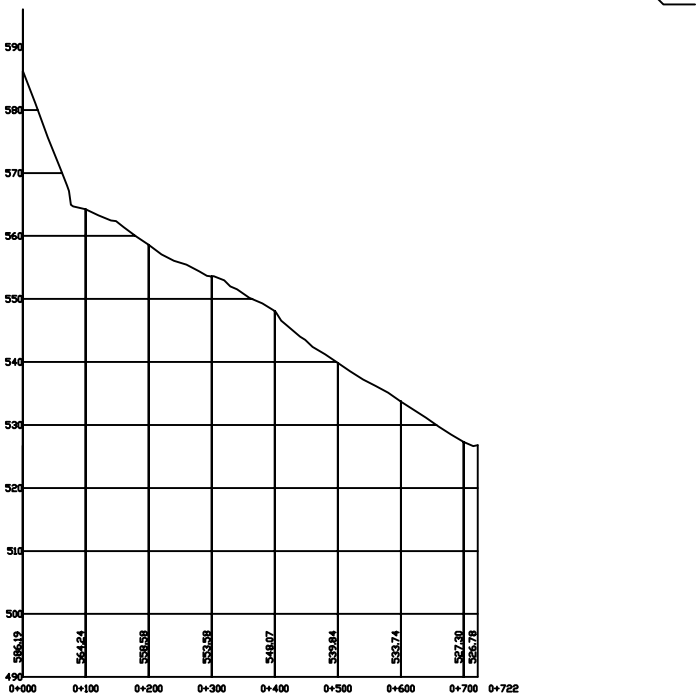
Distribution Main-Zarqa High Reservoir to Existing Distribution Line



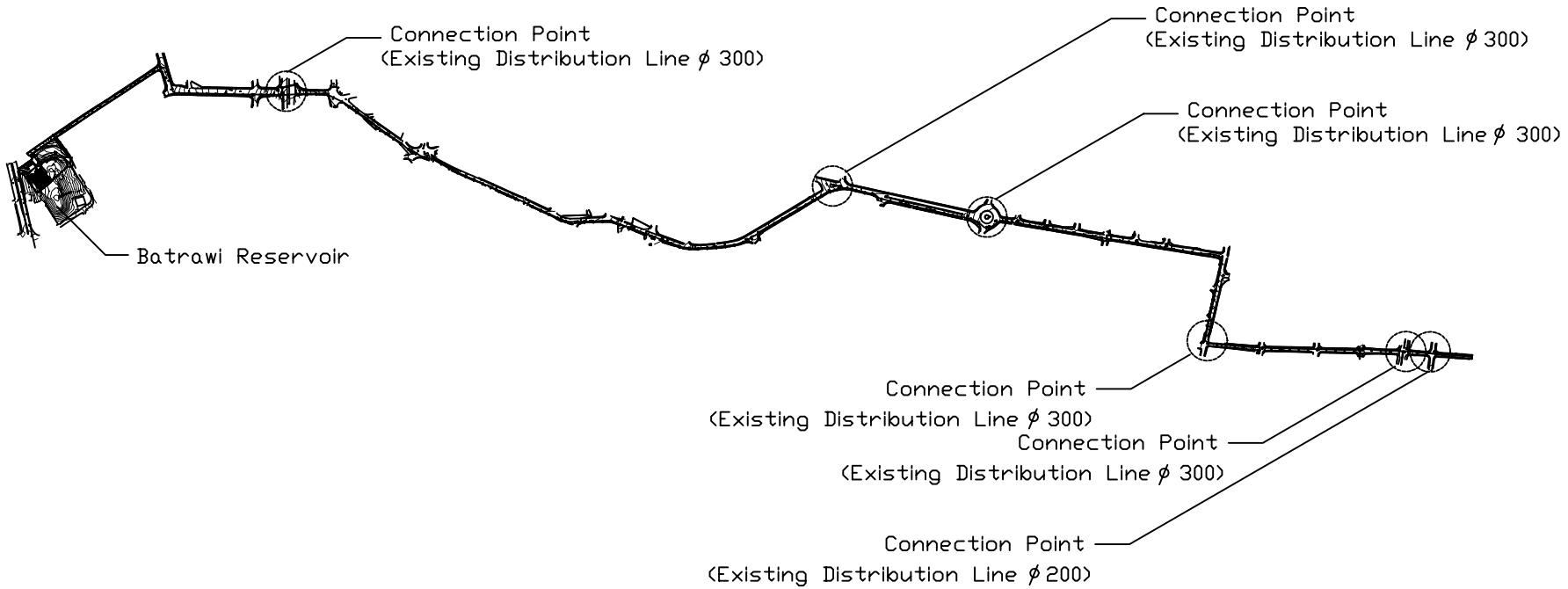
JZP-PL-05

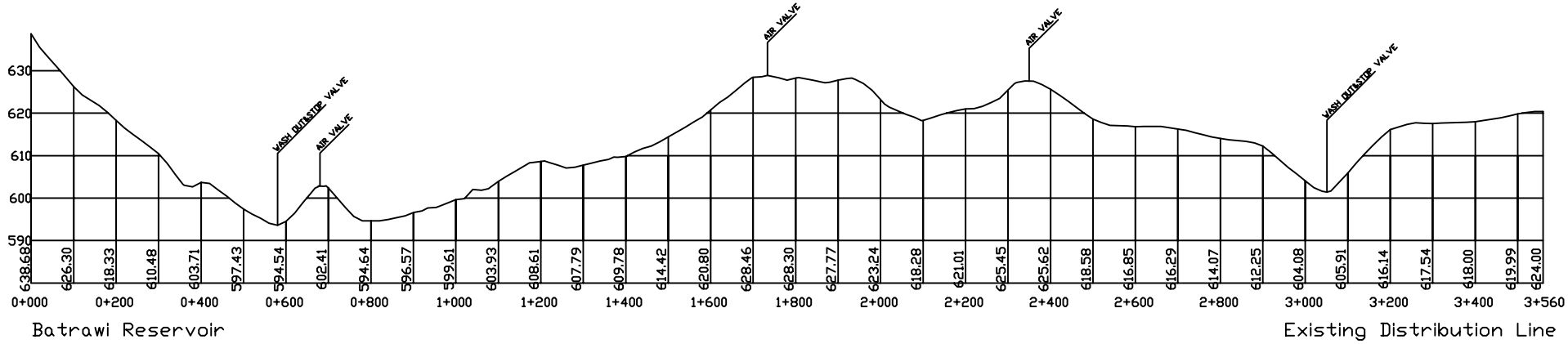
Distribution Main-Hashemeyeh Reservoir to Existing Distribution Line





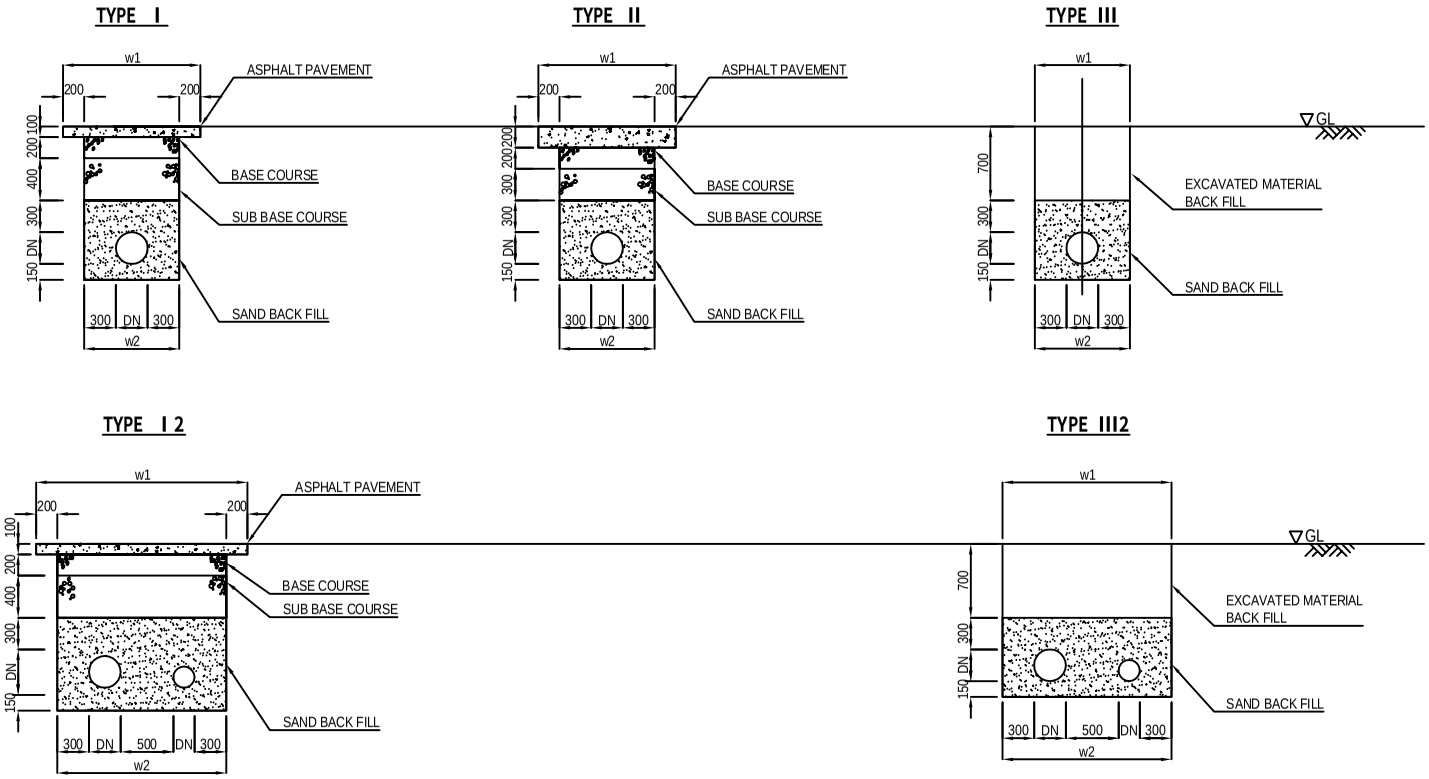
JZP-PL-06
Distribution Main-Sukhna Reservoir to Existing Distribution Line





JZP-PL-07
Distribution Main-Batrawi Reservoir to Existing Distribution Line

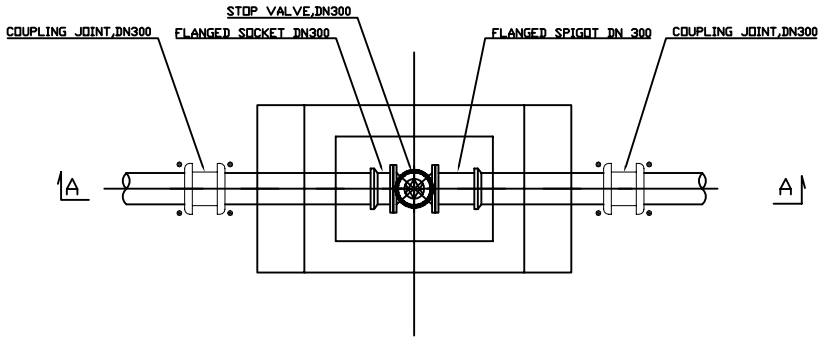
STANDARD DRAWING OF PIPING WORK



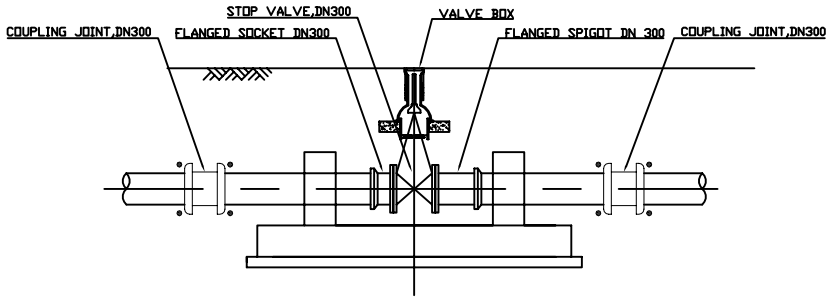
JZP-PL-08
Main-Pipeline-Typical Section

PIPE ARRANGEMENT OF STOP VALVE FORSEPARATION OF WATER DISTRIBUTION ZONES

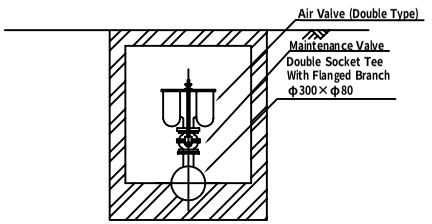
PLAN

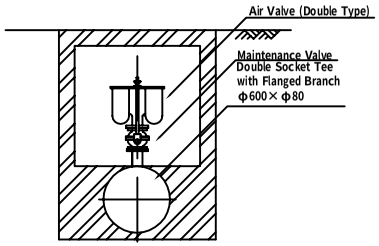


SECTION A-A

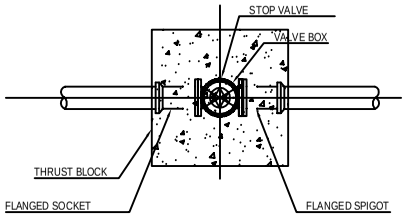


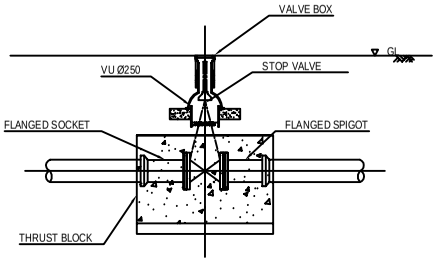
PIPE ARRANGEMENT OF AIR VALVE



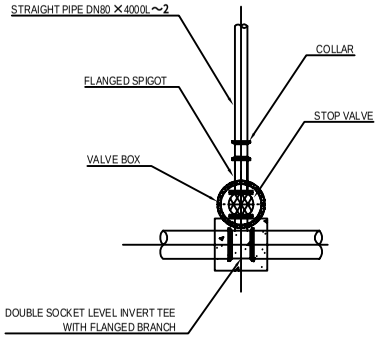


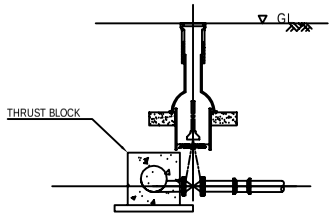
PIPE ARRANGEMENT OF STOP VALVE





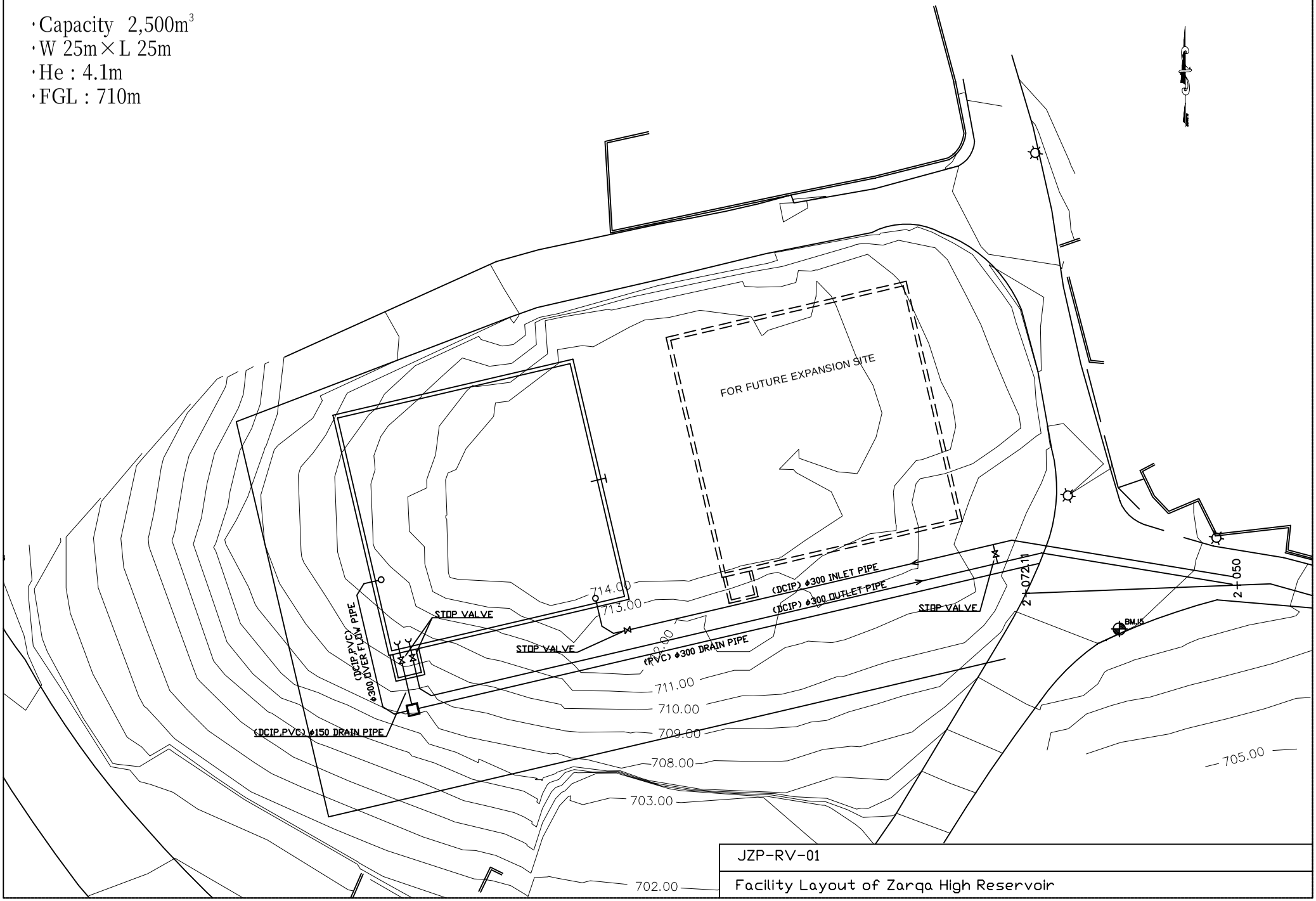
PIPE ARRANGEMENT OF WASH OUT





JZP-PL-09
Typical Installation Drawing of Valves

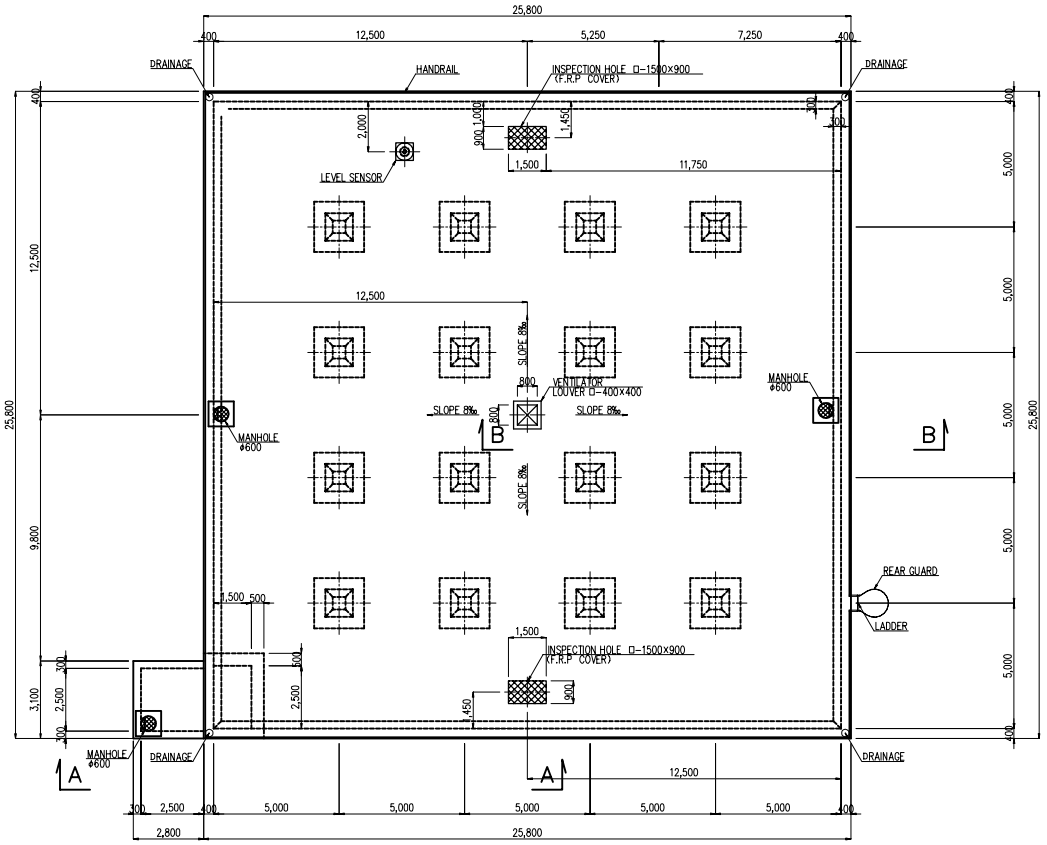
- Capacity 2,500m^3
- W 25m × L 25m
- He : 4.1m
- FGL : 710m



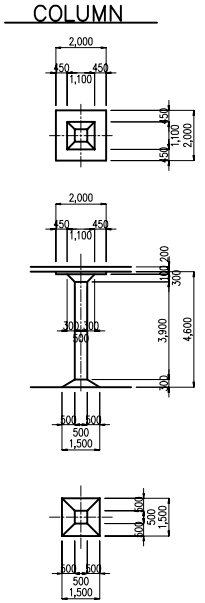
JZP-RV-01
Facility Layout of Zarqa High Reservoir

DISTRIBUTION RESERVOIR (V=2500m3)

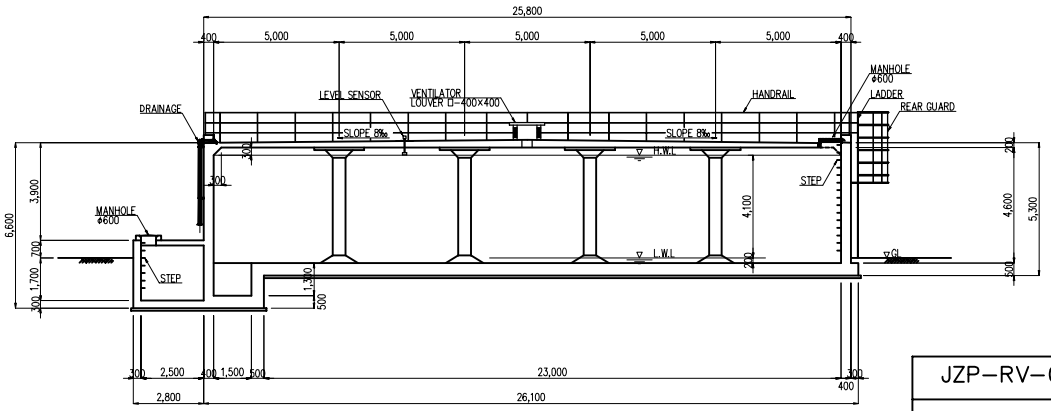
PLAN



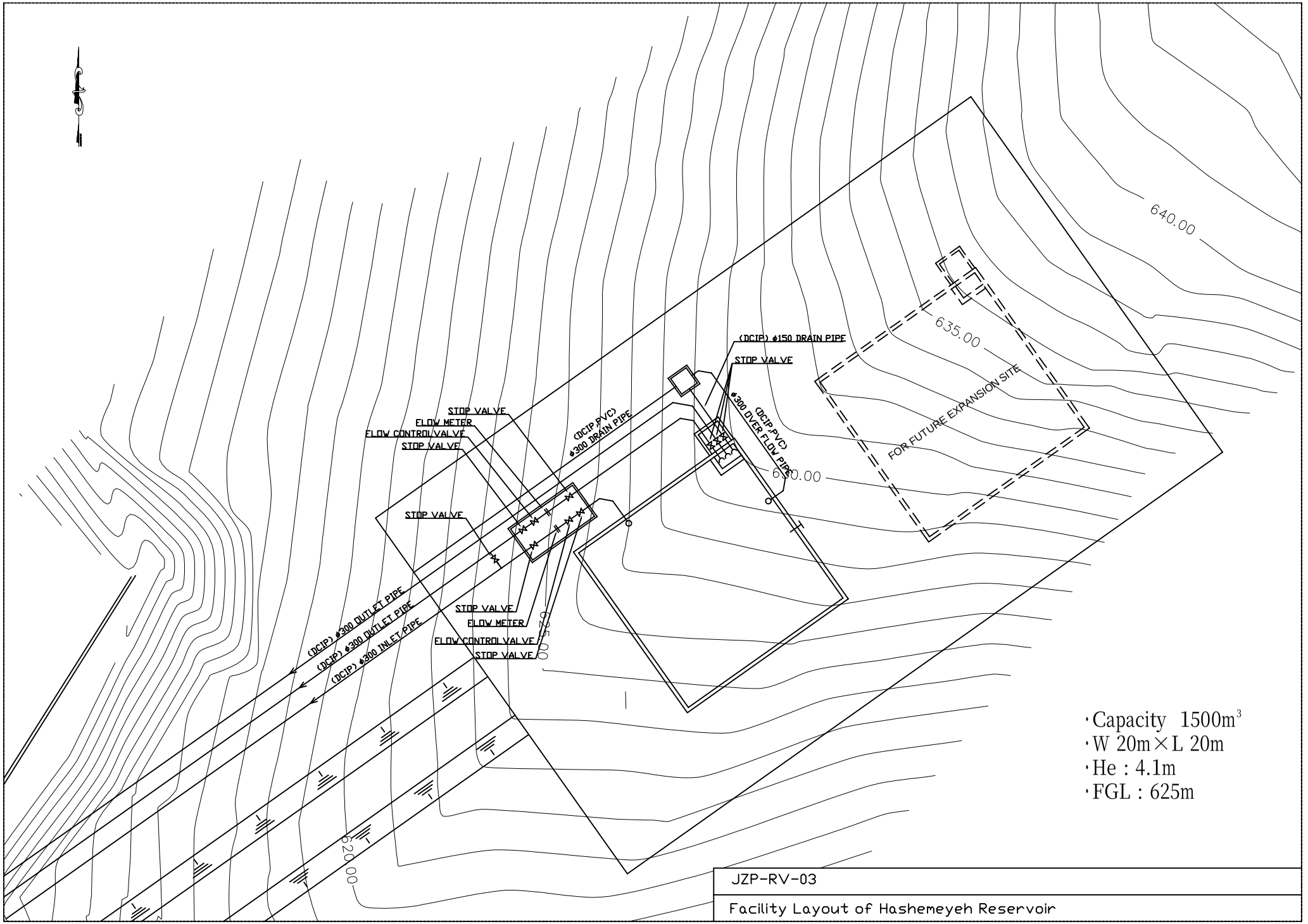
COLUMN



SECTION A–B

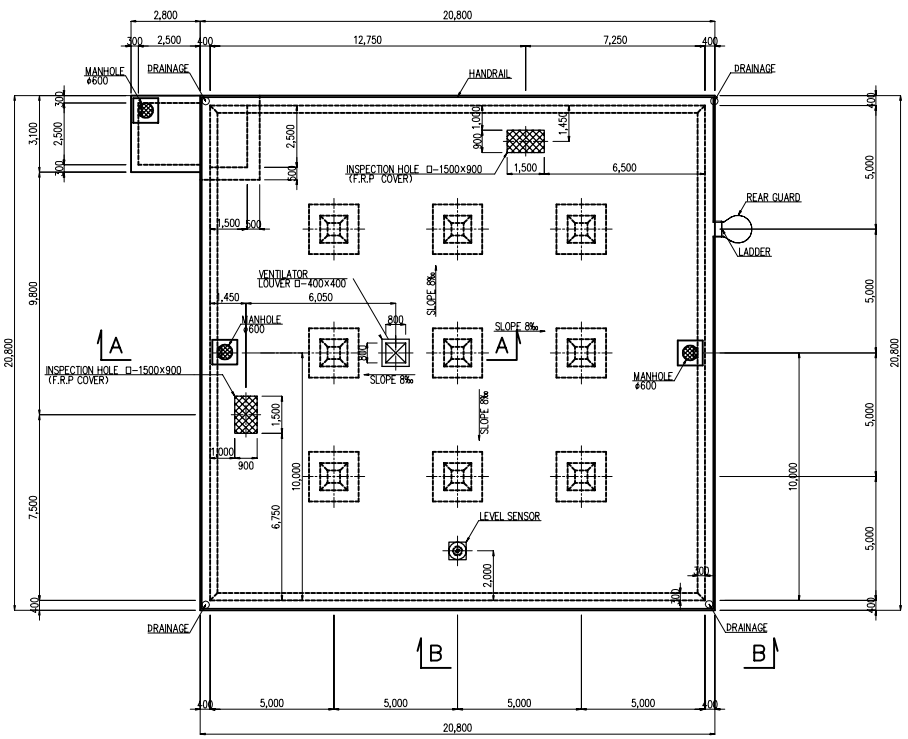


JZP–RV–02	
Structural Plan of Zarqa High Reservoir	

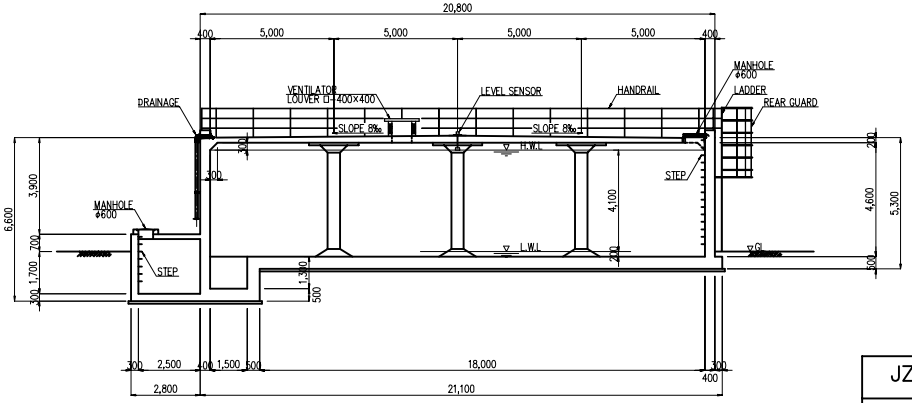

640.00
635.00
630.00
625.00
620.00
FOR FUTURE EXPANSION SITE
(DCIP) ϕ150 DRAIN PIPE
STOP VALVE
ϕ300 OVER FLOW PIPE
(DCIP PVC)
(DCIP PVC)
ϕ300 DRAIN PIPE
STOP VALVE
FLOW METER
FLOW CONTROL VALVE
STOP VALVE
STOP VALVE
STOP VALVE
FLOW METER
FLOW CONTROL VALVE
STOP VALVE
(DCIP) ϕ300 OUTLET PIPE
(DCIP) ϕ300 OUTLET PIPE
(DCIP) ϕ300 INLET PIPE
・Capacity 1500m3
・W 20m×L 20m
・He : 4.1m
・FGL : 625m
JZP-RV-03
Facility Layout of Hashemeyeh Reservoir

DISTRIBUTION RESERVOIR (V=1500m3)

PLAN



SECTION A-B



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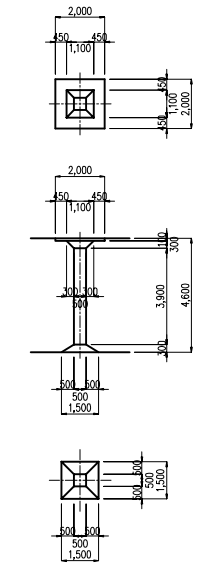
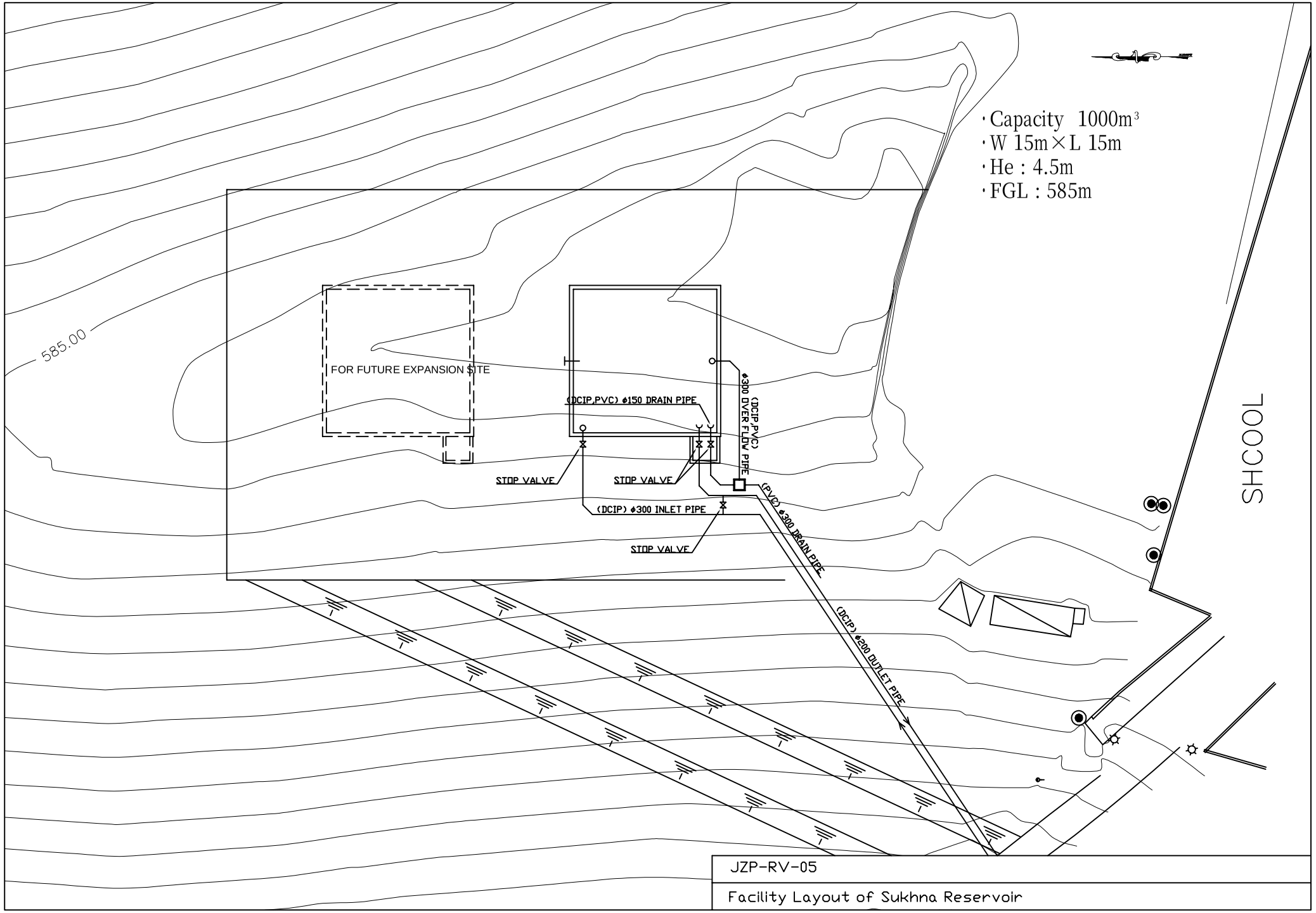


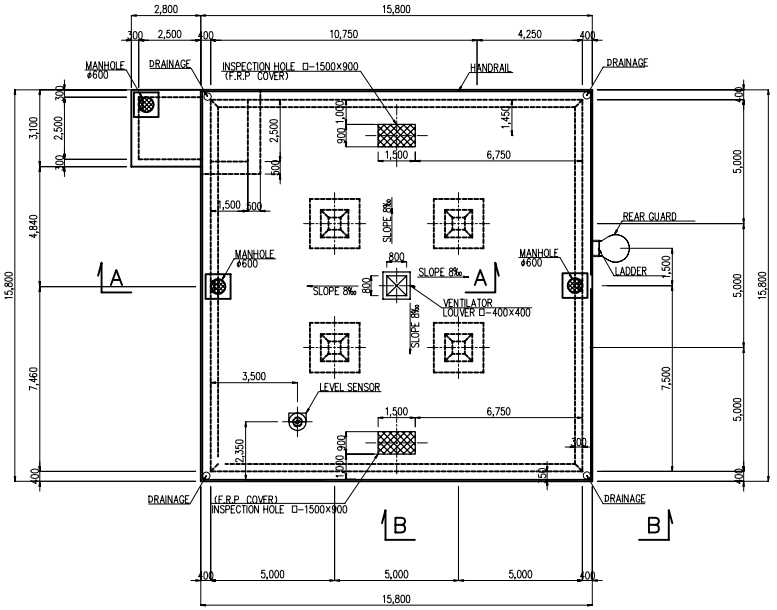
JZP-RV-04

Structural Plan of Hashemeyeh Reservoir

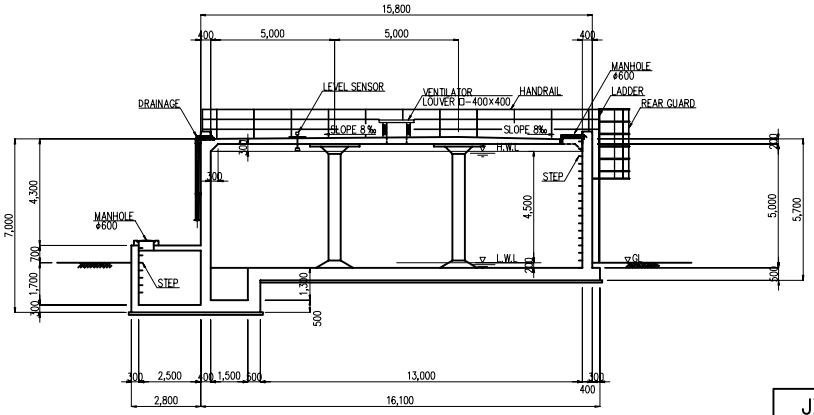

・Capacity 1000m3
・W 15m×L 15m
・He : 4.5m
・FGL : 585m
585.00
FOR FUTURE EXPANSION SITE
(DCIP,PVC) ϕ150 DRAIN PIPE
(DCIP,PVC) ϕ300 OVER FLOW PIPE
STOP VALVE
STOP VALVE
(DCIP) ϕ300 INLET PIPE
STOP VALVE
(PVC) ϕ300 DRAIN PIPE
(DCIP) ϕ200 OUTLET PIPE
SHCOOL
JZP-RV-05
Facility Layout of Sukhna Reservoir

DISTRIBUTION RESERVOIR (V=1000m3)

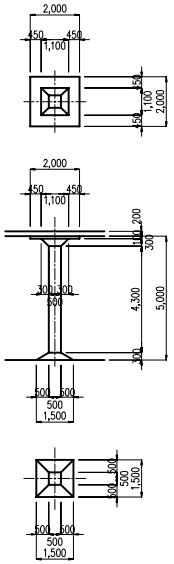
PLAN



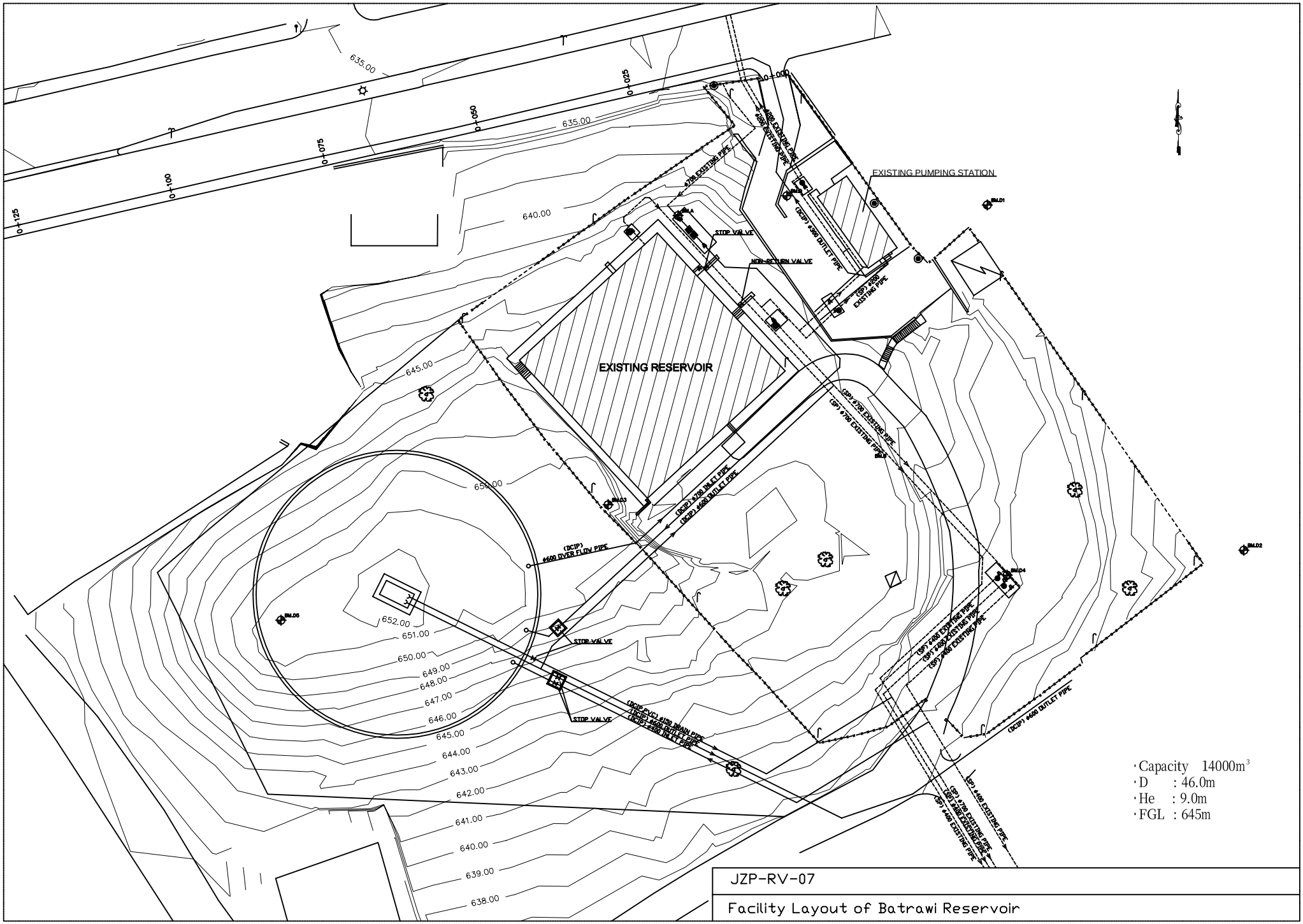
SECTION A–B

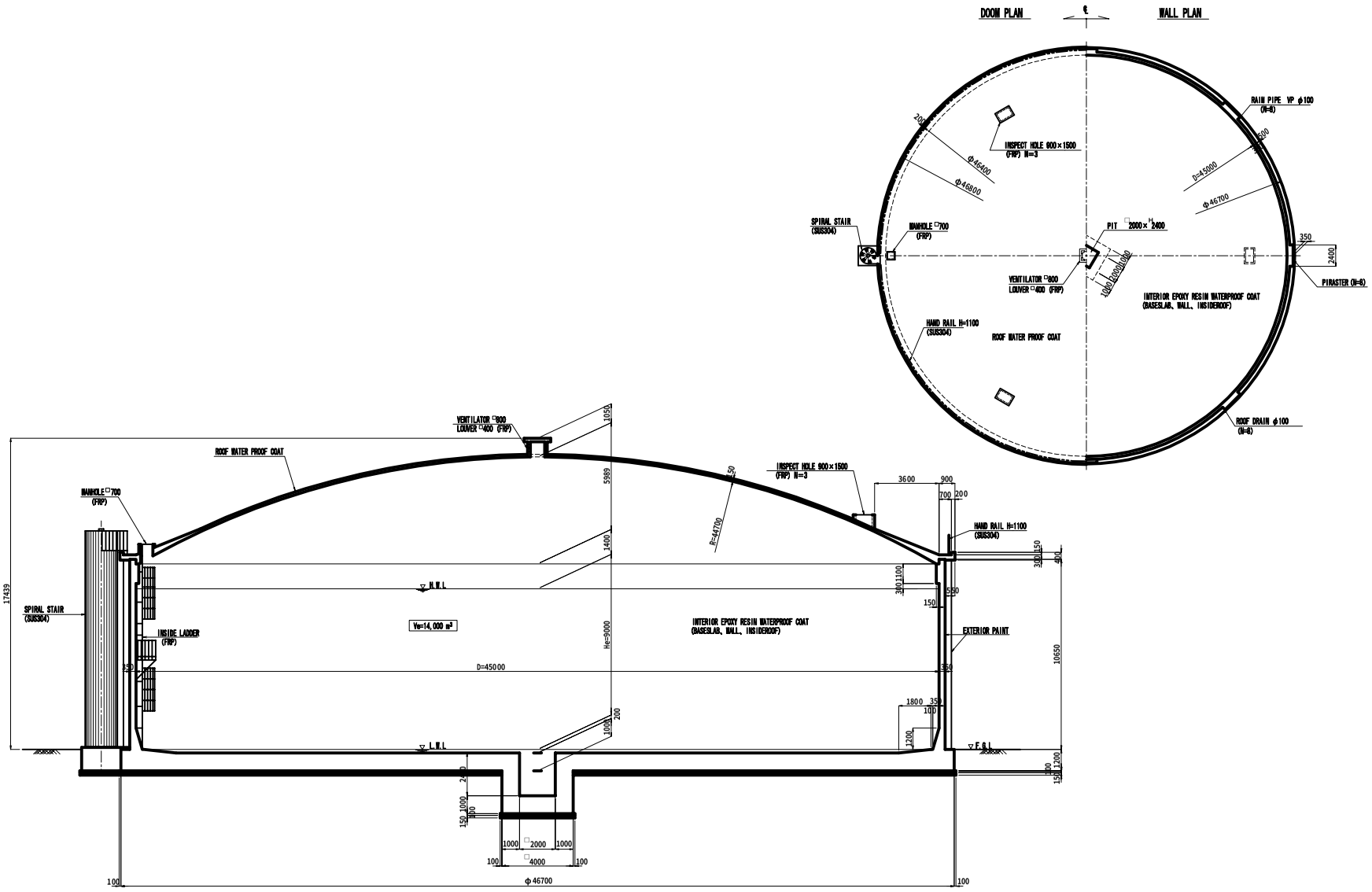


COLUMN



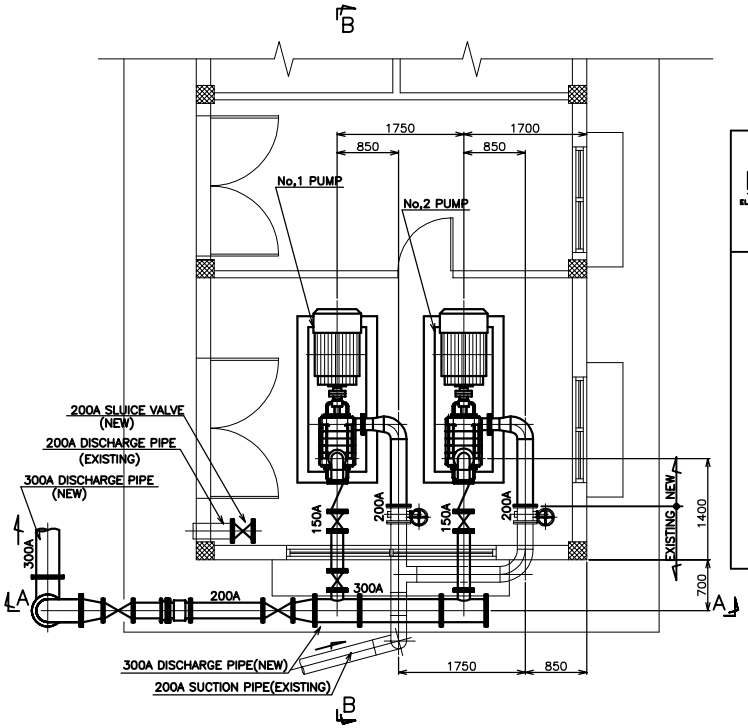
JZP–RV–06	
Structural Plan of Sukhna Reservoir	


EXISTING PUMPING STATION
EXISTING RESERVOIR
STOP VALVE
NON-RETURN VALVE
STOP VALVE
STOP VALVE
(DCIP) Φ600 OUTLET PIPE
(SP) Φ250 EXISTING PIPE
(SP) Φ700 EXISTING PIPE
(DCIP) Φ700 INLET PIPE
(DCIP) Φ600 OUTLET PIPE
(DCIP) Φ600 DIVER FLOW PIPE
(SP) Φ700 EXISTING PIPE
(SP) Φ400 EXISTING PIPE
(DCIP) Φ600 OUTLET PIPE
(SP) Φ400 EXISTING PIPE
BM.01
BM.02
BM.03
BM.04
BM.05
BM.06
635.00
640.00
645.00
650.00
652.00
651.00
650.00
649.00
648.00
647.00
646.00
645.00
644.00
643.00
642.00
641.00
640.00
639.00
638.00
· Capacity 14000m³
· D : 46.0m
· He : 9.0m
· FGL : 645m
JZP-RV-07
Facility Layout of Batrawi Reservoir

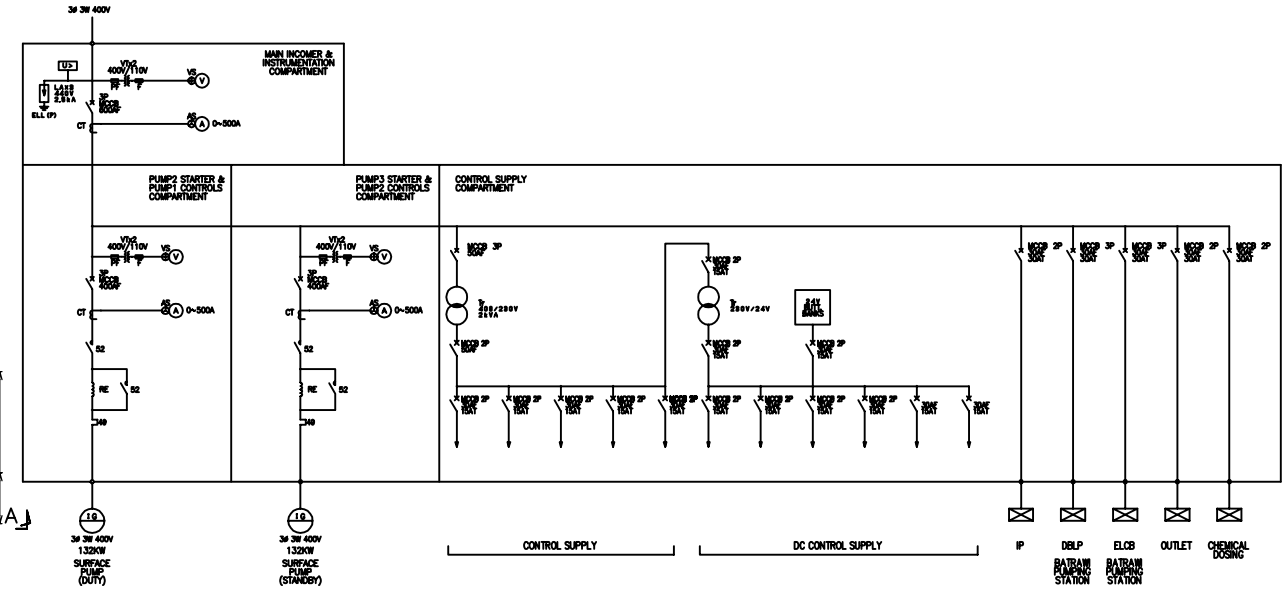


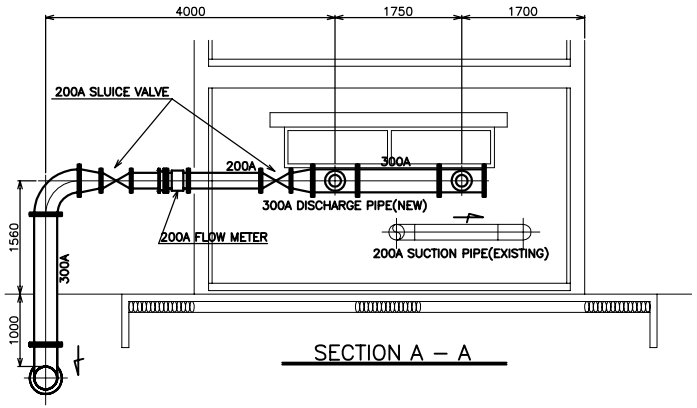
JZP−RV−08	
Structural Plan of Batrawi Reservoir	

PUMP ROOM MECHANICAL WORKS AND SERVICES

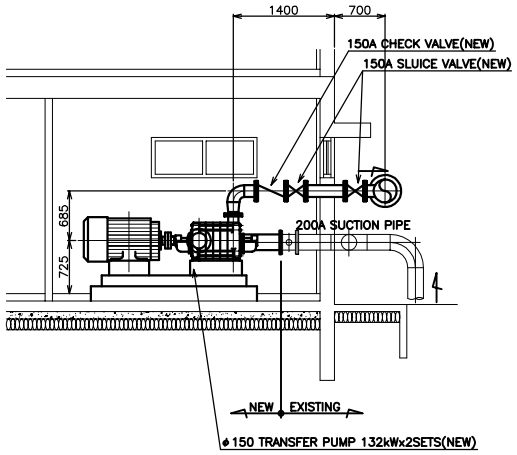


PUMPS ROOM PLAN



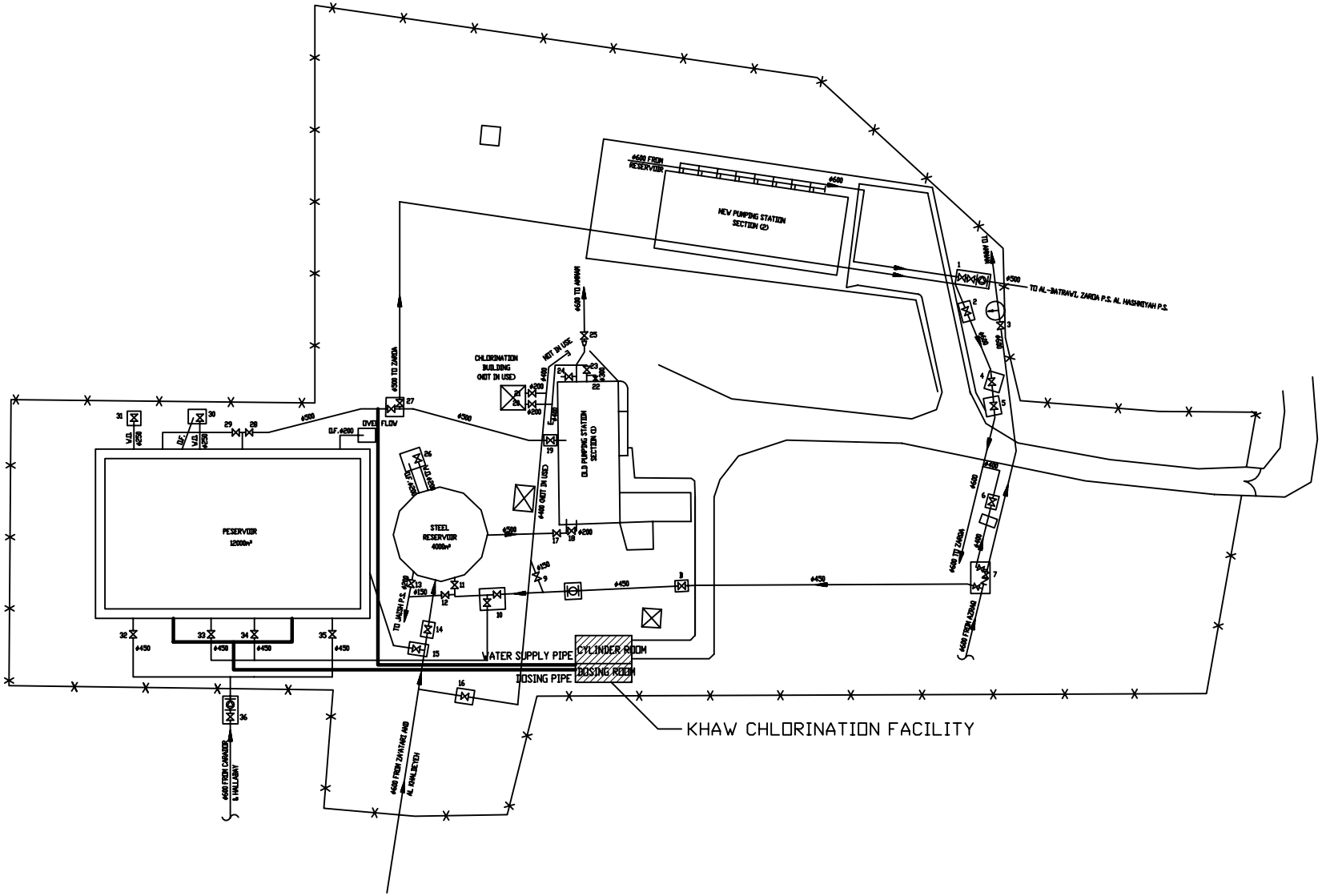


SECTION A – A



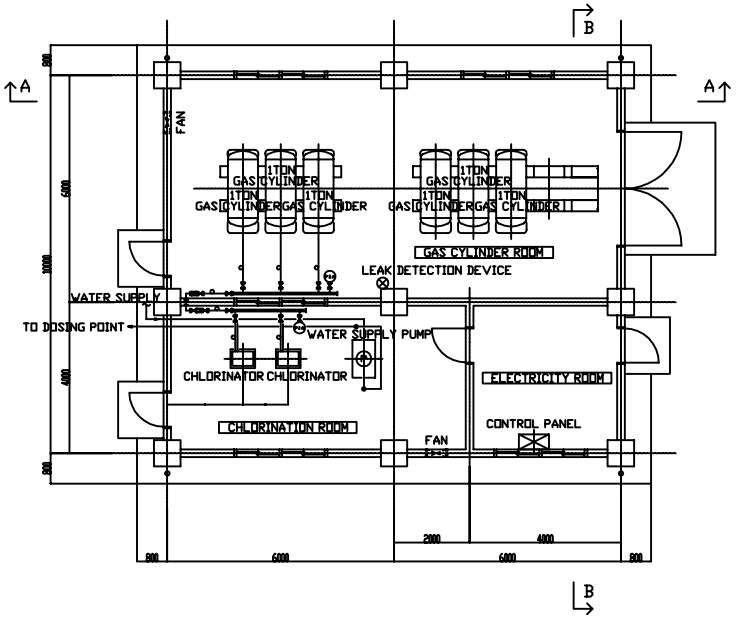
SECTION B – B

JZP–PS–01	
Pump Room Plan of Batrawi Pumping Station	

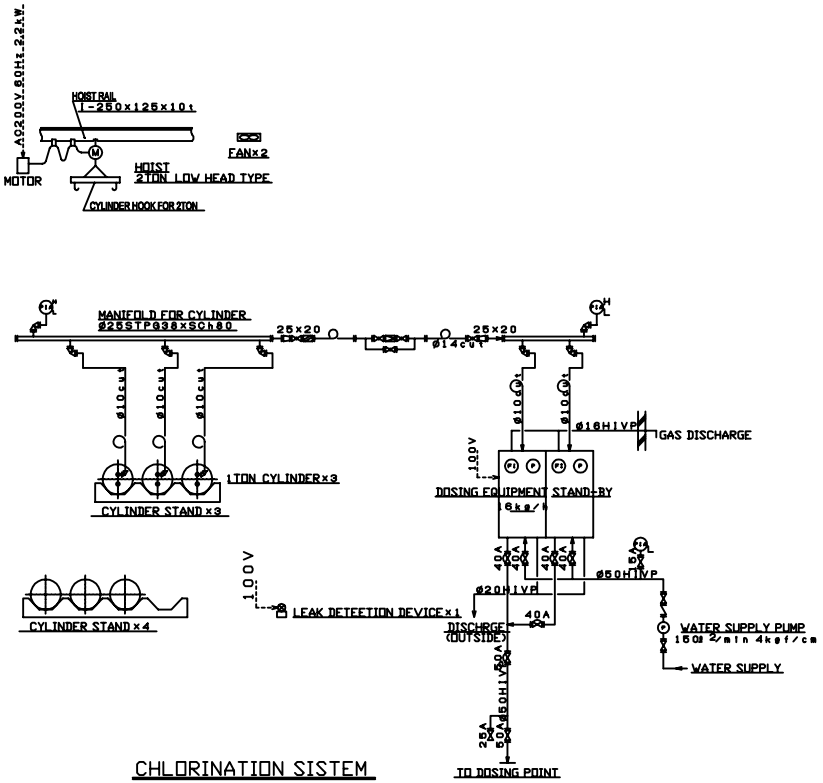


AL KHAW PUMPING STATION SITE PLAN

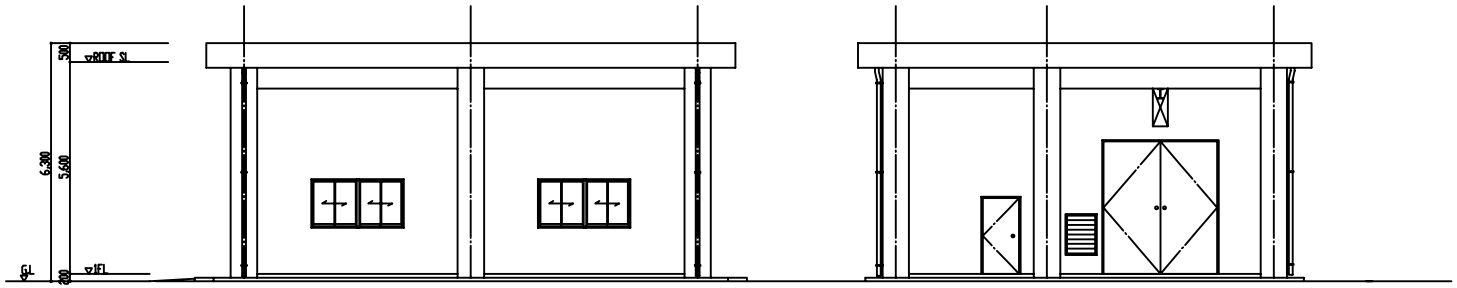
JZP-CL-01	
Facility Layout of Khaw Chlorination Facility	



PLAN OF CHLORINATION FACILITY



CHLORINATION SISTEM



SECTION A-A

SECTION B-B

JZP-CL-02	
Structural Plan of Khaw Chlorination Facility	

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

This project will be implemented in accordance with the framework of Japan's grant aid scheme. Following approval by the Governments of Jordan and Japan, the Exchange of Notes (E/N) regarding the detail design (D/D) will be signed to initiate the actual implementation process of the project. Subsequently, Water Authority of Jordan (WAJ); the implementation agency of the Government of Jordan, will conclude a contract with a Japanese consultant and construction company, and the detail design and construction work will be implemented.

Considering the framework of grant aid and the content of construction of facilities, the construction plan will be formulated for the project to which aid is applicable, in accordance with the basic guidelines below.

(1) Project Implementing Entity

The national organization in Jordan responsible for the supervision related to this project will be the Ministry of Water and Irrigation (MWI). The WAJ will take up the role of the organization implementing the project under this Ministry. The WAJ is responsible for the water supply and sewerage project of the whole country. It consists of 8 Departments (Water Affairs, Sewerage Affairs, Laboratories and Quality, North Region, Middle Region, South Region, Financial Affairs, and Administrative Affairs Departments). The responsible department of the contact related to design and construction work in this project is the Water Affairs Department, and the operation and management after completion of the facilities will be implemented by the Zarqa Office under the Middle Region Department.

(2) Consultant

The Japanese consultant company will conclude an agreement with the project-implementing agency of the Government of Jordan, and will perform the detail design and work supervision. The consultant will also prepare the tender documents, will examine the tenderer’s qualifications, and assist in the tendering work for selecting the contractor by open tender. After the start of construction of the facilities, the consultant will supervise the construction from an objective standpoint and also ensure that the grant aid is being appropriately utilized.

(3) Contractor

In accordance with the framework of Japan’s grant aid scheme, the Japanese contractor selected through open tendering will carry out the construction of facilities according to the construction plan.

As the construction work is to be performed at a remote site quite different from the social environment and social background in Japan, the contractor is required to possess adequate capability to complete the work overseas. Furthermore, since this plan requires the use of locally-procured materials and equipment, and work in congested urban areas, the contractor shall be adequately aware of the local market, local labor laws, the geography of the place, and the local customs and acceptable practices.

The contractor will maintain a proper communication system even after handing over the facilities after completion of the project since after sales services such as response to breakdowns and procurement or replacement parts will be necessary during maintenance and management after completion of the project.

2.2.4.2 Precautions during Construction

The precautions to be taken related to the formulation of the construction plan are as given below.

(1) Construction of Transmission and Distribution Pipelines

The routes for laying the pipelines include main trunk roads and service roads where the traffic volume is high; thus, third-party safety measures, measures against effects of traffic, and measures against existing buried objects become important. Considerations are necessary for preventing any adverse effects on the activities of the local industries and businesses as far as possible.

The work of laying pipelines in sections other than main trunk roads and urban areas should be performed during the daytime by the open-cut method. The work of laying pipelines in sections within the urban areas and main trunk roads will be performed by the open-cut method at night time considering the industrial and business activities at the site.

(2) Construction of Reservoirs

The distribution reservoirs will be circular PC structures and rectangle RC structures. Although PC technology is widespread in Jordan, work involving such technology is being performed in joint ventures with foreign companies. For this reason, the country is dependent on foreign companies for technical skills related to construction and special materials and equipment required for pre-stressing. In view of the above, the contractor must introduce materials/equipment for PC and technical skills from Japan, and also impart guidance and implement transfer of technology.

(3) Renewing pump station equipment

The work of renewing the pumping equipment will be planned so that effects of such work on the

water supply areas are minimized. Plans will be made to renew pumps one by one so that long-period water cuts to the water supply areas are avoided. After the new pumps start operating, the operation will be changed over from the existing equipment to the new equipment, and all the existing equipment will be disposed of. Power must be cut when performing the work of replacing electrical equipment; therefore pumps will not be operating. To enable the normal pumps to operate, temporary facilities such as temporary distribution panels need to be installed. Considering the economics, work stages will be planned such that replacement work is performed systematically when water cuts by way of restrictive water supply (about 3 days a week) are enforced.

(4) Construction of facilities for dosing chlorine and installation of pressure-reducing valves

The installation work for chlorinators, chlorine piping, pressure-reducing valves, and other valves will be performed mainly by Japanese skilled technician, since precision during installation and safety controls are demanded. Safety controls will be established by implementing on-the-job (OTJ) training related to safety controls, such as measures against chlorine leaks, replacement of chlorine cylinders, handling of machinery during trial operations.

(5) Work related to inserting sluice valves

To divide the water distribution zones and to reuse the existing distribution main pipelines as transmission pipelines, materials including sluice valves will be supplied by the Government of Jordan, and the work will be implemented by the Japanese contractor. The quality of materials supplied by the Government of Jordan needs to be ensured during quality control of the work.

2.2.4.3 Scope of Works for Both Countries

The scope of works by Japan and by Jordan is shown in Table 2.2.27.

Table 2.2.27 Demarcation of Construction Works of Facilities between the Two Countries

Construction/Procurement & Installation	Japan	Jordan
1. Service reservoir construction work		
(1) Securing and preparing the construction area		●
(2) Construction of service reservoirs	●	
(3) Primary power supply feed		●●●●●
(4) Access road to the site		
(5) Road paving, lighting, vegetation, fencing, gates, etc., within the site		
(6) Laying of overflow pipelines from the site to the discharge point (existing drain)		
(7) Offer of water and chlorine agent for tests		
2. Installation of transmission and distribution mains		
(1) Installation of transmission mains	●	
(2) Installation of distribution mains	●	
(3) Installation of distribution branch pipelines (to extend water supply areas)		●
(4) Replacement of old distribution water pipelines		●
(5) Servicing of water meters		●
(6) Supply of water and chlorine agent for completion tests		●
3. Pump station construction work		
(1) Renewal of pumping equipment	●	
(2) Supply of primary power of required capacity		●
4. Construction of chlorination facilities		
(1) Construction of buildings	●	
(2) Chlorination equipment	●	
(3) Supply of primary power of required capacity		●
5. Sluice valve insertion work		
(1) Procurement of required materials such as sluice valves and joints		●
(2) Insertion of sluice valves in existing pipelines	●	

2.2.4.4 Construction Supervision Plan

(1) Overall relationships in the implementation plan

The relationships between the main entities for implementing this plan, including supervision of construction, are as shown in the Figure 2.2.15 below.

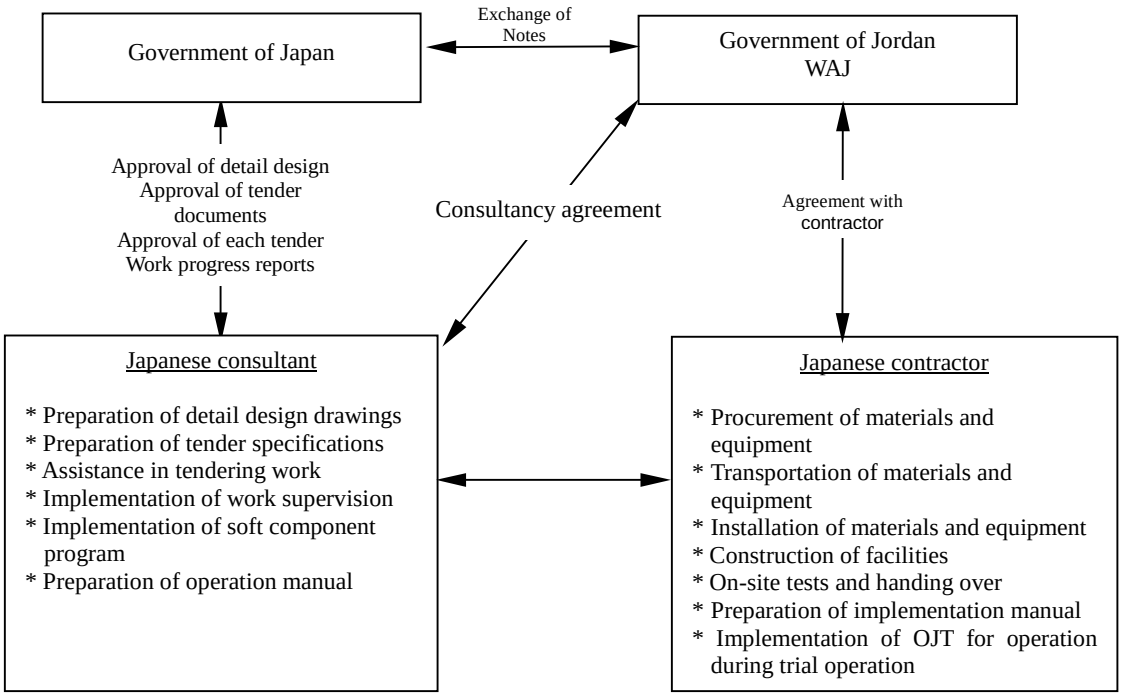


Figure 2.2.15 Relationships between Various Entities during Project Implementation

(2) Work supervision system of consultant

The consultant will supervise and offer guidance to the contractor to achieve "completion of construction of facilities within the predetermined work period," "the work indicated in the contractual drawings," and "implementation of safe work." Furthermore, the consultant also has the role of supervising and confirming from a neutral standpoint that the construction of the facilities is being implemented appropriately under the framework of grant aid.

1) Main supervisory duties of consultant

The description of the main supervisory duties that the consultant is required to perform is given below.

a) Progress control

The consultant will confirm the validity of the progress chart submitted by the contractor, compare the actual progress of construction of facilities with the progress shown in the progress chart, and confirm the progress status of the work daily, monthly and weekly. If delay is a cause for concern, the consultant will issue a warning to the contractor. If a delay occurs, the consultant will study and investigate the causes and measures together with the contractor, and will guide the contractor in the adoption of the required measures. The work supervision will include the following:

- Checking the amount of work done
- Results of input and output of important materials and equipment
- Results of input and output of engineers, workers, etc.

b) Quality control

The quality of facilities and work specified in the agreement is ensured. If there is concern about ensuring quality, the consultant will issue a warning to the contractor and also request that the required modifications and measures be adopted. Quality supervision will be implemented using the measures below.

- Verification of catalogs, specifications, and manufacturing drawings of materials and equipment
- Verification of test results of materials and equipment
- Witnessing tests of materials and equipment
- Verification of construction drawings, installation procedures, etc., of the contractor
- Site inspections, such as inspection of rolling, reinforcing bar arrangement, and concrete strength during work
- Site checks of work implementation status, work methods, etc., and guidance
- Attending tests and trials of facilities and verifying the performance

c) Safety control

The consultant will perform the validity check of the safety control plan of the contractor and check its implementation status. He will supervise the work on site beforehand to prevent accidents at work and accidents to a third party. Safety control will be implemented using the measures below.

- Confirm the measures for safety control plan and the presence of a safety control manager appointed by contractor
- Confirm the validity of the safety control plan proposed and the safety manager appointed by contractor
- Confirm the status of progress of the safety control plan
- Check the scheduled operating route of work vehicles, confirm the validity of precautions during operation, and adherence to the plan
- Check the content of the benefit system, occupational safety and health of workers and confirm that holidays and recesses are being enforced

The proposed sites for construction of the Sukhna and the Hashemeyeh Reservoirs are adjacent to middle school and high school buildings. Special considerations for safety measures for children are necessary. The routes for bringing in construction materials and equipment, and the time of transporting the same will be appropriately arranged. Measures such as arranging adequate watchmen during day and night times will be adopted. Furthermore, safety measures for children will be

formulated in coordination with the implementing organization of Jordan.

2) Work supervision system

The consultant will build the necessary work supervision system for implementing work supervision with the focus on quality control and safety control of the processes mentioned above, and will aim to implement work in the plan smoothly. In this case, work supervision considering the gist of the basic design is necessary, therefore, a system consistent with the series of tasks of basic design, detail design and work supervision will be built. The consultant will build the supervision systems mentioned below since work supervision needs to be implemented in both Japan as well as at the site.

a) On-site work supervision

Since it is important to confirm that the construction work is being performed appropriately under the framework of grant aid, the work supervision on site needs to be performed by Japanese engineers who thoroughly understand the grant aid scheme. The Japanese work supervision system on site considered necessary for this plan is shown in the table below. During the work period, the quality of work will be confirmed by engineers in charge of design and the chief consultant, who hold together the entire project including work within Japan, and who will give instructions such as warnings to the work supervisors at the appropriate time. The consultant will also employ local engineers, and implement work supervision using the local engineers together with the Japanese engineers.

Job title	Type of post	No. of persons	Responsible for
Work supervision engineer (Chief consultant)	Short term	1 person	Overall work supervision, checking kick-off meetings, site conditions, delivery on site, assistance for educational activities
Resident representative supervision engineer	Resident	1 person	Discussions with organizations in Jordan and with contractors, checks and adjustments of various work stages and ranges, overall supervision of work/procurement at site, assistance for educational activities
Civil construction work supervision	Short term	1 person	Inspection at the start of pipeline work and final inspection of service reservoir and pipeline work
Mechanical equipment work supervision	Short term	1 person	Work supervision and final inspection of pumping equipment and chlorine dosing equipment

b) Work supervision in Japan

Systems necessary for overall supervision of the project mentioned below will be maintained in Japan, and the overall work supervision including work at site and work in the country will be supervised.

- Checking the contents of the agreement and the process, progress, and quality
- Studies to resolve issues that have occurred on site and instructions to contractors
- Technical and financial assistance for consultant's local offices

(3) Contractor's work control system

Part of the work on service reservoir and installation of transmission and distribution pipelines can be given to on-site subcontractors also, but PC work must be performed by Japanese experts and skilled technicians. Laying of transmission and distribution pipelines are performed in trunk roads near important facilities and buildings, therefore, strict safety controls are necessary.

For this reason, contractors with extensive overseas experience in similar work with overall quality, process and safety controls must be selected. The resident and short term engineers of contractors will be required according to the scale and type of the facilities of the project may be as assumed below.

Job title	Type of post	No. of persons	Responsible for
On-site representative (Resident representative)	Resident	1 person	Discussions with national organizations of Jordan and with consultant, checks and adjustments of various work ranges and processes, formalities such as work permits, overall work control related to fulfilling the contract
Office Manager	Resident	1 person	On-site labor control, finance control, procurement of materials and equipment, transportation control, and general administrative aspects related to fulfilling the contract.
Chief Engineer (service reservoir)	Resident	1 person	Assistance/proxy to the On-site representative mentioned above, for technical aspects, and overall technical aspects of construction work. Process control, quality control and safety control related to service reservoir structures
Civil engineer (transmission and distribution pipelines)	Resident	1 person	Progress control, quality control and safety control related to transmission and distribution pipeline work
Mechanical and electrical equipment engineers	Short term	1 person	Progress control, quality control and safety control related to mechanical and electrical equipment

The contractor will also employ local engineers, and implement work control using the local engineers together with the Japanese engineers mentioned above.

2.2.4.5 Quality Control Plan

This plan requires quality control of various works such as pipe laying work in congested urban areas, service reservoir work that requires high water-tightness and durability, and chlorination facilities that require precision and safety. The control items to be implemented for quality control of important works are shown in Table 2.2.28.

Table 2.2.28 Quality Control Plan

Type of work	Control item	Method	Standard
Pipe materials	Strength and size Lining and painting	Factory inspection Visual inspection	Japanese standards
Pipe laying work	Joint accuracy Leakage	Clearance gauge measurement Leak test	Japanese standards
Paving work	Base course	CBR test	Japanese standards
Foundation work	Soil bearing capacity	Plate bearing test	Japanese standards
Concreting work	Concrete quality	Mixing test Compressive strength test Air test Aggregate test	Japanese standards
Reinforcement	Strength Reinforcing bar arrangement	Tensile test, bending test Reinforcing bar arrangement test	Japanese standards
Waterproofing work	Paint quality Paint film thickness Leakage	Confirmation of quality control certificate Film thickness test Water filling test	Japanese standards
Machinery installation work	Installation accuracy Functions	Measurement of installed position Actual load operation test	Japanese standards
Electrical equipment installation work	Installation accuracy Functions	Measurement of insulation resistance Sequence interlocking test	Japanese standards

2.2.4.6 Materials and Equipment Procurement Plan

(1) Locations for procurement of materials and equipment

1) Labor

Ordinary laborers and general skilled laborers (carpenters, plumbers, etc.) will be hired locally by the contractor.

2) Materials and equipment

General construction materials and equipment such as cement and reinforcing bars can be procured locally. Good quality ready-mixed concrete can be supplied from the ready-mixed concrete plant in the Marka district of Amman City adjacent to the project area. Since ductile cast iron pipes and valves are not being manufactured in Jordan, these items will be procured from Japan or third countries.

3) Construction machinery

No companies that lease construction machinery exist in Jordan, but general construction machinery such as large breakers, backhoes, bulldozers, dump trucks and truck cranes can be leased from local construction companies. Procurement companies that offer construction machinery at economic prices will be scheduled considering the lease rate, transportation cost, and number of days for which the machinery is offered.

Considering the local conditions mentioned above, the procurement items of main materials and equipment to be used in the project are shown in Table 2.2.29.

Table 2.2.29 Procurement Plan for Main Materials and Equipment

Item	Local	Japan	Third Country
Materials and equipment			
Cement	●		
Reinforcing bars	●		
Aggregate	●		
Base course material	●		
Asphalt	●		
Formwork	●	●	
Scaffolding and support materials	●	●	
Ductile cast iron		●	●
PC steel		●	
Ladders and covers for service reservoirs		●	
Measuring instruments (flow-meters and water level gauges)		●	
Pump		●	
Chlorinators		●	
Construction machinery			
Backhoes	●		
Dump trucks	●		
Bulldozers	●		
Truck cranes	●		
Trucks with crane	●		
Concrete pump vehicles	●		
Generators		●	
Air compressors		●	
Dumping rammer		●	

(2) Transportation plan

Machinery and electrical parts the quality of which may deteriorate during transportation will be adequately packaged in cases, straight pipes and large-sized materials and equipment will be packaged in bundles or as bare packages, considering long-term transportation by sea, loading and unloading at ports, and transport on land to the project area of the materials and equipment procured from Japan and third countries. The unloading port in Jordan is only Aqaba port. Accordingly, the imported materials and equipment will be unloaded at Aqaba port and transported over land to the project area.

2.2.5 Technical Assistance for Operation and Maintenance (Soft Component)

(1) Soft Component of Phase One Project

1) Overview

The phase I project was implemented for the water supply area of Ruseifa municipality and Awajan district of Zarqa municipality. Since the topography of the area is highly undulated and water supply was by pumping, it was very difficult to control distribution pressure and leakage. In the project, the facilities that separate distribution zones, distribute water by gravity from reservoirs and maintain appropriate pressure were constructed. In the project, a soft component program was implemented to enhance the capacity of WAJ to effectively operate and maintain water distribution networks and control the water distribution by helping in network mapping, network analysis and the water distribution control and transferring the integrated technologies with the following 3 outputs.

A) Conditions of networks could be better understood.
   a. Network information for the project area was mapped in GIS software.
   b. Network mapping technique was transferred.

B) Hydraulic characteristics of network could be easily grasped.
   a. Computer network analysis models were formulated.
   b. Network analysis technique was transferred.

C) Technology of distribution control would be improved.
   a. Updating of network mapping was made when new network was installed.
   b. Distribution sub-zones were planned.
   c. Technology of distribution control was transferred.

2) Lessons learnt from the phase I project

To improve the contents of soft components conducted in phase I project and for more effective cooperation in this phase II project, lessons listed below were drawn from discussions between the Japanese side and WAJ Zarqa office.

- One license of software of InfoWorks WS and ArcGIS allows only one user and hence, several users cannot work on these software, simultaneously
- Periodical update of information on networks and other facilities is required
- InfoWork WS and ArcGIS are not used in WAJ Zarqa office but they are kept in WAJ headquarter (HQ).
- Technology transfer to engineers at WAJ Zarqa office was not conducted and technology transfer program was conducted at WAJ HQ mainly
- Theoretical training and practices are conducted.

- Distribution system data is not managed and utilized appropriately
- Without computer data, systematic analysis and interpretation have not been done.

3) Comments on the Soft Component Program by WAJ Zarqa

To understand needs on soft components of implementing agency, WAJ Zarqa, a workshop was held at WAJ Zarqa office. List of comments made by the participants at the workshop are given below.

- Suitable room for training equipped with appropriate sets of computers, printers and appurtenances shall be prepared in WAJ Zarqa office or workshop. (to be provided by WAJ)
- In phase I project, there was only one trainee from WAJ Zarqa and the technology transfer to ZAJ Zarqa was not enough. To take care of this, in the Phase II, training program shall be conducted at WAJ Zarqa office.
- At least six trainees shall be selected from WAJ Zarqa through examination by the Expert dispatched. The trainees shall meet the minimum requirements for the training such as computer skill. Pre-examination and post-examination shall be carried out to assess the effects of these training.
- Working group shall be formed of the selected trainees. Training shall be part time.
- At least four months is required for a productive training.
- The trained staff shall not be transferred to other offices but stay in WAJ Zarqa office to facilitate improvement of water supply system of Zarqa using the acquired skill.
- The pipes with diameter more than 3-inches (75 mm dia) shall be mapped in computer and nodes for 2-inch diameter pipes shall be mapped.
- InfoWorks WS and ArcGIS software license allows only one user at a time and hence, several users cannot work on these softwares, simultaneously. Therefore software for hydraulic analysis, EPANET2 (from USEPA), which provides the facility of being used without charge shall be used in parallel.

(2) Improved Scope of Works of Soft Component

1) Needs of WAJ Zarqa

The following items shall be added to the scope of works of the phase I project in consideration of needs of WAJ Zarqa.

- InfoWork WS and ArcGIS shall be used at WAJ Zarqa office.
- Training shall be provided on periodical update of data on pipelines and other facilities and schedule of training shall be prepared.
- EPANET2 (free software) shall be used for simulation purposes, and consequently several users can work on this software in parallel.

- Demarcation of InfoWork WS and ArcGIS and EAPNET2 will be defined.
- More simulation practice by counterparts will be carried out.
- More on-the job training by counterpart will be undertaken.
- Counterparts will be trained to use softwares (EPANET2) for simulating actual situations related to the work.
- Training shall be provided on basic data compilation, management and storage method and format preparation. Also, manual and computer format will be prepared.
- Training shall also be carried out on computer data input and systematic data analysis and interpretation.

2) Required Input

To carry out the activities mentioned above, following inputs are required.

a. A training room (later used as a distribution management center) in Zarqa main office or workshop, equipped with required furniture to be used by the trainees (four sets of computer desk and chair, shelves, air conditioners, etc.) (to be provided by the Jordanian side)
b. Three computers, One A4-B&W printer and One A3-color printer (to be provided by Jordanian side)
c. Pressure gauge, flow meter and other measurement equipment if needed (to be provided by the Jordanian side)
d. Computer programs for network mapping and geographical information system granted by the Japanese side in the phase I. (to be provided by the Jordanian side)
e. Computer program and manuals for network analysis (EPANET2) (to be provided by the Japanese side)

(3) Need for Soft Component Program

1) Current situation and problems of management and control of water distribution system

Problems of the distribution system operation in Zarqa area (causes, central problem, effects) are shown in the problem series (Figure 2.2.16). They are summarized as follows:

- Conditions of networks are not grasped.
- Data and information required for distribution system management are not centrally managed and not utilized efficiently.
- Hydraulic characteristics are not grasped.

These problems cause a central problem, that is, operation of water distribution system is not effective. This in turn causes many effects; effective rehabilitation cannot be planned, suitable distribution sub-zones cannot be delimitated, and effective distribution control cannot be made. These factors lead

to high leakage and non-revenue water rates and unfair water rationing. Finally, these problems lead to obstruction of development of water supply services.

2) Necessity and role of soft component in the present project

Transmission facilities or infrastructures for distribution control will be constructed in this project. Maximum benefits of the project, however, will not be brought about unless the Jordanian undertakings including daily effective operation and control of water distribution system, periodical replacement of superannuated pipes, operation and maintenance of distribution networks, etc. are not properly made. In view of the present situation, it will be difficult for the WAJ with existing capacity to undertake these undertakings. This soft component program is, therefore, intended to assist the WAJ in the Jordanian undertaking by improving their capacity for sustainable operation of the water distribution system.

In the phase I project, soft component program was conducted for the area of Ruseifa and Awajan and the capacity to manage water distribution system was enhanced to some degree. Based on this technology transfer, WAJ Zarqa office is currently trying to improve water distribution management although their capacity is not enough. In this phase II project, soft component program will be conducted for the target area of this project, i.e., the northern part of Zarqa municipality, Hashemeyeh and Sukhna municipalities and for strengthening of their capacity. Also the WAJ Zarqa office made a strong request for implementation of this component to the Japanese side. To strengthen and supplement the outputs of the phase I project, soft component program will be conducted in this phase II project.

3) Goal of the soft component program

The goal series (Figure 2.2.16) show linkages of goals to improve capacity to operate and maintain the water distribution system. To reach the goal, approaches are identified as shown in Figure 2.2.17. Three approaches thus identified are listed below:

- Network mapping approach
- Network data management approach
- Network analysis approach

These three components will comprise “a project for technology transfer of integrated management of water distribution system,” and will be undertaken in the present soft component program. The program is intended to upgrade capacity of operation and maintenance and thereby bring about the benefits of the grant aid project (reduction of leakage and equitable distribution of water) to their full extents.

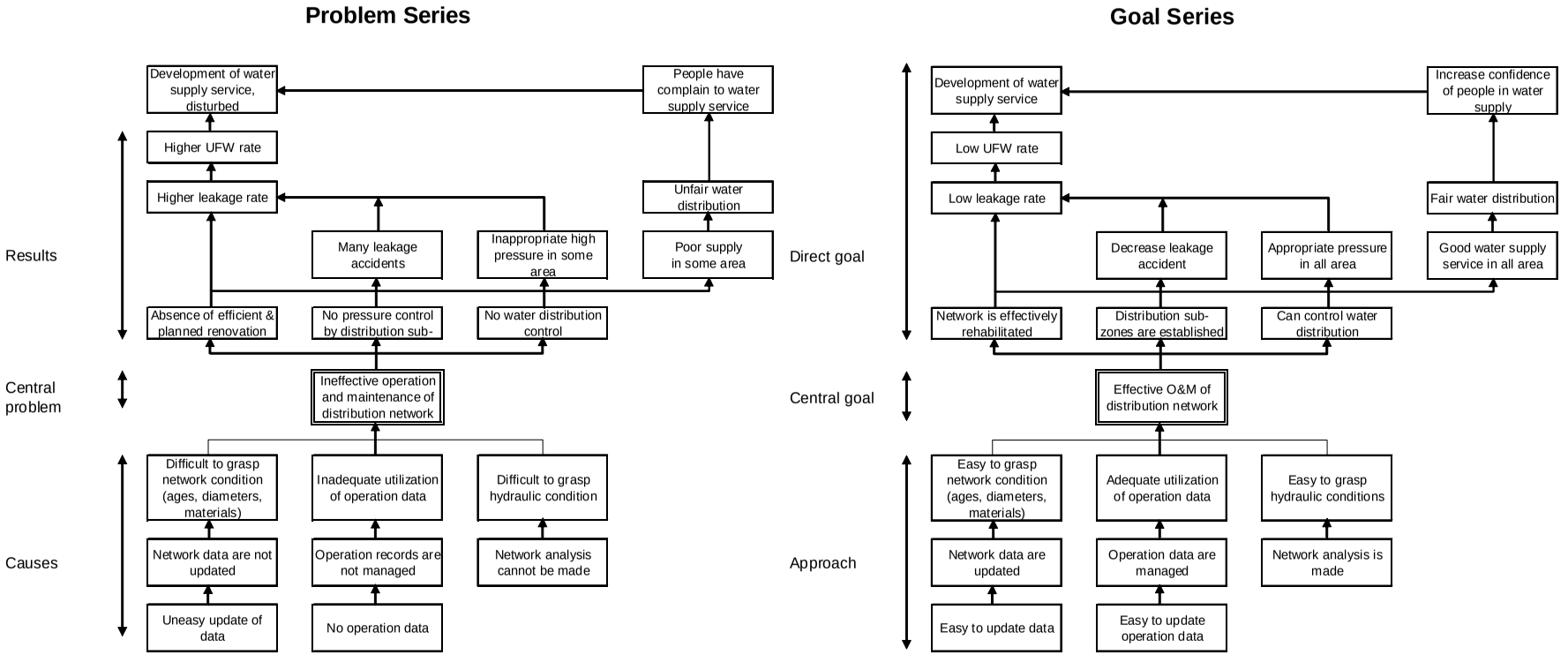


Figure 2.2.16 Problem and Goal Analysis

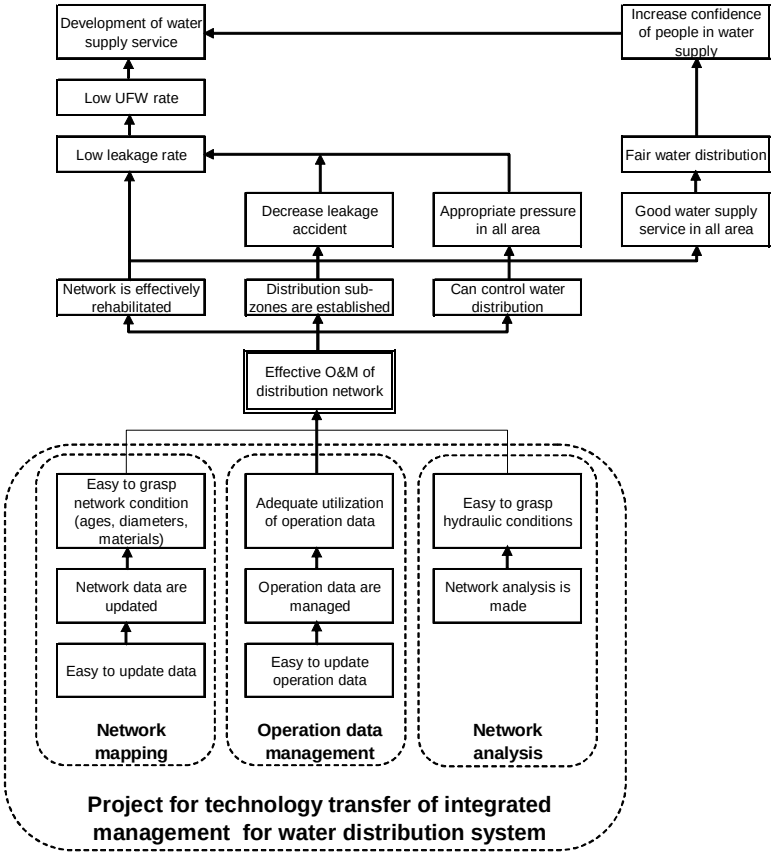


Figure 2.2.17 Approaches for Improvement

(4) Work Plan

1) Objectives

This soft component program is targeted to establish capacity to effectively operate and maintain water distribution system and control the water distribution by transferring integrated technologies of network mapping, network analysis and the water distribution control. Once the capacity is established, fair water distribution (water distribution control) and effective and continuous reduction of leakage will be brought about.

2) Outputs

Outputs resulting from the trainings can be grouped into three categories. Once these three outputs are attained, integrated capacity to manage the distribution system will be brought about.

A Conditions of networks can be easily grasped.

① Network information is mapped.

② Network mapping technique is transferred to the trainees.

B Data on distribution network can be utilized.

① Data on distribution system are fed into computers and maintained well for management of water distribution.

② Data are analyzed and interpreted by trainees.

C Hydraulic characteristics of network can be easily grasped.

① Network analysis models are formulated.

② Network analysis technique is transferred to the trainees.

3) Activities

No.	Activities
(1)	Preparation
a	Preparation in Japan
D-1	Formulate plan for technology transfer
D-2	Preparation of pre-training test paper, questionnaire, text for seminar
b	Preparation of technology introduction seminar
b-1	Establishment of the training center, C/P meeting, site visit, preparation of introduction seminar
b-2	Selection of trainees (small test before training)
b-3	Technology introduction seminar
(2)	Mapping of distribution network
a	Preparation of base map using Geographic Information System
a-1	Set up the software of GIS and network analysis
a-2	Collection of water supply facilities drawings (including location of valves)
a-3	Collection of data map (contours, roads, city block)
a-4	Preparation of data in digital form (put into GIS database)
b	Data Input of present network information
b-1	Formulation of data input system of distribution network
b-2	Input of network map (transmission and distribution mains, water supply pipes, valves)
b-3	Input of data on attributes of network (kind of pipes, diameter, age, elevation, valve, etc.)
b-4	Site survey (facilities check, valve check, test drilling)
c	Transfer of network mapping technology
c-1	Introduction seminar on network mapping (outlines of GIS and mapping software)
c-2	Explanation of data input system of distribution network
c-3	Training on data input (OJT)
c-4	Preparation of seminar (collection of result, visualization)
c-5	Seminar on mapping of distribution network
(3)	Management of distribution network operation data
a	Input of data on distribution network operation
a-1	Collection of data (pipe, pump operation, power consumption, water level, etc.)
a-2	Formulation of data format for distribution network operation
a-3	Input of data on distribution network operation
b	Technology transfer on interpretation of distribution network operation data
b-1	Interpretation of distribution network operation data

No.	Activities
b-2	Preparation of seminar on management of distribution network operation data
b-3	Seminar on management of distribution network operation data
b-4	Preparation of Progress Report
(4)	Network analysis
a	Formulation of distribution network model
a-1	Demand estimation in divided areas (present and future)
a-2	Confirmation of pump and valve operation (water supply rationing)
a-3	Formulation and validation of distribution network model and validation of the model
b	Simulation of distribution network model
b-1	Simulation of present network (pressure, flow, direction)
b-2	Formulation of new distribution zone models
b-3	Network analysis of new distribution zone models (pressure, flow, direction)
c	Transfer on network analysis technology (OJT)
c-1	Network analysis technology (EPANET2)
c-2	Network analysis technology (InfoWorks)
c-3	Plan of transmission and distribution network operation
(5)	Comprehensive evaluation on technology transfer
a	Comprehensive seminar
a-1	Preparation of comprehensive seminar
a-2	Comprehensive seminar
b	Reporting and manual preparation
b-1	Preparation of manual on network mapping system
b-2	Evaluation of soft component
b-3	Preparation of completion report

4) Personnel Assignment and Project Organization

To implement the activities described above, following personnel shall be assigned.

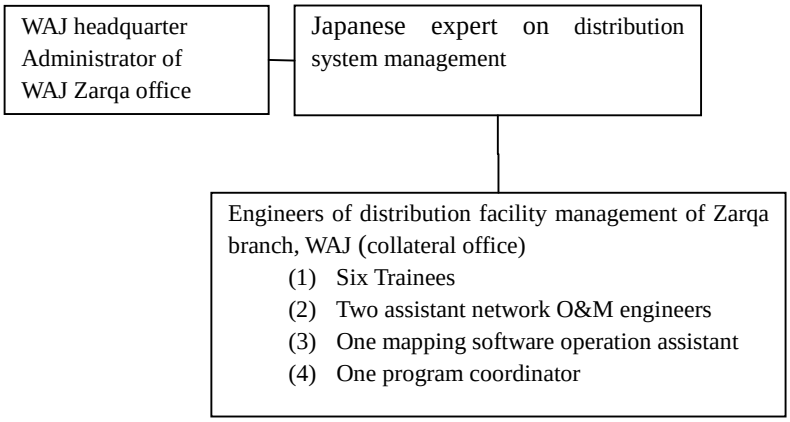
Table 2.2.30 Personnel Assignment for Soft Component

Required staff	Number	Affiliation	Description
Expert from Japan on distribution system management	1	Japanese side	Implement the following activities applying Japanese technology on distribution management to provide training to trainees - Preparation of text for training, holding of training - Preparation of achievement test, homework material - Formulation of data formats - Holding of seminars - Data collection, data editing, formulation of simulation model - Evaluation
Trainees	6	WAJ Zarqa	Selected by WAJ Administrator and the Japanese expert
Network O&M engineer	2	WAJ Zarqa	Assist maintenance engineers in the field to input data, who is conversant with condition of distribution network
Mapping software operation assistant	1	WAJ Zarqa	The trainees cannot concentrate on training full-time as they have day job. So, a full-time assistant shall be employed to assist trainees with mapping data input. This assistant deals with huge quantities of data on distribution facility of 130 km in length. This consultant also takes care of the trainees.
Program coordinator	1	WAJ Zarqa	Assist the Japanese expert: - Taking photo copy of training text - Assistance on preparation of training text - Coordination of training - Assistance on data collection - Assistance on grading of test papers - Assistance on formulation of data formats - Translation of documents written in Arabic

Qualifications of the Japanese expert on distribution system management are listed as follows.

- The expert shall be able to utilize proposed GIS (Geological Information System) and computer software for hydraulic analysis
- The expert shall have understanding of hydraulics on distribution system
- The expert shall be able to formulate distribution management plan
- The expert shall be able to formulate the training program

To implement the activities described above, the following organization led by a Japanese expert for distribution network management shall be established:



5) Implementation Schedule of Soft Component

The construction of the phase II project is divided into three terms. To implement the soft component activities effectively, these activities shall start in Term 2, the time when some facilities have already been completed, and shall be finished at the end of Term 3. Total length of the soft component activities shall be three months. Schedule of each activity is shown in Figure 2.2.18 and schedule of the input in Figure 2.2.19. Figure 2.2.20 shows detailed schedule of activities. Some activities shall run in parallel to shorten implementation period. Required input of the expert of Japanese side is estimated below:

Item	Implementation period	Required days	Adopted man-month
1st technology transfer	The 2nd term project	49 days	1.8 month (incl. 0.1 in Japan)
2nd technology transfer	The 3rd term project	31 days	1.23 month

Note: Equivalent required month is calculated on the condition that one equivalent week equals six work days and one equivalent month equals 25.7 work days

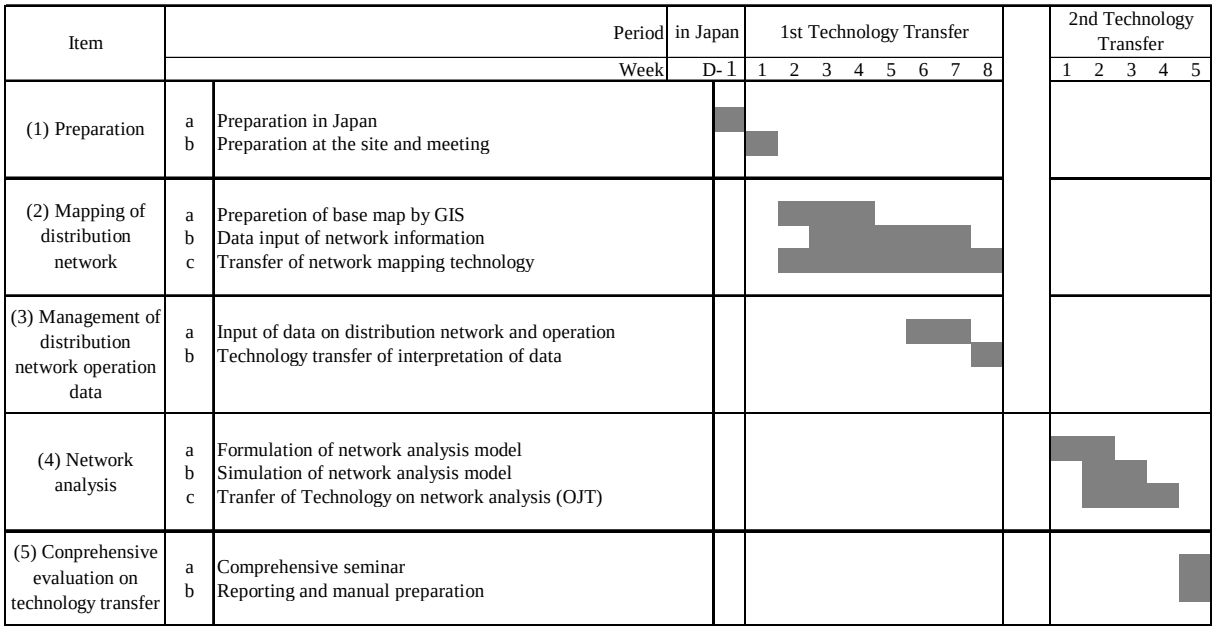


Figure 2.2.18 Implementation Schedule of Activities

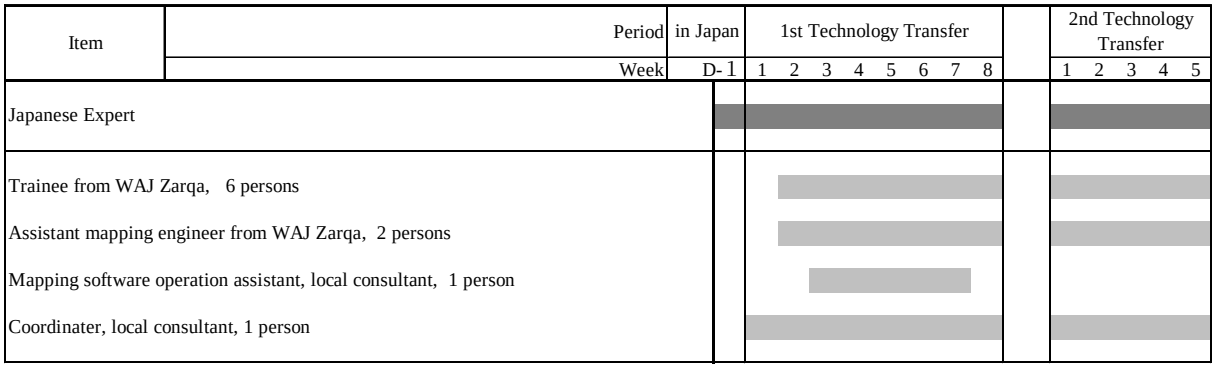


Figure 2.2.19 Input Schedule

Term 2 (1st technology transfer)

	Activities	Man-day	During project Term 2 and 3									Required facilities, texts for training, reports
	Period: Month		in Japan	Month 1					Month 2			
	Day		5	1 - 7	8 - 14	15- 21	22 - 28	29 - 25	25 - 31	31 -37		
(1)	Preparation											
a	Preparation in Japan											
D-1	Formulate plan for technology transfer	1										
D-2	Preparation of pre-training test paper, questionnaire, text for	2										
	Travelling (Project term 2)	2										
	Travelling (Project term 3)	2										
b	Preparation of technology introduction seminar											
b-1	Establishment of the training center, C/P meeting, site visit, preparation of introduction seminar	2										
b-2	Selection of trainees (small test before training)	1										Questionnaire, small test
b-3	Technology introduction seminar	1										Plan for technology transfer
	Sub total	9										
(2)	Mapping of distribution network											
a	Preparation of base map using Geographic Information System											
a-1	Set up the software of GIS and network analysis	1										ArcGIS,
a-2	Collection of water supply facilities drawings (including location of valves)	2										
a-3	Collection of data map (contours, roads, city block)	2										
a-4	Preparation of data in digital form (put into GIS database)	2										ArcGIS,
b	Data Input of present network information											ArcGIS,
b-1	Formulation of data input system of distribution network	2										ArcGIS,
b-2	Input of network map (transmission and distribution mains, water supply pipes, valves)	3										ArcGIS, InfoWorks
b-3	Input of data on attributes of network (kind of pipes, diameter, age, elevation, valve, etc.)	3										ArcGIS, InfoWorks
b-4	Site survey (facilities check, valve check, test drilling)	2										Machine tool, ArcGIS
c	Transfer of network mapping technology											
c-1	Introduction seminar on network mapping (outlines of GIS and mapping software)	1										Software manual
c-2	Explanation of data input system of distribution network	1										IW training
c-3	Training on data input (OJT)	4										ArcGIS,
c-4	Preparation of seminar (collection of result, visualization)	2										ArcGIS,
c-5	Seminar on mapping of distribution network	0.5										Report on
	Sub total	25.5										
(3)	Management of distribution network operation data											
a	Input of data on distribution network operation											
a-1	Collection of data (pipe, pump operation, power consumption, water level, etc.)	2										
a-2	Formulation of data format for distribution network operation	2										MS-EXCEL
a-3	Input of data on distribution network operation	3										MS-EXCEL
b	Technology transfer on interpretation of distribution network operation data											
b-1	Interpretation of distribution network operation data	2										MS-EXCEL
b-2	Preparation of seminar on management of distribution network operation data	2										MS-EXCEL
b-3	Seminar on management of distribution network operation data	0.5										Report on distribution
b-4	Preparation of Progress Report	1										Progress report
	Sub total	12.5										

Term 3 (1st technology transfer)

(4)	Network analysis											
a	Formulation of distribution network model											
a-1	Demand estimation in divided areas (present and future)	1										
a-2	Confirmation of pump and valve operation (water supply)	2										
a-3	Formulation and validation of distribution network model and validation of the model	2										EPANET2, InfoWorks
b	Simulation of distribution network model											EPANET2, InfoWorks
b-1	Simulation of present network (pressure, flow, direction)	2										EPANET2, InfoWorks
b-2	Formulation of new distribution zone models	2										EPANET2, InfoWorks
b-3	Network analysis of new distribution zone models (pressure, flow, direction)	2										EPANET2, InfoWorks
c	Transfer on network analysis technology (OJT)											
c-1	Network analysis technology (EPANET2)	4										EPANET2
c-2	Network analysis technology (InfoWorks)	4										InfoWorks
c-3	Plan of transmission and distribution network operation	2										
	Sub total	21										
(5)	Comprehensive evaluation on technology transfer											
a	Comprehensive seminar											
a-1	Preparation of comprehensive seminar	2										
a-2	Comprehensive seminar	1										
b	Reporting and manual preparation											
b-1	Preparation of manual on network mapping system	1										Manual on
b-2	Evaluation of soft component	1										
b-3	Preparation of completion report	1										Final report
	Sub total	6										
	Travelling and Reporting (Project term 2)	2										
	Travelling and Reporting (Project term 3)	2										
	Soft component (project term 2)	49.0										
	Soft component (project term 3)	31.0										

Figure 2.2.20 Detailed Schedule of Activities

6) Place for Training

The training shall be held in a refurbished room of maintenance workshop of Zarqa office of WAJ. Equipment listed below and refurbishment of the room shall be provided by the Jordanian side.

- Refurbishment of the room
- Four sets of computer desks and chairs
- Shelves for documents
- Whiteboard
- Table for meeting
- Air-conditioning equipment

Training room will be utilized as distribution management center (DMC) of Zarqa office of WAJ after completion of the training.

7) Equipment and Computer Program

Several equipment and software shall be required to carry out this training effectively, of which some will be provided by Japan side and the rest by the Jordan side. These are listed as follows:

① Three computers (one computer for two trainees, to be procured by the Jordanian side)
② One A4 size black and white laser printer (to be procured by the Jordanian side)
③ One A3 size bubble jet color printer (to be procured by the Jordanian side)
④ One A4 size scanner (to be procured by the Jordanian side)
⑤ Operating system software for three computers (to be procured by the Jordanian side)
⑥ MS-Office and AutoCAD (to be procured by the Jordanian side)
⑦ Water pressure gauge, flow-meter and appurtenances if needed (to be provided by Jordanian side)
⑧ ArcGIS, GIS software (to be provided by Jordanian side)
⑨ InfoWorks WS, software for hydraulic analysis of pipe network (to be provided by Jordanian side)
⑩ EPANET2, software for hydraulic analysis of pipe network (to be provided by the Japan side)
⑪ Other required furniture (to be provided by Jordanian side)

8) Evaluation Methods of Achievement of Training

Evaluation of achievement of training shall be performed by the method explained below. The training in this component of the project is considered to be successful if four of six trainees pass the achievement test and they are identified as distribution control engineers at least.

Program	Evaluation methods of achievement of training	Performance measure
Level of ability, before training	Small test	-
Mapping of distribution facilities	Small achievement test on mapping method Reporting on mapping data, representation by a chart, interpretation	Score more than 70 points Score more than 70 points
Data management	Reporting on data of distribution network, representation by a chart, interpretation	Score more than 70 points Score more than 70 points
Hydraulic analysis of distribution network	Reporting on case study, EPANET 2 Reporting on fundamentals of InfoWorks	Score more than 70 points Score more than 70 points

9) Output

(Report)	Description	Timing
Inception Plan of technology transfer program (in English)	Items of soft components, performance goal, detailed schedule, implementation plan	At the start of the project
Progress Report (in English)	Mapping technology for distribution network, contents of technology transfer on distribution facilities management, evaluation	At the end of 1st technology transfer program
Final Report (in English) Abstract of final report (in Japanese)	Comprehensive report on 1st and 2nd technology transfer, evaluation, manual on technology transfer photos, GIS, data on distribution network	At the end of the project
(Output)		
Data on distribution network	Complete data on distribution network	At the end of the project
Data for hydraulic analysis	Data for hydraulic modeling for EPANET2 Data for hydraulic modeling for InfoWorks	At the end of the project
Distribution network operation data	Computerized data on distribution system operation	At the end of the project
Manuals	Manual on mapping technology Manual on hydraulic analysis of distribution network Manual on input of distribution network	At the end of the project
Others	Record on technology transfer, printout of data, text of training	At the end of the project

10) Implementation Method of Lecture, Training and Seminar

The Japanese expert shall prepare contents of the lecture, seminar and the training as a whole. Followed by this, the materials for the training programs shall be prepared and implemented as per the schedule. In the case of seminars, the expert shall explain objectives of the seminars and evaluation of technology transfer, and then the trainees shall prepare materials for seminars accordingly and make a presentation. The expert shall give advice and feedback on the presentation and explain wherever the improvements are required. Finally, the follow-up of training program and evaluation of result of technology transfer seminar shall be implemented by the expert from Japan.

11) Comprehensive Technology Transfer Seminar

Objectives:

① To make trainees understand the contents of technology transfer and learn through the preparation of materials for the seminar based on transferred technology and skills and through presentation in the seminar
② To follow up the training through the preparation and make overall evaluation of the soft component
③ To share the contents of training with other WAJ staff

Contents:

① Evaluation and summary of soft component by the expert
② Presentation by trainees (Topic: network mapping data analysis, Distribution data analysis, network analysis and simulation and transmission and distribution management)
③ Opening of Distribution Management Center

Participants:

Relevant municipality' administrators, WAJ headquarter administrator (assistant secretary), WAJ staff, WAJ Zarqa office administrators and staff and general public etc.

(5) Obligations of Jordanian Side

1) Feasibility of program implementation

In the field study of this Basic Design Study, the study team and the administrators of WAJ Zarqa office discussed about implementation and contents of soft component. Their willingness to participate and cooperate while conducting the component is very high and a strong demand for soft component has been confirmed. Therefore, it is evaluated that the implementation of the soft component program is feasible.

2) Obligations

To conduct this component, Jordanian side shall implement the following obligations as stated above.

- Procurement of computers, printers, software and scanner
- Preparation of a refurbished training room in WAJ Zarqa maintenance workshop
- Provision of GIS software (Arc GIS) and network analysis software (InfoWorks WS)

For a successful implementation of the component, the trainees shall have education and acquire basic knowledge in advance. The trainees shall be prudently selected by the administrators of WAJ Zarqa office and the expert from Japan. The following are minimum requirements of trainees.

- To have some experience of water distribution management
- To have interest in this training
- Should be able to communicate in English

- To have basic knowledge of computer operation
- Should have basic skills of computer softwares (MS- Excel and MS-Word)
- To spare time for the training (3-4 hours per day)

(6) Project Design Matrix

The project design matrix (PDM) that summarizes the contents of the software component is given in Table 2.2.31.

Table 2.2.31 Soft Component Project Design Matrix (PDM)

Project:	Basic Design Study on the Project for Improvement of the Water Supply System for the Zarqa District, Term 2		Period: June 2006 – May 2010
Target area:	Zarqa District, Jordan	Target group: Engineers and technicians in WAJ	Date: March, 2006

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
Overall goal 1. Reduced NRW and leakage ratio 2. Fair (equitable) water distribution	1. To reduce the water leakage rate from 31% (presumed) to 25% 2-1 No area of excessively low water pressure 2-2 The water distribution pressure at 10m to 70m	1-1 Data of NRW rates from WAJ, Zarqa 1-2 Data of leakage repairs from WAJ, Zarqa 2-1 Data of grievances from WAJ, Zarqa 2-2 Data of water pressure from WAJ, Zarqa	• The Jordan side will implement the network rehabilitation plan continuously • The Jordan side will implement water distribution plan continuously • The Jordan side will send the planned amount of water to Zarqa area. • The grant aid facility (Japan and Jordan share the cost) is completed
Project purpose Establish capacity to effectively operate and maintain distribution networks	Four water distribution management engineers are trained and have enough skills and knowledge (out of six trainees).	• Result of achievement test and reporting • Comprehensive report by Japanese expert	• Engineers participating in transfer of technology will keep working in WAJ Zarqa office • Network mapping data will be updated continuously
Outputs 1. Conditions of networks can be easily grasped 2. Data on distribution operation can be utilized adequately 3. Hydraulic characteristics of network can be easily grasped	1-1 Input of network information (75mm or larger in diameter) 1-2 Can utilize required function of ArcGIS 1-3 Can collect data on condition of distribution network 2-1 Input data on distribution operation 2-2 Formulate distribution control system 3-1 Can utilize more than 80% functions of network analysis software EPANET2 3-2 Understand functions of InfoWorks	1-1 Japanese expert will judge 1-2 Judged by test and report 1-3 Judged by test and report 2-1 Judged by learning level of software 2-2 Japanese expert will judge 3-1 Judged by test and report 3-2 Judged by test and report	• Data of present distribution network can be collected to the greater extent • The Jordan side cooperate during data collection
Activities 1-1 Collection of distribution network information 1-2 Input of network information 1-3 Transfer of technology on network mapping 2-1 Input of data on distribution network and	Inputs <u>The Japanese side</u> Human resources Expert for distribution management: 3.0 M/M Local consultants: Machinery	<u>The Jordanian side</u> Human resources Engineer for network management: 6 persons Network O&M engineers: 2 persons Mapping software operation assistant:	• The Jordanian side allocate enough time to this component • Appropriate WAJ Zarqa trainees are selected. • Appropriate expert is dispatched for the component

Narrative summary	Objectively verifiable indicators	Means of verification	Important assumptions
operation 2-2 Technology transfer of interpretation of distribution data 3-1 Formulation of network model 3-2 Simulation 3-3 Technology transfer on hydraulic analysis	-	1.00 M/M Program Coordinator: 3.00 M/M Facility Training center at Zarqa workshop with furniture Machinery Three Computers for mapping One B&W printer One color printer One scanner and appurtenance Water pressure and flow measuring equipment, if needed Software ArcGIS and InfoWorks	
	Software EPANET2 (Software for network analysis)		

2.2.6 Public Relations Activities

The public relations (PR) are the important part of the project since this grant aid is implemented using Japanese taxpayer's money. The Government of Jordan, the beneficiary of the project, shall conduct effective PR activities for the project, with assistance from Japanese side. The following are responsibilities of both sides involved in implementing project activities including schemes under PR activities. The Japanese side will facilitate the implementation of following PR activities.

(Responsibility of Japanese Side)

Construction Term	PR Location	PR Contents
Term 1	· Zarqa High Reservoir (RC: 5m height) · Khaw chlorination facility · Transmission and distribution pipeline routes	· ODA advertisement board · Inscription plate (stone) · Painting messages and pictures related to water supply and ODA mark on the wall of reservoir
Term 2	· Hashemeyeh reservoir (RC: 5m height), face to school · Sukhna Reservoir (RC: 5 m height), face to school · Transmission and distribution pipeline routes	· ODA advertisement board · Inscription plate (stone) · Painting messages and pictures related to water supply and ODA mark on the wall of reservoir · Inscription of ODA mark on the lid of valve chambers
Term 3	· Batrawi Reservoir (PC: 12 m height), center of the city · Transmission and distribution pipeline routes	· ODA advertisement board · Inscription plate (stone) · Painting messages and pictures related to water supply and ODA mark on the wall of reservoir · Inscription of ODA mark on the lid of valve chambers

Jordanian side shall be responsible for facilitating the following PR activities related to public awareness campaign.

（Responsibility of Jordanian Side）

Items	PR activities	Schedule
· Press release	· Distribution of pamphlet on the project · Press release to mass media	· Ground breaking and completion ceremonies
· Contest	· Planning and implementing contests on messages, pictures, paintings related to water supply · Award distribution ceremony along with project ground-breaking ceremony (Awarded works will be painted on the wall of reservoirs) · Press release	· Before and after ground breaking and completion ceremonies
· Public awareness activities	· Planning and implementation of participation and awareness activities of students in school, construction sites and completion facilities, including site visits · NGO involvement (e.g., seminars on water supply for raising public awareness)	· During project implementation

Specially, the proposed sites of Hashemeyeh and Sukhna Reservoirs are facing middle school and high school. Therefore, awareness campaign for students shall be performed in the ground breaking and completion ceremonies.

To conduct comprehensive PR and awareness activities considering the local customs and cultures, it is proposed that WAJ hire local NGO or consultants working in this field. This project will be implemented in three terms and ground breaking and completion ceremonies will be conducted three times, one for each term. Therefore, the WAJ is requested to hire the required personnel for total three months, 15 days for each ceremony (15 days x 6 times). The following are important considerations for implementation of PR and awareness activities.

(1) Responsible person: WAJ Zarqa office in charge
(2) Supporter: Supervision consultants and Contractor's engineers
(3) Local consultants or NGO: 1 senior IEC (information, education and communication) expert and 1 staff for 3 months each

2.2.7 Implementation Schedule

The project will be implemented during three single-year budgets (3 terms) corresponding to Japanese financial year under the framework of the Japan's grant aid scheme. In each term, construction will be started after the approval by the Government of Japan and Exchange of Notes (E/N) between Japan and Jordan. The project implementation is composed of selection of a contractor (detailed design, preparation of tender documents, tendering and contract) and construction. The overall implementation schedule for 3 terms has been shown in Figure below.

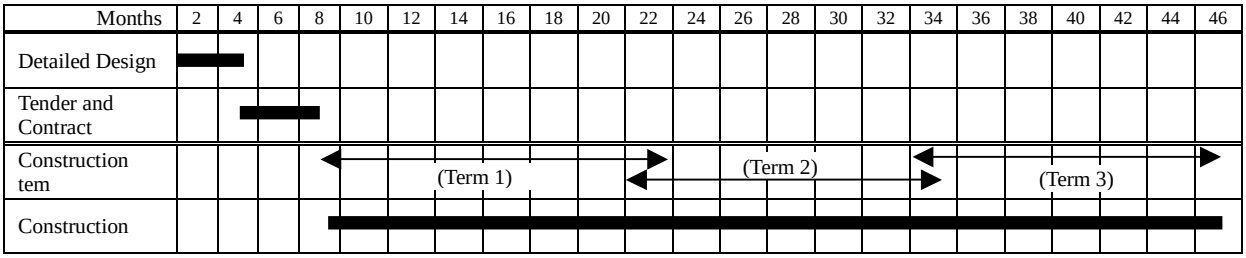


Figure 2.2.21 Overall Implementation Schedule

The project components of each term are summarized in Table 2.2.32 and Figure 2.2.22 and implementation schedules of each term is shown in subsequent Figures.

Table 2.2.32 Project Components of Construction Term

Term	Facility/Component	Components
1	Zarqa High Reservoir	RC structure (rectangular), 2,500 m^3, L25.8 m x W 25.8 x H5.3 m Water level gauge 1 no.
	Transmission mains (Batrawi PS - Zarqa High Reservoir)	Ductile cast iron pipe, dia. 300 mm x L 2,072 m
	Zarqa High Reservoir to the existing distribution mains	Ductile cast iron pipe, dia. 300 mm x L 1,572 m
	Existing Batrawi Pumping Station	Renewing of pumping equipment in the existing Batrawi PS Multi stage centrifugal pump Capacity: 5 m^3/min x 90 m head x 132 kW x 2 units Diameter: suction 150mm x discharge 125mm
	Khaw Chlorination Facility	Dosing equipment: 16 kg/h x 2 units Chlorine leak detector 1 set and safety equipment 1set Concrete building: L12m x W 10 m x H6.3 m
	Sluice Valves	Dia. 300mm x 1 no. for separation of transmission Dia. 150 mm x 3 nos. for distribution zoning Dia. 100 mm x 2 nos. for distribution zoning
2	Hashemeyeh	RC structure (rectangular), 1,500 m^3, L20.8 m x W20.8 m x H 5.3 m Flow meter 2 nos. ,Water level gauge 1 set
	Sukhna	RC structure (rectangular) , 1,000 m^3, L15.8 m x W15.8 m x H 5.7 m Water level gauge 1 set
	Khaw Junction - Hashemeyeh Reservoir	Ductile cast iron pipe, dia. 300mm x L 6,141m
	Hashemeyeh Reservoir - Sukhna Reservoir	Ductile cast iron pipe, dia. 300mm x L 7,798m
	Hashemeyeh Reservoir to the existing distribution mains	Ductile cast iron pipe, dia. 300 mm x L1,338 m
	Sukhna Reservoir to the existing distribution mains	Ductile cast iron pipe, dia. 200 mm x L 722 m
	Soft Component	
3	Batrawi Reservoir (Expansion)	PC structure (circular), 14,000 m^3, D46.7 m x H17.4
	Batrawi Reservoir to the existing distribution mains	Ductile cast iron pipe, dia. 600 mm x L 3,080 m and dia. 400 mm x L 480 m
	Soft Component	

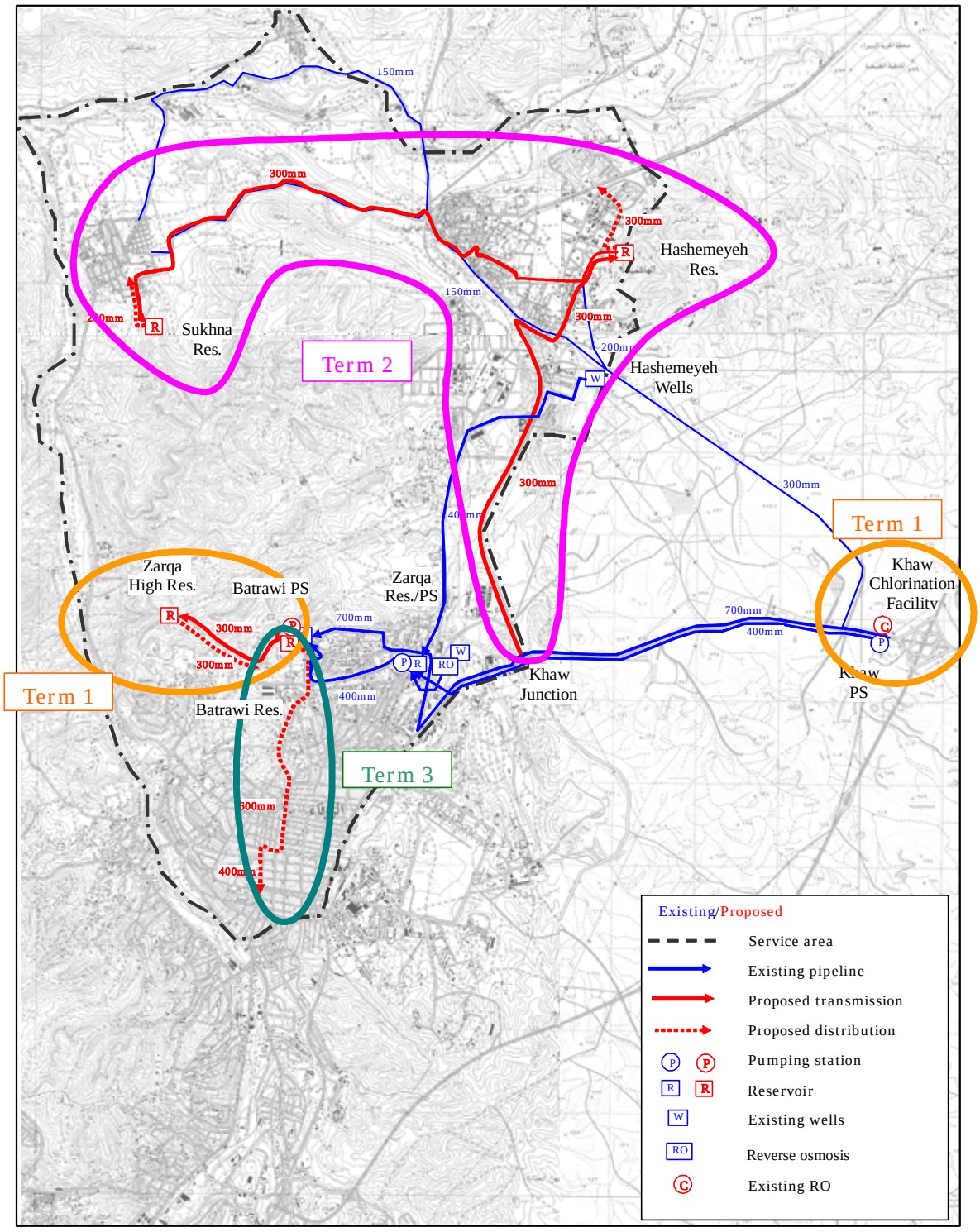


Figure 2.2.22 Project Components by Construction Term

The 1st Term Works

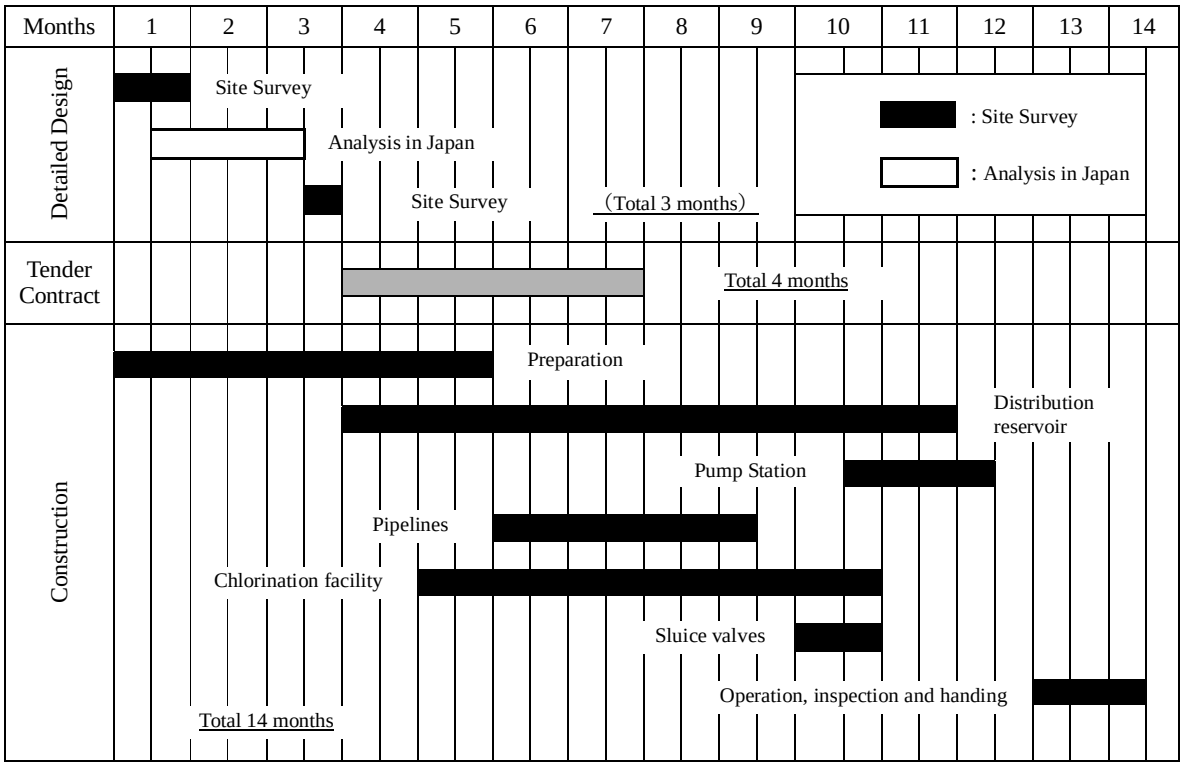


Figure 2.2.23 Implementation Schedule (1st Term Works)

The 2nd Term Works

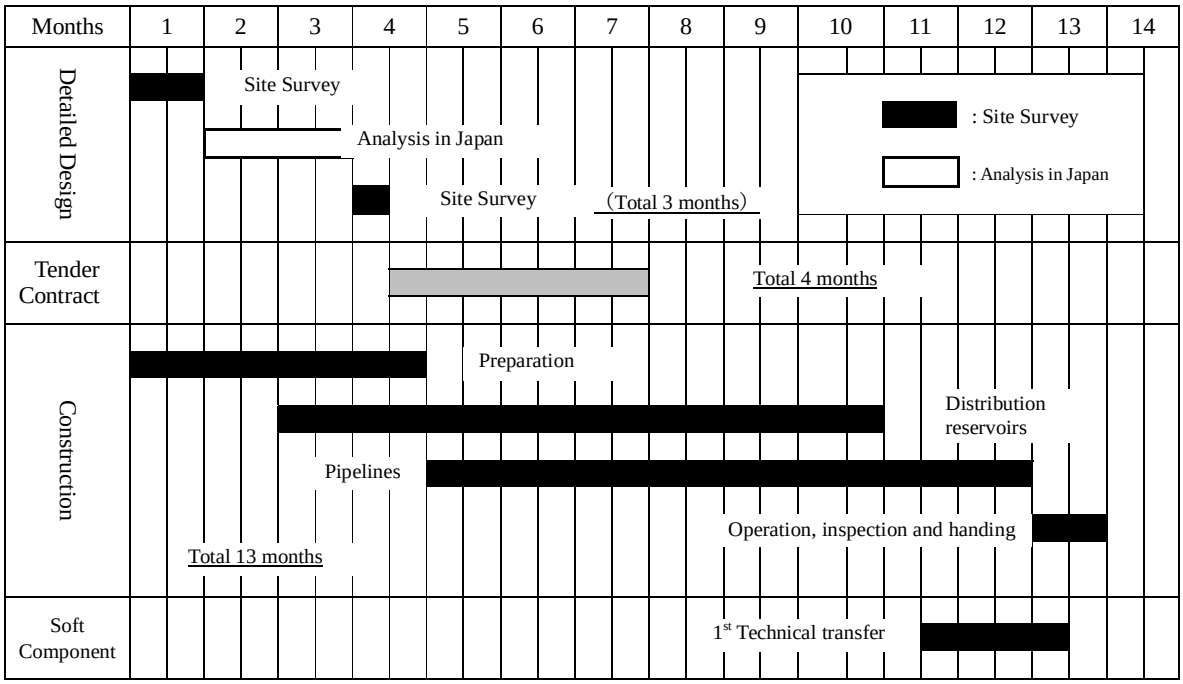


Figure 2.2.24 Implementation Schedule (2nd Term Works)

The 3rd Term Works

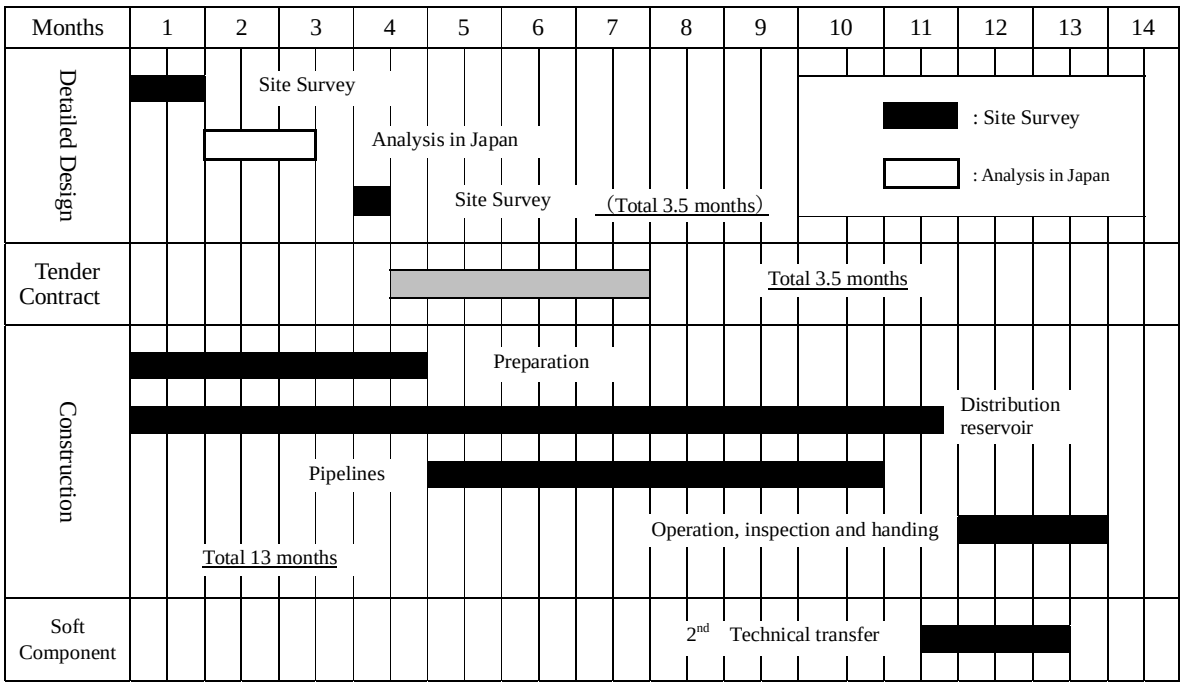


Figure 2.2.25 Implementation Schedule (3rd Term Works)

2.3 Obligations of Recipient Country

The project is composed of Japanese cooperation and the works to be undertaken by Jordanian side with self-effort. The necessary measures and obligations with scheduling of Jordanian side activities for the project are listed as follows:

No.	Items	Schedule
1)	To procure stop valves and fitting materials to divide distribution area and to convert the existing distribution mains to transmission mains	Before the 1st term project
2)	To provide information and data required for detailed design and soft component	Detailed design stage
3)	To coordinate for required approvals and permissions from relevant authorities to conduct D/D study including trail excavation and topographic survey on the roads	Detailed design stage
4)	To complete an EIA study with necessary procedures and obtain approvals from Ministry of Environment for the project implementation, if EIA is required	Before the start of 1st term construction
5)	To acquire the land for reservoir construction sites ① Zarqa High Reservoir (WAJ owned land) ② Hashemeyeh and Sukhna Reservoirs (need land acquisition from private) ③ Batrawi Reservoir (need a land transfer from the Zarqa municipality)	Before the E/Ns of each term
6)	To level the land for reservoirs construction and construct access roads	Before inauguration of each term
7)	To provide temporary stock yards for construction materials and machineries and lands for temporary works	During construction stage
8)	To coordinate for required approvals and permissions to implement construction works	As needed
9)	To coordinate with relevant authorities to implement protection works for underground utilities and to visit and confirm the works at sites	As needed
10)	To cooperate in consultation with residents living near the construction sites and to coordinate procedures for traffic control in works with relevant authorities	During construction stage
11)	To provide disposal sites for excavation debris and drains for wastewater from construction works	During construction stage
12)	To procure equipment for implementation of soft component and to provide a room renovated in the WAJ Zarqa workshop for training	Before the start of 2nd term construction
13)	To select candidates as trainees for the soft component of the Project	Before the start of soft component
14)	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	After signing the contract
15)	To ensure prompt unloading and customs clearance of the goods for the project at the port of disembarkation in Jordan	As needed
16)	To accord Japanese nations 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.	As needed
17)	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	As needed

No.	Items	Schedule
	under the verified contract. And to take necessary measures for such tax exemption.	
18)	To provide electric power lines, telephone lines and drainages for construction to construction sites	During construction stage
19)	To provide electric power supply to the Batrawi pumping station including the acquisition of required permissions from electric power company and installation of a receiving panel and a transformer.	Before the start of the 1st term
20)	To construct reservoir overflow pipes from the boundary of reservoirs to the nearby existing drain (Japanese side will construct them within the site boundary.)	After construction of reservoirs
21)	To construct appropriate drain pipe from the existing Batrawi reservoir to the nearby drain	Before the start of 1st term construction
22)	To provide necessary water and chemicals (chlorine) for trial operation of the facilities constructed	As needed
23)	To use, operate and maintain properly the facilities and equipment constructed or procured under the Japan's Grant Aid program.	After construction
24)	To construct fences and gates along the site boundary of reservoirs	After construction of reservoirs
25)	To make continuous rehabilitation works of existing networks to use supplied water effectively	As planned
26)	To implement publicity activities for this project	Entire project period, esp. inauguration and completion
27)	To bear all the expenses, other than to be borne by the grant Aid, necessary for construction of the facilities	As needed
28)	To procure a testing equipment of residual chlorine and testing chemicals in Khaw chlorination facility	Before trial operation of chlorination facility
29)	To assign staff with appropriate skills to the constructed chlorination facility at Khaw for better operation and maintenance	Before trial operation of chlorination facility
30)	To make appropriate security measures for the students, who go to the school nearby the reservoirs, in cooperation with Japanese Side	During the project

2.4 Project Operation Plan

2.4.1 Basic Policies of Operation and Maintenance

Basic policies for operation and maintenance (O & M) of proposed facilities are listed as following.

1) The number of water supply facilities will be increased in the project. However, the O & M of the proposed gravity distribution system from the reservoirs would be much easier than the current pump distribution system. Therefore, these facilities could be operated and maintained without any increase in the current number of the staff of the WAJ Zarqa Office.
2) An appropriate and effective technology for distribution system management will be transferred to WAJ staff through soft component of the project.
3) For efficient management and control of water distribution system, establishment of a Distribution Management Center is proposed to be located in the WAJ Zarqa workshop.

2.4.2 Establishment of Distribution Management Center

(1) The role of Distribution Management Center (DMC)

To manage and control water distribution system efficiently, establishment of the DMC is proposed. The room, which would be established as a training room for the soft component and will be equipped with required facilities, would be utilized as the DMC after the training. The role of center is shown in following figure. The DMC will collect all the data and information related to water distribution system from the operation & maintenance department and other engineering departments and the collected information would be digitized and compiled in digital formats which could be used also for effective operation and maintenance activities. The compiled digital data will be interpreted and analyzed for making various plans. Analyzed data and plans will be used for efficient operation and maintenance management in each department.

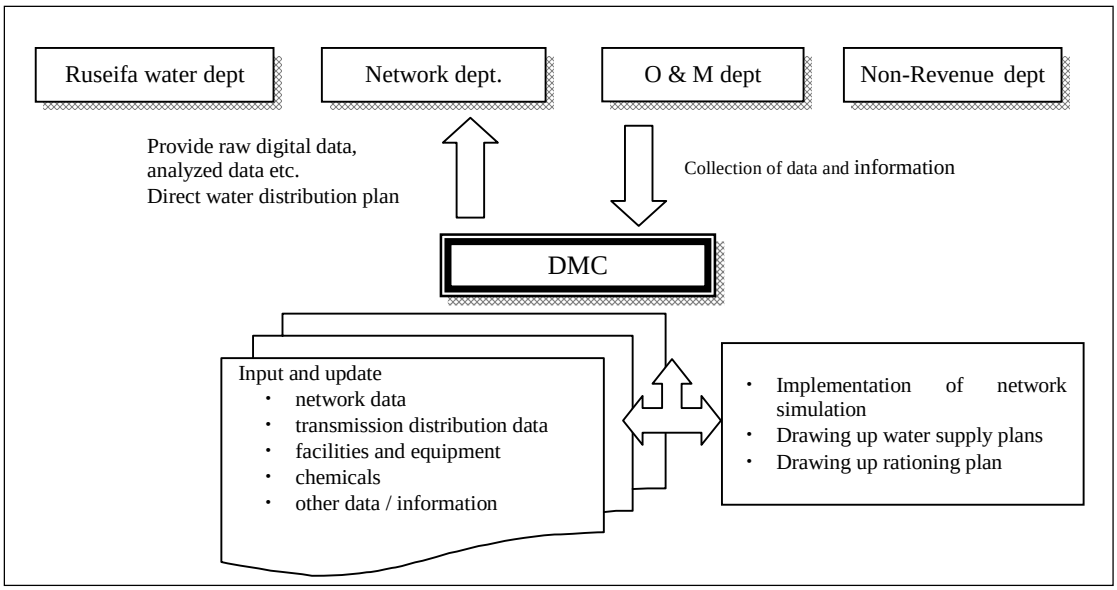


Figure 2.4.1 Distribution Management Center (Newly Established)

(2) Roles of the Responsible Persons in the Center

To carry out the activities in Center efficiently, it would be essential to assign the responsibilities to available staff in the center. Required staff in the DMC and their roles is given in the following Table.

Table 2.4.1 Roles of the Responsible Persons in the Distribution Management Center

Staff	Numbers	Description of role
Center Director (concurrent post with other dept. acceptable)	1	・ Executive of area distribution management ・ Attendance in WAJ Zarqa office meetings ・ Evaluation and approval of reports submitted by responsible persons ・ Reporting operating conditions of transmission and distribution facilities periodically to the administrator of WAJ Zarqa branch ・ Providing plans and calculated data to each department ・ Periodical evaluation of center organization, proper allocation of staff ・ Program developments for skill improvement ・ Evaluation of staff and training
Distribution network analyst	1	・ Implementation of distribution network simulation ・ Researches on efficient transmission and distribution ・ Drawing up annual transmission and distribution plans ・ Drawing up efficient pumping operation plans ・ Drawing up limited or rationing water supply plans ・ Preparation of various information for studies ・ Site survey (grasp of distribution pressure and flow)
Data and information administrator	1	・ Data collection and management ・ Researches on efficient transmission and distribution ・ Drawing up annual transmission and distribution plans ・ Drawing up efficient pumping operation plans ・ Drawing up limited or rationing water supply plans ・ Drawing up chemical feeding plans ・ Preparation of various information for studies
Input staff	1	・ Data input ・ Drawing up charts and tables

(3) Location of the Center

The soft component program of the project will be implemented in the training room, which will be prepared and established in the workshop of the Zarqa office. The well-equipped training center will act as the DMC after the training program is over. As mentioned in the soft component part in this report, following equipment, software, data and manuals are supposed to be provided at the training center through the implementation of the program.

Equipment	・ 3 sets of Computers ・ 1 set of B&W and color printers and scanner ・ 4 sets of tables and chairs, shelves ・ Air conditioners
Software	・ GIS software ・ Distribution network software (InfoWorks W/S and EPANET2)
Data	・ Network data ・ Distribution data ・ Pumping operation data
Manuals	・ Manuals of the above softwares ・ Data input manuals

2.4.3 Organization of Operation and Maintenance

(1) Main Facilities and Items of Operation

Main existing facilities in the Zarqa area and newly established facilities through the implementation of the project with equipment required for their monitoring and control are shown in the following Table.

Table 2.4.2 Main Facilities and Equipment for Monitoring and Control

Items	Proposed or existing	Names of facilities	Equipment for monitoring and control
Reservoirs	Existing	Ruseifa High Reservoir, Ruseifa Low Reservoir, Awajan High Reservoir and Awajan Low Reservoir	Flow meters, level gauges, control valves
	Proposed	Batrawi Reservoir (Zarqa low) and Hashemeyeh Reservoir	Flow meters, level gauges, control valves
	Proposed	Zarqa High Reservoir, Sukhna Reservoir	Level gauges
Pumping stations	Existing	New Khaw Pumping Station (transmission for Zarqa and Hashemeyeh)	Flow meters, pump unit control
	Existing	Old Khaw Pumping Station (transmission to Awajan and Ruseifa, and Amman)	Flow meters, pump unit control
	Existing	Zarqa Pumping Station	Flow meters, pump unit control
	Proposed replacement	Batrawi Pumping Station	Flow meters, pump unit control
Water treatment plants	Existing	Reverse osmosis (RO) facility in Zarqa	Flow meters, pump unit control
Chlorine feeding facilities	Proposed	Khaw Pumping Station	Residual chlorine meters, feeding gauges
	Existing	Zarqa Pumping Station	Residual chlorine meters, feeding gauges
Wells and pumps	Existing	Azraq, Hallabat, Corodor, Zatari, Zarqa, Hashemeyeh	Flow meters, pump unit control

(2) Items and Methods of Monitoring and Operation

1) Monitoring and Operation Methods

The proposed monitoring and operation methods of proposed facilities and main existing facilities in the project area are summarized in the following Table.

Table 2.4.3 Operation Method Items and Methods of Each Facility Management

Facilities	Names	Monitoring items	Monitoring and Operation Methods
Reservoirs	Batrawi (Zarqa Low)	Transmission flow from Khaw, transmission flow to Zarqa High Reservoir, water level of the reservoir	Resident operation
	Zarqa High	Water level of the reservoir	Patrol monitoring
	Hashemeyeh	Transmission flow from Khaw, transmission flow to Sukhna, water level of the reservoir	Patrol monitoring
	Sukhna	Water level of the reservoir	Patrol monitoring
Pumping stations	New Khaw	Units of operating pumps, water flow, water pressure	Resident operation
	Old Khaw	Units of operating pumps, water flow, water pressure	Resident operation
	Zarqa	Units of operating pumps, water flow, water pressure	Resident operation
	Batrawi	Units of operating pumps, water flow, water pressure	Resident operation
Water treatment plants	Reverse osmosis facility in Zarqa	Water quality, flow, residual chlorine	Commission
Chlorine feeding facilities	Khaw Pumping Station	Chlorine feeding ratio, amount of chemical, residual chlorine	Resident operation
	Zarqa Pumping Station	Chlorine feeding ratio, amount of chemical, residual chlorine	Resident operation
Wells and pumps	Zarqa	Groundwater level, units of operating pumps, water level, flow	Resident operation
	Hashemeyeh	Groundwater level, units of operating pumps, water level, flow	Resident operation

2) Transmission and Distribution Flow Control Methods

The control methods of transmission flow in the project are shown in the table and figure below. Distribution from reservoirs is by gravity and no special control is required.

Flow Directions	Control Methods
Transmission from new Khaw PS to Hashemeyeh Reservoir	Transmission flow will be controlled by the control valve before the Hashemeyeh Reservoir and the number of operating pump units in Khaw Pumping Station based on the reading value of the flow-meter in Hashemeyeh Reservoir.
Transmission from Hashemeyeh Reservoir to Sukhna Reservoir	Transmission flow will be controlled by the control valve after Hashemeyeh Reservoir based on the reading value of the flow-meter in Hashemeyeh Reservoir.
Transmission from Khaw Pumping Station to Batrawi Reservoir	Transmission flow will be controlled by the control valve before Batrawi Reservoir and the number of operating pump units in Khaw Pumping Station based on the reading values of the flow-meter before Batrawi Reservoir.
Transmission from Zarqa Pumping Station to Batrawi Reservoir	Transmission flow will be controlled by the number of operating pump units in Zarqa Pumping Station based on the reading values of the flow-meter in Zarqa Pumping Station.
Transmission from Batrawi Pumping Station to Zarqa High Reservoir	Transmission flow will be controlled by Batrawi Pumping Station based on the reading value of the flow-meter after Batrawi Pumping Station.

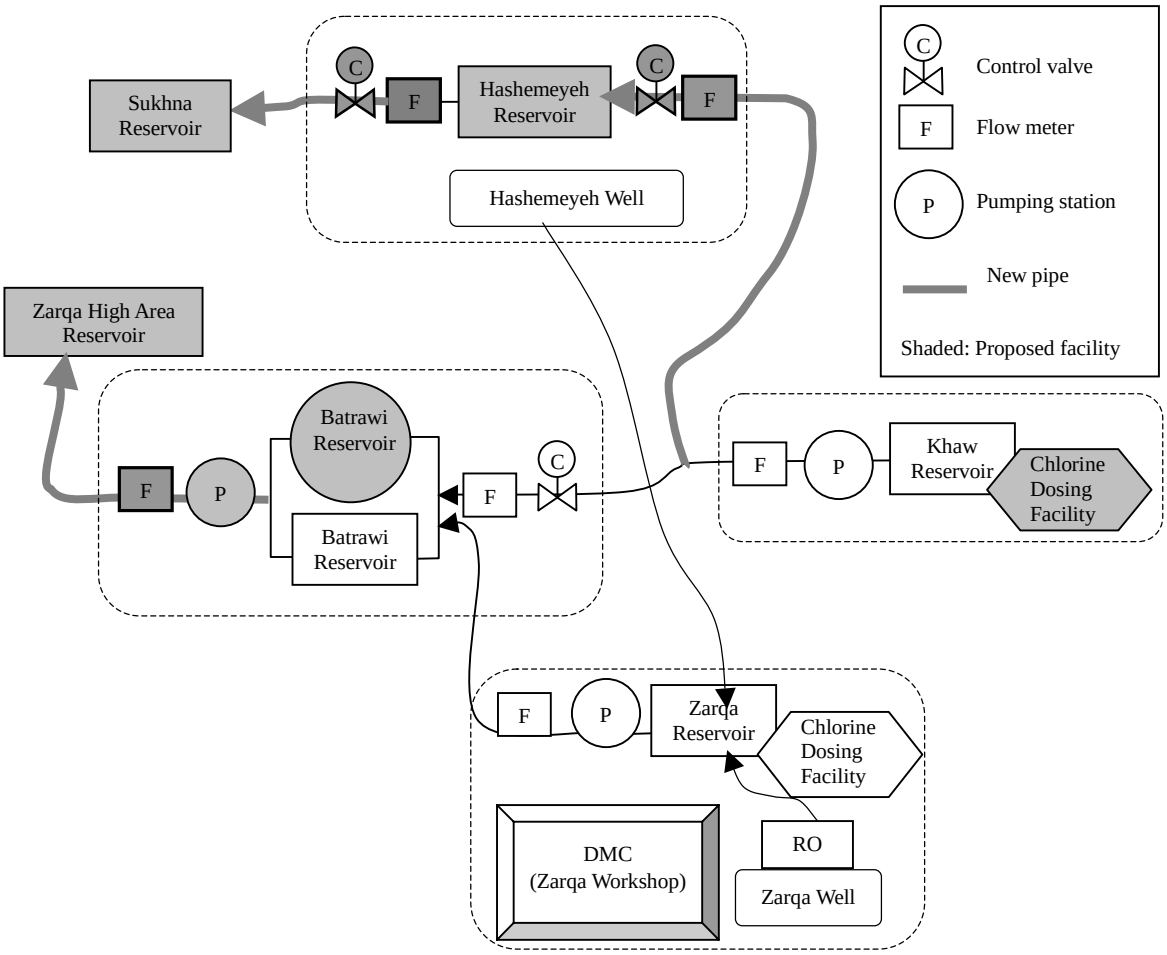


Figure 2.4.2 Arrangement of Flow Control equipment

3) Water Quality Management

a) Water Quality Monitoring Parameter

The quality of water to be supplied shall be of an approved quality satisfying the Jordanian drinking water standards as shown below. It should be noted that problematic items in terms of the quality of water sources at the project site are TDS and NO_3. Therefore, water derived from water sources with high levels of the above items is required to be supplied after mixing with water from good quality water sources.

Parameter	Allowable	Maximum allowable *
pH	(6.5- 8.5)	-
TDS	500	1500
TH	300	500
LAS(MBAS)	0.2	0.5
NH_4	0.5	0.5
Al	0.1	0.2
Mn	0.1	0.2
Fe	0.3	1.0
Cu	1.0	1.5
Zn	3	5
Na	200	400
Cl	200	500
SO_4	200	500

Note: * if good quality of water sources is not available.

Parameter	Symbol	Allowable (mg/l)
Arsenic	As	0.01
Lead	Pb	0.01
Cyanide	CN	0.07
Cadmium	Cd	0.003
Crum	Cr	0.05
Barium	Ba	1.5
Selenium	Se	0.05
Boron	B	2
Mercury	Hg	0.002
Silver	Ag	0.1
Nickel	Ni	0.07
Antimony	Sb	0.005
Fluoride	F	2
Nitrite	NO_2	2
Nitrate	NO_3	50*

Note: * the allowable concentration is 70 mg/l if good quality of water sources is not available.

In order to satisfy the Jordanian drinking water standards in this project, water with high levels of TDS and NO_3 from Zarqa and Hashemeyeh well will be mixed with high quality water from Khaw pumping station in Batrawi reservoir. Therefore, the organization of water quality management in these three water resources and Batrawi reservoir should be strengthened.

b) Organization of Water Quality Management

At present, water quality is monitored including the parameters and schedules as described below. Water quality analysis of all the parameters, except for residual chlorine, is carried out at the central water quality laboratory in WAJ. Residual chlorine is analyzed in the WAJ Zarqa office. It is desirable to carry out analysis of total dissolved solid (TDS) and NO_3 in the WAJ Zarqa office in the future, which needs continuous monitoring, especially for the treated water of Reverse Osmosis (RO) and blended water in Batrawi Reservoir.

- Heavy metal, turbidity, hardness (CO_3, SO_4, HCO_3, K, Na, Mg, Ca) are analyzed once an year.
- EC, pH, NO_3, NH_4, coliform are examined once every two months.
- Residual chlorine (pipe networks in Zarqa, 10 places per week)
- Residual chlorine (every hour at pumping stations)

c) Residual Chlorine

In this project, the water quality parameter that requires particular attention while monitoring is residual chlorine. To ensure microbiological safety of water, residual chlorine should be maintained at 1.5mg/L in the out-flow from pumping stations and should be 0.2-0.8 mg/L in water at water taps. Since the time of stagnation before using is long in individual tanks and there is high possibility of water contamination in pipes during low or negative water pressure, the concentration of residual chlorine at water taps should be also maintained at higher level.

To maintain proper concentration of residual chlorine at taps, the dosing ratio of chlorine will be controlled at the proposed chlorination facility in Khaw. As chlorine is dosed at each well of water source before reaching to the Khaw Reservoir, only additional chlorine should be dosed at the chlorination facility in Khaw, at maximum of 2 mg/L before pumping water to service reservoirs. However, the exact dosing ratio should be decided on the site considering the factors such as the volume of raw water and chlorine consumption.

2.5 Project Cost Estimation

2.5.1 Estimated Project Costs

The total project cost required is preliminarily estimated as 2,310 million Japanese Yen including the Japan's Grant Aid side and the Jordanian side to implement this project. This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

(1) Cost to be Borne by the Japanese Side

Based on the classifications of Jordanian and Japanese side mentioned earlier, total amount of costs covered by Japan would be about 2,199 million Japanese Yen (Table 2.5.1).

Table 2.5.1 Preliminary Estimation of Project Cost (Million Japanese YEN) of Japanese Side

Estimated Project Cost: 2,199.1 million JPY

Item		Project Cost (million JPY)	
Facility Construction	Construction of service reservoir (4 Locations) Installation of transmission pipelines (Length: 16.0km) Installation of distribution pipelines (Length: 7.2km) Renewal of pumping equipment Construction of chlorination facilities Insertion of sluice valves in existing pipelines	1,986.5	2,199.1
Equipment Procurement		0	
Detailed Design, Construction Supervision, Soft-Component		212.6	

*This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant.

(2) Cost to be Borne by the Jordanian Side

The part of estimated costs for this project covered by Jordanian government is summarized in Table below. The details including items, quantity, unit cost and basis of calculations are attached as Annex -12.

Table 2.5.2 Summary of Estimated Costs Covered by Jordanian Side (Million Japanese YEN)

Estimated Project Cost: 111.0 million JPY

Item	Project Cost (million JPY)	
Procurement of stop valves and fitting materials to divide the distribution areas and to convert the existing distribution mains to transmission mains	2.5	111.0
Reclaiming and Leveling the land for reservoirs construction	43.1	
Construction of access roads to the reservoir sites	3.7	
Procurement of equipment for implementation of soft component and provision of a renovated training room in the WAJ Zarqa workshop	1.3	
Construction of reservoir overflow pipe from the boundary of reservoirs to the nearby existing drain	40.8	
Construction of fences and gates along the site boundary of reservoirs	8.8	
Provision of necessary water and chemicals (chlorine) for trial operation of the facilities constructed	10.0	
Implementation of publicity activities for this project	0.8	

(3) Conditions of Calculation

① Month of calculation	December, 2005
② Exchange rate	1 USD = 113.53 JPY (Average from Nov. 31, 2005 to the past 6 months) 1 EURO=137.61 JPY (Average from Nov. 31, 2005 to the past 6 months) 1 JOD = 160.035 JPY (Local currency is exchanged on the basis of fixed USD rate (1USD=0.708 JOD))
③ Project period	The project would be implemented in three terms and detailed design and construction period of each term has been shown in construction schedule described earlier.
④ Others	The project would be implemented under the Japan's Grant Aid Scheme.

2.5.2 Operation and Maintenance Costs

(1) Operation and Maintenance Cost of Proposed Facilities

In the basic design plan, the additional operation and maintenance items required for planned facilities are patrol monitoring for reservoirs and operation of Batrawi Pumping Station and Khaw Chlorination Facility. As present staff is assigned for existing Batrawi Pumping Station and therefore no additional staff is required for this facility. The staff of the existing Zarqa chlorination facility will be assigned to Khaw Chlorination Facility. Therefore, no additional staff is required for the Project.

The annual additional operation and maintenance cost of Batrawi Pumping Station and Khaw Chlorination facility is as follows. The total additional annual cost would be 51,275 JOD, which accounts for only 0.1 % and 1.3 % of the total operation and maintenance cost of the WAJ and the WAJ Zarqa Office, respectively. Therefore, adequate operation and maintenance could be done for the planned facilities.

Table 2.5.3 Additional Operation and Maintenance Cost of the Project

Facility	Cost items	Estimated Cost（JOD/year）
Batrawi Pumping Station	Electricity	48,180
Khaw Chlorination Facility	Chlorine	3,095
Total		51,275

(2) Analysis of the Revenue and Expenditure of WAJ Zarqa Office

The current revenue and expenditure of WAJ Zarqa office is shown as Table 2.5.4 for the year 2003 and 2004. Eighty percent (80 %) of the revenue is generated from water tariff, and 10% from sewage tariff. In 2003, the WAJ Zarqa office had a deficit of 1.15 million JOD.

Table 2.5.4 Revenue and Expenditure of WAJ Zarqa Office

Items	Amount in 2003 (JOD)	Amount in 2004 (JOD)
Revenue		
1. Water Income		
Water tariff	3,678,335	4,171,466
Connection charge	265,544	342,480
Meter installation fee	4,792	2,797
Repair and others	48,370	44,754
Subtotal	**3,997,041**	**4,561,497**
2. Sewerage Income		
Sewerage tariff	397,206	485,648
Connection charge	11,142	13,778
Others	7,584	3,852
Subtotal	**415,932**	**503,278**
Total Profit	**4,412,973**	**5,064,776**
Expenditures		
1. Salaries, wages	1,455,478	1,785,600*1
2. Electricity expense	3,930,625	3,913,281*1
3. Repair and fuel expenses	64,447	N/A
4. Others	118,273	N/A
Expenditures	**5,568,823**	**N/A**
Balance	**-1,155,850**	**N/A**

Note: *1 Unit prices of salary, wage and electricity were assumed by the team as the data could not be collected from WAJ.

Analysis of unit incomes and costs is shown in Table 2.5.5. In 2003, the amount of water supply was 36.86 million m^3/year, which contained revenue water of 17.51 million m^3/year and 52.5% of non-revenue water (NRW). The average annual water charge per subscriber was 35.5 JOD, the average income per subscriber was 42.6 JOD, average income per unit water supply was 0.12 JOD/m^3, and income per unit revenue water (RW) was 0.252 JOD/m^3-RW.

Table 2.5.5 Analysis of the Unit Incomes and Costs of WAJ Zarqa Office

Items	Unit	Values in 2003	Values in 2004
Annual Water Supply	Million m^3	36.86	37.41
Annual Revenue Water	Million m^3	17.51	17.86
NRW Ratio	%	52.5	52.3
Average Annual Customers	Nos.	103,681	106,976
Annual Water Charge per Subscriber	JOD/Subscriber	35.5	39.0
Annual Water Charge per Unit Water Supply	JOD/ m^3	0.100	0.112
Annual Water Charge per Unit Revenue Water	JOD/ m^3-RW	0.210	0.234
Annual Income per Subscriber		42.6	47.3
Annual Income per Unit Water Supply	JOD/Supply m^3	0.120	0.135
Annual Income per Unit Revenue Water	JOD/Sale m^3-RW	0.252	0.284
Electricity expense per Unit Water Supply	JOD/Supply m^3	0.107	0.105
Repair and Fuel Expenses per Unit Water Supply	JOD/Supply m^3	0.0017	-
Other Expenses per Unit Water Supply	JOD/Supply m^3	0.0032	-

Note: RW: Revenue water,

(3) Prediction of Revenue and Expenditure With and Without the Project

1) Basic conditions of calculation

- The revenue and expenditure in the target year of 2010 are estimated considering the cases of with and without the project.
- Price increase is not considered.
- The unit income and cost prices in 2003 or 2004 are used for calculation.
- The unit electricity expense (0.041JOD/kWh) in 2004 is used.
- The future unit electricity consumption (kWh/m^3) of each pumping station per unit of pumped water is assumed to be same as the existing one.
- Estimated electricity expense for pumping stations is roughly estimated value since detailed data on pump operation is not considered.

2) Incomes

Average income per unit revenue water (0.284 JOD) is used to estimate future incomes considering NRW ratio and average daily water demand in 2010 with and without the project.

3) Expenditures

a) Salaries and wages

As present staff will carry out operation and maintenance works for the proposed facilities, increase in salaries and wages is not considered and the salaries and wages are same as the existing ones.

b) Electricity expense

By separating transmission from distribution system, pump operation could become more efficient, and electricity consumption per unit water supply for Khaw, Hashemeyeh and Zarqa Pumping Stations could be reduced. The amount of pumped water from related pumping stations in cases of with and without the project is estimated as shown in Table 2.5.6. Furthermore, annual electricity expense in these pumping stations is estimated and presented in Table 2.5.7 using the current unit cost per unit supplied water assuming that this expense changes in proportion to amount of water supply. The expenses on electricity increase by 185,000 JOD in case of with the project and by 585,000 JOD without the project when compared to the existing one.

Table 2.5.6 Amount of Transmission Water in Related Pumping Stations with / without Project

Pumping stations	Changes due to Project Implementation	2004 Amount of Transmission Water (m^3/y)	Development of New Water Source/(Increase in Transmission Water)	2010 Amount of Water With Project (m^3/y)	2010 Amount of Water Without Project (m^3/y)
Al-Hallabat	Transmission water increases due to the new transmission project	2,641,480	5,260,015	7,901,495	7,901,495
Khaw	Transmission water increases due to increasing transmission water from Al-Halabat. Transmission water to Amman will be transferred to Ruseifa and Awajan areas. As a result, current transmission from Khaw to Ruseifa and Awajan areas through Zarqa Reservoir will become unnecessary	34,086,468	5,260,015	39,346,483	39,346,483
Hashemeyeh	As transmission water from Khaw Pumping Station to Hashemeyeh Reservoir will be direct and water is transmitted by gravity from Hashemeyeh Reservoir to Sukhna Reservoir, it is not necessary to use this pumping station. In the case of without the project, transmission water increases in proportion to demand.	1,937,460	-	0	2,007,500
Zarqa	Water transmission to Awajan and Ruseifa areas from this pumping station will be not required.	22,881,160	-	7,048,515	22,881,160
Batrawi	Transmission water increases due to increasing demand.	1,457,440	-	2,190,000	2,190,000
Al-Tamween	Transmission water increases due to the development of new water source.	847,698	3,939,810	4,787,508	4,787,508
Total		63,851,706	14,459,840	61,274,001	79,114,146

Table 2.5.7 Estimated Annual Electricity Expense of Related Pumping Station with /without Project Implementation

Pumping stations	2004 Electricity Expense	2004 Electricity Expense per unit Transmission Water	2010 With Project	2010 Without Project
	JOD/y	JOD/m^3	(JOD/year)	(JOD/year)
Hashemeyeh	57,195	0.0295	0	59,263
Al-Hallabat	67,149	0.0254	200,865	200,865
Khaw	1,440,200	0.0423	1,662,442	1,662,442
Zarqa	494,084	0.0216	152,202	494,084
Batrawi	29,877	0.0205	44,894	44,894
Al-Tamween	45,878	0.0541	259,101	259,101
Total	2,134,382	0.0334	2,319,504	2,720,649
Increase in Electricity Expense from 2004	0	-	185,122	586,267

c) Repair and Fuel Expenses

Future repair and fuel expenses are estimated using the current cost per unit water supply assuming that these expenses are changed in proportion to amount of water supply.

d) Others

Future values of other expenses are estimated using the current cost per unit water amount supplied assuming that these expenses are changed in proportion to amount of water supply. Chlorine cost is included in these expenses. Chlorination facility at Khaw will be constructed in this Project and the amount of chlorine consumption will increase according to increase of water supply.

e) Depreciation Cost

Depreciation cost of the WAJ Zarqa office in 2010 (Table 2.5.8) is estimated using the analysis of past depreciation costs of WAJ from 2000 to 2004.

- Percentage of the capital assets of Zarqa office of the total WAJ is in proportion to water production. It is assumed as 14.3% of the total WAJ (2003).
- Capital assets increase at annual rate of 8.7% (average from 2000 to 2004)
- Depreciation cost was assumed as 5% of the capital assets.

Table 2.5.8 Estimation of Capital Assets and Depreciation Cost of WAJ Zarqa Office

	2000	2001	2002	2003	2004	2010
Total Capital Assets in WAJ	888,238,930	1,023,711,316	1,083,387,613	1,167,872,726	1,236,832,825	-
Estimated Capital Assets in Zarqa Branch	127,018,167	146,390,718	154,924,429	167,005,800	176,867,094	269,191,717
Estimated Depreciation Cost	6,350,908	7,319,536	7,746,221	8,350,290	8,843,355	13,459,586

4) Estimation of Revenue and Expenditure Balance

Based on the conditions mentioned above, the profit or loss of WAJ Zarqa office in 2010 with /without the project is estimated and given in Table 2.5.9.

Table 2.5.9 Estimation of Revenue and Expenditure Balance of WAJ Zarqa Office in 2010 with /without the Project

Items	Values in 2003	Values in 2004	Estimated Values in 2010 With Project	Estimated Values in 2010 Without Project
Total Income	4,412,973	5,064,776	8,723,344	7,748,656
Expenditures				
1. Salaries, wages	1,455,478	1,785,600	1,785,600	1,785,600
2. Electricity expenses	3,930,625	3,913,281	4,098,404	4,499,549
3. Repair and fuel expenses	64,447	N/A	97,240	97,240
4. Others	118,273	N/A	183,040	183,040
Expenditures	5,568,823	N/A	6,164,284	6,565,429
Profit and Loss	**-1,155,850**	**-**	**2,559,060**	**1,183,227**
Data				
Annual Water Supply (m^3/y)	36,864,488	37,410,572	57,200,000	57,200,000
Annual Revenue Water (m^3/y)	17,509,516	17,860,101	30,716,000	27,284,000
NRW ratio	52.5	52.3	46.3	52.3
Leakage	31	31	25	31

A deficit of 1,100,000 JOD in 2003 will turn to annual profit of 2,500,000 in WAJ Zarqa office in 2010 in case of with the project. The major reasons for this expected change are as following.

- Water supply increases.
- Transmission from Khaw Pumping Station to Amman area is changed to Ruseifa and Awajan areas. By this transfer, operational rate of Zarqa Pumping Station becomes low, which saves electricity cost.
- Related pump operations become more efficient.
- NRW ratio drops down due to the reduction of leakage ratio.

On the other hand, without the project, it is estimated to be 1,100,000 JOD in the black. Therefore, the benefit of the project would be 1,400,000 JOD/y approximately.

5) Balance after Deduction of Depreciation Cost

Depreciation cost in 2010 is assumed as 13,400,000 JOD per year. The balance after deduction of depreciation cost would be 10,900,000 JOD in the red.

6) Recommendations

To cover depreciation cost, it is necessary to improve the efficiency of water facilities and services as well as to raise water tariff.

Average annual income per subscriber is 47.3 JOD/year. On the other hand, average income of household in Zarqa is 4177.4 JOD (2002/2003), which means 1.1 % of the income of household is contributed to water tariff and sewerage tariff. Generally, it is said that the maximum percentage

occupied by the payment of sanitation services in the income of household is 2 to 3 %. The current average water charge is below this value and also not so low while comparing with that of other countries. To increase water tariff, however, the current willingness-to-pay of subscribers for the current water service may not be so high since the water services cannot provide sufficient water, rationing of water supply is practiced, and NRW ratio is very high.

To make WAJ Zarqa office as a financially autonomous organization, the following steps are proposed.

Step	Strategies	Activities	Objectives
Step 1	Enhancement of the efficiency of water supply system (facilities)	To reduce leakage and NRW and control distribution efficiently	To reduce operational cost and increase profit of WAJ
Step 2	Improvement on water services	To improve rationing water supply, low pressure areas and water quality	To enhance willingness of subscribers to pay for the services by WAJ
Step 3	Request of the cooperation from water beneficiaries	To raise water tariff and carry out public participation and awareness activities	To encourage participation and increased payment from subscribers

CHAPTER 3

Project Evaluation and Recommendations

CHAPTER 3 Project Evaluation and Recommendations

3.1 Project Effects

Current situations and problems at the project site, improvement measures to be taken under the Project and effects of the project implementation are compiled in Table 3.1.1.

Table 3.1.1 Current Situations, Problems, Measures to be Taken and Project Effects

Current Situations and problems	Improvement Measures under the Project (Requested Japanese Assistance)	Project Effects
1. High pressure water pumps are used to distribute water to the highly undulating land of the project site, which causes very high water pressure resulting into high leakage ratio of the order of 31% and frequent pipe breaks in the lower area.	Water will be distributed by gravity from planned reservoirs that will be constructed at the highest locations in the newly established four water supply zones.	The leakage ratio will be reduced to 25 % in 2010 because of the reduction in water pressure and frequency of pipe breaks. It is estimated that the water supply pressure will be reduced from 66m to 54m.
2. The water supply pressure is unsatisfactorily low in the higher areas and unnecessarily high in the lower areas due to the highly undulating land.	Water will be distributed by gravity from planned reservoirs that will be constructed at the highest location in the newly established four water supply zones.	The undesirably high water pressure in the lower areas will be reduced to the optimum level whereas the low water pressure at the higher areas will be increased to a desirable higher level.
3. The actual water availability per capita is as low as 84 L/day due to scarce water resources and high leakage.	The leakage will be reduced by the measures stated above which will raise the quantity of water available for allocation to the project site together with the ongoing water resources development projects by the Jordanian side.	The actual water availability per capita, which is as low as 84 L/day, will be increased to 113 L/day in 2010 because of reduced leakage and increased water allocation to the project site.
4. Area-wise water rationing is practiced and water is supplied only 12 to 72 hours per week due to insufficient water amount, insufficient water supply facilities and inappropriate arrangement of facilities.	In addition to the above measures (distribution zoning and water allocation), appropriate capacity of water transmission and distribution mains will be constructed and appropriate capacity of reservoirs and pumps will be installed.	The water supply hours will be increased and water will be supplied for at least three days in the entire project area.
5. Chlorination of water is inadequate in Hashemeyeh and Sukhna, where chlorination facility is inappropriate. There is a concern of contamination of supplied water in pipe networks.	A chlorination facility will be constructed at the existing Khaw pumping station, the major water source of the project area.	Chlorination will be applied appropriately which will maintain sanitary safety of the supplied water.
6. Operation of the water distribution system is not effective since hydraulic characteristics and conditions of the networks are not grasped, data and information required for network management are neither centrally managed nor utilized efficiently.	Technology transfer on network mapping, network data management and network analysis will be conducted by soft component. The outcomes also include the establishment of water distribution management center in the WAJ Zarqa office	The capacity of operation and management of the water distribution system will be enhanced which will lead to an effective operation and management of the distribution system.

The following secondary and indirect effects are expected by the project implementation.

1. Water distribution method will be changed from pumping supply to gravity supply from reservoirs, which improves operation and maintenance of water distribution system and reduces the cost of operation and maintenance of pumps, i.e., electrify cost. In addition, since appropriate water supply zones will be established, planned leakage reduction measures will be easily implemented.
2. The quality of supplied water will be improved, which contributes to reduction of occurrence of water borne diseases.
3. Waiting time for water supply will be reduced and purchase of expensive water from private tankers will be eased. Inconvenient living conditions, especially of women and children due to the low level of water supply services, will be improved.
4. Refugee camps are located in the project area and the improvement of the water supply service will contribute to improved living conditions of the Palestine and Iraqi refugees living in those camps and the residential areas. This will further contribute to the stabilization of people's livelihood in the area.

3.2 Recommendations

The aspects in need of further improvement and related recommendations for the successful implementation of the Project and the sustainable operation and maintenance after the completion of the Project are described as follows.

(1) Implementation of the work by the Jordanian Side

For the smooth implementation of the Project and the achievement of the targets, the WAJ should commit to secure expenses pertaining to the procurement of sluice valves and other required materials to separate water supply zones, land acquisition, leveling and other preparation activities of the reservoir sites, construction of access roads, installation of reservoir overflow pipes and preparation of a training room and procurement of required equipment for soft component programs, and shall implement these components on time.

(2) Improvement of Financial Conditions

Currently the operating expenditure and receipt of WAJ Zarqa office is in the red. After the project implementation in 2010, it is estimated that it will be in the black and financial management will be improved thanks to reduced leakage, increased water supply amount and efficient operation of pumps. However, the non-operating expenditure and receipt will still be in the red in 2010. Toward achieving a financially sound WAJ Zarqa office by covering non-operating expenditure, the largest of which is depreciation, the followings are proposed for stepwise implementation:

- Reduction of non-revenue water ratio
- Improvement of willingness to pay of the customers for water supply by improved water services
- Raise in water tariff

(3) Water Allocation to the Project Site

The WAJ should certainly implement the water allocation plan for the project area to secure the required amount of water by reducing water transmission amount from Khaw pumping station to Amman and increasing water amount to the project area after the completion of ongoing water resources development projects.

(4) Appropriate Operation and Maintenance of Completed Facilities

The WAJ should operate and maintain the constructed facilities appropriately, especially the reservoirs by routine patrol and stationed monitoring. It is required to control the level of water in the reservoirs and pump operation, by which the overflow of water from the reservoirs, that is, wastage of precious

water resources, does not happen. Furthermore, the WAJ should assign staff with appropriate skills to the constructed chlorination facility at Khaw for better operation and maintenance.

(5) Effective Utilization of the Constructed Facilities in the Ongoing Water Supply Project

The WAJ should incorporate the completed facilities in their ongoing project on improvement of the water supply system of Zarqa Governorate and should formulate an appropriate improvement plan, in which the completed facilities should be utilized effectively by planning installation of secondary distribution mains and service pipes and rehabilitation of the networks.

(6) Coordination with the Ongoing JICA's Technical Assistance Project and Further Reduction of Leakage

The WAJ shall coordinate between this Project and the JICA's on-going technical assistance project on the Capacity Development Project for Non Revenue Water Reduction, which is implemented by dispatching experts to WAJ Project Management Unit (PMU), in order to reduce leakage further and increase actual water availability.

(7) Environmental Impacts

Although the study team does not foresee any serious negative environmental impact by the implementation of the Project, the WAJ should follow necessary procedures on environment and acquire approvals from the Ministry of Environment for implementation of the finally agreed project components according to Jordanian environmental regulations. If the study of Environmental Impact Assessment (EIA) is required, the WAJ should complete the study with necessary procedures and obtain approvals from Ministry of Environment for the project implementation before a formal decision of the Project implementation is made by the government of Japan at the latest.